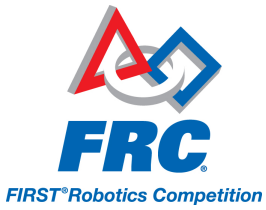
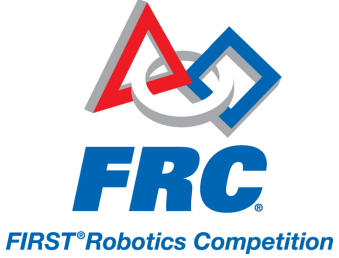
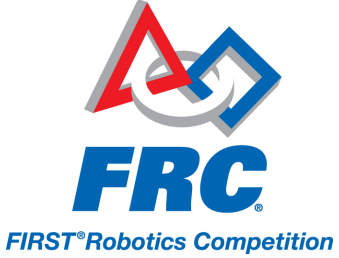
GETTING STARTED WITH THE 2014 CONTROL SYSTEM



FIRST® Robotics Competition

Table of Contents





Getting Started With the ScreenSteps Documentation

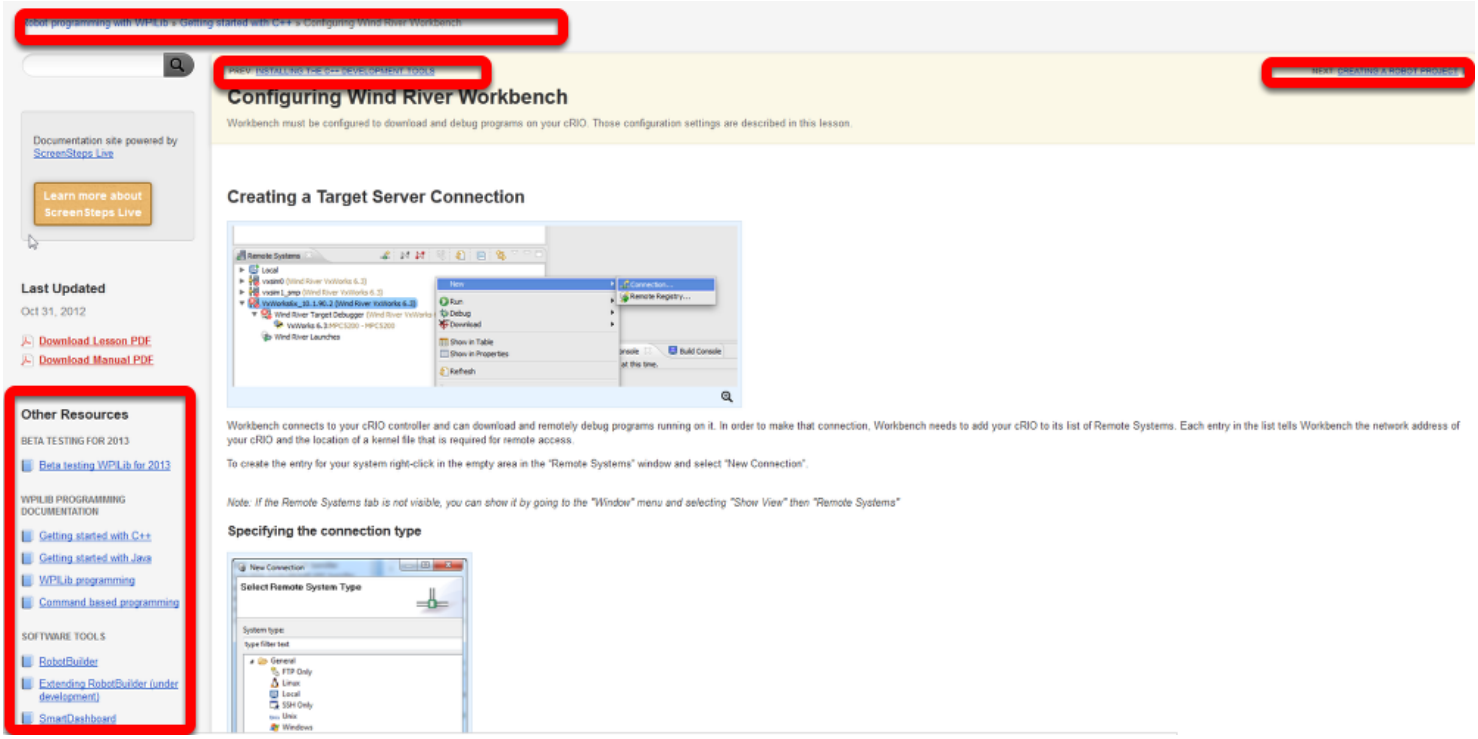
Getting Started With the Screen Steps Documentation

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?

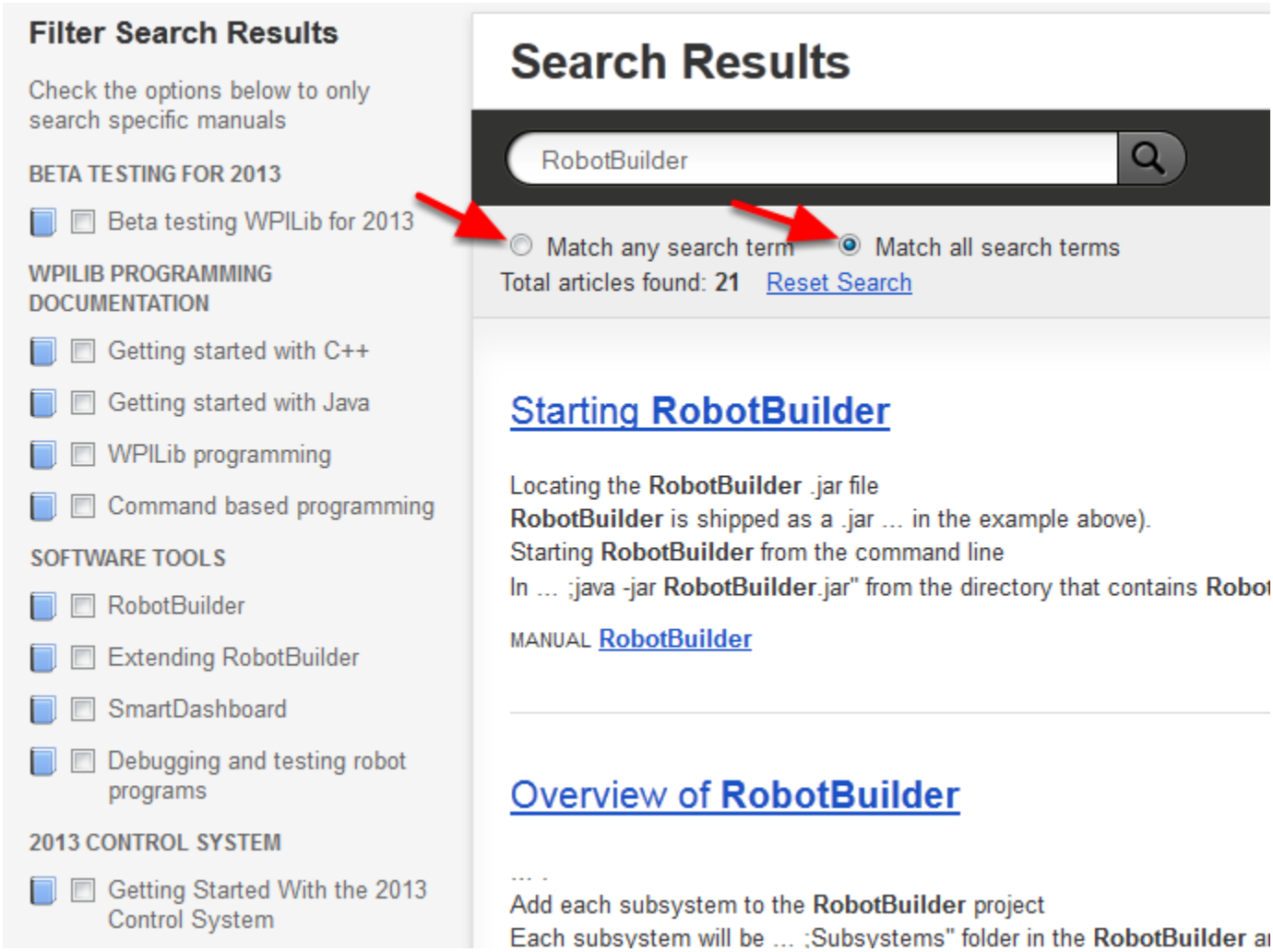
The documentation on the ScreenStepsLive site encompasses a number of potentially familiar documents from previous seasons such as the Getting Started with the 201X Control System, Getting Started with C++, Getting Started with Java, WPILib Cookbook, Vision Whitepaper and more. It also includes quite 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



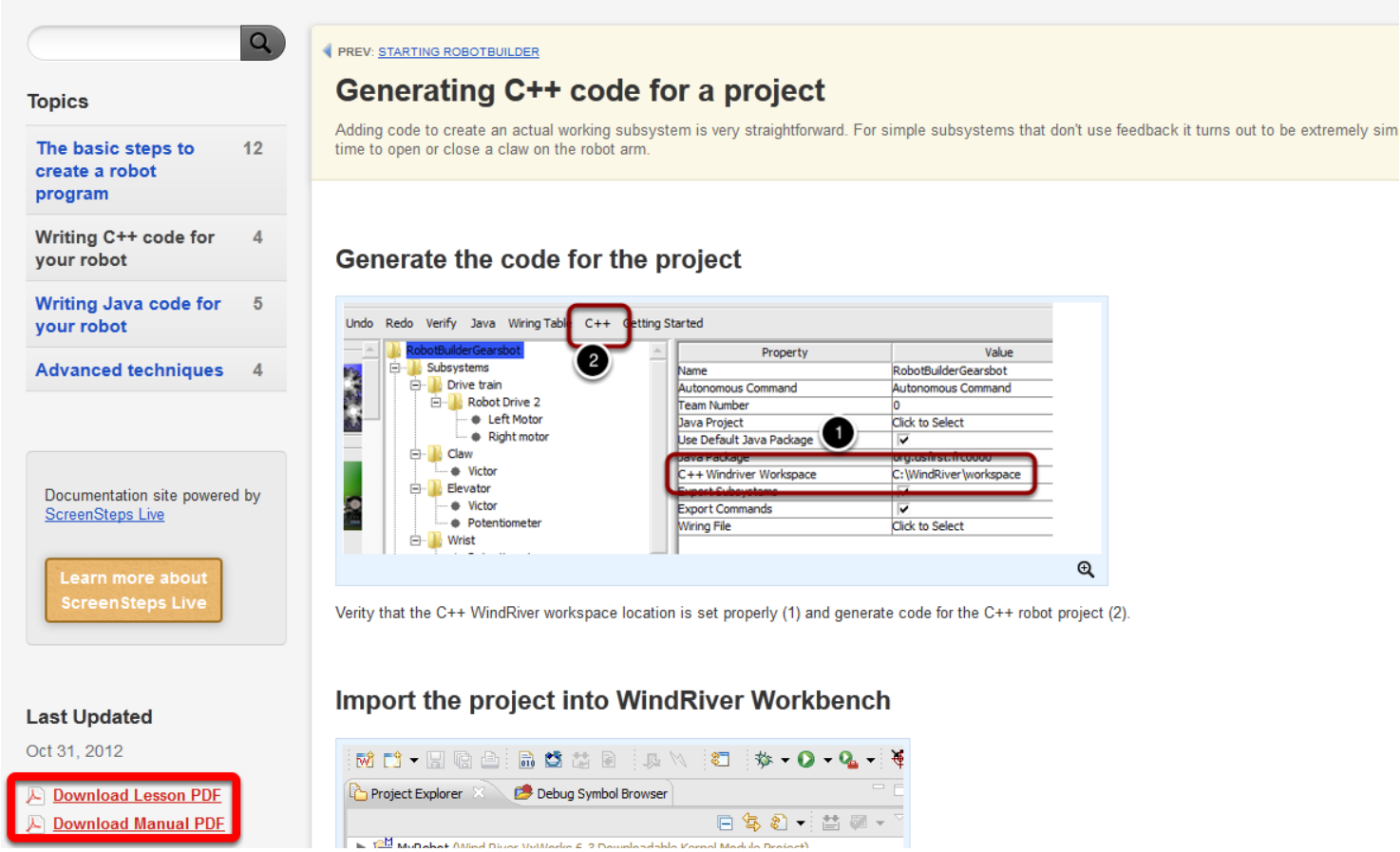
The documentation is organized into a hierarchy with Sections at the very top, followed by Manuals, Chapters, then Lessons. At any time while you are browsing through the documentation, you can use the navigation at the top of the screen to go back to the Manual or to the home screen. You can also use 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.

Using the Search

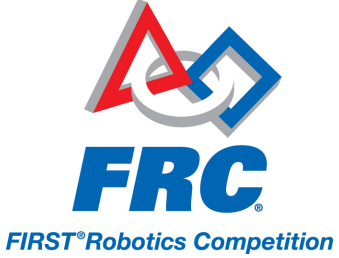


A search bar is located at the top of each page which you can use to search the site. After entering a search query you will be brought to the search results page. From this page you can refine your query by selecting whether to "match any" or "match all" terms in the search. You can also narrow your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

Downloading PDFs



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.



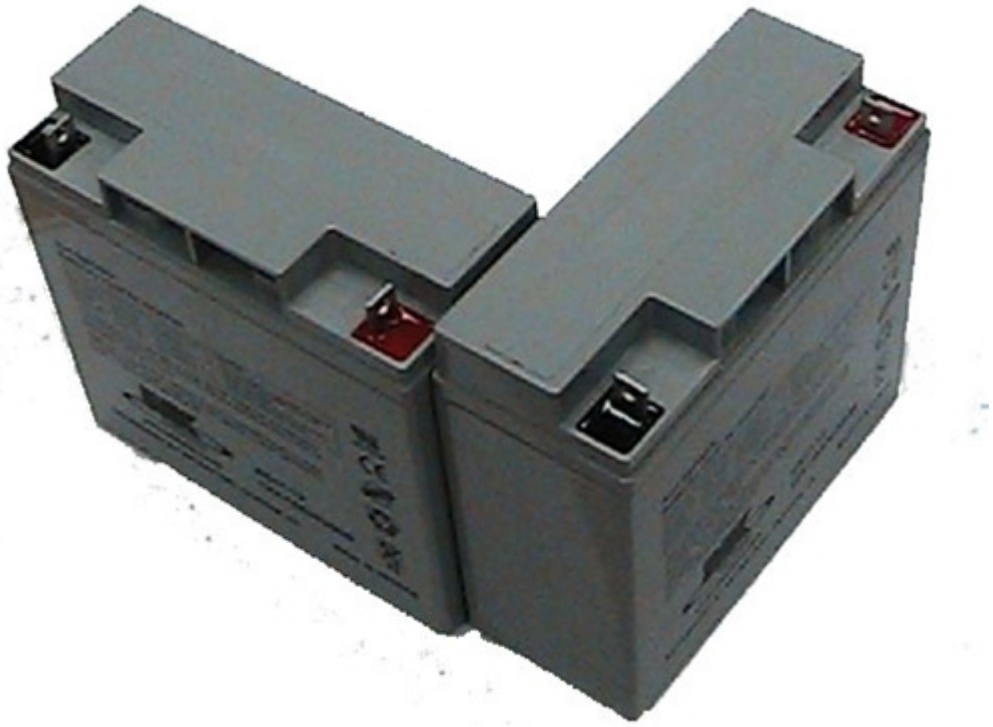
2014 Control System Hardware

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 o n the output, not all components are protected from all conditions. Teams should take caution to check that all wiring is secure and correct before connecting the battery after any wiring changes.

Robot Battery



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

120A Circuit Breaker

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

Power Distribution Board

The Power Distribution Board (PD) is designed to distribute power from a 12VDC battery to various robot components through auto-resetting circuit breakers, as well as provide specialized, regulated supplies for powering specific Control System Components. The PD provides 8 output pairs rated for 40A continuous current and 12 pairs rated for 30A continuous current. The PD provides a regulated 24V power supply to power the cRIO, a special, regulated 12V power supply for powering the robot radio and a 5V power supply for powering an Axis camera.

Snap Action Circuit Breakers

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

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 D-LINK DAP 1522 radio for communications and modules and their associated breakout boards for input and output. The User Manual contains more information about the cRIO-FRCII.

Digital Sidecar

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

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.

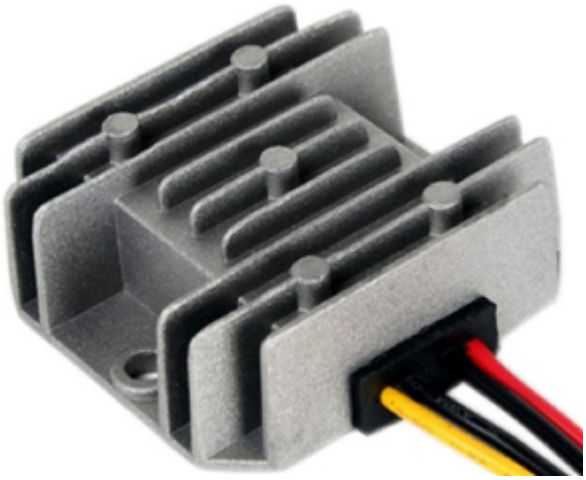
Solenoid Breakout Board

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.

D-Link DAP-1522 Rev B

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

12V-5V Power Converter



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

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

Axis M1013/ M1011 / 206 Ethernet Camera

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

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

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

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

Spike H-Bridge Relay

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 botht he 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
  - Appropriate wire and connectors for size of motors
  - 12V Battery (Enersys NP18-12 recommended)
  - 12V/5V Adapter

    - Dual Lock material

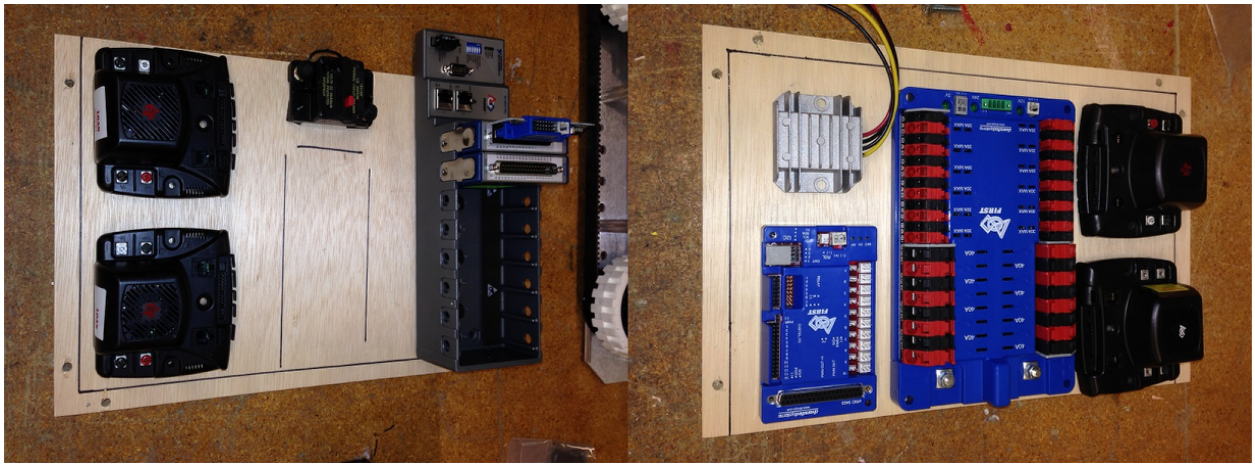
- Tools Required:
    - Wago Tool or small flat-head screwdriver
    - Philips head screw driver
    - M6 nut driver (10mm socket)
    - Wire cutters, strippers, and crimpers
    - 7/16” nut driver

Create the Base for the Control System

Cut 2 pieces of ¼” 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 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 4 controllers should be of the same type, if mismatched paris 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

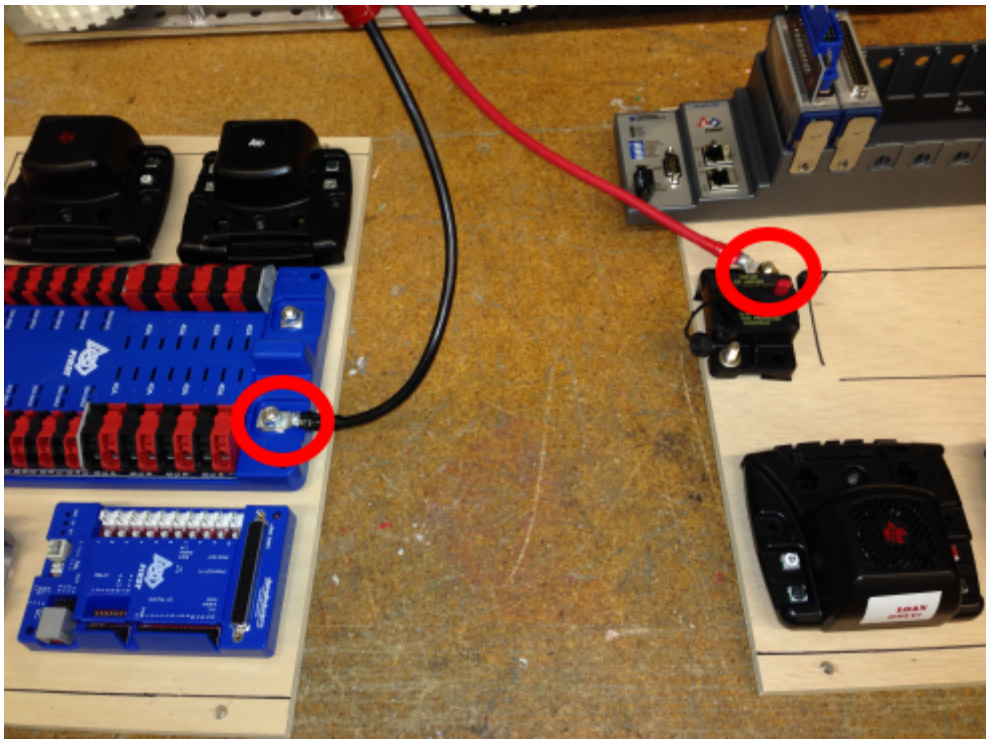
	cRIO-FRC II	cRIO-FRC
Slot 1	9201 (with Analog Breakout)	9201 (with Analog Breakout)
Slot 2	9403 (connected to Digital Sidecar)	9403 (connected to Digital Sidecar)
Slot 3	9472 (connected to Solenoid Breakout)	9472 (connected to Solenoid Breakout)
Slot 4	*Empty*	Either 9201, 9403, or 9472 as needed
Slot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

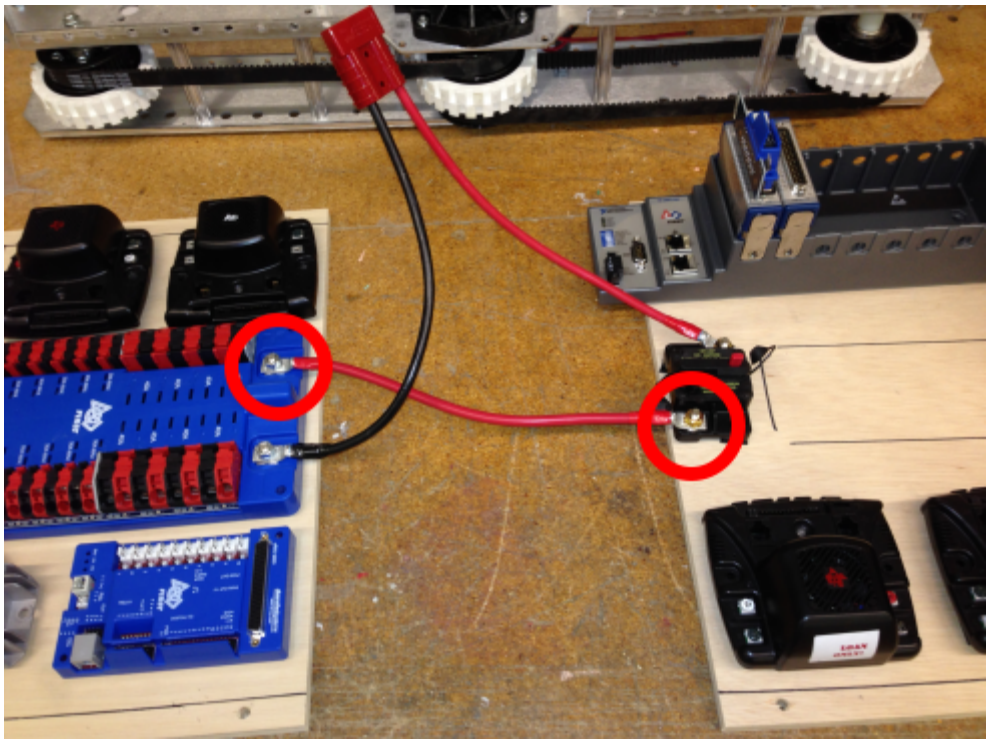
Using wood screws, fasten all components to the board.

Attach Battery Connector



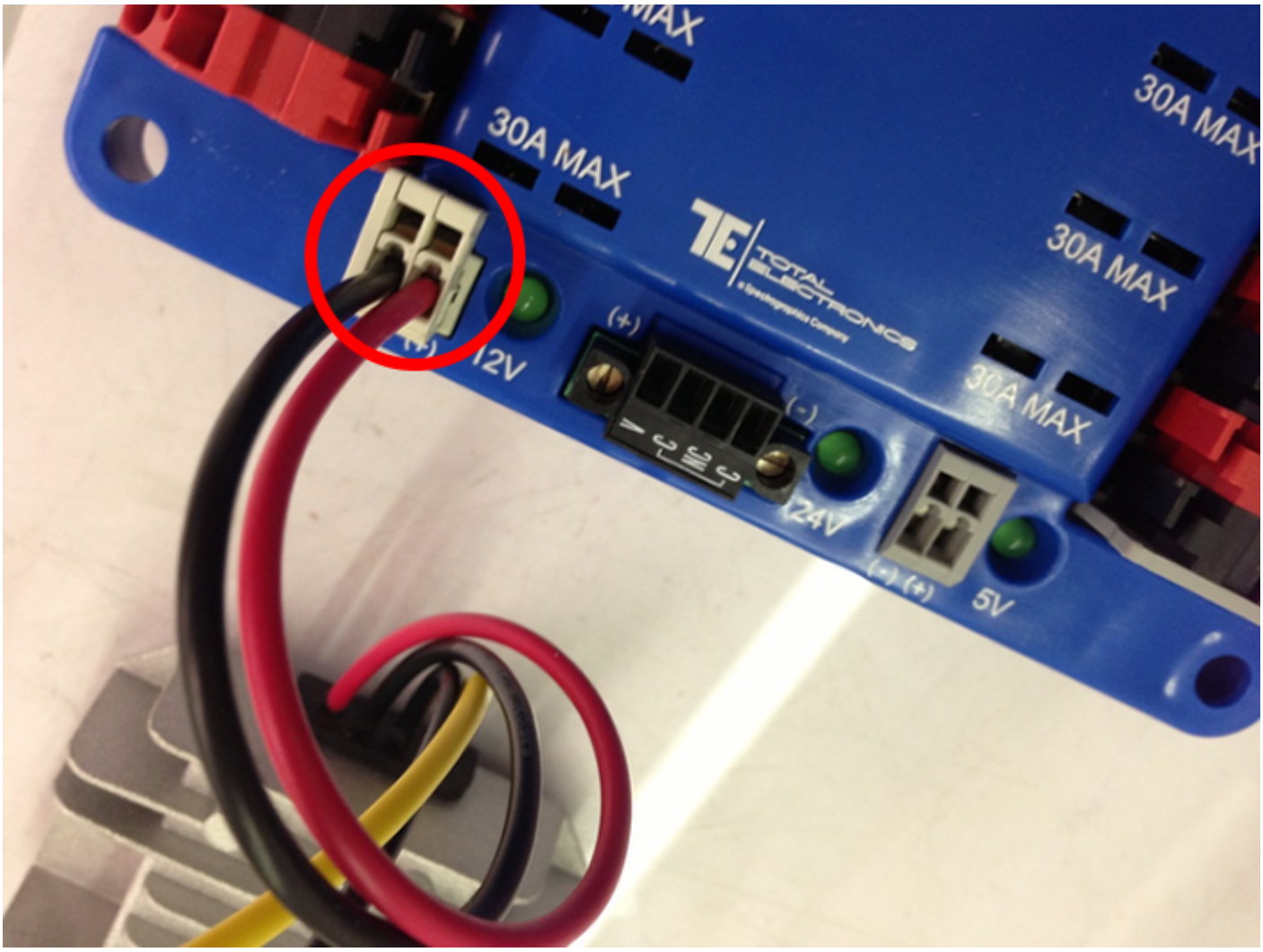
Attach terminal lugs to a battery connector. Then, attach the battery connector to the Power Distribution Board and the 120A Main Breaker.

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

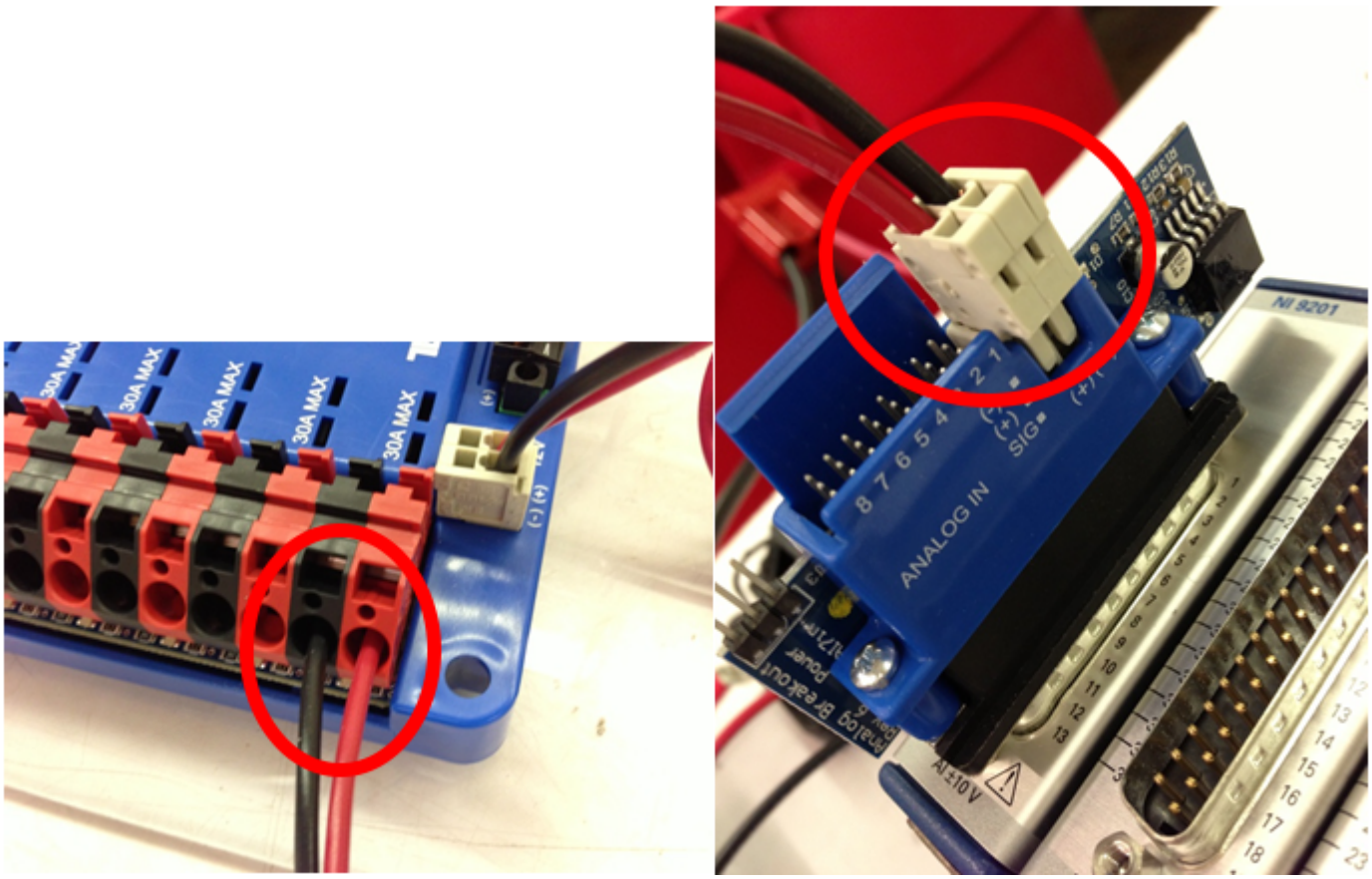


Connect the 12V/5V Converter to the regulated 12V terminal on the PDB using a WAGO connector.

cRIO Power

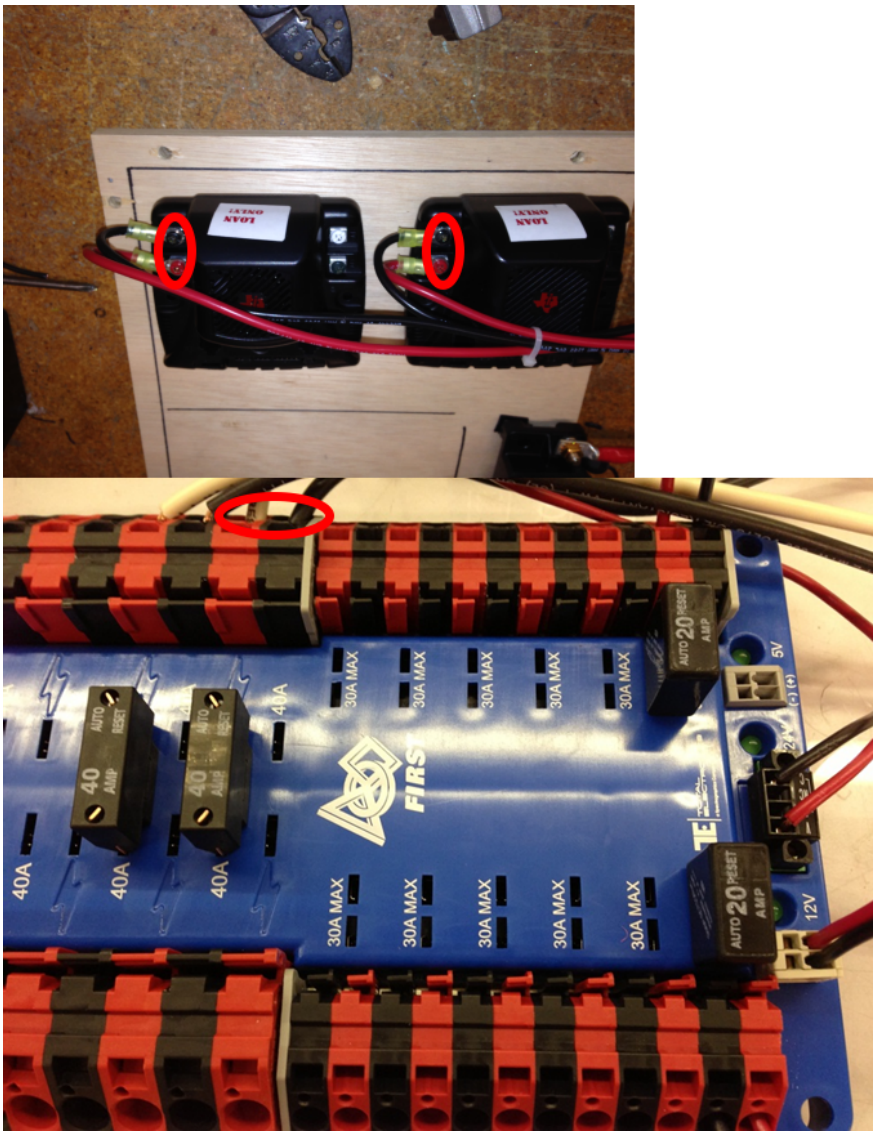
Connect the cRIO power input to the regulated 24V terminal on the PDB using a Sauro connector and 18AWG wire.

Analog Breakout Power



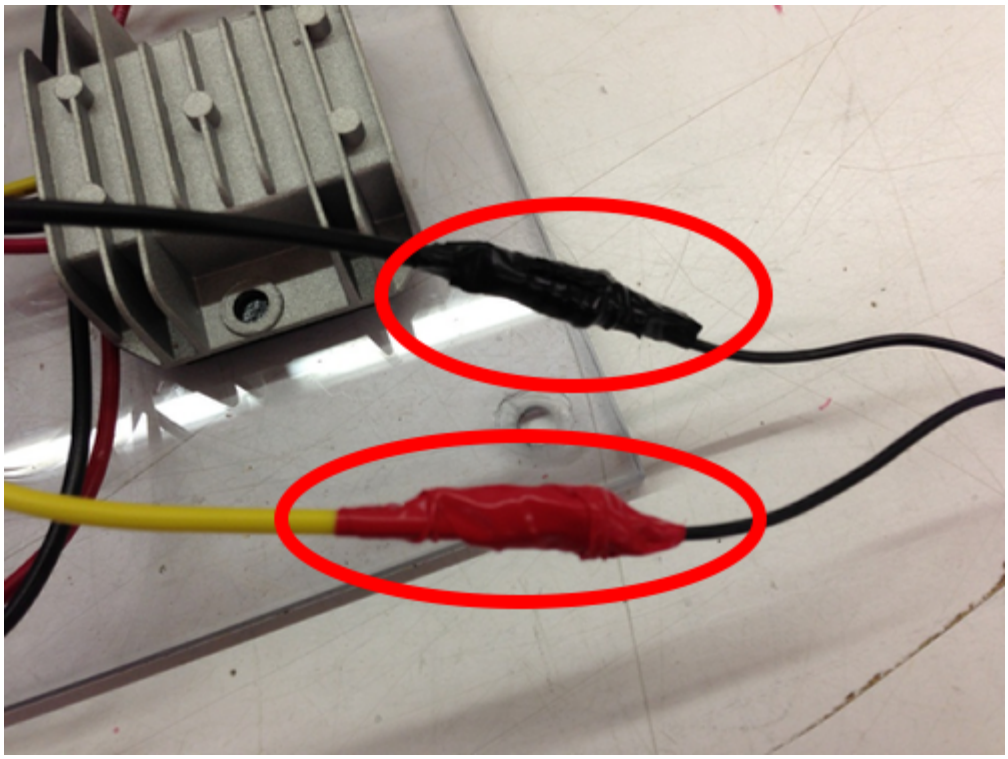
Connect the Analog Breakout (mounted on the 9201 module in Slot 1 of the cRIO) to a 20-amp position the PDB using a WAGO connector and 18AWG wire.

Motor Controller Power



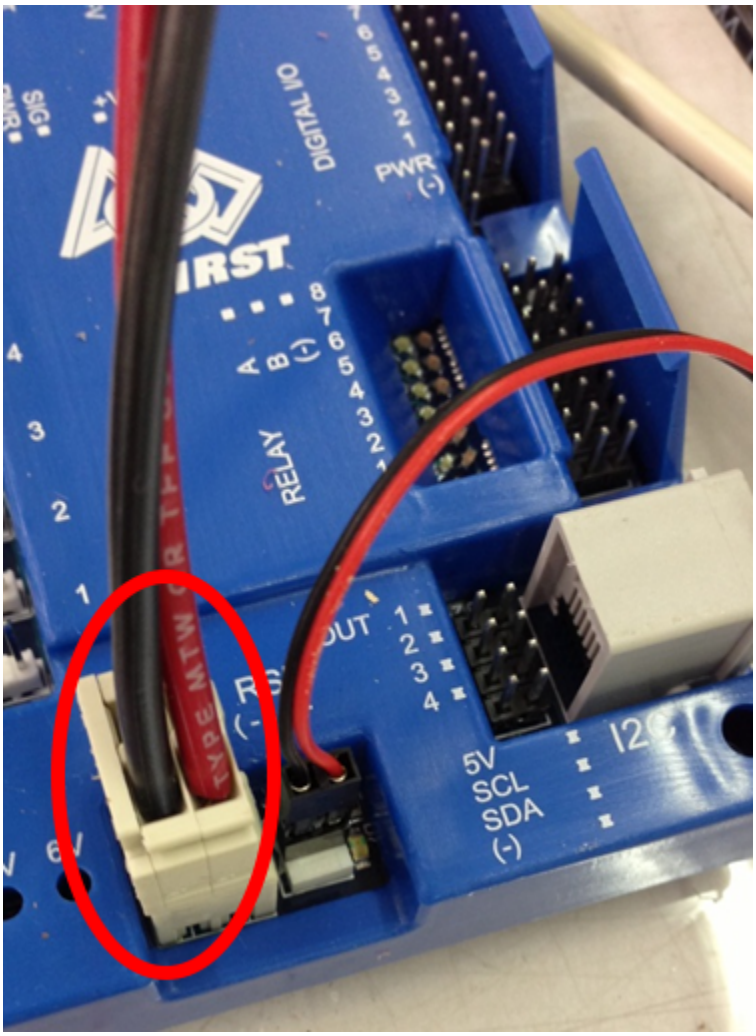
Connect the Motor Controllers to a 40-amp position on the PDB using 12AWG wire. Also, connect the fan wires to the power input terminals on the motor controller.

Wireless Bridge Power



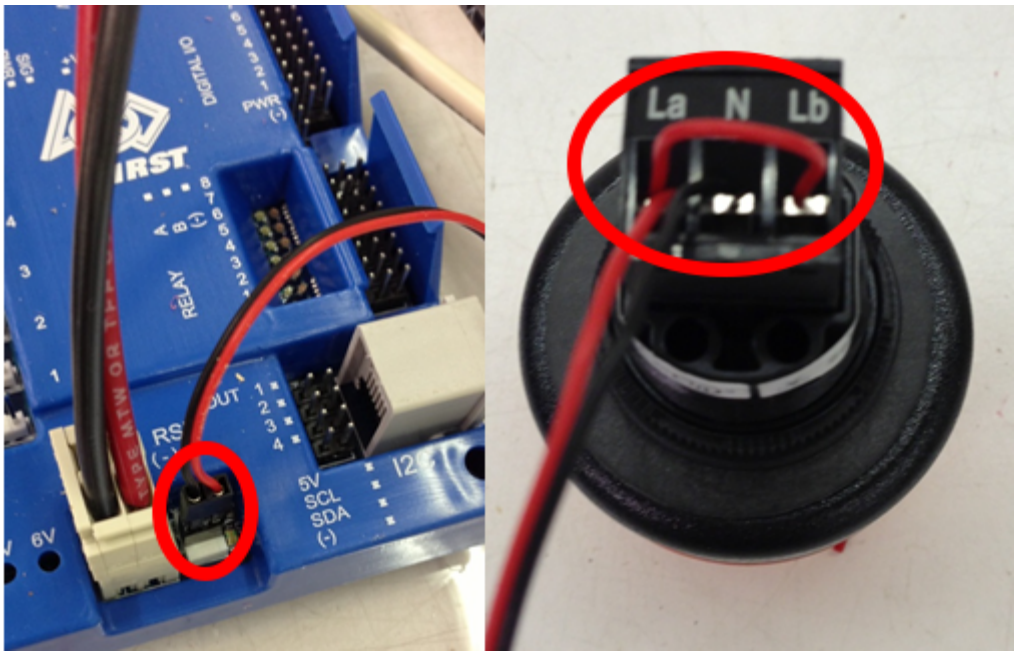
Remove the wall wart from the Wireless Bridge power cord. Then, connect the power cord to the 12V/ 5V converter (yellow wire to black-with stripe wire).

Digital Sidecar Power



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

Robot Signal Light

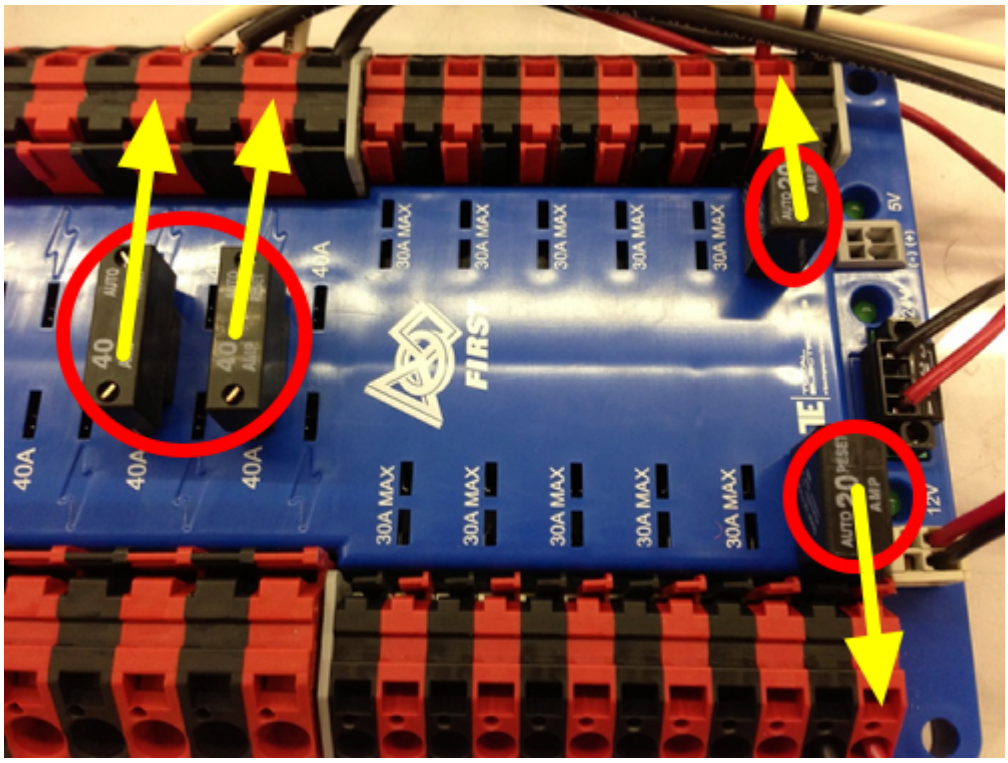


Connect the Robot Signal Light to the “RSL” terminals on the Digital Sidecar. Then, create a jumper between the “La” and “Lb” terminals on the RSL.

Digital Sidecar Data Cable

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

Circuit Breakers

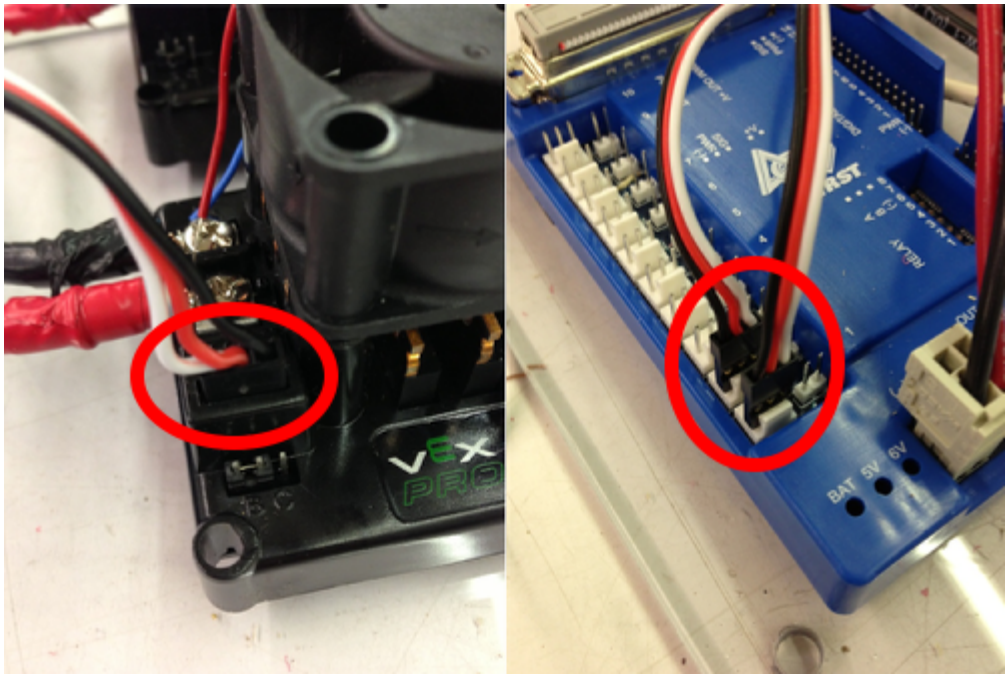


Insert 20-amp and 40-amp Circuit Breakers into positions on the PDB. Note that, for the 40A fuses, the lightning bolt graphic points towards the positive terminal supplied power by that breaker. All negative terminals on the board are directly connected internally.

PWM Cables

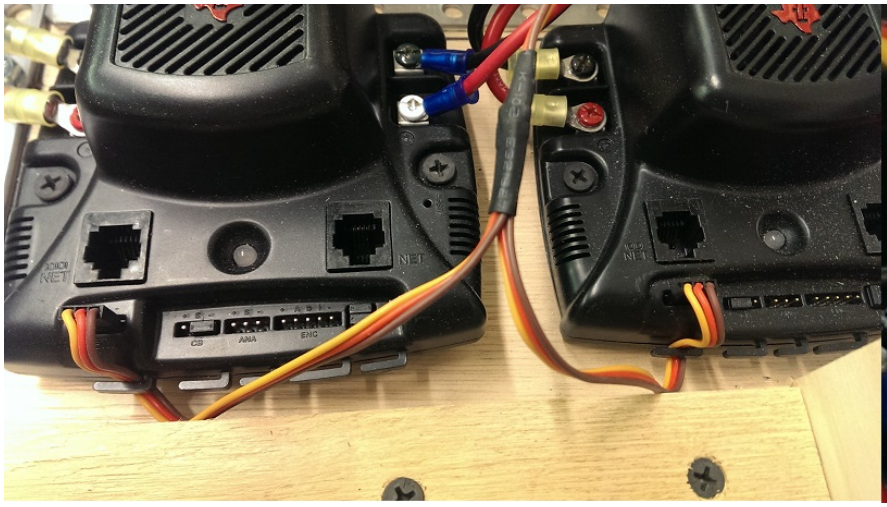
Connect PWM cables as shown in one of the two steps below, depending on the number of speed controllers on the robot.

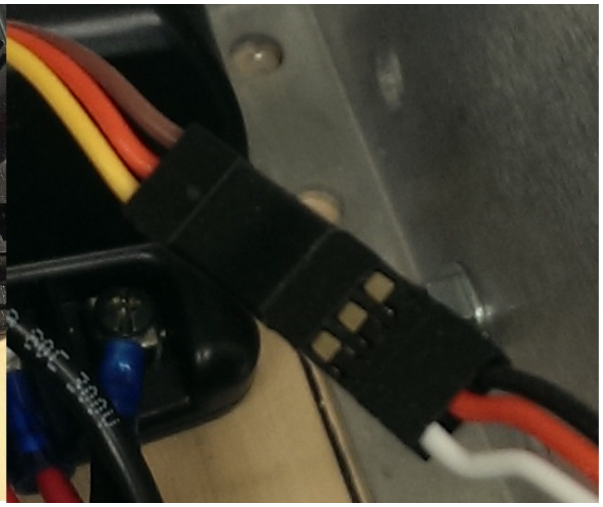
2 Controllers - PWM Cables



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.

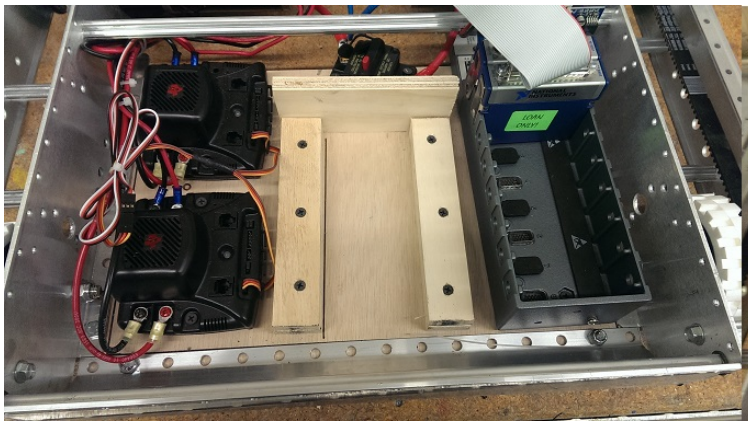
4 Controllers - PWM Cables

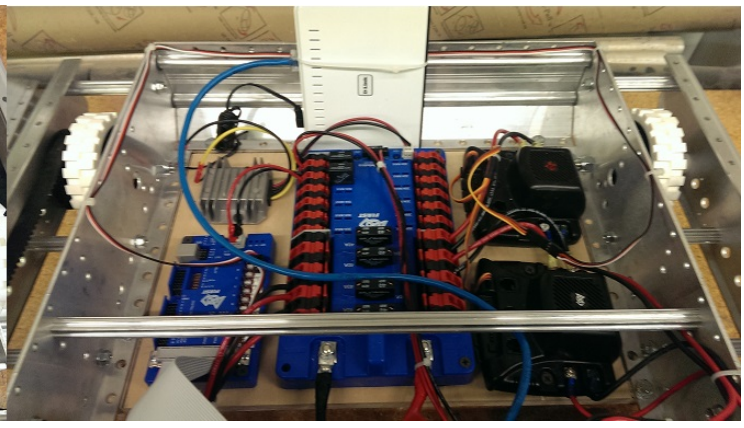




If using 4 motor controllers attach two regular PWM cables to the Digital Sidecar as shown in the 2 Controllers images above. Then attach a PWM Y-Splitter cable to the end of the extension as shown above right (Black->Brown, White->Yellow). Plug the two ends of the Y-Splitter into the pair of controllers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

Attach to Robot





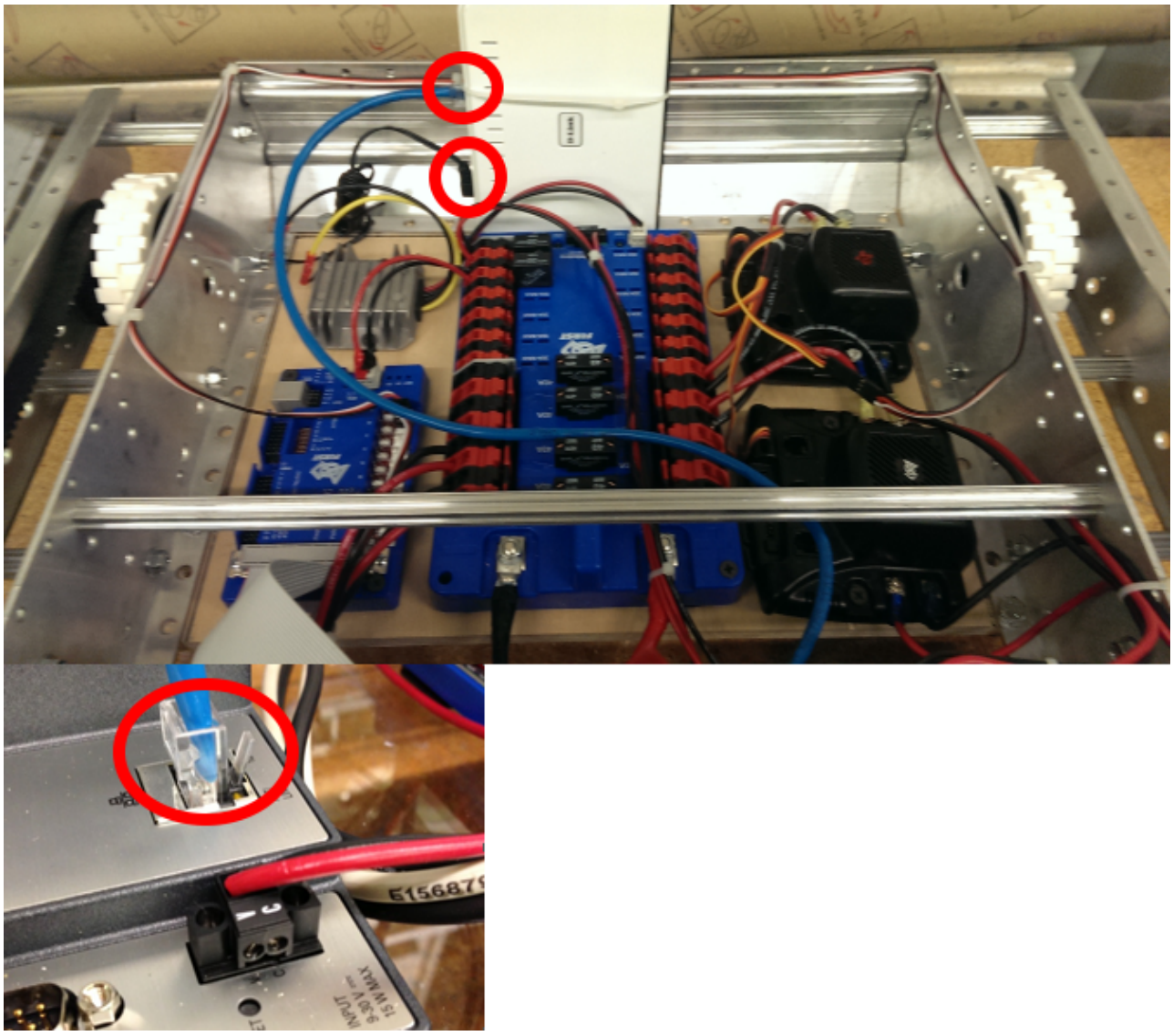
Note that if you are not putting this Control System on a robot, skip this step.

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

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.

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.

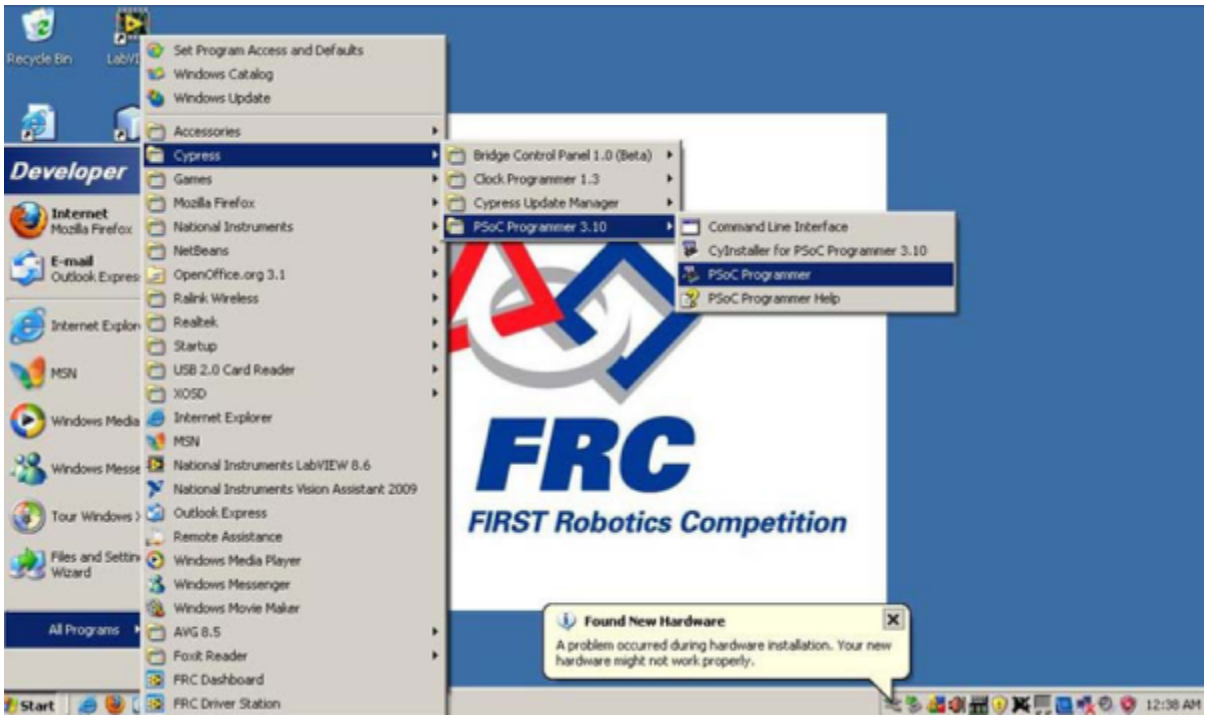
Configuring a FirstTouch I/O Module for FRC

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.

