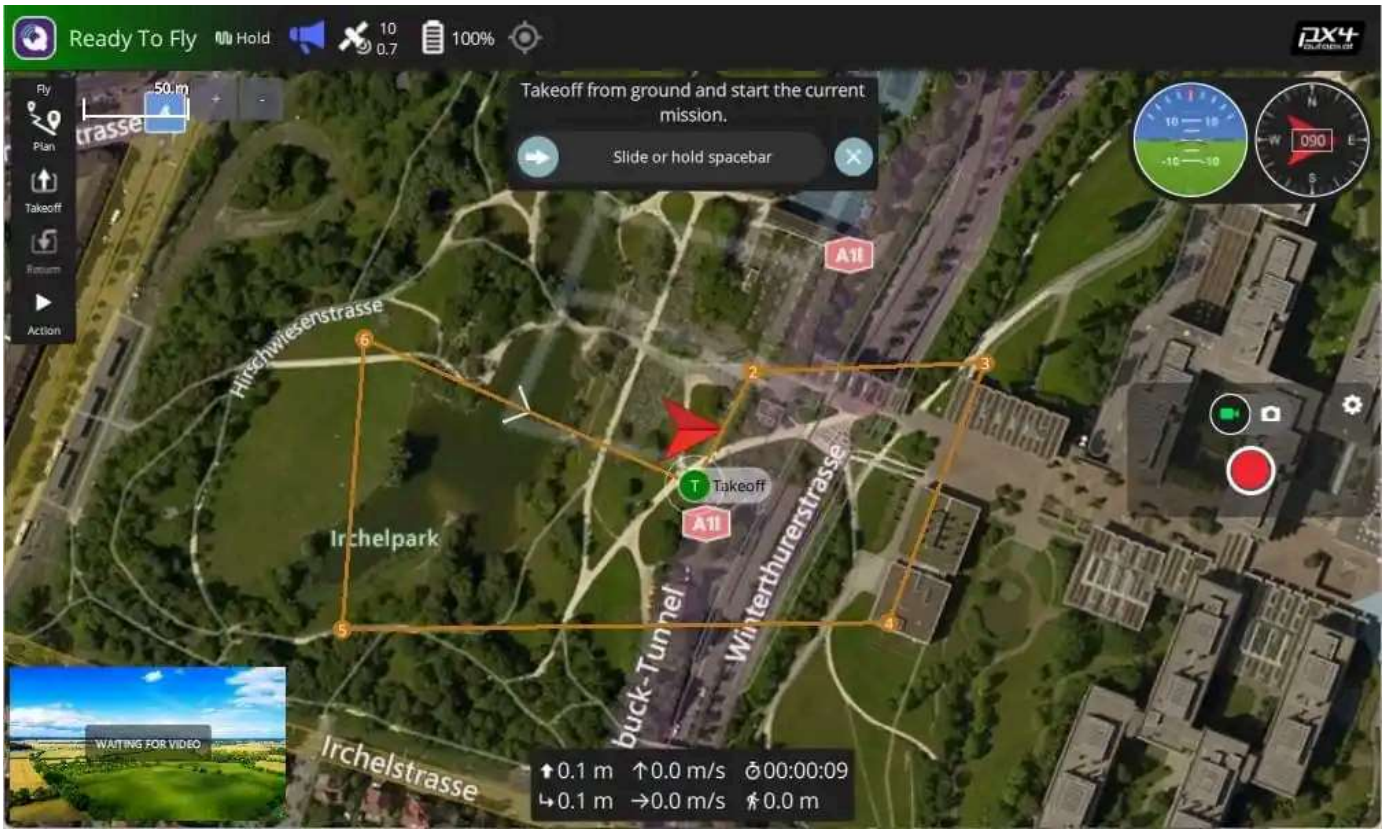
QGroundControl User Guide

QGroundControl provides full flight control and vehicle setup for PX4 or ArduPilot powered vehicles. It provides easy and straightforward usage for beginners, while still delivering high end feature support for experienced users.

Key Features:

- Full setup/configuration of ArduPilot and PX4 Pro powered vehicles.
- Flight support for vehicles running PX4 and ArduPilot (or any other autopilot that communicates using the MAVLink protocol).
- Mission planning for autonomous flight.
- Flight map display showing vehicle position, flight track, waypoints and vehicle instruments.
- 3D viewer visualizing the 3D map of the environment (.osm file), the 3D model of the vehicle (only multi-rotors for the moment), and the mission 3D trajectory (including the waypoints).
- Video streaming with instrument display overlays.
- Support for managing multiple vehicles.
- QGC runs on Windows, OS X, Linux platforms, iOS and Android devices.



INFO

This guide is an active work in progress. The information provided should be correct, but you may find missing information or incomplete pages.

TIP

Information about *QGroundControl* development, architecture, contributing, and translating can be found in the Developer Guide section.

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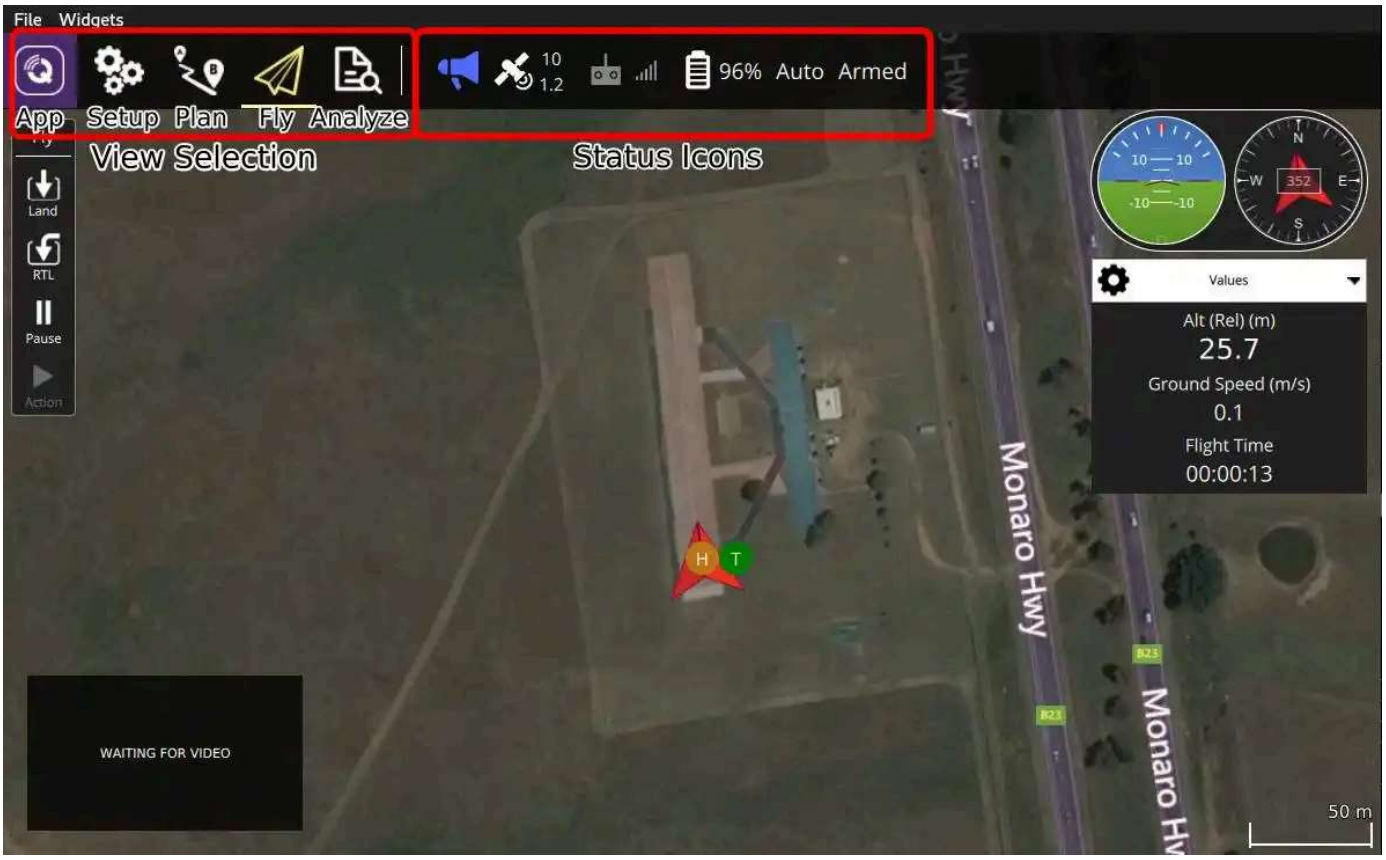
QGroundControl Quick Start

Getting *QGroundControl* up and running is quick and easy:

1. Download and install the application.
2. Start *QGroundControl*.
3. Attach your vehicle to the ground station device via USB, through a telemetry radio, or over WiFi. *QGroundControl* should detect your vehicle and connect to it automatically.

That's it! If the vehicle is ready to fly, *QGroundControl* should display Fly View as shown below (otherwise it will open Setup View).



A good way to become familiar with *QGroundControl* is to start experimenting:

- Use the toolbar to switch between the main views:

- Settings: Configure the *QGroundControl* application.
- Setup: Configure and tune your vehicle.
- Plan: Create autonomous missions.
- Fly: Monitor your vehicle(s) while flying, including streaming video.
- 3D View: A 3D visualization and monitoring of the vehicle, the 3D map of the environment, and the mission while flying.
- [Analyze] ** Description of Analyze view is missing **

- Click the *Status icons* on the toolbar to find out the status of the connected vehicle.

While the UI is fairly intuitive, this documentation can also be referenced to find out more.

INFO

Make sure QGC has an internet connection when you connect a new vehicle. This will allow it to get the latest parameter and other metadata for the vehicle, along with translations.

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Download and Install

Download and Install

The sections below can be used to download the current stable release of *QGroundControl* for each platform.

> **TIP**
>
> See Troubleshooting QGC Setup if *QGroundControl* doesn't start and run properly after installation!

System Requirements

QGC should run well on any modern computer or mobile device. Performance will depend on the system environment, 3rd party applications, and available system resources. More capable hardware will provide a better experience. A computer with at least 8Gb RAM, an SSD, Nvidia or AMD graphics and an i5 or better CPU will be suitable for most applications.

For the best experience and compatibility, we recommend you the newest version of your operating system.

Windows

QGroundControl can be installed on 64 bit versions of Windows:

1. Download QGroundControl-installer.exe.
2. Double click the executable to launch the installer.

> **INFO**

The Windows installer creates 3 shortcuts: **QGroundControl**, **GPU Compatibility Mode**, **GPU Safe Mode**. Use the first shortcut unless you experience startup or video rendering issues. For more information see Troubleshooting QGC Setup > Windows: UI Rendering/Video Driver Issues.

INFO

Prebuilt *QGroundControl* versions from 4.0 onwards are 64-bit only. It is possible to manually build 32 bit versions (this is not supported by the dev team).

Mac OS X

QGroundControl can be installed on macOS 10.11 or later:

1. Download QGroundControl.dmg.
2. Double-click the .dmg file to mount it, then drag the *QGroundControl* application to your *Application* folder.

INFO

QGroundControl continues to not be signed which causes problem on Catalina. To open QGC app for the first time:

- Right-click the QGC app icon, select Open from the menu. You will only be presented with an option to Cancel. Select Cancel.
- Right-click the QGC app icon again, Open from the menu. This time you will be presented with the option to Open.

Ubuntu Linux

QGroundControl can be installed/run on Ubuntu LTS 20.04 (and later).

Ubuntu comes with a serial modem manager that interferes with any robotics related use of a serial port (or USB serial). Before installing *QGroundControl* you should remove the

modem manager and grant yourself permissions to access the serial port. You also need to install *GStreamer* in order to support video streaming.

Before installing *QGroundControl* for the first time:

1. On the command prompt enter:

```sh
sudo usermod -a -G dialout $USER
sudo apt-get remove modemmanager -y
sudo apt install gstreamer1.0-plugins-bad gstreamer1.0-libav gstreamer1.0-gl -y
sudo apt install libfuse2 -y
sudo apt install libxcb-xinerama0 libxkbcommon-x11-0 libxcb-cursor0 -y
```

2. Logout and login again to enable the change to user permissions.

To install *QGroundControl*:

1. Download QGroundControl.AppImage.
2. Install (and run) using the terminal commands:

```sh
chmod +x ./QGroundControl.AppImage
./QGroundControl.AppImage  (or double click)
```

INFO

There are known video steaming issues on Ubuntu 18.04 systems with dual adaptors.

INFO

Prebuilt *QGroundControl* versions from 4.0 cannot run on Ubuntu 16.04. To run these versions on Ubuntu 16.04 you can build QGroundControl from source without video libraries.

Android

QGroundControl is temporily unavailable from the Google Play Store. You can install manually from here:

- Android 32 bit APK
- Android 64 bit APK

Old Stable Releases

Old stable releases can be found on GitHub.

Daily Builds

Daily builds can be downloaded from here.

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Toolbar/Menu

Main Toolbar

The main toolbar provides access to select the different application views, and high level status information for connected vehicles. The toolbar is the same in all views except for "PlanView" (which has a single icon to take you back to "Fly" view).

View-select icons

The following icons are used to switch between the main *Views*. These are displayed even if no vehicle is connected.

Settings

Configure the *QGroundControl* application.

Setup

Configure and tune your vehicle.

Plan

Create autonomous missions.

Fly

Monitor your vehicle(s) while flying, including streaming video.

3D View

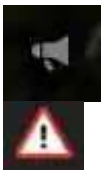
3D Visualization and monitoring of the vehicle and the environment while flying.

Analyze

Download logs, geotag images from a survey mission, access the MAVLink console.

Status icons

Status icons are displayed when *QGroundControl* is connected to a vehicle. These show the high level status of the vehicle, and can be clicked to see more detailed information.



Vehicle Messages

Click to show a list of messages from the vehicle. Note that version on the right is displayed when there are critical messages.

GPS Status

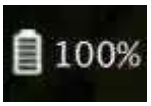
Shows you satellite count and curent HDOP.

RC RSSI

RC signal strength information.

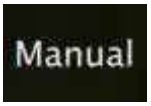
Telemetry RSSI

Telemetry signals strength information.



Battery

Remaining battery percent.



Flight Mode

Current flight mode. Click to change flight mode.

RTK GPS Survey-In Status

Shows you progress of RTK GPS Survey-In process.

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Support

Support

This user guide is meant to be the main provider of support for *QGroundControl*. If you find incorrect or missing information please report an Issue.

Questions about how to use *QGroundControl* should be raised in the discussion forum for the associated flight stack:

- PX4 Pro Flight Stack (discuss.px4.io).
- ArduPilot Flight Stack (discuss.ardupilot.org).

These forums are also the best place to start discussions on bugs/problems you are having with *QGroundControl* and or feature requests you would like to make. From there you may be directed to entering information in a GitHub Issue for further resolution.

Developer Chat

QGroundControl developers (and many regular/deeply-involved users) can be found on the #QGroundControl channel on the Dronecode Discord.

GitHub Issues

Issues are used to track bugs against *QGroundControl* as well as feature requests for later versions. The current list of issues can be found on GitHub here.

> **INFO**
>
> Please contact our developers using the support forums **before** creating GitHub issues for either bugs or feature requests.

Reporting Bugs

If you are directed to create an issue, please use the "Bug report" template and provide all information specified in the template.

Reporting Crashes from Windows Builds

When QGC crashes a crash dump file will be place in the Users LocalAppData directory. To navigate to that directory use the Start/Run command. You can bring this up window WinKey+R. Type into that `%localappdata%` for Open and click Ok. Crash dumps will be in a `QGCCrashDumps` folder in that directory. You should find a new **.dmp** file there. Add a link to that file in a GitHub Issue when reporting you problem.

Reporting Hangs from Windows Builds

If Windows is telling you the *QGroundControl program is unresponsive* use the following steps to report the hang:

1. Open *Task Manager* (right-click TaskBar, select **Task Manager**)
2. Switch to the Processes tab and local **qgroundcontrol.exe**
3. Right-click on **groundcontrol.exe** and select **Create Dump File**
4. Place the dump file in a public location
5. Add a link to the **.dmp** file and above details in the GitHub issue.

Feature Requests

If you are directed to create a feature request after discussion on support forums please use the "Feature request" template which has some helpful information on required details.

Troubleshooting

Troubleshooting information is linked from here.

Console Logging

Console Logs can be helpful when diagnosing *QGroundControl* problems. For more information see: Console Logging.

Help Improve these Docs!

Just like *QGroundControl* itself, the user guide is an open source, user created and supported GitBook. We welcome Pull Requests against the guide for fixes and/or updates.

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Fly

Fly View

The Fly View is used to command and monitor the vehicle when flying.

You can use it to:

- Run an automated pre-flight checklist.
- Arm the vehicle (or check why it won't arm).
- Control missions: start, continue, pause, and resume.
- Guide the vehicle to arm/disarm/emergency stop, takeoff/land, change altitude, go to or orbit a particular location, and return/RTL.
- Switch between a map view and a video view (if available)
- Display video, mission, telemetry, and other information for the current vehicle, and also switch between connected vehicles.

UI Overview

The screenshot above shows the main elements of the fly view:

- **Map:** Displays the positions of all connected vehicles and the mission for the current vehicle.
  - 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.
- **Fly Toolbar:** Key status information for sensors (GPS, battery, RC control), and vehicle 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.
  - The text next to the **Q** icon indicates the flight readiness using text: "Not Ready", "Ready to Fly", "Flying", and status using colour: "green" (all good!), amber (a

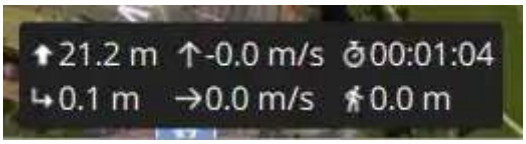
warning), red (serious problem). Select the text when the background is amber or red to find out the cause of any preflight issues (QGC 4.2.0 and later). You can also select the text to reach a button to arm/disarm/emergency-stop the vehicle.

- **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).
- Instrument Panel**:** A widget that displays vehicle telemetry.
- **Attitude/Compass**: A widget that provides virtual horizon and heading information.
- **Camera Tools**: A widget for switching between still and video modes, starting/stopping capture, and controlling camera settings.
- Video/Switcher**:** Toggle between video or map in a window.
  - Press the element to switch *Video* and *Map* to foreground.
  - *QGroundControl* supports RTP and RTSP video streaming over your vehicles UDP connection. It also supports directly connected UVC devices. QGC video support is further discussed in the Video README.
  - A Telemetry Overlay is automatically generated as a subtitle file
- **Confirmation Slider:** Context sensitive slider to confirm requested actions. Slide to start operation. Press **X** to cancel.

There are a number of other elements that are not displayed by default/are only displayed in certain conditions. For example, the multi-vehicle selector is only displayed if you have multiple vehicles, and the preflight checklist tool button is only displayed if the appropriate setting is enabled.

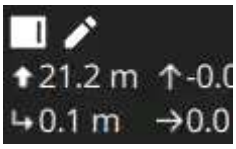
Instrument Panel (Telemetry)

The instrument panel displays telemetry information about the current vehicle.

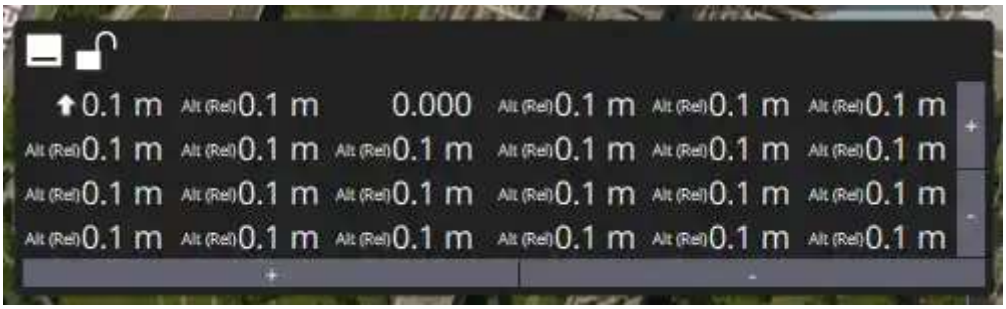


The default values include altitude (relative to the home location), horizontal and vertical speed, total flight time, and distance between vehicle and ground station.

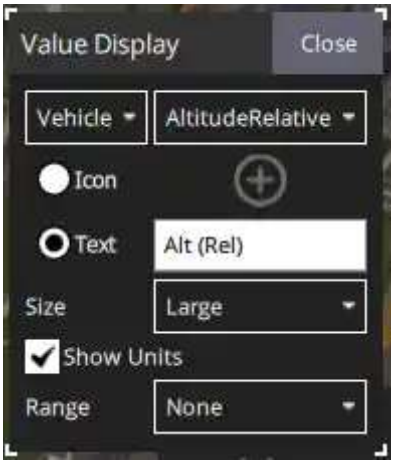
You can configure where the information is displayed by hovering over the panel and selecting the left-side square tool. This toggles the position of the panel between bottom centre and right-centre.



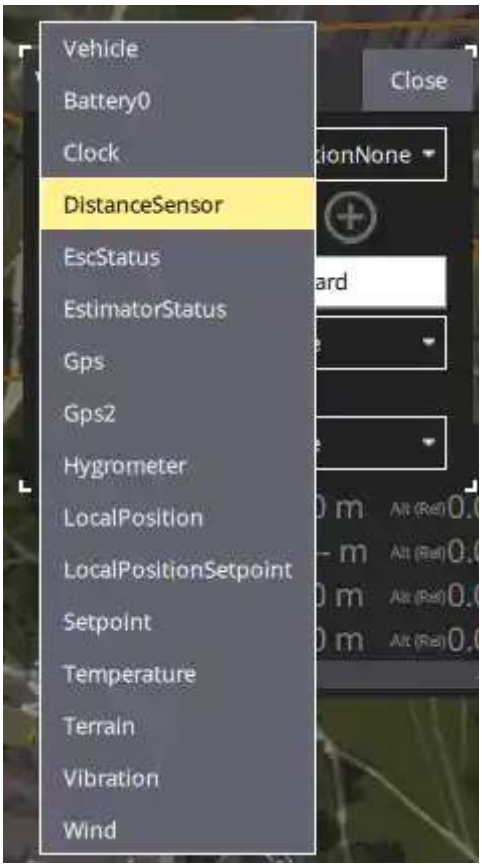
You configure what information is display by selecting the edit/pencil icon. The grid will then display "+" and "-" icons that you can use to add or remove rows and columns (and the pencil icon is replaced by a "lock" icon that you can use to save the settings).



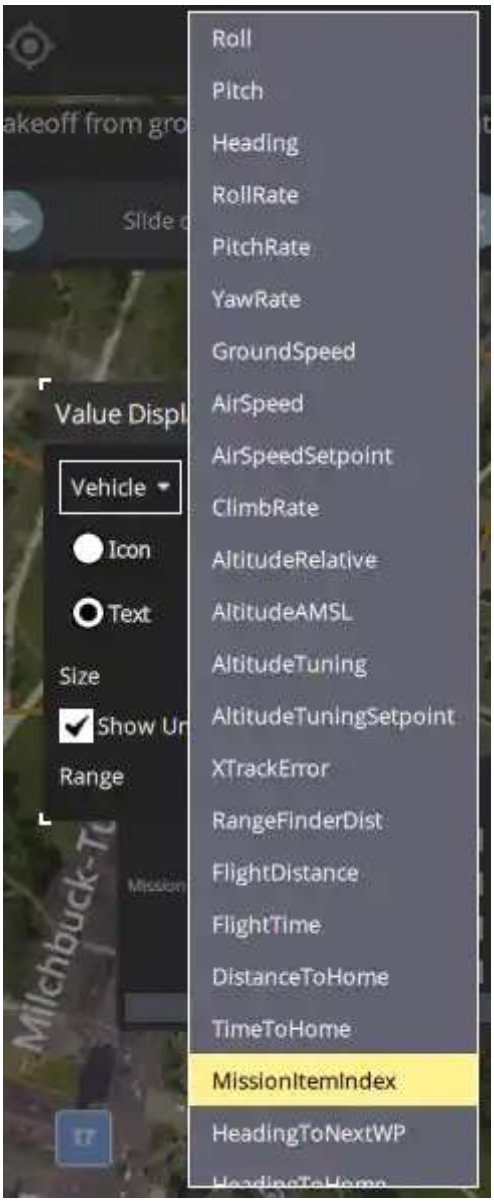
Select a value to launch its "Value Display" editor. This allows you to change the icon, text, size, units and so on of the current telemetry value.



The selection list on the top left is used to change the source of the telemetry. By default this is the vehicle, but you can use the selector to choose a particular sensor type



The selection list on the top right is used to select a particular telemetry value for the vehicle or sensor.

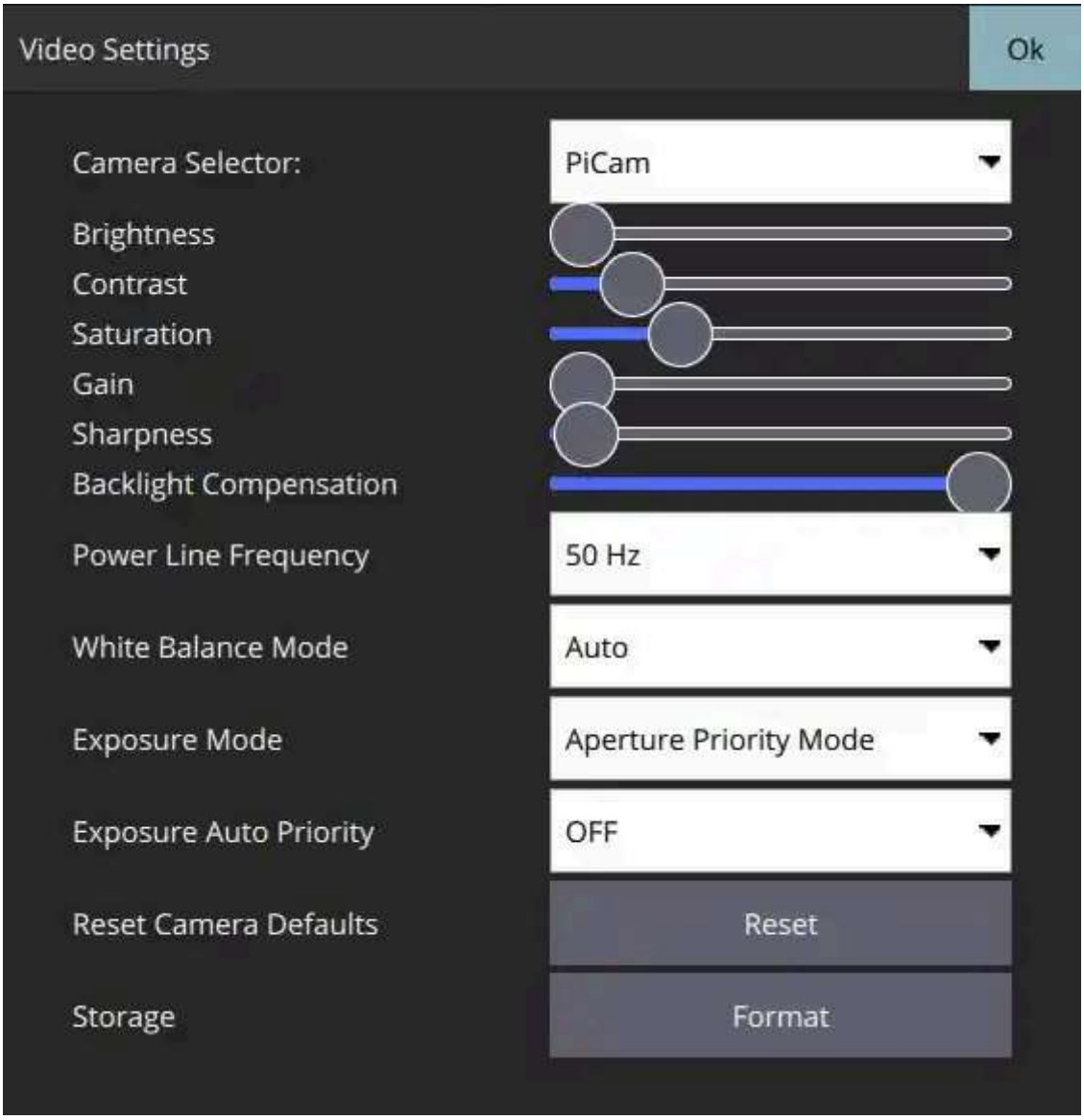


Camera

The camera panel is used to capture still images and video, and to configure the camera.

The camera capture and configuration options depend on the connected camera. The configuration options are selected using the panel gear icon. The configuration for a simple autopilot-connected camera are shown below.

When connected to camera that supports the MAVLink Camera Protocol you can additionally configure and use other camera services that it makes available. For example, if your camera supports video mode you will be able to switch between still image capture and video mode, and start/stop recording.



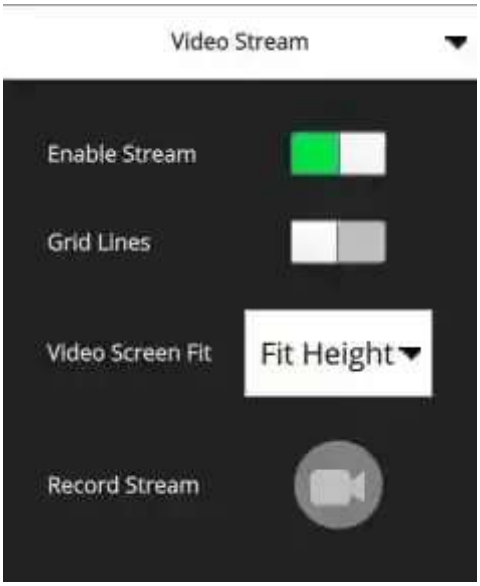
INFO

Most of the settings that are displayed depend on the camera (they are defined in its MAVLink Camera Definition File).

> A few common settings at the end are hard-coded: Photo Mode (Single/Time Lapse), Photo Interval (if Time Lapse), Reset Camera Defaults (sends a reset command to the camera), Format (storage) :::

Video Stream

The video page is used to enable/disable video streaming. When enabled, you can start/stop the video stream, enable a grid overlay, change how the image fits the screen, and record the video locally with QGC.



Actions/Tasks

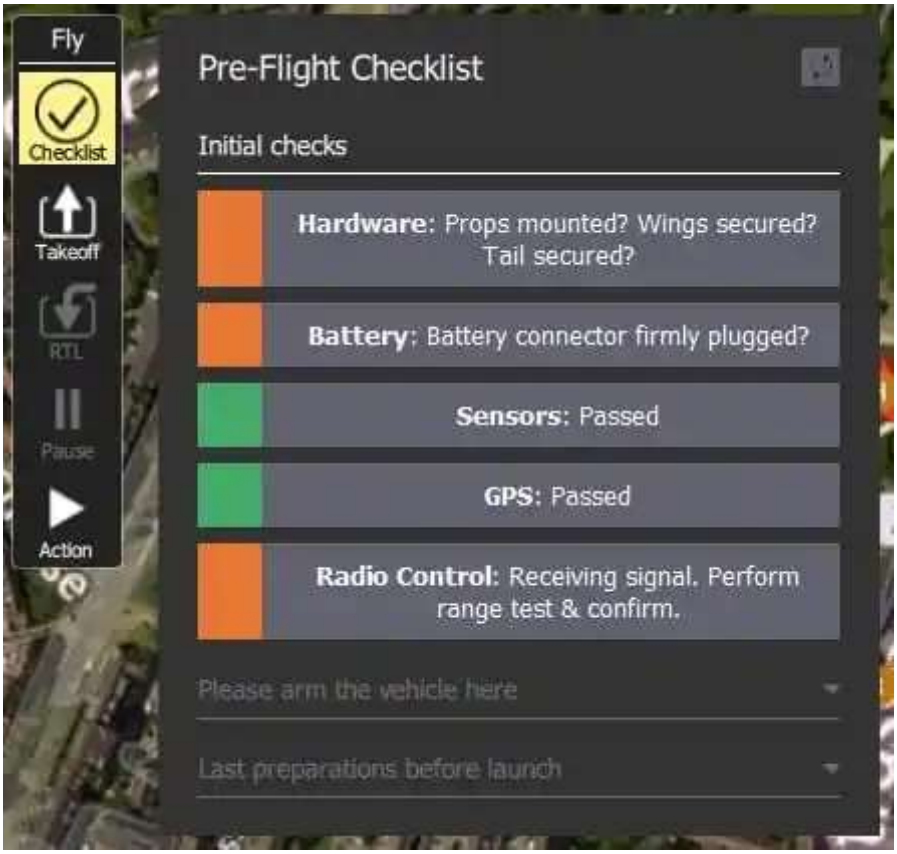
The following sections describe how to perform common operations/tasks in the Fly View.

> **INFO**
>
> Many of the available options depend on both the vehicle type and its current state.

Pre Flight Checklist

An automated preflight checklist can be used to run through standard checks that the vehicle is configured correctly and it is safe to fly.

To view 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 UI to mark it as complete.

Arming and Preflight Checks

Arming a vehicle starts the motors in preparation for takeoff. You will only be able to arm the vehicle if it is safe and ready to fly.

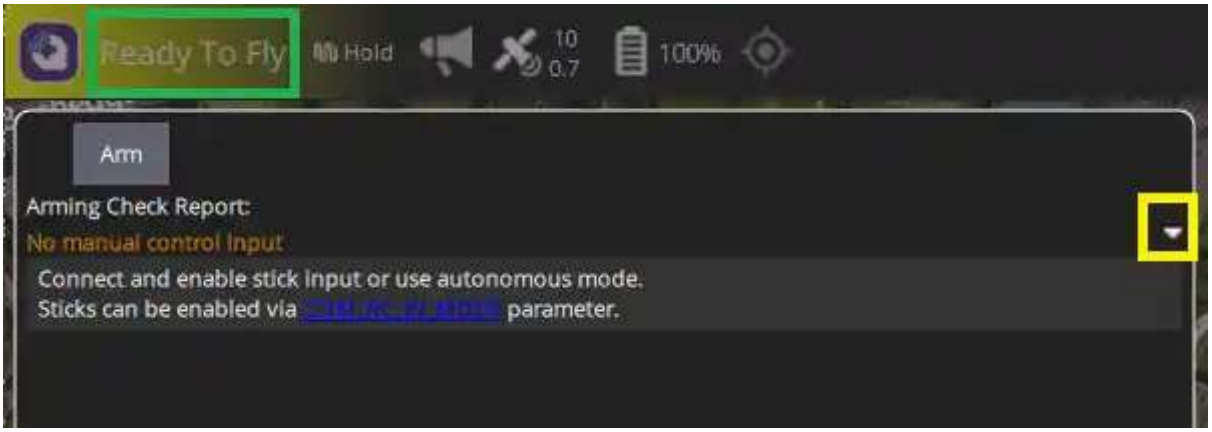
> **TIP**
>
> Generally, if the vehicle is ready to arm, *QGroundControl* will arm the vehicle for you if you start a mission or takeoff.

The vehicle is ready to fly in all modes if the status text says "Ready to Fly" and the background is green.

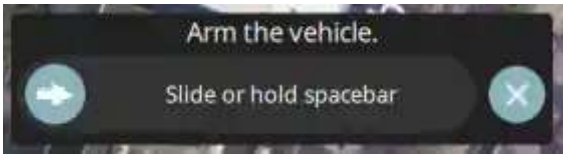
If the background is amber then it is ready to take off in the current mode, but may not be able to switch to other modes. If the background is red and the text is "Not Ready" then you will not be able to arm in the current mode.

From QGC 4.2.0 (at time of writing, a daily build) you can find out the exact cause of the warning or error, and possible solutions, by pushing the status text.

This launches the preflight arming checks popup with a list of all preflight warnings. The toggle on the right expands each error with additional information and possible solutions.



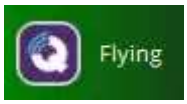
Once each issue is resolved it will disappear from the UI. When all issues blocking arming have been removed you can use the arm button to display the arming confirmation slider, and arm the vehicle (or you can just take off - note that the vehicles will (by default) disarm automatically if you do not take off after a few seconds.



INFO

The status text also displays when flying.

> 
>
> >

> 
>
>
> The arming checks UI will open even when flying, allowing you to emergency disarm. :::

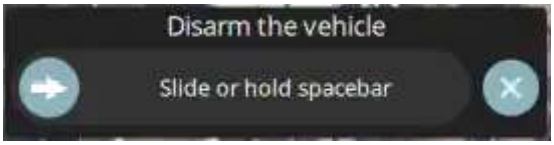
Disarm

Disarming the vehicle when landed stops the motors (making the vehicle safe).

Generally you do not need to explicitly disarm as vehicles will disarm automatically after landing, or shortly after arming if you do not take off.

If needed, you can do so from the Arming Preflight Checks UI.

You will then need to use the disarming slider.



> **INFO**
>
> Disarming the vehicle while it is flying is called an Emergency Stop

Emergency Stop

Emergency stop is effectively the same as disarming the vehicle while it is flying. Your vehicle will crash!

If needed, you can do so from the Arming Preflight Checks UI.

You will then need to use the emergency disarming slider.

Takeoff

> **TIP**
>
> If you are starting a mission for a multicopter, *QGroundControl* will automatically perform the takeoff step.

To takeoff (when landed):

1. Press the **Takeoff** button in the *Fly Tools* (this will toggle to a **Land** button after taking off).
2. Optionally set the takeoff altitude in the right-side vertical slider.
3. Confirm takeoff using the slider.

Land

You can land at the current position at any time while flying:

1. Press the **Land** button in the *Fly Tools* (this will toggle to a **Takeoff** button when landed).
2. Confirm landing using the slider.

RTL/Return

Return to a "safe point" at any time while flying:

1. Press the **RTL** button in the *Fly Tools*.
2. Confirm RTL using the slider.

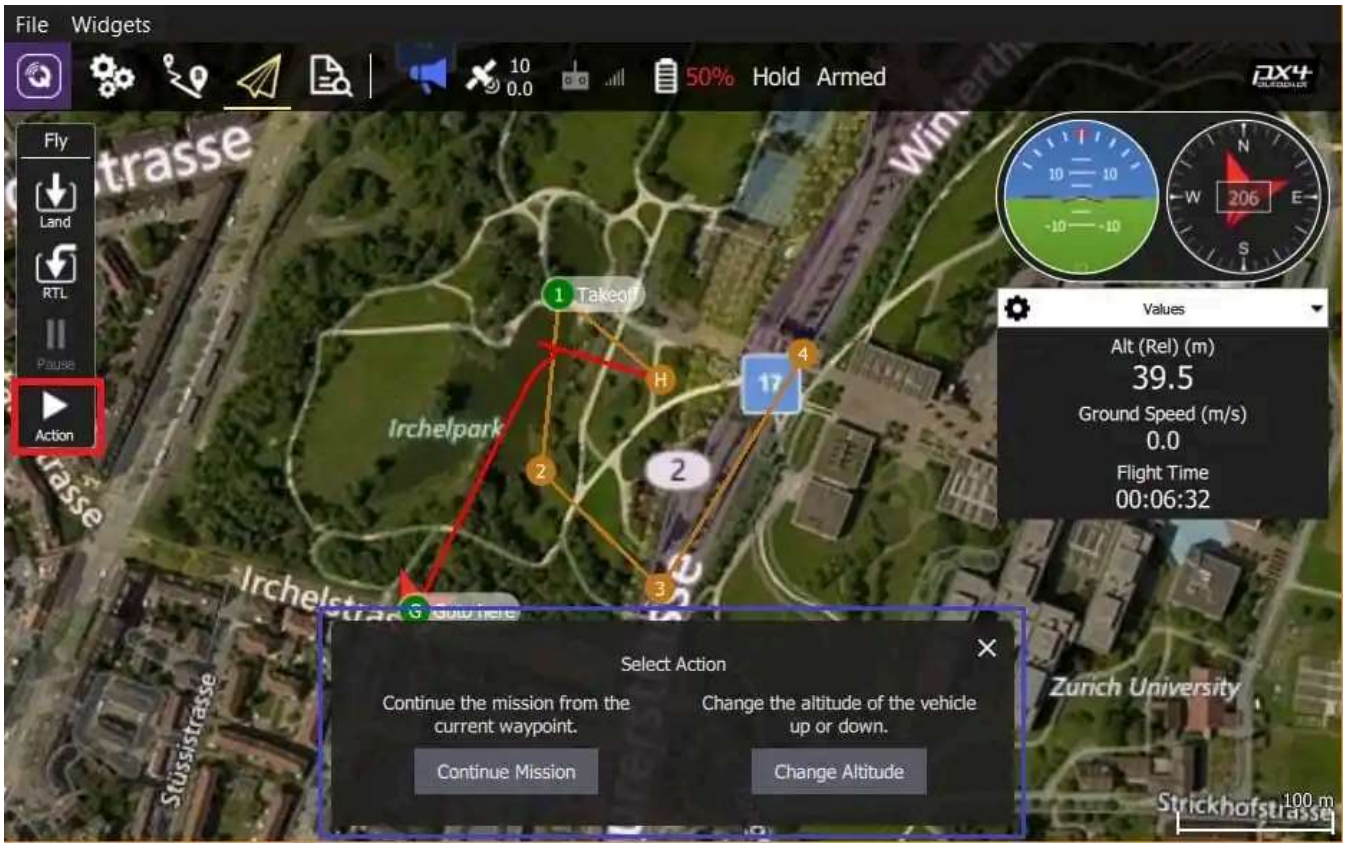
INFO

Vehicles commonly return to the "home" (takeoff) location and land. This behaviour depends on the vehicle type and configuration. For example, rally points or mission landings may be used as alternative return targets.

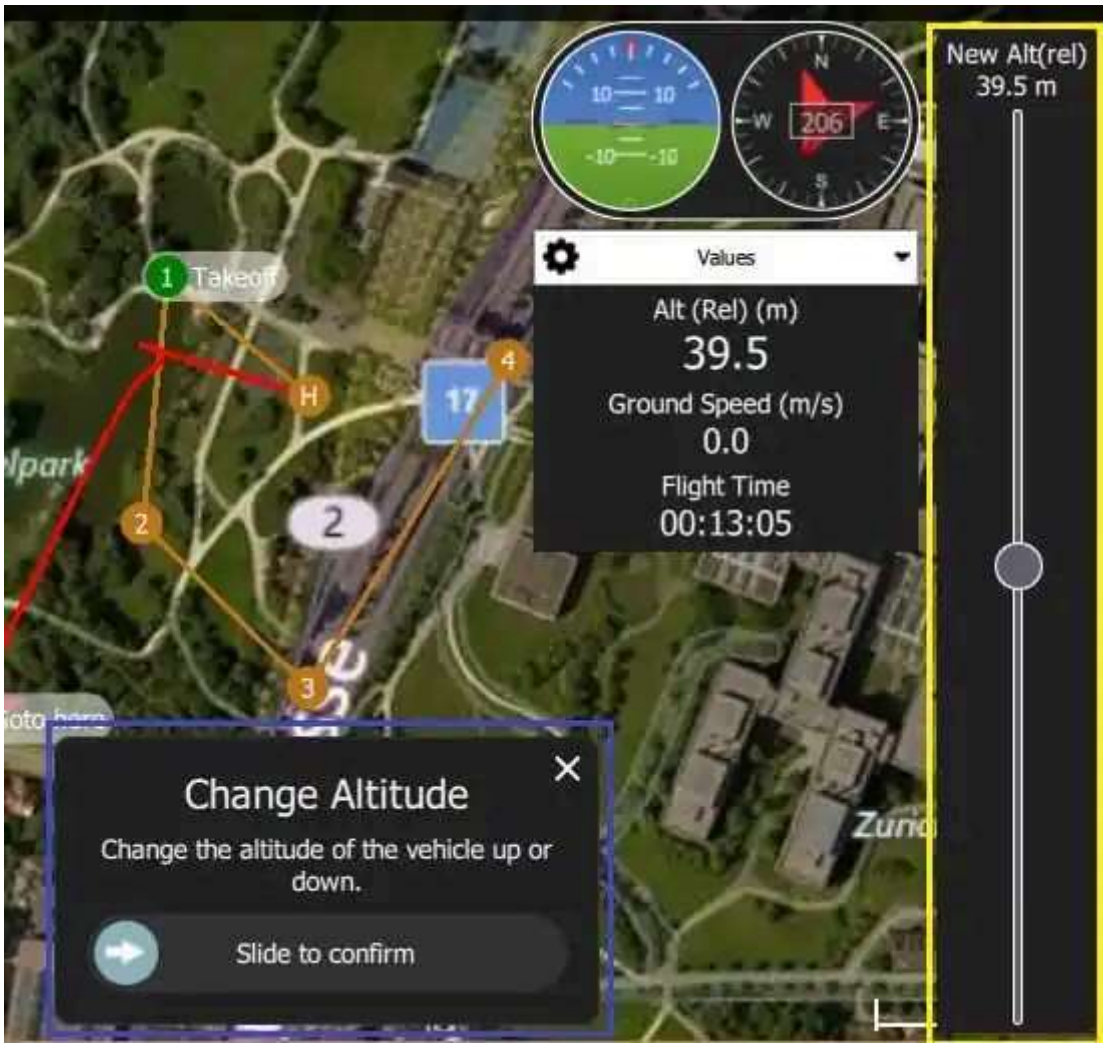
Change Altitude

You can change altitude while flying, except when in a mission:

1. Press the **Action** button on the *Fly Tools*
2. Select the *Change Altitude* action from the dialog.



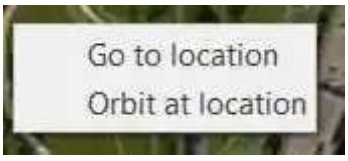
3. Move the vertical slider to the desired altitude, then drag the confirmation slider to start the action.



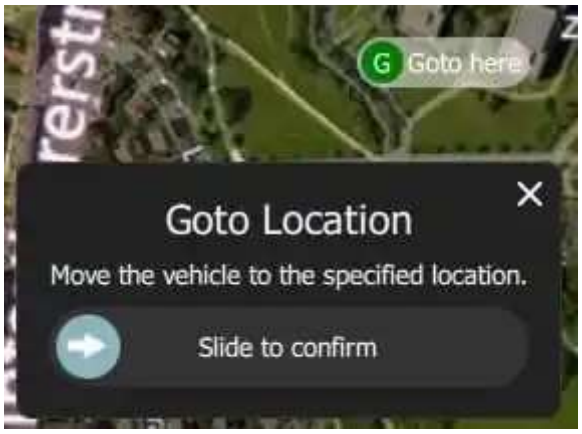
Goto Location

After taking off you can specify that you want to fly to a particular location.

1. Left click/Press on the map where you want the vehicle to move and select **Go to location** on the popup.



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



2. When you're ready, drag the slider to start the operation (or press the **X** icon to cancel it).

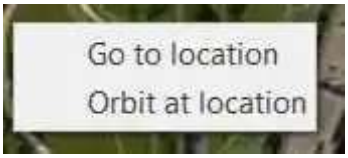
INFO

Goto points must be set within 1 km of the vehicle (hard-coded in QGC).

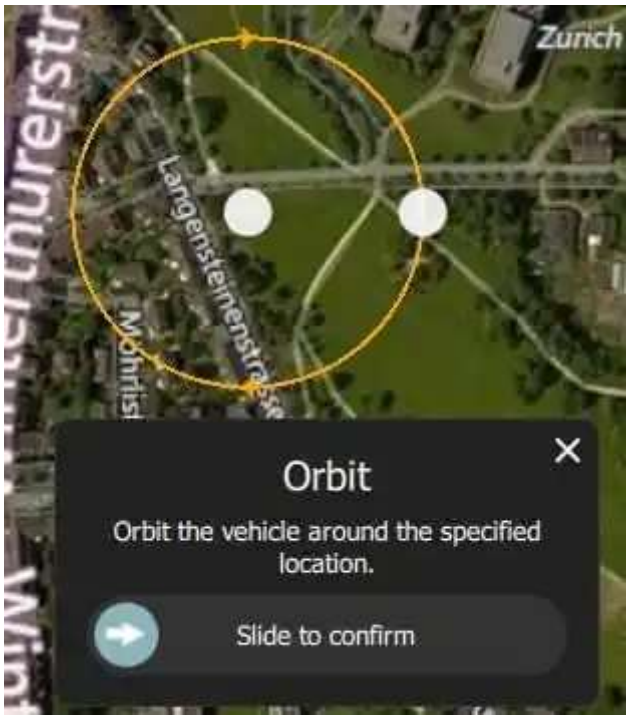
Orbit Location

After taking off you can specify that you want to orbit a particular location.

1. Left click/Press on the map (near the centre of your desired orbit) and select **Orbit at location** on the popup.



1. The proposed orbit will be displayed on the map, along with a confirmation sider.



- 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

2. When you're ready, drag the slider to start the operation (or press the **X** icon to cancel it).

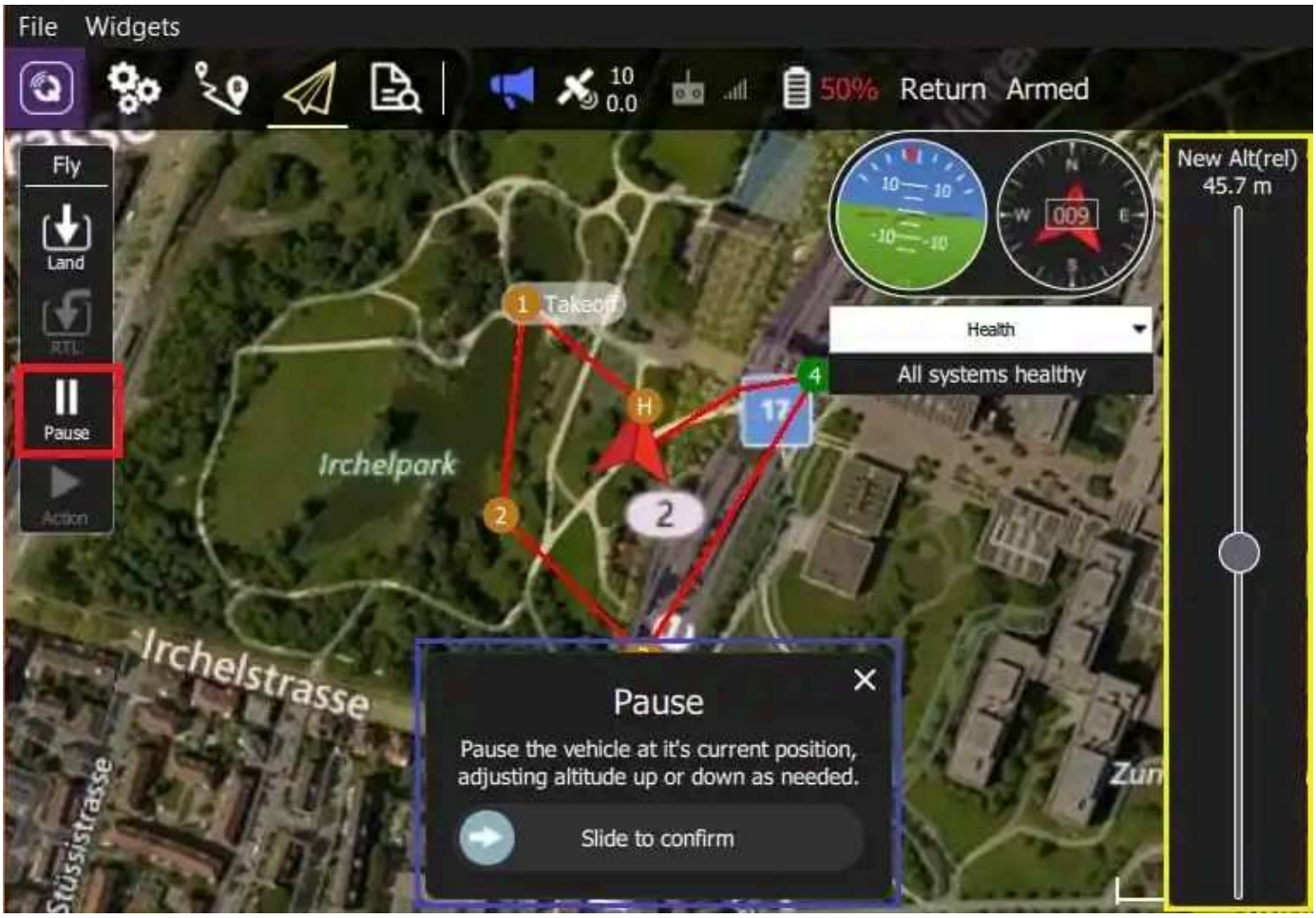
Pause

You can pause most operations, including taking off, landing, RTL, mission execution, orbit at location. The vehicle behaviour when paused depends on the vehicle type; typically a multicopter will hover, and a fixed wing vehicle will circle.

> **INFO**
>
> You cannot pause a *Goto location* operation.

To pause:

1. Press the **Pause** button in the *Fly Tools*.
2. Optionally set a new altitude using the right-side vertical slider.
3. Confirm the pause using the slider.



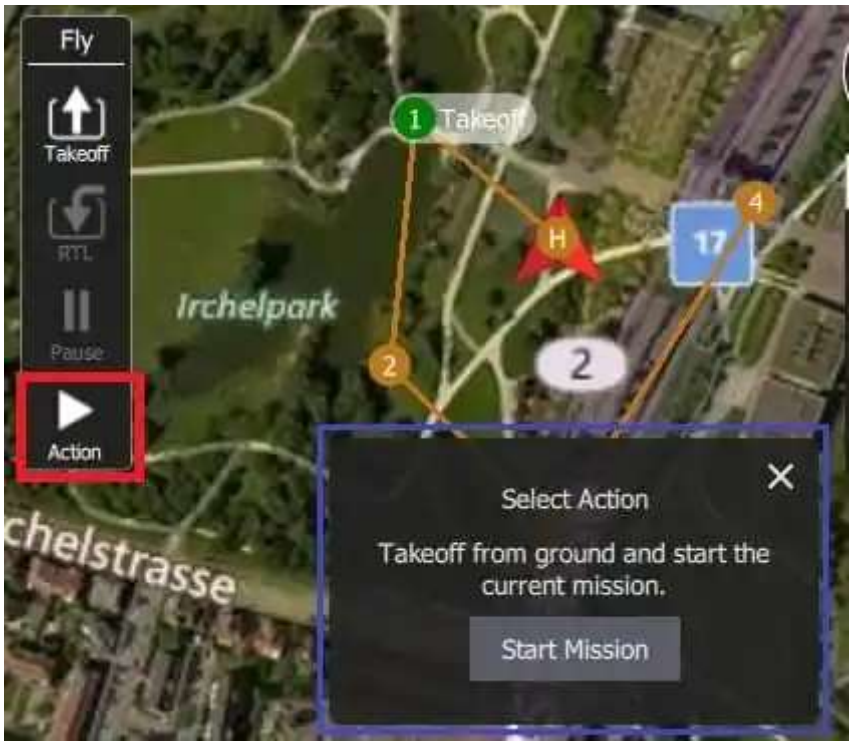
Missions

Start Mission

You can start a mission when the vehicle is landed (the start mission confirmation slider is often displayed by default).

