



# Control Hub Pilot Rules and Resources

Revision 1.1: 11.11.2019

Revision History		
Revision	Date	Description
1	9/9/2019	Initial Release
1.1	11/11/2019	Added rule <CH04>

## REV Control Hub Pilot Regions

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Only Teams in the below regions are eligible to participate in the Control Hub Pilot:

- New Hampshire
- New Jersey
- Texas (Dallas Region only)
- Los Angeles, California
- United Kingdom
- Romania

Teams participating in the pilot are able to use the REV Control Hub only when competing within these regions, and at the World Championship. If a team participating in the pilot chooses to compete outside of the above listed regions, they must swap out the REV Control Hub to either the REV Expansion Hub or Modern Robotics Core Control modules.

## REV Control Hub Resources

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### **Forums**

Teams Participating in the Control Hub Pilot have a separate forum to ask technical questions and receive official answers. This forum should be used for all questions related to the Control Hub. All other questions such as general robot rules and game specific questions should be asked through the Official Q&A Forum.

- Control Hub Pilot Forum - <https://ftcforum.usfirst.org/forum/control-hub-pilot-forum>
- Official Q&A Forum - <https://ftcforum.usfirst.org/forum/first-tech-challenge-skystone-presented-by-qualcomm-game-q-a-forum>

If you have trouble accessing either forum, please email [firsttechchallengeteams@firstinspires.org](mailto:firsttechchallengeteams@firstinspires.org)

### **FAQ**

Teams can access the *FIRST* Tech Challenge blog “Launching a Control Hub Pilot” which has some great FAQ’s to reference: <http://firsttechchallenge.blogspot.com/2019/06/launching-control-hub-pilot.html>

### Online Resources

- Managing a Control Hub: <https://github.com/FIRST-Tech-Challenge/skystone/wiki/Managing-a-Control-Hub>
- FTC Control System: <https://github.com/FIRST-Tech-Challenge/skystone/wiki>

## Game Manual Addendum

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Teams participating in the pilot must follow all of the rules listed in both the Game Manual Part 1 and Game Manual Part 2. The only exceptions to this are the rules listed below. The highlighted text applies only to teams participating in the pilot:

**<RE05> Robot Power** - Robot power is constrained by the following:

- a. Allowed electronic devices may only be powered by power ports on the *Core Power Distribution Module*, *REV Expansion Hub*, or **REV Control Hub** except as follows:
  - i. The *Core Power Distribution Module*, *REV Expansion Hub*, or **REV Control Hub** is powered by the *Robot* main battery.
  - ii. *REV SPARK Mini Motor Controllers* are powered by the *Robot* main battery.
  - iii. Allowed sensors connected to the *Core Device Interface Module*, *REV Expansion Hub*, or **REV Control Hub**.
  - iv. Light sources per <RE12>.
  - v. Video cameras per <RE13>.
- b. The *Robot Controller* Android phone device must be powered by its own internal battery or by the built-in charging feature of the *REV Expansion Hub*; external power is not allowed.

**<RE07> Control Module Quantities** - Robot control module quantities are constrained as follows:

- a. Exactly one (1) *Core Power Distribution Module* is required for Teams using any *Modern Robotics Core Control Modules*.
- b. No more than two (2) *Core Device Interface Modules* are allowed.
- c. Any quantity of *Core Motor*, or *Core Servo Controllers* are allowed.
- d. Any quantity of *REV Servo Power Modules* is allowed.
- e. No more than two (2) *REV Expansion Hubs* are allowed.
  - a. For Teams participating in the **REV Control Hub** pilot, no more than one (1) **REV Expansion Hub** may be used while using the **REV Control Hub**.
- f. Any quantity of *REV SPARK Mini Motor Controllers* are allowed.
- ~~g. The **REV Control Hub** is not allowed.~~

- h. The Core Legacy Module is not allowed.
- i. No more than one (1) *REV Control Hub* is allowed.

**<RE08> Motor and Servo Controllers** - Motor and Servo Controllers are allowed in the following configuration: *Core Motor Controllers*, *Core Servo Controllers*, *REV Expansion Hub*, *REV Control Hub*, *REV Servo Power Module*, and *REV SPARK Mini Motor Controllers* in any combination.

**<RE10> Servos** – A maximum of twelve (12) servos are allowed. Any servo that is compatible with the attached servo controller is allowed. Servos may only be controlled and powered by an allowed Servo Controller, *REV Expansion Hub*, *REV Control Hub*, or *REV Servo Power Module* (when used with an allowed Servo Controller or *REV Expansion Hub*). Servos may be rotary or linear but are limited to 6V or less and must have the three-wire servo connector.

