



FLYABILITY
ELIOS 1

USER MANUAL

VERSION 1.5.2
05/02/2020

Refer to the ELIOS Original Instructions for:

1. CE and FCC compliance declarations.
2. Product warranty and liability terms
3. Pilot Guidelines and Checklists

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1 Elios Pilot Certification

This manual and its referenced documents contain information which must be studied for the Elios 1 Basic and Expert exams. The exams can be taken online.

Link to [Basic Exam](#), activates the warranty for end users.

2 Warranty

2.1 Warranty Limitations

Every Elios comes with a 12-month warranty which is the expression of our commitment to quality. The warranty covers all the malfunctions that could occur during the life of the product, arising from software or equipment included in the Elios UAV & Pack. With the following exceptions:

	No warranty	6 months	12 months
Propellers	x		
Camera Servo		x	
Propulsion System ¹			x
Battery ²		x	
Battery charger		x	
Cage's Carbon-Fiber Pentagons	x		
Decoupling Mechanism (Ring and Beam)			x
Range extender			x
Camera Operator GCS			x

1. One year and no more than 50 flight hours

2. Six months and no more than 40 charge/discharge cycles

Any damage due to improper usage or lack of basic maintenance, cleaning will not be covered by warranty.

In case of malfunction during the warranty period, Flyability commits, to its option, to repair the defective product/part or to deliver to its customer an equivalent product/part to replace the defective item.



The warranty is active starting from the day the pilot has passed the Basic certification and on condition that the Elios has not been modified. Please refer to our GTC for all the conditions and limitations related to the warranty.

2.2 50hours Maintenance

The warranty of the drone is valid for 50 flight hours. It is highly recommended to ship the drone system to a maintenance center for servicing when this period expires, as this will renew the warranty for another 50 flight hours. The following items are replaced during the maintenance.

1. Motors and propellers
2. Camera actuator
3. Video and thermal camera cables

In addition, the drone will be functionally tested to ensure it is safe to operate for another 50 flight hours.

For an up to date list of Flyability Service Centers, please consult our website:

www.flyability.com

3 ELIOS System description

The Flyability ELIOS was specifically developed as a flying platform capable of entering confined and cluttered environments.

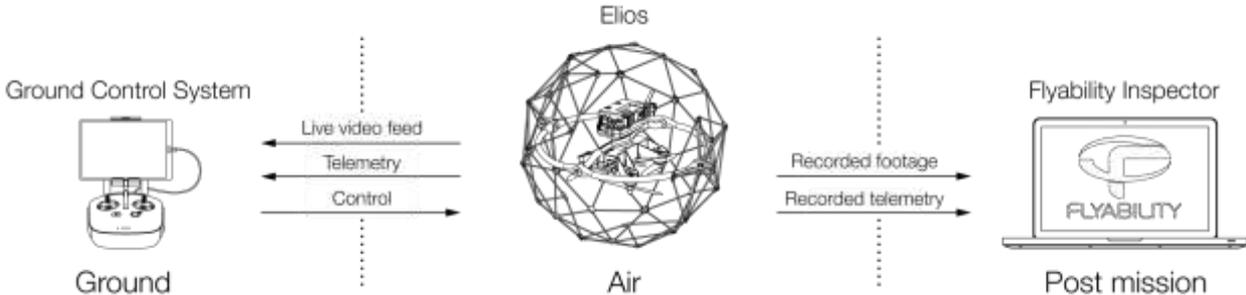


Figure 3.1: System overview

As the operator, you will enjoy a full control of Elios through the Ground Control System (GCS). A tablet allows the operator to monitor a live video feed transmitted by Elios. The Flyability Inspector post-mission analysis software provides a simple solution to visualize the recorded full HD optical video and the thermal video.

3.1 Elios

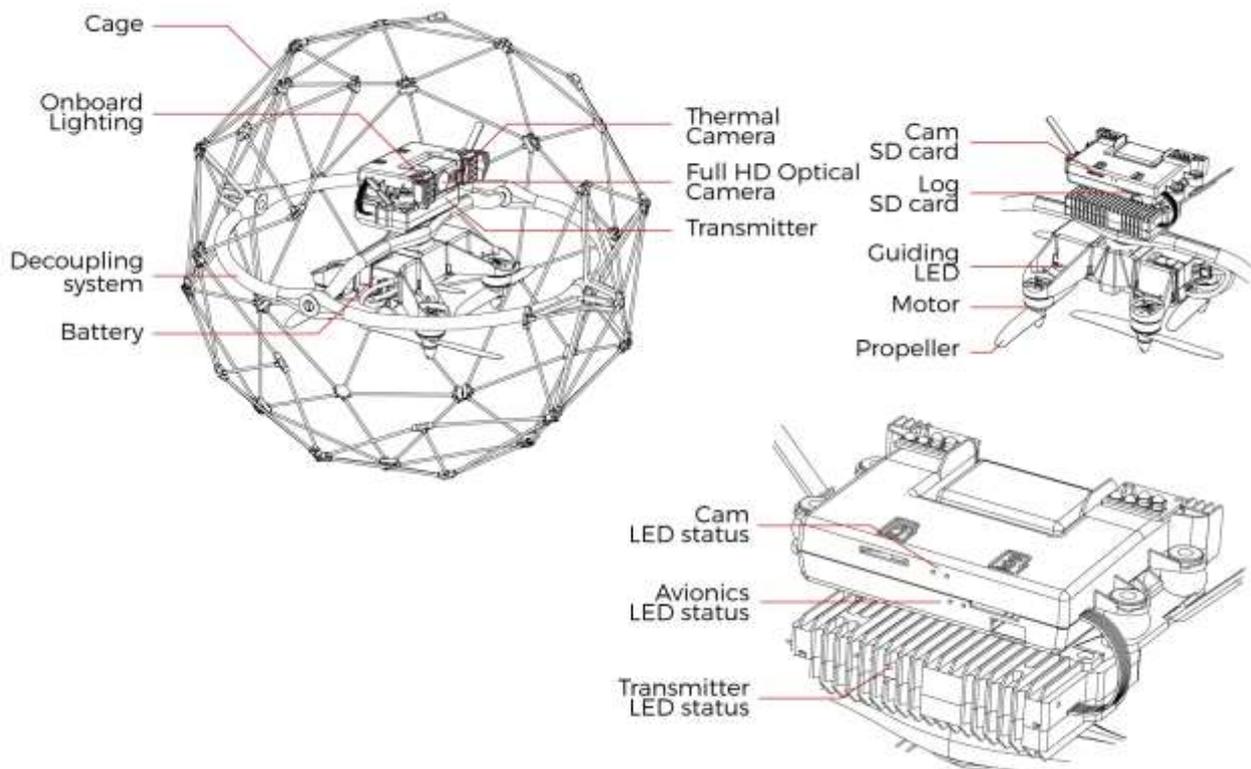


Figure 3.2: Elios overview

Cage

Elios is surrounded by a protective cage. The cage is there to prevent collisions between the propellers and humans or other obstacles.

Decoupling System

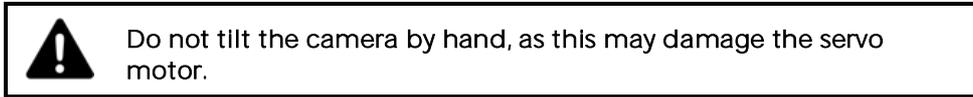
The decoupling system allows the cage to rotate freely around the drone. It is composed of a ring and a beam, giving it 3 degrees of rotation.

Transmitter

The transmitter offers a reliable wireless link between the GCS and Elios.

Full HD Optical Camera

Elios is equipped with a Full HD optical camera. The Standard Definition (480p) live video feed is transmitted to the pilot, and the FHD (1080p) footage is recorded on the SD cards. The camera is mounted on a servo motor allowing it to tilt up or down.



The full HD Optical Camera has three modes:

- **Automatic mode:** The user sets the Exposure Value (EV) whereas the camera automatically sets the ISO and the exposure time to keep the EV constant. The EV corresponds to the overall brightness of the image.
- **Manual low ISO:** The user sets the Exposure time whilst the ISO is set to 50.
- **Manual high ISO:** The user sets the Exposure time whilst the ISO is set to 1600.