To start a mission from landed:

1. Press the **Action** button on the *Fly Tools*
2. Select the *Start Mission* action from the dialog.



(to display the confirmation slider)

3. When the confirmation slider appears, drag it to start the mission.

Continue Mission

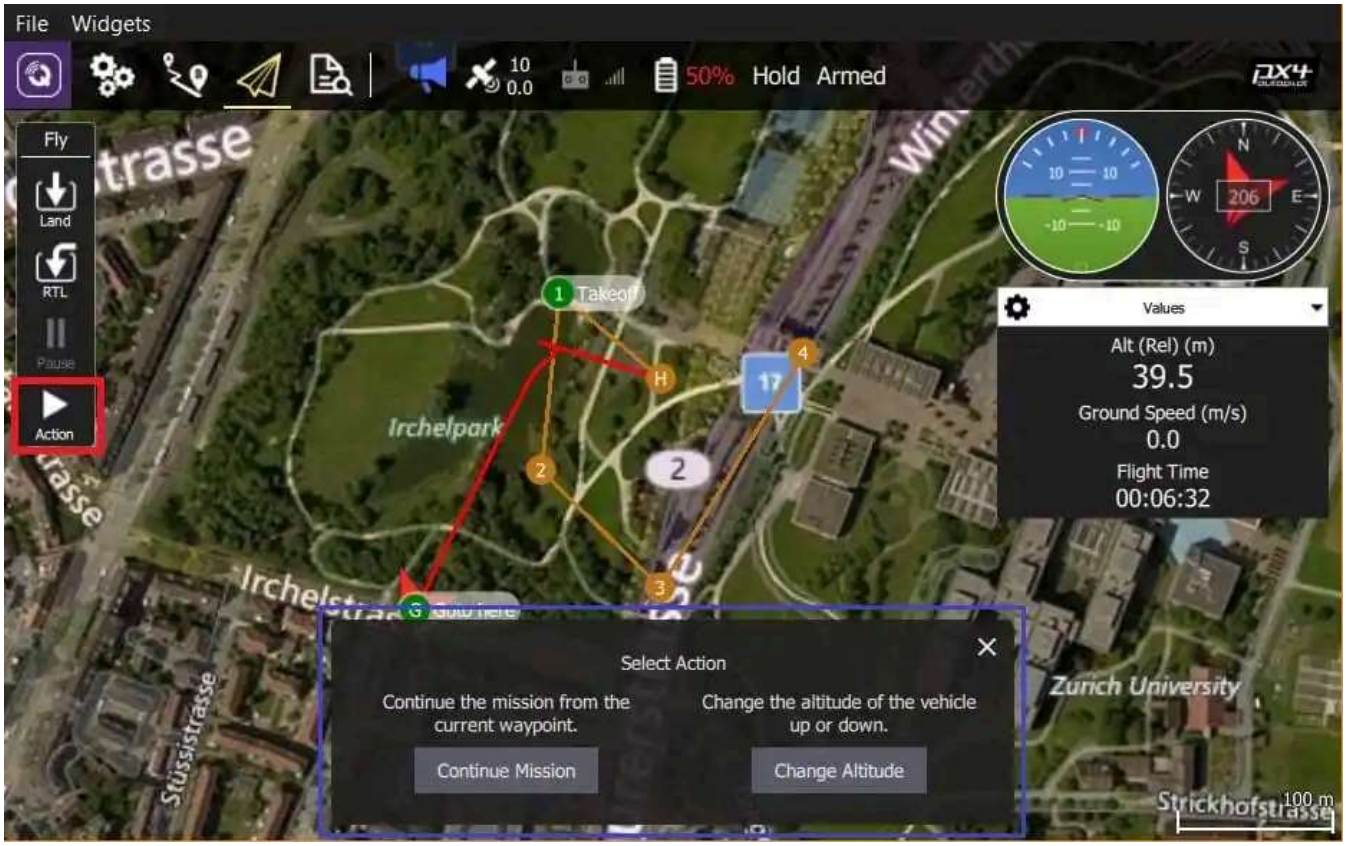
You can *continue* mission from the *next* waypoint when you're flying (the *Continue Mission* confirmation slider is often displayed by default after you takeoff).

> **INFO**
>
> Continue and Resume mission are different! Continue is used to restart a mission that has been paused, or where you have taken off, so you've already missed a takeoff mission command. Resume mission is used when you've used a RTL or landed midway through a mission (e.g. for a battery change) and then wish to continue the next mission item (i.e. it takes you to where you were up to in the mission, rather than continuing from your place in the mission).

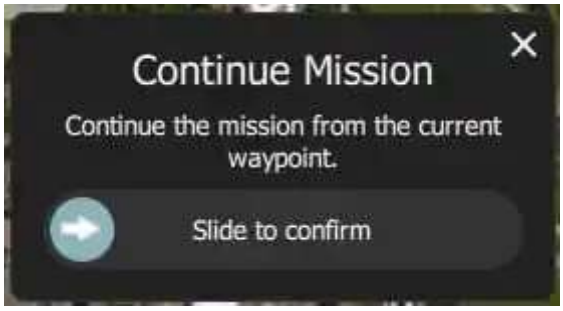
You can continue the current mission while (unless already in a mission!):

1. Press the **Action** button on the *Fly Tools*

2. Select the *Continue Mission* action from the dialog.



3. Drag the confirmation slider to continue the mission.



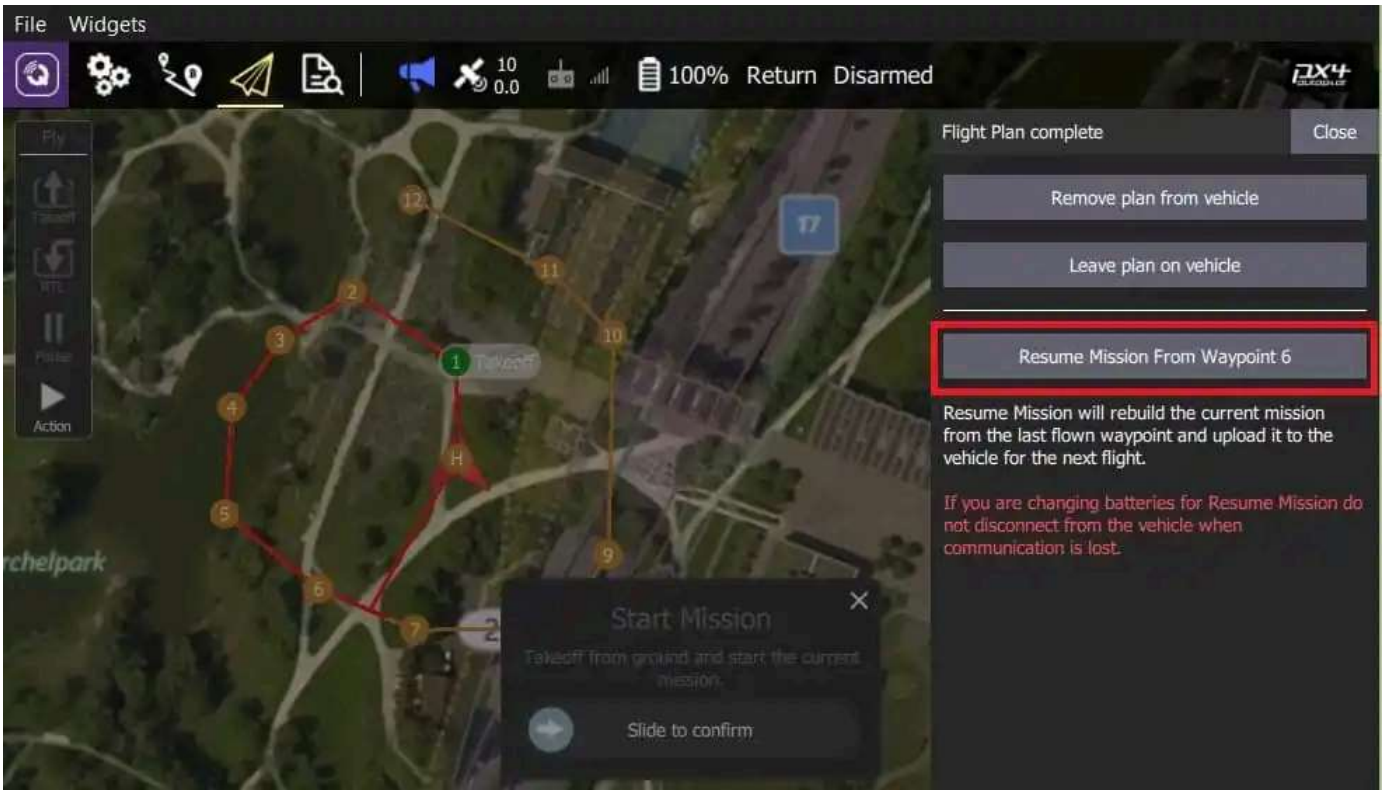
Resume Mission

Resume Mission is used to resume a mission after performing an RTL/Return or Land from within a mission (in order, for example, to perform a battery change).

INFO

If you are performing a battery change, **do not** disconnect QGC from the vehicle after disconnecting the battery. After you insert the new battery *QGroundControl* will detect the vehicle again and automatically restore the connection.

After landing you will be prompted with a *Flight Plan complete* dialog, which gives you the option to remove the plan from the vehicle, leave it on the vehicle, or to resume the mission from the last waypoint that was traveled through.



If you select to resume the mission, then *QGroundControl* will rebuild the mission and upload it to the vehicle. Then use the *Start Mission* slider to continue the mission.

The image below shows the mission that was rebuilt after the Return shown above.

INFO

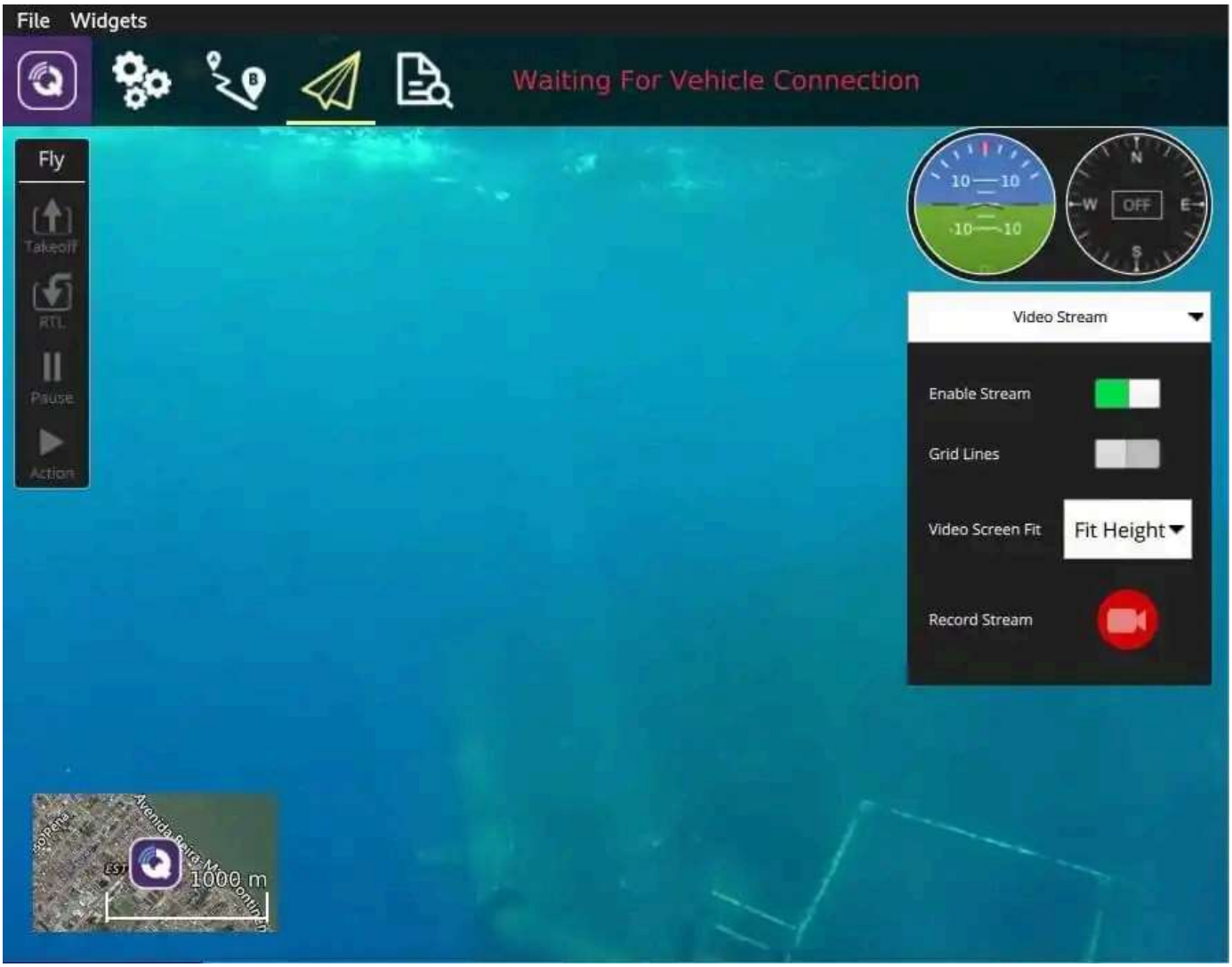
A mission cannot simply resume from the last mission item that the vehicle executed, because there may be multiple items at the last waypoint that affect the next stage of the mission (e.g. speed commands or camera control commands). Instead *QGroundControl* rebuilds the mission, starting from the last mission item flown, and automatically prepending any relevant commands to the front of the mission.

Remove Mission Prompt After Landing

You will be prompted to remove the mission from the vehicle after the mission completes and the vehicle lands and disarms. This is meant to prevent issues where stale missions are unknowingly left on a vehicle, potentially resulting in unexpected behavior.

Display Video

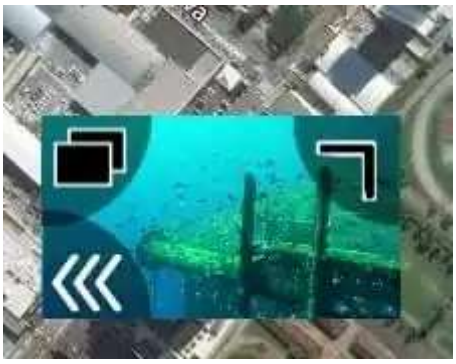
When video streaming is enabled, *QGroundControl* will display the video stream for the currently selected vehicle in the "video switcher window" at the bottom left of the map. You can press the switcher anywhere to toggle *Video* and *Map* to foreground (in the image below, the video is shown in the foreground).



INFO

Video streaming is configured/enabled in Application Settings > General tab > Video.

You can further configure video display using controls on the switcher:



- Resize the switcher by dragging the icon in the top right corner.
- Hide the switcher by pressing the toggle icon in the lower left.

- Detach the video switcher window by pressing on the icon in its top left corner (once detached, you can move and resize the window just like any other in your OS). If you close the detached window the switcher will re-lock to the QGC Fly view.

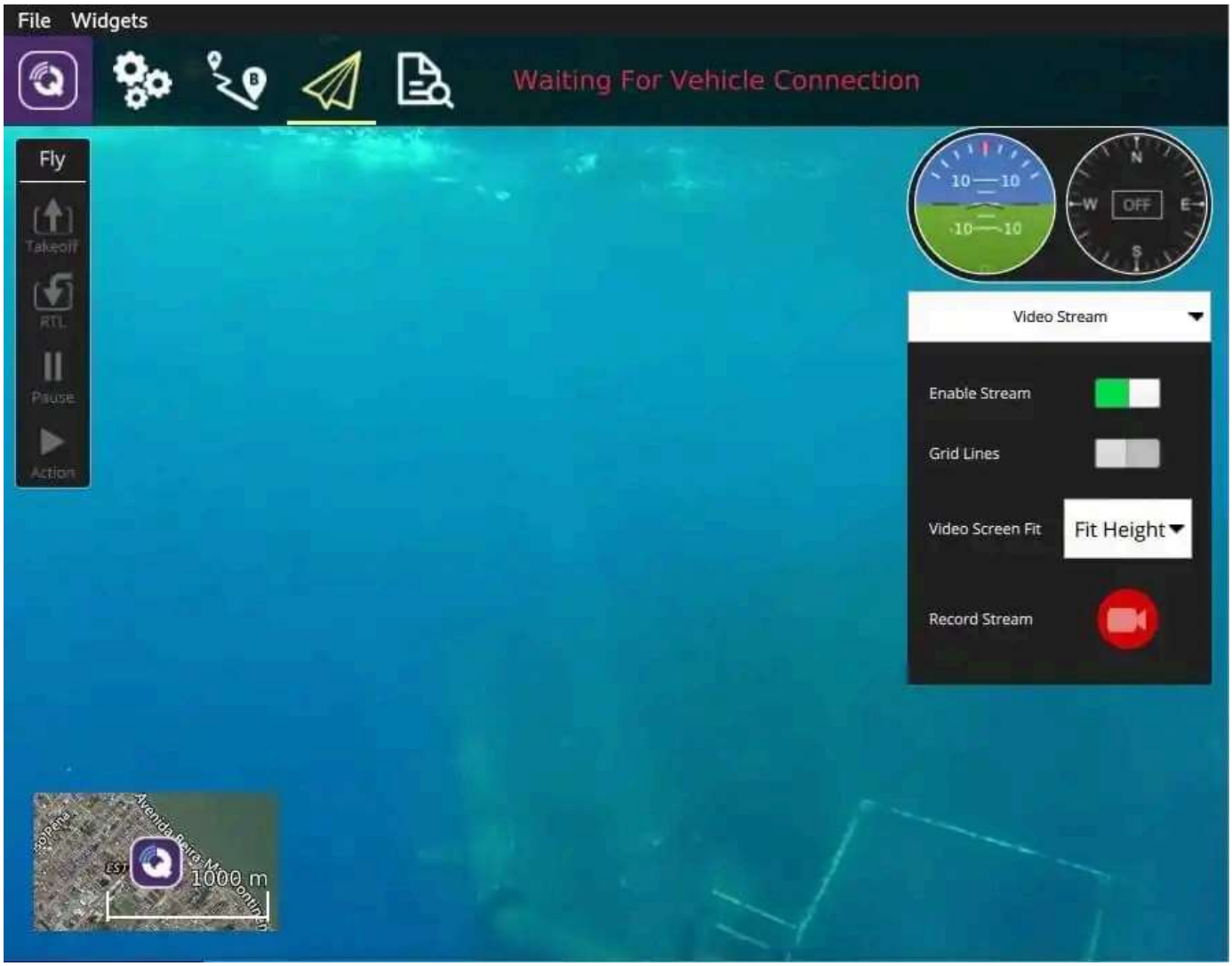
Record Video

If supported by the camera and vehicle, *QGroundControl* can start and stop video recording on the camera itself. *QGroundControl* can also record the video stream and save it locally.

> **TIP**
>
> Video stored on the camera may be of much higher quality, but it is likely that your ground station will have a much larger recording capacity.

Record Video Stream (on GCS)

Video stream recording is controlled on the video stream instrument page. Press the red circle to start recording a new video (a new video file is created each time the circle is pressed); the circle will change into a red square while recording is in progress.



Video stream recording is configured in the Application Settings > General tab:

- Video Recording - specifies the recording file format and storage limits.

> **INFO**
>
> Videos are saved in Matroska format (.mkv) by default. This format is relatively robust against corruption in case of errors.

- Miscellaneous - Streamed video is saved under the **Application Load/Save Path**.

> **TIP**
>
> The stored video includes just the video stream itself. To record video with QGroundControl application elements displayed, you should use separate screen recording software.

Record Video on Camera

Start/stop video recording *on the camera itself* using the [camera instrument page]. First toggle to video mode, then select the red button to start recording.

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Replay Flight Data

Replay Flight Data

WARNING

This feature is intended primarily for **autopilot developers/vehicle creators**. It is only supported on desktop builds (Windows, Linux, Mac OS).

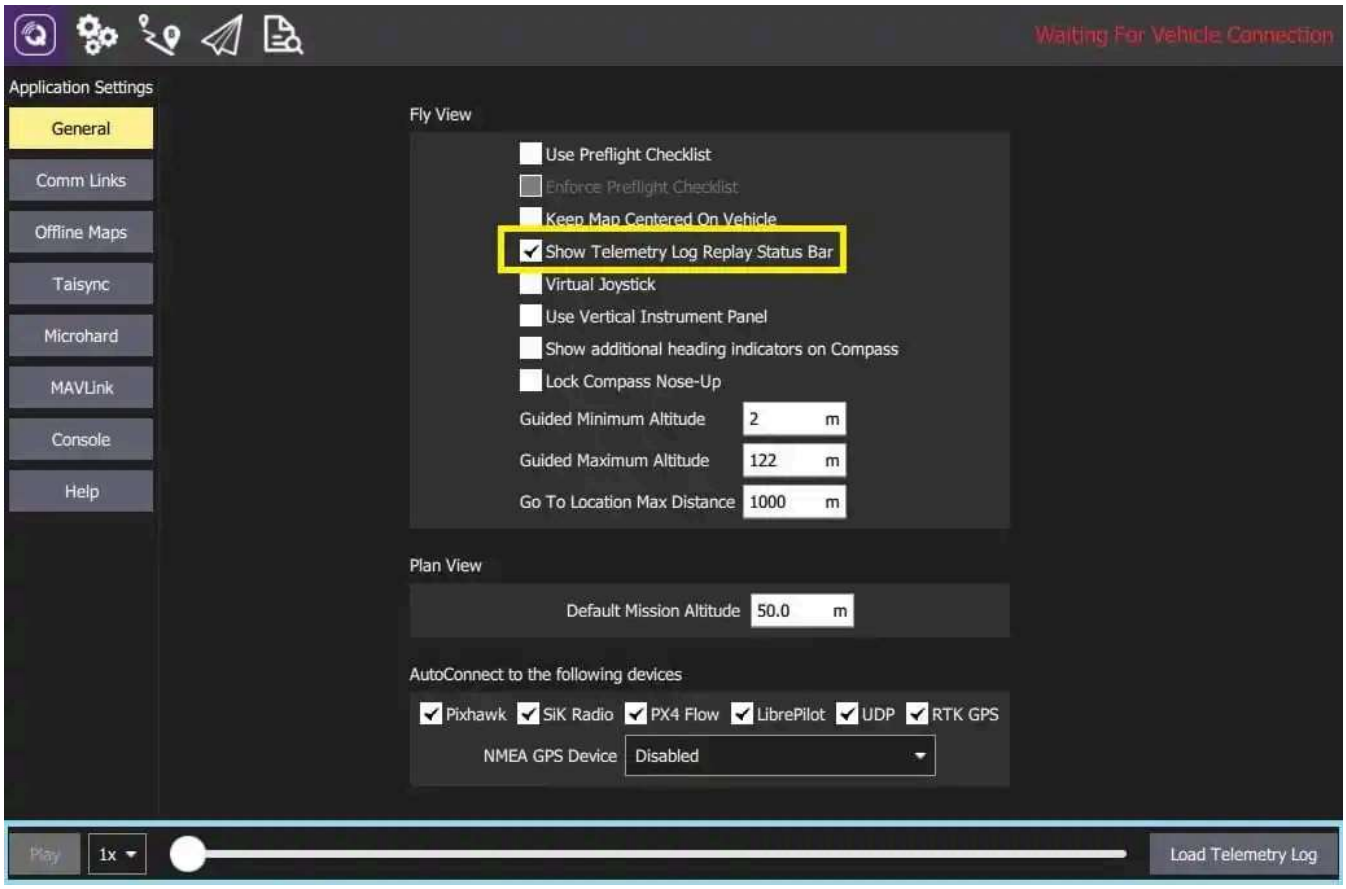
The *Replay Flight Data* feature allows users to replay a telemetry log, enabling review of past or problematic flights. The flight can be started, paused, stopped, restarted etc.

INFO

QGroundControl treats flight replay like an active connection. When you pause/stop playing, the ground station will report "Communication Lost" and wait for disconnection or for more messages.

To replay a flight:

1. Disconnect any active connections.
2. Select **Application Settings > General > Fly View**
3. Check **Show Telemetry Log Replay Status Bar** to toggle the flight replay bar at the bottom of the screen.



4. Select the **Load Telemetry Log** button in the bar to display a *file selection* dialog.
   - Choose a log file to replay from the available telemetry logs.
   - *QGroundControl* will immediately start playing the log.
5. When a log is loaded you can use the:
   - **Pause/Play** button to pause and restart playing.
   - *Slider* to drag to a new position in the log.
   - *Rate* selector to choose the playback speed.
6. To stop replay (i.e. to load a new file to replay), first pause the flight, and then select **Disconnect** (when it appears). After disconnecting, the **Load Telemetry Log** button will be displayed.

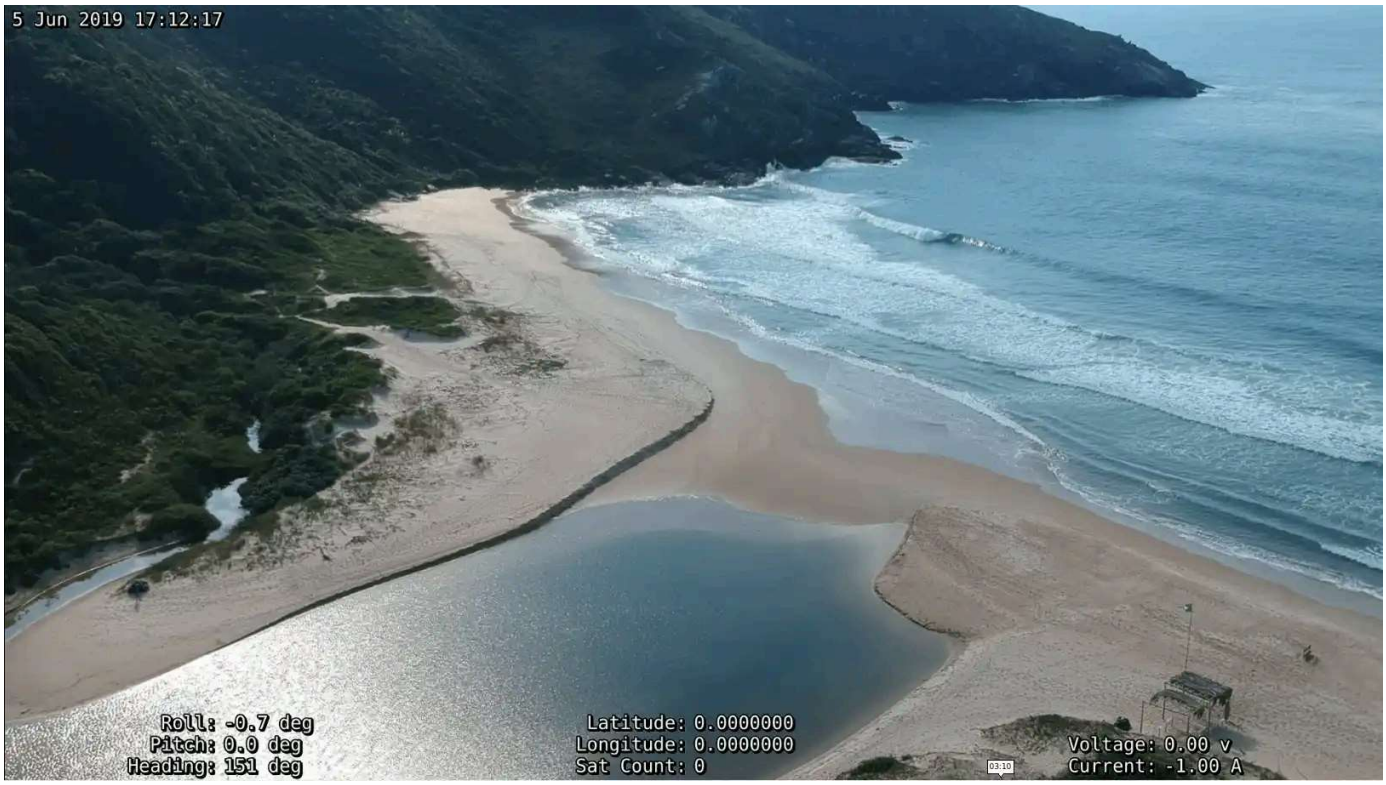
TIP

You can inspect the running replay in more detail using the MAVLink Inspector.

Video Overlay

When QGroundControl is recording a video stream to a file, it will also export a subtitle file with telemetry data that can be used to overlay the telemetry on the video during playback. Whichever telemetry values are selected for display in the telemetry values widget will also be exported to the overlay. The overlay values are updated at 1Hz.

The selected values are laid out in three columns to optimize the screen utilization.



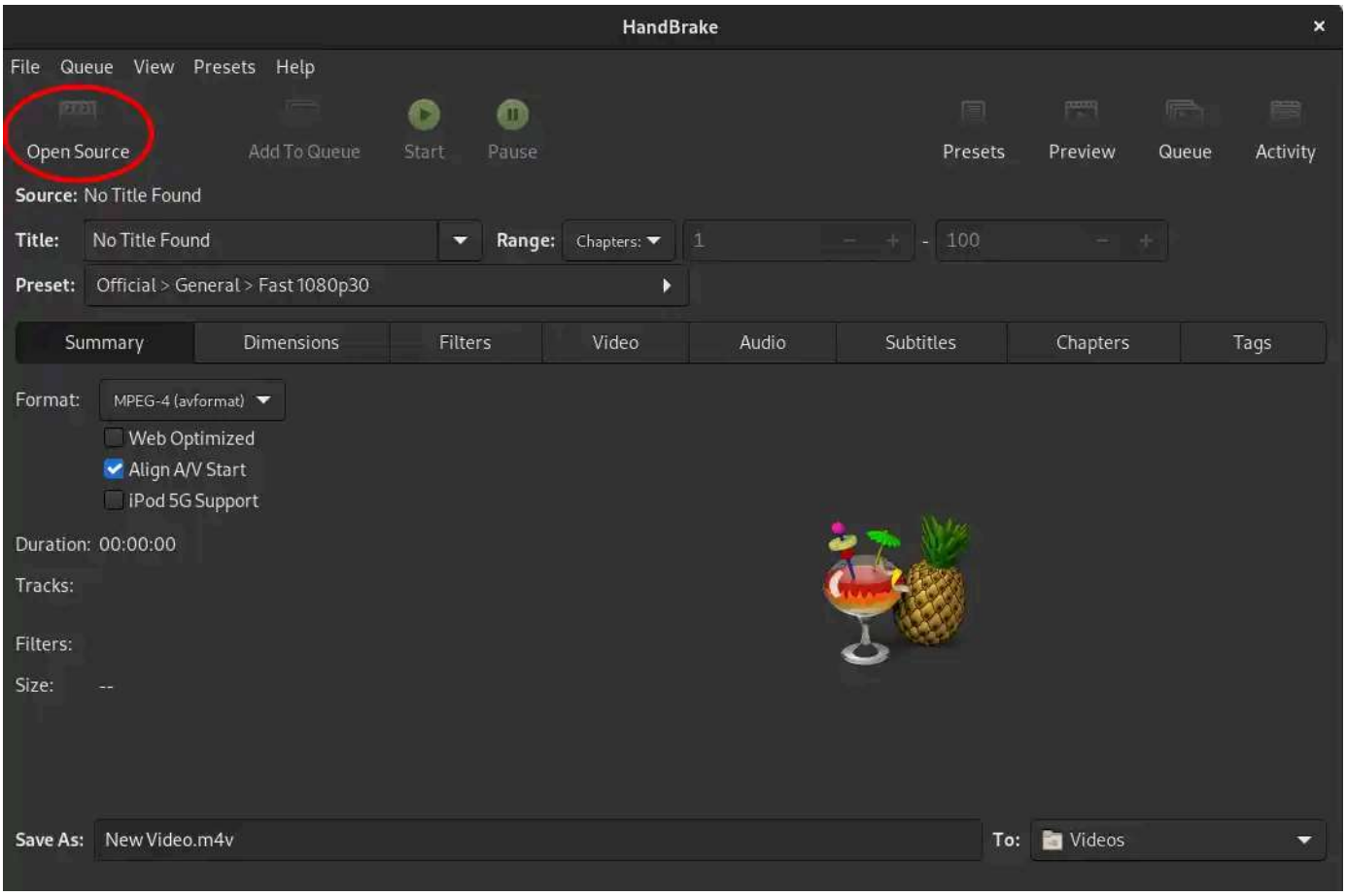
Playing

The overlay can be used with any player that supports the SubStation Alpha subtitle format. Most players will open both files together when you try to play the video. They need to be in the same folder and with the same name, which is how they are created by QGC.

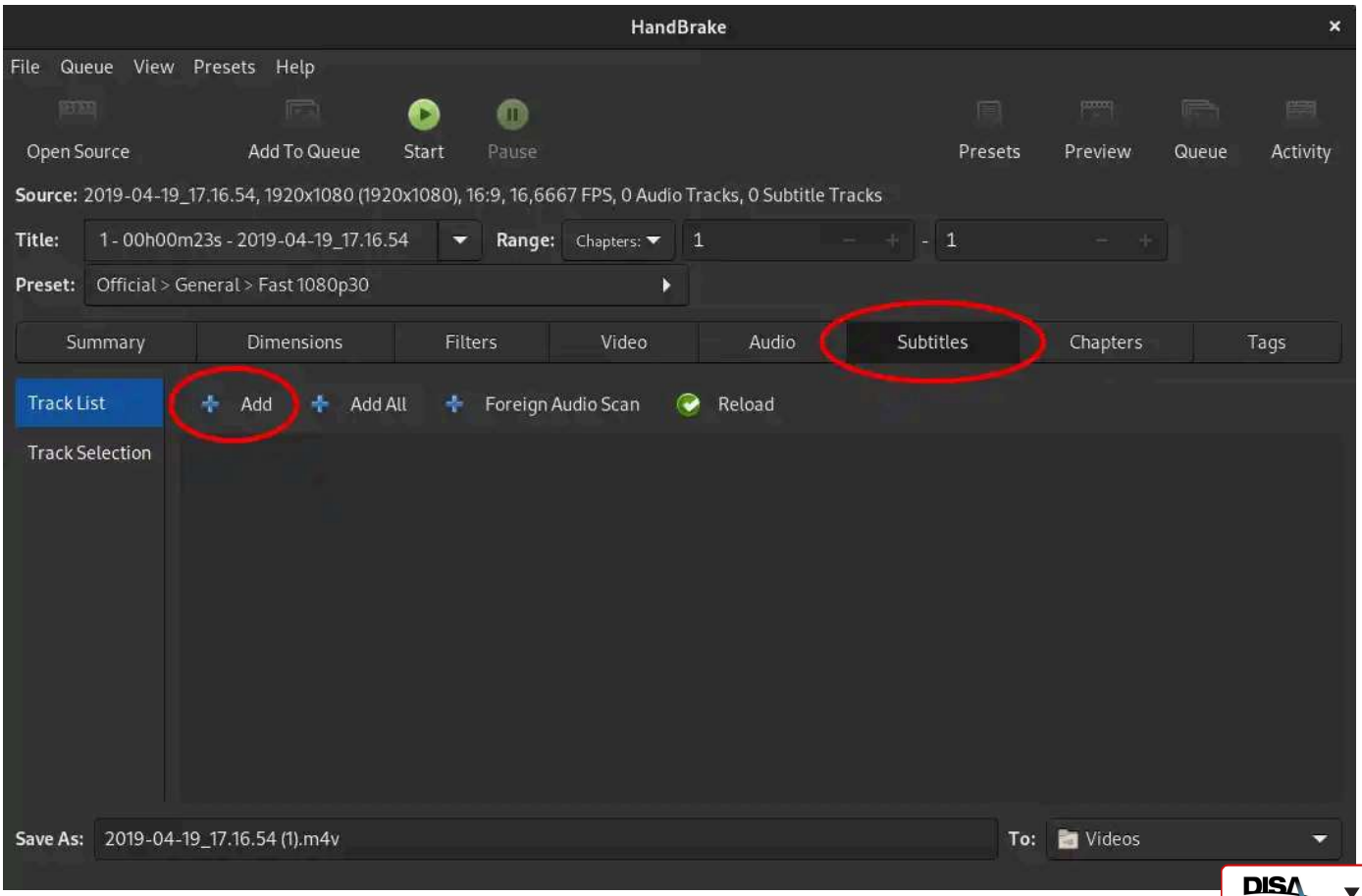
Permanent Video Subtitles using Handbrake

Subtitles can be permanently added to a video file using HandBrake. This will make the subtitles permanently visible on any video player.

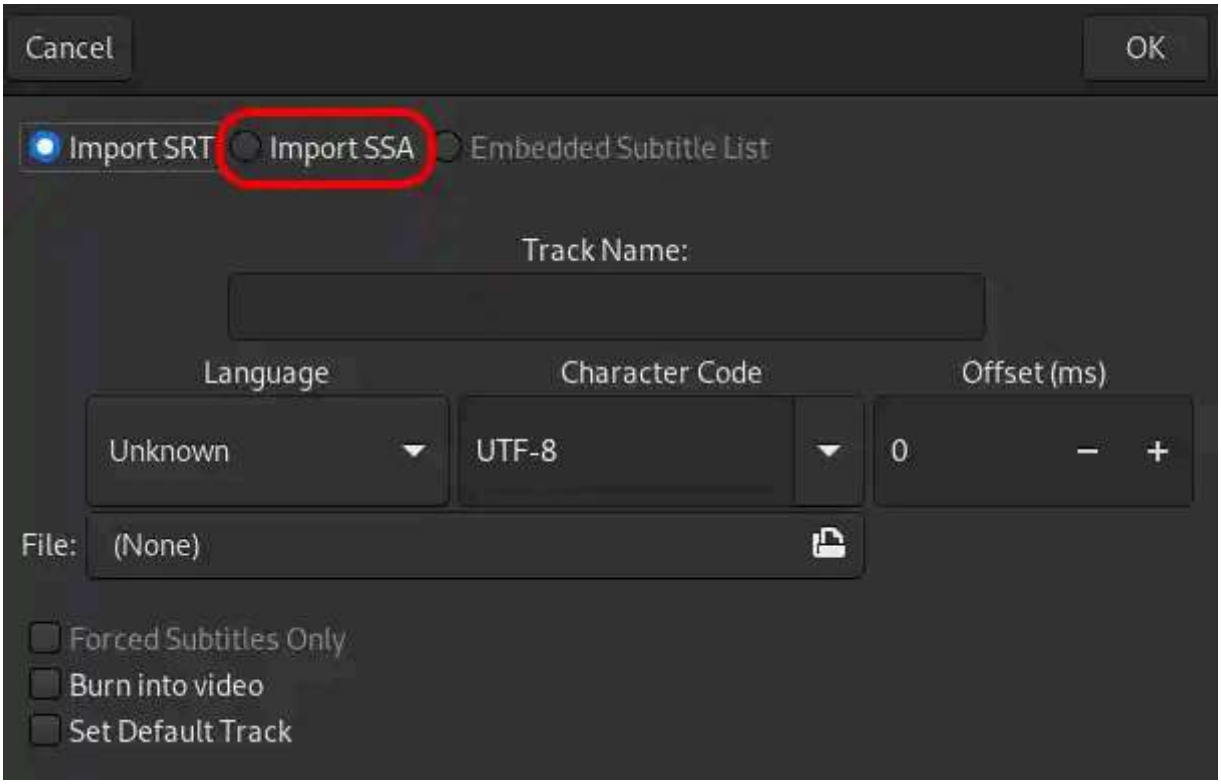
Open **HandBrake**, you should see its main interface. Click **Open** and select the video file.



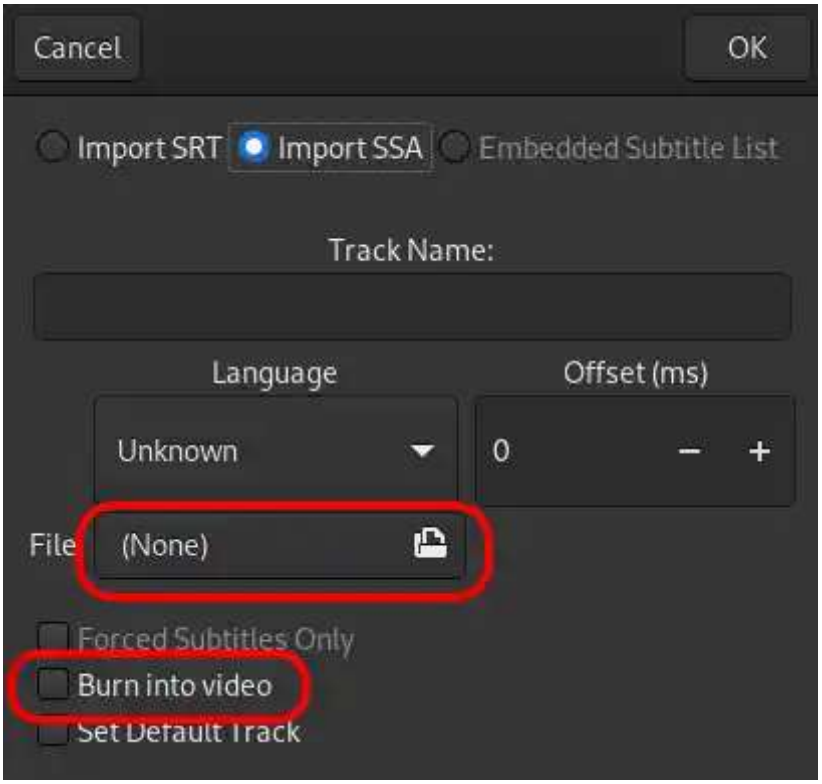
With the video file loaded, switch to the subtitles tab. Click **Add** to load the subtitle file.



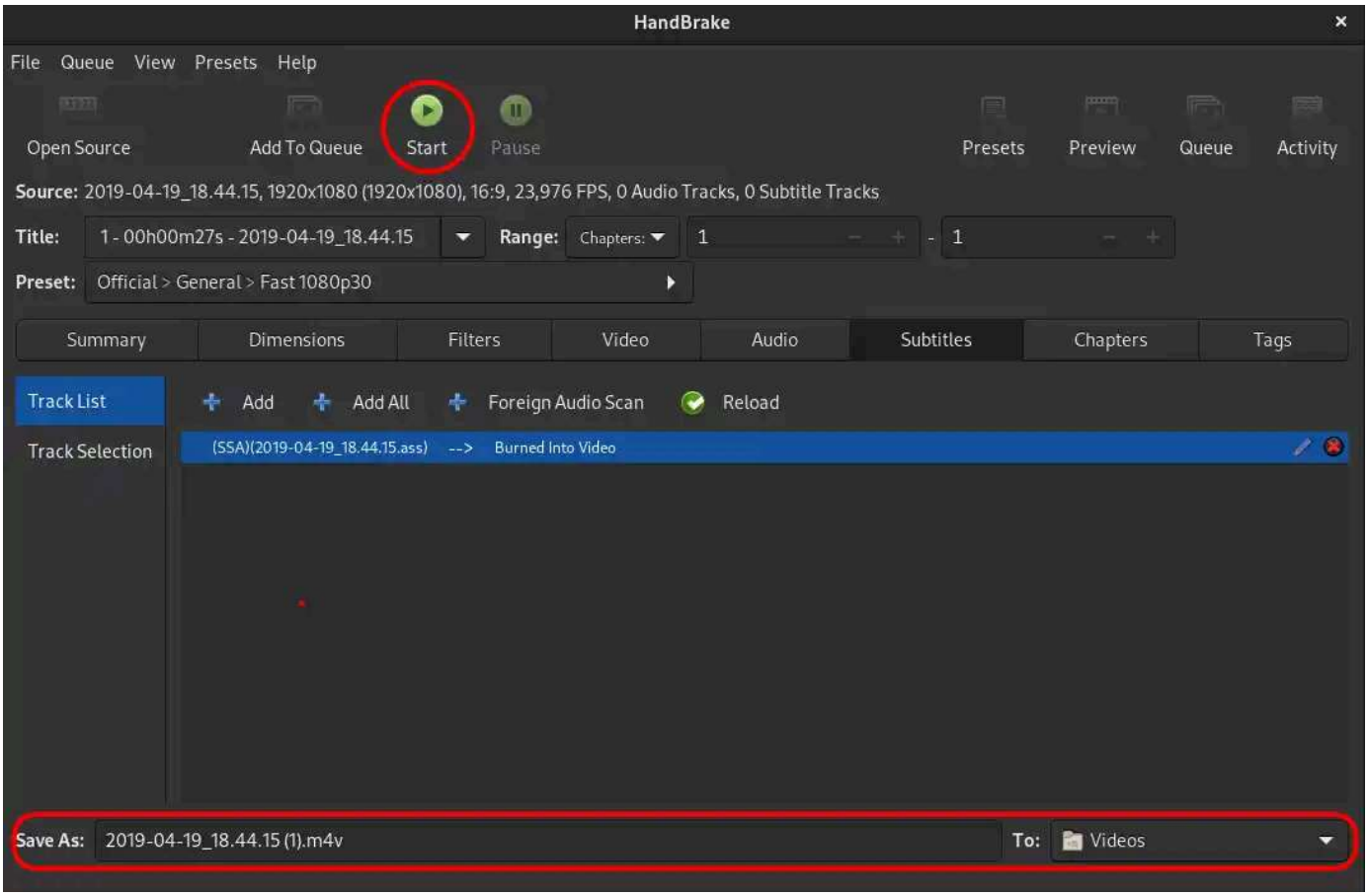
Choose **import SSA** (ASS is an extension of SSA).



Load the **.ass** file corresponding to your video and tick the **Burn into video** checkbox.



Choose where you want to save the new file and click **Start**.



This will start burning the subtitle and video to a new file.

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Custom Mavlink Actions

Custom Mavlink Action

Both the Fly View and Joysticks support the ability execute arbitrary mavlink commands to the active vehicle. In the Fly View these will show up in the Toolstrip Action list. With Joysticks you can assign then to button presses.

Custom Actions File

The custom actions available are defined in a JSON file. The format of that file is as follows:

```
{
    "version":    1,
    "fileType":   "CustomActions",
    "actions":
[
{
    "label":        "First Command",
    "description":  "This is the first command",
    "mavCmd":       10,
    "compId":       100,
    "param1":       1,
    "param2":       2,
    ...
},
{
    "label":        "Second Command",
    "description":  "This is the second command",
    "mavCmd":       20,
    ...
}
```

```
    ]
}
```

Fields:

- actions (required) - An array of json objects, one for each command
- label (required) - The user visible short description for the command. This is used as the button text for the Fly View - Actions command list. For Joysticks, this is the command you select from the dropdown. For Joysticks, make sure your name doesn't conflict with the built in names.
- description (required) - This is a longer description of the command used in the Fly View - Action list. This is not used by joysticks.
- mavCmd (required) - The command id of the mavlink command you want to send.
- compId (options) - The component id for where you want to send the command to. If not specified `MAV_COMP_ID_AUTOPILOT1` is used.
- param1 thru param7 (optional) - The parameters for the command. Parameters which are not specified will default to 0.0

Custom action files should be located in the CustomActions directory of the QGC save location. For example on Linux that would be `~/Documents/QGroundControl/CustomActions` or `~/Documents/QGroundControl Daily/CustomActions`. The Fly View and Joysticks each have there own custom actions files:

- Fly View - FlyViewCustomActions.json
- Joystick - JoystickCustomActions.json

When you start up QGC it will load these files if they exist and make the commands available for use.

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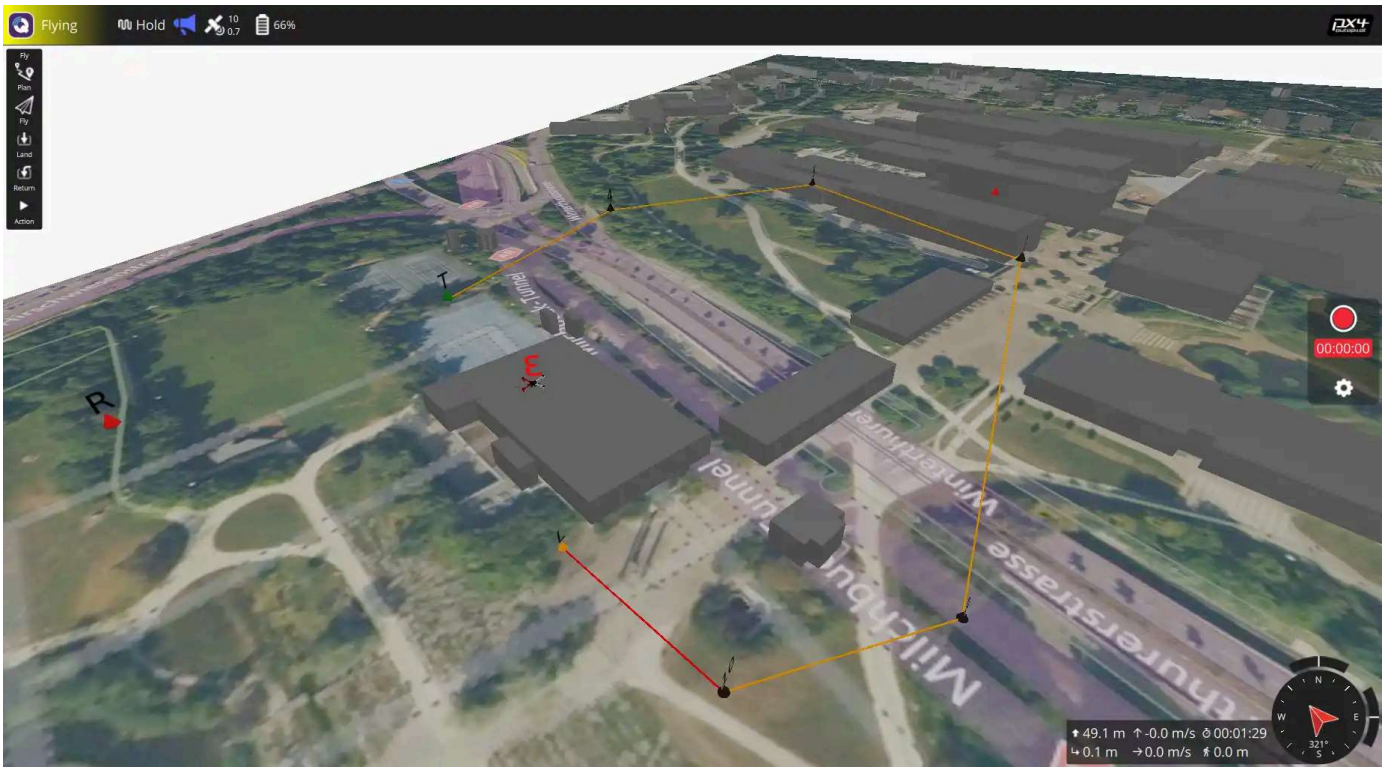
3D View

3D View

The 3D View is used to visualize and monitor the vehicle, the environment, and the planned mission in 3D. Most of the capabilities available in the Fly View is also available in the 3D View.

You can use it to:

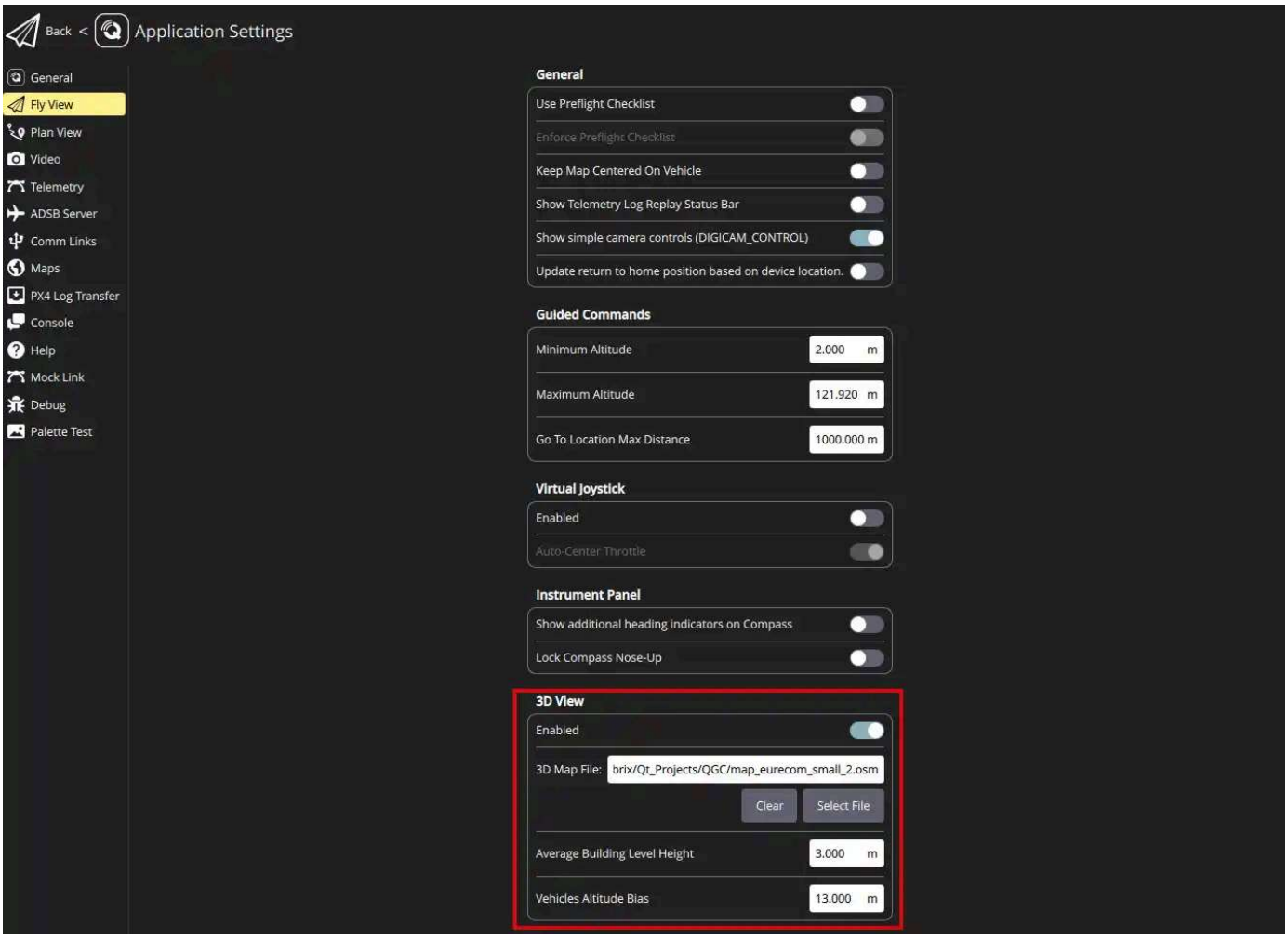
- To import and display the 3D map for any region of interest downloaded from the OpenStreetMap website (.osm file).
- Display the vehicle along with its mission in 3D.
- And most of the capabilities of the Fly View, including:
  - Run an automated pre-flight checklist.
  - Arm the vehicle (or check why it won't arm).
  - Control missions: start, continue, pause, and resume.
  - Guide the vehicle to arm/disarm/emergency stop, takeoff/land, change altitude, and return/RTL.
  - Switch between a map view and a video view (if available)
  - Display video, mission, telemetry, and other information for the current vehicle, and also switch between connected vehicles.



UI Overview

The screenshot above shows the main elements of the 3D View.

Enabling the 3D View: The 3D View is disabled by default. To enable it, go to **Application Settings** →**Fly View** tab, and under the **3D View** settings group, toggle the **Enabled** switch as shown below:



To open the 3D View, when you are in the Fly View, from the toolbar on the left, select the 3D View icon as illustrated below:

Once the 3D View is opened, you can navigate through the 3D environment by using either a mouse or a touchscreen as follows:

- **Mouse:**
  - **To move horizontally and vertically**: Press and hold the mouse left-click, then move the cursor.

- **To rotate**: Press and hold the mouse right-click, then move the cursor.
- **To zoom**: Use the mouse wheel\middle button.

