FLIGHT MANUAL

REVISION D.0 | December 2022

REVISION HISTORY

Revision	Date	Description
A.0	March 2017	Initial Release
B.0	January 2018	Updated Images & Flight Modes
C.0	May 2021	Updated for Mark 2 Release
D.0	December 2022	Updated for Mark 2.3 Release

SwitchBlade-Elite 2.3 Release Notes

Overview

Release Date: 12/15/2022

Starting Serial Number: 20161

SwitchBlade-Elite 2.3 is now available for general use. This minor update includes equipment for FAA Remote ID compliance and improvements to various components for reliability, durability, performance, supply chain stability, transport case aesthetics, and user experience.

What's New

Drivetrain

- Drivetrain upgrades improve reliability, flight performance and flight time, as well as increase supply chain stability for these components.

- Modified motor mounts and cradles with updated bolt patterns.

General

Maximum payload capacity recommendations reduced to 2.0 kg to compensate for additional vehicle mass.

Remote Identification (RID)

- Added Remote ID capabilities to meet FAA requirements. Equipment includes a computer & antenna mounted on the ventral side of the airframe to broadcast the drone and operator's location.
- Update flight computer firmware to Arducopter 4.3.0 (See below)

Gimbal Control

- Dual operator control support added.
- Added ability to pan and yaw gimbal using a single scroll wheel and using the A button to select between functions.
- Long press on the A button centers the gimbal so it points forward.

Optional Camera Control Support

- Optional feature to support camera control using Airpixel AIR Commander ENTIRE R3.
- Functions user can control include:
  - For Sony A7X and A9X: Trigger Photo, Trigger Video, Zoom (motorized zoom only), Aperture, Shutter Speed, ISO, Exposure correction, Trigger AF, Camera power toggle.
  - For the Sony A6xxx, A5xxx series, RX1 series: Trigger Photo, Trigger Video, Zoom, Trigger AF, Camera power toggle.
- Support for in-image geotagging and location of gimbal angle.

Ground Control Station

- Upgrade to Herelink 1.1
  - Brighter screen (600 nit to 1000 nit)
- Removed joystick jack screws to prevent occasional physical jamming
- Updated Herelink firmware for Remote ID support.
  - Remote ID status indicator
  - Ability to enter Remote ID operator information

Retractable Landing Gear

- Landing gear retracts are now field serviceable. Users can also upgrade their retracts from manual to powered at their discretion without the need for Vision Aerial Service assistance.
- Provisional wire routing added to allow for field servicing.
- Larger and more powerful servo improves retract reliability and lifting power.
- Foot attachment geometry has been standardized between aircraft.
- All sheet metal parts have been updated for servo compatibility.
- Linkages, servo horn, and servo have been updated for supply chain stability and longevity.

Transport Case

- Denser foam will help prevent damage during violent shipping handling.
- Payload compartment has been converted to accept a standardized, interchangeable insert for a wide variety of payload options.
- Serial numbers now laser engraved to improve damage tolerance.
- Battery Charge Indicator: Colored rubber bands changed to blue, green, and red connector caps. Added a battery cap rack inside the case. Changed for aesthetic purposes.

Electronic Payload Connection System (EPCS)

- Added a magnetic housing to the primary (Gecko) connector to provide an easier and more robust connection. Removed snap fit feature.
- Altered HDMI cable slot geometry to improve connection ergonomics.
- XT-30 pack power connection added to support high power demand payloads
- Added SMA connector for Remote ID antenna.
- Created adapter kit for modifying old payloads to work with the new EPS.

Mechanical Payload Connection System (PCS)

- Ridges added to base to remove play.
- Cover plate changed to aluminum for improved damage tolerance..
- Bump stop added to base to retain PCS lock ring when in open position. Prevents the ring from rattling when there is no payload.
- Wire Payload Safety Strap added to catch the payload in the event that the PCS fails.

Payload Damping

- Ventral cover, ventral dust plate, and floating plate modified to increase the quantity of damper balls and range of vibration frequency absorption. This will reduce / eliminate the amount of "Jello" seen in video feeds.

Tail Mechanism

- More durable servo horn and linkages have been added.

- Updated keel to improve ground handling damage tolerance.
- Tail light geometry now a vertical slot shape for aesthetic purposes.

Electrical

- Nav lights, wiring, and connectors updated for compatibility and reliability.
- Voltage level shifter added to navigation light circuitry to improve voltage level to the first LED assembly, for Blue Cube compatibility.
- Voltage level shifter added to retract circuitry to increase drive voltage to retract servos.
- Upgraded voltage regulator to improve power-up speed with certain voltage sensitive Gremsy gimbals.
- Provisional 5 volt wiring ran to nose mount for provisional accessories.
- Battery connector strain relief added to improve user ergonomics.

Firmware

- Upgrade to the latest flight computer firmware: ArduCopter 4.3.0
  - Includes new parameters and tuning for drivetrain and Remote ID updates.
  - NMEA data fix for better GPS position tagging to convert decimal GPS to degrees.
  - See ArduCopter Release Notes:
    https://github.com/ArduPilot/ardupilot/blob/master/ArduCopter/ReleaseNotes.txt

Software

- Updated to Flight Deck 2.3 ([See Release Notes](#))

Top Resolved Issues

- FAA Remote ID compliance added.
- Android OS updates no longer uninstall Flight Deck software on the Herelink.
- Parameter updates can now be pushed to systems deployed in the field.
- Resolved issues with some Gremsy gimbals that failed to power on during startup.
- Increased flight times and improved stability in corners of the flight envelope. Manual mode top speed increased from 12.5 m/s to 15 m/s with drivetrain updates.
- Altitude Hold mode removed to prevent pilot error (see Flight Deck 2.3 Release Notes).
- Issues with intermittent retract failures have been resolved.
- Eliminated and/or reduced amount of "Jello" in video feeds.
- Increased granular resolution of GPS accuracy.
- Case improvements allow for more protection during shipping.
- Updates to the mechanical and electronic portion of the Payload Connection System allow users to attach payloads more easily.
- Moving to Herelink 1.1 resolved an issue with HDMI video priority. Allows use of HDM 1 or HDMI 2 regardless of the order.

Open Issues

- During flight, battery percentage remaining is sometimes inaccurate. When the drone lands, if it sits, the battery percentage remaining will climb back up.
- Remote ID requires that the user activate the radio status menu in order to wake up the remote ID functionality.
- GoPro FPV cameras have inconsistent user controls between camera generations.

General Advisories

- Payload capacity reduced to 2.0 kg.

- **WARNING: Battery percentage remaining calculation is no longer being supported for legacy LiPo batteries. Inaccurate battery remaining percentage may occur if a LiPo battery is being used. Users should use the voltage remaining number instead.**

- Drone and operator's location is now viewable to others with Remote ID phone apps.

How to Upgrade Your Unit

Contact Vision Aerial's Service Department at (406) 518-1302 or email service@visionaerial.com to receive an estimate and schedule an appointment.

The cost to upgrade from a SwitchBlade-Elite 2.0 or higher with Solid State batteries is $4950 and time depends on the production queue.

How to Use This Manual

This manual intends to inform and educate the user on how to properly and effectively control, fly, and utilize the full functionality of your Vision Aerial UAS. It is not recommended to operate and fly your Vision Aerial UAS without first reading and understanding the information and guidelines presented in this document.

⚠️ **NOTE**: **This manual is a work in progress. Please [contact us](#) regarding errors or omissions.**

Previous Versions

Previous versions of the manual can be downloaded:

- [SwitchBlade-Elite Flight Manual Archives](#)

- [Vector Flight Manual Archives](#)

Use of Special Terms

⚠️ **NOTE: Operating procedure, practice, or condition that is essential to emphasize.**

⚠️ **CAUTION: Operating procedure, practice, or condition that may result in damage to equipment if not followed or observed.**

⚠️ **WARNING: Operating procedure, practice, or condition that may result in injury or death if not followed or observed.**

Requirement for Compliance

Shall: Application of a procedure is mandatory.
Should: Application of a procedure is recommended.
May: Application of a procedure is optional.
Will: Indicates futurity.

Requirement for Landing

Land as soon as practicable: Extended flight is not recommended, duration is at the discretion of the operator.
Land as soon as possible: Land at the nearest safe site where a landing can be made.
**Land immediately**: Execute a landing without delay.

Features & Specs

The SwitchBlade-Elite is a tri-rotor drone with an articulating tail, powerful and efficient electric motors, and cutting-edge flight components. It is easy to fly, and capable of flying for 50 minutes on a single charge (30 minutes with a typical payload).
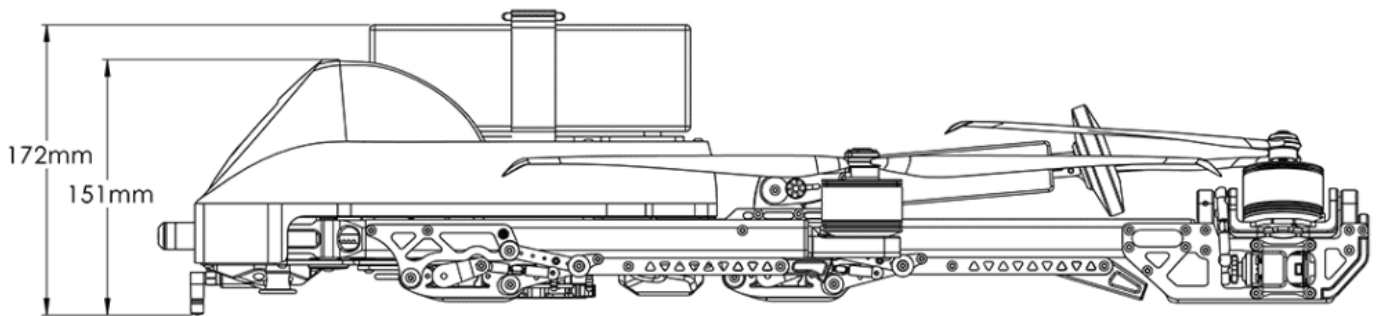
The SwitchBlade-Elite is light and folds up compact for easy transport. When you need to fly, you can transition from the case to flight in less than two minutes.
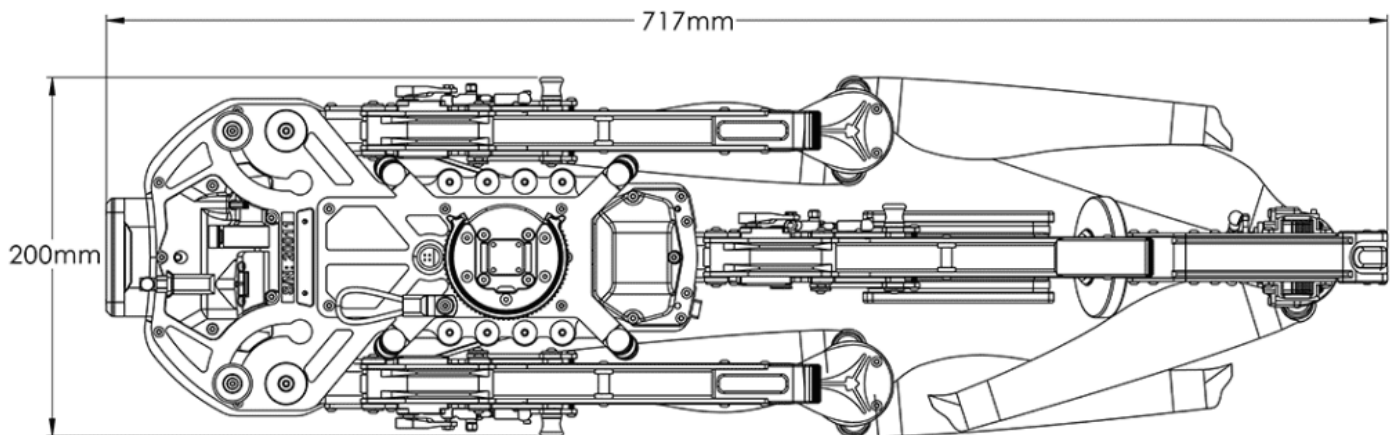
Storage Configuration Dimensions

Equipment: SwitchBlade-Elite 2.3
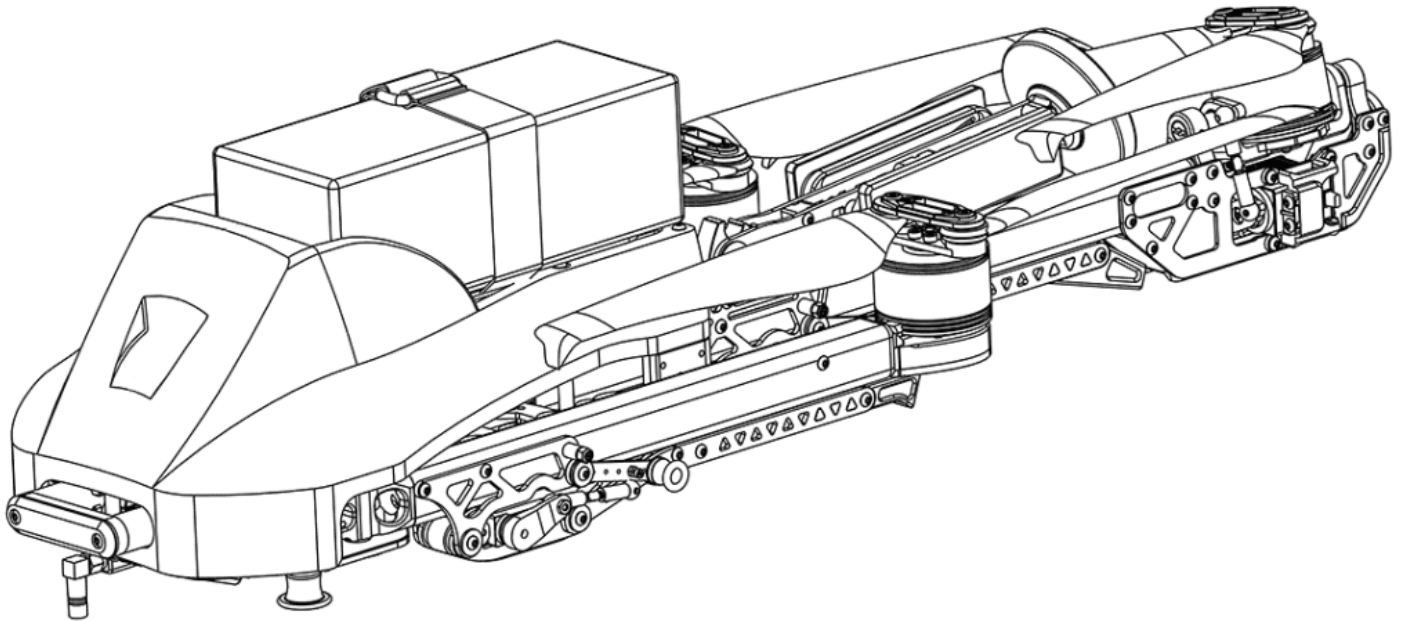
SwitchBlade-Elite 2.3 in folded, storage configuration

Side view of SwitchBlade-Elite 2.3 in folded, storage configuration.
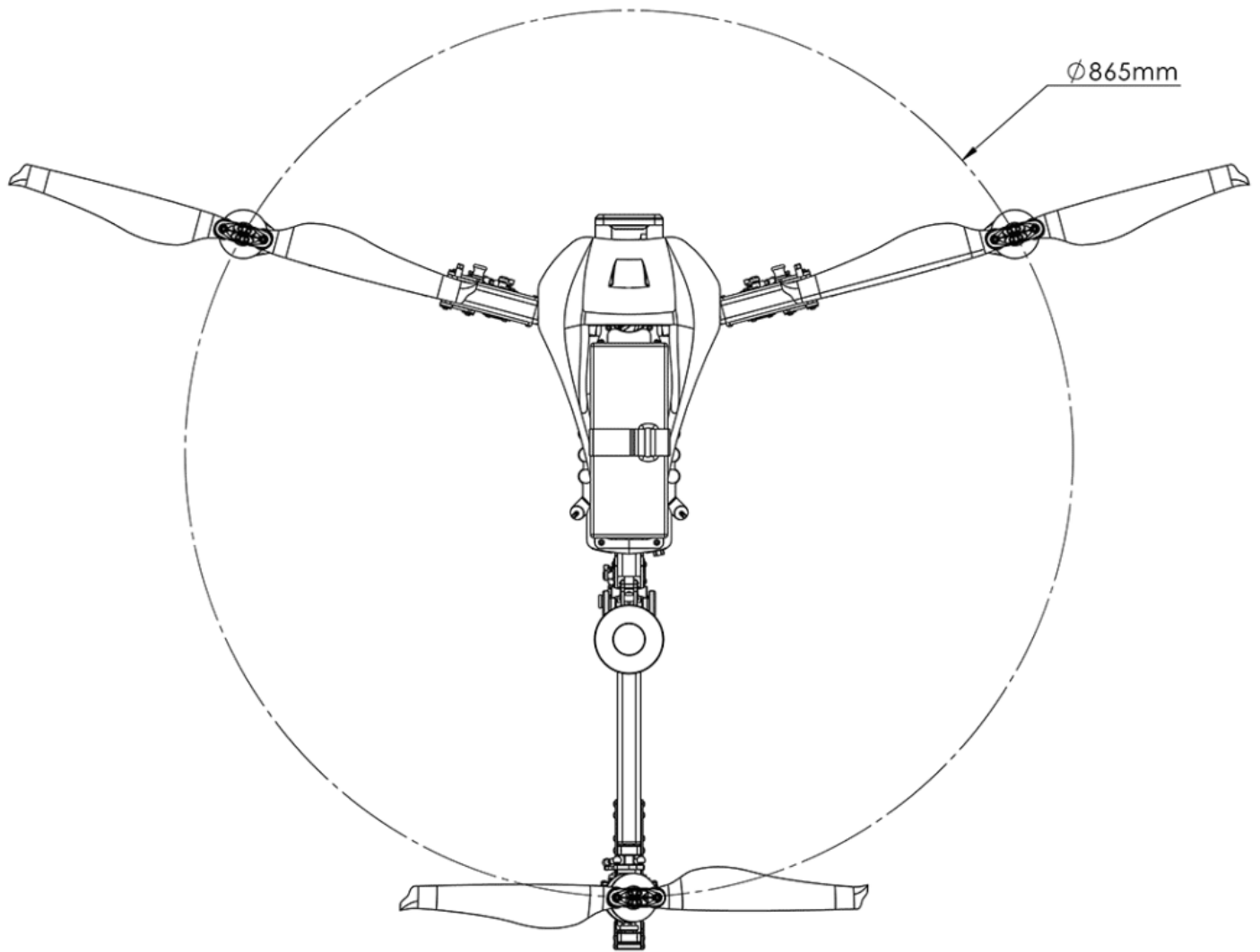

Bottom view of SwitchBlade-Elite 2.3 in folded, storage configuration.