The Full HD Optical Camera doesn't allow to take pictures. But it is recording a 1080p video from which the user can later export frames. The video recording starts when the robot is armed and stops automatically when the robot is disarmed.

Thermal Camera

The FLIR LEPTON thermal camera is coaxially mounted next to the video camera and can also be tilted up and down. The footage of the thermal camera is automatically saved in the LOG SD card and can be reviewed using Flyability Inspector. The pilot can also switch to the video feed of the thermal camera during flight.

Motors and Propellers

Four propellers create the thrust required to fly. Propellers on the arms annotated with an R are spinning counter-clockwise whereas the other two others are spinning clockwise. The R propellers are mounted on the R arms. The non-R propellers are mounted on the non-R arms. This is important when replacing propellers.

Camera SD Card

The Camera SD Card records the full HD optical video feed whilst Elios is flying. Please only use the provided SD card, as this has been tested to ensure it meets write speed requirements.

Log SD Card

The Log SD Card records the thermal video feed as well as plenty of telemetry data. The telemetry will be useful for you to analyze your flight using Flyability Inspector software. Furthermore, it will help the Flyability team run diagnostic tests in case of issues with your system. Please only use the provided SD card, as this has been tested to ensure it meets write speed requirements.

Battery

A removable LiPo battery powers the aircraft, providing up to 10 minutes of flight time.

Onboard lighting

A powerful array of white LEDs offers bright lighting on the front, top, and bottom of the aircraft. It helps operators navigate and gather high-value footage in dark environments, the intensity can be adjusted in flight via the Ground Control Station.

Guiding LED

To help the pilot during Line of Sight (LOS) operations, two colored LEDs are installed to help improve orientation awareness. The Red LED is located on the left and the Green LED on the right side of the aircraft.

If the LEDs are blinking alternatively, it means Elios is waiting to connect to the ground control unit.
If the LEDs are blinking rapidly synchronously, Elios is performing a power-on self-test.

Camera LED status

Gives information about the status of the camera

- Solid green: On and ready
- Blinking green: Recording
- Blinking red: Error or missing SD card

Avionics LED status

Gives information about the status of the avionics:

- Left LED blinking blue: Avionics working properly
- Right LED solid blue: telemetry is being recorded correctly

Transmitter LED status

Gives information about the status of the transmitter.

Right LED:

- Blinks red: Link button pressed. Air System is attempting to link with the Ground System
- Blinks green: Signal detected but not linked to the ground control system
- Solid green: Successfully linked to the ground control system
- Solid red: No signal detected, ensure ground control system is on.

Left LED:

- Solid green: Video from the camera is well received by the transmitter
- Solid red: Error

3.2 Ground Control System

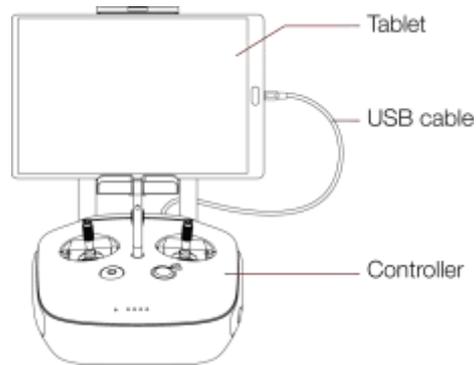


Figure 3.3: GCS overview

3.2.1 Setting up the ground control system

Mount the tablet

To mount the GCS, follow these steps:

1. Put the antennas and the tablet holder in a vertical position.
2. Press the button on the side of the tablet holder to release the clamp.
3. Secure the Tablet inside the clamp.
4. Connect your tablet to the remote controller via the USB cable.

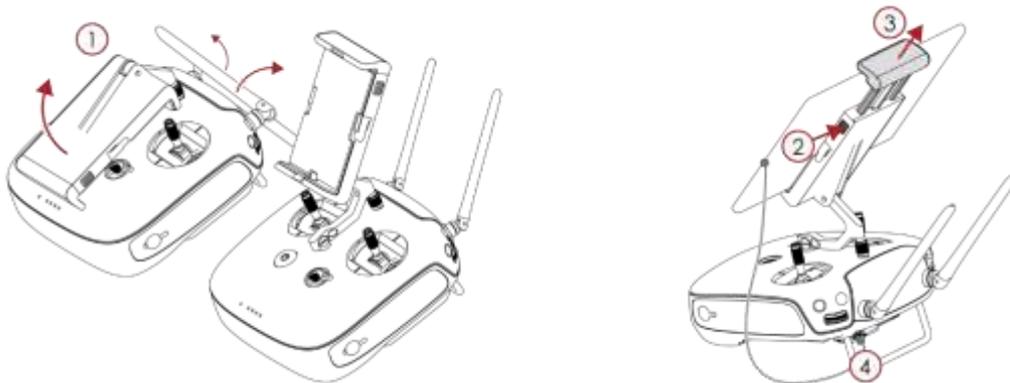


Figure 3.4: Assembly of the GCS

Power on the controller

To turn the controller on/off:

1. press the power button once, it will display the battery level on the LED
 2. Press it again and hold
- The controller will turn on, the same sequence can be used to turn it off again.

Power on the tablet

To turn on/off the tablet, press and hold its power button.

3.2.2 Charging

To charge the tablet, connect the USB cable to the USB port of the tablet. Put the other end of the cable to the USB wall charger. Plug the USB wall charger into the wall socket.

To charge the controller, connect the controller charger to the barrel jack of the controller. Plug the other end of the charger to the wall socket

Use only the provided charger to charge the Controller. The use of a non-approved charger may result in battery damage and risk of fire. While the controller can be charged while in use for piloting the drone, this is not a recommended practice as this may lead to the unit overheating.

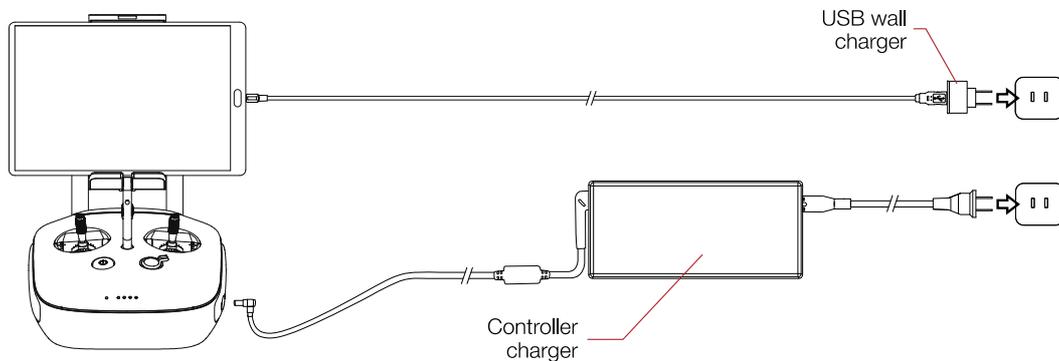


Figure 3.5: GCS charging

3.2.3 Tablet

The tablet provides a visual interface with the Aircraft and controller. It displays the live video feed transmitted by Elios, and important flight parameters. The SAMSUNG ACTIVE II tablet comes standard with every ELIOS system.

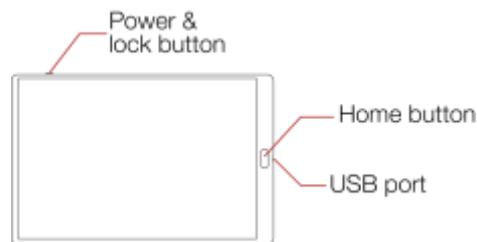


Figure 3.6: Tablet overview

Power & lock button

Power on/off the tablet and lock the screen

Home button

Press this to return to the main menu

USB port

Used as a communication port with the controller, and to recharge the tablet's battery

USB cable

The USB cable is used to connect the Tablet to the Controller.

