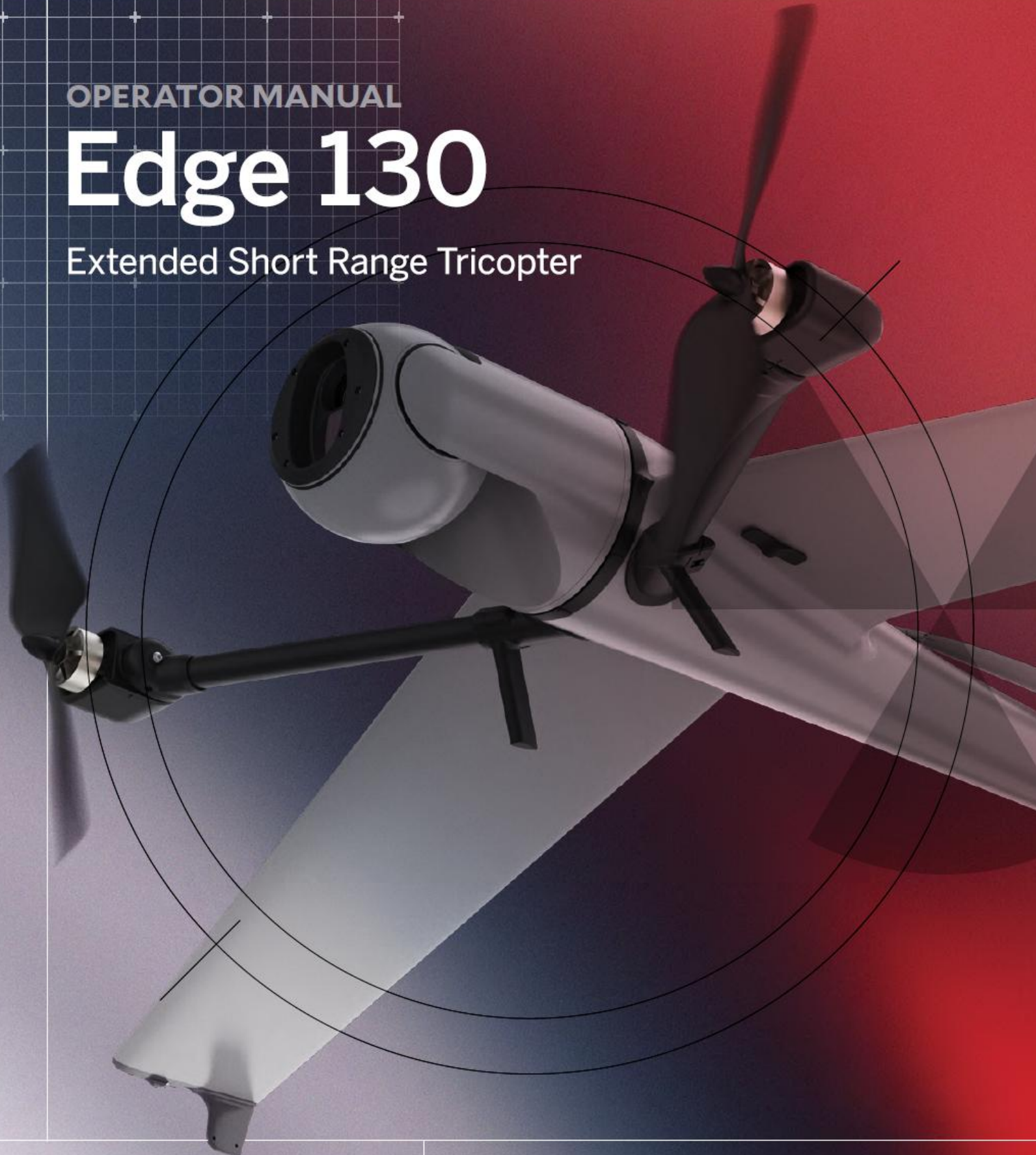


OPERATOR MANUAL

# Edge 130

Extended Short Range Tricopter



 FlightWave  
A  CAT COMPANY

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## Revision History

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# Using this Manual

## Read Before First Flight

Follow all warnings, cautions, and safety guidelines before operating any equipment to avoid injury, equipment damage, or Federal Aviation Administration (FAA) violations.

**Prepare for your first flight by reviewing this operator manual for more information.**

## Searching for Keywords

Search for keywords such as “battery” and “flight controls” to find a topic. If you are using Adobe Acrobat to read this document, press **Ctrl + F (Windows) or Command + F (Mac)** to begin a search.

## Navigating to a Topic

Navigate this manual quickly by using the Table of Contents (TOC). You can **Ctrl + Click (Windows) or Command + Click (Mac)** on any TOC line item to jump directly to the desired section within the document.

Navigation may also be done via **Ctrl + Click (Windows) or Command + Click (Mac)** on underlined, *italicized*, **red text** referencing document headers for more information:

## Acronym List

Acronym	Definition
<b>AC</b>	Alternating Current
<b>AGL</b>	Above Ground Level
<b>AMSL</b>	Above Mean Sea Level
<b>AV</b>	Air Vehicle
<b>BVLOS</b>	Beyond Visual Line of Sight
<b>C2</b>	Command and Control
<b>CFEXPRESS</b>	CompactFlash Express (High-speed data card format)
<b>°C / °F</b>	Degrees Celsius/Degrees Fahrenheit
<b>DOF</b>	Degrees of Freedom
<b>ECCN</b>	Export Control Classification Number
<b>EKF</b>	Extended Kalman Filter (navigation/sensor fusion algorithm)
<b>EO</b>	Electro-Optical (Visible Spectrum Camera)
<b>EO/IR</b>	Electro-Optical/Infrared (Dual-spectrum imaging system)
<b>EAR</b>	Export Administration Regulations
<b>FAA</b>	Federal Aviation Administration
<b>FFC</b>	Flat-Field Correction (Thermal image calibration)
<b>FW</b>	Fixed-Wing Mode
<b>GCS</b>	Ground Control Station
<b>GHz / MHz / kHz</b>	Gigahertz/Megahertz/Kilohertz (Radio frequencies)
<b>GPS</b>	Global Positioning System
<b>GSD</b>	Ground Sample Distance
<b>HDMI</b>	High-Definition Multimedia Interface

<b>HUD</b>	Heads-Up Display
<b>IR</b>	Infrared (Thermal Spectrum Imaging)
<b>ISR</b>	Intelligence, Surveillance, and Reconnaissance
<b>LED</b>	Light-Emitting Diode
<b>LiPo</b>	Lithium Polymer (Battery Type)
<b>LOS</b>	Line of Sight
<b>mAh/Wh /V/A/W</b>	Milliamp-hour/Watt-hour/Volt/Ampere/Watt
<b>MR</b>	Multi-Rotor Mode
<b>NDAA</b>	National Defense Authorization Act (Compliance standard)
<b>OTA</b>	Over-the-Air (Software Updates)
<b>PWM</b>	Pulse Width Modulation
<b>RC</b>	Remote Control
<b>RF</b>	Radio Frequency
<b>RTL</b>	Return-to-Launch (Autonomous return procedure)
<b>SAR</b>	Search and Rescue
<b>SD</b>	Secure Digital (Memory Card Format)
<b>SPI</b>	Sensor Point of Interest
<b>sUAS</b>	Small Uncrewed Aircraft System
<b>UI / UX</b>	User Interface/User Experience
<b>UAV</b>	Uncrewed Aerial Vehicle
<b>USB-C</b>	Universal Serial Bus Type-C Connector
<b>VTOL</b>	Vertical Takeoff and Landing
<b>Wi-Fi</b>	Wireless Fidelity (Wireless Networking Standard)
<b>2D / 3D</b>	Two-Dimensional/Three-Dimensional

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## Safety Precautions

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This chapter outlines the essential safety measures to take before flying.

# Safety Precautions

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Edge 130 and its components, configurations, firmware, and radio-frequency equipment **may not meet certain FAA or FCC design, authorization, or operational requirements** that apply to consumer or general-purpose devices. The system is **not FAA-certified** and operation may require FAA authorizations (including waivers, airspace approvals, or other permissions) and compliance with all applicable federal, state, and local rules.

Users are solely responsible for ensuring the system is operated only by trained and authorized personnel and only within an organizational safety program and any applicable operational approvals. Prior to any operation, users must obtain and maintain all required FAA authorizations, and must ensure all radio-frequency operation is lawful for the intended use, including any required FCC equipment authorization, licensing, coordination, and RF exposure compliance. Users are also responsible for confirming that any modifications, repairs, payload changes, firmware changes, or configuration changes do not create unsafe conditions or noncompliance with applicable requirements. Operation without proper oversight and approvals can result in unsafe operation, loss of control, property damage, injury, and regulatory violations. Except as provided in a specific contract between Red Cat and Customer, **Red Cat Holdings, Inc. (the manufacturer) provides the system “AS IS” and disclaims all warranties, express or implied, including without limitation any implied warranties of merchantability, fitness for a particular purpose, non-infringement, and any warranties arising from course of dealing or usage of trade.**

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## Safety Guidelines

The information in this section affects your **safety, the safety of others, and your legal responsibilities**. You are responsible for any harm or damages arising from failure to follow these guidelines.

### FlightWave Support

If you have questions, visit [www.flightwave.aero](http://www.flightwave.aero) or contact support at [support@flightwave.aero](mailto:support@flightwave.aero).

## Warnings, Cautions, and Notes

Observe identified warnings and cautions for operating procedures before attempting to operate any equipment. Follow safety guidelines to prevent personal injury, damage to equipment, or Federal Aviation Administration (FAA) violations.



### Warning

Indicates a condition or practice that could result in injury or death if not observed.



### Caution

Indicates a condition or practice that could result in damage to equipment or loss of mission capability if not observed.



### Note

Highlights important information essential to safe and efficient operation but not related to personal safety or equipment protection.



### **WARNING – Cut Hazard**

Spinning propellers can cause serious injury. Keep hands, tools, and loose items clear whenever the system is powered on or motors are armed.



### **CAUTION – Battery Management System**

Lithium-ion batteries may become unstable, overheat, damage cells, or catch fire if improperly stored.

- Charge only within 32°F to 113°F (0°C to 45°C).
- Store between -4°F and 113°F (-20°C to 45°C).
- Power down the uncrewed aircraft and GCS before removing or replacing battery packs.
- Never leave batteries in hot vehicles.
- Store in a separate area, away from flammable or combustible materials; use metal storage cabinets if available.
- Do not place heavy objects on top of battery boxes to avoid crushing or puncturing cells, which may lead to short circuits or fire.

## Product Description

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This chapter introduces the major features of the product.

# Introduction

## Purpose and Function

The **FlightWave Edge 130 is a small uncrewed aircraft system (sUAS)** designed to provide reliable aerial intelligence, surveillance, and reconnaissance (ISR) capability through its advanced electro-optical and thermal imaging payloads. It delivers real-time video and telemetry to the FlightWave Ground Control Station (GCS) via a secure digital data link, supporting both commercial and defense operations requiring precision situational awareness.

Edge 130 employs a hybrid fixed-wing and multi-copter configuration that enables vertical takeoff and landing (VTOL) while maintaining the efficiency and endurance of fixed-wing flight. This design allows deployment in confined environments without the need for launch rails, nets, or runways.

The aircraft's modular architecture supports rapid payload interchange through FlightWave's proprietary Twist-Lock Payload System, enabling field-level adaptability between mission types such as mapping, overwatch, and inspection.

## System Architecture

- **Uncrewed Aircraft (UA):** Provides GPS-enabled navigation, EO/IR payload capability, encrypted data link, and onboard processing.
- **Ground Control Station (GCS):** Ruggedized Android device equipped with integrated joysticks and QGC software for flight control and mission management.

## The System Includes:

- One (1) FlightWave Edge 130 aircraft
- One (1) FlightWave Ground Control Station (GCS)
- One (1) radio link system (telemetry and video)

## System Features

The Edge 130 can be rapidly deployed for missions including route reconnaissance, infrastructure inspection, environmental monitoring, target observation, convoy overwatch, and post-event assessments.

- Designed, assembled, and supported in the United States
- Hybrid VTOL architecture — transitions seamlessly between multi-rotor hover and fixed-wing cruise
- Fully modular design for rapid field repair and payload replacement
- NDAA-compliant components
- Encrypted data storage and hardware tamper protection



Figure 2 – Edge 130 System Features

## Capability Overview

The FlightWave Edge 130 supports a diverse set of operational profiles across commercial, industrial, and defense sectors. Its hybrid configuration combines the **hover precision of a multi-rotor** with the **range and endurance of a fixed-wing platform**, allowing missions that would typically require two separate aircraft classes.

### Core Flight Capabilities

- **Vertical Takeoff and Landing (VTOL):** Enables launch and recovery from unprepared terrain and confined areas without auxiliary equipment.
- **Hover and Precision Positioning:** Multi-rotor configuration allows stable hovering for target observation, close inspection, or image capture.
- **Efficient Fixed-Wing Cruise:** Provides extended endurance and coverage compared to multi-rotor-only platforms.
- **Seamless Transition:** Automated conversion between vertical and horizontal flight modes for efficient mission execution.
- **Autonomous Flight Modes:** Includes waypoint navigation, return-to-launch (RTL), and mission pause/resume for operational flexibility.
- **Low Acoustic and Visual Signature:** Designed for minimal detectability during low-altitude or observational missions.
- **Ease of Operation:** Integrated mission planning and manual flight control via touchscreen GCS interface, suitable for both experienced and newly qualified operators.
- **Payload Support:** Accommodates multiple payload types, including the Overwatch Gimbal and Mapping Array, with automatic detection and configuration by the Ground Control Station.

## Imaging Capabilities

The FlightWave Edge 130 supports multiple imaging payload configurations that capture high-fidelity visual and thermal data across a range of operational conditions. These payloads integrate with the aircraft's avionics through the FlightWave Twist-Lock Payload Interface, ensuring secure mechanical attachment and immediate visual recognition via the GCS.

### Dual-Spectrum Vision

#### Electro-Optical (EO) Camera (Visible Spectrum):

Provides high-resolution color or monochrome imagery for daylight operations and visual inspection tasks. This system enables:

- **Situational Awareness:** Real-time assessment of dynamic environments.
- **Inspection Tasks:** Visual detection of surface anomalies or damage in infrastructure.

#### Infrared (IR) Camera (Thermal Spectrum):

Detects emitted heat signatures, allowing imaging and detection in conditions where visible light is limited or unavailable. This capability supports:

- **Visual Detection of Living Beings:** Locating personnel, animals, or heat-generating equipment through foliage or in darkness.
- **Thermal Diagnostics:** Identifying heat loss, electrical overloads, or abnormal temperature gradients in buildings or industrial systems.
- **Fire Assessment:** Spotting ignition points, hotspots, and smoldering materials in post-fire evaluations.
- **Reduced Visibility Imaging:** Maintaining visibility in smoke, haze, or light fog conditions.

## Gimbal Stabilization

The **Overwatch Gimbal Payload** employs a three-axis stabilization system that mechanically isolates the imaging sensors from aircraft vibration and movement. This system ensures:

- **Stabilized Imagery:** Clear, vibration-free video and still images even in crosswind or during maneuvering.
- **Target Tracking:** The ability to maintain focus on a subject regardless of aircraft attitude or heading.
- **Precision Pointing:** Independent control of camera pan, tilt, and zoom axes to maintain accurate orientation toward a region of interest.

## Zoom Capabilities

The EO and IR sensors provide **optical and digital zoom**, allowing for close visual inspection of distant objects without altering flight path or altitude. The system automatically compensates for image shift during zoom transitions to maintain image stability.

## Data Overlay and Annotation

All video and still imagery captured through the GCS can display embedded telemetry data, including:

- GPS coordinates
- Altitude
- Heading
- Timestamp

This metadata provides essential context for post-mission analysis and integration into reporting, mapping, or forensic workflows.

## Package Contents

### System Packing Configuration

Table 1 – System Item Storage Locations

Item Name	Location
Right Wing	A
Left Wing	B
Fuselage	C
Battery 1	D
Battery 2	D
Overwatch Payload	E
Mapping Array Payload	F
Testing Payload	G
GCS	H
GCS Controller Charger	I
CF Express Card Reader	I
International Power Supply Pack	I
60W USB-C Aircraft Battery Charger	I
Spare Propeller Set (3)	I
Threaded Nuts (3)	I
Ground Station Power Bank	J
Left Arm	K
Right Arm	L
Power Cord*	I

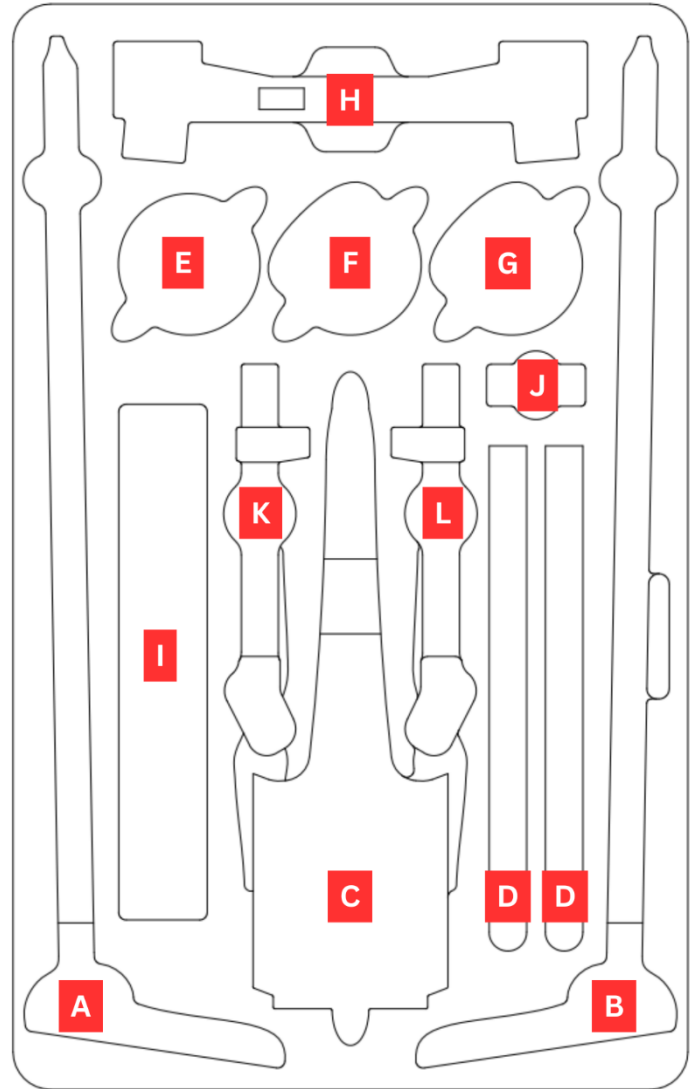


Figure 3 – System Transport Case Storage

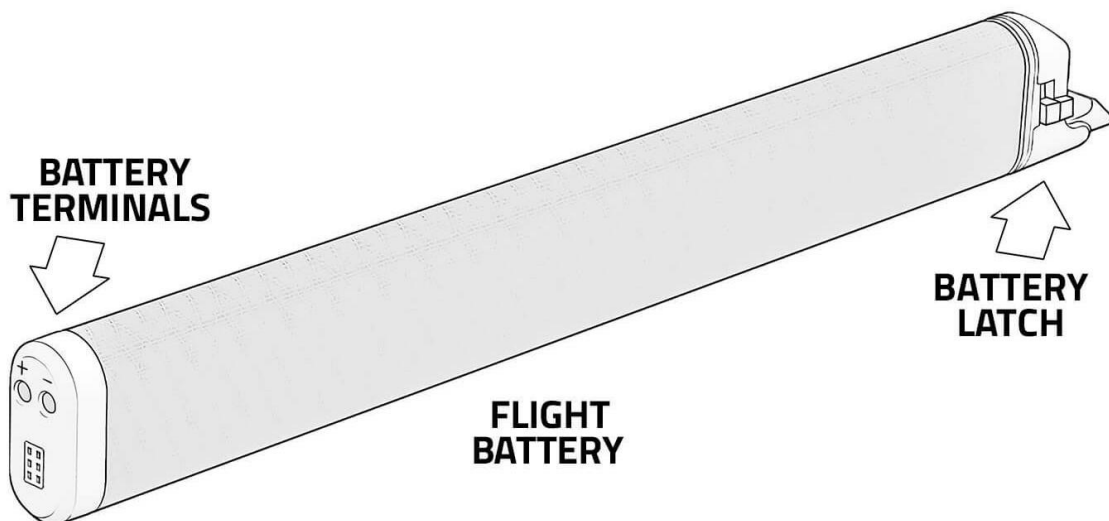
## Battery Management System

The Battery Management System includes all components required to power, charge, and maintain the Edge 130 sUAS. It consists of two (2) Batteries, a Battery Charger, and a region-specific power cable designed for safe and efficient operation across various locations.

### Air Vehicle Battery

**⚠ CAUTION**

Lithium-ion batteries may become unstable, overheat, damage cells, or catch fire if improperly stored.

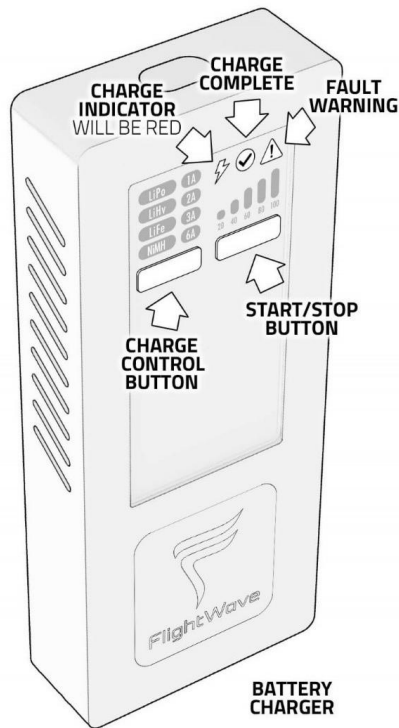


*Figure 4 – Air Vehicle Battery*

The Edge 130 sUAS operates on a single 14.8 V 6 Ah battery pack (4s2p), shown in *Figure 4*. This consists of eight (8) lithium-ion cells wired in a vertical stack of two (2) cells per row. This produces a total nominal voltage of 14.8 V (1.8 V per cell).

## Air Vehicle Battery Charger

The Edge 130 sUAS battery is charged via the provided AV battery charger shown in *Figure 5*.



*Figure 5 – Air Vehicle Battery Charger*

The charger's LED indicators denote the following:

- Charge Type
  - **LiPo – Only use this option when charging the Air Vehicle Battery**
  - LiHv – Unused
  - LiFe – Unused
  - NiMH – Unused

Current

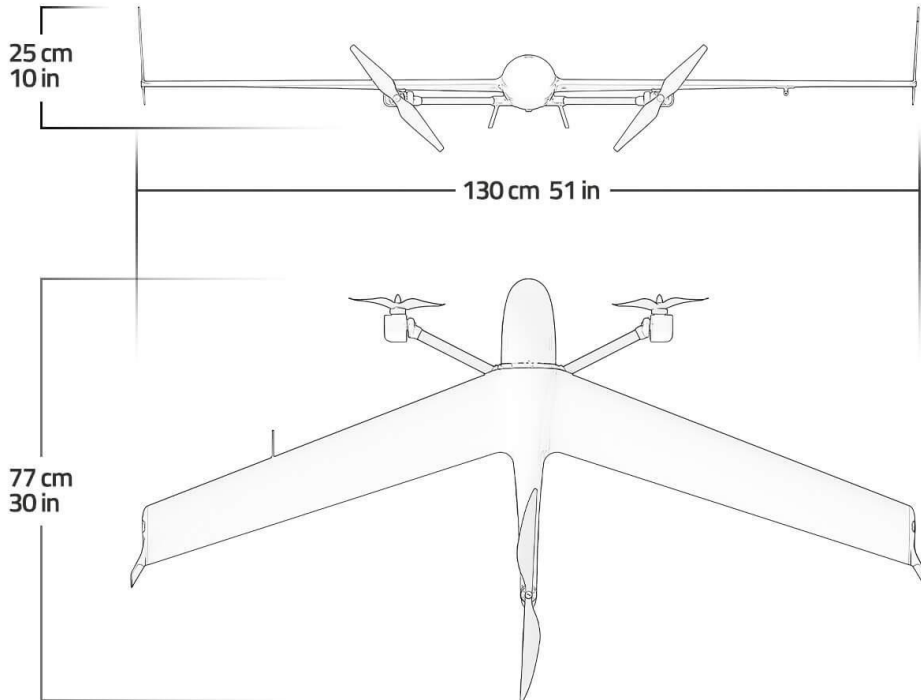
- 1A – Unused
- 2A – Unused
- **3A – Only use this option when charging the Air Vehicle Battery**
- 6A – Unused

- Red Lightning Bolt
  - Denotes active battery charging.
- Green Checkmark
  - Denotes successful charging of the inserted battery.
- Red Warning Sign
  - Denotes a charging fault. **Immediately remove the battery from the charger.**
- Charging Progress Graph
  - 20 – 20% battery charge.
  - 40 – 40% battery charge.
  - 60 – 60% battery charge.
  - 80 – 80% battery charge.
  - 100 – 100% battery charge.
- Start/Stop Button
  - Begin/end battery charging.
- Charge Control Button
  - Long-press to select LiPo.
  - Short-press to select 3A.

When connected to a 100-240 VAC outlet, the Air Vehicle Battery Charger can charge one (1) battery with an estimated charging time of two (2) hours.

See [\*Flight Battery Charging Procedure\*](#) for more information.

## Aircraft Dimensions



*Figure 6 – Edge 130 Aircraft Dimensions*

### **Aircraft Dimensions**

- Height: 25 cm | 10 in
- Width: 130 cm | 51 in
- Length: 77 cm | 30 in

## Ground Station Controller Dimensions



*Figure 7 – Ground Controller Dimensions*

### **Ground Station Controller Dimensions**

- Height: 15.2 cm | 6 in
- Width: 31.75 cm | 12.5 in
- Length: 4.5 cm | 1.8 in

## Operating Parameters



### CAUTION

Operation outside of the specified conditions may result in performance degradation or damage to the AV.

The following table lists the standard operating parameters for the Edge 130 sUAS:

*Table 2 – System Performance Characteristics*

Edge 130 sUAS Air Vehicle		
<b>Manufacturer</b>	<b>FlightWave Aerospace Systems</b>	
<b>Model</b>	<b>Edge 130</b>	
<b>Type</b>	System, Airframe	
<b>Weight</b>	1160 g (2.56 lb) without payload 1280–1460 g (2.8–3.2 lb) with payload	
<b>Dimensions</b>	130 × 77 × 25 cm (51 × 30 × 10 in) including payload	
<b>Hard Case Weight</b>	17 kg (38 lb)	
<b>Hard Case Dimensions (External)</b>	81 × 53 × 32 cm (32 × 21 × 13 in)	
<b>Power</b>	14.8 V 6 Ah battery pack (4s2p)	
<b>Charge Time</b>	115 minutes	
<b>Flight Time</b>	Multi-Rotor/Training Payload	25 minutes
	Fixed-Wing/Training Payload	90 minutes
	Multi-Rotor/Mapping Array	19 minutes
	Fixed-Wing/Mapping Array	60 minutes
	Multi-Rotor/Overwatch	16 minutes
	Fixed-Wing/Overwatch	59 minutes
<b>Nominal Cruise Airspeed</b>	15 m/s (29 kts / 33 mph / 54 kph)	
<b>Max Cruise Airspeed</b>	22 m/s (43 kts / 49 mph / 79.2 kph)	
<b>Min Cruise Airspeed</b>	11 m/s (10 kts / 24 mph / 40 kph)	
<b>Do Not Exceed Airspeed</b>	30 m/s (58 kts / 67 mph / 108 kph)	
<b>Stall Airspeed</b>	10 m/s (9 kts / 22 mph / 36 kph)	
<b>Theoretical Service Ceiling (ASL)</b>	3,650 m (12,000 ft)	

<b>Fixed-Wing Max Climb Rate</b>	3 m/s (10 ft/s)
<b>Fixed-Wing Max Descent Rate</b>	3 m/s (10 ft/s)
<b>Multi-Rotor Max Climb Rate</b>	5 m/s (16 ft/s)
<b>Multi-Rotor Max Descent Rate</b>	3 m/s (10 ft/s)
<b>Fixed-Wing Max Wind Speed</b>	17 m/s (15 kts / 40 mph / 64 kph)
<b>Multi-Rotor Max Wind Speed</b>	13 m/s (11 kts / 30 mph / 48 kph) oriented to headwind 4.5 m/s (4 kts / 10 mph / 16 kph) oriented to side/tailwind
<b>Max Wind Gust (<math>\Delta</math> from Avg.)</b>	6 m/s (5 kts / 13 mph / 21 kph)
<b>Operating Temperature Range</b>	-7 °C (19.4 °F) to 48 °C (118.4 °F)
<b>Water Resistance</b>	IP54
<b>Payload Options</b>	Overwatch Gimbal   Mapping Array
<b>Software/Firmware Updates</b>	Applications update automatically over Wi-Fi through the GCS. Firmware updates are installed by placing a validated <b>FWOTA</b> update file on one of the payload's removable storage media (CFexpress or SD card, depending on the payload), after which the system prompts the operator to begin the update process.
<b>Radio Frequencies</b>	900 MHz telemetry (868 MHz for EU systems), 1 W max, 2.4 GHz video, 1 W max
<b>Max Command / Control Range</b>	8 km   5 mi – clear line of sight
<b>Max Digital Data (Video) Range</b> (Clear line of sight)	<b>Directional antenna:</b> 12.8 km (8 mi) <b>Omnidirectional antenna:</b> 2 km (1.25 mi)
<b>Flight Controller</b>	Pixhawk Cube
<b>NDA Compliance</b>	<b>Both editions:</b> NDA compliant

*Table 3 – GCS Performance Characteristics*

<b>Ground Station Controller</b>	
<b>Property</b>	<b>Limit</b>
<b>Communication Frequencies</b>	868 MHz or 900 MHz, 2.4 GHz, 5.8 GHz
<b>GPS</b>	UBLOX ZED-F9P-04B-01
<b>Radio</b>	pMDDL
<b>Maximum Communication Power</b>	868 / 900 MHz: 1 W   2.4 GHz: 1 W
<b>Maximum Command / Control Range</b>	8 km   5 mi (clear line of sight)
<b>Maximum Video Range</b>	8 km   5 mi (clear line of sight)
<b>Operational Air Temperature</b>	-7 °C to 48 °C   20°F to 120°F
<b>Operational Humidity</b>	0 % to 90 % (non-condensing)
<b>Controller Battery Capacity</b>	59.2 Wh   16.0 Ah   3.7 V
<b>Controller Operational Time</b>	Approximately two (2) hours at full brightness, max radio power, charged external battery pack
<b>Controller Weight</b>	720 g   1.59 lbs

## Edge 130 Parts Identification

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This chapter highlights the key components of the Edge 130 aircraft.

# Edge 130 Parts Identification

## Overall Airframe Assembly

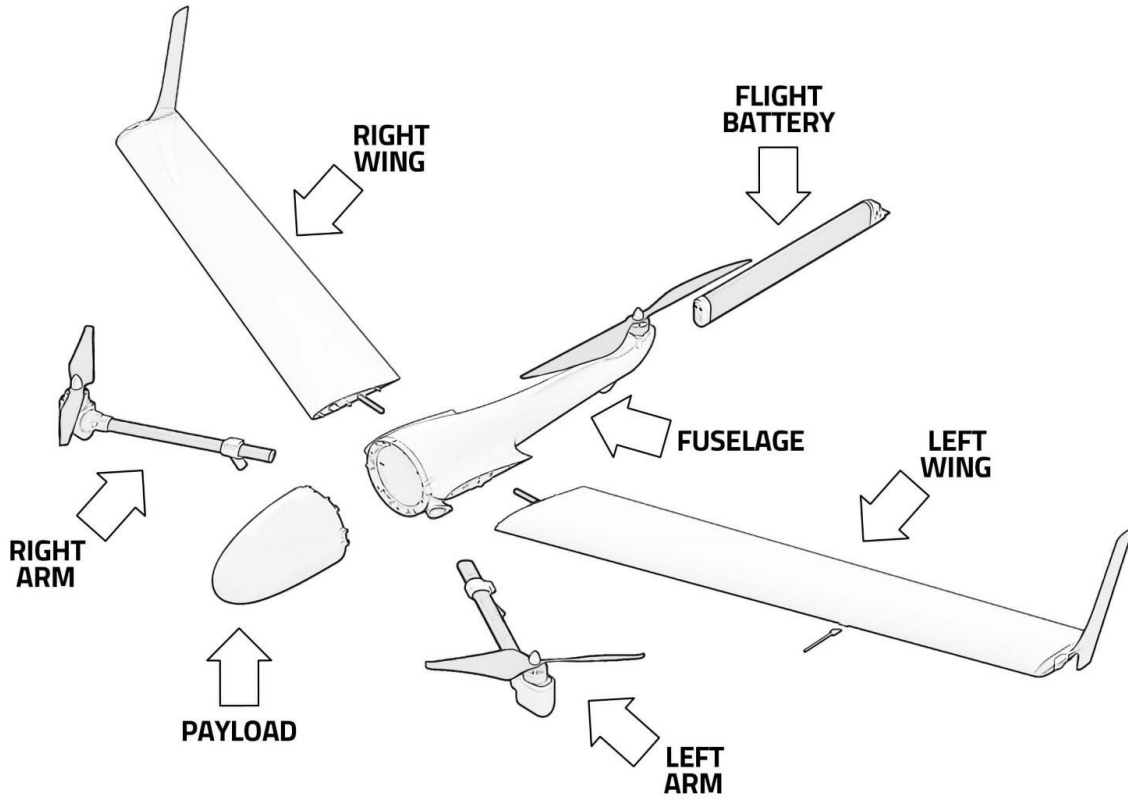


Figure 8 – Overall Airframe Assembly Diagram

## Transition States

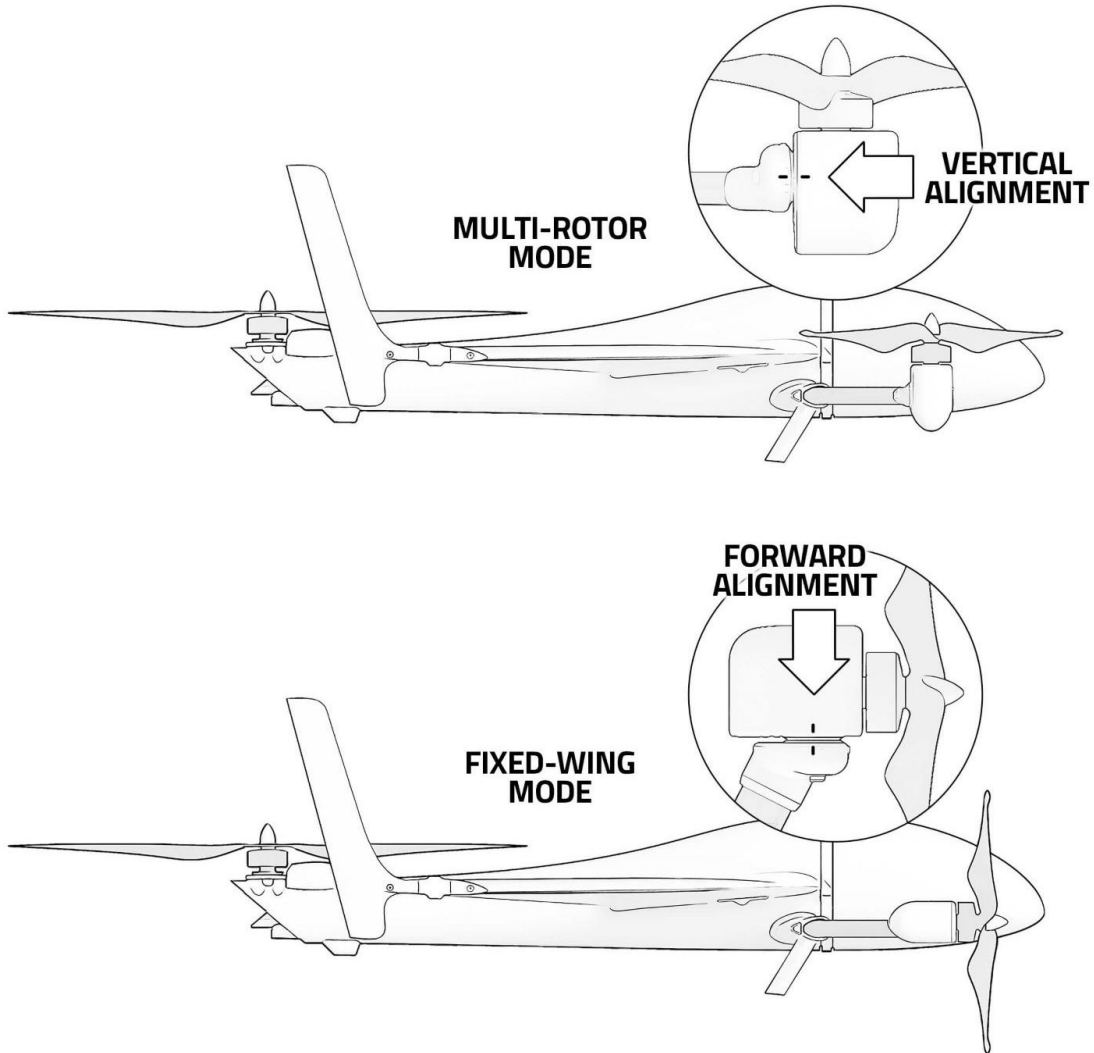
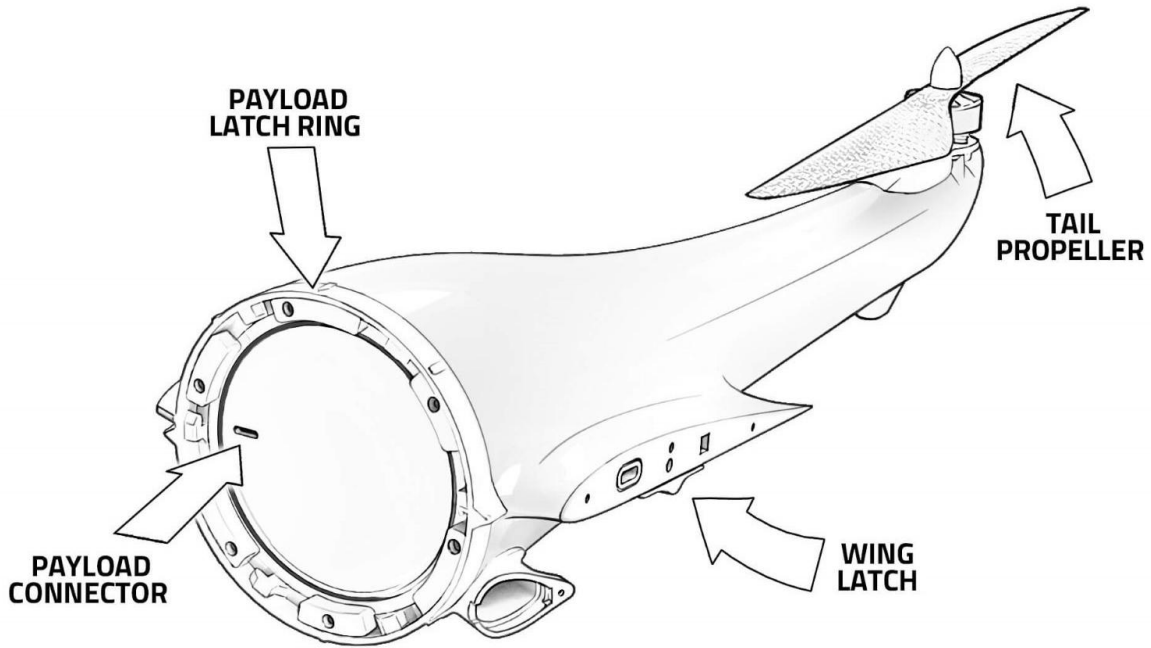


Figure 9 – Transition State Diagram

## Fuselage Parts and Features



*Figure 10 – Fuselage Parts and Features Diagram*

## Wings Parts and Features

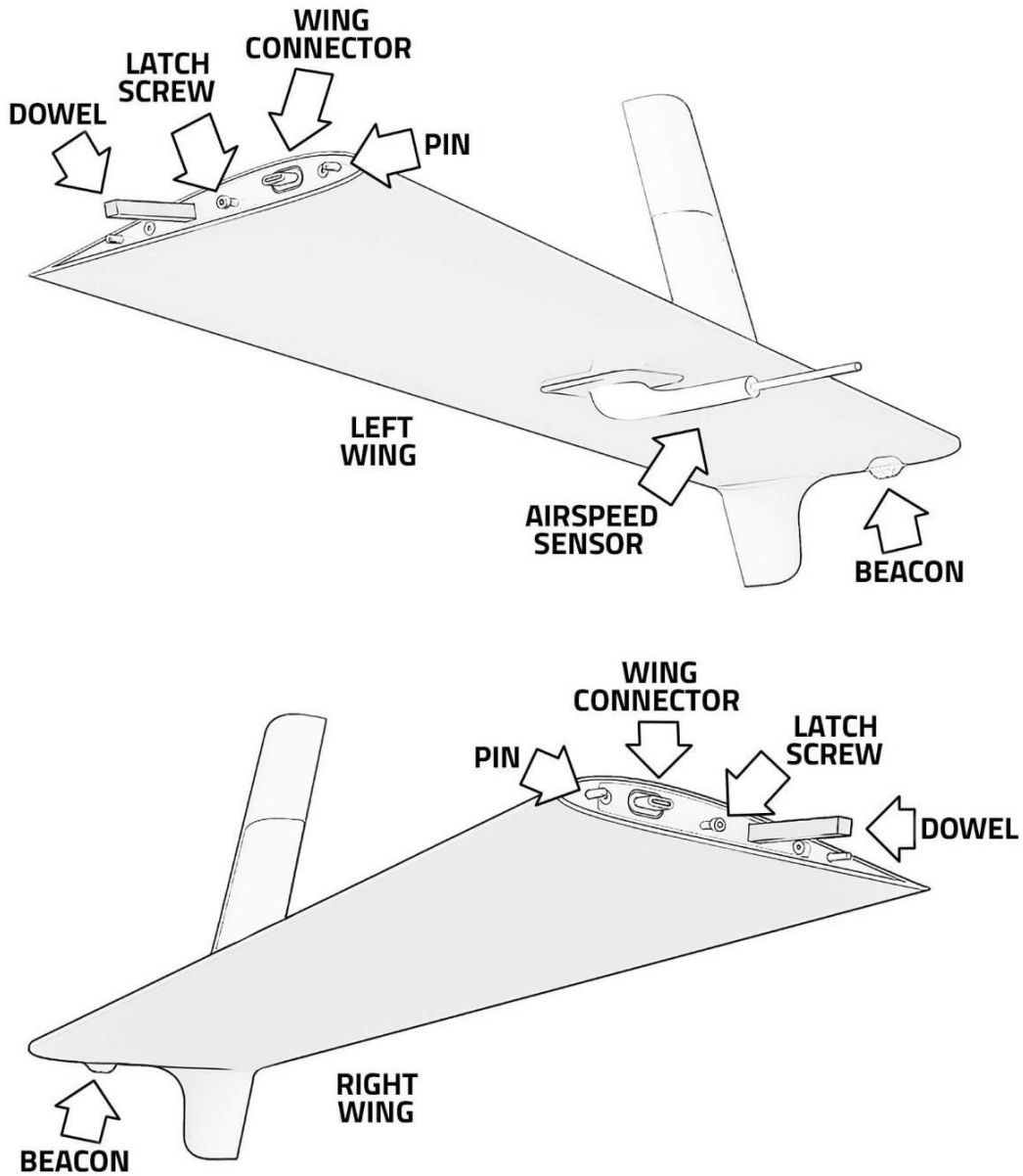


Figure 11 – Wings Parts and Features Diagram

## Arms Parts and Features

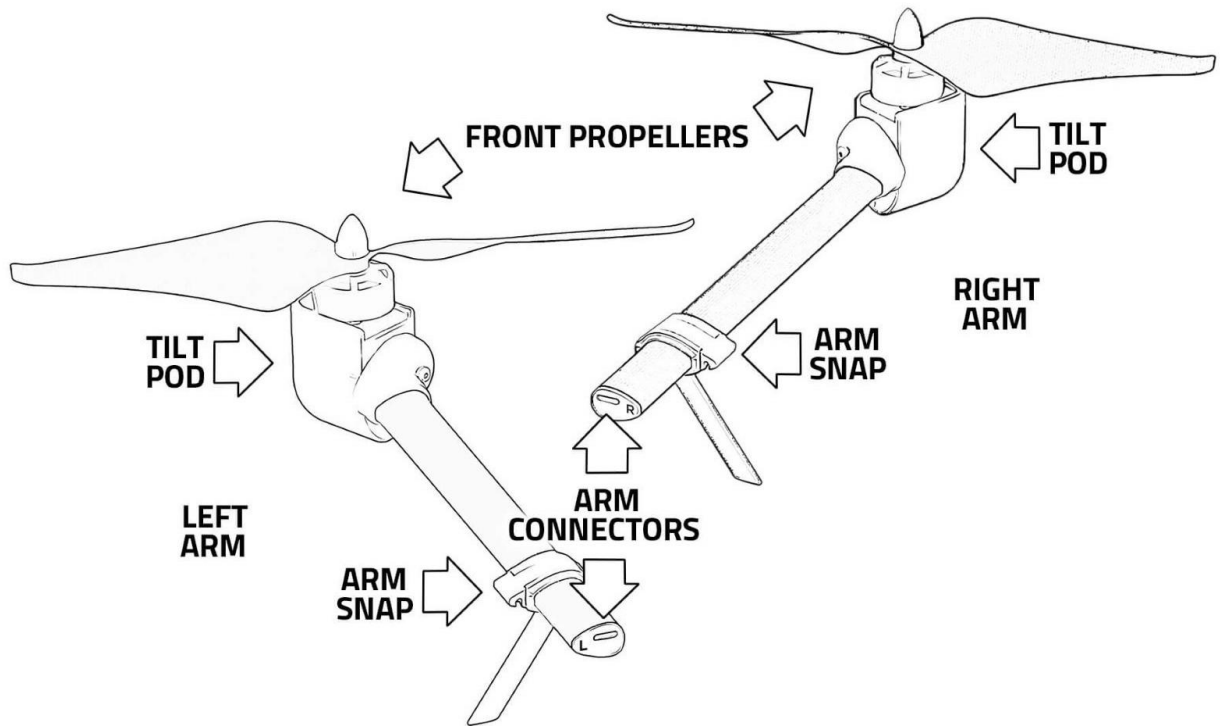


Figure 12 – Arms Parts and Features Diagram

## Payload Parts and Features

**⚠ CAUTION – Payload Latch**

The payload latch may not fully close automatically. Always verify that the latch is completely secured before flight. If necessary, manually close the latch until the alignment arrows are precisely matched.

### PAYLOAD

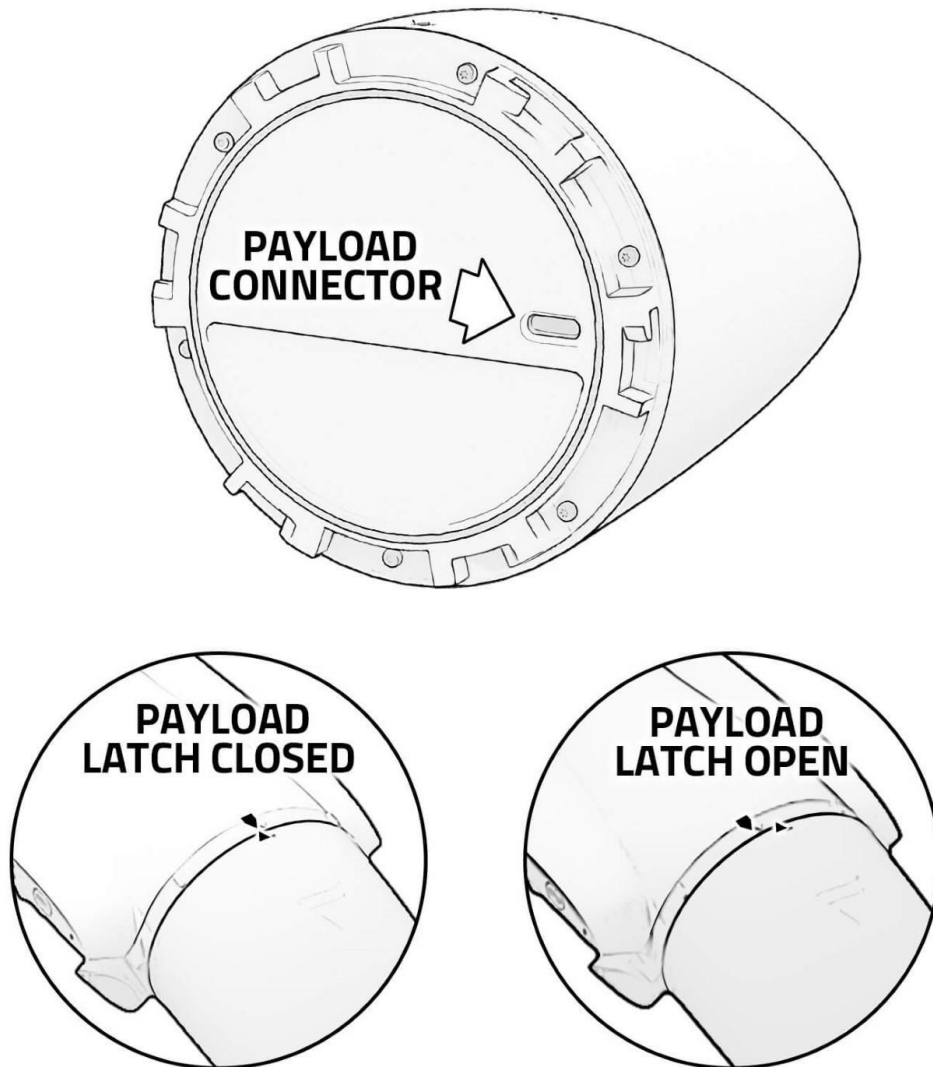


Figure 13 – Arms Parts and Features Diagram

## Battery Parts and Features

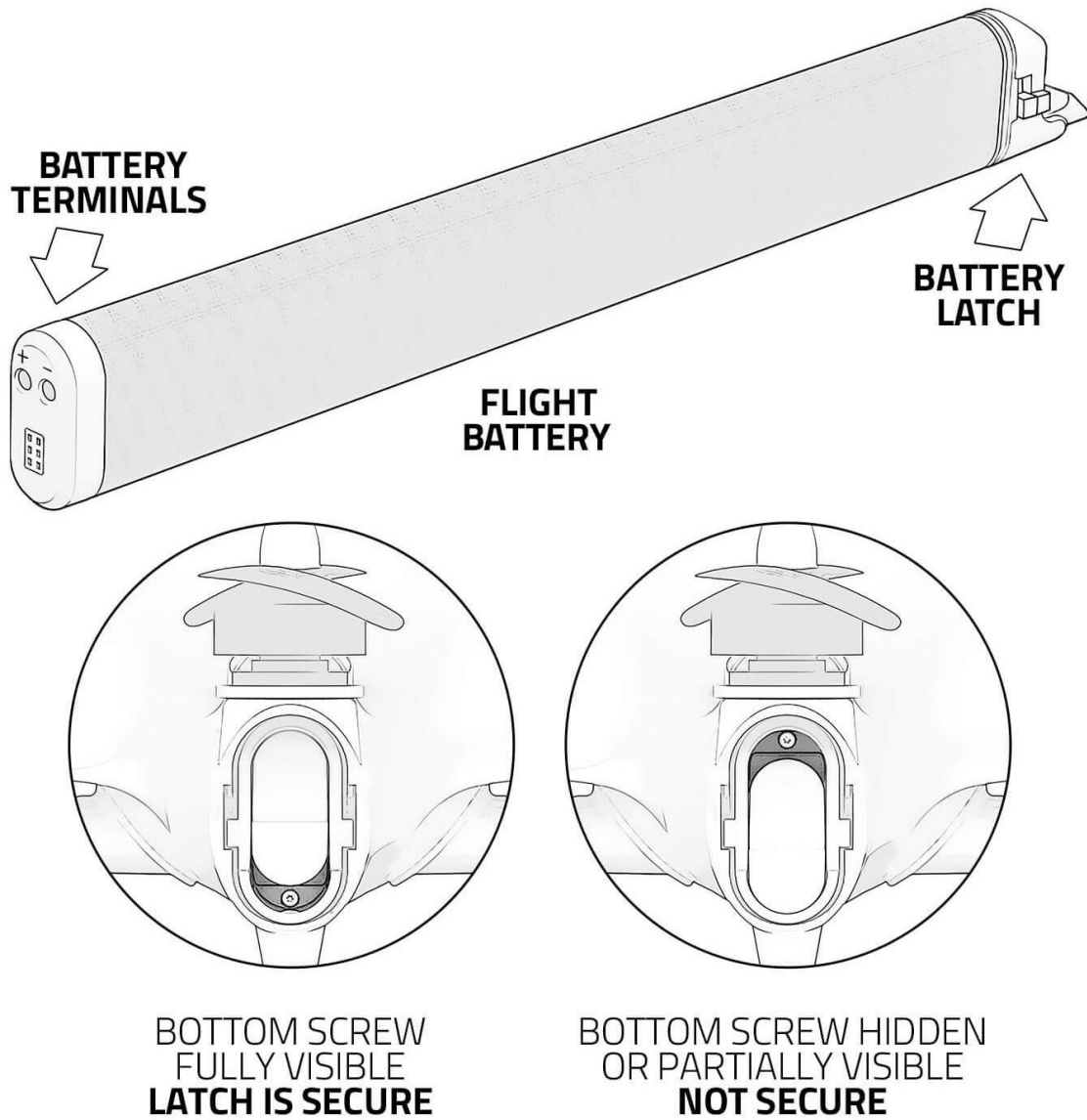


Figure 14 – Battery Parts and Features Diagram

## Flight Battery Charger

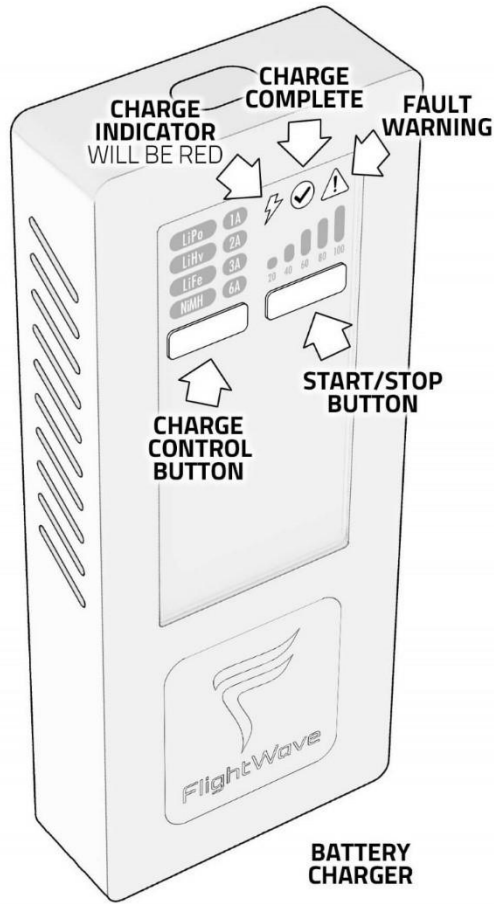


Figure 15 – Flight Battery Charger Diagram

## Flight Battery Usage and Warnings

### **WARNING – Improper Battery Handling**

Improper battery handling can result in fire, explosion, or permanent damage to the aircraft. Always follow these instructions carefully.

for more information.