Flight Configuration Dimensions
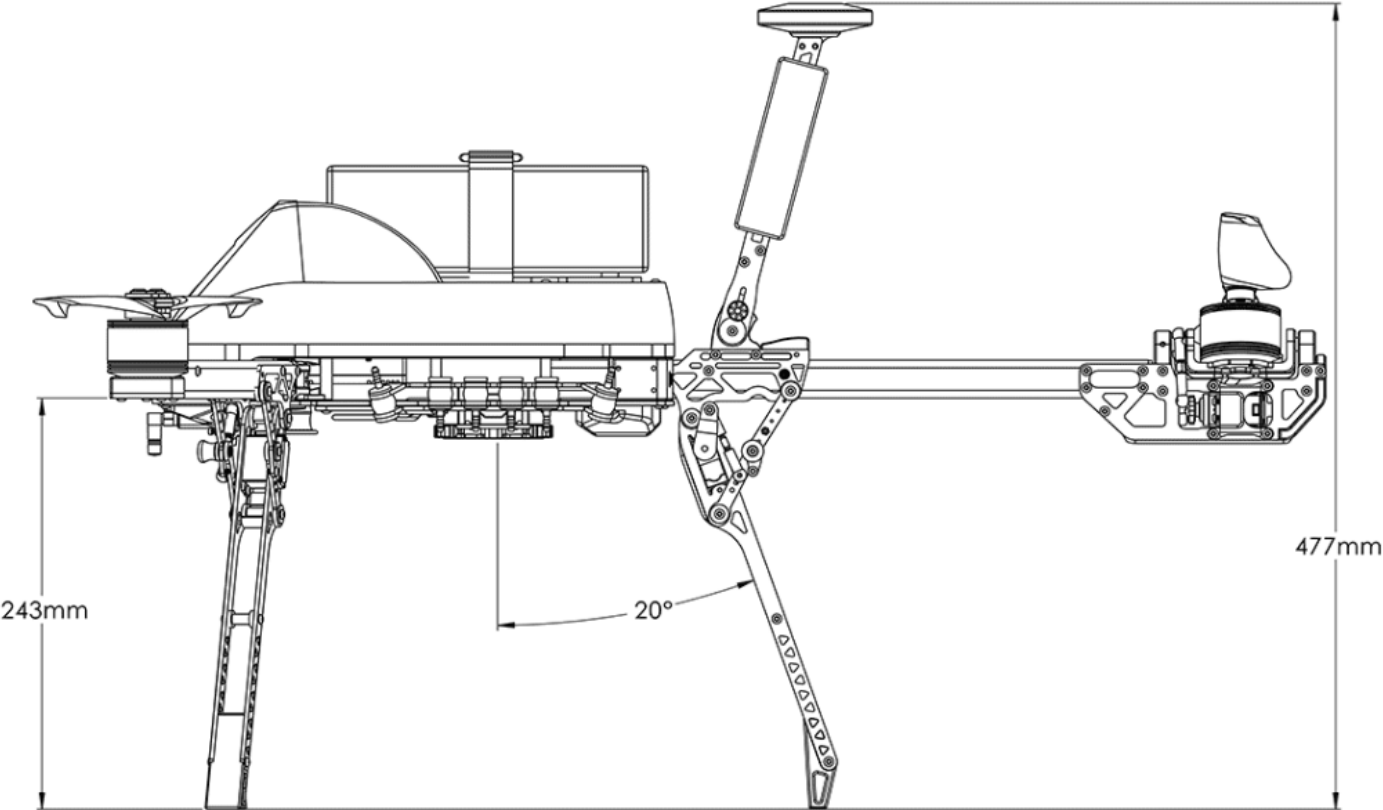
Side view of SwitchBlade-Elite 2.3 in take-off configuration with dimensions.

Ø865mm

Top view of SwitchBlade-Elite 2.3 in flight configuration.

Aircraft Specifications

Empennage: Carbon Fiber
Arms: Carbon Fiber
Frame & Hardware: Aluminum / Stainless Steel
Body: Polycarbonate
Motors: 340kv (910W)
Rotors: 462 mm x 150 mm (18.2″ x 5.9″) Carbon Fiber, folding, and precision balanced
Flight Controller: Blue Cube
Ground Control Station: CubePilot Herelink Controller
Software: Flight Deck
Flight Dimensions: 865 mm (34 in) Diameter
Storage Dimensions: 717 x 200 x 172 mm (28 x 7.9 x 6.8 in)
Case Dimensions: 120 x 42 x 23 cm (47 x 16 x 9 in)
Aircraft Weight (without battery): 3.35 kg (7.4 lbs)
Aircraft Weight (with battery): 5.3 kg (11.7 lbs)
Max. Takeoff Weight: 7.3 kg (15.4 lbs)
Ground Clearance (Powered landing gear, to bottom of PCS): 220 mm (8.6 in)
Ground Clearance (Powered landing gear, to bottom of RID antenna): 210 mm (8.27 in)

Battery / Charger

Flight Battery Included: 22,000 mAh 6S Solid State Lithium Ion
Battery Charger: High capacity AC dual battery charger

Flight Operations

Max. Flight Time*: 50 min
Flight Time* with 0.5 kg payload and 30% Battery Remaining at Touch Down (RTL): 30 min
Direct Control Range: 20 km (12.4 miles)
Autonomous Flight Range (dependent on environmental conditions): Over 25 km (16 miles)

Max Operational Wind Speed: Up to 40 kph (25 mph)
Max Operational Altitude: 3048 m (10,000 ft) MSL
Operational Temperature Range: -10º C to 50º C (14º F to 122º F)
GPS Accuracy non-RTK corrected: ±2.5 meters (± 8.2 feet), typically < ±1 meter
GPS Accuracy RTK corrected (Optional): ±0.1 meters (±0.33 feet)

Payloads

Max Payload: 2.0 kg (4.4 lbs)
Payload Mounting: Vision Aerial Payload Connection System M3 Flathead x 20 mm circular M2.5 Flathead x 25 mm square.
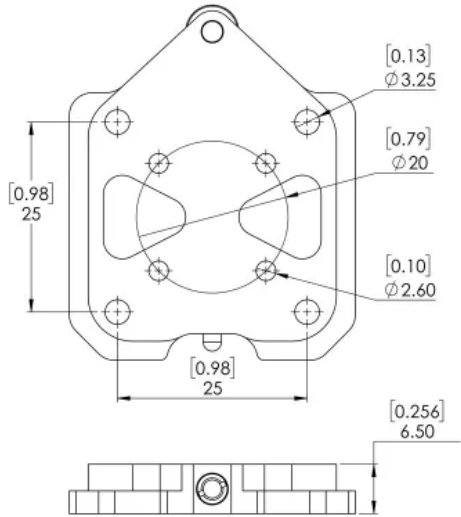
Screw pattern.

[Download screw pattern specifications.](#)

Electrical Connections:

- Primary payload connector: Up to 50 watts of 12V power and 15 watts of 5V power.
- XT-30 connector: Up to 500 watts of unregulated pack power.

Center of Mass: Adjustable Using Battery Positioning

See [Payload Connection System](#) for more information.

Legal

Disclaimer & Warning

Please read this disclaimer and warning carefully and review the Vision Aerial UAS product manual prior to flight.

By using a Vision Aerial UAS, you acknowledge that you have read, understand, and agree to this disclaimer. You agree that you are solely responsible for your conduct while using your Vision Aerial system, and for any direct or indirect consequences that may result from its use. You agree to only use the SwitchBlade-Elite or Vector for proper purposes that are in accordance with all local, state, and federal rules and regulations.

Vision Aerial UAS are not toys and should be operated with extreme care, as improper operation can cause damage to property, serious personal injury, or death.

As with any multi-rotor aircraft, the SwitchBlade-Elite and Vector are precise and technical machines. Novice pilots should invest sufficient time on a flight simulator and seek training from an experienced pilot before operation. The product manual and a flight simulator are no substitute for training with an experienced pilot, particularly when it comes to learning how to safely operate your Vision Aerial UAS. Novice pilots should never fly without the supervision of an experienced pilot.

✔ Always check the UAS and its components prior to operation.

✔ Always maintain a safe distance from the UAS when in use.

✔ Never attempt to touch the UAS when the rotors are moving.

✔ It is strongly recommended not to fly the UAS over or around people, near power lines, or any other difficult-to-see obstacles.

✔ Never fly the UAS near manned aircraft of any kind.

✔ Never fly with any rotors that have visible imperfections or damage.

✔ Always keep children and animals a safe distance away from the UAS when in use.

✔ Only use rotors supplied by Vision Aerial that are designed for use on your Vision Aerial UAS.

✔ Always remove the rotors when making a hardware change to prevent rotor strikes in the event of unintentional motor starts.

Safety

It is your responsibility to learn how to safely operate your Vision Aerial UAS and to adhere to all applicable rules and regulations.

Fly at your own risk.

Vision Aerial systems are tuned with custom components selected for each application. Modification to, removal, or substitution of components will void the warranty and can lead to unsafe operating conditions.

Warranty

Please read and become familiar with [our limited warranty](#).
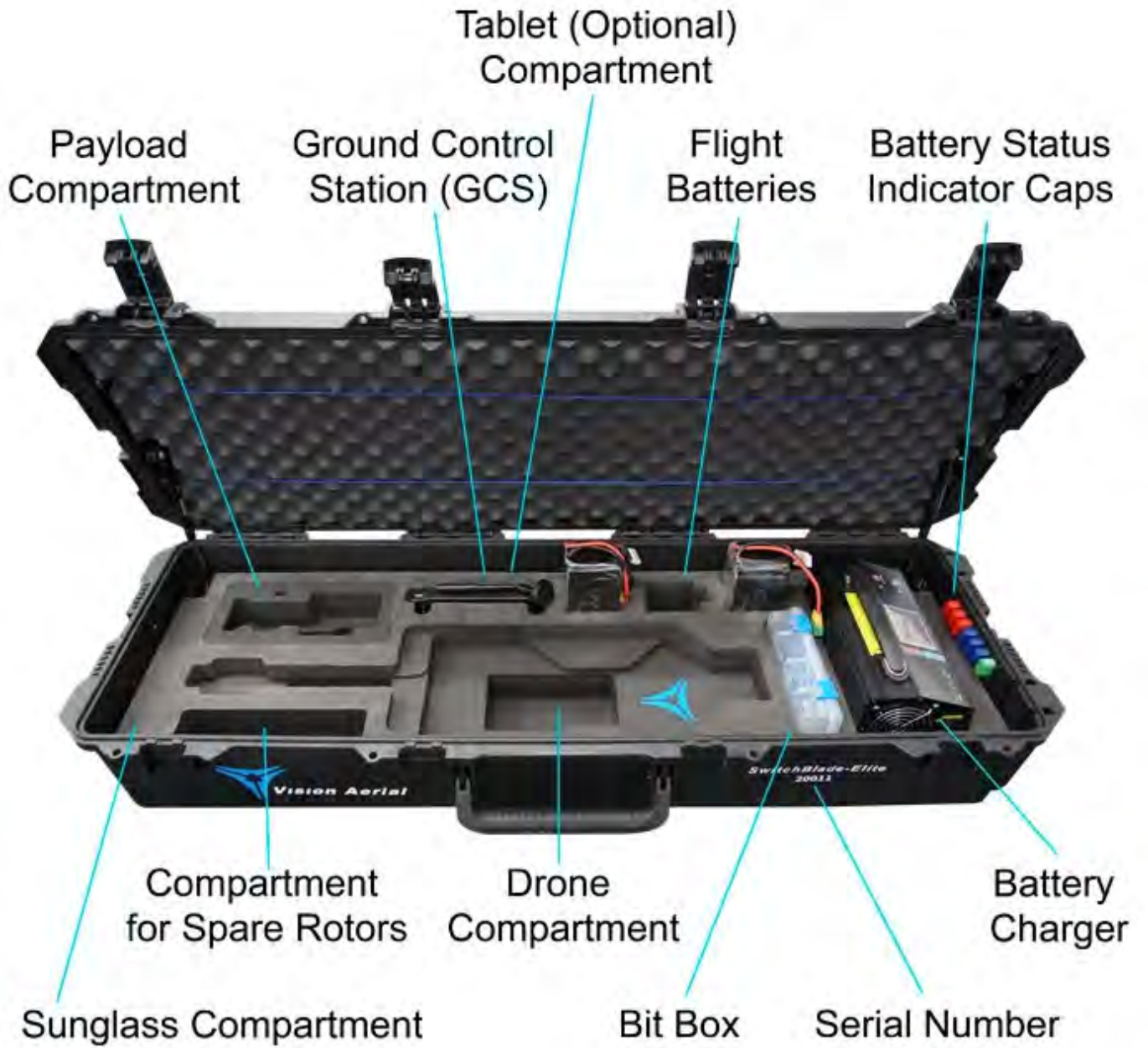
Getting Started

What's Included

The SwitchBlade-Elite package includes:

1. (1) [SwitchBlade-Elite Tricopter](#)
2. (1) [Ground Control Station](#) & Charger
3. (1) Flight Battery
4. (1) [Battery Charger](#)
5. (6) Color-Coded [Battery Status Indicator Caps](#)
6. (1) Hard Transport Case
7. (1) "Bit Box" Hardware and Tool Kit

Unboxing

1. Unlock and lift the six latches on the case.

2. Open the case.

Case components

Charge Flight Batteries

⚠️ **WARNING: Only use the batteries that come with your system or are spec for spec equivalent. Using conventional Lithium Polymer (LiPo) batteries that came with previous systems or batteries from a 3rd party can cause inaccurate voltage readings leading to potential loss of thrust in flight. Your vehicle can crash!**

The kit includes a battery charger. Remove the battery or batteries from the case, attach the charger to a power source, and attach the battery cell balance connector to the battery charger.

- It is recommended to always use the "balance" charge cycle.
- It is recommended to not charge the pack at a greater rate than its capacity rating.

See [Battery Section for full instructions](#).

See [Battery Safety](#) for more information.

Battery Status Indicator Caps

Vision Aerial drones come with Battery Status Indicator Caps. These are located on the inside of the case.
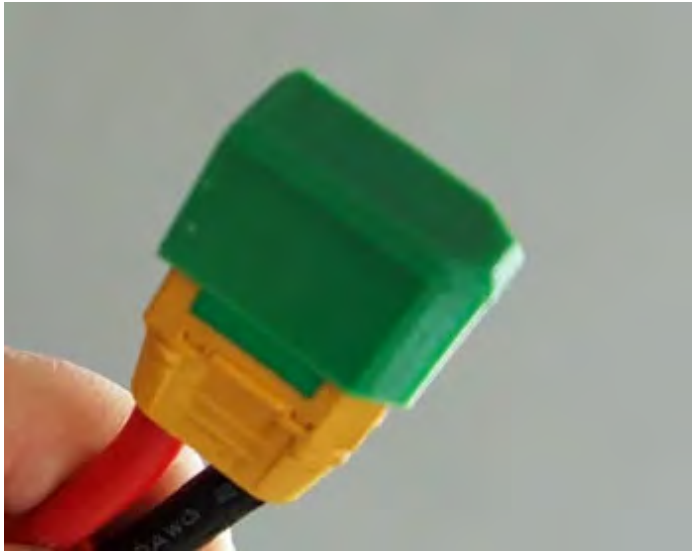
Red = Any Amount Depleted

Green = Fully Charged

Blue = Storage Charge
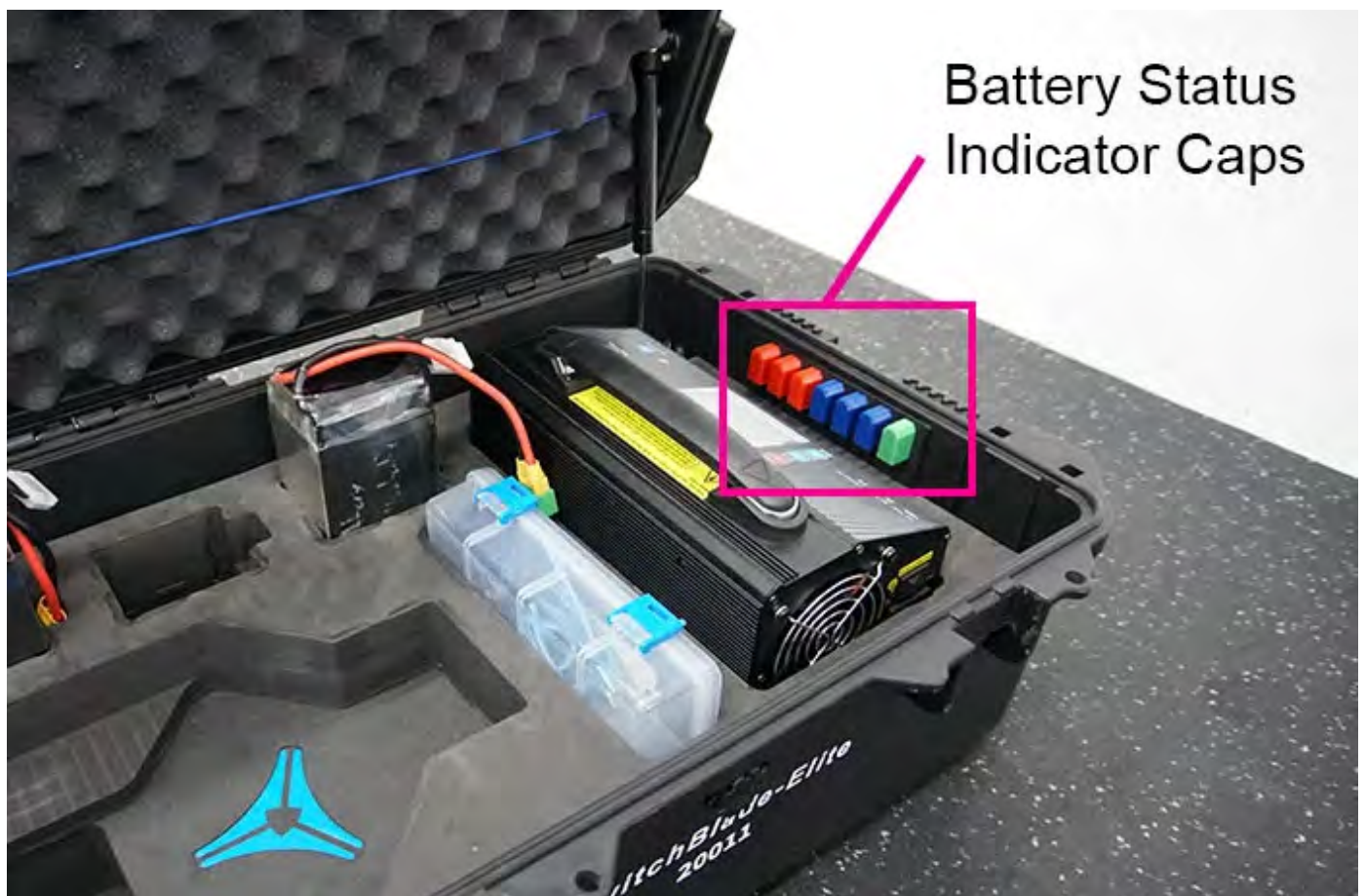
These caps are placed on the battery XT90 connector to indicate the charge level of the battery.

