

# GETTING STARTED WITH THE 2014 CONTROL SYSTEM

# Getting Started With the 2014 Control System

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# **Getting Started With the ScreenSteps Documentation**



# Getting Started With the Screen Steps Documentation

ScreenStepsLive is a new tool that FRC/WPI are using to create and present documentation. This document is a brief introduction to the ScreenStepsLive site and the documentation contained [here](#).

## What's Here?

The documentation on the ScreenStepsLive site encompasses a number of potentially familiar documents from previous seasons such as the Getting Started with the 201X Control System, Getting Started with C++, Getting Started with Java, WPILib Cookbook, Vision Whitepaper and more. It also includes quite a bit of brand new documentation such as the Control System Software and Hardware Overviews, documentation on new features or tools such as Robot Builder and Live Window/Test Mode, and new documentation on existing tools such as Getting Started With the SmartDashboard.

## Navigating the Site

### Navigating the Site

The documentation is organized into a hierarchy with Sections at the very top, followed by Manuals, Chapters, then Lessons. At any time while you are browsing through the documentation, you can use the navigation at the top of the screen to go back to the Manual or to the home screen. You can also use the navigation on the left side of the screen when viewing a Manual or Chapter to jump to a different Manual. Each article also has a Prev and Next link at the top and bottom of the article to take you to the previous article or next article in the Manual.

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## Using the Search

### Using the Search

A search bar is located at the top of each page which you can use to search the site. After entering a search query you will be brought to the search results page. From this page you can refine your query by selecting whether to "match any" or "match all" terms in the search. You can also narrow your search to specific manuals by checking them in the left pane.

## Downloading PDFs

### Downloading PDFs

For offline viewing, every Manual in the documentation can be downloaded as a PDF. From the manual page or from any of the Lessons within the manual you can download the manual PDF by clicking the link on the left side of the window. Additionally, some individual Lesson PDFs can be downloaded from the lesson pages.

# 2014 Control System Hardware

# 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

### 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](#).

## 120A Circuit Breaker

### 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)

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## Power Distribution Board

### 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 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

### 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

### National Instruments cRIO

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

# Getting Started With the 2014 Control System

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

### 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.

## Analog Breakout Board

### 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.

## Solenoid Breakout Board

### 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

### 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

### 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 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

### 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

### 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](#).

## Talon Motor Controller

### 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](#).

## Victor 888 Motor Controller / Victor 884 Motor Controller

### 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](#).



# Getting Started With the 2014 Control System

## Spike H-Bridge Relay

### Spike H-Bridge Relay

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.](#)

# Wiring the 2014 FRC Control System

This document details the wiring of a basic electronics board for bench-top testing or to accompany the 2014 kitbot.

The images shown in this section reflect the setup for a Robot Control System used with the KOP Drive System in the “narrow” configuration, using a 4-slot cRIO and Victor 888’s. The setup is similar for any other chassis setup or using an 8-slot cRIO and/or Jaguars/Talons. The setup also assumes the motor controllers will be used to control two (2) CIM’s in the robot’s drive train. For a bench-top setup, teams may use any 12V DC motors they choose.

## Gather Materials

Locate the following control system components and layout their locations on an appropriate nonconductive surface (e.g. plywood or plastic) to permit wiring connections as shown in the power distribution diagram on the [FRC Kit of Parts Website](#). Plan the positions of the components to leave space to access the various connectors.

- Kit Materials:
  - Power Distribution Board
  - cRIO with modules (1x NI9201 in slot 1; 1x NI 9403 in slot 2; 1x NI 9472 in slot 3)
  - Analog Breakout (to be installed with the NI 9201 module in slot 1)
  - Digital Sidecar (to be connected to the NI 9403 module in slot 2)
  - Solenoid Breakout (to be installed with the NI 9472 module in slot 3)
  - Wireless bridge, DAP-1522 Rev B
  - Circuit breakers
  - Motor controllers, qty 2 or 4 (Victors, Jaguars or Talons may be used)
  - 2 or 4 straight PWM cables
  - 2 Y-Splitter PWM cables (if using 4 controllers)
  - 120-amp circuit breaker
  - CIM motors, qty 4
  - 6 AWG wire and ring terminal connectors
  - 18 AWG wire
  - 12 AWG or larger wire

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- Appropriate wire and connectors for size of motors
- 12V Battery (Energys NP18-12 recommended)
- 12V/5V Adapter
- Dual Lock material
- Tools Required:
  - Wago Tool or small flat-head screwdriver
  - Philips head screw driver
  - M6 nut driver (10mm socket)
  - Wire cutters, strippers, and crimpers
  - 7/16" nut driver

## Create the Base for the Control System

Cut 2 pieces of  $\frac{1}{4}$ " material (wood or plastic) to 15.75" x 10.5" and drill holes per Appendix A (or match drill when aligned with robot chassis). Mark off the outside  $\frac{1}{2}$ " on both short sides and one long side of each piece as shown in the layout image below. These sections will sit under the chassis flanges and must not have components overhanging.

Note that for a non-robot Control System test bed, teams may elect to use only one board.

## Layout the Core Control System Components



Layout the cRIO, Power Distribution Board, Digital Sidecar, 120A Main Breaker, 12V/5V converter and (4) motor controllers per the image. Jaguars are shown in the image as these are the largest of the legal controllers, other controllers may be used and should fit in the same locations. Ideally all

# Getting Started With the 2014 Control System

4 controllers should be of the same type, if mismatched pairs are being used, make sure to have the pairs located together (Victors with Victors or Talons with Talons, etc.). If only using two motors, it is recommended to place one controller on each board, in the location near the unmarked edge of the board. This will put the controller closest to the motor it is controlling, allowing direct connection of the motor wires.

## Add Modules to cRIO

	cRIO-FRC	cRIO-FRC II
<b>Slot 1</b>	9201 (with Analog Breakout)	9201 (with Analog Breakout)
<b>Slot 2</b>	9403 (connected to Digital Sidecar	9403 (connected to Digital Sidecar
<b>Slot 3</b>	9472 (connected to Solenoid Breakout)	9472 (connected to Solenoid Breakout)
<b>Slot 4</b>	<i>Empty</i>	Either 9201, 9403, or 9472 as needed
<b>Slot 5</b>	9201 (with Analog Breakout)	N/A
<b>Slot 6</b>	9403 (connected to Digital Sidecar	N/A
<b>Slot 7</b>	9472 (connected to Solenoid Breakout)	N/A
<b>Slot 8</b>	<i>Empty</i>	N/A

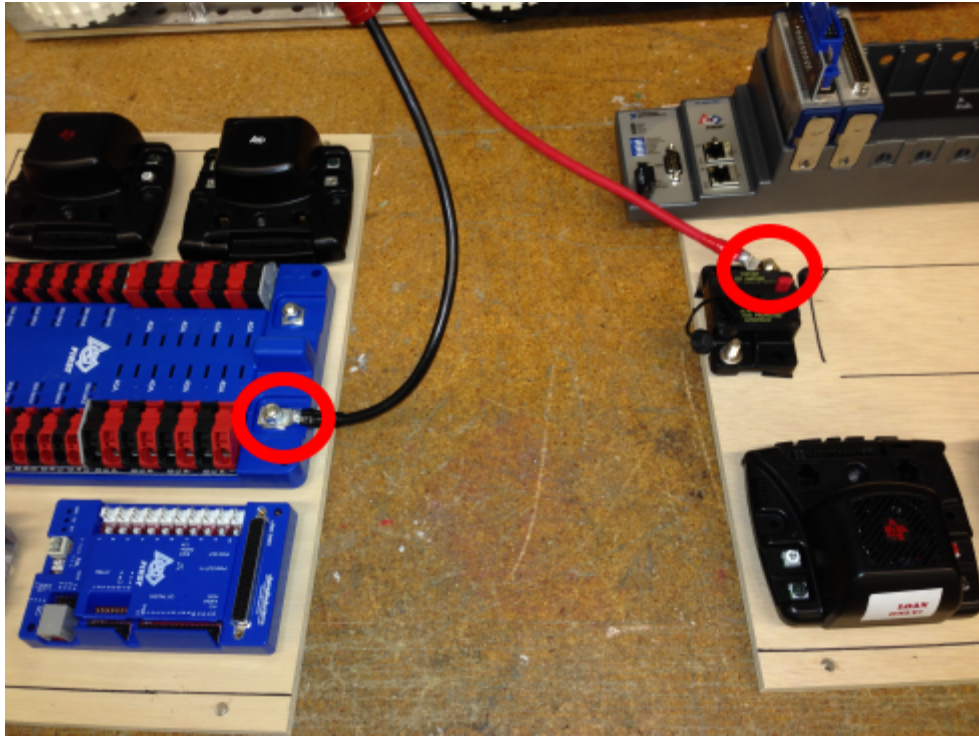
Insert modules into the cRIO slots 1-3 as outlined in the table above. The other modules listed in the table are optional and may be used to expand the IO capability of the system if necessary.

## Fasten components

Using wood screws, fasten all components to the board.

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## Attach Battery Connector

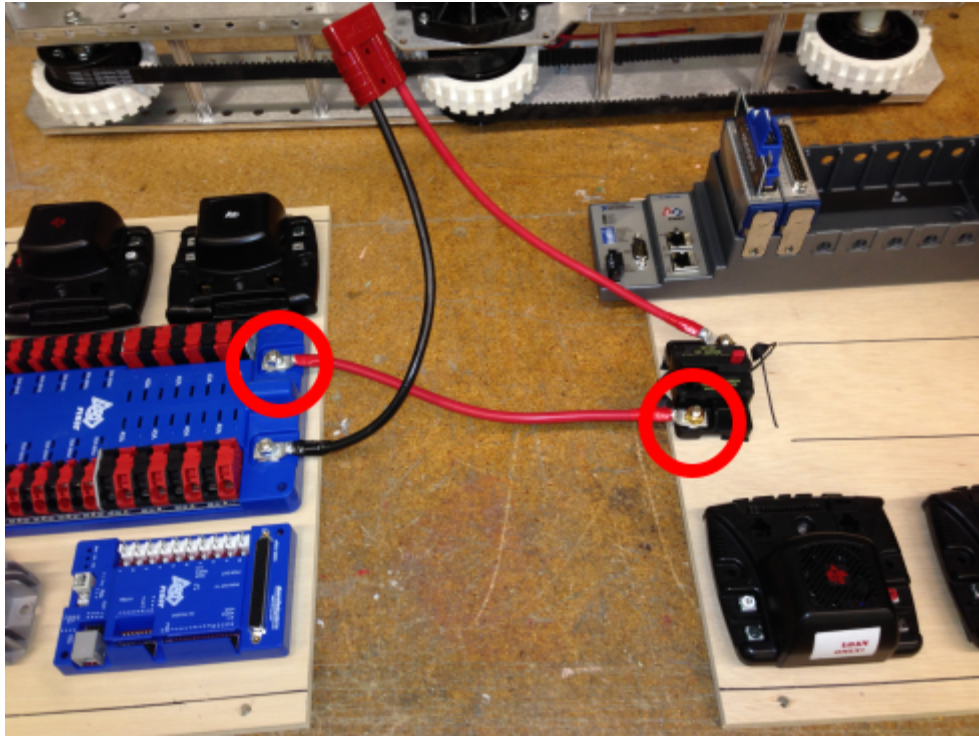


Attach terminal lugs to a battery connector. Then, attach the battery connector to the Power Distribution Board and the 120A Main Breaker.



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## Wire Breaker to PDB



Connect the 120A Main Breaker to the positive terminal on the PDB using red 6AWG wire and terminal lugs.

## Radio 12V-5V Converter

Radio 12V-5V Converter

Connect the 12V/5V Converter to the regulated 12V terminal on the PDB using a WAGO connector.

## cRIO Power

cRIO Power

# Getting Started With the 2014 Control System

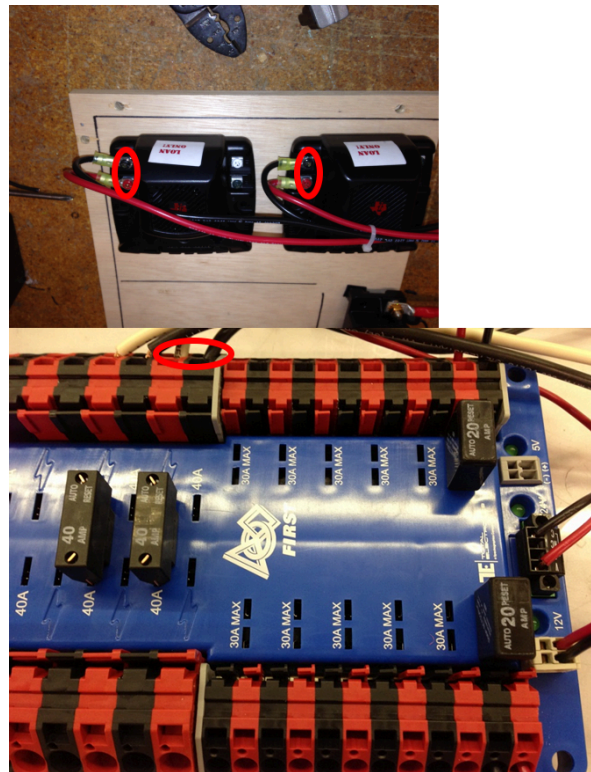
Connect the cRIO power input to the regulated 24V terminal on the PDB using a Sauro connector and 18AWG wire.

## Analog Breakout Power

Analog Breakout Power

Connect the Analog Breakout (mounted on the 9201 module in Slot 1 of the cRIO) to a 20-amp position the PDB using a WAGO connector and 18AWG wire.

## Motor Controller Power



Connect the Motor Controllers to a 40-amp position on the PDB using 12AWG wire. Also, connect the fan wires to the power input terminals on the motor controller.

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## Wireless Bridge Power

### Wireless Bridge Power

Remove the wall wart from the Wireless Bridge power cord. Then, connect the power cord to the 12V/5V converter (yellow wire to black-with stripe wire).

## Digital Sidecar Power

### Digital Sidecar Power

Connect the Digital Sidecar to a 20-amp position on the PDB using a WAGO terminal using 18AWG wire.

## Robot Signal Light

### Robot Signal Light

Connect the Robot Signal Light to the "RSL" terminals on the Digital Sidecar. Then, create a jumper between the "La" and "Lb" terminals on the RSL.

## Digital Sidecar Data Cable

### Digital Sidecar Data Cable

Connect the 9403 module (in Slot 2 of the cRIO) to the Digital Sidecar using the 37-conductor cable.

## Circuit Breakers

### Circuit Breakers



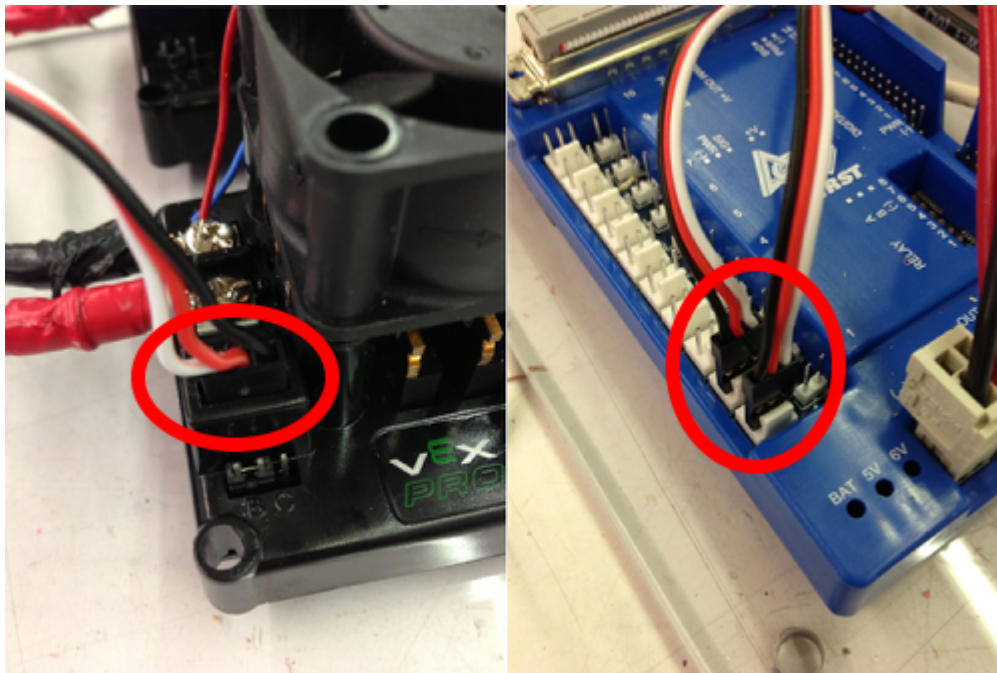
# Getting Started With the 2014 Control System

Insert 20-amp and 40-amp Circuit Breakers into positions on the PDB. Note that, for the 40A fuses, the lightning bolt graphic points towards the positive terminal supplied power by that breaker. All negative terminals on the board are directly connected internally.

## PWM Cables

Connect PWM cables as shown in one of the two steps below, depending on the number of speed controllers on the robot.

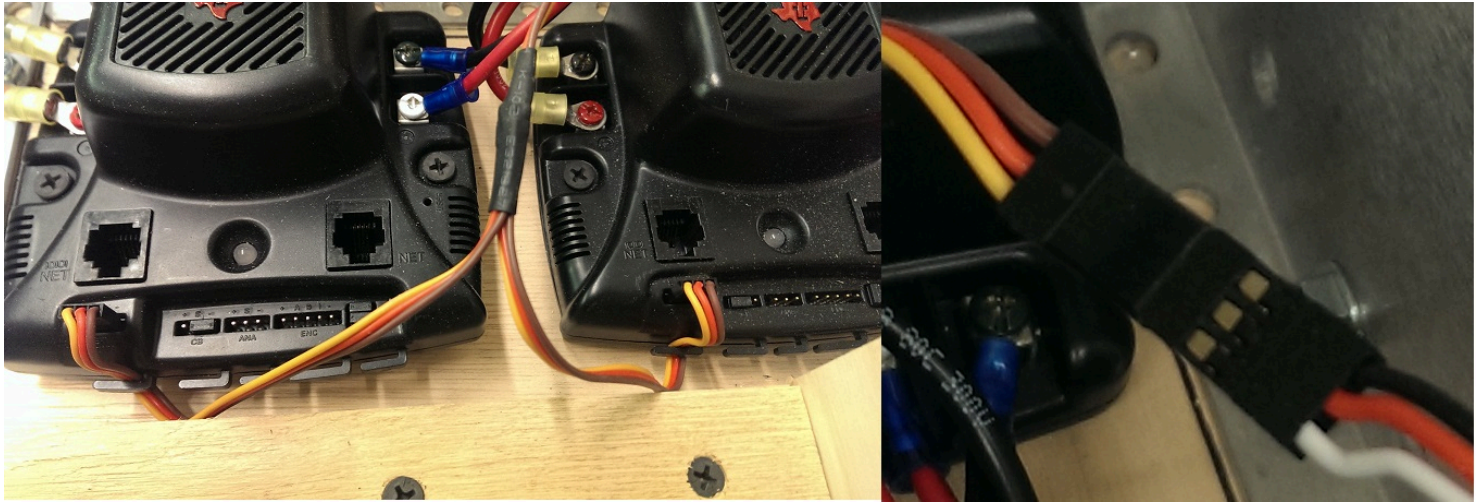
### 2 Controllers - PWM Cables



If using 2 speed controllers, use a regular 3-conductor cable (PWM cable) to connect the Digital Sidecar (PWM OUT Ports 1 and 2) to the Motor Controllers. Make sure to take note of the proper cable orientation on both ends (all FRC legal speed controllers connect with the black wire towards the inside of the controller as shown). Also make sure that the male end of the cable seats fully inside the receptacle on the speed controller.

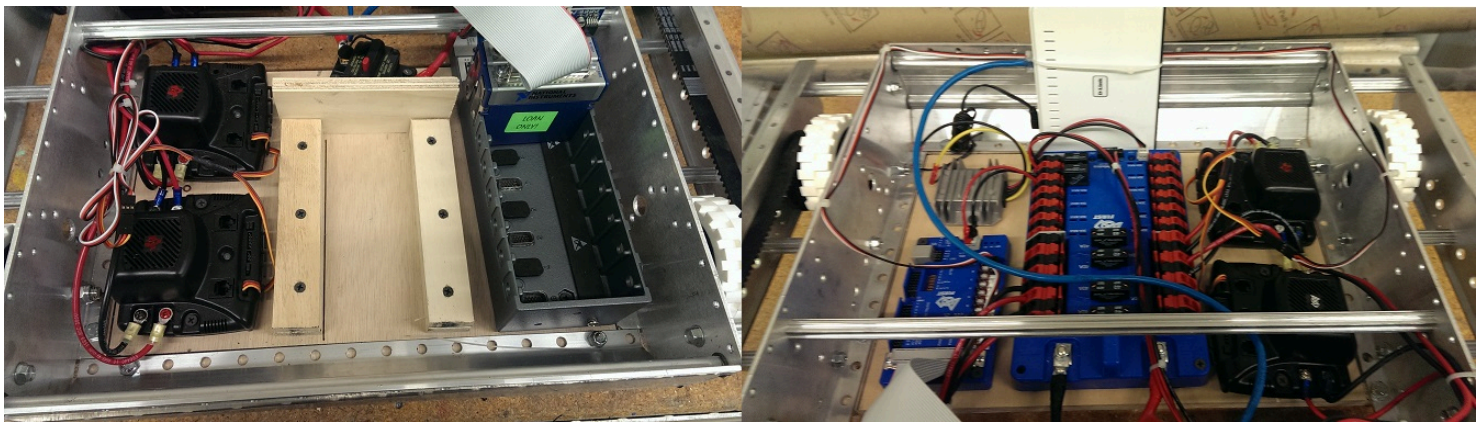
# Getting Started With the 2014 Control System

## 4 Controllers - PWM Cables



If using 4 motor controllers attach two regular PWM cables to the Digital Sidecar as shown in the 2 Controllers images above. Then attach a PWM Y-Splitter cable to the end of the extension as shown above right (Black->Brown, White->Yellow). Plug the two ends of the Y-Splitter into the pair of controllers as shown (Brown wire towards the inside).

## Attach to Robot



Note that if you are not putting this Control System on a robot, skip this step.

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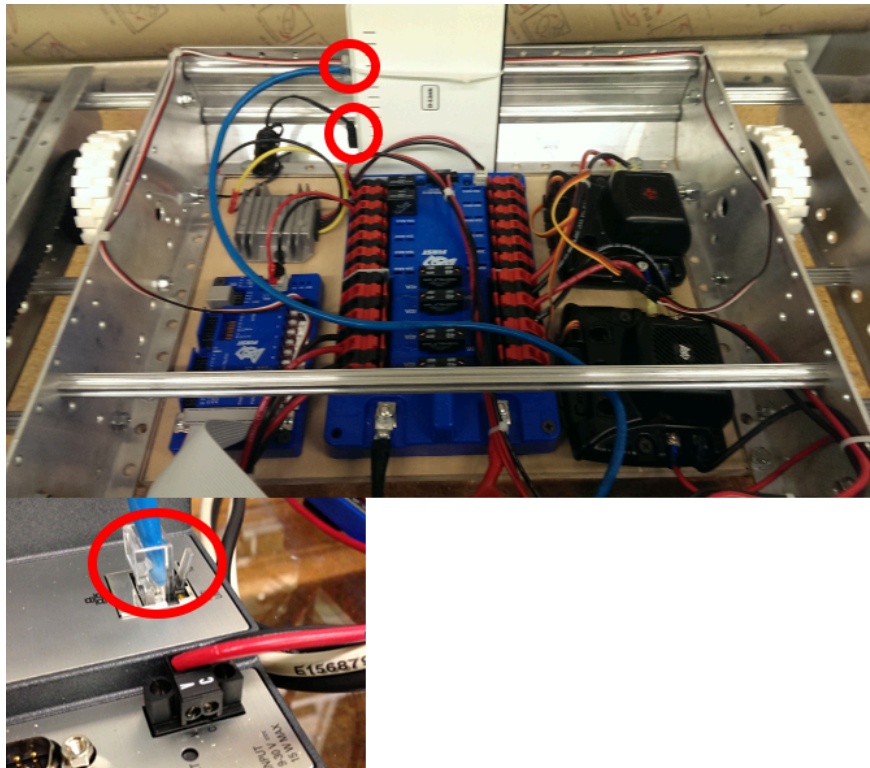
Attach the two boards to the robot (robot shown uses KOP Drive System). Note that temporarily removing some connections (i.e. 37-conductor cable) may make installation easier. Remember to remake all connections.

## Motor Power

### Motor Power

Connect the motors' power leads to the M+ and M- terminals on the Motor Controllers. If using 4 controllers, make sure to connect the power leads from the two motors on the same side of the chassis (e.g. both left motors) to controllers connected to the same Y-cable

## Robot Radio



Connect the Wireless Bridge power and to the Ethernet port on the cRIO. Secure the bridge to the chassis using zip ties.



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## Wire Management

Use cable ties to manage wire runs, ensuring wires won't get caught in moving robot parts (e.g. belts and wheels).

## Check Wiring

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 wiring issues. Teams should take caution to check that all wiring is secure and correct before connecting the battery after any wiring changes.

A best practice is to have someone other than the person that did the wiring check polarity and security on all connections (including the wires attached to the battery) prior to plugging a battery into the system.

# Configuring a FirstTouch I/O Module for FRC

This document covers the configuration of the [Cypress FirstTouch module](#) for use with the FRC Control System. Before using your Cypress FirstTouch I/O module, you must first program firmware into the USB chip on the board. Remember that you only need to do this step once per board. Make sure that you have the most recent version of the Driver Station software before proceeding.

## Hardware Setup

If using the Classmate, log in to the developer account. Plug the USB cable provided in the FirstTouch starter kit into the I/O module and the Classmate. Allow the computer time to find and connect to the new hardware.

## Open PSoC Programmer

Open PSoC Programmer

Next, open the Cypress PSoC Programmer. If you are using LabVIEW on the same computer, you can find the PSoC Programmer in the Utilities tab of the Getting Started Window. Otherwise, click on Start > All Programs > Cypress > PSoC Programmer. If you get an Update Reminder, cancel it. Updating the PSoC Programmer will make the Driver Station unable to see the First Touch module

## Load Image

Load Image

In the top left of the tool bar, you'll see a blue folder icon. Click the folder, browse to Shared or Public Documents/FRC, and select the FRC\_IO.v3.hex or FRC\_IO.v3.2010.hex (or latest version) file. You must select the correct firmware for the version of the module that you have. The location on the Classmate is Computer»Windows (C:) »Users»Public»Documents»FRC. If you are a rookie, you

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have a 2012 module. If you are a veteran teams and got your First Touch module in the 2010 or 2011 kit, use that firmware. Selecting the wrong firmware image will result in an error message and will not damage your First Touch module.

## Select Port

Select Port

Directly below the tool bar, on the left, there is a Port Selection window with the device listed in it. Select the FirstTouch device.

## Programming Succeeded

Programming Succeeded

Click the program button on the tool bar, and wait for the programming operation to complete. You will see Programming Succeeded in the Results window.

## Verification

Unplug and replug the USB cable and your I/O module will be ready to use. You can check to make sure the process was successful by opening the Driver Station software and confirming that the device is being recognized. With the I/O module plugged in, your I/O tab will indicate that the Hardware I/O is selected with a green indicator. Without the I/O module plugged in, it will default to the Virtual I/O.

## Troubleshooting

Troubleshooting

- If you are unable to find the firmware file, make sure that you have installed the Driver Station update.

# Getting Started With the 2014 Control System

- If the PSoC Programmer errors with “The hex file does not match with the acquired device, please check the device”, make sure you selected the correct firmware file for the version of the First Touch module you are using.
- If the Driver Station is unable to detect the First Touch I/O module...
  - Check the version of the PSoC Programmer that you have installed
    - You should have version 3.12.0.827 if you look in Help >> About in PSoC Programmer
  - Check for the module in Device Manager under Universal Serial Bus controllers
  - If the device is listed as “FTK3 (unconfigured)” (USB PID=F119), the CyMiniProg3Service may not be running
    - Check for the service in Control Panel >> Administrative Tools >> Services
    - Check if it is started. If not, start it and configure it to start automatically.
  - If the device is listed as “FTK3 (version)” (USB PID=F11A), and version does not equal 3.4.1.20, you may have installed a newer version of the PSoC Programmer
    - Uninstall the Driver Station Update and the PSoC Programmer update in Control Panel >> Add / Remove Programs
    - Reinstall the Driver Station Update
  - If the device is listed as “FTK3 (3.4.1.20)”
    - Make sure that the bootstrap firmware that is installed matches what the Driver Station needs. The file Program Files\Cypress\Programmer\3.12\Service\ftk\_3\_simfw.hex should be 29,663 bytes.
    - Make sure that C:\Windows\system32\nicyapi.dll is installed and is version 1.0.0.49154
  - The Driver Station still won't see the First Touch I/O Module
    - Try restarting the Driver Station after you've gotten everything else correct and the device is plugged in.

For further help, look for a similar problem on the Cypress forums at <http://www.cypress.com/?app=forum> (be sure to select the “FIRST Robotics Competition” forum).

# Using the AS5145B Magnetic Encoder with the FRC Control System

This article details how to use the Austria Microsystems AS5145B Magnetic Encoder (FIRST Choice P/N fc-13-062) with the FRC Control System

## Sensor Overview

The Austria Microsystems AS5145B Rotary Position Sensor (FIRST Choice P/N fc13-062) is a contactless magnetic rotary position sensor. This sensor has 2 absolute outputs (a serial interface, and a PWM output) and a 12 bit incremental output quadrature A/B and Index mode. The easiest mode of the sensor to interface with the FRC system is the incremental quadrature A/B output. In this mode the sensor will output a quadrature signal on the A and B outputs that is compatible with the Encoder class/VIs of WPILib.

