

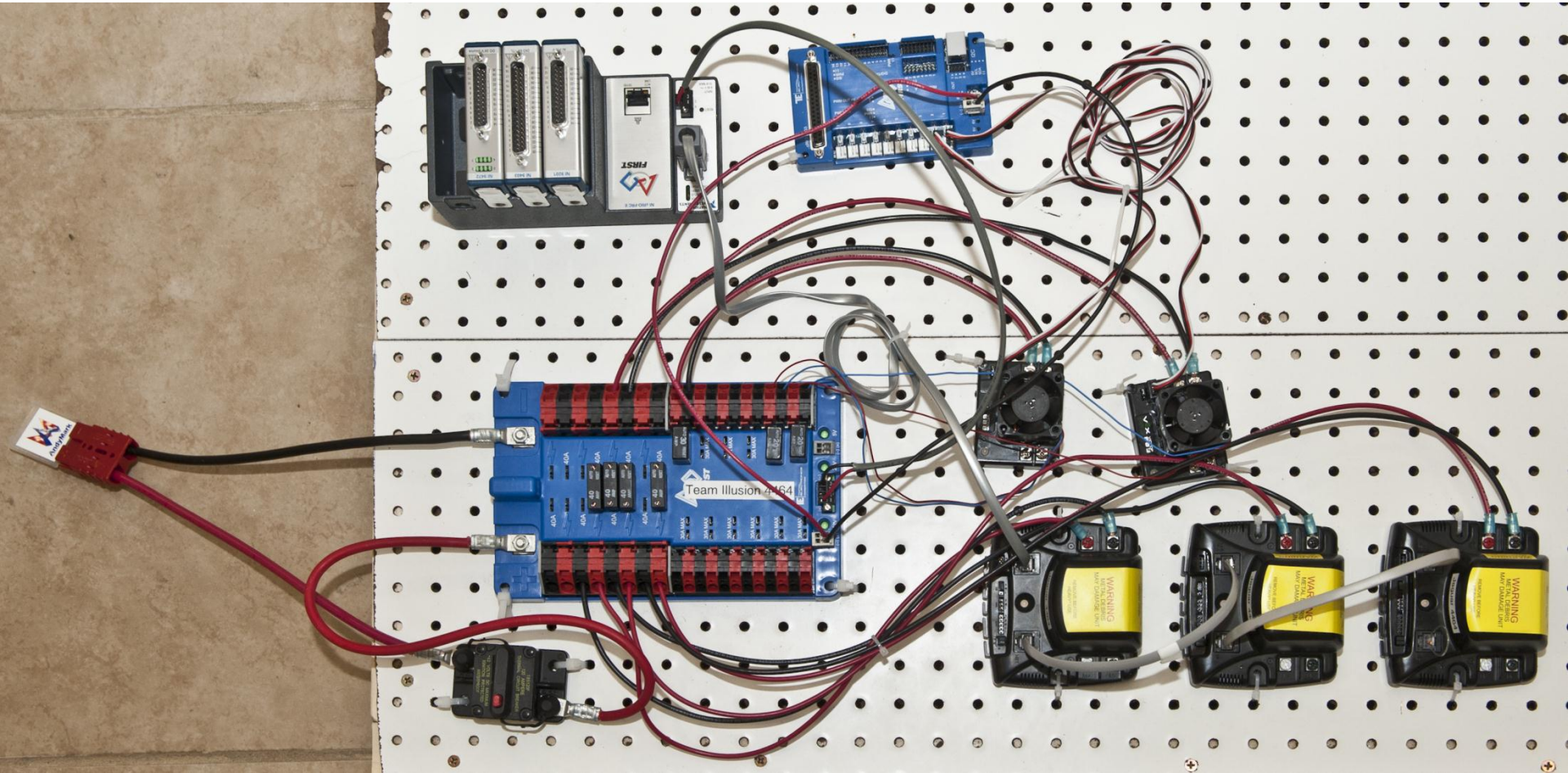
Basic Electrical Board Setup

By Team 4464

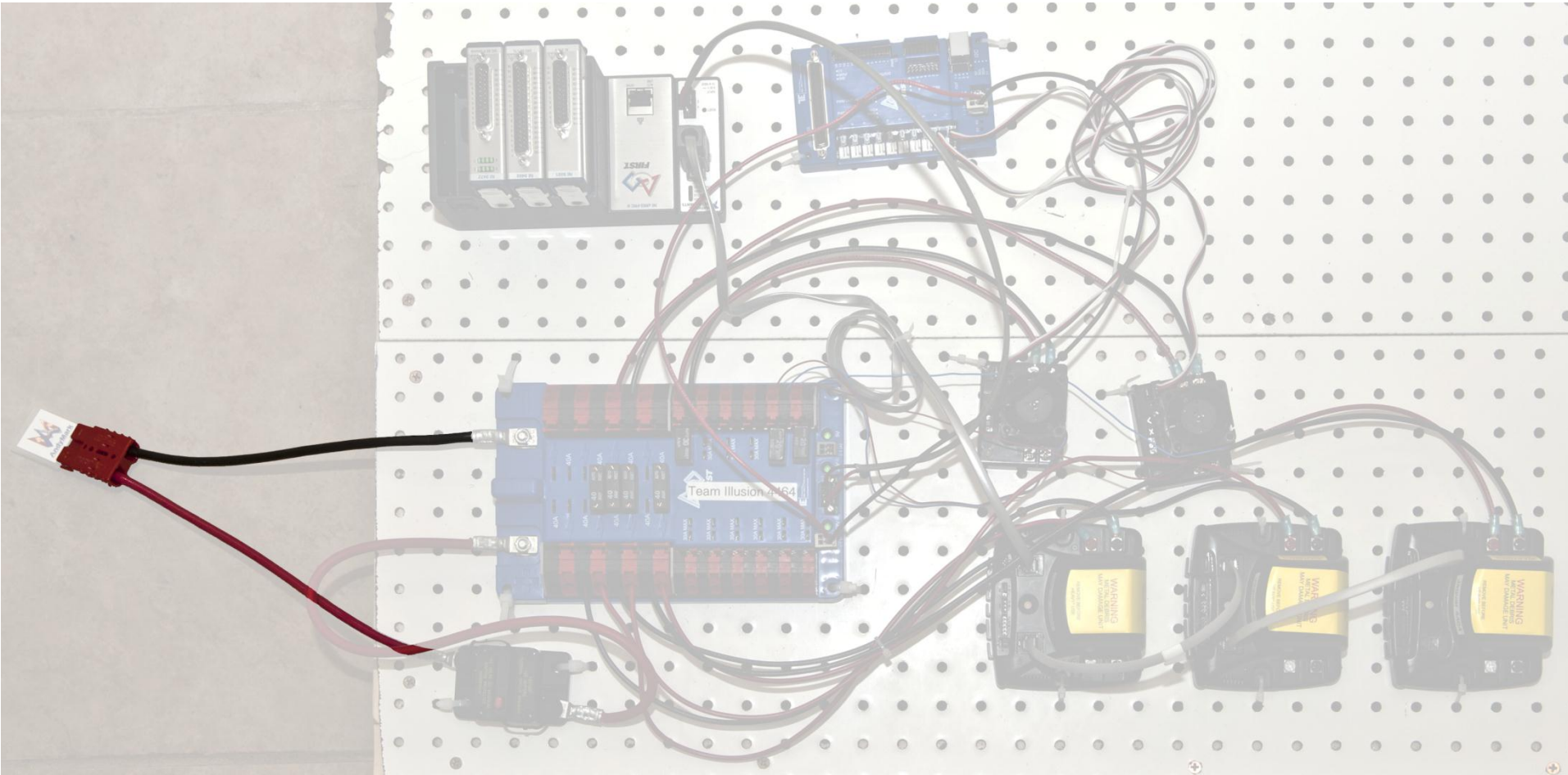
<http://www.teamillusion4464.com/>

2013

Full Board View

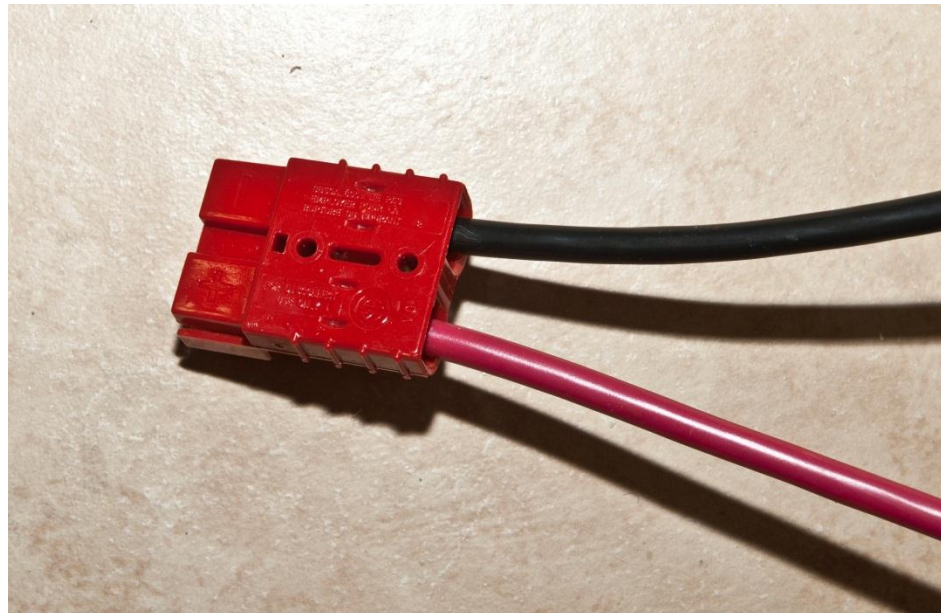


Battery Plug/Terminal

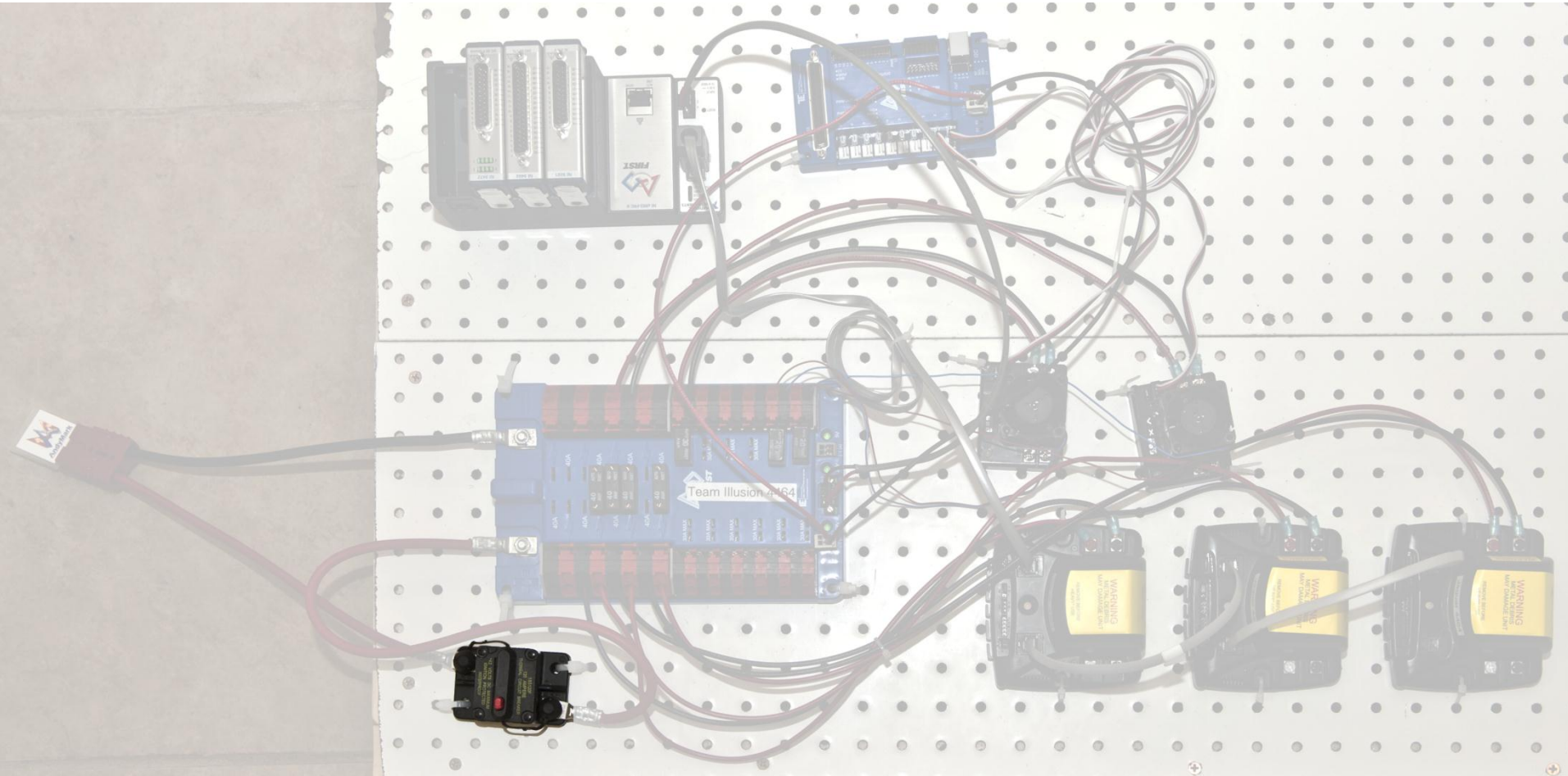


Battery Plug/Terminal

- This part is how the car battery is connected to the robot. It connects the car battery to the Power Distribution Board through the Main Circuit Breaker

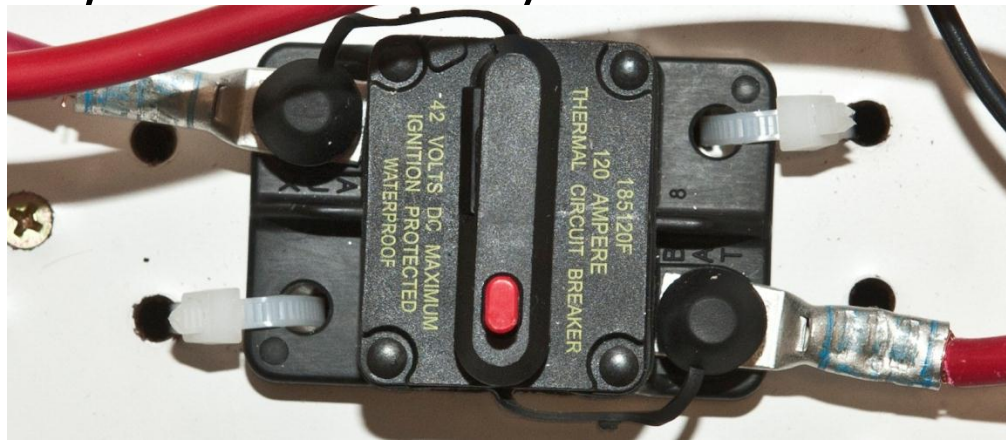