3.2.4 Software

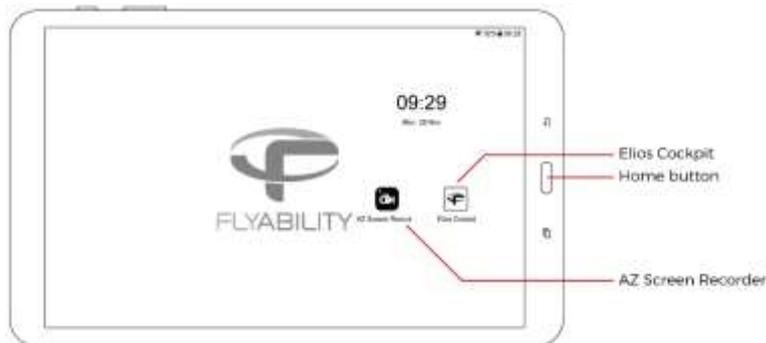
The tablet comes pre-installed with **Cockpit** and **AZ Screen Recorder**. It is recommended to avoid installing other apps, as these might interfere with the performance and functionality of the device. Also avoid running other apps in the background while using cockpit as these might reduce the performance and video quality.

Cockpit App

This app is developed by Flyability and functions as an interface with the drone during flight. It displays the video stream from the drone, as well as important flight parameters and settings. For a complete overview of its functions please refer to the Flyability Cockpit User Manual.

AZ Screen Recorder

This is a third party app intended to provide a video backup in case of a loss of the drone. The App records everything displayed on the screen, as well as the audio from the microphone. It can also be used to record comments made during the flight.



3.2.5 Controller

The controller gives to the pilot full manual control of the aircraft. It is also used to change the camera and lighting settings.

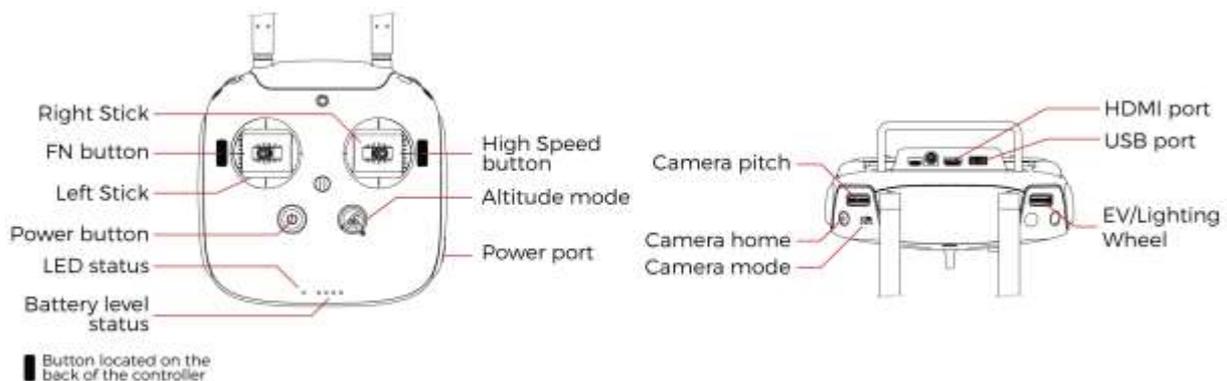


Figure 3.7: Pilot controller overview

The controller is set to Mode 2 by default consult the Cockpit App manual for information on how to switch to Mode 1.

Left stick

Controls the aircraft altitude and yaw.

Right stick

Controls the aircraft horizontal motion (forward/backward, left/right).

The more you push a control stick away from its centre, the faster Elios will follow the command. Give gentle and measured inputs to avoid any jerky and uncontrollable behaviour changes. While flying, always keep your fingers on both control sticks to improve the reaction time and feeling for the controls.

Power button:

Turns the Controller on/off and displays the battery level of the controller. Tap once to view the battery level, tap once and hold to turn on or off.

Status indicator

Indicates the connection status between the controller and Elios:

- Solid red: Controller is on, set as Master but not connected to the aircraft
- Blinks blue: Controller is attempting to bind to the aircraft
- Solid green: Controller is set as Master and connected to the aircraft

- Solid purple: Controller is on, set as Slave, but not connected to the aircraft
- Solid cyan: Controller is set as Slave and connected to the aircraft
- Blinks red: Error. Use DJI GO ("before P4") for further troubleshooting.



DJI GO WILL ASK YOU TO UPDATE THE FIRMWARE OF THE CONTROL UNIT. DO NOT DO THIS. THE FIRMWARE VERSION OF THE CONTROLLER MUST REMAIN AT VERSION 1.2.10

Battery level indicator

Displays the controller's battery level. Each LED corresponds to 25% charge remaining.

Altitude mode

Up: **Manual Thrust Control** mode, gives direct control over the thrust

Down: **Automatic Altitude Control** mode, the altitude is automatically maintained.

The altitude of the drone is measured by an on-board pressure sensor. In some cases, the pressure in an environment will not be stable and Elios will not be able to maintain a constant altitude. To have a better control, the pilot can disable the Automatic Altitude Control mode to have a direct control on the motors' thrust, called Manual Thrust Control. In this case, instead of controlling the height, the up/down stick will regulate the thrust power. Operating in Manual Thrust Control mode is not covered by the warranty.

Camera pitch

Clockwise, camera looks upward.

Counter clockwise, camera looks downward.

Camera home

Horizontally levels the camera when pressed

Camera mode

Set the camera mode

- A: Camera in automatic mode
- C1: Camera in manual low ISO mode
- C2: Camera in manual high ISO mode

FN button

Press and hold this button while turning the EV/Lighting wheel to turn on the LED lights.

EV/Lighting wheel

Wheel:

- Default:
 - Sets the EV if camera in automatic mode
 - Sets the Exposure time if the camera is in manual low ISO mode or in manual high ISO mode.
- While the FN button is pressed the wheel sets the onboard lighting intensity

POI Button

Save a point of interest which can be reviewed after flight in the Flyability Inspector software.

SRC Button

Switches the video feed between HD camera and Thermal camera.

Pro Mode

When pressed, Elios is in **High-Speed** mode. This makes the drone more responsive and increases the attitude angle limitation to achieve higher flight speeds.

The horizontal wind speed is limited to 3m/s (6.7mph) due to the drone's relatively low max airspeed of 6.5m/s (14mph). If Elios needs to fly in higher wind speed conditions the airspeed can be increased to 9m/s (20mph) by using the **PRO Mode**. This allows the drone to operate in wind speeds up to 5m/s (11mph). Operating Elios in PRO mode is not covered by the warranty.

USB port

Connection to the provided tablet

HDMI port

Offers the possibility to connect an external screen to the GCS

Power port

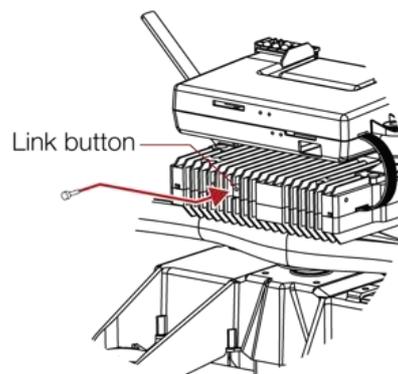
Connect to the controller charger to charge the internal battery of the controller.

Controller Pairing

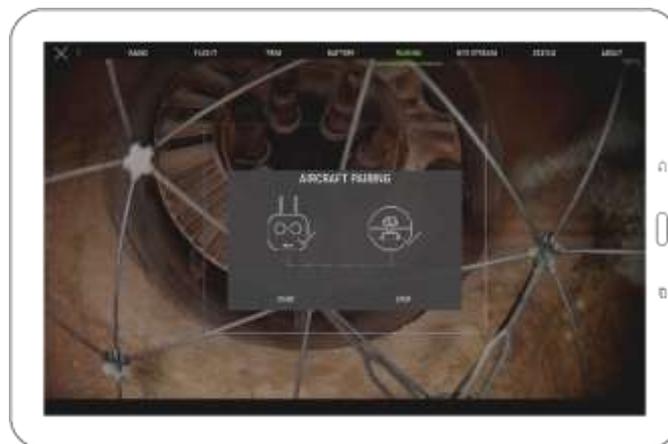
Every drone is paired to its own GCS controller, if you wish to pair a drone to another GCS controller then you must first perform this pairing procure.

Using the Cockpit App

1. Remove the screw located on the back of the transmitter block of the drone.



2. Place the controller and Elios at 1.5 m from each other.
3. Turn on Elios and the controller with the tablet connected.
4. Open Elios Cockpit and go to Settings > Pairing and tap on START.



5. The Controller Status Indicator will blink blue and emit a beep sound when the Controller is ready to link.
6. Using the Sim card remover provided in the Tool kit (or a paperclip), press the link button on the transmitter block on Elios. The controller status indicator will glow solid green and stop beeping if the linkage is successful.
7. Put back the screw.