If **battery damage** is suspected, see [\*Damaged Battery Procedures \(Hazmat Safety\)\*](#) for more information.

To ensure safety and battery longevity, follow these guidelines:

- Use **only FlightWave-certified batteries** in the Edge 130. Charge batteries exclusively with an **authentic FlightWave Charger**.
- Store batteries safely in the **allocated slots** within the device transport case.
- Never allow batteries to contact **metal objects**.
- Do **not** strike, pierce, step on, or otherwise **modify the battery**.
- Keep batteries away from **heat sources, microwave ovens, pressurized environments, and liquids**.

## Edge 130 Anatomy

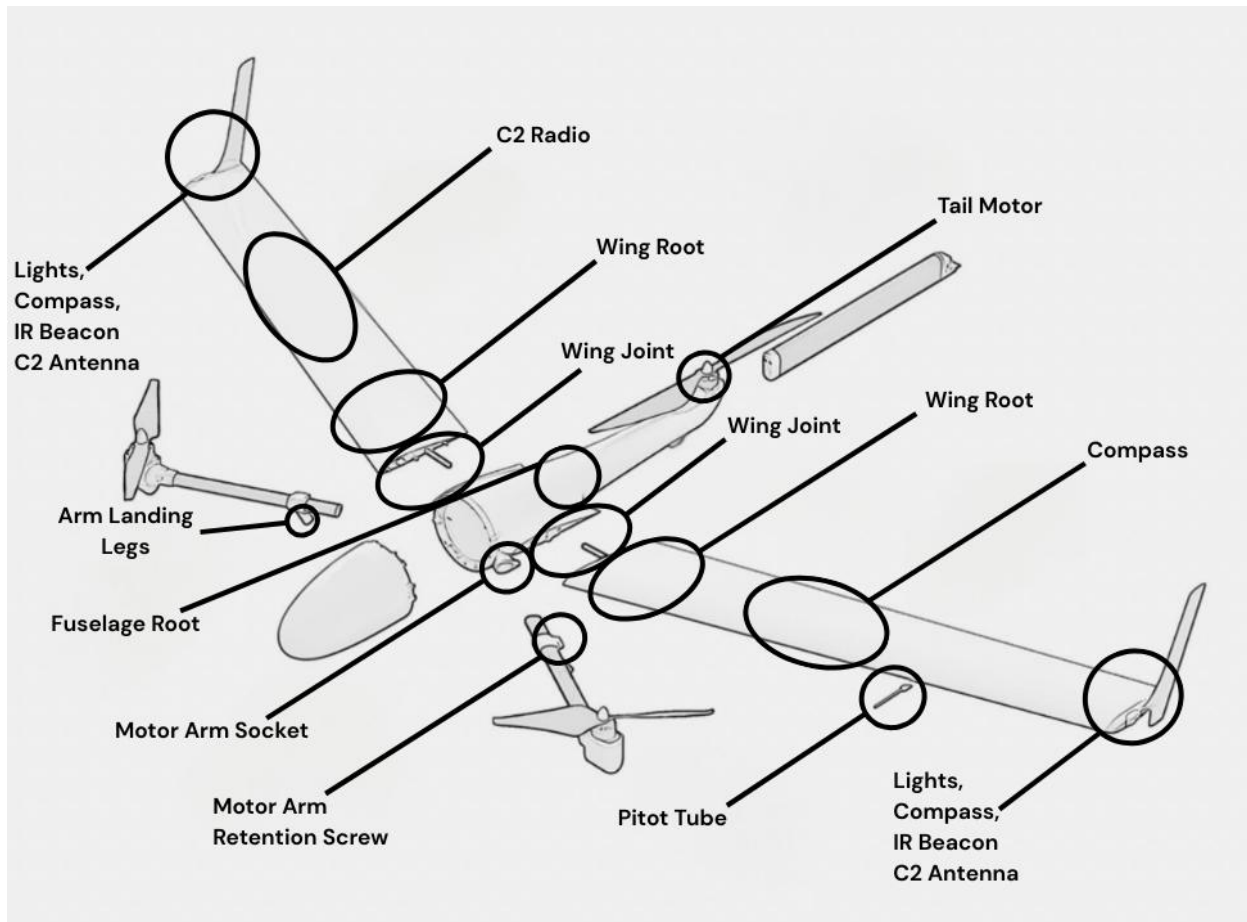


Figure 16 – Edge 130 Anatomy

### Lights

Navigation and status indicator lights are located on the wings and fuselage for visibility and identification.

### Compass

The aircraft uses a magnetic sensor to determine heading and orientation relative to magnetic north.

### Internal Radio Beacon

A transmitter is used to assist in identifying, tracking, and recovering the aircraft.

### **Arm Landing Legs**

Structural legs attached to the motor arms that provide ground clearance and landing support.

### **C2 Radio**

Primary Command-and-Control radio responsible for receiving pilot inputs and transmitting telemetry data.

### **Wing Root**

The inner section of the wing, where it connects to the fuselage.

### **Wing Joint**

The mechanical interface that secures the wing to the fuselage and provides structural support.

### **Fuselage Root**

The reinforced area of the fuselage where wings, arms, and internal systems are anchored.

### **Tail Motor**

Rear-mounted propulsion motor used for forward thrust in fixed-wing flight.

### **Pitot Tube**

An airspeed sensing device that measures airflow to calculate airspeed during flight.

### **Motor Arm Socket**

The fuselage opening that receives and secures each motor arm.

### **Motor Arm Retention Screw**

Mechanical fastener that locks the motor arm into the socket and prevents movement during flight.

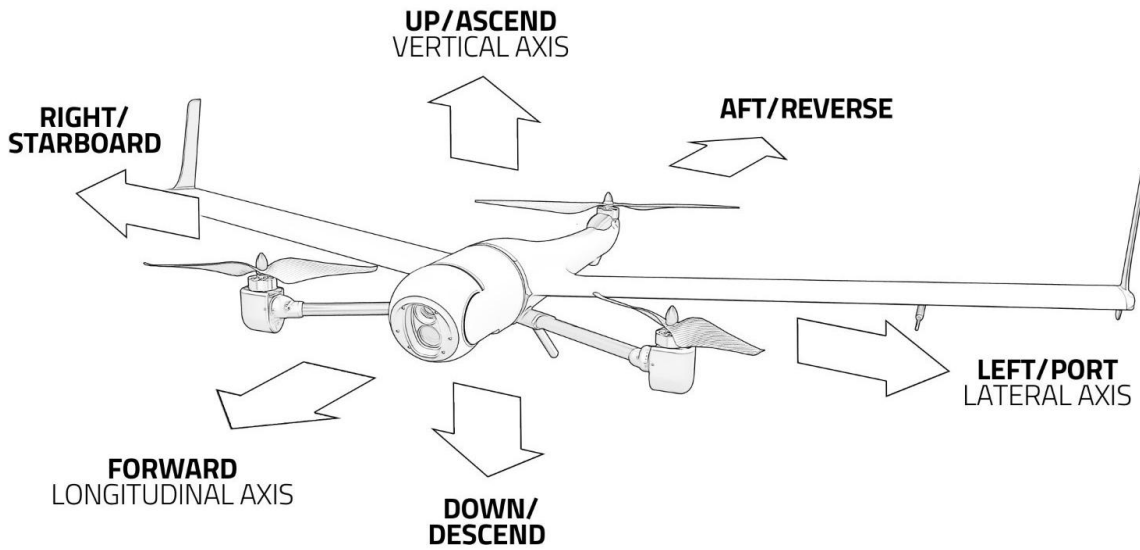
## Flight Terminology

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This chapter outlines the terminology used to describe the Edge 130 directional flight movement.

# Flight Terminology

## Aircraft Directions



*Figure 17 – Aircraft Dimensions*

**Six** principal directions define aircraft translation:

- Forward
- Reverse/Aft
- Left/Port
- Right/Starboard
- Up/Ascend
- Down/Descend

## Aircraft Attitude

Three angles define rotational orientation relative to the horizon:

- **Roll (right/left):** Rotation around the longitudinal axis
- **Pitch (up/down):** Rotation around the lateral axis
- **Yaw (right/left):** Rotation around the vertical axis

Collectively, these define the **aircraft's attitude**. Understanding general rotation responses is sufficient for piloting.

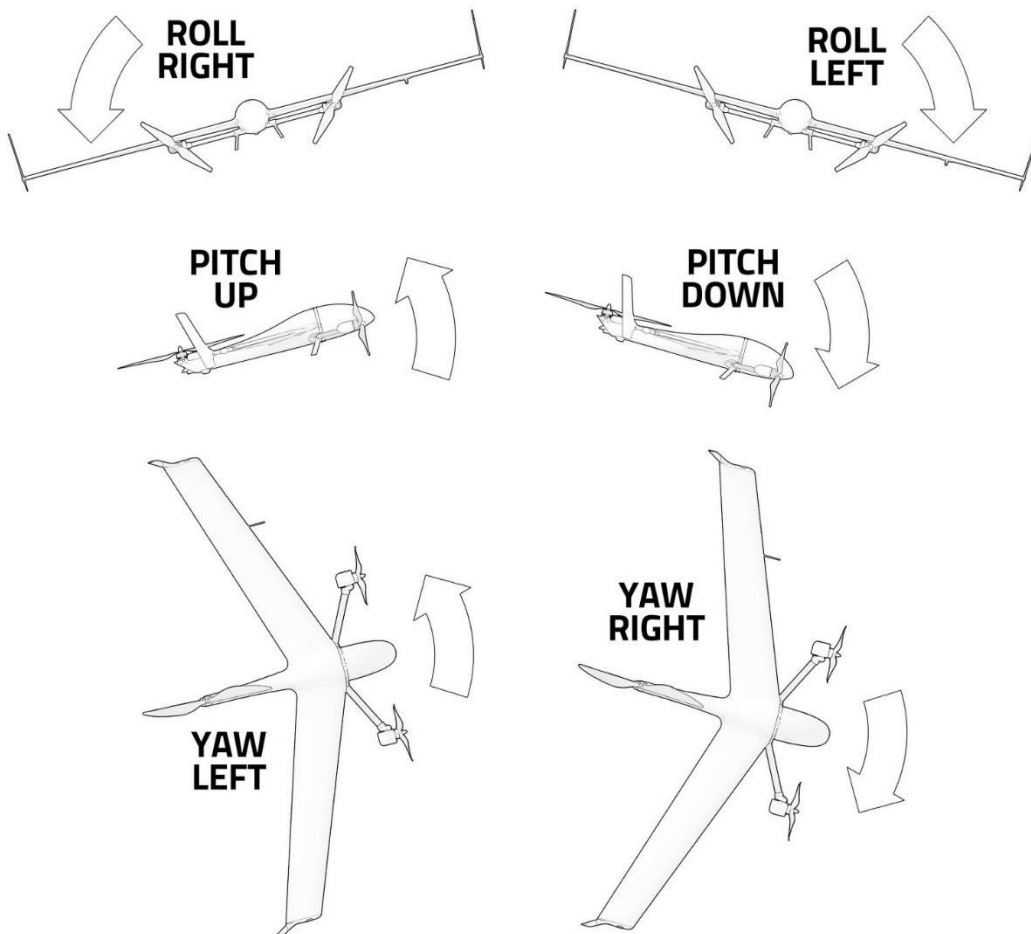


Figure 18 – Aircraft Attitude

## Altitude

- **Altitude Above Sea Level (AMSL):** Vertical distance from mean sea level. Also known as Absolute Altitude.
- **Altitude Above Ground Level (AGL):** Vertical distance above the terrain directly below.
- **Relative Altitude:** Vertical distance above the Home Location (GPS location when armed).
- **Terrain Altitude:** AMSL distance of terrain points relative to mean sea level.

## Speeds

- **Airspeed:** Speed relative to the surrounding air. Critical for stall awareness and performance management.
- **Groundspeed:** Speed relative to the ground; affected by wind.
- **Stall Airspeed:** Minimum airspeed at which the wings generate sufficient lift for safe fixed-wing flight.

## Pre-Flight Operations

---

This chapter outlines the procedures to prepare the system for safe flight operations.

## Pre-Flight Operations



### ACTIONS UPON RECEIPT

Operation outside of the specified preparation conditions may result in performance degradation or damage to the AV.

## Unpacking

This section provides guidance for safely unpacking and inspecting the FlightWave Edge 130 system and its components. Proper unpacking ensures all equipment is present, undamaged, and ready for setup and operation.

Handle all items with care to prevent damage to sensitive electronic components and sensors.

## Packaging Inspection

### 1. Inspect the Outer Packaging:

Before opening the shipping container, examine the exterior for visible signs of damage such as tears, punctures, or compression.

- a. If the packaging shows evidence of mishandling, photograph the damage before opening.
- b. Report any shipping irregularities immediately to *FlightWave Support* before proceeding.

### 2. Verify Shipping Labels:

Ensure that the shipping documentation and label match the intended aircraft configuration and serial number.

## Unpacking Procedure

1. Place the shipping container on a **stable, clean surface** in a well-lit area.
2. Use appropriate tools (e.g., box cutter or scissors) to **carefully cut open** the packaging tape.
  - a. Avoid cutting too deeply to prevent damage to components inside.
3. Remove the **protective foam inserts** and set them aside for future transport or storage.
4. Lift each component individually, using **both hands** for large or heavy items such as the airframe or GCS tablet.
5. Place components on a **static-free, padded surface** to prevent damage during inspection.

## Storage of Packaging Materials

Retain all original packaging materials, including foam inserts and shipping boxes. These materials are **engineered for safe transport** and should be reused whenever the system is shipped or relocated. Proper packaging ensures the continued protection of sensitive components and compliance with FlightWave transport recommendations.

## Initial Inspection

After confirming all components are present:

1. **Visually inspect** each item for cracks, dents, loose fittings, or connector damage.
2. Verify that all **labels, serial numbers, and identification tags** are intact and legible.
3. Gently **check propeller mount alignment** and ensure the arms and fuselage are free of deformation.
4. Examine **electrical contacts and data ports** for foreign debris or corrosion.
5. Do **not connect or power on** any components until all inspections are complete.

## Readiness for Setup

Once the contents have been verified and inspected:

- Proceed to the **GCS First-Time Setup** section to begin system setup.
- Ensure that all packaging materials are stored in a clean, dry environment for future use.
- If any damage, irregularities, or missing items were identified, **do not attempt to assemble or operate** the aircraft until directed by FlightWave Technical Support.

## GCS First-Time Setup

---

This chapter outlines the recommended GCS first-time setup.

## Ground Control Station (GCS) First-Time Setup

This section describes the recommended procedure for configuring the GCS during initial use. Completing these steps ensures correct system behavior, consistent units, reliable map access, and a stable baseline configuration before mission planning or flight operations.

These steps are intended to be performed **once during initial setup**, or again following a factory reset, software reload, or new GCS deployment.

### Physical Setup and Power-On

Before powering on the GCS, ensure the hardware is correctly prepared.

### Hardware Inspection and Preparation

1. Verify all **buttons, ports, and connectors** are free of debris or damage.
2. Confirm that the **battery is fully seated** in the GCS.
3. Inspect antenna connections:
  - Ensure antennas are installed and finger-tight.
  - Antennas should be oriented per operational guidance.
4. Ensure the **cooling fan intake and exhaust are unobstructed**.
  - Do **not** block vents with hands, cases, or mounting hardware.
  - Adequate airflow is required during boot and sustained operation.

#### Why this matters:

Blocking airflow during startup can cause thermal throttling or delayed application loading, particularly during first-time initialization.

## Power-On Behavior

1. Power on the GCS using the designated power button.
2. Observe the startup sequence:
  - The system will display a **loading circle** during initialization.
  - Allow the device to fully boot before launching any applications.
3. Do not interact with the screen until the boot process completes.

 **NOTE**

Initial startup after factory configuration may take longer than subsequent boots.

## Initial Application Launch

Once the GCS has completed booting:

1. Launch the **FlightWave application** from the home screen.
2. On first launch, the app will initialize default settings and load core services.

 **IMPORTANT**

During first-time setup, configuration changes should be made **before** connecting to an aircraft or loading missions.

## General Settings Configuration (First-Time Setup)

Navigate to:

**FlightWave App** → **General Settings**

This section establishes foundational system behavior, including units and measurement standards.

### Restore Factory Defaults

For a clean baseline configuration:

1. In **General Settings**, select **Factory Settings** (or equivalent reset option).
2. Confirm the reset when prompted.

This ensures all values begin from a known, validated state.

### Unit Configuration

After the factory reset, configure units according to operational needs.

#### Default Factory Units

Factory defaults are typically set to:

- **Distance:** Meters
- **Area / Scale:** Square meters
- **Speed:** Meters per second (m/s)

## Changing Units to Imperial

1. In **General Settings**, locate the **Units** section.
2. Change the system units to **Imperial**:
  - Distance → Feet
  - Area / Scale → Feet (or feet-based equivalents)
  - Speed → Feet per second or mph (as applicable)



### IMPORTANT

**Unit changes do not take effect until the application is restarted.**

## Applying Unit Changes

1. After changing units, **fully exit and relaunch** the FlightWave app.
2. Verify that all displayed values now reflect the selected units.

### Why this matters:

Some parameters (such as altitude thresholds and mission constraints) are calculated at load time and will not correctly convert unless the app restarts.

## Minimum Altitude Configuration

Once units are correctly applied:

1. Navigate to altitude-related settings.
2. Set the **Minimum Altitude** value.

### Operational Context:

Minimum altitude configuration is **use-case dependent**:

- Some operations may require a higher minimum altitude for terrain clearance.
- Others may require tighter constraints for confined or urban environments.

## Wi-Fi Usage for Offline Map Setup

Wi-Fi should be enabled **only when needed** to minimize interference and maintain operational reliability during flight.

### Enable Wi-Fi

1. Enable Wi-Fi on the GCS.
2. Connect to a trusted network with internet access.

### Download Offline Maps

Offline maps allow full mission planning and navigation **without an active internet connection** during flight.

Navigate to:

**Maps** → **Offline Maps** → **Add New Set**

### Step-by-Step Offline Map Creation

1. Select **Add New Offline Map Set**.
2. Enter a **Name** for the map set.
  - Use a descriptive name (e.g., *Test Range West, Customer Site Alpha*).
3. Select the **Map Provider**.
  - Use the same provider configured in **General Settings** to ensure visual consistency.
4. Set the **Zoom Levels**:
  - **Minimum Zoom:** 13
  - **Maximum Zoom:** 19
5. Verify the **File Size**:
  - Keep the total download **under 24 MB**.

6. Confirm the selection and select **Download**.
7. Wait for the download to fully complete.



**IMPORTANT**

Do not close the app or disable Wi-Fi until the download is finished.

## **Disable Wi-Fi After Download**

Once offline maps are downloaded:

1. Turn **Wi-Fi OFF**.
2. Confirm the GCS is operating offline.

### **Why this matters:**

Disabling Wi-Fi during operations:

- Reduces potential RF interference.
- Improves system stability.
- Aligns with recommended flight configuration.

## First-Time Setup Completion Check

At this point, the GCS should be considered **pre-flight ready** from a configuration standpoint.

Confirm the following:

- Units are correctly set and applied
- Minimum altitude is configured correctly for the intended use case
- Offline maps are downloaded and accessible
- Wi-Fi is disabled
- No warnings or configuration prompts are present

## Next Steps

With first-time setup complete, the operator may now:

- Load or create missions
- Connect to an aircraft
- Perform pre-flight inspections
- Proceed with normal operational workflows

 **NOTE**

First-time setup should not be rushed. Taking the time to configure the GCS correctly reduces the likelihood of unit mismatches, altitude errors, or map availability issues during flight.

## Edge 130 AV Assembly

---

This chapter outlines the procedures for the Edge 130 AV and Ground Control Station assembly.

## Edge 130 AV Assembly

### CAUTION

The Edge 130 airframe is constructed from lightweight composite materials and precision components. Exercise care during handling and assembly to prevent damage to the skin or structural elements.

This aircraft utilizes **USB-C-type connectors** that are **not standard USB-C interfaces**. **Do NOT** insert any non-FlightWave cables or plugs into these connectors, as this may cause permanent damage.

Do **not** force any components into the fuselage. All parts—such as sliding locks, snaps, and connectors—should seat smoothly when properly aligned and free of debris. Before assembly, visually inspect each connector and mating surface to ensure they are clean and unobstructed.

The **Edge 130** is shipped with its propellers **semi-permanently installed** on the motor arms. The lock nuts securing the propellers to the thrust motor-shaft **are torqued to a specific value**. Under normal operating conditions, **propellers should not be removed** unless replacement of a damaged unit is required.

Due to the aircraft's wingspan and modular design, **adequate workspace** is required for safe assembly. The **transport case lid** may be used as a stable and level surface for this purpose.

**FlightWave Aerospace strongly recommends** that **two qualified personnel** perform the air vehicle (AV) assembly process to prevent damage and ensure proper alignment.

- Verify that the **GCS transition switch** is positioned to the **left** prior to aircraft power-up.

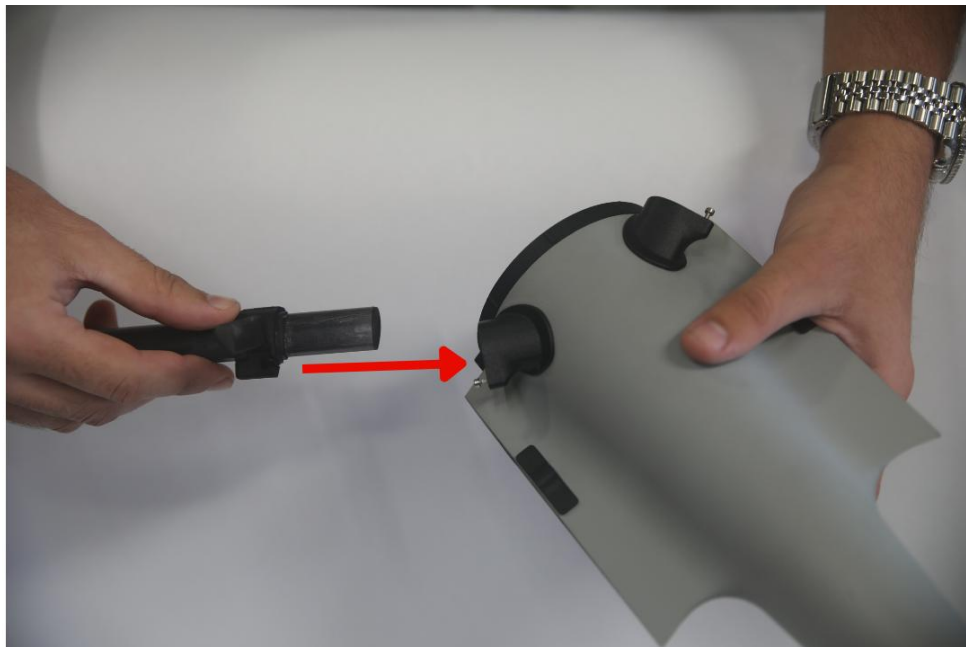
## Fuselage Assembly

1. **Remove the fuselage** from the transport case and place it on a clean, flat, and stable surface.
2. The fuselage is designed to be held **just behind the wing joint**, which serves as the designated grip point for handling.
  - **Do not** apply pressure or squeeze any other section of the fuselage, as this may damage internal components or the outer composite skin.

## Motor Arm Assembly

Perform the following steps **one arm at a time** to ensure proper installation and avoid component damage.

1. **Remove one motor arm** from the transport case and inspect it for any visible signs of damage or obstruction.
2. **Orient the arm** so it aligns with the corresponding socket on the fuselage.
  - When correctly positioned, the **motor should face upward**.



*Figure 19 – Motor Arm Alignment*

3. **Insert the arm** into the fuselage socket and **gently slide it into place**.

A light rotational motion may be required to guide the arm through the **sealing O-ring**

- Do **not** force the arm. It should slide smoothly when correctly aligned.
5. If resistance prevents full insertion, **remove the arm** and confirm that it is being installed on the **correct side of the aircraft**.



*Figure 20 – Motor Arm Installation Procedure*

6. As the **arm latch contacts the retention screw**, use your thumb to **gently lift the latch** and continue inserting the arm fully into the fuselage.
7. Once the arm is seated, **secure the latch** by pressing it firmly into the locked position. Verify that the latch is fully engaged.



*Figure 21 – Seated Motor Arm*

8. Gently attempt to move the arm to confirm that it is **rigidly seated** with **no looseness or movement** at the connection point.
9. **Repeat steps 1-8** for the remaining motor arm.

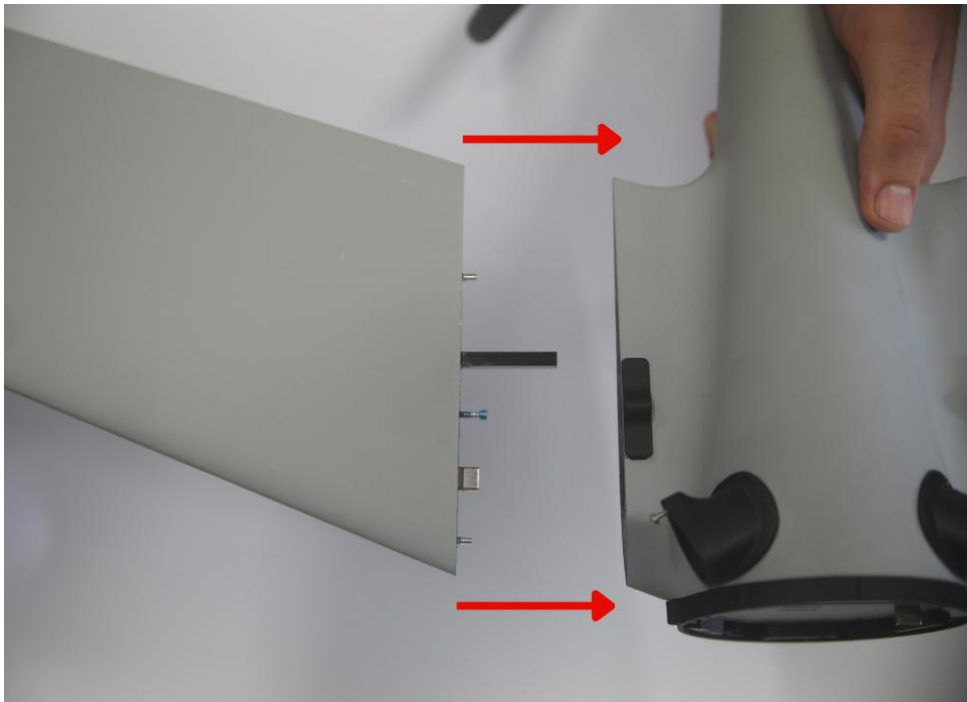
## Wing Assembly

 **CAUTION**

The wing should be handled only near the **root section**, close to the connectors and mounting hardware.

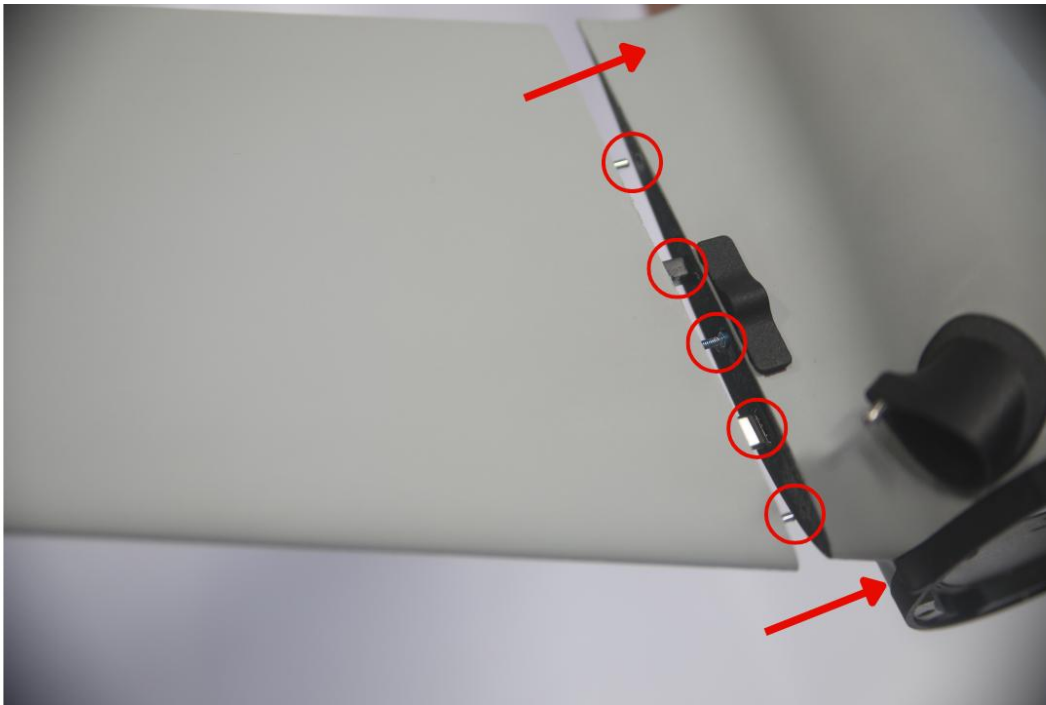
Avoid applying excessive pressure to the wing surfaces — **over-squeezing may cause permanent dents**. While such dents typically do not affect flight performance, they are **cosmetic and cannot be removed** once formed.

1. **Remove one wing** from the transport case and inspect it for any visible damage or obstruction.
2. **Orient the wing** for installation on its corresponding side of the fuselage.
  - The **wing tip should point upward** when correctly positioned.



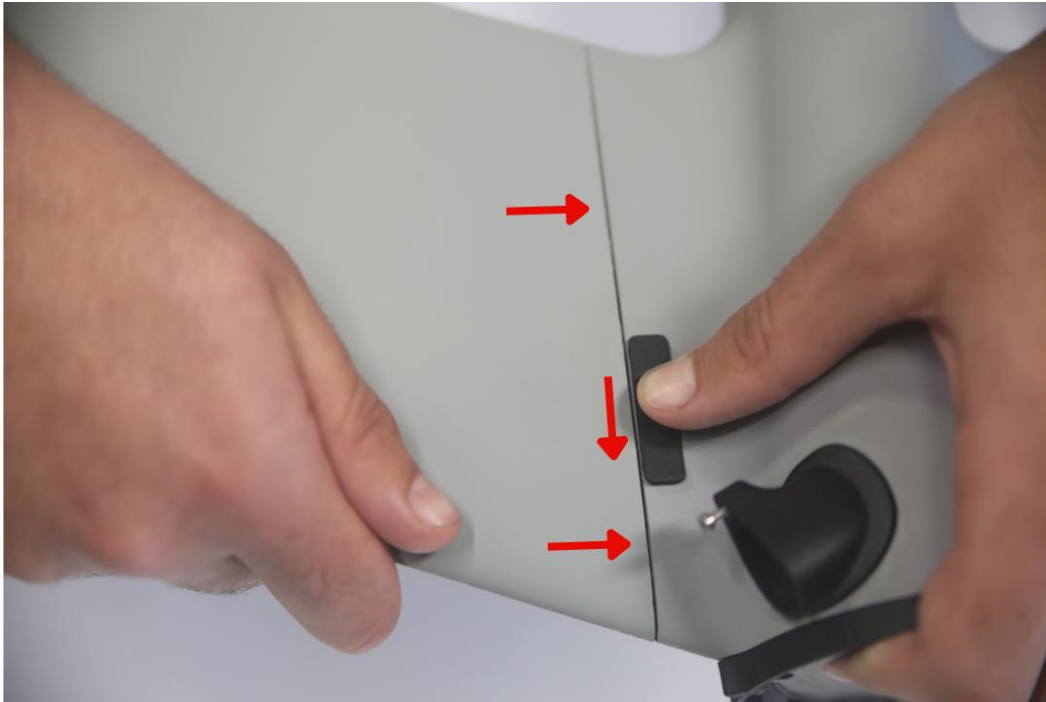
*Figure 22 – Initial Wing Assembly*

3. **Align the main square dowel** on the wing with the corresponding square socket on the fuselage.



*Figure 23 – Verify Wing Alignment*

4. **Verify alignment** of all remaining connection points, including the USB-C connector, guide pin, and latch hardware.
  - If any hardware does not align, confirm that the wing is being installed on the **correct side of the aircraft**.
5. **Insert the wing** into the fuselage joint and **slide it smoothly into place**.
6. Assist as needed by gently guiding the **silver alignment hardware** into its corresponding receiver on the fuselage.



*Figure 24 – Seating Wing with Wing Latch*

7. As the **wing retention screw** begins to seat, **open the wing latch** by pushing it **forward** (toward the nose of the aircraft) with your thumb.
8. If the joint resists closing, **do not force it**. Remove the wing and recheck alignment and side orientation.
9. Once fully seated, **secure the wing latch** by sliding it **rearward** (toward the tail of the aircraft) until it locks firmly.
10. **Verify proper installation:**
  - The wing should be **flush with the fuselage**.
  - The **latch must be fully engaged** and locked in place.
  - Verify O-rings are securely connected by looking for any light or gaps in the wing connection point.
  - Units include a small **black Sharpie alignment mark** on the latch mechanism. This mark provides a quick visual indication that the latch is fully closed. Ensure the mark lines up cleanly with its reference point on the fuselage or payload ring.

## Payload Assembly:

 **CAUTION**

Before beginning, **select the payload** for your mission and review the corresponding payload manual.

Some payloads have **specific handling or operational precautions** that must be observed.



*Figure 25 – Payload Assembly Introduction*

1. **Orient the payload** and position it at the front of the fuselage.



*Figure 26 – Payload Orientation*

2. **Align the payload data connector** with the fuselage data connector. Ensure the payload is **centered on the fuselage's front wall**.

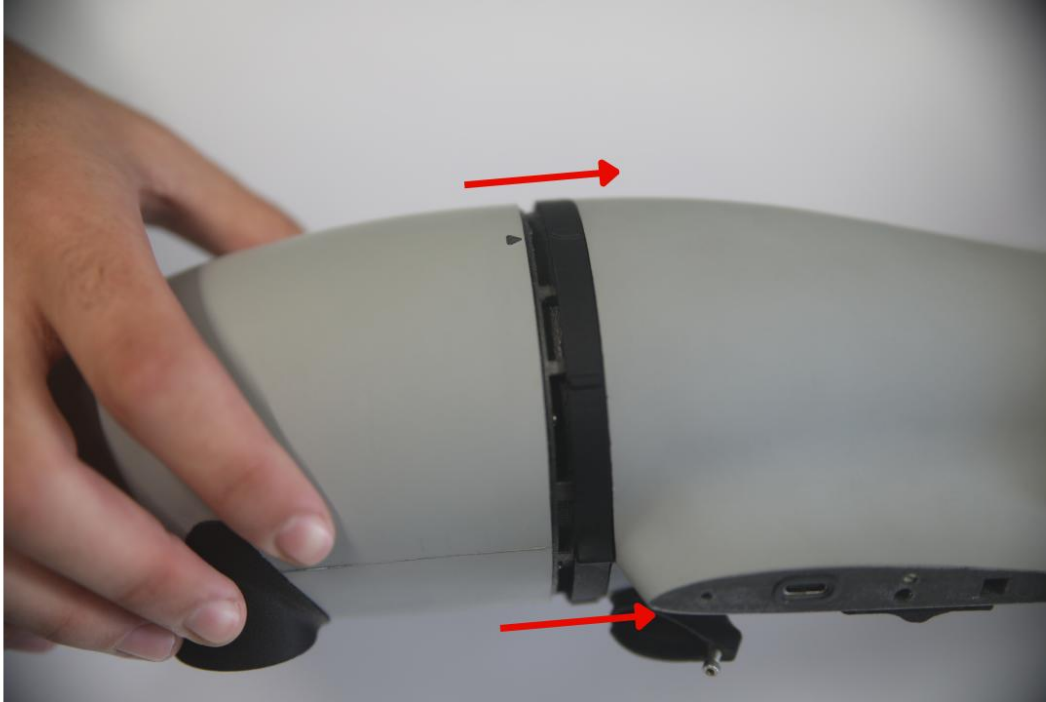


Figure 27 – Insert Payload

3. **Insert the payload** into the fuselage and **press gently into place**.
  - As the payload seats, the **latch ring on the fuselage front** will twist automatically.
4. Once fully inserted, the **latch ring will rotate back** to its original position.
5. **If resistance is encountered**, or hardware seems to catch:
  - Stop immediately.
  - Verify that the payload is **aligned straight and centered** within the latch ring.
  - To retry insertion, release the latch ring by **rotating it counterclockwise** with your fingers.

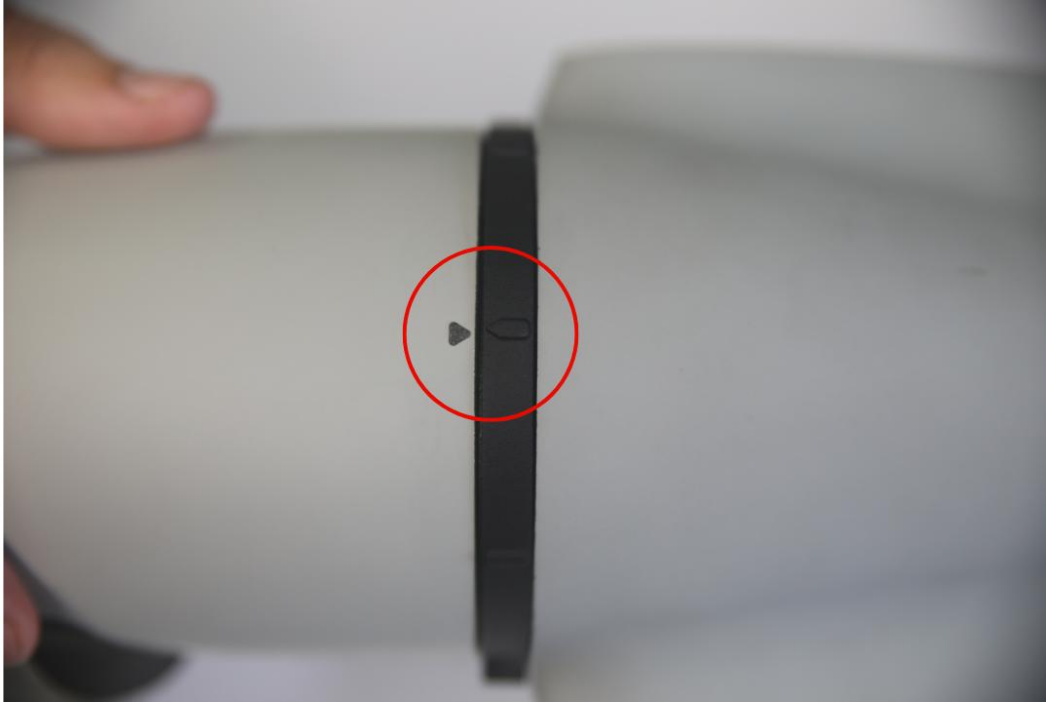
 **NOTE**

When installing the Overwatch Payload, ensure the **rotating alignment ring** is lined up with the fuselage via the previous instruction before installation.



*Figure 28 – Locking Payload Latch Ring*

6. **Close the latch ring** once the payload is fully seated.



*Figure 29 – Proper Payload Alignment*

7. **Confirm proper alignment:**
  - On the **top of the latch ring**, the **home-indicating chevron** must align with the **home-indicating triangle** on the payload.
  - On the **left or right side**, the **triangular tabs** of the latch ring must align with the **leading edge of the wing**.
8. **Inspect the circumference** of the latch ring to ensure **no gaps remain**, confirming the payload is **securely attached** to the fuselage.

## Battery Installation:

### CAUTION

Review the **Battery Removal Procedure** prior to installation to ensure you can safely remove the Flight Battery when required.

### WARNING – Live Terminals

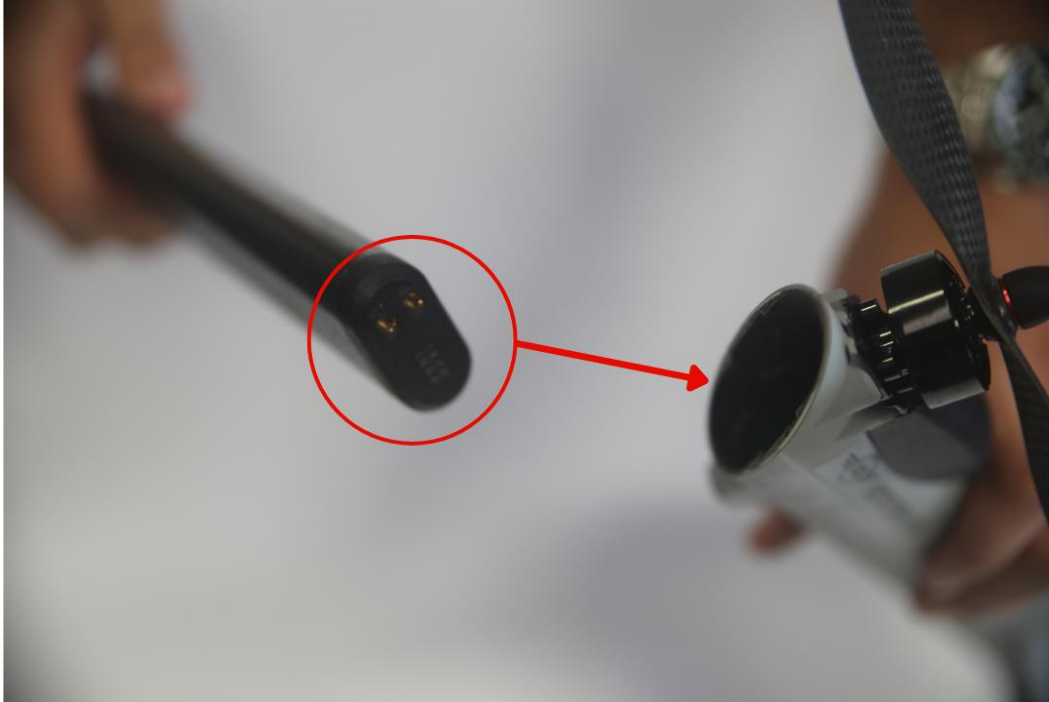
The Flight Battery features **two live terminals** at the front of the pack. **Do not insert metal objects** into these terminals, as this may result in **serious injury or damage**.

### CAUTION

- The aircraft **does not have a dedicated power switch**. Once the battery is fully seated, the aircraft will automatically begin its **power-up sequence**.
- When powered, **motors and propellers become active** and ready for the arming sequence.
- Only install the battery when ready to apply power.

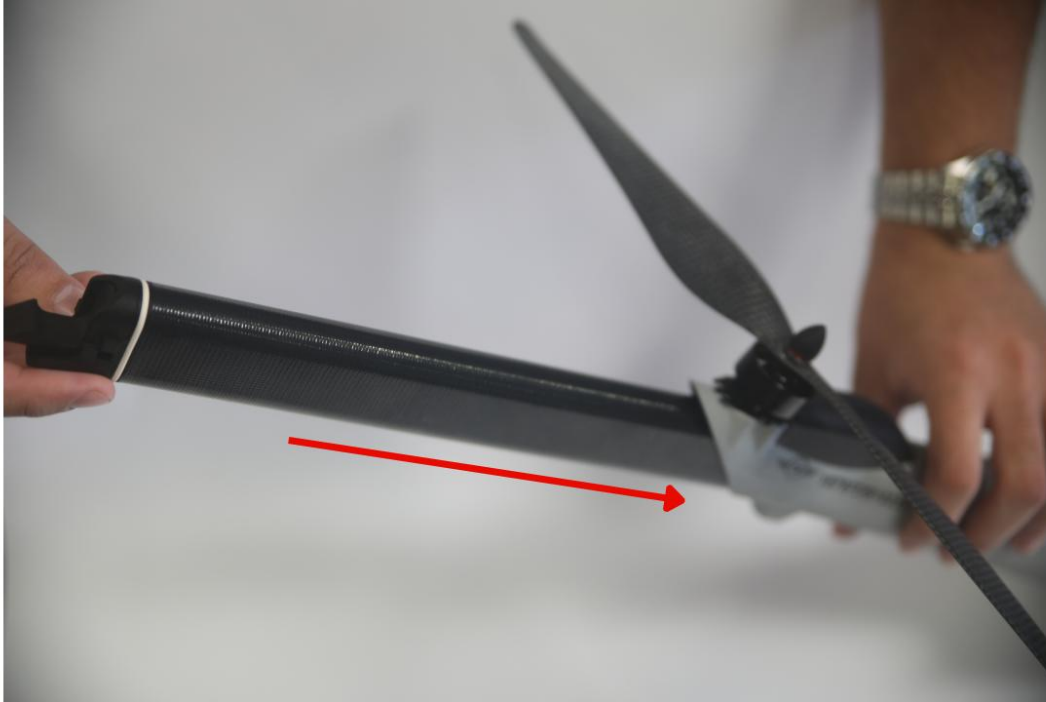
To properly install the AV Battery:

1. Ensure the **Transition Switch** on the fuselage is set to **LEFT (Multi-Rotor Mode)** prior to battery installation.
2. Select a **Flight Battery** and remove it from the case.



*Figure 30 – Orienting the Battery for Install*

3. **Orient the battery** for insertion into the tail of the fuselage:
  - The battery features a **spring-loaded sliding latch**.
  - The **longer part of the latch** should face **downward**, away from the tail motor.



*Figure 31 – Insert Battery into AV*

4. **Insert the terminal side** of the battery into the fuselage first.



Figure 32 – Seating the Battery

5. **Slide the battery fully into the fuselage.**

- If you encounter resistance or a hard stop, **remove the battery** and verify correct orientation.
- If the latch does not automatically close, **gently** pull back the latch while applying pressure to seat the battery.

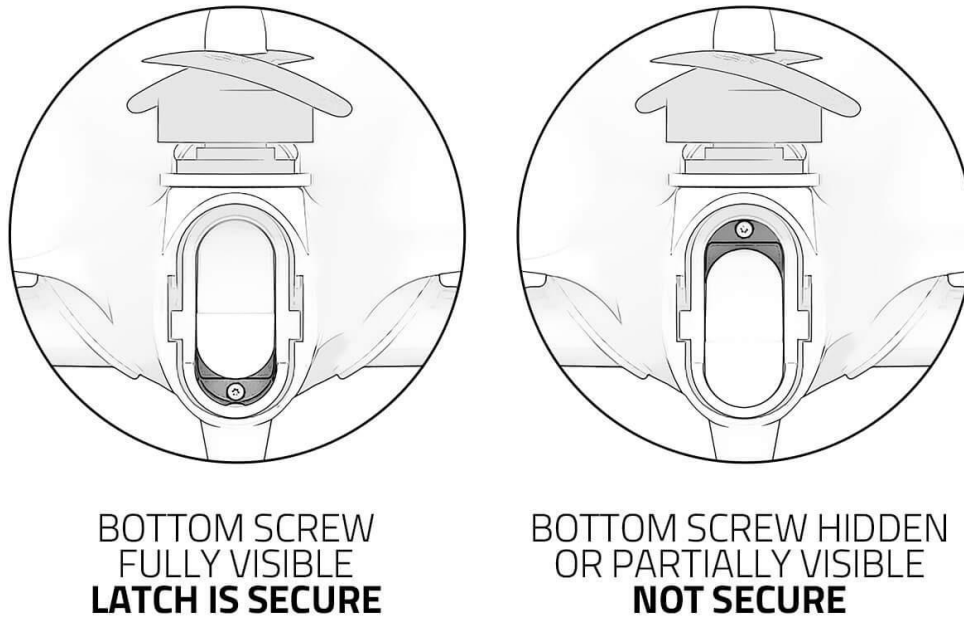
6. Once fully seated, the aircraft will **power up automatically**, and the motor assembly will emit a **beep**.

- At this stage, motors are **live but disarmed**.

 **CAUTION**

Verify the battery is fully seated **even after the ESC beep is heard** to ensure secure connection and battery stability inside of the AV.

7. The battery **latch will automatically slide upward** to its closed position once seated.



*Figure 33 – Proper Battery Seating*

**8. Verify latch closure:**

- The latch is fully closed when the **screw on top of the latch body** is no longer visible, hidden beneath the latch slider.

# Pre-Flight Inspection & System Verification

## Fuselage and Payload Interface

### Fuselage Inspection

1. Inspect the fuselage for visible damage, cracks, or deformation.
2. Verify the **fuselage latch** is intact and operates smoothly.
3. Inspect the **motor sockets**:
  - No debris, damage, or bent contacts
  - USB connectors clean and undamaged
4. Inspect the **payload interface ring**:
  - No cracks, debris, or damage
  - USB connector clean and undamaged
  - O-ring present, seated correctly, and not pinched

**Repeat inspection on both sides where applicable.**

### Motor Socket and Interface Check

1. Verify motor sockets are free of debris.
2. Confirm USB connectors are straight and undamaged.
3. Check O-rings for:
  - Proper placement
  - No cuts, tears, or deformation

## Motor Arms

Perform the following steps **for each motor arm**.