## Wiring The Sensor

To wire the sensor to the FRC Control System, the following connections must be made:

1. The pin labeled 5V on the sensor should be connected to a 5V (labeled "PWR") pin of the Digital Sidecar Digital I/O bank
2. The 2 pins labeled GND should be connected to a ground pin (labeled "(-)") on the Digital Sidecar.
3. The pins A and B should be connected to separate signal pins (labeled "SIG") on the Digital Sidecar.
4. The pin CSn should be connected to a ground pin on the Digital Sidecar (for a description of the purpose of this pin, see "Incremental Power-up Lock Option" on Page 15 of the [datasheet](#))
5. **Optional** - The MAG DECn and MAG INCn pins may be connected to signal pins on the Digital Sidecar. These pins provide information about the strength of the magnetic field and are particularly helpful when positioning the magnet and/or sensor. If connected to separate inputs these pins will behave as described in Table 9 of the [datasheet](#). It is also possible to connect both pins to a single input, in which case the signal will be high when the magnetic field is in range and low otherwise. **Note:** The Digital Sidecar has built-in pull-up resistors so no



# Getting Started With the 2014 Control System

additional pull-up resistor should be required. **Note 2:** These pins are active low pins meaning that a value of "Off" in the table indicates a high (5v) signal at the Digital Sidecar and a value of "On" indicates a low (~0V) signal at the Digital Sidecar.

## Positioning the Magnet

Details on the magnet placement can be found in Section 9.4.2 of the [datasheet](#). The summary of that section is that the magnet should be centered over the chip package and located between .5mm and 1.5mm away from the package. Monitoring the MAG DECn and MAG INCn pins (by sending the data to the Dashboard for example) may help in positioning the magnet/sensor.

## Writing the Code

After the magnet and sensor have been positioned this sensor may be treated the same as any other quadrature encoder in software. The AS5145B is the equivalent of an optical encoder with a 1024 count disc, meaning it will output 1024 pulses per channel per revolution. In 4x decoding mode, this will yield 4096 ticks per revolution.

## Using the AS5145B as an absolute sensor

There are two absolute outputs of the AS5145B sensor. The easier of the two to use with the FRC Control System is the PWM output. The PWM output can be converted to an analog output using a simple low pass filter. A diagram of an appropriate low pass filter circuit, as well as recommended component values can be found on page 18 of the [datasheet](#). Once an analog signal is obtained, this signal can be connected to a channel on the Analog Breakout board and read using the Analog Channel class/VIs.

The other absolute output of the AS5145B is an SSI (Synchronous Serial Interface) which is also known as SPI (Serial Peripheral Interface). Interfacing with this output may be possible by using the SPI class/VIs though FRC has not attempted to use this output with the FRC Control System.

# Light codes on control system components

## Jaguar speed controllers

Jaguar speed controllers

## Talon speed controllers

Talon speed controllers

The LED is used to indicate the direction and percentage of throttle and state of calibration. The LED may be one of three colors; red, orange or green. A solid green LED indicates positive output voltage equal to the input voltage of the Talon. A solid Red LED indicates an output voltage that is equal to the input voltage multiplied by -1(input voltage = 12 volts, output equals -12 volts). The LED will blink it's corresponding color for any throttle less than 100% (red indicates negative polarity, green indicates positive). The rate at which the led blinks is proportional to the percent throttle. The faster the LED blinks the closer the output is to 100% in either polarity.

The LED will blink orange any time the Talon is in the disabled state. This will happen if the PWM input signal is lost, or in FRC, when the robot is disabled. If the Talon is in the enabled state and the throttle is within the 4% dead band, the LED will remain solid orange.

Flashing Red/Green indicate ready for calibration. Several green flashes indicates successful calibration, and red several times indicates unsuccessful calibration.

## Victor speed controllers

Victor speed controllers

LED Indicator Status:

**Green** - full forward

**Orange** - neutral / brake

**Red** - full reverse

**Flashing orange** - no PWM signal

**Flashing red/green** - calibration mode

# Getting Started With the 2014 Control System

**Flashing green** - successful calibration

**Flashing red** - unsuccessful calibration

## Robot Signal Light (RSL)

Robot Signal Light (RSL)

Solid ON - Autonomous enabled

Solid ON but blinks off every 1.5 sec - Teleop enabled

Slow blink (900ms ON / 900ms OFF) - System disabled by system watchdog, user watchdog, or driver station set to disabled

Fast-slow (200ms ON / 900ms OFF) - Low battery (<12V) or no user code AND system disabled either by system watchdog, user watchdog, or Driver Station set to disabled.

Fast (200ms ON / 200ms OFF) - System error; no Driver station communication; bad cRIO image, bad team ID, extensive communication errors

## Spike relay configured as a motor, light, or solenoid switch

Spike relay configured as a motor, light, or solenoid switch

## Spike relay configured as for one or two solenoids

Spike relay configured as for one or two solenoids

## Indicators on the (DSC) Digital Sidecar

Indicators on the (DSC) Digital Sidecar

RSL LED on digital sidecar should show the same pattern as the actual RSL light mounted on the robot.

BAT - battery power indicator that the sidecar is getting 12V battery power from the power distribution board

6V - indicates that the relay buck power supply for PWM indicators is operating

# Getting Started With the 2014 Control System

5V - indicates that the 5V supply is working that is used to supply the DSC circuitry, GPIO, and I2C headers

Relay outputs are the same as the colors on the Spike relays:

RED - when relay is in REVERSE

GREEN - when relay is in FORWARD

OFF - relay is off

## Detailed Hardware Documents

This article serves as a repository for detailed documentation on the 2014 Control System components such as datasheets, schematics, etc.

### Digital Sidecar



[Digital\\_Sidecar\\_Datasheet\\_-\\_Rev\\_8.pdf](#)



[Digital\\_Sidecar\\_Schematic\\_-\\_Rev\\_8.pdf](#)

### Analog Breakout Board



[Analog\\_Breakout\\_Datasheet\\_-\\_Rev\\_6.pdf](#)



[Analog\\_Breakout\\_Schematic\\_-\\_Rev\\_6.pdf](#)

### Solenoid Breakout Board



[Solenoid\\_Breakout\\_Datasheet\\_-\\_Rev\\_4.pdf](#)

# Getting Started With the 2014 Control System



[Solenoid\\_Breakout\\_Schematic\\_-\\_Rev\\_4.pdf](#)

## Power Distribution Board



[Power\\_Distribution\\_Board\\_Datasheet\\_-\\_Rev\\_6.pdf](#)



[Power\\_Distribution\\_Board\\_Schematic\\_-\\_Rev\\_6.pdf](#)

# Control System Troubleshooting

# Preparing your Control System for Competition

This article outlines a number of Control System related items a team can do to prepare for running their robot connected to the field at an event. These tips and tricks should help ensure a smooth experience when bringing your robot to the field and connecting the Field Management System.

## Verify all software is up to date

Check to make sure all your software is up to date. You can find information on the latest versions of all software and how to check here: [Latest Software Revisions](#)

## Check Driver Station Network Settings

When operating at home, everything will work fine with the Driver Station set to a subnet mask of 255.255.255.0 and any IP in the 10.TE.AM.ZZ range. At the competition, the **DS IP must be 10.TE.AM.5 and the subnet mask must be set to 255.0.0.0 to work properly with FMS**. To check the IP and subnet mask of your Driver Station PC, follow the steps below.

## Network Adapter Properties

Network Adapter Properties

To set the IP address, click on **Start > Control Panel > View Network Status and Tasks > Change Adapter Settings**, then double-click on **Local Area Connection** to display the Local Area Connection Properties dialog.



# Getting Started With the 2014 Control System

## TCP/IP Properties

TCP/IP Properties

Click on **Internet Protocol Version 4 (TCP/IPv4)** to highlight it, then click **Properties**.

## Set IP address

Set IP address

On the TCP/IP properties page:

1. Click the bubble next to **Use the following IP address**
2. Enter your **10.xx.yy.5** or .6 address into the **IP address box**
3. Change the **Subnet mask** to **255.0.0.0**
4. Click **OK**. Then click **Close** on the Local Area Connection Properties dialog box.

## Run the Robot in Practice Mode

Run the Robot in Practice Mode

During a match on the official playing field, the robot state will transition from Disabled->Autonomous->Disabled->Teleop->Disabled. To make sure your code works properly with this sequence, you should run at least one complete match using the Practice mode on the DS. To run a match in Practice mode, put the Driver Station in Practice mode, as shown above, then enable the robot. The Driver Station will have a 5 second countdown, then run the robot through the sequence it will experience during a match. Testing in this manner will help catch potential issues with the code transitioning between the states or with variables not being properly reset when changing modes.

# Getting Started With the 2014 Control System

## Have Multiple Copies of Code

Make sure to have multiple copies of your final robot code (and Dashboard code if customized). At least one copy should be on a computer you are bringing to the event and it is recommended to have at least one copy on a USB Flash drive. You may also wish to make sure that at least two people on the team have a copy of the latest code.

## Charge Batteries

Make sure both your Robot and Driver Station Computer batteries are fully charged. Also make sure to have a plan for ensuring batteries are charged throughout the event and keeping track of which batteries are charged and which are depleted. This will help prevent running into any power issues during a match.

## Train your Drivers

Make sure the team members who will be going out to field each match know:

- How to turn the robot on and off
- Where Ethernet cables go if unplugged
- Where the wireless bridge is located and which position the mode switch should be in
- How to test which joysticks are in which position in the Driver Station software and rearrange if necessary
- Any applicable Administrator passwords that may be required to change network or firewall settings on the Driver Station computer

## At the Event

After arriving at the event, there are a few things you can get done early to help things run as smooth as possible when coming to the field:

# Getting Started With the 2014 Control System

## Program Robot Radio

After arriving at the competition, make sure to get the D-Link DAP-1522 Rev B. radio programmed at one of the official event programming kiosks. The radio will need to be placed into Bridge mode for programming and should stay in bridge mode for the entire event, all connections to the radio at the event, but outside the official field should be tethered. It is not necessary to reset the radio prior to programming, only reset the radio if instructed to do so by the programming kiosk and follow the instructions on screen to do so.

## Connect to the Field on Practice Day

Even if your robot is not inspected, or ready to fully compete in the match, make sure to attend at least one practice match to verify that your Driver Station and Robot can connect properly to the field. If you do not make it to the field for any of your Practice Matches, check with your FTA to see if they are having all teams whom have not yet connected come out to the field on Thursday evening to verify that they are able to connect.

# Getting Started With the 2014 Control System

## Ready to play

Being ready to go early is a huge advantage, you get access to the practice field and practice matches. Here are some tips to help you breeze through the control system part of the inspection and make your robot easy to repair. This document was provided by CSA Laura Rhodes, FRC Team 100.

## Follow robot rules carefully

- use correct wire sizes and colors
- power wiring should exactly match FRC supplied schematic
- one motor per speed controller (other than exceptions listed in R54/Table 4-4)
- motor circuits on the appropriately sized breakers
- one wire per Wago connector
- Robot radio powered through supplied regulator, connected to regulated 12V supply on the narrow end of the Power Distribution Board)
- Make sure lights that need to be visible are indeed visible (even after decorating robot)
- Make sure main breaker and manual pneumatic vent valves are easily accessible
- Hook up the Robot Signal Light and verify operation
- Mount cRIO and Axis 206 camera on non-conductive material

## Robot electronics

- Verify that robot electronics are isolated from the frame (measure resistance between frame and each terminal of the robot side of the battery connector with the main breaker in the on position)
- Have a well-documented and up-to-date robot I/O list identifying the signal connections of all actuators and sensors. Bring a hardcopy of the documentation with you - ideally laminated and hung up in a prominent spot in the pits.
- Label EVERYTHING! - both ends of every signal cable, speed controllers and their function, motors with their functions, and use color-coded connectors and/or different colors of electrical tape to make wire reconnection following repairs quick and accurate

# Getting Started With the 2014 Control System

## Be familiar with the control system components

Know how to:

- reconfigure the wired and wireless Ethernet ports on your laptop(s).
- re-image the cRIO, the wireless bridge and the Jaguars (if using CAN)
- download robot program to the cRIO (using the development environment of your chosen language).
- bring up the Driver's Station and understand the various tabs
- use the C:\Program Files\FRC Driver Station\Driver Station Log File Viewer.exe program

## Have correct radio for competition

**Have correct version radio (DAP1522 RevB).**

To avoid any potential problems with WiFi interference make sure **all** computers that have ever been used for Driver's Station or robot programming that your team brings to competition have their WiFi ports turned **off** (even those still asleep in their cases).

## Ask for help

Every FRC Competition has a Control System Advisor whose job it is to make sure that each team has electronics support. Many teams have experienced students and mentors who love the challenge of helping to track down what gremlins are playing havoc with your robot. Ask early to ensure your robot has the opportunity to get out to at least one of its practice rounds.

## Be sure to use practice day

On regional events Thursday the FTA is willing to bend over backwards to make sure your robot connects to and works with the Field Management System. By Friday, his/her priority is to keep the competition running. The schedule might be different for district events, be aware of the schedule and be sure to make good use of the time at the event.

# Getting Started With the 2014 Control System

## Have up to date software

- Stay up-to-date on Driver Station, WPILib, and cRIO firmware Image versions. Be ready to update the cRIO if required upon unbagging of the robot in the pits
- Use source code control to keep track of your robot application code changes. Commit often!! Make multiple backups in possession of more than one person.
- Keep a simplified version of the code and/or have a special test mode in your code to test for proper actuator and sensor connections.

## Startup Checklist

This is a checklist of things to check before and as soon as turning on the robot. This list was provided by CSA Laura Rhodes, FRC Team 100

### Check robot ready to start

- Verify no loose wires/tools/debris around robot electronics
- All hands clear of pinch points
- All personnel clear of robot actuators
- No dangling connectors (wrap any exposed connectors on temporary disconnections in electrical tape and secure loose wire using cable ties)
- Ethernet cables to laptop clear of chains and other moving components
- Verify Ethernet cables plugged in
- Start Driver Station and have operator be ready to hit spacebar and/or Enter if necessary to disable robot
- Connect Battery

### Verify power lights

#### Power distribution board

- 12V LED
- 24V LED
- no circuits tripped LEDs

#### Digital Sidecar

- BAT LED
- 5V LED
- 6V LED
- RSL blinking as expected

#### cRIO

# Getting Started With the 2014 Control System

- Green power LED
- No other status LEDs on (unless so programmed)
- LED next to Ethernet connection flashing with communications

## Radio

- Power indication

## Axis Camera

- Power LEDs (on rear)
- Glow around lens with communications

## Speed Controllers (Jaguar, Talon or Victor)

- Blinking orange to indicate power on/disabled
- Fans on Victors spinning
- Verify that all speed controller's LED's stop blinking orange when the Robot is Enabled (solid orange/yellow for neutral)

## Driver's station

- Wait for Green lights for "Communications" and "Robot Code" on Driver Station
- Change mode to "Enabled" by clicking on "Enable" on Driver Station



## Lights are your friends

Indicator lights on the various control system components can go a long way to helping troubleshoot issues. This guide prepared by CSA Laura Rhodes should give some insight into the possible problems with your robots.

### Robot Signal Light

- Fast Blink = cRIO not communicating with Driver Station
- Slow Blink = disabled
- Short on/long-off Blink = either low battery or no code & disabled
- Long on/short off blink = Teleop mode
- Solid on = Autonomous mode

### Power Distribution Board

- LEDs for each power supply circuit. They light red if and only if there is a load present and either the breaker is absent or the breaker is blown
- Should always have 3 green LED's for 5V, 24V, and 12V indicators

### cRIO

- Verify Ethernet communications by flashing leds next to Ethernet
- Verify green power LED, amber status LED should be off
- Analog Input card and Solenoid Output card will have lit LED when powered

### Digital Sidecar

- Should always have 3 green lights – BAT, 5V, 6V
- RSL matches robot signal light pattern

# Getting Started With the 2014 Control System

## Jaguar speed controllers

Normal:

- Solid Yellow = Neutral (speed set to 0) Fast Flashing Green = Forward
- Fast Flashing Red = Reverse
- Solid Green = Full speed forward
- Solid Red = Full speed reverse

Fault Conditions:

- Slow Flashing Yellow= Loss of CAN or PWM link or Robot Disabled
- Slow Flashing Red = Fault
- No light = no power (check power connection)

## Victor speed controllers

- Solid Green = Full forward
- Solid Orange = Neutral/Brake
- Solid Red = Full Reverse
- Note that no light on the Victor can indicate partial throttle

Fault Conditions:

- Flashing Orange = No PWM signal
- Flashing Red = Failed Calibration
- No light = no power

## Talon speed controllers

- Solid Green = Full Forward (positive output voltage equal to input voltage)
- Flashing Green = Forward (rate of led blinking is proportional to percent throttle)
- Solid Red = Full Reverse (output voltage equal to input voltage multiplied by -1)
- Flashing Red = Reverse (rate of led blinking is proportional to percent throttle)
- Solid Orange = Talon is in the enabled state and the throttle is within the 4% dead band

**Fault Conditions:**

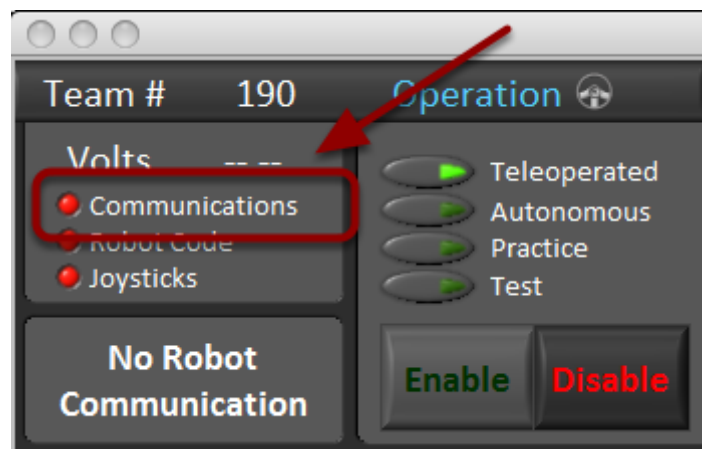
# Getting Started With the 2014 Control System

- Flashing Orange = No PWM signal or robot is disabled.
- Flashing Red+Orange = Fault (Undervoltage, Over temperature, or shorted output)

## Troubleshooting

This is a document put together by CSA Laura Rhodes that contains a lot of information about troubleshooting steps for a lot of common control system problems encountered at events.

### No "Communication" light on Driver's Station



- cRIO is not turned on
- Windows Firewall or other Firewall enabled (turn off)
- Incorrect version of Driver's Station application software
- Incorrect version of cRIO firmware
- Classmate Ethernet port has become detached from board
- Loose cRIO, radio, Power Distribution Board wiring
- On 8-slot cRIO, Ethernet cable should be plugged into Ethernet socket #1 (socket #2 is a totally separate LAN for Camera)
- On 8-slot cRIO, dip switches may have been inadvertently changed – all should be off with the possible exception of the "Console Out" switch.
- The robot battery is disconnected
- The robot battery has insufficient charge (low voltage level)
- cRIO is not in communication (either wired or through the WiFi) – TRY PINGING!
- Driver's Station software is not set up with proper team number. See Setup tab ->Team Number

# Getting Started With the 2014 Control System

- Driver's Station computer has both wired and wireless ports enabled (and is confused). See Setup tab -> Choose NIC. If you want to be sure to use only the wired port, turn off Wireless completely either through the "Network and Sharing Center" or via an external switch on the laptop.
- Driver's Station has its Ethernet port address to be obtained automatically (should be a static IP 10.XX.YY.05 where XXYY is your four digit team number)
- Driver's Station computer has its Ethernet port address on the wrong subnet mask (should be 255.0.0.0)
- The Ethernet cable between the wireless bridge and the cRIO (or between the Driver Station laptop and the bridge) has come unplugged or is bad
- The wireless bridge is not correctly configured

## No "Robot Code" light on Driver's Station

- No robot code installed - C++ debugging may leave cRIO in this state.
- Incomplete code download
- Code Exception/Crash – Check NetConsole for possible details
- Possible missing routine (C++) – Fails dynamic linking on bootup– Check NetConsole for possible details

## Improper Driver Station and/or cRIO software version

This is an inspection failure – shown on "Diagnostics" tab

- Make sure the latest software updates have been applied to the Driver Station computer and any computers used for robot programming.
- Update the cRIO to latest Firmware version using the cRIO imaging tool.
- Reload robot application program after re-imaging cRIO.
- **WARNING NOTE-FIRST may issue software updates up to and during the competition season.**

## Robot grounded to frame

This is an inspection failure, not meeting the requirement of >10k Ohm between either PD battery post and chassis.

- **Check with multimeter set to OHMS ( $\Omega$ )**

# Getting Started With the 2014 Control System

- cRIO chassis should be isolated from the frame. Mount on non-conductive material
- Axis 206 Camera – mounting screw/post on back of camera is grounded – use nylon screws or mount on non-conductive material
- Loose wire making contact with frame
- Faulty motor (Banebots motor likely suspect)

## Robot intermittently loses communications for 5-10 seconds during match

- Robot radio improperly powered. Needs to be powered from 5V regulator, verify polarity before powering up.
- Loose radio power connector
- Battery voltage drop due to excessive motor current
- Radio mounted too close to electronics
- Radio location not ideal – away from motors, outside frame, best
- Loose radio-to-cRIO Ethernet cable
- Improper delay loop in robot program
- Check robot log chart from match: use C:\ProgramFiles\FRCDriverStation\DriverStationLogFile Viewer.exe and observe “LostPackets”
- WiFi interference – make sure **all** computers that have ever been used for Driver’s Station or robot programming that your team brings to competition have their WiFi ports turned **off** (even those still asleep in their cases).
- Excessive bandwidth used by the Axis camera – turn down frame rate and resolution to the minimum required for driver use.

## Robot stops working for 20-30 seconds during match

- Possible cRIO reboot
- Loose cRIO power connector
- Loose radio-to-cRIO Ethernet cable
- Battery voltage drop due to excessive motor current
- Improper delays loop/CPU usage in robot program
- Memory leaks in robot program
- Check robot log chart from match using C:\ProgramFiles\FRCDriverStation\DriverStationLogFileViewer.exe and observe lost packets, cpu usage, and battery voltage
- Check for CPU usage and memory leaks using “Charts” tab on Driver’s Station while running robot test.

# Getting Started With the 2014 Control System

## Motors pulse on and off and/or the message "Output not updated often enough"

Check that the motor safety is either disabled or that the motors speeds are updated periodically. The problem is that the watchdog isn't being "fed" and shuts off the motor signal every 100ms. This will be accompanied by a message that says "Output not updated often enough".

## Robot stops working at some point in match

- Power problems – low battery, disconnected battery cable
- cRIO and/or wireless bridge radio resets – see suggestions above
- Robot Application process crash due to user software bug or library/FPGA bug. Try to reproduce problem in the pit using the "Charts" tab on Driver Station and monitoring the Messages on the "Diagnostics" tab.
- For C++ and Java programs use the Netconsole program on the driver station to look for error messages from the robot. In particular the message "Robots don't quit" is caused by an uncaught exception in a Java robot program that is not caught. Remember though that the **Netconsole is disabled on the field** so you'll have to reproduce this one in the pit.

## Robot behaves differently in the pit than on the field

Try the following things:

- Try running the robot in "Practice mode" from the driver station in the pit. Often there is code in the autonomous part of the program that causes issues with the teleop. If the robot is only tested with the autonomous or teleop code separately, then those issues may never be seen in the pit.

## Joystick controls are "laggy"

- Improper delays loop/CPU usage in robot program. Use "Charts" tab and "Diagnostic" tab messages to diagnose.
- Robot radio problems – see intermittent loss of communications above
- Vision processing taking too much CPU time.

# Getting Started With the 2014 Control System

## Robot does not sync with FMS

- Robot radio problems – see intermittent loss of communications above
- Improper wireless bridge configuration (needs to be in Bridge mode)
- Bad or disconnected cable between wireless bridge and cRIO
- On 8-slot cRIO, Ethernet cable should be plugged into Ethernet socket #1
- Radio not configured at the provided kiosk in the pits

## Driver Station does not sync with FMS

- Bad Ethernet port (especially on Classmates)
- Wired Ethernet port improperly configured
- Wrong version of Driver Station software
- Improper team number on Driver station
- WiFi on Driver Station computer not disabled (only wired Ethernet used on the field and in the pits) and/or is set with a conflicting IP address.
- Driver's Station computer has its Ethernet port address on the wrong subnet mask (should be 255.0.0.0)
- Driver Station plugged into incorrect operator control station.
- Windows Firewall should be disabled.

## Battery Voltage displayed as 0V on Driver Station

- Missing jumper on Analog Input board
- Analog input board not being powered (check for lit power LED on board)
- Analog input board in incorrect slot (Slot 1)

## Battery Voltage displayed as larger than 13V on Driver Station

- Analog input board not being powered correctly (should be powered with 12V but could get 24V if accidentally swap 24V solenoid and 12V analog card power connectors)
- Use of Analog Channel 8 for a different purpose and jumper is in wrong location.



# Getting Started With the 2014 Control System

## Joysticks not responding

- The joystick is not plugged into the Driver's station USB port
- The joystick setup device order is incorrect on the Driver's Station (Setup tab, drag to order)
- The Driver's station is in the Disabled Mode
- The Driver's station is not in the desired Tele-Op Mode
- Incorrect robot programming

## Digital Sidecar does not have BAT, 5V, and 6V LEDs lit

- Bad power connection to Digital Side Car
- Defective Digital Sidecar
- Digital Sidecar output shorted (check for debris and try removing connections one at a time)

## Robot Signal Light (RSL) not functioning

- Bad power connection to Digital Side Car
- Defective Digital Sidecar
- Improper wiring of RSL (needs jumper between La and Lb)
- RSL wiring not connected to RSL port on Digital Sidecar
- Bad or missing cable between NI 9403 Digital I/O card and Digital Sidecar
- NI 9403 Digital I/O card not in correct cRIO slot (Slot 2)

## No lights on a speed controller when robot is powered on

- Missing breaker for the corresponding circuit on Power Distribution board
- Tripped breaker for the corresponding circuit on the Power Distribution board – check break tripped LED on side of PDB.
- Loose power wiring
- The power distribution board is not getting power
- Broken speed controller – replace
- Controller needs calibration (Victor only, fan should be on)

# Getting Started With the 2014 Control System

## Air compressor not turning on

- Verify proper relay output port cable connection from Digital Sidecar to Spike
- Circuit breaker in Spike module
- Check Proper connection of Spike Module to compressor motor.
- Check pressure switch input cable connection to DIO port on Digital Sidecar
- The digital sidecar is not getting power
- Check robot programming assignments for proper assignments of the compressor relay output and Pressure Switch Digital Input. Check for correct usage of the compressor object (there were subtle changes required in 2012 for LabVIEW compared to previous years).
- Check that Green LED next to Relay port on Digital Sidecar is turning on.

## Speed Controller LED doesn't go solid orange/yellow when the robot is enabled (PWM Control)

- A speed controller does not have a PWM control signal cable connected
- Improperly seated PWM signal cable (especially with Victors)
- Incorrect PWM channel on digital sidecar wired (vs. in software)
- Bad or disconnected PWM cable.
- PWM signal cable polarity. On the speed controllers, check for the "S+-" or "B" in the plastic molding near the PWM ports. On the digital sidecar, follow convention printed near the PWM ports.
- PWM signal cable incorrectly plugged into DIO side of Digital sidecar instead of PWM connector side.
- Incorrect robot application software.
- The digital sidecar is not getting power (especially if opening four or more controllers breaks previously working functionality)
- Bad or missing cable between NI 9403 Digital I/O card and Digital Sidecar

## Speed Controller LED doesn't go solid orange/yellow when the robot is enabled (CAN Control-Jaguars only)

- Incorrect robot application software.
- Wiring problems or improper configuration with 2CAN or serial port bus interface
- Bad CAN cable(s)

# Getting Started With the 2014 Control System

- Improperly seated CAN connectors in Jaguars
- Damaged CAN connectors in Jaguar
- Missing termination resistor(s)
- Missing CAN drivers enabling in cRIO (via cRIO imaging tool)

## **Speed Controller LED doesn't show speed changes (going to red and/or green) with joystick changes in Teleop Enabled Mode. Stays solid yellow**

- Incorrect PWM channel on digital sidecar wired
- Incorrect robot application software – may not be specifying correct voltage or driving the motor from multiple areas of the code. Check with motor disconnected, multimeter on Volts DC setting. Use Dashboard or Smart Dashboard to display and check PWM control outputs

## **Motor doesn't move (even though speed controller lights go red and green)**

- A motor is not connected with its speed controller
- A motor is stalled and is drawing too much current
- Two motors are operating against each other rather than together
- The robot battery has insufficient charge (adequate voltage level)
- Possible mechanical problems include broken key, loose set screw on shaft collar

## **Motor moves sluggishly (even though speed controller lights go red and green)**

- A motor is stalled and is drawing too much current due to mechanical problems
- Two motors are operating against each other rather than together
- The robot battery has insufficient charge (adequate voltage level)
- Incorrect robot application software – may not be specifying correct
- Voltage or driving the motor from multiple areas of the code. Check with motor disconnected, multimeter on Volts DC setting. Use Dashboard or Smart Dashboard to display and check PWM control outputs.
- Speed controller type selected in the robot program doesn't match the actual physical model of speed controller.

# Getting Started With the 2014 Control System

## Slow flashing RED LED on Jaguar

- Overcurrent trip, possibly caused by damaged or stalled motor
- Other Jaguar error
- Possible broken Jaguar - replace

## Servo Motor not running

- PWM cable plugged into wrong port on digital sidecar
- Missing 6V jumper on PWM port on digital sidecar.
- Bad or missing cable between NI 9403 Digital I/O card and Digital Sidecar
- The digital sidecar is not getting power
- Incorrect robot application program.

## Analog Sensors (such as gyro) not working

- Incorrect pin assignments on signal cable
- Signal cable not plugged into analog input card
- Signal cable polarity reversed (correct pin polarity shown on side of analog input card)
- No power to the analog input card (unlit LED on card)

## I2C Sensors (such as accelerometer) not working

- Incorrect pin assignments on signal cable
- Signal cable not plugged into I2C pins on Digital Sidecar(they are on the row next to the I2C plug – not on the row labeled “OUT”

# Using the NI Parkway System for Help at an Event

If you have any Control System issue at your event that you need assistance with, each event has at least one Control System Advisor who is there to help. This year FRC will be using the NI Parkway system to help teams connect with the CSA and indicate they have an issue. The Parkway System can be accessed using the Parkway Kiosk found at your event (ask Pit Admin if you can't locate it) or via a mobile device.

