

# GETTING STARTED WITH THE 2016 CONTROL SYSTEM

# Getting Started with the 2016 Control System

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# Getting Started with the ScreenSteps Documentation

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## 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 screenshot shows a documentation page for 'Configuring Wind River Workbench'. The top navigation bar includes links for 'Robot programming with WPILib', 'Getting started with C++', and 'Configuring Wind River Workbench'. A red box highlights the current page title. Below the navigation is a search bar and a 'Documentation site powered by ScreenSteps Live' link. A 'Learn more about ScreenSteps Live' button is also visible. The main content area has a 'PREV: INSTALLING THE C++ DEVELOPMENT TOOLS' link (highlighted with a red box) and a 'NEXT: CREATING A PROJECT' link (also highlighted with a red box). The central text discusses 'Creating a Target Server Connection' and shows a screenshot of the Wind River Workbench interface. A note explains how Workbench connects to a cRIO controller. At the bottom, there's a 'Note' about showing the 'Remote Systems' tab if it's not visible. The sidebar on the left contains sections for 'Other Resources' (including 'BETA TESTING FOR 2013' and 'WPILIB PROGRAMMING DOCUMENTATION' with links to C++, Java, and Command-based programming), 'SOFTWARE TOOLS' (with links to RobotBuilder, Extending RobotBuilder, and SmartDashboard), and a 'Last Updated' section showing 'Oct 31, 2012'.

# Getting Started with the 2016 Control System

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

The screenshot shows the search results for the term "RobotBuilder". On the left, there is a sidebar titled "Filter Search Results" with sections for "BETA TESTING FOR 2013", "WPILIB PROGRAMMING DOCUMENTATION", "SOFTWARE TOOLS", and "2013 CONTROL SYSTEM". Under each section, there are several items listed with icons. Two red arrows point from the sidebar to the search interface: one from the "BETA TESTING FOR 2013" section to the search bar, and another from the "Match any search term" radio button to the search results list. The search bar contains "RobotBuilder". The search results list shows 21 articles found, with the first two being "Starting RobotBuilder" and "Overview of RobotBuilder". Each result has a brief description and a "Read Article" link.

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.

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## Downloading PDFs

The screenshot shows a documentation page for generating C++ code. On the left, there's a sidebar with a search bar and a 'Topics' section containing links to various robot-related topics. Below that is a note about the documentation being powered by ScreenSteps Live, and a button to learn more about it.

The main content area has a header 'Generating C++ code for a project'. It includes a note about creating working subsystems and a screenshot of a software interface. The interface shows a tree view of subsystems like 'RobotBuilderGearbot', 'Drive train', 'Robot Drive 2', 'Claw', 'Elevator', and 'Wrist'. A table on the right lists properties such as 'Name', 'Autonomous Command', 'Team Number', 'Java Project', 'Use Default Java Package', 'Java Package', 'C++ Windriver Workspace', 'Export Favourites', 'Export Commands', and 'Wiring File'. Two specific steps are highlighted: step 1 points to the 'Java Package' field, and step 2 points to the 'Generate code' button.

Below the screenshot, a note says: "Verify that the C++ WindRiver workspace location is set properly (1) and generate code for the C++ robot project (2)."

At the bottom, there's a section titled 'Import the project into WindRiver Workbench' with a screenshot of the WindRiver Workbench interface.

**Topics**

- [The basic steps to create a robot program](#) 12
- [Writing C++ code for your robot](#) 4
- [Writing Java code for your robot](#) 5
- [Advanced techniques](#) 4

Documentation site powered by [ScreenSteps Live](#)

Learn more about [ScreenSteps Live](#)

Last Updated  
Oct 31, 2012

[Download Lesson PDF](#) [Download Manual PDF](#)

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.

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# Getting Started with the 2016 Control System

# Getting Started with the 2016 Control System

## New for 2016!

This article describes some of the new features and changes you'll see in the Control System and software for the 2016 FRC season.

### OpenMesh OM5P-AN Radio



With the DAP-1522 Rev. B radio going End-Of-Life FRC has switched to the OpenMesh OM5P-AN radio for the 2016 season. This radio is smaller and lighter than the DAP-1522, has better signal strength performance in our environment, and uses open source firmware which allows us to implement a number of great features including bandwidth restriction and QoS, better monitoring, and more. The new radio is programmed (including flashing firmware if necessary) with a refreshed version of the FRC Radio Configuration Utility, instructions on using that tool can be found [here](#).

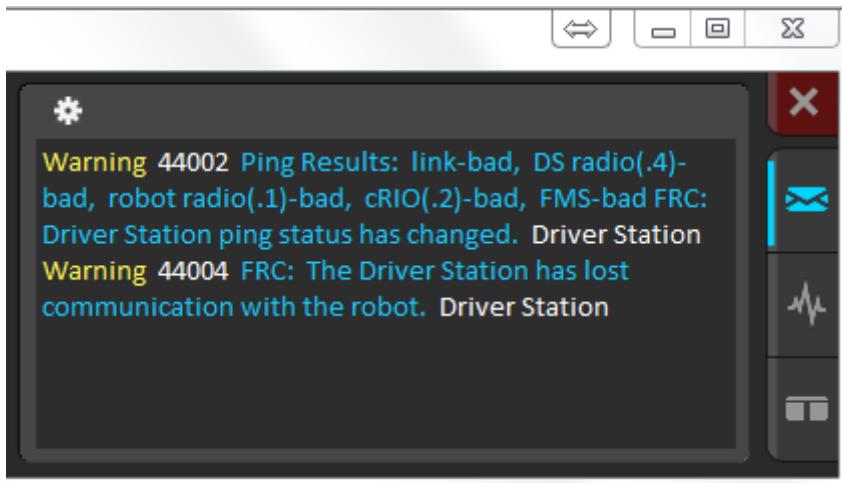
**Heads Up:** While the OM5P-AN uses the same power plug as the DAP1522, it takes a 12V input instead of the 5V input of the D-Link. This means that it DOES NOT plug into the port on the VRM labeled "Radio Power", instead use the 12V 2A connection on the VRM. See the [Wiring the 2016 FRC Control System](#) document for more details.

### Support for Spark and SD540 motor controllers

All three languages have added support for the new [Mindsensors SD540](#) and [Rev Robotics SPARK](#) motor controllers. These classes/VIs contain timings based on empirical testing with device samples and will help teams keep their robot programs clear by referencing the actual devices in use.

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## Console in Driver Station



The [2016 Driver Station](#) and WPILib have been modified to enhance the display of errors and warnings and to display user prints in the DS Messages window. The DS can also launch a separate console window (which can be dragged around, resized, etc.) to view these messages.

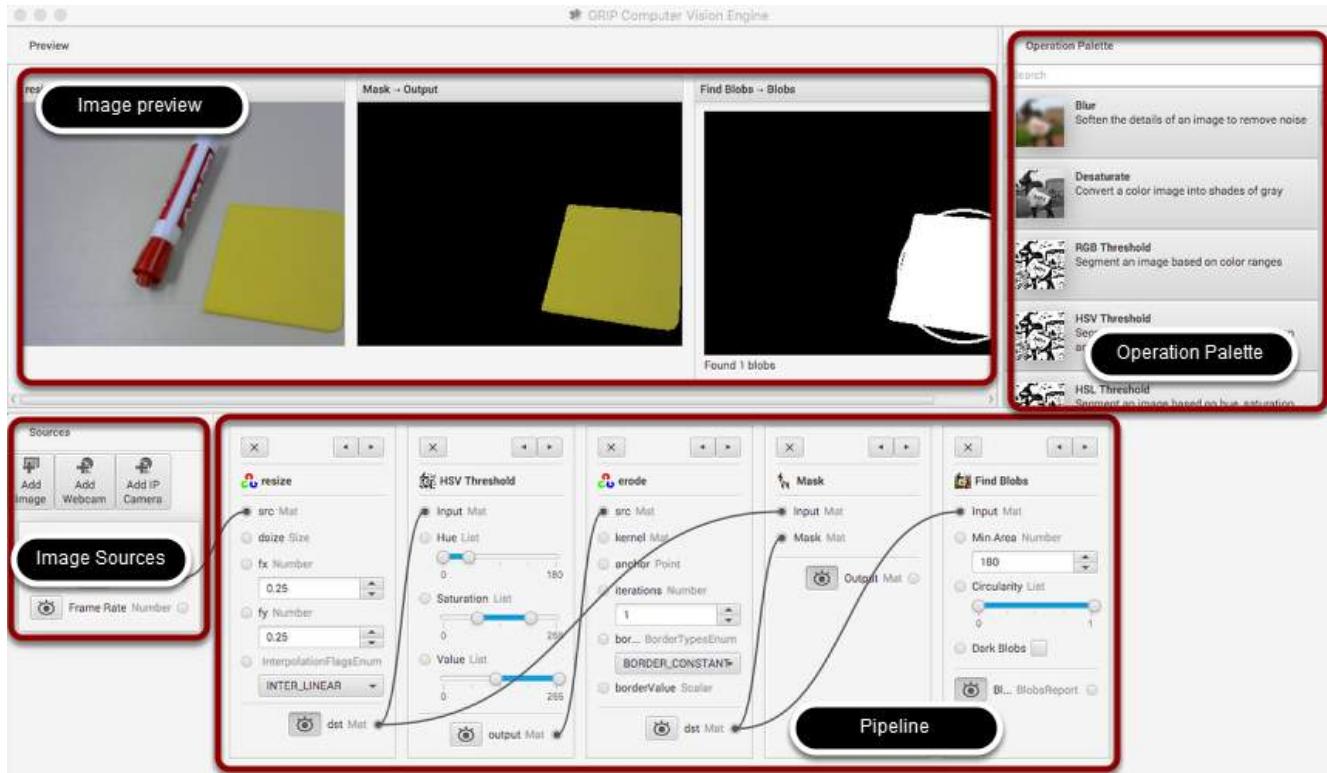
## Automatic Code Recovery

In the event of a user code crash, the roboRIO will now restart the program. This will help prevent a rarely exercised code path from taking you out for a whole match.

Note: If you have a program which continually crashes, this can look a little strange. Keep an eye out for the WPILib prints as the program starts (by turning on Prints in the DS Messages window) to see if your program is crashing and restarting.

# Getting Started with the 2016 Control System

## GRIP - Graphical Image Processing



GRIP is a graphical interface for creating image processing routines using OpenCV. GRIP allows you to develop vision processing routines interactively (viewing the output of each step along the way) and then run the routine on the roboRIO or Driver Station and publish the results to the robot program using Network Tables. For more information and examples, see the [GRIP manual](#).

## Talon SRX enhancements

The TalonSRX firmware and WPILib libraries have been updated with a number of new features including:

- Two new sensor types for CTRE Magnetic Encoder (absolute and relative).
- Voltage Compensation Mode. Motor Output is expressed in output volts, and Talon will modulate the output based on battery voltage measurement.
- Current Closed-Loop Mode. Talon will servo to a target current-draw.
- User can now select the nominal forward and reverse output during Closed-Loop. This means that if the Closed Loop Error is nonzero (or outside of the Allowable Closed-Loop Error) but the Closed-Loop calculates a motor output that is weaker than the specified nominal value, Talon will promote the motor output to the nominal value.
- User can now specify the peak forward and reverse output during Closed-Loop.

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- User can now select the Allowable Closed-Loop error so that the motor drive remains neutral even if closed-loop error is nonzero.
- Talon supports an advanced control mode called Motion Profile, that allows streaming the trajectory points of a motion profile into a Talon, while the Talon executes it. This ensures accurate timing between trajectory points.
- Robot API supports unit scaling so sensor position/velocity and Closed-loop target position and velocity can be expressed in rotations and RPM. roboRIO Web-based config also will decode in rotations and RPM.

For more details, see the [Talon SRX Software Reference Manual](#).

## Faster Current Logging

The Driver Station logging of the PDP current data has been substantially sped up. The data is now logged at an ~20ms rate (this loop is asynchronous to the DS loop so you may see some anomalies) which should allow better detection and correlation of current events.

## Network Tables Re-write

The C++ and Java implementations of Network Tables (the guts of both the LabVIEW and Java SmartDashboard) have been substantially re-written and the LabVIEW implementation has been refreshed to provide increased robustness and some new features such as the ability to make network tables value persistant across runs. C++ and Java teams should check out the [Porting Guide](#) for information about any necessary changes to legacy code to run with the 2016 libraries.

## LabVIEW Command and Control Framework

Inspired by some of the concepts from the C++/Java Command Based programming model, a new (completely optional) framework for FRC LabVIEW programs has been developed. The Command and Control Framework structures the code as groups of subsystems and commands that act on those subsystems to create modular, extensible robot programs.

## C++ 14

The C+ libraries have been updated to take advantage of newer C++ features such as Smart Pointers.

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## Digital Filters for C++ and Java

Some new filter classes have been added to C++ and Java to help expose teams to the basics of Digital Filtering.

## RobotBuilder - Commands, CAN Talons, and custom user supplied components, and more

Robot Builder has been updated to allow you to create parametrized commands, a new click-and-drag command group creation tool, support for CAN Talon SRXs, and custom user supplied components to the Robot Builder palette. Additional devices now supported in Robot Builder include the Power Distribution Panel.

## Java SmartDashboard

In addition to the Network Tables re-write, the SmartDashboard has also added widgets for CAN PID tuning to allow you to tune PID constants for CAN Jaguars and Talon SRXs using LiveWindow.

## Java 3rd Party Libraries

The Java build scripts have been modified to make it easier to include 3rd party libraries in your programs. Check out [this article](#) for more details on how to take advantage of the change.

## mDNS Tweaks

We've made some small tweaks to the mDNS implementation in the Control System, including a new mDNS name for the roborio (roboRIO-####-FRC.local, where #### is your team number). These changes should eliminate at least some of the failure modes seen in 2015.

## Robot simulation with Gazebo with user importable robot models

You can now export your robot models from SolidWorks and import them into the Linux version of the Gazebo robot simulator. Gazebo is the standard for robotics simulation in university research labs. You can add all your motors and sensors to the simulated robots and then run your WPIlib C++ and Java programs to operate the simulated robot. See the [Using FRCSim with C++ and Java](#) section of ScreenSteps for more information.

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## Customizable gyro calibration

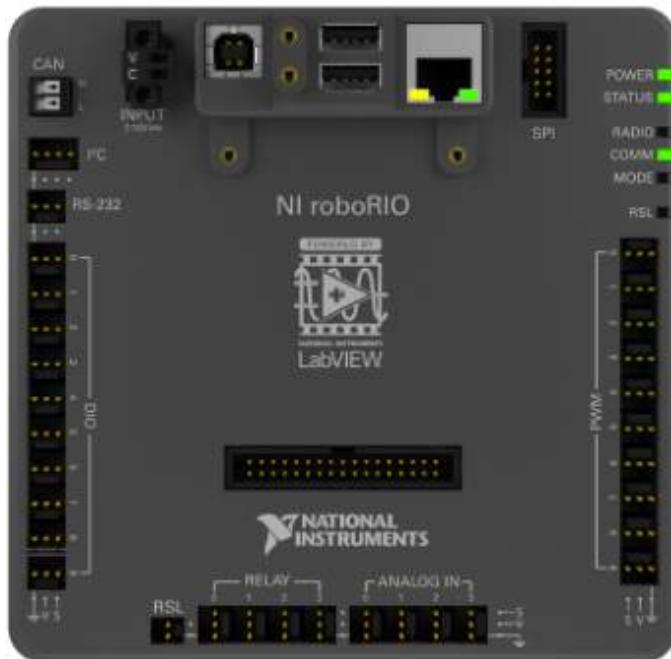
You can now supply your own Gyro calibration values rather than having the gyro do the multi-second calibration step on startup.

# Getting Started with the 2016 Control System

## 2016 FRC Control System Hardware Overview

The goal of this document is to provide a brief overview of the hardware components that make up the 2016 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 2016 Control System](#) document.

### National Instruments roboRIO



The NI-roboRIO is the main robot controller used for FRC 2015. The roboRIO includes a dual-core ARM Cortex™-A9 processor and FPGA which runs both trusted elements for control and safety as well as team-generated code. Integrated controller I/O includes a variety of communication protocols (Ethernet, USB, CAN, SPI, I2C, and serial) as well as PWM, servo, digital I/O, and analog I/O channels used to connect to robot peripherals for sensing and control. The roboRIO should connect to the dedicated 12V port on the Power Distribution Panel for power. Wired communication is available via USB or Ethernet. Detailed information on the roboRIO can be found in the [roboRIO User Manual](#).

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## Power Distribution Panel



The Power Distribution Panel (PDP) is designed to distribute power from a 12VDC battery to various robot components through auto-resetting circuit breakers and a small number of special function fused connections. The PDP provides 8 output pairs rated for 40A continuous current and 8 pairs rated for 30A continuous current. The PDP provides dedicated 12V connectors for the roboRIO, as well as connectors for the Voltage Regulator Module and Pneumatics Control Module. It also includes a CAN interface for logging current, temperature, and battery voltage. For more detailed information, see the [PDP User Manual](#).

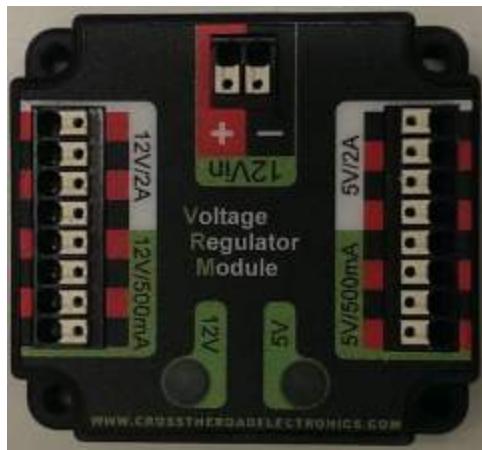
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## Pneumatics Control Module



The PCM is a device that contains all of the inputs and outputs required to operate 12V or 24V pneumatic solenoids and the on board compressor. The PCM is enabled/disabled by the roboRIO over the CAN interface. The PCM contains an input for the pressure sensor and will control the compressor automatically when the robot is enabled and a solenoid has been created in the code. The device also collects diagnostic information such as solenoid states, pressure switch state, and compressor state. The module includes diagnostic LED's for both CAN and the individual solenoid channels. For more information see the [PCM User Manual](#).

## Voltage Regulator Module



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The VRM is an independent module that is powered by 12 volts. The device is wired to a dedicated connector on the PDP. The module has multiple regulated 12V and 5V outputs. The purpose of the VRM is to provide regulated power for the robot radio, custom circuits, and IP vision cameras.

**Note: The two connector pairs associated with each label have a combined rating of what the label indicates (e.g. 5V/500mA total for both pairs not for each pair). The 12V/2A limit is a peak rating, the supply should not be loaded with more than 1.5A continuous current draw.** For more information, see the [VRM User Manual](#).

## Motor Controllers

There are a variety of different motor controllers which work with the FRC Control System. These devices are used to provide variable voltage control of the brushed DC motors used in FRC.

### Jaguar Motor Controller



The Jaguar Motor Controller from VEX Robotics (formerly made by Luminary Micro and Texas Instruments) is a variable speed motor controller 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 BDC-Comm PC program) to the CAN bus. The Jaguar should be connected using one of these control interfaces and powered from the Power Distribution Panel. For more information, see the Jaguar Getting Started Guide, Jaguar Datasheet and Jaguar FAQ on [this page](#).

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## SD540 Motor Controller



The SD540 Motor Controller from Mindsensors is a variable speed motor controller for use in FRC. The SD540 is controlled using the PWM interface. Limit switches may be wired directly to the SD540 to limit motor travel in one or both directions. Switches on the device are used to flip the direction of motor travel, configure the wiring polarity of limit switches, set Brake or Coast mode, and put the device in calibration mode. For more information see the Mindsensors SD540 page: <http://www.mindsensors.com/content/71-frc-motor-controller>

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## SPARK Motor Controller



The SPARK Motor Controller from REV Robotics is a variable speed motor controller for use in FRC. The SPARK is controlled using the PWM interface. Limit switches may be wired directly to the SPARK to limit motor travel in one or both directions. The RGB status LED displays the current state of the device including whether the device is currently in Brake mode or Coast mode. For more information, see the REV Robotics SPARK product page: <http://www.revrobotics.com/product/spark/>

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## Talon Motor Controller



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

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## Talon SRX



The Talon SRX motor controller is a CAN-enabled "smart motor controller" from Cross The Road Electronics/VEX Robotics. The Talon SRX has an electrically isolated metal housing for heat dissipation, making the use of a fan optional. The Talon SRX can be controlled over the CAN bus or PWM interface. When using the CAN bus control, this device can take inputs from limit switches and potentiometers, encoders, or similar sensors in order to perform advanced control such as limiting or PID(F) closed loop control on the device. For more information see the [Talon SRX User Manual](#).

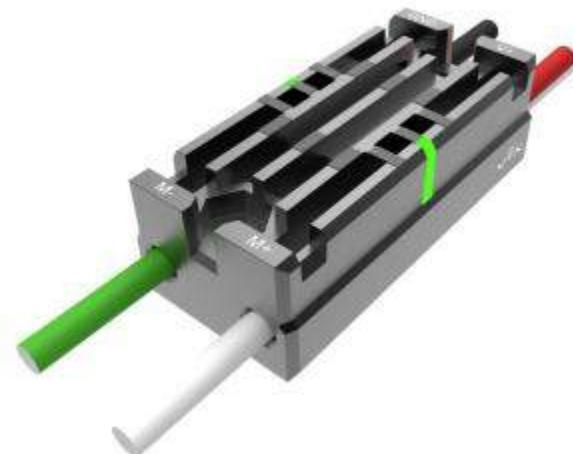
# Getting Started with the 2016 Control System

## Victor 888 Motor Controller / Victor 884 Motor Controller



The Victor 888 Motor Controller from VEX Robotics is a variable speed motor controller 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 roboRIO and powered from the Power Distribution Panel. For more information, see the [Victor 884 User Manual](#) and [Victor 888 User Manual](#).

## Victor SP



# Getting Started with the 2016 Control System

The Victor SP motor controller is a PWM motor controller from Cross The Road Electronics/VEX Robotics. The Victor SP has an electrically isolated metal housing for heat dissipation, making the use of the fan optional. The case is sealed to prevent debris from entering the controller. The controller is approximately half the size of previous models. For more information, see the [Victor SP 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 both the forward and reverse directions. The Spike outputs are independently controlled so it can also be used to provide power to up to 2 custom electronic circuits. The Spike H-Bridge Relay should be connected to a relay output of the roboRIO and powered from the Power Distribution Panel. For more information, see the [Spike User's Guide](#).

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## Axis M1013/M1011/206 Ethernet Camera



The Axis M1013, M1011 and Axis 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 a 5V power output on the Voltage Regulator Module and an open ethernet port on the robot radio. For more information, see [Configuring an Axis Camera](#) and the [Axis 206](#), [Axis M1011](#), [Axis M1013](#) pages.

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## Microsoft Lifecam HD3000



The Microsoft Lifecam HD3000 is a USB webcam that can be plugged directly into the roboRIO. The camera is capable of capturing up to 1280x720 video at 30 FPS. For more information about the camera, see the [Microsoft product page](#). For more information about using the camera with the roboRIO, see the [Vision Processing section](#) if this documentation.

## OpenMesh OM5P-AN Radio



The OpenMesh OM5P-AN wireless radio is used as the robot radio 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 one of the 12V outputs on the VRM and connected to the roboRIO controller over Ethernet. For more information, see [Programming your radio for](#)

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home use and the [Open Mesh OM5P-AN product page](#). Note: For information on purchasing additional radios, please see [this blog post](#).

## 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)

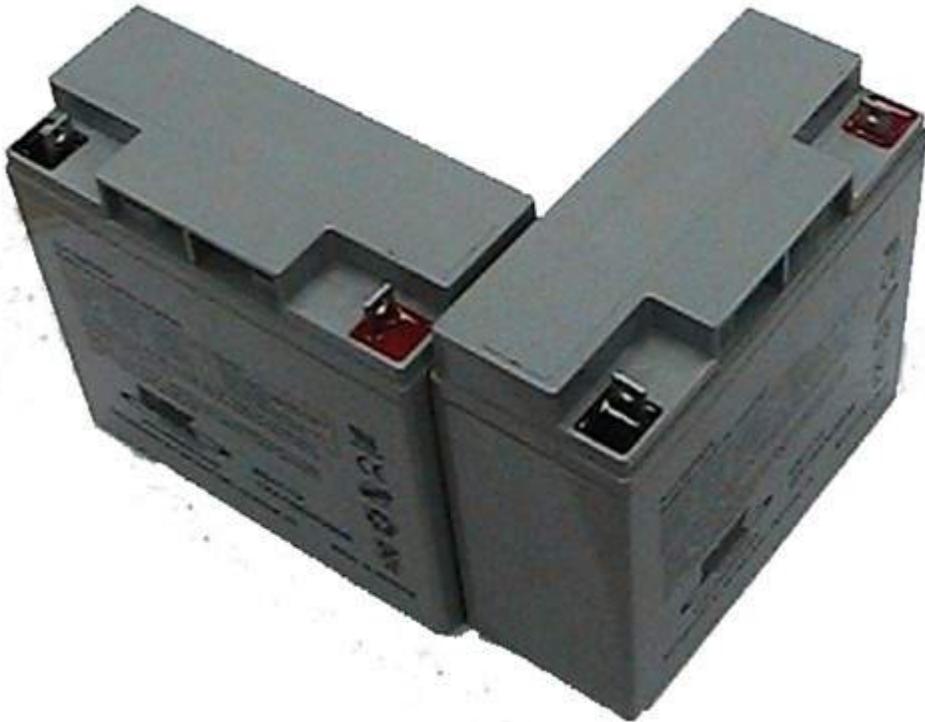
## Snap Action Circuit Breakers



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

## 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](#). Note that other battery part numbers may be legal, consult the 2015 FRC Manual for a complete list.

## Image credits

Image of roboRIO courtesy of [National Instruments](#). Image of SD540 courtesy of [Mindsensors](#). Images of Jaguar Motor Controller, Talon SRX, Victor 888 Motor Controller, Victor SP Motor Controller, and Spike H-Bridge Relay courtesy of [VEX Robotics, Inc](#). Lifecam, PDP, PCM, SPARK, and VRM photos courtesy of FIRST. All other photos courtesy of [AndyMark Inc](#).

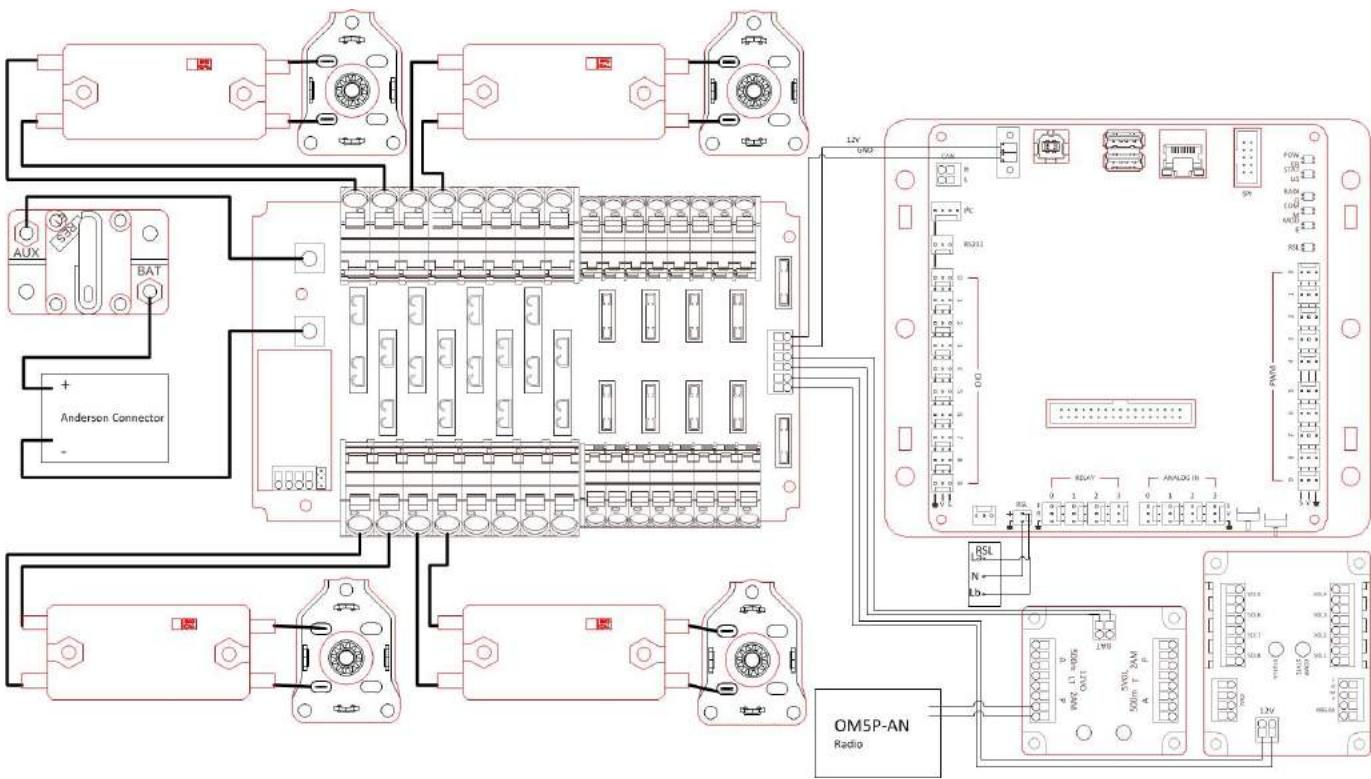
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## Wiring the 2016 FRC Control System

This document details the wiring of a basic electronics board for bench-top testing.

The images shown in this section reflect the setup for a Robot Control System using a roboRIO and VictorSP motor controllers. The setup is similar for Jaguars, Talon SRXs, Victor 884/888s, or Victor SPs.

### Gather Materials



Locate the following control system components and tools

Note: There is one set of items required that is not contained in the Rookie kickoff kit. You will need some method of connecting the Victor SP wires to the CIM motor wires. The images below show the use of both wire nuts (not recommended for permanent FRC use as they are not intended for vibration environments) and quick disconnect terminals. The [Digikey](#), or TE Connectivity vouchers in the [Virtual Kit](#) can be used to purchase suitable quick-disconnecting or splice connectors or they can typically be found at your local hardware or electronics parts store.

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- Kit Materials:
  - Power Distribution Panel (PDP)
  - roboRIO
  - Pneumatics Control Module (PCM)
  - Voltage Regulator Module (VRM)
  - OM5P-AN radio (with power cable and Ethernet cable)
  - Robot Signal Light (RSL)
  - 4x Victor SP speed controllers
  - 2x PWM y-cables
  - 120A Circuit breaker
  - 4x 40A Circuit breaker
  - 6 AWG Red wire
  - 10 AWG Red/Black wire
  - 18 AWG Red/Black wire
  - 22AWG yellow/green twisted CAN cable
  - 2x Andersen SB50 battery connectors
  - 6AWG Terminal lugs
  - 12V Battery
  - Red/Black Electrical tape
  - Dual Lock material or fasteners
  - Zip ties
  - 1/4" or 1/2" plywood
- Tools Required:
  - Wago Tool or small flat-head screwdriver
  - Very small flat head screwdriver (eyeglass repair size)
  - Philips head screw driver
  - 5mm Hex key (3/16" may work if metric is unavailable)
  - 1/16" Hex key
  - Wire cutters, strippers, and crimpers
  - 7/16" box end wrench or nut driver

## Create the Base for the Control System

For a benchtop test board, cut piece of 1/4" or 1/2" material (wood or plastic) approximately 24" x 16". For a Robot Quick Build control board see the supporting documentation for the proper size board for the chosen chassis configuration.

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## Layout the Core Control System Components

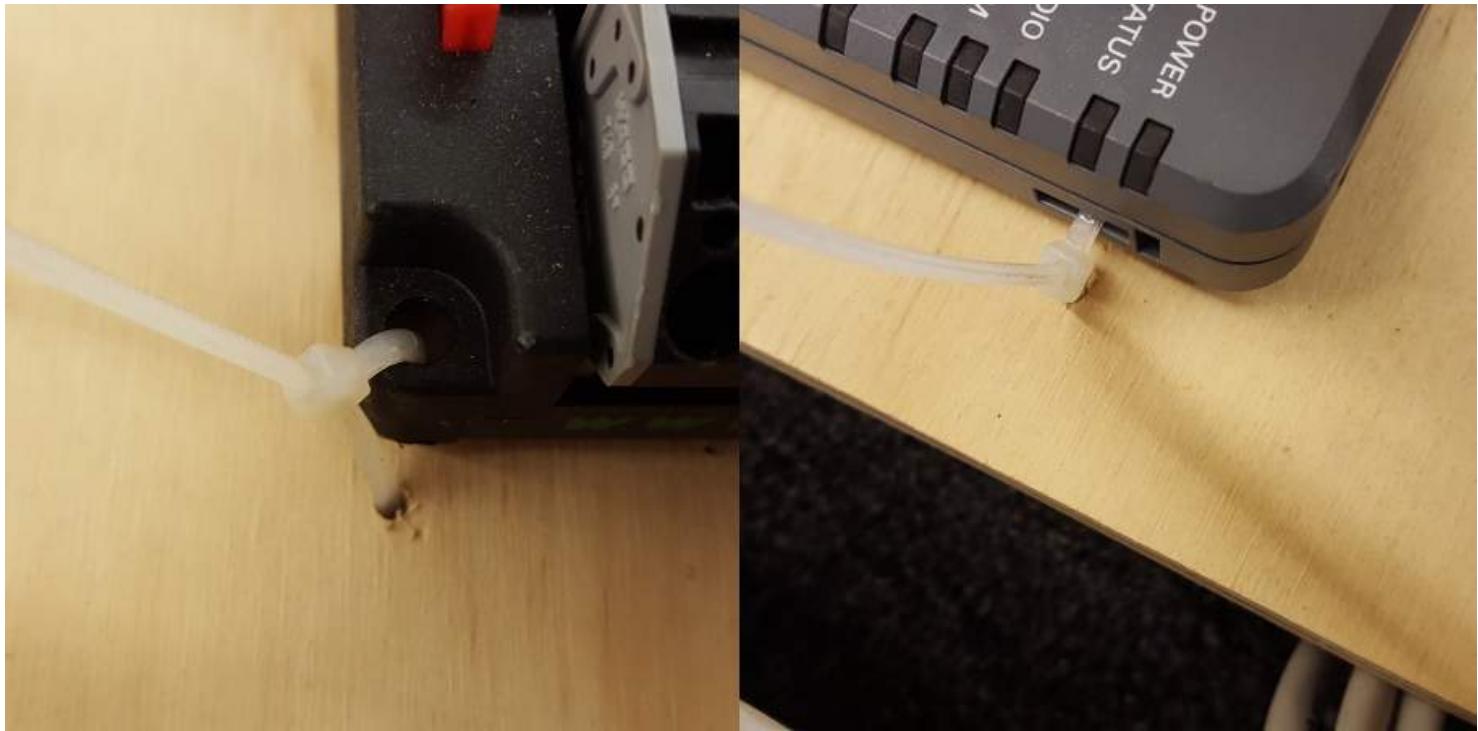


Layout the components on the board. One layout that should work is shown in the images above.

Note: If creating the board for a robot chassis, per the QuickBuild instructions for the **long orientation**, you may wish to turn the battery 90 degrees clockwise compared to the image above and spread the components on each side accordingly in order to accommodate building a box to retain the battery without hitting the CIM motors.

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## Fasten components



Using the Dual Lock or hardware, fasten all components to the board. Note that in many FRC games robot-to-robot contact may be substantial and Dual Lock alone is unlikely to stand up as a fastener for many electronic components. Teams may wish to use nut and bolt fasteners or (as shown in the image above) cable ties, with or without Dual Lock to secure devices to the board.

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## Attach Battery Connector to PDP

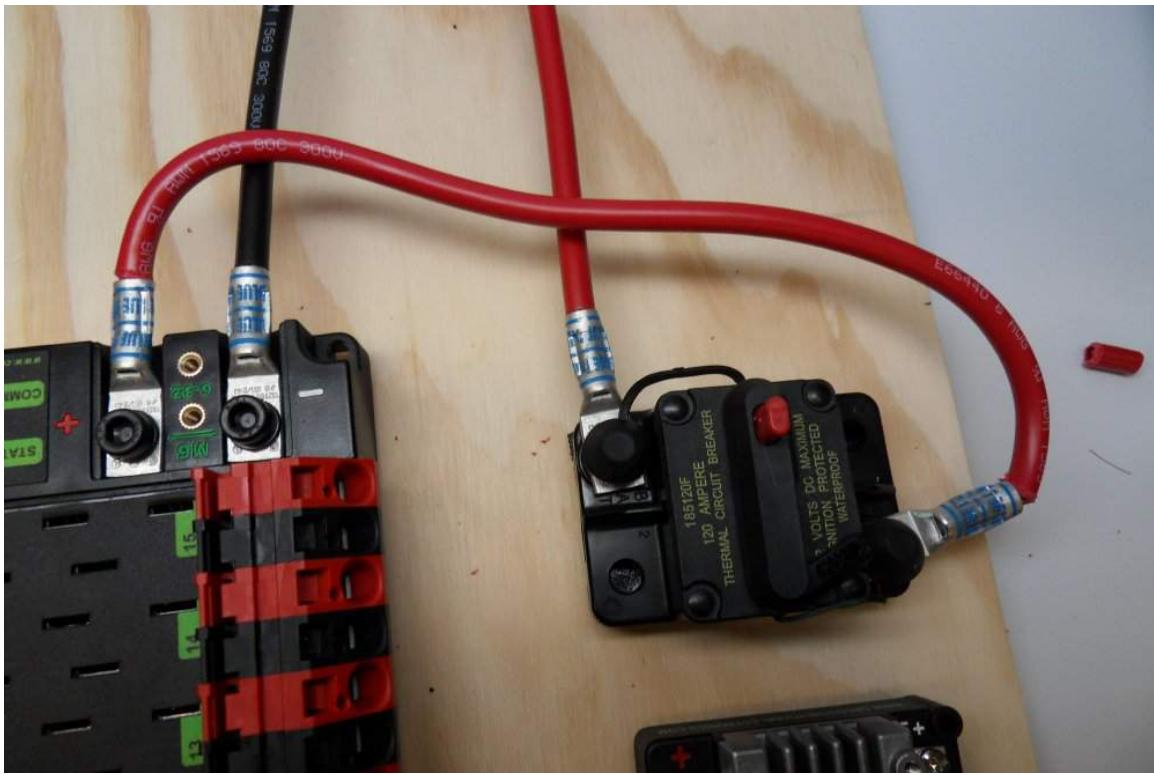


Requires: Battery Connector, 6AWG terminal lugs, 1/16" Allen, 5mm Allen, 7/16" Box end

1. Attach terminal lugs to battery connector.
2. Using a 1/16" Allen wrench, remove the two screws securing the PDP terminal cover.
3. Using a 5mm Allen wrench (3/16" will work if metric is not available), remove the negative (-) bolt and washer from the PDP and fasten the negative terminal of the battery connector.
4. Using a 7/16" box end wrench, remove the nut on the "Batt" side of the main breaker and secure the positive terminal of the battery conenctor

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## Wire Breaker to PDP



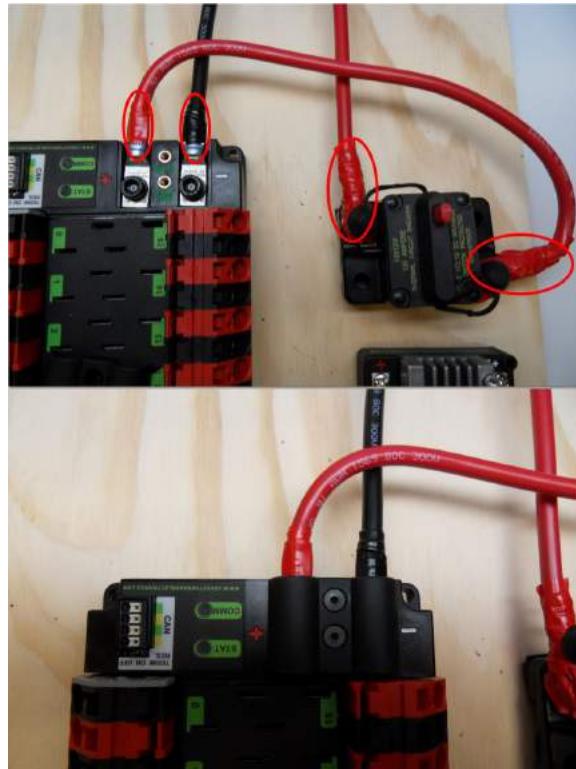
Requires: 6AWG red wire, 2x 6AWG terminal lugs, 5mm Allen, 7/16" box end

Secure one terminal lug to the end of the 6AWG red wire. Using the 7/16" box end, remove the nut from the "AUX" side of the 120A main breaker and place the terminal over the stud. Loosely secure the nut (you may wish to remove it shortly to cut, strip, and crimp the other end of the wire). Measure out the length of wire required to reach the positive terminal of the PDP.

1. Cut, strip, and crimp the terminal to the 2nd end of the red 6AWG wire.
2. Using the 7/16" box end, secure the wire to the "AUX" side of the 120A main breaker.
3. Using the 5mm, secure the other end to the PDP positive terminal.

# Getting Started with the 2016 Control System

## Insulate PDP connections



Requires: 1/16" Allen, Electrical tape

1. Using electrical tape, insulate the two connections to the 120A breaker. Also insulate any part of the PDP terminals which will be exposed when the cover is replaced. One method for insulating the main breaker connections is to wrap the stud and nut first, then use the tape wrapped around the terminal and wire to secure the tape.
2. Using the 1/16" Allen wrench, replace the PDP terminal cover

# Getting Started with the 2016 Control System

## Wago connectors

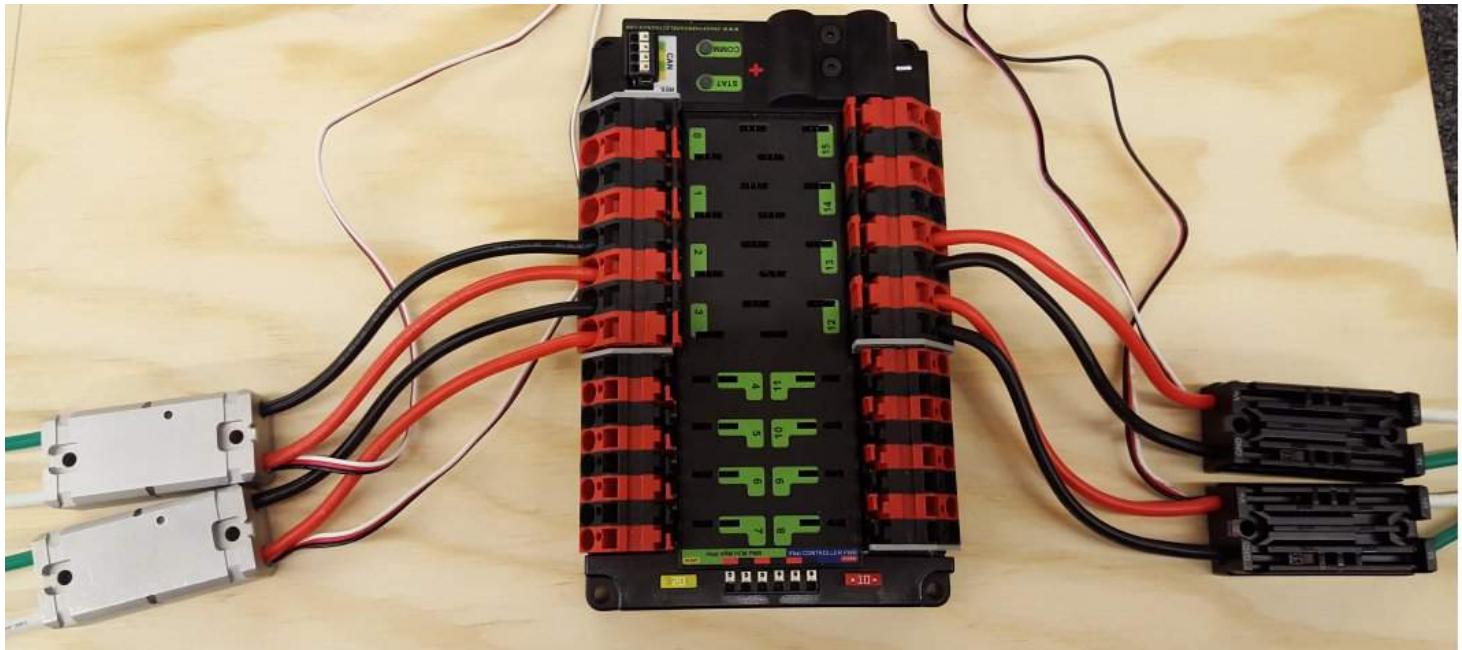
The next step will involve using the Wago connectors on the PDP. To use the Wago connectors, insert a small flat blade screwdriver into the rectangular hole at a shallow angle then angle the screwdriver upwards as you continue to press in to actuate the lever, opening the terminal. Two sizes of Wago connector are found on the PDP:

- Small Wago connector: Accepts 10AWG-24AWG, strip 11-12mm (~7/16")
- Large Wago connector: Accepts 6AWG-12AWG, strip 12-13mm(~1/2")

To maximize pullout force and minimize connection resistance wires should not be tinned (and ideally not twisted) before inserting into the Wago connector.

# Getting Started with the 2016 Control System

## Motor Controller Power



Requires: Wire Stripper, Small Flat Screwdriver,

For each of the 4 Victor SP motor controllers:

1. Cut and strip the red and black power input wires wire, then insert into one of the 40A (larger) Wago terminal pairs.

# Getting Started with the 2016 Control System

## Weidmuller Connectors

The correct strip length is ~5/16" (8mm), not the 5/8" mentioned in the video.

A number of the CAN and power connectors in the system use a Weidmuller LSF series wire-to-board connector. There are a few things to keep in mind when using this connector for best results:

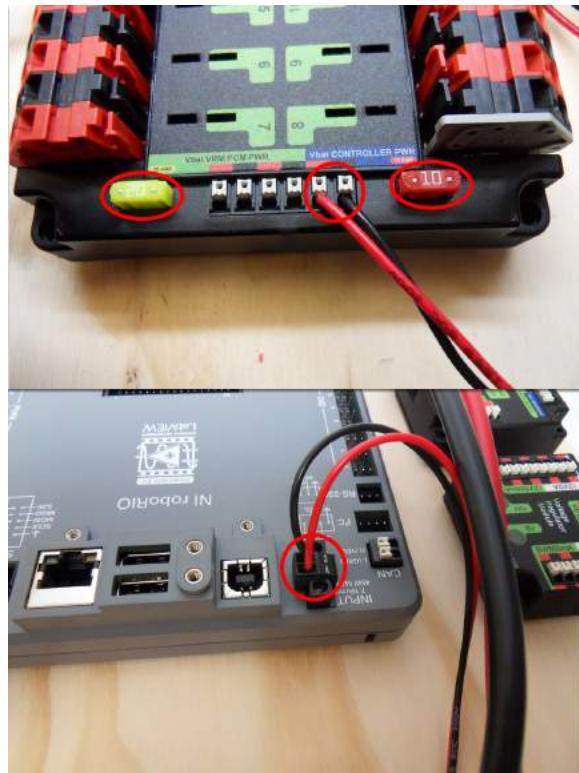
- Wire should be 16AWG to 24AWG (consult rules to verify required gauge for power wiring)
- Wire ends should be stripped approximately 5/16"
- To insert or remove the wire, press down on the corresponding "button" to open the terminal

After making the connection check to be sure that it is clean and secure:

- Verify that there are no "whiskers" outside the connector that may cause a short circuit
- Tug on the wire to verify that it is seated fully. If the wire comes out and is the correct gauge it needs to be inserted further and/or stripped back further.

# Getting Started with the 2016 Control System

## roboRIO Power

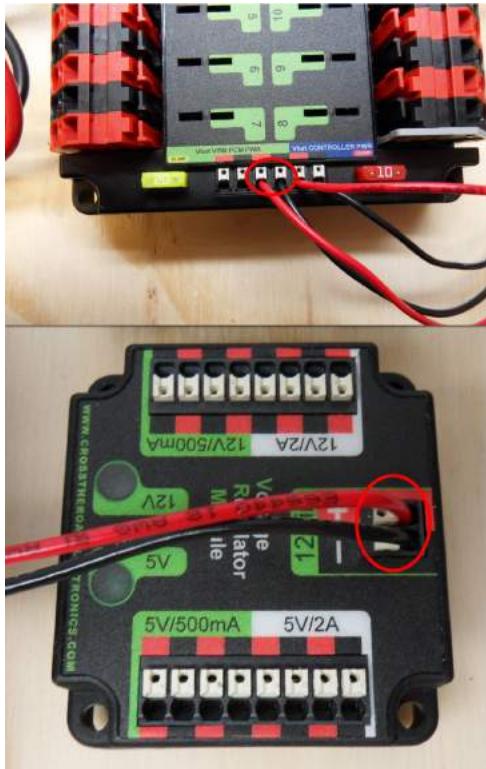


Requires: 10A/20A mini fuses, Wire stripper, very small flat screwdriver, 18AWG Red and Black

1. Insert the 10A and 20A mini fuses in the PDP in the locations shown on the silk screen (and in the image above)
2. Strip ~5/16" on both the red and black 18AWG wire and connect to the "Vbat Controller PWR" terminals on the PDB
3. Measure the required length to reach the power input on the roboRIO. Take care to leave enough length to route the wires around any other components such as the battery and to allow for any strain relief or cable management.
4. Cut and strip the wire.
5. Using a very small flat screwdriver connect the wires to the power input connector of the roboRIO (red to V, black to C). Also make sure that the power connector is screwed down securely to the roboRIO.

# Getting Started with the 2016 Control System

## Voltage Regulator Module Power

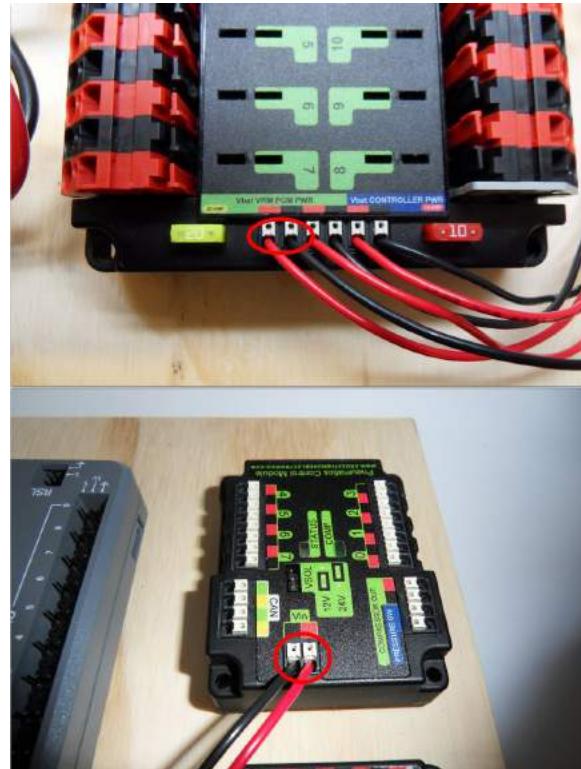


Requires: Wire stripper, small flat screwdriver (optional), 18AWG red and black wire

1. Strip ~5/16" on the end of the red and black 18AWG wire.
2. Connect the wire to one of the two terminal pairs labeled "Vbat VRM PCM PWR" on the PDP.
3. Measure the length required to reach the "12Vin" terminals on the VRM. Take care to leave enough length to route the wires around any other components such as the battery and to allow for any strain relief or cable management.
4. Cut and strip ~5/16" from the end of the wire.
5. Connect the wire to the VRM 12Vin terminals.

# Getting Started with the 2016 Control System

## Pneumatics Control Module Power (Optional)



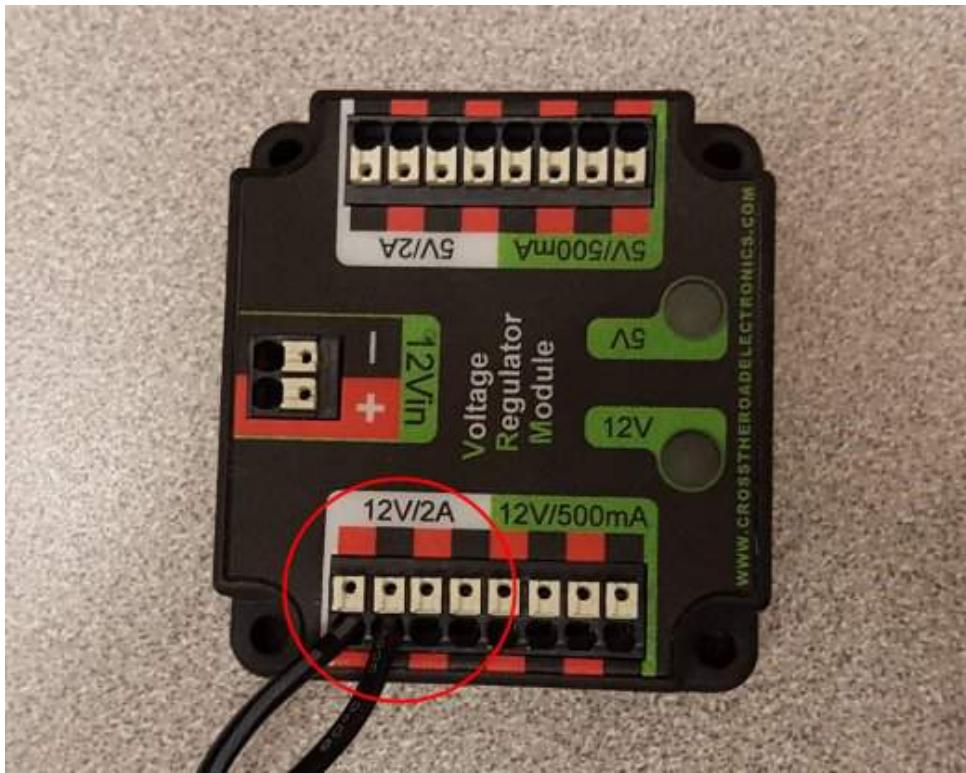
Requires: Wire stripper, small flat screwdriver (optional), 18AWG red and black wire

Note: The PCM is an optional component used for controlling pneumatics on the robot.

1. Strip ~5/16" on the end of the red and black 18AWG wire.
2. Connect the wire to one of the two terminal pairs labeled "Vbat VRM PCM PWR" on the PDP.
3. Measure the length required to reach the "Vin" terminals on the VRM. Take care to leave enough length to route the wires around any other components such as the battery and to allow for any strain relief or cable management.
4. Cut and strip ~5/16" from the end of the wire.
5. Connect the wire to the VRM 12Vin terminals.

# Getting Started with the 2016 Control System

## Radio Power and Ethernet



Note: This is different than the 2015 radio!!!!

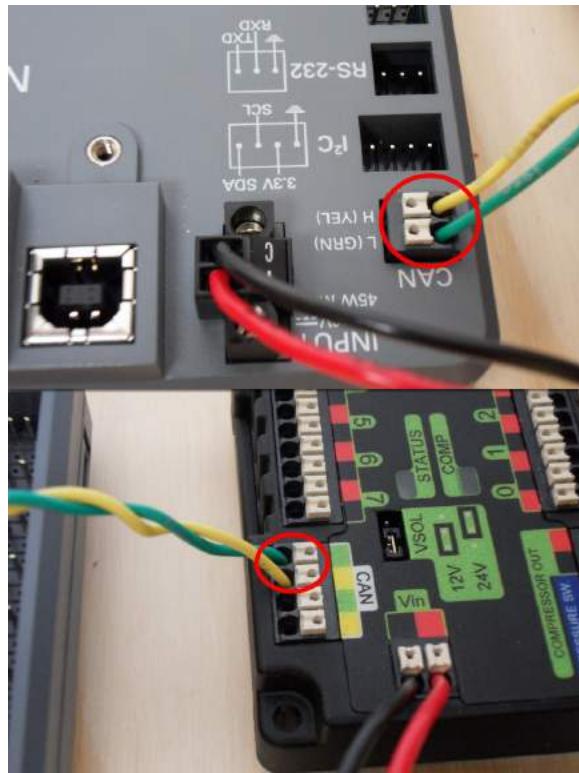
Requires: Wire stripper, small flat screwdriver (optional), OM5P-AN power wiring, Ethernet cable

1. Strip ~5/16" off of each wire on the power cord.
2. Locate the wire with the white stripes on it (one wire has white stripes, the other has writing) and attach it to either of the two red terminals on the "12V/2A" supply of the VRM.
3. Connect the other wire (with writing on it) to the black terminal immediately to the right of the red terminal used above.
4. Plug the barrel connector into the back of the OM5P-AN
5. Plug the Ethernet cable into either port on the back of the OM5P-AN and into the roboRIO.

Note: If you wish to verify the polarity of the radio power connection using a DMM or Continuity tester, the connector is center pin positive. This means that the wire connecting to the red terminal should be connected to the center of the connector, the wire connecting to the black terminal should be connected to the outside of the connector.

