



FLYABILITY

ELIOS 3

USER MANUAL

VERSION 1.3

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1. Before starting

This manual refers to the following documents, which the user must read and understand fully:

- ELIOS 3 Original Instructions—certification compliance, safety guidelines, and checklists.
- ELIOS 3 Smart Battery Guidelines—safety guidelines.

2. ELIOS 3 system description

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

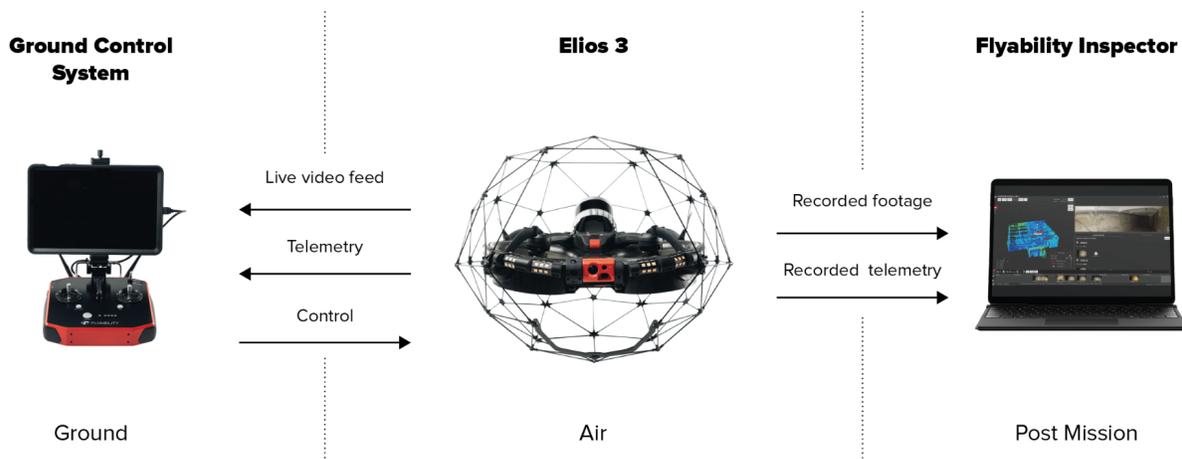


Figure 2.1: System overview

The operator controls ELIOS 3 through the ground control system (GCS). A tablet allows the operator to monitor a live video feed, a 3D Live Map and other information and flight parameters transmitted by ELIOS 3. The Flyability Inspector post-mission analysis software allows the user to visualize the recorded video and the recorded aircraft telemetry.

2.1. ELIOS 3

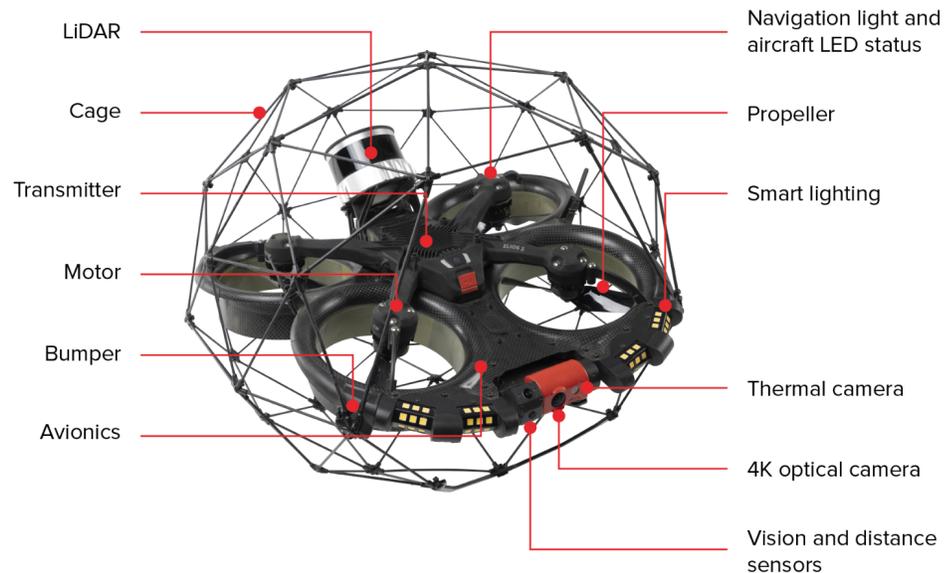


Figure 2.1: ELIOS overview

PROTECTIVE CAGE

A protective cage surrounds ELIOS 3. The cage absorbs collisions with the environment, and provides a relatively smooth, round surface, allowing the drone to slide through extremely confined spaces.

MOTORS AND PROPELLERS

Four shrouded propellers create the thrust required to fly and to maneuver the aircraft. The motors have fast reversing capability, allowing the aircraft to correct the effects of collisions.

AVIONICS

The avionics is one of the brains of the ELIOS 3. On top of its flight control role, the Avionics coordinate all ELIOS 3 sub-systems.

OBC

The onboard computer (OBC) is the other brain of the system, with a real CPU and GPU, as opposed to microcontrollers on the avionics. In case of an issue with the OBC, the avionics can take over and ensure the basic safety of the system.

TRANSMITTER

The transmitter offers a reliable wireless link between the GCS and ELIOS 3. It handles the video transmission, the pilot controls, and the telemetry between the aircraft and the ground control system.

4K OPTICAL CAMERA

The frontal camera payload houses a 4K optical camera. It can record 4K (2160p 30fps), which is recorded onto the CAM SD card. The camera is mounted on a servo motor, allowing it to tilt up or down.



Do not tilt the camera by hand, as this may damage the servo motor.

The exposure time and ISO of the optical camera are fully automated. The user can compensate for the exposure value through the EV settings to get a brighter or darker image if needed.

The 4K optical camera allows users to record video into this resolution:

- 4K UHD: 3840 x 2160 at 30 fps, data-rate 600MB/min

The video recording automatically starts when the drone is armed and stops when the drone is disarmed, provided that there is enough available space on the CAM SD card.

The 4K optical camera allows the user to take 12MP 4000x3000 still images with the POI button. It is important to note that a maximum of 35 images can be taken in a single flight when in 4K UHD mode. The resolution of the still images is always 12MP. Note: the camera data, videos and photos are recorded in 128GB SD cards, However, this SD card cannot be removed from the aircraft. The data can be downloaded to a PC via the Flyability Inspector software.

SSD

Onboard the aircraft there is a solid-state drive card (SSD) with 500 GB of memory. This SSD is used to record all data from the onboard computer (OBC). The flight data can be downloaded to a PC with the Flyability Inspector software.

USB-C CONNECTOR

This port lets you access all content on the drone.

SMART BATTERY

A fast swappable smart LiPo battery powers the aircraft, providing between 9 and 12.30 minutes of flight time, depending on the payload configuration.

VISION SENSORS

ELIOS 3 uses three optical sensors to help stabilize the drone in GPS denied environments. These three cameras measure the velocity of the aircraft with respect to surrounding objects, and are crucial to ensuring the stability of ELIOS 3.

SMART ONBOARD LIGHTING

ELIOS 3 has a smart lighting system composed of multiple LED panels. The panels can be controlled independently to offer optimal lighting for capturing visual inspection data. The intensity of each panel is adjusted depending on the pitch of the camera head to ensure optimal lighting, while saving battery charge and flight time.

LED status

Gives information about the status of the overall aircraft (which includes both avionics & the onboard computer).

2.2. ELIOS 3 smart battery

ELIOS 3 uses smart batteries with an integrated battery management and diagnosis system.

Please note that now Battery FW can now be updated automatically through the drone. During a battery update, which takes less than a minute, the drone flashes light blue and the battery beeps once after which the drone RGB LED remains red for a couple of seconds.

ISO OUTLINE IMAGE OF BATTERY SHOWING latch mechanism, status LEDs, Button

Cell type:	Li-HV
Cell Count:	6 (6S1P)
Nominal Voltage:	22.8V
Max Charge Voltage:	26.1V
Battery Pack Capacity:	4350mAh
Battery Pack Energy:	99.18Wh
Battery Pack Weight:	620g
Dimensions:	140 X 54 x 75.5

2.2.1. Overview



Figure 2.2: Battery Overview

LATCH MECHANISM

The battery is mechanically secured to the drone with this locking latch mechanism.

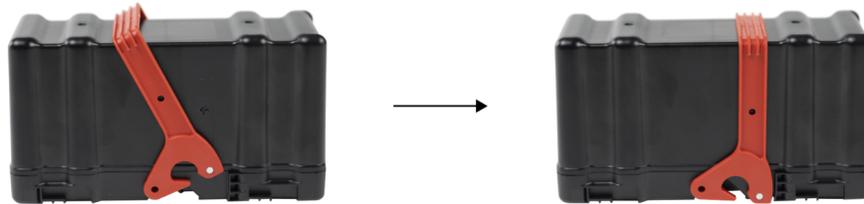


Figure 2.3: Latch Mechanism

BUTTON

The button allows the user to cycle through the menu to display specific information, or to enter discharge/storage modes.



Figure 2.4: Battery Button

STATUS LED

This LED is integrated in the button and displays important information related to the status of the battery via the following color codes.

Green	The battery is in good condition and fully charged
Yellow	The battery is in a warning state, namely a possibly dangerous state for the battery, but still recoverable
Red	The battery has suffered permanent damage
White	The battery is in selection menu mode
Magenta (blinking)	The battery is discharging to 30% for transport
Blue (blinking)	The battery is discharging to 50% capacity for storage
Cyan	The Battery is checking its state of health

CAPACITY LEDs

These LEDs display the remaining capacity of the battery and serve as a selection menu in menu mode.

2.2.2. Displaying state of charge

A short press on the button will reveal the battery's state of charge. If all four capacity LEDs are lit, then the battery is fully charged. The battery will go back into standby mode after 10 seconds.

2.2.3. Entering the selection menu

A long (two second) press on the button will take you into the selection menu, which will be indicated by the white status LED and a short beep. You can cycle through the following four menu items with a short press of the button. You can enter the option you choose from the selection menu with a long press. You can cancel the storage and transport mode command with a long press. At any point, the battery will go back into standby mode after 10 seconds of inaction.

STATE OF CHARGE

This will display the battery state of charge, i.e. how full the battery is. If all four capacity LEDs are lit, then the battery is fully charged.



Figure 2.5: Battery state of charge

Battery Level Indicators				
LED1	LED2	LED3	LED4	Battery Level
○	○	○	○	87.5%~100%
○	○	○	☀	75%~87.5%
○	○	○	○	62.5%~75%
○	○	☀	○	50%~62.5%
○	○	○	○	37.5%~50%
○	☀	○	○	25%~37.5%
○	○	○	○	12.5%~25%
☀	○	○	○	0%~12.5%
○	○	○	○	=0%

STATE OF HEALTH

The state of health is determined by how much energy the battery can still store. It is an indicator of the flight time that this battery can provide on a full charge. Old batteries with many cycles will have a lower state of health, and provide shorter flight times when compared to brand new ones.



Figure 2.6: Battery state of health

STORAGE MODE

Batteries are best stored at 50% charge to avoid long term chemical decay. ELIOS 3 batteries will automatically start to discharge to this level if left unused for 5 days, but you can also trigger this process manually by selecting storage mode. The status LED will blink blue while the battery slowly discharges itself to a 50% state of charge.



Figure 2.7: Battery storage mode

TRANSPORT MODE

According to IATA regulations, all batteries carried on board an aircraft must be discharged to at least 30% state of charge. Selecting transport mode will set the battery to slowly discharge to 30%. The status LED will blink magenta during this process.



Figure 2.8: Battery transport mode



ELIOS 3 BATTERIES GENERATE APPROXIMATELY 1W OF HEAT WHILE SELF DISCHARGING, DO NOT BE ALARMED IF THEY FEEL WARM TO THE TOUCH DURING THIS PROCESS.

2.3. Ground control system



Figure 2.9: GCS overview

2.3.1. Tablet

The tablet provides a visual interface with the aircraft and controller. It displays the live video feed transmitted by ELIOS and the 3D Live Map, as well as important flight parameters. The Samsung Galaxy Tab S7 LTE tablet with the pre-installed cockpit app comes standard with every ELIOS 3 system.



Figure 2.10: Tablet overview

TOUCH SCREEN

Displays information and allows the user to interact with the applications.

STYLUS

Allows precise operation on the touchscreen. Useful while wearing gloves.

USB PORT

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

MICROPHONE

Records the surrounding sounds, such as the voice of the inspector, for reporting.

COCKPIT APPLICATION

This app is developed by Flyability and functions as an interface with the aircraft. It displays the video stream from the aircraft, as well as essential flight parameters and settings. For a complete overview of its functions, please refer to the [Flyability Cockpit part of the Manual](#).

2.3.2. Controller

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



Figure 2.11: Pilot controller overview

The controller is set to mode 2 by default. Consult the Cockpit App section of this user manual for information on how to switch to other stick mapping modes.

LEFT STICK

In mode 2 (default), the left stick controls the aircraft's altitude and yaw.

RIGHT STICK

In mode 2 (default), the right stick controls the aircraft's horizontal motion (forward/backward, left/right). The more you push a control stick away from its center, the faster the aircraft will follow the command. Give gentle and measured inputs to avoid any jerky and uncontrollable behavior changes. While flying, always keep your fingers on both control sticks to improve the reaction time and maintain 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 again and hold to turn on or off.

STATUS INDICATOR

Find below the meaning of each color:

1. Calibration - **Blue**.
2. Operation - **Green**.
3. Error - **Red**.
4. Turn off sequence - **Yellow**.
5. Update - **Violet**.

BATTERY LEVEL INDICATOR

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

DISTANCE LOCK

- Short press: activates the distance lock mode. If a distance has been previously set and is within ± 500 mm from the current front distance, the aircraft will use this value. If not, the aircraft will use the current front distance value.
- Long press: activates the distance lock mode and resets the distance value to the current front distance.
- The set lock distance can be increased or decreased with the "forward/backward" control stick.

ALTITUDE MODE

- Down: **MANUAL THRUST CONTROL** mode, gives direct control over the thrust
- Up: **ALTITUDE CONTROL** mode, the altitude is automatically maintained.

An onboard pressure sensor measures the altitude of the drone. In some cases, the pressure in an environment will not be stable, and ELIOS 3 will not be able to accurately maintain a constant altitude. To have better control, the pilot can disable the Automatic Altitude Control mode to have 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 can lead to final speeds above the maximum limit covered by the warranty. Use this mode with caution and only when necessary.

CAM TILT

The tilt of the payload can be controlled with the rotary lever situated on the left side of the remote control. For clarity, the payload tilt angle is displayed on the left side of the tablet's screen during flight. The switch on the left side of the remote control will allow you to set the payload tilt angle.

FN BUTTON

Press and hold this button to use the secondary functions of other buttons.

