OPERATOR MANUAL

Fang™ F7

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Using This Manual

Read Before First Flight

The purpose of this manual is to provide operators with the necessary knowledge to pilot and operate the FANG system with confidence. This manual includes all the information required for an operator to use the system safely and effectively, and to make informed decisions in unforeseen circumstances.

Advanced troubleshooting, maintenance beyond operator level, and mission-specific procedures may not be addressed.

Configuration, modification, or maintenance of the Goggle Display System beyond normal operational setup is outside the scope of this document.

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

The operator of the system, or PIC (Pilot-in-Command), is responsible for having read this manual in its entirety before operating the system.

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.

Compliance Disclaimer

FANG is a purpose-built, mission-focused system intended for use by trained personnel operating under an organizational safety program and applicable operational approvals. It is **not a consumer product** and is **not intended for purchase, use, or operation by individual operators** outside of an authorized organization.

FANG and its components, configurations, firmware, and radio-frequency equipment **may not meet specific FAA or FCC design, authorization, or operational requirements**

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Acronym List

Acronym	Definition
AC	Alternating Current
AGL	Altitude Above Ground Limit
AI	Artificial Intelligence
Al	Aluminum
AV	Aircraft Vehicle
C2	Command and Control
CC	Constant Current
CCW	Counter-Clockwise
COB	Center of Balance
COM	Communications Port (Windows Serial Port)
CP210x	Silicon Labs CP210x USB-to-UART Bridge
CV	Constant Voltage
CW	Clockwise
DC	Direct Current
DSC	Direct Servo Control
DVR	Digital Video Recorder
EdgeTX	Open-source Radio Transmitter Operating System
ELRS	Express Long Range System
EMI	Electromagnetic Interference
ESC	Electronic Speed Controller
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FPV	First Person View
FTDI	Future Technology Devices International (USB-to-Serial)
GCS	Ground Control Station
GHz	Gigahertz
GPS	Global Positioning System
HT	Head Tracker
ISR	Intelligence, Surveillance, and Reconnaissance
KOZ	Keep Out Zone
kV	Motor Velocity Constant (RPM per Volt)
LCD	Liquid Crystal Display
Li-Ion	Lithium-Ion
$LiCoO_2$	Lithium Cobalt Oxide

LiFe	Lithium Iron (Battery Chemistry)
$LiPF_6$	Lithium Hexafluorophosphate
LiPo	Lithium Polymer
LoS	Line of Sight
LQ	Link Quality
mAh	Milliamp-hour
MHz	Megahertz
mΩ	Milliohm
NDAA	National Defense Authorization Act
OEM	Original Equipment Manufacturer
OSD	On-Screen Display
PE	Polyethylene
PIC	Pilot in Command
PMCS	Preventive Maintenance Checks and Services
POL	Petroleum, Oil, and Lubricants
PP	Polypropylene
Q6AC	iSDT Q6AC Battery Charger (Model)
RF	Radio Frequency
RH	Relative Humidity
RHCP	Right-Hand Circular Polarization
RSSI	Received Signal Strength Indicator
RTB	Return to Base
RTH	Return to Home
RTN	Return (Button)
SMA	SubMiniature Version A (RF Connector)
sUAS	Small Uncrewed Aircraft System
TELE	Telemetry (Button)
TX	Transmitter
UA	Uncrewed Aircraft
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
VTX	Video Transmitter
XT60	High-Current RC Power Connector

Reference Material

This procedure is based on the following documentation:

- **ModalAI Technical Docs**, covering ELRS firmware build workflows, the local-repository configuration method, and the specific targets for the M0184 receiver and M0193 transmitter.
- **ModalAI ELRS Modem Overview**, describing the functions and roles of the M0184 RX and M0193 TX modules.
- **ExpressLRS documentation**, including the transmitter update process, EdgeTX Passthrough instructions, and the foundational “Getting Started” guide for the ExpressLRS Configurator.

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SAFETY PRECAUTIONS

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

Safety Precautions

This section provides general safety information and identifies the conventions used to alert the operator to potential hazards throughout this manual. Before attempting to operate any equipment, read and understand all identified operating warnings and cautions.

The following definitions apply to safety statements appearing in this manual:

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.

