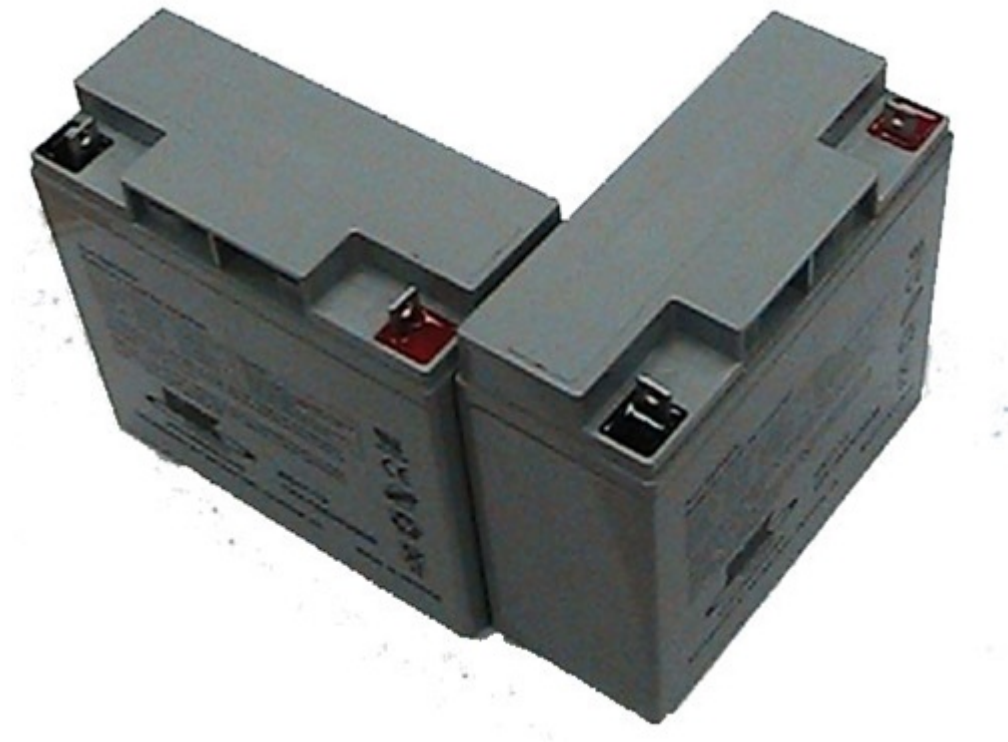


2014 FRC Control System Hardware Overview

The goal of this document is to provide a brief overview of the hardware components that make up the 2014 FRC Control System. Each component will contain a brief description of the component function, a brief listing of critical connections, and a link to more documentation if available. Note that for complete wiring instructions/diagrams, please see the [Wiring the 2014 Control System](#) document, and the [Power Distribution Diagram and Data Connectivity Diagram](#).

Note that while many of the system components have been designed to tolerate reverse polarity input or short circuits on the output, not all components are protected from all conditions. Teams should take caution to check that all wiring is secure and correct before connecting the battery after any wiring changes.

Robot Battery



The power supply for an FRC robot is a single 12V 18Ah battery. The batteries used for FRC are sealed lead acid batteries capable of meeting the high current demands of an FRC robot. For more information, see the Datasheets for the [MK ES17-12](#) and [Energys NP18-12](#).

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120A Circuit Breaker



The 120A Main Circuit Breaker serves two roles on the robot: the main robot power switch and a protection device for downstream robot wiring and components. The 120A circuit breaker is wired to the positive terminals of the robot battery and Power Distribution boards. For more information, please see the [Cooper Bussmann 18X Series Datasheet](#) (PN: 185120F)

Power Distribution Board



The Power Distribution Board (PD) is designed to distribute power from a 12VDC battery to various robot components through auto-resetting circuit breakers, as well as provide specialized, regulated supplies for powering specific Control System Components. The PD provides 8 output

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pairs rated for 40A continuous current and 12 pairs rated for 30A continuous current. The PD provides a regulated 24V power supply to power the cRIO, a special, regulated 12V power supply for powering the robot radio and a 5V power supply for powering an Axis camera.

Snap Action Circuit Breakers



The Snap Action circuit breakers, MX5-A40 and VB3 series, are used with the Power Distribution board to limit current to branch circuits. The MX5-A40 40A MAXI style circuit breaker is used with the larger channels on the Power Distribution Board to power loads which draw current up to 40A continuous. The VB3 series are used with the smaller channels on the PD to power circuits drawing current of 30A or less continuous. For more information, see the Datasheets for the [MX5 series](#) and [VB3 Series](#).

National Instruments cRIO



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The NI-cRIO is the main robot controller used for FRC 2013. The cRIO supplements its PowerPC processor with an FPGA controller and plug-in modules used to interface with IO. For FRC the FPGA controller is loaded with a provided image which provides functionality such as Quadrature decoders and analog accumulators as well as implements safety features. The controller pictured is the 4-slot cRIO-FRCII which is the version currently available from NI and provided in all rookie kits. The previous version, the 8-slot cRIO FRC is still legal and compatible for FRC use. The cRIO should connect to the 24V port on the Power Distribution board for power, an ethernet port on the D-LINK DAP 1522 radio for communications and modules and their associated breakout boards for input and output. The User Manual contains more information about the [cRIO-FRCII](#).

