DeltaQuad Pro operations manual v2

Introduction

Introduction

This document describes how to set up, operate, and maintain your DeltaQuad series VTOL UAV Version 2. To identify your vehicle version, please see the serial number sticker inside the UAV. This will indicate:

Version 1: DeltaQuad Pro
Version 2: DeltaQuad Pro V2

For version 1, please refer to the version 1 documentation

This manual in PDF file format: DeltaQuad Operations Manual.pdf

Safety and legal notice

- The vehicle must be operated in accordance with local laws and regulations.
- The vehicle may not be operated or flown near or over people, roads, vehicles, buildings, or anything that could result in damage or danger to people or property.
- All missions must be validated and pass the DeltaQuad Mission Validator
- Radio or video transmitters might require special licensing and/or permits.
- Vertical Technologies or its affiliates can not be held responsible for vehicles that have not been operated or maintained in accordance with the guidelines set forth in this manual, or for behavior resulting from changes made to the vehicle.
- This operations manual is provided "As-Is". No rights can be obtained from the contents of this manual.
- The original language of this document is English, if this document is read in a translation to any other language, the interpretation of the English version takes precedence.
- Software used in conjunction with the vehicle is provided under their respective license and warranty.
- The vehicle is provided in accordance with the Vertical Technologies Warranty and under the Vertical Technologies Terms & Conditions

Vehicle specifications

Dimensions:	
Wingspan	235 cm
Length	90 cm
Height	17 cm
Wing area	90 sq. dm.
Payload bay	20 x 12 x 9 cm
Flightcase dimensions	122 x 45 x 51 cm
Flightcase weight	~ 25 Kg including vehicle
Weight and Payload:	
Empty weight	3.3 Kg
Empty weight including battery	5 Kg
Maximum takeoff weight	6.2 Kg
Payload capacity	1.2 Kg
Flight Characteristics at no payload:	
Cruise speed	18 m/s (65 Km/h)
Maximum speed	28 m/s (100 Km/h)
Stall speed	12 m/s (43 Km/h)
Maximum flight time*	2+ hours
Range through air*	120 km
Flight Characteristics at max payload:	
Cruise speed	16 m/s (60 Km/h)
Maximum speed	25 m/s (90 Km/h)

Stall speed	13 m/s (47 Km/h)
Maximum flight time*	1 hour 50 minutes
Range through air*	100 km
Flight Characteristics with Auxiliary LiPo:	
Payload capacity	400 g
Maximum flight time*	2 hour 45 minutes
Range through air*	150 km
Power	
Battery type	LiPo
Battery cells	4s
Battery capacity	23Ah
Tolerances	
Maximum takeoff/landing wind **	9 m/s (33 Km/h)
Maximum wind cruise flight **	14 m/s (50Km/h)
Maximum precipitation	Light Rain
Operating temperature	Between -20 and +45 Celsius
Maximum flight altitude AMSL	13.000ft (4000m)

All flight characteristics are based on optimized settings at sea level

* These values assume 90% battery usage, low wind conditions and include a low-altitude vertical takeoff and landing at sea level. EU Export versions are locked to 59 minutes of flight time.

** These values are based on measurements at flight altitude

Video instructions

For your convenience, the following video tutorials have been created. Please keep in mind that these instructions are for information purposes only and the full documentation should be consulted before operating the vehicle.

General video instructions

- Planning a mission and controlling the vehicle

DeltaQuad Pro #MAP

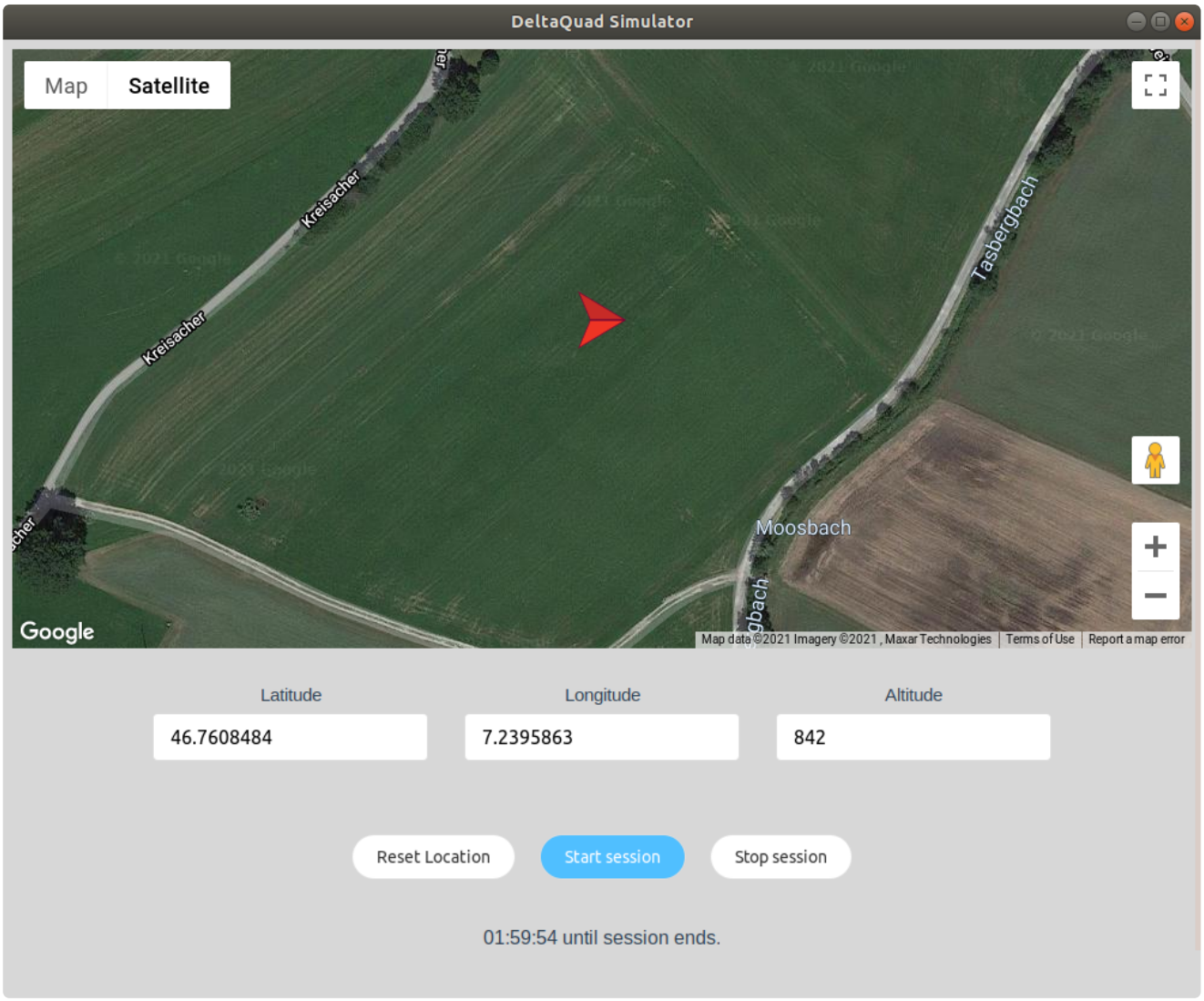
- Planning a survey (mapping) mission
- Setting up a Sony RX1R camera for mapping
- Setting up a Sony A7R camera for mapping
- Installing a mapping camera

DeltaQuad Simulator

The DeltaQuad Simulator is intended to provide users of the DeltaQuad with a means of familiarizing themselves with the Ground Control Software and various flight modes offered by the system. The simulator has been configured to mimic the behavior of the DeltaQuad in actual flight conditions.

The simulator installation instructions will have been provided to you via e-mail.

For more information on the DeltaQuad simulator please refer to the documentation provided to you via e-mail.



Setup

This chapter covers the hardware assembly, software setup, and configuration.

Chapter index

Assembly

In this section, we cover the steps for unpacking and assembling the DeltaQuad.

Package contents

- 1 x Main fuselage
- 2 x Wing
- 2 x Carbon spar (1150mm and 850mm)
- 2 x VTOL module

Optional components:

- Battery charger
- Ground Control Station
- Radio Telemetry Bundle
- 4G Telemetry Bundle
- Auxiliary LiPo module
- Battery connector set

Unpacking and initial hardware setup

For the initial hardware setup, make sure you have ample room to work. Carefully unpack all components from the box and inspect them for any damage. If there is damage to your vehicle please document and report this damage to Vertical Technologies.

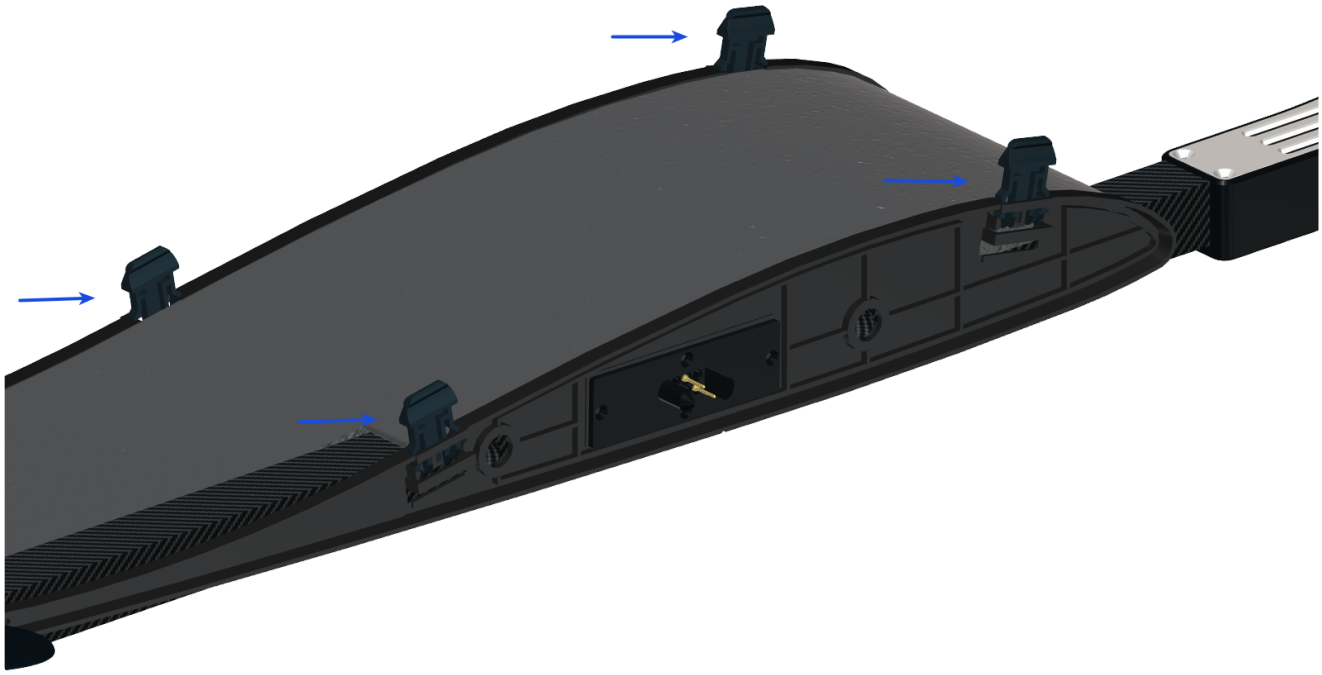
Inserting the carbon spars

Insert the 2 carbon spars through the fuselage. The short carbon spar (850mm) is inserted in front, the long carbon spar (1150mm) is inserted in the back. When inserting the front carbon spar, make sure that nothing is blocking the path of the spar inside the fuselage.

Mounting the VTOL modules

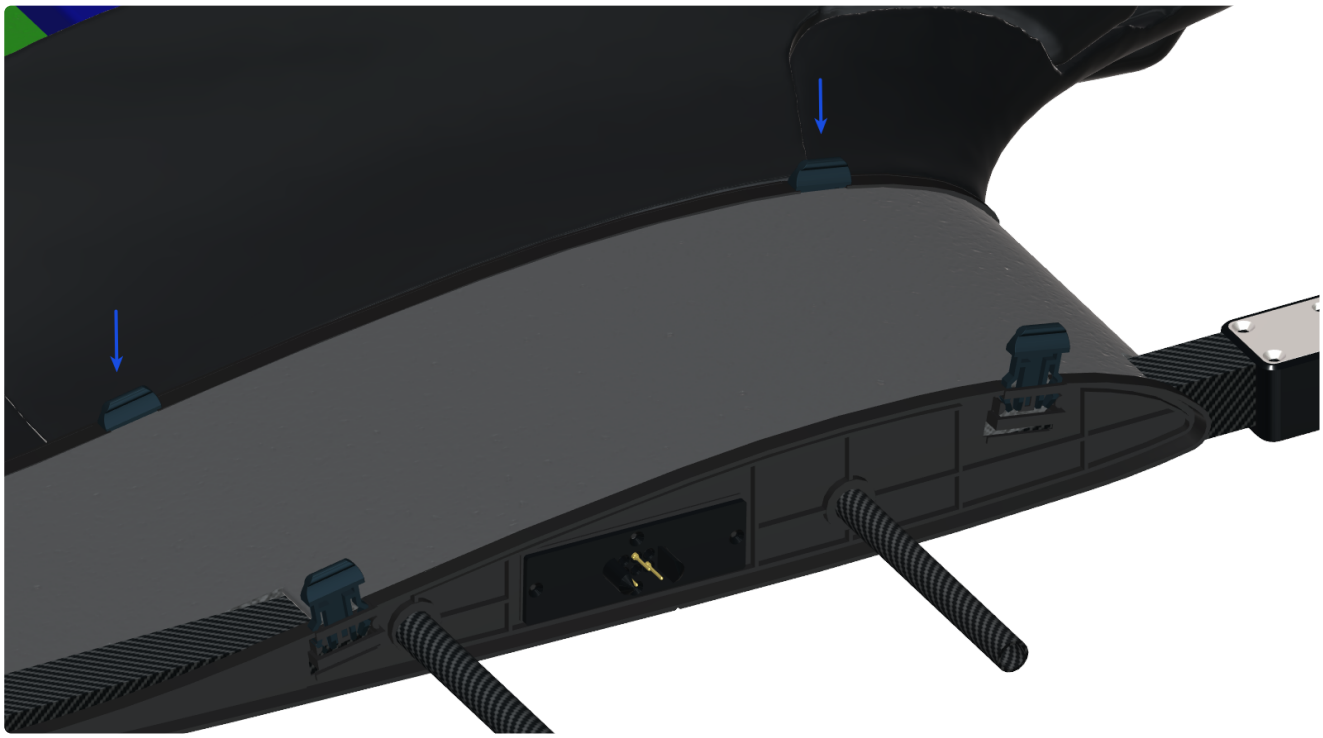
The VTOL modules are indicated by the motor numbers, the module that has the motor numbers 1 and 4 is the right side module, and the module that has the motor numbers 2 and 3 is the left side module.

Before sliding on the module make sure all lock pins on the module are in the open (up) position.



Slide the modules onto the carbon spars and push them firmly against the fuselage.

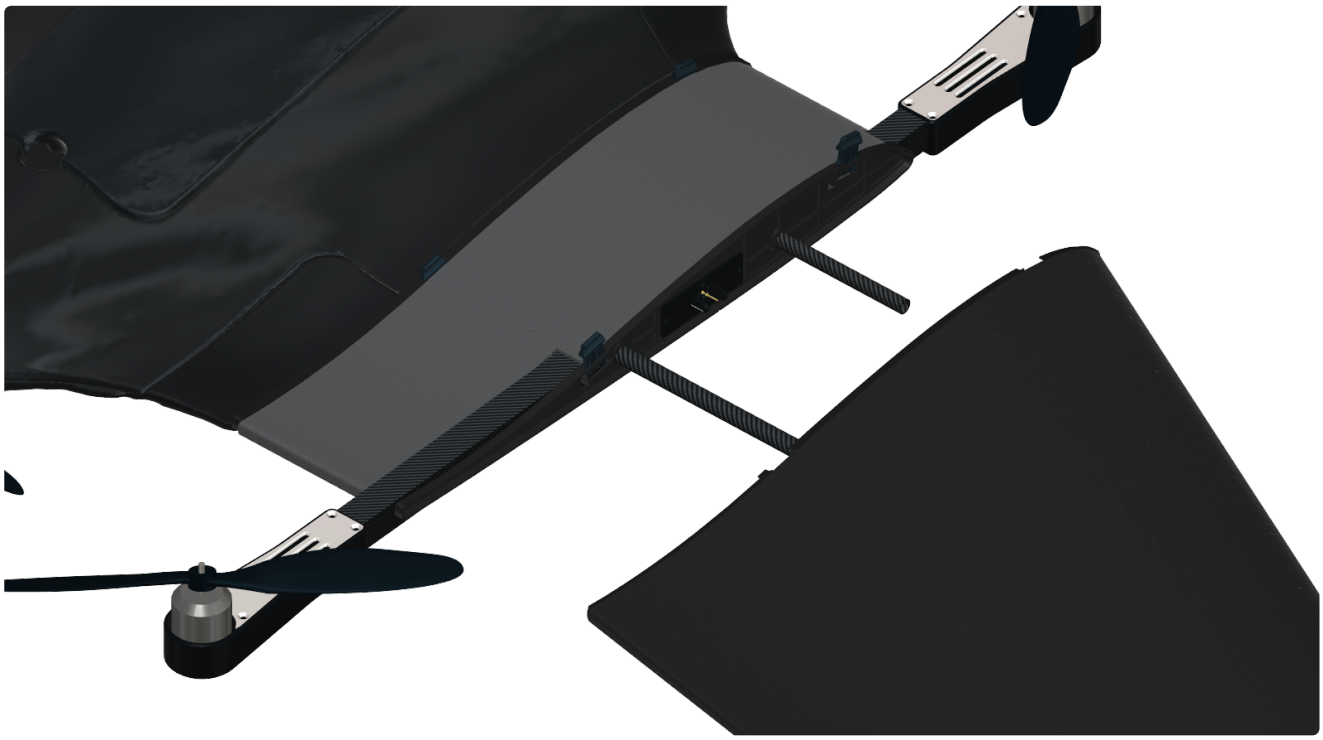
Lock the modules by pushing down the lock pins. Confirm each module is securely fastened.



Mounting the Wings

After attaching the modules, make sure the lock pins on the wing side are in the open (up) position as shown in the image above.

Slide the wings over the carbon spars and press them firmly against the VTOL module. If you feel any resistance it is possible that the carbon spars are not properly centered.

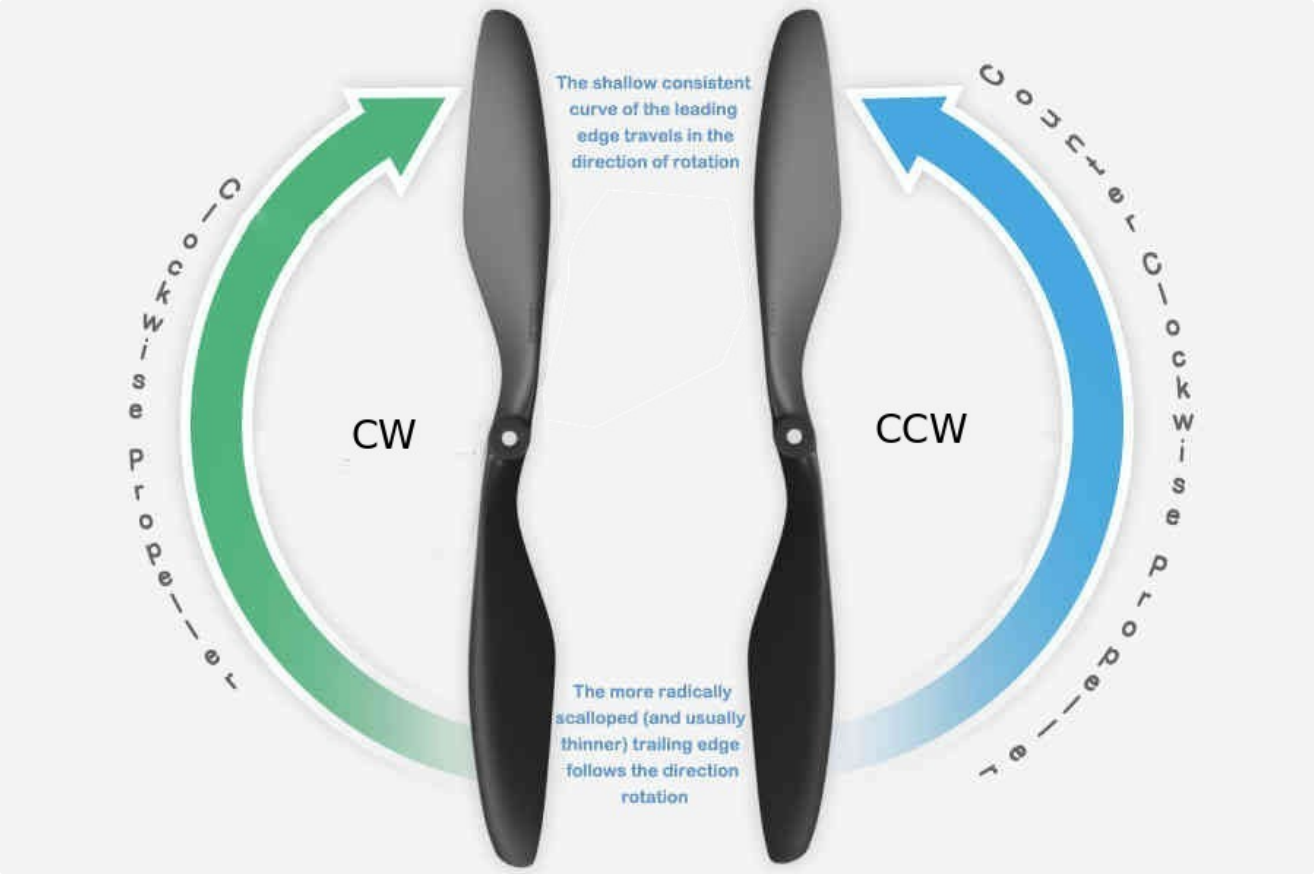


Lock the wings by pushing down the lock pins on the VTOL module, and confirm the wings are securely fastened.

Replacing the propellers

The DeltaQuad comes with 5 propellers, 1 composite "pusher" propeller, and 4 carbon fiber VTOL propellers. The propellers should already be attached when you receive the vehicle. When replacing the propellers please follow these guidelines.

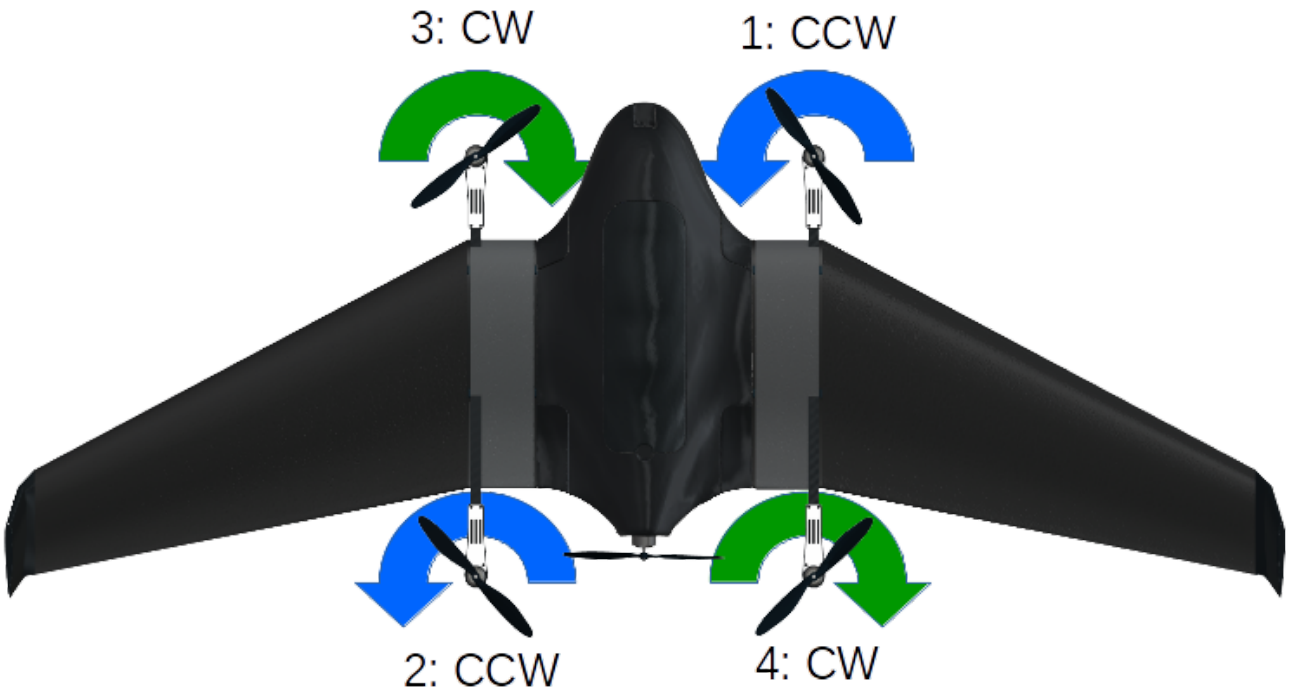
The VTOL propellers consist of 2 Clock Wise (CW) propellers and 2 Counter Clock Wise (CCW).



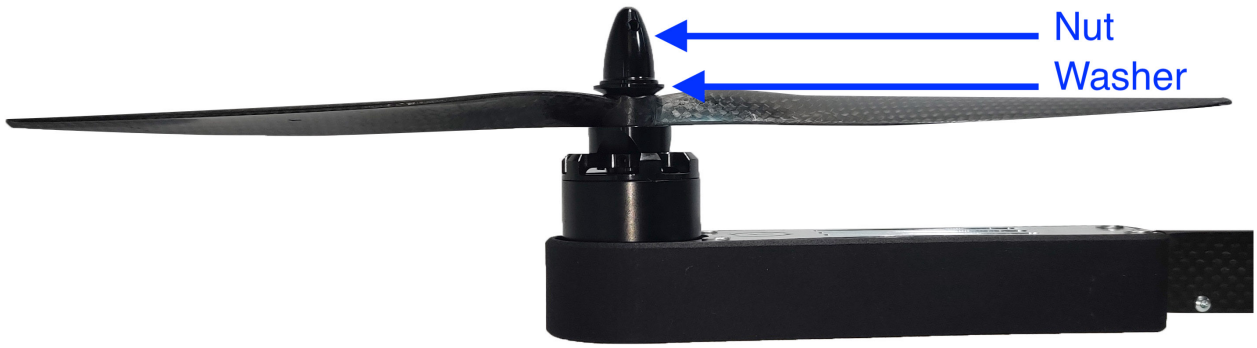
The motors are numbered 1 through 4. The bullet-type nut on the propeller adapters are self-tightening, which means they close by turning them in the **opposite direction** of how the motor/propeller spins. This is done to ensure the propellers do not become detached when the motor spins up. This means that to undo the nut on motors 1 and 2 it turns left, and on motors 3 and 4 it turns right.

The propellers are centered with a small ring inside the mounting hole, this should result in the propeller sitting tightly around the shaft. Always make sure the centering ring is present and the propeller fits tightly around the shaft.

Mount the propellers in the following positions noting the direction of the propeller as indicated below:



The propellers are attached by removing the motor nut and washer, sliding the propeller on the shaft, sliding the washer on top of the propeller and fastening the nut.



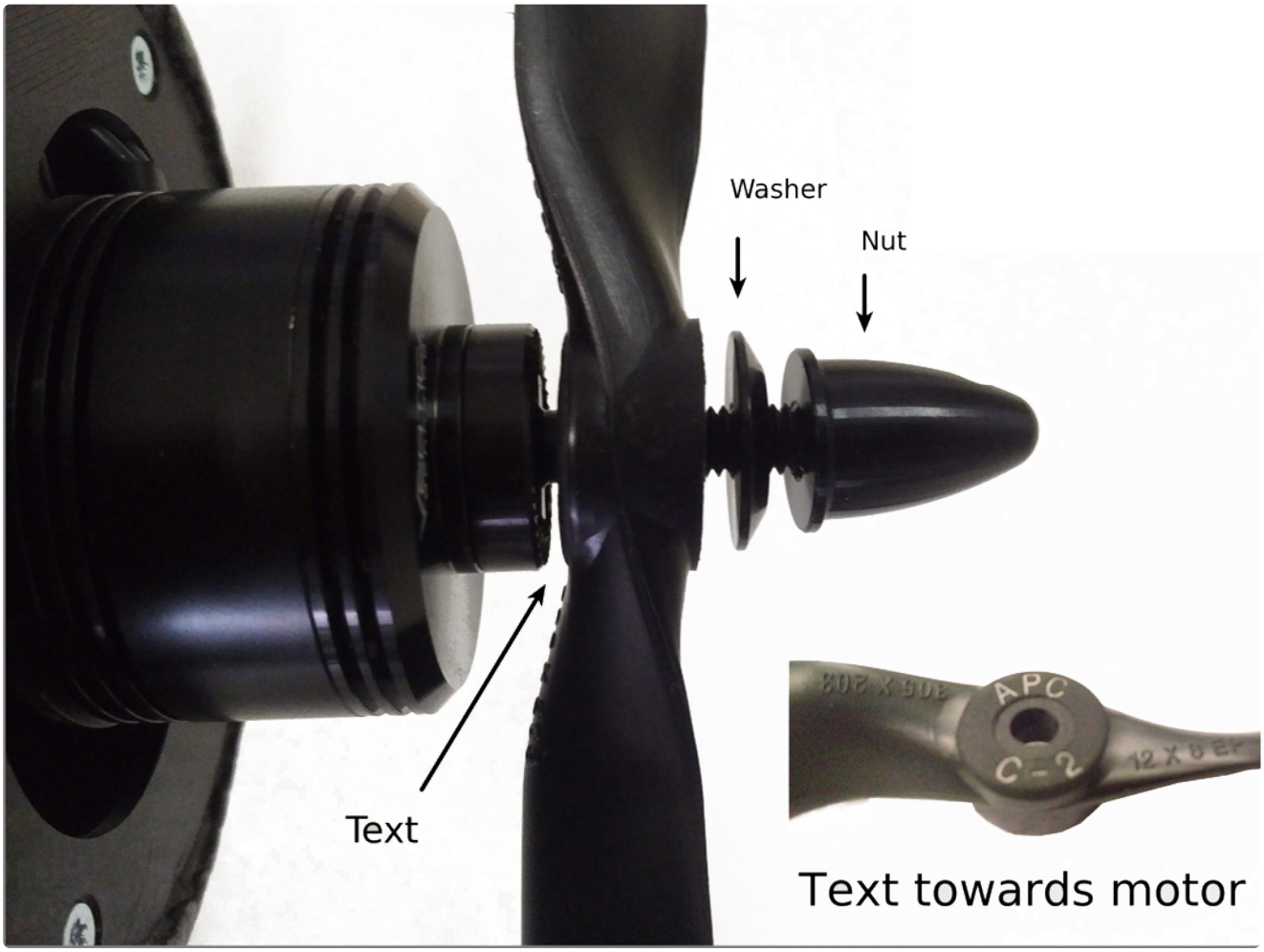
For the vertical motors (VTOL motors), please make sure to install the washer in the right orientation. The washer has the wider side on top.

Replacing the pusher propeller

The DeltaQuad pusher propeller is an APC 13x10EP propeller that contains a modified ring to mount properly on the DeltaQuad pusher motor. Please use DeltaQuad-approved and balanced pusher propellers.

The pusher propeller should be mounted so that the propeller produces thrust towards the rear, this means that the top of the propeller (the side that has the text engraved) should face the motor as shown in the diagram below.

Note: When replacing propellers for the VTOL modules no lock bond is required as these are self-tightening. When replacing the pusher motor propeller lock bond is required on the propeller adapter nut as this motor can spin in both directions.



Note: All propellers are balanced in our factory by hand. This can leave scratch marks on the propeller blades. This does not indicate damage or that the propellers are used. A sign of damage can be structural weakness such as a bent propeller blade. If you find gouges or missing parts anywhere at the tip, the outboard region, or the trailing edge of the blade you need to replace the propeller.

Disassembly and storage

To disassemble the DeltaQuad open the lock pins for the wings and remove the wings.

Note: Never remove the carbon spars while the VTOL modules are attached. This could damage the wing-joiners.
Note: Never store or put the vehicle with the LiPo battery inside the vehicle.

It is recommended to transport the DeltaQuad in the DeltaQuad Flight Case. If you do not have a DeltaQuad Flight Case It is recommended to transport and store the DeltaQuad with the VTOL modules attached.

Battery

The DeltaQuad series UAV is compatible with the DeltaQuad High-Grade LiPo Battery. Using other batteries is not recommended and will impact your warranty.

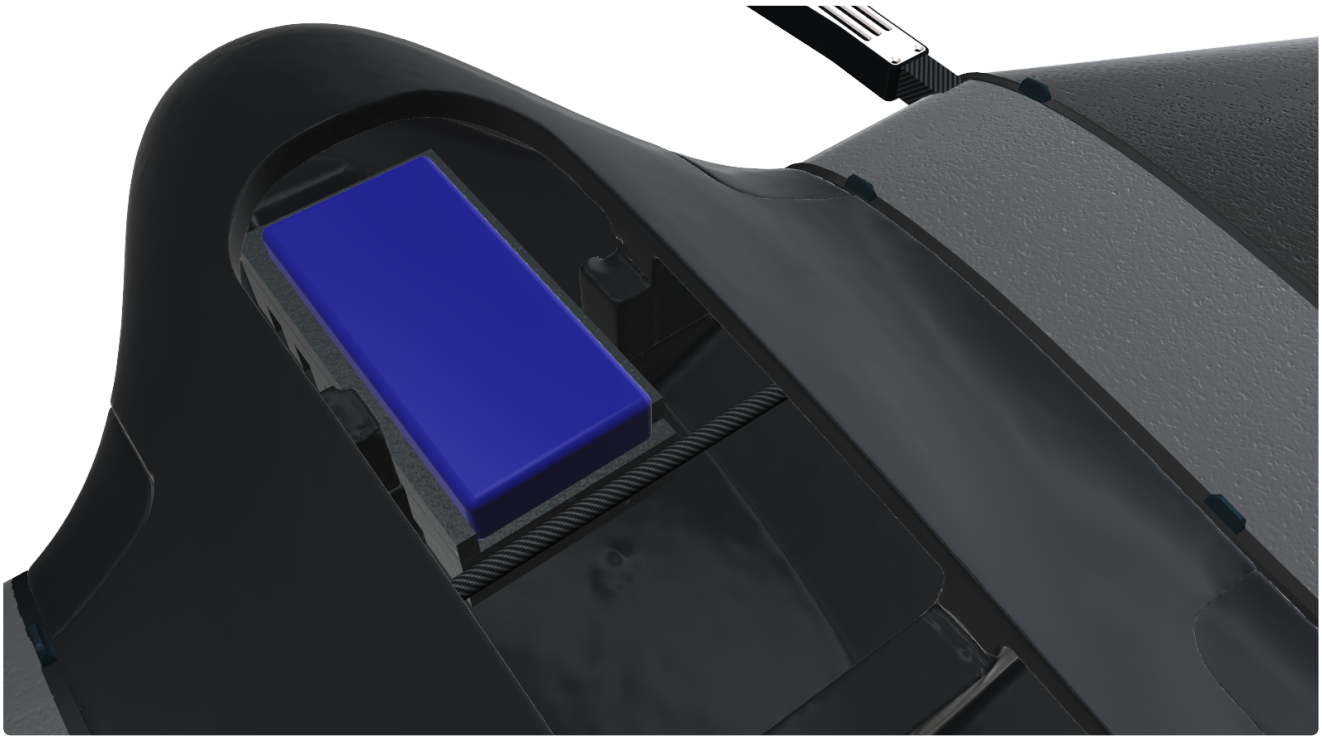
Safety notice

1. Use specific Lithium Polymer charger only. Do not use a NiCd or NiMh charger - Failure to do so may cause a fire, which may result in personal injury and property damage.
2. Never charge batteries unattended unless you charge inside a LiPo Safe. When charging Li-Po batteries you should always remain in constant observation to monitor the charging process and react to potential problems that may occur.
3. If at any time you witness a battery starting to balloon or swell up, discontinue the charging process immediately. Disconnect the battery and dispose of it safely. Continuing to charge a battery that has begun to swell will result in fire. Likewise, never use a battery if you find it swollen or ballooned.
4. Since a delayed chemical reaction can occur, it is best to observe the battery as a safety precaution. Battery observation should occur in a safe area outside of any building or vehicle and away from any combustible material.
5. Wire lead shorts can cause fire! If you accidentally short the wires, the battery must be placed in a safe area for observation for approximately 1 hour. Additionally, if a short occurs and contact is made with metal (such as rings on your hand), severe injuries may occur due to the conductibility of electric current.
6. A battery can still ignite even after 1 hour.
7. A battery that makes a hissing sound is almost certain to ignite. Consider your own safety and that of your environment before attempting any action
8. In the event of a crash, after a 15-minute period to ensure the LiPo was not compromised, you must remove the battery and dispose of it safely.

Placing the LiPo

The DeltaQuad Pro must always be flown with a fully charged battery. If the battery is not fully charged the vehicle is unable to correctly estimate the remaining battery capacity and the indicated percentages may deviate.

Place the LiPo inside the fuselage with the Velcro strips pointing down. Make sure to position the LiPo as far forward as possible.

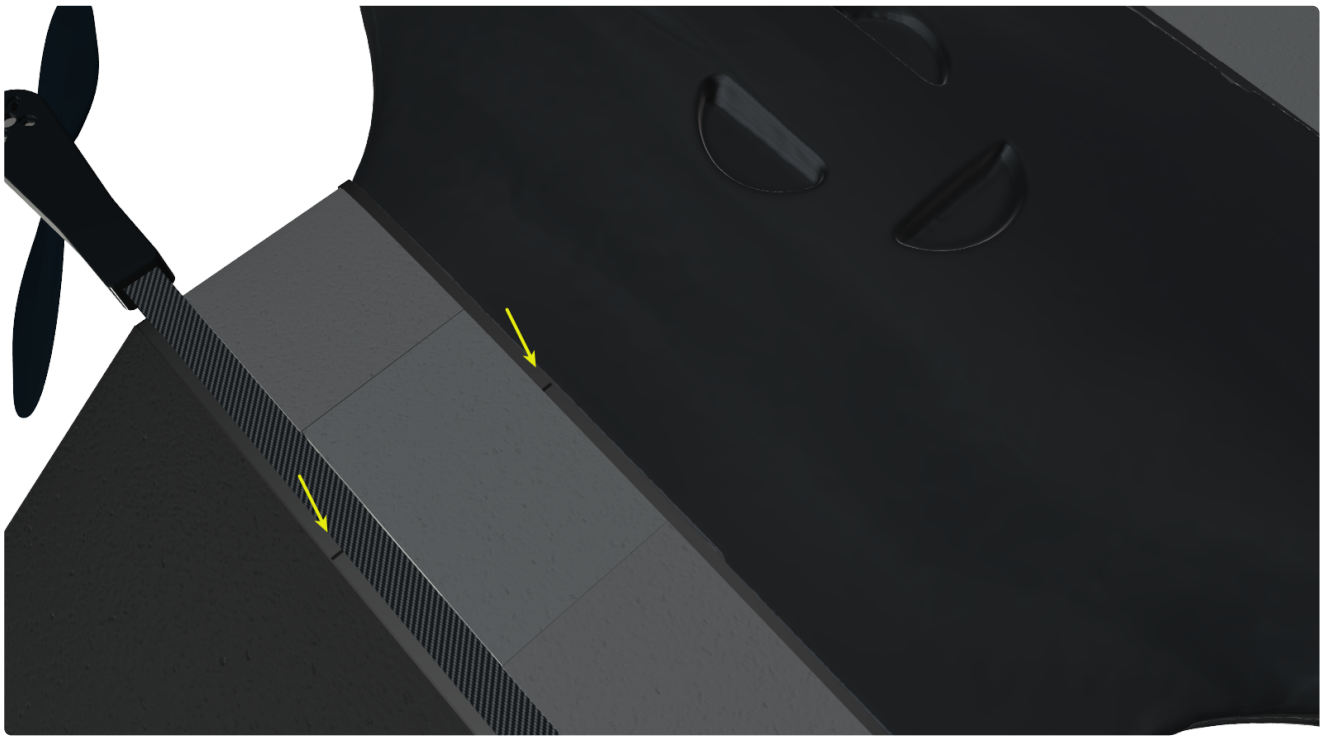


Note: Only place a LiPo before the flight, and remove the LiPo directly after the flight. Always transport the LiPo in a safe transportation unit such as a fireproof bag or storage container.

If any modifications were made to the vehicle or a different LiPo is used other than the DeltaQuad High-Grade LiPo battery be sure to verify the Center of Gravity (CG). The maximum rear CG is indicated by small notches in the composite wing joiners as indicated in the image below. These notches indicate the furthest back the CG is allowed to be. The CG is allowed to be 15mm more towards the nose, but may not be more towards the tail.

You can verify the CG by balancing the vehicle on your fingertips. The vehicle should sit at approximately 5 degrees nose up while verifying the CG.

Note: When verifying the Center of Gravity make sure all components that are used in flight are inserted and attached.



Charging the LiPo

If you have ordered the DeltaQuad with a LiPo battery it will come with a plug-and-play charger. This charger can charge an empty LiPo battery in approximately 6 hours. To charge the battery insert both the power and balance plugs in the charger, it will commence charging automatically. When the LED light on the charger turns green the LiPo will have been charged.

The DeltaQuad LiPo can also be charged using a high-current charging solution and is capable of charging within 1 hour if your charger is capable of providing 20 Amperes. Charging at this rate will limit the durability of the LiPo, it is recommended to charge the LiPo at no more than 5 Amperes for a maximum lifetime.

1. Remove the battery from the vehicle. The battery should never be charged inside the vehicle.
2. Never charge batteries unattended unless you can charge them inside a LiPo safe.
3. Charge in an isolated area, away from other flammable materials.
4. Ensure the battery is at ambient temperature before charging.

Storing the LiPo

The LiPo should be stored in a safe and dark location between 5 and 30 degrees Celsius. If the battery has been fully discharged, it is recommended to put at least some charge (+- 50%) before long-term storage.

Telemetry & Ground Control

In this section, we cover the setup of your Ground Control Station, Video, and Telemetry links. For information on using the ground control station please refer to the Flight sections in this manual.

Installing QGroundControl

The DeltaQuad uses QGroundControl as its primary Ground Control Station. If you have ordered a Ground Control Station with your DeltaQuad it will have been installed and tested before it was shipped to you. You may skip this section and proceed to the installation of your telemetry link. To install QGroundControl on your device please refer to the QGroundControl Installation Manual

Activating 4G VPN Telemetry

If your DeltaQuad has been equipped with 4G telemetry, you will need to insert a suitable sim card in the USB 4G dongle which is located in the nose of the vehicle. To insert the SIM card, remove the USB dongle, slide the top part of the housing down, and insert the SIM card in the SIM card placeholder. To test and optionally configure your 4G dongle, you can attach the dongle to your computer. After approximately 30 seconds it should be activated and you can check the status of your connection by opening a browser and navigating to http://192.168.100.1

If your Ground Control Station came with your vehicle it will have been pre-installed, but will still require an Internet connection. This connection can be established by inserting a micro-sim card into the device. It can also be established by activating a Wi-Fi hotspot on a secondary device and connecting the ground control station to this Wi-Fi network. At startup, the Ground Control Station will connect to the VPN network after approximately 30 seconds.