- **Touchscreen:**
  - **To move horizontally and vertically**: Use a single finger, then tap and move your finger.
  - **To rotate**: Use two fingers, then tap and move your fingers while keeping them together.
  - **To zoom**: Use a pinch with two fingers and move them together or apart to zoom in or out.

To visualize the 3D map of a particular area in the 3D viewer, you have to download the .osm file of that area from the OpenStreetMap website and then import it through the **3D View** settings. More details on the **3D View** settings can be found in the next section.

Settings

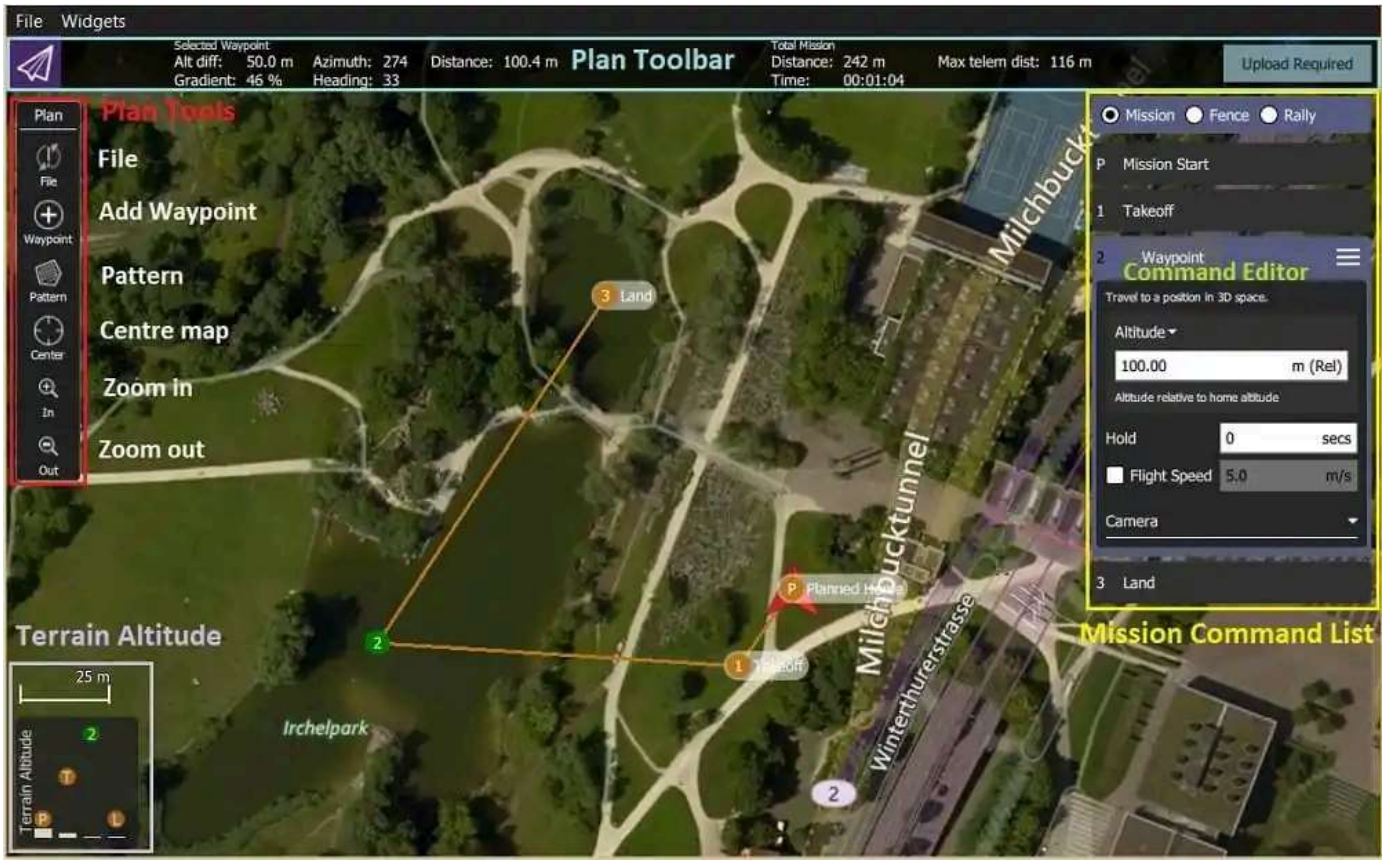
You can change the settings of the 3D View from **Application Settings** →**Fly View** tab under the **3D View** settings group. The following properties can be modified in the 3D View settings group:

- **Enabled**: To enable or disable the 3D View.
- **3D Map File**: The path to the .osm file of a region of interest to be visualized in the QGC. The .osm file can be uploaded by clicking on the **Select File** button. To clear the 3D View from the previously loaded .osm file, you can click on the **Clear** button.
- **Average Building Level Height**: This parameter determines the height of each storey of the buildings, as in .osm file sometimes the height of the buildings is specified in terms of the level/storey.
- **Vehicle Altitude Bias**: This refers to the bias in the altitude of vehicles and their missions with respect to the ground level. It is helpful in cases where the estimated altitude of the vehicle by its flight control is biased, as the relative altitude is currently used in the 3D View.

Plan View

The *Plan View* is used to plan *autonomous missions* for your vehicle, and upload them to the vehicle. Once the mission is planned and sent to the vehicle, you switch to the Fly View to fly the mission.

It is also use to configure the GeoFence and Rally Points if these are supported by the firmware.



UI Overview

The screenshot above shows a simple mission plan that starts with a takeoff at the Planned Home position (H), flies through three waypoints, and then lands on the la

waypoint (i.e. waypoint 3).

The main elements of the UI are:

- **Map:** Displays the numbered indicators for the current mission, including the Planned Home. Click on the indicators to select them (for editing) or drag them around to reposition them.
- **Plan Toolbar:** Status information for the currently selected waypoint relative to the previous waypoint, as well as statistics for the entire mission (e.g. horizontal distance and time for mission).
  - `Max telem dist` is the distance between the Planned Home and the furthest waypoint.
  - When connected to a vehicle it also shows an **Upload** button, can be used to upload the plan to the vehicle.
- Plan Tools**:** Used to create and manage missions.
- Mission Command List/Overlay**:** Displays the current list of mission items (select items to edit).
- **Terrain Altitude Overlay:** Shows the relative altitude of each mission command.

It shows you information related to the currently selected waypoint as well as statistics for the entire mission.

Planning a Mission

At very high level, the steps to create a mission are:

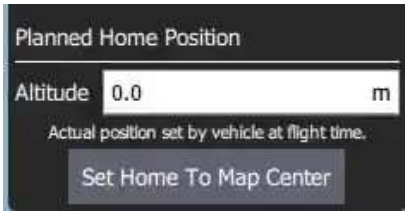
1. Change to *Plan View*.
2. Add waypoints or commands to the mission and edit as needed.
3. Upload the mission to the vehicle.
4. Change to *Fly View* and fly the mission.

The following sections explain some of the details in the view.

Planned Home Position

The *Planned Home* shown in *Plan View* is used to set the approximate start point when planning a mission (i.e. when a vehicle may not even be connected to QGC). It is used by QGC to estimate mission times and to draw waypoint lines.

You should move/drag the planned home position to roughly the location where you plan to takeoff. The altitude for the planned home position is set in the Mission Settings panel.



TIP

The Fly View displays the *actual* home position set by the vehicle firmware when it arms (this is where the vehicle will return in Return/RTL mode).

Plan Tools

The plan tools are used for adding individual waypoints, easing mission creation for complicated geometries, uploading/downloading/saving/restoring missions, and for navigating the map. The main tools are described below.

INFO

Center map, **Zoom In**, **Zoom Out** tools help users better view and navigate the *Plan view* map (they don't affect the mission commands sent to the vehicle).

Add Waypoints

Click on the **Add Waypoint** tool to activate it. While active, clicking on the map will add new mission waypoint at the clicked location. The tool will stay active until you select it again. Once you have added a waypoint, you can select it and drag it around to change its position.

File (Sync)

The *File tools* are used to move missions between the ground station and vehicle, and to save/restore them from files. The tool displays an ! to indicate that there are mission changes that you have not sent to the vehicle.

> **INFO**
>
> Before you fly a mission you must upload it to the vehicle.

The *File tools* provide the following functionality:

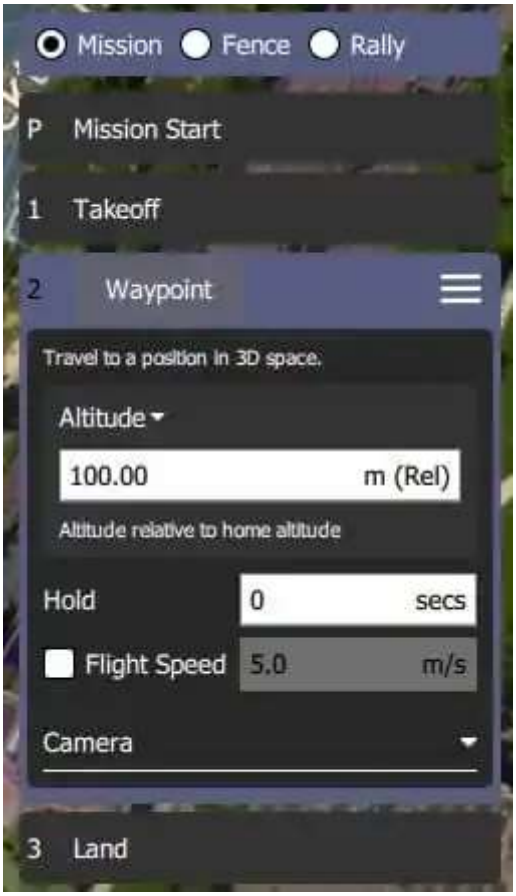
- Upload (Send to vehicle)
- Download (Load from vehicle)
- Save/Save as to File, including as KML file.
- Load from File
- Remove All (removes all mission waypoints from *Plan view* and from vehicle)

Pattern

The Pattern tool simplifies the creation of missions for flying complex geometries, including surveys and structure scans.

Mission Command List

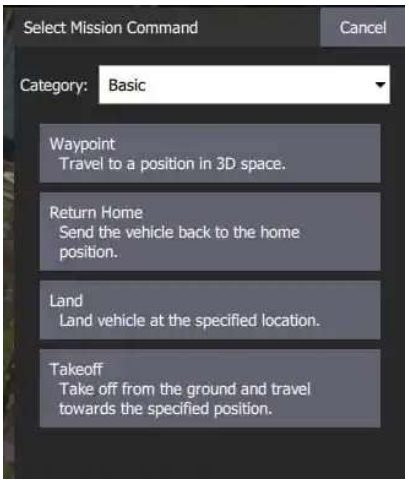
Mission commands for the current mission are listed on the right side of the view. At the top are a set of options to switch between editing the mission, GeoFence and rally points. Within the list you can select individual mission items to edit their values.



Mission Command Editors

Click on a mission command in the list to display its editor (in which you can set/change the command attributes).

You can change the **type** of the command by clicking on the command name (for example: *Waypoint*). This will display the *Select Mission Command* dialog shown below. By default this just displays the "Basic Commands", but you can use the **Category** drop down menu to display more (e.g. choose **All commands** to see all the options).

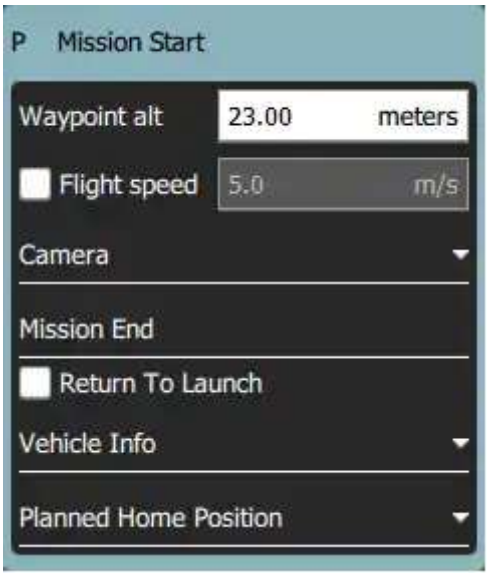


To the right of each command name is a menu that you can click to access to additional options such as *Insert* and *Delete*.

> **INFO**
>
> The list of available commands will depend on firmware and vehicle type. Examples may include: Waypoint, Start image capture, Jump to item (to repeat mission) and other commands.

Mission Settings

The *Mission Start* panel is the first item that appears in the [mission command list](). It may be used to specify a number default settings that may affect the start or end of the mission.



Mission Defaults

Waypoint alt

Set the default altitude for the first mission item added to a plan (subsequent items take an initial altitude from the previous item). This can also be used to change the altitude of all items in a plan to the same value; you will be prompted if you change the value when there are items in a plan.

Flight speed

Set a flight speed for the mission that is different than the default mission speed.

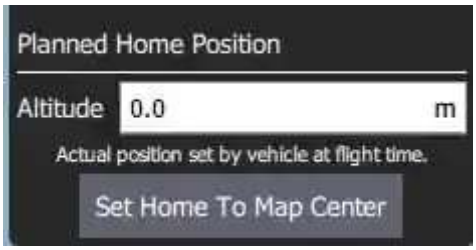
Mission End

Return to Launch after mission end

Check this if you want your vehicle to Return/RTL after the final mission item.

Planned Home Position

The Planned Home Position section allows you to simulate the vehicle's home position while planning a mission. This allows you to view the waypoint trajectory for your vehicle from takeoff to mission completion.



> **INFO**
>
> This is only the *planned* home position and you should place it where you plan to start the vehicle from. It has no actual impact on flying the mission. The actual home position of a vehicle is set by the vehicle itself when arming.

This section allows you to set the **Altitude** and **Set Home to Map Centre** (you can move it to another position by dragging it on the map).

Camera

The camera section allows you to specify a camera action to take, control the gimbal and set your camera into photo or video mode.

The available camera actions are:

- No change (continue current action)
- Take photos (time)
- Take photos (distance)
- Stop taking photos
- Start recording video
- Stop recording video

Vehicle Info

The appropriate mission commands for the vehicle depend on the firmware and vehicle type.

If you are planning a mission while you are *connected to a vehicle* the firmware and vehicle type will be determined from the vehicle. This section allows you to specify the vehicle firmware/type when not connected to a vehicle.

The additional value that can be specified when planning a mission is the vehicle flight speed. By specifying this value, total mission or survey times can be approximated even when not connected to a vehicle.

Troubleshooting

Mission (Plan) Upload/Download Failures

Plan uploading and downloading can fail over a noisy communication link (affecting missions, GeoFence, and rally points). If a failure occurs you should see a status message in the QGC UI similar to:

> Mission transfer failed. Retry transfer. Error: Mission write mission count failed, maximum retries exceeded.

The loss rate for your link can be viewed in Settings View > MAVLink. The loss rate should be in the low single digits (i.e. maximum of 2 or 3):

- A loss rate in the high single digits can lead to intermittent failures.
- Higher loss rates often lead to 100% failure.

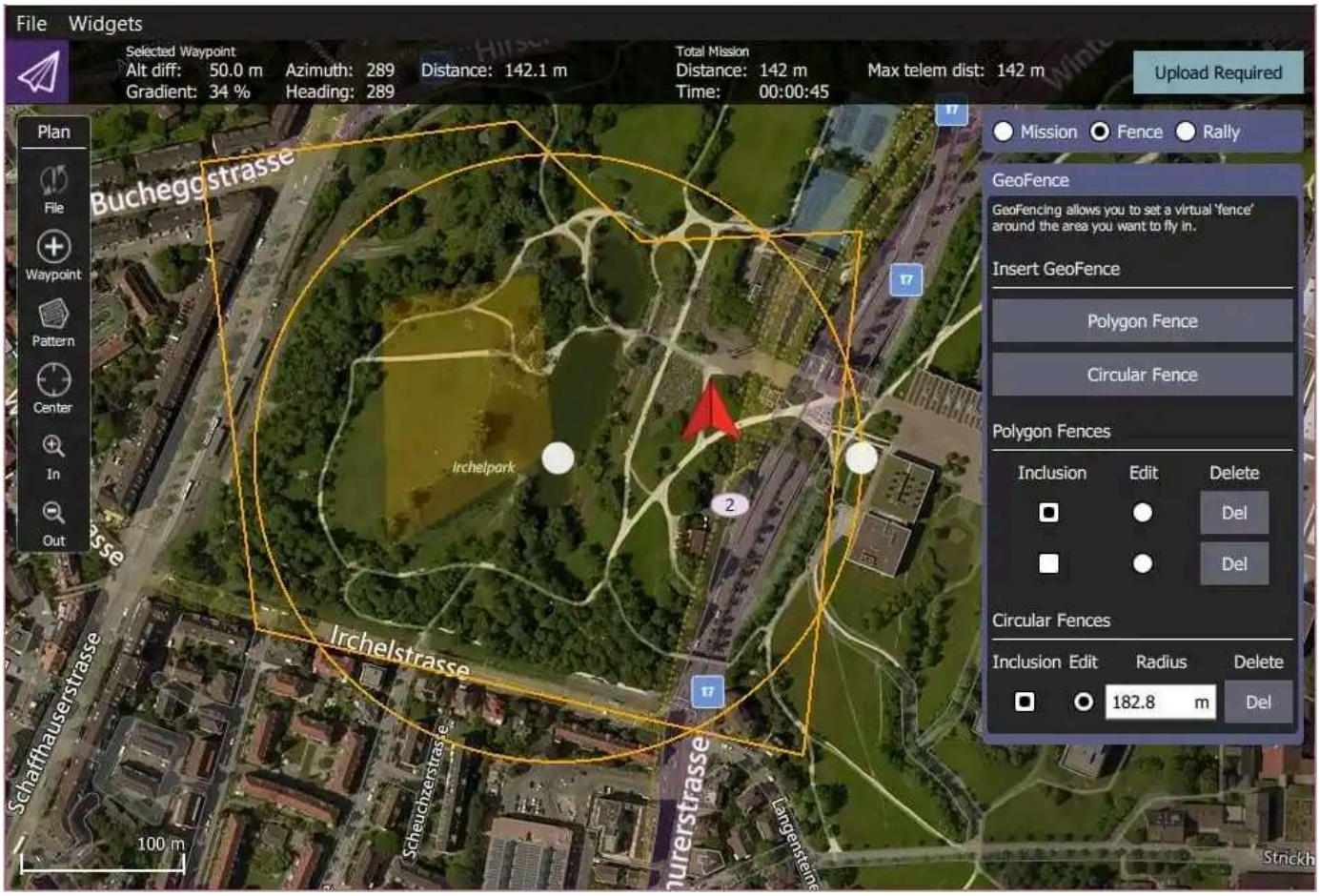
There is a much smaller possibility that issues are caused by bugs in either flight stack or QGC. To analyse this possibility you can turn on Console Logging for Plan upload/download and review the protocol message traffic.

Further Info

- New Plan View features for QGC release v3.2

Plan View - GeoFence

GeoFences allow you to create virtual regions within which the vehicle can fly, or in which it is *not allowed* to fly. You can also configure the action taken if you fly outside permitted areas.



INFO

ArduPilot users: GeoFence support is only supported by Rover 3.6 and Copter 3.7 or higher. It also requires usage of a Daily build or Stable 3.6 (once available). *QGroundControl* will not display the GeoFence options if they are not supported by the connected vehicle.

Create a Geofence

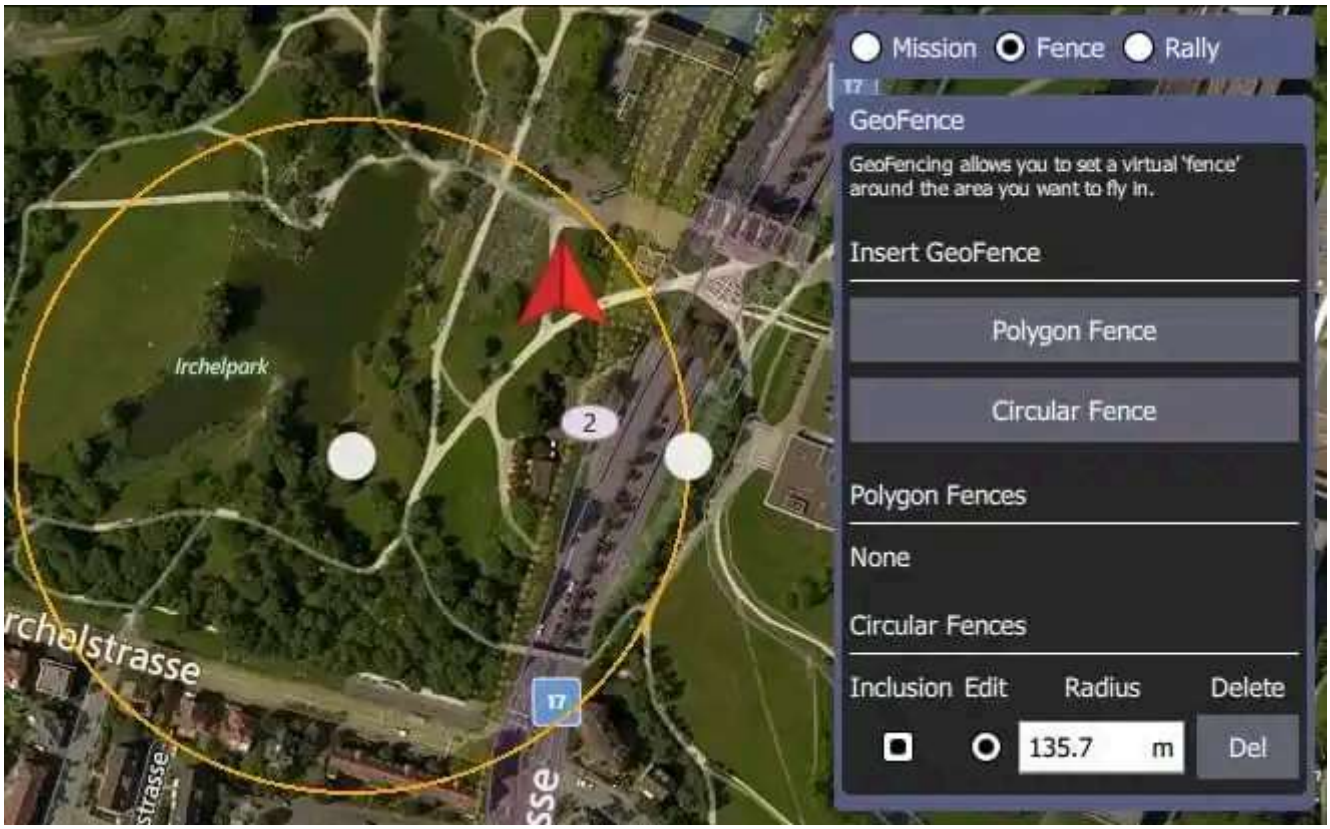
To create a GeoFence:

1. Navigate to the Plan View
2. Select the *Geofence* radio button above the Mission Command List

3. Insert a circular or polygon region by pressing the **Circular Fence** or **Polygon Fence** button, respectively. A new region will be added to the map and to the associated list of fences below the buttons.

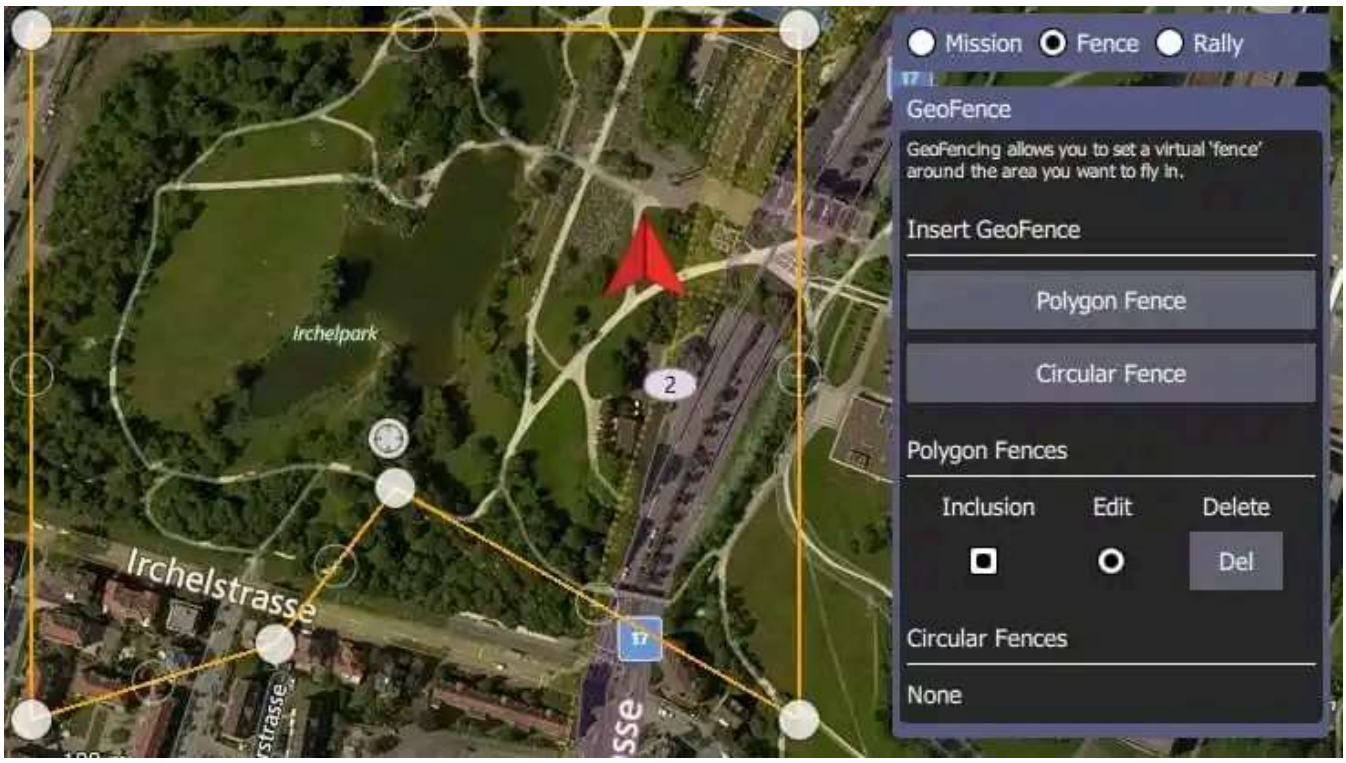
> **TIP**
>
> You can create multiple regions by pressing the buttons multiple times, allowing complex geofence definitions to be created.

- Circular region:



- Move the region by dragging the central dot on the map
- Resize the circle by dragging the dot on the edge of the circle (or you can change the radius value in the fence panel).

- Polygon region:



- Move the vertices by dragging the filled dots

- Create new vertices by clicking the "unfilled" dots on the lines between the filled vertices.

1. By default new regions are created as *inclusion* zones (vehicles must stay within the region). Change them to exclusion zones (where the vehicle can't travel) by unchecking the associated *Inclusion* checkbox in the fence panel.

Edit/Delete a GeoFence

You can select a geofence region to edit by selecting its *Edit* radio button in the GeoFence panel. You can then edit the region on the map as described in the previous section.

Regions can be deleted by pressing the associated **Del** button.

Upload a GeoFence

The GeoFence is uploaded in the same way as a mission, using **File** in the Plan tools.

Remaining tools

The rest of the tools work exactly as they do while editing a Mission.

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Rally Points

Plan View - Rally Points

Rally Points are alternative landing or loiter locations. They are typically used to provide a safer or more convenient (e.g. closer) destination than the home position in Return/RTL mode.

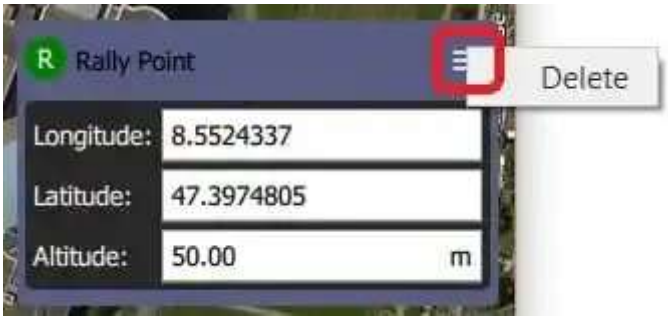
INFO

Rally Points are only supported by ArduPilot on Rover 3.6 and Copter 3.7 (or higher). PX4 support is planned in PX4 v1.10 timeframes. It also requires usage of a Daily build or Stable 3.6 (once available). *QGroundControl* will not display the Rally Point options if they are not supported by the connected vehicle.

Rally Point Usage

To create Rally Points:

1. Navigate to the Plan View
2. Select the *Rally* radio button above the Mission Command List
3. Click the map wherever you want rally points.
   - An **R** marker is added for each
   - the currently active marker has a different colour (green) and can be edited using the *Rally Point* panel.
4. Make any rally point active by selecting it on the map:
   - Move the active rally point by either dragging it on the map or editing the position in the panel.
   - Delete the active rally point by selecting the menu option on the *Rally Point* panel



Upload Rally Points

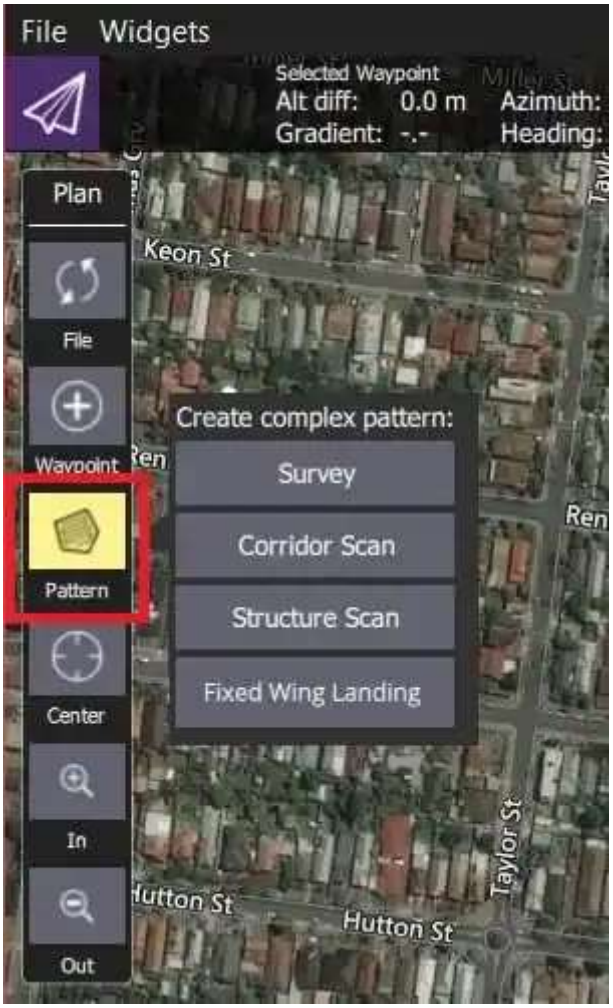
Rally points are uploaded in the same way as a mission, using **File** in the Plan tools.

Remaining tools

The rest of the tools work exactly as they do while editing a Mission.

Pattern

The *Pattern tools* (in the PlanView *Plan Tools*) allow you to specify complex flight patterns using a simple graphical UI. The available pattern tools depend on the vehicle (and support for the vehicle-type in the flight stack).



Pattern	Description	Vehicles
Survey	Create a grid flight pattern over a polygonal area. You can specify the polygon as well as the specifications for the grid and camera settings appropriate for creating geotagged images.	All

Pattern	Description	Vehicles
Structure Scan	Create a grid flight pattern that captures images over vertical surfaces (polygonal or circular). These are typically used for the visual inspection or creation of 3D models of structures.	MultiCopter, VTOL
Corridor Scan	Create a flight pattern which follows a poly-line (for example, to survey a road).	All
Fixed Wing Landing	Add a landing pattern for fixed wing vehicles to a mission.	Fixed Wing

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Survey

Survey (Plan Pattern)

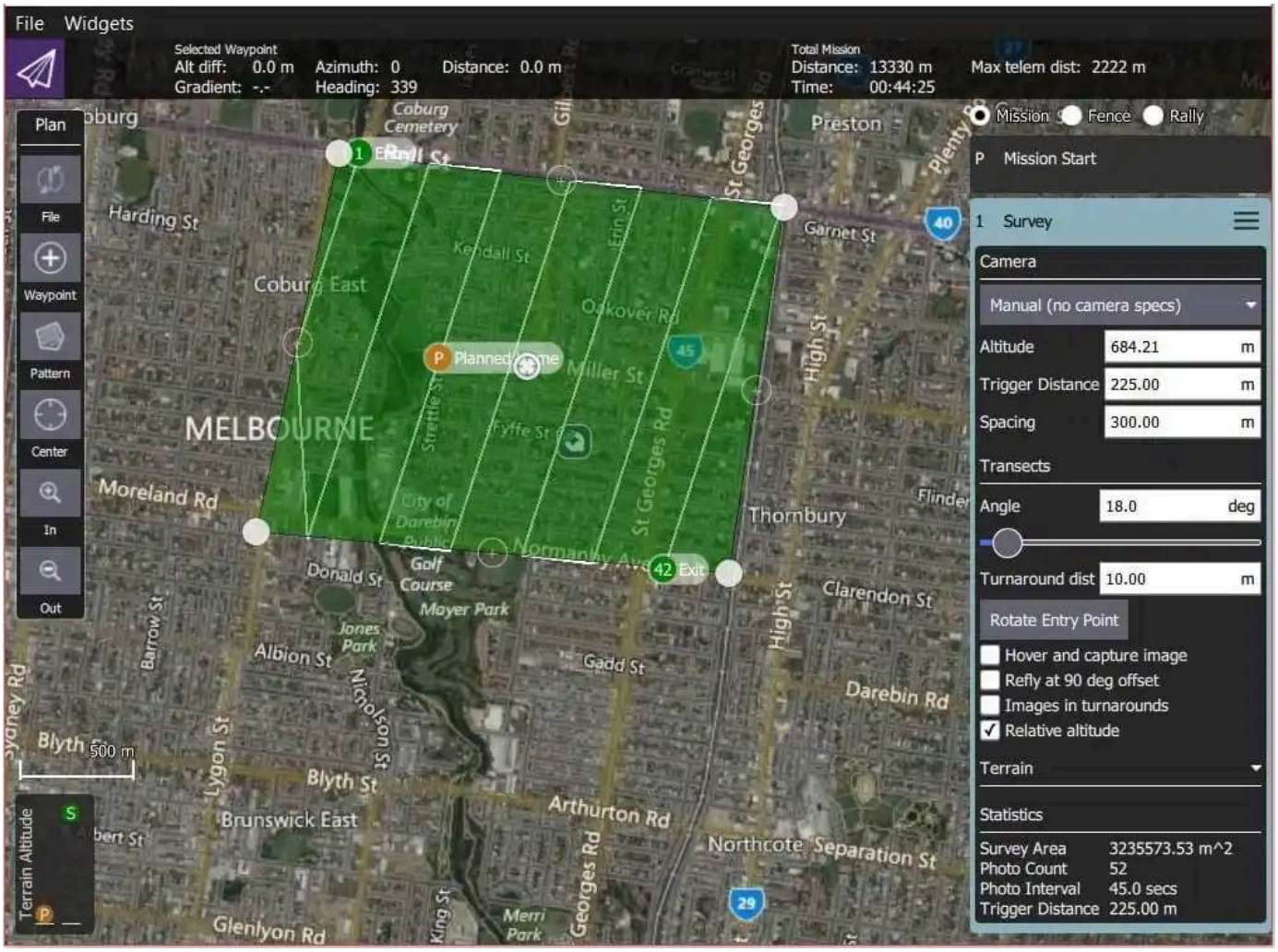
A survey allows you to create a grid flight pattern over a polygonal area. You can specify an arbitrary polygon, the angle and other properties of the grid, and camera settings appropriate for creating geotagged images.

WARNING

If the survey area has significant elevation variation then consider enabling Terrain Following.

When planning a Survey using camera specifications, the ground under the survey area are assumed to be flat - i.e. at the same altitude as the launch/home location. If the ground elevation under the survey is either higher or lower than the home location the effective overlap in images will be less or more (respectively) than calculated. If ground elevation under the survey area is *significantly* higher than the home location you could inadvertently plan a mission path that causes the vehicle to fly into ground-level obstacles.

Using terrain following ensures that the survey more closely matches the desired altitude above terrain, and reduces the likelihood of planning a mission that is too close to ground level.



Creating a Survey

To create a survey:

1. Open PlanView *Plan Tools*.

2. Choose the *Pattern Tool* from the *Plan Tools* and then select *Survey*.

This will add a survey grid to the map, and a *Survey* item to the mission list (on the right).

3. On the map drag the vertices to change the shape of the polygon.
4. Click the `(+)` symbol between existing vertices to create a new vertix. The new vertix can then be dragged into a new position.

The survey settings are covered in the next section.

Settings

The survey can be further configured in the associated mission item (in the mission item list on the right hand side of the *Plan View*).

Camera

Camera triggering behaviour depends on the camera/camera settings. You can select an existing camera, custom camera, or manually enter the settings. The list of available cameras (QGC 3.4) is given below.

Known Camera

Selecting a known camera from the option dropdown generates a grid pattern based on the camera capabilities.

The default settings can be tuned for your survey using the configuration options:

- **Landscape/Portrait** - Camera orientation relative to the "normal" orientation of the vehicle.
- **Overlap** - Overlap between each image capture. This can be configured separately for when flying along grid lines or across them.
- Select one of:

- **Altitude** - Survey altitude (ground resolution will be calculated/displayed for this altitude).
- **Ground resolution** - Ground resolution for each image (altitude required to achieve this resolution calculated and shown).

Custom Camera

Selecting the custom camera option allows you to specify the settings for a new camera in a similar way to a known camera.

The camera-specific settings are:

- **Sensor width/height** - The size of the image sensor of the camera.
- **Image width/height** - The resolution of the image captured by the camera.
- **Focal Length** - The focal length of the camera lens.

The remaining settings are the same as for a known camera.

Manual Camera

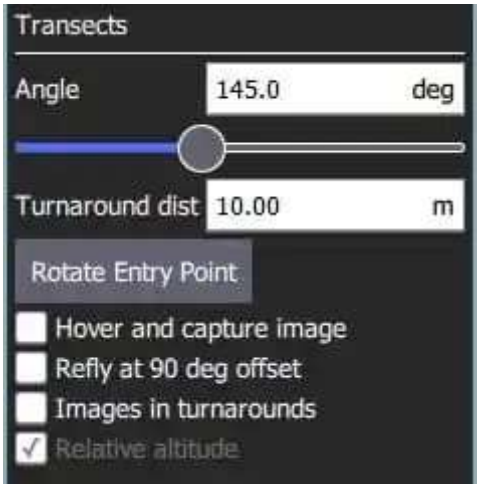
The manual camera option allows you to specify desired survey height, trigger interval and appropriate grid spacing for your camera.

The configurable options are:

- **Altitude** - Survey altitude to fly the whole grid.
- **Trigger Distance** - The distance over ground between each camera shot.
- **Spacing** - Distance between adjacent grid (flight path) lines across the corridor.

Transects

The *Transects* section is used for grid settings that are independent of the camera used.



The configurable options are:

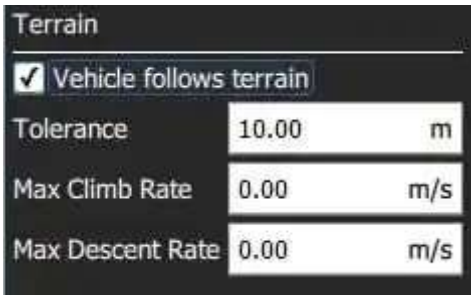
- **Angle** - The angle of the grid lines, relative to North.

- **Turnaround dist** - Amount of additional distance to add outside the survey area for vehicle turn around.
- **Rotate Entry Point** - Press button to swap the start and end point of the survey.
- **Hover and capture image** - Hover to capture images (multicopter only).
- **Refly at 90 degree offset** - Check to refly the whole mission at a 90 degree offset.

- **Images in turnarounds** - Check to take images when turning
- **Relative altitude** - Check to make specified altitudes relative to home (if unchecked they are AMSL).

Terrain

By default, a flying vehicle will follow the survey path at a fixed altitude. Enabling *Terrain Following* makes the vehicle maintain a constant height relative to ground.



INFO

Terrain following uses terrain heights queried from *AirMap* servers.

The configurable options are:

- **Vehicle follows terrain** - Check to enable terrain following (and display the following options).
  - **Tolerance** - The accepted deviation in altitude from the target altitude.
  - **Max Climb Rate** - Maximum climb rate when following terrain.
  - **Max Descent Rate** - Maximum descent rate when following terrain.

Statistics

The *Statistics* section shows the calculated survey area, photo interval, photo spacing and planned photo count.

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Structure Scan

Structure Scan (Plan Pattern)

A *Structure Scan* allows you to create a grid flight pattern that captures images over *vertical surfaces* (e.g. walls) around a structure with an arbitrary polygonal (or circular) ground footprint. Structure Scans are typically used for the visual inspection or creating 3D models of structures.

Structure Scans may be inserted into a mission using the Plan view **Pattern > Structure Scan** tool.

INFO

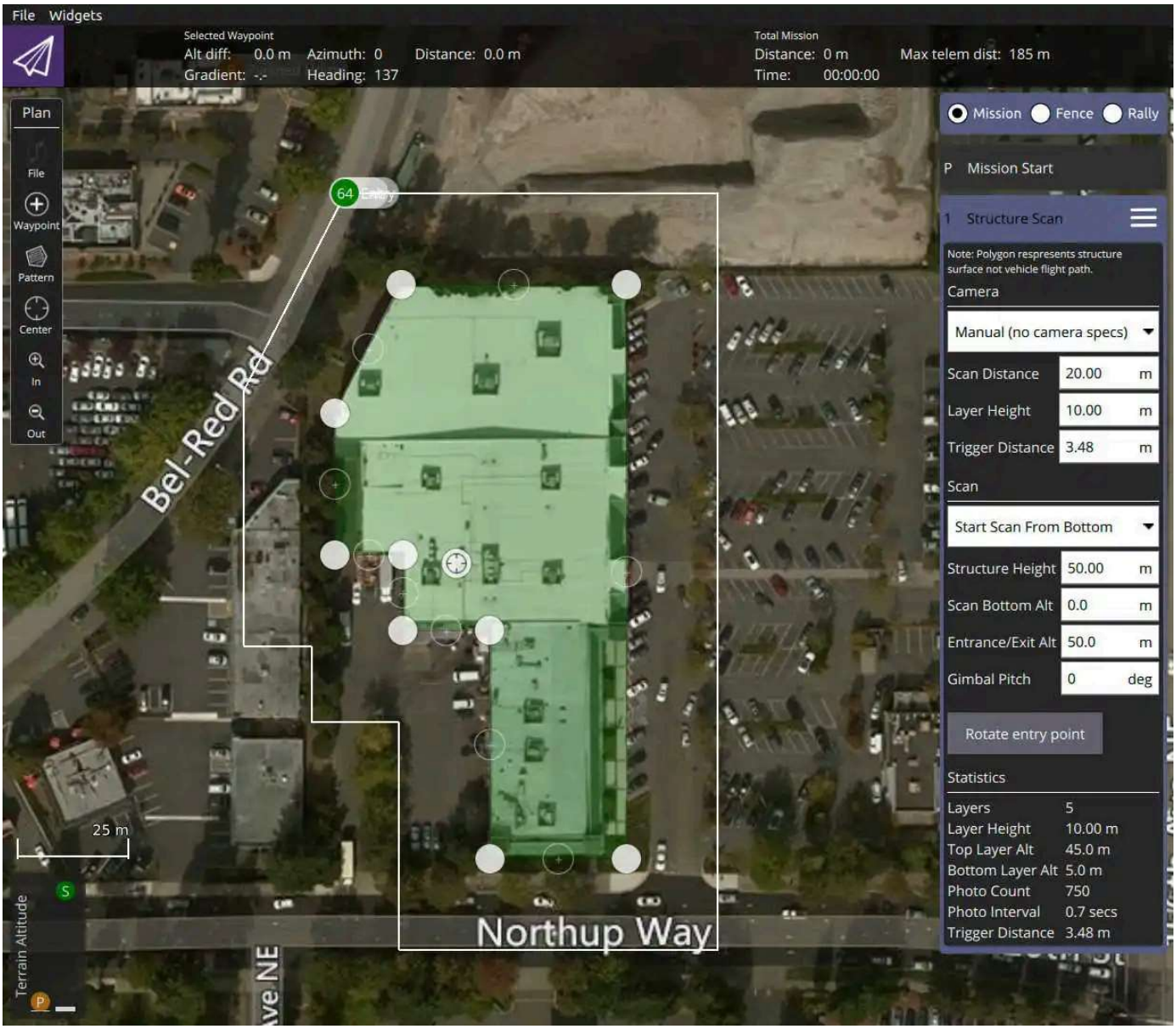
The new version of *Structure Scan* can't read older *Structure Scan* plans. They will need to be recreated.

WARNING

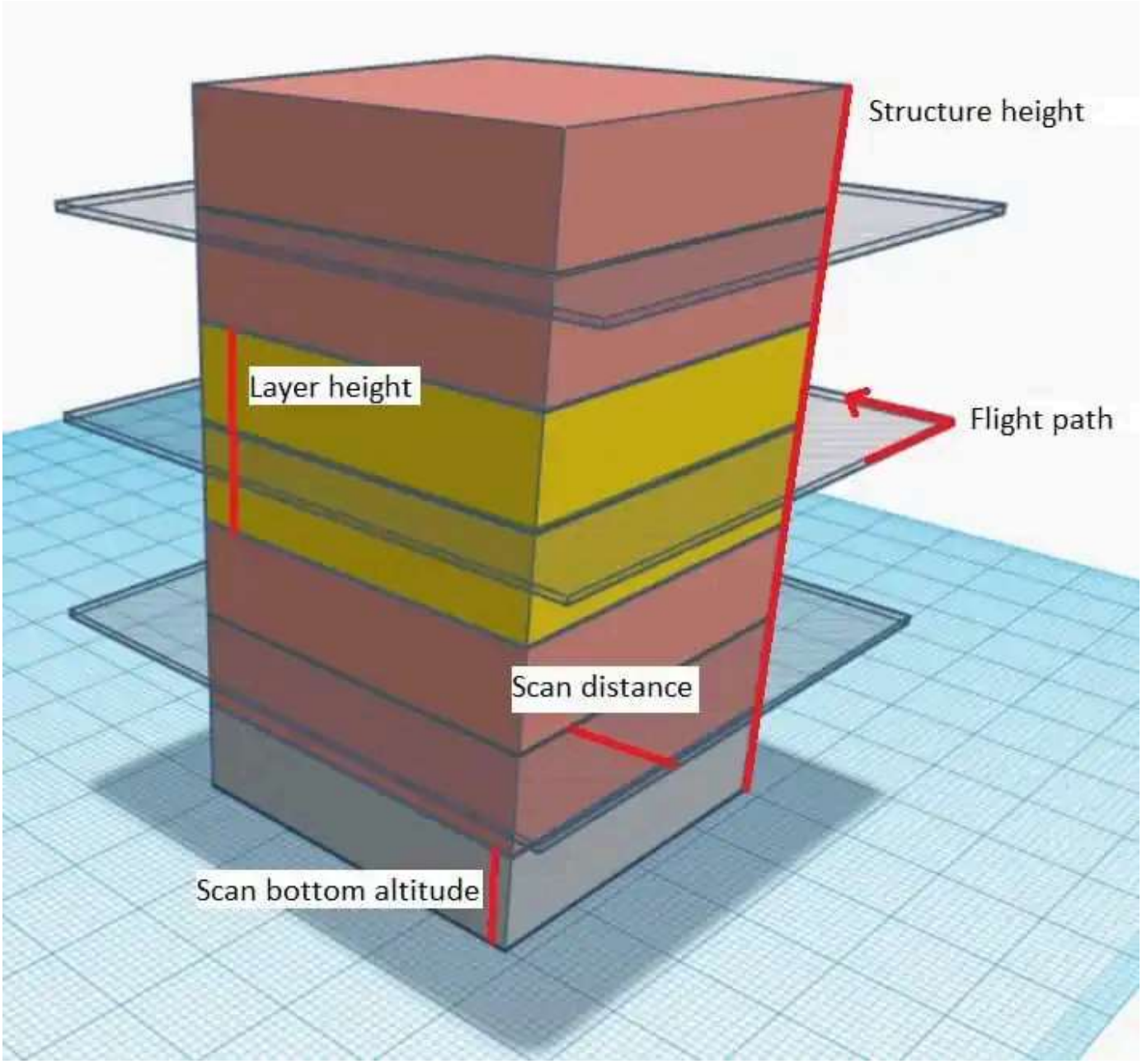
This feature is not yet supported by ArduPilot firmware. It is supported in PX4.

Overview

The image below shows a screenshot of structure scan. The green polygon is used to mark out the ground footprint of the structure, while the white line around it indicates the vehicle flight path. The green numbered circle on the flight path is the scan entry/exit point (where the scan starts).



The scan divides the structure evenly into layers; the vehicle flies all the way around the structure at a particular altitude and *scan distance* from the structure, then repeats the process at each layer until the whole surface has been scanned.



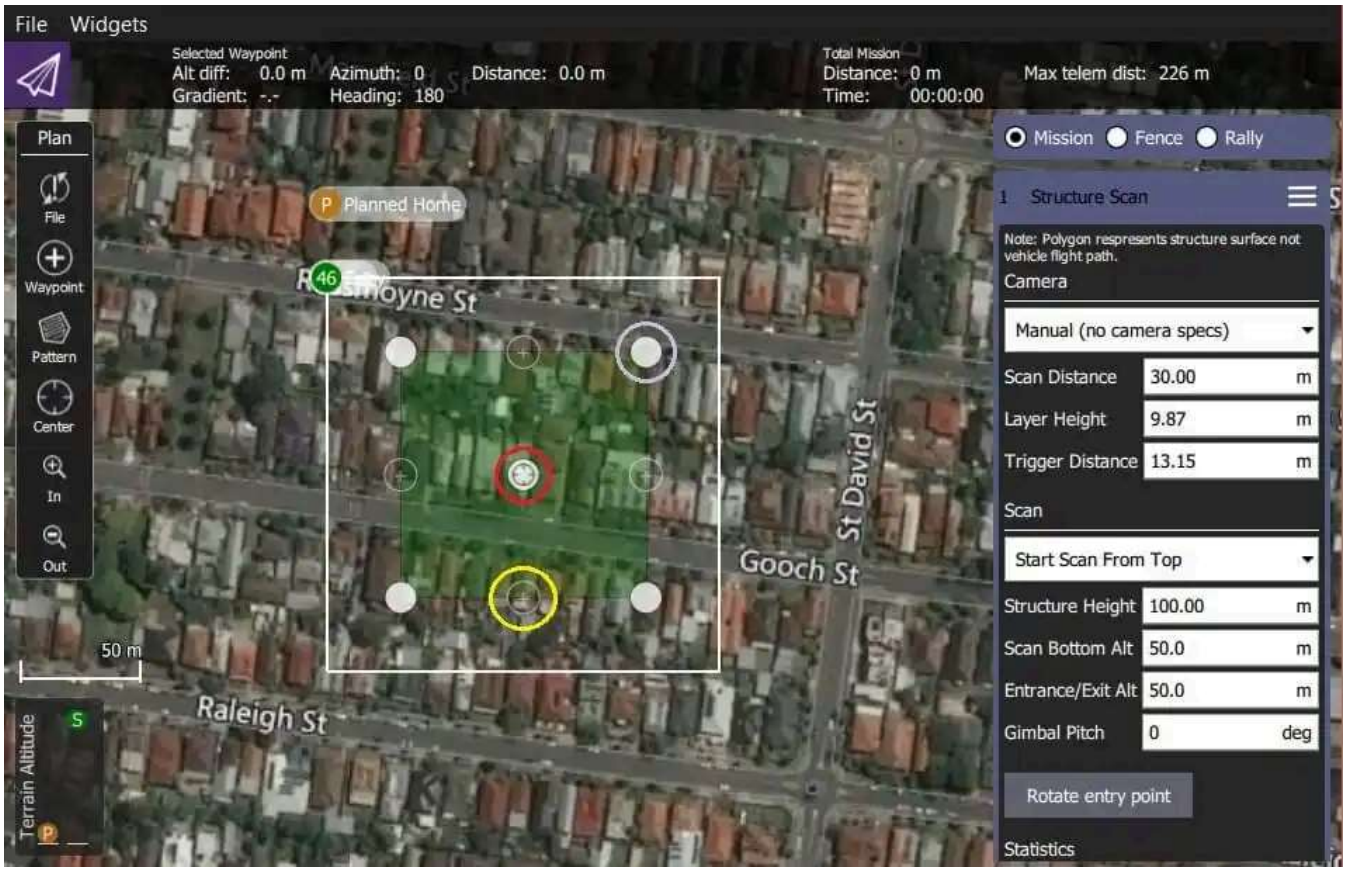
Users can set the *scan bottom altitude* to avoid obstacles at the bottom of the structure, and the *extrance/exit altitude* to avoid obstacles as the vehicle travels to/from the scan.

Creating a Scan

To create a scan:

1. In the **Plan View** select **Pattern tool > Structure Scan**.

1. This will create a simple square structure scan on the map.

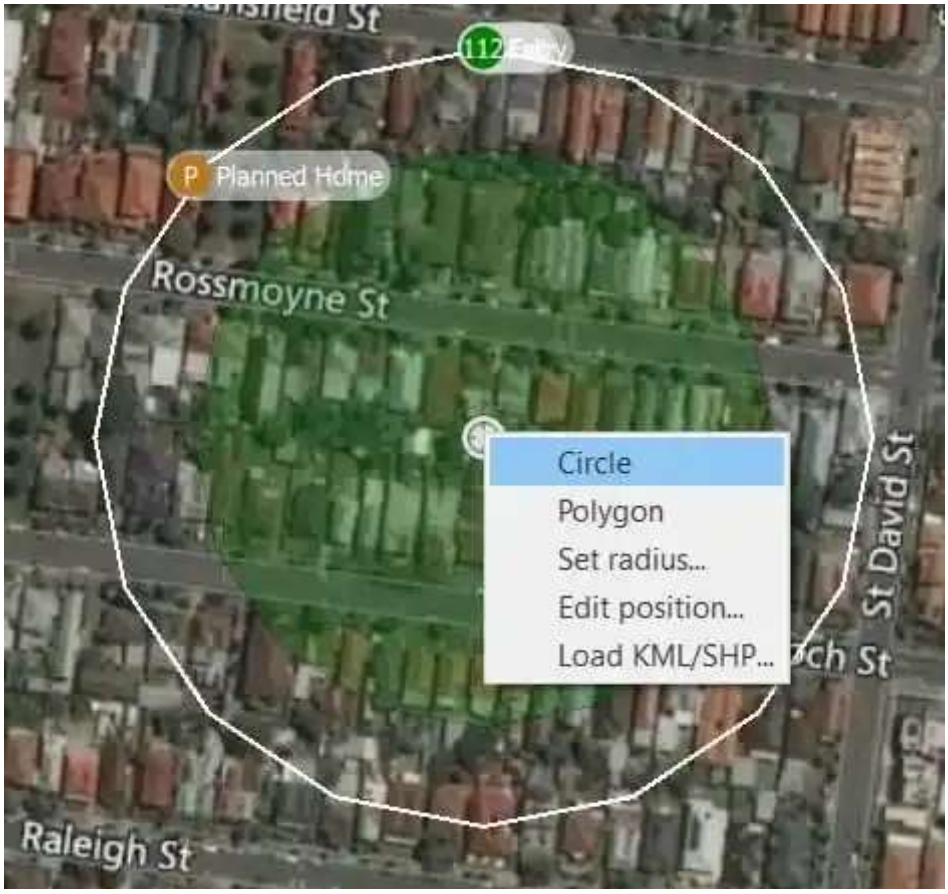


The region shown in green must be modified so that it surrounds the structure.