Main Circuit Breaker

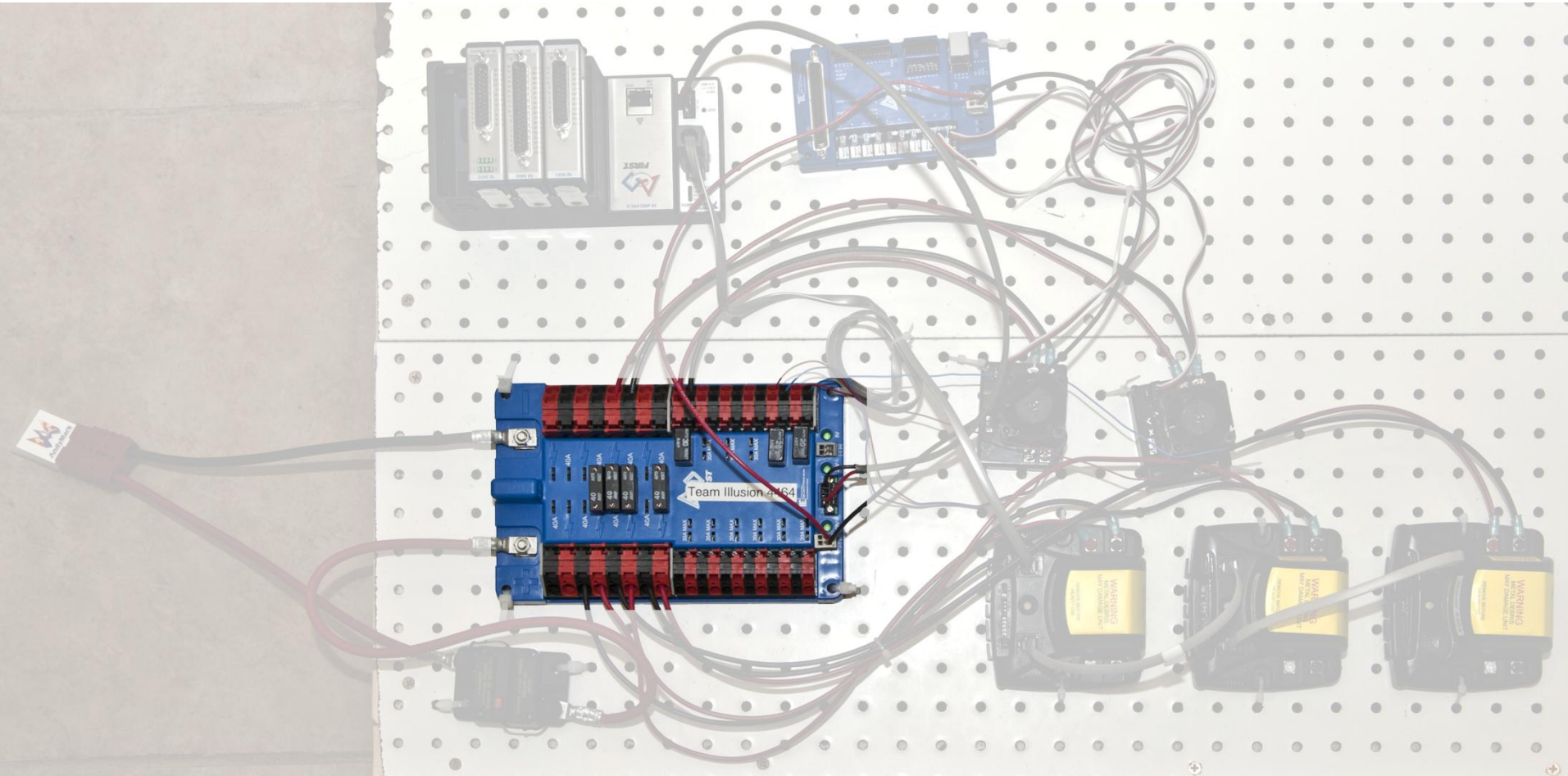


Main Circuit Breaker

- This part acts both as a switch to the robot and a circuit breaker. Power is passed from the Battery Plug to the main circuit breaker and from there, is it passed to the Power Distribution Board. If too much current flows from the battery to the robot, the circuit breaker will cut the connection, turning off the robot. Pushing the red button on the circuit breaker also cuts the connection, and is one way to turn off a robot.