If you choose to install your own ground control station, or if you wish to install additional ground control stations, please refer to the ZeroTier installation guide for additional setup steps. This guide will have been made available to you via e-mail. This will also contain the settings required to activate the video stream.

When inserting the USB dongle in the vehicle and switching the vehicle on by connecting the LiPo battery, the USB dongle should start blinking (first green, then white). After approximately 30 seconds it should go to solid white. At this point, the vehicle has an active internet connection. It will take another 20 seconds for the vehicle to connect to the VPN network and your ground control station.

Activating Radio Telemetry

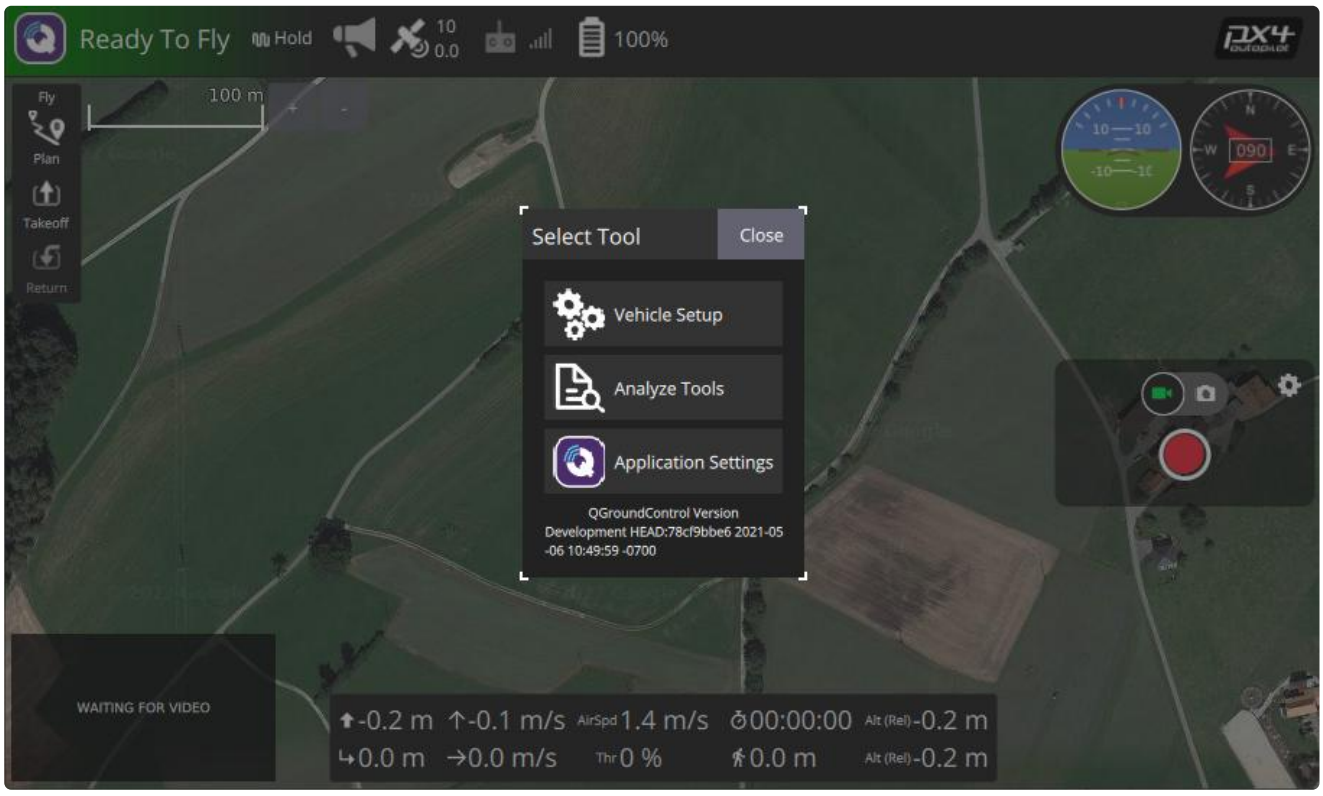
If your vehicle is equipped with radio telemetry, no setup is required on the vehicle side. To activate radio telemetry on the ground control station simply attach the receiving unit of the radio telemetry system to the ground control station. If the vehicle does not automatically connect, add a new link manually to QGroundControl by clicking on Settings -> Comm Links -> Add, and selecting the proper serial device. This varies by system.

Key parameters

From the Ground Control Station, the vehicle parameters can be modified. Some parameters may need to be adjusted for a specific situation or payload. To access the vehicle's parameters you will need to switch the vehicle on and establish a connection between the Ground Control Station and the vehicle.

Modifying parameters

To modify parameters click the Q icon from QGroundControl and then select the Vehicle Setup. Then select the parameters tab.



Key parameters

The following parameters are considered safe to modify within the bounds described. To find a specific parameter the search function can be used.

BAT_CAPACITY

Min: 10000
Max: 33000
Default: 23000

This defines the total capacity in mAh of the battery when fully charged. The default value is set to 23000 (23 Amp/Hour). If your vehicle is equipped with a 20Ah battery set this to 20000. If you have an Auxiliary LiPo attached you can add the capacity of this LiPo to the total capacity. For example, with a 23Ah DeltaQuad LiPo and a 10Ah Auxiliary LiPo set this value to 33000.

The capacity entered in this parameter should be reduced by 10% every 75 charge cycles on a given battery.

FW_THR_CRUISE

Min: 52%
Max: 58%
Default: 54%

This defines the cruise throttle percentage. Setting this higher than the default value will increase the cruise speed of the vehicle, but decrease the efficiency. Setting this lower is not recommended as the vehicle will also fly less efficiently and could stall. When flying with maximum payload a value of 54 or higher is required.

Flight type	Conditions	Throttle value
Maximum efficiency	Low wind conditions, light payload, no significant altitude changes	52
Stable flight	Medium low wind, normal payload	54
Fast flight	Medium to high wind and/or high payload and/or large altitude changes	56
Maximum speed	All weather conditions	58

VT_FW_ALT_ERR

Min: 10
Max: 100
Default: 20

This function also known as QuadChute, defines the maximum altitude deviation the vehicle will accept when flying in fixed-wing mode. If the vehicle drops below this deviation, and it is descending it will automatically revert to quadcopter mode. This functionality is required to ensure safe flight. Disabling this functionality will void your warranty and introduce a serious safety hazard.

MPC_LAND_SPEED

Min: 0.4
Max: 1.2
Default: 0.6

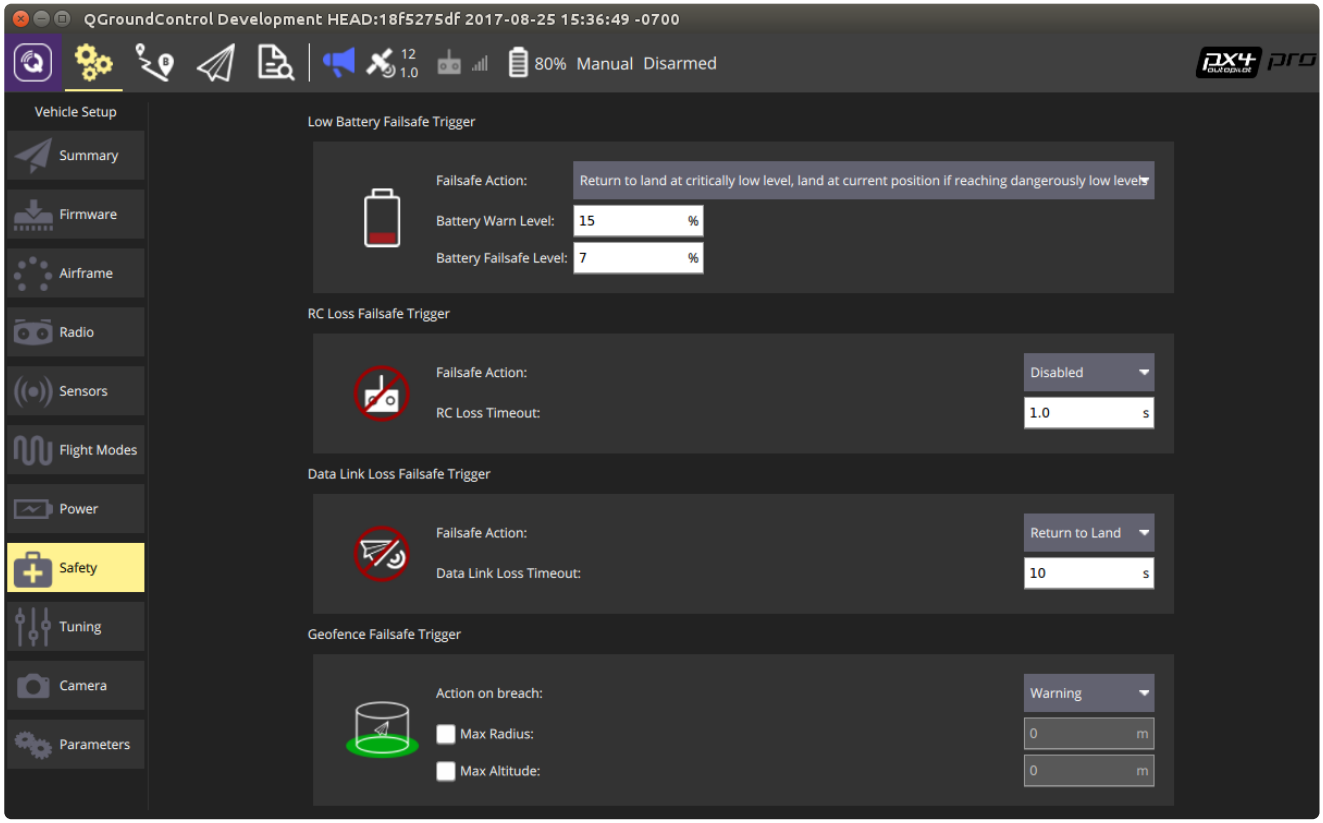
This parameter controls the descent speed during the final stage of landing. The vehicle will use this value as maximum speed. If wind conditions are erratic the vehicle will lower this speed automatically to remain stable. A lower value will result in more energy being required for landing.

Safety features

This section covers the flight controller's safety features. To access the safety features configuration screen you will need to switch the vehicle on and establish a connection between the Ground Control Station and the vehicle.

Modifying the safety features

To modify parameters select the settings icon from QGroundControl and then select the Safety tab.



Safety features

Low Battery Failsafe Trigger

Default: Return at critical level, land at emergency level

Default Warn level: 10%

Default Failsafe level: 7%

Default Emergency level: 5%

These parameters define what the vehicle does when reaching low battery levels.

Note: The levels are those estimated to be reached when having flown to the landing site. This means that the further the vehicle is from its intended landing location, the sooner these actions will be taken. The vehicle will attempt to maintain these values when landed.

Warn level: The percentage where the vehicle will give a visible and audible warning to the Ground Control Station

Failsafe level: The level at which the vehicle initiates the critical battery action. (return)

Emergency level: The level at which the vehicle initiates the emergency battery action. (land)

RC Loss Failsafe trigger

Default: Disabled

The DeltaQuad does not come with a traditional radio remote control. If such a transmitter/receiver is added this setting defines the behavior when the signal from this transmitter is lost. The DeltaQuad Controller will have both RC and DataLink functionality, but as these signals are sent over the same link it is recommended that you leave this setting disabled.

Data Link Loss Failsafe Trigger

Default: Disabled

Default timeout: 100s

This controls the behavior of the vehicle when the telemetry link is lost. When flying fully autonomous missions where the loss of telemetry is allowed or expected, this parameter should be set to Disabled.

Some local laws require this value to be set to "Return to Land".

The Settings of the Data Link Loss Failsafe Trigger should be checked before pausing the vehicle mid-flight.

If the trigger is disabled and the Data Link is lost after the vehicle is paused and in Hold Mode, the pilot has no possibility of giving a new pilot command. Until the Data Link is regained the DeltaQuad will remain in Hold mode. If the Data Link can't be re-established the vehicle will remain in Hold Mode until the Low Battery Failsafe Trigger is activated.

Geofence Failsafe Trigger

Default action: Warning

Default max radius: Disabled

Default max altitude: Disabled

The geofence failsafe trigger can be set to limit the vehicle's radius and/or altitude. When setting these parameters the vehicle will perform the defined action upon breaching any of these.

Return Home Settings

Default climb: 60m

Default home action: Land immediately

These settings define how the vehicle behaves when it engages the Return to Land function. The Climb altitude is the minimum altitude relative to the home the vehicle will maintain for its return path.

If the altitude of the DeltaQuad is lower than the Default climb value, in this case, 60 meters, the UAV will ascend to that Default climb altitude of 60 meters.

If the vehicle is higher at the point where the Return to Land is triggered it will maintain that altitude to return.

The DeltaQuad can perform an autonomous Return to Land when instructed from the Ground Control Station, when instructed from a mission, or when triggered by a failsafe event.

If the DeltaQuad is in Fixed-wing mode when the Return to Land event is triggered the UAV will make use of the Landing Pattern from the planned mission.

The DeltaQuad will return in Fixed-wing mode to the Loiter waypoint of the Landing pattern in a straight line at the altitude the UAV was at when the RTL was initiated.

If the altitude of the DeltaQuad is higher than the Default climb value the UAV will stay at its altitude and return to the Loiter Waypoint.

When reaching the "Loiter" waypoint the DeltaQuad will loiter and descend to the set Approach Altitude. In the final approach towards the Land item, the DeltaQuad will perform a transition to Multirotor mode and land as planned in the mission.

Be aware that if your planned Land item is not at the same location as your Launch item, the DeltaQuad will land in a different location rather than your Home Position.

If the DeltaQuad is in Multirotor mode when the Return To Land event is triggered the UAV will return to the Land item in a straight line at the altitude it was at when the RTL was initiated.

Because the DeltaQuad is in Multirotor mode it will not make use of the Loiter waypoint and the Landing Pattern but head directly for the Land item.

If the altitude of the DeltaQuad is lower than the Default climb value (60m) the UAV will ascend to that Default climb altitude (60m) whilst heading for the Landing item.

If the altitude of the DeltaQuad is higher than the Default climb value the UAV will stay at its altitude and return to the Landing Pattern.

When reaching the Land item the DeltaQuad will descend in Multirotor mode and touchdown at the Land location.

Be aware that if your planned Land item is not at the same location as your Launch item, the DeltaQuad will land in a different location rather than your home location.

Land Mode Settings

Default Descent Rate: 1,2m/s

Disarm after: 5s

This controls the landing behavior. The default descent rate is the maximum speed the DeltaQuad descends in Multirotor during a landing.

In windy conditions, the vehicle will correct itself by applying a lower descent rate and the indicated descent rate might not be achieved. The DeltaQuad will brake and slow down its descent from approximately 8 meters above the Home Position to guarantee a soft landing.

The default value of the Descent Rate can be left at 1,2m/s. Nevertheless, if it needs to be changed it should not be increased above 1.5m/s.

The disarm time is the time the vehicle waits before disarming (stopping the motors) after it has detected a landing. The value should not be set lower than 5 seconds.

Integrating payloads

The DeltaQuad has been optimized for payload integration. The payload integration features consist of the following;

- Large payload bay located directly on the CG, this allows live swapping of payloads without having to re-balance the vehicle.
- Expandable blind mate connectors to allow electronics integration in the VTOL modules and wings.
- Open-source flight control with Mavlink compatibility.
- Fully accessible secondary on-board computer for software integration.

Payload specifications

Name	Value
Maximum payload weight (without Aux LiPo)	1.2Kg
Maximum payload weight (with Aux LiPo)	400g
Payload bay height:	80mm minimum (oval shaped)
Payload bay length:	120mm
Payload bay width:	200mm minimum (oval shaped)
VTOL module to fuselage connector	2 x power + 5 x signal + 5 x signal positions available
VTOL module to wing connector	3 x signal + 3 x signal positions available

Payload integration best practices

When integrating your payload it is recommended to stay within the payload bay, and as much as possible inside the fuselage. The DeltaQuads EPO foam is easy to modify and is also easy to glue. When installing a device that needs to sit outside of the vehicle (such as a camera gimbal) it is recommended to stay inside the fuselage as much as possible. External objects can cause drag and will make the vehicle perform less efficiently.

It is recommended to increase the cruise speed after installing an external object by a few percent, and slowly decrease the value based on the vehicle's performance. The vehicle should fly at an average pitch angle between 3 and 8 degrees when flying level.

If the payload requires power it is recommended to install additional BEC units and not draw power from the primary avionics. An additional BEC can be installed by soldering it onto the wires that also power the avionics BEC.

If the payload consumes significant power the BAT_CAPACITY parameter should be reduced by the amount of energy the payload is estimated to consume over the course of an entire LiPo discharge.

It is recommended to perform a sensor calibration when integrating any additional payload containing any electric or metallic components.

Onboard computer integration

The onboard computer exposes Mavlink locally and over the 4G VPN network on UDP port 14550. If integrating additional applications on the secondary computer, make sure your application does not flood the onboard computer's CPU, this could result in loss of Telemetry.

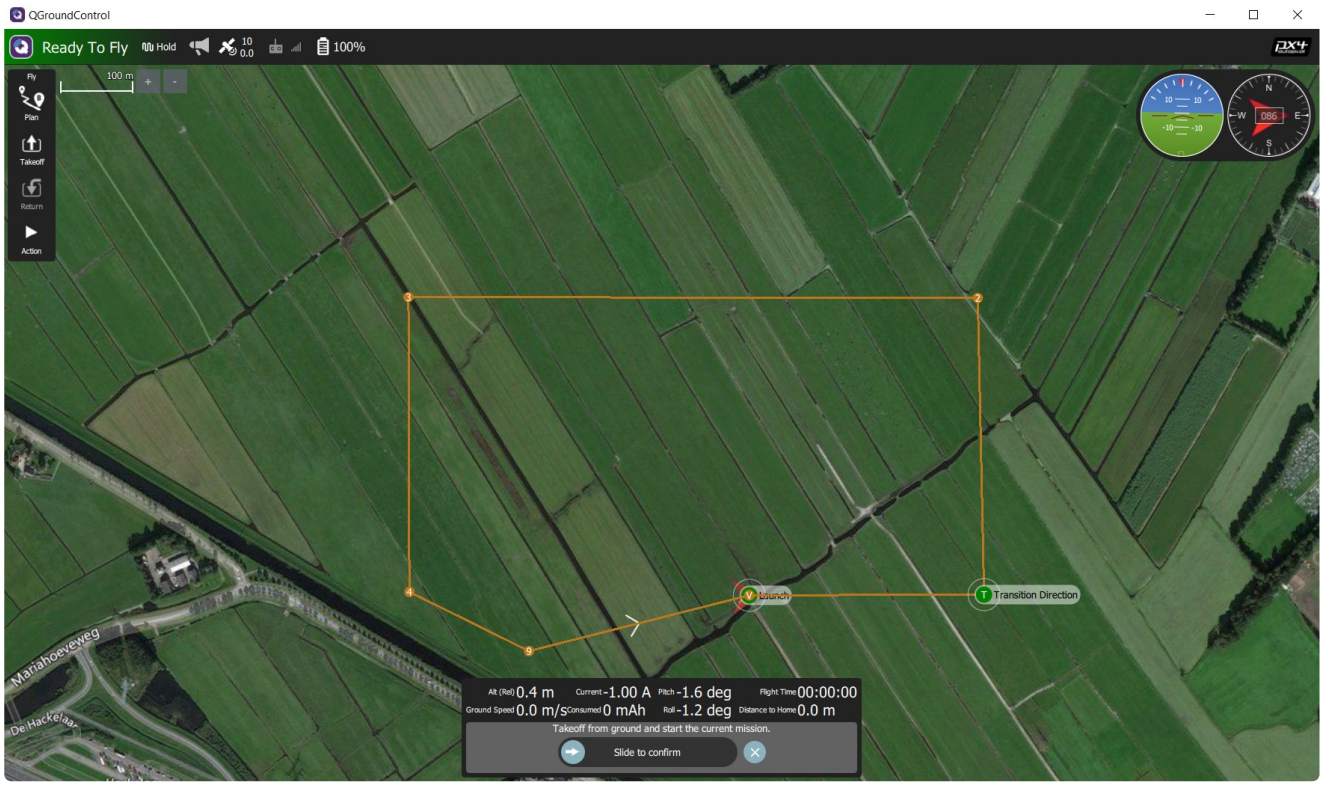
Flight

This chapter covers the command and control features of the vehicle.

Chapter index

Ground Control Station overview

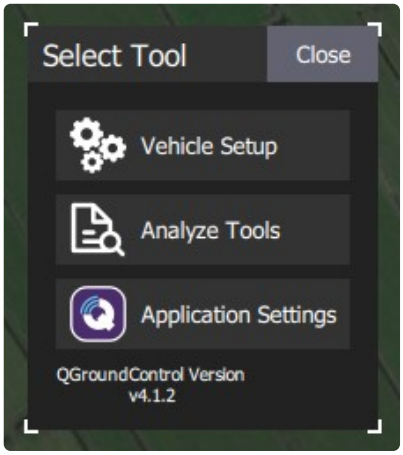
The DeltaQuad uses QGroundControl as its primary Ground Control Station (GCS). After installing and connecting your GCS you will see the primary interface. The GCS consists of buttons and has been optimized for use with touchscreen devices.



The main menu bar

The main menu bar is located at the top of the GCS screen and consists of the following buttons:

By clicking the **"Q"** symbol the Select Tool will prompt, giving you the following three options to choose from:



Vehicle Setup: Configure the DeltaQuad's parameters, safety features and perform sensor calibration.

Analyze Tools: Download logs, geotag images from a survey mission, and access the Mavlink console.

Application Settings: Configure the QGroundControl application. Please refer to the QGC settings manual.

Status icons

Arm status: Displays and controls current armed status.
Flight mode: Displays the current flight mode, when clicked it offers control over the flight mode.

Note: The DeltaQuad is designed to operate in the following flight modes:

- Mission
- Position (only when using the DeltaQuad Controller)
- Altitude
- Hold
- Return

Other flight modes are **not** supported and should not be activated.

Notifications: Click to show a dropdown of messages from the vehicle. This will change to a Yield sign if there are critical messages.
GPS Status: Displays current GPS satellite link information.
RC Status: RC signal strength information, is only applicable when using a traditional transmitter.
Battery status: Displays remaining percentage and additional information when clicked.

Planning a mission

The DeltaQuad has been designed to fly autonomously, this is achieved by planning and executing missions. Missions are set through the Ground Control Station. They can be created and sent to the vehicle directly, loaded from an existing mission plan, or saved to a mission plan. This section covers the basics of planning a mission for the DeltaQuad. For advanced usage of the mission planning features please review the QGroundControl mission planning documentation.

Preparing a mission plan

Before the mission plan can be created, the following steps should be taken to ensure safe execution:

1. A mission plan should only be executed after a thorough inspection of the entire mission on site. All altitude differences and obstacles should be known and taken into account.
2. Missions must be allowed to be executed in accordance with local laws and regulations.
3. The mission path must be free of obstructions for at least 200 meters in each horizontal direction.
4. During fixed-wing flight the vehicle should stay 50m above ground level, near the end of the mission, to reduce landing energy consumed, an altitude of 25m above ground is recommended.
5. For maximum endurance a takeoff altitude can be set to 25m, however, to ensure the safety systems can function properly, the takeoff altitude should be at a minimum of 60 meters above ground level.
6. The takeoff and land sites must consist of a level, flat surface that is free of obstructions for at least 5x5 meters.
7. The takeoff altitude should be set high enough for the vehicle to be able to perform a transition in any direction.
8. The weather conditions must fall within the maximum allowed conditions.
9. Both the front and back transition paths must be planned in such a way that the vehicle is pointing with its nose toward the wind while performing the transition.
10. The intended mission should not consume more than 85% of the total energy available.
11. At any point in the mission, the vehicle must be able to return to its takeoff point in a straight line at its current altitude.
12. At any point in the mission, the vehicle must be able to initiate an unscheduled landing without causing damage to itself or its environment.

Video instruction

For video instruction on planning a mission please visit https://www.youtube.com/watch?v=7FOLx5L5_sw

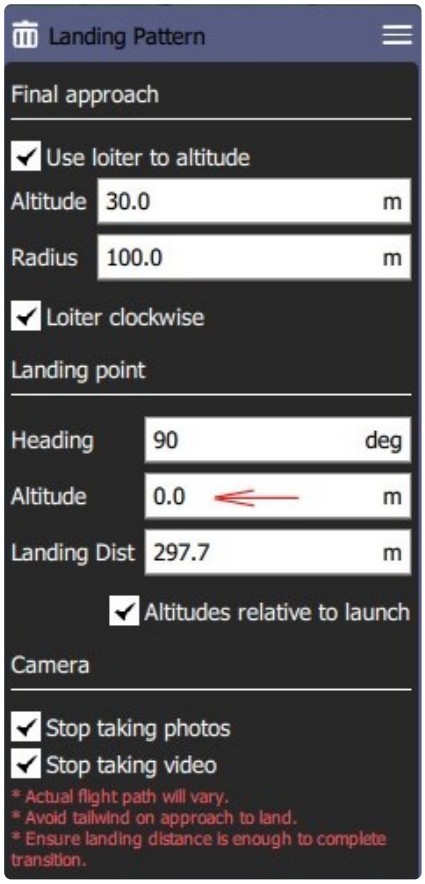
DeltaQuad Mission Validator

After planning your mission you can validate it using the DeltaQuad Mission Validator

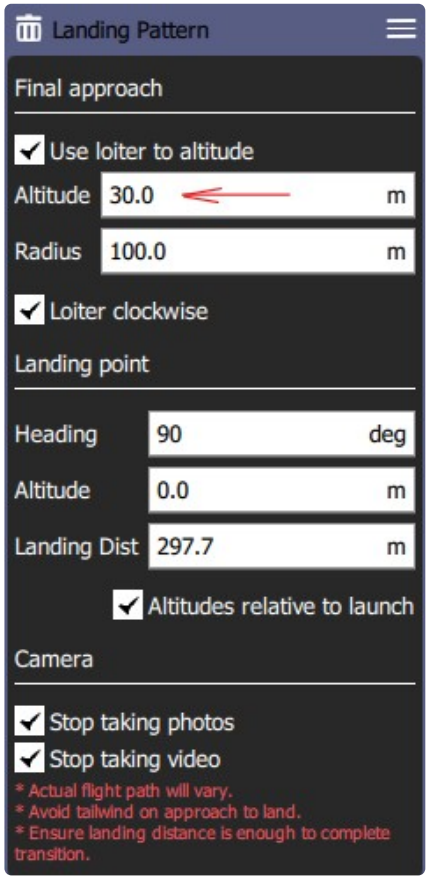
The Validator will check your mission for feasibility, sanity, and safety. It will also check weather conditions, terrain altitudes, and no-fly zones. The DeltaQuad Mission Validator can not be used as an authoritative validation, it is provided as an additional verification system and all validations should be verified manually.

Best practices and tips

- A vertical takeoff or landing consumes significantly more energy than a fixed-wing flight. For maximum efficiency, an altitude between 20 and 30 meters is recommended for landing. A takeoff altitude should be at a minimum of 60 meters for all safety systems to function.
- The altitude of the "Landing point" defines the expected touch-down altitude.



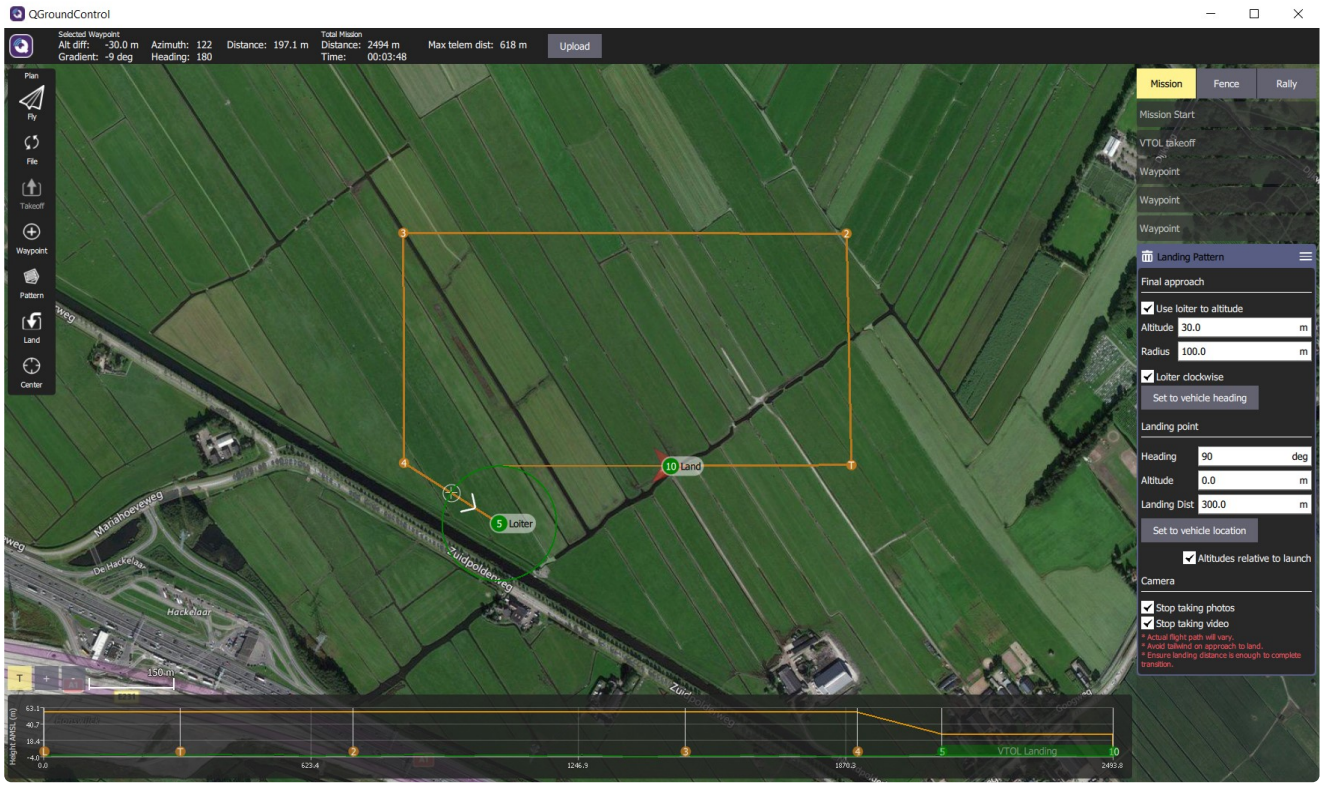
- The back transition from fixed-wing to quadcopter flight is performed at the altitude set in the Final approach of the "Landing Pattern" command.



- Most wind forecasts are based on ground-level wind. Even 10 meters above the ground the wind can be significantly stronger. The DeltaQuad Mission Validator will indicate estimated wind levels at transition and cruise altitude.
- During the transition phase of the "Transition Direction" item, the vehicle has limited navigational abilities and could drift from its intended direction. The transition should therefore always be performed at an altitude where it is safe for the vehicle to perform the transition in any direction.
- Validate your mission in the DeltaQuad Mission Validator

Plan view

Planning a mission can be done from the Ground Control Station by entering the Plan View.



The Plan View is used to plan autonomous missions for your vehicle. Once the mission is planned and sent to the vehicle, switch to the Fly View to perform pre-flight checks and fly the mission.

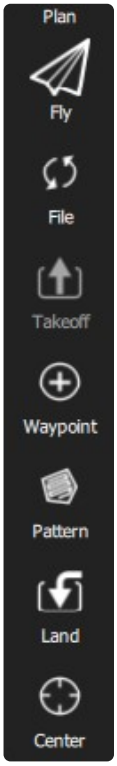
The image above shows a simple mission that starts with a "Launch" and a "Transition Direction" item. The mission continues to fly through three waypoints which are followed by a "Landing Pattern", ending in a "Land" command at the indicated location.

The steps for creating missions are:

1. Change to Plan View.
2. Add commands to the mission and edit as needed.
3. Send the mission to the vehicle.
4. Change to Fly View and fly your mission.

Plan Tools

On the left edge of the screen, you will see the Plan Tools.



The order of the tools from top to bottom is:

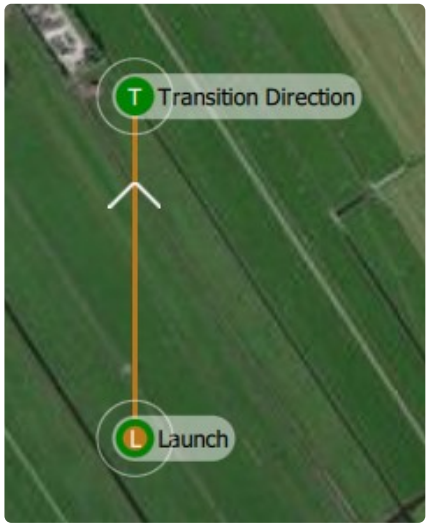
- Fly View
- File (Sync)
- Takeoff
- Waypoint
- Pattern (Survey)
- Land
- Center map

Add Commands

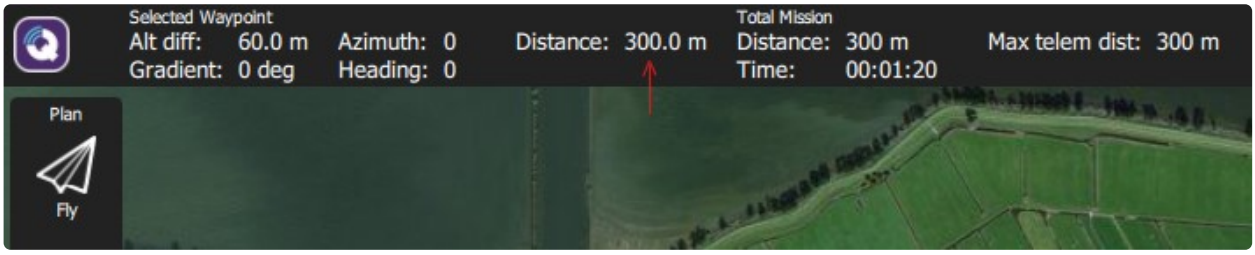
The first items to be placed in a mission are the "Launch" and "Transition Direction" items.

Click to activate the "Takeoff" tool.

While active, clicking on the map will add a "Launch" and a "Transition Direction" item at the clicked location with the direction North.

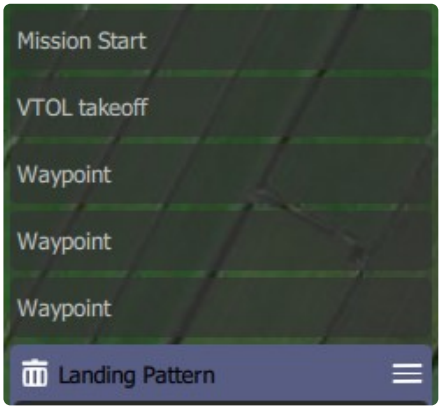


By default, the distance between the "Launch" and "Transition Direction" items is at the recommended minimum of 300 meters.

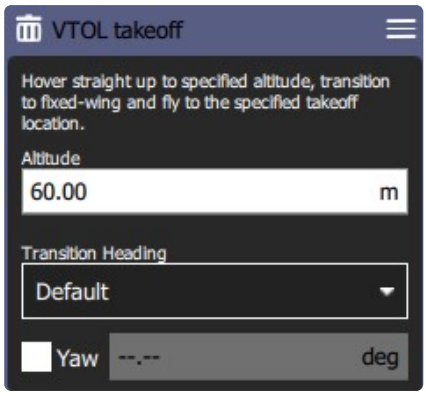


- If the DeltaQuad is connected to the Ground Control Station the "Launch" item will be automatically placed where the DeltaQuad is positioned.

- On the right side of the screen, you find the mission command list where all commands such as waypoints are accessible and can be edited by clicking on the individual items.



- The first waypoint in the mission command list is called "VTOL takeoff" command. On the map, it is displayed as "T-Transition Direction". This waypoint will be the position the DeltaQuad flies to after it has ascended vertically to the altitude defined in the VTOL takeoff command. i.e. if the first waypoint is set at 60 meters altitude and 300m north of the current position, the DeltaQuad will ascend to 60 meters, transition to forward flight and proceed 300m north.



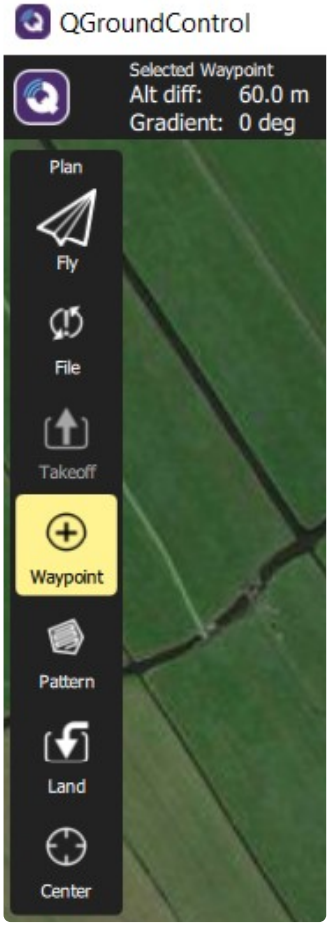
- Set the desired transition altitude. A minimum altitude of 25 meters is recommended, the takeoff altitude should never be below 20m. As mentioned before, for all safety systems to function properly, the takeoff altitude should be at a minimum of 60 meters.

Note: The first waypoint should be a minimum of 300m, and a maximum of 800m away from the takeoff position.
Note: The vehicle has been designed to transition into the direction it was when positioned on the ground. This allows the operator to perform upwind transitions, regardless of the mission plan. During the transition phase, the vehicle may travel as much as 300 meters. The mission plan should account for this.
Note: During the transition phase the vehicle's heading may change due to wind influence. The mission plan should account for this.

Set intermediate waypoints.

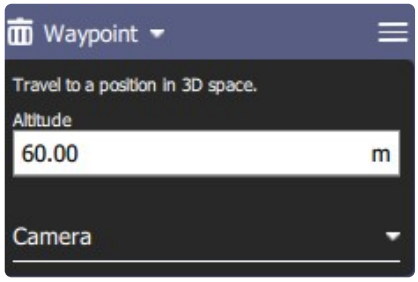
The DeltaQuad will proceed to these waypoints, continuing in fixed-wing mode.

- Activate the "Waypoint" Tool by clicking on it.



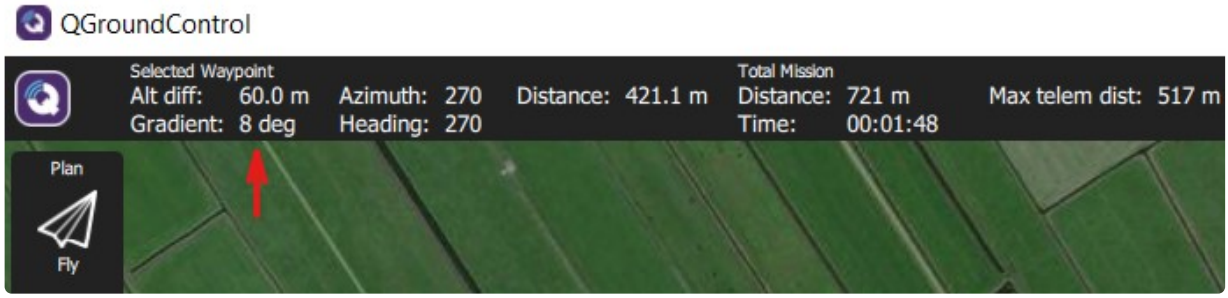
- Click on the map to select the desired position.

- Set the desired altitude the vehicle should have when reaching this position.



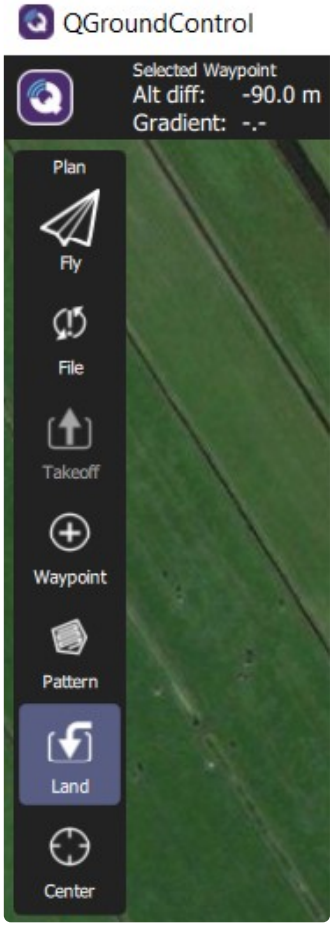
Note: The vehicle will fly from its current altitude to the defined altitude linearly and reach the target altitude when arriving at the waypoint.

Note: The ground control station will indicate the Gradient (degrees of climb along the path). The gradient should not exceed 10 deg.



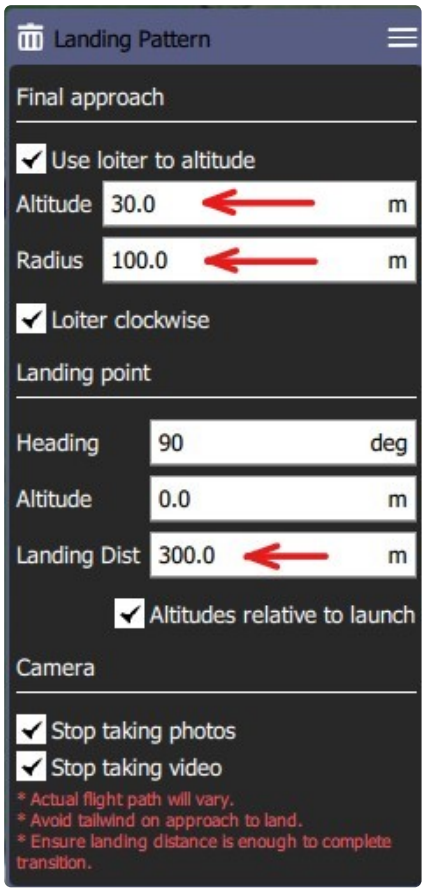
Set landing waypoint

- Select the "Land" Tool.

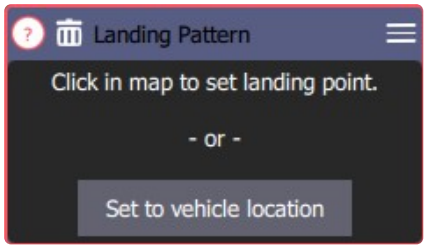


- Click on the map to select the desired position.
- The "Land" Tool creates a "Loiter" waypoint where the DeltaQuad circles and descends to the set altitude for the final approach.