1. Inspect the **arm latch**:
  - No cracks or damage
  - Latch moves freely and locks securely
2. Inspect the **USB connector**:
  - No bent pins or debris
3. Inspect the **latch housing** for cracking or wear.
4. Verify all **screws** are present and tight.
5. Grasp the **motor arm and tilt pod**:
  - Apply light force to check for play
  - No looseness should be present
6. Rotate the motor by hand:
  - Spin smoothly
  - No grinding, resistance, or noise
7. Grasp the **motor bell housing**:
  - Confirm it is secure with no axial or radial play
8. Install the motor arm:
  - Slide straight into the socket
  - Verify latch fully locks
  - Check again for any play
9. Repeat for the **opposite motor arm**.



### CAUTION

If the thrust motor on a motor arm does not initialize or spin during the preflight tilt actuation check, reseal the affected motor arm and repeat the preflight inspection before proceeding.

## Wings

1. Inspect wing surfaces:
  - No cracks, dents, or delamination
2. Inspect connections:
  - Pitot tube clear and undamaged
  - No obstructions
3. Inspect alignment hardware:
  - Guide pins straight and undamaged
  - USB connector clean and intact
  - Wing screw not bent
  - Dowel rod not bent, cracked, or damaged
4. Install wings and verify:
  - Wings fully seated
  - O-rings compressed together
  - Electrical connector is **not visible**
  - No gap between wing root and fuselage
5. Verify wings are locked and have **no movement**.

## Camera / Payload

1. Inspect the payload locking ring:
  - No grinding when rotating
  - Smooth operation
2. Verify payload has:
  - Free and unobstructed movement
  - No binding
3. Inspect USB connector:
  - Not damaged
  - Fully seated
4. Verify SD card is installed (if applicable).

## Battery

1. Inspect battery casing:
  - No swelling, cracks, or deformation
2. Inspect the **O-ring**:
  - Present and undamaged
3. Inspect the **battery latch**:
  - Moves freely
  - Locks securely
4. Inspect battery pinholes:
  - No debris or obstructions

**Do not install a battery showing any signs of damage or swelling.**

## Power-On Sequence

### Before Installing the Battery

1. Power on the **RC transmitter / radio**.
2. Verify good signal strength.

### Battery Installation

1. Insert battery until **initial resistance** is felt.
2. Gently continue pushing until fully seated.
3. Verify latch engages and locks.
4. Confirm:
  - Propellers are flat and oriented correctly
  - Front propellers are perpendicular to the fuselage

## GCS and System Status Checks

### Messages and Alerts

1. Check system messages.
2. Clear any non-critical messages.
3. Investigate and resolve any warnings or errors.

### GPS and Link Quality

1. Verify GPS count is sufficient.
2. Confirm **HDOP < 1.0**.
3. Verify RC signal strength (good dBm).
4. Check error count:
  - No increasing or abnormal error values

## Battery and Power Status

1. Confirm **100% battery** on:
  - Aircraft
  - GCS
2. Verify battery thresholds:
  - Safety threshold: **30%**
  - Warning threshold: **25%**
  - Critical threshold: **10–15%** (mission dependent)

## Camera and Gimbal Verification (Overwatch)

1. Open the camera view.
2. Verify:
  - Video feed is live
  - Image quality is acceptable
3. Take a test photo.
4. Perform FFC (if applicable).
5. Verify:
  - Left and right cameras function correctly
  - Gimbal centers properly

## Vehicle Summary Verification

Navigate to **Vehicle Summary** and verify:

1. **Video and telemetry indicators are green.**
2. All sensors show **green / healthy** status.
3. Return-to-Home behavior:
  - Return delay: **3 seconds**
  - Data-link loss return: **after 10 seconds**
  - If increasing delay, ensure battery margin is sufficient
4. Geofence:
  - **350 ft** for Class G (if applicable)
5. RTL altitude:
  - **164 ft** if signal is lost
6. Fixed-Wing minimum altitude:
  - Set to **highest obstacle clearance** in operating area

## Final Functional Checks

1. Arm and disarm the aircraft (motors should not spin).
2. Verify **tilt pod operation**:
  - Smooth movement
  - No binding or abnormal sounds

## Recommended Value Widgets

The following widgets are recommended for display during flight operations:

### MGRS Position

Displays the aircraft's current geographic position using the **Military Grid Reference System (MGRS)**. This format provides a standardized grid-based location reference commonly used for tactical operations, mapping, and coordination with external teams.

### Flight Time

Indicates the elapsed time since the aircraft was armed or the motors were started. This value helps operators track mission duration and manage battery usage throughout the flight.

### Altitude (Local)

Displays the aircraft's altitude relative to the **takeoff point**. This is the primary altitude reference used by the aircraft for in-flight control, navigation, and autonomous behaviors.

### Vehicle Airspeed

Shows the speed of the aircraft relative to the surrounding air mass. Airspeed is primarily relevant in fixed-wing flight and is used by the autopilot to maintain aerodynamic performance and flight stability.

### Ground Speed (rel)

Displays the aircraft's speed relative to the ground. Ground speed is influenced by wind conditions and may differ from airspeed, particularly in headwind or tailwind situations.

## Distance to Home

Indicates the straight-line distance from the aircraft's current position to the designated **Home** location. This value assists operators in maintaining situational awareness and planning return-to-home actions.

## Distance to GCS

Displays the straight-line distance between the aircraft and the Ground Control Station (GCS). This metric is useful for assessing link range, operational distance, and maintaining reliable command and control connectivity.

These values provide immediate situational awareness and support safe decision-making during flight.

## Overwatch Payload Inspection

Prior to flight, perform a complete inspection of the Overwatch Gimbal Payload to ensure proper function, secure mounting, and operational readiness.

1. **Visual Inspection of Camera and Gimbal Housing:**

Examine the gimbal and camera assembly for any signs of physical damage, cracks, or deformation.

2. **Payload Ring Check:**

Verify that the payload ring is intact and rotates smoothly without resistance or obstruction.

3. **Connector Inspection:**

Inspect the camera USB-C connector for bent pins, debris, or any obstruction that could affect data transfer or payload operation.

4. **SD Card Verification:**

Confirm that the payload SD card is correctly inserted and fully seated to ensure proper data recording.

5. **Gimbal Cleaning:**

If dirt or debris is present in the gimbal mechanism, carefully remove it using a soft brush or air blower. Avoid using abrasive materials.

6. **Camera Lens Maintenance:**

Inspect the lens for dust, fingerprints, or smudges. Clean with a damp microfiber cloth if necessary, ensuring no scratches or residue remain.

## Mapping Array Payload Inspection

Before flight, conduct a thorough inspection of the Mapping Array Payload to ensure operational readiness and data integrity.

1. **Visual Inspection of Cameras and Housing:**

Examine all cameras and the surrounding housing for any signs of physical damage, cracks, or deformation.

2. **Payload Ring Check:**

Confirm that the payload ring is intact and undamaged, allowing proper rotation and secure attachment.

3. **CFEXPRESS Card Verification:**

Ensure the CFEXPRESS storage card is correctly inserted and fully seated to guarantee proper image capture and storage.

4. **Connector Inspection:**

Check the camera USB-C connector for bent pins, debris, or other obstructions that could impede data transfer.

5. **Camera Lens Maintenance:**

Inspect lenses for dirt, dust, or fingerprints. Clean with a damp microfiber cloth if necessary, taking care to avoid scratches or residue.

## Battery Inspection

Prior to flight, ensure the battery and its connections are in proper condition to maintain safety and optimal performance.

1. **Visual Battery Check:**

Inspect the battery for any signs of swelling, leakage, cracks, or other physical damage. Do not use a compromised battery.

2. **Battery Latch Inspection:**

Verify that the battery latch moves freely and is undamaged, ensuring secure attachment to the airframe.

3. **Terminal Examination:**

Inspect both main battery terminals for damage, corrosion, or obstructions that could interfere with power delivery.

## Flight Battery Charging Procedure

### CAUTION

- Only use the **FlightWave-specified charger** and **60W USB-C power adapter**.
  - **Never modify charging settings** or use alternative configurations, as this may result in **battery damage, fire, or personal injury**.
  - **Never leave batteries unattended** while charging.
  - If the battery is **hot after flight**, allow at least **20 minutes** for cooling before charging.
1. Connect one end of the **USB-C cable** to the **60W USB charger power adapter**.
  2. Connect the other end of the USB-C cable to the **FlightWave Battery Charger**.
  3. Plug the **charger power adapter** into a standard wall outlet.
  4. The charger will emit a **beep after 10 seconds**, indicating it is ready for use.



*Figure 34 – Correct Charging Configuration*

5. Confirm the charger is configured for:
  - **Battery Type:** LiPo
  - **Charge Current:** 3A

 **NOTE**

Only use above configuration. Charging with any other setting is unsafe.

6. To **change battery type**, press the **left button once** quickly.  
To **change charge current**, press and hold the **left button**, then release when the desired current is displayed.



*Figure 35 – Battery Terminal Identification*



*Figure 36 – Inserting AV Battery into Charger*

7. Insert the **Flight Battery** into the charger.
  - The charger status will display the battery's current state.
  - If a fault is detected, the **exclamation mark icon** will illuminate.



*Figure 37 – Initiate Battery Charging*

8. Begin charging by pressing and **holding the right button**.
  - The **red lightning bolt icon** will illuminate, indicating charging is in progress.
9. A **full charge** typically requires **approximately two hours**.
10. Upon completion, the **round checkmark icon** will glow **green**, indicating the battery is fully charged.
11. Press and hold the **right button** to stop the charger and **safely remove the battery**.

## Ground Control Station

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This chapter provides an overview and setup procedure for the FlightWave Ground Control Station

# Ground Control Station

## Introduction

This section provides detailed instructions and guidance on the FlightWave Ground Control Station (GCS) and its integration with the Edge 130.

This covers:

- Key GCS components and their functionality.
- Assembly and disassembly procedures for safe handling and transport.
- Proper setup and configuration to ensure optimal system performance.
- Connecting the Edge 130 to the GCS for mission planning and flight operations.
- Configuring aircraft safety settings and operational parameters.
- Downloading and managing necessary maps for flight planning.
- Adjusting general settings within the FlightWave application for user-specific preferences.

This guide is intended for operators assembling, operating, or storing the GCS and Edge 130. Step-by-step instructions are provided to promote safe, efficient, and effective use of the system.

## Export Compliance Notice:

The information provided in this course pertains specifically to the Edge 130 UAV, which is classified as **EAR99** under the Export Administration Regulations (EAR, 15 C.F.R. §§ 730–774). Consequently, the system:

- Is **not subject to ITAR** (International Traffic in Arms Regulations, 22 C.F.R. §§ 120–130).
- Is **not controlled under any specific Export Control Classification Number (ECCN)** under the EAR.

Operators must still adhere to all applicable local, federal, and international regulations regarding the transport and use of UAV systems.

# Ground Control Station Device Information and Wireless Settings

## GCS Device Platform

The FlightWave Ground Control Station (GCS) is built on the **Samsung Galaxy Tab Active3** platform. Each unit is preconfigured by FlightWave with the correct system settings, security parameters, performance optimizations, and required FlightWave applications.

Operators should not modify core device settings outside of those described in this manual.

## Wireless Interference Considerations



### IMPORTANT – Disable WiFi & Bluetooth

To ensure stable command-and-control (C2) performance and eliminate sources of potential radio interference prior to arming the aircraft or conducting any flight operations:

- **Disable Wi-Fi**
- **Disable Bluetooth**

Leaving Wi-Fi or Bluetooth enabled may introduce additional 2.4 GHz emissions, which can interfere with telemetry and digital video links. The GCS does not require Wi-Fi or Bluetooth during active flight, and all flight-critical communication is handled through the integrated long-range radios.

These wireless interfaces may be enabled temporarily for tasks such as:

- Software or application updates
- Map downloads
- Support file transfer
- Initial device configuration

They **must** be disabled again before flying.

## Controller Overview

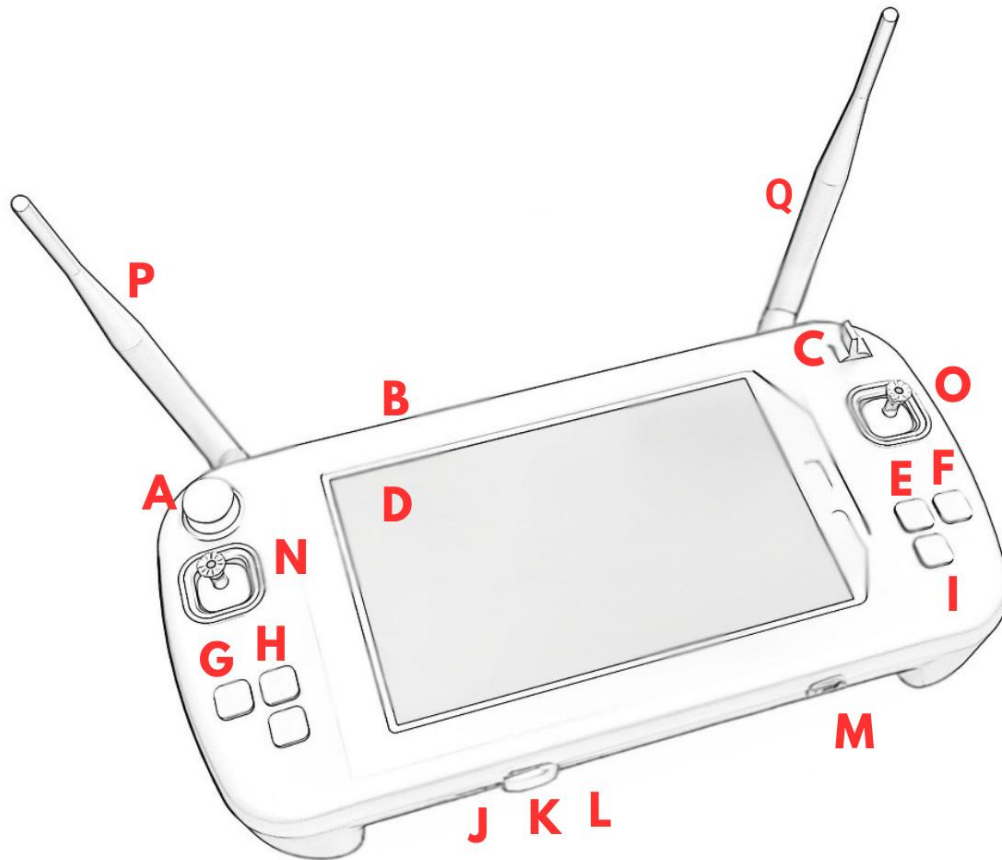


Figure 38 – Ground Control Station Overview

### Controller Layout:

#### A – Camera Control Stick

- Press **Up** (12 o'clock) = Gimbal Up
- Press **Down** (6 o'clock) = Gimbal Down
- Press **Right** (3 o'clock) = Slew Right
- Press **Left** (9 o'clock) = Slew Left

## **B – Tablet Power Switch**

- Push and hold to power on the tablet.

## **C – Transition Switch**

- Press **Right** = Fixed Wing Mode (FW)
- Press **Left** = Multi-Rotor Mode (MR)

## **D – End User Device (Display)**

- Samsung Touch Screen Tablet

## **E – Hold Mode**

- Push and hold the button until the mode is announced by the Controller.

## **F – Mission Mode**

- Push and hold the button until the mode is announced by the Controller.

## **G – Position Mode**

- Push and hold the button until the mode is announced by the Controller.

## **H – Altitude Mode**

- Push and hold the button until the mode is announced by the Controller.

## **I – Return Mode**

- Push and hold the button until the mode is announced by the Controller.

## **J – Charge Port (USB-C)**

- USB-C External charge pack plug in.

## **K – Radio Switch**

- To power on the Radios, slide the Radio Power Switch to the **left**.
- The indication light next to the switch will turn **blue**.
- This switch turns on the 868 MHz or 900MHz Telemetry Radio (depending on your configuration), and the 2.4 GHz Digital Video Radio.
- With this switch turned **on**, the controller will immediately start sending **manual remote control (RC)** commands to the aircraft.

## **L – Radio Power LED**

## **M – HDMI Out**

- The controller is configured to provide HDMI mirroring.
- This requires a USB-C to HDMI adapter, which is not included in the standard kit.
- Plug the USB-C into the HDMI adapter into the right USB-C port and then connect an HDMI cable from the adapter to the display.

## **N – Left Air Control Stick**

- AV Control Stick actions are different between Multi-Rotor Mode (MR) and Fixed Wing Mode (FW). Please refer to Flight Mode Descriptions Module for further explanation.

## **O – Right Air Control Stick**

- AV Control Stick actions are different between Multi-Rotor Mode (MR) and Fixed Wing Mode (FW). Please refer to Flight Mode Descriptions Module for further explanation.

## **P – C2GCS Antenna**

## **Q – Video GCS Radio**

## GCS External Battery Pack

The External Battery Pack provides supplemental power to the Ground Control Station (GCS), extending operational time during mission planning, flight operations, and post-flight review. When connected, the External Battery Pack delivers continuous power to the GCS tablet and radios without requiring internal battery swaps or extended downtime.



*Figure 39 – GCS External Battery*

### Purpose and Function

The GCS External Battery Pack:

- Extends operational endurance beyond the internal battery's runtime
- Provides stable power during high radio-power missions or long-duration hovering operations
- Prevents unexpected shutdowns when performing firmware updates, mission uploads, or telemetry log transfers
- Enables extended field use in environments where wall power may not be available

The pack connects directly to the GCS via USB-C and automatically begins powering the device once attached—no additional configuration is required.

## Installation Procedure

1. Remove the External Battery Pack and USB-C cable from the transport case.
2. Position the External Battery Pack on the underside of the GCS, ensuring it does not obstruct cooling vents or interfere with hand placement.
3. Connect the USB-C cable from the External Battery Pack to the **leftmost USB-C port** on the bottom of the GCS.
4. Verify that the cable is fully seated and free from strain or bending.
5. Check that the GCS displays an on-screen charging indicator to confirm proper power delivery.

## Operational Notes

- The External Battery Pack will power the GCS and charge the internal tablet battery simultaneously when capacity allows.
- When the external pack is depleted, the GCS automatically switches to its internal battery without interrupting operations.
- High radio power settings (e.g., max TX output) will draw significantly more current using the external pack is strongly recommended in these cases.
- The pack can be swapped mid-mission if needed; simply disconnect the depleted pack and attach a charged one. No reboot is required.

## Charging the External Battery Pack

- Charge the pack using its dedicated USB-C charging port and any standard 5V/2A or PD-compatible charger.
- A full charge typically requires **approximately 2–3 hours**, depending on charger output.
- LED indicators on the External Battery Pack provide battery-level status during charging and discharge.

## Storage and Handling

- Store in a cool, dry environment between **-4°F and 113°F (-20°C to 45°C)**.
- Avoid exposing the pack to direct sunlight or leaving it inside a hot vehicle.
- Do not place heavy objects on top of the pack inside the transport case.
- Ensure the pack is at **40–60% charge for long-term storage** (over 3 months).

## FlightWave Application Suite

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This chapter outlines the FlightWave Application Suite and a description of available settings

# FlightWave Application Suite

## Introduction



*Figure 40 – FlightWave Applications*

The FlightWave Application Suite consists of three applications:

- **App Manager**
  - Update FlightWave applications/read release notes.
- **FlightWave Settings**
  - Firmware update procedures
  - GCS access to the Operator's manual.
  - Management of the Overwatch and Mapping array payloads.
- **Command Deck**
  - Mission planning and execution application.
  - Discussed at length beginning at .

## FlightWave Settings

The **FlightWave Settings App** provides a centralized interface for configuring the Edge-series aircraft ecosystem. The application enables users to manage connected payloads, monitor subsystem status, load firmware updates, and access reference documentation including the user guide and release notes. The app may be used on a tablet or laptop depending on ground control configuration.

### Purpose

The FlightWave Settings App allows operators and technicians to:

- View connected aircraft and payload hardware
- Manage payload registration and configuration
- Perform firmware updates for all subsystems
- Access documentation, including the User Guide, quick-start resources, and support links

This application is used during initial setup, maintenance events, payload changes, and when applying software or firmware updates.

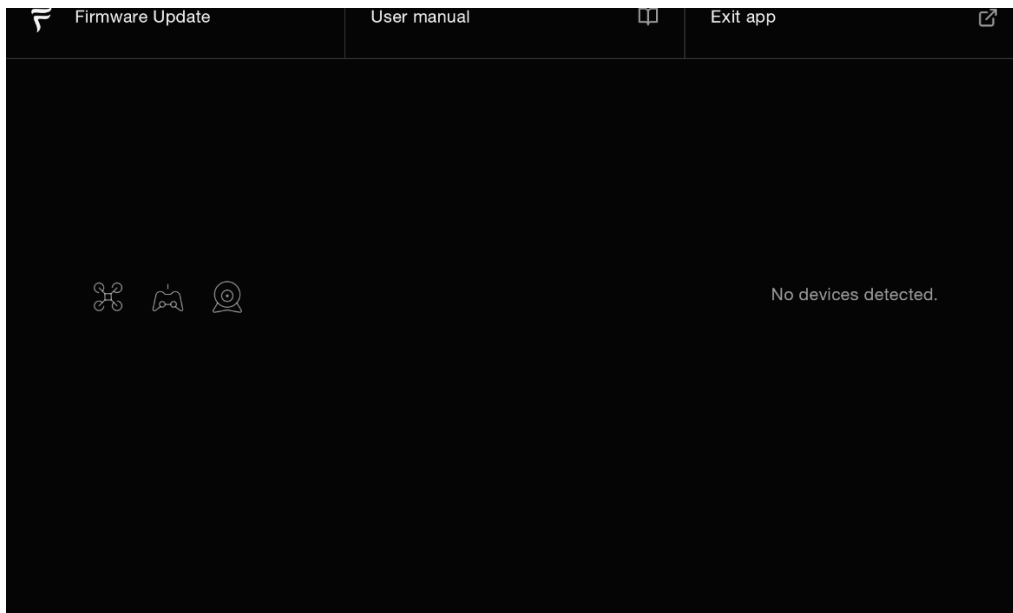


Figure 41 – FlightWave Settings

## Connected Payload Management

When the aircraft is powered and connected, the Settings App automatically detects installed payloads.

The **Connected Payloads** pane displays:

- Payload type (Overwatch EO/IR, Mapping Array, etc.)
- Firmware version currently installed
- Serial number and hardware revision
- Operational status (Ready, Requires Update, Not Compatible, etc.)

*Table 4 – Payload Actions*

Action	Description
<b>Identify Payload</b>	Confirms hardware is recognized; displays model and serial number.
<b>Configure Payload Settings</b>	Enables payload-specific settings (e.g., camera defaults, metadata options).
<b>Remove / Swap Payload</b>	Prompts operator when payload is disconnected or changed.

*Table X – Connected Payload Actions*

 **NOTE**

When a payload is replaced or updated, the app will refresh and confirm compatibility with the current aircraft firmware.

## Firmware Updates

The Settings App serves as the update hub for the aircraft and all associated subsystems:

- Aircraft flight controller (main firmware)
- Companion computer / mission computer
- Payload firmware
- Accessory modules (e.g., comms or storage modules)

### Firmware Update Workflow:

1. Open the **Firmware** tab.
2. The app automatically compares installed versions with the latest approved release.
3. Select **Update** to begin. Progress bars indicate update state.
4. The app validates successful installation and prompts the user to reboot affected systems if required.



#### IMPORTANT

Do **not** disconnect or power off the aircraft during a firmware update.

## Documentation and User Guide Access

The Settings App includes integrated access to FlightWave documentation to support training and field operations.

Available resources include:

- Edge-Series **User Guide (PDF)**
- **Release Notes** summarizing capability changes and fixes
- Firmware **Change Log**
- Support knowledge base / link to FlightWave Customer Support

Operators can launch the documents directly from the interface, or download the latest versions to the Ground Control System for offline access.

### Quick Access Buttons

*Table 5 – Quick Access Buttons*

Button	Function
<b>Open User Guide</b>	Opens latest version in-app (PDF viewer).
<b>Download User Guide</b>	Saves a copy to local storage.
<b>View Release Notes</b>	Displays the version history and known behaviors.
<b>Support / Contact FlightWave</b>	Opens support portal link.

## **Notifications and System Health**

The Settings App provides notifications when:

- A component requires a firmware update
- A payload is incompatible with the current software revision
- Battery or storage health may impact mission readiness

Whenever a subsystem prompts action, the notification will include a clear recommended corrective step.

## **Operator Benefit**

Using the FlightWave Settings App ensures:

- Aircraft and payloads are always on the approved firmware version
- Compatibility is maintained between aircraft and payload assemblies
- The operator has immediate access to the latest guidance and documentation

This centralization reduces configuration time and simplifies maintenance records, supporting reliable field operations.

## App Manager

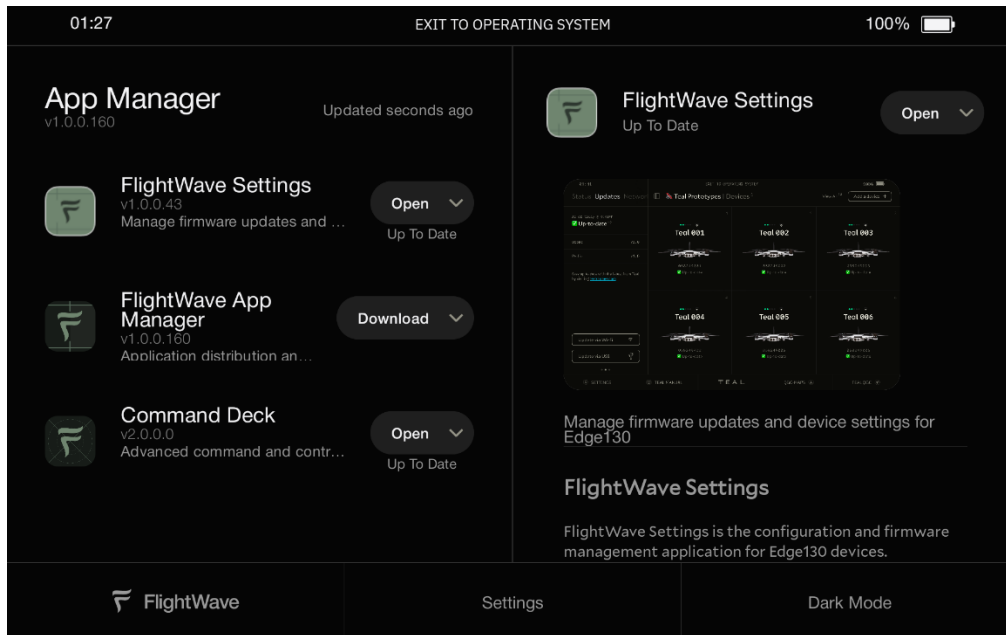


Figure 42 – Application Manager

### Purpose

The App Manager allows users to:

- Check version status of all installed FlightWave applications
- Download and apply updates from FlightWave
- View release notes prior to installation
- Track changes introduced in current and previous versions

This minimizes downtime and ensures that updates are applied consistently across the system.

## Application Version Overview

Upon launch, the App Manager presents the installed FlightWave applications in a list format. For each application, the following information is displayed:

- **App Name**
- **Current Version Installed**
- **Latest Available Version**
- **Status** (*Up to Date, Update Available, Pending Restart, etc.*)

Applications included in the list may include:

- FlightWave **Settings App**
- **GCS Mission App / Mission Planner**
- **Payload Tools** (e.g., Overwatch Controls, Mapping Array interface)
- **Diagnostics / Logging Utilities**

If an update is available, the status indicator is highlighted to draw the operator's attention.

## Updating Applications

The App Manager handles update download, installation, and verification.

### Update Procedure

1. Select the app from the list.
2. Review the release notes (optional).
3. Select **Update App**.
4. Allow the application to download and install the update.
5. Restart the application if prompted.

During installation, progress indicators display:

- Download progress (%)
- Install progress
- Verification status (checksum and compatibility check)

**Do not close the App Manager during installation.**

## Accessing Release Notes

For each application, the App Manager provides access to detailed release notes.

### Release Notes Include:

- New features and enhancements
- Bug fixes or stability improvements
- Known behaviors or limitations (if applicable)
- Firmware-to-software compatibility notes when relevant

### How to view release notes:

1. Select the application in the list.
2. Choose **View Release Notes**.
3. Notes open in a scrollable in-app viewer; they may also be exported or saved.

Viewing release notes prior to updating is recommended when the update involves changes to compatible payloads or new workflows.

## System Notifications & Update Status

The App Manager will notify users when:

- A new application version is available
- An installed app is running an older version that may impact compatibility
- An update is pending restart, or installation failed validation

A global notification badge appears on the App Manager icon whenever an update requires action.

## Operator Benefits

Using the App Manager ensures:

- All FlightWave applications remain current and compatible
- Updates are applied through a single, controlled interface
- Operators have full visibility into release content and system changes

Centralized management reduces configuration errors, simplifies training, and supports reliable system operation in the field.

## FlightWave Controller Application

This chapter outlines the functions and features of the FlightWave Controller Application

# FlightWave Controller Application

## Introduction

The FlightWave Controller Application provides comprehensive control and monitoring of the Edge 130 Air Vehicle (AV) and its connected payloads. The interface is designed to provide both quick access to critical flight information and detailed control for advanced operations.

## Application Interface



Figure 43 – Fly View Interface

The diagram above illustrates the key elements of the **Fly View**:

- **Fly Status Bar:** Displays critical sensor and vehicle status, including GPS, battery, RC connectivity, Armed/Disarmed state, flight mode (MR/FW), and control mode.
  - Press individual icons for additional details.
  - Toggle the Armed/Disarmed state by pressing the corresponding icon. During flight, this also provides access to **Emergency Stop**.




- Switch between Multirotor (MR) and Fixed-Wing (FW) modes using the MR/FW icon.
- Change flight control mode (e.g., "Position") by selecting the **control mode** text.
- **Settings:** Provides access to configuration options for both the Ground Control Station (GCS) and the Edge 130 aircraft, including system, telemetry, and safety settings.
- **HUD (Heads-Up Display):** Displays real-time flight telemetry and vehicle status in an overlay format for immediate situational awareness.
- **Map:** Shows the positions of all connected vehicles and the current mission for the selected aircraft.
  - The map can be dragged to reposition it.
  - When the aircraft is armed, the map automatically re-centers on the AV after a few seconds.
- **Actions Bar:** Provides mission and vehicle control functions, including:
  - Mission planning
  - AV lights toggle
  - Takeoff and landing
  - Pause/resume operations (e.g., landing or mission)
  - Return to Launch (RTL) or "Return to Operator" functions
  - Additional context-sensitive actions, such as adjusting altitude or continuing a paused mission

- **Video Window:** Displays live video feeds from the aircraft payload, if available.
  - Icons in the corners allow resizing or hiding of the window.
  - Clicking the center swaps the video to the foreground and the map to the background; click again to revert.
- **Instrument Panel:** Multi-panel display showing comprehensive vehicle telemetry, camera and video status, system health, and vibration monitoring.
- **Camera Settings:** Provides full control of the Edge 130 payload cameras, including:
  - Switching between EO (color) and IR (thermal) modes
  - Selecting IR palettes
  - Picture-in-Picture view
  - Switching between still image and video capture
  - Accessing the image gallery
  - Fine control over camera orientation, zoom, and other payload functions

## Fly View Map Icons:

These icons provide visual reference points within the **Fly View** map:

*Table 6 – Fly View Map Icons*

Icon	Description
	<b>Home Position</b> – the return location in case of loss of link or emergency.
	<b>Aircraft Location</b> – shows position and heading of the aircraft.
	<b>Ground Station</b> – indicates the controller's position.

## Instrument Panel:



Figure 44 – Instrument Panel

The **Instrument Panel** is a multi-display interface that provides essential information about the active Edge 130 vehicle, including:

- Telemetry data
- Camera feed data
- System health status

### Customizing the Instrument Panel:

- Click the **gear icon** in the top-left corner of the panel to access layout settings.
- From the menu, select or deselect value widgets to match mission requirements.

 **NOTE**

The panel supports a maximum of **eight widgets** simultaneously: up to **two large widgets** and **six small widgets**.

## Camera Settings:



Figure 45 – Camera Settings

The **Camera Settings** panel enables operators to configure and manage the onboard camera system of the Edge 130. When connected to a FlightWave Payload, additional options become available to optimize imaging performance:

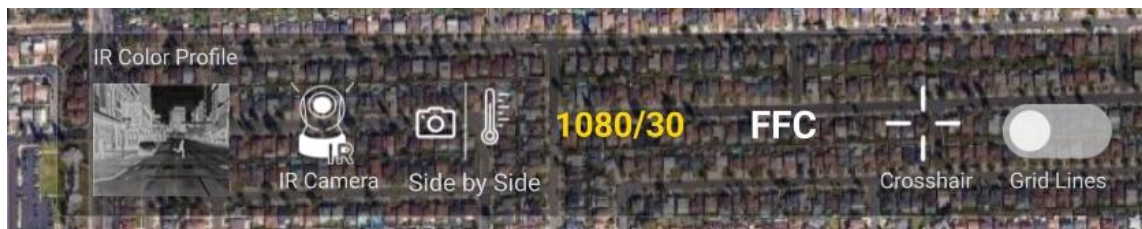


Figure 46 – Unfolded Settings Banner

- **IR Color Profile:** Adjust the infrared color palette for thermal imaging.
- **IR Camera:** Enable or configure infrared camera functionality.
- **Side-by-Side EO/IR Imaging:** Simultaneously view electro-optical (EO) and infrared (IR) feeds.

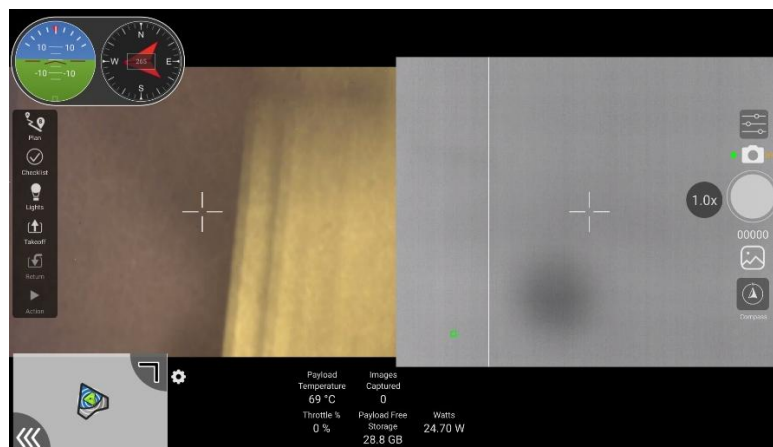


Figure 47 – Side by Side Camera Setting

- **Flat-Field Correction (FFC):** Perform calibration to enhance IR image quality.
- **Grid Lines:** Overlay reference lines on the video feed for alignment and targeting.
- **Capture Mode Switching:** Toggle between still image and video recording modes.
- **Zoom Level Bar:** Access up to **10x digital zoom** for detailed inspection.
- **Gimbal Mode Selection:** Choose from **Compass, Pilot,** or **Coordinate** modes for gimbal control.
- **Crosshair:** Toggle visual crosshair showing where the Overwatch is aiming.

For detailed camera configuration information, see [Image and Video Capture](#).

### Photo Library:

The **Photo Library** provides centralized access to imagery captured by the active payload and allows operators to review, manage, and synchronize photos directly from the Ground Control Station (GCS).

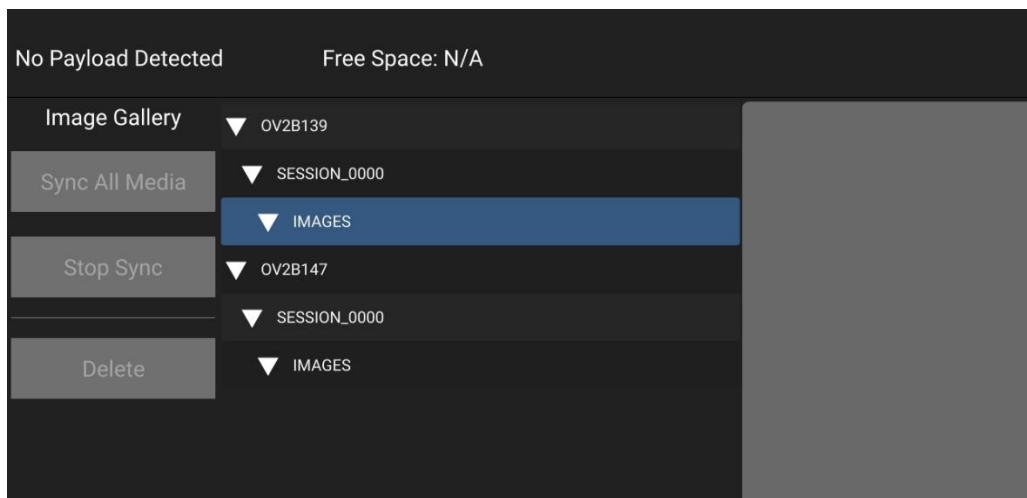


Figure 48 – Photo Library

The Photo Library is accessed by selecting the **Image icon** in the **Camera Toolbar** during flight or post-flight review.

#### Accessing the Photo Library

1. Locate the **Camera Toolbar** in Fly View.
2. Select the **Image icon**.

3. The Photo Library page opens, displaying available payload image folders and management controls.

### **Photo Library Controls**

The following controls are available at the top of the Photo Library interface:

#### **Sync All Media**

Initiates synchronization of all available payload media from the aircraft or payload storage to the GCS.

- Copies images from payload storage to the controller for local review.
- Progress is shown during the synchronization process.
- Sync behavior depends on connection quality and total media size.

#### **Operational Note:**

Ensure sufficient controller storage space and a stable data link before initiating a full media sync.

#### **Stop Sync**

Immediately halts an active media synchronization process.

- Any files already transferred remain available on the GCS.
- Files not yet transferred will remain on the payload storage.

#### **Delete**

Deletes selected images or folders from the GCS storage.

#### **Warning:**

Delete operations apply to media stored on the controller. Payload storage is not affected unless explicitly indicated. Confirm media has been successfully backed up before deletion.

### **Media Organization and Navigation**

#### **Payload-Based Folder Structure**

Images in the Photo Library are organized automatically based on the payload configuration at the time of capture.

- Each **Overwatch payload** creates a **parent folder** named after the payload.
- This allows operators to quickly differentiate media captured by different payloads.

### **Session-Based Subfolders**

Within each Overwatch payload parent folder:

- Images are grouped into **session folders**.
- Each session folder corresponds to an individual operational session or power cycle.
- This structure simplifies post-flight review and data management.

### **Folder Navigation**

- Dropdown bars allow operators to expand or collapse:
  - Overwatch payload parent folders
  - Individual session folders
- Selecting a folder displays the images captured during that session.

### **Operational Considerations**

- Image organization is automatic and does not require manual sorting.
- Session-based grouping helps maintain clear separation between flights.
- Operators should sync and review imagery as part of post-flight procedures to verify data integrity.

## Light Beacons:

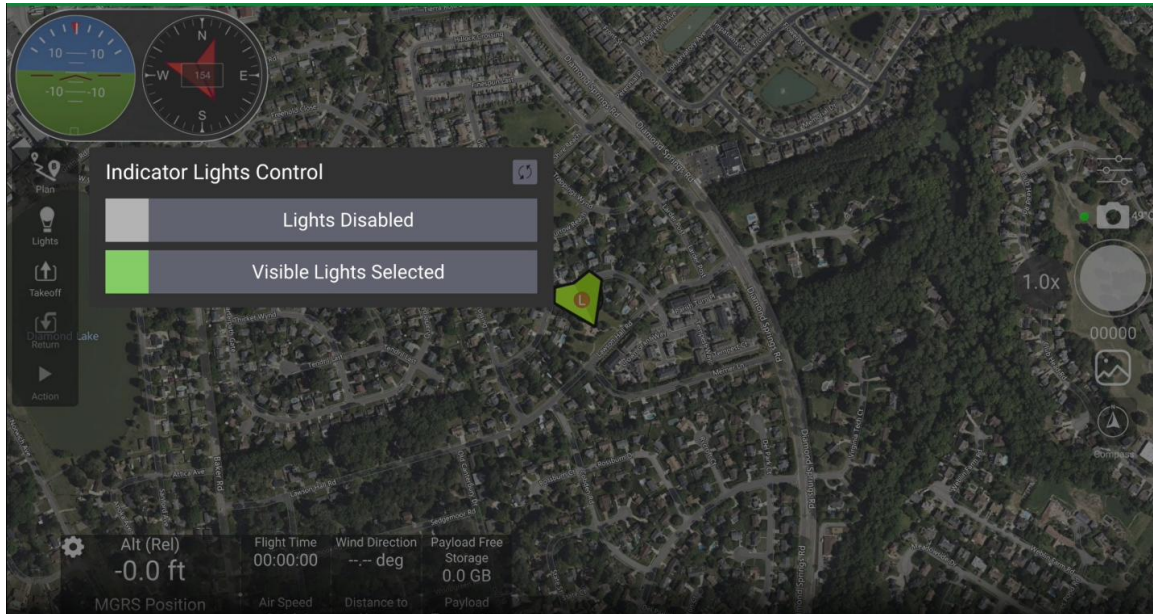


Figure 49 – Light Beacons

The **Indicator Lights** control panel, accessible via the lightbulb icon, allows operators to manage the Edge 130’s visible and infrared (IR) light beacons.

- Selecting the icon opens the control panel, which dims the rest of the interface. Tap outside the panel to close it.
- Two configurable options are provided for the light beacons:

**Enable/Disable:** Toggle the light beacon on or off. When enabled, the lights flash twice approximately every 1.5 seconds.

**Visible/IR:** Toggle between visible and infrared lighting when the beacon is enabled.

## Value Widget Setup

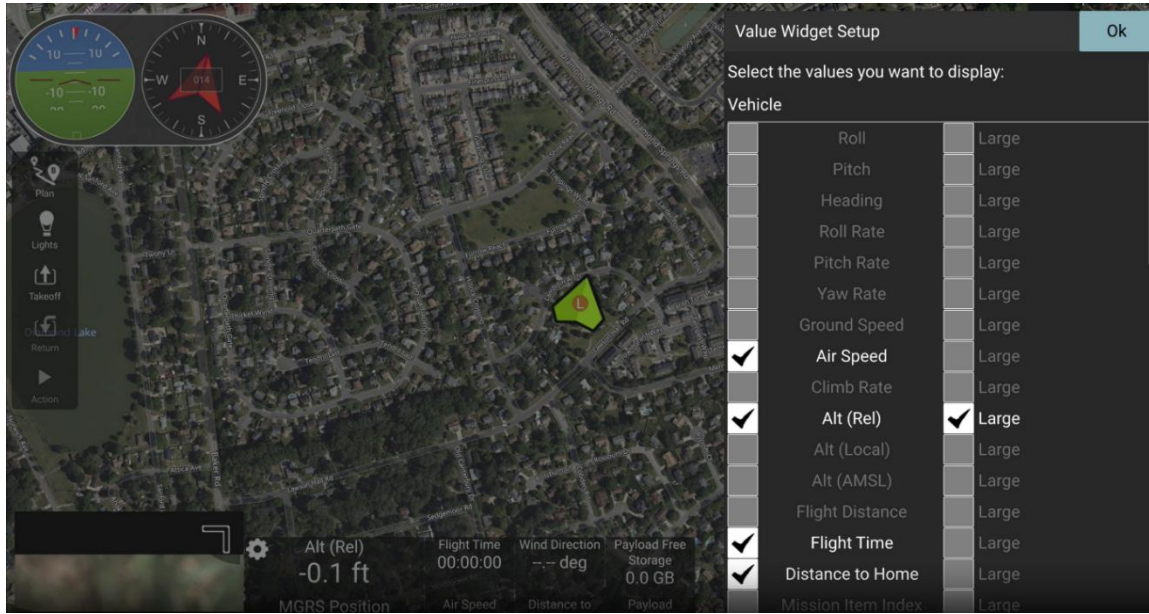


Figure 50 – Value Widget Setup

Pressing the settings cog in the instrument panel will present the Value Widget Setup allowing the pilot to augment the Instrument Panel with the following options:

Each widget allows for the selection to make the display large.

Table 7 – Vehicle Value Widgets

Vehicle	
Widget	Description
<b>Roll</b>	Displays the aircraft’s rotational angle around the longitudinal axis (left/right banking).
<b>Pitch</b>	Shows the aircraft’s nose-up or nose-down angle around the lateral axis.
<b>Heading</b>	Indicates the aircraft’s compass direction in degrees (0–360°).
<b>Roll Rate</b>	Measures how quickly the aircraft is rolling left or right (°/s).
<b>Pitch Rate</b>	Measures the rate of nose-up or nose-down rotation (°/s).

<b>Yaw Rate</b>	Displays the rate of rotational movement around the vertical axis (°/s).
<b>Ground Speed</b>	Speed relative to the ground, factoring in wind effects.
<b>Air Speed</b>	Speed relative to the surrounding air mass—critical for fixed-wing stability.
<b>Climb Rate</b>	Vertical velocity showing ascent or descent rate (m/s or ft/s).
<b>Alt (Rel)</b>	Displays the vehicle’s relative altitude compared to the controller’s position. Accuracy depends on the controller having a valid GPS fix at the time the vehicle is armed.
<b>Alt (Local)</b>	Displays the vehicle’s altitude relative to the takeoff point. This value is used by the aircraft for in-flight altitude calculations and control.
<b>Alt (AMSL)</b>	Altitude measured above mean sea level.
<b>Flight Distance</b>	Total cumulative distance traveled during the current flight.
<b>Flight Time</b>	Duration of the active flight mission since arming.
<b>Distance to Home</b>	Distance from aircraft to the designated home location.
<b>Mission Item Index</b>	Displays the active mission waypoint or command number.
<b>Next WP Heading</b>	Required heading to reach the next mission waypoint.
<b>Heading to Operator</b>	Direction the aircraft must fly to return to operator.
<b>Distance to GCS</b>	Distance from aircraft to the Ground Control Station.
<b>Throttle %</b>	Current throttle output as a percentage of available power.
<b>Fuselage CPU Temperature</b>	Onboard computer temperature inside the fuselage.

<b>Fuselage CPU Usage</b>	Real-time processing load of the aircraft’s flight computer.
<b>Controller CPU Usage</b>	Processor load of the Ground Control Station tablet.
<b>Hobbs Meter</b>	Total aircraft operation time accumulated across all flights.

*Table 8 – Battery Value Widgets*

<b>Battery</b>	
<b>Widget</b>	<b>Description</b>
<b>Voltage</b>	Displays the real-time output voltage of the aircraft’s battery pack. Sudden drops may indicate high load or nearing depletion.
<b>Percent</b>	Shows the estimated remaining battery capacity as a percentage of total charge.
<b>Consumed</b>	Indicates how many milliamp-hours (mAh) have been drawn from the battery during the current flight.
<b>Current</b>	Displays the instantaneous electrical current draw (amps) from the battery. High current values occur during climb, hover, or MR transitions.
<b>Temperature</b>	Shows the internal temperature of the battery pack. Elevated temperatures may affect performance or trigger protective limits.
<b>Watts</b>	Represents total power consumption (volts × amps), indicating the aircraft’s real-time power demand.
<b>Time Remaining</b>	An estimate of usable flight time remaining based on current power consumption and battery capacity.
<b>Charge Status</b>	Indicates whether the battery is charging, discharging, full, or in a protected/idle state (depending on connection and power flow).

*Table 9 – Camera Value Widgets*

Camera	
Widget	Description
<b>Images Captured</b>	Displays the number of still images captured during the current flight session. Useful for verifying image count during Mapping missions or ISR documentation.
<b>Payload Temperature</b>	Shows the current internal temperature of the connected payload (Overwatch or Mapping Array). Operators should monitor this value and avoid extended ground operations if temperatures approach high thresholds.
<b>Payload CPU Usage</b>	Indicates the processing load on the payload’s onboard computing module. High values may occur during video streaming, mapping capture bursts, or IR processing.

*Table 10 – Clock Value Widgets*

Clock	
Widget	Description
<b>Time</b>	Displays the current system time based on the Ground Control Station’s internal clock. Useful for mission logging, event correlation, and tracking flight operations relative to local time.
<b>Date</b>	Shows the current calendar date taken from the GCS system clock. This is used in mission records, log file timestamps, and metadata applied to captured images and videos.

Table 11 – GPS Value Widgets

GPS	
Widget	Description
<b>Latitude</b>	The aircraft’s current latitude coordinate in degrees.
<b>Longitude</b>	The aircraft’s current longitude coordinate in degrees.
<b>MRGS Position</b>	Displays the aircraft’s position in the Mission-Relative Grid System, used for plotting local mission offsets or relative coordinates.
<b>HDOP</b>	Horizontal Dilution of Precision—indicates GPS accuracy for horizontal positioning. Lower values represent better accuracy.
<b>VDOP</b>	Vertical Dilution of Precision—indicates accuracy of altitude measurements from GPS. Lower values represent higher precision.
<b>Course Over Ground</b>	Direction of the aircraft’s movement across the ground, shown in degrees (0–360°).
<b>GPS Lock</b>	Indicates whether the aircraft has achieved a valid satellite lock suitable for flight.
<b>Sat Count</b>	Number of GPS satellites currently received. Higher counts generally provide more accurate positional data.

*Table 12 – Payload Value Widgets*

<b>Payload</b>	
<b>Widget</b>	<b>Description</b>
<b>Payload Type</b>	Identify the connected payload (e.g., Overwatch, Mapping Array) detected by the aircraft.
<b>Payload Mode</b>	Displays the active payload mode, such as EO, IR, Fusion, Mapping, or Standby.
<b>Payload Pan Setpoint</b>	The commanded pan (left/right rotation) angle sent to the payload gimbal.
<b>Payload Tilt Setpoint</b>	The commanded tilt (up/down) angle for the payload gimbal.
<b>Payload Latitude Setpoint</b>	The target latitude for coordinate-based pointing, when using SPI or coordinate gimbal modes.
<b>Payload Longitude Setpoint</b>	The target longitude for coordinate-based pointing.
<b>Payload Altitude Setpoint</b>	The commanded altitude value for coordinate-based pointing or tracking modes.

## Flat Field Calibration

### Overview

The Overwatch thermal camera uses an internal sensor array to detect heat differences in the environment. Over time, slight temperature changes within the camera can cause uneven sensor response, which may appear as faint **horizontal or vertical lines** (banding) across the thermal image.

**Flat-Field Calibration (FFC)** is a built-in correction process that re-balances the sensor output and restores a clean, uniform thermal image.

This is a normal maintenance function and does not indicate a fault with the payload.

### When to Perform FFC

Execute a Flat-Field Calibration when any of the following are observed:

- Faint horizontal or vertical lines appear across the thermal image
- Image contrast appears uneven or patchy
- Thermal uniformity degrades after extended use
- The camera has experienced a significant temperature change
- Transitioning between hot and cold environments

As a general best practice, perform FFC:

- Once after the payload has warmed up (approximately 1–2 minutes after startup)
- Periodically during long missions
- Any time image quality begins to degrade

## FFC Procedure

1. Ensure the Overwatch payload is powered on and displaying thermal imagery.
2. Point the camera at a **flat, uniform-temperature surface** such as:
  - The ground
  - Clear sky (recommended)
  - A uniform wall or open field
3. Avoid surfaces with strong hot or cold spots (vehicles, people, shaded areas, metal roofs, etc.).
4. Press the **FFC** button in the **Camera Settings toolbar** on the GCS.
5. The image will briefly freeze or momentarily close during the calibration process.
6. Within a few seconds, the live thermal image will return with improved uniformity.



### **NOTE – Best Practice for Accurate Calibration**

For optimal results, perform Flat-Field Calibration while pointing the camera at a surface with **minimal thermal variation**. Strong thermal contrasts can reduce the effectiveness of the correction and may require an additional FFC cycle.