Ground Control Station

The Vision Aerial systems come standard with a Herelink ground control station (GCS). Some come with an optional, TAA (Made in America) compliant, Blue Herelink. Both ground control stations function in the same manner.

Herelink GCS

Blue Herelink GCS (TAA compliant)

⚠️ **WARNING: Do not intentionally turn the controller off during flight. Any loss of communication or GCS power will initiate an immediate lost link failsafe.**

Overview

Safety

Keep the controller away from liquids, fire, microwaves, and other hazardous or combustible materials. Don't expose the controller to extreme temperatures. If the controller is hot to the touch, wait for it to cool before using or charging. Perform periodic visual inspections of the controller battery to check for any damage and handle the controller battery using the same safety precautions as the flight battery.

Ground Control Station Antenna Configuration

For the strongest connection to your Vision Aerial drone, position the Omni-Directional antenna so its vertical axis is in alignment with the center of the earth, or perpendicular to the ground. Position the Directional antenna so it points at the aircraft.
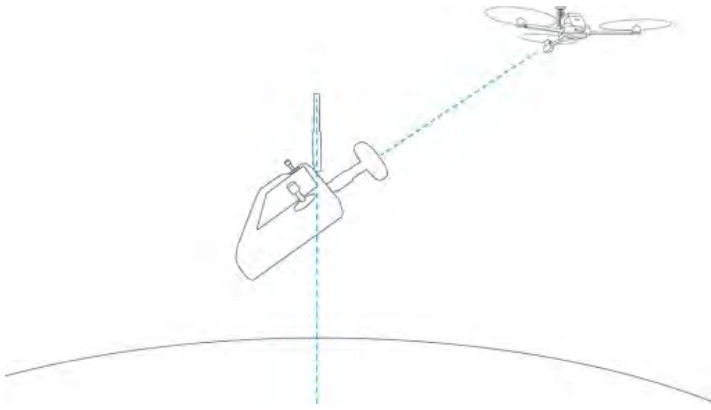
Charging the Ground Control Station

To charge the controller, plug the included Micro USB cable into a power source and the other end into the Micro USB port on the bottom of the controller.

Mission Planning

Review the section on Flight Deck to learn more about mission planning and the flight control software.

Controller Features

The controller features and control inputs are shown below.

Left Joystick Controls altitude and yaw.

Right Joystick Controls pitch and roll.

Upper Left Wheel Controls camera Pan and Tilt.

Upper Right Button Toggle between Manual and Brake Mode.

Button A Toggle between camera Pan and Tilt operation.

Button B Programmable C1 functions. (See "button programming" to come.)

Power Button Controller Power button. Press and hold for 5 seconds to turn on or off. Tap to put it into power save (sleep) mode.

Home Button Initiates [Return To Launch (RTL)](#).

Button C Programmable C1 functions.

Button D Programmable C1 functions.
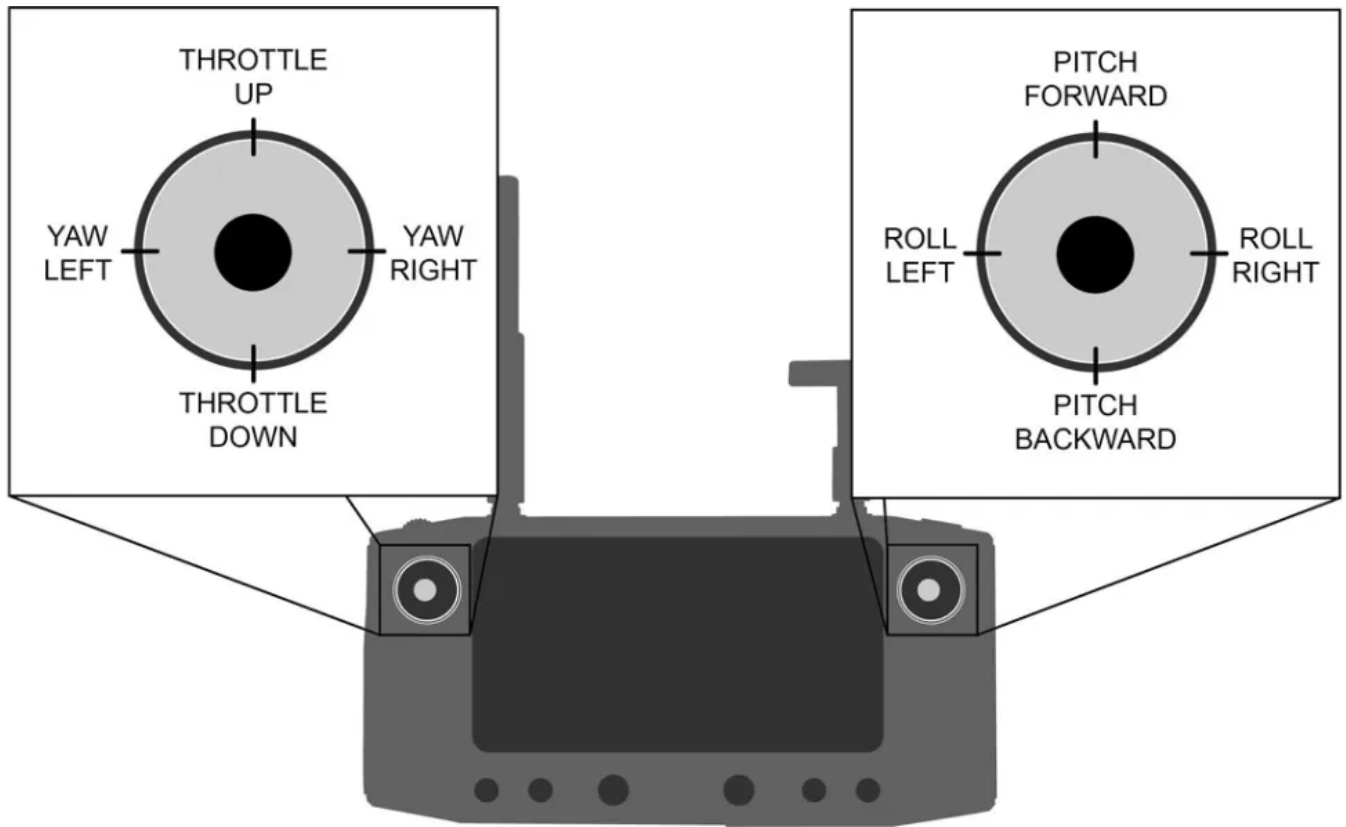
The left stick controls the altitude (throttle) and rotation (yaw) of the SwitchBlade-Elite.

Use the right stick to fly forward, back, left, and right. These movements are relative to the tail-in orientation, so always maintain awareness of the drone's forward-facing direction before inputting control.

See Flight Controls for more information.

Camera Pan and Tilt Functions

Tapping on the A Button toggles between camera Pan and Tilt operation. The scroll wheel will either Pan the camera right or left when Pan is selected and Tilt up and down when Tilt is selected. Pan or Tilt will remain active on the scroll wheel, will remain in effect until the A button is tapped again.

⚠ **Note: There is no operator feedback as to when Pan or Tilt are selected, therefore the operator will need to move the scroll wheel and observe the camera effect to determine which is active. If the camera Tilts when the scroll wheel is moved off center, and Pan is the desired operation, a short press on the "A" Button will toggle the scroll wheel operation to Pan and vice versa.**

Resetting Pan and Tilt to Default Positions

A long press on the "A" Button will reset the camera a default 0° pan angle (pointing directly forward) and 0° horizontal tilt.

⚠ **Caution: Before moving the UAS from the current position, it is recommended to reset the camera to its default position by performing a long press on the "A" Button. There is potential for pilot disorientation when the camera direction is not in alignment with the UAS.**

Flight Controls

Vision Aerial systems use standard Mode 2 controls (user adjustable).

⚠ **CAUTION: This document is for reference only and should not be considered a substitute for flight training.**

⚠ **CAUTION: Vision Aerial UAS are precision machines designed to be controlled with very disciplined and smooth inputs. During the familiarization with the aircraft, small subtle inputs result in a smooth flight.**

⚠ **NOTE: All controls are given from the perspective of a "tail-in" orientation with respect to the pilot.**
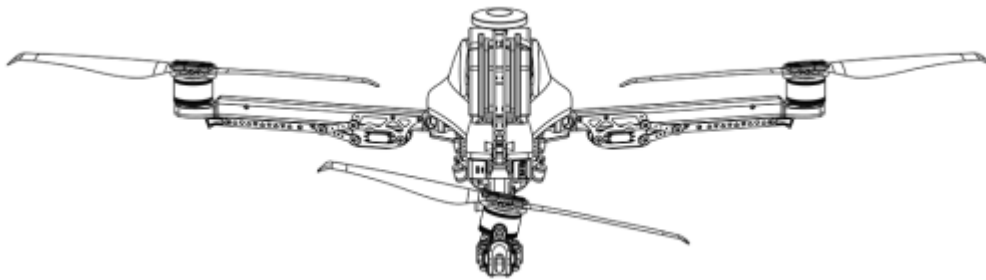
Tail-In Orientation

Left Stick (Throttle)

Move the left stick vertically to control the UAS's altitude and vertical acceleration.

To take off and gain altitude, move the throttle above the center position.

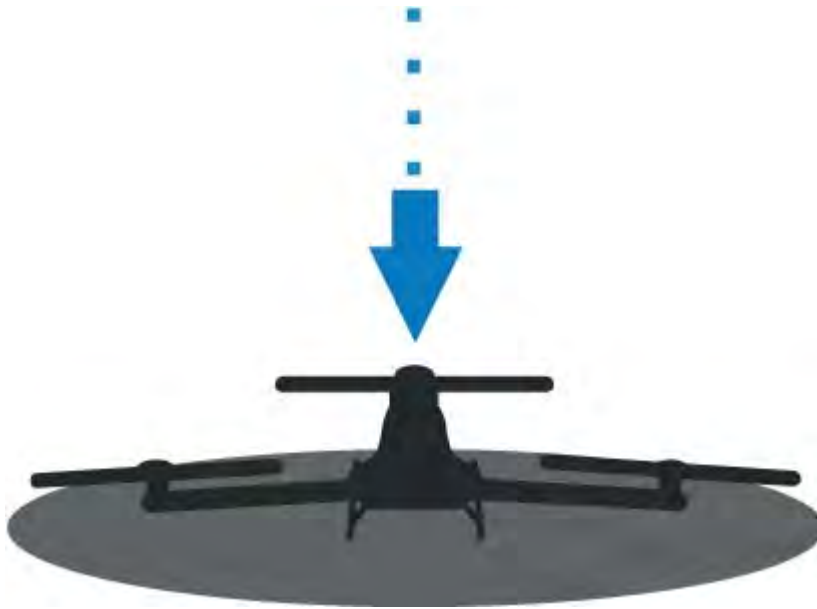Set the throttle to center to maintain current altitude.
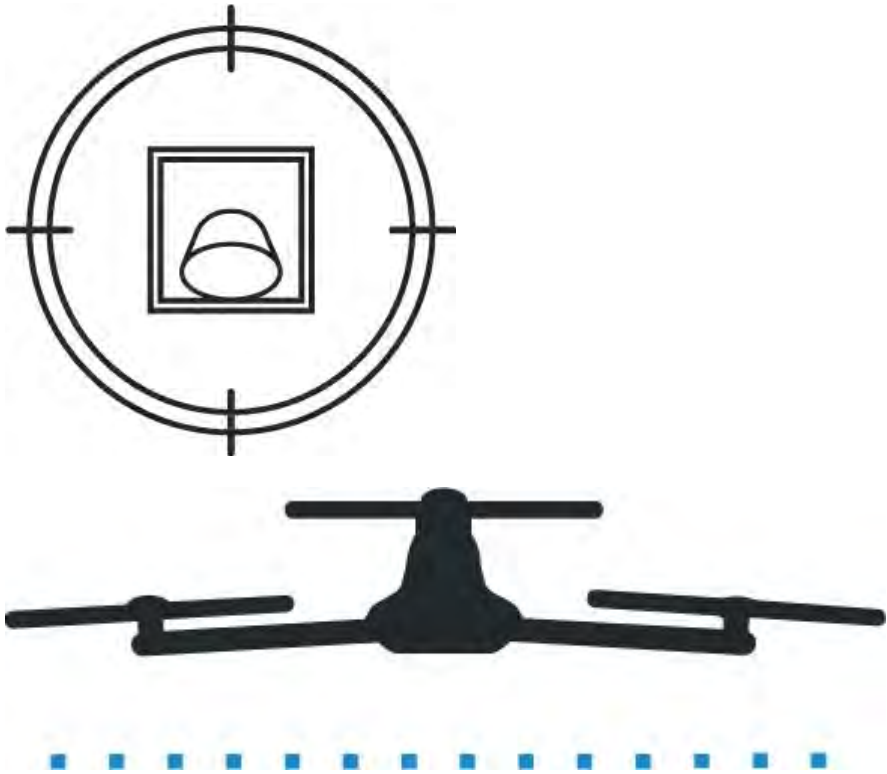
Move the throttle below center to decrease altitude.

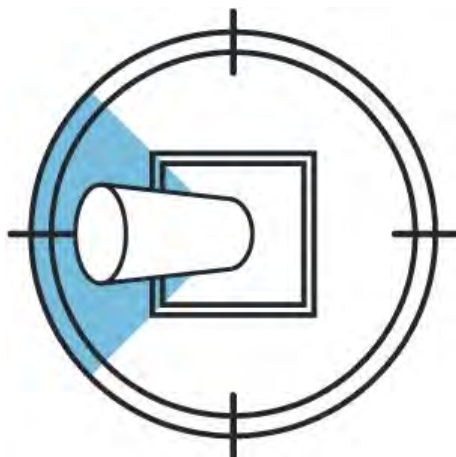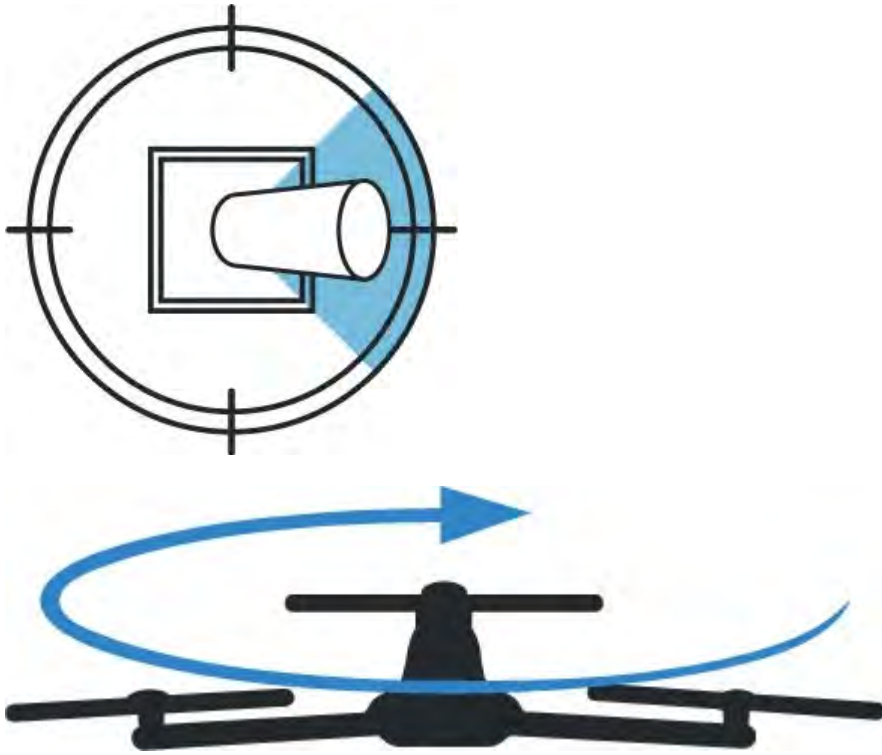Set the throttle to full down once the vehicle has made contact with the ground.

Left Stick (Yaw)

Move the left stick horizontally to rotate or "yaw" the UAS and control orientation.
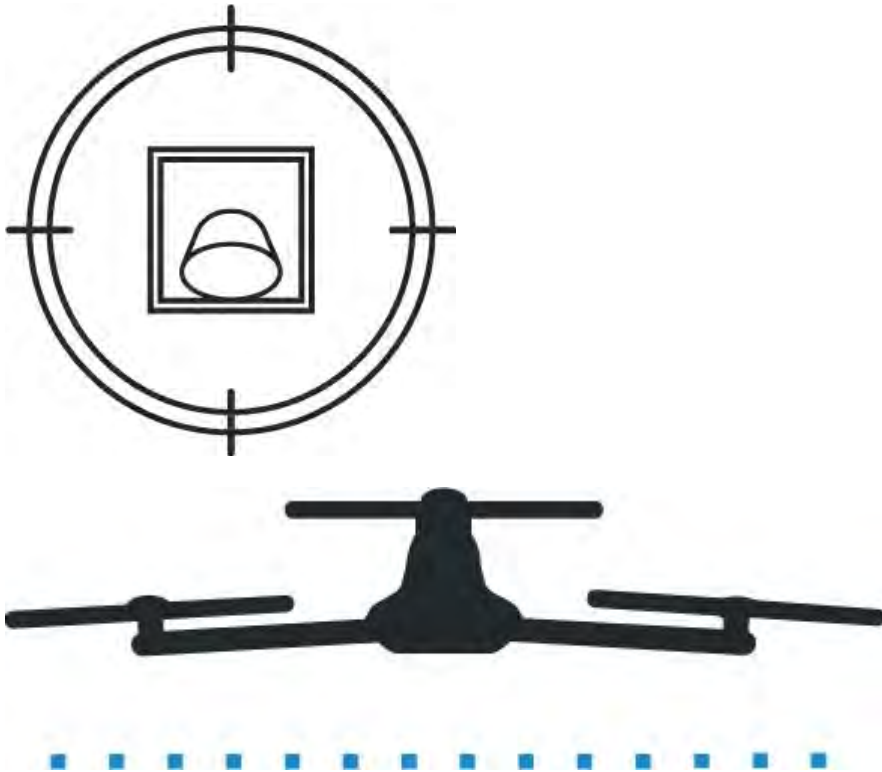
Move the stick to the left to rotate counter clockwise. (As viewed from above.)