- The altitude of the final approach should be between 20m and 30m. The Loiter Radius needs to be at 100m. The second item created by the "Land" Tool is the "Land" item. The distance between the "Land" and "Loiter" items will be automatically set to 300m. You can change this distance by dragging the "Land" item on the map. The recommended minimum distance between "Loiter" and "Land" is 250m.

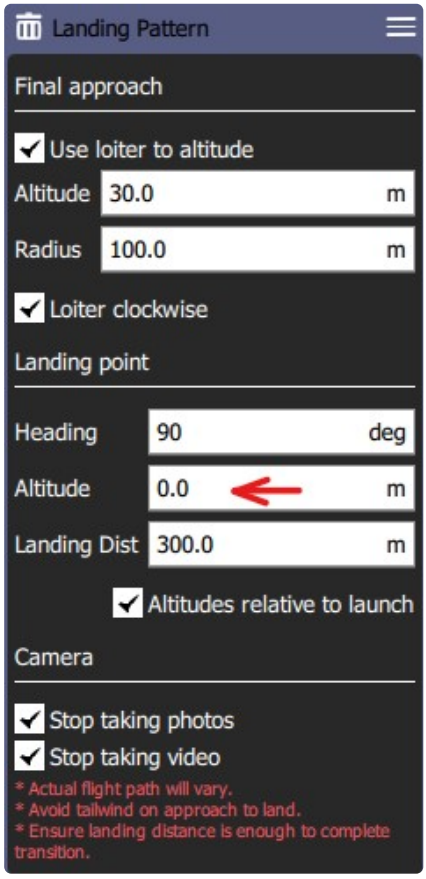


- The "Land" Tool automatically positions the "Loiter" and "Land" items in the same direction as the "Launch" and "Transition Direction" items. As the DeltaQuad needs to launch and transition into the wind it also needs to do the final approach and landing into the wind.
- If the DeltaQuad is connected to the Ground Control Station you will have the option to click anywhere on the map to set the landing point or set the landing point to the vehicle location. By choosing the last option the landing point is automatically the same as the takeoff point.



- If the DeltaQuad is not connected to the Ground Control Station you can either click anywhere on the map for the landing point or choose the takeoff point as the landing point manually. Just click on the map close to the takeoff point. When applied drag the "Land" item on top of the "Launch" item.

- The altitude of the "Landing point" is the relative altitude to the "Launch" item where the vehicle is expected to touch down. When landing at the same altitude where the takeoff occurred this can be left at 0.

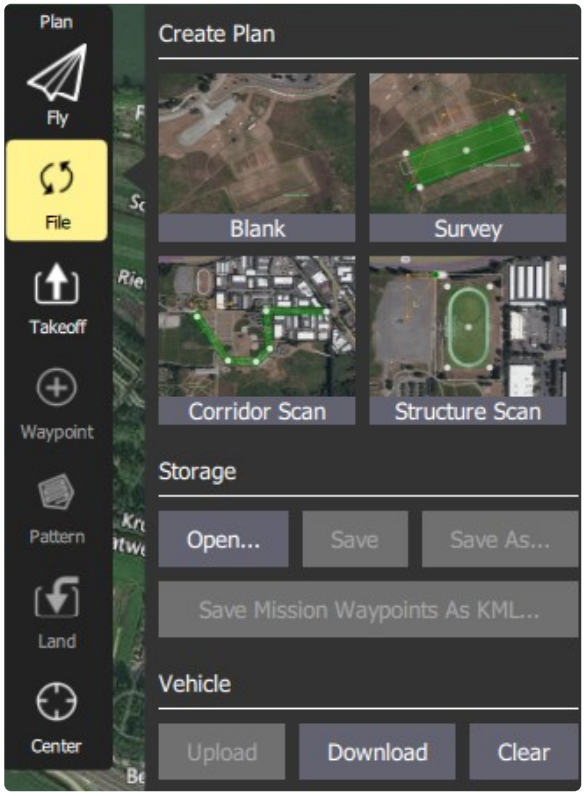


File/Sync

The "File" Tool allows you to move missions back and forth between QGroundControl and your Vehicle. Before you fly a mission you must be sure to upload your mission to your vehicle. If you have made changes to your mission which you have not sent to your vehicle a blinking button will appear in the Plan Toolbar reading "Upload Required".

The "File" tool will change to have an "!" within it to indicate that you made changes to your mission which you have not sent to your vehicle.

The "File" Tool provides the following functionality:



Create Plan

- Blank - Start a mission from scratch.
- Survey, Corridor scan, and Structure scan - Provides templates for specific tasks.

Storage

- Open
- Save
- Save As...
- Save Mission Waypoints As KML...

Vehicle

- Upload - Send to Vehicle.
- Download - Load from Vehicle.
- Clear - Clear mission from the vehicle.

To ensure the mission was correctly sent to your vehicle it is recommended to perform a "Download" from the vehicle after performing an "Upload" to the vehicle and verify the correct mission is loaded.

Mission Command-List

On the right edge of the display is the list of mission commands for this mission. You can click on one of these to edit the values for the item. Above are a set of options to switch between editing the Mission and GeoFence. Rally Points are currently not supported.

Mission Command Editors

Click on a mission command to show its editor which allows you to specify the values for the command. You can also change the type of the command by clicking on the command name. This allows you to choose from a set of available commands to build your mission. The trash bin left to the command name deletes the command. To the right of the command name is a menu you can open by clicking. This menu provides you access to additional options.

Launch item

When planning a mission, the "Launch" item is shown. This is used to simulate the home position of the vehicle such that waypoint lines can be drawn correctly to the first actual waypoint. Keep in mind that the actual home position for a mission is set by the vehicle at the takeoff position and may differ from the "Launch" position.

Mission Display

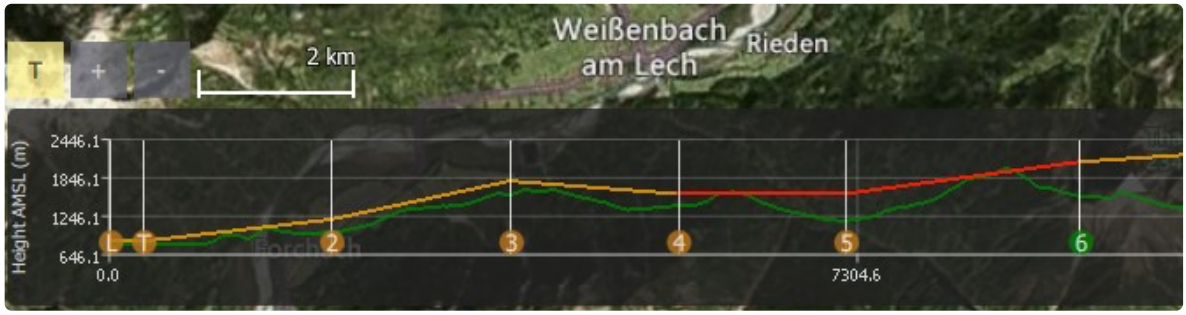
In the center of the map, you will see a visualization of your current mission. You can click on the waypoint indicators to select them and also drag them around to move.

Mission Height Display

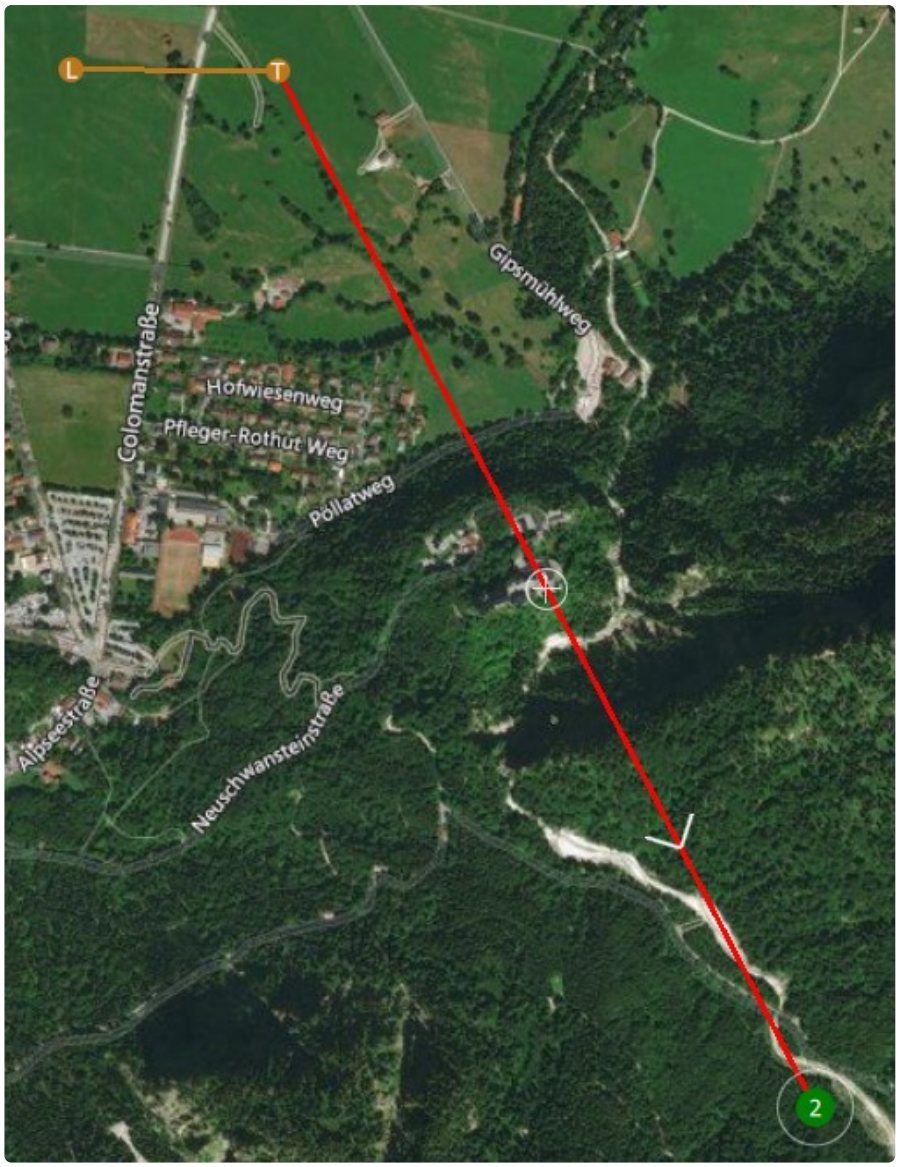
At the bottom of the map, the "Mission Height Display" is located.

The letters and numbers at the bottom of the "Mission Height Display" indicate the mission commands and waypoints. The orange graph on top indicates the altitudes of the different mission commands and waypoints and the altitude changes of the Deltaquad. The green graph in the middle represents the relative height above ground level.

The orange graph will become red in case a waypoint or the trajectory between two waypoints is lower than the ground elevation. That means that you have a collision with the ground.



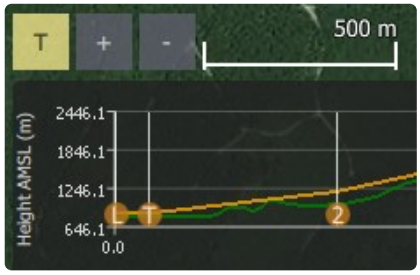
On the "Mission Display", you can also see a collision between two waypoints. The orange line turns red when a collision with the ground is detected.



The ground level is an estimation based on satellite surveys, these do not account for structures like buildings, power lines, or trees. A visual on-site inspection must always be performed.

The DeltaQuad Mission Validator will verify terrain altitudes across the entire mission path.

The "Zoom Tool" is located in the left corner above the "Mission Height Display".



Use the "plus" and "minus" signs to zoom in and zoom out. By pressing the letter "T", the "Mission Height Display" will be hidden.

Pre-flight checks

Mission

- Mission conforms with local laws and regulations.
- The mission was planned in accordance with the guidelines set forth in the Plan section.
- The mission passed the DeltaQuad Mission Validator
- Altitudes verified across terrain height.
- The mission path is free of obstructions for at least 200 meters in each horizontal direction.
- VTOL Takeoff and VTOL Land items were correctly applied.
- The takeoff location is free from obstructions at transition altitude for 500m in every direction.
- Takeoff and land site are clear of obstacles and structures higher than transition altitude.
- The path for takeoff and landing is set so that the vehicle points into the wind.

Airframe

- The vehicle does not exceed the scheduled maintenance or preventive maintenance cycles.
- The airframe conforms with all local rules and regulations and is permitted to fly the intended mission.
- The propellers are mounted in the correct position, orientation, and direction as specified in the Assembly section.

Visual inspection for damage, and dirt, correctly mounted and securely fastened:

- Propellers
- Motors
- Wings
- Servos
- Elevons
- Devices inside the fuselage
- Flight battery

Before closing hatch

- When the vehicle sits outside, the hatch must not be closed until the vehicle is ready for takeoff as the components inside could overheat when sitting idle. Exposure to direct sunlight when idle for more than 5 minutes should be avoided.
- Flight battery - Securely attached, moved as far forward as possible, connector fully joined.
- Telemetry - Attached and working.
- SD-card installed.
- Aileron linkage - Properly secured without slop or play.
- The payload sits within the payload bay (center bay) and does not exceed 1.2kg.
- Components inside the fuselage are securely fastened and cannot move during flight.

After closing hatch

- Hatch secured (unable to pull up)
- The hatch sits flush with the fuselage (no obstructions under the hatch legs)
- VTOL modules and wing joiners are properly secured with lock clips down.

Before takeoff

- Weather conditions and mission within tolerances.
- The vehicle is pointing into the wind.
- No warnings on GCS.
- The wing servos are powered (try to move the elevons and feel resistance from the servo).
- The vehicle's current physical orientation matches the heading observed on GCS.
- The flight battery is fully charged.
- The ground equipment has sufficient charge to perform the mission.
- Safety features are set correctly.
- GPS lock is stable with at least 10 registered satellites.
- Mission uploaded and downloaded to verify.
- The takeoff waypoint is active (green)

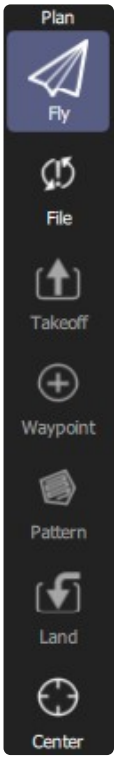
Executing and monitoring a mission

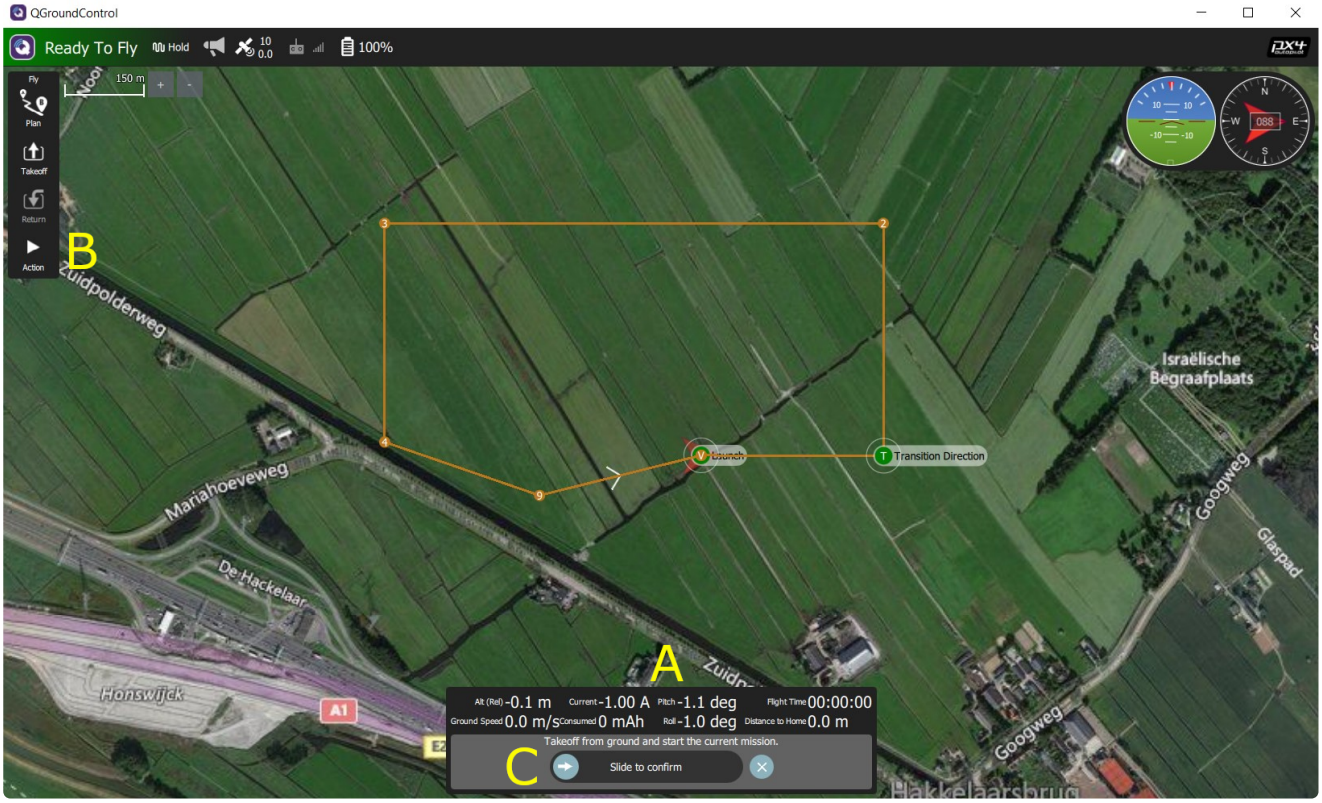
Before executing a mission the following conditions must have been met:

1. The mission must be planned in accordance with the guidelines set out in Planning a mission.
2. The mission plan must have passed the DeltaQuad mission plan validator.
3. The Pre-flight checks must have been performed and passed.
4. The vehicle should be pointing with its nose towards the wind.
5. All flights must be started with a fully charged battery.
6. The operator and any observers must keep a safe distance from the vehicle, a 10m minimum is recommended.

Setting up the Flyscreen

From the Ground Control Station (GCS) activate the Flyscreen.

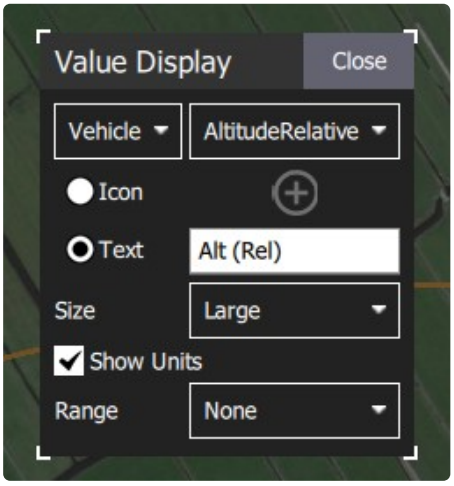




From the Flyscreen, ensure all key telemetry data "A" has been activated. The key telemetry data can be configured by clicking anywhere on the telemetry display.

You will now have the possibility to add vertically and horizontally extra lines to the display by using the "plus" and "minus" signs or to change the category of the existing telemetry data.

By clicking on any of the displayed values a window will open which gives you the option to select any of the available data to be displayed in the field where you clicked.



By clicking the "Lock" you finish the setup and lock the telemetry data display.

The following telemetry data is recommended:

- Altitude-rel: The relative altitude of the vehicle compared to its home position.
- Ground speed: The ground speed in meters per second.
- Current: The amount of Current in Amperes currently consumed by the vehicle.
- Consumed: The total amount of current drawn from the battery since starting the vehicle.
- Pitch: The current pitch angle in degrees.
- Roll: The current roll angle in degrees.
- Flight time: The total flight time from the moment of arming the vehicle.
- Distance to home: The distance in meters from the takeoff location.

Execute the mission

When all checks are performed, and everything is set up and working properly, you can start the mission. The mission can be started by sliding the "Start mission" activator to the right as indicated under "C". If the start mission block has been closed this will be available under the action button "B".

Returning the vehicle during a mission

When the vehicle needs to be returned while executing a mission, the recommended method is to direct the UAV toward a waypoint that will provide a clean entry into the pre-defined landing sequence. You can change the active waypoint that the vehicle is following by clicking the desired waypoint from the fly screen and confirming the change request.

Please note: when changing the active waypoint, the vehicle will immediately change its altitude to the altitude of the selected item. It will not gradually climb or descend but reach the new altitude as fast as possible. It is therefore recommended to select a waypoint that has an altitude at which the vehicle can safely return from its current position. If a waypoint with a safe altitude is not available, it is recommended to first reposition the UAV to a safe location by tapping a location on the map. While repositioning the UAV it will maintain its current altitude.

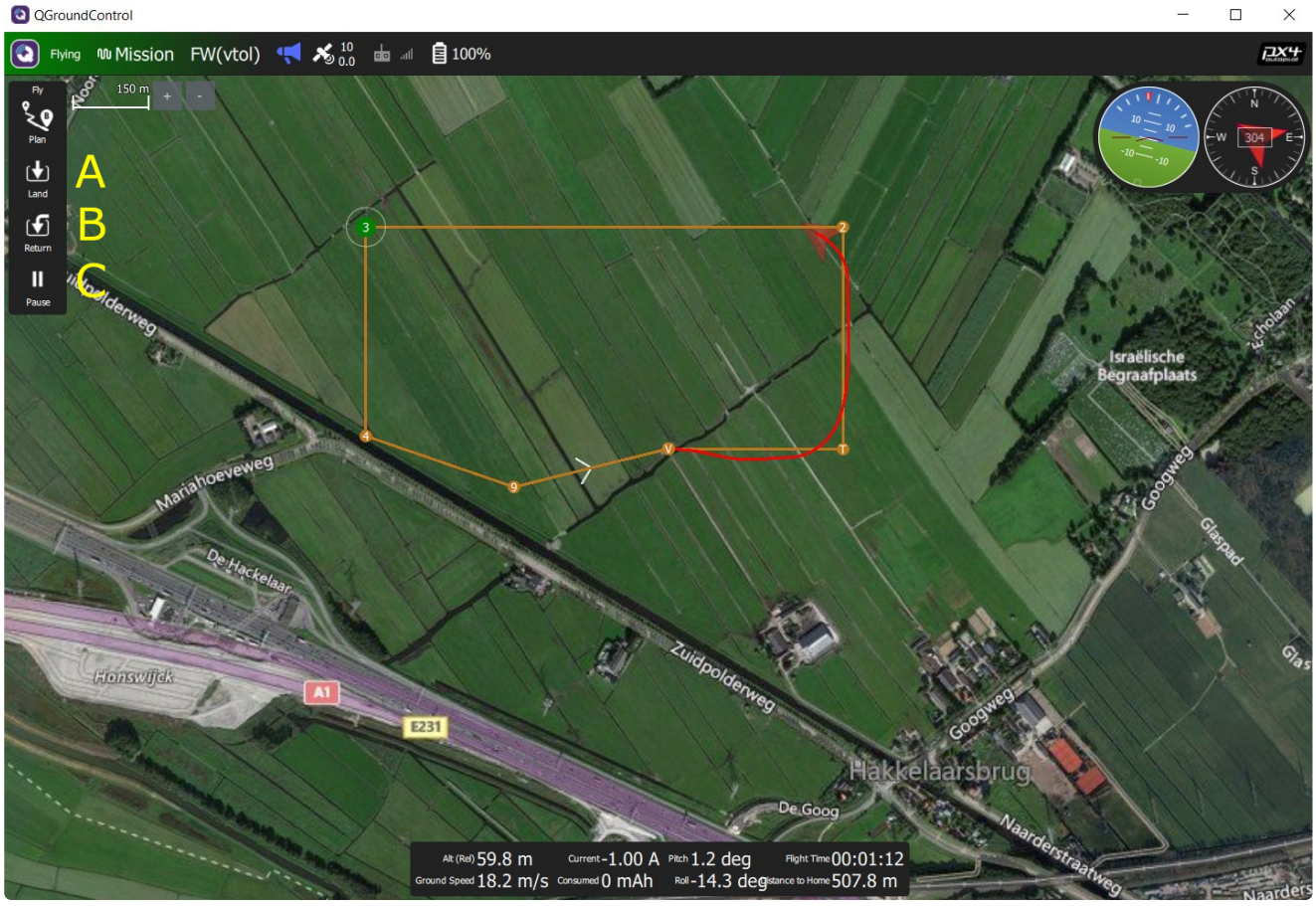
Using the simulator is recommended to practice returning the UAV during a mission using the method described in this section.

Monitoring the mission

Throughout the mission, both the telemetry data and the vehicle should be monitored. This task can be performed by a single operator, but it is recommended to perform this task with one operator and an observer. The observer should continue to watch the vehicle and its surroundings and alert the operator of any problems or nearby traffic.

Note: It is highly recommended to practice the following exercise in the simulator several times before operating the vehicle.

From the flight screen, and when the vehicle is armed, the following key functions are available:



LAND (A): Land immediately.

The vehicle will land at its current location. If the vehicle is in Fixed Wing mode the vehicle will transition back to quadcopter mode first.

This button is called "Take off" while on the ground.

RTL (B): Return To Launch.

The vehicle will return to its takeoff point via the "Landing Pattern" command which consists of the "Loiter" waypoint and the "Land" item.

The vehicle will reach the "Landing Pattern" command in a straight line from its current location at its current altitude. If the current altitude is lower than the Return Home altitude in the Safety settings it will climb to this altitude. If the vehicle is flying in Quadcopter mode it will return to the "Landing Pattern" command and land in this mode. If the vehicle is in Fixed Wing mode it will return as Fixed Wing to the "Landing Pattern" command, perform a back transition when reaching the takeoff location, and land in quadcopter mode.

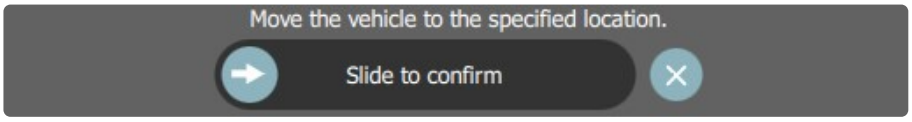
The advantage of facilitating the "Landing Pattern" command is that it will provide a clean entry into the pre-defined landing sequence and execute the transition and landing into the wind.

Note: using RTL is a last resort. The recommended method of returning the vehicle in fixed-wing mode is described in the section "Returning the vehicle during a mission" above.

PAUSE (C): The vehicle will hold its current position.

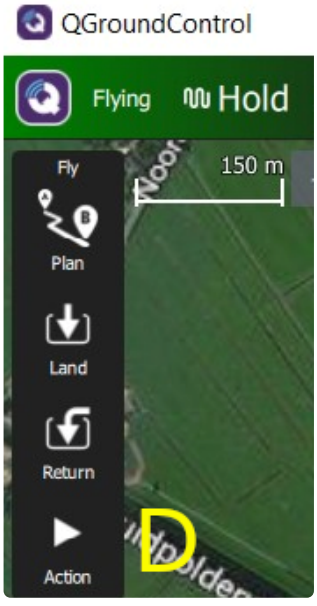
In Fixed Wing mode it will circle the current position with a radius of 100 meters. While in pause mode, when there are no open dialogs, tapping anywhere on the map will give you the ability to select "Goto location".

When sliding to confirm the goto command, the vehicle will proceed to the selected location.



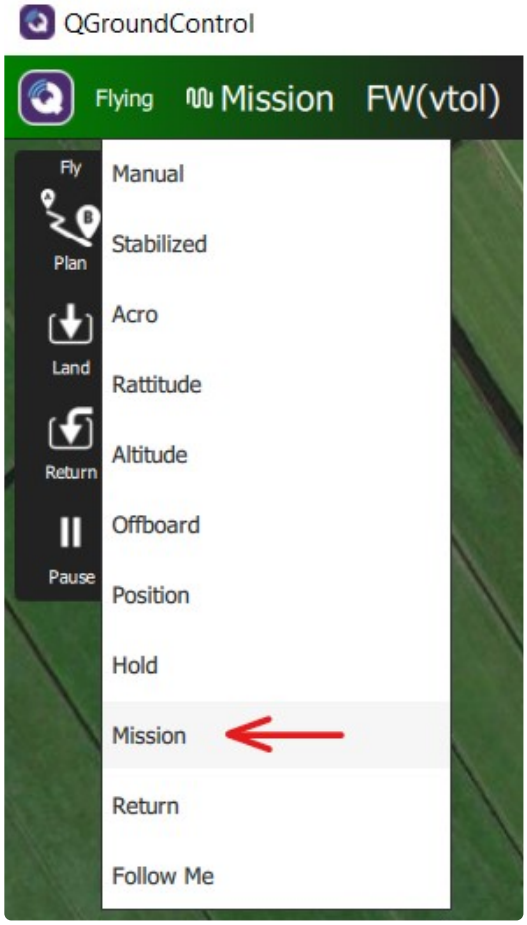
ACTION (D): The "Action" button.

With the "Action" button the mission can proceed, or the flight altitude can be changed. The "Action" button becomes available when the vehicle is in HOLD mode (pause). See the picture below.

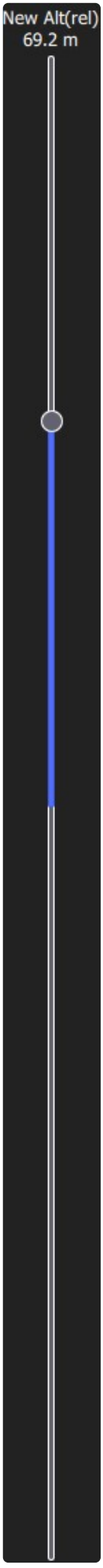


When tapping the action button two options become available.

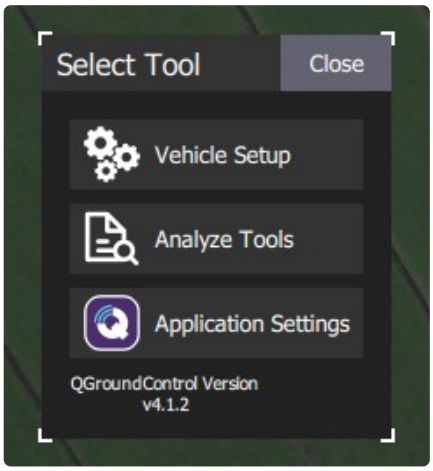
CONTINUE MISSION will resume the mission towards the next waypoint indicated by a green color. If the option CONTINUE MISSION is not available you can resume the mission by switching to MISSION mode using the "Flight Mode" button.

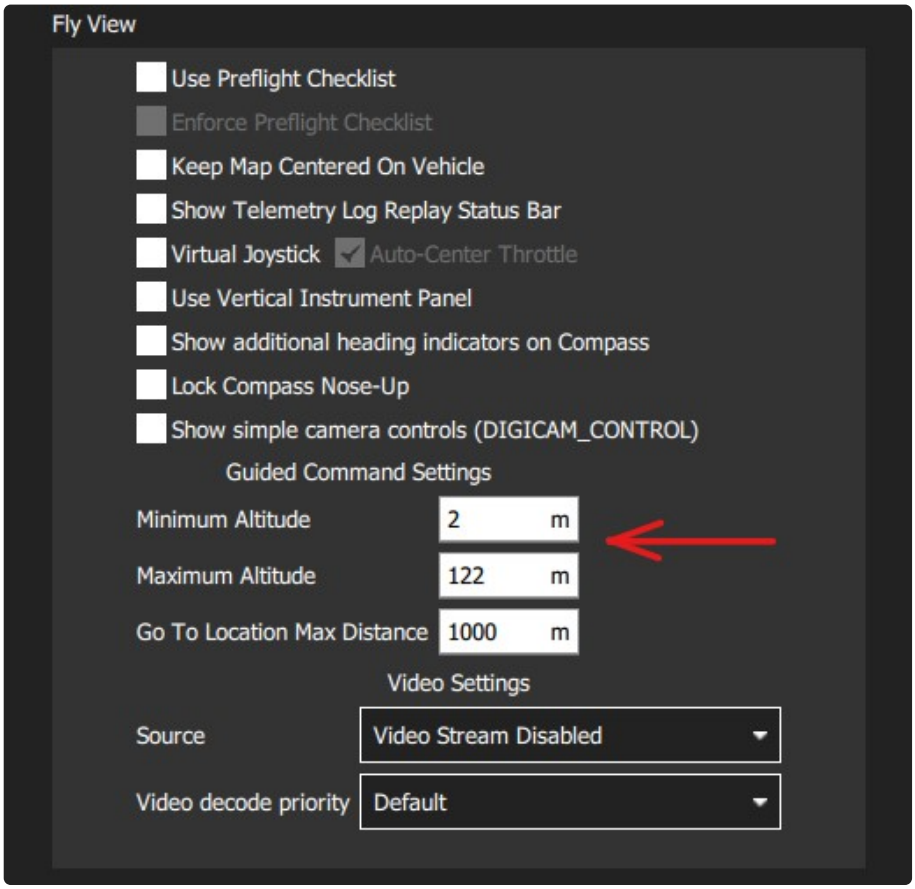


CHANGE ALTITUDE will present a slider on the right side of the screen to change the vehicle's altitude.


New Alt(rel)
69.2 m

The minimum and maximum altitudes can be set in the "Application Settings" under the "Q" icon.





FLYING/READY TO FLY (E): This button will indicate the current state of the DeltaQuad.

When the vehicle is in flight (armed) this button can be clicked and the option to "Disarm" the vehicle will appear.

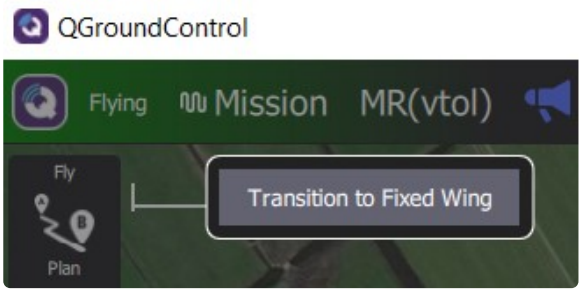
When clicking the "Disarm" button the emergency stop box will appear.

When confirming the emergency stop all motors will stop **IMMEDIATELY.** This procedure should only be used while the vehicle is on the ground or as a last resort to avoid damage to people or property.

Note: Using this function during flight will crash your vehicle and void your warranty.

FLIGHT MODE (F): This button displays the current flight mode. By tapping this button a new flight mode can be selected. Supported flight modes are HOLD, RETURN, and MISSION. Switching flight modes using this method will not require slider confirmation. **Note: When a new flight mode is selected this will be activated immediately.**

VTOL MODE (G): This button indicates if the vehicle is currently in multi-rotor or fixed-wing mode. Tapping this button will provide the option to switch mode.



At altitudes higher than 100m above ground, or in strong winds, it is not recommended to switch from fixed-wing to multi-rotor mode.

WAYPOINT items:

The waypoint items on the screen can be tapped. When tapped a dialog appears asking if the vehicle should proceed to the selected waypoint. When confirmed the vehicle will proceed in a straight line towards the selected waypoint. It will also immediately change to the altitude of the selected waypoint.

The operator should monitor the following:

During takeoff

The following should be monitored directly after takeoff while the vehicle is ascending vertically to its transition altitude.

Toilet bowling
Operator action: **LAND**
The vehicle should take off in a straight line after the first few meters. If the vehicle starts "toilet bowling" (circling up) the mission should be aborted and a sensor calibration must be performed.

Not holding position
Operator action: **LAND**
The vehicle should take off in a straight line. If the vehicle starts drifting from its position more than a few meters it should be commanded to LAND. Contact Vertical Technologies support to have your log files analyzed.

Takeoff failure
Operator action: **DISARM**
If the vehicle fails to take off or only one half of the vehicle rises it is likely that the quadcopter propellers are damaged, mounted incorrectly, or upside down. The operator should disarm the vehicle and review the propeller's configuration as described in the assembly section.

Excessive current draw
Operator action: **LAND**
If the current draw indicated by CURRENT from the telemetry display exceeds 180 Amperes the flight should be aborted. The vehicle could be overweight, flying outside of tolerable wind conditions, or has a malfunction. In the case of a malfunction inspect the vehicle for visible damage to the propellers or a higher resistance in any of the motors. If there was no evident damage then contact Vertical Technologies support for analysis.

During transition

After reaching transition altitude the vehicle will commence the transition to fixed-wing flight. (switching from quadcopter to fixed wing). It will transition into the direction that the vehicle was placed in, but wind can have an effect on the direction, especially if the vehicle is not positioned with its nose directly into the wind. The vehicle will engage full thrust for 15 seconds using its pusher motor. After this period it should navigate towards the takeoff location or the first waypoint.

No forward motion
Operator action: **LAND**
If the vehicle is not moving forward or is drifting with the wind and does not seem to transition towards fixed wing there is likely a problem with the pusher motor or propeller.

Flying backward
Operator action: **LAND**
If the vehicle starts flying backward with increasing speed it is likely to have the pusher propeller mounted in the wrong direction. The transition should be aborted and the pusher motor should be inspected.

High current slow forward flight
Operator action: **RTL**
If the vehicle is moving horizontally in the direction of the first waypoint at low speed, with the quadcopter motors still engaged after 15 seconds, and the current draw remains above 30 Amperes, it is likely that the mission did not issue a VTOL TAKEOFF command but a TAKEOFF command. The vehicle will attempt to complete the mission in quadcopter mode. If this was not intended, RTL should be initiated by the operator.
Note: The DeltaQuad can activate its pusher motor in quadcopter mode too. The spinning of the pusher motor is no indication that the vehicle is attempting fixed-wing flight.

During Fixed-wing flight

Switch to multi-rotor mode
Operator action: **Transition to fixed-wing or LAND**
There are some conditions where the vehicle can switch to multi-rotor mode. These include loss of positional awareness or accidental mode switching by the operator. In these events, it is usually prudent to attempt to resume fixed-wing flight by pressing the VTOL mode switch (G). If this fails for any reason, the vehicle must be landed. When the vehicle is higher than 200m this must happen immediately as the multirotor mode may consume too much energy to complete a full return.

Abort error displayed due to loss of altitude or maximum bank angle
Operator action: **LAND**
This error is displayed on the Ground Control Station when the vehicle has activated the failsafe system. The UAV must be landed as soon as possible. Do not attempt to complete the automatic return sequence if the vehicle is higher than 100m or further than 800m from the home position. If the battery is lower than 35% it should always be landed. Use the map to locate a safe area to land the UAV and direct the UAV to this location. Then press the LAND button to land immediately.

After such an event the cause must be determined before a new flight is attempted. Please contact Vertical Technologies support for assistance in analyzing the cause of the failsafe event.

Excessive altitude loss
Operator action: **Return or LAND**
During and shortly after transition, the vehicle may lose some altitude, this is generally not more than 5 meters. In extreme cases (high payload, strong wind). This can be up to 8 meters. The vehicle should recover from this loss quickly, and regain and maintain altitude. Some altitude gain or loss may occur when banking (changing direction). This should not exceed 5 meters.

If the vehicle does not maintain altitude, or if the altitude error exceeds 10m and the vehicle does not recover from this altitude error an RTL should be commanded. If the vehicle does not adequately perform the RTL procedure (continues to lose altitude or fails to navigate back) a LAND instruction should be given. After a LAND instruction is given, and the vehicle is performing a landing in quadcopter mode, the RTL instruction can be given again to have the vehicle return in quadcopter mode. This should only be attempted when the vehicle is less than 1km from the takeoff site and more than 50% of the battery capacity is available.

The reason this can occur could be related to weight, balance or a problem with the servos or pusher drive. A thorough inspection of the vehicle is required. If the problem can not be found and resolved you should contact Vertical Technologies support.

Failure to track the mission path
Operator action: **Return or LAND**
During the transition, the vehicle does not fly in the direction expected:

When the transition phase completes, the vehicle should fly towards its takeoff location or first waypoint. If the vehicle does not follow its intended path after the transition phase, an RTL should be commanded. If the vehicle does not adequately perform the RTL procedure (continues to lose altitude or fails to navigate back) a LAND instruction should be given. After a LAND instruction was given, and the vehicle is commencing a landing in quadcopter mode, the RTL instruction can be given again to have the vehicle return in quadcopter mode. This should only be attempted when the vehicle is less than 1km from the takeoff site and more than 70% of the battery capacity is available.

The reason this can occur can be related to a failure of the servo actuation or an incorrect mission being loaded.

Excessive pitch
Operator action: **Increase cruise throttle / Return**
The DeltaQuad should cruise at an average pitch angle between 3 and 9 degrees unless a change in altitude is commanded. If the pitch angle consistently exceeds 12 degrees while the vehicle is not attempting to climb to a higher altitude the cruise throttle should be increased. Increasing the cruise throttle can be done by changing the parameter as described in the Key parameters section. This parameter can be changed during flight. If this does not resolve the problem the flight should be aborted by issuing an RTL command.
Note: When changing the cruise throttle during flight special care must be taken to monitor the battery level.

The reason for this could be related to sensor calibration, overweight, too low cruise throttle, or a problem with the fixed-wing drive. To resolve this attempt to level the vehicle as described in the sensor calibration section, verify the weight or increase the cruise throttle. If the problem persists please contact Vertical Technologies support.

Battery level and current consumption
Operator action: **Return**
The battery level percentage indicated in the top bar of the flight screen should be monitored throughout the flight. the percentage should always be higher than the relative distance the vehicle still has to travel. For example, if only 50% battery remains, more than 50% of the mission should have been completed. The CURRENT and CONSUMED values will also help determine this. The DeltaQuad should draw between 9 and 15 Amperes of current on average during cruise flight. This value increases;

- The vehicle is flying significantly above sea level
- If the vehicle is flying with maximum payload.
- As the battery percentage drops.
- When the vehicle is climbing or banking.
- When the cruise throttle is set higher.
- When the LiPo gets older.
- When a power-consuming payload is active.

Ground speed
Operator action: **Increase cruise throttle**
The DeltaQuad will generally maintain a constant speed through air, but wind conditions will impact the effective ground speed. If the ground speed drops below 6 m/s the cruise throttle should be increased. Increasing the cruise throttle can be done by changing the parameter as described in the Key parameters section. This parameter can be changed during flight.
Note: When changing the cruise throttle during flight special care must be taken to monitor the battery level.

When this happens the vehicle is likely flying in wind conditions that exceed the specified tolerance.

During back transition

When the DeltaQuad is flying towards its last waypoint (the VTOL_LAND waypoint) it will determine the appropriate distance from the waypoint to initiate its back transition. The distance depends on the current ground speed and can vary between 5 and 100 meters from the land position. During the back transition, the DeltaQuad will activate its pusher motor in reverse direction to slow down.

Excessive overshoot
Operator action: **None**
If the vehicle overshoots its landing waypoint significantly and does not seem to slow down during the back transition, there could be a problem with the pusher reverse system. The vehicle should be thoroughly inspected for loose connectors on the flight controller (specifically connectors 7 and 8 as indicated on the wiring diagram). If no problem was found with the connectors the vehicle should be grounded and undergo extended maintenance.

Unstable descent
Operator action: **None**
If the vehicle becomes unstable during landing the land speed as indicated in the safety features is likely set too high.