## Expected Results

After a successful FFC:

- Banding artifacts should be removed
- Thermal contrast should appear more consistent
- Edges and temperature gradients will appear clearer
- Overall image quality and reliability will improve

If the image does not improve after performing FFC, ensure the payload is not overheating and repeat the procedure after allowing the sensor to stabilize.



### **NOTE – FFC Scheduling**

FFC should always be performed after air transport of the AV, and shipping

## Ground Control Station General Settings

The following instructions outline the procedure for configuring **General Settings** within the FlightWave Ground Control Station (GCS). Proper configuration of these settings is critical to ensure safe and efficient operation of the Edge 130 air vehicle (AV).

The **General Settings** menu allows operators to adjust application-wide parameters that are independent of any specific vehicle connection. The Edge 130 does not need to be powered on or connected to access these settings.

### Procedure:

1. Select the **three-dot settings icon** located in the top-right corner of the GCS interface.
2. Choose the **General Settings** option.
3. Expand the drop-down menus within each section to access and adjust available configuration options.

## Units:

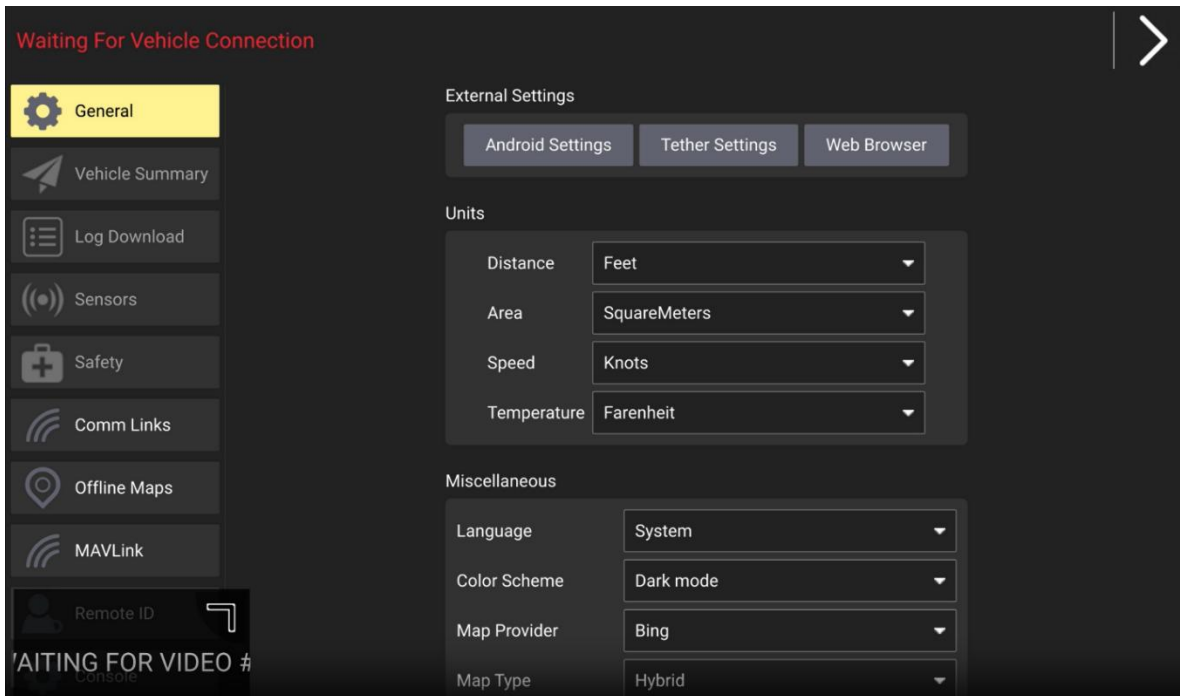


Figure 51 – Units

The **Units** section allows operators to define the measurement units displayed throughout the FlightWave GCS application. Proper configuration ensures that all telemetry, mission planning, and sensor data are presented in the preferred units for clarity and consistency.

### Available Unit Options:

- **Distance:** Meters (m), Feet (ft)
- **Area:** Square Meters (m<sup>2</sup>), Square Feet (ft<sup>2</sup>), Square Kilometers (km<sup>2</sup>), Hectares (ha), Acres (ac), Square Miles (mi<sup>2</sup>)
- **Speed:** Meters per Second (m/s), Feet per Second (ft/s), Miles per Hour (mph), Kilometers per Hour (kph), Knots (kt)
- **Temperature:** Celsius (°C), Fahrenheit (°F)

Operators can select their preferred units from the drop-down menus. Changes are applied upon application restart. Unit change is reflected across all relevant displays and mission data within the GCS.

## Miscellaneous Settings:

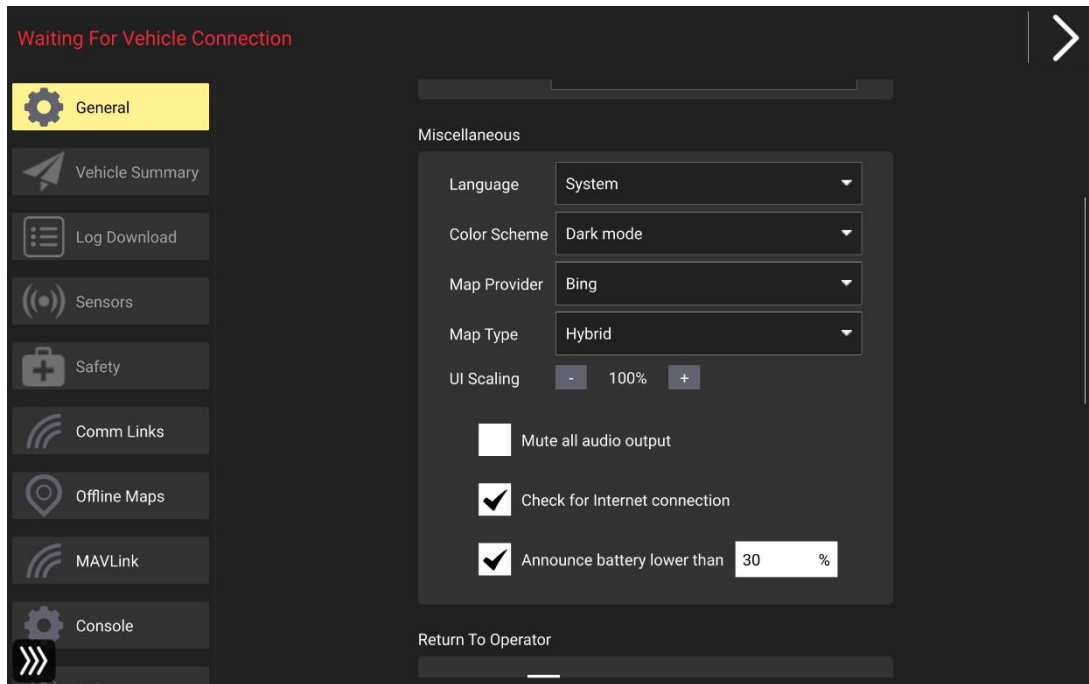


Figure 52 – Miscellaneous

The **General Settings** menu allows operators to configure system behavior, user interface preferences, units of measure, return logic, and mission planning defaults. These settings directly affect how information is displayed, how commands are interpreted, and how the aircraft responds during both manual and autonomous operations.

Operators should review and configure these settings during initial setup and verify them prior to flight operations.

## External Settings

### Android Settings

Opens the underlying Android operating system settings for the GCS tablet. This includes system-level controls such as Wi-Fi, Bluetooth, display brightness, power management, date/time, and device security.

### **Operational Note:**

Changes made here affect the tablet globally and may impact GCS performance or connectivity if misconfigured.

### **Tether Settings**

Accesses Android tethering options, allowing the GCS to share its internet connection with external devices via USB, Wi-Fi hotspot, or Bluetooth.

### **Use Case:**

Useful for providing internet access to peripherals or support devices when operating in the field.

### **Web Browser**

Launches the system web browser. This may be used for accessing online documentation, support resources, or internal tools when internet connectivity is available.

## **Units**

These settings control how all numerical data is displayed throughout the GCS, including telemetry, mission planning, and warnings.

### **Distance**

- **Feet**
- **Meters**

Controls the unit used for altitude, distances, and separation values.

### **Area**

- Square Feet
- Square Meters
- Square Kilometers
- Hectares
- Acres
- Square Miles

Used primarily for mission planning, survey coverage calculations, and mapping outputs.

### **Speed**

- Feet per second
- Meters per second
- Miles per hour
- Kilometers per hour
- Knots

Applies to airspeed, ground speed, wind limits, and performance displays.

### **Temperature**

- Celsius
- Fahrenheit

Controls how temperature values are displayed in system readouts and warnings.

## Miscellaneous

### Language

Sets the GCS interface language.

Available options:

- System Language (Default)
- Bulgarian
- Chinese
- Dutch
- English
- Finnish
- French
- German
- Greek
- Hebrew
- Italian
- Japanese
- Korean
- Norwegian
- Polish
- Portuguese
- Russian
- Spanish

**Note:**

Selecting *System Language* follows the tablet's Android language setting.

**Color Scheme**

- **Dark Mode**
- **Light Mode**

Controls the overall UI theme. Dark Mode is recommended for low-light or night operations to reduce glare.

**Map Provider**

Selects the map imagery source used in both Fly View and Plan View.

Available providers include:

- Google
- Bing
- Statkart
- Eniro
- Mapbox
- VWorld
- Copernicus
- Japan-GSI
- LINZ

**Operational Note:**

Map availability and resolution depend on region and offline map downloads.

## UI Scaling

Adjusts the size of UI elements using percentage-based scaling via plus (+) and minus (–) controls.

### Use Case:

Useful for adapting the interface to operator preference, gloves, or lighting conditions.

## Mute All Audio Output

- Checkbox (Yes / No)

When enabled, all GCS audio alerts and spoken warnings are muted.



### **WARNING – Disabling Audio**

Disabling audio removes audible safety cues such as low-battery announcements.

Operators must actively monitor telemetry if audio is muted.

## Check for Internet Connection

- Checkbox (Yes / No)

When enabled, the GCS verifies internet connectivity and may display connectivity-related notifications.

## Announce Battery Lower Than

- Checkbox (Enable / Disable)
- Battery percentage input field

When enabled, the GCS announces an audible warning once the vehicle battery drops below the specified percentage.

### **Best Practice:**

Maintain audio output enabled and set this threshold to ensure timely operator awareness of battery state.

## Return to Operator (RTO)

Return to Operator modifies how the aircraft executes a Return-to-Launch (RTL) command by referencing the operator's current position instead of the original launch location.

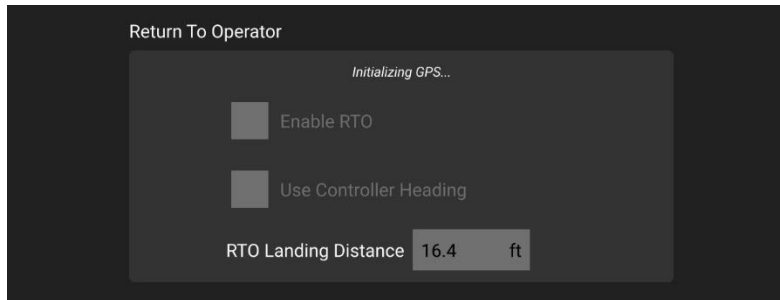


Figure 53 – RTO Settings

### Enable RTO

- Checkbox (Yes / No)
- **Enabled:**  
A notification appears indicating that RTO is active. When RTL is commanded, the aircraft will return to the operator's current position.
- **Disabled:**  
A notification indicates RTO is off. RTL will return the aircraft to the original launch point.

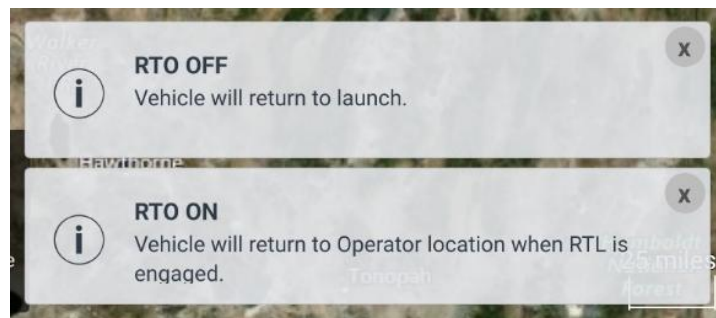


Figure 54 – RTO On/Off Notifications

## Use Controller Heading

- Checkbox (Yes / No)

When enabled, the aircraft aligns its landing or approach orientation based on the controller's heading during RTO.

## RTO Landing Distance

Numeric input field (feet or meters, based on unit settings)

Defines the horizontal distance from the operator at which the aircraft will land during an RTO event.

## Fly View

These settings affect in-flight visualization and operator workflow.

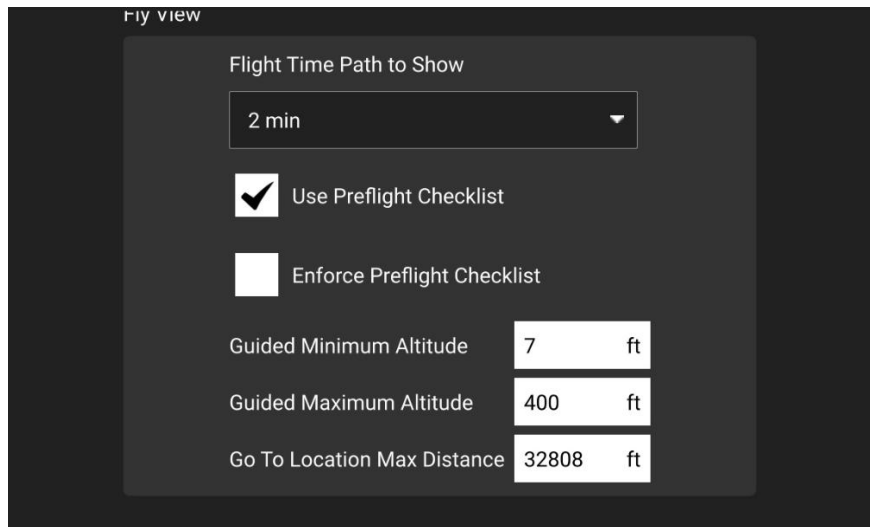


Figure 55 – Fly View Settings

## Flight Time Path to Show

Controls how much historical flight path is displayed:

- Show All
- 30-second increments up to 5 minutes

### **Use Preflight Checklist**

- Checkbox (Yes / No)

Enables the built-in preflight checklist for operator reference prior to arming.

### **Enforce Preflight Checklist**

- Checkbox (Yes / No)

When enabled, the checklist must be completed before arming is permitted.

### **Guided Minimum Altitude**

Numeric input field (feet or meters)

Defines the minimum altitude allowed for guided commands (e.g., Go To, Hold).

### **Guided Maximum Altitude**

Numeric input field (feet or meters)

Defines the maximum altitude allowed for guided commands.

### **Go To Location Max Distance**

Numeric input field (feet or meters)

Limits the maximum horizontal distance allowed for Go To Location commands.

## Plan View

These settings affect mission creation and planning behavior.

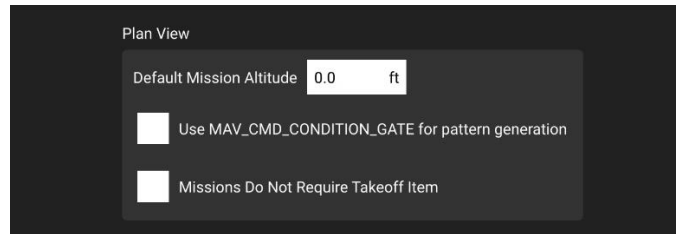


Figure 56 – Plan View Settings

### Default Mission Altitude

Numeric input field (feet or meters)

Sets the default altitude applied to newly created mission items.

### Use MAV\_CMD\_CONDITION\_GATE for Pattern Generation

- Checkbox (Yes / No)

When enabled, mission pattern generation uses Mavlink condition gate commands for more precise camera trigger timing at survey boundaries instead of standard waypoints.

### Missions Do Not Require Takeoff Item

- Checkbox (Yes / No)

When enabled, missions may be executed without an explicit takeoff command, assuming the aircraft is already airborne.

### Use Case:

Useful for advanced workflows or mission continuation scenarios.

## Comm Links

The **Comm Links** tab allows operators to configure how the Ground Control Station (GCS) communicates with the Edge 130 and other connected systems. From this screen you can:

- Add one or more communication links
- Name each link for easy identification
- Select the link type (**Serial**, **TCP**, or **UDP**)
- Configure whether the link should **automatically connect on startup**
- Enable **high latency** handling for long-delay networks
- For Serial links, select the **serial port** and **Baud rate**

Correct configuration of these options ensures stable telemetry, command, and payload data exchange between the GCS and the aircraft.

### Adding a Communication Link

At the top of the Comm Links tab, there is an option to **add a comm link**.

The screenshot shows a configuration dialog for adding a communication link. It is divided into two main sections: 'General' and 'Serial Link Settings'. In the 'General' section, the 'Name' field is 'Unnamed', the 'Type' is 'Serial', 'Automatically Connect on Start' is unchecked, and 'High Latency' is checked. The 'Serial Link Settings' section shows 'Serial Port' as 'No serial ports available' and 'Baud Rate' as '57600'. 'OK' and 'Cancel' buttons are located at the bottom right of the dialog.

Figure 57 – Add Comm Link

### Typical workflow:

1. Select **Add Link**.
2. Enter a **Name** for the link.
3. Choose a **Type** (Serial, TCP, or UDP).
4. Configure additional options (Auto Connect, High Latency, Serial Port & Baud rate if applicable).
5. Save your changes.

### Best Practice:

Use descriptive names (e.g., *"Primary Air Link (900 MHz)"*, *"Ground Network TCP Link"*) so operators can quickly identify which link is active during operations or troubleshooting.

## Link Name

Each communication link has a **Name** field.

- This name is **purely for user reference** and does not affect how the link behaves at the protocol level.
- Choose a name that reflects:
  - The physical interface (e.g., "USB Serial Radio")
  - The purpose (e.g., "UAV Telemetry", "Simulated Vehicle")
  - The medium (e.g., "LTE TCP Link", "Local UDP Bridge").

A clear naming scheme is helpful when multiple links are configured or when switching between different radios or network configurations.

## Link Type: Serial, TCP, UDP

You can select one of three link **Types**:

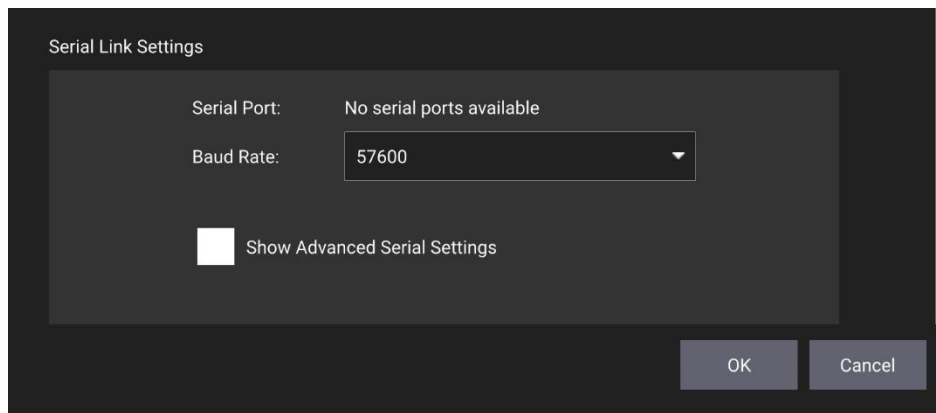
- **Serial**
- **TCP**
- **UDP**

Each type corresponds to a different underlying transport method.

## Serial

**Serial** links are used when the GCS connects directly to a device over a serial interface, typically via:

- USB-to-serial adapter
- Direct UART port
- Dedicated radio modem connected as a COM/TTY device



*Figure 58 – Serial Link Settings*

Serial links are most common for:

- Telemetry radios connected to the GCS
- Direct wired connections to ground modems or test rigs

When **Serial** is selected:

- The **Serial Link Settings** box is enabled.
- You must choose a **Serial Port** (if available).
- You must choose an appropriate **Baud rate**.

## TCP

**TCP (Transmission Control Protocol)** links use a network connection (wired or wireless) that provides a **reliable, connection-oriented** data stream.

Typical use cases:

- GCS connected to a telemetry server on a LAN or WAN
- Integration with a simulator or remote host that exposes a TCP endpoint
- Systems where packet ordering and guaranteed delivery are important

In a typical configuration, one side acts as a **server** (listens on a port) and the other as a **client** (connects to that server). The Comm Links Tab will present fields appropriate for specifying the TCP connection (e.g., host/port), depending on your system configuration.

## UDP

**UDP (User Datagram Protocol)** links use a network connection that is **connectionless** and **packet-based**.

Typical use cases:

- High-rate telemetry where occasional packet loss is acceptable
- Broadcasting data to multiple listeners on a network
- Simulator or test environments where low latency is more important than guaranteed delivery

UDP does not guarantee:

- Delivery
- Ordering
- Duplication avoidance

Because of that, it is often used where bandwidth is limited or where low latency is critical and the application can tolerate some loss.

 **NOTE**

When using TCP or UDP, additional network parameters (such as IP address and port) must be configured as appropriate for your specific deployment or simulator environment.

## Auto Connect on Start

Each comm link has an **“Automatically connect on start”** checkbox.

- **Enabled (checked):**  
The GCS will automatically attempt to open this communication link when the application starts.
- **Disabled (unchecked):**  
The link will remain idle on startup and must be manually connected by the operator.

### When to enable Auto Connect:

- For **primary telemetry links** that are used for every mission.
- When you want the GCS to be ready as soon as the radios are powered on and the aircraft is active.

### When to leave Auto Connect disabled:

- For **backup links** or test links used only in specific scenarios.
- When the link may not always be physically connected (e.g., certain USB adapters) and repeated auto-connect attempts could cause unnecessary warnings or clutter.

## High Latency Checkbox

The “**High latency**” checkbox is used to tell the system that the link may experience **significant communication delay** (round-trip latency), such as:

- Satellite communications (SATCOM)
- Cellular/LTE connections over distant networks
- Long-haul VPN or remote link paths
- Heavily congested or bandwidth-limited networks

When **High Latency** is enabled:

- Internal timeouts and link-handling behavior are often adjusted to **tolerate longer delays** without immediately flagging them as link loss.
- The system is more forgiving about delayed acknowledgements, reducing unwanted failsafes or disconnect messages caused purely by slow networks.

When **High Latency** is **not** enabled on a slow link:

- The GCS may interpret network delay as dropped packets or lost connection, which can lead to:
  - Frequent link warnings
  - Erratic connection status indicators
  - Possible automatic link resets

### Guidance:

- Enable **High Latency** for any link where round-trip delays above normal radio latency are expected.
- Leave it **unchecked** for direct serial or short-range radio links where latencies are typically low.

## Serial Link Settings

When the **Type** is set to **Serial**, the **Serial Link Settings** section becomes active. This section allows you to specify:

- **Serial Port**
- **Baud Rate**

### Serial Port

The **Serial Port** dropdown lists available serial interfaces detected by the system, such as:

- COM1, COM3, COM4 (on Windows)
- /dev/ttyUSB0, /dev/ttyACM0 (on Linux or Android-based systems)

### Selection Guidelines:

- Choose the serial port corresponding to your **connected radio** or **interface cable**.
- If you are unsure which port is correct:
  - Disconnect the cable or device, note available ports.
  - Reconnect it and check which new port appears, then select that one.
- Ensure no other application is already using that port. Only one application can usually open a port at a time.

## Baud Rate

The **Baud Rate** determines how quickly data is transmitted over the serial link. The following selectable options are available:

- 2400
- 4800
- 9600
- 19200
- 38400
- 57600
- 115200
- 230400
- 460800
- 500000
- 576000
- 921600

### Key Principles:

- The **Baud rate on the GCS side must match the baud rate on the connected device** (e.g., telemetry radio, modem, or interface board).
- Mismatched baud rates typically result in:
  - Garbled data
  - No telemetry
  - Failed or unstable connections

### Typical Usage Guidelines:

- **9600 / 19200 / 38400**
  - Very conservative, low data rate.
  - Suitable for extremely bandwidth-limited or older equipment, but generally not recommended for modern sUAS telemetry.
- **57600 / 115200**
  - Common defaults for many telemetry radios.
  - Provide a good balance of reliability and throughput for typical mission needs.
- **230400 / 460800 / 500000 / 576000 / 921600**
  - High-speed options used when:
    - Large volumes of telemetry or payload data must be transmitted.
    - The hardware and cable quality support these higher rates.
  - More sensitive to cable length, electrical noise, and connector quality.

### Best Practice:

Use the baud rate specified in your radio or interface documentation. If you are unsure, start with **57600** or **115200**, as these are common defaults for many modern systems.

## Operational Considerations & Best Practices

- **One Primary Link, Clear Naming:**  
Configure at least one primary comm link (typically a **Serial** link to your radio) with a descriptive name and Auto Connect enabled.
- **Backup Links:**  
Additional **TCP** or **UDP** links can be configured as backups or for advanced integrations (e.g., simulators, network bridges). Leave Auto Connect disabled if they are used only occasionally.
- **High Latency Usage:**  
Only enable **High Latency** when you know the path will introduce significant delay. Using it on low-latency serial or radio links is unnecessary and may delay detection of real link issues.
- **Change One Thing at a Time:**  
When troubleshooting, change only one parameter at a time (port, baud, or type) and test again. This makes it easier to identify what fixed the issue.
- **Documentation Alignment:**  
Always align your Comm Links configuration with the **recommended settings for your specific FlightWave hardware** (radios, GCS hardware, or network configuration), as provided in your system documentation or integration guide.

## MAVLink

The **MAVLink** section under General Settings allows operators to configure how the Ground Control Station (GCS) behaves as a MAVLink endpoint and how it interacts with connected vehicles and other MAVLink-enabled systems. Proper configuration ensures that:

- The GCS identifies itself correctly on the MAVLink network
- Only compatible vehicles are accepted (if desired)
- Heartbeats and forwarding behavior are correctly managed
- Operators can monitor link health in real time

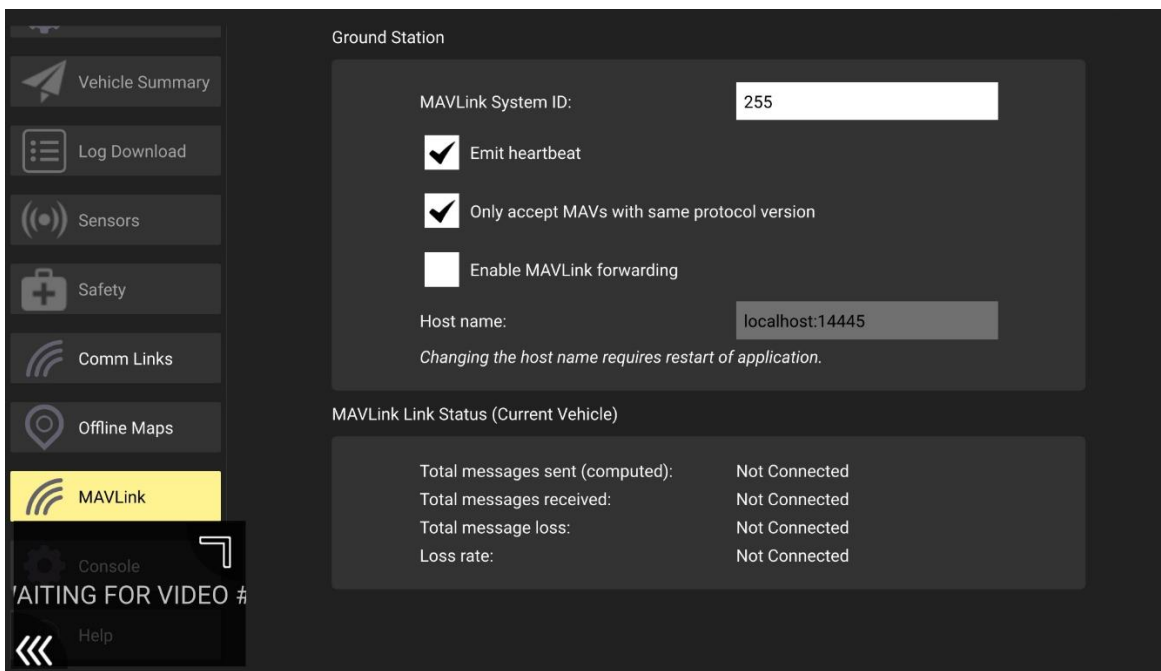


Figure 59 – MAVLink

Once the **MAVLink** section is selected, two main areas are available:

1. **Ground Station** (MAVLink configuration)
2. **MAVLink Link Status (Current Vehicle)** (live telemetry link statistics)

## Ground Station – MAVLink Configuration

This section defines how the GCS presents itself on the MAVLink network and how it handles MAVLink messages.

### MAVLink System ID

**Field:** *MAVLink System ID*

**Type:** Numeric entry (user can type or select a number)

The **MAVLink System ID** uniquely identifies the GCS on the MAVLink network. In MAVLink, every system (vehicle, GCS, companion computer, simulator, etc.) is assigned an ID.

- Typical ID ranges:
  - 1–255 for MAVLink v1
  - 1–255 (extended in v2 for components, but system IDs are still typically kept within this range)
- The aircraft (UAV) and the GCS **must have different IDs** so the network can distinguish between them.

### Usage Guidelines:

- If you are using a single GCS with a single vehicle, the default ID is usually sufficient.
- If you have **multiple GCS units** or **multiple MAVLink systems** on the same network, ensure each one uses a **unique System ID** to prevent message collisions or confusion.
- Do not use the same ID as the vehicle; this can cause undefined behavior or misrouted messages.

### Best Practice:

Record your chosen MAVLink System ID in your configuration or SOP so all team members configure their GCS consistently and avoid conflicting IDs on shared networks.

## Emit Heartbeat (Checkbox)

**Option:** *Emit Heartbeat* (Enable/Disable)

MAVLink **heartbeat messages** announce the presence and status of a system at regular intervals. When **Emit Heartbeat** is enabled:

- The GCS periodically sends MAVLink heartbeat messages.
- Other MAVLink systems (vehicles, companion computers, simulators) can recognize the GCS as an active system and may display it in their own system lists.

### When to enable:

- In almost all standard operations, **Emit Heartbeat should be enabled**, so the GCS is visible to the vehicle and any other MAVLink participants.
- Required when you want the aircraft to treat the GCS as a valid control or monitoring endpoint.

### When to consider disabling:

- In some specialized test setups where you do not want the GCS announcing itself on the network (e.g., passive monitoring only), you may disable heartbeats.
- This is uncommon in typical field operations.

#### **NOTE**

If heartbeats are disabled, some systems may assume the GCS is offline or may not route messages to it as expected.

## Only Accept MAVs with Same Protocol Version (Checkbox)

**Option:** *Only Accept MAVs with the same protocol version (Enable/Disable)*

MAVLink has different protocol versions (primarily **MAVLink v1** and **MAVLink v2**). When this option is enabled:

- The GCS will **only accept connections from MAVs using the same MAVLink protocol version** as the GCS.
- Messages from MAVs using a different protocol version will be ignored or rejected.

### Benefits of enabling:

- Ensures protocol-level compatibility and avoids misinterpretation of messages.
- Prevents unexpected behavior when older or mismatched MAVLink devices are present on the same network.

### When to enable:

- Mixed environments where some older MAVLink devices might be operating.
- Any situation where strict protocol consistency is required.

### When to leave disabled:

- If you are troubleshooting version-related issues or working with legacy hardware that may only support an older MAVLink version.
- In controlled test environments where you intentionally want to observe behavior from different versions.

### Best Practice:

For production operations, enabling this option improves robustness and reduces risk from protocol mismatches.

## Enable MAVLink Forwarding (Checkbox)

**Option:** *Enable MAVLink forwarding* (Enable/Disable)

MAVLink **forwarding** allows the GCS to pass MAVLink messages between different links, effectively acting as a router/bridge. When this option is enabled:

- The GCS will **forward MAVLink messages** received on one link to other connected links, according to its forwarding rules.
- This can be used to:
  - Bridge a vehicle's MAVLink stream to another GCS.
  - Forward telemetry to a simulator or logging system.
  - Mirror data to a network-based ground station or cloud service.

### Use Cases:

- Sending telemetry from a field GCS to a remote command center over TCP/UDP.
- Recording full MAVLink traffic on a separate logging machine.
- Integrating a hardware GCS link with a software simulator.

### Risks and considerations:

- If misconfigured, forwarding can cause **loops** or **duplicate messages** when multiple forwarding nodes exist.
- Increased bandwidth usage if forwarding large message sets to multiple destinations.
- In complex networks, careful planning is needed to avoid multiple forwarding paths between the same endpoints.

### When to enable:

- When you explicitly need to share MAVLink data to other systems or network endpoints.
- In multi-node or distributed monitoring setups.

### When to leave disabled:

- For simple one-GCS/one-vehicle setups that do not require relaying traffic.
- When you are unsure of the network topology or want to avoid accidental loops/duplicates.

## Host Name

**Field:** *Host Name*



### NOTE

Changing the host name requires restart of the application.

The **Host Name** field lets you assign a human-readable identifier to the Ground Station within the MAVLink environment or related network services. This name can be used:

- To identify the GCS in logs, status messages, or other network tools.
- In multi-GCS environments to make it clear which station is responsible for a mission (e.g., "Command-GCS-Alpha", "Observer-GCS-1").

### Behavior and considerations:

- The Host Name is used at the application/os level and may be referenced by MAVLink-aware tools and services.
- **Any change to the Host Name requires a restart of the application** for the new value to take effect. Until restarted, the system continues to use the previous Host Name.
- Choose a name that clearly indicates:
  - Location (e.g., "TOC-GCS1")
  - Role (e.g., "PrimaryFlightGCS")
  - Unit or mission identifier (e.g., "TeamA-Overwatch-GCS")

## MAVLink Link Status (Current Vehicle)

The **MAVLink Link Status (Current Vehicle)** section provides **live feedback** on the health and performance of the MAVLink connection with the currently selected vehicle. These statistics help operators quickly assess link quality and diagnose communication issues.

The following metrics are displayed:

- **Total Messages Sent (Computed)**
- **Total Messages Received**
- **Total Message Loss**
- **Loss Rate**

These values update in real time while a MAVLink link is active.

### Total Messages Sent (Computed)

This shows the **cumulative number of MAVLink messages sent from the GCS** to the current vehicle.

- “Computed” indicates this value is calculated by the GCS based on its internal message transmission counts.
- Includes all types of outgoing MAVLink messages:
  - Commands
  - Parameter requests
  - Mission uploads
  - Heartbeats
  - Status queries

### How to use it:

- Confirm that the GCS is actively sending data during mission planning or control.
- Compare with **Total Messages Received** to understand the overall message flow balance.

### Total Messages Received

This shows the **cumulative number of MAVLink messages received from the current vehicle.**

- This includes all incoming telemetry, status, sensor data, and any responses to commands.
- A steadily increasing count indicates the link is active and the vehicle is reporting as expected.

### How to use it:

- Validate that the GCS is receiving a continuous stream of telemetry from the aircraft.
- If this count is not increasing while the link should be active, there may be:
  - A radio issue
  - Network or routing problem
  - Vehicle-side communication failure

## Total Message Loss

**Total Message Loss** represents the cumulative number of MAVLink messages that were **expected but not received**.

- Typically based on **sequence numbers** embedded in MAVLink messages: if sequence numbers jump, the system infers that some messages were lost in transit.
- This is a running count over the lifetime of the current link session.

### How to interpret:

- A small amount of message loss is normal over RF links, especially at longer ranges or in noisy environments.
- Rapid increases in Total Message Loss may indicate:
  - Degraded RF conditions
  - Interference
  - Obstructions (terrain, structures, vehicles)
  - Overloaded or failing communication hardware

#### **NOTE**

Message loss does not necessarily mean critical commands are failing, but **persistent or high loss** can reduce the accuracy and timeliness of telemetry and may impact system responsiveness.

## Loss Rate

**Loss Rate** is typically expressed as a **percentage**, representing the proportion of messages that were lost relative to the total number of messages sent/expected.

- For example, a Loss Rate of 1–2% across a normal RF link may be acceptable in many scenarios.
- Higher Loss Rates (e.g., >5–10%) may begin to impact control smoothness, telemetry fidelity, or both.

### Operational Interpretation:

- **Low Loss Rate (near 0%)**
  - Excellent link performance.
- **Moderate Loss Rate (1–5%)**
  - Usually acceptable but may warrant monitoring if mission is critical.
- **High Loss Rate (>5–10%)**
  - Investigate:
    - Antenna orientation and integrity
    - Distance and line-of-sight
    - Interference sources
    - Baud rate / bandwidth saturation

### Best Practice:

Monitor Loss Rate during test flights and establish a “normal” baseline for your typical operating environment. Significant deviation from that baseline is a strong indicator that conditions or hardware have changed.

## Telemetry Logs from Vehicle:

### **Recommended: Save Log After Each Flight.**

Telemetry logs are essential for diagnosing issues, reviewing mission performance, and providing FlightWave Support with accurate system data. Selecting **“Save Log after each flight”** ensures that:

- Flight data is automatically stored without the operator needing to remember
- Logs are available for post-flight review (e.g., GPS, power, vibration, wind, sensor data)
- Support teams can quickly troubleshoot anomalies
- Mission records are preserved for compliance and documentation

This setting ensures reliable data capture with no additional steps required from the pilot

## Fly View:

### **Recommended: Leave these set to default.**

The default Fly View settings are optimized for:

- Best readability during flight
- Maximum situational awareness
- Standardized control layout across training and operations
- Minimizing accidental changes that can confuse operators under stress

Customizing Fly View may interfere with familiar UI layouts or obscure critical indicators. Leaving defaults ensures all operators see consistent displays and reduces the chance of mode or widget misconfiguration.

## Plan View:

### **Default Mission Altitude – Recommended to use the default value.**

The default waypoint altitude is selected to align with:

- Airframe performance
- Sensor standoff requirements
- Typical mission planning envelopes
- Terrain-avoidance safety margins

While operators may adjust altitude for specific missions, maintaining the default setting prevents accidental low-altitude mission uploads and maintains a standard baseline for general operations.

## Edge130 Air Vehicle Setup

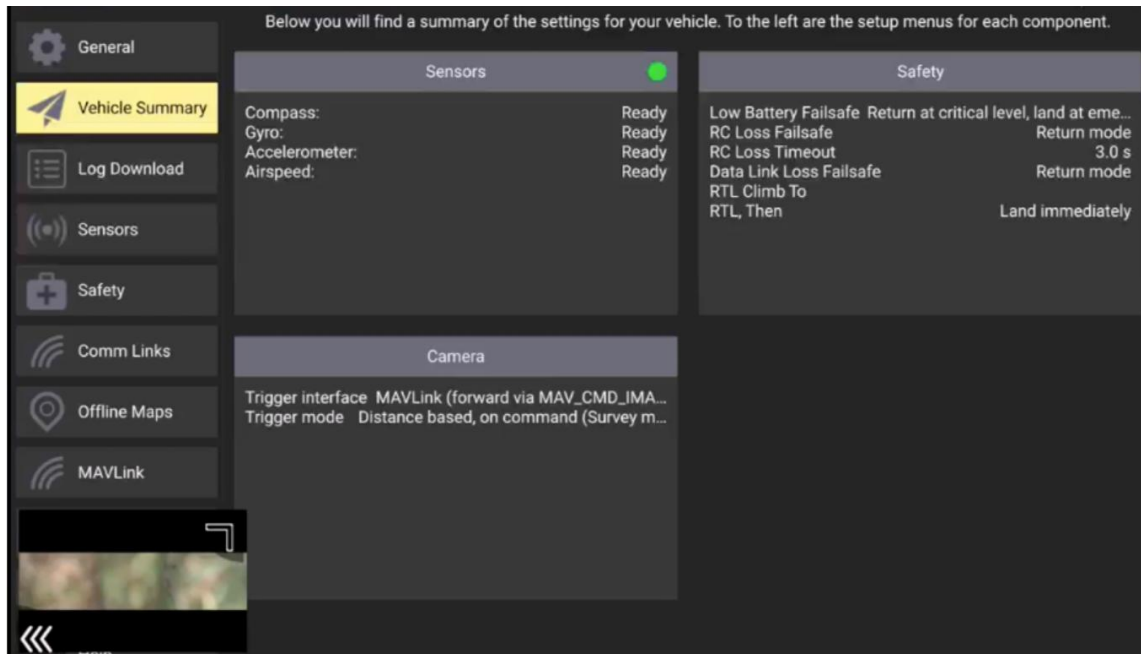


Figure 60 – Vehicle Summary

### Vehicle Summary:

The **Vehicle Summary** provides a comprehensive overview of the Edge 130's configuration and operational readiness, including sensor calibrations, safety parameters, and camera settings.

Indicators within this view highlight the current status of each subsystem. If any warnings or errors are displayed—such as uncalibrated sensors or improperly configured safety settings—the operator must resolve these issues prior to takeoff.

All available setup and configuration options can be accessed via the menu on the left side of the screen, allowing operators to review, adjust, and verify system parameters efficiently before flight.

## Sensor Calibration:

To access the **Sensor Calibration** page, select **Sensors** from the left-hand menu. A list of available sensors will be displayed, each with an associated button. Click the button corresponding to a specific sensor to initiate its calibration sequence.

### NOTE

FlightWave performs factory calibration of all sensors prior to shipping, so calibration is typically unnecessary. Only perform calibration if the autopilot reports a pre-flight check failure specifying a sensor requires calibration.

After completing any calibration procedure, **power-cycle the aircraft** by removing and reinserting the battery to ensure proper sensor initialization.

### Before You Calibrate Sensors

#### 1. Verify the necessity of calibration:

- Ensure the aircraft is powered on and connected to the Ground Control Station (GCS).
- Rotate the aircraft in all axes—left, right, up, and down—to provide diverse data for sensor self-assessment.
- Run the pre-flight checklist and briefly arm the vehicle on the ground. If no warnings appear, calibration is not required.

#### 2. If sensor warnings persist:

- Power-cycle the vehicle by removing the battery, wait five seconds, and reinsert it.
- Repeat the pre-flight checklist and attempt to arm the vehicle again.

#### 3. Perform calibration only if necessary:

- If warnings continue, calibrate the specific sensor indicated by the system.
- For **EKF errors**, ensure at least 10 GPS satellites are visible before calibrating the **accelerometer**, **compass**, and, if required, the **gyroscope**.

## Gyroscope Calibration:

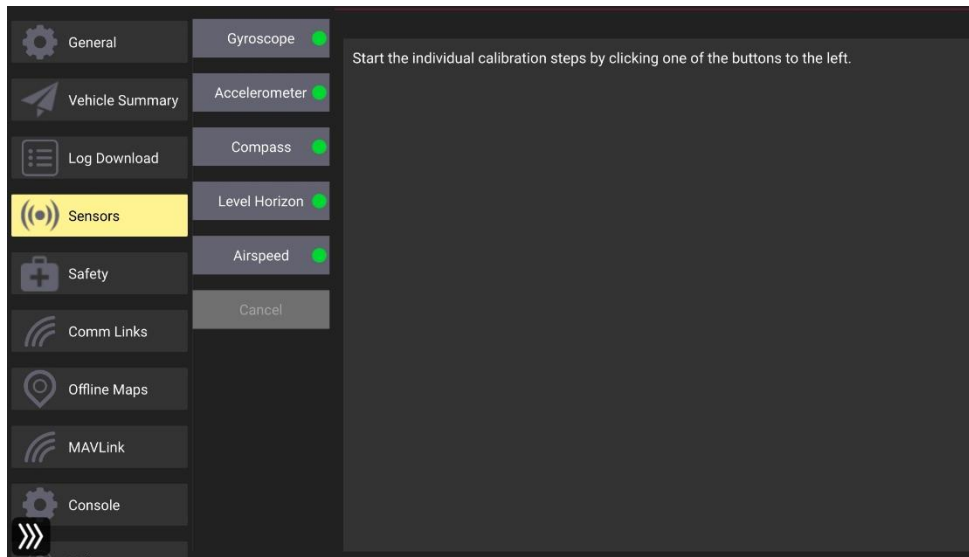


Figure 61 – Gyroscope Calibration

Gyroscope calibration ensures accurate angular rate measurements for stable flight and precise control.

### Calibration Procedure:

1. Select the **Gyroscope Sensor** button in the Ground Control Station.
2. Place the aircraft on a **flat, stable surface**. The surface does not need to be perfectly level but must not move during calibration.
3. Click **OK** to begin the calibration sequence.
4. The gyroscope will calibrate automatically for approximately **five seconds**.
5. When calibration is complete, the progress bar will display **“Calibration Complete.”**
6. **Power-cycle the aircraft** by removing and reinserting the battery to finalize the calibration.

**NOTE**

Ensure the aircraft remains completely stationary during calibration.

Any movement during this process may result in inaccurate calibration and require a repeat of the procedure.

**Accelerometer Calibration:**

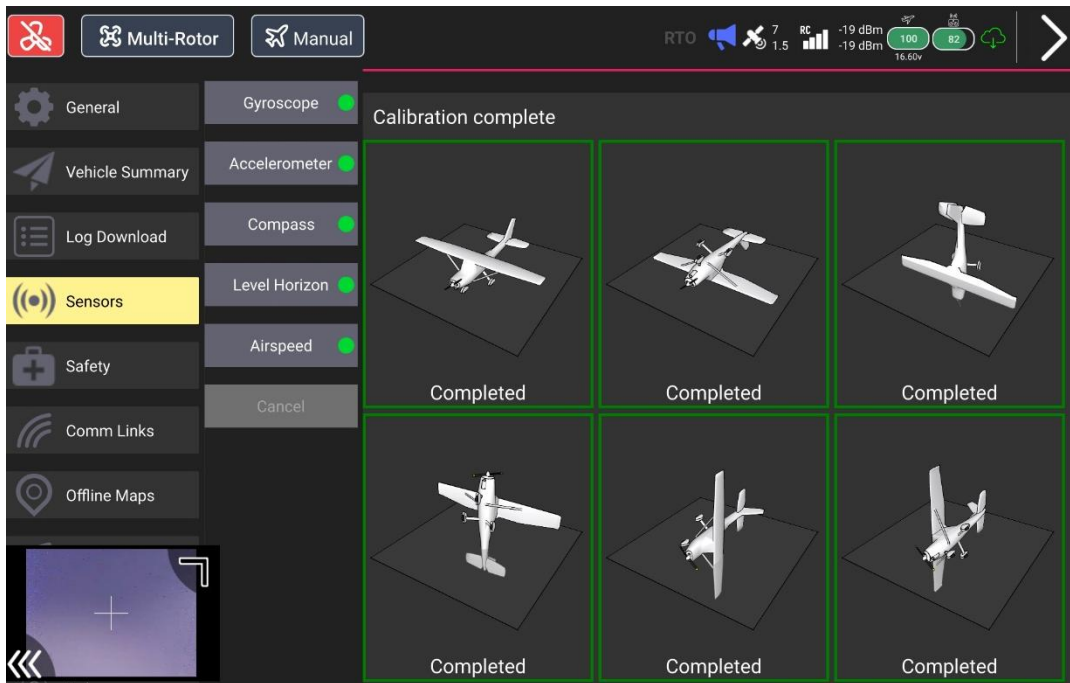


Figure 62 – Accelerometer Calibration

Accelerometer calibration is rarely required but may be necessary to clear a pre-flight sensor check. This process ensures accurate orientation sensing by calibrating the vehicle in six distinct positions relative to gravity.

**Calibration Procedure:**

1. Select the **Accelerometer Sensor** button in the Ground Control Station.
2. Click **OK** to begin the calibration sequence.
3. Follow the on-screen diagrams illustrating the six required orientations. These positions are relative to gravity—do not assume the ground is level.

4. Pick up and rotate the aircraft to any orientation marked with a **red border** and labeled **“Incomplete.”**
5. Hold the aircraft steady in that orientation, stabilizing with both hands if necessary.
6. The diagram will change to **yellow** with the label **“Hold Still.”**
  - If the color or message does not appear, verify the aircraft alignment with gravity.
7. After approximately five seconds, the orientation will turn **green** and display **“Complete.”**
8. Repeat steps 4–7 for all remaining incomplete orientations.
9. Once all six positions are successfully completed, the progress bar will indicate **“Calibration Complete.”**



**NOTE – Hold Still**

If the aircraft is moved during the **“Hold Still”** phase, the calibration must be canceled and restarted.



**IMPORTANT – When to Perform Sensor Calibration**

Most drones require recalibration when traveling long distances to a new geographical region or when operated near large metal structures, vehicles, concrete buildings, or other sources of magnetic interference. These environmental factors can affect compass alignment, accelerometer accuracy, or gyroscope stability.

If unexpected sensor errors, erratic flight behavior, or calibration warnings appear on the GCS, performing a full **Sensor Calibration** is an effective troubleshooting step.

## Compass Calibration:

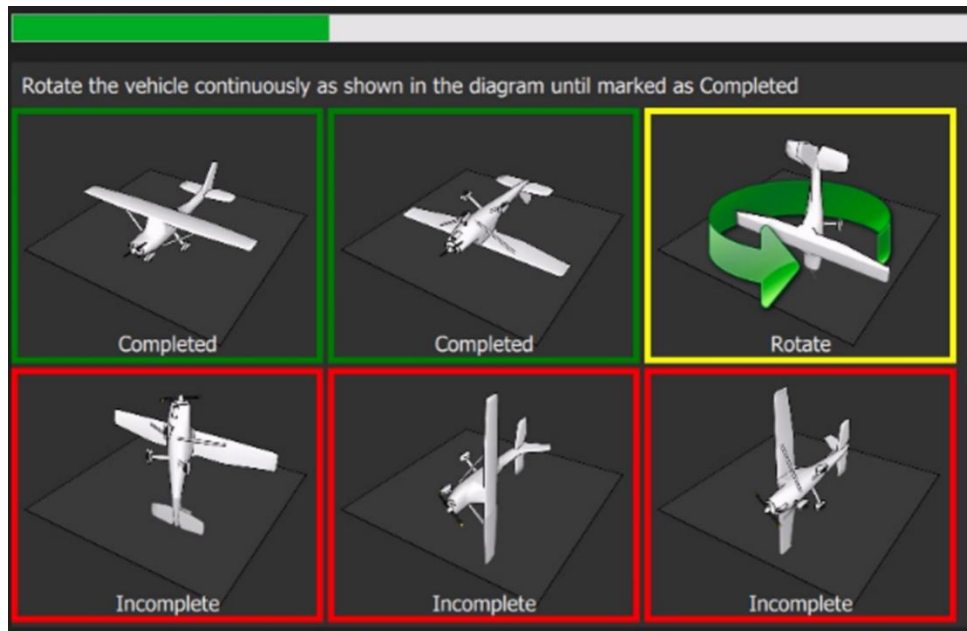


Figure 63 – Compass Calibration

Compass calibration is performed to ensure accurate heading and navigation data. This procedure requires rotating the aircraft through multiple orientations relative to gravity.

### Calibration Procedure:

1. Select the **Compass Sensor** button in the Ground Control Station.
2. Click **OK** to begin the calibration sequence.
3. The display will show six orientations. These positions are relative to gravity—do not assume the ground is level.
4. Pick up the aircraft and rotate it to any orientation marked with a **red border** labeled **“Incomplete.”**
5. Hold the aircraft steady in that orientation.
6. The diagram will change to **yellow** and display **“Rotate.”**
7. Rotate the aircraft around the specified axis as indicated on-screen. You may spin your body while keeping the aircraft’s vertical axis aligned with gravity.

8. Complete **at least two full rotations** within approximately five seconds.
9. After the rotations, the orientation will turn **green** and display **“Complete.”**
10. Repeat steps 4–9 for all remaining incomplete orientations.
11. Once all orientations are successfully completed, the progress bar will indicate **“Calibration Complete.”**
12. **Power-cycle the aircraft** by removing and reinserting the battery to finalize the calibration.

 **NOTE**

Ensure smooth, controlled rotations to avoid sensor errors.

If the aircraft is moved incorrectly during the calibration, the orientation may fail, requiring a restart of the sequence.