- Drag the opaque vertices on the map to the edge of the structure (example circled in mauve above).

- If the structure footprint is more than a simple square you can click the semi-transparent circles between the vertices to create a new vertex.

2. You can also change to a circular footprint by clicking on the central "vertix" (marked in red) and selecting *Circle* in the popup menu.



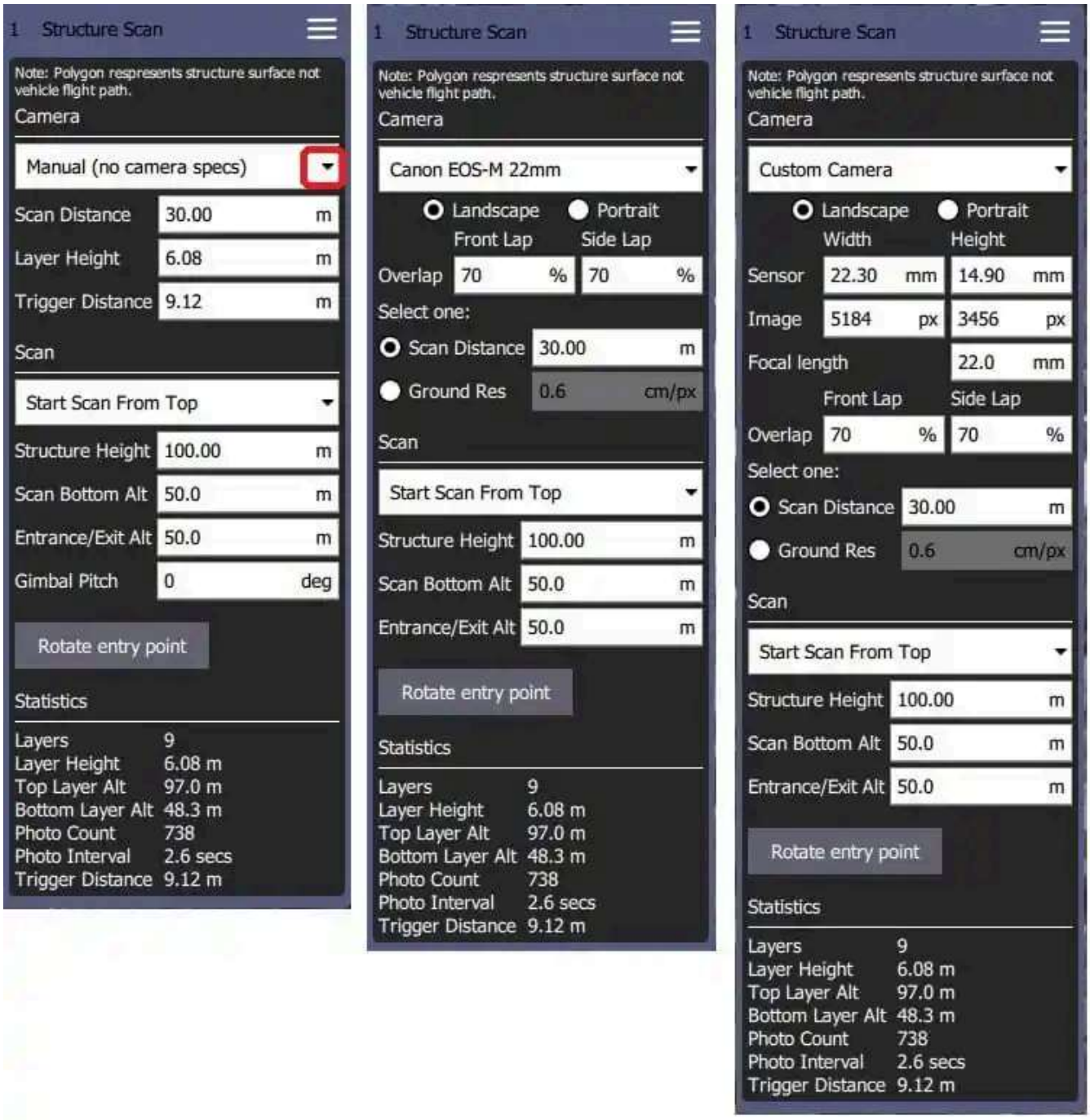
.

- From the popup menu you can switch back to a polygon footprint and change the radius and/or position of the scan.
- Drag the central vertix to position the centre of the circle.

3. The rest of the configuration is handled using the *Structure Scan* editor on the right hand side of the view. First select whether you want to perform a manual scan, a scan using a particular camera, or a scan using a custom camera definition.

> **INFO**
>
> The main difference between the modes is that predefined cameras are already set up to correctly calculate an effective layer height and trigger distance.

Options for the different modes are shown below.



The user can always configure the following settings:

- **Start scan from top/bottom:** The direction in which layers are scanned.
- **Structure height:** The height of the object being scanned.
- **Scan distance:** Distance from the structure to the flight path.
- **Entrance/Exit Alt:** Use this setting to avoid obstacles between the last/next waypoint and the structure to be scanned.
  - The vehicle will fly to the *Entrance/Exit* point at this altitude and then descend to the initial layer to start the scan.

    - The vehicle will ascend to this altitude after completing the scan and then move to the next waypoint.
- **Scan Bottom Alt:** Use this setting to avoid obstacles around the base of the structure. This adjust the bottom of the structure to be above the ground, and hence the altitude of the first scan (the height of the lowest layer flight path is shown in the scan statistics as *Bottom Layer Alt*.
- **Rotate Entry Point:** Move the start/finish point to the next vertix/position on the flight path.

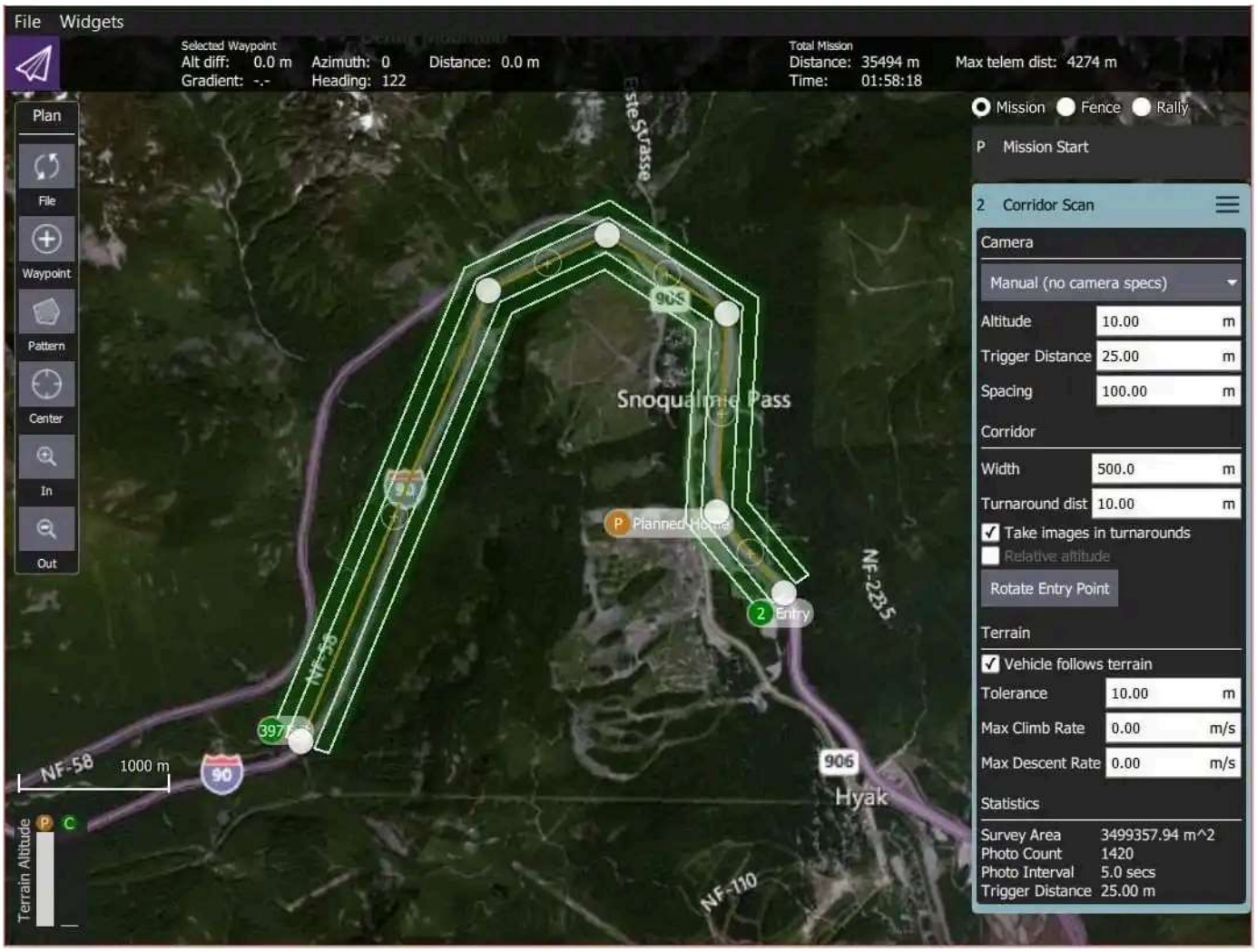
The remaining settings depend on the *camera mode*:

- *Manual Mode* allows you to specify:
    - **Layer height:** The height of each layer.
    - **Trigger Distance:** The distance between each camera trigger. The camera is only triggered while flying the layer path. It does not trigger images while transitioning from one layer to the next.
    - **Gimbal Pitch** - Gimbal pitch you want to use for the scan.
- *Known/pre-defined cameras* automatically calculates layer heights and image triggering from required image overlap, and allows you to trade off scan distance and require image resolution. It also ensures that the camera is pointed directly at the surface when it is capturing images (i.e. at a right angle rather than some tangent). The settings are:
    - **Camera Orientation:** Portrait or Landscape
    - *Overlap*:
        - **Front Lap:** Image overlap from top to bottom (increasing shrinks layer height and increases layer count).
        - **Side Lap:** Image overlap at sides (increasing takes more images in each lap/layer scan).
    - **Scan distance:** Distance from the structure to the flight path.
    - **Ground Res:** Required image resolution/sample quality of surface.
- *Custom camera* selection allows you to enter your own camera characteristics, but otherwise behaves the same as a predefined camera.

Corridor Scan (Plan Pattern)

A corridor scan allows you to create a flight pattern that follows a poly-line. This can be used to, for example, survey a road. It is supported on all autopilots and vehicle types.

> **Important** When planning a Corridor Scan using camera specifications the ground elevations under your survey area are assumed to be at the same altitude as your launch/home location. If the ground elevation under your survey area is either higher or lower than your launch/home location the effective overlap in your images will be less or more (respectively) than calculated. If ground elevation under your survey area is significantly higher than your launch/home location you could inadvertently plan a mission which causes the vehicle to fly into trees, obstacles, or the ground. Use Terrain Follow to create a survey that more closely maintains the desired altitude above terrain that has significant elevation differences from your launch/home altitude.



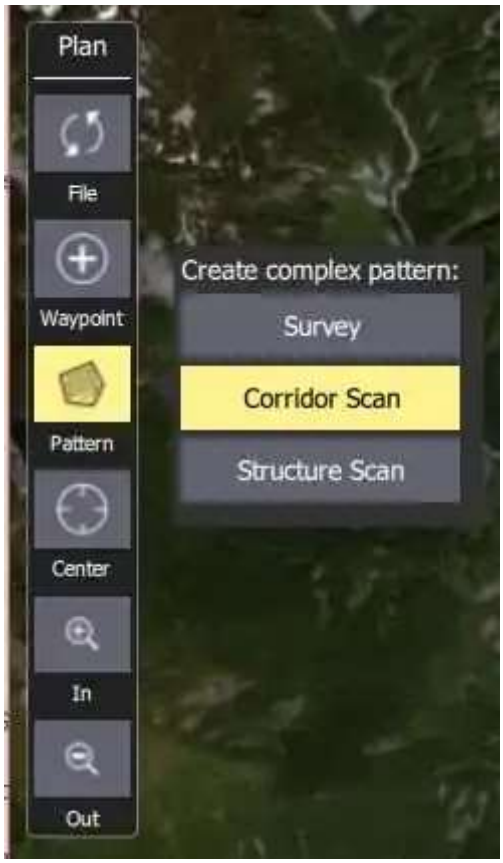
You can specify the path, the width of the corridor, and camera settings appropriate for creating geotagged images.

Creating a Scan

To create a corridor scan:

1. Open PlanView *Plan Tools*.

2. Choose the *Pattern Tool* from the *Plan Tools* and then select *Corridor Scan*.



This will add a corridor to the map, and a *Corridor Scan* item to the mission list (on the right).

3. On the map drag the ends of the corridor to the start and end positions of the scan, respectively.

4. Click the `(+)` symbol at the centre of a line to create a new vertex. The new vertex can then be dragged into position to follow the path of the desired corridor.

The corridor scan settings are covered in the next section.

Settings

The corridor scan can be further configured in the associated mission item (in the mission item list on the right hand side of the Plan View).

Camera

Camera triggering behaviour depends on the camera/camera settings. You can select an existing camera or manually enter the settings. The list of available cameras (QGC 3.4) is given below.

Known Camera

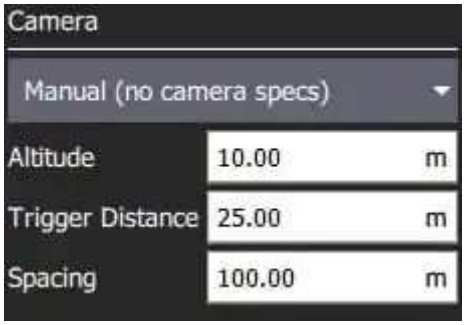
Selecting a known camera from the option dropdown allows you to generate a grid pattern based on the camera's specifications.

The configurable options are:

- **Landscape/Portrait** - Camera orientation relative to the "normal" orientation of the vehicle.
- **Image Overlap** - Overlap between each image.
- Select one of:
  - **Altitude** - Survey altitude (ground resolution will be calculated/displayed for this altitude).
  - **Ground resolution** - Ground resolution for each image (altitude required to achieve this resolution calculated and shown).

Manual Camera

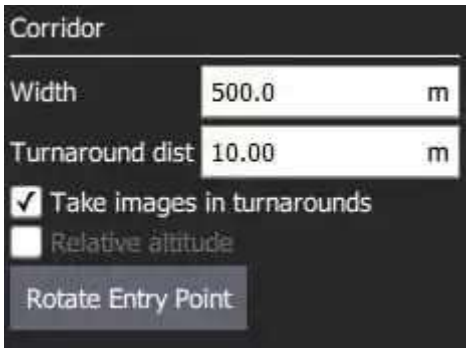
The manual camera option allows you to specify desired survey height, trigger interval and appropriate grid spacing for your camera.



The configurable options are:

- **Altitude** - Survey altitude.
- **Trigger Distance** - The distance over ground between each camera shot.
- **Spacing** - Distance between adjacent grid (flight path) lines across the corridor.

Corridor

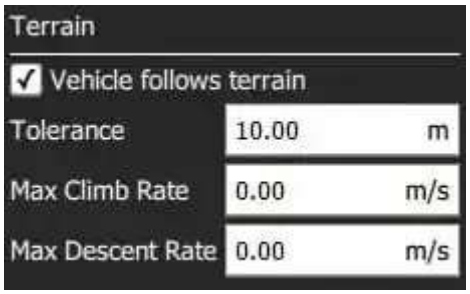


The configurable options are:

- **Width** - Set the width of the scan around the polyline that defines the path.
- **Turnaround dist** - Amount of additional distance to add outside the survey area for vehicle turn around.
- **Take images in turnarounds** - Check to enable image capture a turnaround points.
- **Relative altitude** - Check to specify a relative altitude. This is only supported for manual grids that are not using terrain following.
- **Rotate entry point** - Press button to swap the start and end point of the corridor scan.

Terrain Following

By default a flying vehicle will follow the corridor path at a fixed altitude. Enabling *Terrain Following* makes the vehicle maintain a constant height relative to ground.



INFO

Terrain following uses terrain heights queried from *AirMap* servers.

The configurable options are:

- **Vehicle follows terrain** - Check to enable terrain following (and display the following options).
  - **Tolerance** - The accepted deviation in altitude from the target altitude.
  - **Max Climb Rate** - Maximum climb rate when following terrain.
  - **Max Descent Rate** - Maximum descent rate when following terrain.

Statistics

The *Statistics* section shows the calculated survey area, photo interval, photo spacing and planned photo count.

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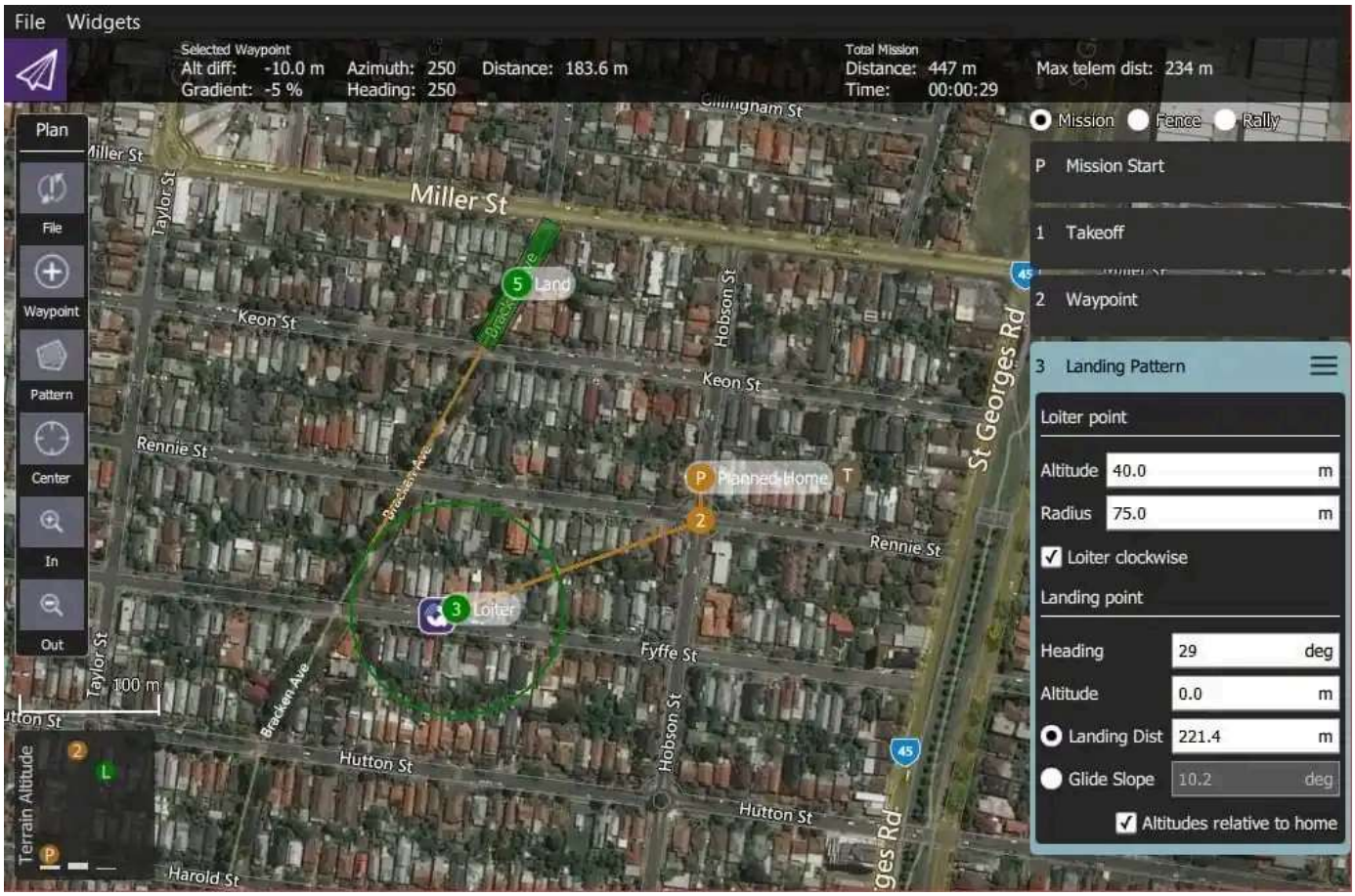
Fixed Wing Landing Pattern

Fixed Wing Landing Pattern (Plan Pattern)

The *Fixed Wing Landing Pattern* tool allows you to add a fixed wing landing pattern to a mission. It is supported on both ArduPilot and PX4.



The first point of the pattern is a loiter point with a specific altitude and the second is a landing point. The vehicle will loiter at the first point until it reaches the target altitude, and then begin the landing sequence to fly down to the specified landing spot.

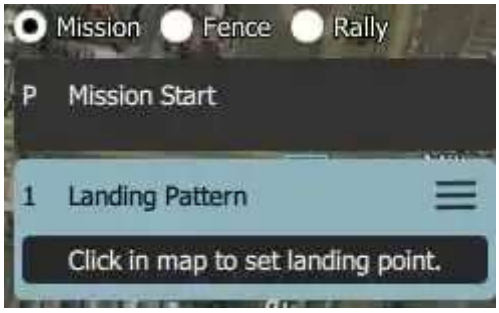
Both the loiter and land points can be dragged to new positions, and a number of other settings can be configured in the associated mission item.

Creating a Landing Pattern

To create a landing pattern:

1. Open PlanView *Plan Tools*.
2. Choose the *Pattern Tool* from the *Plan Tools* and then select *Fixed Wing Landing Pattern*.

This will add a *Landing Pattern* item to the mission list (on the right).



3. Click on the map to create both the loiter point and the landing point. These can be moved on the map.

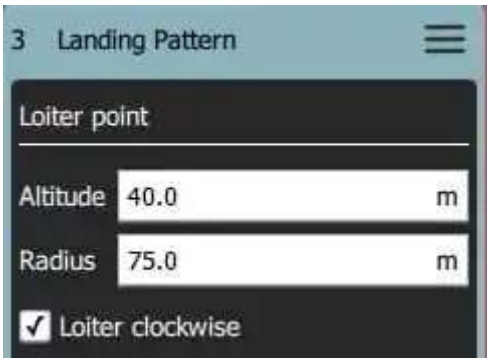
Additional settings are covered in the next section.

Settings

The landing pattern can be further configured in the associated mission item (in the mission item list on the right hand side of the Plan View).

Loiter Point

The *Loiter Point* settings are used to configure the loiter altitude, radius and direction.

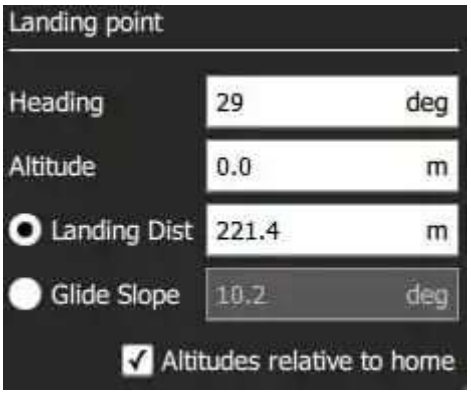


The configurable options are:

- **Altitude** - Loiter altitude.
- **Radius** - Loiter radius.
- **Loiter clockwise** - Check to loiter in a clockwise direction (anti-clockwise is the default).

Landing Point

The *Landing Point* settings are used to configure the landing position and path.



The configurable options are:

- **Heading** - Heading from loiter point to land point.
- **Altitude** - Altitude for landing point (nominally zero).
- *Radio Buttons*
  - **Landing Dist** - Distance between loiter point and landing point.
  - **Glide Slope** - Glide slope between loiter point and landing point.
- **Altitudes relative to home** - Check to set all altitudes in mission item to be relative to home (default is AMSL).

Implementation

This pattern creates three mission items:

- `DO_LAND_START` - If you abort a landing it sends `DO_GO_AROUND` to the vehicle, which then causes the mission to return to this point and try to land again.
- `NAV_LOITER_TO_ALT` - Start point for landing
- `NAV_LAND` - End point for landing

The vehicle flares to landing using a flight path generated by the firmware between the `NAV_LOITER_TO_ALT` point and the `NAV_LAND` point.

If those two locations violate the vehicle's flare constraints (e.g. descent angle is too steep) an error will be raised after you upload the invalid mission to the vehicle.

> **INFO**
>
> On PX4, violating the flare constraints sends an error message to the ground station at upload time, and the autopilot will refuse to start the mission (since it fails integrity checks).

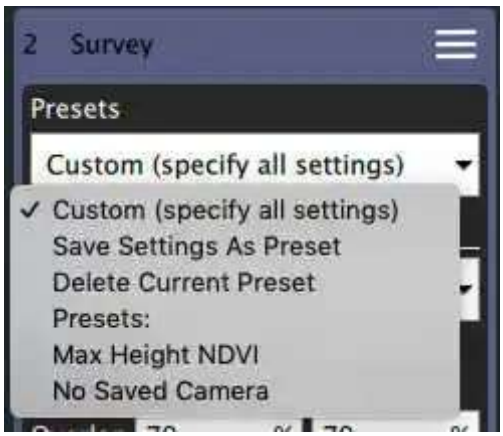
Plan View - Pattern Presets

Allows you to save commonly used settings as a named preset.

INFO

Currently only supported by Survey. Support for other Patterns is in development.

Managing Presets



Pattern items have a new selection at the top which allows you to manage presets:

- **Custom (specify all settings)** This allows you to *not* use a preset and specify all settings manually.
- **Save Settings As Preset** Saves the current settings as a named preset.
- **Delete Current Preset** Deletes the currently selected preset.
- **Presets:** Below this item will be listed the available presets for this pattern.

Creating/Updating A Preset

When you select **Save Settings As Preset** you will be prompted for the preset name. To save new settings for an existing preset select **Save Settings As Preset** while a preset is currently selected.

You can also specify whether you want to save the currently selected camera in the preset. If you choose not to save the camera with the preset then the current camera will be used when loading the preset. You will also be able to change to a different camera when using the preset. Unless you fly your vehicle with different cameras at different times with the same preset you should select to save the camera in the preset.

Viewing Preset Settings

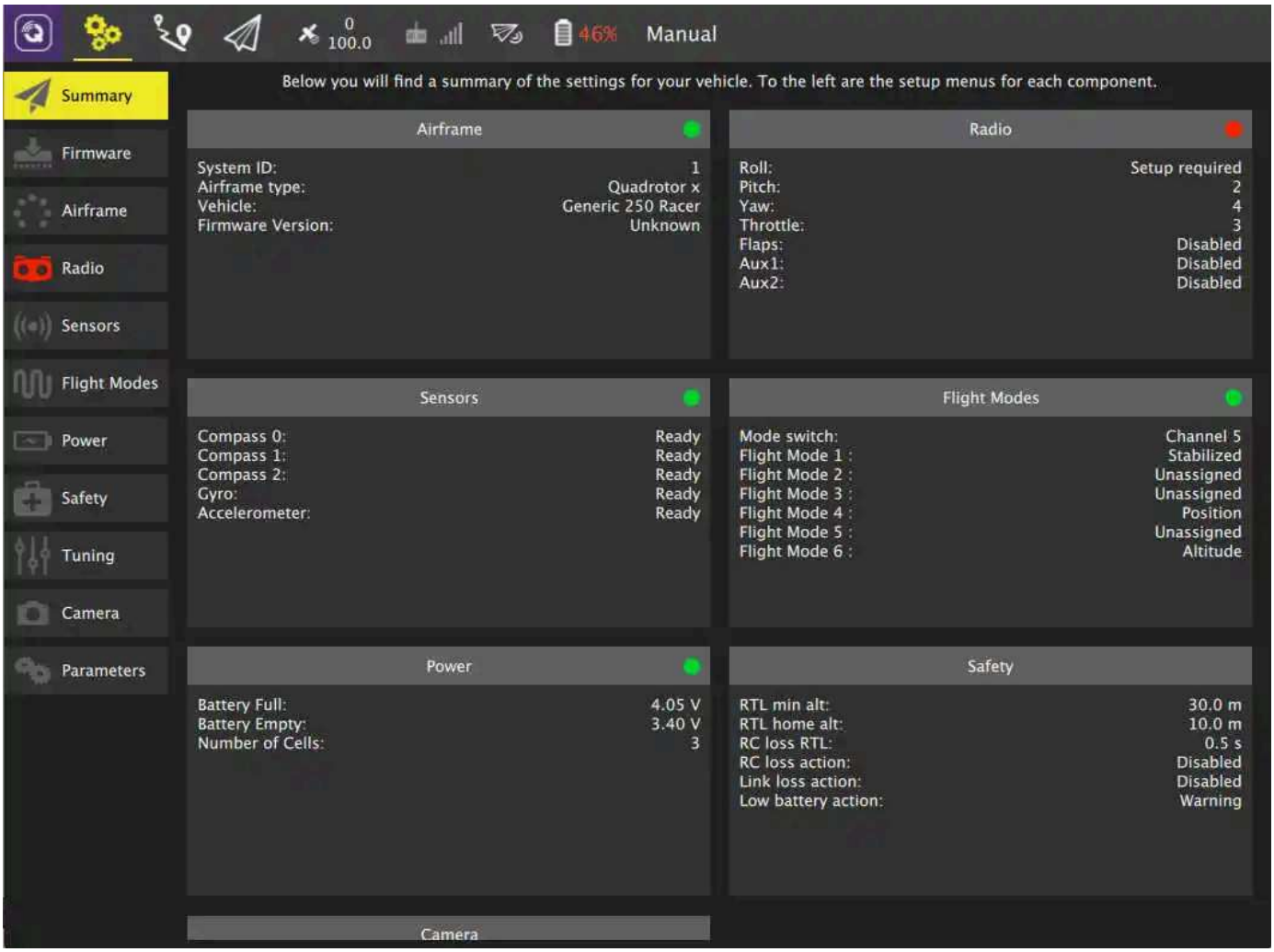
If you want to view what the exact settings are for a Preset switch back to **Custom (specify all settings)** which will show you all the settings. Then you can switch back to using the named preset when done.

Presets In A Plan File

The currently selected Preset is also saved in the Plan file such that when you load the Plan back the preset will once again be selected. Keep in mind that presets are specific to your version of QGroundControl. If you share a Plan file with a preset with another user, incorrect behavior may occur if that other user also has a preset of the same name but different settings.

Setup View

The Setup View is used to configure a new vehicle prior to first flight and/or tune a configured vehicle.



Setup Options

To the left of the screen are the set of available setup options. A setup button is marked with a red icon if there are still settings needed to be adjusted/specified. You should not fly

if any of these are red. In the above image the Radio setup is not yet complete.

> **INFO**
>
> The set of options shown and the contents of each option may differ based on whether the vehicle is running PX4 Pro or ArduPilot firmware. The image above is from a vehicle which is running PX4 Pro firmware.

Summary

An overview of all the important setup options for your vehicle. Similar to the individual setup buttons, the summary blocks show a red indicator when those settings are not fully configured.

Firmware

Flash new firmware onto your vehicle.

Airframe

Specify the airframe type for the vehicle.

Radio

Calibrate your Radio Control Transmitter.

Sensors

Calibrate the sensors on the vehicle.

Flight Modes

Used to assign flight modes to your RC Transmitter switches.

Power

Battery settings and additional power options such as ESC calibration.

Motors

Motors testing and setup.

Safety

Specify settings for options related to Safety such as Return to Home or Failsafes.

Tuning

Tune flight characteristics of the vehicle.

Camera

Configure settings for camera and gimbal.

Parameters

Allows you to modify all parameters associated with your vehicle.

Previous page
Pattern Presets

Next page
Firmware

Loading Firmware

QGroundControl **desktop** versions can install PX4 Pro or ArduPilot firmware onto Pixhawk-family flight-controller boards. By default QGC will install the current stable version of the selected autopilot, but you can also choose to install beta builds, daily builds, or custom firmware files.

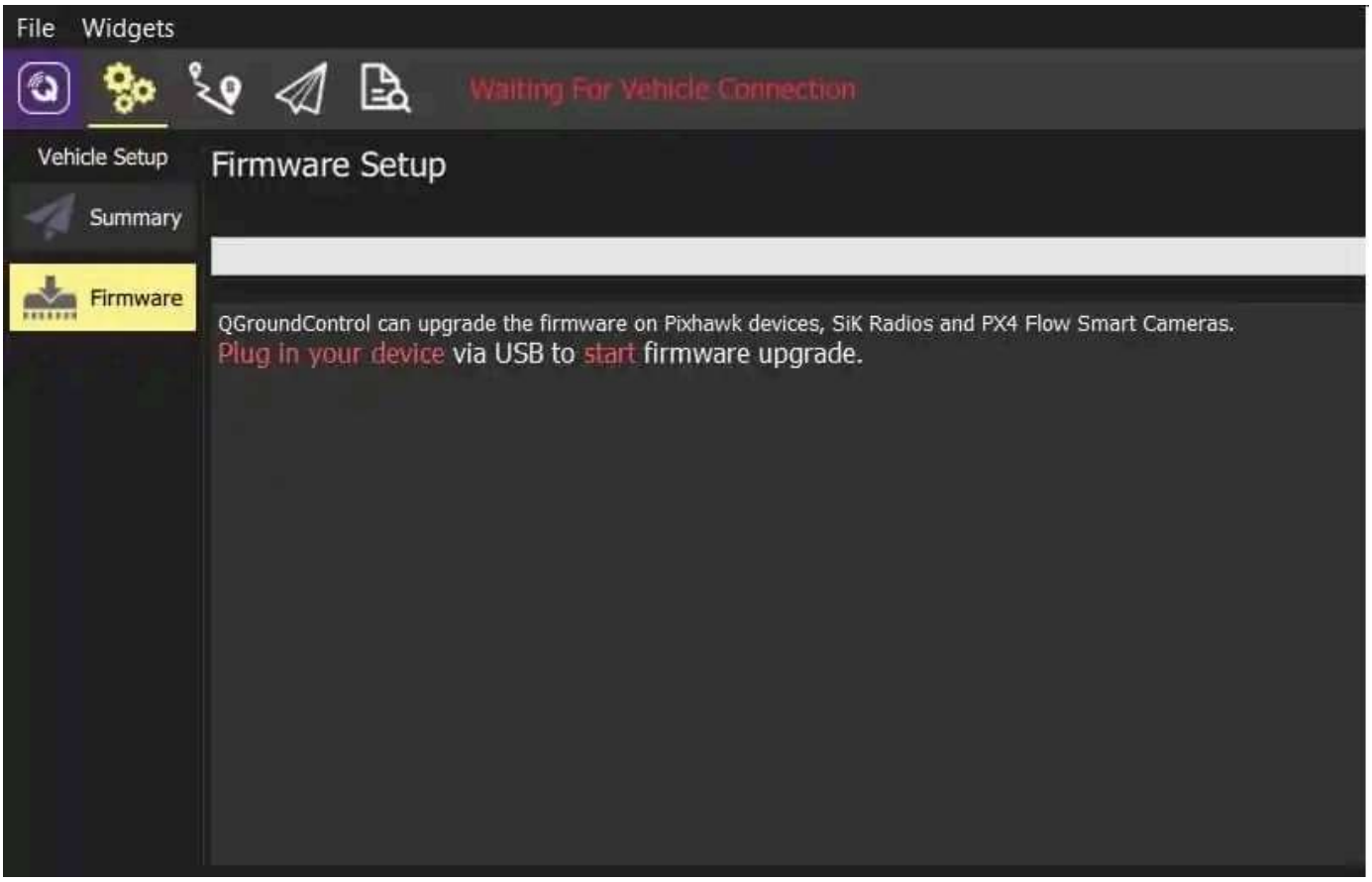
QGroundControl can also install the firmware for SiK Radios and PX4 Flow devices.

> **Caution** Loading Firmware is currently not available on tablet or phone versions of *QGroundControl*.

Connect Device for Firmware Update

> **Caution Before you start installing Firmware** all USB connections to your vehicle must be *disconnected* (both direct or through a telemetry radio). The vehicle must *not be* powered by a battery.

1. First select the **Gear** icon (*Vehicle Setup*) in the top toolbar and then **Firmware** in the sidebar.



1. Connect your device (Pixhawk, SiK Radio, PX4 Flow) directly to your computer via USB.

> **INFO**
>
> Connect directly to a powered USB port on your machine (do not connect through a USB hub).

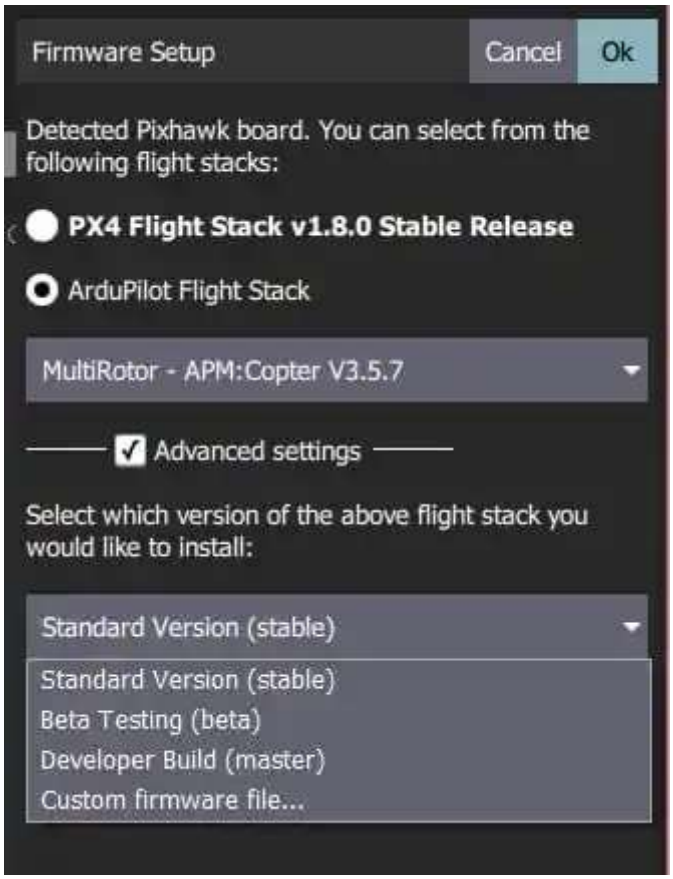
Select Firmware to Load

Once the device is connected you can choose which firmware to load (*QGroundControl* presents sensible options based on the connected hardware).

1. For a Pixhawk-compatible board choose either **PX4 Flight Stack vX.X.X Stable Release** or **ArduPilot Flight Stack** radio buttons to download the *current stable release*.

If you select *ArduPilot* you will also have to choose the specific firmware and the type of vehicle (as shown below).

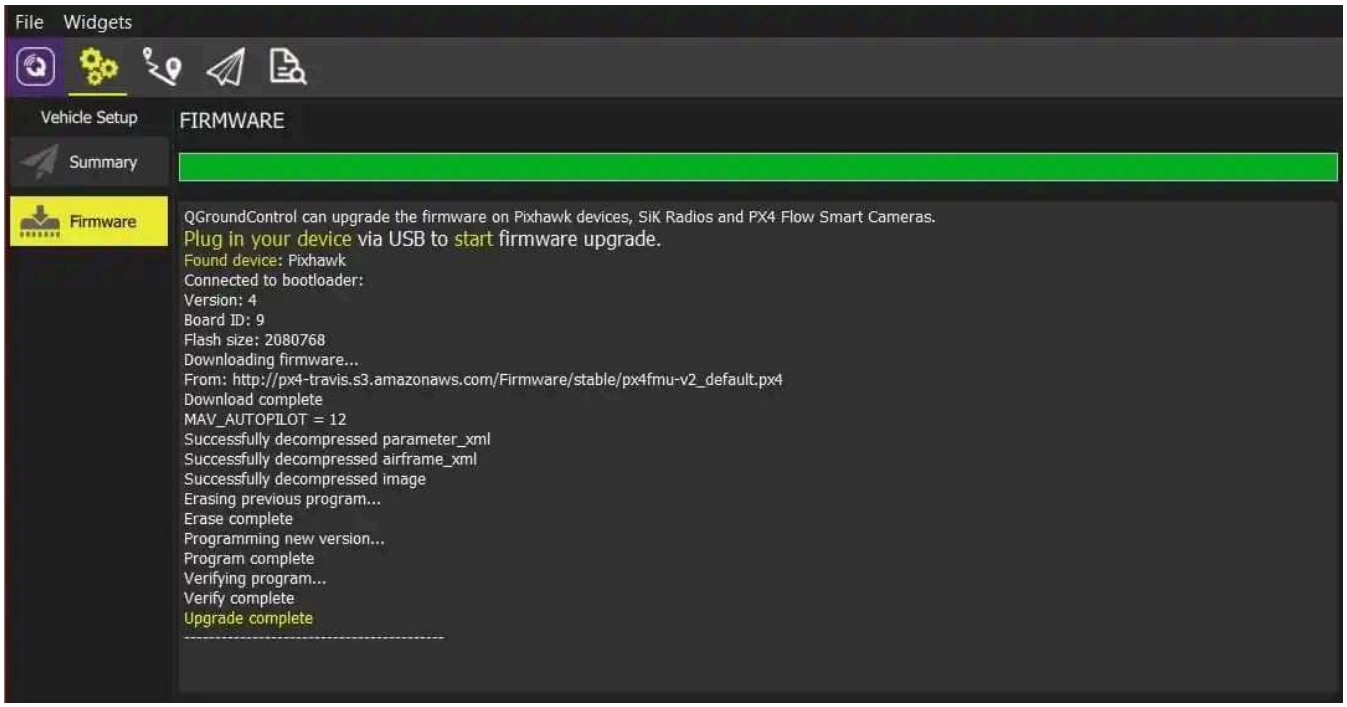
2. Check **Advanced settings** to select specific developer releases or install firmware from your local file system.



Update the firmware

1. Click the **OK** button to start the update.

   The firmware will then proceed through a number of upgrade steps (downloading new firmware, erasing old firmware etc.). Each step is printed to the screen and overall progress is displayed on a progress bar.



Once the firmware has finished loading the device/vehicle will reboot and reconnect. Next you will need to configure the airframe (and then sensors, radio, etc.)

Edit on GitHub

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Vehicle Setup

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Airframe

Radio Setup

Radio Setup is used to configure the mapping of your main transmitter attitude control sticks (roll, pitch, yaw, throttle) to channels, and to calibrate the minimum, maximum, trim and reverse settings for all other transmitter controls/RC channels.

The main calibration process is identical for PX4 and ArduPilot (a number of additional flight-controller specific settings/tools are detailed below).

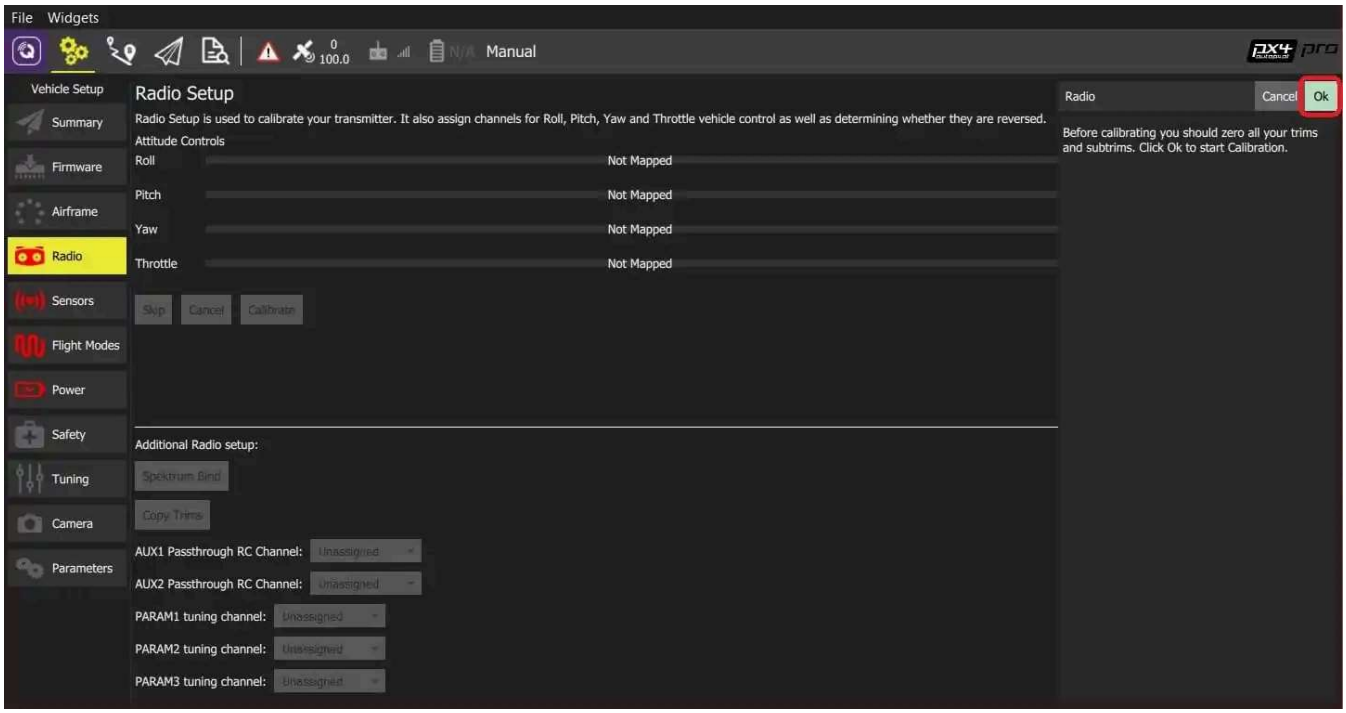
> **INFO**
>
> Before you can calibrate the radio system the receiver and transmitter must be connected/bound. The process for binding a transmitter and receiver pair is hardware specific (see your manual for instructions).

Performing the Calibration

The calibration process is straightforward - you will be asked to move the sticks in a specific pattern that is shown on the transmitter diagram on the top right of the screen. Simply follow the instructions to complete calibration.

To calibrate the radio:

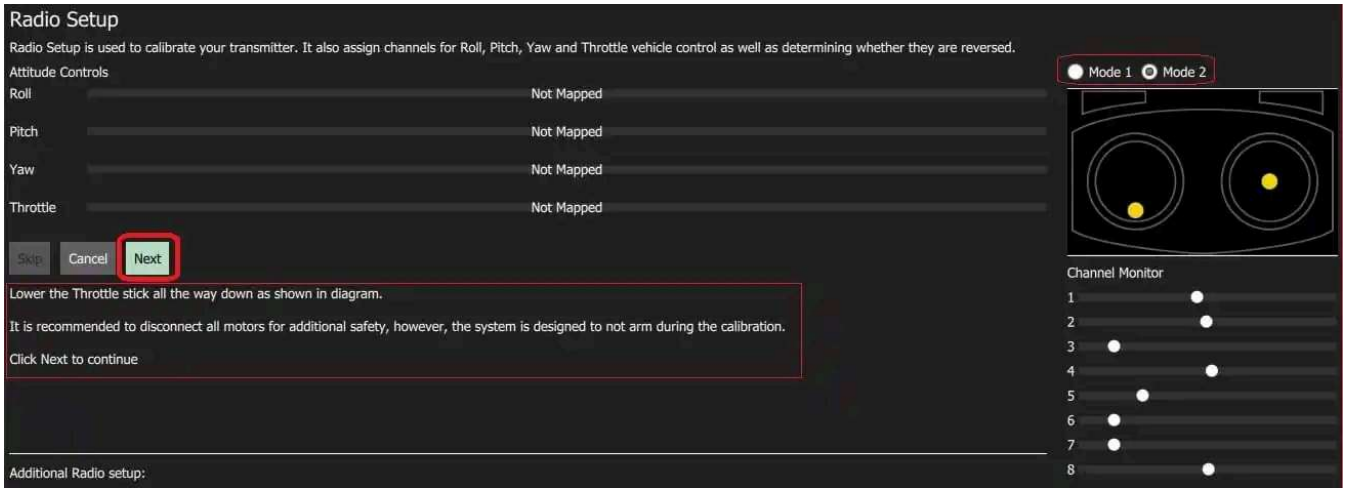
1. Select the **Gear** icon (Vehicle Setup) in the top toolbar and then **Radio** in the sidebar.
2. Turn on your RC transmitter.
3. Press **OK** to start the calibration.



INFO

The image above is for PX4 Pro. Calibration/top section is the same for both firmware, but the *Additional Radio setup* section will differ.

4. Set the *transmitter mode* radio button that matches your transmitter configuration (this ensures that *QGroundControl* displays the correct stick positions for you to follow during calibration).



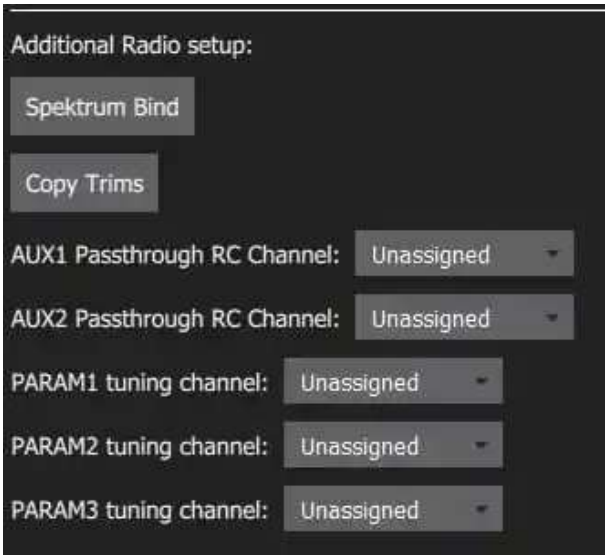
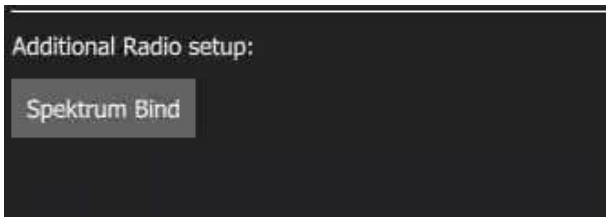
5. Move the sticks to the positions indicated in the text (and on the transmitter image). Press **Next** when the sticks are in position. Repeat for all positions.

6. When prompted, move all other switches and dials through their full range (you will be able to observe them moving on the *Channel Monitor*).
7. Press **Next** to save the settings.

Radio calibration is demonstrated in the PX4 setup video here (youtube).

Additional Radio Setup

At the lower part of the *Radio Setup* screen is firmware-specific *Additional Radio setup* section. The options for each autopilot are shown below.

PX4	ArduPilot
	

Spectrum Bind (ArduPilot/PX4)

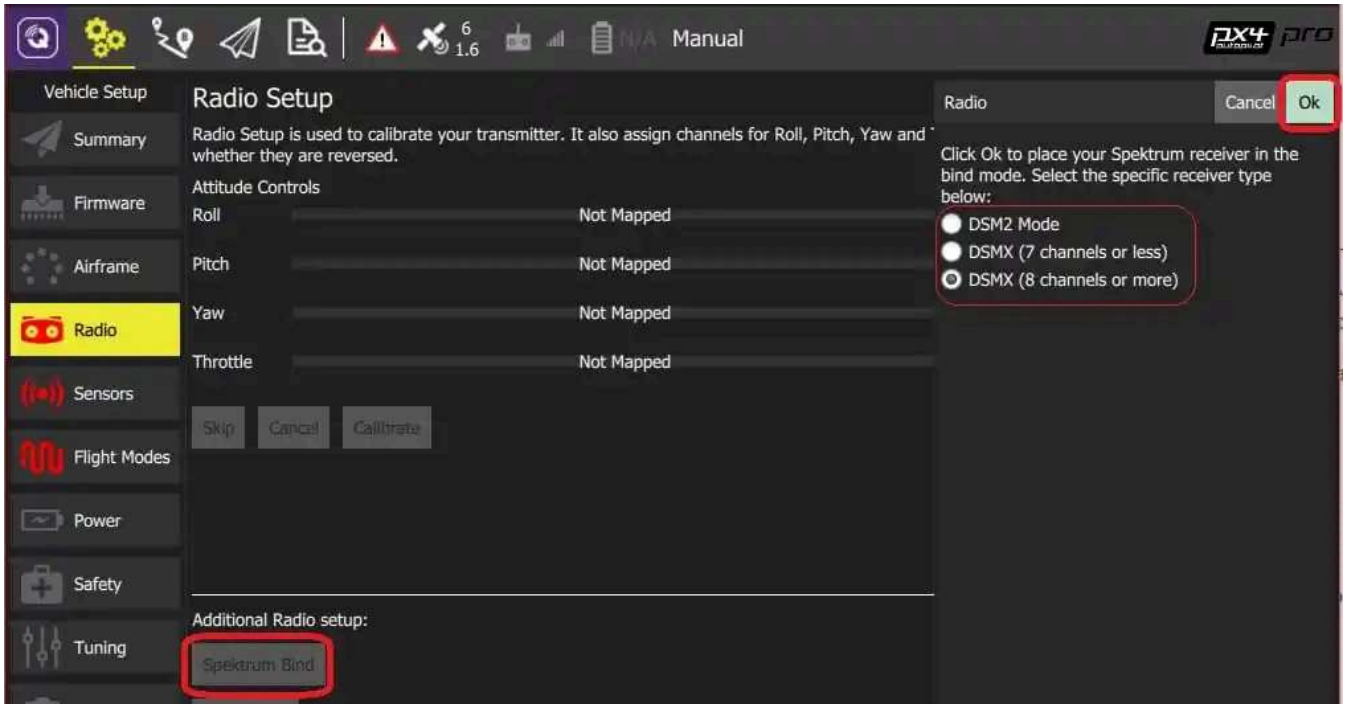
Before you can calibrate the radio system the receiver and transmitter must be connected/bound. If you have a *Spektrum* receiver you can put it in *bind mode* using *QGroundControl* as shown below (this can be particularly useful if you don't have easy physical access to the receiver on your vehicle).