No auto disarm after touchdown
Operator action: **Disarm**
The DeltaQuad should disarm automatically 5 to 10 seconds after touchdown. If the vehicle does not disarm automatically the disarm command (emergency stop) should be sent. This command can be sent by pressing the "Armed" label.

The reason for this could be related to landing on a significantly uneven surface or slope. It can also indicate the sensors need calibration.

Manual override

Using the DeltaQuad Controller, The vehicle is capable of being controlled in a manual override mode referred to as ALTITUDE mode. This mode is useful in the following conditions:

1. When the vehicle is flying in GPS-denied environments
2. When granular control over the vehicle is required
3. When the vehicle experiences a compass misalignment during takeoff or landing

Safety warnings

- Altitude mode requires some piloting skills and should only be performed by operators who have some experience flying drones using joysticks.
- While in multirotor mode, the pusher motor can still activate if the vehicle is more than 3 meters above the ground and forward movement is requested.
- If the data link is lost during Altitude mode, the vehicle will always activate an automatic return mode, regardless of the safety settings.

ALTITUDE mode explained

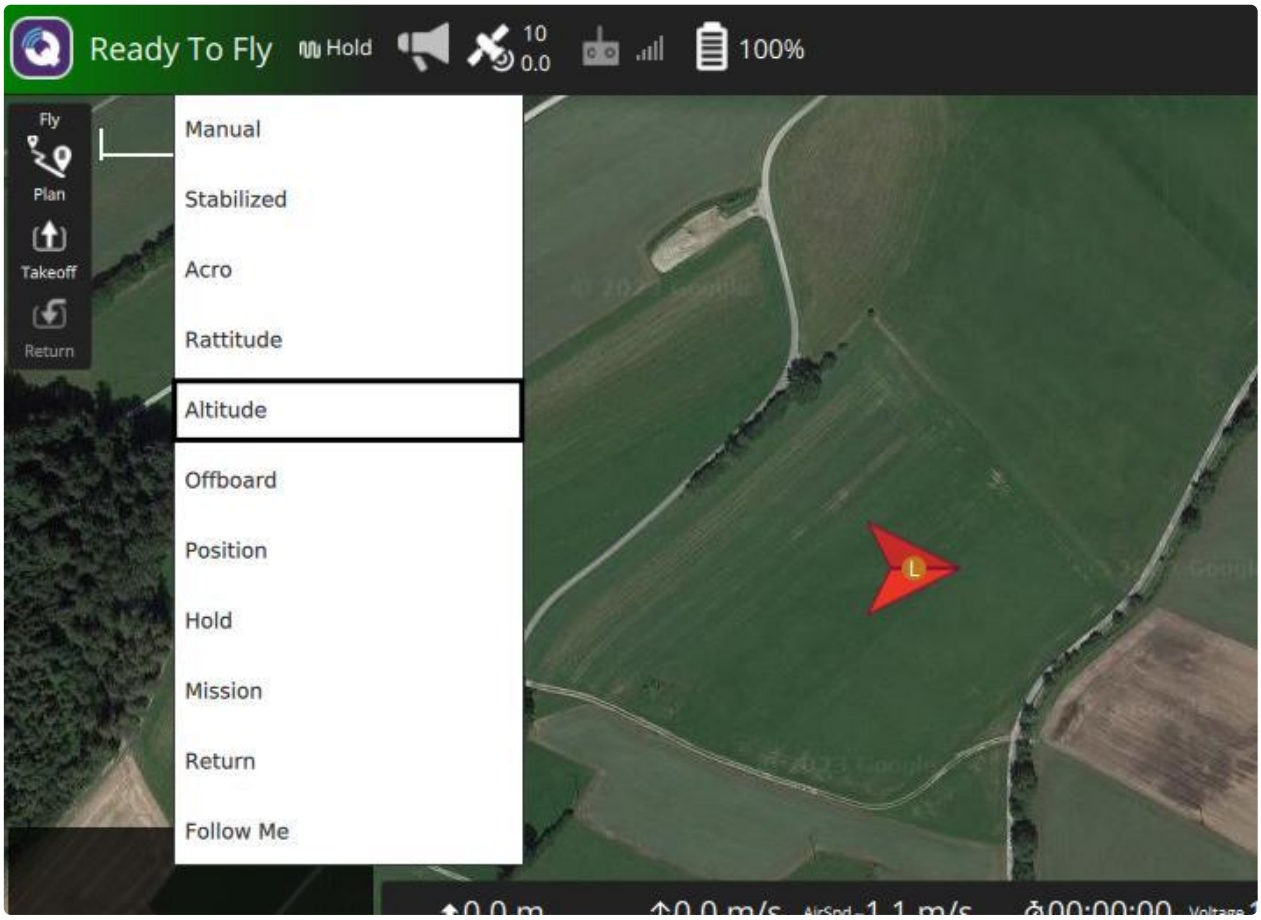
In ALTITUDE mode the vehicle no longer relies on the GPS or compass sensor data. It will maintain altitude based on the barometer and accelerometer data only. The vehicle is capable of flight in this mode both in multirotor and fixed-wing mode.

As the vehicle does not use positioning data in this mode, wind can cause the vehicle to drift away. It is the pilot's responsibility to position the vehicle by using the control joysticks on the DeltaQuad Controller.

Activating ALTITUDE mode

To activate ALTITUDE mode tap on the flight mode button in the top bar.

This will present a dropdown menu with a list of all flight modes. Taping on the word "Altitude" will activate the Altitude flight mode.



Caution: when tapping on a flight mode from this menu, the flight mode is applied immediately, there is no confirmation required. If the wrong flight mode is selected, press the pause button before deciding your next step.

Controlling the vehicle in ALTITUDE mode

In multirotor mode, the left joystick's up and down position controls the desired altitude. The center position will hold the current altitude, moving the joystick up or down will result in upward or downward movement of the UAV.

In fixed-wing mode, the right joystick (pitch) controls the altitude in a similar way a manned aircraft is controlled. Moving the right joystick forward results in a "nose down" command which will tell the aircraft to descend. Moving the joystick backward will result in a "nose up" command which will tell the aircraft to climb. Keeping the left joystick centered will make the vehicle maintain its current altitude.

Taking off and landing in ALTITUDE mode

When the vehicle is on the ground, it can be launched in ALTITUDE mode if needed. To do this, activate ALTITUDE mode first, then press the "Ready to fly" button and press ARM. after confirming the ARM action the vehicle will start the motors. Pushing the left joystick up within 10 seconds will make the vehicle perform a takeoff. When the vehicle is at a safe altitude for a transition, it can be transitioned to fixed-wing mode by pressing the VTOL MODE switch (G).

When in fixed-wing mode, the same method can be used to transition the vehicle back to multirotor mode.

To land the vehicle in ALTITUDE mode, make sure the vehicle is in multirotor mode and navigate to the desired landing spot. Holding the left joystick down will cause the vehicle to descend. When the vehicle touches down, keep holding the left joystick down for approximately 5 seconds. The vehicle will automatically disarm.

Post-flight

When the DeltaQuad has completed operations it should be switched off, inspected, dismantled, and stored. Flight logs should be retrieved and registered.

Switching off the vehicle

Before approaching the vehicle to switch it off note the following;

- The vehicle should never be approached when the motors are spinning.
- In the unlikely event of a crash, the vehicle should not be approached within 15 minutes. The battery could have been damaged and may ignite.
- Always stay clear of the propellers until the vehicle has been powered off by disconnecting the main flight battery.

To switch the vehicle off open the canopy clip and remove the lid. Then disconnect the main battery connector and remove the battery. The battery should be stored directly and safely.

Inspect the vehicle

After a landing, specifically a hard landing or a grass landing, the DeltaQuad should be inspected for damage. Inspecting the vehicle visually at the landing site can help in determining the cause of any problems that might arise in the future. It is recommended, specifically when in doubt or with visible damage, to take pictures of the vehicle before dismantling it.

If there is any dirt on the vehicle or the propellers this should be removed with a damp cloth. Dirt on the wings, fuse, or propellers will significantly impact the performance.

Special care must be taken to inspect the propellers both before and after every flight. If there is any visible or palpable damage to a propeller it should be replaced directly in accordance with the preventative maintenance section.

Dismantle the vehicle

Dismantle the vehicle in accordance with the assembly section. If you are able to transport and store the vehicle safely with only the wings detached this is recommended as it will reduce the risk of assembly problems.

Note: Never remove the carbon spars with the VTOL modules still attached. This can damage the wing joiner and void your warranty.

Transporting and storing the vehicle

The DeltaQuad should be transported and stored inside the DeltaQuad Flightcase.

Retrieving the on-board logs and registering the flight

After every session of flights the on-board logs should be retrieved from the SD-Card and the flight should be registered in the flight log. For more information on retrieving the on-board logs and maintaining the flight log, refer to the flight logs section.

Maintenance

This chapter covers the maintenance of your vehicle and logging of your flights.

Chapter index

Sensor calibration

Sensor calibration

The DeltaQuad requires a compass calibration in the following conditions:

- When indicated by events described in this manual.
- When the telemetry readings are inconsistent with reality.

The DeltaQuad requires a gyro calibration in the following conditions:

- When indicated by the UAV

The DeltaQuad requires an accelerometer calibration in the following conditions:

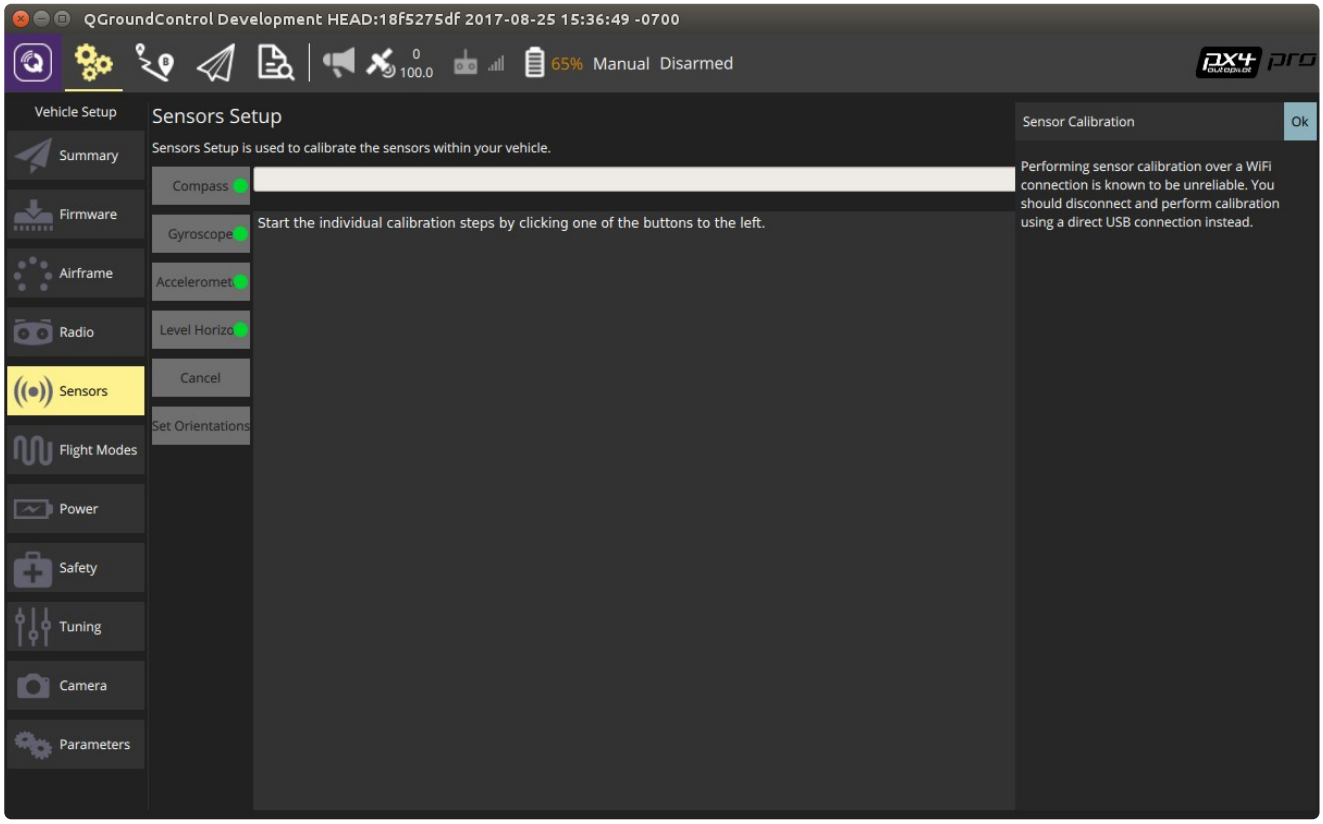
- When indicated by the UAV

The DeltaQuad requires a level horizon in the following conditions:

- When indicated pitch or roll does not match reality
- When indicated by the supplier

Accessing the calibration screen

Sensor calibration is performed in QGroundControl. To access the sensor calibration, you will need to switch the vehicle on and establish a connection between the Ground Control Station and the vehicle. Navigate to the settings view and select the Sensors tab.



QGroundControl will issue a warning about sensor calibration over a WiFi connection. This can safely be ignored by clicking OK.

The following sensor calibrations should be performed:

- Compass
- Gyroscope
- Accelerometer
- Level Horizon

All calibrations should be performed with the VTOL modules attached, and any additional payload installed and powered on.

After every calibration step, the autopilot must reboot. The autopilot can be rebooted quickly from the parameters tab under the tools button.

Compass calibration

A compass calibration is best performed outside, away from metallic objects, and electrical or magnetic interference. To start the compass calibration, click the compass button and follow the instructions on the screen. The calibration process starts when clicking OK. The autopilot orientation parameter in the GCS should remain unchanged. A compass calibration involves rotating the vehicle 3 times over all axes. This calibration step can be performed by hand. The canopy should be closed and the LiPo battery and any additional payload should be inserted and securely fastened.

Perform the calibration as indicated by the images on the ground station. When all axes are finished (images turn green) click OK, leaving the external magnetometer orientation unchanged. Then reboot the vehicle.

After the compass calibration ALWAYS verify the compass is reading correctly by pointing the vehicle north, east, south, and west, and at every turn verify that the vehicle icon on the ground station is pointing in the correct direction, and remains pointed in that direction for at least 30 seconds. if the compass is not reading correctly by more than 8 degrees, please retry the calibration. If the problem persists please contact Vertical Technologies.

Gyroscope calibration

The gyroscope calibration is best performed indoors. It requires the vehicle to sit level based on the VTOL arms. To level the vehicle based on the VTOL arms it is recommended to find a level surface (a table) and place 4 objects of equal height under the quadcopter motors. For example soda cans. The foam underside of the vehicle should be free from the table and the carbon VTOL arms should sit level horizontally.

When the vehicle is sitting level, press OK to start the calibration. This will be completed in about 20 seconds. The vehicle should not be touched or moved during the calibration process. Then reboot the vehicle. If, for any reason, the vehicle is moved during the calibration process then repeat the process from the beginning.

Accelerometer calibration

To start the accelerometer calibration, click the accelerometer button and follow the instructions on the screen. The calibration process starts when clicking OK. The autopilot orientation parameter in the GCS should remain unchanged. An accelerometer calibration involves positioning the vehicle on all axes. This calibration step can be performed by hand. The canopy should be closed and the LiPo battery should be inserted and securely fastened.

Perform the calibration as indicated by the images on the Ground Control Station, ensuring the vehicle is motionless at each point in the calibration process. Then reboot the vehicle.

Level horizon

> WARNING: This calibration is rarely needed outside of the factory. Performing this calibration incorrectly can cause the vehicle to become unstable or crash.

Before leveling the horizon all other calibrations, except compass calibration, must have been completed.

The Level Horizon calibration is best performed indoors. It requires the vehicle to sit level based on the VTOL arms. To level the vehicle based on the VTOL arms it is recommended to find a level surface (a table) and place 4 objects of equal height, such as soda cans or soup tins, under the quadcopter motors. The foam underside of the vehicle should be free from the table and the carbon VTOL arms should sit level horizontally.

When the vehicle is sitting level, press OK to start the calibration. This will be completed in about 20 seconds. The vehicle should not be touched or moved during the calibration process. Then reboot the vehicle. If, for any reason, the vehicle is moved during this calibration process then repeat the process from the beginning.

Firmware upgrade

When purchasing a DeltaQuad you will be notified of relevant firmware upgrades for your vehicle via email. The email will contain a link to the relevant firmware upgrade page and can contain specific instructions. You should only perform firmware upgrades when instructed to do so by your supplier. Under no circumstances should you reset your parameters to default.

If you are in need of assistance to perform the upgrade please contact support@verticaltechnologies.com

Preparing an upgrade

A firmware upgrade can only be performed using QGroundControl from a Windows or MacOS computer and requires a standard micro-USB cable. It can not be performed from an Android or IOS device.

A firmware upgrade generally consists of one binary file and one parameter file. The binary file has a *.px4* extension and the parameter file has a *.params* extension. You should download both files to your computer.

Make sure you can safely position your vehicle close to your computer and do not attach the flight battery.

Performing the upgrade

To perform a firmware upgrade please follow the steps below;

1. Download and install QGroundControl on your computer.
2. Download the firmware binary and the parameter file to your computer. These files will be available on the link sent to you via email.
3. Insert a USB type C cable in the flight controller's USB port which is located near the serial number sticker in your UAV (do not attach it to your computer yet)
4. Start QgroundControl
5. Click on the settings button (cogwheel icon on top)
6. Click on 'Firmware'
7. Attach the USB cable to your computer, when properly connected this will be indicated on QGroundControl.
8. Make sure the PX4 firmware option is selected, check 'Advanced' and choose 'Custom' from the drop-down list, then click OK.
9. A file select dialog should appear, select the correct .px4 file. The upgrade process should now start and will inform you when it has finished. If the upgrade fails you can try again or use a different (thicker) USB cable.
10. Proceed to load the new parameter file as described below

Loading the new parameters

Most firmware upgrades come with a parameter file. It is important to install the new parameters as they can contain crucial settings for the new firmware.

To load the parameters please use the following steps;

1. While the USB cable is connected, start QgroundControl and wait for the vehicle to connect
2. Click on the settings button (cogwheel icon on top)
3. Click on 'Parameters'
4. Click on the 'Tools' drop-down on the right side of the screen
5. Select 'Load from file'
6. Select the correct parameter file from your computer and click "open"
7. Leave the USB cable connected for at least 10 seconds after selecting the parameter file.
8. Perform any additional tasks as described in
9. Remove the USB cable.

Post-upgrade steps

The email instructions for your firmware upgrade will include a method of validating the upgrade. Please make sure you validate the upgrade before flight.

Sometimes it will be required to perform a new sensor calibration after upgrading. This will be indicated with the firmware upgrade. When indicated, please follow the steps on the sensor calibration page. Do not calibrate the sensors with the USB cable attached. Use your standard ground control station and telemetry unit for this.

Battery charging and storage

Safety notice

1. Use a specific Lithium Polymer battery charger only. Do not use a NiCd or NiMH charger - Failure to do so may cause a fire, which may result in personal injury and property damage.
2. Never charge batteries unattended unless you charge inside a LiPo Safe. When charging Li-Po batteries you should always remain in constant observation to monitor the charging process and react to potential problems that may occur.
3. If at any time you witness a battery starting to balloon or swell up, discontinue the charging process immediately. Disconnect the battery and dispose of it safely. Continuing to charge a battery that has begun to swell will result in fire. Likewise, never use a battery if you find it swollen or ballooned.
4. Since delayed chemical reactions can occur, it is best to observe the battery as a safety precaution. Battery observation should occur in a safe area outside of any building or vehicle and away from any combustible material.
5. Wire lead shorts can cause a fire! If you accidentally short the wires, the battery must be placed in a safe area for observation for at least 1 hour. Additionally, if a short occurs and contact is made with metal (such as rings on your hand), severe injuries may occur due to the conductibility of electric current in such objects.
6. A battery can still ignite even after 1 hour.
7. A battery that makes a hissing sound is almost certain to ignite. Consider your own safety and that of your environment before attempting any action
8. In the event of a crash, you must remove the battery and dispose of it safely.

Charging the LiPo

If you have ordered the DeltaQuad with a LiPo battery it will come with a plug-and-play charger. This charger can charge an empty DeltaQuad main flight battery in approximately 6 hours. To charge the battery insert both the power and balance plugs in the charger, it will commence charging automatically. When the LED light on the charger turns green the LiPo will have been charged.

The DeltaQuad LiPo can also be charged using a third-party charging solution and is capable of charging in approximately 1 hour if your charger is capable of providing 20 Amperes. Charging at this rate can be convenient but may limit the durability of the LiPo, it is recommended to charge the LiPo at no more than 5 Amperes for a maximum lifetime.

1. Remove the battery from the vehicle. The battery should never be charged inside the vehicle.
2. Never charge batteries unattended unless you can charge them inside a LiPo safe.
3. Charge in an isolated area, away from other flammable materials.
4. Let the battery cool down to ambient temperature before charging.
5. Never charge the battery at more than 23 Amperes, as this will reduce the number of charge cycles and efficiency of the battery.

Operating the LiPo with your vehicle

The DeltaQuad can measure Voltage and Current from the main battery. To estimate the total amount of energy available in a battery it will use both of these metrics. The Voltage can give some indication of the state of charge but this is not always accurate. New batteries maintain a high voltage even when their capacity is low. The vehicle will also measure the amount of current that has been drawn from a battery and know the total capacity of the DeltaQuad LiPo. If the battery is fully charged it can use this accurate method of estimating the state of charge.

To prevent any situation where the vehicle may incorrectly estimate the state of charge of the battery, it is required to start every flight with a fully charged battery.

Storing the LiPo

When storing a LiPo for a period longer than 1 week make sure to store it at approximately 50% charge. This will increase the lifetime of your battery. The LiPo should be stored in a safe and dark location between 5 and 25 degrees Celsius and never left exposed to direct sunlight for a prolonged period of time.

Flight logs

The DeltaQuad records on-board logs that contain vast amounts of information regarding the flights. These onboard logs are stored on the SD Card and should be retrieved and processed after one or more flights.

Every DeltaQuad should have a well-maintained logbook that keeps a record of every flight. In most cases when having your vehicle certified this is a requirement.

Processing the on-board flight logs

On-board flight logs can be retrieved from the SD Card in the flight controller. Remove the SD Card and download the log files from the Log folder on the card. The logs will be stored in a subfolder that is named by the date of the flights. Logs can be uploaded to DeltaQuad Flight Review for an easy overview. Logs should also be stored locally as the DeltaQuad Flight Review server does not store logs indefinitely.

Logs can also be reviewed using the Flightplot application. This does require in-depth knowledge of the log format.

After retrieving the on-board flight logs remember to re-insert the SD Card in the flight controller. As this can be easily overlooked it is recommended to store a spare SD Card in your flight kit. Always use industrial temperature-rated rated sd-cards.

Maintaining a logbook

For professional use and fleet management, Vertical Technologies recommends the use of AlarisPro. The DeltaQuad is a known vehicle in this system and all components and maintenance schedules are pre-configured.

For other, or self-designed log books the following information should at least be present;

Per vehicle

- Serial number
- Total flight hours
- Last maintenance cycle
- Replaced components including the replacement date

Per flight

- Vehicle serial number
- Date and time
- Flight time
- Link to the on-board log and/or flight review
- Operator
- Weather conditions/wind speed
- Flight notes, failures, damage, and field replacements

Preventative maintenance

To keep your DeltaQuad in proper condition the following steps should be taken:

After every flight

- Clean the propellers of any dirt and inspect for damage.
- Clean the fuselage and wings, this will improve performance.
- Inspect the avionics, and make sure all components are still securely attached in their proper place and all connectors are securely fastened.
- Inspect motor and servo linkage screws. Should they have come undone, lock bond must be used on all screws when re-attaching.

After 200 flights or 12 months

To keep your vehicle in the best condition and safe to operate beyond this point scheduled maintenance should be performed. This entails the preventive replacement of many components and a thorough inspection and test flight.

Replacing components

The DeltaQuad has been designed to allow easy replacement of components. Every component on the DeltaQuad is available as a replacement part. If you require replacement parts please contact Vertical Technologies.

When replacing motors or elevon linkages, lock bond must be used on all screws and nuts.
When replacing propellers for the VTOL modules no lock bond is required as these are self-tightening.
When replacing the pusher motor propeller lock bond is required on the propeller adapter nut as this motor can spin in both directions.

Scheduled maintenance

The recommended service cycle for the DeltaQuad UAV is 12 months. Beyond this point, the vehicle can fly less efficiently and there could be a potential risk of failure. Using the Vertical Technologies Extended Maintenance Service you can extend the lifetime of your vehicle and maintain a warranty on the serviced components.

Vehicles flown beyond the recommended maintenance cycles void their warranty.

Extended Maintenance Service

With the Extended Maintenance Service, you can send back your vehicle and we will completely refurbish it. It will be returned as good as new. If the vehicle was damaged beyond repair it can be completely replaced. We offer this service free of any obligation and for a fixed fee. All replaced components are provided with a new warranty.

There are 3 types of extended maintenance requests:

	Custom repair	Basic tuneup	Complete refresh
Software upgrade			
Recalibration of sensors			
Full inspection and test flight			
New propellers			
New motors			
New speed controllers			
New BECs			
New servos			
New connectors			
New board computers			
New GPS			
New power module			
New wiring			
Recommended after	Crash or damage	12 months	24 months

Please contact us to schedule your maintenance cycle.

Self Service

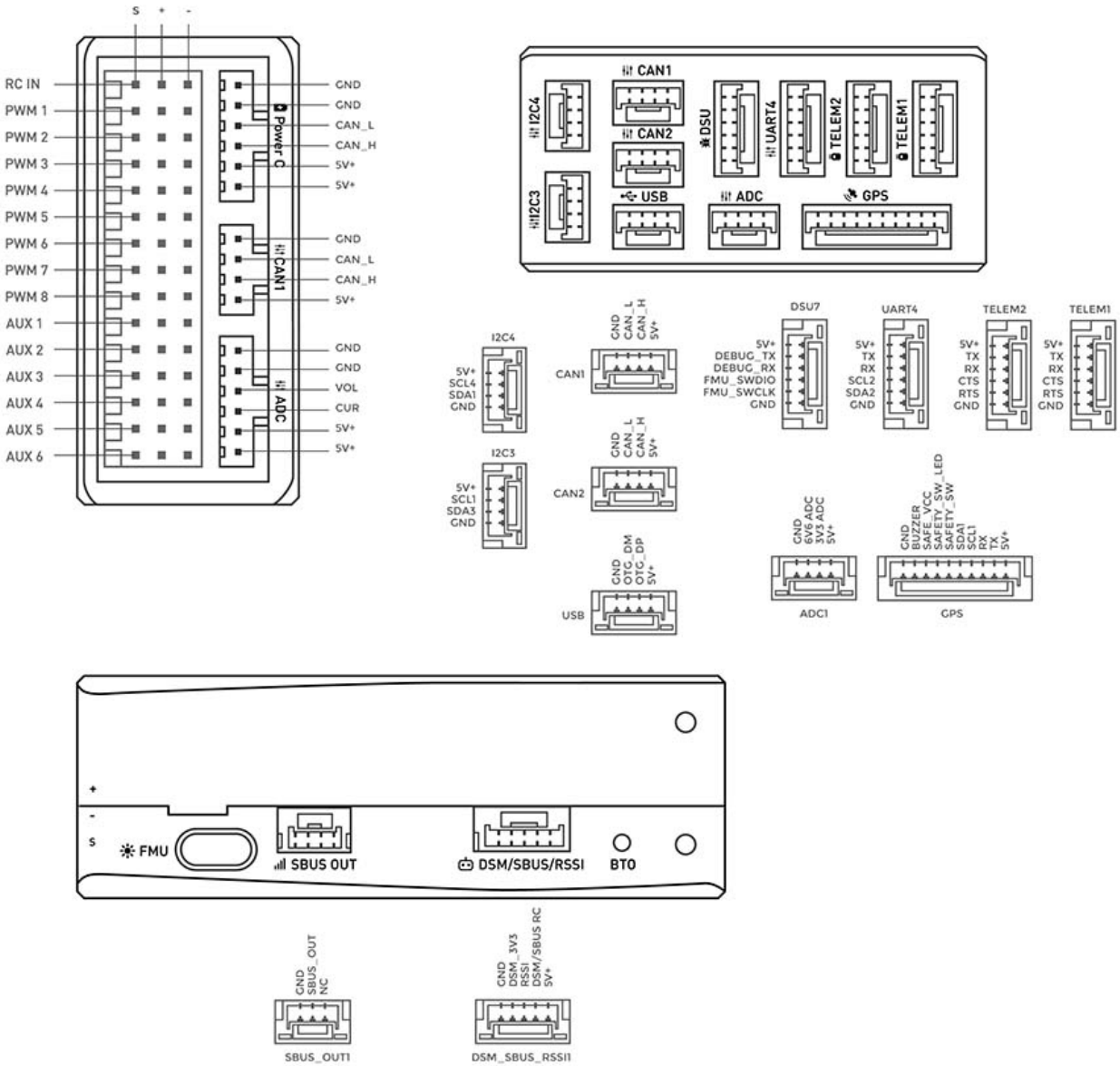
Maintenance packages are available on request. Performing Self Service Maintenance does not extend your warranty. A high technical level is required to perform scheduled maintenance.

If you would like to acquire a maintenance package please contact Vertical Technologies Support.

Wiring diagram

The following schematic shows the correct wiring for the DeltaQuad Pro flight controller. Depending on the model and options, not all connections will be in use. Making changes to the configuration of your vehicle may impact your warranty. Before making any modifications always contact your DeltaQuad representative.

Flight controller pinout



Connector	Type	Mating component
RCIN	DuPont 3 pin	Radio SBUS port
PWM1	DuPont 4 pin position 1 (green)	Motor #1
PWM2	DuPont 4 pin position 2 (blue)	Motor #2
PWM3	DuPont 4 pin position 3 (gray)	Motor #3
PWM4	DuPont 4 pin position 4 (purple)	Motor #4
PWM5	DuPont 3 pin	Right wing servo
PWM6	DuPont 3 pin	Left wing servo
PWM7	DuPont 3 pin	Pusher motor thrust
PWM8	DuPont 3 pin (1 loaded)	Pusher motor reverse
AUX1	DuPont 3 pin	*Stealth switch control
AUX2	DuPont 3 pin	
AUX3	DuPont 3 pin	*ISR camera mount retract
AUX4	DuPont 3 pin	
AUX5	DuPont 3 pin	*Camera trigger port 1 or Payload Drop Mechanism
AUX6	DuPont 3 pin	*Camera trigger port 2
Power C	Molex Mili-Grid 6 pin	Power module
Telem 1	JSH-GH 6 pin	TRIP5 COM1 on #VIEW Radio UART0 on others
Telem 2	JSH-GH 6 pin	*ADS-B receiver
UART 4	JSH-GH 6 pin	*Auxiliary telemetry or Ruggedized GPS
GPS	JSH-GH 10 pin	GPS

*Optional components

DELTAQUAD PRO #VIEW

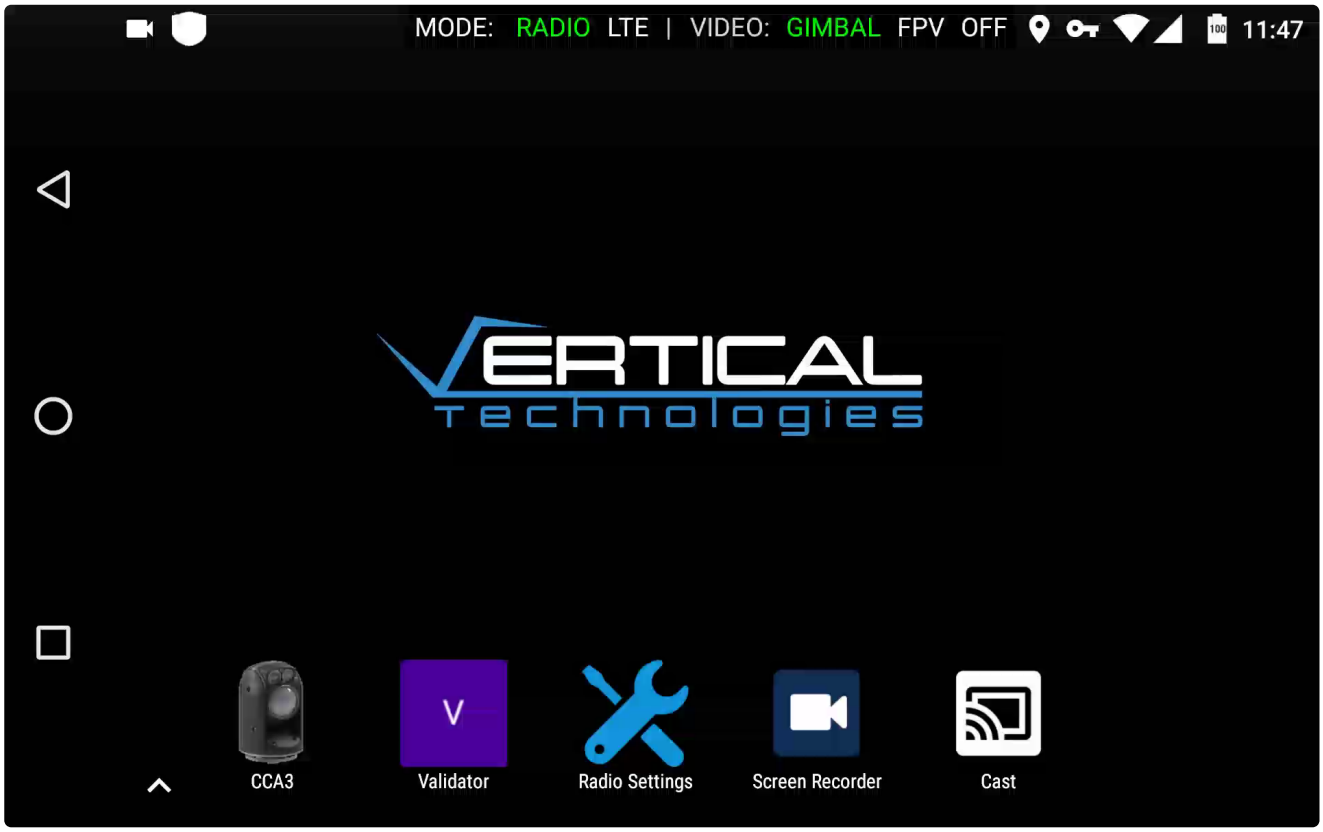
DeltaQuad Controller

Introduction

Your DeltaQuad Pro #VIEW comes with the DeltaQuad Controller. The DeltaQuad controller provides the communication link between your UAV and the ground systems.

Getting started

To connect your UAV to the DeltaQuad controller simply switch on the UAV and press and hold the POWER button on the controller for 3 seconds. Once the controller is booted up, the main menu will display.



Before launching your flight control system it is recommended to connect the controller to a mobile hotspot or Wi-Fi network, The controller uses internet connectivity to load satellite maps and for LTE connectivity to the UAV. The DeltaQuad controller needs to be connected to a 5Ghz mobile hotspot or WiFi network. As the main communication link for the controller is based on 2.4 GHz, these networks will not be displayed. When using a mobile phone hotspot please make sure you configure the hotspot for 5Ghz.

At the top of the screen, you will find the data link bar.

The data link bar will always remain visible and allows you to control the type of transmission and select the active camera feed. The available modes will display in white, and the currently active mode will display in green.

- MODES:
  - RADIO: This mode uses the internal radio system. The radio system is capable of transmission ranges up to 30KM, or up to 50KM when your system is equipped with the booster package.
  - LTE: This mode uses mobile network over a VPN-secured data link. To use LTE mode the following needs to be activated:
    - A SIM card needs to be installed inside the UAV. The LTE dongle is located in the nose section of the vehicle and can be accessed when the battery is disconnected. Make sure the sim card has sufficient data available and that it is not secured with a pin code. To test the connectivity of your LTE dongle with your sim card you can insert the dongle into a Windows-based laptop. After approximately 1 minute a webpage will open with the dongle settings and status.

    - The DeltaQuad controller needs to be connected to a WiFi network or mobile hotspot.
- VIDEO FEEDS:
  - GIMBAL: This is the Nighthawk2 camera gimbal feed. Activate this feed when deploying the Nighthawk2 Camera gimbal.
  - FPV: This is the static nose camera feed. While the gimbal is retracted it is recommended to use this feed.
  - OFF: This disables both feeds and stops any data consumption. If the data link becomes intermittent it is recommended to disable the video feeds to remain connected to your UAV.

For more information please refer to the Transmission Modes & Stream Rates section

Starting the UAV control system

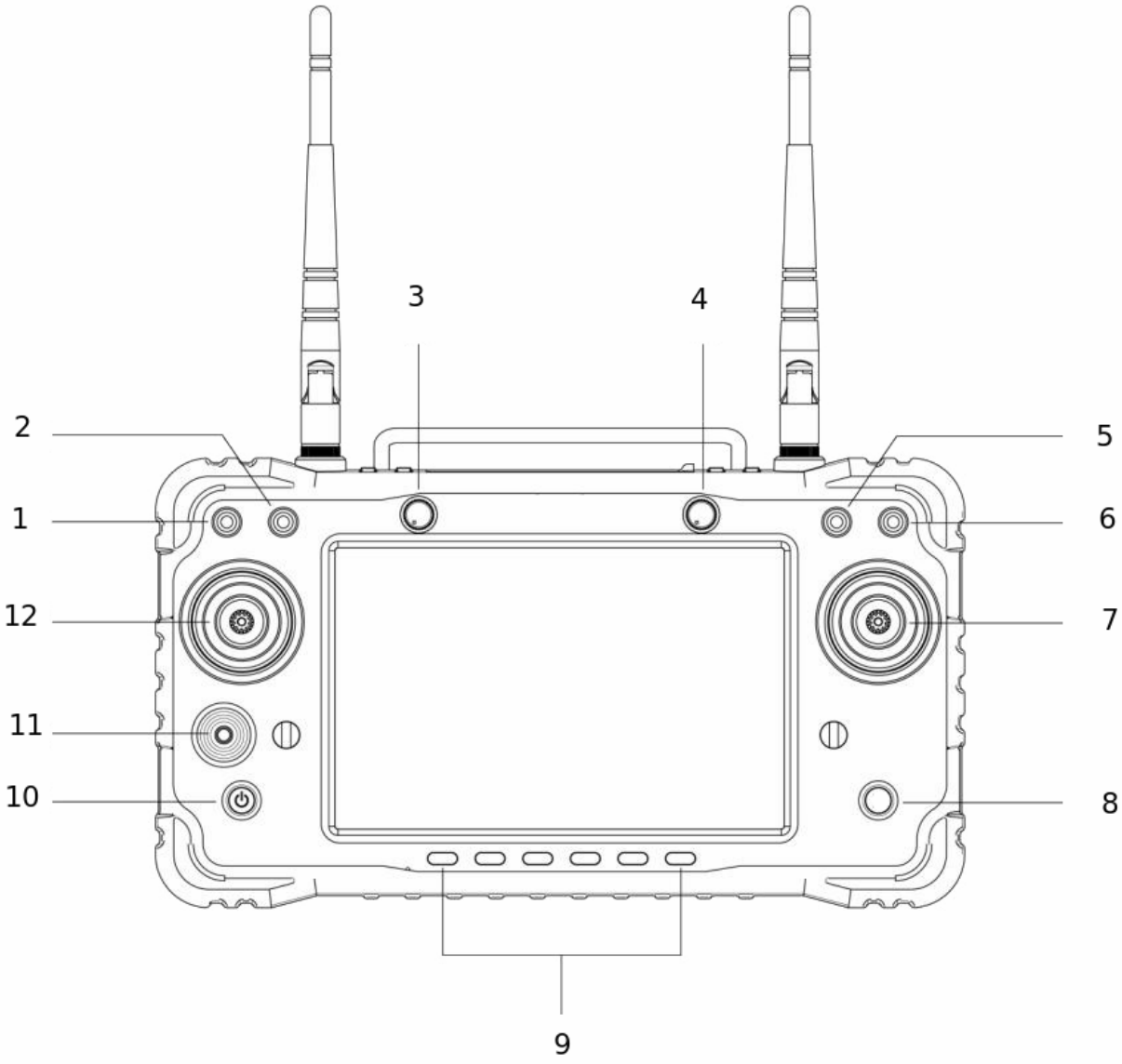
> ⓘ Before takeoff, always center all switches, and turn all dials to the left.

From the main menu launch the CCA3 app. This application, based on QGroundControl, is specifically designed for compatibility with your Nighthawk2 camera system.

From the CCA3 app, you will be able to plan your initial mission. Missions are always planned to ensure the vehicle has a predefined takeoff and landing pattern. Even when you intend to manually control the UAV or control the UAV using repositioning or target following commands, it is recommended to plan a mission for takeoff and landing.

Please review the mission planning section for detailed information on how to plan a mission.

Overview of the buttons


3
4
2
5
1
6
12
7
11
10
8
9

Number	Type	Function
1	3 position switch **FLIGHT MODE**	UP: Position flight mode CENTER: neutral - no functic DOWN: Mission flight mode
2	3 position switch **RETURN**	UP: Return flight mode CENTER: neutral - no functic DOWN: neutral - no function
3	Dial **FLIGHT SPEED**	Left: minimum flight speed Right: maximum flight speed
4	Dial	Not assigned
5	3 position switch	Not assigned
6	3 position switch **FOLLOW**	UP: Activate object following CENTER: deactivate object following DOWN: deactivate object following
7	Joystick	**In hover mode** Stick up: move forward Stick down: move backward Stick left: move left Stick right: move right **In fixed-wing mode** Stick up: descend (nose dow Stick down: climb (nose up) Stick left: bank left Stick right: bank right
8	Push button **RETRACT/ DEPLOY CAMERA**	Not active (light off): retract camera gimbal Active (light on): deploy came gimbal (when armed) Press and hold (light blinking force deploy *RETRACT BEFORE LANDI*
9	A to F push buttons **LTE STREAM RATE**	LTE stream rate control More information
10	Push button **POWER**	Press and hold: power on/off Press: screen on/off

11	Joystick	UP: Zoom in DOWN: Zoom out
12	Joystick	**In hover mode** Stick up: climb Stick down: descend Stick left: yaw left Stick right: yaw right **In fixed-wing mode** Stick up: gimbal up Stick down: gimbal down Stick left: gimbal left Stick right: gimbal right

Shutting down & charging the controller

The DeltaQuad Controller can operate continuously for approximately 6 hours. If more operation time is required, the controller can be charged during operation.

To charge the controller, open the rubber cover between the antennas and attach the provided USB charger to the USB-C port. The controller requires high-voltage charging. Standard USB chargers or USB sockets from laptops are not always capable of providing high voltage, but they will extend the battery life of the controller.

To shut down the controller, press and hold the power button until the shutdown menu appears. Select "Power off" to shut down the controller.

Booster Package and Antenna Installation

If your DeltaQuad Pro #VIEW comes with the Booster Package you can follow these instructions for installation.

The DeltaQuad booster package will increase the operational range of the DeltaQuad Controller up to 50 km. The package consists of an easy-to-remove panel antenna, an 8-watt ground booster with a power bank, and a 3-watt booster inside the UAV.