Move the stick to the right to rotate clockwise. (As viewed from above.)
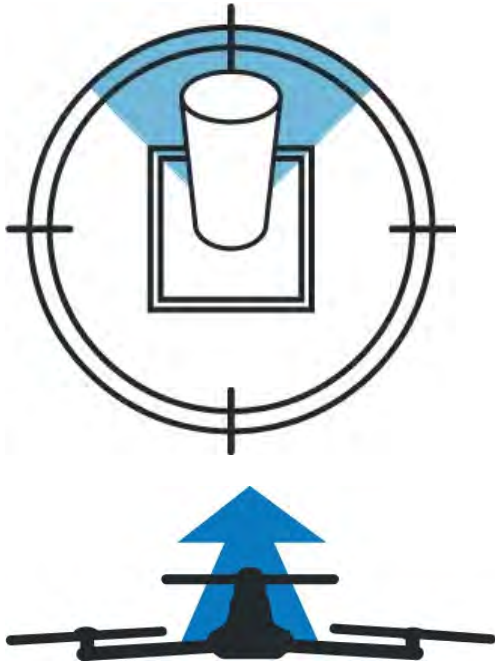
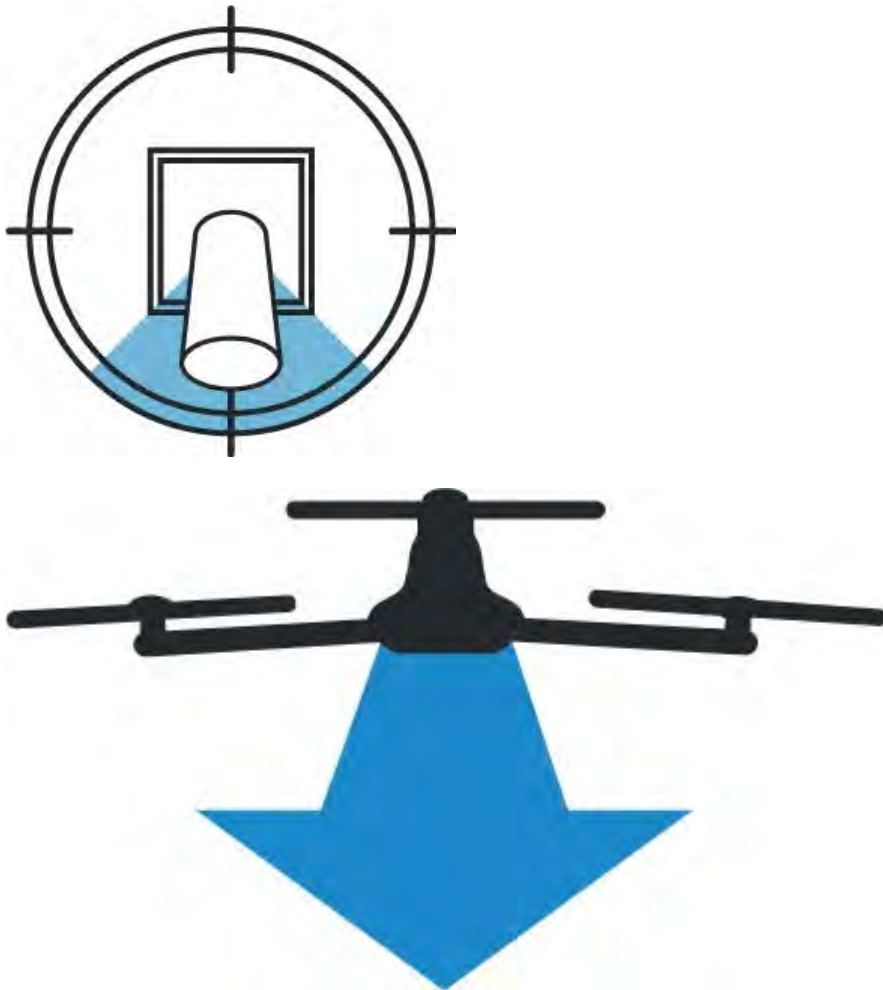Release the stick to stop rotating and maintain the current orientation.

Right Stick (Pitch)

Move the right stick vertically to control pitch.

Move the right stick up to fly forward.
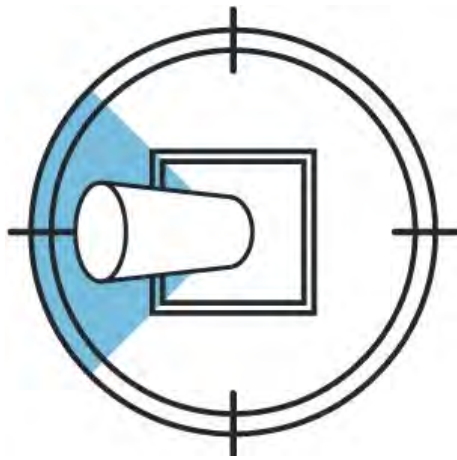
Move the right stick down to fly backward.

Right Stick (Roll)

Move the right stick horizontally to control roll.

Move the stick left to fly left.

Move the stick right to fly right.

Setting Up the SwitchBlade-Elite

Removing the Drone from the Case

1. Firmly grab the UAS by the battery plate and pull out of the case

⚠️ **Note: Do not grab the UAS by just the plastic body as it could cause damage**.

Extending the Arms

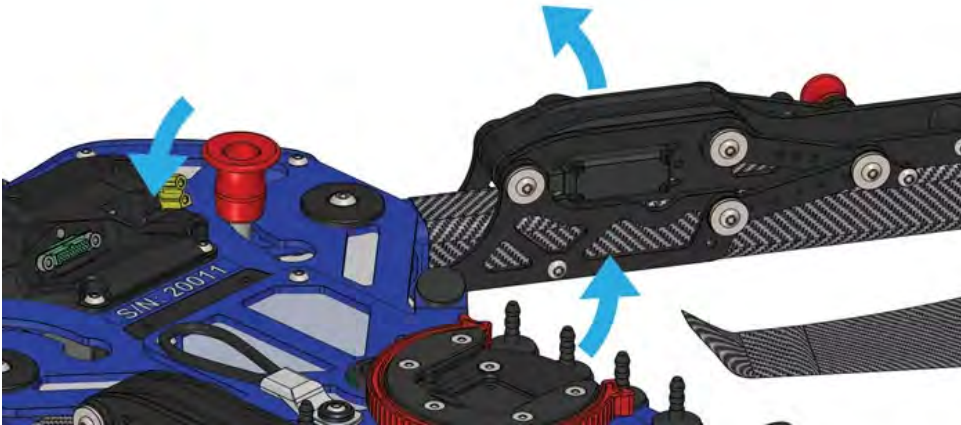The SwitchBlade-Elite features two arms that fold in and lock for compact travel, protection, and safety. The arms are secured with red, spring-loaded pull knobs underneath the chassis.
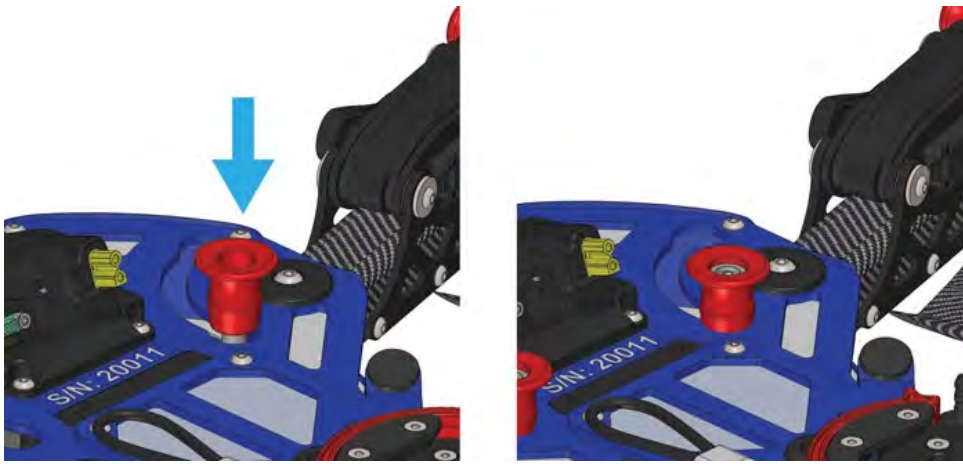
1. Remove the SwitchBlade-Elite from its case.

2. Select one arm and pull out on the corresponding red knob.
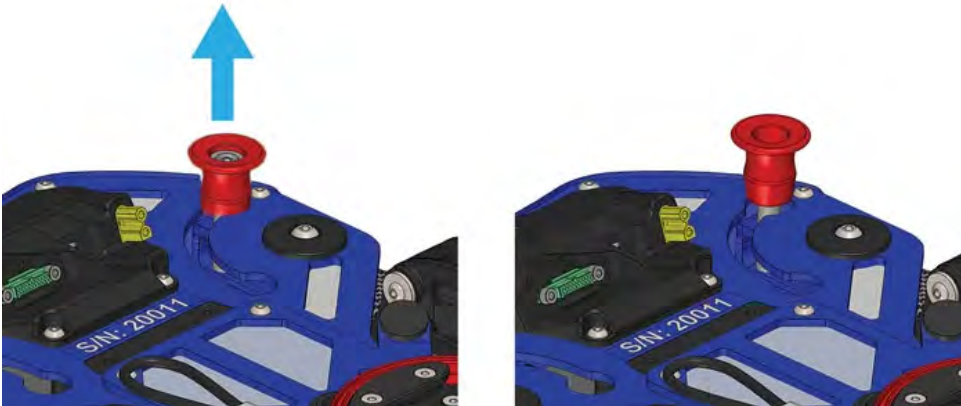
3. Rotate the arm away from the tail.

4. Once reaching the stop, release the knob to allow locking.

5. Gently move the arm back and forth to verify the knob is engaged and seated thoroughly.
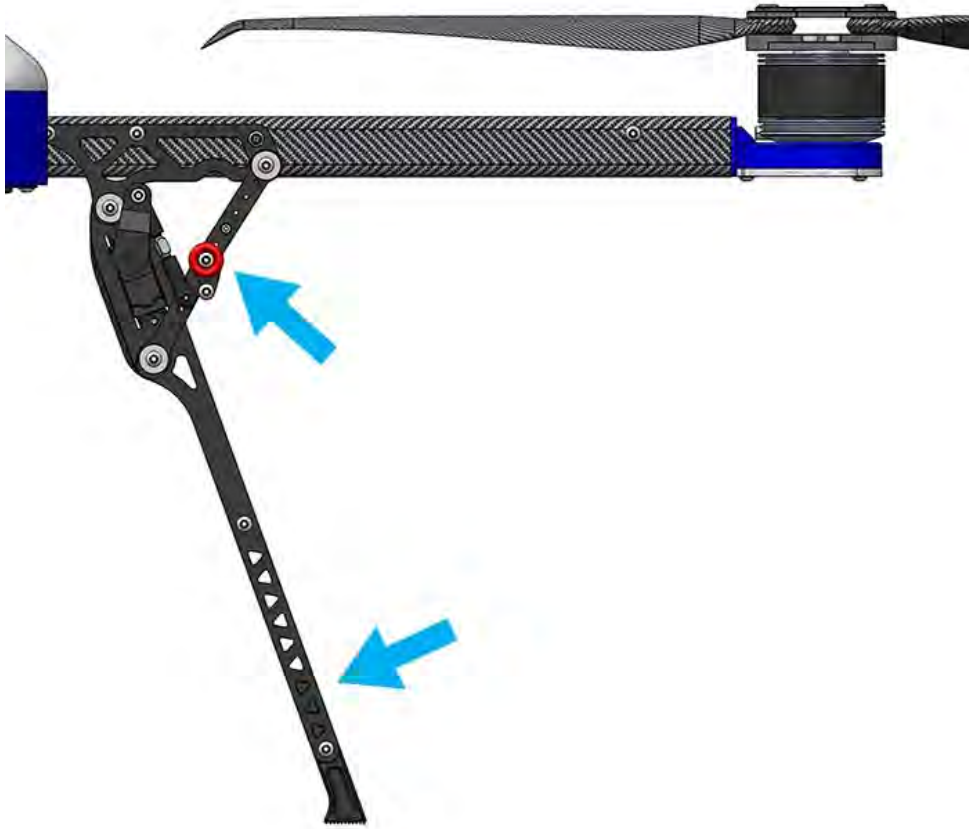
6. Repeat the process with the other arm.

Lower the Landing Gear

1. Securely hold the vehicle. Gently pull the red knob located on the landing gear retract toward the center of the vehicle.

2. Push the red knob in until the landing gear is fully extended.

Raise and Secure GPS Mast

1. Slide the pins back to unlock them from the stowed position.
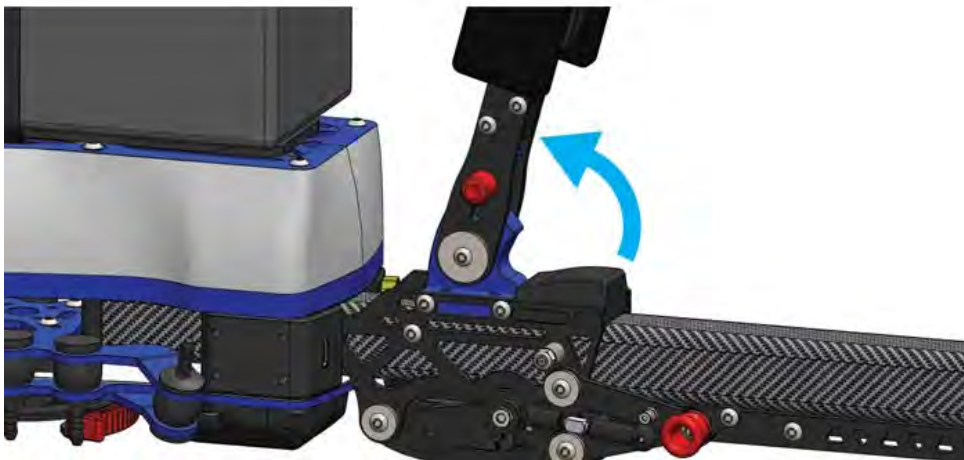
2. Once the pins are released, gently lift the mast to raise it into an upright position. The pins will lock into place once the mast is properly seated.

Extend Rotors

1. Unfold each rotor so the blades point in opposite directions along the long dimension of the blade mount for all three rotors.

2. Remove protective blade sleeves.
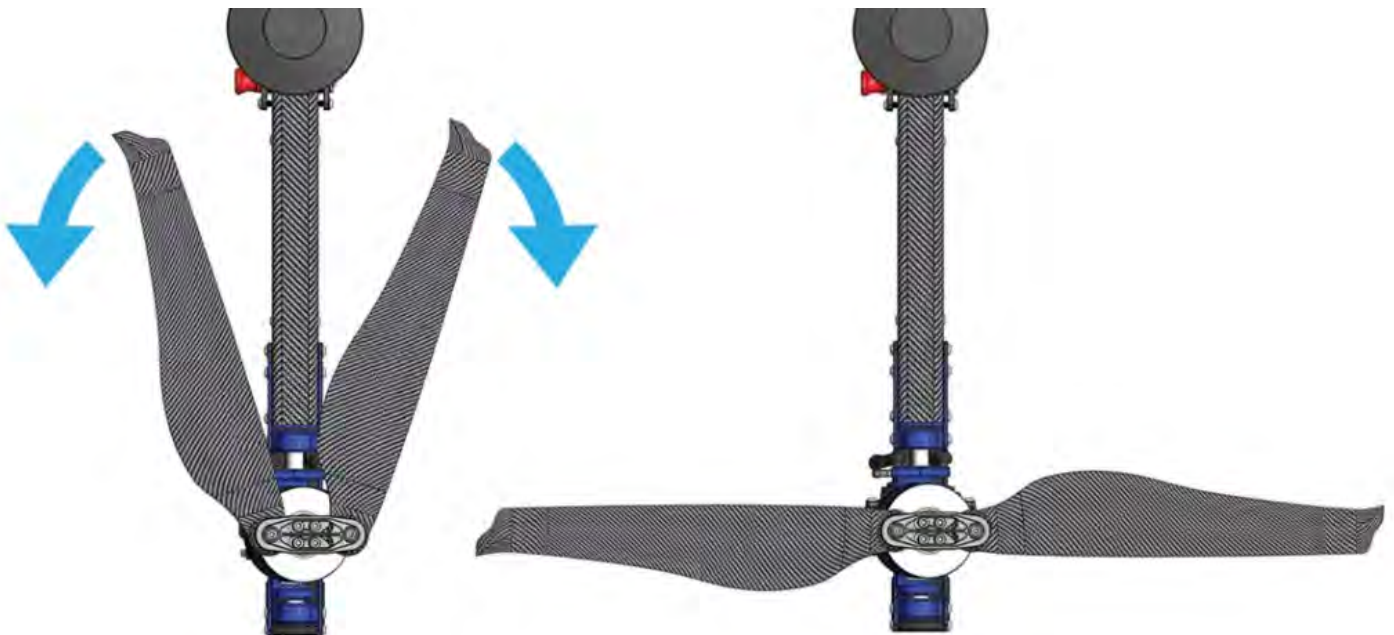
Set Up Additional Equipment

1. Set up accessories (if applicable).
[Instructions for accessories and payload-specific information is available here](#).

Payload Connection System (PCS)

Attach Payloads

If flying with a payload, attach it to the airframe with the Payload Connection System.