EV | LIGHT PoWER

- Default: Increases or decreases the EV of the camera.
- While the function (FN) button is pressed, it increases or decreases the onboard lighting intensity.

DUST LIGHT | OBLIQUE LIGHT

- Default: Enable or disable the dust proof light.
- While the FN) button is pressed: cycles oblique lighting (left, right) or both LED panels.

FLIGHT MODE SWITCH

This 3-way switch selects the flight mode of the drone.

POI BUTTON

Press to take a 12MP still image. This will also create a Point Of Interest (POI), which can be reviewed after the flight in the Flyability Inspector software. Please note that you can take a maximum of 40 POI per flight.

SRC BUTTON

Switches the video feed between the 4K optical camera and thermal camera. Both cameras will continue to record continuously, regardless of the feed setting.

ATTI / SPORT

When pressed once and kept pressed, the drone disables the vision and distance sensors and enters ATTI mode. In this state, the ELIOS 3 is stabilized only by the IMUs accelerometers and gyroscopes. Press twice and hold to enter SPORT mode. This is similar to ATTI mode, but increases responsiveness and airspeed.

AUX BUTTON

This button is used to calibrate the RC.



Figure 2.11: Remote Control Overview

USB-C PORT

Use this port to connect the RC to the tablet.

ANTENNA

We recommend attaching the antennas before powering on the unit. Operating the system without the antennas attached will significantly reduce range and might damage the controller.

CHARGE PORT

This port connects the controller to the controller charger to charge the internal battery of the controller.

USB MINI-B

This USB connection can be used to connect the controller to a PC for firmware updates.

2.4. LiDAR payload

ELIOS 3 can carry an optional LiDAR payload. The LiDAR data is used in real time by the drone to generate a 3D Live Map of the surrounding environment. The 3D Live Map is streamed directly to the pilot on the tablet for improved situational awareness. The user can see both the live visual feed and the 3D Live Map on the tablet, and can choose which of the two to make the primary image. LiDAR data is saved on ELIOS 3's on board SSD and can be post-processed to generate high accuracy point cloud models of the flight environment through an external software (GeoSLAM).

Please note that, to save energy and prevent the drone from overheating, the LiDAR is automatically shut down after 1 min when the drone is connected to a computer over USB.

2.4.1. SPECS

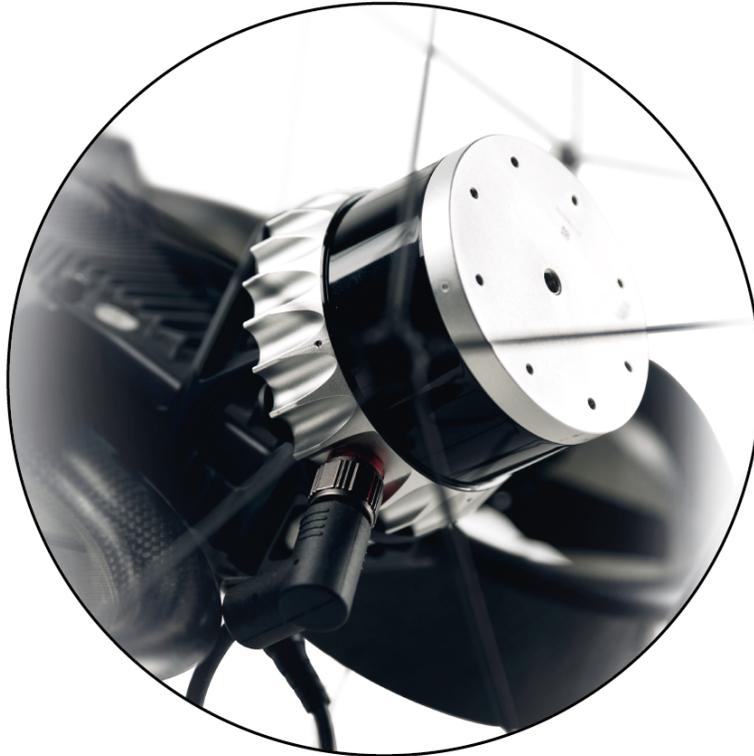


Figure 2.12: LiDAR overview

Our ELIOS 3 comes with Ouster's OS0-32 beam LiDAR. To learn more about it, please visit [the Ouster website](#):

2.4.1. Mounting & removing the LiDAR

2.4.1.2. HOW TO REMOVE THE LiDAR

REQUIRED TOOLS:

- Torque adjustable driver, adjusted at 0,4 Newton meters.
 - T8 Torx size bit.
1. Before removing the LiDAR assembly from the electronic body, we recommend you turn the ELIOS 3 upside down while securing the LiDAR with two fingers, as per the video instructions, that you can find at our [Support page](#).
 2. Disconnect the LiDAR cable from the drone by pulling the connector ring. Please make sure not to remove the cable on the LiDAR side, as this connector is glued in place, and removing it would break the LiDAR sensor.
 3. Remove the two inner screws that attach the LiDAR support to the drone. The two inner screws should be left untouched, since they fix the carbon frame to the central housing of the drone.

4. Now you can slide the LiDAR assembly out from the drone.

2.4.1.3. HOW TO ATTACH THE LiDAR

REQUIRED TOOLS:

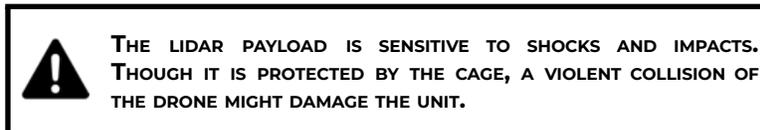
- LiDAR.
 - Torque adjustable driver, adjusted at 04 Newton meters.
 - T8 Torx size bit.
1. After turning the drone upside down, insert the LiDAR assembly by sliding it into place. Before inserting the LiDAR assembly, make sure that the slot in which you slide the LiDAR mount is free of dirt and dust, so you can slide it to the end. Same goes for the LiDAR mount—it should be clean prior to its installation.
 2. Tighten the 2 screws with the T8 screwdriver attached to the torque control driver adjusted at 0.4 Nm. Those 2 screws will maintain the whole structure, so it is important that you tighten them correctly.
 3. Once the LiDAR has been fixed to the drone, you need to connect the cable to the AUX connector. To do this, align the dot on the rubber of the connector on the LiDAR side with the white dot of the connector on the drone side. You will know that the cable has been well connected once you hear a clear audible click. If you do not connect the LiDAR sensor properly you risk having an intermittent connection in flight, which can lead to problems with your data gathering efforts.

Please make sure not to try to remove the connector from the LiDAR directly, as this isn't meant to be removed and will break the LiDAR if you do so.

2.4.2. Limitations

The LiDAR technology has these limitations::

- Collision (ATTI, SPORT): Even though light collisions won't affect the map, heavy collisions in ATTI and Sport mode might create divergences, double walls, or a complete disorientation of the model.



- Axi-symmetrical long assets (+10m) with flat surfaces and <2m in diameter: In contexts such as chimneys, tunnels, or sewers, when confronted with a long symmetrical asset (> +10m) that has a flat surface, the LiDAR does not perceive movements in the direction of the central axis.
- Cylindrical assets with flat surfaces or no distinguishable features (>20m diameter and >20m high): If within the asset there are distinguishable features of the size >20cm, the LiDAR will be able to pick up those features so long as the asset is thoroughly covered regarding LiDAR data collection while the drone is in flight.
- Outdoor (no distinguishable features): When flying outdoors, the ambient light conditions and direct sunlight on the LiDAR will significantly reduce the measuring range. As for strong winds, the drone will not drift in winds up to 5m/s (16.4f/s) when flying in ASSIST. Above 5m/s (16.4f/s) the pilot needs to actively push the sticks to counteract drift. Above 7m/s (23 f/s) wind, even pushing the sticks will not help and the drone will start to drift away.
- Dusty environments: Staying too long in a cloud of dust will generate points in the model representing the dust. Flying fast through the dust so the drone is not in the middle of it ensures that you will create a nice model and no drift will happen. Also, filtering will get rid of most dust.

Please note that any collision, regardless how strong, will reduce the ability significantly for obtaining a high quality map with GeoSLAM or other 3D modeling software in post-processing.

2.4.3. Flight time

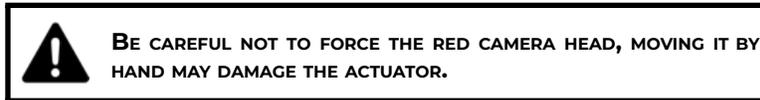
The flight time of the ELIOS 3 with the LiDAR sensor mounted is 9 minutes in total. Without the LiDAR sensor mounted, the flight time is 12 minutes and 30 seconds.

The following conditions will deteriorate flight time in general:

- Flying with a cold battery (< 20°C)
- Flying with an old battery (please refer to the [Battery Safety Guidelines Manual](#) for further information)
- Flying in high wind conditions and/or at a high speed in SPORT
- Making many collisions and aggressive maneuvers
- Flying in very confined spaces
- Flying with dirty [motors](#) and/or damaged [propellers](#) (please look at the linked videos, to know if a motor or a propeller need to be changed, and on how to change them)
- Flying at high altitude above sea level.

3. Setting up ELIOS 3

3.1. Clean the camera lens and the optical sensors



Using the lens cleaner provided in the tool kit, follow these steps to properly clean the 4K optical camera lens, the optical sensors, and the LiDAR before **EACH** flight. Following these steps will improve the stability of the drone, improve the image quality, increase the value of the footage obtained during an inspection, and give you higher chances for a coherent and dense 3D map.

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 3.1: Lens cleaner overview

3.2. Setting up the ground control system

ATTACH THE ANTENNAS

Not having the antennas (or a range extender) properly connected before turning on the controller will significantly limit the range and might even damage the controller.

MOUNT THE TABLET

To mount the tablet onto the controller, follow these steps:

1. Put the antennas and the tablet holder in a vertical position.

2. Adapt the clamp height to the correct height for the tablet to fit in and then lock the tablet in place with the locking knob situated on top of the tablet holder.
3. Connect your tablet to the remote controller via the USB-C cable.



Figure 3.2: Assembly of the GCS

POWER ON THE CONTROLLER

To turn the controller on/off:

- press the power button once; it will display the battery level on the LEDs
 - 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 down its power button.

RUN THE COCKPIT APP

- The cockpit app is used to view the live video and telemetry data from the drone. The cockpit app comes pre-installed on the tablet shipped with the ELIOS 3 pack.

3.3. Insert and plug in the battery

1. Slide the battery into the battery tray.
2. The battery must be secured under the drone. If the battery is not properly secured, the main button of the drone will blink yellow. Make sure the battery is correctly aligned, then push the red handle in two motions until it is secured.

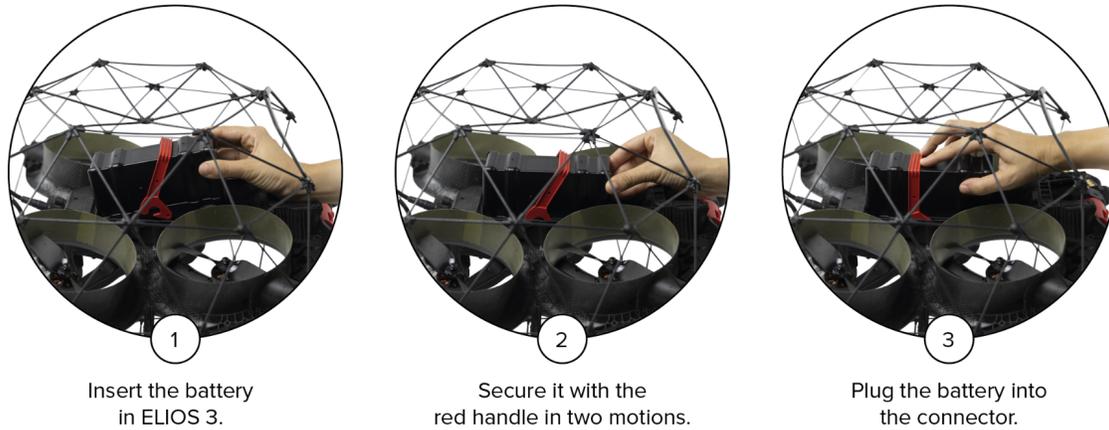


Figure 3.3: Battery insertion and connection

Once the battery is plugged in, ELIOS 3 will be in sleep mode.



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

1. Unlock the battery.
2. Remove the battery from the drone.

4. Flying ELIOS 3

Every ELIOS 3 pilot must complete Flyability's "Introductory training" course before operating the drone. Different training options are available and all the details can be found on our website [under the training section](#).

4.1. Power button

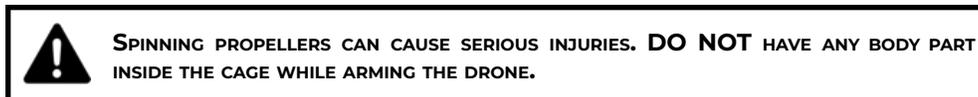
ELIOS 3 is equipped with a power button. Press this button to switch on the drone before takeoff.



Figure 4.1: Power Button

Pressing the power button will power up all the electronics and payloads on the drone, which will needlessly drain the battery if done too long before take-off. We recommend turning on the drone shortly before flight. Please be aware that the drone will automatically shut down after 5 minutes of inactivity, unless you keep wiggling the sticks of the remote control (this will prevent it from turning off).

4.2. Arming



When the battery is connected and the power button has been pressed, ELIOS 3 is switched on and in standby mode. The aircraft must be armed before takeoff.

Place the 3 position switch of the GCS on the C1 position ASSIST MODE.

To arm ELIOS 3, 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 4.2: Arming sequence

Once armed, ELIOS 3 will power on its motors and be able to take off. Please note that the ramping up of the motors will take 3 to 5 seconds. Make sure not to drop the drone if you do a hand launch. During the arming delay while performing a mapping flight, the drone checks for movement and aborts arming if the drone moves.

4.3. Disarming

Once ELIOS 3 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 4.3: Disarming sequence



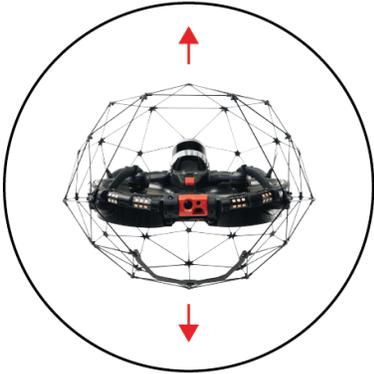
THE AIRCRAFT CAN ALSO BE DISARMED IN MID-AIR, RESULTING IN A FREE-FALL. IF PERFORMED AT MORE THAN 1M (3.3 FEET) ABOVE GROUND THIS WILL SERIOUSLY DAMAGE THE AIRCRAFT.