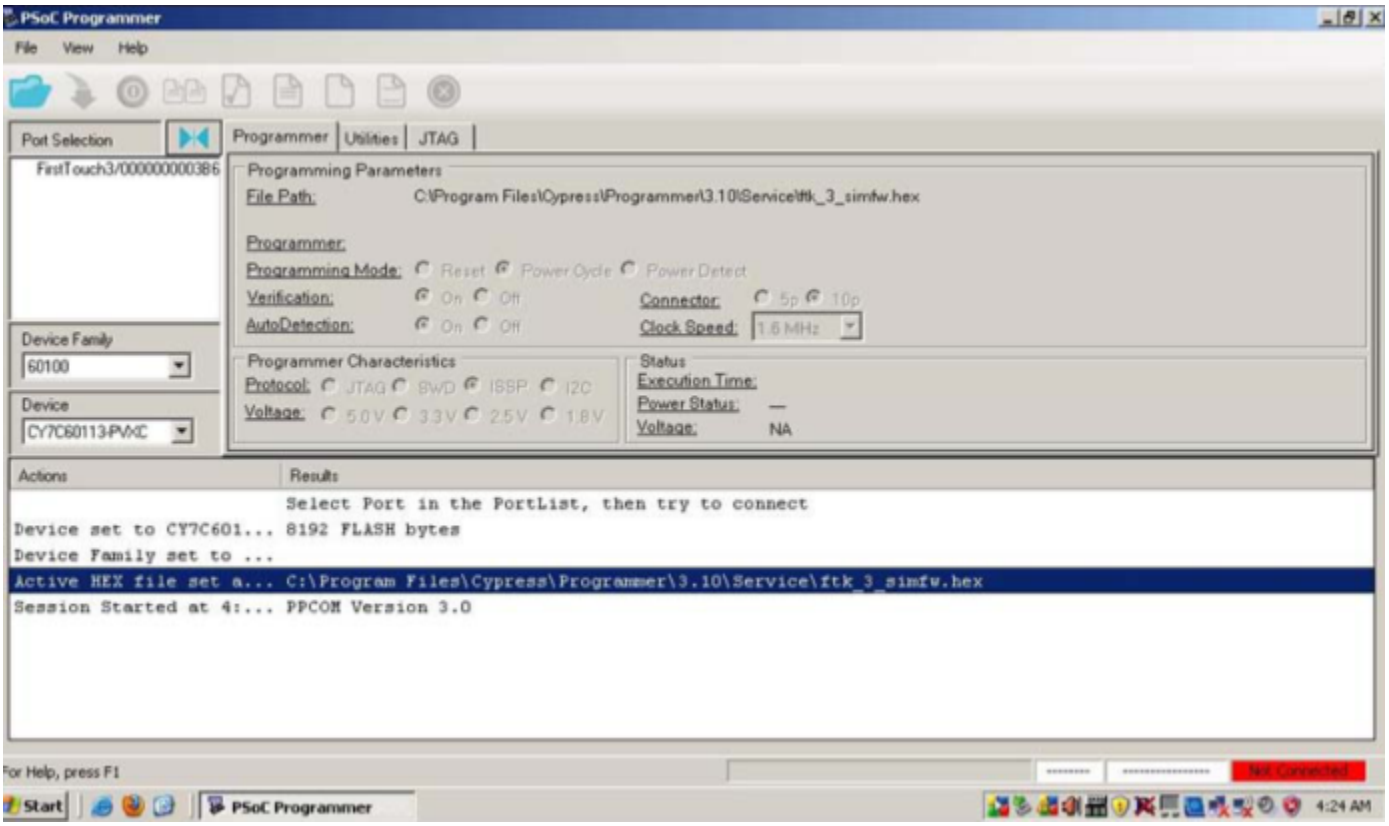
Open PSOC Programmer



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 >

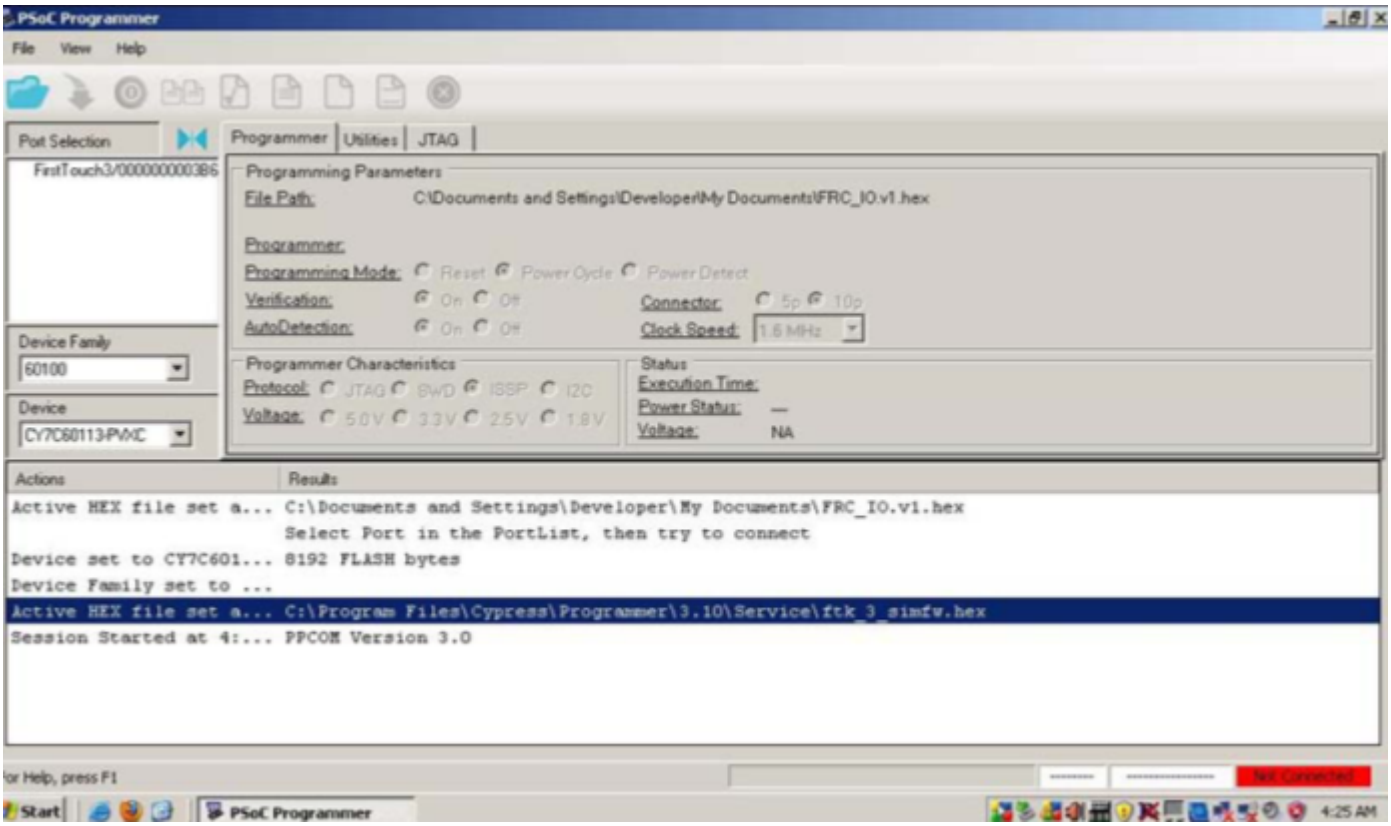
All Programs > Cypress > PSoC Programmer. If you get an Update Reminder, cancel it. Updating the PSoC Programmer will make the Driver Station unable to see the First Touch module

Load Image



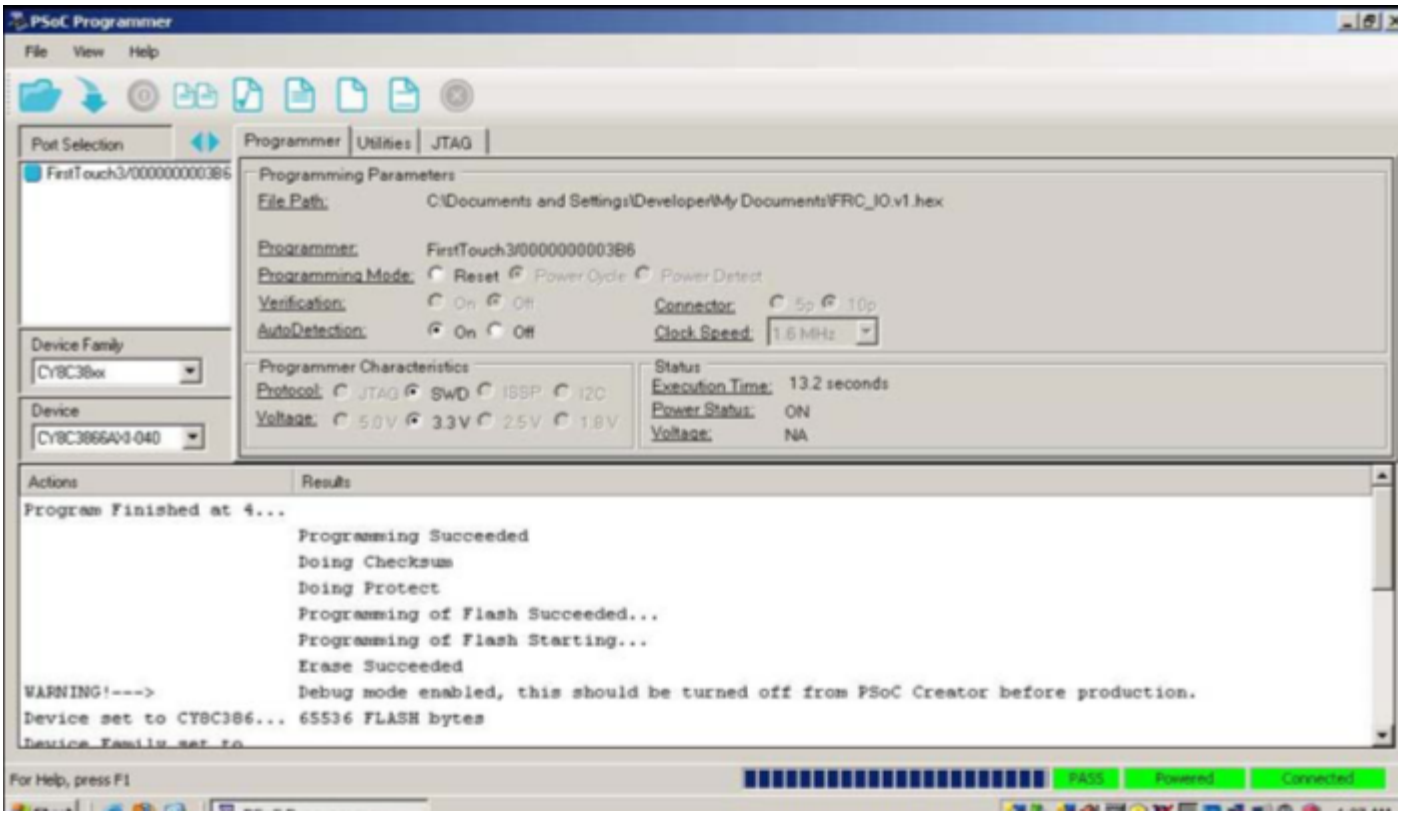
In the top left of the tool bar, you'll see a blue folder icon. Click the folder, browse to Shared or Public Documents/FRC, and select the FRC_IO.v3.hex or FRC_IO.v3.2010.hex (or latest version) file. You must select the correct firmware for the version of the module that you have. The location on the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



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 Suceeded

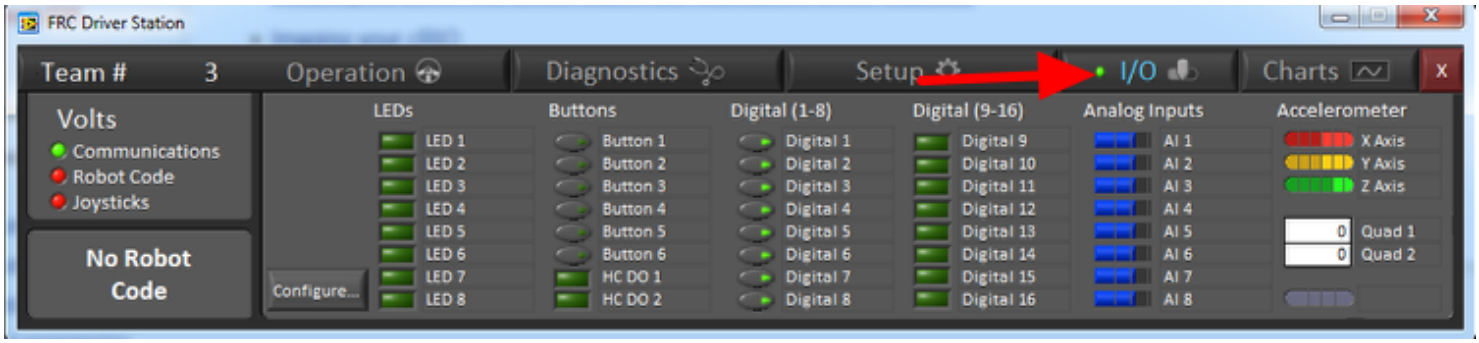


Click the program button on the tool bar, and wait for the programming operation to complete. You will see Programming Succeeded in the Results window.

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



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

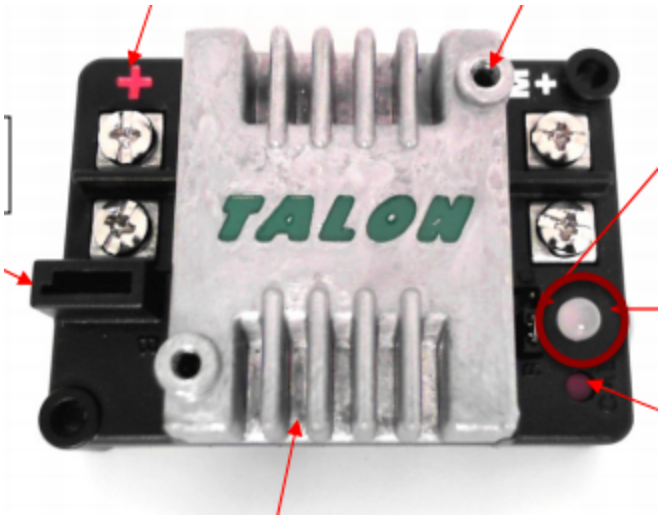
Many of the components of the FRC Control System have indicator lights that can be used to quickly diagnose problems with your robot. This guide shows each of the hardware components and describes the meaning of the indicators. Photos and information from Innovation FIRST and Cross the Road Electronics.

Jaguar speed controllers

LED State	Module Status
Normal Operating Conditions	
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 servo or Network link
Fast Flashing Yellow	Invalid CAN ID
Slow Flashing Red	Voltage, Temperature, or Limit Switch fault condition
Slow Flashing Red and Yellow	Current fault condition

LED State	Module Status
Calibration Conditions	
Fast Flashing Red and Green	Calibration mode active
Fast Flashing Red and Yellow	Calibration mode failure
Slow Flashing Green and Yellow	Calibration mode success
Slow Flashing Red and Green	Calibration mode reset to factory default settings success
Other Conditions	
Slow Flashing Green	Waiting in CAN Assignment mode

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

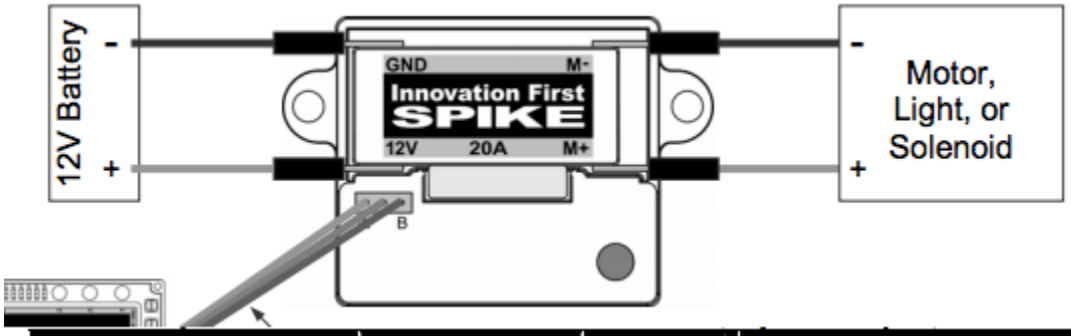
LED Indicator Status:

Green - full forward
Orange - neutral / brake
Red - full reverse
Flashing orange - no PWM signal
Flashing red/green - calibration mode
Flashing green - successful calibration
Flashing red - unsuccessful calibration

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

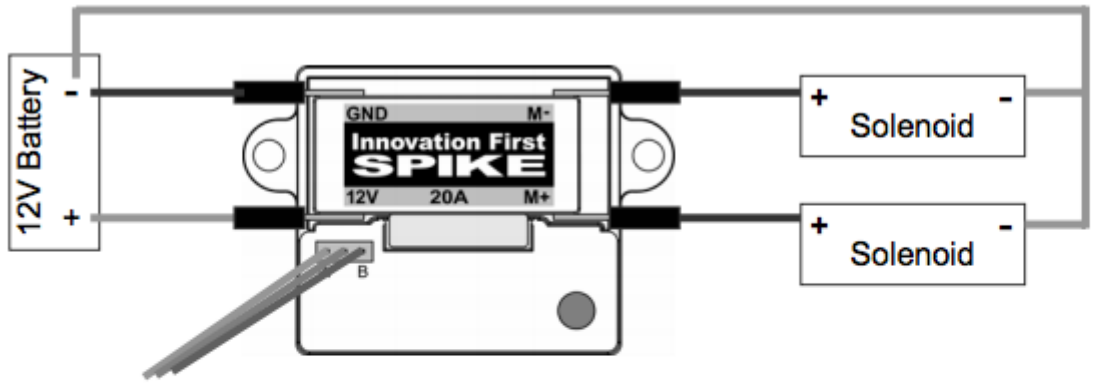


INPUTS		OUTPUTS			
Fwd(Wht)	**Rev(Red)**	**M+**	**M-**	**Indicator**	**Motor Function**
0	0	GND	GND	Orange	OFF / Brake Condition (default)
1	0	+12v	GND	Green	Motor rotates in one direction
0	1	GND	+12v	Red	Motor rotates in opposite direction
1	1	+12v	+12v	Off	OFF / Brake Condition

Notes:

1. 'Brake' refers to the dynamic stopping of the motor due to the shorting of the motor inputs. This condition is not optional when going to an off state.
2. The INPUT Fwd and Rev are defined as follows: 0 (Off) and 1 (On).

Spike relay configured as for one or two solenoids

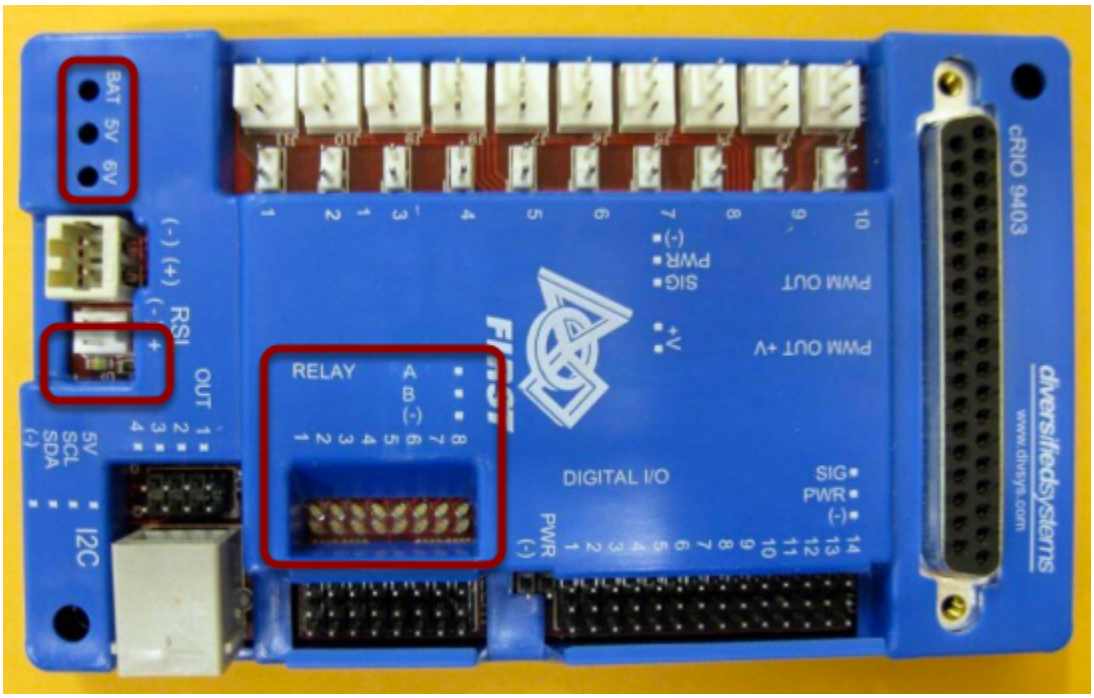


INPUT		OUTPUTS			
Fwd(Wht)	**Rev(Red)**	**M+**	**M-**	**Indicator**	**Solenoid Function**
0	0	GND	GND	Orange	Both Solenoids OFF (default)
1	0	+12v	GND	Green	Solenoid connected to M+ is ON
0	1	GND	+12v	Red	Solenoid connected to M- is ON
1	1	+12v	+12v	Off	Both Solenoids ON

Note:

1. The INPUT Fwd and Rev are defined as follows: 0 (Off) and 1 (On).

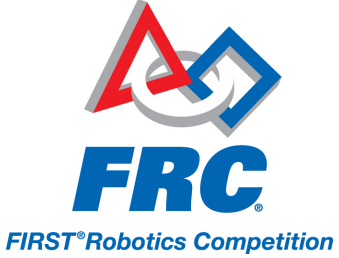
Indicators on the (DSC) Digital Sidecar



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
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



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.

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

1. E09, E11, E12, or E14 Classmate computer

2. 8GB or larger USB drive
3. 7-Zip software installed. Download here (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.

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

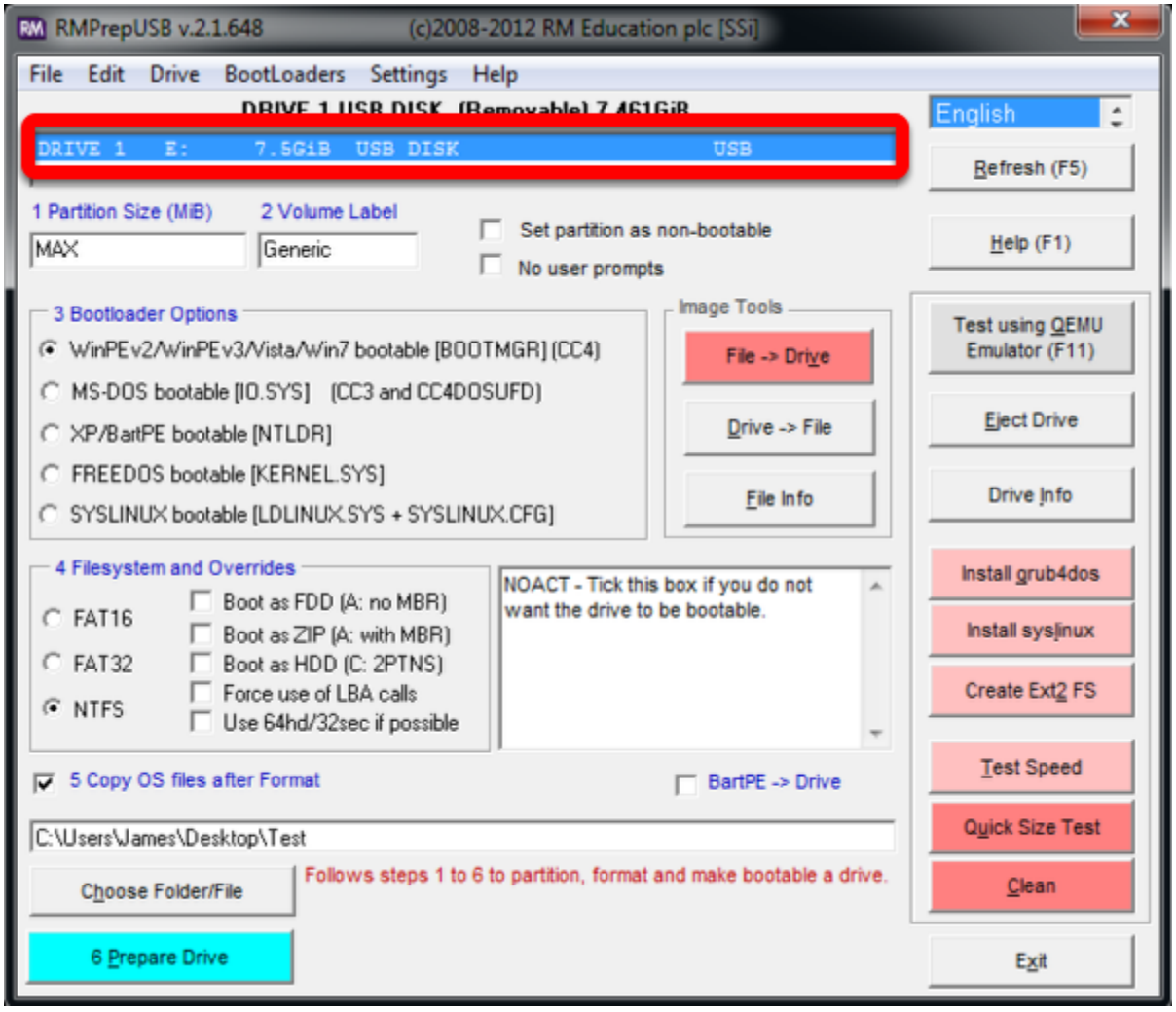
Download the Classmate image from the Intel classmate PC *FIRST* FRC System Image Portal http://www.intel.com/content/www/us/en/intel-learning-series/first-frc-image-system-overview.html There are several Classmate images available for the 2014 season. Once you have logged into the download site, select 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, separate images are necessary for each of the development environment options. The E11 and E12 have sufficient space which allows for all the development environments to be installed at the same time.

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)**

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 Preperation near the bottom of this document.

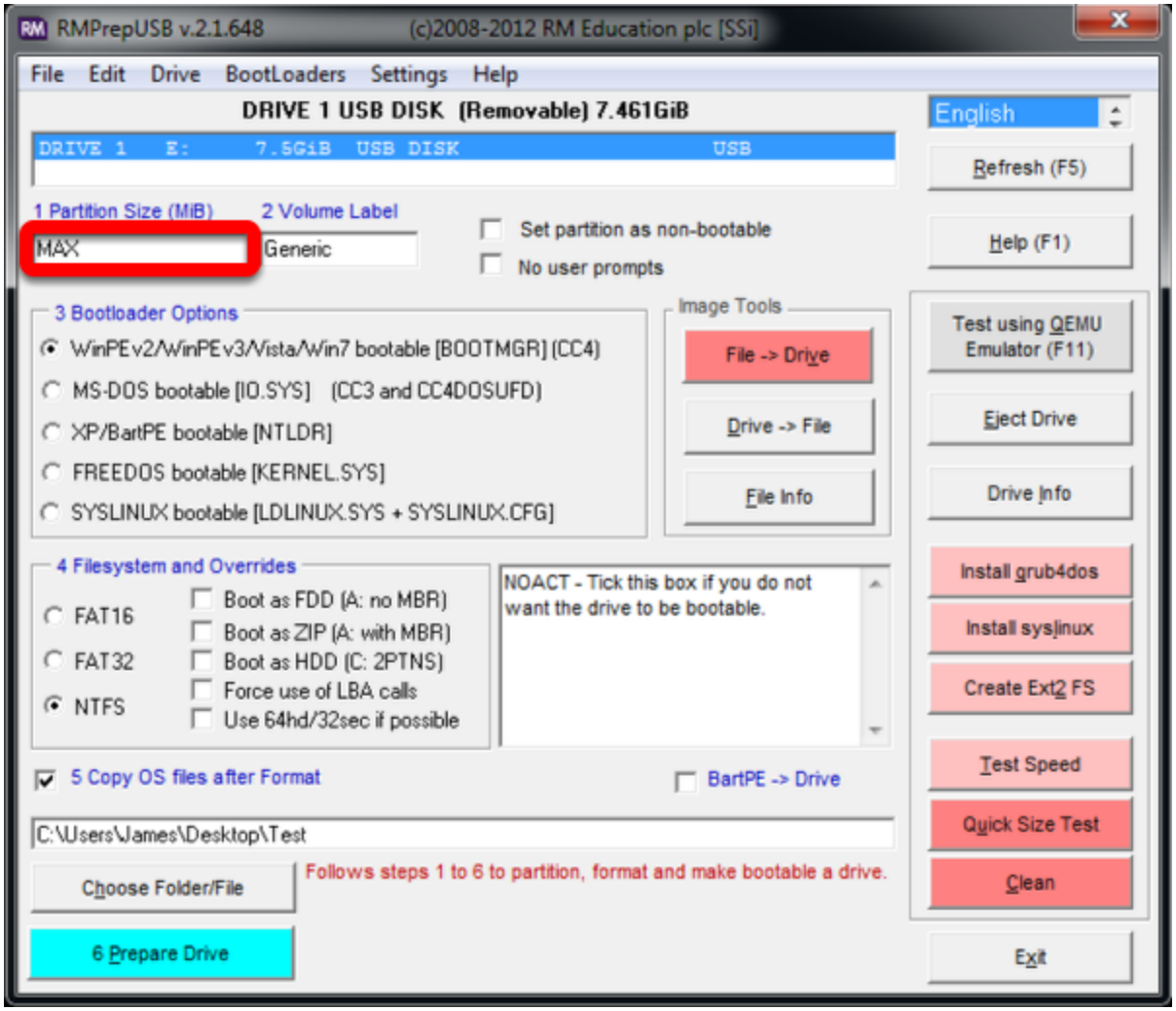
RMPrep



Start/Run RMprepUSB

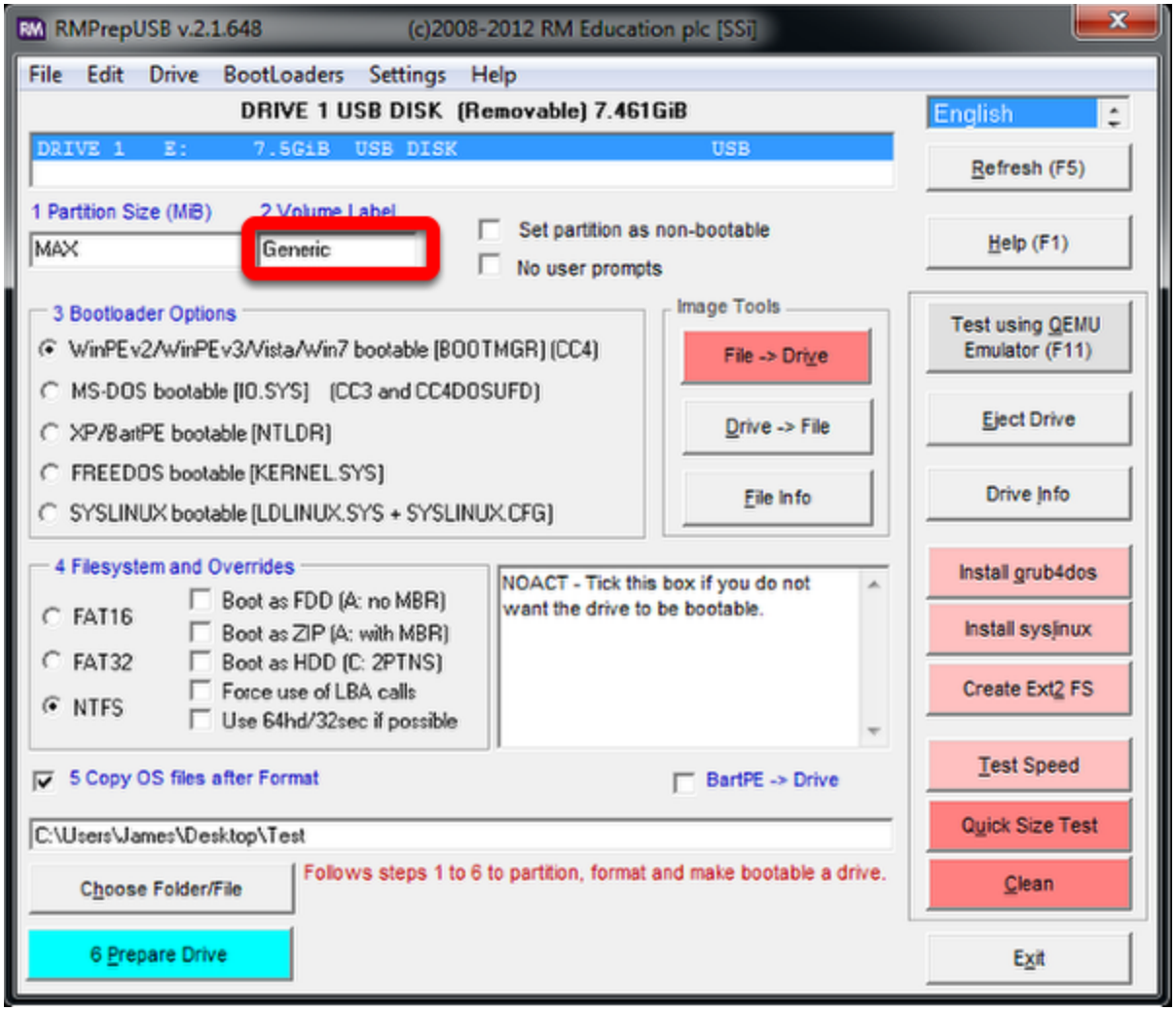
Select USB Drive

Set Partition Size



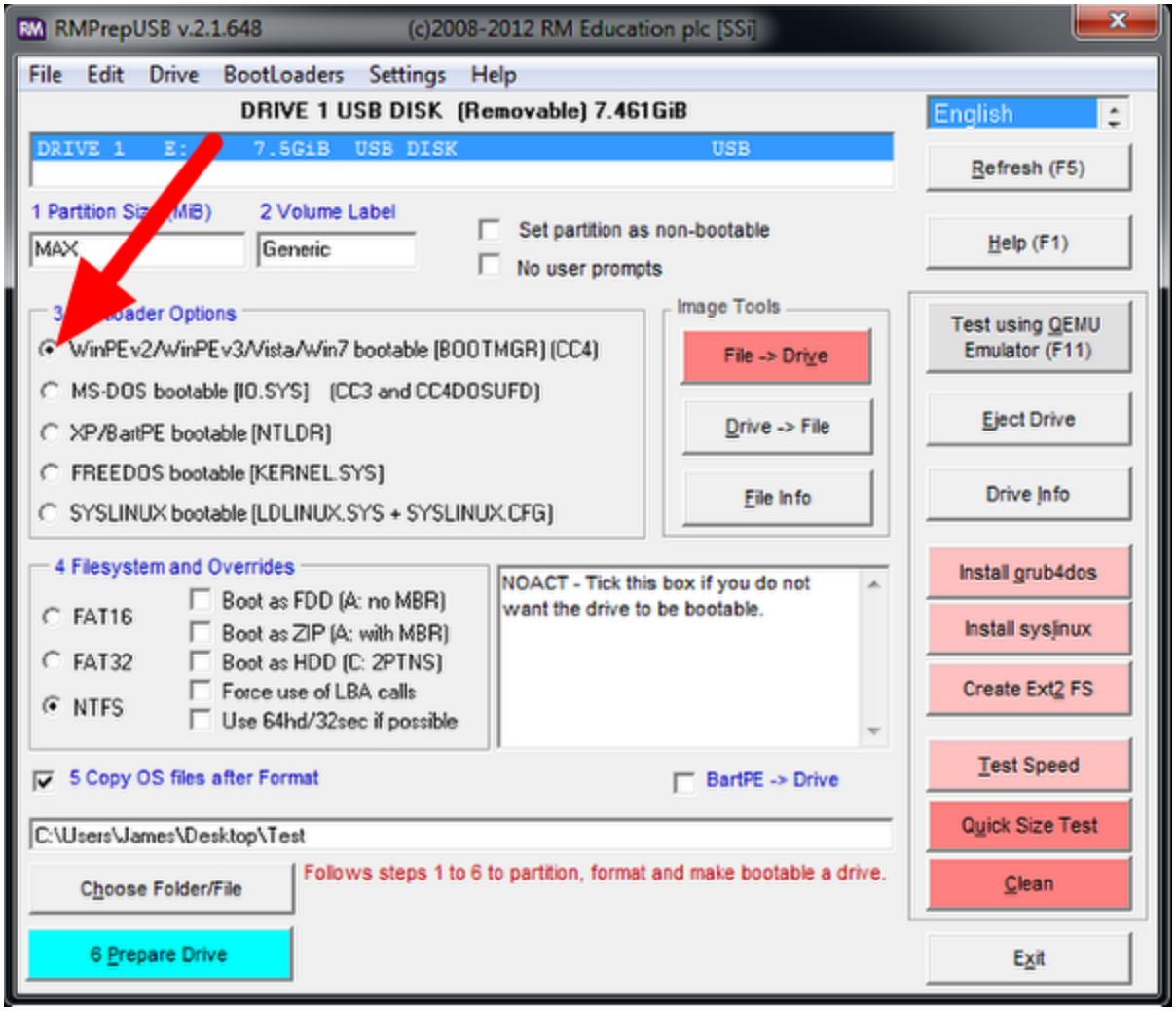
Set Partition Size to MAX

Set Volume Label



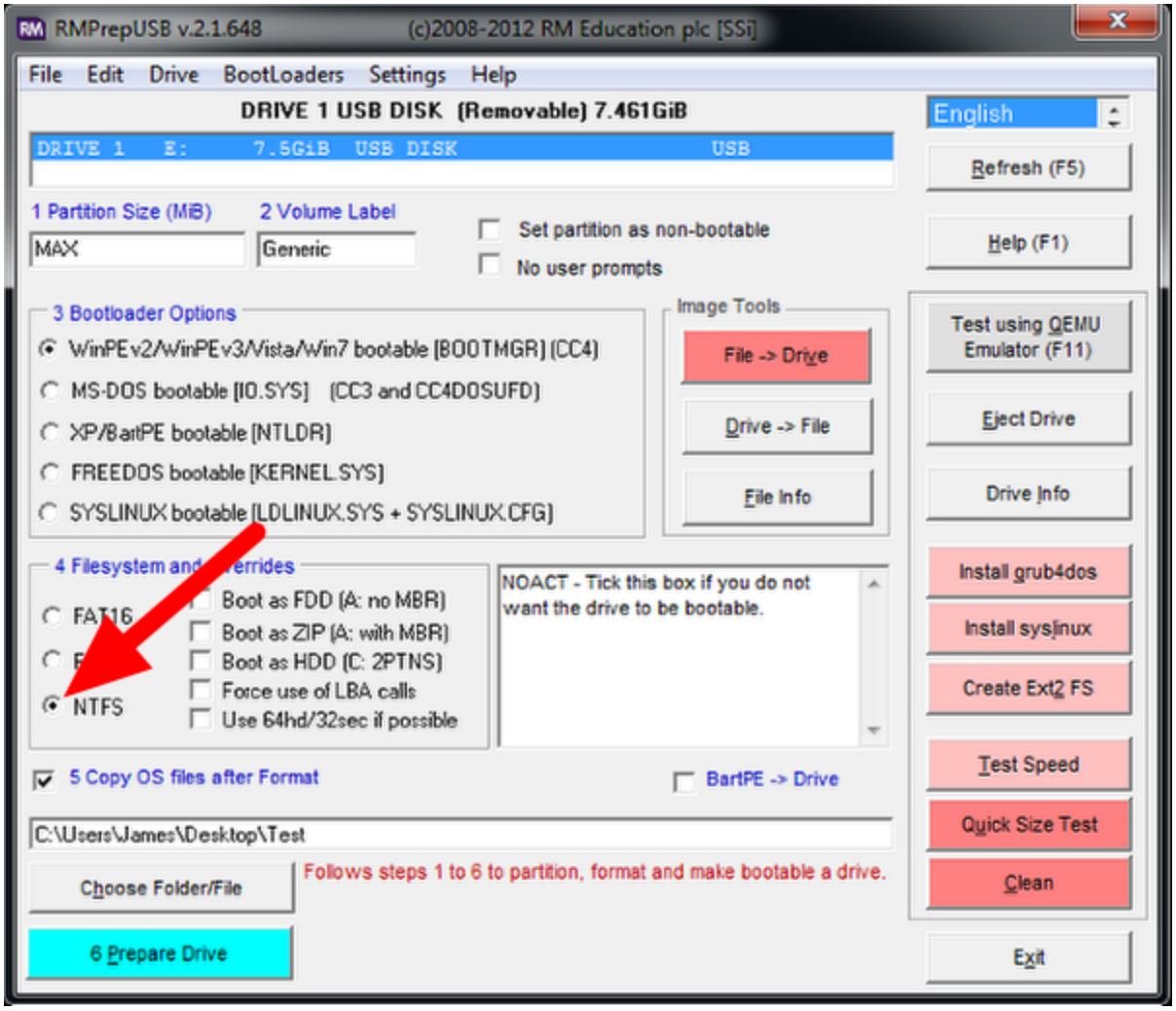
Set Volume Label to Generic

Set Bootloader Option



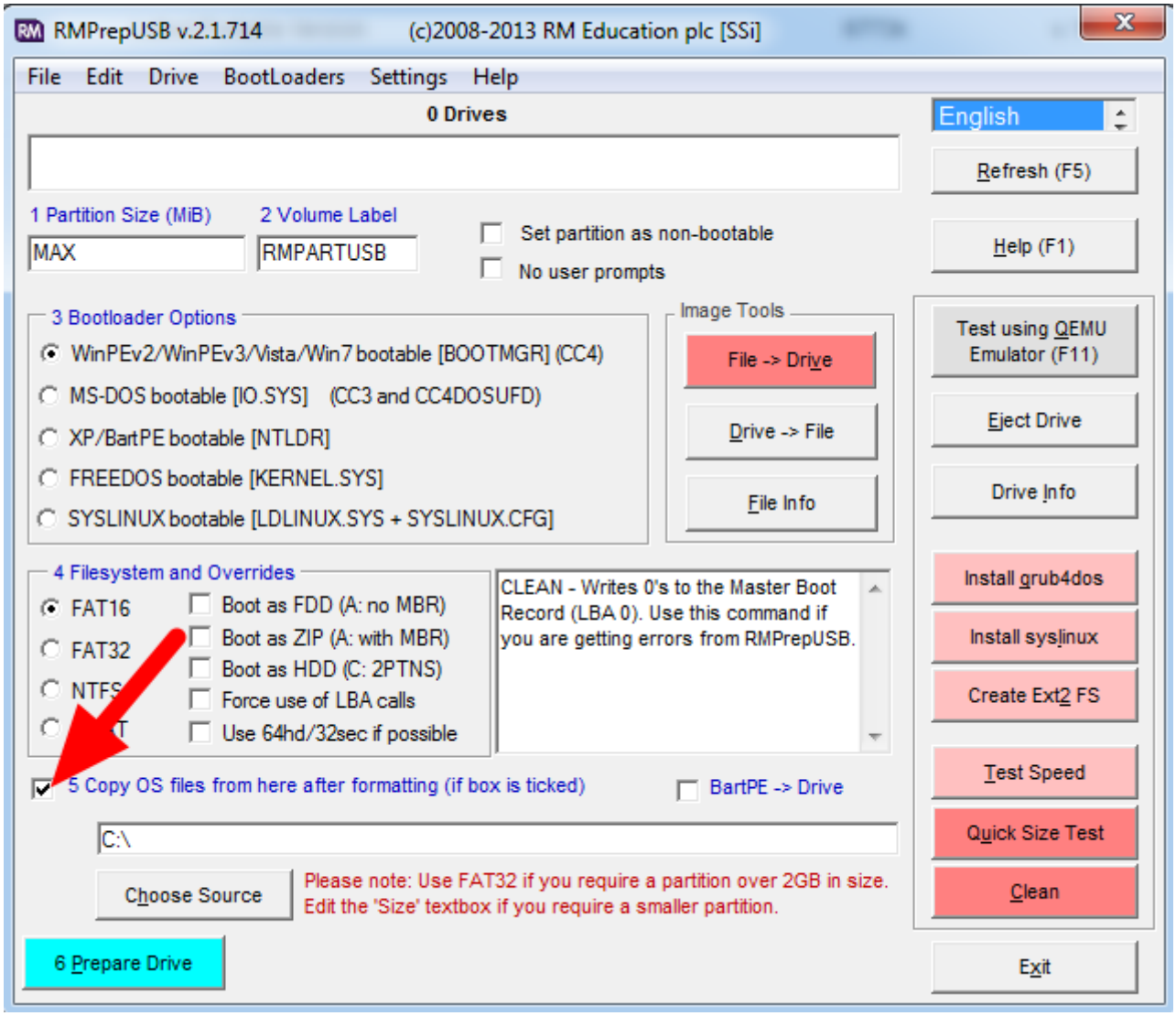
Select Bootloader Option “WinPE v2/WinPE v3/Vista/Win7 bootable”

Select Filesystem



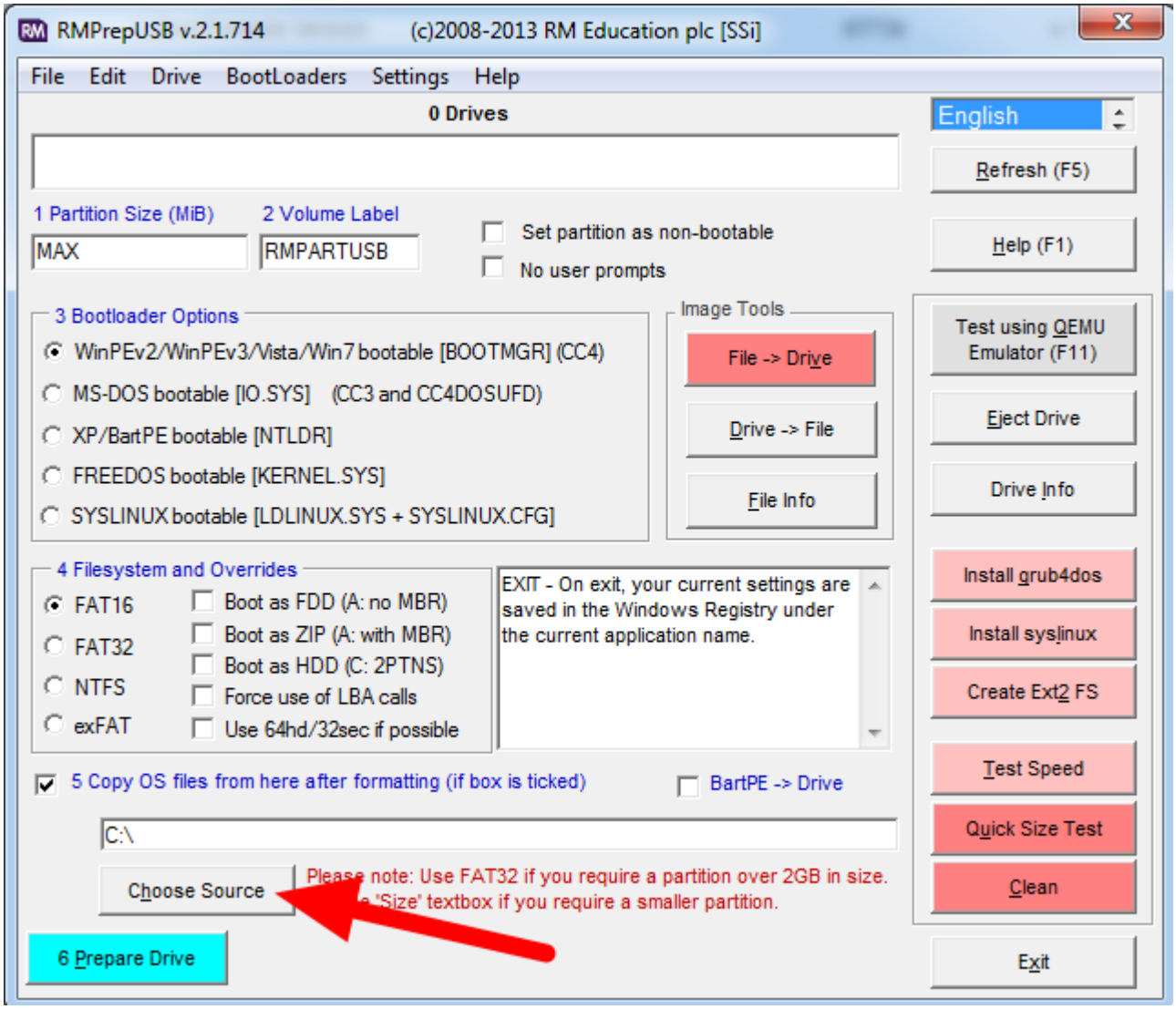
Select NTFS Filesystem

Copy OS Files Option



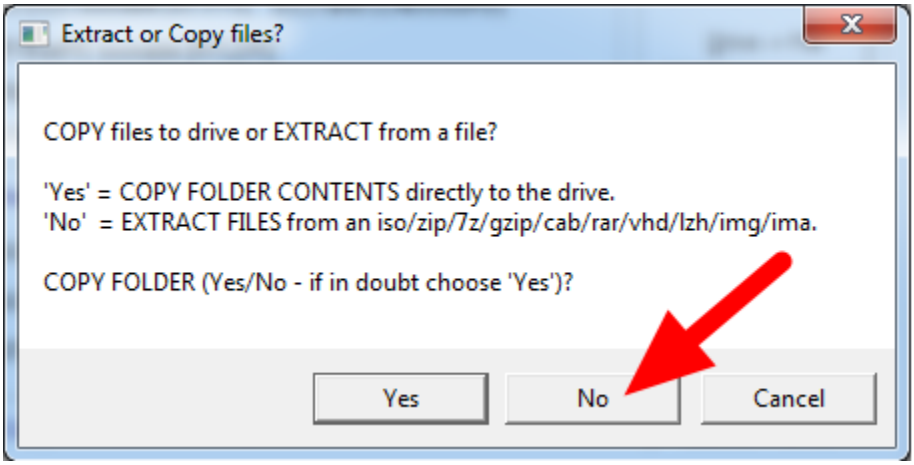
Ensure the “Copy OS files from here after formatting” box is checked

Locate Image



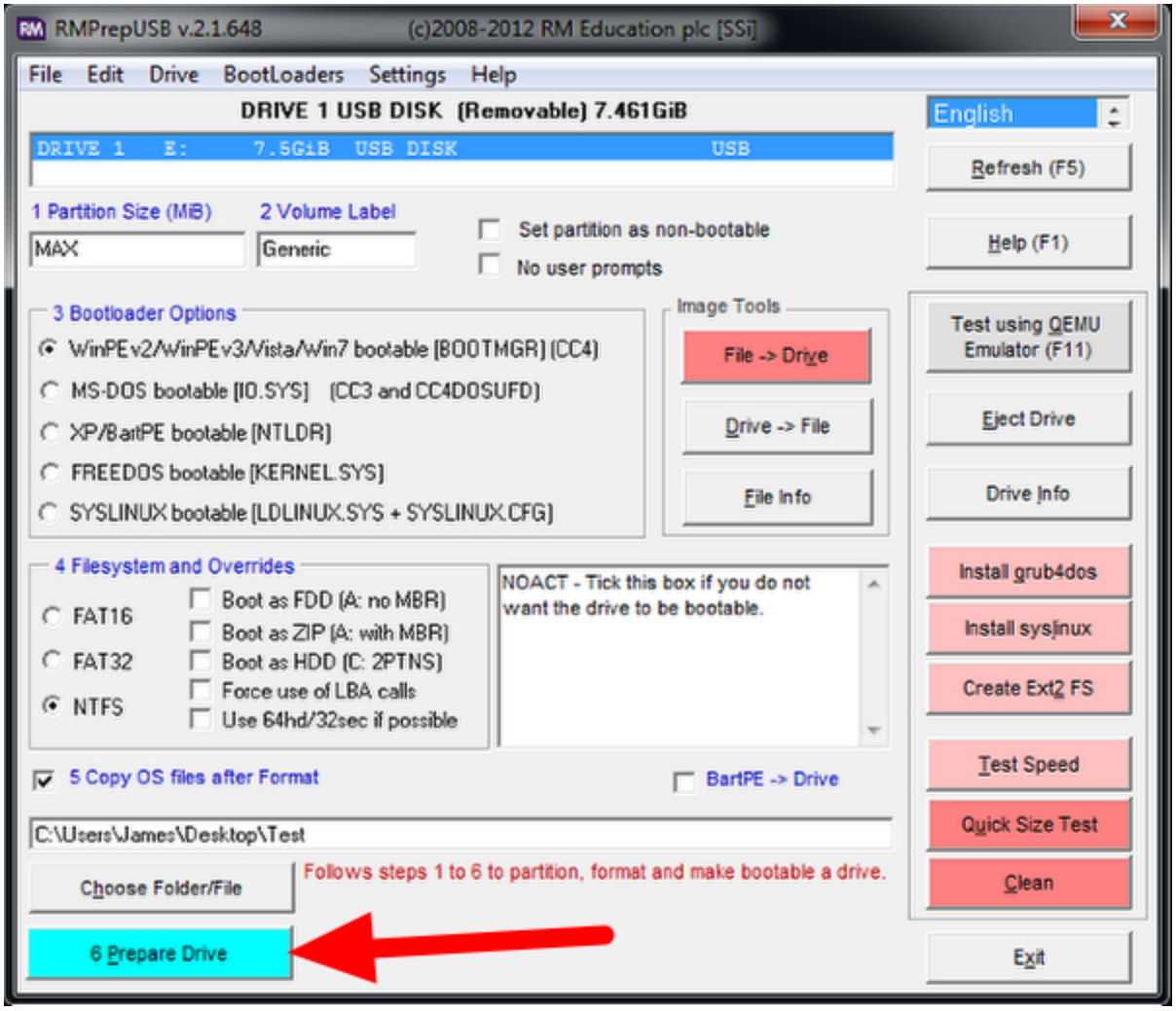
Select the “Choose Source” button

Copy Files Dialog



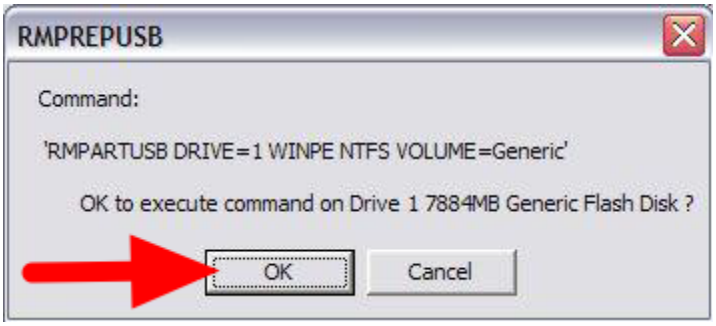
Choose “No” and select your .7z image

Prepare Drive



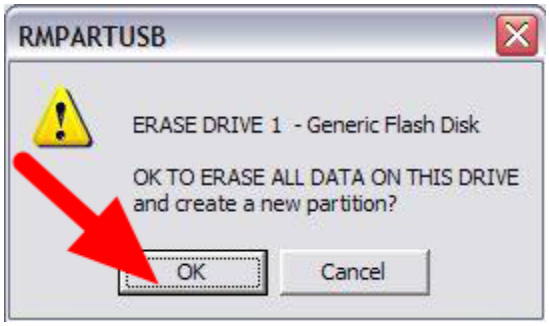
All configuration settings are now complete. Select “Prepare Drive” to begin the process

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



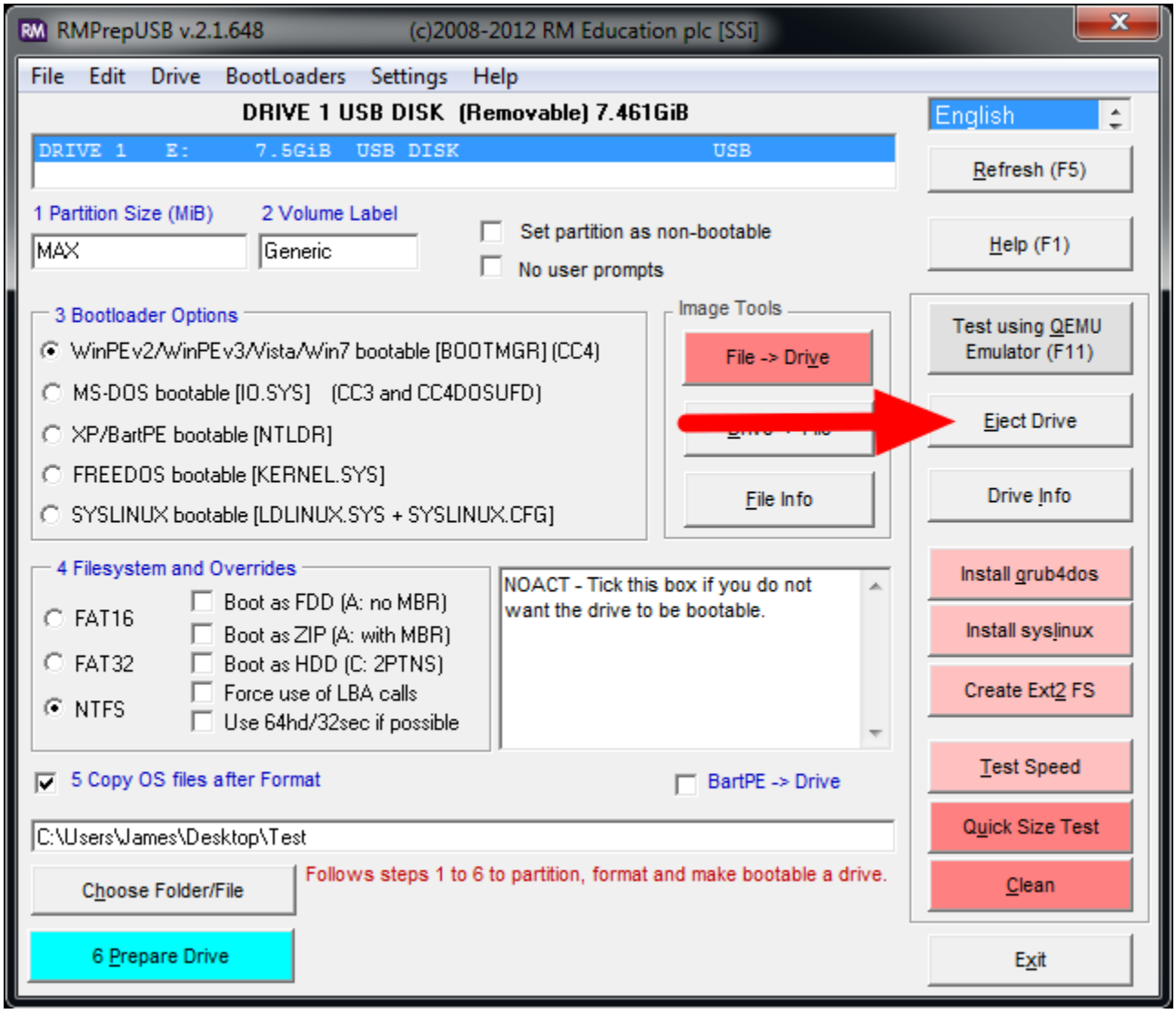
Click “OK” to format the USB drive

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



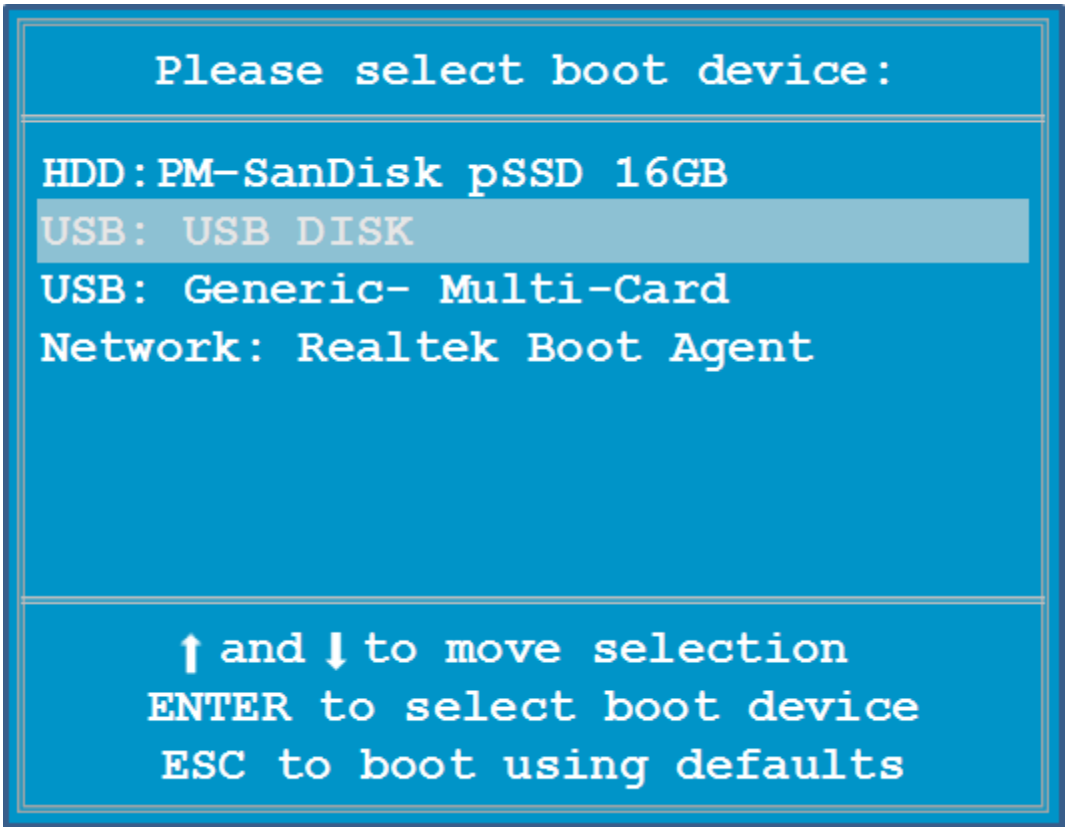
Press the “Eject Drive” button to safely remove the USB drive. The USB drive is now ready to be used to restore the image onto the Classmate PC.