Using only the Controller unit

The process can also be performed without using the tablet and the Cockpit App by following all the steps above, except that instead of step 4 you simultaneously press and hold the FN button, the Pro Mode button, and the Camera home button. The controller will start beeping. Then press the scroll EV/Lighting Wheel. The controller's status indicator will flash blue. The controller will beep faster. Then proceed with step 6.

3.3 Camera operator GCS (option)

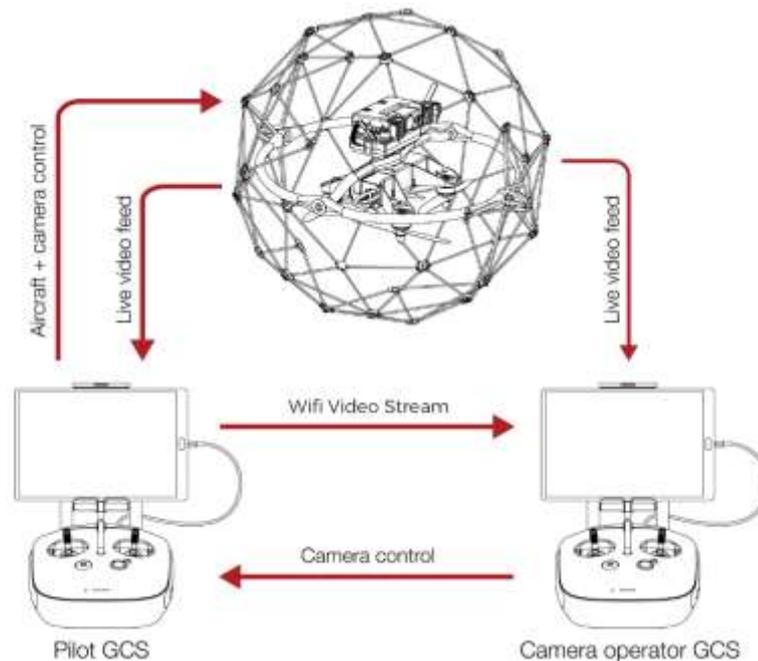


Figure 3.8: Camera operator overview

The pilot can be assisted by a camera operator to acts as a copilot relieving the pilot from all other tasks than piloting. In dual GCS mode, the pilot GCS controls the movement of the aircraft whilst the camera operator controls the camera settings, pitch angle and LED lighting. At any time, the pilot can override the camera operator command.

Both of Pilot and Camera Operator GCS receive the live video feed directly from the drone. If the Camera operator GCS is used in combination with the Range Extender antenna module then the Camera Operator must use the WIFI video stream directly from the Pilot GCS table. This can be enabled in the Cockpit App.

The buttons on the Camera Operator GCS, have the same functions as on the Pilot GCS, but all inputs which control the drones flight are disabled. The only exception to this is that the Camera Operator is also capable of disarming the drone.

Any ELIOS GCS unit can be reconfigured by the user to serve as a camera operator unit.

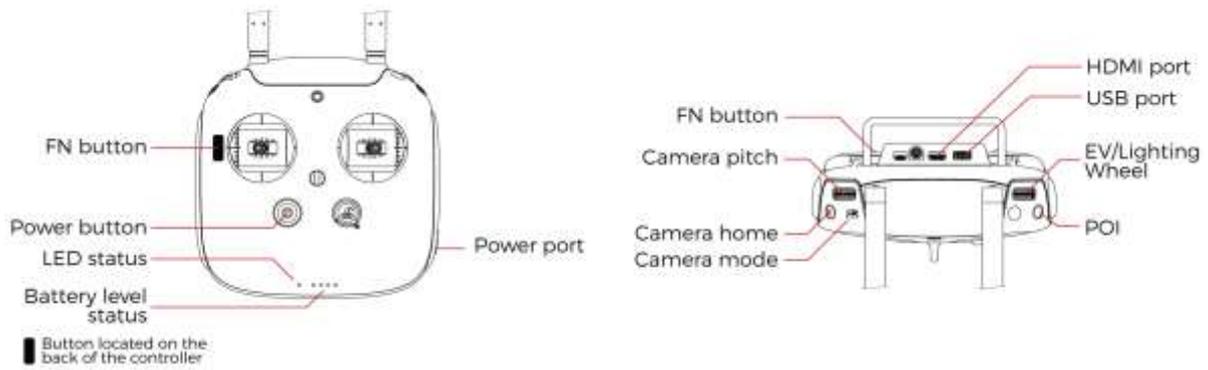


Figure 3.9: Camera operator controller overview

3.3.1 Connect a Camera Operator GCS to a Pilot GCS

Elios Cockpit doesn't have the capability of performing this operation, so the use of the DJI GO "for products before P4" App is required. As DJI GO and Elios Cockpit don't get along. We recommend that you do not install it on the tablet provided by Flyability, instead install DJI GO on your personal device for example a smartphone.

Be sure to have the same firmware installed on both GCS, this can also be updated with the DJI GO App.



DJI GO WILL ASK YOU TO UPDATE THE FIRMWARE OF THE CONTROL UNIT. DO NOT DO THIS. THE FIRMWARE VERSION OF THE CONTROLLER MUST REMAIN AT VERSION 1.2.10

What you need:

- 2x USB Device with DJI GO installed (DJI GO—for products before P4 version).
- 2x USB Cable.
- 2x GCS fully charged.

The following steps have to be followed:

1. Deploy, connect the USB cable and turn on the Pilot GCS and the Camera Operator GCS.

On the Camera Operator GCS:

2. Launch DJI GO.
3. Once the Remote Controller Picture appears, tap on Camera.



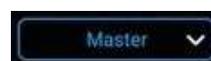
4. Tap the settings menu button in the top right corner ,



5. Select the RC Tab.



6. Set Remote Controller Function to Slave mode.



7. A confirmation window will appear, tap OK.

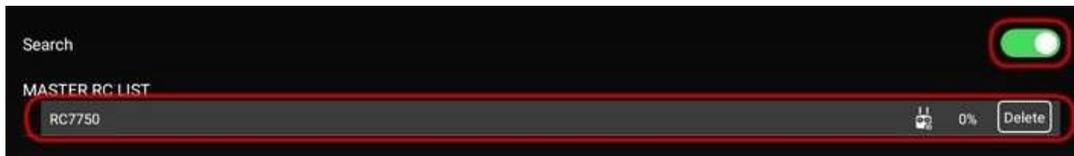
8. The status LED of the GCS will become purple, indicating that the GCS is in Slave mode.

On the Pilot GCS:

9. Launch DJI GO.
10. Tap on camera.
11. Go to the RC Tab in the settings menu and make sure that it is set as **Master**.

On the Camera Operator GCS:

12. Enable "Search".
13. In the master list, the Remote Controller name will appear.
14. Select the correct RC in the list and tap the password of the Pilot GCS then press OK.



15. Both GCS will emit a beep.

On the Pilot GCS:

16. The Slave RC will appear in the Slave GCS List.

On the Camera Operator GCS:

17. Tap on "Request Permission", then tap OK when a pop-up window will be displayed.

On the Pilot GCS:

18. A window will be displayed confirming the control of the camera, tap on Agree.

If a Pilot GCS is turned into a CamOp GCS then the drone it was previously paired to will have to be re-paired with the new Pilot GCS.

If the Pilot (Master) GCS is paired to a new drone then the Camera Operator (Slave) GCS will automatically follow it.

4 Flying Elios

4.1 Setting up Elios

4.1.1 Insert the SD cards

 Please only use the provided SD card, as this has been tested to ensure it meets write speed requirements.

Place the two SD cards in their corresponding slots behind the drone's camera head.

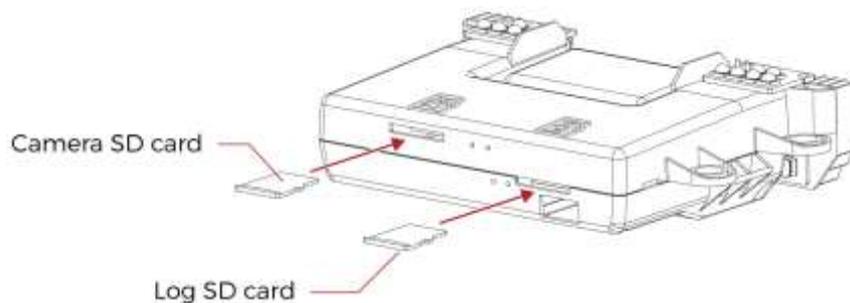


Figure 4.1: SD card mounting

4.1.2 Clean the Full HD Optical Camera Lens

 Be careful not to force the red camera assembly, moving it by hand may damage the actuator.

