

FRC DRIVER STATION

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Classmate PC

Rookie USB stick

The computer provided in the 2017 Rookie Kit of Parts comes preloaded with an existing Windows install. The computer **should not be reimaged** and no image is provided for doing so Veteran teams may not need to image their machines, but should see the section on [Image Download](#) if they wish to do so.

Rookie USB Stick

As the computer comes pre-loaded with Windows, the Rookie USB stick does not contain an image as it has in prior seasons. Instead it contains a copy of the LabVIEW DVD contents and pre-downloaded copies of Eclipse for C++, Eclipse for Java and Steamworks DLC packs 1 and 2 ([Pack 3](#) was not available in time for inclusion).

Teams should follow the [Getting Started with the 2017 Control System](#) pages, and simply skip download steps for components they already have on the USB drive. **Note: To use Eclipse, teams will need to download the Java JDK in addition to the FRC specific plugins.**

Imaging your Classmate (Veteran Image Download)

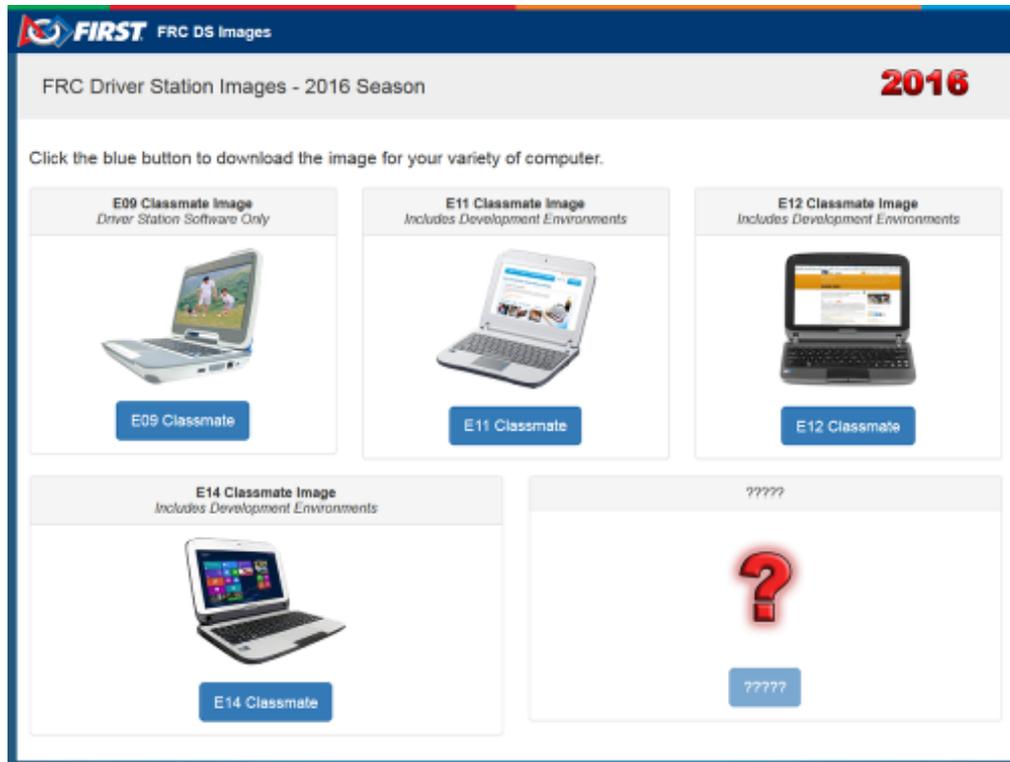
This document describes the procedure for creating a bootable USB drive to restore the 2017 FRC image on a Classmate computer. Note that Veteran teams are not required to re-image their Classmates. If you do not wish to re-image your Classmate you will need either a USB optical drive or to copy the contents 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

FRC Driver Station

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 LabVIEW base installation already present and Eclipse already downloaded.

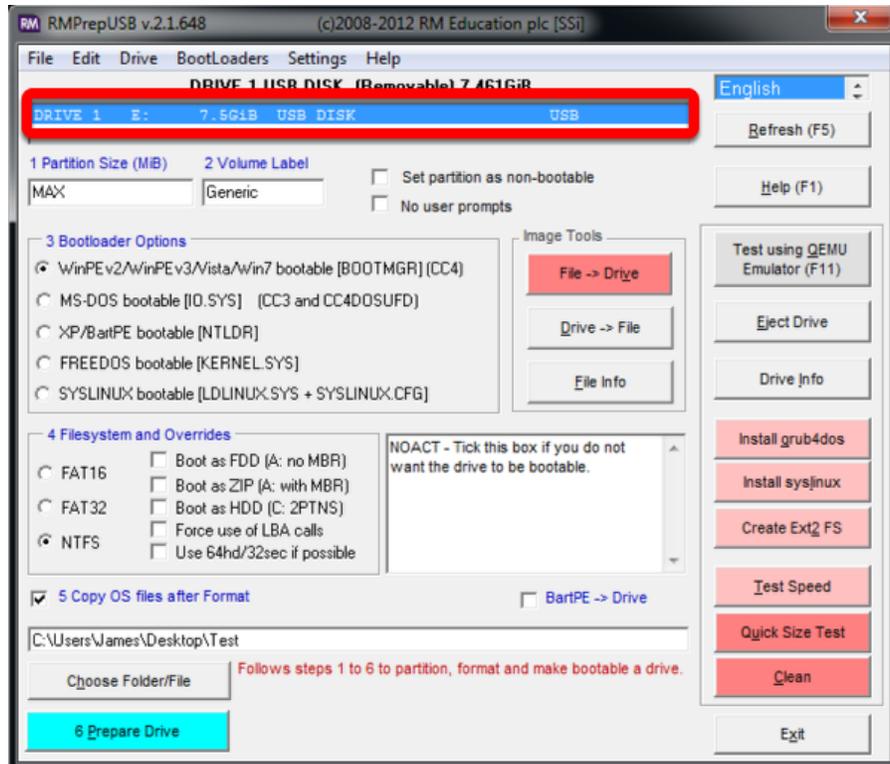
NOTE: These images only install the prerequisite core FRC software, it is still necessary to install the FRC specific updates. See the [Update Software](#) step for more information.

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.

