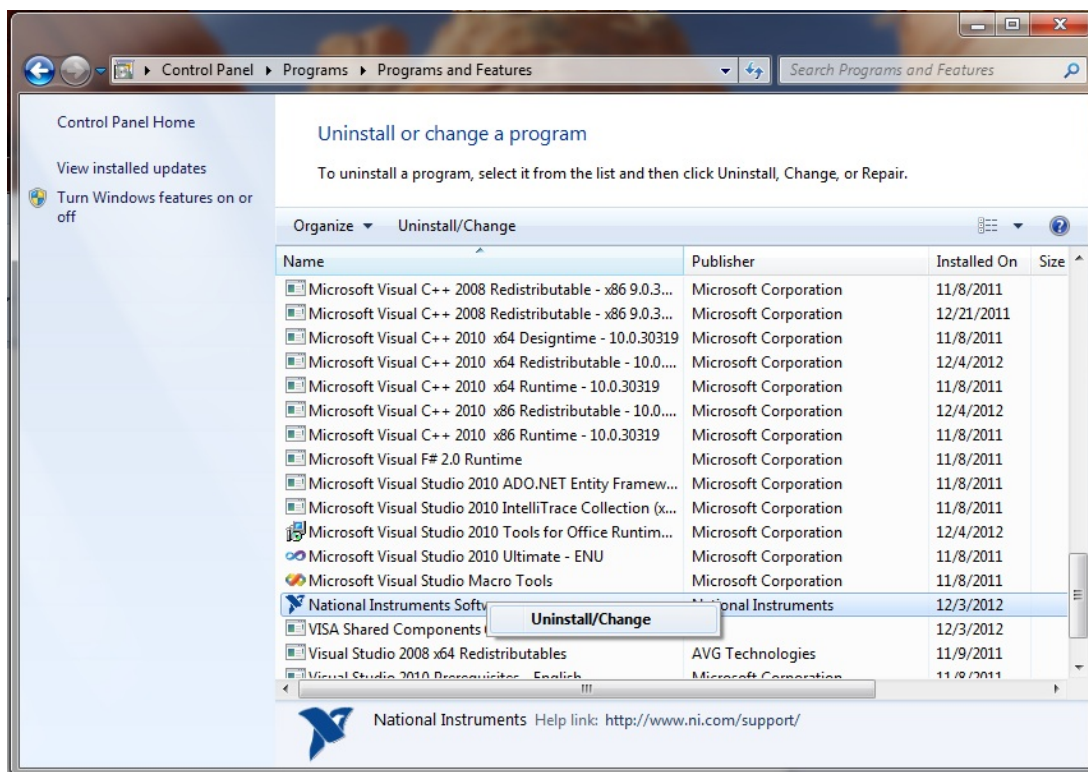# FRC LABVIEW PROGRAMMING

Table of Contents

Setting up the Development Environment

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

FRC LabVIEW 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 2017 only. Make sure to back up any team code located in the "User\LabVIEW Data" directory before uninstalling. Then click **Start** >> **Control Panel** >> **Uninstall a Program.** Locate the entry labeled "**National Instruments Software",** right-click on it and select **Uninstall/Change.**

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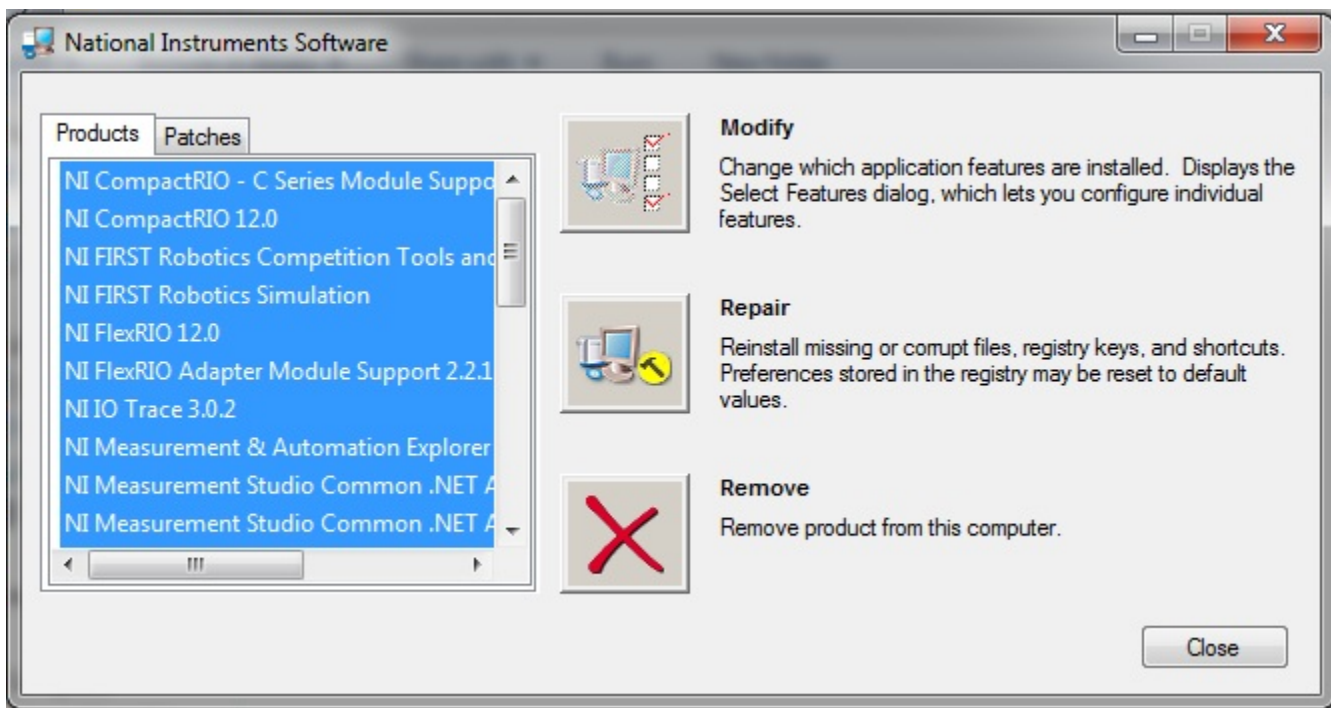
In the left pane of the dialog box that appears, **select all entries**. The easiest way to do this is to click the top entry to highlight it, then scroll down to the bottom entry, press and hold shift and click on the last entry then release shift. Click **Remove**. Wait for the uninstaller to complete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

Getting LabVIEW Installer

Either locate and insert the LabVIEW DVD or download the LabVIEW 2017 installer from
http://www.ni.com/download/labview-for-frc-17.0/6489/en/

FRC LabVIEW Programming

If downloaded, right click on the downloaded file (NI_FRC2017.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.

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 2017 season expires on January 31, 2018)

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.
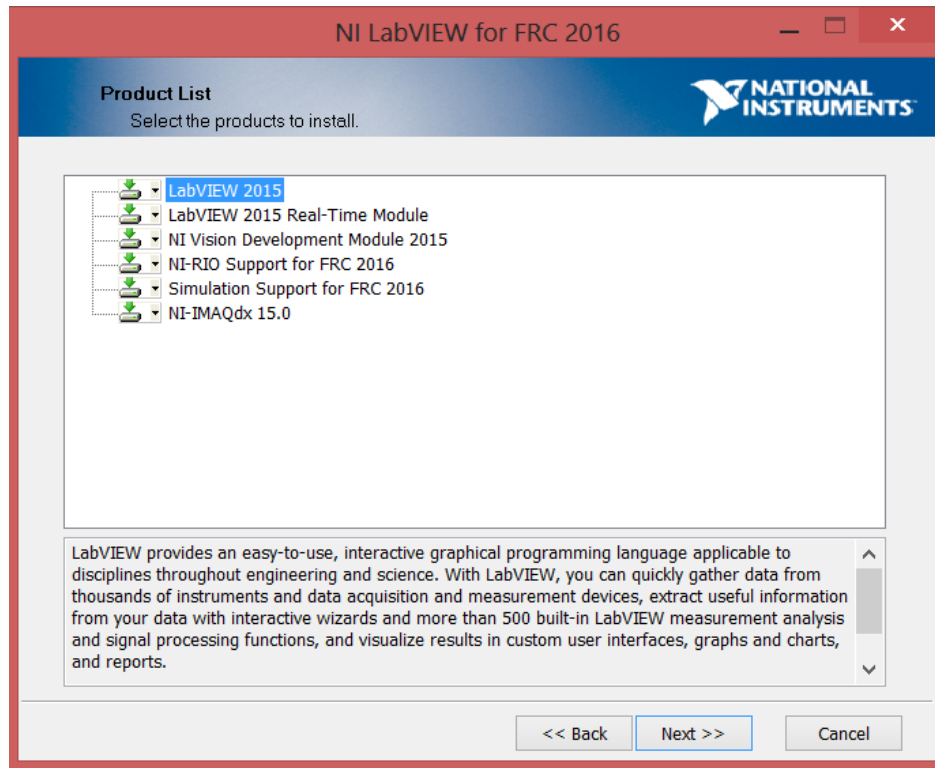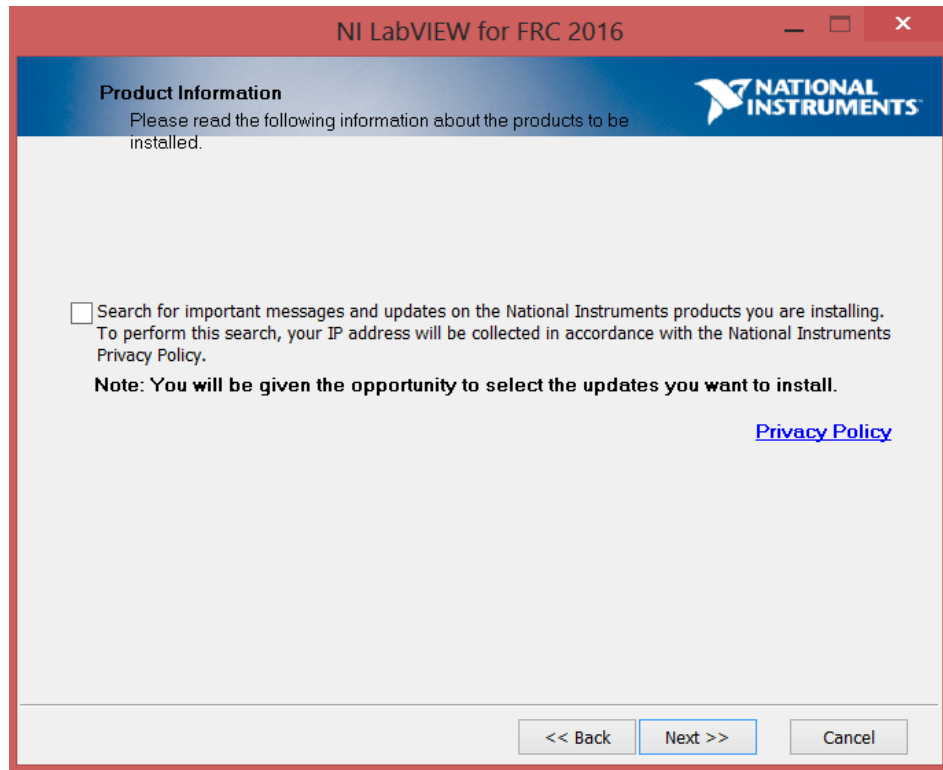
Warnings

Click "Next"

FRC LabVIEW Programming

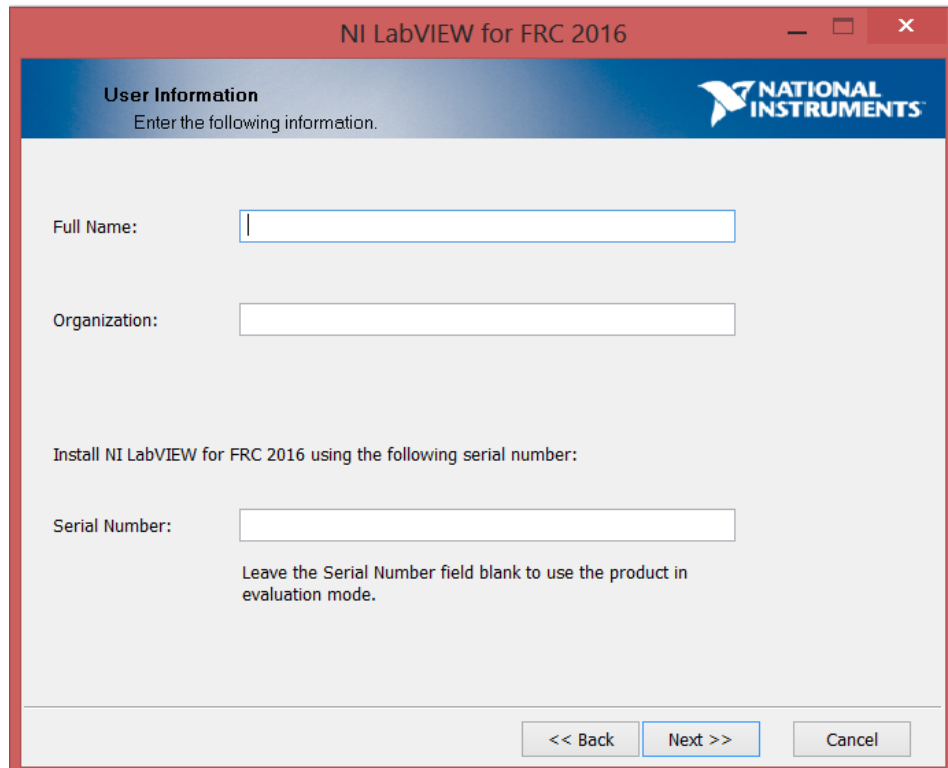## Product List

Click "Next"

FRC LabVIEW Programming

Product Information

Un-check the box, then click "Next"
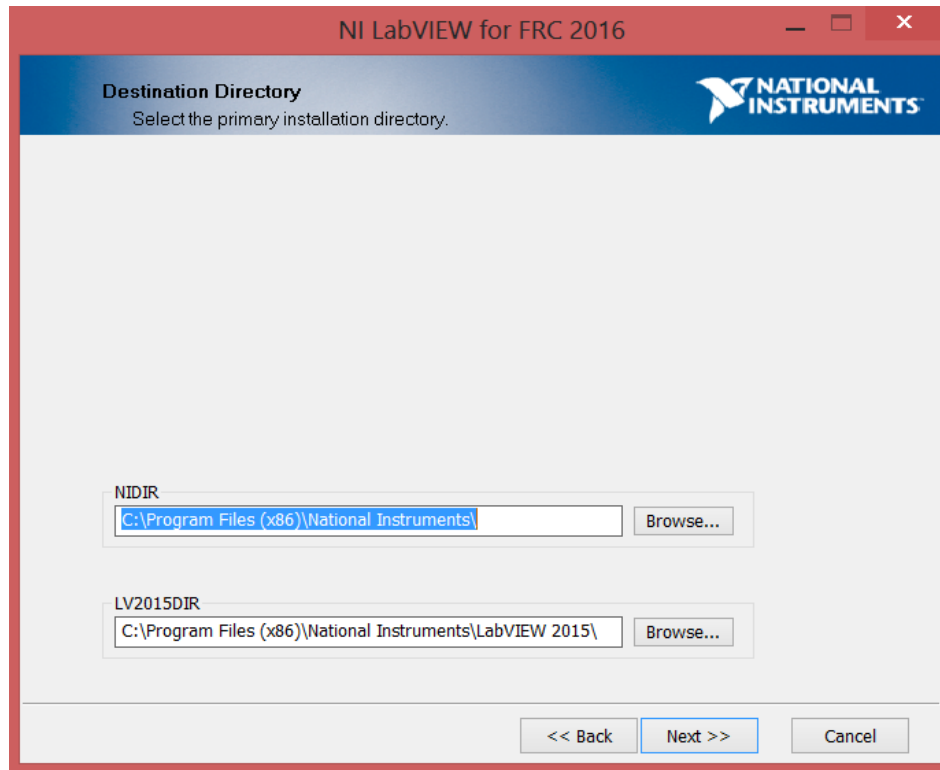
FRC LabVIEW Programming

User Information

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

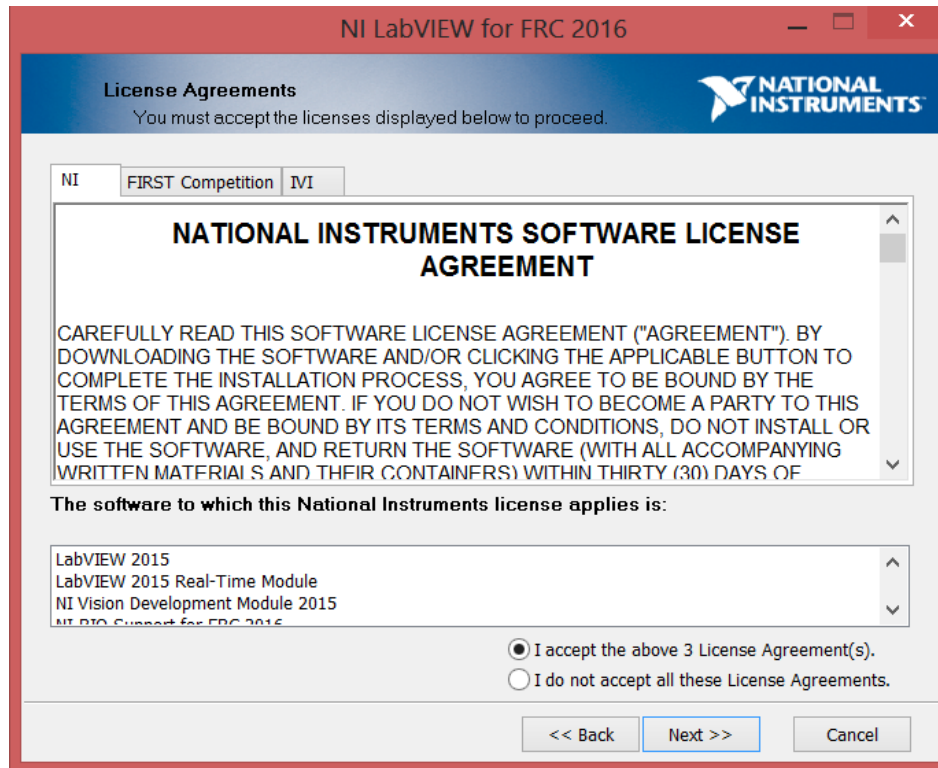# FRC LabVIEW Programming

Destination Directory

Click "Next"