To bind a Spektrum transmitter/receiver:

1. Select the **Spektrum Bind** button

2. Select the radio button for your receiver

3. Press **OK**



4. Power on your Spektrum transmitter while holding down the bind button.

Copy Trims (PX4)

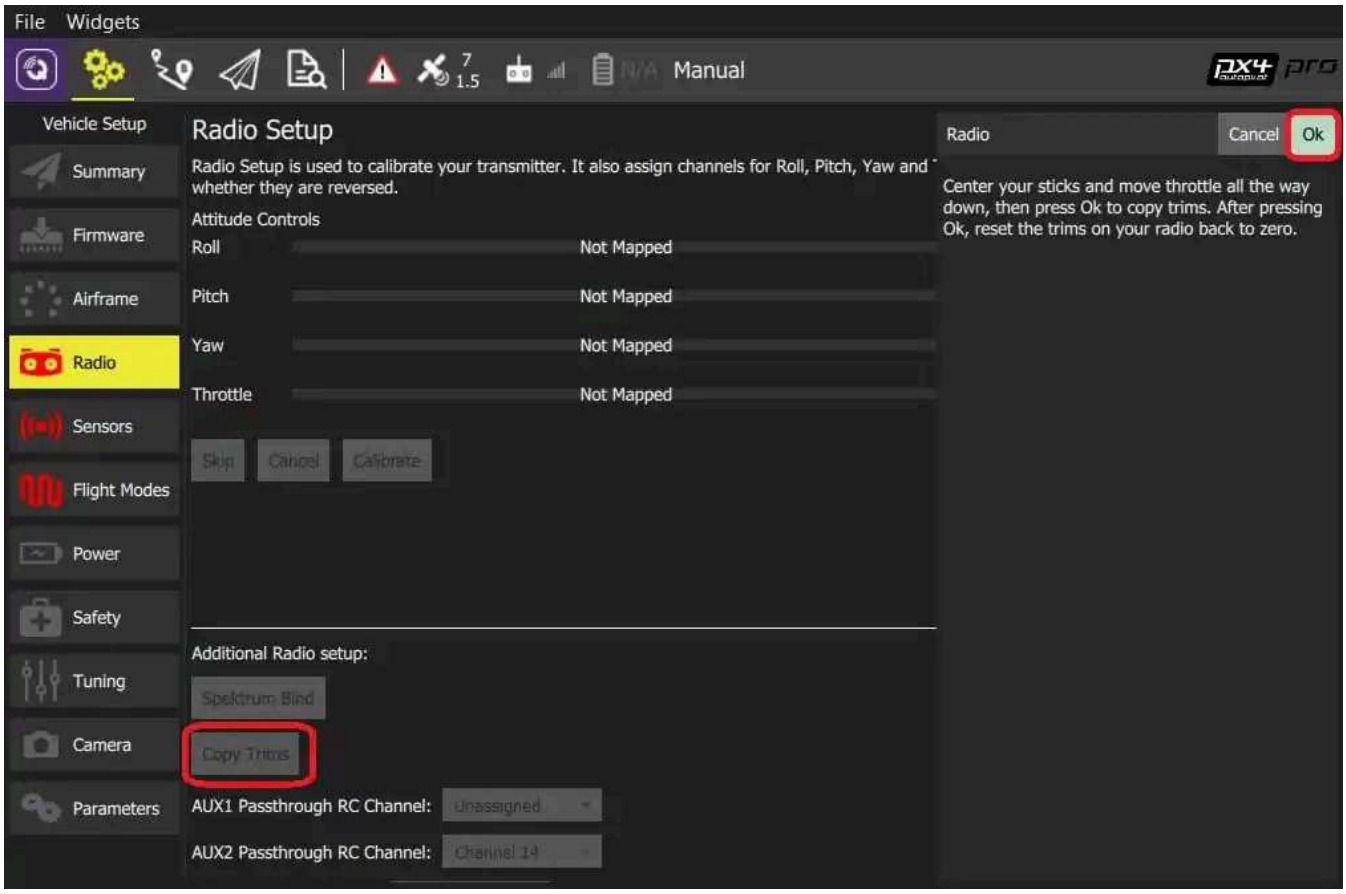
This setting is used to copy the manual trim settings from your radio transmitter so that they can be applied automatically within the autopilot. After this is done you will need to remove the manually set trims.

To copy the trims:

1. Select **Copy Trims**.

2. Center your sticks and move throttle all the way down.

3. Press **Ok**.



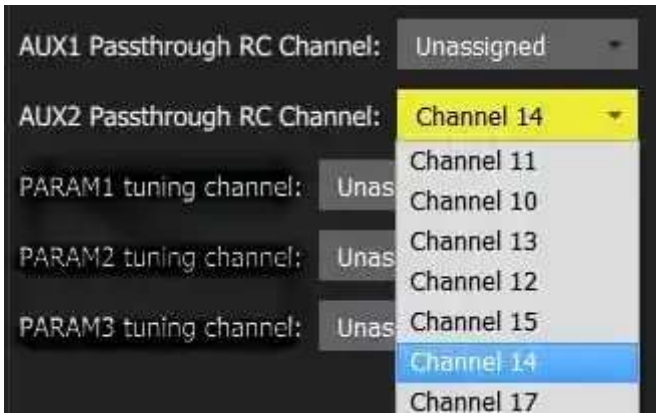
4. Reset the trims on your transmitter back to zero.

AUX Passthrough Channels (PX4)

AUX passthrough channels allow you to control arbitrary optional hardware from your transmitter (for example, a gripper).

To use the AUX passthrough channels:

1. Map up to 2 transmitter controls to separate channels.
2. Specify these channels to map to the AUX1 and AUX2 ports respectively, as shown below. Values are saved to the vehicle as soon as they are set.



The flight controller will pass through the unmodified values from the specified channels out of AUX1/AUX2 to the connected servos/relays that drive your hardware.

Param Tuning Channels (PX4)

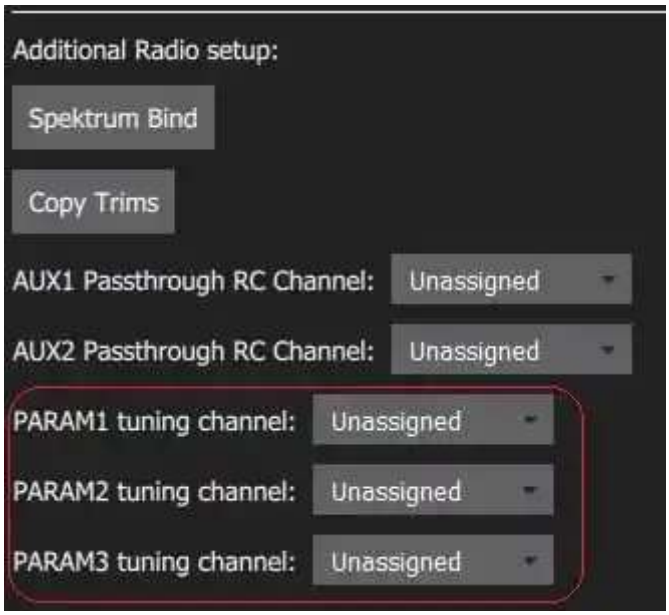
Tuning channels allow you to map a transmitter tuning knob to a parameter (so that you can dynamically modify a parameter from your transmitter).

> **TIP**
>
> This feature is provided to enable manual in-flight tuning.

The channels used for parameter tuning are assigned in the *Radio* setup (here!), while the mapping from each tuning channel to its associated parameter is defined in the *Parameter editor*.

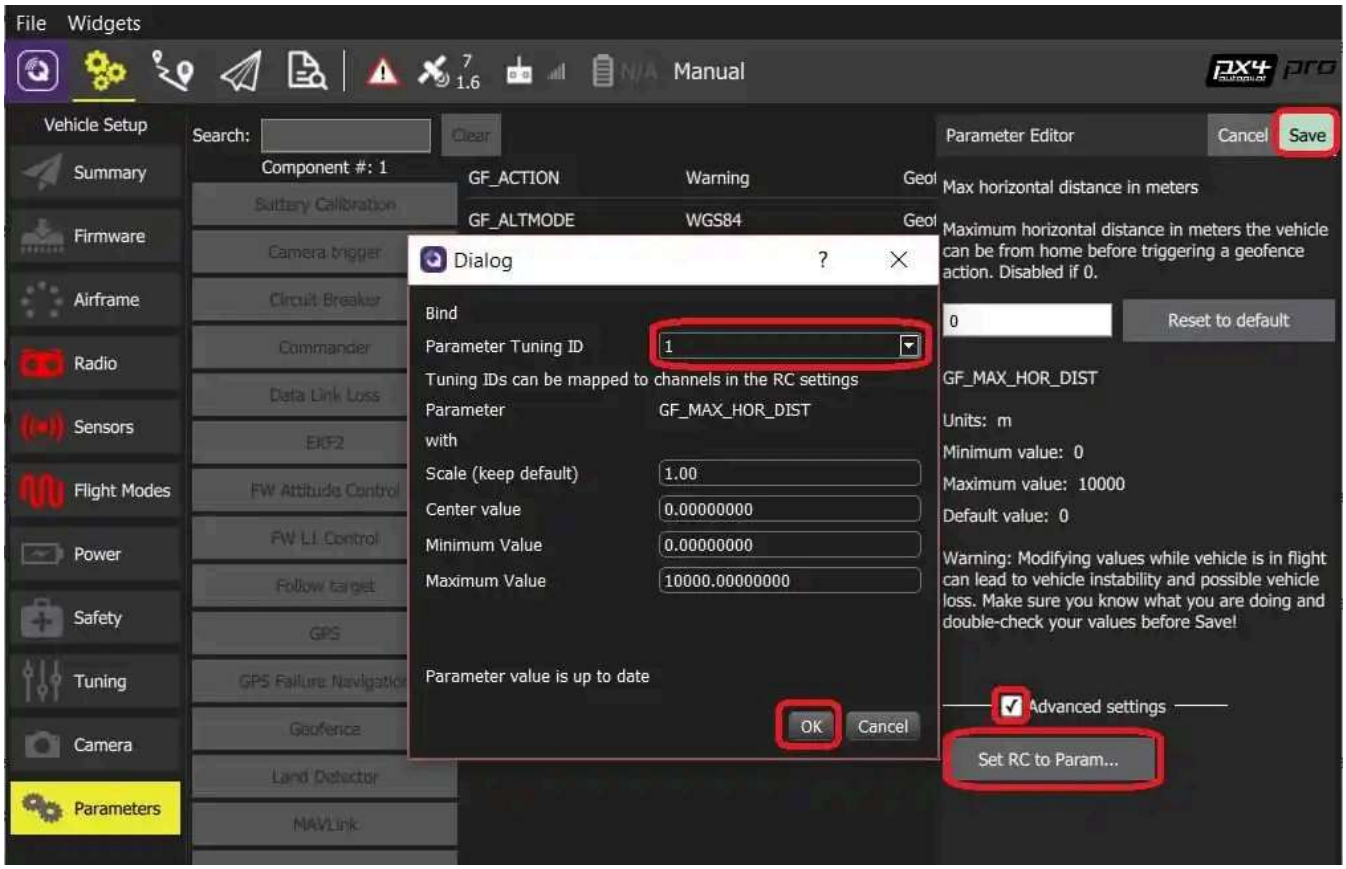
To set up tuning channels:

1. Map up to 3 transmitter controls (dials or sliders) to separate channels.
2. Select the mapping of *PARAM Tuning Id* to radio channels, using the selection lists. Values are saved to the vehicle as soon as they are set.



To map a PARAM tuning channel to a parameter:

1. Open the **Parameters** sidebar.
2. Select the parameter to map to your transmitter (this will open the *Parameter Editor*).
3. Check the **Advanced Settings** checkbox.
4. Click the **Set RC to Param...** button (this will pop-up the foreground dialog displayed below)



5. Select the tuning channel to map (1, 2 or 3) from the *Parameter Tuning ID* selection list.

6. Press **OK** to close the dialog.

7. Press **Save** to save all changes and close the *Parameter Editor*.

TIP

You can clear all parameter/tuning channel mappings by selecting menu **Tools > Clear RC to Param** at the top right of the *Parameters* screen.

Edit on GitHub

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Airframe (PX4)

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Sensors

PX4 Flight Modes Setup

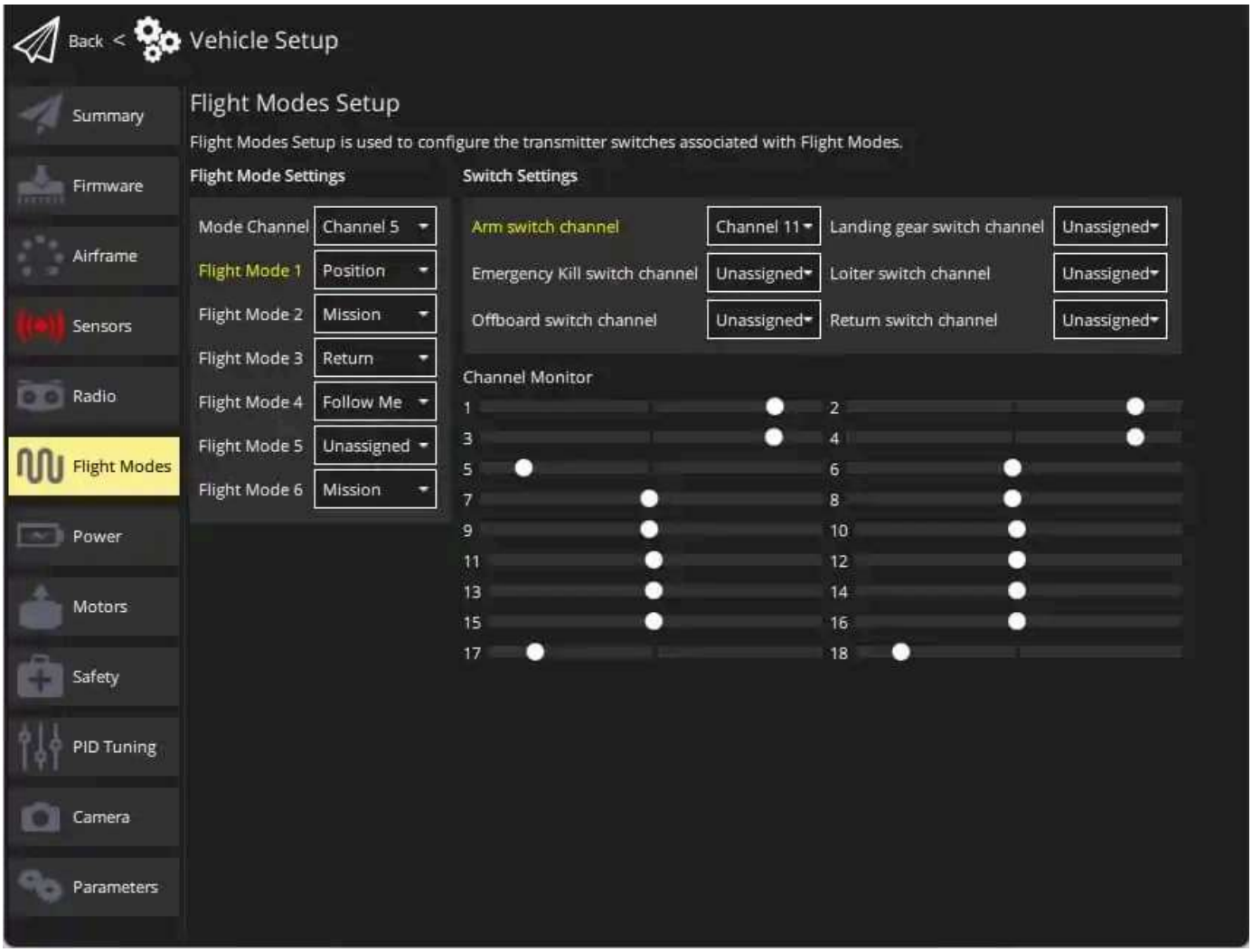
The *Flight Modes* section allows you to configure which flight modes and other actions are triggered by particular switches/switch positions on your RC transmitter.

INFO

In order to set up flight modes you must already have

- Configured your radio in order to set flight modes.
- Setup the RC transmitter (Flight Modes > Transmitter Setup)

To access this section, select the **Gear** icon (Vehicle Setup) in the top toolbar and then **Flight Modes** in the sidebar.

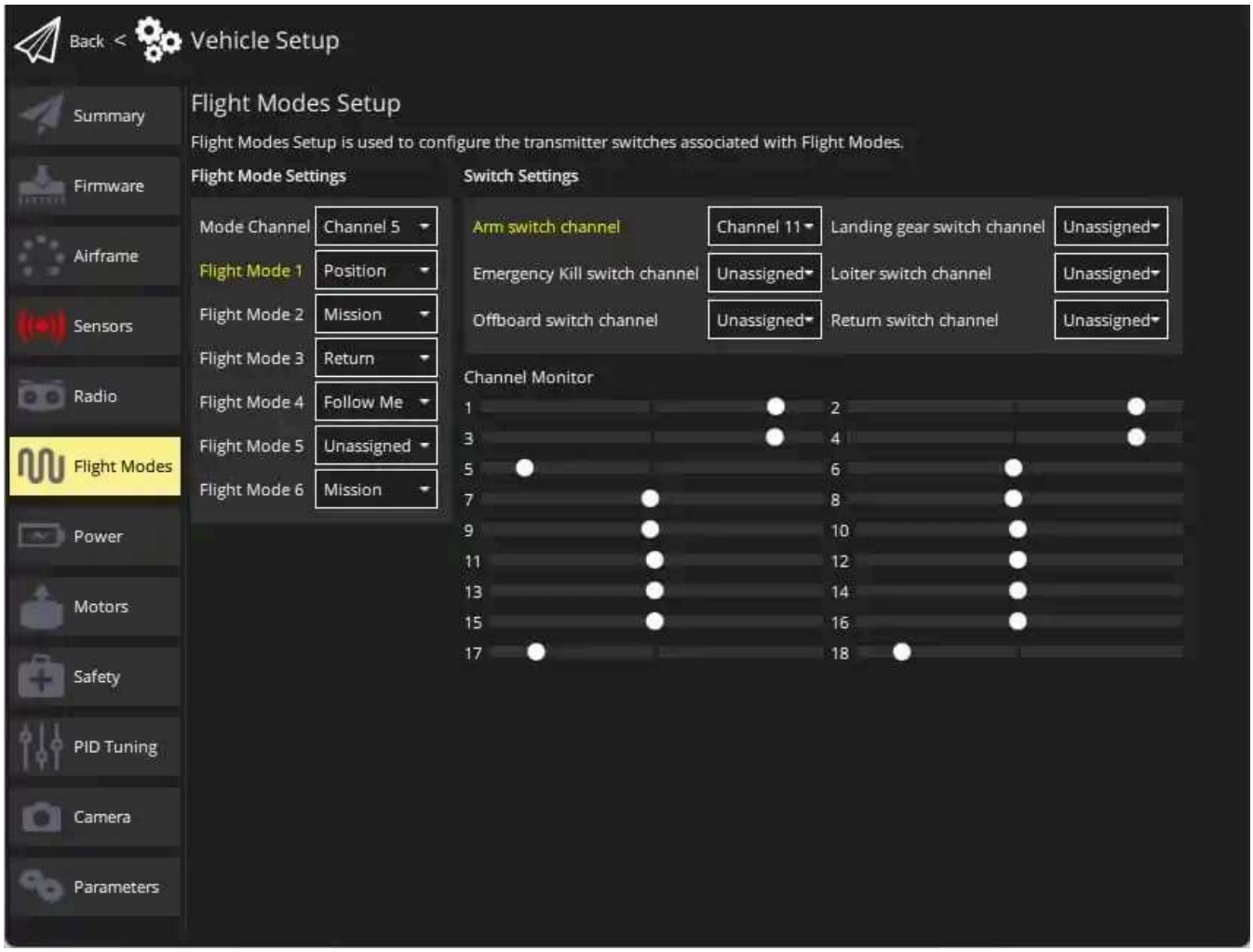


Flight Mode Settings

The screen allows you to specify a "mode" channel and select up to 6 flight modes that will be activated based on the value sent on the channel. You can also assign a small number of channels to trigger particular actions, such as deploying landing gear, or emergency shutdown (kill switch).

The steps are:

1. Turn on your RC transmitter.
2. Select the **Gear** icon (Vehicle Setup) in the top toolbar and then **Flight Modes** in the sidebar.



3. Specify *Flight Mode Settings*:

   - Select the transmitter **Mode channel** (shown as Channel 5 above).
   - Select up to six **Flight Modes** for switch positions encoded in the channel.

   INFO

   Position mode, return mode and mission mode are recommended.

4. Specify *Switch Settings*:

   - Select the channels that you want to map to specific actions - *Kill switch*, landing gear, etc. (if you have spare switches and channels on your transmitter).

5. Test that the modes are mapped to the right transmitter switches:

   - Check the *Channel Monitor* to confirm that each switch moves the expected channel.

- Select each mode switch on your transmitter in turn, and check that the desired flight mode is activated (the text turns yellow on *QGroundControl* for the active mode).

All values are automatically saved as they are changed.

See Also

- PX4 Flight Modes

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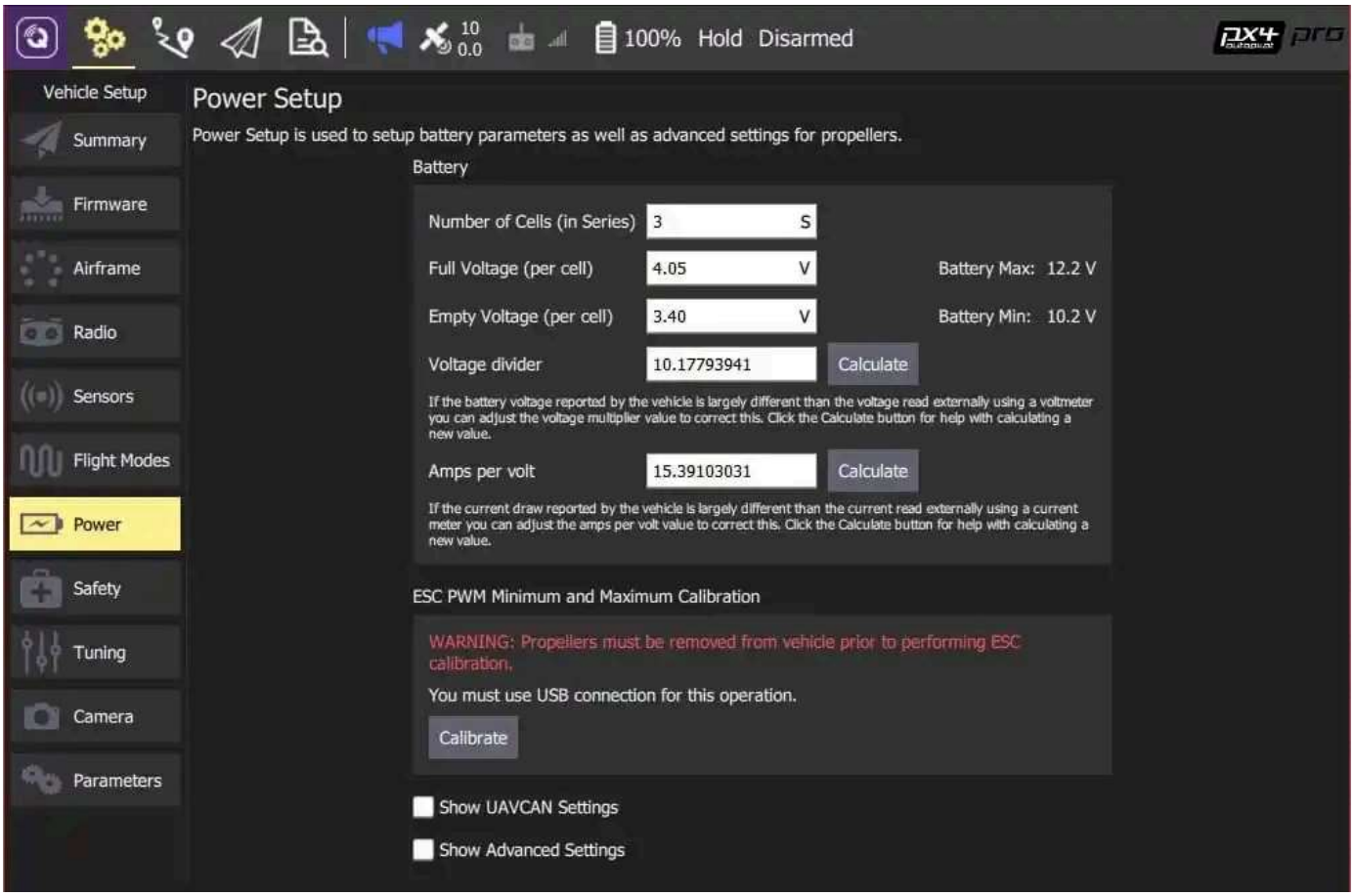
ArduPilot Flight Modes Setup

Next page
Power

Power Setup

The *Power Setup* screen is used to configure battery parameters and also provide advanced settings for propellers.



Battery Voltage/Current Calibration

Enter data for your battery/power module from its data sheet: number of cells, full voltage per cell, empty voltage per cell. If provided, also enter voltage divider and amps-per-volt information.

QGroundControl can be used to calculate appropriate voltage divider and amps-per-volt values from measurements:

1. Measure the voltage from the battery using a multimeter.
2. Click **Calculate** next to the *Voltage divider* field. On the prompt that appears:
3. Enter the measured voltage.
4. Click **Calculate** to generate a new voltage-divider value.
5. Click **Close** to save the value into the main form.
6. Measure the current from the battery.
7. Click **Calculate** next to the *Amps per volt* field. On the prompt that appears:
8. Enter the measured current.
9. Click **Calculate** to generate a new *amps per volt* value.
10. Click **Close** to save the value into the main form.

Advanced Power Settings

Click the **Show Advanced Settings** checkbox to specify advanced power settings.

Voltage Drop on Full Load

Batteries show less voltage at high throttle. Enter the difference in Volts between idle throttle and full throttle, divided by the number of battery cells. The default value should be used if unsure!

> **WARNING**
>
> If the value is too high the battery may be deep-discharged and damaged.

ESC PWM Minimum and Maximum Calibration

To calibrate the ESC max/min PWM values:

1. Remove the propellers.
2. Connect the vehicle to QGC via USB (only).
3. Click the **Calibrate** button.

> **WARNING**
>
> Never attempt ESC calibration with props on.
>
> Motors should not spin during ESC calibration. However if an ESC doesn't properly support/detect the calibration sequence then it will respond to the PWM input by running the motor at maximum speed.

Other Settings

Select the **Show UAVCAN Settings** checkbox to access additional settings for UAVCAN Bus Configuration and motor index and direction assignment.

Edit on GitHub

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PX4 Flight Modes Setup

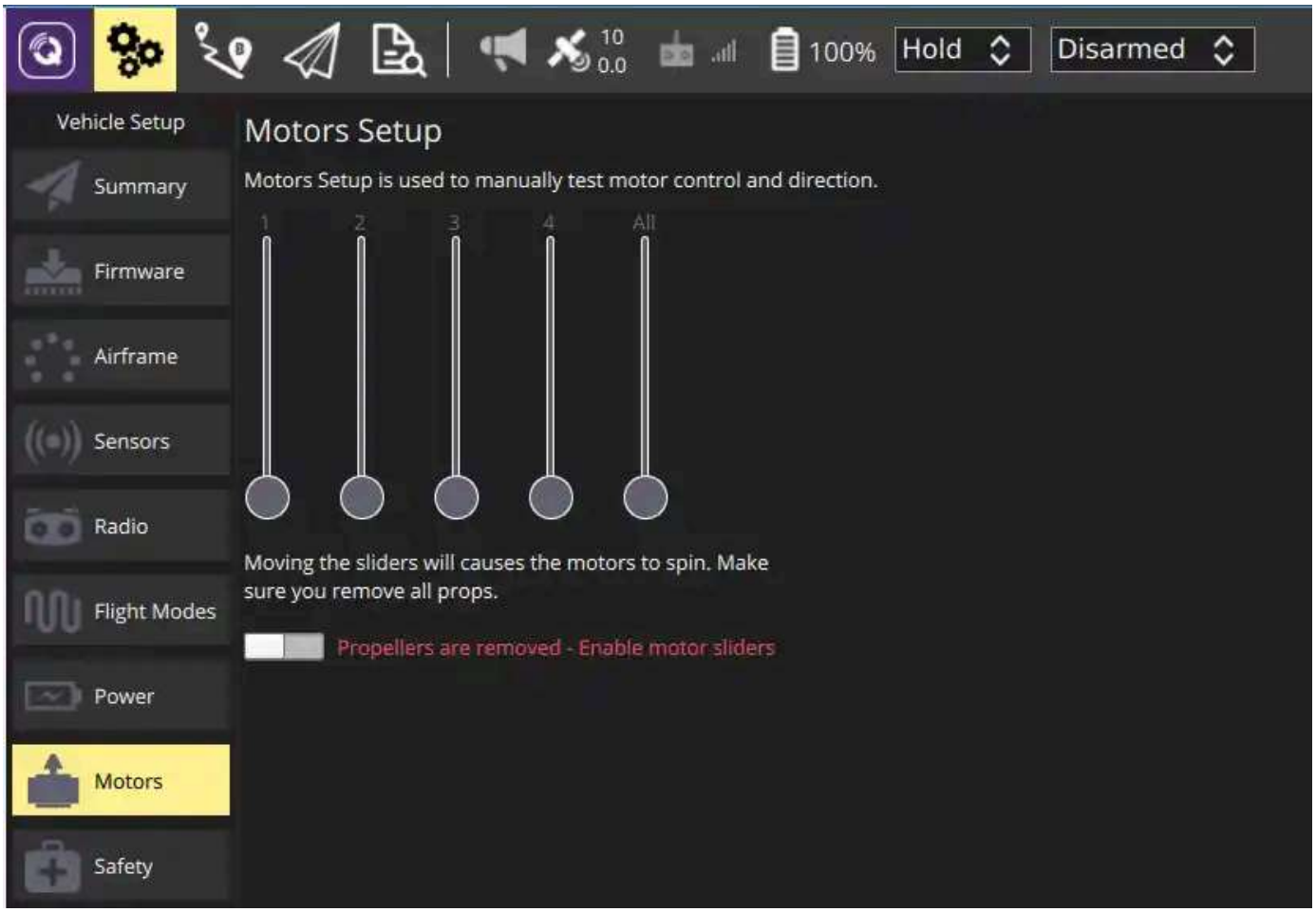
Next page
Motors

Motor Setup

Motor Setup is used to test individual motors/servos (for example, to verify that motors spin in the correct direction).

TIP

These instructions apply to PX4 and to most vehicle types on ArduPilot. Vehicle-specific instructions are provided as sub-topics (e.g. Motors Setup (ArduSub)).



Test Steps

To test the motors:

1. Remove all propellers.

   WARNING

   You must remove props before activating the motors!

2. (*PX4-only*) Enable safety switch - if used.
3. Slide the switch to enable motor sliders (labeled: *Propellers are removed - Enable motor sliders*).
4. Adjust the individual sliders to spin the motors and confirm they spin in the correct direction.

   INFO

   The motors only spin after you release the slider and will automatically stop spinning after 3 seconds.

Additional Information

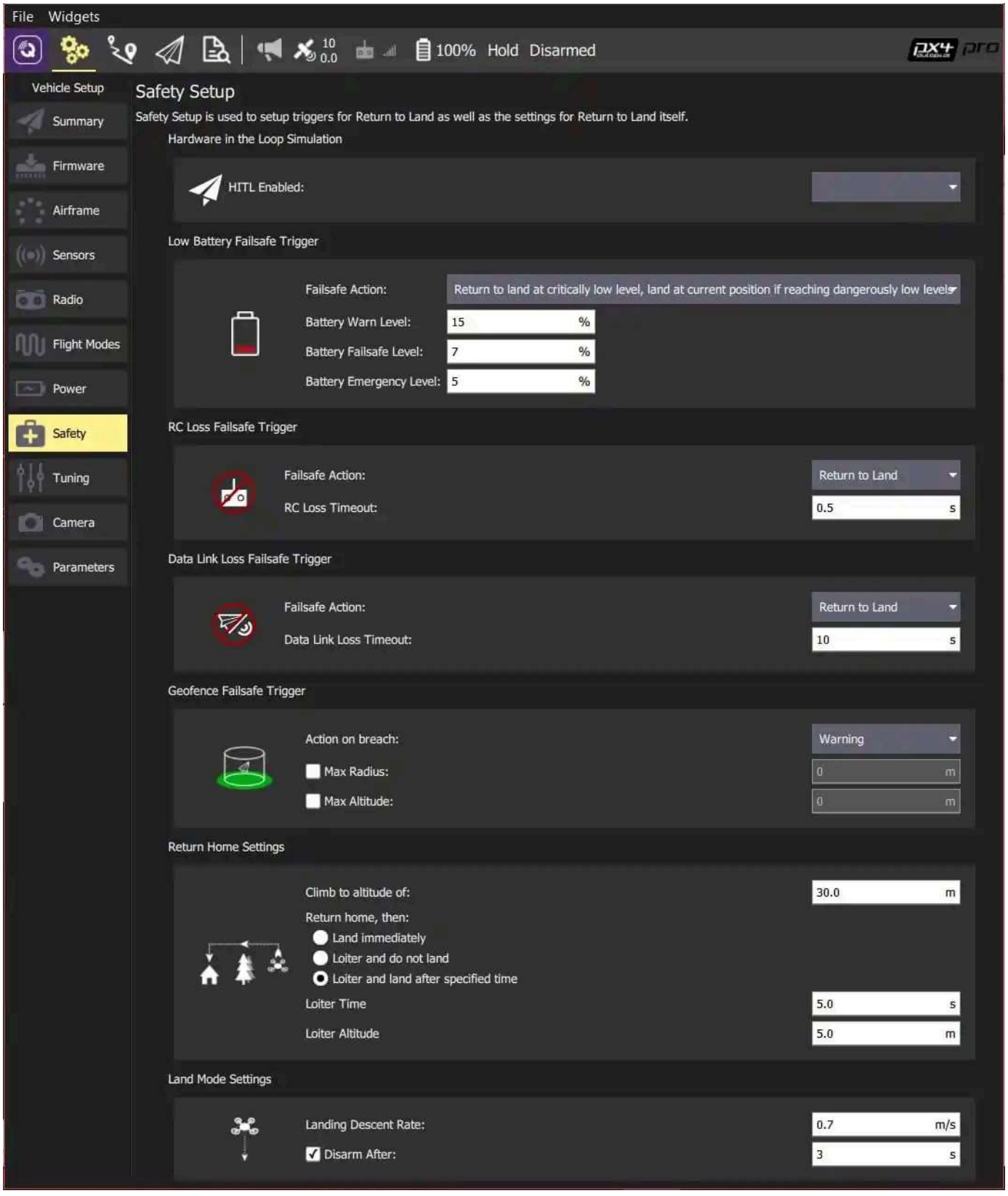
- Basic Configuration > Motor Setup (*PX4 User Guide*) - This contains additional PX4-specific information.

Safety Setup

The *Safety Setup* page allows you to configure the most important failsafe settings (other failsafe settings can be set via the parameters described in the failsafe documentation for each vehicle type).

For ArduPilot safety page information see: Safety (ArduPilot)

The PX4 page is shown below.



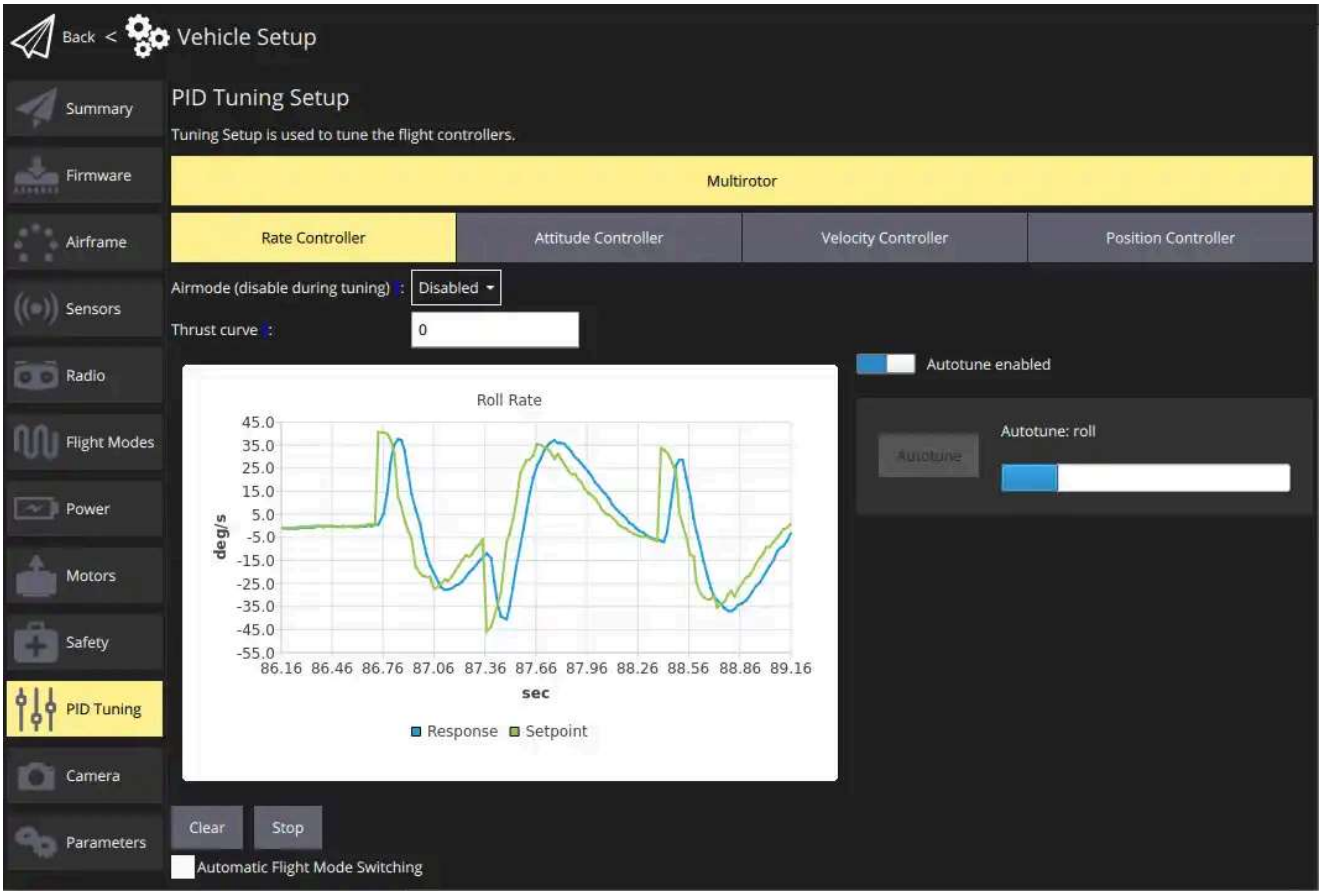
INFO

For additional PX4 safety settings and information see: [Safety Configuration](#).

Tuning (PX4)

Tuning only needs to be done once, and is recommended unless you're using vehicle that has already been tuned by the manufacturer (and not modified since).

Auto-tuning should generally be used for frame types and controllers that support it (multicopter, fixed wing, and hybrid VTOL fixed wing vehicles). The tuning UI also supports manual tuning of all controllers.



INFO

During Airframe Setup you should have selected the frame that most closely matches your vehicle. This will usually be tuned well enough to fly, and it *may* also be sufficiently well tuned to run autotuning.

Autotune

Auto-tuning automates the process of tuning the PX4 rate and attitude controllers, which are the most important controllers for stable and responsive flight (other tuning is more "optional").

> **INFO**
>
> This guide shows the default usage of this feature. Additional information and configuration can be found in the PX4 Autotuning Guide (PX4 User Guide).

Pre-Autotuning Test

Auto-tuning is performed while flying. The vehicle must be able to fly and adequately stabilize itself before running auto-tune. This test ensures that the vehicle can fly safely in position controlled modes.

To make sure the vehicle is stable enough for auto-tuning:

1. Perform a normal preflight safety checklist to ensure the flight zone is clear and has enough space.
2. Takeoff and prepare for the test
   - **Multicopters:** Take off and hover at 1m above ground in **Altitude mode** or Stabilized mode.
   - **Fixed-wing mode:** Take off and fly at cruise speed in **Position mode** or **Altitude mode**.
3. Use the RC transmitter roll stick to perform the following maneuver, tilting the vehicle just a few degrees: *roll left > roll right > center* (The whole maneuver should take about 3 seconds). The vehicle should stabilise itself within 2 oscillations.
4. Repeat the maneuver, tilting with larger amplitudes at each attempt. If the vehicle can stabilise itself within 2 oscillations at ~20 degrees move to the next step.
5. Repeat the same maneuvers but on the pitch axis. As above, start with small angles and confirm that the vehicle can itself within 2 oscillations before increasing the tilt.

If the drone can stabilize itself within 2 oscillations it is ready for the auto-tuning procedure.

If not, see the PX4 User Guide > Autotuning > Troubleshooting.

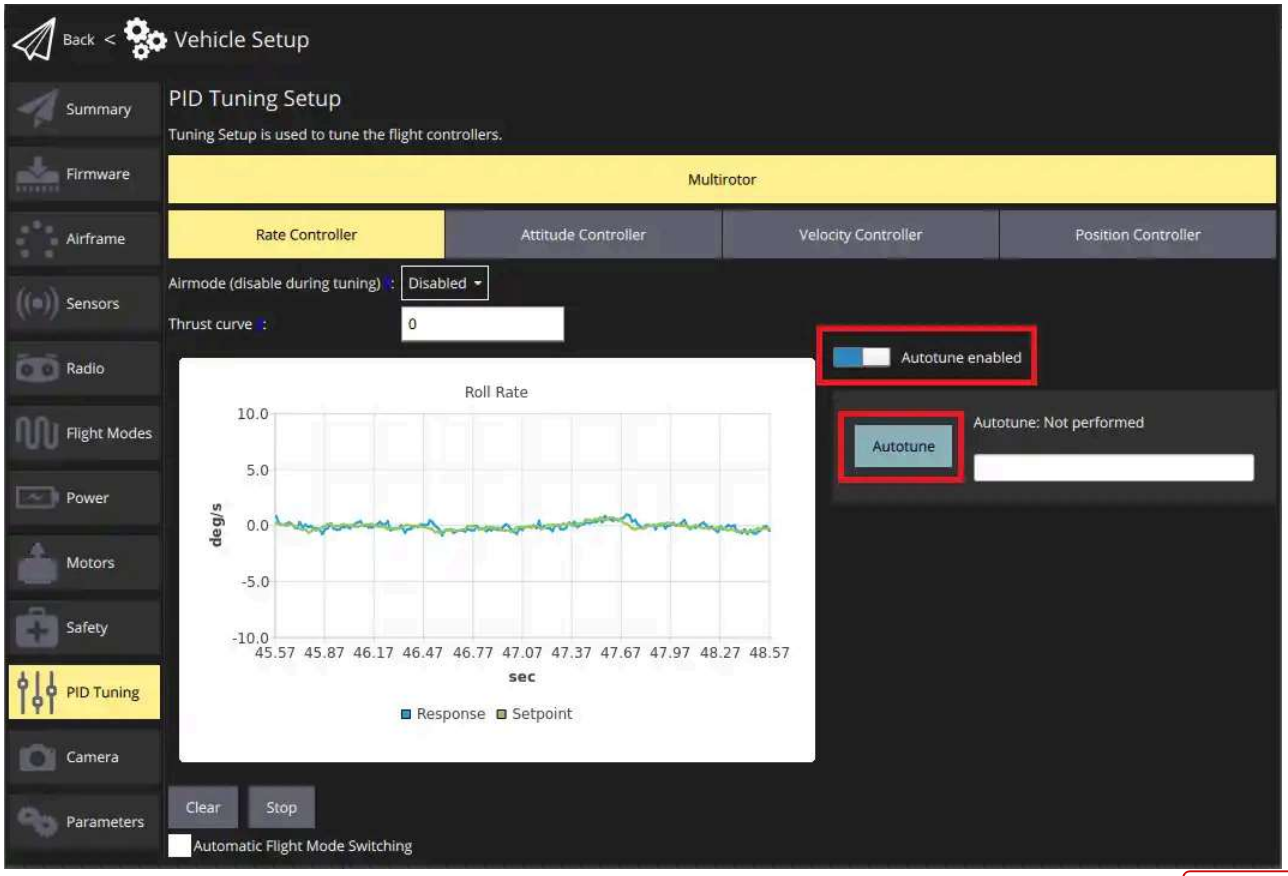
Auto-tuning procedure

The auto-tuning sequence must be performed in a **safe flight zone, with enough space**. It takes about 40 seconds (between 19 and 68 seconds). For best results, we recommend running the test in calm weather conditions.

> **INFO**
>
> Be ready to abort the autotuning process by moving the RC controller sticks.

The test steps are:

1. Perform the pre-tuning test above.
2. Takeoff using RC control and prepare for test:
   - **Multicopters:** Takeoff using the remote controller in **Altitude mode**. Hover the vehicle at a safe distance and at a few meters above ground (between 4 and 20m).
   - **VTOL in Fixed-wing mode:** Once flying at cruise speed, activate **Hold Mode**. This will guide the plane to fly in circle at constant altitude and speed.
3. In QGroundControl, open the menu: **Vehicle setup > PID Tuning**



4. Select either the *Rate Controller* or *Attitude Controller* tabs. Ensure that the **Autotune enabled** button is enabled (this will display the **Autotune** button and remove the manual tuning selectors).

5. Stop moving the joysticks and click on the **Autotune** button. Read the warning popup and click on **OK** to start tuning.

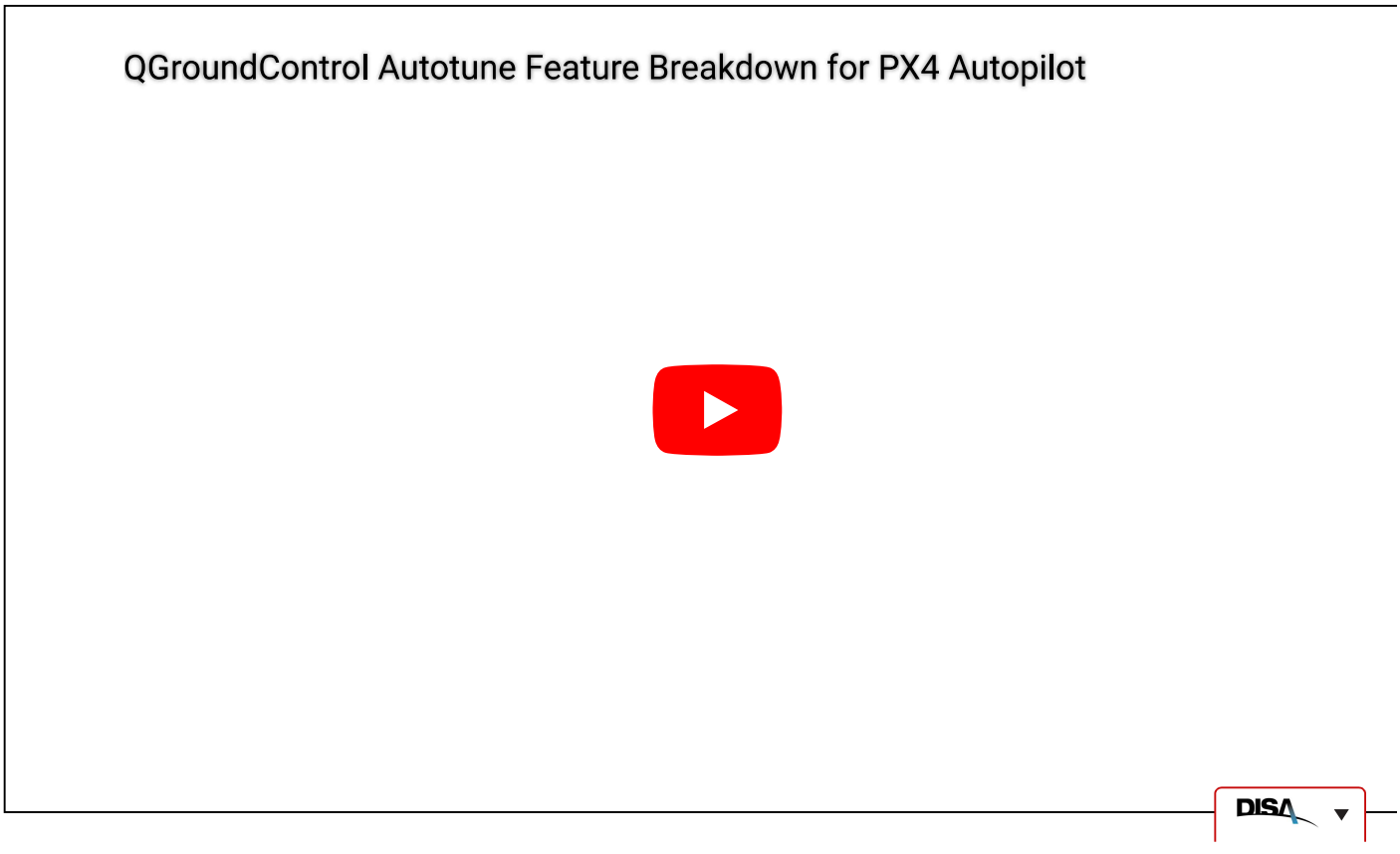
6. The drone will first start to perform quick roll motions followed by pitch and yaw motions. The progress is shown in the progress bar, next to the *Autotune* button.

7. Apply the tuning:

   - **Fixed Wing:** The tuning will be immediately/automatically be applied and tested in flight (by default). PX4 will then run a 4 second test and revert the new tuning if a problem is detected.
   - **Multicopters:** Manually land and disarm to apply the new tuning parameters. Takeoff carefully and manually test that the vehicle is stable.

8. If any strong oscillations occur, land immediately and follow the instructions in [PX4 User Guide > Autotuning > Troubleshooting].

A video of the process is shown below:



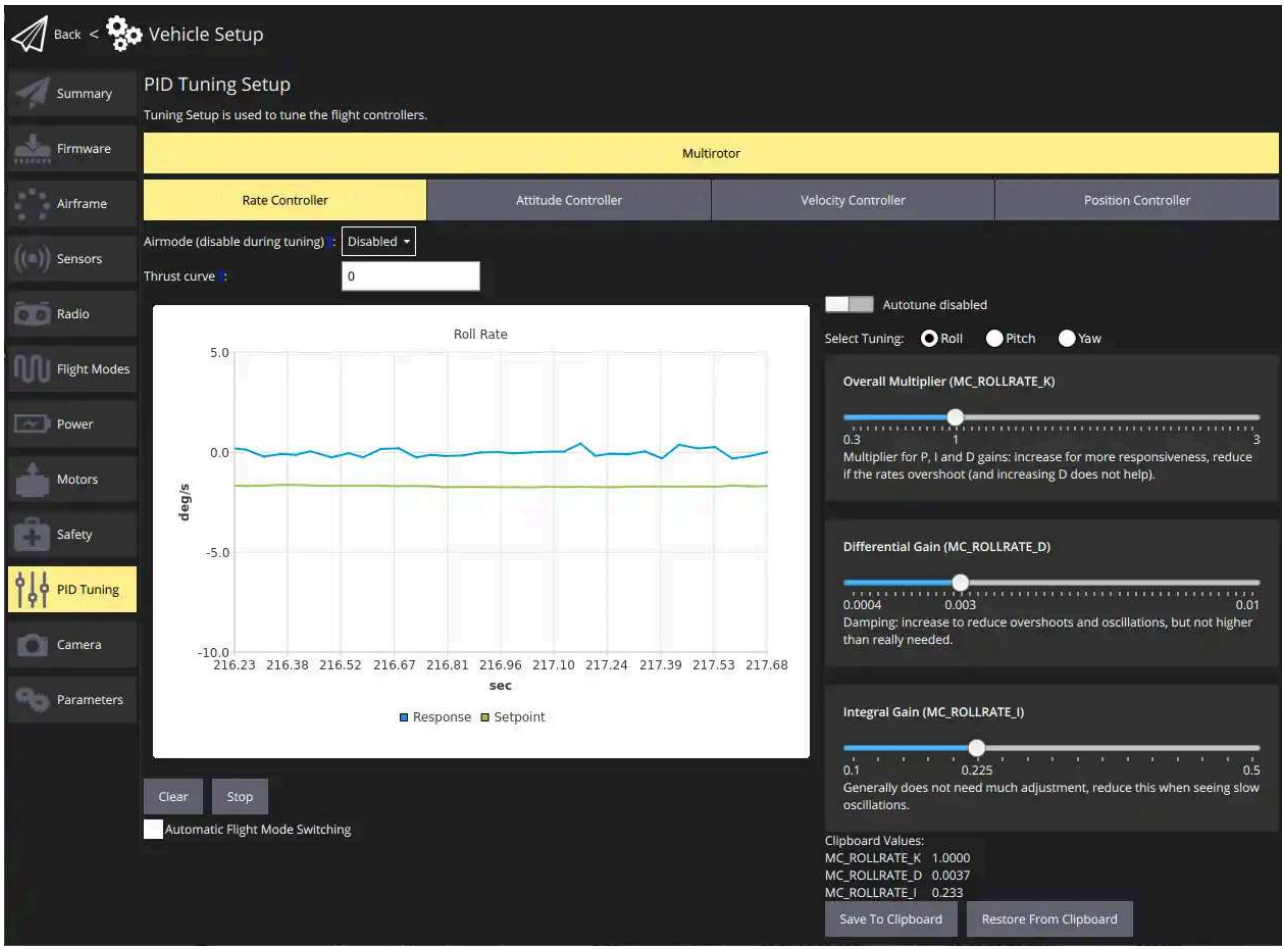
Manual Tuning

Manual tuning is done in-flight, so your vehicle must already be tuned well enough to fly with (this is normally the case if you have selected an appropriate default airframe).

The instructions below explain how you can use the manual tuning UI. It is designed to be read/used in conjustion with the PX4 Manual PID Tuning Guides, which provide more detailed hints on the kinds of step sizes to use when changing PID values.

In overview:

1. Takeoff using RC control and prepare for test:
   - **Multicopters:** Takeoff using the remote controller in **Altitude mode**. Hover the vehicle at a safe distance and at a few meters above ground (between 4 and 20m).
   - **Fixed-wing:** Once flying at cruise speed, activate **Hold Mode**. This will guide the plane to fly in circle at constant altitude and speed.
2. In QGroundControl, open the menu: **Vehicle setup > PID Tuning**
3. Select the *Rate Controller* tab. Ensure that the **Autotune enabled** button is is turned off.



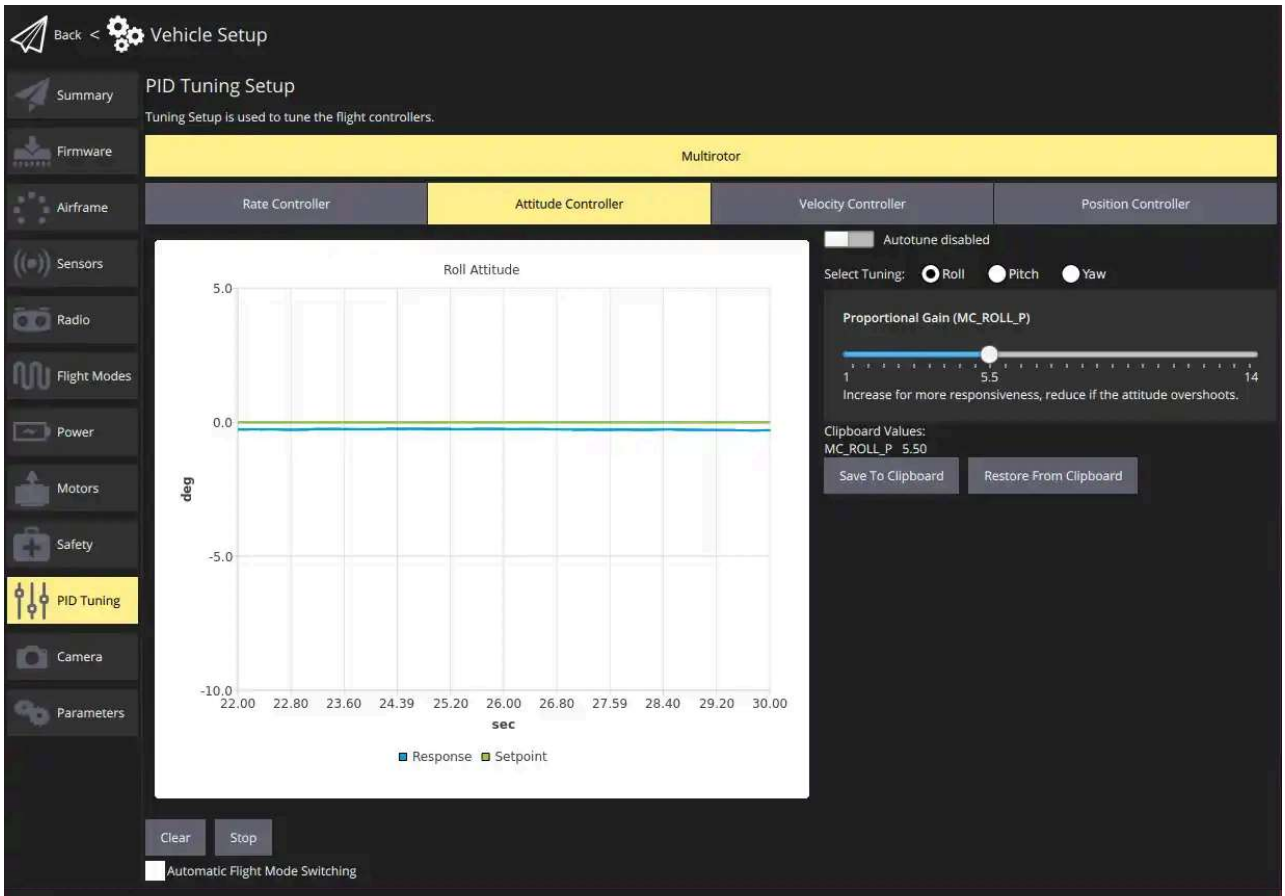
4. Select the *Tuning axis* to tune: **Roll**, **Pitch** or **Yaw** (each axis is tuned separately).