# Getting Started with the 2016 Control System

## RoboRIO to PCM CAN



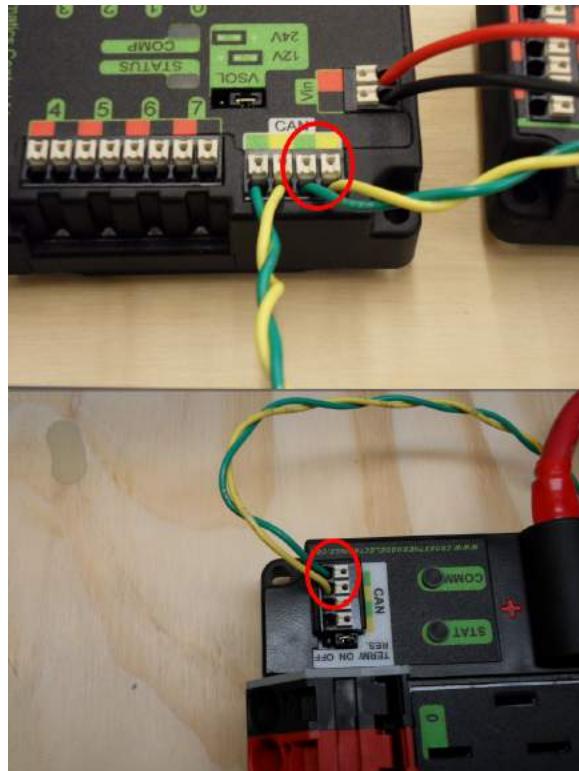
Requires: Wire stripper, small flat screwdriver (optional), yellow/green twisted CAN cable

Note: The PCM is an optional component used for controlling pneumatics on the robot. If you are not using the PCM, wire the CAN connection directly from the roboRIO (shown in this step) to the PDP (show in the next step).

1. Strip ~5/16" off of each of the CAN wires.
2. Insert the wires into the appropriate CAN terminals on the roboRIO (Yellow->YEL, Green->GRN).
3. Measure the length required to reach the CAN terminals of the PCM (either of the two available pairs). Cut and strip ~5/16" off this end of the wires.
4. Insert the wires into the appropriate color coded CAN terminals on the PCM. You may use either of the Yellow/Green terminal pairs on the PCM, there is no defined in or out.

# Getting Started with the 2016 Control System

## PCM to PDP CAN



Requires: Wire stripper, small flat screwdriver (optional), yellow/green twisted CAN cable

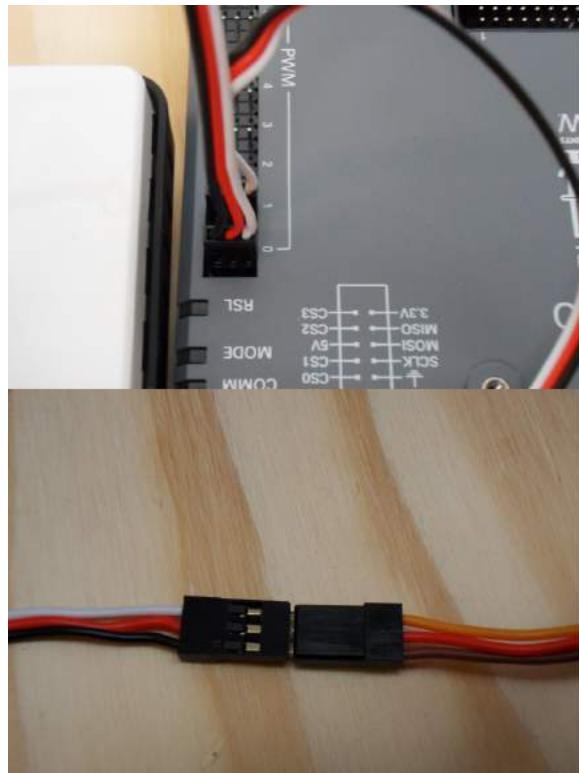
Note: The PCM is an optional component used for controlling pneumatics on the robot. If you are not using the PCM, wire the CAN connection directly from the roboRIO (shown in the above step) to the PDP (show in this step).

1. Strip ~5/16" off of each of the CAN wires.
2. Insert the wires into the appropriate CAN terminals on the PCM.
3. Measure the length required to reach the CAN terminals of the PDP (either of the two available pairs). Cut and strip ~5/16" off this end of the wires.
4. Insert the wires into the appropriate color coded CAN terminals on the PDP. You may use either of the Yellow/Green terminal pairs on the PDP, there is no defined in or out.

Note: The PDP ships with the CAN bus terminating resistor jumper in the "ON" position. It is recommended to leave the jumper in this position and place any additional CAN nodes between the roboRIO and the PDP (leaving the PDP as the end of the bus). If you wish to place the PDP in the middle of the bus (utilizing both pairs of PDP CAN terminals) move the jumper to the "OFF" position and place your own 120 ohm terminating resistor at the end of your CAN bus chain.

# Getting Started with the 2016 Control System

## PWM Cables



Requires: (Optional) 2x PWM Y-cable

Option 1 (Direct connect):

1. Connect the PWM cables from each Victor SP directly to the roboRIO. The black wire should be towards the outside of the roboRIO. It is recommended to connect the left side to PWM 0 and 1 and the right side to PWM 2 and 3 for the most straightforward programming experience, but any channel will work as long as you note which side goes to which channel and adjust the code accordingly.

Option 2 (Y-cable):

1. Connect 1 PWM Y-cable to the PWM cables for the Victor SPs controlling one side of the robot. The brown wire on the Y-cable should match the black wire on the PWM cable.
2. Connect the PWM Y-cables to the PWM ports on the roboRIO. The brown wire should be towards the outside of the roboRIO. It is recommended to connect the left side to PWM 0 and the right side to PWM 1 for the most straightforward programming experience, but any channel will work as long as you note which side goes to which channel and adjust the code accordingly.

# Getting Started with the 2016 Control System

## Robot Signal Light



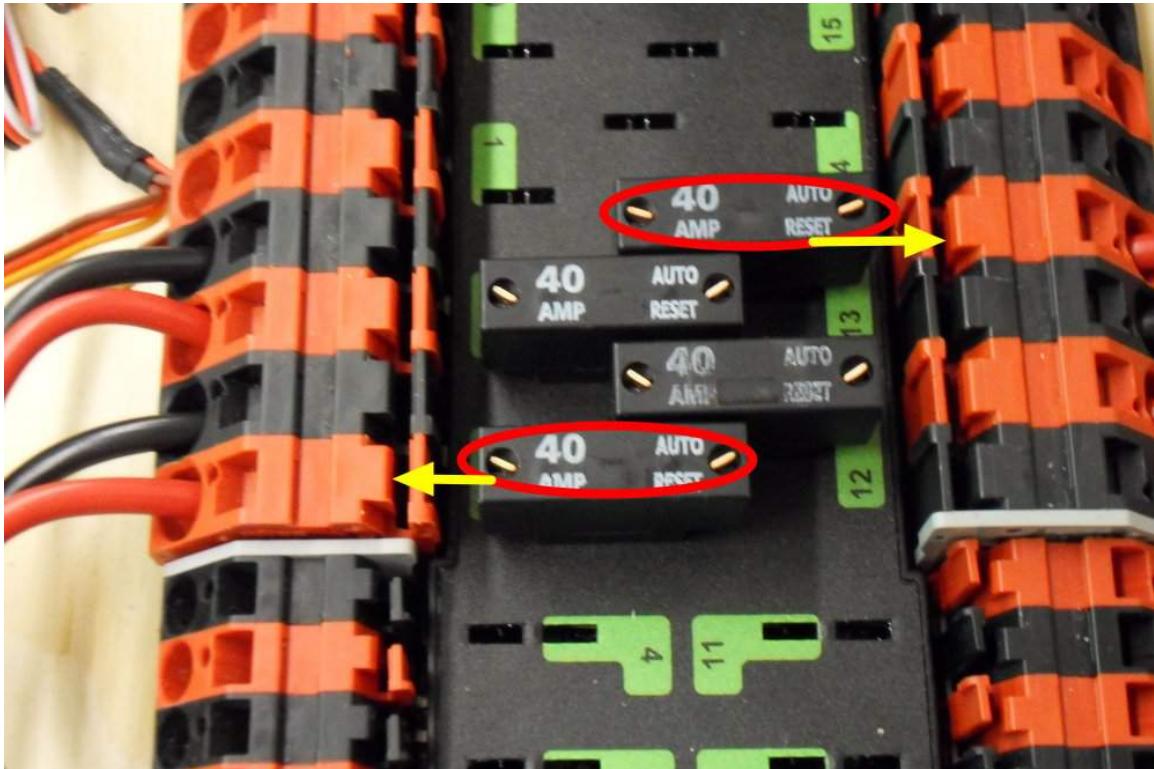
Requires: Wire stripper, 2 pin cable, Robot Signal Light, 18AWG red wire, very small flat screwdriver

1. Cut one end off of the 2 pin cable and strip both wires
2. Insert the black wire into the center, "N" terminal and tighten the terminal.
3. Strip the 18AWG red wire and insert into the "La" terminal and tighten the terminal.
4. Cut and strip the other end of the 18AWG wire to insert into the "Lb" terminal
5. Insert the red wire from the two pin cable into the "Lb" terminal with the 18AWG red wire and tighten the terminal.
6. Connect the two-pin connector to the RSL port on the roboRIO. The black wire should be closest to the outside of the roboRIO.

You may wish to temporarily secure the RSL to the control board using zip ties or Dual Lock (it is recommended to move the RSL to a more visible location as the robot is being constructed)

# Getting Started with the 2016 Control System

## Circuit Breakers



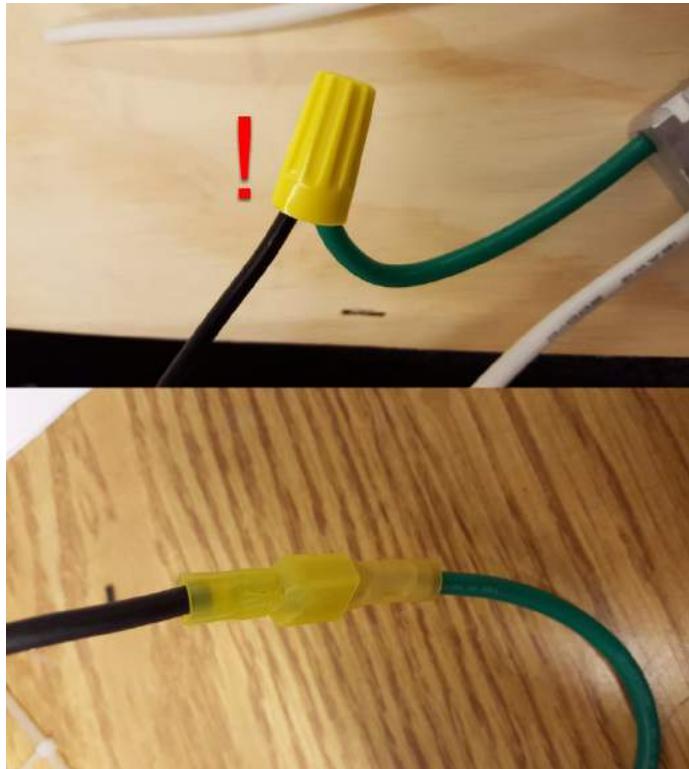
Requires: 4x 40A circuit breakers

Insert 40-amp Circuit Breakers into the positions on the PDP corresponding with the Wago connectors the Talons are connected to. Note that, for all breakers, the breaker corresponds with the nearest positive (red) terminal (see graphic above). All negative terminals on the board are directly connected internally.

If working on a Robot Quick Build, stop here and insert the board into the robot chassis before continuing.

# Getting Started with the 2016 Control System

## Motor Power



Requires: Wire stripper, wire crimper, phillips head screwdriver, wire connecting hardware

For each CIM motor:

1. Strip the ends of the red and black wires from the CIM and the white and green wires from the Victor SP
2. Connect the motor wires to the Victor SP output wires (it is recommended to connect the red wire to the white M+ output)

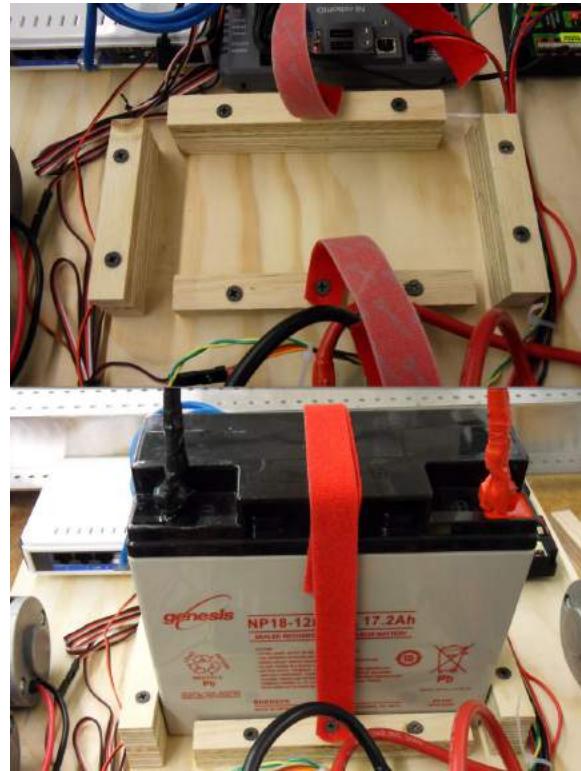
The images above show examples using wirenuts or quick disconnect terminals.

**Warning: Wire nuts are not recommended for permanent FRC use as they are not intended for vibration environments. They are shown only as an example of a possible temporary solution.**

The [Digikey](#), or TE Connectivity vouchers in the [Virtual Kit](#) can be used to purchase suitable quick-disconnecting or splice connectors or they can typically be found at your local hardware or electronics parts store.

# Getting Started with the 2016 Control System

## Battery Box



Requires: Plywood Scraps, plywood cutting tool (e.g. saw), 10x 2" wood screws, drill, 1/8" drill bit, Philips head driver bit or philips head screwdriver, velcro wrap

Construct a battery box. the design shown uses scraps of plywood left over from cutting out the electronics board (4 pieces 4"x1.5" for the short sides of the battery stacked 2 high, 3 pieces 6"x1.5" for the front and back stacked 2 high in the back). Use the velcro wrap to make a pair of straps which will overlap to secure the battery.

Note: The battery box shown here is an example, sufficient for driving the robot. Teams should ensure that their battery will be securely held in their final design in the face of potentially violent robot-to-robot collision.

# Getting Started with the 2016 Control System

**STOP**



**STOP!!**

Before plugging in the battery, make sure all connections have been made with the proper polarity. Ideally have someone that did not wire the robot check to make sure all connections are correct.

- Start with the battery and verify that the red wire is connected to the positive terminal
- Check that the red wire passes through the main breaker and to the + terminal of the PDP and that the black wire travels directly to the - terminal.
- For each motor controller, verify that the red wire goes from the red PDP terminal to the Talon input labeled with the red + (not the white M+!!!!)
- For each device on the end of the PDP, verify that the red wire connects to the red terminal on the PDP and the red terminal on the component.
- Verify that the wire with the white stripe on the radio power supply is connected to the red terminal of the Radio supply on the VRM

**It is also recommended to put the robot on blocks so the wheels are off the ground before proceeding. This will prevent any unexpected movement from becoming dangerous.**

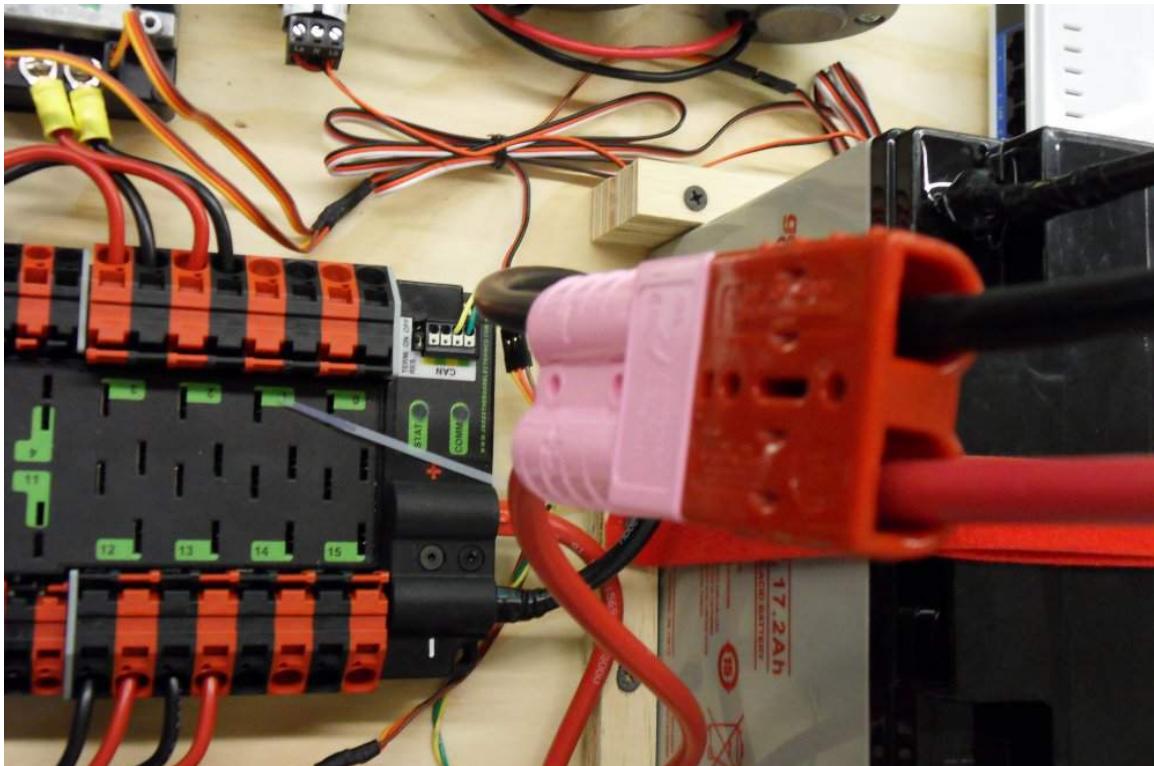
# Getting Started with the 2016 Control System

## Manage Wires

Requires: Zip ties

Now may be a good time to add a few zip ties to manage some of the wires before proceeding. This will help keep the robot wiring neat.

## Connect Battery



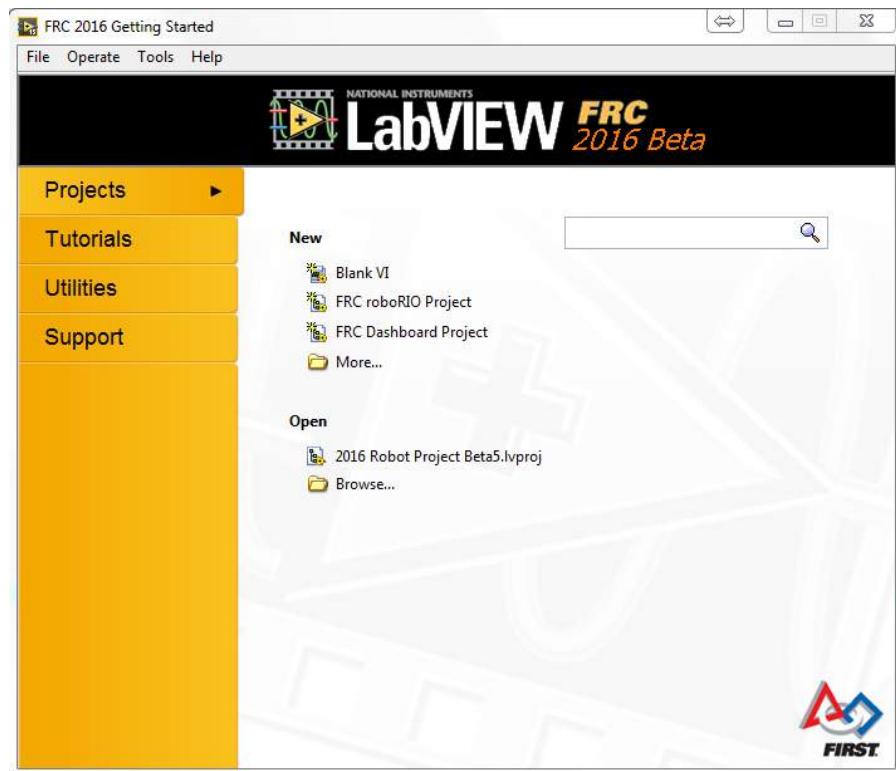
Connect the battery to the robot side of the Andersen connector. Power on the robot by moving the lever on the top of the 120A main breaker into the ridge on the top of the housing.

# Getting Started with the 2016 Control System

## 2016 FRC Software Component Overview

The 2016 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.

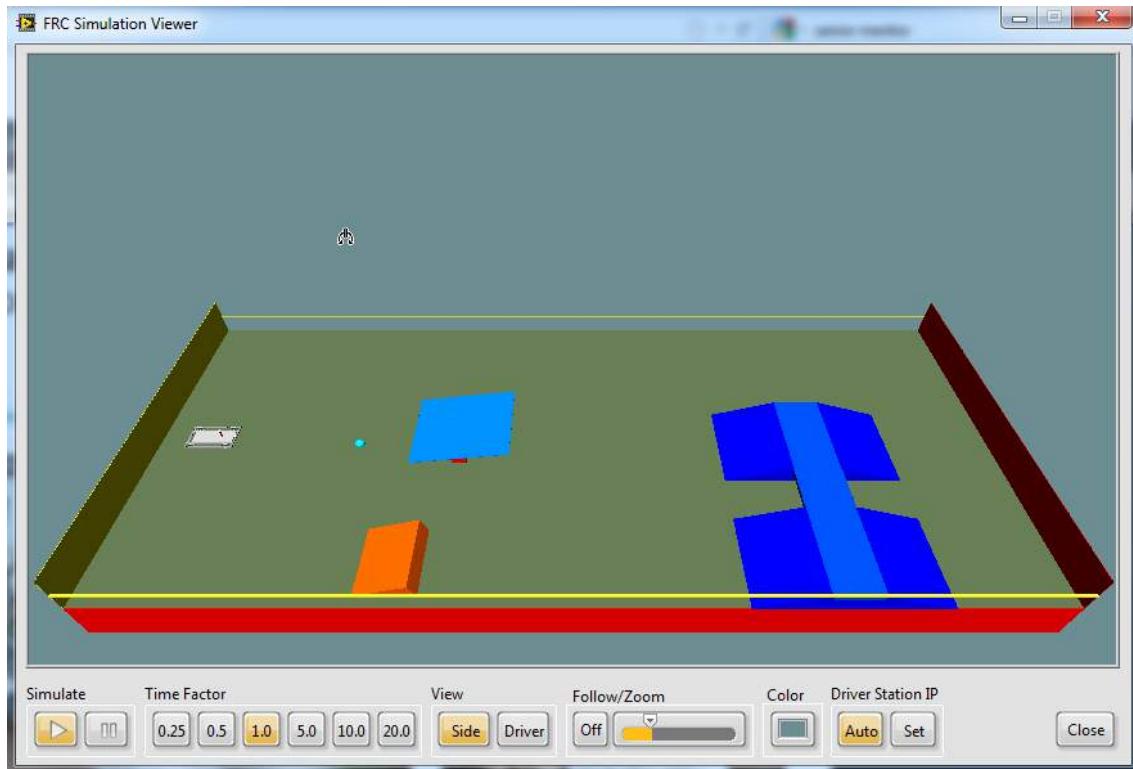
### LabVIEW FRC 2016



LabVIEW FRC 2016, based on National Instruments' LabVIEW 2015, is the development environment for LabVIEW, one of the three officially supported languages for programming an FRC robot. 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 2016 installer is distributed on a DVD found in the Kickoff Kit of Parts and is also available for download (see installation instructions page linked below). Instructions for installing the FRC libraries (package also includes Driver Station and Utilities) can be found [here](#). A guide to getting started with the LabVIEW FRC 2016 software, including installation instructions can be found [here](#).

# Getting Started with the 2016 Control System

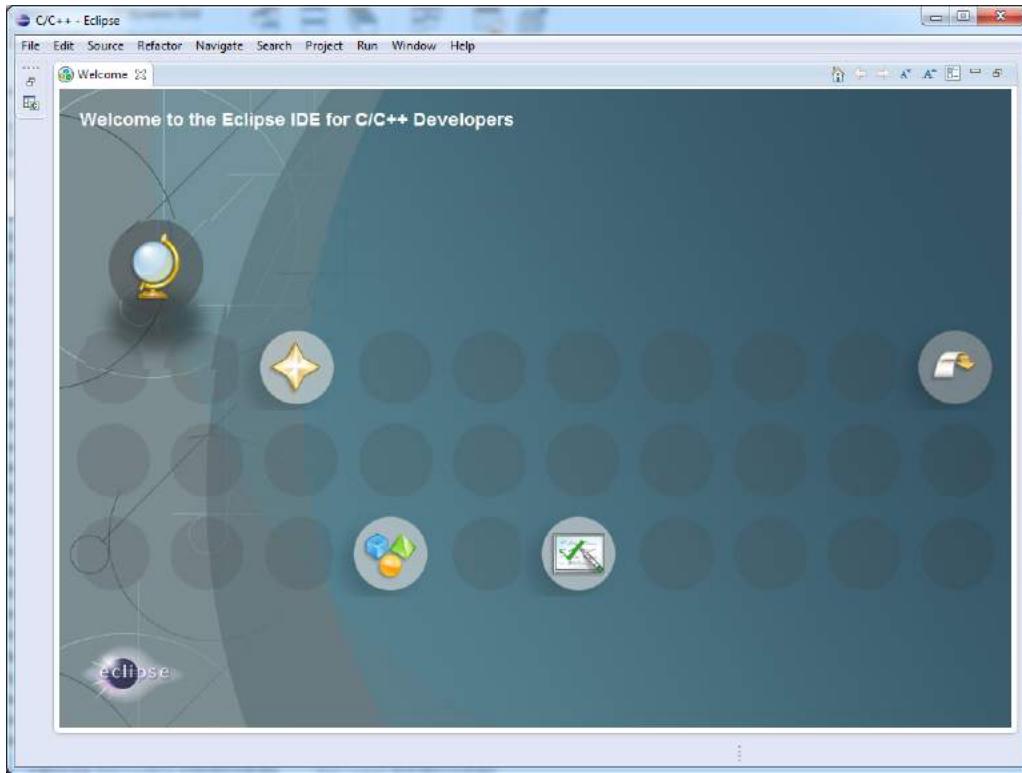
## FRC Robot Simulator



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 2016. Information on using the FRC Robot Simulator can be found by opening the Robot Simulation Readme.html file in the LabVIEW Project Explorer.

# Getting Started with the 2016 Control System

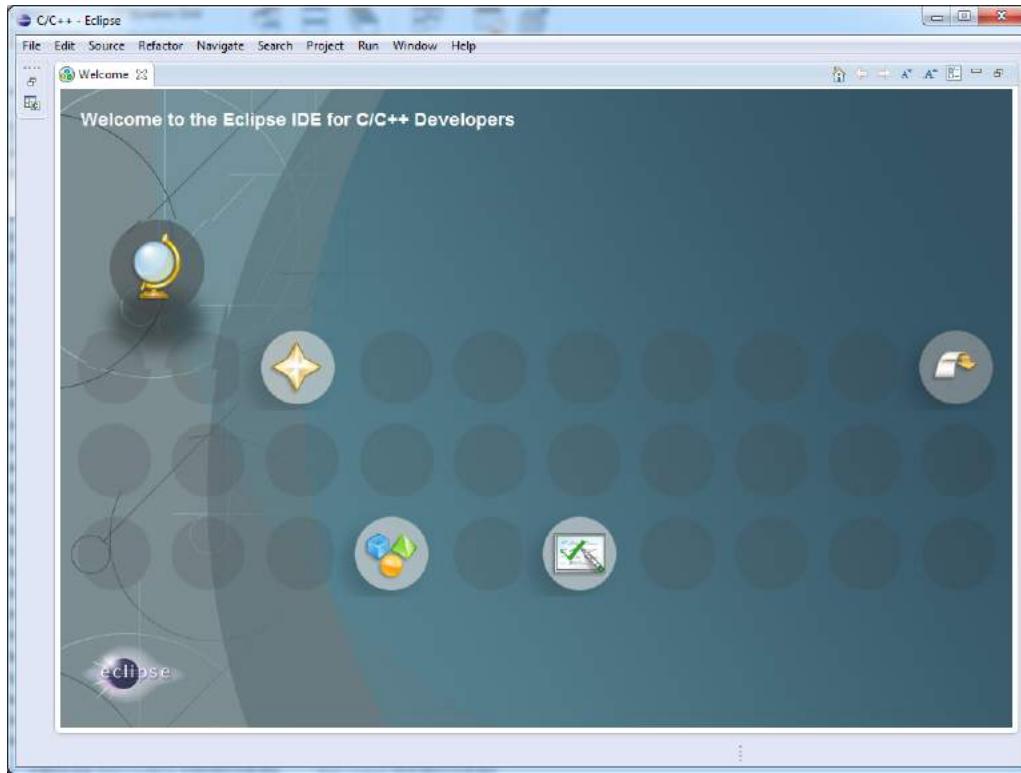
## Eclipse IDE for C/C++ Developers



Eclipse IDE for C/C++ Developers is the supported development environment for C++, one of the three supported languages used for programming an FRC robot. 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. It is recommended to install the language specific updates through Eclipse in order to be automatically notified of updates. A guide to getting started with C++ for FRC, including the installation and configuration of Eclipse IDE for C/C++ Developers can be found [here](#).

# Getting Started with the 2016 Control System

## Eclipse IDE for Java Developers



Eclipse IDE for C++ Developers (with Java development tools installed) is the primary supported development environment for Java, one of the three supported languages used for programming an FRC robot. 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. A guide to getting started with Java for FRC, including the installation and configuration of the Eclipse IDE can be found [here](#).

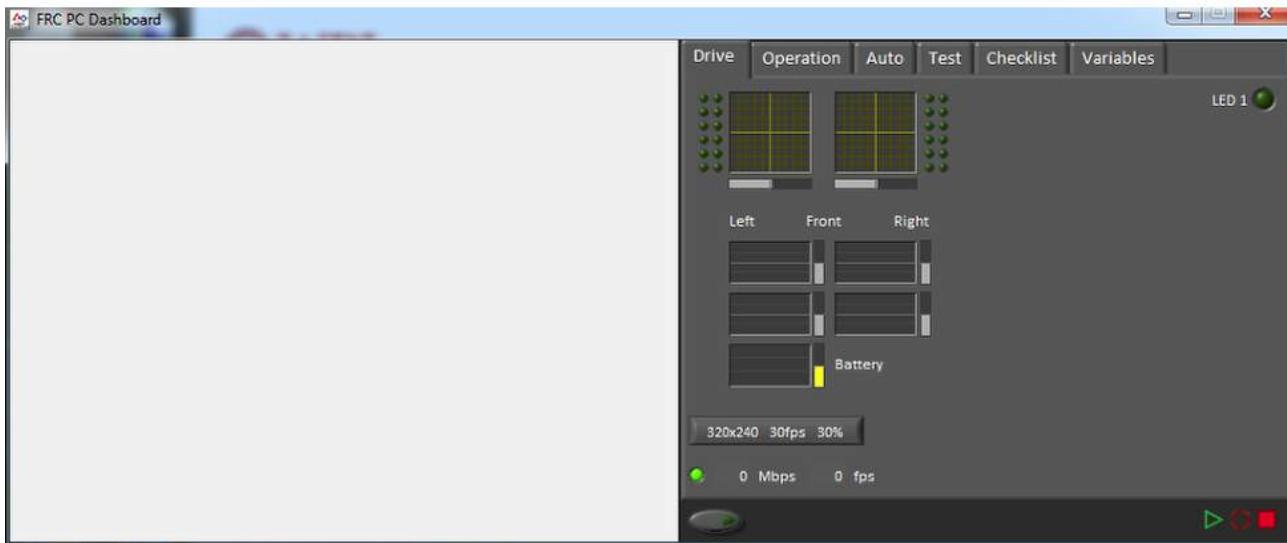
## FRC Driver Station Powered by NI LabVIEW



# Getting Started with the 2016 Control System

The FRC Driver Station Powered by NI LabVIEW 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, and customizable IO boards. It also contains a number of tools used to help troubleshoot robot issues such as status indicators and log file creation. Instructions for installing the FRC Driver Station Powered by NI LabVIEW (included in the FRC Update Suite) can be found [here](#), More information about the FRC Driver Station Powered by NI LabVIEW can be found [here](#).

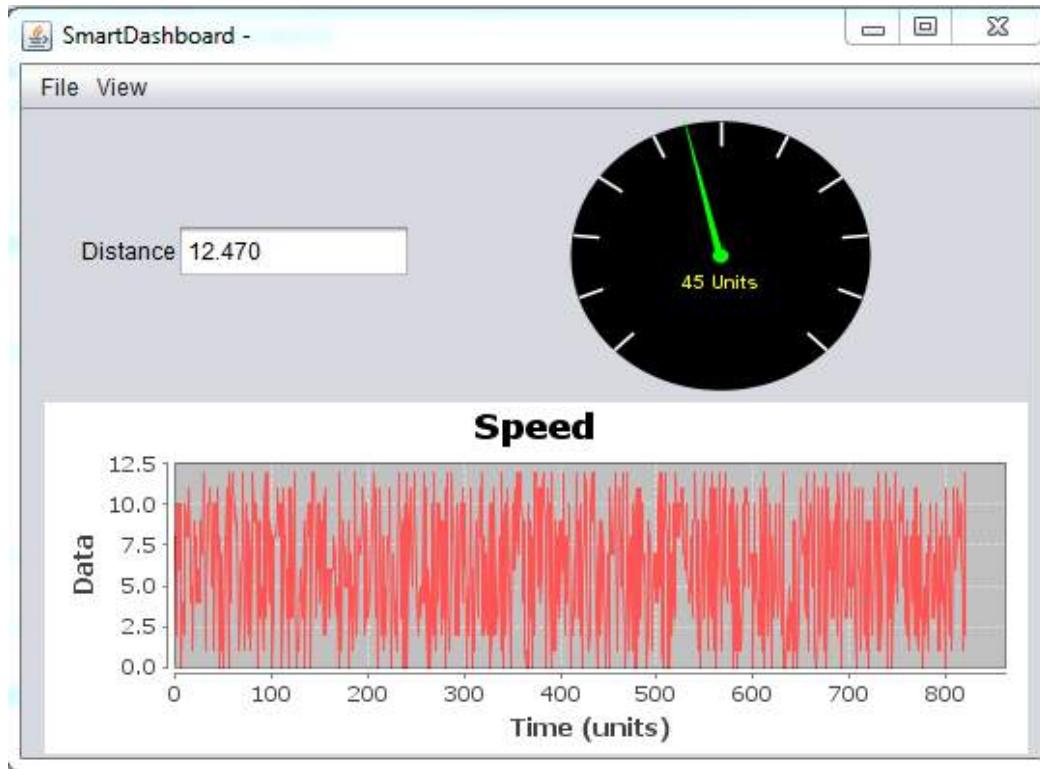
## FRC LabVIEW Dashboard



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 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 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 FRC Update Suite. Installation instructions can be found [here](#). More information about the FRC Default Dashboard software can be found [here](#).

# Getting Started with the 2016 Control System

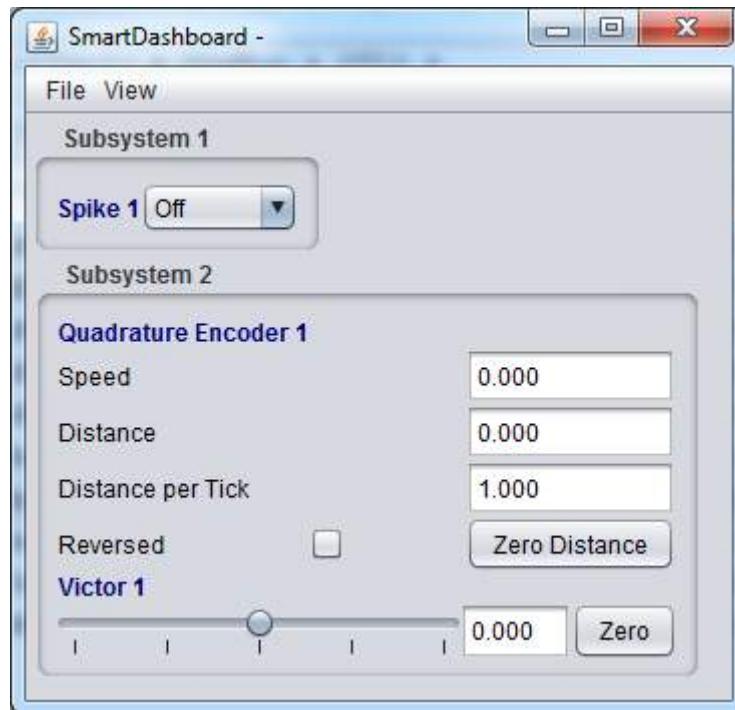
## SmartDashboard



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). 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](#).

# Getting Started with the 2016 Control System

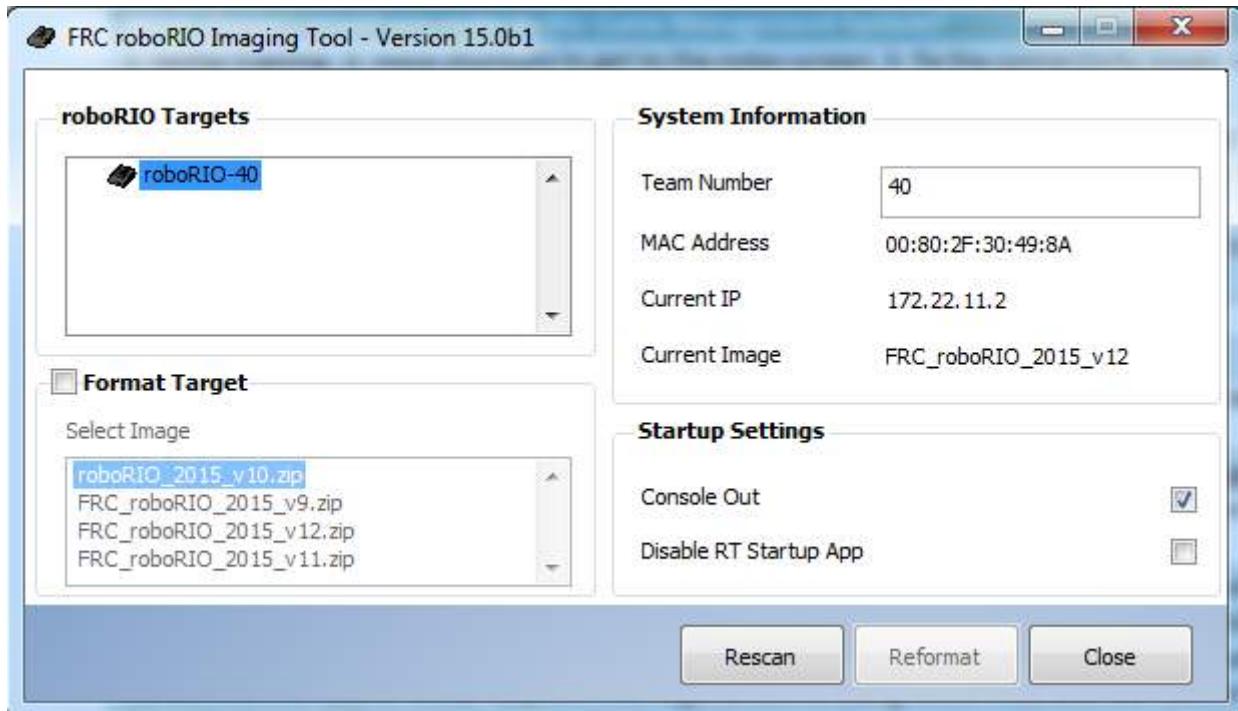
## LiveWindow



LiveWindow is a new mode of the SmartDashboard for 2013, designed for use with the new Test Mode of the Driver Station. LiveWindow allows the user to see feedback from sensors on the robot and control actuators independent of the written user code. More information about LiveWindow can be found [here](#).

# Getting Started with the 2016 Control System

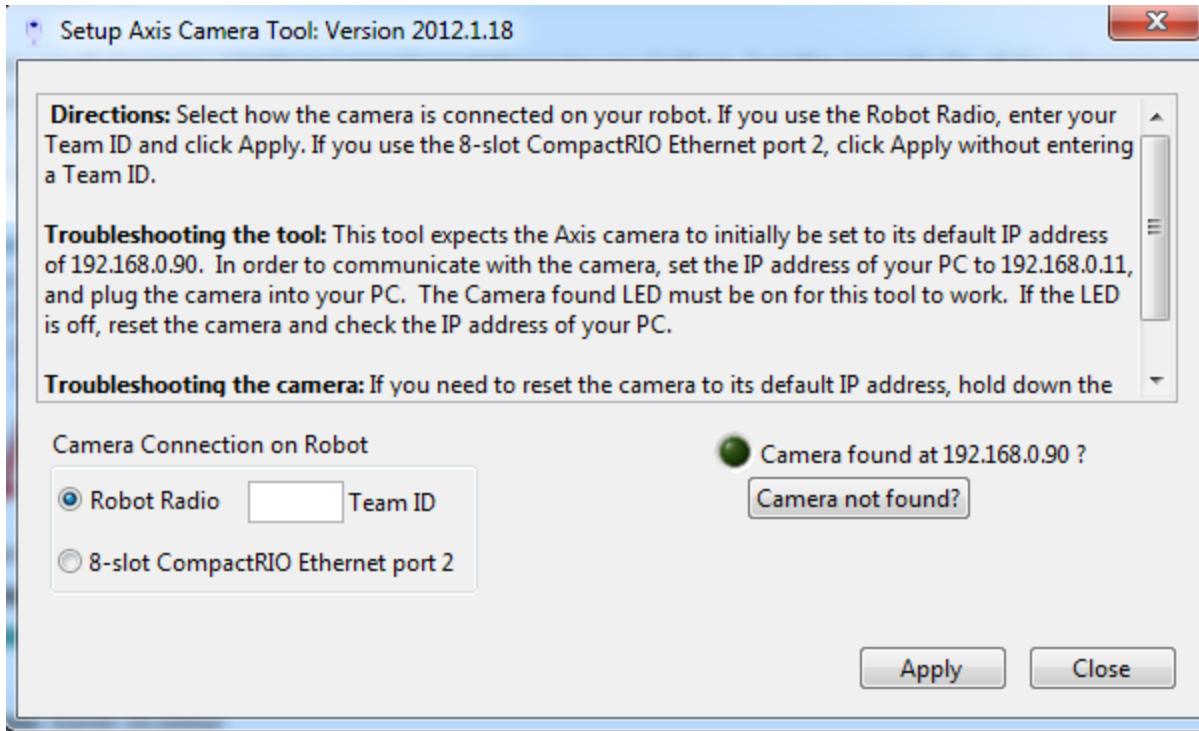
## FRC roboRIO Imaging Tool



The FRC roboRIO Imaging Tool is a software tool used to format and setup an roboRIO-FRC device for use in FRC. The tool detects any roboRIO device on the network, reports the current MAC, name, IP and Image version. The tool allows the user to configure the team number, set options including Console Out and whether an applications runs on Startup, and install the latest software image on the device. The FRC roboRIO Imaging Tool is installed as part of the FRC Update Suite. Installation instructions can be found [here](#). Additional instructions on imaging your roboRIO using this tool can be found [here](#).

# Getting Started with the 2016 Control System

## Setup Axis Camera



The Setup Axis Camera utility is a LabVIEW program used to configure an Axis 206, M1011 or 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 FRC Update Suite. Installation instructions can be found [here](#). Instructions for using the tool to configure the camera are located [here](#).

# Getting Started with the 2016 Control System

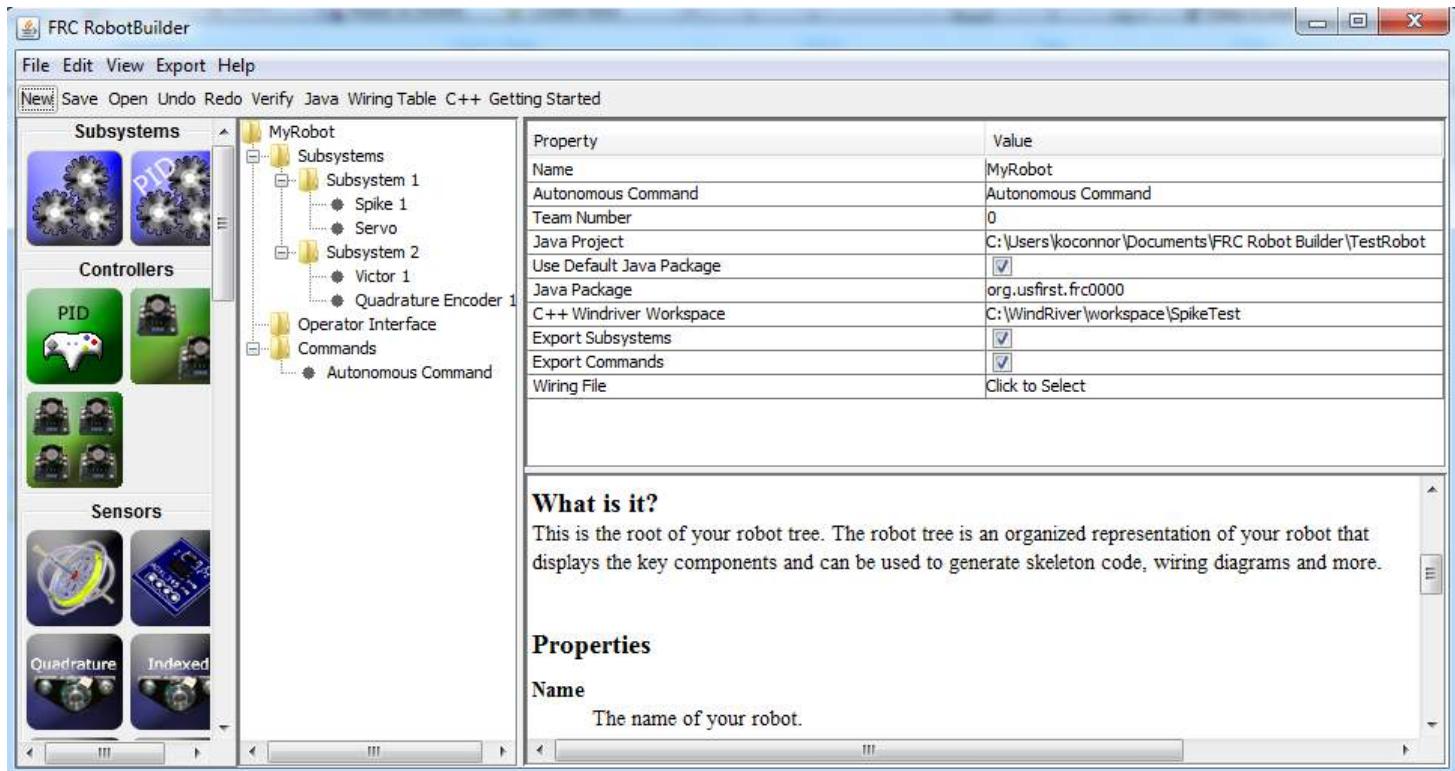
## FRC Driver Station Log Viewer



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

# Getting Started with the 2016 Control System

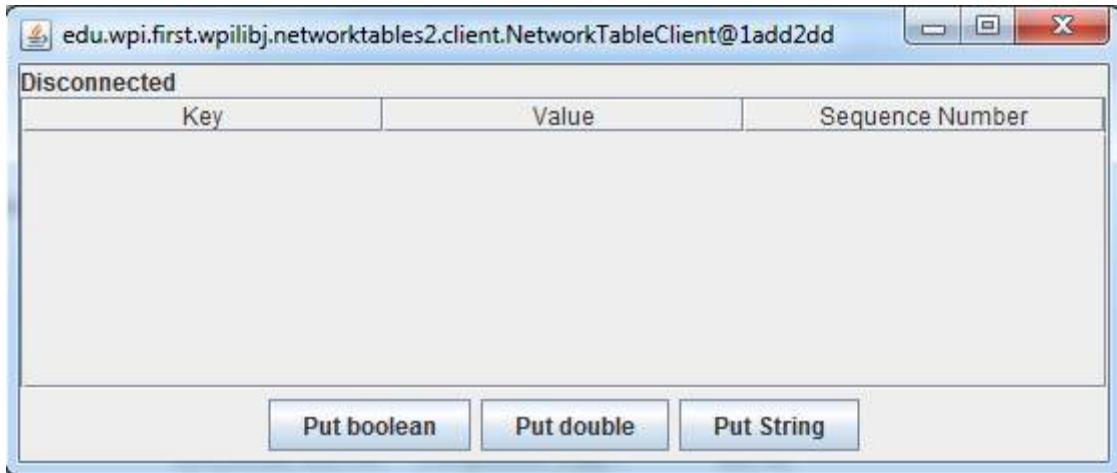
## Robot Builder



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](#) (in the USER\wpilib\tools directory). 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 in the [C++](#) and [Java](#) manuals.

# Getting Started with the 2016 Control System

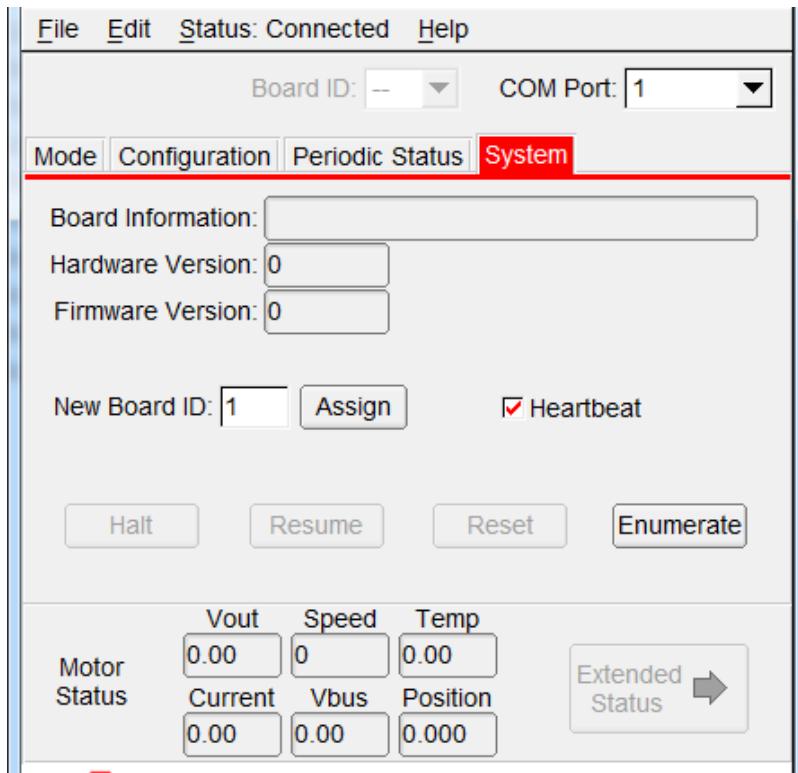
## Outline Viewer



The Outline 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 Outline Viewer is included in the [C++ and Java](#) language updates (found in USER\tools\wpilib). 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.

# Getting Started with the 2016 Control System

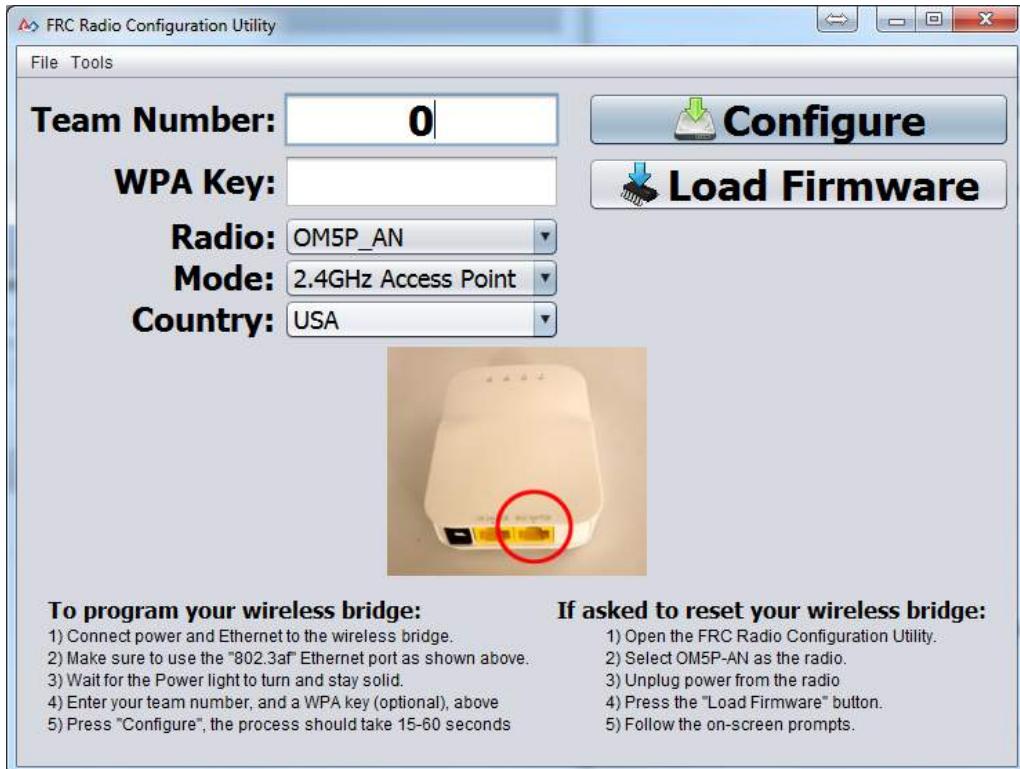
## BDC-COMM



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 Update Suite (installation instructions found [here](#), installed to PUBLICDOCUMENTS\frc) or can be downloaded from [here](#).

# Getting Started with the 2016 Control System

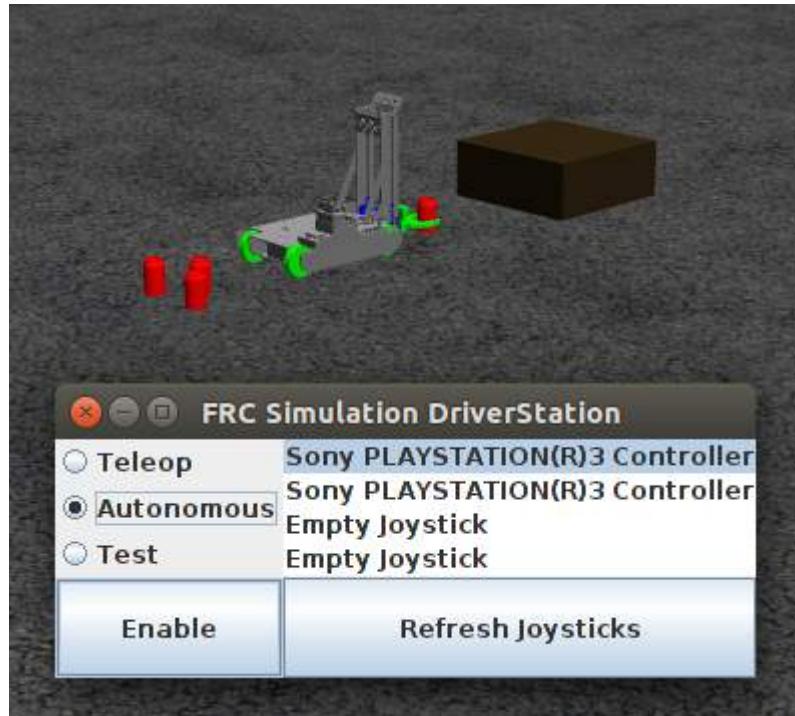
## FRC Radio Configuration Utility



The FRC Bridge Configuration Utility is a tool used to configure the the OpenMesh OM5P-AN 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 by a standalone installer, instructions on installing and using the FRC Bridge Configuration Utility to configure your radio can be found [here](#).

# Getting Started with the 2016 Control System

## FRCSim



FRCSim is a simulator for teams using C++ or Java based on the Gazebo simulation software. For the 2016 season, FRCSim requires a computer running Linux (for more specific info, see the details in the FRCSim documentation). Installation and usage instructions for the FRCSim simulator can be found in the [Using FRCSim with C++ and Java](#) manual.

# Getting Started with the 2016 Control System

## Offline Installation Preparation

This article contains instructions\links to components you will want to gather if you need to do offline installation of the FRC Control System software.

### Documentation

The screenshot shows the FRC Control System documentation site. The left sidebar lists topics like 'Getting Started with the ScreenSteps Documentation' and 'Getting Started with the 2016 Control System'. The main content area shows the 'Getting Started with the 2016 Control System' page with various sub-topics. A red arrow points to the 'Download Manual PDF' link located at the bottom left of the sidebar.

The ScreenSteps documentation can be downloaded for offline viewing. At a minimum you will want to get a copy of the Getting Started with the Control System manual, you may also wish to download some or all of the other manuals as well. The link to download the PDF of a Manual is located on the left sidebar of the Manual page or any Lesson in the Manual. See [Getting Started With the Screen Steps Documentation](#) for more details about the ScreenSteps site and content organization.

### Installers

All Teams:

- [2016 NI FRC Update Suite](#)

# Getting Started with the 2016 Control System

- [2016 FRC Radio Configuration Utility](#)

## LabVIEW Teams

- LabVIEW DVD or [Download](#)

## C++ Teams

- [Java 8 SE Development Kit](#) (x86/x64 should match Eclipse)
- [Eclipse C++ version](#) (x86/x64 should match Java)
- [WPI Plugin Zip](#)

## Java Teams

- [Java 8 SE Development Kit](#) (x86/x64 should match Eclipse)
- [Eclipse Java version](#) (x86/x64 should match Java)
- [WPI Plugin Zip](#)

# Getting Started with the 2016 Control System

## Current Software Revisions

This document lists the uniquely installable software components of the 2016 Control System and the kickoff, required and latest released versions of each.