Teams should be prepared during *Robot* inspection to show documentation confirming that the servos individually and together on the same servo controller do not exceed the manufacturer specifications for the controller.

The VEX EDR 393 motor is considered a servo and it is subject to the maximum, an overall total of twelve (12) servos. *Core Servo Controllers* may control up to two (2) VEX EDR 393 Motors per module. A VEX Motor Controller 29 must be used between a servo module and each VEX EDR 393 motor. *REV Expansion Hubs* or *REV Control Hubs* must use a *REV Servo Power Module* between the *REV Expansion Hub* and the VEX Motor Controller 29. A maximum of two (2) VEX EDR 393 Motors may be controlled/powered per *REV Servo Power Module*.

**<RE11> Sensors** - Sensors are subject to the following constraints:

- a. Compatible sensors from any manufacturer may be connected to the *Core Device Interface Module*, *REV Expansion Hub*, or *REV Control Hub*.
- b. Compatible sensors from any manufacturer may be connected to the *Logic Level Converter and/or the I<sup>2</sup>C Sensor Adapter Cable*. Refer to Rule <RE14.k> for details on the use of *Logic Level Converter* and the *I<sup>2</sup>C Sensor Adapter Cable*.
- c. Passive electronics may be used as recommended by sensor manufacturers at the interfaces to the sensors.
- d. Voltage sensors are allowed; except on an output port of a motor or servo controller.
- e. Current sensors are allowed; except on an output port of a motor or servo controller.
- f. Simple I<sup>2</sup>C multiplexers are allowed and they may only be connected to and powered from the I<sup>2</sup>C connections available on the *Core Device Interface Module*, *REV Expansion Hub*, or *REV Control Hub*.
- g. Voltage and/or current sensors are also allowed to connect between the battery pack and the *REV Expansion Hub*, *REV Control Hub*, or *Core Power Distribution Module*.

**<RE12> Light Sources** - Functional and/or decorative light sources (including LEDs) are allowed with the following constraints:

- a. Focused or directed light sources (for example: lasers and mirrors) are not allowed

except for the REV Robotics 2m Distance sensor (REV-31-1505).

- b. Light-source control by compatible ports on the *REV Expansion Hub*, *REV Control Hub*, and *Modern Robotics Core Control Modules* is allowed.
- c. Commercial Off the Shelf (COTS) interface modules (without user programmable microprocessors) are allowed between the light source and the components listed in <RE12>b.
- d. The only approved power sources for lights are as follows:
  - i. Internal (as supplied by the Commercial Off the Shelf manufacturer) battery pack or battery holder.
  - ii. Power ports on the *Core Power Distribution Module*.
  - iii. Motor-control ports on the *Core Motor Controller Module*.
  - iv. *REV Expansion Hub* or *REV Control Hub* Motor-control ports, spare XT30 ports, 5V auxiliary power ports, and I2C sensor ports.

#### <RE13> Video Cameras

- a. Self-contained video recording devices (GoPro or similar) are allowed providing they are used only for non-functional post- *Match* viewing and the wireless capability is turned off. Approved self-contained video cameras must be powered by an internal battery (as supplied by the manufacturer).
- b. *UVC Compatible Cameras* are allowed for computer vision-related tasks. It is recommended that *UVC Compatible Cameras* be connected to a phone *Robot Controller* through a powered USB hub that is in turn connected to the *Robot Controller* through an OTG adapter.

*Teams using the REV Control Hub Robot Controller can connect the UVC camera directly to the REV Control Hub without a powered hub.*

#### <RE14> Robot Wiring - Robot wiring is constrained as follows:

- a. USB Surge Protectors connected to USB cables are allowed.
- b. Ferrite chokes (beads) on wires and cables are allowed.
- c. A *Mini USB to OTG (On-The-Go) Micro Cable* or any combination of a *Mini USB cable*, a *USB hub*, and an *OTG Micro Adapter* may be used to connect the *Robot Controller* Android device (*phone or REV Control Hub*) to the *Robot* electronics. Note that the *OTG Micro Adapter* may be integrated into the USB hub. These devices may connect to the *Robot* electronics in the following ways:
  - i. Built-in USB input port of the *Core Power Distribution Module*, or
  - ii. Built-in USB input port of the *REV Expansion Hub*, or
  - iii. A USB hub that connects to the built-in USB input port of the *REV Expansion Hub*. If a powered hub is used, it must draw its energy from either