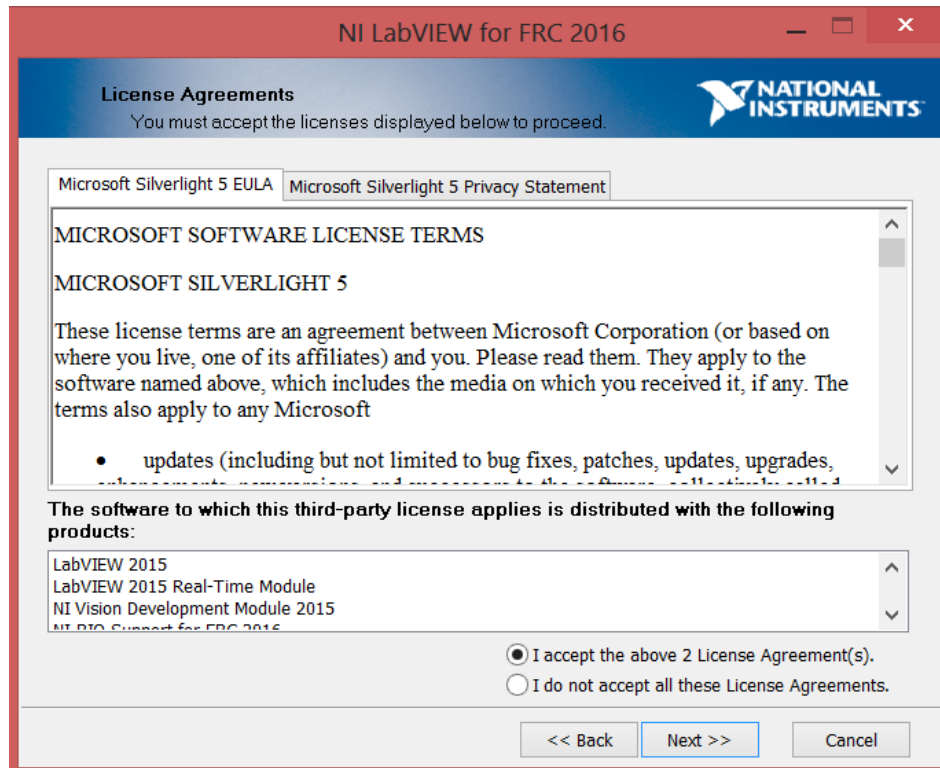---

FRC LabVIEW Programming

License Agreements (1)

Check "I accept..." then Click "Next"
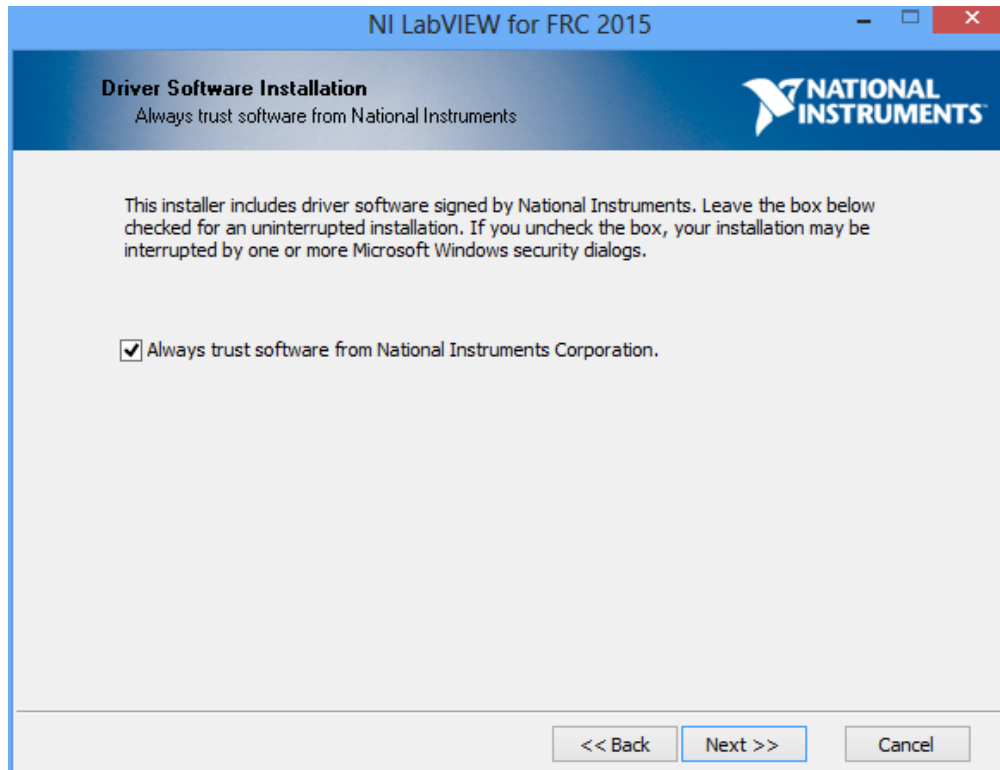
FRC LabVIEW Programming

License Agreements (2)

Check "I accept..." then Click "Next"
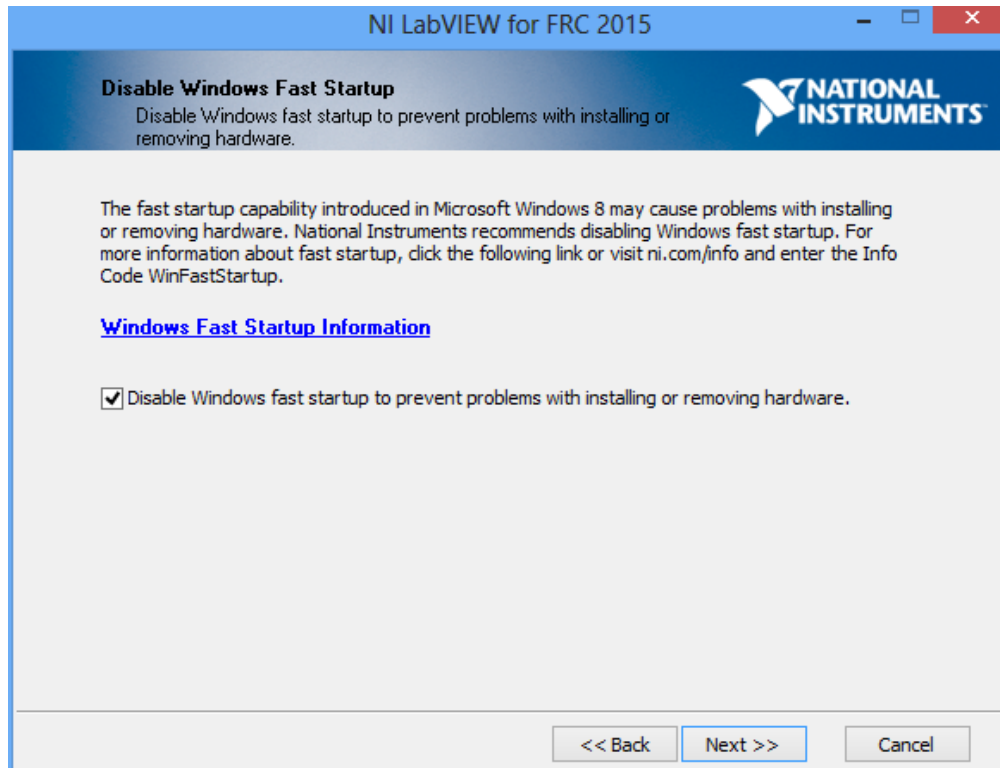
FRC LabVIEW Programming

Driver Software Installation

If you see this screen, Click "Next"

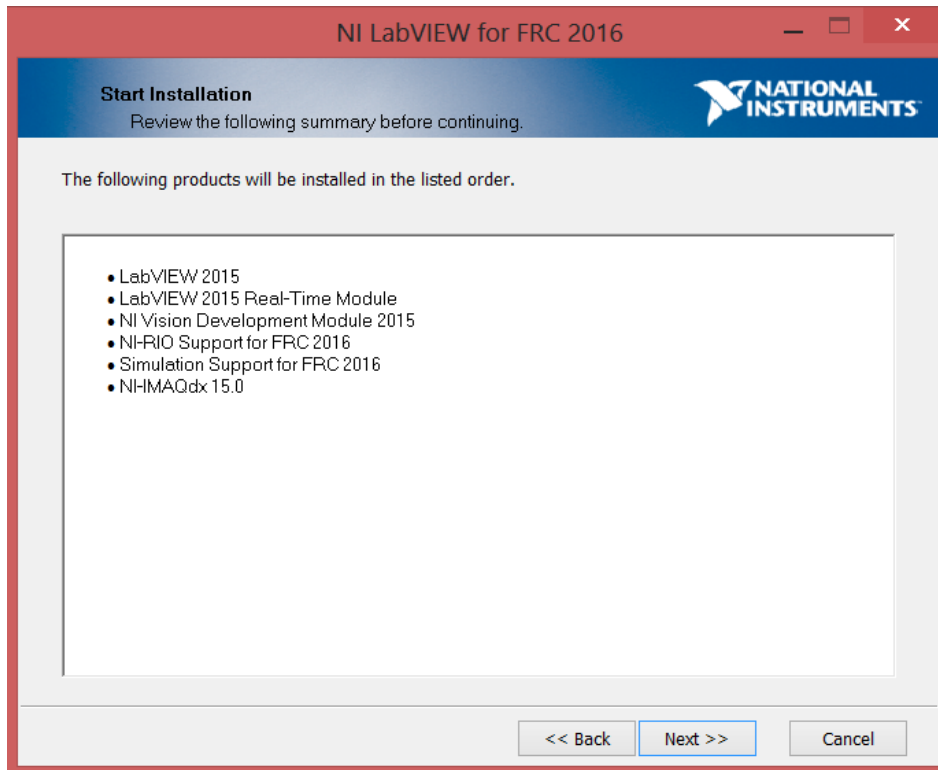# FRC LabVIEW Programming

Disable Windows Fast Startup

If you see this screen, click "Next"

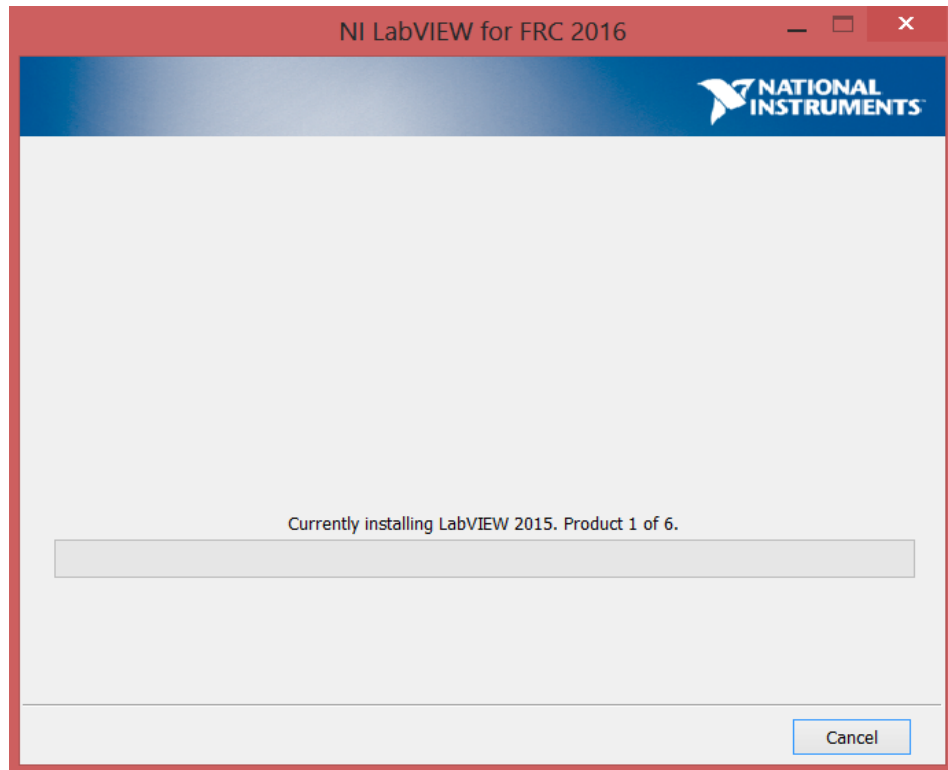# FRC LabVIEW Programming

Start Installation

Click "Next"

FRC LabVIEW Programming

Overall Progress

Overall installation progress will be tracked in this window

FRC LabVIEW Programming

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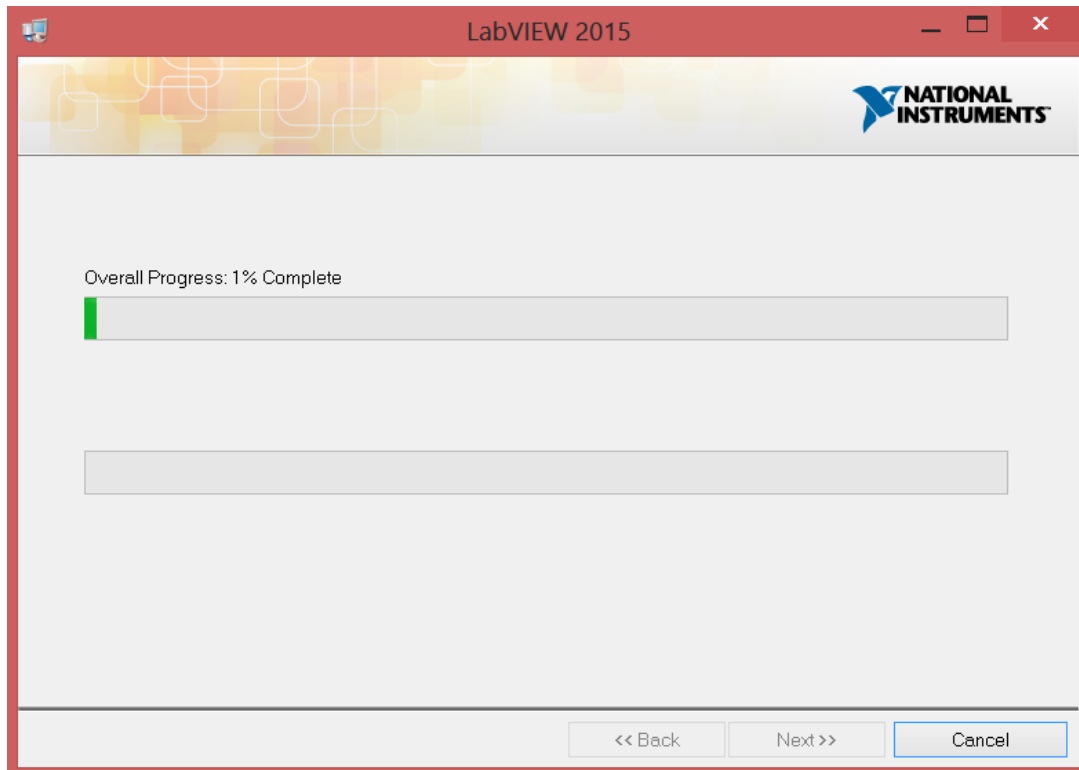
Each product installed will also create an individual progress window like the one shown above.

FRC LabVIEW Programming

Product Information
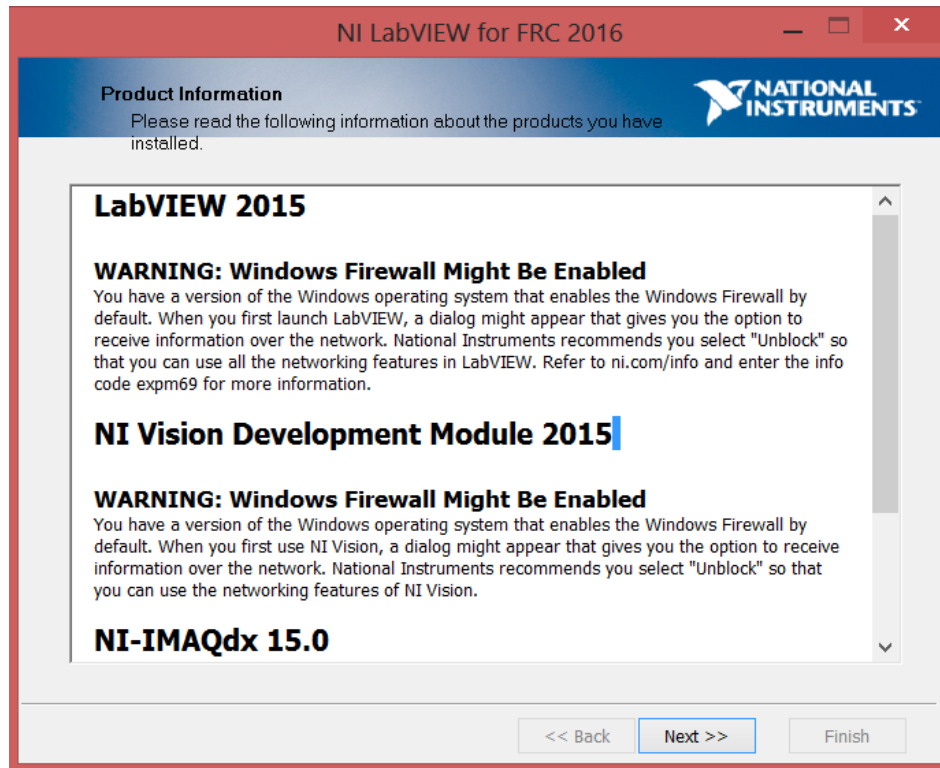
Click "Next"

FRC LabVIEW Programming

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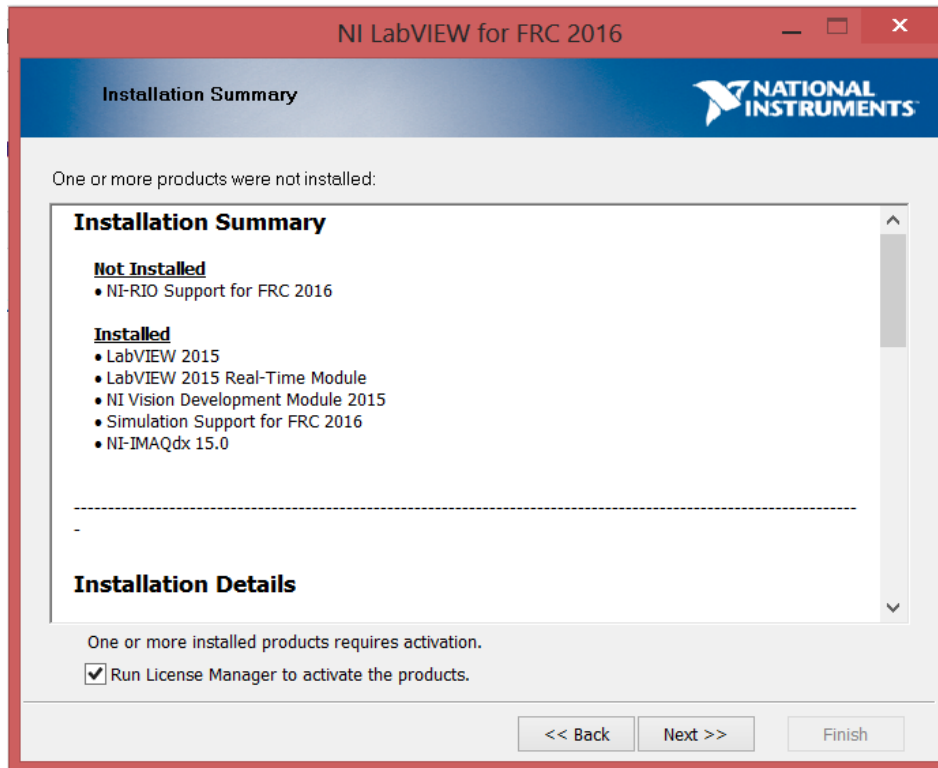
If internet access is available and you are ready to activate, click "Next"; otherwise uncheck the "Run License Manager..." and click "Next".