Using the lens cleaner provided in the tool kit, follow those steps to properly clean the Full HD Optical Camera Lens before **each** flight. This will significantly improve the image quality and increase the value of the footage obtained during an inspection.

1. Using the brush side, remove all the dust from the lens.
2. Using the dry cleaner side, remove all the grease and fingerprints from the optics.

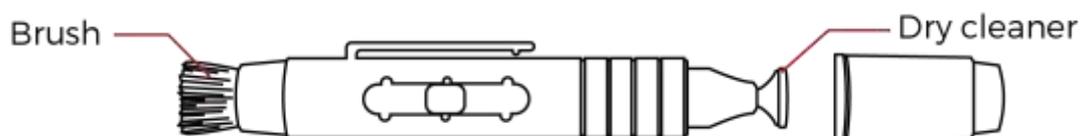


Figure 4.2: Lens cleaner overview

4.1.3 Insert and plug in the Battery

1. Slide the Battery into the Battery Holder.
2. Secure the battery by gently tightening a the strap.
3. To plug in the battery, simply slide the green battery connector all the way into the Elios' Power connector. The red safety clip should click into place and prevent the connector from unplugging itself during flight.

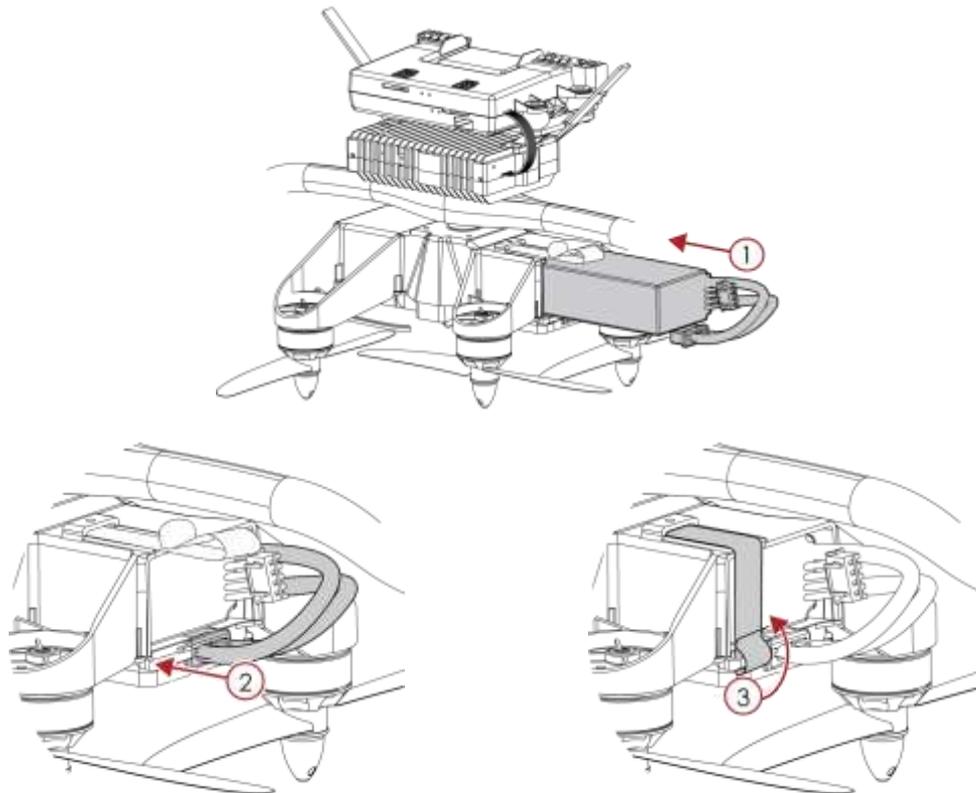


Figure 4.3: Battery insertion and connection

Once the battery is plugged in, Elios is in standby and ready to fly.



If the battery strap is not properly secured, the battery may slide out during flight. This will severely affect the stability of the drone and can lead a crash.

After flight, the battery can be removed in reverse order:

1. Unplug in the battery connector while pressing the red safety clip
2. Unstrap the battery.
3. Remove the Battery from the drone.

4.2 Elios control

4.2.1 Arming



Spinning propellers can cause serious injuries. **DO NOT** have any body part inside the cage whilst arming the robot.
 In case of doubt, go back to the Safety section and be sure you are following the checklists.

When the battery is connected, Elios is turned on and in standby mode. The drone must be armed before take off.

Unlike regular drones, Elios' inner part is not initially in an upright position. As its inner part is decoupled from its cage the latter is in random orientation. Hence, Elios has to first perform an upright maneuver as soon as the propellers spin up. Elios might roll around if is not held in place during this maneuver, and it is recommended to constrain it between your feet while arming.

To arm Elios, perform the following arming sequence **in rapid succession**:

1. Place the left stick on the bottom right
2. Keeping the left stick down, slide it to the bottom left.
3. Slide back the left stick to the bottom right

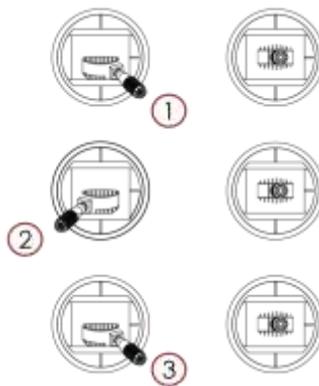


Figure 4.4: Arming sequence

Once armed, Elios will perform the upright maneuver. If after 5 seconds, Elios is not in a stable upright position, disarm Elios and contact Flyability.

4.2.2 Disarm

Once Elios has landed on the ground or is safely held by an operator, you must stop the motors. To do so disarm the drone with the following input:

1. Left and right stick down and to the center



Figure 4.5: Disarming sequence 2



The Drone can also be disarmed in mid air, resulting in a free-fall. If performed at an altitude of more than 1m above ground this will seriously damage the drone.

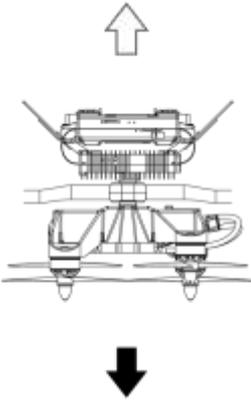
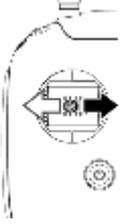
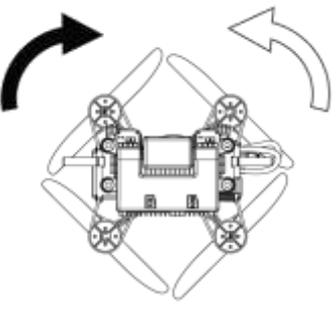


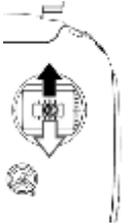
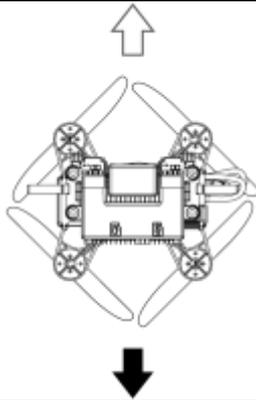
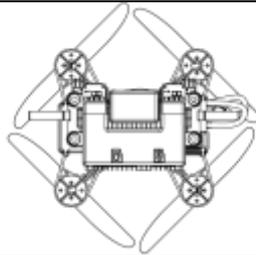
The camera operator controller is also capable of disarming Elios by using the same sequence.

4.2.3 Aircraft control

Elios' orientation and flight direction are defined regarding to the inner frame. It is very important that the operator ignores the motion of the cage whilst piloting.

By default, the control of Elios is mapped to the control sticks in mode 2, this can be changed to Mode 1 via the Cockpit App.

