FRC Control System 2018 Beta

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Forward Cautionary Note!

- All information based on ***Beta Testing*** done this fall
- We received ***beta*** versions of control system software and documentation
- Near end, docs and software are near final product
- We didn't receive any game info or part legality information!!
- So…..

Be sure to read the game and robot manual after kickoff!

What we directly tested….

- Software:
  - Radio Programming Tool (and new firmware)
  - Updated NI Utilities for RoboRio
  - Updated Driver Station Software
  - C++ Updates to WPILib
  - Java Updates to WPILib
  - New dashboard: “Shuffleboard”
  - CTRE Programming Libraries (“drivers”)
  - Camera Library changes
- Hardware:
  - Nidec Brushless Motor

Items We Followed

- LabVIEW changes
- New motor controller (Victor SPX)
- New 3rd party products (CANifier, Talon Tach, etc)

OM5P: Changes/Fixes for 2018

- OM5P-AN (2016) and OM5P-AC (2017): Both radios are similar in form and function and both SHOULD BE? WILL BE? legal
- OM5P-AC second ethernet port “fixed” (it was a firmware problem)
- Radio now acts as DHCP server while in bridge (competition) mode
  - Radio reserves the address 10.XX.YY.2 for the RoboRIO
  - Less frustration when tethering in pits!
- Boot times remain about 50 seconds
- **All teams urged to upgrade radio firmware at home, before competition!! (Check Before You Bag!)**

Motor Controllers

"Old" but still good!

Color Codes

PWM
CAN Bus
Both!!

Jaguar
TI, VeX
(N/A)

Victor-884/888
VeX
(N/A)

Talon
CTRE
(N/A)

Talon-SRX
CTRE/VeX
($89.99)

Victor-SP
CTRE/VeX
(N/A)

SPARK
REV Robotics
($40 - price dropped!)

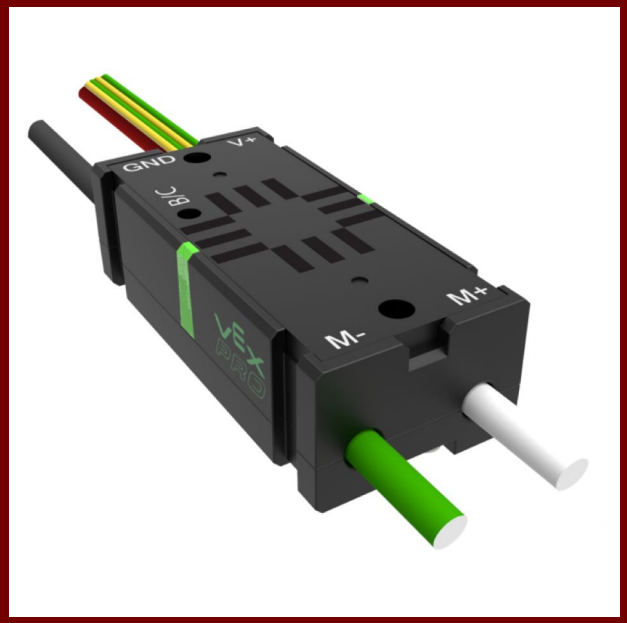
SD540B, SD540C
mindsensors.com
($49)

DMC 60
Digilent
($49.99 - price dropped!)

Motor Controllers
Changes to existing controllers

- Jaguar - rules changes!
  - Still usable, but…
  - Only legal to use PWM this year!
  - CAN software support removed
- Talon-SRX - software overhaul!
  - Only relevant if using CAN-based control
  - Massive rewrite of “driver” software
  - APIs significantly changed
  - Firmware **must** be updated on existing controllers!! Drivers will fail otherwise...