The DeltaQuad Controller will also include the standard antennas for omnidirectional use of up to 30 km.

The following video shows the installation of the booster antenna on the DeltaQuad Controller.

How to install the Booster Antenna on the DeltaQuad Controller.

Step 1 - Make sure the DeltaQuad Controller is turned off!

> *NOTE*: Before detaching the omnidirectional antennas, please make sure that your DeltaQuad Controller is turned off!
>
> Having the DeltaQuad Controller powered on without the antennas installed will cause damage to the radio module. This will render your controller unusable.

Step 2 - For the installation, you need (from left to right).

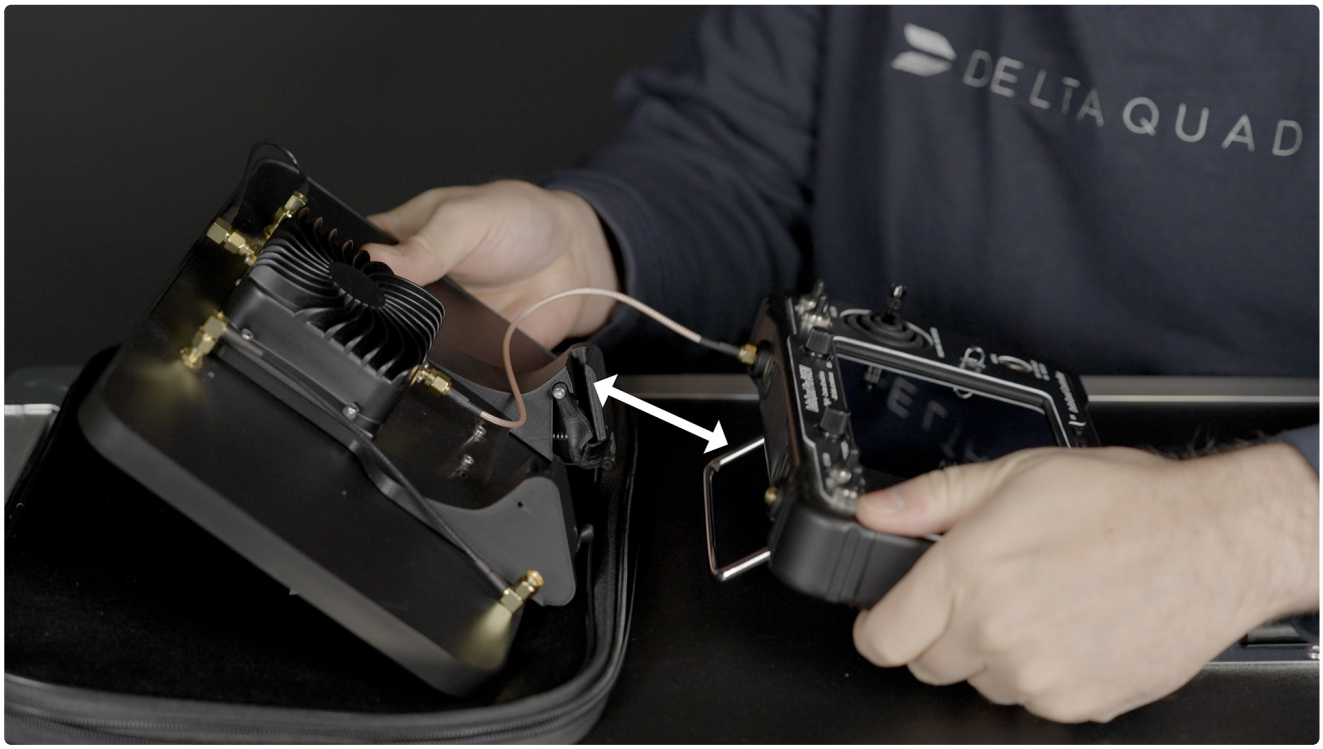
1. Booster for the DeltaQuad Controller
2. DeltaQuad Controller
3. Open-end wrench
4. Power bank
5. Power cable

Step 3 - Remove the two omnidirectional antennas at the top of the controller by turning them at the base of the antenna counterclockwise.

Step 4 - Lay the booster face down on a flat surface.

Step 5 - Connect the copper-colored SMA cable to the right SMA antenna connection of the controller.

Step 6 - Slide the handle of the controller into the dedicated holding mechanism on the booster.



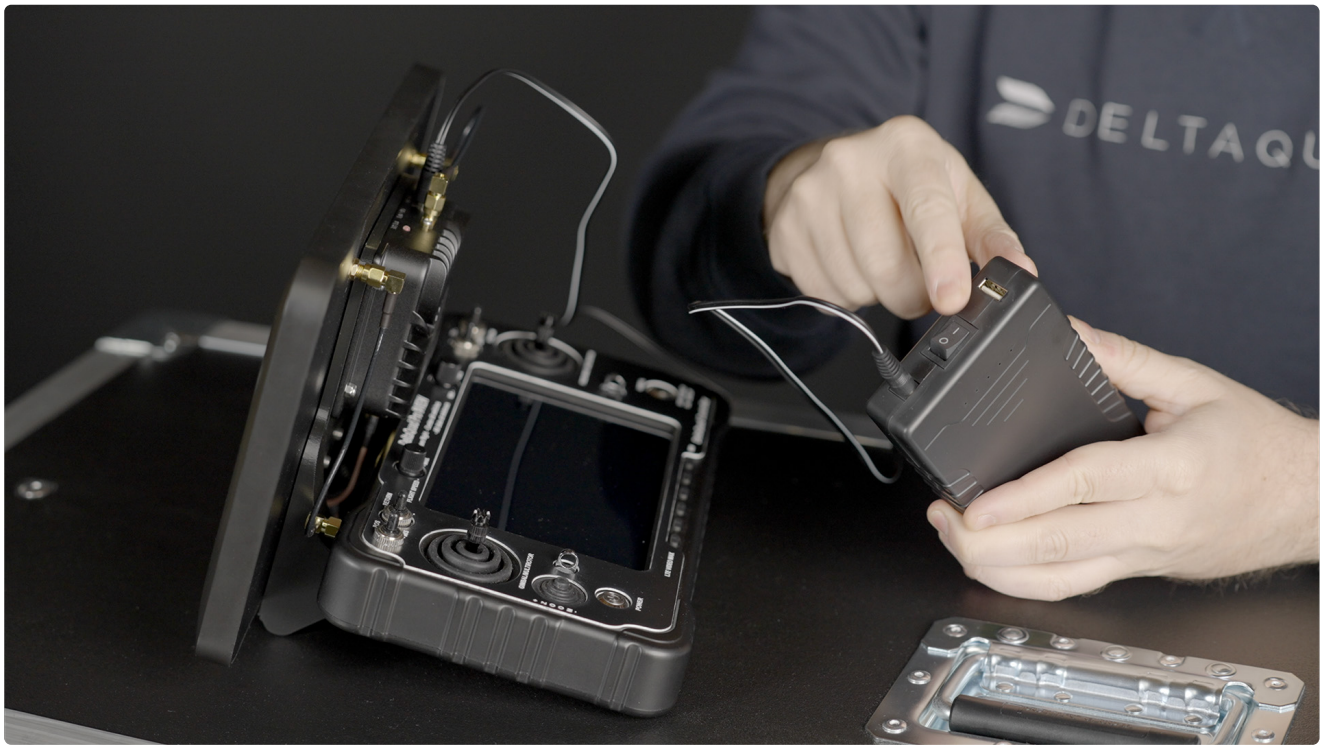
Step 7 - Connect the left black-colored SMA cable to the left SMA antenna connection of the controller and tighten it with the open-end wrench.

You now installed the booster antenna on the DeltaQuad Controller.

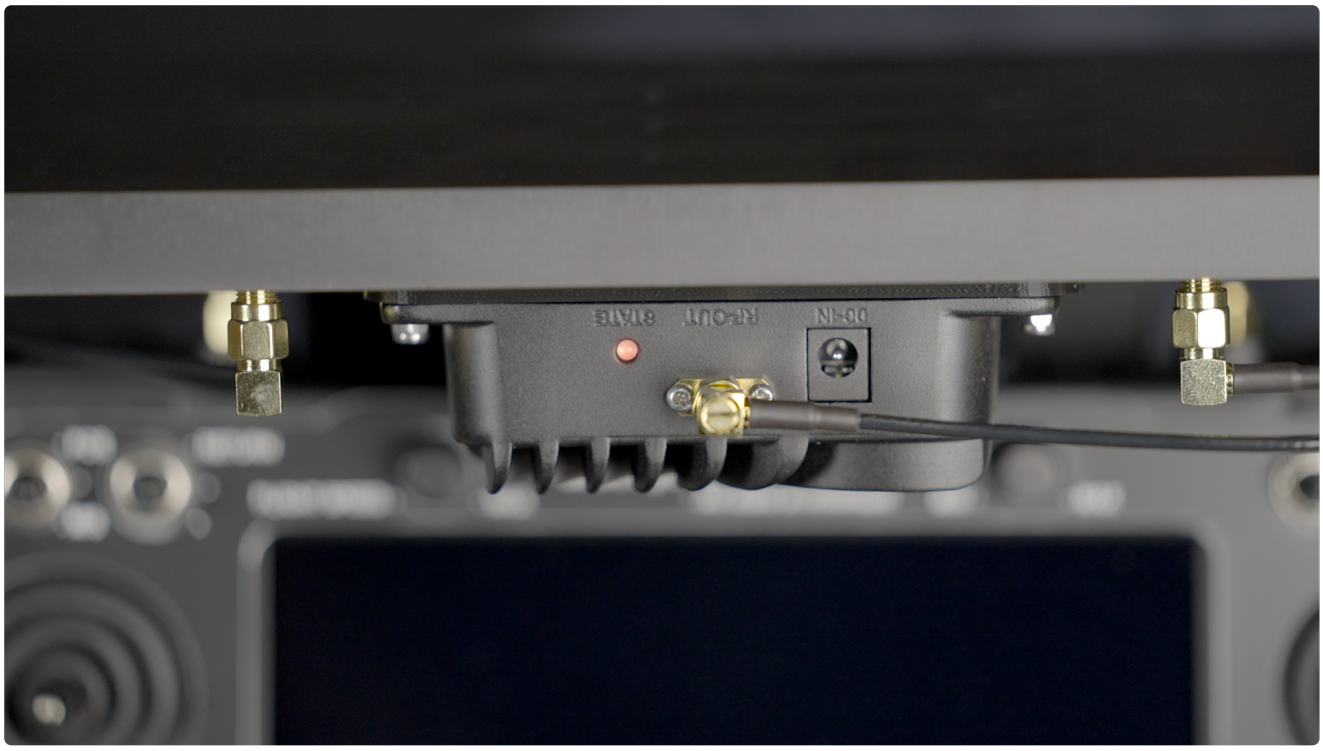
> *NOTE*: To work properly, the booster antenna needs to be powered with the included power bank.

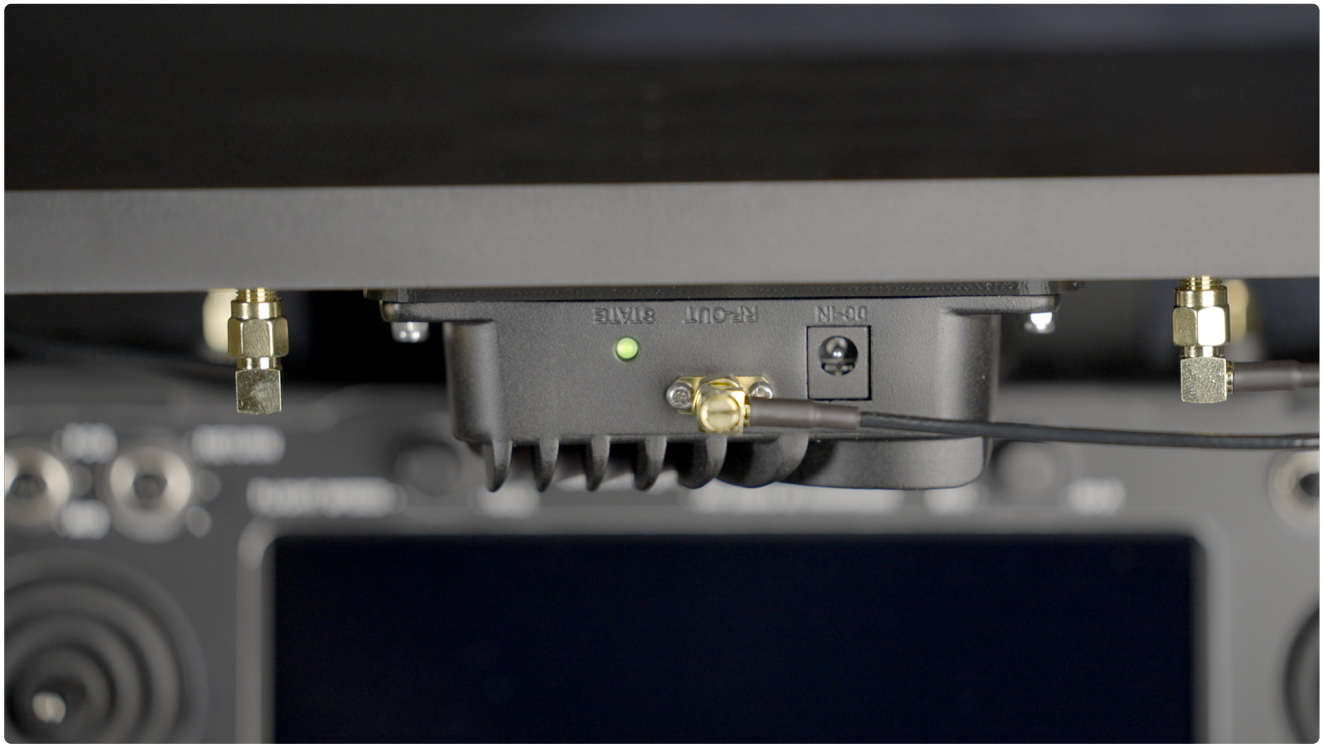
Step 9 - Connect the cable of the power bank to the top side of the booster.

Step 10 - Connect the other side of the cable to the power bank and switch it on.



Step 11 - When turned on the LED at the top of the booster will be red. When connected to the DeltaQuad it will be green.





NOTE: For the disassembly, please follow the steps in reverse order.

Always make sure that the DeltaQuad Controller is turned off when disconnecting the antennas or antenna cables.

When detaching the booster antenna, push the levers of the closing mechanism away from the DeltaQuad Controller. By doing so, the booster antenna will slide off the handle by itself.

During this process, hold the booster antenna at all times as the copper-colored SMA cable is still connected to the DeltaQuad Controller. Any strain on this cable and its connectors can damage the hardware.

Controlling the vehicle

This section describes how to control your vehicle using the DeltaQuad Controller.

Introduction

The CCA3 Application that is installed on your DeltaQuad Controller is the main application to control your UAV and camera gimbal. The application was specifically designed for the Nighthawk2 camera gimbal. Before launching the CCA3 application please carefully review the DeltaQuad Controller section

Mission planning

Before starting a flight a mission needs to be planned to instruct the vehicle on the takeoff and landing patterns. You can choose to plan a full surveillance mission, or only plan a takeoff and landing mission. It is possible to take control of the vehicle after takeoff and initiate a Return command when the mission has ended. The vehicle will use the landing pattern from the mission plan to execute a return command.

When starting the CCA3 application the FLY view is displayed.

From the FLY view, you will need to switch to the PLAN view to plan your mission. You can switch to the PLAN view by pressing the PLAN button on the left-side command bar.

Please review the mission planning section for detailed information on planning a mission.

Launching your vehicle

Once your mission is uploaded you can return to the FLY view by pressing the FLY button in the left side command bar. Once you have performed the preflight checks you can start the mission by sliding to confirm the Start Mission command. If the slider is not displayed you can press the ACTION button in the left side command bar and choose "start mission". When sliding to confirm the takeoff your vehicle will start its motors and takeoff.

Before starting your first flight, you will need to be familiar with the DeltaQuad Controller button and joystick functions as described in the DeltaQuad Controller section.

> *NOTE: Before launching, make sure all switches are in their center position, all dials are turned all the way to the left, and the deploy button is switched off.*

Operating your vehicle

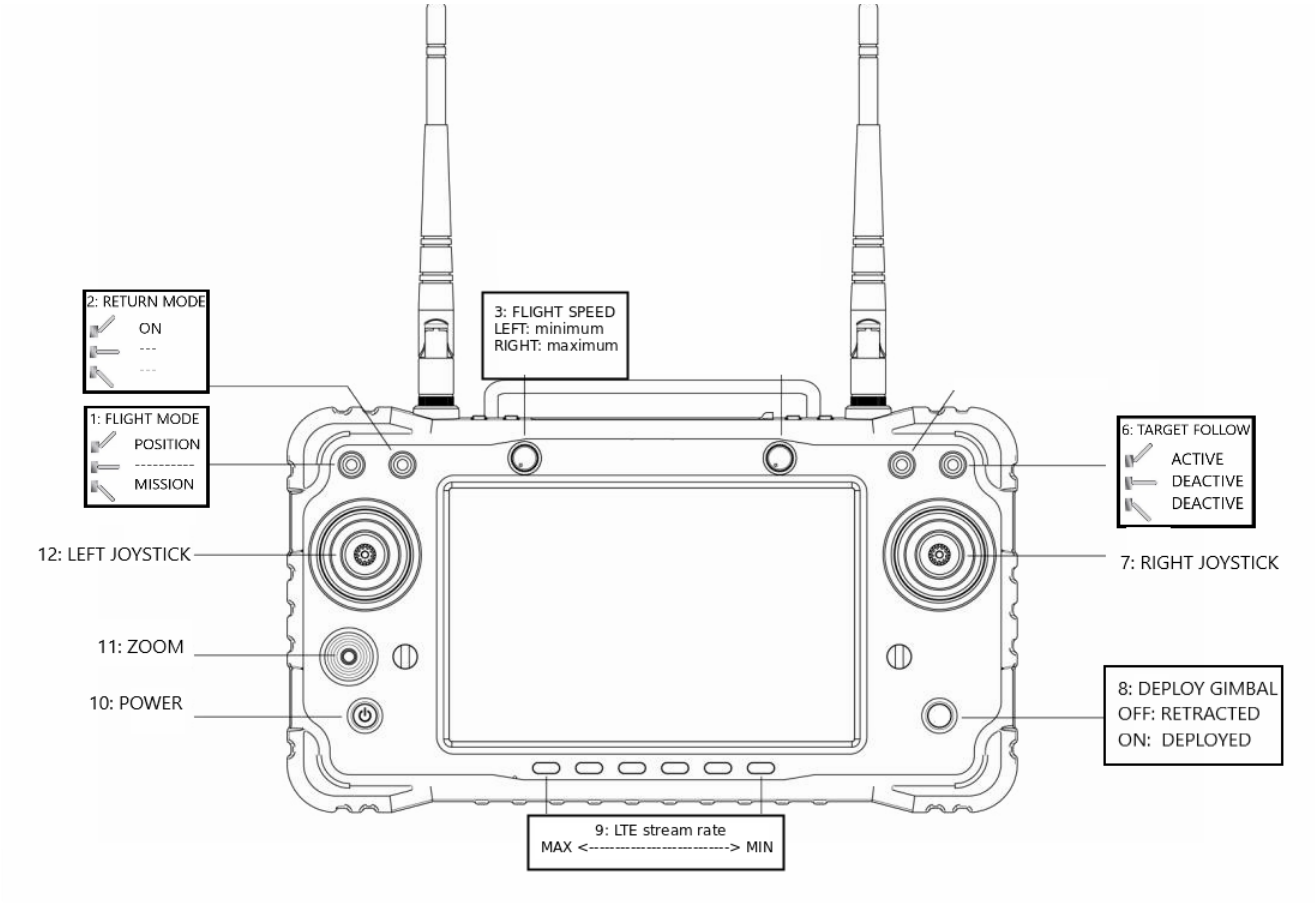
Once the vehicle is launched and has transitioned to fixed-wing flight mode, you can control the flight of your vehicle through the following methods.

Repositioning the vehicle

While the vehicle is in flight, you can tap anywhere on the satellite map and choose "Goto location".

After sliding to confirm the reposition command, the vehicle will enter "HOLD" flight mode, fly towards the indicated location, and circle the location clockwise in a radius of 100m.

Joystick control



The vehicle can be controlled using the right-side joystick (7). To activate the joystick control, switch the flight mode switch (1) to POSITION mode. In this mode, the vehicle will fly in a straight line at its current altitude until a joystick command is received.

Moving the joystick left or right will make the vehicle change direction.

Moving the joystick forward or backward controls the altitude of the vehicle. A forward (up) joystick movement moves the nose of the vehicle down and decreases altitude. A backward (down) joystick movement pulls the nose of the vehicle up and increases altitude.

If the vehicle loses connection to the DeltaQuad Controller while it is flying in POSITION mode, it will automatically return home, regardless of the Safety settings.

> *NOTE: for inexperienced pilots, the joystick controls can seem counterintuitive. It is recommended to practice joystick operation in close proximity while flying at sufficient altitude.*

Target following

While the vehicle is flying a mission, target following mode can be used to reposition the vehicle by actively following a target.

For more information on target following please refer to the Target tracking & following section.

Changing flight speed

The DeltaQuad Pro #VIEW is configured for a standard cruise speed of +- 16 meters per second at sea level. As the altitude increases, the air density reduces and the speed is increased. Using the flight speed dial (3), you can increase the flight speed.

> *NOTE: increasing your flight speed can significantly reduce the maximum flight time. Always start your flight with the flight speed dial at the minimum value, only increase as needed.*

Changing altitude

While the vehicle is in POSITION, HOLD, or TARGET FOLLOWING mode, the altitude can be changed by tapping on the ACTION button in the FLY screen and selecting "change altitude". A vertical slider will appear on the right side of the screen that allows you to select a new altitude. Once the correct altitude is selected, slide the "change altitude" slider to confirm the altitude change command.

When the vehicle is following a mission path, it will always track the altitude as defined in the mission plan. When resuming a mission the vehicle will immediately change the altitude to match the currently active waypoint.

Resuming a mission

When the vehicle is in POSITION, HOLD, or TARGET FOLLOWING mode, the mission can be resumed by moving the flight mode switch to the MISSION position. Alternatively, the mission can be resumed by tapping on the ACTION button on the FLY screen and selecting "resume mission".

Please make sure to disengage the target following switch before returning to MISSION flight mode.

Returning the vehicle

At any point in the flight, the vehicle can be returned by activating the RETURN switch. Alternatively, RETURN mode can be activated by tapping on the RETURN button on the FLY screen, and sliding to confirm the command.

In RETURN mode, the vehicle will immediately fly towards the landing pattern that was defined in the mission. The landing pattern consists of a circle-to-altitude item, a direction and altitude on which to exit the circle, and a landing coordinate.

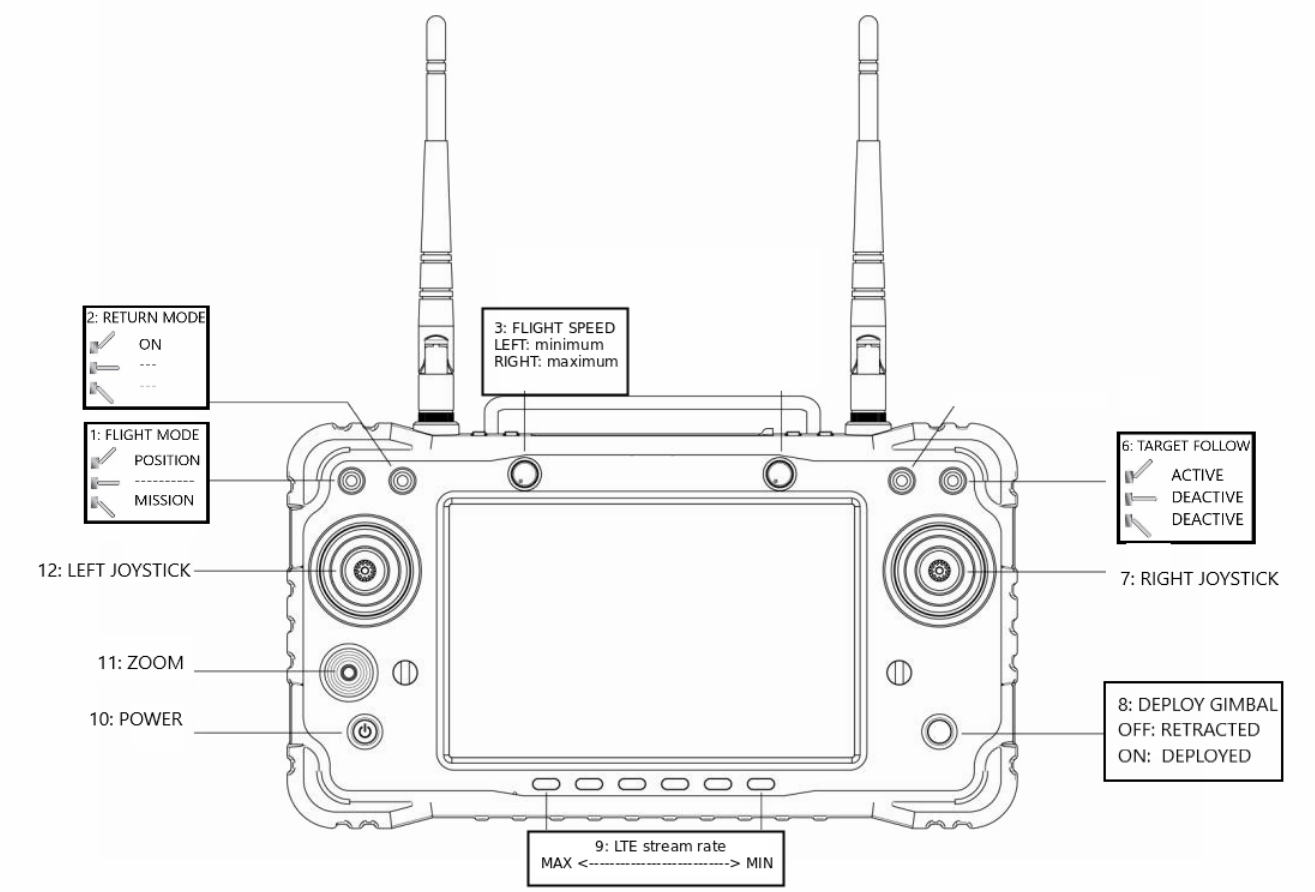
When the RETURN mode is activated, the vehicle will fly at its current altitude towards the 'circle to altitude' part of the landing pattern. When reaching this location the vehicle will circle down to the indicated altitude, and complete the circle until it has reached the indicated exit heading of the circle. It will then proceed toward the landing coordinates, transition to multirotor flight mode, and land in the indicated position.

> *NOTE: Always make sure your camera gimbal is retracted before the vehicle enters the landing pattern.*

Controlling the vehicle in multirotor mode

During takeoff or landing, your vehicle is in multirotor mode. Multirotor mode means the 4 motors for Vertical takeoff and Landing are activated.

To take control of the vehicle in multirotor mode, change the flight mode switch to POSITION mode. In this mode, the vehicle will hold its position and altitude until joystick commands are received.



The LEFT main joystick (12) controls the vehicle's altitude and heading. Moving the joystick UP will increase the altitude. Moving the joystick down will decrease the altitude. Moving the joystick left or right changes the heading (yaw) of the vehicle.

The RIGHT joystick (7) controls the position of the vehicle. Moving this joystick, forward, backward, left, or right changes the position of the vehicle relative to its current heading.

> *NOTE: it is recommended to keep the camera gimbal retracted during multirotor flight as the left joystick will control both the vehicle and the camera gimbal at the same time.*

Controlling the camera

This section describes how to control the camera gimbal.

Deploying and retracting the gimbal

The Deploy Gimbal button (8) on your controller is used to deploy and retract the gimbal. The button can be pressed once to deploy the gimbal when the vehicle is flying. The light around the button will light up indicating it has switched the mode to Deployed. If the vehicle is not flying the command will be ignored to prevent damage to the camera.

For ground testing purposes you can force deploy the gimbal. This is achieved by pressing and holding the deploy button. The light around the button will blink fast indicating the Force Deploy mode is active. Make sure you place the vehicle in such a way that the gimbal can safely deploy before using this function.

When the vehicle has transitioned into fixed-wing mode you may deploy the camera gimbal using the deploy gimbal button. It is recommended not to deploy the camera gimbal until the vehicle has passed its takeoff waypoint.

> *NOTE: Never deploy the camera gimbal while the vehicle is sitting on the ground. This may damage the camera gimbal.*

The FLY view

When the camera is deployed the video feed will be visible either in the main screen or in the small video screen in the bottom-left section of the FLY view. You can switch the main screen between the satellite map and video feed by tapping on the small screen in the bottom-left corner.

On the right side of the fly screen, the camera controls are displayed. These controls allow you to change the mode of the Nighthawk2 camera system. The controls can be hidden by pressing the arrow inside the circle above the controls window.

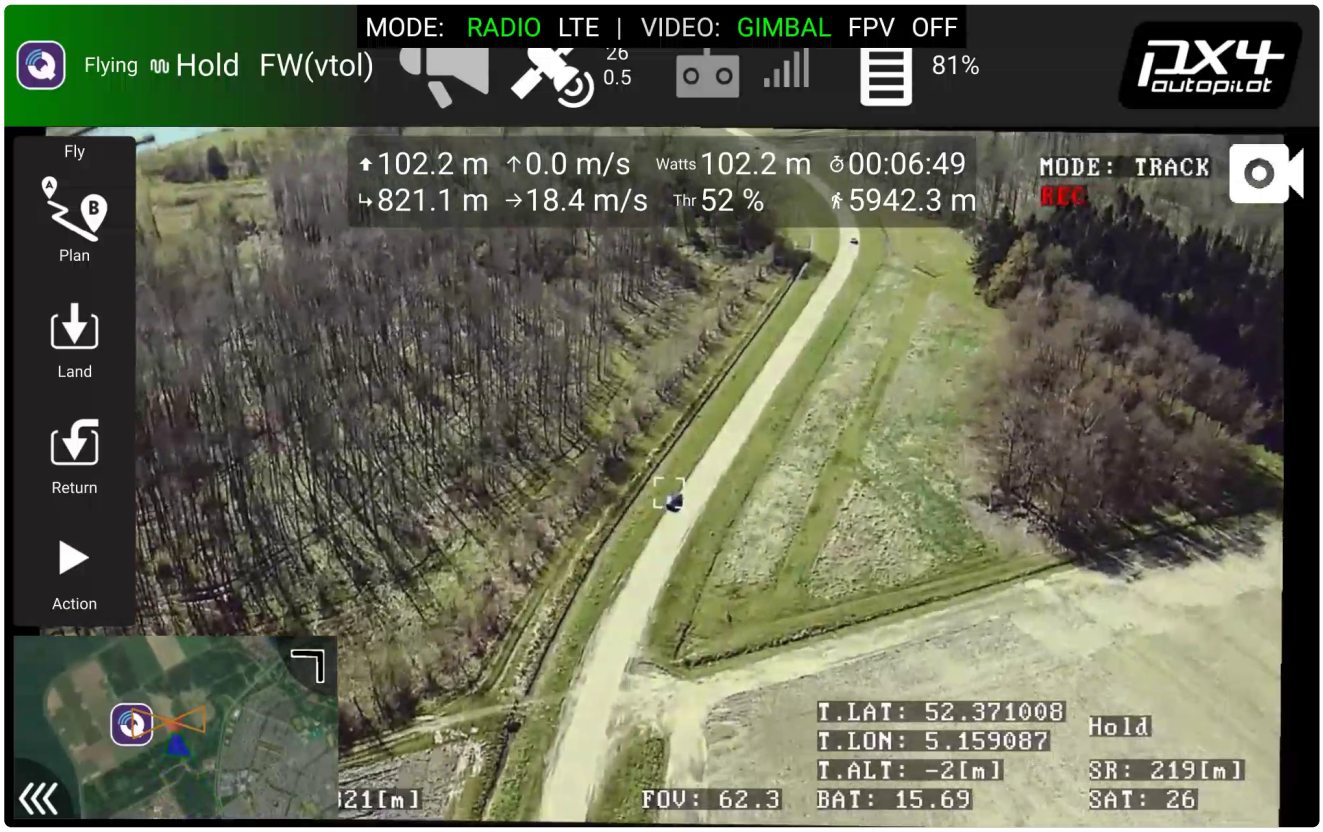
The camera controls window allows you to set the following camera modes:

- OBS: In this mode, the camera will hold its position relative to the vehicle's movement. The joystick controls the camera.
- GRR: In this mode, the camera will hold its position relative to the ground. This is the recommended mode for camera control. The joystick controls the camera.
- STOW: In this mode, the camera will point toward the nose of the vehicle. The joysticks are disabled in this mode.
- DAY: This activates the RGB (normal color video) mode of the camera
- THERMAL: This activates the Infrared camera for night vision and seeing between foliage.
- NUC: After engaging the THERMAL mode, the IR camera needs to be calibrated for a clear view. NUC performs this calibration which takes about 3 seconds.
- Color.P: This activates the color palette mode for the thermal camera
- B/W.P: This activates the black-and-white palette mode for the thermal camera
- RETRACT: This retracts or deploys the camera gimbal. It is recommended to use the deploy button on the controller instead of this function.
- REC ON/OFF: This activates or deactivates onboard SD card recording. This function only works when an SD card is installed in the camera control computer which is located next to the camera.

Using the DeltaQuad controller

The DeltaQuad Controller can be used to control the camera gimbal. For a full overview of the available joystick controls and switch functions, please read the DeltaQuad Controller section.

On Screen Display

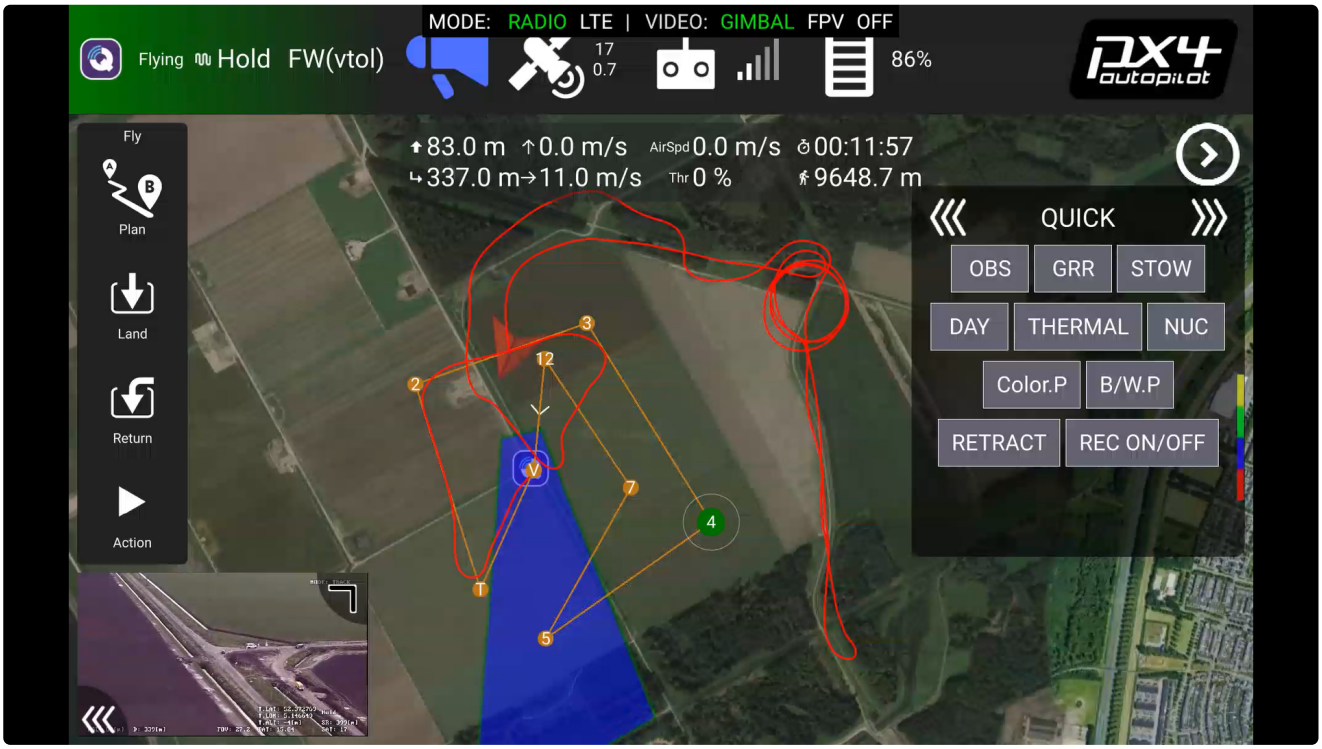


The video feed of the camera gimbal is equipped with On Screen Display (OSD) telemetry information. This information contains the following:

Name	Location	Function
MODE	Top right	Current gimbal mode TRACK: Actively tracking an object For other modes see above
REC	Top right	Onboard recording active
T.LAT	Bottom right	Target latitude (can be set to MGRS)
T.LON	Bottom right	Target longitude (can be set t MGRS)
T.ALT	Bottom right	Target altitude MSL
SR	Bottom right	Slant Range (distance to targ in meters)
SAT	Bottom right	Number of satellites
FOV	Bottom center	Field Of View 3.0 is fully zoomed in 62.3 is fully zoomed out
D	Bottom left	Distance from home in meter

Map integration

While the camera is deployed, the satellite map on the FLY screen will display the current Field Of View for the camera. The blue area in the map shows the current viewing area of the camera based on its position and zoom.


MODE: RADIO LTE | VIDEO: GIMBAL FPV OFF
Flying
Hold
FW(vtol)
17
0.7
86%
PX4 autopilot
Fly
Plan
Land
Return
Action
83.0 m
0.0 m/s
AirSpd 0.0 m/s
00:11:57
337.0 m
11.0 m/s
Thr 0 %
9648.7 m
QUICK
OBS
GRR
STOW
DAY
THERMAL
NUC
Color.P
B/W.P
RETRACT
REC ON/OFF

Target tracking & following

The DeltaQuad Pro #VIEW is capable of tracking and/or following static or moving objects such as cars, humans or other UAVs.

Target Tracking

Target tracking is the mode where the camera will remain focused on a target. The target can be moving or static. To activate target tracking simply tap anywhere in the video feed and the camera will enter tracking mode and track the target that was tapped on. You can tap several times to fine-tune your target tracking mode.

When a target is being tracked, a white square is displayed on the object that is being tracked. By moving the camera joystick, tracking is disabled and the camera returns to the previous mode.

> TIP: The camera can rotate 360 degrees. To avoid reaching the maximum rotation angle it is recommended to fly towards, follow, or directly above a tracked object.

Target following

Target following is the mode where the vehicle actively follows a tracked target. To engage target following mode you will first need to track a target. Once a target is locked you can engage the target following switch as described in the DeltaQuad Controller section. The system will start following a target when these conditions are met:

- A target is actively being tracked
- The target is less than 2,000 m away from the vehicle
- The target following switch is set to active

When first entering target following mode the vehicle will switch its flight mode to "HOLD" mode. The target following system will then issue reposition commands every 1.5 seconds for as long as the target following conditions are met. If the conditions are no longer met the vehicle will remain circling the position of the last known target location. If the tracked target was lost you can re-engage target tracking by simply tapping on the object in the video feed, the system will follow any target selected while the target following switch is engaged and the conditions are met.

If the vehicle is flying above the tracked target, or if the vehicle is flying faster than the tracked target, it will circle above the target keeping the target in view at all times.

If the target following switch is disengaged the vehicle will start circling its current position.

Transmission modes and stream rates

This section describes how the transmission modes and stream rates are controlled.

Transmission mode

Controlling the active transmission mode is done by using the data link bar. The data link bar is displayed in the top of the screen and will always remain visible.

The available modes will display in white, and the currently active mode will display in green.

- MODES:
  - RADIO: This mode uses the internal radio system. The radio system is capable of transmission ranges up to 30KM, or up to 50KM when your system is equipped with the booster package.
  - LTE: This mode uses the mobile network over a VPN-secured data link. To use LTE mode the following needs to be activated:
    - A SIM card needs to be installed inside the UAV. The LTE dongle is located in the nose section of the vehicle and can be accessed when the battery is disconnected. Make sure the sim card has sufficient data available and that it is not secured with a pin-code. To test the connectivity of your LTE dongle with your sim card you can insert the dongle into a Windows-based laptop. After approximately 1 minute a webpage will open with the dongle settings and status.
    - The DeltaQuad controller needs to be connected to a WiFi network or mobile hotspot.
- VIDEO FEEDS:
  - GIMBAL: This is the Nighthawk2 camera gimbal feed. Activate this feed when deploying the Nighthawk2 Camera gimbal.
  - FPV: This is the static nose camera feed. While the gimbal is retracted it is recommended to use this feed.
  - OFF: This disables both feeds and stops any data consumption. If the data link becomes intermittent it is recommended to disable the video feeds to remain connected to your UAV.

Stream rates

The DeltaQuad can control the stream rate of the Nighthawk2 camera gimbal. A high stream rate provides high-quality video and a low stream rate provides lower-quality video.