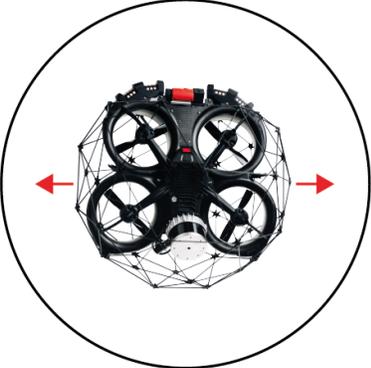
During the arming delay while performing a mapping flight, the drone checks for movement and aborts arming if the drone moves during the arming countdown.

4.4. Aircraft controls

ELIOS 3 orientation and flight direction are defined in relation to its inner-frame.

By default, the control of ELIOS 3 is mapped to the control sticks in mode 2. The setting can be changed to other modes via the Cockpit App.

Controller	Aircraft	Explanation
		<p>In Automatic Altitude control: Moving the left stick up and down changes ELIOS 3's altitude.</p> <p>Up increases altitude. Down decreases altitude. Centered ELIOS 3 maintains its altitude.</p> <p>In Manual Thrust control: Moving the left stick up and down changes ELIOS 3's thrust.</p> <p>Up increases thrust. Down decreases thrust.</p> <p>In this mode, 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 the drone.</p> <p>Left makes the aircraft rotate counterclockwise. Right makes the aircraft rotate clockwise. Centered, ELIOS 3 maintains its orientation with a drift of max. 10°/minute.</p> <p>The pilot should remain aware of the heading at all times, as the right stick inputs are relative to the drone's 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 3, making the aircraft go forward or backward.</p> <p>Up makes the aircraft going forward. Down makes the aircraft go backward. Centered, ELIOS 3 stays level.</p>
		<p>Moving the right stick left and right controls the bank angle of ELIOS 3, making the aircraft go to the left or the right.</p> <p>Left makes the aircraft go to the left. Right makes the aircraft go to the right. Centered, ELIOS 3 stays put.</p>



IN ASSIST MODE, THE DRONES SENSORS HELP IT STAY FIXED IN ONE PLACE.
IN ATTI MODE, THE PILOT MUST MAKE CONTINUOUS INPUTS TO CORRECT THE DRIFT CAUSED BY SMALL TRIM ERRORS AND LOCAL AIR CURRENTS.

4.5. Flight modes

ELIOS 3 offers multiple flight modes depending on the payload configuration. It is essential that the pilot understands the differences between the several modes and when to use them.

4.5.1. Sensor Stabilized control—ASSIST (default)

Optical sensor limitation: Presence of dust, direct sunlight, or featureless surfaces.

LiDAR limitation: Presence of dust, cylindrical or general symmetric environments, as there are no geometrical features to help the sensor understand where you are along the axis of symmetry.

By default, ELIOS 3 uses its optical sensors coupled with its IMU (accelerometer and gyroscope) to increase its stability close to surfaces or objects.

ASSIST mode ensures that you never exceed the maximum collision speed of the drone and is thus the safest mode to fly in.

4.5.2. Attitude control—ATTI

Limitation: Unstable static pressure

In an environment where ASSIST mode does not function due to the limitations of all the available sensors, ELIOS 3 will fall back to relying solely on its IMU and barometer for stability. While in attitude control mode (ATTI), the altitude of the aircraft is automatically handled by the barometer. The drone will **not** automatically remain stationary in this mode and will constantly drift due to local wind and turbulence effects.

The flight control system continuously monitors the quality of the sensor data, and automatically switches to ATTI when necessary. Although the drone should always function with reliable stability it is ultimately the pilot's duty to assess whether the stabilization is functioning sufficiently in a given environment, and to be ready to manually switch to ATTI mode if needed.

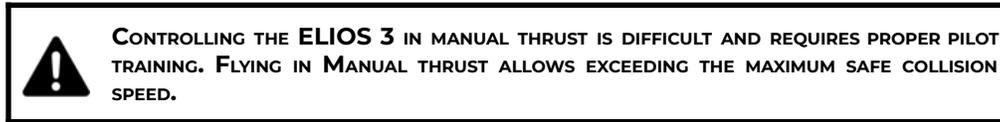
Please note that in this mode the drone may exceed the maximum safe collision speed, ensuring you avoid high-speed collisions, as they might result in loss of the aircraft.

4.5.3. Manual thrust control—MAN

Both the ASSIST and ATTI flight modes rely partially on barometric pressure data to maintain a constant altitude. Strong local wind, ventilation, or natural drafts may disturb the static pressure measured by the barometer of the drone, leading to erratic flight behavior. The pilot can disable the barometer by switching to Manual Thrust Control (MAN). Switching on Manual thrust mode will automatically switch on ATTI mode.

In the MAN flight mode, the altitude joystick directly controls the motor RPM, leading to virtually unlimited climb and descent speeds which can easily lead to extremely hard collisions. Please note that in this mode the

drone may exceed the maximum safe collision speed. For this reason, it is important to avoid high-speed collisions when flying in MAN mode, as they might result in loss of or permanent damage to the aircraft.



4.5.4. SPORT ATTI

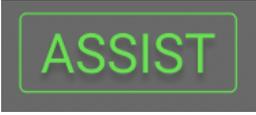
When in need of flying faster, ELIOS 3 allows the pilot to boost its airspeed with SPORT mode, which increases the speed of the aircraft. Using SPORT mode will automatically switch on ATTI mode. Please note that in this mode the drone may exceed the maximum safe collision speed. For this reason, it is important to avoid high-speed collisions when flying in SPORT ATTI mode, as they might result in loss of or permanent damage to the aircraft.



4.5.5. Sport mode Assist—SPORT ASSIST

The SPORT ASSIST mode is to be used when you are in need of increasing the speed of the drone but not in need of going to the drone's maximum speed. In SPORT ASSIST mode the drone operates based on its optical sensors coupled with its IMU. This mode provides both high speed and stability. Please note that in this mode the drone may exceed the maximum safe collision speed. For this reason, it is important to avoid high-speed collisions when flying in SPORT ASSIST mode, as they might result in loss of or permanent damage to the aircraft.

4.5.6. How to use the flight control modes

Mode	Flight mode	Activation	When to use it
	ASSIST	3 position switch	Visual features, closer than 20m (65.6f) Indoors and outdoors Low to medium amounts of dust.
	Forced ATTI	Automatic	When the stability system is automatically disabled.
	ATTI	3 position switch -> ATTI OR Click on the ATTI button on the back right of the drone. PILOT ASSIST OFF	To navigate faster than in ASSIST SPORT from point A to B Or for advanced pilots who want full control.
	ATTI + MAN	Manual Thrust switch	For advanced pilots who fly in very confined spaces where the altitude control is compromised
	ASSIST + SPORT	Moving the 3 way switch to the right	When wanting to navigate quicker than in ASSIST while flying in similar environments
	ATTI + SPORT	Double press and hold the SPORT mode	For very advanced pilots who want to fly fast
	ATTI + SPORT + MAN	Double press and hold the SPORT mode + Manual Thrust switch	For very advanced pilots who want to fly fast in both the horizontal and vertical direction

4.5.7. Failsafe

LOSS OF COMMUNICATION

If the communication link between the aircraft and the GCS is lost, ELIOS 3 will automatically enter the emergency landing mode. In this mode, the drone will maintain altitude for 5 seconds and then slowly descend and land on the ground. Once on the ground, the motors will be shut down after 30 seconds and the drone will remain in standby mode. If at any time the communication link is re-established, flight may be resumed.

BATTERY LEVEL CRITICAL

If the battery reaches a critical level, ELIOS 3 will automatically enter emergency landing mode, and the aircraft will slowly descend after hovering for 5 seconds. The pilot is still able to override this descent. However, to prevent any accident or damage to the battery, the drone should be landed.



OVERRIDING THIS FAILSAFE FOR TOO LONG MIGHT RESULT IN PERMANENT DAMAGE TO THE BATTERY AND COULD RESULT IN A CRASH.

4.6. Camera control

The following control inputs can be made by the pilot:

The tilt lever of the controller allows you to change the pitch of the cameras.



The tilt of the payload can be controlled with the rotary lever on the left side of the remote control. For clarity, the payload tilt angle is displayed on the left side of the tablet's screen during flight.

The lever on the left side of the remote control will allow you to set the payload tilt angle. There is a small indent on the lever to indicate the neutral zero degree tilt camera position.

While flying, you can set brightness parameters on the 4K optical camera.



The EV switch sets the camera's exposure value.

UP increases brightness.

DOWN decreases brightness.

The camera will automatically choose an optimal combination of ISO and exposure time to match the required brightness level. While the FN button is pressed, it increases or decreases the onboard lighting intensity.

4.7. Lighting controls

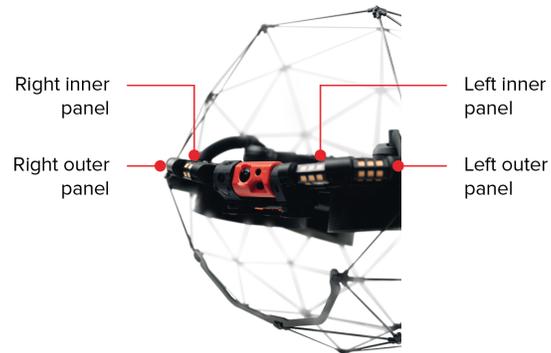


Figure 4.4: Lighting Controls

ELIOS 3 has a smart lighting system composed of several LED panels. The panels can be controlled independently to offer the best lighting for the inspection footage. The intensity of each panel is adjusted automatically according to the pitch of the camera head to ensure optimal lighting while saving battery capacity and flight time.

ELIOS 3 has four separate LED panels:

- Left inboard+outboard panel
- Right inboard+outboard panel

The lighting system has 3 settings:

- Normal—all the panels are lit
- Dust proof light—only the outboard panels are lit
- Oblique lighting—left or right panels are lit, offering improved depth perception of defects such as pitting or cracks.

The intensity of all the panel lights can be controlled in flight via the GCS.



Figure 4.5: Lighting Intensity

DUST PROOF LIGHT

The Dust Proof light should be used whenever flying the Elios 3 in a dusty environment, as less light will be reflected on the airborne particles. It can be manually activated. To switch to the Dust mode, you will have to press the OBL. LIGHT button located at the back top right of the remote control.

OBLIQUE LIGHTING

The outboard panels can also be lit individually to provide oblique lighting. If the drone is positioned at a shallow angle to a surface while one of the outboard panels is individually lit, then it will create shadows, which greatly accentuate deformations and holes. To use the Oblique Lighting, you have to keep pressing the FN button (located at the back left of the remote control) and at the same time, click on the OBL. light button, as many times as needed to cycle between left, right or full mode.

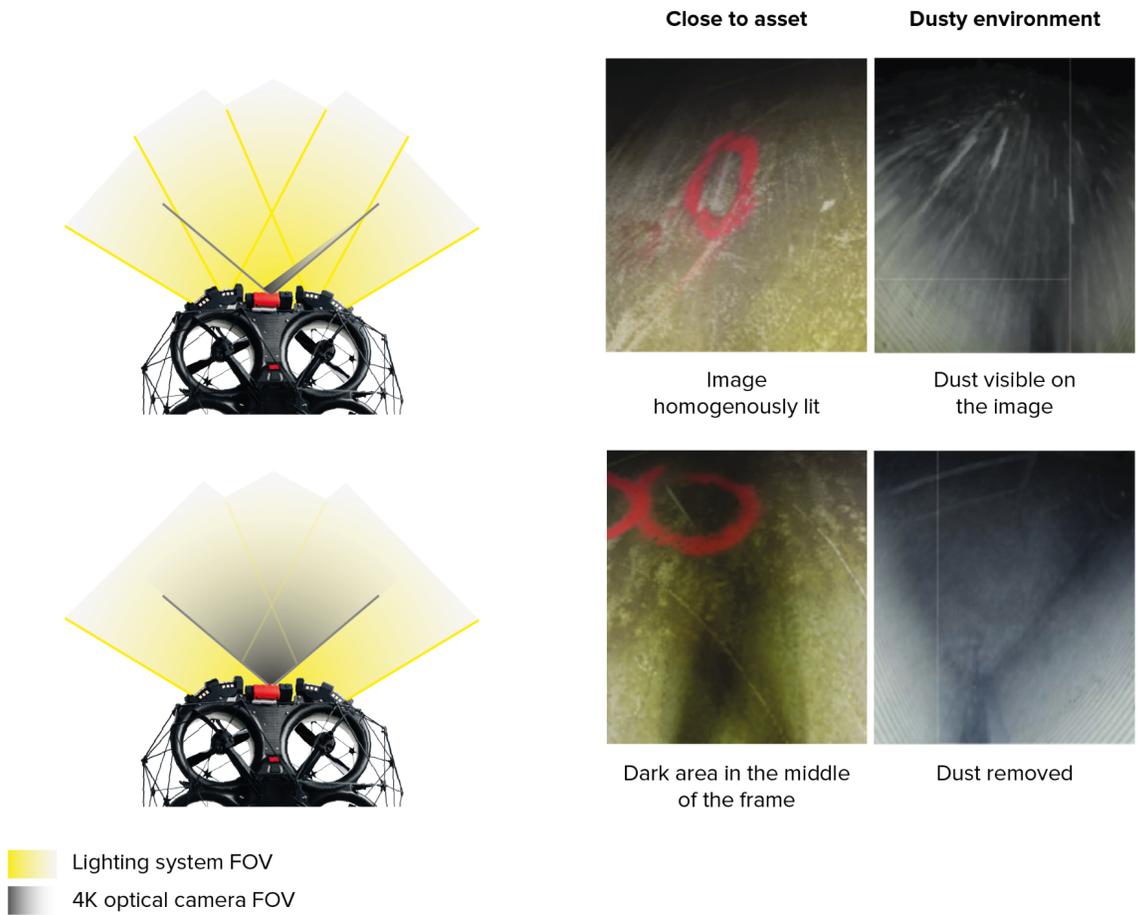


Figure 4.6: Drone shown with the no dust removal (left); Images captured with the dust removal (right)