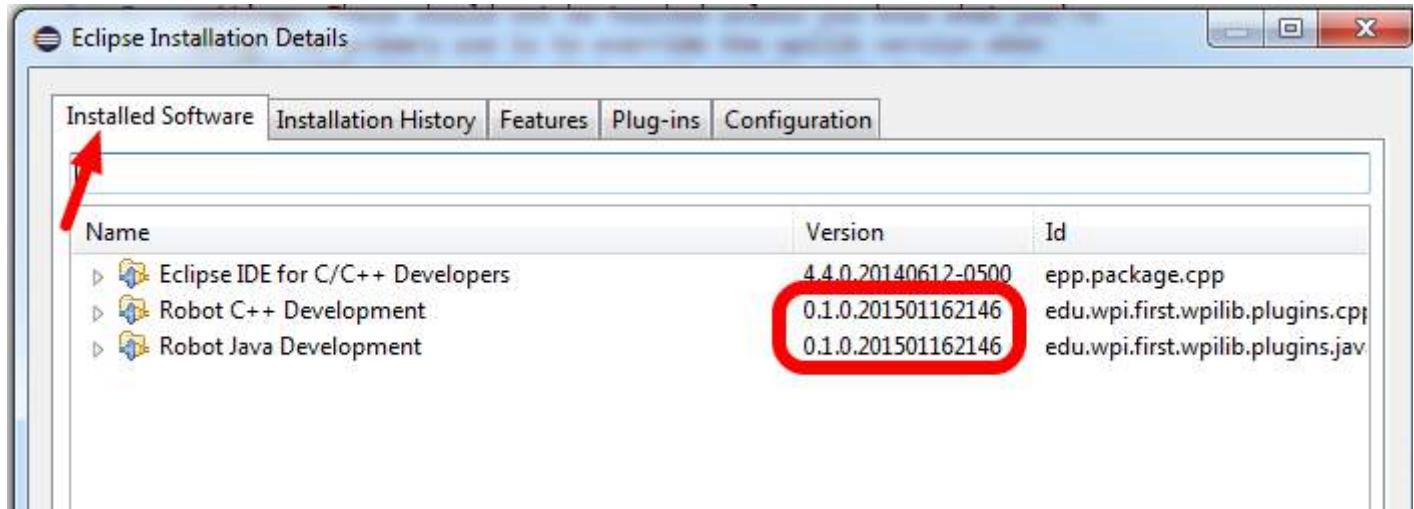
### Revision Table

Software	Kickoff Version	Minimum Required Version	Latest Version	More info
Eclipse C++\Java Plugins	0.1.0.201601072029	N/A	Update 4 (0.1.0.201602112135)	See Eclipse Plugin Versioning below
FRC Driver Station	16.0.1	16.0.2	16.0.2	See the Diagnostics tab of the Driver Station (second tab down on the left).
FRC LabVIEW Update	Installed by same installer as Driver Station, see above			
FRC NI Tools (roboRIO Imaging Tool, etc.)	Installed by same installer as Driver Station, see above			
PDP Firmware from NI FRC Update Suite	1.30 installed on PDP, 1.40 on PC	1.37	1.40	<a href="#">Updating and Configuring Pneumatics Control Module and Power Distribution Panel</a> for instructions on updating. v1.40 installed to "C:\Users\Public\Public Documents\FRC" by NI Update Suite.
PCM Firmware PC from NI FRC Update Suite	1.65 installed on new PCMs, 1.65 on	1.62	1.65	<a href="#">Updating and Configuring Pneumatics Control Module and Power Distribution Panel</a> for instructions on updating. v1.62 installed to "C:\Users\Public\Public Documents\FRC" by NI Update Suite
Jaguars (Grey or	<107 or non-FRC installed on Jaguar,	109	109	<a href="#">Updating CAN Jaguar Firmware</a> for update instructions. v109 installed

# Getting Started with the 2016 Control System

Black) used on CAN	109 on PC from NI FRC Update Suite			to "C:\Users\Public\Public Documents\FRC" by NI Update Suite
Talon- SRX PWM	1.01 installed on new Talon-SRX, 2.00 on PC from NI FRC Update Suite	0.28	2.00 (0.28 last with PWM changes)	<a href="#">Talon SRX User's Guide</a> for information on checking installed version and updating. v2.0 installed to "C:\Users\Public\Public Documents\FRC" by latest NI Update Suite.
Talon- SRX CAN	1.01 installed on new Talon-SRX, 2.00 on PC from NI FRC Update Suite	1.01	2.00	<a href="#">Talon SRX User's Guide</a> for information on checking installed version and updating. v2.0 installed to "C:\Users\Public\Public Documents\FRC" by NI Update Suite
RoboRIO	2.0.0b86 installed on roboRIO. firmware included with NI Update Suite	3.0.0f0	3.0.0f0	See the <a href="#">Updating your roboRIO firmware</a> document for instructions on checking and updating.
RoboRIO Image	2016v19	2016v19	2016v19	See the <a href="#">Imaging your RoboRIO</a> document for information on instructions.

## Eclipse Plugin Versioning



The installed version of the Eclipse plugins can be checked by selecting Help->Installation Details then clicking the Installed Software tab. See the bottom of the [Installing Eclipse \(C++/Java\)](#) for update instructions.

# Getting Started with the 2016 Control System

## Imaging your Rookie DS PC (Rookie USB stick)

This document outlines the procedure to image an Acer Aspire ES1 PC using the USB Stick provided in the 2016 Rookie Kit of Parts. Veteran teams may not need to image their machines, but should see the section on [Image Download](#) if they wish to do so.

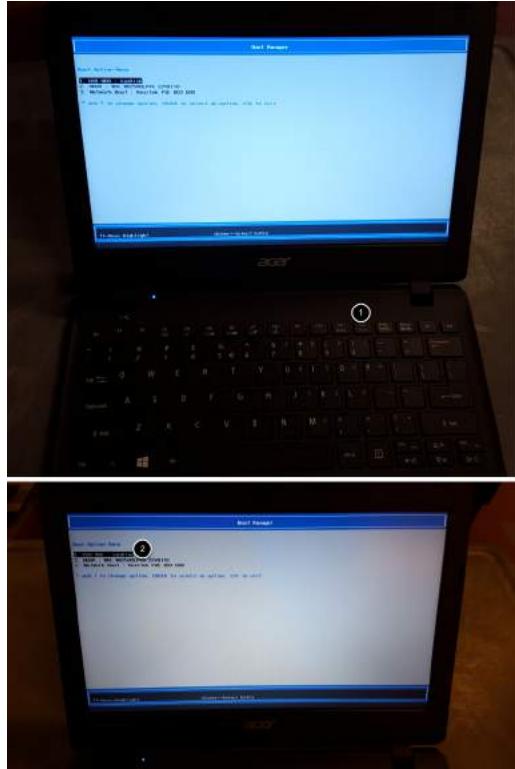
### Hardware Setup



1. Make sure the computer is turned off, but plugged in.
2. Locate the "2016 ES1 Image" USB Thumb Drive from the Kit of Parts (located in Bag 9) into a USB port on the computer.

# Getting Started with the 2016 Control System

## Boot to USB

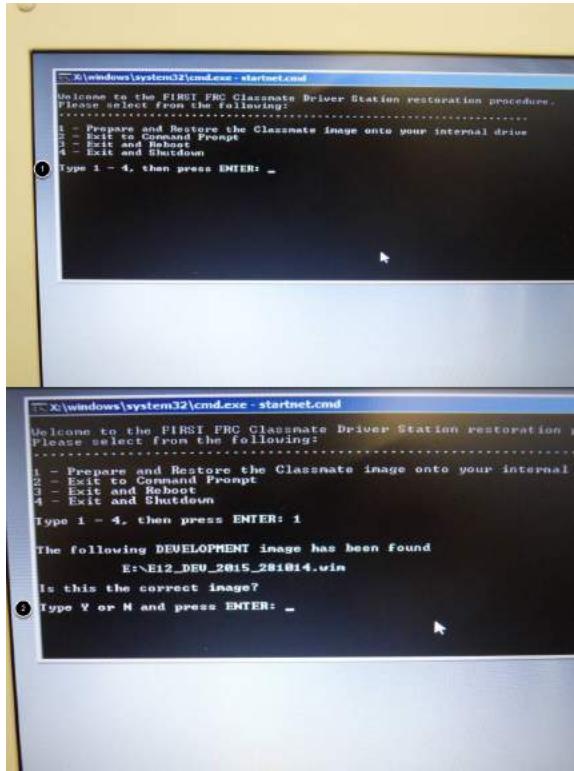


1. Power on the computer and tap the F12 key on the keyboard. Tapping the F12 key during boot will bring up the boot menu.
2. Use the up/down keys to select the USB HDD: SanDisk entry on the menu. Press the ENTER key when the USB device is highlighted.

If pressing F12 does not pull up the boot menu or if the USB device is not listed in the boot menu, see "Checking BIOS Settings" at the bottom of this article.

# Getting Started with the 2016 Control System

## Image the Computer



1. To confirm that you want to reimage the computer, type "1" and press ENTER.
2. Then, type "Y" and press ENTER. The computer will begin re-imaging. The installation will take 15-30 minutes.
3. When the installation is complete, remove the USB drive.
4. Restart the computer. The computer will boot into Windows.

## Initial Driver Station Boot

The first time the computer 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.

# Getting Started with the 2016 Control System

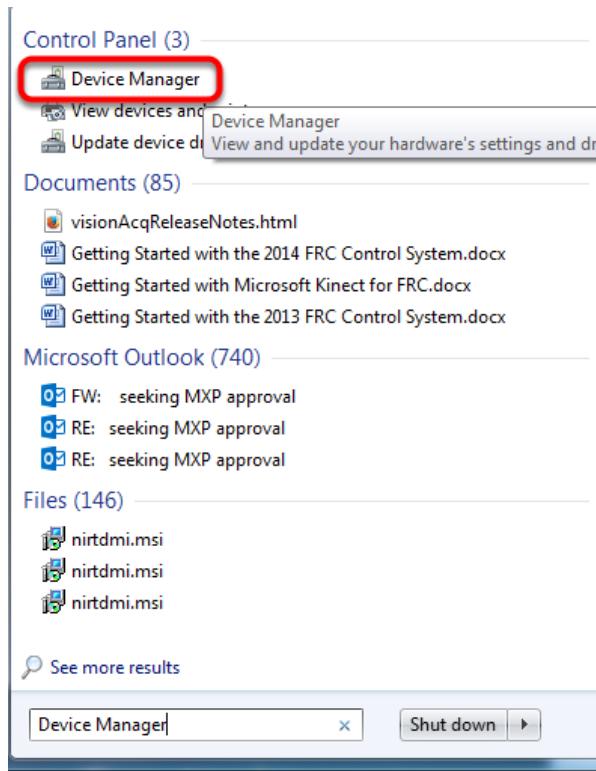
## Activate Windows

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.

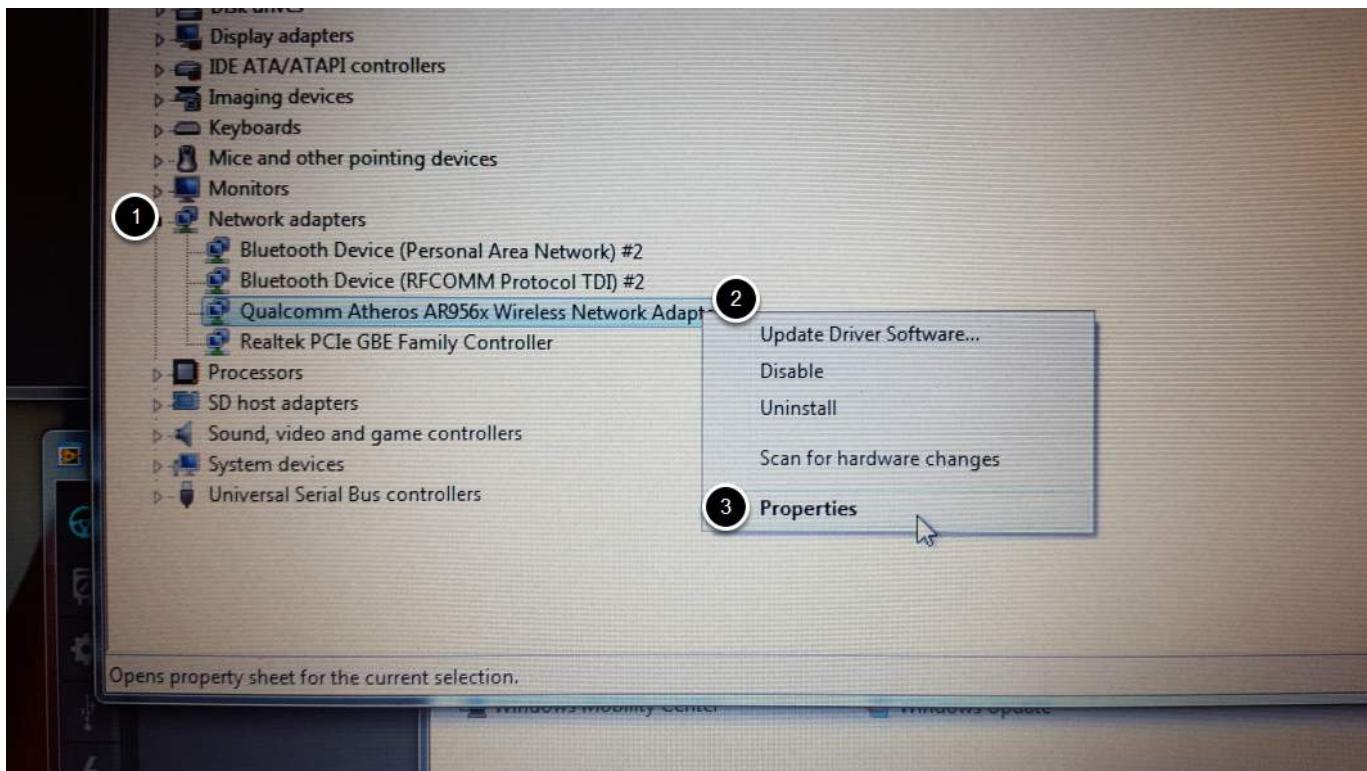
## Fix Wireless Driver



The default wireless driver in the image may have issues with intermittent communication with the robot radio. The correct driver is in the image, but could not be set to load by default. To load the correct driver, open the Device Manager by clicking start, typing "Device Manager" in the box and clicking Device Manager

# Getting Started with the 2016 Control System

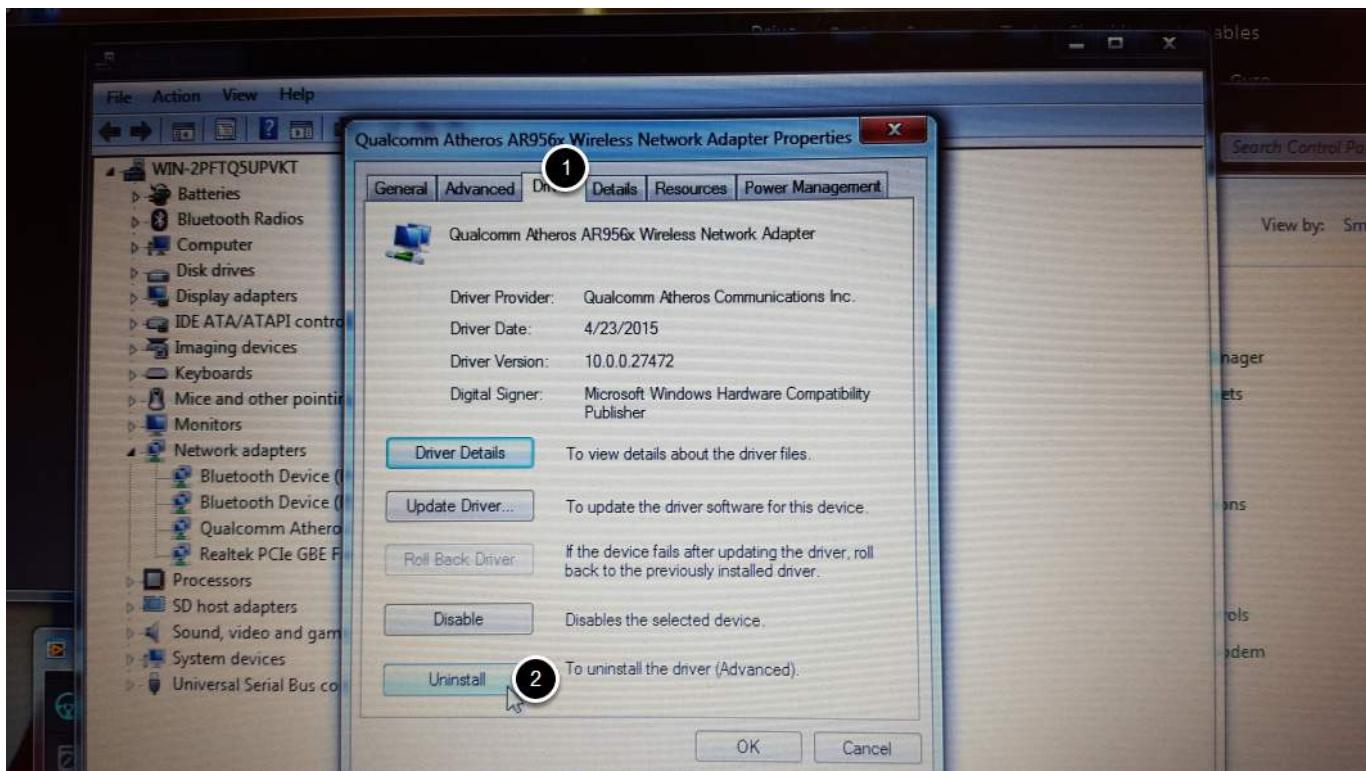
## Open Wireless Device Properties



Click on the arrow next to Network Adapters to expand it and locate the Wireless Network Adapter. Right click the adapter and select Properties.

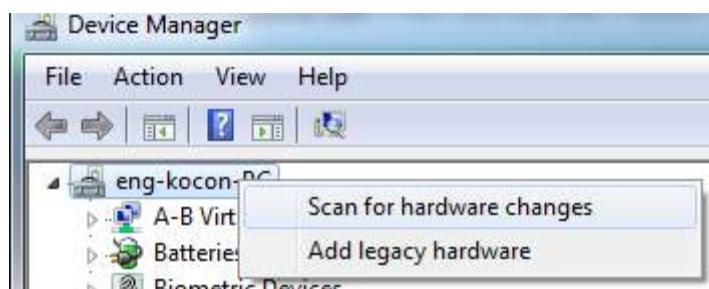
# Getting Started with the 2016 Control System

## Uninstall Driver



Click on the Driver tab, then click the Uninstall button. Click Yes at any prompts.

## Scan for New Hardware



Right click on the top entry of the tree and click "Scan for hardware changes". The wireless adapter should automatically be re-detected and the correct driver should be installed.

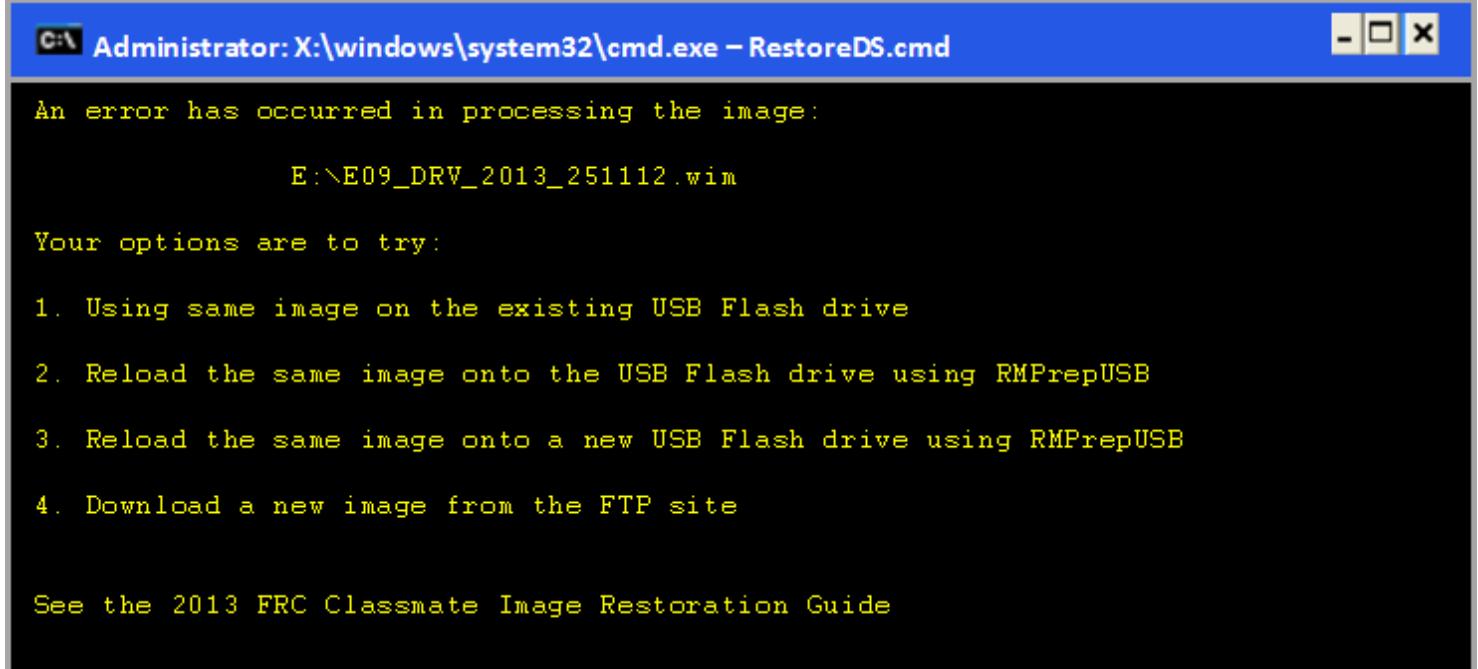
## Update Software

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 software for FRC some additional components will

# Getting Started with the 2016 Control System

need to be installed. LabVIEW teams should continue with the [Installing the FRC 2016 Update Suite \(All Languages\)](#) article. C++ or Java teams should continue with [Installing Eclipse \(C++/Java\)](#) but can skip to configuring Eclipse and installing the plugins (Eclipse and Java are installed in the image).

## Errors during Imaging Process



The screenshot shows a Windows Command Prompt window titled "Administrator: X:\windows\system32\cmd.exe – RestoreDS.cmd". The window contains the following text:

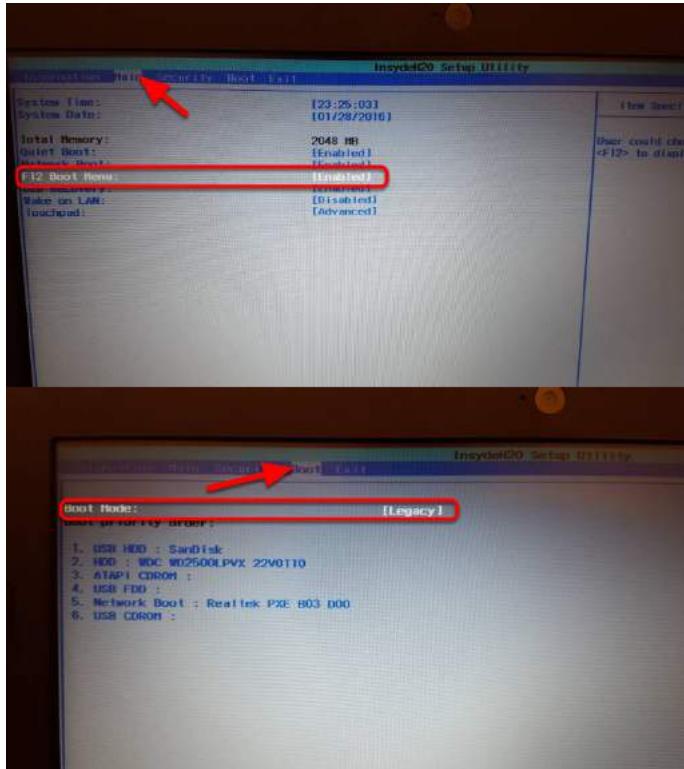
```
An error has occurred in processing the image:  
E:\E09_DRV_2013_251112.wim  
  
Your options are to try:  
1. Using same image on the existing USB Flash drive  
2. Reload the same image onto the USB Flash drive using RMPrepUSB  
3. Reload the same image onto a new USB Flash drive using RMPrepUSB  
4. Download a new image from the FTP site  
  
See the 2013 FRC Classmate Image Restoration Guide
```

If an error is detected during the imaging process, the following screen will appear. Note that the screenshot above shows the error screen for the 2013 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. To image the Classmate you will need to borrow a working USB drive from another team, request a new drive from [frcparts@usfirst.org](mailto:frcparts@usfirst.org) or re-create the drive using the instructions in [Imaging your Classmate \(Veteran/Rookie Image Download\)](#).

# Getting Started with the 2016 Control System

## Checking BIOS Settings



If you are having difficulty booting to USB, check the BIOS settings to insure they are correct. To do this:

- Repeatedly tap the F2 key while the computer is booting to enter the BIOS settings
- Once the BIOS settings screen has loaded, use the right and left arrow keys to select the **Main** tab, then check if the line for **F12 Boot Menu** is set to **Enabled**. If it is not, use the Up\Down keys to highlight it, press Enter, use Up\Down to select **Enabled** and press Enter again.
- Next, use the Left\Right keys to select the **Boot** tab. Make sure that the **Boot Mode** is set to **Legacy**. If it is not, highlight it using Up\Down, press Enter, highlight **Legacy** and press Enter again. Press Enter to move through any pop-up dialogs you may see.
- Press F10 to save any changes and exit.

## Imaging your Classmate (Veteran/Rookie Image Download)

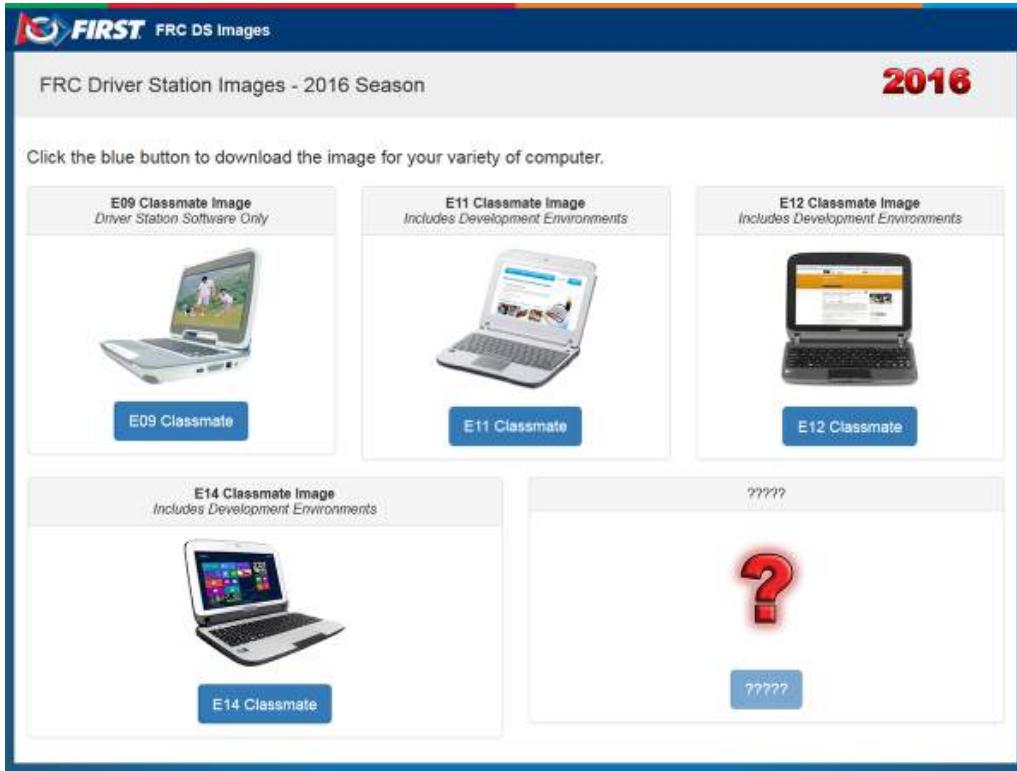
This document describes the procedure for creating a bootable USB drive to restore the 2015 FRC image on a Classmate computer. Note that Veteran teams are not required to re-image their Classmates. If you do not wish to re-image your Classmate you will need either a USB optical drive or to copy the contents of the LabVIEW DVD to a USB Flash drive then you can start with the appropriate document for [C++\Java](#), [LabVIEW](#), or [DS only](#).

### Prerequisites

1. E09, E11, E12, or E14 Classmate computer or Acer ES1 computer
2. 16GB or larger USB drive
3. 7-Zip software installed. [Download here \(www.7zip.org\)](http://www.7zip.org) As of the writing of this document, the current released version is 9.20 (2010-11-18)
4. RMprepUSB software installed. [Download here \(http://www.rmprepusb.com/documents/release-2-0\)](http://www.rmprepusb.com/documents/release-2-0) Scroll down the page and select the stable (Full) version's download link. As of the writing of this document, the current stable version is 2.1.725

# Getting Started with the 2016 Control System

## Download the Computer Image



Download the image from the [FIRST FRC Driver Station System Image Portal](#). There are several computer images available for the 2016 season, one for each model. On the download site, select the option that matches your computer by clicking the button below the image. Due to the limited size of hard drive in the E09, it is supported with a DS/Utilities image only and does not have the IDEs for LabVIEW or C++/Java installed. All other images have the base LabVIEW base installation already present and Eclipse already downloaded.

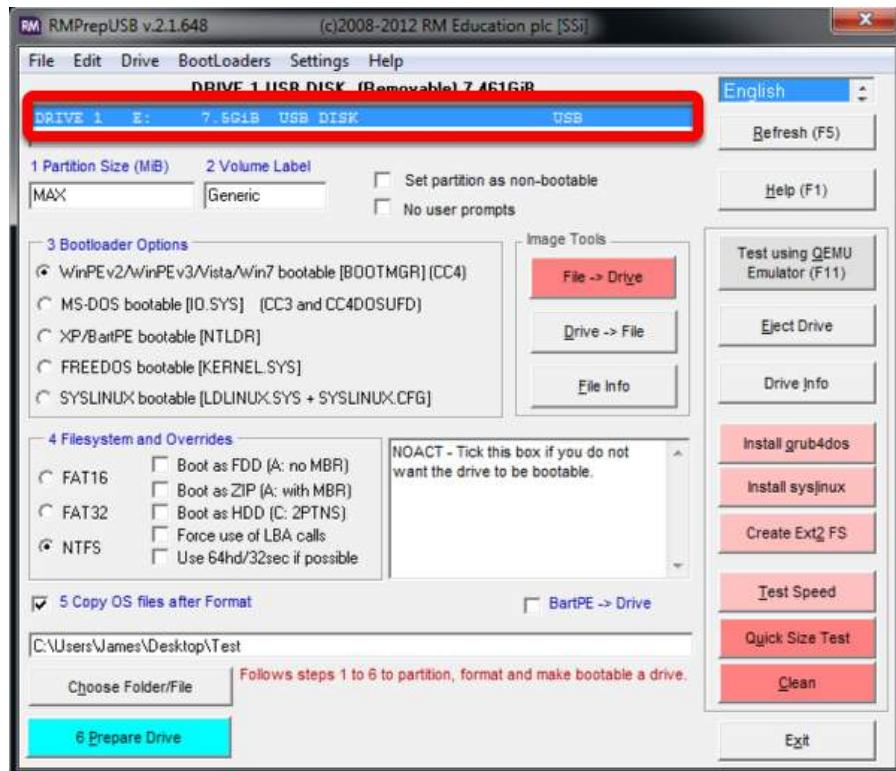
NOTE: These images only install the prerequisite core FRC software, it is still necessary to install the FRC specific updates. See the [Update Software](#) step for more information.

## Preparation

1. Place the image file downloaded from the site to a folder on your root drive (e.g. C:\2016\_Image)
2. Connect 16GB or larger USB Flash drive to the PC to use as the new restoration drive.

# Getting Started with the 2016 Control System

## RMPrep

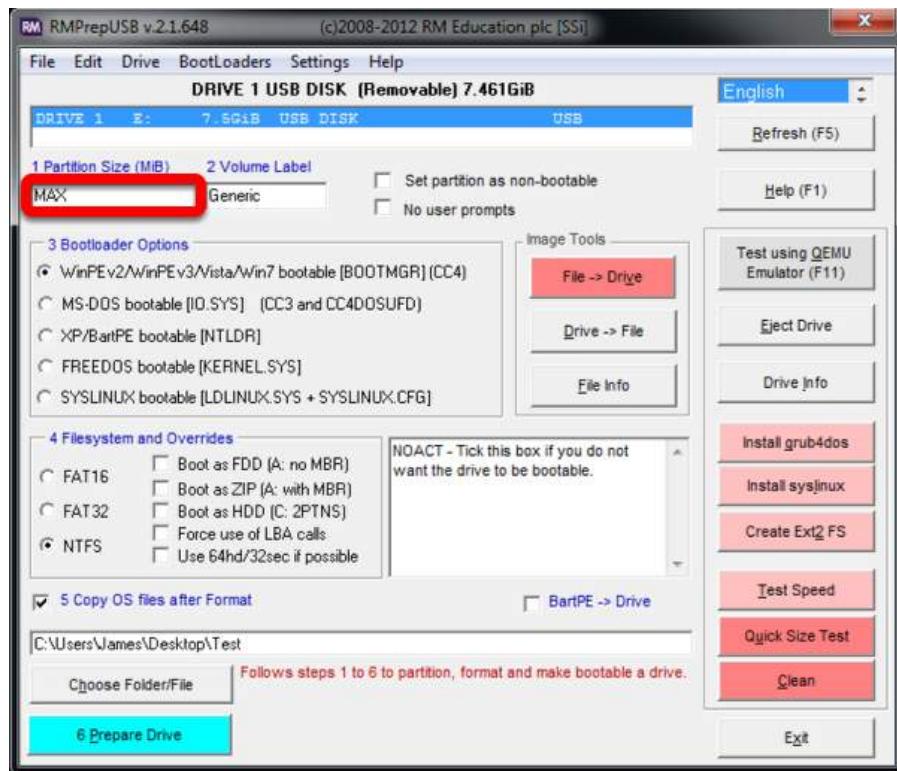


Start/Run RMprepUSB

Select USB Drive

# Getting Started with the 2016 Control System

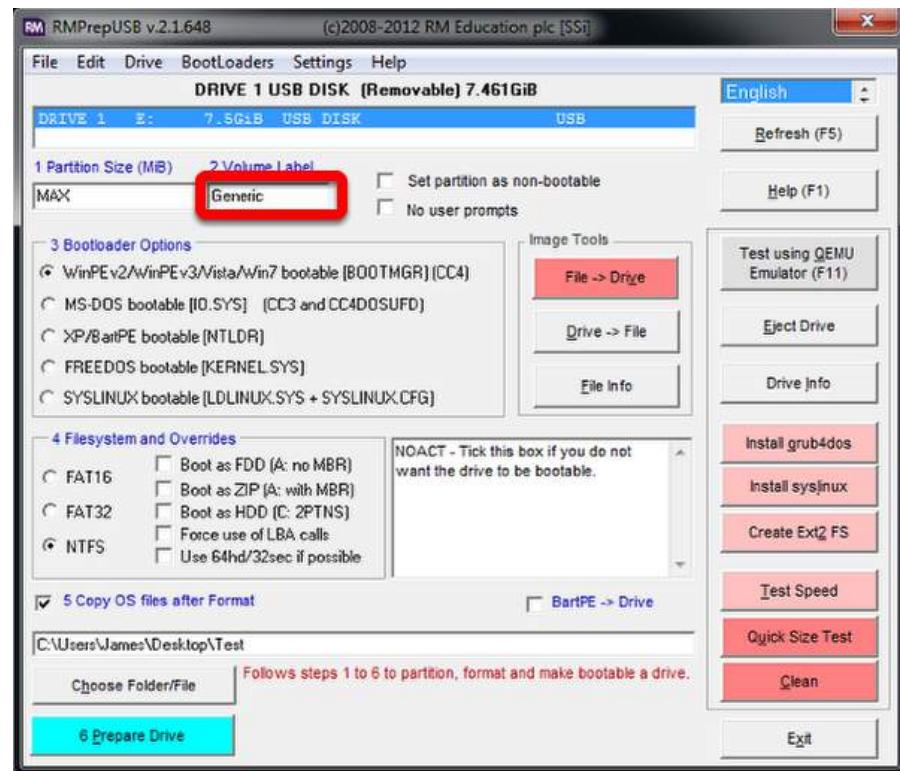
## Set Partition Size



Set Partition Size to MAX

# Getting Started with the 2016 Control System

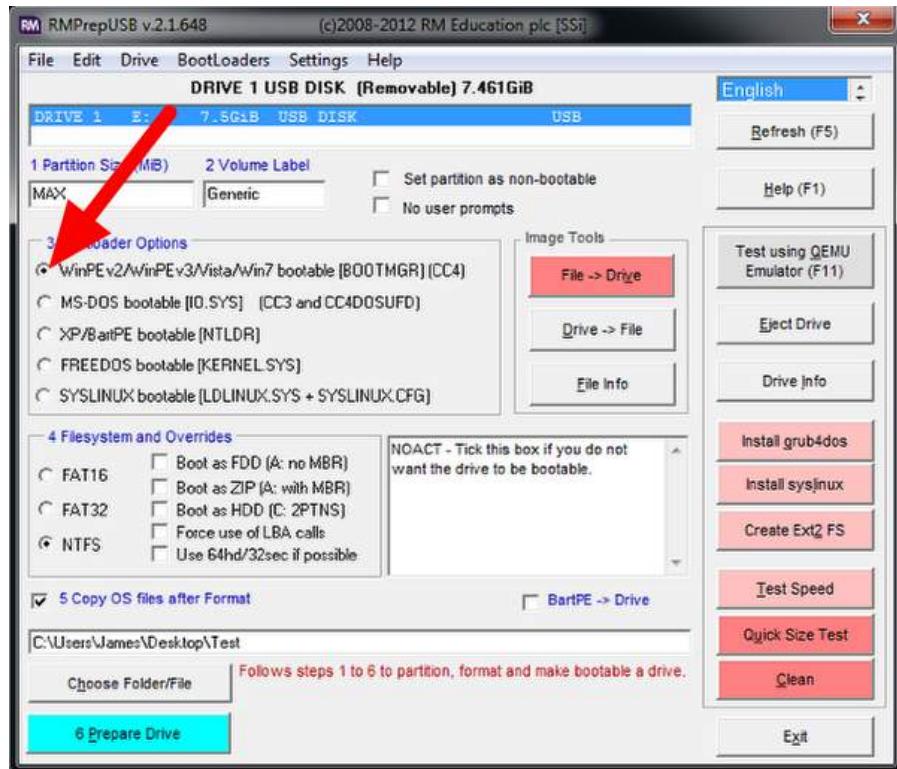
## Set Volume Label



Set Volume Label to Generic

# Getting Started with the 2016 Control System

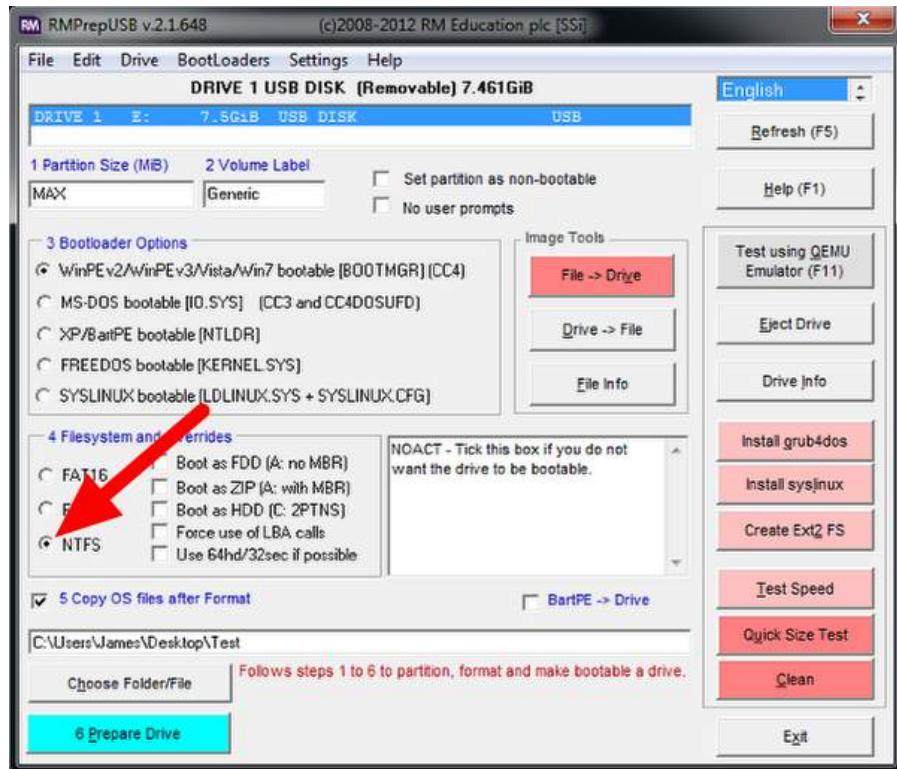
## Set Bootloader Option



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

# Getting Started with the 2016 Control System

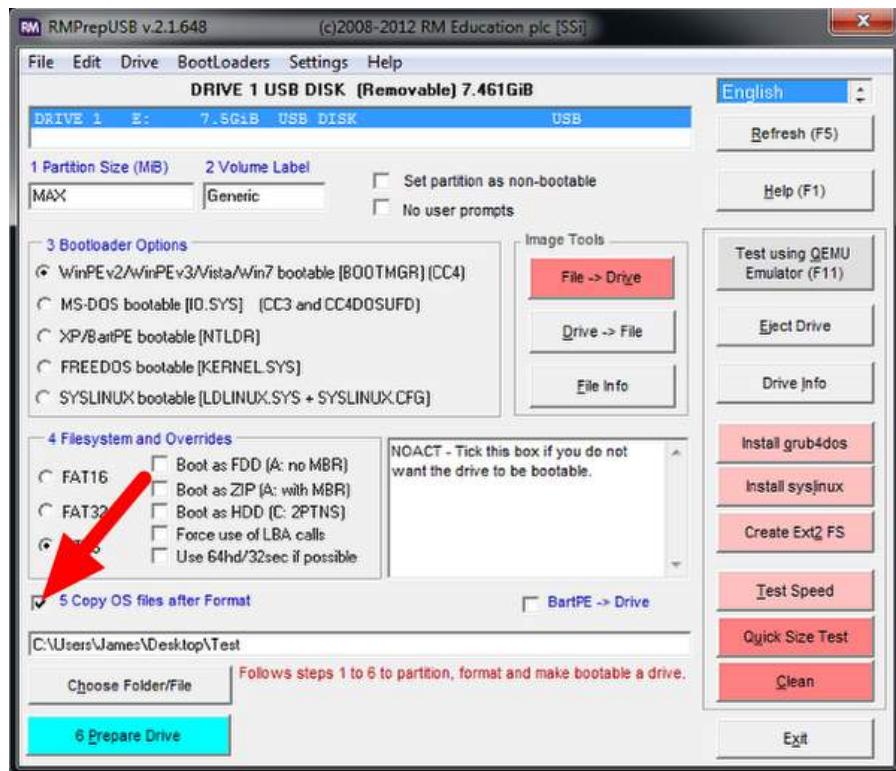
## Select Filesystem



Select NTFS Filesystem

# Getting Started with the 2016 Control System

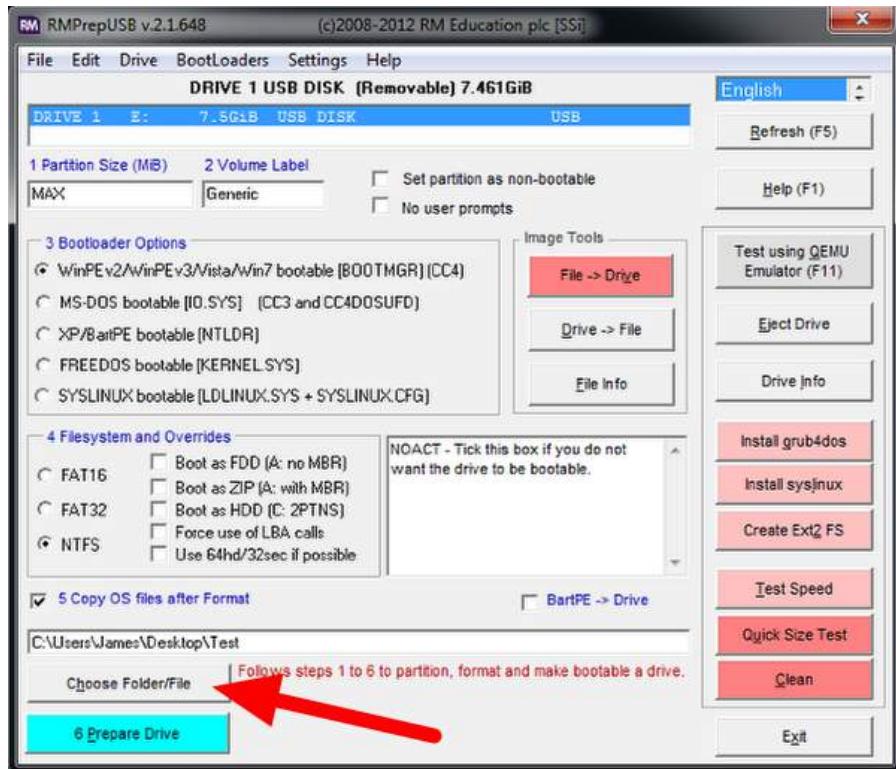
## Copy OS Files Option



Ensure the “Copy OS files after Format” box is checked

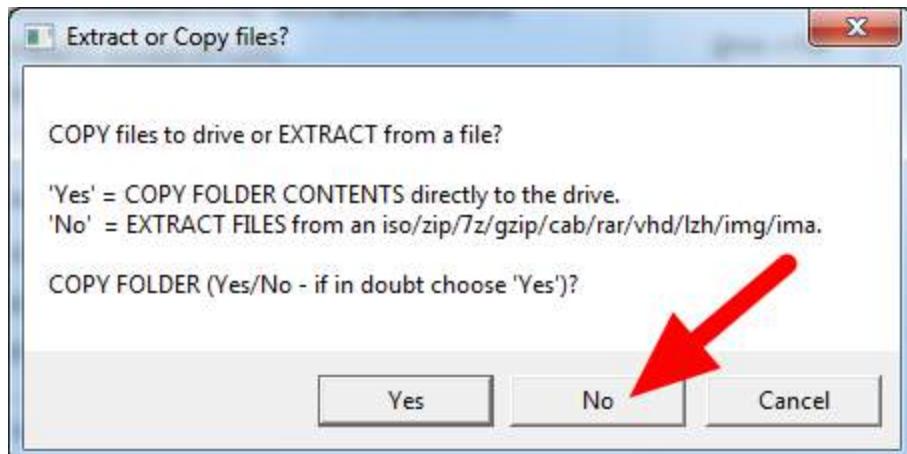
# Getting Started with the 2016 Control System

## Locate Image



Select the “Choose Folder/File” button

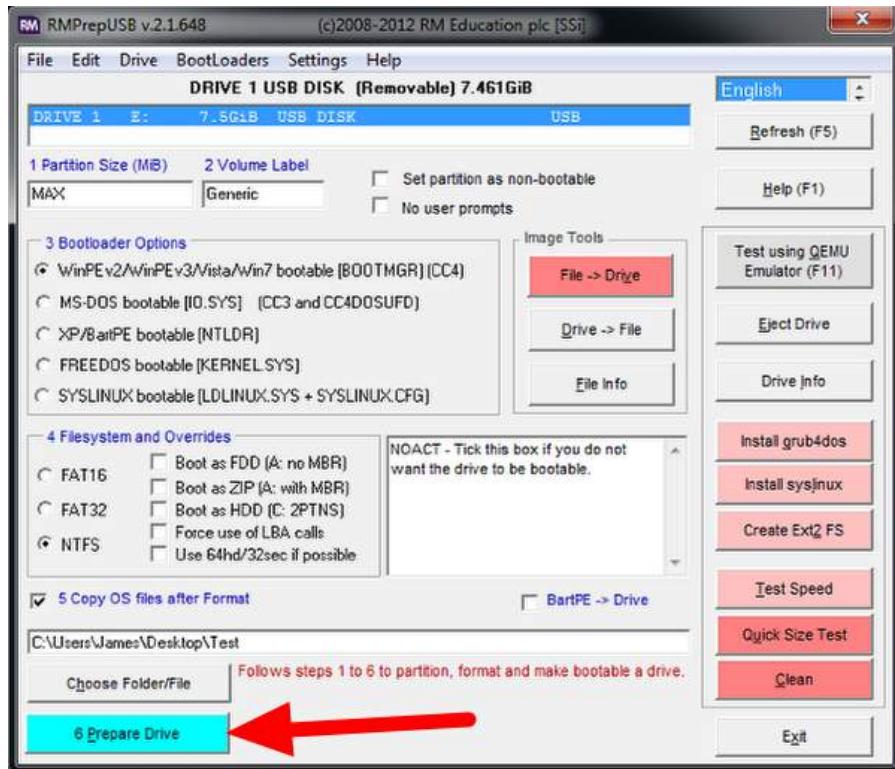
## Copy Files Dialog



Choose “No” and select your .7z image

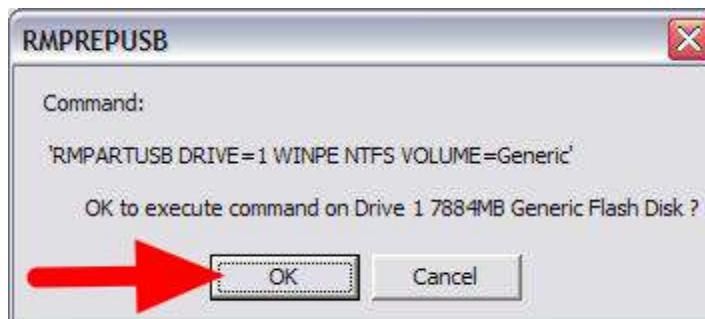
# Getting Started with the 2016 Control System

## Prepare Drive



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

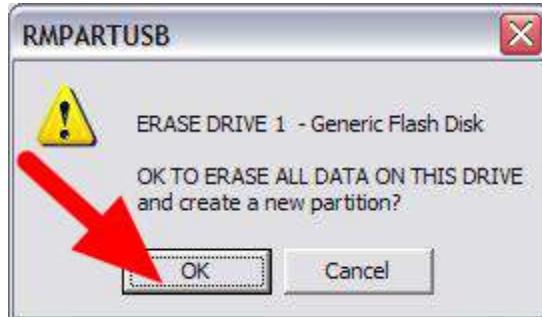
## Confirmation Dialog 1



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

# Getting Started with the 2016 Control System

## Confirmation Dialog 2



Click "OK" to format the USB drive

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

## Decryption

Note: If you are using an encrypted version of the image downloaded before kickoff you will be prompted to enter the decryption key found at the end of the Kickoff video.

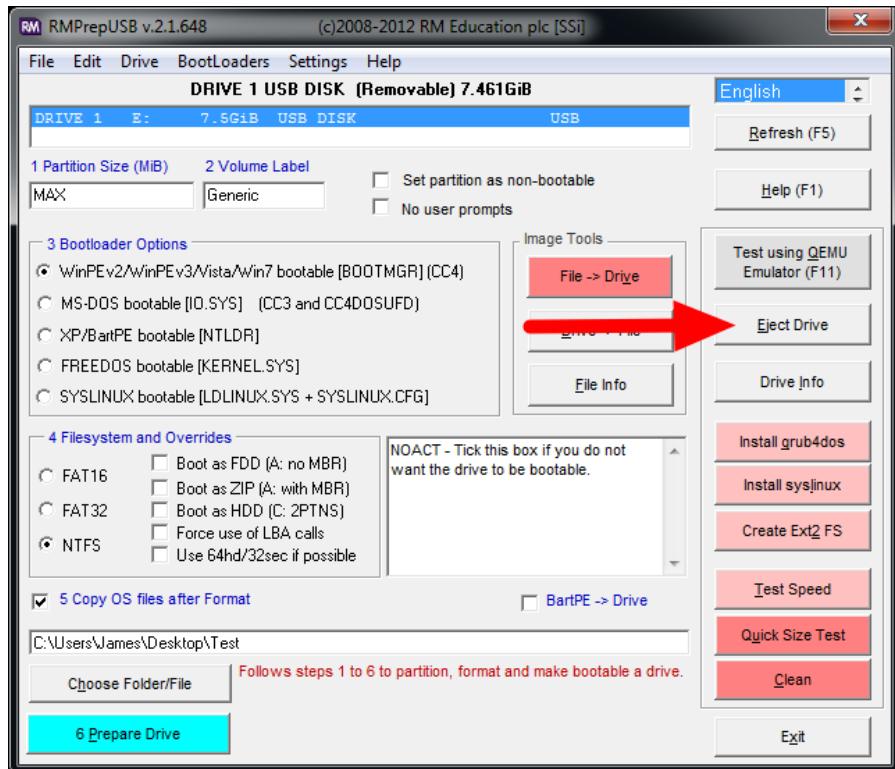
## Copy Complete



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.

# Getting Started with the 2016 Control System

## Eject Drive



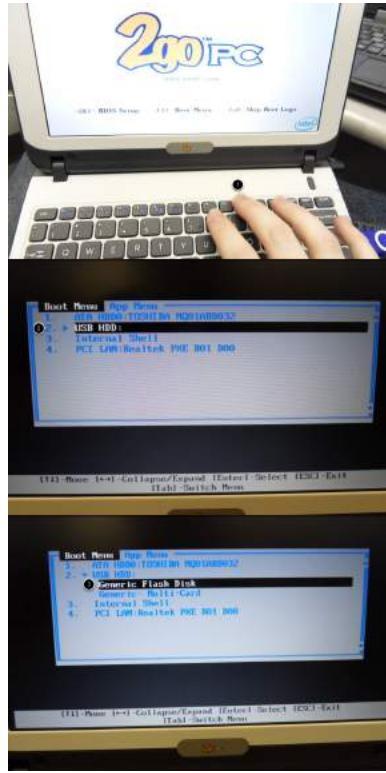
Press the “Eject Drive” button to safely remove the USB drive. The USB drive is now ready to be used to restore the image onto the PC.

## Hardware Setup

1. Make sure the computer is turned off, but plugged in.
2. Insert the USB Thumb Drive into a USB port on the Driver Station computer.

# Getting Started with the 2016 Control System

## Boot to USB



Classmate:

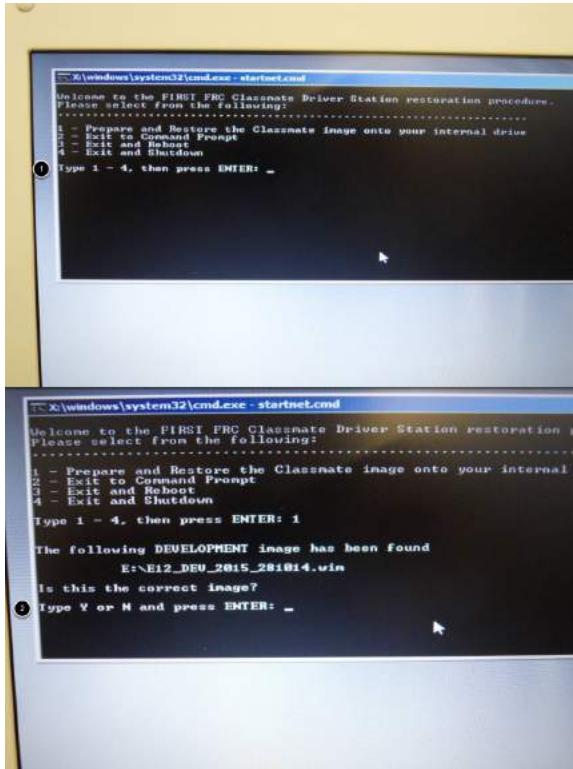
1. Power on the Classmate and tap the F11 key on the keyboard. Tapping the F11 key during boot will bring up the boot menu.
2. Use the up/down keys to select the **USB HDD:** entry on the menu, then press the right arrow to expand the listing
3. Use the up/down arrow keys on the keyboard to select the USB device (it will be called "Generic Flash Disk"). Press the ENTER key when the USB device is highlighted.

Acer ES1

1. Power on the computer and tap the F12 key on the keyboard. Tapping the F12 key during boot will bring up the boot menu.
2. Use the up/down keys to select the **USB HDD: Generic** entry on the menu, then press the ENTER key when the USB device is highlighted.

# Getting Started with the 2016 Control System

## Image the Classmate



1. To confirm that you want to reimage the Classmate, type "1" and press ENTER.
2. Then, type "Y" and press ENTER. The Classmate will begin re-imaging. The installation will take 15-30 minutes.
3. When the installation is complete, remove the USB drive.
4. Restart the Classmate. The Classmate will boot into Windows.