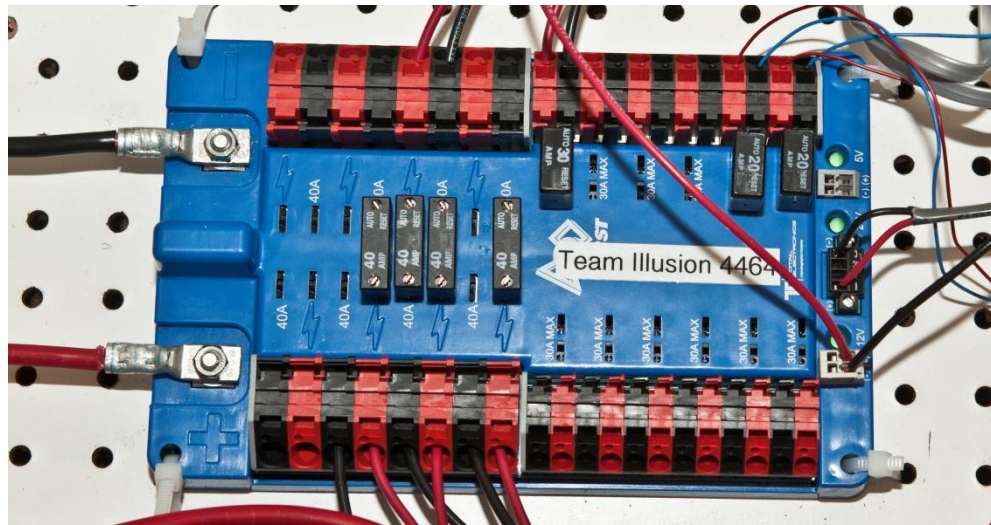


Power Distribution Board

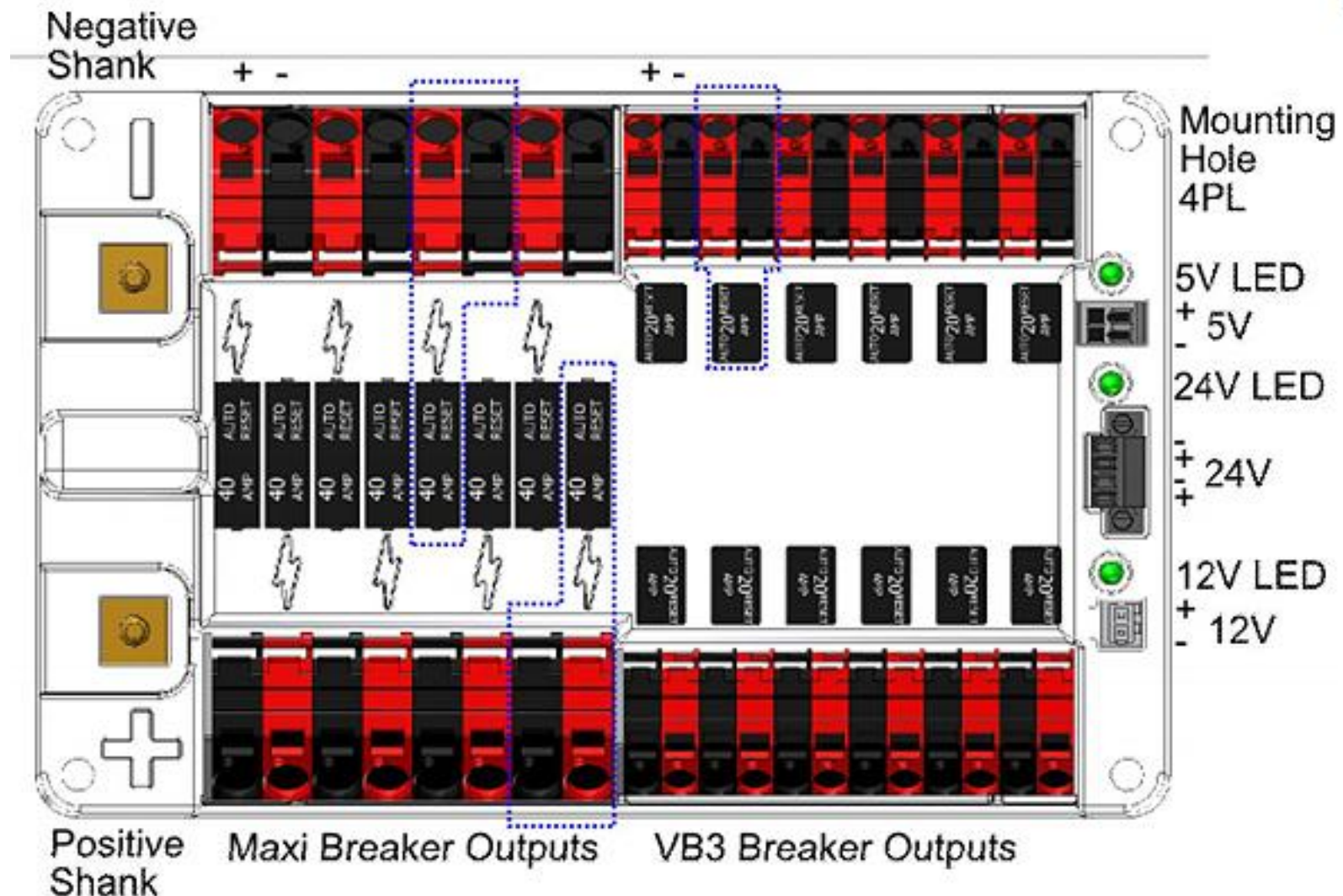


Power Distribution Board

- This part takes in the power from the battery and distributes it to all the other electrical components on the robot. It has several sets of terminals which will be explained in the following slides.



Power Distribution Board Diagram



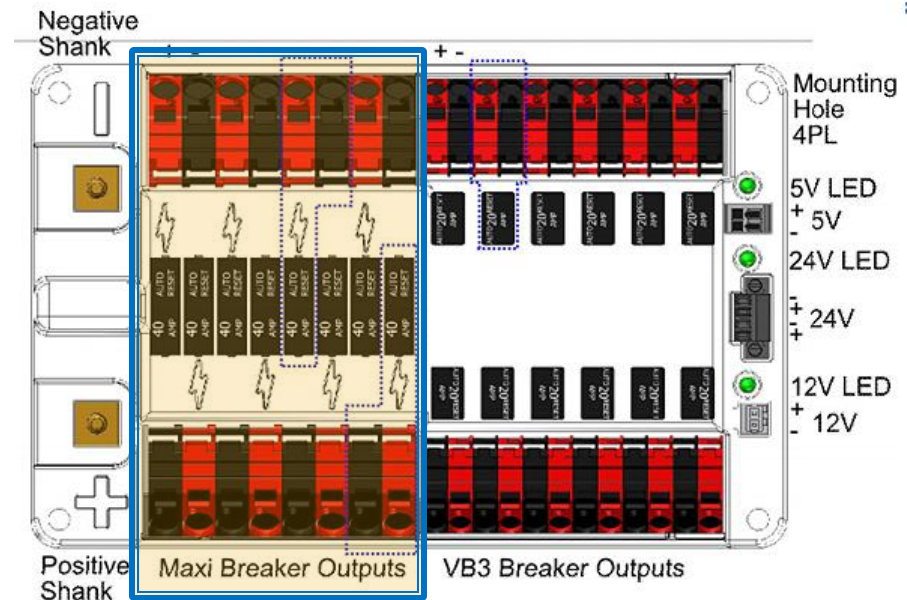
Terminals

- The Power Distribution Board contains 20 basic terminal pairs to which you can connect various electronic components. Power flows from the battery through these terminals, which are at the same voltage as your battery. The terminals come in black and red pairs, with the black always being the ground terminal and the red always being the power or positive terminal.
- Each terminal pair must have a circuit breaker attached in order to function. These circuit breakers are plugged into the slots adjacent to each terminal pair. Their function is to cut the power to that terminal when too much current flows into it, such as when an electrical short occurs.