General Safety Precautions

Clear any hazards from the propeller blades prior to arming. Such hazards include grass, sticks, dirt, and living things. The drone will attempt to spin its propellers when armed, regardless of obstructions, until it is either disarmed or loses control of the signal. This can lead to injury, damage to the drone, uncommanded actions, and even become a fire hazard.

FANG does not have obstacle avoidance capabilities. Colliding with objects will cause harm and damage, and the FANG will not attempt to avoid obstructions.

Keep out Zone

A Keep Out Zone (KOZ) is a safety buffer around the pilot and Radio Controller. Keep all people, equipment, and obstacles at least 25 feet away from this area during takeoff, landing, and flight operations. Maintaining a clear KOZ helps prevent accidental contact, signal issues, and unexpected aircraft movement, ensuring safe and controlled UAS operations.

Warnings and Cautions

Warning – Cut Hazard

Rotating propellers on this aircraft can cause lacerations or puncture injuries. Sharp edges may be present even when the aircraft is powered off. Contact with rotating or stationary components may result in serious injury.

To reduce the risk of injury:

- Keep hands, fingers, and loose clothing clear of propellers at all times.
- Do not handle the aircraft while propellers are rotating or when motors are armed.
- Inspect propellers regularly for cracks, chips, or sharp edges, and replace damaged components before flight.

Warning – Burn Hazard

The power connection, battery leads, and adjacent aircraft surfaces may become hot during operation or immediately after power-off. Portions of the aircraft body, particularly near the power connection and onboard electronics, may retain heat after flight. Contact with energized or recently powered components or surfaces may result in skin burns.

To reduce risk of injury:

- Do not touch the power connector, battery leads, or nearby aircraft surfaces while the aircraft is powered on or immediately after flight.
- Allow sufficient cooling time before handling, servicing, or disconnecting the battery.
- Disconnect the battery by gripping the connector housing—never pull on the wires.

Failure to follow these precautions may result in personal injury or damage to equipment.

Warning – Antenna Separation Distance

Maintain a minimum separation distance of 20 cm (8 in) between the antenna and the operator's body (excluding hands, wrists, ankles, and feet) to meet FCC RF exposure requirements.

Warning – Battery Power

Do not use LiFe or incorrect battery chemistries. Incorrect batteries, polarity reversal, or unattended charging may cause damage, fire, or injury.

Product Description

This chapter introduces the major features of the product.

FANG™ F7 – Product Description

The FANG™ F7 is a rugged, retrievable 7-inch First Person View (FPV) small unmanned aircraft system (sUAS) engineered for training, reconnaissance, and tactical support missions. Built for hands-on, immersive drone operation, FANG provides pilots with direct manual control, a secure U.S.-made hardware architecture, and the durability required for repeated operational use. Designed to be cost-effective without compromising performance, FANG opens the door to scalable, high-frequency training and mission flexibility for defense, public safety, and government users.

System Architecture

The FANG™ system is composed of the following core components, each designed to support secure, reliable, and retrievable FPV operations:

- **Uncrewed Aircraft (UA):** Provides manual FPV flight capability through a rugged 7-inch airframe, detachable propellers, and a modular electronics stack. The UA includes the powertrain, FPV camera, flight controller, ELRS receiver, and analog video transmitter. It is designed for high-agility maneuvering, repetitive training cycles, and rapid field recovery.
- **Ground Control Station (GCS):** A handheld FPV radio controller used to operate the FANG manually via dual-stick inputs. The GCS provides ELRS-based command-and-control (C2), failsafe configuration, and real-time responsiveness for FPV-style flight handling. Depending on the user configuration, the GCS may integrate an FPV monitor or goggles for immersive viewing.
- **Data Link:** A low-latency communication system composed of:
    - **915 MHz ELRS control link** for command inputs, telemetry return, and adaptive power output.
    - **5.8 GHz analog video link** delivering real-time FPV video to goggles or GCS display. The system prioritizes responsiveness and signal stability for training and ISR environments.
- **Video Display Device (FPV Goggles or Monitor):** Provides the pilot with the first-person-view feed necessary for accurate flight control. The display device receives analog video from the UA, enabling immersive navigation, obstacle awareness, and target observation.