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

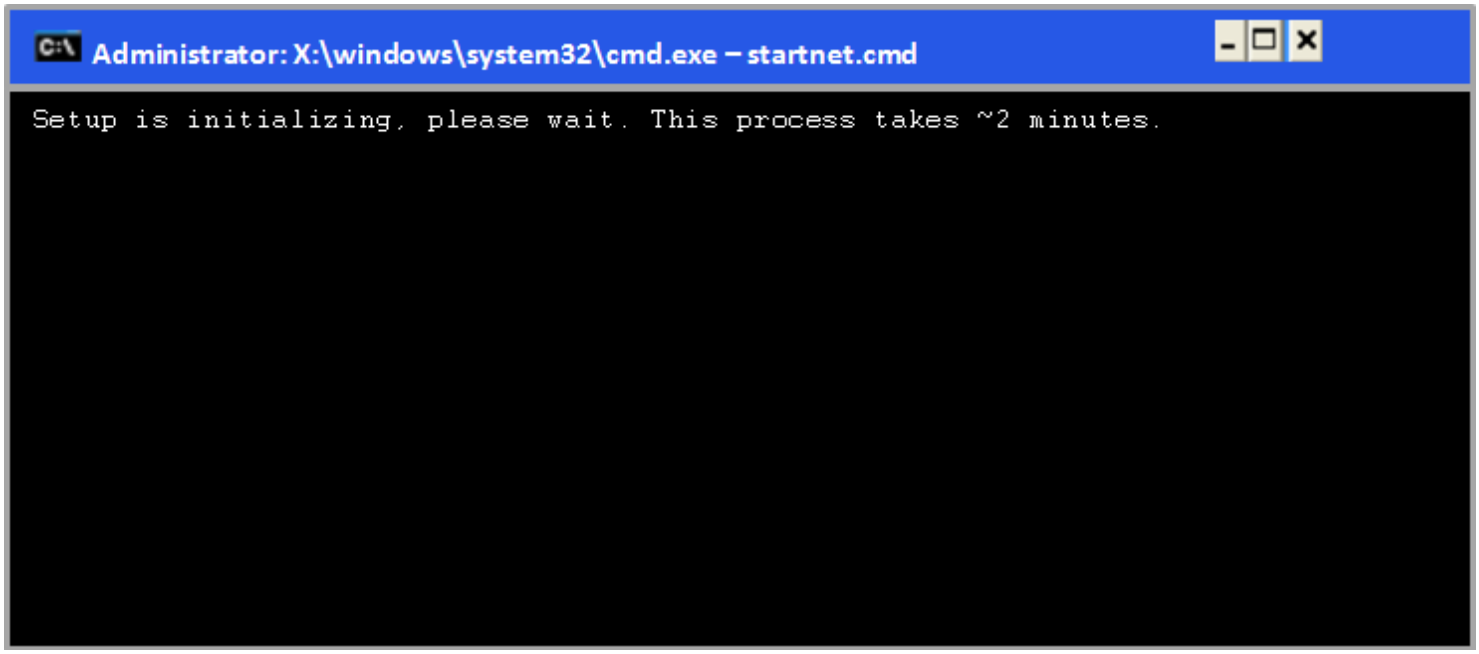
Select USB Drive



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

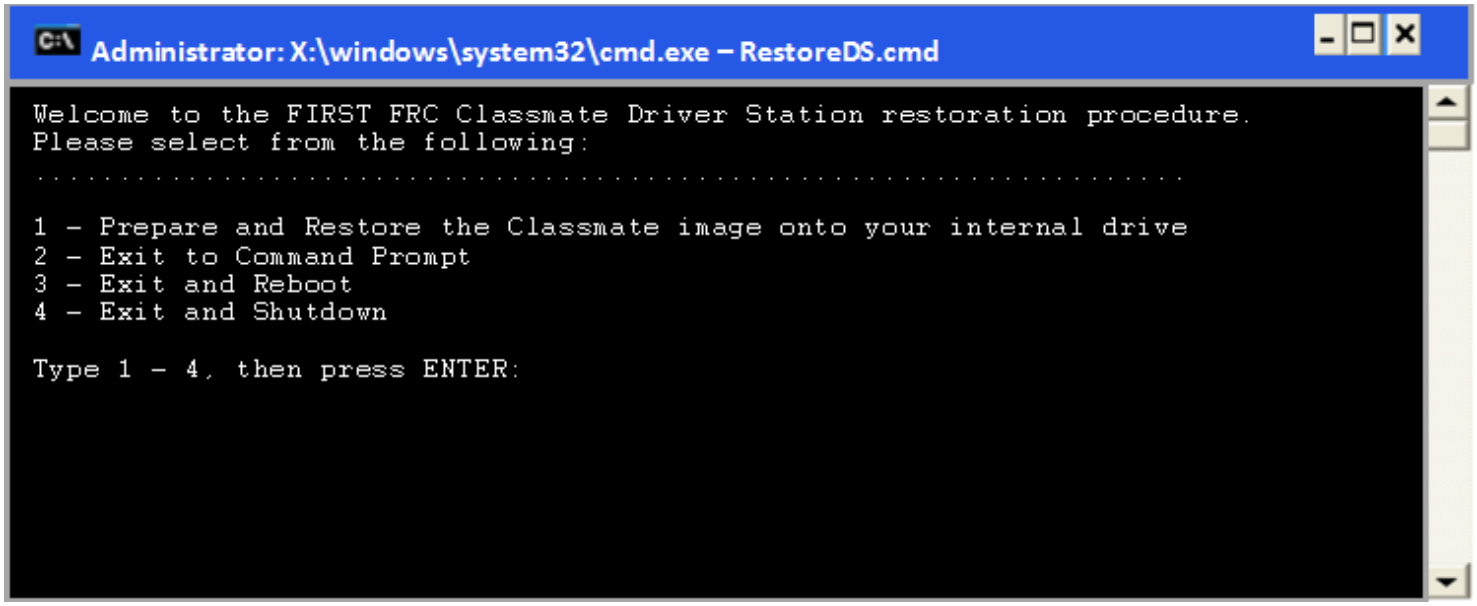
Note, the USB drive used to create this document came up listed only as “USB DISK”. Your USB device may be listed under a different name.

Setup Initializing



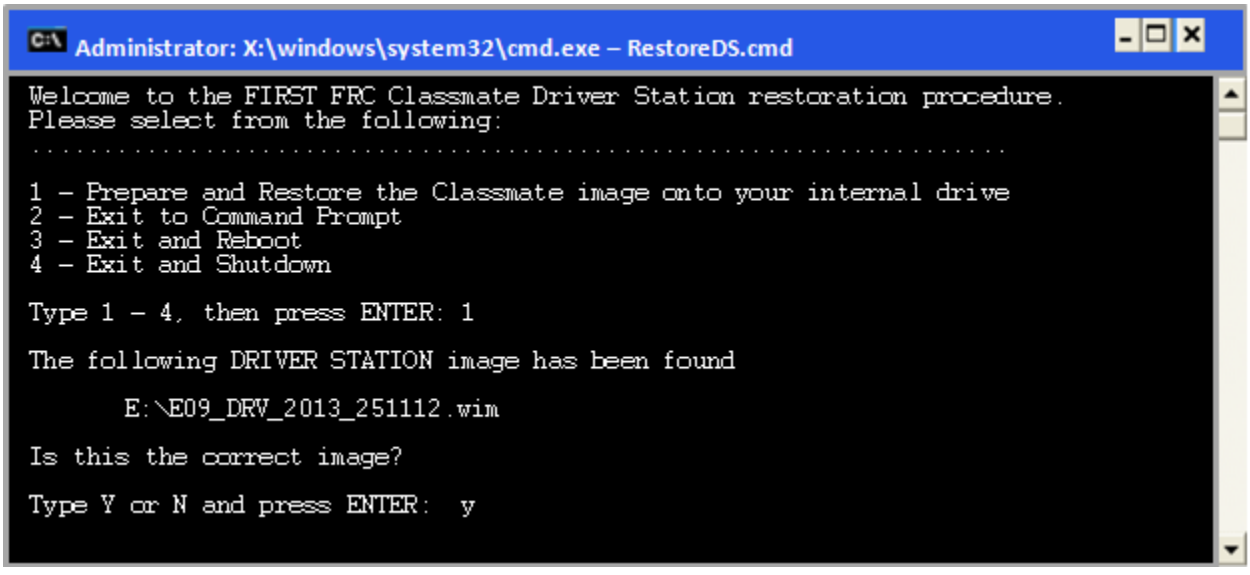
Windows setup will begin to install. This Command Prompt window will be displayed:

Main Menu



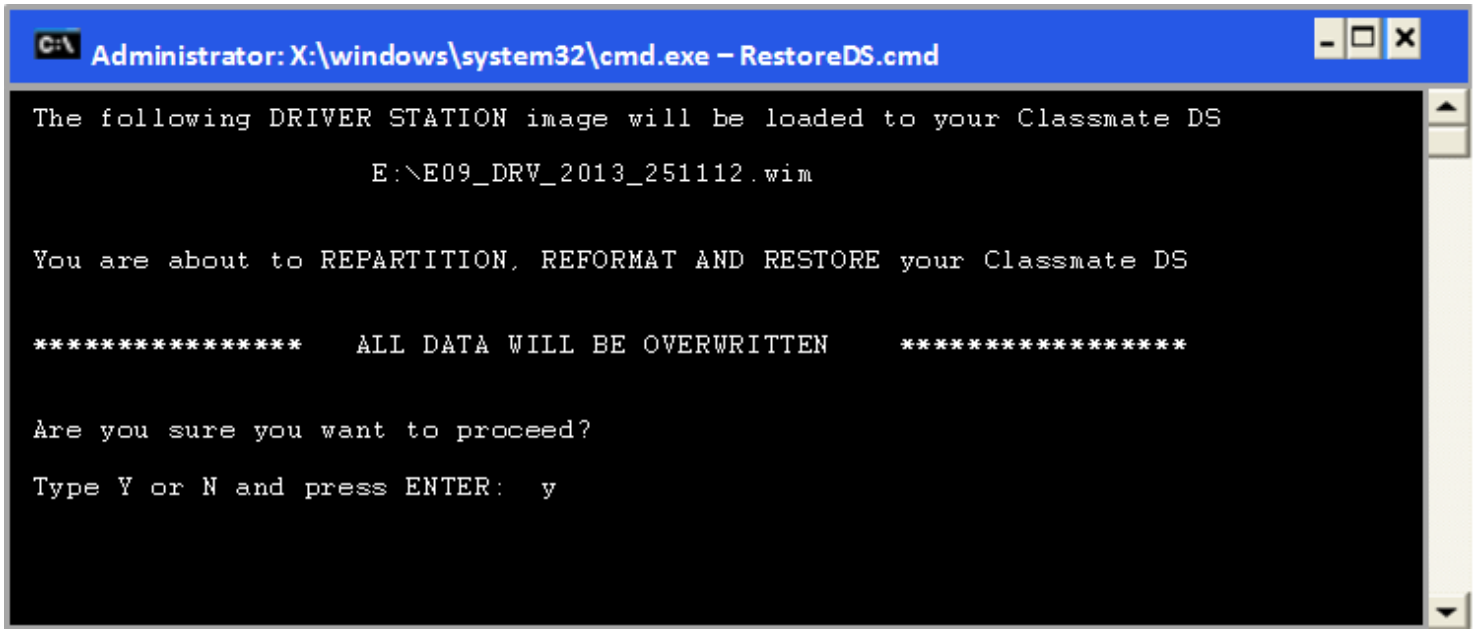
When Setup completes, the Main menu will display.Type 1 to restore the Classmate then press Enter

Image Confirmation



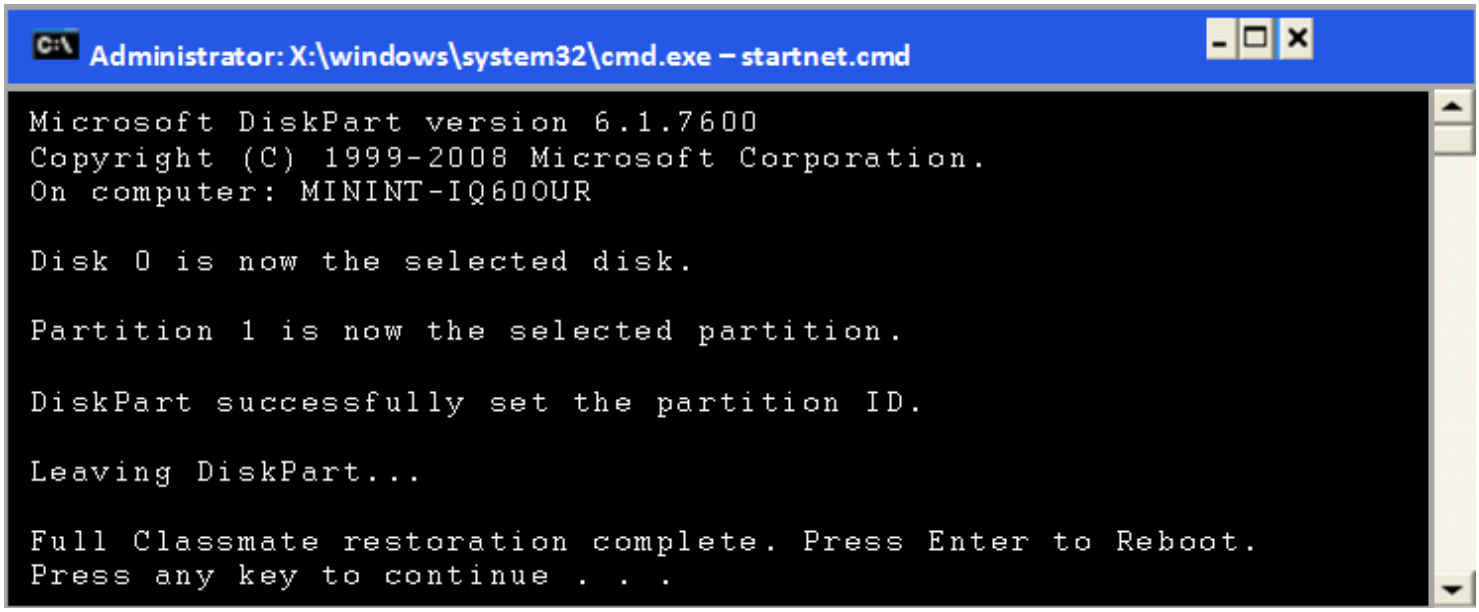
Confirm the Image is correct for your model Classmate and desired image type. Then type “Y” and press Enter. The screenshot below shows the installation for the Driver Station-only image for the E09.

Confirm Restore



Confirm the Restoration by typing “Y” then press Enter

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.

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".
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

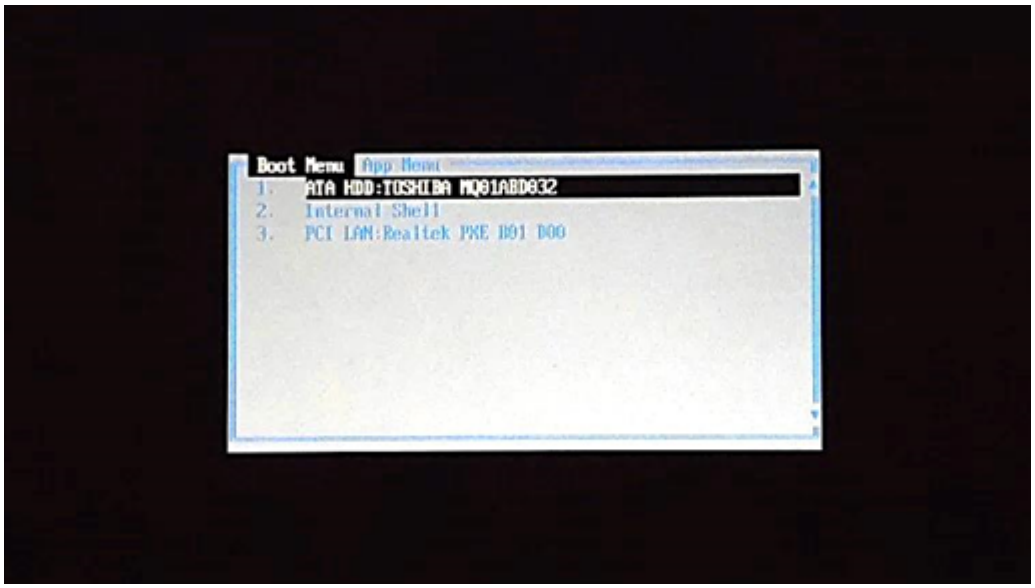
In order for the Classmates to arrive at Kickoff locations in time, they were shipped before the final version of the software was ready. It is essential that you update your classmate software before proceeding so that you are using the most updated software throughout this set up and during competition.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

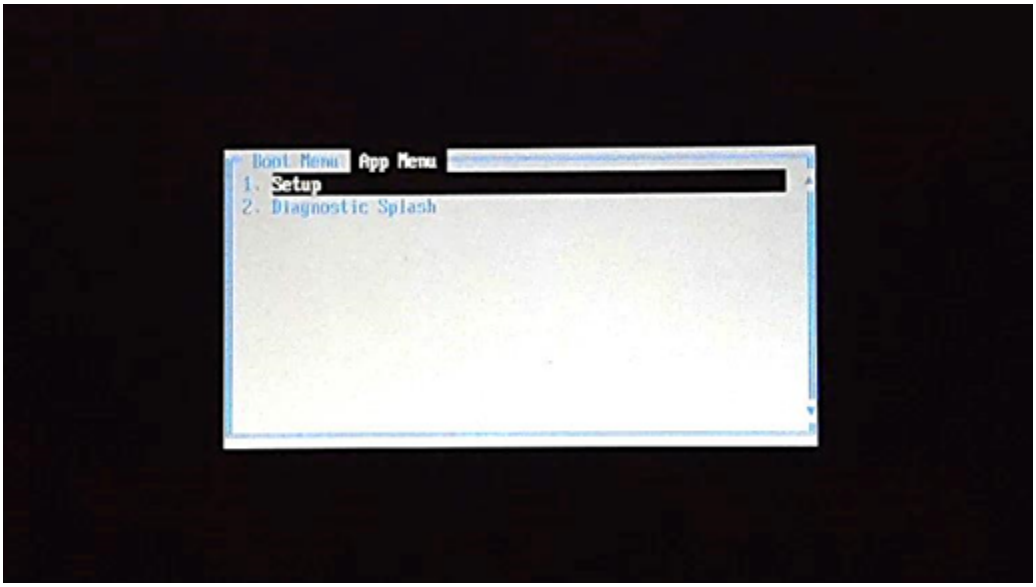
The E14 Classmate ships with UEFI SecureBoot enabled which needs to be disabled before the machine can be imaged with the FIRST provided image.

Boot Menu



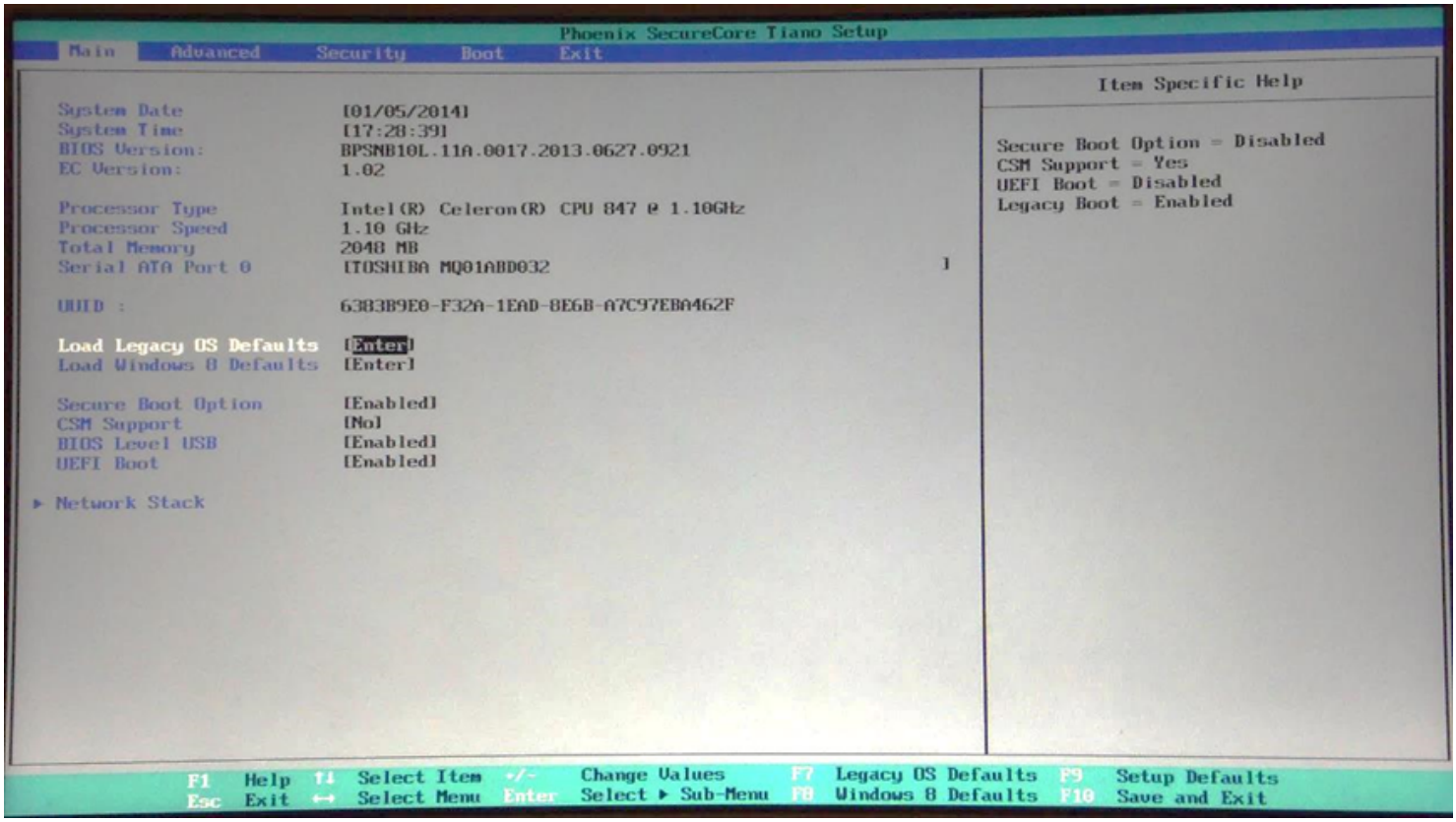
Power-up the Classmate; when the **CTL** splash screen appears repeatedly press the **F11** key to get to the *Boot Menu*

App Menu



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

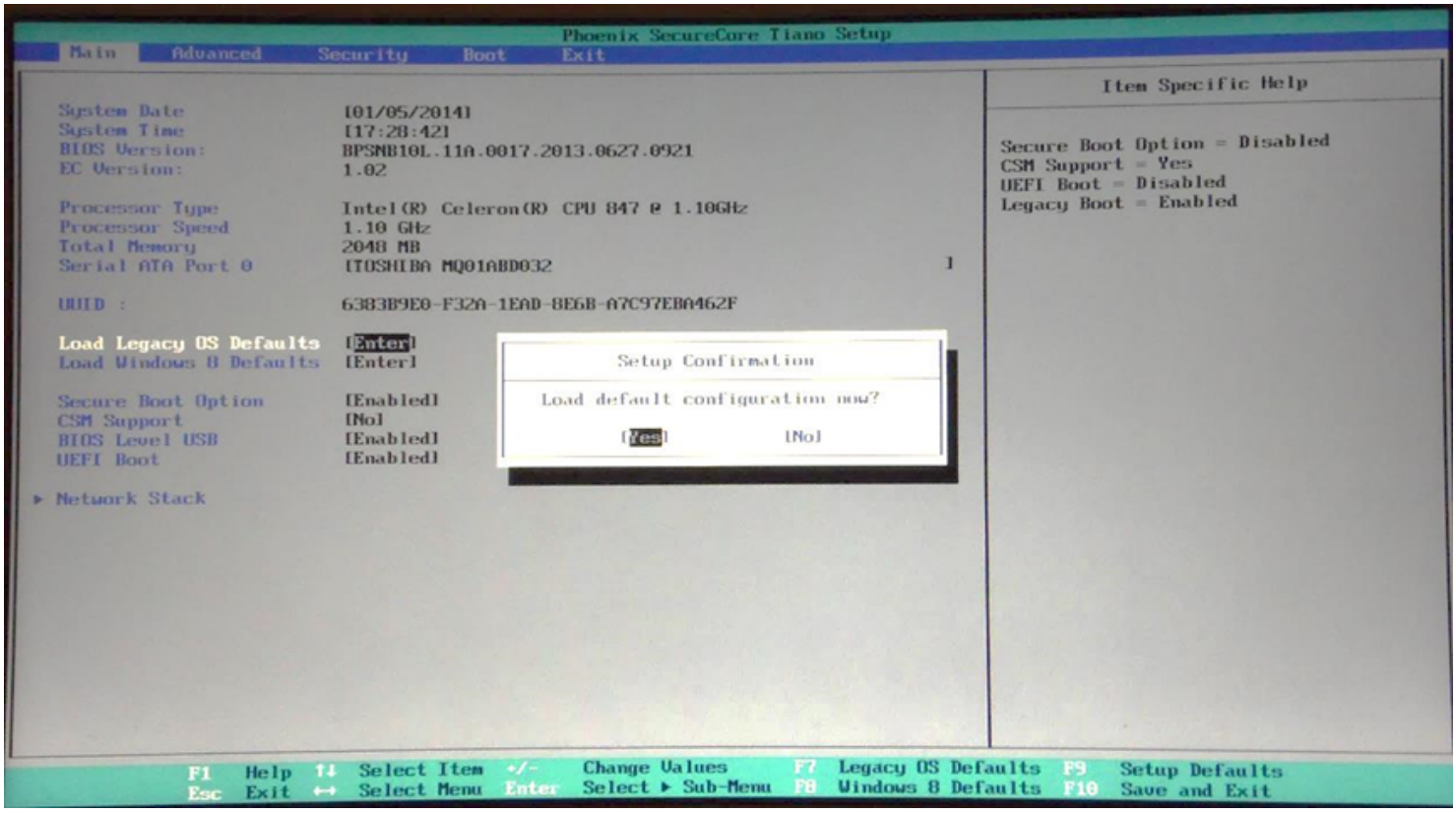
Load Legacy OS Defaults



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**

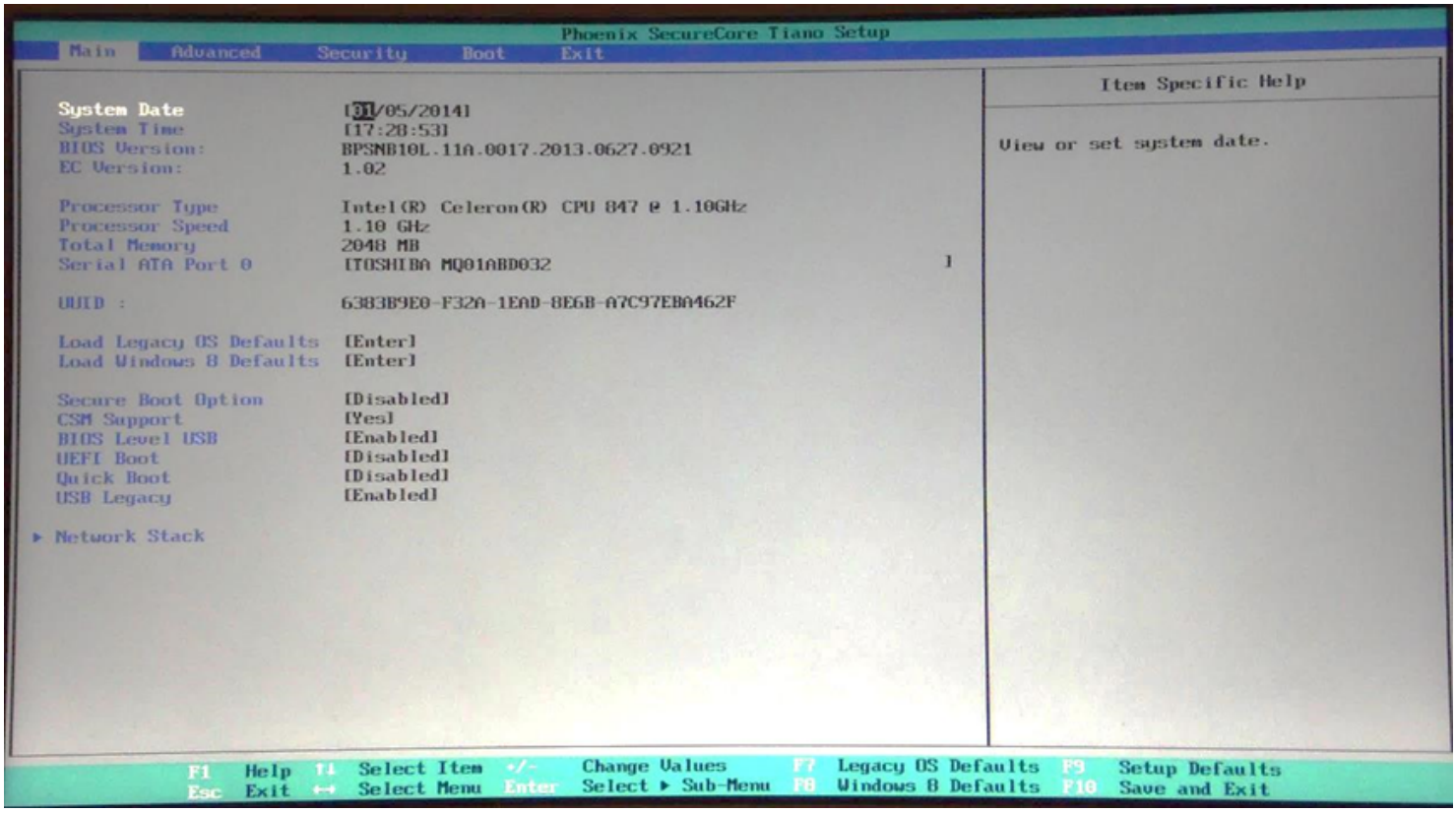
Note: The changes being made are listed in the Item Specific Help column at the right side of the screen

Confirm



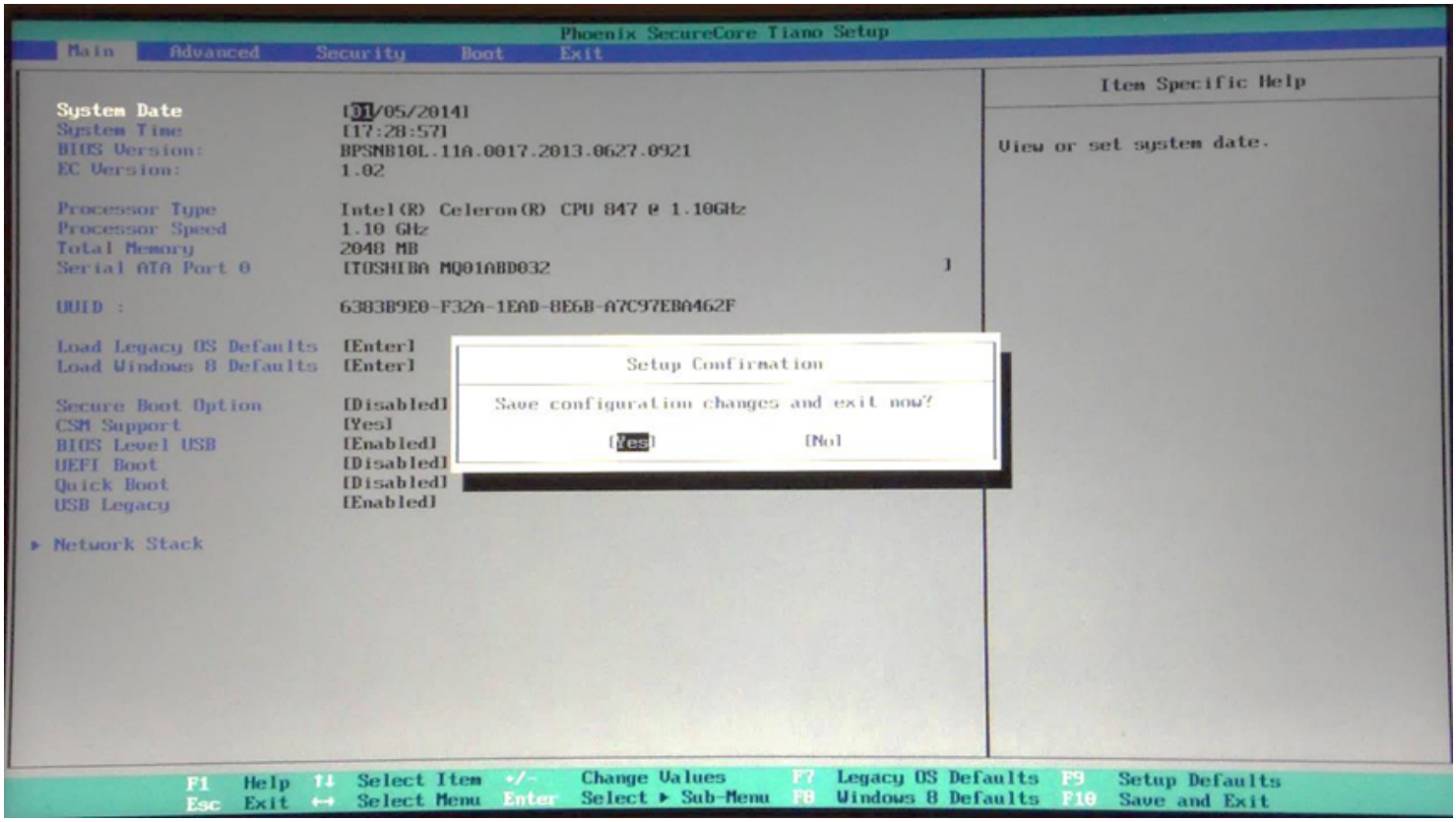
Press **Enter** to confirm

Save Changes



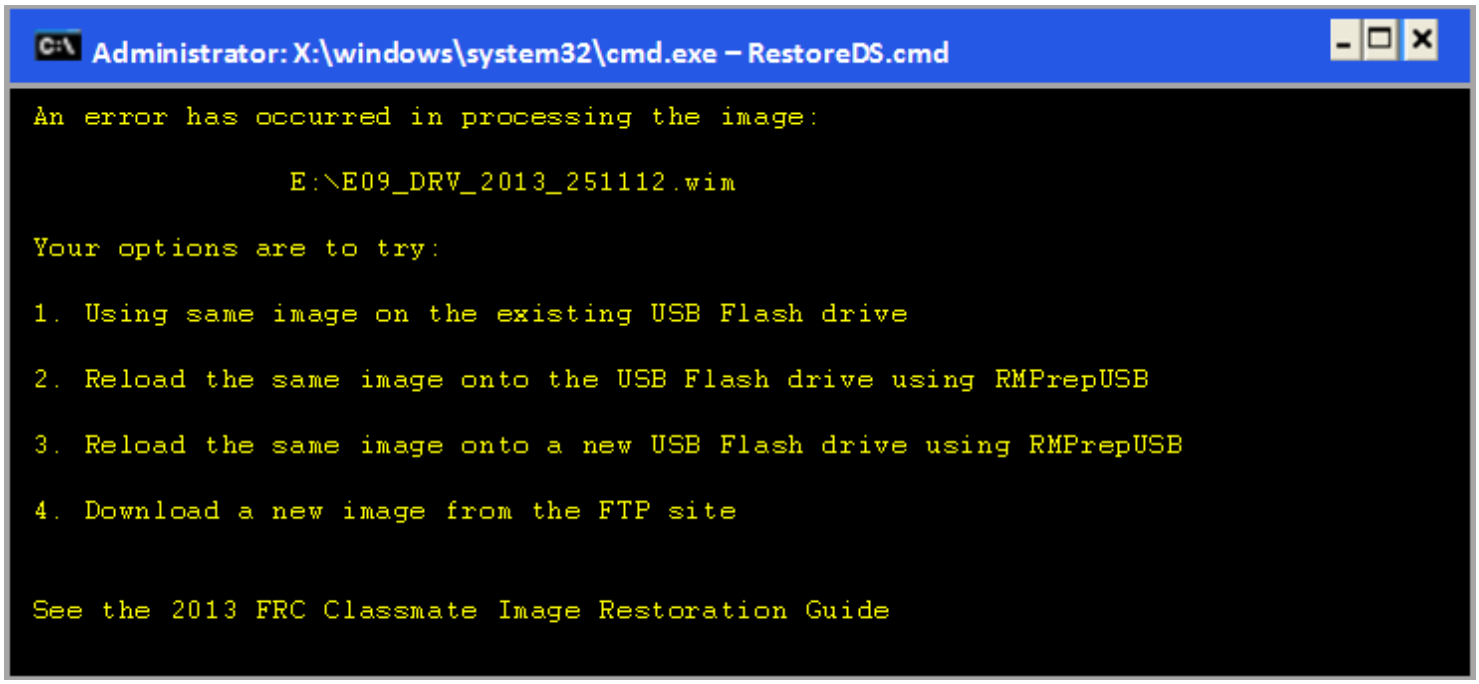
Press **F10** to Save the changes and Exit the Setup application

Confirm



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

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 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.

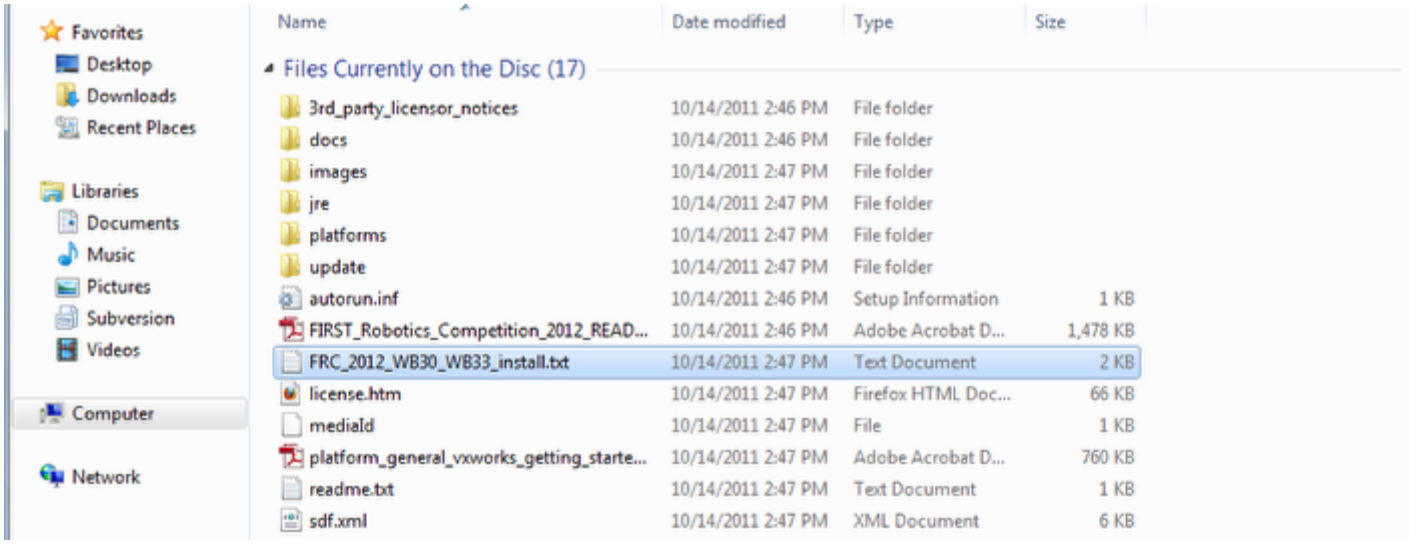
Option 4

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

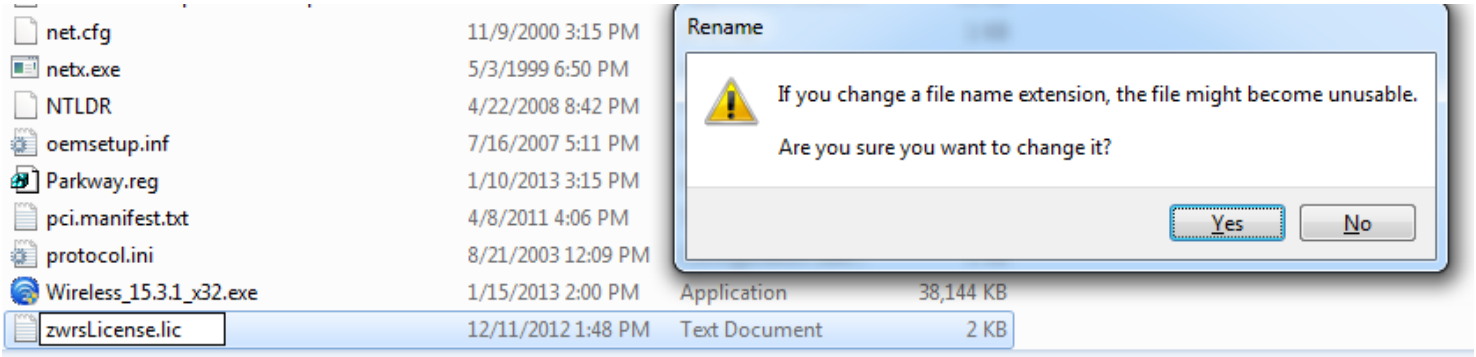
Due to timing constraints the copy of Wind River Workbench included on Classmate Images was activated using the 2013 license. This license will expire on January 31st, 2014. This article details how to activate the software using the 2014 license from the disc provided in your Kit of Parts.

Locating the 2014 License file



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).

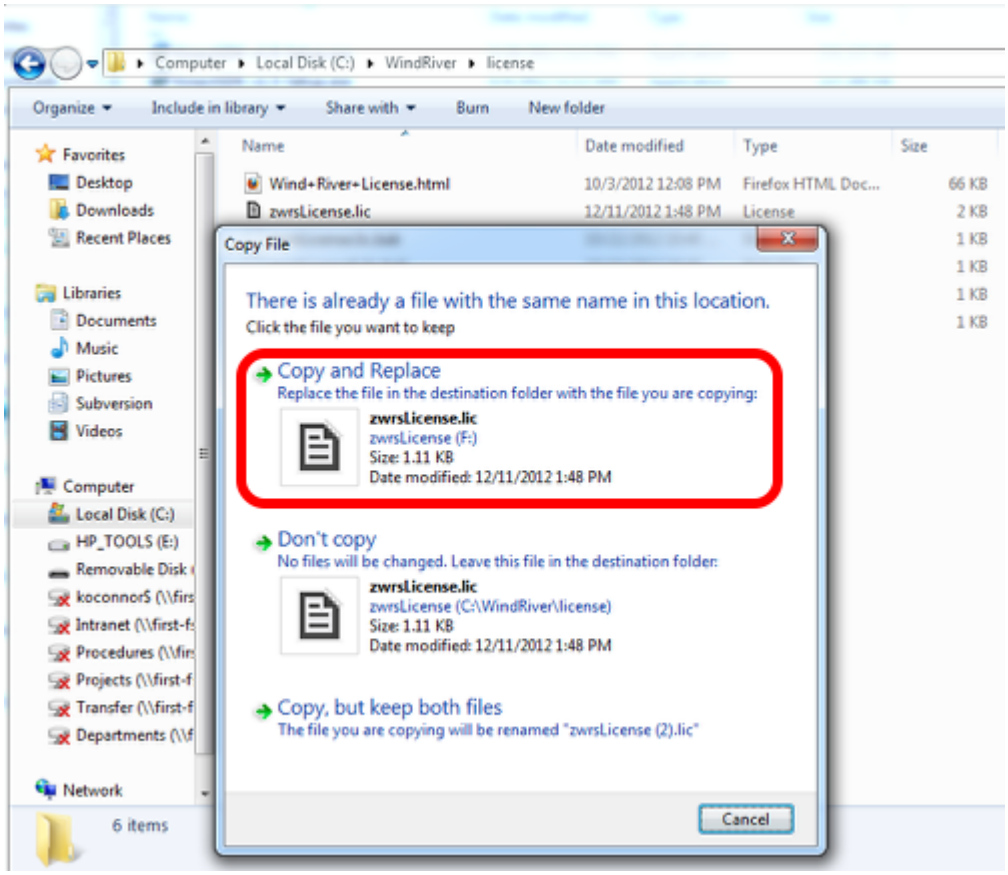
Copy and Rename



Copy the file to a flash drive and rename it to zwrsLicense.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 zwrsLicense.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.**

Copy to Classmate

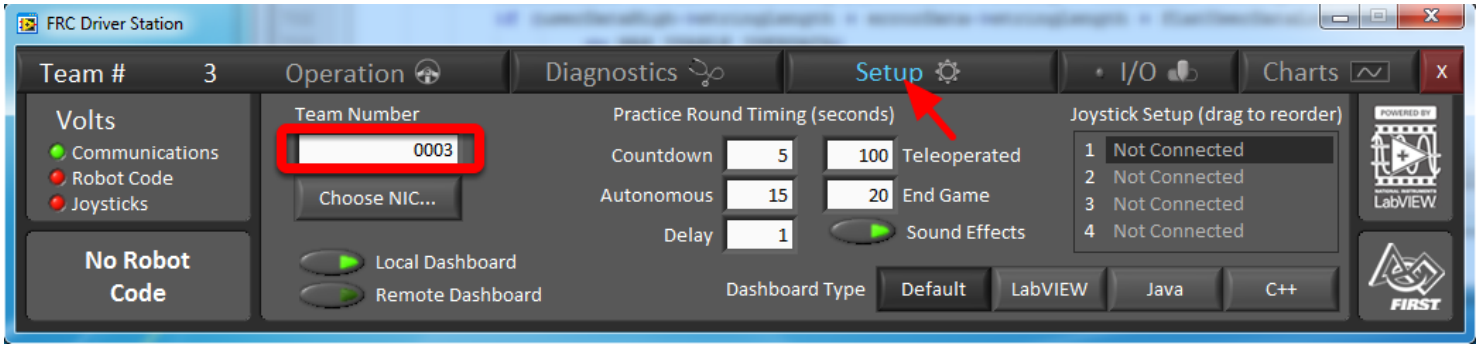


Plug the flash drive into the Classmate, then copy the **zwrsLicense.lic** file to **C:\Windriver\license.** When prompted, select to **Copy and Replace**. Wind River should now be licensed through January of 2015.

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

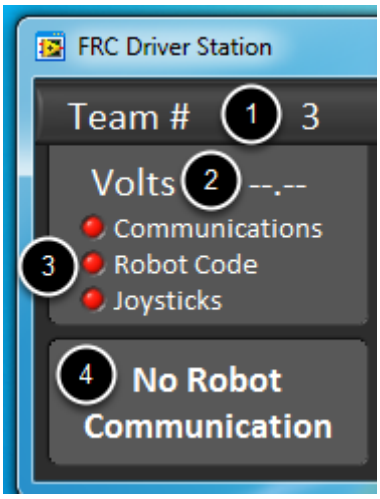


For information on installing the Driver Station software see this document. Typically the Driver Station will set the appropriate settings automatically, but if you do have to set the network settings manually, the DS should use the following settings:

- 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.

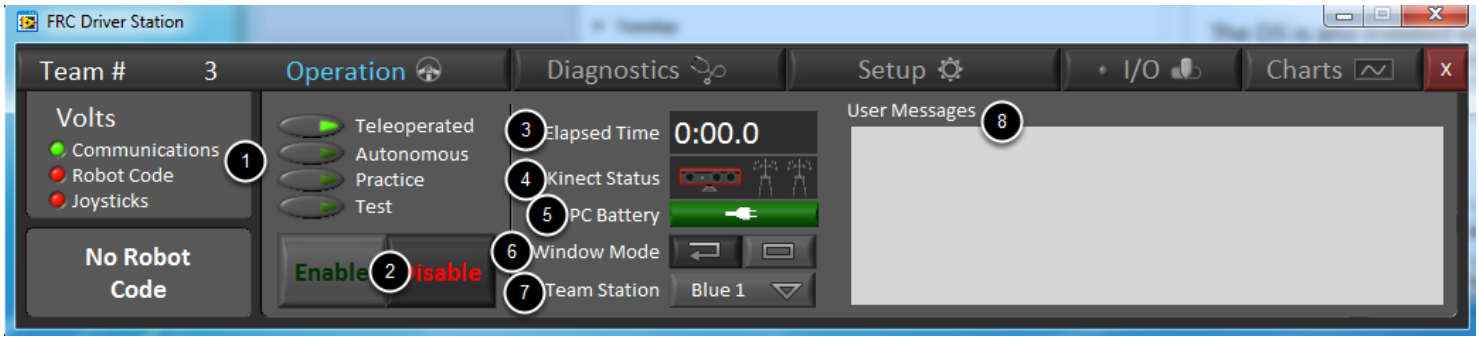
Status Pane



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
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

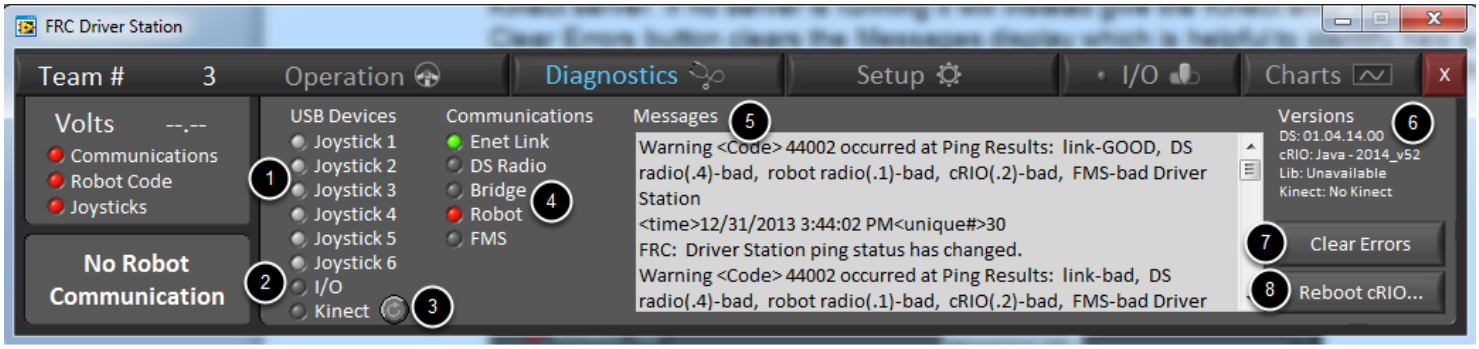


The Operations Tab is used to control the mode of the robot and provide additional key status indicators while the robot is running.

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.

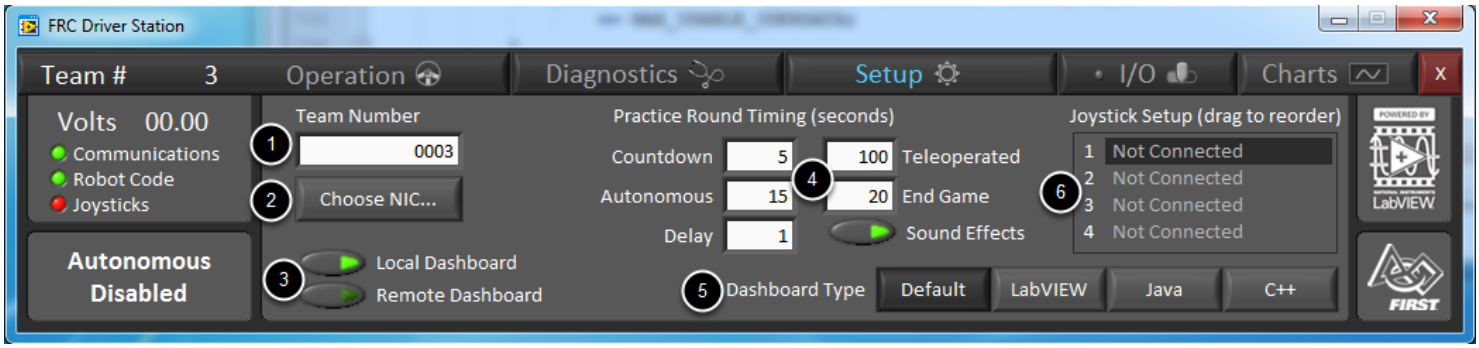
Diagnostics Tab



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 Cypess 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)

Setup Tab

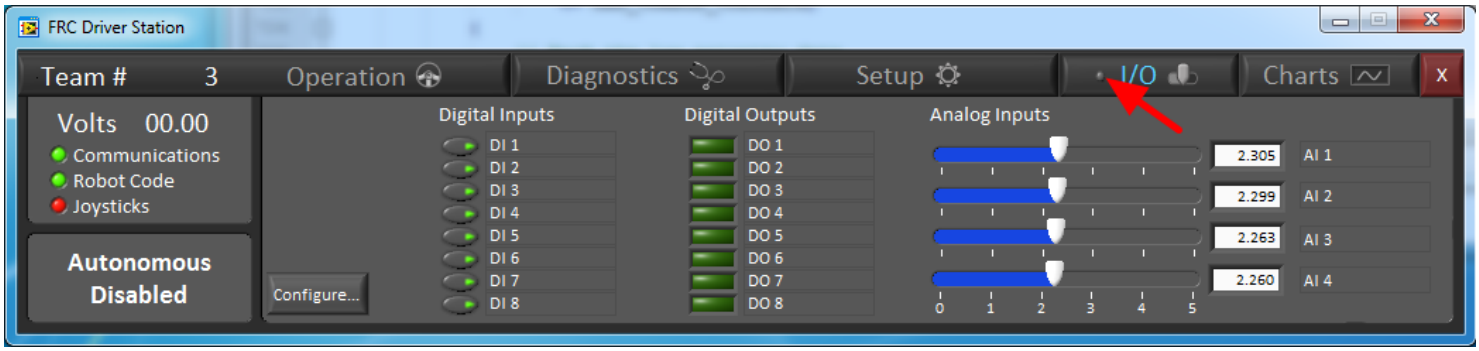


The Setup Tab contains a number of buttons teams can use to control the operation of the Driver Station:

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!!!**

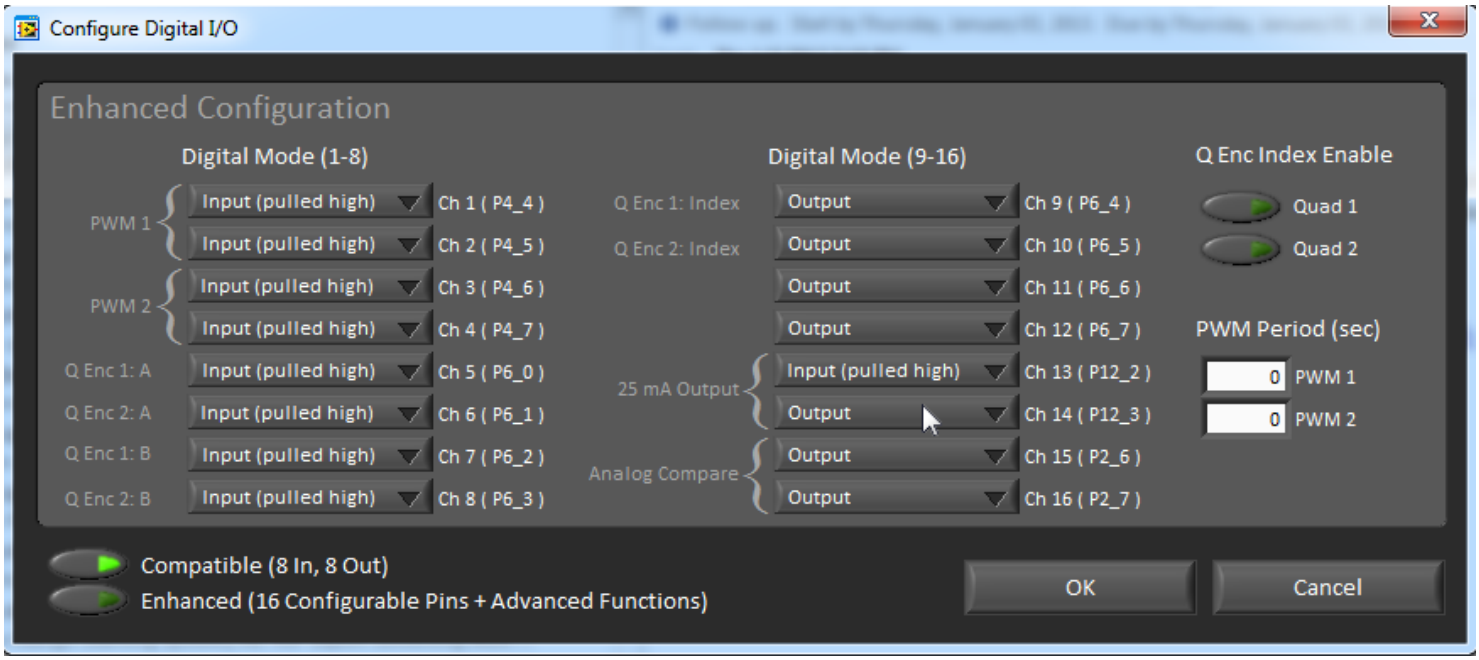
I/O Tab - Compatible Mode



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.

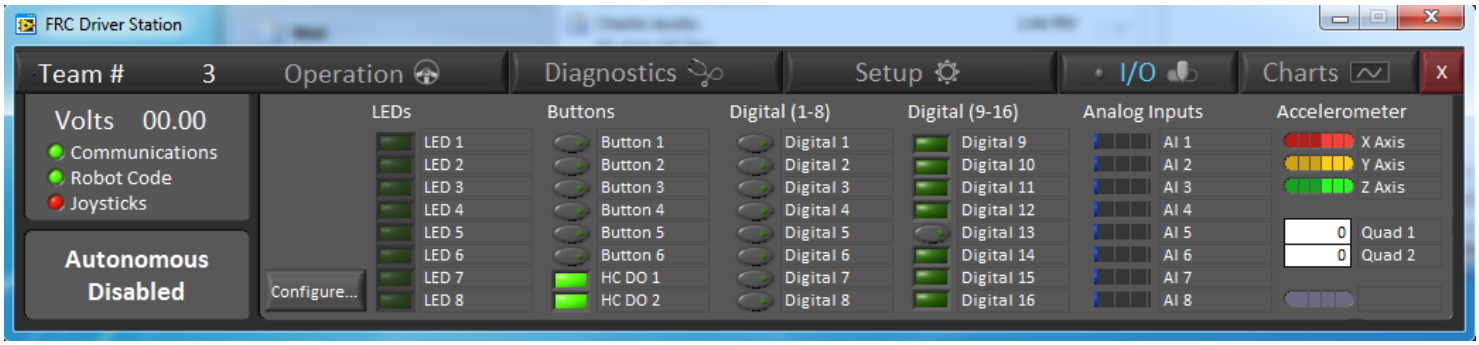
Clicking the Configure button will bring up the Configuration dialog.