FRC LabVIEW Programming

NI Activation Wizard
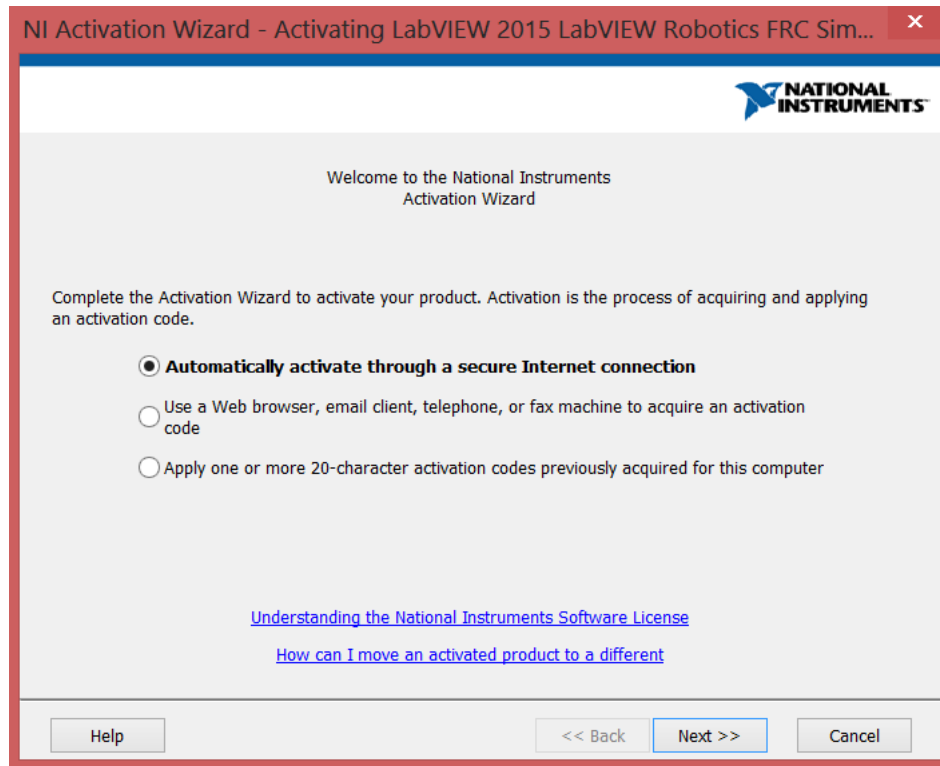
If internet connection is available, click "Next"

NI Activation Wizard (2)
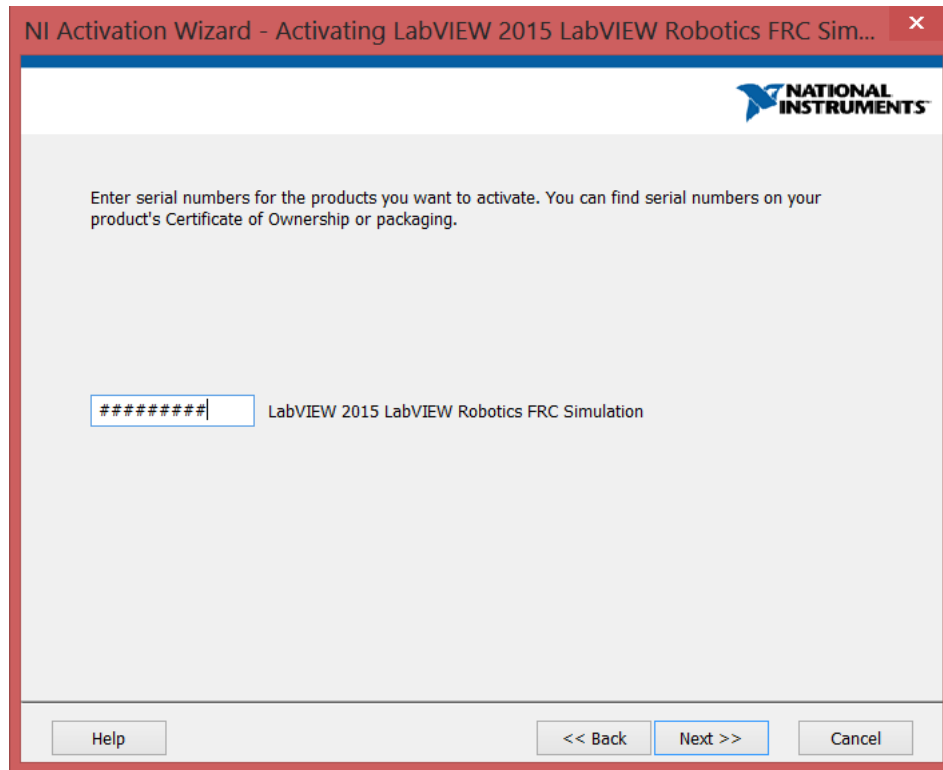
The serial number you entered at the "User Information" screen should appear in all of the text boxes, if it doesn't, enter it now. Click "Next".

FRC LabVIEW Programming

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".

FRC LabVIEW Programming

NI Activation Wizard (4)
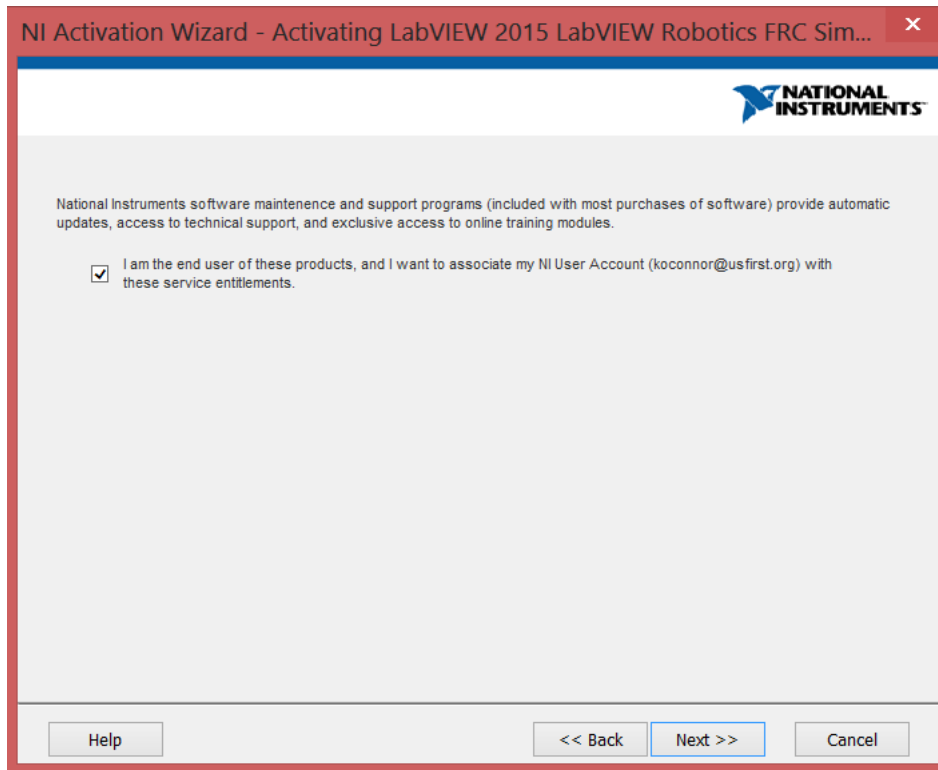
Click "Next".

FRC LabVIEW Programming

NI Activation Wizard (5)
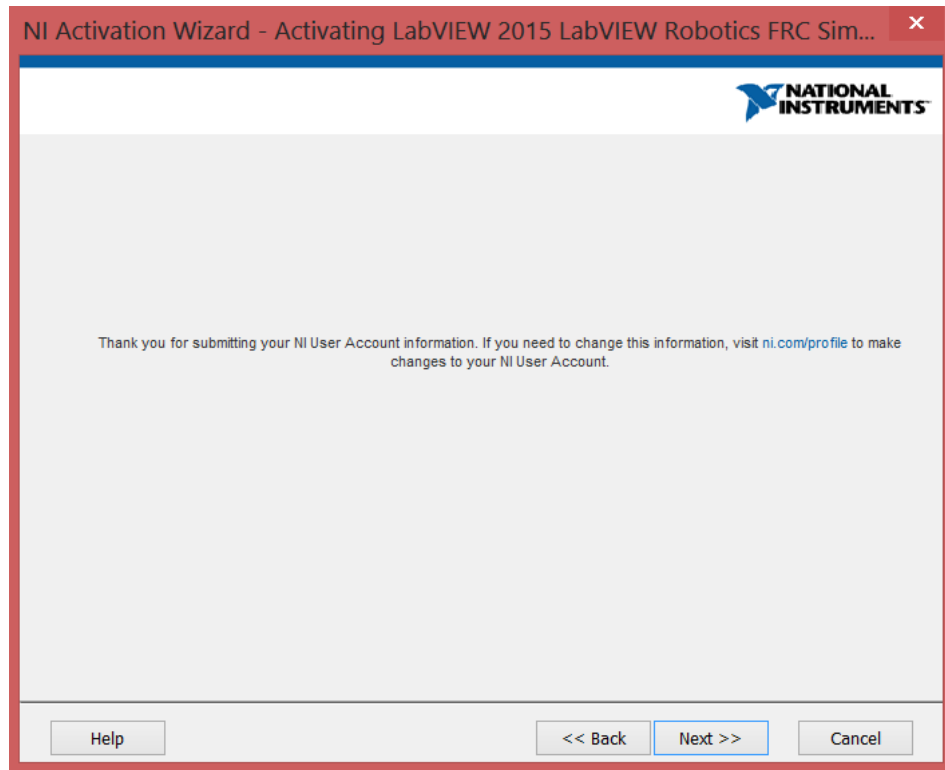
Click "Next".

FRC LabVIEW Programming

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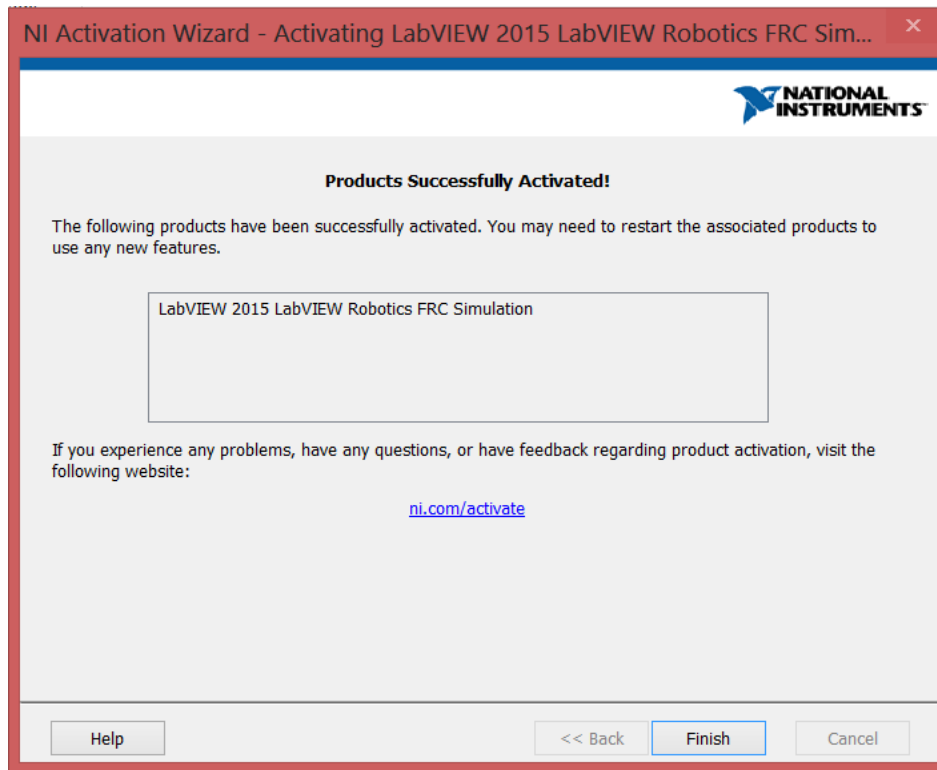
The Activation Wizard will contact NI and complete the activation. You should then see the window shown above. Click "Finish" to complete the installation.

Restart Message
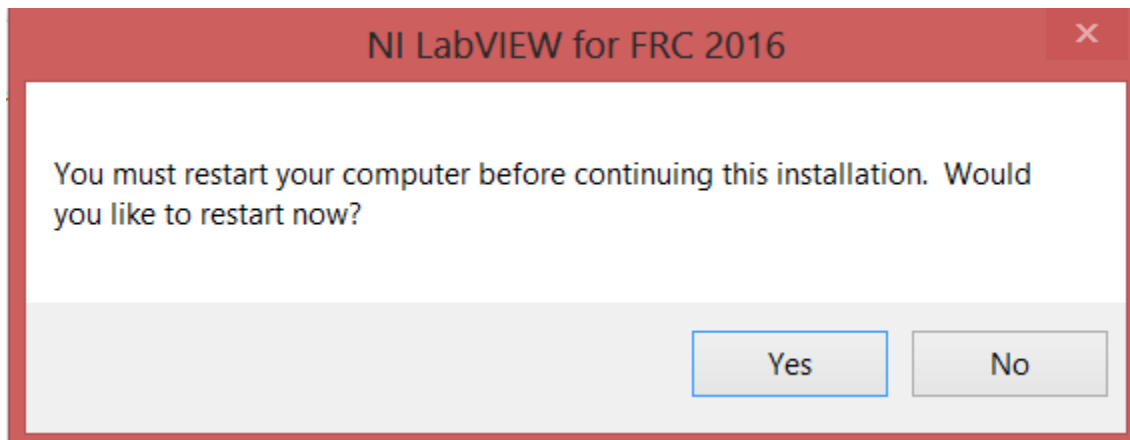
Select "Yes"

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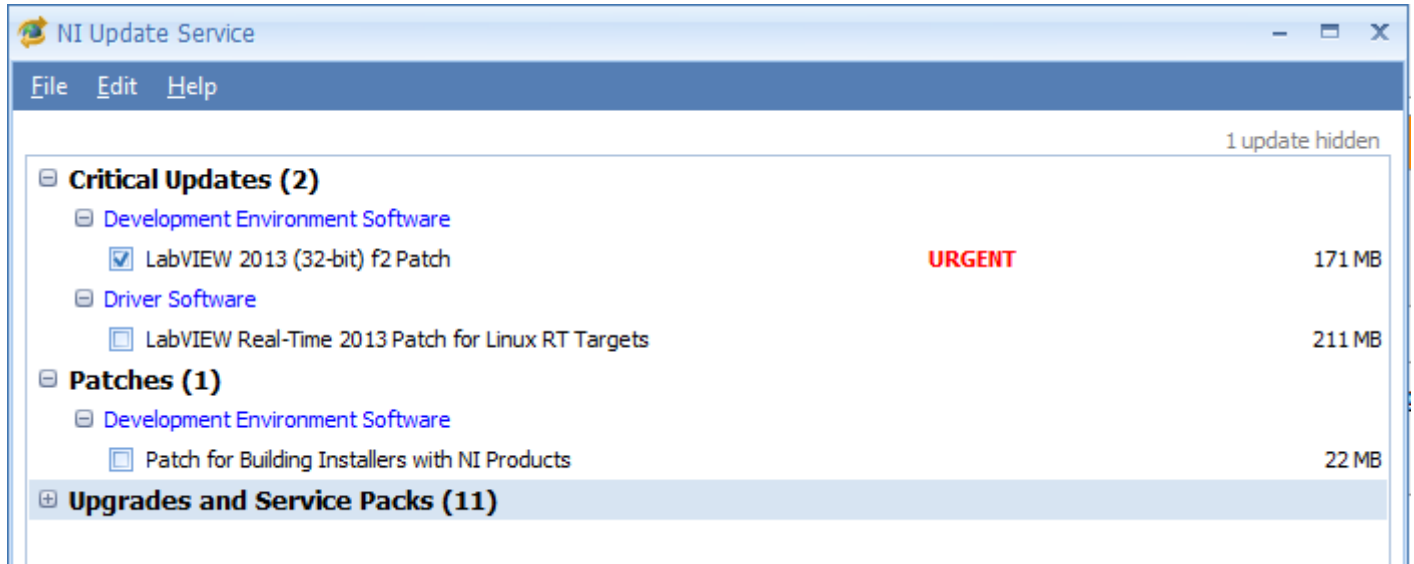
On occasion you may see alerts from the NI Update Service about patches to LabVIEW. **It is not recommended to install these updates unless directed by FRC through our usual communication channels (Frank's Blog, Team Updates or E-mail Blasts).**

Installing the FRC 2017 Update Suite (All Languages)

The FRC 2017 Update Suite contains the following software components: LabVIEW Update, FRC Driver Station, and FRC Utilities. If an FRC 2017 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 2017 DS will only work on Windows 7, Windows 8, Windows 8.1, and Windows 10. It will not work on Windows XP.