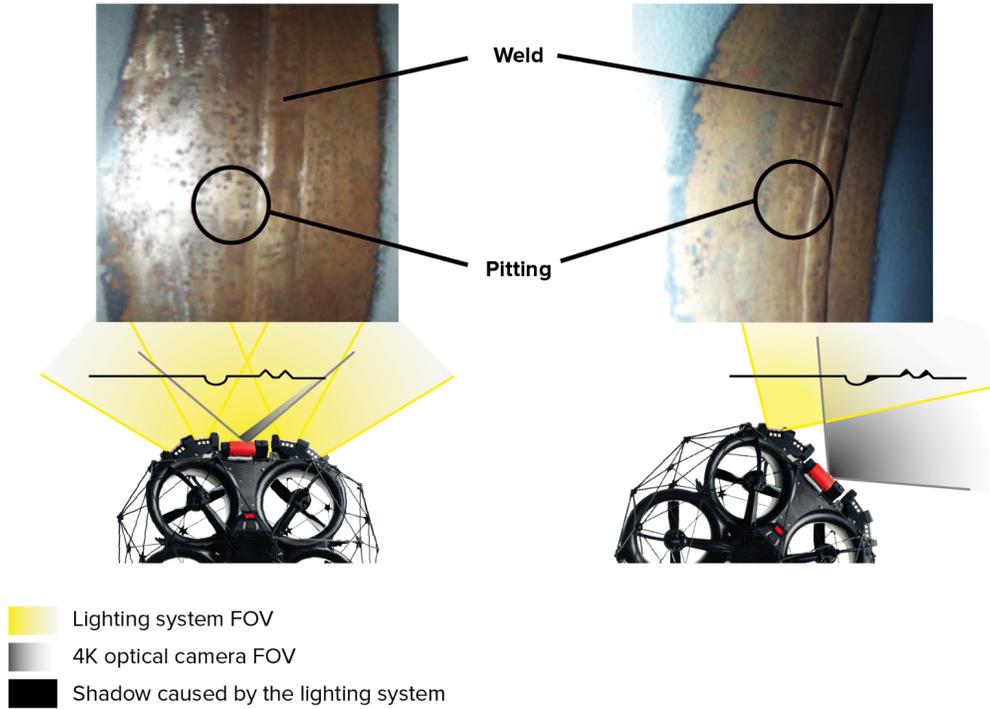


Figure 4.7: Drone and image captured with the oblique light not used—the surface appears quite flat (left); Drone and image captured with the oblique light in use highlighting relief this case, pitting and welding (right)

4.8. 2D measurements

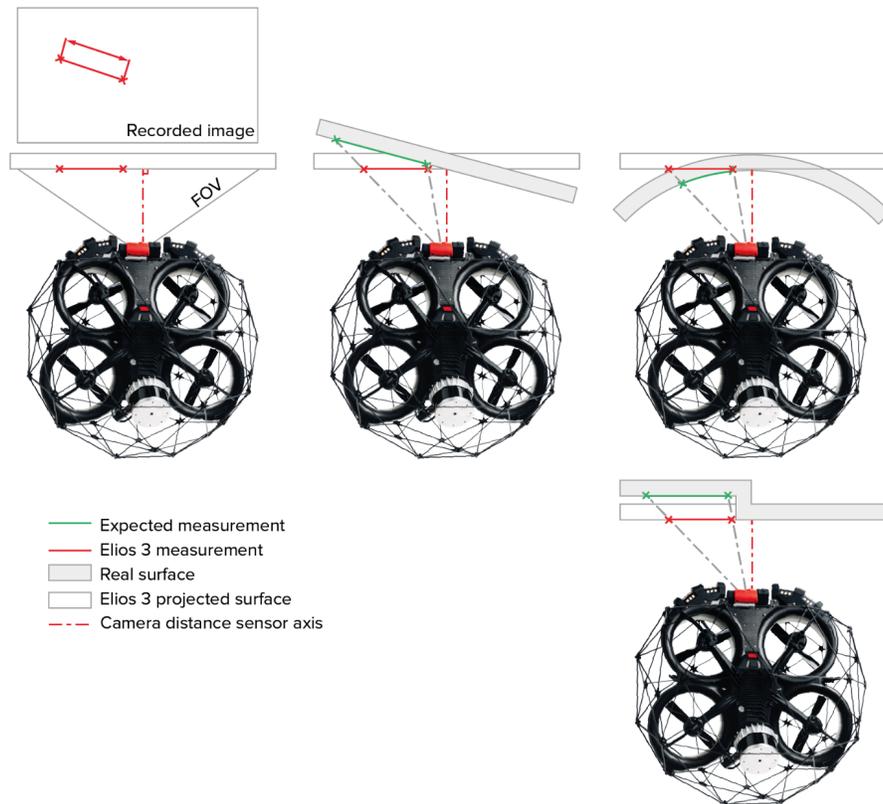


Figure 4.8: Example showing limitations of the 2D measurements considering the geometric constraints.

Limitation: The feature to measure needs to be on a flat surface perpendicular to the camera's optical axis. The accuracy of the measurement is $\pm 10\%$ of the measured length with a maximum of ± 5 mm accuracy.

Thanks to its camera distance sensor, ELIOS 3 is capable of measuring the size of a feature on a flat surface using Flyability's Inspector post-processing software.

4.9. Distance lock

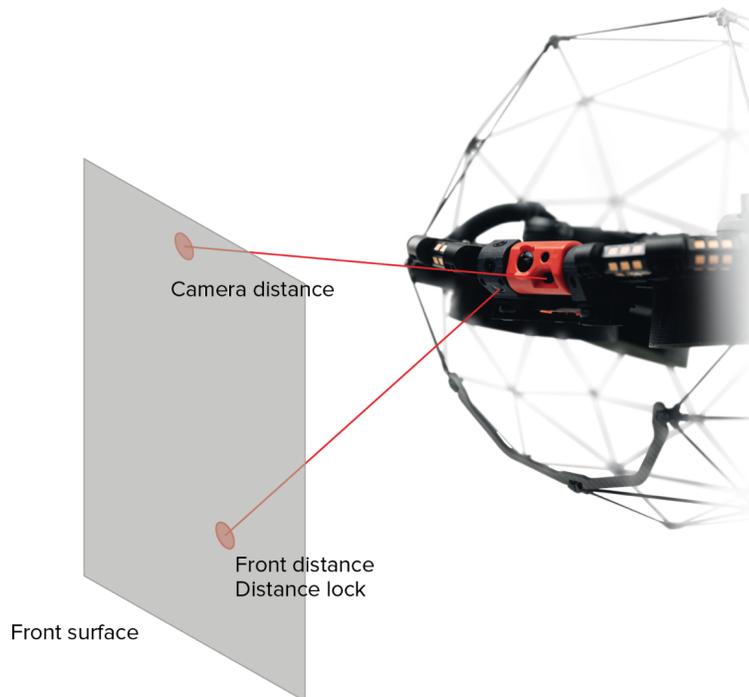


Figure 4.9: Distance lock uses the co-axial distance sensor, which follows the camera's head pitch.

Using measurements from the distance sensor, ELIOS 3 is able to fix its distance from a surface. The distance is measured between the front of the camera and the nearest surface in the middle of the field of view.

Limitations:

- The surface can't be too thin or be a reflective surface.
- Distance lock works for distances from the drone to a wall of between 0 and 2m (6.6 f).
- Distance lock works for camera pitch angles up to 10° UP and 5° DOWN.
- The distance is controlled in a range of +/- 0.5m around the setpoint distance.
- The drone will start to oscillate if you try to lock its distance on heavily concave surfaces, like those found in tunnels.

4.10. Flight data logging and video recording

4.10.1. Data logging

AV SD CARD

The Avionics LOG files contain the flight information, such as sensor values, internal aircraft states, and even controller inputs from the pilot. These files are the “black box” of the drone. This data can be downloaded and sent to Flyability engineers to analyze malfunctions should they occur, but they are not readable for the end user.

4.10.2. Video recording

Video recording starts as soon as ELIOS 3 is armed and stops when ELIOS is disarmed, provided that the CAM SD card has enough free space. Video as well as still images are saved onto the CAM SD card.

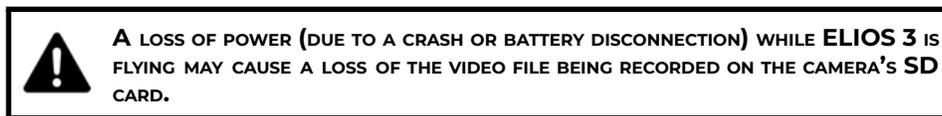
4.10.3. LiDAR recording

LiDAR raw data is stored in a .bag file in the OBC. This data is needed for debugging and GeoSLAM integration. The trajectory of the flight is saved in a .csv file, and the map is saved in an .las file as well as in the OBC. Everything is handled transparently through the Inspector importation.

4.10.4. Tablet backup recording

The video stream received by the tablet can be saved to create a low-quality backup of the flight video and telemetry data displayed on the cockpit app. This backup prevents a complete loss of data in case of an accident and thus is very valuable for the Flyability customer support team.

This feature is on by default. A video file with the received video stream and with the telemetry data will be saved on the tablet's internal memory. Also, an .STN file is present as an extra backup. Older flights are automatically overwritten to save storage space.



5. Drone user interface



Figure 4.10: Drone Button LED & Navigation Lights

5.1. Button LED & navigation lights

ELIOS 3 comes with navigation light LEDs and button LEDs. These LEDs give information about the status of the transmitter.

They are located at the front of the drone (where the power button is located), and on the back of the drone.

Here is a description of what each color stands for:

GREEN LED

The operation system is working properly.

RED LED

There is an error. Don't fly the drone.

BLUE LED

The calibration is still on-going.

YELLOW LED

The turn off sequence has been initiated.

VIOLET LED

The system is updating.

6. Application—Cockpit

6.1 Overview and setup & upgrade

Cockpit is the official Flyability application used to pilot the ELIOS 1, ELIOS 2, and ELIOS 3. Cockpit v3.0 and upwards are only compatible with ELIOS 3 and with the Samsung Galaxy Tab S7 LTE tablet running Android 12. Cockpit comes preinstalled on the tablet you purchased with the ELIOS 3.

Cockpit's primary use is to serve as a way to view the live video feed and the 3D Live Map from the aircraft, enabling FPV flights. In addition, a dashboard with useful flight and camera telemetry is shown to the pilot.

First-time installation of Cockpit

SYSTEM REQUIREMENTS

Cockpit 3 is developed and tested to work on the Samsung Galaxy Tab S7 LTE tablet.

GET THE APPLICATION

The Cockpit application is distributed as a standard Android application file (.apk), which is available on our [website](#).

Using the USB connection of your tablet, copy the APK file to a place you can browse to, using a file explorer on the tablet. An alternate solution is to copy the file onto an SD card, especially for Mac users.

ALLOW UNKNOWN SOURCES IN ANDROID

- Go to the settings screen on your Android tablet.
- Go to Lock screen and Security.
- Verify that "Unknown sources" is enabled. A warning may appear about application security concerns. Acknowledge the warning.

INSTALL THE APPLICATION

Using the file explorer on your tablet, browse to the APK file location you have just copied from your computer. Tap the file to run the software installer. Some confirmations about access to specific features may appear. You can acknowledge these notifications without concerns.

After following these steps, a Flyability icon should now be available in your application menu and your home screen. Click this icon to initiate Cockpit.

Updating an application that is already installed

Updates to an application that is already installed can be done in two ways:

INTERNET UPDATE PROCESS:

- Be sure your device has Internet access. As you start Cockpit, the availability of updates is checked.
- Should a more recent version be available, you will be notified and prompted to proceed with the update or decline it. If you proceed, download of the newer installation file begins automatically.

Please note, the next time you connect your aircraft to the system, the application will prompt you to perform a firmware upgrade.

First launch of Cockpit

Upon a fresh install or unboxing of your Flyability aircraft, steps that are specific to the first launch may be encountered.

Please be patient when the application starts for the first time. Initialization of long-standing components should take place. This is normal behavior. Some of the long procedures run during the first launch only.

AUTHORIZATIONS

Be sure to accept all requested Android system authorizations.

Cockpit keeps your data safe.

1. Cockpit will never initiate paid phone calls or contact paid services on its own. Cockpit will never upload videos, flight logs, or data from the Android device. The only data that is uploaded is minimal aircraft identification data for servicing purposes, for the sole use of Flyability. A safe offline mode is available to block any such data transfers if this is a concern.

If you are installing the Cockpit on a tablet that hasn't been provided by us, please make sure to follow those extra steps: *

DEVELOPER MODE

Select the About Tablet option on the Settings Menu. Once that is done, click on the "Software information" option, and then on the "Build Number" 10 times, until the system tells you that the Developer mode has been turned on. Now the Developer options tab will be showing, and this is where you will be able to activate the USB tethering.

USB TETHERING

Make sure to change the default USB configuration to have the “USB tethering” as your default USB mode. To do so, click on the Tablet Settings, and then activate the Developer Options (following the steps indicated in the above section), and then scroll down on the right menu until you find the networking menu. There, you will find the Default USB configuration. Make sure to click on this button, and then it will redirect you to a page in which you have to enable the USB tethering.

*Note: These additional setup steps are not required if you are using a tablet that we have provided.

Aircraft firmware upgrade

A warning appears on the tablet's screen if the firmware and Cockpit are no longer compatible (see screenshot below for an example of this warning). Please note that you should always update the drone firmware when updating the software and vice versa. If not, your drone will not function properly. To upgrade the system, you will have to connect to the Inspector 4 software.



Figure 6.1: Aircraft Firmware Update

6.2 User interface

Home screen



Figure 6.2: Home Screen

When starting the application, the user arrives on the home screen. The home screen contains the following elements.

1. ASSET NAME – FLIGHT NAME

The asset and flight naming window records the mission name, and the name of the upcoming flight.

The asset and flight names are visible during post-processing with the Inspector software. Accurately naming your flights will greatly simplify the post-flight analysis process. We recommend you create some kind of naming convention for organization, such as “DATE_LOCATION_ASSET_FLIGHTNUMBER”

or whatever data you are interested in recording for each of your flights. Please be aware that the flight number will be updated automatically by the application.

2. CHECKLIST

This is a short checklist to help you verify that your system is good to fly.

3. SAFETY REMINDER

Flyability recommends the user to wear eye protection, ear protection, and a hard hat while operating the aircraft. The user MUST have read the aircraft user manual prior to using the system.

4. CONNECTION STATUS

Three icons are displayed at the bottom of the screen during the connection process. From left to right, these icons represent: the tablet, the remote controller, and the drone. The dotted lines represent the connection status between each component of the ELIOS 3 system.

Once all components are connected and ready, two options will appear. Those two options are:

- The “FLY NOW” button. Via this option, the user can toggle the camera preview by tapping this button.
- The “MAPPING FLIGHT” toggle. This will allow the user to perform a flight that is compatible with GeoSLAM. Please know that this requires a longer still period before arming, as ELIOS 3 needs to execute extra calibration to prepare for a mapping flight. This still period might require 15 seconds compared to 3 seconds in the standard (i.e., non-mapping) mode.