## Level Horizon Calibration:

Level Horizon calibration is rarely required on the Edge 130. The aircraft is factory-calibrated to maintain a stable and level hover relative to the horizon.

## Airspeed Sensor:

- Edge 130 utilizes airspeed sensors that do not require additional calibration

 **NOTE**

FlightWave calibrates **all sensors** prior to shipping each aircraft. Therefore, it is uncommon to perform additional calibration in the field. Only conduct sensor calibration if the autopilot indicates a **failed pre-flight check** and **explicitly identifies** a specific sensor requiring calibration.

## Air Vehicle Safety Settings

This section covers the configuration of **Safety Settings** to ensure safe and reliable operation of the Air Vehicle (AV). Proper configuration of these parameters is essential to prevent flight anomalies and ensure the AV responds appropriately to potential system faults such as **loss of communication, low battery voltage, or sensor failure**.

By setting the appropriate safety parameters, operators can ensure that the Edge 130 executes safe contingency procedures automatically protecting both the aircraft and mission-critical equipment.

### Safety Settings:

The following steps outline the procedure for accessing and configuring the **Safety Settings** within the FlightWave Controller Application. These parameters define how the Edge 130 responds to critical conditions, such as communication loss or low battery events.

#### Procedure:

1. Ensure that both the **Ground Control Station (GCS)** and the **air vehicle (AV)** are powered on and connected.
2. On the FlightWave Controller interface, select the **three-dot settings icon** located in the upper-right corner of the screen.
3. From the menu, select the **Safety** icon to open the **Safety Settings** configuration page.

## Low Battery Failsafe Trigger:

Proper configuration of the **Low Battery Failsafe** ensures that the Edge 130 executes safe and automated responses when battery levels reach critical thresholds. This protects the aircraft from power loss during flight and prevents potential damage from uncontrolled landings.

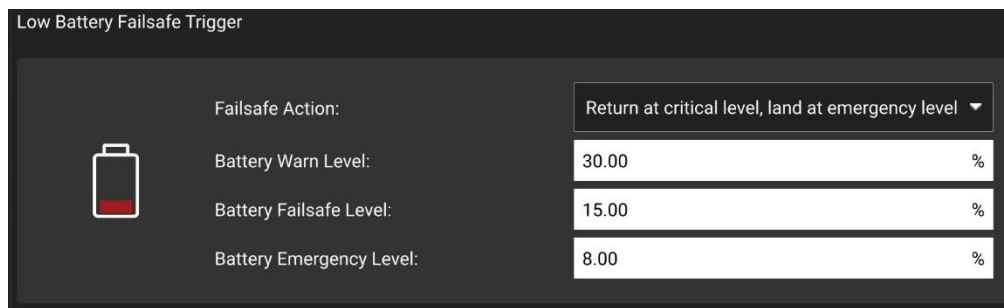


Figure 64 – Low Battery Failsafe Trigger Settings

### Programming the Low Battery Failsafe Trigger

1. **Failsafe Action:**

Set the system to **Return at Critical Level** and **Land at Emergency Level**.

This configuration ensures the AV automatically returns to the launch point when reaching the critical threshold and performs an immediate landing if power becomes dangerously low.

2. **Battery Warn Level:**

Set to **30%** – Triggers an **audible alert** to notify the operator of reduced battery capacity.

3. **Battery Failsafe Level:**

Set to **15%** – Initiates **Auto-RTL (Return to Launch)** to safely return the aircraft before depletion.

4. **Battery Emergency Level:**

Set to **10%** – Commands the AV to **Land in Place**, preventing total power loss during flight.

## RC Loss Failsafe Actions:

The **RC Loss Failsafe** (also referred to as **C2 Link Loss**) ensures the Edge 130 responds appropriately in the event of a lost radio communication link between the Ground Control Station (GCS) and the aircraft. Proper configuration of this parameter prevents uncontrolled flight and enables automatic recovery procedures.

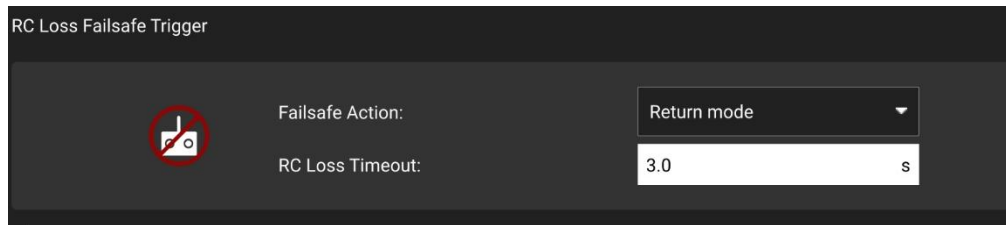


Figure 65 – Low Battery Failsafe Trigger Settings

### Programming the RC Loss Trigger (C2 Link)

1. **Failsafe Action:**

Set the system to **Return Mode**.

This configuration commands the aircraft to automatically execute a **Return-to-Launch (RTL)** procedure if communication with the GCS is lost.

2. **RC Loss Time:**

Set to **10 seconds**.

This value defines how long the system waits after losing communication before activating the failsafe.

## Data Link Loss Failsafe Trigger:

The **Data Link Loss Failsafe** ensures the Edge 130 responds correctly if the video/data link between the aircraft and the GCS is interrupted. This prevents uncontrolled flight and maintains situational awareness during the loss of video feed.

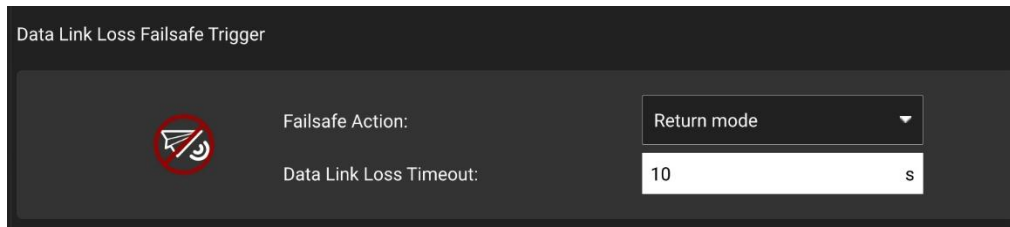


Figure 66 – Data Link Loss Failsafe Trigger

### Programming the Data Link Loss Trigger

1. **Failsafe Action:**

Set to **Return Mode**.

The aircraft will automatically initiate a **Return-to-Launch (RTL)** procedure if the video/data link is lost.

2. **Data Link Loss Time:**

Set to **10 seconds**.

This defines the duration the system waits after losing the video/data link before executing the failsafe.

## Geofence Failsafe Trigger:

The **Geofence** feature restricts the Edge 130's operational area, preventing the aircraft from flying outside a defined boundary. This is particularly useful when operating in confined spaces or near sensitive areas.

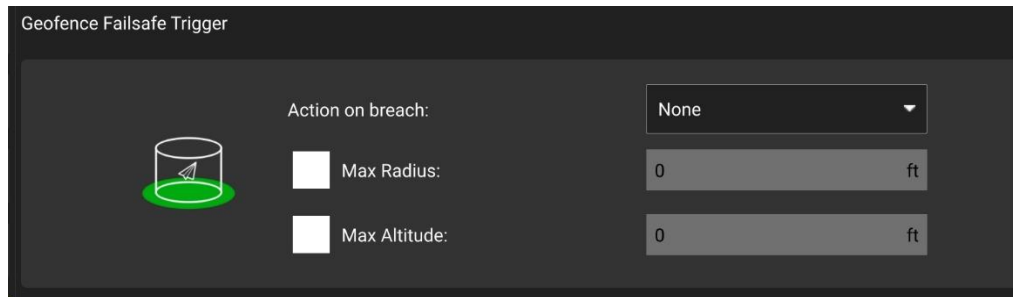


Figure 67 – Geofence Failsafe Trigger

### Programming the Geofence

1. **Enable Geofence:** Turn on the geofence feature in the Safety Settings menu.
2. **Define Boundary:** Set the maximum horizontal distance and altitude limits for safe operation.
3. **Failsafe Action:** Select the desired response if the aircraft reaches the geofence limit, such as **Return-to-Launch (RTL)** or **Hover/Stop**.
4. **Confirm Settings:** Ensure the geofence boundary is properly configured before flight to prevent inadvertent limit breaches.

## Return-to-Launch (RTL) Settings:

The **Return-to-Launch (RTL)** feature ensures that the Edge 130 safely returns to its launch point in the event of a failsafe, such as low battery or communication loss. Proper configuration is critical to avoid obstacles during the RTL maneuver.

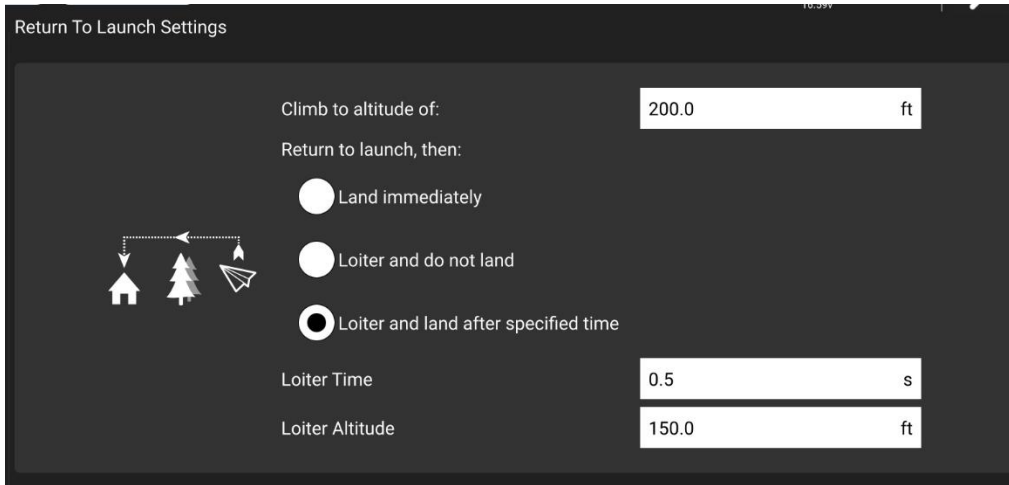


Figure 68 – Return-To-Launch Settings

### Programming RTL

#### 1. Climb to an Altitude of:

- Set this altitude based on your mission environment.
- Recommended: Above the tallest obstacle in the operational area to ensure safe transit.

#### 2. Return-to-Launch Action:

- Upon reaching the launch point, the aircraft will **Land Immediately**.

## Fixed-Wing Minimum Altitude:

The **Fixed-Wing Minimum Altitude** setting defines the lowest altitude at which the Edge 130 can operate in fixed-wing flight mode.

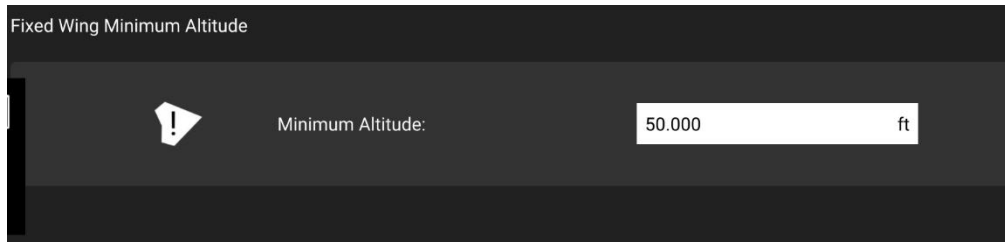


Figure 69 – Fixed-Wing Minimum Altitude

### Configuration Guidelines

#### 1. Minimum Altitude:

- If the aircraft descends below this altitude, it will automatically switch to **multi-copter mode** to maintain safety.

#### 2. Recommended Setting:

- Avoid setting this to zero, as flying at ground level increases the risk of collisions or aircraft loss.
- Set the minimum altitude **above the tallest obstacle** in your operational area for safe fixed-wing transitions.

## Downloading Maps on the Ground Control Station

### Introduction:

The following instructions will guide the operator through the process of downloading maps on the GCS.

### Connect to Wi-Fi:

To access internet-based services, map updates, and software features, connect the Ground Control Station (GCS) to a Wi-Fi network.

### Procedure

1. **Disable the GCS Radio:**
  - Move the **Radio Power Switch** to the **OFF (right)** position.
  - The GCS cannot connect to Wi-Fi while the radio is powered on.
2. **Connect to Wi-Fi:**
  - Open the **Samsung Settings** app.
  - Navigate to **Wi-Fi** and select your preferred hotspot.
  - Confirm connection is established.
3. **Launch the FlightWave Application:**
  - Once connected, open the **FlightWave App** to access online features and updates.

## Downloading Maps:

Offline maps allow the Ground Control Station (GCS) to operate in areas without cellular or internet connectivity. Follow the steps below to download and configure offline maps.

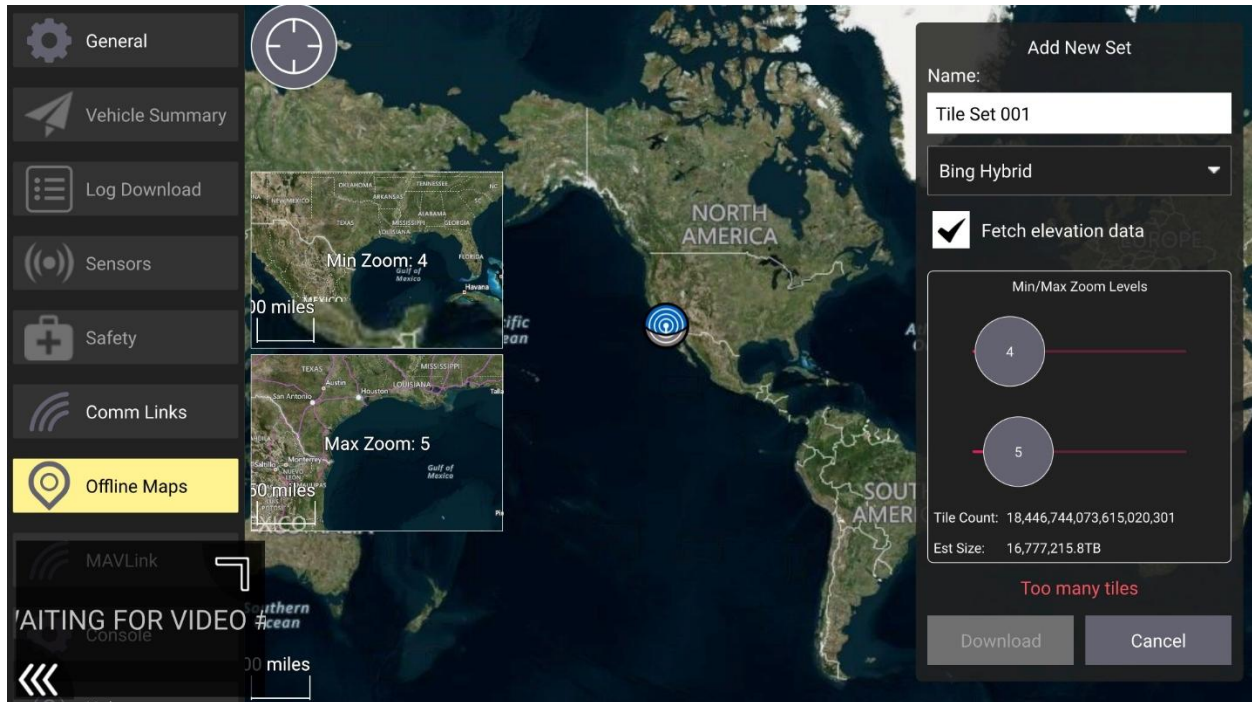


Figure 70 – Offline Maps Settings

### Procedure

1. Tap the **three dots settings icon** in the top-right corner of the FlightWave App.
2. Select **Offline Maps** from the menu.
3. Tap **Add New Set** to create a new map package.
4. Enter a **name** for the map set.
5. Select the **map type**, ensuring it matches the map type configured in **GCS General Settings**.
6. Configure the **zoom levels**. Recommended zoom levels: **13–18** for optimal detail and manageable file size.

7. Pinch and zoom the map to select the desired area. Ensure the total download size is **less than 25 MB** over the hotspot network.
8. Tap **Download** to begin.
9. Monitor progress on the **Offline Maps** page. Wait for the download to complete before proceeding.
10. Once downloaded:
  - Return to **Samsung Settings** and disable Wi-Fi.
  - Turn the **GCS Radio Switch** back on to resume normal aircraft communication.

 **NOTE**

Proper zoom and area selection help balance map resolution and file size for efficient offline operation.

## Offline Map Options

### Max Cache Disk Size (MB)

Defines the maximum amount of persistent storage space on the GCS allocated for offline map tiles.

- Value is entered in **megabytes (MB)**.
- Map tiles are stored on internal storage for reuse between sessions.
- Increasing this value allows more map data to be retained for offline use.

 **NOTE**

Changes to this setting require a **Command Deck application restart** to take effect.

### Max Cache Memory Size (MB)

Defines the maximum amount of system memory (RAM) allocated for temporary map tile caching during operation.

- Value is entered in **megabytes (MB)**.
- A higher value can improve map panning and zoom performance.
- Excessively large values may impact overall system responsiveness.

 **NOTE**

Changes to this setting require a **Command Deck application restart** to take effect.

### Map Service Access Tokens

Some map providers require authentication tokens to access premium or licensed map data. These tokens are typically obtained directly from the map service provider and are tied to a user or organization account.

## Mapbox Access Token

A **Mapbox Access Token** is a unique authentication key issued by Mapbox that allows the GCS to access Mapbox map tiles and services.

- Required for Mapbox-based map providers.
- Tokens are generated through a Mapbox account.
- Entering a valid token enables access to Mapbox imagery and map layers.

### Operational Note:

If no valid token is provided, Mapbox map layers may be unavailable or limited.

## Esri Access Token

An **Esri Access Token** is an authentication key used to access Esri map services and imagery.

- Required for Esri-based map providers.
- Tokens are issued through an Esri account.
- Enables access to Esri basemaps and geospatial data layers.

## Save and Cancel Controls

### Save

Applies all configured offline map settings.

- Cache size changes will take effect after restarting Command Deck.
- Token changes apply immediately upon save.

### Cancel

Closes the Offline Map Options screen without applying changes.

## GCS Disassembly and Storage

Proper disassembly and storage of the Ground Control Station (GCS) ensures longevity and optimal performance of the system. Follow the steps below:

### Procedure

#### 1. Power Down

- Press and hold the **tablet power button** to turn off the GCS.
- Ensure the **radio switch** is set to **OFF** (blue/green LEDs should be off).

#### 2. Remove External Battery Pack

- Detach the **external charging pack** carefully from the underside of the GCS.

#### 3. Antenna Storage

- The GCS **can be stored with the antennas attached** in the Edge 130 carrying case.
- If preferred, remove the antennas for compact storage.

#### 4. Long-Term Storage and Charging

- Charge the GCS at least **once every three (3) months** while in storage to maintain battery health.

#### NOTE

Handle the GCS carefully during disassembly to avoid damage to connectors, ports, and the display.

## Downloading Logs

### Overview

The Edge 130 stores a comprehensive set of flight, telemetry, and system-status logs that support mission review, maintenance diagnostics, and troubleshooting. These logs can be downloaded directly to the Ground Control Station (GCS) or to an external device for long-term storage and analysis.

This section describes how to access, download, and manage logs from the aircraft and payload systems.

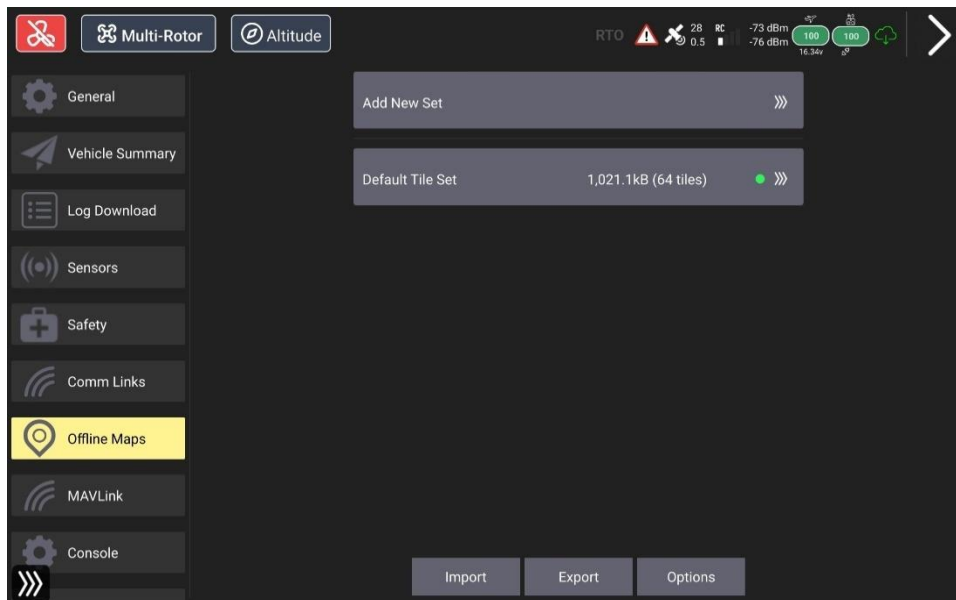


Figure 71 – Log Download

### Accessing the Log Menu

1. Power on the Ground Control Station and connect to the aircraft.
2. Launch the **FlightWave Controller Application**.
3. Open the **Settings** menu (three-dot icon in the top-right).
4. Select **Log Download**.

Once connected, the GCS retrieves a list of available logs stored on the aircraft's onboard memory.

## Types of Logs Available

The following log categories may be available for download:

- **Flight Controller Logs**  
Includes position, attitude, power, vibration, and system health data.
- **Telemetry & Communications Logs**  
Records link quality, signal strength, message integrity, and RC/GCS connectivity.
- **Payload Logs**  
*Overwatch:* gimbal operations, temperature, FFC events, sensor status  
*Mapping Array:* capture timestamps, storage performance, calibration events
- **Event Logs**  
Records warnings, alerts, failsafes, transitions, and other system events.

Not all logs are stored for every flight; availability depends on system configuration and storage status.

## Downloading Logs to the GCS

1. In the log menu, select the desired flight or log category.
2. Tap **Download** to transfer the log file to GCS storage.
3. A progress bar will display the download status.
4. Once complete, the log is saved locally on the GCS for review or export.

Downloaded logs remain stored on the aircraft until memory is full or manually cleared.

## Exporting Logs to External Storage

To transfer logs off the GCS:

1. Connect a USB-C flash drive, SSD, or other removable storage to the GCS.
2. Navigate to the **Downloads** or **Logs** directory using the GCS file browser.
3. Select the desired log files.
4. Choose **Copy** and move them to the attached storage device.

Files can also be transferred wirelessly (if supported) or via USB-C PC connection.

## Clearing Logs

Periodically clearing logs from the aircraft helps maintain optimal onboard storage capacity.

1. Open **Settings** → **Data Persistence**.
2. Select **Clear Aircraft Logs**.
3. Confirm the action when prompted.

## Best Practices

- Download logs after **every mission**, especially after anomalies or system alerts.
- Back up logs to external storage for fleet management and long-term analysis.
- Provide logs to FlightWave Support when reporting issues or requesting diagnostics.
- Avoid clearing logs until the operator has confirmed successful download.

Proper log management improves system diagnostics, maintenance effectiveness, and mission traceability.

## Screen Mirroring and Recording

This section describes how to mirror and record the Ground Control Station (GCS) display on the **Samsung Tab Active 3**. These capabilities are useful for:

- Training and instructor-led demonstrations
- Flight test documentation and customer reviews
- Debugging workflows and recording unexpected behaviors

### NOTE

Screen mirroring and recording capture the **GCS user interface only**. They do not change flight behavior or aircraft control logic.

### Screen Mirroring (Casting the GCS Display)

**Screen mirroring** allows the live tablet display (including the FlightWave GCS) to be shown on an external screen (TV, projector, or capture device).

Typical use cases:

- Classroom / training environments
- Customer demos where multiple viewers need to see the GCS
- Recording the GCS output via HDMI capture hardware

### Requirements

- **Samsung Tab Active 3** with Wi-Fi and Bluetooth enabled (for most wireless casting modes).
- A **compatible display device**, such as:
  - Smart TV with screen mirroring / casting support
  - Wireless display adapter (e.g., Miracast-compatible dongle) connected to a monitor or projector

- HDMI capture device connected to a PC that supports casting input
- The display and the tablet should typically be on the **same Wi-Fi network** (for most casting solutions).

**Operational Note:**

Screen mirroring is for **training and evaluation**. During critical flight operations, avoid changing network connections or display settings that could disrupt the GCS or add latency to touch input.

**Enabling Screen Mirroring on Samsung Tab Active 3**

Below is a generic Android / Samsung flow suitable for documentation. The exact names may vary slightly depending on One UI / Android version, but the sequence is the same.

**Step-by-Step: Connect to a Wireless Display**

1. **Prepare the External Display**
  1. Power on the TV, projector, or wireless display adapter.
  2. Put it into **Screen Mirroring / Casting / Miracast** mode (refer to the device’s instructions).
2. **Open the Quick Panel on the Tablet**
  1. On the **Samsung Tab Active 3**, swipe down from the top of the screen to open the **Quick Settings** panel.
  2. If necessary, swipe down again to see the full set of quick toggles.
3. **Select the Screen Mirroring / Smart View Option**
  1. Look for **“Smart View”** or **“Screen Mirroring”** in the Quick Settings icons.
  2. Tap **Smart View** (or equivalent).
  3. The tablet scans for available devices.

#### 4. Choose the Target Display

1. When the list of available devices appears, tap the name of the TV / wireless adapter / receiver you want to connect to.
2. If prompted on the external display, accept or allow the connection.

#### 5. Start Mirroring

1. Once connected, the content of the tablet screen—including the FlightWave GCS app—will appear on the external display.
2. Confirm that the orientation and scaling are acceptable for viewers.

#### 6. Adjust Settings (Optional)

- Some devices allow you to:
  - Toggle **sound output** between tablet and TV.
  - Change aspect ratio or cropping.
- These adjustments can improve readability of the GCS UI for an audience.

#### 7. End Mirroring

1. When finished, open **Smart View** again (Quick Settings).
2. Tap **Disconnect** or select the active device and choose **Stop**.



#### TIP

For day-to-day operations, you can pin **Smart View** in your Quick Settings row for faster access.

## Screen Recording (Capturing GCS Activity)

**Screen recording** allows you to capture a video of the tablet display, including touches and UI interactions. This is particularly useful for:

- Flight test documentation (with commentary)
- Training material creation
- Capturing issues or anomalous behavior for later review or support

### Considerations Before Recording

- **Performance:** Screen recording consumes CPU, GPU, and storage. On the Tab Active 3 this is usually acceptable, but avoid recording at very high resolution/bitrate in extremely resource-intensive scenarios.
- **Storage:** Confirm that the tablet has sufficient **free storage** (videos can be large).
- **Privacy / Security:** Be aware that any on-screen information (flight ID, location, operator details) will be captured in the recording.

### Enabling the Built-In Screen Recorder

Most Samsung Tab Active 3 devices include a **Screen Recorder** in the Quick Settings panel.

### Step-by-Step: Start a Screen Recording

#### 1. Prepare the Device

Ensure the tablet is **unlocked** and the **GCS app is installed** and functioning.

It is often helpful to start on the GCS home / main map screen before beginning the recording.

#### 2. Open Quick Settings

- Swipe down from the top of the screen to open **Quick Settings**.
- Swipe down again if needed to show all icons.

### 3. Locate Screen Recorder

- Look for **“Screen recorder”** in the Quick Settings icons.
- If you do not see it, tap the **:** (**three dots**) menu → **Edit buttons**, then drag **Screen recorder** into the active Quick Settings area.

### 4. Start Recording

- Tap **Screen recorder**.
- A dialog may appear asking for:
  - **Sound source** (No sound / Media sounds / Media + Mic)
  - **Show touches** (enable/disable touch indicators)

Choose **Media + Mic** if you want to narrate during the recording, or **Media only** if you want a silent UI capture.

Tap **Start recording**. A short countdown appears.

### 5. Record GCS Activity

Once the countdown completes, the tablet begins recording whatever is on the screen.

### 6. Switch to or continue working in the **FlightWave GCS** app.

Perform the desired actions:

- Mission planning
- Mode changes
- Payload views
- Map interactions

## 7. Stop Recording

You'll see a floating **recording control** (often a small red dot or toolbar).

Tap **Stop** when you are finished.

A notification will confirm that the video has been saved (commonly to the **Gallery** or **Screen recordings** folder).

## 8. Review and Export

Open the **Gallery** app (or Files → Movies / Screen recordings).

Locate the new recording.

Play it back to confirm quality and content.

Export if needed:

- Share via email or messaging
- Copy to USB drive
- Import to a PC for editing or archiving

### **Best Practice:**

Before an important test or demo, perform a short test recording to confirm audio levels, orientation, and that the GCS UI is readable.

## Operational Guidelines and Best Practices

### 1. Use Mirroring for Group View, Recording for Documentation

- If a group needs to watch the GCS in real time, use **Screen Mirroring**.
- If you need a permanent record, use **Screen Recording**, with or without mirroring.

### 2. Avoid Mid-Flight Network Changes

- Do not connect/disconnect Wi-Fi or drastically change tablet network settings while flying.
- Set up mirroring **before** arming when possible.

### 3. Conserve Resources During Critical Missions

- On long or complex missions, consider **not** screen recording if you are concerned about performance or thermal load.
- For routine or training flights, recording is usually acceptable.

### 4. Label Recordings

- After a recording is saved, rename the file (e.g., 2025-10-22\_Edge130\_TestFlight1\_GCS.mp4) so you can correlate it with flight logs, mission IDs, or aircraft serial numbers.

### 5. Data Privacy

- Screen recordings contain **all visible data**, including maps, locations, operator IDs, and notes.
- Handle recordings as operational artifacts and store or share them according to your organization's data policies.

#### 4. Example Use Cases

- **Training:**  
Screen mirror the GCS to a large display while an instructor narrates, and optionally record the session for future trainees.
- **Customer Demonstrations:**  
Use mirroring to show live operations to observers without crowding around the tablet.
- **Issue Reproduction for Support:**  
When an anomaly occurs, screen record the sequence that reproduces it and provide the video along with logs to engineering or FlightWave Support.

## Edge 130 Flight Modes

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This chapter outlines the different Flight Modes for the Edge 130 sUAS

# Edge 130 Flight Modes

## Introduction

This course provides a comprehensive overview of flying the **Edge 130** in both **Multi-Rotor (MR)** and **Fixed-Wing (FW)** modes. It is designed to ensure operators understand flight dynamics, control procedures, and emergency response protocols for safe and efficient operation.

Key topics covered include:

### 1. Multi-Rotor Mode Flight Descriptions

- Understand the flight dynamics, control inputs, and maneuvering characteristics specific to Multi-Rotor mode.
- Learn how to safely hover, navigate tight spaces, and perform precision maneuvers.

### 2. Fixed-Wing Mode Flight Descriptions

- Explore Fixed-Wing flight fundamentals, including control surface behavior, flight efficiency, and glide characteristics.
- Learn the techniques required for extended range, higher-speed flight, and sustained cruise operations.

### 3. Transition Procedures

- Understand how to safely transition between Multi-Rotor and Fixed-Wing modes.
- Learn the proper techniques for seamless transitions, ensuring stable and controlled flight in all phases.

### 4. Emergency Procedures

- Prepare for unexpected situations, including loss of communication or power.
- Review Return-to-Home (RTL) protocols, emergency landing procedures, and other critical contingencies.

By the end of this course, operators will be proficient in:

- Managing the Edge 130 across both flight modes.
- Executing smooth transitions between MR and FW configurations.
- Responding effectively to in-flight emergencies.

## Multi-Rotor Mode (MR) Flight Controls

### Introduction:

The **Edge 130** behaves differently in **Multi-Rotor (MR)** and **Fixed-Wing (FW)** modes. In **MR mode**, the aircraft operates similarly to a quadcopter, offering vertical takeoff, hovering, and agile maneuvering. Unlike some traditional multi-rotors, the Edge 130 **cannot reverse directly into the wind**.

This section provides an overview of the **various flight modes available in MR**. Each mode has unique characteristics and operational behaviors that the pilot must understand to ensure safe and efficient flight.

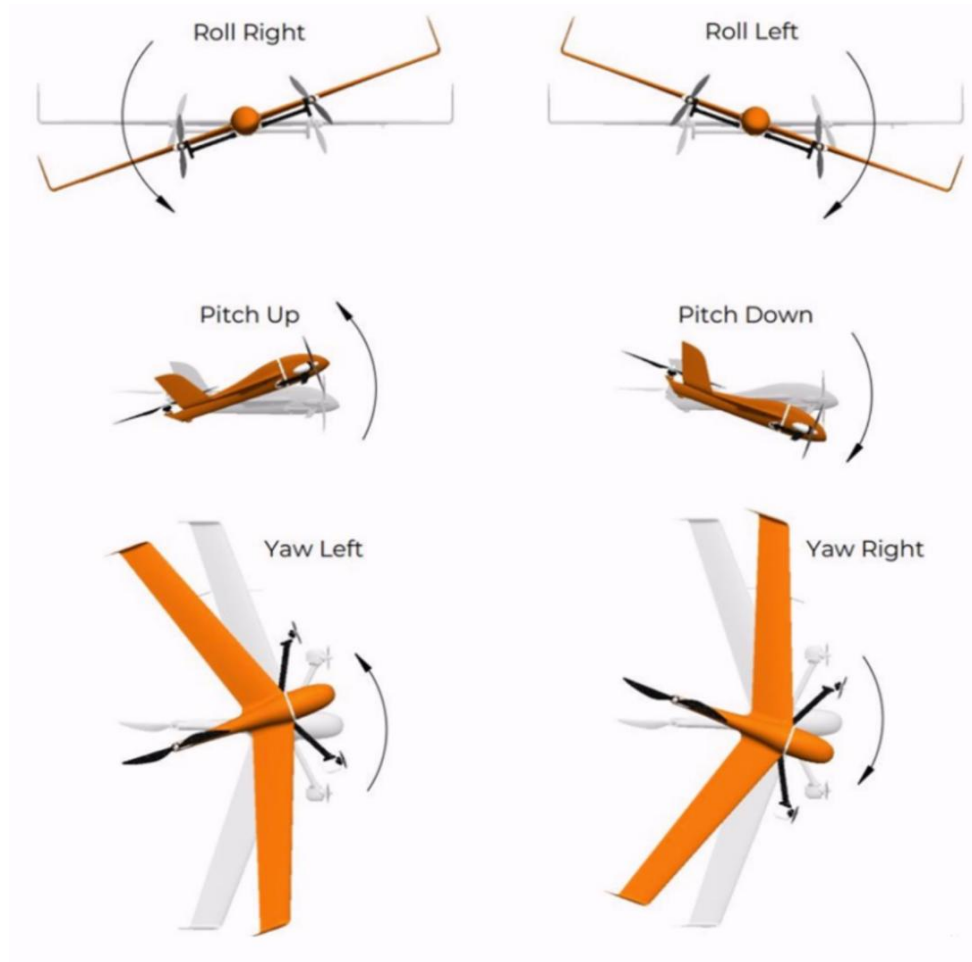


Figure 72 – Multi-Rotor Mode (MR) Flight Controls

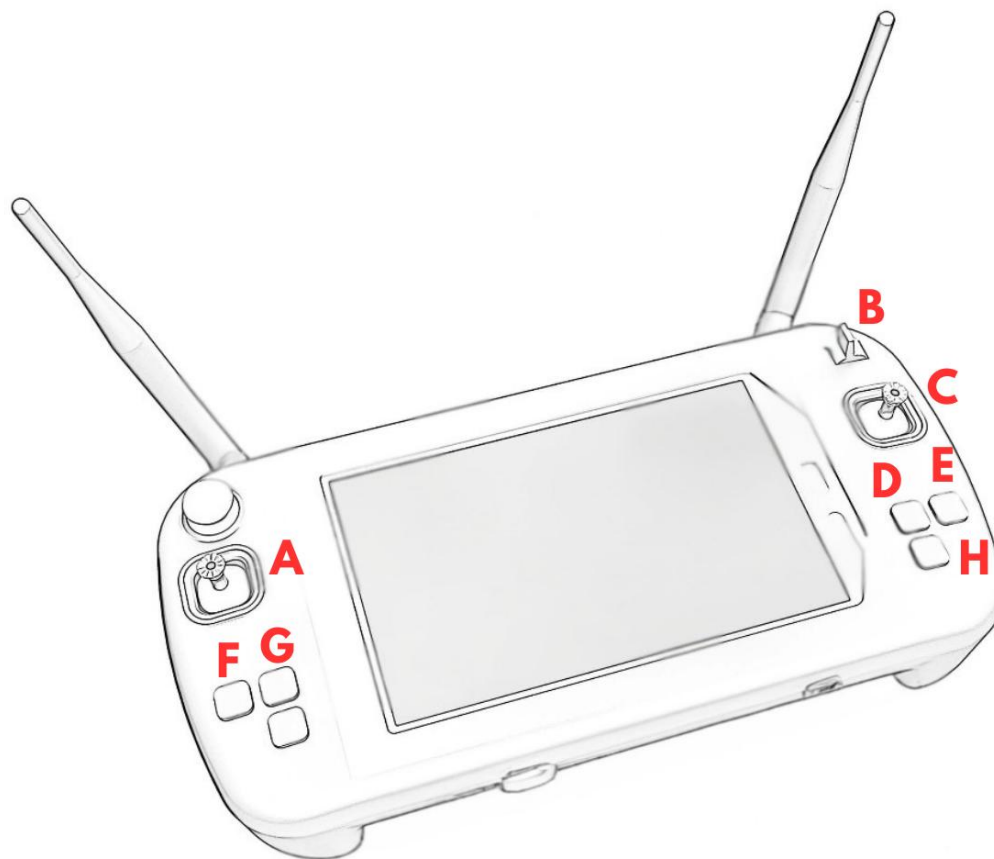


Figure 73 – Multi-Rotor (MR) GCS Controls

#### **A – Left Flight Stick (MR)**

- Press Up (12 o'clock) = Ascend
- Press Down (6 o'clock) = Descend
- Press Right (3 o'clock) = Yaw Right
- Press Left (9 o'clock) = Yaw Left

#### **B – Transition Switch**

- Press Right = Fixed Wing Mode (FW)
- Press Left = Multi-Rotor Mode (MR)

## **C – Right Flight Stick (MR)**

- Press Up (12 o'clock) = Pitch Forward
- Press Down (6 o'clock) = Pitch Back
- Press Right (3 o'clock) = Roll Right
- Press Left (9 o'clock) = Roll Left

## **D – Hold Mode**

Hold Mode is an autonomous flight mode in which the pilot does not have direct manual control over the aircraft. Instead, all commands are managed via the Ground Station tablet interface.

- In Multi-Rotor Mode, Hold Mode functions similarly to Position Mode but ignores input from the flight sticks.
- Upon entering Hold Mode, the aircraft maintains its current three-dimensional position.
- Wind-Vaning remains active, automatically orienting the aircraft into the wind for stable hovering.

## **E – Mission Mode**

Mission Mode (MR Mode)

When operating in Multi-Rotor (MR) mode, the Mission Mode button enables the aircraft to begin or resume an automated mission sequence that has been loaded into the Ground Control Station.

Press and hold the Mission Mode button until the mode is announced by the controller.

In MR mode, Mission Mode will:

- Initiate mission execution if the aircraft is on the ground and a mission is armed.
- Begin the automated takeoff and transition sequence if the mission includes automatic takeoff parameters.
- Resume a paused mission if the operator previously interrupted automated flight.

- Maintain full autonomous navigation, while allowing the pilot to interrupt at any time by selecting a manual flight mode or using Pause/Return functions.

Mission Mode is only available when a valid mission is loaded and all required pre-flight checks are satisfied.

## F – Position Mode

Position Mode is the recommended mode for manual piloting in most missions. It utilizes all available sensors, including GPS, to maintain a fixed three-dimensional position in the sky. **Wind-Vaning** is active, automatically keeping the aircraft oriented into the wind for optimal stability.

### Pilot Control:

The pilot can adjust the aircraft's position using the flight sticks:

- **Left Stick:** Controls ascent/descent and yaw.
- **Right Stick:** Controls forward/backward motion and strafing (left/right).

This mode allows precise manual control while benefiting from automated stabilization and wind compensation.

## G – Altitude Mode

Altitude Mode provides enhanced control for navigating challenging environments or confined spaces. In this mode, the autopilot **maintains only the aircraft's altitude**, while the pilot is fully responsible for controlling horizontal position and heading.

- **GPS-Independent:** Altitude Mode does not rely on GPS, making it a reliable fallback in the event of GPS loss or errors.
- **Wind-Vaning Disabled:** The pilot has complete control over the aircraft's heading during hover, allowing precise orientation in any wind condition.
- **Manual Position Control:** Forward/backward and lateral (sideways) movement is fully pilot-controlled, enabling careful maneuvering in tight spaces.

## Hovering Multi-Rotor Characteristics:

The **Edge 130** is best described as an “**airplane that hovers,**” blending features of both fixed-wing aircraft and quadcopters. While it retains multi-rotor agility, there are several key distinctions pilots should understand:

During forward or reverse movement in Multi-Rotor (MR) mode, operators may observe a small amount of unintended vertical drift (slight climb or descent). This behavior is normal.

Because the Edge 130 retains its fixed-wing lifting surfaces during hover operations, airflow over the wings can generate minor upward or downward aerodynamic forces when the aircraft is translating horizontally. Once forward or reverse input is released, the aircraft will automatically stabilize and return to the commanded altitude.

This effect is modest, predictable, and typically lasts only for the duration of the horizontal movement.

- **Pitch Control:** The aircraft body does **not pitch forward or backward**. Instead, the **tilt motors** adjust to control forward and backward movement.
- **Roll Control:** The aircraft rolls left or right to **strafe**, similar to a conventional multi-rotor. Roll angles are **limited by the autopilot**.
- **Yaw Control:** Yaw authority is greater than in standard multi-rotors. The tilt motors adjust the heading in hover, enabling **quick yaw movements**, though yaw rates are also constrained by the autopilot.
- **Hover Efficiency:** The aircraft hovers most efficiently and stably when **facing into the wind**, as wind moving across the wings generates lift. Gusts from the front are easily rejected.
- **Wind Effects:**
  - Side winds may induce **minor rolling**.
  - Tail winds can cause **slight pitching**.
  - Overall, the aircraft can **reject most gusts** while hovering.

## Wind-Vaning:

**Wind-Vaning** is a core feature of the Edge 130 during hover, designed to maintain **efficient and stable flight** by automatically keeping the aircraft oriented **into the wind**.

- **Operational Modes:** Wind-Vaning is active in **GPS-managed position modes**, including **Position, Hold, Return, and Mission**, but it is **not active in Altitude Mode**.
- **Automatic Yaw Adjustment:** The system uses onboard sensors to detect wind direction and commands the aircraft to yaw into the wind. Wind-Vaning engages **only above a minimum wind speed**. The autopilot applies a **yaw speed approximately one-third** of what a pilot can command manually.
- **Pilot Override:** Pilots may override Wind-Vaning using the **left flight stick**. Once the stick is released, the aircraft will **resume Wind-Vaning** automatically.
- **Interaction with Strafing:** Horizontal movements of the right stick (strafing) can also induce yaw, aiding the aircraft in maintaining proper orientation relative to wind.

**Pilot Tip:** Familiarity with Wind-Vaning behavior is critical. The **First Flight Exercise** is recommended to experience and understand how the aircraft interacts with wind while hovering.

## Position Mode:

**Position Mode** is the recommended mode for **manual piloting** during most missions. This mode leverages **all onboard sensors**, including GPS, to maintain a **fixed 3D position in the sky**, with **Wind-Vaning** active. The pilot controls the aircraft's position primarily via the **flight sticks**.

### Flight Stick Controls:

#### Left Flight Stick:

- **Up/Down:** Command **ascent** (up) or **descent** (down).
  - Maximum climb rate: **3 m/s**
  - Maximum descent rate: **2 m/s**
- **Left/Right:** Command **yaw**. The aircraft yaws left or right.
  - When centered, the aircraft automatically follows **Wind-Vaning** to face the wind.
  - Maximum yaw rate: **30°/s**

#### Right Flight Stick:

- **Up/Down:** Command **forward/backward ground speed**.
  - Maximum speed: **7 m/s**
- **Left/Right:** Command **strafing** (lateral movement).
  - Maximum speed: **7 m/s**
  - While strafing, **Wind-Vaning** will cause the aircraft to yaw, assisting in wind compensation.

### Control Summary

In Position Mode, the pilot primarily uses the **right stick** for horizontal motion and the **up/down movement** of the left stick for vertical motion. This combination provides precise control over the aircraft's position while maintaining stability in wind conditions.

## Altitude Mode:

**Altitude Mode** provides pilots with enhanced control for navigating **confined spaces** or **challenging environments**. In this mode:

- The **autopilot maintains altitude only**.
- The pilot is fully responsible for controlling the aircraft's **horizontal position**.
- **GPS is not used**, making Altitude Mode a reliable fallback in the event of GPS errors.
- **Wind-Vaning is disabled**, giving the pilot full control of the aircraft's heading during hover.

## Flight Stick Controls

### Left Flight Stick:

- **Up/Down:** Command **ascent** or **descent**.
  - Maximum climb rate: **3 m/s**
  - Maximum descent rate: **2 m/s**
- **Left/Right:** Command **yaw**. The aircraft maintains its heading independent of wind.
  - Maximum yaw rate: **30°/s**

### Right Flight Stick:

- **Up/Down:** Command **forward/backward ground speed**.
  - Maximum forward speed: **15 m/s**
  - Maximum backward speed: **7 m/s**
- **Left/Right:** Command **strafing** (sideways movement).
  - The aircraft maintains **level roll** during lateral motion.

## Operational Notes

- Pilots should become familiar with Altitude Mode, as it may be **required during emergency landings** or **GPS signal loss**.
- This mode provides **full manual control** of heading and position while maintaining altitude automatically.

## Hold Mode:

**Hold Mode** is an **autonomous flight mode** where the pilot does **not have direct manual control** via the flight sticks. Instead, the aircraft's movement is managed through the **Ground Control Station (GCS) tablet interface**.

### Multi-Rotor Mode Behavior

- Functions similarly to **Position Mode**, maintaining the aircraft's **3D position** upon entering Hold Mode.
- **Wind-Vaning remains active**, helping the aircraft maintain an efficient heading relative to the wind.
- Flight sticks are **disabled**; all movement commands are issued through the GCS.

### Changing Aircraft Position

#### 1. Horizontal Position (X/Y):

1. On the **Map View**, tap the desired location.
2. Select **"GoTo"** (do **not** select other options).
3. Verify that there are **no obstacles** between the aircraft's current location and the target location. The aircraft will **not detect obstacles autonomously**.
4. Slide to confirm. The aircraft will navigate to the new location.

#### 2. Vertical Position (Altitude):

1. Tap the **Action** icon on the left toolbar.
2. Select **"Change Altitude"** from the menu.
3. Set the desired **target altitude** using the slider.
4. Confirm there are **no obstacles** along the ascent or descent path.
5. Slide to confirm. The aircraft will move to the new altitude.

## Return to Launch (RTL) Mode:

**Return to Launch (RTL)** is an **autonomous flight mode** that guides the aircraft back to its designated **Launch location** (typically the arming point). This mode operates in both **Multi-Rotor (MR)** and **Fixed-Wing (FW)** configurations.

### NOTE

In Multi-Rotor mode, the aircraft may **transition to Fixed-Wing mode** if it is far from Home. Return Home can be triggered manually by the pilot or automatically in certain emergency scenarios.

### Return Mode Procedure

#### 1. Activation in Multi-Rotor Mode:

- The aircraft **ascends vertically** to the programmed **Return Altitude** as defined in the Safety Settings.

#### 2. Transition to Fixed-Wing Mode:

- If the aircraft is **more than 500 meters** from Home, it will **autonomously transition** to Fixed-Wing flight for faster transit.

#### 3. Journey to Launch Location:

- The aircraft travels **directly to the Launch location**.
- **Obstacle avoidance is not active**; the pilot must ensure the flight path is clear before activating RTL.

#### 4. Transition Back to Multi-Rotor Mode:

- Upon reaching the horizontal position of Home, the aircraft will **transition back to Multi-Rotor mode** if needed.
- This may take a few seconds as the aircraft **adjusts its heading** relative to wind and positions itself over Home.

#### 5. Descent and Landing:

- The aircraft descends vertically, pausing briefly at **30 meters** and then **10 meters** above Home.
- Upon touchdown, the aircraft **automatically disarms after two seconds**.

## Return to Operator (RTO) Mode

**Return to Operator (RTO)** is an autonomous recovery mode that commands the aircraft to navigate to the **current position of the operator (GCS)** rather than a fixed Home location. Unlike Return-to-Home (RTH), which returns to the recorded takeoff point, RTO is dynamic and is based on the operator's live GPS position at the moment RTO is commanded. This mode is useful when the operator is mobile, operating from a vehicle, or repositioning during a mission.

### RTO Mode Behavior

When **RTO** is selected:

- The aircraft captures the **current GCS GPS position** at the moment the button is pressed.
- The aircraft navigates to that position using autonomous guidance.
- The return target **does not continuously update** while RTO is active.

#### Key Concept:

RTO returns the aircraft to where the system "sees" the operator **at the instant RTO is initiated**, not where the operator moves afterward.

### Preconditions for Using RTO

Before using Return to Operator Mode, the following conditions must be met:

#### 2.1 GPS Availability

- **GCS GPS must be online and valid.**
- RTO relies on the operator's GPS position; if the GCS does not have a reliable GPS fix, RTO accuracy cannot be guaranteed.

#### Best Practice:

Verify GCS GPS status and accuracy prior to flight if RTO may be used.

## Mission Context Awareness

The process for creating or modifying a mission **differs depending on aircraft state**:

- **With aircraft powered and payload connected:**
  - Mission planning includes live vehicle context and payload feedback.
- **Without aircraft powered (GCS-only planning):**
  - Missions are created purely within the GCS environment and may not reflect live vehicle state.

### Operational Note:

Operators should be aware of which planning context they are in, as this can affect how and when RTO is selected or enabled.

## When RTO Can Be Selected

RTO can be selected:

- **Before flight** (preselected as the intended recovery mode), or
- **During flight** at any time, provided system conditions allow.

Once selected, the aircraft will transition into RTO behavior immediately.

## Updating the Operator Position During RTO

Because RTO captures a **single snapshot** of the operator's position:

- Moving the GCS **after RTO is initiated** will *not* update the target location.
- If the operator relocates and wants the aircraft to return to the **new** position, additional action is required.

## Updating RTO Target After Activation

To update the operator position:

1. **Exit RTO Mode** by selecting a different flight mode (e.g., Hold, Position, or Manual).
2. Allow the aircraft to fully transition into the new flight state.
3. **Re-select RTO.**
4. The aircraft will now capture the **new GCS position** and return to that updated location.



### IMPORTANT

Simply moving the GCS while RTO is active does **not** update the return target.

## Operational Use Cases

RTO is particularly effective in scenarios such as:

- Mobile operations where the operator is repositioning during flight
- Vehicle-based missions where the launch point and recovery point differ
- Large-area surveys where the operator relocates closer to the recovery zone

In these cases, RTO provides more flexibility than Return-to-Home, provided the operator understands how and when the target position is captured.

### NOTE

Pressing up or down on the right/left stick at **any** time during RTO will resume **manual** control of the AV.

## Best Practices for Safe RTO Use

- Confirm **GCS GPS lock** before flight.
- Avoid unnecessary movement immediately after initiating RTO unless you plan to reselect it.
- If repositioning during recovery:
  - Change flight mode first
  - Then re-enter RTO
- Monitor battery state before using RTO, especially if the operator has moved farther from the aircraft.
- Understand the difference between:
  - **RTO** (returns to operator's current GPS location at selection time)
  - **RTH** (returns to fixed Home position)

## Summary

- RTO returns the aircraft to the **operator's GPS position at the time RTO is selected**.
- GPS must be active on the GCS for accurate operation.
- RTO can be selected **before or during flight**.
- To update the return location after activating RTO, the operator must **change flight mode and reselect RTO**.
- Awareness of mission planning context (aircraft on vs. GCS-only) is important for predictable behavior.

