

Playbook Module

Introduction to the Drone Flight Controller - Part 1

Level: Beginner

Objective: Learn how to use the beginner level flight control screens and functions in the Q Ground Control App

Learning Objectives:

- Learn how to use the flight controller
- Learn the beginner level modes/commands

1. Overview

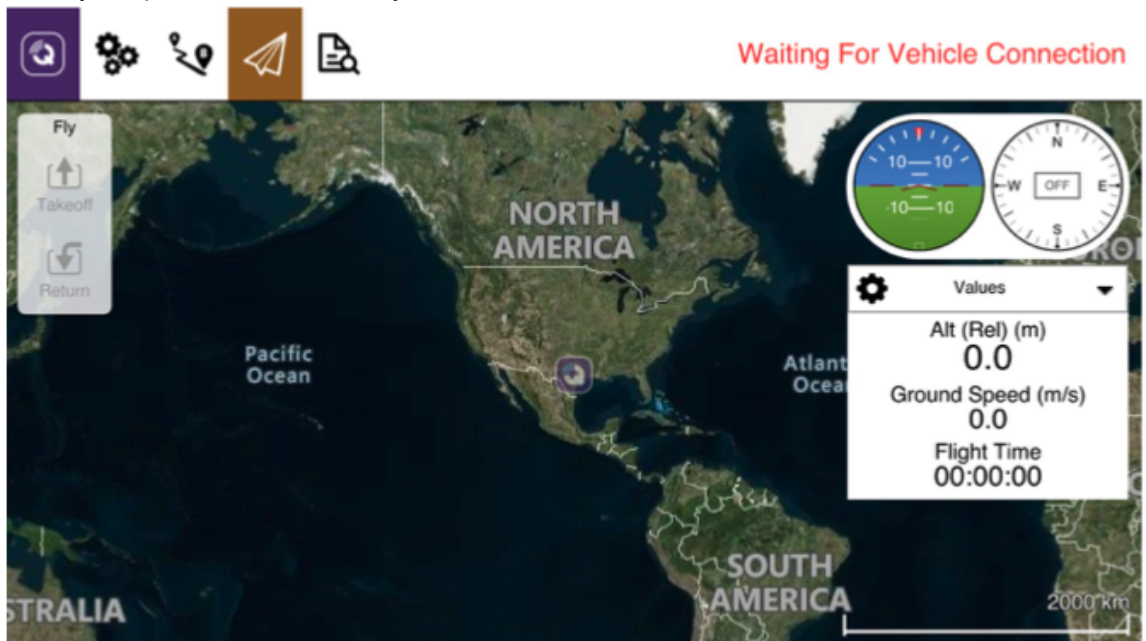
- a. In order to use the Flight Controller module, you must be using an iOS or Android-based smartphone (or tablet with a built-in cellular capability).
- b. QGroundControl is a publicly shared software package for flying drones. The QGroundControl users guide is located at: <https://docs.qgroundcontrol.com/en/>. The BSA Drone uses a quadcopter airframe, the PX4 firmware and the PixHawk FMU.

2. Modes available for beginners, intermediate, and advanced

Flight Controller Modes	Beginner	Intermediate	Advanced/Expert
Fly View	Arm/Disarm, Takeoff/Land, RTL, Change Altitude, Go to location, Orbit location, Pause, Display/record video	Beginner + Fly Missions	All
Plan View	X	Mission Planning	All
Vehicle Setup	Firmware load, Use pre-set configuration	Firmware load, Calibration only: Radio, Sensors Power (Battery) setup, Motor setup, Tuning - Basic tuning only, Camera Setup, Joystick calibration/configuration only	All
Settings View	General app settings for units, miscellaneous only	All General, Offline maps	All
Analyze View	Log Download	Log Download	All
App Menus	X	X	All

3. Startup sequence

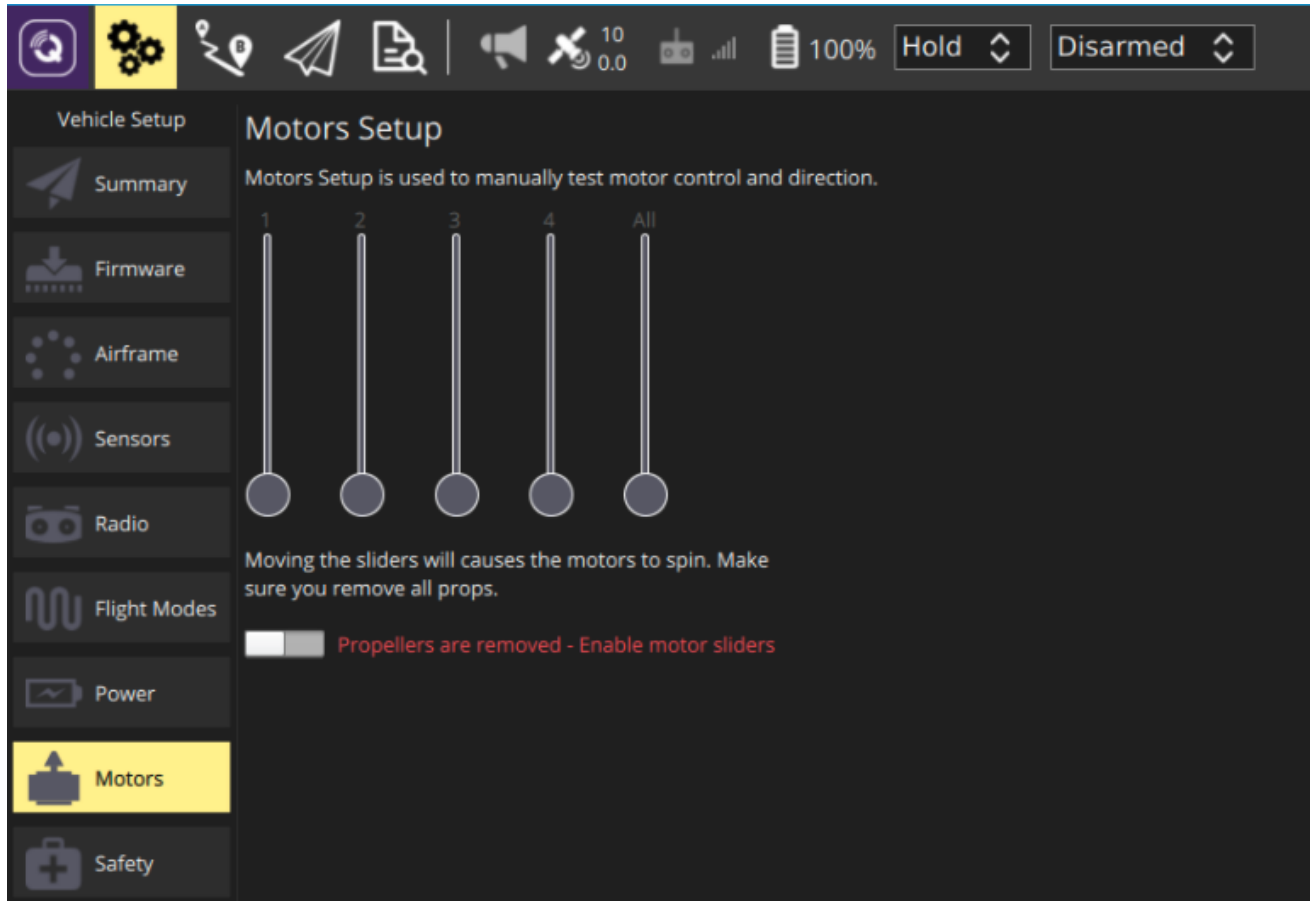
- a. **WARNING: If you are with other people who are also connecting to their drones, make sure you each do this a minute or so apart so that your controller does not get confused and connect to the wrong drone!**
- b. Turn your RC Controller on and confirm it is fully charged.
- c. Remove the rear-bottom body plate and Insert your aircraft battery into the Battery Bay of the drone. Make sure the wires are going through the hole in the plate and replace the rubber bands.
- d. Connect the battery plug to the Power Distribution board plug. This turns on the drone.
- e. Wait until you have a green GPS symbol - indicating that the GPS has gotten locked to enough satellites.
- f. Turn your drone on using the ARM button located on the top of the drone.
- g. When you open QGroundControl you will see this screen



- h. You will first have to connect to your drone's unique Wi-Fi Service Set Identifier (SSID). For both iPhone and Android, the WiFi name is called **ArduPilot** and the password is **ardupilot** all lowercase.
- i. Once connected, the drone's GPS receiver will need to get a good GPS lock-on.
- j. Once you have done that and the Drone has done its auto checks you are ready to check your motor rotation and then calibrate the drone.