FRC Driver Station

RMPrep

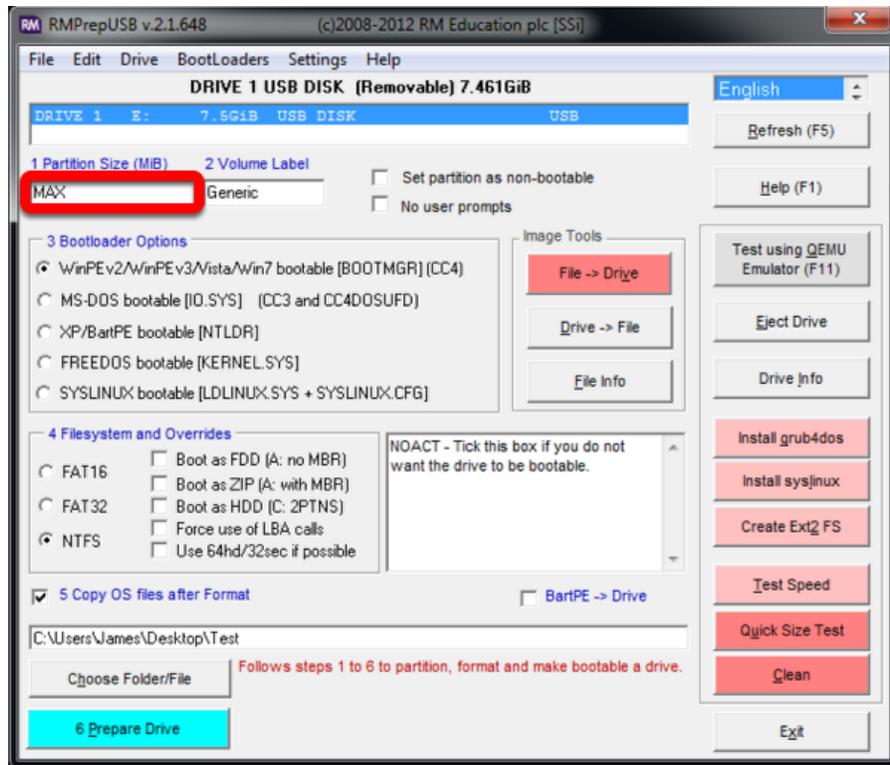


Start/Run RMPrepUSB

Select USB Drive

FRC Driver Station

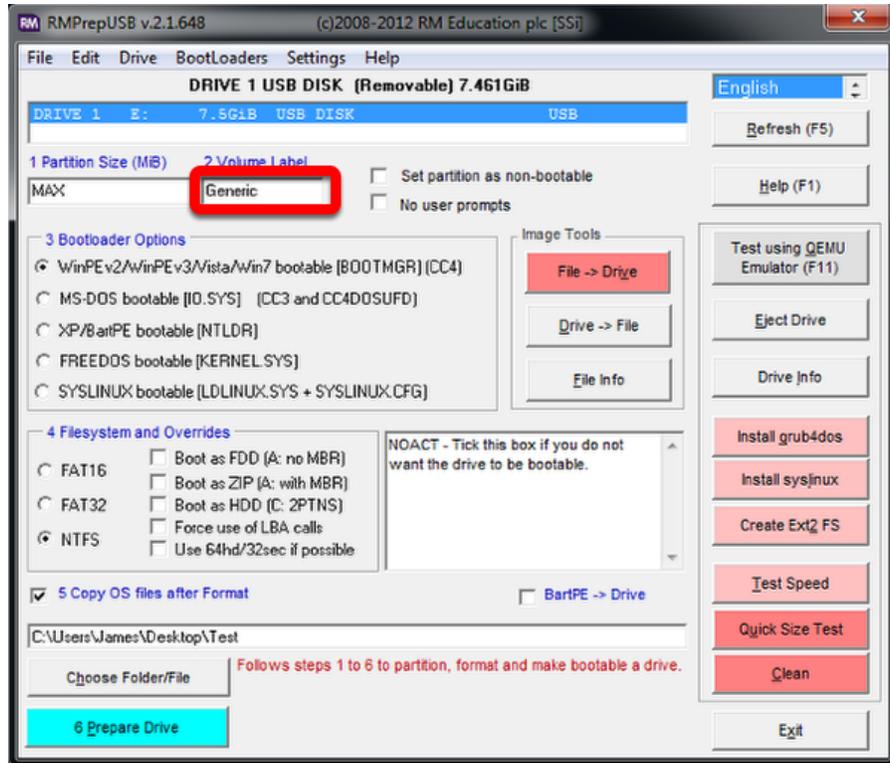
Set Partition Size



Set Partition Size to MAX

FRC Driver Station

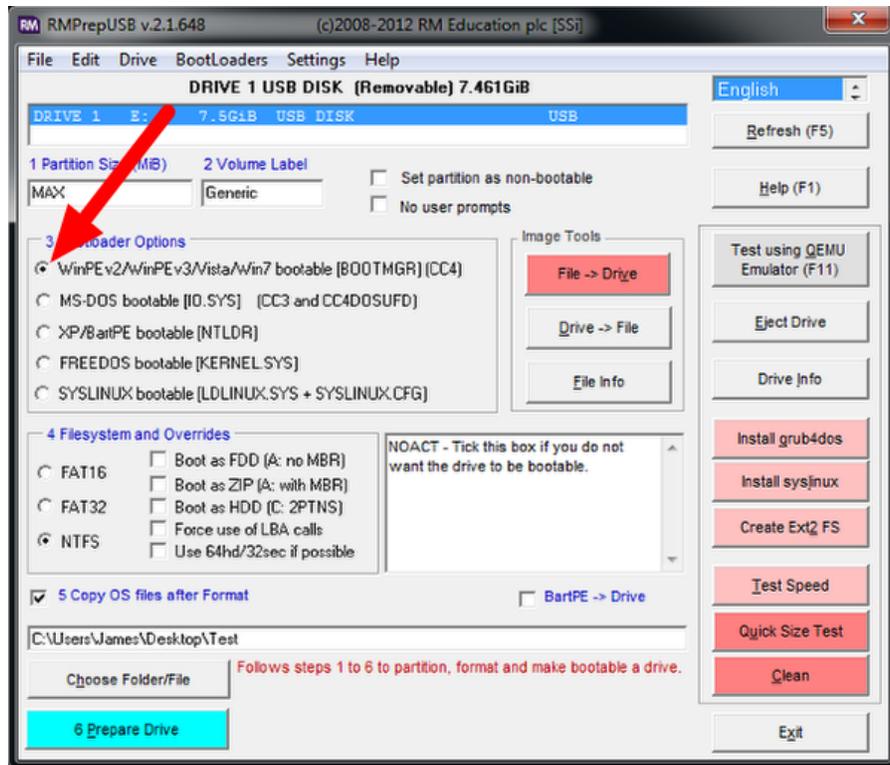
Set Volume Label



Set Volume Label to Generic

FRC Driver Station

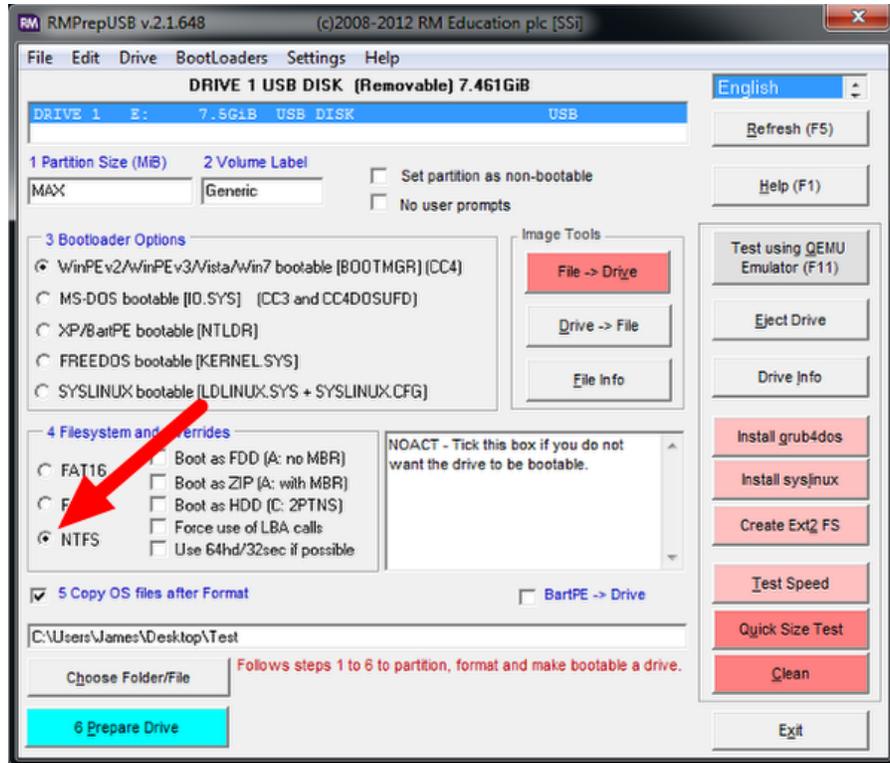
Set Bootloader Option



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

FRC Driver Station

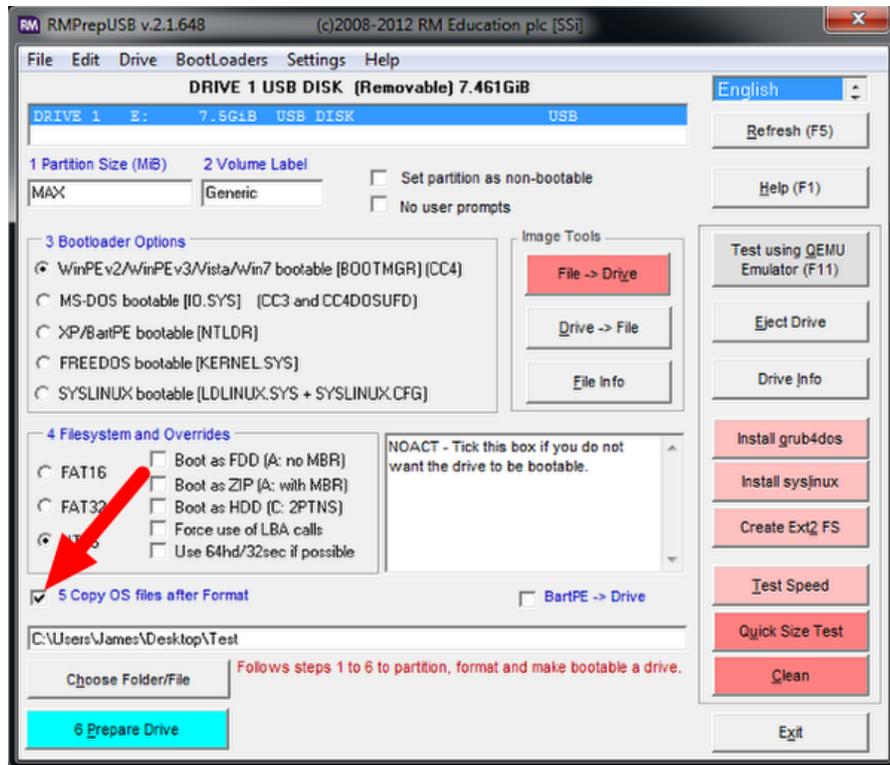
Select Filesystem



Select NTFS Filesystem

FRC Driver Station

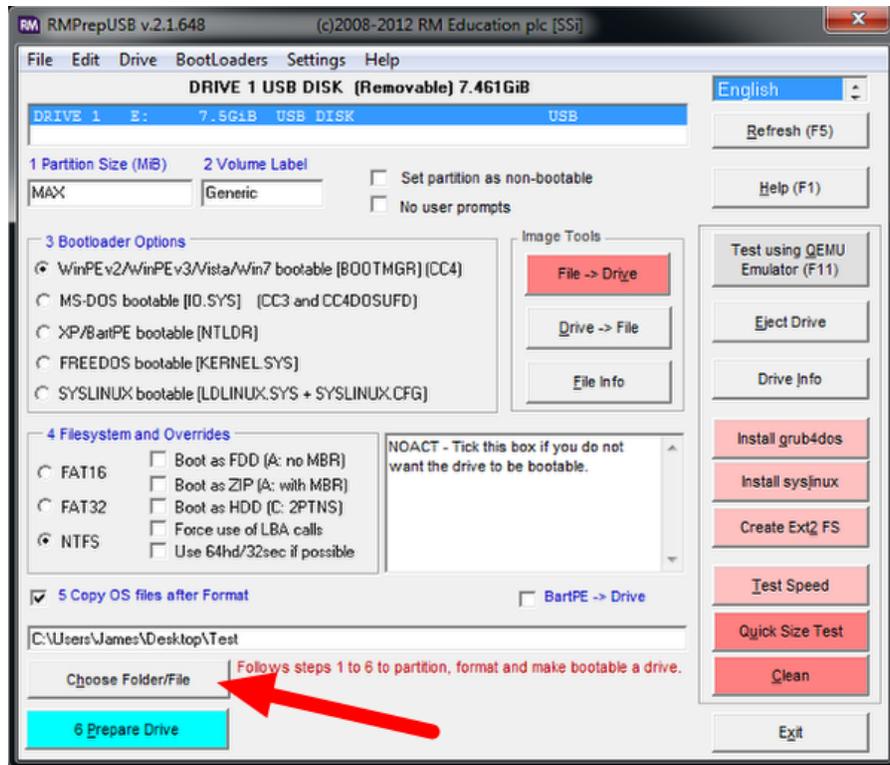
Copy OS Files Option



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

FRC Driver Station

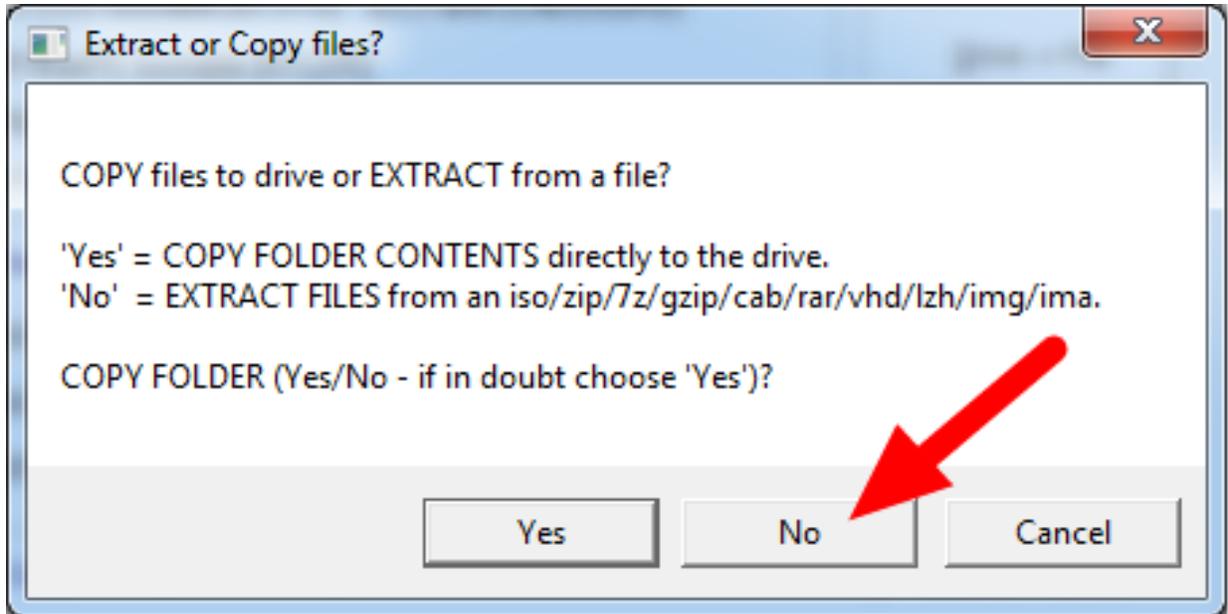
Locate Image



Select the "Choose Folder/File" button

FRC Driver Station

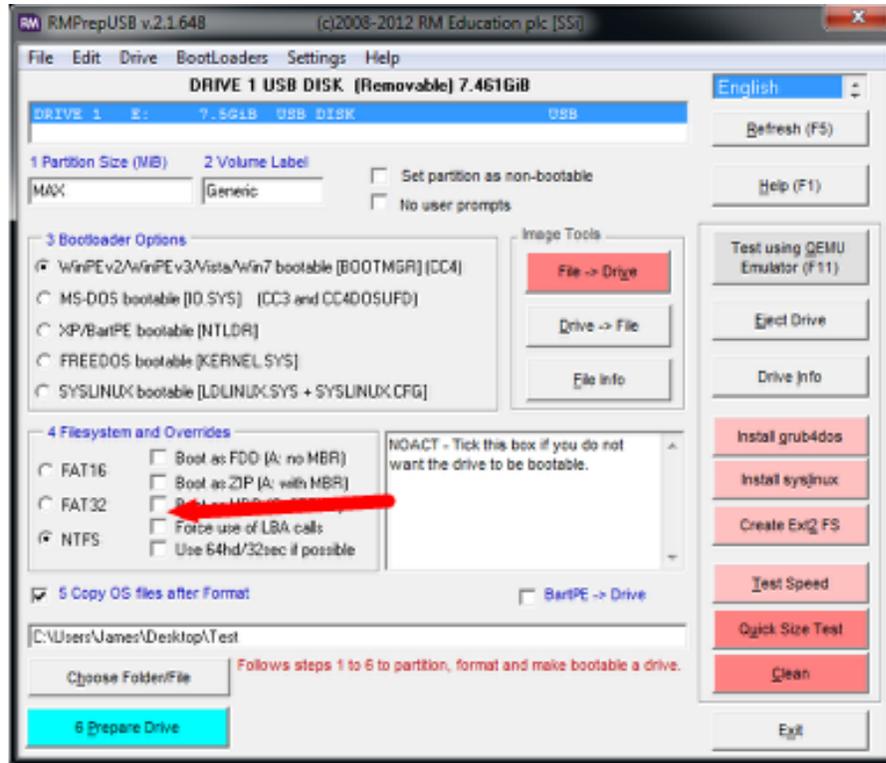
Copy Files Dialog



Choose "No" and select your .7z image

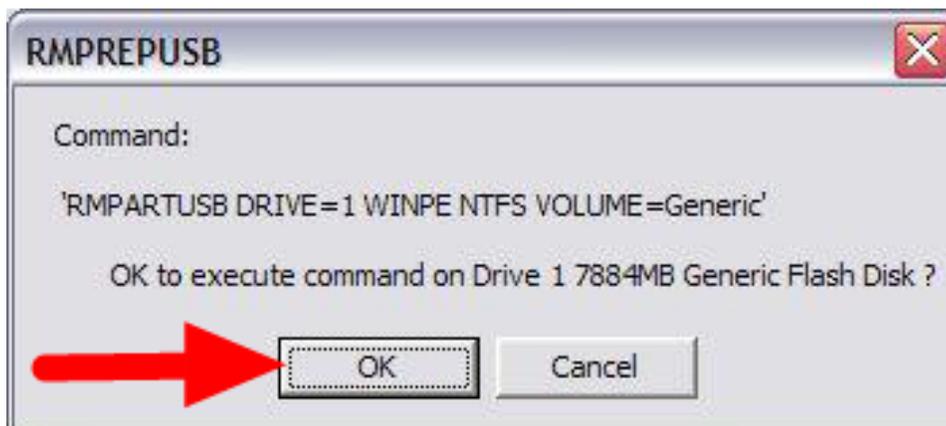
FRC Driver Station

Prepare Drive



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

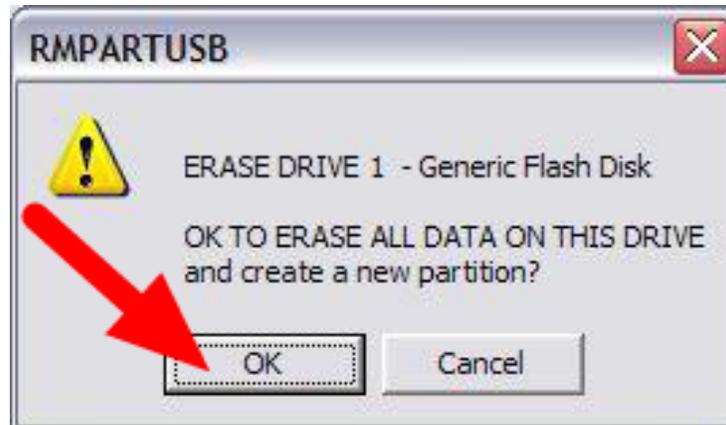
Confirmation Dialog 1



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

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Confirmation Dialog 2



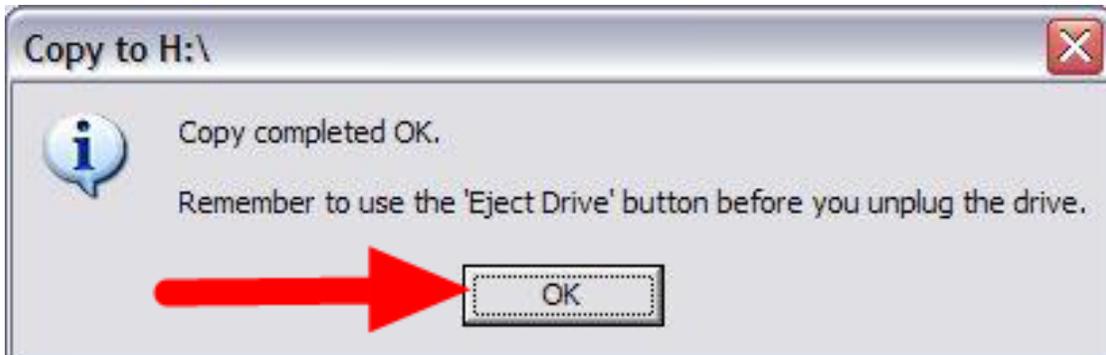
Click "OK" to format the USB drive

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.

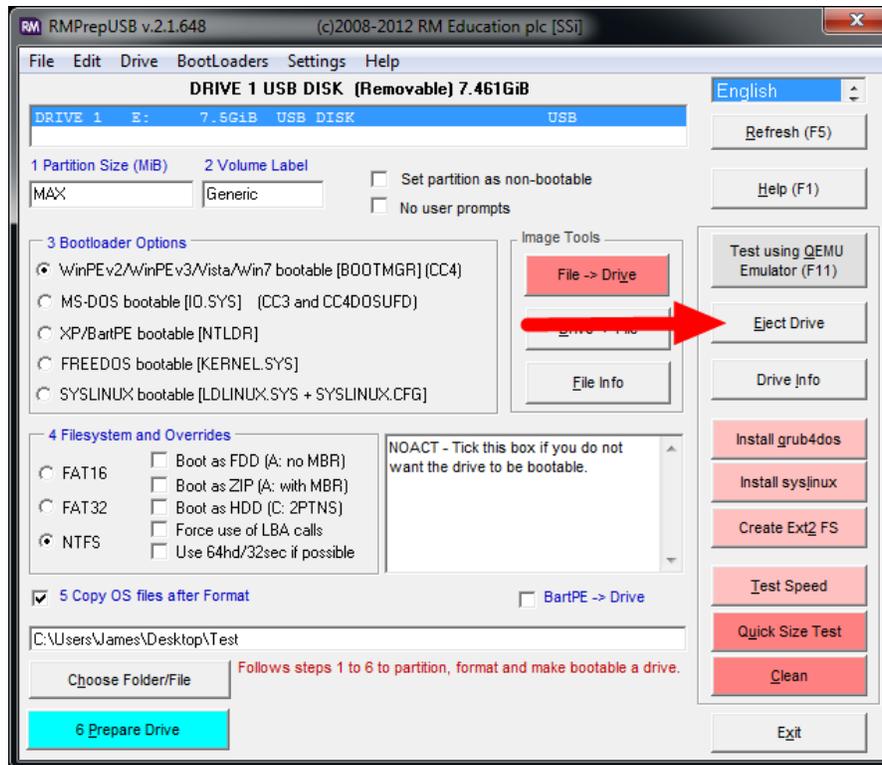
Copy Complete



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.

FRC Driver Station

Eject Drive



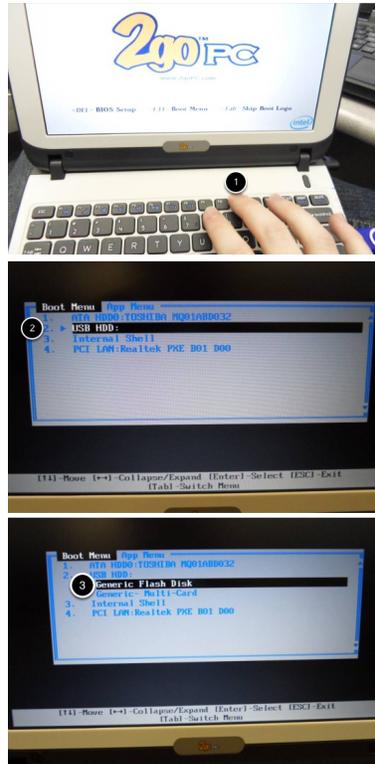
Press the “Eject Drive” button to safely remove the USB drive. The USB drive is now ready to be used to restore the image onto the PC.

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.

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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.