## 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.

# Getting Started with the 2016 Control System

## 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.

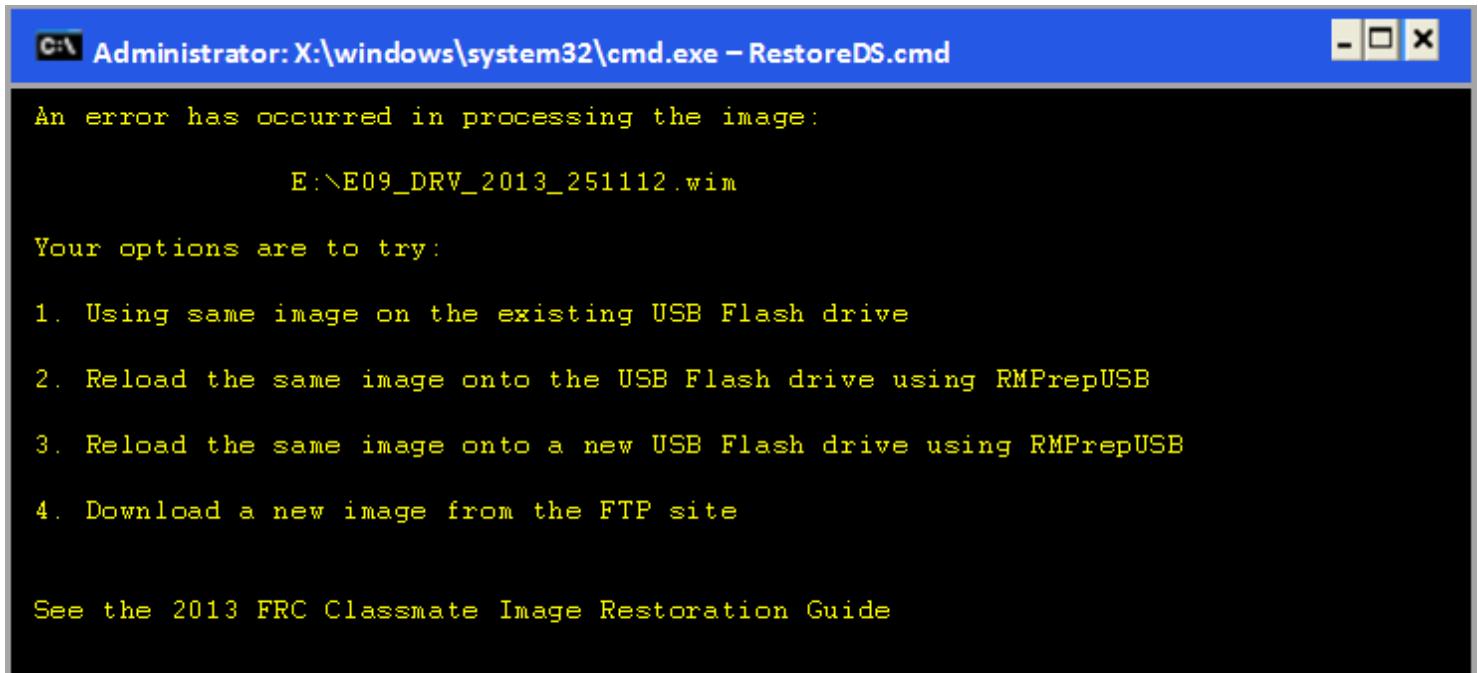
## Microsoft Security Essentials

Navigate through the Microsoft Security Essentials Setup Wizard. Once it is complete, close all of the 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 software for FRC some additional components will need to be installed. LabVIEW teams should continue with the [Installing the FRC 2016 Update Suite \(All Languages\)](#) article. C++ or Java teams should continue with [Installing Eclipse \(C++/Java\)](#) but can skip to configuring Eclipse and installing the FRC plugins.

## Errors during Imaging Process



The screenshot shows a Windows Command Prompt window titled "Administrator: X:\windows\system32\cmd.exe – RestoreDS.cmd". The window contains the following text:

```
An error has occurred in processing the image:  
E:\E09_DRV_2013_251112.wim  
Your options are to try:  
1. Using same image on the existing USB Flash drive  
2. Reload the same image onto the USB Flash drive using RMPrepUSB  
3. Reload the same image onto a new USB Flash drive using RMPrepUSB  
4. Download a new image from the FTP site  
  
See the 2013 FRC Classmate Image Restoration Guide
```

# Getting Started with the 2016 Control System

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 [Image the Classmate](#).

## 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 starting with [RMPrep](#) 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 starting with [RMPrep](#).

## Option 4

*Download a new image:* An issue with the downloaded image may also cause an error when imaging. Press any key to return to the main menu and select #4 to safely shutdown the Classmate. Starting with [Download the Classmate Image](#) create a new copy of the imaging stick.

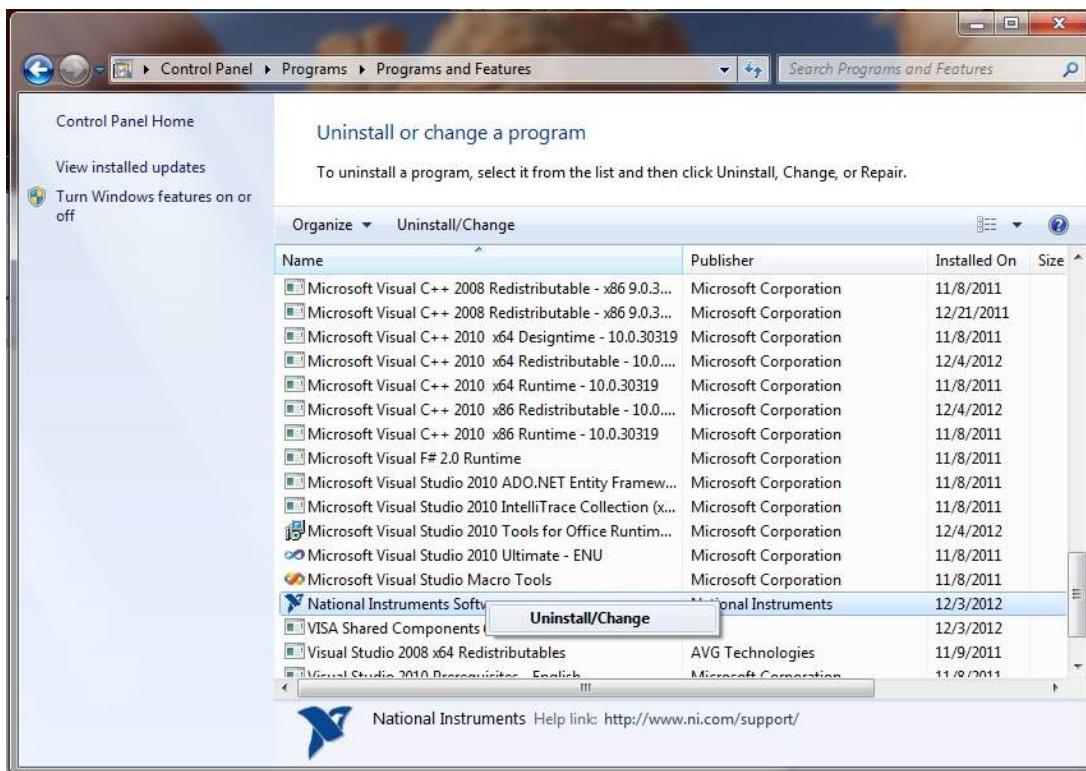
# Getting Started with the 2016 Control System

## Installing LabVIEW for FRC 2017 (LabVIEW only)

Note: This installation is for teams programming in LabVIEW or using NI Vision Assistant only. C++ and Java teams not using these features do not need to install from the DVD.

Download and installation times will vary widely with computer and internet connection specifications, however note that this process involves a large file download and installation and will likely take at least an hour to complete.

### Uninstall Old Versions (Recommended)



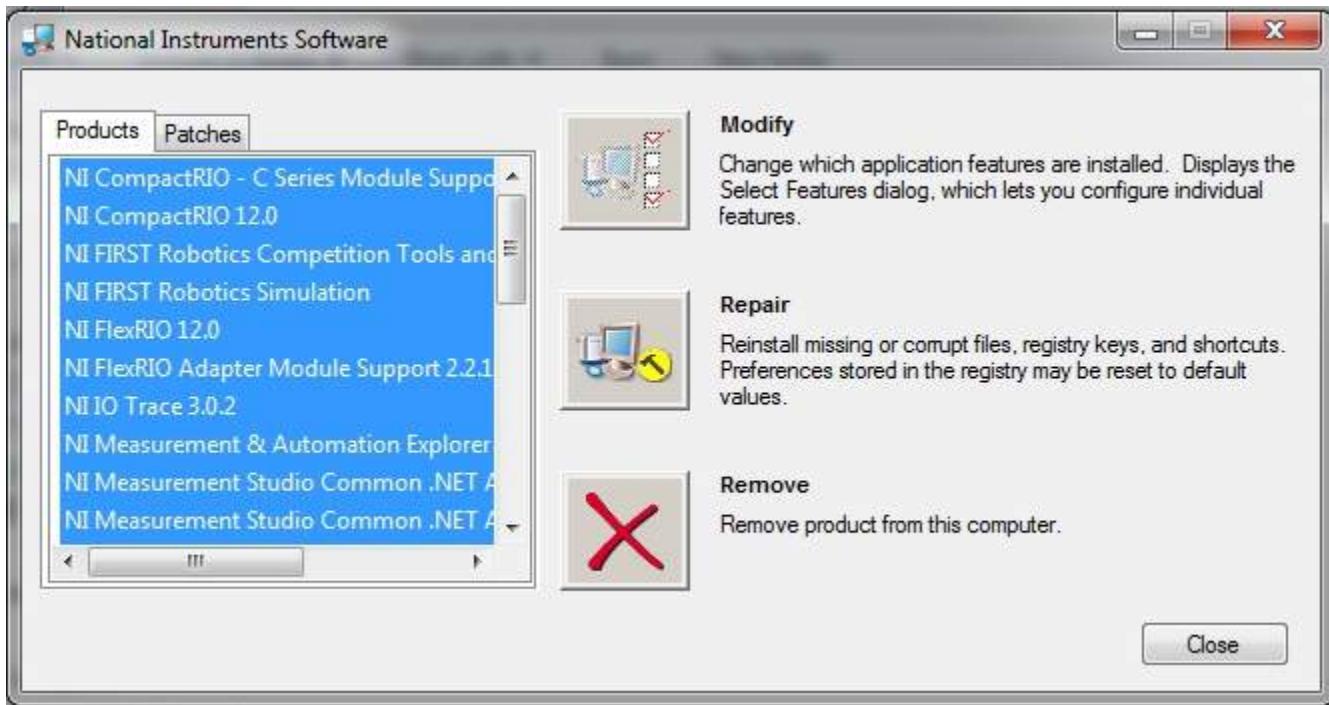
**NOTE:** The cRIO-FRCII (4-slot) is supported by the 2015 software, but the cRIO-FRC (8-slot) is not. The LabVIEW for FRC 2014 license has been extended. If you wish to keep programming 8-slot cRIOS you will need to maintain an install of LabVIEW for FRC 2014. While these versions should be able to co-exist on a single computer, this is not a configuration that has been extensively tested.

Before installing the new version of LabVIEW it is recommended to remove any old versions. The new version will likely co-exist with the old version, but all testing has been done with FRC 2015 only. Make sure to back up any team code located in the "User\LabVIEW Data" directory before un-

# Getting Started with the 2016 Control System

installing. 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.

## Getting LabVIEW Installer

Either locate and insert the LabVIEW DVD or download the LabVIEW 2016 installer from <http://ni.com/download/cds/view/p/id/5774/lang/en>

If downloaded, right click on the downloaded file (NI\_FRC2016.zip) and select Extract All.

Note: This is a large download (~4GB). It is recommended to use a fast internet connection and to use the NI Downloader to allow the download to resume if interrupted.

# Getting Started with the 2016 Control System

## Installing LabVIEW

National Instruments LabVIEW requires a license. Each season's license is active until January 31st of the following year (e.g. the license for the 2016 season expires on January 31, 2017)

Teams are permitted to install the software on as many team computers as needed, subject to the restrictions and license terms that accompany the applicable software, and provided that only team members or mentors use the software, and solely for FRC. Rights to use LabVIEW are governed solely by the terms of the license agreements that are shown during the installation of the applicable software.

## Welcome



Double click on autorun.exe to launch the installer. If prompted to allow changes click Yes. To install LabVIEW to program your FRC robot, click the top option **Install Everything for LabVIEW Development**. To install only NI Vision Assistant for use with C++ or Java, click **Install Only NI Vision Development Module**.

# Getting Started with the 2016 Control System

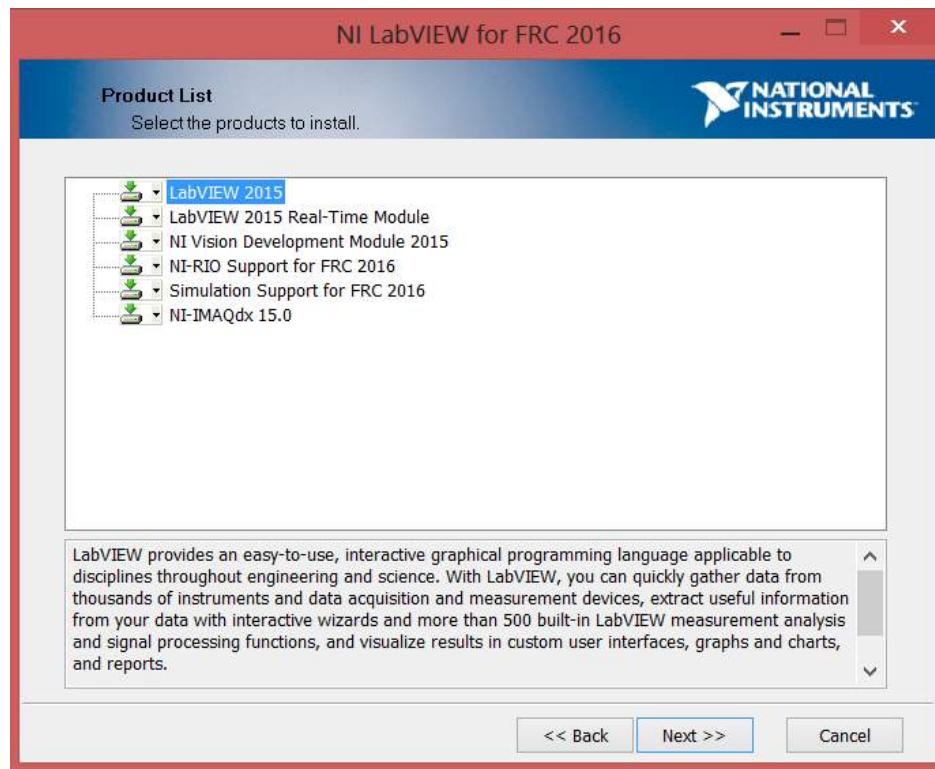
## Warnings



Click "Next"

# Getting Started with the 2016 Control System

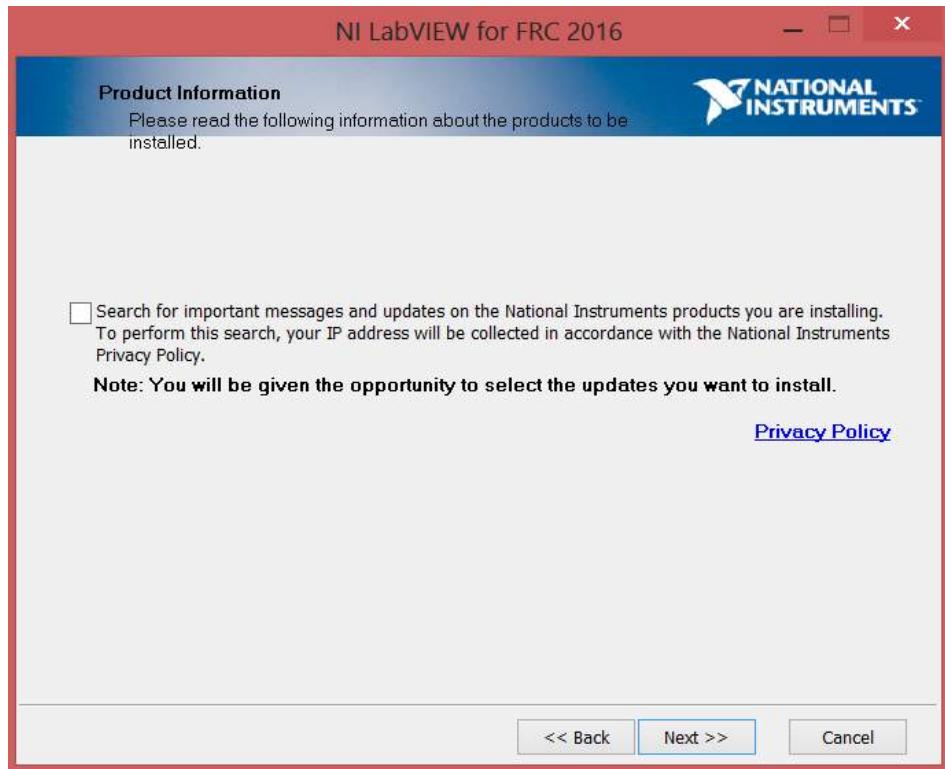
## Product List



Click "Next"

# Getting Started with the 2016 Control System

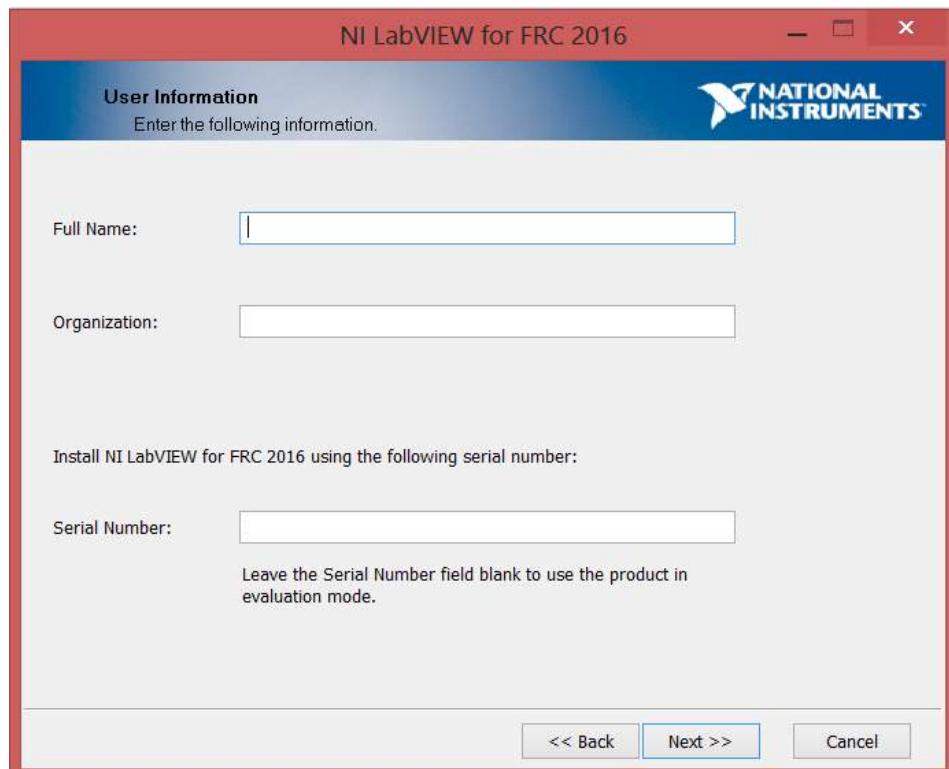
## Product Information



Un-check the box, then click "Next"

# Getting Started with the 2016 Control System

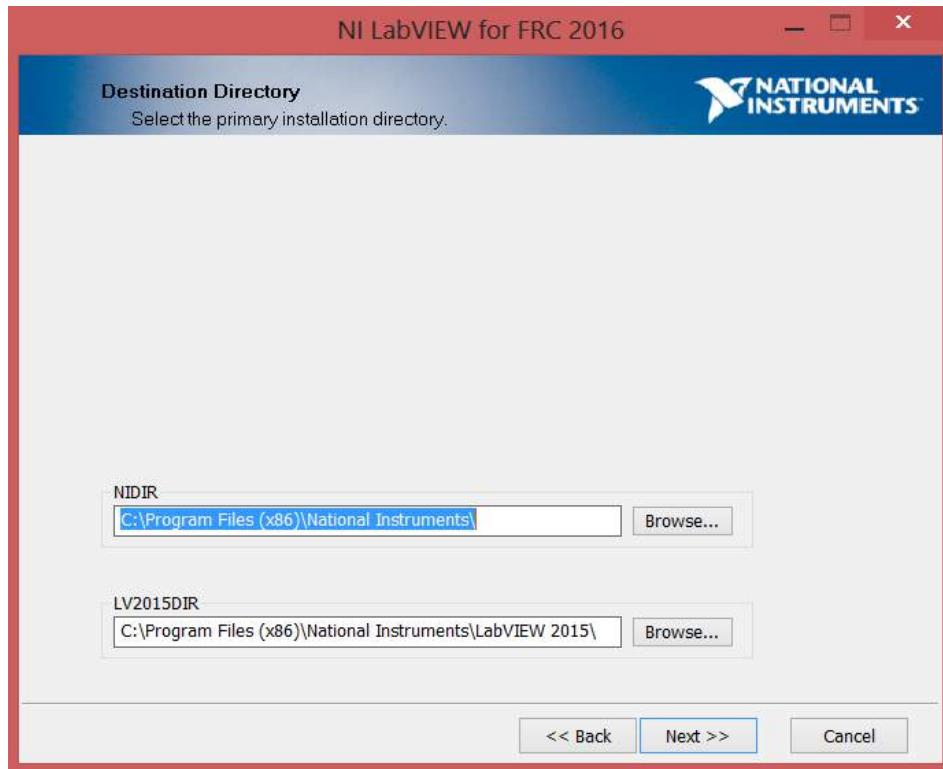
## User Information



Enter name, organization, and the serial number from your KOP. Click "Next"

# Getting Started with the 2016 Control System

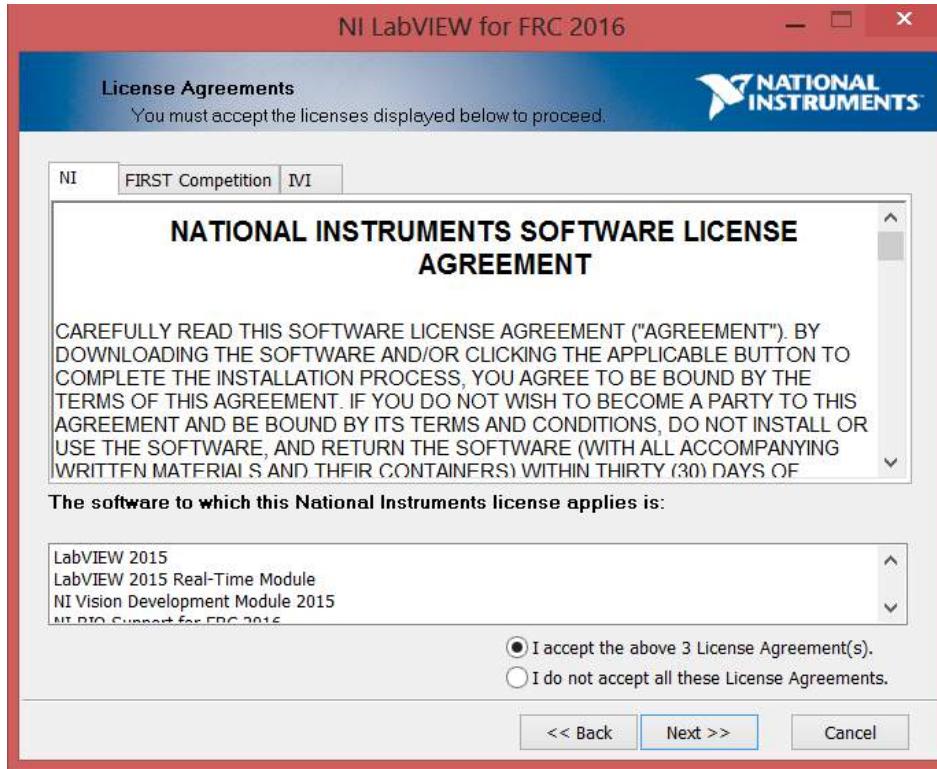
## Destination Directory



Click "Next"

# Getting Started with the 2016 Control System

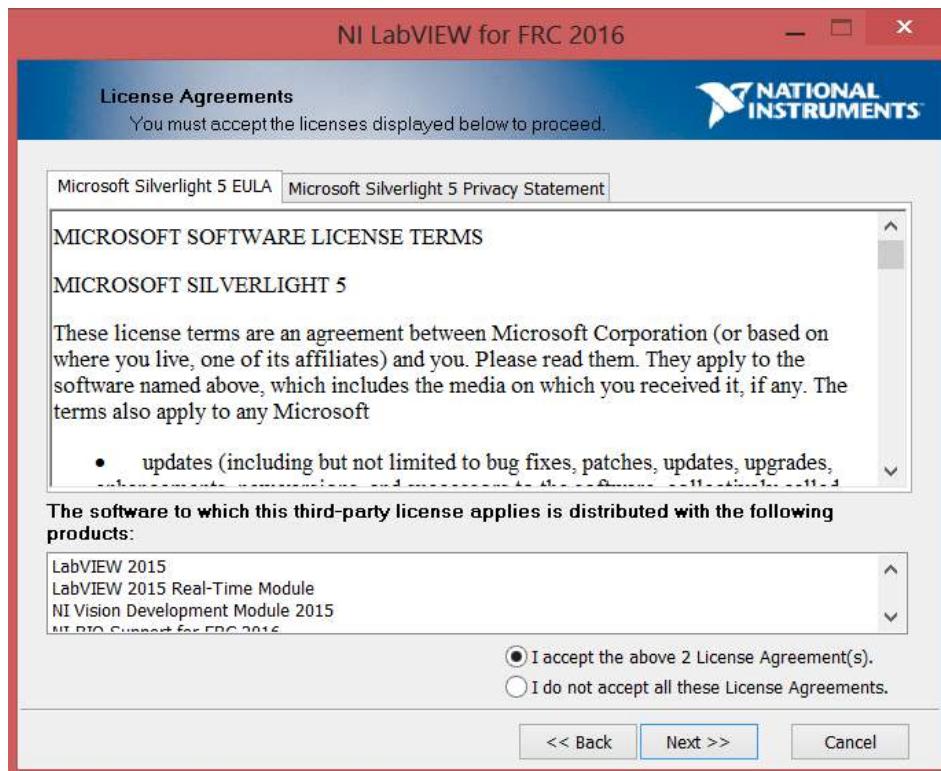
## License Agreements (1)



Check "I accept..." then Click "Next"

# Getting Started with the 2016 Control System

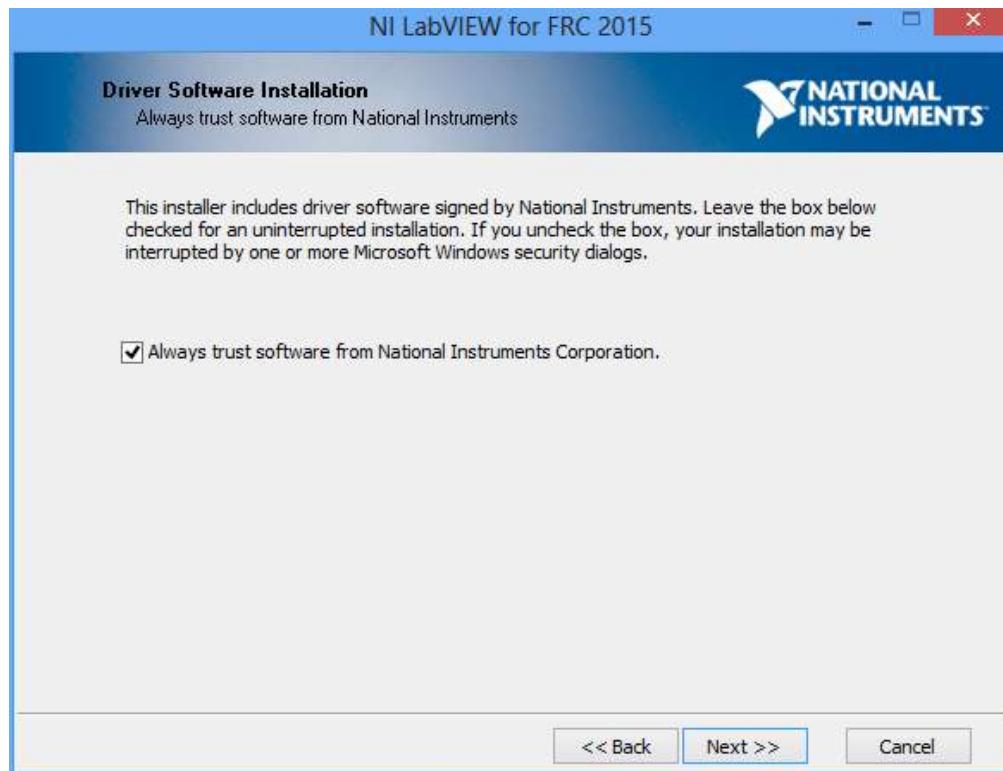
## License Agreements (2)



Check "I accept..." then Click "Next"

# Getting Started with the 2016 Control System

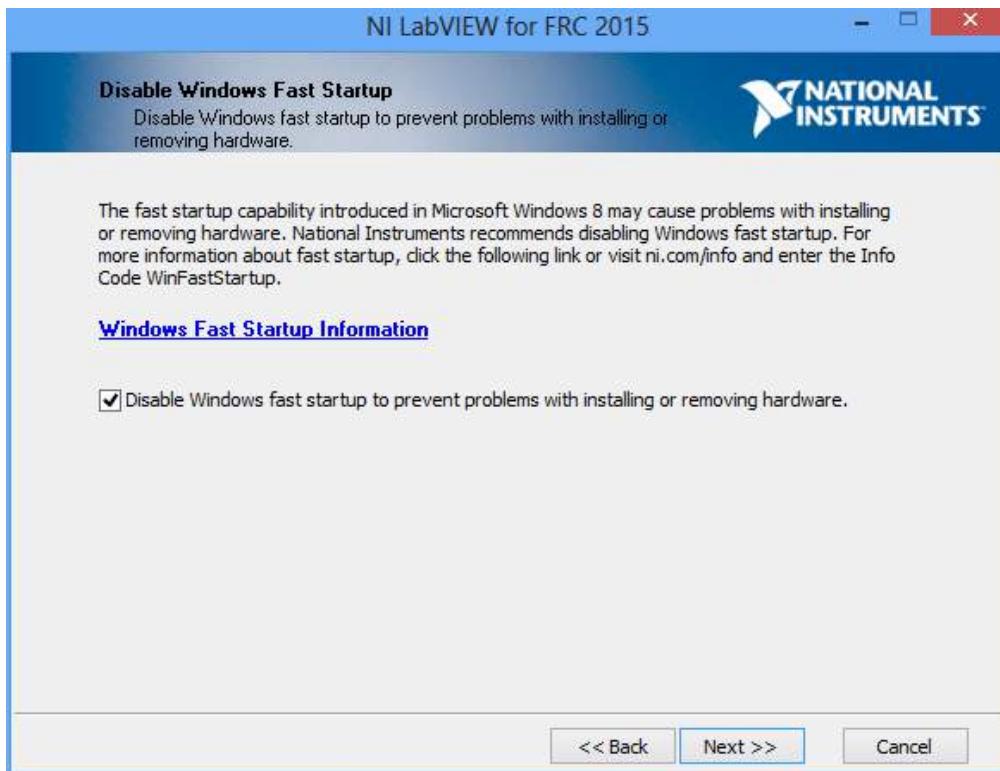
## Driver Software Installation



If you see this screen, Click "Next"

# Getting Started with the 2016 Control System

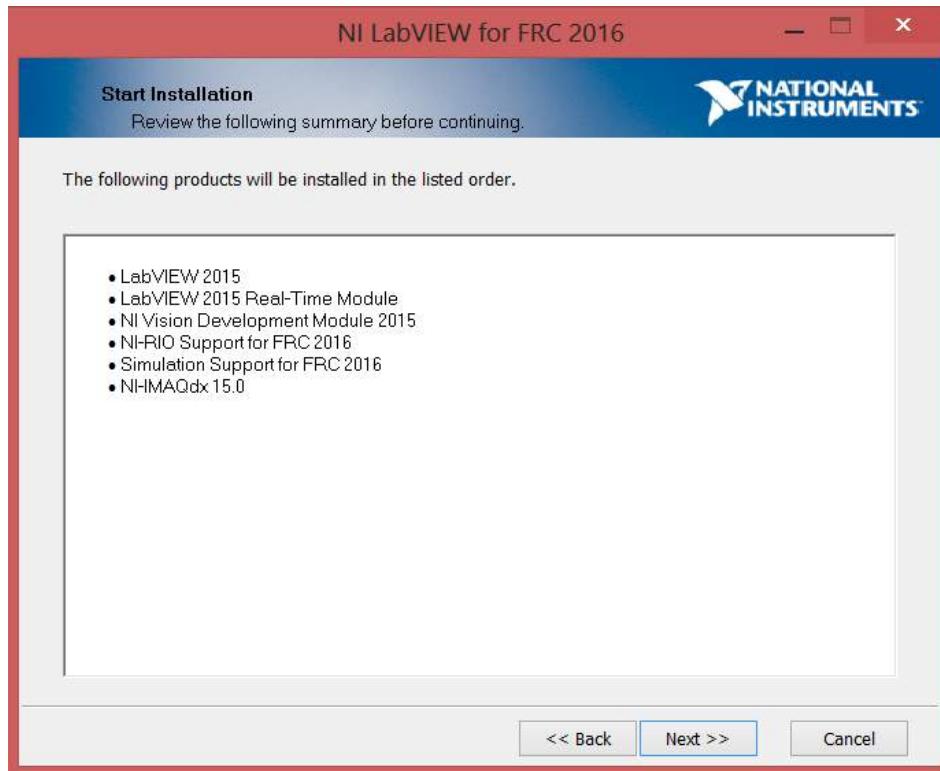
## Disable Windows Fast Startup



If you see this screen, click "Next"

# Getting Started with the 2016 Control System

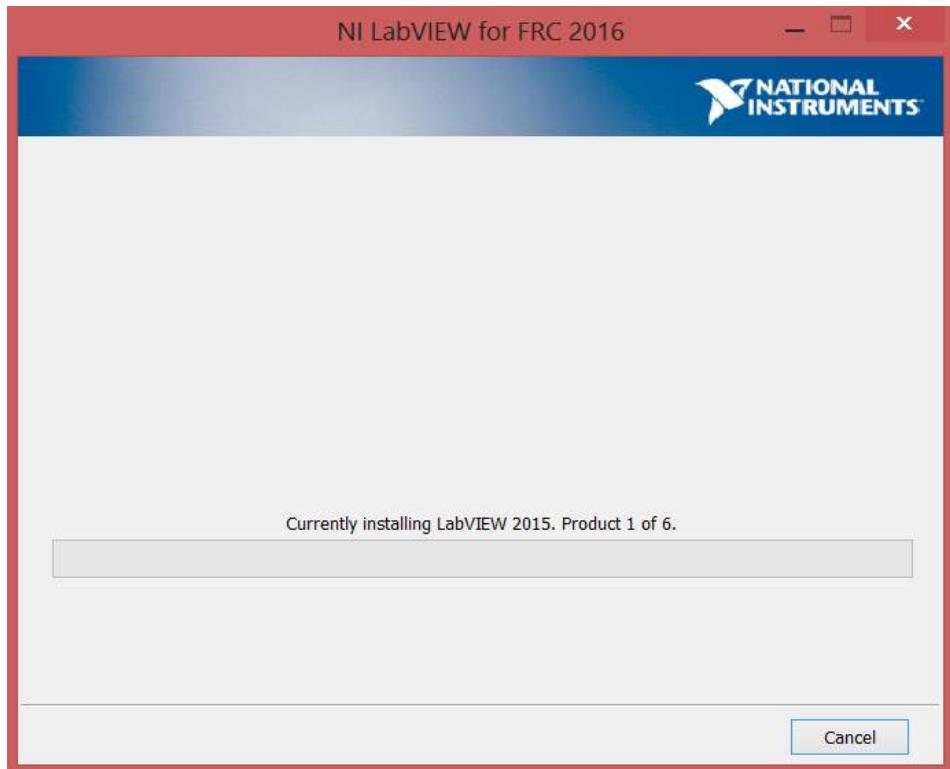
## Start Installation



Click "Next"

# Getting Started with the 2016 Control System

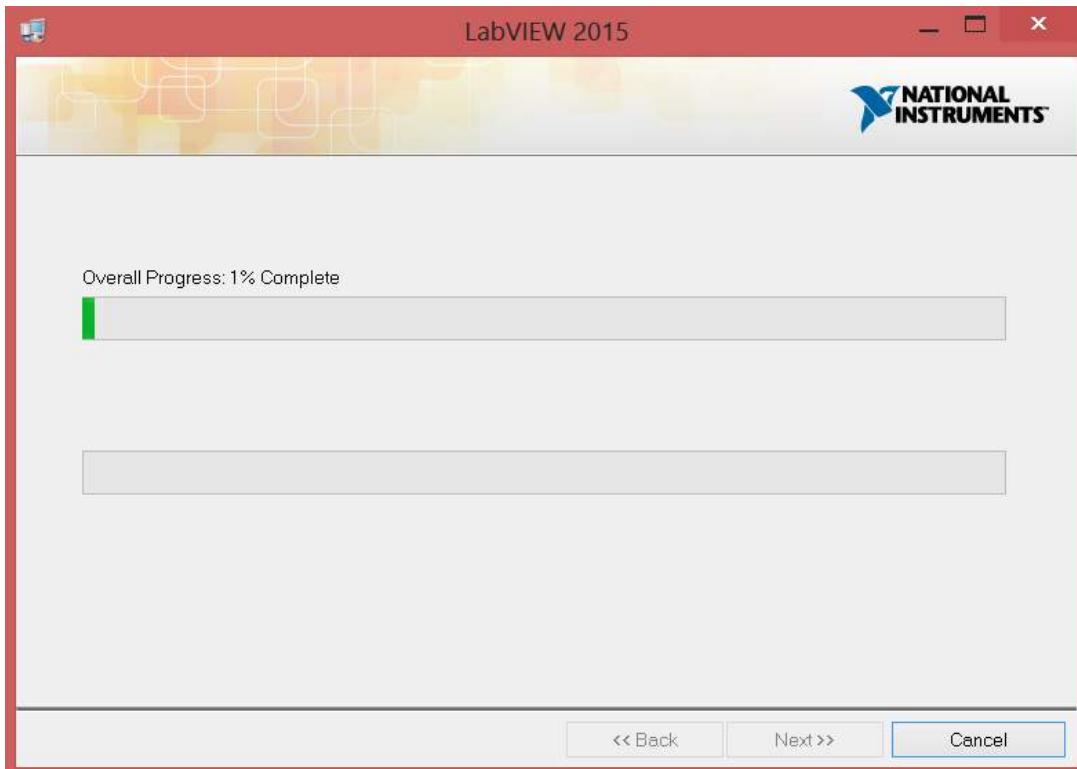
## Overall Progress



Overall installation progress will be tracked in this window

# Getting Started with the 2016 Control System

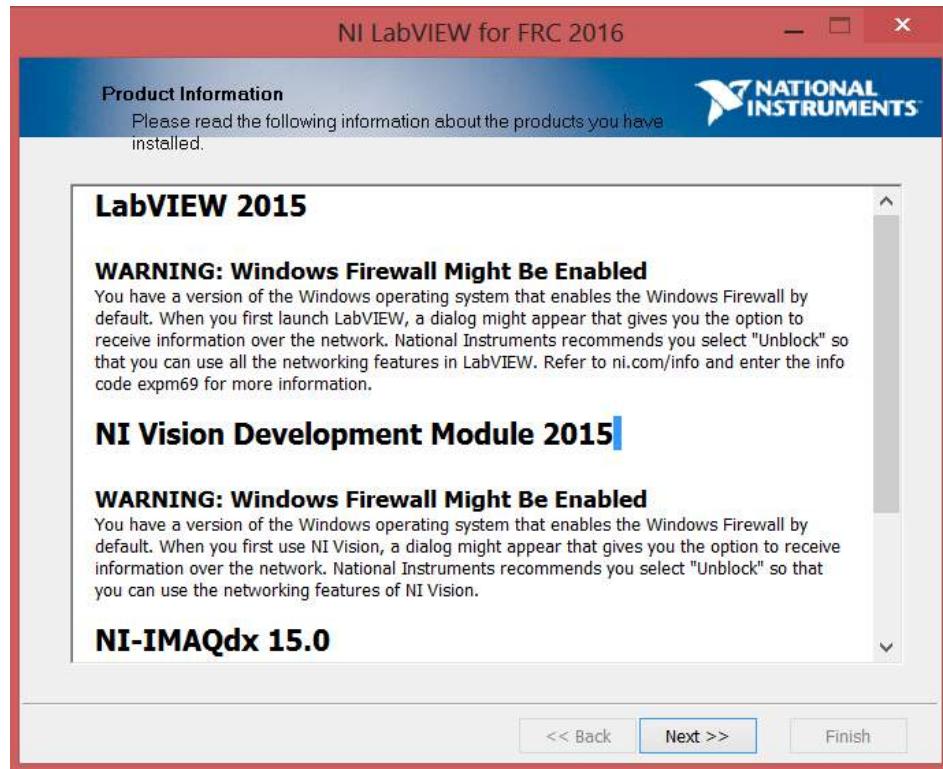
## Individual Product Progress



Each product installed will also create an individual progress window like the one shown above.

# Getting Started with the 2016 Control System

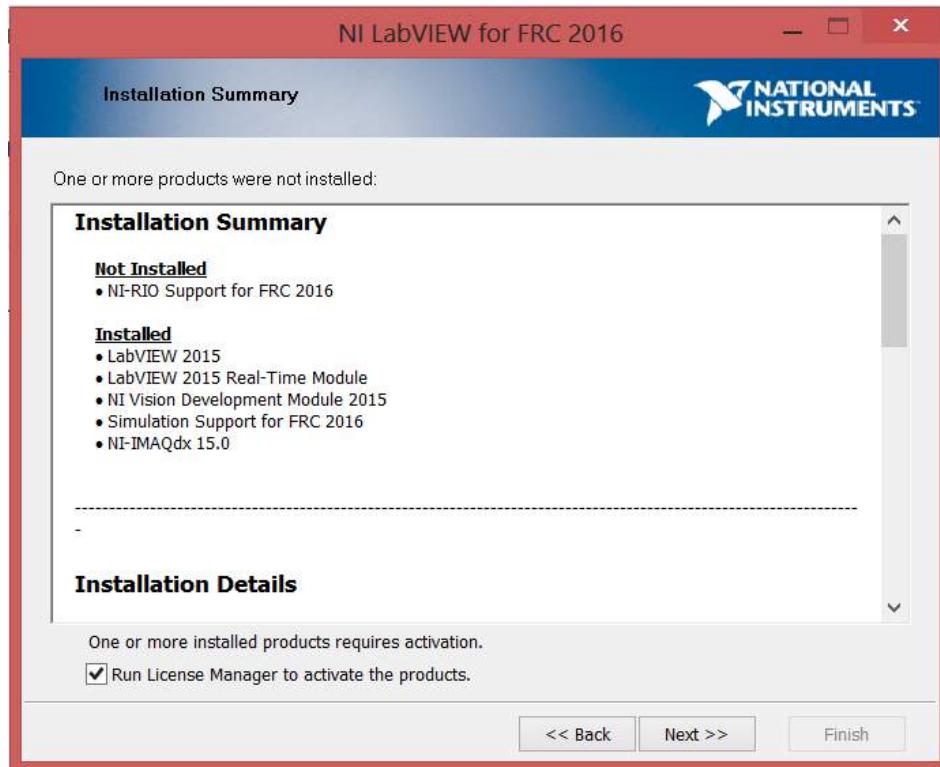
## Product Information



Click "Next"

# Getting Started with the 2016 Control System

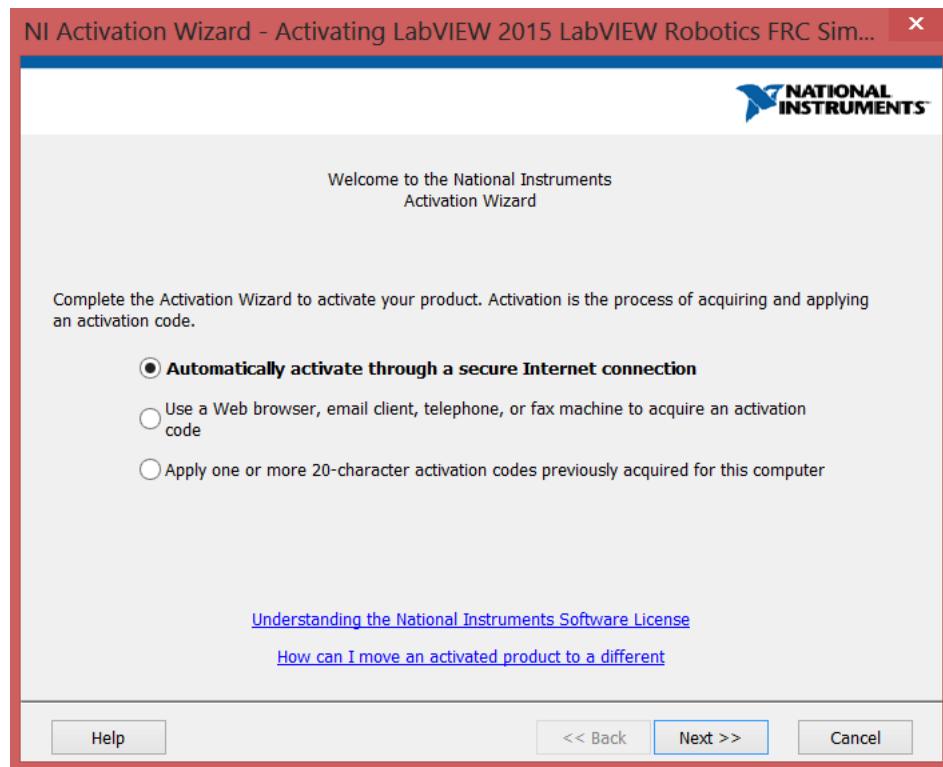
## Installation Summary



If internet access is available and you are ready to activate, click "Next"; otherwise uncheck the "Run License Manager..." and click "Next".

# Getting Started with the 2016 Control System

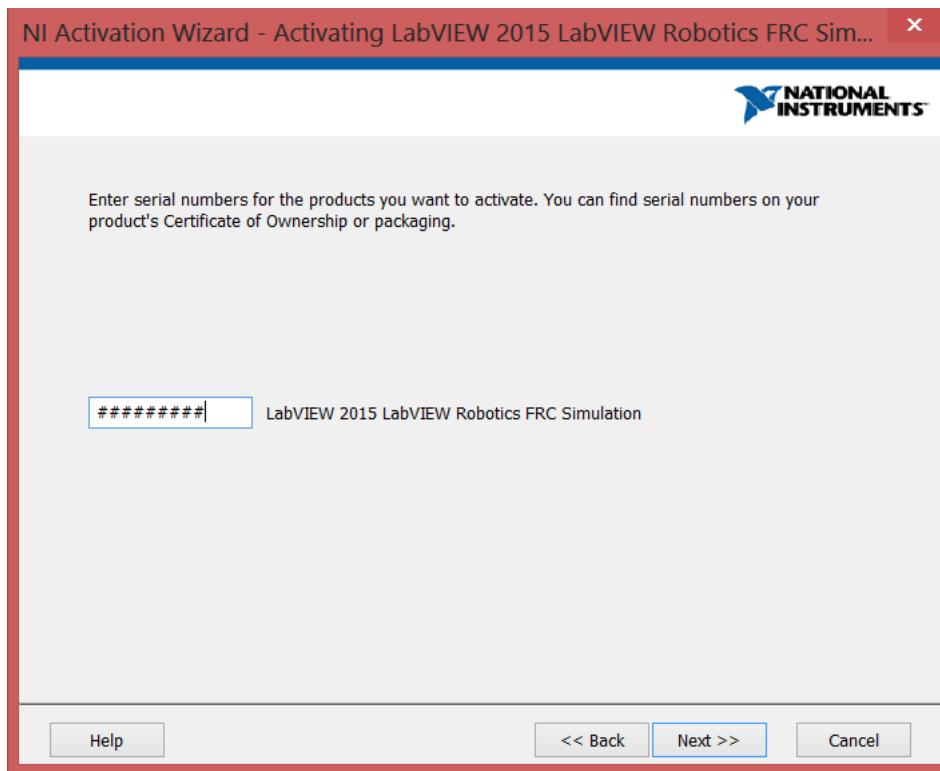
## NI Activation Wizard



If internet connection is available, click "Next"

# Getting Started with the 2016 Control System

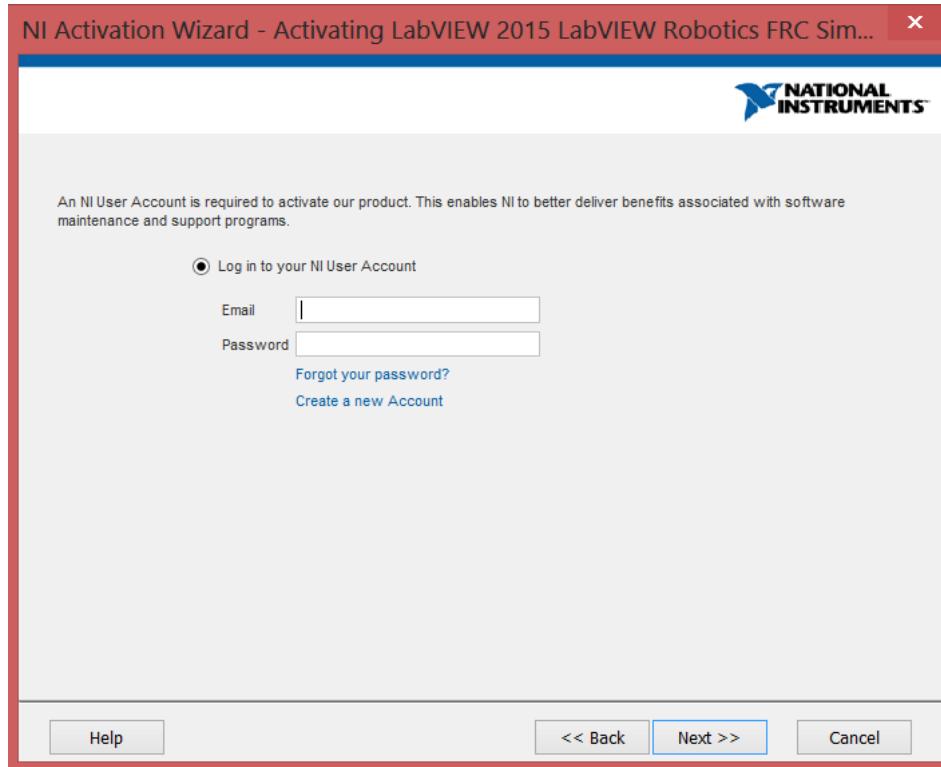
## NI Activation Wizard (2)



The serial number you entered at the "User Information" screen should appear in all of the text boxes, if it doesn't, enter it now. Click "Next".

# Getting Started with the 2016 Control System

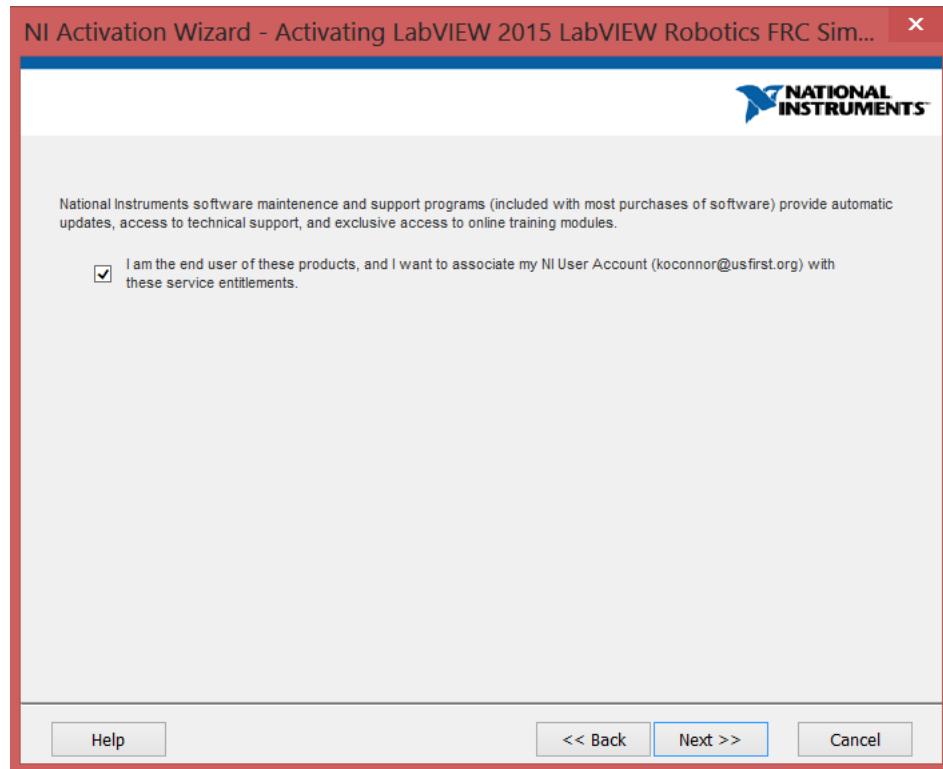
## NI Activation Wizard (3)



Check "Log in to your User Profile" and enter your NI user profile information, or click "Create a new Account" then click "Next".

# Getting Started with the 2016 Control System

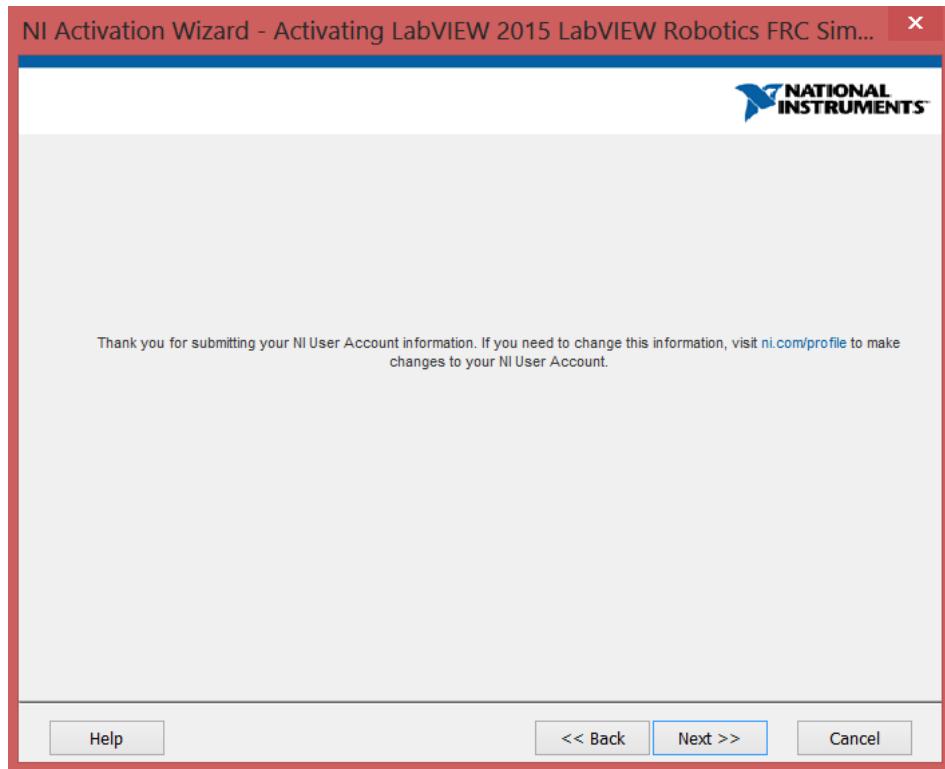
## NI Activation Wizard (4)



Click "Next".

# Getting Started with the 2016 Control System

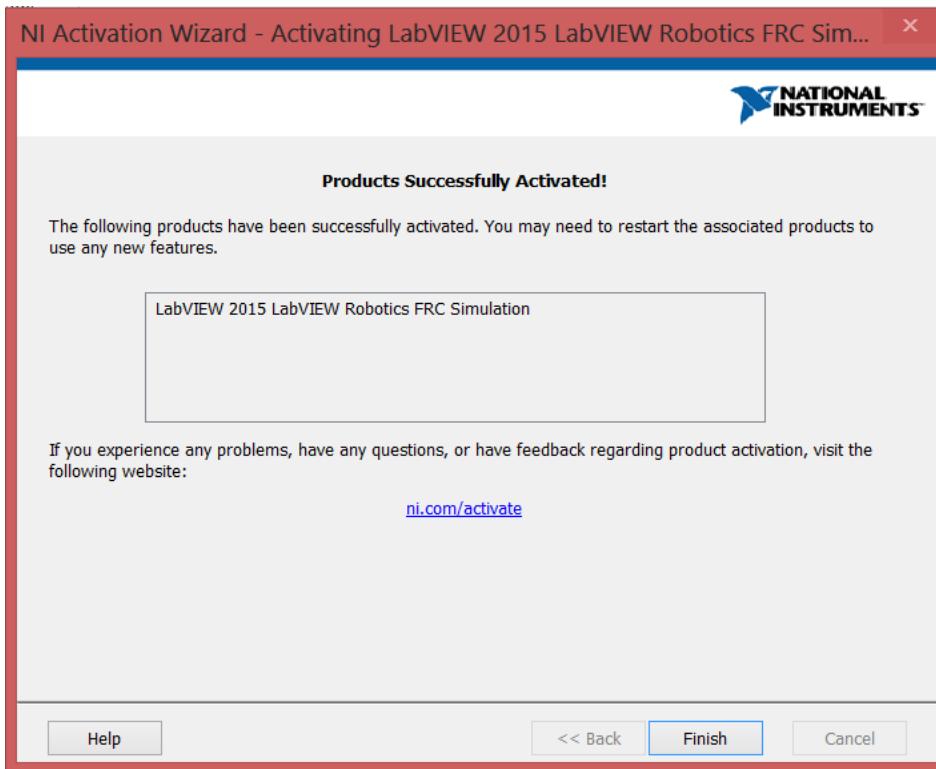
## NI Activation Wizard (5)



Click "Next".