Controller	Aircraft	Explanation
		<p>In Automatic Altitude control: Moving the left stick up and down changes Elios' altitude.</p> <p>Up increases altitude. Down decreases altitude. Centered Elios maintains its altitude.</p> <p>In Manual Thrust control: Moving the left stick up and down changes Elios' thrust.</p> <p>Up increases thrust Down decreases thrust</p> <p>In this mode, keeping the stick centered will cause Elios to descend slowly. The pilot has to give constant inputs to maintain the aircraft at the desired altitude.</p>
		<p>Moving the left stick sideways controls the rotation (yaw) of Elios.</p> <p>Left makes the aircraft rotate counter clockwise. Right makes the aircraft rotate clockwise Centered, Elios maintains its orientation with a drift of max. 1°/second.</p> <p>The pilot should stay aware of Elios' heading at all times, as the right stick inputs are relative to Elios' heading, i.e. where the front of the drone is pointing.</p>

		<p>Moving the right stick up and down controls the pitch angle of Elios, making the aircraft go forwards or backwards.</p> <p>Up makes the aircraft go forwards. Down makes the aircraft go backwards. Centered, Elios stays level.</p>
		<p>Moving the right stick left and right controls the bank angle of Elios, making the aircraft go to the left or to the right.</p> <p>Left makes the aircraft go to the left Right makes the aircraft go to the right Centered, Elios stays level..</p>

 The drone does not have an onboard GPS to help it stay fixed in one place. The pilot must make continuous inputs to correct the drift caused by small trim errors and local air currents.

4.2.4 Failsafe

Loss of communication

If the communication link between Elios and the GCS is lost, the aircraft will automatically enter the emergency landing mode. It will slowly descend and land on the ground, wait 30s and then shut down the motors.

The aircraft will leave this mode if the communication link is re-established, after which flight may be resumed.

Battery level critical

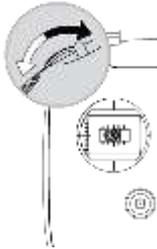
If the battery reaches a critical level, Elios will automatically enter the emergency landing mode, and the aircraft will slowly descend. The pilot is still able to override this, but to prevent any accident, the drone should be landed and turned off within 30sec.

 Overriding this failsafe for too long might result in permanent damage to the battery and could result in a crash.

4.2.5 Camera Control

The following control inputs can be made either by the Pilot or Camera Operator.

The left wheel of the Controller allows you to change the pitch of the cameras.



The left dial controls Elios camera's pitch.

Counter-clockwise makes the camera look downwards.

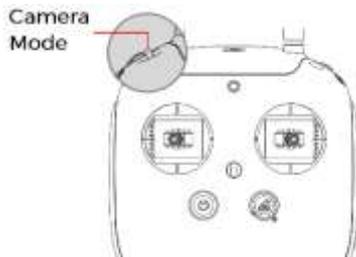
Clockwise makes the camera look upwards.

Centered, the camera will keep its current pitch.

It is possible to reset the camera position to level with the Camera home button.

Whilst flying, you can set several different parameters on the Full HD optical camera.

The three way Camera Mode switch sets the camera mode.



Auto – You set the Exposure Value (**EV**) and the camera changes with the ISO and exposure time. The EV is equivalent to the overall brightness of the image.

C1: Camera in manual **Low ISO** mode – ISO is set to **50** and you set the exposure time.

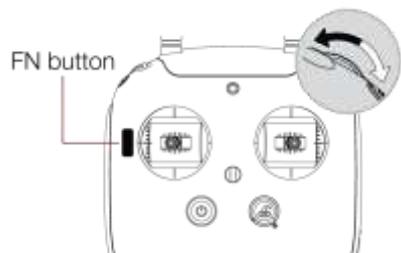
C2: Camera in manual **High ISO** mode – ISO is set to **1600** and you set the exposure time.



The right wheel sets the camera's exposure value (in automatic mode), or the camera's exposure time (in the manual low ISO mode and manual high ISO mode).

Clockwise increases brightness.

Counter-clockwise decreases brightness.



With the FN button on the back side of the controller is pressed, the right dial sets the onboard lighting LED's power.

Clockwise increases LED power.

Counter-clockwise decreases LED power.

4.3 Flight data logging and video recording

4.3.1 Data logging

As soon as the battery is plugged in, Elios is turned on and it starts to record data onto a LOG file on the LOG SD card. This file contains the Thermal camera footage data, as well as flight information such as sensor values, camera settings, and even controller inputs from the pilot. This data can be sent to Flyability engineers to analyze malfunctions should they occur.

The LOG file can be read with the Flyability Inspector software in order to access the Thermal Camera footage and flight parameters such as altitude and heading. Flight is not possible with the LOG SD card removed.

4.3.2 Video recording

The video recording starts as soon as Elios is armed and stops when Elios is disarmed, provided that the correct SD card is inserted.

4.3.3 Tablet Backup Recording

The video stream received by the tablet can be saved locally to create a low quality backup of the flight vide as well as some telemetry data, preventing a complete loss of data in case of an accident. This can be done in two ways:

AZ Free Recorder

This app is pre installed on the GCS Tablet and can be used to record everything on the screen of the tablet, as well as the audio recorded by the microphone. This can be useful to capture comments made by the pilot of the observing inspector during the flight.

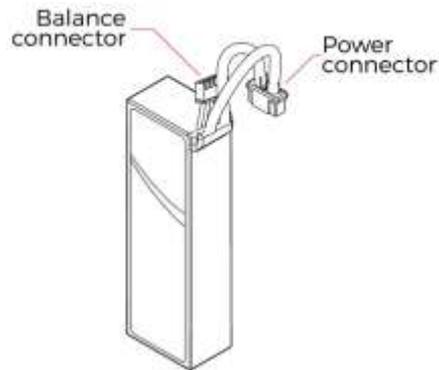
Cockpit Backup Recorder

This feature can be turned on in the settings menu of the Cockpit App. It records a video file with the received video stream, and creates a subtitle file (.srt) with the telemetry data.



A loss of power (due to a crash or battery disconnection) while Elios is flying may cause a loss of the video file being recorded on the camera SD card.

5 Battery



Chemistry	Lithium Polymer
Weight	170g
Capacity	2800mAh
Nominal Voltage	11,1 V
Cell Count	3
Dimensions	33.5x22.5x107mm

 Only use batteries provided by Flyability.

 To avoid fire, serious injury, and property damage, observe the safety guidelines when using, charging, transporting, or storing your batteries.



Fire hazard



Explosive hazard



Toxic hazard



Corrosive hazard

Please refer to the following documents for battery handling guidelines:

Elios Battery Safety Guidelines

Elios Balance Charger Manual

Elios Charger/Discharger Manual

6 Maintenance

6.1 Cleaning the drone

It is important to clean the robot after a flight in a dusty or dirty environment. To do so, use compressed air from an air blow gun or gas duster can. If necessary, Isopropanol alcohol can be used to clean the cage and any surface of the robot. Apply gently with a toothbrush or a rag.

Avoid the use of water, as this may damage the electronics.

6.1.1 LED lights

Take special care of the onboard lighting system. Accumulated dust or other dirt on the LEDs' surfaces will reduce the lighting capacity of Elios.

6.1.2 Motors

Pay special attention to the motors. Dust or other particles may damage the motors if allowed to build up inside. Use Compressed air to remove all dust and particles from the motors, check regularly for build up in between flights, especially in a metallic dust environment, as this will stick to the magnets of the motor.



If you blow compressed air on the motors, please wear gloves and hold the corresponding propeller. The air flow may make the propeller spin.

6.2 Changing a Propeller



A damaged or incorrectly installed propeller may seriously damage the aircraft.

Propellers should be changed when they are damaged. Damage is typically caused by large items entering the cage, but dust and small particles will also abrade the propellers in the long term.

1. Unscrew the nut with the screw driver provided in the tool kit, turn counter clockwise to loosen.
2. Replace the propeller. Be careful, the robot has two kinds of propellers. Propeller 5040R shall be placed on the front left and bottom right motors, propeller 5040 on the front right and bottom left motors. The propellers' labels must be facing up when Elios is in an upright orientation. Do not use pliers or other tools to hold the rotor. It might bend the motor shaft. Gloves should be used instead.
3. Screw on and tighten a new motor nut. Elios is shipped with a Dynamometric screwdriver which is pre-set to the correct torque of 1.4Nm. Using this tool eliminates the risk of overtightening the motor nuts and damaging the threaded motor shafts.