Motor Controllers
New for 2018 (Victor SPX - CTRE/VeX)



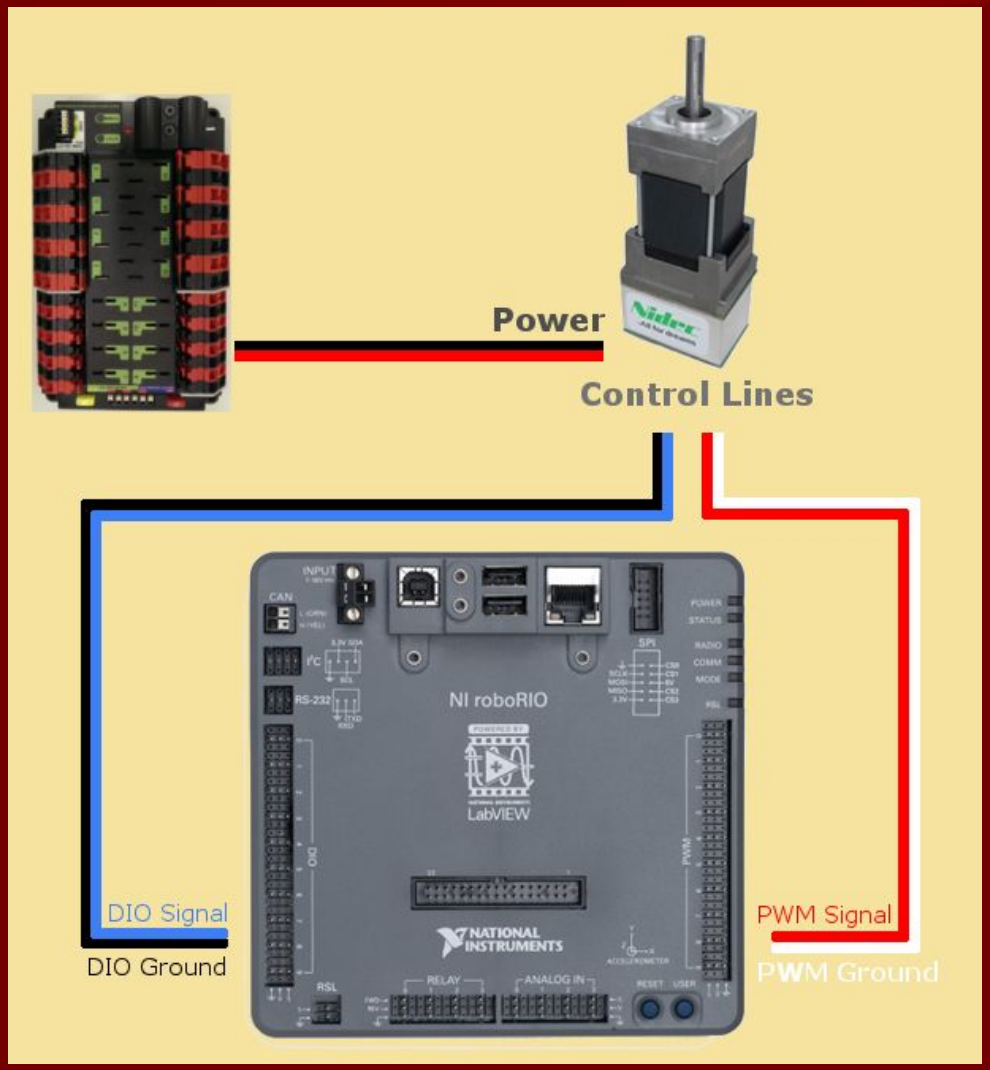
- Successor to Victor-SP
  - Supports PWM and CAN
  - Shorter and wider
  - Lighter - 0.19 lbs
  - Connectorized control lines!
  - Can slave to (follow) a Talon-SRX when used over CAN
- Differences to Talon-SRX:
  - No sensor/limit inputs
  - No current sensors
  - Limited onboard software capabilities
- $49.99

Motor Controllers
New for 2018 (Nidec Dynamo BLDC)

- First Brushless motor
- Integrated motor and motor controller
- Integrated tachometer
- Output shaft same as CIM
- Mounting holes similar to VersaPlanetary's end
- 44 W output
- 1.5 lbs.
- $99.00

Motor Controllers

New for 2018 (Nidec Dynamo BLDC)