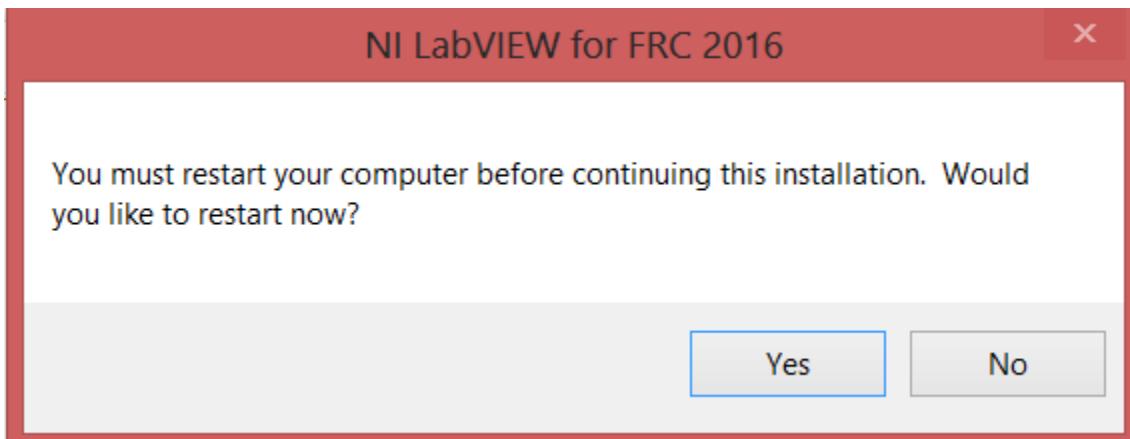
# Getting Started with the 2016 Control System

## Activation Success



The Activation Wizard will contact NI and complete the activation. You should then see the window shown above. Click "Finish" to complete the installation.

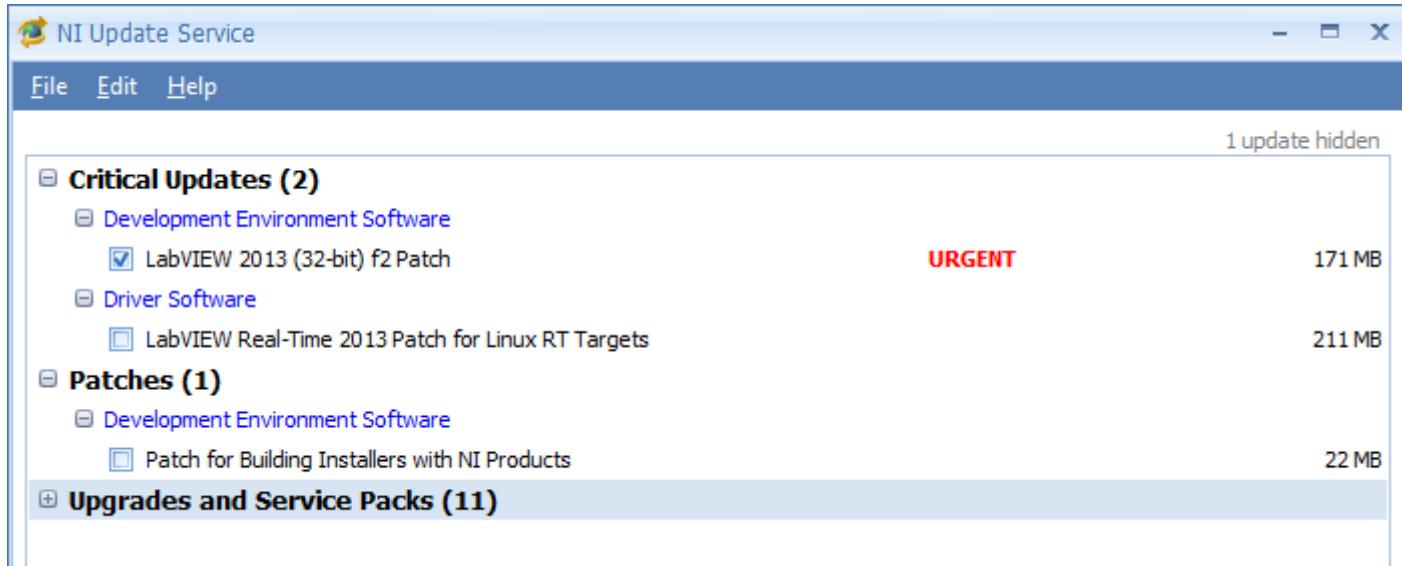
## Restart Message



Select "Yes"

# Getting Started with the 2016 Control System

## NI Update Service



On occasion you may see alerts from the NI Update Service about patches to LabVIEW. **It is not recommended to install these updates unless directed by FRC through our usual communication channels (Frank's Blog, Team Updates or E-mail Blasts).**

# Getting Started with the 2016 Control System

## Installing Eclipse (C++/Java)

The 2015 suite of text-based languages, Java and C++, utilize the current version of Eclipse as a development environment. The FRC specific tools for the chosen language are installed as Eclipse plugins. You can install both the Java and C++ development tools into the same installation of Eclipse to allow programs to be written with either language using a common set of tools and user interface.

The 2016 Eclipse plugins have been tested with both Eclipse Luna and Eclipse Mars. Teams with existing installs of Luna from 2015 can update their installations by checking for plugin updates and (if using C++) installing the new C++ toolchain (instructions for both are part of the instructions below).

*Note: The C++ and Java tools and environment are available for Windows, Mac OSX and Linux, though the Windows version is the one that has been the most heavily tested. You should be able to use any of the three for your development platform, however you should keep in mind that you will need a Windows computer to run the Driver Station software and roboRIO Imaging tool.*

## Getting Java

**Java SE Development Kit 8u11**  
You must accept the [Oracle Binary Code License Agreement for Java SE](#) to download this software.

Accept License Agreement  Decline License Agreement

Product / File Description	File Size	Download
Linux x86	133.58 MB	<a href="#">jdk-8u11-linux-i586.rpm</a>
Linux x86	152.55 MB	<a href="#">jdk-8u11-linux-i586.tar.gz</a>
Linux x64	133.89 MB	<a href="#">jdk-8u11-linux-x64.rpm</a>
Linux x64	151.65 MB	<a href="#">jdk-8u11-linux-x64.tar.gz</a>
Mac OS X x64		
Solaris SPARC 64-bit (SVR4 package)	96.14 MB	<a href="#">jdk-8u11-solaris-sparcv9.tar.gz</a>
Solaris SPARC 64-bit	135.7 MB	<a href="#">jdk-8u11-solaris-x64.tar.Z</a>
Solaris x64 (SVR4 package)	93.18 MB	<a href="#">jdk-8u11-solaris-x64.tar.gz</a>
Windows x86	151.81 MB	<a href="#">jdk-8u11-windows-i586.exe</a>
Windows x64	155.29 MB	<a href="#">jdk-8u11-windows-x64.exe</a>

x86/64 should match Eclipse version

A red box highlights the 'Accept License Agreement' radio button. Another red box highlights the note 'x86/64 should match Eclipse version'. A third red box highlights the Windows x86 and x64 download sections.

# Getting Started with the 2016 Control System

To use Eclipse you must have Java JDK installed on your system. You can get Java from the web site: <http://www.oracle.com/technetwork/java/javase/downloads/index.html>. Select "JDK Download", then scroll down the page to "Java SE Development Kit". Accept the license agreement and download the Java SDK for your platform. The version (either x86 or x64) should match the version of Eclipse that you have installed or plan to install on your computer. This has been tested with Java SE 8u11 but will probably work with later versions as well.

Java 8 is installed on the RoboRIO and to take advantage of all the features it offers, it is suggested that you use Java 8 on your development system. You may use an earlier version, however it should be noted that the Java-installer program for loading the JRE on the roboRIO requires Java 8 (so you will need at least one computer with it) as does the rioLog Eclipse plugin which is used to view console output.

*Note: Java is required to be installed even if you are doing C++ development since Eclipse, the development environment, is a Java program. Also, the Oracle web page might change over time, so the images shown here might not exactly match what you see.*

## Installing the C++ Toolchains (C++ teams only)



# Getting Started with the 2016 Control System

Download the appropriate C++ Toolchains installer for your platform from <http://first.wpi.edu/FRC/roborio/toolchains/>

*Note: Remaining Toolchain installation instructions describe Windows installation, instructions for the other two platforms are listed on the download pages.*

**Note: The Windows toolchains will install to the drive the installer is run from. To install from a USB drive, make sure to copy the installer to a permanent drive on the computer before running it. If you accidentally install in the wrong location, run the installer again and select "Remove" to uninstall, move the installer to the desired drive and then re-install.**

**Windows:** Double click on the downloaded file to launch it. If you receive a Security Warning, click Run. Check the box to accept the License Agreement, then click Install. When the install completes, click Finish.

**Mac OSX:** Double-click on the downloaded file in Finder to unzip it. In Finder, right-click on the "FRC ARM Toolchain.pkg" file, then press the option key on your keyboard, and click "Open". Follow the steps to install the package.

**Linux:** See the instructions in the text file on the toolchains page.

## Getting Eclipse



You can get eclipse from the web site: <http://www.eclipse.org> then press the "Download" button to select the version to be used.

# Getting Started with the 2016 Control System

## Download Eclipse

The screenshot shows the Eclipse IDE download page. It features two main sections: 'Eclipse IDE for Java Developers' and 'Eclipse IDE for C/C++ Developers'. Both sections include download links for Windows (32-bit and 64-bit) and Mac OS X (32-bit and 64-bit). A red callout box highlights the text '32/64 should match Java version'.

**Eclipse IDE for Java Developers**  
166 MB | 918,911 DOWNLOADS  
The essential tools for any Java developer, including a Java IDE, a Git client, XML Editor, Mylyn, Maven integration and WindowBuilder...  
Windows  
32 bit | 64 bit

**Eclipse IDE for C/C++ Developers**  
176 MB | 377,192 DOWNLOADS  
An IDE for C/C++ developers with Mylyn integration.  
Windows  
32 bit | 64 bit

32/64 should match Java version

Select the version of eclipse that matches your desired programming language (there are instructions below for adding C++ to Java or Java to C++). You should choose the version of eclipse that matches your operating system and version of Java from above.

At the time of this writing the current version is Mars (4.5) and that is what we've been using for development of the tools. On the next screen choose a download site and start the download. Choose a location such as the downloads folder for the zip file.

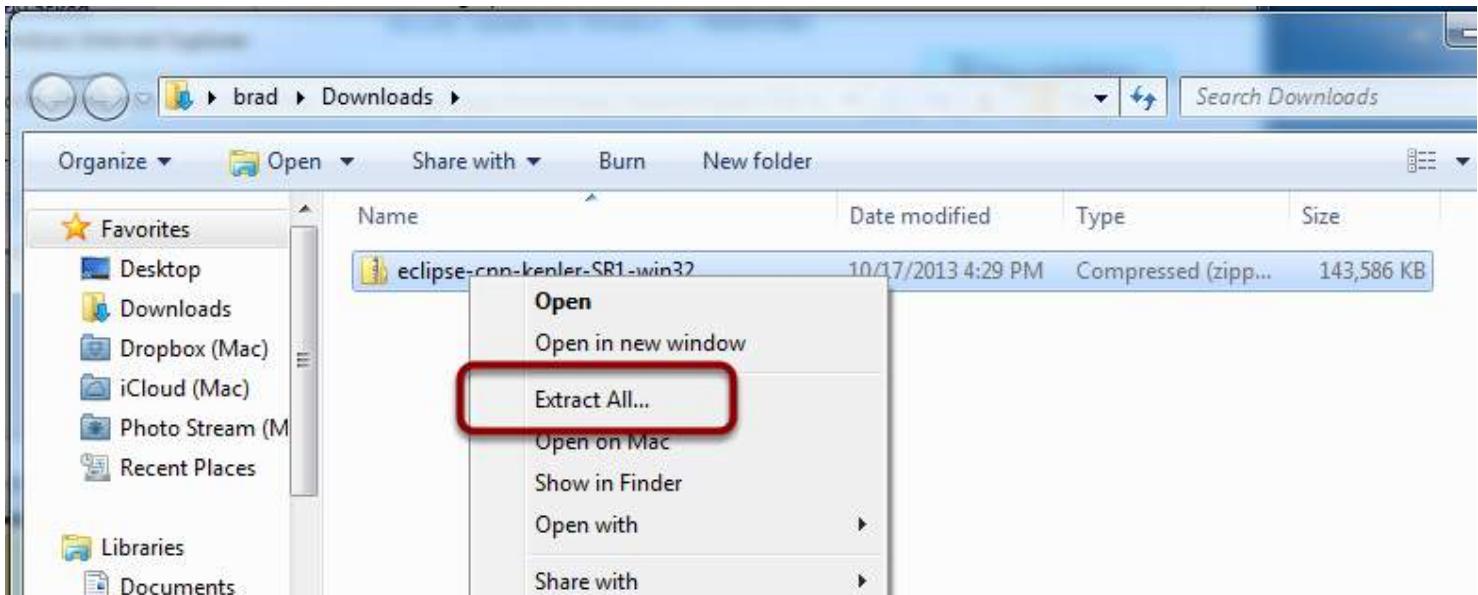
Note: on 64 bit Linux systems it might be necessary to install 32 bit version of libc. For example, on Ubuntu Linux, the command would be:

```
sudo apt-get install libc6-i386
```

This is necessary to run the gcc binaries as part of the plugins since they are compiled for 32 bit linux.

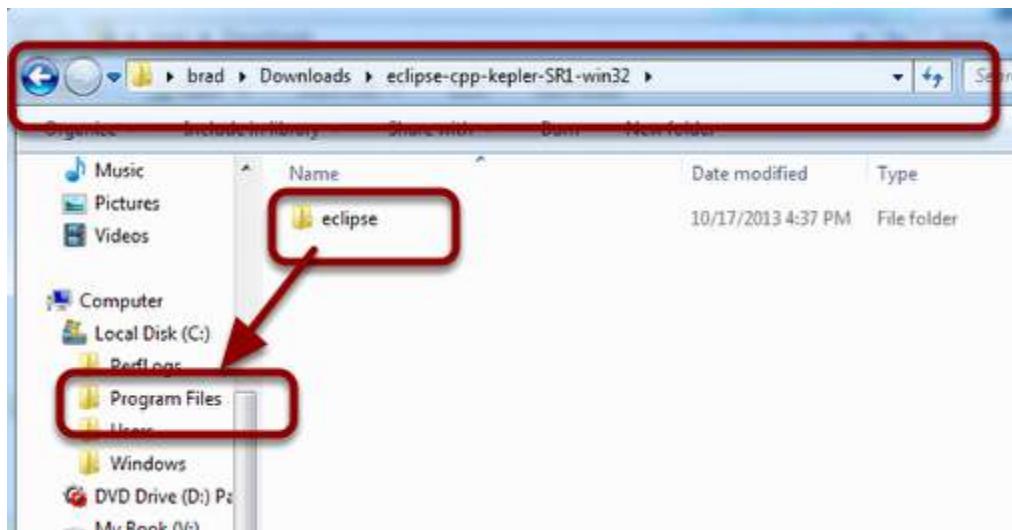
# Getting Started with the 2016 Control System

## Unpack the eclipse folder and move it to Program Files



Extract the contents of the zip file by right-clicking on the .zip file in a windows explorer window and selecting "Extract All..." and taking the default for the location to extract it.

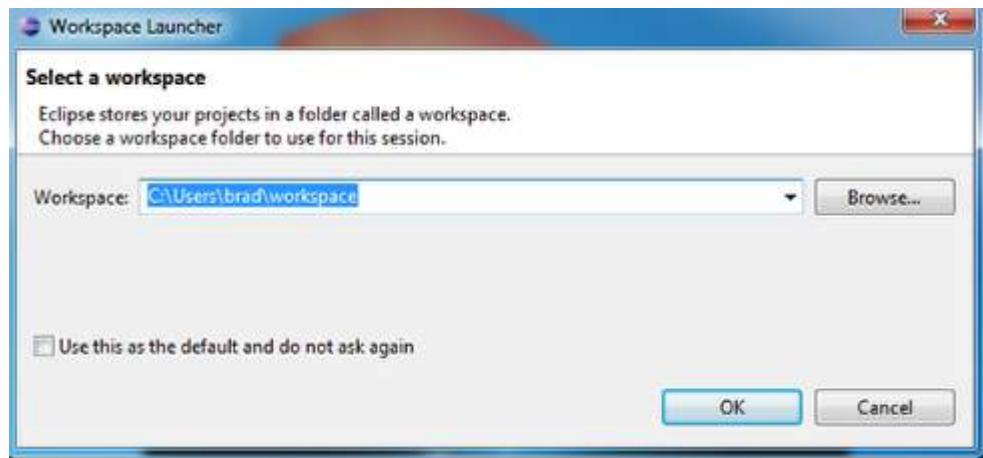
## Move the extracted eclipse folder to Program Files



Move the extracted folder to Program Files or some other convenient location from which to easily run it. Within the eclipse folder you'll see the file "eclipse.exe". You can right-click on "eclipse.exe" and select "Pin to start menu" to make it easier to run eclipse without having to find the installation location.

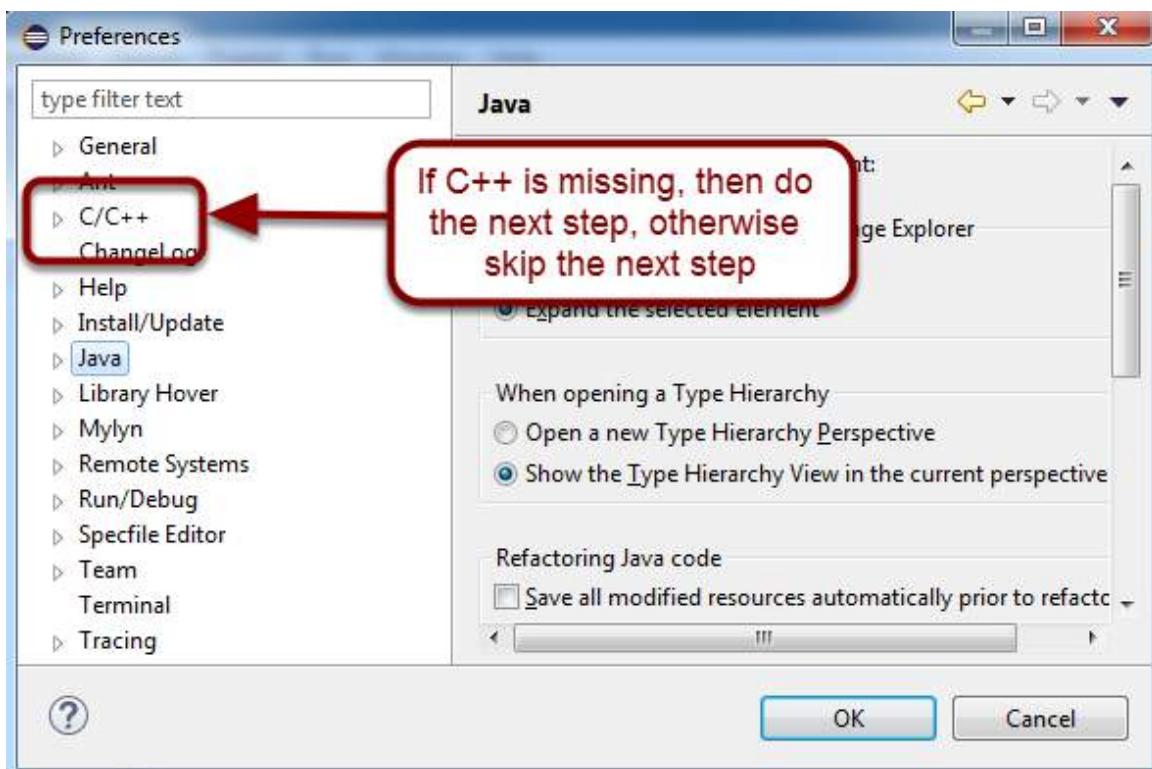
# Getting Started with the 2016 Control System

## Starting Eclipse for the first time



Start Eclipse (it will be on your start menu if you chose to pin it from the previous step.) The first time Eclipse starts it will ask you for the location of your workspace. A workspace is the location on disk where projects and files are stored by default. You can have more than one workspace, but it's suggested to take the default location until you have more experience with Eclipse.

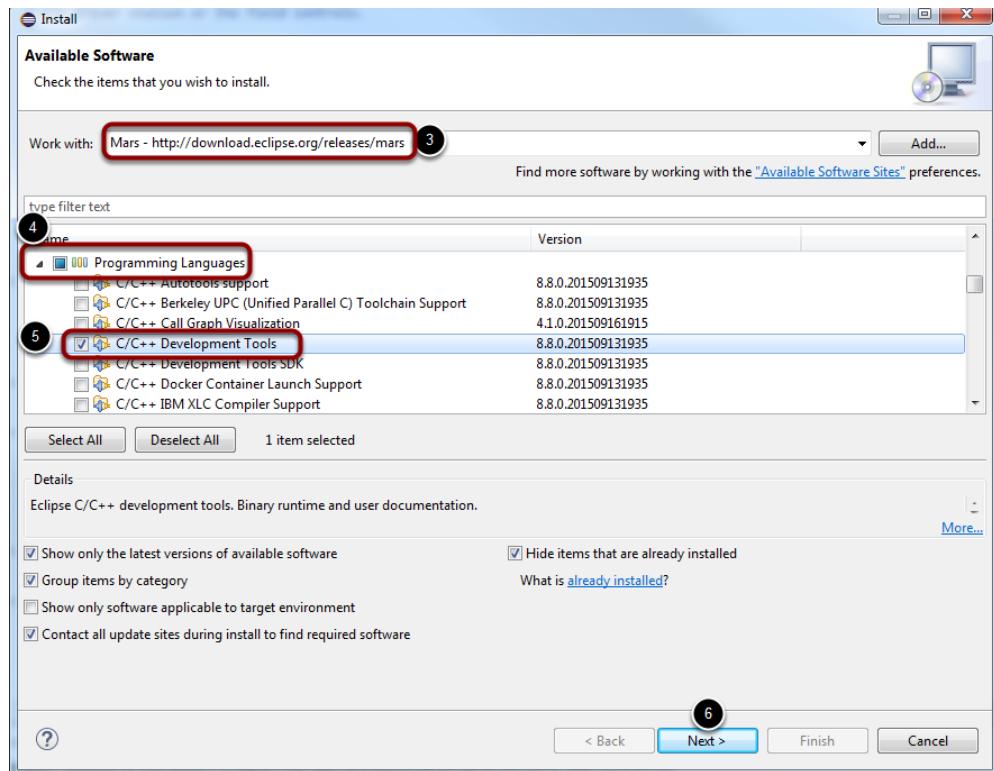
## Adding C++ to Java Eclipse



# Getting Started with the 2016 Control System

To program C++ with the Java version of Eclipse, you will need to have the C++ Development Tools (CDT) installed. To determine if they're already installed, select Window, then Preferences from the menu bar. Then look for C/C++ on the left side of the Preferences window. If it is missing then you must install it. The installation procedure is in the next step.

## Install Eclipse C++ Development Tools



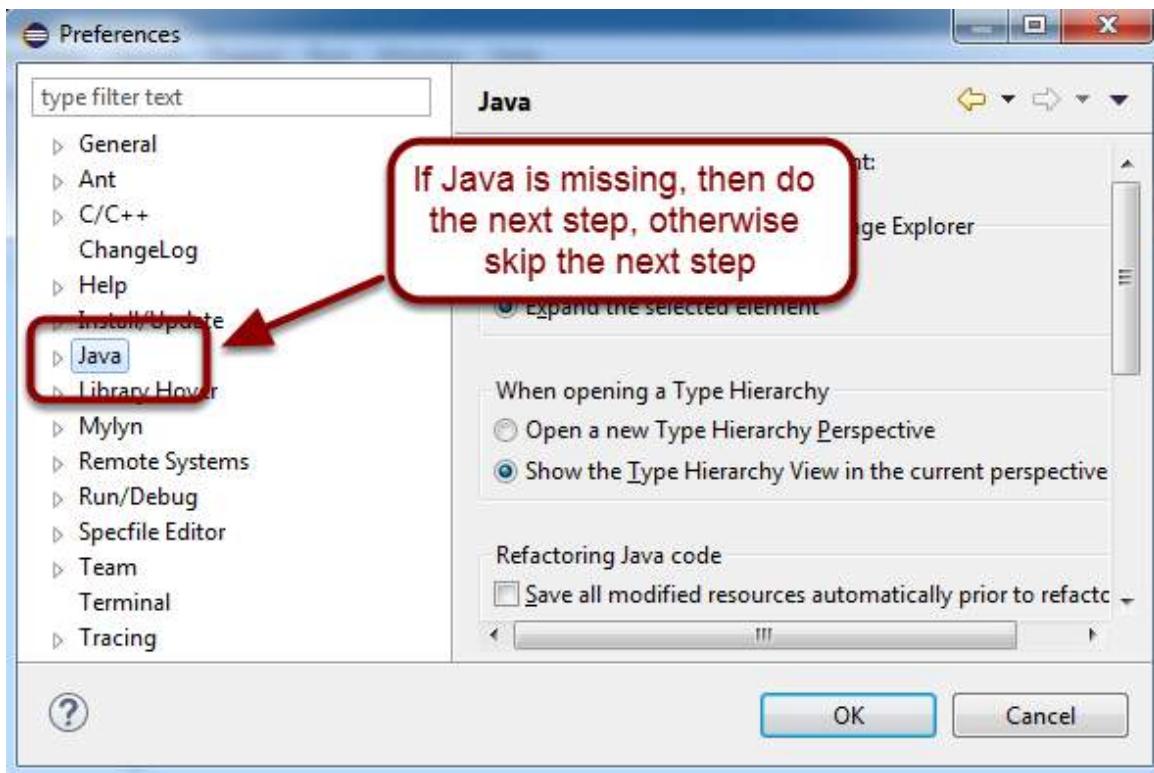
If C/C++ is missing from the preferences window (see previous step), then it must be installed

1. Close the Preferences window if it's open.
2. Select Help, then Install New Software... from the menu bar.
3. Click the dropdown and select the "Mars" site as shown.
4. Scroll down to the Programming Languages section and click the arrow to expand.
5. Click the checkbox to choose Eclipse C++ Development Tools
6. Click Next.
7. Take the defaults for the other options and let Eclipse restart.

When these steps are finished, and Eclipse has restarted, C++ should be an available option on the Preferences window, and all the C++ perspectives will be available.

# Getting Started with the 2016 Control System

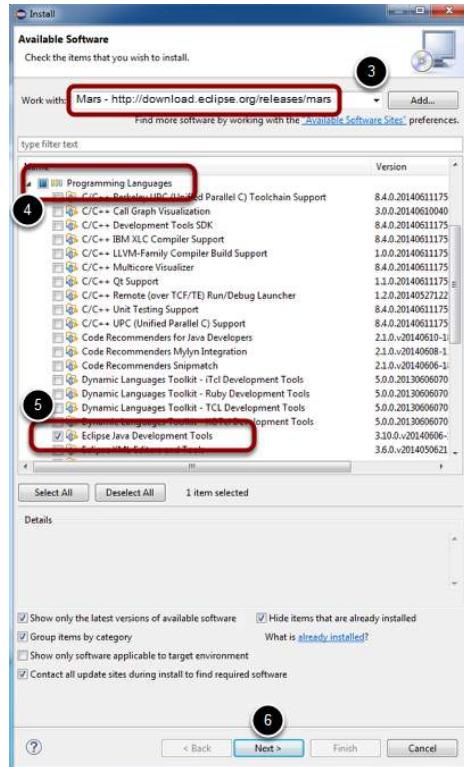
## Adding Java to C++ Eclipse



To program Java with the C++ version of Eclipse, you will need to have the Java Development Tools (JDT) installed. To determine if they're already installed, select Window, then Preferences from the menu bar. Then look for Java on the left side of the Preferences window. If it is missing then you must install it. The installation procedure is in the next step. If you do have the Java development tools installed (Java is shown), then skip the next step and continue configuring to Setting up the JDK in Eclipse.

# Getting Started with the 2016 Control System

## Install Eclipse Java Development Tools



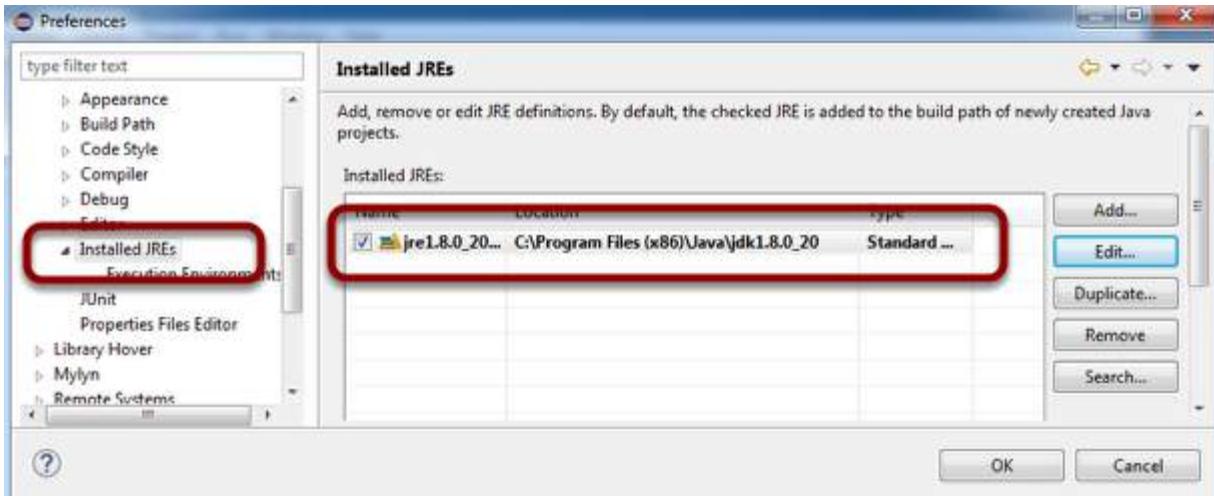
If Java is missing from the preferences window (see previous step), then it must be installed

1. Close the Preferences window if it's open.
2. Select Help, then Install New Software... from the menu bar.
3. Click the dropdown and select the "Mars" site as shown.
4. Scroll down to the Programming Languages section and click the arrow to expand.
5. Choose Eclipse Java Development Tools
6. Click Next.
7. Take the defaults for the other options and let Eclipse restart.

When these steps are finished, and Eclipse has restarted, Java should be an available option on the Preferences window, and all the Java perspectives will be available.

# Getting Started with the 2016 Control System

## Setting up the JDK in eclipse (Java teams only)

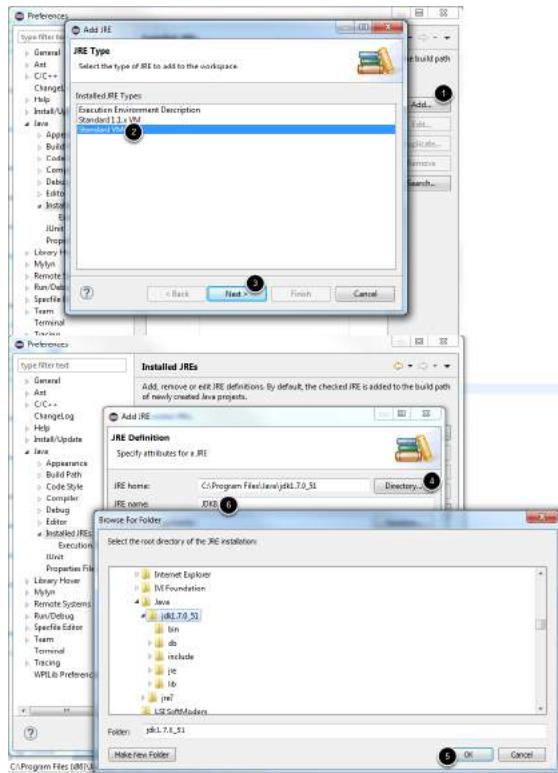


Select Windows from the menu bar, then Preferences. Choose Java preferences in the list on the left of the Preferences window, then Installed JREs. Be sure that the installed JDK is selected as shown (make sure the "Location" field includes jdk 8 or 1.8, the name field may be the same in either location). This will enable eclipse to build Java programs for the RoboRIO. Without this setting you will see error messages about the JRE path not being set correctly.

If you do not see any option with the appropriate location, see the next step "Adding the JDK". If you do have the appropriate option, skip the next step.

# Getting Started with the 2016 Control System

## Adding the JDK

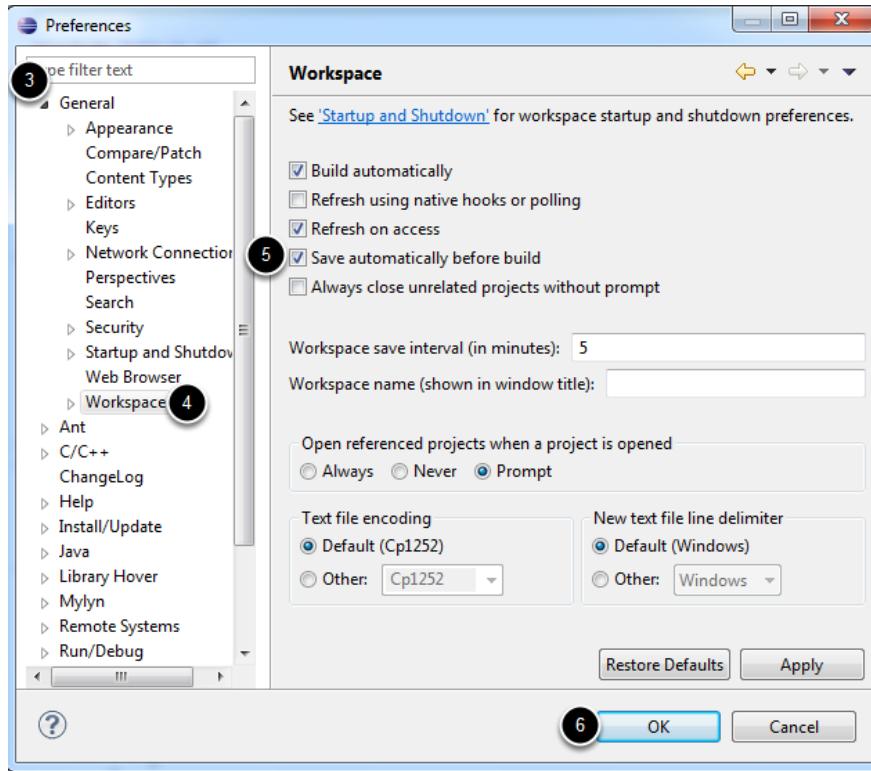


Only if the JDK is not shown in the step above:

1. Click Add
2. Select Standard VM
3. Click Next
4. Click Directory and browse to the folder for the JDK (usually C:\Program Files\Java\\* or C:\Program Files (x86)\Java\\*). The image shows jdk1.7.0\_51, you will likely have a jdk1.8.\* version.
5. Click OK. Pick a name for the JRE such as JDK8.
6. Click Finish
7. Make sure the box for the newly added JDK entry is checked.

# Getting Started with the 2016 Control System

## Configuring eclipse

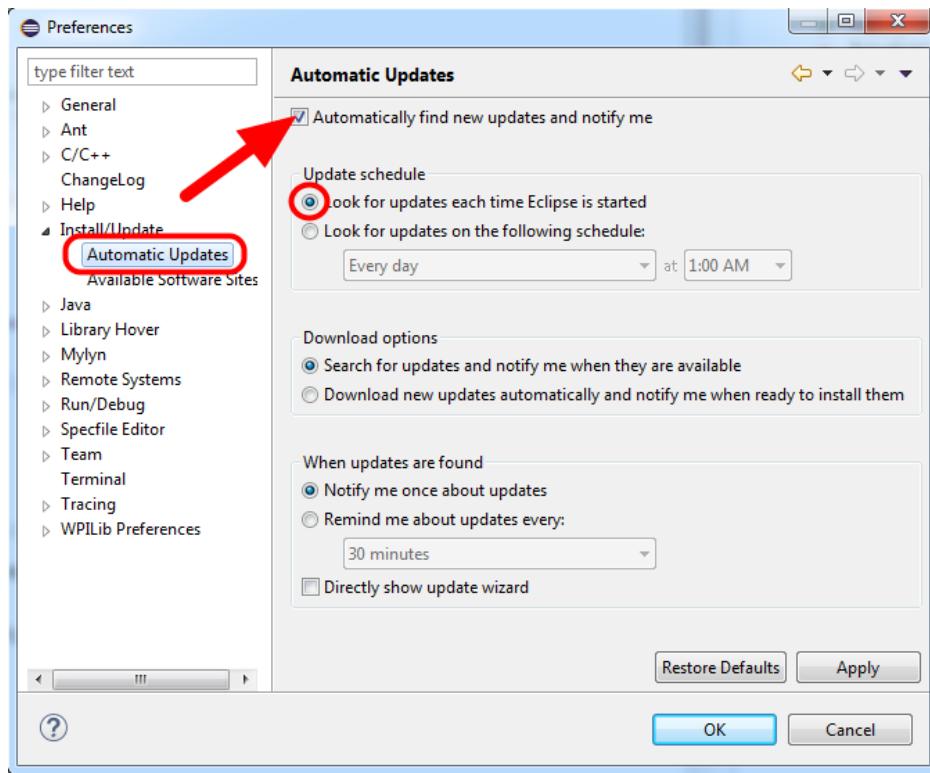


There are a huge number of configuration options for eclipse to set up the environment for your preferences. One suggested setting to note is: "Save automatically before build." This setting will cause all of your workspace changes to be saved when you build the project. If you don't set this, remember to save changes before building, otherwise the rebuilt program won't reflect your newest updates.

To set this, go to Window -> Preferences -> General -> Workspace -> Check Save automatically before build -> OK

# Getting Started with the 2016 Control System

## Automatic Updates

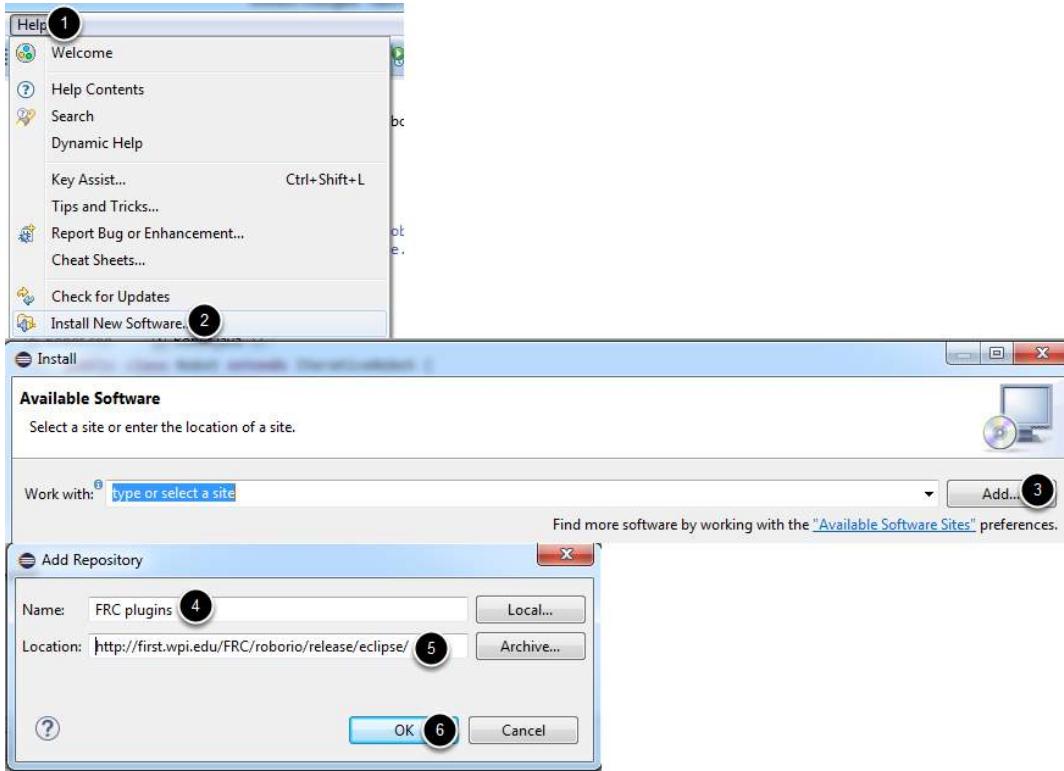


Another recommended setting is enabling Automatic Updates. With Automatic Updates enabled, Eclipse will check for updated versions of the plugins each time it starts and inform you if an update is available. This will help insure you are notified of new versions of the WPILib plugins.

To enable Automatic Updates, select **Install/Update** then **Automatic Updates**. Check the box at the top to **Automatically find new updates and notify me**. Select the radio button to **Look for updates each time Eclipse is started**. Then click **OK**.

# Getting Started with the 2016 Control System

## Installing the development plugins - Option 1: Online Install



It is recommended to install the plugins using this method, which requires an active internet connection and fetches the plugins directly from the WPILib site. This will allow you to check for updates to the plugins using Eclipse.

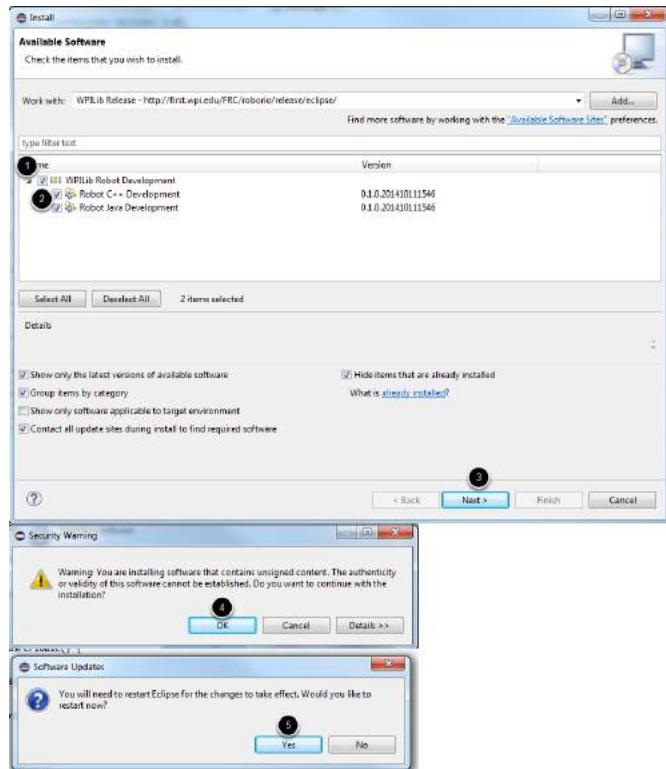
Eclipse extensions are based on user-installed plugins. To get the WPILib development tools you will need to install the correct plugin for your language.

When Eclipse starts:

1. Select "Help"
2. Click "Install new software".
3. From here you need to add a software update site, the location where the plugins will be downloaded. Push the "Add..." button then fill in the "Add Repository" dialog with:
  4. Name: FRC Plugins
  5. Location: <http://first.wpi.edu/FRC/roborio/release/eclipse/>
  6. Click "OK".

# Getting Started with the 2016 Control System

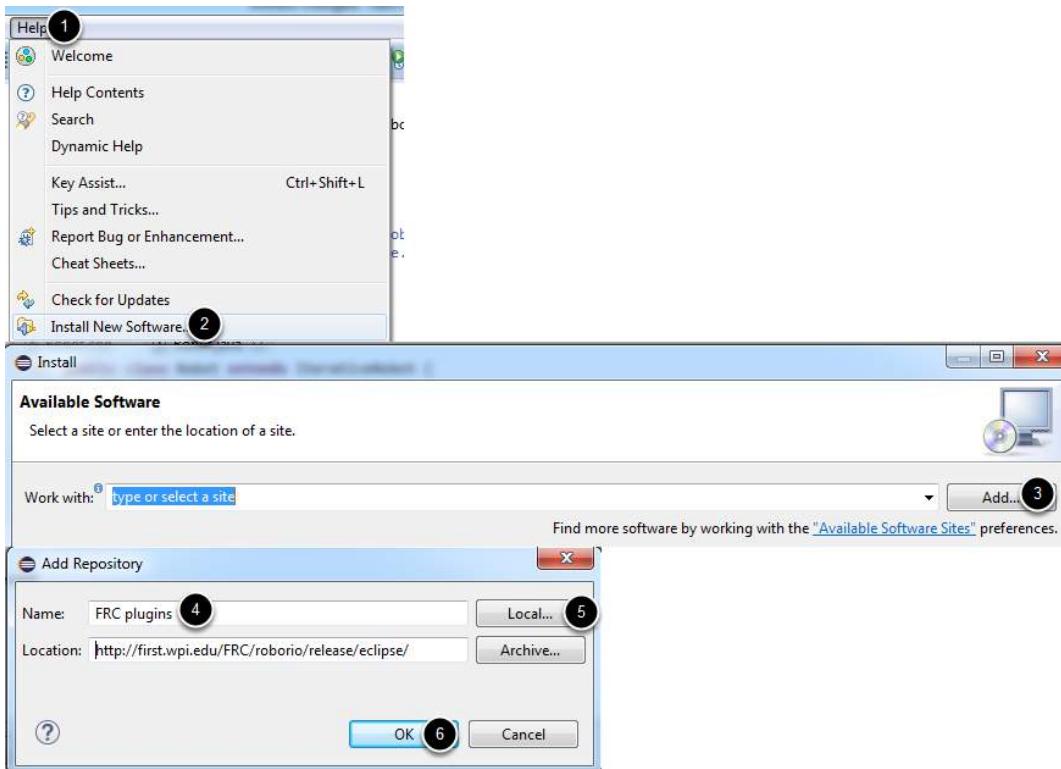
## Selecting the correct plugins



1. Click the arrows if necessary to expand the WPILib Robot Development menu.
2. Select the WPILib Robot Development plugin for your desired language (you can install both if you wish to try programming in both languages)
3. Click Next, Next on the next page, then click the radio button to accept the license agreement and click Finish
4. If you receive a Security Warning prompt, click OK to continue.
5. When prompted, restart Eclipse. After Eclipse restarts and you select your Workspace (if prompted) you will see a dialog that says Installing Java. This details the installation progress of the plugins, wait for the install to complete before proceeding. This dialog should only appear when the plugins are first installed or updated.

# Getting Started with the 2016 Control System

## Installing the development plugins - Option 2: Download and install offline



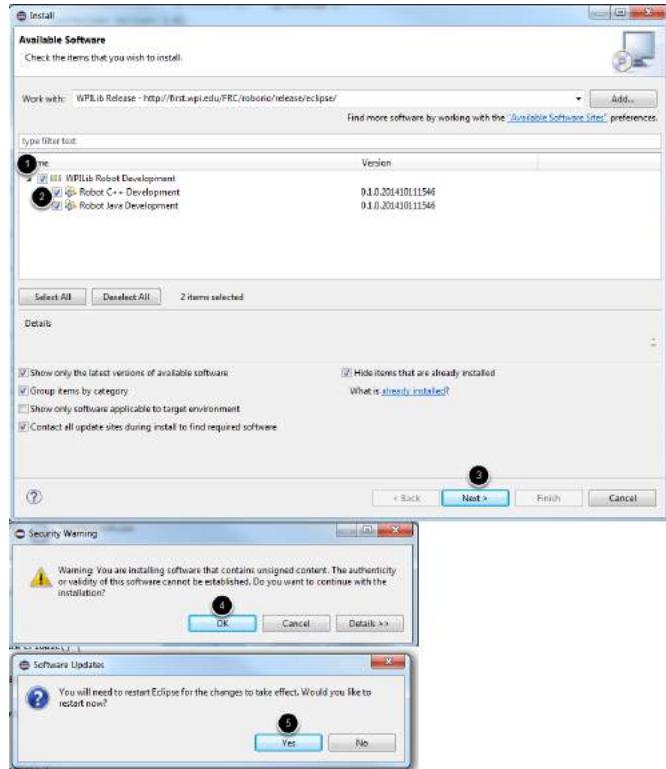
If you need to download the plugins and install them on a different machine offline, you will be unable to check for updates using Eclipse. Download the zipfile containing the plugins from <http://first.wpi.edu/FRC/roborio/release/EclipsePluginsV5.zip>. Right click on the zip and select Extract All to extract the files.

When Eclipse starts:

1. Select "Help"
2. Click "Install new software".
3. From here you need to add the downloaded plugin location. Push the "Add..." button then fill in the "Add Repository" dialog with:
4. Name: FRC Plugins Offline
5. Click Local
6. Browse to the "site" directory inside the directory you extracted the zip file to.
7. Click "OK".

# Getting Started with the 2016 Control System

## Selecting the correct plugins

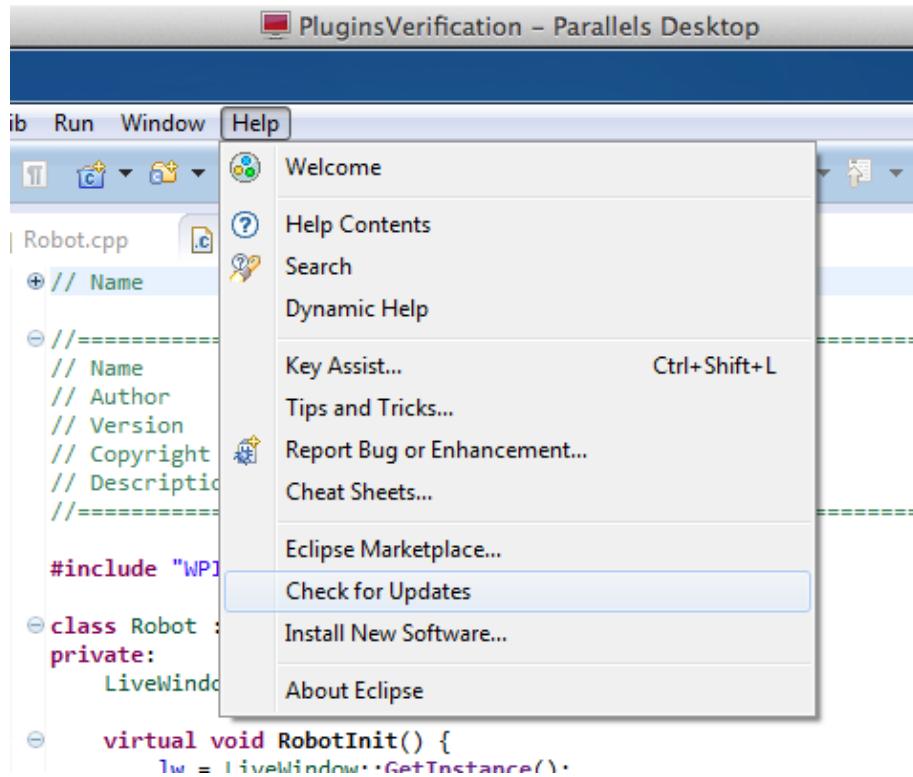


1. Click the arrows if necessary to expand the WPILib Robot Development menu.
2. Select the WPILib Robot Development plugin for your desired language (you can install both if you wish to try programming in both languages)
3. Click Next, Next on the next page, then click the radio button to accept the license agreement and click Finish
4. If you receive a Security Warning prompt, click OK to continue.
5. When prompted, restart Eclipse. After Eclipse restarts and you select your Workspace (if prompted) you will see a dialog that says Installing Java. This details the installation progress of the plugins, wait for the install to complete before proceeding. This dialog should only appear when the plugins are first installed or updated.

If updated plugins are released, you can either repeat this process (you will get one additional Eclipse window telling you that the components are already installed and an upgrade will be performed instead of an install), or if online installation is an option, you can complete the online installation steps above, then get future updates using the Eclipse Automatic Updates (or the manual update check described below)

# Getting Started with the 2016 Control System

## Updating the plugins manually



Note: This only works if the plugins were installed using Option 1 - Online Install from above. For updating plugins when the offline install was used, see the note at the end of the step above.

If you choose not to enable Automatic Updates as described above, you will need to manually have Eclipse check for updates to install new versions of the plugins.

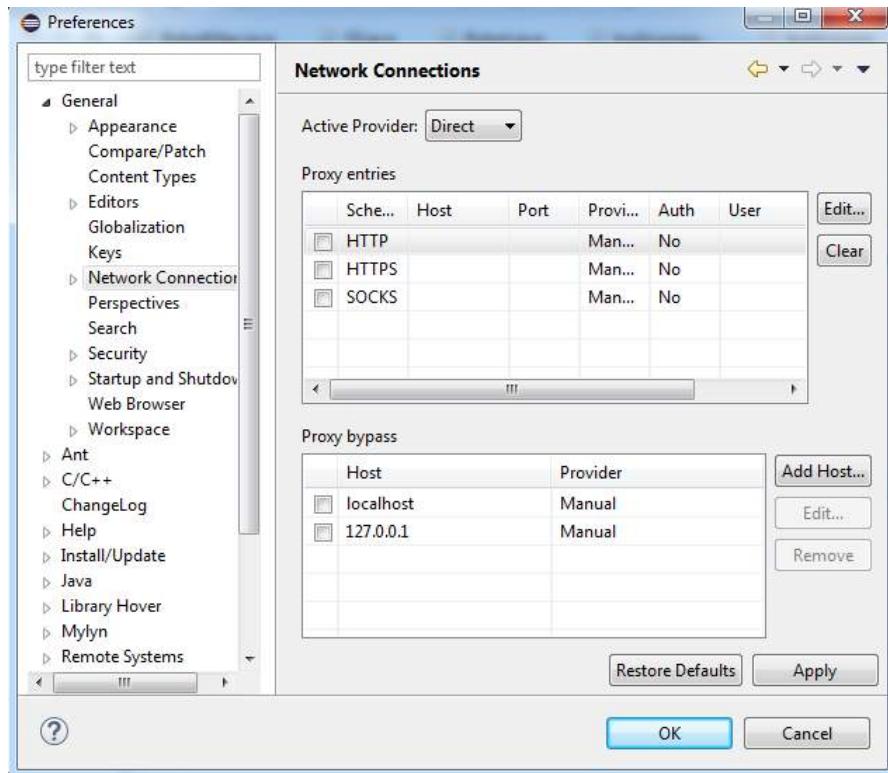
Select **Help** from the menu bar, followed by **Check for updates**. Eclipse will check if there is a newer version available of any installed plugin and inform you if an update is found. Updating the plugins will ensure that your development system is up to date with the latest version of the development tools.

## Troubleshooting

Below are some troubleshooting steps for commonly encountered issues

# Getting Started with the 2016 Control System

Unable to read repository at <http://first.wpi.edu/FRC/roborio/release/eclipse/content.xml>"



This error occurs if Eclipse cannot contact the server to download the plugins. There are a couple possible causes of this issue:

1. Your computer is not connected to the Internet. Verify your network connection and try again.
2. Your firewall is blocking Eclipse. Try adding an exception for Eclipse or disabling your Firewall.
3. Your proxy settings were read improperly by Eclipse. In Eclipse Select Window->Preferences->General->Network Connections. If you don't use a proxy or don't know, set the Active Provider to Direct. If you use a proxy set the Active Provider to Manual and configure the proxy information by selecting the protocol and clicking Edit.

## Need Java 1.7 or newer

If you get an error message when attempting to run Eclipse that says you "need Java 1.7 or newer", you have mismatched versions of Java and Eclipse installed. The easiest fix is to go back and download the other version of Eclipse (32 bit if you had 64, 64 if you had 32).

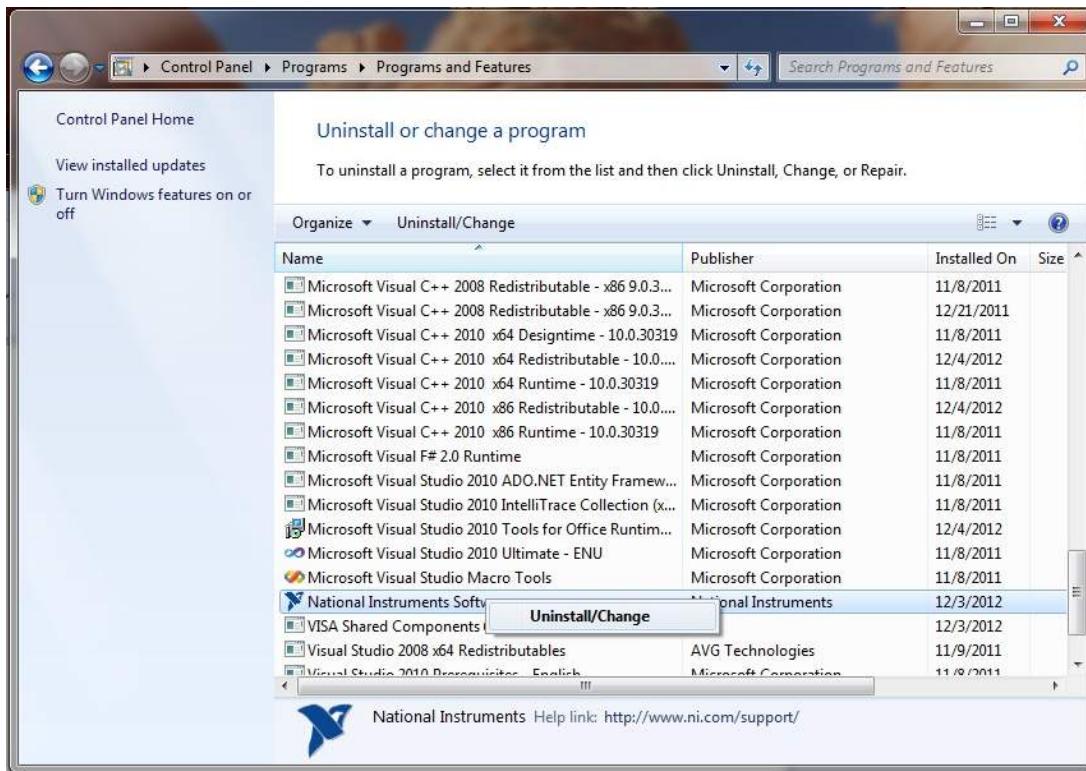
# Getting Started with the 2016 Control System

## Installing the FRC 2016 Update Suite (All Languages)

The FRC 2016 Update Suite contains the following software components: LabVIEW Update, FRC Driver Station, and FRC Utilities. If an FRC 2015 LabVIEW installation is found, the LabVIEW Update will be installed or updated, otherwise this step will be skipped. The FRC Driver Station and FRC Utilities will always be installed or updated. The LabVIEW runtime components required for the driver station and utilities is included in this package. No components from the LabVIEW DVD are required for running either the Driver Station or Utilities.