5. Motor Rotation Check

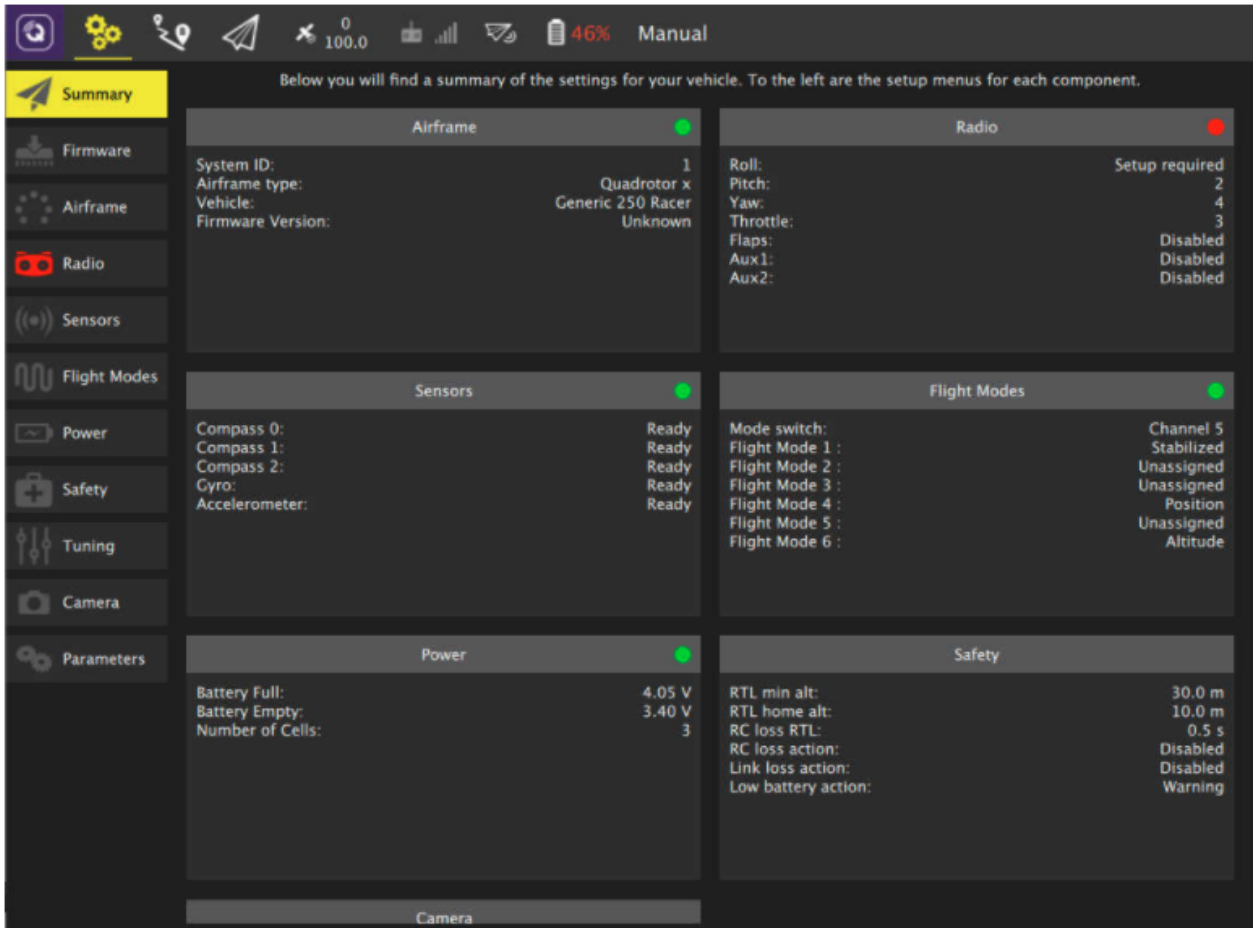
- Before you calibrate and fly, you want to verify that you have the motors wired correctly for clockwise and counterclockwise rotation as described in the assembly videos.
- First, remove the propellers and place a small piece of tape on the top shaft of each motor. This will make it easy to see which direction the motors are turning.
- Use the arm button on your drone to arm it, then use the arm/disarm slider on your QGC screen to arm the drone.
- Click on the **Setup** icon on the upper right, then select the **Motors** button on the left.



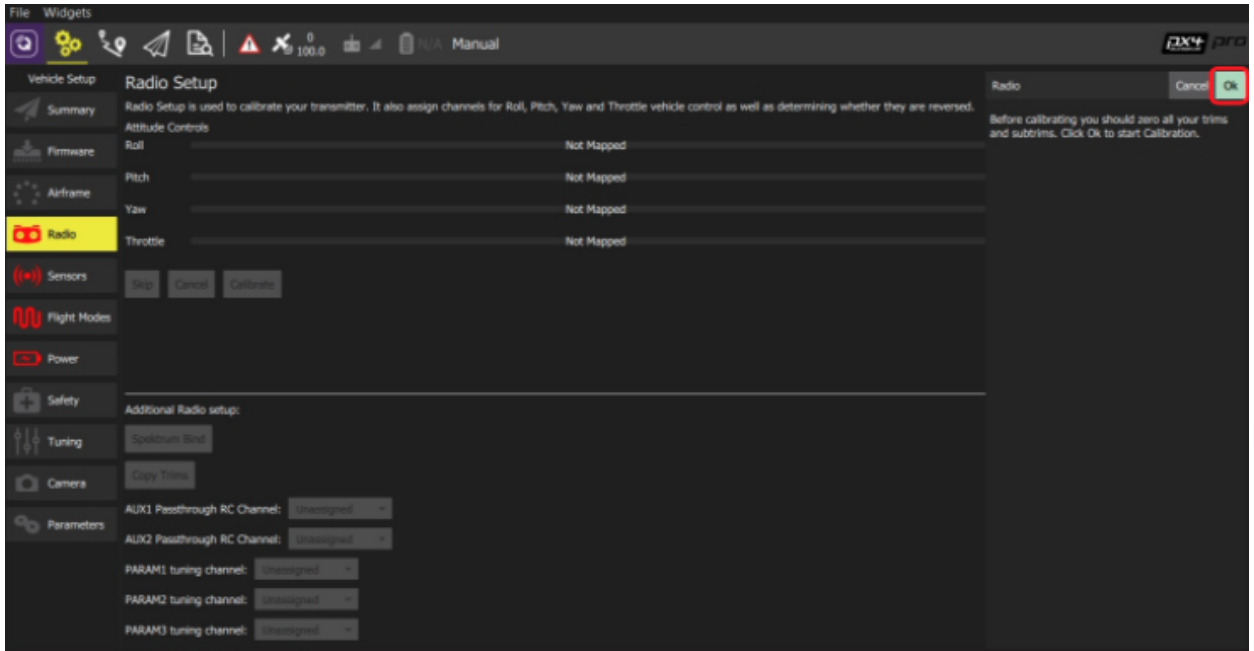
- Slide the switch to enable motor sliders (labeled: Propellers are removed - Enable motor sliders).
- Adjust the individual sliders to spin the motors and confirm they spin in the correct direction and the number of the slider matches the arm number.

7. Drone Calibration

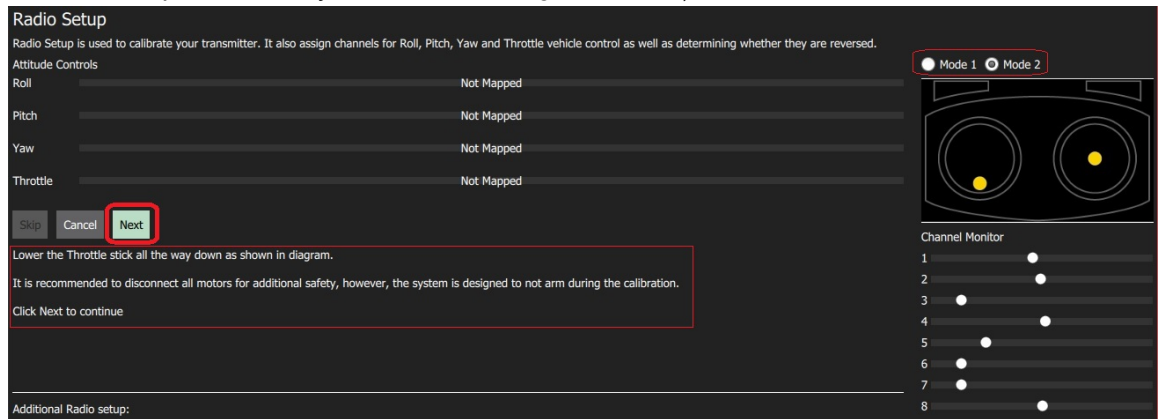
- a. There are 4 calibration procedures you will be using.
- b. Press the **Setup** icon on the upper left of the screen. This will display the Summary Screen.