I/O Tab - Configuration Dialog



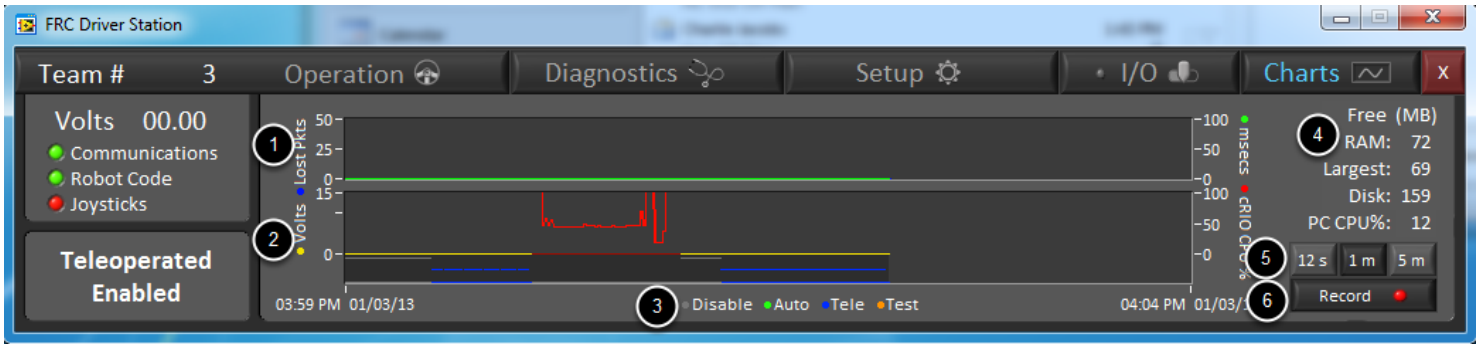
The Configure Digital I/O Dialog is used to configure the mode of the Cypress board (Compatible or Enhanced) and, if using Enhanced mode, to configure the function of each pin and the behavior of the quadrature encoder input and PWM output if used. Teams should take care to set the configuration of the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

I/O Tab - Enhanced Mode



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



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:

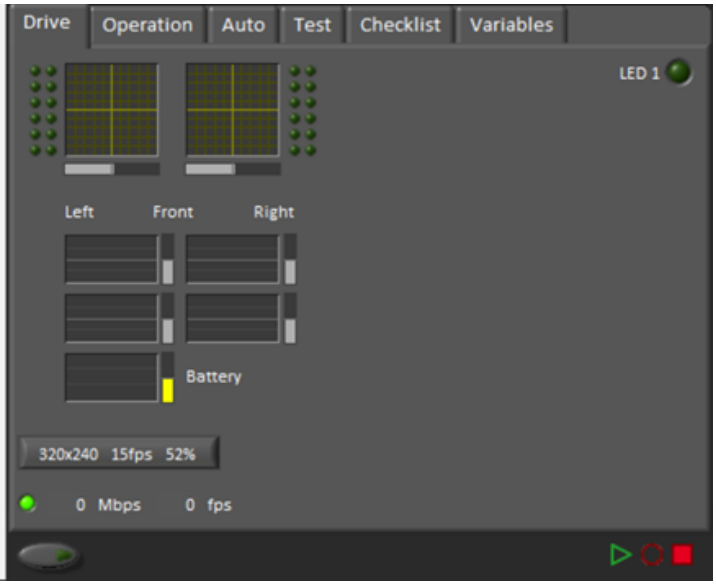
- F1 - Enable the robot. If the robot is enabled, force a Joystick refresh.
- Enter - Disable the Robot

- 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

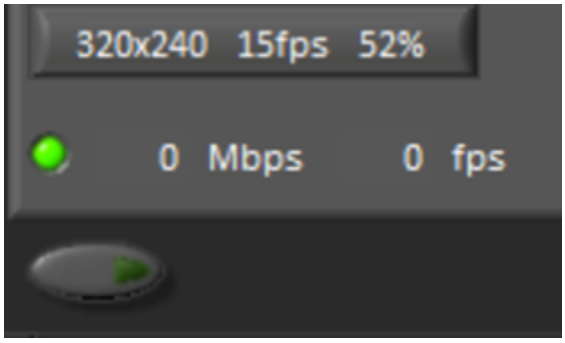
The Dashboard application installed and launched by the FRC Driver Station is a LabVIEW program designed to provide teams with basic feedback from their robot, with the ability to expand and customize the information to suit their needs. The 2014 Dashboard includes a new record and playback feature allowing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

Layout



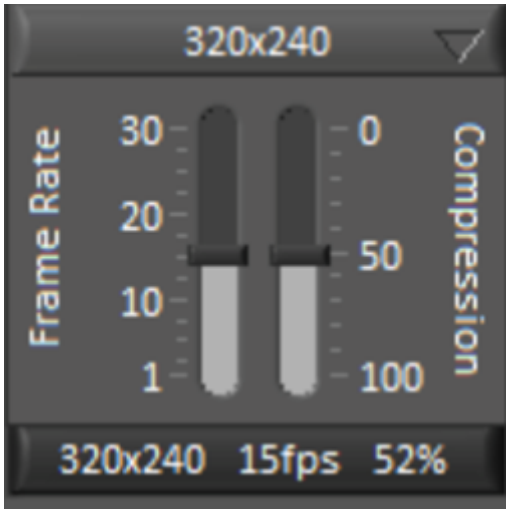
The default dashboard uses the left column for camera display. The right column has a few settings located on the bottom row so that they always present. The remainder are located within the tab control on the right.

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



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.

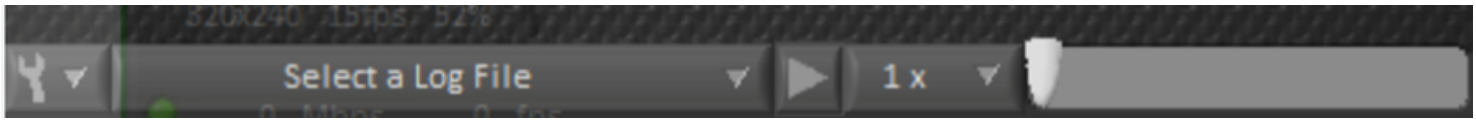
- Resolution is selected using the top button.
- Frame rate is set using the slider on the left.
- Compression is set using the slider on the right.

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.

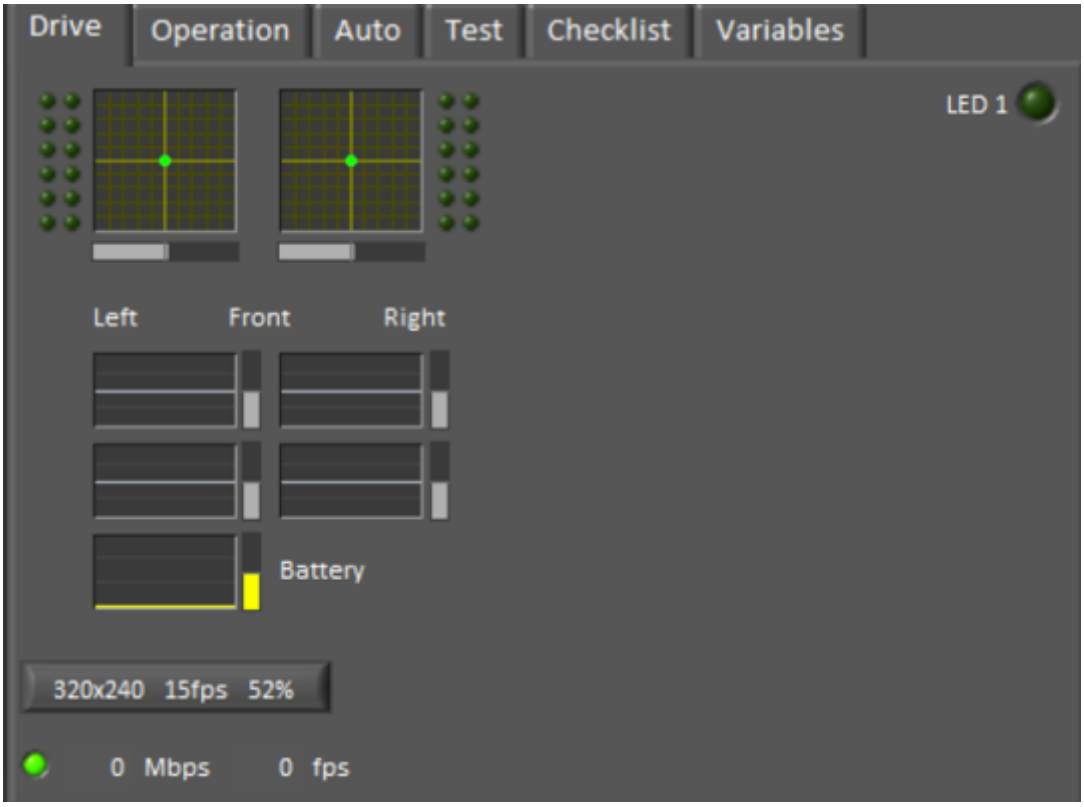
Playback Panel



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.
- 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.

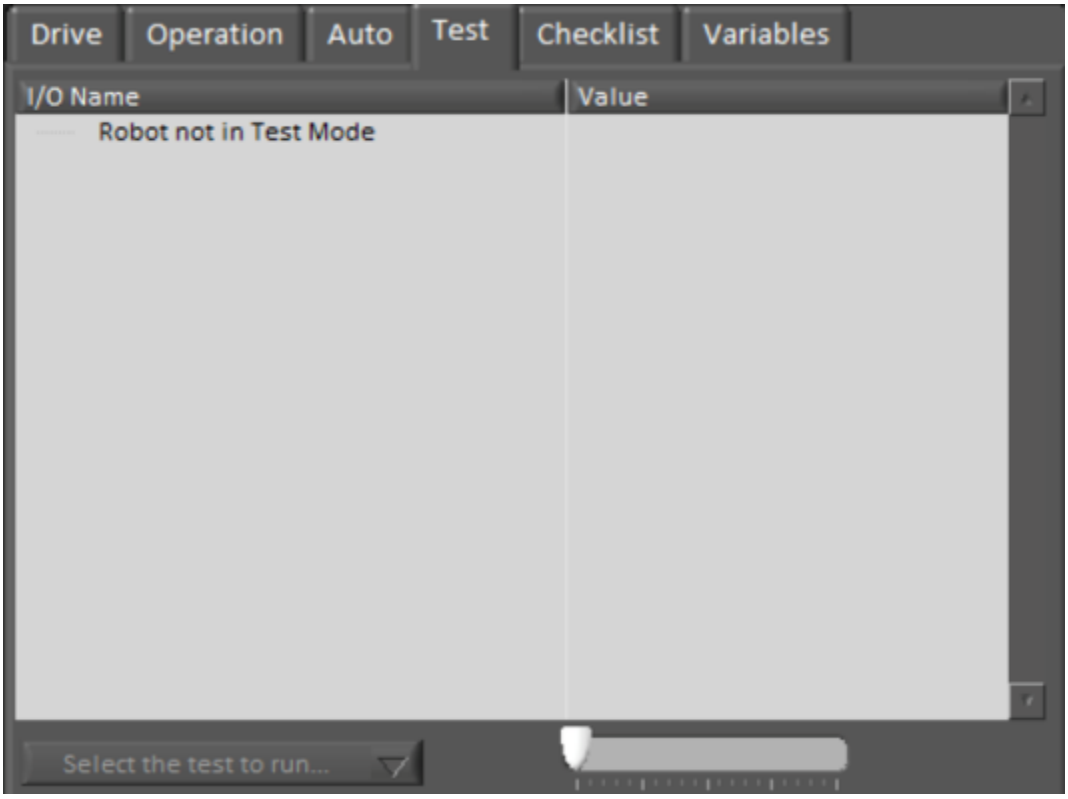
Operation Tab

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.

Auto Tab

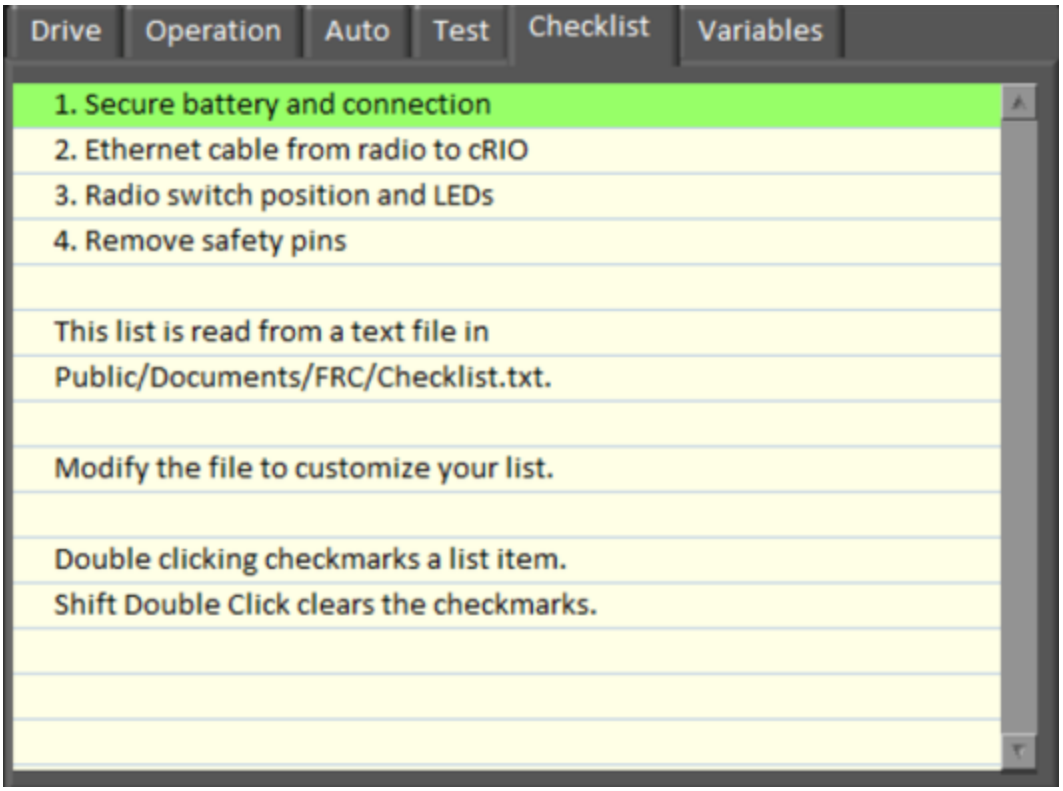
The Auto tab initially contains two checkboxes bound to SmartDashboard variables Checkbox 1 and Checkbox 2. While not limited to autonomous mode, this is a convenient place for the variables that can influence autonomous mode.

Test Tab



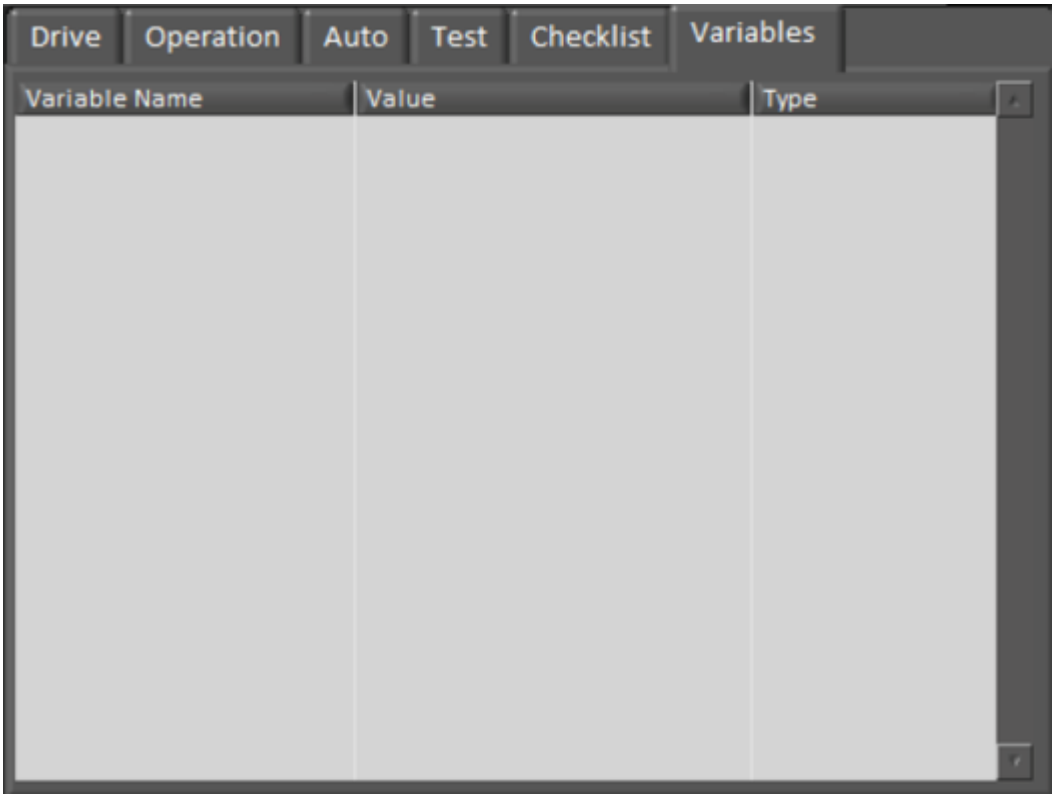
The test tab contains a table useful for testing your robot's I/O. When placed in test mode, the table will list all I/O that is opened and named using the LabVIEW WPILib functions. More details on test mode are available later in this document.

Checklist Tab



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

Variables Tab

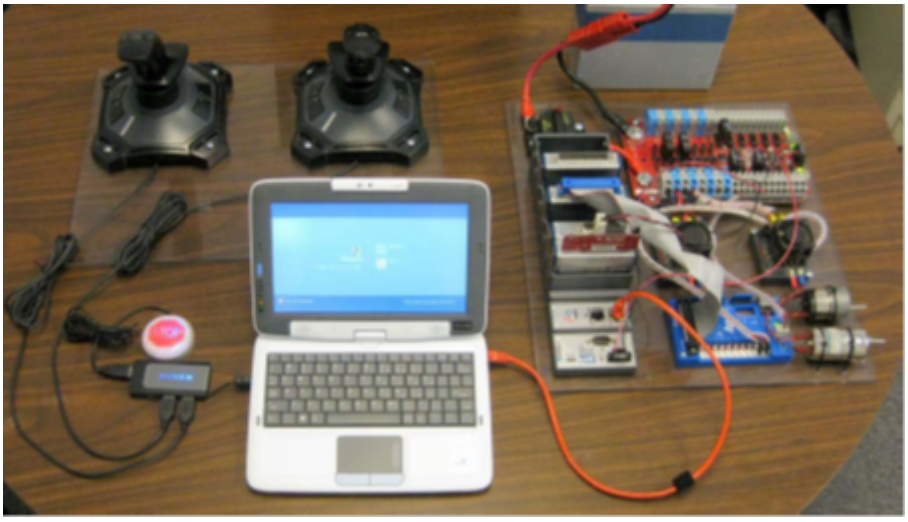


The variables tab displays the name, value, and type of all Network Tables variables on the robot.

Using the Classmate with your cRIO

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

Hardware Setup



Plug the following devices into your Classmate:

1. Joysticks
2. cRIO using an Ethernet cable

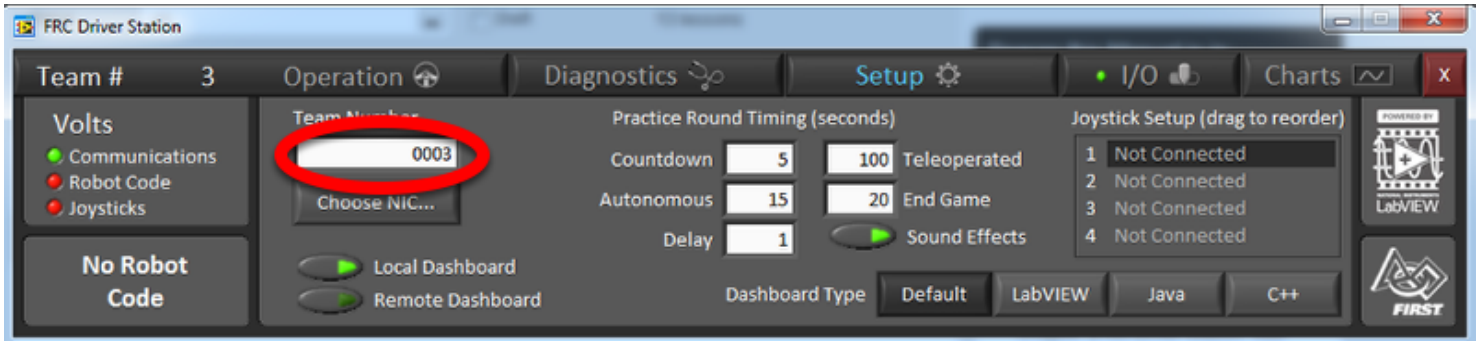
Classmate Login

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

Power on the cRIO

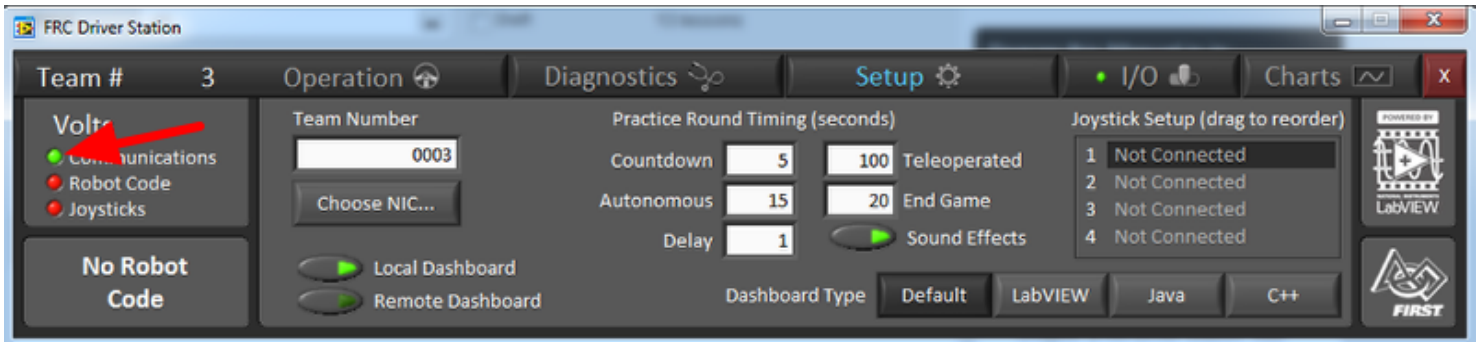
Turn on your cRIO using the 120A main circuit breaker. Make sure that the Analog Breakout Board is attached to the 9201 module in slot 1 of your cRIO and that it has the jumper installed for battery voltage tracking.

Set your Team Number in the DS



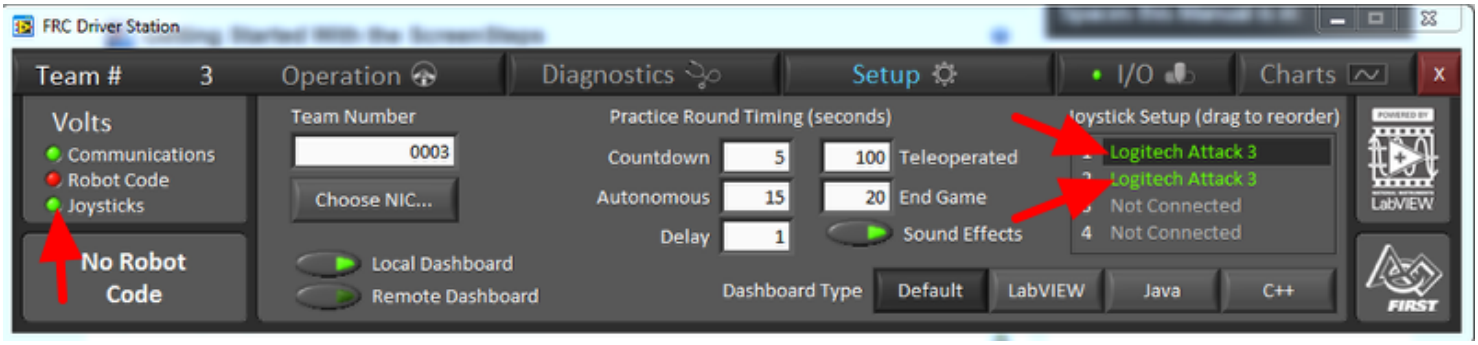
Click on the Set up Tab and enter your team number in the field provided and Tab out of the field. We've used team number 3 for this example.

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



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

```
Warning <Code> 44006 occurred at Driver Station
<time>2/6/2013 11:30:06 AM<unique#>5
FRC:  Custom I/O is not enabled or is not connected to the driver
station.
```

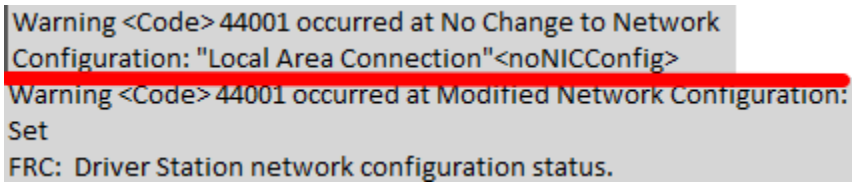
This warning indicates that the DS does not detect a Cypress Board attached and properly configured. This warning will also be generated if the Cypress board is disconnected after the DS has started. If no Cypress Board is detected when the DS is started, this is the first warning printed.

Joystick Unplugged

```
ERROR <Code> -44009 occurred at Driver Station
<time>2/5/2013 4:43:54 PM<unique#>1
FRC:  A joystick was disconnected while the robot was enabled.
```

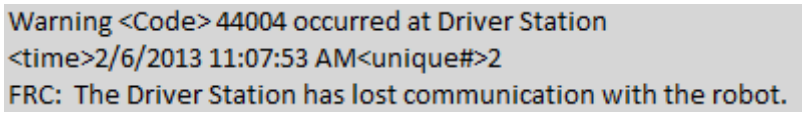
This error is triggered when a Joystick is unplugged. Contrary to the message text this error will be printed even if the robot is not enabled, or even connected to the DS. You will see a single instance of this message occur each time the Driver Station is started, even if Joysticks are properly connected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

NIC Config



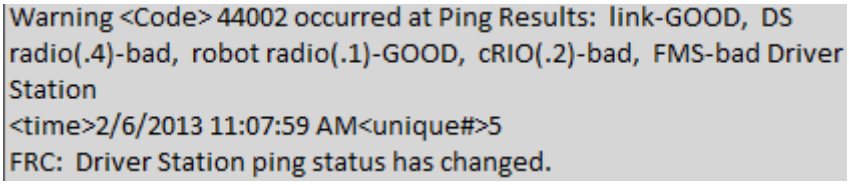
This warning is triggered by the Driver Station whenever it attempts to configure the network interfaces of the DS computer. The top warning shows an example of the Driver Station making no change to the wired interface (because it was already set correctly) and not being configured to set the wireless 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



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

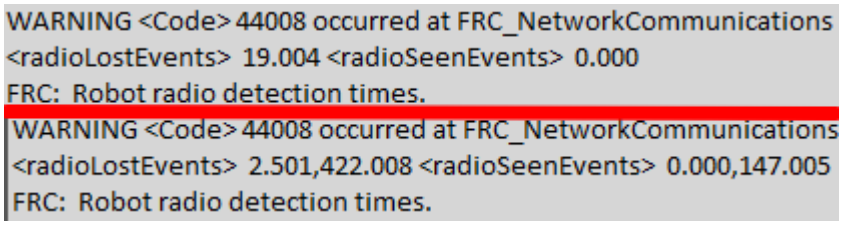


A Ping Status warning is generated each time the Ping Status to a device changes while the DS is not in communication with the cRIO. As communications is being established when the DS starts up, a few of these warnings will appear as the Ethernet link comes up, then the connection to the robot radio, 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

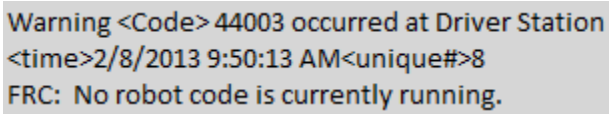
This message is printed each time the DS begins communicating with the cRIO. The message indicates the up-time, in seconds, of the cRIO and can be used to determine if a loss of communication was due to a cRIO Reboot.

Radio Detection Times



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



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.

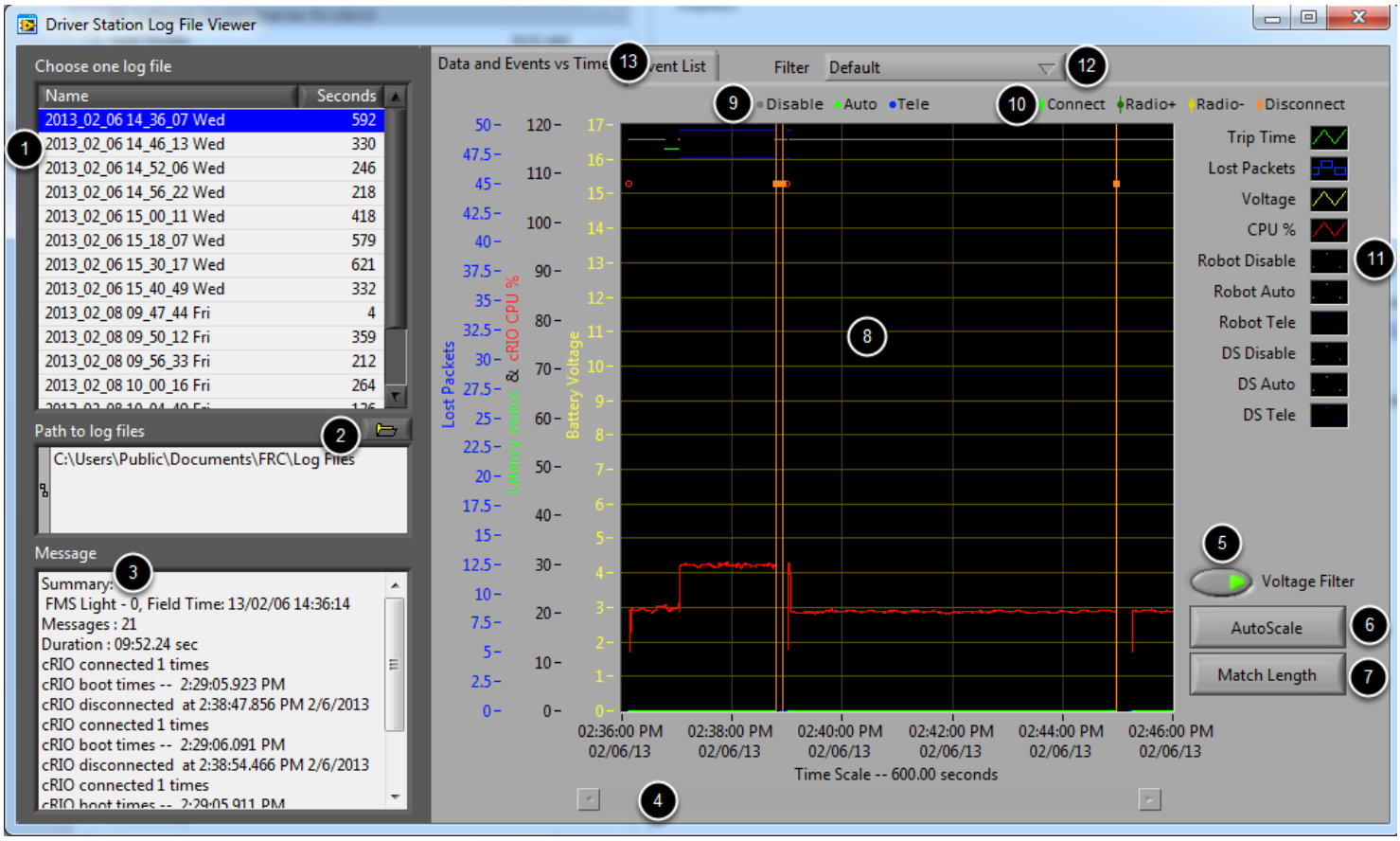
Driver Station Log File Viewer

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

A new addition to the Driver Station logging this year is the Event Log. 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 Viewer UI



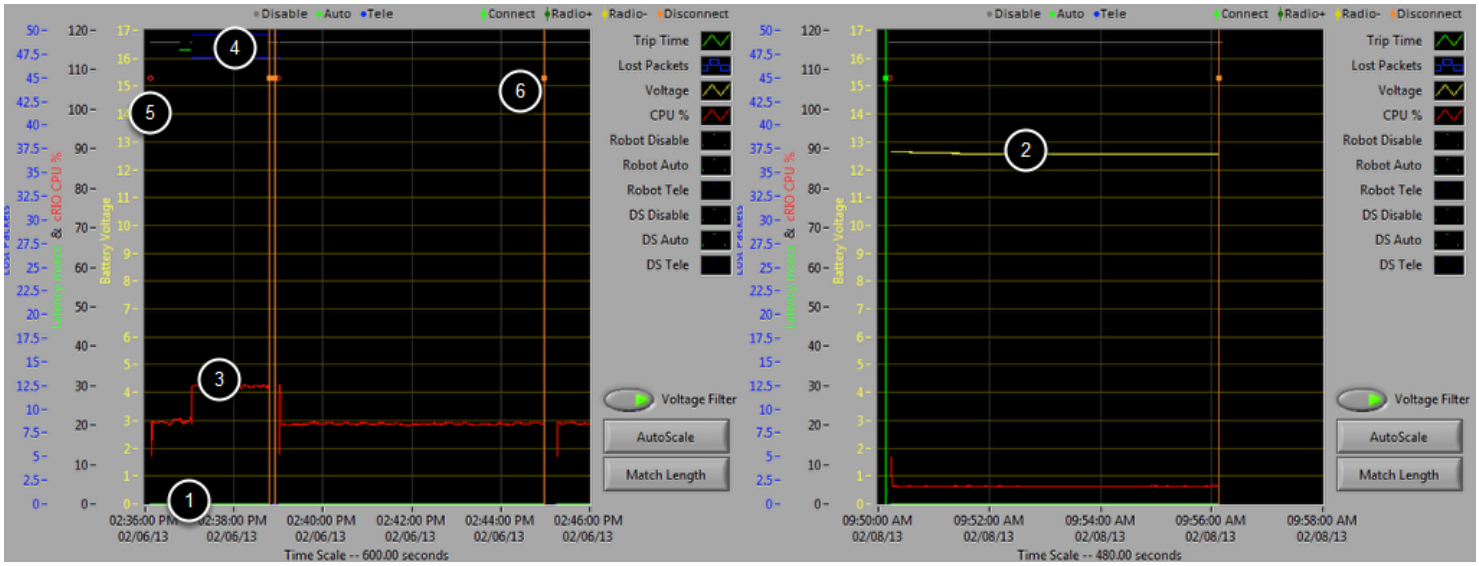
The Log Viewer contains a number of controls and displays to aid in the analysis of the Driver Station log files:

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.
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



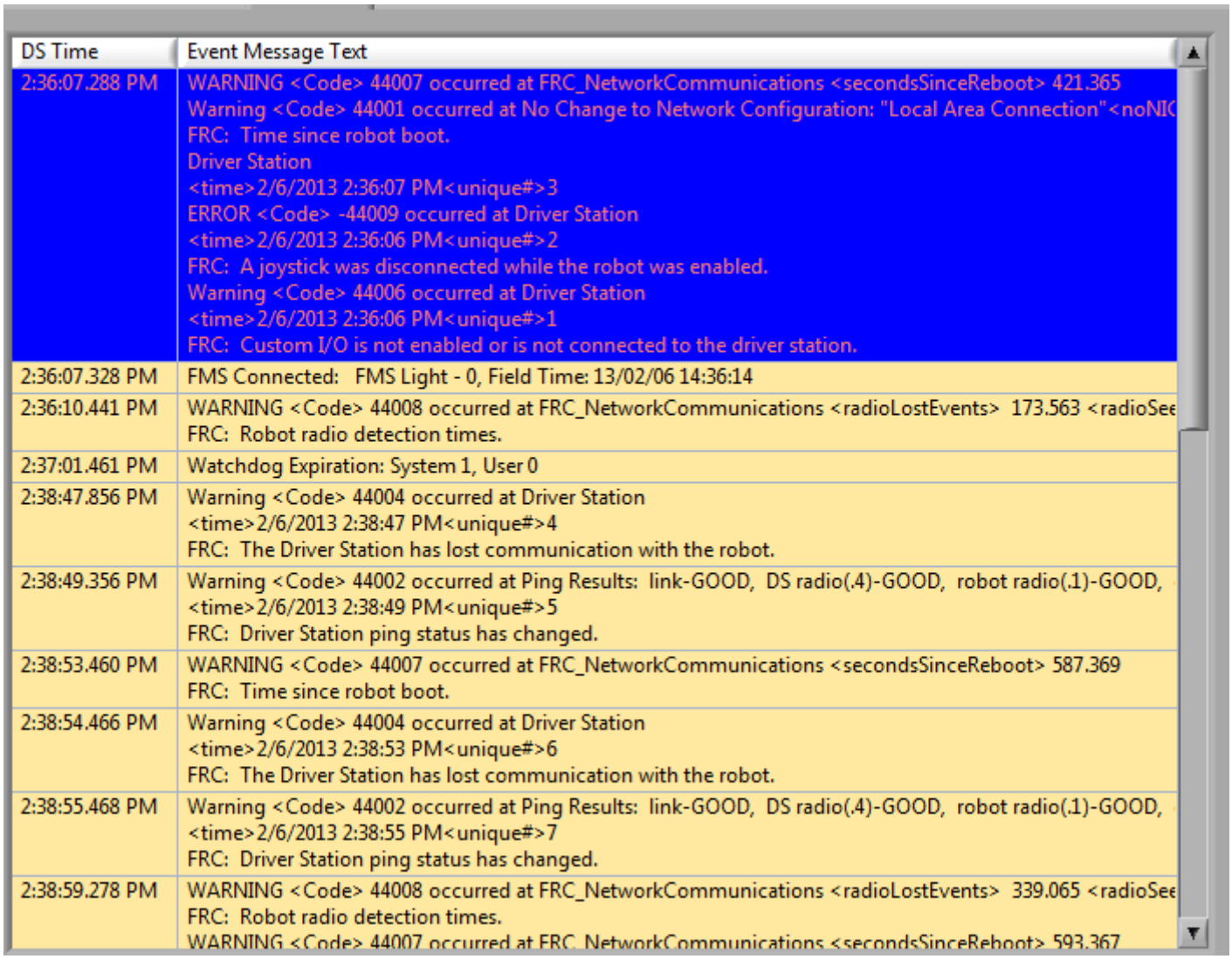
The Graph Display contains the following information:

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.

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



DS Time	Event Message Text
2:36:07.288 PM	WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 421.365 Warning <Code> 44001 occurred at No Change to Network Configuration: "Local Area Connection" <noNIC FRC: Time since robot boot. Driver Station <time>2/6/2013 2:36:07 PM<unique#>3 ERROR <Code> -44009 occurred at Driver Station <time>2/6/2013 2:36:06 PM<unique#>2 FRC: A joystick was disconnected while the robot was enabled. Warning <Code> 44006 occurred at Driver Station <time>2/6/2013 2:36:06 PM<unique#>1 FRC: Custom I/O is not enabled or is not connected to the driver station.
2:36:07.328 PM	FMS Connected: FMS Light - 0, Field Time: 13/02/06 14:36:14
2:36:10.441 PM	WARNING <Code> 44008 occurred at FRC_NetworkCommunications <radioLostEvents> 173.563 <radioSee FRC: Robot radio detection times.
2:37:01.461 PM	Watchdog Expiration: System 1, User 0
2:38:47.856 PM	Warning <Code> 44004 occurred at Driver Station <time>2/6/2013 2:38:47 PM<unique#>4 FRC: The Driver Station has lost communication with the robot.
2:38:49.356 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-GOOD, <time>2/6/2013 2:38:49 PM<unique#>5 FRC: Driver Station ping status has changed.
2:38:53.460 PM	WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 587.369 FRC: Time since robot boot.
2:38:54.466 PM	Warning <Code> 44004 occurred at Driver Station <time>2/6/2013 2:38:53 PM<unique#>6 FRC: The Driver Station has lost communication with the robot.
2:38:55.468 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-GOOD, <time>2/6/2013 2:38:55 PM<unique#>7 FRC: Driver Station ping status has changed.
2:38:59.278 PM	WARNING <Code> 44008 occurred at FRC_NetworkCommunications <radioLostEvents> 339.065 <radioSee FRC: Robot radio detection times. WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 593.367

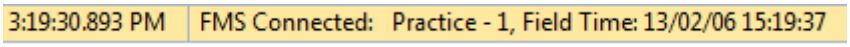
The Event List tab displays a list of events (warnings and errors) recorded by the Driver Station. The events and detail displayed are determined by the currently active filter (images shows "All Events, All Info" filter active).

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 occured.
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



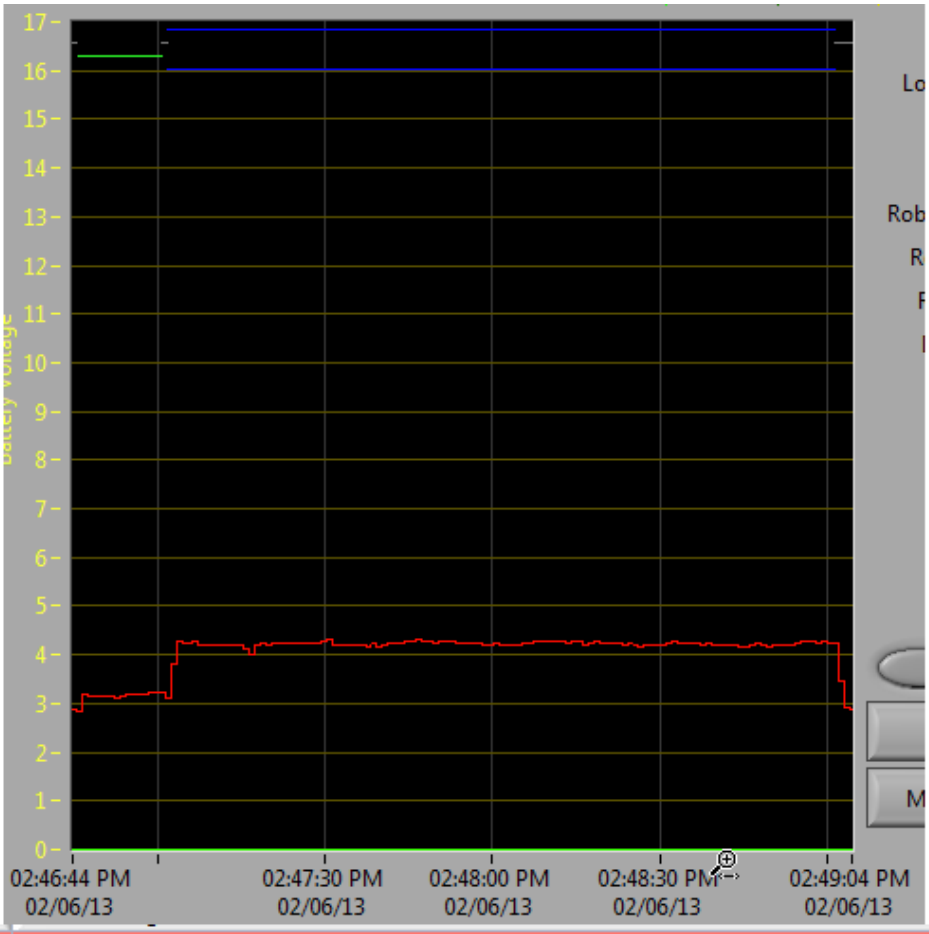
A common task when working with the Driver Station Logs is to identify which logs came from competition matches. Logs which were taken during a match can now be identified using the FMS Connected event which will display the match type (Practice, Qualification or Elimination), match number, and the current 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

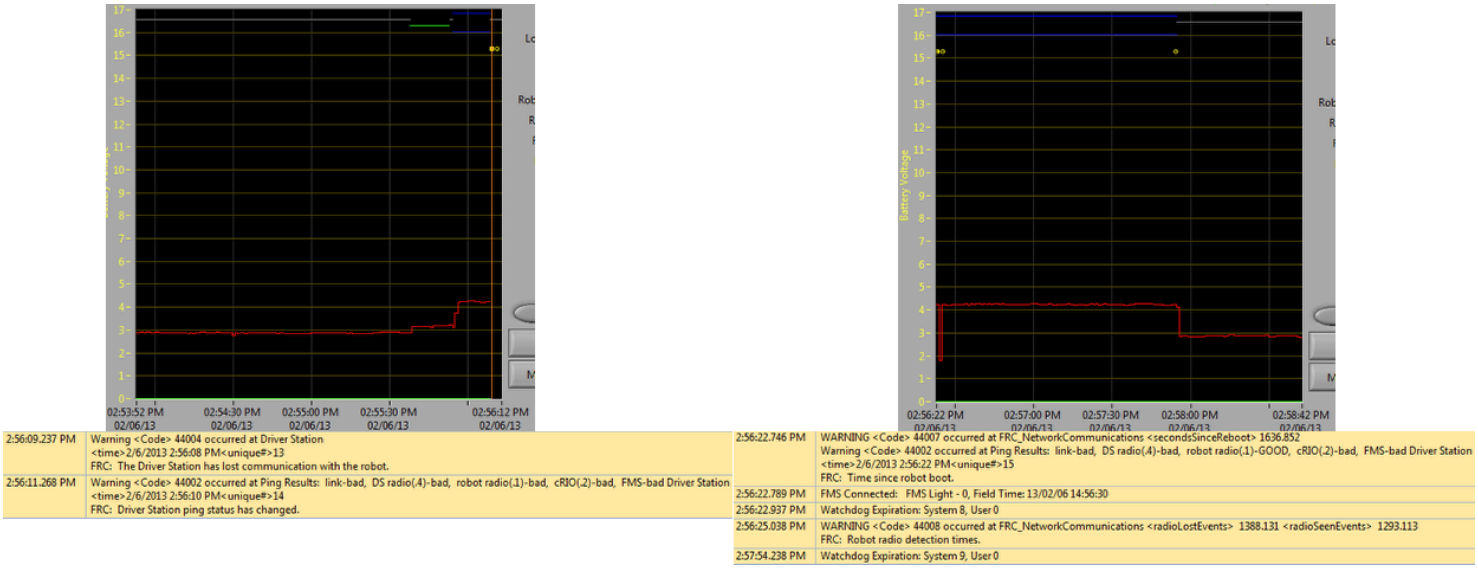


2:46:13.575 PM	WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 1027.648 Warning <Code> 44001 occurred at No Change to Network Configuration: "Local Area Connection"<noNIC FRC: Time since robot boot. Driver Station <time>2/6/2013 2:46:13 PM<unique#>3 ERROR <Code> -44009 occurred at Driver Station <time>2/6/2013 2:46:13 PM<unique#>2 FRC: A joystick was disconnected while the robot was enabled. Warning <Code> 44006 occurred at Driver Station <time>2/6/2013 2:46:13 PM<unique#>1 FRC: Custom I/O is not enabled or is not connected to the driver station.
2:46:13.617 PM	FMS Connected: FMS Light - 0, Field Time: 13/02/06 14:46:21
2:46:16.471 PM	WARNING <Code> 44008 occurred at FRC_NetworkCommunications <radioLostEvents> 779.588 <radioSee FRC: Robot radio detection times.

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

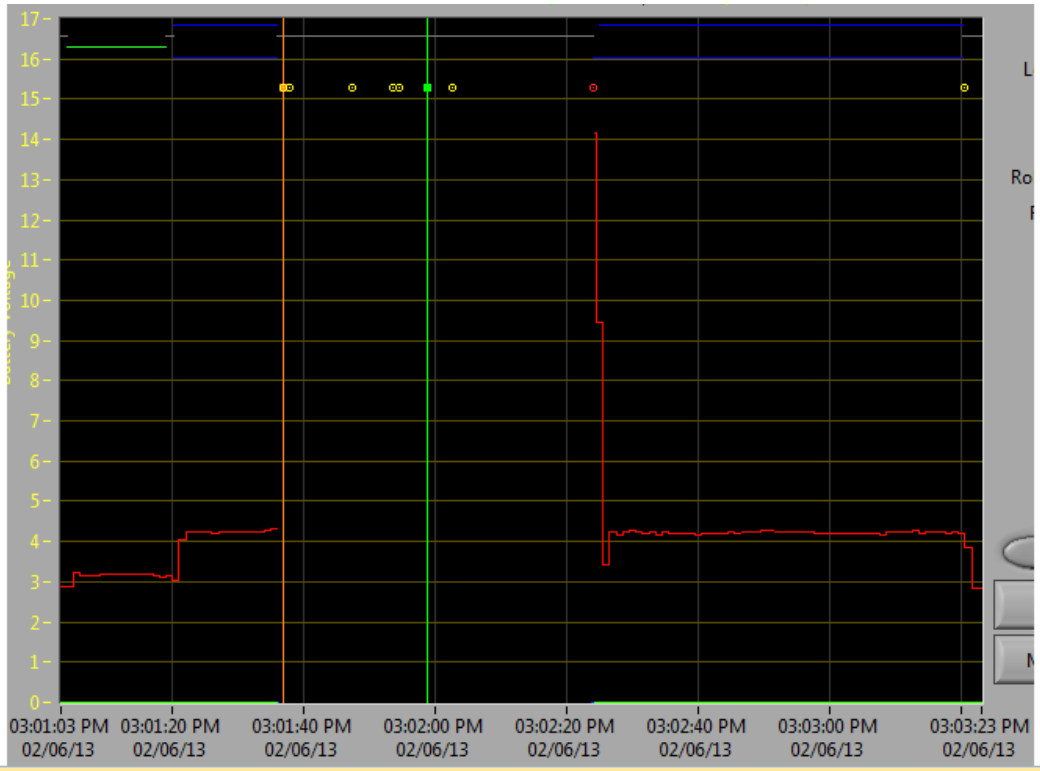
first connecting to the DS (it occurs 3 seconds after connecting to FMS) and occurs roughly 30 seconds before the match started.

Disconnected from FMS



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

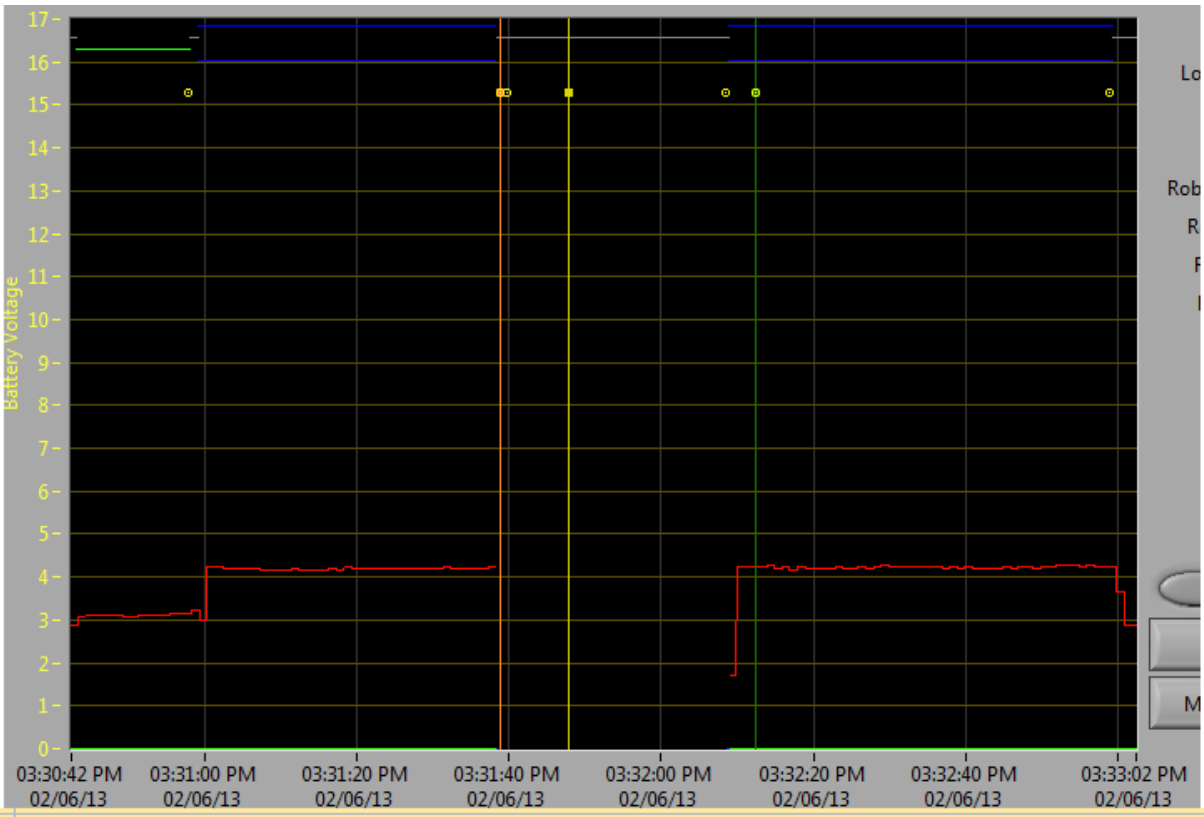


3:01:36.869 PM	Warning <Code> 44004 occurred at Driver Station <time>2/6/2013 3:01:36 PM<unique#>4 FRC: The Driver Station has lost communication with the robot.
3:01:37.871 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-GOOD, cRIO(.2)-bad, FMS-GOOD Driver Station <time>2/6/2013 3:01:37 PM<unique#>5 FRC: Driver Station ping status has changed.
3:01:47.281 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-GOOD, cRIO(.2)-GOOD, FMS-GOOD Driver Station <time>2/6/2013 3:01:46 PM<unique#>6 FRC: Driver Station ping status has changed.
3:01:53.689 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-GOOD, cRIO(.2)-bad, FMS-GOOD Driver Station <time>2/6/2013 3:01:52 PM<unique#>7 FRC: Driver Station ping status has changed.
3:01:54.490 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-GOOD, cRIO(.2)-GOOD, FMS-GOOD Driver Station <time>2/6/2013 3:01:53 PM<unique#>8 FRC: Driver Station ping status has changed.
3:02:02.512 PM	WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 3.682 FRC: Time since robot boot.
3:02:24.128 PM	ERROR <Code> -44003 occurred at WPI_CameraIssue HTTP Request with Authentication.vi>>WPI_CameraIssue Get.vi>>WPI_CameraGet Image Appea <time>21:30:35 02/06/2013 FRC: Operation failed due to a communication failure with the camera.
3:02:24.151 PM	Warning <Code> 44003 occurred at Driver Station <time>2/6/2013 3:02:24 PM<unique#>9 FRC: No robot code is currently running.

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

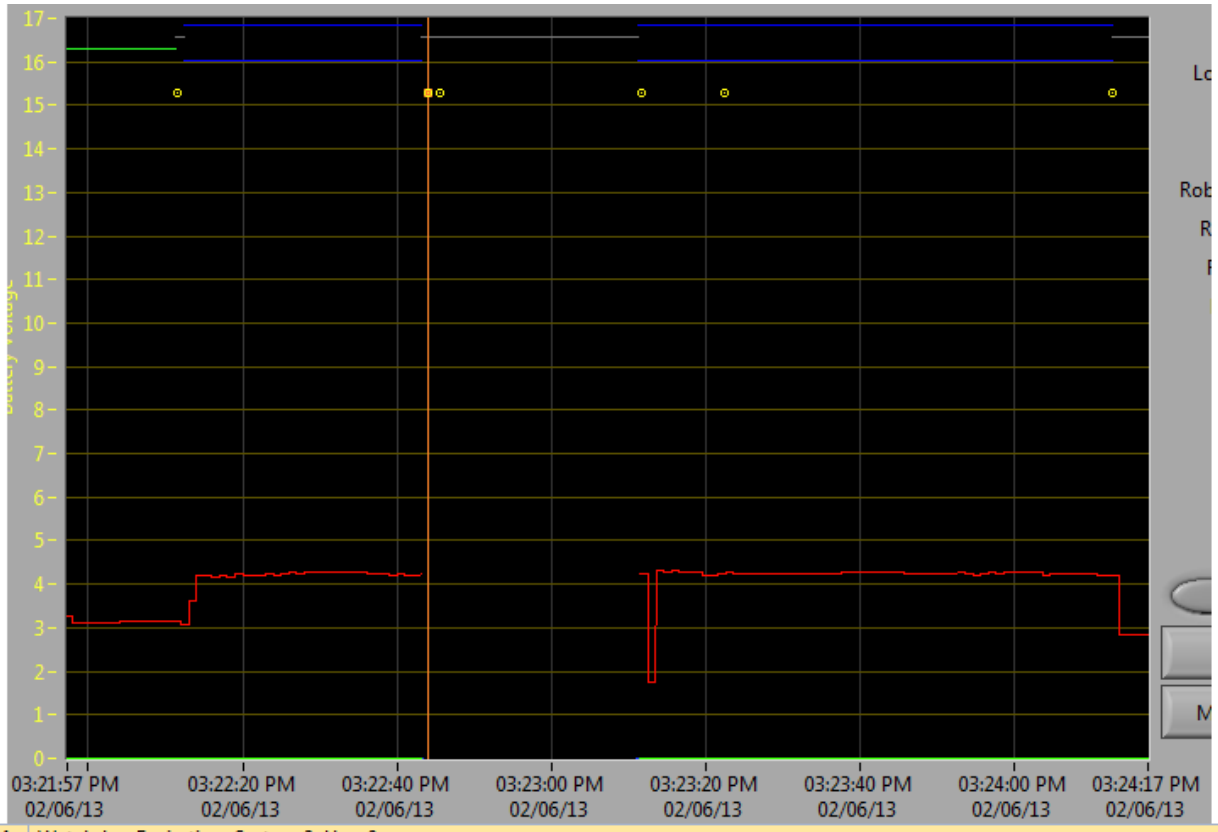


3:30:57.799 PM	Watchdog Expiration: System 5, User 0
3:31:38.800 PM	Warning <Code> 44004 occurred at Driver Station <time>2/6/2013 3:31:38 PM<unique#>10 FRC: The Driver Station has lost communication with the robot.
3:31:39.801 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-GOOD, cRIO(.2)-bad, FMS-GOOD Driver Station <time>2/6/2013 3:31:39 PM<unique#>11 FRC: Driver Station ping status has changed.
3:32:08.449 PM	WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 1809.393 FRC: Time since robot boot.
3:32:12.399 PM	WARNING <Code> 44008 occurred at FRC_NetworkCommunications <radioLostEvents> 24.505,1492.752 <radioSeenEvents> 0.000,260.086 FRC: Robot radio detection times.
3:32:59.018 PM	Watchdog Expiration: System 7, User 0

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,

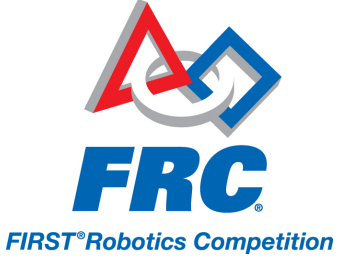
the robot Ethernet cable was disconnected at 3:31:38. The ping status indicates that the D-Link radio is still connected. When the robot reconnects at 3:32:08 the "Tim since robot boot" is 1809 seconds indicating that the cRIO clearly did not reboot. At 3:32:12 the robot indicates that it lost the radio 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.

Radio reboot

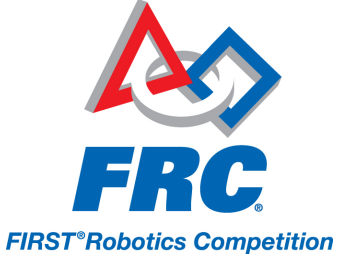


3:22:11.489 PM	Watchdog Expiration: System 2, User 0
3:22:44.030 PM	Warning <Code> 44004 occurred at Driver Station <time>2/6/2013 3:22:43 PM<unique#>6 FRC: The Driver Station has lost communication with the robot.
3:22:45.531 PM	Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS radio(.4)-GOOD, robot radio(.1)-bad, cRIO(.2)-bad, FMS-GOOD Driver Station <time>2/6/2013 3:22:45 PM<unique#>7 FRC: Driver Station ping status has changed.
3:23:11.620 PM	WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 1272.775 FRC: Time since robot boot.
3:23:11.690 PM	Watchdog Expiration: System 3, User 0

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 gas 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".