Note: If correctly tightened the propeller should not have any play on the motor shaft, nor should it be possible to rotate the propeller in relation to the motor shaft. An insufficiently tightened nut can cause a crash and might result in serious damage to the robot and injure people or infrastructure.

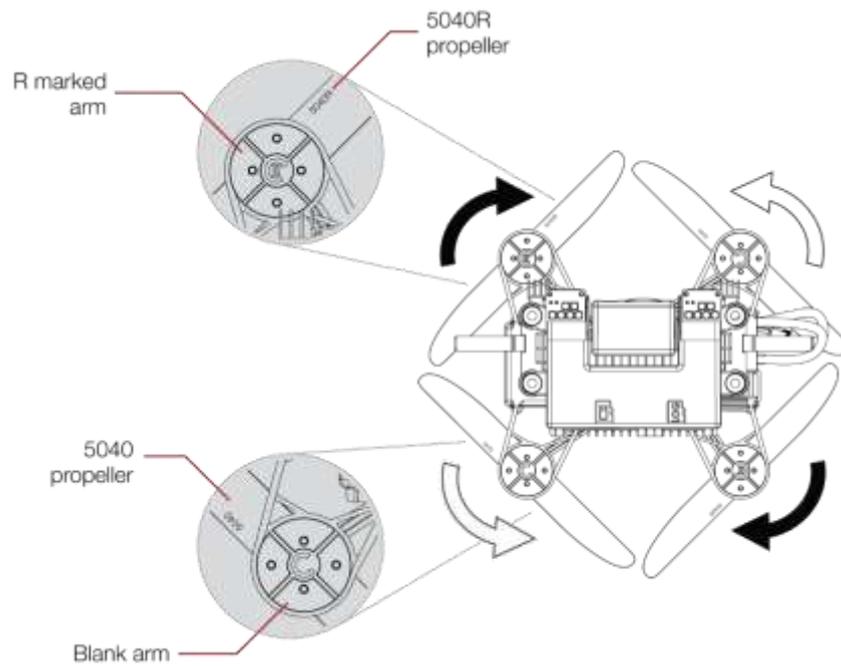


Figure 6.1: Propeller marking

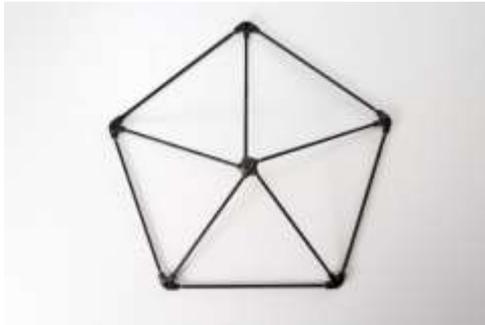
 Never use the same motor nut more than once, as the nylon locking ring will be less effective when re-used.

 Use only the propellers provided by Flyability.

6.3 Repairing the cage

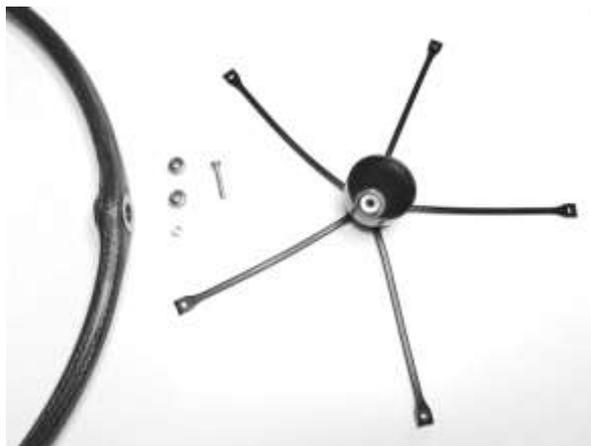
A cage with damaged elements becomes softer and more fragile. Not maintaining the cage can significantly reduce its collision tolerance.

6.3.1 Changing a pentagon



1. Identify the damaged pentagon, cut the surrounding zip ties with the cutting pliers and remove the damaged pentagon.
2. Take the new pentagon and attach it with new zip ties. Be careful to place the zip ties' ratchet on the inner side of the cage.
3. Tighten the zip ties using the needle nosed pliers.
4. Using the cutting pliers, trim the zip ties flush with the ratchet.

6.3.2 Changing a suspension



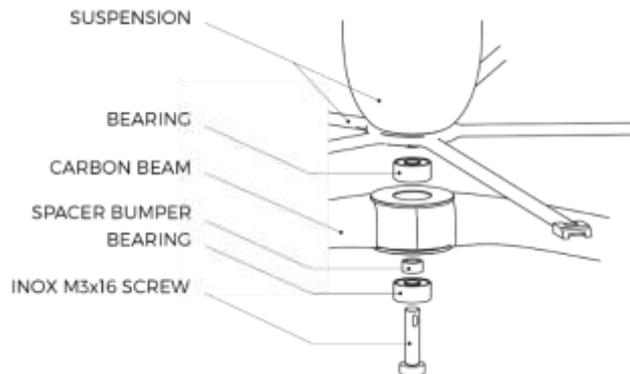
What you need*:

- 2x Bearings Ø8x3X4mm
- 1x Spacer bearing
- 1x M3x16 Screw with Tuflok
- 1x Suspension
- 1x Pentagon
- Cutting pliers
- Needle nosed pliers
- 5 Zip-ties

**The bearings, spacers and screws can be re-used if no new items are available.*

Assembly instructions:

1. Assemble the bumpers to the ring as shown on the schematic below



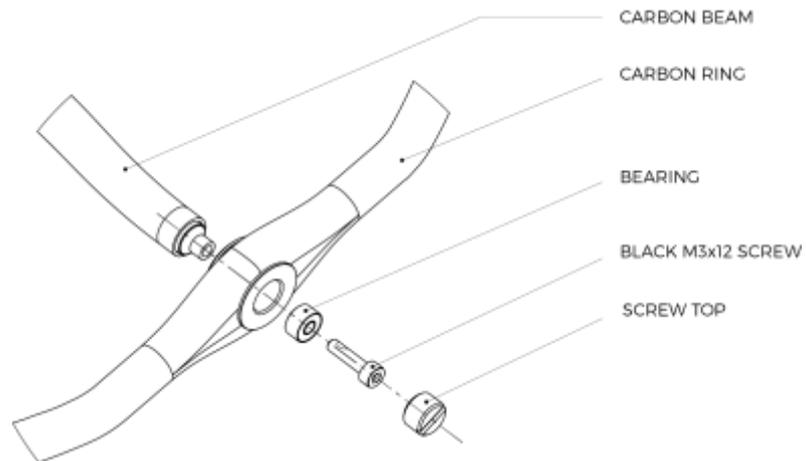
2. Place the zip-ties on the cage's connector, be sure that the zip-ties ratchets are located on the inside of the cage.
3. Pass the zip-ties' tape through the pentagon, then through the suspension.



4. Tighten zip-ties with the needle nosed pliers
5. Trim the zip ties close to the ratchet with the cutting pliers

6.3.3 Changing the carbon ring

The carbon ring may break during impacts above 4m/s or when the ring impacts a sharp object directly. A spare ring can be ordered from flyability in case a replacement is needed. It can be replaced by the end user.



1. Install the **bearing** from the outside into the carbon ring.
2. Position the drone by inserting the **Carbon Beam** into the **ring**.
3. Tighten up the **carbon beam** into the **ring** with the **black M3x12 screw**. Use the small T10 screwdriver provided in the toolkit.
4. Repeat steps 1. 2. and 3. on the other side.
5. Tighten the **Screw Top** into the **carbon ring** on both sides with a flathead screwdriver. Apply a light torque by hand.

6.4 Transporting Elios



Elios should never be transported with a battery installed

Elios should be attached to its cage to keep the drone from spinning inside its cage during transportation. To do so, follow these steps:

1. Make sure no battery is installed in the aircraft
2. Close the battery strap
3. Pass the transportation strap through the battery strap, the ring and the cage as shown below.
4. Do not tighten the yellow strap too much to avoid stretching out the battery strap.