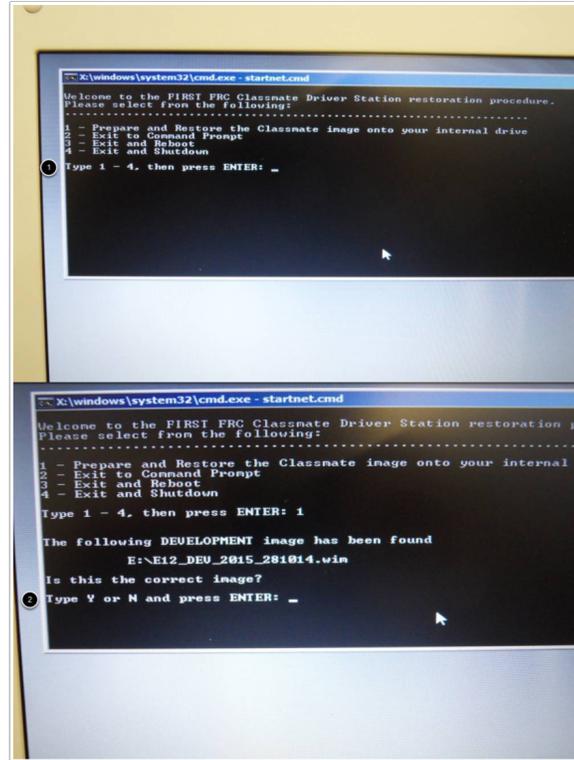
Acer ES1

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.

Acer ES1: 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.

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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.

FRC Driver Station

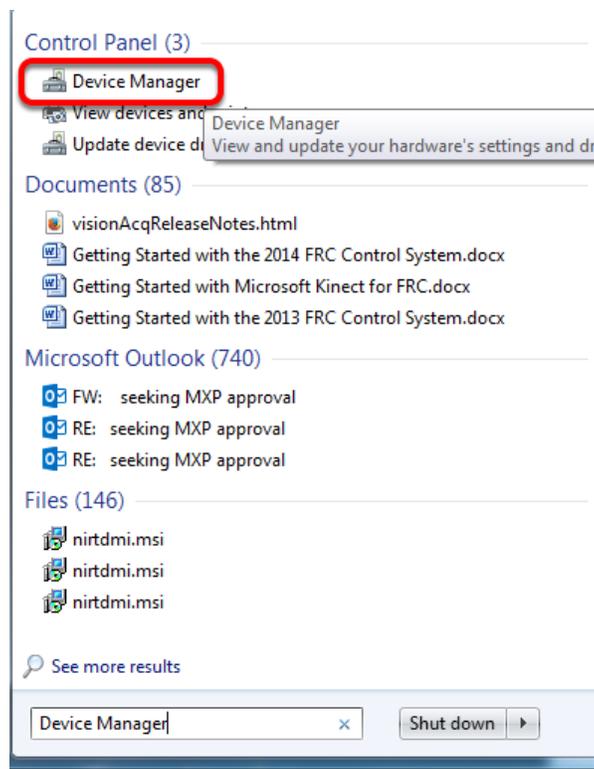
Activate Windows

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.

Acer ES1: Fix Wireless Driver



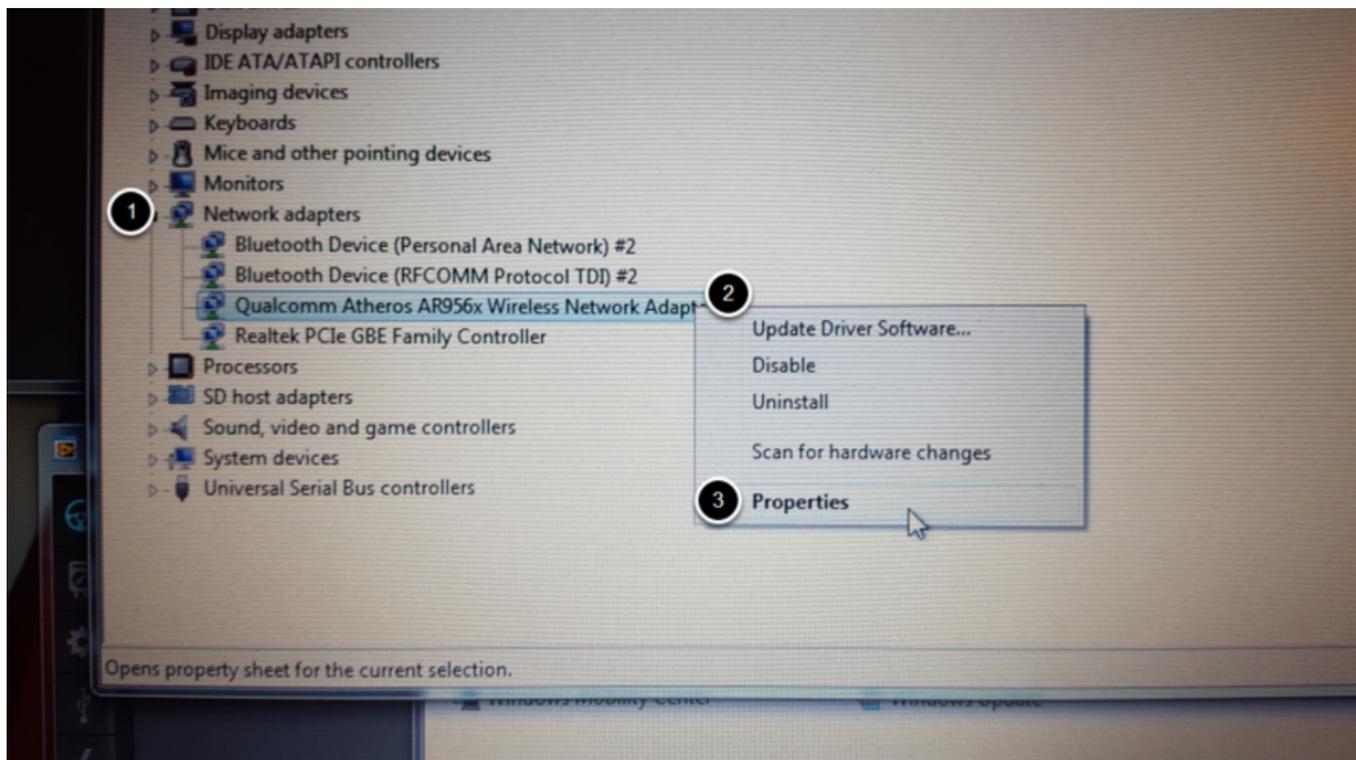
Acer ES1 PC only!

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

FRC Driver Station

correct driver, open the Device Manager by clicking start, typing "Device Manager" in the box and clicking Device Manager

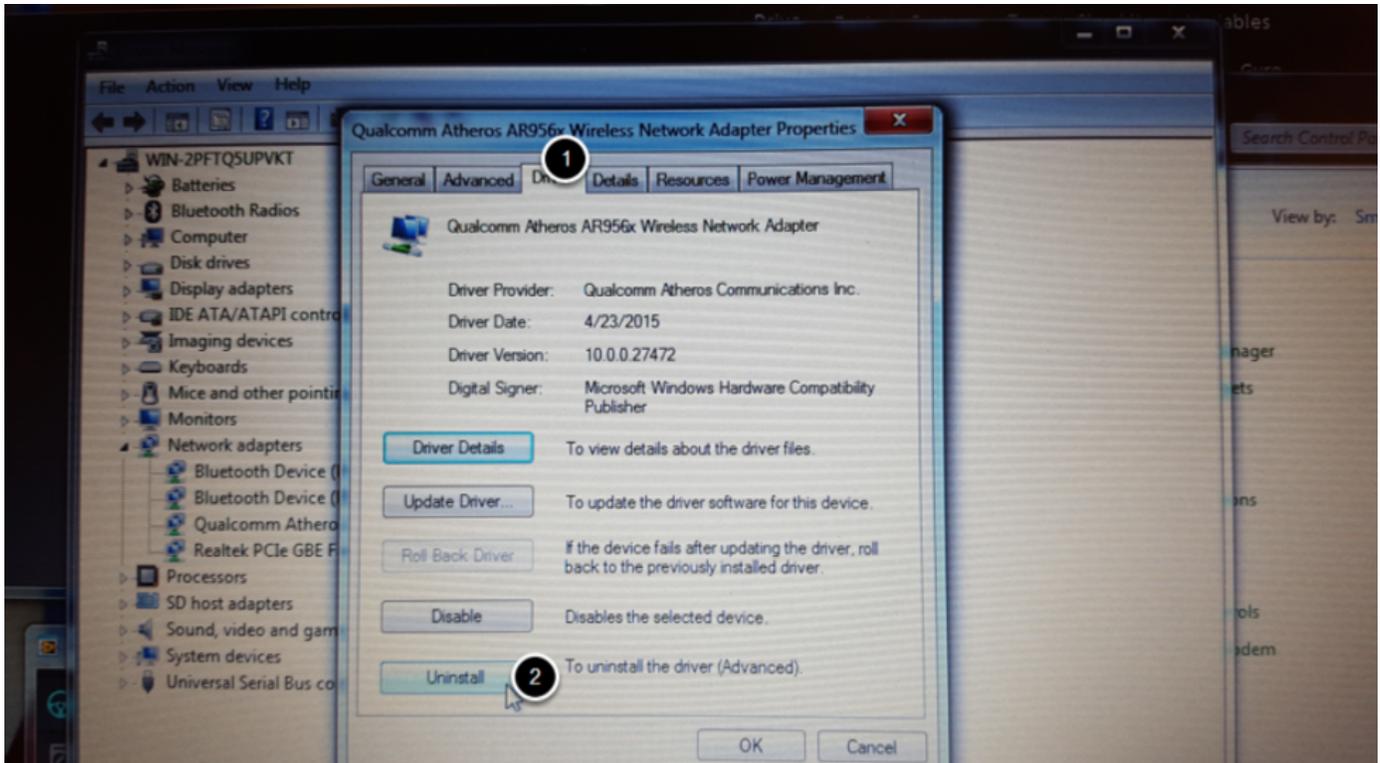
Open Wireless Device Properties



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

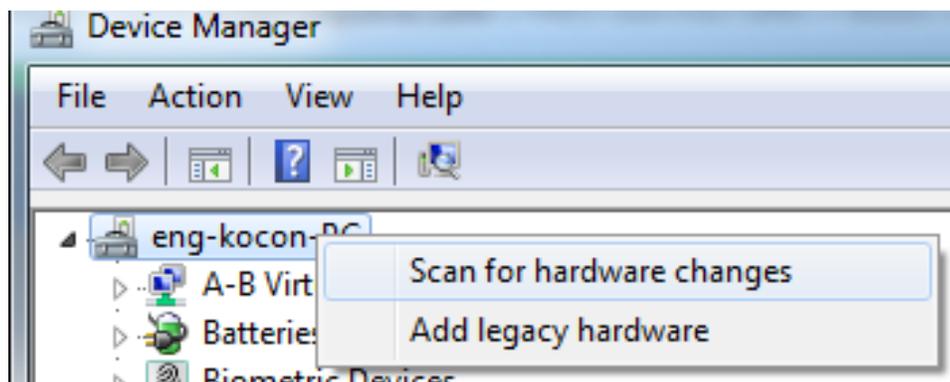
FRC Driver Station

Uninstall Driver



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

Scan for New Hardware



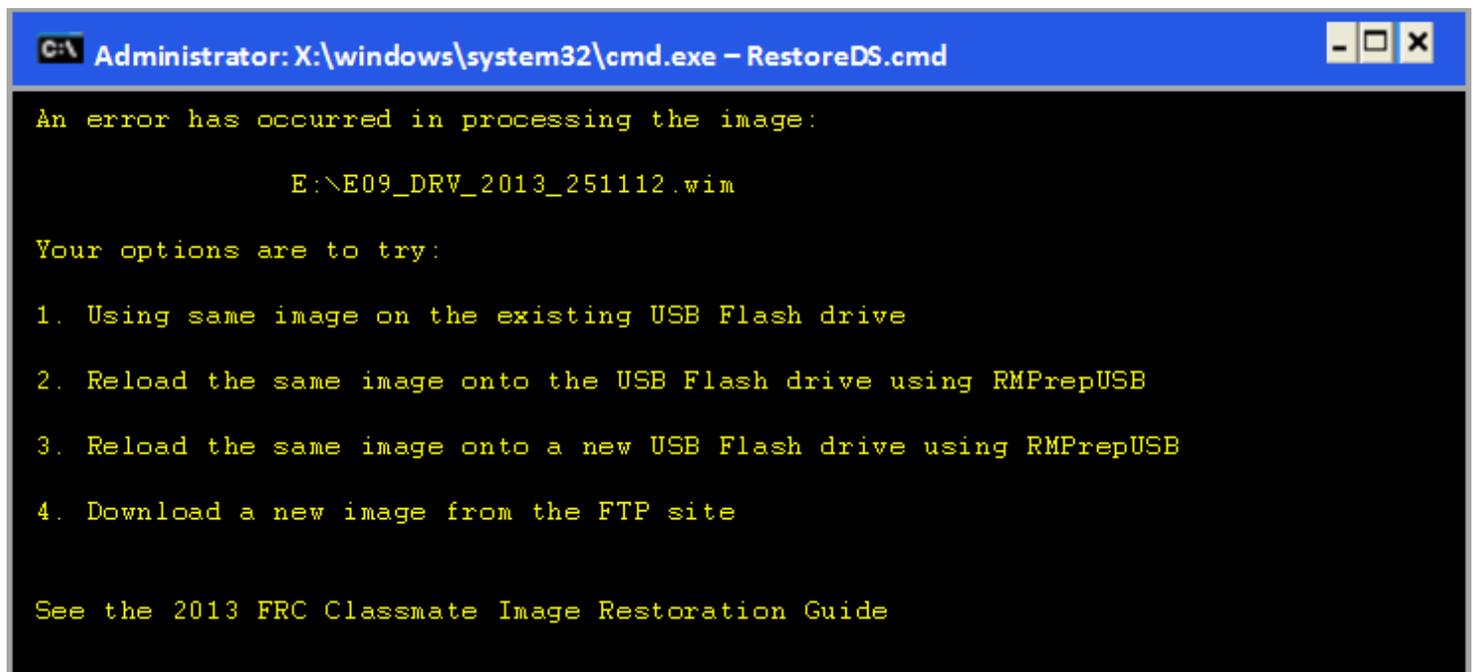
Right click on the top entry of the tree and click "Scan for hardware changes". The wireless adapter should automatically be re-detected and the correct driver should be installed.

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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



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.

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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

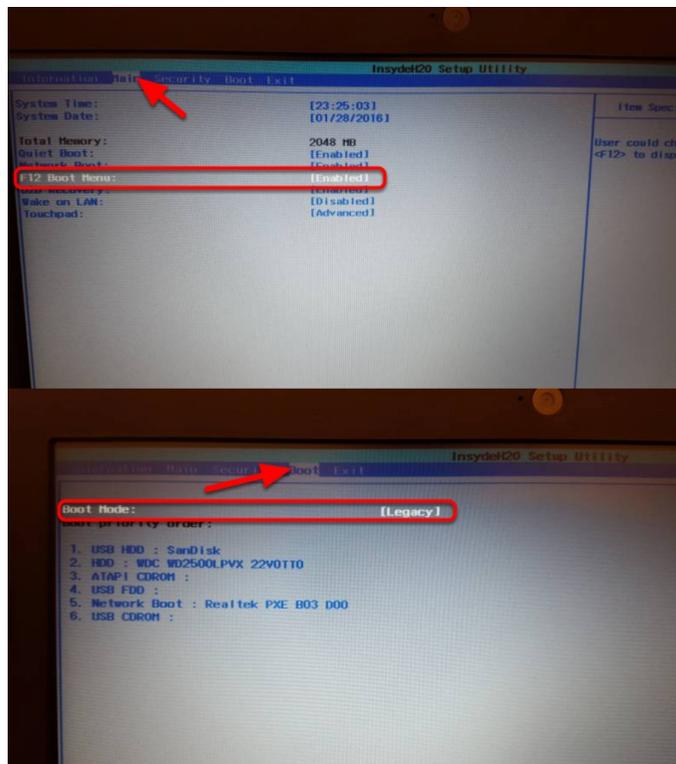
Reload the same image onto a new USB Flash drive using RMPrepUSB: The error message displayed may also be caused by an error with the USB Flash drive itself. Press any key to return to the main menu and select #4 to safely shutdown the Classmate. Select a new USB Flash drive and follow the steps starting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

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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.