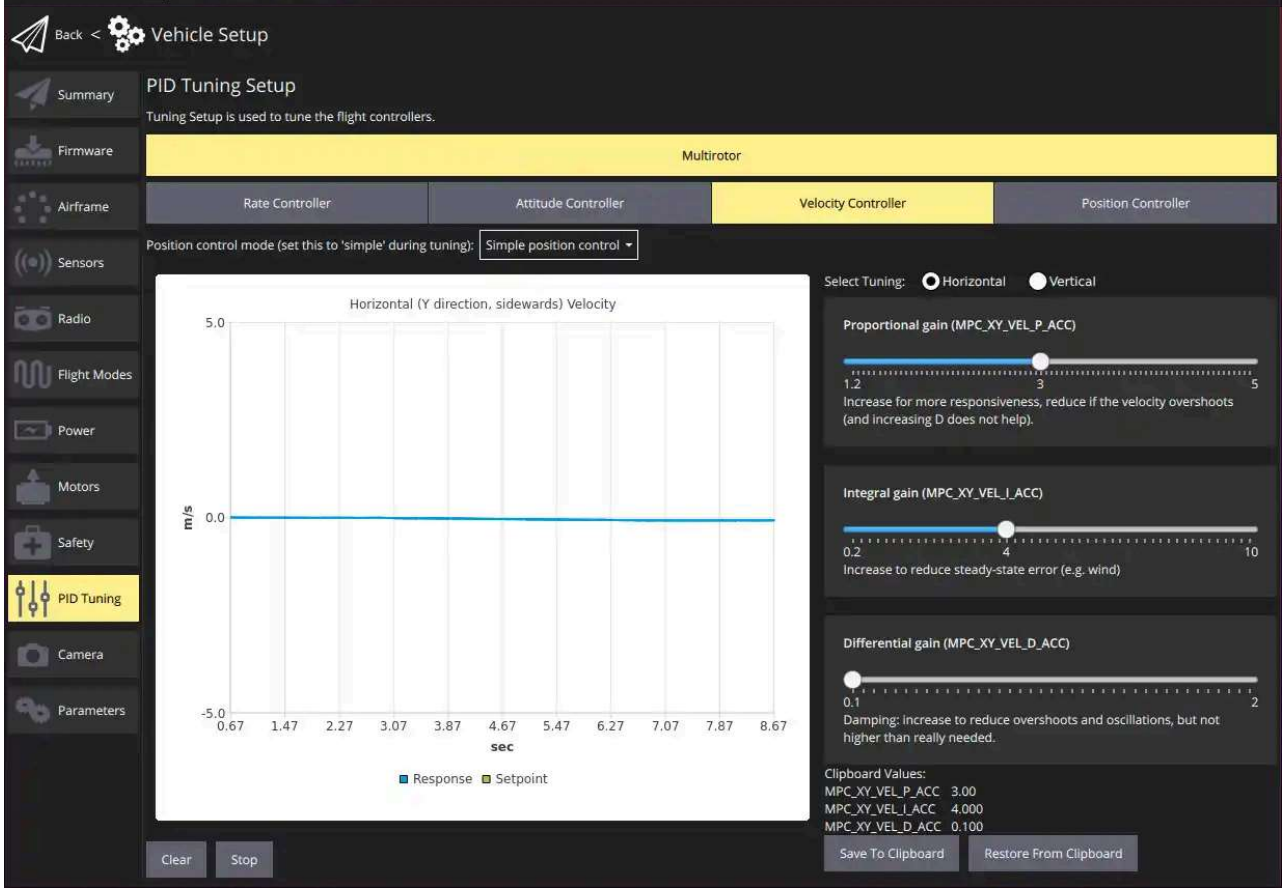
5. Fly the vehicle, observing the tracking on the chart.

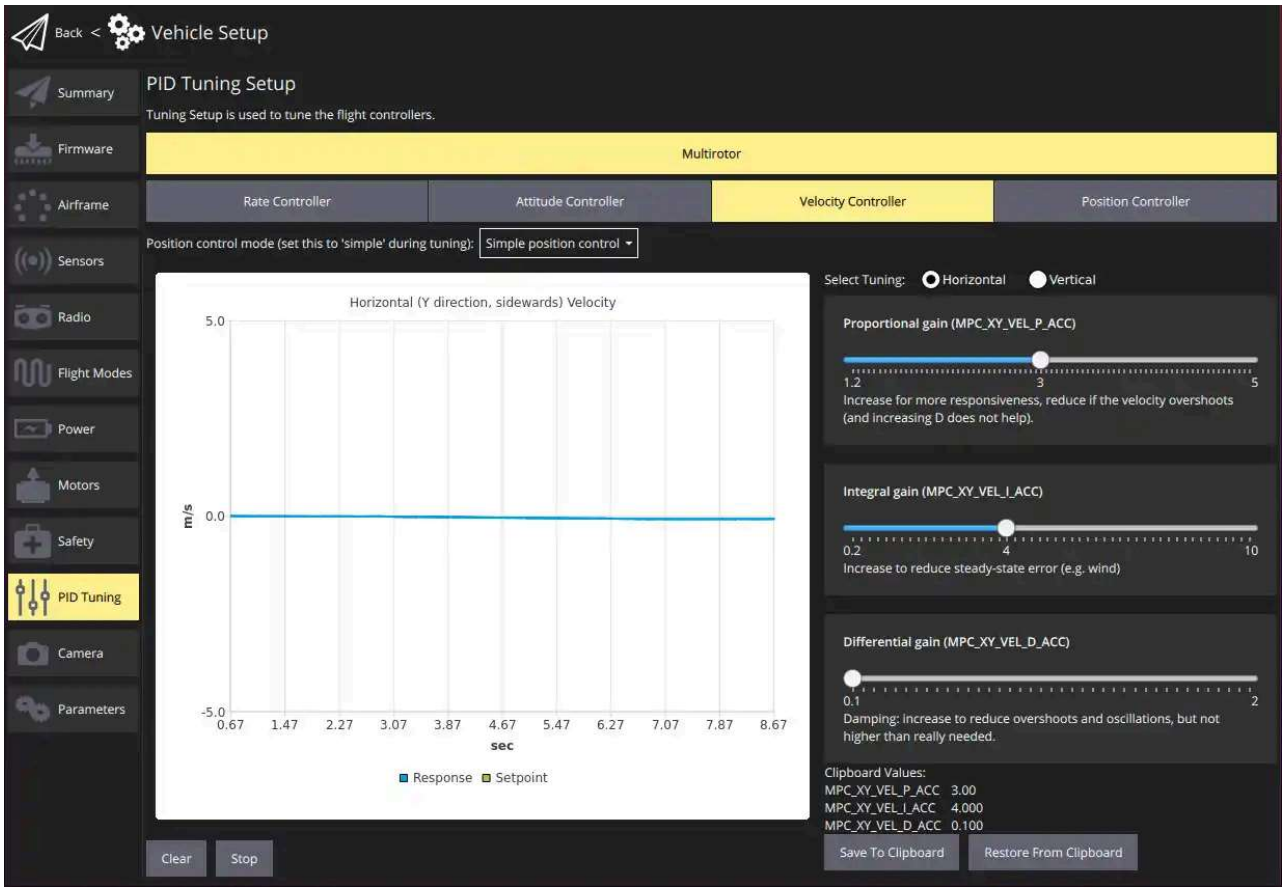
   - Adjust the *Tuning Values* (parameters) to improve the tracking shown on the graph using the slider.
   - The values are automatically saved, but you may wish to use the **Save to Clipboard** and **Restore from Clipboard** buttons to store the last known good configuration.
   - You can also **Clear**/**Stop** the chart using the buttons provided.

6. Tune the other axes.

7. Switch to the other controllers and repeat the process. Screenshots of the tuning pages are shown below.


Back
Vehicle Setup
Summary
Firmware
Airframe
Sensors
Radio
Flight Modes
Power
Motors
Safety
PID Tuning
Camera
Parameters
PID Tuning Setup
Tuning Setup is used to tune the flight controllers.
Multirotor
Rate Controller
Attitude Controller
Velocity Controller
Position Controller
Roll Attitude
5.0
0.0
-5.0
-10.0
deg
22.00 22.80 23.60 24.39 25.20 26.00 26.80 27.59 28.40 29.20 30.00
sec
Response
Setpoint
Autotune disabled
Select Tuning:
Roll
Pitch
Yaw
Proportional Gain (MC_ROLL_P)
1
5.5
14
Increase for more responsiveness, reduce if the attitude overshoots.
Clipboard Values:
MC_ROLL_P 5.50
Save To Clipboard
Restore From Clipboard
Clear
Stop
Automatic Flight Mode Switching


Back
Vehicle Setup
Summary
Firmware
Airframe
Sensors
Radio
Flight Modes
Power
Motors
Safety
PID Tuning
Camera
Parameters
PID Tuning Setup
Tuning Setup is used to tune the flight controllers.
Multirotor
Rate Controller
Attitude Controller
Velocity Controller
Position Controller
Position control mode (set this to 'simple' during tuning):
Simple position control
Horizontal (Y direction, sidewards) Velocity
5.0
0.0
-5.0
m/s
0.67 1.47 2.27 3.07 3.87 4.67 5.47 6.27 7.07 7.87 8.67
sec
Response
Setpoint
Select Tuning:
Horizontal
Vertical
Proportional gain (MPC_XY_VEL_P_ACC)
1.2
3
5
Increase for more responsiveness, reduce if the velocity overshoots (and increasing D does not help).
Integral gain (MPC_XY_VEL_I_ACC)
0.2
4
10
Increase to reduce steady-state error (e.g. wind)
Differential gain (MPC_XY_VEL_D_ACC)
0.1
2
Damping: increase to reduce overshoots and oscillations, but not higher than really needed.
Clipboard Values:
MPC_XY_VEL_P_ACC 3.00
MPC_XY_VEL_I_ACC 4.000
MPC_XY_VEL_D_ACC 0.100
Save To Clipboard
Restore From Clipboard
Clear
Stop



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ArduSub Tuning

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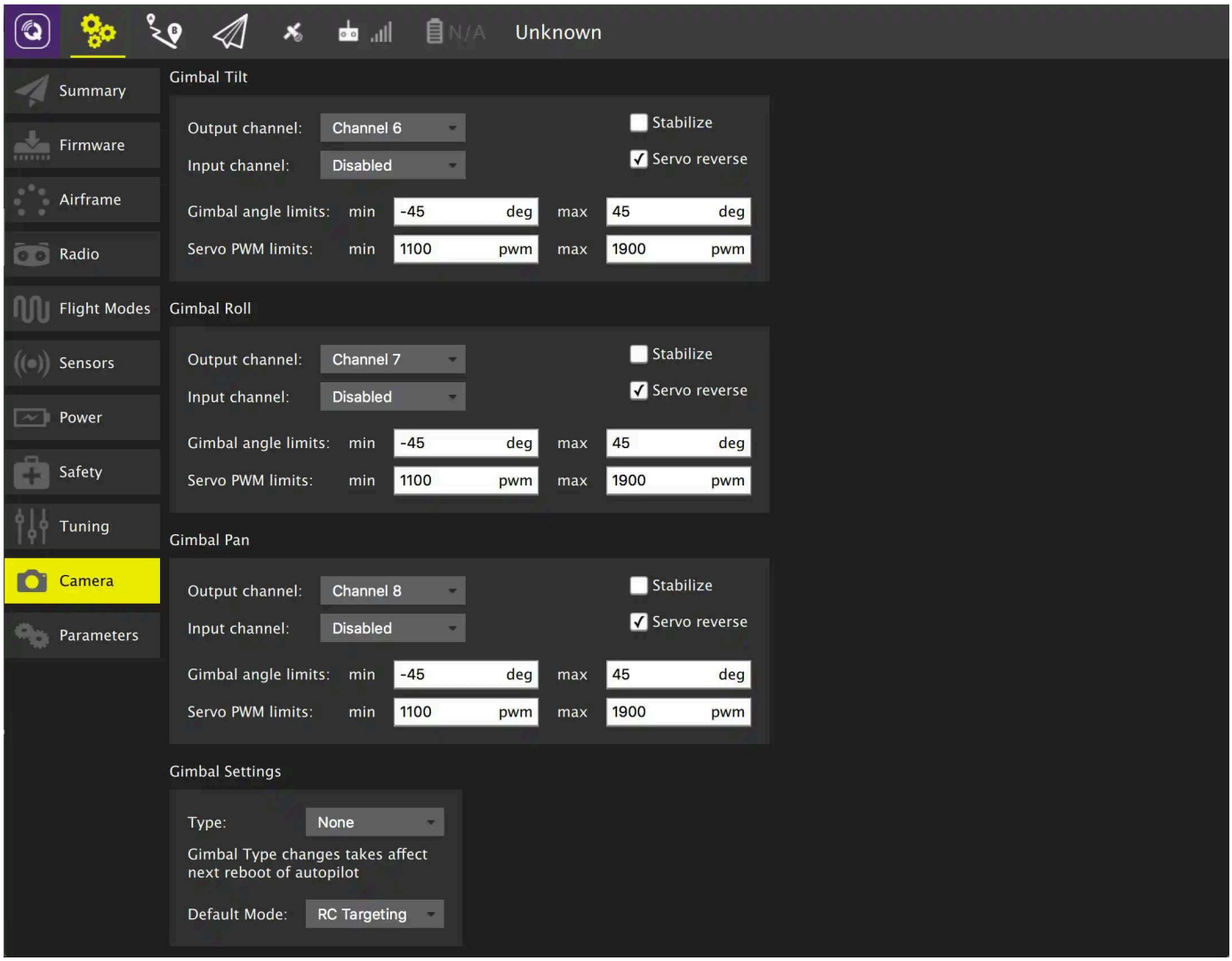
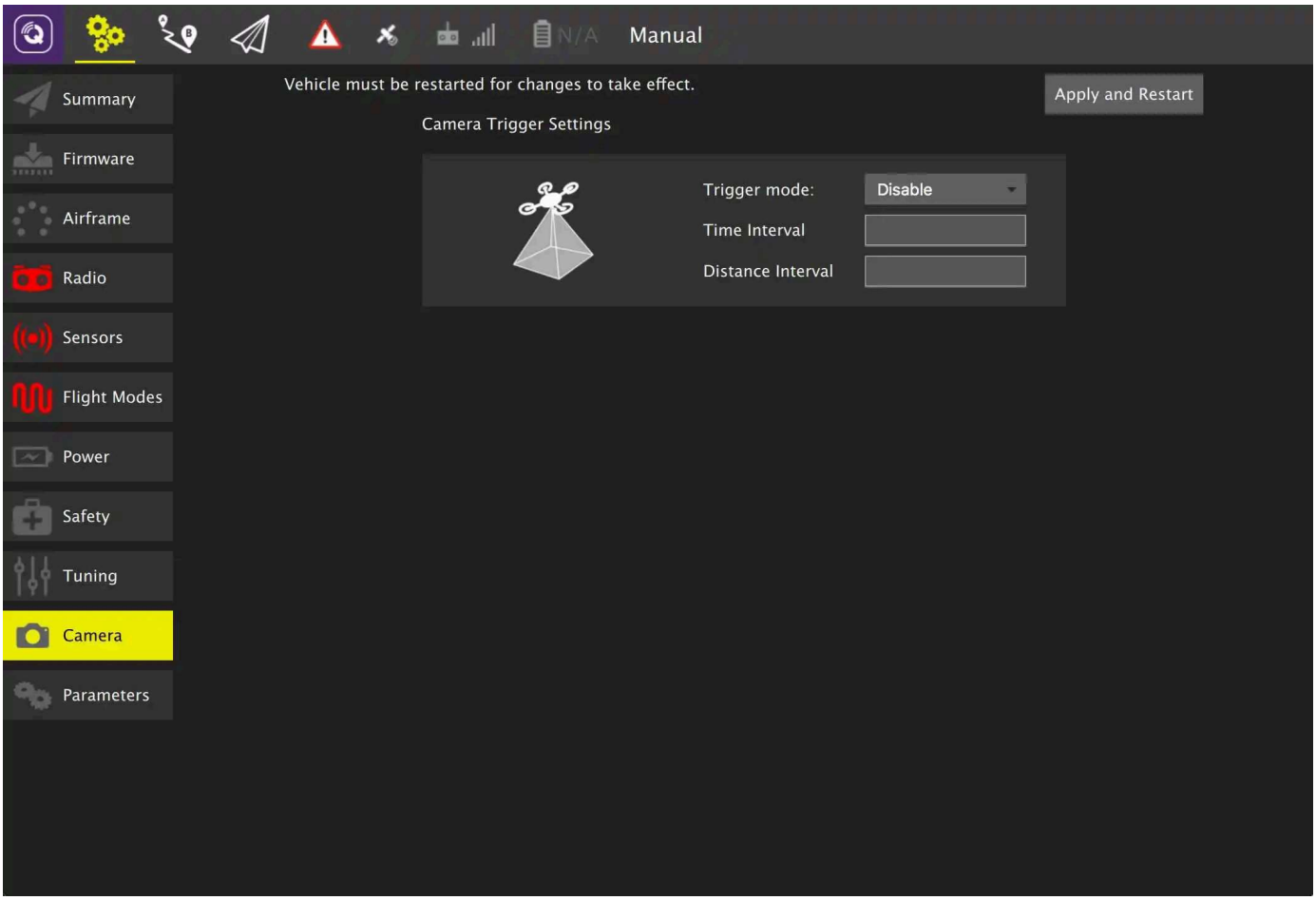
Camera

Camera Setup

The details of the page differ if you are using PX4 firmware or ArduPilot firmware.

ArduPilot Camera Setup





For more information see Camera (PX4 User Guide).

INFO

The camera settings section is not available by default for FMUv2-based flight controllers (e.g. 3DR Pixhawk) because the camera module is not automatically included in firmware. For more information see this topic.

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Joystick Setup

QGroundControl allows you to control a vehicle using a joystick or gamepad instead of an RC Transmitter.

INFO

Flying with a Joystick (or virtual thumb-sticks) requires a reliable high bandwidth telemetry channel to ensure that the vehicle is responsive to joystick movements (because joystick information is sent over MAVLink).

INFO

Joystick and Gamepad support is enabled using the cross-platform SDL2 library. Compatibility with a particular controller depends on SDL (all buttons that are exposed by that API are displayed through the *QGroundControl* UI). A number of common joysticks and gamepads are known to work.

INFO

The joystick is *enabled* as the last step of the calibration process.

Enabling PX4 Joystick Support

To enable Joystick support in PX4 you need to set the parameter `COM_RC_IN_MODE` to `1` - *Joystick*. If this parameter is `0` then *Joystick* will not be offered as a setup option.

This is enabled by default for PX4 SITL builds (see the Parameters topic for information on how to find and set a particular parameter).

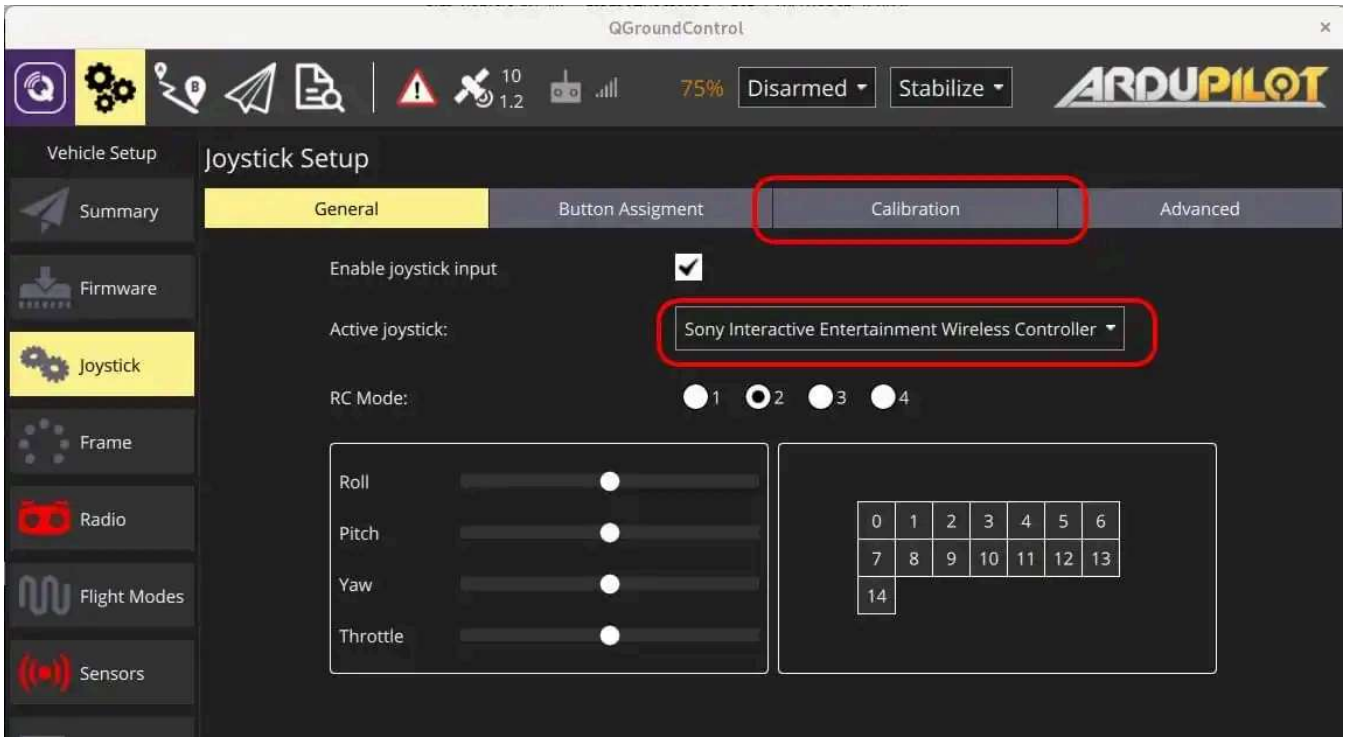
Ardupilot Joystick Support

All ArduPilot vehicles are supported. No parameter configuration is necessary.

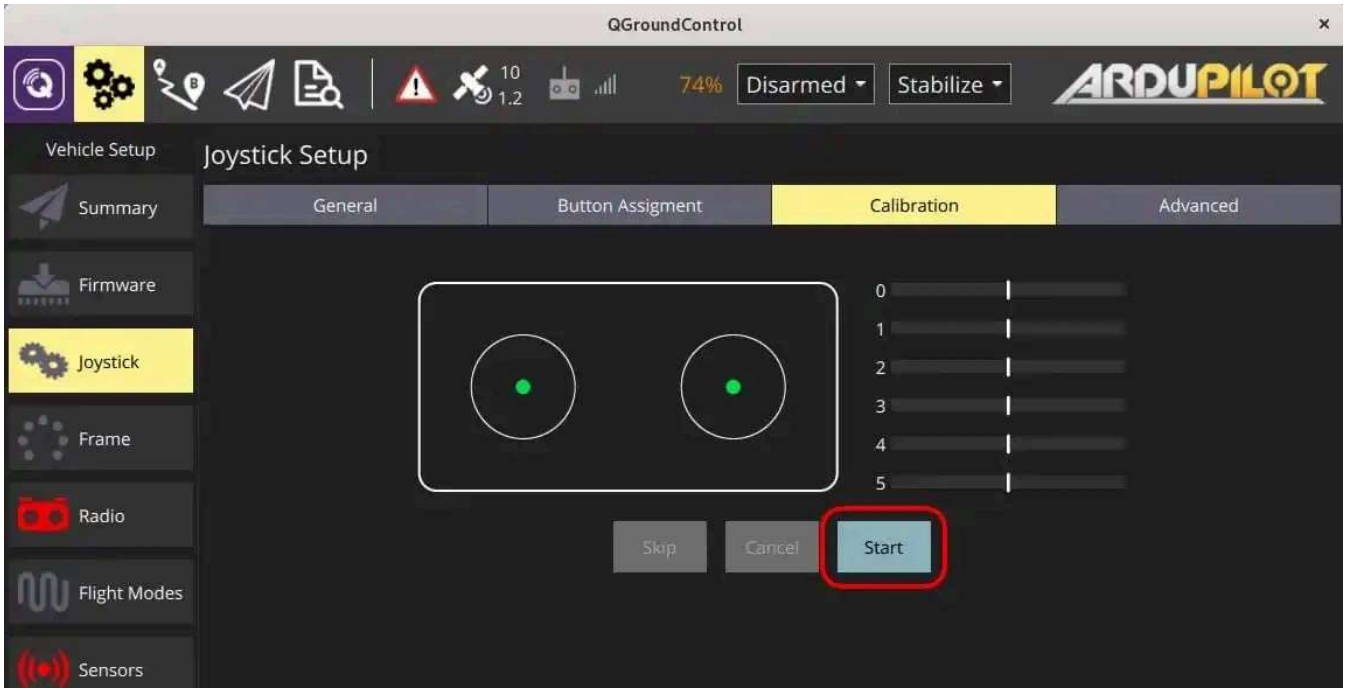
Configuring the Joystick

To configure a joystick:

1. Start *QGroundControl* and connect to a vehicle.
2. Connect the Joystick or Gamepad to a USB port.
3. Select the **Gear** icon (Vehicle Setup) in the top toolbar and then **Joystick** in the sidebar. The screen below will appear.



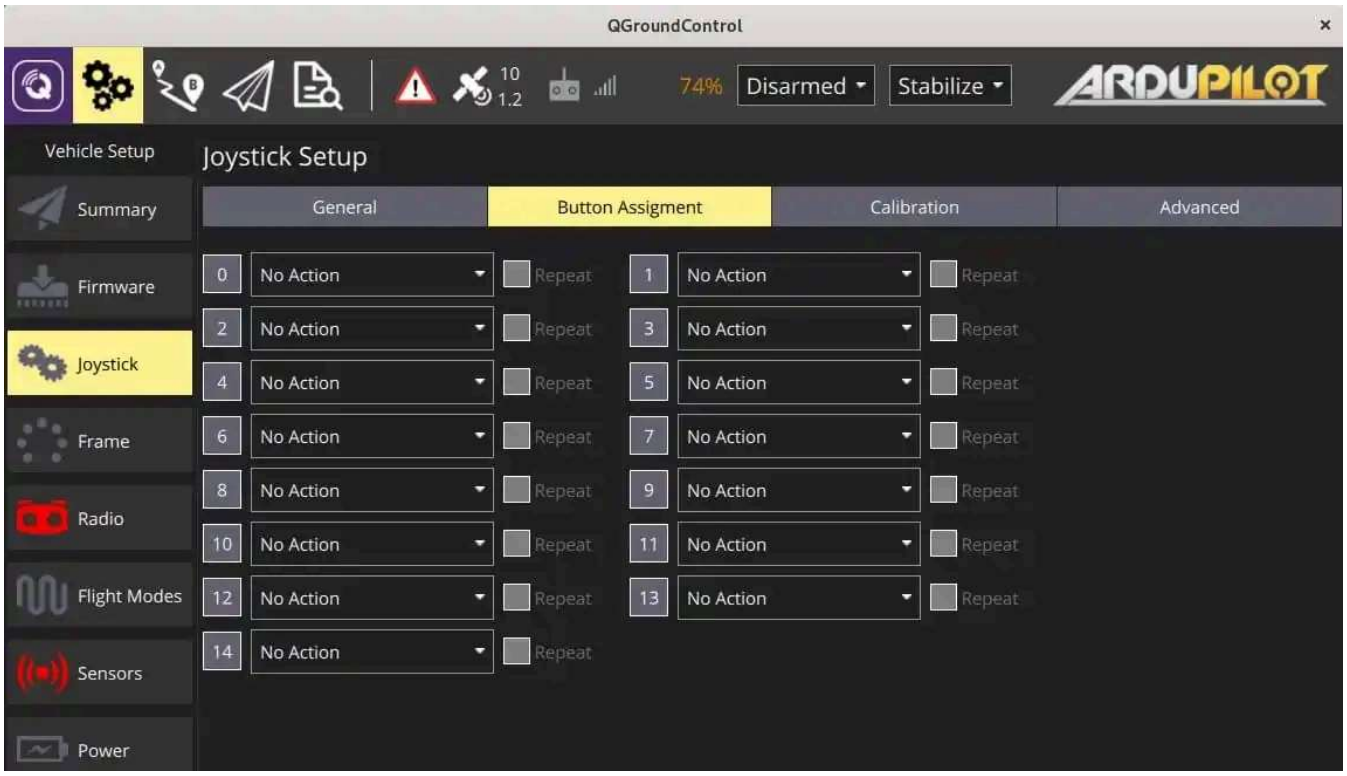
4. Make sure your joystick is selected in the **Active joystick** dropdown.
5. Go to the **Calibrate** Tab, press the **Start** button and then follow the on-screen instructions to calibrate/move the sticks.



The joystick is *enabled* as the last step of the calibration process.

6. Test the buttons and sticks work as intended by pressing them, and viewing the result in the Axis/Button monitor in the **General** tab.

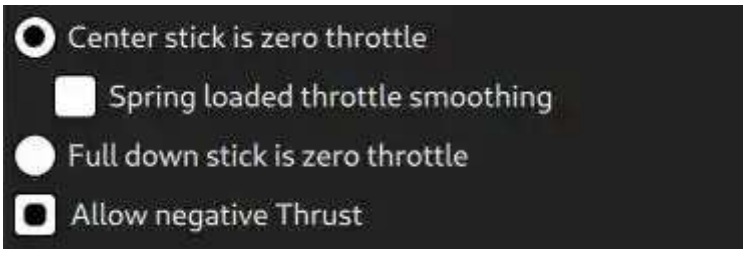
7. Select the flight modes/vehicle functions activated by each joystick button.



Advanced Options

Some additional Options are available at the **Advanced** tab. These options may be useful for specific, unsual setups, for increasing sensibility, and for handling noisy joysticks.

Throttle Options

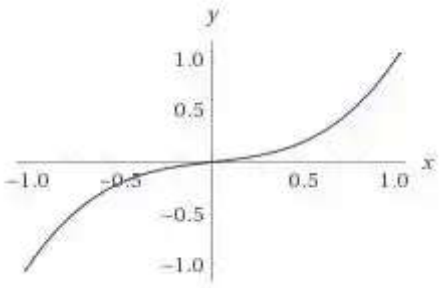


- **Center stick is zero throttle**: Centered or lowered stick sends 0 in MANUAL_CONTROL z, raised stick sends 1000.
  - **Spring loaded throttle smoothing**: In this mode you control not the throttle itself, but the rate at which it increases/decreases. This is useful for setups where the throttle stick is spring loaded, as the user can hold the desired throttle while releasing the stick.
- **Full down stick is zero throttle**: In this mode, lowered stick sends 0 in MANUAL_CONTROL z, centered stick 500, and raised 1000.
- **Allow negative thrust**: When in **Center stick is zero throttle** mode, this allows the user to send negative values by lowering the stick. So that lowered stick sends -1000 in MANUAL_CONTROL z, centered sends zero, and raised stick sends 1000. This mode is only enabled for vehicles that support negative thrust, such as Rover.

Expo

The expo slider allows you to make the sticks less sensitive in the center, allowing finer control in this zone.

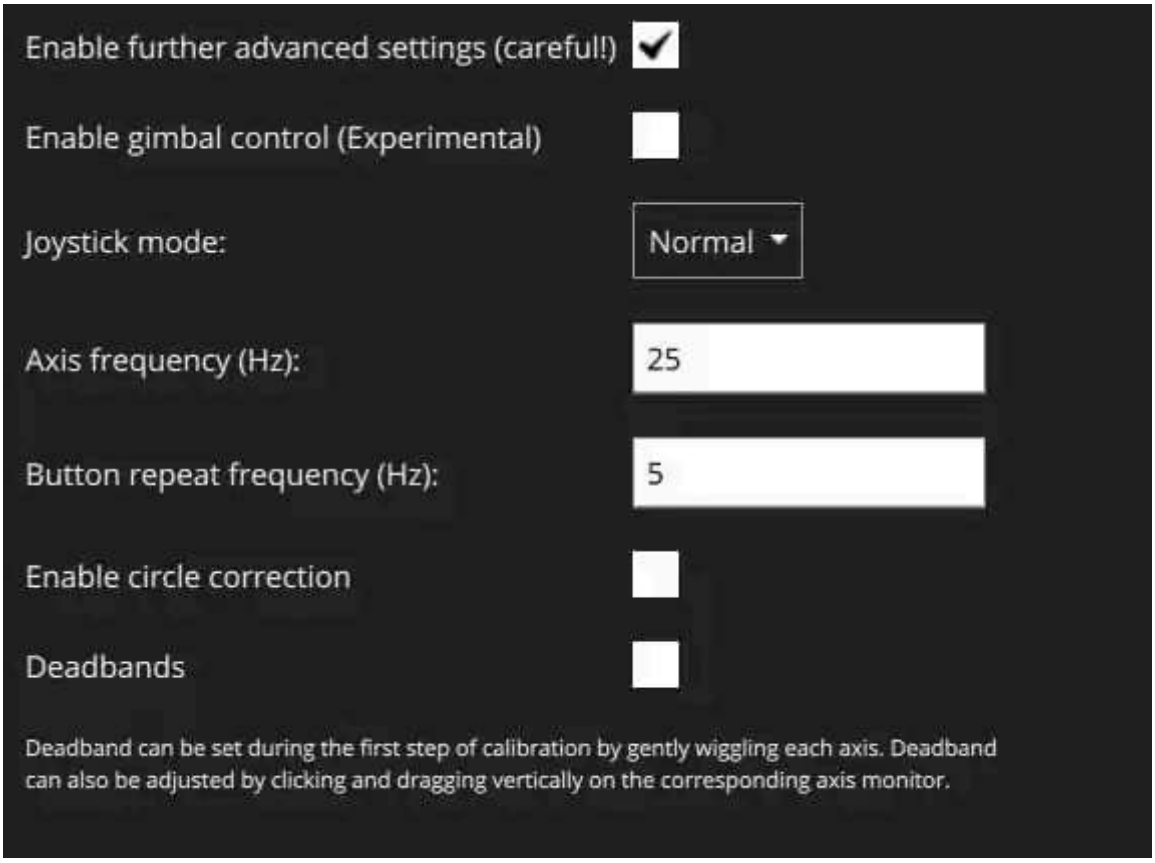
The slider adjusts the curvature of the exponential curve.



The higher the Expo value, the flatter the curve is at the center, and steeper it is at the edges.

Advanced Settings

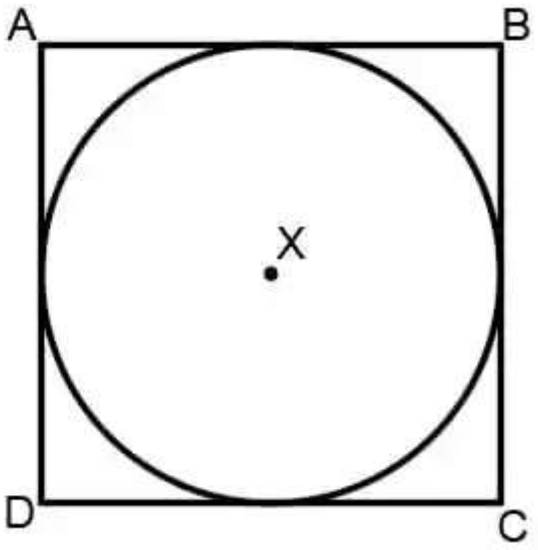
The advanced settings are not recommended for everyday users. They can cause unpredicted results if used incorrectly.



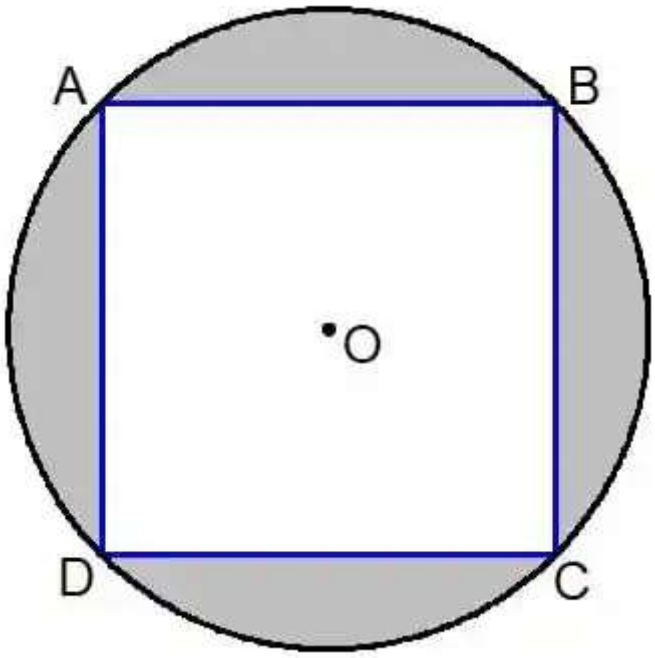
The following settings are available:

- **Enable Gimbal Control**: Enabled two additional channels for controlling a gimbal.
- **Joystick Mode**: Changes what the joystick actually controls, and the MAVLink messages sent to the vehicle.

    - **Normal**: User controls as if using a regular RC radio, MAVLink MANUAL_CONTROL messages are used.
    - **Attitude**: User controls the vehicle attitude, MAVLink SET_ATTITUDE_TARGET messages are used.
    - **Position**: User controls the vehicle position, MAVLink SET_POSITION_TARGET_LOCAL_NED messages with bitmask for **position** only are used.
    - **Force**: User controls the forces applied to the vehicle, MAVLink SET_POSITION_TARGET_LOCAL_NED messages with bitmask for **force** only are used.
    - **Velocity**: User controls the forces applied to the vehicle, MAVLink SET_POSITION_TARGET_LOCAL_NED messages with bitmask for **velocity** only are used.
- **Axis Frequency**: When the joystick is idle (inputs are not changing), the joystick commands are sent to the vehicle at 5Hz. When the joystick is in use (input values are changing), the joystick commands are sent to the vehicle at the (higher) frequency configured by this setting. The default is 25Hz.
- **Button Frequency**: Controls the frequency at which repeated button actions are sent.
- **Enable Circle Correction**: RC controllers sticks describe a square, while joysticks usually describe a circle. When this option is enabled a square is inscribed inside the joystick movement area to make it more like an RC controller (so it is possible to reach all four corners). The cost is decreased resolution, as the effective stick travel is reduced.
    - **Disabled:** When this is **disabled** the joystick position is sent to the vehicle unchanged (the way that it is read from the joystick device). On some joysticks, the (roll, pitch) values are confined to the space of a circle inscribed inside of a square. In this figure, point B would command full pitch forward and full roll right, but the joystick is not able to reach point B because the retainer is circular. This means that you will not be able to achieve full roll and pitch deflection simultaneously.



- **Enabled:** The joystick values are adjusted in software to ensure full range of commands. The usable area of travel and resolution is decreased, however, because the area highlighted grey in the figure is no longer used.



- **Deadbands:** Deadbands allow input changes to be ignored when the sticks are near their neutral positions. This helps to avoid noise or small oscillations on sensitive sticks which may be interpreted as commands, or small offsets when sticks do not re-center well. They can be adjusted during the first step of the calibration, or by dragging vertically on the corresponding axis monitor.

Supported Joysticks

The following joysticks/controllers have been shown to work with relatively recent *QGroundControl* builds.

Sony Playstation 3/4 Controllers

Both these joysticks are highly recommended. They work well "out of the box" and have many buttons that you can map to flight modes.

Sony PS4 - DualShock 4 Controller V2 (Wireless setup)

This controller supports both USB and Bluetooth wireless connection. Wired USB connection usually works out of the box. The wireless connection needs some setup.

Linux Ubuntu setup

To make the controller work wirelessly under Linux the jstest-gtk and ds4drv utilities are needed.

The steps are:

1. Install *jstest-gtk*:

   ```
   sudo apt install jstest-gtk
   ```

2. Install *ds4drv*:

   ```
   sudo pip install ds4drv
   ```

3. Run ds4drv

   ```
   sudo ds4drv
   ```

4. Hold **Share** button and then **PS** button until controller LED starts blinking rapidly. The *ds4drv* should then detect a new device.

5. Last of all, you should check the controller setup by running the *jstest-gtk* utility.

FrSky Taranis XD9 plus

The *FrSky Taranis XD9 plus* remote control can also be connected as a joystick. You will need to connect it via the USB port on the back.

The Taranis does not allow you to use button options (to be precise, you can set the options, but toggling the buttons on your transmitter does not cause them to be pressed).

> **INFO**
>
> The Taranis is an open system that is openly being worked on. It is possible that at time of writing there is a firmware or configuration that allows it to work effectively as a joystick.

Logitech Gamepad F310

The Logitech Gamepad F310 has been tested via USB on MacOSX "Sierra".

Logitech Extreme 3D Pro

The Logitech Extreme 3D Pro Joystick has been tested on all platforms (Linux, Windows, Mac OSX). This is a single stick controller that can also be twisted. The main stick axes are used for pitch and roll, while the twist action is used for yaw. The throttle is mapped onto a separate wheel.

Logitech F710 Gamepad

This gamepad is great for flying a multirotor manually via QGroundControl. It works on Windows, Linux and Mac OS.

Mac OS Leopard / Lion Setup

The F710 is detected under Leopard / Lion but is not automatically configured as an input device. In order to get a working configuration, the F710 has to be recognised as *Rumblepad2*.

First check how it is recognised: **Apple > About this Mac > Additional Information > System Report > USB**. It is detected as "Logitech Cordless RumblePad 2" then nothing further needs to be done.

If it is detected as a "Logitech Wireless 710", perform these steps:

1. Unplug the USB receiver of the gamepad
2. Prepare to quickly plug it into a USB port
3. Hit the Logitech button (its silver with the Logitech Logo on it in the center of the pad)
4. Quickly connect the USB receiver to your Mac
5. The pad should now be detected in the system report as "Logitech Cordless RumblePad 2". If not, retry the above steps.

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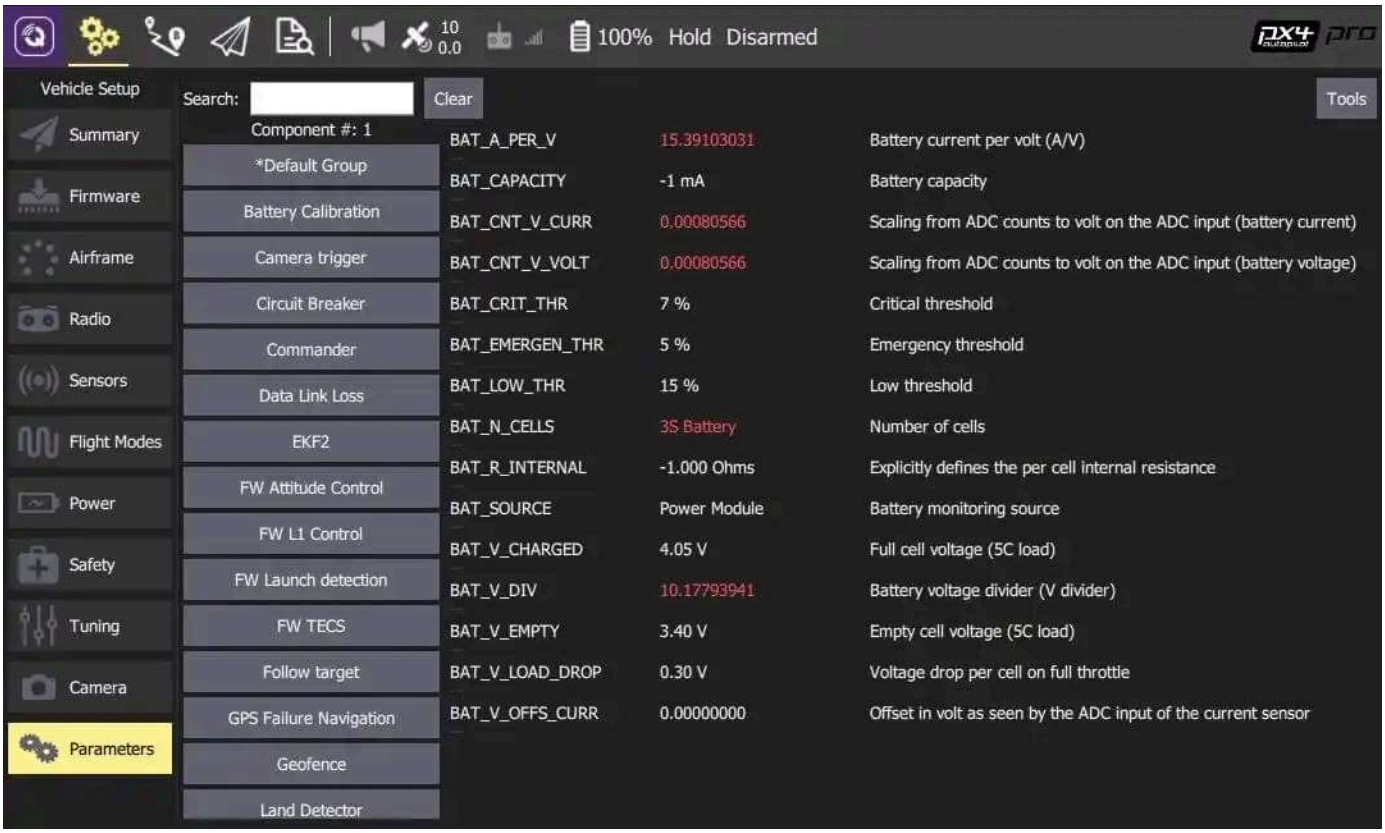
Parameters

Parameters

The *Parameters* screen allows you to find and modify any of the parameters associated with the vehicle.



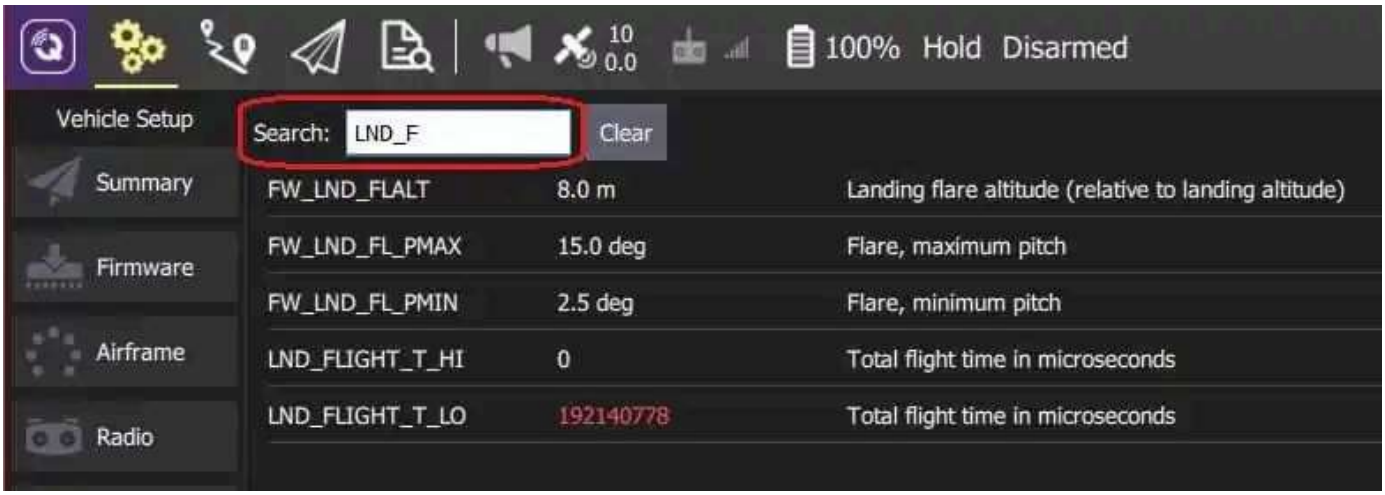
INFO

PX4 Pro and ArduPilot use different parameter sets, but they are both managed as described in this section.

Finding a Parameter

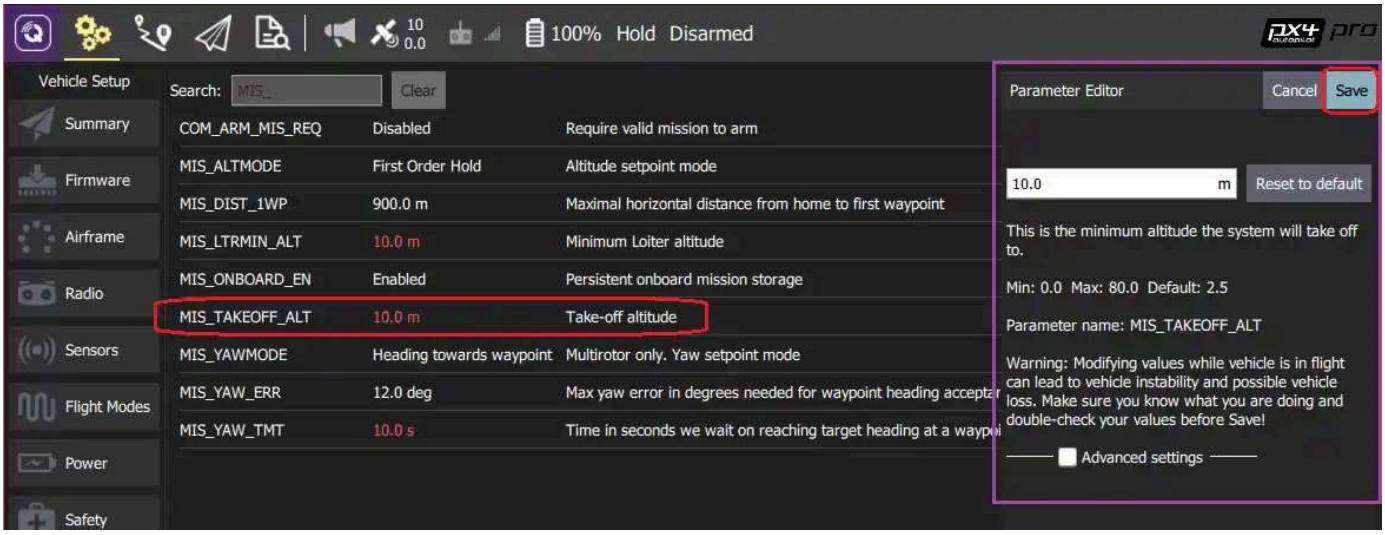
The parameters are organized in groups. Select a group of parameters to view by clicking on the buttons to the left (in the image above the *Battery Calibration* group is selected).

You can also *search* for a parameter by entering a term in the *Search* field. This will show you a list of all parameter names and descriptions that contain the entered substring (press **Clear** to reset the search).



Changing a Parameter

To change the value of a parameter click on the parameter row in a group or search list. This will open a side dialog in which you can update the value (this dialog also provides additional detailed information about the parameter - including whether a reboot is required for the change to take effect).

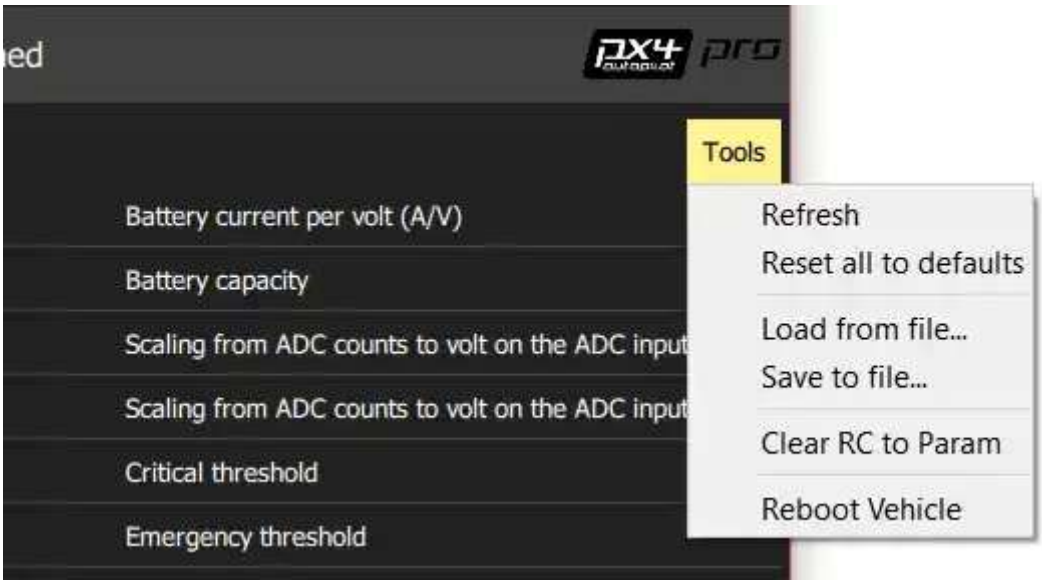


INFO

When you click **Save** the parameter is automatically and silently uploaded to the connected vehicle. Depending on the parameter, you may then need to reboot the flight controller for the change to take effect.

Tools

You can select additional options from the **Tools** menu on the top right hand side of the screen.



Refresh

Refresh the parameter values by re-requesting all of them from the vehicle.

Reset all to defaults

Reset all parameters to their original default values.

Load from file / Save to file

Load parameters from an existing file or save your current parameter settings to a file.

Clear RC to Param

This clears all associations between RC transmitter controls and parameters. For more information see: Radio Setup > Param Tuning Channels.

Reboot Vehicle

Reboot the vehicle (required after changing some parameters).