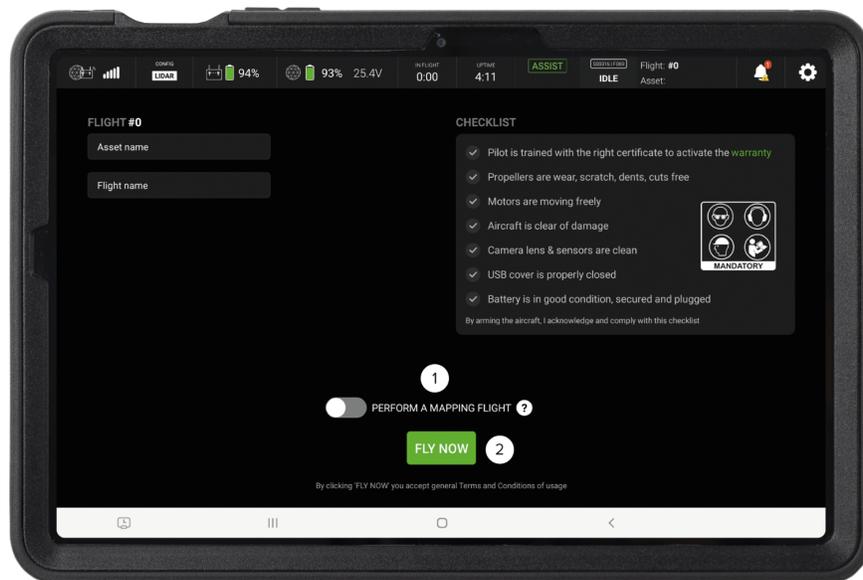


Figure 6.3: Fly Now - Home Screen

Main flight display

The instrument panel can be shown once all connections are established and the application has received data from the aircraft.



Figure 6.4: ELIOS 3 cockpit

1. Ambient temperature
2. Signal strength
3. LiDAR
4. Remote controller battery charge
5. Aircraft battery charge
6. Aircraft battery voltage

7. Flight time
8. Uptime (time elapsed since the battery is plugged in)
9. Flight control mode
10. Drone status (armed/disarmed)
11. Mission and flight name
12. Notification Center
13. Settings menu
14. Map (Default shows the Live Map window)
15. Camera parameters
16. Definition/ISO/IV/Exposure of the Camera
17. Camera tilt angle

SIGNAL STRENGTH

Signal quality reading includes:

The signal quality is represented by 5 bars. A warning appears when the signal is too low. Be sure to fly closer to the remote control to regain some signal quality and reduce the risk of completely losing communication. Alternatively, for your next flight, use a range extender to optimize the signal inside the flight environment.

For detailed data about the signal quality, refer to the radio panel of the settings menu.

BATTERY REMAINING CHARGE AND VOLTAGE

When the aircraft is not able to estimate its own percentage of battery charge left, “?” or “**N/A**” is displayed instead. In such situations, you can only rely on the battery voltage and flight time to estimate the remaining flight time, but this method is generally unreliable and should not be used in critical environments.

The battery charge indicator changes colors to warn when the remaining charge becomes too low.

Green	Battery charge is good.
Yellow	Battery charge is low. If in flight, consider finishing the current flight.
Red	Battery charge is critically low. Land immediately to avoid damaging the battery.

The voltage level can raise warnings as well, independently from the battery charge level. If the voltage indicator is red, the battery voltage is below the safe limit, and you should land immediately.

ALTIMETER DISTANCE

The altimeter (H) indicates the altitude of the drone relative to the take-off position.

Altitude and distance units (meters or feet) can be changed in the settings menu.

Altimeter data is logged during the flight and can be used in the Inspector software for added situational awareness during post processing.

HEADING

ELIOS 3 is not equipped with a magnetic sensor, as the magnetic field inside metallic structures can be irregular and erratic. Therefore, the heading indication is made based on inertial measurements relative to the heading at take-off.

Heading information is logged during the flight and can be used in the Inspector software for added situational awareness during post processing.



MAP

The embedded LiDAR sensor constantly scans the drone's surroundings to build a high-density point cloud (also called a 3D map), which shows the drone's trajectory and environment. This 3D Live Map is displayed instantly in the Cockpit App, empowering pilots with exceptional locational awareness.

This 3D map is beneficial as it always shows the pilot where the drone is located. Also, cumulative mapping data shows the completeness of the map, so you can instantly assess your inspection coverage.



CAMERA PARAMETERS

The following key camera parameters are displayed in this area:

- The image quality used for the current recording.
- Remaining memory
- ISO, shutter speed, and EV. The EV can be modified via a dedicated switch on the controller, which automatically changes the ISO and shutter speed accordingly.

The cameras on board the drone begin recording video as soon as the arming sequence is performed. An indicator on-screen shows a timer in red and a recording symbol. The time shown corresponds to the aircraft video recorder. Optionally, the tablet also records a backup video for immediate review and backup purposes. You can view the backup videos in Device Storage/Flyability/Cockpit/Recordings.

LIGHTING PARAMETERS AND FRONTAL DISTANCE MEASUREMENT

The LED lights display the status of the power level of the lighting system and which panels are lit.

Note that you cannot set the LEDs to full power until the aircraft takes off. This is because the heat generated by the LEDs needs to be cooled down by the propellers' airflow.

The frontal distance is measured by a sensor mounted next to the camera and displayed over the lighting parameter display. The units can be changed in the settings menu.

CONTROL MODE

Depending on the situation and the pilot's wishes, the aircraft can be in different flight modes, which can affect control and stability. Please refer to the aircraft user manual to learn more.

CAMERA TILT ANGLE

The tilt angle of the camera is indicated on the scale on the left hand side of the screen. The red dot indicates the angle of the camera with relation to the rest of the drone. The camera can tilt 90 degrees up and 90 degrees down.

SETTINGS MENU

The settings button opens the settings menu.

THERMAL CAMERA TARGET

The frame shows the field of view of the thermal camera. Only the objects inside this frame will get their thermal images recorded. The frame can be changed and/or hidden in the settings menu.

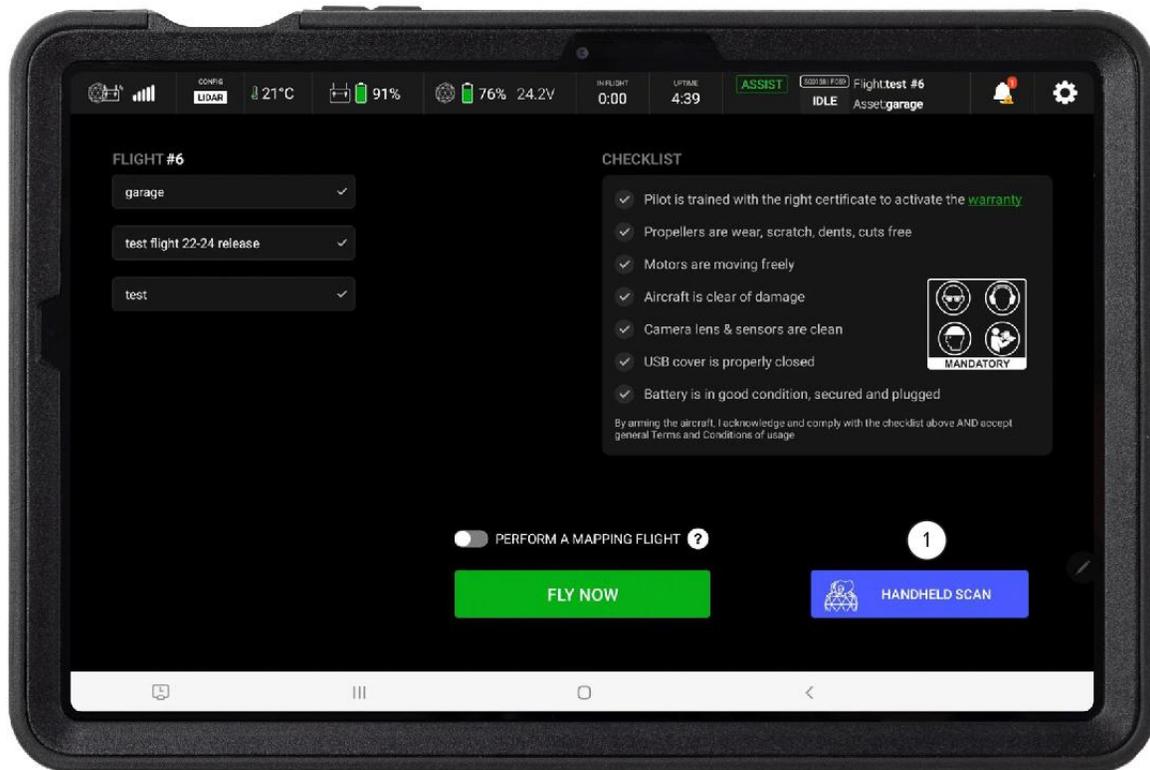
Handheld LiDAR mapping workflow

A handheld lidar mapping workflow has been introduced in Cockpit. If a LiDAR sensor is mounted on the drone, a blue button will be available on the main page in Cockpit to start a handheld mapping session. During this session the BUTTON LED will be colored solid blue. The drone will be fully functional as usual, allowing the customer to register POI's, record a video, use the thermal camera, and control the lighting and camera exposure. Starting and stopping of the session is done with a button on the tablet's screen, rather than the remote control. Just like a flown mapping flight, the handheld mapping session requires a calibration phase of 15s at the start of the mapping session.

To execute a successful handheld mission, we recommend you follow those instructions:

- Place the drone on top of your head (when possible), or in front of you, making sure not to cover the LiDAR and the camera of the drone (as per image below).
- Walk slowly within the space you want to map.
- Use the FHD recording resolution (further explanation below).

Please note that -if you want to post-process an inspection with Geoslam Connect-, the maximum recording length for a handheld session is 20 minutes. Anything beyond that time will result in an excess of data, which will be too large to process. If you have to use data collected over a period of more than 20 minutes then, you will need to do multiple handheld mapping sessions of 20 minutes each, and then merge the data using Geoslam Connect.



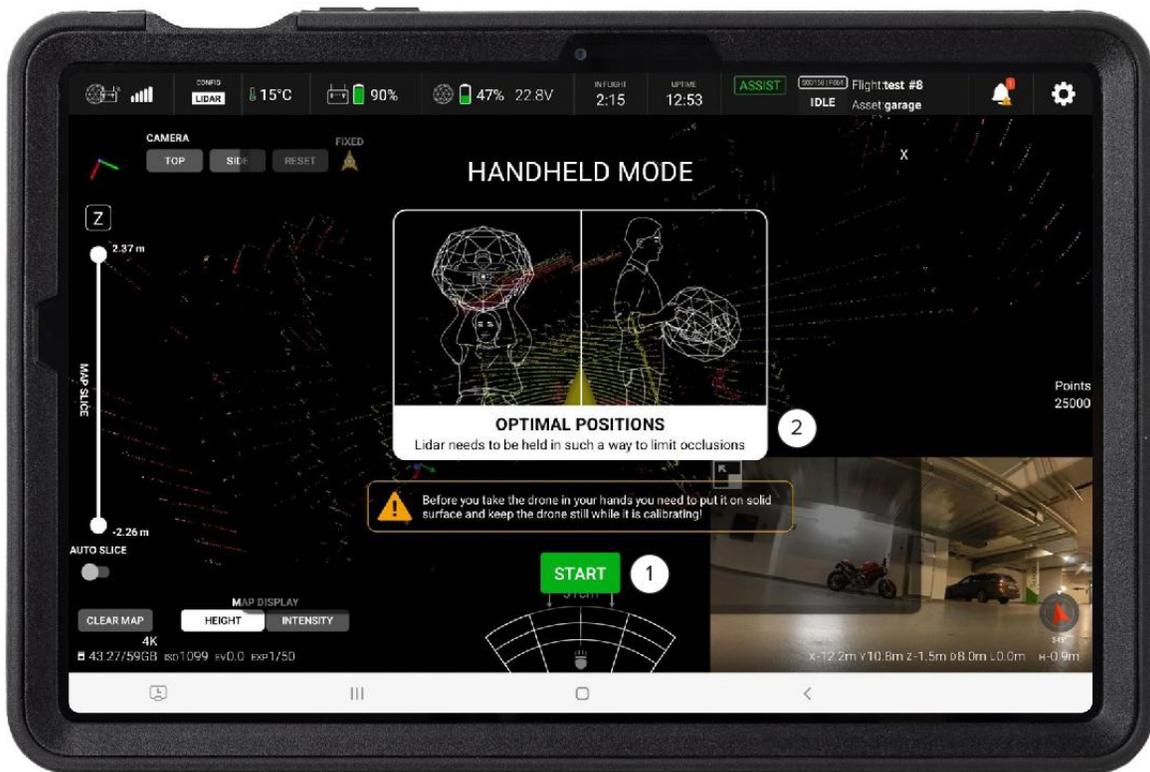
We advise you to use FHD recording resolution for handheld mapping. In FHD video you can record about 150 minutes of handheld mapping before the camera SD card is full, assuming you start with an empty card. In 4k video, on the other hand, you will only be able to record about 30 minutes of handheld mapping before the camera SD card is full, assuming you start with an empty one.

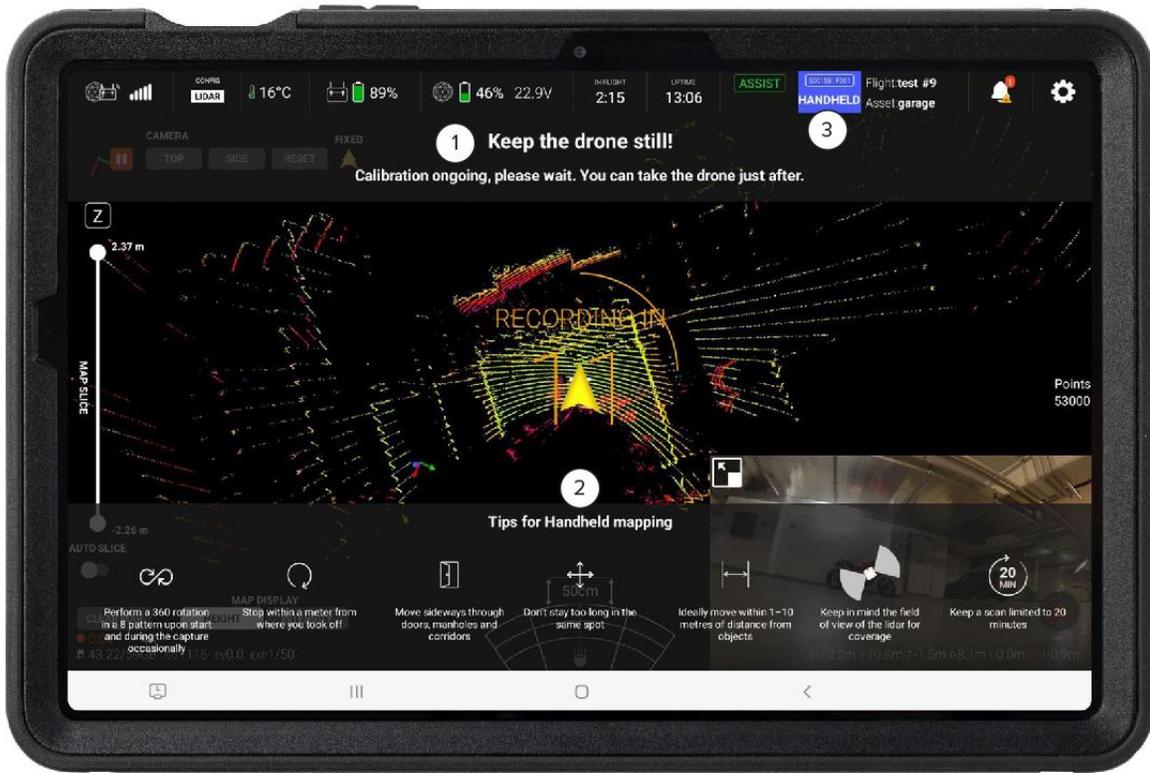
BATTERY LIFE

Between 100 to 150 minutes. The Camera SD card size and LiDAR temperature resistance are the main limiting factors for handheld mapping.