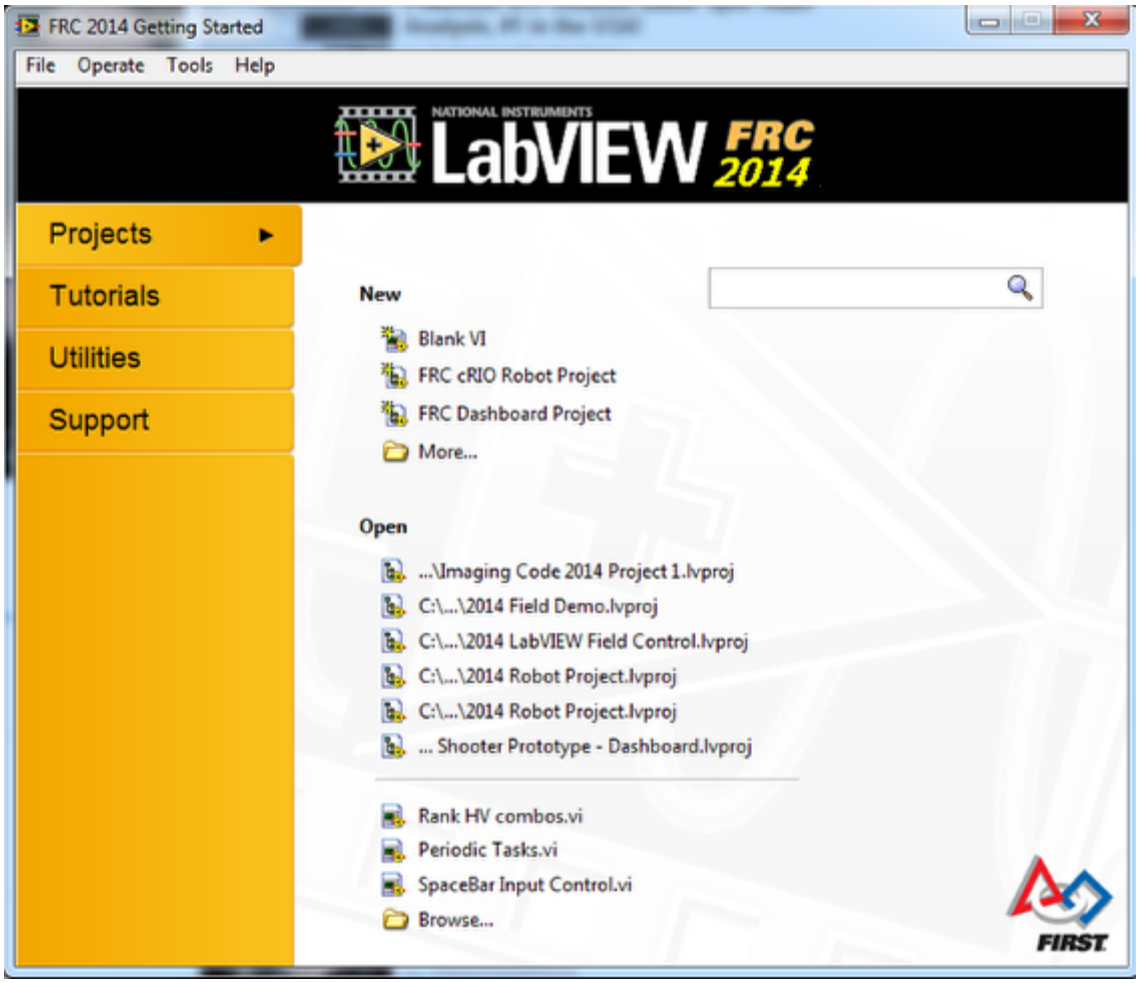
2014 Control System Software



2014 FRC Software Component Overview

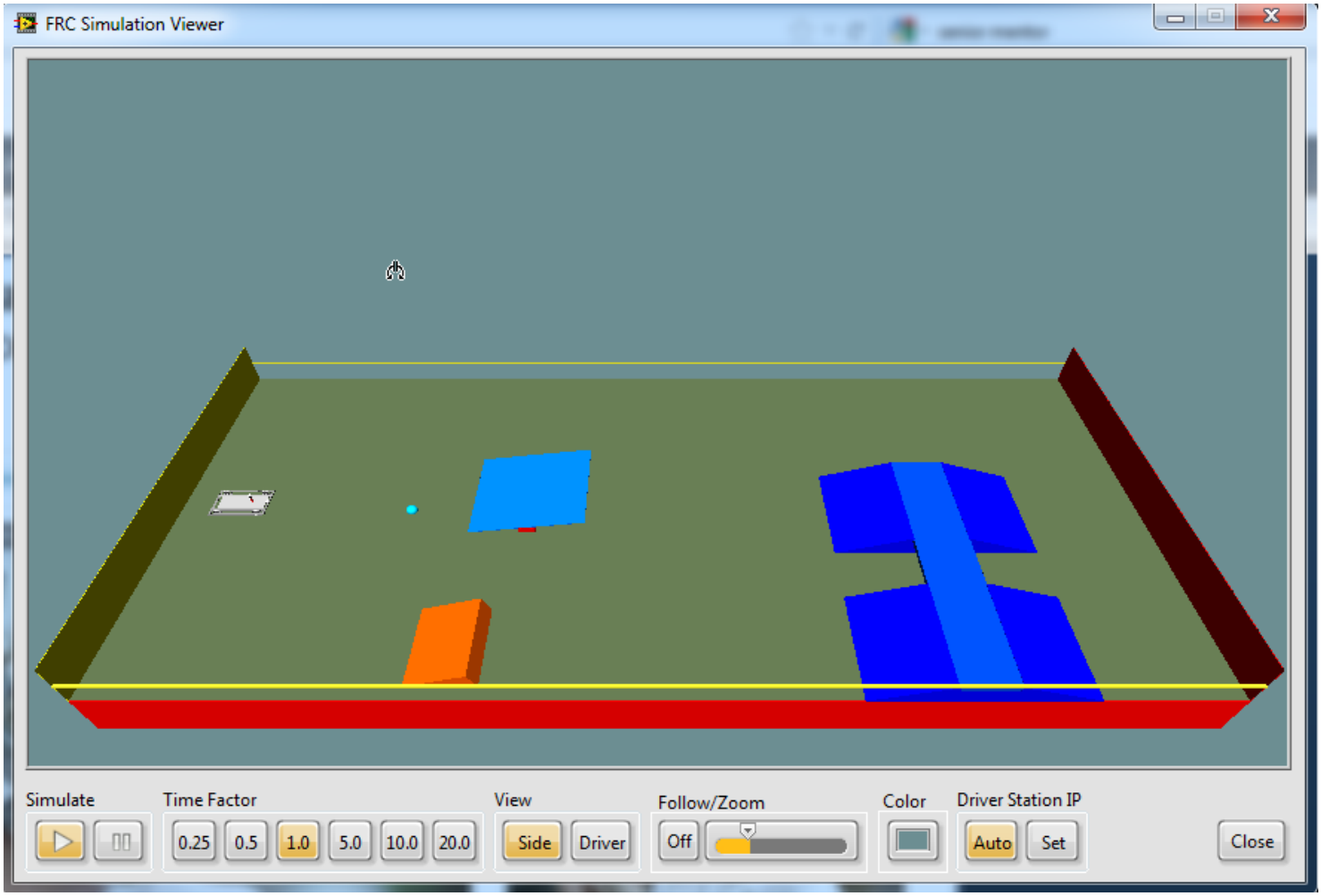
The 2014 FRC Control System consists of a wide variety of mandatory and optional software components designed to assist you in the design, development and debugging of your robot code, control robot operation, and provide feedback to assist with troubleshooting. For each software component this document 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



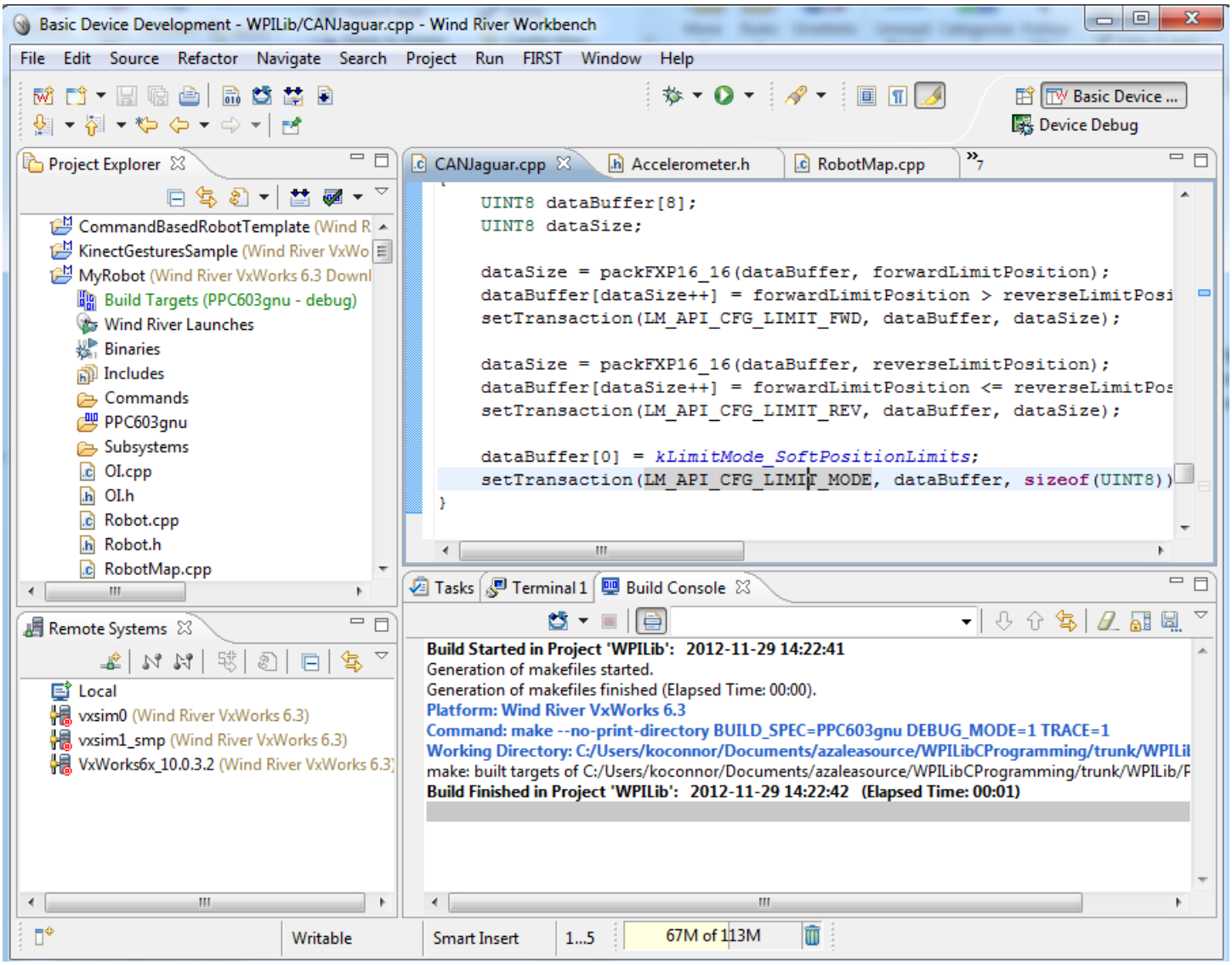
LabVIEW FRC 2014, based on National Instruments' LabVIEW 2013, is the development environment for LabVIEW, one of the three officially supported languages for programming an FRC Robot in 2014. LabVIEW is a graphical, dataflow-driven language. LabVIEW programs consist of a collection of icons, called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



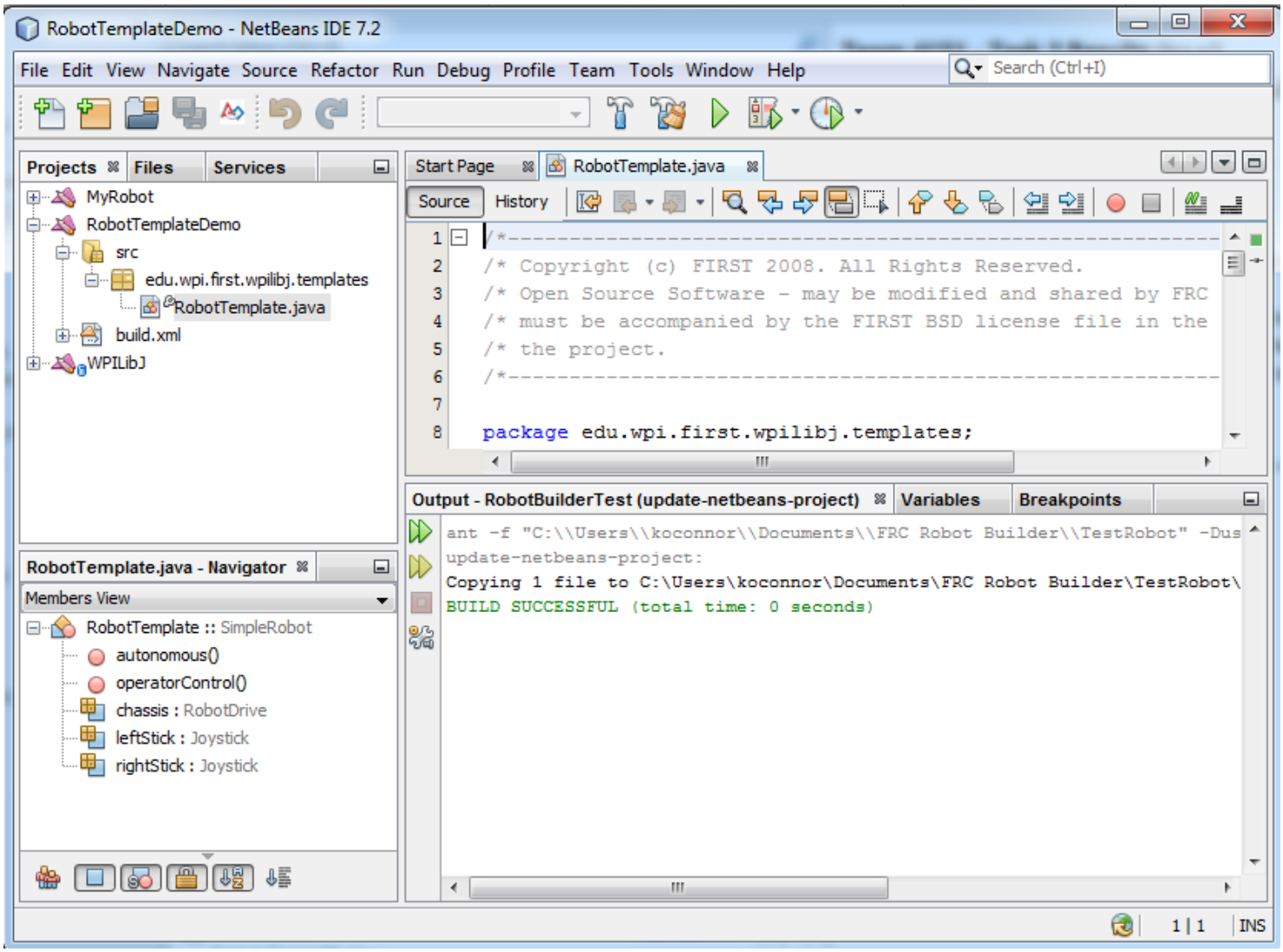
The FRC Robot Simulator is a component of the LabVIEW programming environment that allows you to operate a predefined robot in a simulated environment to test code and/or Driver Station functions. It utilizes a LabVIEW code project as the robot code and communicates with the FRC Driver Station for robot 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



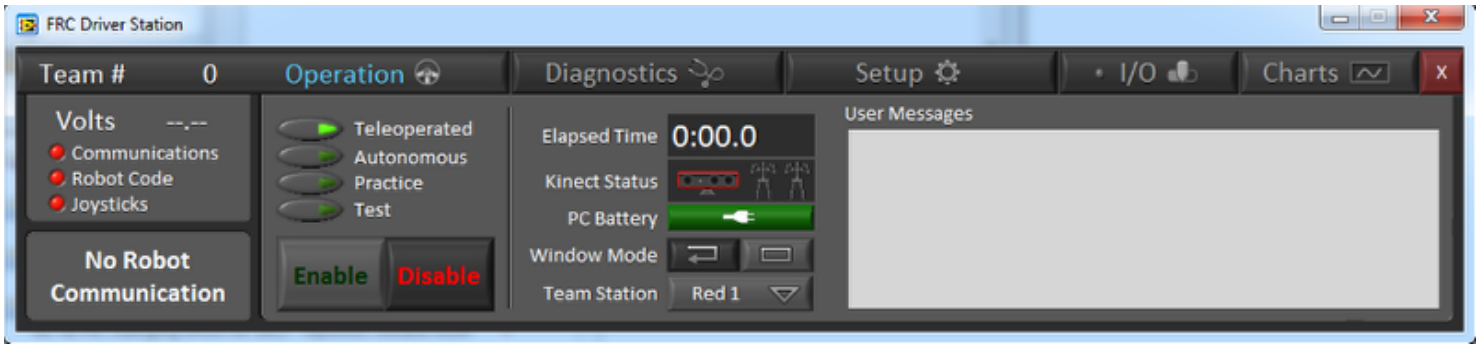
Wind River Workbench is the supported development environment for C++, one of the three supported languages used for programming an FRC robot in 2014. C++ is an object-oriented text based programming language. A program in C++ (for FRC) consists of a number of header (.h) and implementation (.cpp) files. 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



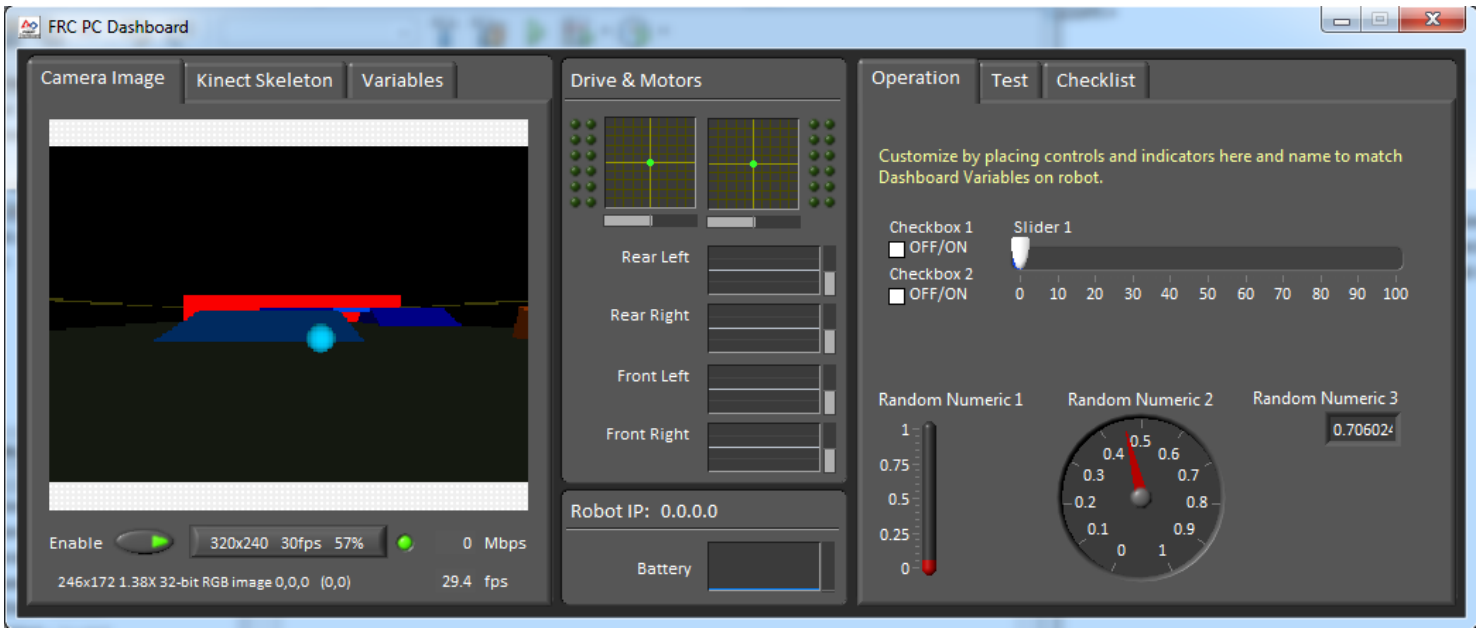
Netbeans is the primary supported development environment for Java, one of the three supported languages used for programming an FRC robot in 2014. Java is an object-oriented text base programming language. A program in Java (for FRC) consists of one or more .java files contained in one or more packages.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



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.

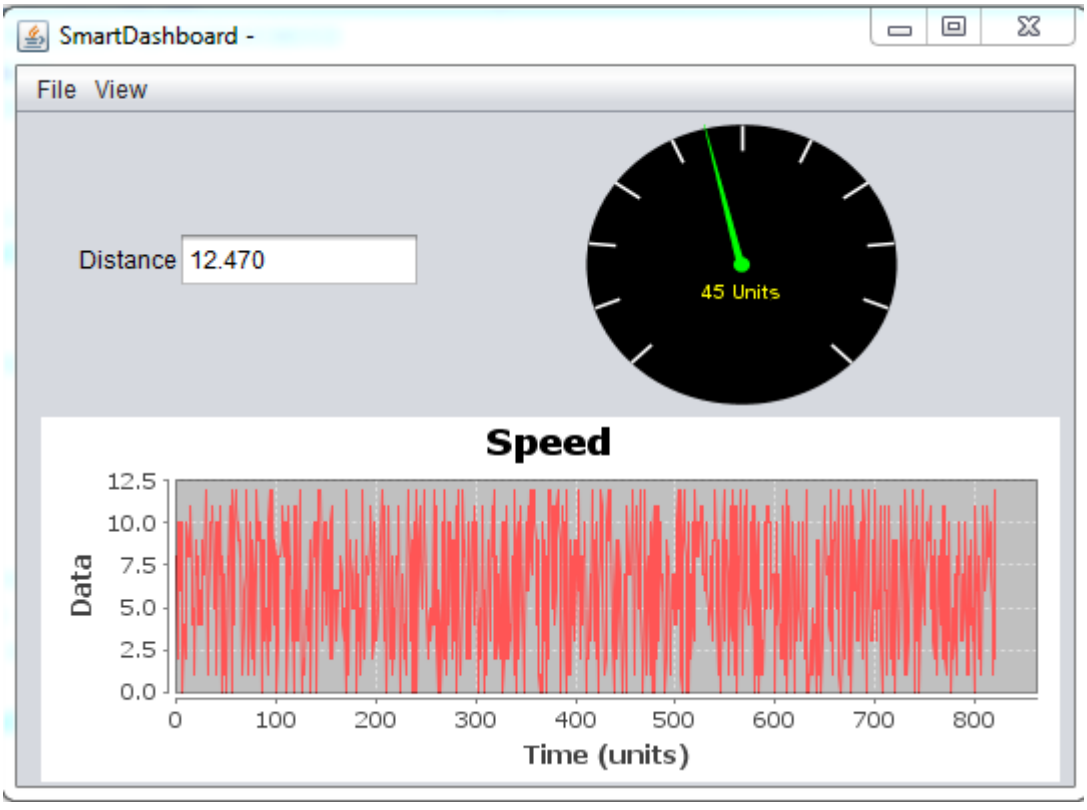
FRC LabVIEW Dashboard



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 a 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.

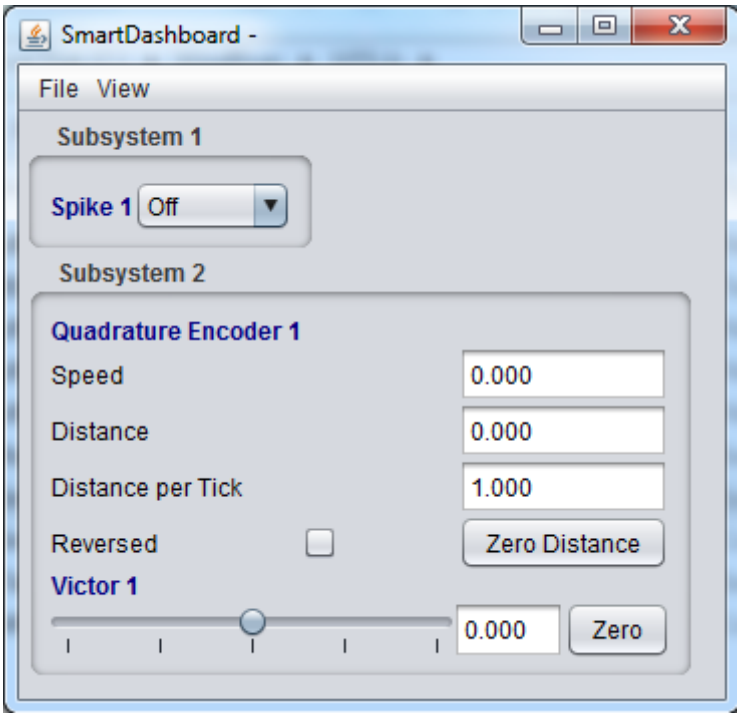
SmartDashboard



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

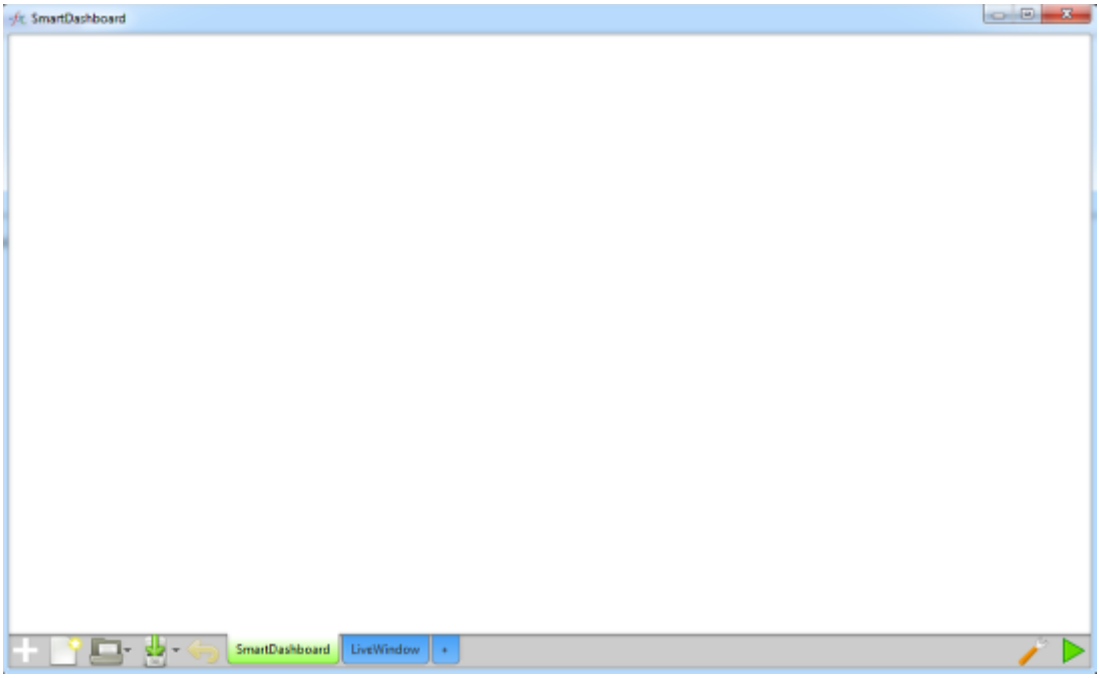
found here. Note that teams may need to install the Java Runtime Environment to use the SmartDashboard on computers not set up for Java programming. Additional documentation on the SmartDashboard can be found here.

LiveWindow



LiveWindow 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.

SFX

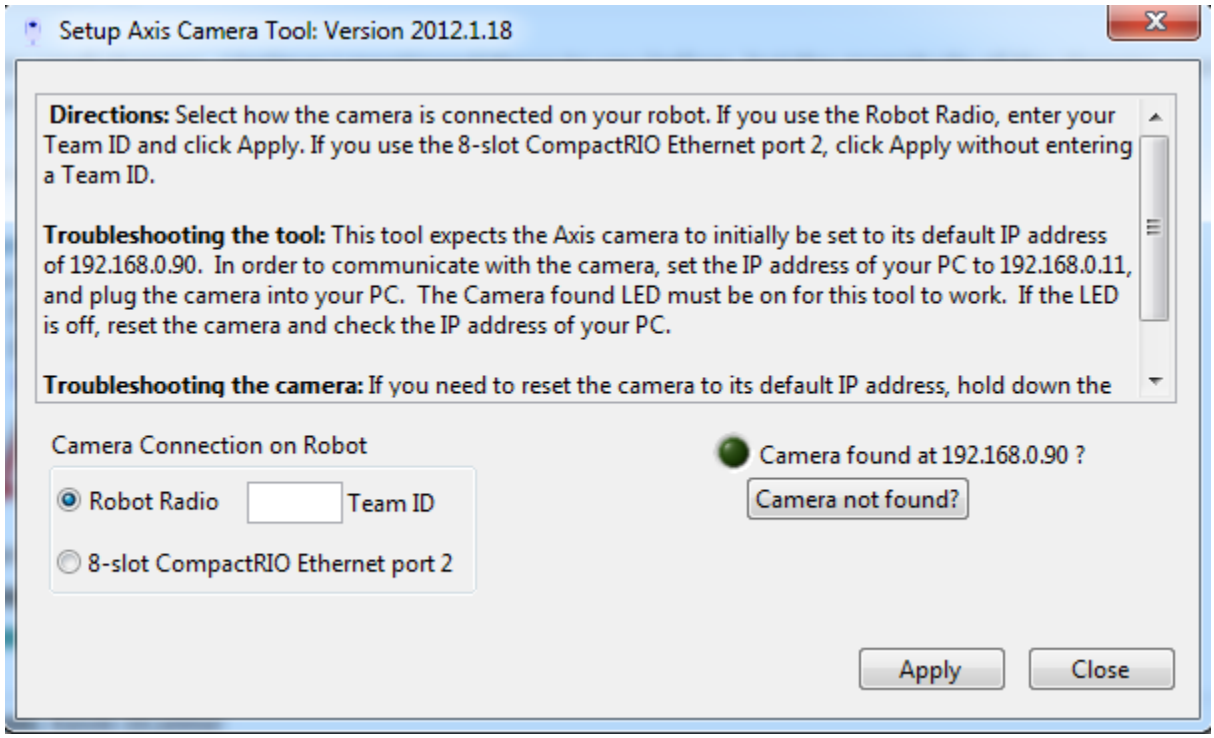


There is a new version of SmartDashboard this year that teams may choose to use. The previous version will still be installed by the language updates for C++ and Java and the Standalone Vision installer and will be launched by using the C++ and Java buttons on the DS. The new version is based on the 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

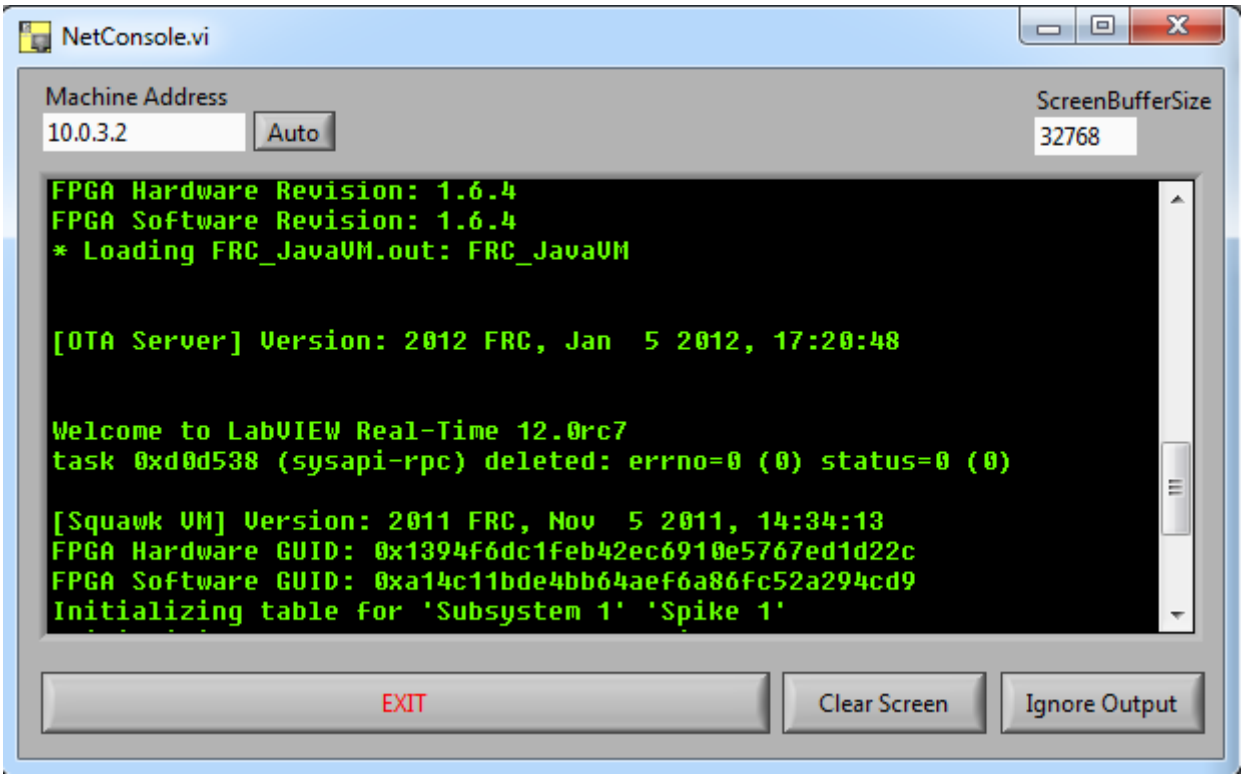
The FRC 2014 cRIO Imaging Tool is a software tool used to format and setup an cRIO-FRC or cRIO-FRCII device for use in FRC. The tool detects any cRIO device on the network, reports the current MAC, name, IP and Image version and indicates if the modules are installed in the correct locations. The tool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



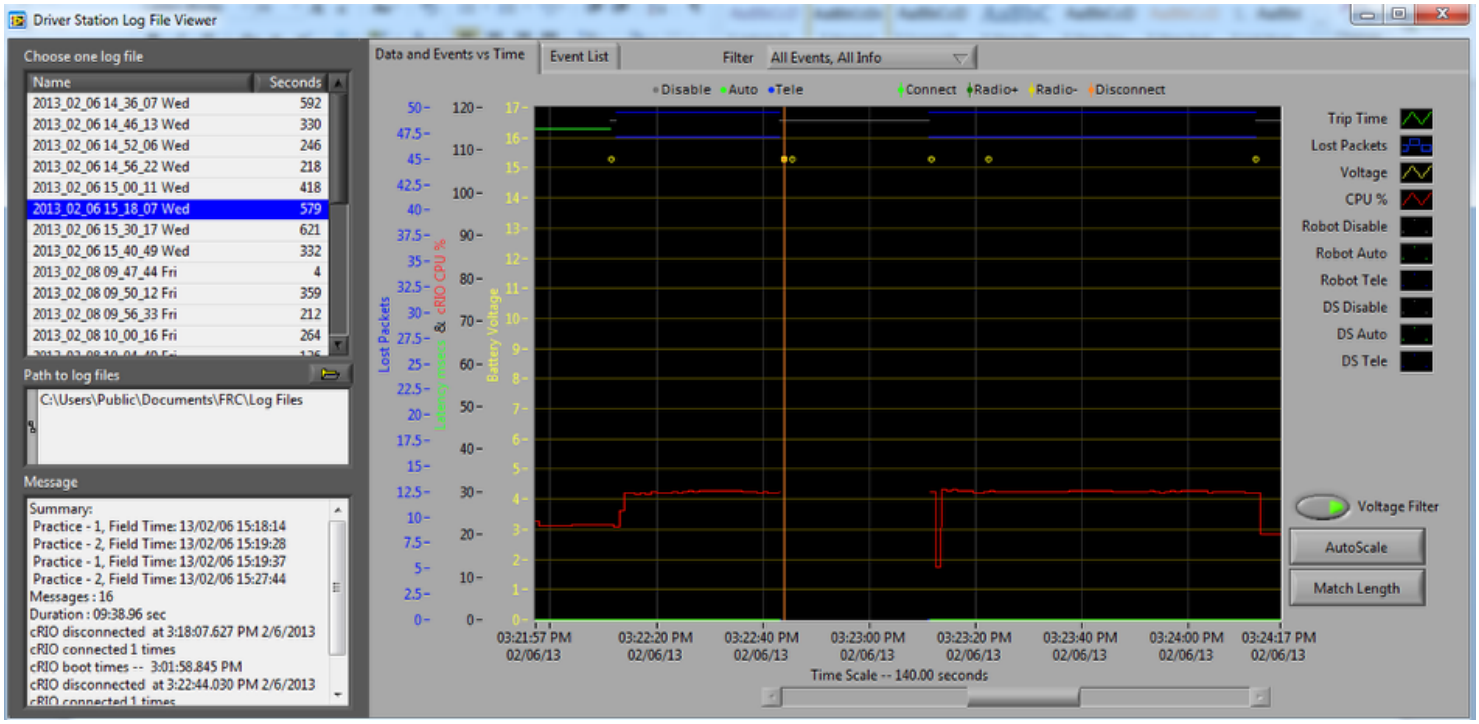
The Setup Axis Camera utility is a LabVIEW program used to configure an Axis 206, M1011, M1013 camera for use on the robot. The tool takes a factory reset camera connected directly to the computer and configures the IP, username and password, anonymous access, and default framerate and compression (for 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



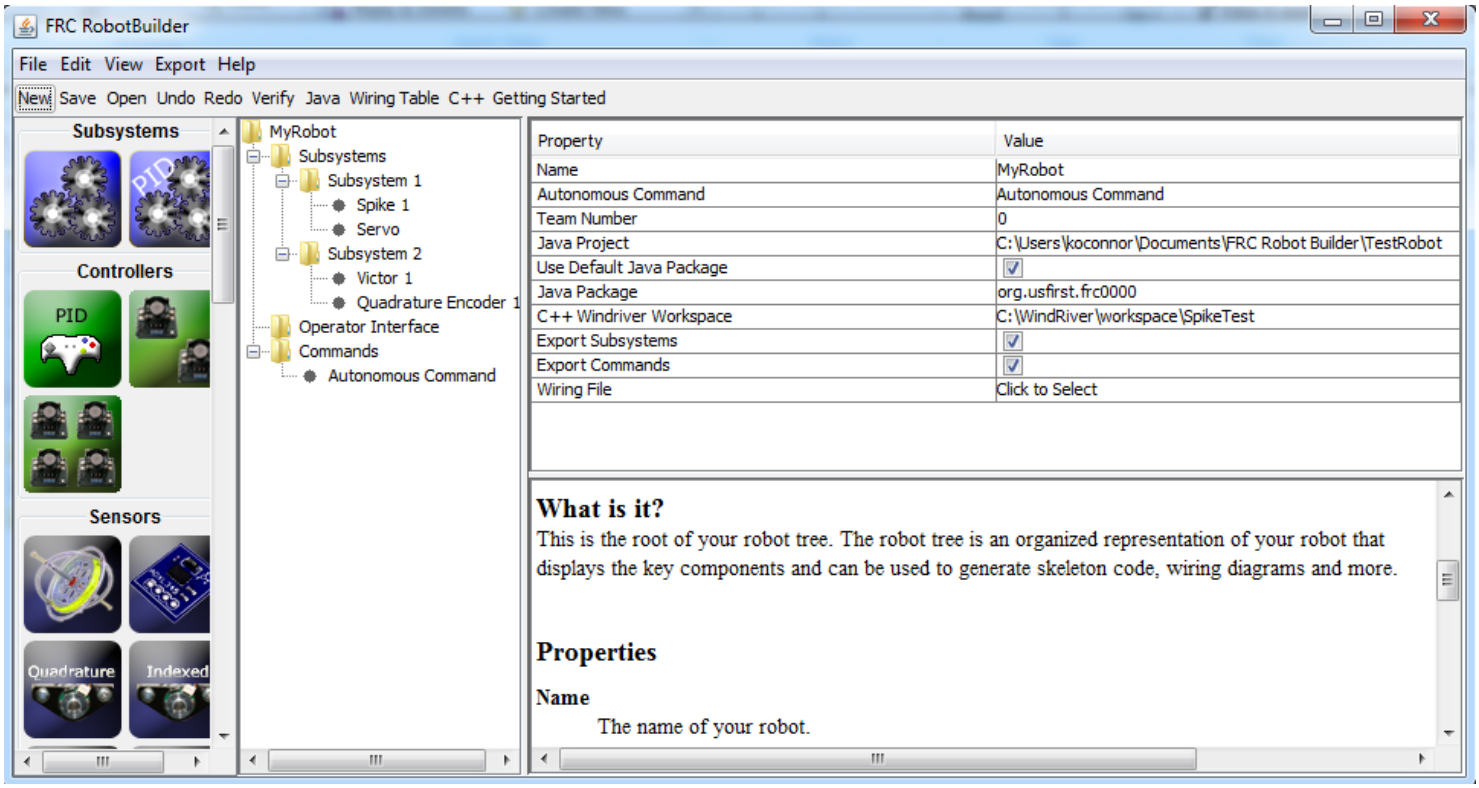
NetConsole for cRIO is a LabVIEW program that, combined with enabling the plugin on the robot with the cRIO Imaging Tool, allows for remote access to the serial console on the cRIO over the network. This allows the user to view diagnostic output from the cRIO, WPILib and any print statements they have 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



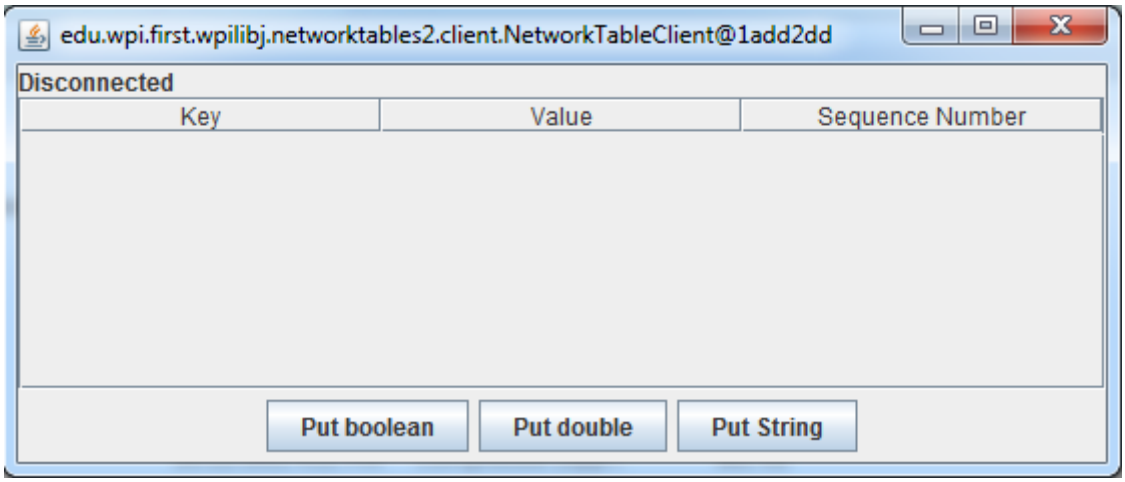
The FRC Driver Station Log Viewer is a LabVIEW program used to view logs created by the FRC Driver Station. These logs contain information such as battery voltage, trip time, CPU% and robot mode, as well as events such as joystick removal. The FRC Driver Station Log Viewer is included in the NI FRC 2014 Update. More information about the FRC Driver Station Log Viewer and understanding the logs can be found here.

Robot Builder



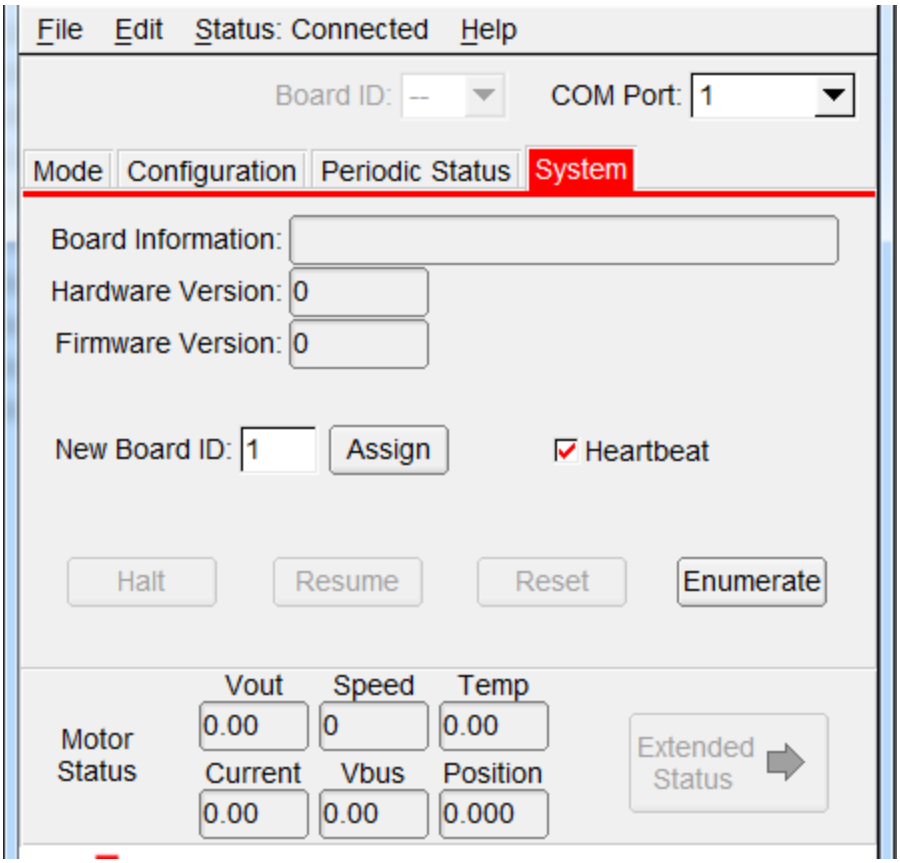
Robot Builder is a tool designed to aid in setup and structuring of a Command Based robot project for C++ or Java. Robot Builder allows you to enter in the various components of your robot subsystems and operator interface and define what your commands are in a graphical tree structure. Robot Builder 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



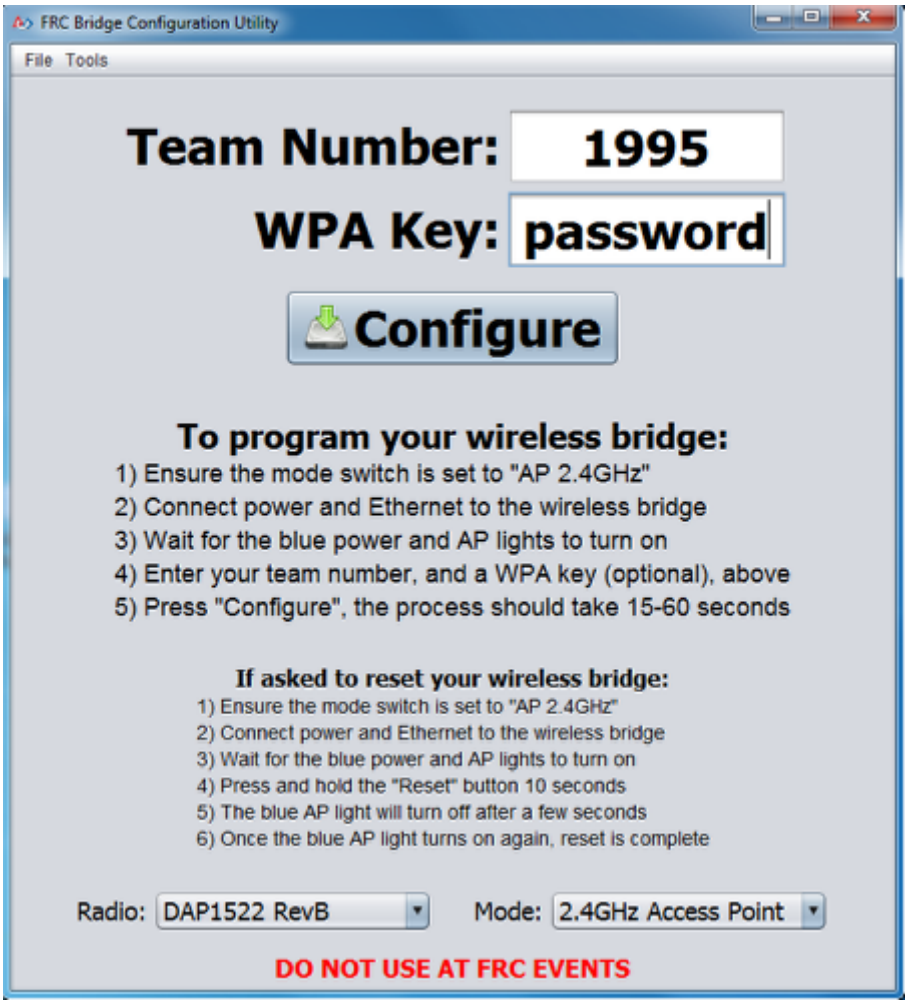
The Network Table Viewer is a utility used to view, modify and add to the contents of the Network Tables for debugging purposes. It displays all keys currently in the Network Table along with the value and Sequence Number and can be used to modify the value of existing keys or add new keys to the Table. 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.

BDC-COMM



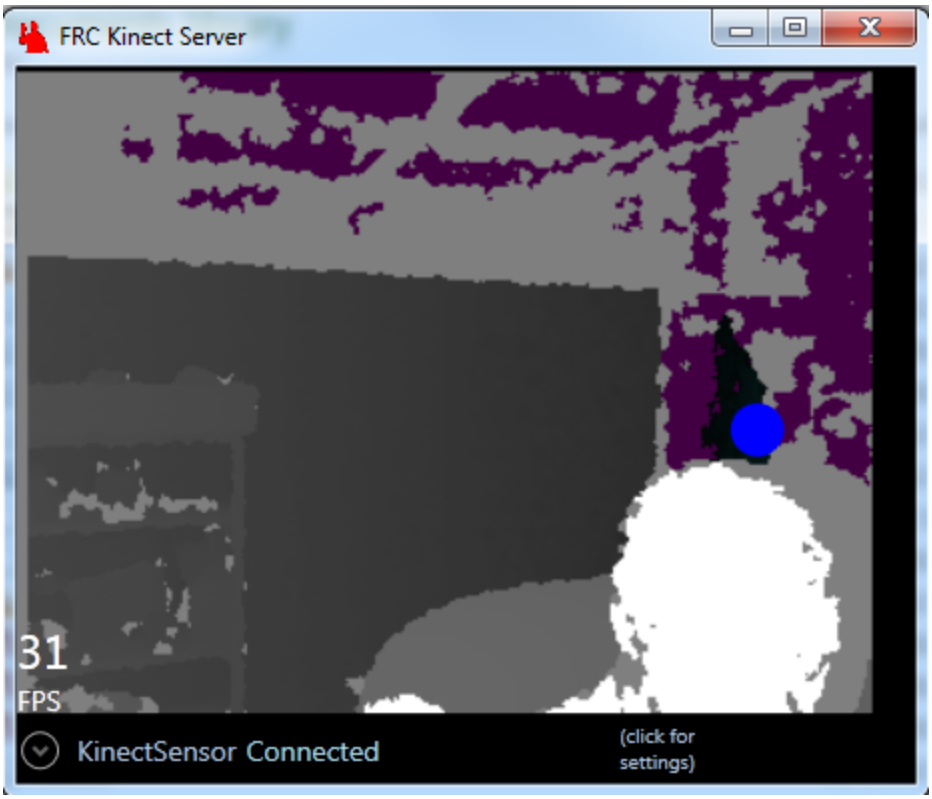
BDC-COMM is a software utility used to configure, update and test Black Jaguar motor controllers over the Serial/CAN interface. This tool can be used to update the Black Jaguar firmware, set the Board ID, and set configuration values such as the fault time and soft limits. The tool can also be used to 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

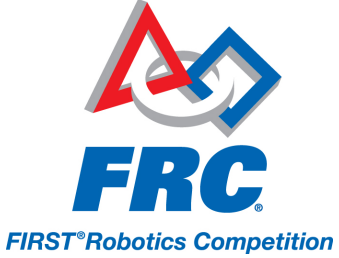


The FRC Bridge Configuration Utility is a tool used to configure the D-Link DAP-1522 radio for practice use at home. This tool sets the appropriate IP, and network settings for proper network connection, as well as the QOS settings required to mimic the bandwidth limiting and packet prioritization experience 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



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 1/22/14

Known Issues

Updated 1/22/14

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

Java FRC Plugins

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.

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:

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

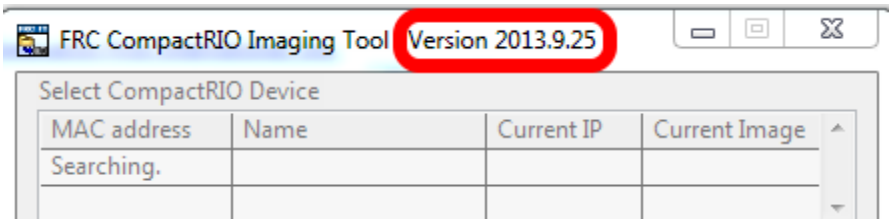
Other Changes:

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.