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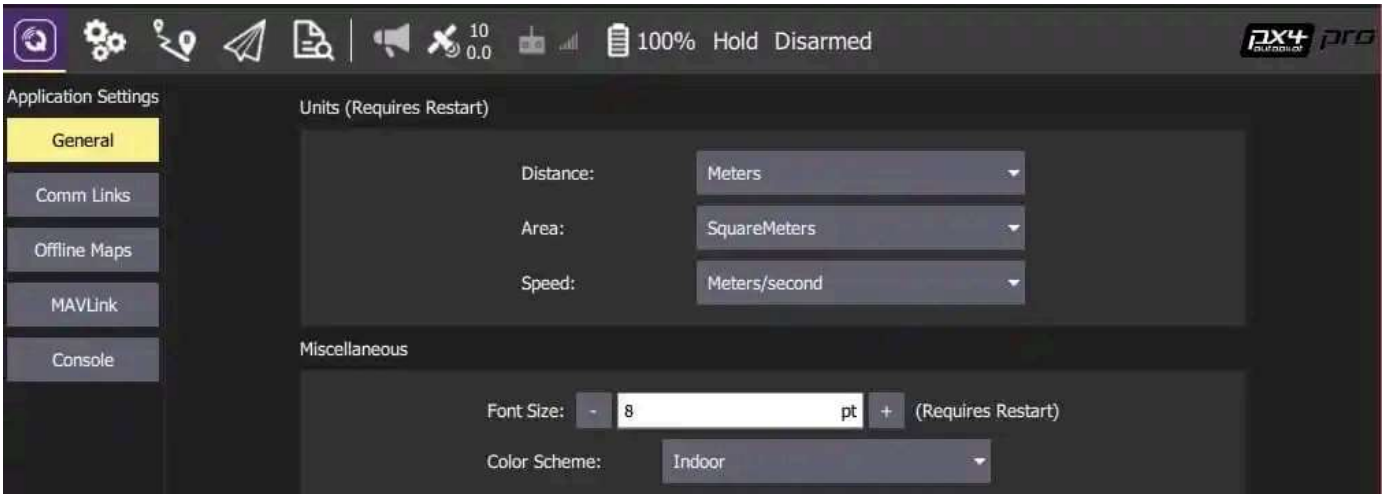
Application Settings

Settings View

The *Settings View* is used to configure the settings for the *QGroundControl* application (rather than a specific vehicle). You do not have to have a vehicle connected to change these values.

You can switch between the various settings options by clicking the buttons in the left-sidebar.



Settings Options

General

The main application configuration settings. These are used to specify: display units, autoconnection devices, video display and storage, RTK GPS, etc.

Comm Links

Allows you to manually create communication links and connect to them. *Keep in mind that normally this is not needed since QGroundControl will automatically connect to the most common devices.*

Offline Maps

Allows you to cache maps for use while you have no Internet connection.

MAVLink

Settings associated with the MAVLink connection to a vehicle.

Console

Used to capture application logs for help with diagnosing application problems.

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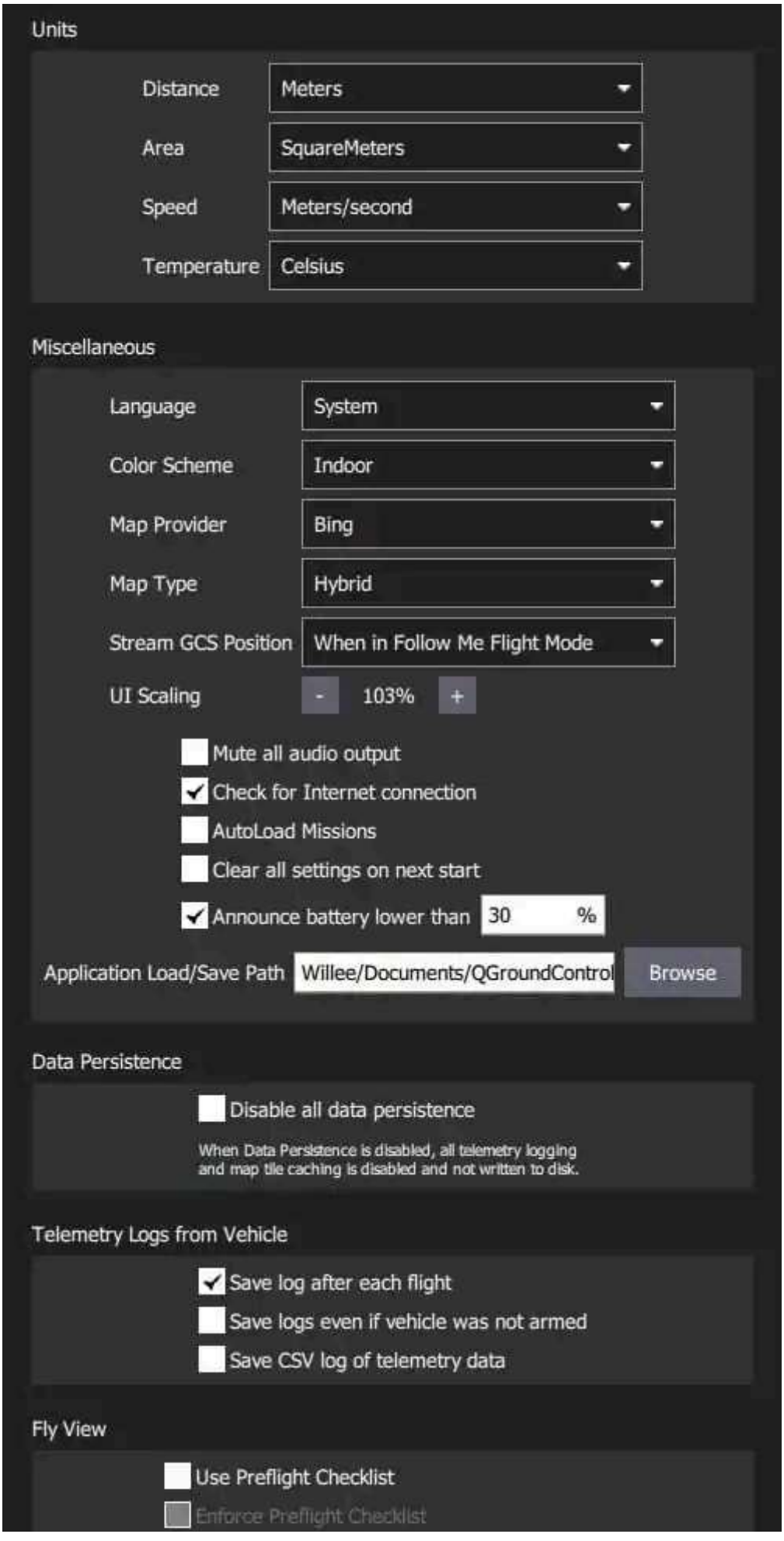
General

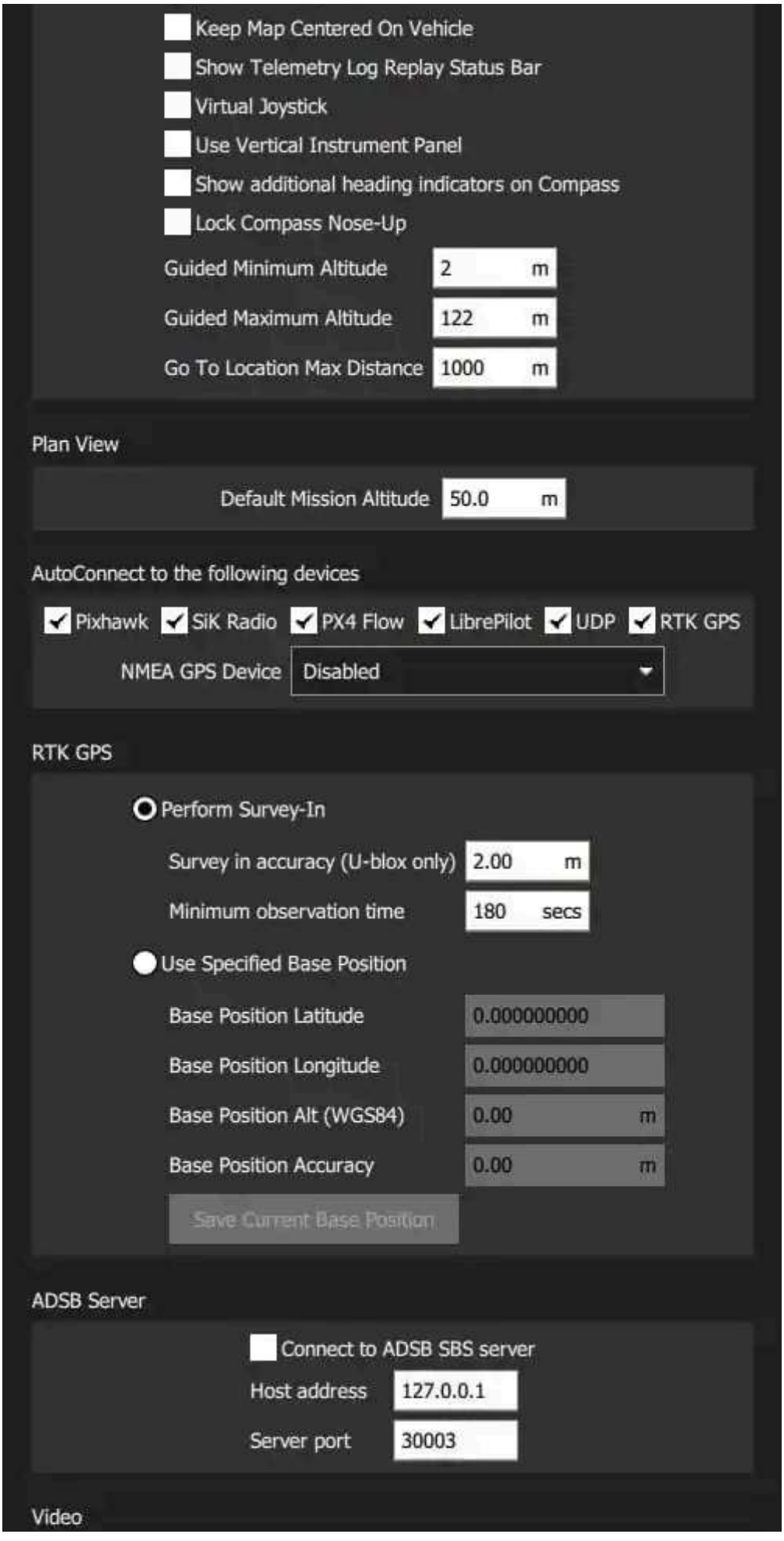
General Settings (Settings View)

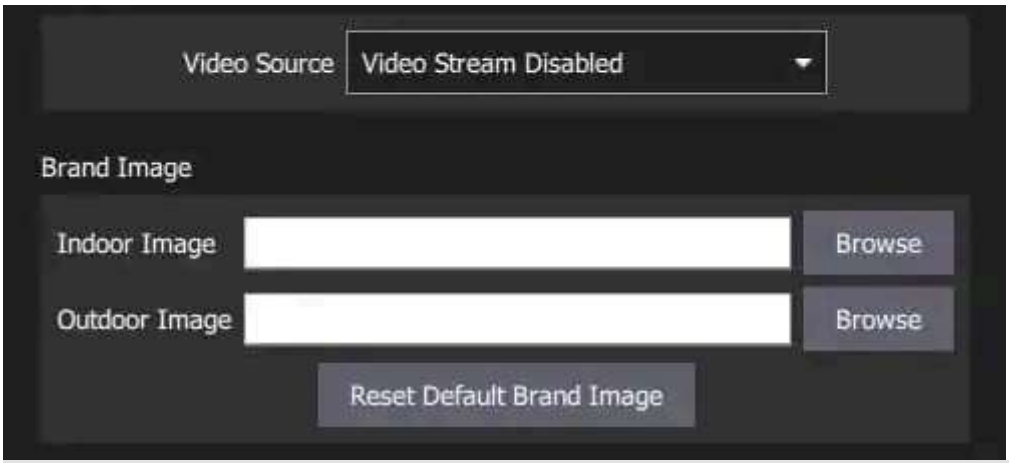
The general settings (**SettingsView > General Settings**) are the main place for application-level configuration. Settable values include: display units, autoconnection devices, video display and storage, RTK GPS, brand image, and other miscellaneous settings.

INFO

Values are settable even if no vehicle is connected. Settings that require a vehicle restart are indicated in the UI.

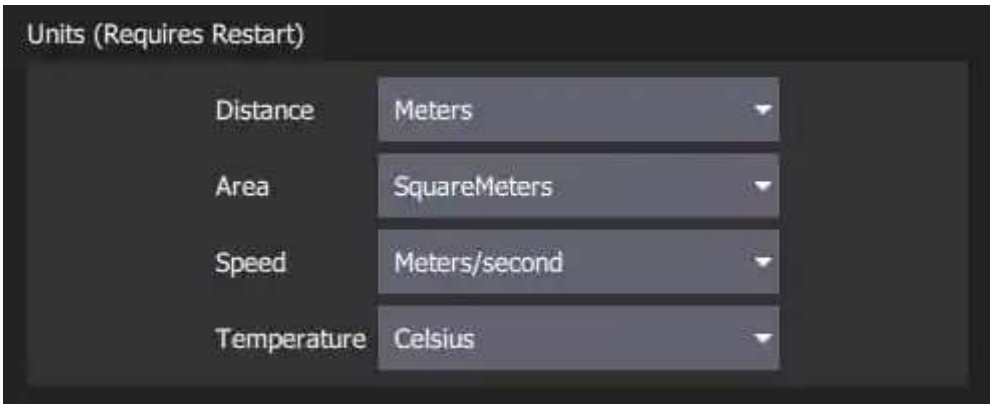

Units
Distance
Meters
Area
SquareMeters
Speed
Meters/second
Temperature
Celsius
Miscellaneous
Language
System
Color Scheme
Indoor
Map Provider
Bing
Map Type
Hybrid
Stream GCS Position
When in Follow Me Flight Mode
UI Scaling
-
103%
+
Mute all audio output
Check for Internet connection
AutoLoad Missions
Clear all settings on next start
Announce battery lower than
30
%
Application Load/Save Path
Willee/Documents/QGroundControl
Browse
Data Persistence
Disable all data persistence
When Data Persistence is disabled, all telemetry logging
and map tile caching is disabled and not written to disk.
Telemetry Logs from Vehicle
Save log after each flight
Save logs even if vehicle was not armed
Save CSV log of telemetry data
Fly View
Use Preflight Checklist
Enforce Preflight Checklist


Keep Map Centered On Vehicle
Show Telemetry Log Replay Status Bar
Virtual Joystick
Use Vertical Instrument Panel
Show additional heading indicators on Compass
Lock Compass Nose-Up
Guided Minimum Altitude 2 m
Guided Maximum Altitude 122 m
Go To Location Max Distance 1000 m
Plan View
Default Mission Altitude 50.0 m
AutoConnect to the following devices
Pixhawk SiK Radio PX4 Flow LibrePilot UDP RTK GPS
NMEA GPS Device Disabled
RTK GPS
Perform Survey-In
Survey in accuracy (U-blox only) 2.00 m
Minimum observation time 180 secs
Use Specified Base Position
Base Position Latitude 0.000000000
Base Position Longitude 0.000000000
Base Position Alt (WGS84) 0.00 m
Base Position Accuracy 0.00 m
Save Current Base Position
ADSB Server
Connect to ADSB SBS server
Host address 127.0.0.1
Server port 30003
Video



Units

This section defines the display units used in the application.

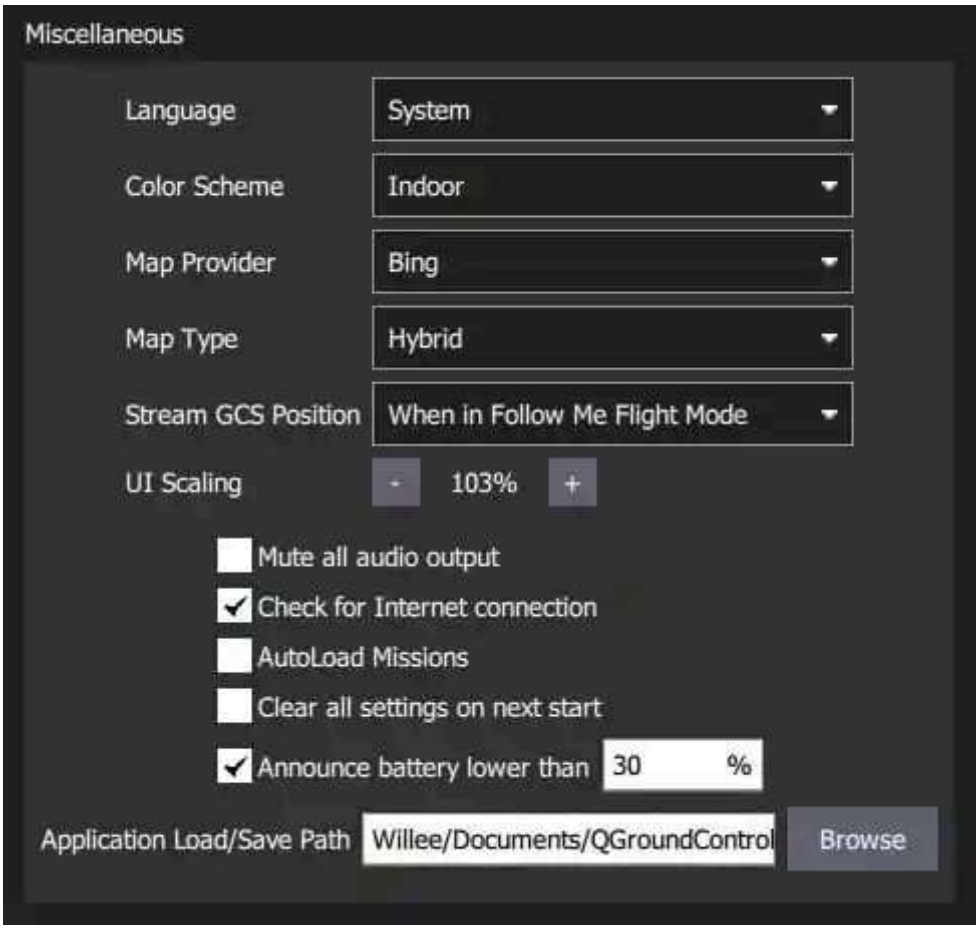


The settings are:

- **Distance**: Meters | Feet
- **Area**: SquareMetres | SquareFeet | SquareKilometers | Hectares | Acres | SquareMiles
- **Speed**: Metres/second | Feet/second | Miles/hour | Kilometres/hour | Knots
- **Temperature**: Celsius | Fahrenheit

Miscellaneous

This section defines a number of miscellaneous settings, related to (non exhaustively): font sizes, colour schemes, map providers, map types, telemetry logging, audio output, low battery announcement levels, default mission altitude, virtual joysticks, mission autoloading, default application file load/save path etc.



The settings are:

- **Language**: System (System Language) | Bulgarian, Chinese, ...

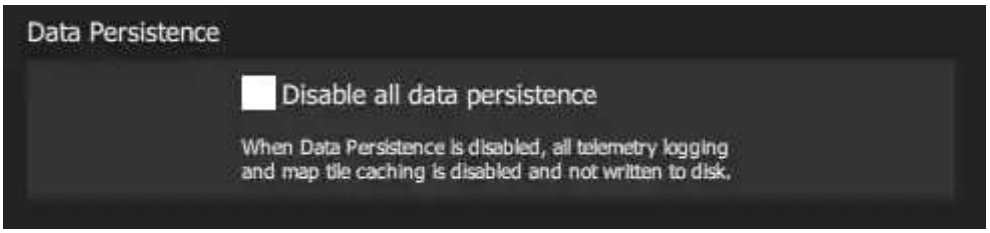
Translations are generally built into the application and selected automatically based on the system language.

Metadata downloaded from the vehicle (such as parameter descriptions) might have translations as well. These are downloaded from the internet upon vehicle connection. The translations are then cached locally. This means an internet connection during vehicle connection is required at least once.

- **Color Scheme**: Indoor (Dark) | Outdoor (Light)
- **Map Provider**: Google | Mapbox | Bing | Airmap | VWorld | Eniro | Statkart
- **Map Type**: Road | Hybrid | Satellite
- **Stream GCS Position**: Never | Always | When in Follow Me Flight Mode.

- **UI Scaling**: UI scale percentage (affects fonts, icons, button sizes, layout etc.)
- **Mute all audio output**: Turns off all audio output.
- **Check for Internet Connection**: Uncheck to allow maps to be used in China/places where map tile downloads are likely to fail (stops the map-tile engine continually rechecking for an Internet connection).
- **Autoload Missions**: If enabled, automatically upload a plan to the vehicle on connection.
  - The plan file must be named **AutoLoad#.plan**, where the `#` is replaced with the vehicle id.
  - The plan file must be located in the Application Load/Save Path.
- **Clear all settings on next start**: Resets all settings to the default (including this one) when *QGroundControl* restarts.
- **Announce battery lower than**: Battery level at which *QGroundControl* will start low battery announcements.
- **Application Load/Save Path**: Default location for loading/saving application files, including: parameters, telemetry logs, and mission plans.

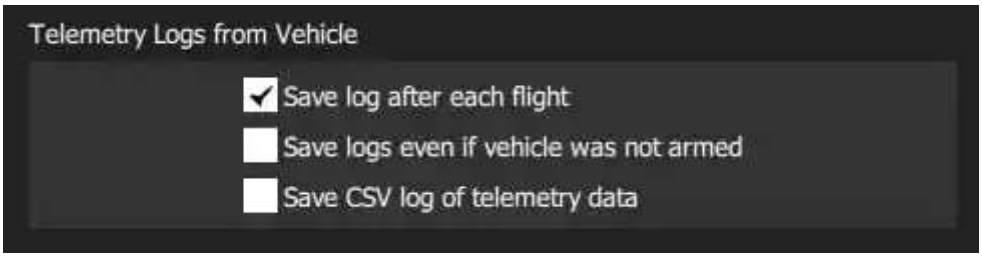
Data Persistence



The settings are:

- **Disable all data persistence**: Check to prevent any data being saved or cached: logs, map tiles etc. This setting disables the telemetry logs section.

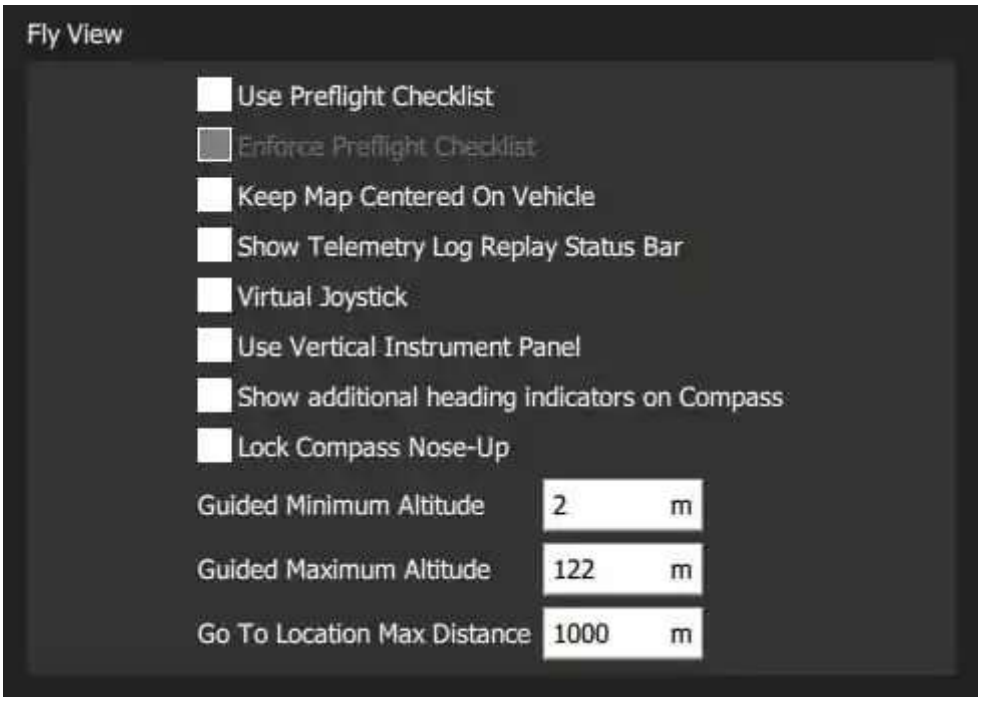
Telemetry Logs from Vehicle



The settings are:

- **Save log after each flight**: Telemetry logs (`.tlog`) automatically saved to the *Application Load/Save Path* (above) after flight.
- **Save logs even if vehicle was not armed**: Logs when a vehicle connects to *QGroundControl*. Stops logging when the last vehicle disconnects.
- CSV Logging: Log subset of telemetry data to a CSV file.

Fly View



The settings are:

- **Use Preflight Checklist**: Enable pre-flight checklist in Fly toolbar.
- **Enforce Preflight Checklist**: Checklist completion is a pre-condition for arming.
- **Keep Map Centered on Vehicle**: Forces map to center on the currently selected vehicle.

- **Show Telemetry Log Replay Status Bar**: Display status bar for Replaying Flight Data.
- **Virtual Joystick**: Enable virtual joysticks (PX4 only)
- **Use Vertical Instrument Panel**: Align instrument panel vertically rather than horizontally (default).
- **Show additional heading indicators on Compass**: Adds additional indicators to the compass rose:
- *Blue arrow*: course over ground.
- *White house*: direction back to home.
- *Green line*: Direction to next waypoint.
- **Lock Compass Nose-Up**: Check to rotate the compass rose (default is to rotate the vehicle inside the compass indicateor).
- **Guided Minimum Altitude**: Minimum value for guided actions altitude slider.
- **Guided Maximum Altitude**: Minimum value for guided actions altitude slider.
- **Go To Location Max Distance**: The maximum distance that a Go To location can be set from the current vehicle location (in guided mode).

Plan View

The settings are:

- **Default Mission Altitude**: The default altitude used for the Mission Start Panel, and hence for the first waypoint.

AutoConnect to the following devices

This section defines the set of devices to which *QGroundControl* will auto-connect.

Settings include:

- **Pixhawk:** Autoconnect to Pixhawk-series device
- **SiK Radio:** Autoconnect to SiK (Telemetry) radio
- **PX4 Flow:** Autoconnect to PX4Flow device
- **LibrePilot:** Autoconnect to Libre Pilot autopilot
- **UDP:** Autoconnect to UDP
- **RTK GPS:** Autoconnect to RTK GPS device
- **NMEA GPS Device:** Autoconnect to an external GPS device to get ground station position (see below)

Ground Station Location (NMEA GPS Device)

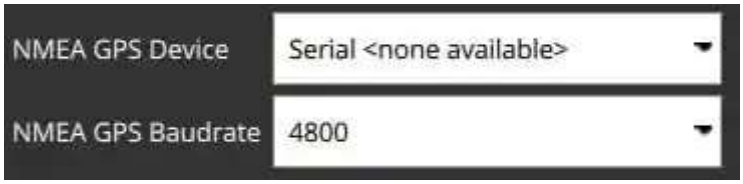
QGroundControl will automatically use an internal GPS to display its own location on the map with a purple `Q` icon (if the GPS provides a heading, this will be also indicated by the icon). It may also use the GPS as a location source for *Follow Me Mode* - currently supported on PX4 Multicopters only.

You can also configure QGC to connect to an external GPS device via a serial or UDP port. The GPS device must support the ASCII NMEA format - this is normally the case.

> **TIP**
>
> A higher quality external GPS system may be useful even if the ground station has internal GPS support.

Use the *NMEA GPS Device* drop-down selector to manually select the GPS device and other options:

- USB connection:

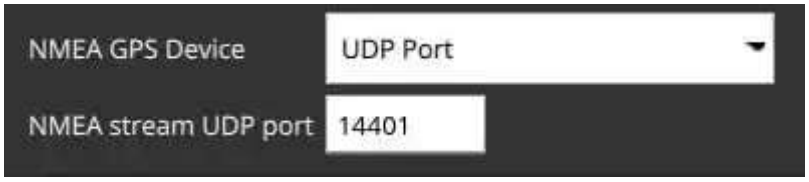


  - **NMEA GPS Device:** *Serial*
  - **NMEA GPS Baudrate**: The baudrate for the serial port

    TIP

    To troubleshoot serial GPS problems: Disable RTK GPS auto connection, close *QGroundControl*, reconnect your GPS, and open QGC.

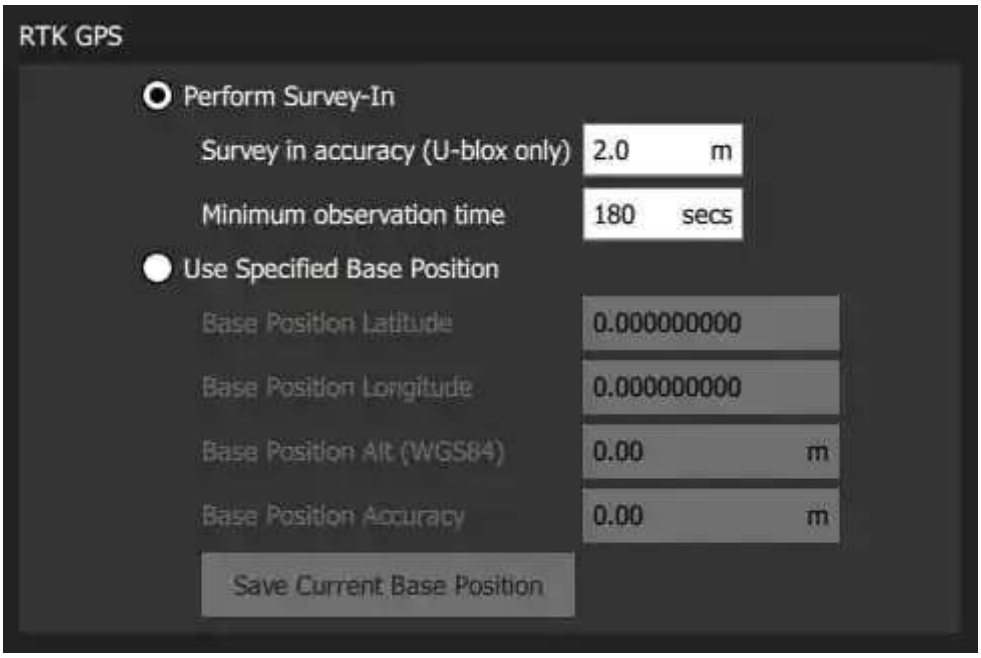
- Network connection:



  - **NMEA GPS Device:** *UDP Port*.
  - **NMEA Stream UDP Port**: The UDP port on which QGC will listen for NMEA data (QGC binds the port as a server)

RTK GPS

This section allows you to specify the RTK GPS "Survey-in" settings, to save and reuse the result of a Survey-In operation, or to directly enter any other known position for the base station.



INFO

The *Survey-In* process is a startup procedure required by RTK GPS systems to get an accurate estimate of the base station position. The process takes measurements over time, leading to increasing position accuracy. Both of the setting conditions must met for the Survey-in process to complete. For more information see RTK GPS (PX4 docs) and GPS- How it works (ArduPilot docs).

TIP

In order to save and reuse a base position (because Survey-In is time consuming!) perform Survey-In once, select *Use Specified Base Position* and press **Save Current Base Position** to copy in the values for the last survey. The values will then persist across QGC reboots until they are changed.

The settings are:

- Perform Survey-In
  - **Survey-in accuracy (U-blox only):** The minimum position accuracy for the RTK Survey-In process to complete.
  - **Minimum observation duration:** The minimum time that will be taken for the RTK Survey-in process.
- Use Specified Base Position
  - **Base Position Latitude:** Latitude of fixed RTK base station.
  - **Base Position Longitude:** Longitude of fixed RTK base station.

- **Base Position Alt (WGS94):** Altitude of fixed RTK base station.
- **Base Position Accuracy:** Accuracy of base station position information.
- **Save Current Base Position** (button): Press to copy settings from the last Survey-In operation to the *Use Specified Base Position* fields above.

ADSB Server

The settings are:

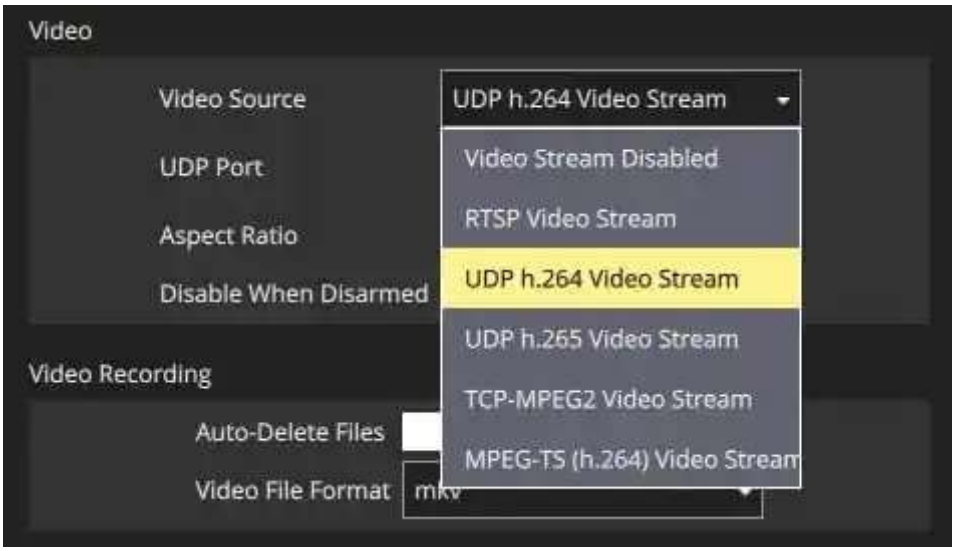
- **Connect to ADSB SBS server**: Check to connect to ADSB server on startup.
- **Host address**: Host address of ADSB server
- **Server port**: Port of ADSB server

QGC can consume ADSB messages in SBS format from a remote or local server (at the specified IP address/port) and display detected vehicles on the Fly View map.

> **TIP**
>
> One way to get ADSB information from nearby vehicles is to use dump1090 to serve the data from a connected RTL-SDR dongle to QGC.
>
> The steps are:
>
> 1. Get an RTL-SDR dongle (and antenna) and attach it to your ground station computer (you may need to find compatible drivers for your OS).
> 2. Install *dump1090* on your OS (either pre-built or build from source).
> 3. Run `dump1090 --net` to start broadcasting messages for detected vehicles on TCP localhost port 30003 (127.0.0.1:30003).
> 4. Enter the server (`127.0.0.1`) and port (`30003`) address in the QGC settings above.
> 5. Restart QGC to start seeing local vehicles on the map.

Video

The *Video* section is used to define the source and connection settings for video that will be displayed in *Fly View*.



The settings are:

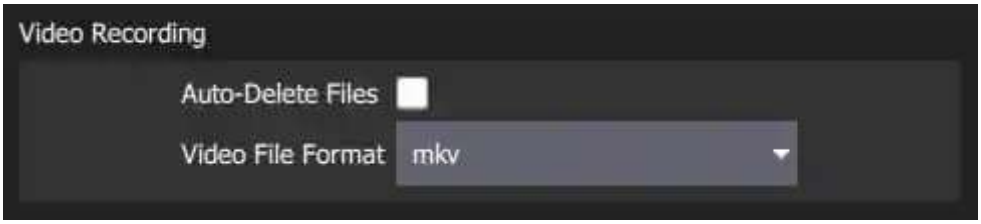
- **Video Source**: Video Stream Disabled | RTSP Video Stream | UDP h.264 Video Stream | UDP h.265 Video Stream | TCP-MPEG2 Video Stream | MPEG-TS (h.264) Video Stream | Integrated Camera

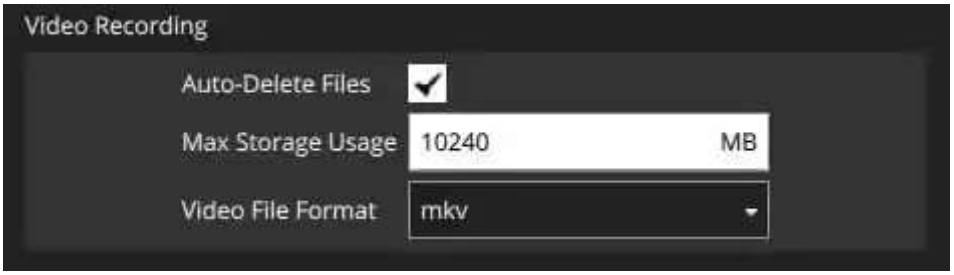
  > **INFO**
  >
  > If no video source is specified then no other video or *video recording* settings will be displayed (above we see the settings when UDP source is selected).

- **URL/Port**: Connection type-specific stream address (may be port or URL).
- **Aspect Ratio**: Aspect ratio for scaling video in video widget (set to 0.0 to ignore scaling)
- **Disabled When Disarmed**: Disable video feed when vehicle is disarmed.
- **Low Latency Mode**: Enabling low latency mode reduces the video stream latency, but may cause frame loss and choppy video (especially with a poor network connection).

Video Recording

The *Video Recording* section is used to specify the file format and maximum allocated file storage for storing video. Videos are saved to a sub-directory ("Video") of the Application Load/Save Path.





The settings are:

- **Auto-Delete Files**: If checked, files are auto deleted when the specified amount of storage is used.
- **Max Storage Usage**: Maximum video file storage before video files are auto deleted.
- **Video File Format**: File format for the saved video recording: mkv, mov, mp4.

Brand Image

This setting specifies the *brand image* used for indoor/outdoor colour schemes.

The brand image is displayed in place of the icon for the connected autopilot in the top right corner of the toolbar. It is provided so that users can easily create screen/video captures that include a company logo/branding.

The settings are:

- **Indoor Image**: Brand image used in indoor color scheme
- **Outdoor Image**: Brand image used in outdoor color scheme
- **Reset Default Brand Image**: Reset the brand image back to default.

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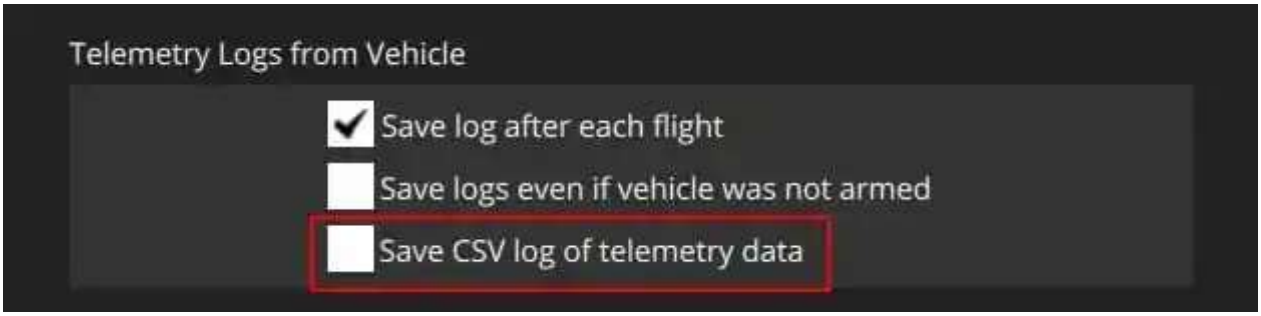
CSV Logging



When checked, a CSV (comma-separated value) telemetry file will be created along with the usual **.tlog** telemetry file. The file is only created if **Save log after each flight** is enabled, and is recorded for the same duration.

This CSV file contains the most relevant vehicle telemetry data available for quick analysis such as GPS position, attitude, battery status, and others. It is populated at 1 Hz and while it is not as detailed as the telemetry log, it is a lot easier to work with and quicker to extract data out of.

The file can be opened by common spreadsheet software, including: Microsoft Excel, Google Sheets, LibreOffice Calc or OpenOffice Calc.

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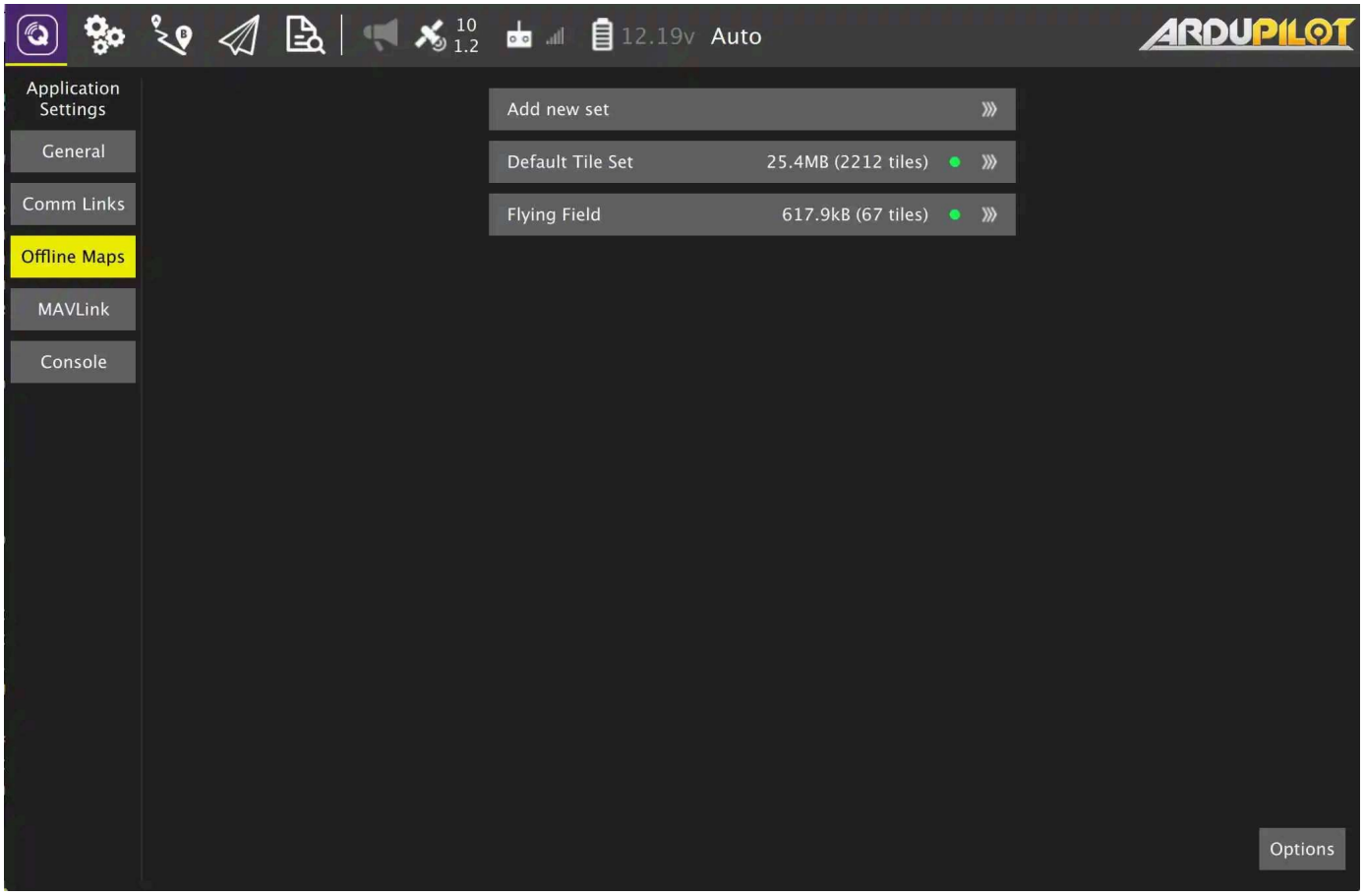
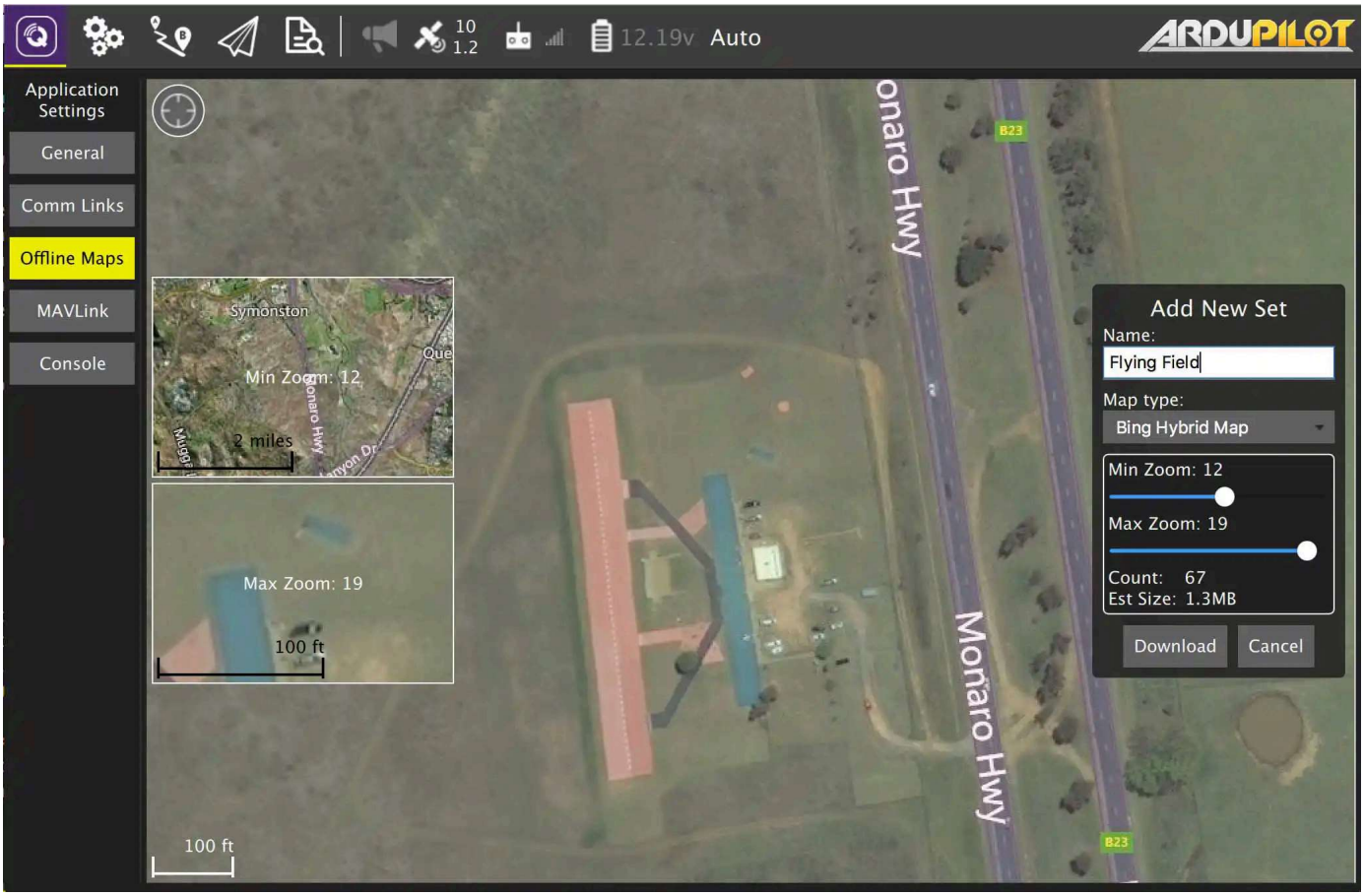
Offline Maps



Offline Maps allows you to cache map tiles for use when not connected to the Internet. You can create multiple offline sets, each for a different location.

Add new set

To create a new offline map set, click "Add new set". Which will take you to this page:



From here you can name your set as well as specify the zoom levels you want to cache. Move the map to the position you want to cache and then set the zoom levels and click Download to cache the tiles.

To the left you can see previews of the min and max zoom levels you have chosen.

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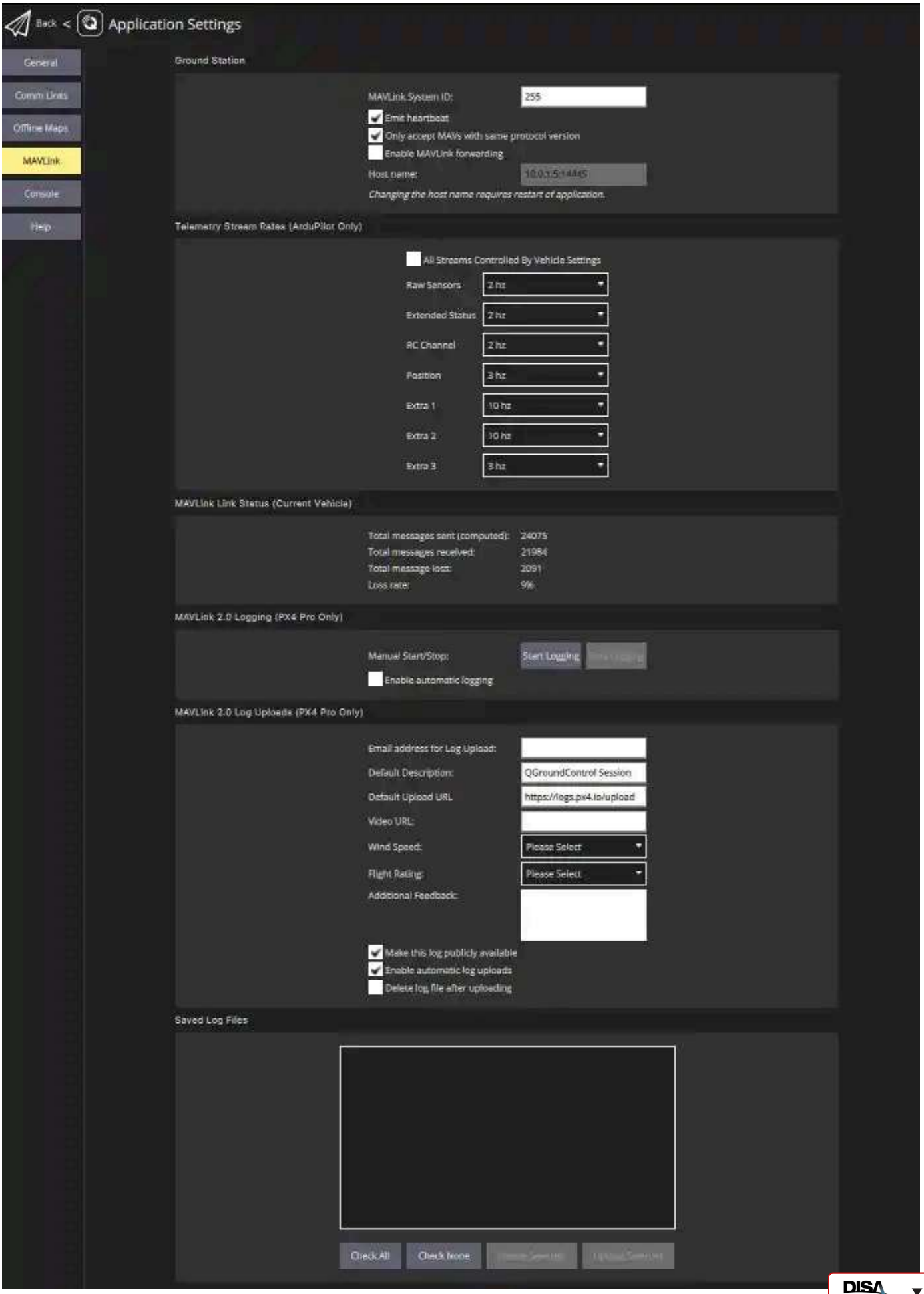
MAVLink Settings

The MAVLink settings (**SettingsView > MAVLink**) allow you to configure options and view information specific to MAVLink communications. This includes setting the MAVLink system ID for *QGroundControl* and viewing link quality.

The screen also allows you to manage MAVLink 2 Log Streaming (PX4 only), including *automating log upload to Flight Review*!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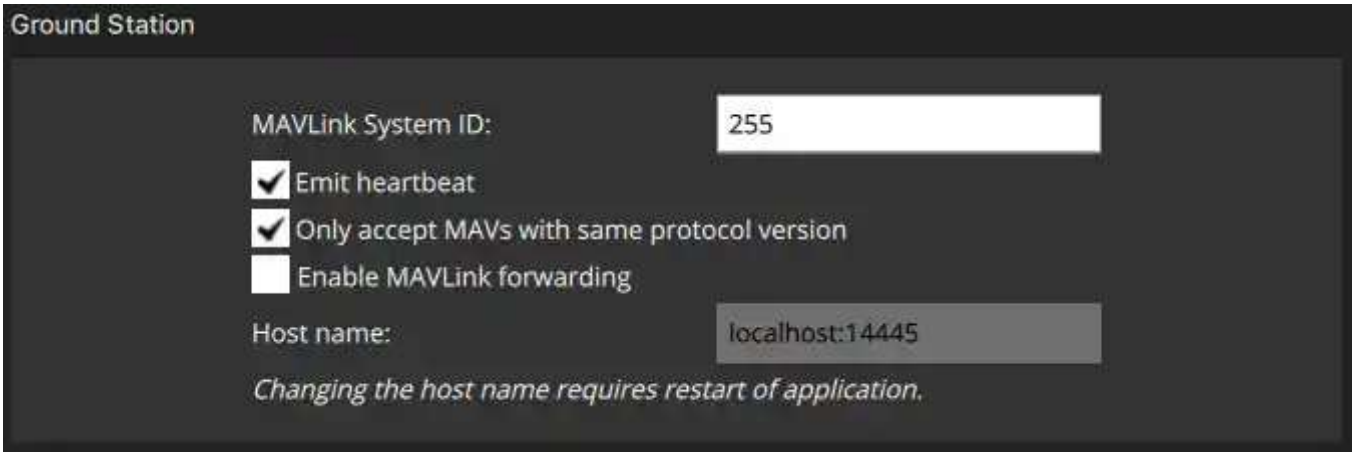
Help
Ground Station
MAVLink System ID:
255
Emit heartbeat
Only accept MAVs with same protocol version
Enable MAVLink forwarding
Host name:
Changing the host name requires restart of application.
Telemetry Stream Rates (ArduPilot Only)
All Streams Controlled By Vehicle Settings
Raw Sensors
2 hz
Extended Status
2 hz
RC Channel
2 hz
Position
3 hz
Extra 1
10 hz
Extra 2
10 hz
Extra 3
3 hz
MAVLink Link Status (Current Vehicle)
Total messages sent (computed):
24075
Total messages received:
21984
Total message loss:
2091
Loss rate:
9%
MAVLink 2.0 Logging (PX4 Pro Only)
Manual Start/Stop:
Start Logging
Enable automatic logging
MAVLink 2.0 Log Uploads (PX4 Pro Only)
Email address for Log Upload:
Default Description:
QGroundControl Session
Default Upload URL:
https://logs.px4.io/upload
Video URL:
Wind Speed:
Please Select
Flight Rating:
Please Select
Additional Feedback:
Make this log publicly available
Enable automatic log uploads
Delete log file after uploading
Saved Log Files
Check All
Check None

Ground Station

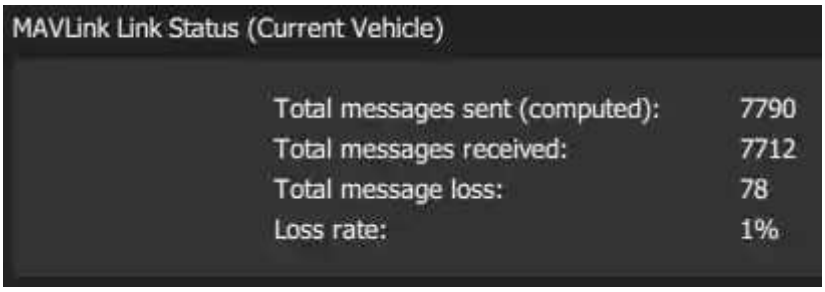
This section sets the MAVLink properties and behaviour of *QGroundControl*.



