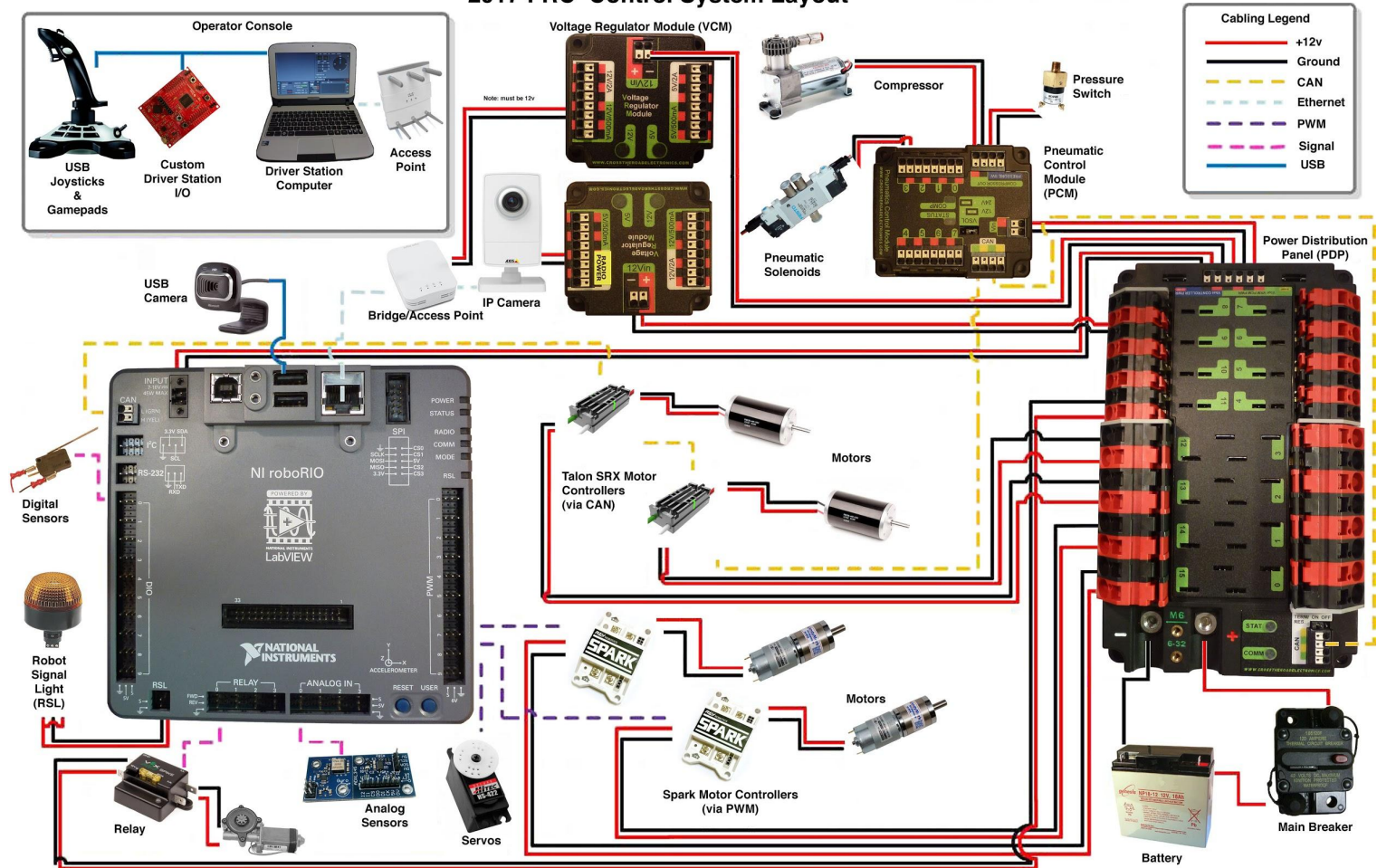




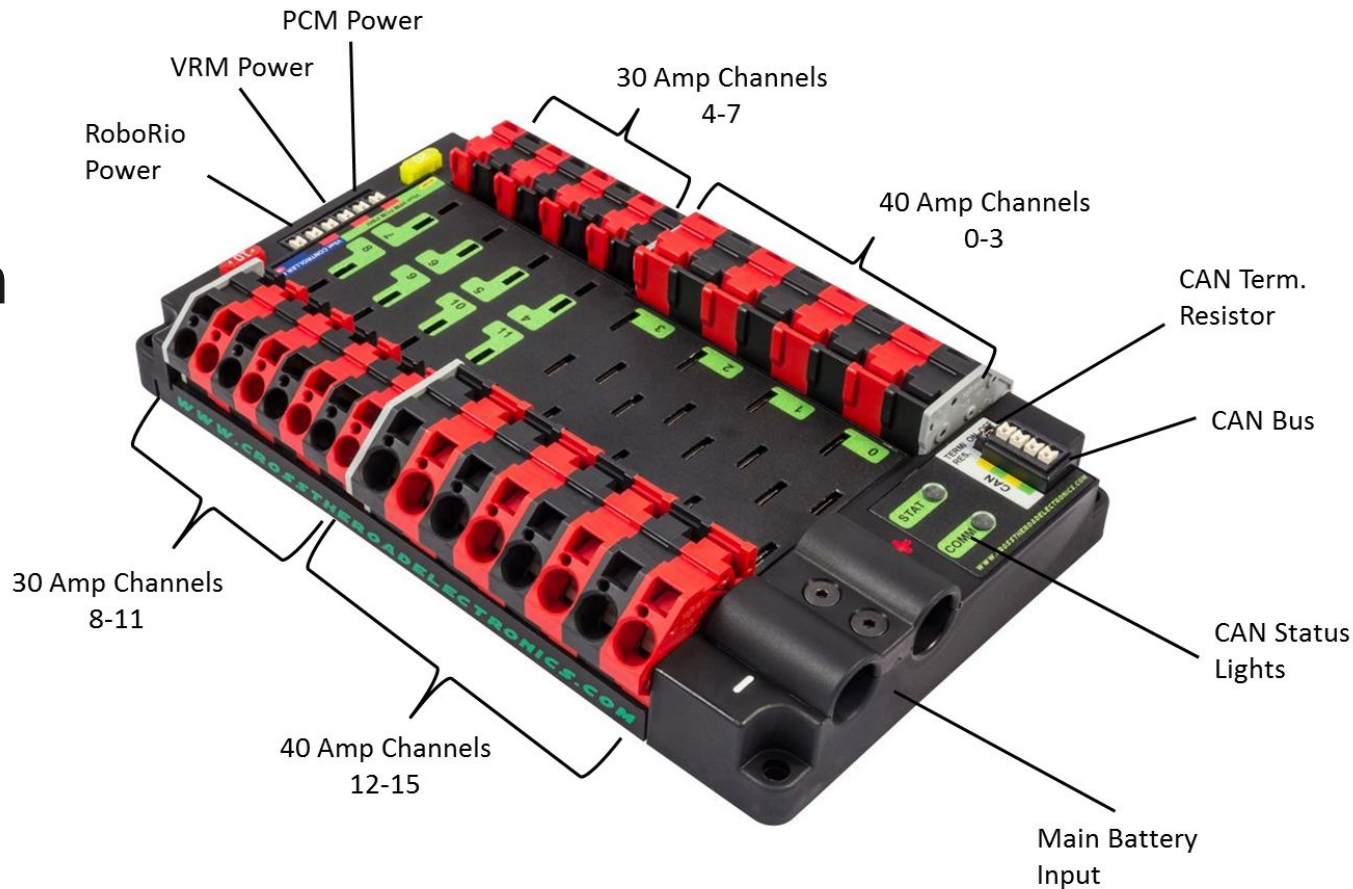
2890 The Hawk Collective

Electrical Level 3- Specialty ports, Troubleshooting & fault codes

2017 FRC® Control System Layout



Power Distribution Board



PDB - Trouble Lights

Lights should
always match
except in
Bootloader
Mode

LED Blink/Color	Description
Fast Green Blink	Robot is enabled.
Slow Green Blink	Robot is disabled.
Slow Orange Blink	Robot is disabled. Sticky Fault present.
Slow Red Blink	No CAN Comm.
(COMM LED only) Green/Orange Blink	Device is in boot-loader. Field-upgrade necessary.
Both LEDS off	Device is NOT powered.