⚠️ **Note: Depending on the mass of the payload, the user may need to adjust the number of damper balls used.**

⚠️ **Warning: The damper balls come with a high-frequency whisker. These are functional items and should not be cut off.**

Damper balls

1. Determine how many damper balls are needed for your payload.

Payload Mass	Example Payload	Number of Damper Balls
0–0.75 kg (0–1.7 lbs)	Nadir mounted Sony a6400 or RX1Rii	4
0.6–1.5 kg (1.3–3.3 lbs)	WIRIS Pro on Pixy-WP	8
1.25–2 kg (2.75–4.4 lbs)	Custom payload	12

⚠️ **Note: Always remove the center most damper balls first. For example, if you have a payload that weighs around 1 kg (2.2 lbs), the 4 damper balls in the middle should be removed (2 from the left side and 2 from the right side). If you have a light payload that weighs around 0.5 kg (1.1 lbs), the 8 damper balls in the middle should be removed and you'll just have the 4 outermost corners remain.**

Remove Center (4) Damper Balls First

Remove Center (8) Damper Balls For Lighter Payloads
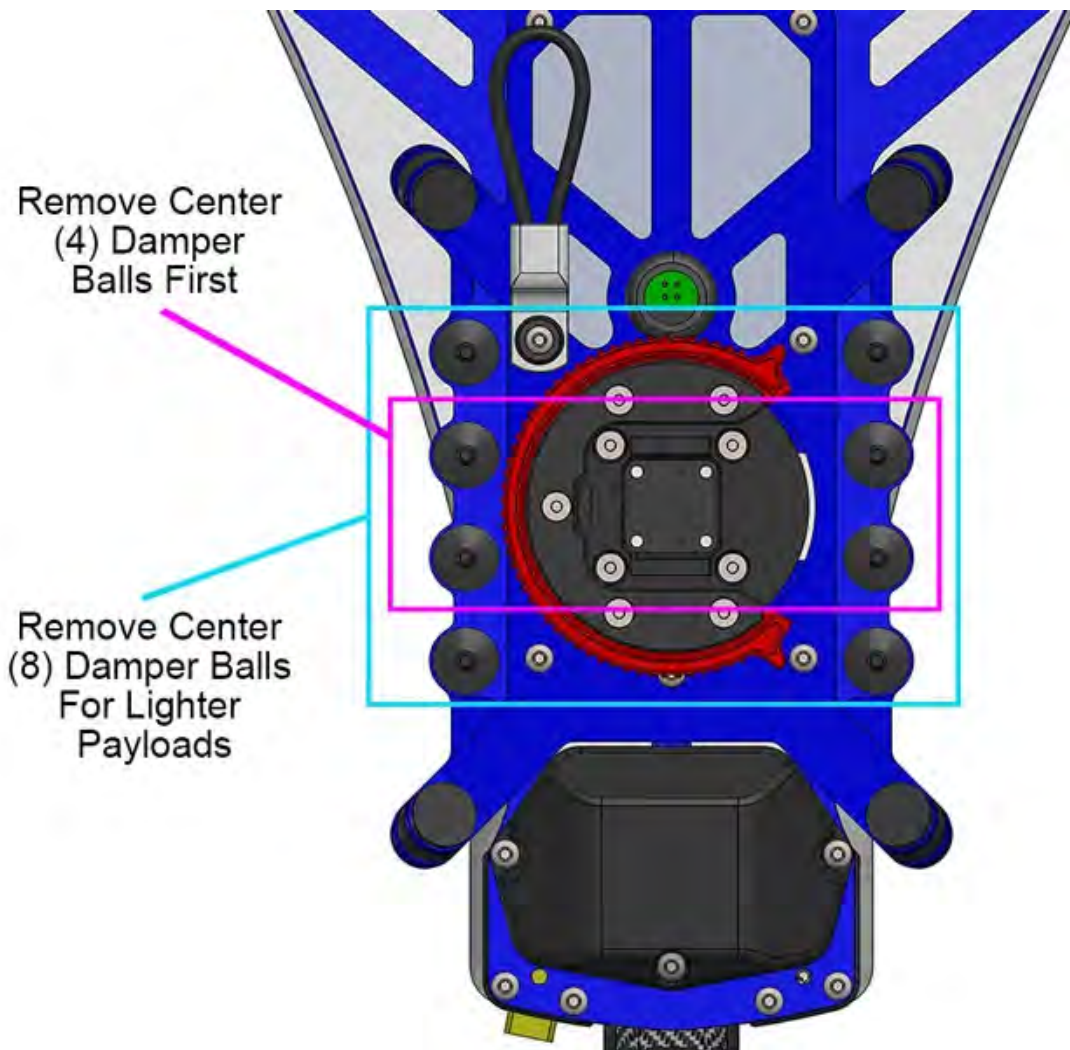
2. If you need to remove damper balls:

- First, gently pushing the top of the damper ball through the floating plate. Be careful not to apply too much force, or the damper balls can tear and will need to be replaced.
- Then, push the bottom of the damper ball through the lower main plate.
- Pull the damper ball out sideways, between both plates.
- Place them in the bit box for storage.
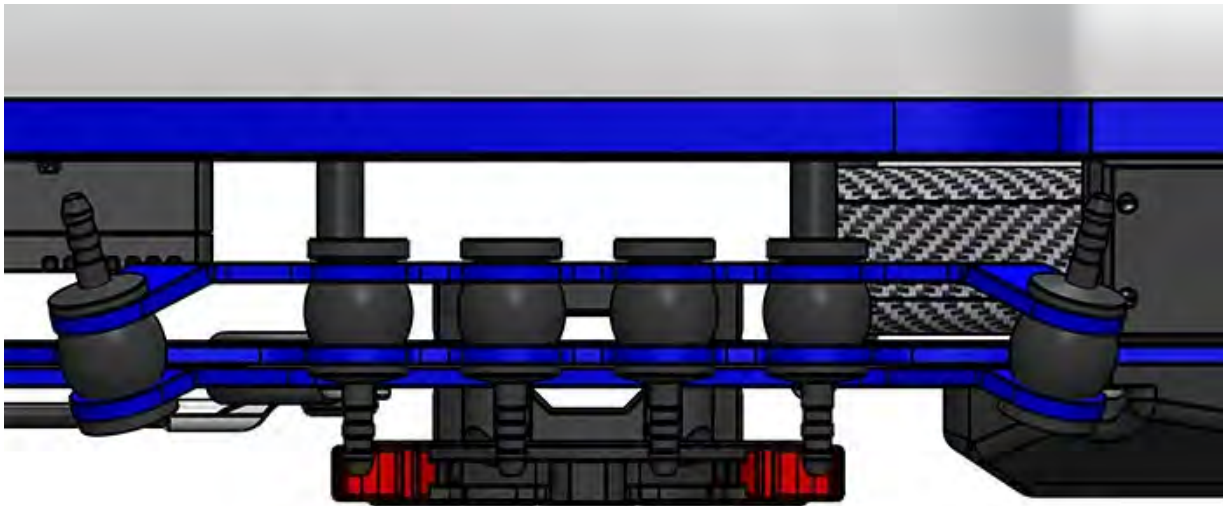
Proper seating of damper balls between upper and lower plates. Note the upward or download facing position.

3. If you need additional damper balls:

- Remove damper balls from the bit box.
- Start by adding the center-most damper balls first, and work outwards.
- Gently poke the damper ball into place. Be careful not to use anything that is too sharp because it can tear through the damper ball.
- Double check that all damper balls are securely seated in place on the top and bottom.

4. Once the correct number of damper balls have been set, slide the payload into place. The payload mounting bracket on the top of the payload slides into the opening of the payload connection system on the belly of the aircraft.
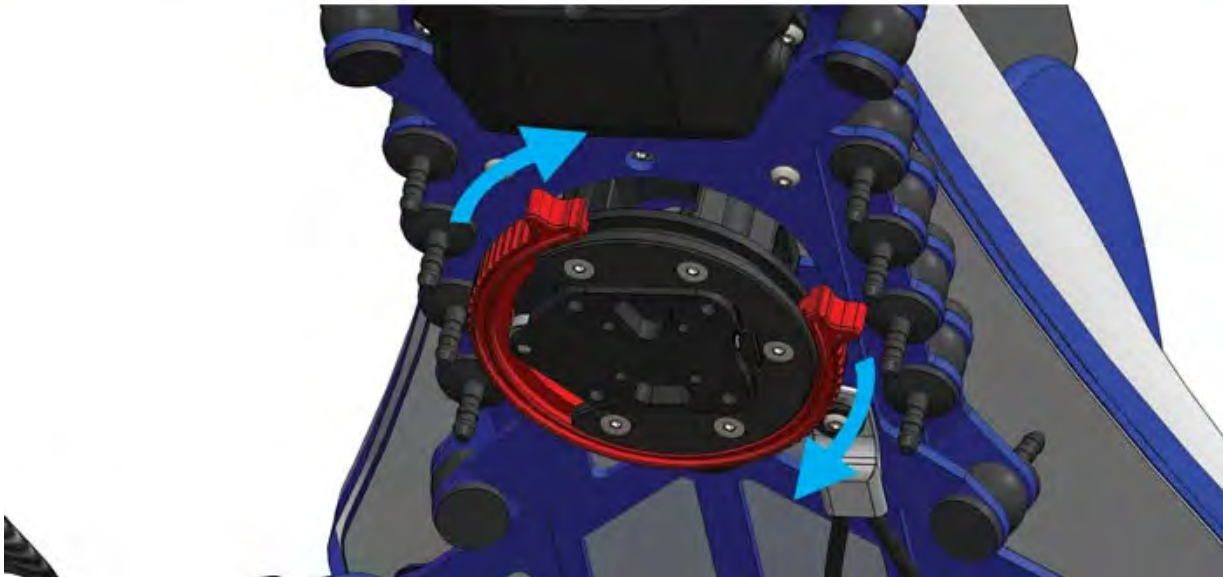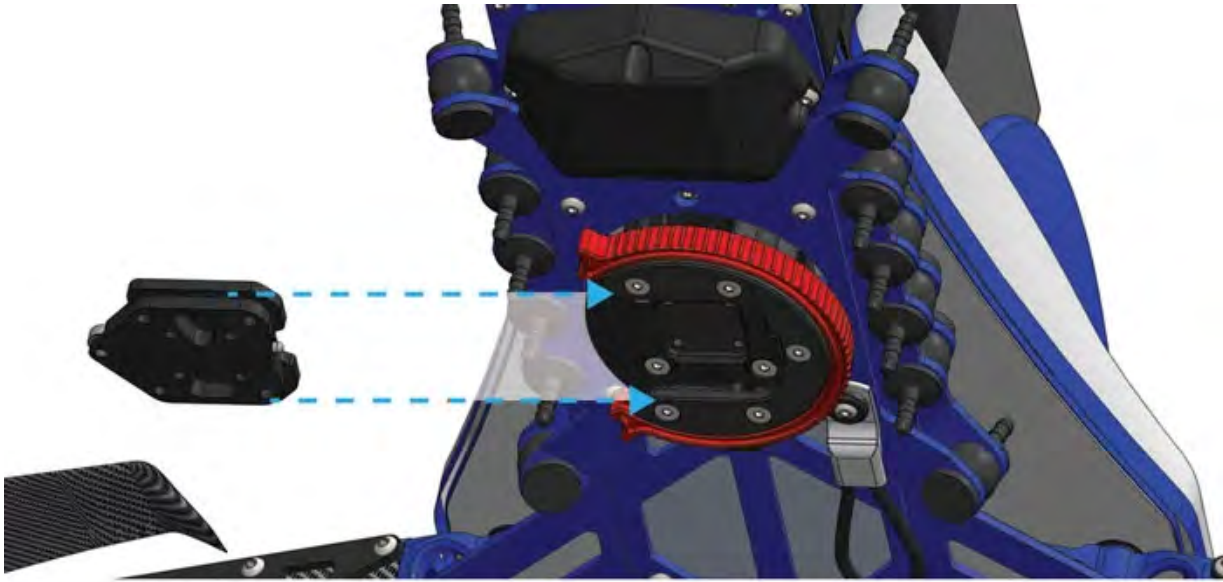
Payload is not shown in this illustration for clarity.

5. Once the payload is seated, rotate the red ring to secure it.

6. Run the wires for the payloads through the safety loop on the bottom of the aircraft.
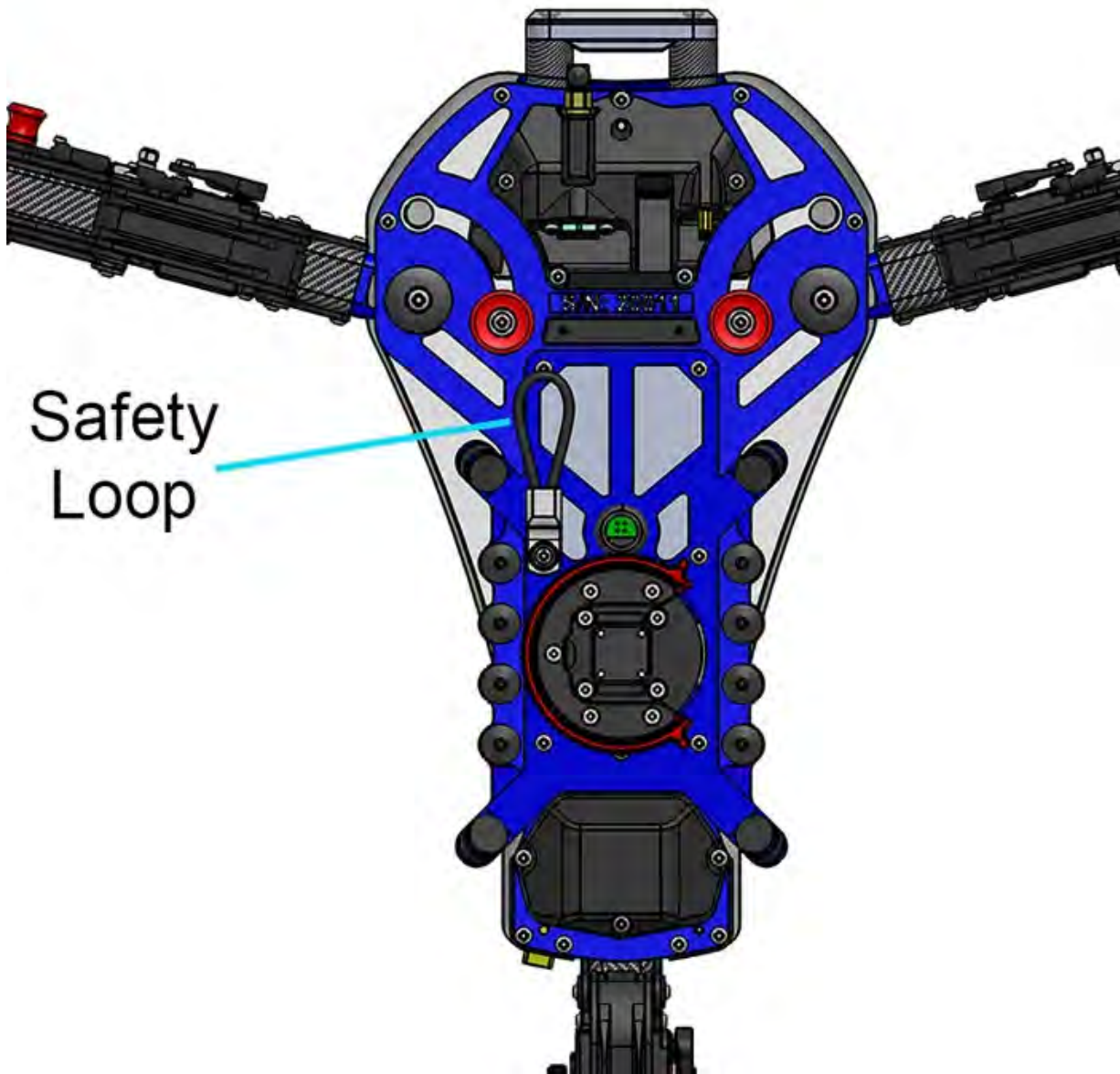
Safety Loop

7. Plug in the payload. Any Vision Aerial payload will come with one or more of the appropriate connector(s) listed below.

XT-30 Connector · HDMI Connector · Primary Connector
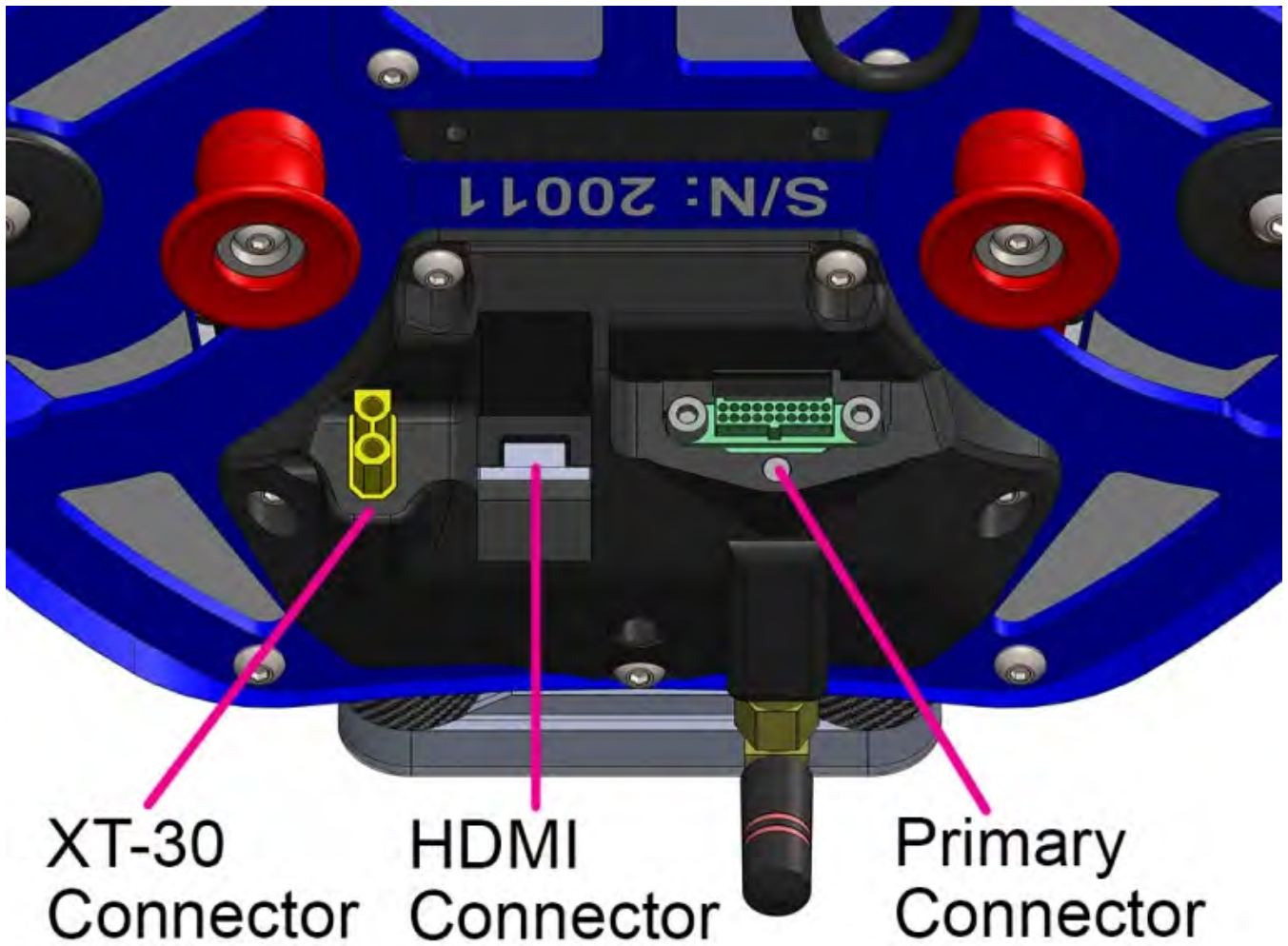
- For low power and data, connect the **primary payload connector**.
    - 1. Ensure the cable is in the correct orientation with the screw on the bottom.
    - 2. Move the cable to the connection on the bottom of the drone until the two ends are secured.

    - ⚠️ **NOTE: The magnet is intended to retain the connection, but not make the connection. Be sure to press the two ends together firmly.**

- For video, connect the **HDMI connector** from your payload to the EPCS.

Images Coming Soon

For high power, connect the **XT-30 connector** from your payload to the EPCS.

⚠ **NOTE: The XT-30 connector is not needed for all payloads. Only high-powered payloads require this connection.**

Images Coming Soon

6. Turn on your payload (if applicable).
(See [Payload Section for payload-specific information](#).)

⚠ **NOTE: Payloads cannot be hot-swapped. Power shall be removed for payload changes. Failure to power off the drone during payload swaps can result in damage to the sensor.**

⚠ **NOTE: If applicable, ground test the payload and associated equipment.**

Operating Procedures

Fly safely by remaining in the line-of-sight (LOS), while staying aware of your flight environment.