- **MAVLink System ID:** System ID of *QGroundControl* on the MAVLink network (Default: 255). Vehicles are typically allocated IDs from 1. You may have to specify another ID if there are multiple ground stations or MAVLink applications on the network.
- **Emit heartbeat:** Disable emission of regular MAVLink HEARTBEAT message (Default: True). Generally speaking, you should not turn this off.
- **Only accept MAVs with the same protocol version:** Set true to only connect to MAVLink 1 or to MAVLink 2 vehicles (Default: True).
- **Enable MAVLink forwarding:** Enable *QGroundControl* to forward MAVLink messages from connected vehicles to another UDP endpoint (Default: False). Note that this forwarding is one-way: from QGC to the specified host. Any MAVLink messages that are received from the specified host will be ignored.

Link Status

This shows the status of MAVLink message transfer over the communications link. A high **Loss rate** may lead to protocol errors for things like parameter download or mission upload/download.



MAVLink 2 Logging (PX4 only)

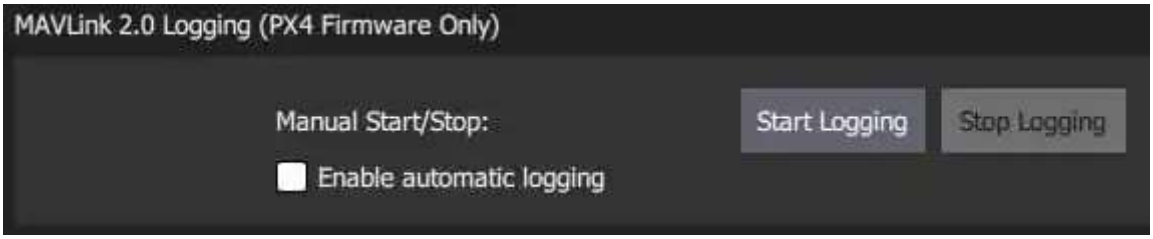
The *MAVLink 2 Logging* settings (PX4 only) configure real-time log streaming from PX4 to *QGroundControl* and upload of logs to Flight Review.

> **WARNING**
>
> MAVLink 2 Logging cannot be used on "basic" setups because it requires a constant high-rate MAVLink connection to the vehicle (it *may* work over WiFI but will *not* work over a Telemetry link).

> **TIP**
>
> In theory log streaming allows real time analysis of data. At time of writing real-time analysis has not yet been implemented.

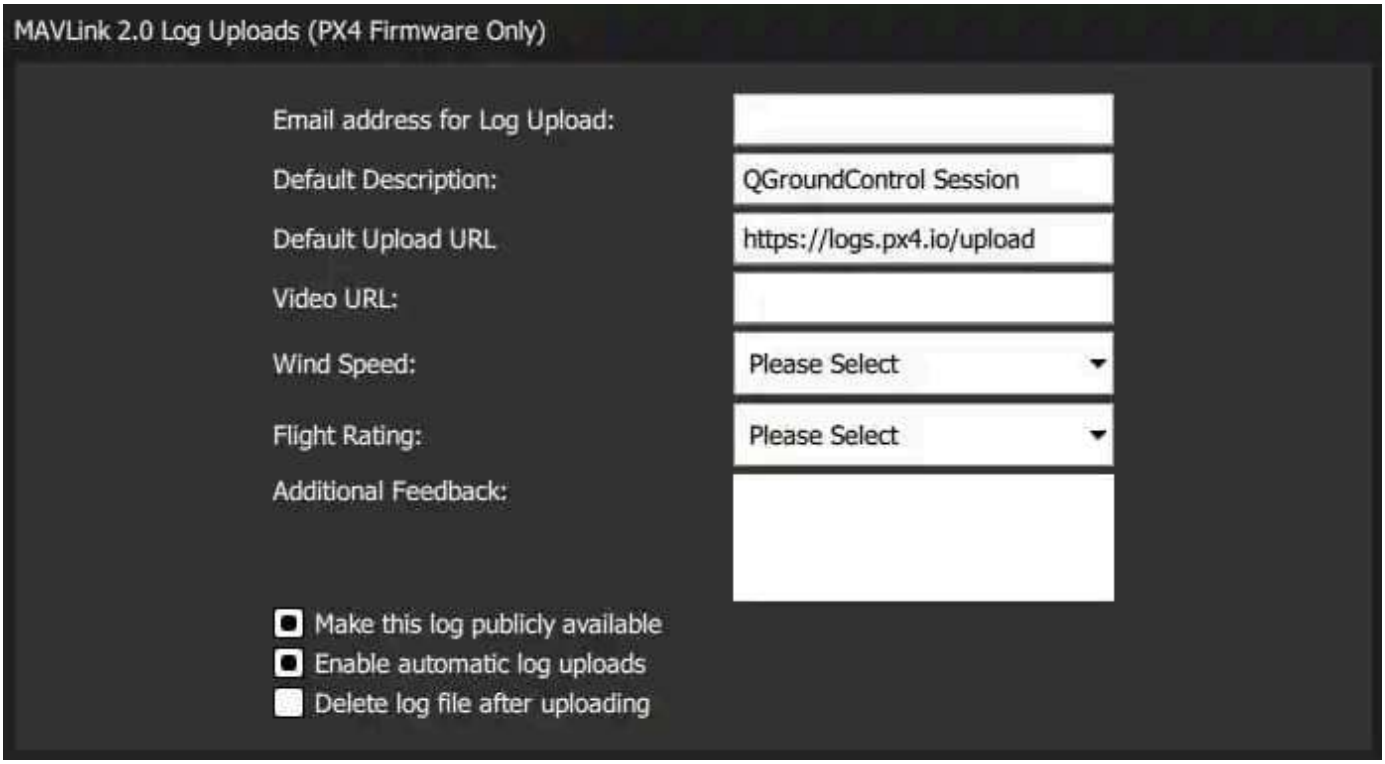
The log format is the same as for SD Card logs (downloaded using Analyze View > Log Download), but actual data logged may be slightly different because log start/stop time is controlled by *QGroundControl* and because some dropouts may occur when streaming over a lossy channel.

The *MAVLink 2 Logging* section allows you to manually start and stop logging, and to enable automatic capture of logs.



The *MAVLink 2 Log Uploads* section allows you configure uploading of MAVLink logs to Flight Review. You can specify all the fields that you would otherwise have to direc

in the site, and also choose whether logs are automatically or manually uploaded.



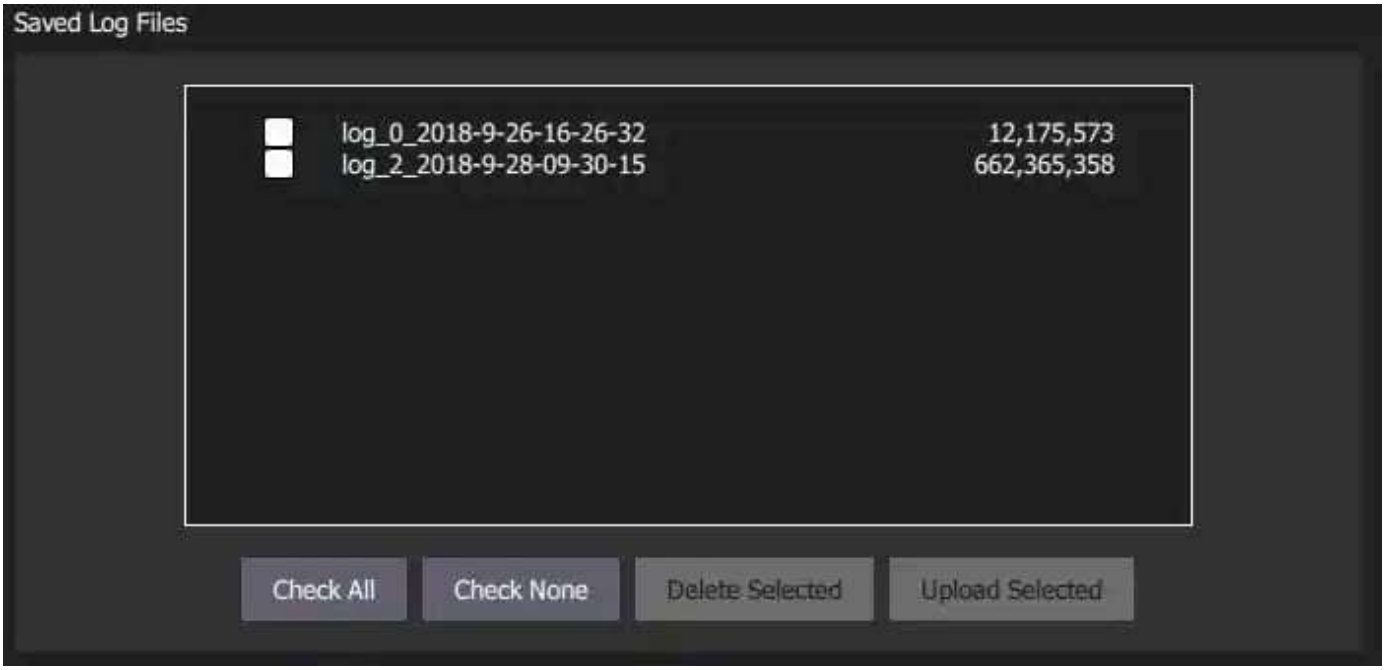
The fields are:

- **Email address for Log Uploads:** *Flight Review* will email you a link to the upload at this address. This is important as otherwise you will have no way to access a non-public log after upload.
- **Default Description:** Description/name of flight used for log.
- **Default Upload URL:** URL for upload of the log/log metadata. This is set by default to the *Flight Review* URL.
- **Video URL:** (Optional) URL for video of flight associated with log. This may be included on the Flight Review page to ease analysis.
- **Wind Speed:** Used to aid debugging and filtering (from multiple flights). Allowed values: *Calm* | *Breeze* | *Gale* | *Storm*.
- **Flight Rating:** Used to aid debugging and filtering (from multiple flights). Allowed values: *Crashed (Pilot Error)* | *Crashed (Software or Hardware Issue)* | *Unsatisfactory* | *Good* | *Great*.
- **Additional Feedback:** (Optional). Enter a more detailed description of the flight or behaviour.
- **Make this log publically available:** If set, the log will be visible and searchable on *Flight Review*. If not set, it will only be available via the link emailed on upload.

- **Enable automatic log uploads:** If set, the log will automatically be uploaded on completion.
- **Delete log file after uploading:** If set, the log will automatically deleted after upload.

The *Saved Log Files* section is used to manually manage log uploads. Use the checkboxes and buttons to select logs, and either delete or upload them.

> **TIP**
>
> You can change the parameters in *MAVLink 2 Log Uploads* above to specify separate descriptions for uploaded logs.



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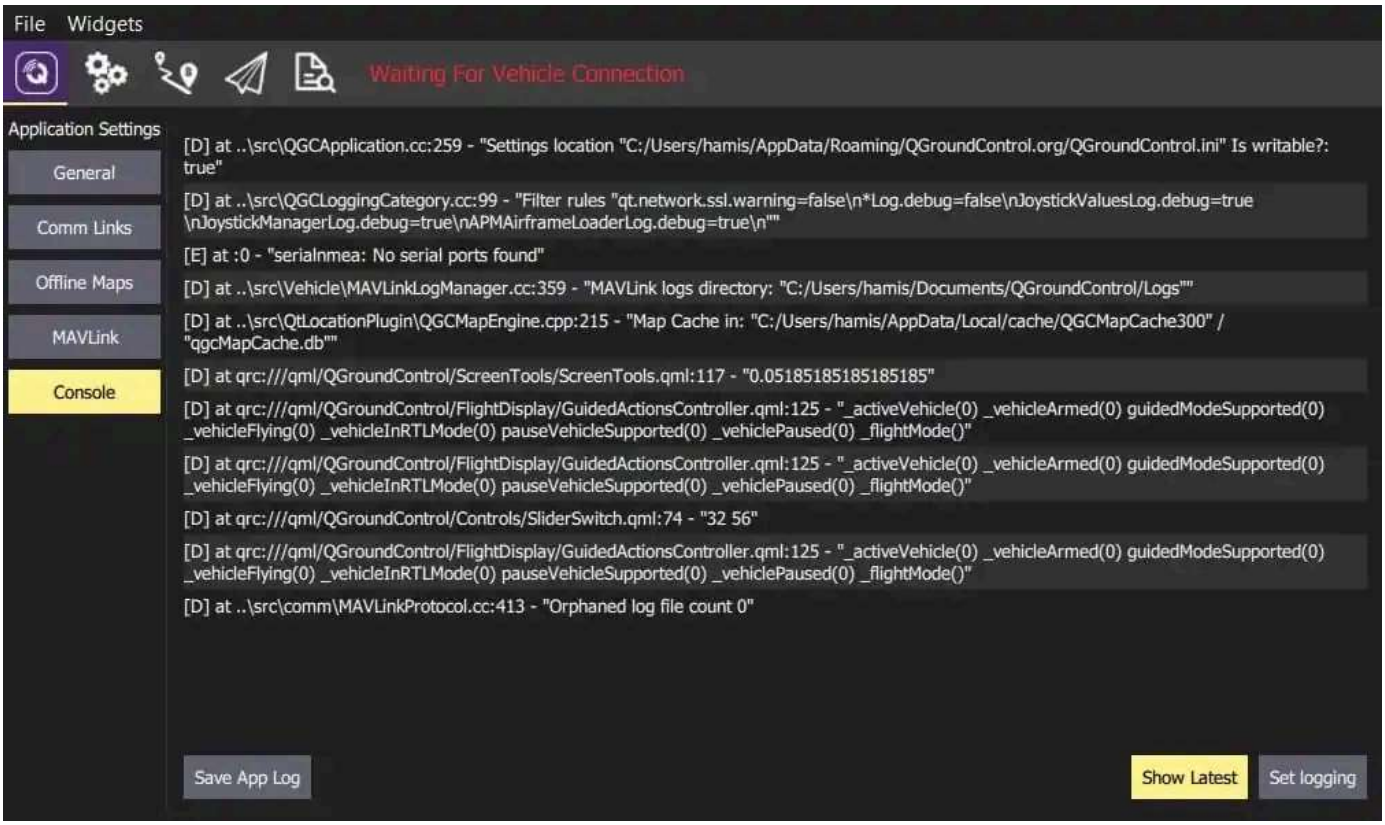
Console Logging

The *Console* can be helpful tool for diagnosing *QGroundControl* problems. It can be found in **SettingsView > Console**.



Click the **Set Logging** button to enable/disable logging information displayed by *QGroundControl*.

Common Logging Options

The most commmonly used logging options are listed below.

Option(s)	Description
`LinkManagerLog` , `MultiVehicleManagerLog`	Debug connection problems.
`LinkManagerVerboseLog`	Debug serial ports not being detected. Very noisy continuous output of available serial ports.
`FirmwareUpgradeLog`	Debug firmware flash issues.
`ParameterManagerLog`	Debug parameter load problems.
`ParameterManagerDebugCacheFailureLog`	Debug parameter cache crc misses.
`PlanManagerLog` , `MissionManagerLog` , `GeoFenceManagerLog` , `RallyPointManagerLog`	Debug Plan upload/download issues.
`RadioComponentControllerLog`	Debug Radio calibration issues.

Logging from the Command Line

An alternate mechanism for logging is using the `--logging` command line option. This is handy if you are trying to get logs from a situation where *QGroundControl* crashes.

How you do this and where the traces are output vary by OS:

- Windows
  - You must open a command prompt, change directory to the **qgroundcontrol.exe** location, and run it from there:

```sh
cd "\Program Files (x86)\qgroundcontrol"
qgroundcontrol --logging:full
```

  - When *QGroundControl* starts you should see a separate console window open which will have the log output
- OSX

- You must run *QGroundControl* from Terminal. The Terminal app is located in Applications/Utilities. Once Terminal is open paste the following into it:

```sh
cd /Applications/qgroundcontrol.app/Contents/MacOS/
./qgroundcontrol --logging:full
```

- Log traces will output to the Terminal window.

- Linux

```sh
./qgroundcontrol-start.sh --logging:full
```

- Log traces will output to the shell you are running from.

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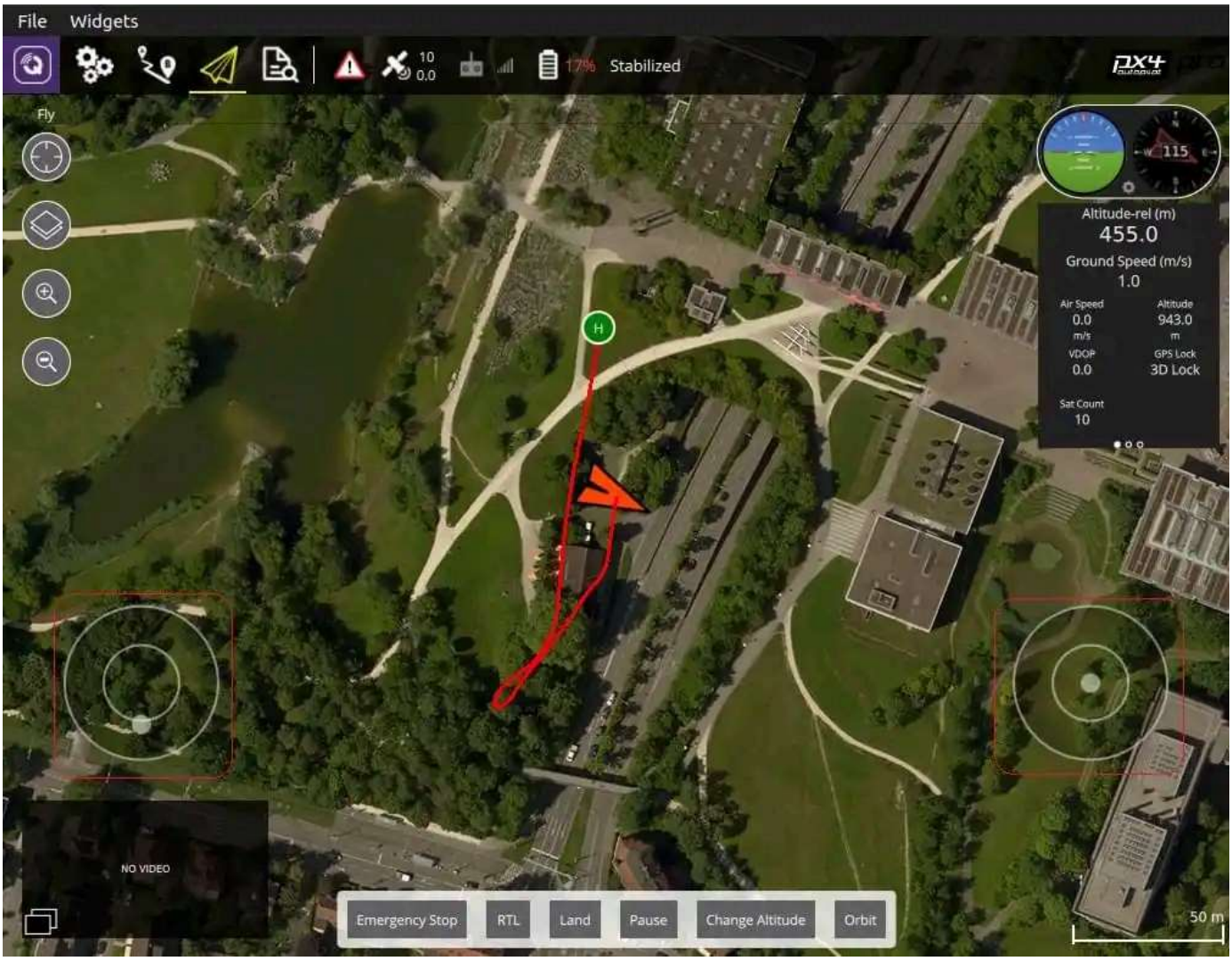
Virtual Joystick (PX4)

Virtual Joystick

QGroundControl allows you to control a vehicle with on-screen virtual thumbsticks. These are displayed as shown below in the flight view.



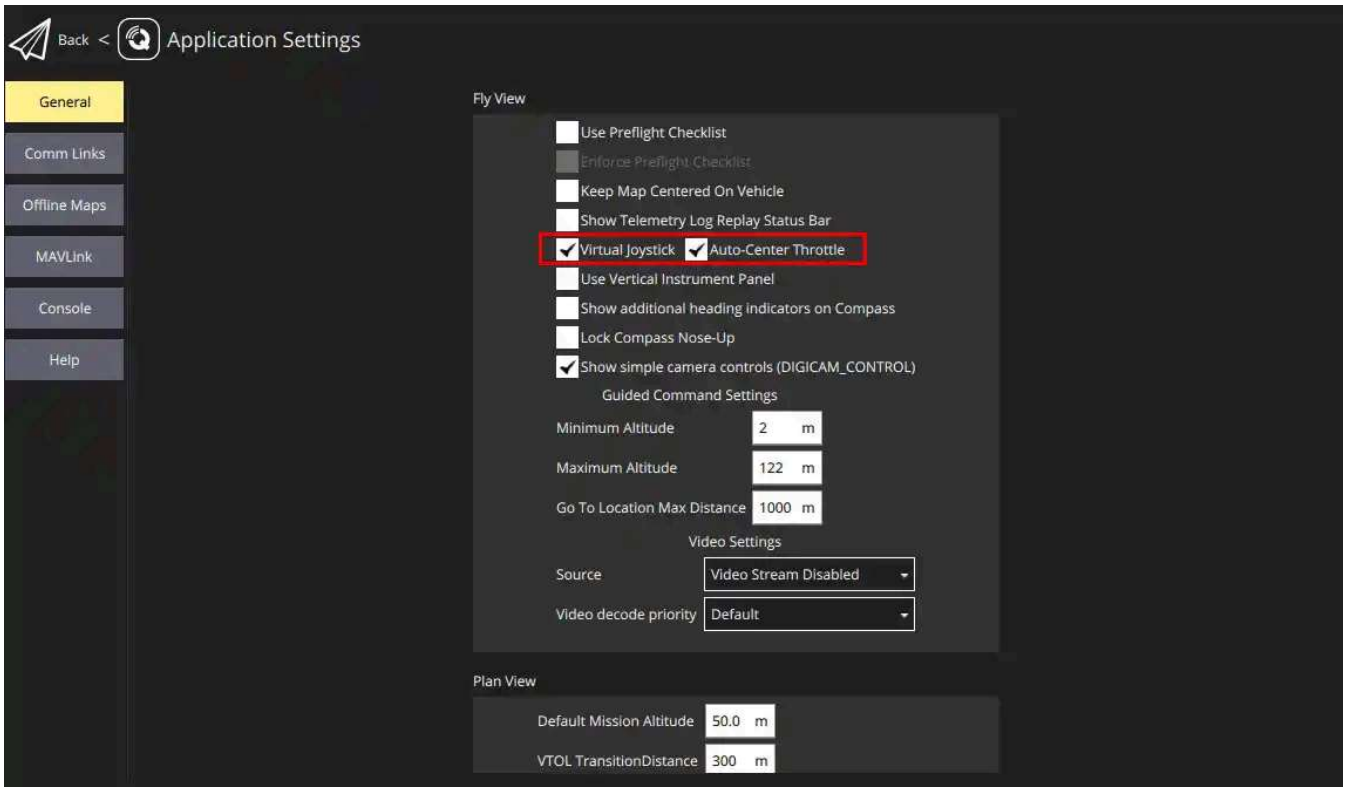
INFO

Thumbstick control is not as responsive as using an RC Transmitter (because the information is sent over MAVLink). Another alternative is to use a USB Joystick/Gamepad.

Enable the thumbsticks

To enable the virtual joysticks:

1. Select the **Q** icon from the top toolbar
2. Open the **Application Settings**
3. Make sure you're on the **General** tab
4. Check the **Virtual joystick** box



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Analyze

Analyze View

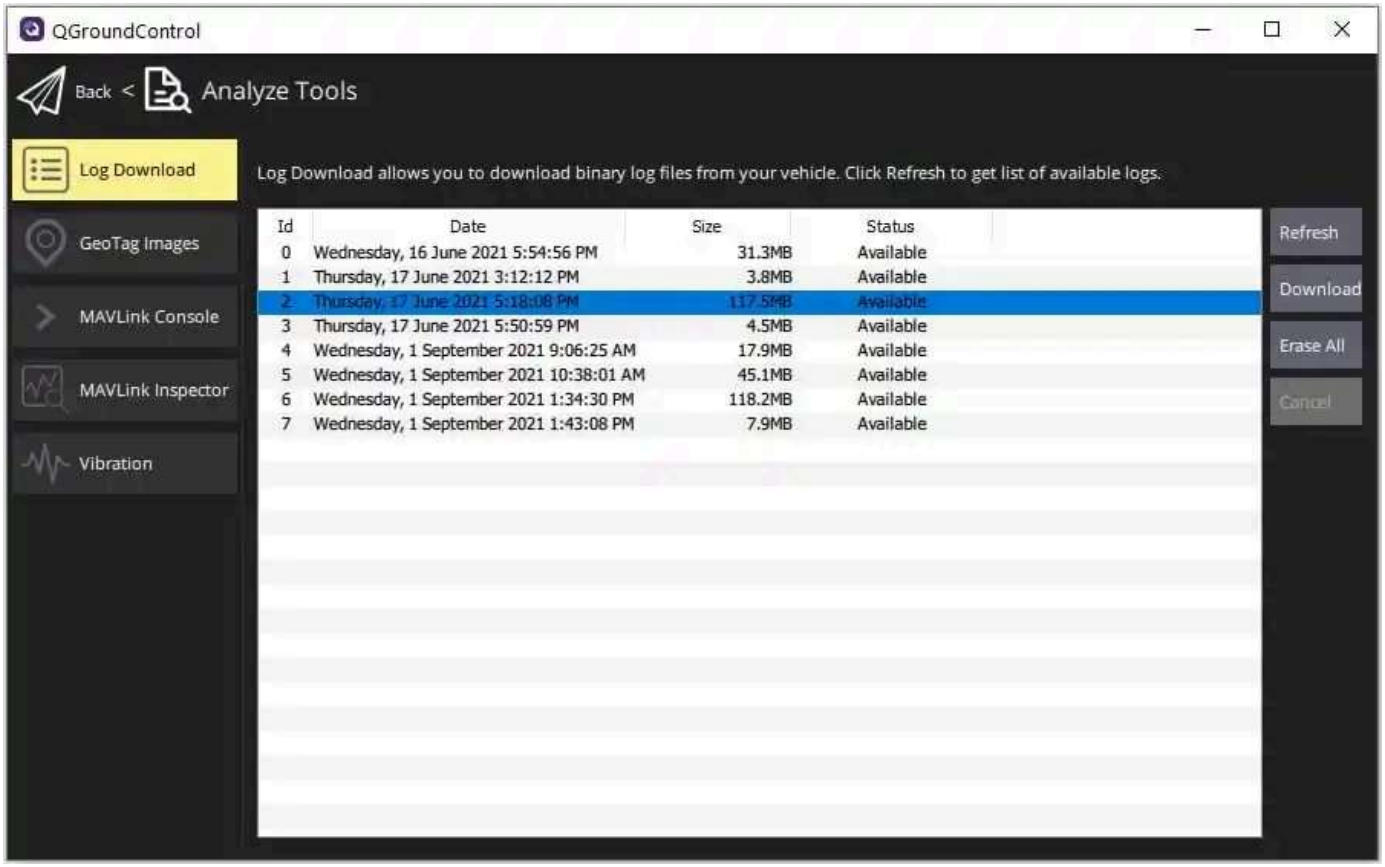
The *Analyze View* is accessed by selecting the *QGroundControl* application menu ("Q" icon in the top left corner) and then selecting the **Analyze Tools** button (from the *Select Tool* popup).

The view provides tools to:

- Download Logs — List, download and clear logs on the vehicle.
- GeoTag Images (PX4) — Geotag survey mission images using the flight log (on a computer).
- MAVLink Console (PX4) — Access the the nsh shell running on the vehicle.
- MAVLink Inspector — Display and chart received MAVLink messages/values.

Log Download (Analyze View)

The *Log Download* screen (**Analyze > Log Download**) is used to list (*Refresh*), *Download* and *Erase All* log files from the connected vehicle.



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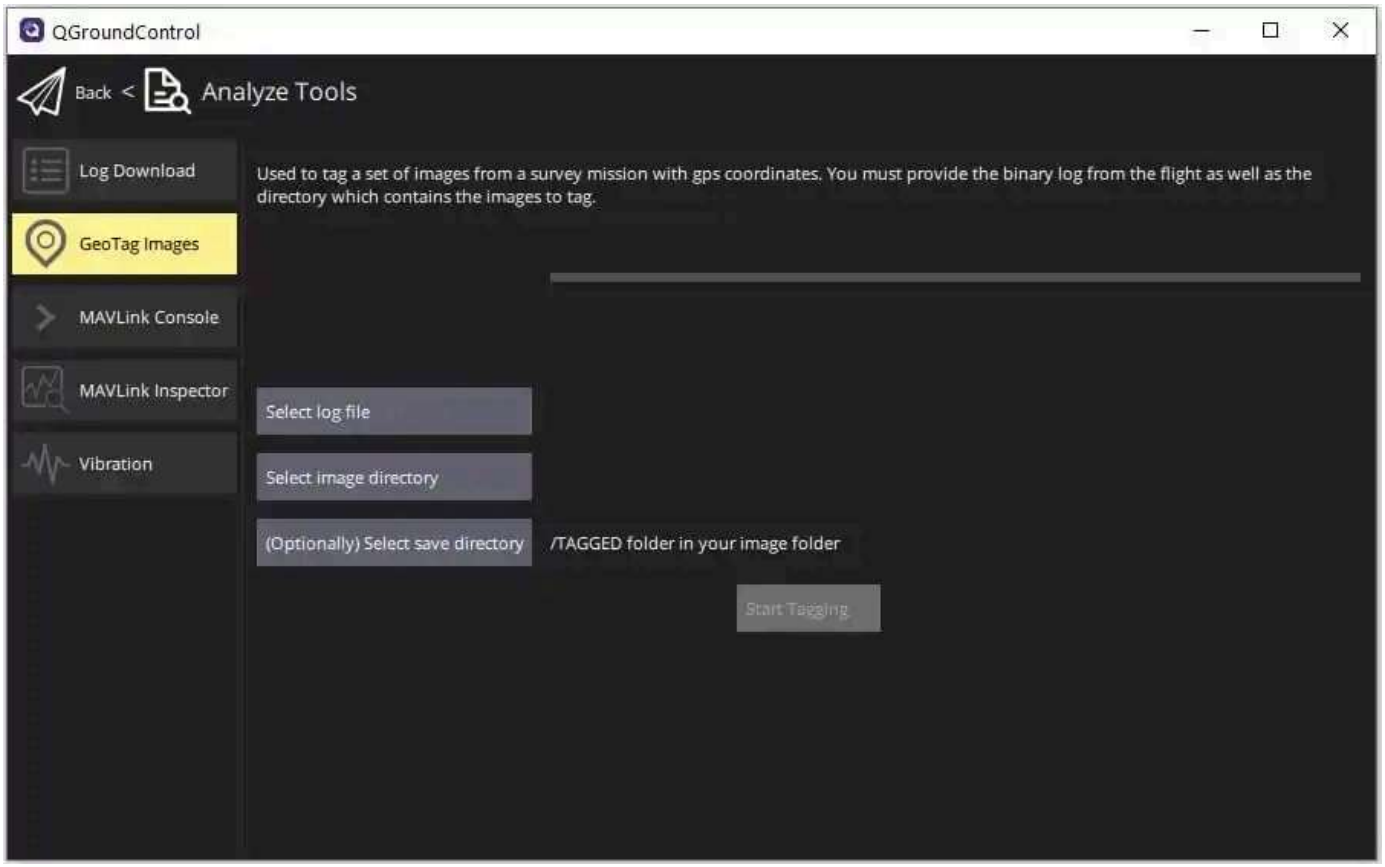
GeoTag Images (Analyze View)

The *GeoTag Images* screen (**Analyze > GeoTag Images**) allows you to geotag images from a survey mission using information in the flight log.

INFO

This feature only works with *PX4* flight stack logs. ArduPilot is not supported.



Select the log file, image directory and (optionally) output directory for geotagged images using the buttons provided. Click **Start Tagging** to generate the geotagged images.

MAVLink Console (Analyze View)

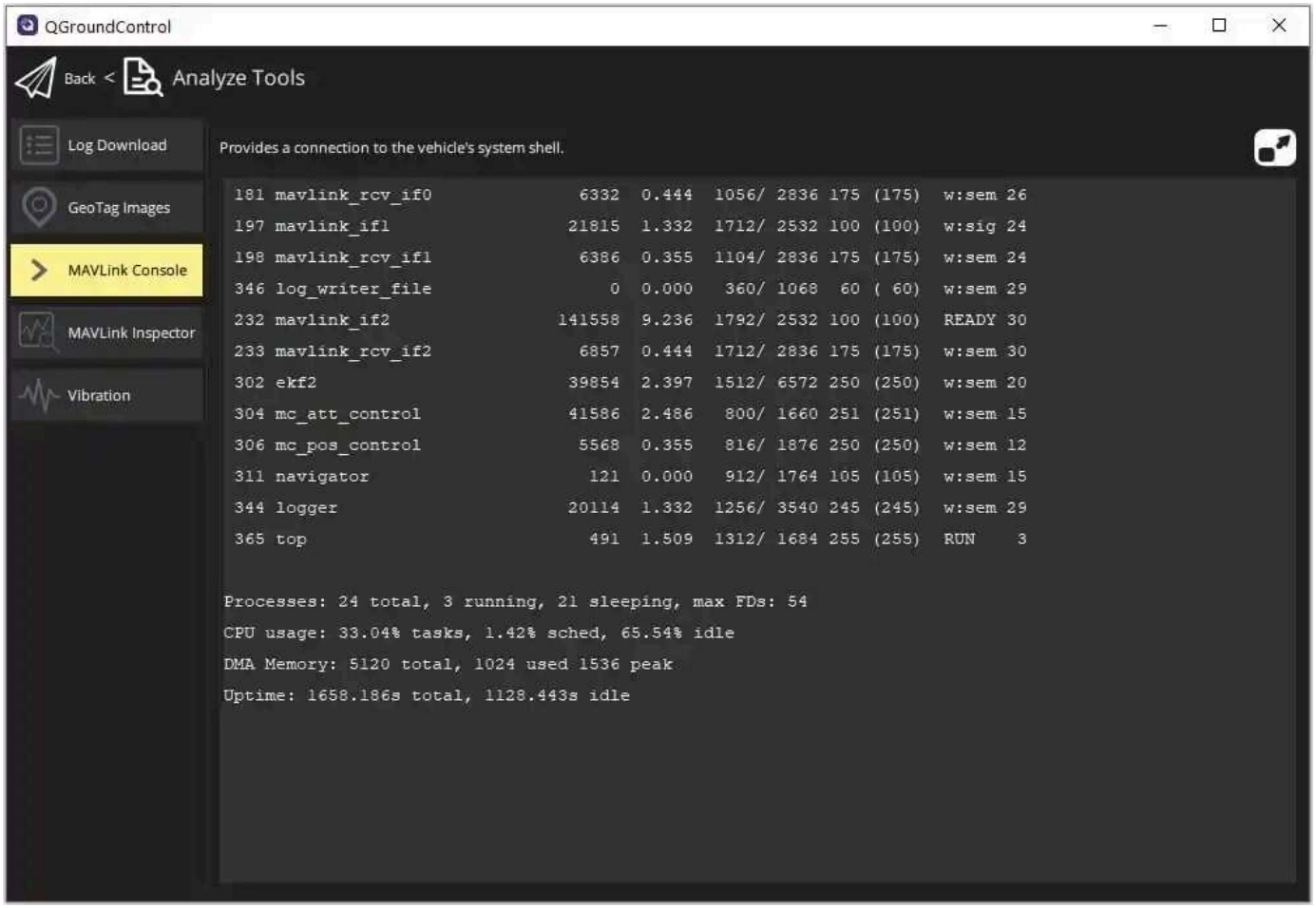
The MAVLink Console (**Analyze > Mavlink Console**) allows you to connect to the PX4 System Console and send commands.

INFO

The console only works when connected to *hardware* running the *PX4* flight stack. PX4 SITL and ArduPilot are not supported.

TIP

This is a very useful feature for developers as it allows deep access to the system. In particular, if you are connected via Wifi, you can have this same level of access while the vehicle is flying.



The view does not display any output except in response to commands. Once the vehicle is connected, you can enter commands in the bar provided (for a full list of available commands enter: `?`).

Command output is displayed in the view above the command bar. Click **Show Latest** to jump to the bottom of the command output.

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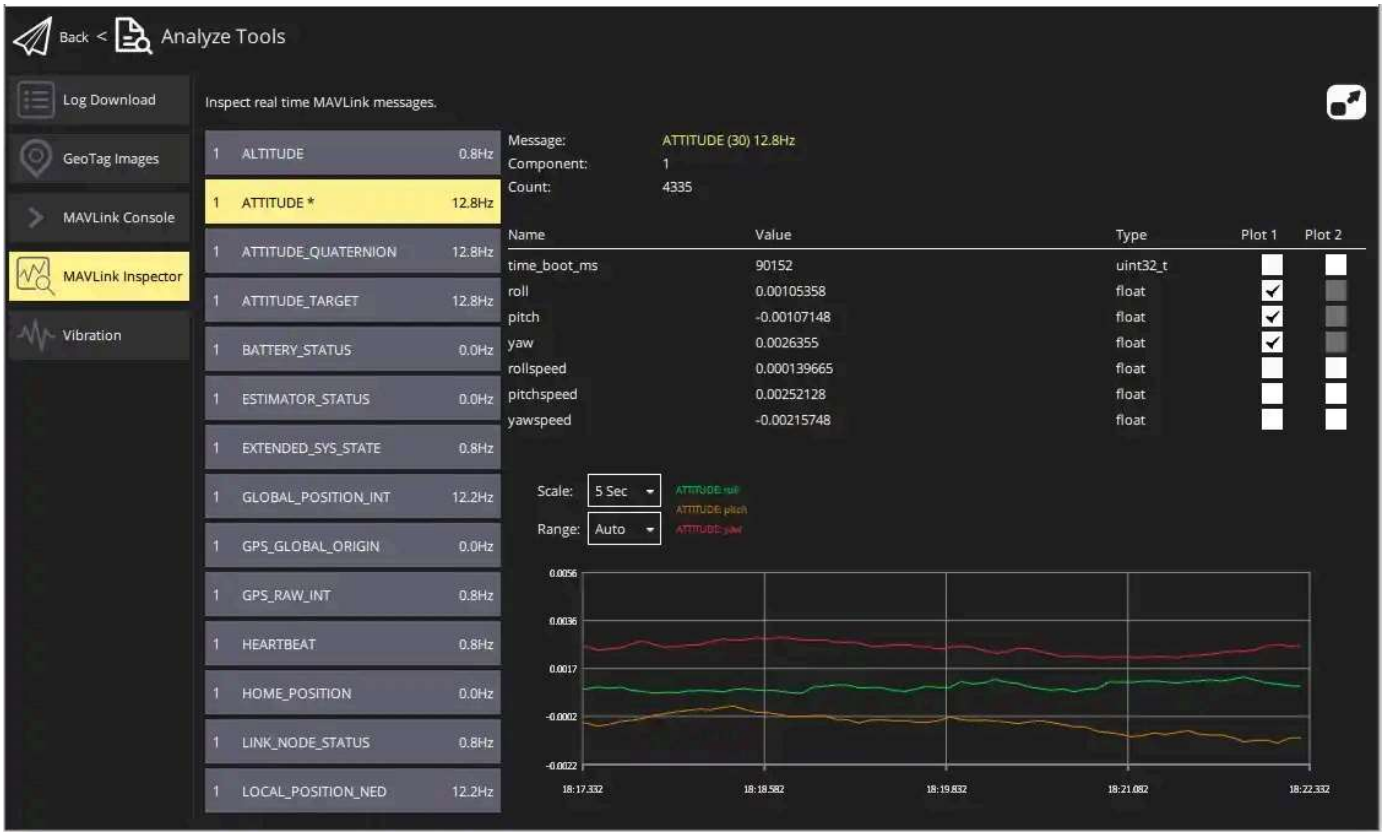
MAVLink Inspector

The *MAVLink Inspector* provides real-time information and charting of MAVLink traffic received by *QGroundControl*.

WARNING

This feature is intended primarily for **autopilot developers/vehicle creators**. It is only supported on desktop builds (Windows, Linux, Mac OS).



The inspector lists all received messages for the current vehicle, along with their source component id and update frequency. You can drill down into individual messages to get the message id, source component id, and the values of all the individual fields. You can also chart field values in real time, selecting multiple fields from multiple messages to display on one of two charts.

To use the *MAVLink Inspector*:

1. Open *Analyze View* by selecting the *QGroundControl* application menu ("Q" icon in top left corner) and then choosing the **Analyze Tools** button (from the *Select Tool* popup).

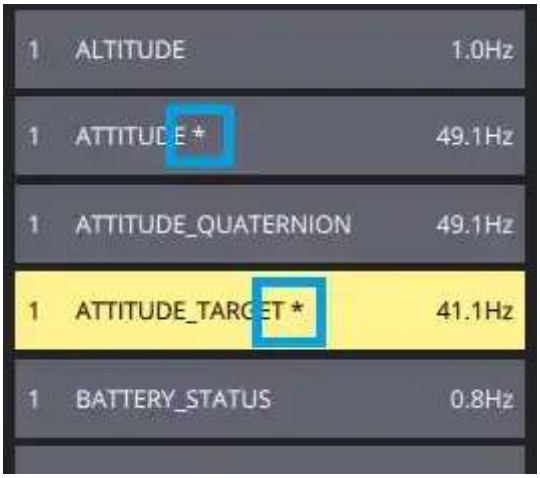
2. Select the **MAVLink Inspector** from the sidebar.

   The view will start populating with messages as they are received.

3. Select a message to see its fields and their (dynamically updating) value:

4. Add fields to charts by enabling the adjacent checkboxes (plot 1 is displayed below plot 2).

- Fields can be added to only one chart.
- A chart can have multiple fields, and fields from multiple messages (these are listed above each chart). Messages containing fields that are being charted are highlighted with an asterisk.



- The *Scale* and *Range* are set to sensible values, but can be modified if needed.

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Troubleshooting QGC Setup

This topic lists troubleshooting information related to *QGroundControl* setup and installation on the host computer.

> **TIP**
>
> Problems when **using** *QGroundControl* to interact with a vehicle are covered in: QGC Vehicle Interaction Problems.

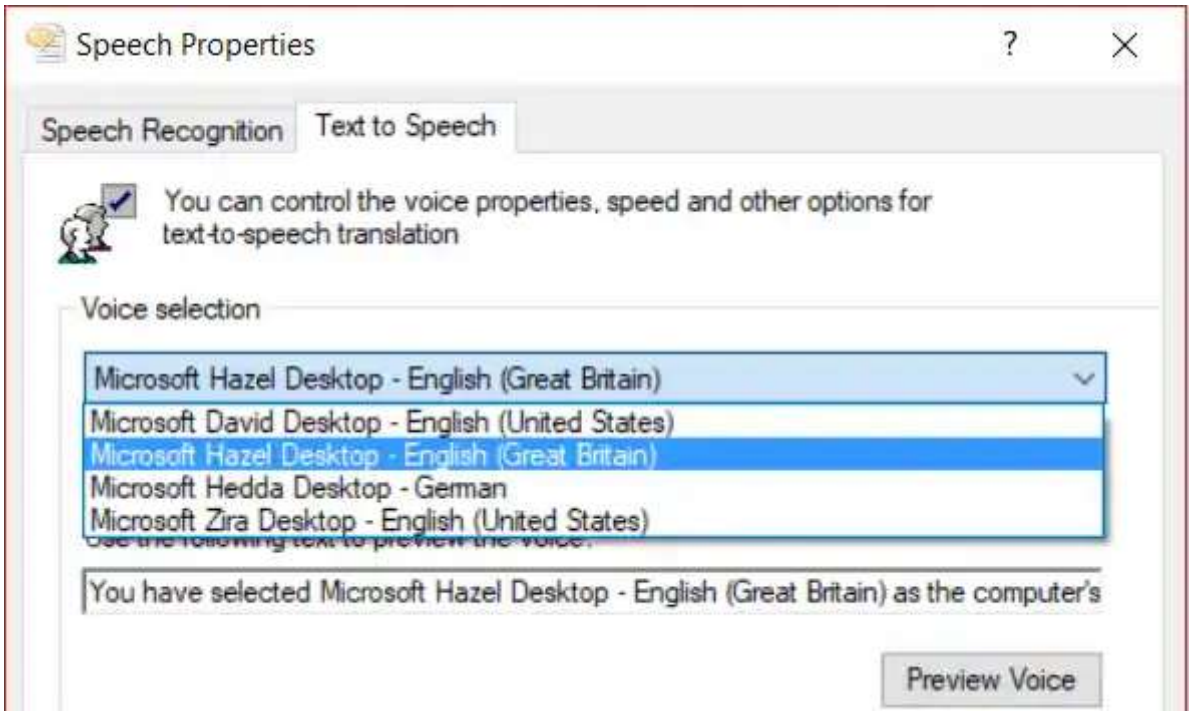
64-bit Windows: Audio in Unexpected Language

On Windows 64-bit machines *QGroundControl* may sometimes play audio/messages in a language that does not match the *Text-to-speech* setting in **Control Panel > Speech** (e.g. audio spoken in German on an English machine).

This can occur because 64-bit Windows only displays 64-bit voices, while *QGroundControl* is a 32-bit application (on Windows) and hence can only run 32-bit voices.

The solution is to set the desired *32-bit voice* for your system:

1. Run the control panel application: **C:\Windows\SysWOW64\Speech\SpeechUX\sapi.cpl**.
2. Make your desired *Voice selection* and then click **OK** at the bottom of the dialog.



INFO

Menu

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Windows: UI Rendering/Video Driver Issues

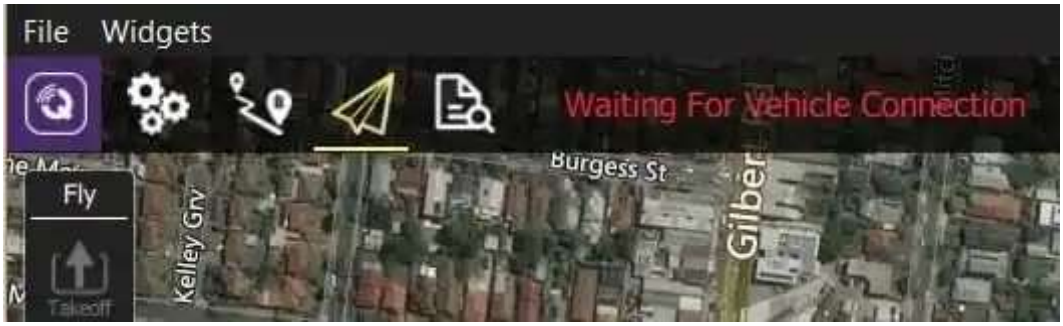
If you experience UI rendering issues or video driver crashes on Windows, this may be caused by "flaky" OpenGL drivers. *QGroundControl* provides 3 shortcuts that you can use to start *QGroundControl* in "safer" video modes (try these in order):

- **QGroundControl:** QGC uses OpenGL graphics drivers directly.
- **GPU Compatibility Mode:** QGC uses ANGLE drivers, which implement OpenGL on top of DirectX.
- **GPU Safe Mode:** QGC uses a software rasterizer for the UI (this is very slow).

Windows: Doesn't connect to Vehicle over WiFi

If *QGroundControl* sits forever (for example, *Waiting For Vehicle Connection*) when trying to connect to the vehicle over Wifi, a possible cause is that IP traffic is being block

firewall software (e.g. Windows Defender, Norton, etc.).



The solution is to allow the *QGroundControl* app through the firewall.

> **INFO**
>
> It is possible to simply switch the network profile from Public to Private to allow connections, but this exposes your PC to the Network, so be careful

If using *Windows Defender*:

- In the **Start** bar, enter/select: *Firewall & Network Protection* (System Settings).
- Scroll to and select the option: *Allow an app through firewall*.
- Select *QGroundControl* and change the *Access* selector to **Allow**.

> **TIP**
>
> Programs are listed in alphabetical order by description (not filename). You'll find QGC under **O**: *Open source ground control app provided by QGroundControl dev team*

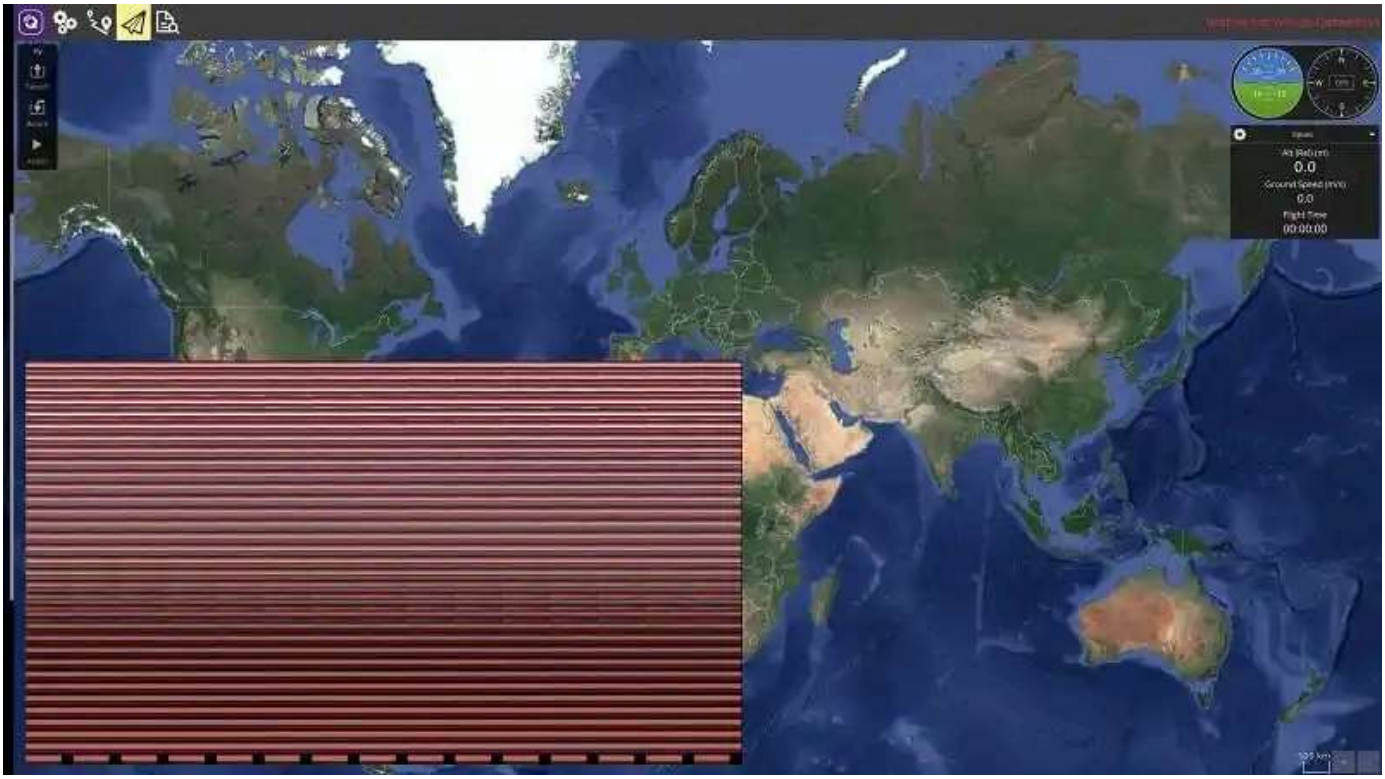
Ubuntu: Video Streaming Fails (Missing Gstreamer)

On Ubuntu you must install *Gstreamer* components in order to see video streams. If these are not installed *QGroundControl* is unable to create the gstreamer nodes and fails with:

```sh
VideoReceiver::start() failed. Error with gst_element_factory_make('avdec_h264')
```

The [download/install instructions for Ubuntu] include *GStreamer* setup information.

Ubuntu 18.04: Video Streaming Fails on Dual Video Adapter Systems



The version of GSteamer in Ubuntu 18.04 has a bug that prevents video displaying when using a VA API based decoder (i.e. vaapih264dec etc.) on systems that have both Intel and NVidia video display adapters.

> **INFO**
>
> More generally, while the problem is known to occur on Ubuntu 18.04 with Intel and NVidia VGAs, it might occur on any linux system and other types of (dual) VGAs.

The easiest way to get *QGroundControl* to work in this case is to start it using the following command line:

```
LIBVA_DRIVER_NAME=fakedriver ./QGroundControl)  will this make the
```

Other alternatives are to disable one of the VGAs, uninstall VA API components, or upgrade to GStreamer 1.16 (there is no easy way to do this on Ubuntu 18.04 - please contribute a recipe if you find one!)

Ubuntu 16.04: GLIBC_2.27 not found

The pre-built AppImages for QGroundControl 4.0 (and later) can only run on Ubuntu 18.04 LTS (or later). They do not run on Ubuntu 16.04.

If you try you will get the error as shown:

```sh
$ ./QGroundControl.AppImage
/tmp/.mount_i4hPuB/QGroundControl: /lib/x86_64-linux-gnu/libm.so.6: version `GLIBC_2.2
```

If you need to use Ubuntu 16.04 then one workaround is to build from source without the video libraries.

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Vehicle Connection Problems

Vehicle does not show up in UI

QGC will automatically connect to a vehicle as soon as a communication link is created (using USB, or WiFi, etc.) If you establish that link and you don't see your vehicle show up in the QGC UI you can use console logging to help debug the problem.

Use the following steps to debug the issue:

- Start with the hardware vehicle link not connected. Don't plug in the USB connection and/or establish the WiFi link in your OS for example.
- Turn on `LinkManagerLog` console logging in QGC. This will log output about the link which QGC sees and connects to.
- Establish the hardware vehicle communication link.
- The console log output should display something like this:

```
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:563 - "Wai
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:563 - "Wai
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:563 - "Wai
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:563 - "Wai
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:572 - "Wai
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:613 - "New
```

- The first few lines indicate QGC has established a hardware link and finally the auto-connect.

If you don't see any of this then QGC is not recognizing the hardware link. To see if your hardware is being recognized at the OS level do this:

- Start with the hardware vehicle link not connected. Don't plug in the USB connection and/or establish the WiFi link in your OS for example.
- Turn on `LinkManagerVerboseLog` console logging in QGC. This will log output for all serial hardware connections that QGC recognizes.
- You will see continuous output of the serial ports on your device.
- Plug in your USB comm device.
- You should see a new device show in in the console output. Example:

```
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:520 - "---
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:521 - "por
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:522 - "sys
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:523 - "des
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:524 - "man
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:525 - "ser
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:526 - "ven
[D] at /Users/travis/build/mavlink/qgroundcontrol/src/comm/LinkManager.cc:527 - "pro
```

- After that it should continue to log a connection to that device as shown in the first example.

If you don't see a new serial port should up in the console output when you plug it in then something is likely wrong with your hardware at the OS level.

Error: Vehicle is not responding

This indicates that although QGC was able to connect to the hardware link to your vehicle there is no telemetry going back and forth on the link. This can unfortunately indicate a number of problems:

- Hardware communication setup problems
- Firmware problems

Lastly it can happen if QGC attempts to automatically connect to a device which is connected to your computer which isn't a vehicle. You can identify this case using the steps above and noting the device information which QGC is attempting to connect to. In order to make auto-connect work the filter it uses on devices it attempts to auto-connect to is somewhat broad and can be incorrect. If you find this happening you will need to turn off auto-connect from General Settings and create a manual connection to the comm link for your vehicle. You can also remove the device causing the problem from your computer but that may not always be possible.

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