FRC Driver Station and Dashboard

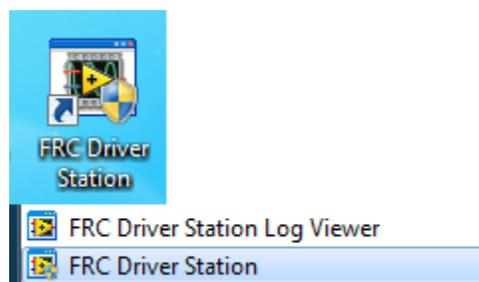
FRC Driver Station

FRC Driver Station Powered by NI LabVIEW

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

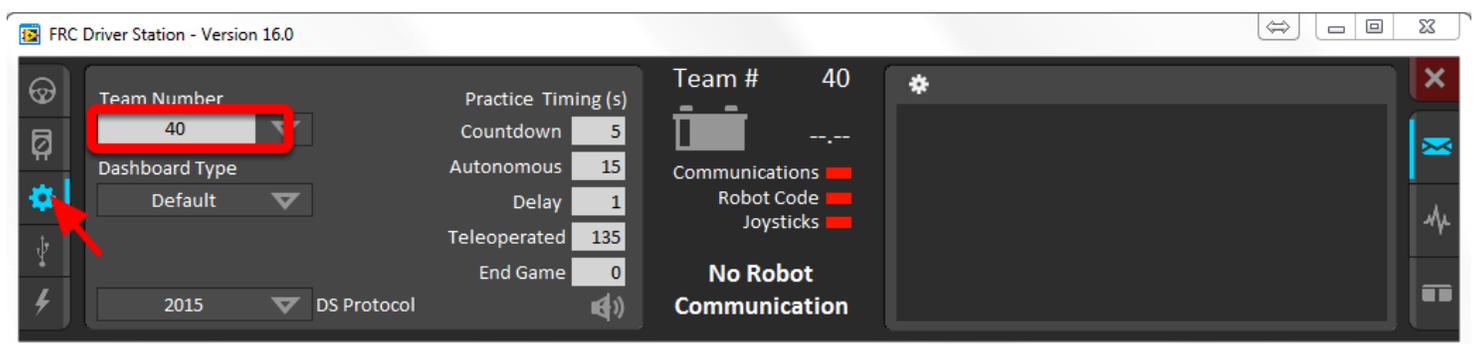
For information on installing the Driver Station software see [this document](#).

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



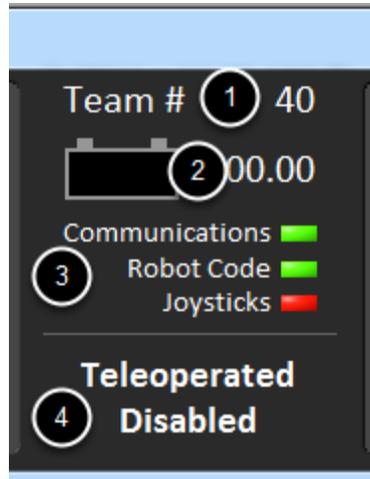
Typically the Driver Station will set the appropriate settings automatically, but if you do have to set the network settings manually, the DS should use the following settings:

- 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.

FRC Driver Station

Status Pane

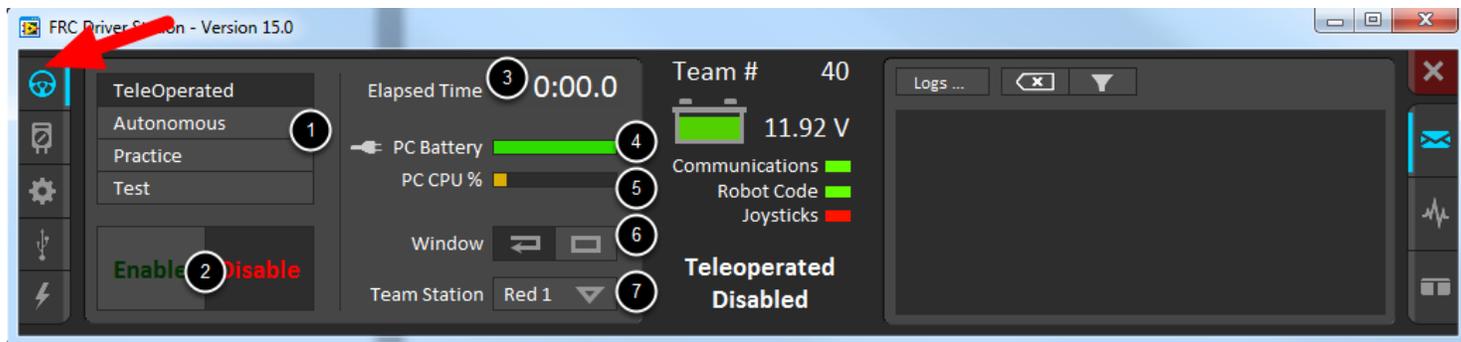


The Status Pane of the Driver Station is located in the center of the display and is always visible regardless of the tab selected. It displays a selection of critical information about the state of the DS and robot:

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".

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Operation Tab



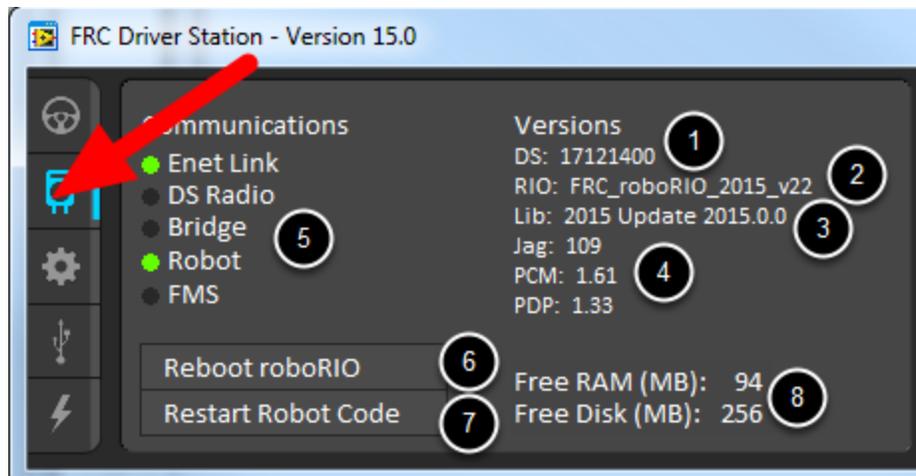
The Operations Tab is used to control the mode of the robot and provide additional key status indicators while the robot is running.

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.

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Diagnostics Tab

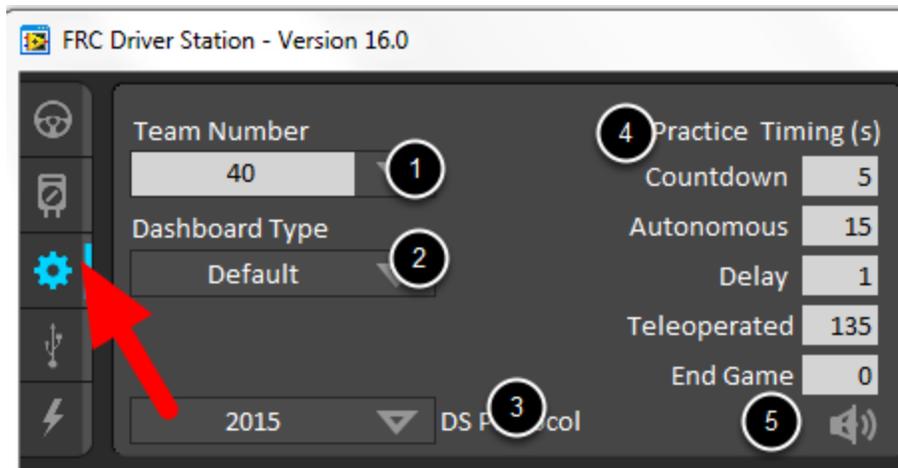


The Diagnostics Tab contains additional status indicators that teams can use to diagnose issues with their robot:

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

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Setup Tab

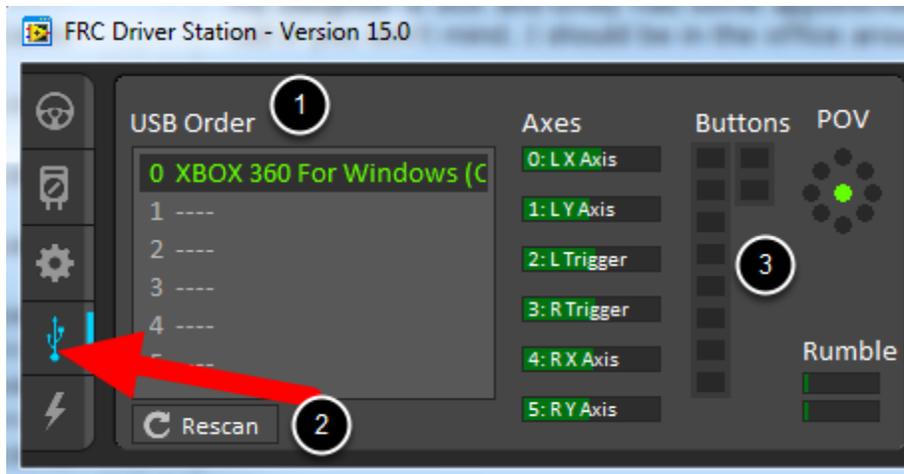


The Setup Tab contains a number of buttons teams can use to control the operation of the Driver Station:

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.

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USB Devices Tab

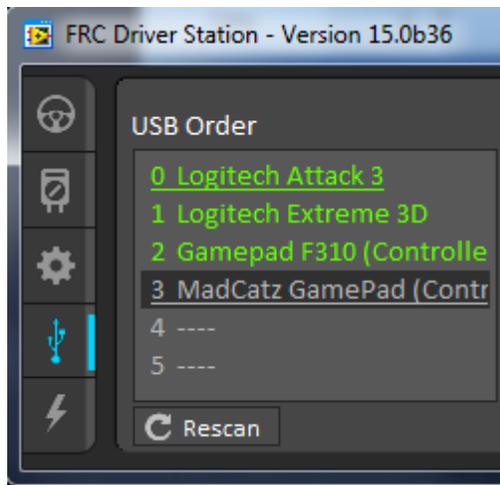


The USB Devices tab includes the information about the USB Devices connected to the DS

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.

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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 its 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

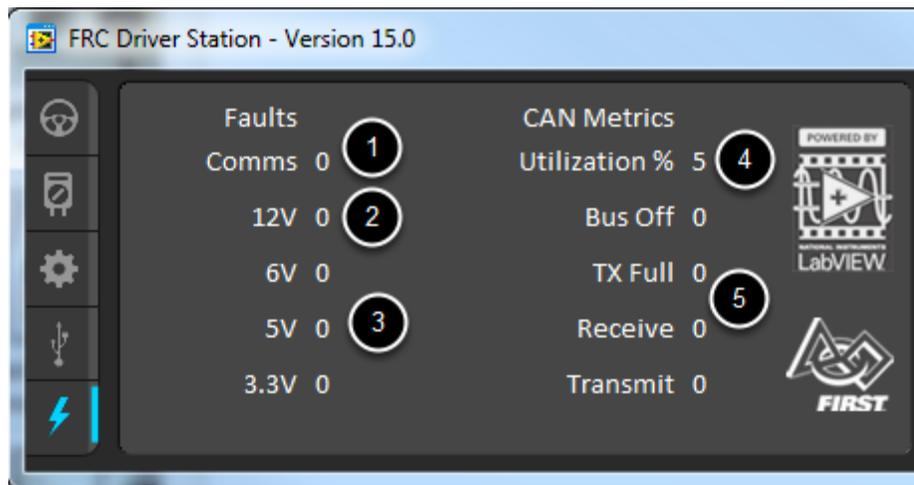
In this example, unplugging the Logitech Extreme 3D joystick will result in the F310 Gamepad moving up to slot 1. Plugging in the MadCatz Gamepad (even if the devices in Slots 1 and 2 are removed and those slots are empty) will result in it occupying Slot 3.

FRC Driver Station

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.

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Charts Tab

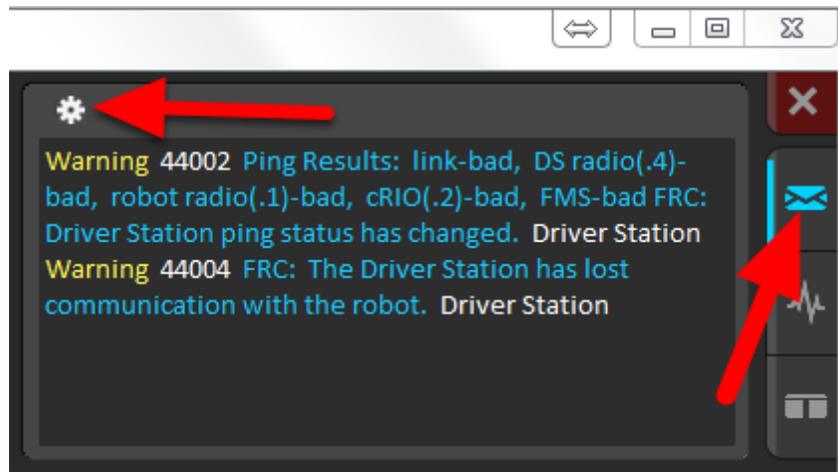


The Charts tab plots and displays advanced indicators of robot status to help teams diagnose robot issues:

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

FRC Driver Station

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

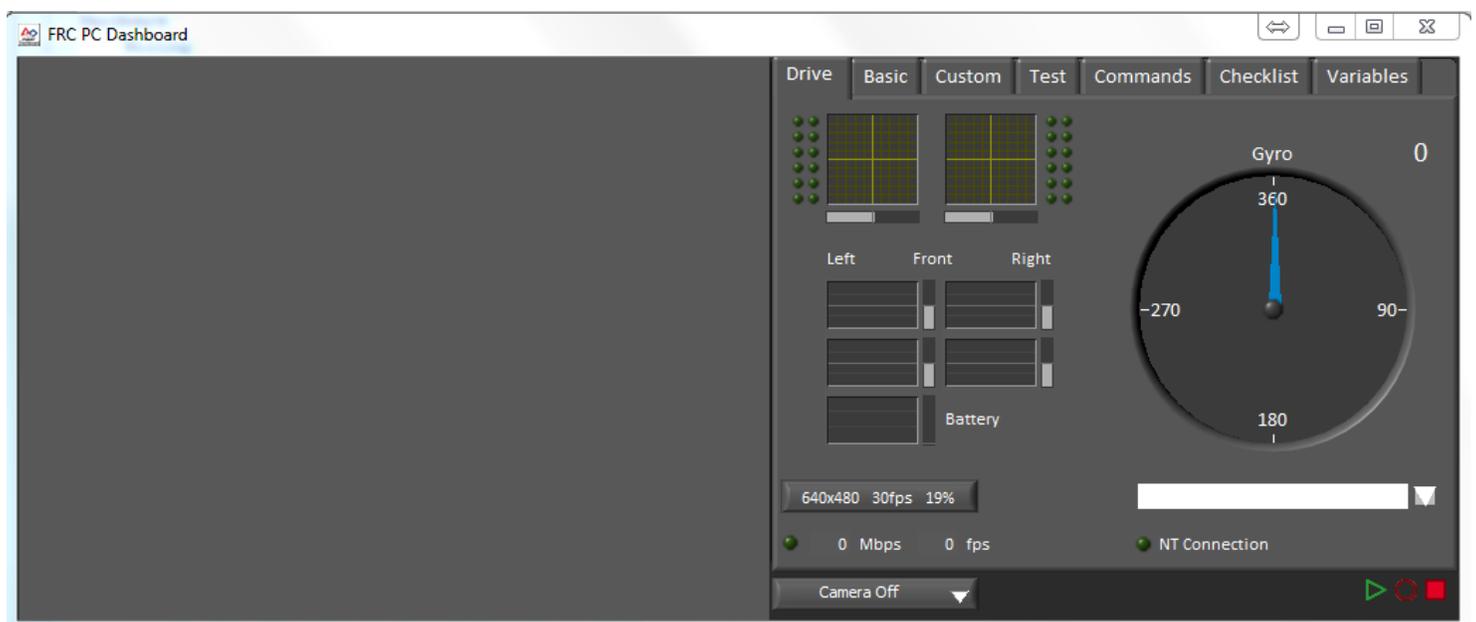
The following keys can be used to control Driver Station operation:

- 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**

FRC Driver Station LabVIEW Dashboard

The Dashboard application installed and launched by the FRC Driver Station is a LabVIEW program designed to provide teams with basic feedback from their robot, with the ability to expand and customize the information to suit their needs. This Dashboard application uses Network Tables and contains a variety of tools that teams may find useful.