Note: The 2016 DS will only work on Windows 7, Windows 8, Windows 8.1, and Windows 10. It will not work on Windows XP.

### Uninstall Old Versions (Recommended)

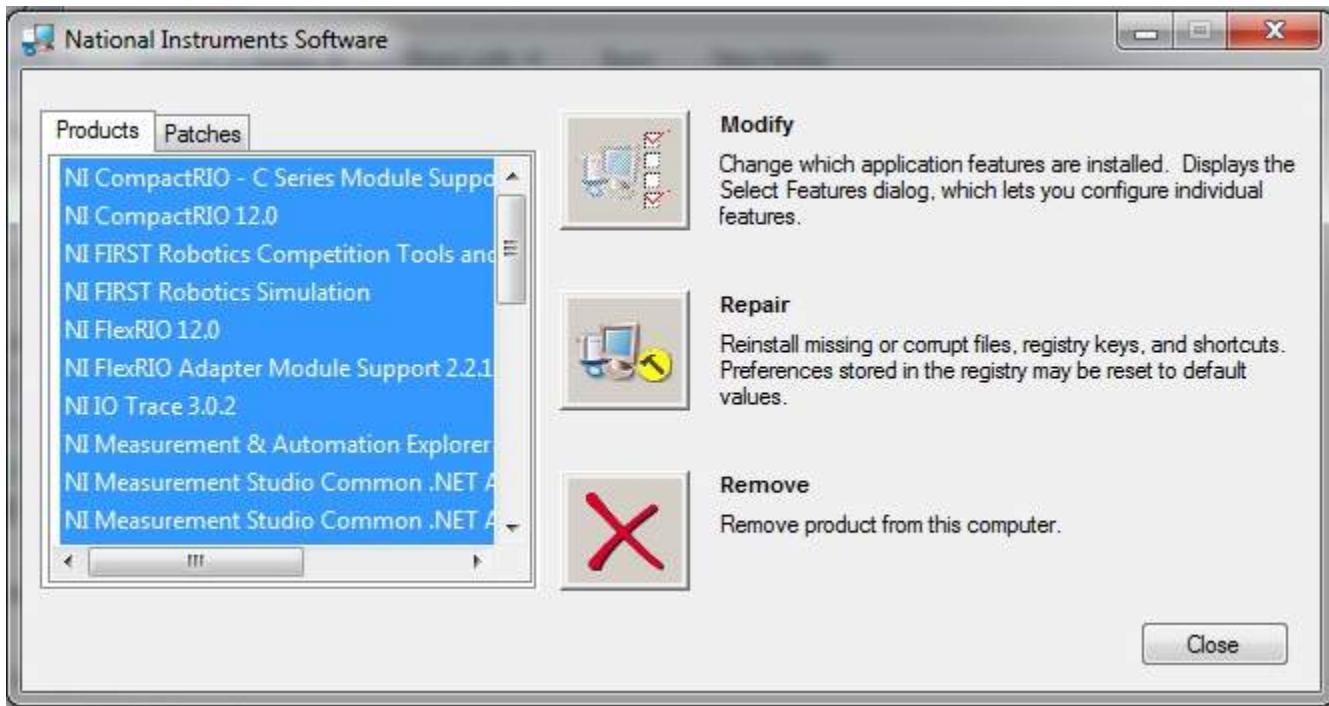


**LabVIEW teams have already completed this step, do not repeat it.** Before installing the new version of the NI Update it is recommended to remove any old versions. The new version will likely properly overwrite the old version, but all testing has been done with FRC 2015 only. Make sure to

# Getting Started with the 2016 Control System

back up any team code located in the "User\LabVIEW Data" directory before un-installing. 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



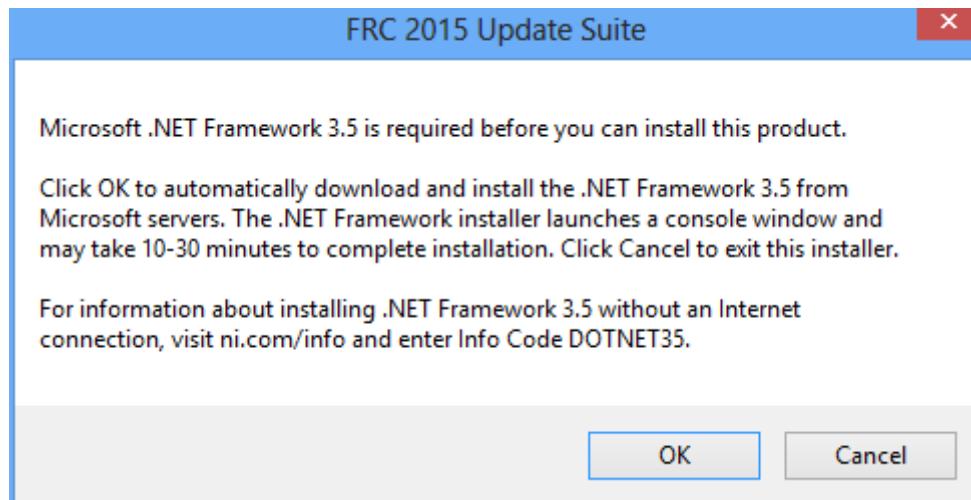
In the left pane of the dialog box that appears, select all entries. The easiest way to do this is to click the top entry to highlight it, then scroll down to the bottom entry, press and hold shift and click on the last entry then release shift. Click Remove. Wait for the uninstaller to complete and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

## Downloading the Update

Download the update from <http://ni.com/download/cds/view/p/id/5773/lang/en>

# Getting Started with the 2016 Control System

## Windows 8



If installing on Windows 8 or 10 and the above error appears, jump down to the [Addendum on Windows 8 installation](#) before returning here to re-start the installation.

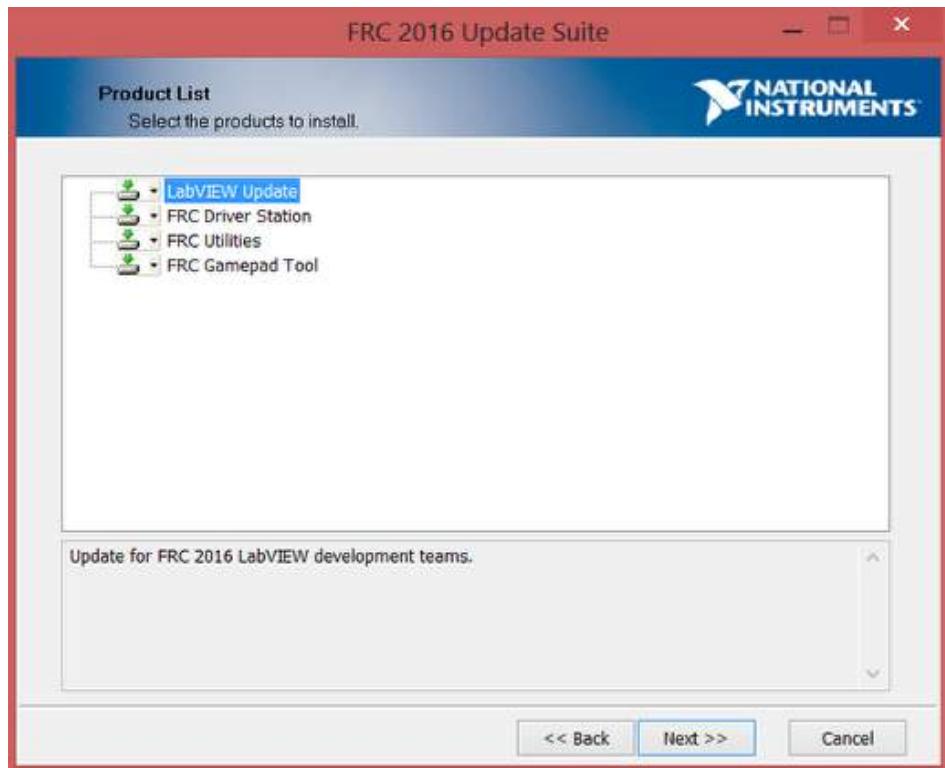
## Welcome



# Getting Started with the 2016 Control System

Right click on the downloaded zip file and select Extract All. If you downloaded the encrypted zip file, you will be prompted for encryption key @Ahead)Together!FRC^2016 Open the extracted folder and any subfolders until you reach the folder containing "setup" (may say "setup.exe" on some machines). Double click on the setup icon to launch the installer. Click "Yes" if a Windows Security prompt appears. Click "Next" on the splash screen that appears.

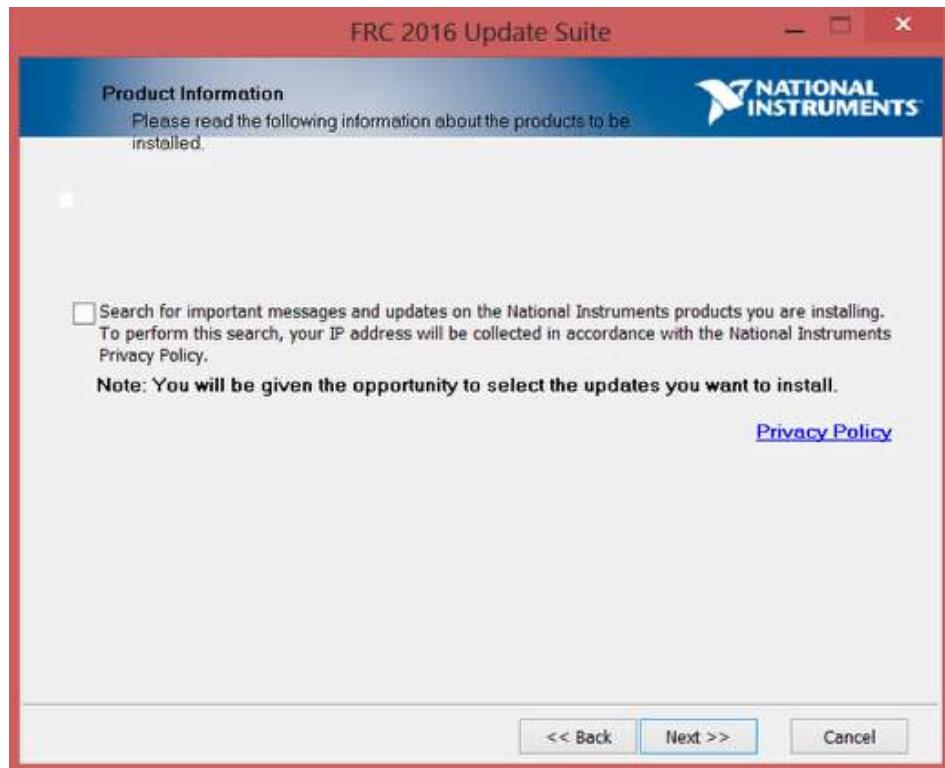
## Product List



Click "Next"

# Getting Started with the 2016 Control System

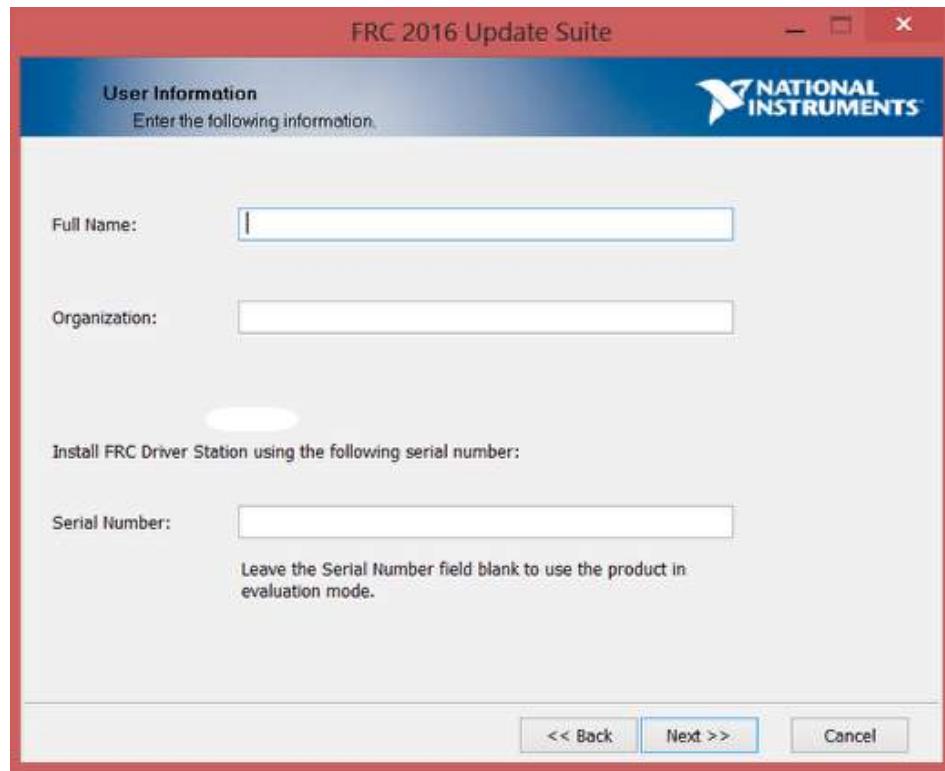
## Product Information



Un-check the box, then Click "Next"

# Getting Started with the 2016 Control System

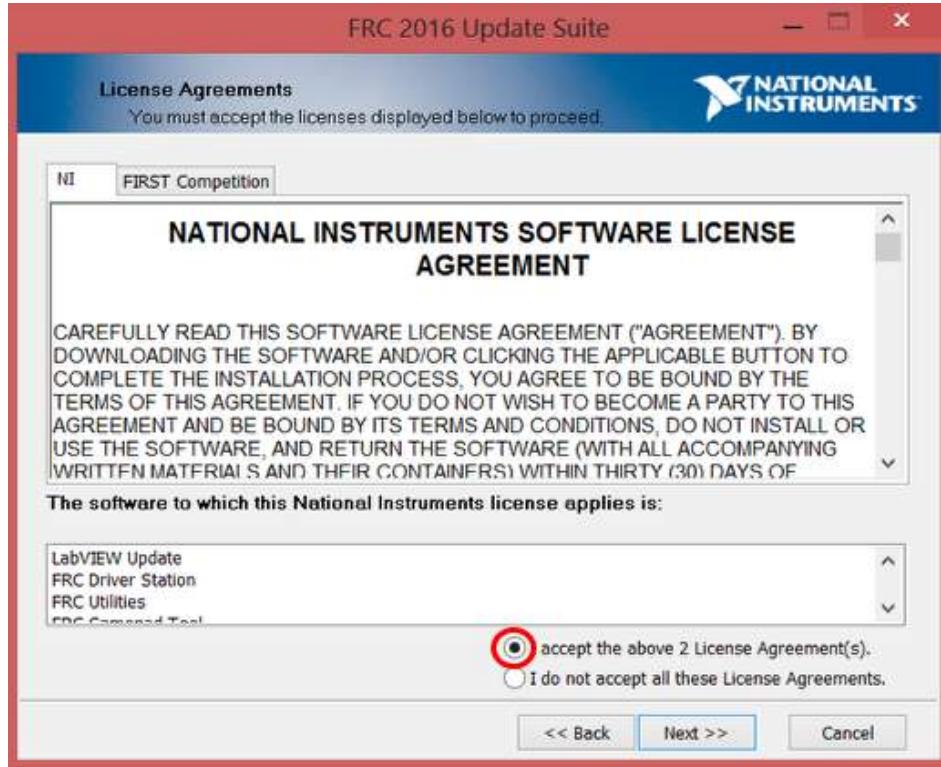
## User Information



Enter full name and organization and the serial number from your kit of parts then click Next

# Getting Started with the 2016 Control System

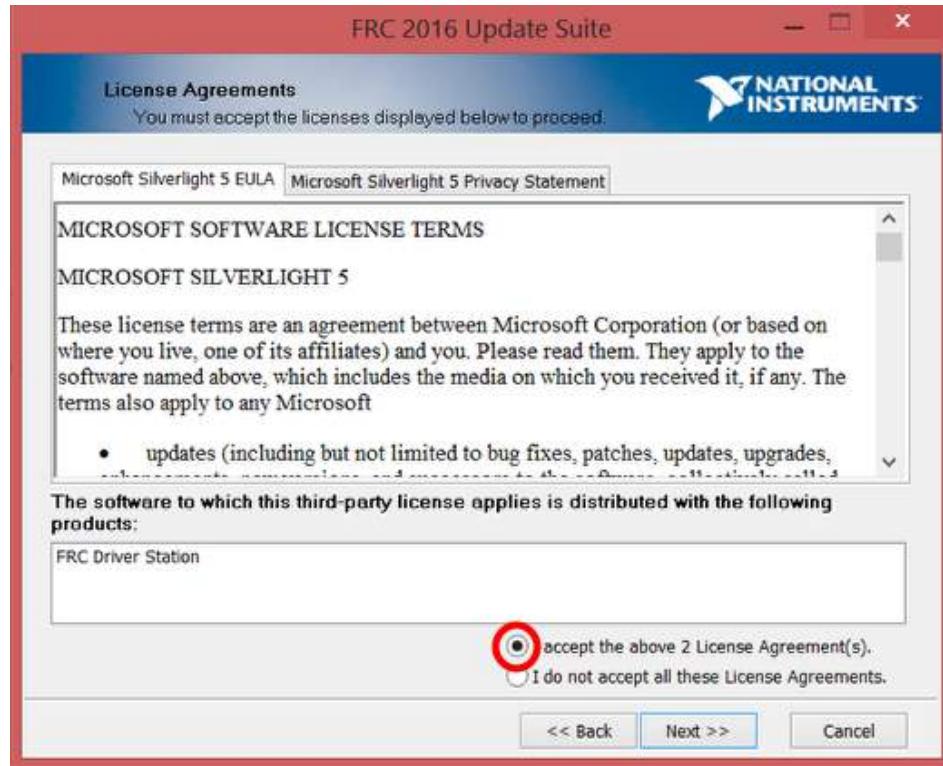
## License Agreements



Select "I accept..." then click "Next"

# Getting Started with the 2016 Control System

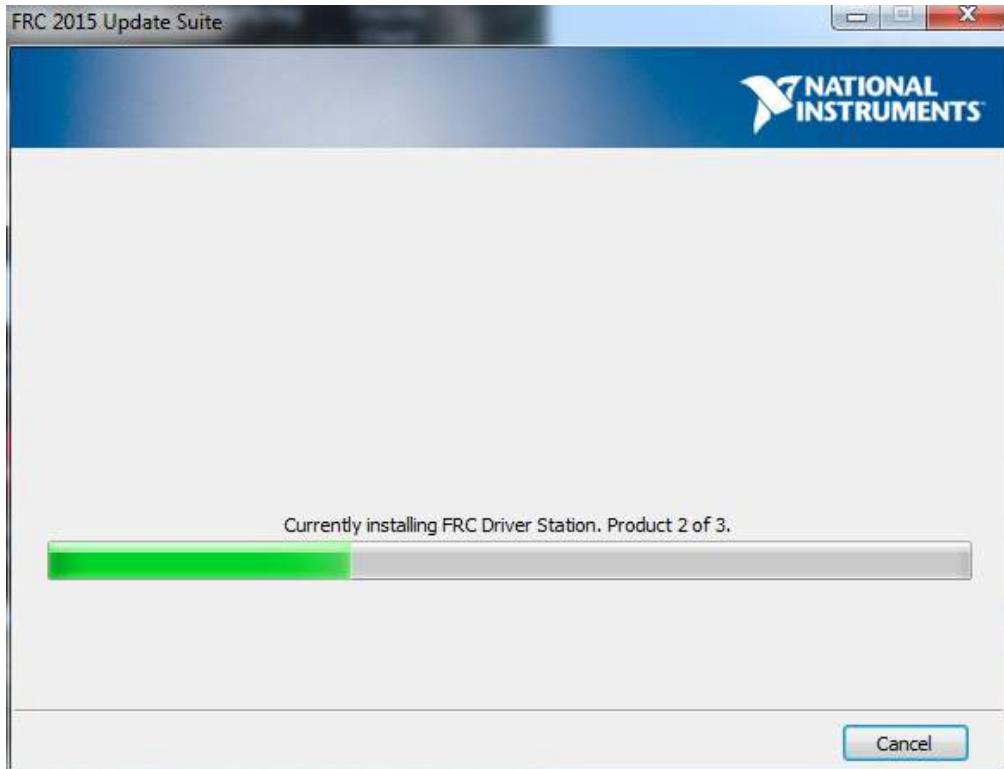
## License Agreements Page 2



Select "I accept..." then click "Next"

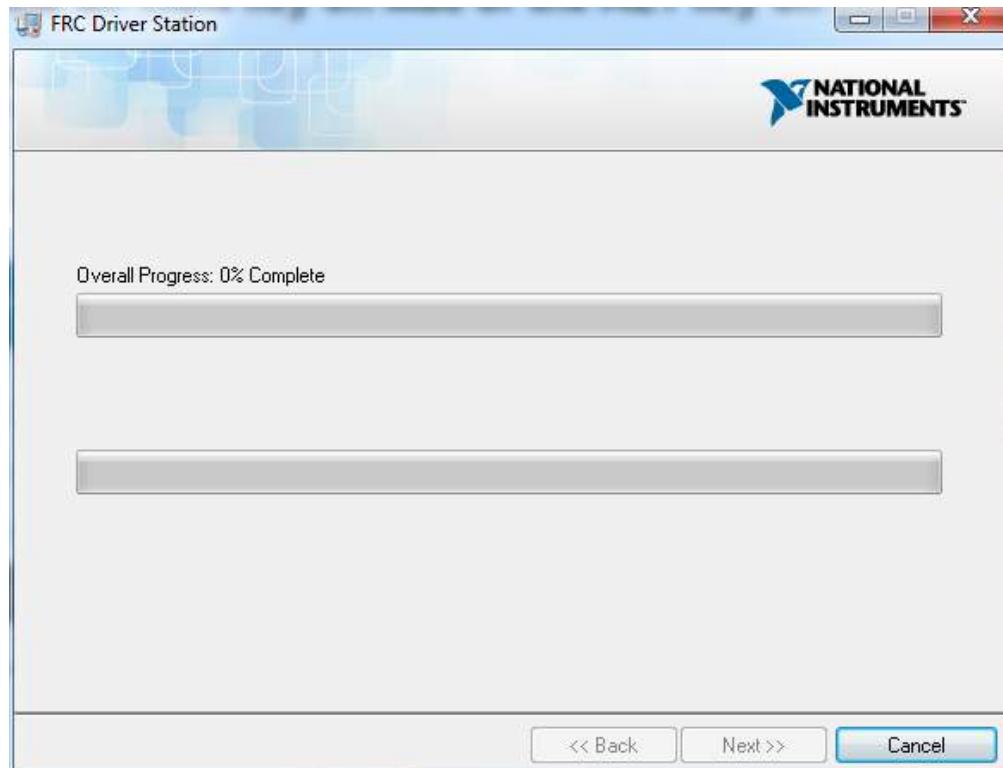
# Getting Started with the 2016 Control System

## Summary Progress



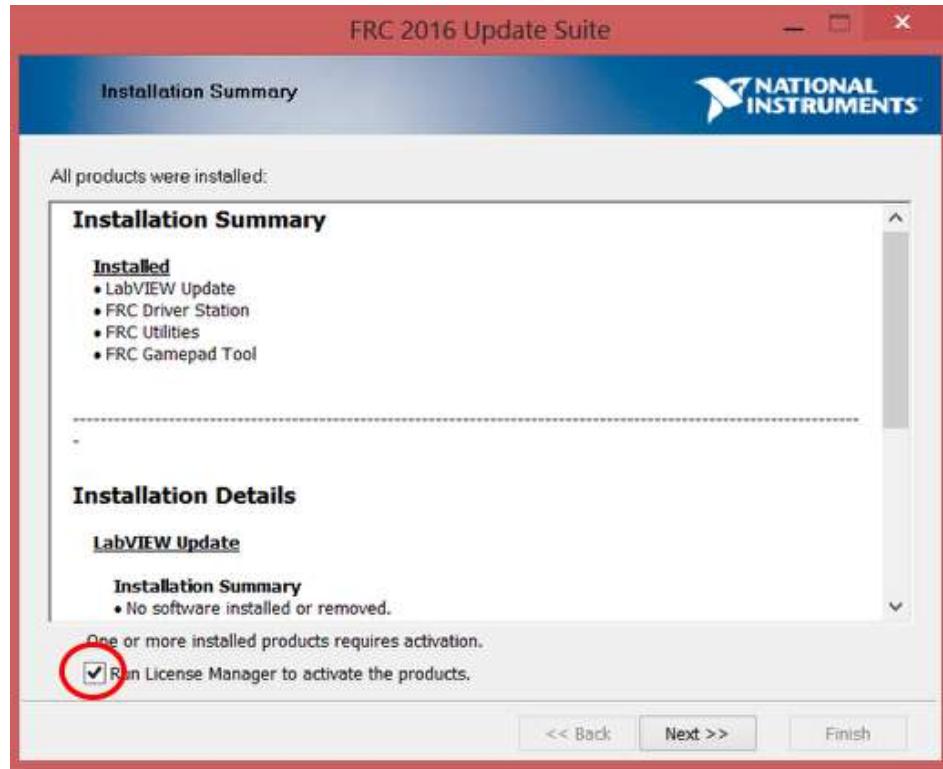
# Getting Started with the 2016 Control System

## Detail Progress



# Getting Started with the 2016 Control System

## Installation Summary



Make sure the box is checked to Run License Manager... then click Next

# Getting Started with the 2016 Control System

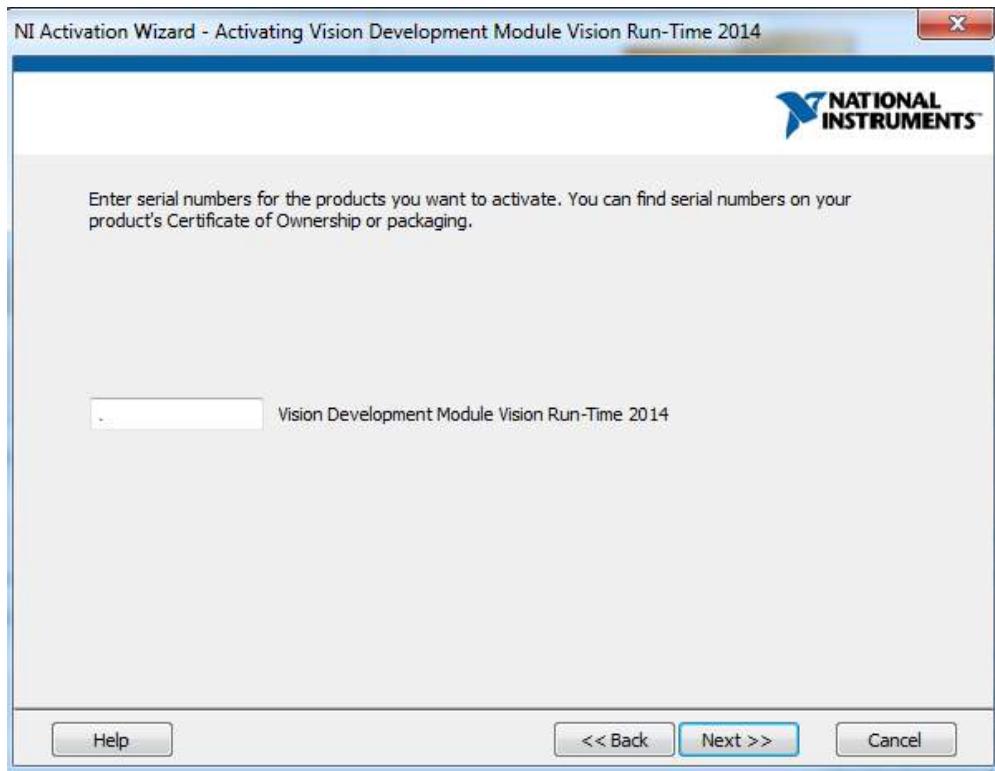
## Activate



Select your desired activation method (Internet activation recommended), then click Next

# Getting Started with the 2016 Control System

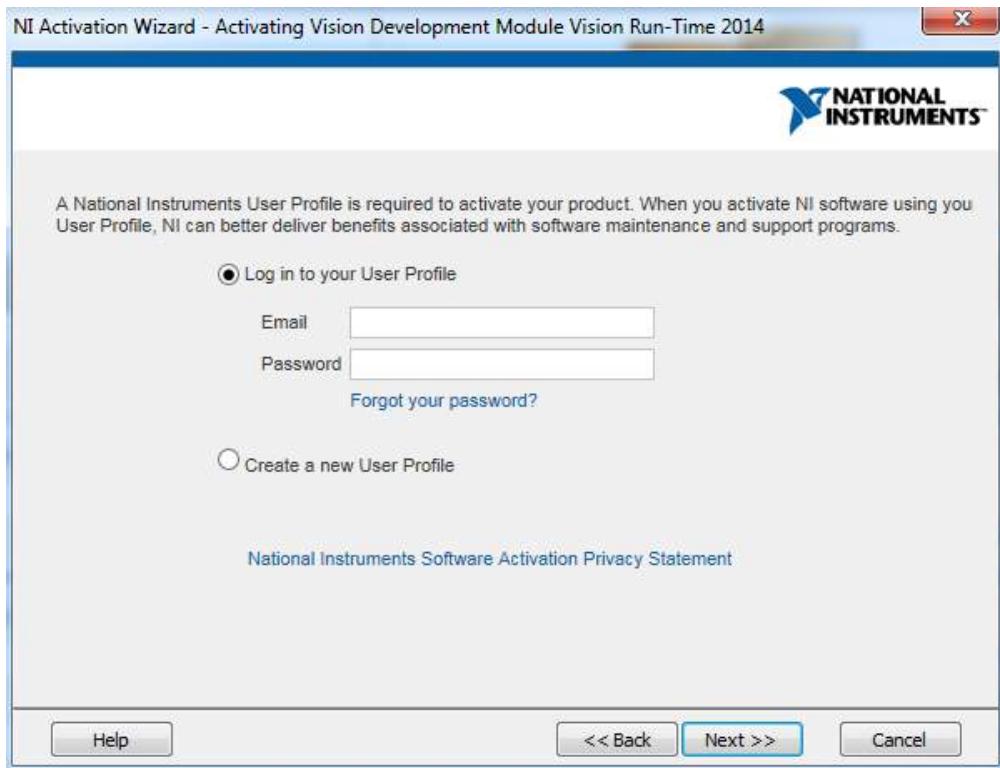
## Serial Number Confirmation



Make sure the serial number in the box matches the one from your kit, then click **Next**

# Getting Started with the 2016 Control System

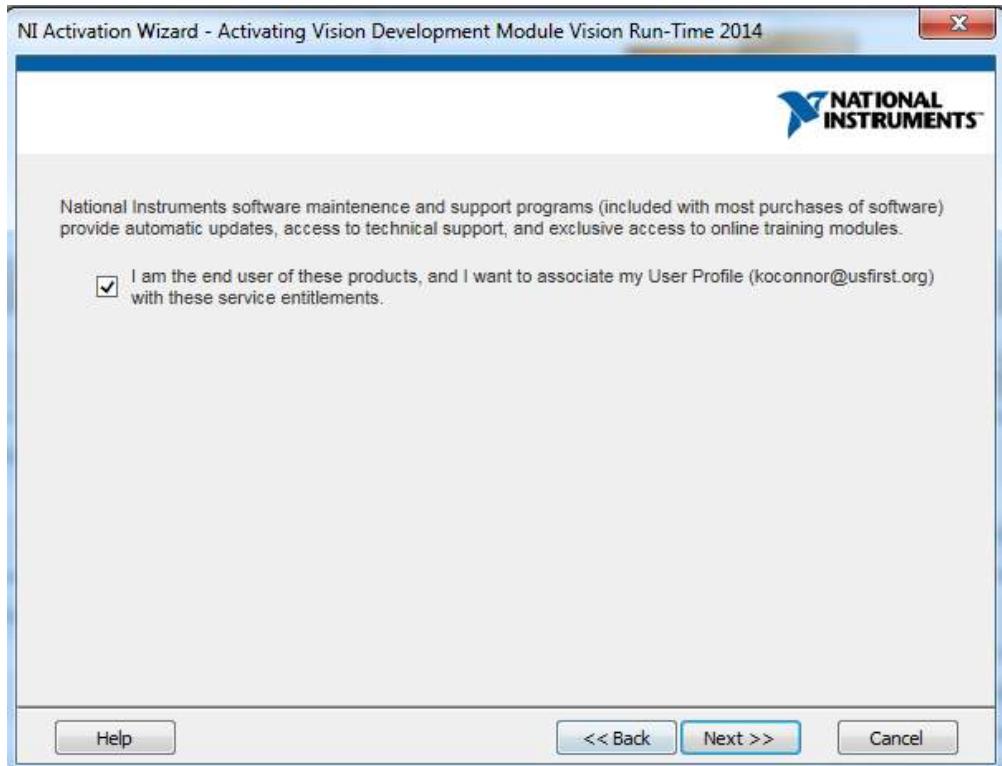
## User Profile



Log in or create an NI Profile. One profile may be used for multiple installations.

# Getting Started with the 2016 Control System

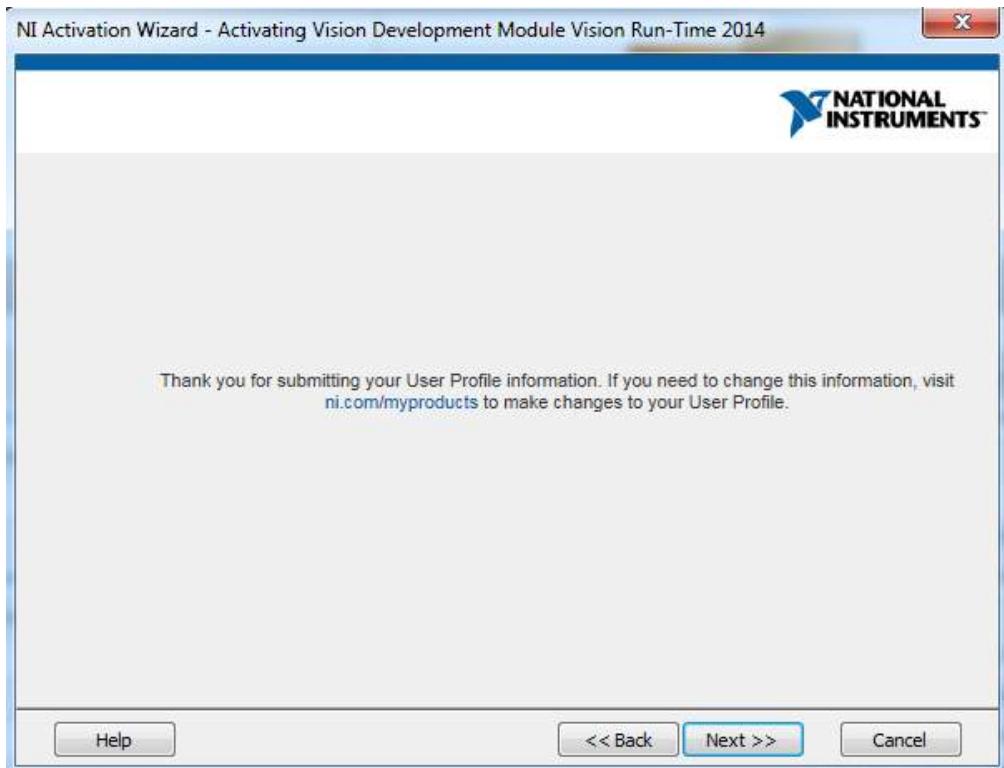
## User Profile 2



Click Next

# Getting Started with the 2016 Control System

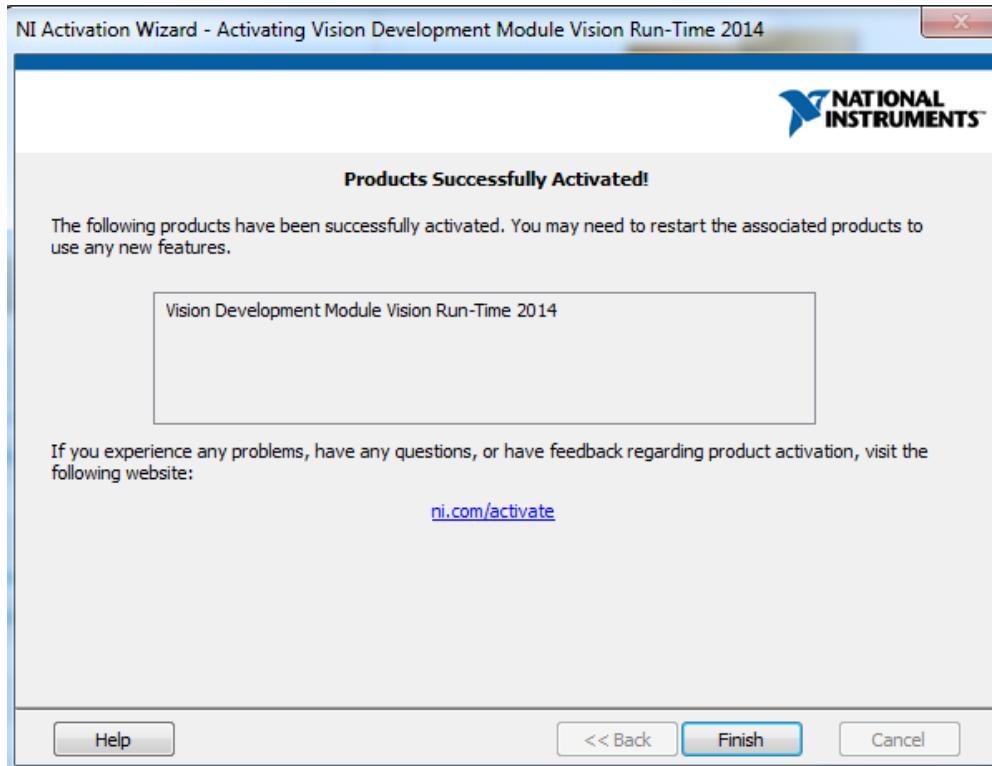
## User Profile 3



Click Next

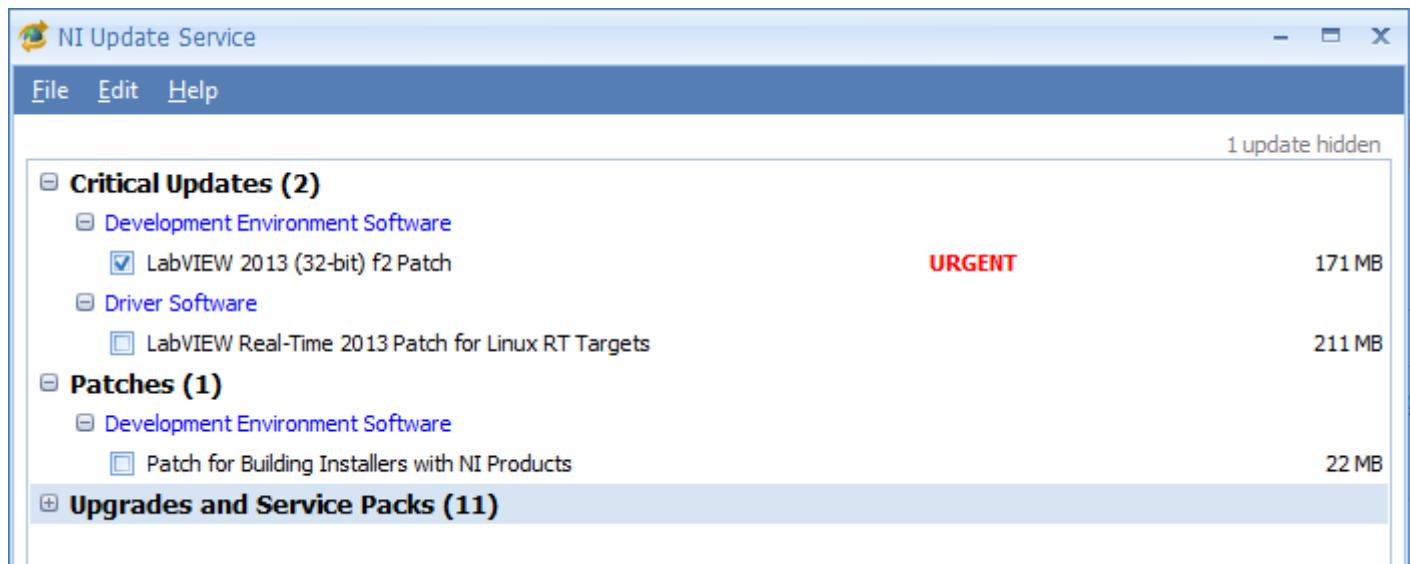
# Getting Started with the 2016 Control System

## Finish



After the product is activated, Click Finish. If prompted to Reboot, click Yes

## NI Update Service



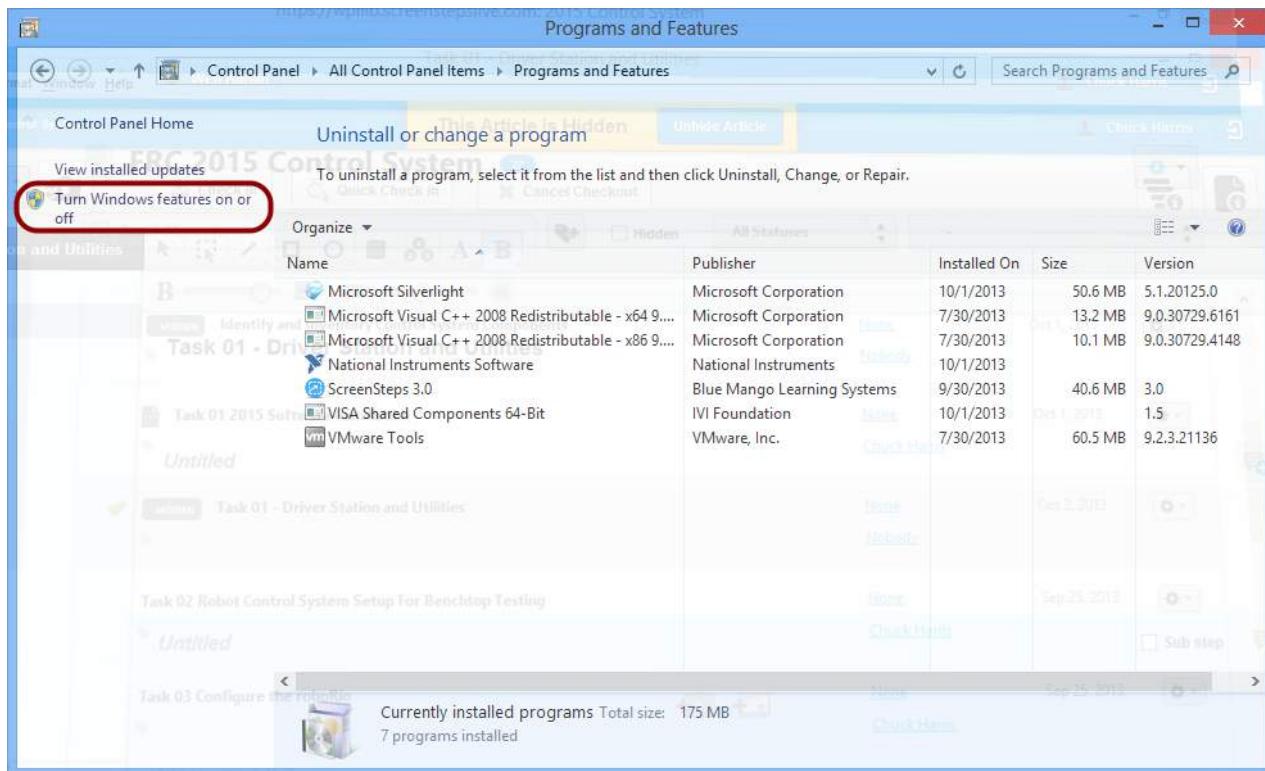
# Getting Started with the 2016 Control System

On occasion you may see alerts from the NI Update Service about patches to LabVIEW. It is not recommended to install these patches. FRC will communicate any recommended updates through our usual channels (Frank's Blog, Team Updates or E-mail Blasts).

## Addendum - Installing on Windows 8

If installing on Windows 8 or 10, the Microsoft .NET Framework 3.5 may need to be installed. If you see the dialog shown above, click "Cancel" and perform the steps shown below. An internet connection is required to complete these steps.

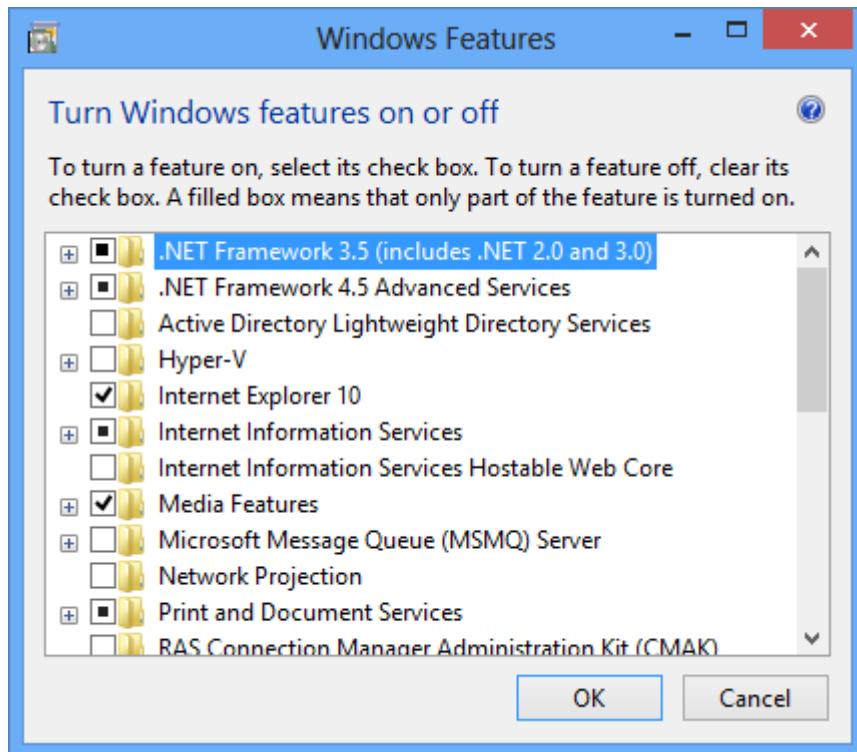
## Programs and Features



Open the "Programs and Features" window from the control panel and click on "Turn Windows features on or off"

# Getting Started with the 2016 Control System

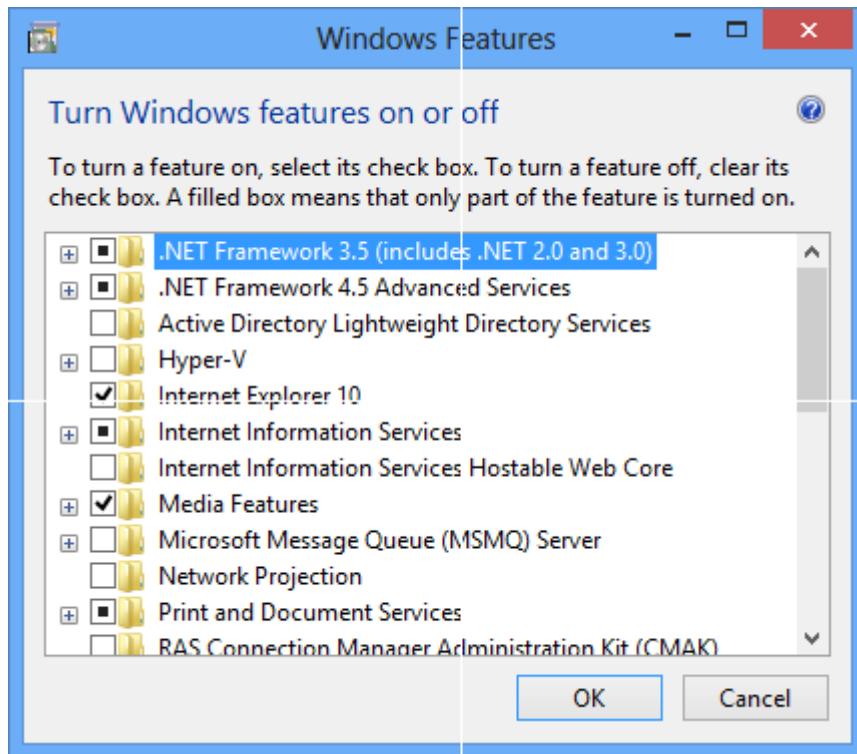
## Windows Features (.NET Framework 3.5 not on)



Select ".NET Framework 3.5 (includes .NET 2.0 and 3.0)" to enable it (a black dot, not a check box will appear) and then click "OK". When installation finishes [restart installation of FRC 2016 Update Suite](#).

# Getting Started with the 2016 Control System

## Windows Features (.NET Framework 3.5 already on)



If a black dot is shown next to ".NET Framework 3.5" the feature is already on. Click "Cancel" and [restart installation of FRC 2016 Update Suite](#).

# Getting Started with the 2016 Control System

## Updating your roboRIO firmware

Before updating firmware on your roboRIO, you must have completed installation of the [FRC Update Suite](#). You also must have the roboRIO power properly wired to the Power Distribution Panel as described [here](#).

Note that the firmware is separate from the roboRIO image. You will need to update your roboRIO firmware once after receiving the roboRIO and should only need to do so again if instructed specifically by an update.

**Make sure the power wires to the roboRIO are secure and that the connector is secure firmly to the roboRIO (4 total screws to check).**

## Configuring the roboRIO

The roboRIO must be wired for power and connected to the computer via USB in order to update the firmware.

### USB Connection



# Getting Started with the 2016 Control System

Connect a USB cable from the roboRIO USB Device port to the PC. This requires a USB Type A male (standard PC end) to Type B male cable (square with 2 cut corners), most commonly found as a printer USB cable.

**Note: The roboRIO should only be imaged via the USB connection. Do not update via the Ethernet connection.**

**Make sure that nothing (including the radio) is connected to the Ethernet port when updating the roboRIO firmware.**

## Driver Installation

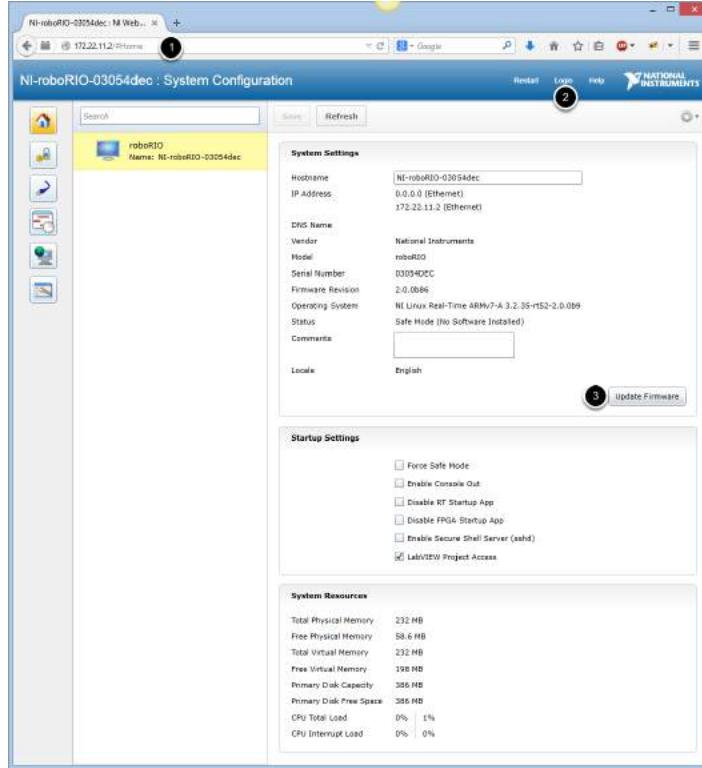
The device driver should install automatically. If you see a "New Device" pop-up in the bottom right of the screen, wait for the driver install to complete before continuing. If the Driver Installation fails, make sure you have installed the [2016 FRC Update Suite](#) and that you have rebooted the computer. If that does not work, try a different USB cable, a bad USB cable can result in the driver installation failing.

## Firmware Update Using Web Browser

The embedded web server on the roboRIO requires using a browser which supports [Silverlight](#). Note that Google Chrome has removed Silverlight support, using Internet Explorer is recommended.

# Getting Started with the 2016 Control System

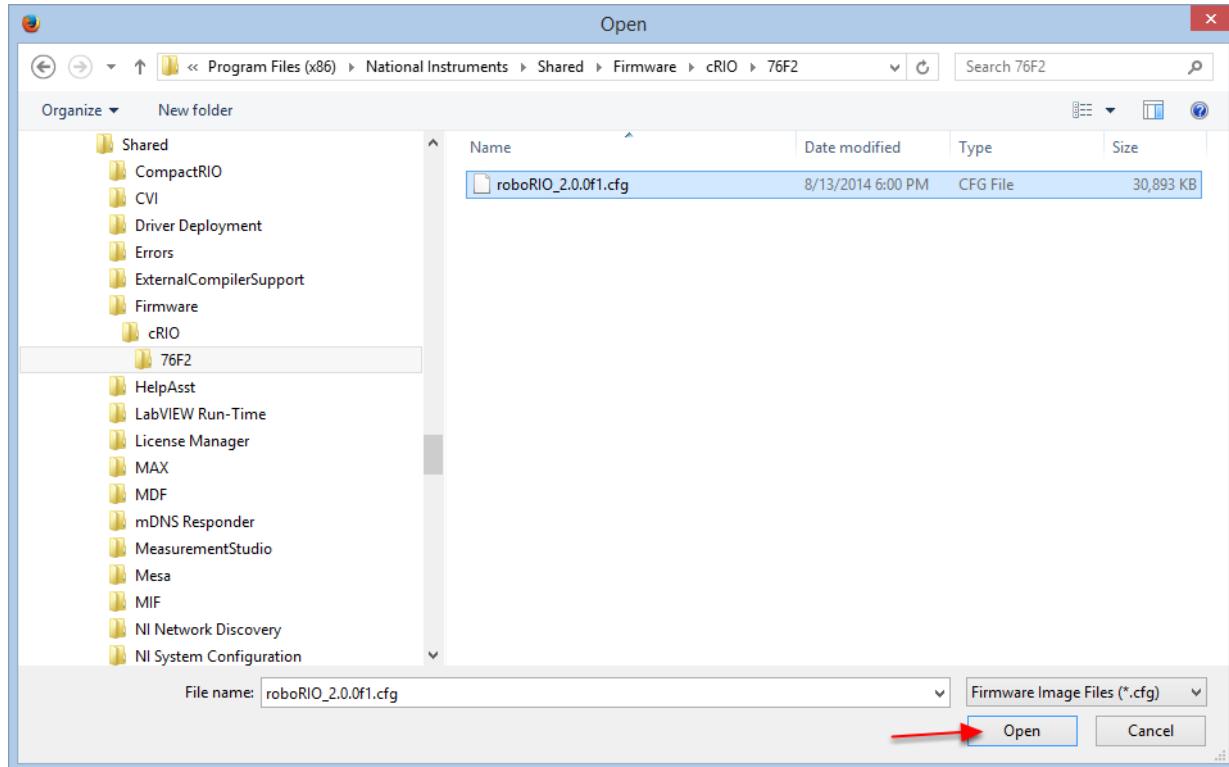
## Launch Compatible Browser and Navigate to roboRIO



1. Enter the address 172.22.11.2 in your browser's address bar and press enter.
2. Click Login. Enter "admin" in the Username field and leave the Password field blank.
3. Click Update Firmware

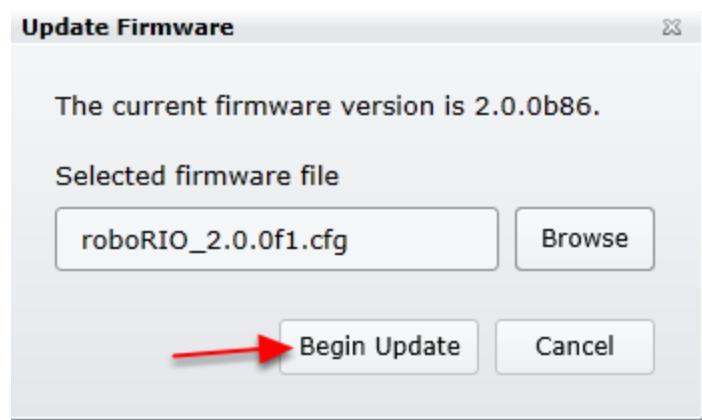
# Getting Started with the 2016 Control System

## Locate Firmware



Browse to Program Files\National Instruments\Shared\Firmware\cRIO\76F2\ Program Files(x86) on 64 bit and select the latest firmware, then click Open (this image shows version 2.0.0f1).