Latest Software Revisions

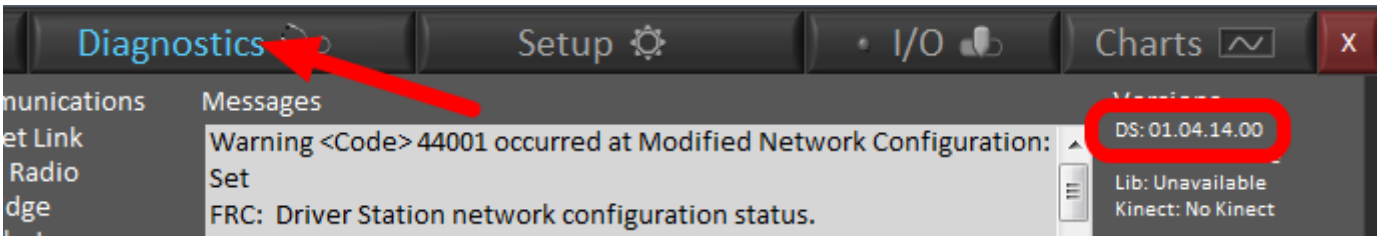
This article details the latest revision of various software components of the FRC Control System.

cRIO Imaging Tool



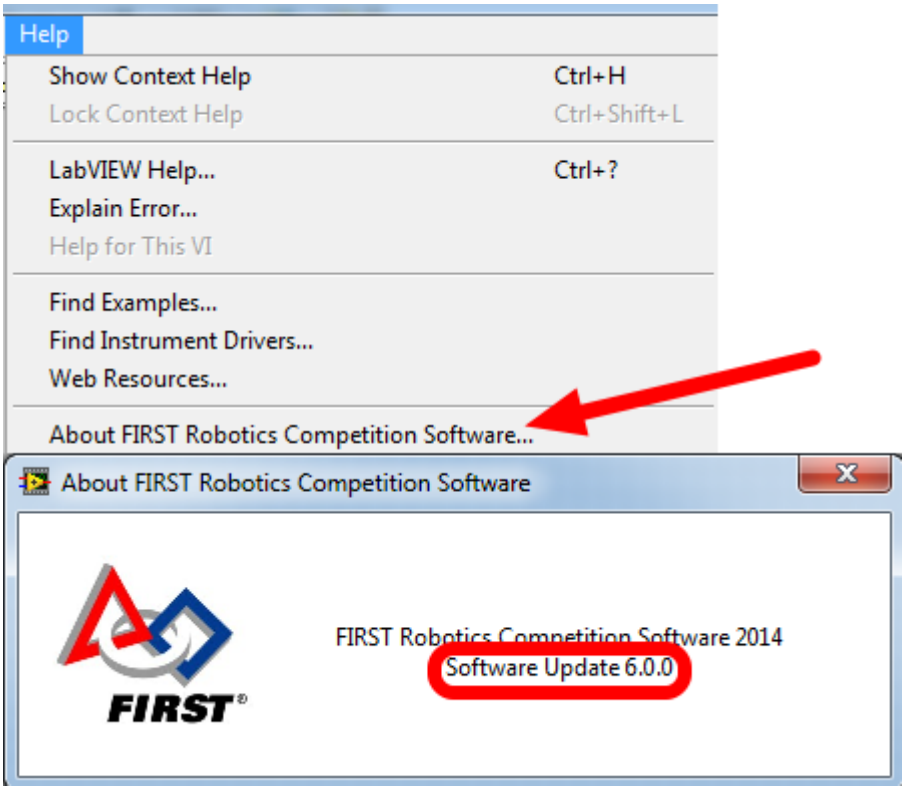
Version 2013.9.25. Installed with 2014 NI FRC Update

FRC Driver Station



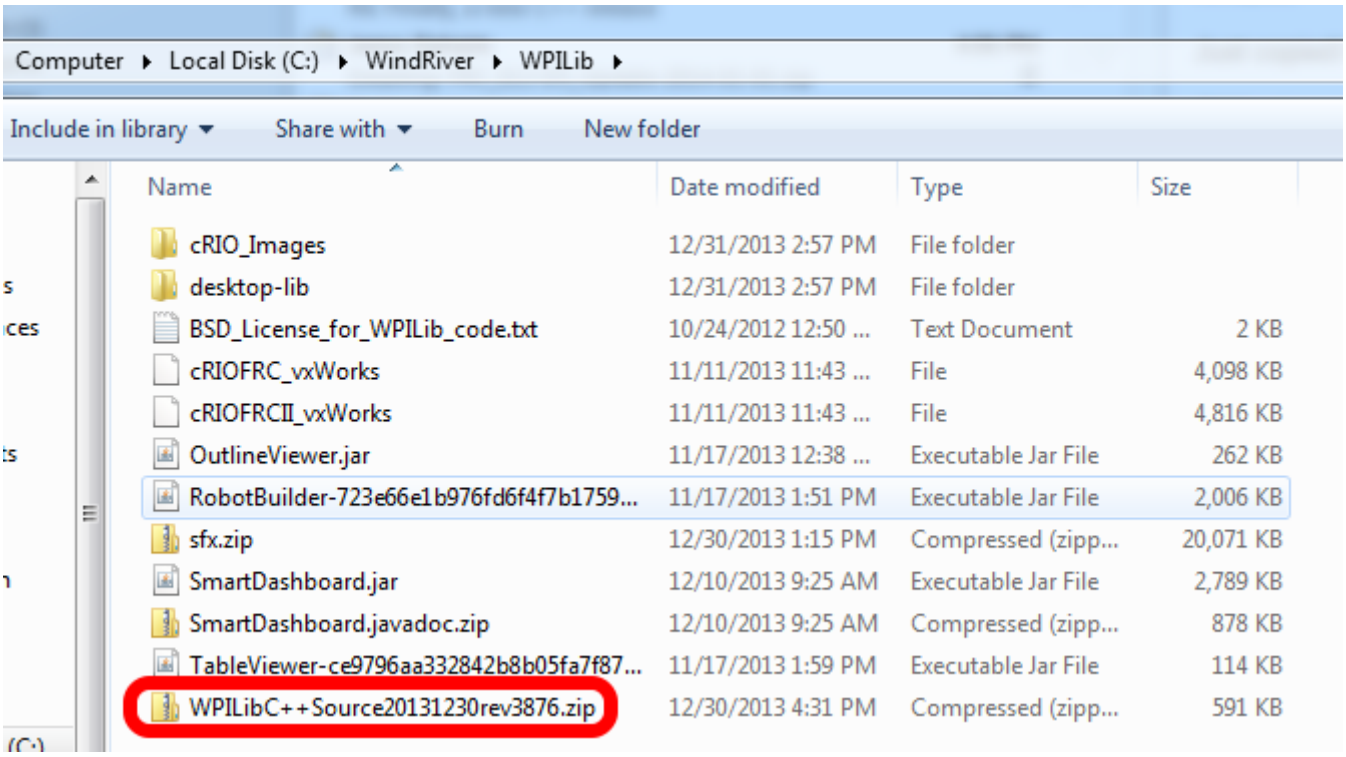
Version 01.04.14.00. Installed with 2014 NI FRC Update

LabVIEW Language Update



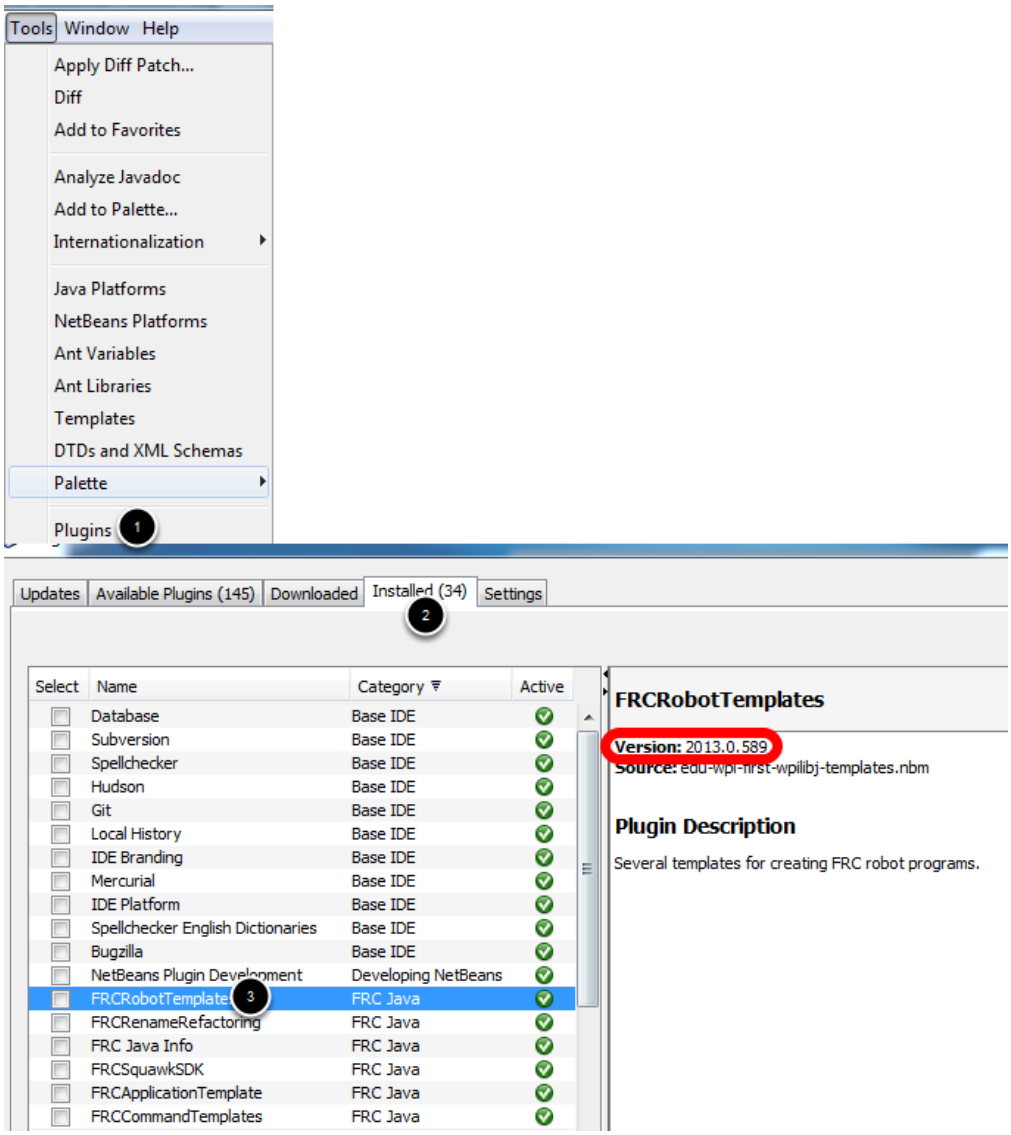
Version 6.0.0. Installed with 2014 NI FRC Update

C++ Language Update



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

Java FRC Plugins

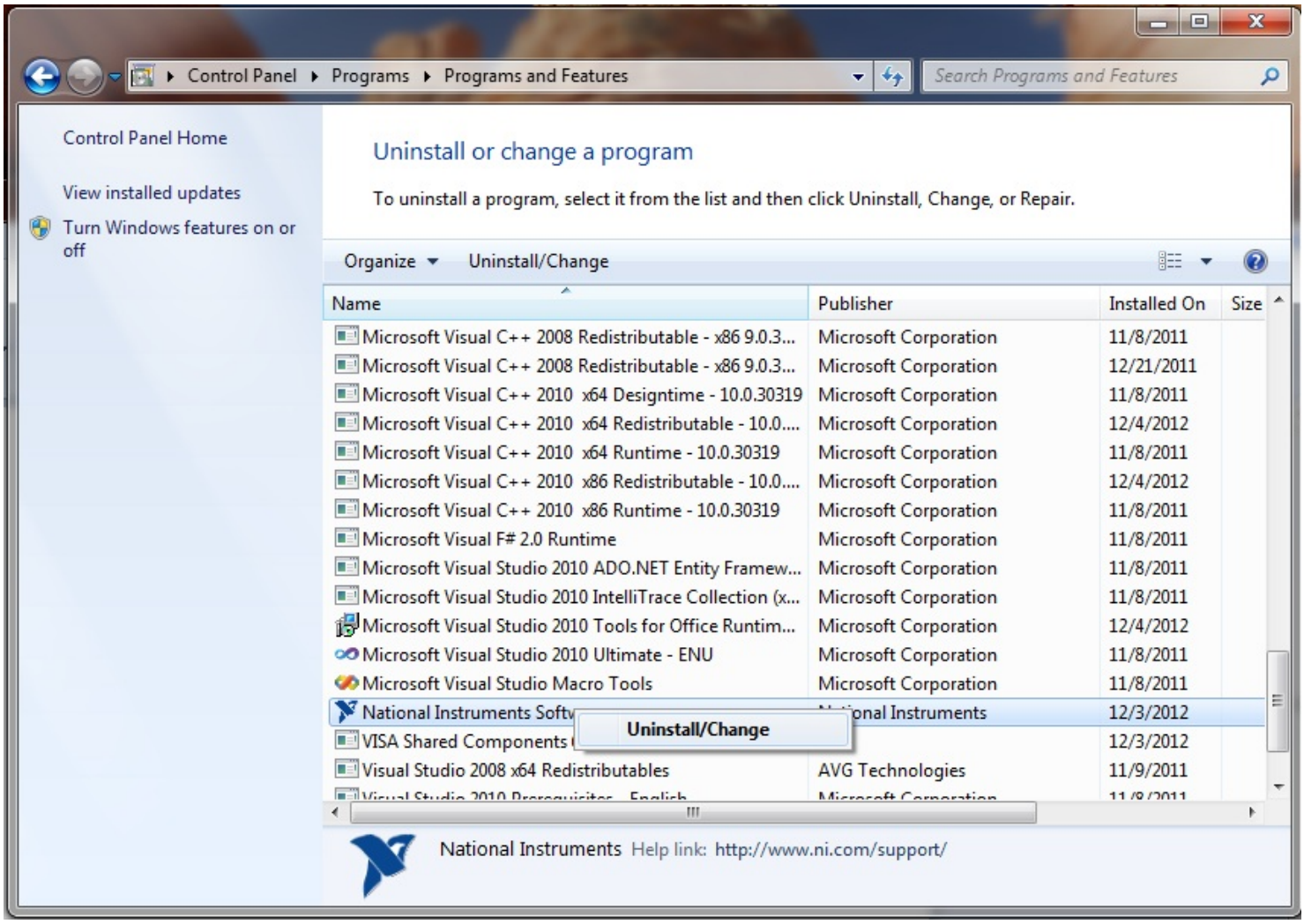


Version 2013.0.589 AKA **Java 2014 Update 0** (when viewed from the DS Diagnostics tab). Install instructions.

Installing the 2014 FRC NI Update (for ALL TEAMS)

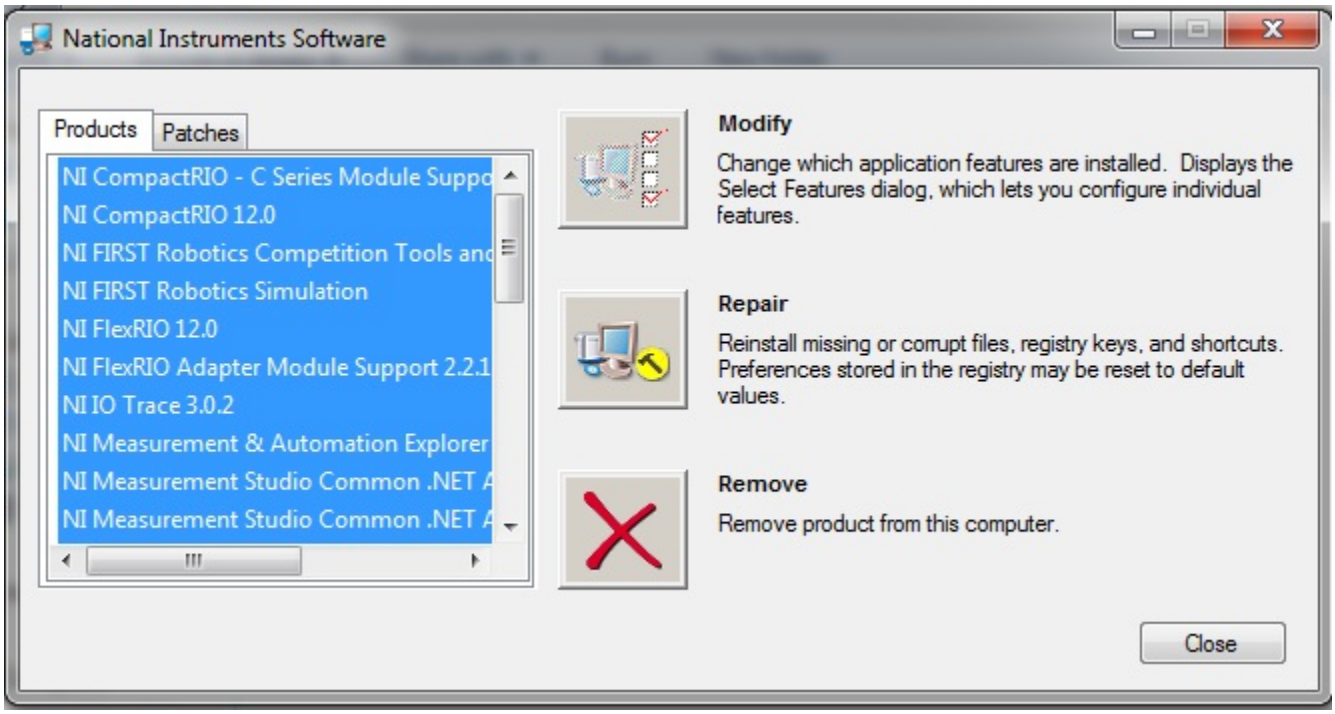
This year the NI updates have been reconfigured into a single standalone installer. This means that the FRC Driver Station, cRIO Imaging Tool and other utilities such as the Camera Configuration Tool will all be bundled into a single installer which will **not require any components from the DVD**. The 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)



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



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.

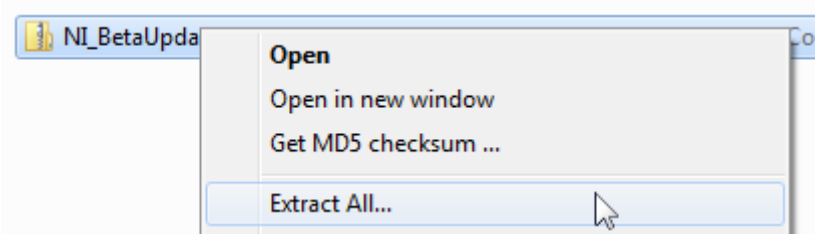
OPTIONAL - Install LabVIEW

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/

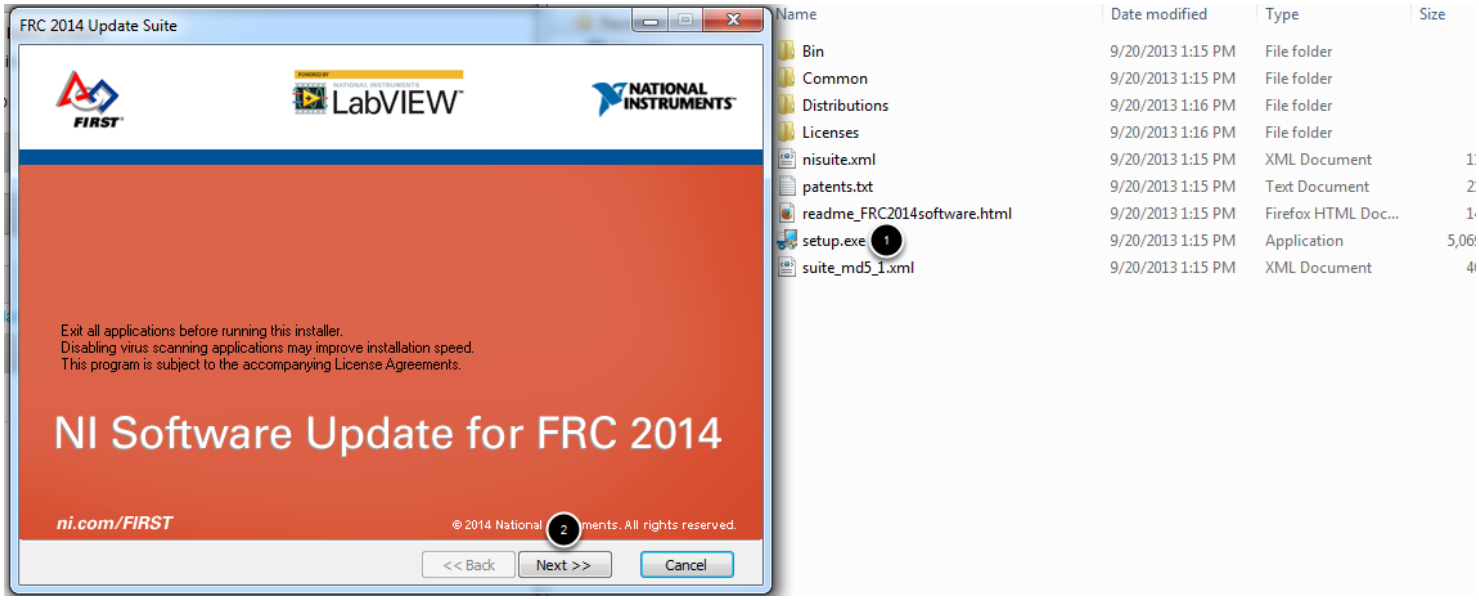
Unzip the Update



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.

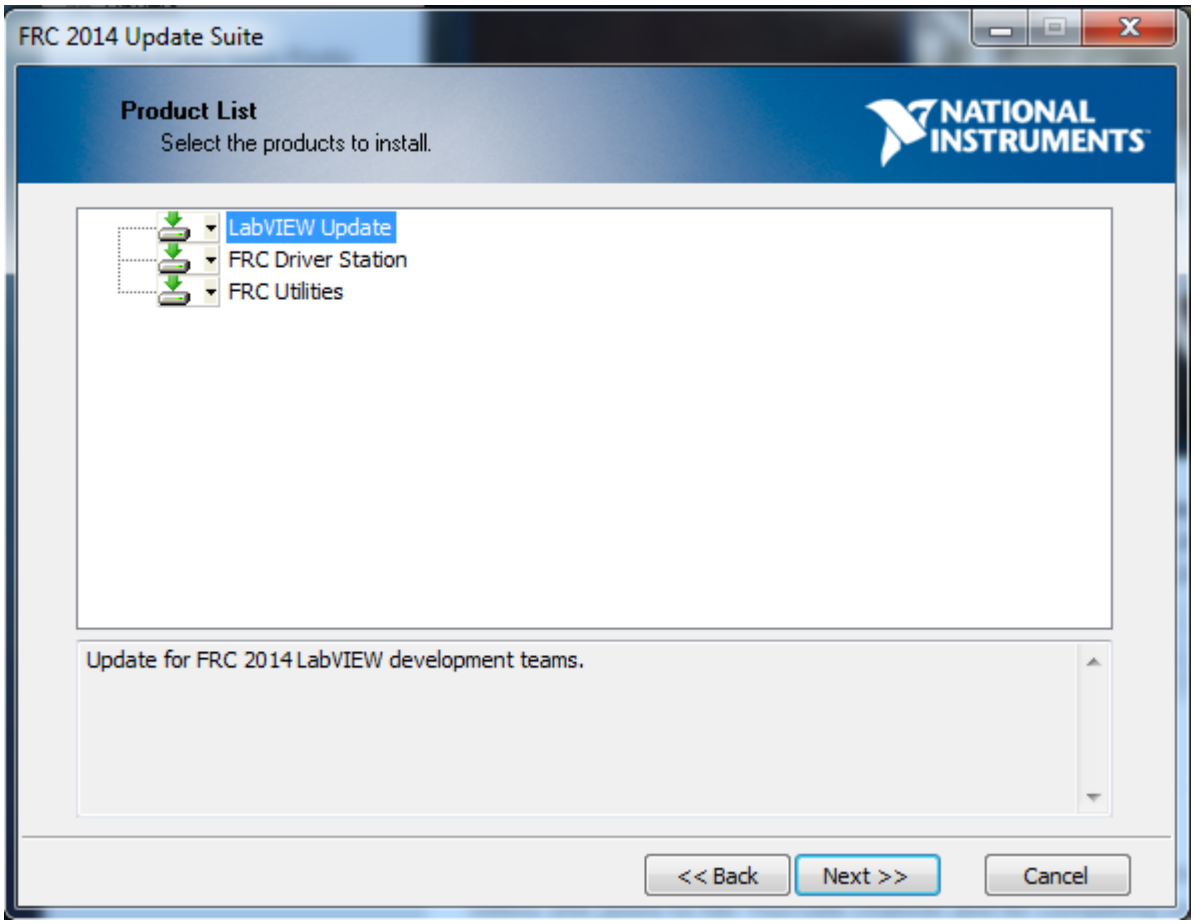
Note that the update is currently still encrypted with the 2014 game password 3Zones2Goals1Alliance!

Run Installer



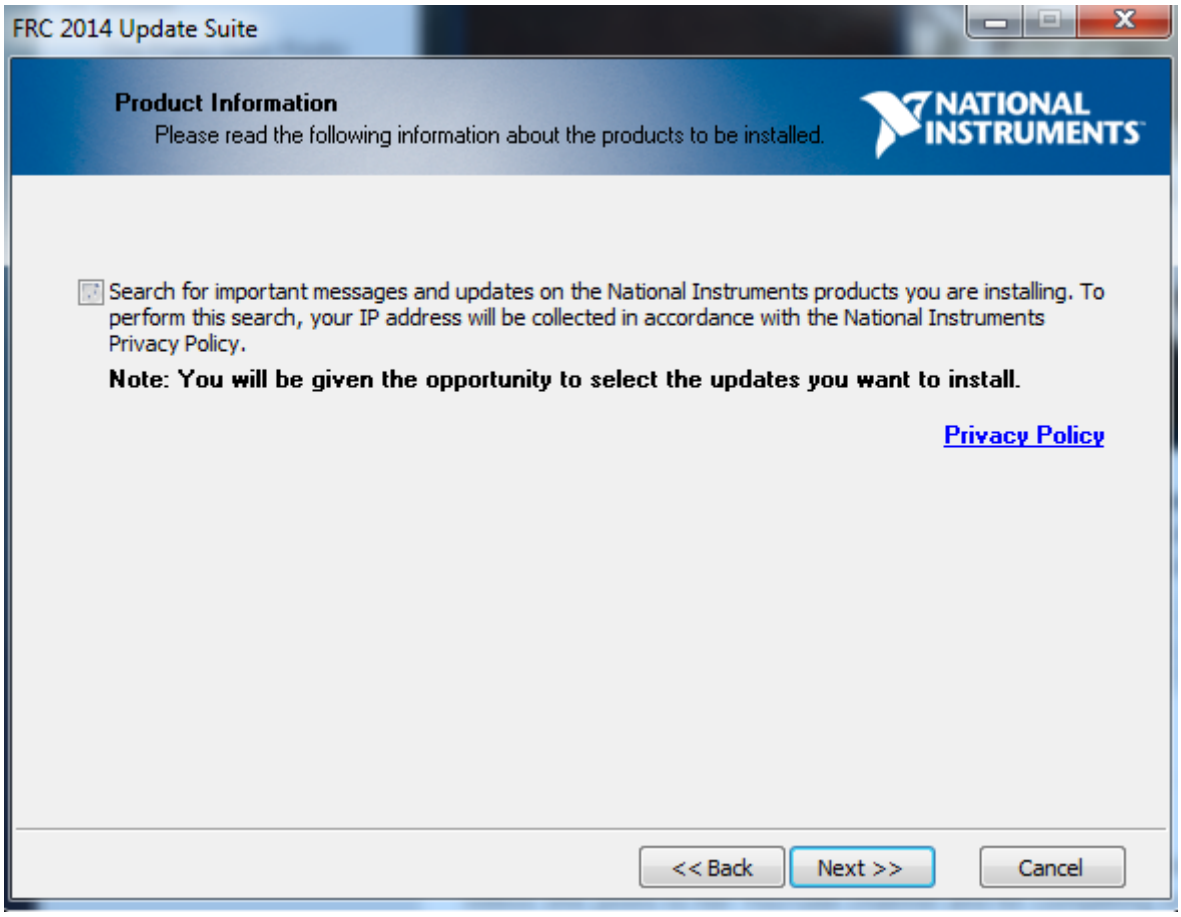
Browse down into the folder structure until you locate the installer **Setup.exe**. Double click on the installer to launch the installation. Click **Next** to advance.

Select Components



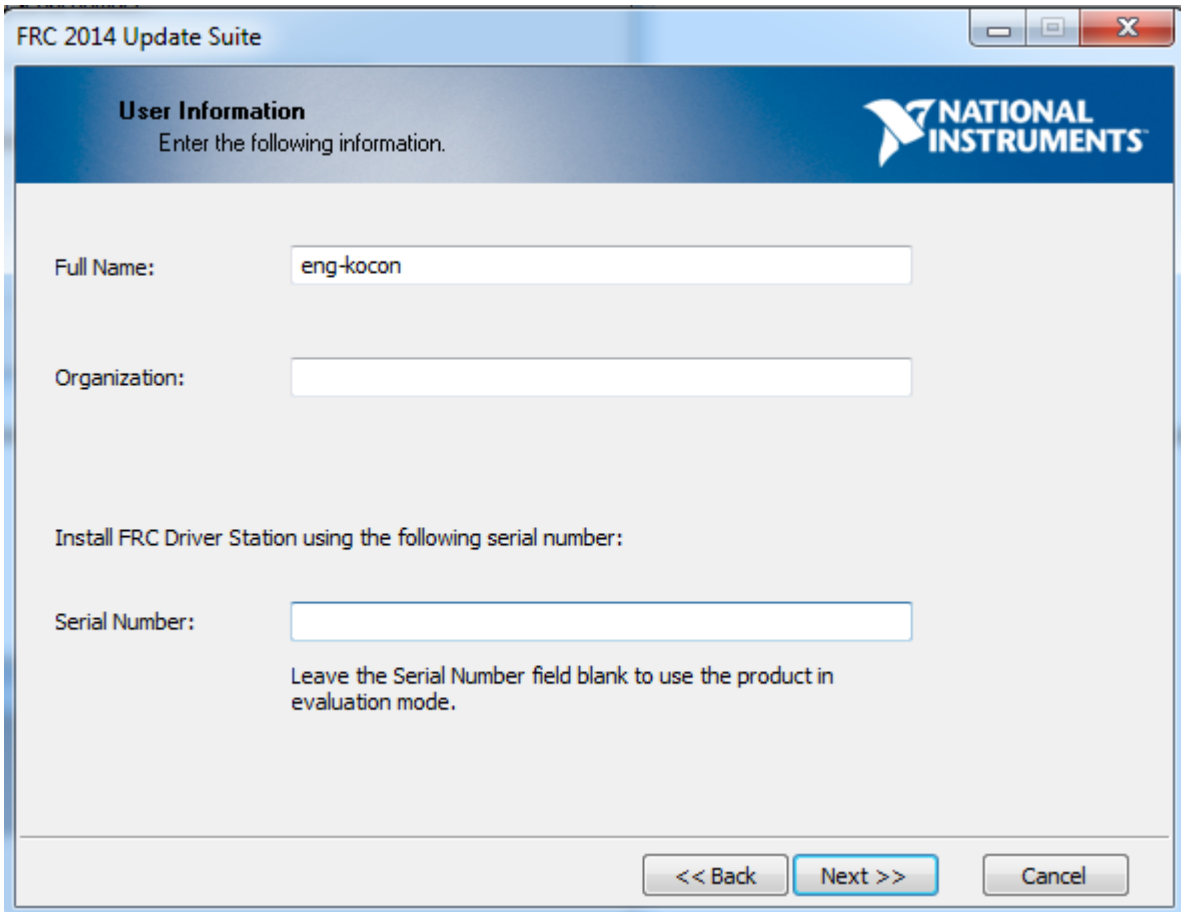
On the Product List screen, click **Next** to advance. **The LabVIEW Update will detect if LabVIEW is installed and will automatically determine whether to install or not.**

Search for Updates



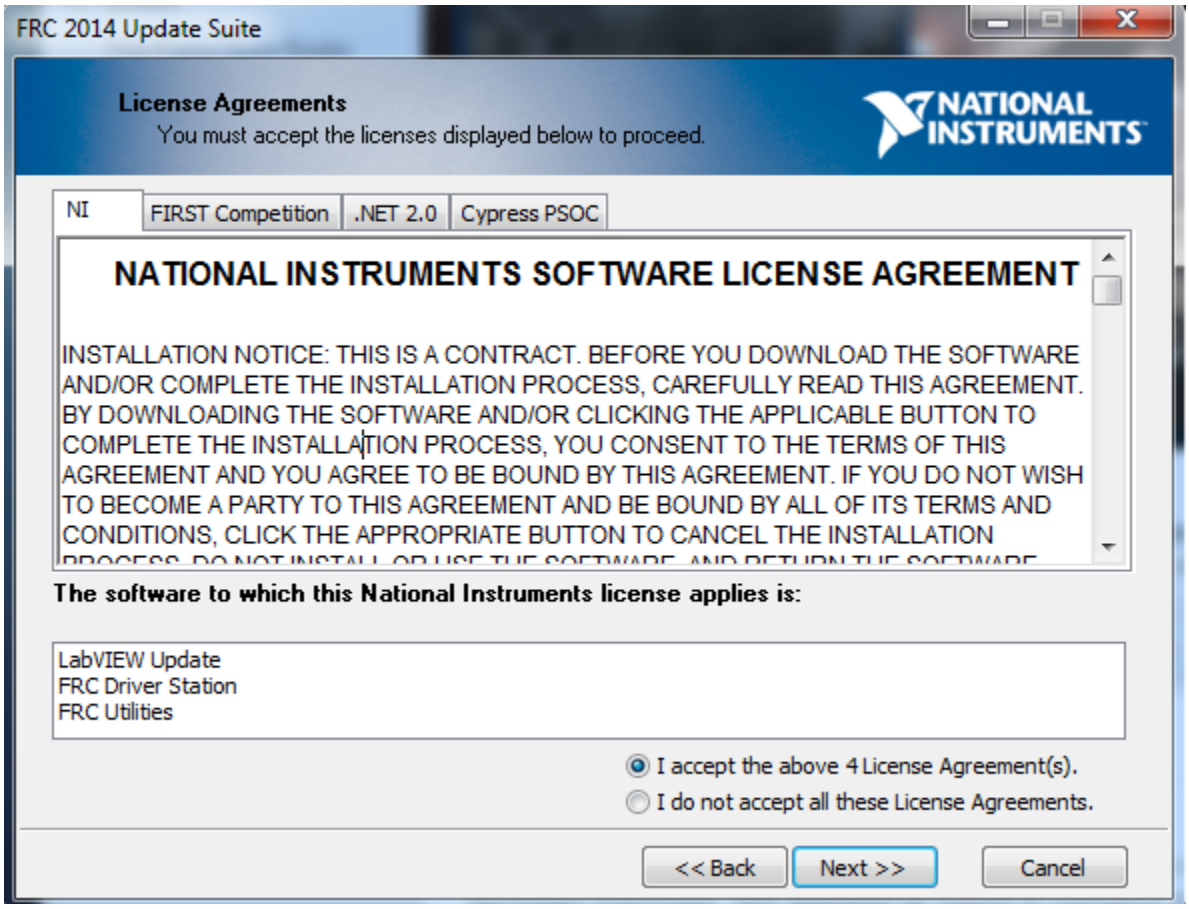
Uncheck the box to search for updates then click **Next.**

Enter Serial Number



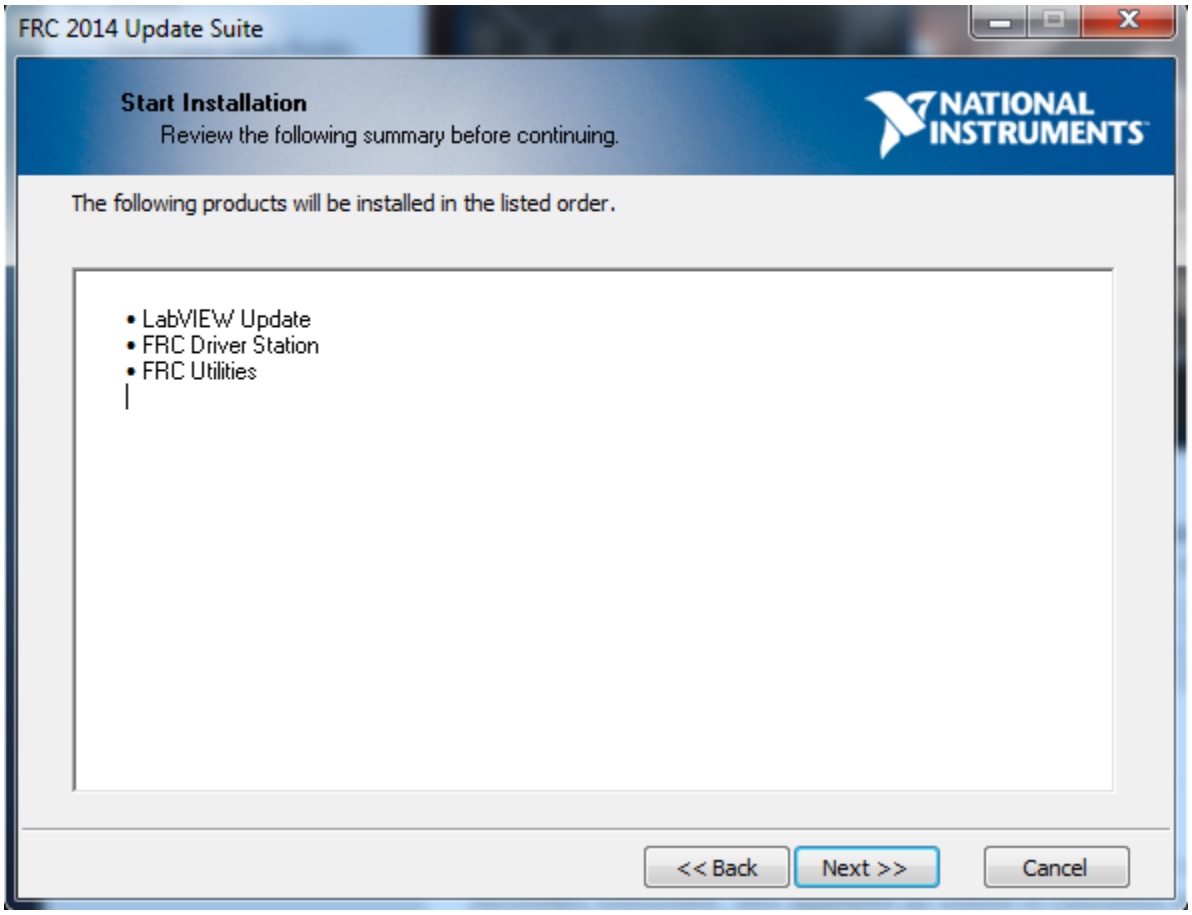
Enter your name or computer name and organization if desired. Enter the serial number from the NI DVD in your Kit of Parts in the box and click **Next.**

Licenses



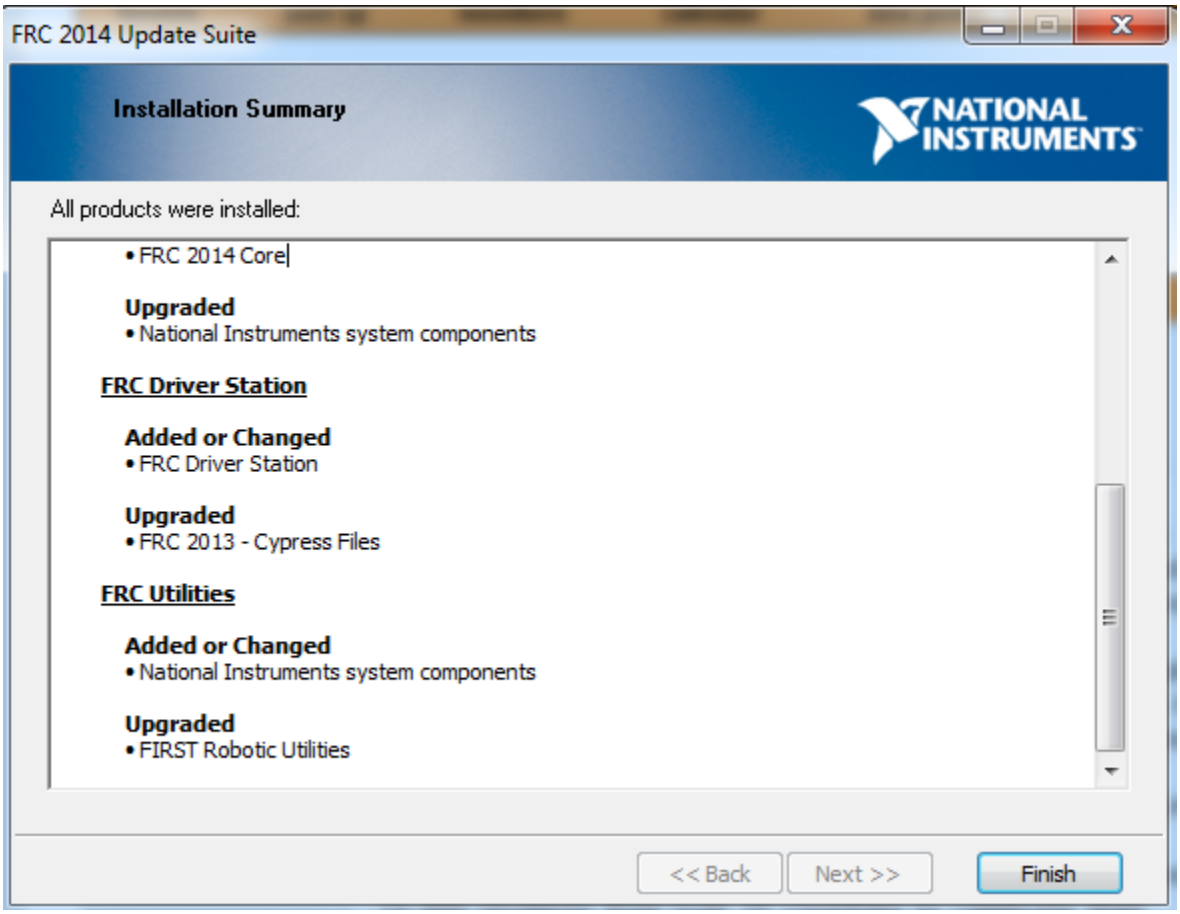
Click the I accept bubble to indicate you accept the 4 licenses displayed on the tabs. Then click **Next** to proceed.

Installation Review



Click **Next** to start the installation.

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

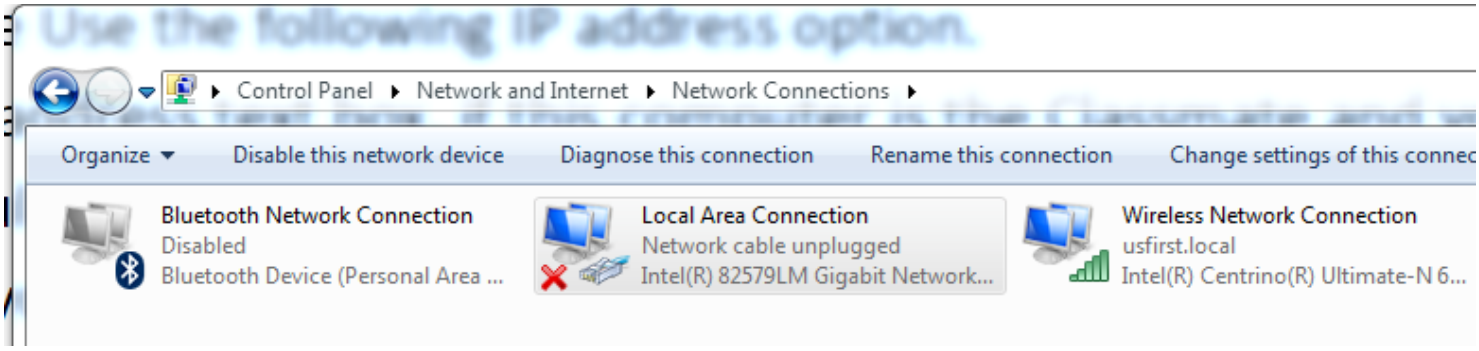
Before imaging your cRIO, you must have completed installation of the the development environment and language updates for the appropriate programming language (C++, Java, LabVIEW).You must also complete the NI FRC Update installation. You also must have the cRIO power properly wired to the Power Distribution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

Configure computer IP address

Team Number	IP Address
45	10.0.45.5
234	10.2.34.5
1024	10.10.24.5

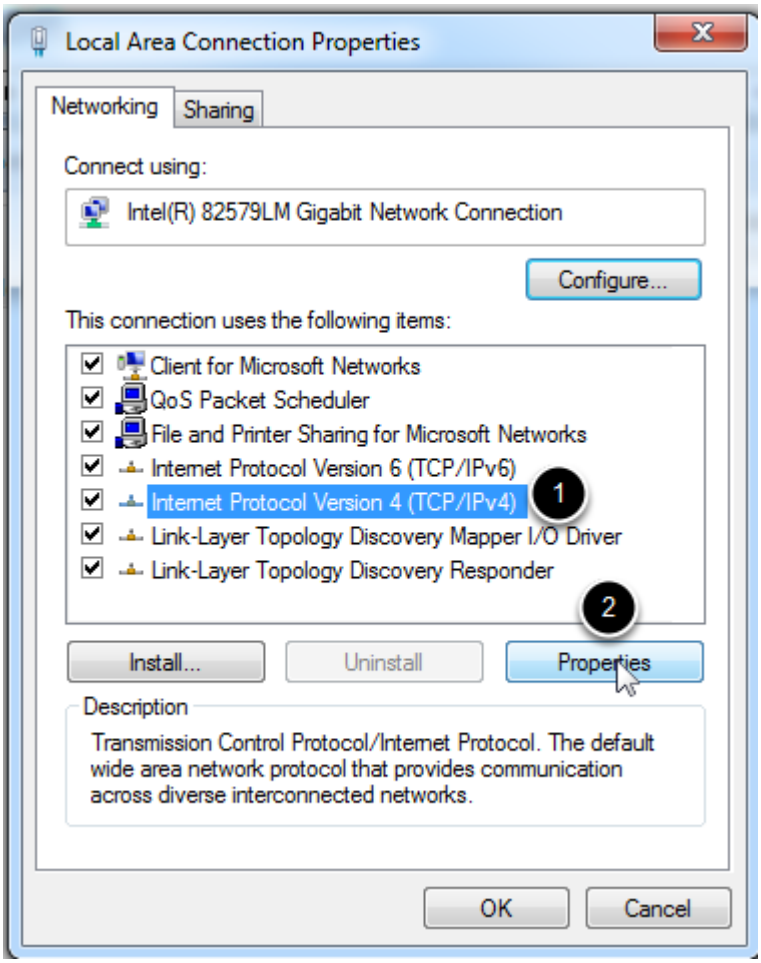
To image the cRIO, the IP address of your computer should be set to 10.xx.yy.5 where XXYY is your 4 digit team number (see chart for examples). The instructions below detail how to set this on Windows 7, there may be slight differences on Vista or XP. *Note: If you are planning on running the Driver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



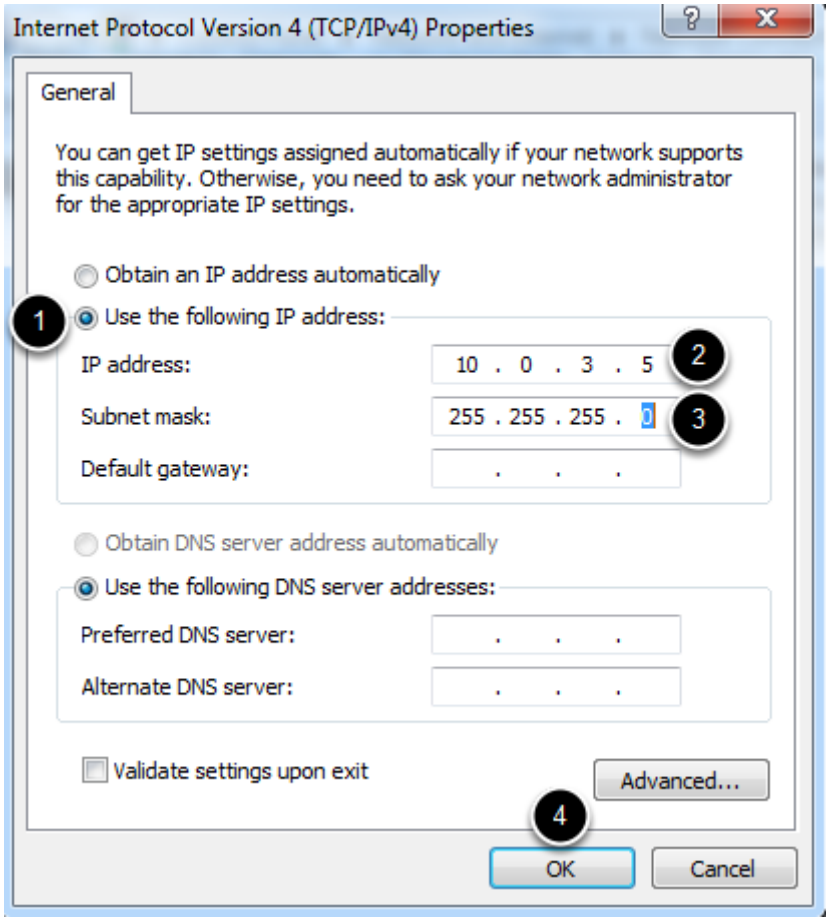
To set the IP address, click on **Start > Control Panel > View Network Status and Tasks > Change Adapter Settings,** then double-click on **Local Area Connection** to display the Local Area Connection Properties dialog.

TCP/IP Properties



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

Set IP address

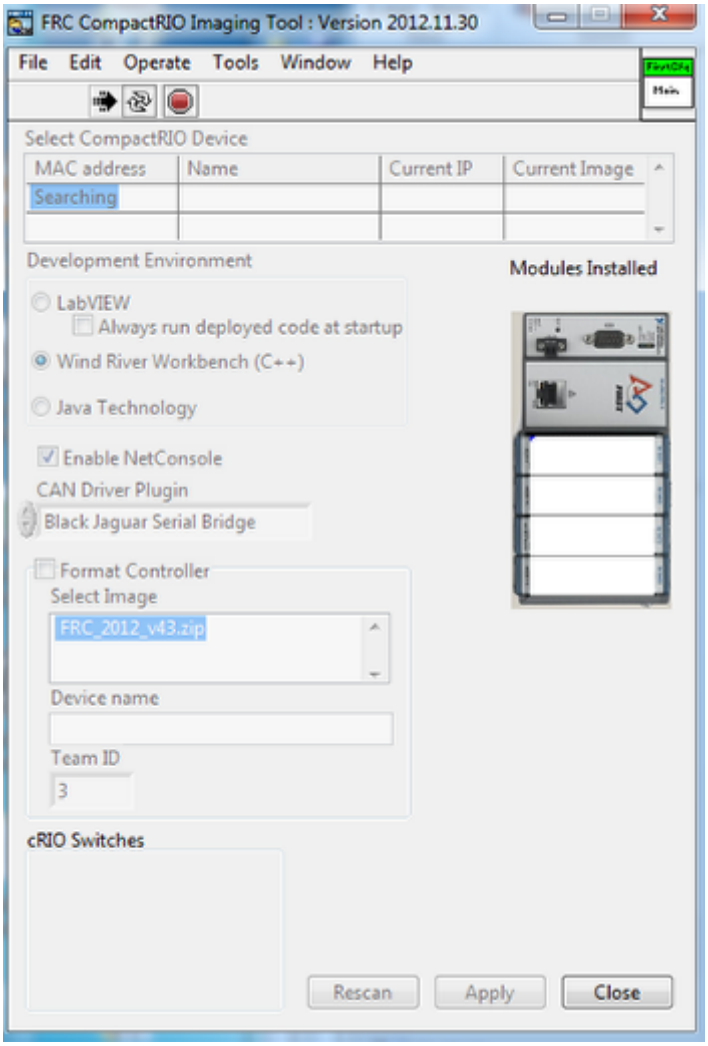


On the TCP/IP properties page:

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,

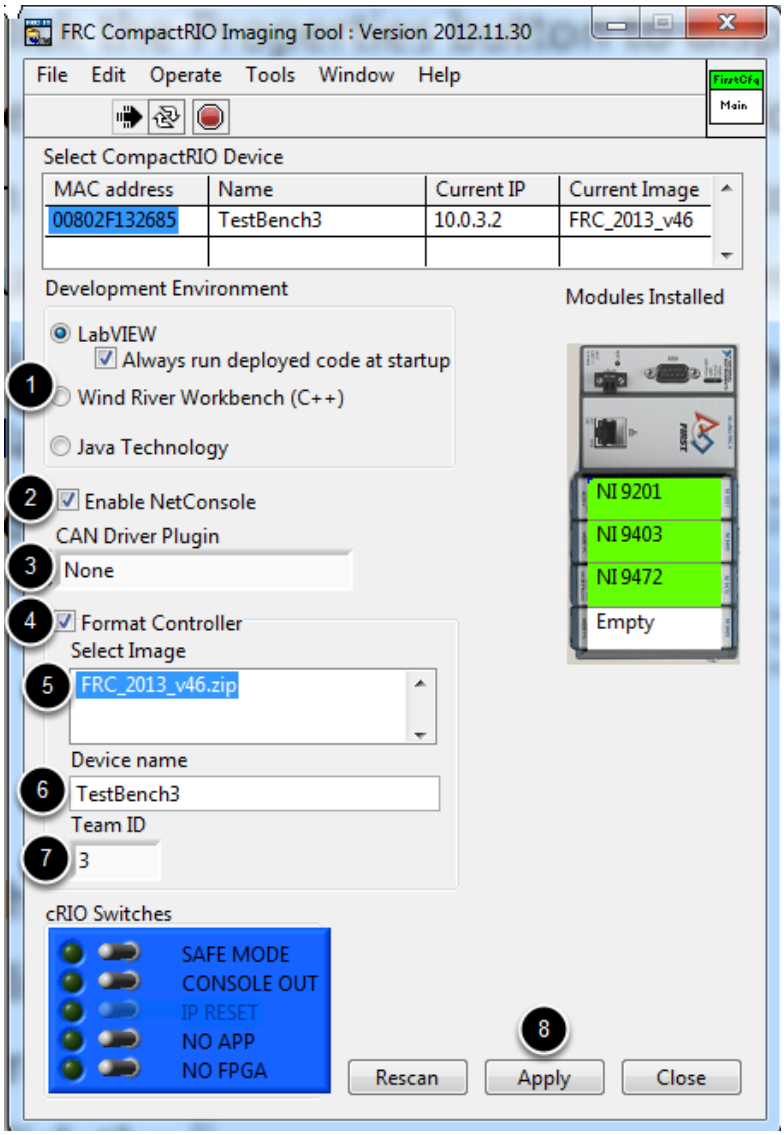
Note: For proper operation on the playing field at competition the subnet mask should be set back to 255.0.0.0 after imaging is complete if this PC will be used as a Driver Station.

Connect cRIO Ethernet to PC



Connect 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



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)

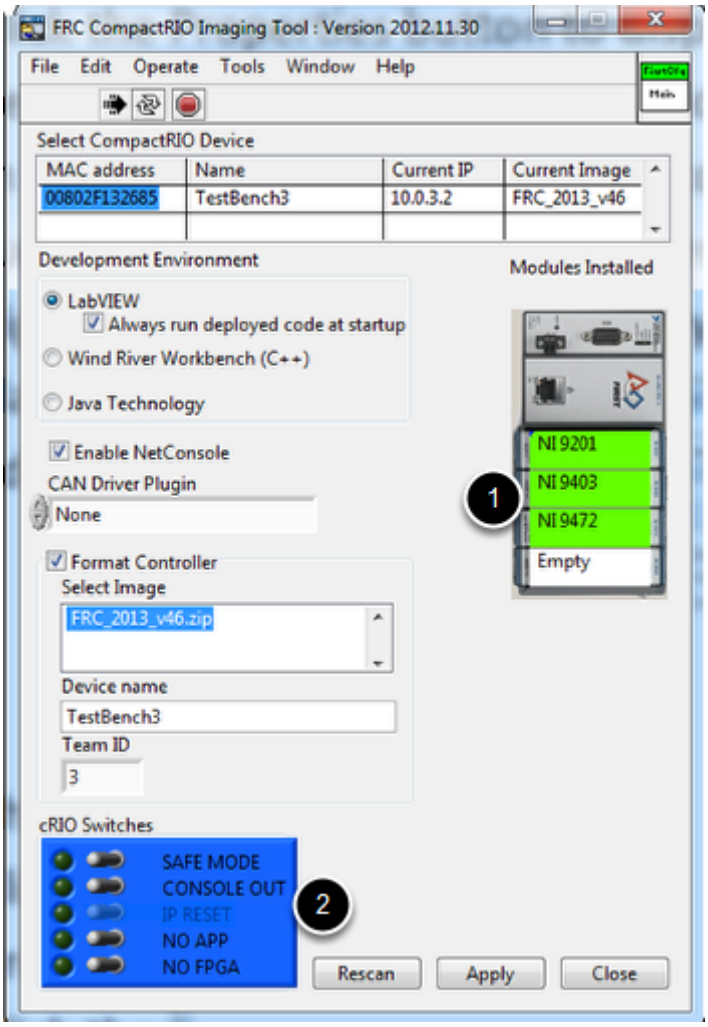
3. Select a CAN plugin if appropriate. Note that if you select a CAN plugin with the Console Out feature enabled, on a 4-slot cRIO-FRCII the Console Out will be disabled automatically, on an 8-slot cRIO-FRC you will see a prompt to flip the switch to disable Console Out.
4. Check the box next to **Format 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



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

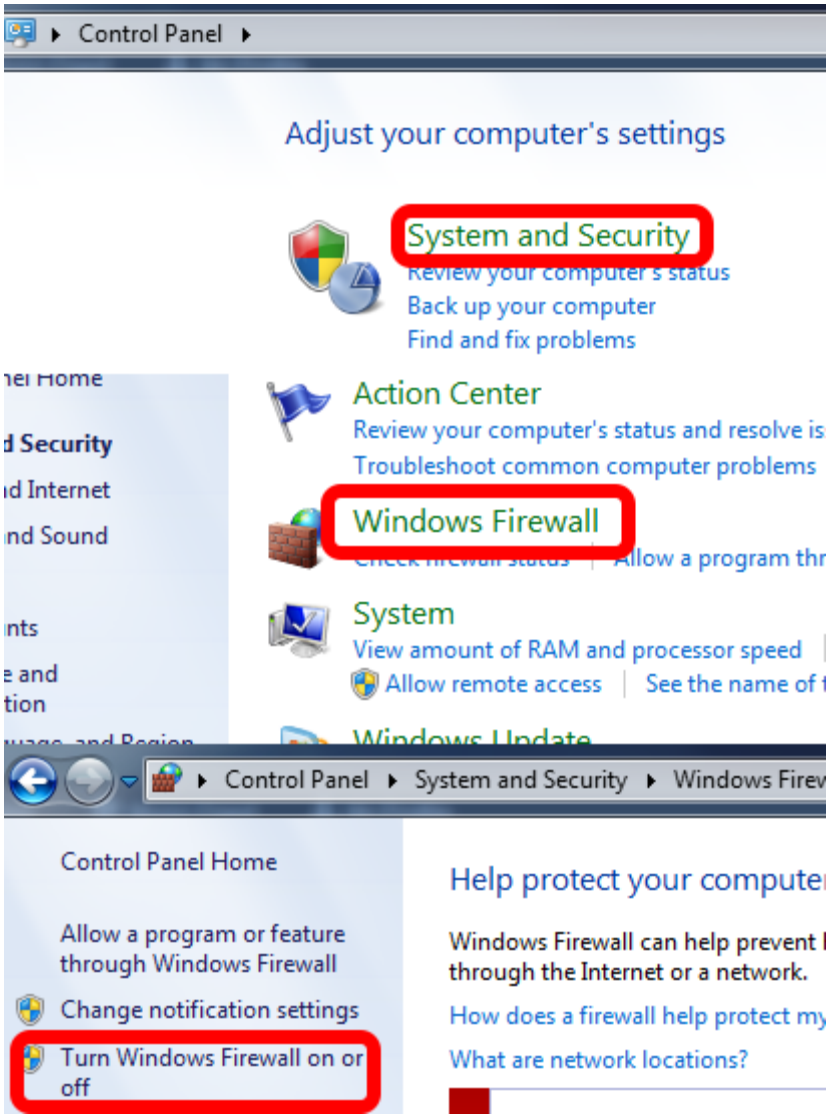
1. Module Validation: The cRIO Imaging Tool will show the modules currently detected by the cRIO and highlight valid slots in green and invalid slots in red. Hover over any invalid or empty slot for more information about the correct module to install there.
2. cRIO Switches: On the 8-slot cRIO-FRC this 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 Timout 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.

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

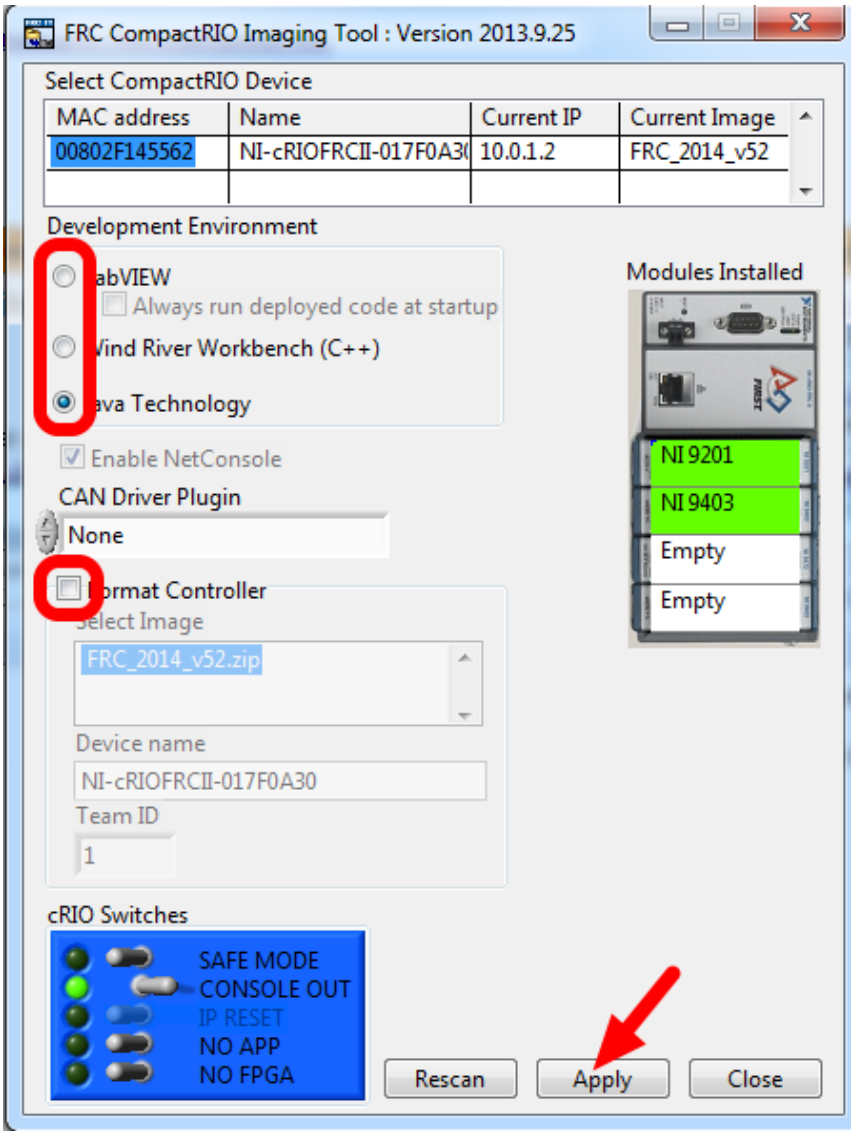
Changing Languages and Settings Using the cRIO Imaging Tool

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

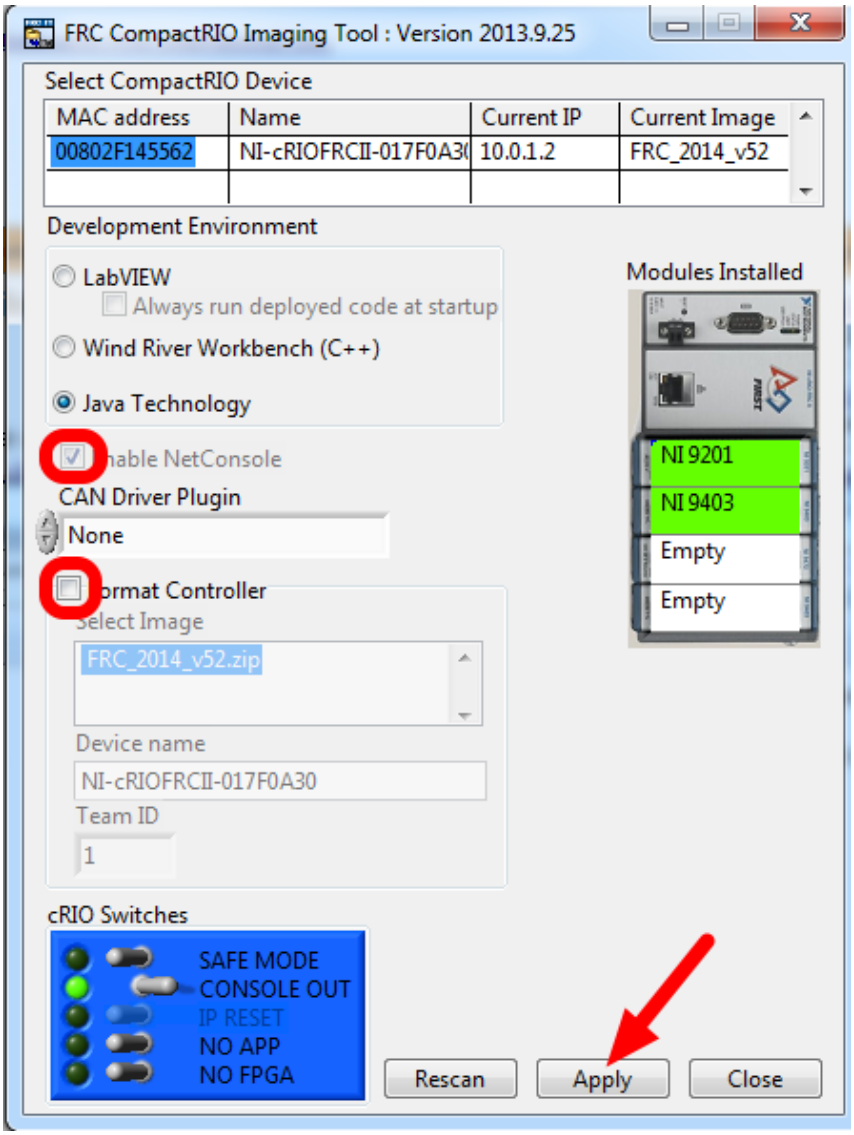
As in the previous section on Imaging the cRIO, the IP of the computer must be set to 10.XX.YY.5 or .6

Changing the Programming Language



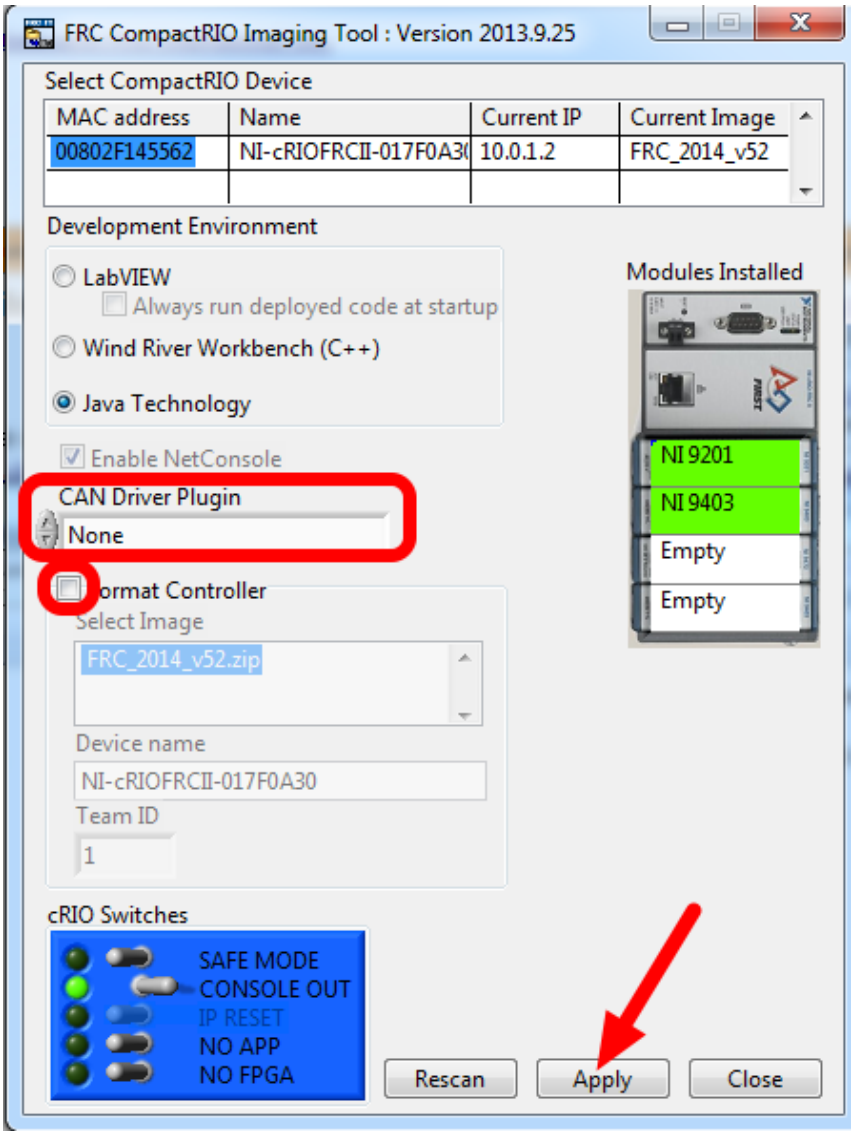
The programming language the cRIO is set for can be changed using the cRIO Imaging Tool without reformatting the cRIO. To do this, make sure the **Format** box is **unchecked**, select the bubble for the desired language, then click **Apply**.