LabVIEW Dashboard



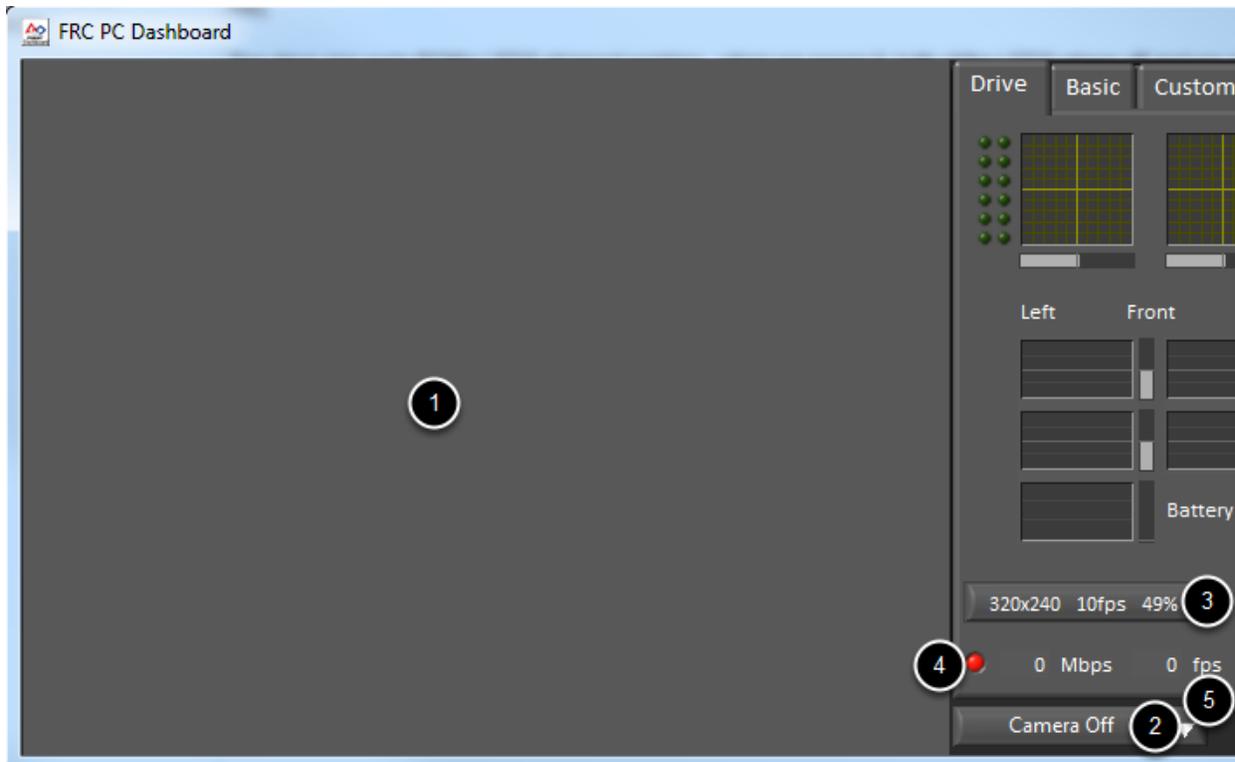
The Dashboard is broken into two main sections. The left pane is for displaying a camera image. The right pane contains:

- Drive tab that contains indicators for joystick and drive motor values (hooked up by default when used with LabVIEW robot code), a gyro indicator, an Autonomous selection text box, a connection indicator and some controls and indicators for the camera,
- Basic tab that contains some default controls and indicators,
- Custom tab for customizing the dashboard using LabVIEW
- Test tab for use with Test Mode in the LabVIEW framework
- Commands tab for use with the new LabVIEW C&C Framework
- Checklist tab that can be used to create task lists to complete before and/or between matches
- Variables tab that displays the raw Network Tables variables in a tree view format

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The LabVIEW Dashboard also includes Record/Playback functionality, located in the bottom right. More detail about this feature is included below under Record/Playback.

Camera Image and Controls



The left pane is used to display a video feed from an Axis camera or USB camera located on the robot. For instructions on setting up the Axis Camera to work with this display [see here](#). There are also some controls and indicators related to the camera in the right pane on the Drive tab and below the tab area:

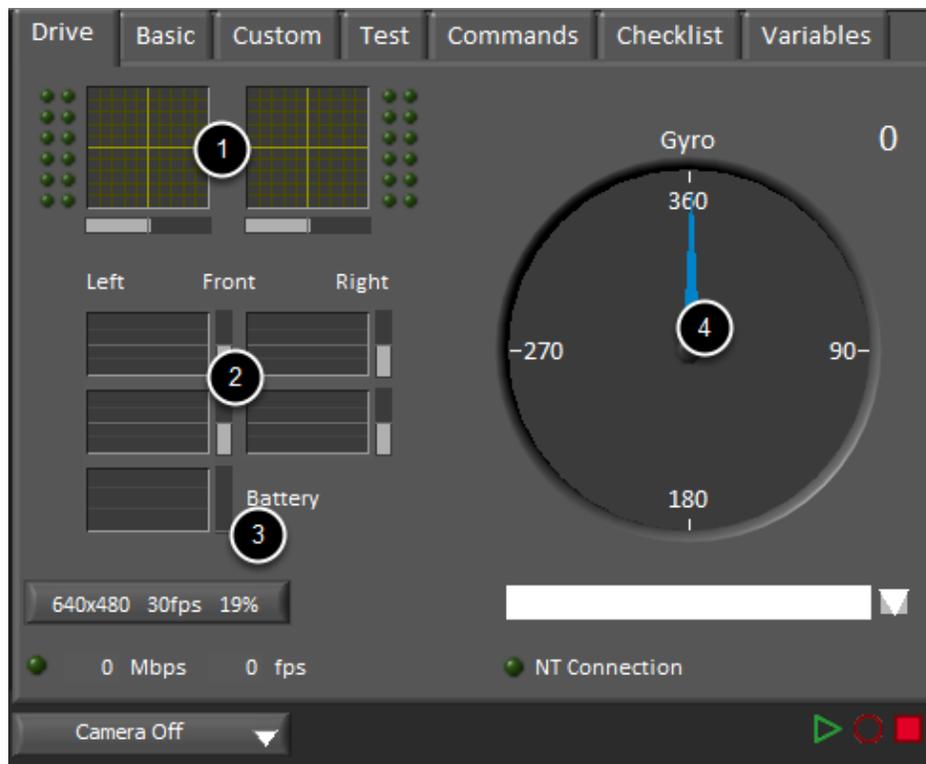
1. Camera Image Display
2. Mode Selector - This drop-down allows you to select the type of camera display to use. The choices are Camera Off, USB Camera SW (software compression), USB Camera HW (hardware compression) and IP Camera (Axis camera). Note that the IP Camera setting will not work when your PC is connected to the roboRIO over USB.
3. Camera Settings - This control allows you to change the resolution, framerate and compression of the image stream to the dashboard, click the control to pop-up the configuration.
4. Bandwidth Indicator - Indicates approximate bandwidth usage of the image stream. The indicator will display green for "safe" bandwidth usage, yellow when teams should use

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caution and red if the stream bandwidth is beyond levels that will work on the competition field.

5. Framerate - Indicates the approximate received framerate of the image stream.

Drive



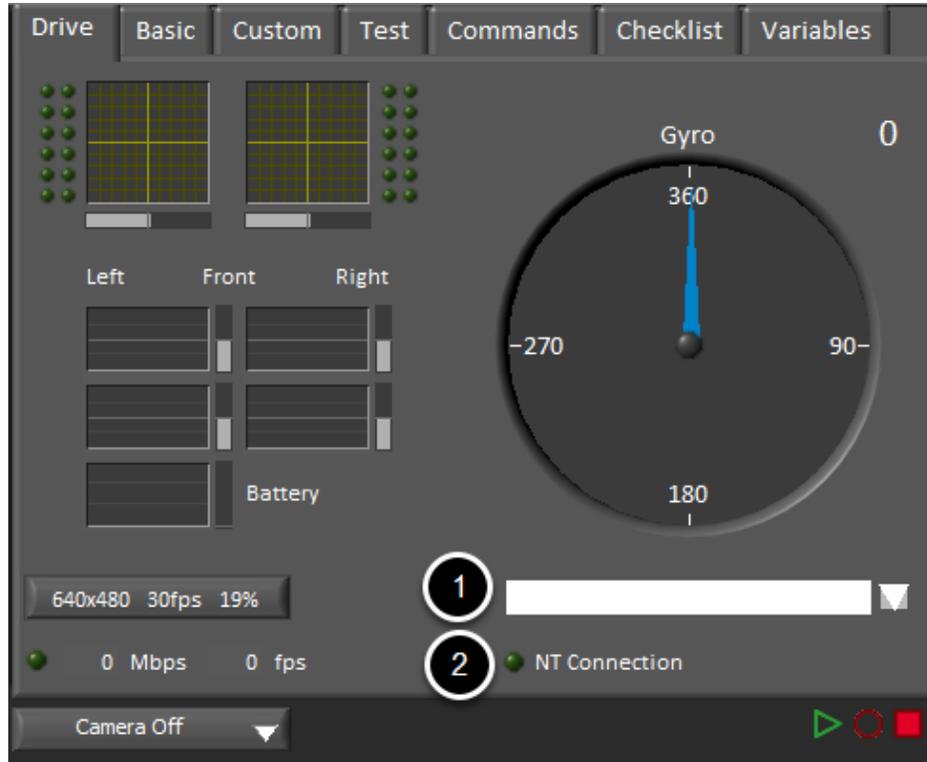
The center pane contains a section that provides feedback on the joysticks and drive commands when used with the LabVIEW framework and a section that displays the robot IP and reported battery voltage:

1. Displays X,Y and Throttle information and button values for up to 2 joysticks when using the LabVIEW framework
2. Displays values being sent to motor controllers when using LabVIEW framework
3. Displays a brief chart of the reported battery voltage
4. Displays a Gyro value

These indicators (other than the Gyro) are hooked up to appropriate values by default when using the LabVIEW framework. For information on using them with C++/Java code see [Using the LabVIEW Dashboard with C++/Java Code.](#)

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Autonomous Selection Box and Connection Indicator

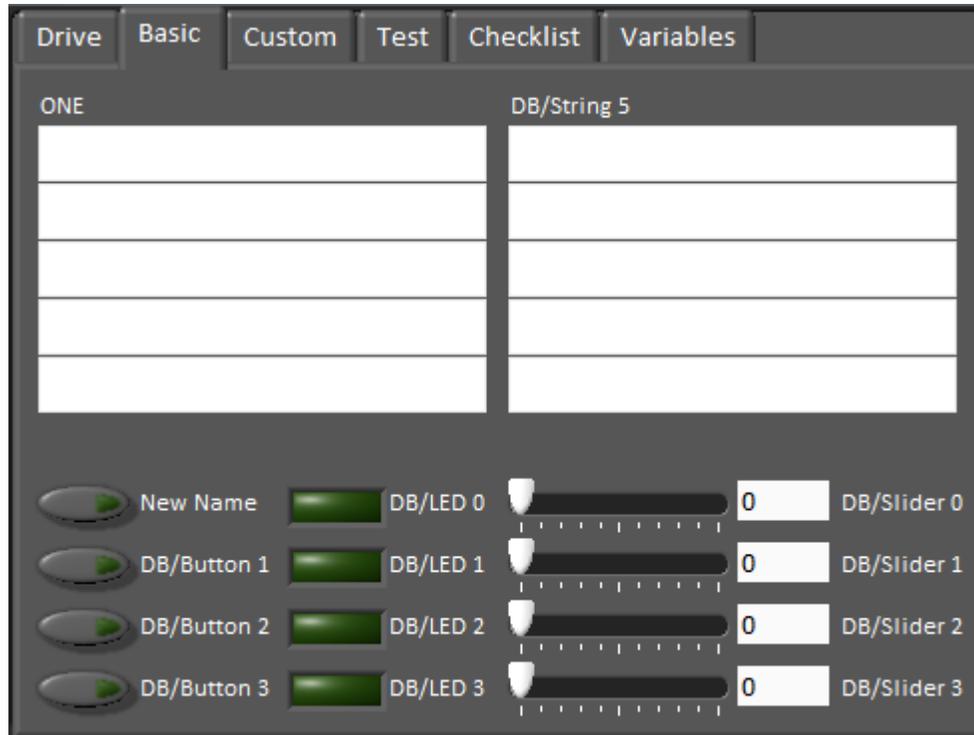


This year the Dashboard also contains 2 new elements on the Drive tab:

1. A text box that can be used to select Autonomous modes. Each language's code templates have examples of using this box to select from multiple autonomous programs.
2. A connection indicator for the connection to the robot.

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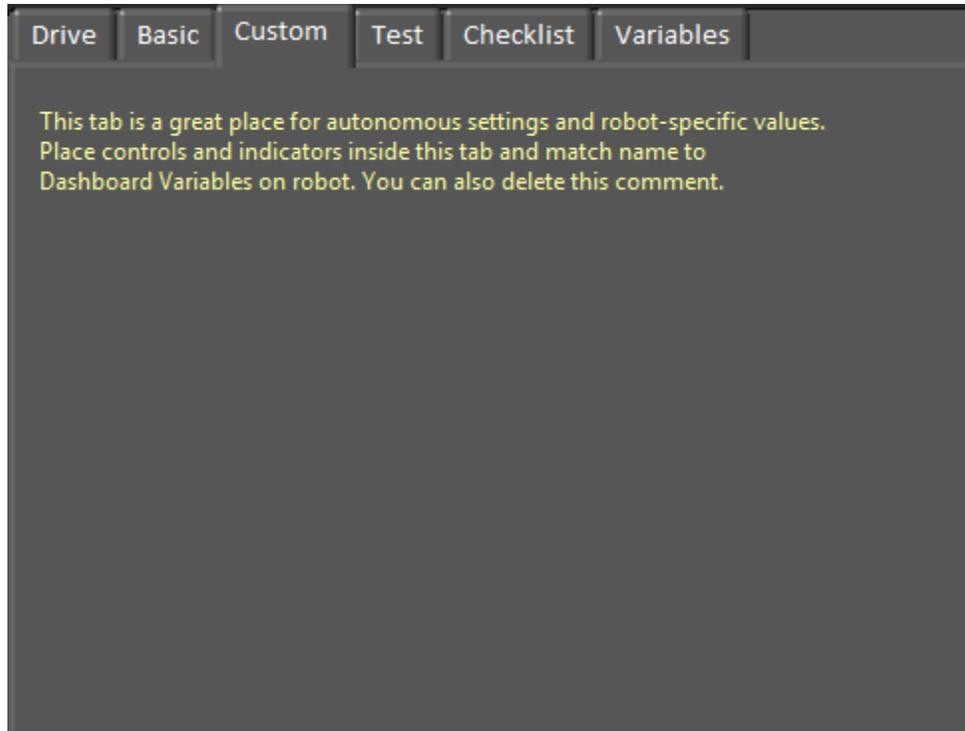
Basic



The Basic tab contains a variety of pre-populated bi-directional controls/indicators which can be used to control the robot or display information from the robot. The SmartDashboard key names associated with each item are labeled next to the indicator with the exception of the Strings which follow the same naming pattern and increment from DB/String 0 to DB/String 4 on the left and DB/String 5 to DB/String 9 on the right. The LabVIEW framework contains an example of reading from the Buttons and Sliders in Teleop. It also contains an example of customizing the labels in Begin. For more detail on using this tab with C++\Java code see [Using the LabVIEW Dashboard with C++\Java Code](#).