## Getting to Parkway

Getting to Parkway

If using the Parkway Kiosk, you should already be on the Parkway homepage, if not you can press Alt+Home or Alt+Back until you reach the home page. If accessing Parkway from a mobile device enter [www.niparkway.com](http://www.niparkway.com) in your web browser.

## Make a Request

Make a Request

To enter a request for assistance, click on the Make Request button, you will be shown a list of Live events in the right pane. Click on the appropriate event from the list of Live Events.

## Select Team Number

Select Team Number

Click on the Select Team dropdown and pick the appropriate Team Number from the list. Enter a description of the request/issue in the box, and then click **Submit**.

# Getting Started With the 2014 Control System

## Viewing Requests

### Viewing Requests

To view or respond to a request (including leaving a comment or closing a request) click the Help Out button on the NI Parkway home page. Click on the appropriate event from the list of Live Events in the right pane. Numbers listed next to the event describe the number of open requests.

## Select a Request

### Select a Request

A list of teams with Open Requests will be shown at the top of the page (with a summary of the latest request below the team number). A list of all teams at the event will be immediately below it. To search for team or request use the search box at the top. To view a team's request(s) click on the team number.

## Request Page

### Request Page

The View Request page has the following buttons/information:

1. Request Info The Request number and Summary are displayed at the top of right pane
2. Comments All comments on the request are displayed in the collapsible element under the request summary
3. Mark/Unmark as solution Each comment has a check or minus underneath which allows you to mark or unmark the comment as the solution. Marking comment as a solution will close the request. Unmarking a comment as the solution will re-open the request. To close a request there must be at least one comment to be marked as the solution
4. Add Comment Press this button to display the Add Comment dialog. Enter the name you want displayed above the comment and the comment text, and then click Submit.
5. XXXX Team Data button Click to view or update the team data page (contains information such as software language and usage of advanced features such as vision)

# Getting Started With the 2014 Control System

6. Other Requests Shows any other requests this team has made, including requests that have been closed. This data is persistent across events so if a team has been to a previous event, their requests from that event will also display here.
  - An “!” next to a request shows the request is open.

# 2014 Driver Station



# Imaging your Classmate (Rookie USB stick)

This document outlines the procedure to image an E12 Classmate PC using the USB Stick provided in the 2014 Rookie Kit of Parts if necessary. Veteran teams may not need to image their machines, but should see the section on [Image Download](#) if they wish to do so.'

**Note that the Rookie Classmates are provided with a Windows 7 image installed and do not necessarily need to be imaged with the provided USB stick. If you are experiencing an issue with the Drive account or with activating Windows please see below.**

After the E12 Rookie machines were imaged and USB sticks were created an error was discovered that prevents the Driver Station from launching properly on the Driver Account. Teams can either follow the instructions located [here](#) to download and install one of the online images or follow the instructions below to fix the Driver account after imaging with the provided USB key.

## Do Not Image Using Rookie USB Stick

We are currently investigating multiple reports of rookie E12 USB images failing to load. **It is not recommended to image your Classmate using the USB Image provided in the KOP at this time.** As noted above you can use the E12 as provided (with the fix below) or follow the instructions to download one of the online images and use that to re-image the machine.

## Apply Driver Account Fix

Download the FRC 2014 Rookie E12 Image Fix from <http://www.usfirst.org/roboticsprograms/frc/Technical-Resources>. If you have downloaded the file on another machine transfer it to the Classmate PC using a flash drive, if you have downloaded it from the E12 directly, locate it in a folder you will be able to access from the Driver account. Unzip the file by right clicking and selecting Unzip All.

# Getting Started With the 2014 Control System

## Log on to the Driver Account

Log on to the Driver Account. You should see the normal Windows environment load instead of the Driver Station.

## Run the fix

Double click on the FRC\_E12-DS\_Update-2014-01.exe file to run the fix. You should see a Console Window appear and complete the fix. Reboot the computer and log on to the Driver Account. The machine should now load the Driver Station as expected.

## Issues Activating Windows

If you are having issues activating Windows

## Update Software

In order for the Classmates to arrive at Kickoff locations in time, they were shipped before the final version of the software was ready. To use the Classmate as a Driver Station you will need to install the [2014 NI FRC Update](#). To use the machine for development in C++ or Java you will also need to install the language update for the language of your choice: [C++](#), [Java](#). The LabVIEW Language update is included in the NI FRC Update.

# Imaging your Classmate (Veteran/Rookie Image Download)

This document describes the procedure for creating a bootable USB drive to restore the 2014 FRC image on a Classmate computer. Note that Veteran teams are not required to re-image their Classmates. If you do not wish to re-image your Classmate you will need either a USB optical drive or to copy the contents of the NI FRC Update, and optionally the LabVIEW DVD (if programming in LabVIEW) or WindRiver DVD (if programming in C++) then you can start with the appropriate document for [C++](#), [Java](#), [LabVIEW](#), or [DS only](#).

UPDATE 1/3/14: We discovered an error with the E09 Classmate Image E09\_DRV\_2014\_161213. While we fix the image, [here's a document](#) on how you can correct the issue.

**E09\_DRV\_2014\_030114 no longer has this issue.**

## Prerequisites



Figure 1: E09 Classmate



Figure 2: E11 Classmate



Figure 3: E12 Classmate

# Getting Started With the 2014 Control System

1. E09, E11, E12, or E14 Classmate computer
2. 8GB or larger USB drive
3. 7-Zip software installed. [Download here \(www.7zip.org\)](http://www.7zip.org) As of the writing of this document, the current released version is 9.20 (2010-11-18)
4. RMPrepUSB software installed. [Download here](#). Scroll down the page and select the full version's download link. As of 13-May-2014, the current released version is Install\_RMPrepUSB\_Full\_v2.1.718.zip

## Download the Classmate Image

Image Filename	Classmate Model	DS Capable	LabVIEW 2013	C++ (Windriver)	Java (Netbeans)
E09_DRV_2014_030114.7z	E09	YES	NO	NO	NO
E11_DRV_2014_051113.7z	E11	YES	NO	NO	NO
E11_DEV_2014_081113.7z	E11	YES	YES	YES	YES
E12_DRV_2014_171213.7z	E12	YES	NO	NO	NO
E12_DEV_2014_171213.7z	E12	YES	YES	YES	YES
E14_DRV_2014_301213.7z	E14	YES	NO	NO	NO
E14_DEV_2014_301213.7z	E14	YES	YES	YES	YES

Download the Classmate image via the [links below](#). Select the option that best fits your desired use case; as a Driver Station only, or as a Driver Station and robot code development platform. Due to the limited size of hard drive in the E09, only the Driver Station option is available. The E11 and E12 have sufficient space which allows for all the development environments to be installed at the same time along with the Driver Station software.

- [E09 - Driver Station only \(E09\\_DRV\\_2014\\_030114.7z\)](#)
- [E11 - Driver Station only \(E11\\_DRV\\_2014\\_051113.7z\)](#)
- [E11 - Driver Station and robot code development \(E11\\_DEV\\_2014\\_081113.7z\)](#)
- [E12 - Driver Station only \(E12\\_DRV\\_2014\\_171213.7z\)](#)
- [E12 - Driver Station and robot code development \(E12\\_DEV\\_2014\\_171213.7z\)](#)
- [E14 - Driver Station only \(E14\\_DRV\\_2014\\_301213.7z\)](#)
- [E14 - Driver Station and robot code development \(E14\\_DEV\\_2014\\_301213.7z\)](#)

**NOTE: These images only install the prerequisite core FRC software, it is still necessary to install the 2014 season-specific updates (see the Update Software step near the end of this document)**

# Getting Started With the 2014 Control System

## Preparation

1. Place the image file downloaded from the Intel site to a folder on your root drive (e.g. C:\2014\_Image)
2. Connect USB Flash drive to the PC to use as the new restoration drive.
3. If using the E14 see the E14 Supplemental Preparation near the bottom of this document.

## RMPrep

RMPrep

Start/Run RMprepUSB

Select USB Drive

## Set Partition Size

Set Partition Size

Set Partition Size to MAX

## Set Volume Label

Set Volume Label

Set Volume Label to Generic

## Set Bootloader Option

Set Bootloader Option

Select Bootloader Option "WinPE v2/WinPE v3/Vista/Win7 bootable"

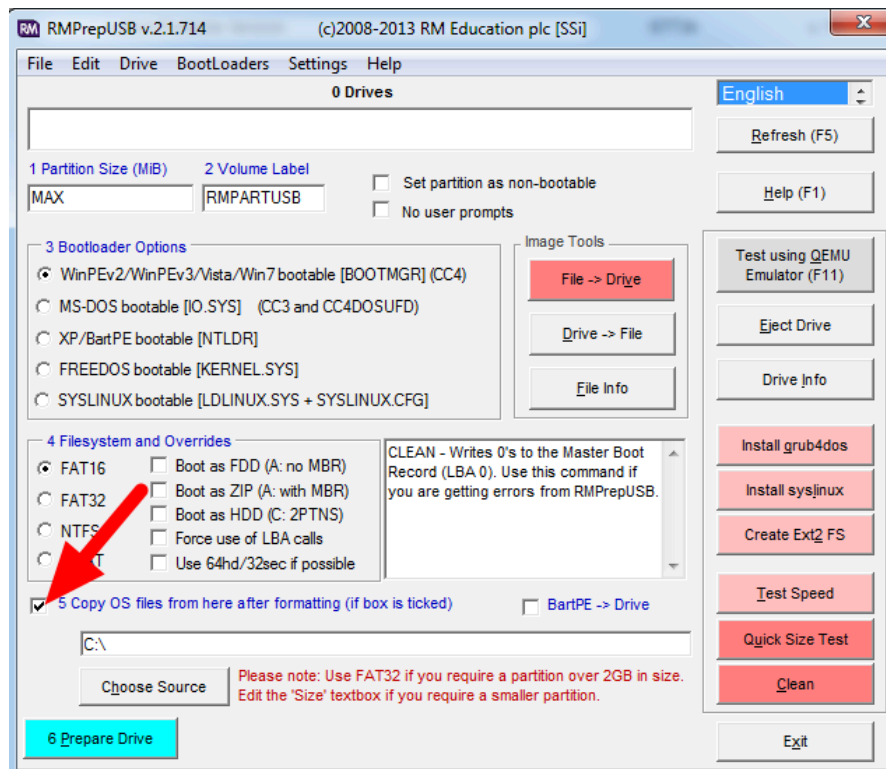
# Getting Started With the 2014 Control System

## Select Filesystem

Select Filesystem

Select NTFS Filesystem

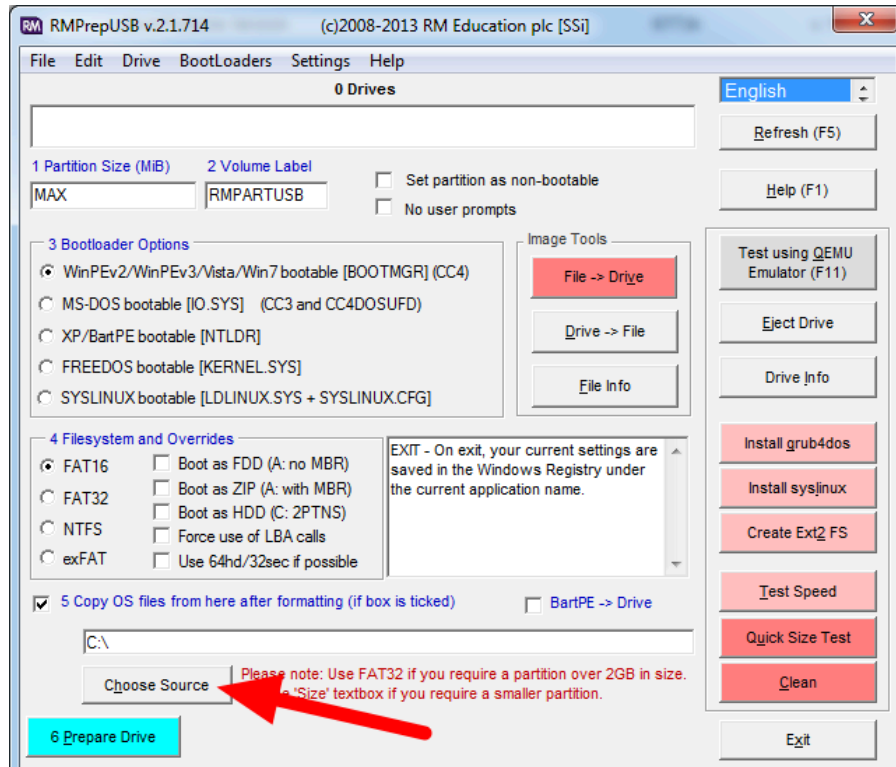
## Copy OS Files Option



Ensure the “Copy OS files from here after formatting” box is checked

# Getting Started With the 2014 Control System

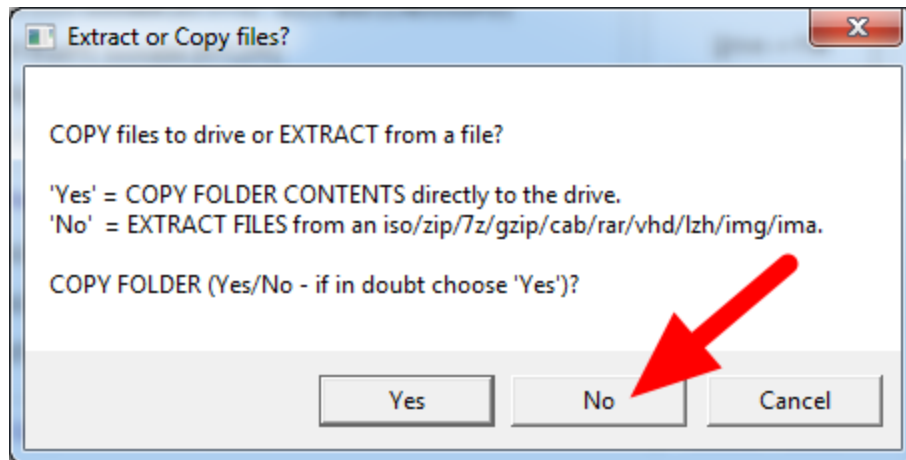
## Locate Image



Select the "Choose Source" button

# Getting Started With the 2014 Control System

## Copy Files Dialog



Choose "No" and select your .7z image

## Prepare Drive

Prepare Drive

All configuration settings are now complete. Select "Prepare Drive" to begin the process

## Confirmation Dialog 1

Confirmation Dialog 1

Click "OK" to execute the command on the selected USB Flash drive. A Command Prompt will open showing the progress.

## Confirmation Dialog 2

Confirmation Dialog 2

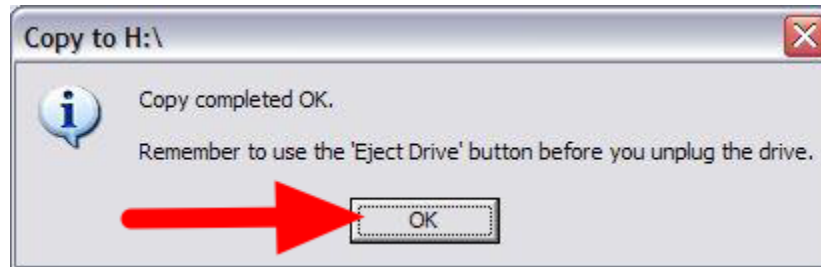


# Getting Started With the 2014 Control System

Click "OK" to format the USB drive

**NOTE: ALL DATA ON THE DRIVE WILL BE ERASED!**

## Copy Complete



Once formatting is complete, the restoration files will be extracted and copied to the USB drive. This process should take ~15 minutes when connected to a USB 2.0 port. When all files have been copied, this message will appear, press OK to continue.

## Eject Drive

Eject Drive

Press the "Eject Drive" button to safely remove the USB drive. The USB drive is now ready to be used to restore the image onto the Classmate PC.

## Applying the Image

1. With the Classmate turned 'Off'; insert the USB Flash drive with the Restoration image into a USB port on the Classmate
2. Turn the Classmate 'On'; when the "2Go PC" splash screen appears, repeatedly press/release (as if typing) the F11 key until the Boot Options screen appears

## Select USB Drive

Select USB Drive

# Getting Started With the 2014 Control System

Using the arrow keys scroll down to the USB Device and press Enter .

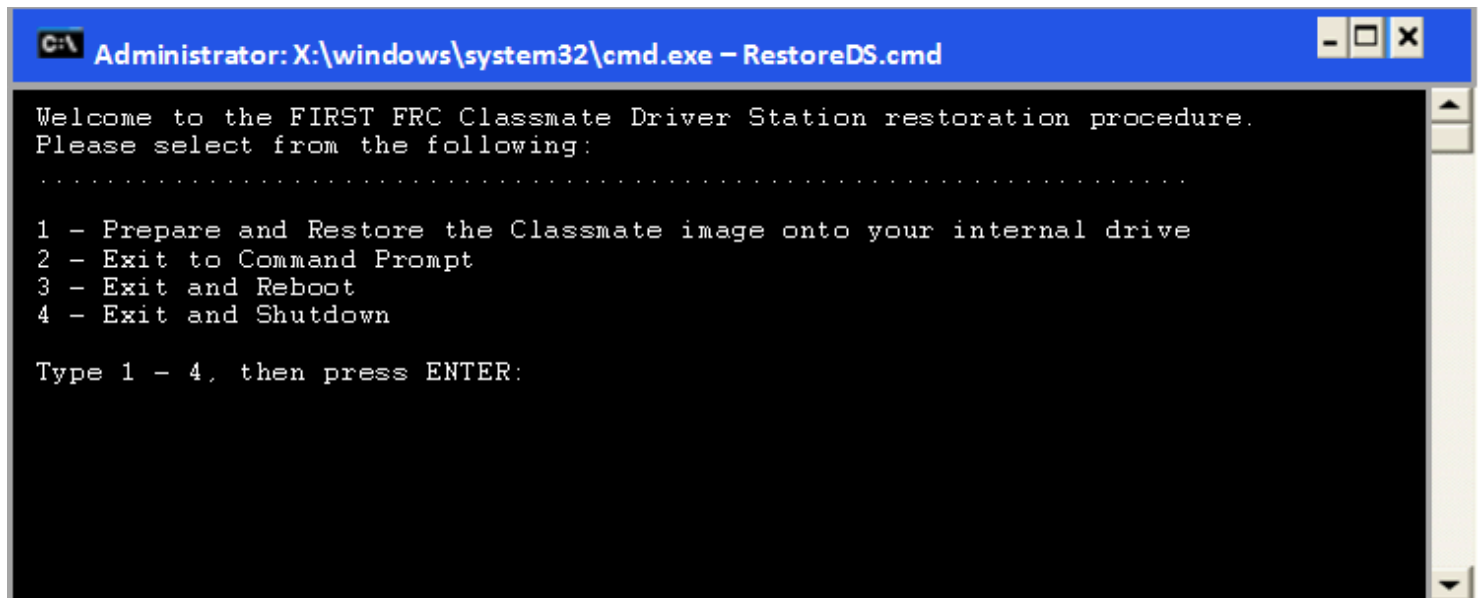
Note, the USB drive used to create this document came up listed only as "USB DISK". Your USB device may be listed under a different name.

## Setup Initializing

Setup Initializing

Windows setup will begin to install. This Command Prompt window will be displayed:

## Main Menu



```
C:\ Administrator: X:\windows\system32\cmd.exe - RestoreDS.cmd

Welcome to the FIRST FRC Classmate Driver Station restoration procedure.
Please select from the following:
.....

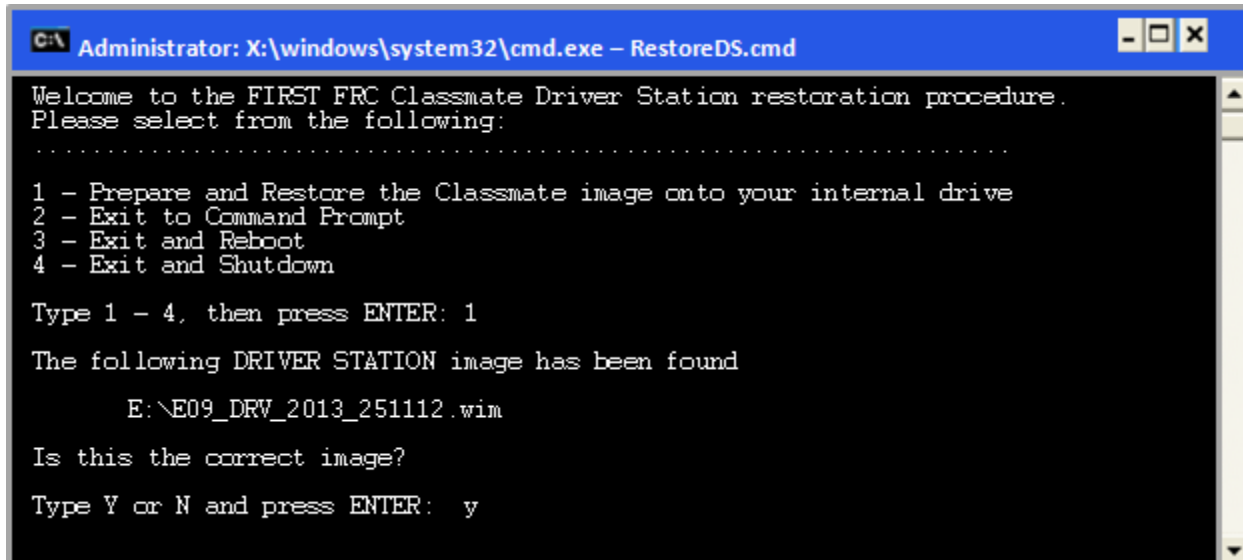
1 - Prepare and Restore the Classmate image onto your internal drive
2 - Exit to Command Prompt
3 - Exit and Reboot
4 - Exit and Shutdown

Type 1 - 4, then press ENTER:
```

When Setup completes, the Main menu will display. Type 1 to restore the Classmate then press Enter

# Getting Started With the 2014 Control System

## Image Confirmation



```
C:\ Administrator: X:\windows\system32\cmd.exe - RestoreDS.cmd

Welcome to the FIRST FRC Classmate Driver Station restoration procedure.
Please select from the following:
.....
1 - Prepare and Restore the Classmate image onto your internal drive
2 - Exit to Command Prompt
3 - Exit and Reboot
4 - Exit and Shutdown

Type 1 - 4, then press ENTER: 1

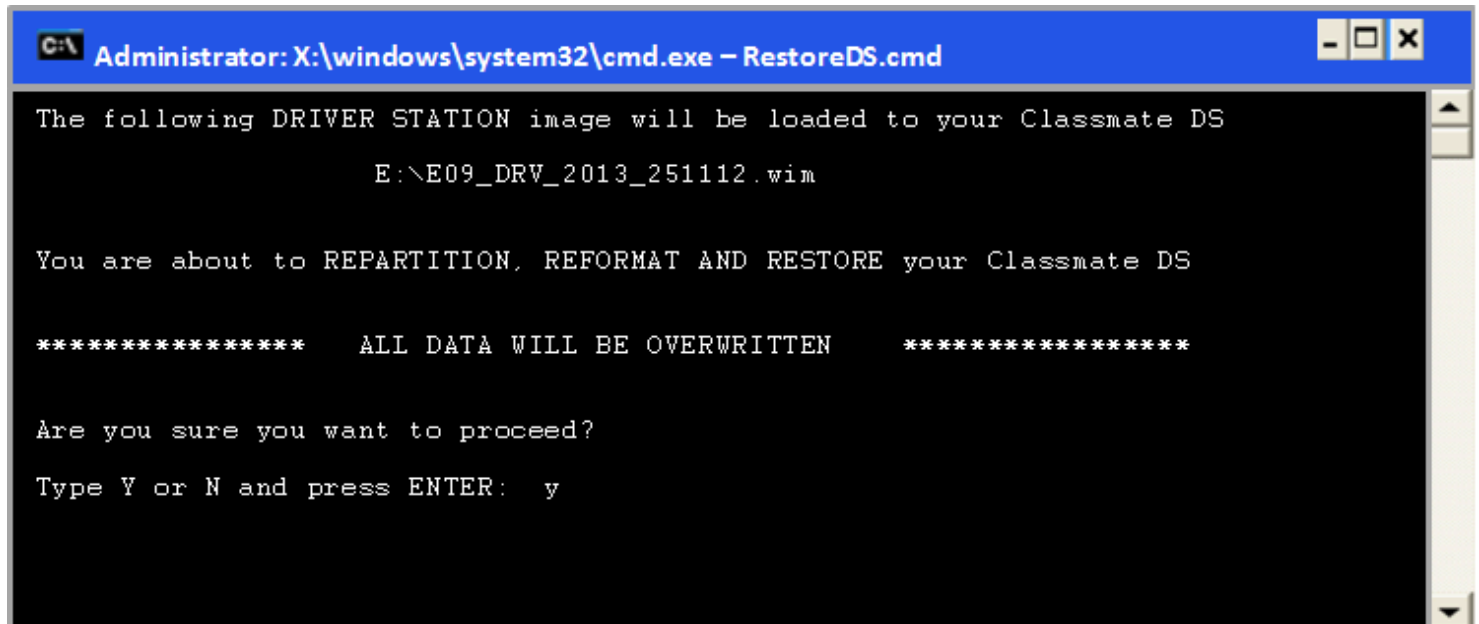
The following DRIVER STATION image has been found
      E:\E09_DRV_2013_251112.wim

Is this the correct image?
Type Y or N and press ENTER:  y
```

Confirm the Image is correct for your model Classmate and desired image type. Then type “Y” and press Enter. The screenshot below shows the installation for the Driver Station-only image for the E09.

# Getting Started With the 2014 Control System

## Confirm Restore



```
C:\> Administrator: X:\windows\system32\cmd.exe - RestoreDS.cmd

The following DRIVER STATION image will be loaded to your Classmate DS
      E:\E09_DRV_2013_251112.wim

You are about to REPARTITION, REFORMAT AND RESTORE your Classmate DS

***** ALL DATA WILL BE OVERWRITTEN *****

Are you sure you want to proceed?
Type Y or N and press ENTER:  y
```

Confirm the Restoration by typing “Y” then press Enter

## Restoration Complete

Restoration Complete

When the Restoration is complete, press any key to reboot

## Remove USB Drive

Remove the USB Flash Drive while the Classmate is rebooting.

# Getting Started With the 2014 Control System

## Initial Driver Station Boot

The first time the Classmate is turned on, there are some unique steps, listed below, that you'll need to take. The initial boot may take several minutes; make sure you do not cycle power during the process.

Please note that these steps are only required during original startup.

## Enter Setup

1. Log into the Developer account.
2. Click "Ask me later".
3. Click "OK". The computer now enters a Set Up that may take a few minutes.

## Activate Windows

1. Establish an Internet connection.
2. Once you have an Internet connection, click the Start menu, right click "Computer" and click "Properties".
3. Scroll to the bottom section, "Windows activation", and Click "Activate Windows now"
4. Click "Activate Windows online now". The activation may take a few minutes.
5. When the activation is complete, close all of the windows.

## Microsoft Security Essentials

1. Navigate through the Microsoft Security Essentials Setup Wizard. Once it is complete, close all of the windows.

## Select a theme

1. Set a theme for your computer by right clicking anywhere on the Desktop and clicking "Personalize".

# Getting Started With the 2014 Control System

2. Scroll within the themes and select a theme. We recommend “Windows 7 Basic”. Note that using any of the “Aero” themes has been shown to slow down processing when using the Microsoft Kinect.

## Update Software

In order for the Classmates to arrive at Kickoff locations in time, they were shipped before the final version of the software was ready. It is essential that you update your classmate software before proceeding so that you are using the most updated software throughout this set up and during competition. For instructions on software updates see:

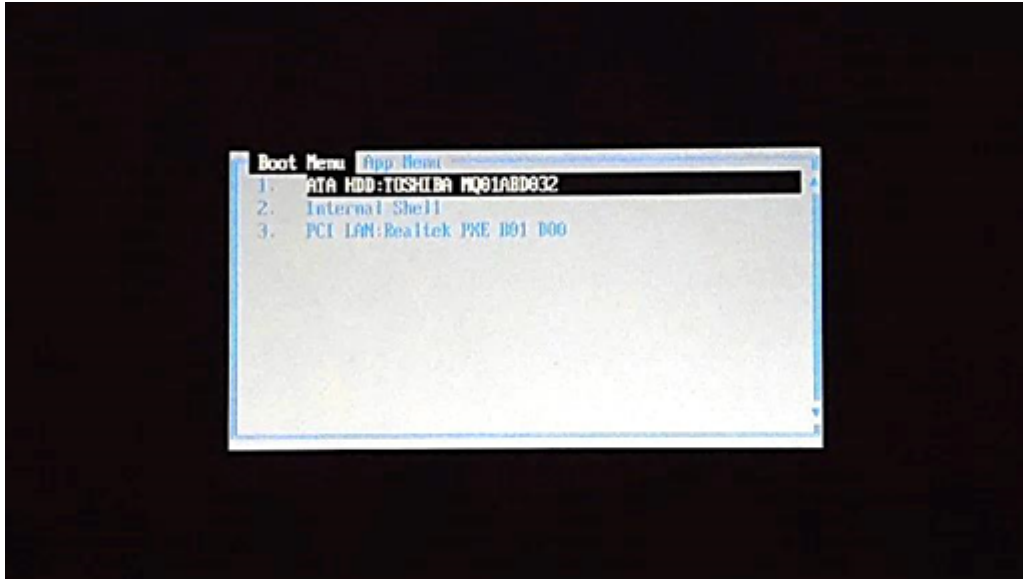
- Java: [Installing the Java Development Tools \(Installing the NetBeans plugins\)](#) then [Installing the 2014 FRC NI Update](#)
- C++: [Activating Windriver Workbench on an Imaged Classmate](#) then [Installing the FRC Specific C++ Components](#) then [Installing the 2014 FRC NI Update](#)
- LabVIEW: [Installing the 2014 FRC NI Update](#)
- DS Only: [Installing the 2014 FRC NI Update](#)

## E14 Supplemental Preperation

The E14 Classmate ships with UEFI SecureBoot enabled which needs to be disabled before the machine can be imaged with the FIRST provided image.