Robot Rio - Ports - CAN

CAN connector is the communications backbone of the robot. We use CAN to communicate to the PCM, Motor controllers, and PDB. The newer versions of the RIO have the color names printed on them.

Green = LOW

Yellow = HIGH



Robot Rio - Ports - I2C

I2C = Inter Integrated Circuit

A two wire communication system, similar to CAN. Hundreds of devices can be connected to this port with only 2 data wires as long as each device has a unique address.

Rio = Master I2C Device = Slave I2C

4 pins

Ground - Power(3.3v) - System Clock - System Data

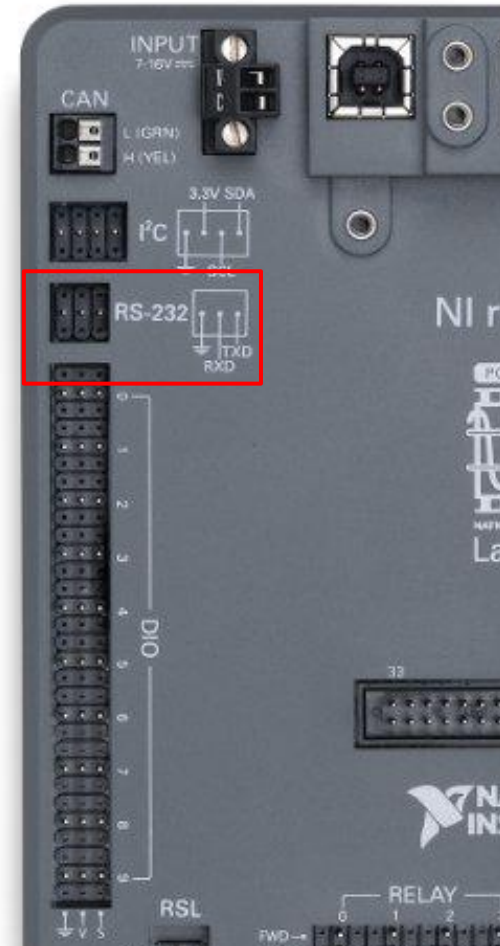


Robot Rio - Ports - RS-232

Also known as UART. This is a basic Serial Communications system. Relatively slow communications, but very universal.

3 pins

Ground - Receive - Transmit





Robot RIO - buttons

Reset =reboots the FPGA and Processor in the Rio when the button is held down for 5 seconds.

User = Button that can be accessed in the code.