- c. **RC Controller Joystick Calibration:** This only needs to be done when you first build your drone or if you see a message requiring the calibration to be done again.
 - Remove the propellers from your drone.
 - Turn on your drone and RC controller
 - Select the **Radio** icon on the left of the screen



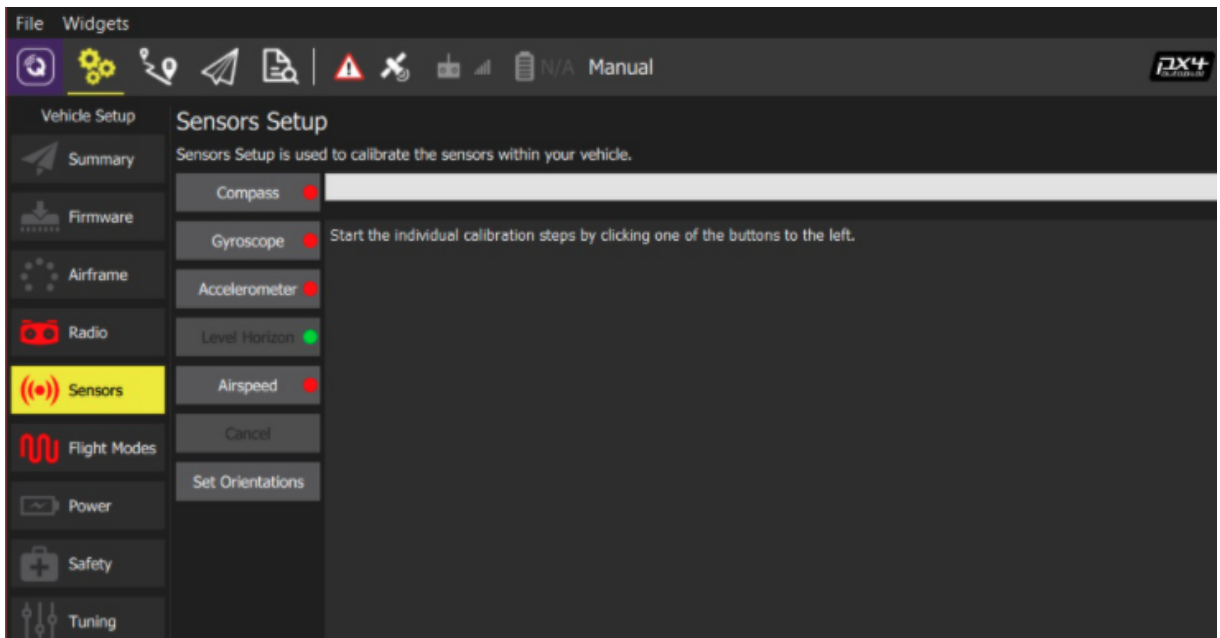
- Press the **OK** icon on the far right/top of the screen.
- Verify that the Mode on the right is set to Mode 2. (this ensures that QGroundControl displays the correct stick positions for you to follow during calibration).



- Move the sticks to the positions indicated in the text (and on the transmitter image). Press **Next** when the sticks are in position. Repeat for all positions.
- When prompted, DO NOT calibrate the other switches on your controller.
- Press **Next** to save the settings.
- Radio calibration is demonstrated in the [PX4 setup video here](#) (youtube)

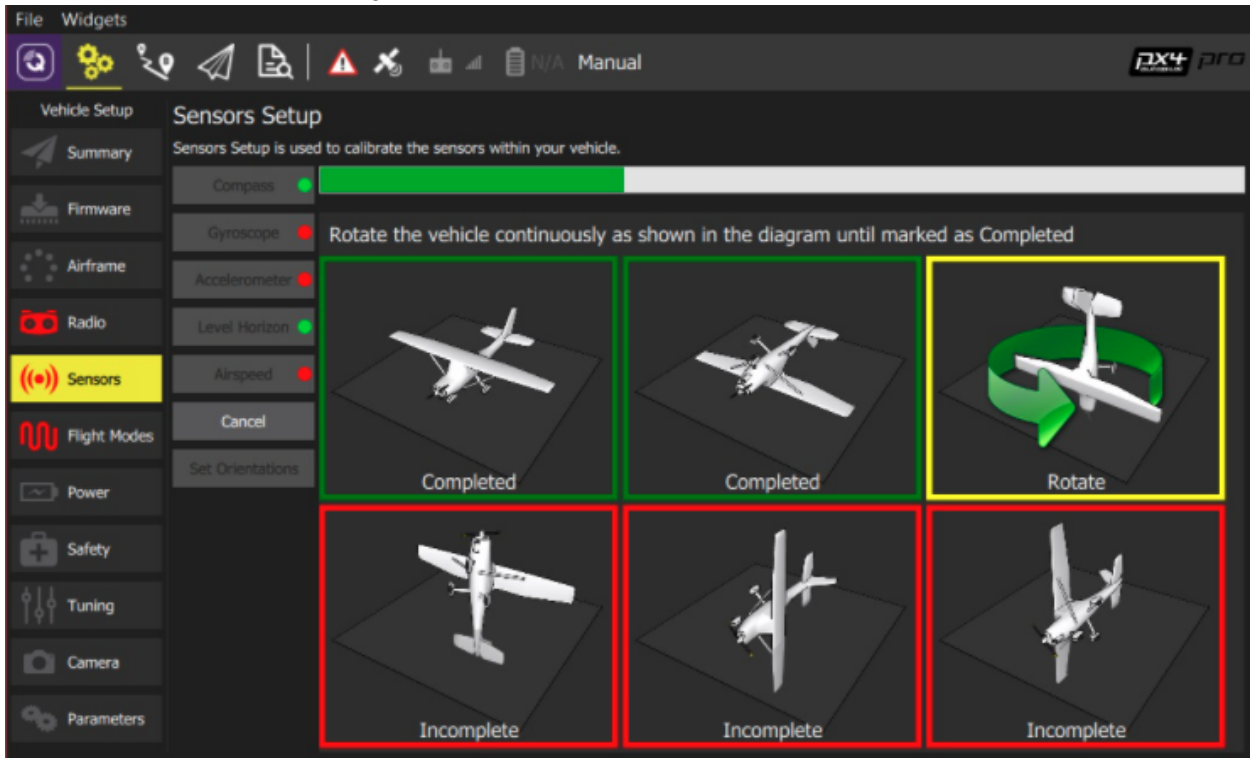
d. **Compass, Gyroscope, Accelerometer and Level Horizon Calibration**

- All these sensors, except **Airspeed**, should be calibrated before your first flight.
- Compass calibration should be redone before any flight which is at a different location than your last flight.
- Press the **Setup** icon on the upper left of the display, then press the **Sensors** icon on the left.