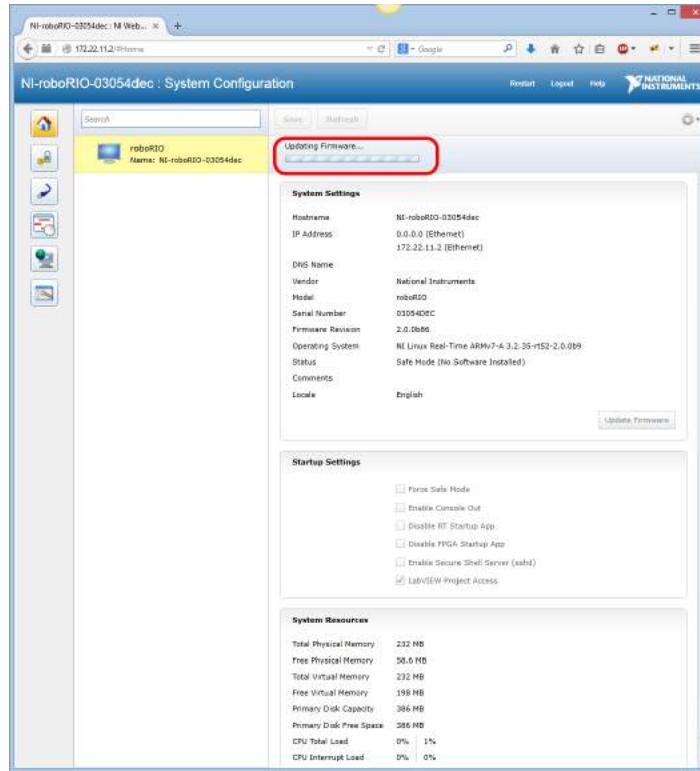
## Begin Update



Verify that the firmware selected is correct, then click Begin Update

# Getting Started with the 2016 Control System

## Updating



A progress indicator will appear below the toolbar. Do not close the browser or power off the roboRIO until the process completes and the message appears "The firmware update completed successfully".

# Getting Started with the 2016 Control System

## Imaging your roboRIO

Before imaging your roboRIO, you must have completed installation of the development environment and language updates for the appropriate programming language ([C++\Java](#), [LabVIEW](#)) and the [FRC Update Suite](#). You also must have the roboRIO power properly wired to the Power Distribution Panel as described [here](#) and have updated the firmware as described in the [previous article](#).

Make sure the power wires to the roboRIO are secure and that the connector is secure firmly to the roboRIO (4 total screws to check).

## Configuring the roboRIO

The roboRIO Imaging Tool will be used to image your roboRIO with the latest software.

### USB Connection



Connect a USB cable from the roboRIO USB Device port to the PC. This requires a USB Type A male (standard PC end) to Type B male cable (square with 2 cut corners), most commonly found as a printer USB cable.

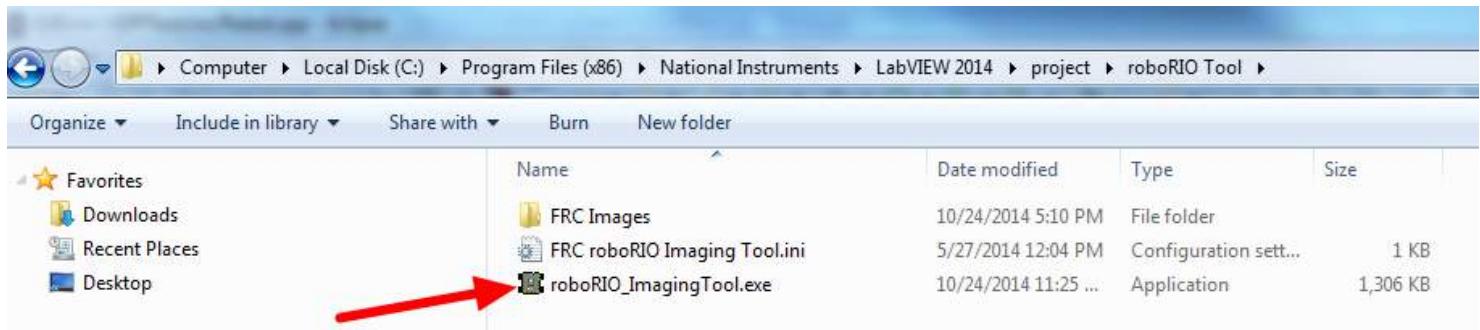
# Getting Started with the 2016 Control System

Note: The roboRIO should only be imaged via the USB connection. It is not recommended to attempt imaging using the Ethernet connection.

## Driver Installation

The device driver should install automatically. If you see a "New Device" pop-up in the bottom right of the screen, wait for the driver install to complete before continuing.

## Launching the Imaging Tool

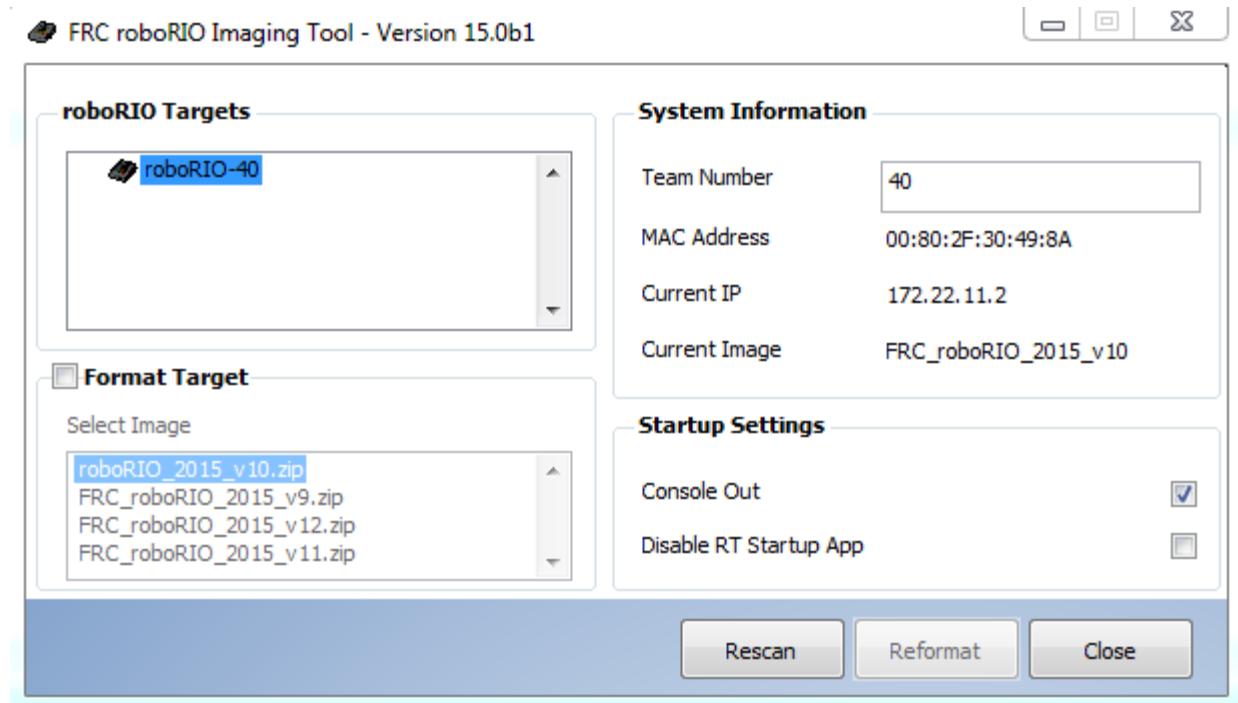


The roboRIO imaging tool and latest image are installed with the NI Update Suite. Browse to C:\Program Files (x86)\National Instruments\LabVIEW 2015\project\roboRIO Tool and double click on roboRIO\_ImagingTool.exe

Note: For 32-bit machines the path is C:\Program Files\National Instruments\LabVIEW 2015\project\roboRIO Tool

# Getting Started with the 2016 Control System

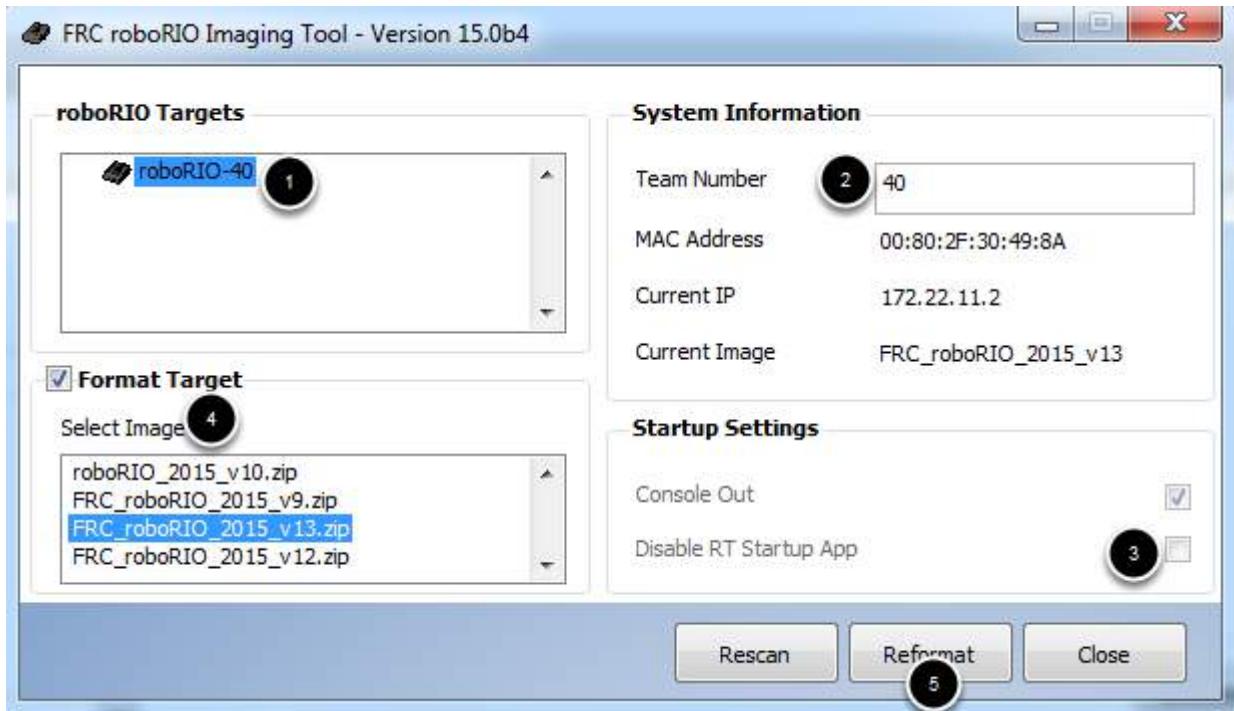
## roboRIO Imaging Tool



After launching, the roboRIO Imaging Tool will scan for available roboRIOs and indicate any found in the top left box. The bottom left box will show the available image versions that may be loaded onto the roboRIO. The right hand column contains information and settings for the roboRIO selected in the top left pane.

# Getting Started with the 2016 Control System

## Imaging the roboRIO



1. Make sure the roboRIO is selected in the top left pane
2. Enter your team number in the box in the top right
3. Make sure the Disable RT Startup App box is unchecked in the bottom right
4. Check the box to Format Target and select the latest image version in the box.
5. Click Reformat to begin the imaging process.

## Imaging Complete



When the imaging completes you should see the dialog above. Click Ok, then click the Close button at the bottom right to close the imaging tool. **Reboot the roboRIO using the Reset button to have the new team number take effect.**

## Installing Java 8 on the roboRIO using the FRC roboRIO Java Installer (Java only)

Running robot Java programs requires the Java runtime to be installed on the roboRIO. This can be done easily using the FRC Java Installer application. The application itself uses java, so Java 8 must be installed on the development system to use the installer. In addition a connection to the roboRIO and the internet are required to download the roboRIO Java runtime and then transfer it to the roboRIO. The installer also has provisions to download Java from the internet once, then install on multiple roboRIOs, or reinstall it after re-imaging a roboRIO.

The computer used to run the installer can be running Microsoft Windows, Mac OS X, or Linux.

**Note:** Whenever a new image is installed on the roboRIO (either when initially setting it up or later if the image is updated or reinstalled) the Java runtime must be replaced. This is an easy to overlook step so be sure to keep this in mind.

### Prerequisite

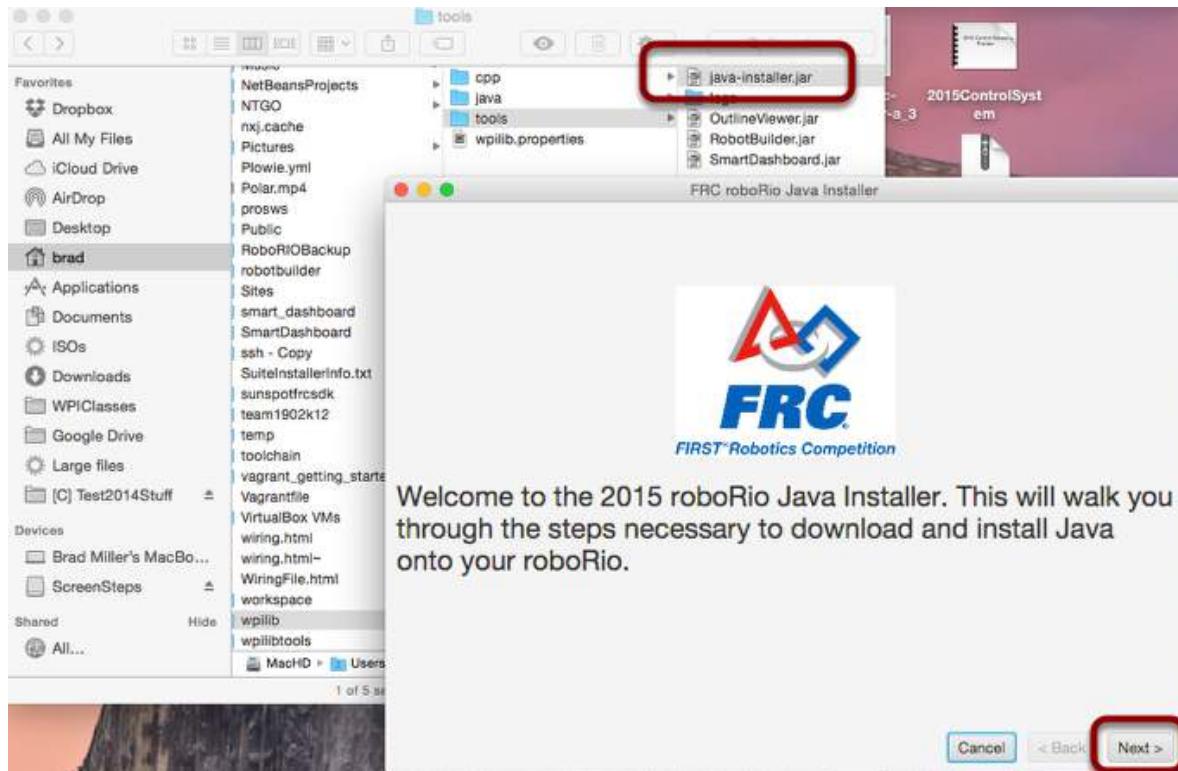
Your roboRIO must be wired (both powered and connected to your PC) and imaged prior to installing the JRE. You also need the Eclipse FRC Java plugin installed. It is recommended that you follow the steps in the [Getting Started with the 2016 Control System](#) manual in order.

*Note: Java 8 must be installed on the computer used to run the installer, previous versions of Java prior to Java 8 will not work to run the Java installer.*

Oracle has updated their page with a new version of the JRE. The 1/23 Eclipse plugin update includes a fix for the Java installer. If you cannot find the right file on the page (the file described and shown in the documentation below), you are using the old Eclipse plugin and need to update. Details about updating Eclipse plugins can be found near the bottom of the [Installing Eclipse \(C++/Java\) document](#).

# Getting Started with the 2016 Control System

## Start the FRC Java Installer

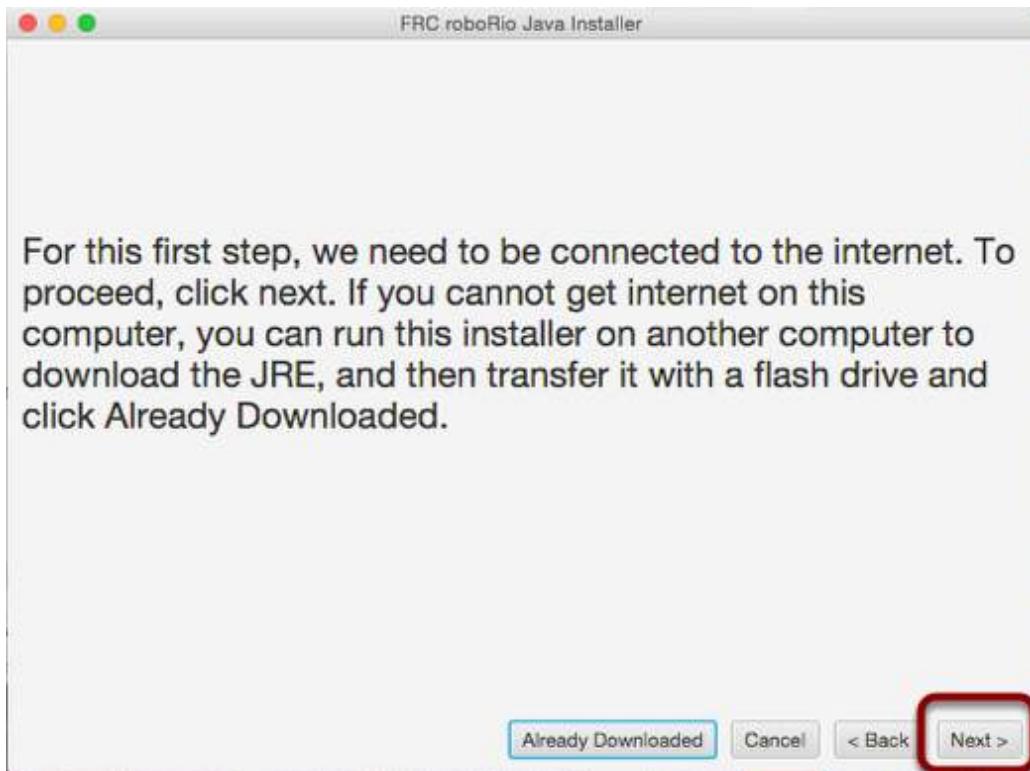


The FRC Java Installer application is written in Java. You can usually run it (depending on your computer operating system) by double-clicking on the file in <home-directory>/wpilib/tools/java-installer.jar. So if your home directory is c:\Users\george then the installer is c:\Users\george\wpilib\tools\java-installer.jar. When it starts you'll see the start screen.

The installation takes several steps and the Next button is usually used to navigate between steps. To get started click "Next".

# Getting Started with the 2016 Control System

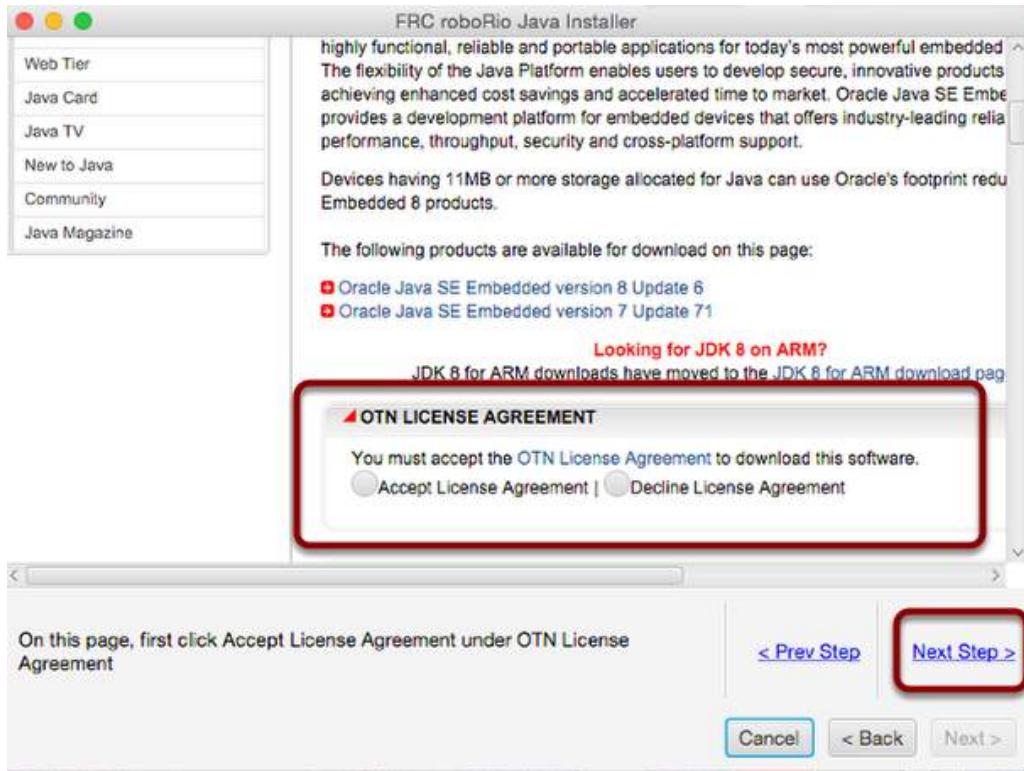
## Getting ready to download Java from the internet



In this step you have the option of using an already downloaded JRE (Java Runtime Edition) or getting it now. Letting the installer help you download Java is the most common option and you get to it by clicking "Next".

# Getting Started with the 2016 Control System

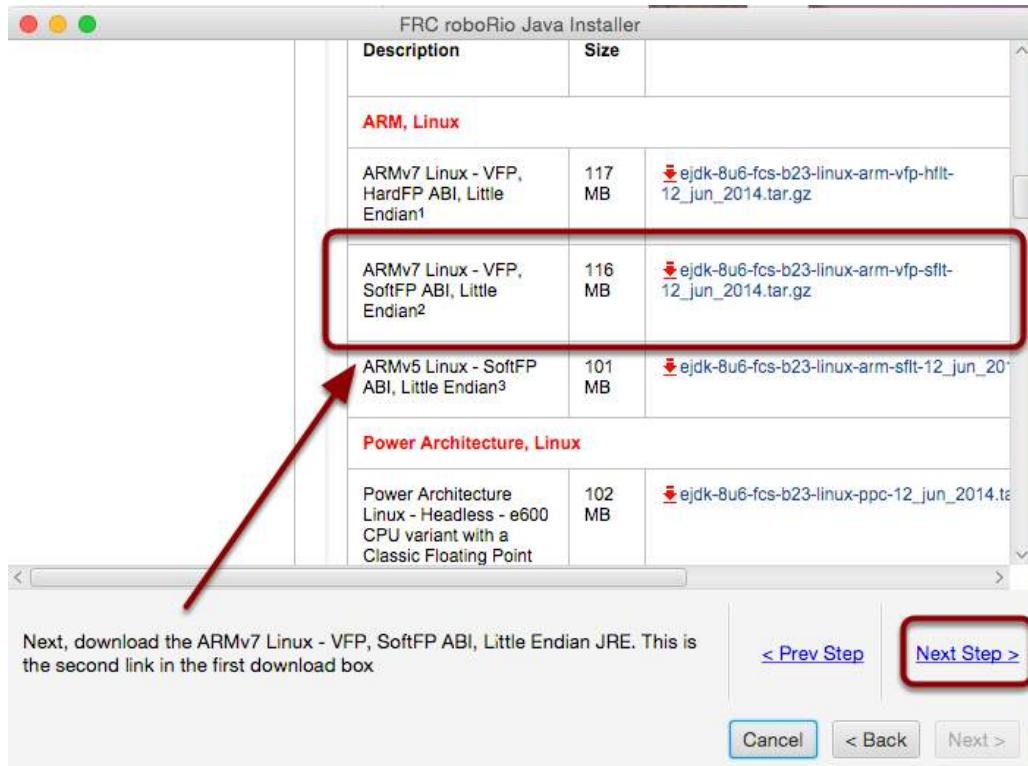
## Accepting the Oracle Java license agreement



In this step you must accept the License Agreement by clicking on the "Accept License Agreement" radio button. You might have to scroll down the page to see the button. Once you've done that, click "Next Step".

# Getting Started with the 2016 Control System

## Select the version of Java to download



You now select the correct version of Java to download. For the roboRIO, that is the "ARMv7 Linux - VFP, SoftFP ABI, Little Endian JRE". This is shown in the installer instruction window.

# Getting Started with the 2016 Control System

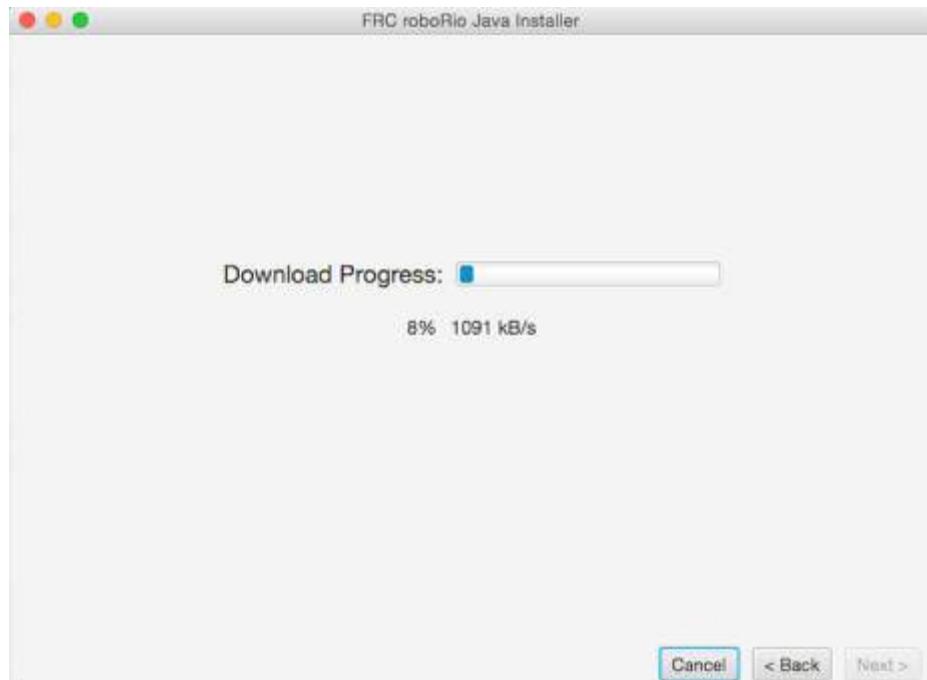
## Log into the Oracle web site



To download Java, Oracle requires you to create a free account. If you already have an account you can just log in. If you don't yet have an account, click the "Sign Up" link and follow the steps to create an account. When you sign in, the download will begin.

# Getting Started with the 2016 Control System

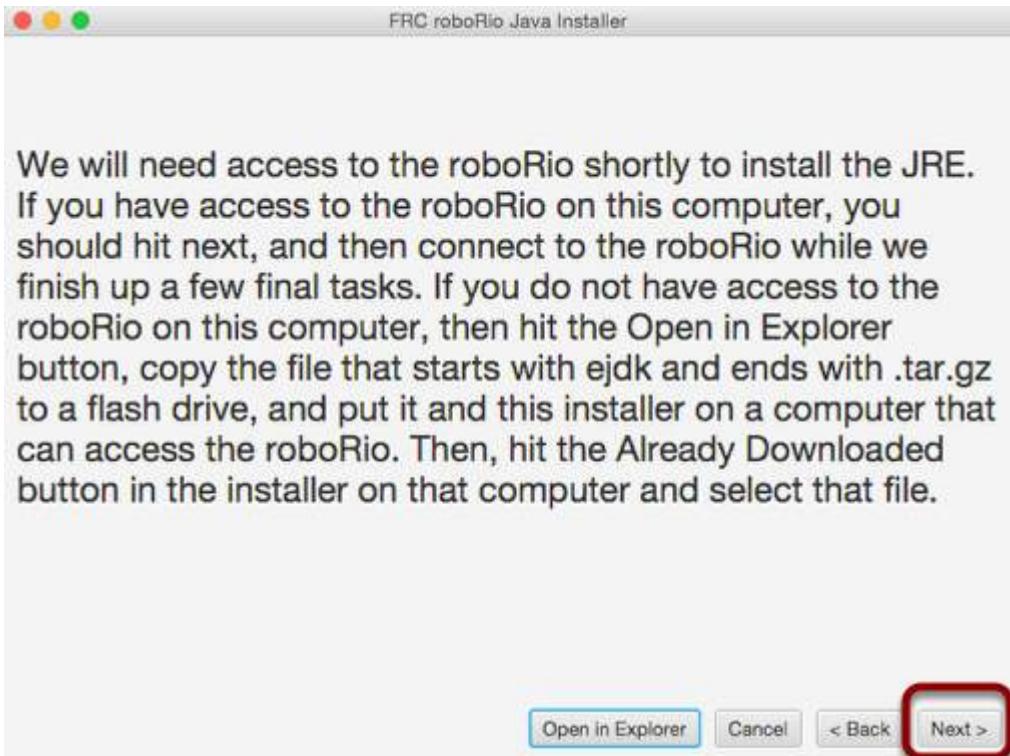
## Java downloads to your computer



The download will start once logged into your Oracle account. Let it finish and you will be redirected to the next step.

# Getting Started with the 2016 Control System

## Getting ready to install the JRE onto the roboRIO

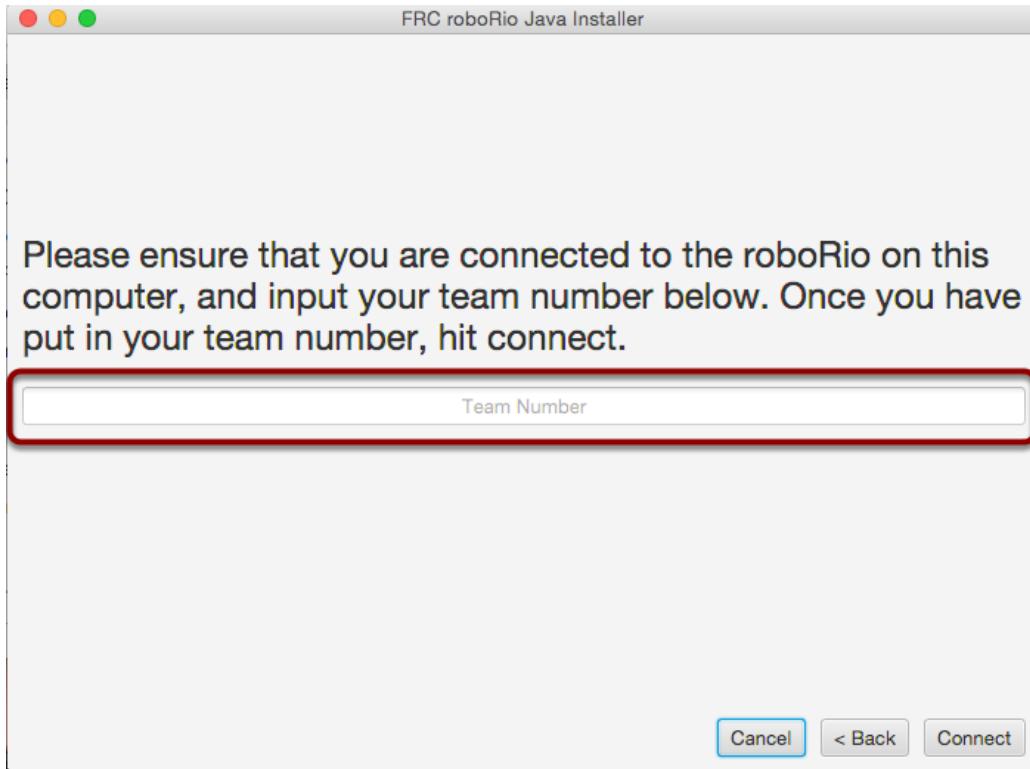


Make sure your computer is connected to the roboRIO. If this computer can not be connected to the roboRIO, then you can take the downloaded Java file and the installer and continue on a computer that is connected to the roboRIO. Click "Next" when you're ready to proceed.

It is recommended to use the USB connection, but Ethernet should also work; however, both interfaces (USB and Ethernet) should not be connected at the same time.

# Getting Started with the 2016 Control System

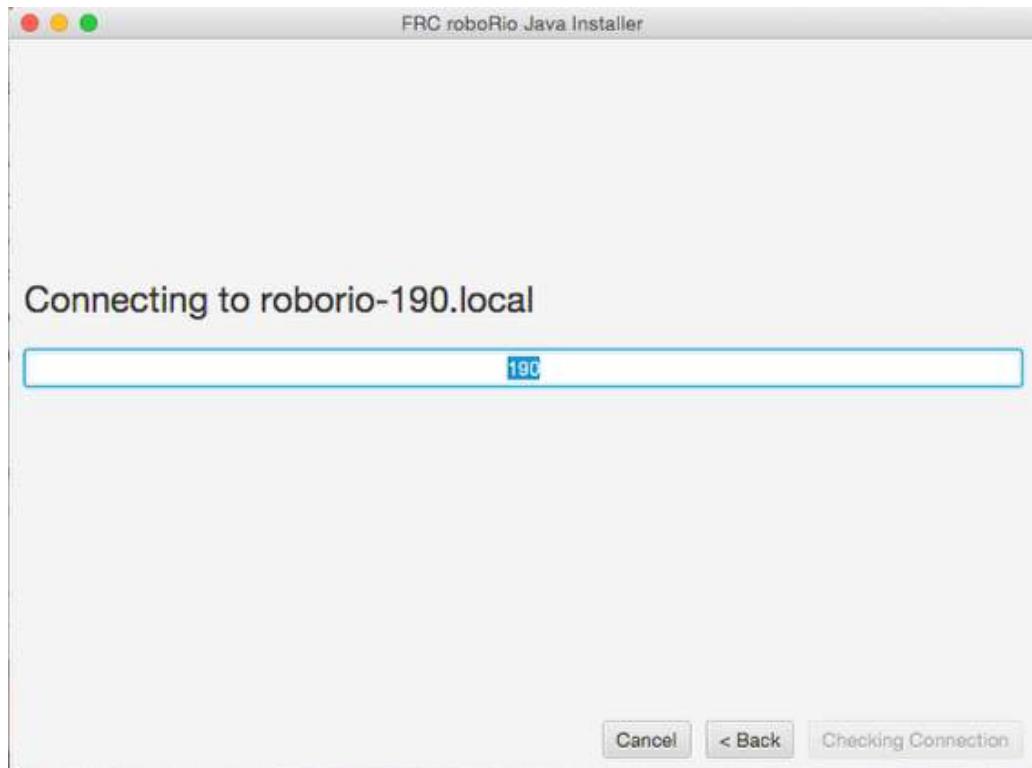
## Uncompressing and getting Java ready to install



In this next step, the installer will automatically complete a number of steps to get Java ready to install on your roboRIO. Then you must enter your team number so the roboRIO can be located on the network. When you have entered the team number and the roboRIO is connected, click "Connect".

# Getting Started with the 2016 Control System

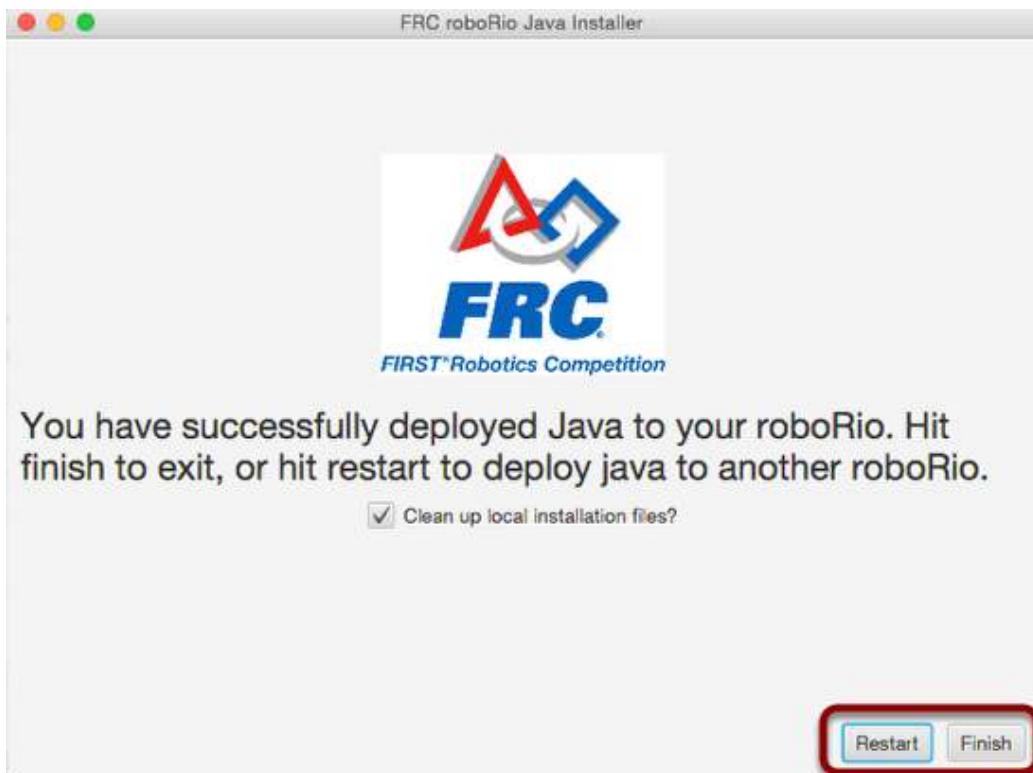
## Downloading Java to the roboRIO



The installer will now connect and then install Java to your roboRIO. If the installer has trouble connecting, make sure the computer is on the same network as the roboRIO. You may also try turning off other network interfaces temporarily to make sure the installer finds your roboRIO.

# Getting Started with the 2016 Control System

## Successful installation



A successful installation is indicated and you may exit the installer by clicking "Finish". If you want to install Java on another roboRIO, click "Restart".

# Getting Started with the 2016 Control System

## RoboRIO Networking

The network setup used on the 2016 system is a little bit different than the previous Control System. The new scheme utilizes mDNS to allow for the use of DHCP addressing and seamless transition from ethernet to USB and back.

This document discusses the typical setup at home. For more information about the networking environment at events, or about using Static IPs see [IP Networking at the Event](#)

### mDNS

The FRC Driver Station, LabVIEW, and the Eclipse plugins for C++ and Java are all programmed to discover your roboRIO using the mDNS protocol. This means that the roboRIO can be detected regardless of the interface or IP being used.

### mDNS - Principles

Multicast Domain Name System (mDNS) is a system which allows for resolution of host names to IP addresses on small networks with no dedicated name server. To resolve a host name a device sends out a multicast message to the network querying for the device. The device then responds with a multicast message containing its IP. Devices on the network can store this information in a cache so subsequent requests for this address can be resolved from the cache without repeating the network query.

### mDNS - Providers

To use mDNS, an mDNS implementation is required to be installed on your PC. Here are some common mDNS implementations for each major platform:

Windows:

- NI mDNS Responder - [Installed with the NI FRC Update Suite](#)
- Apple Bonjour - Installed with iTunes

OSX:

- Apple Bonjour - Installed by default

Linux:

# Getting Started with the 2016 Control System

- nss-mDNS/Avahi/Zeroconf - Installed and enabled by default on some Linux variants (such as Ubuntu or Mint). May need to be installed or enabled on others (such as Arch)

## mDNS - Firewalls

To work properly mDNS must be allowed to pass through your firewall. Depending on your PC configuration, no changes may be required, this section is provided to assist with troubleshooting. Because the network traffic comes from the mDNS implementation and not directly from the Driver Station or IDE, allowing those applications through may not be sufficient. There are two main ways to resolve mDNS firewall issues:

- Add an application/service exception for the mDNS implementation (NI mDNS Responder is C:\Program Files\National Instruments\Shared\mDNS Responder\nimdnsResponder.exe)
- Add a port exception for traffic to/from UDP 5353 (IP ranges 10.0.0.0-10.255.255.255  
172.16.0.0-172.31.255.255 192.168.0.0-192.168.255.255 169.254.0.0-169.254.255.255  
224.0.0.251)

## mDNS - Browser support

Most web-browsers should be able to utilize the mDNS address to access the roboRIO webserver as long as an mDNS provider is installed. To access the webdashboard, the browser must also support Microsoft Silverlight. Internet Explorer is recommended.

## USB

If using the USB interface, no network setup is required (you do need the [NI Update Suite](#) installed to provide the roboRIO USB Driver). The roboRIO driver will automatically configure the IP address of the host (your computer) and roboRIO and the software listed above should be able to locate and utilize your roboRIO

## Ethernet/Wireless

The 2016 FRC Radio Configuration Utility will enable the DHCP server on the OM5P-AN in the home use case (AP mode), if you are putting the OM5P-AN in bridge mode and using a router you can enable DHCP addressing on the router. The bridge is set to the same team based IP address as before (10.TE.AM.1) and will hand out DHCP address from 10.TE.AM.20 to 10.TE.AM.199. When connected to the field, FMS will also hand out addresses in the same IP range.

# Getting Started with the 2016 Control System

## roboRIO Ethernet Configuration

The roboRIO Ethernet interface should be set to DHCP. When connected to the OM5P-AN bridge, the roboRIO will receive an IP from the bridge. When tethered directly to a PC, both devices will self-assign IPs.

## PC Adapter Configuration

**When connecting via Ethernet (to either the radio or directly to the roboRIO) or Wireless (to the OpenMesh radio), your computer adapter should be set to DHCP.** When connecting through the OM5P-AN, your PC will receive an IP address from the radio. If tethered directly to the roboRIO both devices will self-assign IPs.

## IP Lists

IPs for system components:

roboRIO USB: 172.22.11.2

roboRIO mDNS: roboRIO-####-FRC.local (where ##### is your team number with no leading zeroes) You should be able to use this address to communicate with the roboRIO over either interface through ping, browser, etc. **Note: This is different than 2015!!**

Robot Radio: 10.TE.AM.1 (where TE.AM is your 4 digit team number with leading zeroes if required)

roboRIO Ethernet: DHCP, assigned by the Robot Radio

Driver Station PC: DHCP, assigned by the Robot Radio

Additional Programming computers: DHCP, assigned by the Robot Radio

DHCP range: 10.TE.AM.20 to 10.TE.AM.199

## Troubleshooting

See [RoboRIO Network Troubleshooting](#)

# Getting Started with the 2016 Control System

## FRC Driver Station Powered by NI LabVIEW

This article describes the use and features of the 2016 FRC Driver Station Powered by NI LabVIEW.

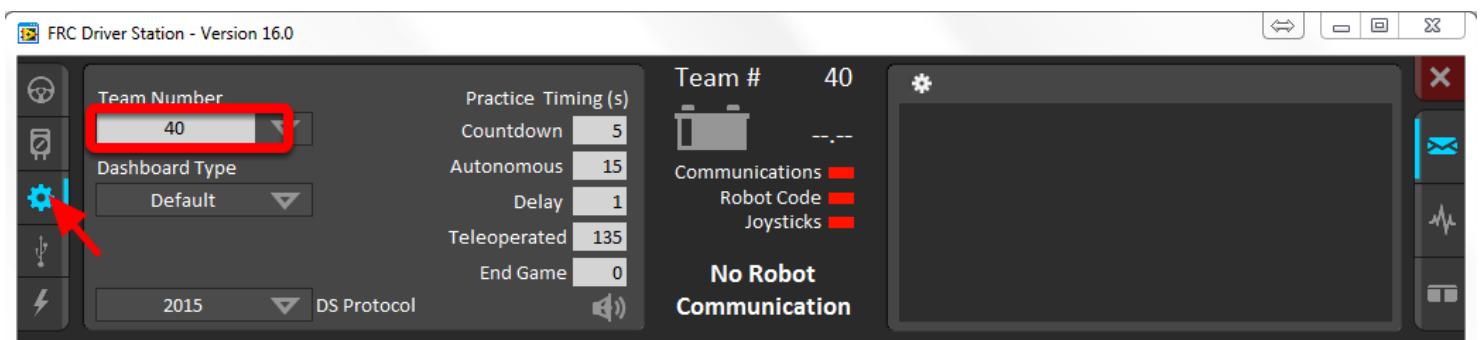
For information on installing the Driver Station software see [this document](#).

### Starting the FRC Driver Station



The FRC Driver Station can be launched by double-clicking the icon on the Desktop or by selecting Start->All Programs->FRC Driver Station.

### Setting Up the Driver Station



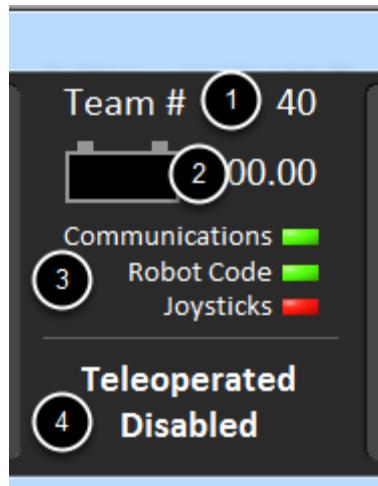
Typically the Driver Station will set the appropriate settings automatically, but if you do have to set the network settings manually, the DS should use the following settings:

- IP: DHCP

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.

# Getting Started with the 2016 Control System

## Status Pane



The Status Pane of the Driver Station is located in the center 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 the roboRIO this displays current battery voltage as a number and with a small chart of voltage over time in the battery icon. The background of the numeric indicator will turn red when the roboRIO brownout is triggered. See [RoboRIO Brownout and Understanding Current Draw](#) for more information.
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 roboRIO (this year it is split in half for the TCP and UDO communication). 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". When the roboRIO brownout is triggered this will display "Voltage Brownout".

# Getting Started with the 2016 Control System

## Operation Tab



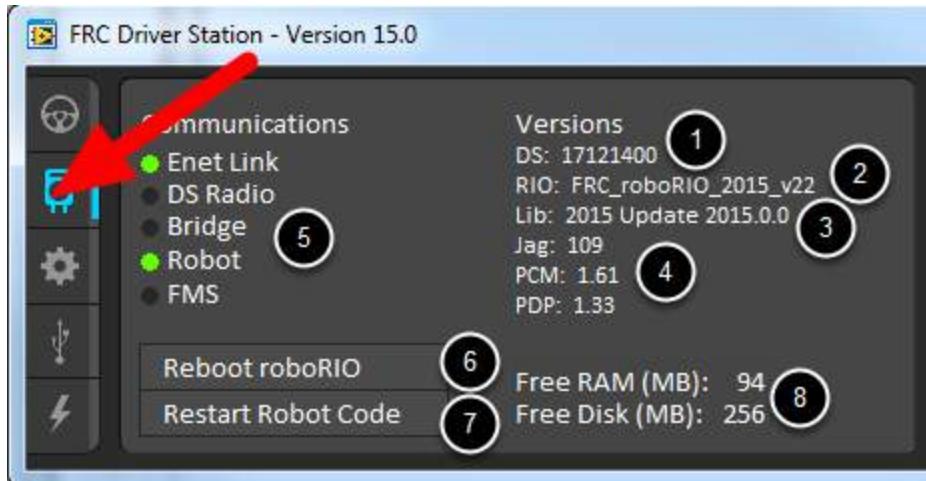
The Operations Tab is used to control the mode of the robot and provide additional key status indicators while the robot is running.

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 key combination []\ (the 3 keys above the enter key on most keyboards) to enable the robot and the Enter key to Disable the robot. **The Spacebar will Emergency Stop the Robot**
3. Elapsed Time - Indicates the amount of time the robot has been enabled
4. PC Battery - Indicates current state of DS PC battery and whether the PC is plugged in
5. PC CPU% - Indicates the CPU Utilization of the DS PC
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.

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

# Getting Started with the 2016 Control System

## Diagnostics Tab

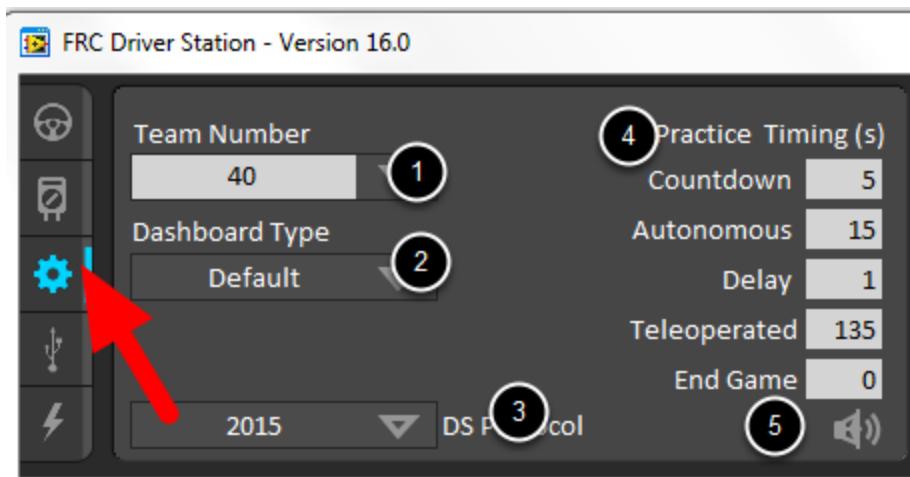


The Diagnostics Tab contains additional status indicators that teams can use to diagnose issues with their robot:

1. DS Version - Indicates the Driver Station Version number
2. roboRIO Image Version - String indicating the version of the roboRIO Image
3. WPILib Version - String indicating the version of WPILib in use
4. CAN Device Versions - String indicating the firmware version of devices connected to the CAN bus
5. 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 roboRIO using mDNS (with a fallback of a static 10.TE.AM.2 address). "FMS" indicates if the DS is receiving packets from FMS (this is NOT a ping indicator).
6. Reboot roboRIO - This button attempts to perform a remote reboot of the roboRIO (after clicking through a confirmation dialog)
7. Restart Robot Code - This button attempts to restart the code running on the robot (but not restart the OS)
8. Memory Stats - This section shows stats about the roboRIO memory

# Getting Started with the 2016 Control System

## 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 mDNS name that the DS expects the robot to be at. **New: Shift clicking on the dropdown arrow will show all roboRIO names detected on the network for troubleshooting purposes.**
2. 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.
3. DS Protocol - This control defaults to 2015. Use 2014 for communicating with a 2014 cRIO image.
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.
5. Audio Control - This button controls whether audio tones are sounded when the Practice Mode is used.

# Getting Started with the 2016 Control System

## USB Devices Tab



The USB Devices tab includes the information about the USB Devices connected to the DS

1. USB Setup List - This contains a list of all compatible USB devices connected to the DS. Pressing a button on a device will highlight the name in green and put 2 \*'s before the device name
2. Rescan - This button will force a Rescan of the USB devices. While the robot is disabled, the DS will automatically scan for new devices and add them to the list. To force a complete re-scan or to re-scan while the robot is Enabled (such as when connected to FMS during a match) press F1 or use this button.
3. Device indicators - These indicators show the current status of the Axes, buttons and POV of the joystick.
4. Rumble - For XInput devices (such as X-Box controllers) the Rumble control will appear. This can be used to test the rumble functionality of the device. The top bar is "Right Rumble" and the bottom bar is "Left Rumble". Clicking and holding anywhere along the bar will activate the rumble proportionally (left is no rumble = 0, right is full rumble = 1). This is a control only and will not indicate the Rumble value set in robot code.

# Getting Started with the 2016 Control System

## Re-Arranging and Locking Devices



The 2015 Driver Station has the capability of "locking" a USB device into a specific slot. This is done automatically if the device is dragged to a new position and can also be triggered by double clicking on the device. "Locked" devices will show up with an underline under the device. A locked device will reserve it's slot even when the device is not connected to the computer (shown as grayed out and underlined). Devices can be unlocked (and unconnected devices removed) by double clicking on the entry.

Note: If you have two or more of the same device, they should maintain their position as long as all devices remain plugged into the computer in the same ports they were locked in. If you switch the ports of two identical devices the lock should follow the port, not the device. If you re-arrange the ports (take one device and plug it into a new port instead of swapping) the behavior is not determinate (the devices may swap slots). If you unplug one or more of the set of devices, the positions of the others may move, they should return to the proper locked slots when all devices are reconnected.

Example: The image above shows 4 devices:

- A Locked "Logitech Attack 3" joystick. This device will stay in this position unless dragged somewhere else or unlocked
- An unlocked "Logitech Extreme 3D" joystick
- An unlocked "Gamepad F310 (Controller)" which is a Logitech F310 gamepad
- A Locked, but disconnected "MadCatz GamePad (Controller)" which is a MadCatz Xbox 360 Controller

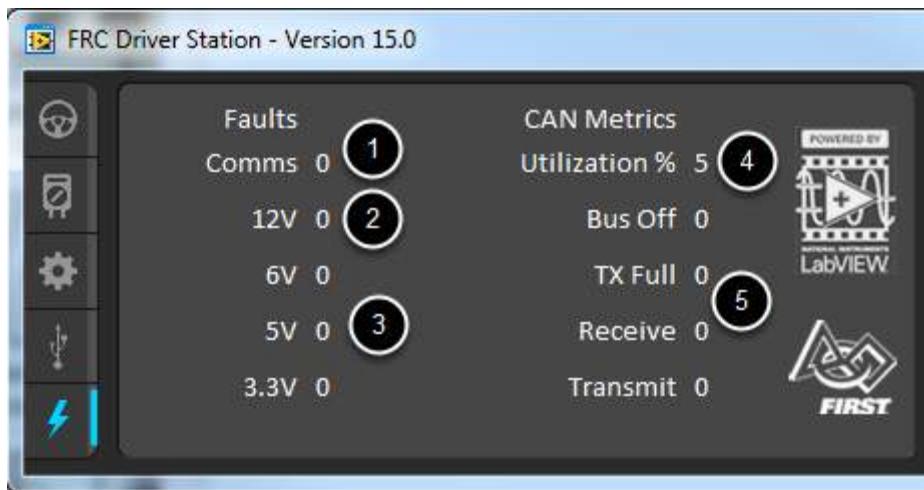
In this example, unplugging the Logitech Extreme 3D joystick will result in the F310 Gamepad moving up to slot 1. Plugging in the MadCatz Gamepad (even if the devices in Slots 1 and 2 are removed and those slots are empty) will result in it occupying Slot 3.

# Getting Started with the 2016 Control System

## Joystick Setup Best Practice

Note: When using the Re-Arranging and Locking feature described above, teams should take care to make sure devices behave as they expect when the DS is restarted, and when the DS computer is rebooted with the devices connected, after initial setup. XInput devices such as Xbox controller may enumerate differently when they are connected 1-at-a-time versus all at once.

## CAN\Power Tab



The last tab on the left side of the DS is the CAN\Robot Power Tab. This tab contains information about the power status of the roboRIO and the status of the CAN bus:

1. Comms Faults - This indicates the number of Comms faults that have occurred since the DS has been connected
2. 12V Faults - This indicates the number of input power faults (Brownouts) that have occurred since the DS has been connected
3. 6V/5V/3.3V Faults - This indicates the number of faults (typically cause by short circuits) that have occurred on the User Voltage Rails since the DS has been connected
4. CAN Bus Utilization - This indicates the percentage utilization of the CAN bus
5. CAN faults - These indicate the counts of each of the 4 types of CAN faults since the DS has been connected

If a fault is detected, the indicator for this tab (shown in blue in the image above) will turn red.

# Getting Started with the 2016 Control System

## Charts Tab

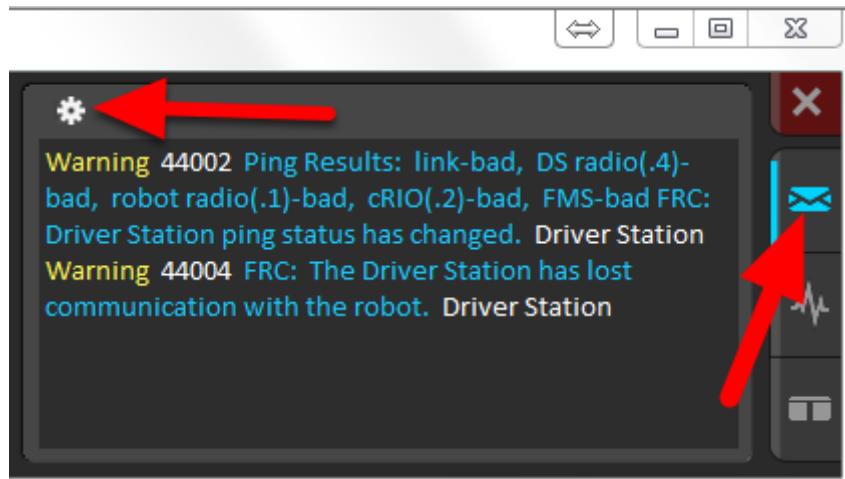


The Charts tab plots and displays advanced indicators of robot status to help teams diagnose robot issues:

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), roboRIO CPU in red (against the axis on the right), 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. Chart scale - These controls change the time scale of the DS Charts
5. This button launches the DS Log File Viewer

# Getting Started with the 2016 Control System

## Messages Tab



The Messages tab displays diagnostic messages from the DS, WPILib and/or the roboRIO. The messages are filtered by severity. By default, only Errors are displayed.

To access settings for the Messages tab, click the Gear icon. This will display a menu that will allow you to select the detail level (Errors, Errors+Warnings or Errors+Warnings+Prints), Clear the box, launch a larger Console window for viewing messages, or launch the DS Log Viewer.

New for 2016 - This window will display prints from WPILib and User Code.