Note for LabVIEW Teams: CAN Talon SRX has been removed from WPILib. See this blog for more info and find the CTRE Toolsuite installer here: http://www.ctr-electronics.com/control-system/hro.html#product_tabs_technical_resources

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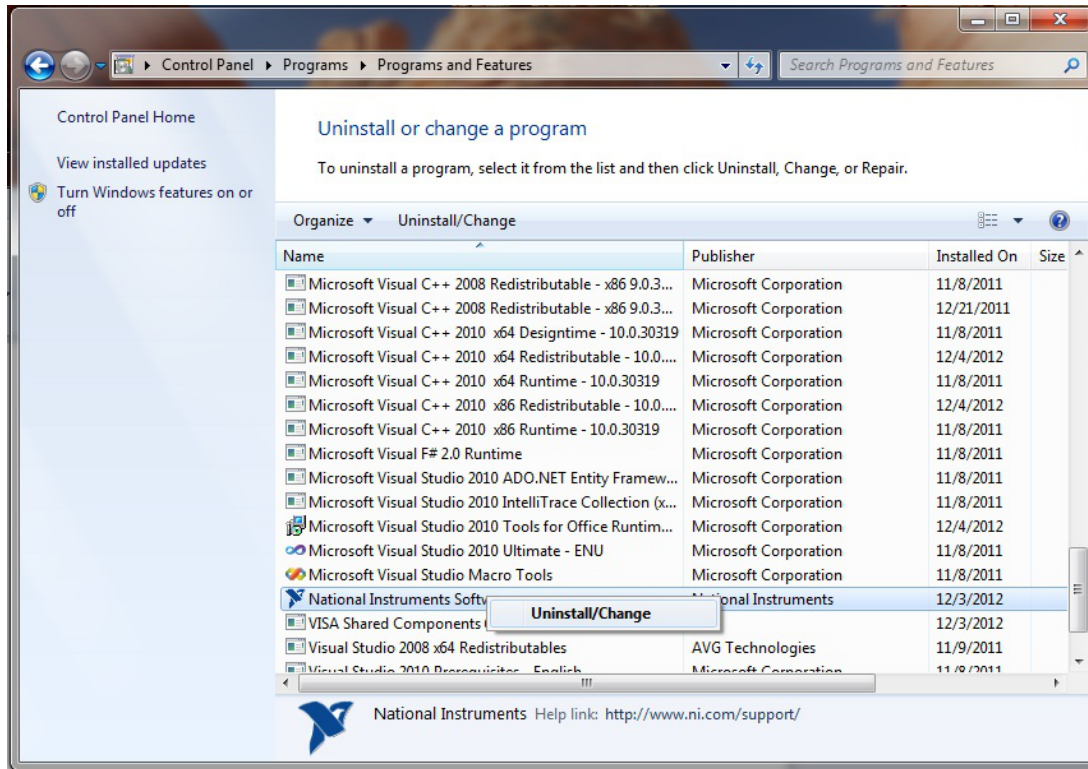
LabVIEW teams have already completed this step, do not repeat it. Before installing the new version of the NI Update it is recommended to remove any old versions. The new version will likely properly overwrite the old version, but all testing has been done with FRC 2015 only. Make sure to back up any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

FRC LabVIEW Programming

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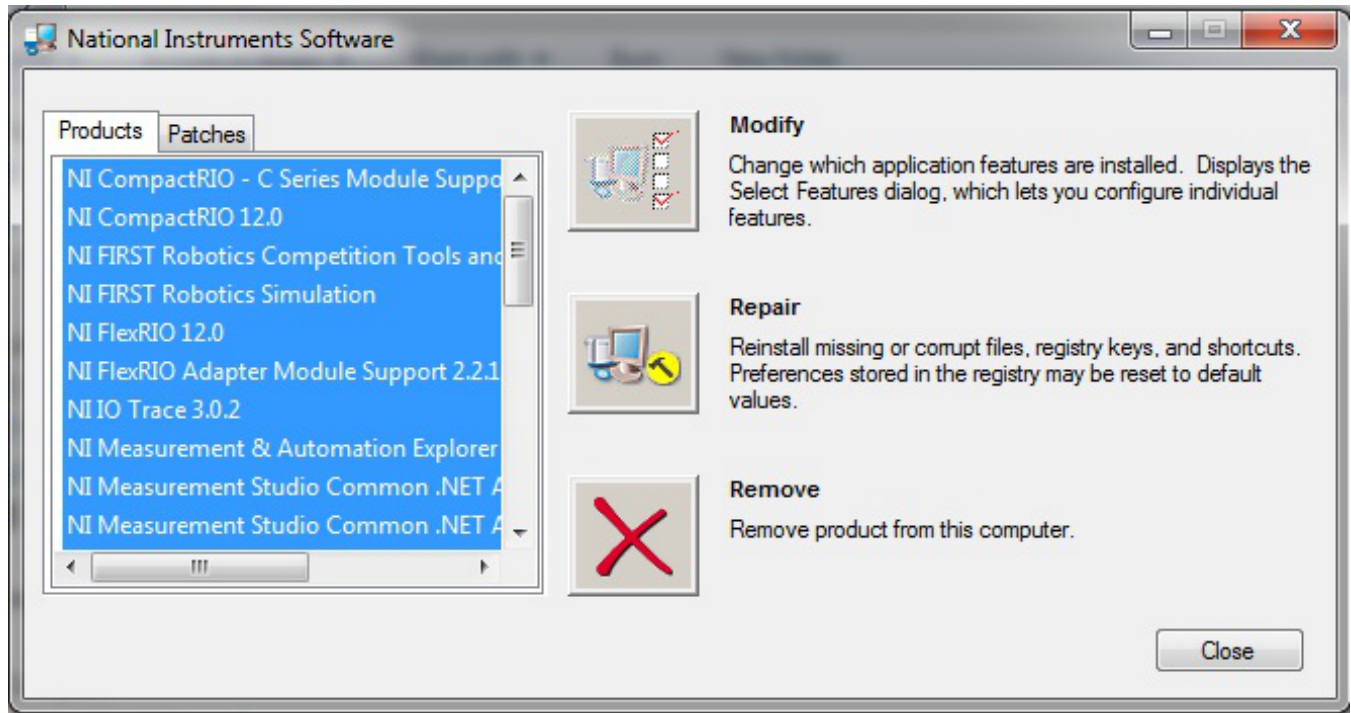
In the left pane of the dialog box that appears, **select all entries**. The easiest way to do this is to click the top entry to highlight it, then scroll down to the bottom entry, press and hold shift and click on the last entry then release shift. Click **Remove**. Wait for the uninstaller to complete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

Downloading the Update

Download the update from http://www.ni.com/download/first-robotics-software-2015/5112/en/
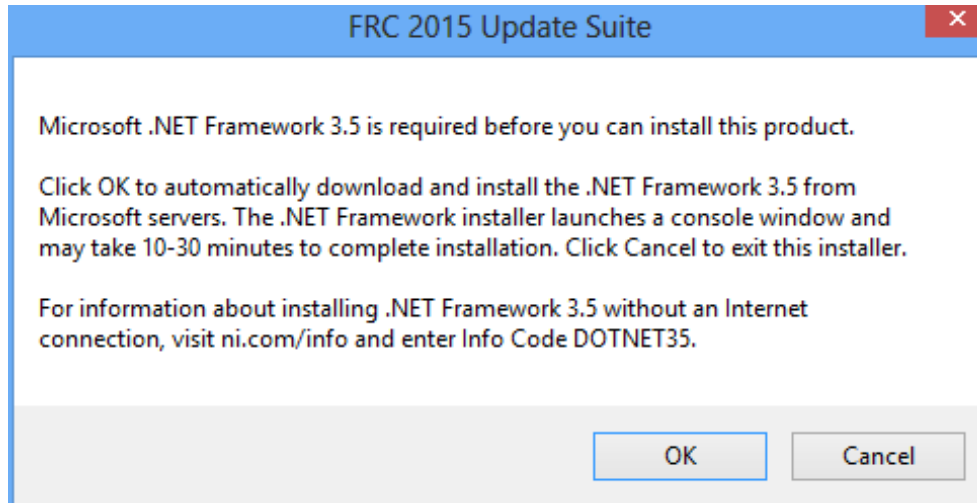
Windows 8

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

FRC LabVIEW Programming

RIght click on the downloaded zip file and select Extract All. If you downloaded the encrypted zip file, you will be prompted for the encryption key which is **&Full$team^Ahead!** 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
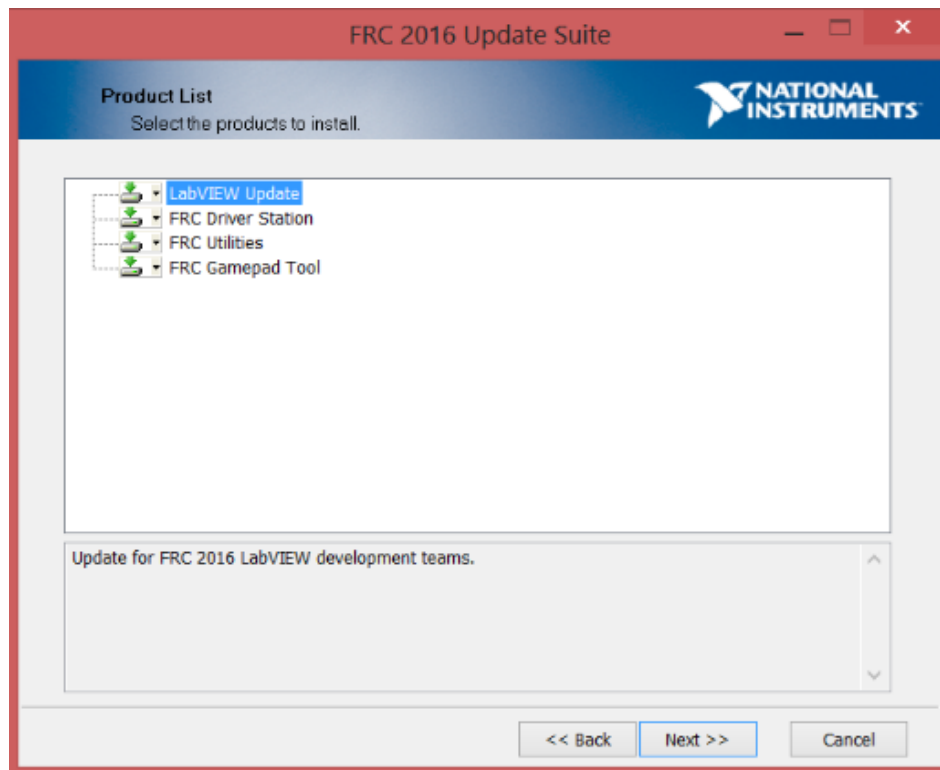
Click "Next"

Product Information

Un-check the box, then Click "Next"

FRC LabVIEW Programming

User Information

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

FRC LabVIEW Programming

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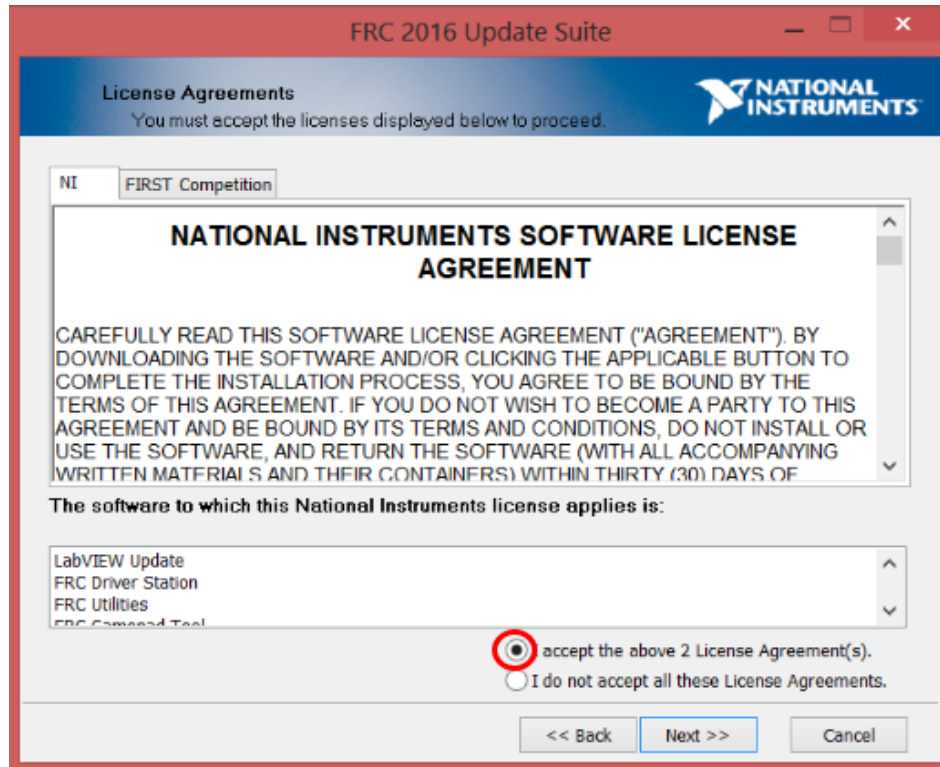
Select "I accept..." then click "Next"

FRC LabVIEW Programming

License Agreements Page 2
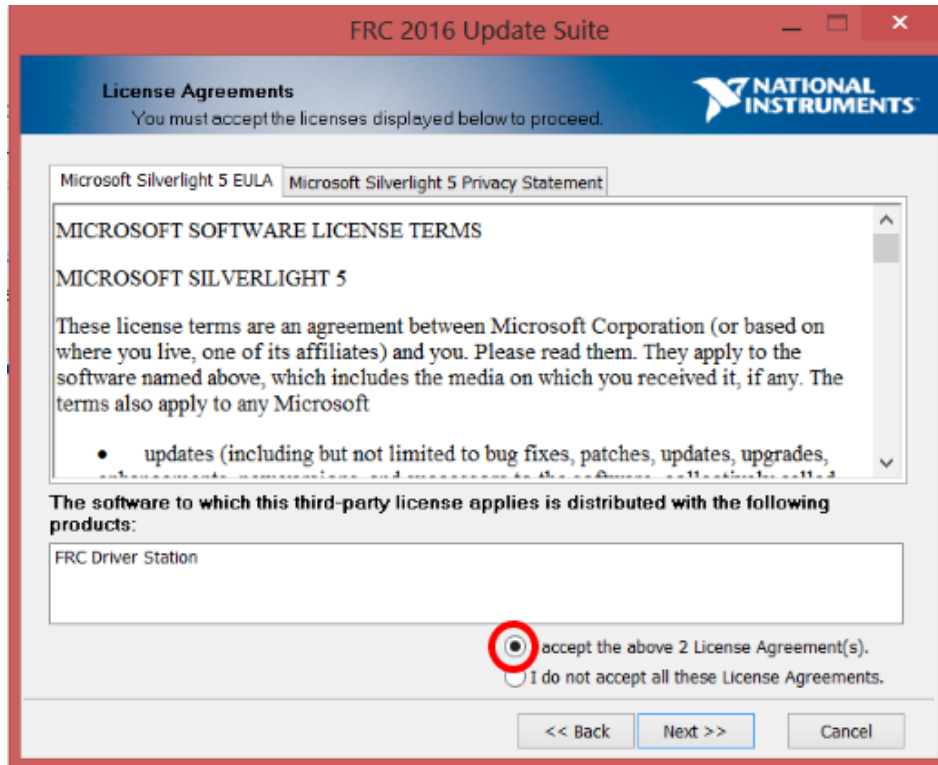
Select "I accept..." then click "Next"

FRC LabVIEW Programming

Summary Progress
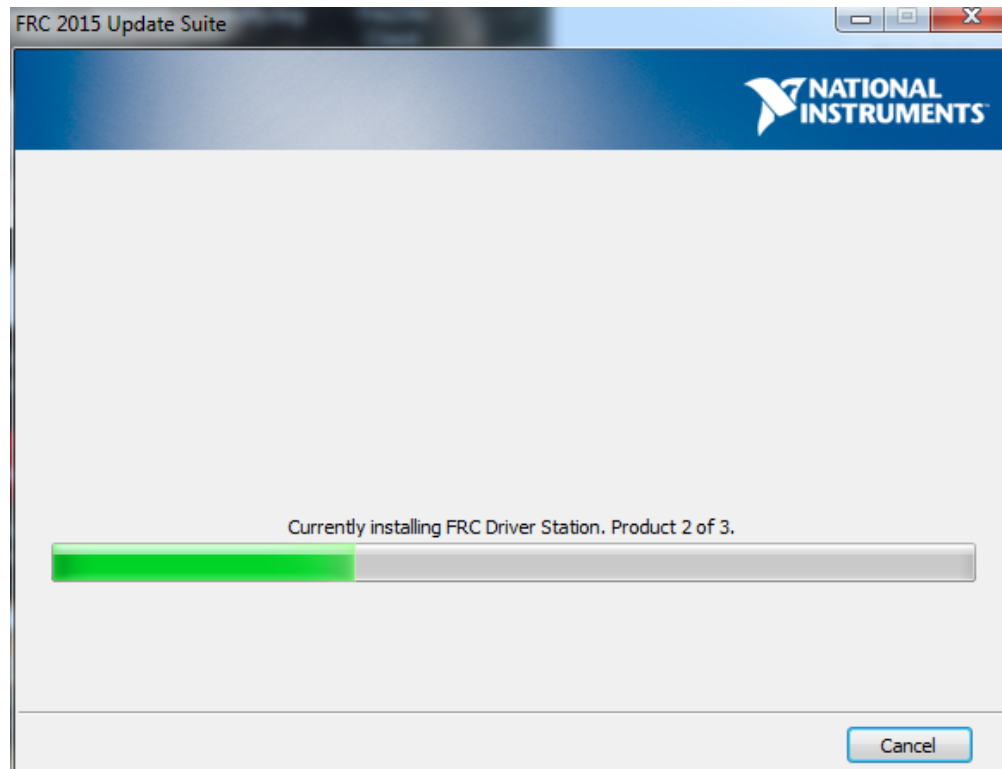
FRC LabVIEW Programming