- Set your drone on a flat ground area.
- Press the **Compass** sensor button

- Click **OK** to start the calibration.
- Place the drone in any of the orientations shown in red (incomplete) and hold it still. Once prompted (the orientation-image turns yellow) rotate the drone around the specified axis in either/both directions. Once the calibration is complete in that orientation the associated image on the screen will turn green

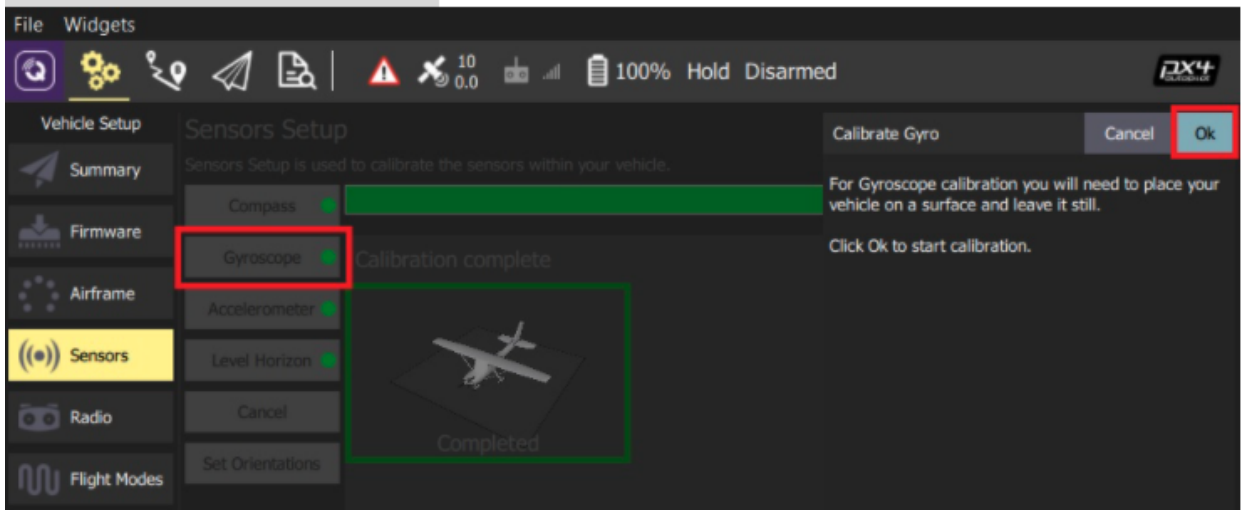


- Repeat the calibration process for all vehicle orientations.
- Once you've rotated the vehicle in all the positions QGroundControl will display Calibration complete (all orientation images will be displayed in green and the progress bar will fill completely) You can then proceed to the next sensor.

e. **Gyroscope Calibration**

- Place your drone back on a flat surface and keep it still.
- Click the Gyroscope sensor button.

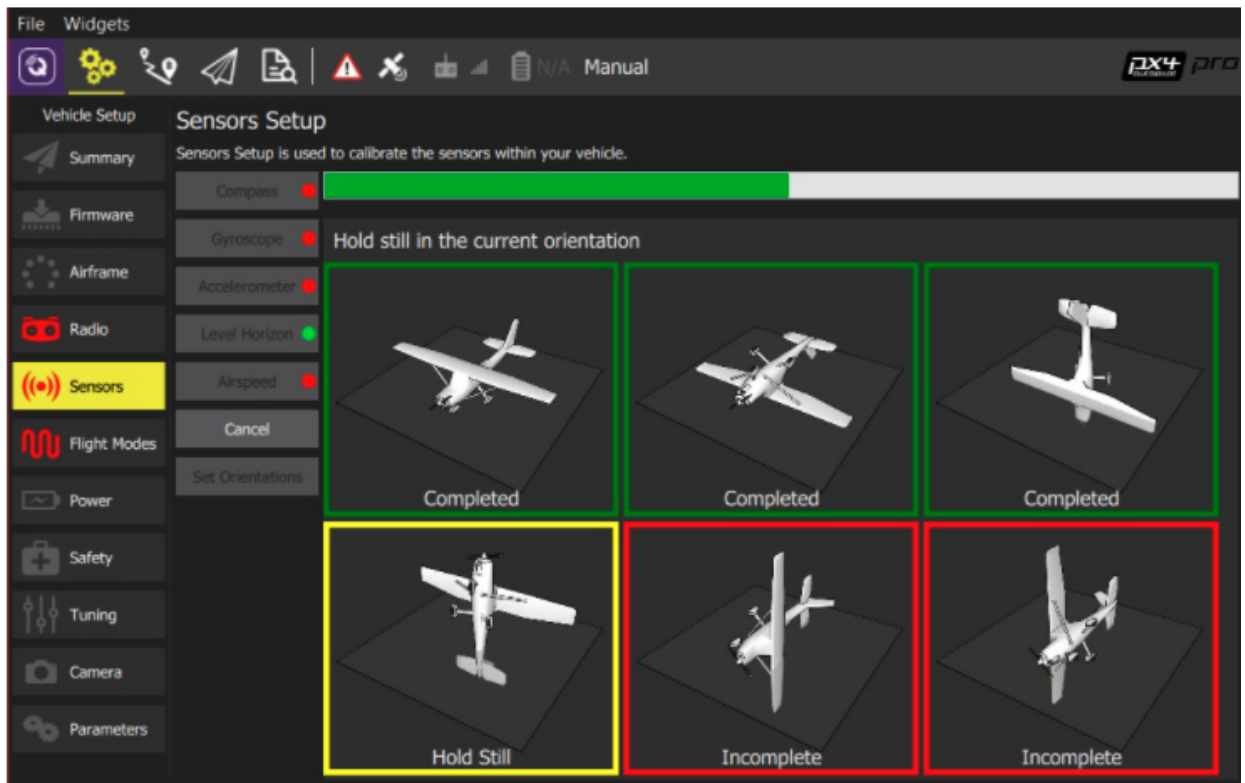
Click the **Gyroscope** sensor button



- Click OK to start the calibration. The bar at the top shows the calibration progress. When finished, the plane box will turn green and say "completed"
- Proceed to the next sensor.

f. Accelerometer Calibration

- To calibrate the flight controller accelerometers you will be asked to place and hold your vehicle a number of orientations (you will be prompted when to move between positions).
- Click the Accelerometer sensor button
- Click **OK** to start the calibration.
- Position the vehicle as guided by the images on the screen. This is very similar to compass calibration. Except that you want the drone to not be moving as you do each position. Gently place the drone in the indicated position and get it stable then remove your hands while the calibration runs. The drone does not have to be perfectly vertical for these steps. A few books or similar objects can be used to balance the drone especially for the “wing down” and “Wing up” steps.



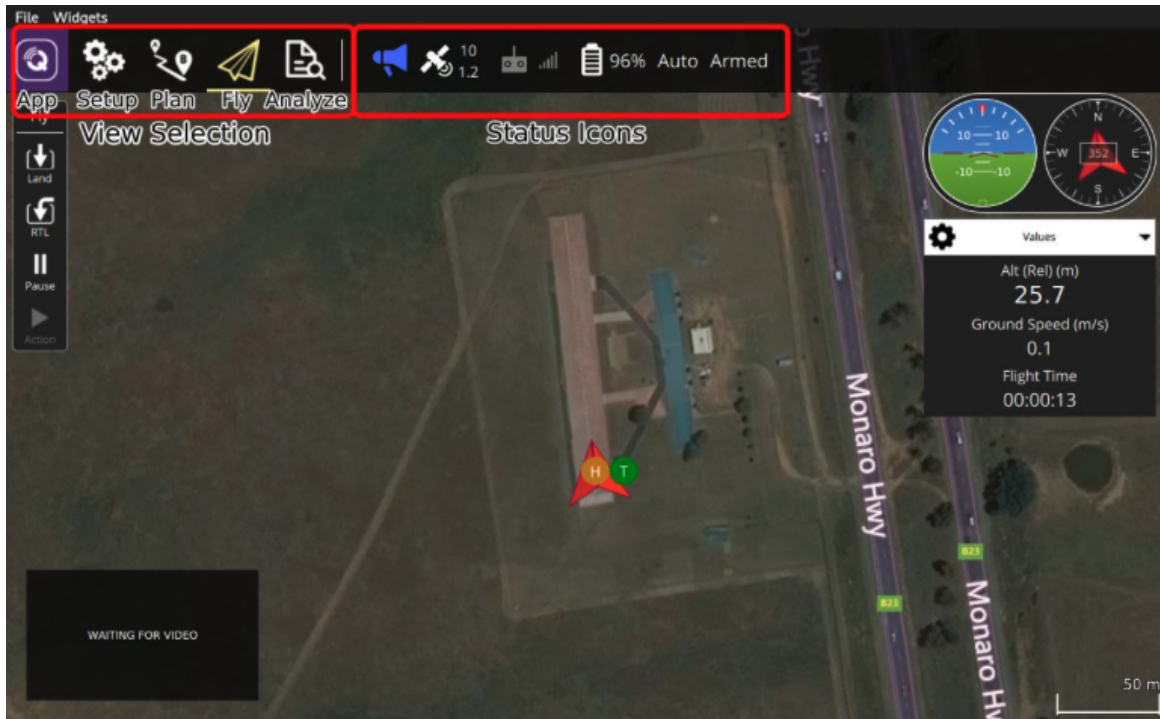
- Repeat the calibration process for all vehicle orientations.
- Once you've rotated the vehicle in all the positions QGroundControl will display Calibration complete and you can then proceed to the next sensor.

g. Level Horizon Calibration





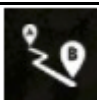

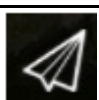



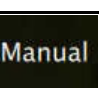

- If the horizon (as shown in the HUD) is not level after completing accelerometer calibration you can calibrate the level horizon for your drone. You will be asked to place the drone in a level orientation while it captures the information.
- Click the **Level Horizon** sensor button.
- Place the drone on a flat and level surface.:
- Click OK to start the calibration.
- When it is finished, exit the calibration modes.