Digital Sidecar



The Digital Sidecar is a breakout board which converts the digital I/O from the NI 9403 module into forms more readily usable for FRC. The Digital Sidecar provides 10 PWM outputs with 6V servo jumpers for controlling motor controllers and servos, 8 relay output pairs for controlling Spike H-Bridge Relays, 14 general purpose Digital I/O headers, a 6 pin header for I2C connections, an NXT cable compatible I2C connector, and an output for the Robot Signal Light. The Digital Sidecar should be connected to a cRIO 9403 module, the Power Distribution Board, and motor controller devices or I/O as necessary.

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Analog Breakout Board



The Analog Breakout board converts the Analog input pins of the NI 9201 module into a form more readily usable by FRC teams. The board provides a jumper for monitoring battery input voltage and 8 3 pin headers providing 5V power, an Analog input and ground. Note that the battery voltage monitoring functionality utilizes channel 8. The Analog Breakout board should be plugged into an NI 9201 and connected to the Power Distribution Board.

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Solenoid Breakout Board



The Solenoid Breakout Board takes the Digital Outputs of the NI 9472 module and converts them into a form more readily usable by FRC teams. The Solenoid breakout board accepts 12V or 24V input power and provides a signal and ground output for each of the 8 output channels. The Solenoid Breakout Board should be plugged into the NI 9472 module and plugged into the Power Distribution Board.

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D-Link DAP-1522 Rev B



The D-Link DAP-1522 Rev B robot radio is used to provide wireless communication functionality to the robot. The device can be configured as an Access Point for direct connection of a laptop for use at home. It can also be configured as a bridge for use on the field. The robot radio should be powered by the 12V-5V power converter and connected to the cRIO controller over Ethernet. For more information, see [Programming your radio for home use](#) and the [D-Link DAP1522 Support Page](#).

12V-5V Power Converter



The 12V-5V Power Converter converts the 12V power output from the dedicated radio output on the Power Distribution Board to 5V for use with the D-Link DAP-1522 Robot Radio. The Power

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Converter should be connected to the dedicated radio output on the end of the Power Distribution Board and to the D-Link DAP 1522 robot radio power input.

Axis M1013/ M1011 / 206 Ethernet Camera



The Axis M1013, M1011 and 206 Ethernet cameras are used for capturing images for vision processing and/or sending video back to the Driver Station laptop. The camera should be wired to the 5V power output on the Power Distribution Board and either the robot radio or ethernet port 2 of an 8-slot cRIO-FRC. For more information, see [Configuring an Axis Camera](#) and the [Axis 206](#), [M1011](#), and [M1013](#) pages.

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Jaguar Motor Controller



The Jaguar Motor Controller from VEX Robotics is one of three variable speed motor controllers for use in FRC. The Jaguar can be controlled using either the PWM interface or over the CAN bus. The Black Jaguar can also be used to convert from RS232 (from the cRIO serial port or BDC-Comm program) to the CAN bus. The Jaguar should be connected using one of these control interfaces and powered from the Power Distribution Board. For more information, see the Jaguar Getting Started Guide, Jaguar Datasheet and Jaguar FAQ on [this page](#).

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Talon Motor Controller



The Talon Motor Controller from Cross the Road Electronics is one of three variable speed motor controllers for use in FRC. The Talon is controlled over the PWM interface. The Talon should be connected to a PWM output of the Digital Sidecar and powered from the Power Distribution Board. For more information see the [Talon User Manual](#).

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Victor 888 Motor Controller / Victor 884 Motor Controller



The Victor 888 Motor Controller from VEX Robotics is one of three variable speed motor controllers for use in FRC. The Victor 888 replaces the Victor 884, which is also usable in FRC. The Victor is controlled over the PWM interface. The Victor should be connected to a PWM output of the Digital Sidecar and powered from the Power Distribution Board. For more information, see the [Victor 884 User Manual](#) and [Victor 888 User Manual](#).

Spike H-Bridge Relay



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The Spike H-Bridge Relay from VEX Robotics is a device used for controlling power to motors or other custom robot electronics. When connected to a motor, the Spike provides On/Off control in both the forward and reverse directions. The Spike outputs are independently controlled so it can also be used to provide power to up to 2 custom electronic circuits. The Spike H-Bridge Relay should be connected to a relay output of the Digital Sidecar and powered from the Power Distribution Board. For more information, see the [Spike User's Guide](#).

Image credits

Image of cRIO-FRCII courtesy of [National Instruments](#). Images of Jaguar Motor Controller, Victor 888 Motor Controller and Spike H-Bridge Relay courtesy of [VEX Robotics, Inc.](#). All other photos courtesy of [AndyMark Inc.](#)