## Fixed-Wing Mode (FW) Flight

### Fixed Wing Flight Controls:

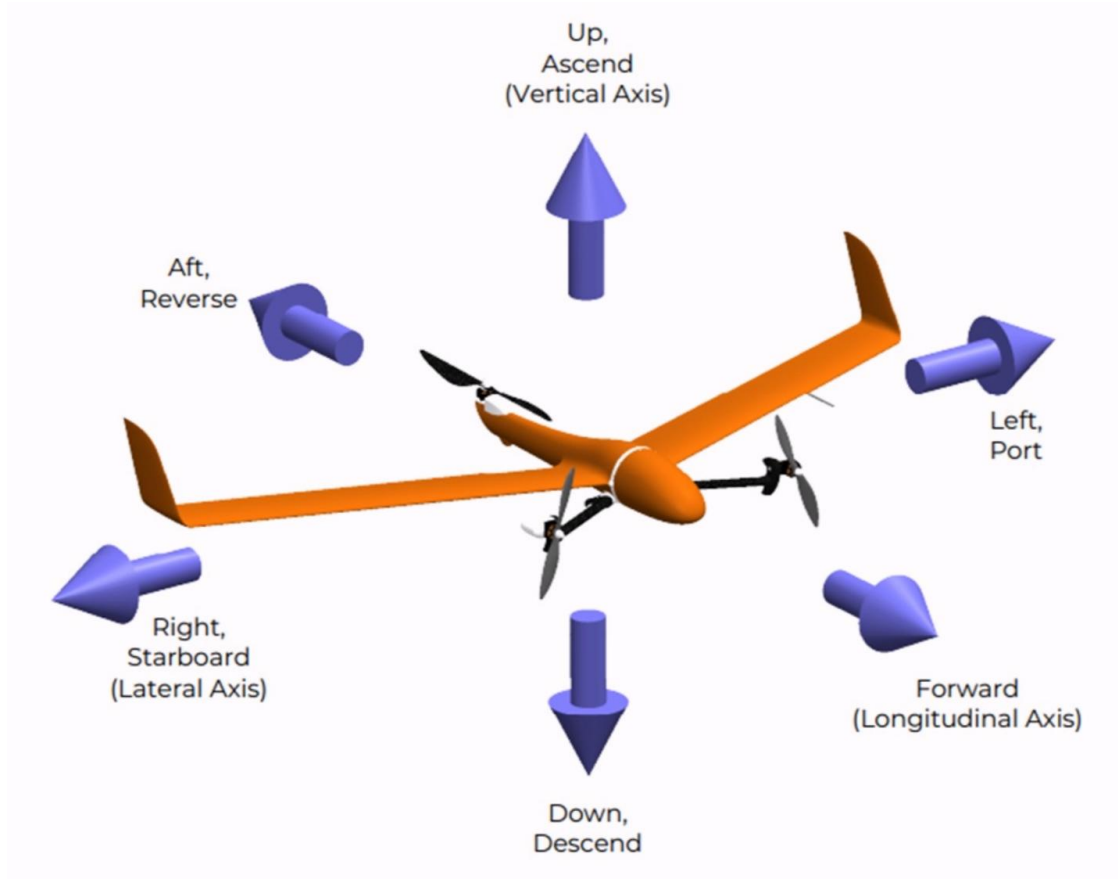
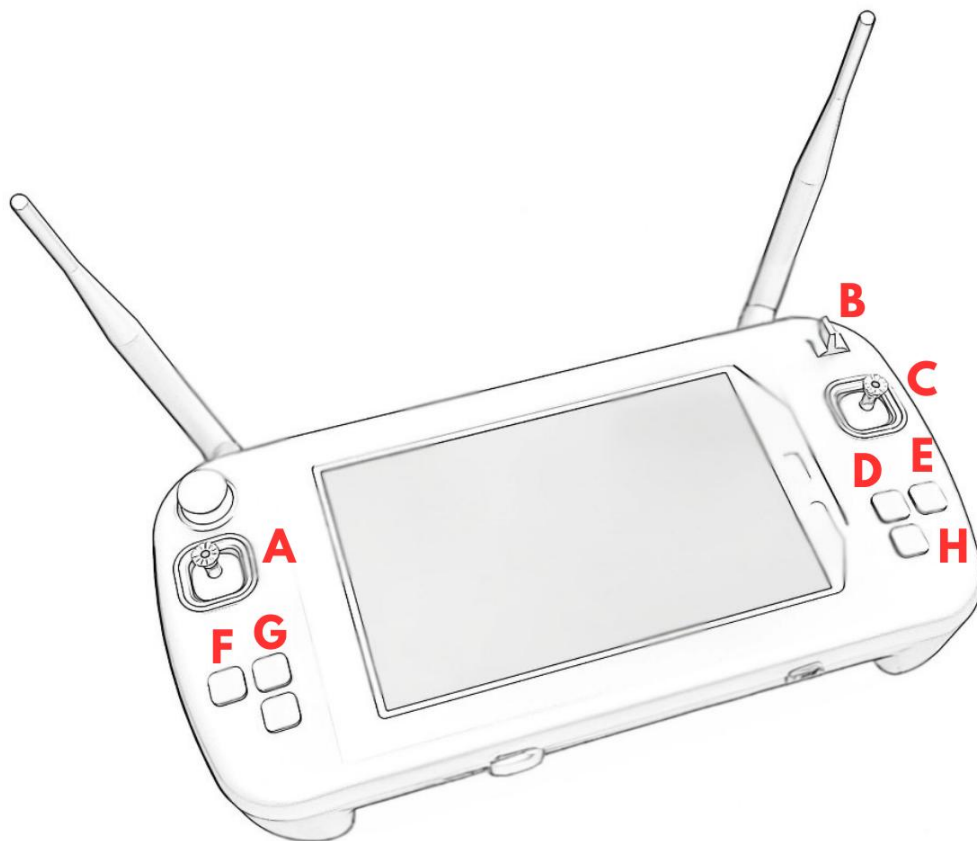


Figure 74 – Fixed-Wing (FW) Flight Controls



*Figure 75 – Fixed-Wing (FW) GCS Controls*

**A – Left Flight Stick:**

- Press Up (12 o'clock) = Increase Airspeed
- Press Down (6 o'clock) = Decrease Airspeed
- Press Right (3 o'clock) = No Action
- Press Left (9 o'clock) = No Action

**B – Transition Switch:**

- Press Right = Fixed Wing Mode (FW)
- Press Left = Multi-Rotor Mode (MR)

### C – Right Flight Stick:

- Press Up (12 o'clock) = Increase Airspeed
- Press Down (6 o'clock) = Decrease Airspeed
- Press Right (3 o'clock) = No Action
- Press Left (9 o'clock) = No Action

### D – Hold Mode:

- Hold Mode is an autonomous flight mode used when the Edge is operating in Fixed-Wing configuration. In this mode, flight control is managed entirely through the Ground Station tablet interface, and manual inputs from the flight sticks are disabled.
- Upon activation, the aircraft establishes its current GPS position as the center of a Loiter Circle, maintaining steady flight within this area. By default, the Loiter Circle has a radius of 100 meters, which can be adjusted in coordination with FlightWave guidance or mission settings.
- The aircraft will fly to the perimeter of the defined circle and begin circling clockwise around the center point, maintaining altitude, airspeed, and stability automatically.

 **NOTE**

In Hold Mode, the position, altitude, and hold radius can be adjusted directly through the GCS.

## **E – Mission Mode**

When the aircraft is in Fixed-Wing (FW) mode, the Mission Mode button commands the Edge 130 to enter or resume automated mission flight along the programmed route.

Press and hold the Mission Mode button until the controller announces the mode change.

In FW mode, Mission Mode will:

- Resume the active mission from the nearest waypoint or the last completed command.
- Navigate autonomously along all programmed waypoints, altitudes, and flight paths using fixed-wing control laws.
- Manage transitions, climbs, descents, and turns automatically, based on mission parameters.
- Maintain optimal cruise performance for efficiency and stability throughout the mission.
- Allow the pilot to override automation at any time by switching to another flight mode (e.g., Position, Hold, or Return).

## **F – Position Mode**

- Position Mode is the recommended flight mode for Fixed-Wing operation. In this mode, the aircraft behaves similarly to Altitude Control Mode, with the added capability of autonomous ground track correction.
- The autopilot continuously monitors the aircraft's GPS position and heading to maintain a consistent flight path over the ground, automatically compensating for steady wind conditions. This ensures stable and predictable navigation, even in moderate crosswinds.

## G – Altitude Mode:

- **Altitude Mode** in Fixed-Wing configuration is an altitude- and airspeed-controlled flight mode. When no pilot input is provided through the flight sticks, the autopilot maintains a commanded altitude and airspeed while holding the aircraft at a level roll attitude.
  - *Unlike Position Mode, which maintains a defined ground track, Altitude Mode follows a commanded heading. As a result, wind conditions may cause the aircraft to drift laterally while still holding the selected heading and altitude.*
- The autopilot continuously adjusts pitch and thrust to sustain stable flight, making larger corrections as needed to counteract wind gusts or turbulence.
- In Altitude Mode, the aircraft will continue to fly forward autonomously, even beyond the pilot’s line of sight, until manual input is applied or the battery is depleted.

## H – Return Mode

- Return Mode is an autonomous flight mode in which the aircraft follows a pre-programmed sequence to return to the designated Home location, typically the point where the aircraft was armed or launched.
- This mode can be manually activated by the pilot or automatically triggered during certain failsafe events, such as RC signal loss or low battery, depending on system configuration. When triggered automatically, the aircraft will initiate a return-to-home sequence and transition to multirotor flight directly over the home position before descending.

## Fixed Wing Flight Modes:

This section outlines the **Fixed-Wing flight modes** available on the Edge 130. Each mode offers unique flight characteristics and control behaviors, which differ from Multi-Rotor operation.

It is essential to **read this section carefully** and understand how each mode functions, as proper selection and operation of Fixed-Wing flight modes are critical for safe, efficient, and reliable missions.

## **Fixed-Wing Flight Characteristics**

In **Fixed-Wing (FW) mode**, the Edge 130 operates like a conventional fixed-wing aircraft, but with several key differences that pilots must understand:

### **Motor Configuration:**

- The front motors tilt forward to provide propulsion.
- The tail motor stows the propeller after transition; this process may take up to a few seconds. A partially stowed tail propeller does not impact flight performance.

### **Control Surfaces:**

- The Edge 130 lacks traditional aerodynamic control surfaces such as elevons or ailerons.
- Pitch, roll, and yaw are controlled entirely via the tilt and thrust of the front motors.

### **Stability:**

- Pitch and roll stability rely on forward thrust rather than airspeed.
- The aircraft is more sensitive to sudden decelerations compared with conventional fixed-wing aircraft.

### **Yaw Control:**

- Pilots do not directly control yaw in FW mode.
- The aircraft automatically performs coordinated turns based on roll input from the right stick.

### Control Layout:

- FlightWave adopts a traditional RC fixed-wing stick layout, which differs from Multi-Rotor control.
- To ascend, pull the **right stick toward you** ("Pull Up").
- Horizontal and vertical movements are separated on the right stick; inadvertent altitude changes can occur during turns if the stick is not carefully managed.

### Speed Considerations:

- Airspeed and groundspeed are critical for performance in FW mode.
- Strong winds affect travel time and battery consumption.
- Fixed-wing flight protections maintain a minimum groundspeed of 11 m/s.
- Upwind flights consume more battery and may reduce range, especially on long-distance missions.
- Always account for wind direction on return flights to avoid power depletion or delays.

### Fixed-Wing Position Mode

**Position Mode** is the recommended pilot mode for Fixed-Wing operation. In this mode, the autopilot maintains a consistent track over the ground while compensating for steady wind conditions, ensuring smooth and coordinated flight. The aircraft behaves similarly to Altitude Mode, but with added airspeed and course management.

### Flight Stick Functions:

#### Left Flight Stick (Throttle / Airspeed Control)

- **Up/Down:** Command airspeed.
  - **Centered:** Aircraft cruises at 15 m/s ( $\approx$ 30 mph).
  - **Pushed up:** Aircraft accelerates to sprint airspeed of 22 m/s ( $\approx$ 44 mph), adjustable via FlightWave.

- **Pulled back:** Aircraft reduces airspeed to 12 m/s ( $\approx 27$  mph), conserving power but approaching stall speed.
- **Left/Right:** Not used in Fixed-Wing Position Mode.

### Right Flight Stick (Pitch / Roll Control)

- **Up/Down:** Command ascent or descent rate.
  - **Centered:** Maintains current altitude.
  - **Pulled back:** Ascends at up to 3 m/s.
  - **Pushed forward:** Descends at up to 3 m/s.

#### NOTE

This control is inverted compared to Multi-Rotor mode.

- **Left/Right:** Command coordinated turns using thrust-vectoring.
  - **Centered:** Aircraft maintains its current course over the ground. Wind will cause the aircraft to “crab” into the wind to maintain a straight-line trajectory.
  - **Pushed right:** Aircraft rolls up to  $45^\circ$  and initiates a coordinated right turn.
  - **Pushed left:** Aircraft rolls and initiates a coordinated left turn.
  - **Stick release:** Aircraft automatically yaws to adjust orientation and compensate for wind, establishing a new heading.

### Key Characteristics:

- Ensures smooth, coordinated flight while maintaining ground track.
- Autopilot compensates for steady wind, reducing pilot workload.
- Ideal for mission planning where maintaining course and airspeed is critical.

## Fixed-Wing Altitude Mode

**Altitude Mode** is a simplified flight mode that focuses on maintaining a constant altitude and airspeed. Unlike Position Mode, the autopilot does not actively maintain a ground track or compensate for wind direction. This mode is particularly useful for understanding aircraft behavior and for flying in situations where ground tracking is less critical.

### Autopilot Behavior

- Maintains constant altitude and airspeed with level roll.
- Automatically adjusts pitch and thrust to counter wind gusts and maintain stable flight.
- Aircraft will continue forward flight without pilot input until battery depletion.

### Flight Stick Functions:

#### Left Flight Stick (Throttle / Airspeed Control)

- **Up/Down:** Command airspeed.
  - **Centered:** Aircraft cruises at 15 m/s ( $\approx$ 30 mph).
  - **Pushed up:** Aircraft accelerates to sprint airspeed of 22 m/s ( $\approx$ 44 mph), adjustable via FlightWave.
  - **Pulled back:** Aircraft reduces airspeed to 12 m/s ( $\approx$ 27 mph), conserving power but approaching stall speed.
- **Left/Right:** Not used in Altitude Mode; heading adjustments are controlled with the right stick.

#### Right Flight Stick (Pitch / Roll / Heading Control)

- **Up/Down:** Command ascent or descent rate.
  - **Centered:** Maintains current altitude.
  - **Pulled back:** Ascends at up to 3 m/s.

- **Pushed forward:** Descends at up to 3 m/s.
- *Note: This input is inverted compared to Multi-Rotor Mode.*
- **Left/Right:** Command coordinated turns using thrust-vectoring.
  - **Centered:** Maintains level roll and heading.
  - **Pushed right/left:** Rolls up to 45° and executes a coordinated turn.
  - Turn radius depends on airspeed and wind; tighter turns require additional power.

### Key Characteristics:

- Autopilot manages level flight and airspeed, reducing pilot workload.
- Pilot retains control over airspeed, ascent/descent, and coordinated turns.
- Ideal for training and basic flight operations where precise ground tracking is not required.

### Fixed-Wing Hold Mode

**Hold Mode** is an autonomous flight mode in Fixed-Wing configuration, designed to maintain a controlled loiter around a fixed point. In this mode, pilot inputs from the flight sticks are disabled, and the Ground Control Station (GCS) tablet interface is used for positioning and altitude adjustments.

### Loiter Circle Behavior

- Upon entering Hold Mode, the aircraft sets its current GPS location as the center of a **Loiter Circle**.
- Default radius: **100 meters** (adjustable via FlightWave guidance).
- The aircraft will fly to the edge of the circle and maintain a **clockwise orbit** around the center.

## Changing the Loiter Center or Altitude

### Horizontal Position Adjustment (Center of Loiter):

1. Tap the desired position on the map in the Ground Station Application.
2. Select the **“GoTo”** option (do **not** select other options).
3. Confirm the new position using the **slide-to-confirm** slider.
4. The aircraft will fly immediately to the new center and resume the Loiter Circle.

### Vertical Position Adjustment (Loiter Altitude):

1. Tap the **Action** icon in the left toolbar.
2. Select **“Change Altitude”**.
3. Adjust the altitude using the slider.
4. Confirm using the **slide-to-confirm** slider.
5. The aircraft will immediately adjust to the new altitude.



#### CAUTION

Always verify that there are no obstacles between the aircraft’s current location and the new target position. The aircraft **does not autonomously avoid obstacles** while in Hold Mode.

## Fixed-Wing Return Mode

**Return Mode** is an autonomous flight mode that guides the aircraft back to its **Home location** (typically the arming location). This mode can be activated by the pilot or triggered automatically in emergency scenarios.

### Return Procedure (Fixed-Wing)

1. **Climb to Return Altitude:**
  - The aircraft ascends to the **Return Altitude** configured in the Safety Settings.
2. **Transit to Home:**
  - Once at altitude, the aircraft flies directly to the Home location.
  - **Important:** The aircraft does **not** avoid obstacles along this path.
3. **Transition to Multi-Rotor Mode:**
  - Upon reaching the Home position, the aircraft transitions from Fixed-Wing to Multi-Rotor mode.
  - It adjusts its heading to compensate for wind and hovers over the Home position.
4. **Descent and Landing:**
  - The aircraft descends vertically, pausing briefly at **30 meters** and **10 meters** above Home.
  - After touchdown, the aircraft automatically disarms after **two seconds**.
  - Control can be taken at any time by moving the sticks during Multi-Rotor portion of RTL.



#### CAUTION

Use caution in confined or obstacle-rich areas. During Fixed-Wing transit and deceleration, the aircraft may collide with objects. Ensure the flight path is clear before activating Return Mode.

## Transition Procedure

### Introduction:

The **Transition Procedure** is managed by the autopilot and is initiated using the **Transition Switch**. This procedure allows the Edge 130 to switch between **Multi-Rotor (MR)** and **Fixed-Wing (FW)** flight modes.

- Transition from MR to FW, or vice versa, can take **up to five seconds** to complete.
- During the transition, the aircraft will accelerate in Fixed-Wing mode and decelerate when returning to Multi-Rotor mode.

### Transition Switch Behavior

While the Transition Switch indicates the pilot's desired flight mode, there are circumstances where the switch is **temporarily ignored**:

1. **Power-Up:**
  - The Transition Switch is ignored until the aircraft is manually switched to Multi-Rotor mode.
2. **Autonomous Missions:**
  - During mission execution, the Transition Switch is ignored.
3. **Emergency Transitions:**
  - In emergency transitions to Multi-Rotor mode, the switch is ignored until the aircraft is returned to Multi-Rotor flight.



#### CAUTION

If the pilot changes the control mode out of an autonomous mode, the switch will remain ignored until the current transition completes.

Flip the switch to match the desired flight mode once the aircraft is ready to accept manual transitions.

## Transition to Fixed-Wing:

1. **Prepare for Transition:**
  - Ensure the aircraft is in **Multi-Rotor (MR) Mode** with **Position Control** active.
  - Hover and climb to a safe transition altitude. For first-time pilots, a recommended altitude is **60 meters above ground**, ensuring at least **40 meters clearance** above the tallest obstacle in the practice area.
2. **Align the Aircraft:**
  - If operating in **Altitude Control**, yaw the aircraft so the nose faces **into the wind**.
  - Smoothly center both flight sticks.
3. **Initiate Transition:**
  - Flip the **Transition Switch** to the right to switch to **Fixed-Wing (FW) Mode**.
  - Observe the aircraft as it transitions, which typically takes **approximately 5 seconds**.
4. **During Transition:**
  - The aircraft will begin forward flight while maintaining altitude.
  - The **Ground Station App** will display **“Fixed-Wing”** in the top bar upon completion.
  - The **tail propeller** will gradually stop rotating; note that it may take several seconds to fully stow.
  - If audio is enabled, the Controller provides a **voice callout** confirming the transition.
5. **Troubleshooting:**
  - If the transition takes longer than expected, the aircraft may **abort** and issue an alert.
  - Common causes include not facing the wind during transition. Reposition the aircraft and attempt the transition again.
6. **Post-Transition:**
  - Fixed-Wing control mappings are now active.
  - Begin piloting the Edge as a **Fixed-Wing aircraft**, following the appropriate control inputs and flight procedures.

## Transition to Multi-Rotor:

### 1. Prepare for Transition:

- Ensure the aircraft is in **Fixed-Wing (FW) Mode** with **Position Control** active.
- Climb or descend to a safe transition altitude. For first-time pilots, a recommended altitude is **60 meters above ground**, ensuring at least **40 meters clearance** above the tallest obstacle in the practice area.

### 2. Align the Aircraft:

- Smoothly center both flight sticks before initiating the transition.

### 3. Initiate Transition:

- Flip the **Transition Switch** to the left to switch to **Multi-Rotor (MR) Mode**.
- Observe the aircraft as it transitions, which typically takes **approximately 1 second**.

### 4. During Transition:

- The **tail motor** will immediately begin spinning, and the aircraft will maintain its current altitude.
- The **Ground Station App** will display **“Multi-Rotor”** in the top bar.
- If audio is enabled, the Controller provides a **voice callout** confirming the transition.

### 5. Post-Transition:

- The aircraft will decelerate and stabilize into a **hover**.
- Multi-Rotor control mappings are now active.
- Begin piloting the Edge as a **Multi-Rotor aircraft**, following the appropriate control inputs and hover procedures.

## Emergency Procedures

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This chapter outlines the procedures for the Edge 130 sUAS in the event of an emergency.

# Emergency Procedures

## Emergency Pilot Actions

### Aircraft Tumbles in Flight:

If the aircraft experiences a tumble during flight while the **Transition Switch** is set to **RW Mode**, follow these procedures:

1. **Immediate Checks:**

- **Verify Safe Altitude:** Ensure the aircraft is at a safe height to perform corrective actions.
- **Check Aircraft Controllability:** Assess whether the vehicle responds to control inputs.

2. **Decision Point:**

- Evaluate whether it is safer to **return home** or continue the mission.
- If the aircraft is stable and controllable, transition back to **Fixed-Wing (FW) Mode** and resume the mission.

3. **If the Aircraft is Uncontrollable:**

- **Command Return Home (RTL):** Initiate an autonomous return procedure.
- **Monitor and Record:** Track the aircraft's behavior and record the last known position, heading, and any relevant telemetry data for post-flight analysis.

## Loss of Telemetry (Momentary):

### 1. Immediate Checks:

- **Aircraft Control:** Verify that the vehicle is still responding to control inputs.
- **Safety Settings:** Confirm that all pre-programmed failsafe parameters are active.

### 2. Radio Transmitter:

- Cycle the radio transmitter power if required to restore communication.

### 3. After Telemetry is Regained:

- If telemetry is restored but the cause of the loss is unknown:
  - Select the appropriate **Flight Mode** based on current flight conditions.
  - **Land Immediately** to ensure the safety of the aircraft and surrounding area.

## Loss of Telemetry (Greater than 5 Seconds):

### 1. Record Last Known Data:

- Note the aircraft's **last known heading and direction** before telemetry was lost.

### 2. Activate Failsafe:

- Command the aircraft to enter **Return Mode** to initiate an autonomous return to the Home location.

## Landing Inaccuracy (Autonomous RW Mode):

If the aircraft exhibits landing inaccuracies while in autonomous Return-to-Home (RW) mode:

1. **Switch to Position Mode:**

- Take manual control using Position Mode on the flight sticks.

2. **Stabilize Aircraft:**

- Allow the aircraft to stabilize and orient itself **into the wind** for optimal landing control.

3. **Land Manually:**

- Execute a controlled manual landing, ensuring a safe touchdown.

## Autonomous Emergency Actions

### Communication Loss:

If the Edge 130 loses communication with the Ground Station, it will automatically initiate a **Return-to-Home (RTH) procedure**. A communication loss is declared under either of the following conditions:

- **Telemetry Loss:** No telemetry data received for more than **10 seconds**.
- **RC Transmission Loss:** Manual RC signal lost for over **0.5 seconds**.

Once a lost link is detected, the **Fail Safe Action** is to return to the **Home location**, defined as the GPS coordinates where the aircraft was armed.

### Return-to-Home Procedure:

1. The aircraft climbs to **70 meters** altitude.
2. If the aircraft is more than **500 meters from Home**, it will **transition to Fixed-Wing mode** to optimize travel efficiency.
3. The aircraft flies directly to the Home location, **transitioning back to Multi-Rotor mode** if necessary.
4. Upon reaching Home, it descends while performing a **0.5-second pause at 30 meters** above the landing site.
5. The aircraft lands and **automatically disarms** upon touchdown.

## Emergency Flight Transitions:

The Edge 130 autopilot may command an **emergency transition to Multi-Rotor (MR) mode** under certain critical conditions. When such a scenario occurs, the aircraft will immediately transition to MR mode. The controller will announce that an **Emergency Transition** has been executed and display the reason for the action.

### Triggers for Emergency Transition:

1. **Stall Airspeed Breached**
  - The aircraft's measured airspeed falls below the defined stall threshold.
2. **Pitch or Roll Angle Breached**
  - The aircraft exceeds a **pitch angle of  $\pm 35^\circ$**  or a **roll angle of  $\pm 60^\circ$** .
3. **Minimum Altitude Breached**
  - The aircraft descends below **30 meters above Home**.
4. **Outbound Transition Timeout**
  - The aircraft fails to complete a transition within **10 seconds**.

In all cases, the autopilot will prioritize immediate stabilization and controlled hover in MR mode to maintain safety.

## Low Battery:

The Edge 130 Air Vehicle (AV) is equipped with a tiered low-battery emergency protocol to ensure safe operation and landing. The system defines three levels of battery warnings and corresponding emergency actions:

### Battery Warning Levels and Actions

#### 1. 30% Battery – Advisory Warning

- Audio and visual alerts will indicate that **Return to Launch (RTL)** is advised.
- This serves as an early caution to the pilot to prepare for landing.

#### 2. 15% Battery – Automatic Return to Launch

- The autopilot will **automatically initiate RTL**.
- This action **can be overridden** by the pilot if needed.

#### 3. 8% Battery – Automatic Land at Current Location

- The autopilot will **automatically land the aircraft** at its current position.
- This action **cannot be overridden** and ensures safety in critical battery conditions.



#### CAUTION

The pilot remains ultimately responsible for monitoring the battery state and ensuring a safe landing. Always plan missions to land with at least **10% battery** remaining.

## Pre-Flight/Takeoff

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This chapter outlines the pre-flight/takeoff procedures for the Edge 130 sUAS.

# Pre-Flight/Takeoff

## Introduction

This section provides the essential procedures and knowledge required to operate the Edge 130 safely and effectively. Following these steps ensures that the aircraft is fully prepared for flight and that takeoff is performed under controlled, safe conditions.

Key areas covered in this section include:

### 1. Basic System Limitations

- Understand the operational limits of the Edge 130, including maximum speeds, altitudes, payload restrictions, and environmental factors such as wind, temperature, and precipitation.
- Awareness of these limitations helps prevent system overload, instability, or unsafe flight conditions.

### 2. Preflight Checks

- Conduct a thorough inspection of all components, including the airframe, propellers, motors, battery, payload, and control surfaces.
- Verify all sensors, calibration status, and safety parameters are within operational limits.
- Confirm communication with the Ground Control Station (GCS) and ensure adequate GPS satellite visibility.

### 3. Takeoff Procedures

- Prepare the aircraft in a clear, obstacle-free area.
- Power up the AV and GCS, verify status indicators, and arm the aircraft.
- Initiate a controlled vertical or forward takeoff while maintaining smooth control inputs.
- Monitor system status and environmental conditions throughout ascent.

### 4. Transitioning to Fixed-Wing Flight

- Execute the transition from Multi-Rotor to Fixed-Wing mode using the Transition Switch.
- Maintain proper orientation and airspeed during transition to ensure a smooth changeover.
- Verify the aircraft stabilizes in Fixed-Wing mode and tail propellers stow correctly.

### 5. Landing Procedures

- Plan landing well in advance, accounting for wind and obstacles.
- Execute controlled descent using either manual or autonomous modes.
- Confirm touchdown and safe disarm of the aircraft post-landing.



#### **CAUTION – Propeller Strike When Landing**

If a propeller strike occurs during landing, inspect the propeller tips for chips, cracks, or deformation before the next flight. Replace any propeller that shows signs of damage.

## Weather Vane – Flight Characteristic

The Edge exhibits a **Weather Vane** behavior while hovering, which is a critical flight characteristic for maintaining stability and efficiency. This behavior automatically aligns the aircraft's nose into the wind, optimizing lift and minimizing drift during hover operations.

### Operational Details

- **Active Modes:** This feature is active whenever the Edge is hovering in **GPS-managed position modes**, including:
  - **Position Mode**
  - **Hold Mode**
  - **Return Mode**
  - **Mission Mode**
- **Inactive Modes:** The Weather Vane behavior does **not** activate in Fixed-Wing Altitude Mode.
- **Functionality:**
  - Sensors detect wind direction, and the autopilot automatically commands the aircraft to yaw. This aligns the nose into the wind.
  - The feature activates only above a minimum wind speed. Below this threshold, the aircraft will maintain its current heading.
  - The autopilot commands a yaw rate approximately **one-third** of the maximum rate achievable manually by the pilot.

- **Pilot Override:**

- Pilots can temporarily override the Weather Vane behavior using **left/right inputs on the left flight stick**.
- Upon releasing the stick, the aircraft will automatically resume pointing into the wind.
- Strafing with the **right stick's horizontal movements** will also induce yaw, which is normal and assists in compensating for wind effects.



**NOTE**

Understanding and leveraging the Weather Vane behavior improves hover stability and efficiency, especially in gusty conditions.



**WARNING – Wind Advisory**

Do **NOT** back the aircraft into the wind on takeoff.

This will result in uncontrolled altitude variations, due to the wing shapes, which may result in a crash.

## Pre-Flight

### Pre-Flight Checklist:

The **Pre-Flight Checklist** is an essential safety tool that verifies the aircraft is fully prepared for flight. By systematically inspecting mechanical components, confirming system functionality, and ensuring procedural compliance, the checklist helps:

- Identify potential mechanical or electrical issues before takeoff.
- Verify that all sensors, avionics, and safety systems are operational.
- Promote consistency and reduce human error during flight preparation.
- Enhance overall flight safety and mission efficiency.



#### **CAUTION – Thermal Management**

In high-temperature environments, avoid leaving the aircraft powered on for extended periods before takeoff. The Edge 130's avionics, radios, and payloads generate heat during idle operation, and prolonged on-ground runtime in hot weather may increase internal temperatures.

To maintain optimal system performance:

- Power on the aircraft **only when pre-flight checks are ready to begin**.
- Minimize idle time in direct sunlight.
- If possible, keep the aircraft shaded before takeoff or delay power-on until immediately prior to arming.

This helps ensure all onboard systems remain within safe thermal operating limits and reduces the risk of heat-related performance degradation.



### CAUTION – Thermal Monitoring

Both the Mapping Array and Overwatch payloads continuously report their internal temperature to the Ground Control Station (GCS). Operators should monitor these values during pre-flight and ground operations.

If a payload temperature approaches or exceeds **80°C**, avoid allowing the system to remain powered on while on the ground. High on-ground temperatures can cause thermal saturation, reduced image quality, or automatic protective shutdown of the payload.

If temperatures rise above 80°C:

- Power down the aircraft and allow the payload to cool naturally.
- Move the aircraft into shade or reduce direct sunlight exposure.
- Delay takeoff until temperatures return to a normal operating range.

Maintaining acceptable payload temperature ensures optimal imaging performance and prevents overheating events that may impact mission execution.

## Inspect the Air Vehicle

Perform a thorough inspection of the aircraft before each flight to ensure it is in optimal condition and ready for safe operation.

### Inspection Steps:

1. **General Airframe** – Conduct a detailed visual check of the airframe for any cracks, dents, or other signs of damage.
2. **Motor Arms & Motor Latches** – Ensure all motor arms are fully seated and securely latched. Inspect for debris, wear, or any physical damage.
3. **Wings & Wing Latches** – Verify that wings are properly installed and latches are locked. Confirm that all surfaces are free of debris, cracks, or other damage.
4. **Payload / Camera** – Check that cameras and payloads are clean, unobstructed, and securely mounted. Ensure gimbals move freely and lenses are clean.
5. **SD Card** – Confirm that the SD card is correctly inserted and fully seated.
6. **Battery** – Ensure the battery is fully charged and properly installed in its compartment.
7. **Orientation** – Position the aircraft facing into the wind to ensure optimal lift, stability, and control during takeoff.

## Inspect the Payload

Before flight, ensure that the payload is correctly installed and fully operational.

### Inspection Steps:

1. **System Recognition** – Confirm that the payload is recognized by both the Aircraft Vehicle (AV) and the Ground Control Station (GCS).
2. **Camera Functionality** – Verify that all cameras are operational, including gimbal movement, zoom, and focus, before takeoff.
3. **Troubleshooting** – If the camera is not recognized or functioning incorrectly:
  - Ensure the payload is properly seated in its mount.
  - Disconnect and securely reconnect the camera or payload connection.
  - Recheck system recognition and confirm camera functionality.



### NOTE

Resolving payload issues on the ground ensures mission success and prevents in-flight disruptions.

## Settings Menu Verification

Before flight, ensure that all vehicle systems and safety settings are correctly configured via the Ground Control Station (GCS).

### 1. Access Settings

- Tap the **three dots icon** in the upper-right corner of the GCS interface to open the **Settings menu**.

### 2. Vehicle Summary

- Confirm that all sensors display a **green (ready) status**.
- Verify that all **Safety Settings** are loaded correctly.
- Ensure the **camera interface** is properly configured and operational.

### 3. Sensors

- Navigate to the **Sensors submenu**.
- Confirm that all sensors show **green (ready)** status.
- Check for any alerts or warnings that may require recalibration.

### 4. Safety Settings

- Navigate to the **Safety submenu** and verify that:
  - **Low Battery Response** is programmed correctly.
  - **RC Loss Behavior** is configured according to operational requirements.
  - **Data Link Loss Response** is set appropriately.
  - **Geofence Parameters** match the operational area.
  - **Return-to-Launch (RTL) Settings** are correctly defined.



#### NOTE

Any warning or misconfiguration in the Settings menu should be resolved before takeoff to ensure safe and reliable flight operations.

## Flight Data Verification

Before takeoff, ensure that all flight data is accurate and reliable to guarantee safe operations.

### 1. Display Readouts

- Confirm that the **heading, altitude, and attitude** indicators display accurate readings.
- Verify that these readings correspond correctly with data from the **compass, magnetometer, and GPS**.

### 2. Stability Check

- Monitor the aircraft for any signs of **instability or incorrect sensor data** while on the ground.
- Look for unusual drift, erratic readings, or unexpected deviations in telemetry.

### 3. Calibration

- If discrepancies or abnormal readings are observed, verify that all relevant sensors are properly calibrated.
- Perform **sensor calibration** as needed to ensure accurate and stable flight data before takeoff.



#### NOTE

Proper flight data verification is critical to maintaining safe and controlled operations, particularly during autonomous or high-speed maneuvers.

## Mission Management

Proper mission management ensures that the aircraft executes flight operations safely and as planned. Follow these steps before starting a new mission:

### 1. Access Mission Planning

- Tap the **Plan** icon in the Ground Control Station interface to enter the mission planning module.

### 2. Clear Previous Missions

- Navigate to **File** and select the **Clear** button to remove any previously loaded missions from the aircraft.
- Confirm that the **mission list is empty** before creating or uploading a new mission.

 **NOTE**

Always verify that no residual missions remain on the aircraft to prevent accidental execution of outdated flight plans.

## Final Pre-Flight System Checks

Before takeoff, perform a comprehensive verification of all aircraft and system parameters to ensure safe and reliable operation.

### 1. Announcements Menu

- Tap the **megaphone icon** to open the Announcements menu.
- Confirm or clear any active warnings or system messages.

### 2. GPS & Positioning

- Verify GPS lock with **more than 10 satellites**.
- Ensure **HDOP** (Horizontal Dilution of Precision) is **less than 1.0 m** for reliable positioning.
- If these conditions are not met. The AV **will not arm**.

### 3. Battery Status

- Confirm both **AV (Air Vehicle)** and **GCS (Ground Control Station)** batteries are at sufficient operating levels for the planned mission.

### 4. Flight Mode Check

- Press and hold each **Flight Mode** button individually.
- Confirm correct audible announcements for each mode (if audio is enabled).
- **Important:** Do **not** press the **Mission** button if a mission is currently loaded, as this will automatically arm the aircraft and initiate the mission.

### 5. MR/FW Transition Switch

- Verify the **Multicopter/Fixed-Wing (MR/FW) Transition Switch** is functioning correctly.
- Ensure propellers are **parallel to the ground** before activating the switch to avoid damage from motor transitions on hard surfaces.

## 6. Map Display

- Confirm the map displays the **correct operational area**.
- Ensure the **aircraft icon** is visible and accurately positioned on the map.

## 7. Mission Planning (If required)

- Conduct any pre-mission autonomous plan creation and upload to the aircraft, if necessary.

 **NOTE**

This step can be completed without a live connection to the aircraft. Refer to the **Mission Planning** section for detailed instructions. Completing these final checks minimizes the risk of errors during takeoff and ensures the aircraft is ready for safe operation.

## Arming and Disarming Procedure

### Arming the Aircraft

1. Tap the **Arm** icon located in the top-left corner of the screen.
2. A **slide-to-arm** prompt will appear at the bottom of the screen.
3. Slide to arm the aircraft and verify that the **motors activate correctly**.

### Disarming the Aircraft

1. Tap the **Disarm** icon, also located in the top-left corner.
2. A **slide-to-disarm** prompt will appear at the bottom of the screen.
3. Slide to disarm the aircraft and confirm that the **emergency disarm function** operates properly.



#### CAUTION

Never disarm the aircraft while in flight unless it is an **emergency**, as doing so will result in immediate loss of lift and control.

## Takeoff and Function Check



### CAUTION

Upon arming, propellers will spin at **idle speed**.

**Propellers are dangerous** and can cause serious injury. **Maintain a minimum distance of 10 feet (3 meters) from the aircraft while it is armed.**

The aircraft will naturally **point into the wind** upon arming. In higher wind conditions, the pilot may need to provide control inputs to maintain a safe distance from obstacles or personnel.

For optimal stability during hover, **ensure the Edge is oriented into the wind.**

### Introduction:

The **Takeoff and Function Check** procedure verifies that all systems are operating correctly prior to flight. Performing this check helps:

- Identify potential issues before they affect the mission.
- Ensure all flight controls, sensors, and payloads respond correctly.
- Confirm safe and controlled operation during initial ascent.

This step is **critical for mission success and overall flight safety.**

## Takeoff and Function Check Procedure:

### 1. Arm the Aircraft

- Hold the **left flight stick** down and inward for 2 seconds to arm the aircraft.

### 2. Initial Lift-Off

- Once armed, smoothly return the left stick to center.
- Gradually push up on the left stick to initiate a controlled ascent.
- Climb to approximately **15 ft AGL** (Above Ground Level), then return the stick to neutral.
- Allow the aircraft to stabilize and face into the wind. Be prepared to manually adjust roll if necessary.

### 3. Controllability Check

- Command the aircraft in all directions to verify responsiveness:
  - Forward
  - Right
  - Left
  - Yaw Right
  - Yaw Left
- Confirm that all movements are smooth and responsive.

#### 4. Climb and Transition

- After verifying controllability, climb to the **mission altitude** or a safe altitude for Fixed-Wing (FW) transition.
- Ensure at least **150 ft of clear space** in front of the aircraft.
- Initiate FW transition if required.

 **NOTE**

Transition may take **up to 5 seconds**. The aircraft will not respond to climb commands until the transition is complete.

## Transitioning to Fixed-Wing Flight – Notes:

- **Control Stick Behavior:** Flight controls will operate differently in Fixed-Wing mode. Study the Fixed-Wing control layout thoroughly before piloting in this mode.
- **Cruise Speed:** The aircraft will travel at approximately **31 MPH** when entering and cruising in Fixed-Wing mode. Ensure there is sufficient room for safe maneuvering.
- **Autopilot Management:** The transition process is actively managed by the autopilot. Simply flipping the **Transition Switch** commands the aircraft to switch modes, simplifying the process for the pilot.
- **Returning to Multi-Rotor Mode:** When switching back to Multi-Rotor mode, the aircraft requires **20–50 feet** to decelerate to a stable hover.
- **Transition Switch Behavior:** The Transition Switch indicates the mode the pilot **wants**, rather than triggering an instantaneous action.
  - Full transition can take up to **5 seconds** after flipping the switch.
- **Scenarios Where the Transition Switch is Ignored:**
  - **Power-Up:** The switch is ignored until switched to Multi-Rotor mode.
  - **Autonomous Missions:** The switch is ignored during mission execution.
  - **Emergency Transitions:** If the autopilot commands an emergency transition back to Multi-Rotor, the switch is ignored until manually switched back to Fixed-Wing mode.
  - **Control Mode Change Out of Autonomous Mode:** The switch is ignored until it matches the aircraft's current transition state.

## Landing & Post-Flight

### Landing Overview:

The recommended method for landing the Edge 130 AV is by using the **Return** button on the Ground Control Station (GCS). However, descending from a high mission altitude in Multi-Rotor mode can consume significant battery during the autonomous landing sequence.

### Battery Management During Landing:

To conserve battery power:

- Consider manually flying the aircraft to a lower altitude while in Fixed-Wing mode.
- Transition to Multi-Rotor mode only once the aircraft is over the intended landing site.
- Always monitor battery levels closely.
  - If the battery reaches 8%, the aircraft will land automatically.

### Landing Procedure:

1. Slowly descend the aircraft to the **Recovery Altitude** as set in the Safety Settings menu.
2. Verify a **safe return altitude** and confirm that the landing site is clear of obstacles.
3. Command **Return** via the GCS and monitor the aircraft's descent until it touches down and automatically disarms.
4. Be prepared to manually **Disarm** the aircraft if necessary, typically within **1–2 feet** of the ground. Note that the aircraft may drift due to **prop wash** from the rotors, which can delay automatic disarming.

### Pilot Responsibility:

- The pilot is ultimately responsible for responding to low-battery conditions to ensure a safe landing.
- Always plan to land with at least **10% battery remaining** to maintain control and safety.

 **NOTE**

When transitioning from Fixed-Wing (FW) mode back into Multi-Rotor (MR) mode, operators should expect a noticeable drop in the power meter. This is normal.

During transition, the tilt motors rotate to vertical orientation and all multi-rotor lift motors spool up simultaneously to support hover. This momentary increase in current draw causes the power meter to drop more rapidly than in steady-state flight. Once the aircraft stabilizes in MR mode, the power consumption rate will return to typical hover levels.

**Recommended Battery Level for Landing Approach**

To ensure safe landing operations, FlightWave recommends initiating the transition from FW to MR with the battery at **25% or higher**.

This margin accounts for:

- Transition surge current
- Wind corrections during descent
- Hover time during approach and touchdown
- Possible repositioning or go-around requirements

Operators should avoid initiating a landing transition when the battery is below 20%, as reduced power margins may limit control authority or compromise descent stability. Landing below this threshold should be reserved for emergency conditions only.

## Edge 130 Mission Planning

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This chapter outlines the mission planning procedures for the Edge 130 sUAS.

# Edge 130 Mission Planning

## Introduction

This section is designed to provide operators with the skills and knowledge required to **effectively plan, execute, and manage missions** using the Edge 130 AV. Mastering mission planning ensures safe, efficient, and successful operations in a variety of environments.

### Topics Covered:

#### 1. Mission Planning Overview

Learn the fundamentals of mission planning, including how to:

- Define mission objectives.
- Assess environmental factors.
- Develop comprehensive plans that ensure safe and efficient operations.

#### 2. Survey Missions

Understand how to plan and execute survey missions:

- Gather and process data from multiple sources.
- Analyze terrains and environmental features.
- Optimize flight paths for complete and accurate coverage.

#### 3. Waypoint Navigation

Gain expertise in autonomous navigation using waypoints:

- Program and adjust waypoints for precise route guidance.
- Ensure smooth transitions between waypoints.
- Maintain reliable navigation and mission accuracy.

#### 4. **Border Scans**

Learn to plan border scanning missions for security, surveillance, or environmental monitoring:

- Efficiently cover designated areas.
- Optimize data collection to meet mission objectives.
- Ensure complete and accurate monitoring of borders or restricted zones.

By the end of this section, operators will have the knowledge and tools to **plan and execute a wide range of missions**, achieving optimal navigation, data accuracy, and operational success.

## Mission Plans – General Overview

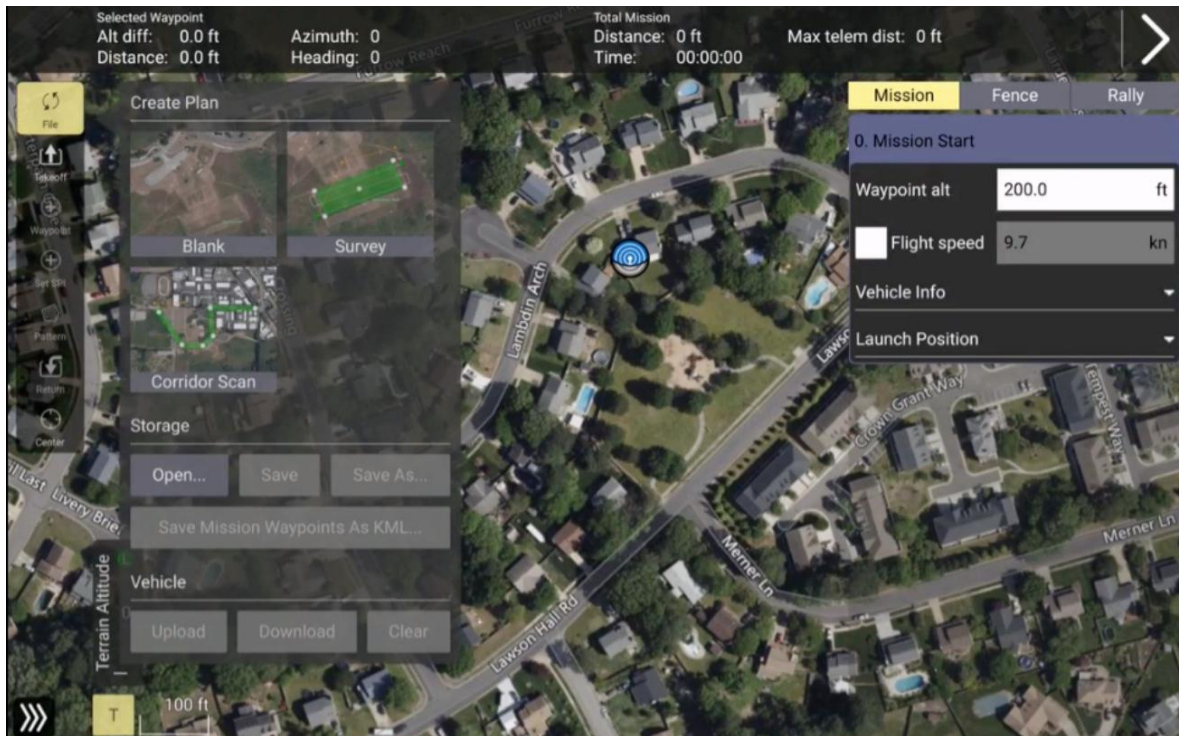


Figure 76 – Mission Plans Overview

The FlightWave Mission Planner allows operators to create and manage **several types of missions**; each tailored to specific operational objectives. All missions follow a structured workflow for planning, execution, and data collection.

### Mission Types:

#### 1. Survey Missions

- Primarily used to create **2D and 3D maps**.
- Requires post-processing with additional software to “stitch” collected imagery.
- Captures a high volume of photos over a pre-defined area for detailed mapping and analysis.

## 2. Waypoint Navigation with SPIs (Sensor Points of Interest)

- Ideal for **BVLOS (Beyond Visual Line of Sight)** operations.
- Allows operators to collect imagery across multiple designated points efficiently.
- Supports complex missions with multiple objectives in a single flight.

## 3. Border Scan Missions

- Optimized for scanning **linear features** such as roads, fences, or boundaries.
- Ensures coverage within airspace restrictions.
- Useful for surveillance, security, or environmental monitoring missions.

### **NOTE**

Missions must be **uploaded to the aircraft while it is powered ON and connected to the GCS.**

For photogrammetry and high-resolution mapping, use the **Mapping Array payload.**

## Survey Missions

Survey missions, also referred to as **photogrammetry**, involve using the Edge 130 system to capture a series of images over a designated area. These images are then used to generate **2D and 3D maps** via external software.

### NOTE

The FlightWave Ground Control Station (GCS) does **not** generate 2D or 3D maps onboard. Its role is to collect imagery suitable for mapping software.

FlightWave and RedCat **do not endorse any specific photogrammetry software**. The following tools have been tested and are compatible with FlightWave imagery.

### Free Drone Mapping Tools:

#### 1. **SkyeBrowse**

- Offers both free and paid services.
- Free version provides unlimited basic 2D and 3D model generation.
- Advanced features are available a la carte.
- Website: [www.skyebrowse.com](http://www.skyebrowse.com)

#### 2. **WebODM**

- Comprehensive open-source software for photogrammetry.
- Requires technical knowledge to operate effectively.
- Website: [www.opendronemap.org/webodm](http://www.opendronemap.org/webodm)

### 3. Drone Deploy

- Offers a **14-day free trial**; no longer free as of late 2024.
- User-friendly interface, though processing times can be long for large datasets.
- Website: [www.dronedeploy.com](http://www.dronedeploy.com)

### 4. Polycam

- Provides basic free photogrammetry capabilities.
- Export options are limited, primarily to “gIFT” file types.
- Website: [www.poly.cam/tools/drone-photogrammetry](http://www.poly.cam/tools/drone-photogrammetry)

By leveraging these tools with imagery captured by the Edge 130, operators can create accurate and detailed maps for surveying, inspection, and analysis purposes.

## Best Practices for 2D / 3D Modeling:

To ensure high-quality 2D and 3D models from survey missions, follow these recommended best practices:

### 1. Overlapping Coverage

- High overlap is critical for accurate model generation.
- Set missions to capture approximately **70%–80% overlap** in both forward and side directions.
- Greater coverage results in more detailed and precise models.

### 2. Lighting Conditions

- Avoid deep shadows or low-light environments.
- Conduct surveys under bright, evenly illuminated conditions for optimal image clarity.

### 3. Flight Path Stability

- Minimize drone movement during image capture.
- Avoid flying in gusty winds.
- Extend the flight path slightly during turns (lead-in lines) to allow smoother transitions and consistent overlap.

### 4. Altitude Considerations

- Maintain an altitude between **400–600 feet AGL** for best imagery quality.
- At this range, the Ground Sampling Distance (GSD) is typically **less than 2 cm**, providing sufficient resolution for accurate modeling.

### 5. Memory Management

- Survey missions generate large amounts of image data.
- Ensure the SD card is cleared or has sufficient capacity prior to beginning the mission to avoid interruptions.

By adhering to these practices, operators will maximize the accuracy, clarity, and usability of the resulting 2D and 3D models.

## Creating Surveys with FlightWave Mission Planner

### Survey Mission Overview:

Survey missions, often referred to as photogrammetry missions, rely on GPS-guided flight paths to capture imagery across a designated area. The Edge 130 collects high-resolution photos along a pre-planned route, which can later be processed into 2D or 3D maps using external software.