9. Fly Mode

- a. Click on the “Fly Now” icon on the bottom of your screen. That takes you to the top screen of the Flight Controller



- b. Icons

Toolbar: View Selection Icons		Toolbar: Status Icons	
	App/Settings allows you to configure the application		Vehicle Messages Click to show a dropdown of messages from the drone. This will change to a Yield sign if there are critical messages
	Setup Allows you to configure and tune your drone.		GPS Status Shows your satellite count and current HDOP (smaller is better)
	Plan allows you to create autonomous Missions		RC RSSI RC Controller radio signal strength information
	Fly allows you to monitor your drone while flying, including viewing the streaming video from the drone.		Telemetry RSSI Telemetry WiFi signal strength from your drone to your phone
	Analyze allows you to download flight logs, geotag images from a survey mission, and access the MAVLink Console		Battery Remaining battery percent
			Flight Mode Current flight mode. Click to change flight mode to GPS or Manual
			RTK GPS Survey-In Status Shows you progress of GPS Survey-In process

10. Parameter trees

- a. Each Drone configuration requires a specific Parameter Tree. As a Beginner Pilot, the Parameter tree for your drone is pre-configured. **Please do NOT change the parameters as you can make your drone non-flyable.**

11. Fly View

- a. Fly View is the view you will use the most as a Beginner Proficiency Pilot. In Fly Mode, you can:
 - Run an automated pre-flight checklist.
 - Control pre-planned missions. [Missions are only available for Intermediate, Advanced and Expert proficiency pilots.](#)
 - Command your drone to: Arm/Disarm/emergency stop, GPS assisted takeoff & Land, Change altitude, Go to or Orbit a particular location, and Return/RTL.
 - Switch between a map view and a video view.
 - Display video, mission (if enabled), telemetry and other information for your drone, and switch between multiple drones connected to your controller.



- b. **Map:** Displays the positions of all connected drones and the mission (if enabled) for the current drone.
 - You can drag the map to move it around (the map automatically re-centres after a certain amount of time).
 - Once flying, you can click on the map to set a Go to or Orbit at location.
- c. **Fly Toolbar:** Key status information for sensors (GPS, battery, RC control), and drone state (Flight mode, Armed/Disarmed status).
 - Select the sensor indicators to view more detail.
 - Press the *Flight mode* text (e.g. "Hold") to select a new mode. Not every mode may be available.
 - Press the *Armed/Disarmed* text to toggle the armed state.
- d. **Fly tools:** You can use these to:
 - Toggle between takeoff/land.
 - Pause/restart the current operation (e.g. landing, or the mission).
 - Safety return (also known as RTL or Return).
 - The *Action* button offers other appropriate options for the current state (these overlay the *Confirmation Slider*). Actions include changing the altitude or continuing a mission.

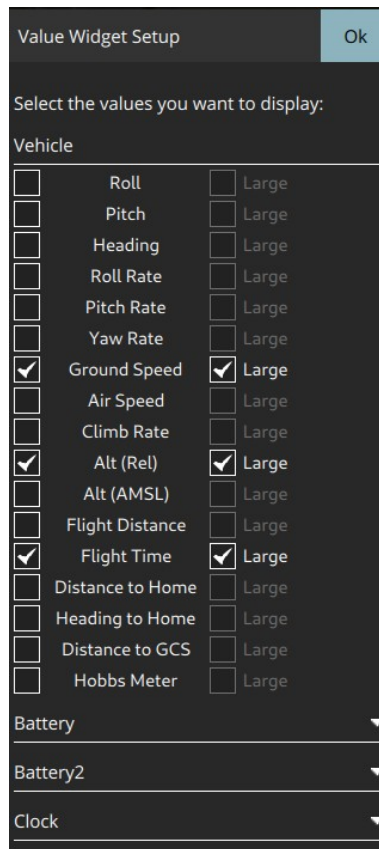
- Enable the preflight checklist (tool option disabled by default).
- e. **Instrument Panel:** A multi-page widget that displays drone information including: telemetry, camera, video, system health, and vibration.
- f. **Video/Switcher:** Toggle between video or map in a window.
 - Press the element to switch *Video* and *Map* to foreground.
- g. **Confirmation Slider:** Context sensitive slider to confirm requested actions. Slide to start operation. Press **X** to cancel.
- h. There are a number of other elements that are not displayed by default/are only displayed in certain conditions. For example, the multi-drone selector is only displayed if you have multiple drones, and the preflight checklist tool button is only displayed if the appropriate setting is enabled.

12. Fly View: Instrument Panel

- a. The instrument panel is a multi-page widget that displays information about the current drone, including: telemetry, camera, video, system health, and vibration information. The default page displays drone telemetry - use the drop down menu on the to right to select the other options.
- b. **Values (Telemetry):** The values page shows telemetry information; by default the altitude (relative to the home location) and the ground speed.



- c. You can configure what information is displayed by pressing the small gear icon on the top left of the panel. Each value can be displayed in normal or "large" size (large size shows just one value per row in the page, while normal shows 2).

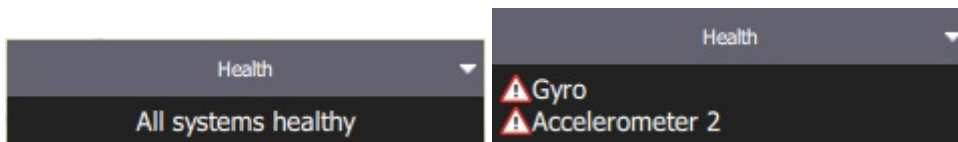


13. Fly View/Camera ***The Camera Functions are not currently supported***

14. Fly View/Video Stream ***The Video Functions are not currently supported***

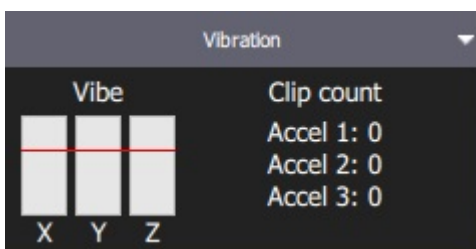
15. Health

- a. The health page shows you the health of the systems within your drone. The BSA Raptor Academy App will switch to this page automatically if any systems change to unhealthy.



16. Vibration

- a. The vibration page shows current vibration levels and clip counts.



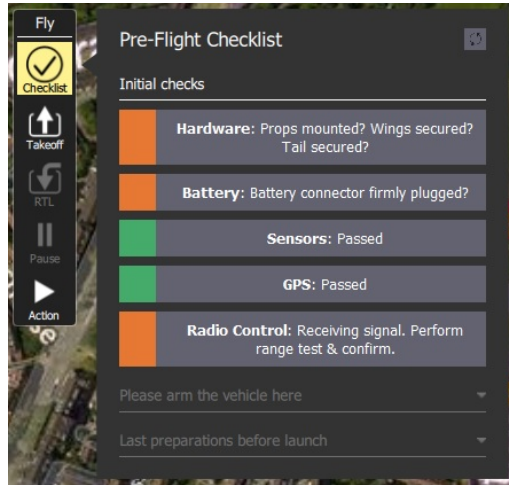
17. Operations

The following sections describe how to perform common operations/tasks in the Fly View.