- i. A commercial USB battery pack, or
    - ii. A 5V auxiliary power port on a *REV Expansion Hub* or *REV Control Hub*.
  - d. Non-powered USB hubs connected to the *Core Power Distribution Module* are allowed.
  - e. Anderson Powerpole, and similar crimp or quick-connect style connectors are required to connect downstream electronics with the *Core Power Distribution Module* and are recommended for joining electrical wires throughout the *Robot*. Power distribution splitters are recommended where appropriate to reduce wiring congestion. All connectors and distribution splitters should be appropriately insulated.
  - f. Installed connectors (such as battery-pack connectors, battery charger connectors, and *Core Power Distribution Module* power input connectors) may be replaced with Anderson Powerpole or any compatible connector.
  - g. Power and motor control wires must use consistent color-coding with different colors used for the positive (red, white, brown, or black with a stripe) and negative/common (black or blue) wires.
  - h. Wire and cable management products of any type are permitted (for example, cable ties, cord clips, sleeving, etc.).
  - i. Wire insulation materials of any type are permitted when used to insulate electrical wires or secure motor control wires to motors (for example, electrical tape, heat shrink, etc.).
  - j. Power, motor control, servo, encoder, and sensor wires and their connectors may be extended, modified, custom made, or COTS subject to the following constraints:
    - i. Power wires are 18 AWG or larger.
    - ii. Motor control wires as follows:
      - ii 22 AWG or larger for TETRIX Max 12V DC motors and REV Robotics Core Hex (REV-41-1300) 12V DC motors
      - ii 18 AWG or larger for all other 12V DC motors
    - iii. PWM (servo) wires are 20 AWG or 22 AWG.
    - iv. Sensor wires should be the same size or larger than the original wiring.
- Teams should be prepared during Robot inspection to show documentation confirming the wire gauges used; particularly for multi-conductor cables.*
- k. *Logic Level Converters* – *Logic Level Converters* that are used to connect a *REV Expansion Hub* or *REV Control Hub* to a 5V-compatible I<sup>2</sup>C sensor or a 5V-compatible digital sensor are allowed. Exactly one *Logic Level Converter* per I<sup>2</sup>C device and one *Logic Level Converter* per digital sensor are allowed. A *Logic Level Converter* should only draw power from the *REV Expansion Hub* or *REV Control Hub*.
  - l. Electrically grounding the Control System electronics to the frame of the *Robot* is only

permitted using a *FIRST*-approved, commercially manufactured Resistive Grounding Strap. The only Resistive Grounding Strap approved for use is the REV Robotics Resistive Grounding Strap (REV-31-1269). *Teams* that have electronics with Powerpole-style connectors may also use the REV Robotics Anderson Powerpole to XT30 Adapter (REV-31-1385) in conjunction with the REV Robotics Resistive Grounding Strap. No other grounding straps or adapters are permitted. For additional details on installation of the grounding strap or adapter, please see the [Robot Wiring Guide](#).

**<RE17> Additional Electronics** – Electronic devices that are not specifically addressed in the preceding rules are not allowed. A partial list of electronics that are not allowed includes: Arduino boards, Raspberry Pi, relays, and custom circuits.

#### 7.3.4 Robot Software Rules

**<RS01> Android Device Names** - Each *Team* MUST “name” their *Robot Controller* (phone or *REV Control Hub*) with their official *FIRST* Tech Challenge *Team* number and –RC (for example, “12345-RC”). Each *Team* MUST “name” their *Driver Station* with their official *Team* number and –DS (for example, 12345-DS). *Teams* with more than one *Driver Station* or *Robot Controller* Android device must name these devices with the *Team* number followed by a hyphen then a letter designation beginning with “A” (for example, “12345-A-RC”, “12345-B-RC”).

**<RS02> Recommended Programming Language** - *Java* and the Blocks Development Tool are the recommended programming languages for the *FIRST* Tech Challenge. The minimum allowed app version number is 5.2. Programming must be done using one of the following applications:

- a. FTC Blocks Development tool – a visual, blocks-based programming tool hosted by the *Robot Controller*.
- b. Android Studio – a text-based integrated development environment.
- c. Java Native Interface (JNI) & Android Native Development Kit (NDK) – *Teams* can incorporate native code libraries into their apps using the JNI framework and the Android NDK.
- d. FTC OnBot Java Programming tool – a text-based integrated development environment hosted by the *Robot Controller*.

If mandatory updates are announced by *FIRST* later in the season, *Teams* must install them before the time of competition. Additionally, beta versions of the software are allowed at official tournaments.