- Not debounced

Research Usage



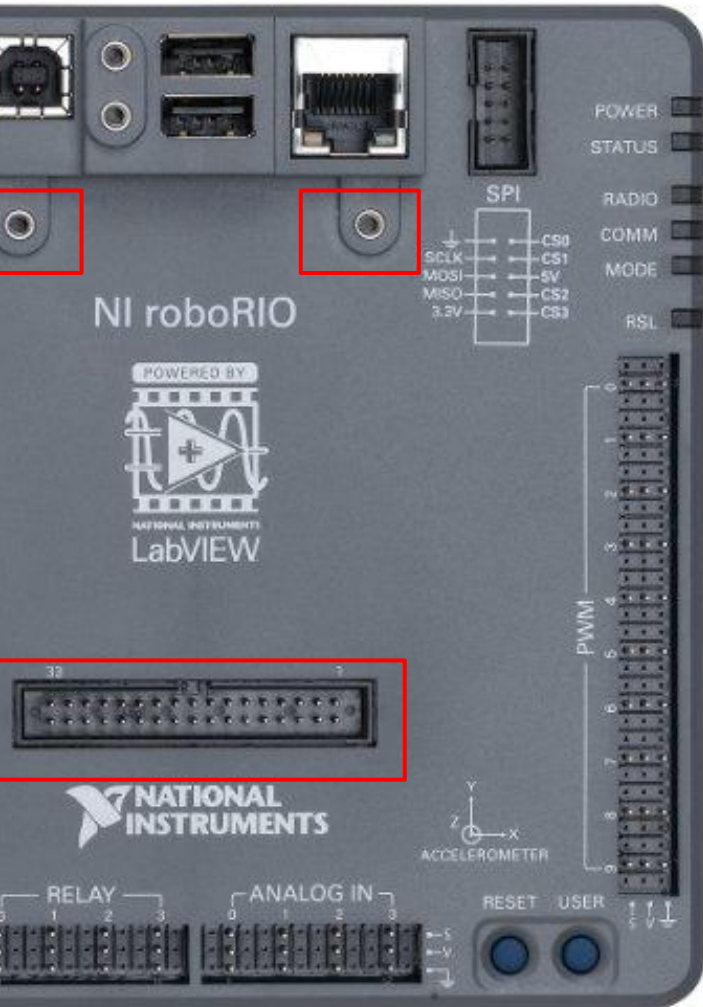
Robot RIO - Ports - SPI

Serial Parallel Interface - Port with the ability to talk in parallel to multiple devices on a common network. Each **C**hip **S**elect # pin enables the individual device (4 devices). While the pins on the left side of the socket are shared amongst all the devices.

SCK = System Clock

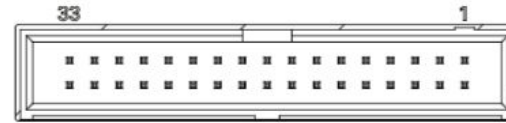
MOSI = Master Out Slave In

MISO= Master In Slave Out



Robot Rio - MXP

Expansion port- Accepts speciality designed circuit boards that expand the functionality of the Rio.
Screw points used to secure the expansion board.



+3.3V	DIO10 / PWM6	DIO9 / PWM5	DIO8 / PWM4	DIO7 / SPI MOSI	DIO6 / SPI MISO	DIO5 / SPI CLK	DIO4 / SPICS	DIO3 / PWM3	DIO2 / PWM2	DIO1 / PWM1	DIO0 / PWM0	A13	A12	A11	A10	+5V
33	31	29	27	25	23	21	19	17	15	13	11	9	7	5	3	1
34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2
DIO15 / I2C SDA	DIO14 / I2C SCL	DGND	DGND	DIO13 / PWM9	DGND	DIO12 / PWM8	DGND	DIO11 / PWM7	DGND	UART TX	UART RX	DGND	DGND	AGND	AO1	AO0

Research Usage



Robot Rio -Lights - RSL

Mimics the RSL light showing connection status.



Robot RIO - Lights - Mode

Shows the current mode of the robot.

Off = Outputs disabled

Solid Green = Outputs enabled - Autonomous

Solid Yellow = Outputs enabled - Teleoperation

Solid Red = Outputs unknown, undetermined, test mode



Robot Rio -Lights - Comm

Shows the communications status of the robot.

Solid **Red** = No Code

Blinking **Red** = E-Stop was activated

Solid **Green** = Active, Driver station connected.

Any **Yellow** = Reserved



Robot Rio -Lights - Comm

Shows the current Communications of the robot.

Off = Off

Blinking **Yellow** = Radio Booting as AP

Solid **Yellow** = Radio is Active as AP

Blinking **Green** = Radio Booting as Bridge

Solid **Green** = Radio is Active as Bridge

Any **Red** = Reserved



Robot RIO -Lights - Status

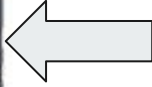
Shows the current Self test status of the boot process.

2 blinks = Probably failed upgrade.

3 blinks = Safe mode

4 blinks = Multiple crashes without reboots. Probably out of memory.

Regular blinking / solid on = Irrecoverable crash (call NI).



Robot RIO -Lights - Power

Shows the current Communications of the robot.

Off= voltage outside normal range.

Solid **Green** = No faults

Solid **Red** = One or more voltage rails are shorted or overcurrent

Blinking **Red** = Over 16v applied to Rio outputs disabled

Solid **Yellow** = Brownout Under 6 volts outputs disabled



General Troubleshooting

When confronted a problem on the robot, unskilled technicians will jump from device to device. They often prioritize the devices that they are most comfortable with to least. By achieving Level 3 status you will develop a new skill for troubleshooting.