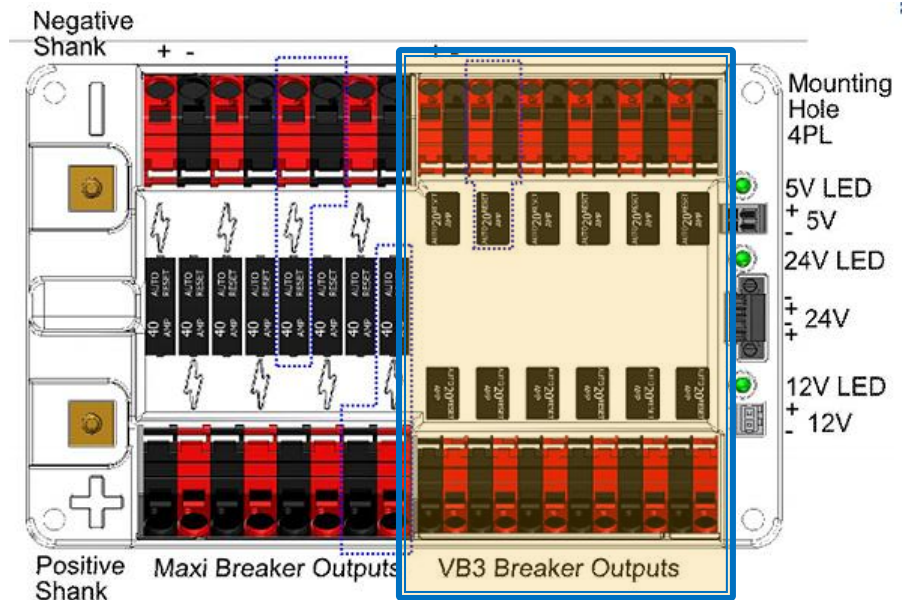
Maxi Breaker Outputs

- These are terminals which accept circuit breakers with a capacity up to 40A. Use these terminals for your most power hungry components, as they can handle the most current. (Note that each breaker is dedicated to one ground-power terminal pair, and that these pairs alternate sides. The power terminal which corresponds to each breaker is denoted with a lightning bolt symbol, as shown in the diagram.)



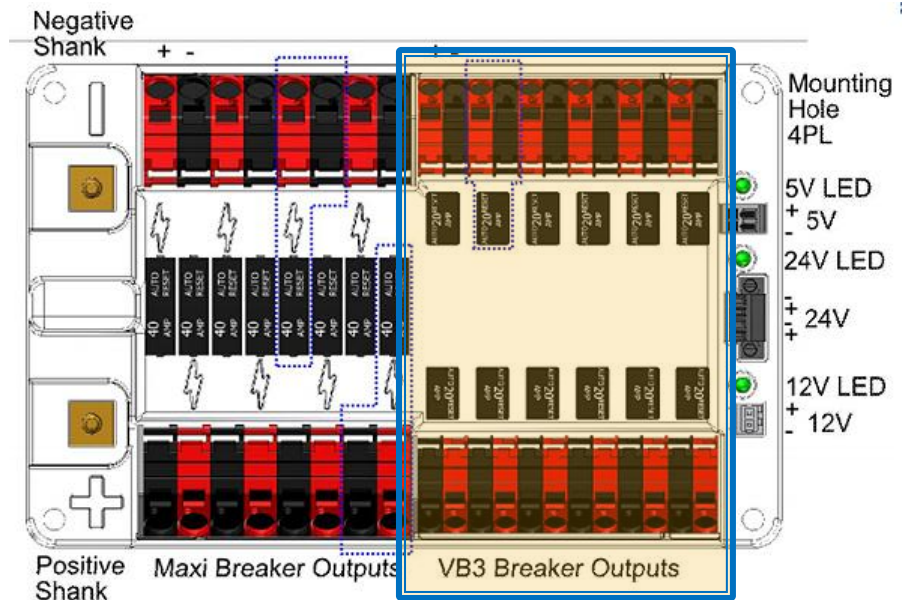
VB3 Breaker Outputs

- These are terminals which accept circuit breakers with a capacity up to 30A. Use these terminals for any electrical components which will not need over 30A. (Note that each breaker is dedicated to one ground-power terminal pair. In this case, the circuit breaker layout is more obvious, with each breaker directly adjacent to its terminal pair.)



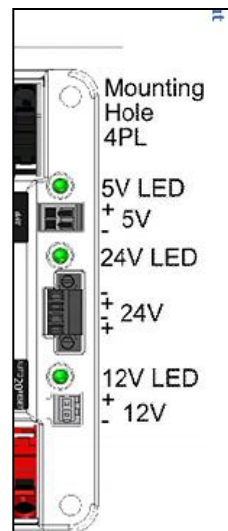
VB3 Breaker Outputs

- These are terminals which accept circuit breakers with a capacity up to 30A. Use these terminals for any electrical components which will not need over 30A. (Note that each breaker is dedicated to one ground-power terminal pair. In this case, the circuit breaker layout is more obvious, with each breaker directly adjacent to its terminal pair.)

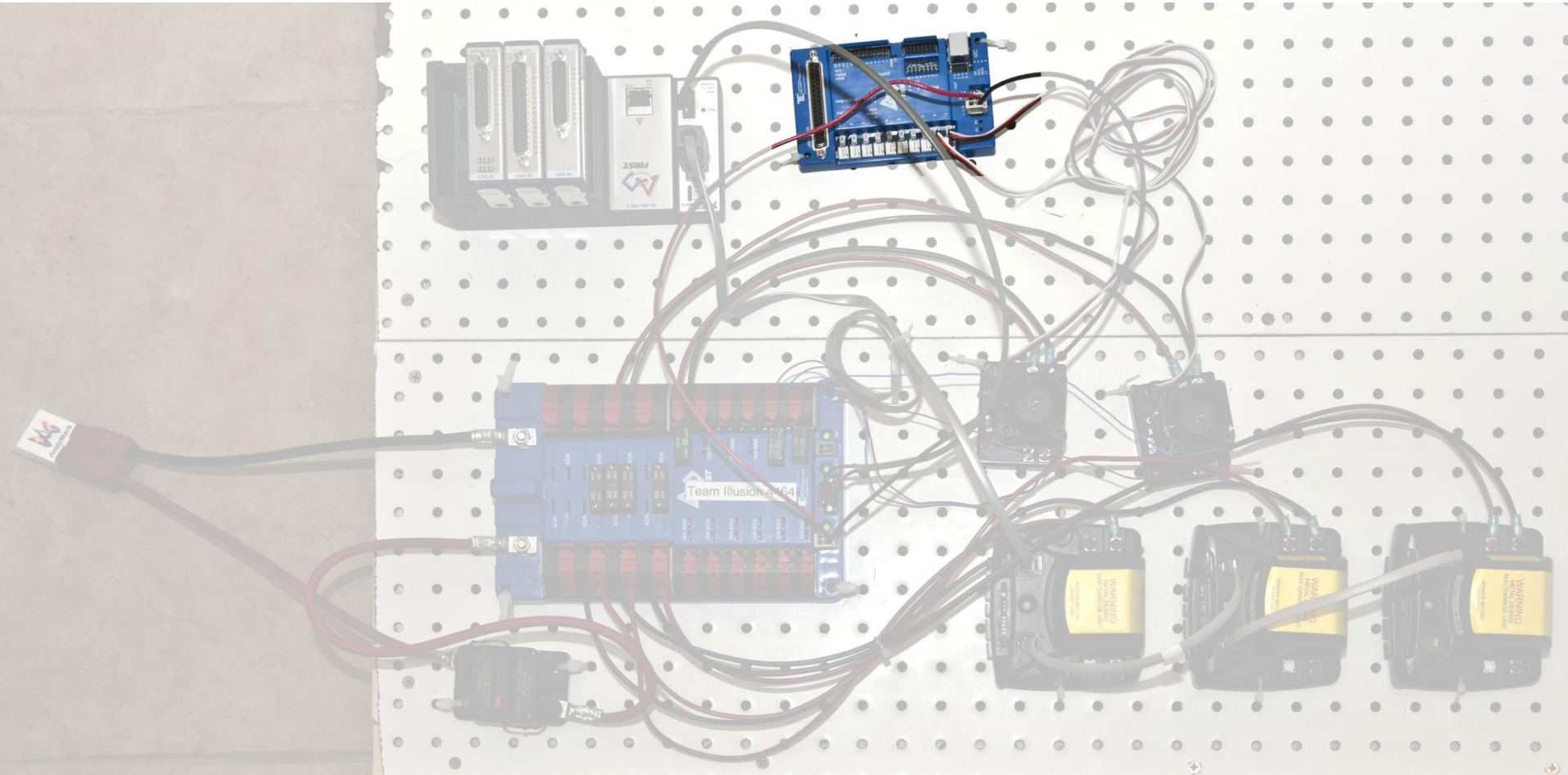


Additional Terminals/Outputs

- The bottom row of the Power Distribution Board contains several other power terminals of varying structure and voltage. These are:
 1. 5V/3A output: Outputs 5V and up to 3A. Frequently used to power Ethernet camera.
 2. 12V/2A output: Can be used to power Wireless Bridge.
 3. 24V/1.5A output: Used to power cRIO.