LIMITATIONS

The handheld mode has time limits related to ambient temperature. At room temperature (25 °C), the drone can capture about 30 minutes of reliable data. At 50°C the time duration will be limited to about 10 minutes.





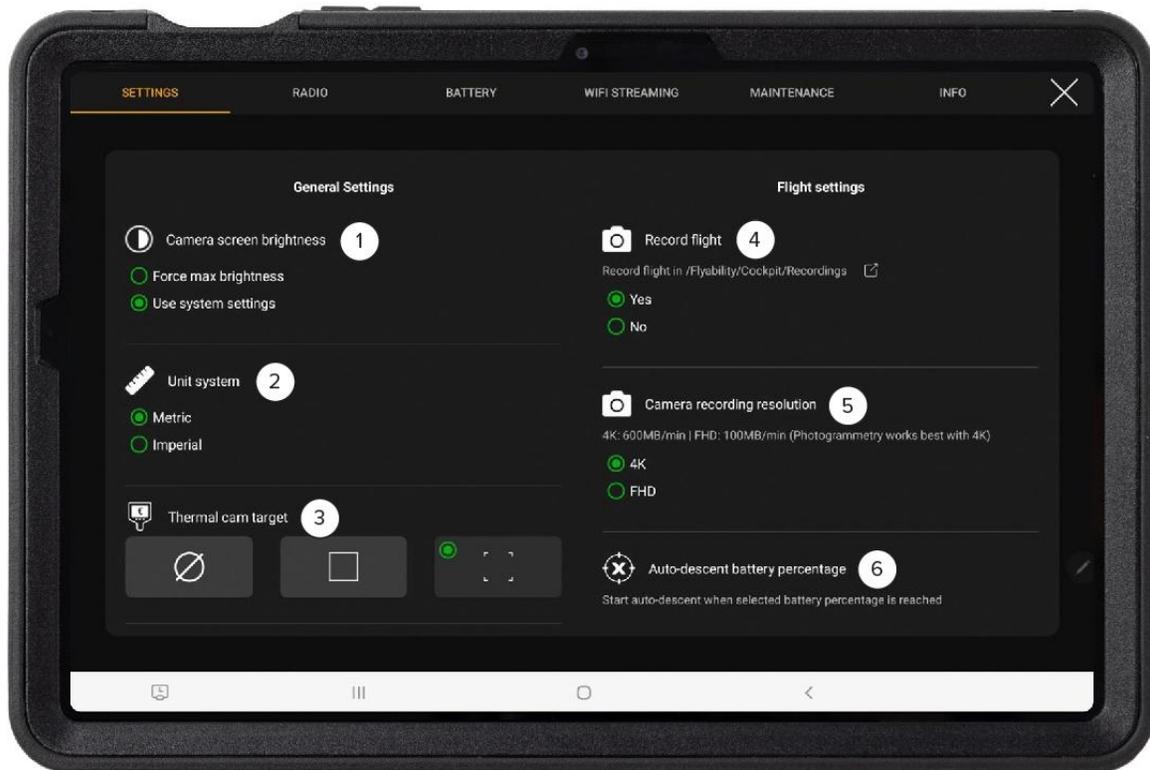
6.3 Settings menu

The settings button opens the settings menu, allowing you to change various settings and parameters for the drone.

To close the settings screen and go back to the main screen, press the *back* button of the tablet, or the close button in the top right corner of the screen.

The content of the settings is organized in multiple tabs. Swipe the tabs horizontally to browse through the panels and tap on the tabs to view their contents.

Settings



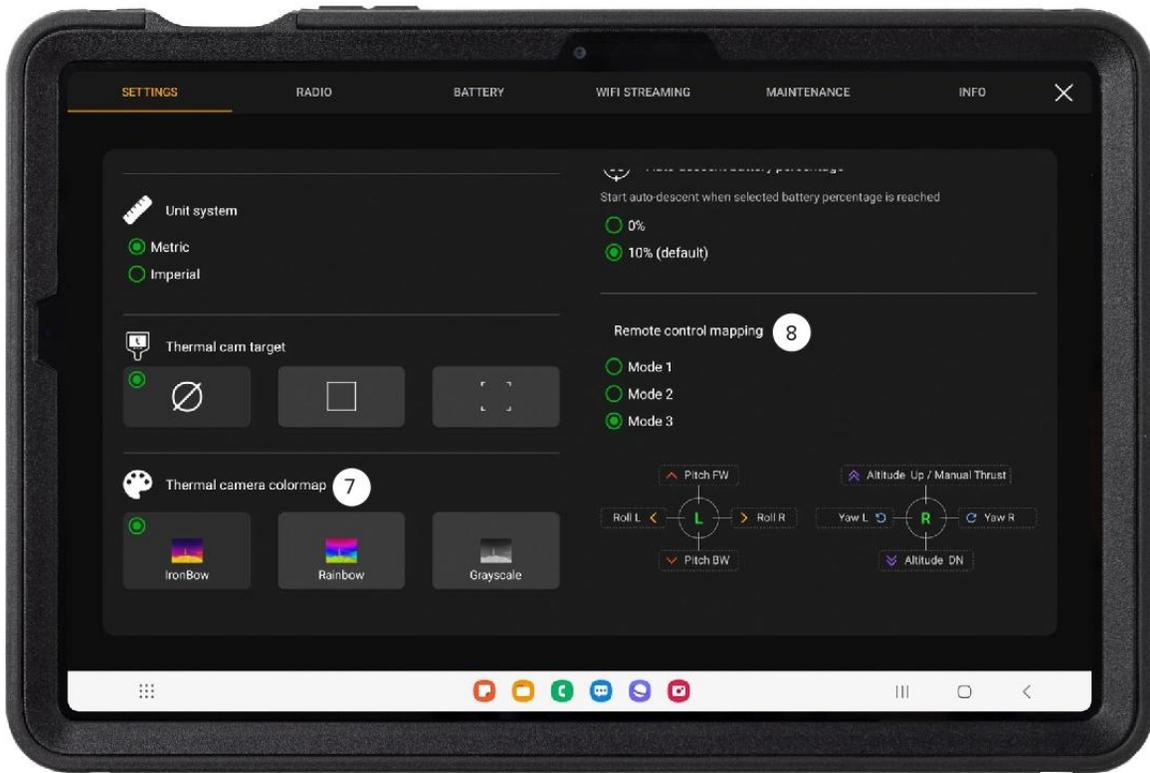


Figure 6.5: ELIOS 3 Settings

1. Camera screen brightness
2. Select the unit system
3. Thermal camera target
4. Record Flight (Yes or No)
5. Camera recording resolution (4K or FHD)
6. Select the battery percentage level at which the auto-descent process is started
7. Thermal camera colormap
8. Remote control mapping

This allows you to decide which mode to use when flying the drone. Mode 2 will be set by default. The available modes are:

- a. Mode 1.
- b. Mode 2.
- c. Mode 3.

To switch from mode 1 to mode 2, please select mode 1 on the Remote Control Mapping control, and vice versa to switch back to mode 2. Same goes for mode 3.

Radio panel



Figure 6.6: ELIOS 3 Radio Panel

This panel displays detailed data about the radio link quality between the controller and the aircraft.

Regular flight operations should not require changing the settings shown here. However, you can use the information to quantitatively verify the signal quality in high risk environments.

1. Air Unit. This table lists the different metrics measured by the air unit.

2. Ground unit. This table lists the different metrics measured by the ground unit.
3. Channel selection. The radio system will select the channel with the least noise.
4. Pairing button. Press this button to start the pairing procedure. Press the start button on the drone for seven seconds to complete the pairing.

Battery panel



Figure 6.7: ELIOS 3 Battery Panel

This panel shows data about the current battery status of the ELIOS 3 System

1. Aircraft battery remaining charge and voltage.
2. Uptime—the elapsed time since the battery was plugged in.
3. Battery firmware version and serial number.

4. Cell balance—the battery is made of six cells connected in series. The individual cell voltages are displayed here.
5. Battery voltage, current, and temperature.
6. Number of charge/discharge cycles on the current battery.
7. Internal resistance.
8. Tablet battery charge.
9. Controller battery charge.

Please refer to the aircraft and battery instructions for more details and limiting values for each of the above items.

Wi-Fi streaming panel

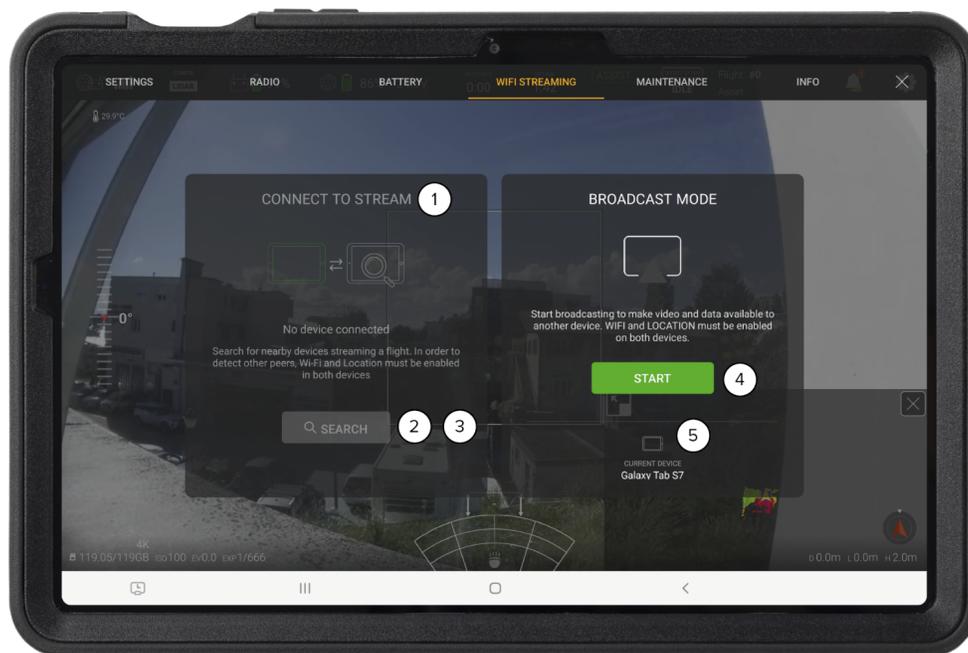


Figure 6.8: ELIOS 3 Wi-Fi Streaming Panel

This panel controls everything related to data streaming between two devices through Wi-Fi. Wi-Fi streaming allows using a secondary device as a simple viewer without needing to connect it to an actual remote controller. Using this feature, two people can monitor a flight while using a single remote controller. Wi-Fi streaming requires all devices to support Wi-Fi Direct.

1. List of detected Wi-Fi direct devices—used to connect to a streaming device when in the receiving role.
2. Streaming devices search button—starts a new search of devices around.
3. Disconnect button—disconnects active connection, available when a connection is established.
4. Broadcast start/stop button—starts streaming from the current device and makes it visible from other devices.
5. Name of this Android device as listed in Wi-Fi system options. Refer to this name when searching the current device from another device in the receiving role.

Maintenance panel



Figure 6.9: ELIOS 3 Wi-Fi Streaming Panel

The Maintenance panel gives an overview of the status of:

1. The optical and visual sensors
2. Motors
3. Camera/SD card
4. OBC & SSD
5. LiDAR payload (if present)

The panel displays the status of the sensors. They can be:

LiDAR:

INITIALIZING // When the sensor is booting and not yet outputting data.

WARMUP // Sensor has gone into thermal warmup state.

UPDATING // When the sensor is updating the FPGA firmware on the first reboot after a firmware upgrade.

RUNNING // When the sensor has reached the final running state where it can output data.

STANDBY // The sensor has been configured into a low-power state where the sensor is on but not spinning.

ERROR // Check error codes in the alerts list for more information.

UNCONFIGURED // An error with factory calibration that requires a manual power cycle or reboot.

VIO:

UNKNOWN // Status of the component is not yet known.

BOOTING // Component is starting up.

OK // Components are operating normally.

SHUTTING_DOWN // Component is shutting down.

TIMED_OUT // Communication has been lost.

OVERHEATING // Component is overheating.

DEGRADE // Component is in a degraded state.

FAILED // Component has failed.

UPDATING // Component is updating.

OBC and Camera:

ON // Device is running.

OFF // Device not running.

Info

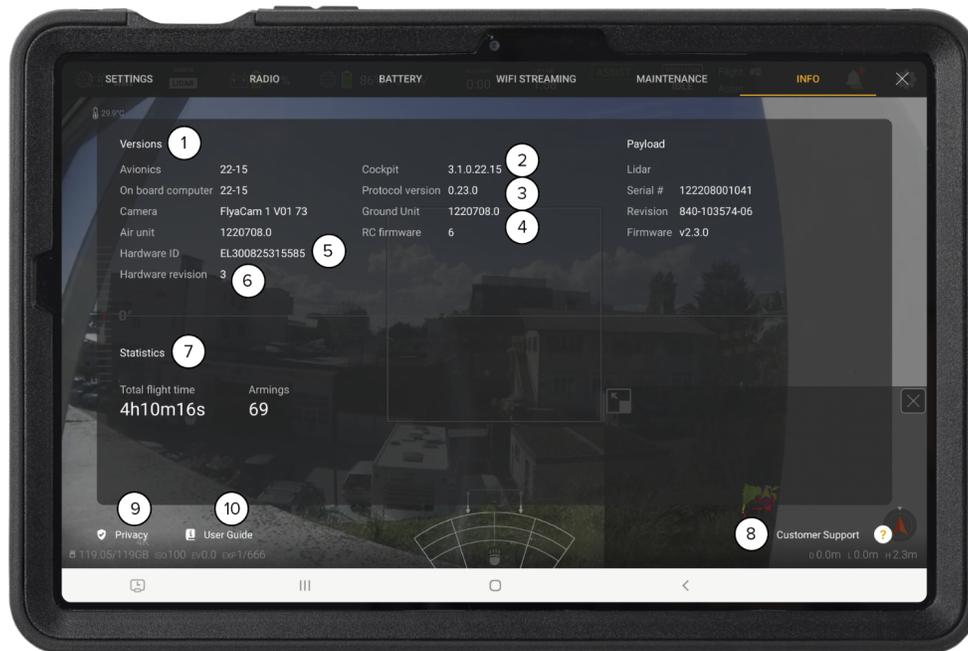


Figure 6.10: ELIOS 3 Info Panel

The different version numbers and identifiers of the ELIOS 3 system are listed on this page.