Troubleshooting procedures:

- 1) Mentally isolate the subsystem.
- 2) Check the “trouble / signal lights” for a clue.
- 3) Start closest to the affected device (motor, solenoid, sensor).

Have Programmers check the code for this item while you are doing the hardware side.

- 4) Check all input sources on that device. (power, signal, air)

Look for **loose/poor/weak/broken connections/ bad crimps / solder joints.**

- 5) Move up the substem, branching and checking at each point. Until you reach a known good item.

-> Know good items are devices that connect to multiple devices, and the other devices are still functioning.



2890 Trouble Protocols

When troubleshooting a subsystem.

1. Call out “Im Troubleshooting _____” (pneumatics/ electrical/ drive drain)
2. A second person who has any level certs in that area will “hover” and assist.
3. The primary person will verbalize what they are checking and what they are thinking.
4. The secondary will listen and only speak up if a step/subsection/trouble spot was missed.

(If no certified secondary is available a mentor will step in)





Resolving Problems

Once a probable defective device has been identified:

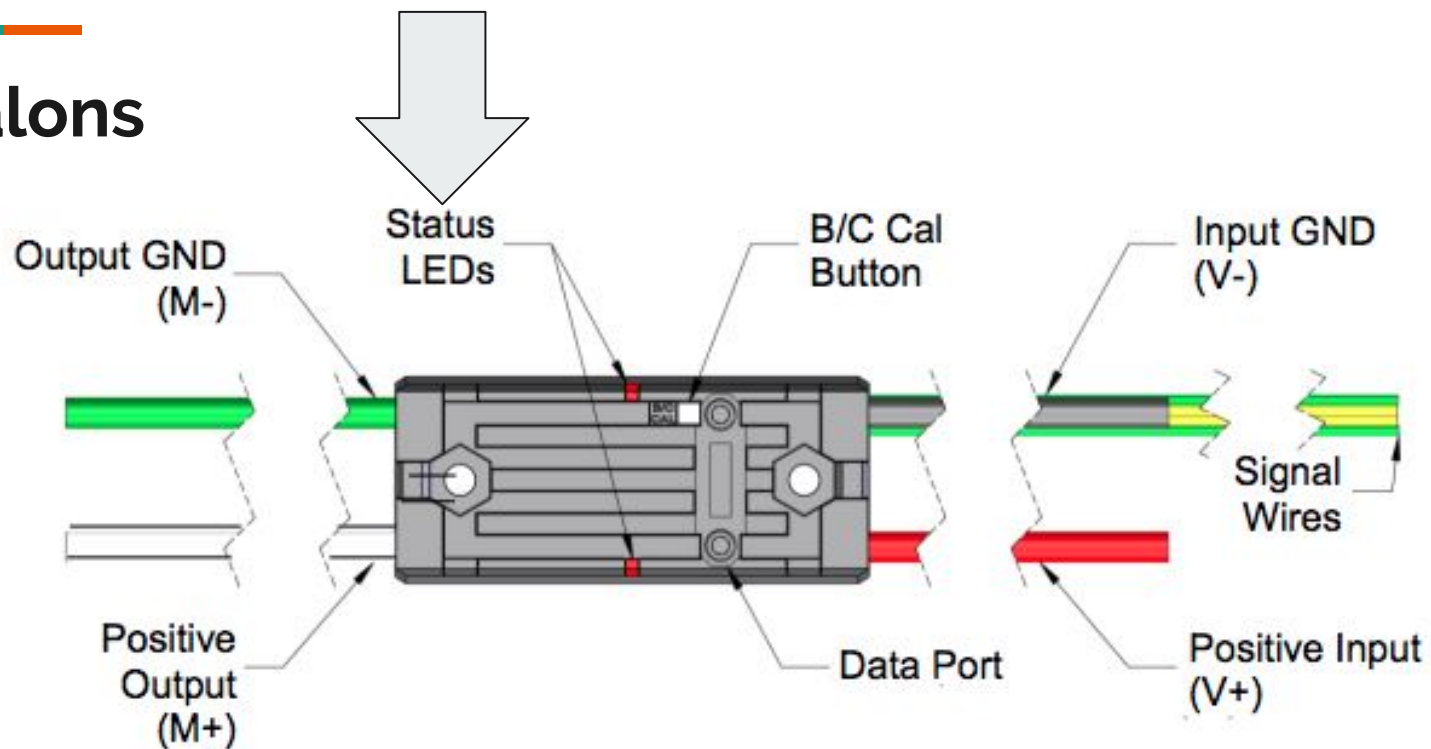
- 1) Quick swap identical item, Communicate the swap with all the Subsystem Leads so they can make all necessary changes while the swap is occurring.
- 2) As soon as the device has been swapped, check it, check it again, and then **check it again**.