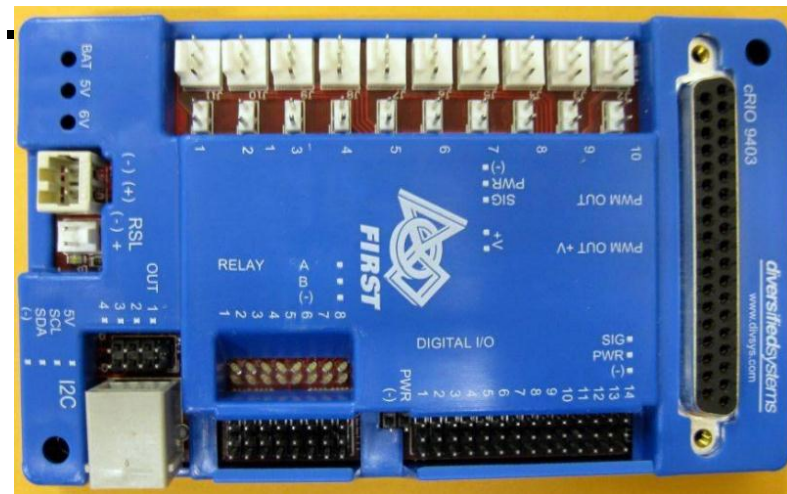


Digital Sidecar

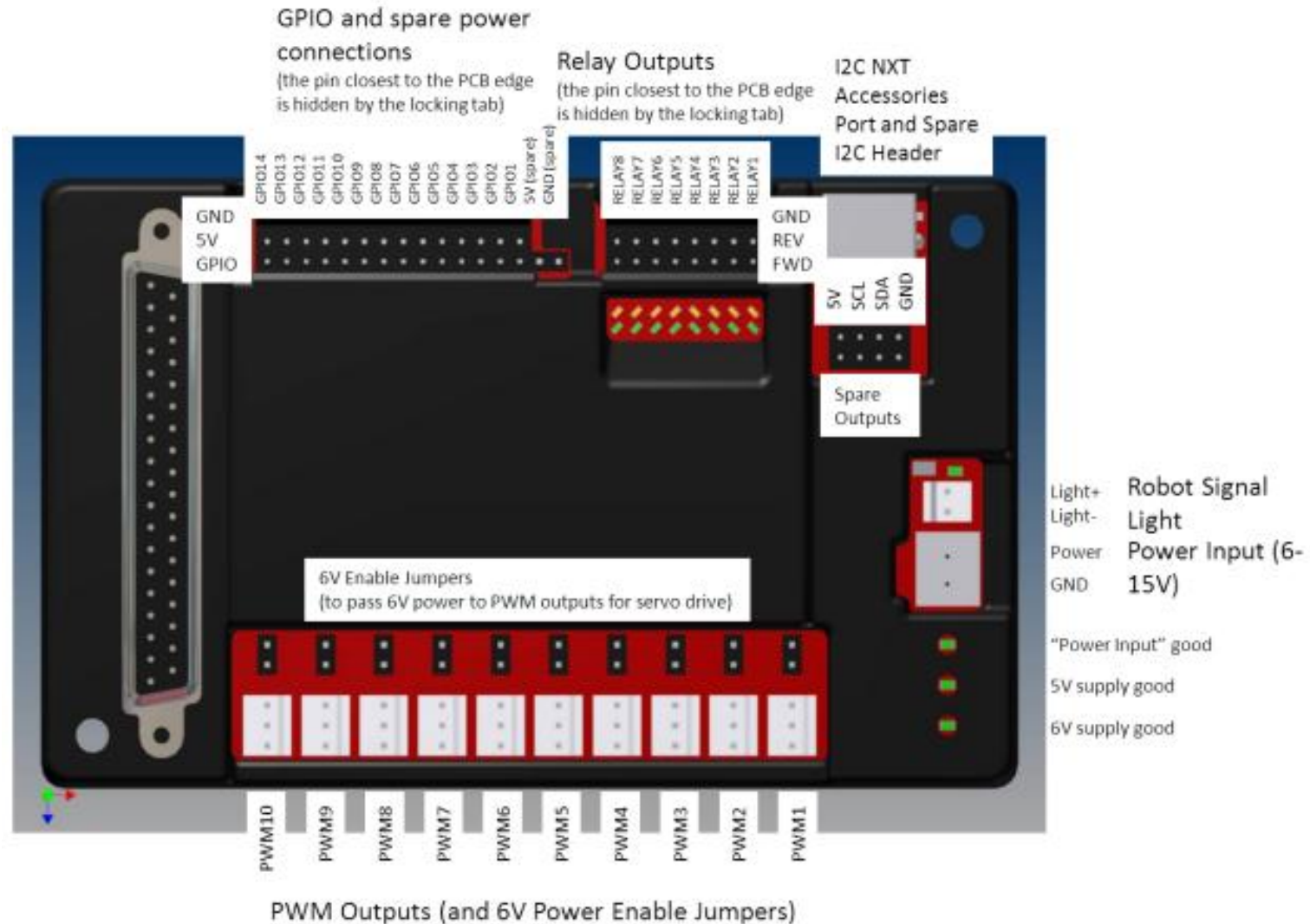


Digital Sidecar

- The Digital Sidecar adapts the I/O module of the cRIO into a set of I/O that is more familiar or easier to use.
- It allows the user to send signals between the cRIO and various electric components such as servos, relays, and sensors.

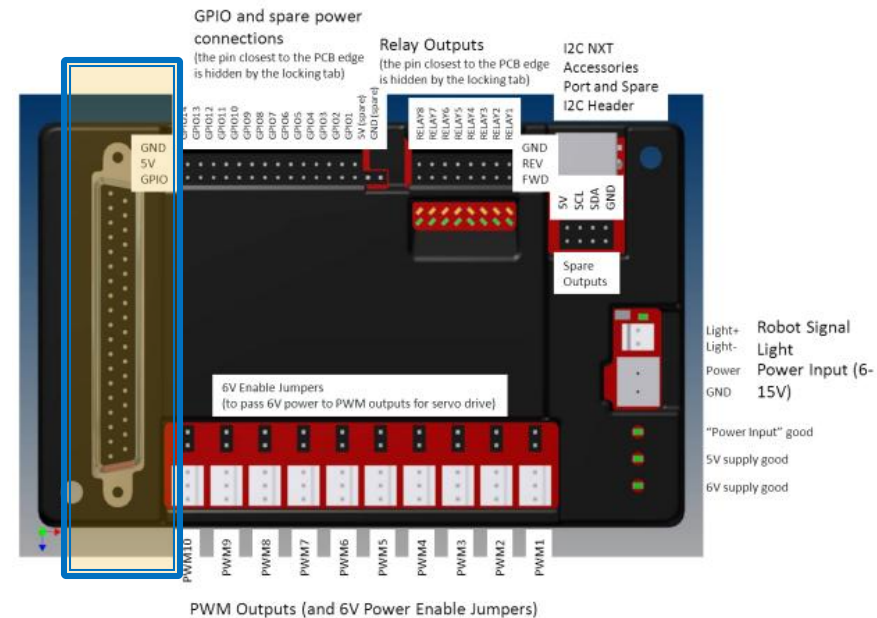


Digital Sidecar Diagram



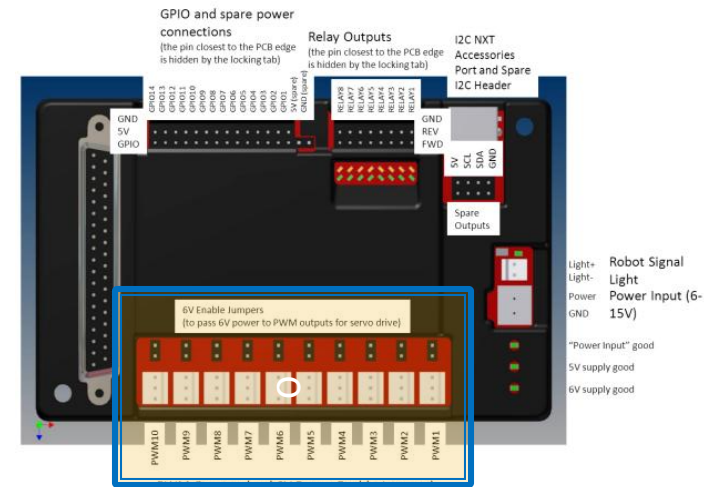
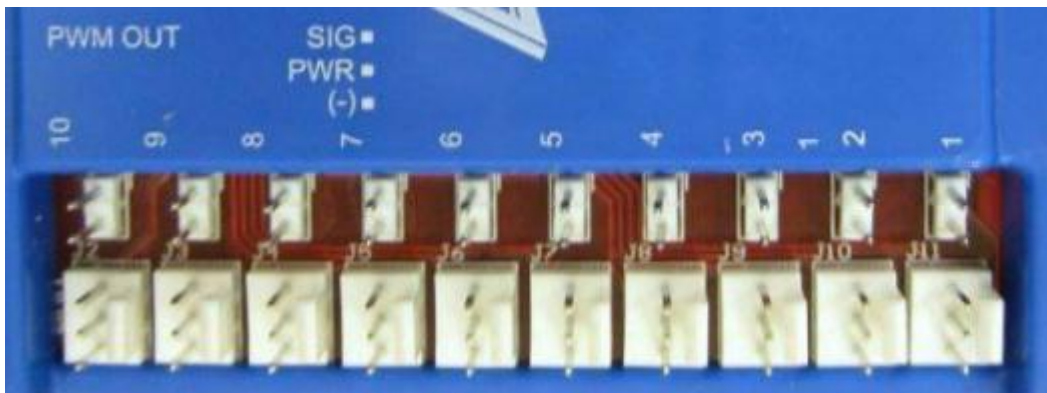
cRIO Connector

- A 37 line female connector. This accepts a cable which runs from the cRIO and serves as the communication link between the cRIO and the Digital Sidecar.