In RADIO mode

When the transmission mode is set to Radio, the system constantly monitors the available bandwidth and

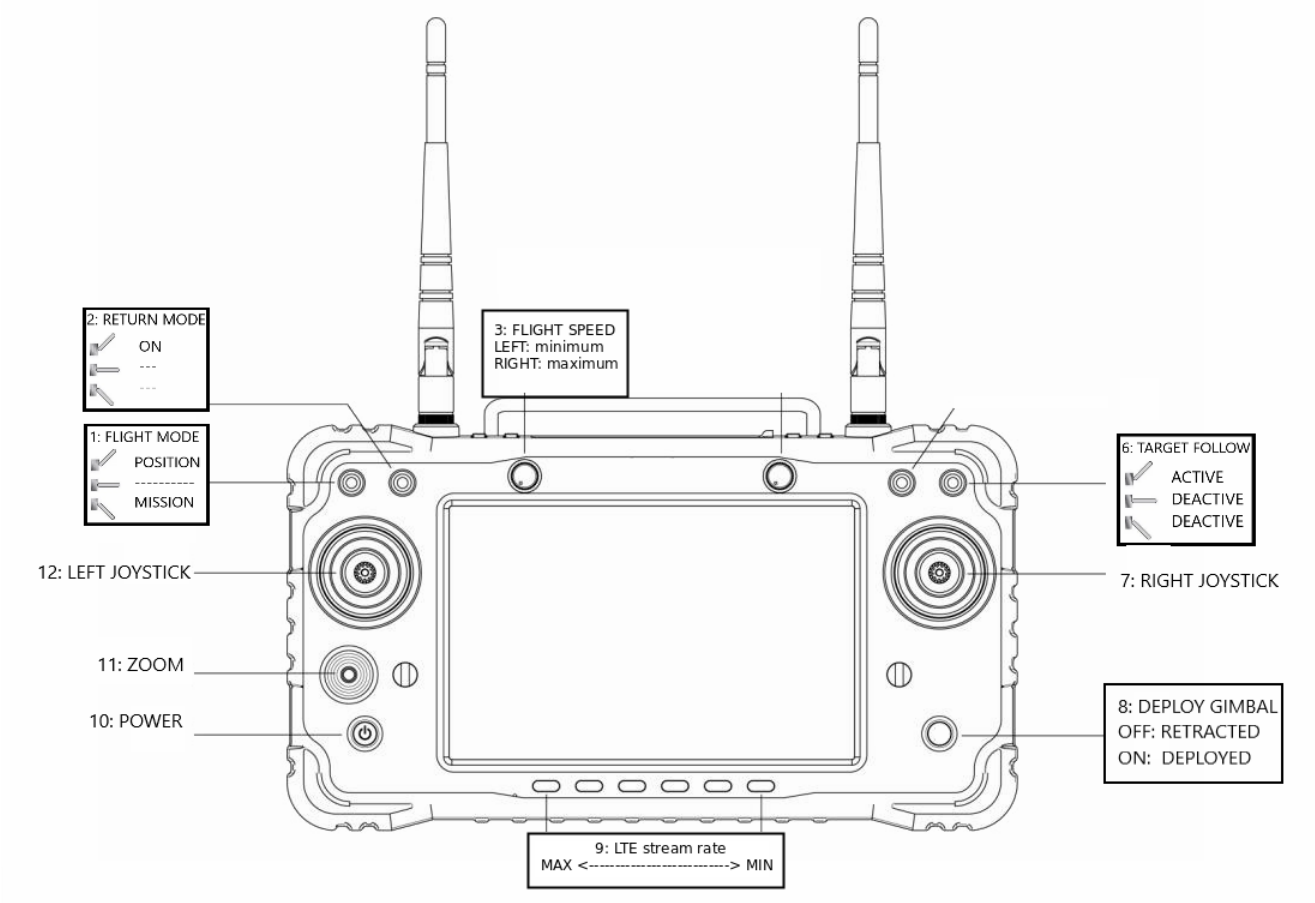
automatically tunes the camera stream to provide the best possible quality given the available bandwidth. This process is automatic and no manual input is required to tune the stream rate.

In LTE mode

When the transmission mode is set to LTE, the system can not automatically determine the available bandwidth. For LTE-based transmission, both the vehicle and the DeltaQuad Controller require an internet connection. The available bandwidth in LTE mode depends on several factors such as:

- Distance from the cell tower
- Flight altitude
- Mobile network capabilities (3G/4G/LTE)
- VPN server proximity
- Network limitation

The DeltaQuad controller offers buttons that can control the stream rate while the vehicle is in LTE transmission mode. Stream rate control is only available for the Nighthawk2 Camera gimbal, it will not change the stream rate for the FPV nose camera.



The LTE stream rate buttons (9) are labeled A to F. When a button from this section is pressed, it will light

up to indicate the currently active mode. The stream rate is adjusted according to the selected button. Button A is the default mode and provides the highest stream rate. The following table provides approximate data rates for each of the buttons:

Button	Data rate
A	960 KB/s
B	800 KB/s
C	640 KB/s
D	480 KB/s
E	310 KB/s
F	150 KB/s

When flying on LTE-based transmission, and your data rate exceeds your available bandwidth, the video feed will become unstable or delayed. If this happens, you can lower the stream rate until the video feed is stable. You may also choose to lower the stream rate to save data.

Changing camera settings

Introduction

The Nighthawk2 camera gimbal is controlled by a dedicated board computer called the TRIP. The TRIP board computer controls most features of the camera gimbal system.

Logging in to the configuration website

To change the settings of your camera system, connect to your UAV with the DeltaQuad Controller. On the DeltaQuad Controller open the Firefox browser app, and navigate to http://192.168.144.201. This will open the login page to the TRIP camera board computer. The default username is 'admin' and the password is 'microcam'. You may change this as required.

> *NOTE: Changing settings other than those described in this manual can cause damage to your camera system.*

Roll Derotation

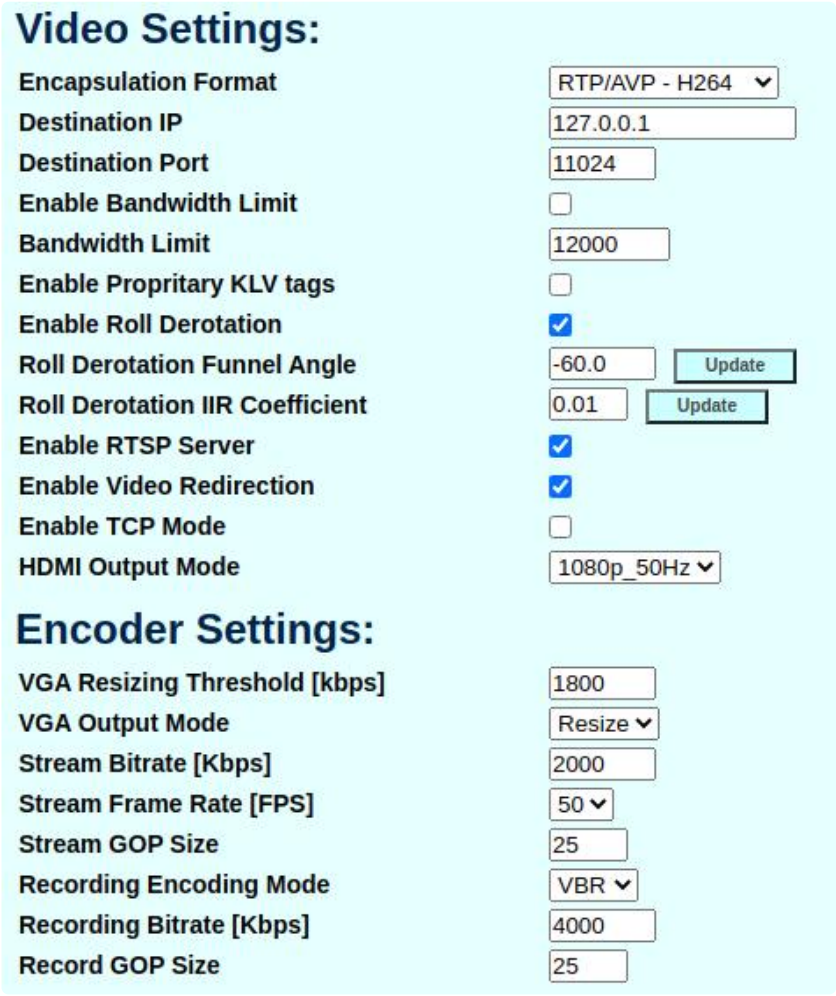
The camera is capable of keeping the video stream aligned with the horizon when the vehicle is banking. This is called Roll Derotation.

When roll derotation is active the video image displayed on the controller will rotate in such a way that the image remains level. The trade-off is that the video can show black corners when the vehicle is banking.

Roll Derotation enabled

Roll Derotation disabled

To enable or disable Roll Derotation select "Channel settings" and change the value of the checkbox next to "Enable Roll Derotation". After changing the values click on "UPDATE" at the bottom of the screen.



On Screen Display

The video feed contains an On Screen Display (OSD). This means that the video feed receives an overlay with telemetry and status information. The OSD overlay is visible in the video stream on the controller and on the onboard recorded video.

To change the settings of the OSD select "OSD Settings" and select the options you wish to display. The OSD coordinate system can be changed from WGS84 LAT/LON to the military standard MGRS system.


- General
- Network Settings
- Channel Settings
- Protocol Settings
- Tracker Settings
- Camera Settings
- OSD Settings
- RC Settings
- ALPR Settings
- LTE Settings
- Debug Settings
- System Settings
- System Status

OSD Settings:

OSD Mode	Operational
OSD Mini Map	Large - 200x200 px
Show Ground Crossing Info	☐
Show Craft GPS Info	☐
Show Craft Flight Mode	☐
Show Craft Air Speed	☐
Show Date & Time	☐
Daylight Savings Time (Adds 1 Hour)	☐
OSD Coordinate Format	WGS84
Low Battery Level [V]	12.0
50% Battery Level [V]	14.2

Update Reboot

Connecting a second screen

This section describes how to connect a second screen to your DeltaQuad Controller.

Introduction

The second screen function can be used to stream video to a local or even remote device. There are several methods of streaming the video feeds to a second screen which are described below.

The DeltaQuad Controller provides an RTSP-based video stream and a secondary telemetry link. The second screen will connect to the DeltaQuad Controller, not directly to the UAV. This is to prevent the UAV from having to use double the amount of bandwidth. It also enables screen sharing over LTE, even when the UAV is flying outside of LTE range, as long as the DeltaQuad Controller is connected to the LTE network.

The video feed displayed on the second screen is the video feed that has been activated by the pilot.

Using a WiFi hotspot

If your controller is connected to a 5ghz WiFi hotspot, a second device can connect to the same hotspot. For information on how to connect the DeltaQuad Controller to a WiFi hotspot, please see the DeltaQuad Controller section.

Once connected you will need to determine the IP address that was assigned to the controller by the WiFi hotspot. To do this you can open the Settings app, scroll down and select About Phone, and tap on Status. Here you will find the item "IP address" which shows the values for the IP addresses assigned by the hotspot. The value required is the sequence of 4 numbers separated by a dot. For example 192.168.43.124

The DeltaQuad Controller can also be used to host a WiFi hotspot. To enable the WiFi hotspot on the DeltaQuad Controller, enter the Android settings and activate the Mobile Hotspot. When the DeltaQuad Controller is hosting a mobile hotspot it will have no internet connectivity and LTE modes will be disabled.

The second device can be a Windows, Mac, or Linux-based laptop or tablet. The recommended software for viewing the video stream is VLC Media Player. To open the video stream launch VLC Media Player and select "media" -> "open network stream". In the "network URL" field enter the following address:

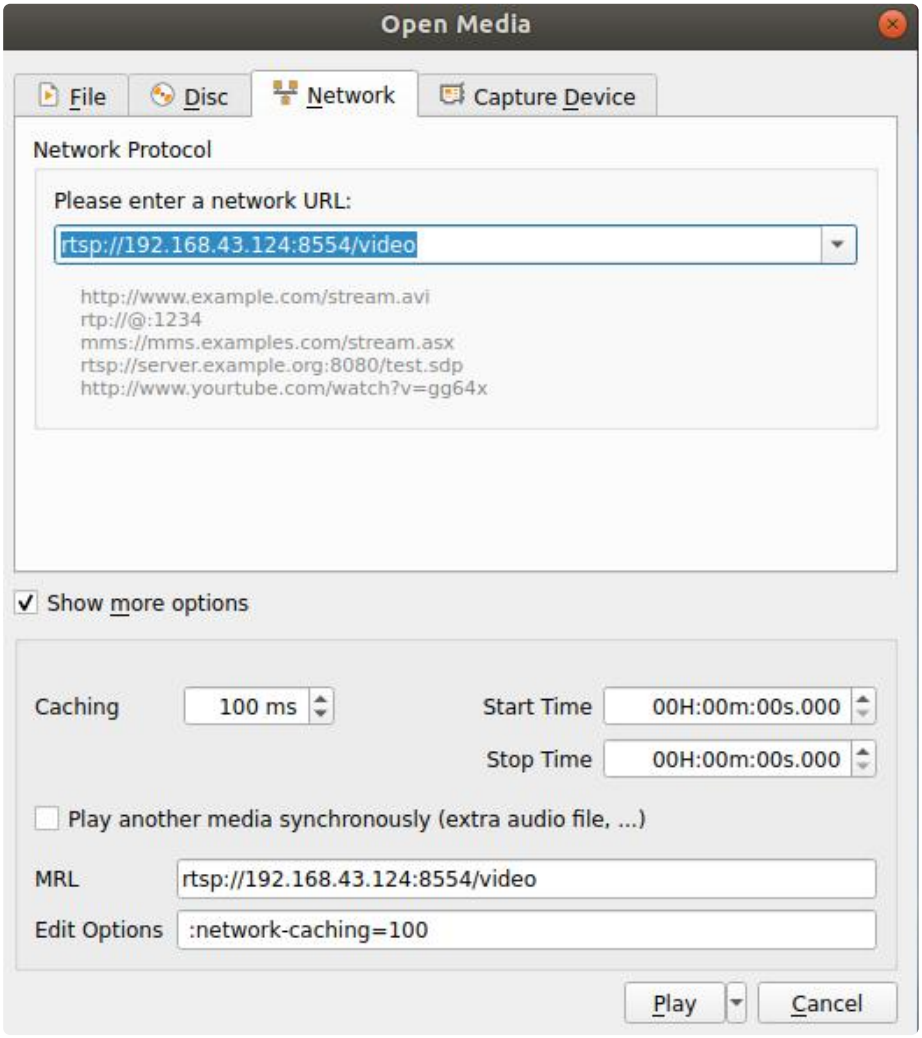
```
rtsp://[IP-ADDRESS]:8554/video
```

For example rtsp://192.168.43.124:8554/video

Select the checkbox "Show more settings"

Change "Caching" to 100 ms

Click "Play"



Remotely using the mobile network

You can attach your second screen to a DeltaQuad Controller using the mobile network. When your vehicle is shipped you will receive an email with account information that contains the VPN profile for your second screen. To use this VPN profile you will need to download and install the OpenVPN client.

When the VPN Client is installed, click on the VPN icon in the bottom right section of your taskbar. That will open the VPN client interface to import the VPN profile that was sent to you.

Once connected to the VPN network for your controller, you can retrieve the camera feed on your second device.

The second device can be a Windows, Mac, or Linux-based laptop or tablet. The recommended software for viewing the video stream is VLC Media Player. To open the video stream over VPN, launch VLC Media Player and select "media" -> "open network stream". In the "network URL" field enter any of the following addresses:

The active feed of the DeltaQuad Controller (recommended)

```
rtsp://100.96.1.34:8554/video
```

Directly to the UAV Camera Gimbal

```
rtsp://100.96.1.18:8554/cam1
```

Directly to the UAV FPV nose camera

```
rtsp://100.96.1.18:8554/cam3
```

Select the checkbox "Show more settings"
Change "Caching" to 100 ms
Click "Play"

> TIP: *It is recommended to connect to the active feed for the DeltaQuad Controller. This will prevent the mobile connection for the UAV to stream multiple video feeds and thus use double the bandwidth. It also allows the UAV to fly outside of mobile network range while the DeltaQuad Controller is connected to the UAV using RADIO mode. The DeltaQuad Controller can still provide VPN-based video streams to the second device in this mode.*

Using Screen Casting

Screen Casting can be used to replicate the display on the DeltaQuad Controller. The DeltaQuad Controller comes pre-installed with a Cast app on the home screen. When launching the Cast app, you will see a list of devices that support casting. Select the intended device and follow the instructions to enable casting on your remote screen.

Casting is based on Miracast and is supported on Windows, Mac, and certain Smart TV systems. To cast to a second screen, the second screen will need to be attached to the same WiFi network as the DeltaQuad Controller, or connected to the VPN network as described above.

On Windows 10 or later, you will need to enable the Wireless Display option. To do this, open the Windows settings and search for "projector settings". Follow the steps indicated to enable "Projecting to this PC". Once these steps have been completed, the Windows system will show in the Cast list of the DeltaQuad Controller.

Using the Camera Control Laptop

If you have purchased a Camera Control Laptop, you will be able to run the CCA3 application for both video and camera control on the Camera Control Laptop. This system comes with a joystick for camera control and offers a touch-screen for mission planning, UAV control, and Camera control.

After booting up the laptop you may choose to connect the laptop to the same WiFi hotspot as the DeltaQuad Controller or connect it to the Internet to enable VPN-based LTE connectivity to the DeltaQuad Controller.

From the home screen of the laptop, you launch the Connection Manager to choose a Local or VPN-based connection. After that, you can launch CCA3 to view and/or control the UAV and/or Camera Gimbal.

DELTAQUAD PRO #MAP

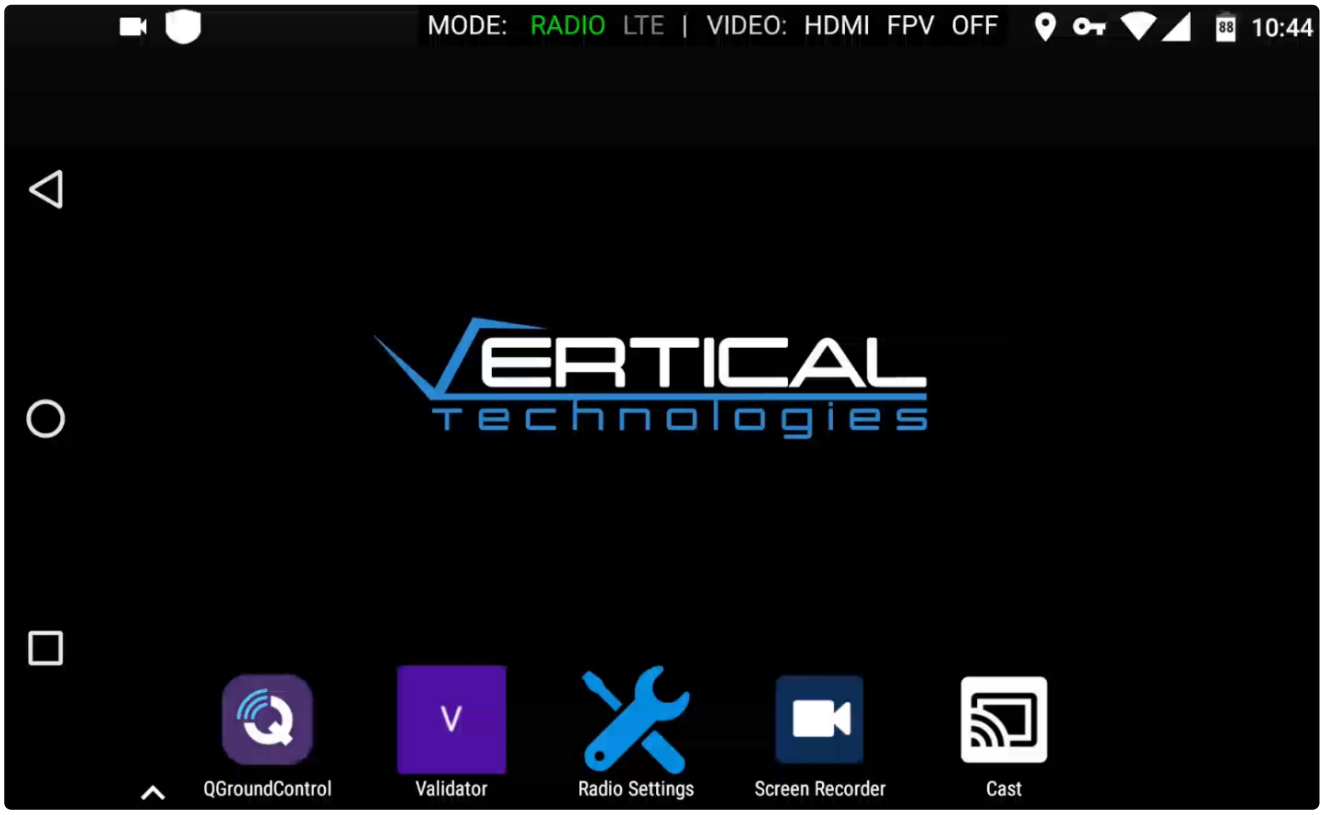
DeltaQuad Controller

Introduction

When your DeltaQuad Pro #MAP comes with the DeltaQuad Controller, the DeltaQuad controller provides the communication link between your UAV and the ground systems.

Getting started

To connect your UAV to the DeltaQuad controller simply switch on the UAV and press and hold the POWER button on the controller for 3 seconds. Once the controller is booted up, the main menu will display.



Before launching your flight control system it is recommended to connect the controller to a mobile hotspot or Wi-Fi network, The controller uses internet connectivity to load satellite maps and for LTE connectivity to the UAV. The DeltaQuad controller needs to be connected to a 5Ghz mobile hotspot or WiFi network. As the main communication link for the controller is based on 2.4 GHz, these networks will not be displayed. When using a mobile phone hotspot please make sure you configure the hotspot for 5Ghz.

In the top of the screen, you will find the data link bar.

The data link bar will always remain visible and allows you to control the type of transmission and select the active camera feed. The available modes will display in white, and the currently active mode will display in green.

- MODES:
  - RADIO: This mode uses the internal radio system. The radio system is capable of transmission ranges up to 30KM, or up to 50KM when your system is equipped with the booster package.
  - LTE: This mode uses mobile network over a VPN-secured data link. To use LTE mode the following needs to be activated:
    - A SIM card needs to be installed inside the UAV. The LTE dongle is located in the nose section of the vehicle and can be accessed when the battery is disconnected. Make sure the sim card has sufficient data available and that it is not secured with a pin-code. To test the connectivity of your LTE dongle with your sim card you can insert the dongle into a Windows-based laptop. After approximately 1 minute a webpage will open with the dongle settings and status.
    - The DeltaQuad controller needs to be connected to a WiFi network or mobile hotspot.
- VIDEO FEEDS:
  - HDMI: This is the HDMI-enabled camera feed of your mapping sensor.
  - FPV: This is the static nose camera feed.
  - OFF: This disables both feeds and stops any data consumption. If the data link becomes intermittent it is recommended to disable the video feeds to remain connected to your UAV.

Starting the UAV control system

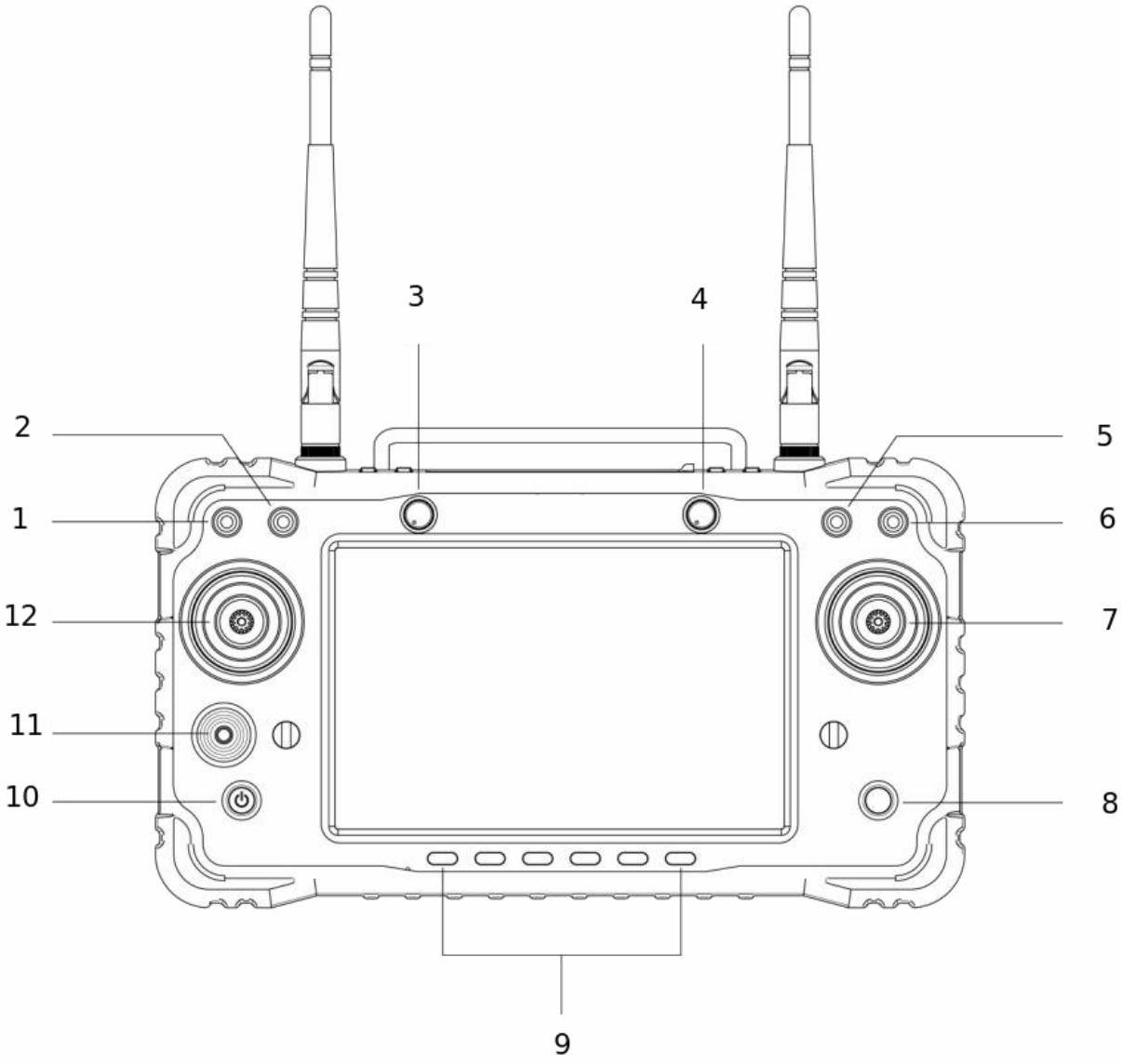
> ⓘ Before takeoff, always center all switches, and turn all dials to the left.

From the main menu launch the QGroundControl app (QGC). This application

From the QGroundControl app, you will be able to plan your initial mission. Missions are always planned to ensure the vehicle has a predefined takeoff and landing pattern. Even when you intend to manually control the UAV or control the UAV using repositioning or target following commands, it is recommended to plan a mission for takeoff and landing.

Please review the mission planning section for detailed information on how to plan a mission.

Overview of the buttons


3
4
2
5
1
6
12
7
11
10
8
9

Number	Type	Function
1	3 position switch **FLIGHT MODE**	UP: Position flight mode CENTER: neutral - remain in current mode DOWN: Mission flight mode
2	3 position switch **RETURN**	UP: Return flight mode CENTER: neutral - no functic DOWN: neutral - no function
3	Dial	Not assigned
4	Dial	Not assigned
5	3 position switch	Not assigned
6	3 position switch	Not assigned
7	Joystick	**In hover mode** Stick up: move forward Stick down: move backward Stick left: move left Stick right: move right **In fixed-wing mode** Stick up: descend (nose dow Stick down: climb (nose up) Stick left: bank left Stick right: bank right
8	Push button	Not assigned
9	A to F push buttons	Not assigned
10	Push button **POWER**	Press and hold: power on/off Press: screen on/off
11	Joystick	Not assigned
12	Joystick	**In hover mode** Stick up: climb Stick down: descend Stick left: yaw left Stick right: yaw right **In fixed-wing mode** Not activated

Shutting down & charging the controller

The DeltaQuad Controller can operate continuously for approximately 6 hours. If more operation time is required, the controller can be charged during operation.

To charge the controller, open the rubber cover between the antennas and attach the provided USB charger to the USB-C port. The controller requires high-voltage charging. Standard USB chargers or USB sockets from laptops are not always capable of providing high voltage, but they will extend the battery life of the controller.

To shut down the controller, press and hold the power button until the shutdown menu appears. Select "Power off" to shut down the controller.

Controlling the vehicle

Introduction

The QGroundControl Application that is installed on your DeltaQuad Controller or tablet is the main application to control your UAV.

Mission planning

Before starting a flight a mission needs to be planned to instruct the vehicle on the takeoff and landing patterns. You can choose to plan a full mapping mission, or only plan a takeoff and landing mission. It is possible to take control of the vehicle after takeoff and initiate a Return command when the mission has ended. The vehicle will use the landing pattern from the mission plan to execute a return command.

When starting the QGroundControl application the FLY view is displayed.

From the FLY view, you will need to switch to the PLAN view to plan your mission. You can switch to the PLAN view by pressing the PLAN button on the left-side command bar.

Please review the mission planning section for detailed information on planning a mission.

Launching your vehicle

Once your mission is uploaded you can return to the FLY view by pressing the FLY button in the left side command bar. Once you have performed the preflight checks you can start the mission by sliding to confirm the Start Mission command. If the slider is not displayed you can press the ACTION button in the left side command bar and choose "start mission". When sliding to confirm the takeoff your vehicle will start its motors and takeoff.

Before starting your first flight, you will need to be familiar with the DeltaQuad Controller button and joystick functions as described in the DeltaQuad Controller section.

> *NOTE: Before launching, make sure all switches are in their center position, all dials are turned all the way to the left, and the deploy button is switched off. Always make sure the Transition Direction (waypoint 1) is the active waypoint, indicated by a green circle.*

Operating your vehicle

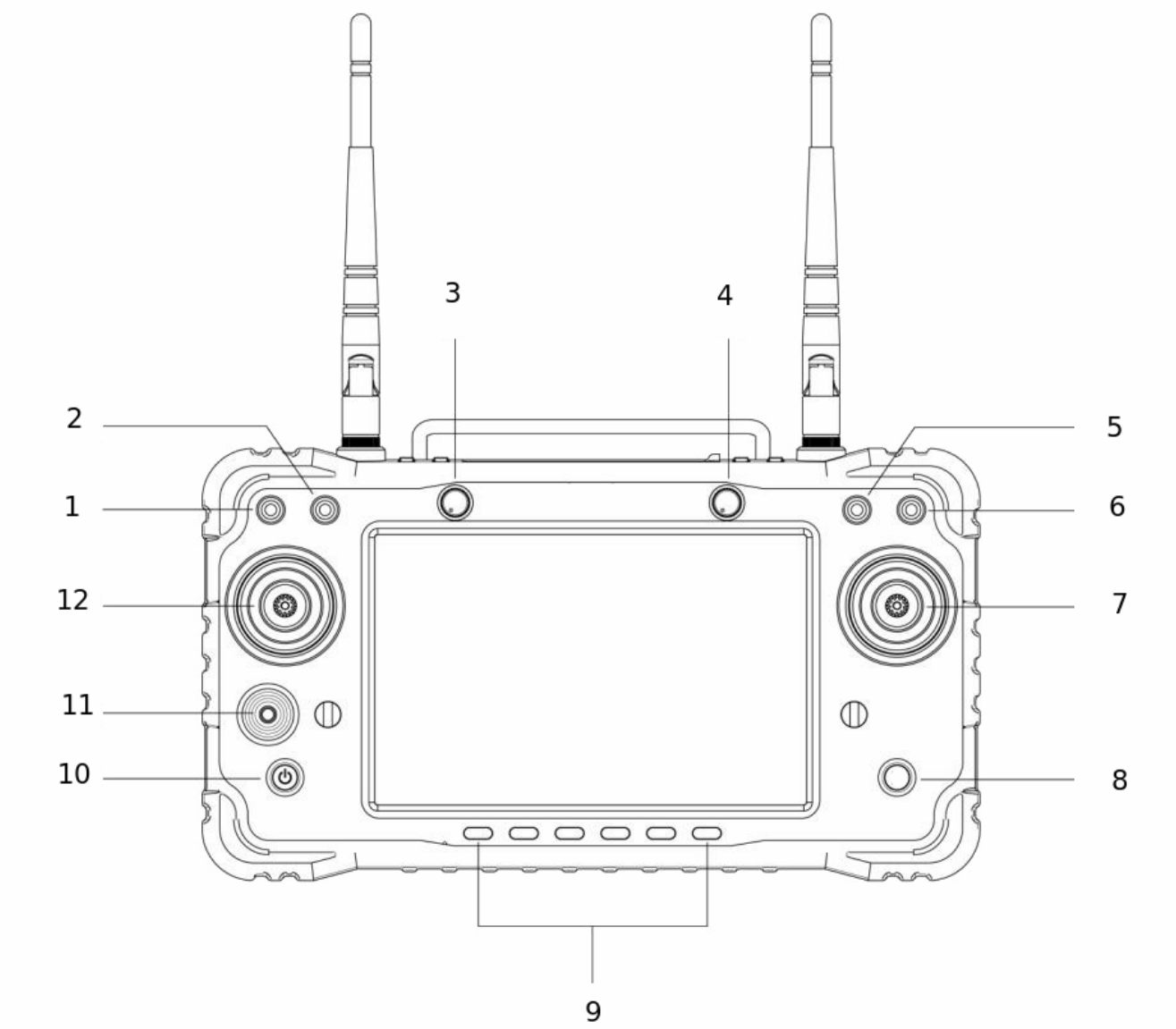
Once the vehicle is launched and has transitioned to fixed-wing flight mode, you can control the flight of your vehicle through the following methods.

Repositioning the vehicle

While the vehicle is in flight, you can tap anywhere on the satellite map and choose "Goto location".

After sliding to confirm the reposition command, the vehicle will enter "HOLD" flight mode, fly towards the indicated location, and circle the location clockwise in a radius of 100m.

Joystick control



The vehicle can be controlled using the right-side joystick (7). To activate the joystick control, switch the flight mode switch (1) to POSITION mode (UP). In this mode, the vehicle will fly in a straight line at its current altitude until a joystick command is received.

Moving the joystick left or right will make the vehicle change direction.

Moving the joystick forward or backward controls the altitude of the vehicle. A forward (up) joystick movement moves the nose of the vehicle down and decreases altitude. A backward (down) joystick movement pulls the nose of the vehicle up and increases altitude.

If the vehicle loses connection to the DeltaQuad Controller while it is flying in POSITION mode, it will automatically return home, regardless of the Safety settings.

> *NOTE: for inexperienced pilots, the joystick controls can seem counterintuitive. It is recommended to practice joystick operation in close proximity while flying at sufficient altitude.*

Changing altitude

While the vehicle is in POSITION or HOLD mode, the altitude can be changed by tapping on the ACTION button in the FLY screen and selecting "change altitude". A vertical slider will appear on the right side of the screen that allows you to select a new altitude. Once the correct altitude is selected, slide the "change altitude" slider to confirm the altitude change command.

When the vehicle is following a mission path, it will always track the altitude as defined in the mission plan. When resuming a mission the vehicle will immediately change the altitude to match the currently active waypoint.

Resuming a mission

When the vehicle is in POSITION or HOLD mode, the mission can be resumed by moving the flight mode switch to the MISSION position. Alternatively, the mission can be resumed by tapping on the ACTION button on the FLY screen and selecting "resume mission".

Returning the vehicle

At any point in the flight, the vehicle can be returned by activating the RETURN switch. Alternatively, RETURN mode can be activated by tapping on the RETURN button on the FLY screen, and sliding to confirm the command.

In RETURN mode, the vehicle will immediately fly towards the landing pattern that was defined in the mission. The landing pattern consists of a circle-to-altitude item, a direction and altitude on which to exit the circle, and a landing coordinate.

When the RETURN mode is activated, the vehicle will fly at its current altitude towards the 'circle to altitude' part of the landing pattern. When reaching this location the vehicle will circle down to the indicated altitude, and complete the circle until it has reached the indicated exit heading of the circle. It will then proceed toward the landing coordinates, transition to multirotor flight mode, and land in the indicated position.

Controlling the vehicle in multirotor mode

During takeoff or landing, your vehicle is in multirotor mode. Multirotor mode means the 4 motors for Vertical takeoff and Landing are activated.

To take control of the vehicle in multirotor mode, change the flight mode switch to POSITION mode. In this mode, the vehicle will hold its position and altitude until joystick commands are received.

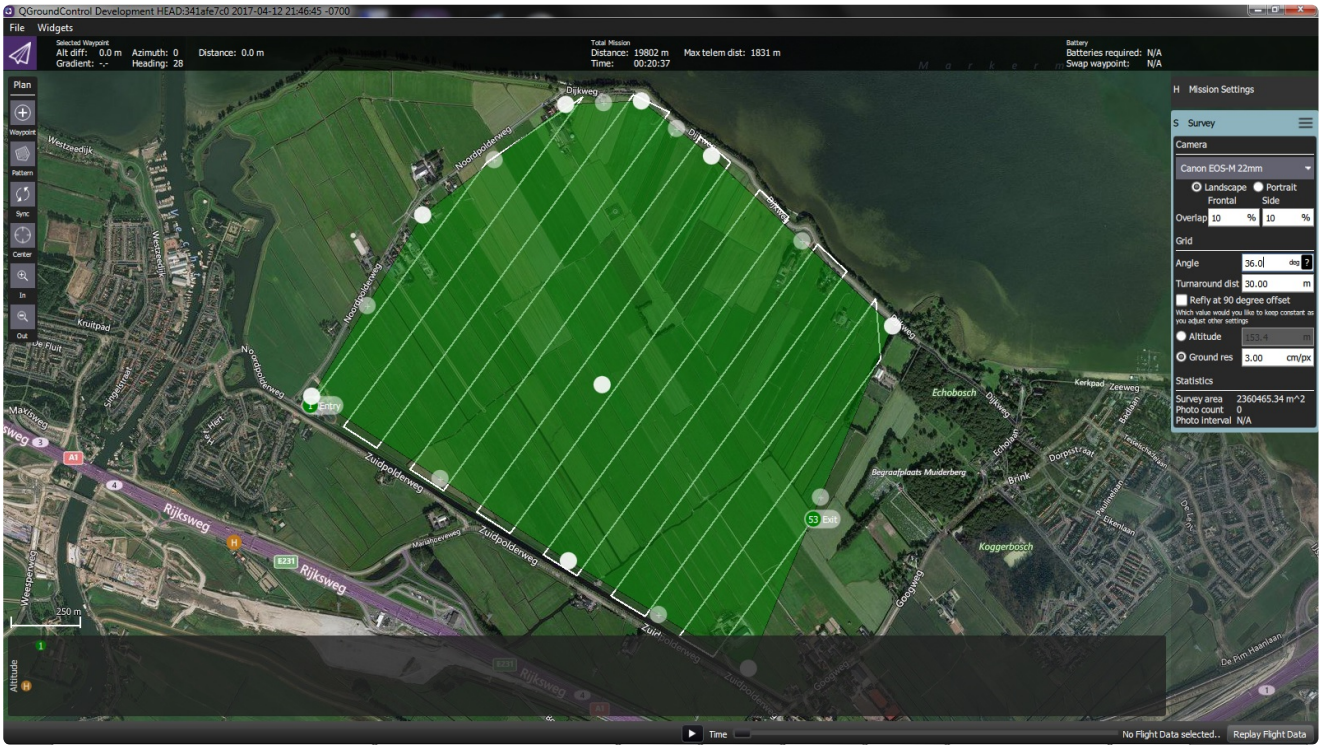
The LEFT main joystick (12) controls the vehicle's altitude and heading. Moving the joystick UP will increase the altitude. Moving the joystick down will decrease the altitude. Moving the joystick left or right changes the heading (yaw) of the vehicle.

The RIGHT joystick (7) controls the position of the vehicle. Moving this joystick, forward, backward, left, or right changes the position of the vehicle relative to its current heading.

Planning survey missions

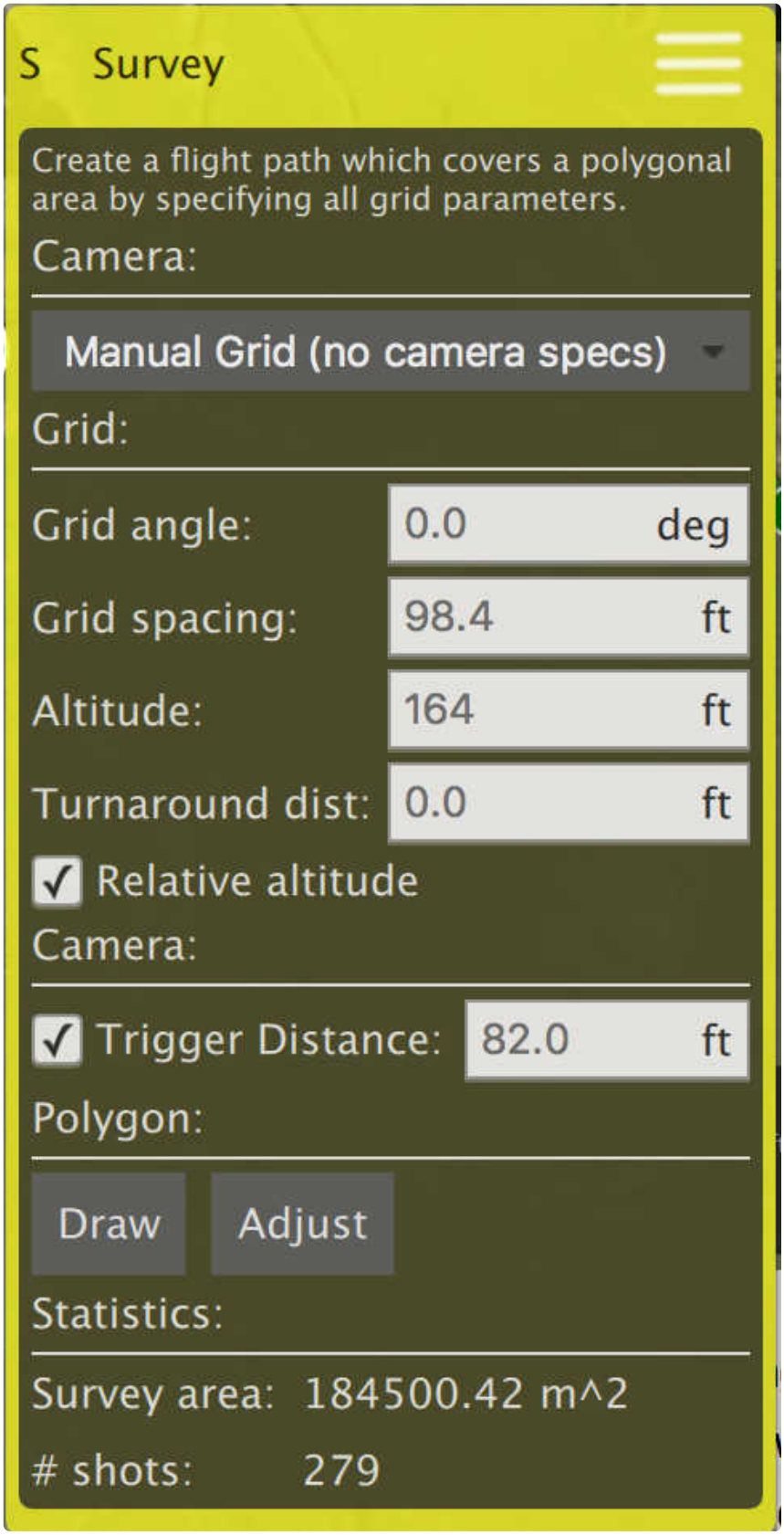
A survey allows you to create a grid flight pattern over a polygonal area. You can specify the polygon as well as the specifications for the grid and camera settings appropriate for creating geotagged images. To set up your camera for mapping please see this instruction video

To draw the polygon for your survey, click the "Draw" button and click on the map to set polygon vertices.



There are multiple options for a survey grid. You can select the main option from the dropdown at the top of the editor.

Manual Grid



The Manual Grid option allows you to specify all the values for generating the grid pattern over the polygon by hand.

- Grid angle - The angle for the parallel flight tracks of the grid. For example, 0 degrees will generate parallel lines that travel north/south.
- Grid spacing - The distance between each parallel flight track.
- Altitude - The altitude to fly the entire grid pattern.
- Turnaround distance - The amount of additional distance to fly past the edge of the polygon before performing the turnaround for the next flight track.
- Trigger Distance - Used to trigger an image taken by the camera based on the distance flown.