# Getting Started With the 2014 Control System

## Boot Menu



Power-up the Classmate; when the **CTL** splash screen appears repeatedly press the **F11** key to get to the *Boot Menu*

# Getting Started With the 2014 Control System

## App Menu

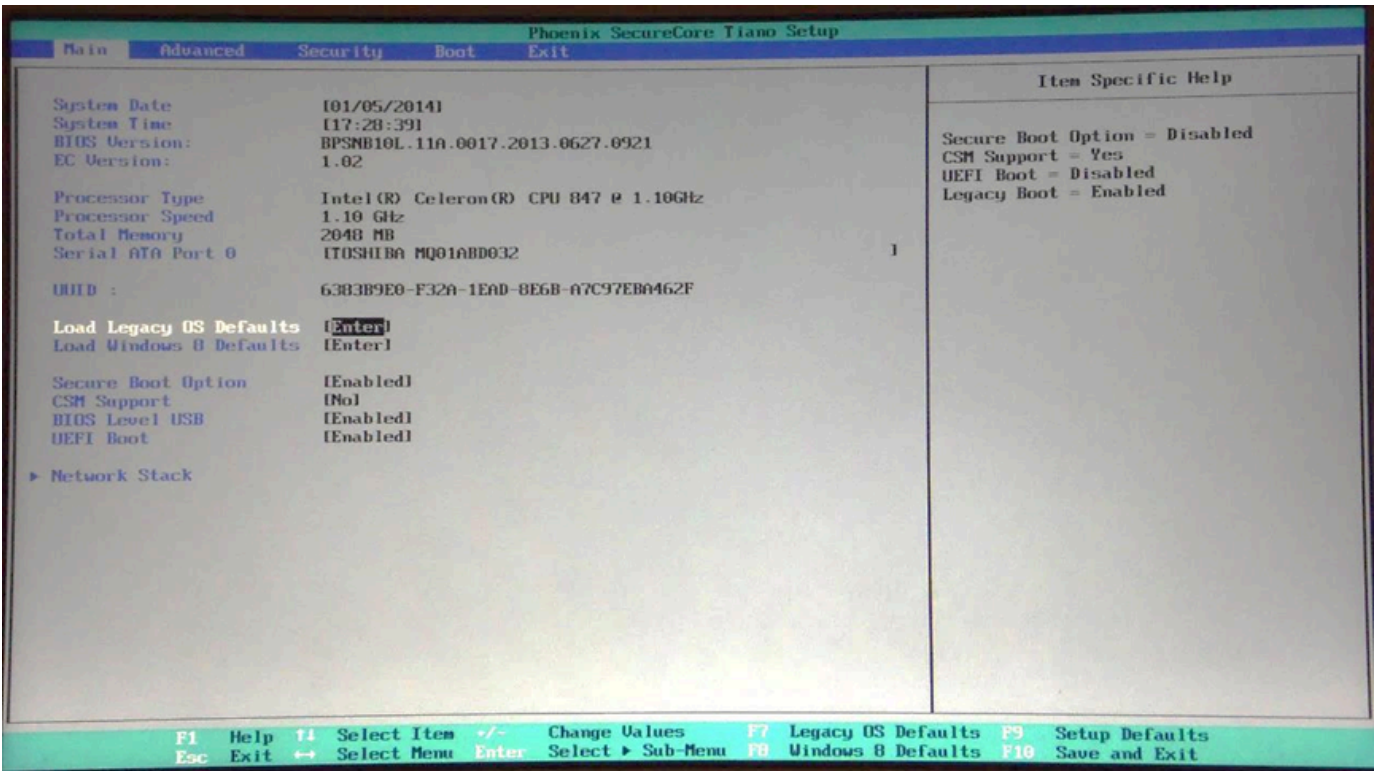


Press the **Tab** key to get to the *App Menu*. Leave the *Setup* line highlighted and press **Enter** to continue



# Getting Started With the 2014 Control System

## Load Legacy OS Defaults

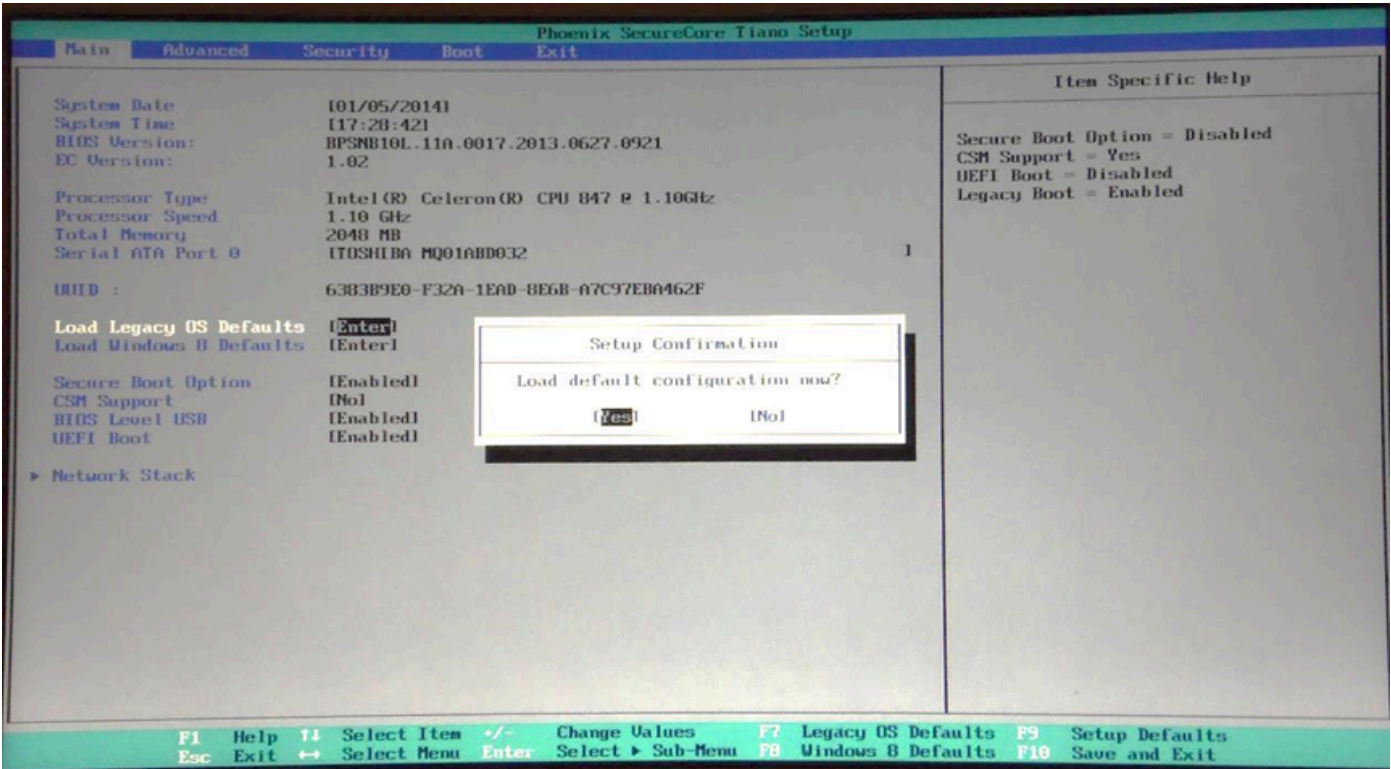


On the **Main** page of the **Phoenix SecureCore Tiano Setup**, use the arrow keys to move the cursor to the *Load Legacy OS Defaults* setting. Press **Enter**

Note: The changes being made are listed in the Item Specific Help column at the right side of the screen

# Getting Started With the 2014 Control System

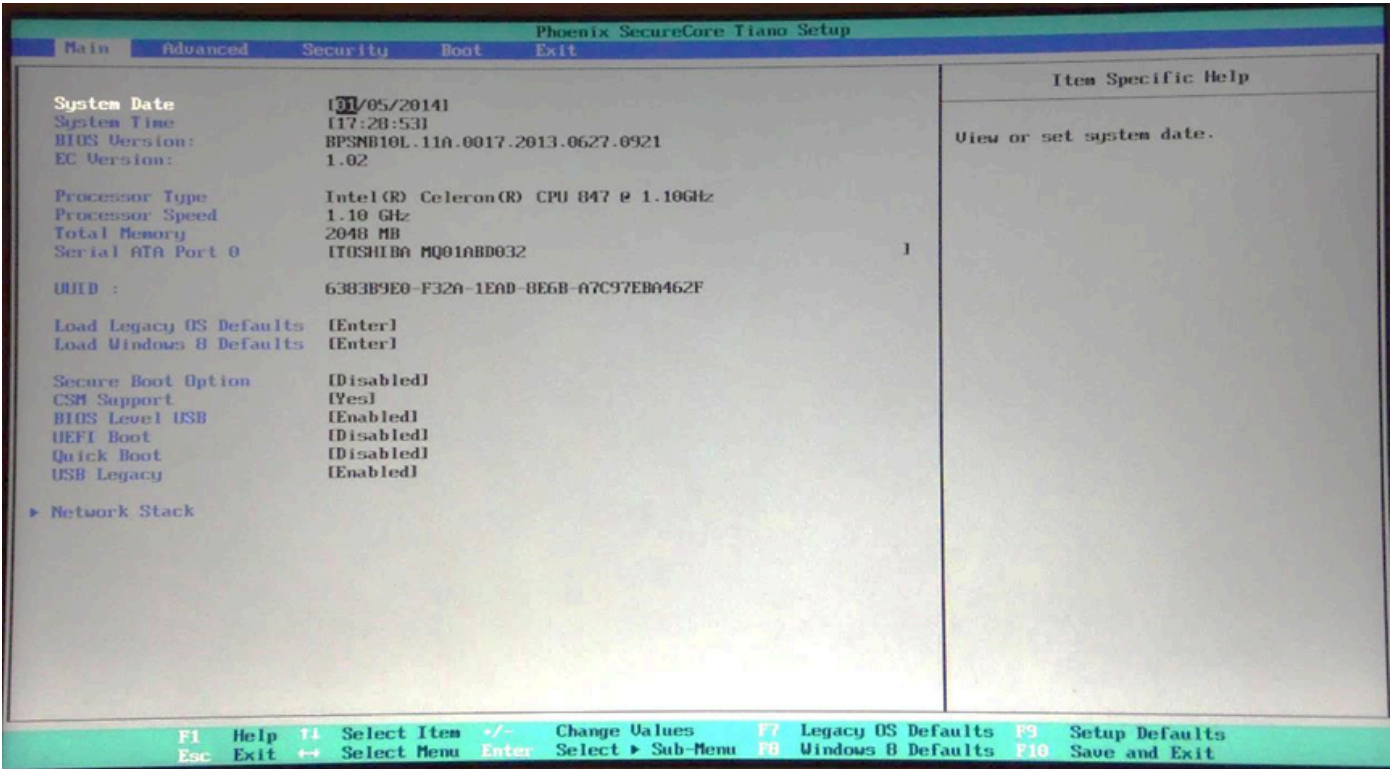
## Confirm



Press **Enter** to confirm

# Getting Started With the 2014 Control System

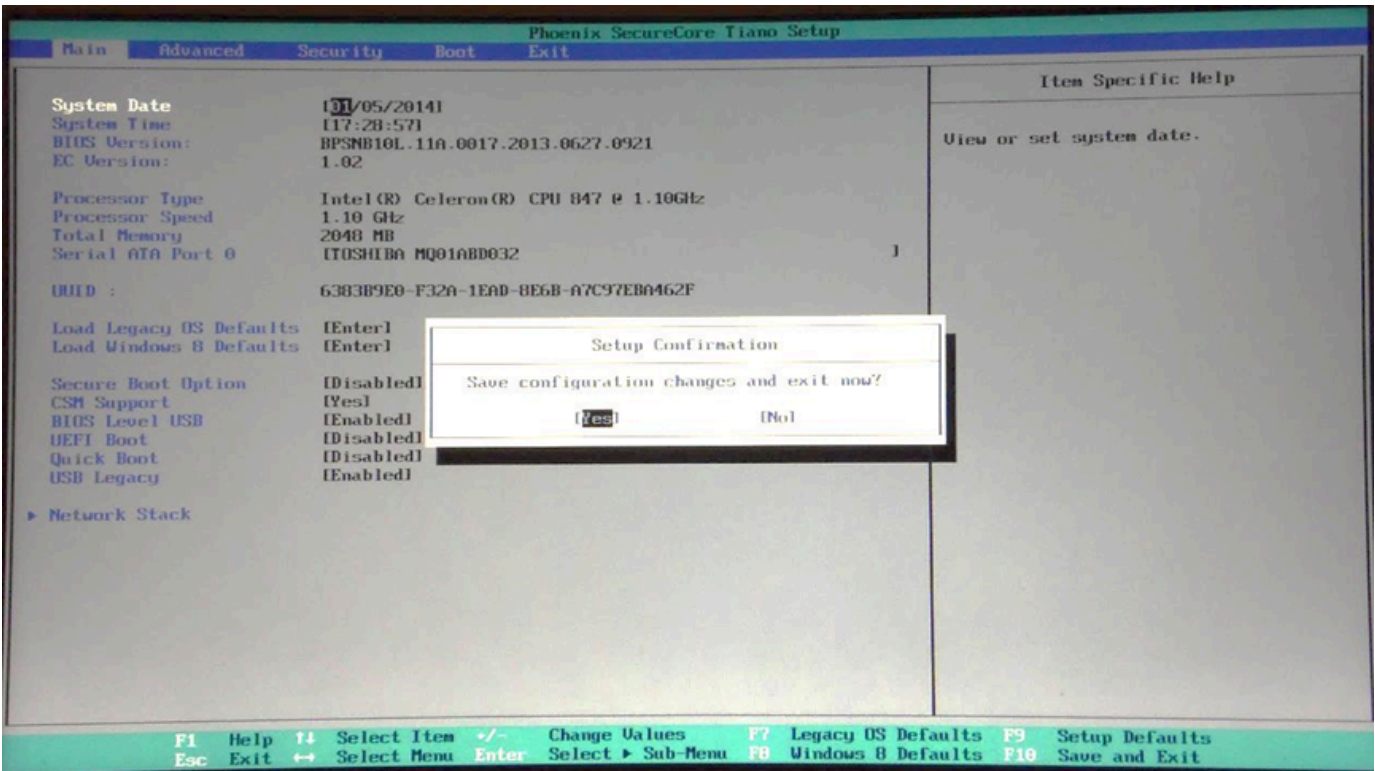
## Save Changes



Press **F10** to Save the changes and Exit the Setup application

# Getting Started With the 2014 Control System

## Confirm



Press **Enter** to confirm. The Classmate will now reboot. Scroll back up and proceed from the RMPrep section.

## Errors during Imaging Process

### Errors during Imaging Process

If an error is detected during the imaging process, the following screen will appear. Note that the screenshot below shows the error screen for the Driver Station-only image for the E09. The specific image filename shown will vary depending on the image being applied.

The typical reason for the appearance of this message is due to an error with the USB device on which the image is stored. Each option is listed below with further details as to the actions you can

# Getting Started With the 2014 Control System

take in pursuing a solution. Pressing any key once this error message is shown will return the user to the menu screen shown in Step 4 on page 10.

## Option 1

*Using same image on the existing USB Flash drive:* To try this option, press any key to return to the main menu and select #1. This will run the imaging process again.

## Option 2

*Reload the same image onto the USB Flash drive using RMPrepUSB:* It's possible the error message was displayed due to an error caused during the creation of the USB Flash drive (e.g. file copy error, data corruption, etc.) Press any key to return to the main menu and select #4 to safely shutdown the Classmate then follow the steps outlined starting on page 3 of this document to create a new USB Restoration Key using the same USB Flash drive.

## Option 3

*Reload the same image onto a new USB Flash drive using RMPrepUSB:* The error message displayed may also be caused by an error with the USB Flash drive itself. Press any key to return to the main menu and select #4 to safely shutdown the Classmate. Select a new USB Flash drive and follow the steps outlined starting on page 3 of this document.

## Option 4

*Reload the same image onto a new USB Flash drive using RMPrepUSB:* The error message displayed may also be caused by an error with the USB Flash drive itself. Press any key to return to the main menu and select #4 to safely shutdown the Classmate. Select a new USB Flash drive and follow the steps outlined starting on page 3 of this document.

# Activating Wind River Workbench on an Imaged Classmate

Due to timing constraints the copy of Wind River Workbench included on Classmate Images was activated using the 2013 license. This license will expire on January 31st, 2014. This article details how to activate the software using the 2014 license from the disc provided in your Kit of Parts.

## Locating the 2014 License file

Locating the 2014 License file

Insert Wind River Workbench DVD 1 (v3.0.1) into a computer with a DVD drive. If the installer launches automatically, close it. Browse to the drive and locate the file **FRC\_2014\_WB30\_WB33\_install.txt** (Note: the image shows the 2012 file).

## Copy and Rename

Copy and Rename

Copy the file to a flash drive and rename it to **zwrslLicense.lic**. Click **Yes** at the prompt to confirm changing the file extension. If prompted to provide administrator permission, click **Continue**.

Note: If you do not see the .txt file extension, you will have to enable viewing file extensions in order to avoid renaming the file **zwrslLicense.lic.txt**. To do this, click **Start>>Control Panel>>Appearance and Personalization>>Folder Options**. Then click on the **View** tab and find the box for **Hide extensions for known file types** and uncheck it, then click **OK**.



# Getting Started With the 2014 Control System

## Copy to Classmate

### Copy to Classmate

Plug the flash drive into the Classmate, then copy the **zwrsLicense.lic** file to **C:\Windriver\license**. When prompted, select to **Copy and Replace**. Wind River should now be licensed through January of 2015.

## FRC Driver Station Software

This document details the operation of the FRC Driver Station software and explains the purpose and function of the controls and indicators it contains.

### Setting Up the Driver Station

#### Setting Up the Driver Station

For information on installing the Driver Station software see [this document](#). Typically the Driver Station will set the appropriate settings automatically, but if you do have to set the network settings manually, the DS should use the following settings:

- IP: 10.XX.YY.05 (wired interface) or 10.XX.YY.09 (wireless) where XXYY is your 4 digit FRC team number
- Subnet Mask: 255.0.0.0

The DS must be set to your team number in order to connect to your robot. In order to do this click the **Setup** tab then enter your team number in the team number box. Press return or click outside the box for the setting to take effect.

### Status Pane

#### Status Pane

The Status Pane of the Driver Station is located on the left side of the display and is always visible regardless of the tab selected. It displays a selection of critical information about the state of the DS and robot:

1. Team # - The Team number the DS is currently configured for. This should match your FRC team number, to change the number see the Setup Tab.
2. Battery Voltage - If the DS is connected and communicating with a cRIO with a properly wired 9201 and Analog Breakout, this reports the current robot battery voltage



# Getting Started With the 2014 Control System

3. Major Status Indicators - These three indicators display major status items for the DS. The "Communications" indicates whether the DS is currently communicating with the FRC Network Communications Task on the cRIO. The "Robot Code" indicator shows whether the team Robot Code is currently running (determined by whether or not the Driver Station Task in the robot code is updating the battery voltage), The "Joysticks" indicator shows if at least one joystick is plugged in and recognized by the DS.
4. Status String - The Status String provides an overall status message indicating the state of the robot, some examples are "No Robot Communication", "No Robot Code", "Emergency Stopped", and "Teleoperated Enabled". If the DS is connected to a Field Management System (FMS) a light blue stripe will appear immediately below the Status String. This helps to verify field connection regardless of the selected tab.

## Operation Tab

### Operation Tab

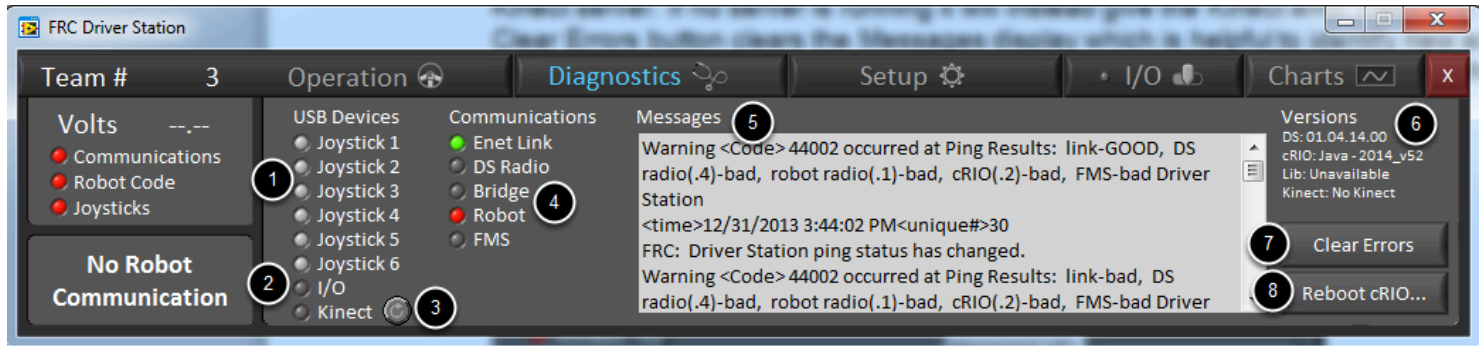
The Operations Tab is used to control the mode of the robot and provide additional key status indicators while the robot is running.

1. Robot Mode - This section controls the Robot Mode. Practice Mode causes the robot to cycle through the same transitions as an FRC match after the Enable button is pressed (timing for practice mode can be found on the setup tab).
2. Enable/Disable - These controls enable and disable the robot. You can also use the F1 key to enable the robot and the Enter key to Disable the robot.
3. Elapsed Time - Indicates the amount of time the robot has been in this mode
4. Kinect Status - Indicates the Status of the Kinect device and number of detected skeletons
5. PC Battery - Indicates current state of DS PC battery and whether the PC is plugged in
6. Window Mode - When not on the Driver account on the Classmate allows the user to toggle between floating (arrow) and docked (rectangle)
7. Team Station - When not connected to FMS, sets the team station to transmit to the robot.
8. User Messages - Displays User Messages sent from the robot using the Driver Station LCD Classes/VIs

Note: When connected to the Field Management System the controls in sections 1, and 2 will be replaced by the words FMS Connected and the control in Section 7 will be greyed out.

# Getting Started With the 2014 Control System

## Diagnostics Tab



The Diagnostics Tab contains additional status indicators that teams can use to diagnose issues with their robot:

1. Joystick connection indicators - Green if the joystick is connected. **New for 2014 - This now shows 6 joysticks. Only the first 4 are transmitted to the robot.**
2. I/O Connection - Indicates if the Cypress I/O board is connected.
3. Kinect - Indicates if the Kinect is connected. Red if no Kinect Server is connected or if Kinect is plugged in, but not working. Grey if a Kinect Server is running but the Kinect is not connected. The arrow terminates and restarts the FRC Kinect Server if installed
4. Connection Indicators - Indicate connection status to various components. "Enet Link" indicates the computer has something connected to the ethernet port. "DS Radio" is a legacy indicator used to indicate the ping status to an external radio on the DS side at 10.XX.YY.4. "Bridge" indicates the ping status to the robot wireless bridge at 10.XX.YY.1. "Robot" indicates the ping status to the cRIO at 10.XX.YY.2. "FMS" indicates if the DS is receiving packets from FMS (this is NOT a ping indicator).
5. Messages - This box contains diagnostic warning/error message produced by the Driver Station. Teams will notice many more messages appearing here than in previous years. This is due to many additional warning messages added to the DS in order to help teams diagnose exactly what is going on if they have issues with their robot.
6. Versions - This area contains information on the versions of the DS, cRIO (version and language), WPILib running on the cRIO (language and version) and the Kinect Server version/status if running.
7. Clear Errors - This button clears the Messages box.
8. Reboot cRIO - This button attempts to perform a remote reboot of the cRIO (after clicking through a confirmation dialog)

# Getting Started With the 2014 Control System

## Setup Tab

### Setup Tab

The Setup Tab contains a number of buttons teams can use to control the operation of the Driver Station:

1. Team Number - Should contain your FRC Team Number. This controls the IP that the DS attempts to set your computer to as well as the IP it expects the robot to be at.
2. Choose NIC button - Brings up the "Choose NIC" dialog which can be used to set which network interfaces the DS will attempt to automatically configure.
3. Dashboard Location Controls - Chooses where to forward the Dashboard information, local dashboard is for a dashboard located on the same machine. Remote Dashboard is used to forward the dashboard information to another PC, clicking this option will create a box to enter the IP of the remote machine.
4. Practice Mode Timing - These boxes control the timing of each portion of the practice mode sequence. When the robot is enabled in practice mode the DS automatically proceeds through the modes indicated from top left down to bottom left then up to top right and down. **Note that these settings persist, even across updates of the DS, check to make sure these settings match the desired timing when using Practice Mode on the DS.**
5. Dashboard Type - Controls what Dashboard is launched by the Driver Station. **Default** launches the file pointed to by the "FRC DS Data Storage.ini" file, by default this is Dashboard.exe in the Program Files\FRC Dashboard folder. **LabVIEW** attempts to launch a dashboard at the default location for a custom built LabVIEW dashboard, but will fall back to the default if no dashboard is found. **Java** and **C++** launch the SmartDashboard included with the language update for that language. To use the SmartDashboard with camera extension leave the option set to Default and see the [SmartDashboard](#) section of the documentation.
6. Joystick Setup - All connected and recognized joysticks will be displayed in this box. Currently enabled joysticks will be displayed in green. Pressing any button on the joystick should turn the display teal and show asterisks next to the device name (\*\*). Click and drag any device name to reorder to the devices, the order and numbering shown here will match the way the device should be accessed in the robot code. Disconnecting a joystick will disable the robot. If connected to FMS, the robot will not be disabled and the joystick will not be automatically detected if it is reconnected, press the F1 key to force a refresh. **New for 2014 - This box now shows up to 6 joysticks to allow use of the full 4 devices when only using 1 part of a compound device such as the TI Launchpad. Only the first 4 devices are transmitted to the robot!!!**

# Getting Started With the 2014 Control System

## I/O Tab - Compatible Mode

### I/O Tab - Compatible Mode

The I/O Tab can be used with the Cypress FirstTouch I/O board, or if the Cypress board is not used, can be used as a virtual I/O Panel. If the Cypress board is connected and functioning the indicator on the I/O tab will be green. If the Cypress board is being used, the state of all objects on this panel will be controlled by the state of the board. If the Cypress board is not being used, the Digital and Analog Input controls can be used with the computer mouse. These controls will send data in the same way as the Cypress Board in Compatible mode and can be read on the robot.

Clicking the Configure button will bring up the Configuration dialog.

## I/O Tab - Configuration Dialog

### I/O Tab - Configuration Dialog

The Configure Digital I/O Dialog is used to configure the mode of the Cypress board (Compatible or Enhanced) and, if using Enhanced mode, to configure the function of each pin and the behavior of the quadrature encoder input and PWM output if used. Teams should take care to set the configuration of the Enhanced I/O in the robot code, or on the DS, but not both.

## I/O Tab - Enhanced Mode

### I/O Tab - Enhanced Mode

When in Enhanced Mode, the I/O tab shows additional indicators for the various Cypress Board functions. The DS I/O tab cannot be used as a virtual I/O panel in Enhanced Mode.

## Charts Tab

### Charts Tab

# Getting Started With the 2014 Control System

The Charts tab plots and displays advanced indicators of robot status to help teams diagnose robot issues:

1. The top graph charts trip time in milliseconds in green (against the axis on the right) and lost packets per second in blue (against the axis on the left)
2. The bottom graph plots battery voltage in yellow (against the axis on the left, note that this example is reporting a battery voltage of 0), cRIO CPU in red (note that in the Kickoff release the cRIO CPU is plotted against the Voltage scale resulting in the CPU frequently going off scale, for proper display view the log using the Driver Station Log File Viewer), DS Requested mode as a continuous line on the bottom of the chart and robot mode as a discontinuous line above it.
3. This key shows the colors used for the DS Requested and Robot Reported modes in the bottom chart.
4. Realtime RAM/Disk/CPU indicators - These indicators show the cRIO available RAM, largest free RAM block and free disk space and the PC CPU% in real time. Note that the RAM and Disk indicators retain their value when the robot is disconnected so if a disconnect occurs and the RAM indicator says 0 it is likely that the robot ran out of free memory.
5. Chart scale - These controls change the time scale of the DS Charts
6. This button controls whether the chart data is recorded to a log file. Note that this control will default to on each time the DS is started as the DS log is a very helpful tool to have to diagnose robot issues after the fact.

## Driver Station Keys

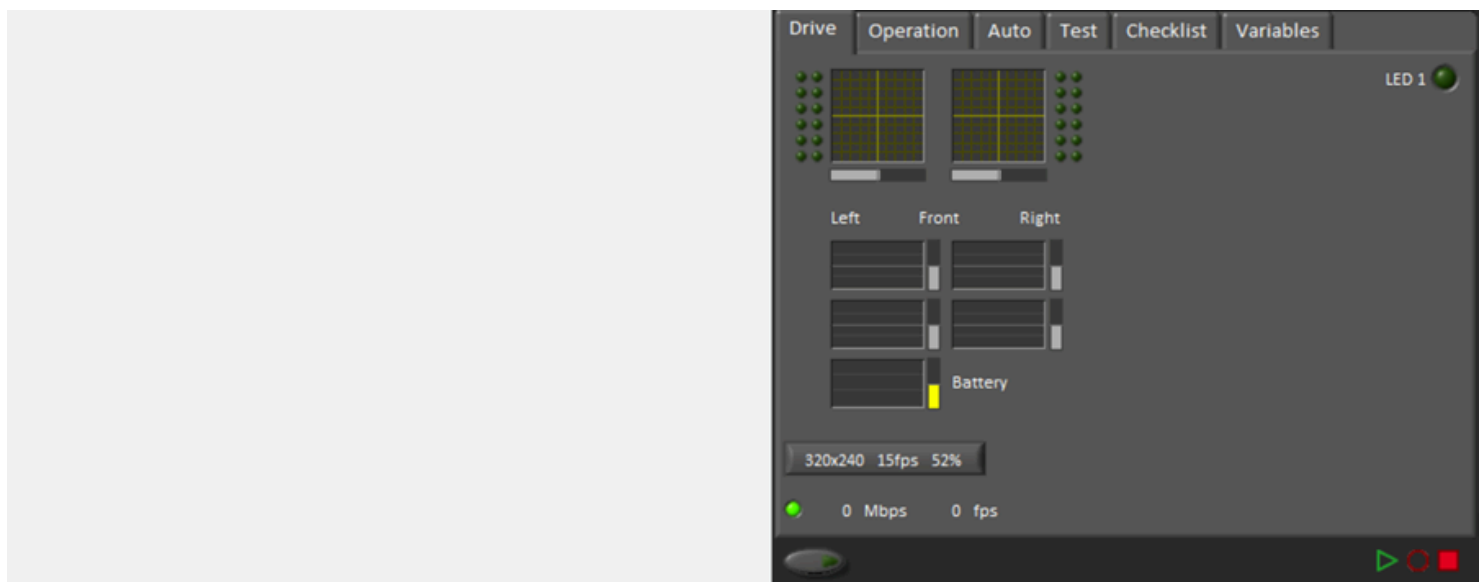
The following keys can be used to control Driver Station operation:

- F1 - Enable the robot. If the robot is enabled, force a Joystick refresh.
- Enter - Disable the Robot
- Space - Emergency Stop the robot. After an emergency stop is triggered the cRIO will need to be rebooted before the robot can be enabled again.