Many of the available options depend on both the drone type and its current state.

a. Pre Flight Checklist

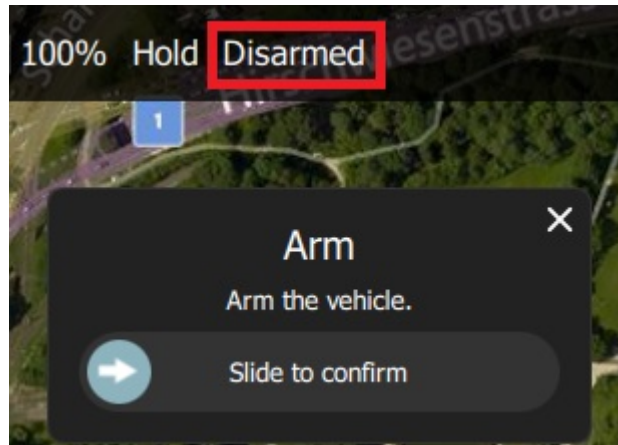
- An automated preflight checklist can be used to run through standard checks that the drone is configured correctly and it is safe to fly.
- To use the checklist, first enable the tool by navigating to Application Settings > General > Fly View and selecting the **Use preflight checklist** checkbox. The tool will then be added to the *Flight Tools*. Press it to open the checklist:



- Once you have performed each test, select it on the screen to mark it as complete.

c. Arm

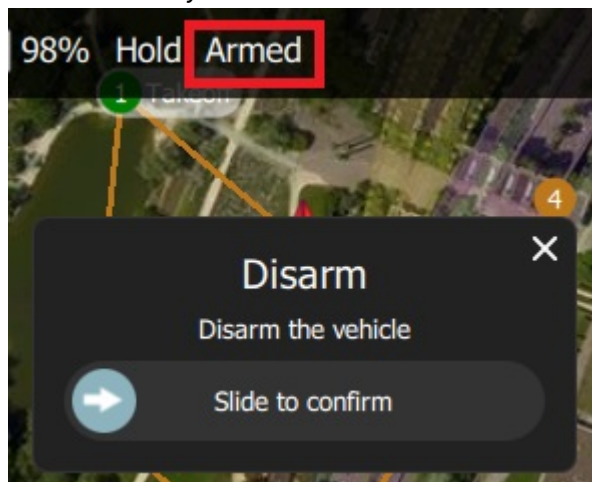
- Arming a drone starts the motors in preparation for takeoff.
- **When you are ready to takeoff, use the arm button on the top of the drone to arm it.**
- To arm the drone in the app, select **Disarmed** in the *Fly Toolbar* and then use the confirmation slider



- The BSA Raptor Drones disarm automatically if you do not take off after a few seconds.

d. Disarm

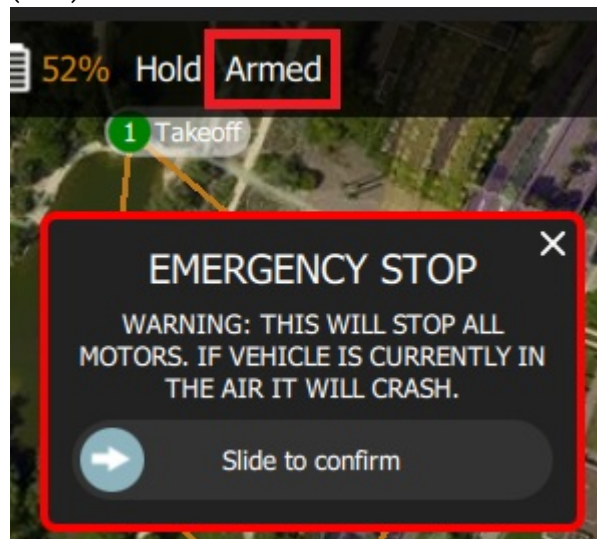
- There are 3 ways to disarm your drone.
 - The **recommended method** is to use the kill switch on your RC controller. This is fast and safe. The kill switch is on the back left side of the RC controller and is marked "**CH8**". **You should always descend and touch down on the ground before using the kill switch. This should be done quickly to avoid bouncing or typing over due to wind.**
 - Use the disarm slider shown below. This takes several seconds to navigate to this slider and a gust of wind can tip your drone over while you are trying to disarm it.
 - Use the arm/disarm button on the top of the drone - this can be dangerous as you have rotating propellers all around it.
- Disarming the drone stops the motors (making the drone safe). To disarm the drone select **Armed** in the *Fly Toolbar* when the drone is **landed**.



- Disarming the drone while it is flying is called an Emergency Stop

f. Emergency Stop

- Emergency stop is effectively the same as disarming the drone while you are flying. Your drone will crash!
- To disarm the drone select **Armed** in the *Fly Toolbar* when the drone is flying, or use the kill switch (CH8) on the RC Controller.



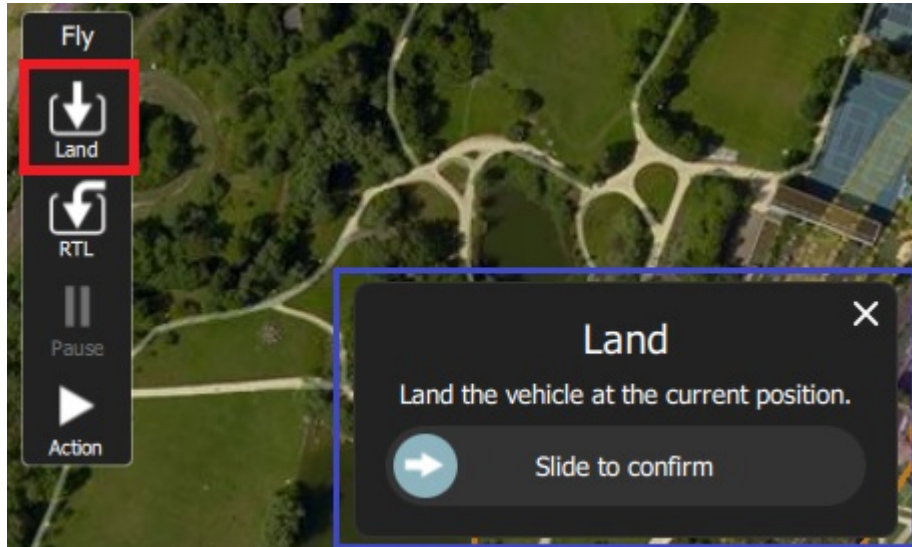
g. Takeoff

- If you are starting a mission *QGroundControl* can be set to automatically perform the takeoff step.
- To takeoff (when on the ground):
- Press the **Takeoff** button in the *Fly Tools* (this will toggle to a **Land** button after taking off). You can also ARM your drone and slowly throttle up on the left joystick of the RC controller.
- Optionally set the takeoff altitude in the right-side vertical slider.
- Confirm takeoff using the slider.



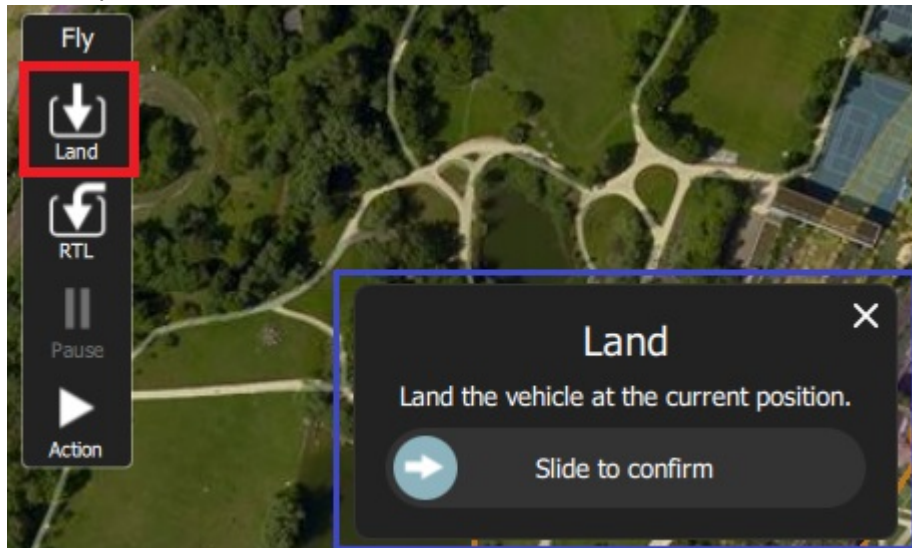
i. **Land**

- You can land at the current position at any time while flying by:
 - Slowly throttle down, descend slowly and land. This is the safest way to land.
 - Alternately, press the **Land** button in the *Fly Tools* (this will toggle to a **Land** button when landed).
- Confirm landing using the slider.