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.

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.

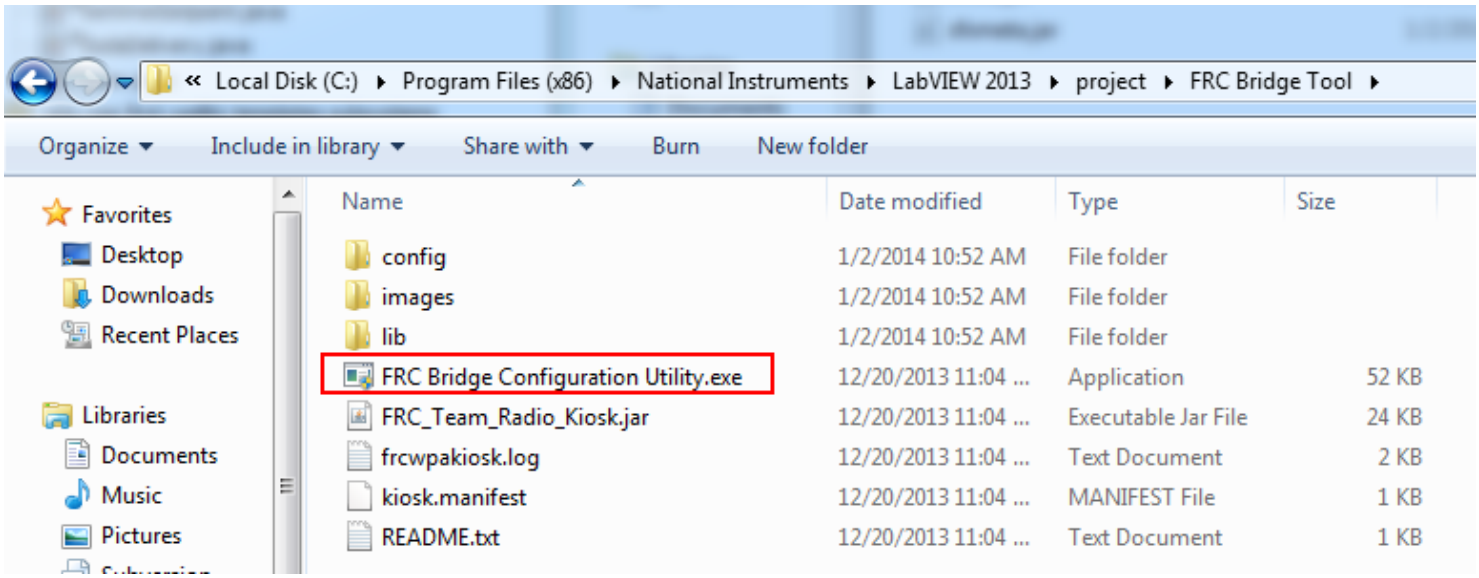
Installing the JRE

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

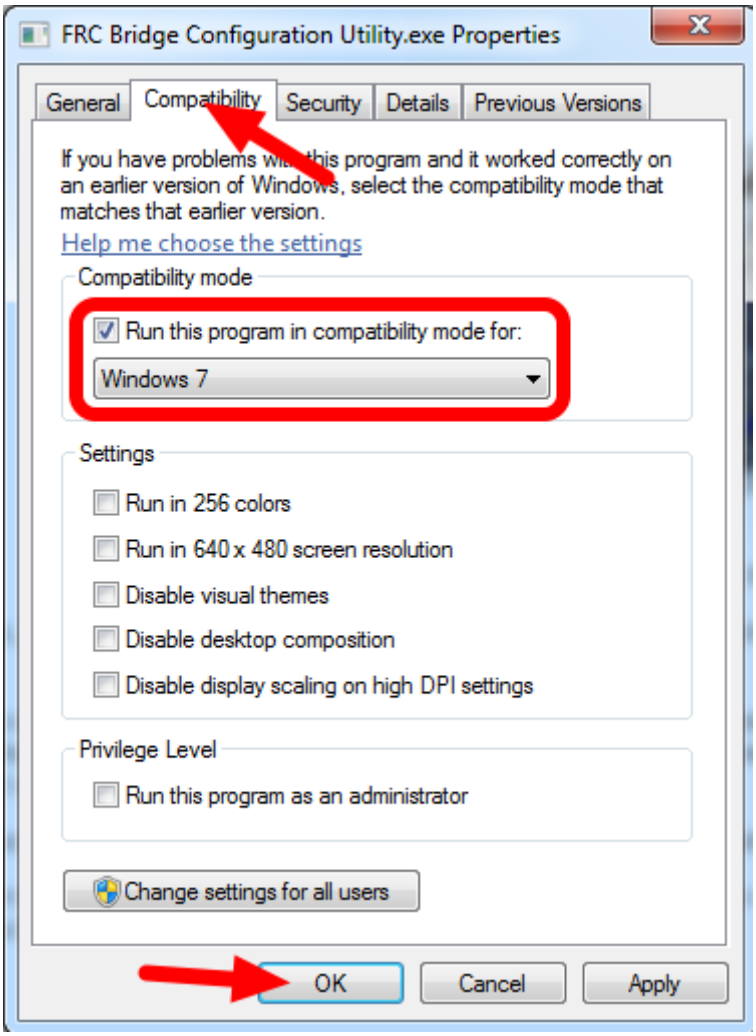
The FRC Bridge Configuration Utility is installed with the NI FRC Update. If you have not already installed this update see the Installing the 2014 NI FRC NI Update article for details.

Launch the software



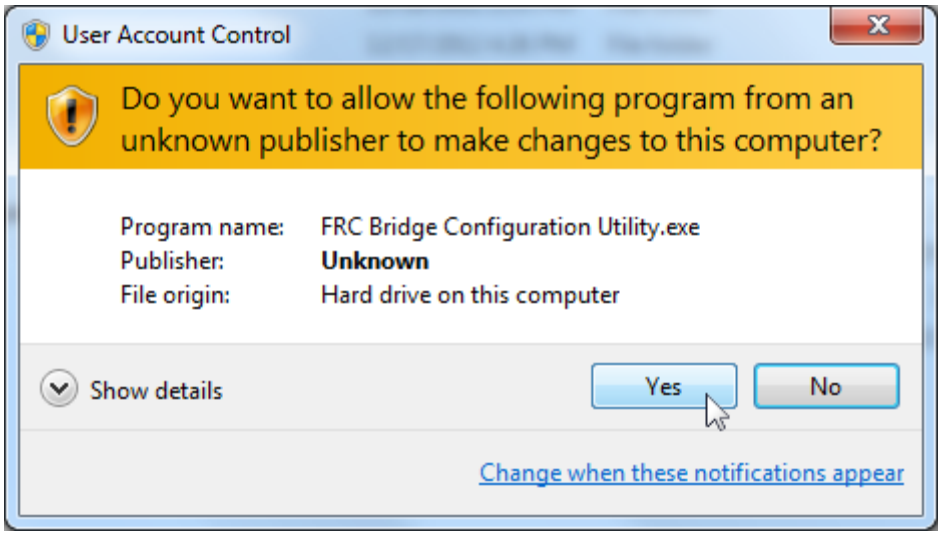
Browse to C:\Program Files\National Instruments\LabVIEW 2013\project\FRC Bridge Tool (Program Files (x86) on 64 bit machines). On Windows XP, Vista or 7 double click on FRC Bridge Configuration Utility to launch the utility. On Windows 8 see the next step to set compatibility mode before launching.

Windows 8 - Set Compatibility



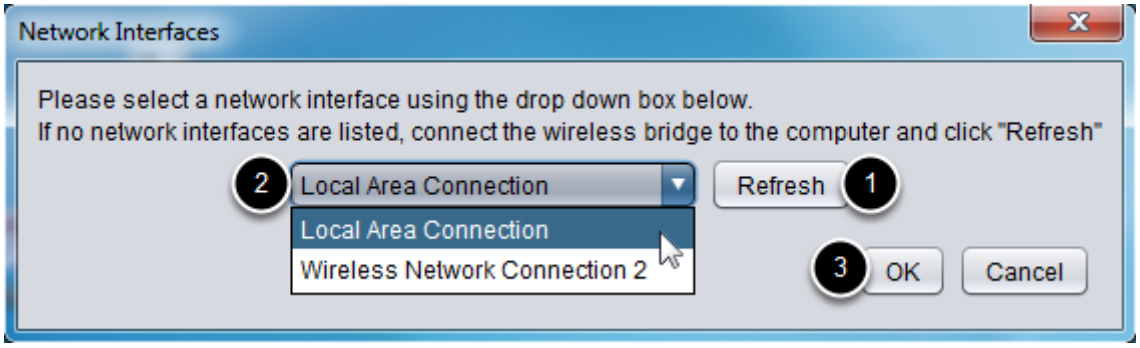
To run on Windows 8 the program must be set to launch in Windows 7 compatibility mode. To do this right click on the file (as shown in the step above) and click Properties. Select the Compatibility tab, check the box for Compatibility Mode, select Windows 7 from the dropdown, then click OK. Start the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

Allow the program to make changes, if prompted



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.

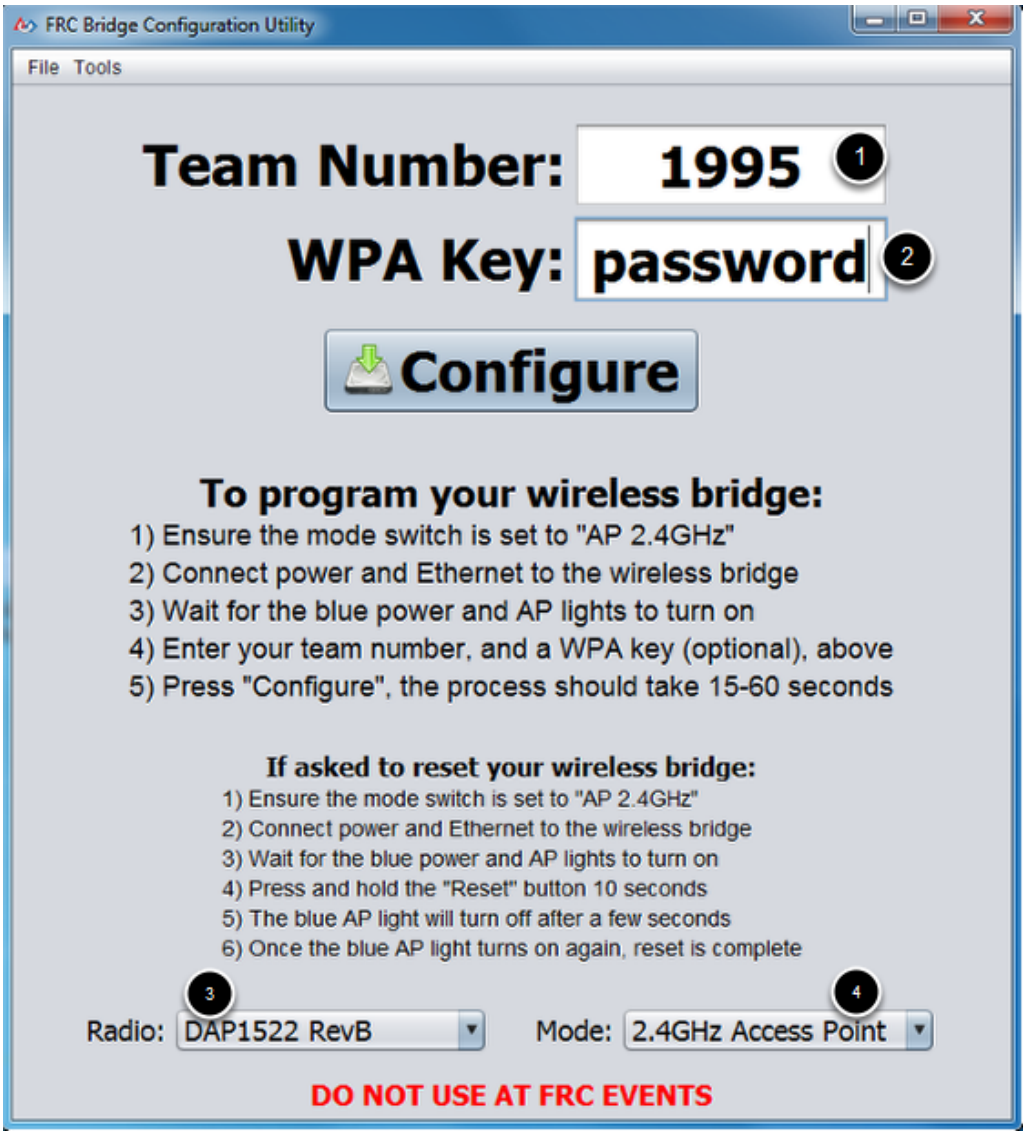
Select the network interface



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.

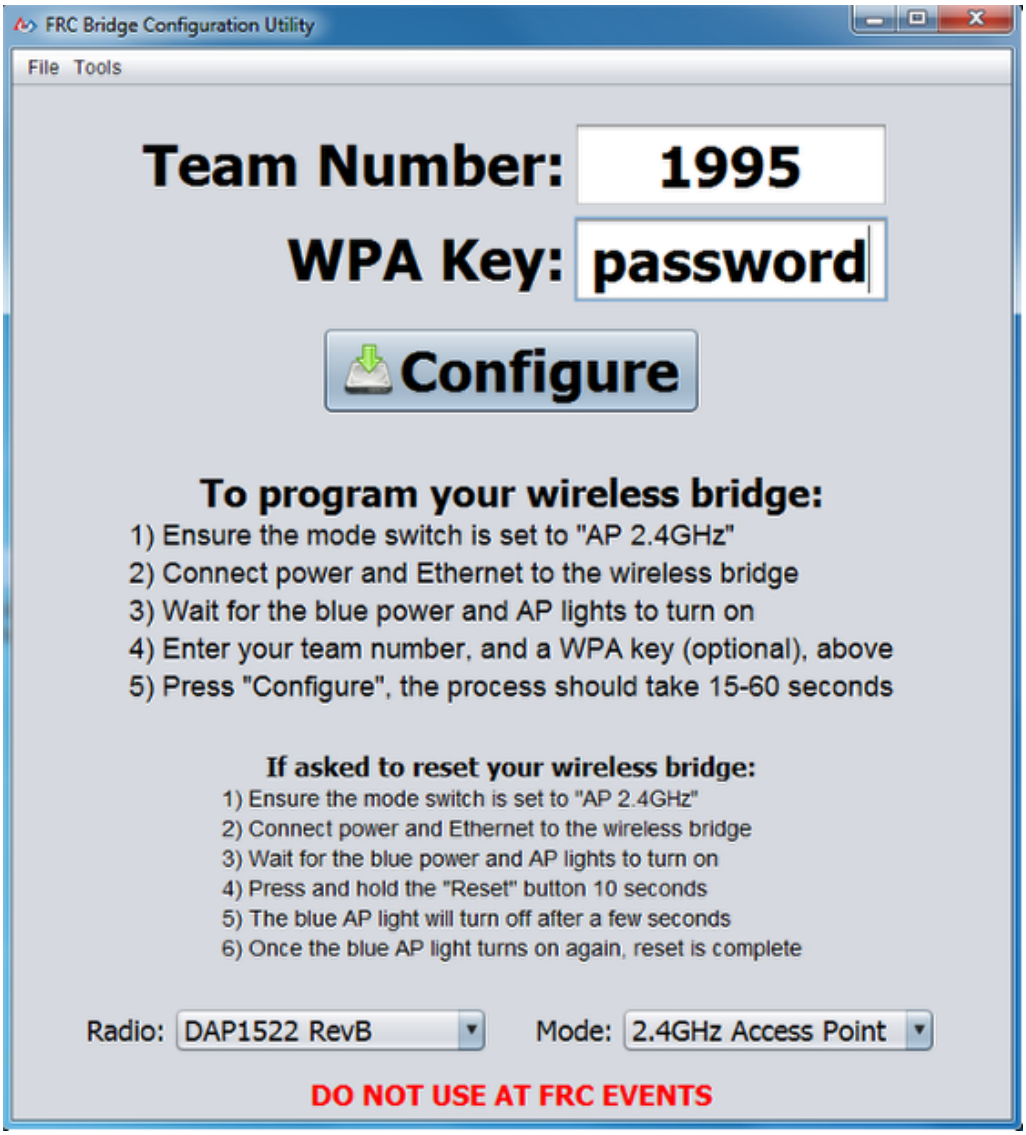
1. If no ethernet interfaces are listed, click "Refresh" to re-scan for available interfaces
2. Select the interface you want to use from the drop-down list
3. Click "OK"

Select a bridge model and operating mode



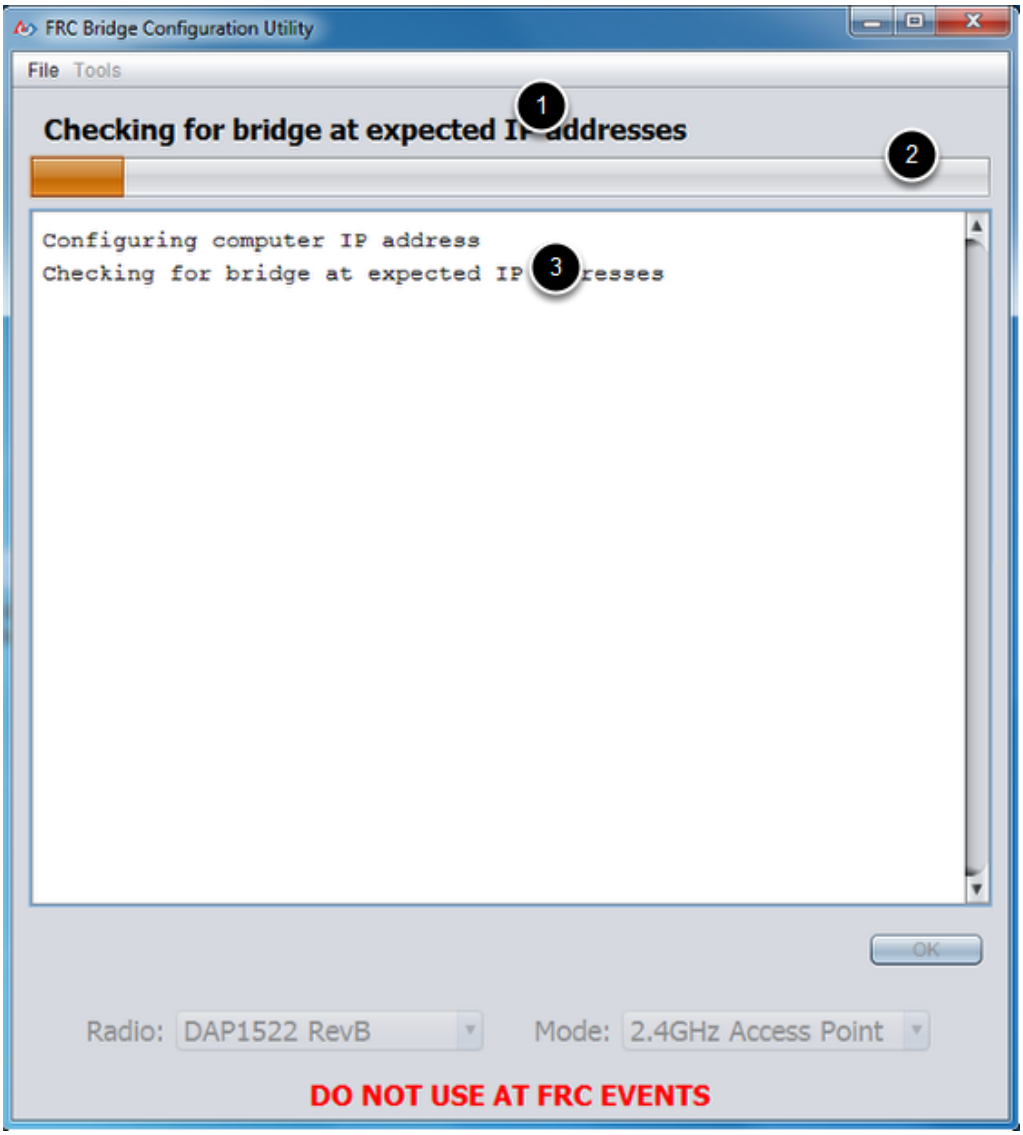
1. Enter the team number to configure the bridge for.
2. Enter the desired WPA key. Leave blank to configure with no security.
3. Select which DAP1522 revision you are configuring using the drop-down list
4. Select which operating mode you want to configure. For most cases, the default selection of 2.4GHz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

Prepare and start the configuration process



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.

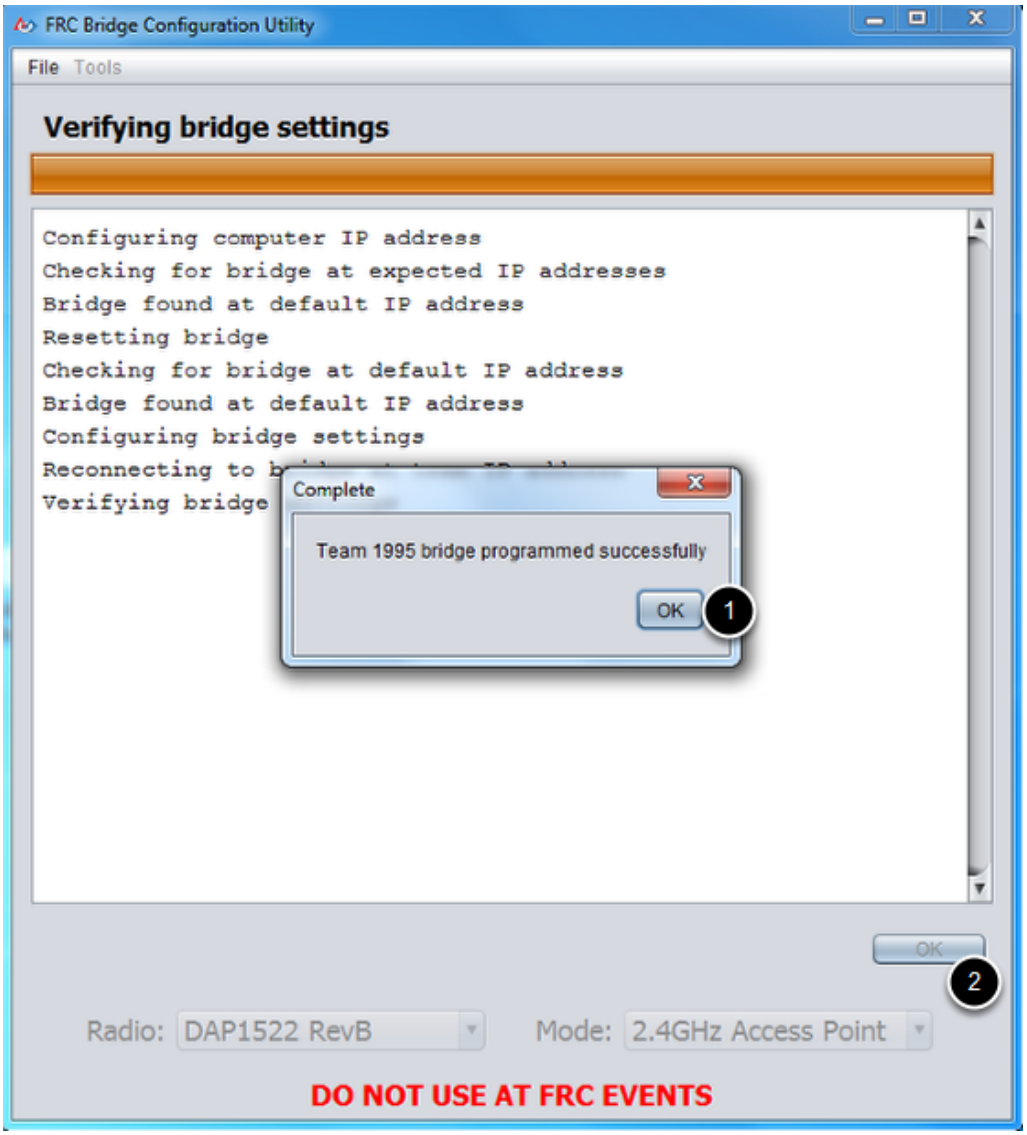
Configuration Progress



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

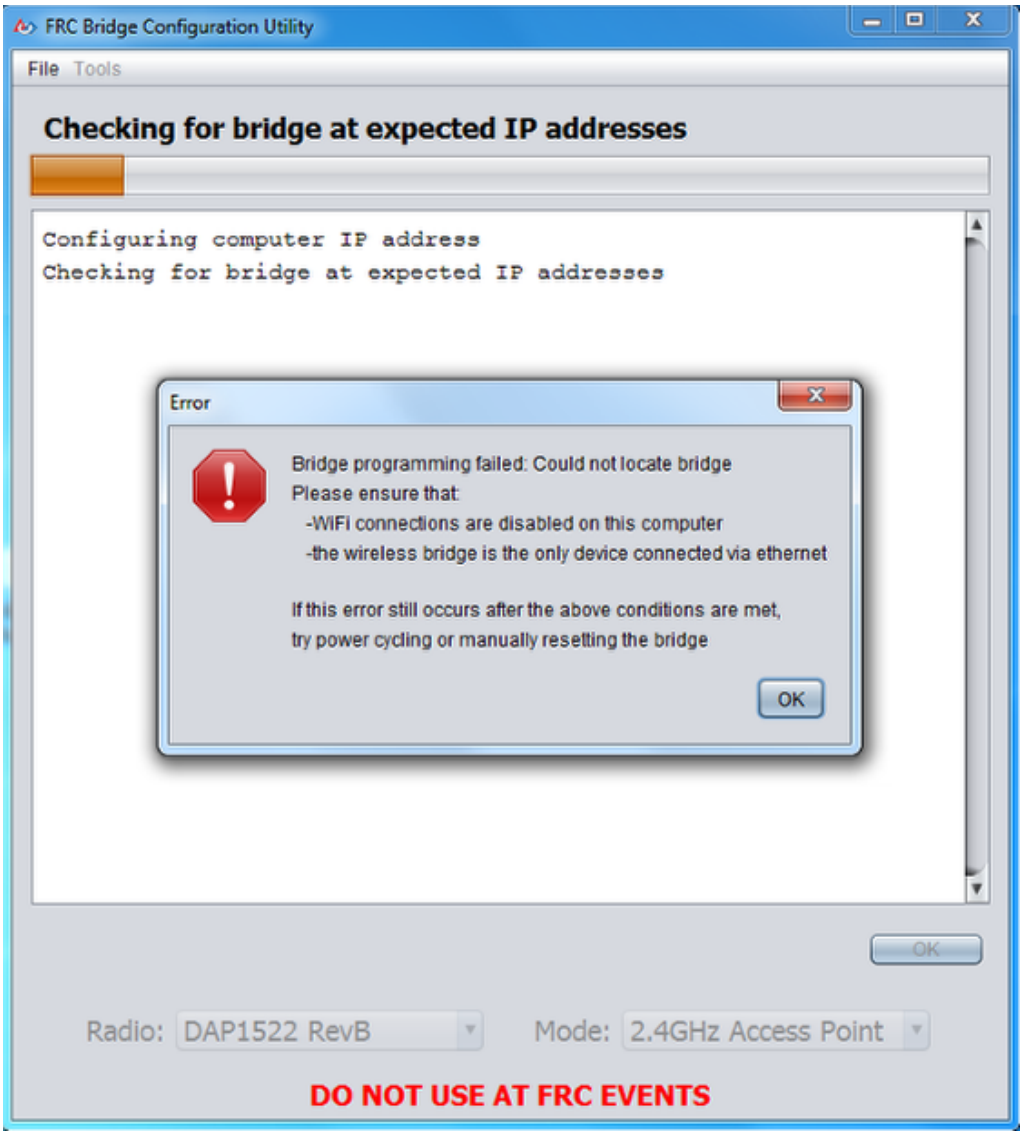
Configuration completed



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

Configuration errors



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

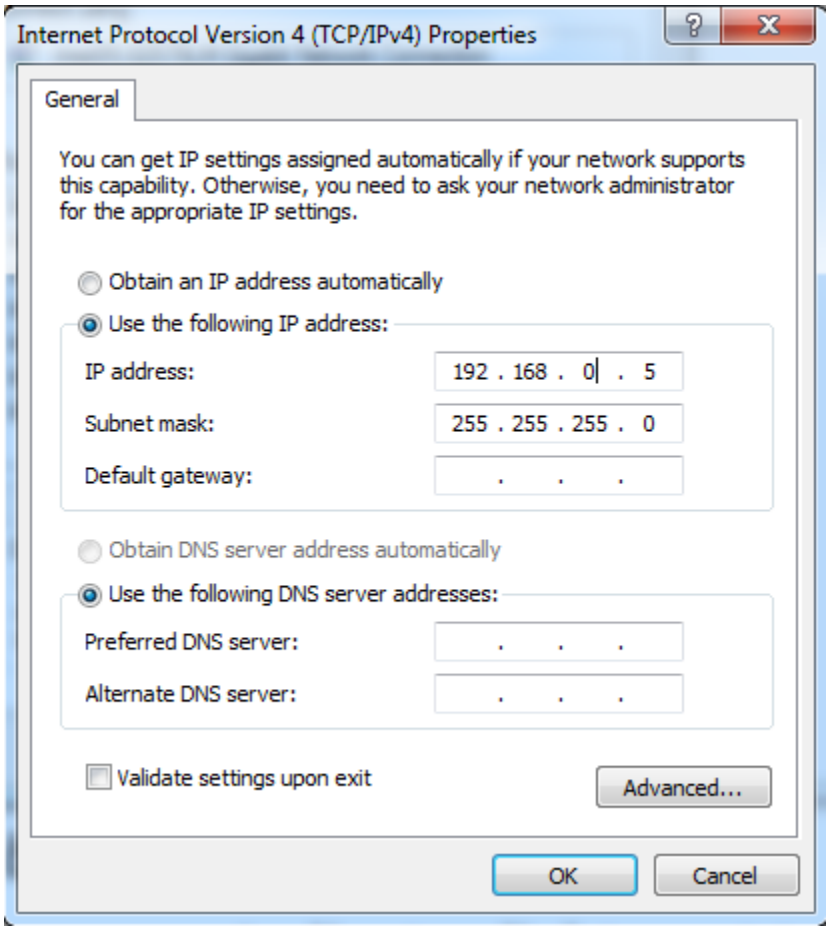
Configuring an Axis Camera

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

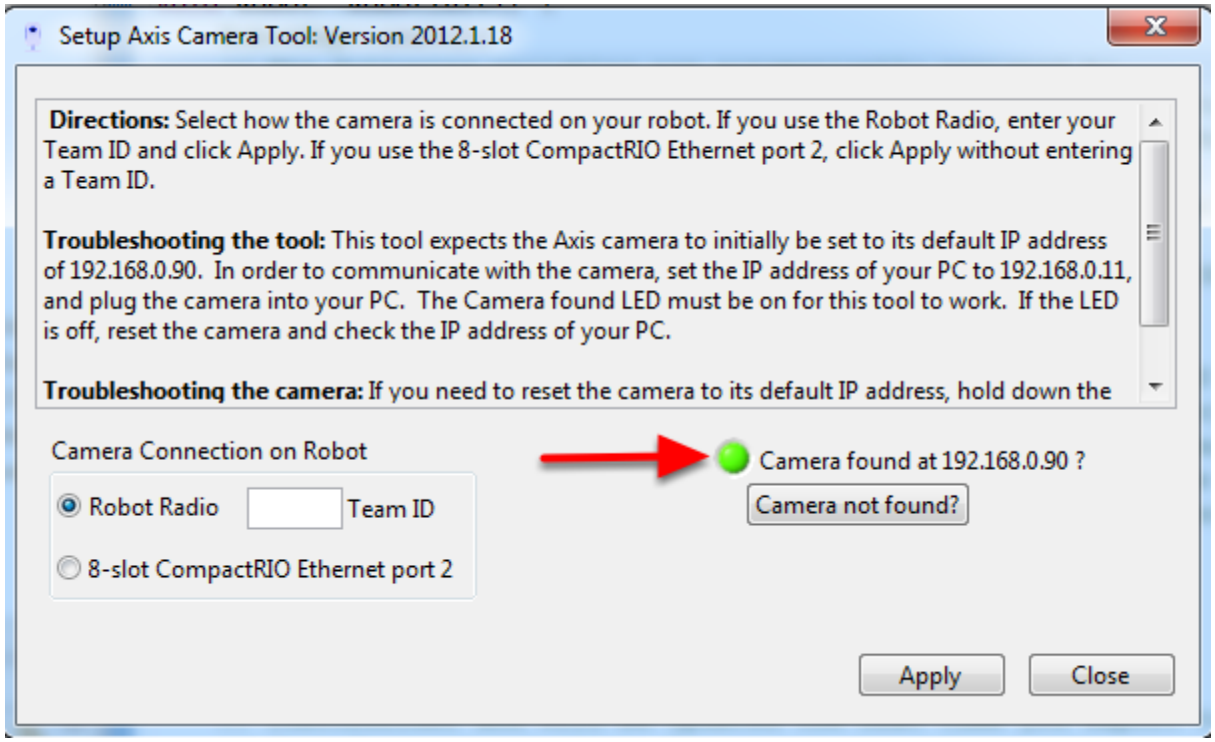
Connect the Axis camera to the computer using an Ethernet cable. Most modern computers are equipped with auto-sensing ports and will work with a normal Ethernet cable, but a crossover cable, or network switch between the devices may be necessary for some computers.

Configure computer IP address



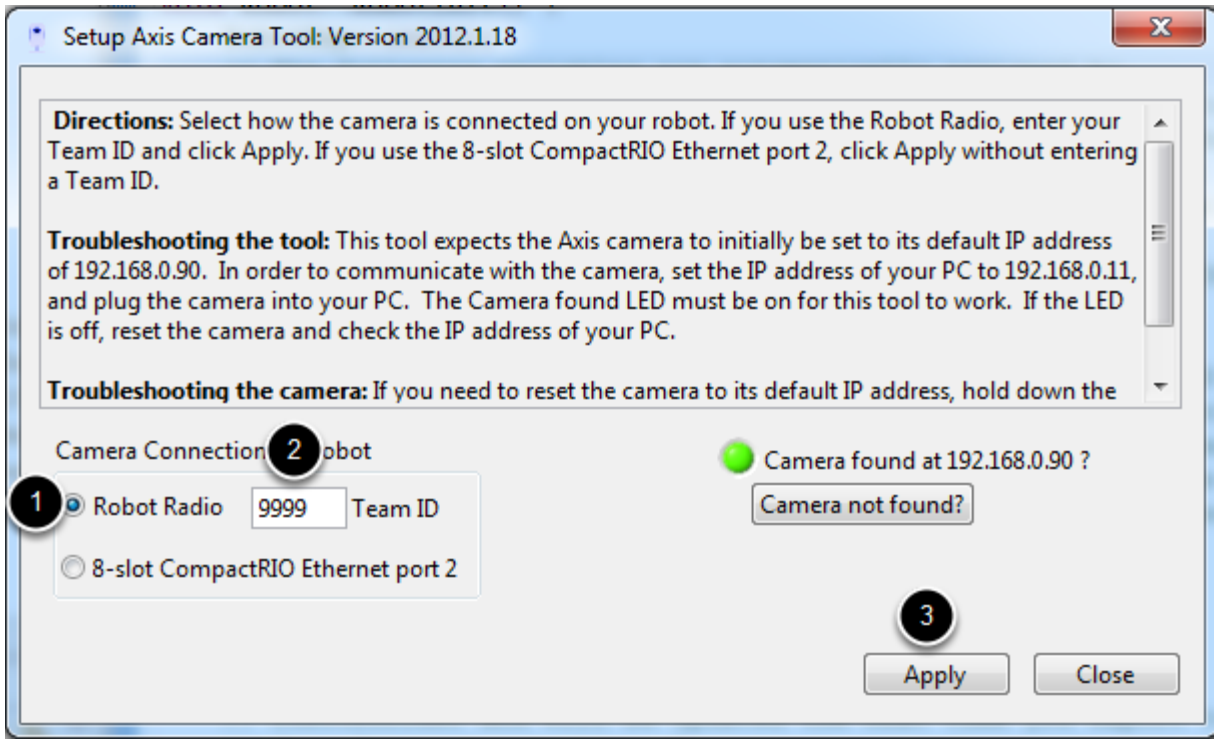
Set your computer's IP address to 192.168.0.5. For instructions on how to set your computer IP, see the Imaging your cRIO document.

Launch the Setup Axis Camera Tool



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.

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.**

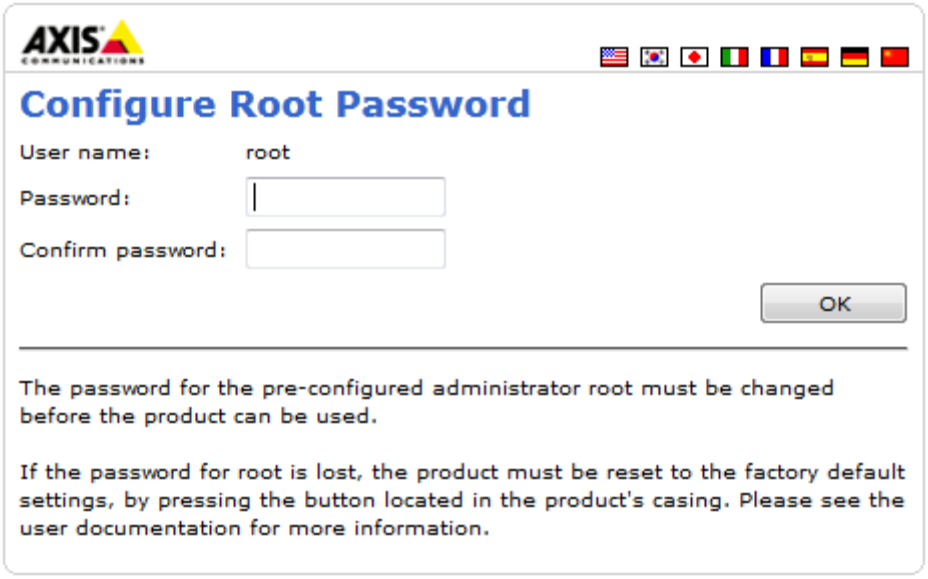
This will automatically configure the following settings on the camera:

- 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.

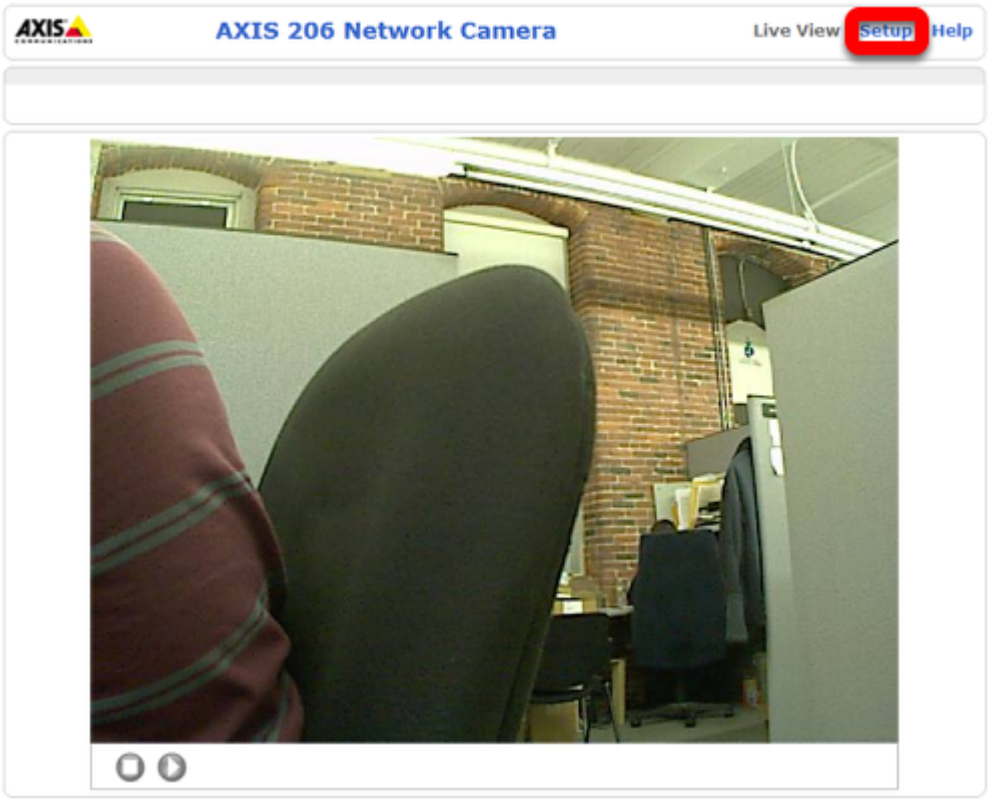
For more information about camera image settings see the Camera Settings article in the Vision Processing manual.

Manual Camera Configuration



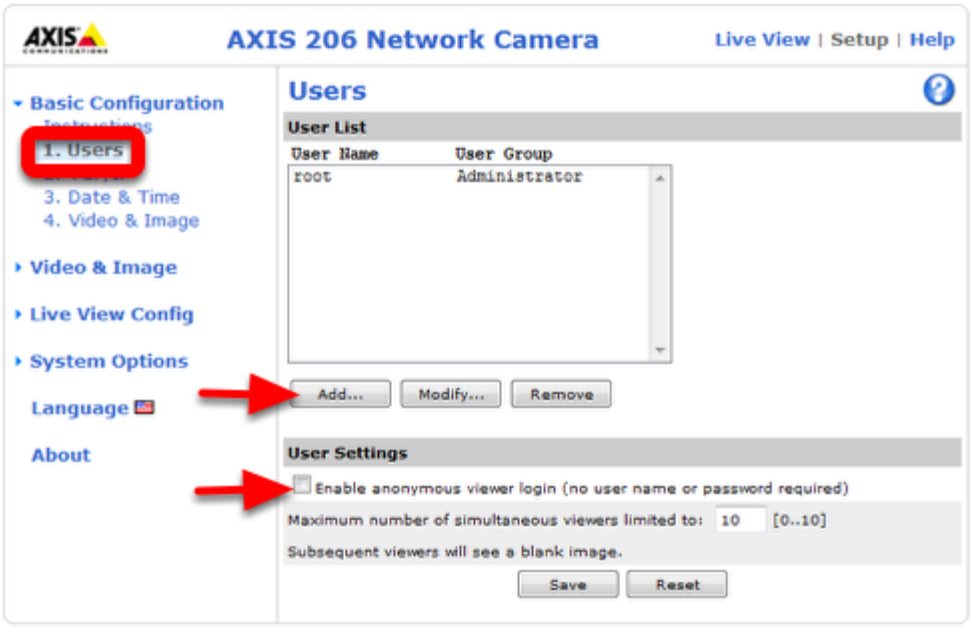
It is recommended to use the Setup Axis Camera Tool to configure the Axis Camera. If you need to configure the camera manually, follow the instructions above for connecting the camera to the computer and setting the IP, then open a web browser and enter **192.168.0.90** in the address bar and press enter.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

Setup Page



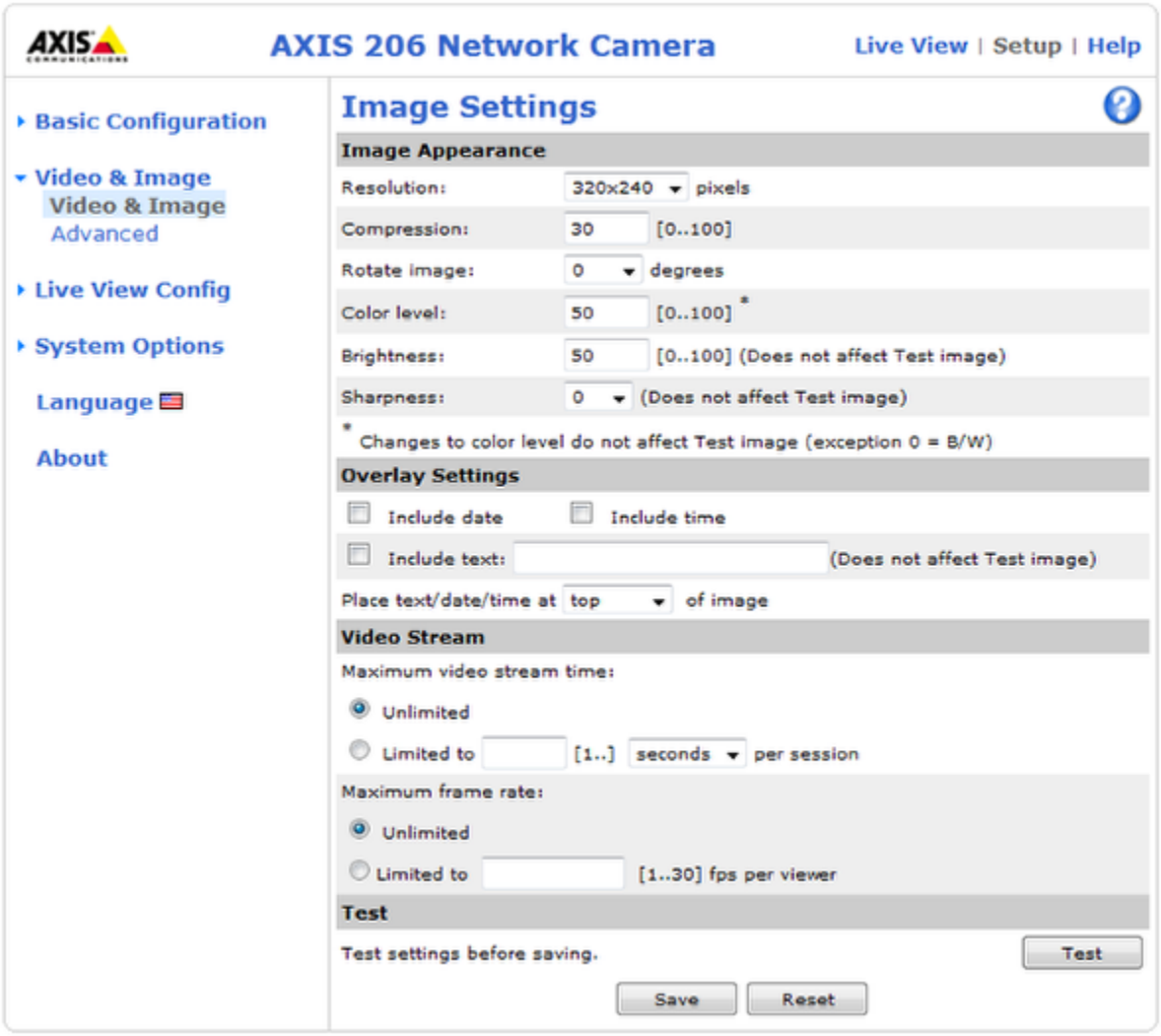
Click **Setup** to go to the setup page.

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

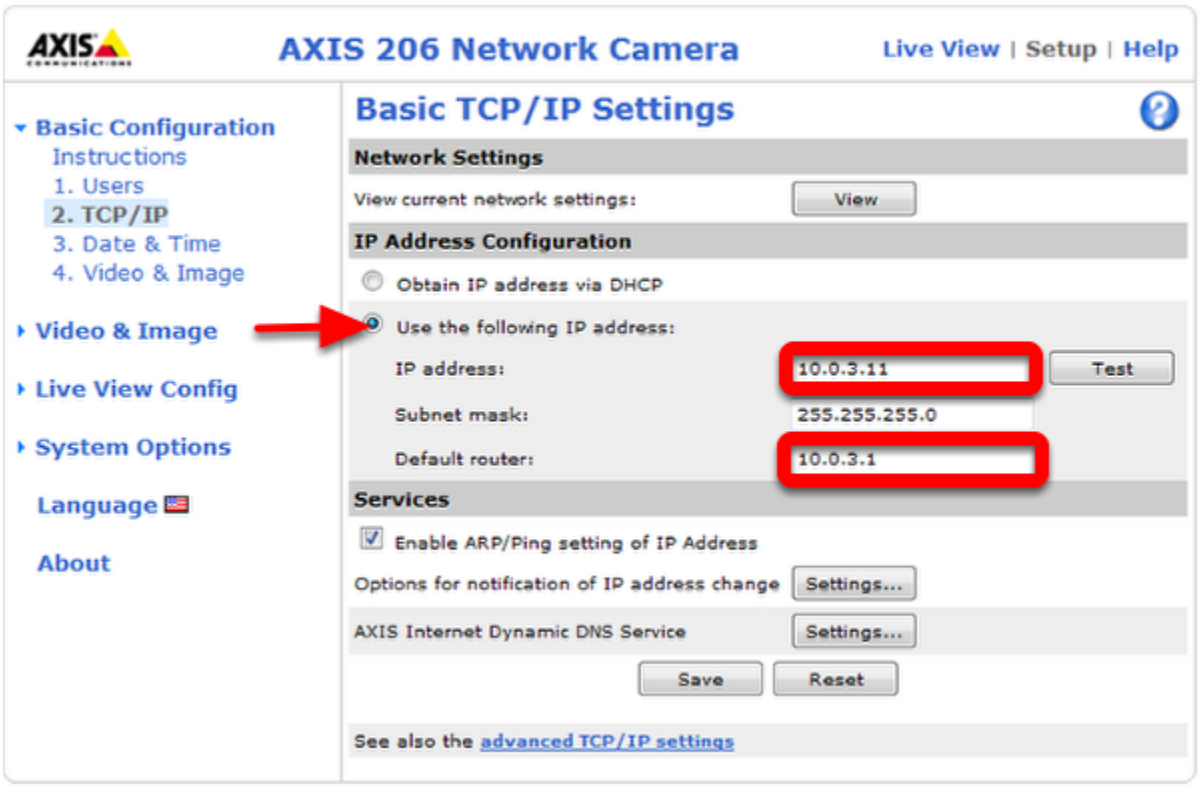


Click **Video & Image** on the left side to open the image settings page. Set the **Resolution** and **Compression** to the desired values (recommended **320x240, 30**). To limit the framerate to under 30 FPS, select the **Limited to** bubble under **Maximum frame rate** and enter the desired rate in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

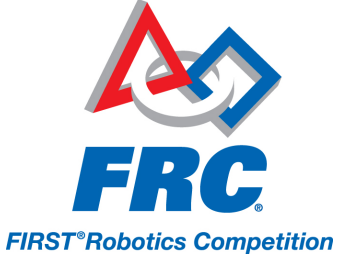
Note that the LabVIEW Dashboard and/or LabVIEW robot code will override these settings for their streams.

For more information about camera image settings see the Camera Settings article in the Vision Processing manual.

Configure Network Settings



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

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

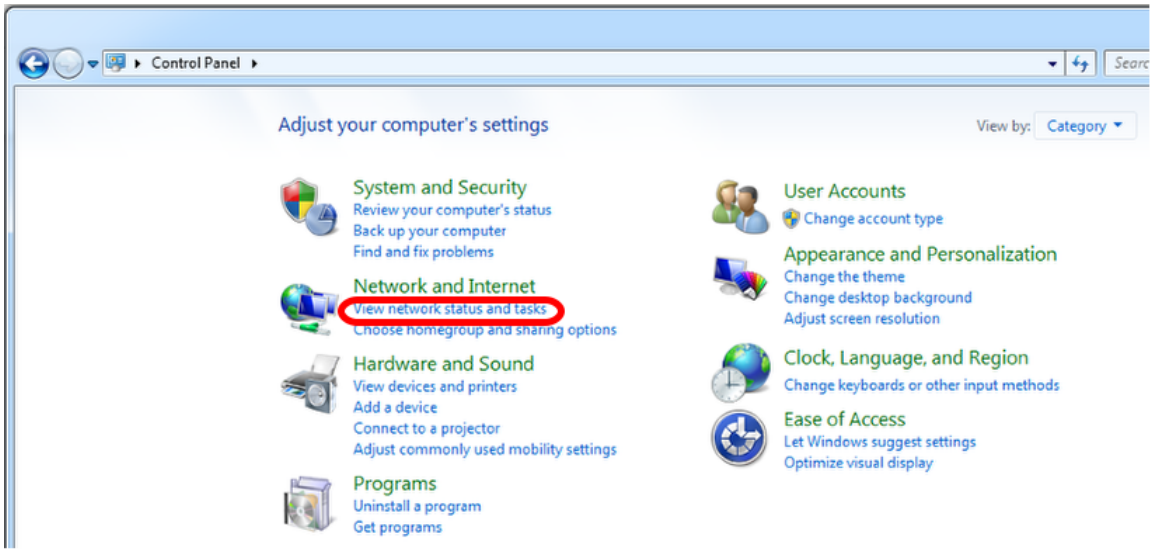
Have a LabVIEW, cRIO, or Driver Station question? NI provides phone support for FRC teams during the build season (1/5/12-2/19/12) Monday through Friday 1pm-7pm CST by calling 866-511-6285.

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.

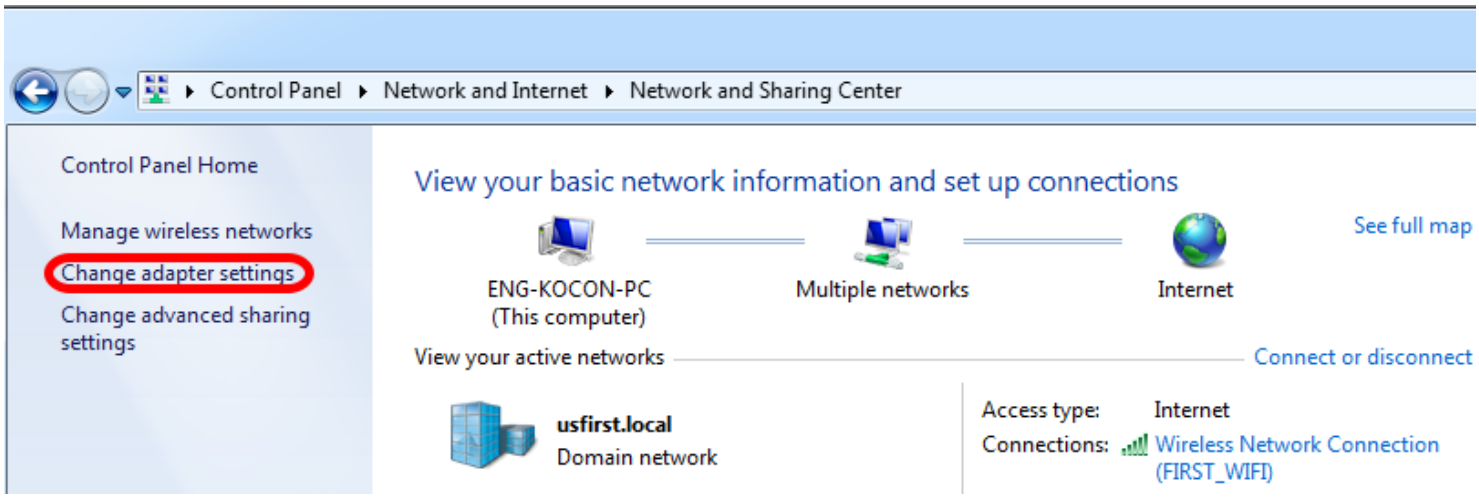
Checking for and Removing dual IPs on an adapter

Control Panel



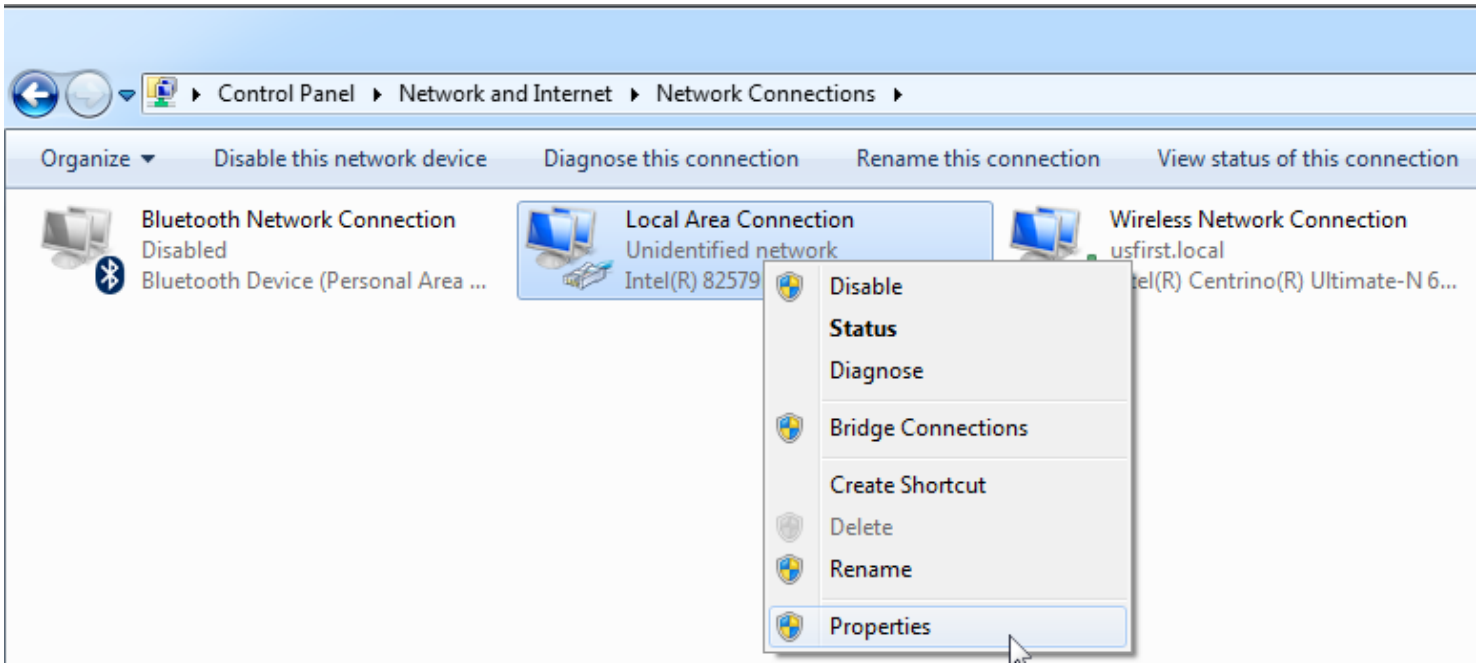
Click **Start >> Control Panel** to open the Control Panel. Then click **View network status and tasks**.