Geotagging

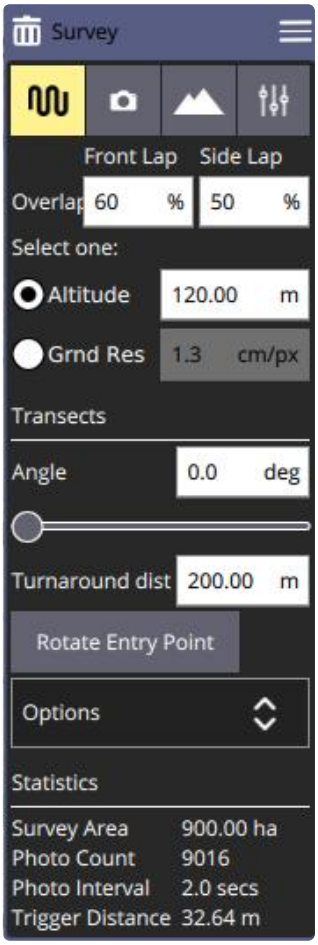
Please refer to the Geo-referencing section.

Configuring your camera

Camera

Selecting a known camera from the options dropdown allows you to generate a grid pattern based on the camera's specifications. All RGB cameras supported by the DeltaQuad are listed as known cameras.

- Landscape/Portrait - Specifies the orientation that the camera is placed on the vehicle.
- Image Overlap - This allows you to specify the amount of overlap you want between each image.
- Altitude - Selecting this value allows you to specify the altitude for the survey. The ground resolution will be calculated and shown for the specified altitude.
- Ground resolution - Selecting this value allows you to specify the ground resolution you want for each image. The altitude required to achieve this resolution is calculated and shown.

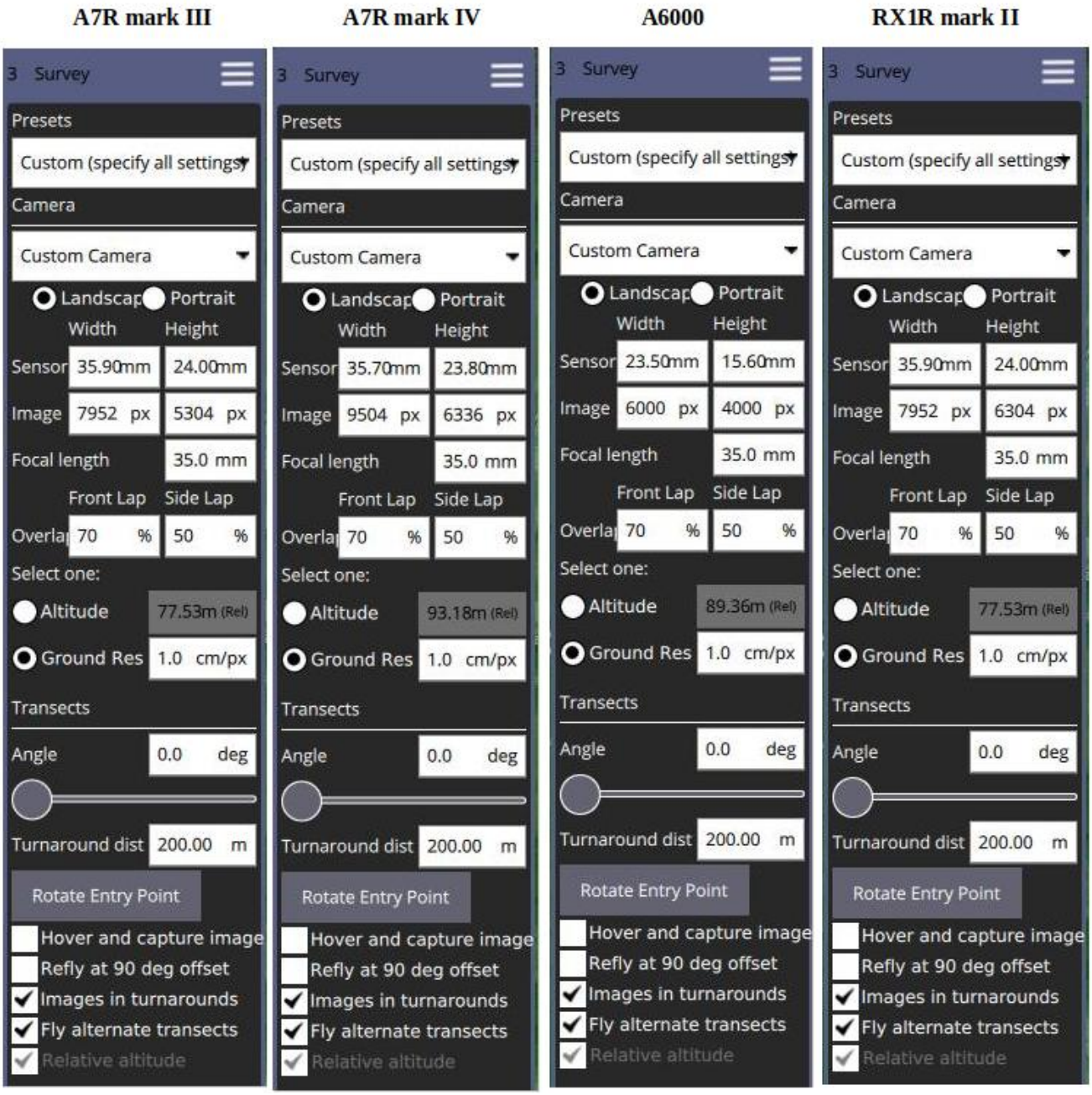


Custom Camera

The custom camera option is similar to the known camera option. The difference is that you must specify the details for the camera specifications yourself.

- 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 following camera settings should be used corresponding to your camera model:



Camera settings

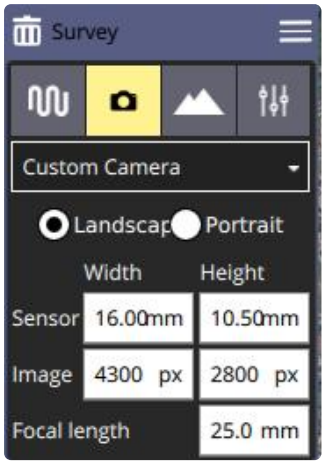
The following guidelines should be followed for Sony cameras:

- Set focus to Automatic Continuous (AF-C)
- Set AF on Shutter to OFF
- Set camera to single shooting mode
- Set Auto Review to OFF

- Set mode dial to manual (M)
- Set DRO to OFF
- Set Steady shot to OFF
- Set aperture to f4.5
- Airplane mode to ON
- Set shutter time to
  - Low light: 1/2500
  - Daylight: 1/3200
  - Very sunny: 1/4000
- Set ISO to auto
- Manual white balance suitable for scene

Agrowing A7R4 QUAD

For the Agrowing A7R4 QUAD, a custom camera must be selected using the following settings:



For the Agrowing A7R4 QUAD camera please use the following settings:

- Set focus to Automatic Continuous (AF-C)
- Set AF on Shutter to OFF
- Set the camera to single-shooting mode
- Set Auto Review to OFF
- Set Focus Area to Wide
- Set Quality to Extra fine(for JPEG only)
- Set mode dial to Shutter Priority
- Set DRO to OFF
- Set Steady shot to OFF
- Set Release w/o Lens to Enable
- Set Release w/o Card to Disable
- Set Airplane mode to ON
- Set Pwr Save Start Time to 30min
- Set White balance to Auto
- Set shutter time to 1/1000 – 1/3200
- Set ISO to auto

Geo-referencing

If your DeltaQuad is equipped with a mapping payload you will need to post-process the images to add the geographic coordinates. This is called geo-referencing (or geotagging). Some camera systems have a built-in GPS solution, these include the Micasense, Flir, and Workswell sensors. Other systems such as the Sony or Agrowing cameras require post-processing for geo-referencing.

Post-processing can be performed on 2 methods:

1. Using the onboard flight logs. For this step please skip to the section "When using onboard log files". This provides an easy, but relatively low-accuracy method of georeferencing pictures.
2. If your DeltaQuad was equipped with an Emlid Reach PPK/RTK solution you can georeference using the Emlid Reach method. This provides highly accurate georeferencing of your images.

Once your images have been geo-referenced, you can import them into stitching software to reconstruct a 2D and/or 3D model of the surveyed area. Examples of stitching software are Pix4D and Agisoft.

When using the Emlid Reach system

> ⓘ NOTE: The Emlid Reach solution requires an initial setup process. Make sure this process was executed before executing your first mapping mission.

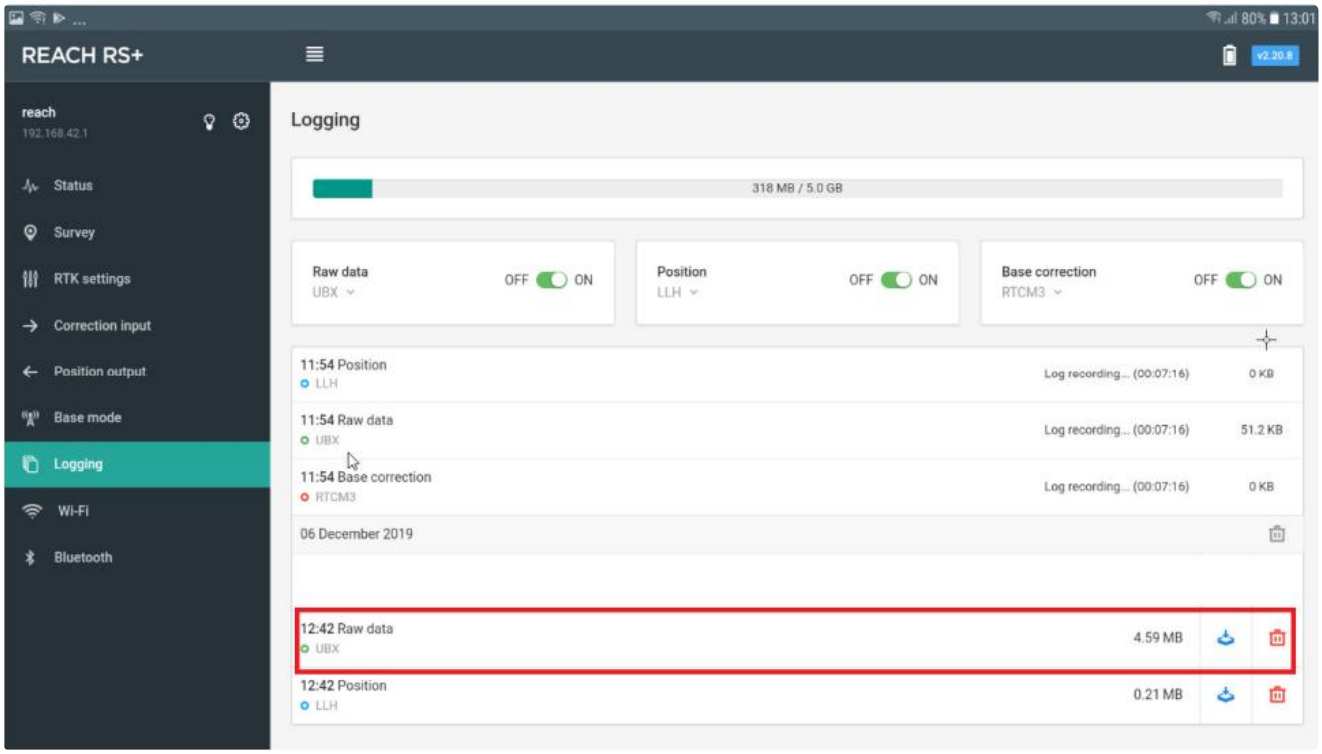
> ⓘ TIP: If you are experiencing problems connecting to the Emlid Reach over WiFi, you can disconnect the main battery power and connect a micro-USB cable to the Emlid Reach, wait 60 seconds and then browse to http://192.168.2.15/. This will allow you to perform the initial setup and/or download the UBX files. **Do not connect USB and main battery power at the same time, this will damage the system.**

Before you can use your Emlid Reach system you will need to perform the initial setup procedure as described here: https://docs.emlid.com/reach/before-you-start/first-setup

When following this procedure you will have installed the ReachView app which will be required for the next steps.

After completing a mapping mission flight please complete the following steps:

Step 1: Power off and on your base station and browse to the address as shown in the ReachView app.
Step 2: Download the UBX file corresponding to your flight, call this file "base.zip"



Step 3: Power on your UAV and browse to the address as shown in the ReachView app.
Step 4: Download the UBX file corresponding to your flight. Call this file "rover.zip"
Step 5: Extract both base and rover files in a separate folder.

Using Emlid Studio

The recommended method of geo-referencing your images is by using Emlid Studio. Emlid Studio is available for Windows and Mac-based operating systems. It allows you to geotag photos obtained during the flight for further mapping in photogrammetry software.

To process your data using Emlid Studio please use the following steps;

1. Download and install the Emlid Studio application from: https://docs.emlid.com/emlid-studio/
2. In the top-right corner click on the word PPK, and change the mode to "Droned data PPK"
3. Click on the "Drone" box and select the file with the .UBX extension from the rover folder. If your dataset consists of multiple flights, you can add multiple UBX files.
4. Click on the "Base" box and select the UBX file from the base folder.
5. Click on "Process" and wait for the files to be processed.
6. Click on the "Folder with photos" box, this will indicate how many photos are expected. This should match the number of pictures on the SD card from your camera. It is recommended to move the pictures from the SD card to a hard drive before processing.
7. It is recommended to switch "Update original photos" on, as this will prevent the system from duplicating the photos and will increase processing speed.
8. Click on "Tag photos" and wait for the process to finish

The photos will now contain the PPK-corrected geographic information. You can now use them for processing in your stitching software such as Pix4DMapper or AgiSoft Metashape.

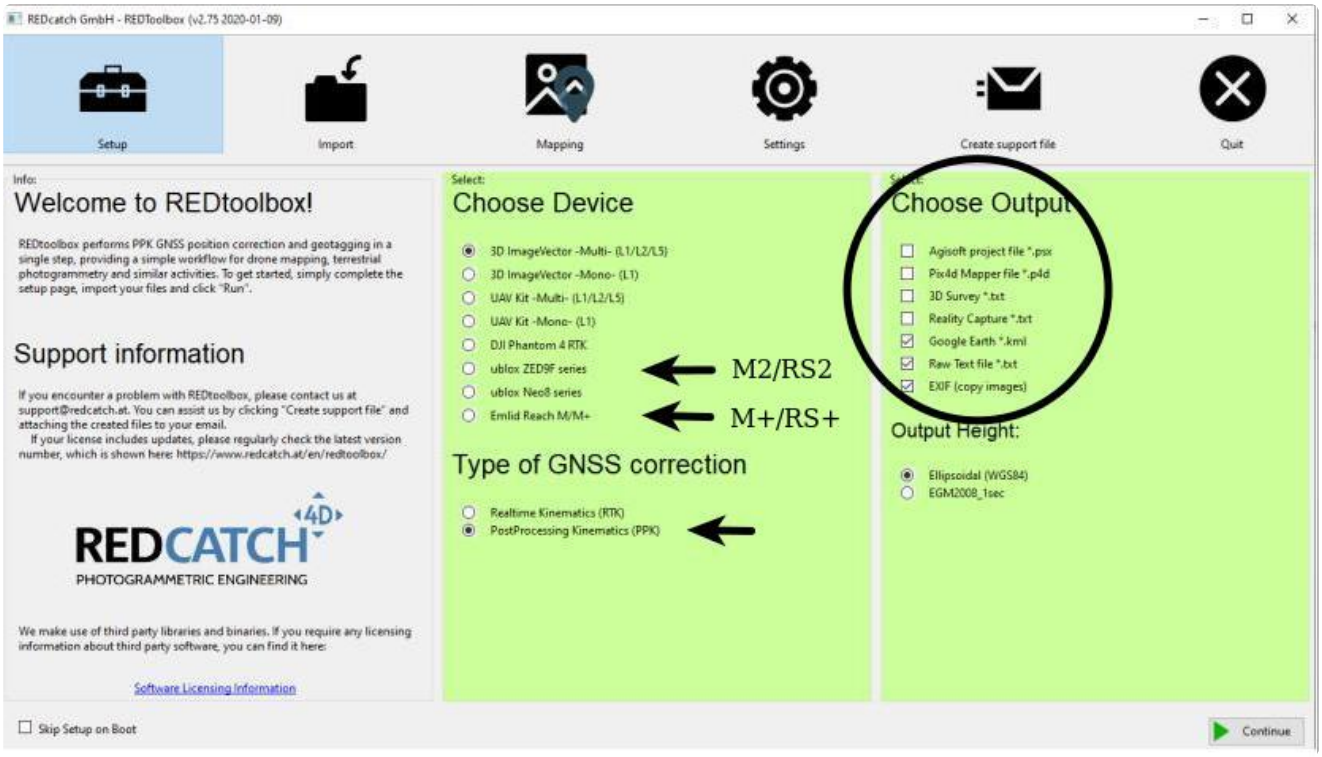
A full and in-depth explanation of the usage and options in Emlid Studio can be found here.

Using RedToolBox

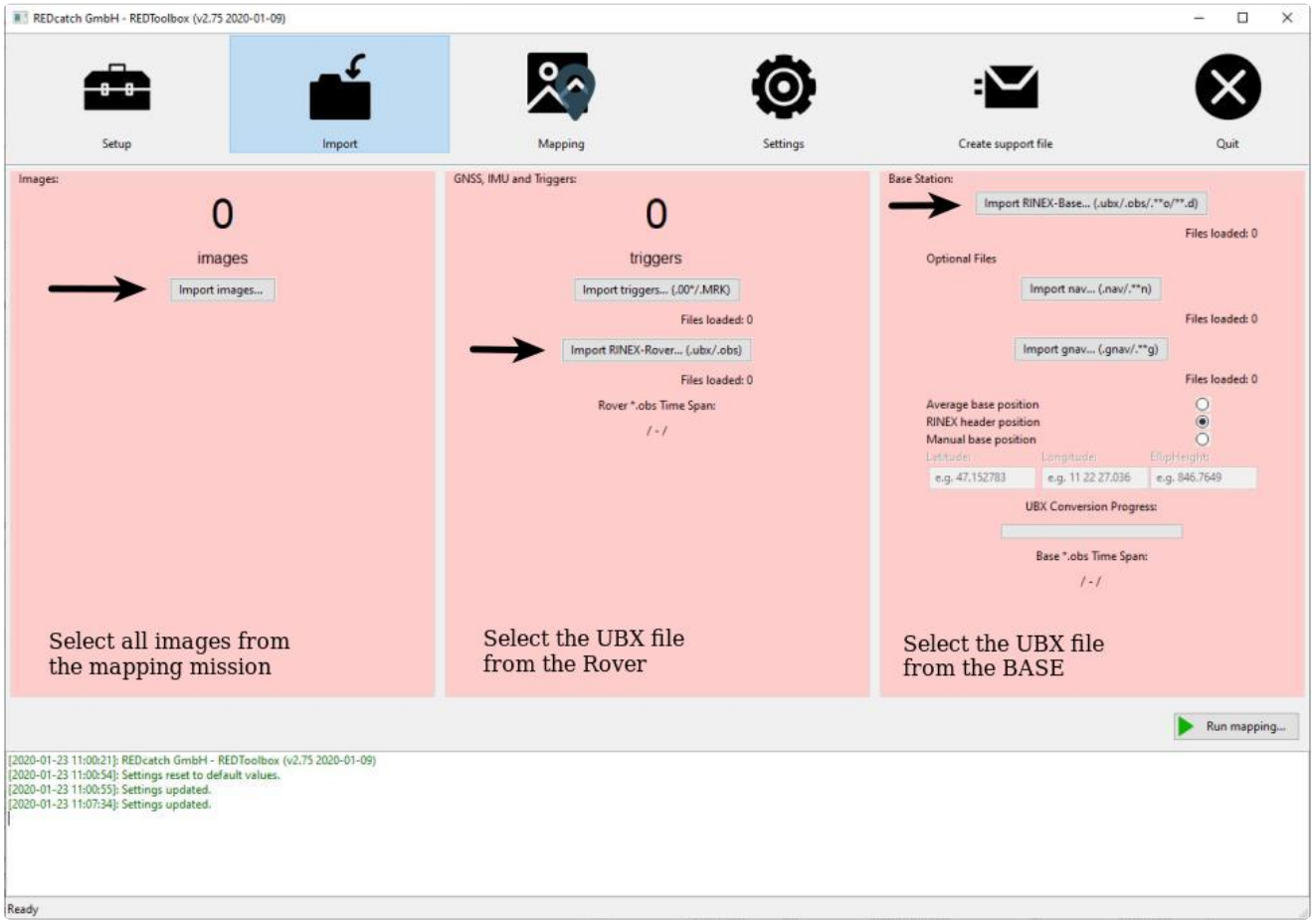
Alternatively, you may use RedToolBox, this application is capable of de with situations where the number of pictures does not match the number of recorded trigger events.

RedToolBox can be downloaded from here: https://www.redcatch.at/redtoolbox/

Step 1: Open RedToolBox by running the RedToolBox-V2.exe file
Step 2: Choose Device: When using the Emlid Reach M+/RS+ please select "Emlid Reach M/M+". When using the Emlid Reach M2/RS2, please select "Ublox ZED9F".
Step 3: Select the desired output for your post-processing option. Note that EXIF will work for virtually any platform but it is a slow process. For Agisoft or Pix4D we recommend using the designated outputs.



Step 4: Open the Import tab and select all pictures from your mapping mission.
Step 5: Click on the "Import Rinex ..." button under the GNSS section and select your rover UBX file
Step 6: Click on the "Import Rinex ..." button under the BASE section and select your base UBX file



Step 7: Click "Run mapping"

For more information on RedToolBox please see the RedToolBox User Manual

When using onboard log files

The following procedure should only be used when not using a PPK solution.

To Georeference the images you can remove the sd-card from the flight controller to copy the logfile from the flight. The log file will be stored in the 'logs' subfolder under the date & time of the flight.

Download the DeltaTag application (Windows or Linux) here:
https://drive.google.com/drive/folders/1WkI42DHv62ShBsdqhzm9Sjsh_Zq2FG5S?usp=sharing

Step 1: Select the flight log by clicking on "Log file"
Step 2: Select the images folder by clicking on "Image folder"
Step 3: Click on "RUN"

The meta information of your images (EXIF information) will now be updated to include the geo-coordinates of the vehicle at the time the trigger was sent.

> ⓘ NOTE: The DeltaTag application uses the LAST image in your folder to calibrate the timestamps of your images with the triggers in your log file. It is important not to include any images that were not taken from the survey mission. (test images, manual shots, etc)

You can verify the geotagging using an online service like Pic2Map.
Pix4D Mapper or Agisoft Metashape can be used for 3D reconstruction.

Connecting a Secondary Control Terminal

Introduction

The DeltaQuad Controller provides an RTSP-based video stream and a secondary telemetry link. The Secondary Control Terminal will connect to the DeltaQuad Controller, not directly to the UAV. This is to prevent the UAV from having to use double the amount of bandwidth. It also enables connecting a Secondary Control Terminal over LTE, even when the UAV is flying outside of LTE range, as long as the DeltaQuad Controller is connected to the LTE network.

The Secondary Control Terminal can control the vehicle in the same way the DetaQuad Controller can, with the exception of the joystick and button functions. The UAV will always follow the last command received, regardless of the source (Controller or Secondary Control Terminal).

The video feed displayed on the Secondary Control Terminal is the video feed that has been activated by the pilot.

Using a WiFi hotspot

If your controller is connected to a 5ghz WiFi hotspot, a second device can connect to the same hotspot. For information on how to connect the DeltaQuad Controller to a WiFi hotspot, please see the DeltaQuad Controller section.

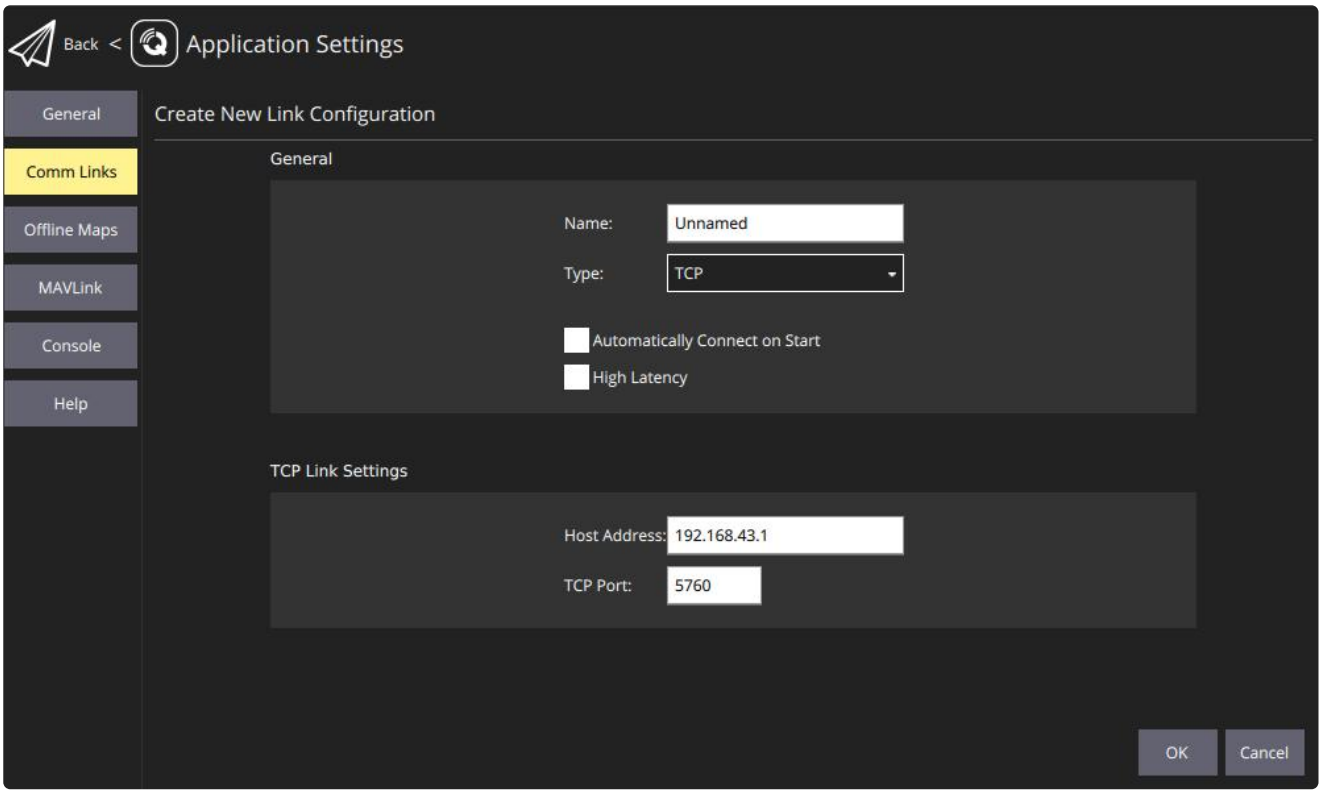
Once connected you will need to determine the IP address that was assigned to the controller by the WiFi hotspot. To do this you can open the Settings app, scroll down and select About Phone, and tap on Status. Here you will find the item "IP address" which shows the values for the IP addresses assigned by the hotspot. The value required is the sequence of 4 numbers separated by a dot. For example 192.168.43.124

The DeltaQuad Controller can also be used to host a WiFi hotspot. To enable the WiFi hotspot on the DeltaQuad Controller, enter the Android settings and activate the Mobile Hotspot. When the DeltaQuad Controller is hosting a mobile hotspot it will have no internet connectivity and LTE modes will be disabled.

Using the IP Address from the DeltaQuad Controller you can now add a TCP-based connection from QGroundControl on the Secondary Control Terminal to the Controller. To do this use the following steps:

1. In QGroundControl on the Secondary Control Terminal click on the Q icon
2. Click on Application Settings
3. Select "Comm links"
4. Click on "Add"
5. Select type "TCP"
6. In "Host Address" enter the IP address of the DeltaQuad Controller
7. Leave the TCP port on 5760
8. Click OK

9. Click CONNECT



Remotely using the mobile network

You can attach your Secondary Control Terminal to a DeltaQuad Controller using the mobile network. When your vehicle is shipped you will receive an email with account information that contains the VPN profile for your second screen. To use this VPN profile you will need to download and install the OpenVPN client.

When the VPN Client is installed, click on the VPN icon in the bottom right section of your taskbar. That will open the VPN client interface to import the VPN profile that was sent to you.

Once connected to the VPN network for your controller, you can use the IP address 100.96.1.34 and follow the steps listed in Using a WiFi Hotspot above.

Using Screen Casting

Screen Casting can be used to replicate the display on the DeltaQuad Controller. The DeltaQuad Controller comes pre-installed with a Cast app on the home screen. When launching the Cast app, you will see a list of devices that support casting. Select the intended device and follow the instructions to enable casting on your remote screen.

Casting is based on Miracast and is supported on Windows, Mac, and certain Smart TV systems. To cast to a second screen, the second screen will need to be attached to the same WiFi network as the DeltaQuad Controller, or connected to the VPN network as described above.

On Windows 10 or later, you will need to enable the Wireless Display option. To do this, open the Windows settings and search for "projector settings". Follow the steps indicated to enable "Projecting to this PC". Once these steps have been completed, the Windows system will show in the Cast list of the DeltaQuad Controller.

DELTAQUAD PRO #INSPECT

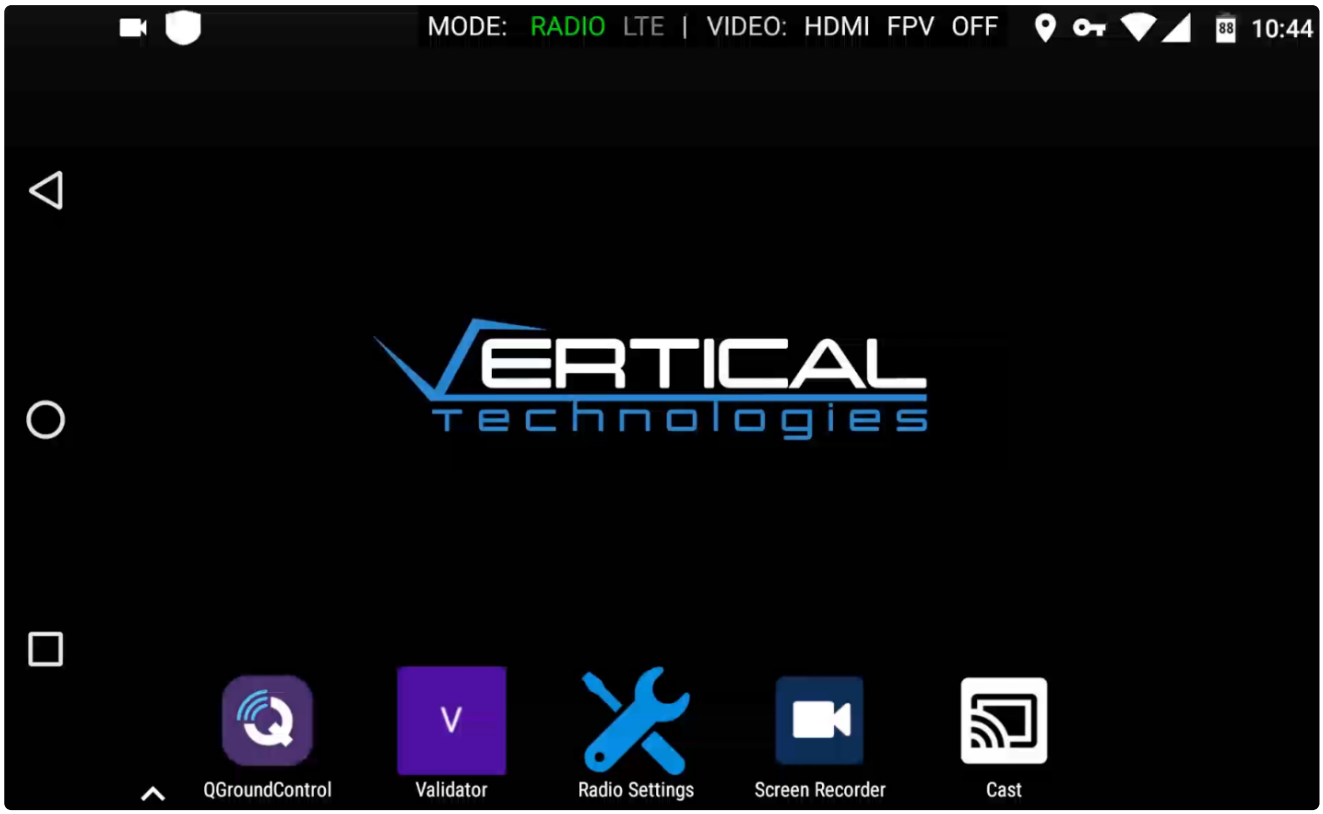
DeltaQuad Controller

Introduction

When your DeltaQuad Pro #INSPECT comes with the DeltaQuad Controller, the DeltaQuad controller provides the communication link between your UAV and the ground systems.

Getting started

To connect your UAV to the DeltaQuad controller simply switch on the UAV and press and hold the POWER button on the controller for 3 seconds. Once the controller is booted up, the main menu will display.



Before launching your flight control system it is recommended to connect the controller to a mobile hotspot or Wi-Fi network, The controller uses internet connectivity to load satellite maps and for LTE connectivity to the UAV. The DeltaQuad controller needs to be connected to a 5Ghz mobile hotspot or WiFi network. As the main communication link for the controller is based on 2.4 GHz, these networks will not be displayed. When using a mobile phone hotspot please make sure you configure the hotspot for 5Ghz.

At the top of the screen, you will find the data link bar.

The data link bar will always remain visible and allows you to control the type of transmission and select the active camera feed. The available modes will display in white, and the currently active mode will display in green.

- MODES:
  - RADIO: This mode uses the internal radio system. The radio system is capable of transmission ranges up to 30KM, or up to 50KM when your system is equipped with the booster package.
  - LTE: This mode uses mobile network over a VPN-secured data link. To use LTE mode the following needs to be activated:
    - A SIM card needs to be installed inside the UAV. The LTE dongle is located in the nose section of the vehicle and can be accessed when the battery is disconnected. Make sure the sim card has sufficient data available and that it is not secured with a pin-code. To test the connectivity of your LTE dongle with your SIM card you can insert the dongle into a Windows-based laptop. After approximately 1 minute a webpage will open with the dongle settings and status.

    - The DeltaQuad controller needs to be connected to a WiFi network or mobile hotspot.
- VIDEO FEEDS:
  - HDMI: This is the HDMI-enabled camera feed of your mapping sensor.
  - FPV: This is the static nose camera feed.
  - OFF: This disables both feeds and stops any data consumption. If the data link becomes intermittent it is recommended to disable the video feeds to remain connected to your UAV.

Starting the UAV control system

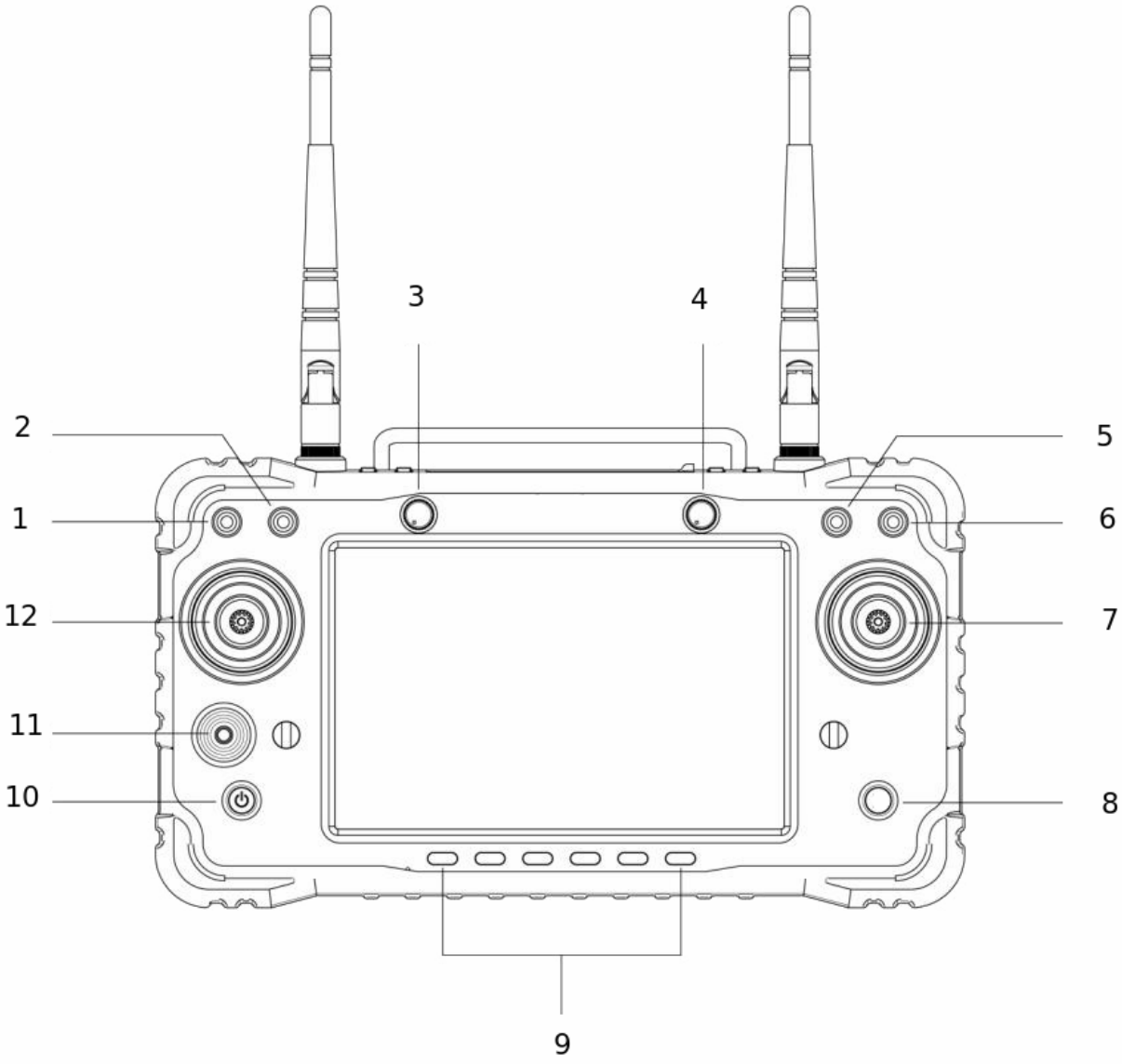
> ⓘ Before takeoff, always center all switches, and turn all dials to the left.

From the main menu launch the QGroundControl app (QGC). This application

From the QGroundControl app, you will be able to plan your initial mission. Missions are always planned to ensure the vehicle has a predefined takeoff and landing pattern. Even when you intend to manually control the UAV or control the UAV using repositioning or target following commands, it is recommended to plan a mission for takeoff and landing.

Please review the mission planning section for detailed information on how to plan a mission.

Overview of the buttons


3
4
2
5
1
6
12
7
11
10
8
9

Number	Type	Function
1	3 position switch **FLIGHT MODE**	UP: Position flight mode CENTER: neutral - remain in current mode DOWN: Mission flight mode
2	3 position switch **RETURN**	UP: Return flight mode CENTER: neutral - no functio DOWN: neutral - no function
3	Dial	Not assigned
4	Dial	Not assigned
5	3 position switch **Flir button 2**	Programmable switch PWM 2 Default function: Switch IR co palette UP: Black hot CENTER: Colorized Down: White hot
6	3 position switch **Flir button 1**	Programmable switch PWM 1 Default function: Active video feed UP: RGB ONLY CENTER: RGB with inline IR overlay Down: IR only
7	Joystick	**In hover mode** Stick up: move forward Stick down: move backward Stick left: move left Stick right: move right **In fixed-wing mode** Stick up: descend (nose dow Stick down: climb (nose up) Stick left: bank left Stick right: bank right
8	Push button **Flir button 3**	Programmable switch PWM 3 Default function: Start/stop recording Light on: Start recording (vide or mapping) Light off: Stop recording (vide or mapping)

A to F push buttons	Not assigned	
10	Push button **POWER**	Press and hold: power on/off Press: screen on/off
11	Joystick	Not assigned
12	Joystick	**In hover mode** Stick up: climb Stick down: descend Stick left: yaw left Stick right: yaw right **In fixed-wing mode** Not activated

Shutting down & charging the controller

The DeltaQuad Controller can operate continuously for approximately 6 hours. If more operation time is required, the controller can be charged during operation.

To charge the controller, open the rubber cover between the antennas and attach the provided USB charger to the USB-C port. The controller requires high-voltage charging. Standard USB chargers or USB sockets from laptops are not always capable of providing high voltage, but they will extend the battery life of the controller.

To shut down the controller, press and hold the power button until the shutdown menu appears. Select "Power off" to shut down the controller.

Controlling the vehicle

Introduction

The QGroundControl Application that is installed on your DeltaQuad Controller or tablet is the main application to control your UAV.

Mission planning

Before starting a flight a mission needs to be planned to instruct the vehicle on the takeoff and landing patterns. You can choose to plan a full mapping mission, or only plan a takeoff and landing mission. It is possible to take control of the vehicle after takeoff and initiate a Return command when the mission has ended. The vehicle will use the landing pattern from the mission plan to execute a return command.

When starting the QGroundControl application the FLY view is displayed.

From the FLY view, you will need to switch to the PLAN view to plan your mission. You can switch to the PLAN view by pressing the PLAN button on the left-side command bar.

Please review the mission planning section for detailed information on planning a mission.

Launching your vehicle

Once your mission is uploaded you can return to the FLY view by pressing the FLY button in the left side command bar. Once you have performed the preflight checks you can start the mission by sliding to confirm the Start Mission command. If the slider is not displayed you can press the ACTION button in the left side command bar and choose "start mission". When sliding to confirm the takeoff your vehicle will start its motors and takeoff.

Before starting your first flight, you will need to be familiar with the DeltaQuad Controller button and joystick functions as described in the DeltaQuad Controller section.