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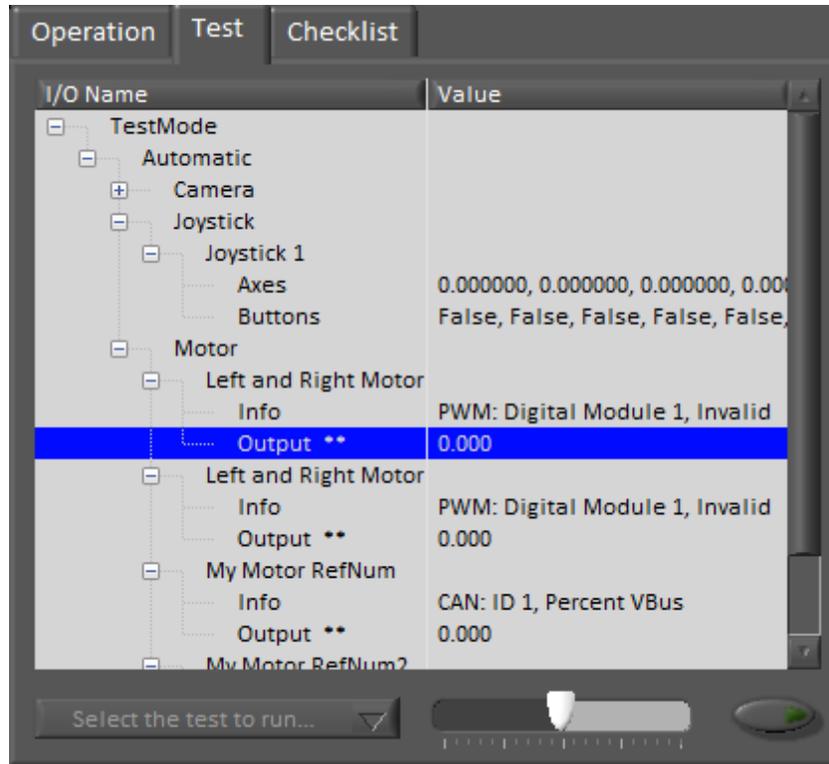
Custom



The Custom tab allows you to add additional controls/indicators to the dashboard using LabVIEW without removing any existing functionality. To customize this tab you will need to create a Dashboard project in LabVIEW.

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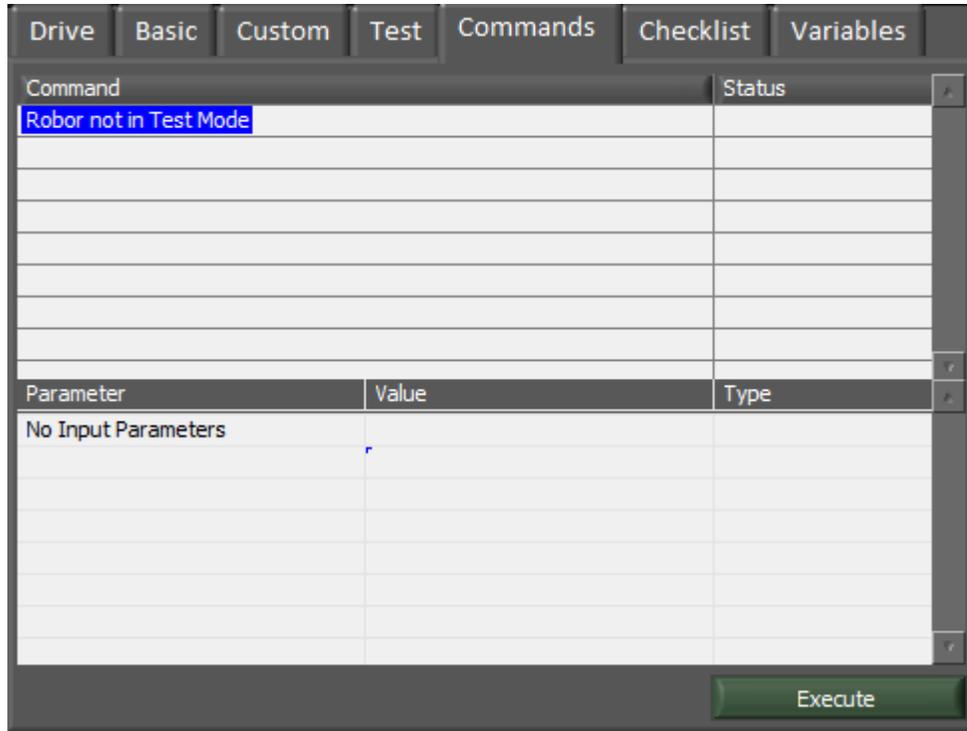
Test



The Test tab is for use with Test mode for teams using LabVIEW (Java and C++ teams should use the Java SmartDashboard when using Test Mode). For many items in the libraries, Input/Output info will be populated here automatically. All items which have ** next to them are outputs that can be controlled by the dashboard. To control an output, click on it to select it, drag the slider to set the value then press and hold the green button to enable the output. As soon as the green button is released, the output will be disabled. This tab can also be used to run and monitor tests on the robot. An example test is provided in the LabVIEW framework. Selecting this test from the dropdown box will show the status of the test in place of the slider and enable controls.

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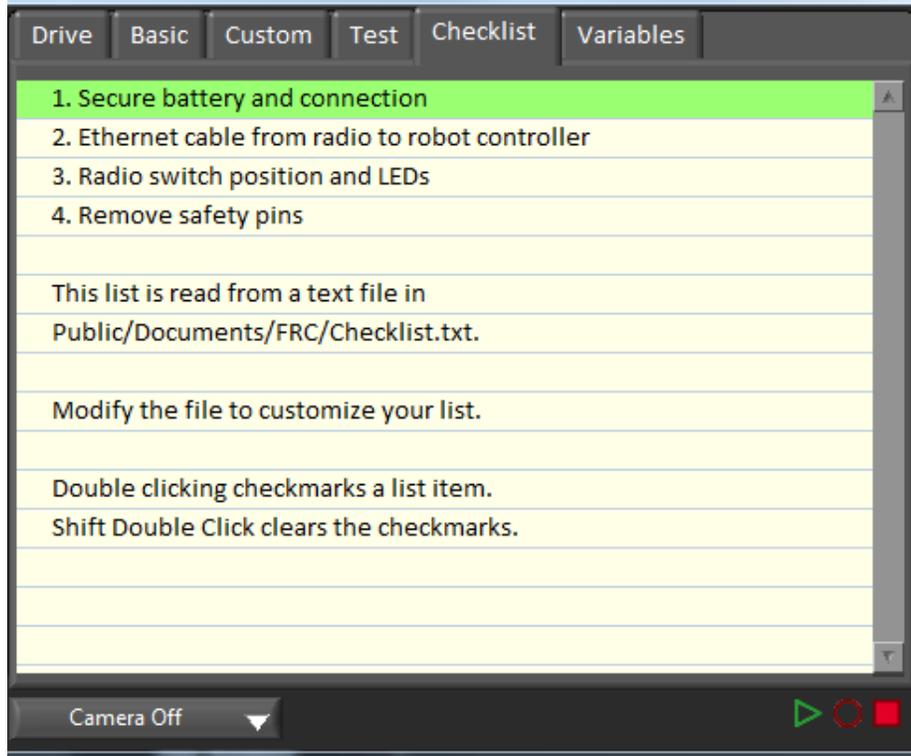
Commands



The Commands tab can be used with the Robot in Test mode to see which commands are running and to manually run commands for test purposes.

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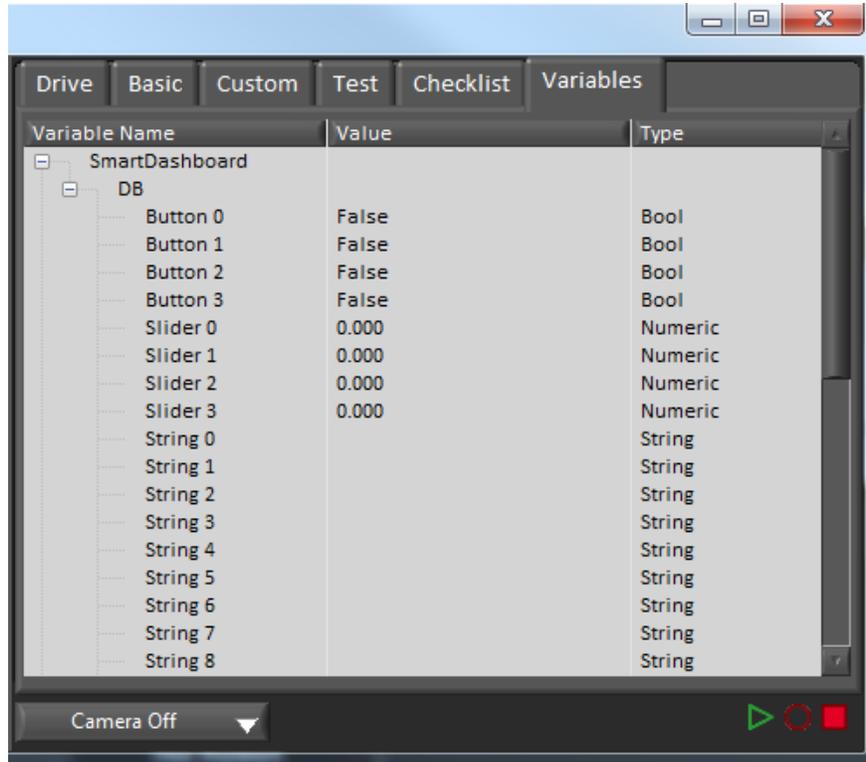
Checklist



The Checklist tab can be used by teams to create a list of tasks to perform before or between matches. Instructions for using the Checklist tab are pre-populated in the default checklist file.

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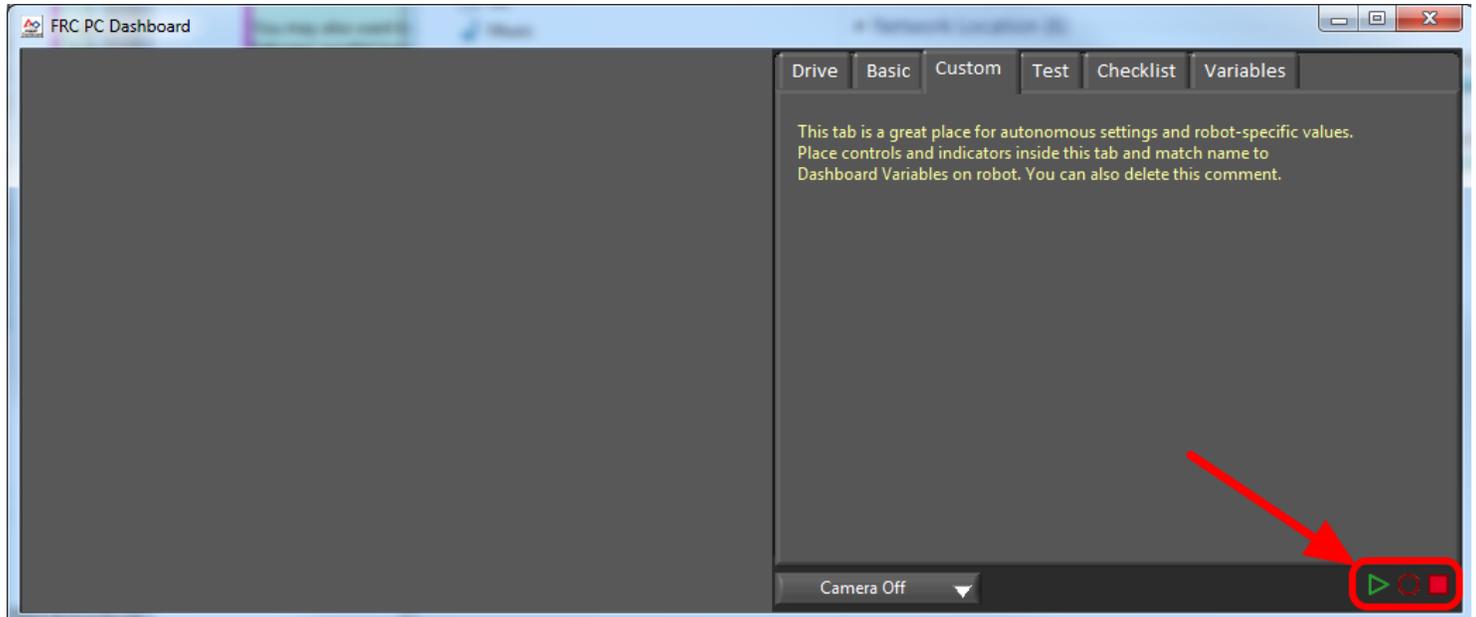
Variables



The Variables tab of the left pane shows all Network Tables variables in a tree display. The Variable Name (Key), Value and data type are shown for each variable. Information about the Network Tables bandwidth usage is also displayed in this tab. Entries will be shown with black diamonds if they are not currently synced with the robot.

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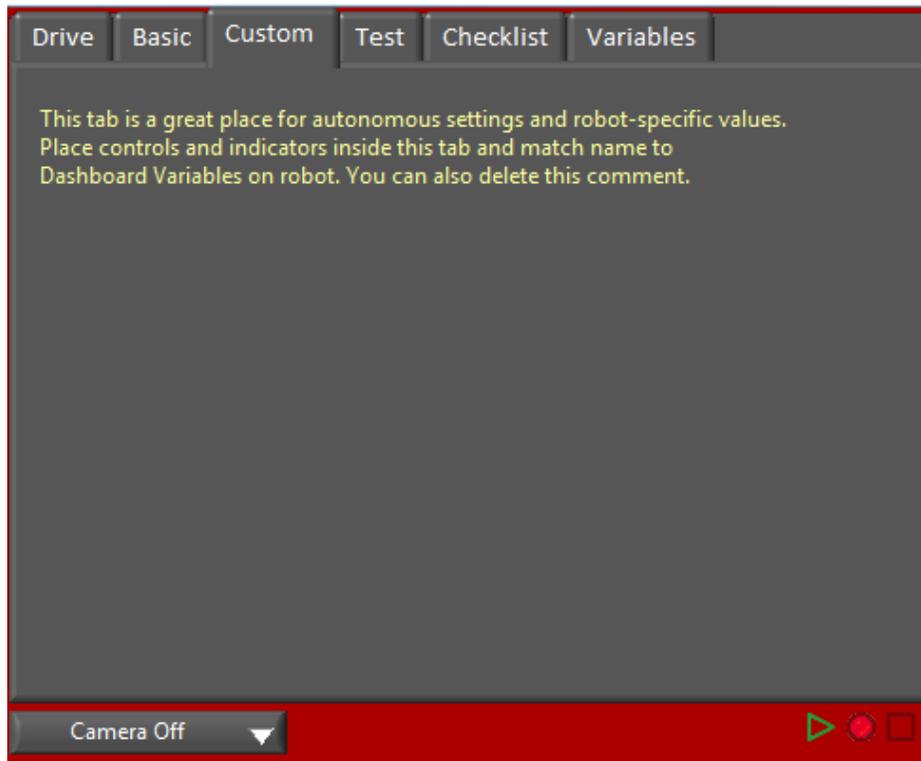
Record/Playback



The LabVIEW Dashboard includes a Record/Playback feature that allows you to record video and Network Tables data (such as the state of your Dashboard indicators) and play it back later.