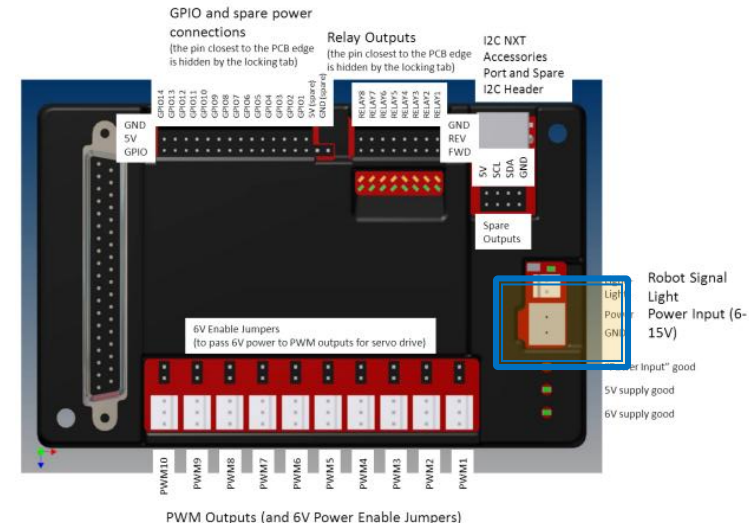
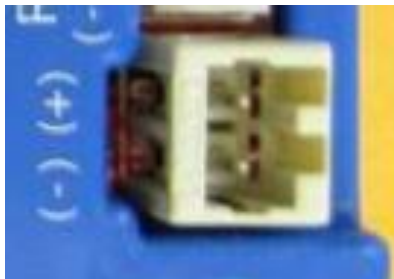
PWM Outputs

- There is a set of 10 PWM Outputs on the Digital Sidecar. Each is a 3-pin male connector, which are designated Ground, 5V, and Signal in order from the outside in. These outputs are used to control servos and speed/motor controllers.
- Each PWM output also has a pair of pins below it, which make up its 6V Enable. This allows the PWM to output 6V on its middle pin. To enable the 6V, put a .1" jumper across the two pins. This should only be used when the pin is powering a servo.



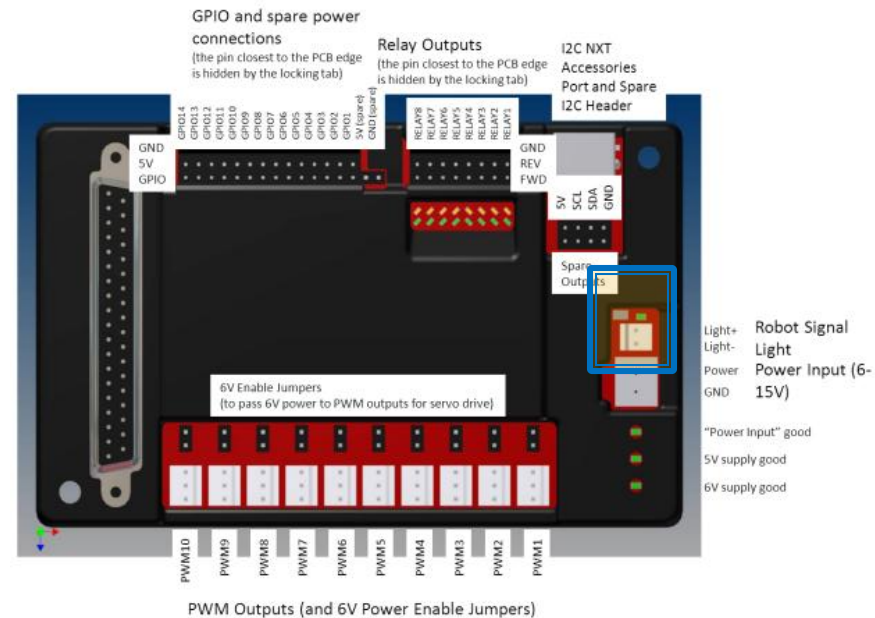
Power Input

- This terminal connects the Digital Sidecar to the Power Distribution Board in order to provide power to it and its outputs. It is rated from 5-16V and should be connected to a regular 12V terminal pair on the Power Distribution Board.



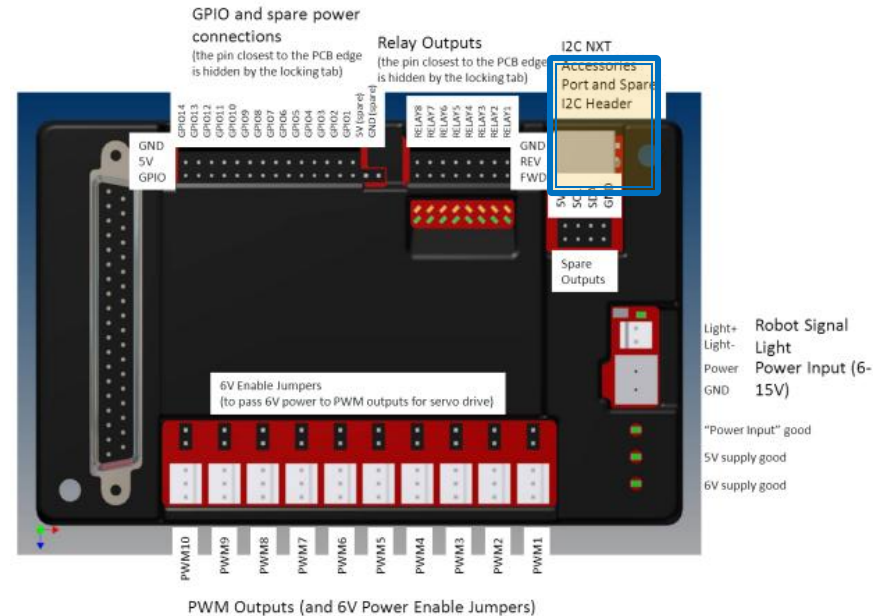
Robot Signal Light (RSL)

- This output is meant to power the FRC required indication light.



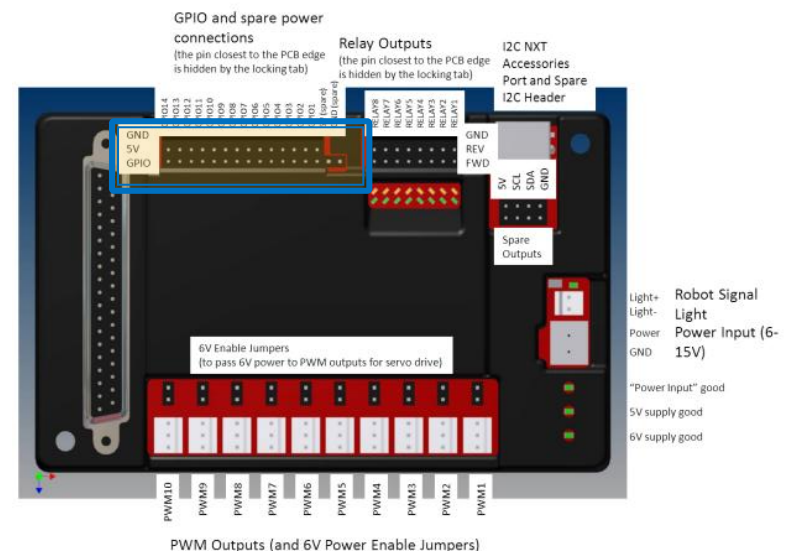
I2C Header

- This connector can connect to NXT-compatible accessories as well as other I2C compatible components.



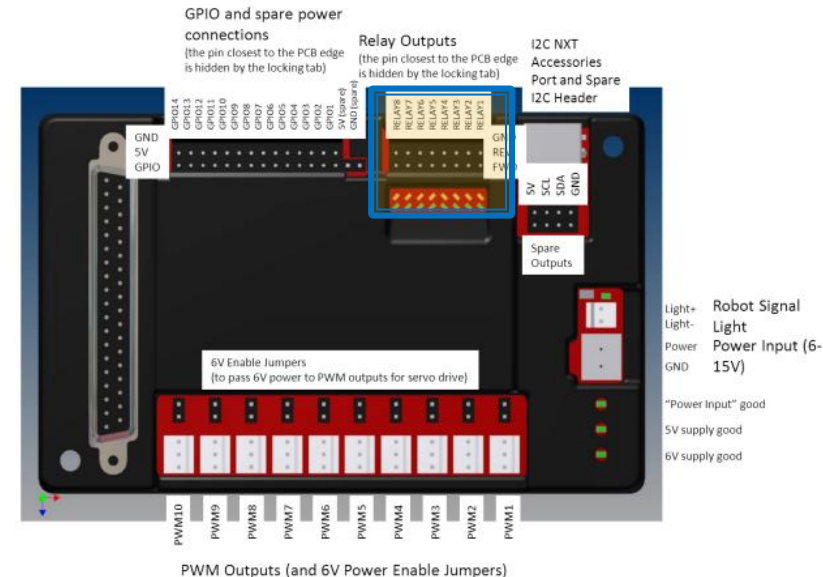
Digital I/O

- The Digital Sidecar also has a set of 14 Digital I/O ports. These have a similar layout to the PWM outputs, with ground, 5V, and signal pins in order from the outside edge inwards. These pins allow for reading in and sending out digital signals. This is useful for sensors but can be used in a variety of ways. Unlike the PWM's, these pins do not have 6V Enables.