> *NOTE: Before launching, make sure all switches are in their center position, all dials are turned all the way to the left, and the deploy button is switched off. Always make sure the Transition Direction (waypoint 1) is the active waypoint, indicated by a green circle.*

Operating your vehicle

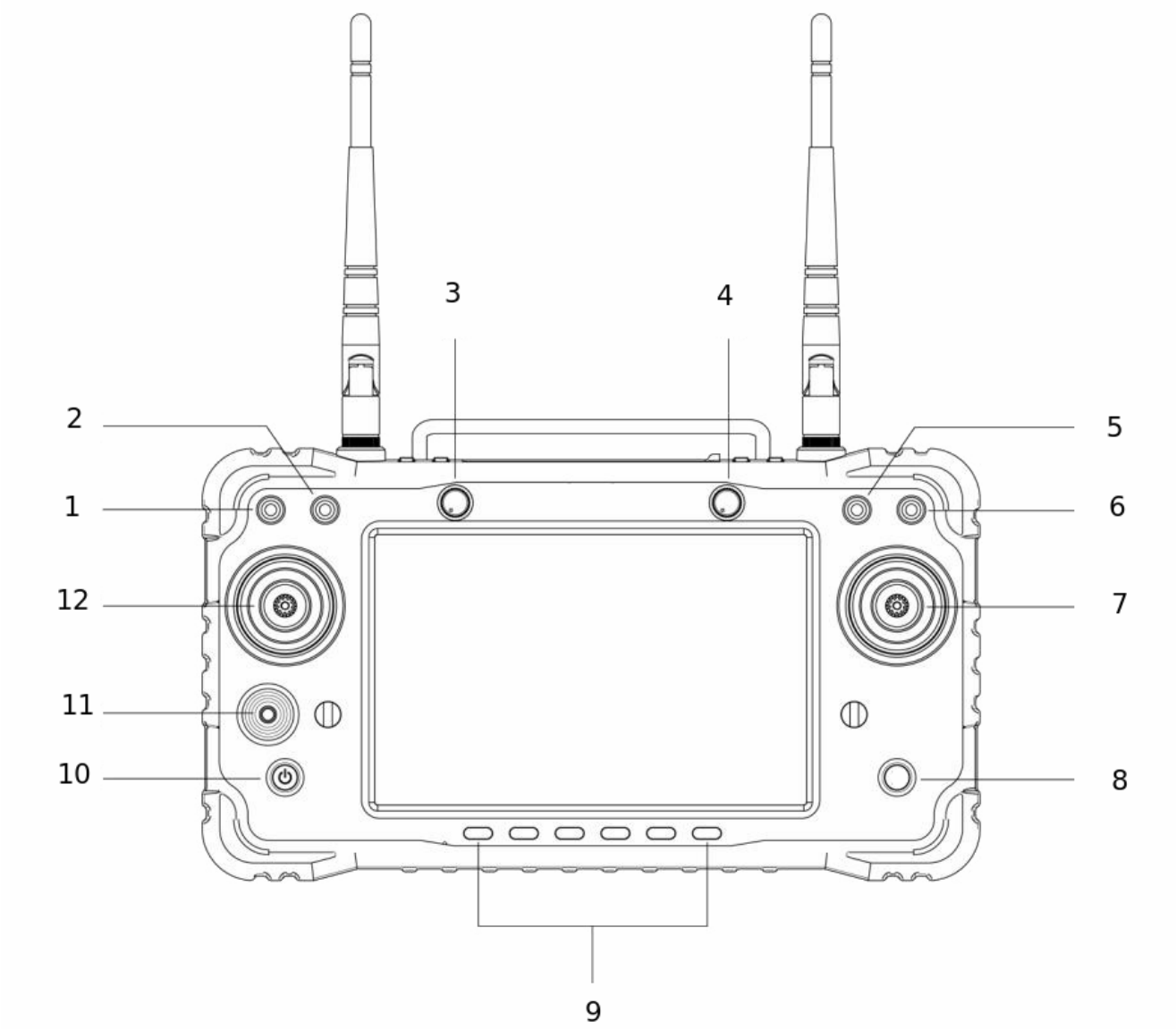
Once the vehicle is launched and has transitioned to fixed-wing flight mode, you can control the flight of your vehicle through the following methods.

Repositioning the vehicle

While the vehicle is in flight, you can tap anywhere on the satellite map and choose "Goto location".

After sliding to confirm the reposition command, the vehicle will enter "HOLD" flight mode, fly towards the indicated location, and circle the location clockwise in a radius of 100m.

Joystick control



The vehicle can be controlled using the right-side joystick (7). To activate the joystick control, switch the flight mode switch (1) to POSITION mode (UP). In this mode, the vehicle will fly in a straight line at its current altitude until a joystick command is received.

Moving the joystick left or right will make the vehicle change direction.

Moving the joystick forward or backward controls the altitude of the vehicle. A forward (up) joystick movement moves the nose of the vehicle down and decreases altitude. A backward (down) joystick movement pulls the nose of the vehicle up and increases altitude.

If the vehicle loses connection to the DeltaQuad Controller while it is flying in POSITION mode, it will automatically return home, regardless of the Safety settings.

> *NOTE: for inexperienced pilots, the joystick controls can seem counterintuitive. It is recommended to practice joystick operation in close proximity while flying at sufficient altitude.*

Changing altitude

While the vehicle is in POSITION or HOLD mode, the altitude can be changed by tapping on the ACTION button in the FLY screen and selecting "change altitude". A vertical slider will appear on the right side of the screen that allows you to select a new altitude. Once the correct altitude is selected, slide the "change altitude" slider to confirm the altitude change command.

When the vehicle is following a mission path, it will always track the altitude as defined in the mission plan. When resuming a mission the vehicle will immediately change the altitude to match the currently active waypoint.

Resuming a mission

When the vehicle is in POSITION or HOLD mode, the mission can be resumed by moving the flight mode switch to the MISSION position. Alternatively, the mission can be resumed by tapping on the ACTION button on the FLY screen and selecting "resume mission".

Returning the vehicle

At any point in the flight, the vehicle can be returned by activating the RETURN switch. Alternatively, RETURN mode can be activated by tapping on the RETURN button on the FLY screen, and sliding to confirm the command.

In RETURN mode, the vehicle will immediately fly towards the landing pattern that was defined in the mission. The landing pattern consists of a circle-to-altitude item, a direction and altitude on which to exit the circle, and a landing coordinate.

When the RETURN mode is activated, the vehicle will fly at its current altitude towards the 'circle to altitude' part of the landing pattern. When reaching this location the vehicle will circle down to the indicated altitude, and complete the circle until it has reached the indicated exit heading of the circle. It will then proceed toward the landing coordinates, transition to multirotor flight mode, and land in the indicated position.

Controlling the vehicle in multirotor mode

During takeoff or landing, your vehicle is in multirotor mode. Multirotor mode means the 4 motors for Vertical takeoff and Landing are activated.

To take control of the vehicle in multirotor mode, change the flight mode switch to POSITION mode. In this mode, the vehicle will hold its position and altitude until joystick commands are received.

The LEFT main joystick (12) controls the vehicle's altitude and heading. Moving the joystick UP will increase the altitude. Moving the joystick down will decrease the altitude. Moving the joystick left or right changes the heading (yaw) of the vehicle.

The RIGHT joystick (7) controls the position of the vehicle. Moving this joystick, forward, backward, left, or right changes the position of the vehicle relative to its current heading.

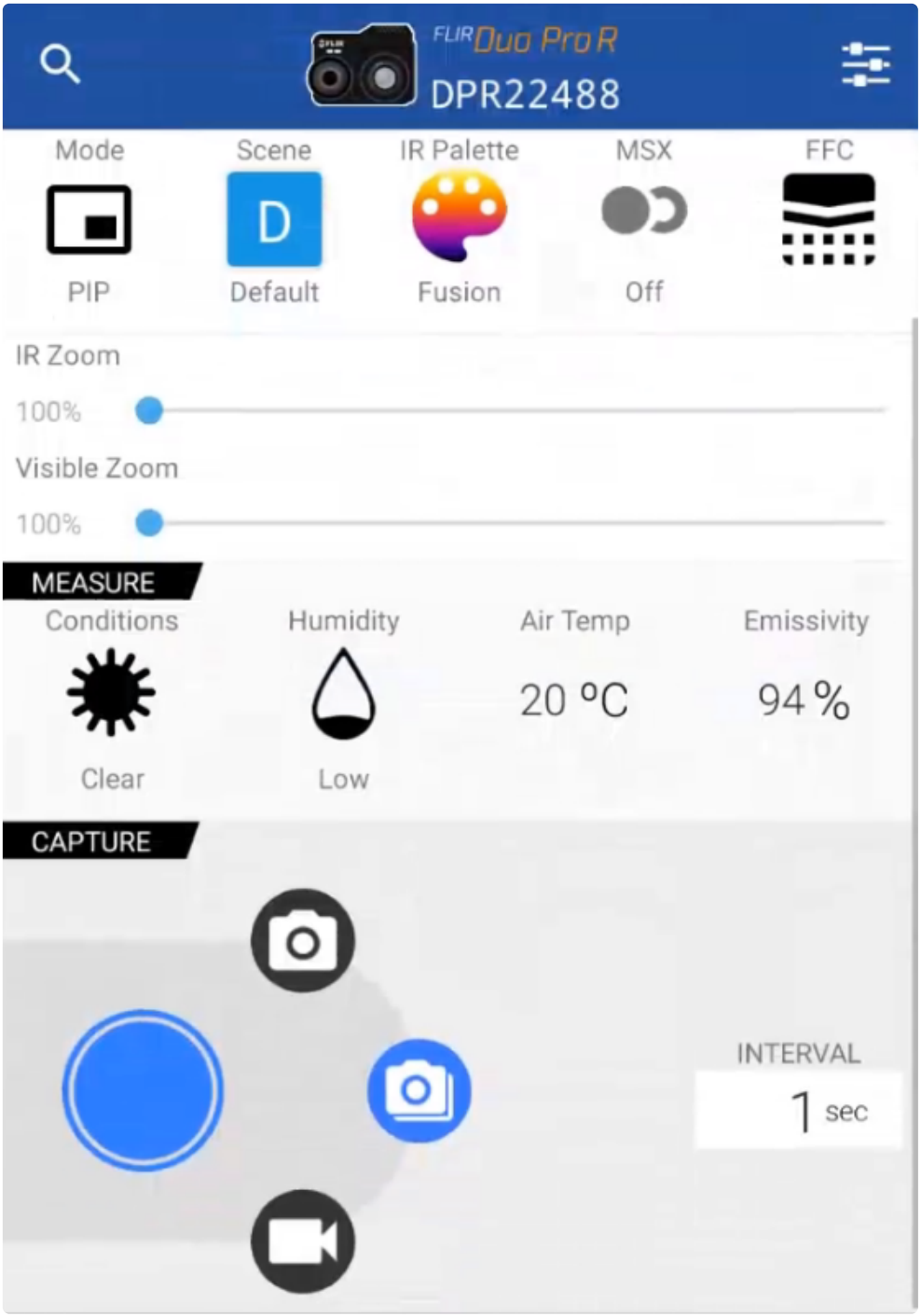
Configuring your camera

Your Ground Control Station comes equipped with the Flir UAS app. This app uses Bluetooth to communicate with your Flir Duo Pro R. To connect to your camera make sure you are close to your UAV as the Bluetooth connection has limited range.

When first powering on the UAV, the camera will enable Bluetooth for approximately 1 minute. It will indicate this by a blue light. If the blue light is not solid or blinking, press the Bluetooth button on your camera. The app should automatically detect the camera.

The Flir Duo Pro is not triggered by the flight controller, it needs to be programmed for either distance or time interval triggering. If you wish to perform radiometric mapping with the Flir Duo Pro you will need to take the following steps:

1. Launch the Flir UAS app
2. Select the multi-image capture mode with an interval of 1 second
3. In the settings screen, make sure the function of PWM 3 is set to "start/stop recording"
4. Start the trigger process by clicking the big blue record button. When using the DeltaQuad Controller, this can be performed in flight by activating the trigger by switching button 8 as described in the DeltaQuad Controller section.



For more information on configuring your Flir Duo Pro R for the correct scene and thermal functions, please refer to the Flir Duo Pro Quick Start Guide or the Flir Duo Pro R manual.

DELTAQUAD PRO #CARGO

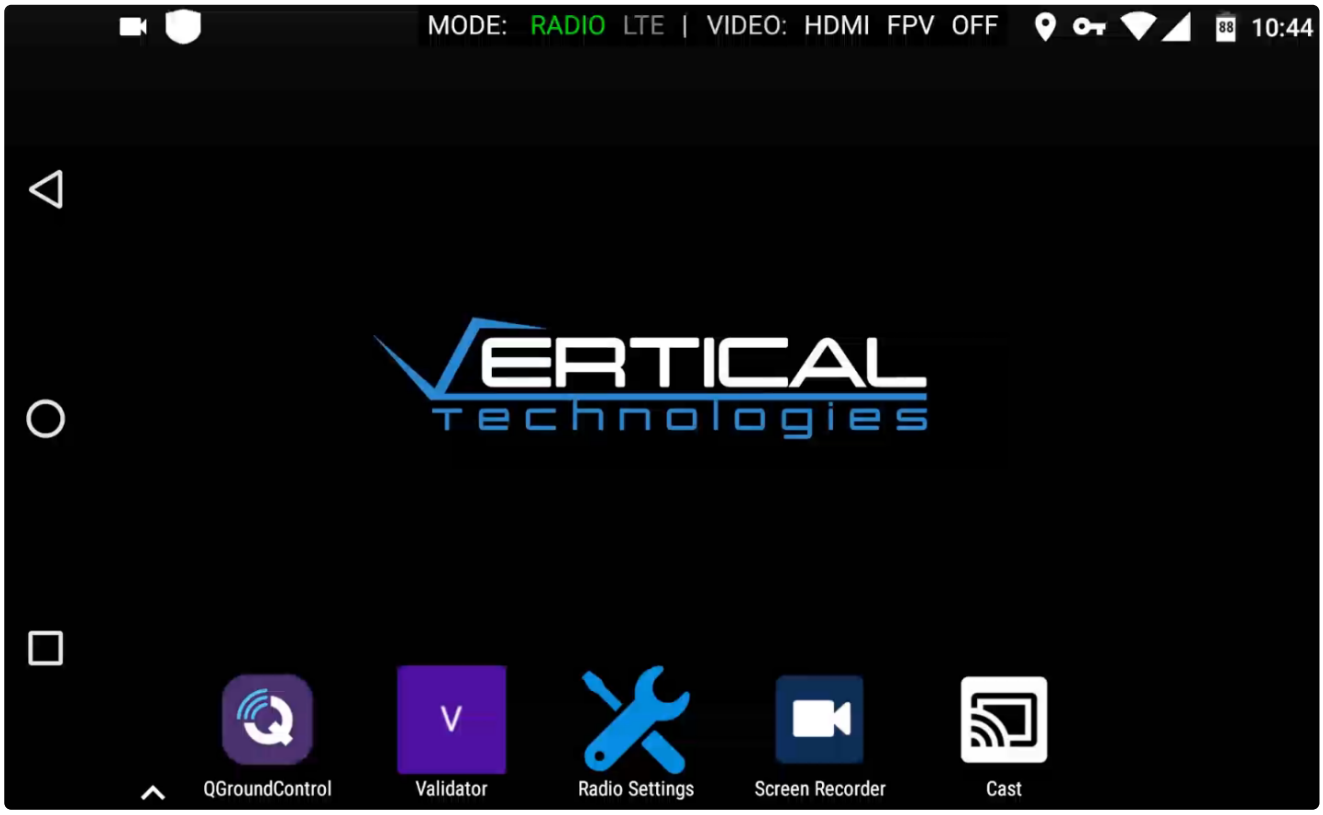
DeltaQuad Controller

Introduction

When your DeltaQuad Pro #CARGO comes with the DeltaQuad Controller, the DeltaQuad controller provides the communication link between your UAV and the ground systems.

Getting started

To connect your UAV to the DeltaQuad controller simply switch on the UAV and press and hold the POWER button on the controller for 3 seconds. Once the controller is booted up, the main menu will display.



Before launching your flight control system it is recommended to connect the controller to a mobile hotspot or Wi-Fi network, The controller uses internet connectivity to load satellite maps and for LTE connectivity to the UAV. The DeltaQuad controller needs to be connected to a 5Ghz mobile hotspot or WiFi network. As the main communication link for the controller is based on 2.4 GHz, these networks will not be displayed. When using a mobile phone hotspot please make sure you configure the hotspot for 5Ghz.

At the top of the screen, you will find the data link bar.

The data link bar will always remain visible and allows you to control the type of transmission and select the active camera feed. The available modes will display in white, and the currently active mode will display in green.

- MODES:
  - RADIO: This mode uses the internal radio system. The radio system is capable of transmission ranges up to 30KM, or up to 50KM when your system is equipped with the booster package.
  - LTE: This mode uses mobile network over a VPN-secured data link. To use LTE mode the following needs to be activated:
    - A SIM card needs to be installed inside the UAV. The LTE dongle is located in the nose section of the vehicle and can be accessed when the battery is disconnected. Make sure the sim card has sufficient data available and that it is not secured with a pin-code. To test the connectivity of your LTE dongle with your sim card you can insert the dongle into a Windows-based laptop. After approximately 1 minute a webpage will open with the dongle settings and status.
    - The DeltaQuad controller needs to be connected to a WiFi network or mobile hotspot.
- VIDEO FEEDS:
  - HDMI: When an HDMI camera is attached to the HDMI port of the modem, this will activate the HDMI feed. The HDMI feed needs to be at least 1080p.
  - FPV: This is the static nose camera feed.
  - OFF: This disables both feeds and stops any data consumption. If the data link becomes intermittent it is recommended to disable the video feeds to remain connected to your UAV.

Starting the UAV control system

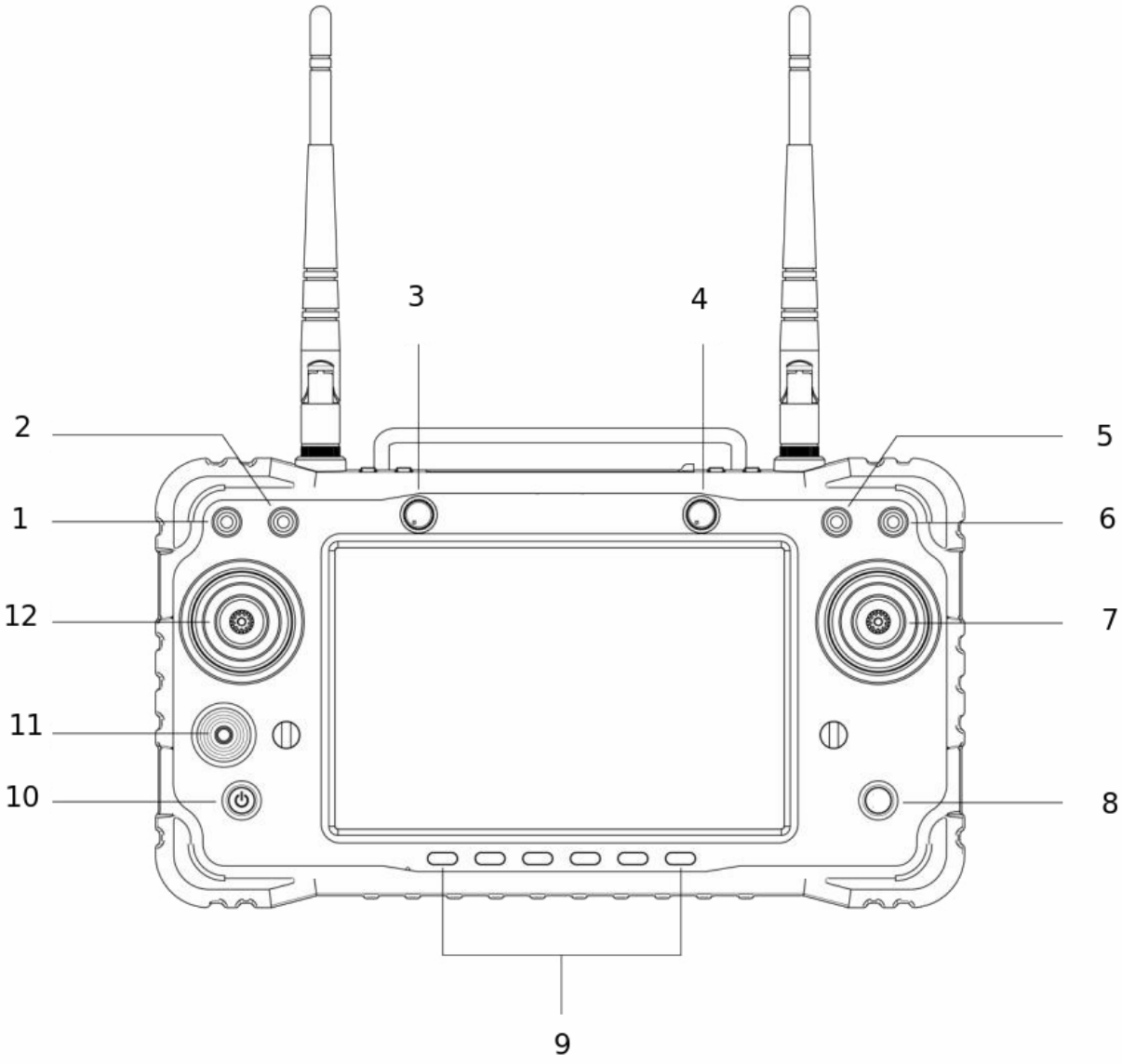
> ⓘ Before takeoff, always center all switches, and turn all dials to the left.

From the main menu launch the QGroundControl app (QGC). This application

From the QGroundControl app, you will be able to plan your initial mission. Missions are always planned to ensure the vehicle has a predefined takeoff and landing pattern. Even when you intend to manually control the UAV or control the UAV using repositioning or target following commands, it is recommended to plan a mission for takeoff and landing.

Please review the mission planning section for detailed information on how to plan a mission.

Overview of the buttons


3
4
2
5
1
6
12
7
11
10
8
9

Number	Type	Function
1	3 position switch **FLIGHT MODE**	UP: Position flight mode CENTER: neutral - remain in current mode DOWN: Mission flight mode
2	3 position switch **RETURN**	UP: Return flight mode CENTER: neutral - no functic DOWN: neutral - no function
3	Dial	Not assigned
4	Dial	Not assigned
5	3 position switch	Not assigned
6	3 position switch	Not assigned
7	Joystick	**In hover mode** Stick up: move forward Stick down: move backward Stick left: move left Stick right: move right **In fixed-wing mode** Stick up: descend (nose dow Stick down: climb (nose up) Stick left: bank left Stick right: bank right
8	Push button	Not assigned
9	A to F push buttons	Not assigned
10	Push button **POWER**	Press and hold: power on/off Press: screen on/off
11	Joystick	Not assigned
12	Joystick	**In hover mode** Stick up: climb Stick down: descend Stick left: yaw left Stick right: yaw right **In fixed-wing mode** Not activated

Shutting down & charging the controller

The DeltaQuad Controller can operate continuously for approximately 6 hours. If more operation time is required, the controller can be charged during operation.

To charge the controller, open the rubber cover between the antennas and attach the provided USB charger to the USB-C port. The controller requires high-voltage charging. Standard USB chargers or USB sockets from laptops are not always capable of providing high voltage, but they will extend the battery life of the controller.

To shut down the controller, press and hold the power button until the shutdown menu appears. Select "Power off" to shut down the controller.

Booster Package and Antenna Installation

If your DeltaQuad Pro #CARGO comes with the Booster Package you can follow these instructions for installation.

The DeltaQuad booster package will increase the operational range of the DeltaQuad Controller up to 50 km. The package consists of an easy-to-remove panel antenna, an 8-watt ground booster with a power bank, and a 3-watt booster inside the UAV.

The DeltaQuad Controller will also include the standard antennas for omnidirectional use of up to 30 km.

The following video shows the installation of the booster antenna on the DeltaQuad Controller.

How to install the Booster Antenna on the DeltaQuad Controller.

Step 1 - Make sure the DeltaQuad Controller is turned off!

> *NOTE*: Before detaching the omnidirectional antennas, please make sure that your DeltaQuad Controller is turned off!
>
> Having the DeltaQuad Controller powered on without the antennas installed will cause damage to the radio module. This will render your controller unusable.

Step 2 - For the installation, you need (from left to right).

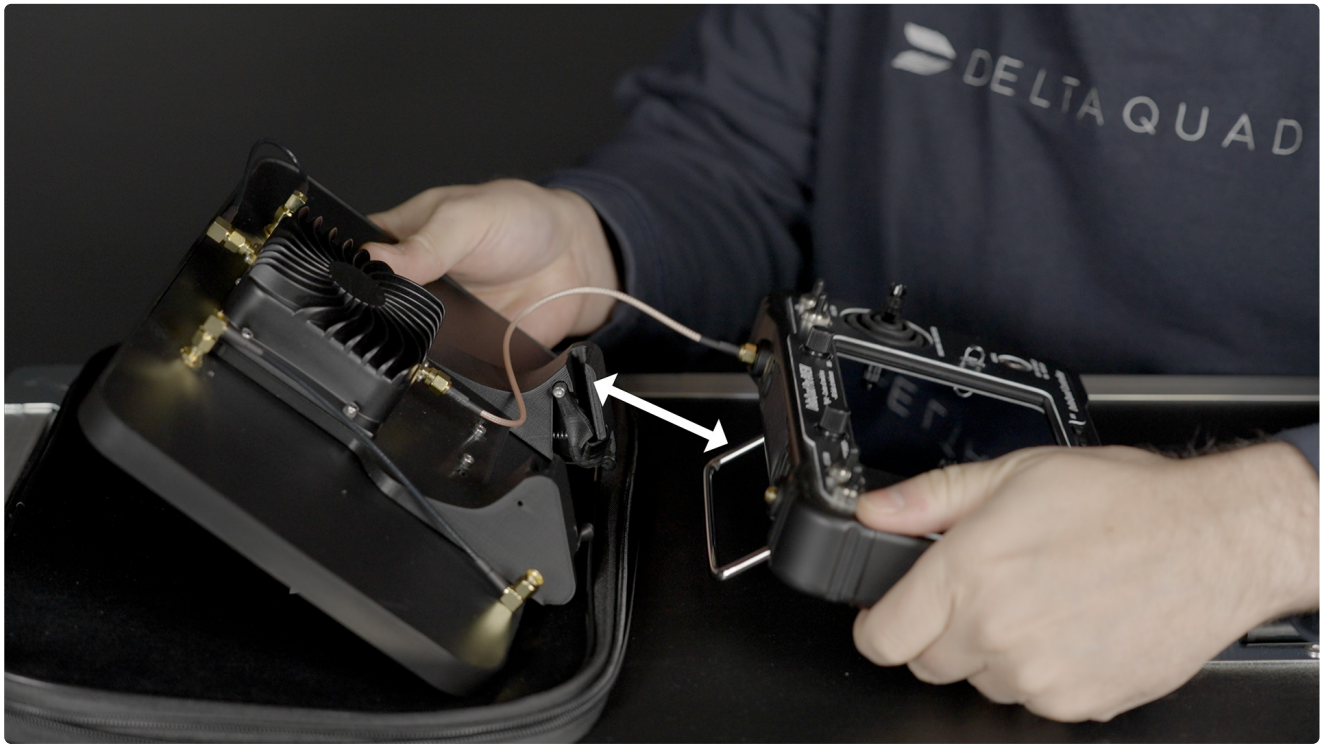
1. Booster for the DeltaQuad Controller
2. DeltaQuad Controller
3. Open-end wrench
4. Power bank
5. Power cable

Step 3 - Remove the two omnidirectional antennas at the top of the controller by turning them at the base of the antenna counterclockwise.

Step 4 - Lay the booster face down on a flat surface.

Step 5 - Connect the copper-colored SMA cable to the right SMA antenna connection of the controller.

Step 6 - Slide the handle of the controller into the dedicated holding mechanism on the booster.



Step 7 - Connect the left black-colored SMA cable to the left SMA antenna connection of the controller and tighten it with the open-end wrench.

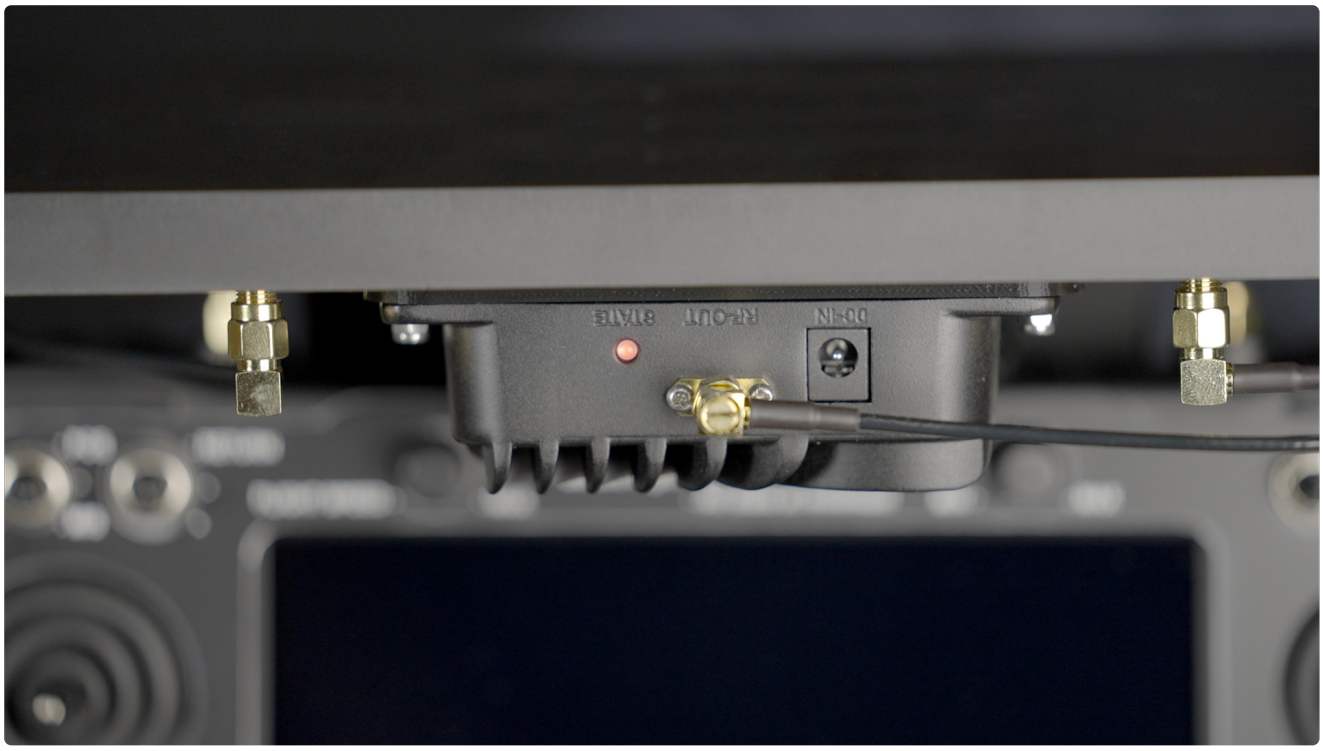
You now installed the booster antenna on the DeltaQuad Controller.

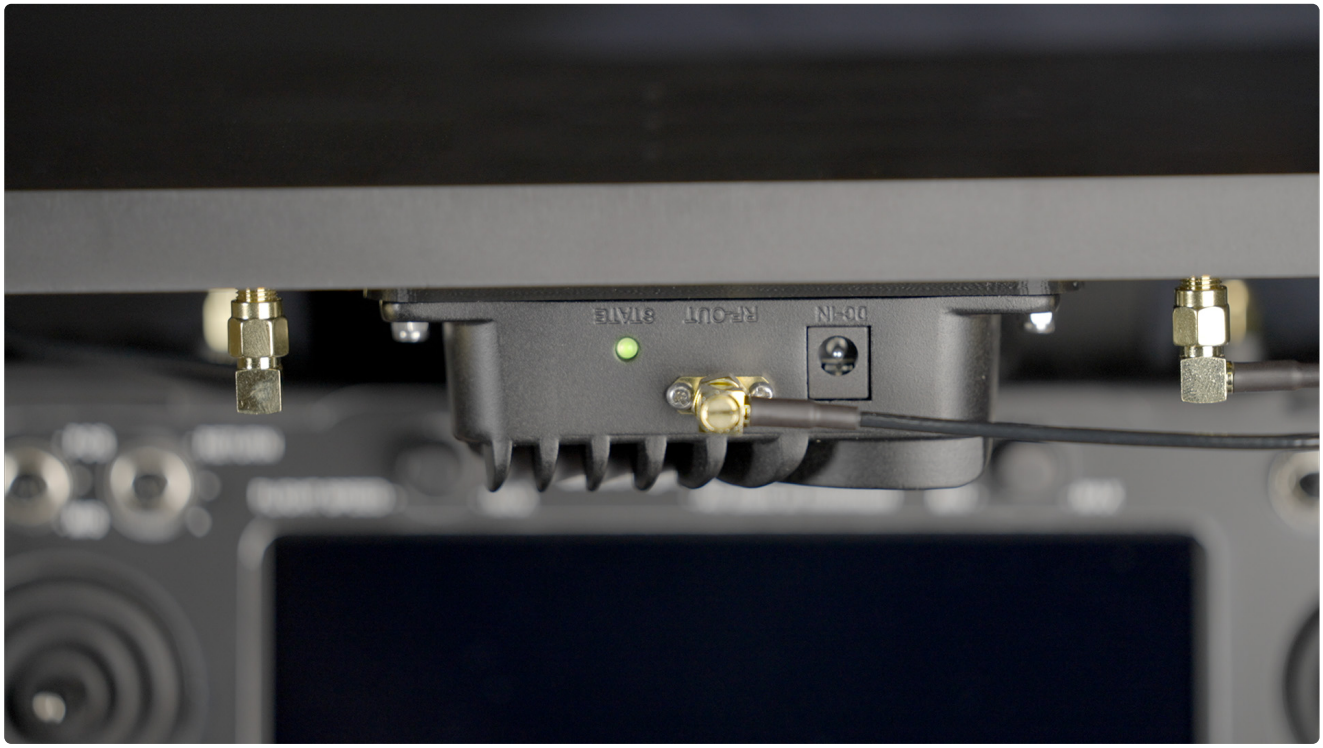
> *NOTE*: To work properly, the booster antenna needs to be powered with the included power bank.

Step 9 - Connect the cable of the power bank to the top side of the booster.

Step 10 - Connect the other side of the cable to the power bank and switch it on.

Step 11 - When turned on the LED at the top of the booster will be red. When connected to the DeltaQuad it will be green.





NOTE: For the disassembly, please follow the steps in reverse order.

Always make sure that the DeltaQuad Controller is turned off when disconnecting the antennas or antenna cables.

When detaching the booster antenna, push the levers of the closing mechanism away from the DeltaQuad Controller. By doing so, the booster antenna will slide off the handle by itself.

During this process, hold the booster antenna at all times as the copper-colored SMA cable is still connected to the DeltaQuad Controller. Any strain on this cable and its connectors can damage the hardware.

Payload Drop Mechanism

If your DeltaQuad is equipped with a Payload Drop Mechanism (PDM) you may use the following instructions to operate the PDM. Please note that dropping payloads from a UAV might require special permits. Please check with your local authorities before using the payload drop mechanism. Never operate the PDM near people, roads, or property.

Mechanical

The PDM consists of a payload bay with 2 payload doors that are operated by servo motors. The Servo motors are attached to the payload doors with steel rods. Never operate the payload doors when they are obstructed as this might damage the system.

Payload bay dimensions	10 cm x 15 cm x 9 cm
Payload capacity	1 Kg

Operating the PDM

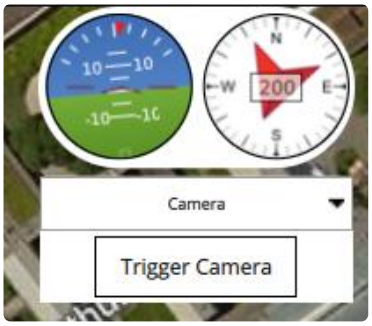
When the payload doors are triggered, either manually or from a mission command, the doors open for 3 seconds, and then automatically close. From the Ground Control Station, the PDM is considered a camera system. It uses the camera trigger functionality to operate.

Testing the payload doors

> ⚠ WARNING: never trigger the payload doors when the vehicle is sitting on the ground with the payload doors obstructed. This may damage your PDM.

To test the payload doors position the vehicle such that the doors can open unobstructed, you could place the vehicle between 2 tables for example. Then use the following steps;

1. Switch the vehicle and Ground Control Station on
2. From the "Fly" screen, tap the drop-down box that reads "Values" and select "Camera"
3. Press the "Trigger Camera" button



This method can also be used to manually control when the payload is dropped during a mission flight.

Dropping the payload during a mission

Payloads can be dropped while the vehicle is flying as a fixed wing (airplane mode) or as multi rotor (hover mode). Fixed wing drops are the easiest, safest, and most efficient in terms of battery consumption, but they are not very precise. Multi-rotor drops are very precise but require significantly more energy and low wind conditions.

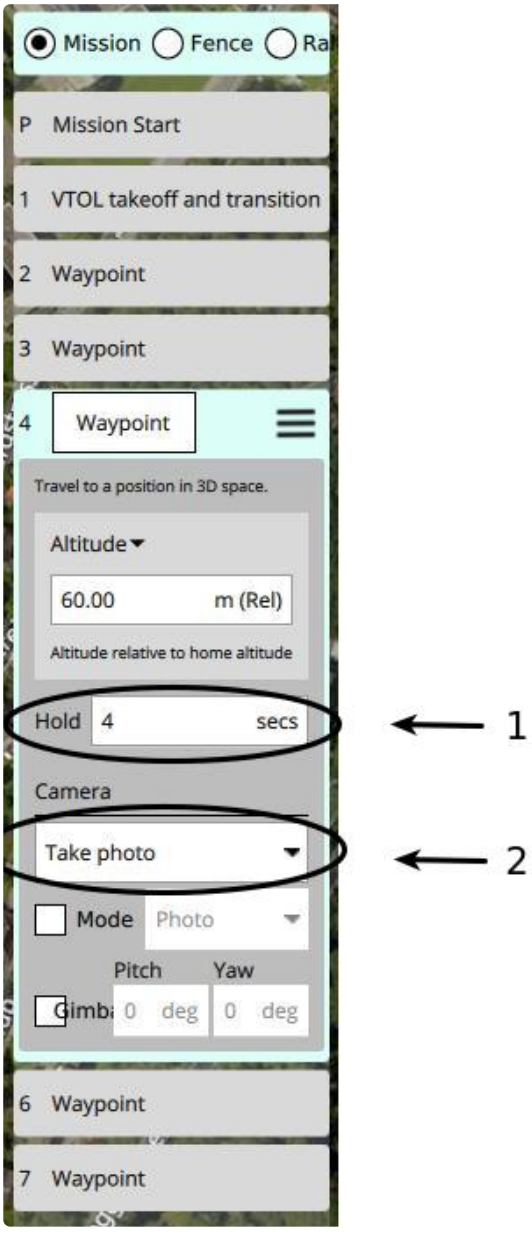
For payload drops please consider the following;

- Do not set camera patterns such as Survey or Corridor scan, doing this will trigger the payload drop mechanism.
- Payloads are dropped from the altitude the vehicle is maintaining, payloads should be able to resist falling from such a height without damage, or they should be equipped with a parachute
- Wind can affect where the payload is dropped. In fixed wing mode It is advised to face the wind direction when dropping the payload.

Fixed wing drop

To plan a drop in fixed wing mode please ensure the drop zone area is at least 50 meters or more. Plan your mission using the following steps;

1. Plan a standard mission as indicated in the Planning a mission section.
2. Place a waypoint on the target drop zone
3. Change the "Hold" value of the waypoint to 4 seconds, indicated below (1)
    1. If the payload is dropped too late use a lower value
    2. If the payload is dropped too soon use a higher value
4. Expand the "Camera" options by clicking on it
5. Set the camera action to "Take photo", indicated below (2)

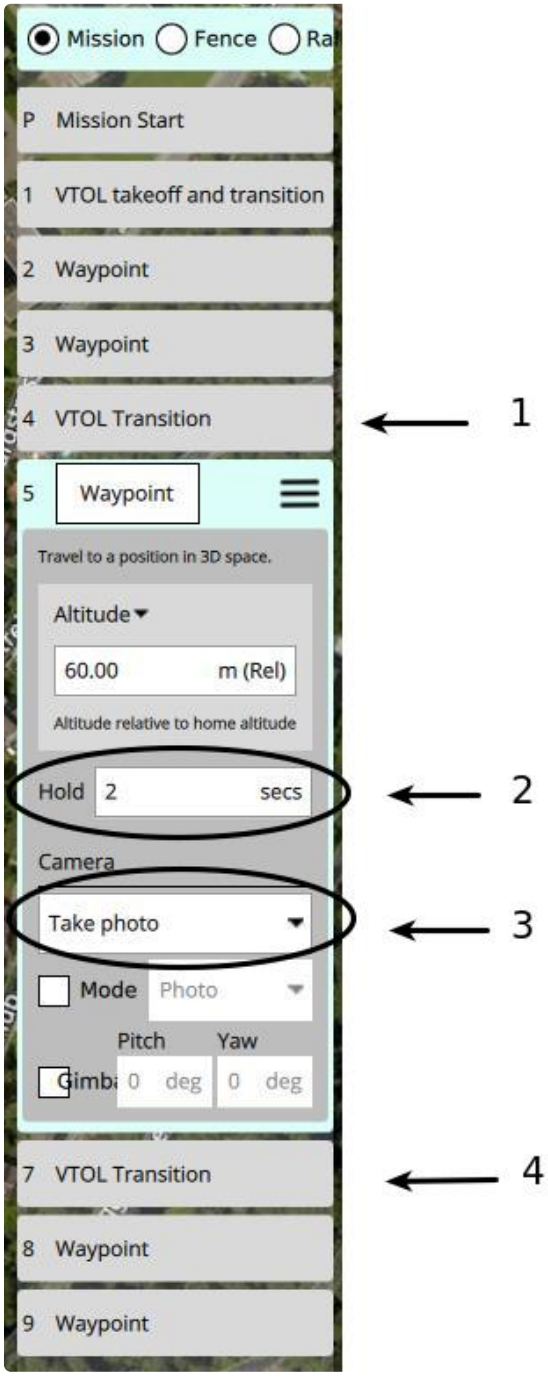


Multi-rotor precision drop

When planning a precision drop the vehicle will return to hover mode, drop the payload, and return back to fixed-wing mode. This requires proper planning and should only be performed in low wind conditions (< 6m/s). When using precision drop please make sure that the vehicle has sufficient battery power to do so. A minimum of 20% battery use must be considered for this procedure.

To plan a precision drop use the following steps;

1. Plan a standard mission as indicated in the Planning a mission section.
2. Place a waypoint 2 meters before the target drop zone
3. Place an extra waypoint near the drop zone, as indicated below (1)
    1. Change the category to VTOL
    2. Select VTOL Transition
    3. Select the mode "Hover mode"
4. Place a waypoint on top of the drop zone
    1. Change the "Hold" value to 2 seconds, as indicated below (2)
    2. Expand the "Camera" options by clicking on it
    3. Set the camera action to "Take Photo" as indicated below (3)
5. Place an extra waypoint after the drop waypoint
    1. Change the category to "VTOL"
    2. Select VTOL Transition
    3. Select the mode "Plane mode"
6. Make sure the next waypoint is at least 300m away from the drop zone, and in a straight line in relation to the approach path.
7. If the altitude of the drop zone was lowered (< 40m) then make sure the altitude is increased again before performing the transition to fixed wing mode. This can be done by placing an extra waypoint 2 meters after the payload drop waypoint with the correct altitude.



Sample missions

The following sample mission shows how to plan a standard "Fixed wing" drop. You can import this mission into the Ground Control Station as an example of how to plan a fixed-wing payload drop.

PDM.plan

The following sample mission shows how to plan a precision "Multirotor" drop. You can import this mission into the Ground Control Station as an example of how to plan a fixed-wing payload drop.

PDM precision.plan