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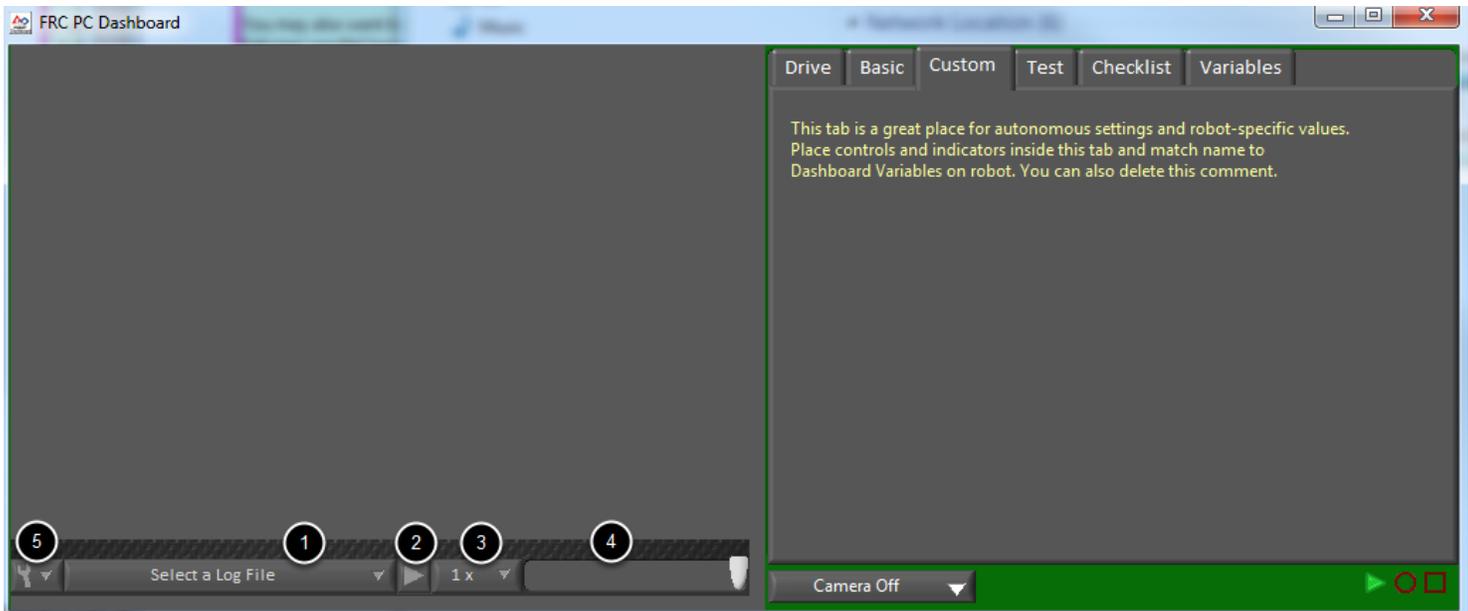
Recording



To begin recording, click the red circular Record button. The background of the right pane will turn red to indicate you are recording. To stop recording, press the red square Stop button.

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Playback



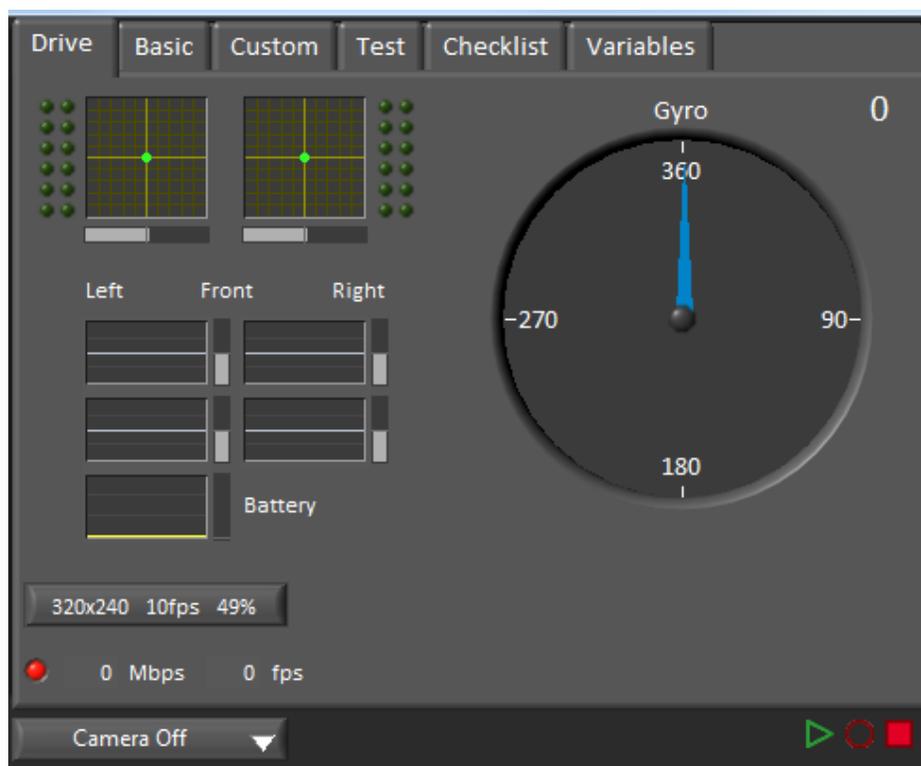
To play a recording back, click the green triangle Play button. The background of the right pane will begin pulsing green and playback controls will appear at the bottom of the camera pane.

1. File Selector - The dropdown allows you to select a log file to play back. The log files are named using the date and time and the dropdown will also indicate the length of the file. Selecting a logfile will immediately begin playing that file.
2. Play/Pause button - This button allows you to pause and resume playback of the log file.
3. Playback Speed - This dropdown allows you to adjust playback speed from 1/10 speed to 10x speed, the default is real-time (1x)
4. Time Control Slider - This slider allows you to fast-forward or rewind through the logfile by clicking on the desired location or dragging the slider.
5. Settings - With a log file selected, this dropdown allows you to rename or delete a file or open the folder containing the logs in Windows Explorer (Typically C:\Users\Public\Documents\FRC\Log Files\Dashboard)

Using the LabVIEW Dashboard with C++\Java Code

The default LabVIEW Dashboard utilizes Network Tables to pass values and is therefore compatible with C++ and Java robot programs. This article covers the keys and value ranges to use to work with the Dashboard.

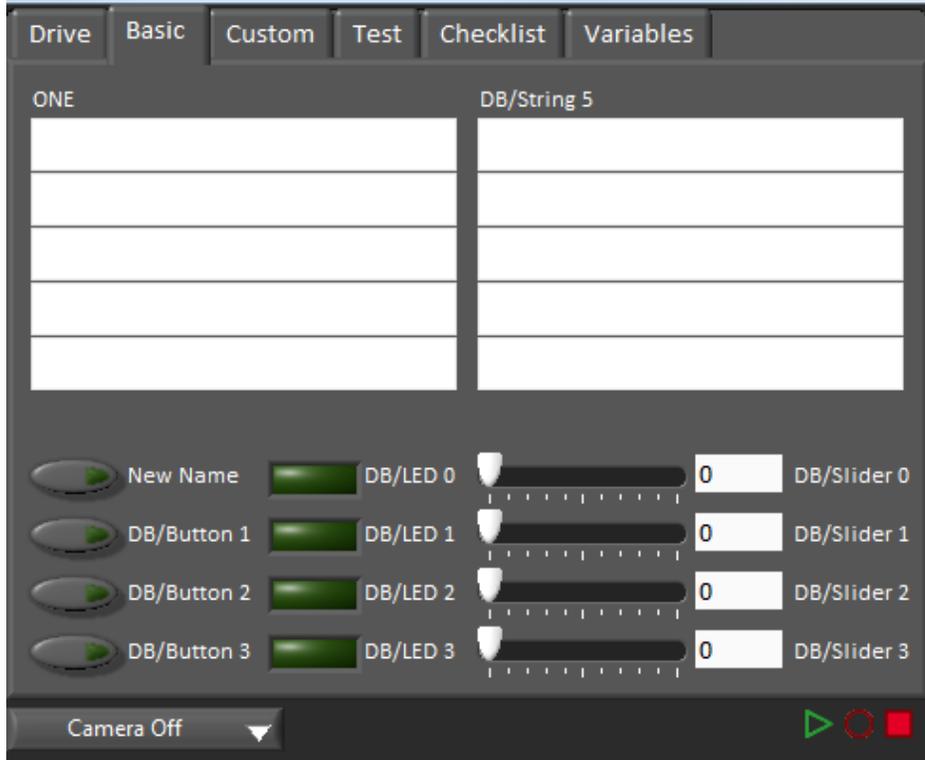
Drive Tab



Most of the indicators on the Drive tab utilize arrays. The c++ and Java SmartDashboard classes do not currently support sending arrays.

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Basic Tab

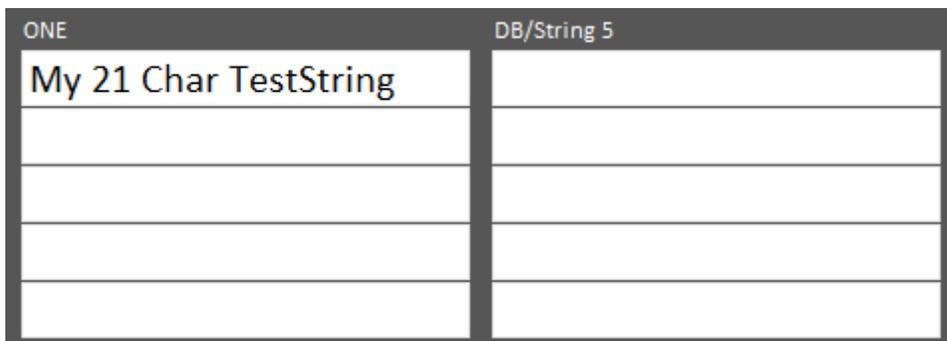


The Basic tab uses a number of keys in the a "DB" sub-table to send/recieve Dashboard data. The LED's are output only, the other fields are all bi-directional (send or recieve).

Labels

The labels are currently sent as an array. C++ and Java SmartDashboard classes do not currently support sending arrays.

Strings



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The strings are labeled top-to-bottom, left-to-right from "DB/String 0" to "DB/String 9". Each String field can display at least 21 characters (exact number depends on what characters). To write to these strings:

```
Java: SmartDashboard.putString("DB/String 0", "My 21 Char TestString");
```

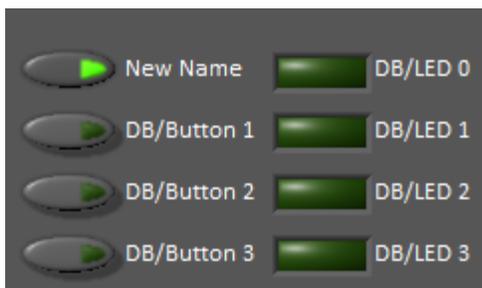
```
C++: SmartDashboard::PutString("DB/String 0", "My 21 Char TestString");
```

To read string data entered on the Dashboard:

```
Java: String dashData = SmartDashboard.getString("DB/String 0", "myDefaultData");
```

```
C++: std::string dashData = SmartDashboard::GetString("DB/String 0", "myDefaultData");
```

Buttons and LEDs



The Buttons and LEDs are boolean values and are labeled top-to-bottom from "DB/Button 0" to "DB/Button 3" and "DB/LED 0" to "DB/LED 3". The Buttons are bi-directional, the LEDs are only able to be written from the Robot and read on the Dashboard. To write to the Buttons or LEDs:

```
Java: SmartDashboard.putBoolean("DB/Button 0", true);
```

```
C++: SmartDashboard::PutBoolean("DB/Button 0", true);
```

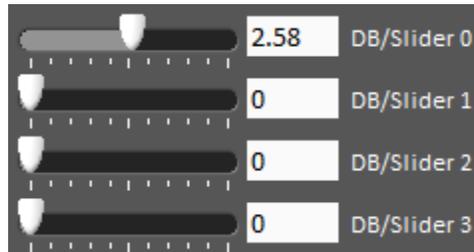
To read from the Buttons:

```
Java (default value of false): boolean buttonValue = SmartDashboard.getBoolean("DB/Button 0", false);
```

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C++ (default value of false): `bool buttonValue = SmartDashboard::GetBoolean("DB/Button 0", false);`

Sliders



The Sliders are bi-directional analog (double) controls/indicators with a range from 0 to 5. To write to these indicators:

Java: `SmartDashboard.putNumber("DB/Slider 0", 2.58);`

C++: `SmartDashboard::PutNumber("DB/Slider 0", 2.58);`

To read values from the Dashboard into the robot program:

Java (default value of 0.0): `double dashData = SmartDashboard.getNumber("DB/Slider 0", 0.0);`

C++ (default value of 0.0): `double dashData = SmartDashboard::GetNumber("DB/Slider 0", 0.0);`

FRC Driver Station Errors/Warnings

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

Joystick Unplugged

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

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

Lost Communication

```
Warning <Code> 44004 occurred at Driver Station  
<time>2/6/2013 11:07:53 AM<unique#>2  
FRC: The Driver Station has lost communication with the robot.
```

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

Ping Status

```
Warning <Code> 44002 occurred at Ping Results: link-GOOD, DS  
radio(.4)-bad, robot radio(.1)-GOOD, cRIO(.2)-bad, FMS-bad Driver  
Station  
<time>2/6/2013 11:07:59 AM<unique#>5  
FRC: Driver Station ping status has changed.
```

A Ping Status warning is generated each time the Ping Status to a device changes while the DS is not in communication with the roboRIO. As communications is being established when the DS

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starts up, a few of these warnings will appear as the Ethernet link comes up, then the connection to the robot radio, then the roboRIO (with FMS mixed in if applicable). If communications are later lost, the ping status change may help identify at which component the communication chain broke.