In any incident report, please make sure to include the data listed here. This information helps Flyability to troubleshoot the issue you are experiencing and expedites incident response time.

1. Versions: This is where you will find the current version for each of these items:
 - a. Avionics version of connected aircraft
 - b. Camera firmware version of connected aircraft
 - c. Air unit version of connected aircraft
 - d. Payload
2. Cockpit version
3. Protocol version of connected aircraft

4. Ground unit (remote controller firmware) version.
5. Hardware identifier of connected aircraft
6. Hardware revision of connected aircraft
7. Statistics of the connected aircraft
 - a. Total flight time
 - b. Armings
8. Customer support information button (shows support contact information)
9. Privacy settings button (opens the [privacy settings window](#))
10. User guide button

Privacy settings

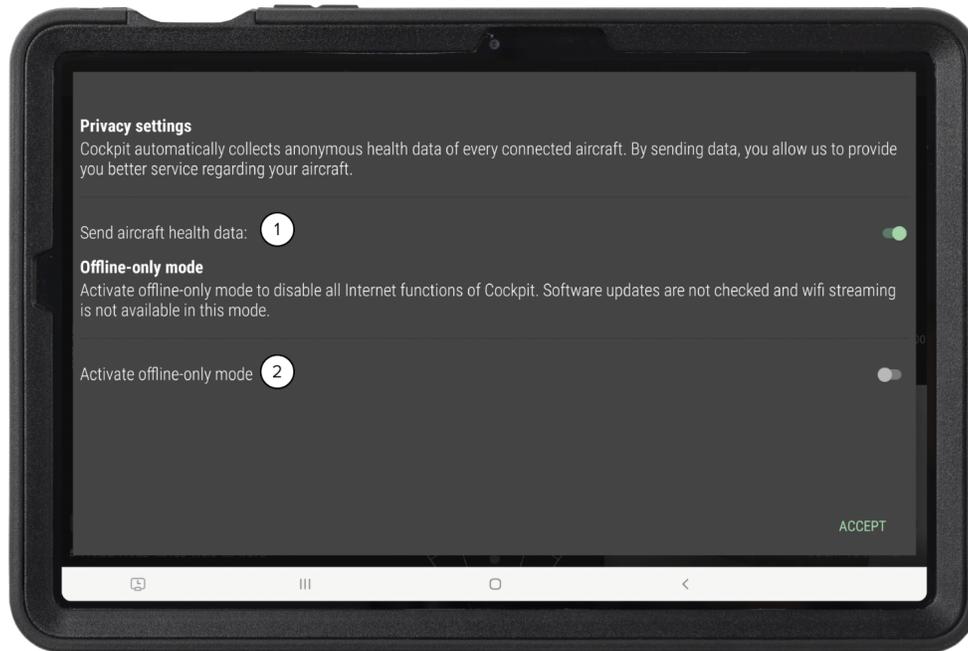


Figure 6.11: ELIOS 3 Privacy Settings

Accessed from the About panel, the privacy settings screen contains settings related to privacy and data security.

1. Send aircraft health data—enables Flyability to receive periodic updates about aircraft flight time and prepare better maintenance procedures.
2. Activate offline-only mode—disables all Internet-related features of Cockpit.

OFFLINE-ONLY MODE

Operators in sensitive sites may have to disable all internet access from their devices to comply with company policies.

Offline-only mode disables all internet functions of Cockpit, including:

1. Software updates check

2. Sending aircraft health data to Flyability

When using offline-only mode you will need to actively check for software updates on your own to get them as they are available.

Checking streamed video recordings

Cockpit automatically starts recording the tablet screen when the aircraft is flying and stops when the flight is over.

Main uses of streamed video recordings are:

1. Real-time review of flight on the tablet, without extracting data from SD card
2. Backup in case aircraft cannot be recovered

Such recordings have lower quality than the onboard footage. To review those videos:

1. Open the file manager application on your Android device
2. Browse into Device Storage/Flyability/Cockpit/Recordings

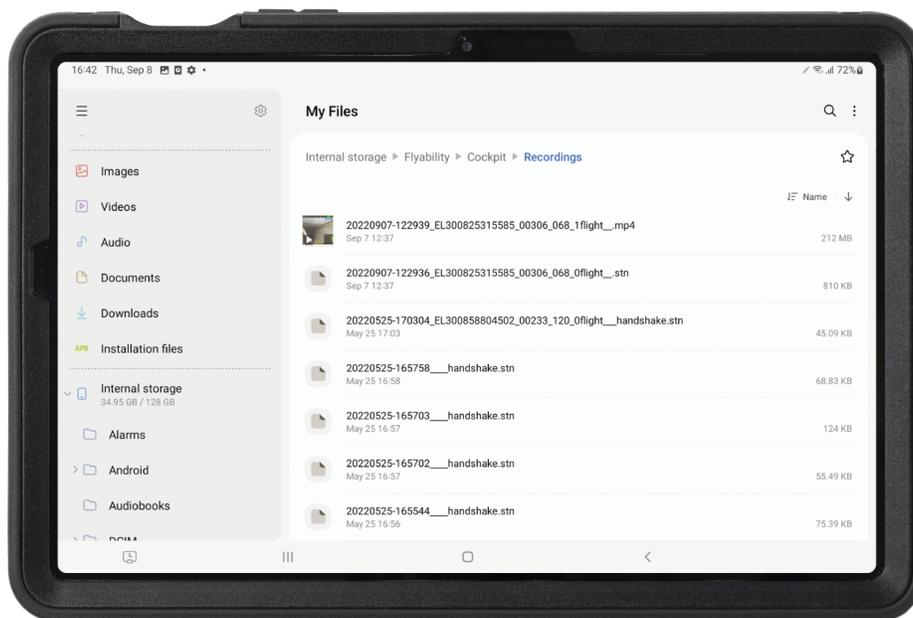


Figure 6.12: ELIOS 3 Video Recordings

3. Find the video files corresponding to your previous flights. Files are named by date and time of recording. STN-files accompany the videos and contain valuable debugging information for Flyability customer support. (Always share both of these files with Flyability when you open a support case.)
4. Tap a video file to play it using the system video player.

VIDEO STORAGE LIMITS

For performance and space management, once the total size of the recordings folder exceeds 128GB, the oldest videos are automatically deleted as new footage is recorded. Please be aware that we have a circular buffer in place.

Warning messages

To ensure the best experience with ELIOS 3 and prevent failures, the application will issue warnings when necessary. It is essential to take action as described in the table below when such warnings appear.



Warning types

Multiple levels of importance are given to different warning messages, which are expressed using different colors.

COLOR	SEVERITY	EXPLANATION
Blue	Information	Advice for improving the user experience of the ELIOS system. Provides recommended actions, which are good for most cases but can be ignored depending on the pilot's skill level.
Yellow	Warning	Point that requires attention.
Red	Critical / Error	Point that requires immediate action. Safety of aircraft, people, and property can be impacted, or flight can be made impossible.

Audible warnings

Low battery warnings trigger a flashing frame around the screen and an audible tone.

Make sure the system sound level of the tablet is raised so that the alarm tone can be heard, especially if flights take place in a noisy environment.

Error messages

Here is a list of actions that should be taken for a particular error or warning message:

CONTROL AND AVIONICS

Error Code	MESSAGE	REQUIRED ACTION / EXPLANATION
A01	Stabilization system disabled automatically—fly with caution	The stability system has been disabled automatically, while switching to FORCED ATTI. We recommend you fly with caution. Access the maintenance tab in the Cockpit app for further diagnosis. Contact Flyability support for further help.
A02	Temporary loss of LiDAR data	A temporary loss of LiDAR data has occurred. LiDAR data is not available at the moment. Access the maintenance tab in the Cockpit app for further diagnosis. Contact Flyability support for further help.
A03	LiDAR disconnection detected	A LiDAR communication timeout has just happened. Access the maintenance tab in the Cockpit app for further diagnosis. Contact Flyability support for further help.
A04	Stability sensors damaged—ASSIST stability performance diminished.	An issue with the VIO camera has just been detected. We recommend you restart the drone. If the problem persists you must contact Flyability support for further help.

BATTERY

Error Code	MESSAGE	REQUIRED ACTION / EXPLANATION
B01	Critically low battery—land now	Aircraft batteries have reached a very low level. This is critical—immediately land the aircraft in safe conditions and replace the battery with a fully charged one to continue flying. Discharging a battery to a too-low voltage can damage it irreversibly.
B02	Low battery	Low battery—a reminder that you only have a 25% remaining charge.
B03	Battery communication error	The battery management system is unresponsive—reconnect and try again. If the problem persists, use a different battery and restart the drone.
B04	Battery permanent failure	The battery is damaged and you shouldn't fly the drone with it. We recommend you land immediately, and you replace the battery.

B05	Battery lever unlatched	The battery lever is unlatched, and so the battery is not attached properly. Check that the lever is closed. Restart flying only once it has been closed correctly.
B06	Too cold battery	<p>The onboard system has evaluated the battery as risky. Batteries with the same conditions can have critical issues during flight, including loss of power during flight and crashes, even if charged at a good level. Arming is impossible in this situation for safety reasons.</p> <p>Replace the battery before flight.</p> <p>If you are in a cold environment, such as during winter, the battery can be faulty due to the low temperature, although it is otherwise in good condition. Replace the battery with one at a normal ambient temperature (typically 10°C-30°C / 50°F - 86 °F). One recommended way to keep batteries warm is by using a special LiPo-safe bag with built-in electric temperature control.</p>
B07	Too warm battery	<p>The onboard system has evaluated the battery as risky. Batteries with the same conditions can have critical issues during flight, including loss of power during flight and crashes, even if charged at a good level. Arming is impossible in this situation for safety reasons.</p> <p>Replace the battery before flight.</p> <p>If you are in a hot environment, such as during summer, the battery can be faulty due to the high temperature, although it is otherwise in good condition. Replace the battery with one at a normal ambient temperature (typically 10°C to 30°C / 50°F - 86 °F). One recommended way to keep batteries cool is by using a special LiPo-safe bag with built-in electric temperature control.</p>
B08	Controller battery low	Controller battery is low. Even if the controller does not discharge as fast as the aircraft, consider charging it soon.
B09	Tablet battery low	Tablet battery is low. Even if the tablet does not discharge as fast as the aircraft, consider charging it soon.
B10	Battery is getting old.	Battery performance is guaranteed for 40 discharge cycles. This warning is displayed when the battery has over 35 cycles. We recommend you contact support to buy new ones. You have X remaining cycles.
B11	Max Battery Life Cycle reached	<p>Battery performance is guaranteed for 40 discharge cycles. This warning is displayed when the battery has exceeded 40 cycles, warranty is void. Use a newer battery.</p> <p>State of charge % will not be indicated on flight display during flight.</p>

PROPULSION

Error Code	MESSAGE	REQUIRED ACTION / EXPLANATION
P01	Motor communication error—drone cannot fly	A communication issue occurred between the aircraft and its motors. You must try to restart the aircraft and try again. If the problem persists, contact Flyability.
P02	Motor telemetry communication timeout	<p>Failure detected in the aircraft propulsion system.</p> <p>Check that propellers are in good condition, tightly attached to the motors, and each one is mounted to a motor with the correct direction of rotation.</p> <p>A propeller may be broken, loose, or in the wrong place.</p> <p>This error message can also signal a motor failure. If you are confident that you have properly tightened the propellers and the motors are in their correct state, try arming the aircraft again.</p>
P03	Motors overheating—flight performance might be reduced	Motors are overheating and are throttled back to avoid damage. This might affect flight performance and stability.
P04	Motor is getting old	Motor reliability and performance is guaranteed for 25 flight hours. This error message means that the 25 flight hour time limit will soon be exceeded by one or more motors. Prepare to replace the motors with new ones.
P05	Max motors life reached	Motor reliability and performance is guaranteed for 25 flight hours. This error message means that the 25 hour flight time has been exceeded by one or more motors, Warranty is void. Replace the motors with new ones immediately.

CAMERA PAYLOAD

Error Code	MESSAGE	REQUIRED ACTION / EXPLANATION
C01	Manual thrust engaged	The Manual thrust mode (MAN) has been engaged. For you to enable the Altitude hold, or to arm it, move the switch down.
C02	Sport mode engaged	The SPORT mode has been engaged. We recommend you fly with caution, and that you switch to ASSIST to limit the drone speed. Release button to slow down.
C03	Not in ASSIST mode	The aircraft is not in ASSIST mode. Move the switch to C1—ASSIST mode and release the PRO MODE button to be able to arm the drone.

G01	Camera SD card full	The camera SD card is full. The aircraft is not able to record video anymore. Empty the SD card to resume recording.
G02	Camera SD card error	Error concerning camera SD card operation. Can be caused by a corrupt card.
G03	Camera SD card missing	Please insert an SD card in the CAM SD card slot to have your video footage saved.
G04	OBC storage getting low	The OBC storage is getting low. Free up 20GB to do a flight.
G05	OBC SSD almost full	The OBC storage is almost full. Free up 20GB to do a flight.
G06	No space left on OBC	Logging on the OBC stopped, since the OBC storage is full. From now on, data won't be recorded.

CALIBRATION

Error Code	MESSAGE	REQUIRED ACTION / EXPLANATION
I01	FC calibration changed, please restart the drone	Calibration needs to be updated—please restart the drone.
I02	FC calibration communication error, performance may be diminished	Calibration communication error—stability performance may be diminished.
I03	FC calibration error, performance may be diminished	Calibration error—stability performance may be diminished.
I04	FC calibration file error, performance may be diminished	Calibration error—stability performance may be diminished.
I05	FC calibration SN mismatch, performance may be diminished	Calibration SN mismatch—stability performance may be diminished.
I06	DSM calibration changed, please restart the drone	Calibration needs to be updated—please restart the drone.
I07	DSM calibration communication error, performance may be diminished	Calibration communication error—stability performance may be diminished.