**<RS03> Allowed Android Operating Systems** - The only allowed operating systems for the *Robot Controller* and *Driver Station* Android devices are:

- a. ZTE Speed: 4.4 or higher (Kit Kat)
- b. Motorola Moto E4, Motorola Moto E5, Motorola Moto G4 Play, Motorola Moto G5, Motorola Moto G5 Plus: 7.0 or higher (Nougat)
- c. Motorola Moto G 2<sup>nd</sup> Generation, Motorola Moto G 3<sup>rd</sup> Generation, Google Nexus 5, Samsung Galaxy S5: 6.0 or higher (Marshmallow)

d. **REV Control Hub: Operating system version 1.0 or higher**

**IMPORTANT:** Rules <RS02> or <RS03> do not require that *Teams* upgrade to the latest version of the software. A mandatory upgrade would only be required if *FIRST* determined there was a critical software fix that must be adopted by *Teams*. Mandatory upgrades will be communicated in the following ways:

- Via [Team Blast](#) – The mandatory upgrade and version number will be communicated to *Teams* on the *Team Blast*, which will also show the date the required upgrade must be made.
- Online – the minimally required software will be listed on our [Technology Resources](#) page, with the date *Teams* are required to make the mandatory software upgrade.
- Forum – The minimally required software will be listed in the [Technology Forum](#) page, with the date *Teams* are required to make the mandatory software upgrade.

Templates for all programming choices are available through the links located at <http://www.firstinspires.org/node/5181>.

**<RS04> Autonomous to Driver-Controlled Transition** - *Teams* that expect to operate their *Robot* during the Autonomous period must demonstrate during Field Inspection the *Driver Station* switches the *Robot Controller* (**phone or REV Control Hub**) between Autonomous mode and Driver-Controlled mode.

**<RS05> Robot Controller App** - The *Robot Controller* (**phone or REV Control Hub**) must have a designated “FTC *Robot Controller*” app that is the default application for the *Core Robot modules* (*Servo, Motor, and Device Interface*) or the *REV Expansion Hub*. The *Robot Controller* App must not be installed on the *Driver Station Android Device*.

**<RS06> Driver Station App** – *Teams* must install the official “FTC *Driver Station*” app onto their *Driver Station Android Device* and use this app to control their *Robot* during a *Match*. The *Driver Station* software version number must match the version number of the *Robot Controller* app. The *Driver Station* App must not be installed on the *Robot Controller* (**phone or REV Control Hub**) *Android Device*.

**<RS07> Android Device Operating System Settings** - The *Robot Controller* and *Driver Station* must be set to:

- a) Airplane mode must be turned on (**does not apply for Teams using the REV Control Hub**)
- b) Bluetooth must be turned off
- c) Wi-Fi must be turned on.

**<RS08> Wi-Fi Direct Channel Changing App** - The *Robot Controller* must have the *FIRST* Tech Challenge “Wi-Fi Direct Channel Changing” App installed (ZTE Speed ONLY).

**<RS09> Software Modification** - *Teams* are not allowed to modify the *FIRST* Tech Challenge *Driver Station* App in any fashion. When using the *Robot Controller* SDK, *Teams* are not allowed to replace or modify the portions of the SDK which are distributed as binary .AAR files.

**<RS10> Driver Station Communication** - Communication between the *Robot* and *Driver Station* is only allowed via the *Robot Controller* and *Driver Station* applications.

Communication between the *Robot Controller* and the *Driver Station* is limited to the unmodified mechanisms provided by the official *FIRST* Tech Challenge (FTC) software, which consists of the official FTC Software Development Kit (SDK), the FTC *Robot Controller* app, and the FTC *Driver Station* app. *Teams* are not permitted to stream audio, video or other data using third-party software or modified versions of the FTC software. *Teams* may only use the unmodified telemetry feature included with the FTC software to transfer additional data between the *Robot Controller* and the *Driver Station*. Software that is preinstalled by an approved phone's manufacturer and cannot be disabled is exempt from this constraint.

During a *Match*, a *Team's Robot Controller* and a *Team's Driver Station* are not allowed to be connected wirelessly to any other device besides each other.

## Control Hub Specific Rules

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<CH01> *Teams* using the *REV Control Hub* as the *Robot Controller* cannot add an Android phone as a secondary *Robot Controller* on their *Robot*.

<CH02> The *REV Control Hub* must be used as the *Robot Controller* as part of the pilot. *Teams* cannot switch the *Robot Controller* off on the *REV Control Hub*.

<CH03> *REV Control Hub* pilot *Teams* are permitted to use an external HDMI monitor before or after a match to configure or debug their *REV Control Hub*. However, all monitors must be removed before a match begins. An external HDMI monitor **may not** be connected to a *REV Control Hub* during a match.

<CH04> *REV Control Hub* pilot *Teams* must change the factory default password on their *REV Control Hub* prior to the start of any competition.