j. **RTL/Return**

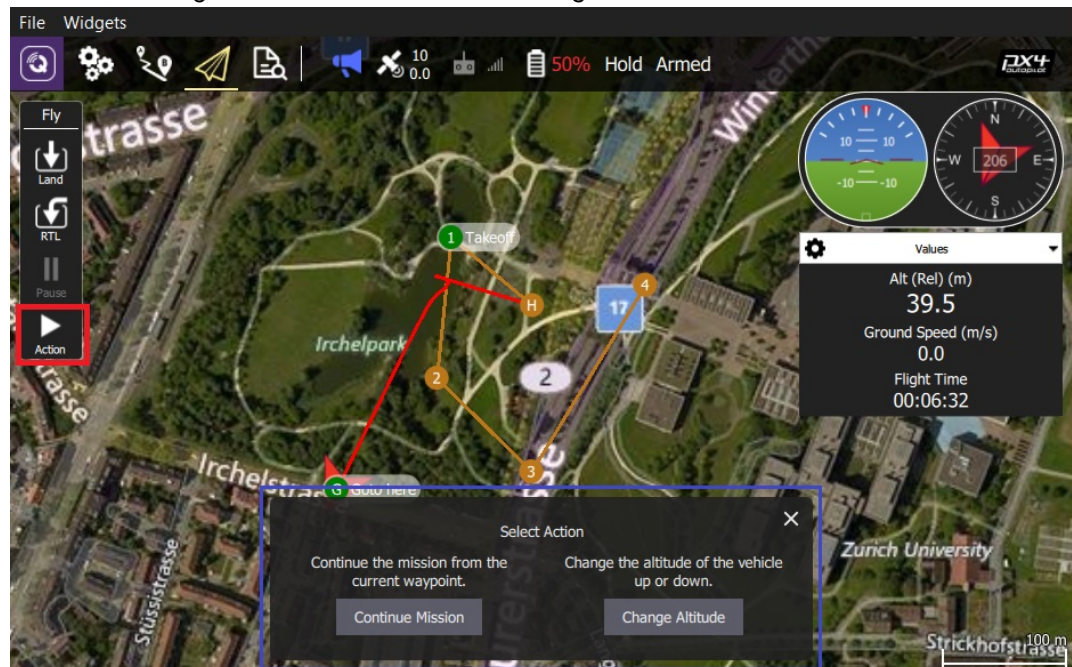
- Return to the home position at any time while flying:
- Press the **RTL** button in the *Fly Tools*.
- Confirm RTL using the slider.
- The drone will ascend to a safe height that should be above any trees, fly a direct path back to the takeoff point, and descend.



- The drone may also land at the home position, depending on its type and configuration.

I. Change Altitude

- You can change altitude while flying when in a mission only:
- Press the **Action** button on the *Fly Tools*
- Select the *Change Altitude* action from the dialog.

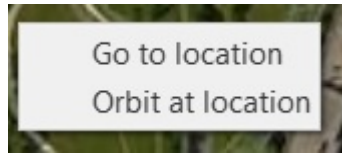


- Move the vertical slider to the desired altitude, then drag the confirmation slider to start the action.

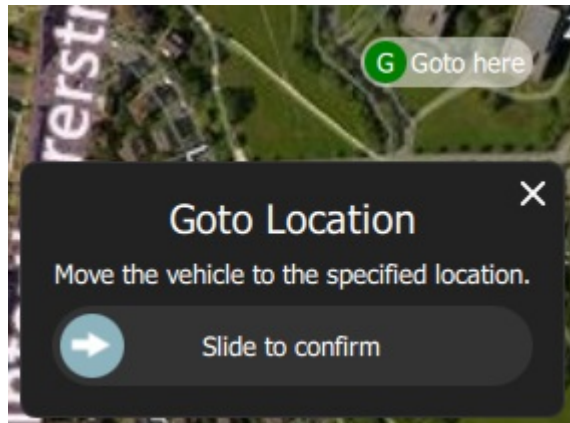


n. Goto Location

- After taking off you can specify that you want to fly to a particular location.
- Press the map where you want the drone to move and select **Go to location** on the popup.



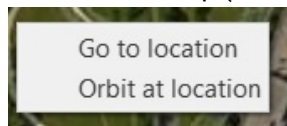
- The location will be displayed on the map, along with a confirmation slider.



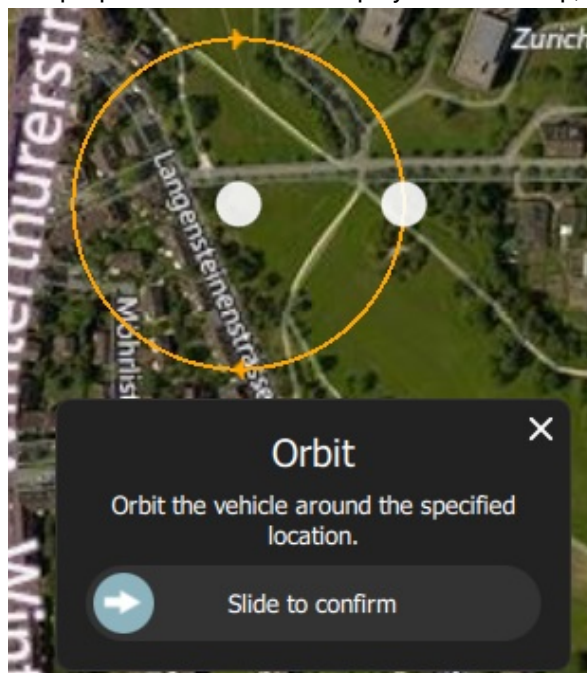
- When you're ready, drag the slider to start the operation (or press the **X** icon to cancel it).
- Goto points must be set within 500 feet of the drone and always within your view.

o. Orbit Location

- After taking off you can specify that you want to orbit a particular location.
- Press on the map (near the centre of your desired orbit) and select **Orbit at location** on the popup.



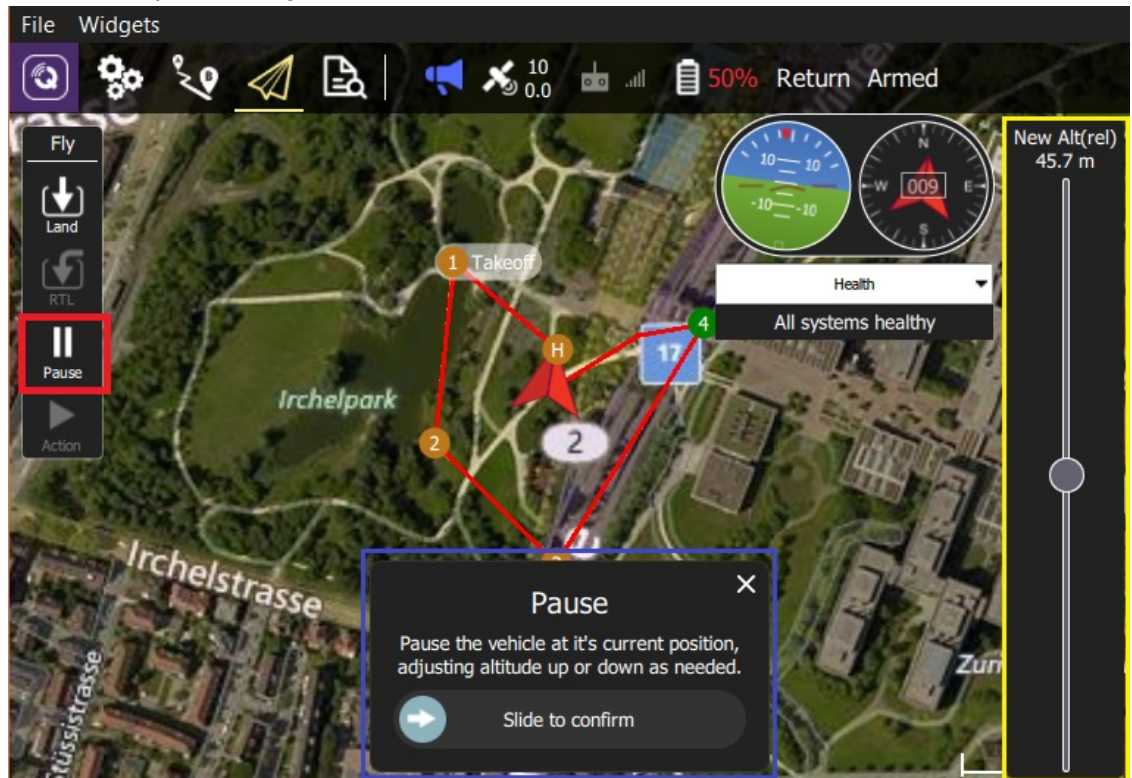
- The proposed orbit will be displayed on the map, along with a confirmation slider.