Time Since Robot Boot

```
WARNING <Code> 44007 occurred at FRC_NetworkCommunications  
<secondsSinceReboot> 3.585  
FRC: Time since robot boot.
```

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

Radio Detection Times

```
WARNING <Code> 44008 occurred at FRC_NetworkCommunications  
<radioLostEvents> 19.004 <radioSeenEvents> 0.000  
FRC: Robot radio detection times.  
WARNING <Code> 44008 occurred at FRC_NetworkCommunications  
<radioLostEvents> 2.501,422.008 <radioSeenEvents> 0.000,147.005  
FRC: Robot radio detection times.
```

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

No Robot Code

```
Warning <Code> 44003 occurred at Driver Station  
<time>2/8/2013 9:50:13 AM<unique#>8  
FRC: No robot code is currently running.
```

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

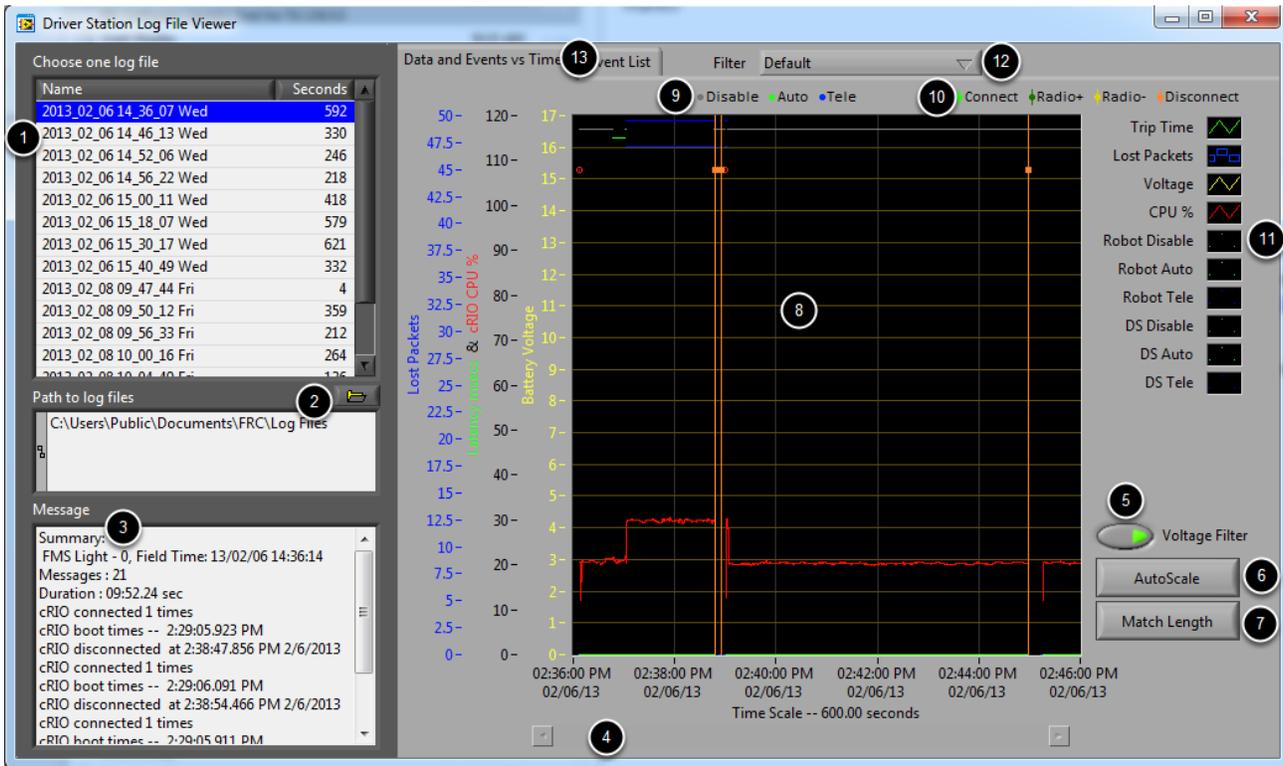
Driver Station Log File Viewer

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

Event Logs

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

Log Viewer UI

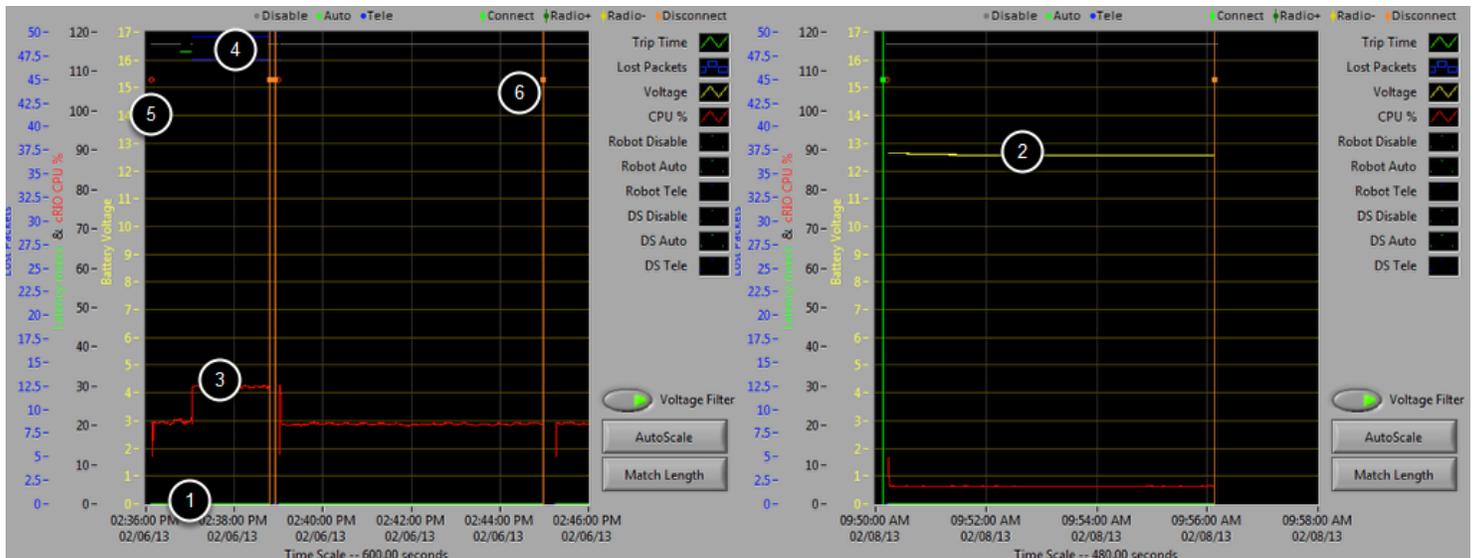


The Log Viewer contains a number of controls and displays to aid in the analysis of the Driver Station log files:

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1. File Selection Box - This window displays all available log files in the currently selected folder. Click on a log file in the list to select it.
2. Path to Log Files - This box displays the current folder the viewer is looking in for log files. This defaults to the folder that the Driver Station stores log files in. Click the folder icon to browse to a different location.
3. Message Box - This box displays a summary of all messages from the Event Log. When hovering over an event on the graph this box changes to display the information for that event.
4. Scroll Bar - When the graph is zoomed in, this scroll bar allows for horizontal scrolling of the graph.
5. Voltage Filter - This control turns the Voltage Filter on and off (defaults to on). The Voltage Filter filters out data such as CPU %, robot mode and trip time when no Battery Voltage is received (indicating that the DS is not in communication with the roboRIO). This does not filter out data when the battery voltage being received is 0 due to a missing jumper on the Analog Module or no power provided to the Analog Module.
6. AutoScale - This button zooms the graph out to show all data in the log.
7. Match Length - This button scales the graph to approximately the length of an FRC match (2 minutes and 30 seconds shown). It does not automatically locate the start of the match, you will have to scroll using the scroll bar to locate the beginning of the Autonomous mode.
8. Graph - This display shows graph data from the DS Log file (voltage, trip time, roboRIO CPU%, Lost Packets, and robot mode) as well as overlaid event data (shown as dots on the graph with select events showing as vertical lines across the entire graph). Hovering over event markers on the graph displays information about the event in the Messages window in the bottom left of the screen.
9. Robot Mode Key - Key for the Robot Mode displayed at the top of the screen
10. Major event key - Key for the major events, displayed as vertical lines on the graph
11. Graph key - Key for the graph data
12. Filter Control - Drop-down to select the filter mode (filter modes explained below)
13. Tab Control - Control to switch between the Graph (Data and Events vs. Time) and Event List displays.

Using the Graph Display



The Graph Display contains the following information:

1. Graphs of Trip Time in ms (green line) and Lost Packets per second (displayed as blue vertical bars). In these example images Trip Time is a flat green line at the bottom of the graph and there are no lost packets
2. Graph of Battery voltage displayed as a yellow line.
3. Graph of roboRIO CPU % as a red line
4. Graph of robot mode and DS mode. The top set of the display shows the mode commanded by the Driver Station. The bottom set shows the mode reported by the robot code. In this example the robot is not reporting it's mode during the disabled and autonomous modes, but is reported during Teleop.
5. Event markers will be displayed on the graph indicating the time the event occurred. Errors will display in red; warnings will display in yellow. Hovering over an event marker will display information about the event in the Messages box at the bottom left of the screen.
6. Major events are shown as vertical lines across the graph display.

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

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Event List

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

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

Filters

Three filters are currently available in the Log Viewer:

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

Identifying Logs from Matches

3:19:30.893 PM FMS Connected: Practice - 1, Field Time: 13/02/06 15:19:37

FRC Driver Station

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

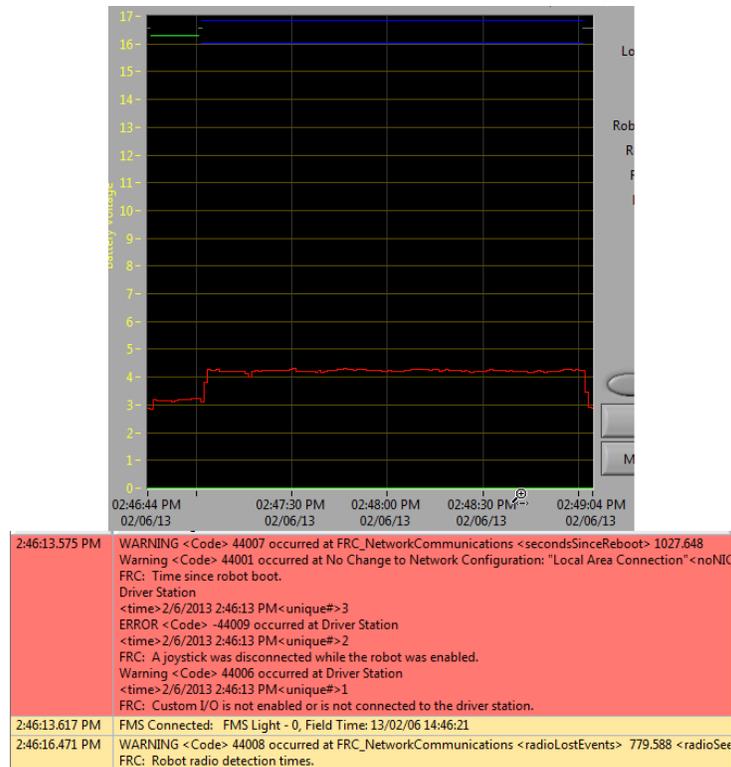
Identifying Common Connection Failures with the Log Viewer

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

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

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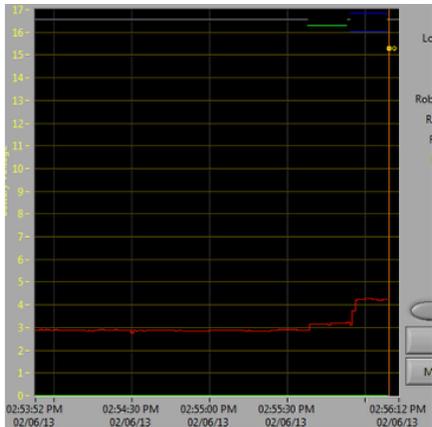
"Normal" Log



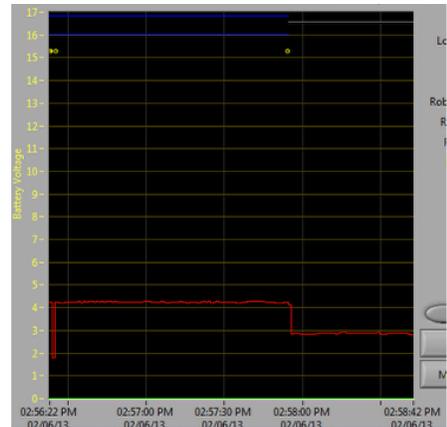
This is an example of a normal match log. The errors and warnings contained in the first box are from when the DS first started and can be ignored. This is confirmed by observing that these events occurred prior to the "FMS Connected:" event. The last event shown can also be ignored, it is also from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

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Disconnected from FMS



2:56:09.237 PM Warning <Code> 44004 occurred at Driver Station
<time>2/6/2013 2:56:08 PM<unique#>13
FRC: The Driver Station has lost communication with the robot.
2:56:11.268 PM Warning <Code> 44002 occurred at Ping Results: link-bad, DS radio(4)-bad, robot radio(1)-bad, cRIO(2)-bad, FMS-bad Driver Station
<time>2/6/2013 2:56:10 PM<unique#>14
FRC: Driver Station ping status has changed.



2:56:22.746 PM WARNING <Code> 44007 occurred at FRC_NetworkCommunications <secondsSinceReboot> 1636.852
Warning <Code> 44002 occurred at Ping Results: link-bad, DS radio(4)-bad, robot radio(1)-GOOD, cRIO(2)-bad, FMS-bad Driver Station
<time>2/6/2013 2:56:22 PM<unique#>15
FRC: Time since robot boot.
2:56:22.789 PM FMS Connected: FMS Light - 0, Field Time: 13/02/06 14:56:30
2:56:22.937 PM Watchdog Expiration: System 8, User 0
2:56:25.038 PM WARNING <Code> 44008 occurred at FRC_NetworkCommunications <radioLostEvents> 1388.131 <radioSeenEvents> 1293.113
FRC: Robot radio detection times
2:57:54.238 PM Watchdog Expiration: System 9, User 0

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

FRC Driver Station

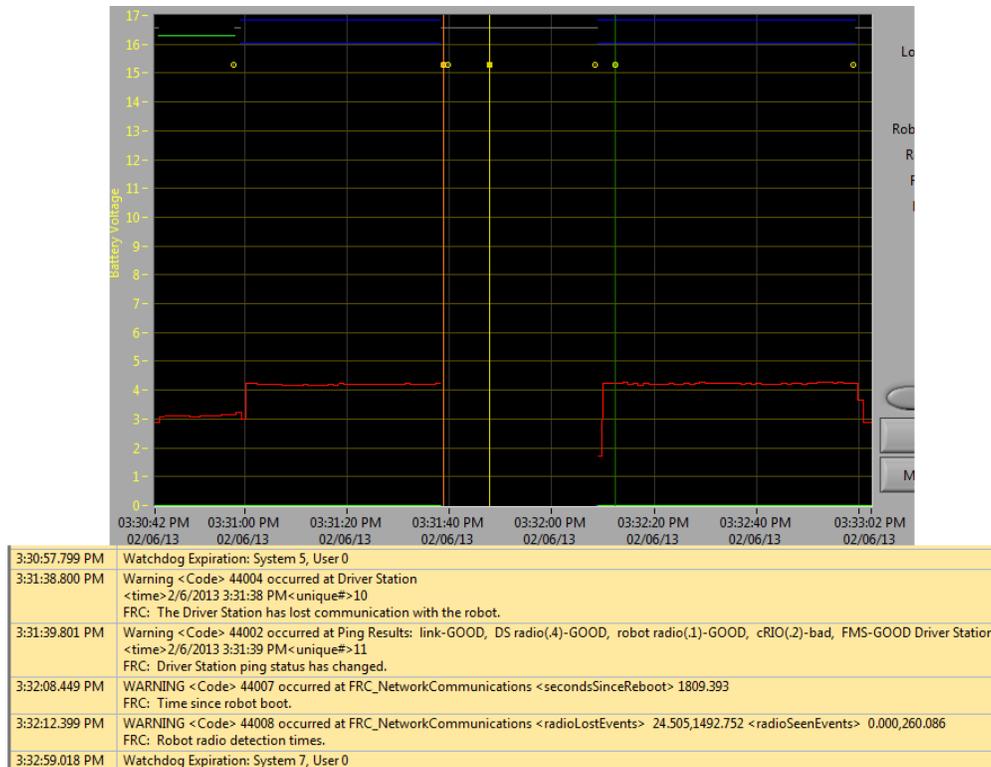
roboRIO Reboot



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

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Ethernet cable issue on robot



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

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Radio reboot



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