Detail Progress
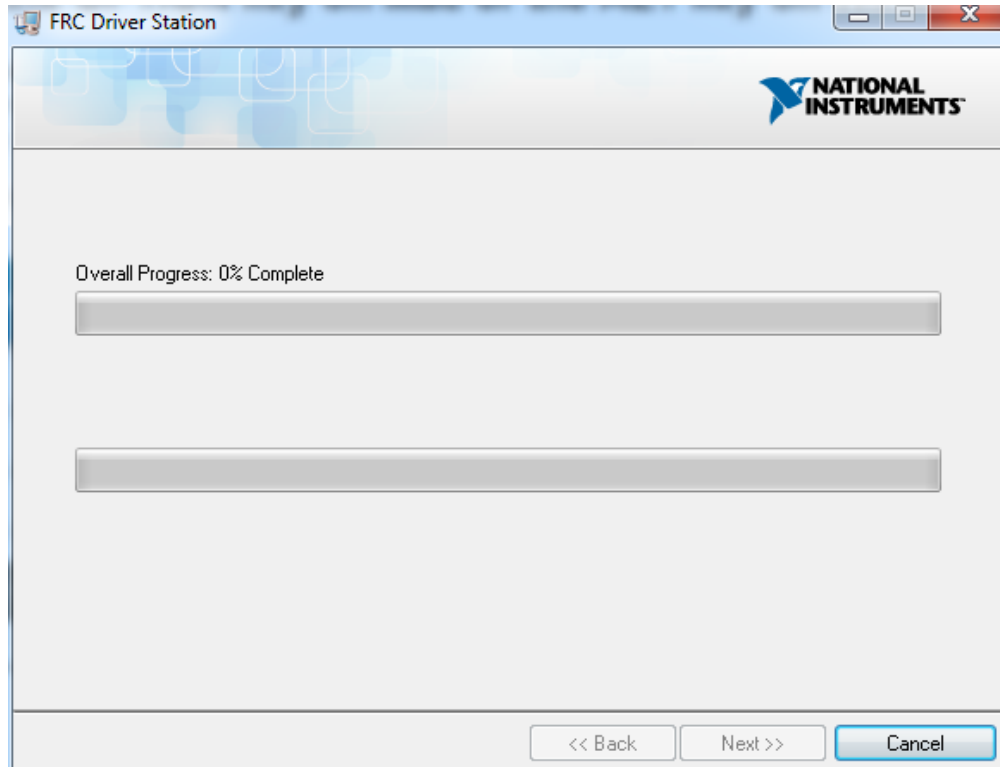
Installation Summary
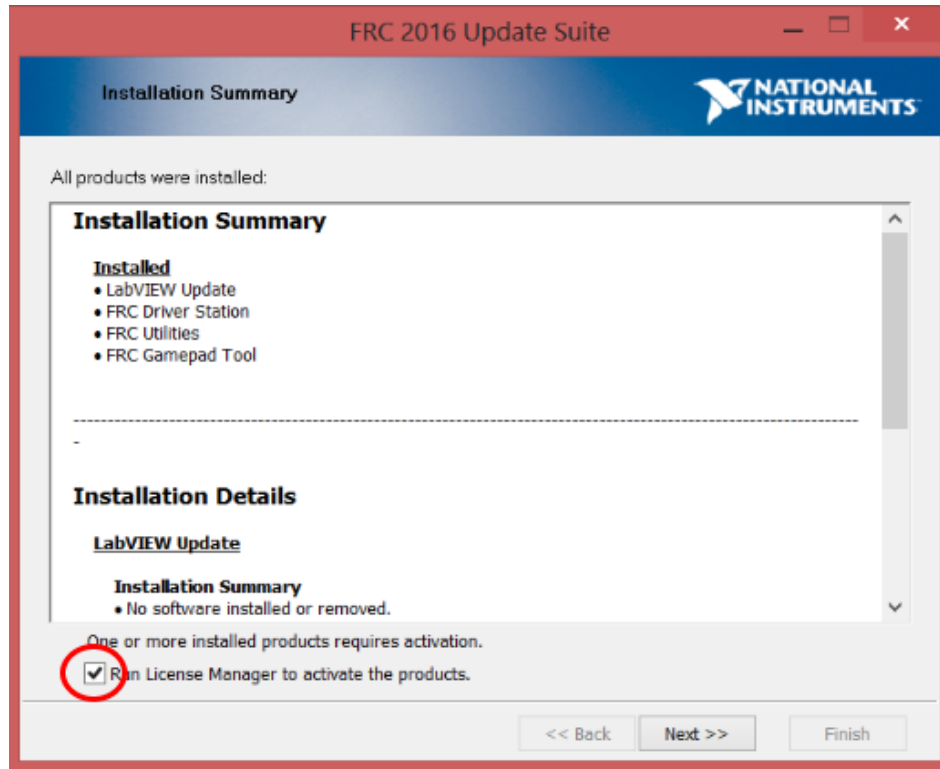
Make sure the box is checked to **Run License Manager...** then click **Next**

FRC LabVIEW Programming

Activate
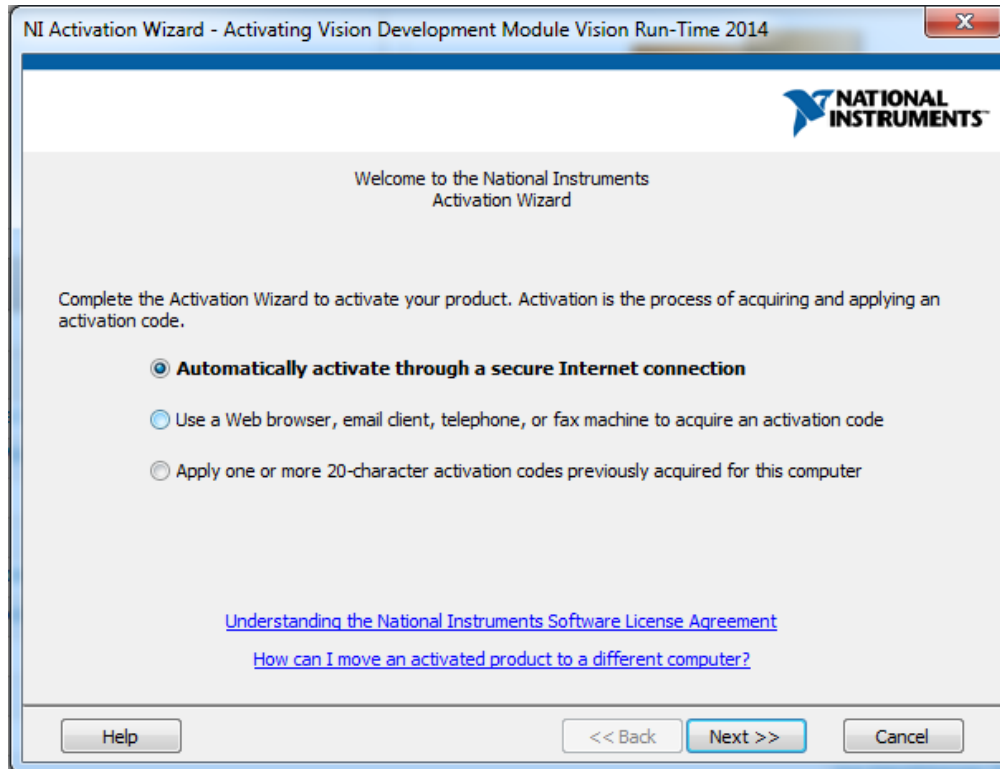
Select your desired activation method (Internet activation recommended), then click **Next**
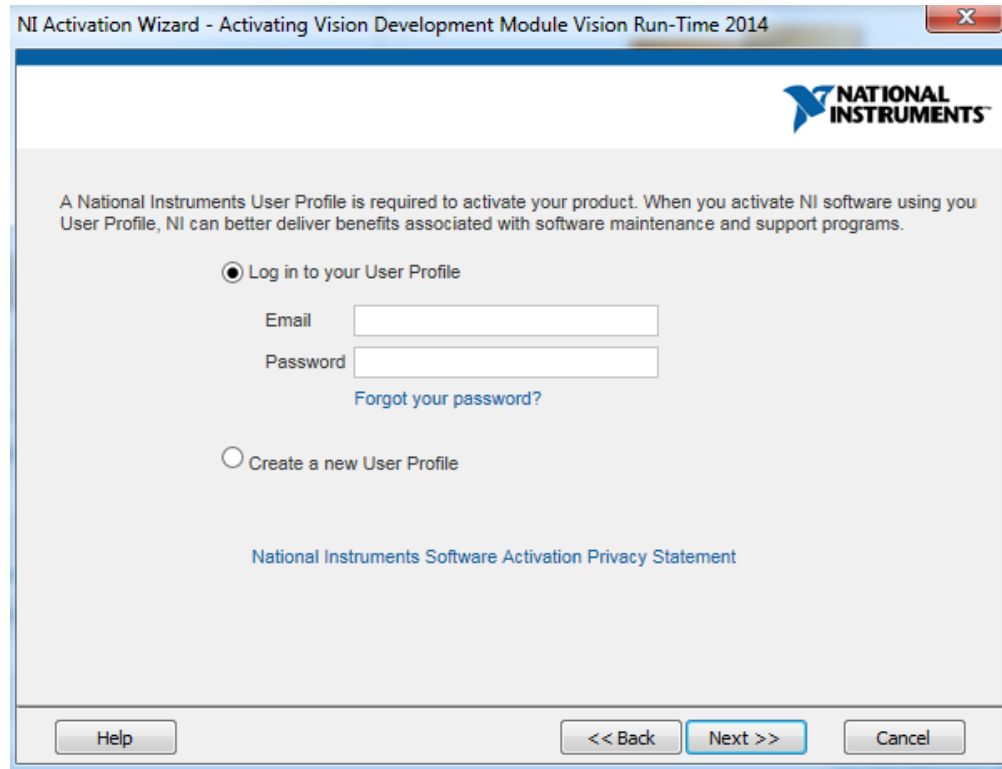
Serial Number Confirmation
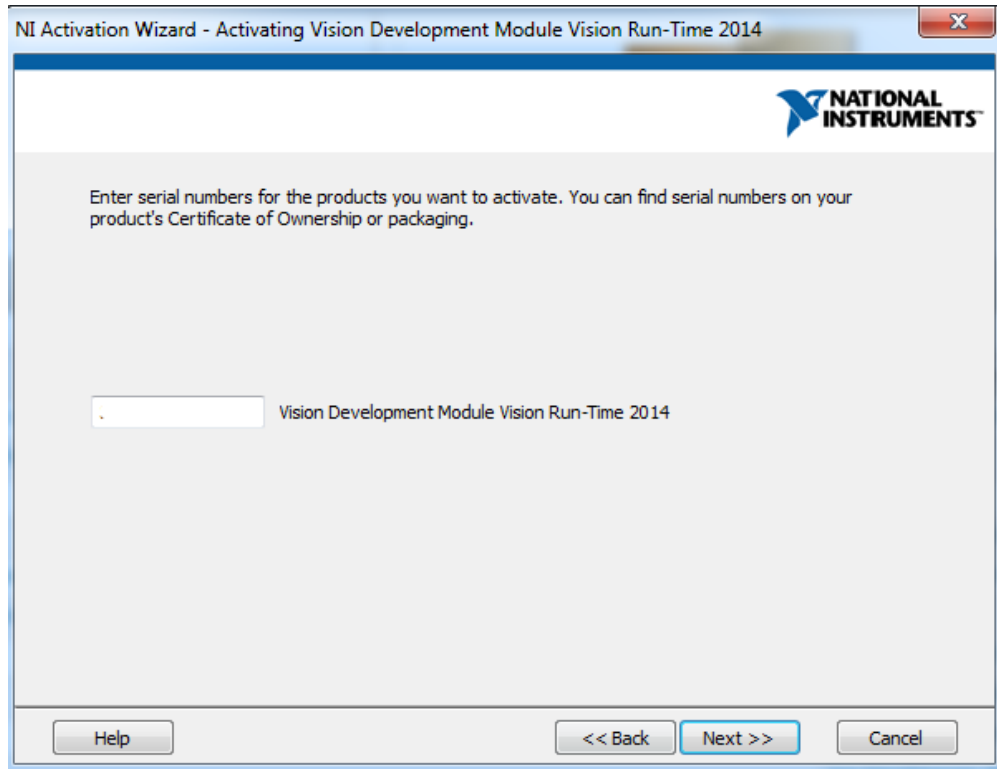
Make sure the serial number in the box matches the one from your kit, then click **Next**

FRC LabVIEW Programming

User Profile

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

User Profile 2

Click **Next**

User Profile 3
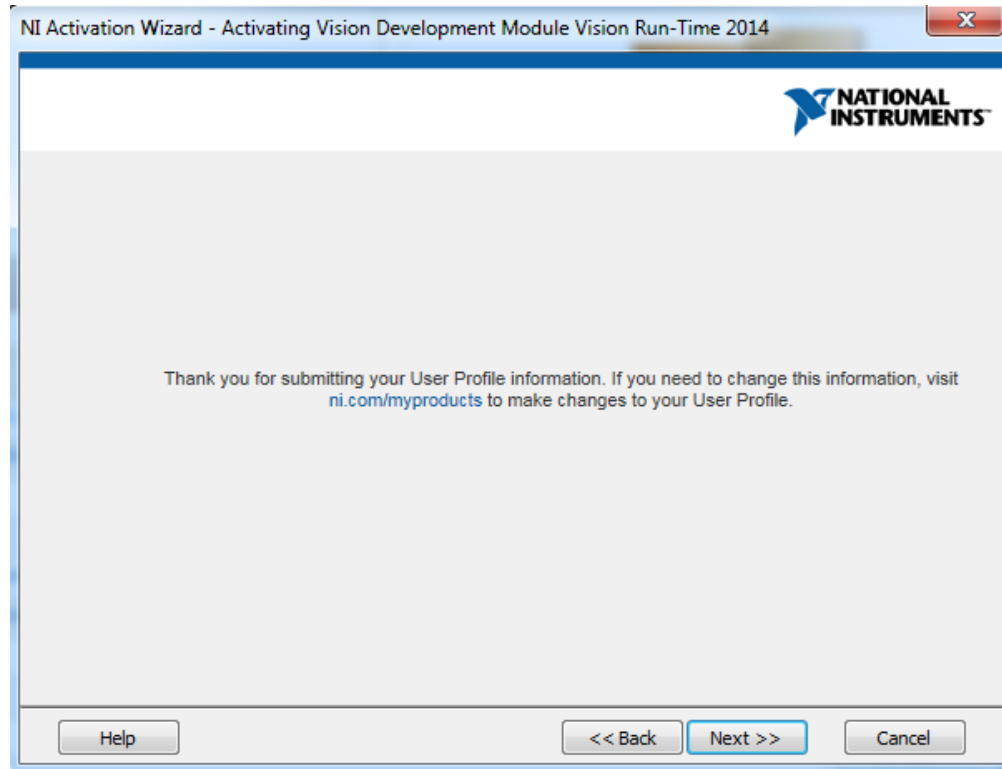
Click **Next**

FRC LabVIEW Programming

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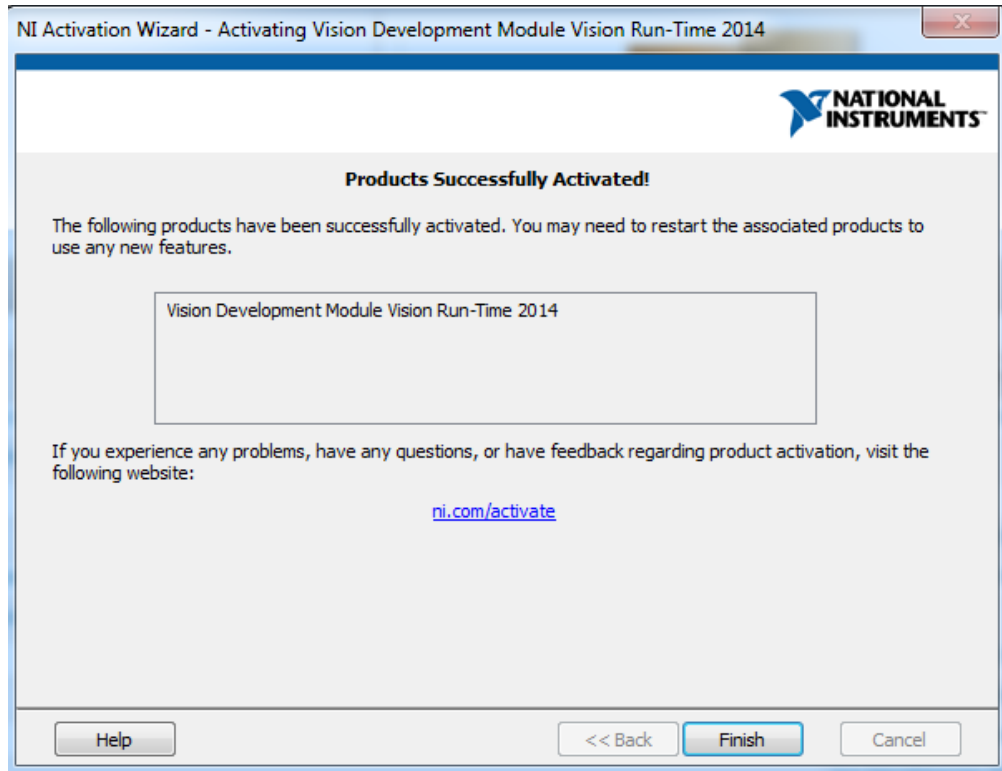
After the product is activated, Click **Finish.** If prompted to Reboot, click **Yes**

NI Update Service
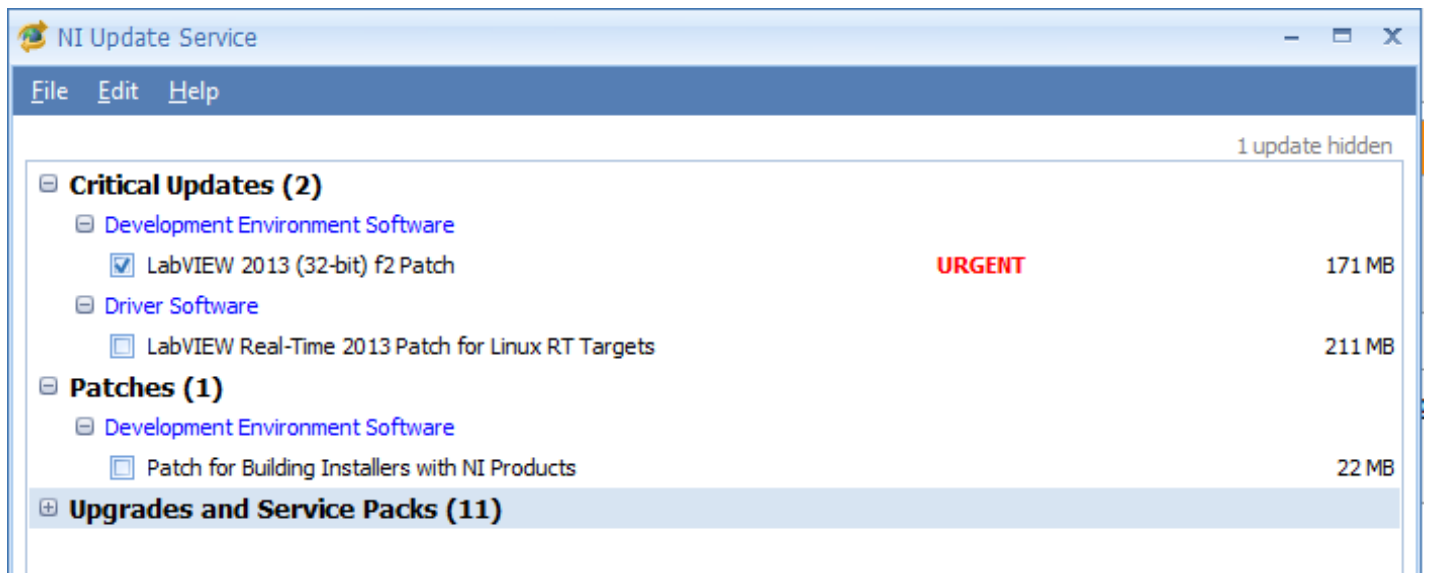
FRC LabVIEW Programming