# FRC Driver Station LabVIEW Dashboard

The Dashboard application installed and launched by the FRC Driver Station is a LabVIEW program designed to provide teams with basic feedback from their robot, with the ability to expand and customize the information to suit their needs. The 2014 Dashboard includes a new record and playback feature allowing you to record video and dashboard data while operating your robot and play it back onto the dashboard later for debugging.

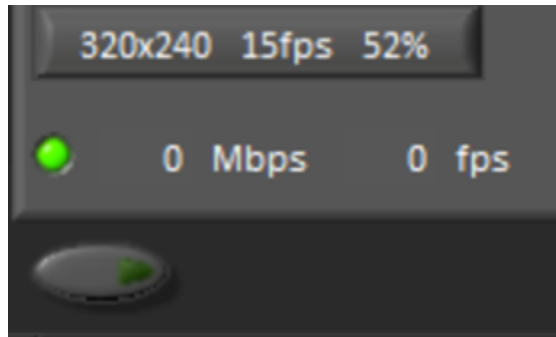
## Layout



The default dashboard uses the left column for camera display. The right column has a few settings located on the bottom row so that they always present. The remainder are located within the tab control on the right.

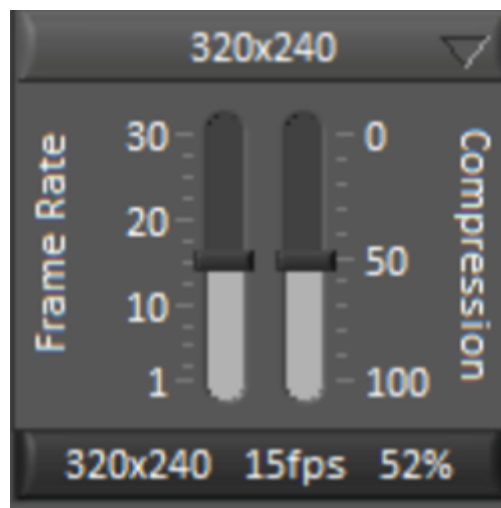
# Getting Started With the 2014 Control System

## Camera Configuration



- Camera configuration is summarized on the top button. Click to modify the settings details shown below.
- The next row indicates the frames per second and megabits per second used by the camera. The LED indicates whether this is within recommended range.
- The button on the bottom row enables and disables the dashboard camera connection. It has no impact on robot vision capabilities.

## Camera Configuration Panel



# Getting Started With the 2014 Control System

When pressed, the camera configuration button opens a small configuration panel. These settings directly impact the network bandwidth used by the camera. Press the button again to close the panel.

- Resolution is selected using the top button.
- Frame rate is set using the slider on the left.
- Compression is set using the slider on the right.

## Record/Playback



The buttons in the lower right are used to control recording and playback of matches in the dashboard. The dashboard background color changes to help identify the mode that is selected.

- Play brings up a panel for selecting a previously recorded match. It also ends any recording already underway. In playback mode, the camera and other dashboard indicators are not live, but update with recorded values.
- Record creates a new recording session.
- Stop ends either playback or recording mode.

## Playback Panel



The playback panel is shown when play button is pressed.

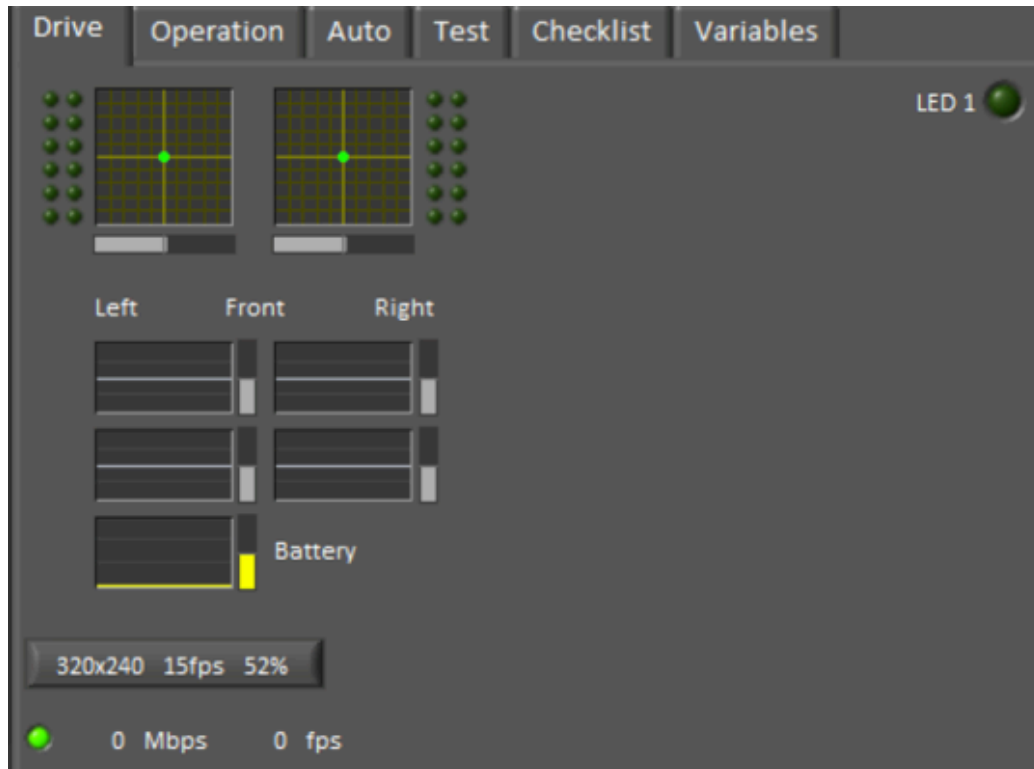
- The left button contains actions for renaming or deleting the selected log file. For backups or larger cleanups, the bottom action opens the folder in an explorer window.
- The second button displays a list of all recorded matches located in the Public Documents/FRC/Log Files/Dashboard folder. Selecting a file begins playback at the selected playback speed.
- The third button selects between playing and pausing the selected recording.
- The fourth button selects the playback speed, 1x being normal speed.



# Getting Started With the 2014 Control System

- The slider on the right edge is a scrub slider that shows the current position in the playback. Click to modify the position. Pause and move the slider left or right to rapidly move through the recording.

## Drive Tab



The drive tab displays axes and buttons of the first two joysticks. It contains the motor values being sent to drive wheels and the battery voltage of the robot. LED 1 is an example indicator mapped to the SmartDashboard variable named LED 1.

# Getting Started With the 2014 Control System

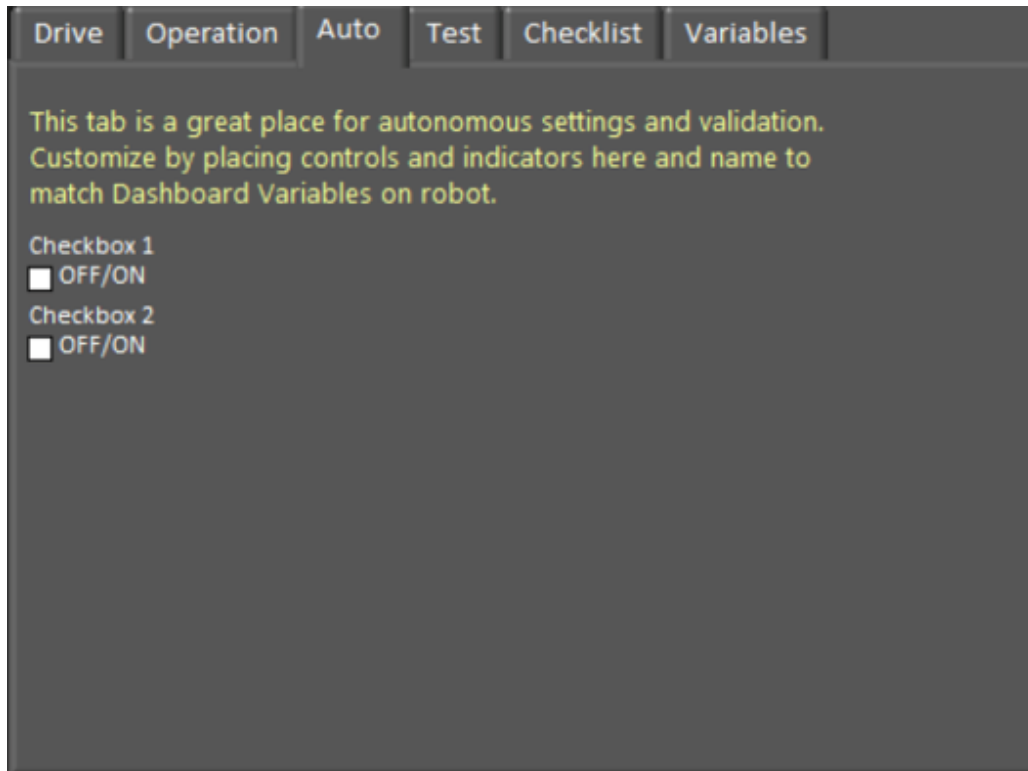
## Operation Tab



The operation tab initially contains one slider bound to a SmartDashboard variable named Slider 1. As the comment indicates, it is very easy to modify and add variable controls and indicators.

# Getting Started With the 2014 Control System

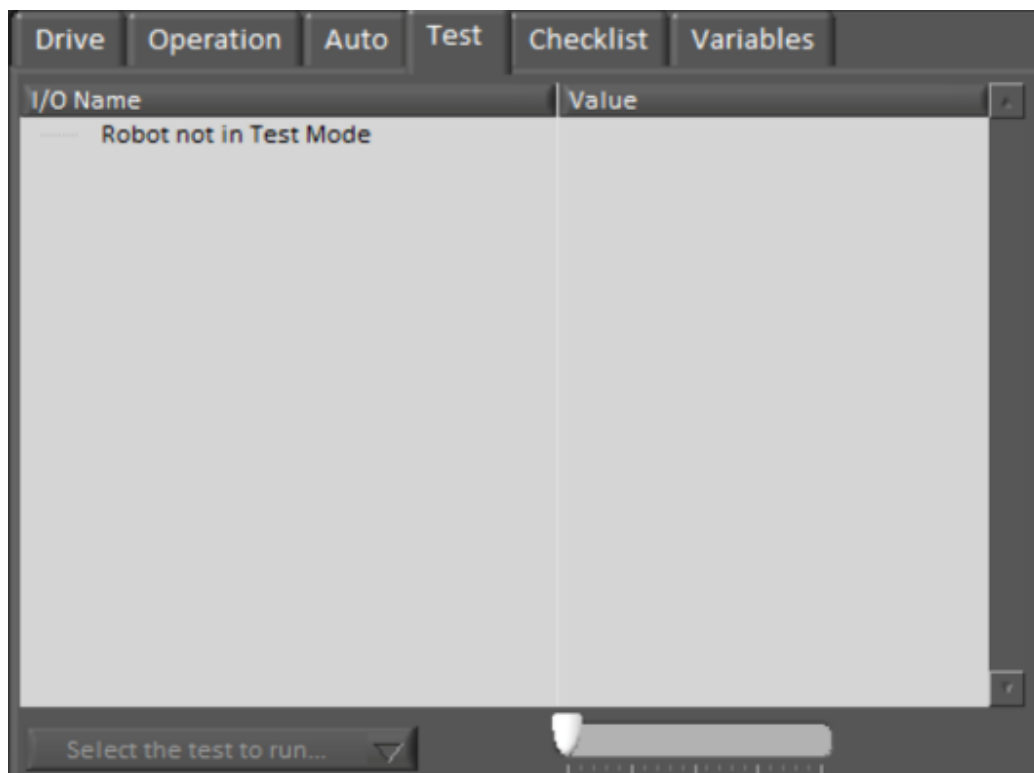
## Auto Tab



The Auto tab initially contains two checkboxes bound to SmartDashboard variables Checkbox 1 and Checkbox 2. While not limited to autonomous mode, this is a convenient place for the variables that can influence autonomous mode.

# Getting Started With the 2014 Control System

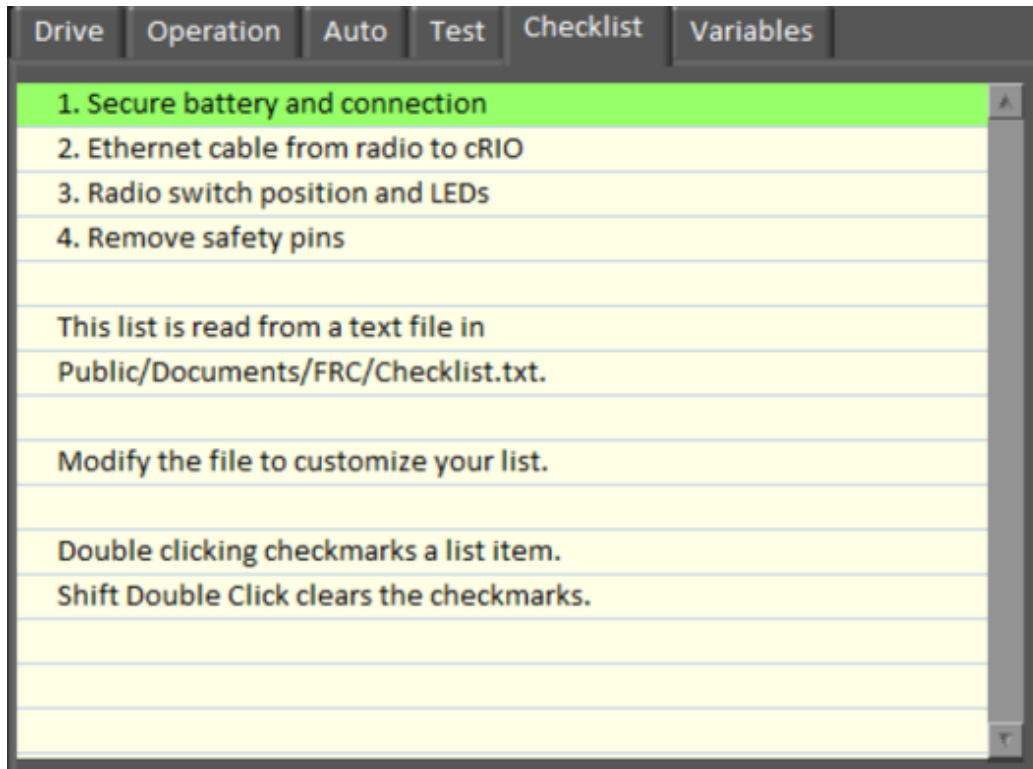
## Test Tab



The test tab contains a table useful for testing your robot's I/O. When placed in test mode, the table will list all I/O that is opened and named using the LabVIEW WPILib functions. More details on test mode are available later in this document.

# Getting Started With the 2014 Control System

## Checklist Tab



The checklist tab displays the contents of the robot checklist file located Public Documents/FRC/ Checklist.txt

## Variables Tab

The variables tab displays the name, value, and type of all Network Tables variables on the robot.

# Using the Classmate with your cRIO

This document details the basics of connecting your Classmate Computer to a cRIO.

## Hardware Setup

### Hardware Setup

Plug the following devices into your Classmate:

1. Joysticks
2. cRIO using an Ethernet cable

## Classmate Login

Power on the Classmate PC and log in to the Driver Account.

## Power on the cRIO

Turn on your cRIO using the 120A main circuit breaker. Make sure that the Analog Breakout Board is attached to the 9201 module in slot 1 of your cRIO and that it has the jumper installed for battery voltage tracking.

## Set your Team Number in the DS

Set your Team Number in the DS

Click on the Set up Tab and enter your team number in the field provided and Tab out of the field. We've used team number 3 for this example.

# Getting Started With the 2014 Control System

## Confirm Communication

### Confirm Communication

On the left side of the Driver Station window, check the status indicators to confirm that the Classmate has communication with the cRIO (meaning that IP addresses are set and the cRIO has been imaged). This will be indicated with a green light next to Communications.

## Confirm Joysticks are Recognized

### Confirm Joysticks are Recognized

In the Setup Tab, confirm that the Driver Station recognizes your joysticks. Joysticks should be listed in green. You should also see the Joysticks indicator in the left pane turn green.

## Writing and Loading a Program

To being programming teams need to install the software update for the appropriate language. Teams should proceed to the install instructions for the appropriate language, [C++ \(Start with the section titled C++ WPILib Workbench Update\)](#), [Java \(Start with Setting the internet plugin location in NetBeans or Set the local path to the downloaded plugins for pre-downloaded encrypted plugins\)](#), [LabVIEW \(Start with Installing the LabVIEW Update\)](#). Teams can continue on from the end of those documents to the documents describing how to write and load their first program.



# FRC Driver Station Errors/Warnings

In an effort to provide both Teams and Volunteers (FTAs/CSAs/etc.) more information to use when diagnosing robot problems, a number of Warning and Error messages have been added to the Driver Station. These messages are displayed in the DS diagnostics tab when they occur and are also included in the DS Log Files that can be viewed with the Log File Viewer. This document discusses the messages produced by the DS (messages produced by WPILib can also appear in this box and the DS Logs).

## Custom I/O Not Detected: 44006

Custom I/O Not Detected: 44006

This warning indicates that the DS does not detect a Cypress Board attached and properly configured. This warning will also be generated if the Cypress board is disconnected after the DS has started. If no Cypress Board is detected when the DS is started, this is the first warning printed.

## Joystick Unplugged: -44009

Joystick Unplugged: -44009

This error is triggered when a Joystick is unplugged. Contrary to the message text this error will be printed even if the robot is not enabled, or even connected to the DS. You will see a single instance of this message occur each time the Driver Station is started, even if Joysticks are properly connected and functioning.

## NIC Config: 44001

NIC Config: 44001

# Getting Started With the 2014 Control System

This warning is triggered by the Driver Station whenever it attempts to configure the network interfaces of the DS computer. The top warning shows an example of the Driver Station making no change to the wired interface (because it was already set correctly) and not being configured to set the wireless interface (indicated by "<noNICConfig>"). The second image shows an example of the message when the DS does change the configuration of the Network Interface.

## Lost Communication: 44004

Lost Communication: 44004

This Warning message is printed whenever the Driver Station loses communication with the robot (Communications indicator changing from green to red). A single instance of this message is printed when the DS starts up, before communication is established.

## Ping Status: 44002

Ping Status: 44002

A Ping Status warning is generated each time the Ping Status to a device changes while the DS is not in communication with the cRIO. As communications is being established when the DS starts up, a few of these warnings will appear as the Ethernet link comes up, then the connection to the robot radio, then the cRIO (with FMS mixed in if applicable). If communications are later lost, the ping status change may help identify at which component the communication chain broke.

## Time Since Robot Boot: 44007

Time Since Robot Boot: 44007

This message is printed each time the DS begins communicating with the cRIO. The message indicates the up-time, in seconds, of the cRIO and can be used to determine if a loss of communication was due to a cRIO Reboot.

## Radio Detection Times: 44008

Radio Detection Times: 44008

This message may be printed when the DS begins communicating with the cRIO and indicates the time, in seconds, since the last time the radio was lost and seen. In the first example image above the message indicates that the cRIO's connection to the radio was lost 19 seconds before the message was printed and the radio was seen again right when the message was printed. If multiple radioLost or radioSeen events have occurred since the cRIO booted, up to 2 events of each type will be included, separated by commas as seen in the second example image.

## No Robot Code: 44003

No Robot Code: 44003

This message is printed when the DS begins communicating with the cRIO, but detects no robot code running. A single instance of this message will be printed if the Driver Station is open and running while the cRIO is booting as the DS will begin communication with the cRIO before the robot code finishes loading.

# Driver Station Log File Viewer

In an effort to provide information to aid in debugging, the FRC Driver Station creates log files of important diagnostic data while running. These logs can be reviewed later using the FRC Driver Station Log Viewer. The Log Viewer can be found via the shortcut installed in the Start menu or in the FRC Driver Station folder in Program Files.

## Event Logs

The Driver Station now logs all messages sent to the Messages box on the Diagnostics tab (not the User Messages box on the Operation tab) into a new Event Log file. When viewing Log Files with the Driver Station Log File Viewer, the Event Log and DSLog files are overlaid in a single display.

## Log File Locations

When the Log File Viewer launches it will default to the path for logs on Windows 7 machines:  
C:\Users\Public\Documents\FRC\Log Files

If you are on Windows XP, you will need to point the Viewer to the XP location for the files:  
C:\Documents and Settings\All Users\Documents\FRC\Log Files

## Log Viewer UI

Log Viewer UI

The Log Viewer contains a number of controls and displays to aid in the analysis of the Driver Station log files:

1. File Selection Box - This window displays all available log files in the currently selected folder. Click on a log file in the list to select it.

# Getting Started With the 2014 Control System

2. Path to Log Files - This box displays the current folder the viewer is looking in for log files. This defaults to the folder that the Driver Station stores log files in. Click the folder icon to browse to a different location.
3. Message Box - This box displays a summary of all messages from the Event Log. When hovering over an event on the graph this box changes to display the information for that event.
4. Scroll Bar - When the graph is zoomed in, this scroll bar allows for horizontal scrolling of the graph.
5. Voltage Filter - This control turns the Voltage Filter on and off (defaults to on). The Voltage Filter filters out data such as CPU %, robot mode and trip time when no Battery Voltage is received (indicating that the DS is not in communication with the cRIO). This does not filter out data when the battery voltage being received is 0 due to a missing jumper on the Analog Module or no power provided to the Analog Module.
6. AutoScale - This button zooms the graph out to show all data in the log.
7. Match Length - This button scales the graph to approximately the length of an FRC match (2 minutes and 20 seconds shown). It does not automatically locate the start of the match, you will have to scroll using the scroll bar to locate the beginning of the Autonomous mode.
8. Graph - This display shows graph data from the DS Log file (voltage, trip time, cRIO CPU%, Lost Packets, and robot mode) as well as overlaid event data (shown as dots on the graph with select events showing as vertical lines across the entire graph). Hovering over event markers on the graph displays information about the event in the Messages window in the bottom left of the screen.
9. Robot Mode Key - Key for the Robot Mode displayed at the top of the screen
10. Major event key - Key for the major events, displayed as vertical lines on the graph
11. Graph key - Key for the graph data
12. Filter Control - Drop-down to select the filter mode (filter modes explained below)
13. Tab Control - Control to switch between the Graph (Data and Events vs. Time) and Event List displays.

## Using the Graph Display

### Using the Graph Display

The Graph Display contains the following information:

1. Graphs of Trip Time in ms (green line) and Lost Packets per second (displayed as blue vertical bars). In these example images Trip Time is a flat green line at the bottom of the graph and there are no lost packets
2. Graph of Battery voltage displayed as a yellow line.

# Getting Started With the 2014 Control System

3. Graph of cRIO CPU % as a red line
4. Graph of robot mode and DS mode. The top set of the display shows the mode commanded by the Driver Station. The bottom set shows the mode reported by the robot code. In this example the robot is not reporting it's mode during the disabled and autonomous modes, but is reported during Teleop.
5. Event markers will be displayed on the graph indicating the time the event occurred. Errors will display in red; warnings will display in yellow. Hovering over an event marker will display information about the event in the Messages box at the bottom left of the screen.
6. Major events are shown as vertical lines across the graph display.

To zoom in on a portion of the graph, click and drag around the desired viewing area. You can only zoom the time axis, you cannot zoom vertically.

## Event List

### Event List

The Event List tab displays a list of events (warnings and errors) recorded by the Driver Station. The events and detail displayed are determined by the currently active filter (images shows "All Events, All Info" filter active).

## Filters

Three filters are currently available in the Log Viewer:

1. Default: This filter filters out many of the errors and warnings produced by the Driver Station. This filter is useful for identifying errors thrown by the code on the Robot.
2. All Events and Time: This filter shows all events and the time they occurred.
3. All Events, All Info: This filter shows all events and all recorded info. At this time the primary difference between this filter and "All Events and Time" is that this option shows the "unique" designator for the first occurrence of a particular message.

## Identifying Logs from Matches

### Identifying Logs from Matches

# Getting Started With the 2014 Control System

A common task when working with the Driver Station Logs is to identify which logs came from competition matches. Logs which were taken during a match can now be identified using the FMS Connected event which will display the match type (Practice, Qualification or Elimination), match number, and the current time according to the FMS server. In this example, you can see that the FMS server time and the time of the Driver Station computer are fairly close, approximately 7 seconds apart.

## Identifying Common Connection Failures with the Log Viewer

When diagnosing robot issues, there is no substitute for thorough knowledge of the system and a methodical debugging approach. If you need assistance diagnosing a connection problem at your events it is strongly recommended to seek assistance from your FTA and/or CSA. The goal of this section is to familiarize teams with how some common failures can manifest themselves in the DS Log files. Please note that depending on a variety of conditions a particular failure show slightly differently in a log file.

Note that all log files shown in this section have been scaled to match length using the Match Length button and then scrolling to the beginning of the autonomous mode. Also, many of the logs do not contain battery voltage information, the platform used for log capture was not properly wired for reporting the battery voltage.

### "Normal" Log

"Normal" Log

This is an example of a normal match log. The errors and warnings contained in the first box are from when the DS first started and can be ignored. This is confirmed by observing that these events occurred prior to the "FMS Connected:" event. The last event shown can also be ignored, it is also from the robot first connecting to the DS (it occurs 3 seconds after connecting to FMS) and occurs roughly 30 seconds before the match started.

### Disconnected from FMS

Disconnected from FMS

# Getting Started With the 2014 Control System

When the DS disconnects from FMS, and therefore the robot, during the match it may segment the log into pieces. The key indicators to this failure are the last event of the first log, indicating that the connection to FMS is now "bad" and the second event from the 2nd log which is a new FMS connected message followed by the DS immediately transitioning into Teleop Enabled. The most common cause of this type of failure is an ethernet cable with no latching tab or a damaged ethernet port on the DS computer.

## cRIO Reboot

### cRIO Reboot

The "Time since robot boot" message is the primary indicator in a connection failure caused by the cRIO rebooting. In this log the DS loses connection with the cRIO at 3:01:36 as indicated by the first event. The second event indicates that the ping initiated after the connection failed was successful to all devices other than the cRIO. At 3:01:47 the cRIO begins responding to pings again, one additional ping fails at 3:01:52. At 3:02:02 the Driver Station connects to the cRIO and the cRIO reports that it has been up for 3.682 seconds. This is a clear indicator that the cRIO has rebooted. The code continues to load and at 3:02:24 the code reports an error communicating with the camera. A warning is also reported indicating that no robot code is running right before the code finishes starting up.

## Ethernet cable issue on robot

### Ethernet cable issue on robot

An issue with the ethernet cable on the robot is primarily indicated by the ping to the cRIO going to bad and Radio Lost and Radio Seen events when the cRIO reconnects. The "Time since robot boot" message when the cRIO reconnects will also indicate that the cRIO has not rebooted. In this example, the robot Ethernet cable was disconnected at 3:31:38. The ping status indicates that the D-Link radio is still connected. When the robot reconnects at 3:32:08 the "Time since robot boot" is 1809 seconds indicating that the cRIO clearly did not reboot. At 3:32:12 the robot indicates that it lost the radio 24.505 seconds ago and it returned 0.000 seconds ago. These points are plotted as vertical lines on the graph, yellow for radio lost and green for radio seen. Note that the times are slightly offset from the actual events as shown via the disconnection and connection, but help to provide additional information about what is occurring.



# Getting Started With the 2014 Control System

## Radio reboot

### Radio reboot

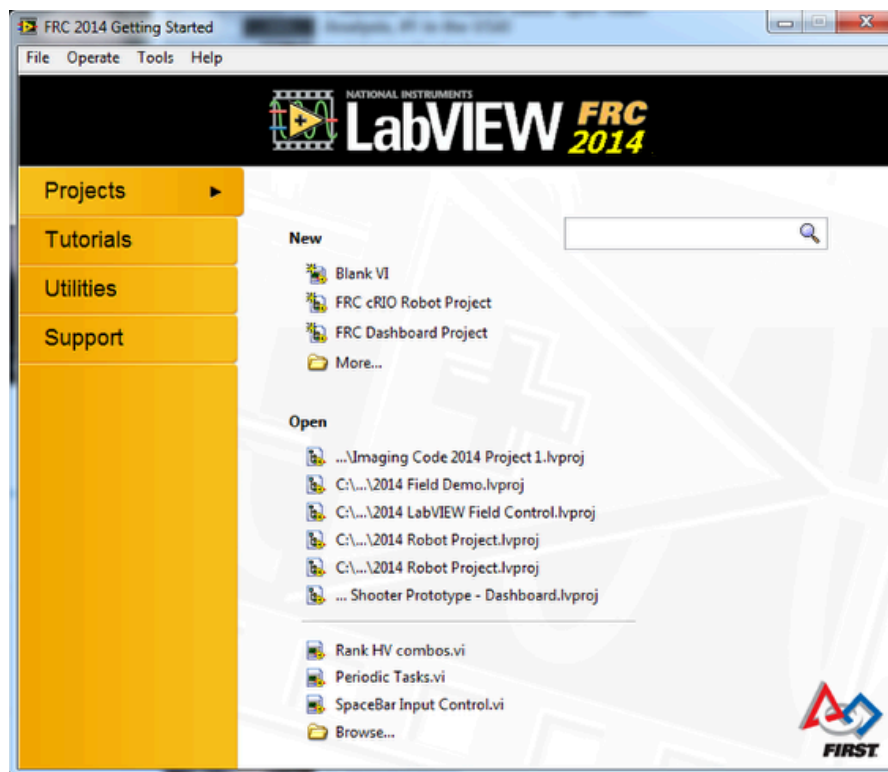
A reboot of the robot radio is typically characterized by a loss of connection to the radio for ~25-30 seconds. In this example, the radio briefly lost power at 3:22:44, causing it to start rebooting. The event at 3:22:45 indicates that the ping to the radio failed. At 3:23:11, the DS regains communication with the cRIO and the cRIO indicates it has been up for 1272.775 seconds, ruling out a cRIO reboot. Note that the network switch on the radio comes back up very quickly so a momentary power loss may not result in a "radio lost"/"radio seen" event pair. A longer disturbance may result in radio events being logged by the DS. In that case, the distinguishing factor which points towards a radio reboot is the ping status of the radio from the DS. If the radio resets, the radio will be unreachable. If the issue is a cabling or connection issue on the robot, the radio ping should remain "GOOD".