See Flight Controls

See Mission Planning

⚠️ **WARNING: Don't fly your Vision Aerial UAS indoors. Always fly outside in clear, open areas at a safe distance from yourself, other people, power lines, obstacles, and buildings. As the pilot, you are responsible for navigating the UAS to avoid obstacles.**

⚠️ **CAUTION: Don't fly within 5 miles of an airport or any airspace restricted by your local, state, or national airspace authority without proper authorization. As the pilot, you are responsible for knowing and understanding the regulations that govern small unmanned aircraft like the Vision Aerial UASs in your jurisdiction (check resources like the B4Ufly app).**

⚠️ **CAUTION: Don't fly Vision Aerial UASs in extreme weather conditions such as rain, high winds, snow, or fog. Extreme weather conditions can permanently damage the Vision Aerial UAS or cause instability in flight.**

⚠️ **CAUTION: Determine safe flight boundaries at your location. Be aware of any risks, including bodies of water, structures, trees, power lines, etc, and designate a few areas where you can land the Vision Aerial UAS in case of an unsafe situation. Throughout your flight, be prepared to recover the UAS manually or use an emergency procedure if the UAS flies outside the safe flying area.**

Once a suitable environment is selected, prepare the UAS for flight.

Connect Battery and Power the UAS

Power on the Ground Control Station (GCS)

(See Ground Control Station)

1. To power up the GCS, press and hold the power button on the Herelink controller for 5 seconds.

The Herelink battery level can be checked in the upper right corner of the powered GCS in the Control Center.

⚠️ **WARNING: Ground controller power level should not be less than 25% for flight. An auxiliary power source may be used during operation to supplement the controller battery.**
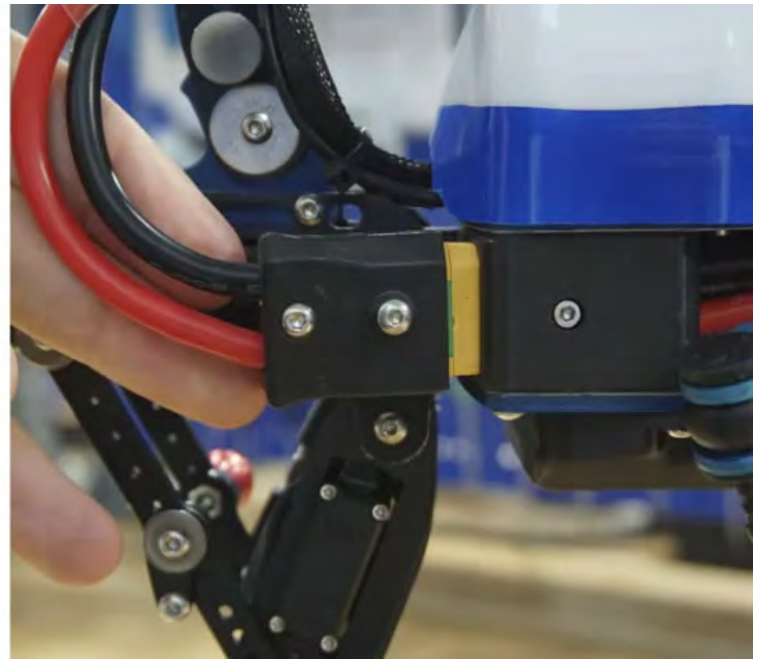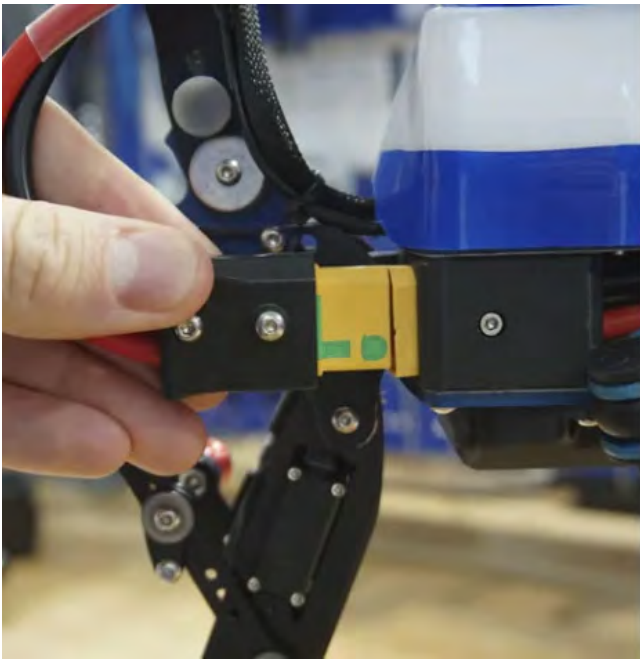
Power Up the Aircraft

1. Place the battery on the battery plate and securely attach with the Velcro strap. Apply tension to ensure battery is firmly attached.

Pull tight on the Velcro strap to ensure the battery is seated securely.

2. Power up the aircraft by plugging the battery connector in.

Ensure the battery connector is plugged in all the way.

3. Leave the aircraft motionless for 10 seconds to allow the gyroscopes to calibrate. (Indicator light will flash red/blue during calibration.)

LED Indicators

When the vehicle is powered the GPS antenna will display various LED light colors:

Flashing red and blue: Initializing gyroscopes. Hold the vehicle still and level while it initializes the sensors.

Flashing blue: Disarmed, no GPS lock found.

Solid blue: Armed with no GPS lock.

Flashing green: Disarmed (ready to arm), GPS lock acquired.

Fast flashing green: Same as above but GPS is using SBAS.

Solid green, with single long tone at the time of arming: Armed, GPS lock acquired. Ready to fly.

Double flashing yellow: Failing pre-arm checks (system refuses to arm). Please check the pre-arm error message.

Single flashing yellow: Radio failsafe activated.

Flashing yellow, with quick beeping tone: Battery failsafe activated.

Flashing yellow and blue, with high-high-high-low tone sequence (dah-dah-dah-doh): GPS glitch or GPS failsafe activated.

Flashing red and yellow, with rising tone: EKF or Inertial Nav failure

Flashing purple and yellow: Barometer glitched

Solid red: Error. Usually due to cannot detect SD card (please try to re-plug or replace SD card), MTD device, or IMU sensors. Analysis can be found in BOOT.txt in SD card.

Solid red with SOS tone sequence: SD Card missing (or other SD error like bad format etc.)

Not lighting up: No firmware detected or firmware corrupted.

⚠️ **NOTE: Vehicle will not arm unless GPS status is a pulsing or fast flashing green LED.**

⚠️ **NOTE: With Remote ID equipment, both the drone and operator need a clear view of the sky to acquire a GPS lock prior to allowing aircraft to arm.**

Verify Remote ID is Functioning

See Flight Deck for initial setup instructions.

1. Look at the Herelink screen to confirm Remote ID is operational. You should see a green exclamation mark in the bottom right corner.
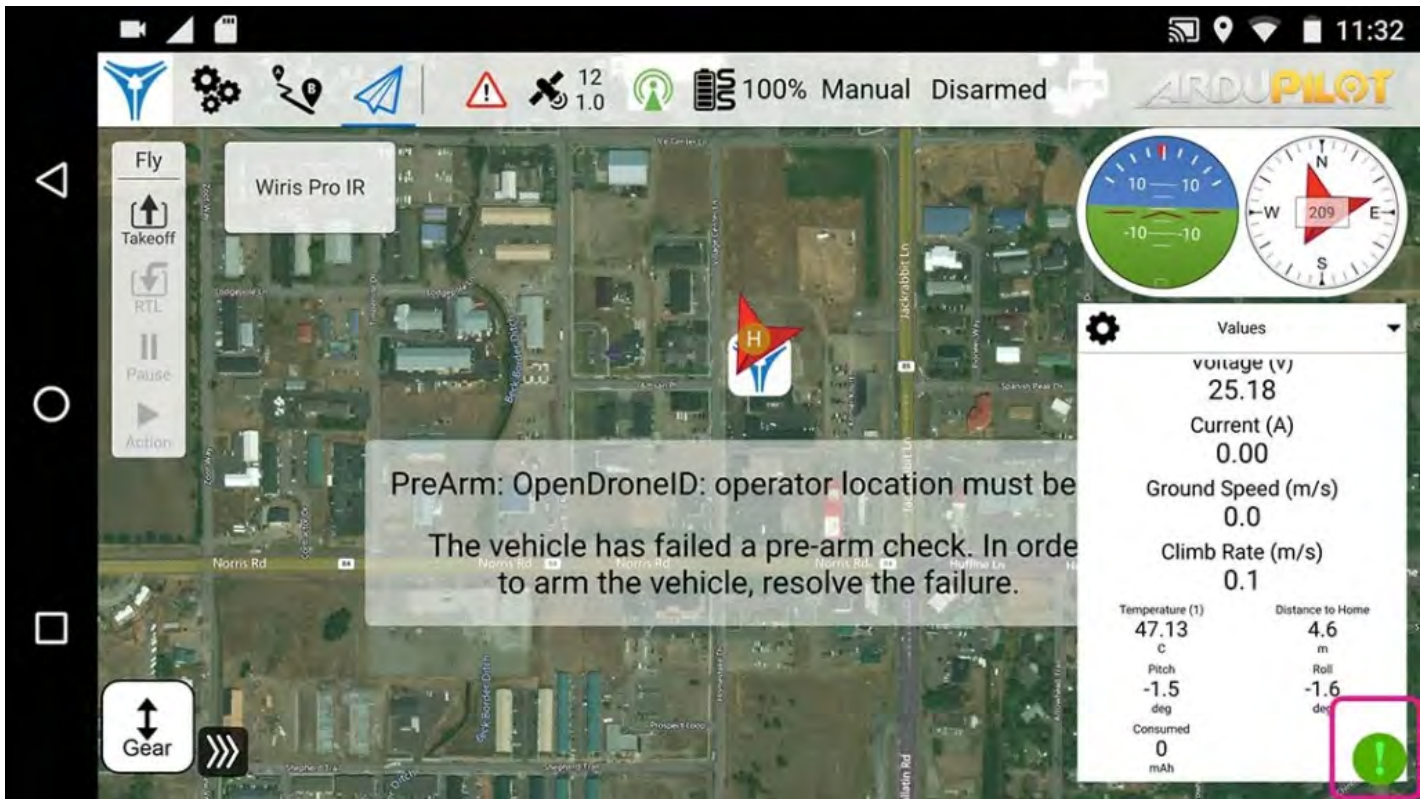
Perform Visual PreFlight

Perform a visual survey of all electrical & mechanical connections to ensure proper connection.

See Checklists for more information.

Arming & Takeoff

1. Arm the aircraft by holding the left joystick at the bottom right position for 5 seconds. When it arms an audible cue will be initiated stating "Arming."
2. Gently bring up the throttle (left joystick) and initiate take-off

Arming for Takeoff

⚠ **NOTE: In colder temperatures, the IMU may take more time to warm up. This is normal.**

Flight Modes

Vision Aerial UASs come programmed standard with five different flight modes:

● **Manual**: Manual flight mode.

● **Brake**: Vehicle holds position, joysticks deactivated (Prevents unintentional user input).

● **Auto**: Engages pre-programmed autonomous mission (User adjustable).

● **Land**: Land vehicle at current location.

● **RTL**: Return-To-Launch site at pre-programmed altitude (User adjustable).

● **Altitude Hold**: When the aircraft is in Altitude Hold mode, it will use its barometer to hold altitude, but the x and y position of the aircraft will drift.

● **Guided Mode**: "Tap-to-fly" function based on user selected commands.

Manual Mode

The active flight mode, Manual Mode, is adjusted by tapping the upper right button on the Herelink Controller.
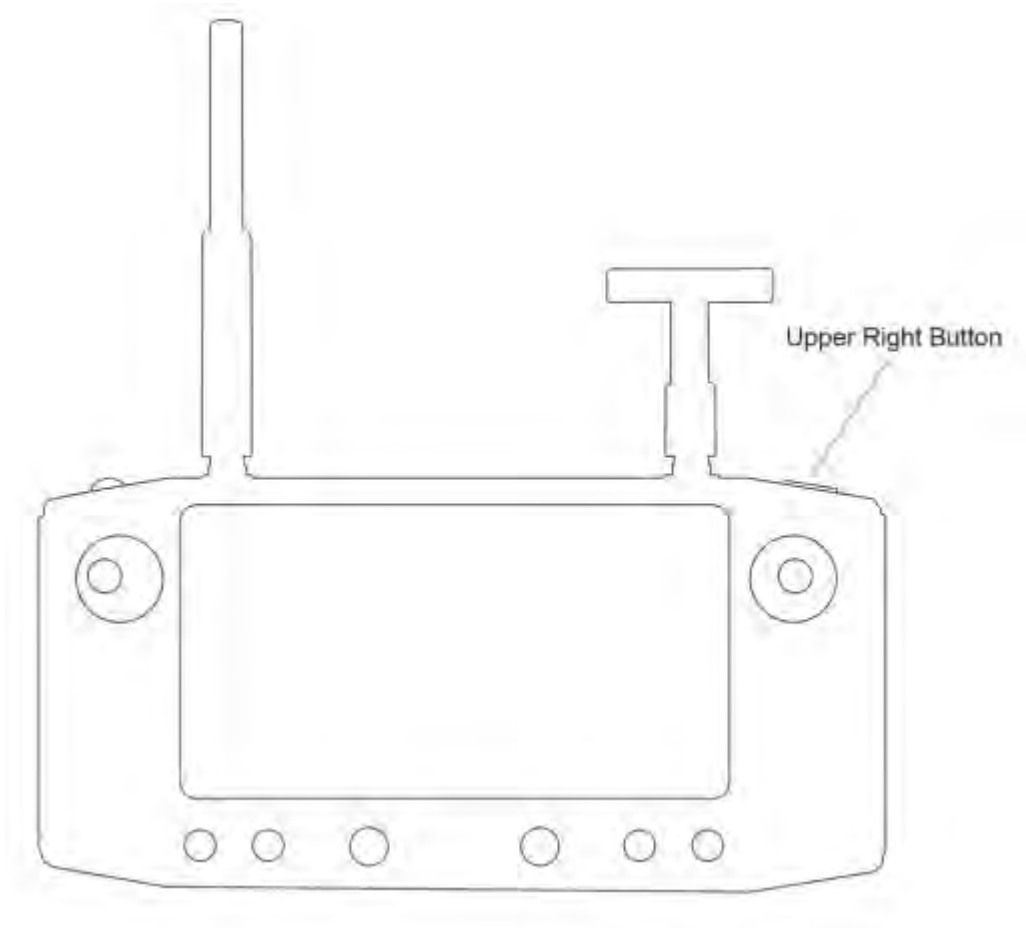
⚠️ **NOTE: In Manual Mode, the joystick movements are directly proportional to the ground speed of the UAS.**

For example: If the roll joystick is moved left to half of its travel, the UAS will choose its roll angle to achieve 50% of the programmed max ground speed for that direction.

This can be useful for applications like aerial filming when keeping the ground speed constant is desirable.

⚠️ **NOTE: The throttle does not directly correlate to the RPM of the motors. The throttle correlates to the desired climb and descent rates.**

Brake Mode

Brake Mode functions similarly to Manual Mode except the control sticks are completely deactivated. This mode is useful when the pilot wishes to reduce the risk of unintentional control input.

⚠️ **CAUTION: Never leave an airborne aircraft unattended.**

This mode is activated by tapping the upper right button on the Herelink Controller.
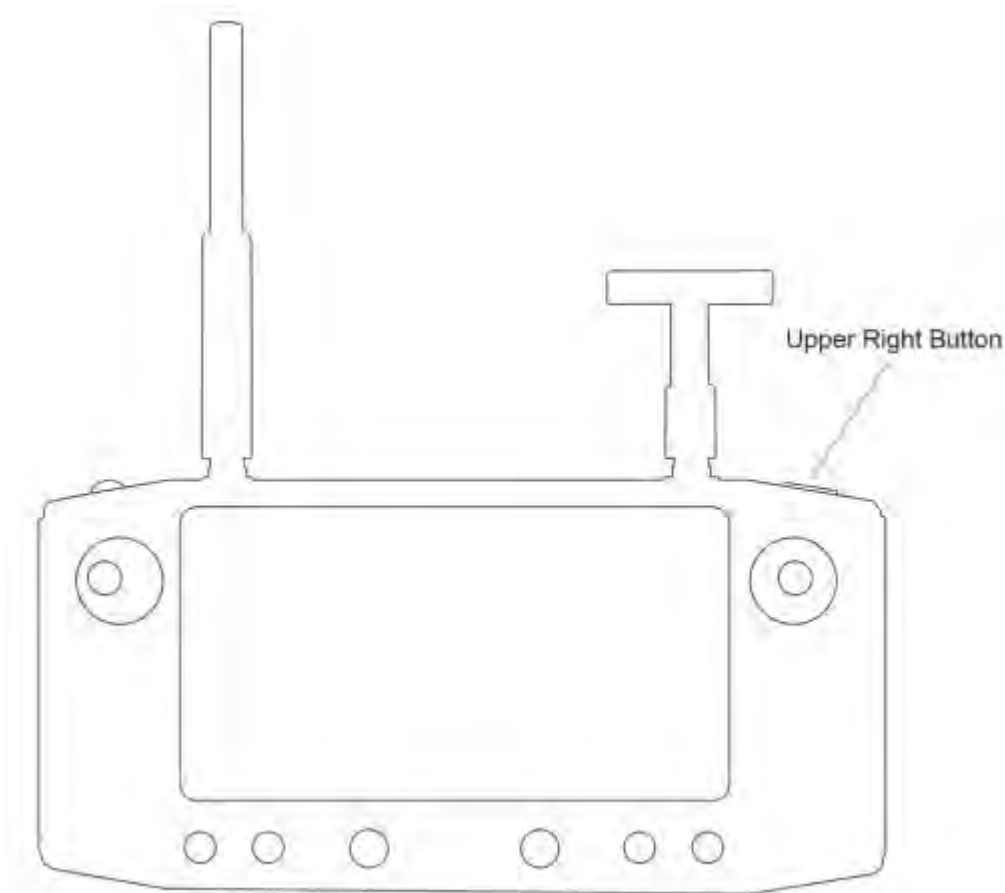
Autonomous Flight (Auto)

Autonomous Mode is for use with pre-planned missions created in advance using mission planning software. A best practice is to design the missions so the pilot launches in Manual Mode and then, once airborne, enables Auto to execute the mission. This increases the pilot's ability to adapt to unpredicted events during launch (such as non-participants, bird activity, sudden changes in the flight environment, etc).