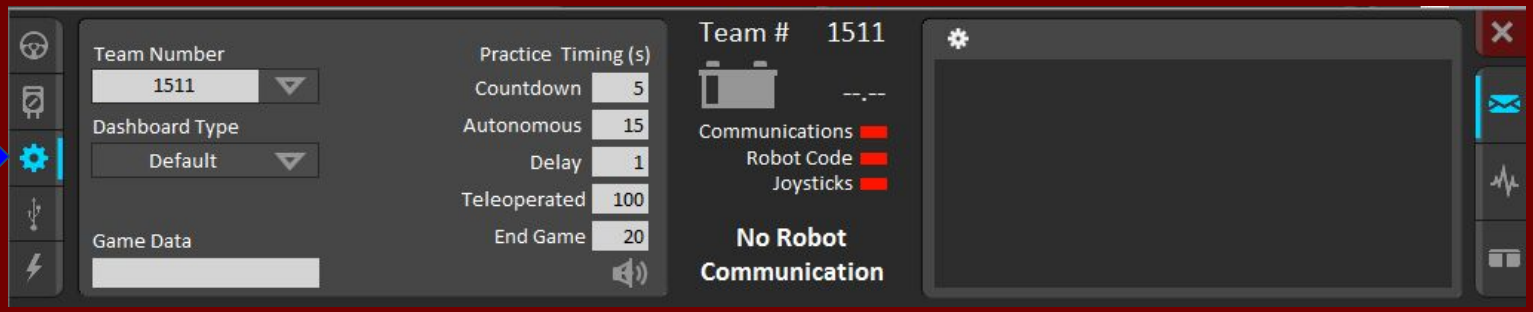


- Power from PD Board
  - Check rules on which breaker (maybe 10A)
- 4 Control lines:
  - DIO generates alternate frequency PWM to control speed
  - PWM lines control enable/disable by cutting sensor power
- Wiring harness included
  - Does not expose tachometer signal

Driver Station Software Changes

- Support for controlling cRIOs removed
  - Protocol selection dropdown is gone, no more "2014" option
  - Install 2014 version of Driver Station to run old robots
- Minor improvements to diagnostic info and interface
- New interface to enter "game specific data"
  - Text box allows entry of arbitrary text
  - Used to simulate data sent by FMS during competition
  - Data is shared with your robot and accessible from within your robot code

Select "Setup"



Enter data to test with here

WPILib Updates: C++ & Java

- New main Robot base class - TimedRobot
  - Starts main loop iteration based on user-adjustable period (default of 0.05 seconds), regardless of DS data arrival
  - Command-based programming now uses this in its templates
  - Existing options remain:
    - IterativeRobot: Main loop iterations timed to DS data packet arrival
    - SampleRobot: No main loop timing - do it yourself
- Some class library name changes
  - TalonSRX class renamed to PWMTalonSRX
  - CANTalon (in CTRE drivers) renamed to TalonSRX

WPILib Updates: C++ & Java

- Deployment accelerated by checked all possible RoboRIO addresses at once - other compiling optimizations
- RobotDrive removed and split into distinct classes for different drive types:
  - DifferentialDrive - used for Tank and West Coast style drives
  - MechanumDrive
  - KilloughDrive
- CommandBased addition: SubSystem now contains periodic() function, called every time the scheduler is called
- "cscore" OpenCV-based camera and imaging classes (CameraServer and friends) received a number of bug fixes
  - nivision compatibility support library no longer supported

WPILib Updates: C++ & Java

- New API to access "game specific data"
  - Sent by FMS to your DS during competition play
  - Entered into DS manually during practice at home
  - Has roughly a 4 second delay getting to robot
  - Accessed via new method in DriverStation object

c++: *std::string gData = DriverStation::GetInstance().GetGameSpecificMessage();*
Java: *String gameData = DriverStation.getInstance().getGameSpecificMessage();*

- New methods to access match information in DriverStation:
  - getEventName
  - getMatchNumber
  - getReplayNumber
  - getMatchType
  - Joins existing match info methods: getMatchTime, getAlliance and getLocation

ShuffleDashboard

- Replacement for SmartDashboard (Original still in Plug-In download)
- Uses JavaFX (native to Java 8)
- Cleaner look
- Objects snap into a grid
- New, so fewer plug-in add-on options

Device Support Libraries

- Modular support for 3rd party devices (was new in 2017)
  - Some device specific implementations now only available via separate installer/package
  - Install **after** obtaining FRC plug-ins for Eclipse on ***all*** programming laptops
  - ***Old libraries from 2017 on your system may cause problems when building your robot code this year - may need to manually delete the old libraries!***