I08	DSM calibration error, performance may be diminished	Calibration error—stability performance may be diminished.
I09	DSM calibration file error, performance may be diminished	Calibration error—stability performance may be diminished.
I10	DSM calibration SN mismatch, performance may be diminished	Calibration SN mismatch—stability performance may be diminished.
I11	VIO calibration changed, please restart the drone	Calibration needs to be updated—please restart the drone.
I12	VIO calibration communication error, performance may be diminished	Calibration communication error—stability performance may be diminished.
I13	VIO calibration error, performance may be diminished	Calibration error—stability performance may be diminished.
I14	VIO calibration file error, performance may be diminished	Calibration error—stability performance may be diminished.
I15	VIO calibration SN mismatch, performance may be diminished	Calibration SN mismatch—stability performance may be diminished

LiDAR

Error Code	MESSAGE	REQUIRED ACTION / EXPLANATION
L01	LiDAR system error	The LiDAR has a system error. Please restart the drone and contact Flyability support if the problem persists.
L02	The LiDAR is too hot and stopped working	LiDAR stopped working because it was too hot.
L03	LiDAR is getting hot	The LiDAR is too hot. We recommend you turn the drone off.
L04	The LiDAR is too hot. Performance might be reduced	LiDAR is too hot—performance may be reduced.
L05	The LiDAR is too hot. Performance is reduced. Further heating will shut the LiDAR down	LiDAR is too hot—performance is reduced.

TRANSMISSION

Error Code	MESSAGE	REQUIRED ACTION / EXPLANATION
T01	Weak signal—fly closer	Weak radio signal—fly closer to the remote control to avoid losing the connection.

SOFTWARE

	MESSAGE	REQUIRED ACTION / EXPLANATION
S01	Drone didn't shut down correctly	Check for a CRD file on the Avionics SD card and contact Flyability Support.
S02	Communication protocol version mismatch	Not the same starnet version on Cockpit and Drone (i.e., starnet mismatch). Please update both Cockpit and the drone.
S03	Transmission FW version mismatch	Transmission FW version mismatch between ground and air unit.
S04	Cockpit version not compatible with the drone	Please make sure that both systems are up to date.
S05	Avionics stopped logging	The avionics stopped logging.
S06	OBC is initializing	The OBC logging system is initializing. Please wait until it does so.
S07	OBC did not initialize properly	The OBC logging system did not initialize properly and thus timed out. Please wait until it restarts and properly initiates.
S08	OBC logging system failure	OBC logging failure—please restart the drone.
S09	Drone cannot be armed in current state	The drone cannot be armed in the current state. Please restart it. Contact Flyability support if a problem persists.
S10	Unable to communicate with the ethernet switch	Internal communication error.
S11	Switch status doesn't show a connected port on OBC side	Internal communication error.
S12	Switch status doesn't show a connected port on LiDAR side	Internal communication error.

S13	Altitude estimation error	Altitude estimation error, drone cannot be armed in current state—please restart the drone.
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7. Advanced set-up

7.1. 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 procedure.

There are no items needed for you to pair the controller to the drone.

- Press the power button of the drone, and keep it pushed in until it starts blinking blue.
- Then, pair the controller with Cockpit by putting it into pairing mode.
- The Controller status indicator will blink blue and emit a beep sound when the Controller is ready to link.

8. Charging

8.1. Charging GCS

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 piloting the drone, this is not a recommended practice, since this may lead to the unit overheating.

How would you know that the RC is charged? The 4 LEDS lights are white, indicating that the RC is charged.



Figure 8.1: GCS charging

8.2. Charging the battery

Flyability's charger comes with a built-in power supply. You can connect the AC power cord to a 100-240V AC socket directly:

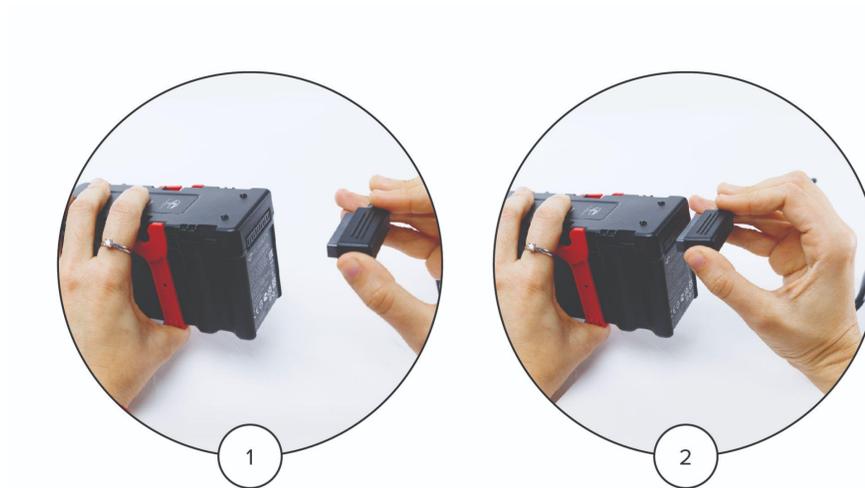


Figure 8.2: How to charge the battery

While doing so, please, pay particular attention to the following details:

1. Connect them while keeping the battery and charger connector straight and centered
2. No visible damage is reported on the battery or the charger connectors

Please refer to the following steps to charge the battery:

1. Insert the AC power cord into the charger.
2. Connect the AC power cord into a 100-240V AC socket. The LED will turn green.
3. Connect the battery pack to the charger.
 - The battery LEDs will show the progression of the charge.
 - The charger LED will turn red, indicating that the charge is ongoing.
4. The battery will be fully charged when the charger LED turns green again.

If the charger LED remains green upon connection it might mean that either:

1. The battery is already fully charged. Check the state of charge of the battery with a short press on the battery button.
2. The battery is outside its temperature range.
 - a. If warm, let it cool down before retrying to charge it.
 - b. If cold, warm the battery before retrying to charge it.

In both cases, the battery will beep and display a yellow LED. Until the LED will stay yellow the battery is still outside the temperature range for the charge, and therefore it won't charge.

3. The battery is permanently damaged due to over-discharging. Please contact Flyability Professional Services at support@flyability.com

9. Maintenance

9.1. Update the aircraft firmware

For you to update the aircraft firmware, please consult our [product Support pages](#).

9.2. Cleaning the drone

It is important to clean the drone after a flight in a dusty or dirty environment. To do so, use compressed air from an air blow gun or gas duster can.

Please note that using a wet cloth with normal water should always be the first choice to clean prior to trying isopropanol alcohol. If necessary, Isopropanol alcohol can be used to clean the cage and any surface of the drone, but be aware that not all the material of the drone should be treated with isopropanol regularly. If you do use isopropanol to clean the drone, apply it gently with a toothbrush or a rag.

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

9.2.1 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 3.

9.2.2. Motors

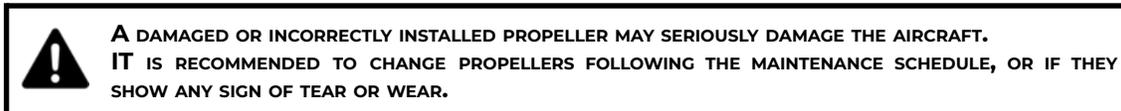
Pay special attention to the motors. Dust or other particles may damage the motors if allowed to build up inside. Use compressed air to remove all dust and particles from the motors and regularly check for dust ingress in between flights, especially when flying in a metallic dust environment as metallic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

To guarantee the performance and reliability of the motors, they must be replaced following our maintenance schedule, which can be found on our Support Page, [here](#).



IF YOU BLOW COMPRESSED AIR ON THE MOTORS, PLEASE WEAR GLOVES AND HOLD THE CORRESPONDING PROPELLER. THE AIR FLOW MAY MAKE THE PROPELLER SPIN **FAST DAMAGING THE MOTOR AND INJURING THE USER.**

9.3. Changing a propeller:



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

The clearance between the tip of the propeller and the duct is extremely important for the efficiency and flight time of the drone. Propellers must be replaced if they are worn down to the white markers.

REQUIRED TOOLS (YOU WILL FIND ALL THOSE TOOLS WITHIN THE PROVIDED TOOLBOX):

- 8 mm hex socket.
- 1.4 Nm fixed torque driver.

Here is the step by step procedure:

- Identify the propeller in need of replacement (following the previous instructions).
- Find the right propeller/propellers in the drone's box (please note that numbers and letters will be printed on the propellers). ELIOS 3 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.
- Remove the damaged propeller/propellers with the appropriate tool (i.e., the provided 8mm hex socket).
- Change the propeller/propellers, making sure to place the letter against the structure.
- Tighten the propeller to the motor shaft with the 1.4N.m torque driver and hex socket. You must always use a new nut when replacing a propeller.
- Before each mission, you should check your propellers and you should also check that the nuts are correctly tightened with the 1.4 Nm torque driver.

Note: As a general best practice for propeller maintenance, we encourage users to replace all propellers at the same time. Doing so ensures proper pacing for the maintenance schedule for your propellers. Replacing a single or a few propellers will make it difficult or impossible to keep track of which ones need to be changed and which ones do not.

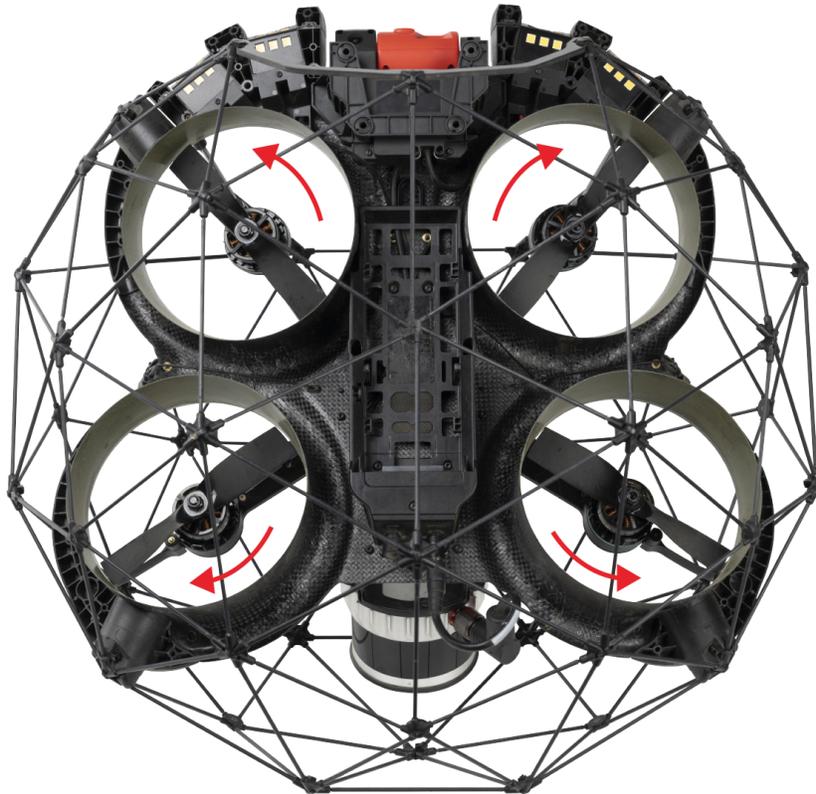


Figure 9.1: Propeller marking

To learn more about this topic, please watch the related support video. Support videos can be found [here](#).

 **USE ONLY THE PROPELLERS PROVIDED BY FLYABILITY.**

9.4. Changing motors

Motors should be changed when they are damaged following the maintenance schedule. Damage is typically caused by wear or tear in the long term.



REQUIRED TOOLS (YOU WILL FIND ALL THOSE TOOLS WITHIN THE TOOLBOX THAT COMES WITH YOUR DRONE):

- T8 bit.
- 0.4 Nm torque driver.
- ELIOS 3 motor centering tool.
- 8mm hex socket and driver for the propellers.

Here is the step-by-step procedure:

- Remove the 3 screws with a T8 screwdriver.
- Pull down the old motor.
- Take a new motor, and verify that the o-ring is well in place.
- Align the motor connector and the arm connector.
- Push the motor in place.
- Place the 3 motors screw with their washers.
- Tighten the 3 screws, keeping the motor free to move slightly. Don't block the screws yet!
- Place the centering tool through the duct on top of the motor shaft and push it against the motor rotor.
- "Wobble" the motor so it finds its centered position.
- Tighten each motor screw with the T8 screwdriver progressively, screw by screw. Once all the screws feel tight, tighten at the 0.4N.m torque.
- Repeat the tightening 2 times on each screw, one at a time.
- Remove the centering tool.
- Place the propeller back. We recommend changing the propeller each time you need to change a motor. Remember that you should always use a new propeller nut.



To learn more about this topic, please watch the related support video. Support videos can be found [here](#).

9.5. Changing a cage element

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

You must replace cage elements whenever a rod or connector is broken.

The ELIOS 3 cage is composed of 6 different parts, which are:

- A top Hexagon (biggest)—letter A.
- 4 Top Pentagons—letter B.
- 2 Triangles (side ones)—no letter.
- 5 Bottom Pentagons—letter C.
- 1 Bottom Hexagon—letter D.
- 1 Cage Bottom opening (Carbon fiber part).

Here is the step-by-step procedure on how to change a pentagon in the drone's cage:

- When you need to replace a pentagon, make sure to pick the right one, and try to add it to the structure.
- Then with a cutting plier, cut the zip ties, and remove the broken parts and zip ties.
- After you have replaced the new part and zip ties, tie them by hand. Please keep in mind that the zip ties have to be placed from the inside of the cage in order for the head of the zip tie to remain inside the cage. To tie them better, you can use the flat plier, and use the cutting one, to remove the part of the zip tie that isn't needed.



To learn more about this topic, please watch the related support video. Support videos can be found [here](#).

9.6. Changing an LED:

REQUIRED TOOLS (YOU WILL FIND ALL THOSE TOOLS WITHIN THE PROVIDED TOOLBOX):

1. Torx T6 screwdriver.



Here is the step-by-step procedure on how to change an LED panel:

- Remove the top and bottom screw of the panel you need to replace.
- Remove the panel by pulling it out in the direction of the front of the drone.
- Once the panel is out, gently pull on it to get the cable out.
- Disconnect the cable by gently pushing down the lever of the connector while wiggling it to unplug.
- Only one cable is connected on the outermost panels.
- On the central (near the camera) panel you have two cables. The one with the red ring must be connected to the connector closest to the camera.
- Take the new LED panel.
- Connect the cable (or cables).
- Slide the panel in. Pay attention to the panel sliding above the plastic tabs and under the plastic frame.
- Place the top and down screws and tighten them. Don't apply extreme force, just enough to block the screw in place.
- Connect the system to check that the LED works again.



To learn more about this topic, please watch the related support video. Support videos can be found [here](#).

10. Technical specifications

To learn more about the technical specifications of the ELIOS 3, please refer to the “Technical specifications” document stored in our Support Page. The Technical specifications can be found [here](#).



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Content subject to change.
Find the latest version on:
www.flyability.com