How to use Auto Flight Mode:

1. [Pre-plan the mission using mission planning software](#) in the Herelink.
2. Power and connect the Herelink to the aircraft.
3. When the pattern or waypoints are complete, select "Upload" to send the mission to the vehicle.
4. Manually launch the aircraft and perform systems check.
5. Select the "Action" soft key on the touch screen, then select the "Slide to confirm" soft key under "Continue Mission" for the uploaded mission
6. Now the SwitchBlade-Elite will perform the mission according to the uploaded plan.

⚠️ **NOTE: To pause or stop an autonomous mission, activate Brake Mode by tapping the button on the top right edge of the Herelink Controller. Once a mission is paused, the UAS will hover in place. To resume a mission, "Slide to confirm" the "Continue Mission" button on the Herelink screen and the vehicle will continue as previously programmed.**

Land Mode

When Land Mode is activated, the UAS will deploy its landing gear and begin a gentle descent over its current position. It is recommended to use a 6 meter diameter or larger landing environment, as the precision of the GPS can vary up to ±2.5m.

Land Mode is initiated by pressing "Land" on the Herelink screen and slide to confirm.

Land Mode as a Failsafe Protocol

Land Mode will automatically be activated if the battery becomes critically low. In most situations, this failsafe will prevent the aircraft from uncontrolled descents from altitudes of <10m. It is not recommended to fly the UAS when it has less than 10% of its available battery capacity, to ensure an adequate margin of safety.

To learn more about failsafe modes, see [Emergency Procedures](#).

⚠️ **NOTE: If the pilot wishes to retake control during the descent portion of Land Mode, they may do so by moving the left joystick to full up position (full throttle) or by enabling Brake/Manual Mode by tapping the button on the top right edge of the Herelink controller.**

Return to Launch (RTL)

When RTL is activated (and the vehicle has GPS lock), the UAS will autonomously climb to 50 meters (user adjustable) or maintain altitude if above 50 meters. The vehicle will then return to the launch location on a direct path, hover for 5 seconds, deploy its landing gear, and begin a slow landing descent sequence. It is recommended to use a 6 meter diameter or larger launch/land environment, as the accuracy of the GPS can vary up to ±2.5m.

There are four ways RTL Mode can be activated:

1. Return to Launch Mode is initiated automatically when battery voltage drops below 30% (user definable) for 60 continuous seconds. The GCS will produce an audible "Low Voltage" warning followed by a "Return to Launch" audible warning.
2. Return to Launch can also be manually activated by selecting the "RTL" soft button on the main menu of the Herelink screen. The user will need to verify this action by the "Slid to confirm" soft key. The Herelink will also produce an audible "Return to Launch" cue.

Return to Launch (RTL)
Soft Button on Screen
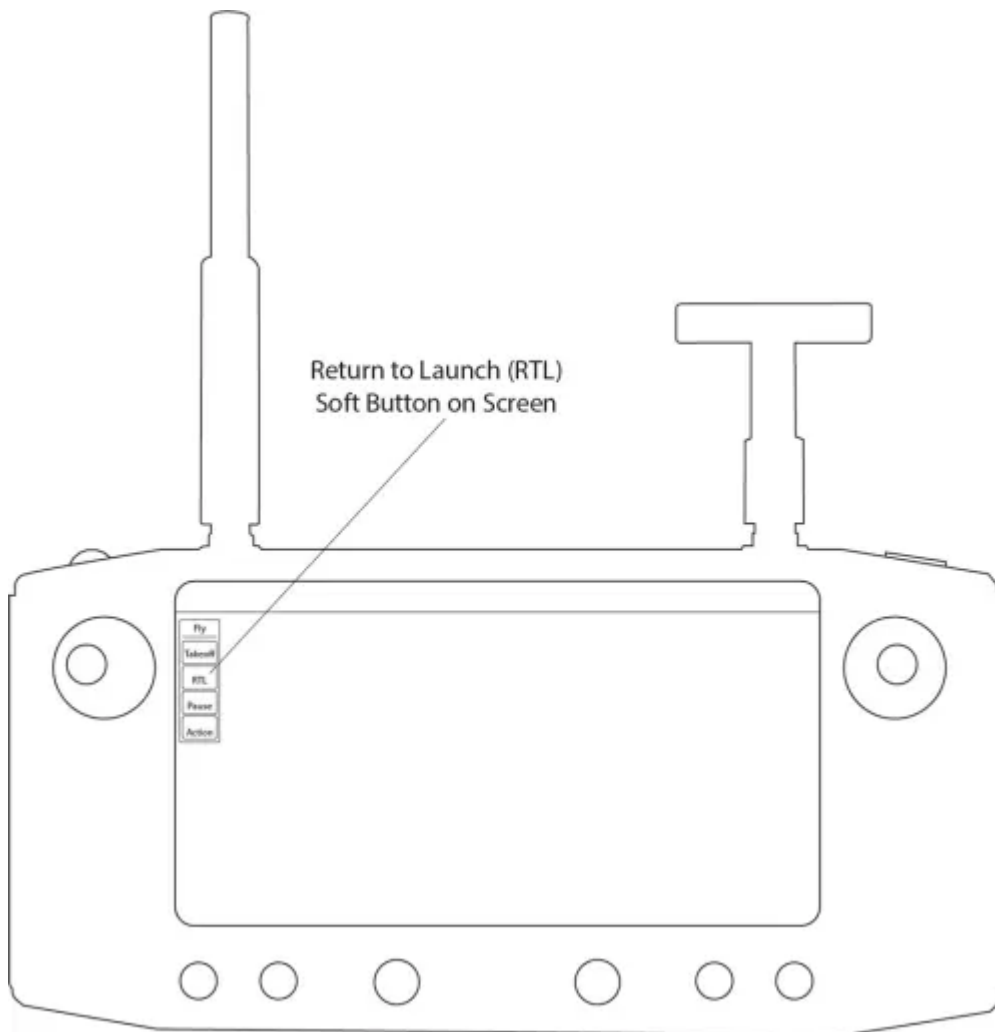
3. Return to Launch can also be activated as a final stage in [Mission Planning](#).

4. Return to Launch can also be activated as a user selectable flight mode in the flight modes drop down list in Flight Deck on the GCS.

RTL can be overridden by changing to any other flight mode.

If the flight environment is significantly higher than the launch location, a 50 m climb altitude may not be adequate. If 50 m is not adequate for your flight environment, the setting can be changed in the parameters section of the Mission Planner software. Additionally, if the launch location itself is moving (such as on a moving vessel) it is best to avoid the use of Return to Launch Mode.

Return to Launch (RTL) Mode as a Failsafe Protocol

Return to Launch will be activated automatically if the SwitchBlade-Elite loses communication with the controller. To learn more about failsafe modes, see [Emergency Procedures](#).

⚠️ **NOTE: If the pilot wishes to retake control during RTL Mode, by enabling Brake/Manual Mode by clicking the button on the top right edge of the Herelink controller.**

⚠️ **NOTE: During the descent portion of the landing sequence the landing cycle can be aborted by applying 50% or more throttle.**

Altitude Hold

There are two ways that Altitude Hold can be triggered:

1. Loss of GPS position will trigger a switch to Altitude Hold Mode.

2. The user may manually select Altitude Mode for environments that lack adequate GPS signal such as under bridges, heavy vegetation, etc.

Loss of GPS Position

The loss of GPS will create an audible "EKF Failure" tone. In the event of loss of GPS, the user will retain controllability of the vehicle. However, RTL Mode and the ability of the vehicle to maintain station will be compromised. When the aircraft is in Altitude Hold mode, it will use its barometer to hold altitude, but the x and y position of the aircraft will drift.

Guided Mode

Guided mode is a "tap-to-fly" function based on user selected commands. The pilot can tap a position on the base map, and the drone will autonomously fly to that location. The aircraft will remain at its current altitude.

Landing & Disarming

Before landing the aircraft, check the landing site environment to ensure it is clear of power lines, people, animals, etc.

1. If landing manually, extend the landing gear.

2. Land the aircraft (ideally on a level surface).

3. Disarm by holding the left joystick in the full down position for at least 3 seconds. If the vehicle has not taken off, hold the joystick down and to the left.

⚠️ **NOTE: To disarm more quickly if the system was armed but did not launch, hold the stick down and to the left.**

4. If carrying a payload, remove it by unplugging the electrical connections and unlocking the mechanical ring. (See Payload Connection System.)

Disarm (Full Down)

Post Flight & Storage
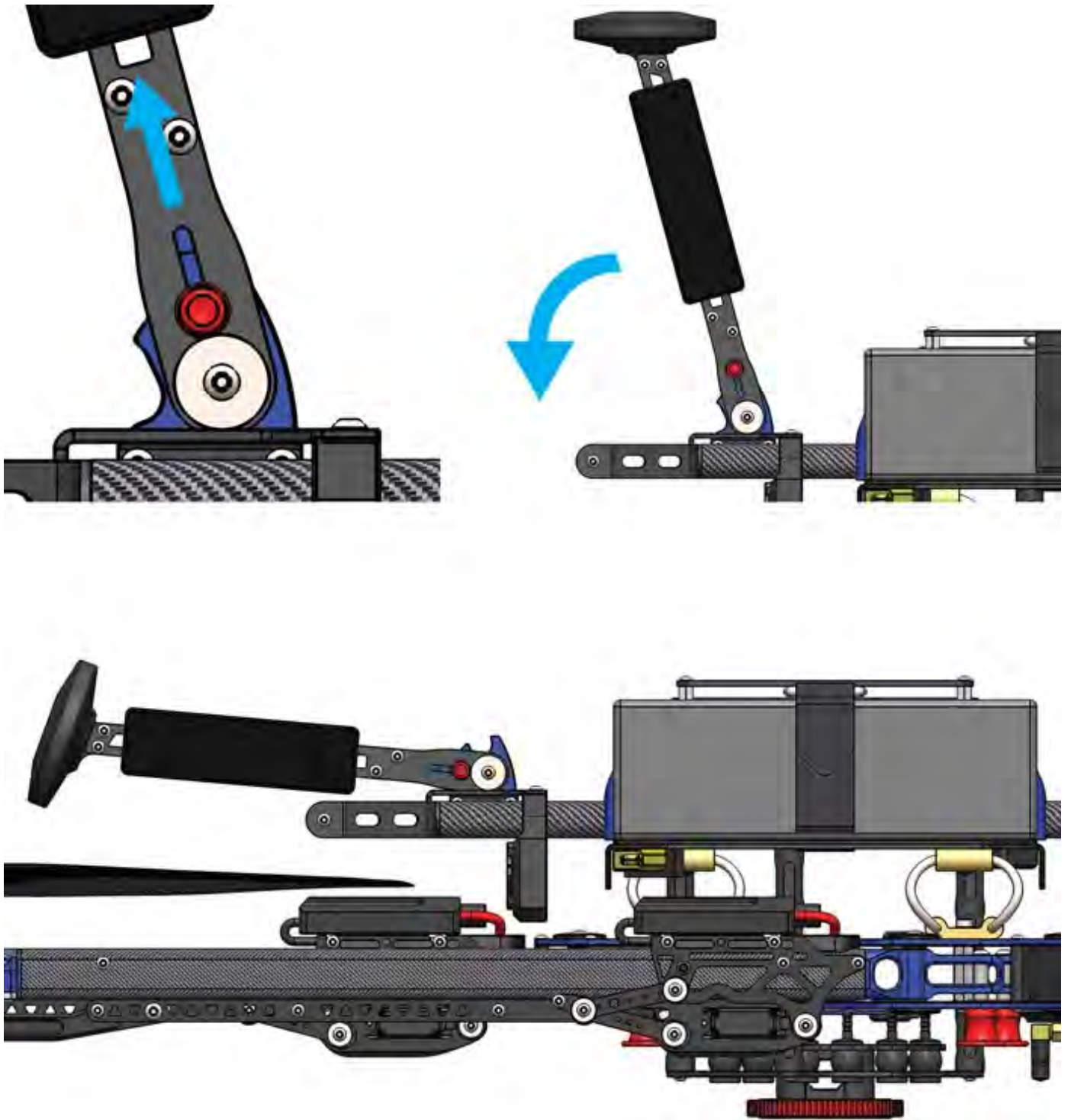
Post Flight

1. Disconnect the battery from the aircraft.
2. Power down the GCS.
3. Visually survey all electrical and mechanical connections.
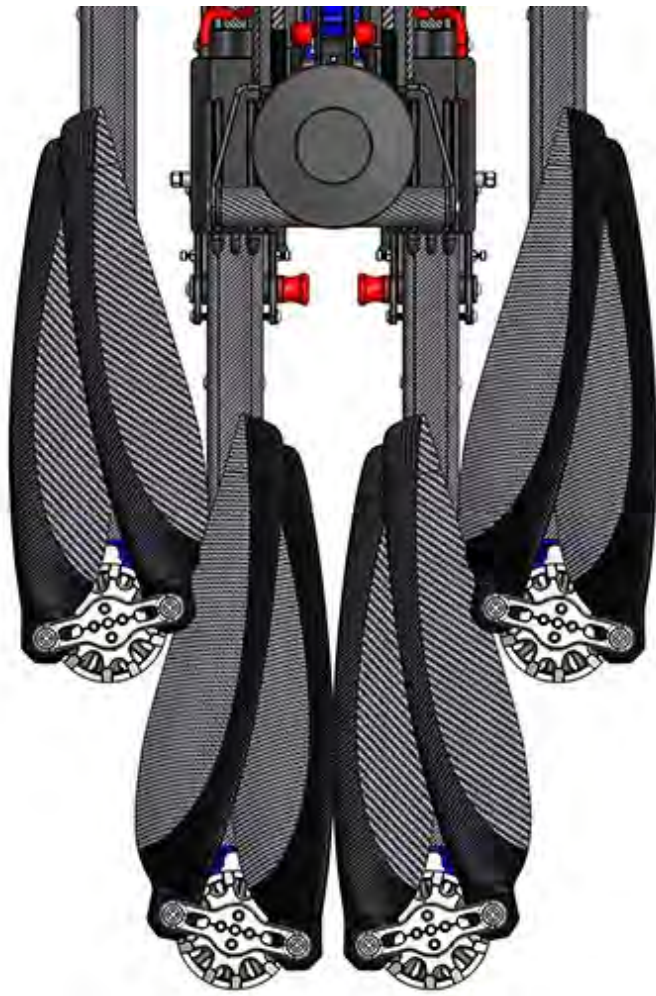
Storage

Retract the GPS Mast

Unsecure and lower the GPS mast by lifting the pull pin vertically and rotating the mast back toward the tail motor.

Retract the Rotors

Fold in the tail rotors so the blades point forward.
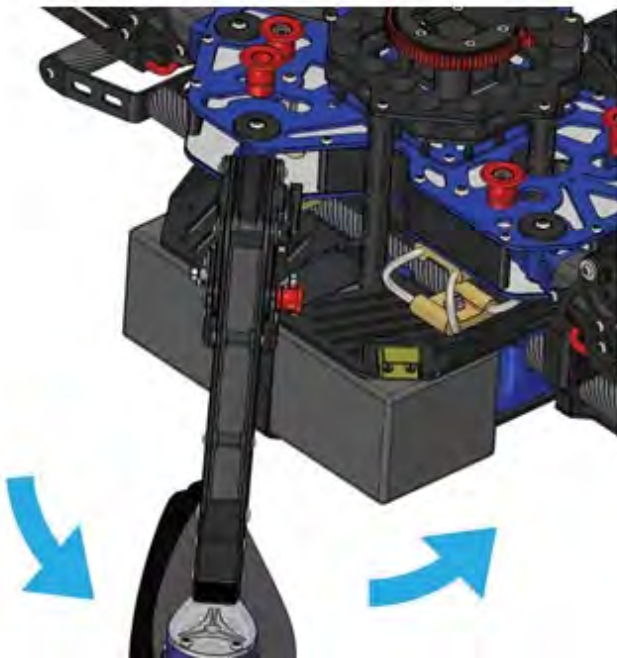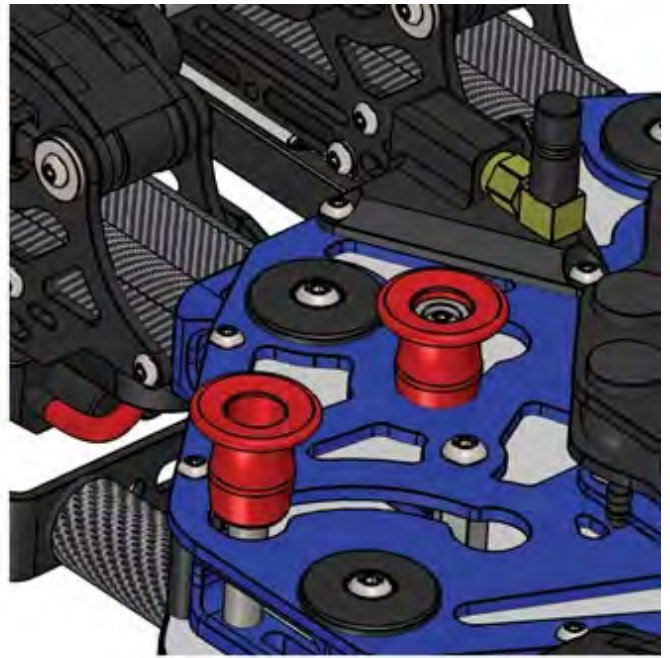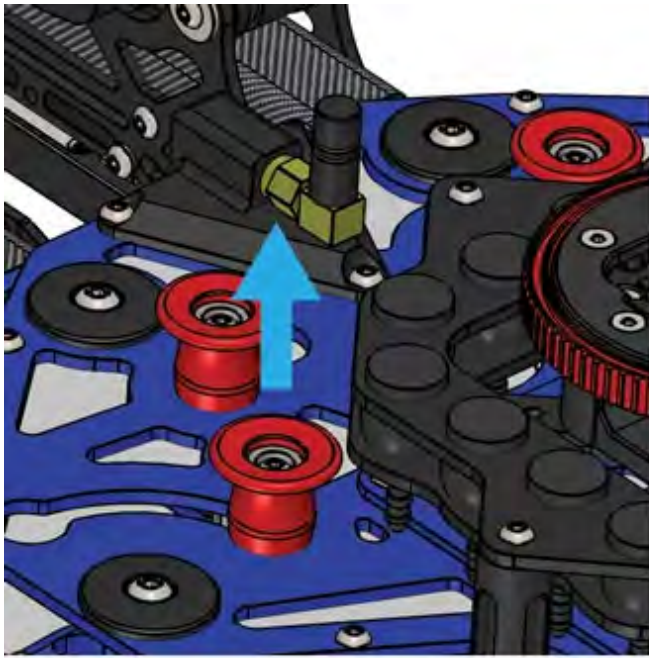
Retract Arms and Landing Gear

1. Select one arm and pull out on the corresponding red knob.

2. Rotate the arm towards the tail.
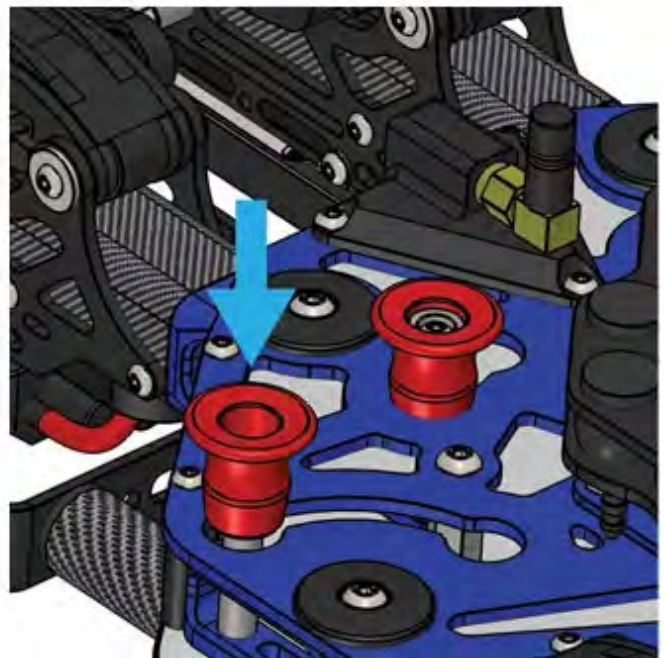
3. Once reaching the stop, release the knob to allow locking.