Change Adapter Settings



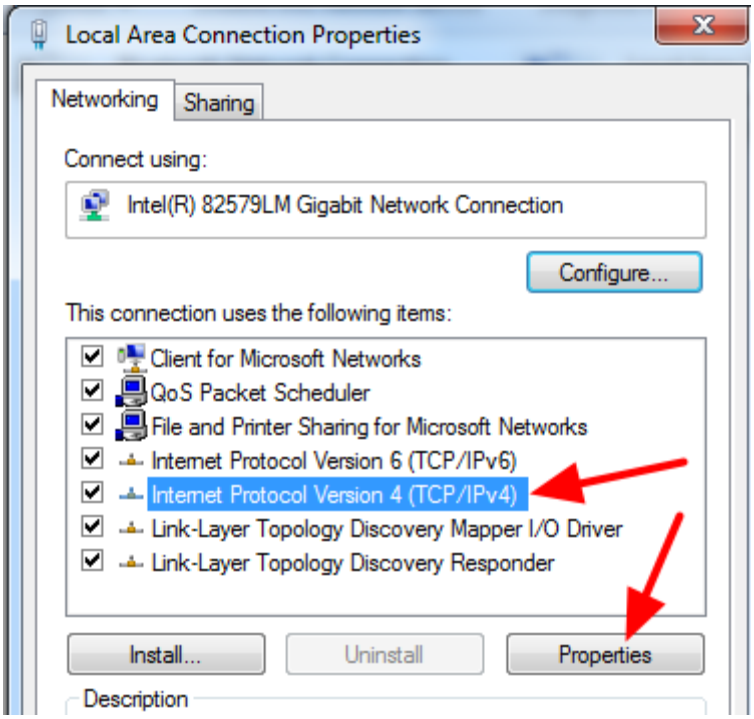
Select **Change Adapter Settings.**

Open Adapter Properties



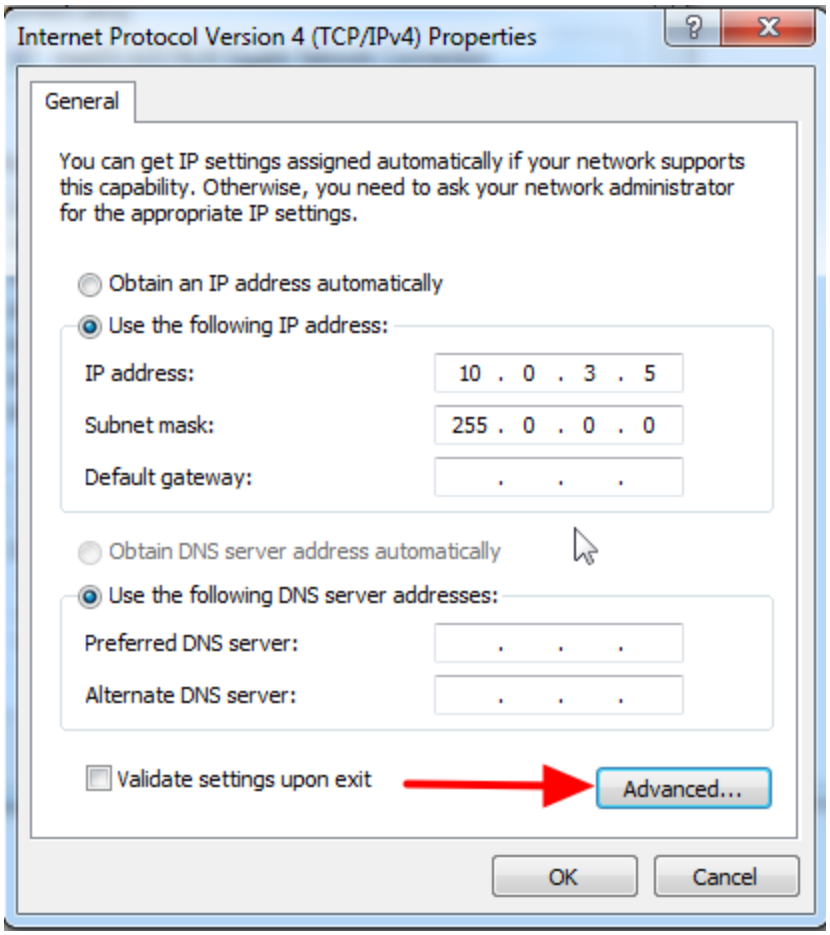
Right-click on the appropriate adapter (typically Local Area Connection) and select **Properties.**

Open TCP/IP Properties



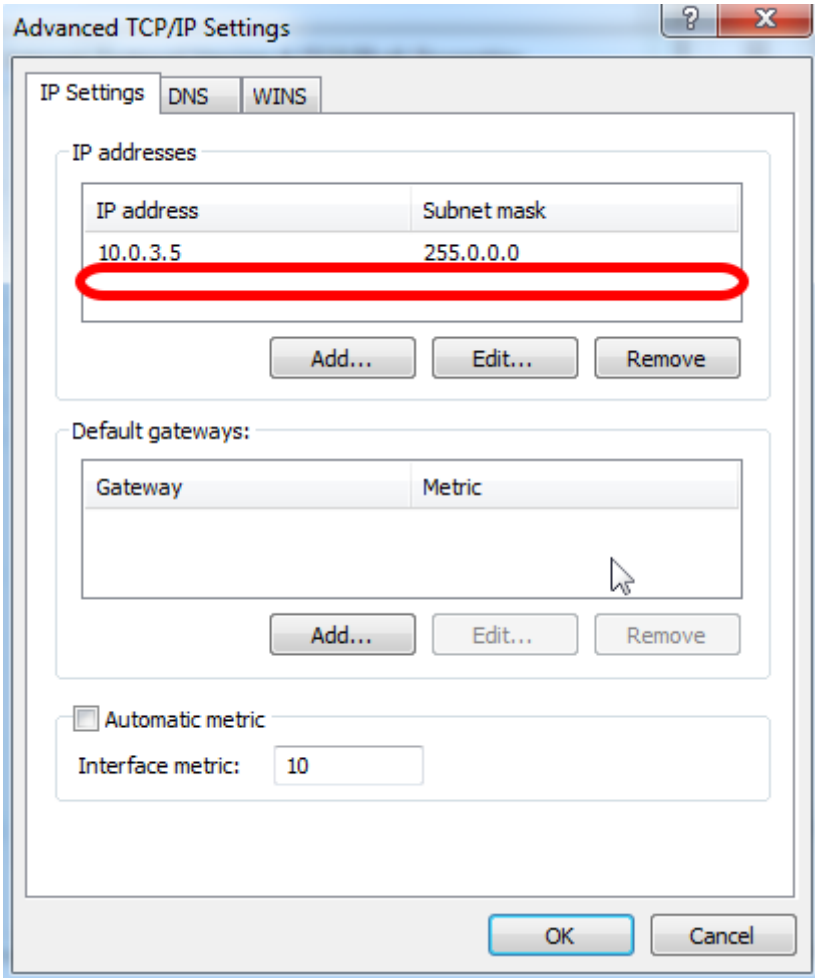
Click on the **Internet Protocol Version 4** line to highlight it, then click **Properties**.

Open Advanced Properties



Click the **Advanced** button.

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.

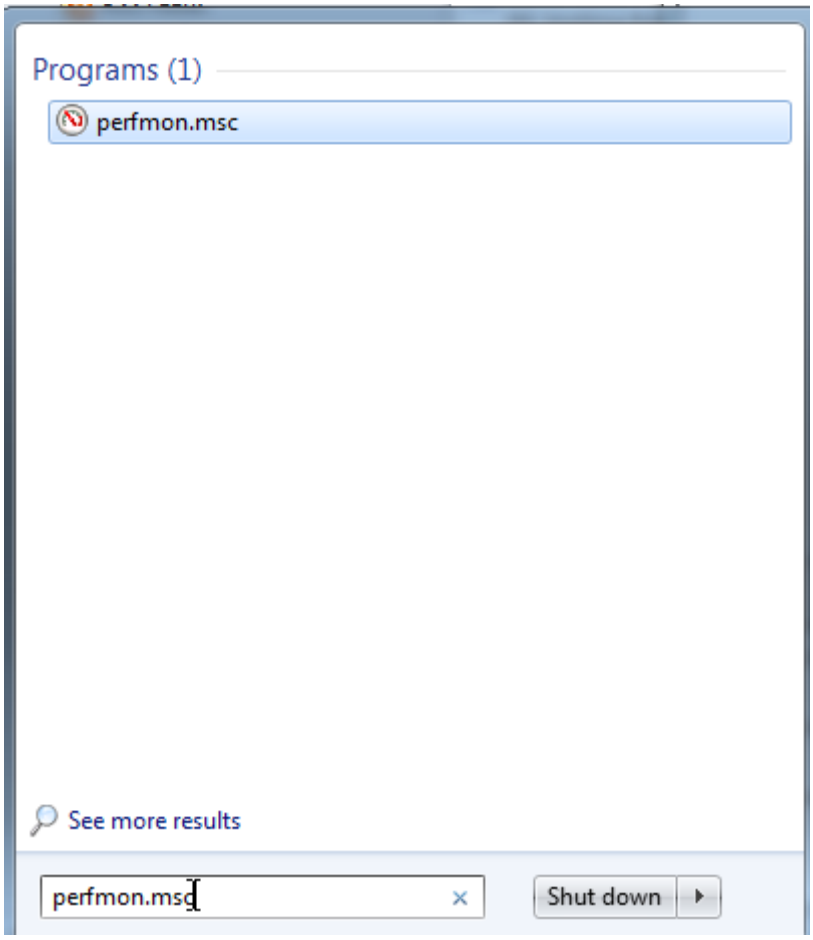
Measuring Bandwidth Usage

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 Perfomance Monitor (Win 7 only)

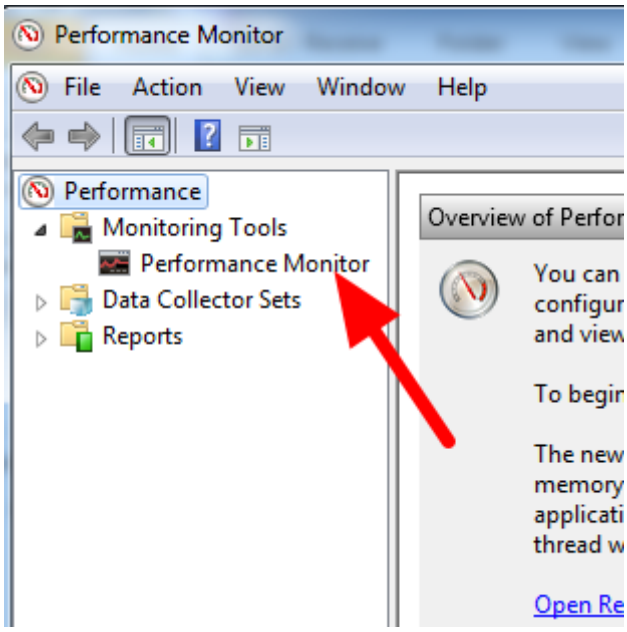
Windows 7 contains a built-in tool called the Performance Monitor that can be used to monitor the bandwidth usage over a network interface.

Launching the Performance Monitor



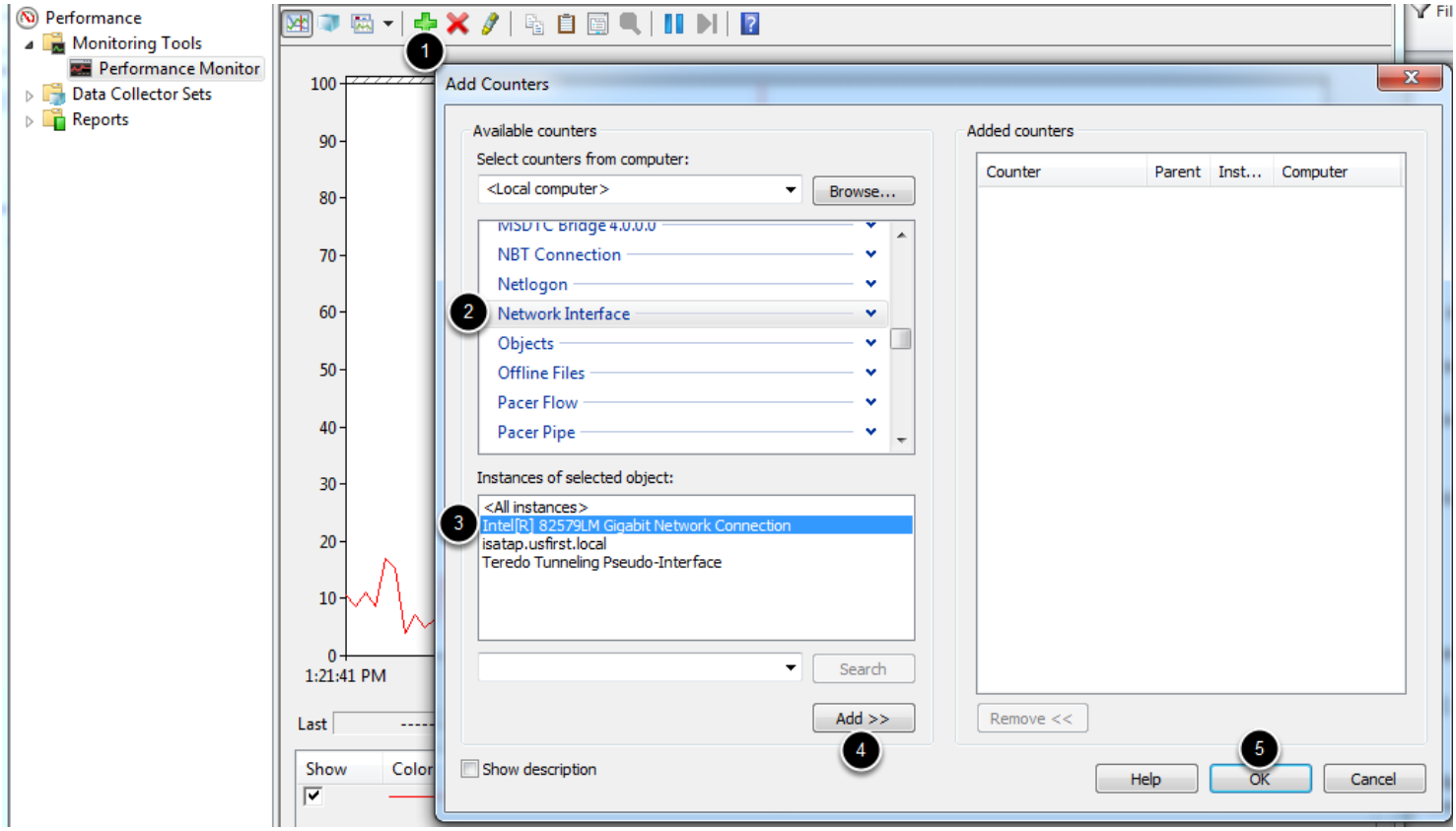
Click **Start** and in the search box, type **perfmon.msc** and press Enter.

Open Real-Time Monitor



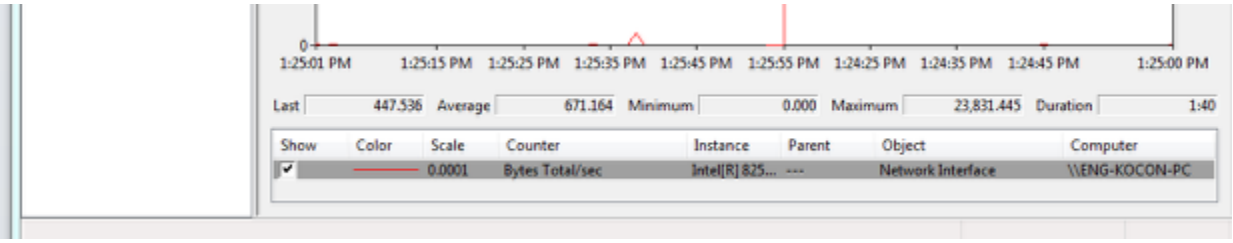
In the left pane, click Performance Monitor to display the real-time monitor.

Add Network Counter



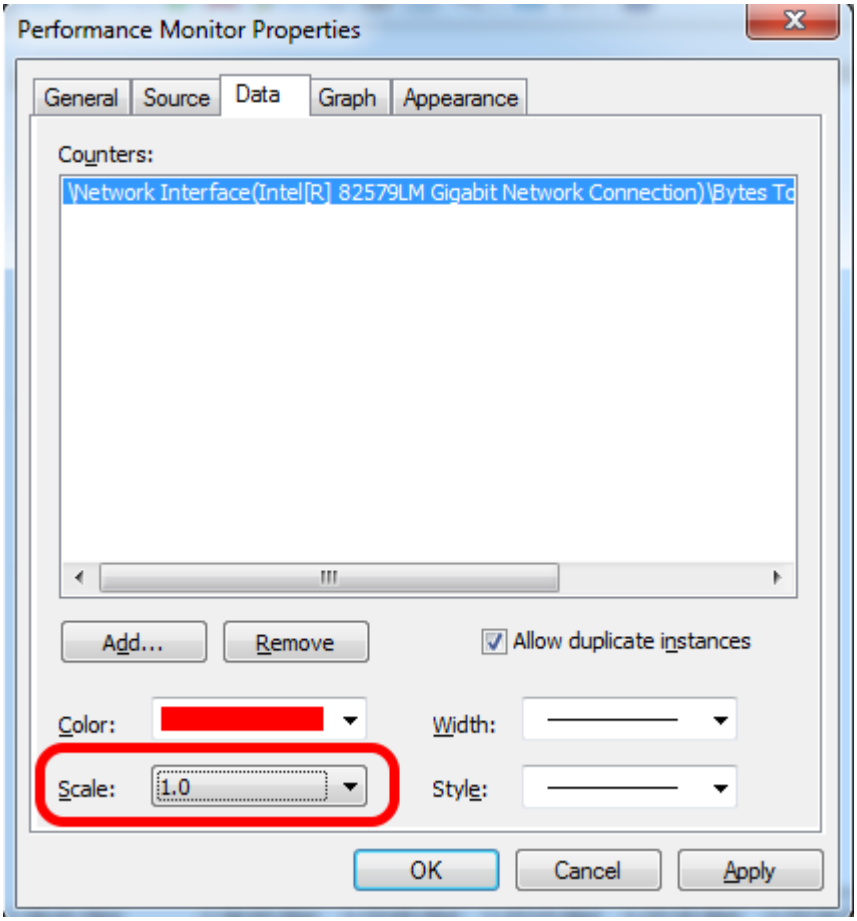
1. Click the green plus near the top of the screen to add a counter
2. In the top left pane, locate and click on **Network Interface** to select it
3. In the bottom left pane, locate the desired network interface (or use All instances to monitor all interfaces)
4. Click **Add>>** to add the counter to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

Remove extra counters



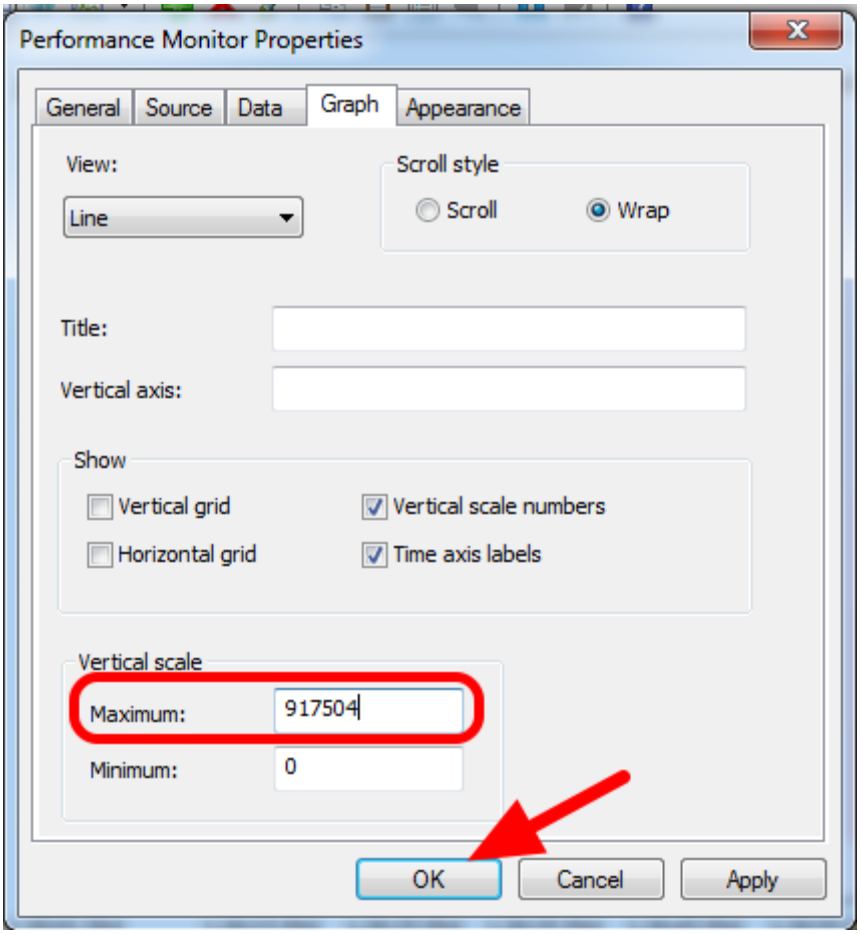
In the bottom pane, select each counter other than **Bytes Total/sec** and press the **Delete** key. The **Bytes Total/sec** entry should be the only entry remaining in the pane.

Configure Data Properties



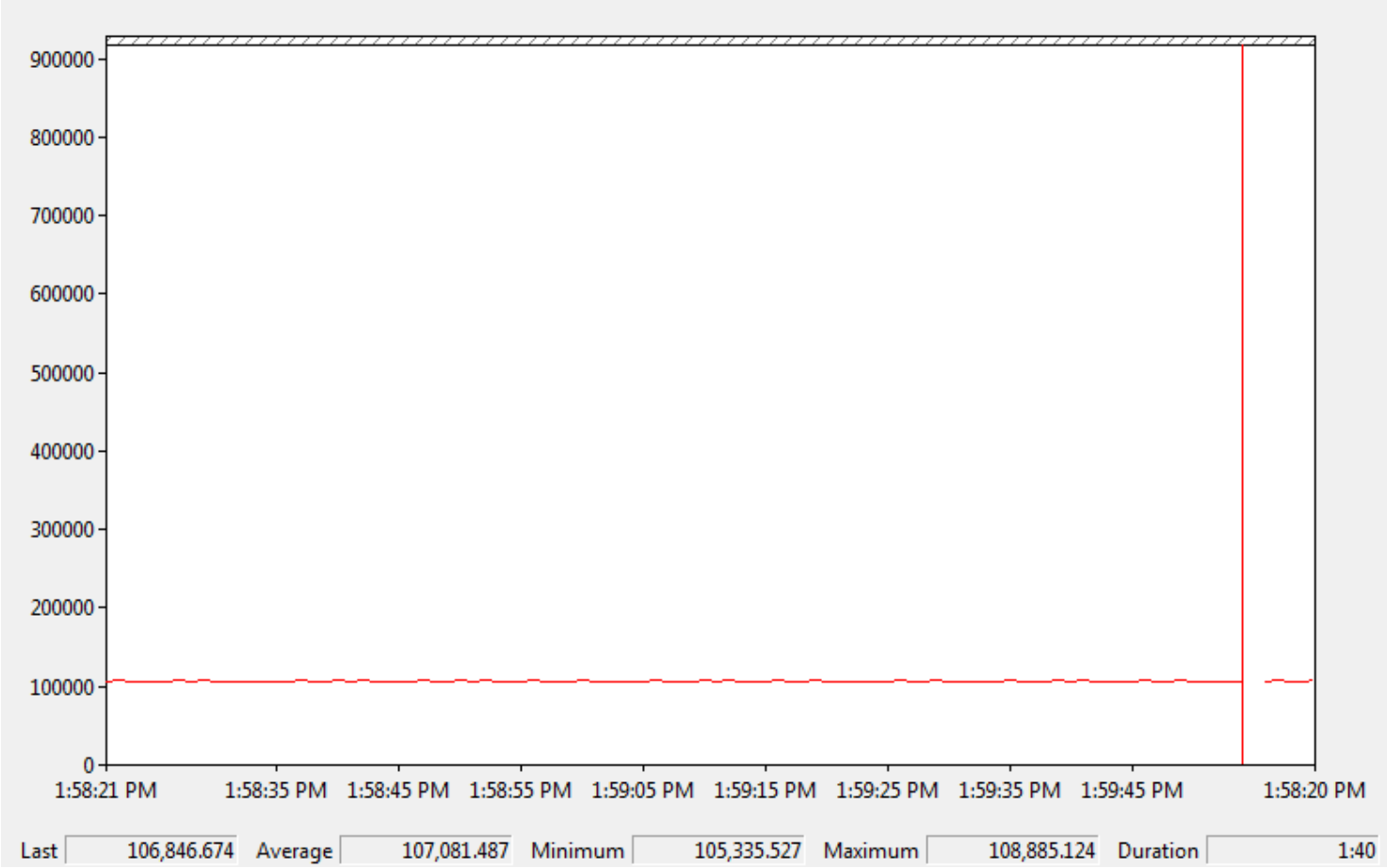
Press **Ctrl+Q** to bring up the Properties window. Click on the dropdown next to **Scale** and select **1.0**. Then click on the **Graph** tab.

Configure Graph Properties



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. The click **OK** to close the dialog.

Viewing Bandwidth Usage

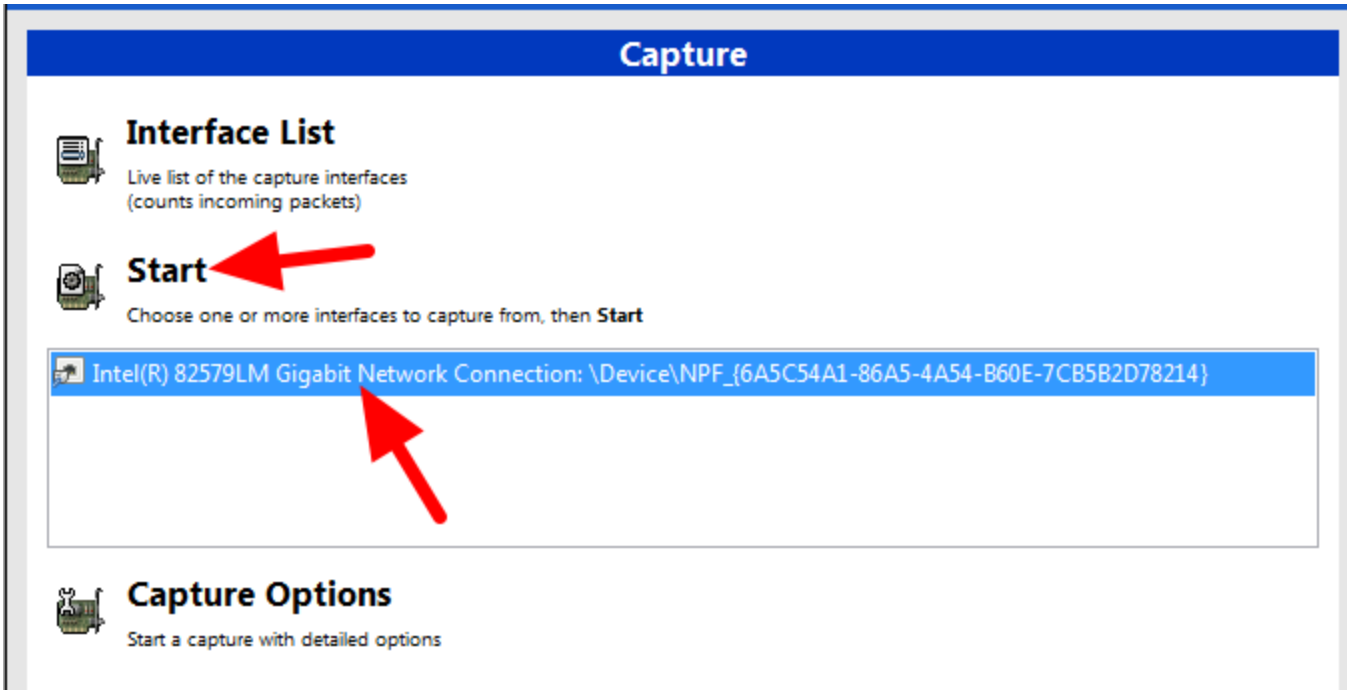


You may now connect to your robot as normal over the selected interface (if you haven't done so already). The graph will show the total bandwidth usage of the connection, with the bandwidth cap at the top of the graph. The Last, Average, Min and Max values are also displayed at the bottom of the graph. 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

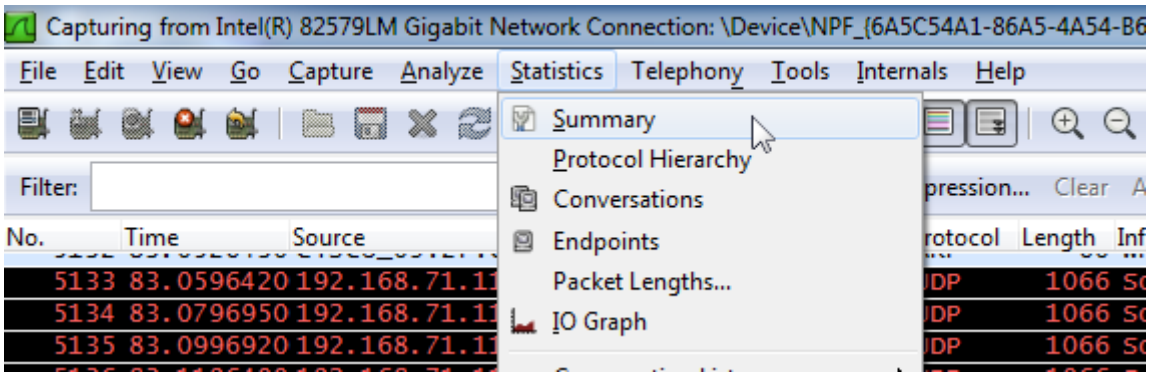
If you are not using Windows 7, you will need to install a 3rd party program to monitor bandwidth usage. One program that can be used for this purpose is Wireshark. Download and install the latest version of Wireshark for your version of Windows. After installation is complete, locate and open Wireshark. 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



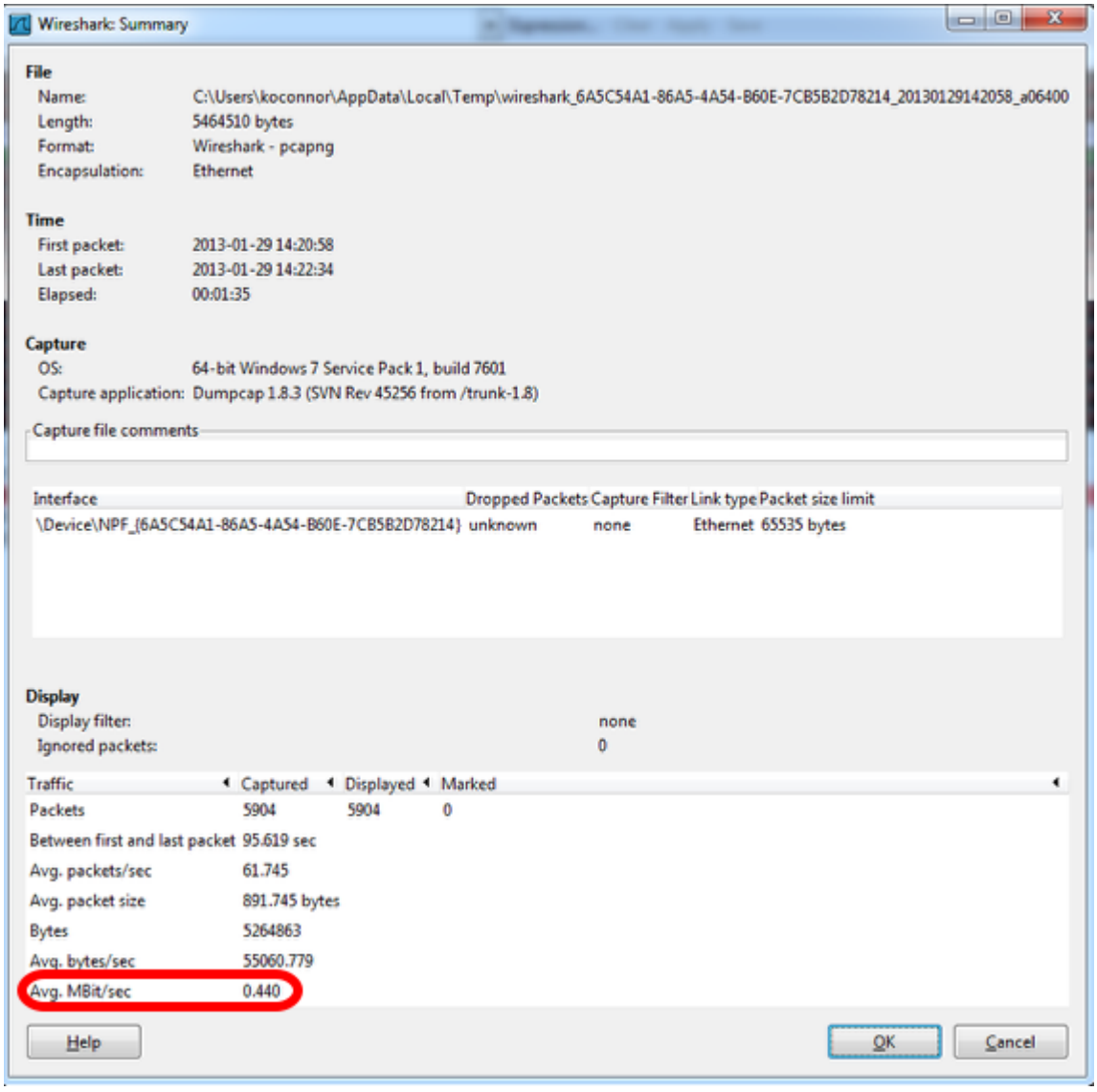
In the Wireshark program on the left side, select the interface you are using to connect to the robot and click **Start.**

Open Statistics Summary



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

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.

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

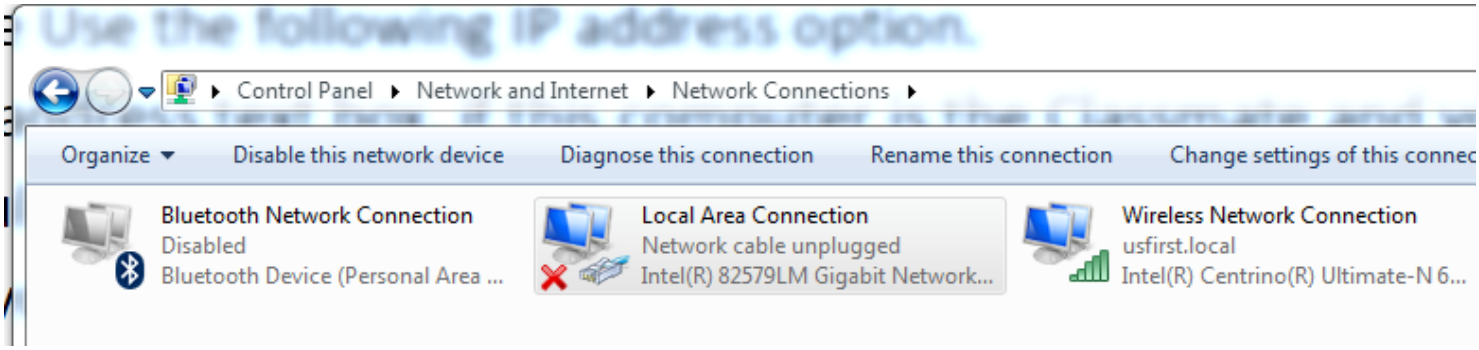
Check to make sure all your software is up to date. The latest versions of each piece of software are:

- Driver Station - Update 3 (2.12.13.00)
- LabVIEW - Update 5.10
- C++ - Midseason Update 2 (rev3615)
- Java - Midseason Update 2 (2013.0.429) Also downloadable from inside Netbeans
- SmartDashboard Vision Installer - 1.0.5

Check Driver Station Network Settings

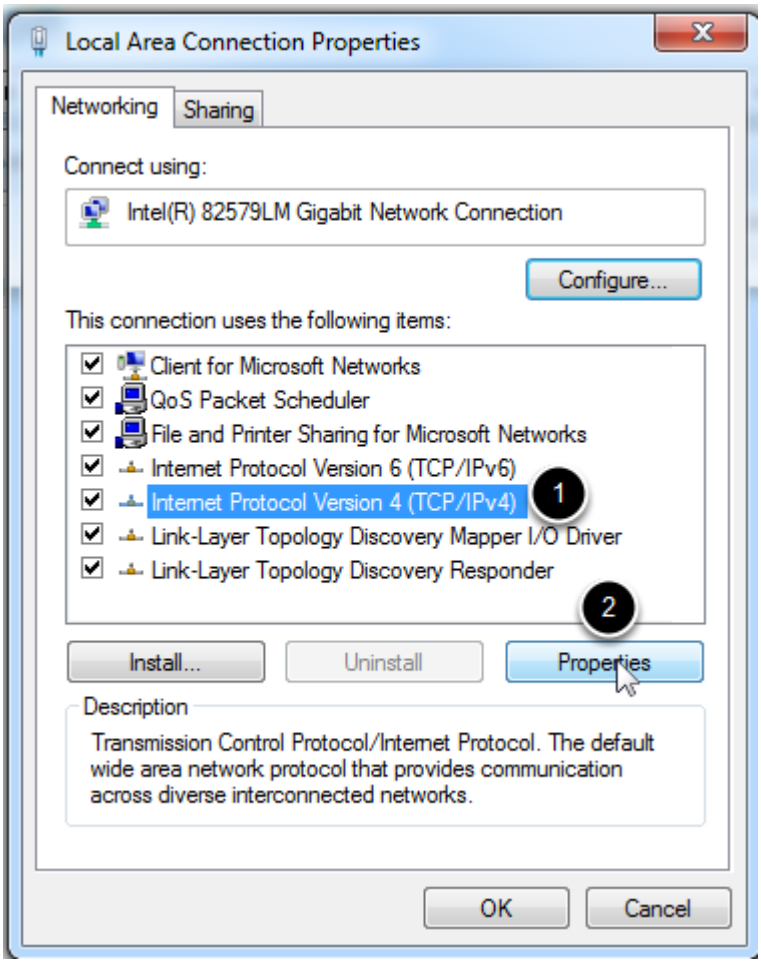
When operating at home, everything will work fine with the Driver Station set to a subnet mask of 255.255.255.0 and any IP in the 10.TE.AM.ZZ range. At the competition, the **DS IP must be 10.TE.AM.5 and the subnet mask must be set to 255.0.0.0 to work properly with FMS.** To check the IP and subnet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

Network Adapter Properties



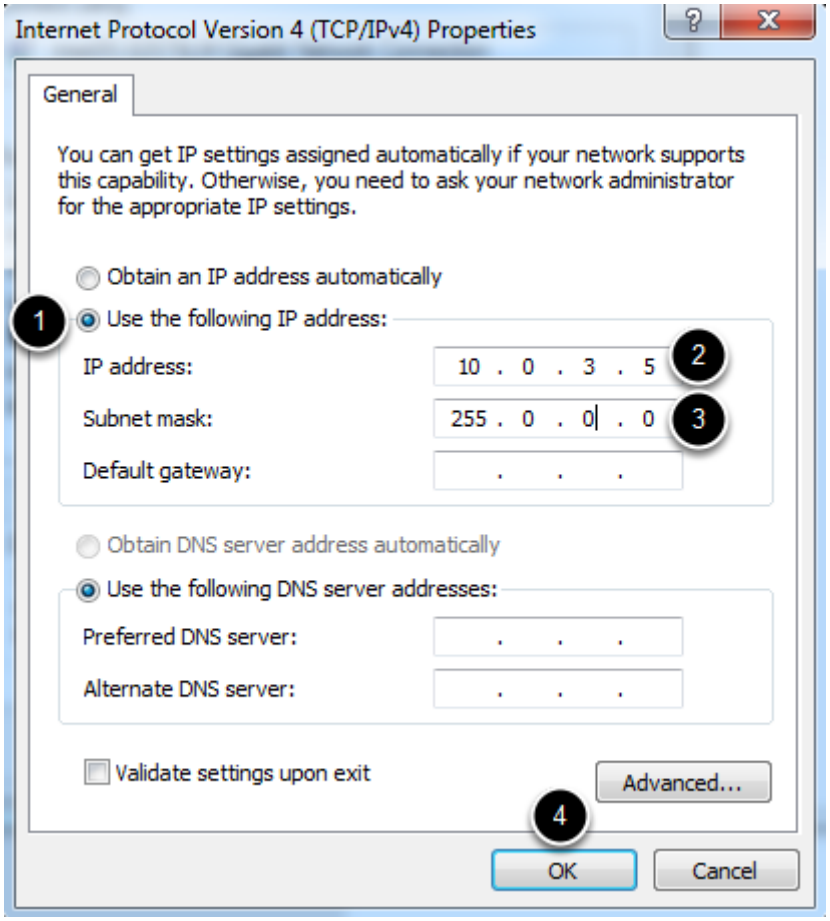
To set the IP address, click on **Start > Control Panel > View Network Status and Tasks > Change Adapter Settings,** then double-click on **Local Area Connection** to display the Local Area Connection Properties dialog.

TCP/IP Properties



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

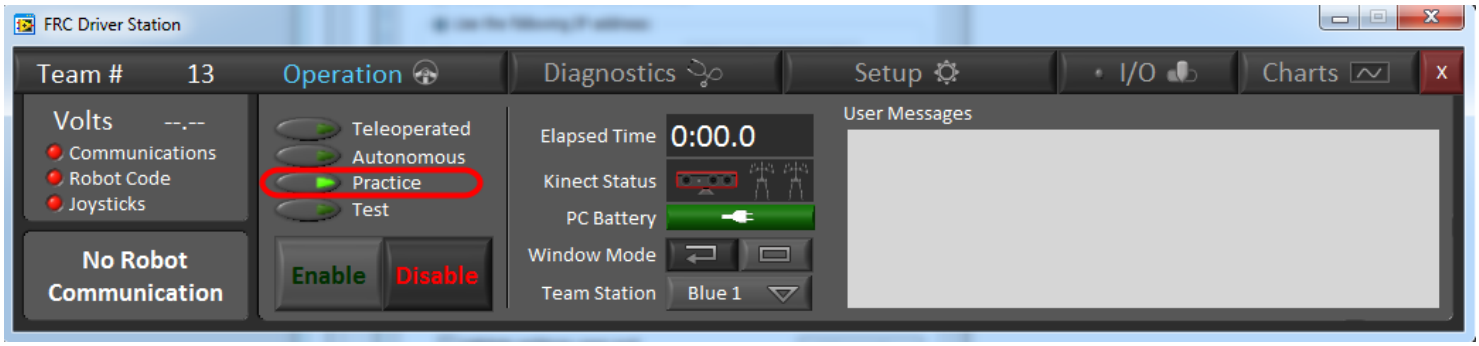
Set IP address



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



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.

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:

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.

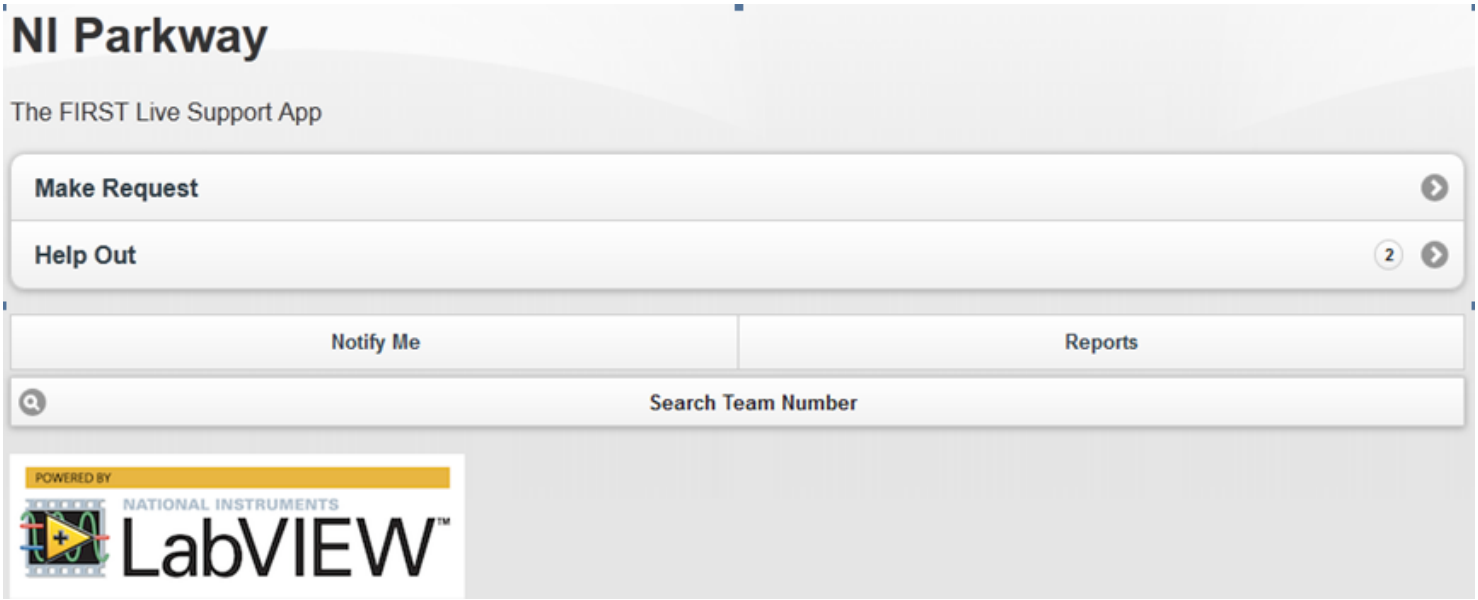
Connect to the Field on Practice Day

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.

Using the NI Parkway System for Help at an Event

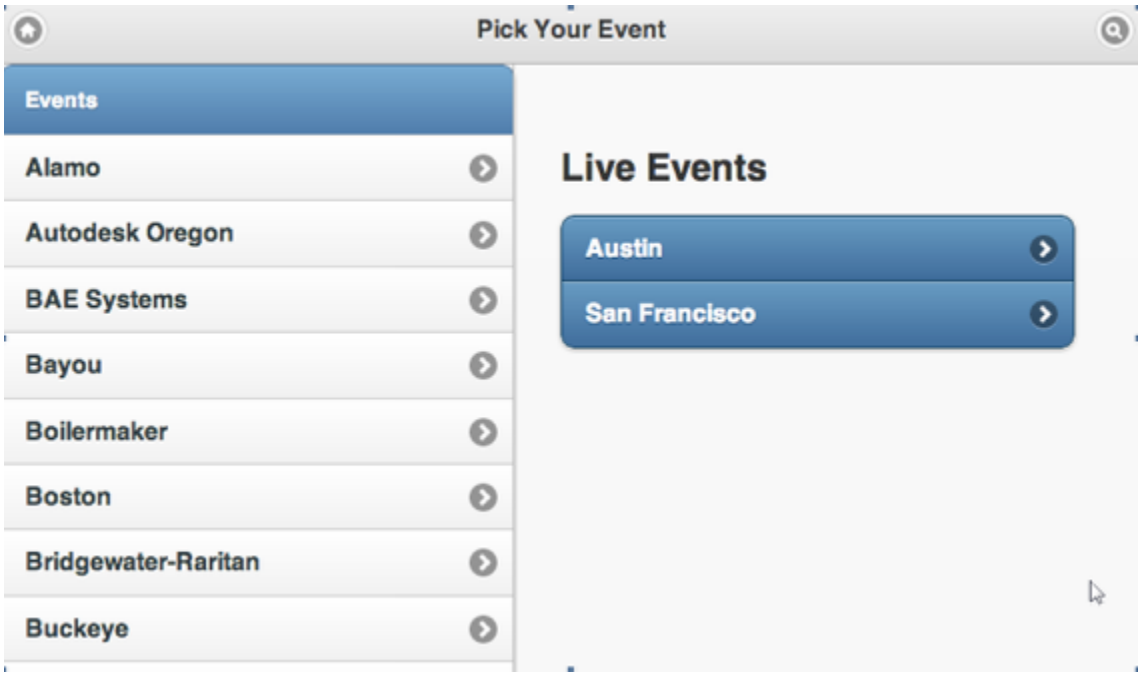
If you have any Control System issue at your event that you need assistance with, each event has at least one Control System Advisor who is there to help. This year FRC will be using the NI Parkway system to help teams connect with the CSA and indicate they have an issue. The Parkway System can be accessed 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



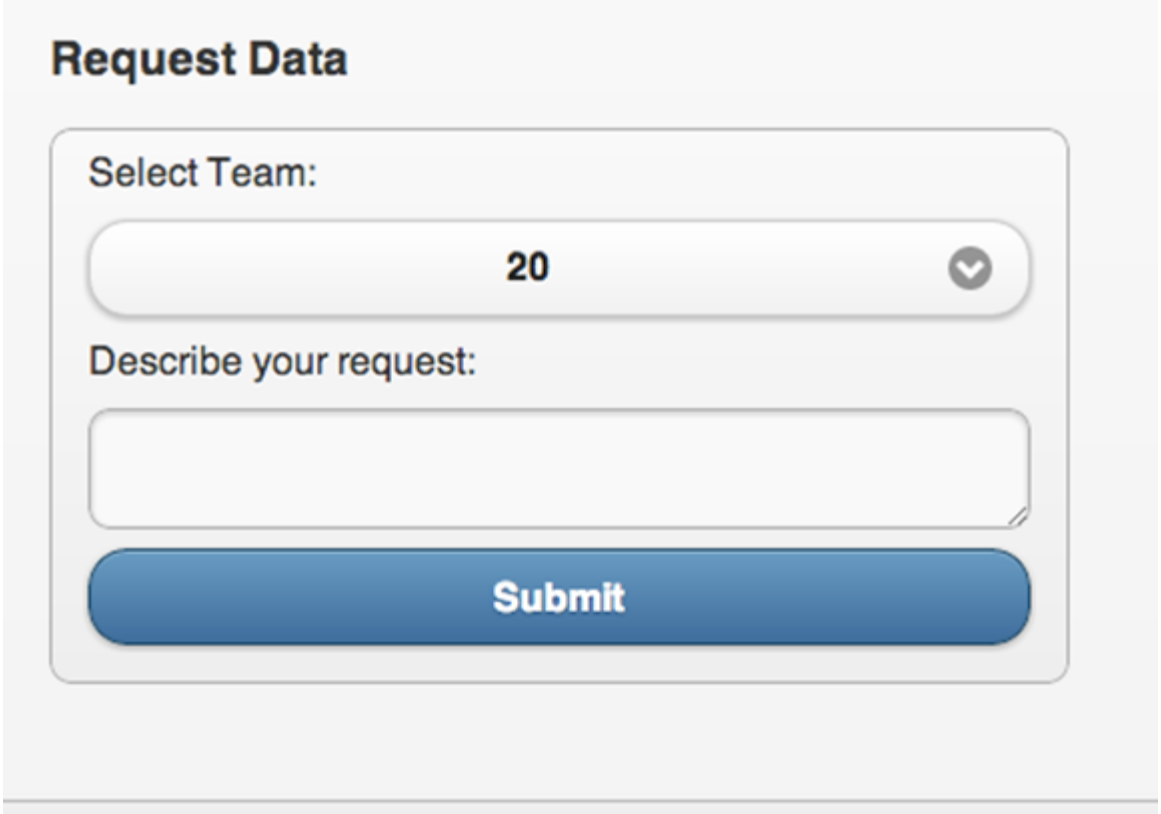
If using the Parkway Kiosk, you should already be on the Parkway homepage, if not you can press Alt+Home or Alt+Back until you reach the home page. If accessing Parkway from a mobile device enter www.niparkway.com in your web browser.

Make a Request



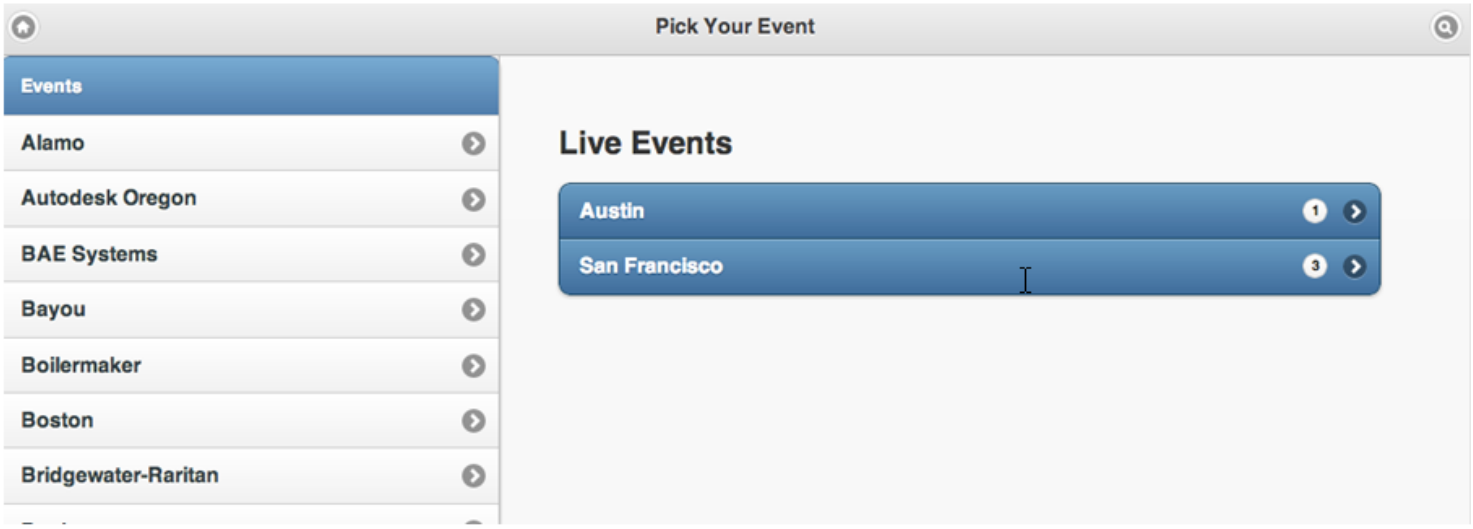
To enter a request for assistance, click on the Make Request button, you will be shown a list of Live events in the right pane. Click on the appropriate event from the list of Live Events.

Select Team Number



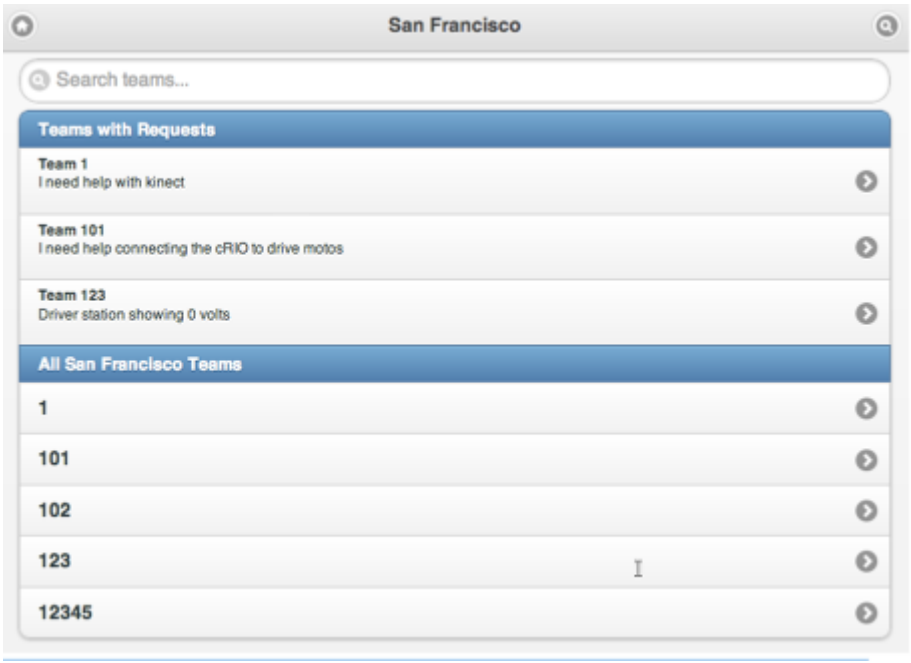
Click on the Select Team dropdown and pick the appropriate Team Number from the list. Enter a description of the request/issue in the box, and then click **Submit**.

Viewing Requests



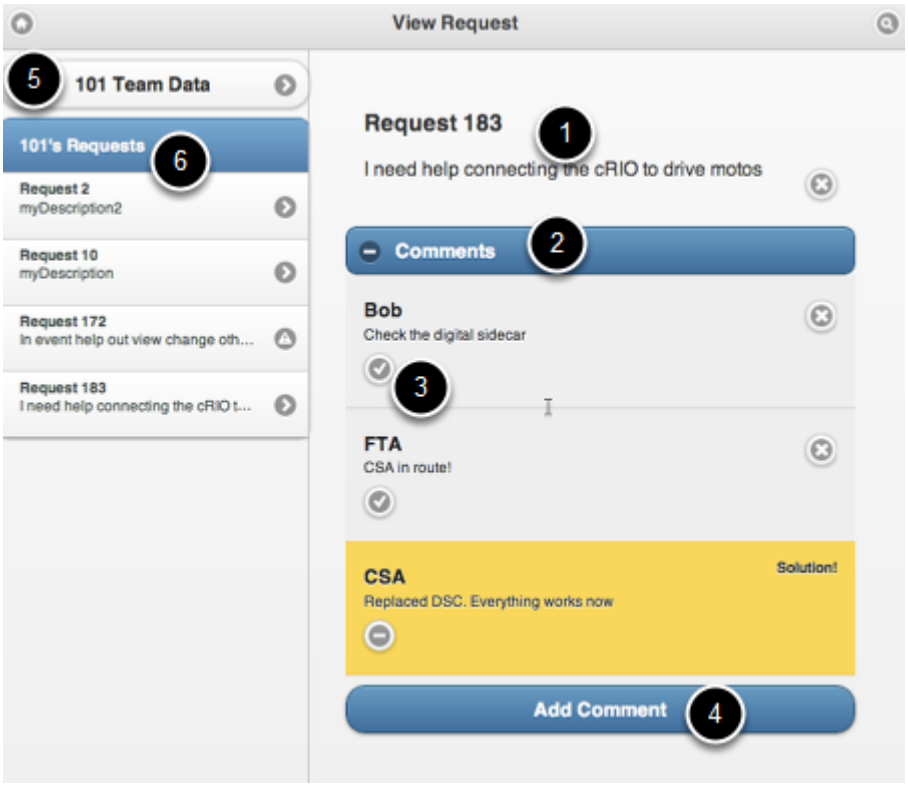
To view or respond to a request (including leaving a comment or closing a request) click the Help Out button on the NI Parkway home page. Click on the appropriate event from the list of Live Events in the right pane. Numbers listed next to the event describe the number of open requests.

Select a Request



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



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)
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.