# 2014 Control System Software

## 2014 FRC Software Component Overview

The 2014 FRC Control System consists of a wide variety of mandatory and optional software components designed to assist you in the design, development and debugging of your robot code, control robot operation, and provide feedback to assist with troubleshooting. For each software component this document will provide a brief overview of its purpose, a link to the package download if appropriate, and a link to further documentation where available.

### LabVIEW FRC 2014



LabVIEW FRC 2014, based on National Instruments' LabVIEW 2013, is the development environment for LabVIEW, one of the three officially supported languages for programming an FRC Robot in 2014. LabVIEW is a graphical, dataflow-driven language. LabVIEW programs consist of a collection of icons, called VIs, wired together with wires which pass data between the VIs. The

# Getting Started With the 2014 Control System

LabVIEW FRC 2014 installer is distributed on a DVD found in the Kickoff Kit of Parts or can be downloaded from [here](#), the language specific update can be found [here](#). A guide to getting started with the LabVIEW FRC 2014 software, including installation instructions can be found [here](#)

## FRC Robot Simulator

### FRC Robot Simulator

The FRC Robot Simulator is a component of the LabVIEW programming environment that allows you to operate a predefined robot in a simulated environment to test code and/or Driver Station functions. It utilizes a LabVIEW code project as the robot code and communicates with the FRC Driver Station for robot control and the FRC Default Dashboard for robot feedback. The FRC Robot Simulator is installed with LabVIEW FRC 2014. Information on using the FRC Robot Simulator can be found by opening the Robot Simulation Readme.html file in the LabVIEW Project Explorer.

## Wind River Workbench

### Wind River Workbench

Wind River Workbench is the supported development environment for C++, one of the three supported languages used for programming an FRC robot in 2014. C++ is an object-oriented text based programming language. A program in C++ (for FRC) consists of a number of header (.h) and implementation (.cpp) files. The Wind River Workbench installer is distributed on two DVDs found in the Kickoff Kit of Parts and is not available for download, the C++ Workbench Update can be found [here](#). A guide to getting started with C++ for FRC, including installation of Wind River Workbench, can be found [here](#).

## Netbeans

### Netbeans

Netbeans is the primary supported development environment for Java, one of the three supported languages used for programming an FRC robot in 2014. Java is an object-oriented text base programming language. A program in Java (for FRC) consists of one or more .java files contained in one or more packages. The Netbeans IDE can be downloaded [here](#). It is recommended to install

# Getting Started With the 2014 Control System

the language specific updates through Netbeans in order to be automatically notified of updates, if manual installation must be used, the plugins can be found [here](#). A guide to getting started with Java for FRC, including the installation and configuration of Netbeans can be found [here](#).

## FRC Driver Station

### FRC Driver Station

The FRC Driver Station software is the only software allowed to be used for the purpose of controlling the state of the robot during competition. This software contains the code necessary to send data to your robot from a variety of input devices such as joysticks, gamepads, the Cypress FIRSTTouch IO Board, and the Microsoft Kinect. It also contains a number of tools used to help troubleshoot robot issues such as status indicators and log file creation. The FRC Driver Station is included in the NI FRC 2014 Update found [here](#). More information about the FRC Driver Station software can be found [here](#).

## FRC LabVIEW Dashboard

### FRC LabVIEW Dashboard

The FRC LabVIEW Dashboard is the default dashboard program installed with, and automatically launched by, the FRC Driver Station. The purpose of the Dashboard is to provide feedback about the operation of the robot. The FRC Default Dashboard serves as an example of the types of feedback teams may want from their robot. It includes a tabbed display that can switch between viewing an image from a camera on the robot, a Kinect skeleton or a display of NetworkTables variables, a display of information regarding the joysticks and drive motors, an indicator of the robot IP and battery voltage, and a second tabbed display that can switch between examples of custom indicators and controls, a test tab for use with the Driver Station Test Mode and a Checklist tab that teams can use to enter a custom checklist to complete before each match. The FRC Default Dashboard is included in the NI FRC 2014 Update. More information about the FRC Default Dashboard software can be found [here](#).

## SmartDashboard

### SmartDashboard

# Getting Started With the 2014 Control System

The SmartDashboard is an alternate dashboard application written in Java. The SmartDashboard automatically creates a widget for each variable sent from the Robot sent using the SmartDashboard class or VIs. These widgets can be configured to a number of preset display types, or users can create custom extensions in Java. Vision extensions are available for the SmartDashboard which allow it to display images from the Axis camera on the robot. The SmartDashboard is included in the C++ and Java language updates (enabled by clicking the C++ or Java buttons respectively on the Setup tab of the Driver Station). The Vision extensions and a standalone installer for the SmartDashboard (for use by LabVIEW teams or installing on a DS without the C++ or Java programming environments) can be found [here](#). Note that teams may need to install the Java Runtime Environment to use the SmartDashboard on computers not set up for Java programming. Additional documentation on the SmartDashboard can be found [here](#).

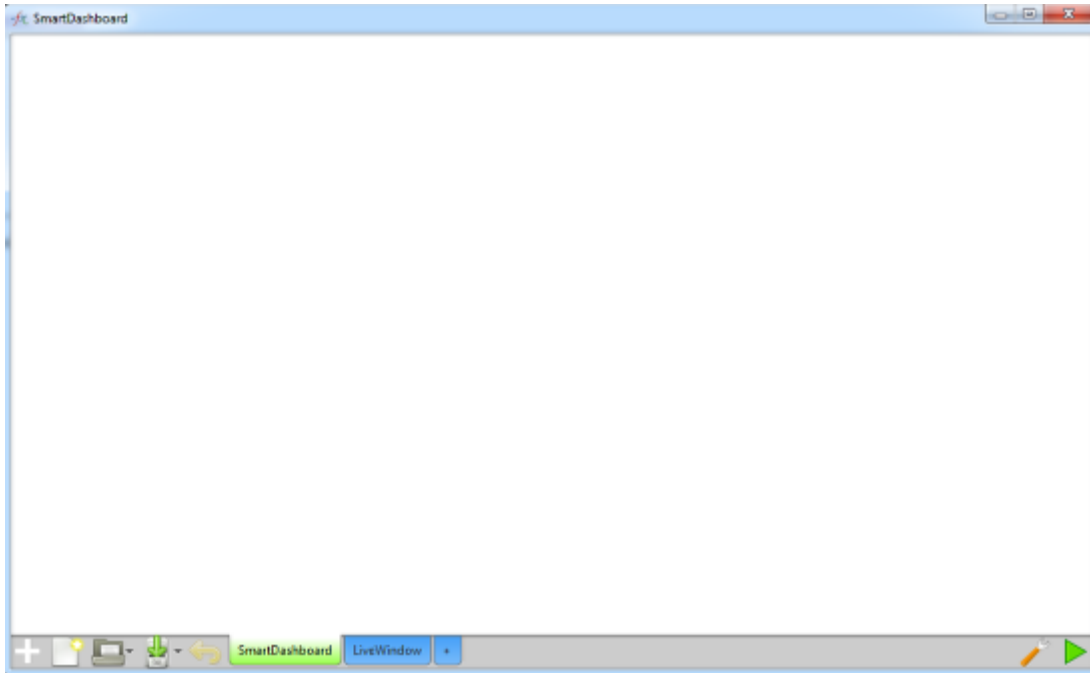
## LiveWindow

### LiveWindow

LiveWindow is a mode of the SmartDashboard, designed for use with the new Test Mode of the Driver Station. LiveWindow allows the user to see feedback from sensors on the robot and control actuators independent of the written user code. More information about LiveWindow can be found [here](#).

# Getting Started With the 2014 Control System

## SFX



There is a new version of SmartDashboard this year that teams may choose to use. The previous version will still be installed by the language updates for C++ and Java and the Standalone Vision installer and will be launched by using the C++ and Java buttons on the DS. The new version is based on the JavaFX framework and includes new widgets, an easier system for customization (using JavaFX CSS), tabs and a record/playback feature that will allow for recording of video and Network Tables variables to be played back on the dashboard later. More information about SFX can be found [here](#).

## FRC 2014 cRIO Imaging Tool

### FRC 2014 cRIO Imaging Tool

The FRC 2014 cRIO Imaging Tool is a software tool used to format and setup an cRIO-FRC or cRIO-FRCII device for use in FRC. The tool detects any cRIO device on the network, reports the current MAC, name, IP and Image version and indicates if the modules are installed in the correct locations. The tool allows the user to configure the software language, CAN plugin, enable/disable

# Getting Started With the 2014 Control System

NetConsole, and set the virtual DIP-switches (cRIO-FRCII only) without formatting the device. If the device is being formatted the Device Name and Team ID can also be changed. The FRC 2014 cRIO Imaging Tool is installed as part of the NI FRC 2014 Update. Additional instructions on imaging your cRIO using this tool can be found [here](#).

## Setup Axis Camera

### Setup Axis Camera

The Setup Axis Camera utility is a LabVIEW program used to configure an Axis 206, M1011, M1013 camera for use on the robot. The tool takes a factory reset camera connected directly to the computer and configures the IP, username and password, anonymous access, and default framerate and compression (for use with the SmartDashboard or other access methods). The Setup Axis Camera tool is installed as part of the NI FRC 2014 Update found [here](#). Instructions for using the tool to configure the camera are located [here](#).

## NetConsole for cRIO

### NetConsole for cRIO

NetConsole for cRIO is a LabVIEW program that, combined with enabling the plugin on the robot with the cRIO Imaging Tool, allows for remote access to the serial console on the cRIO over the network. This allows the user to view diagnostic output from the cRIO, WPILib and any print statements they have added to their code as well as provide input to the serial console. The NetConsole for cRIO tool is installed as part of the NI FRC 2014 Update. Additional information and instructions for using the NetConsole for cRIO utility are available [here](#).

## FRC Driver Station Log Viewer

### FRC Driver Station Log Viewer

The FRC Driver Station Log Viewer is a LabVIEW program used to view logs created by the FRC Driver Station. These logs contain information such as battery voltage, trip time, CPU% and robot mode, as well as events such as joystick removal. The FRC Driver Station Log Viewer is included in



# Getting Started With the 2014 Control System

the NI FRC 2014 Update. More information about the FRC Driver Station Log Viewer and understanding the logs can be found [here](#).

## Robot Builder

### Robot Builder

Robot Builder is a tool designed to aid in setup and structuring of a Command Based robot project for C++ or Java. Robot Builder allows you to enter in the various components of your robot subsystems and operator interface and define what your commands are in a graphical tree structure. Robot Builder will then verify that you have no port allocation conflicts and can generate a wiring table indicating what is connected to each port as well as C++ or Java code. The code created generates the appropriate files, constructs the appropriate objects and adds LiveWindow code for each sensor and actuator, but does not write any of the actual Subsystem or Command methods. The user must write the appropriate code for these methods for the robot to function. Robot Builder is installed with the C++ or Java language specific updates (found in the WindRiver/WPILib and sunspotfrcsdk/tools directories respectively). Note that teams may need to install the Java Runtime Environment to use the Robot Builder on computers not set up for Java programming. More information about Robot Builder can be found [here](#). More information about the Command Based programming architecture can be found [here](#).

## Network Tables Viewer

### Network Tables Viewer

The Network Table Viewer is a utility used to view, modify and add to the contents of the Network Tables for debugging purposes. It displays all keys currently in the Network Table along with the value and Sequence Number and can be used to modify the value of existing keys or add new keys to the Table. The Network Table Viewer is included in the C++ and Java language updates (found in the WindRiver/WPILib and sunspotfrcsdk/tools directories respectively). LabVIEW teams can use the Variables tab of the LabVIEW Dashboard to accomplish this functionality. Note that teams may need to install the Java Runtime Environment to use the Network Tables Viewer on computers not set up for Java programming. Additional documentation on the Network Table Viewer can be found [here](#).

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## BDC-COMM

### BDC-COMM

BDC-COMM is a software utility used to configure, update and test Black Jaguar motor controllers over the Serial/CAN interface. This tool can be used to update the Black Jaguar firmware, set the Board ID, and set configuration values such as the fault time and soft limits. The tool can also be used to control, and report the status of, an individual Jaguar in the various modes for testing. BDC-COMM is installed as part of the NI FRC 2014 Update or can be downloaded from [here](#).

## FRC Bridge Configuration Utility

### FRC Bridge Configuration Utility

The FRC Bridge Configuration Utility is a tool used to configure the D-Link DAP-1522 radio for practice use at home. This tool sets the appropriate IP, and network settings for proper network connection, as well as the QOS settings required to mimic the bandwidth limiting and packet prioritization experience on the FRC playing field. The FRC Bridge Configuration Utility is installed with the 2014 NI FRC Update. Instructions on using the FRC Bridge Configuration Utility to configure your radio can be found [here](#).

## FRC Kinect Server

### FRC Kinect Server

The FRC Kinect Server is a software tool that interfaces with a Microsoft Kinect device and provides the information to the FRC Default Dashboard and Robot via the Driver Station. The FRC Kinect Server utilizes the Microsoft Kinect for Windows SDK's skeleton capabilities in order to provide both raw skeleton data and processed pseudo-joystick data to the dashboard and robot. The FRC Kinect Server is available [here](#). Additional information about the FRC Kinect Server, including installation instructions is available [here](#).

# 2014 Software Changelog and Known Issues

This article describes changes to the libraries and tools and known issues for the released software as of the 2014 Kickoff.

This includes updates for bug fixes and improvements since the 2014 kickoff.

**Updated 3/25/14**

## Known Issues

**Updated 3/25/14**

Below is a compiled list of known issues for official FRC software for 2014

### **C++ WPILib - Updated 3/25/14**

An issue with thread deadlocking can cause Robot Code to lock up if a Network Tables network operation fails. This has the possibility of occurring in any C++ code which utilizes Network Tables (including SmartDashboard). All teams utilizing SmartDashboard in C++ are recommended to install the update.

An update which addresses this issue can be found here: <http://first.wpi.edu/FRC/c/update/Release/WorkbenchUpdate20140325rev3887.exe>

After installing the update you must re-build and re-download your robot code. You can verify that your code was built with the update by verifying that the version on the right hand side of the Driver Station Diagnostics tab reads C++ Update 1 (C++ Update 0 is the kickoff release).

This release also fixes [artf1712](#) regarding the Driver Station GetMatchTime() method. The time now properly sets to 10s instead of 15s on the first teleop packet.

The final change is a modification to the Serial Port class to attempt to recover from certain types of errors. Previously these errors would result in the Serial Port being inoperable until the code was restarted. Now WPILib will attempt to Reset the Serial Port on a limited set of errors. This will result in any data currently in the buffer being lost, but may allow for the Serial Port to resume operation.

# Getting Started With the 2014 Control System

## Java FRC Plugins - Updated 1/22/14

An initialization error in the Java library causes serial communication to fail with the error "VI\_ERROR\_RSRC\_NFOUND in function viOpen". This is described here: <http://forums.usfirst.org/showthread.php?21290-SerialPort-viOpen-error> and has been fixed in build 598 of the Netbeans FRC Plugins.

The stable release including this fix can be installed by setting the Netbeans plugin update location to: <http://first.wpi.edu/FRC/java/netbeans/update/Stable/updates.xml> and checking for updates. Stable updates will be promoted to Release updates periodically but are made available as interim updates for teams. Please report any problems in the FIRST Forums with this software.

## FRC Driver Station - Updated 2/10/14

The USB Devices indicator lights on the DS currently do not behave reliably. The status of USB joystick or gamepad devices can be determined using the Joystick Setup box on the Setup Tab. The status of the Cypress Enhanced I/O board can be determined using the indicator light on the tab selector and the Kinect status can be determined using the Kinect version string on the right side of the Diagnostics tab.

## 2014 Changes for C++ and Java

### Updated 12/30/13

The new big features in the 2014 FRC software release include:

SmartDashboard 2.0 - new version of the Java SmartDashboard, completely rebuilt from the ground up using JavaFX. This version also incorporates record/playback functionality for video and dashboard variables. The previous SmartDashboard is still included with the update and available for use by teams.

All-in-One Installer for NI Utilities - The NI Utilities are now bundled as a single standalone installer. The 2014 NI FRC Update includes the FRC Driver Station and Dashboard, cRIO Imaging Tool, Camera Configuration Tool and all components required to run them (**no DVD required**). It also includes the 2014 FRC Bridge Configuration Utility which requires the Java Runtime Engine to run. Most computers will already have the JRE installed; if you do not have the JRE, the instructions on using the Bridge Configuration Utility will indicate where to get it.

The following library API changes may effect existing code that was written with the previous versions of WPILib:

# Getting Started With the 2014 Control System

1. C++ VxWorks types (UINT32, INT16, etc) were converted to more standard types (uint32\_t, int16\_t). Custom builds of WPILib or code which extends WPILib classes may need to change types or casts to match.
2. Deprecated SerialPort print method in Java. Printing arguments to a string and using write(string.getBytes()) is more reliable and efficient.
3. I2C Compatibility mode now defaults to enabled. This will improve reliability for the majority of devices, but could possibly cause an issue with some devices. Call SetCompatabilityMode(false) to disable.

## New Features/Methods:

1. FPGA averaging is now exposed for Counters and Encoders.
2. Counters now have a GetDistance and GetRate method.
3. Counters now implement PIDSource.
4. Gyro's now have a GetRate method and a SetPIDSourceParameter to allow using rate or angle with a PIDController.
5. SPIDevice class and ADXL345\_SPI have been added to Java.
6. CancelWhenPressed/active and ToggleWhenPressed/Active actions added to buttons and triggers for Command Based programming.
7. Analog Channel now contains a SetVoltageForPID method to set whether to use Voltage or raw values for PIDGet.
8. Analog Potentiometer Class added.

## Bug Fixes:

1. Double Solenoid now works with LiveWindow / Test Mode
2. Motors are all properly set to 0 when entering LiveWindow
3. Timer no longer doubles when stopped and restarted.
4. Java DS LCD class now contains a clear method.
5. Java I2C now correctly casts signed bytes
6. Motor Safety Helper no longer prints messages in Test mode
7. Java Serial Port now properly clears the bytes from the buffer and properly decodes strings

## Other Changes:

1. A 2014 Vision Example has been added for both languages.
2. An Iterative Template example has been added back to C++.
3. The C++ Default Code demo has had the continuous methods removed.

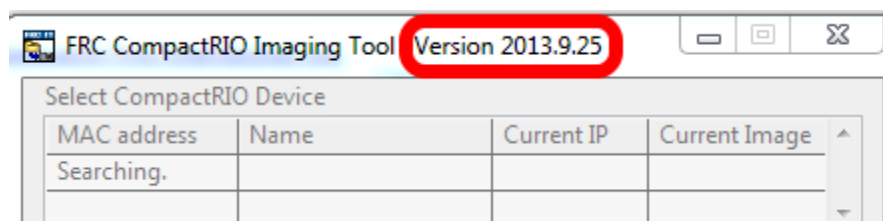
# Getting Started With the 2014 Control System

## Latest Software Revisions

This article details the latest revision of various software components of the FRC Control System.

**Updated 3/25/14**

### cRIO Imaging Tool

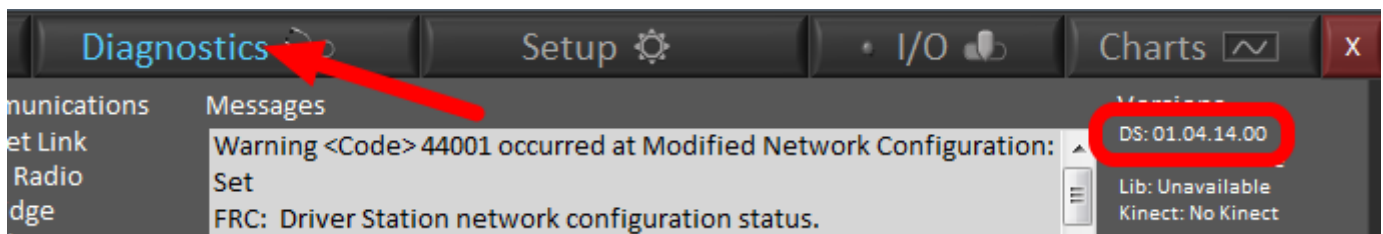


Version 2013.9.25. Installed with [2014 NI FRC Update](#)

### cRIO Image Version

FRC\_2014\_v52

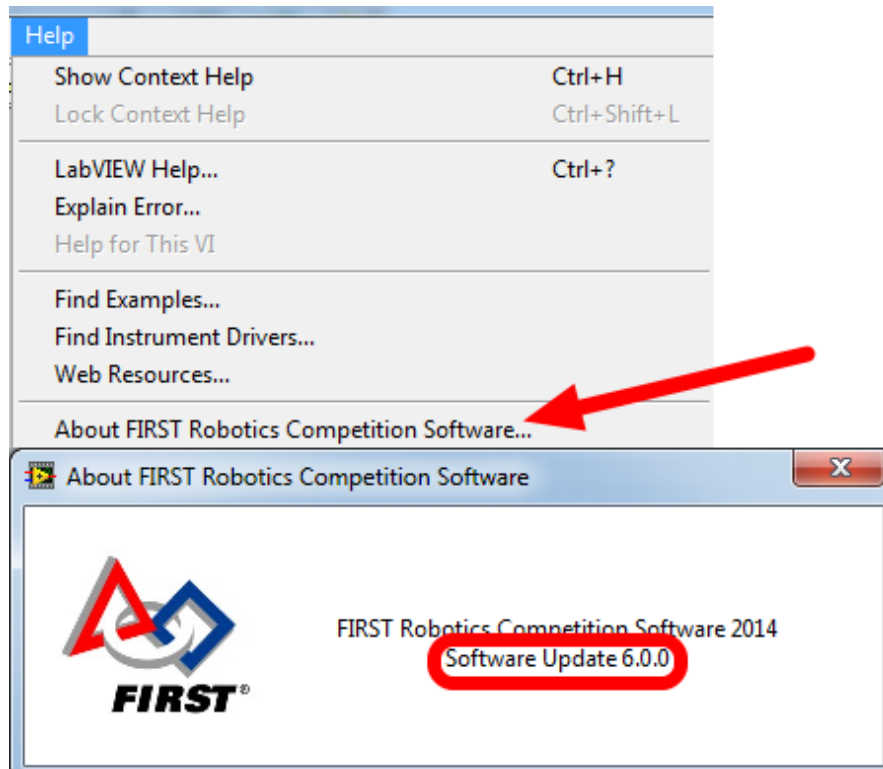
### FRC Driver Station



Version 01.04.14.00. Installed with [2014 NI FRC Update](#)

# Getting Started With the 2014 Control System

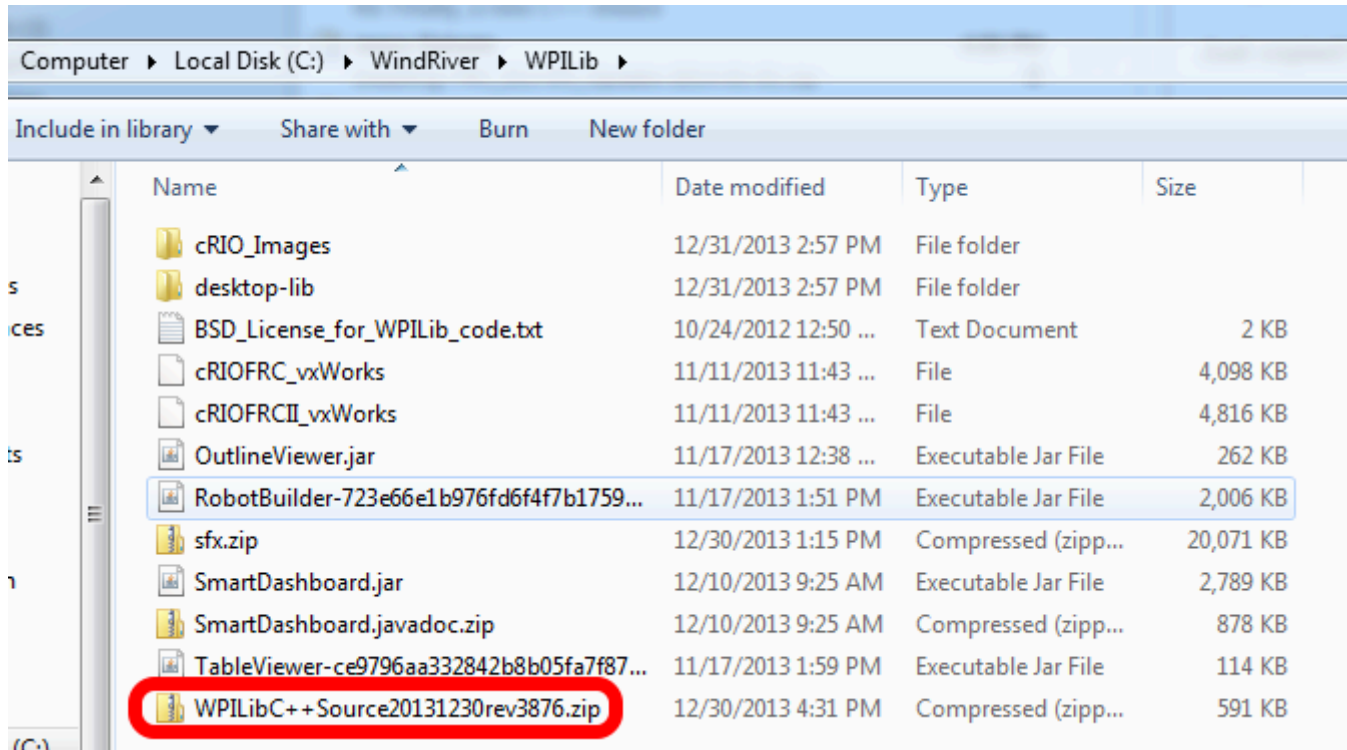
## LabVIEW Language Update



Version 6.0.0. Installed with [2014 NI FRC Update](#)

# Getting Started With the 2014 Control System

## C++ Language Update



**20131230rev3876** AKA **C++ 2014 Update 0** (when viewed from the DS Diagnostics tab).

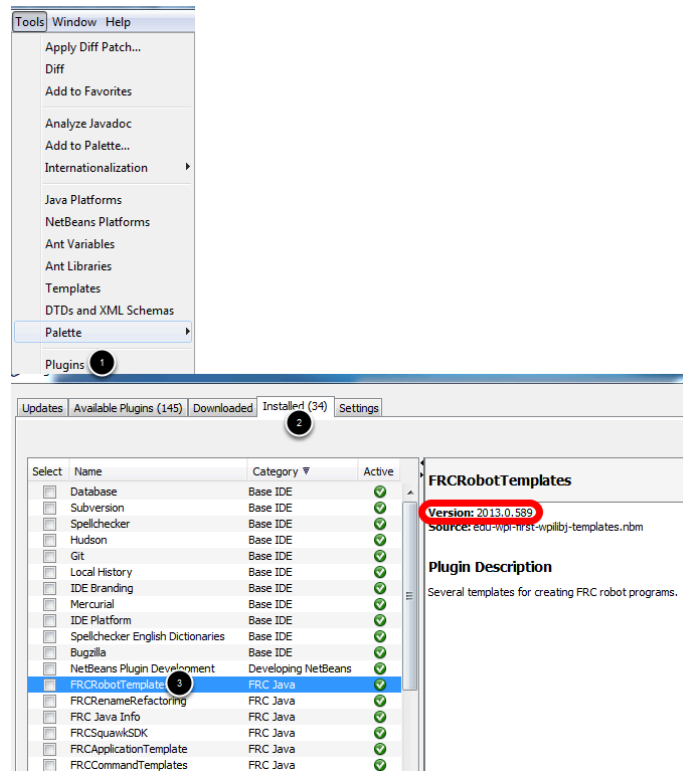
**Optional update - 20140325rev3887** AKA **C++ 2014 Update 1** (when viewed from the DS Diagnostics tab).

[Install instructions.](#)



# Getting Started With the 2014 Control System

## Java FRC Plugins



**Version 2013.0.589** AKA **Java 2014 Update 0** (when viewed from the DS Diagnostics tab). [Install instructions.](#)

# Installing the 2014 FRC NI Update (for ALL TEAMS)

This year the NI updates have been reconfigured into a single standalone installer. This means that the FRC Driver Station, cRIO Imaging Tool and other utilities such as the Camera Configuration Tool will all be bundled into a single installer which will **not require any components from the DVD**. The LabVIEW update is also included in this installer and will install if a LabVIEW installation is detected. **To use the DS and Imaging tool all teams must install the 2014 NI Update.**

## Uninstall Old Versions (Optional)

### Uninstall Old Versions (Optional)

Before installing the new version of LabVIEW it is recommended to remove any old versions, note that old versions will coexist with the new version, but the license for the FRC 2012 software will be expiring very shortly. Make sure to back up any team code located in the "User\LabVIEW Data" directory before uninstalling. Then click **Start >> Control Panel >> Uninstall a Program**. Locate the entry labeled "**National Instruments Software**", right-click on it and select **Uninstall/Change**.