4. Gently move the boom back and forth to verify the knob is engaged and seated.

5. Repeat this process with the other arm.

6. Place the aircraft in its case and secure latches.

Emergency Procedures

Introduction

The emergency procedures listed in this section are the recommended practices for handling the aircraft in an emergency. This guidance should be considered and applied as necessary.

The risk of an emergency occurring can be reduced substantially through proper aircraft maintenance, by performing thorough inspections before and after all flights, careful pre-flight planning, and thorough flight environment surveying prior to flight.

Emergency situations are dynamic events, and not all conditions or procedures can be anticipated or applied during the event. These procedures are not a substitute for a thorough understanding of aircraft systems and sound pilot judgment.

If an emergency occurs, three basic actions can be applied to most situations:

1. **Maintain aircraft control**
   Small emergencies can quickly escalate if the pilot is distracted by attempting to troubleshoot the problem. Always maintain visual contact with the aircraft during an emergency to reduce the likelihood of losing orientation.
2. **Analyze the situation**
   Once the aircraft is stabilized, begin to assess the cause of the emergency if practical.
3. **Take appropriate action**
   In many cases, the appropriate action will be to land the aircraft as soon as possible. Always consider the safety of yourself and others before attempting to save the aircraft in an emergency.

Emergency Procedures

Emergency Stop (Disarm)

These instructions will stop the blades from spinning when other methods are not applicable.

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

To disarm the vehicle select **Armed** in the *Fly Toolbar* when the vehicle is flying.

See [Flight Deck Fly View](#) for related information.

Aircraft Error

During any portion of the flight if the user makes an aircraft movement that is undesired.

1. Neutralize controls
2. Select Brake Mode (as required)
3. Analyze the situation and make an appropriate response

Uncontrollable Environmental Change

An unanticipated change in the environment such as pilot distraction or unforecast weather may require user action.

1. Neutralize Controls
2. Switch to Loiter Mode and pilot to a safe landing location

   If flight environment does not change or conditions warrant:
3. Select RTL (as required)

Lost Orientation

Condition of flight environment, distance/location of the vehicle and the perception of the user can all lead to a misinterpretation of the vehicle's spatial orientation. Restoration of the user to the orientation to the vehicle is paramount for mission continuation and safe vehicle recovery. Primary consideration is the orientation of the vehicle before any mission is executed or continued.

In the event of **Lost Orientation**:

1. Reference telemetry on GCS
   The GCS provides multiple opportunities for a pilot to regain orientation of the aircraft. Reference the background map, compass indicator, and a selectable readout for compass heading to home.

   If telemetry is unavailable:

2. Reference FPV (if equipped)

   If FPV is unavailable:
3. Perform Orientation Turn maneuver
   Input a 1-second yaw and then a 1-second roll in the same direction until the drone's movements correspond with the inputs, eventually back to a tail-in orientation.
4. RTL: Select manually

Lost Link

Loss of link is a condition that is the result of some interruption of communication between the vehicle and GCS. Loss of link can be the result of many situations. Loss of power in GCS, GCS Failure, unpredictable RF environment or terrain/obstructions (inside a vehicle) may cause a loss of link. Proper preflight planning by ensuring GCS charge and understanding the flight environment will mitigate the majority of lost link issues.

Loss of link will manifest in several forms. GCS will furnish an audible "Communications Lost" message. User will experience a loss of control from right and left joysticks. Vehicle will begin an RTL unless communication is regained, and the user selects a different mode.

In the event of Lost Link:

1. **Launch/Landing site**: Ensure area is clear for RTL landing
2. **Communication**: Attempt to regain by resetting GCS and/or attaching charging source to device.
3. **Monitor RTL**
4. **Launch/Landing Site**: Monitor for safe vehicle recovery

In-Flight Battery Emergencies (RTL)

Battery emergencies can be classified as low battery or critical battery conditions. In either case the failsafe will be triggered by pre-programed values. The intent is to alert the user and for the vehicle to complete a flight action that will produce a favorable outcome in recovering/reusing the vehicle.

A **low battery** situation is triggered by battery voltage dropping below 30% battery remaining continuously for 60 seconds. The GCS will produce an audible "Low Voltage" warning followed by a "Return to Launch" audible warning.

A **critical battery** situation is triggered when the battery is at or below 10%. The GCS will produce an audible "Critical battery" warning. The warning will be followed by a "Landing" audible cue and the vehicle will begin an immediate landing sequence.

In both cases, the vehicle will continue the programmed landing sequence unless action is taken by the user.

In the event of **Low Battery** (RTL Mode):

1. **Mode select**: Override RTL Mode if Manual Mode is desired or required.
2. **Landing site**: Identify landing site and ensure the area is clear.
3. **Landing sequence**:
   a. *If in RTL Mode*: Monitor landing site and landing sequence while monitoring voltage.
   b. *If in Manual Mode*: Maneuver vehicle to desired landing site while monitoring battery voltage.

⚠️ **WARNING: When Landing Mode has been engaged due to critical voltage, vehicle can land in its immediate vicinity without operator action. In the event the operator overrides and continues extended flight, the vehicle may lose functional lift and will result in catastrophic loss of vehicle and potential damage loss of any persons/property in its flight path.**

⚠️ **CAUTION: Continued extended flight after RTL or Landing Mode has been engaged due to low voltage is not recommended.**

In the event of **Critical Battery** (Landing Mode):

1. **Mode select**: Override Landing Mode if Manual Mode is desired or required.
2. **Landing site**: Identify landing site and note location.
3. **Landing sequence**:
   a. *If in RTL Mode*: monitor landing site and landing sequence while monitoring voltage.
   b. *If in Manual Mode*: Maneuver vehicle to desired landing site while monitoring battery voltage.

Loss of GPS (Altitude Hold)

Loss of GPS position will trigger a switch to Altitude Hold Mode. Additionally, the user may manually select Altitude Mode for environments that lack adequate GPS signal such as under bridges, heavy vegetation, etc. The loss of GPS will create an audible "EKF Failure" tone. In the event of loss of GPS, the user will retain controllability of the vehicle. However, RTL Mode and the ability of the vehicle to maintain station will be compromised.

In the event of **Lost GPS**:

1. Altitude: Climb to avoid all obstacles
2. Manually pilot vehicle referencing telemetry as needed
3. Manual landing as required

⚠️ **NOTE: Loss of GPS will require the user to account for external forces like wind.**

Failed Landing Gear

A landing gear failure can manifest in multiple ways. In a failure, the landing gear may present limited deployment/retraction of single or multiple arms. Consideration should also be given to the presence of a payload and when attached, the type of payload.

In the event of any landing gear malfunction:

1. Determine the presence and type of payload.
2. If no payload is present: Belly land aircraft manually with no yaw input.

⚠️ **NOTE: Type of payload will predicate action taken for landing. Consideration should be given for the survivability of payload over vehicle.**

Partially failed landing gear

1. Landing gear: Cycle (If landing gear extends to full down, land as required)
2. Landing gear remains partial failed: Return to landing site
3. Prepare site to land vehicle on substitute landing device (bush, piled up clothing, etc) to facilitate a level landing which protects payload from impact
4. At minimum hover (2-3 cm) disarm flight by selecting the onscreen "armed" button and sliding to confirm disarm.

Fully failed landing gear

1. Landing gear: Cycle (If landing gear extends to full down, land as required)

2. Landing gear remains fully failed: Return to landing site
3. Prepare a site to land the vehicle on a substitute landing device (trash can, bucket, etc) to facilitate a level landing that supports landing points and protects the payload from impact
4. At minimum hover (2-3 cm) disarm flight by selecting the onscreen "armed" button and sliding to confirm disarm.

Yaw Malfunctions (SwitchBlade-Elite Only)

Yaw Malfunctions will manifest in either a right or left uncontrollable yaw. While left joystick yaw control will be ineffective, all other controls will be fully functional. The GCS may produce an audible "EKF Failure." In a worst-case scenario, the vehicle will begin to spin.

Loss of yaw control (Compromised tail)

1. Manually engage RTL
2. If RTL is unavailable or not desired, utilize a pulsing forward movement in the direction of the landing zone
3. If no payload is present, land with gear up on a soft surface
4. If a payload is present, landing gear down
5. Position over the intended landing site
6. At minimum hover (2-3 cm): Disarm flight

Support

Vision Aerial is here to help you get the most out of your SwitchBlade-Elite. If you have any questions, please contact us at info@visionaerial.com or call +1 (406) 333-1795.

To submit a support request through our website, visit www.visionaerial.com/support.

Maintenance

Rotor Caution

The SwitchBlade-Elite comes with three attached, folding rotors.

⚠️ **WARNING: Anytime rotor bolts are removed, apply Loctite 277 (RED)
to the bolts when reattached to keep them from loosening during transport
or operation.**

⚠️ **WARNING: Avoid contact with the UAS's high-speed rotors**.

✓ Always disarm the UAS before handling
✓ Before starting motors for takeoff, always ensure that the rotors are clear of any obstructions and at least 5 meters (16.5 feet) away from any people, animals, or property before activating
✓ Do not touch moving rotors or approach the UAS while the rotors are spinning
✓ Always disarm the UAS before picking it up
✓ Do not approach the UAS until the rotors stop spinning

Before Every Flight

Arm Locks

The arm locks should move freely and lock solidly both in the storage and flight configurations.

GPS Mast

Check that GPS mast locks should move freely and lock solidly both in the storage and flight configurations.

Landing Gear Retracts

When the landing gear is fully deployed, check that the upper linkage screws makes contact with the lower linkage on both sides of the assembly.

Rear Yaw Mechanism

This applies to the SwitchBlade-Elite UAS only.

1. Inspect all four connection points of the control links between the servo and yaw motor cradle are securely attached and move freely.
2. Inspect that the yaw motor cradle moves unobstructed from any debris, wires, etc.
3. Ensure cradle spring is secured on both sides.

Rotors

1. Check that all screws in the motor hub assembly are present and tight.
2. Confirm that the lock nut on the bottom of the rotor is in place and secure.
3. Inspect for chips, typically found on the leading edge. If chips greater than 1.5mm are found, it is recommended the rotor be replaced.
4. Inspect for cracks and excessive flexibility. If significantly more flexibility in the rotor is detected, replace the rotor.
5. An example of a healthy rotor is shown in the image.
6. Once preflight checks are complete, use the throttle to gently rotate the rotors and check that each prop is rotating in the correct direction.

"Left" and "Right" are inscribed on the rotors for easy identification.

SwitchBlade-Elite 2.3 Rotor Direction
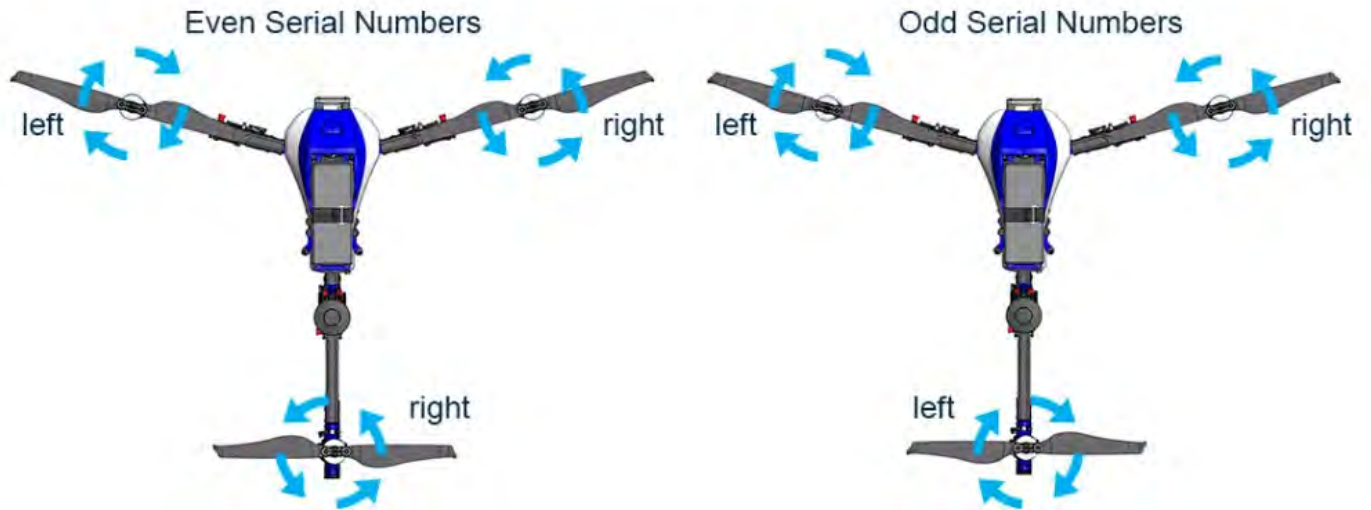
Even serial numbers will have a right tail rotor. Odd serial numbers will have a left tail rotor.

Every 25 Flights

Tools Needed: 2mm Allen key, thread locker, and Phillips screwdriver.

1. **Motors**
   With the aircraft unpowered, slowly rotate each motor feeling & listening for any grinding or rubbing, any significant grinding or rubbing warrants a motor replacement or rebuild.
2. **Batteries**
   Plug each battery pack into the charger and complete a full charge via the balance charging program. Once complete, compare the highest voltage cell to the lowest voltage cell. If the difference is greater than 50mV (0.05V) recycle the pack.
3. **Arms**
   Inspect carefully the carbon fiber arms & empennage for cracks and/or delamination. Small surface level delaminations of the clear coat pose no significant threat, however any crack or separation that is deeper than the clear coat warrants an immediate replacement of the arm.

How to Download Flight Logs

1. Download and install Mission Planner on a Windows-based PC:
   https://ardupilot.org/planner/docs/mission-planner-installation.html

2. Connect to the drone via the USB-C cable that is included in the bit box.
   - On the Switchblade Elite, the USB port is located opposite the battery connection port.
   - On the Vector, the USB port is located on the corner of the battery plate.

3. Open Mission Planner and click on the drop-down menu for the COM port in the top right corner.
   - Select the COM port that says "**Cube Mavlink**" in the name.
   - Set the baud rate to **115200** in the menu to the right.
   - Press connect. It will take a few seconds as all the parameters from the drone are loaded.
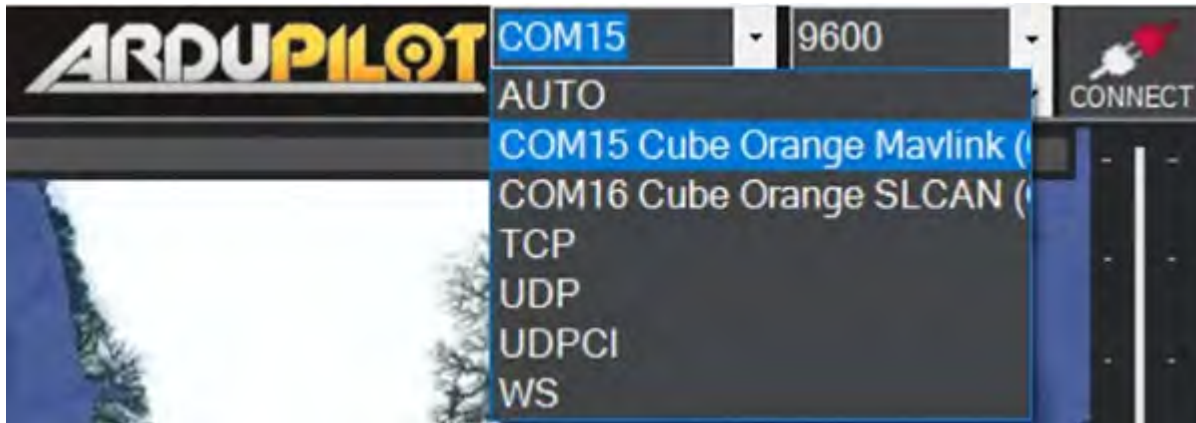
4. On the left side of the screen, there is a menu that has tabs for "Quick", "Actions", "Messages", etc… Scroll to the right to find the tab that says "DataFlash Logs".

5. Click "**Download DataFlash Log Via Mavlink**".
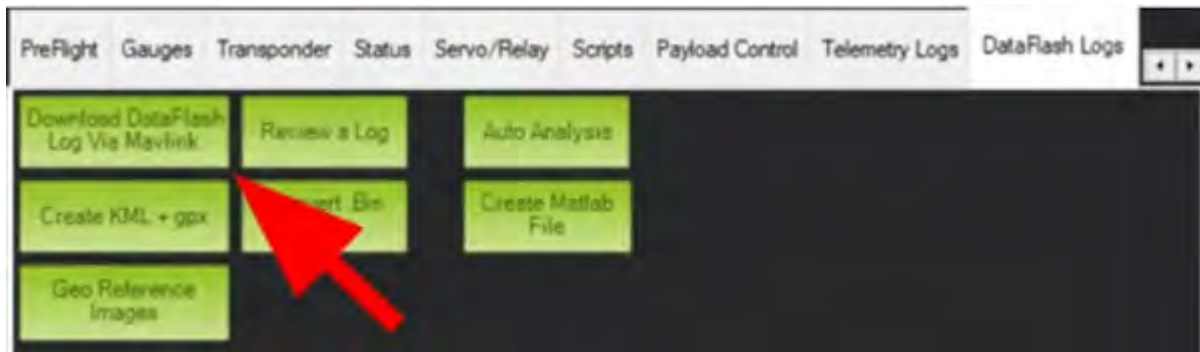
6. Select the log(s) that you would like to download – the most recent log will be at the bottom.

7. Click "**Download Selected Logs**"

8. The downloaded logs will be saved in:
   C:\Users\User Name\Documents\Mission Planner\logs\TRICOPTER\1