- Some device support library examples:
  - Talon SRX CAN driver
    - CTRE Toolsuite, http://www.ctr-electronics.com
  - mindsensors.com SD540C CAN driver
    - mindsensors FRC library, http://mindsensors.com
  - Kauai Labs navX
    - https://www.pdocs.kauailabs.com/navx-mxp/software/roborio-libraries/

CTRE Software Libraries

- Device support libraries for CTRE devices unified into one package named "Phoenix Framework"
  - TalonSRX for CAN-based communication
  - CANifier
  - Pigeon IMU
- API has changed drastically from 2017!
  - Classes renamed and reorganized
  - Fully restructured and method signatures changed entirely
- Documentation significantly lacking compared to 2017 quality (as of Jan 3, likely to improve)
  - https://github.com/CrossTheRoadElec/Phoenix-Documentation
  - Has beginnings of a migration guide in place
- CTRE "Lifeboat" utility included in installer
  - 2018 roboRio FRC image lacks CAN device support in web interface
  - **Must use this tool after imaging roboRio for 2018** to see CAN devices on roboRio web interface!
  - Necessary to set CAN IDs of PCM, PDP, Talon-SRX, etc.

Software: System Requirements

- Some software components of the control system will function on non-Windows computers
  - Driver station software and most NI-provided tools require Windows!
  - Radio configuration utility requires Windows
- Windows 7, 8, 8.1, and 10 have been tested
  - XP will **not** work!
- RoboRIO web interface requires Microsoft Silverlight
  - Web interface access is a must for basic configuration of roboRIO (firmware loading, device setup, diagnostic)
  - Silverlight plug-in support was **removed** in recent versions of Firefox (but not Firefox ESR)
  - A non-Chrome/non-Edge browser that supports SilverLight is required (Internet Explorer, older Firefox ESR versions)
- Only Java 8 is supported! Java 9 is ***not*** supported!!

Software Installation Packaging

- Installation Steps based on Programming Language
- LabVIEW teams:
  - Install LabVIEW from Kit DVD or Internet Download
  - Install NI FRC Update Suite
- C++ teams:
  - Download and install C++ "Toolchain"
  - Download and install Java JDK from Oracle (not a typo!)
  - Download and install Eclipse IDE
  - Install FRC Plug-ins into Eclipse
  - Install any device support libraries
  - Install NI FRC Update Suite
  - Installing anything from LabVIEW DVD is not necessary this year
- Java teams - Same as C++, but without C++ toolchain install!
- **All teams:** Download and install radio configuration utility!

- All software downloads are linked from control system documentation:
  http://wpilib.screenstepslive.com

Software Installation Packaging

- Installing for Driver Station only? (no programming)
  - Install NI Update Suite
  - Done!
- Keeping up to date:
  - NI Updates provide updated tools and RoboRIO images
  - C++ and Java plug-ins updated directly from Eclipse "Check for Updates" feature
  - **Whenever you update either** roboRIO Image or C++/Java plug-ins, **be sure the versions are meant to work together**
  - Easy rule: if you update one, check updates for the other!
  - **Keep an eye on device support libraries you use and keep them updated!**

Imaging RoboRIO

- Imaging process similar to past years, with some improvements!
- After NI Update Suite installed….
  - Connect to roboRIO using USB
  - Use the roboRIO imaging tool
  - Shortcut to this tool now created on desktop!
  - Now includes a progress bar!
- If you want CAN support in roboRIO web interface: Install CTRE Phoenix, then use LifeBoat to upgrade roboRIO web interface
- Java teams:
  - FRC is utilizing a new Java Virtual Machine on roboRIO in 2018
  - Now packaged inside FRC Eclipse plug-ins and deployed to roboRIO when deploying your code!
  - No longer necessary to do a separate Java install to roboRIO!

2018 Quick Start

1. Read the documentation!! http://wpilib.screenstepslive.com
2. Read the manual for legality of parts!! http://firstinspires.org
3. Setup programming computer (prior slides)
4. Image roboRIO (prior slides)
5. Update firmware and setup robot radio using the 2018 radio tool!
6. If using CAN controllers (Talon-SRX, Victor-SPX, SD340C) install driver support libraries and use Lifeboat to "upgrade" roboRIO
7. Deploy a simple program from one of the examples
8. Run Driver Station software and setup team #
9. Verify basic functionality

Download URL:

http://penfieldrobotics.com/controlsystem-2018.pdf