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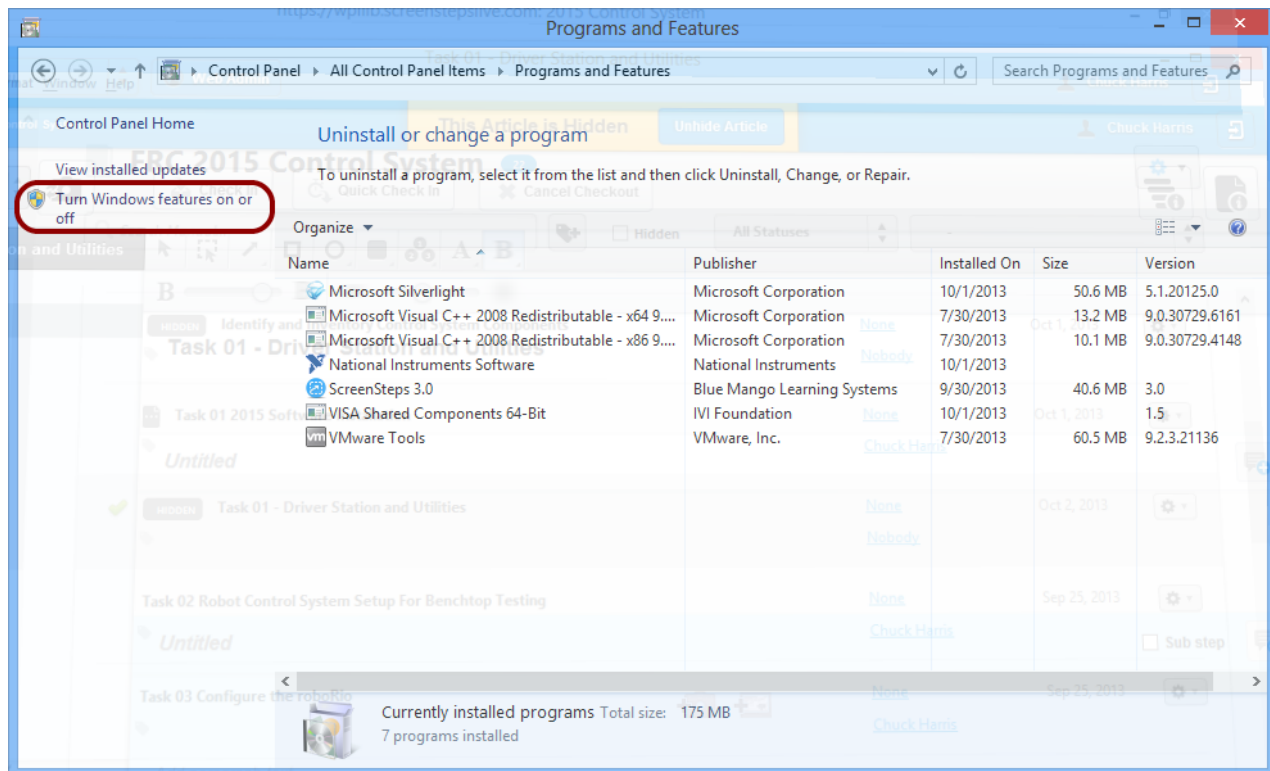
Open the "Programs and Features" window from the control panel and click on "Turn Windows features on or off"

FRC LabVIEW Programming

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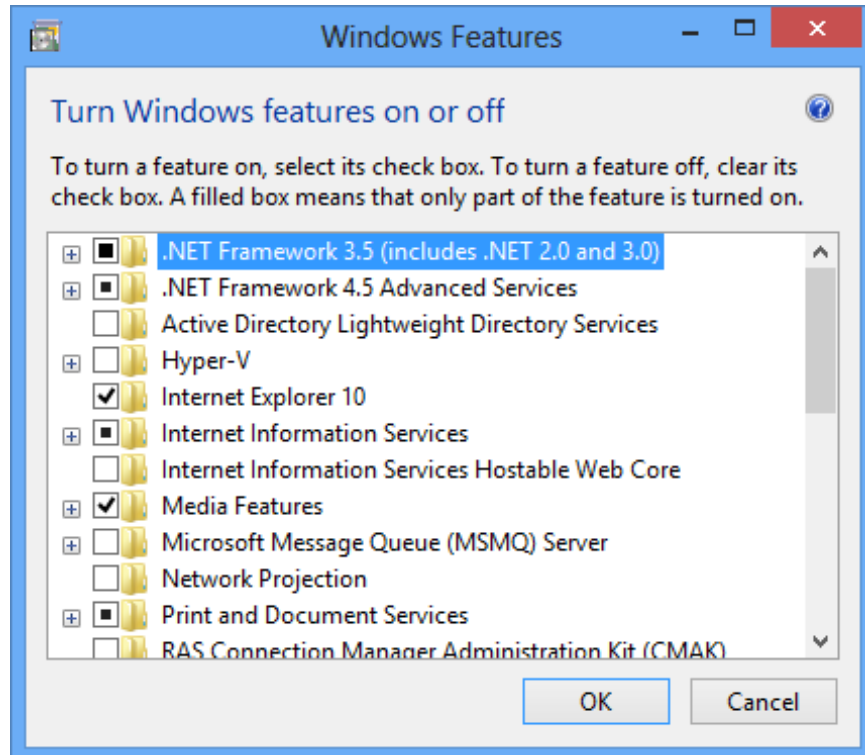
Select ".NET Framework 3.5 (includes .NET 2.0 and 3.0)" to enable it (a black dot, not a check box will appear) and then click "OK". When installation finishes restart installation of FRC 2016 Update Suite.

FRC LabVIEW Programming

Windows Features (.NET Framework 3.5 already on)
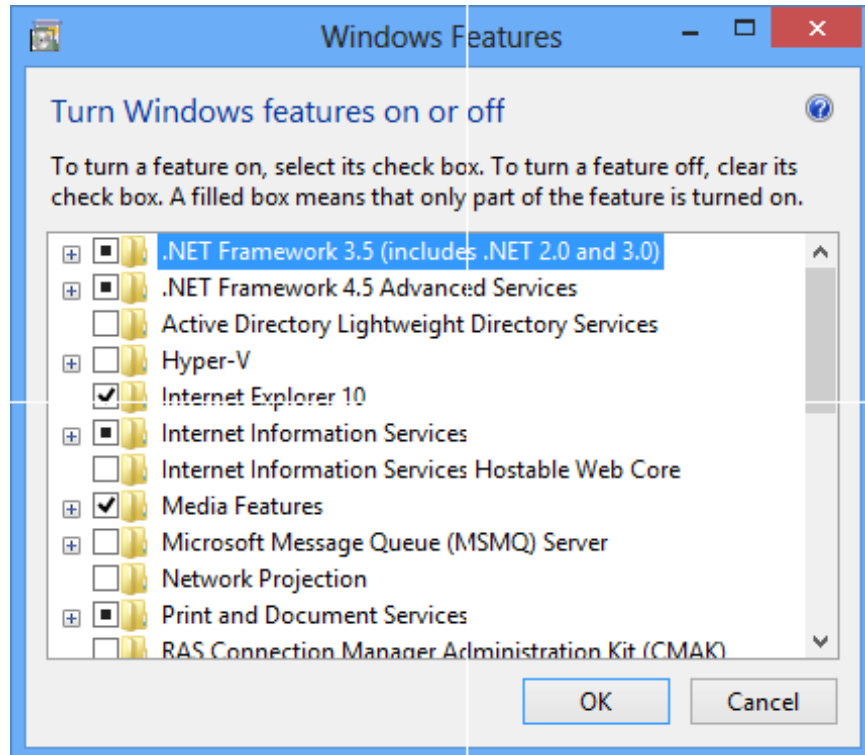
If a black dot is shown next to ".NET Framework 3.5" the feature is already on. Click "Cancel" and restart installation of FRC 2017 Update Suite.

Creating Robot Programs

Creating, Building and Loading your Benchtop Test Program

This document covers how to create, build and load an FRC LabVIEW program onto a roboRIO. Before beginning, make sure that you have installed LabVIEW for FRC and the FRC Driver Station and that you have configured and imaged your roboRIO as described in the [Getting Started with the 2016 Control System manual.](#)

Creating a Project
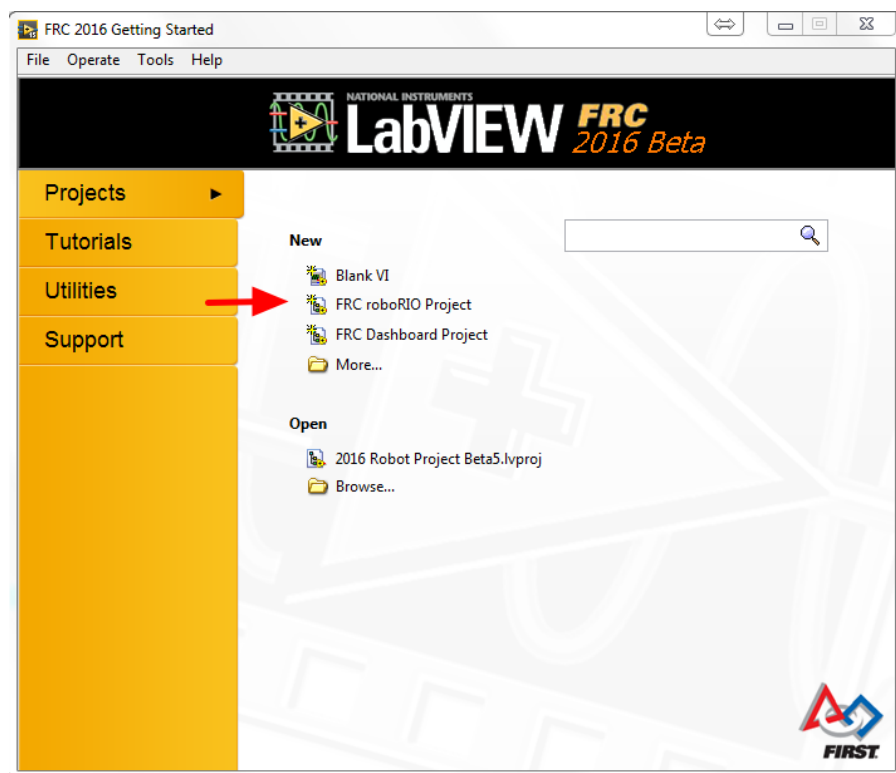
Launch LabVIEW and click the FRC roboRIO Robot Project link in the Projects window to display the Create New FRC Robot Project dialog box.

Configuring Project
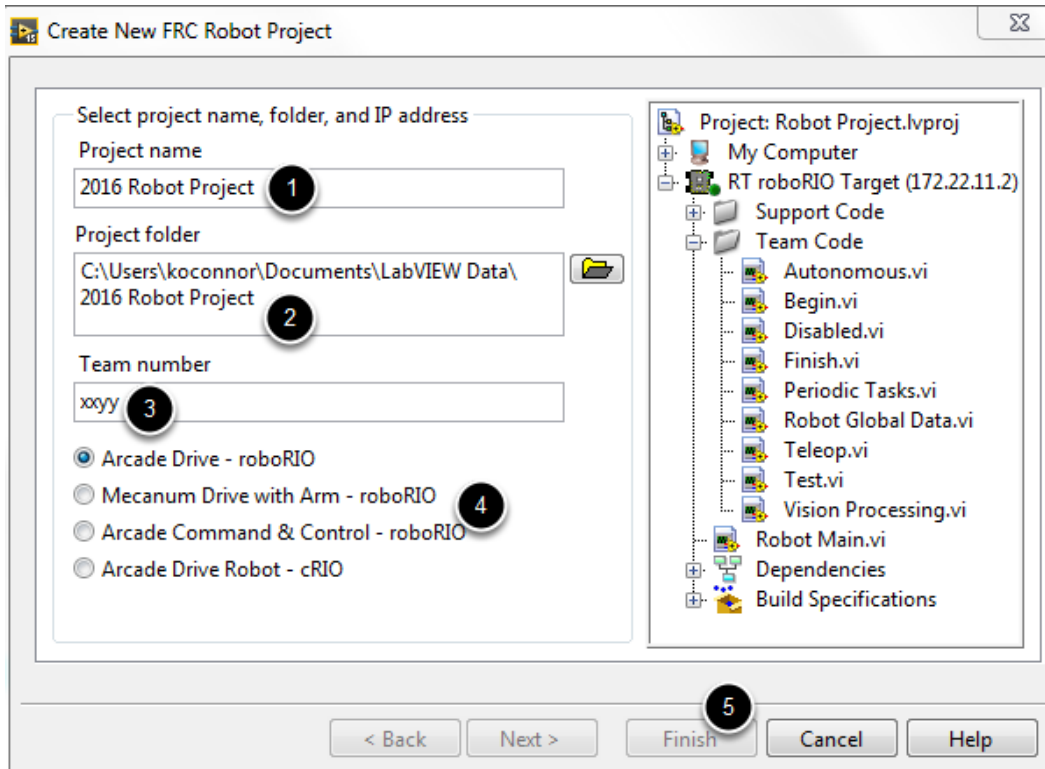
Fill in the Create New FRC Project Dialog:

1. Pick a name for your project
2. Select a folder to place the project in.
3. Enter your team number
4. Select a project type. If unsure, select Arcade Drive - roboRIO.
5. Click Finish

FRC LabVIEW Programming

Running the Program
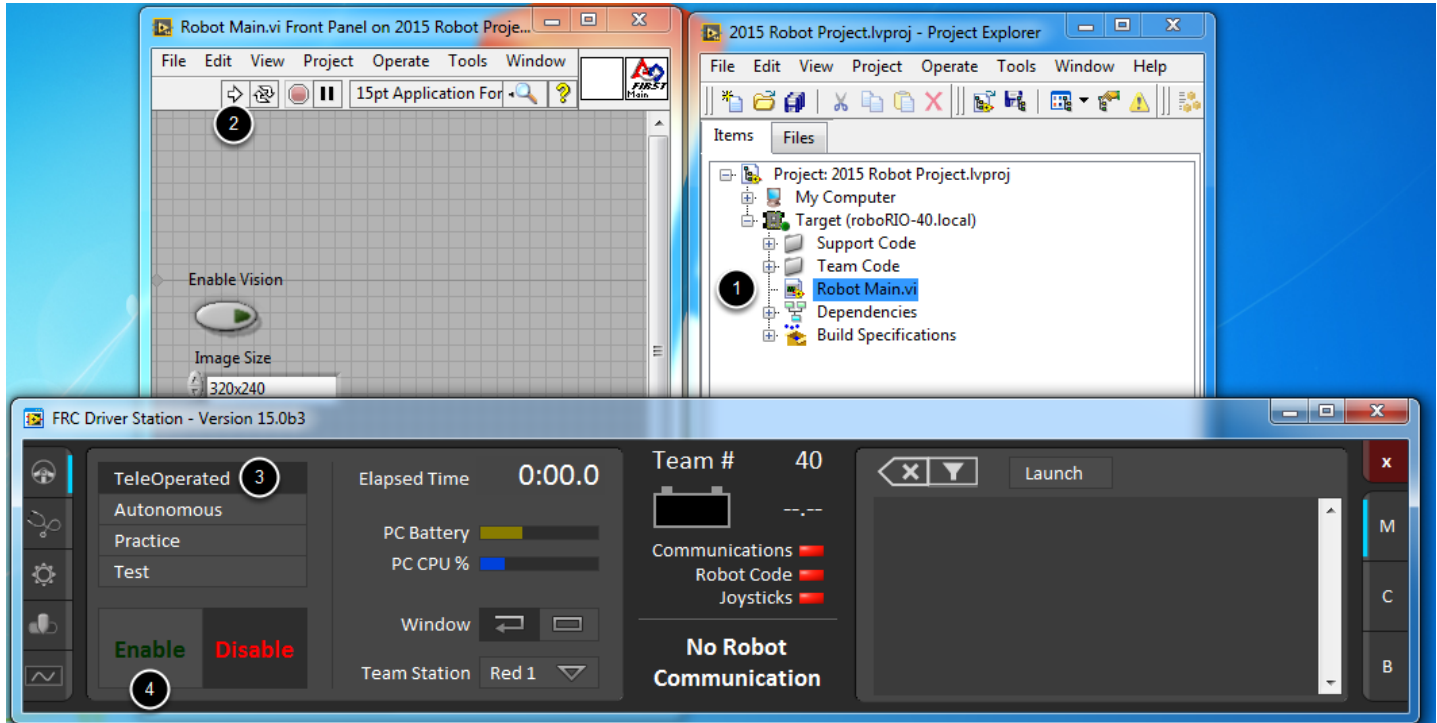
1. In the Project Explorer window, double-click the Robot Main.vi item to open the Robot Main VI.
2. Click the Run button (White Arrow on the top ribbon) of the Robot Main VI to deploy the VI to the roboRIO. LabVIEW deploys the VI, all items required by the VI, and the target settings to memory on the roboRIO. If prompted to save any VIs, click Save on all prompts.
3. Using the Driver Station software, put the robot in Teleop Mode. For more information on configuring and using the Driver Station software, see the FRC Driver Station Software article.
4. Click **Enable**.
5. Move the joysticks and observe how the robot responds.
6. Click the Abort button of the Robot Main VI. Notice that the VI stops. When you deploy a program with the Run button, the program runs on the roboRIO, but you can manipulate the front panel objects of the program from the host computer.

Note that a program deployed in this manner will not remain on the roboRIO after a power cycle. To deploy a program to run every time the roboRIO starts follow the next step, Deploying the program.

Deploying the program
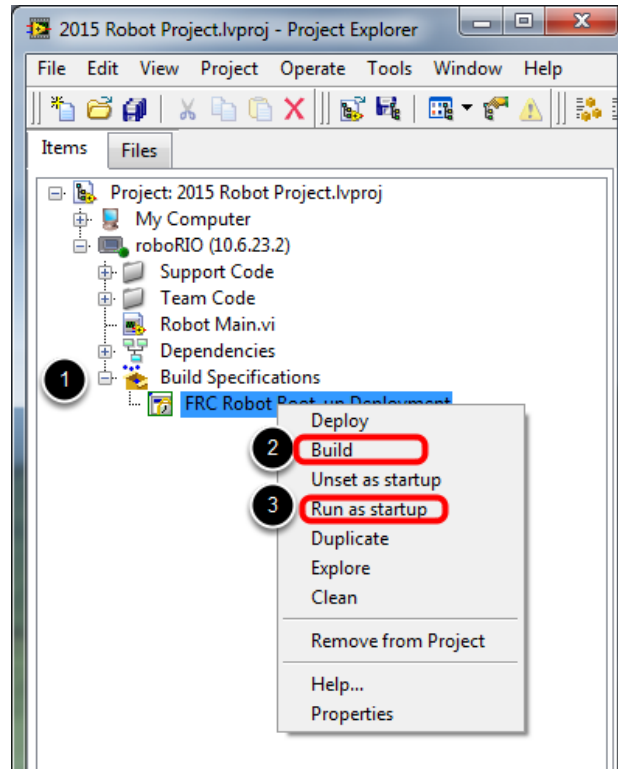
To run in the competition, you will need to deploy a program to your roboRIO. This allows the program to survive across reboots of the controller, but doesn't allow the same debugging features (front panel, probes, highlight execution) as running from the front panel. To deploy your program:

1. In the Project Explorer, click the + next to Build Specifications to expand it.
2. Right-click on FRC Robot Boot-up Deployment and select Build. Wait for the build to complete.
3. Right-click again on FRC Robot Boot-Up Deployment and select Run as Startup. If you receive a conflict dialog, click OK. This dialog simply indicates that there is currently a program on the roboRIO which will be terminated/replaced.
4. Either check the box to close the deployment window on successful completion or click the close button when the deployment completes.
5. The roboRIO will automatically start running the deployed code within a few seconds of the dialog closing.