## Select Components to Uninstall

### Select Components to Uninstall

In the left pane of the dialog box that appears, **select all entries**. The easiest way to do this is to click the top entry to highlight it, then scroll down to the bottom entry, press and hold shift and click on the last entry then release shift. Click **Remove**. Wait for the uninstaller to complete and reboot if prompted.

# Getting Started With the 2014 Control System

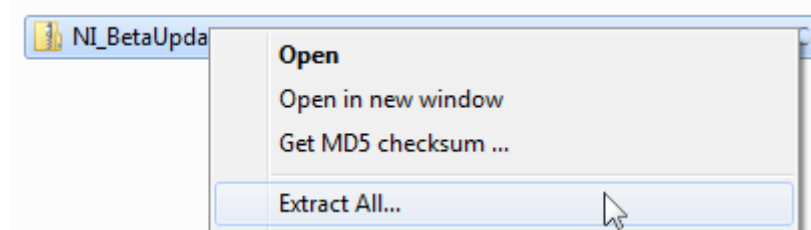
## OPTIONAL - Install LabVIEW

If you will be using LabVIEW to program your robot or if you wish to use the NI Vision Assistant software, [install LabVIEW from the DVD](#) before applying the NI Update. **C++ and Java teams not using NI Vision Assistant do not need to install anything from the DVD.**

## Download the NI Update

Download the NI Update from <http://www.ni.com/download/first-robotics-software-2014/4546/en/>

## Unzip the Update

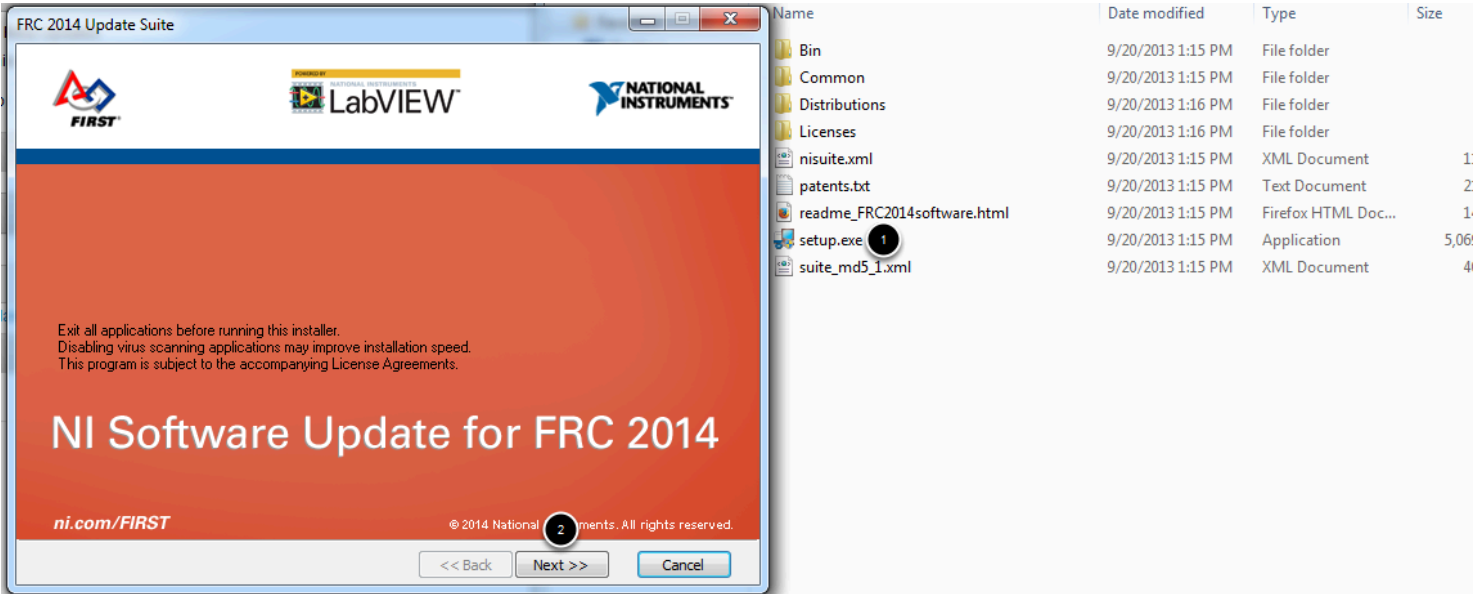


Locate and right click on the downloaded file and select **Extract All** to Unzip. By default the files will be unzipped to the current directory, press Browse if you wish to unzip to a different location. Click **Extract** to complete the operation.

Note that the update is currently still encrypted with the 2014 game password 3Zones2Goals1Alliance!

# Getting Started With the 2014 Control System

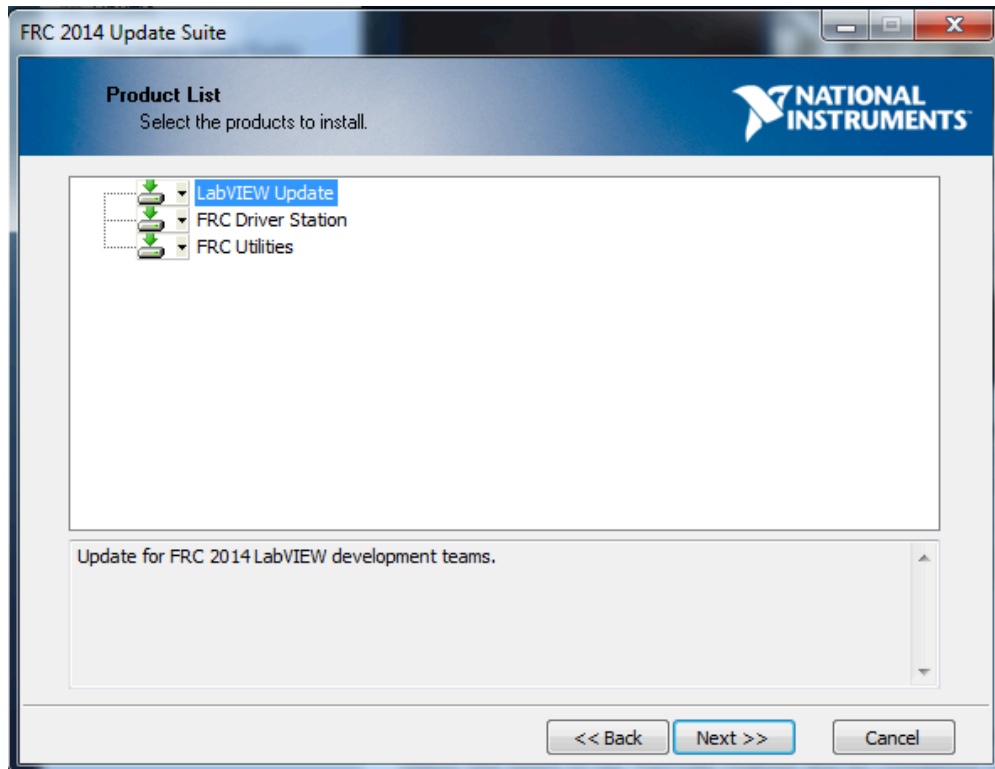
## Run Installer



Browse down into the folder structure until you locate the installer **Setup.exe**. Double click on the installer to launch the installation. Click **Next** to advance.

# Getting Started With the 2014 Control System

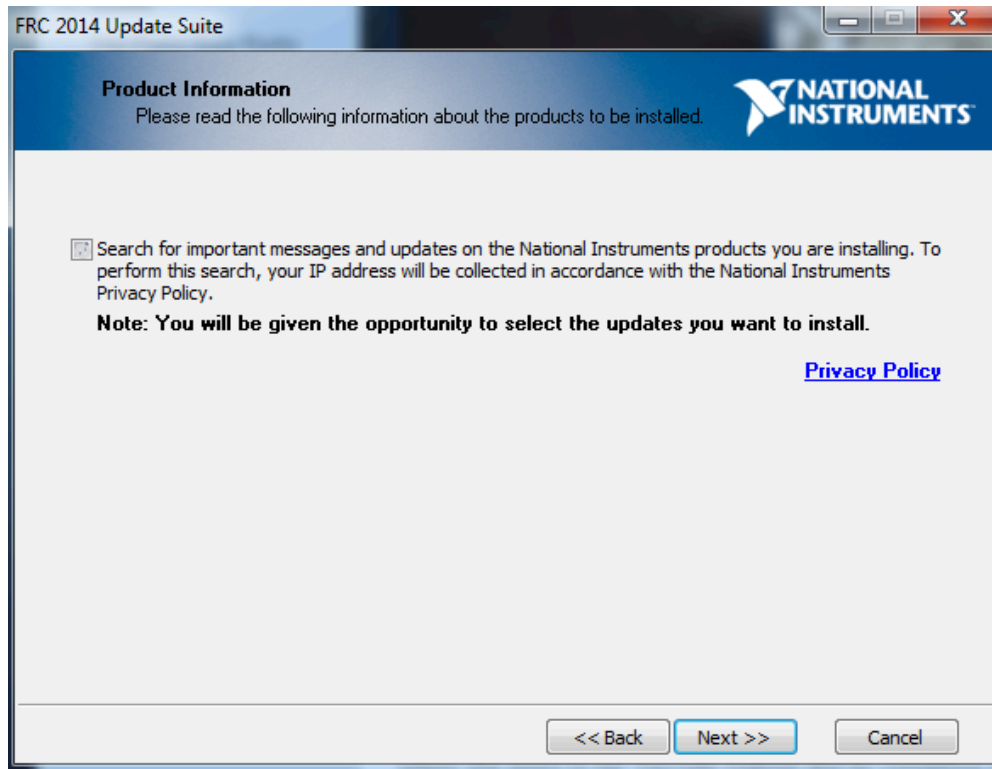
## Select Components



On the Product List screen, click **Next** to advance. **The LabVIEW Update will detect if LabVIEW is installed and will automatically determine whether to install or not.**

# Getting Started With the 2014 Control System

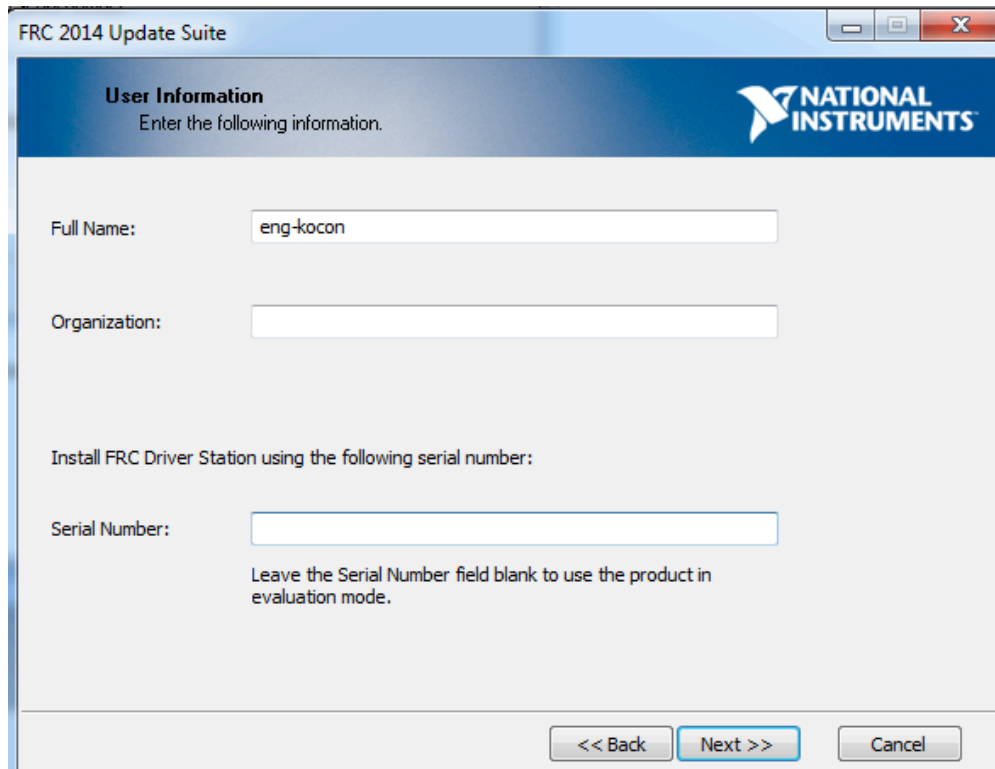
## Search for Updates



Uncheck the box to search for updates then click **Next**.

# Getting Started With the 2014 Control System

## Enter Serial Number

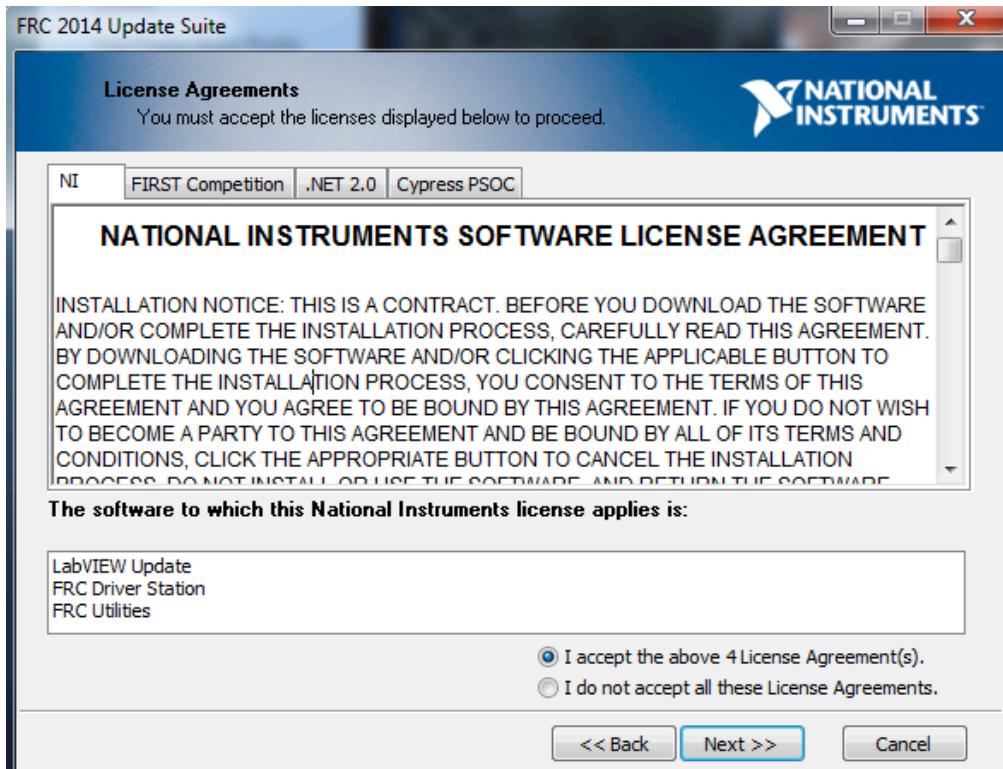


The screenshot shows a Windows-style dialog box titled "FRC 2014 Update Suite". The dialog has a blue header bar with the text "User Information" and "Enter the following information." on the left, and the National Instruments logo on the right. The main area is light gray and contains three input fields: "Full Name:" with the text "eng-kocon" entered, "Organization:" which is empty, and "Serial Number:" which is also empty. Below the "Serial Number:" field, there is a note: "Leave the Serial Number field blank to use the product in evaluation mode." At the bottom of the dialog, there are three buttons: "<< Back", "Next >>" (which is highlighted with a blue border), and "Cancel".

Enter your name or computer name and organization if desired. Enter the serial number from the NI DVD in your Kit of Parts in the box and click **Next**.

# Getting Started With the 2014 Control System

## Licenses

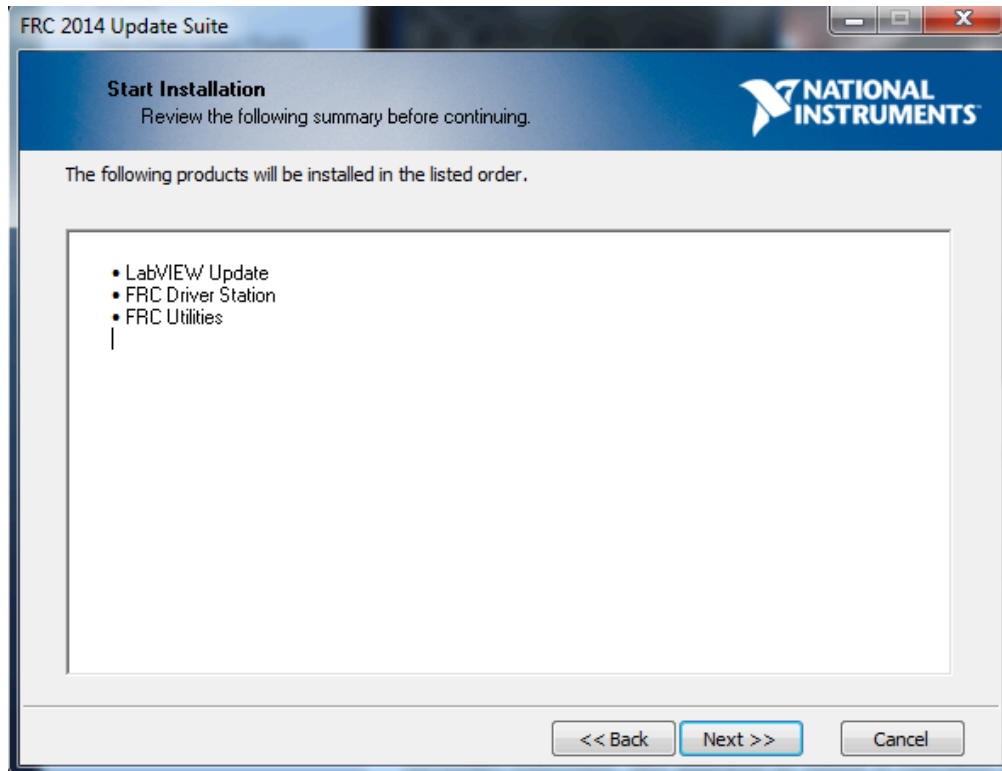


Click the I accept bubble to indicate you accept the 4 licenses displayed on the tabs. Then click **Next** to proceed.



# Getting Started With the 2014 Control System

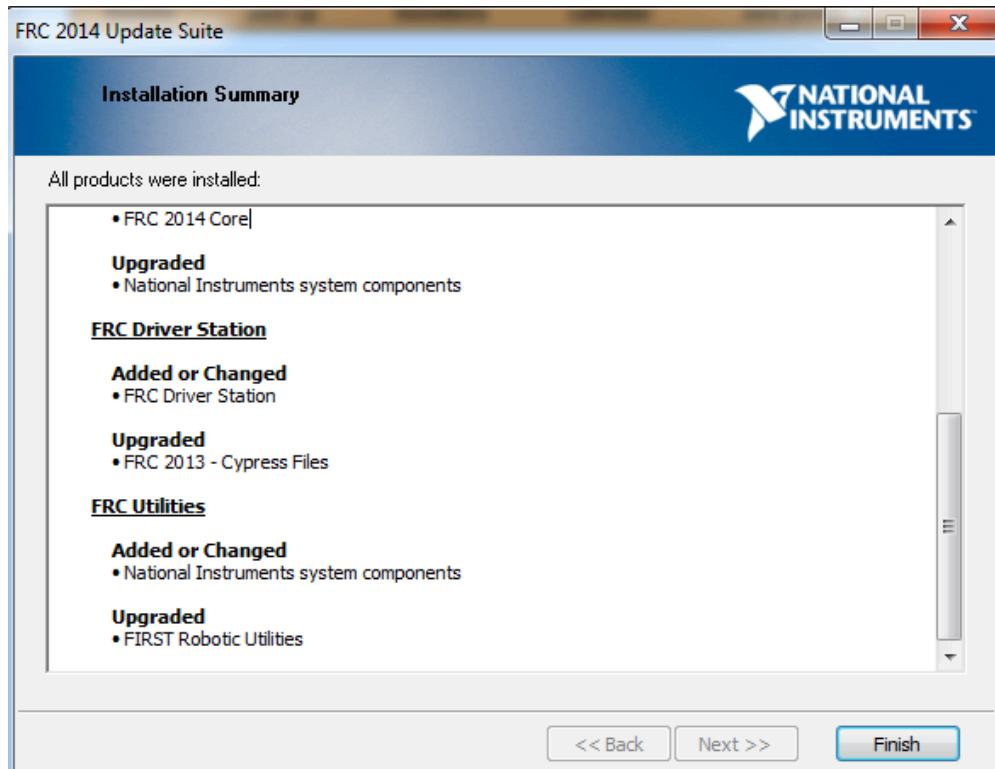
## Installation Review



Click **Next** to start the installation.

# Getting Started With the 2014 Control System

## Finish Installation



After the installation completes, click Finish to exit the installer.

## Imaging Your cRIO

Now that you have the software tools installed and updated, the next step is to [image your cRIO controller](#).

## Imaging your cRIO

Before imaging your cRIO, you must have completed installation of the the development environment and language updates for the appropriate programming language ([C++](#), [Java](#), [LabVIEW](#)). You must also complete the [NI FRC Update installation](#). You also must have the cRIO power properly wired to the Power Distribution board (see this document for instructions)

## Configure computer IP address

Configure computer IP address

To image the cRIO, the IP address of your computer should be set to 10.xx.yy.5 where XXYY is your 4 digit team number (see chart for examples). The instructions below detail how to set this on Windows 7, there may be slight differences on Vista or XP. *Note: If you are planning on running the Driver Station software on a separate PC, you should use an address ending in .6 instead of .5 as the Driver Station uses .5*

## Network Adapter Properties

Network Adapter Properties

To set the IP address, click on **Start > Control Panel > View Network Status and Tasks > Change Adapter Settings**, then double-click on **Local Area Connection** to display the Local Area Connection Properties dialog.

## TCP/IP Properties

TCP/IP Properties

Click on **Internet Protocol Version 4 (TCP/IPv4)** to highlight it, then click **Properties**.

# Getting Started With the 2014 Control System

## Set IP address

Set IP address

On the TCP/IP properties page:

1. Click the bubble next to **Use the following IP address**
2. Enter your **10.xx.yy.5** or .6 address into the **IP address box**
3. Change the **Subnet mask** to **255.255.255.0**
4. Click **OK**. Then click **Close** on the Local Area Connection Properties dialog box,

**Note: For proper operation on the playing field at competition the subnet mask should be set back to 255.0.0.0 after imaging is complete if this PC will be used as a Driver Station.**

## Connect cRIO Ethernet to PC

Connect cRIO Ethernet to PC

Connect the ethernet cord from the cRIO to the PC. It is sometimes helpful to use a network switch between the cRIO and PC to prevent the PC from disabling the ethernet port when the cRIO reboots. It is **NOT** recommended to try re-imaging over WiFi. The imaging tool will begin searching for your cRIO automatically.

## Select Options and Image cRIO

Select Options and Image cRIO

Once your cRIO is detected, it should be displayed in the box near the top of the Imaging Tool. Select the options you wish to use, then image the cRIO:

1. Select the programming language to use. LabVIEW teams are strongly recommended to check the **Always run deployed code at startup** checkbox.
2. Select whether to enable NetConsole (Java teams will have NetConsole enabled automatically)

# Getting Started With the 2014 Control System

3. Select a CAN plugin if appropriate. Note that if you select a CAN plugin with the Console Out feature enabled, on a 4-slot cRIO-FRCII the Console Out will be disabled automatically, on an 8-slot cRIO-FRC you will see a prompt to flip the switch to disable Console Out.
4. Check the box next to **Format Controller**.
5. Verify that the image listed is **FRC\_2014\_v52.zip** (Note: The picture above shows 2013\_v46). If there is no image listed in this box or the image is not v52, make sure you have installed the latest update for your programming language.
6. Enter a name for the cRIO device.
7. Enter your FRC team number in the **Team ID** box.
8. Click **Apply**. The cRIO imaging tool will begin imaging your cRIO, after it is complete, you should see a message indicating that the imaging is complete and you need to load code in order to use the cRIO.

**Note: For proper operation on the playing field at competition the subnet mask should be set back to 255.0.0.0 after imaging is complete if this PC will be used as a Driver Station.**

For instructions on connecting the Driver Station to the cRIO for the first time and verifying connectivity see [Using the Classmate with your cRIO](#).

For instructions on writing and loading your first program see one of these documents or manuals: [C++](#), [Java](#), [LabVIEW](#).

## Other Features of the Imaging Tool

### Other Features of the Imaging Tool

The cRIO Imaging Tool contains two other features you may find useful:

1. **Module Validation:** The cRIO Imaging Tool will show the modules currently detected by the cRIO and highlight valid slots in green and invalid slots in red. Hover over any invalid or empty slot for more information about the correct module to install there.
2. **cRIO Switches:** On the 8-slot cRIO-FRC this box will show the status of the hardware DIP switches, no changes can be made to the 8-slot switch configuration using this tool. For the 4-slot cRIO-FRC the hardware dip switches have been removed and replaced by virtual software switches which can be configured using the cRIO Imaging Tool.

## Troubleshooting cRIO Imaging

If the cRIO Imaging Tool is unable to locate the cRIO, or a Timeout error message is displayed during cRIO Imaging, the issue is likely with the network configuration. One or more of the following steps may be necessary in order to image your cRIO:

1. Disable all other Network Adapters on the computer. Open the Network Connections window from the Control Panel (see **Network Adapter Properties** step above), then for each adapter other than the Local Area Connection you are using to image the cRIO, right-click on the adapter and select **Disable**.
2. Try using a network switch between the cRIO and computer: Some computers have issues reconnecting to the cRIO after the cRIO reboots as part of the imaging process. Placing a switch between the two devices, such as the D-Link DAP-1522 provided in the Kit of Parts typically mitigates this problem.
3. Disable Windows Firewall or other firewalls: Windows Firewall may be blocking the cRIO Imaging Tool, preventing it from detecting the cRIO. If possible, temporarily disable the Firewall by following the steps below.
4. Check that the adapter is set to a single IP address. To do this open the Network Properties as shown in the **Configure Computer IP Address** steps above. When you reach the last step, click the Advanced button and verify that only one address is listed in the top box. If multiple addresses are present, select the extra addresses and click Remove.
5. If the cRIO is still not detected, try rebooting the cRIO in Safe Mode. To reboot in Safe Mode on an 8-slot cRIO, flip the Safe Mode DIP switch, then reset the cRIO. To reboot in Safe Mode on a 4-slot cRIO, hold the reset button for 5 seconds, then release. If the cRIO is detected by the imaging tool attempt to format. The tool will prompt you to take the cRIO out of Safe Mode, then try again.
6. Try a different PC: If none of the above steps work, try using a different computer to image the cRIO.

# Getting Started With the 2014 Control System

## Disabling Windows Firewall



Browse to **Start > Control Panel > System and Security > Windows Firewall > Turn Windows Firewall on or off**. Make sure to turn the firewall off for all locations listed, then click OK.

If the Firewall cannot be disabled, make sure that the FRC cRIO Imaging Tool is allowed through by selecting **Allow a program or feature through Windows Firewall** from the Windows Firewall screen, then click **Change Settings** and make sure that **FRC CRIO Imaging Tool** is listed and has a checkmark for all three network locations. If it is not listed you will have to add it using the **Allow another program...** button and browsing to the imaging tool location C:\Program Files\National Instruments\LabVIEW 2013\project\CRIO Tool

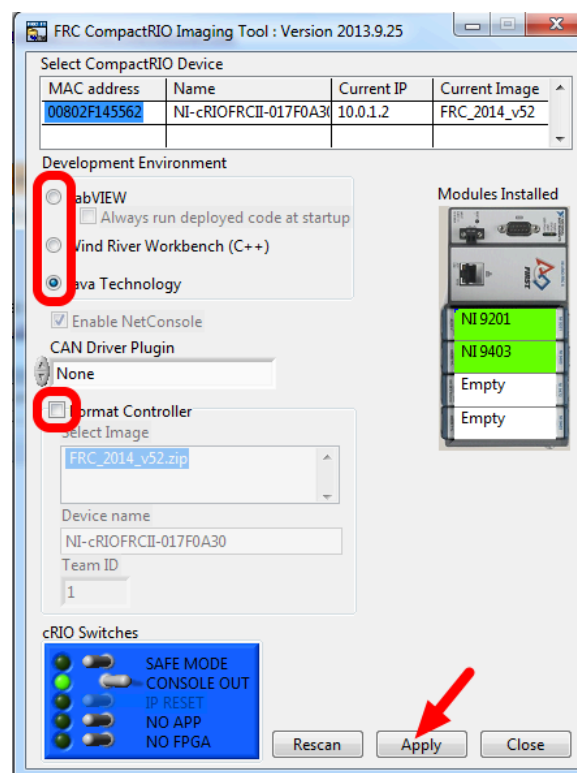
# Changing Languages and Settings Using the cRIO Imaging Tool

In addition to formatting the cRIO, the Imaging Tool can also be used to configure the programming language and a few other settings on the cRIO.

## Setting the Computer IP

As in the previous section on Imaging the cRIO, the IP of the computer must be set to 10.XX.YY.5 or .6

## Changing the Programming Language

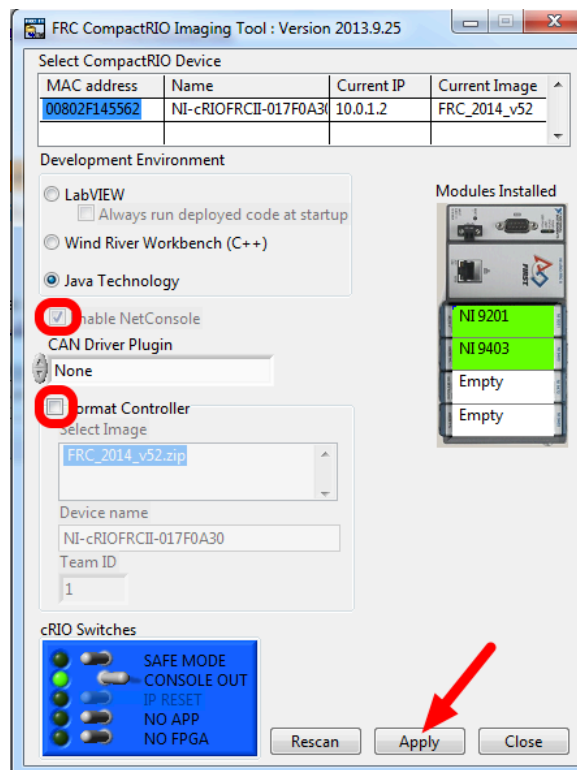




# Getting Started With the 2014 Control System

The programming language the cRIO is set for can be changed using the cRIO Imaging Tool without reformatting the cRIO. To do this, make sure the **Format** box is **unchecked**, select the bubble for the desired language, then click **Apply**.