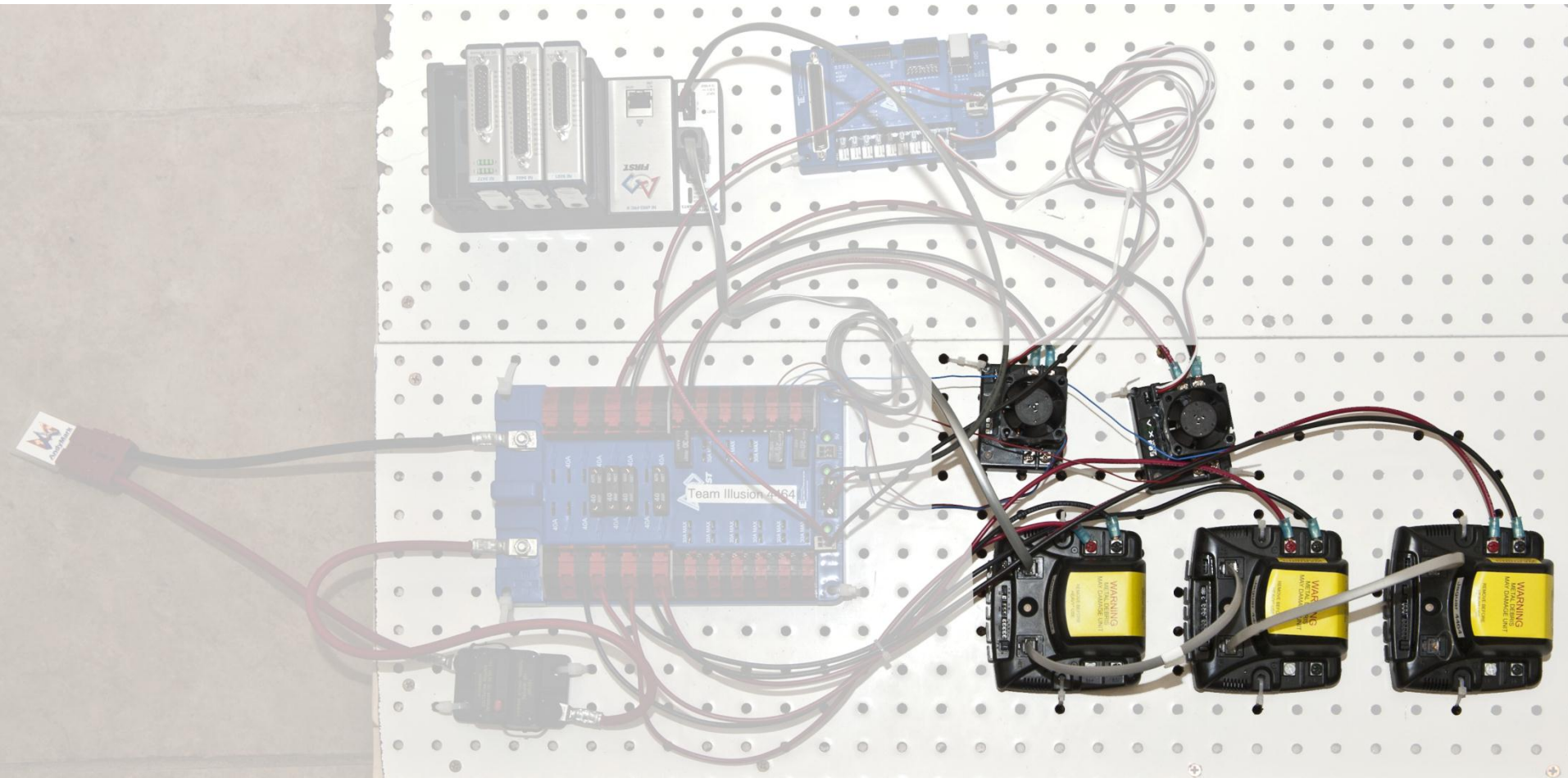


Relay Outputs

- The Digital Sidecar also has a set of 8 relay outputs. These consist of 3 pins organized as Ground, Reverse, Forward from the outer edge inwards.
- These pins are used to drive relays which in turn are used to control other various components or functions.



Motor Controllers



Motor Controllers

- Motor controllers are devices which allow your robot (specifically the cRIO) to control the speed, and frequently direction, of its electric motors. These devices take 2 types of inputs: power and communication. They also have 1-2 outputs: power to the motor (and on chained Jaguars, communication to additional motor controllers).
- There are two main types of motor controllers in FRC, the Jaguar and the Victor.