### Planning:

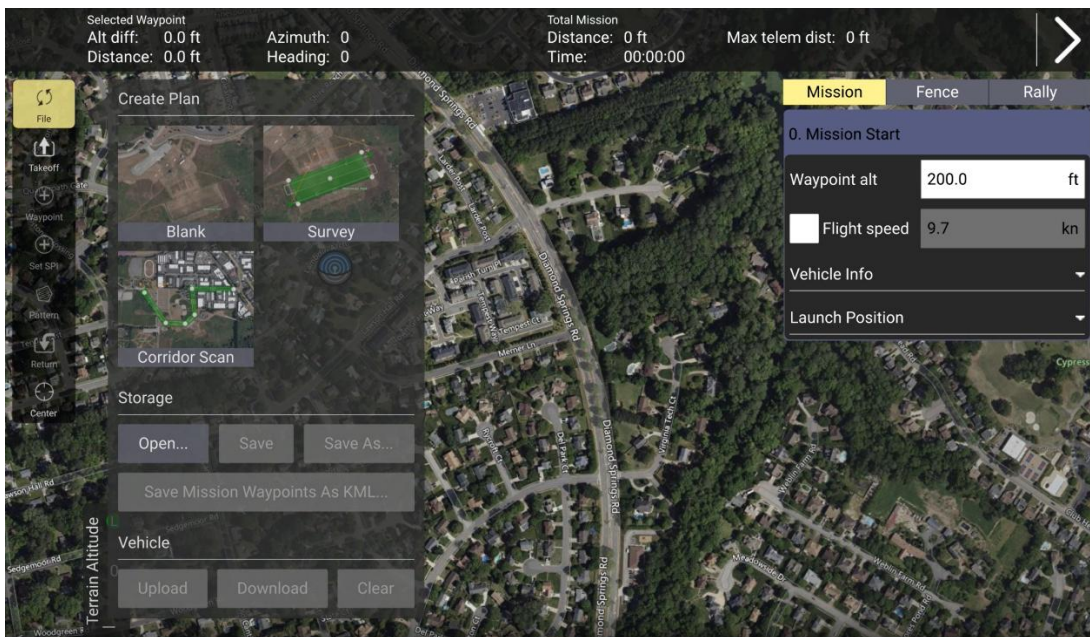


Figure 77 – Access Mission Planning

#### 1. Access Mission Planning

- Tap the **Plan** icon in the Actions Bar on the left side of the GCS screen.

#### 2. Create a Survey Mission

- Select the **Survey** icon to begin a new mission plan.
- Define the survey area by tapping or dragging points on the map to create the mission boundary.

## Mission Start:

### 1. Set Operational Altitude

- Specify the altitude at which the Edge 130 should navigate during the mission.

### 2. Configure Flight Speeds (Optional)

- Adjust **cruise speed** and **hover speed** if necessary.
- **Recommendation:** Retain the default airspeeds, as they are optimized for stable flight, battery efficiency, and overall mission safety.

### 3. Verify Mission Parameters

- Double-check the altitude, speeds, and survey area before starting the mission.
- Ensure that all pre-flight checks have been completed and the aircraft is armed safely.

## Takeoff and Transition:

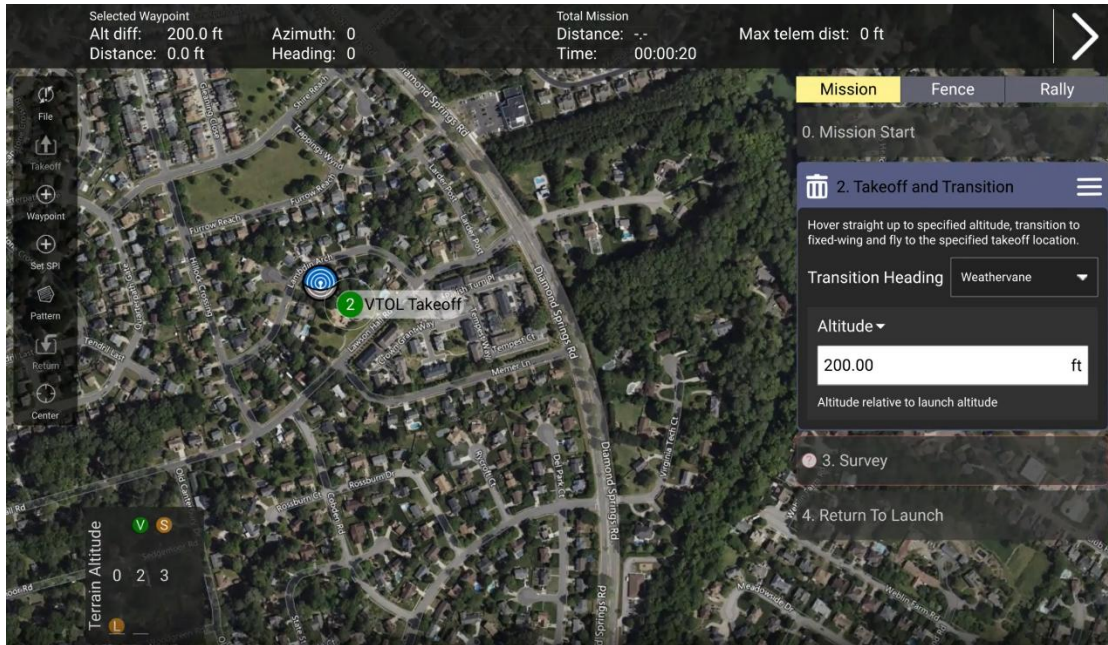


Figure 78 – Takeoff and Transition

### 1. Designate Takeoff Location

- Tap the map in the GCS to select the approximate takeoff point.

### 2. Verify Altitude Settings

- Ensure the takeoff altitude matches the intended altitude for the mission waypoints.
- The Edge 130 will automatically ascend to this altitude upon initiating takeoff.

### 3. Initiate Takeoff

- Begin the mission, allowing the aircraft to climb to the specified altitude.
- Confirm the aircraft stabilizes and is aligned with the planned flight path before transitioning to mission navigation.

## Survey:

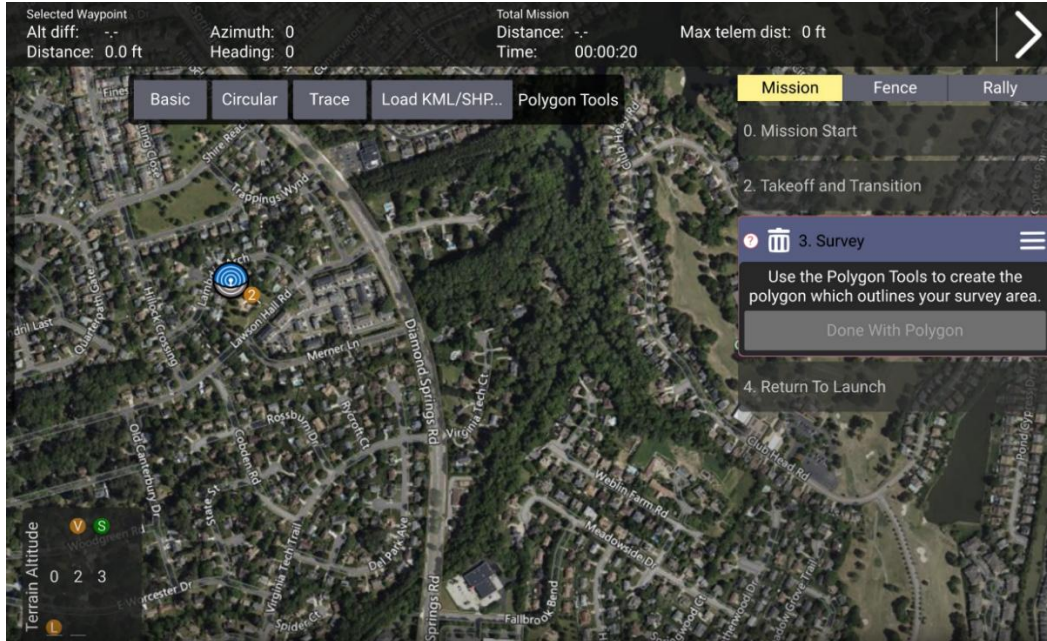


Figure 79 – Survey

### 1. Define Survey Route

- Use the Polyline tools to create the survey path for your mission.

### 2. Polyline Tool Options

- **Basic Tool:**
  - Creates a square survey path.
  - Adjust the route by selecting the faint '+' symbol to add waypoints.
  - Reposition waypoints as needed to shape the survey area.
- **Circular Tool:**
  - Creates a circular survey path.
  - Adjust the size by selecting and dragging the solid white circle. Zoom in or out as required.
- **Trace Tool:**
  - Allows creation of a custom survey path by clicking directly on the map.
  - Ideal for following complex or irregular routes precisely.

### 3. Finalize Route

- Once the survey path is complete, select **Done With Polyline** to save the mission route.

## Survey Settings:

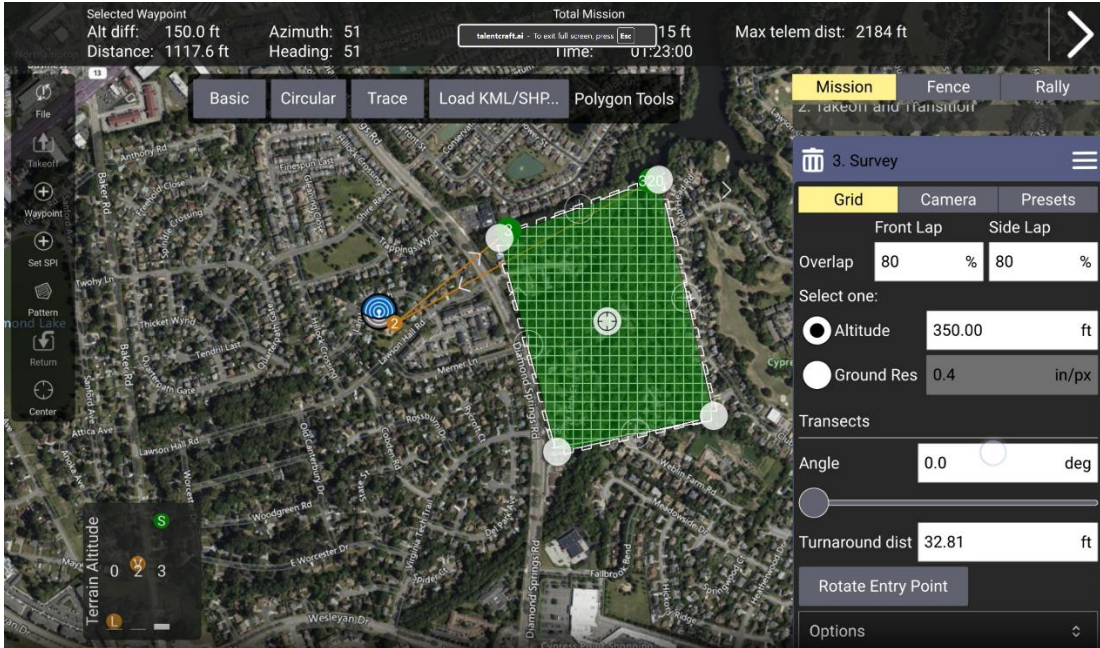


Figure 80 – Survey Settings

### Grid

- **Overlap:** Adjust image overlap to ensure high-quality, seamless imagery. Optimal overlap depends on terrain and mission requirements.
- **Altitude:** Set the operational altitude for the survey mission.

### Transects

- **Angle:** Define the angle at which the survey area will be scanned.
- **Turnaround Distance:** Increase this value in windy conditions to allow the aircraft to stabilize after a turn before capturing images.

### Transect Options:

- **Hover and Capture Image:** Pause at each waypoint to capture images.
- **Reply at 90° Offset:** Rotate image capture direction relative to flight line.
- **Images in Turnarounds:** Capture images during turnaround segments.
- **Fly Alternate Transects:** Enables alternating flight lines to optimize coverage.
- **Rotate Entry Point:** Change the starting point of the survey scan.

### Terrain

- **Above Terrain Mode:** Sets flight altitude relative to terrain height at the selected location. Note: Terrain elevations are not sent to the aircraft; only the offset above ground level is applied.

### Statistics

Displays key mission metrics, including:

- Survey Area
- Photo Count
- Photo Interval
- Trigger Distance

## Transition and Land:

### Fly to Specified Location

- The aircraft will navigate autonomously to the designated landing point at its current altitude.
- Upon arrival, it will transition to **Multi-Rotor mode** and begin the landing sequence.

### Set Ground Altitude

- The operator can specify the approximate ground altitude for the landing location.
- Typically, this is set to **0 meters** when landing at the original launch site.

### Adjust Landing Waypoint

- The landing waypoint can be repositioned by dragging it to the desired location directly on the map interface.

## Mission Information:

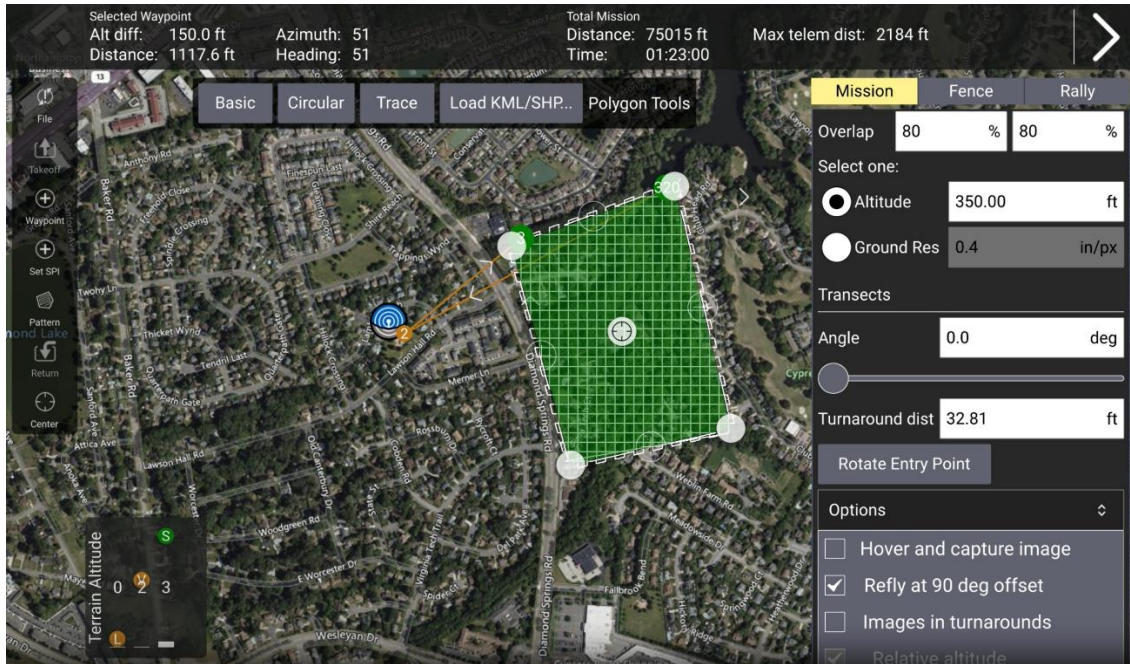


Figure 81 – Mission Information

### Mission Summary

- At the top of the Mission Planner screen, the operator can view key mission metrics:
  - **Total Flight Distance:** The cumulative distance the aircraft will cover during the mission.
  - **Estimated Mission Time:** The projected duration to complete the survey.

### Purpose

- This information helps validate:
  - **Mission feasibility** – ensuring the aircraft can complete the planned route.
  - **Battery requirements** – confirming that sufficient charge exists for safe mission execution.

## Save Survey Mission:

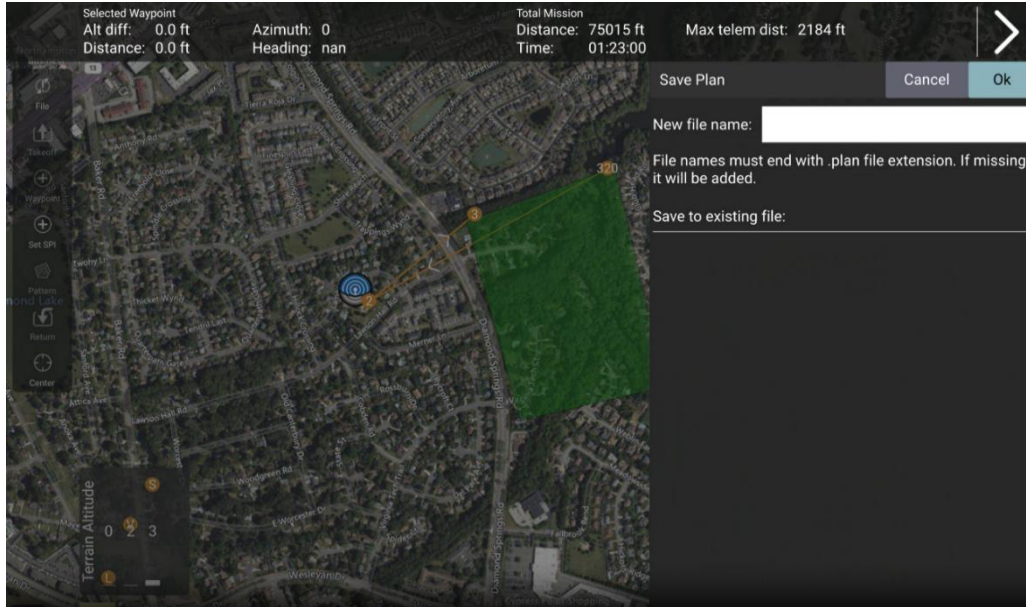


Figure 82 – Save Survey Mission

### Purpose

- Saving the mission ensures all planning steps are recorded and ready to be uploaded to the aircraft.

### Procedure

1. Tap the **File** icon located in the top-right corner of the screen.
2. Select **Save As**.
3. Enter a descriptive name for the mission file.
4. Select **OK** to confirm and save the mission.

### NOTE

Always verify that the mission is saved correctly before attempting to upload it to the aircraft. Unsaved changes will not be reflected in the flight plan.

## Waypoint Navigation with SPIs

### Introduction:

- Waypoint missions are similar to survey missions in terms of planning and uploading procedures.
- The primary distinction is **mission behavior**: during a waypoint mission, the aircraft navigates to each GPS-defined waypoint and executes a specific action assigned by the operator, called a **Sensor Point of Interest (SPI)**.

### Key Concepts

1. **Waypoint** – A GPS coordinate that the aircraft will fly to during the mission.
2. **SPI (Sensor Point of Interest)** – A specific action the aircraft performs at a waypoint, such as:
  - Capturing a photo
  - Triggering a payload
  - Pausing to hover for observation

### Mission Behavior

- The aircraft will fly autonomously from waypoint to waypoint using GPS guidance.
- At each waypoint, the assigned SPI action will be executed before proceeding to the next waypoint.
- SPIs allow operators to tailor missions for inspection, monitoring, or data collection tasks beyond simple aerial surveys.

 **NOTE**

Waypoint missions require a reliable GPS connection and a stable air vehicle state to ensure proper execution of SPIs.

## Planning:

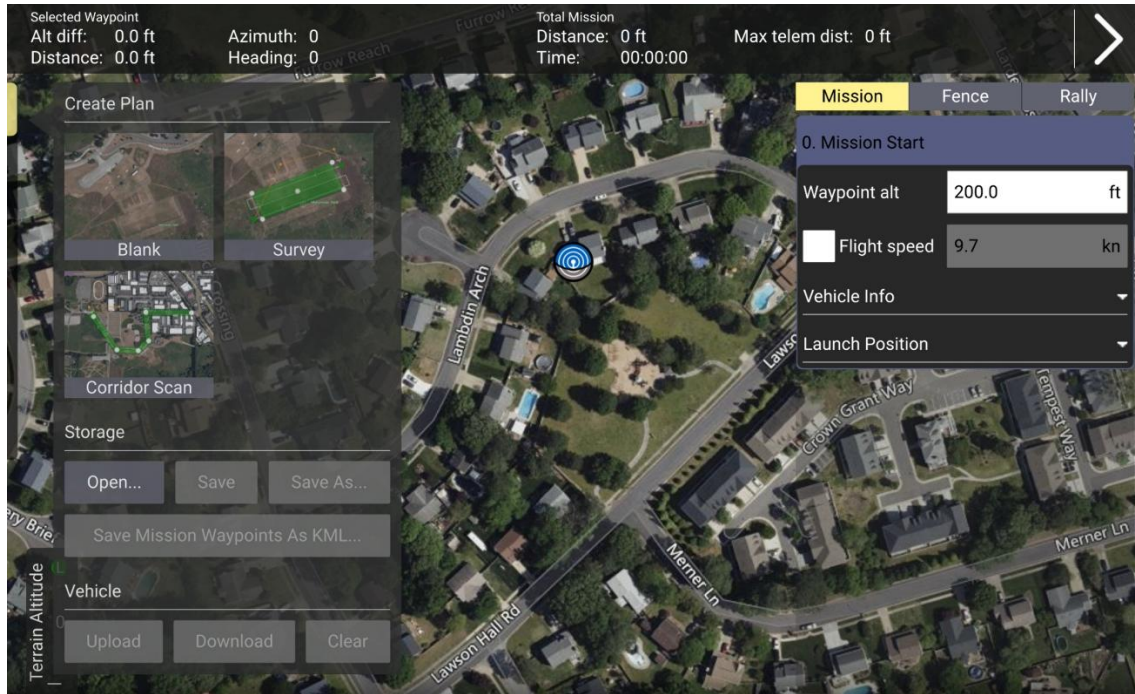


Figure 83 – Planning

### 1. Access Mission Planning

- Tap the **Plan** icon located in the **Actions Bar** on the left side of the screen.

### 2. Create a New Mission

- Click the **Blank** icon to start a new waypoint mission plan.

#### **NOTE**

Ensure the aircraft is powered on and connected to the GCS before beginning mission planning.

## Mission Start:

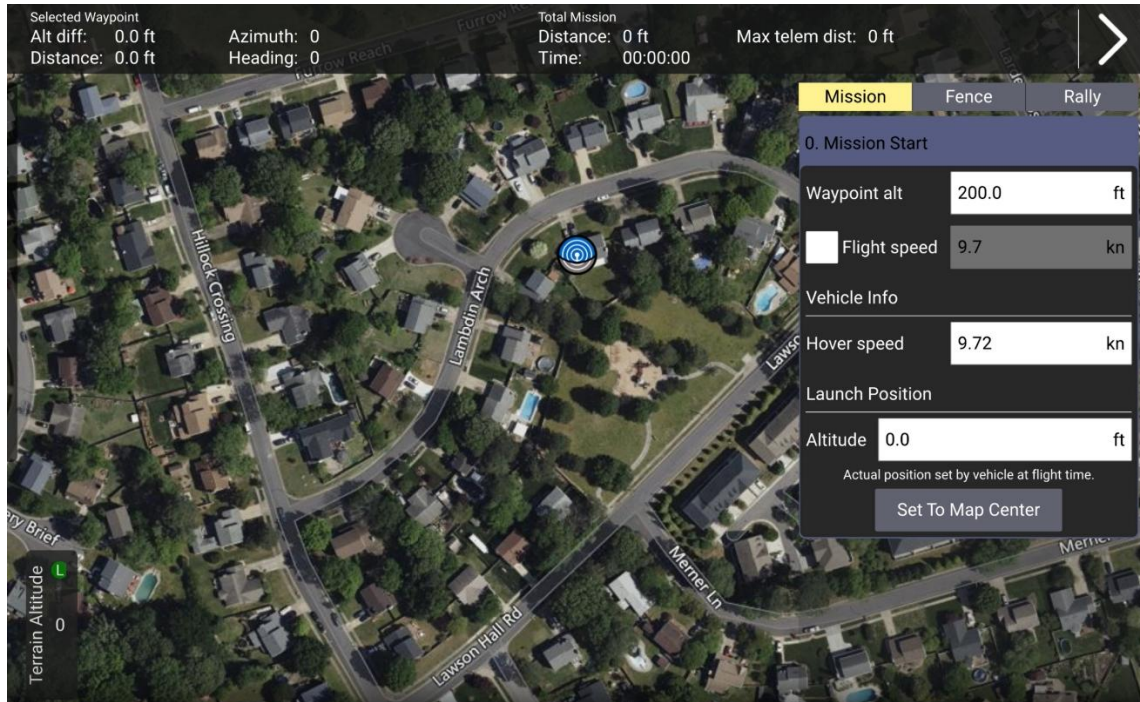


Figure 84 – Mission Parameters

### 1. Set Mission Altitude

- Define the desired altitude at which the aircraft should operate during waypoint navigation.
- This altitude will apply to all waypoints unless overridden individually.

### 2. Optional Settings

- Configure cruise speed and hover speed for the mission.
- It is recommended to maintain the default airspeeds, as they are optimized for flight performance and safety.

 **NOTE**

Always confirm that the set altitude maintains safe clearance above obstacles and terrain.

## Takeoff Location:

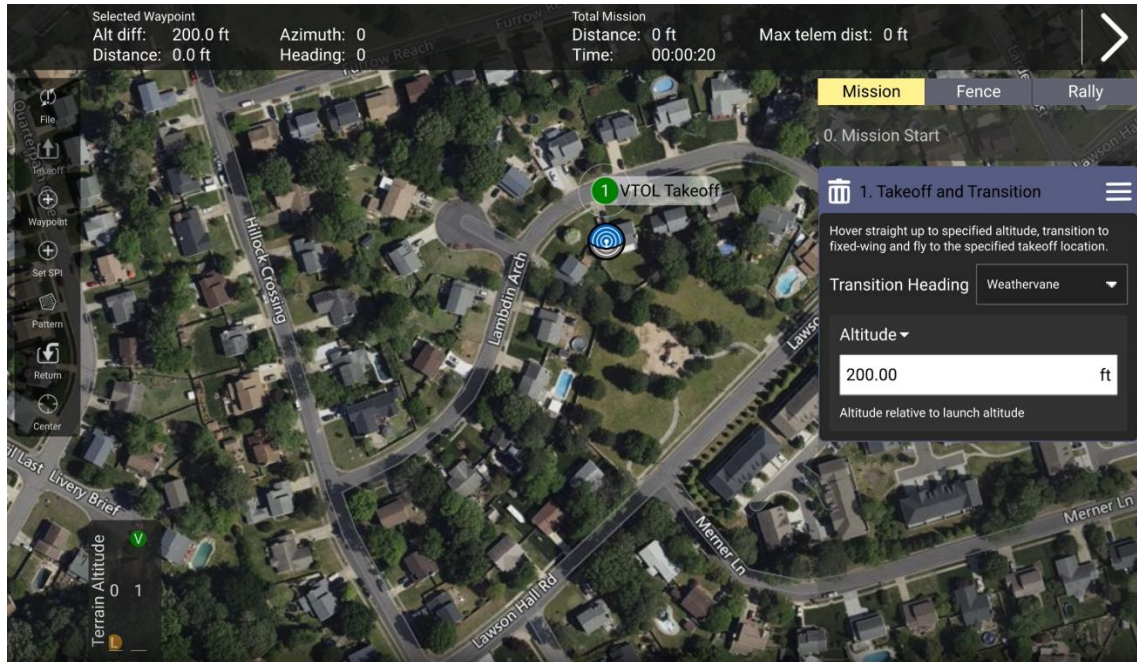


Figure 85 – Takeoff Location

1. **Select Takeoff Icon**
  - Tap the **Takeoff** icon located in the Actions Bar on the left side of the screen.
2. **Designate Takeoff Location**
  - Click on the map to select the approximate takeoff point.
  - Ensure the set altitude matches the intended operational altitude for the subsequent mission waypoints.
3. **Aircraft Behavior**
  - Upon initiating takeoff, the aircraft will automatically ascend to the specified altitude before beginning the waypoint navigation mission.

 **NOTE**

Verify that the takeoff location is free from obstacles and provides sufficient clearance for a safe ascent.

## Sensor Point of Interest (SPI):

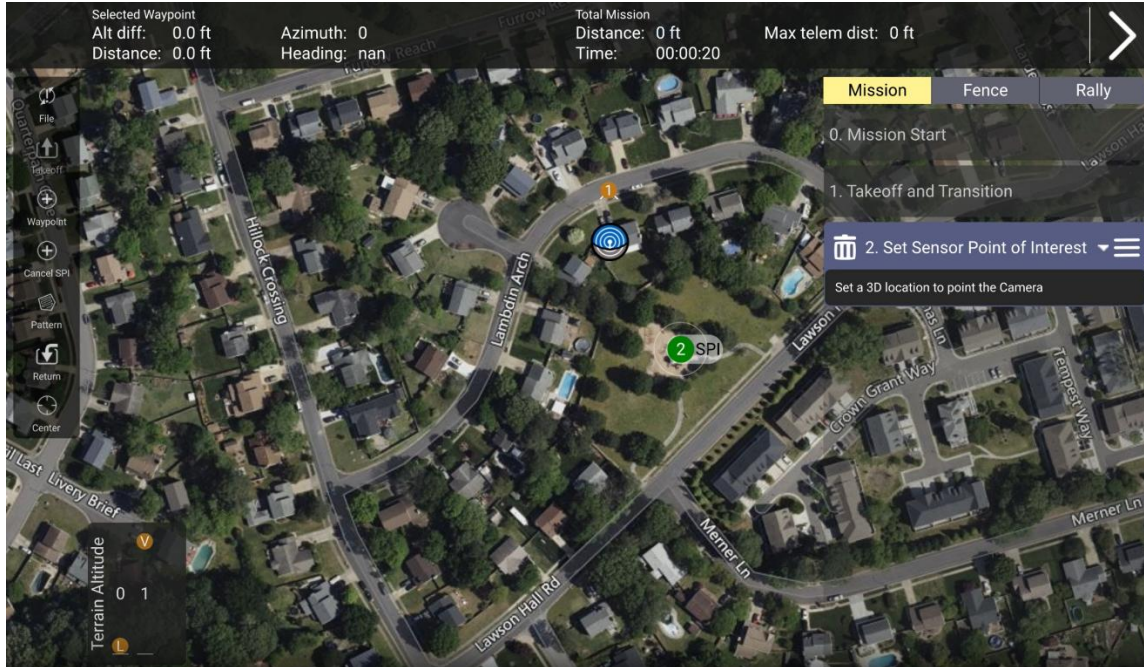


Figure 86 – Sensor Point of Interest (SPI)

Sensor Points of Interest (SPIs) allow the aircraft to focus its camera on a specific location during waypoint missions. **This feature applies only to the Overwatch Gimbal payload.**

### 1. Select the SPI Tool

- Tap the **Set SPI** icon in the Mission Planner interface.

### 2. Designate SPI Location

- Click on the map to select the approximate location for the SPI.
- The camera will orient and focus on this location as the aircraft passes through or navigates near the SPI.

#### **NOTE**

Ensure the SPI location is clear of obstacles and verify that the camera can safely capture the intended target.

## Waypoints:

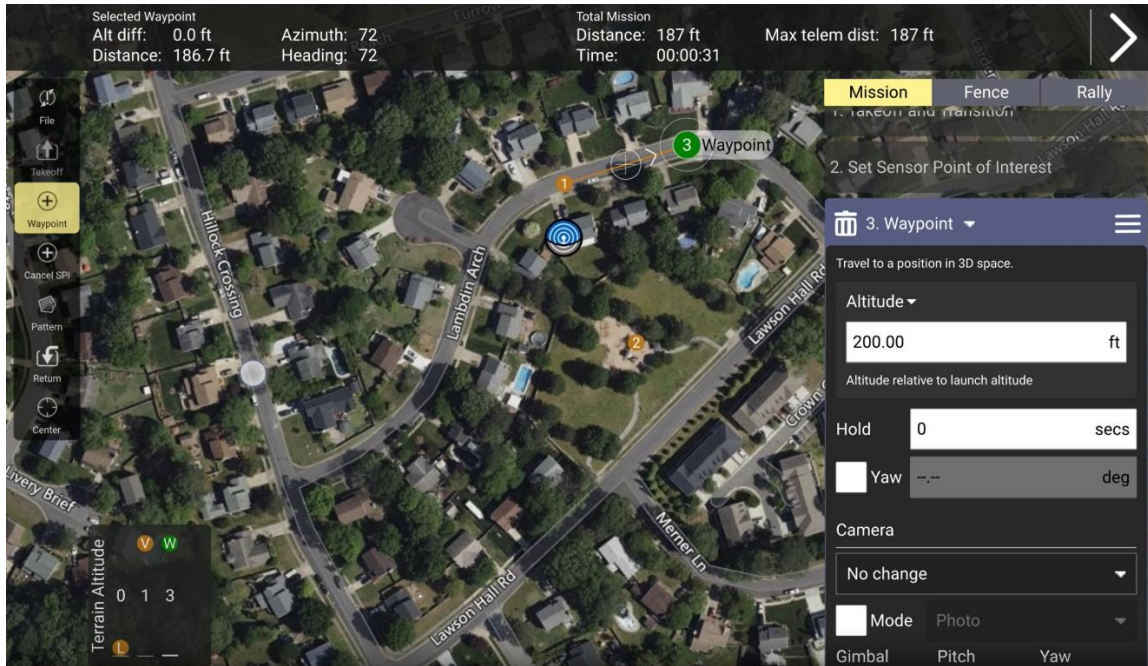


Figure 87 - Waypoints

Waypoints define the route for the aircraft during a waypoint navigation mission. Each waypoint can be configured with specific parameters, including altitude, hold time, and camera or gimbal actions, to accomplish mission objectives.

1. **Select the Waypoint Tool**
  - Tap the **Waypoint** icon in the Mission Planner interface.
2. **Add Waypoints**
  - Click on the map to designate the approximate location of each waypoint.
  - Configure optional parameters for each waypoint as needed (e.g., altitude, hover time, camera orientation).
3. **Repeat**
  - Continue adding waypoints until the full mission path is defined.

 **NOTE**

Verify that waypoints avoid obstacles and maintain safe distances from restricted areas or terrain features.

## Return to Launch (RTL):

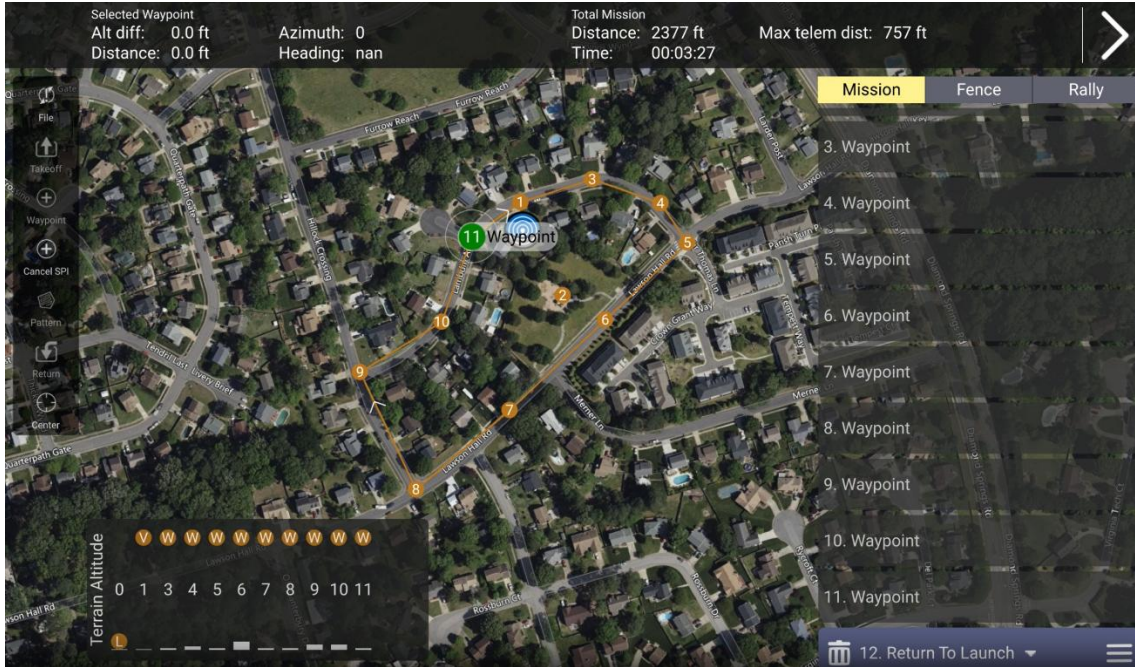


Figure 88 – Return to Launch (RTL)

The Return-to-Launch (RTL) command ensures the aircraft returns safely to its home location after completing the mission. Without an RTL or landing command, the aircraft will not return automatically.

### Procedure:

1. **Select the RTL Tool**
  - Tap the **Return** icon in the Mission Planner interface.
2. **Insert RTL Command**
  - Place the RTL command at the end of the mission plan.



### **BEST PRACTICE**

Always conclude the mission with a landing or RTL command to ensure safe recovery. Alternatively, the mission can be manually interrupted by selecting a different flight mode if needed.

## Save Waypoint Mission:

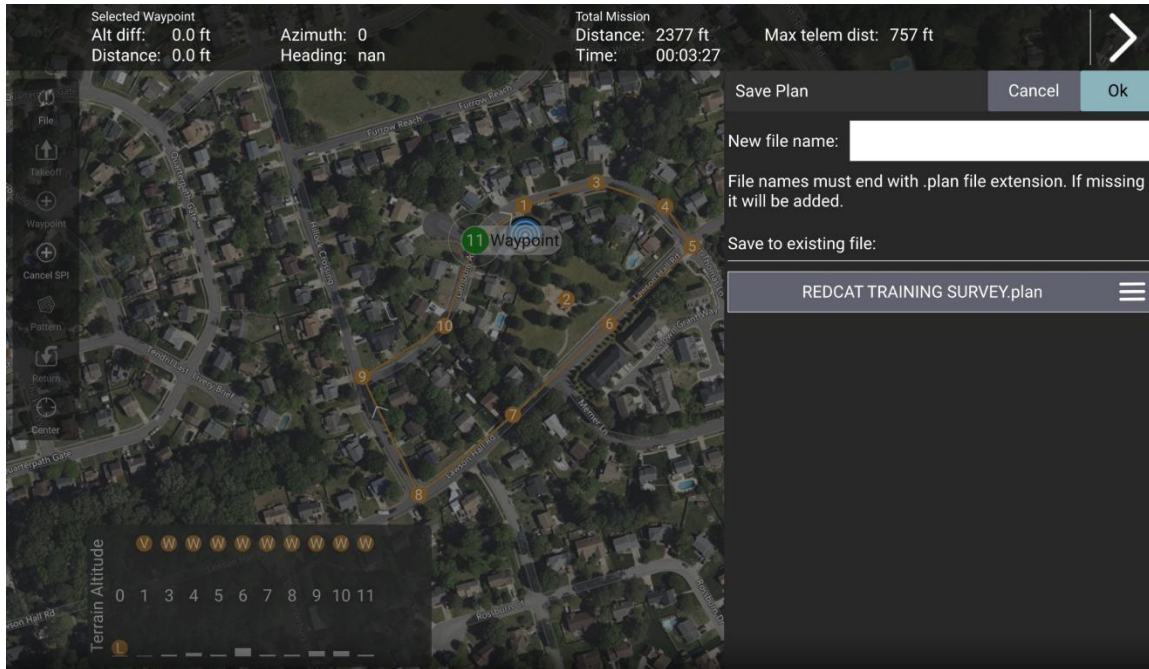


Figure 89 – Save Waypoint Mission

After completing all mission planning steps, the mission plan must be saved before it can be uploaded to the aircraft.

### Procedure:

1. **Open File Menu**
  - Select the **File** icon in the top-right corner of the Mission Planner screen.
2. **Save Mission**
  - Click **Save As**.
  - Enter a descriptive name for the mission file.
  - Select **OK** to confirm and save.

### **NOTE**

Saving the mission ensures that all waypoints, SPI commands, and Return-to-Launch settings are preserved for upload to the aircraft.

## Border Scans

### Border Scans (Corridor Scans) Introduction:

Border Scans, also referred to as Corridor Scans, are specialized missions used to survey linear features such as roads, fences, or perimeter boundaries.

#### Overview:

- Corridor Scan missions are created similarly to Waypoint Navigation missions.
- The primary difference is in the aircraft's behavior: during a Corridor Scan, the aircraft navigates along a defined route while performing automated image capture or sensor monitoring.
- These missions rely on GPS for accurate navigation and are ideal for surveying extended linear areas without leaving controlled airspace.



#### NOTE

As with other mission types, the aircraft must be powered on and connected to the Ground Control Station (GCS) to upload a Corridor Scan mission.

## Planning:

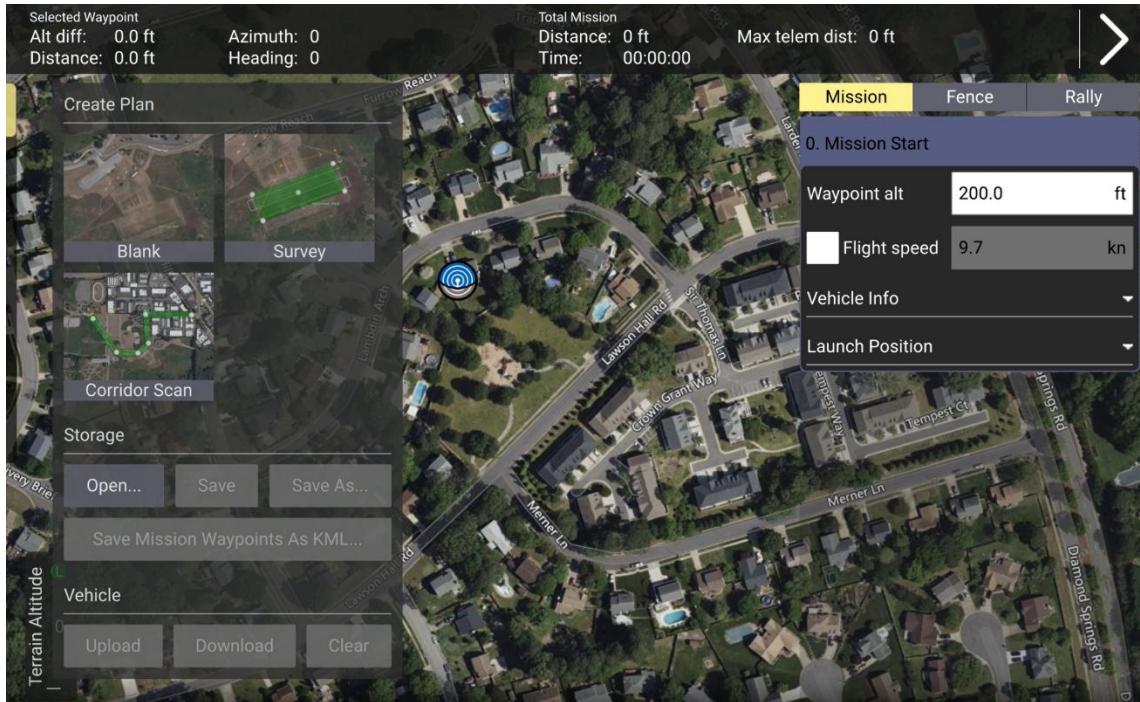


Figure 90 – Planning

### 1. Access Mission Planning:

Tap the **Plan** icon located in the Actions Bar on the left side of the screen.

### 2. Create Corridor Scan Mission:

Click the **Corridor Scans** icon to begin a new mission plan.

#### NOTE

Ensure the aircraft is powered on and connected to the GCS before creating the mission.

## Mission Start:

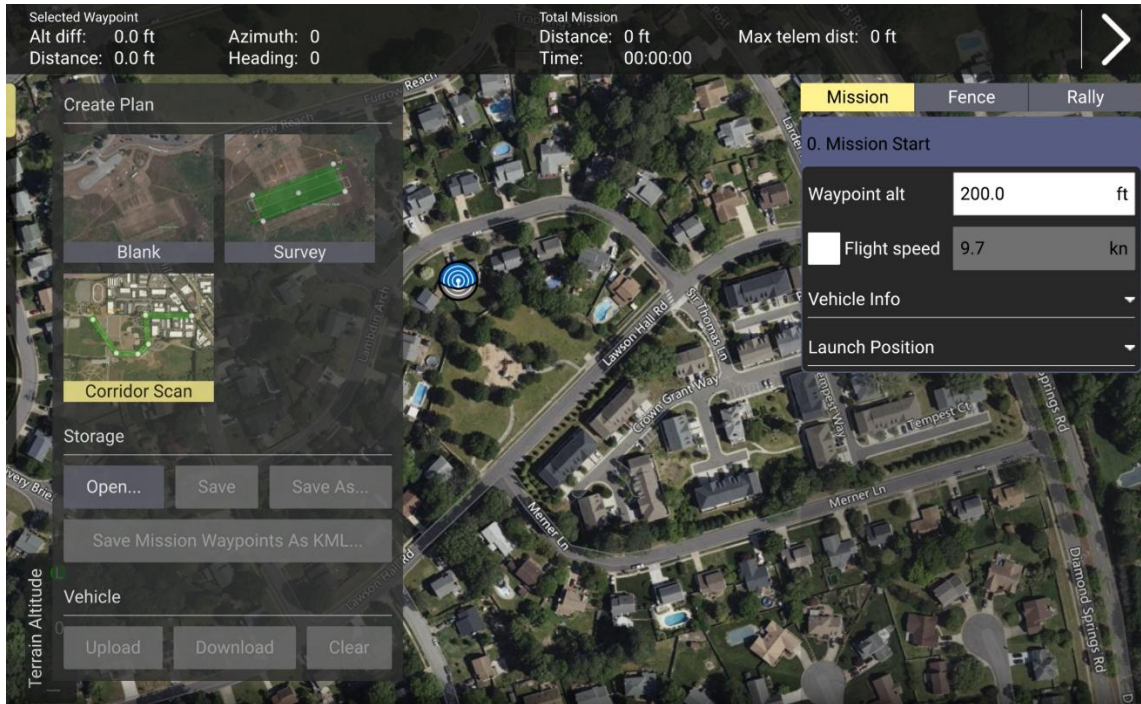


Figure 91 – Mission Start

### 1. Set Operational Altitude:

Define the desired altitude at which the Edge 130 will navigate during the Corridor Scan mission.

### 2. Configure Speeds (Optional):

Adjust cruise speed and hover speed as needed.



#### RECOMMENDATION

Maintain the default airspeeds, as they are optimized for safe and efficient flight performance.

## Takeoff and Transition:

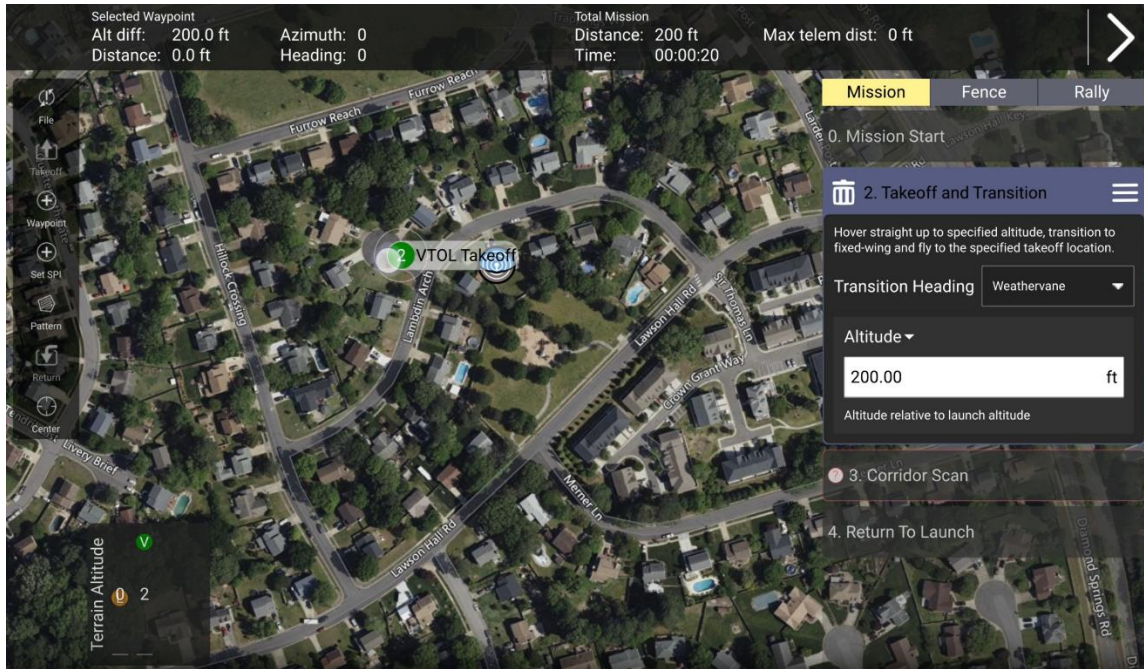


Figure 92 – Takeoff and Transition

### 1. Designate Takeoff Location:

Click on the map to set the approximate takeoff point for the mission.

### 2. Set Takeoff Altitude:

Ensure the altitude matches the planned altitude for the mission waypoints.

### 3. Initiate Takeoff:

Upon starting the mission, the Edge 130 will ascend to the specified altitude and prepare to follow the Corridor Scan route.

### NOTE

Confirm that the takeoff area is clear of obstacles and personnel for a safe ascent.

## Corridor Scan:

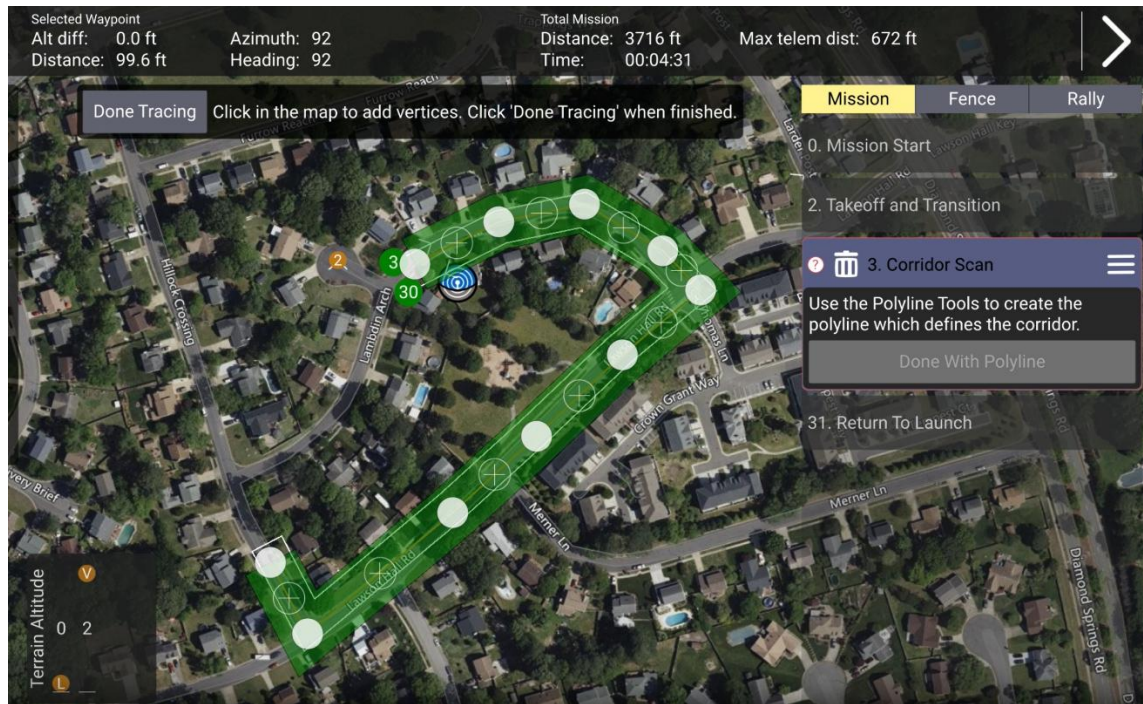


Figure 93 – Corridor Scan

### 1. Define Corridor Route:

Use the Polyline tools to create the desired corridor path for the scan mission.

### 2. Polyline Tool Options:

- **Basic Tool:** Creates a straight corridor path. Adjust the route by selecting the faint '+' symbol to add waypoints. Reposition these waypoints as needed to shape the corridor.
- **Trace Tool:** Allows the operator to click directly on the map to create a custom corridor path that precisely follows the desired route.

### 3. Finalize Corridor:

Once the corridor route is complete, select **Done With Polyline** to confirm.

#### NOTE

Ensure the corridor path is clear of obstacles and aligned with the mission objectives for optimal data collection.