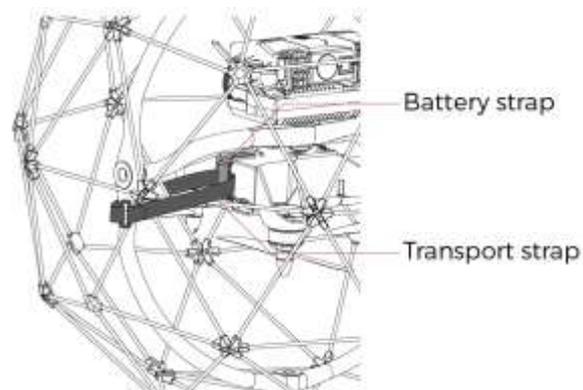


Figure 6.2: Attaching the inner frame to the cage

6.5 Firmware

The firmware is software running on the components of the Elios system. Updates are made available regularly to improve functionality and add features, so make sure you are using the latest version on all the components of the Elios System.

Cockpit Application

The Flyability Cockpit application is installed on the tablet of the ground control station. Cockpit version 1.1 or above can be updated by connecting to the internet, an installation menu will automatically appear if a new version is available.

It can also be updated offline manually by running the latest APK installation file.

Avionics

The avionics firmware is installed on the Elios drone. This is automatically updated 'over the air' via the cockpit app on the tablet.

It can also be updated manually by uploading a binary file on the LOG SD card.

Camera

The camera firmware controls the Elios' on board camera features, should it be necessary, it can also be updated manually by uploading a binary file on the LOG SD card.

Ground unit

The ground unit also runs software which defines the control protocols with Elios and the tablet. **THIS SHOULD NEVER BE UPDATED**, as it will leave the controller unusable, and can not be rolled back.

Flyability Inspector

The Inspector software can be installed on your computer to improve post flight footage It is regularly updated to improve features and compatibility.

7 Technical Specifications

7.1 ELIOS System Specifications

Flight mode	
Types	Throttle: Altitude hold / Manual thrust Control: Attitude mode / Speed mode Speed: Slow / Fast / PRO mode
Availability	Switch between modes at any time
Fail safes	Controlled descent on low-battery (override available) Controlled descent on signal loss
Onboard Electronics	
Avionics-board	Autopilot, thermal video and system management
Power-board	Motor control
ELIOS Aircraft	
Type	Quadcopter configuration
Dimensions	Fits in 400 mm sphere
Motors	4 electric brushless DC motors
Propellers	4 propellers, 5 inches diameter
Take-off weight	700 g including battery, payload & protection
Flight time	Up to 10 minutes
Max. climb rate	1.5 m/s (in altitude hold mode) 5 m/s (in manual thrust mode)
Max. airspeed	6.5 m/s (in normal fast mode) 9 m/s (in pro mode)
Wind resistance	Max. 5 m/s (in pro mode)
Max. Flight Altitude	Sustained flight at 2500m density altitude Battery life allows up to 200m climb and descent
Flight sensors	IMU, magnetometer, barometer
Materials	Cage: carbon fiber + Epoxy, Polyolefin coating, TPU and PA12 Connectors Propellers: Polycarbonate Body: Polycarbonate, Magnesium, Aluminium, Steel Cameras: Glass and Germanium Dioxide optics
Operating temperature	10 °C to 40 °C (50F to 104F) 0°C to 50°C (32F to 122F) with some restrictions
Ingress Protection	Equivalent to IP53
Radiation Resistance	Tested at 800 Rem/Hour (8 Sv/Hour) during 10 minutes
Remote controller (ground control system)	
Type	Ergonomic joysticks and payload controls, integrated video outputs
Frequency	2.4GHz & 5.8GHz
Weight	810g
Operating temperature	0 °C to 40 °C (Tablet display max 35°C)
Output ports	HDMI, SDI, USB
Battery	6000 mAh, 2S
Controls	Payload settings and aircraft control
Options	Optional remote controller (camera operator) with video stream reception on a secondary screen, and dual control of camera settings. Range between the two remote controllers is 50m.
Wireless communication Remote Controller to UAV	
Type	Digital, bidirectional, long range, video and data downlink to remote controller (RC), command and data uplink to UAV
Frequency	2404 - 2480 MHz
Range	Up to 500 m in direct line of sight
EIRP RC to UAV	100mW
EIRP UAV to RC	CE Mode: 18dBm (60mW) EIRP on AirUnit. Limit is 20dBm FCC Mode: 26.6dBm (456mW) RF power on AirUnit. Limit is 30dBm
Wireless communication Remote Controller to Camera Operator Remote Controller	

EIRP RC to RC	4mW
Frequency	5738-5808 MHz 920.6 MHz to 928 MHz (Japan)
System power	
Type	Lithium polymer battery, 3 cells, 2800 mAh, 33.08 Wh
Charging time	1 h
Battery change time	< 1 mn
Integrated payload	
Payload (camera) head	Damped from vibrations
Upwards tilt	+65 degrees
Downwards tilt	-60 degrees
Main camera	
Video	FHD (1920 x 1080) at 30 fps, good low light performance, recorded on board and streamed to pilot and camera operator
Horizontal field of view	130 degrees
Vertical field of view	75 degrees
Total vertical field of view	215 degrees (considering payload up/down rotation)
Control modes	Auto with EV correction, full manual mode
Thermal camera	
Type	Uncooled FLIR camera core
Video	160x120 pixels at 9 fps, recorded on board
Horizontal field of view	56 degrees
Vertical field of view	42 degrees
Thermal sensitivity	<50mK
Range	10°C to 400°C
Wavelength	LWIR, 8 to 14 um
Lighting system	
Type	5 arrays of high-efficiency LEDs for even lighting in front, top, and bottom
Control	From remote controller, adaptive light beam controlled by camera pitch
Power	11.4 W nominal power for front lighting, 28 W total installed max.
Operational safety & Crashworthiness	
Navigation lights	Green (right) and red (left) lights
Protection cage	Carbon fiber cage with soft coating, modular subcomponents for maintenance ease, thermoplastic elastomer suspensions, size of openings: triangles of about 11 cm sides allowing for hand to access inside to swap batteries
Collision tolerance	Uniform all around the drone, up to 3 m/s on sharp objects, up to 4 m/s on flat objects
Decoupling	3-axes gimbal system, carbon fiber composite ring and transverse beam
Accessories	
Transport case	IATA compliant transport case for checked-in luggage, dimensions: 60 cm x 52 cm x 50 cm
Chargers	3A / 35 W lithium polymer battery balance charger, with charging status indicator, RC charger: 17.4 V, 57 W, tablet USB charger: 5 V
Mobile application used during flight (Elios Cockpit)	
Features	Real time video and UAV telemetry, status visualization (remaining battery, payload settings, warnings, etc.), control payload settings and various configurations.
Operating system	Android, optimized for tablet provided with UAV system
Post Flight Video, Thermal and Log Analysis (Flyability Inspector)	
Features	Video and Thermal video viewer (frame by frame), flight log analysis including point of interests recorded during flight, screenshots and flight data export.
Operating systems	Windows 7, 8 and 10 (64bit only)

7.2 ELIOS System transmitted Power

Ellos:

Frequency band Tx	2406 - 2476 MHz
Maximum output power	60mW, 18dBm in 2.4GHz band (CE mode) 456mW, 26.6dBm in 2.4GHz band (FCC mode)
Designation of emissions	Digital bidirectional video and data downlink to remote controller, command and data uplink to to UAV
Technology	OFDM, wideband
Modulation type	OFDM
E-Field Strength	7.13V/m (measured at 20cm)

GCS:

Frequency band Tx	2404 - 2480 MHz 5738 - 5808MHz (CamOp) 920.6 MHz to 928 MHz (CamOp Japan)
Maximum output power	40mW, 16dBm in 2.4GHz band (CE and FCC mode) 6.3mW, 8dBm in 5.8GHz band (CE mode) 4.4mW, 6.4dBm in 5.8GHz band (FCC mode)
Designation of emissions	Radio Video Downlink and telemetry and uplink of the from Drone
Technology	OFDM, wide band
Modulation type	OFDM

In order to comply to both FCC and CE standards concerning transmission power, the ground unit uses a GPS module to determine its geographic location and the power is adjusted accordingly. FCC mode is used in the following countries: USA, Canada, Mexico, Australia, Brazil, Taiwan. In other countries, or if no GPS position can be obtained, the system uses the more conservative CE standard.



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