- Select and drag the central marker to move the orbit location.
- Select and drag the dot on the outer circle to change the orbit radius
- When you're ready, drag the slider to start the operation (or press the **X** icon to cancel it).

p. Pause

- You can pause most operations, including taking off, landing, RTL, missions, Orbit at location. Your drone will hover.
- **You cannot pause a Goto location operation.**
- To pause:
 - Press the **Pause** button in the *Fly Tools*.
 - Optionally set a new altitude using the right-side vertical slider.
 - Confirm the pause using the slider.



q. Missions ***This Function is currently not supported***

r. Display Video ***The Video Functions are not currently supported***

s. Record Video ***The Video Functions are not currently supported***

t. Record Video Stream (on QGC) ***The Video Functions are not currently supported***

u. Record Video on Camera ***The Video Functions are not currently supported***

18. Plan View

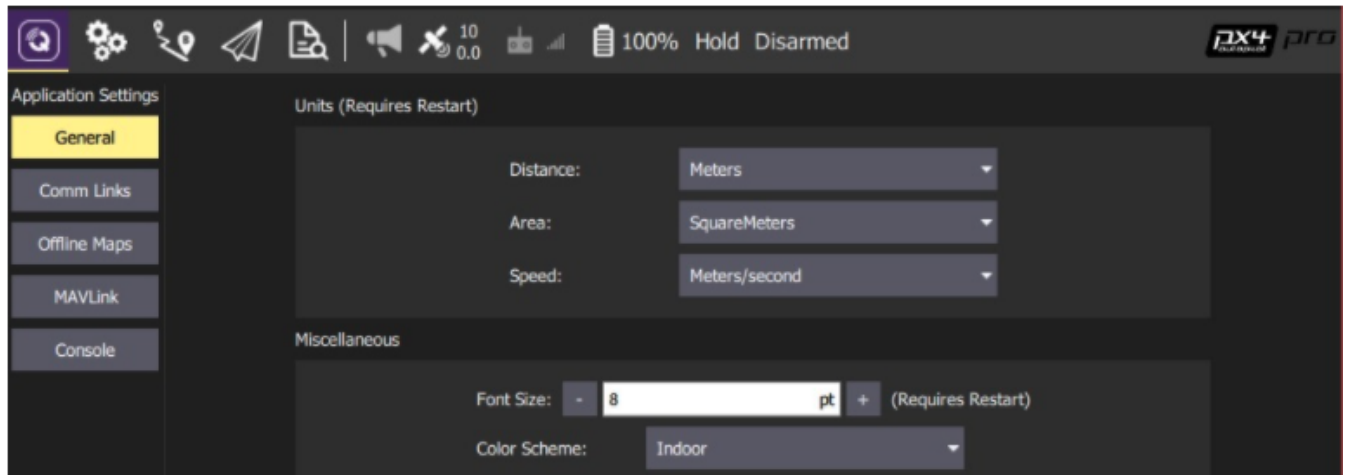
- a. Plan View is available for intermediate proficiency level drone pilots

19. Vehicle Setup

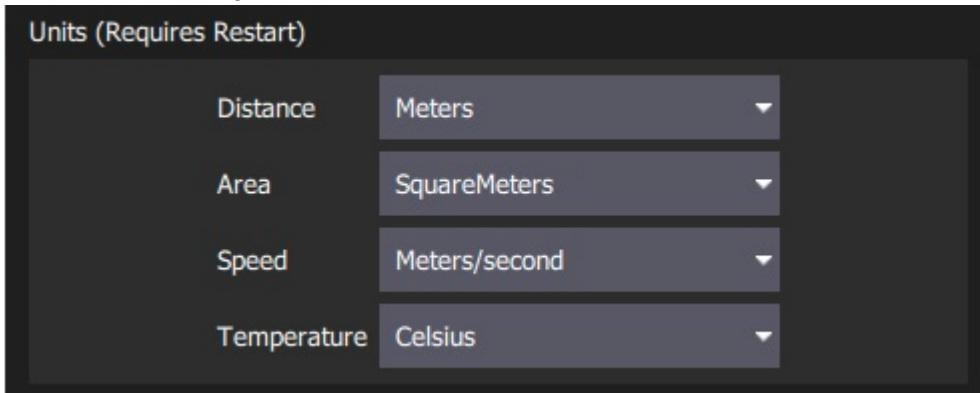
- a. The setups are already preconfigured in your drone and do not need to be changed.

21. Settings View

- a. This view is for setting the App (rather than a specific drone). We do not recommend changing any of these settings other than the ones listed below. **WARNING: Changing these settings should only be done if you are sure you know the effect on your drone - you may render it unflyable and have to reset to factory settings!**



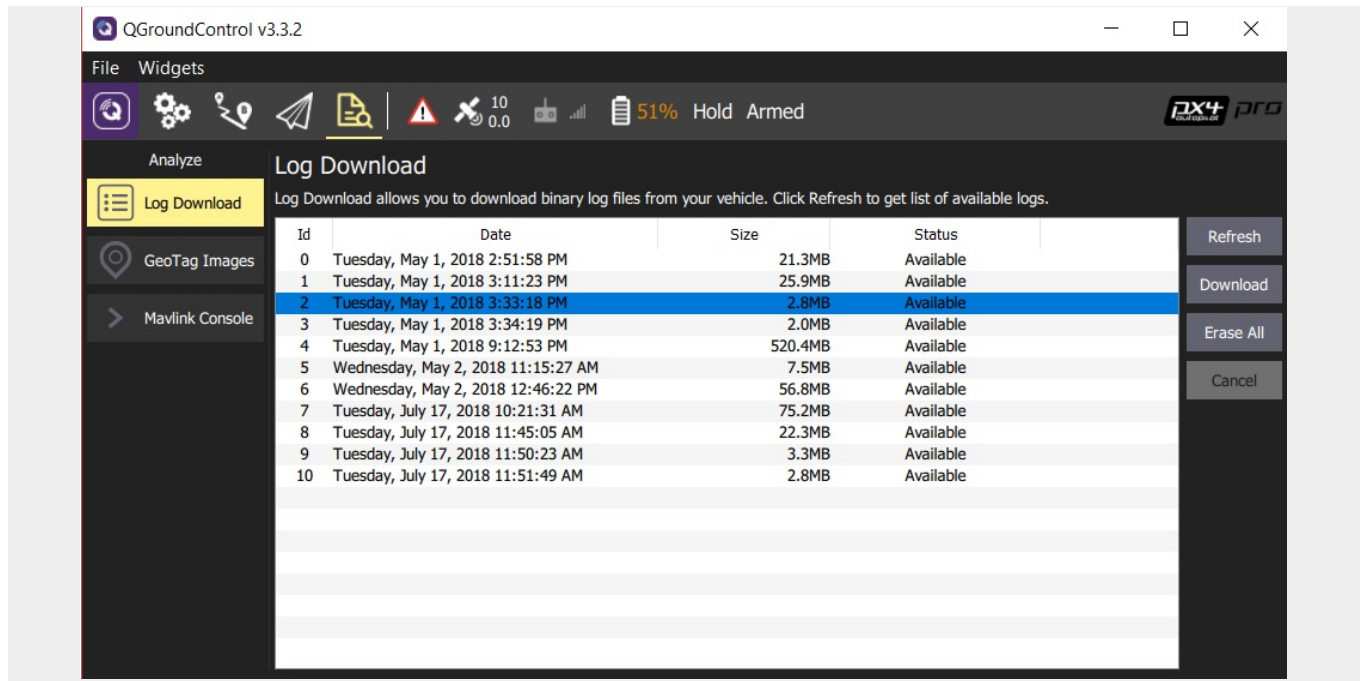
- b. Press the “App/Settings” icon on the upper left of the screen. You can switch between the various settings options by clicking the buttons in the left-sidebar.
- c. Select “General” to get to Units



- d. The settings are:
- **Distance:** Meters | Feet
 - **Area:** SquareMetres | SquareFeet | SquareKilometers | Hectares | Acres | SquareMiles
 - **Speed:** Metres/second | Feet/second | Miles/hour | Kilometres/hour | Knots
 - **Temperature:** Celsius | Fahrenheit
- e. You should also adjust 3 settings in the Fly View Settings
- f. Select “General” again
- g. Select the “Fly View” settings
- Set Guided Minimum Altitude to 2 meters or 6 feet
 - Set Guided Maximum Altitude to 122 meters or 400 feet
 - Set Go To Location Max Distance to 300 meters or 1000 feet

23. Analyze View

- a. As a beginner level pilot, the only function you will use in this view is the download logs screens.
- b. **Log Download (Analyze View)**
- c. The *Log Download* screen (**Analyze > Log Download**) is used to list (*Refresh*), *Download* and *Erase All* log files from the connected vehicle.



24. App Menus

- These screens are restricted to Expert level pilots.