## Both Tab

The last tab on the right side is the Both tab which displays Messages and Charts side by side

## Driver Station Keys

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

- F1 - Force a Joystick refresh.
- '[' + ']' + '\' - Enable the robot (the 3 keys above Enter on most keyboards)
- Enter - Disable the Robot
- Space - Emergency Stop the robot. After an emergency stop is triggered the roboRIO will need to be rebooted before the robot can be enabled again. Note: This will E-Stop the robot regardless of if the Driver Station window has focus or not

# Getting Started with the 2016 Control System

## Running your Benchtop Test Program - Tethered

Running your benchtop testing program while tethered to the Driver Station via ethernet or USB cable will confirm the the program was successfully deployed and that the driver station and roboRIO are properly configured.

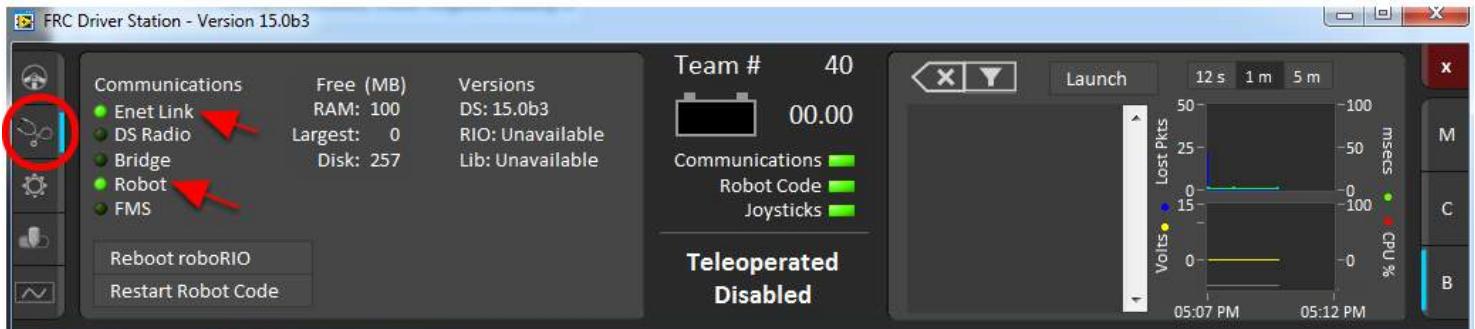
### Overview

You should create and download a Benchtop Test Program as described for your programming language:

- [C++](#)
- [Java](#)
- [LabVIEW](#)

The roboRIO should be powered on and connected to the PC over Ethernet or USB. The Driver Station software should be configured with your team number as described in the [previous article](#).

### Confirm Connectivity

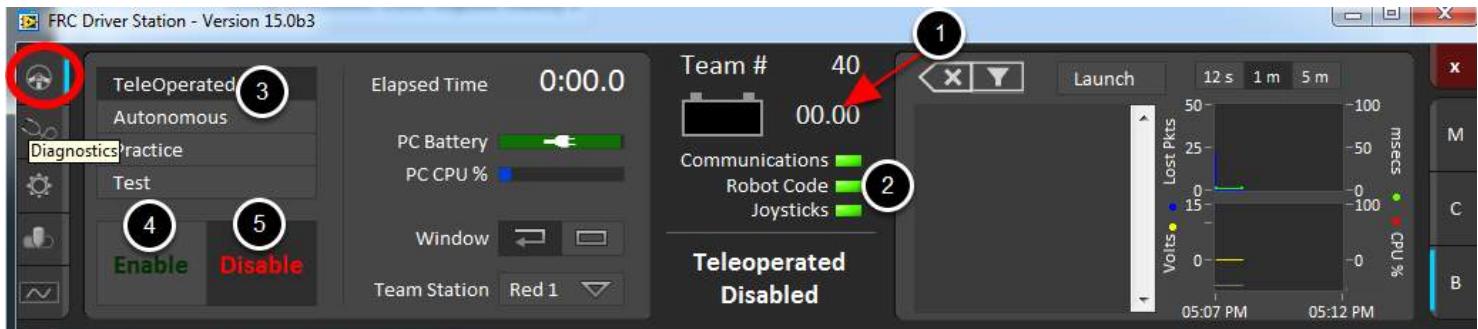


Using the Driver Station software

Click Diagnostics and confirm that the Enet Link and Robot leds are green.

# Getting Started with the 2016 Control System

## Tethered Operation



Click the Operation Tab

1. Confirm that battery voltage is displayed
2. Communications, Robot Code, and Joysticks indicators are green.
3. Put the robot in Teleop Mode
4. Click Enable.- Move the joysticks and observe how the robot responds.
5. Click Disable

# Getting Started with the 2016 Control System

## Programming your radio for home use

This guide will show you how to use the 2016 FRC Radio Configuration Utility 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. Note that for the OM5P-AN bridge, you must use a particular Ethernet port. See the on screen image and instructions for more information.

The OM5P-AN uses the same power plug as the D-Link DAP1522, however it is a 12V radio. **Wire the radio to the 12V 2A terminals on the VRM (center-pin positive).**

## Pre-Requisites

The 2016 FRC Radio Configuration Utility requires the Java Runtime Engine (JRE). If you do not have Java installed, you can download the JRE from here: <https://www.java.com/en/download/>

The FRC Radio Configuration Utility requires Administrator privileges to configure the network settings on your machine. The program should request the necessary privileges automatically (may require a password if run from a non-Administrator account), but if you are having trouble try running it from an Administrator account.

## Application Notes

The 2016 Radio Kiosk will program the radio to enforce the 7Mbps bandwidth limit on traffic exiting the radio over the wireless interface. In the home configuration (AP mode) this is a total, not a per client limit. This means that streaming video to multiple clients is not recommended.

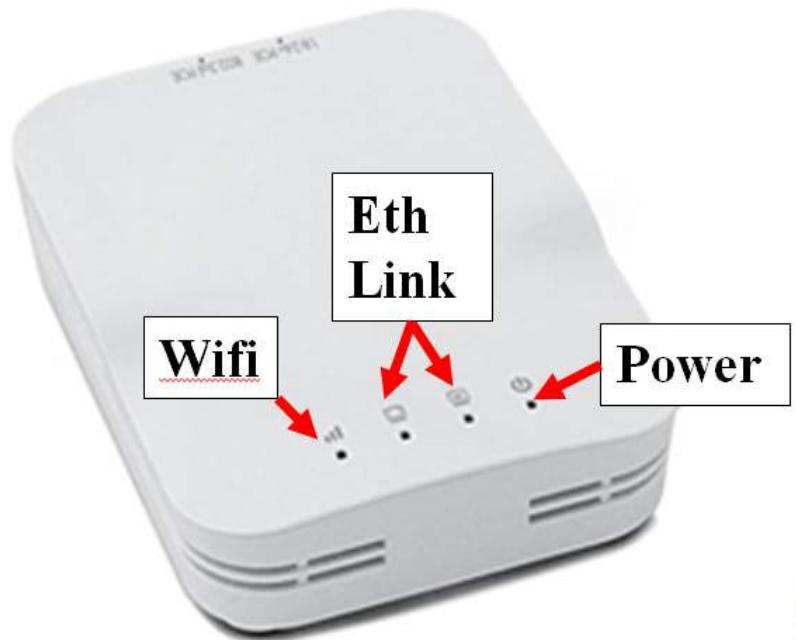
The 2016 Kiosk has been tested on Windows 7, 8 and 10. It may work on other operating systems, but has not been tested.

# Getting Started with the 2016 Control System

## Programmed Configuration

Power	
Blue	On or Powering up
Blue Blinking	Powering up
Eth Link	
Blue	Link Up
Blue Blinking	Traffic present
WiFi	
Red	Bridge Mode, unlinked
Yellow\Orange	Bridge Mode, Linked
Green	AP Mode
Off	Unprogrammed

**WiFi light only works after radio has been power cycled.**



The Radio Configuration Utility programs a number of configuration settings into the radio when run. These settings apply to the radio in all modes (including at events). These include:

- Set a static IP of 10.TE.AM.1
- Set an alternate IP on the wired side of 192.168.1.1 for future programming
- Bridge the wired ports so they may be used interchangeably
- The LED configuration noted in the graphic above
- 7Mb/s bandwidth limit on the outbound side of the wireless interface
- QoS rules for internal packet prioritization (affects internal buffer and which packets to discard if bandwidth limit is reached). These rules are Robot Control and Status (UDP 1110, 1115, 1150) >> Robot TCP & Network Tables (TCP 1735, 1740) >> Bulk (All other traffic).

In AP mode only:

- DHCP server enabled. Serves out 10.TE.AM.11 - 10.TE.AM.111 on the wired side, 10.TE.AM.130 - 10.TE.AM.230 on the wireless side, subnet mask of 255.255.255.0, broadcast address 10.TE.AM.255 (not in kickoff version, will be in next update)
- DNS server enabled. DNS server IP and domain suffix (.lan) are served as part of the DHCP.

When programmed with the team version of the Radio Configuration Utility, the user accounts will be left at (or set to) the firmware defaults:

# Getting Started with the 2016 Control System

- Username: root
- Password: root

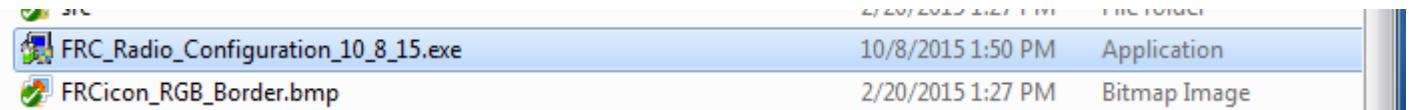
Note: It is not recommended to modify the configuration manually

## Download the software

The screenshot shows the TeamForge web interface. At the top, there's a navigation bar with links for Projects, My Workspace, Admin, History, More, a search bar (pkg1105), a 'Jump to ID' dropdown, user 'koconnor', and a help icon. Below the navigation is a toolbar with icons for Project Home, Trackers, Source Code, File Releases (which is selected), Documents, Wiki, Discussions, Reports, and Project Admin. The main content area has a breadcrumb trail: WPIlib / File Releases / FRC Radio Configuration Utility / List Releases. On the left, a sidebar titled 'File Release' lists categories: Summary, Packages, Driver Station, FRC Radio Configuration Utility (which is selected and highlighted in blue), and Simulation. The right side shows 'Package Details' for the selected package, including the Package Name (FRC Radio Configuration Utility), Description (Tool to configure FRC Robot Radios.), and a note about Show Download Link (No). Below this is a 'Releases' table with columns: Release ID, Name, Maturity, Created On, Status, Files, Downloads, Related Tracker, and Related Planning Folders. A filter and row limit (15 Rows) are at the top of the table. A message 'No results found.' is displayed. At the bottom of the table are buttons for Download Selected, Monitor, Delete, Edit, and Add.

Download the latest FRC Radio Configuration Utility Installer from the [WPIlib project File Releases](#).

## Install the software

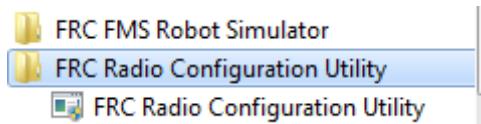


Double click on FRC\_Radio\_Configuration\_MM\_DD\_YY.exe to launch the installer. Follow the prompts to complete the installation.

Part of the installation prompts will include installing WinPCap if it is not already present. The WinPCap installer contains a checkbox (checked by default) to start the WinPCap driver on boot. You should leave this box checked.

# Getting Started with the 2016 Control System

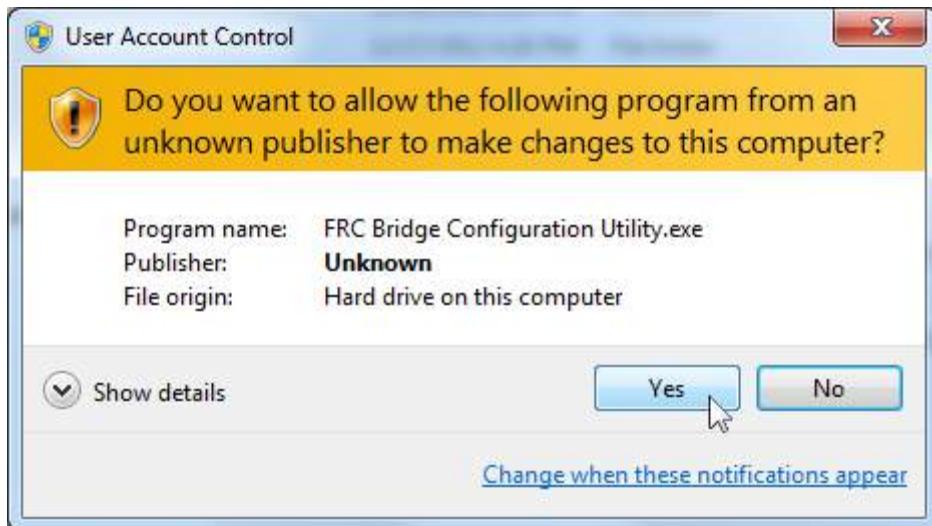
## Launch the software



Use the Start menu or desktop shortcut to launch the program.

Note: If you need to locate the program it is installed to C:\Program Files (x86)\FRC Radio Configuration Utility. For 32-bit machines the path is C:\Program Files\FRC Radio Configuration Utility\

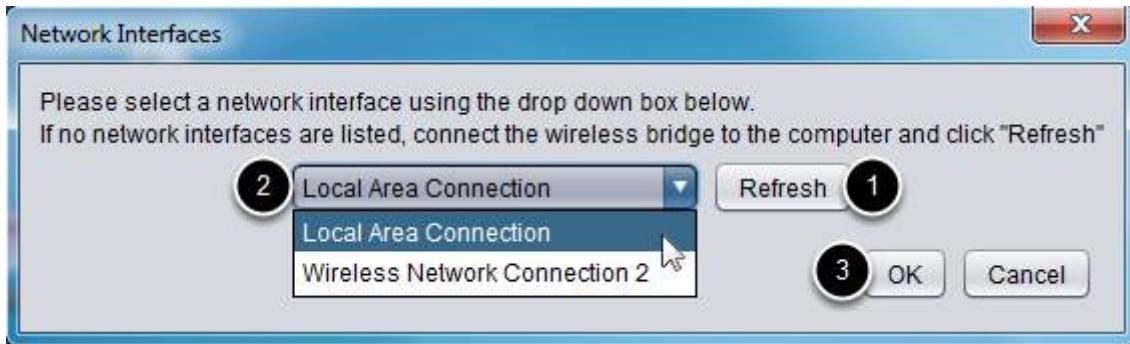
## Allow the program to make changes, if prompted



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

# Getting Started with the 2016 Control System

## 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"

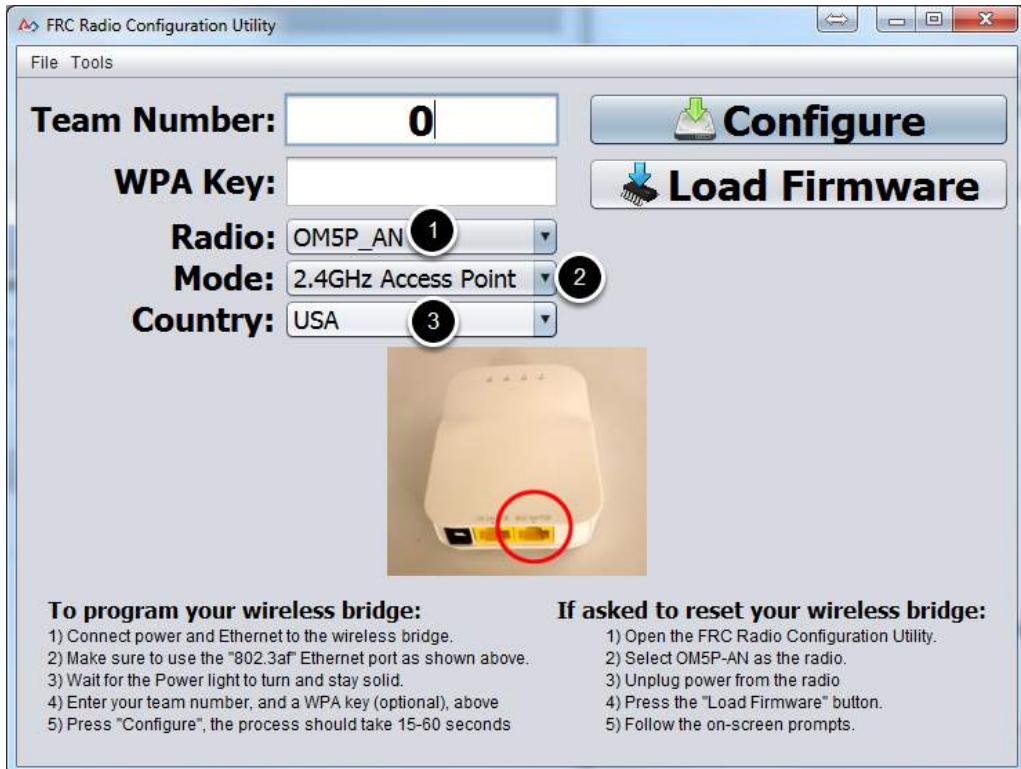
## OM5P-AN Firmware Note

For the FRC Radio Configuration Utility to program the OM5P-AN radio, the radio must be running an FRC specific build of the OpenWRT firmware. Radios received in the KOP are already flashed with the FRC firmware and should not need to be re-flashed, proceed to the next step.

If you do need to re-flash the firmware, or reset the radio (the only way to reset is to re-flash), see the instructions at the end of this document on how to do so using the FRC Radio Configuration Utility.

# Getting Started with the 2016 Control System

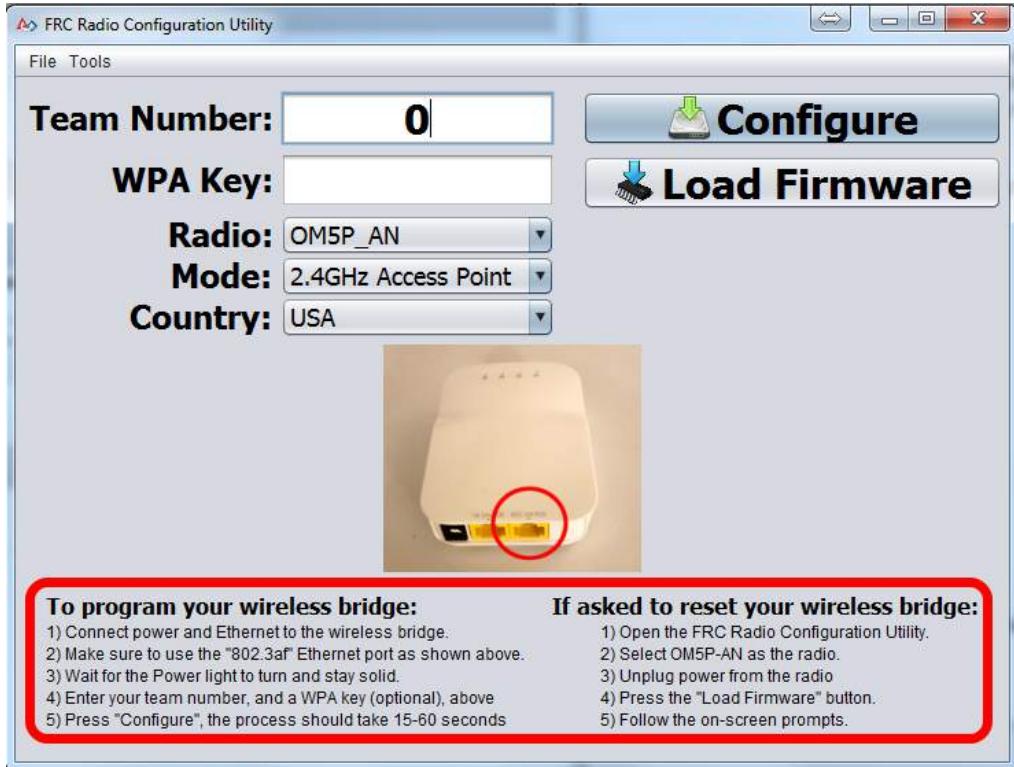
## Select a bridge model and operating mode



1. Select which radio you are configuring using the drop-down list.
2. Select which operating mode you want to configure. For most cases, the default selection of 2.4GHz Access Point will be sufficient. Note that the 2.4GHz + 5GHz simultaneous AP mode is not supported by the D-Link radios.
3. If located outside the USA, select the Country as well to program the proper country specific restrictions.

# Getting Started with the 2016 Control System

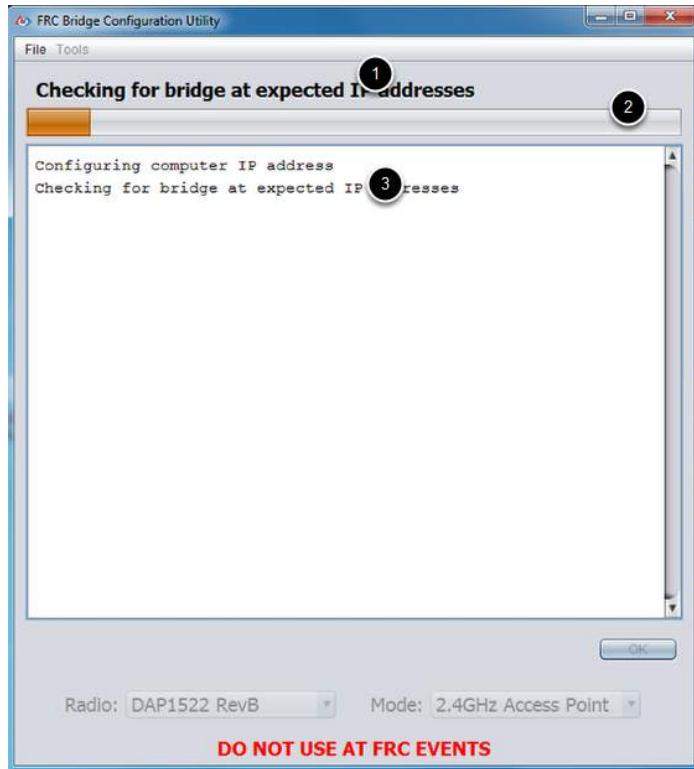
## Prepare and start the configuration process



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.

# Getting Started with the 2016 Control System

## Configuration Progress

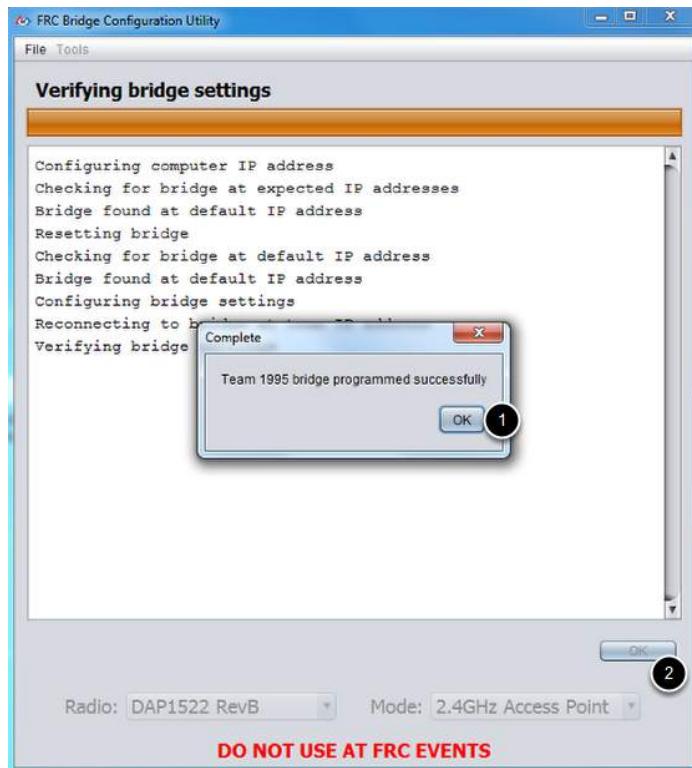


Throughout the configuration process, the window will indicate:

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

# Getting Started with the 2016 Control System

## Configuration completed



Once the configuration is complete:

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

# Getting Started with the 2016 Control System

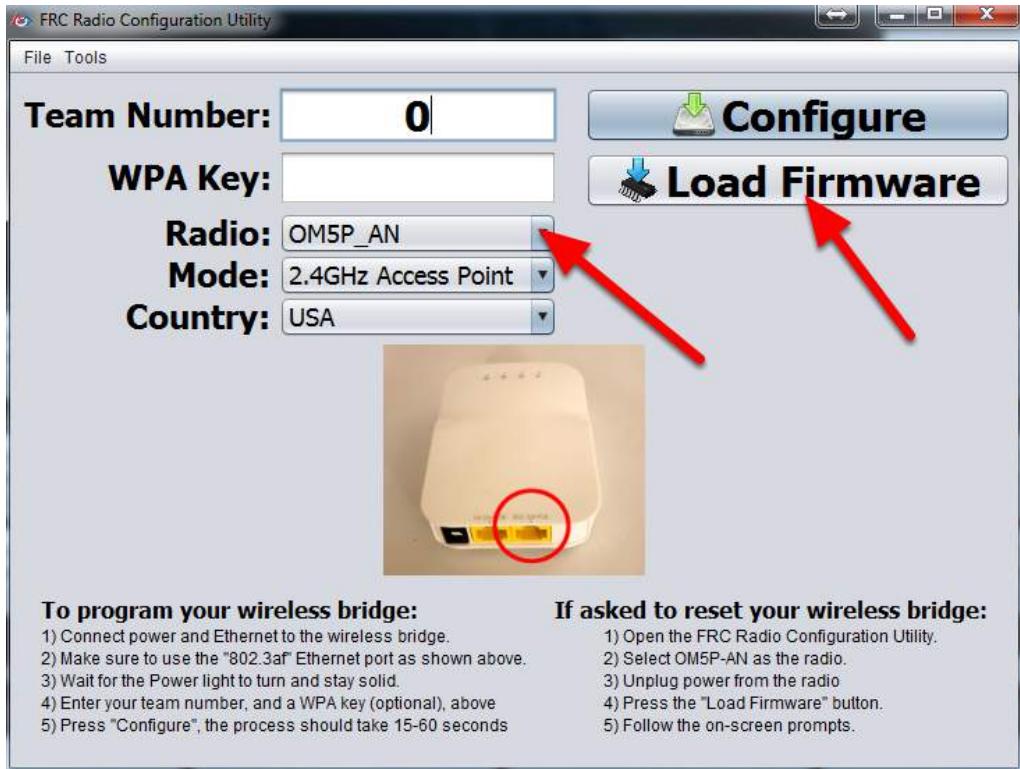
## Configuration errors



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

# Getting Started with the 2016 Control System

## Loading FRC Firmware to OM5P-AN



If you need to load the FRC firmware (or reset the radio), you can do so using the FRC Radio Configuration Utility.

1. Follow the instructions above to install the software, launch the program and select the Ethernet interface.
2. Make sure the OM5P-AN radio is selected in the Radio dropdown.
3. Make sure the radio is connected to the PC via Ethernet.
4. Unplug the power from the radio
5. Press the Load Firmware button
6. When prompted, plug in the radio power. The software should detect the radio, load the firmware and prompt you when complete.

# Getting Started with the 2016 Control System

## Running your Benchtop Test Program - Wireless

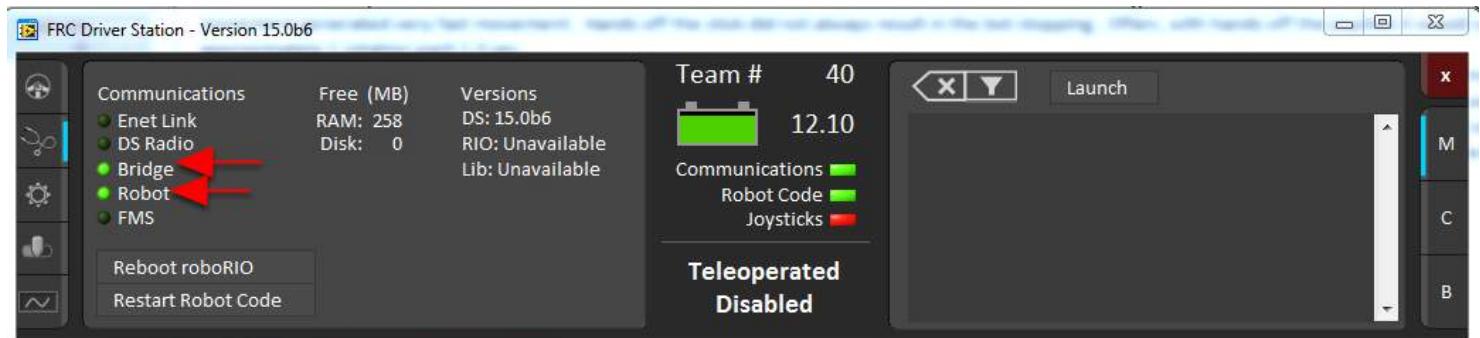
Before attempting wireless operation, tethered operation should have been confirmed as described in the [previous article](#). Running your benchtop testing program while connected to the Driver Station via WiFi will confirm that the access point is properly configured

### Configuring the access point

See the article [Programming your radio for home use](#) for details on configuring the DAP1522 for use as an access point.

After configuring the access point, connect the driver station wirelessly to the robot. The SSID will be your team number (as entered in the Bridge Configuration Utility). If you set a key when using the Bridge Configuration Utility you will need to enter it to connect to the network. Make sure the computer network adapter is set to DHCP ("Obtain an IP address automatically").

### Confirm Connectivity

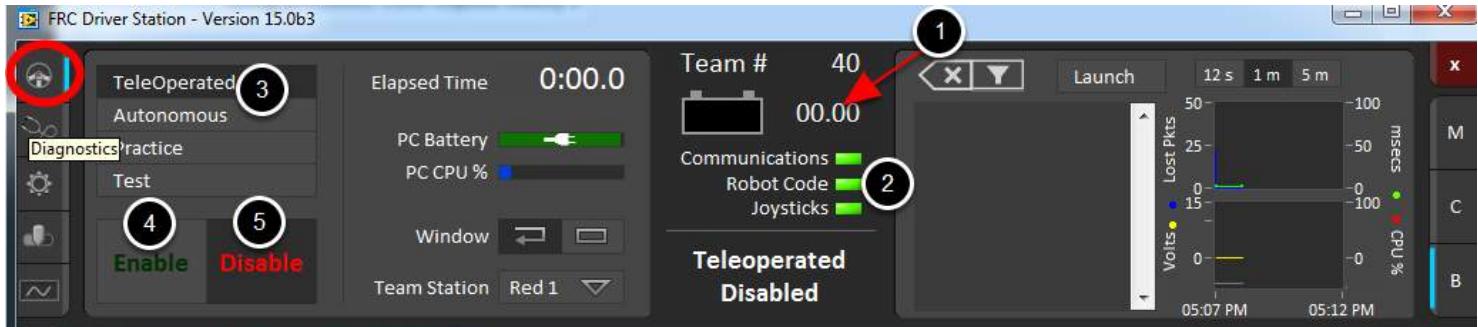


### Using the Driver Station software

Click Diagnostics and confirm that the Bridge, and Robot LEDs are green.

# Getting Started with the 2016 Control System

## Wireless Operation



Click the Operation Tab

1. Confirm that battery voltage is displayed
2. Communications, Robot Code, and Joysticks indicators are green.
3. Put the robot in Teleop Mode
4. Click Enable.- Move the joysticks and observe how the robot responds.
5. Click Disable

# Getting Started with the 2016 Control System

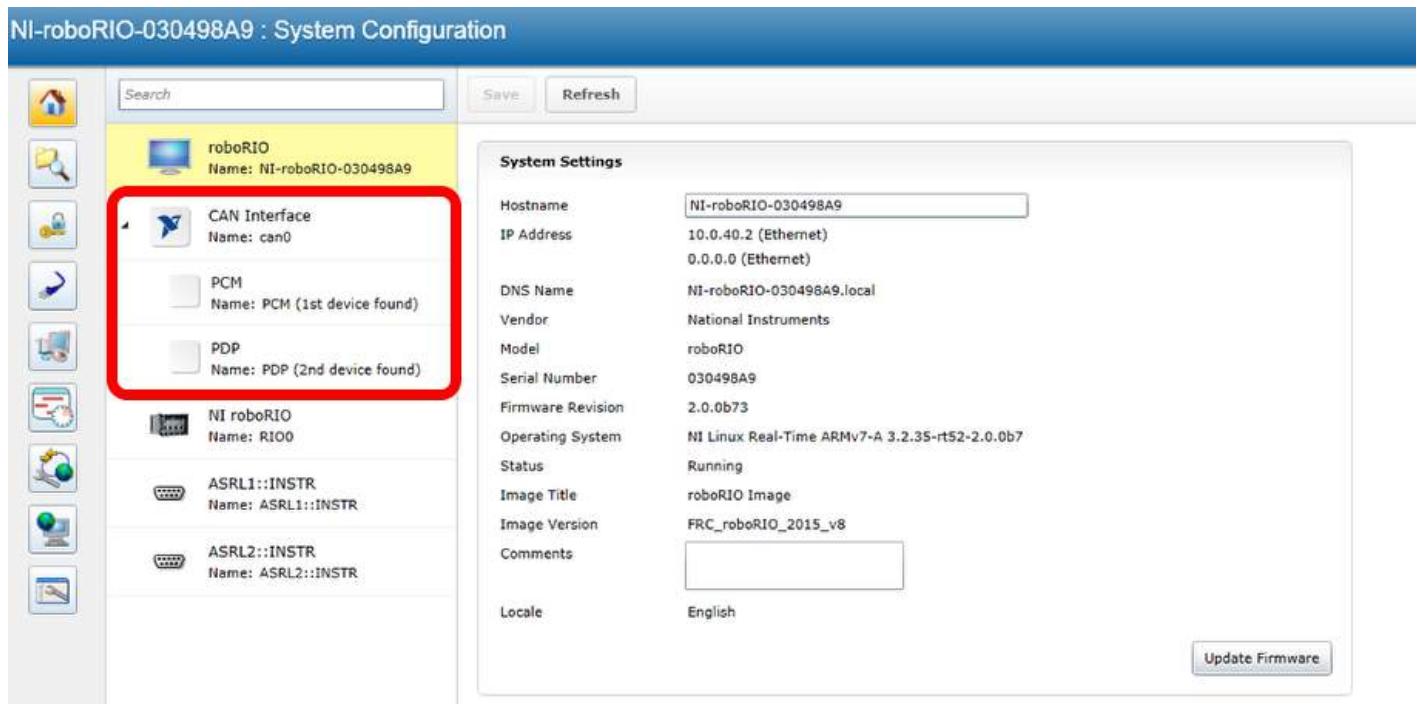
## Updating and Configuring Pneumatics Control Module and Power Distribution Panel

This document describes the process of updating the firmware on the Cross the Road Electronics CAN devices.

**Note: Google Chrome is removing support for the Silverlight plugin. You will need to use a different browser such as Internet Explorer to access the roboRIO webdashboard.**

**Note: The mDNS address for the roboRIO has changed for 2016. Please pay close attention to the new address when attempting to access the roboRIO webdashboard.**

### Accessing CAN Node Settings



Open the WebDash by using a browser to navigate to the roboRIO's address (172.22.11.2 for USB, or "roboRIO-####-FRC.local where #### is your team number, with no leading zeroes, for either interface). You should see a page that looks like the image above, with the CAN devices listed out below the CAN Interface.

# Getting Started with the 2016 Control System

Note: The discovery order (e.g. "1st device found") is needed to separate devices of the same type but has no actual significance. You may see the PDP or a Jaguar or Talon SRX discovered first on your CAN network, even if the PCM is the first node in your CAN chain.

## Troubleshooting

If you do not see any nodes below the CAN Interface entry try the following:

- Check the CAN cabling. If the LEDs on the PCM and PDP are red then they are not seeing CAN. Note that just because the LEDs on the devices are green does not mean the CAN cabling to the roboRIO are correct, they will turn green if the two other devices can see each other on the CAN network.
- Try refreshing the page. The device polling is done once every five seconds and the webpage itself doesn't always react to the Refresh button so if in doubt force a refresh by using the browser's refresh button or closing and re-opening the page.
- Make sure the CAN Interface is expanded. Double clicking the CAN Interface entry (or clicking the triangle to the left of the entry if present) will collapse the tree, repeating will expand it.
- Try restarting the browser. Occasionally the Silverlight plugin may crash or lock up resulting in the CAN devices silently not refreshing.

## Settings

The screenshot shows the 'Settings' page for a CAN node. On the left, a tree view lists nodes: 'roboRIO roboRIO-40', 'CAN Interface can0', 'PCM (PCM (1st device found))' (which is highlighted in yellow), 'PDP (PDP (2nd device found))', 'NI roboRIO RIO0', 'ASRL1::INSTR ASRL1::INSTR', and 'ASRL2::INSTR ASRL2::INSTR'. The right pane displays the 'Settings' for the selected PCM node, with fields including Name (PCM (1st device found)), Device ID (0), Light Device LED (unchecked), Software Status (Running Application.), Hardware Revision (1.1 - 1.3), Manufacture Date (Aug 26, 2013 (Alpha)), Bootloader Revision (2.1 (no support for dynIds)), Vendor (Cross The Road Electronics), Model (PCM), Firmware Revision (1.26 (no dynId support)), and Status (Present). A 'Update Firmware' button is at the bottom right.

Settings	
Name	PCM (1st device found)
Device ID	0
Light Device LED	<input type="checkbox"/>
Software Status	Running Application.
Hardware Revision	1.1 - 1.3
Manufacture Date	Aug 26, 2013 (Alpha)
Bootloader Revision	2.1 (no support for dynIds)
Vendor	Cross The Road Electronics
Model	PCM
Firmware Revision	1.26 (no dynId support)
Status	Present

To access the Settings page of one of the CAN nodes, select the node by clicking on its entry in the list. The settings for that node will then be displayed in the right pane.

# Getting Started with the 2016 Control System

## Setting CAN IDs

The screenshot shows a software interface for managing device settings. At the top, there are three buttons: 'Save', 'Revert', and 'Self-Test'. Below them is a section titled 'Settings' containing the following information:

Name	PCM (1st device found)
Device ID	0 <input type="text"/>
<input type="checkbox"/> Light Device LED	
Software Status	Running Application.
Hardware Revision	1.1 - 1.3
Manufacture Date	Aug 26, 2013 (Alpha)
Bootloader Revision	2.1 (no support for dynIds)
Vendor	Cross The Road Electronics
Model	PCM
Firmware Revision	1.26 (no dynId support)
Status	Present

At the bottom right of the settings area is a 'Update Firmware' button.

Each device comes with the CAN ID set to a default value of 0. If using only a single device of that type it is recommended to leave the ID at the default value to allow for the use of default Opens/Constructors. If using multiples of a particular device type (I.E. 2 PCMs or 4 Talon SRXs) you will need to change the node ID of all but one device. To change the node ID:

- Highlight>Select the Device ID and replace it with your desired ID.
- Press "Save". The "Save" button will depress and the "Refresh" button will appear.
- The PDP, PCM and Talon SRX require no additional action to save the new ID. For CAN Jaguars, a notice will appear instructing you to push the user button within 5 seconds. After doing so, click Refresh and verify that the new Device ID has been set.

# Getting Started with the 2016 Control System

## ID Ranges

The screenshot shows a web-based configuration interface for a device. At the top, there is a yellow warning box with a yellow exclamation mark icon and the text: "There was a problem saving the settings for this device. Device ID must be in the range 0 - 63". Below this, the interface has a title "Settings" and two configuration fields. The first field is labeled "Name" with the value "PCM (1st device found)". The second field is labeled "Device ID" with the value "94" entered into a text input box. To the right of the "Device ID" field is a checkbox labeled "Light Device LED" which is unchecked.

The valid ID ranges for each type of device are:

- Pneumatics Control Module (PCM) ID - 0 to 62 (inclusive)
- Power Distribution Panel (PDP) ID - 0 to 62 (inclusive)
- Jaguar ID- 1 to 63 (inclusive)
- Talon SRX ID- 0 to 62 (inclusive)

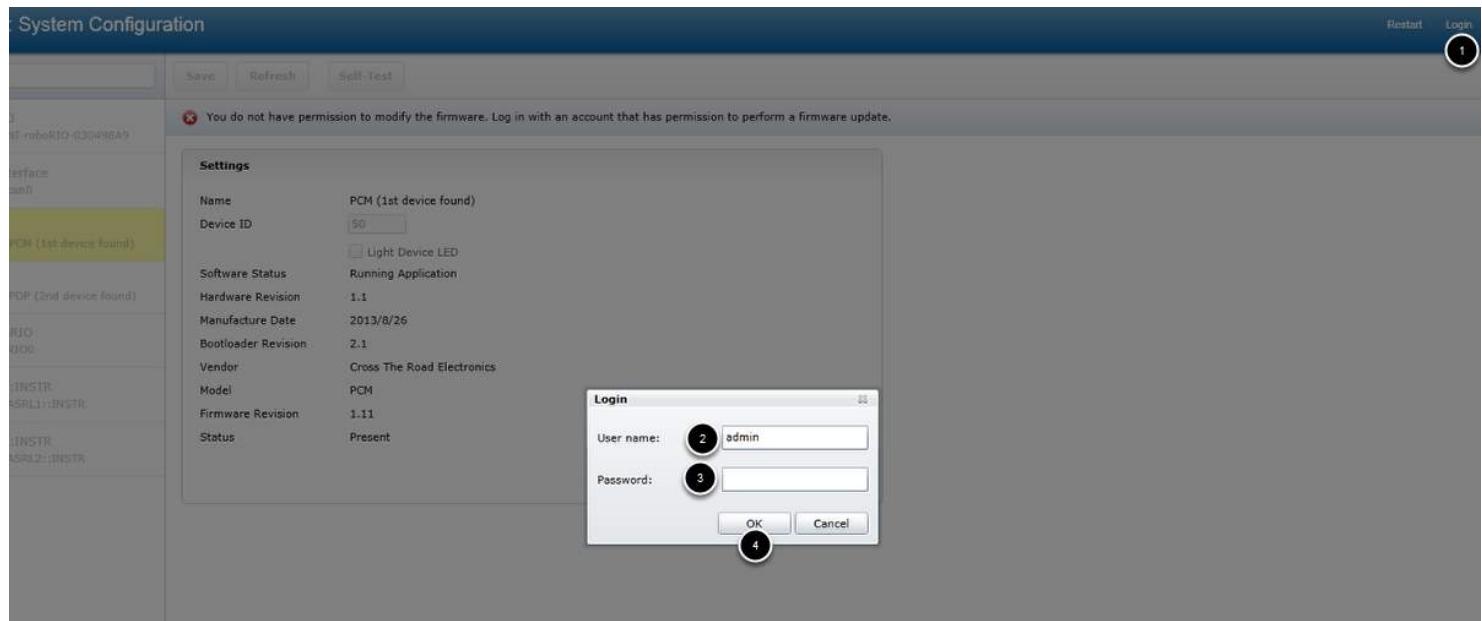
Since the ID ranges for different products don't overlap there is no issue with two or more CAN nodes of different types having the same Device ID (e.g. a PDP with ID=0, a PCM with ID=0, and a Talon SRX with ID=0 on the same bus). Using multiple devices of the same type, such as multiple PCMs or multiple Jaguars with the same node ID will result in a conflict. The web plugin supports a strategy that will allow for recovery of this condition for all devices other than Jaguars, but the devices are not properly usable from within a robot program while in this state. To recover Jaguars which have been set to the same ID you will have to remove all but one of the devices from the bus, then set the devices to non-conflicting IDs.

If you select an invalid ID you will get an immediate prompt like the one shown above.

Changing the PDP ID while using C++\Java WPILib is not recommended as there is no way to change the desired node ID in the library. PCM node IDs may be set as desired and addressed using the appropriate Open or Constructor of the Solenoid or Double Solenoid class.

# Getting Started with the 2016 Control System

## Updating CAN Node Firmware

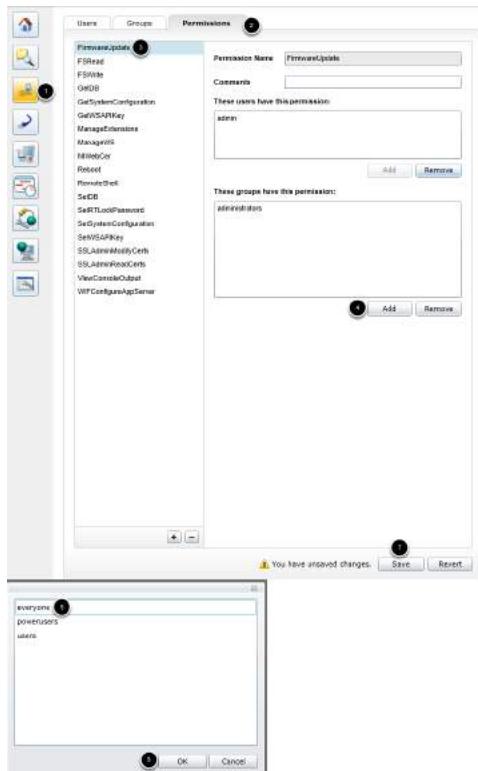


This page can also be used to update the device firmware. To load new firmware you must be logged in:

1. Click "Login" at the top right of the page.
2. Enter the User Name "admin"
3. Leave the Password field blank.
4. Click Ok.

# Getting Started with the 2016 Control System

## Updating Permissions



If you would like to skip the Login step in the future you can set up Permissions to allow firmware updates:

1. Click the Lock Icon in the far left pane.
2. Click the Permissions tab.
3. Select Firmware Update from the list.
4. Click Add below the second large box.
5. Select "everyone"
6. Click Ok.
7. Click Save.

# Getting Started with the 2016 Control System

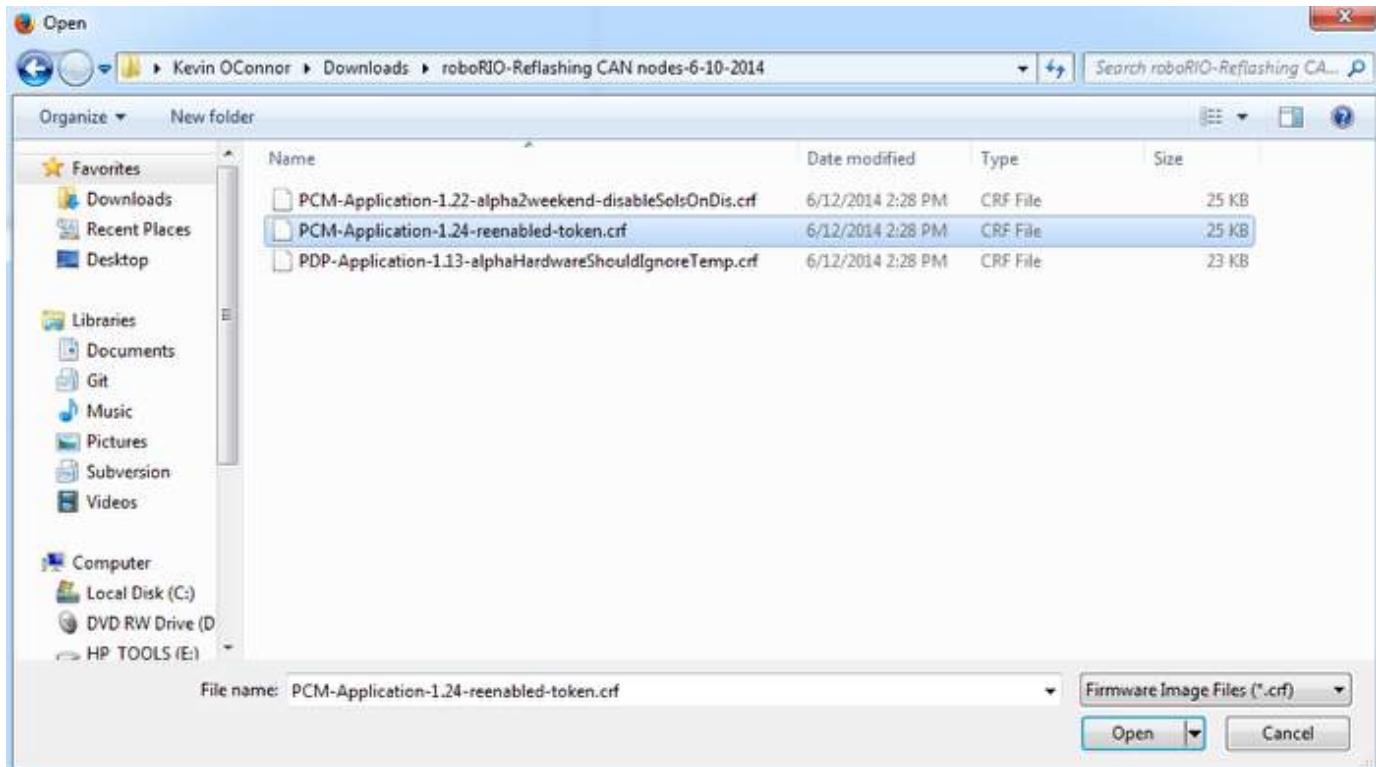
## Update Firmware

Settings	
Name	PCM (1st device found)
Device ID	<input type="text" value="0"/>
	<input type="checkbox"/> Light Device LED
Software Status	Running Application.
Hardware Revision	1.1 - 1.3
Manufacture Date	Aug 26, 2013 (Alpha)
Bootloader Revision	2.1 (no support for dynIds)
Vendor	Cross The Road Electronics
Model	PCM
Firmware Revision	1.26 (no dynId support)
Status	Present
 <input type="button" value="Update Firmware"/>	

The firmware on a CAN Node is updated from the Setting's page for that node. To update the firmware of a CAN Node, press the Update Firmware button.

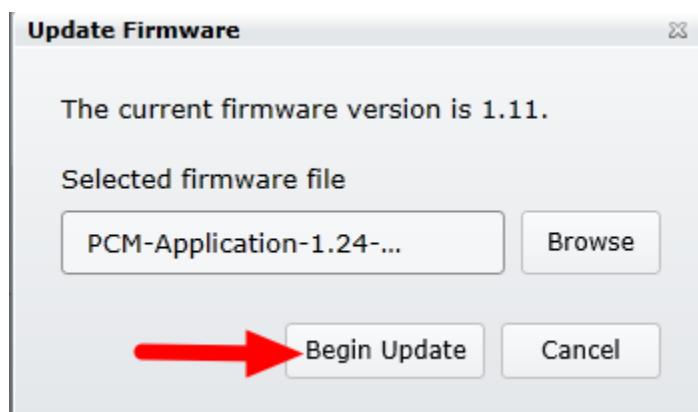
# Getting Started with the 2016 Control System

## Select New Firmware



CTRE Devices use a file format call CRF (Cross The Road Firmware). Using the dialog, browse to the correct location on your computer and select the new firmware file, then click Open. Firmware for CTRE devices can be found in the C:\Users\Public\Public Documents\FRC folder.

## Confirmation



On the dialog that appears, click Begin Update.

# Getting Started with the 2016 Control System

## Update Complete

The screenshot shows a user interface for a control system. At the top, there are three buttons: 'Save', 'Refresh', and 'Self-Test'. Below them is a success message: 'The firmware update completed successfully.' This message is highlighted with a red rectangular border. The main area is titled 'Settings' and contains the following information:

Name	PCM (1st device found)
Device ID	0
<input type="checkbox"/> Light Device LED	
Software Status	Running Application
Hardware Revision	1.1
Manufacture Date	2013/8/26
Bootloader Revision	2.1
Vendor	Cross The Road Electronics
Model	PCM
Firmware Revision	1.24
Status	Present

If the update completes successfully, you should see a confirmation message near the top of the page and the Firmware Revision should update to match the new file.

# Getting Started with the 2016 Control System

## Troubleshooting

The screenshot shows a web-based interface for managing a device. At the top, there is an error message box with a red border containing the text: "There was a problem updating the firmware for this device. PCM (1st device found) : CTRE\_DI\_CouldNotErase". Below this, the main interface has a title "Settings". It contains a table of device information:

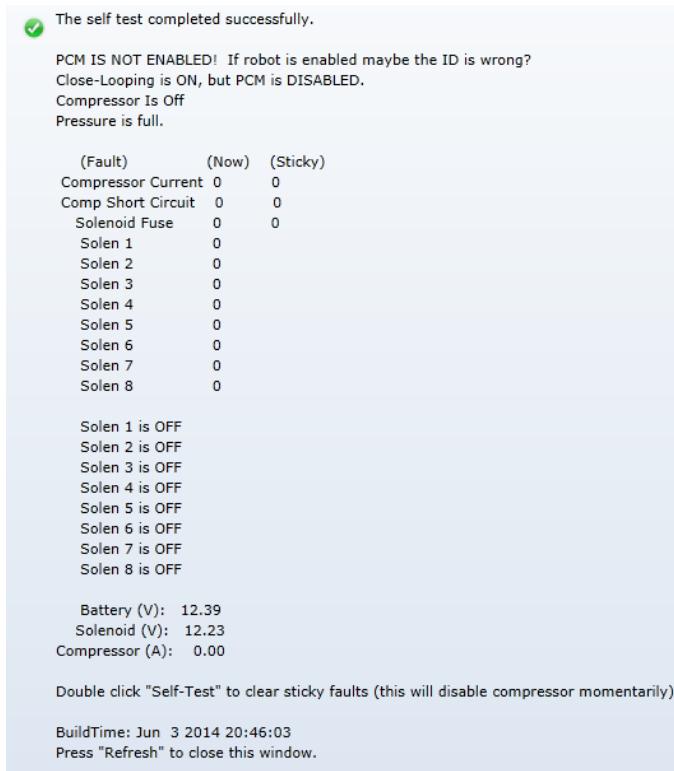
Name	PCM (1st device found)
Device ID	0
Software Status	<input type="checkbox"/> Light Device LED Bootloader, LED is blinking green/orange.
Hardware Revision	1.1
Manufacture Date	2013/8/26
Bootloader Revision	2.1
Vendor	Cross The Road Electronics
Model	PCM
Firmware Revision	255.255
Status	Present

At the bottom right of the interface is a button labeled "Update Firmware".

Since ten seconds is plenty of time for power/CAN to be disconnected, an error code will be reported if a reflash is interrupted or fails. Additionally the Software Status will report “Bootloader” and Firmware Revision will be 255.255 (blank). If a CAN Device has no firmware, it’s bootloader will take over and blink green/yellow on the device’s corresponding LED. It will also keep it’s device ID, so the RIO can still be used to set device ID and reflash the application firmware (crf). This means you can reflash again using the same web interface (there is no need for a recovery button).

# Getting Started with the 2016 Control System

## Self-Test



Pressing Self Test will display data captured from CAN Bus at time of press. This can include fault states, sensor inputs, output states, measured battery voltage,etc...

At the bottom of the section, the build time is displayed for checking what firmware revision is installed. The image above is an example of pressing "SelfTest" with PCM. Be sure to check if PCM is ENABLED or DISABLED. If PCM is DISABLED then either the robot is disabled or team code is talking to the wrong PCM device ID (or not talking to the PCM at all).

# Getting Started with the 2016 Control System

## Sticky Faults

The self test completed successfully.

PCM is enabled.  
Compressor is close-looped on sensor  
Compressor Is Off  
Pressure is full.

(Fault)	(Now)	(Sticky)
Compressor Current	0	0
Comp Short Circuit	0	1
Solenoid Fuse	0	0
Solen 1	0	
Solen 2	0	
Solen 3	0	
Solen 4	0	
Solen 5	0	
Solen 6	0	
Solen 7	0	
Solen 8	0	

Most likely the compressor output was shorted

Solen 1 is OFF  
Solen 2 is OFF  
Solen 3 is OFF  
Solen 4 is OFF  
Solen 5 is OFF  
Solen 6 is OFF  
Solen 7 is OFF  
Solen 8 is OFF

Battery (V): 12.39  
Solenoid (V): 12.22  
Compressor (A): 0.00

Double click "Self-Test" to clear sticky faults (this will disable compressor momentarily).

BuildTime: Jun 3 2014 20:46:03  
Press "Refresh" to close this window.

After enabling the robot and repressing “SelfTest” we see the PCM is enabled but an intermittent short on the compressor output reveals itself in a sticky fault.

Sticky faults persist across power cycles. They also cause orange blinks on the device LED. The PCM will orange blink to signal a sticky fault only when the robot is disabled. The PDP will orange blink anytime it sees a sticky fault (since PDPs are not output devices they don’t care if robot is enabled or not).

# Getting Started with the 2016 Control System

## Clearing Sticky Faults



To clear Sticky Faults, double click Self Test in a rapid fashion. If the faults don't clear you may need to triple click, or rapidly click until you see the "Faults cleared!" text appear.

# Getting Started with the 2016 Control System

## PDP Self-Test

The self test completed successfully.

```
✓ Channel 1 (A): < 1.73
Channel 2 (A): < 1.73
Channel 3 (A): < 1.73
Channel 4 (A): < 1.73
Channel 5 (A): < 1.73
Channel 6 (A): < 1.73
Channel 7 (A): < 1.73
Channel 8 (A): < 1.73
Channel 9 (A): < 1.73
Channel 10 (A): < 1.73
Channel 11 (A): < 1.73
Channel 12 (A): < 1.73
Channel 13 (A): < 1.73
Channel 14 (A): < 1.73
Channel 15 (A): < 1.73
Channel 16 (A): < 1.73
Battery(V) : 13.52
Temp(C) : 98.09
FaultHardwareStatus : 0
Current FAULTS : 0000000000000000
FaultTemp : 0
FaultVbat : 0
Current FAULTS : 0000000000000000 (sticky)
StickyFaultTemp : 0
StickyFaultVbat : 0

Double click "Self-Test" to clear sticky faults.

BuildTime: Jun 3 2014 20:46:03
Press "Refresh" to close this window.
```

Here's an example for PDP. Notice here this PDP sees a temperature of 98.09C (don't worry this board does not have the temp sensor populated). With this firmware, no temp fault is recorded because this hardware revision does not have the temp sensor populated.