Next Steps

To continue Getting Started with the 2016 Control System, see [Programming your radio for home use.](#)

To learn more about LabVIEW, see [LabVIEW Resources](#)

Tank Drive Tutorial

Question: How do I get my robot to drive with two joysticks using tank drive?

Solution: There are four components to consider when setting up tank drive for your robot. The first thing you will want to do is make sure the tank drive.vi is used instead of the arcade drive.vi or whichever drive VI you were utilizing previously. The second item to consider is how you want your joysticks to map to the direction you want to drive. In tank drive, the left joystick is used to control the left motors and the right joystick is used to control the right motors. For example, if you want to make your robot turn right by pushing up on the left joystick and down on the right joystick you will need to set your joystick's accordingly in LabVIEW (this is shown in more detail below). Next, you will want to confirm the PWM lines that you are wired into, are the same ones your joysticks will be controlling. Lastly, make sure your motor controllers match the motor controllers specified in LabVIEW. The steps below will discuss these ideas in more detail:

1. Open LabVIEW and double click "FRC roboRIO Project."
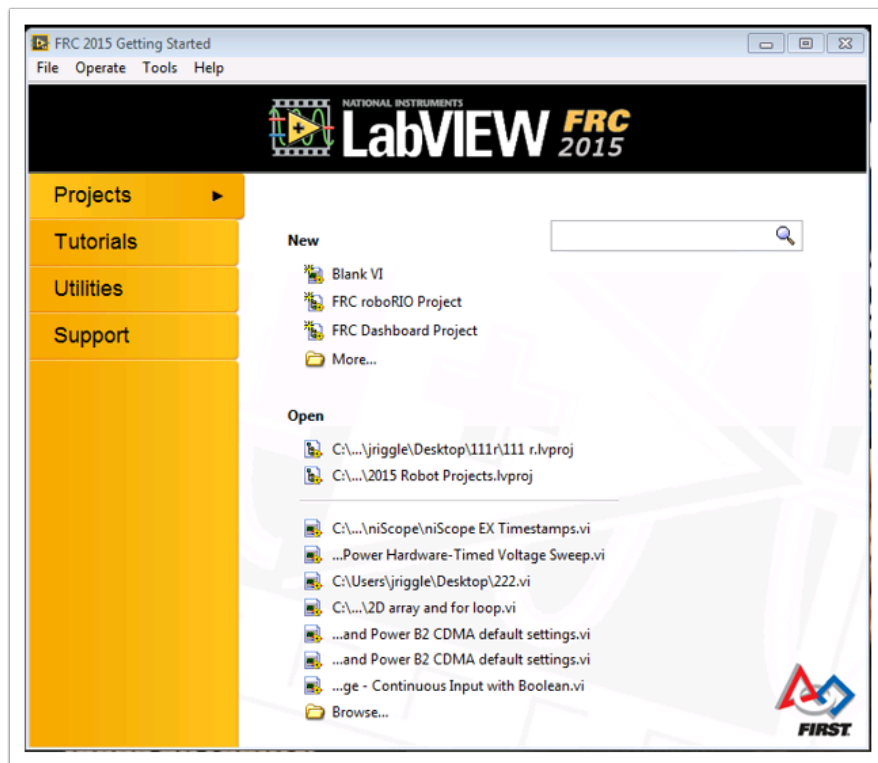
FRC LabVIEW Programming

2.   Give your project a name, add your team number, and select Arcade Drive Robot roboRIO.
You can select another option as well; however, this tutorial will discuss how to setup tank drive
for this project.

3.   In the Project Explorer window, open up the "Robot Main.vi."

4.   Push Ctrl + E to see the block diagram. It should look like the following image:
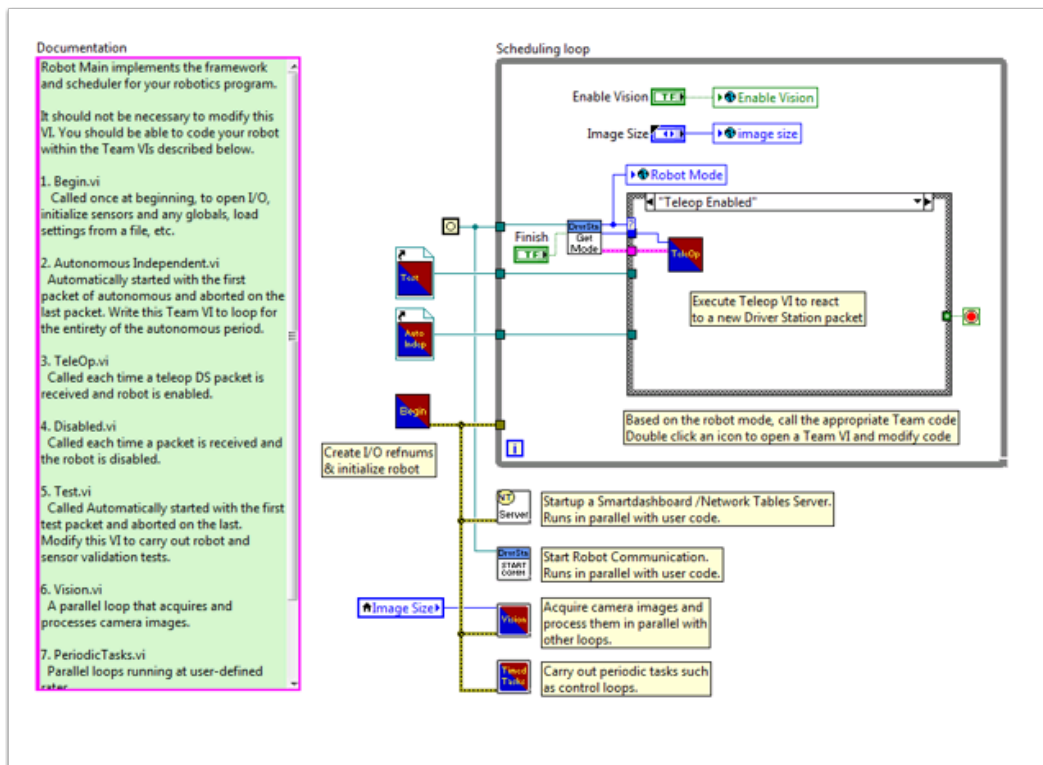
5.   Double click the "Teleop" vi inside of the Teleop Enabled case structure. Look at its block
diagram. You will want to make two changes here:

A.   Replace Arcade Drive with the tank drive.vi. This can be found by right clicking on the
block diagram >> WPI Robotics Library >> Robot Drive >> and clicking the Tank Drive VI.

B.   Find the Index Array function that is after the Get Values.vi. You will need to create two
numeric constants and wire each into one of the index inputs. You can determine what the
values of each index should be by looking at the USB Devices tab in the FRC Driver Station.
Move the two joysticks to determine which number (index) they are tied to. You will likely
want to use the Y-axis index for each joystick. This is because it is intuitive to push up on the

joystick when you want the motors to go forward, and down when you when them to go in reverse. If you select the X-axis index for each, then you will have to move the joystick left or right (x-axis directions) to get the robot motors to move. In my setup, I've selected index 1 for my left motors Y-axis control and index 5 as the right motors Y-axis control. You can see the adjustments in LabVIEW in the following image:
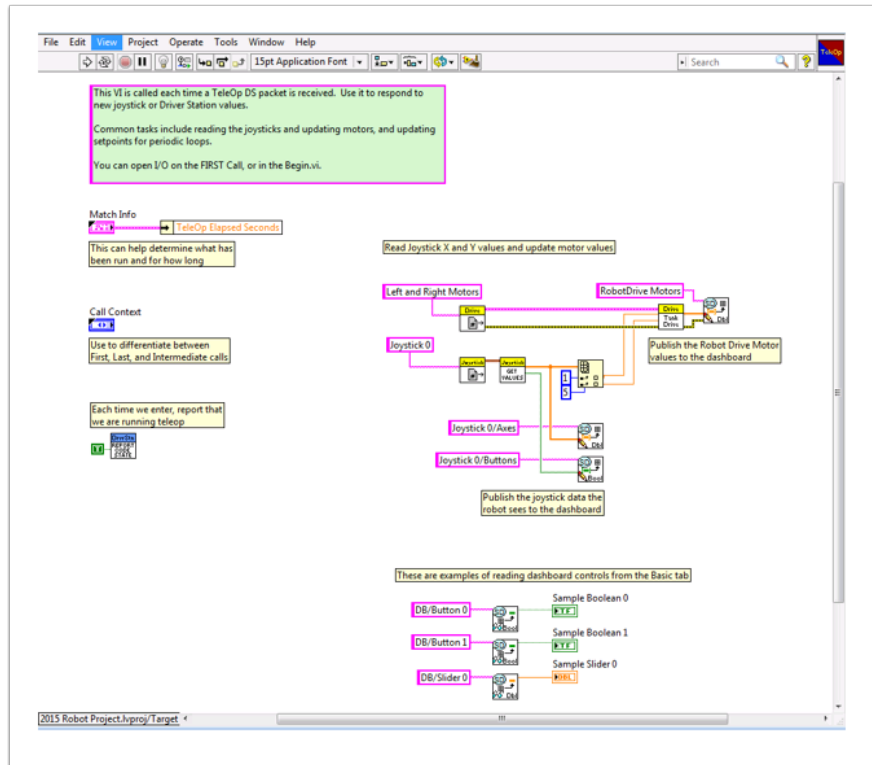
6.   Next you will want to go back to your "Robot Main.vi" and double click on the "Begin.vi."

7.   The first thing to confirm in this VI is that your left and right motors are connected to the same PWM lines in LabVIEW as they are on your PDP (Power Distribution Panel).

8.   The second thing to confirm in this VI is that the "Open 2 Motor.vi" has the correct motor controller selected (Talon, Jaguar, Victor, etc.).

    For example, I am using Jaguar motor controllers and my motors are wired into PWM 8 and 9. The image below shows the changes I need to make:

FRC LabVIEW Programming
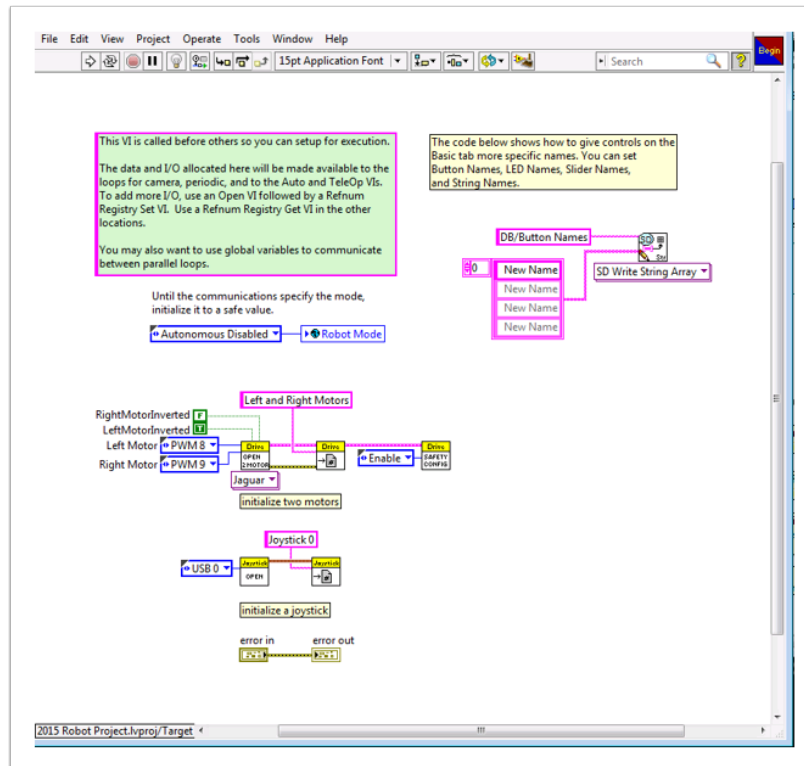
9.   Save all of the Vis that you have made adjustments to and you are now able to drive a robot with tank drive!

LabVIEW Resources

LabVIEW Porting Guide - 2014 to 2015

LabVIEW teams will find the VIs and palletes in the 2015 FRC version of LabVIEW very familiar. Teams should only need to make minor changes to get a 2014 program to run on a roboRIO. This document highlights changes in the 2015 VIs and how they correspond with the old code.

Joystick Get
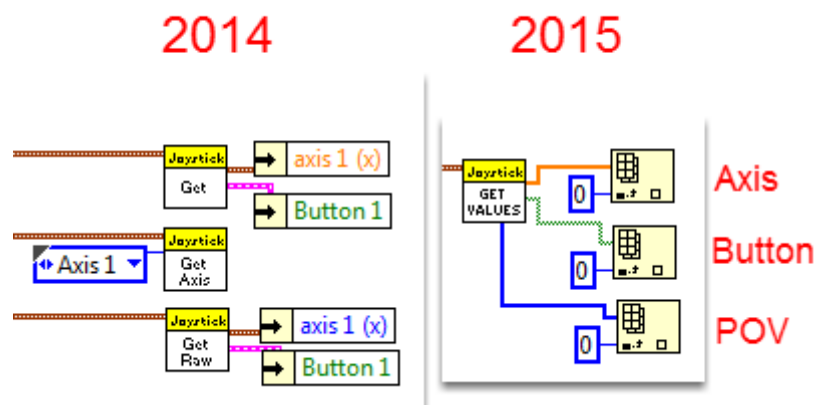
- The old Joystick Get VIs have been replaced with a single VI that provides an array (instead of a cluster) for each type of input (axes, buttons and POVs).
- POVs have been changed to be a unique output and to an angle (0 to 360 with -1 indicating not pressed).
- Joysticks, axes, POVs, and buttons (in LabVIEW, buttons are still 1 based in C++\Java) are 0 based
- The DS will now support up to 6 joysticks with a dynamic number of axes, buttons and POVs

Module and Channel numbers
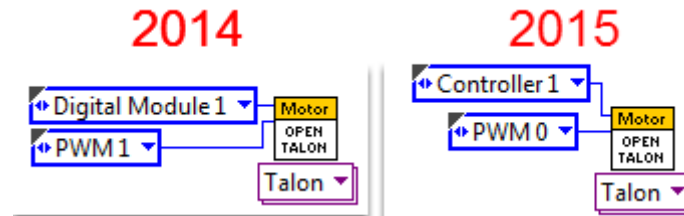
As the roboRIO has no modules, module numbers have been changed to a Controller number which currently has only one option (and therefore does not need to be wired). Channel numbers have been changed to be 0-based (matching the channel numbers on the roboRIO).

Compressor
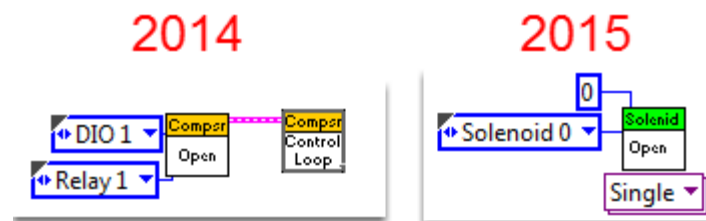
Compressor code is no longer required (when using the PCM) unless you wish to get advanced information from or exercise control over the compressor. Opening any solenoid on the PCM the compressor is attached to will automatically enable the closed loop control for that compressor.

Sensor "Start/Stop" - Encoders, Counters, etc.
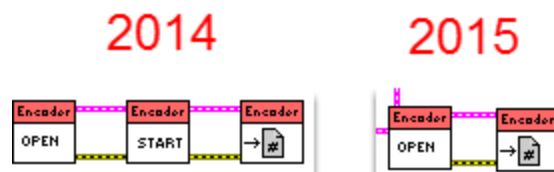
Sensors which uses to require explicit Start and Stop VIs have been changed to Start on Open. Stop has been removed. If you wish to keep track of values over a single explicit period, call Reset at the start of the period. If you wish to keep track of values over multiple explicit periods, you will have to track this in your code (Reset at the start of each period and keep track of the sum in your code).

DS User Messages

2014

Text
◀▸ Main - Line 1 ▾   DrvrStn WRITE USER MSG

2015

DB/String 0
Text   SD
SD Write String ▾   Str
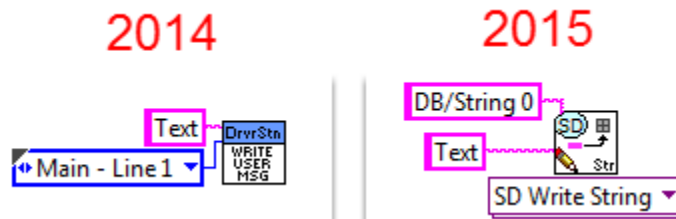
The User messages window on the Driver Station has been removed, therefore this functionality has been removed from the pallete. As a replacement, the default Dashboard contains a number of controls and indicators of different types on the "Basic" tab that teams may wish to use to display robot information or provide input. To write to these controls, use the SmartDashboard VIs, the key names to use are listed on the Dashboard.

File IO

2014

C:\MyFile.txt

2015

/home/lvuser/MyFile.txt

On the cRIO, files could be written to the root drive (C:\) or you could create subfolders within that location. On the roboRIO you should write files to /home/lvuser or create a subdirectory underneath that for your files. Note that a File Create will fail if the directory does not exist so you will need to programatically create the directory or create it via SFTP/SSH before trying to create a file in that directory.

DS IO, Enhanced IO, and Kinect

The Cypress Firsttouch board support and Kinect server support has been removed from the DS so these palletes and VIs have been removed. Teams can use the Dashboard or USB HID devices to replace the Cypress board functionality. The TI Launchpad and 16 Hertz Leonardo++ included in your Kit of Parts can both be programmed to appear as HID devices to be used for custom I/O (click the links for more info). Teams wishing to use the Kinect as an input device will need to modify the Kinect server to send data directly to the robot using Network Tables or one of the ports available on the field network.