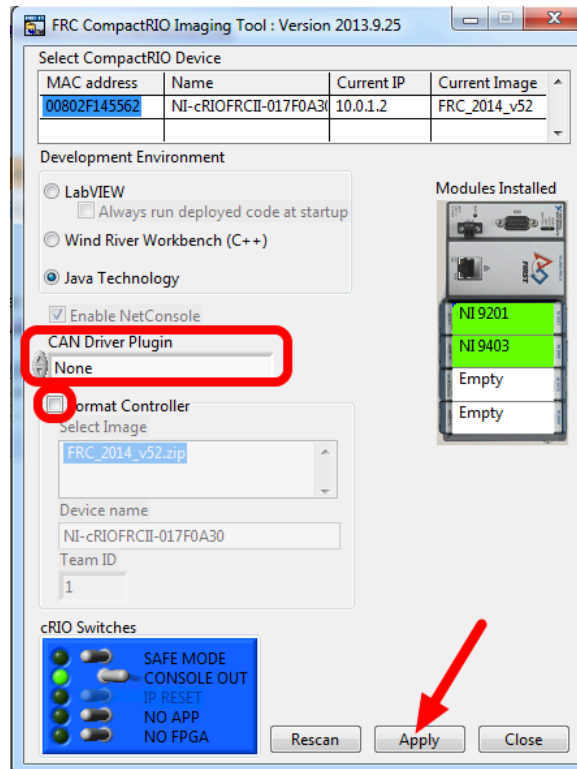
## Enable or Disable NetConsole



NetConsole is a small application on the cRIO which allows you to view the console output over the network. NetConsole can be enabled or disabled on the cRIO by making sure the **Format** box is **unchecked**, checking or un-checking the Enable NetConsole box, then clicking Apply. Note that NetConsole is required for Java and cannot be disabled.

# Getting Started With the 2014 Control System

## Change or Disable CAN Plugin



The CAN plugin currently in use on the cRIO can also be changed without formatting. Choose the appropriate option for your CAN bridge (Black Jaguar, 2CAN or None), make sure the Format box is unchecked, then click Apply.

## Programming your radio for home use

This guide will show you how to use the 2013 FRC Bridge Configuration Tool software to configure your robot's wireless bridge for use outside of FRC events.

Before you begin using the software:

1. Disable WiFi connections on your computer, as it may prevent the configuration utility from properly communicating with the bridge
2. Make sure no devices are connected to your computer via ethernet, other than the wireless bridge.

## Installing the JRE



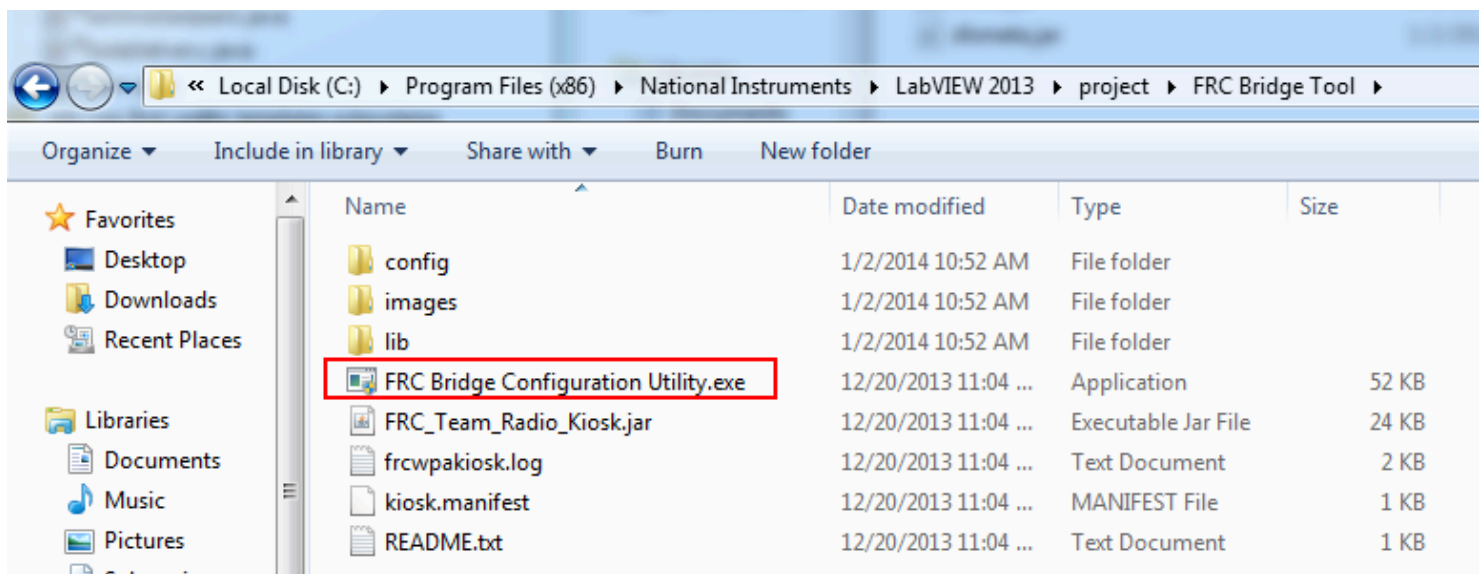
# Getting Started With the 2014 Control System

The Java Runtime is required to use the FRC Bridge Configuration Tool. Many computers will already have Java installed, you can check by looking for a Java icon in the Control Panel. If you do not have Java already installed, download and install it from <http://www.java.com/en/download/index.jsp>

## Install the Software

The FRC Bridge Configuration Utility is installed with the NI FRC Update. If you have not already installed this update see the [Installing the 2014 NI FRC NI Update](#) article for details.

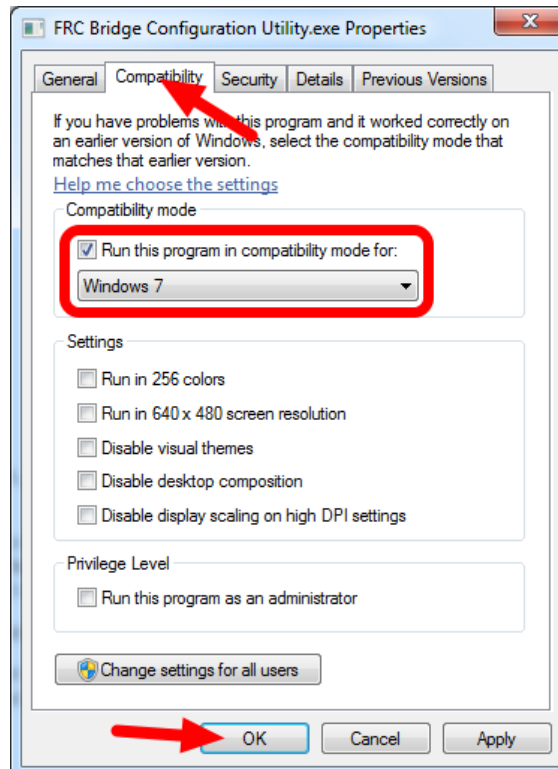
## Launch the software



Browse to C:\Program Files\National Instruments\LabVIEW 2013\project\FRC Bridge Tool (Program Files (x86) on 64 bit machines). On Windows XP, Vista or 7 double click on FRC Bridge Configuration Utility to launch the utility. On Windows 8 see the next step to set compatibility mode before launching.

# Getting Started With the 2014 Control System

## Windows 8 - Set Compatibility



To run on Windows 8 the program must be set to launch in Windows 7 compatibility mode. To do this right click on the file (as shown in the step above) and click Properties. Select the Compatibility tab, check the box for Compatibility Mode, select Windows 7 from the dropdown, then click OK. Start the program by double-clicking on the icon.

## Allow the program to make changes, if prompted

Allow the program to make changes, if prompted

If the your computer is running Windows Vista or Windows 7, a prompt may appear about allowing the configuration utility to make changes to the computer. Click "Yes" if the prompt appears.

# Getting Started With the 2014 Control System

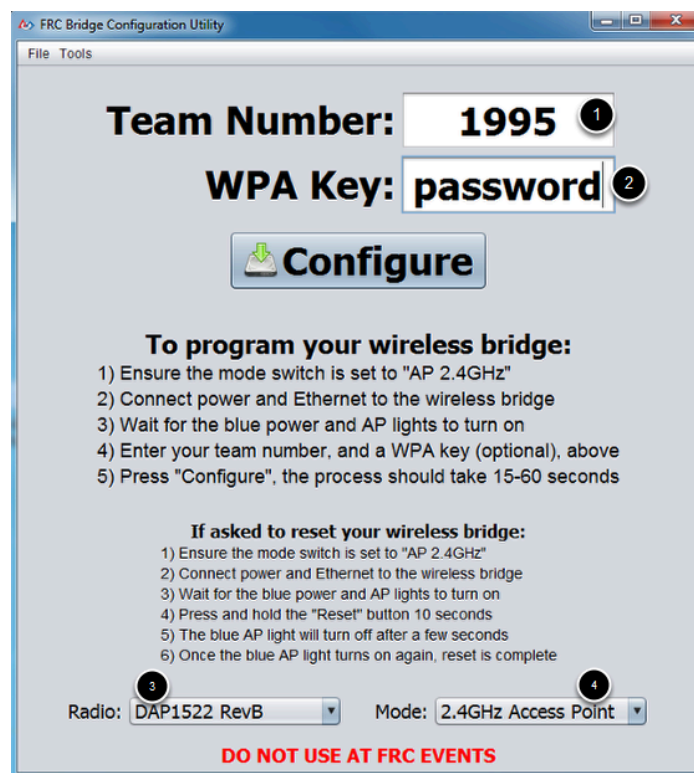
## Select the network interface

Select the network interface

Use the pop-up window to select the which ethernet interface the configuration utility will use to communicate with the wireless bridge. On Windows machines, ethernet interfaces are typically named "Local Area Connection". The configuration utility can not program a bridge over a wireless connection.

1. If no ethernet interfaces are listed, click "Refresh" to re-scan for available interfaces
2. Select the interface you want to use from the drop-down list
3. Click "OK"

## Select a bridge model and operating mode



1. Enter the team number to configure the bridge for.

# Getting Started With the 2014 Control System

2. Enter the desired WPA key. Leave blank to configure with no security.
3. Select which DAP1522 revision you are configuring using the drop-down list
4. Select which operating mode you want to configure. For most cases, the default selection of 2.4GHz Access Point will be sufficient.

## Prepare and start the configuration process

Prepare and start the configuration process

Follow the on-screen instructions for preparing your wireless bridge, entering the settings the bridge will be configured with, and starting the configuration process. These on-screen instructions update to match the bridge model and operating mode chosen at the bottom of the window.

## Configuration Progress

Configuration Progress

Throughout the configuration process, the window will indicate:

1. The step currently being executed
2. The overall progress of the configuration process
3. All steps executed so far

## Configuration completed

Configuration completed

Once the configuration is complete:

1. Press "OK" on the dialog window
2. Press "OK" on the main window to return to the settings screen

# Getting Started With the 2014 Control System

## Configuration errors

### Configuration errors

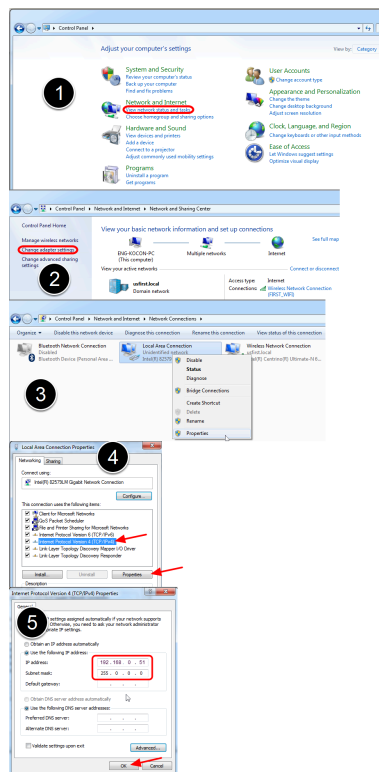
If an error occurs during the configuration process, follow the instructions in the error message to correct the problem.



## Manual Radio Configuration

This article describes how to manually configure a DAP1522 Rev B. for a competition

### Configure computer IP



1. Click **Start >> Control Panel** to open the Control Panel. Then click **View network status and tasks**.
2. Select **Change Adapter Settings**.
3. **Right-click** on the appropriate adapter (typically Local Area Connection) and select **Properties**.
4. Click on the **Internet Protocol Version 4** line to highlight it, then click **Properties**.
5. Select **Use the following IP address**, then enter the IP **192.168.0.51** and the Subnet Mask **255.0.0.0**. Then click **OK**.

# Getting Started With the 2014 Control System

## Reset the DAP1522



Reset your DAP1522 to factory settings using the following procedure:

1. Switch your D-Link unit to **Bridge** mode using the switch on the back (the wireless bridge should always be in bridge mode at competition)
2. Plug in the power and Ethernet connections
3. Wait for the either the orange Bridge light or blue Access Point light to begin flashing
4. Hold the reset button (on the back of the unit) for 10 seconds then release
5. Wait for the light to stop flashing (this signals the wireless bridge is starting to reset)
6. Wait for the light to resume flashing, your wireless bridge is now reset

Connect the wireless bridge to your computer using an **Ethernet** cable

## Connect to the Bridge

Product Page : DAP-1522

Firmware Version : 1.00

DAP-1522

1 SETUP

ADVANCED

MAINTENANCE

STATUS

HELP

WIZARD

2 WIRELESS

NETWORK SETTINGS

**WIRELESS NETWORK**

Use this section to configure the wireless settings for your access point. Please note that changes made on this section may also need to be duplicated on your Wireless Client.

**Helpful Hints...**

Select the SSID which you want your bridge to connect to.

If you have enabled Wireless Security, make sure you write down the

# Getting Started With the 2014 Control System

Start Internet Explorer and type in an address of **192.168.0.50**

- Username = **admin**
- Password = blank

Click on the **Setup** tab on the top menu bar. Click on the **Wireless** tab on the left side of the page.

## Configure Wireless Settings

The screenshot shows the 'WIRELESS NETWORK' configuration page. At the top, there's a header 'WIRELESS NETWORK' with a sub-header 'WIRELESS NETWORK SETTINGS'. Below this, there are several sections: 'WIRELESS SECURITY MODE', 'WPA', 'PRE-SHARED KEY', and 'WI-FI PROTECTED SETUP (ALSO CALLED WCN 2.0 IN WINDOWS VISTA)'. Numbered callouts (1-6) point to specific settings: 1 points to the 'Wireless Network Name' field, 2 points to the 'Security Mode' dropdown, 3 points to the 'WPA Mode' and 'Cipher Type' dropdowns, 4 points to the 'Passphrase' field, 5 points to the 'Enable' checkbox for Wi-Fi Protected Setup, and 6 points to the 'Save Settings' button at the top left.

**WIRELESS NETWORK**

Use this section to configure the wireless settings for your access point. Please note that changes made on this section may also need to be duplicated on your Wireless Client.

Save Settings Don't Save Settings

**WIRELESS NETWORK SETTINGS**

Wireless Mode : Bridge Mode Site Survey

Enable Wireless : ☒

Wireless Network Name : 9999 (Also called the SSID)

802.11 Band : ☐ 2.4GHz ☐ 5GHz ☒ 2.4GHz/5GHz

802.11 Mode : Mixed 802.11 abgn

Enable Auto Channel Scan : ☐

Wireless Channel : 6

Transmission Rate : Best(automatic) (Mbit/s)

Channel Width : 20 MHz

Visibility Status : ☒ Visible ☐ Invisible

**WIRELESS SECURITY MODE**

Security Mode : WPA-Personal

**WPA**

WPA Mode : WPA2 Only

Cipher Type : AES

Group Key Update Interval : (seconds)

**PRE-SHARED KEY**

Passphrase : 9999WPAKey

**WI-FI PROTECTED SETUP (ALSO CALLED WCN 2.0 IN WINDOWS VISTA)**

Enable : ☐

Configure the wireless settings:

1. Set the **Wireless Network Name** to your team number.
2. Set the **Wireless Security Mode** to **WPA-Personal**.
3. Set the **WPA Mode** to **WPA2 Only** and the **Cipher Type** to **AES**
4. Set the **Passphrase** to the WPA key for the event (obtain from the FTA)
5. Uncheck the box to disable Wi-Fi Protected Setup
6. Click **Save Settings**

# Getting Started With the 2014 Control System

## Configure Network Settings

**LAN SETTINGS**

Use this section to configure the internal network settings of your access point. The IP Address that is configured here is the IP Address that you use to access the Web-based management interface. If you change the IP Address here, you may need to adjust your PC's network settings to access the network again.

<b>LAN Connection Type :</b>	Static IP	Set the IP address to 10.xx.yy.1 where <u>xxxx</u> is your team number
<b>Access Point IP Address :</b>	10.19.95.1	
<b>Subnet Mask :</b>	255.0.0.0	Set the Subnet Mask to 255.0.0.0
<b>Default Gateway :</b>	10.19.95.4	Set the Default Gateway to 10.xx.yy.4

Click **Network Settings** from the left sidebar.

1. Set the IP to 10.xx.yy.1 where XXYY is your team number
2. Set the Subnet Mask to 255.0.0.0
3. Set the Default Gateway to 10.xx.yy.4
4. Click **Save Settings**

# Configuring an Axis Camera

Three different Axis camera models are supported by the FRC software, the Axis 206, Axis M1011, and Axis M1013. This document provides instructions on how to configure one of these cameras for FRC use. To follow the instructions in this document, an installation of [2014 NI FRC Update](#) is required.

## Connect the camera

Connect the Axis camera to the computer using an Ethernet cable. Most modern computers are equipped with auto-sensing ports and will work with a normal Ethernet cable, but a crossover cable, or network switch between the devices may be necessary for some computers.

## Configure computer IP address

Configure computer IP address

Set your computer's IP address to 192.168.0.5. For instructions on how to set your computer IP, see the [Imaging your cRIO document](#).

## Launch the Setup Axis Camera Tool

Launch the Setup Axis Camera Tool

Double click on the desktop icon that says Setup Axis Camera to launch the Setup Axis Camera Tool. The camera should be automatically detected and the green indicator light should be lit. If it is not, make sure the camera is powered on (the ring on the camera face should be green) and connected to your computer. If the indicator remains off follow the instructions in the tool textbox next to **Troubleshooting the camera** to reset the camera. You can also use the **Camera not found?** button to check the IP address of your computer.

# Getting Started With the 2014 Control System

## Setup the Camera

### Setup the Camera

The recommended configuration (and the default expected by the robot code examples and FRC Dashboard) is to connect the camera to the Robot Radio. To configure the camera for this setup:

1. Make sure the **Robot Radio** bubble is selected
2. Enter your FRC team number in the **Team ID** box
3. Press **Apply**.

This will automatically configure the following settings on the camera:

- IP
- Add Username and Password: FRC/FRC
- Anonymous Viewing: Enabled (required for use with SmartDashboard)
- Resolution: 320x240
- Compression: 30
- Frame Rate: 15FPS

Note that the LabVIEW Dashboard and/or LabVIEW robot code will override these settings for their streams.

For more information about camera image settings see the [Camera Settings](#) article in the Vision Processing manual.

## Manual Camera Configuration

### Manual Camera Configuration

It is recommended to use the Setup Axis Camera Tool to configure the Axis Camera. If you need to configure the camera manually, follow the instructions above for connecting the camera to the computer and setting the IP, then open a web browser and enter **192.168.0.90** in the address bar and press enter. You should see a Configure Root Password page, set this password to whatever you would like, but **admin** is recommended.

# Getting Started With the 2014 Control System

## Setup Page

### Setup Page

Click **Setup** to go to the setup page.

## Configure Users

### Configure Users

On the left side click **Users** to open the users page. Click **Add** then enter the Username **FRC** Password **FRC** and click the **Administrator** bubble, then click **OK**. If using the SmartDashboard, check the **Enable anonymous viewer login** box. Then click **Save**.

## Configure Image Settings

### Configure Image Settings

Click **Video & Image** on the left side to open the image settings page. Set the **Resolution** and **Compression** to the desired values (recommended **320x240, 30**). To limit the framerate to under 30 FPS, select the **Limited to** bubble under **Maximum frame rate** and enter the desired rate in the box. Color, Brightness and Sharpness may also be set on this screen if desired. Click **Save** when finished.

Note that the LabVIEW Dashboard and/or LabVIEW robot code will override these settings for their streams.

For more information about camera image settings see the [Camera Settings](#) article in the Vision Processing manual.

## Configure Network Settings

### Configure Network Settings

## Getting Started With the 2014 Control System

To connect the camera directly to the DLink DAP-1522 on the robot, the IP settings need to be changed. Click **Basic Configuration** then **TCP/IP** on the left side of the screen to go to the network configuration page. Click the bubble to **Use the following IP address**, then enter 10.xx.yy.11 in the box where xxyy is your 4-digit team number (pictured example is set for team 3). In the **Default Router** box enter 10.xx.yy.1. Click **Save**. Your Axis camera is now set up for use on the robot.



# Troubleshooting

# Getting Started With the 2014 Control System

## Support Resources

In addition to the documentation here, there are a variety of other resources available to FRC teams to help understand the Control System and software.

## Other Documentation

In addition to this site there are a few other places teams may check for documentation:

- [NI FRC Community Documents Section](#)
- [USFIRST.org Technical Resources Page](#)
- [VEXPro Jaguar Page](#)

## Forums

Stuck? Have a question not answered by the documentation? Official Support is provided on these forums:

- [NI FRC Community Discussion Section](#) (cRIO, LabVIEW and Driver Station software questions)
- [USFIRST.org Control System Forum](#) (wiring, hardware and Driver Station questions)
- [USFIRST.org Programming Forum](#) (programming questions for C++, Java, or LabVIEW)

## NI Phone Support

Have a LabVIEW, cRIO, or Driver Station question? NI provides phone support for FRC teams during the build season (1/5/12-2/19/12) Monday through Friday 1pm-7pm CST by calling 866-511-6285.

## Bug Reporting

Found a bug? Let us know by reporting it on the [WPILib Bug Tracker](#). Note that you will have to create a FIRSTForge account if you do not already have one, but **you do not need** to apply for project membership.

# Checking for and Removing dual IPs on an adapter

## Control Panel

Control Panel

Click **Start >> Control Panel** to open the Control Panel. Then click **View network status and tasks**.

## Change Adapter Settings

Change Adapter Settings

Select **Change Adapter Settings**.

## Open Adapter Properties

Open Adapter Properties

**Right-click** on the appropriate adapter (typically Local Area Connection) and select **Properties**.

## Open TCP/IP Properties

Open TCP/IP Properties

Click on the **Internet Protocol Version 4** line to highlight it, then click **Properties**.

# Getting Started With the 2014 Control System

## Open Advanced Properties

Open Advanced Properties

Click the **Advanced** button.

## Identify and Remove Additional Addresses

Identify and Remove Additional Addresses

In the top pane, you should see a single IP/Subnet pair. If there are multiple lines, click each line below the first and select **Remove**. Click **OK** or **Close** on each open dialog to save the changes.

# Measuring Bandwidth Usage

On the 2013 FRC Field (and at home when the DAP-1522 is configured using the FRC Bridge Configuration Utility) each team is limited to 7Mb/s of network traffic (see the [FMS Whitepaper](#) for more details). The FMS Whitepaper provides information on determining the bandwidth usage of the Axis camera, but some teams may wish to measure their overall bandwidth consumption. This document details how to make that measurement.

## Measuring Bandwidth Using the Performance Monitor (Win 7 only)

Windows 7 contains a built-in tool called the Performance Monitor that can be used to monitor the bandwidth usage over a network interface.

### Launching the Performance Monitor

Launching the Performance Monitor

Click **Start** and in the search box, type **perfmon.msc** and press Enter.

### Open Real-Time Monitor

Open Real-Time Monitor

In the left pane, click Performance Monitor to display the real-time monitor.

### Add Network Counter

Add Network Counter

# Getting Started With the 2014 Control System

1. Click the green plus near the top of the screen to add a counter
2. In the top left pane, locate and click on **Network Interface** to select it
3. In the bottom left pane, locate the desired network interface (or use All instances to monitor all interfaces)
4. Click **Add>>** to add the counter to the right pane.
5. Click **OK** to add the counters to the graph.

## Remove extra counters

Remove extra counters

In the bottom pane, select each counter other than **Bytes Total/sec** and press the **Delete** key. The **Bytes Total/sec** entry should be the only entry remaining in the pane.

## Configure Data Properties

Configure Data Properties

Press **Ctrl+Q** to bring up the Properties window. Click on the dropdown next to **Scale** and select **1.0**. Then click on the **Graph** tab.

## Configure Graph Properties

Configure Graph Properties

In the **Maximum Box** under **Vertical Scale** enter 917504 (this is 7Megabits converted to Bytes). If desired, turn on the horizontal grid by checking the box. Then click **OK** to close the dialog.

## Viewing Bandwidth Usage

Viewing Bandwidth Usage

# Getting Started With the 2014 Control System

You may now connect to your robot as normal over the selected interface (if you haven't done so already). The graph will show the total bandwidth usage of the connection, with the bandwidth cap at the top of the graph. The Last, Average, Min and Max values are also displayed at the bottom of the graph. Note that these values are in Bytes/Second meaning the cap is 917,504. With just the Driver Station open you should see a flat line at ~100000 Bytes/Second.

## Measuring Bandwidth Usage using Wireshark

If you are not using Windows 7, you will need to install a 3rd party program to monitor bandwidth usage. One program that can be used for this purpose is Wireshark. [Download](#) and install the latest version of Wireshark for your version of Windows. After installation is complete, locate and open Wireshark. Connect your computer to your robot, open the Driver Station and any Dashboard or custom programs you may be using.

## Select the interface and Start capture

Select the interface and Start capture

In the Wireshark program on the left side, select the interface you are using to connect to the robot and click **Start**.

## Open Statistics Summary

Open Statistics Summary

Let the capture run for at least 1 minute, then click **Statistics>>Summary**.

## View Bandwidth Usage

View Bandwidth Usage

Average bandwidth usage, in Megabits/Second is displayed near the bottom of the summary window. The bandwidth cap on the field is 7 Megabits/second.

# Getting Started With the 2014 Control System

## Cannot access java.lang

Sometimes the plugins get out of date or have an older version than the libraries that are installed on the system.

## You see errors on almost all library references

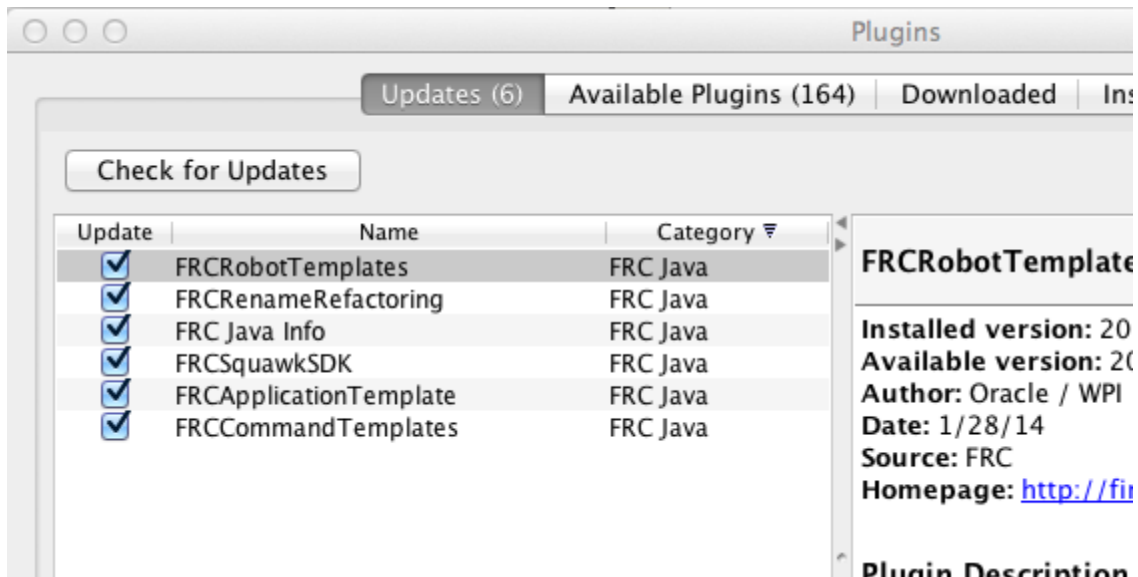
```
1 package edu.wpi.first.wpilibj.templates.Commands;
2
3 import edu.wpi.first.wpilibj.comman
4 import edu.wpi.first.wpilibj.smartd
5 import edu.wpi.first.wpilibj.templa
6 import edu.wpi.first.wpilibj.templates.subsystems.ExampleSubsystem;
7
8 /**
9  * The base for all commands. All atomic commands should subclass CommandBase.
10  * CommandBase stores creates and stores each control system. To access a
11  * subsystem elsewhere in your code in your code use CommandBase.exampleSubsystem
12  * @author Author
```

The symptom is that you see error messages on many lines where the WPILib code is referenced. This might be due to an old copy of WPILib installed in Netbeans.



# Getting Started With the 2014 Control System

## Check for updates for the plugins



Click the "Tools" then "Plugins" in the menu bar. In the dialog box that pops up, click on "Updates" then "Check for Updates". Install any updates for the FRC Plugins and allow Netbeans to restart. When it restarts the errors should be gone.

If there errors persist, try uninstalling and reinstalling the plugins as described in the "Getting started with Java" documentation under the **"Uninstalling the previous version of the plugins"** section here: <http://wpilib.screenstepslive.com/s/3120/m/7885/l/79405-installing-the-java-development-tools>.