If hardware fixes are not resolving the problems:

- Communicate with the lead programmer all actions taken by the hardware team.



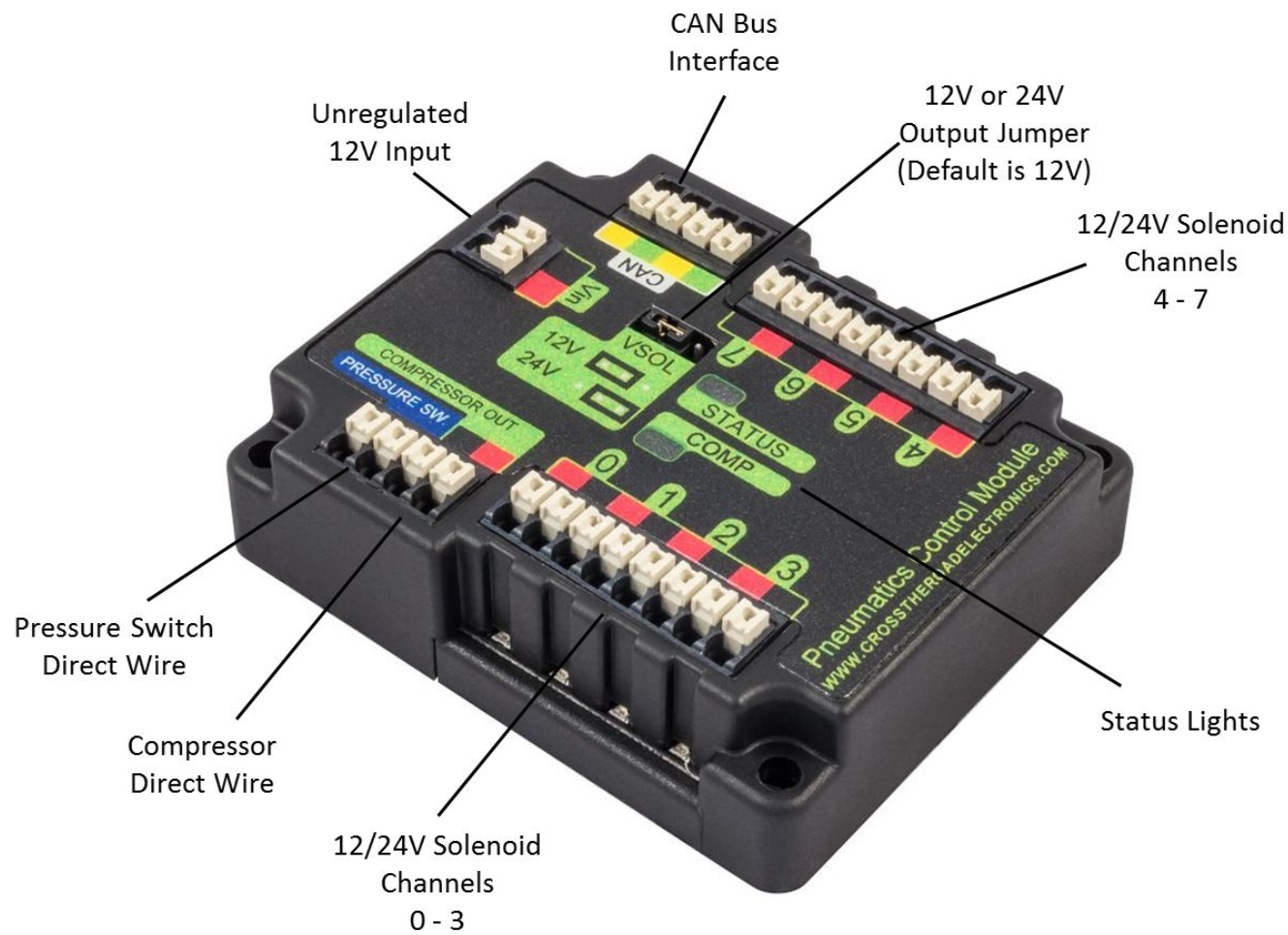
Talons



Talon LED Codes

Blink Codes During Normal Operation		
LEDs	Colors	Talon SRX State
Both	Blinking Green	Forward throttle is applied. Blink rate is proportional to Duty Cycle
Both	Blinking Red	Reverse throttle is applied. Blink rate is proportional to Duty Cycle
None	None	No Power is being applied to Talon SRX
LEDs Alternate ¹	Off/ Orange	CAN bus detected, robot disabled
LEDs Alternate ¹	Off/ Red	CAN bus/PWM is not detected
LEDs Alternate ¹	Switching between Red/Orange and Orange/Red	Damaged Hardware
LEDs Strobe "towards" (M+) ²	Off/ Red	Forward Limit Switch or Forward Soft Limit
LEDs Strobe "towards" (M-) ²	Off/ Red	Reverse Limit Switch or Reverse Soft Limit
LED1 Only "closest" to M+/V+	Green/Orange	In Boot-loader
Both	Solid Orange	Neutral throttle is applied. Throttle is zero or is within dead band.

Pneumatic Control Module



PCM Status LEDs

3.3.1. STATUS LED Fault Table

*LED Color	Strobe	Slow	Long
Green	No Fault - Robot Enabled	No Fault - Robot Disabled	NA
Orange	NA	Sticky Fault	NA
Red	NA	No CAN Comm. OR Compressor Fault OR Solenoid Fault (Blinks Solenoid Index)	Compressor Fault

*If STATUS LED contains more than one color, see LED Special States Table

PCM Status LEDs

3.3.2. Fault Resolution Table

Problem	Behavior	Resolution	CAN State	Robot State