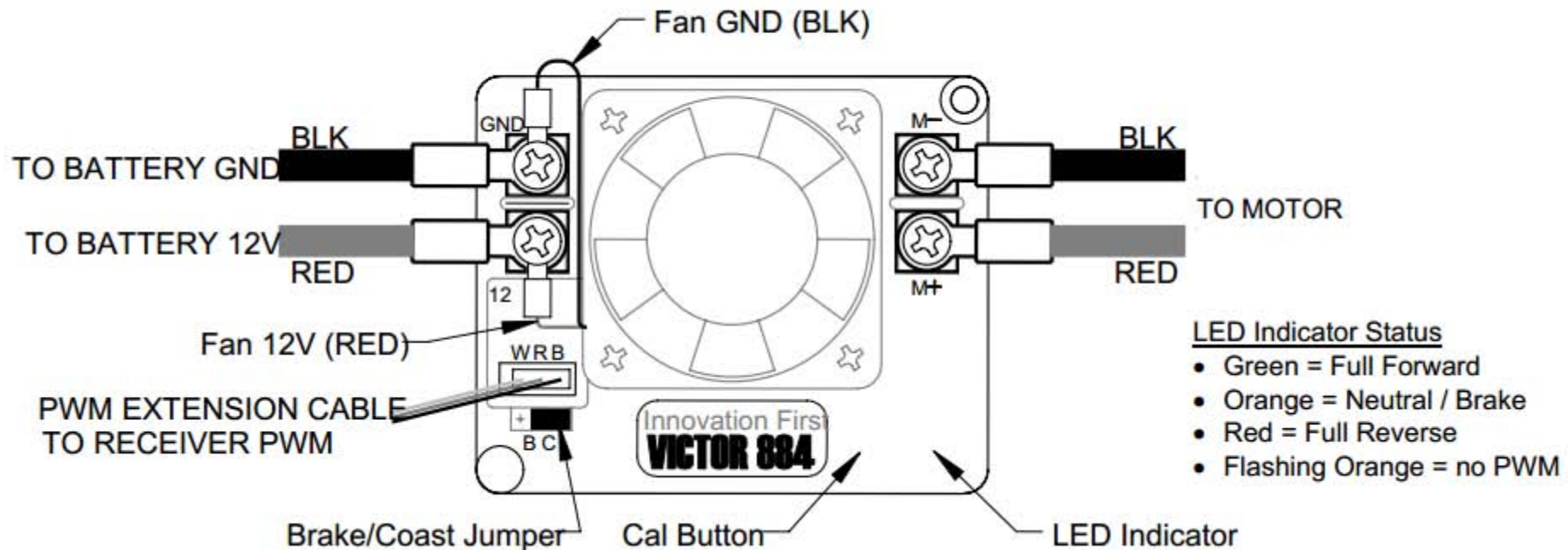
Jaguar



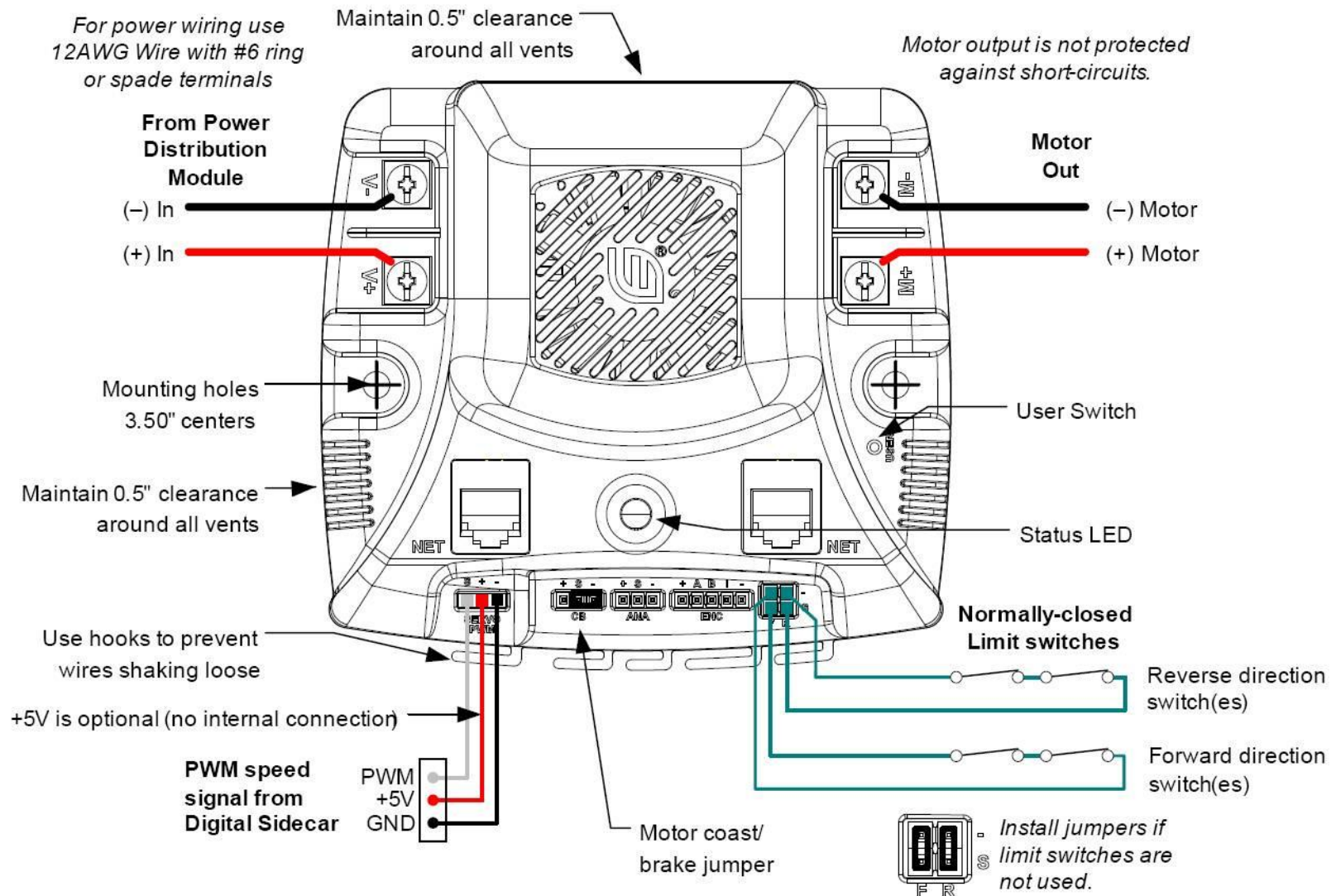
Victor



Motor Controller Diagrams (Victor)



Motor Controller Diagrams (Jaguar)

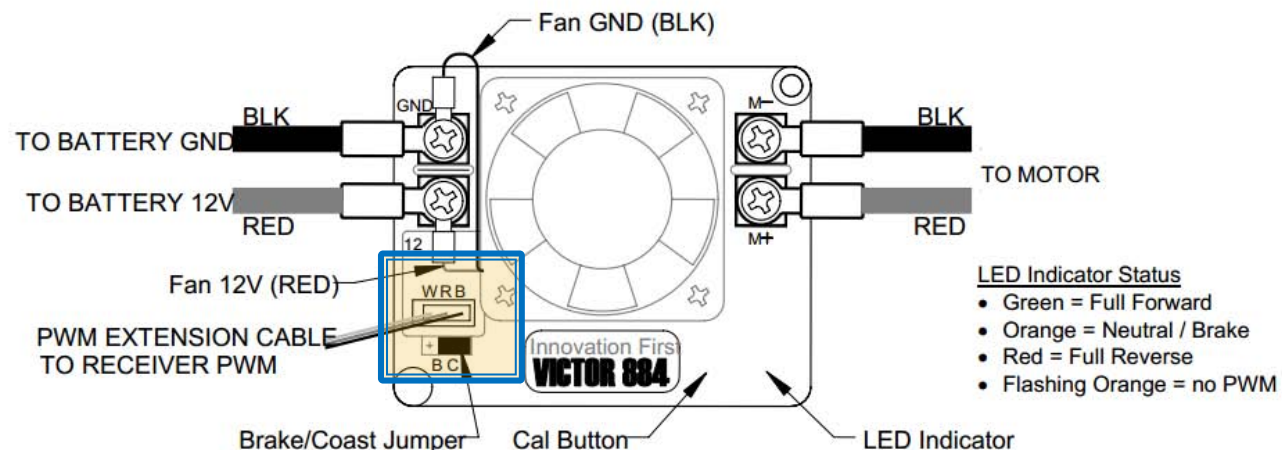
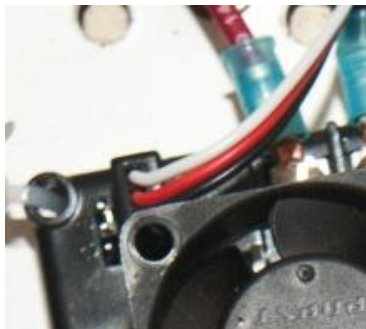


Motor Controller Connections

- Power Input/Output: Both motor controller types have the same power input and output connection layout. Power and Ground from the **Power Distribution Board** are connected on the left side. Power and Ground are output on the opposite side. It is important to note that connecting the Power Inputs to the motor controllers in the right configuration is critical. Otherwise you may damage your motor controllers.

Motor Controller Connections

- Communication (PWM): Both motor controllers types can be controlled using PWM through standard PWM connections of their front side. These would be connected to the Digital Sidecar PWM outputs.



Motor Controller Connections

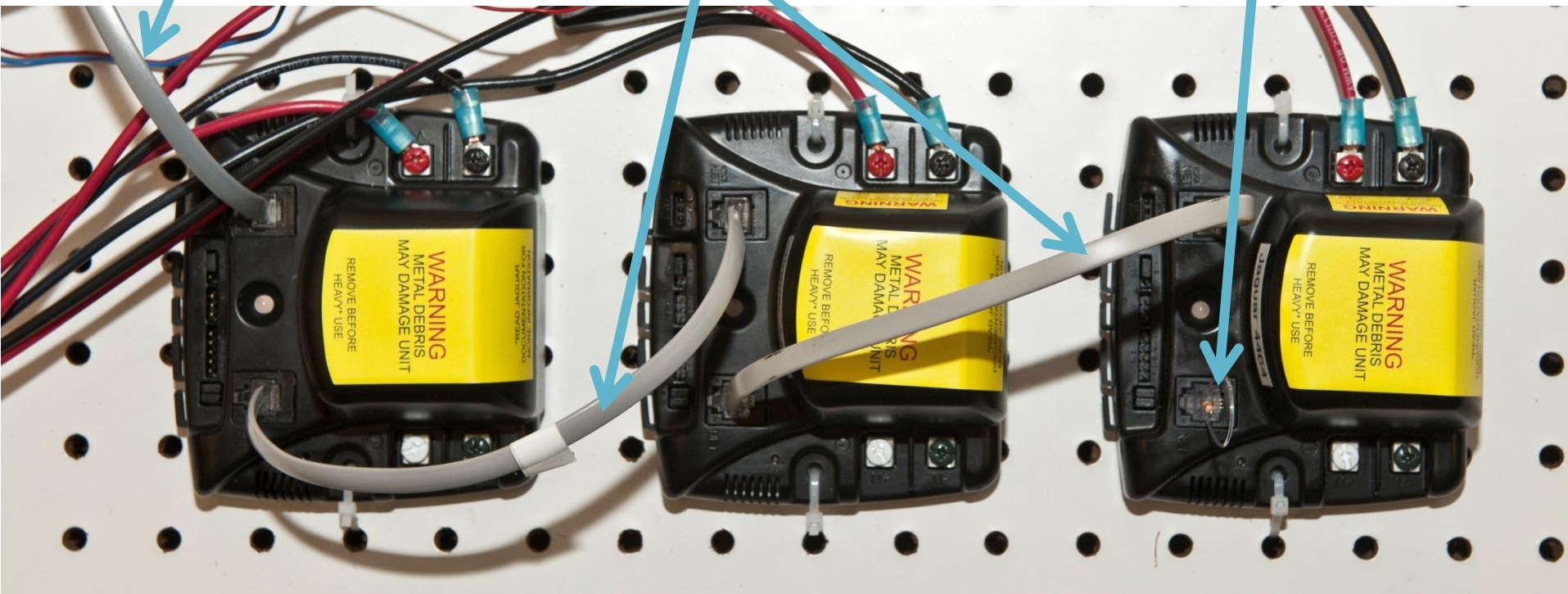
- Communication (CAN): Jaguars can communicate with the cRIO in another way, the CAN Network.
- To do this, connect a CAN cable from the cRIO to a Jaguar's CAN input port. If any additional Jaguars will be used, chain the Jaguars by connecting the previous Jaguar's CAN output to the next Jaguar's CAN input. On the final Jaguar, it is necessary to put a terminator into the CAN output. This completes the chain.

Motor Controllers CAN Network

Input from cRIO

CAN Cable connecting
to next Jaguar

CAN Terminator



Sources:

- Slides and Electrical Board/Component images
 - Team Illusion 4464: <http://www.teamillusion4464.com/>
- Power Distribution Board Diagrams/Specs
 - http://www.usfirst.org/sites/default/files/uploadedFiles/Robotics_Programs/FR_C/Game_and_Season_Info/2012_Assets/Power%20Distribution%20Board.pdf
- Digital Sidecar Diagrams/Specs
 - http://www.usfirst.org/sites/default/files/uploadedFiles/Robotics_Programs/FR_C/Game_and_Season_Info/2012_Assets/Digital%20Sidecar.pdf
- Full Robot Wiring Diagram (Not used directly but referenced. A great graphic)
 - <http://www.entech281.com/images/content/Entech-FrcRobotOverview.png>
- Victor Diagram
 - <http://content.vexrobotics.com/docs/ifi-v884-users-manual-9-25-06.pdf>
- Jaguar Diagram (By Team 358, very well done)
 - <http://team358.org/files/programming/ControlSystem2009-/JaguarDiagram.jpg>
- Victor top-view
 - http://t3.gstatic.com/images?q=tbn:ANd9GcQi4ohz2HJUQpTbijQ3GML_pGtfdKocTVTPzpByohFicNSAMOGwlvSCeqMweg