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SPI
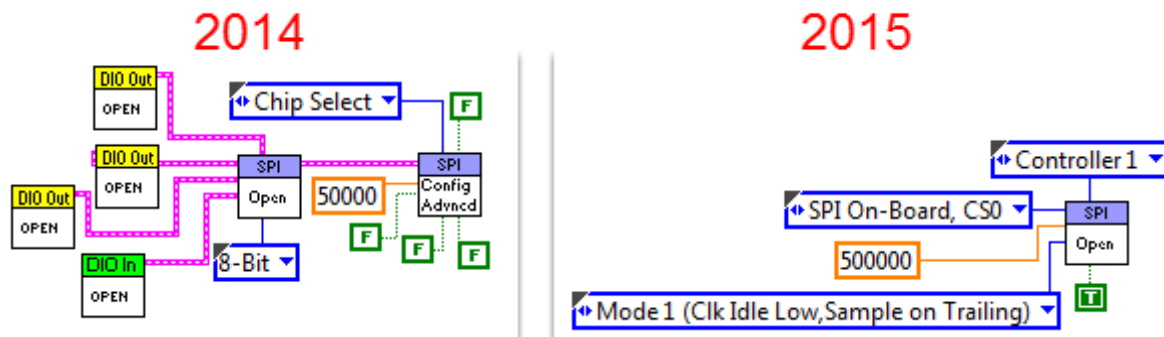
With the built-in SPI ports, the SPI Ooen and configuration has been simplified and consolidated to a single VI:

- The Clock Phase and Clock Active state have been combined into a mode Enum
- The "MSB First" boolean input has been removed, you will need to flip your data before sending if you need to send LSB first
- The "Frame Mode" input has been removed. The SPI port on the roboRIO does not support this.
- The "Bits per word" input has been removed. The SPI port on the roboRIO does not support this.
- The "Chip Select Active Low" input on the 2014 config VI has been flipped to be a "Chip Select Active High" input on the 2015 open VI.

I2C
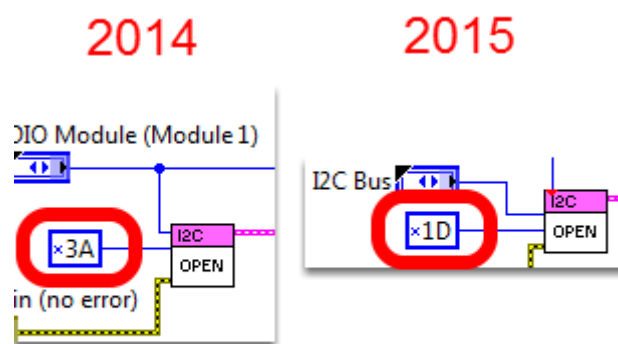
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The Compatibility mode input has been removed from the I2C Read and I2C Write VIs. This is not necessary on the roboRIO I2C.

I2C addressing has changed from an 8-bit address on the cRIO to a 7-bit address on the roboRIO. An 8-bit address includes the bit for whether an operation is a read or write while a 7-bit address does not (the R/W bit is appended by the driver when performing the operation).

Camera
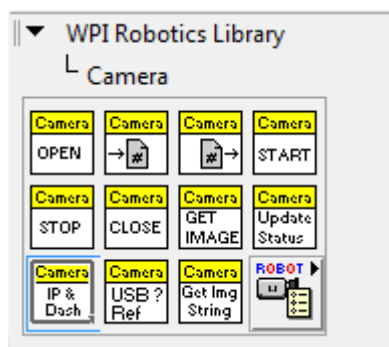
The Camera VIs have been modified to support USB cameras (tested with the Microsoft Lifecam HD3000). For complete information see the examples and the Vision Processing section.

New VIs

In addition to the changes, a number of new VIs have been added to support the new capabilities of the roboRIO and the new Control System. For additional help with these VIs, drag them into your project, right click on them and select Help.
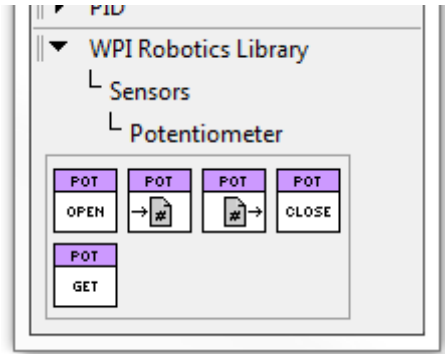
Joystick Info
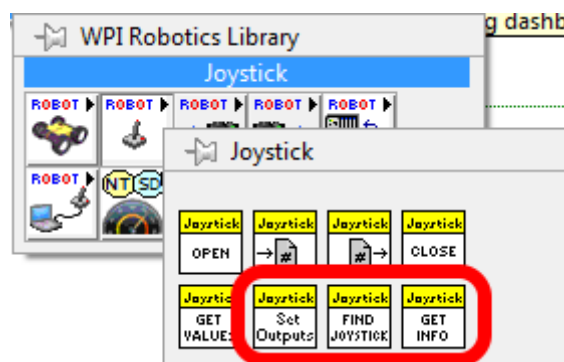
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New VIs have been added to get information such as the name, type, and axis, button and POV count of each Joystick and to set HID outputs for devices which support them (such as the TI Launchpad).

Potentiometer

These VIs use the output voltage of the analog supply to provide a normalized (0 to 1) reading from a potentiometer or other ratiometric sensor
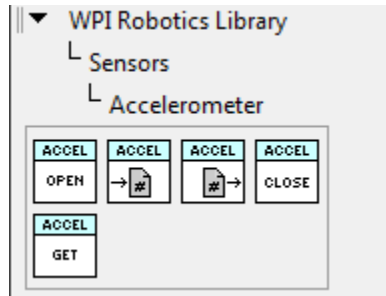
Switch
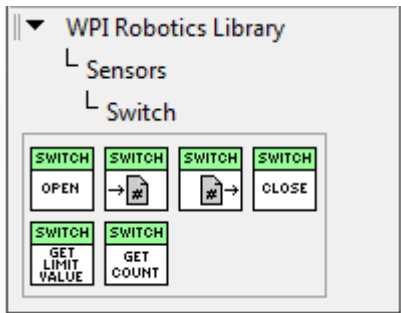
These VIs help abstract switches used as Limit Switches or Counting Switches.

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Accelerometer

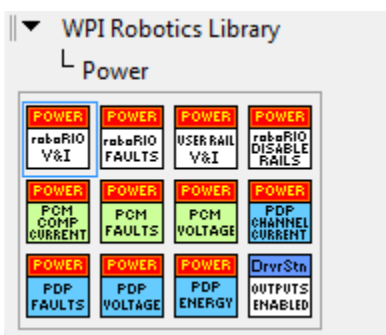The accelerometer VIs have been generalized to apply to the internal accelerometer, analog accelerometer, or the ADX345 connected to either the I2C or SPI interface.

Analog Output
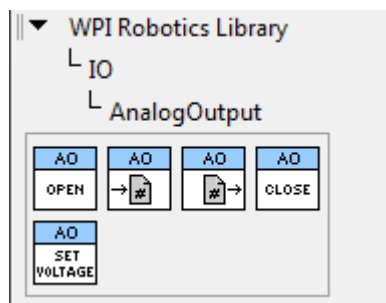
These VIs control the 2 Analog Outputs on the MXP port

Power

These VIs provide information about the roboRIO power state, PCM faults, current, and voltage, PDP faults, current and voltage, and the enabled state of the FPGA outputs.

LabVIEW Resources

To learn more about programming in LabVIEW and specifically programming FRC robots in LabVIEW, check out the following resources.

LabVIEW Basics

National Instruments provides a [combination of videos](#) and [traditional text/picture tutorials on the basics of LabVIEW](#). These tutorials can help you get acquainted with the LabVIEW environment and the basics of the graphical, dataflow programing model used in LabVIEW.

FRC Mastery Videos

Though they have not been updated to match changes to the robot framework code, the [FRC Mastery](#) series of videos are still a helpful guide to understanding the basics of FRC programming in LabVIEW. Most or all of the content in Steps 1, 2, 3, 4, 6, and 7 of the [2011 FRC Steps to Robot Success](#) will match fairly closely to the 2015 code.

NI FRC Tutorials

National Instruments also hosts many [FRC specific tutorials and presentations ranging from basic to advanced](#). For an in-depth single resource check out the FRC Basic and Advanced Training Classes linked near the bottom of the page.

Installed Tutorials and Examples

There are also tutorials and examples for all sorts of tasks and components provided as part of your LabVIEW installation. To access the tutorials, from the LabVIEW Splash screen (the screen that appears when the program is first launched) click on the **Tutorials** tab on the left side. Note that the tutorials are all in one document, so once it is open you are free to browse to other tutorials without returning to the splash screen.

To access the examples either click the **Support** tab, then **Find FRC Examples** or anytime you're working on a program open the **Help menu,** select **Find Examples** and open the **FRC Robotics f**older.

Waiting for Target to Respond - Recovering from bad loops

If you download LabVIEW code which contains an unconstrained loop (a loop with no delay) it is possible to get the roboRIO into a state where LabVIEW is unable to connect to download new code. This document explains the process required to load new, fixed, code to recover from this state.

The Symptom
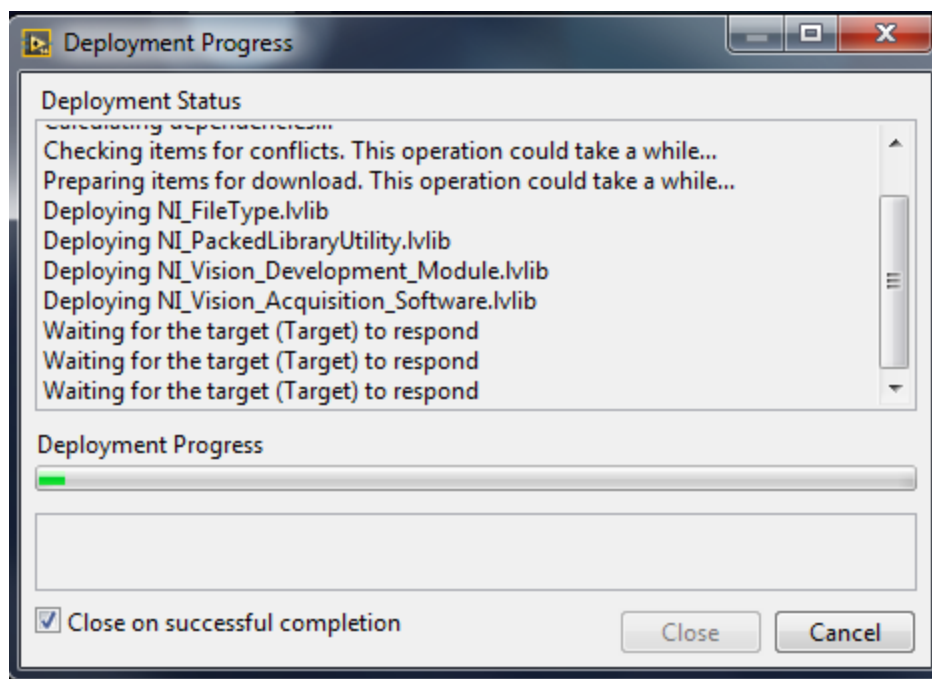
The primary symptom of this issue is attempts to download new robot code hang at the "Waiting for the target (Target) to respond" step as shown above. Note that there are other possible causes of this symptom (such as switching from a C++\Java program to LabVIEW program) but the steps described here should resolve most or all of them.

Click Cancel to close the download dialog.

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The Problem
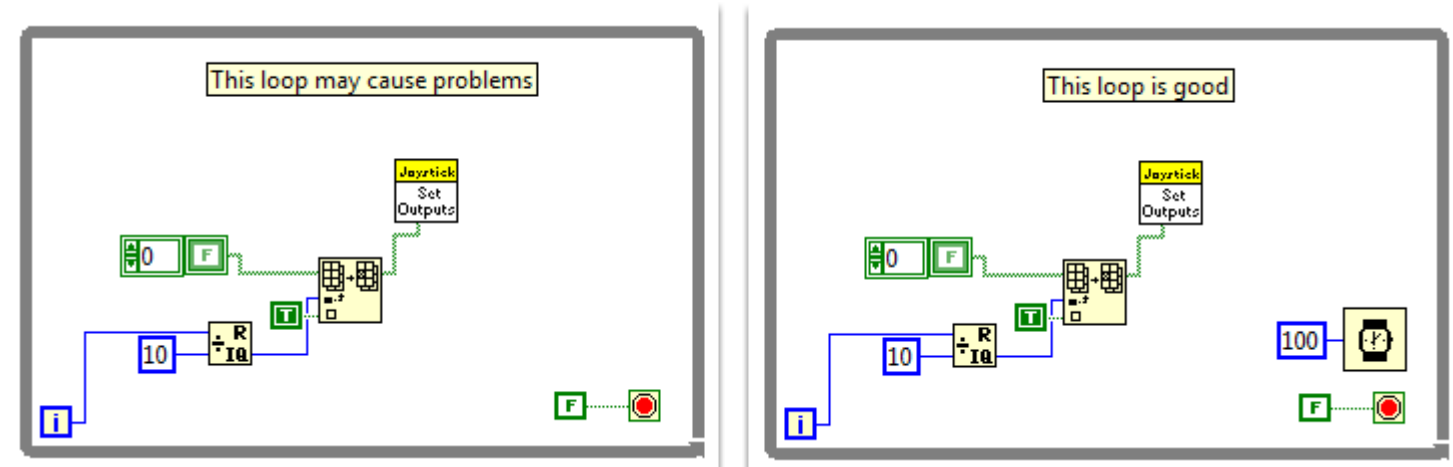
One common source of this issue is unconstrained loops in your LabVIEW code. An unconstrained loop is a loop which does not contain any delay element (such as the one on the left). If you are unsure where to begin looking, Disabled.VI, Periodic Tasks.VI and Vision Processing.VI are the common locations for this type of loop. To fix the issue with the code, add a delay element such as the Wait (ms) VI from the Timing palette, found in the right loop.
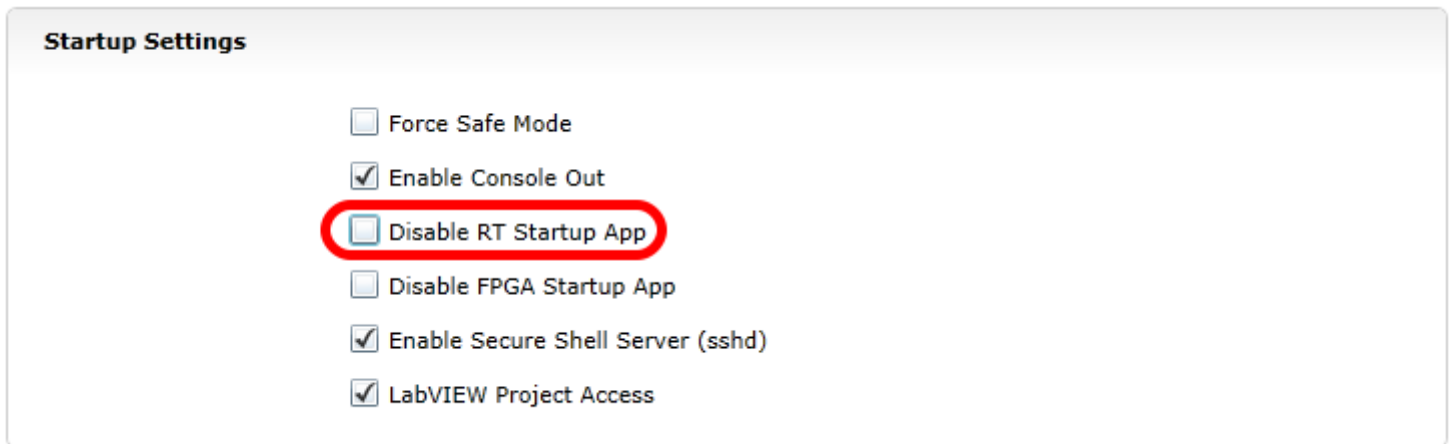
Set No App
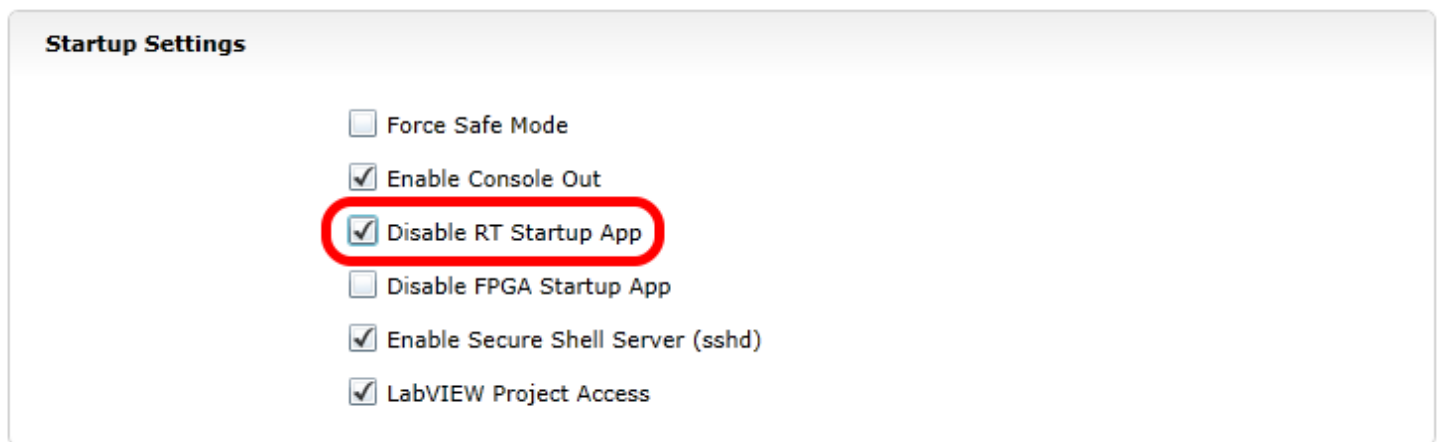
Using the roboRIO webserver (see the article [RoboRIO Webdashboard](#) for more details). Check the box to "Disable RT Startup App".

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Reboot

Reboot the roboRIO, either using the Reset button on the device or by click Restart in the top right corner of the webpage.

Clear No App

Using the roboRIO webserver (see the article [RoboRIO Webdashboard](#) for more details). Uncheck the box to "Disable RT Startup App".

Load LabVIEW Code

Load LabVIEW code (either using the Run button or Run as Startup). Make sure to set LabVIEW code to Run as Startup before rebooting the roboRIO or you will need to follow the instructions above again.

Talon SRX CAN

The Talon SRX motor controller is a CAN-enabled "smart motor controller" from Cross The Road Electronics/VEX Robotics. 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.

Extensive documentation about programming the Talon SRX in all three FRC languages can be found in the Talon SRX Software Reference Manual on CTRE's Talon SRX product page.

Note: CAN Talon SRX has been removed from WPILib. See this blog for more info and find the CTRE Toolsuite installer here: http://www.ctr-electronics.com/control-system/hro.html#product_tabs_technical_resources

How To Toggle Between Two Camera Modes

This code shows how to use a button to toggle between two distinct camera modes.