Sticky Fault	PCM will slow blink orange. PCM has previously encountered (but is not actively having) a Solenoid Fault or Compressor Fault. Sticky Fault clears via user command over the CAN bus. Sticky Fault does NOT clear on power cycle.	<ol style="list-style-type: none">1. Access PDP logger2. Identify the most recent fault (Solenoid Fault or Compressor Fault)3. Respond to the fault via the Fault Resolution Table4. Clear the sticky fault via CAN	Good	Disabled
Solenoid Fault	PCM will blink the number of the faulted solenoid followed by a pause. Fault clears on power cycle.	<ol style="list-style-type: none">1. Check faulted solenoid2. Remove damaged solenoids3. Remove any metal debris4. Power cycle5. Clear sticky fault	Good	NA
Compressor Fault	PCM will blink red in 2 second intervals. Compressor will allow new run attempt every 5 seconds. Fault clears on power cycle OR successful enabling of compressor	<ol style="list-style-type: none">1. Check for short across compressor ports2. Remove any metal debris3. Clear sticky fault	Good	Enabled
No CAN Comm.	No PCM functionality	<ol style="list-style-type: none">1. Connect CAN cable2. Apply termination resistor3. Power roboRIO	Bad	NA



To Achieve Electronic Technician Level 3

1. Read this presentation and memorize the memorize the fault light codes for Rio, PCM, Talons.
2. Find the slides marked with “Research Usage”. Research one instance of another team/device using this port.
3. Take the Pretest for Electronics Technician Level 3
4. Schendle an in person test with a Electronics Trainer for level 3.

Next-Electronic Technician Level 4 - Trainer

1. Assist in each lower level training procedures least twice with guidance from Mentor/System Lead
2. Participate in updating / upgrading tests / training materials.
3. Retake all 3 Q&A Pre-test/test in a single supervised sitting lasting no more than 1 hour.