## Corridor Scan Settings:

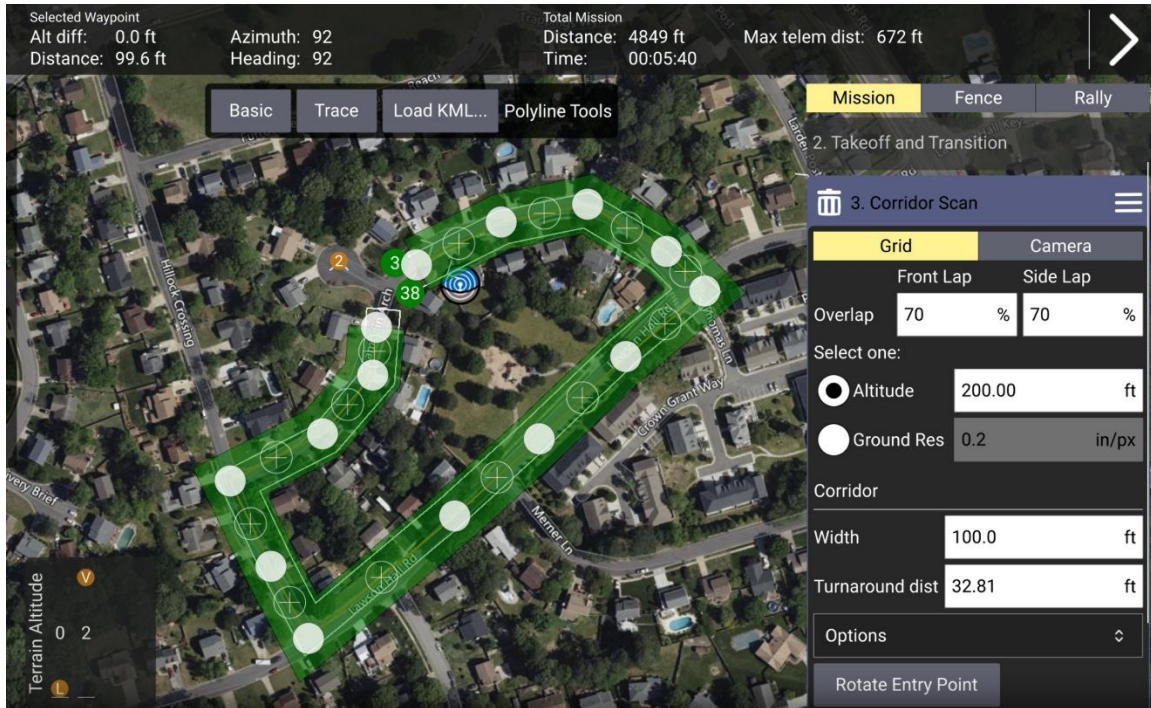


Figure 94 – Corridor Scan Settings

### Camera

- **Select Camera:** Choose the appropriate camera to be used for the corridor scan.

### Grid

- **Overlap:** Adjust image overlap to ensure high-quality, seamless imagery. Optimal overlap may vary depending on terrain and mission requirements.
- **Altitude:** Set the desired operational altitude for the mission.

### Corridor

- **Width:** Define the width of the corridor to be scanned.
- **Turnaround Distance:** Increase this value, particularly in windy conditions, to give the aircraft sufficient time to stabilize after a turn before capturing images.

- **Options:**

- Enable or disable image capture during turnarounds.
- **Relative Altitude** is always selected by default.
- **Rotate Entry Point:** Allows the operator to change the location where the aircraft begins the scan.

### Terrain

- **Above Terrain Mode:** Sets the flight altitude relative to terrain height at the selected location. Terrain heights are not sent to the vehicle; only the offset above ground level is applied.

### Statistics

- Displays key mission metrics, including:
  - Survey Area
  - Photo Count
  - Photo Interval
  - Trigger Distance



**NOTE**

Adjust overlap, corridor width, and turnaround distance based on wind conditions and terrain to ensure complete and stable image capture.

## Transition and Land:

- **Fly to Specified Location:** The aircraft will navigate to the designated landing point at its current altitude, transition to Multi-Rotor mode, and initiate landing.
- **Set Ground Altitude:** The operator can specify the approximate ground altitude for the landing location. This is typically set to **0 meters** when landing at the original launch site.
- **Adjust Landing Waypoint:** The landing waypoint can be repositioned by dragging it to the desired location directly on the interface map.

### NOTE

Verify that the landing location is clear of obstacles and hazards before initiating the transition to ensure a safe landing.

## Mission Information

- **Mission Summary:** At the top of the screen, the operator can view key mission metrics, including:
  - **Total Flight Distance:** The full distance the aircraft will travel during the corridor scan.
  - **Estimated Mission Time:** The approximate time required to complete the scan.

### NOTE

This information is critical for validating mission feasibility, ensuring sufficient battery life, and planning safe flight operations.

## Save Corridor Scan Mission:

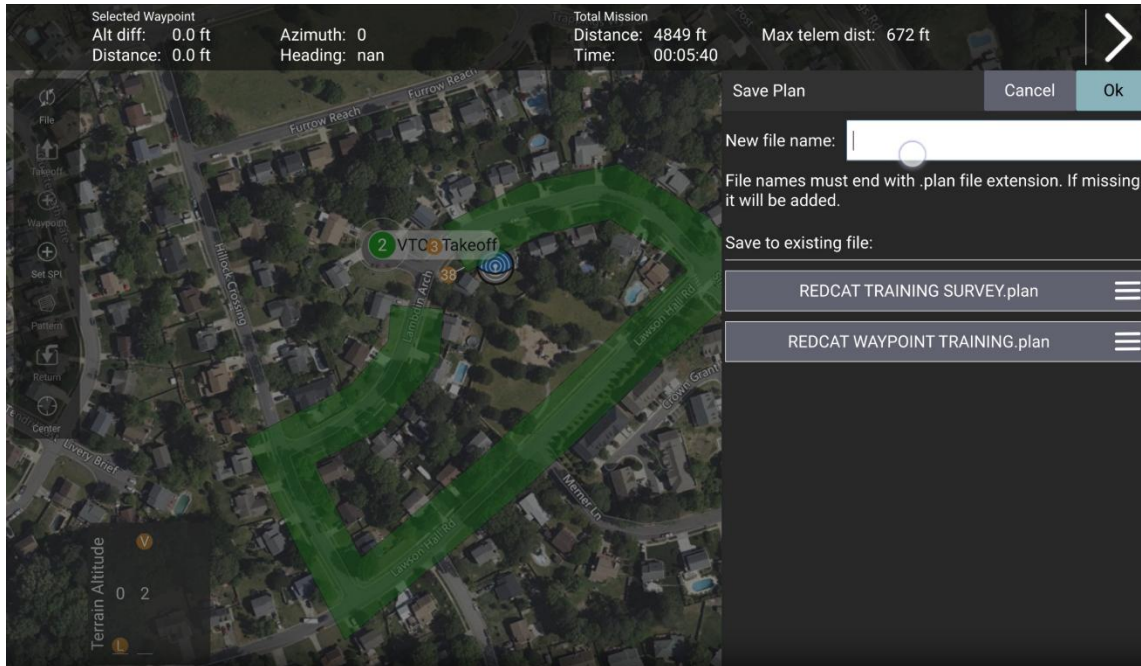


Figure 95 – Save Corridor Scan Mission

### Save the Mission Plan:

Once all necessary steps have been completed, the mission must be saved to allow upload to the aircraft.

#### Procedure:

1. Select the **File** icon in the top-right corner of the screen.
2. Click **Save As**.
3. Enter a descriptive name for the mission file.
4. Select **OK** to confirm and save.

 **NOTE**

Saving the mission ensures that all waypoints, settings, and configurations are preserved for execution by the Edge 130.

## Mapping Array Payload

---

This chapter outlines the functionality of the Mapping Array Payload

# Mapping Array Payload

## Overview

The **FlightWave Mapping Array Payload** is a high-precision imaging system designed for advanced survey, photogrammetry, and terrain mapping missions.

It integrates seamlessly with the **Edge 130** airframe and the **FlightWave Mission Planner** software to enable efficient data capture across large or complex survey areas.

The Mapping Array combines optimized optics, GPS time-stamping, and automated camera triggering accurate, high-resolution imagery suitable for both **2D orthomosaic** and **3D reconstruction** applications.

## Payload Description

The Mapping Array Payload is a modular, lightweight camera assembly engineered to maintain optimal performance under variable environmental and flight conditions.

Key design features include:

- **High-resolution image sensors** with calibrated lenses for distortion-free imaging.
- **Integrated GPS and IMU synchronization** for precise geotagging of every image.
- **Automated triggering** during survey or corridor missions based on predefined overlap and interval settings.
- **Vibration-isolated mount** to ensure sharp imagery even during transition or light turbulence.
- **Plug-and-play payload bay interface** for quick installation and removal.

## Installation and Setup

### 1. Inspect the Payload:

Verify that the Mapping Array lens, connectors, and mounting interface are free of dust, debris, or damage before installation.

### 2. Mount the Payload:

- a. Align the payload's mounting rail or quick-attach interface with the aircraft's payload bay.
- b. Slide and secure until a positive mechanical click is felt.
- c. Verify that all locking mechanisms are fully engaged.

### 3. Connect Data and Power:

- a. Attach the payload's multi-pin connector to the corresponding aircraft port.
- b. Ensure connectors are fully seated and secured.
- c. Avoid bending or twisting the cable assembly during installation.

### 4. System Recognition:

Power on the aircraft and Ground Control Station (GCS).

The FlightWave Mission Planner will automatically detect the Mapping Array and display its status in the **Payload Configuration** panel.

## Pre-Flight Configuration

### 1. Select the Camera:

Within **Survey Settings** or **Corridor Scan Settings**, choose

**“FlightWave Mapping Array Payload”** from the *Select Camera* dropdown.

### 2. Adjust Survey Parameters:

Configure the following for optimal data collection:

- a. **Altitude:** Defines ground sampling distance (GSD).
- b. **Overlap:** Adjust forward and side overlap (typically 70–80%) for image stitching accuracy.
- c. **Transect Angle and Width:** Align flight lines with terrain or area of interest for efficient coverage.

### 3. Trigger Settings:

The system automatically controls image capture using distance-based triggers defined by the *Photo Interval* and *Trigger Distance* in the **Survey Statistics** window.

### 4. Verify Camera Operation:

Use the **Test Capture** function in the Mission Planner to confirm that image capture, storage, and metadata logging are functioning correctly.

## Image Capture and Data Management

- **Automatic Capture:**

During a survey mission, the payload captures imagery at consistent intervals based on the selected mission parameters.
- **Storage:**

Images are stored on the onboard CFEXPRESS or designated solid-state drive. Ensure adequate storage capacity prior to flight.
- **Metadata:**

Each image is geotagged with GPS coordinates, altitude, and timestamp data. This metadata enables precise alignment during post-processing in mapping software such as Pix4D, Agisoft Metashape, or FlightWave Mapping Suite.
- **Data Offload:**

After flight, remove the storage device or connect via data cable to the GCS to transfer imagery.  
Maintain organized file structures by labeling each mission folder according to the mission's name and date.

## Maintenance and Care

To ensure continued performance and accuracy, follow these best practices:

1. **Lens Cleaning:**

Use only an approved microfiber cloth and optical cleaning solution. Avoid touching the lens directly.
2. **Firmware Updates:**

Periodically check for updates to the Mapping Array firmware via the FlightWave Support Portal. Install only verified firmware versions.
3. **Connector Care:**

Keep all data and power connectors covered when not in use. Inspect for bent pins or corrosion prior to each flight.
4. **Storage:**

When not in use, store the payload in a **temperature-controlled, dust-free** environment within its protective case.

#### 5. **Transport:**

Always use the original padded transport case to protect the payload from vibration and impact during shipment.

## Operational Recommendations

- Perform a **test capture** at the start of each mission to validate focus, exposure, and data logging.
- Avoid launching with condensation or debris on the lens.
- Use consistent **altitude and overlap settings** across survey areas to simplify post-processing.
- Maintain **direct line-of-sight** to the aircraft during mapping missions to ensure continuous telemetry and image trigger reliability.

## Post-Processing Workflow (Optional)

1. Transfer all captured images to a designated workstation.
2. Organize data by mission name and date.
3. Use preferred photogrammetry software (e.g., Pix4D, Agisoft Metashape) for map generation.
4. Apply ground control points (GCPs) if high precision georeferencing is required.
5. Review final outputs for image alignment and coverage consistency.

## Overwatch Gimbal Payload

---

This chapter outlines the functionality of the Overwatch Gimbal Payload

# Overwatch Gimbal Payload

## Overview

The **Overwatch Gimbal Payload** is a stabilized, multi-sensor imaging system engineered for precision observation, surveillance, and inspection missions.

It combines advanced electro-optical (EO) and infrared (IR) imaging with three-axis mechanical stabilization to deliver sharp, stable imagery in real time — even under demanding flight conditions.

Seamlessly integrated with the **Edge 130** and **FlightWave Mission Planner**, the Overwatch 2.0 provides both manual and automated control of pan, tilt, and zoom functions, as well as on-map targeting through **Sensor Points of Interest (SPIs)**.

## Payload Description

The Overwatch is a rugged, all-weather stabilized gimbal designed for both **daylight and low-light operations**. It enables operators to capture live imagery, perform reconnaissance, and conduct target tracking directly from the Ground Control Station (GCS).

### Key Features:

- **Dual-sensor system:** Integrated EO (visible light) and IR (thermal) cameras.
- **Three-axis stabilization:** Delivers steady imagery in high-wind or dynamic flight conditions.
- **Precision pointing:** Controlled manually or through SPI targeting.
- **Zoom and focus control:** Accessible directly through the GCS interface.
- **Onboard video recording:** Supports local storage for mission playback and analysis.
- **Plug-and-play payload integration:** Automatically detected by the aircraft upon connection.

## Installation and Setup

### 1. Inspect the Payload:

Ensure that the gimbal, connectors, and lens assemblies are clean and undamaged prior to installation.

### 2. Mount the Gimbal:

- a. Align the gimbal mount with the Edge 130 payload bay.
- b. Slide the assembly into place until you feel a positive mechanical lock.
- c. Verify that all latching mechanisms are fully engaged.

### 3. Connect Data and Power:

- a. Attach the gimbal's data/power connector to the designated payload port.
- b. Confirm a secure connection; do not force or twist the plug.

### 4. System Recognition:

Power on the aircraft and GCS.

The **FlightWave Mission Planner** will automatically detect the Overwatch 2.0 Payload and display the camera status on the *Payload Panel*.

## Gimbal Control Overview

The Overwatch can be operated via the **FlightWave Ground Station** interface or through the aircraft's control sticks (if configured).

### Manual Control:

- **Pan / Tilt:** Adjust the gimbal's orientation using the on-screen joystick or assigned control axes.
- **Zoom / Focus:** Controlled via on-screen sliders or mapped controller buttons.
- **Mode Switching:** Toggle between EO and IR views or use the *Fusion* display to blend both feeds.
- **Recenter:** The camera control stick includes a built-in re-center feature for rapid gimbal alignment. Pressing **straight down (joystick click)** instantly commands the gimbal to return to its default forward-facing, level orientation.

## Automated Control:

- **SPI (Sensor Point of Interest):**
  - Define an SPI location on the map.
  - The gimbal will automatically orient toward the specified coordinates, maintaining focus throughout the mission.
  - SPIs can be created during **Waypoint Missions** or **Manual Flight Operations**.

## Gimbal Operating Modes

**Compass Mode** – The gimbal aligns its visual heading with the aircraft’s heading, continuously tracking the aircraft’s orientation.

**Pilot Mode** – The gimbal locks to a fixed heading set by the pilot and maintains that direction regardless of aircraft movement.

**Coordinate Mode** – The gimbal holds its aim on the current ground point (lat/long) and automatically adjusts to stay focused on that location.

**SPI Mode** – The gimbal maintains continuous aim on a predefined coordinate (lat/long) specified by the operator in the ground control station.

## Payload Modes

The Overwatch supports multiple operational modes to suit diverse mission profiles:

Table 13 – Payload Modes

Mode	Description
<b>EO (Electro-Optical)</b>	High-resolution daylight imagery for detailed visual inspection.
<b>IR (Infrared)</b>	Thermal imaging for night operations or temperature-based detection.
<b>Fusion View</b>	Combines EO and IR feeds for enhanced situational awareness.
<b>Track Mode</b>	Automatically locks onto a defined target or SPI coordinate.
<b>Stow Mode</b>	Centers and locks the gimbal in a secure position for takeoff, landing, or transport.

## Image and Video Capture

- **Live Feed:** The video feed from the Overwatch appears on the GCS display during flight.

### NOTE

After powering on the aircraft or connecting a payload, the live video stream may take **up to 1 minute** to initialize and appear on the Ground Control Station. This delay is normal during payload boot-up and link establishment.

If no imagery appears after approximately one minute, **disconnect and reconnect the payload**, then verify that the payload latch and data connector are fully seated.

- **Recording:** Start and stop video recording via the GCS interface or controller command.
- **Capture Still Images:** Tap the camera icon to capture a still frame from the active video channel.
- **Storage:** All imagery and video data are saved locally on the payload's onboard storage or on the aircraft's central drive (depending on configuration).

## SPI (Sensor Point of Interest) Operations

1. **Set SPI:**

Select the *Set SPI* icon in the Mission Planner.

Click on the desired map location.

2. **Gimbal Response:**

The gimbal will automatically slew to the SPI coordinate and maintain orientation during flight.

3. **Waypoint Integration:**

SPIs can be embedded into **Waypoint Missions** to direct the gimbal automatically at specific points of interest during autonomous flight.

4. **Manual Override:**

The operator can regain manual gimbal control at any time by switching the gimbal mode out of SPI in the set of gimbal modes.

## Flat-Field Correction (FFC)

Over time, the thermal sensor may develop faint horizontal or vertical banding across the image. This is a normal effect caused by gradual thermal drift within the sensor array, resulting in slight non-uniformity.

Pressing the **FFC** button performs a *Flat-Field Correction*, recalibrating the sensor by normalizing its thermal response. This process removes banding artifacts and restores a clean, uniform thermal image.

### NOTE

For optimal calibration results, point the Overwatch payload at a **flat, uniform-temperature surface** with **no strong hot or cold spots** before performing FFC. High-contrast or irregular thermal patterns may lead to sub-optimal correction.

## Thermal Display Modes

The Overwatch thermal camera supports **nine distinct display modes**, each providing a different color palette and contrast mapping to highlight temperature differences. These modes allow operators to tailor the thermal view for various environments and mission needs, improving:

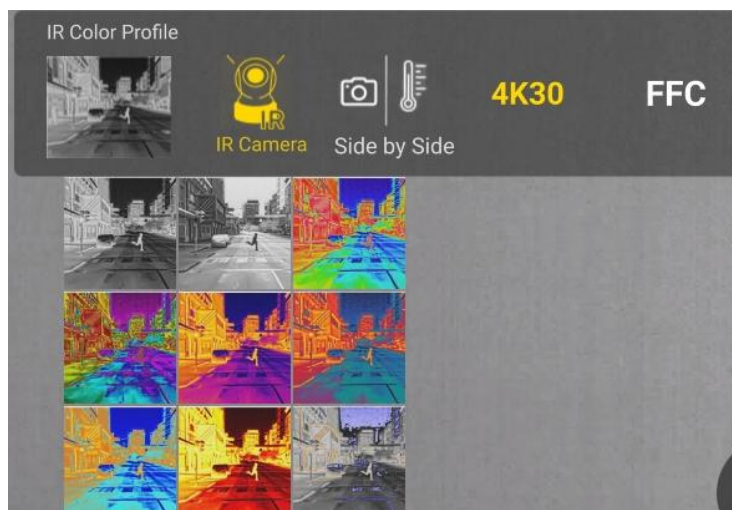


Figure 96 – IR Color Profiles

- Target detection
- Scene interpretation
- Heat signature contrast
- Situational awareness

Operators can switch between the thermal modes at any time using the **Camera Settings toolbar** within the GCS. Selecting the mode that provides the clearest representation of the current environment is recommended, especially when transitioning between daylight, nighttime, or mixed-thermal scene

Operators may also view a dual Thermal/Camera View by pressing the **Side by Side** Button.

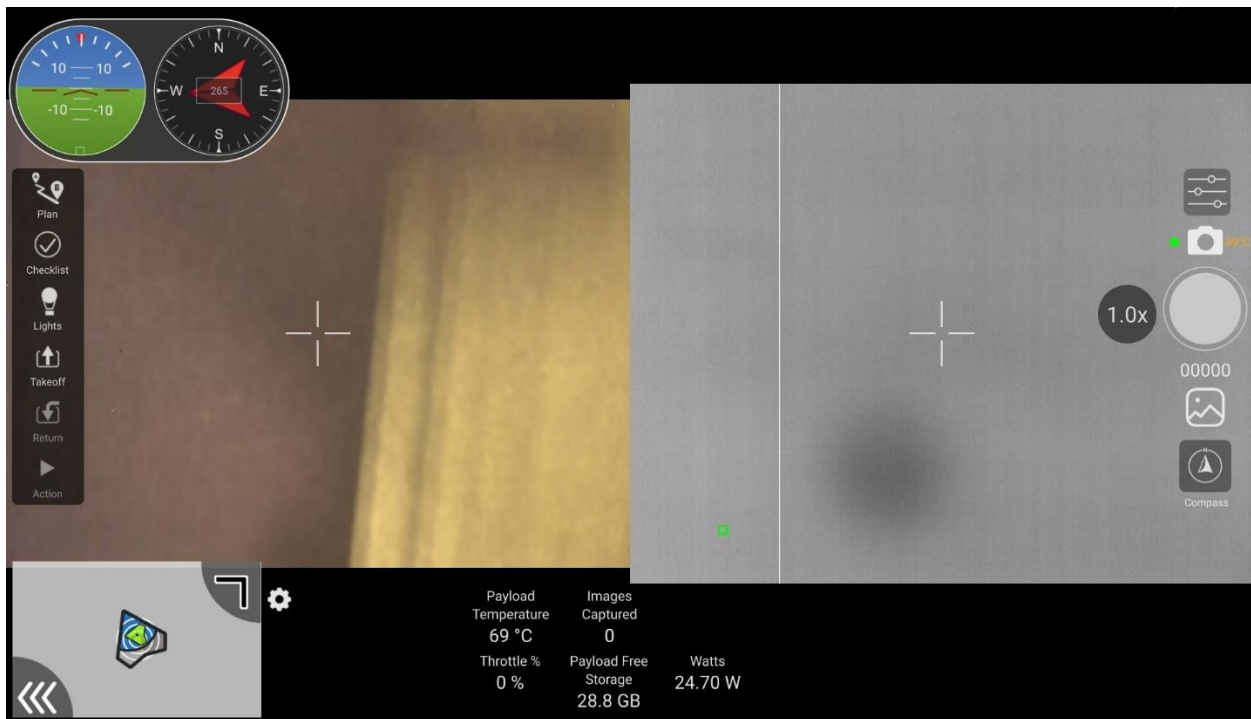


Figure 97 – Side by Side View

## Maintenance and Care

To maintain optimal performance and imaging quality:

### 1. Lens Cleaning:

- a. Use only approved optical cleaning materials.
- b. Avoid touching the lens directly.
- c. Remove dust using compressed air or a soft lens brush.

### 2. Mechanical Inspection:

- a. Inspect the gimbal for secure mounting and free motion before each flight.
- b. Verify all axes move smoothly and without obstruction.

### 3. Firmware Updates:

- a. Check for firmware updates through the FlightWave Support Portal.
- b. Install updates only when aircraft power is disconnected.

### 4. Transport and Storage:

- a. Always stow the gimbal in its transport-safe mode.
- b. Use the provided padded case during transport.
- c. Store in a clean, dry environment between 40°F–85°F (5°C–30°C).

## Operational Recommendations

- Perform a **Gimbal Initialization Check** before each mission.
  - Ensure the SD Card is **properly inserted**.
  - After the Overwatch payload powers on, visually confirm that **each axis of the gimbal has completed its homing sequence**. All stages—pan, tilt, and roll—should settle into their neutral, centered positions without excessive vibration, oscillation, or drifting.
  - If any axis fails to home or appears unresponsive, power-cycle the aircraft and ensure the payload is fully seated and latched before attempting flight.
- Avoid rapid yaw movements during flight to maintain stable imagery.
- Use **SPI Targeting** for precision observation instead of manual aim during high-speed or long-range missions.
- Keep the gimbal in **Stow Mode** during takeoff, landing, or transport to prevent mechanical stress.
- Regularly verify both **EO and IR lens clarity** prior to launch.

## Firmware Update Procedure

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This chapter outlines the procedure to perform Firmware updates on the Edge 130 sUAS and GCS.

# Firmware Update Procedure

## Offline Firmware Update Guide

The following steps will outline the procedure to install the firmware update file from the FlightWave Customer Support Team.

- The SD Card provided will be used to transfer the firmware package to your device.

### Step 1

- Detach the Payload Device, and take out its SD Card.



*Figure 98 – Overwatch SD Card*

## Step 2

- Connect the payload device SD card to your computer via the provided SD card reader.



Figure 99 – SD Card Input to Card Reader

## Step 3

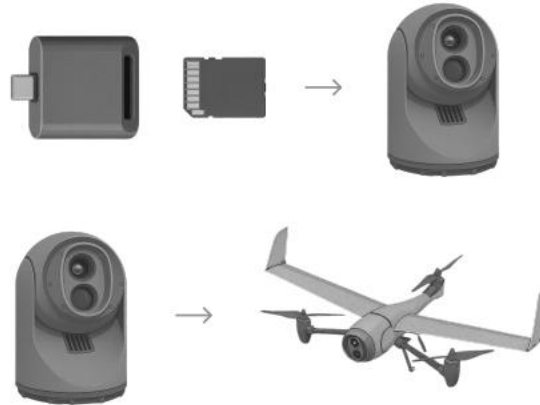
- Copy the new firmware file (provided by our Customer Support team) into the following **SD card folder** location:
  - lib > myota > uploads



Figure 100 – Transfer Files to SD Card

## Step 4

- Disconnect the SD card from your computer.
- Re-insert the SD card into the payload device
- Reconnect the payload to the fuselage.



*Figure 101 – Insert SD Card and Attach Payload*

## Step 5

- Reconnect the payload to the fuselage.
- Launch the Command Deck application.
- Navigate to **Settings** → **Vehicle Summary** → **Firmware Update**.
- Select the subsystem to flash:
  - *Air Vehicle Firmware*
  - *Payload Firmware*
  - *Companion/Radio Firmware*
- The system will validate compatibility and initiate updates.
  - Wait for confirmation banner: **"Firmware Update Complete."**



### **IMPORTANT – Flash Chronology**

Flash ***each subsystem sequentially*** — do not disconnect power until the completion banner is displayed.

## Maintenance & Repairs

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This chapter outlines the maintenance and repair instructions for both the Edge 130 sUAS and GCS

# Maintenance & Repairs

## Edge 130 Scheduled Maintenance Cycle

This section provides a field-ready preventive maintenance guide for the Edge 130 VTOL aircraft. Adhering to the recommended maintenance schedule ensures optimal performance, operational safety, and longevity of the Edge 130 system components, including batteries, propellers, and motor arms. Maintenance intervals are based on flight hours, operational conditions, and battery cycles.

### 1 Battery Maintenance Cycle:

**Edge 130 Battery:** 86.4 WH, 6.0 AH, 14.8V Li-Ion Battery Pack

*Table 14 – Battery Maintenance Cycle*

Interval	Maintenance Task	Notes
Before Each Flight	Inspect battery for swelling, physical damage, or overheating	Replace immediately if any abnormalities are observed
After 150 Charge Cycles	Replace battery	Ensures flight time is maximized and prevents degraded performance

## 2 Propeller Maintenance Cycle

### Edge 130 Propellers: Front & Rear Composite Propellers

*Table 15 – Propeller Maintenance Cycle*

Interval	Maintenance Task	Notes
Before Each Flight	Inspect for cracks, chips, or imbalance	Replace any propeller showing visible damage
Every 25 Flight Hours	Torque check on propeller mounting bolts	Torque to 20 in-lbs; prevents loosening due to vibration
Every 100 Flight Hours or 12 Months	Replace propellers	Prevents performance degradation and ensures operational safety

### 3 Motor Arm Maintenance Cycle

#### Edge 130 Motor Arms: Replacement L&R Tilt Pod Arms & Motors

Table 16 – Motor Arm Maintenance Cycle

Interval	Maintenance Task	Notes
Before Each Flight	Inspect for cracks, looseness, or unusual vibrations	Ensure all mounting bolts are properly secured. Replace damaged components as necessary
After Each Takeoff (Before Transition Altitude)	Observe arms for 10 seconds during hover	Look for excessive high-amplitude vibrations; minor vibrations are normal. Apply brief forward/reverse stick inputs during this check
Every 100 Flight Hours or 6 Months	Structural inspection	Check for micro-fractures, stress wear, or signs of fatigue
Every 300 Flight Hours	Replace motor arms	Maintains operational reliability and reduces risk of failure during flight

 **NOTE**

Preventive maintenance should be documented in a logbook or digital record to track component usage, flight hours, and replacement history. Consistent adherence to this schedule supports safe, reliable VTOL operations for the Edge 130.

## Edge 130 Aircraft Cleaning (Post-Flight)

Perform after operations in:

- Dusty environment
- Sand
- Salt air
- Rain/high humidity
- Vegetation/debris contact

### Procedure:

- Power off aircraft and remove battery
- Use small compressed air blower (do not exceed 40 PSI)
- Brush dirt from:
  - Motor housings
  - Arm joints
  - Wing joints
  - Payload bay
- Wipe fuselage with **damp microfiber cloth**
- Ensure no standing moisture remains before storage



#### NOTE

Never use solvents, alcohol, gasoline, or detergents

## Overwatch Payload Maintenance

### Lens & Housing:

- Use microfiber cloth only
- Avoid direct lens contact with fingers
- Inspect for scratches or moisture

### Gimbal Movement:

- Verify smooth motion on all axes
- Check for stutter, resistance, or vibration

### FFC Calibration (Thermal)

Perform when:

- Banding appears
- Temperature environments change
- After startup warmup

### Procedure:

- Aim camera at flat surface
- Press FFC button in GCS
- Allow calibration to complete

## Mapping Array Maintenance

- Inspect lenses for debris
- Clean with microfiber cloth
- Ensure CFExpress card is fully seated
- Inspect housing for cracking or warping
- Confirm latch ring integrity

## Edge 130 Air Vehicle Repairs

### Tightening Wing Joint Screws:

If the wing joint feels loose during pre-flight inspection, the wing latch screw may require adjustment. Follow these procedures carefully:

1. Power down the aircraft and completely remove the battery.
2. Remove the wing from the fuselage.
3. Using a T8 hex-key wrench, tighten the wing latch screw **incrementally by ¼ turn**.
4. Reinstall the wing and fully close the latch. Inspect the tightness of the wing joint.
5. Repeat this procedure as necessary until:
  - The wing joint feels properly stiff
  - The latch closes fully without resistance.



#### NOTE

Do not overtighten. If the latch does not fully close or the wing joint stiffness does not improve, **contact FlightWave support for assistance**.

## Tightening Arm Latch Screws:

If the motor arm feels loose during pre-flight inspection, the arm latch screw may require adjustment. Follow the procedures below:

1. Power down the aircraft and completely remove the battery.
2. Remove the motor arm from the fuselage.
3. Using a T6 hex-key wrench, tighten the arm latch screw **incrementally by ¼ turn**.
4. Reinstall the motor arm and fully close the latch. Inspect the tightness of the motor arm and the latch.
5. Repeat this procedure as necessary until:
  - The motor arm feels properly stiff, and
  - The latch closes fully without resistance.

## Replacing the Propeller:

### **WARNING – Propeller Advisory**

Do **not** attempt to unscrew propellers unless you intend to fully remove them. Propellers are secured to the motors with an anti-slip lock nut. Loosening this nut improperly may cause the propeller to unscrew during flight, creating a severe safety hazard.

If a propeller is found to be damaged during pre-flight inspection, follow the procedure below:

1. Power down the aircraft and completely remove the battery.
2. Remove the propeller nut cover.
3. Remove the propeller self-locking nut from the motor using an 8 mm hex wrench.
4. Discard the damaged propeller.
5. Verify that the replacement propeller matches the propeller being removed, then install the new propeller.

**IMPORTANT**

“Match” refers to *both* the propeller **type** and its **rotation direction**.

The Edge 130 uses left-hand (counter-clockwise) and right-hand (clockwise) propellers.

Even if a propeller appears similar—such as having the same size or being installed on a front or rear motor—it must also match the **correct rotation orientation** for that motor arm. Installing a propeller with the wrong rotation direction will result in loss of lift and unsafe flight behavior.

6. Verify the following before installation:
7. **Same size** (front vs. rear size if applicable)
8. **Same rotation direction** (Left/CW or Right/CCW, as marked)
9. **Same hub style and mounting interface**
10. Only after confirming all three attributes should the replacement propeller be installed.
11. Install the self-locking nut.
12. Lightly tighten the nut with the 8 mm hex wrench.
13. Using an 8 mm torque wrench, tighten the nut to **20 in-lbs**.
14. Reinstall the nut cover.

**NOTE**

When reinstalling the nut cover, ensure it is tightened **by hand only**. The cover should sit **flush with the lock nut** and should not require the use of tools.

Do **not** overtighten using an 11 mm hex wrench. Doing so may cause the nut cover to bind, making future removal difficult and potentially damaging the cover or the propeller hub.

## Replacing the Landing Leg:

If a landing leg is damaged or broken, follow the procedure below to replace it:

1. Power down the aircraft and completely remove the battery.
2. Remove the corresponding motor arm from the fuselage.
3. Drill a small pilot hole into the broken landing leg.
4. Insert a self-tapping screw into the hole to create a grip point.
5. Use a pair of pliers to carefully remove the broken landing leg.
6. Clean the leg socket, removing any debris, glue, or residue.
7. Slide the replacement landing leg into the socket.
8. **Optional:** The landing leg should fit securely without adhesive. If the leg feels loose, apply a minimal amount of suitable glue to ensure a snug fit.

 **NOTE**

Ensure that the landing leg is fully seated and stable before reassembling the motor arm and powering on the aircraft. Improper installation may compromise takeoff, landing, and overall flight safety.

## Firmware & Software Maintenance

- Check FlightWave Settings App regularly
- Update:
  - Air Vehicle firmware
  - Companion computer
  - Payload firmware
- Perform updates with:
  - Battery > 50%
  - Aircraft stationary
  - No environmental vibration



### CAUTION

**Never** power off during update process.

## Storage & Transport Requirements

Table 17 – Storage & Transport Requirements

Condition	Requirement
<b>Humidity</b>	< 70%
<b>Temperature</b>	5 °C – 30 °C (40 °F – 85 °F)
<b>Battery storage</b>	40–60% charge
<b>Transportation</b>	Use original hard case only
<b>Gimbal</b>	Must be in stow mode



### CAUTION

**Never** store assembled in extreme heat or direct sunlight.

## Special Maintenance Conditions

Table 18 – Special Maintenance Conditions

Environment	Action Required
<b>Sand / Desert</b>	Daily inspection + compressed air cleaning
<b>Marine</b>	Thorough drying + corrosion check
<b>Cold (&lt;20 °F)</b>	Warm battery before use
<b>High Heat (&gt;110 °F)</b>	Reduce flight time + check temps

## Troubleshooting

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This chapter outlines the procedures for troubleshooting the Edge 130 sUAS Air Vehicle and GCS

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## Troubleshooting — Edge 130 sUAS & GCS

### Purpose

This section provides structured, step-by-step guidance for diagnosing and correcting common (and advanced) issues with the **Edge 130 Air Vehicle (AV)**, **Ground Control Station (GCS)**, and connected **payloads** (Overwatch / Mapping Array). Its objectives are to:

- Rapidly restore operational capability
- Prevent repeat failures
- Improve flight safety
- Reduce downtime and unnecessary part replacement

### How to Use This Section

1. Identify the symptom category (power, link, GPS, stability, payload, environmental, etc.).
2. Follow the causes in top-to-bottom order (most common → least common).
3. Apply corrective actions **in sequence**.
4. If unresolved after full sequence, stop operations and escalate with logs.

## Power & Connectivity Issues

### Symptom:

Aircraft fails to power on or connect to the GCS.

### Likely Causes

- Battery not properly seated or below safe voltage
- Corrosion or debris on terminals
- Damaged power or data connector
- RF interference near takeoff site
- GCS radio switch disabled

### Corrective Procedure

1. Remove and reseal the battery firmly until the latch clicks.
2. Inspect battery for swelling, heat damage, or fluid leaking.
3. Check connectors for dust, corrosion, bent pins, or foreign material.
4. Power-cycle the aircraft and GCS completely.
5. Move at least 30 ft from buildings, vehicles, or antenna towers.
6. Verify the **GCS Radio Switch** is ON (indicator illuminated).
7. If still no link, substitute with a known-good battery.

## Telemetry or Communication Drop

### Symptom:

Telemetry freezes, drops, or displays “No Link”.

### Possible Causes

- Obstruction between antennas
- Operating outside effective range
- Antenna misalignment
- RF congestion
- EMI from nearby electronics

### Corrective Procedure

1. Inspect both AV and GCS antennas for correct upright orientation.
2. Verify line-of-sight (no trees, poles, hills, or buildings blocking signal).
3. Relocate GCS to an elevated position.
4. Reduce distance between AV and controller.
5. If link is not restored in 10 seconds, the AV automatically engages **Return To Launch (RTL)** per fail-safe protocol.
6. After landing, download telemetry logs for analysis.

## GPS / Positioning Errors

### **Symptom:**

Drifting, poor navigation accuracy, or unstable hover.

### **Cause Indicators**

- Less than 10 satellites
- HDOP > 1.0
- Nearby metal or RF sources

### **Corrective Actions**

1. Wait for satellite count to reach  $\geq 10$  before arming.
2. Relocate aircraft 20–30 ft away from vehicles or buildings.
3. Restart GPS initialization.
4. Confirm GPS antenna is not shielded or damaged.
5. Do not launch until stable position lock is confirmed.

## Payload / Camera / Gimbal Failure

### Symptom:

No video stream, jerky image, frozen picture, or non-responsive gimbal.

### Possible Causes

- Payload not seated
- Gimbal not homed
- SD card missing
- Overheating
- Firmware mismatch

### Corrective Actions

1. Remove payload and reinsert until latch fully locks.
2. Confirm SD card is installed and securely inserted.
3. Restart aircraft and check gimbal's homing sequence.
4. Perform **Flat Field Calibration (FFC)** on Overwatch:
  - Aim at flat surface
  - Press FFC
5. Update payload firmware if needed.
6. Replace with backup payload for confirmation.

## Sensor or Calibration Errors

### Symptom:

“Sensor Error” or misaligned mapping data.

### Resolving Steps

1. Perform full power-cycle of AV and GCS.
2. Confirm correct payload detected in Mission Planner.
3. Validate firmware compatibility.
4. Redo calibration on mapping array.

**If persistent**, isolate payload and perform dry test (bench).

## **Flight Instability / Excessive Vibration**

### **Symptom:**

Shaking, drifting, oscillation, high current draw.

### **Causes**

- Damaged propeller
- Loose motor arm
- Structural fatigue
- Imbalanced payload

### **Corrective Actions**

1. Replace any chipped or warped propellers.
2. Torque propeller bolts to 20 in-lbs.
3. Inspect motor arms for micro fractures.
4. Replace arms at 300 flight hours life limit.
5. Verify payload mount tightness.

## Overheating Conditions

### High-Temperature Limitations

- Do not fly in temps above **118°F / 48°C**
- Avoid prolonged sun exposure
- Keep aircraft in shade

### Battery Overheat

- Let cool to ambient before recharging
- Store away from direct heat

## Cold Temperature Failures

### Symptoms

- Low power
- Sudden drop in voltage
- Sluggish response

### Resolution

1. Pre-warm battery to **68°F / 20°C**
2. Idle aircraft for 5 minutes prior to launch.
3. Land early due to reduced capacity.

## Wind-Related Handling Issues

### Symptom:

Difficulty landing or holding position in gusts.

### Resolution

- Perform **manual landing** in MR mode
- Overfly pad, descend while drifting backward

## Emergency Recovery

*Table 19 – Emergency Recovery*

Event	Action
<b>Loss of control</b>	Engage RTL
<b>Severe vibration</b>	Land immediately
<b>Battery warning</b>	Return & land
<b>Overheat</b>	Power down & cool

### After emergency:

- Pull diagnostic logs
- Do NOT relaunch until root cause identified

## Log Retrieval for Analysis

Downloading logs is critical for deeper troubleshooting.

### Steps

1. GCS → Settings → Log Download
2. Select category
3. Save or export via USB-C
4. Clear aircraft log memory periodically

### Includes:

- Flight Controller Logs
- Telemetry Logs
- Payload Logs
- Event Logs

## Damaged Battery Procedures (Hazmat Safety)

Lithium-ion batteries used in the FlightWave system must be handled with extreme care, especially if they become damaged, overheated, punctured, swollen, or are otherwise suspected of being unsafe. A damaged battery can rapidly transition into a hazardous state, including thermal runaway, fire, toxic vapor release, or explosive venting. This section outlines the procedures operators must follow to identify, isolate, and safely manage damaged or compromised batteries.

**These procedures are mandatory for all operators and maintenance personnel.**

### Recognizing a Damaged or Unsafe Battery

A battery is considered **damaged** or **unsafe** if any of the following conditions are present:

- Visible dents, punctures, cracks, or deformation of the casing
- Swelling or bulging
- Signs of leakage or residue near terminals or casing
- Overheating, unusual warmth while idle, or hot spots
- Strong chemical smell, metallic odor, or unusual vapors
- Audible popping, hissing, or crackling sounds
- Burn marks, charring, or melted plastic
- Battery fails to charge or drains unusually fast
- A battery involved in a crash or exposed to impact forces

**Assume a damaged battery is hazardous until proven otherwise.**

## Immediate Response to a Suspected Damaged Battery

If you suspect a battery is damaged:

1. **Stop using the battery immediately.**
2. **Power off the aircraft or device** if safe to do so.
3. **Do not attempt to charge** the suspected battery.
4. **Do not attempt to remove the battery** if swelling or heat makes it difficult to handle—allow it to cool before touching.
5. **Move personnel away** from the area if the battery is smoking, hissing, or rapidly overheating.

 **WARNING – Battery Damage**

Never puncture, crush, or expose a damaged battery to water.

If the battery appears stable but unsafe, proceed to isolation procedures.

## Safe Handling and Isolation Procedures

A damaged or compromised battery must be **isolated** to prevent escalation.

### Safe Handling

- Wear **PPE** (gloves, eye protection) when handling a damaged battery.
- Hold the battery only by non-deformed edges.
- Avoid applying pressure to swollen or punctured areas.
- Keep the battery away from:
  - Heat sources
  - Open flames
  - Sparks or metal tools
  - Direct sunlight

### Isolation Container

Place the battery in one of the following:

- **Li-ion fire containment bag** (preferred)
- **Metal fire-rated container** with a nonflammable lining (e.g., sand, ceramic insulation)
- **Sand-filled bucket** or **dry storage container** specifically designated for damaged batteries

After placing the battery inside the container:

- Keep the container at least **15 ft (5 m)** away from people, structures, and flammable materials.
- Do not seal the container air-tight; venting may be necessary during thermal events.

## Cooling and Observation

Allow the battery to:

- Sit in isolation for **at least 2 hours** before further handling
- Fully cool to ambient temperature
- Be monitored for signs of thermal activity (smoke, heat, odor)

**If the battery reignites or vents, evacuate the area and contact emergency services if required.**

## Emergency Procedures (Thermal Runaway or Fire)

If the battery enters thermal runaway or catches fire:

1. **Do NOT use water.** Lithium-ion fires react violently with water.
2. Use a **Class D fire extinguisher** (if available) or a **dry chemical extinguisher** rated for lithium-ion fires.
3. If an extinguisher is not available:
  - Evacuate the area
  - Allow the battery to burn out while ensuring safe distance
4. Ventilate the area after the event; lithium-ion fires can release toxic gases.
5. Notify organizational safety personnel and FlightWave Support.



### SAFETY NOTE

Burning lithium-ion batteries can reignite multiple times due to trapped thermal pockets.

## Storage and Transport of Damaged Batteries

Damaged batteries must **not** be transported with operational equipment or stored in normal battery cabinets.

Follow these guidelines:

- Store only in a **designated hazmat battery isolation area**.
- Do not store damaged batteries indoors unless required by facility safety policy.
- Transport only in:
  - A fire-rated metal container, **clearly labeled DAMAGED Li-ion Battery – HAZMAT**
  - A non-passenger vehicle compartment

Follow all applicable transportation regulations (FAA, DOT, ICAO, or local equivalents).

**Never ship a damaged battery using standard mail or courier methods.**

## Disposal of Damaged Batteries

Damaged lithium-ion batteries must be disposed of through an approved **hazardous materials disposal facility**.

Steps for disposal:

1. Contact your organization's environmental health & safety (EHS) office or equivalent.
2. Transport the battery in an approved hazmat container.
3. Provide:
  - Battery serial number (if available)
  - Description of damage
  - Details of any thermal or electrical events

**Do not** dispose of batteries in standard waste streams.

## Preventing Battery Damage

Proper handling reduces the likelihood of damage:

- Avoid dropping or striking batteries.
- Keep batteries within recommended temperature limits during operation and charging.
- Do not store batteries fully discharged or fully charged for long periods.
- Inspect batteries before every mission.
- Only use approved chargers and power sources.
- Replace batteries that consistently show reduced capacity or irregular behavior.

## Documentation and Reporting

Whenever a battery is damaged:

- Record the incident in the maintenance log.
- Document:
  - Battery serial number
  - Nature of the damage
  - Whether thermal events occurred
  - Steps taken to isolate and handle the battery
- Inform FlightWave Support if:
  - The incident occurred during flight
  - Damage appears to be related to manufacturing
  - There were repeat failures across multiple batteries

This information assists in fleet safety analysis and continuous product improvement.

## Environmental Considerations

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This chapter outlines the procedures for use during inclement weather.

# Environmental Considerations

## Overview

Understanding and managing environmental conditions is essential for safe and efficient operation of the Edge 130 system. Environmental factors such as temperature, wind, and precipitation directly affect aircraft performance, battery life, and flight stability. Pilots must always evaluate local weather conditions prior to launch and ensure all flights are conducted within the aircraft's operational limits.

## High Temperature

### Payload Thermal Management

#### Overview

Both the Overwatch Gimbal and Mapping Array payloads contain active imaging sensors and onboard processing modules that generate heat during operation. In high-temperature environments or prolonged pre-flight setup conditions, payload components may exceed their optimal thermal limits.

To ensure reliable payload performance, operators must proactively manage temperature exposure during pre-flight, flight, and post-flight cycles.

## Minimizing Pre-Flight Heat Exposure

To reduce the likelihood of payload thermal rise before takeoff:

- **Limit pre-flight idle time.** Power on the aircraft and payloads only when pre-flight checks are ready to begin.
- **Avoid direct sunlight exposure.** Whenever possible, assemble and prepare the aircraft under shade or inside a vehicle shelter.
- **Keep lens housings out of radiant heat.** The EO/IR sensors and Mapping Array lenses absorb heat quickly when exposed to direct sun.
- **Delay power-on if payload is already warm.** If the system was transported or stored in a warm case, allow components to cool before applying power.

These steps help maintain sensor and processor temperatures well within their operational range.

## High-Temperature Flight Behavior

During extended hover, low-altitude loiter, or high ambient-temperature missions, payload electronics may experience slow thermal accumulation.

The aircraft may also perform automated thermal load balancing, including:

- Reduced gimbal slew responsiveness
- Temporary limitations on zoom or IR palette refresh rates
- Thermal throttling of onboard processors (Mapping Array)

These behaviors are normal safeguards to protect hardware.

## Payload Overheat Conditions

If a payload approaches its maximum safe operating temperature, the system will provide an on-screen warning through the GCS.

Typical indicators include:

- **Thermal Warning / High Payload Temperature** alert
- Reduced video frame rate
- Temporary pause of image capture or IR processing
- In extreme cases, automatic sensor shutdown

This is a protective measure and does **not** indicate equipment failure.

## Operator Actions if a Payload Overheats

If a thermal warning or shutdown occurs:

1. **Reduce system load:**
  - Transition to Fixed-Wing (FW) mode if possible (greater airflow).
  - Reduce hover time or abandon stationary observation tasks.
2. **Descend to cooler air** if operating at high ambient altitude or in direct midday sun.
3. **Return to Launch (RTL)** if warnings persist for more than 1–2 minutes.
4. **Power down the payload** (if applicable) once landed.
5. **Allow the payload to cool naturally.**

Do not attempt rapid cooling with ice packs, water, compressed air, etc., as this can damage lenses and gimbal seals.
6. **Inspect for obstructions** around vents, lens shrouds, or gimbal housings before the next flight.

Once cooled, the payload will automatically resume normal operation at next power-on.

## Best Practices for Thermal Prevention

- Operate during cooler portions of the day when possible.
- Use ground shade during mission planning, staging, and assembly.
- Limit prolonged loitering in MR mode in high-temperature conditions.
- Ensure firmware is up to date, as thermal management updates may be included in new releases.
- Maintain proper airflow around the payload during flight; avoid unnecessary hovering near obstacles that disrupt prop wash.

Operating in high-temperature environments can place additional stress on both the propulsion system and onboard electronics.

### Operational Guidance:

- Do **not** fly in ambient temperatures exceeding **118°F (48°C)**.
- Prolonged exposure to direct sunlight may cause **battery overheating**—store and stage aircraft in shaded or ventilated areas whenever possible.
- **Monitor battery temperatures** before, during, and after flight. If battery temperature exceeds safe thresholds, delay the next operation until normal temperatures are restored.
- Expect a **reduction in flight endurance** due to increased power consumption from propeller and motor cooling demands.
- Always allow batteries to cool to ambient temperature before charging. Charging hot batteries may cause permanent damage or reduced capacity.

## Low Temperature

Cold environments can affect the aircraft's mechanical systems and battery efficiency.

### Operational Guidance:

- For flight operations below **14°F (-10°C)**, allow the AV to idle for ~5 minutes to ensure the battery has warmed to optimal flight temperature.
- **Pre-warm batteries** to at least **68°F (20°C)** before flight to maintain proper voltage and capacity.
- Be aware of **shortened flight duration** due to decreased battery performance in cold air.
- Inspect control surfaces and propellers for **ice accumulation** or frost prior to flight. Ice buildup can disrupt lift and cause instability.
- Store aircraft and batteries in a temperature-controlled environment whenever possible.

## Excessive Wind Speeds

High wind speeds and gusty conditions can impact aircraft stability, controllability, and flight efficiency. The Edge 130 is designed to operate effectively in moderate wind conditions but may experience performance limitations in severe weather.

### Landing Considerations in High Winds



#### NOTE - Manual Landing Recommended in High Winds

When operating in elevated or gusting wind conditions near the aircraft's maximum rated limits, FlightWave recommends performing a **piloted (manual) landing** rather than relying solely on automated mission landing routines.

Automated landings are optimized for nominal wind envelopes and predictable descent profiles. In high-wind conditions, especially with strong headwinds or shifting gusts, manual control provides the operator with improved responsiveness and enables more precise touchdown placement.

### High-Wind Landing Technique

In very strong winds, the aircraft may not be able to descend vertically into the landing point when positioned directly above it. In these cases, operators may use the following technique:

- **Overfly the landing location** by several meters in the *upwind* direction.
- Begin a controlled descent while **allowing the aircraft to drift backward** toward the landing point as it descends through the final 10–20 ft (3–6 m).
- Adjust attitude and descent rate as needed to maintain directional control and alignment with the intended touchdown area.
- Maintain MR mode for the final phase of landing to maximize stability and maneuvering authority.

This method uses wind drift to counteract excessive headwind forces, allowing the aircraft to settle safely and accurately onto the landing point.

## Operator Priority

Manual landing is strongly recommended when:

- Winds approach the aircraft's maximum MR wind limits
- Gusts exceed the rated gust delta
- Obstructions near the landing zone can create unpredictable turbulence
- The aircraft struggles to make forward progress when descending directly into the wind
- Touchdown accuracy is critical (confined areas, small pads, cluttered terrain)

Automation can be safely re-engaged after landing and disarming.