System Highlights

- 7-inch FPV aircraft with ruggedized frame and retrievable design
- Secure ELRS control link for stable, responsive manual flight
- Analog FPV video system that provides low-latency, real-time situational awareness
- U.S.-manufactured components, including electronics, frame, and critical assemblies
- Designed for ISR, reconnaissance, pilot training, and multi-role operations

Core Capabilities

- **Retrievable & Reusable Design** – Built for repeated launches, recoveries, and training cycles — not one-time use. Durable construction ensures a long service life and reduces the procurement burden.
- **Manual, FPV-Focused Control** – A non-autonomous control interface places the operator fully "in the cockpit," enabling intuitive, real-time maneuvering for both training and mission execution.
- **NDAA-Compliant & U.S.-Sourced** – All critical components are built in the United States and aligned with NDAA sourcing guidance, providing a secure, trusted supply chain.
- **Multi-Mission Flexibility** – Optimized for FPV and ISR operations, with the ability to support a variety of payloads and mission sets in training or live operational environments.
- **Cost-Effective for High-Volume Training** – Its low acquisition and sustainment cost allow organizations to conduct significant levels of hands-on flight training without risking expensive platforms.

Operational Applications

- **Training Units & Operators** – Enables frequent, affordable practice flights to build operator proficiency without risking high-end or one-time-use drones.
- **ISR / Reconnaissance Teams** – Delivers lightweight, mobile FPV capability for close-in surveillance, reconnaissance, and mission support.
- **Budget-Conscious Program Managers** – Delivers governmental/institutional procurement compliance (NDAA) combined with low total cost of ownership.
- **Modular Mission Architects** – Provides a flexible platform that can support additional payloads or be integrated into broader mission architectures.

System and Component Overview

Aircraft Components, Controls, and Indicators

Figure 1: FANG System Overview – Complete Configuration (Bottom View)

Aircraft Bottom Components, Controls, and Indicators

1. 1200TVL 4:3 Analog Camera
2. 2806.5 1300kv Motor (4x)
3. Counter-Clockwise (CCW) Propeller (1/2)
4. Battery Pack
5. Clockwise (CW) Propeller (1/2)
6. Antenna (Removable)
7. CCW Propeller (2/2)
8. 2.5W Analog Video TX
9. Battery/Aircraft Connection Point
10. Battery Strap (2x)
11. CW Propeller (2/2)

Figure 2: FANG System Overview – Complete Configuration (Top View)

Aircraft Top/Internal Components, Controls, and Indicators

1. ESC: 55A 2-8S (Internal)
2. Flight Controller: Brave F7 (Internal)

Radio Controller Component, Controls, and Indicators

Figure 3: Radio Controller – Complete Configuration (Front View)

Figure 4: Radio *Controller Controls, Indicators, and Components (Front View)*

Radio Controller Front Controls and Components

1. TELE Button
2. PAGE < Button
3. PAGE > Button
4. RTN Button
5. SYS Button
6. Trim Button (Left)
7. Left Gimbal (Removeable Joystick)
8. Lanyard Loop
9. Monochrome LCD Screen (128 × 64)
10. Right Gimbal (Removeable Joystick)
11. On/Off Button
12. Trim Button (Right)
13. Menu Wheel / ENT
14. MDL Button
15. Speaker

Figure 5: Radio *Controller Components (Rear View)*

Radio Controller Rear Components

1. 18650 Battery Compartment (Left)
2. Stick Storage Compartment (Left)
3. Stick Storage Compartment (Right)
4. 18650 Battery Compartment (Right)
5. External Module Bay

Figure 6: Radio *Controller – Top View*

Radio Controller Top Controls and Components

1. S1-Pot
2. Antenna Port (Straight)
3. SC: Flight Mode Switch
4. SD: Arm Switch
5. USB-C Charging Port
6. Antenna Port (Angled)
7. DSC Trainer Port
8. SA: Position Switch
9. SB: Crash Recovery Switch
10. SE: Momentary Switch

Figure 7: Radio *Controller – Bottom View*

Radio Controller Bottom Components

1. USB-C Charging Port
2. 3.5 mm Audio Jack
3. SD Card Slot
4. USB Data Port

Figure 8: BetaFPV Moxon V2 Antenna (Left); RadioMaster Pocket Antenna (Right)

FPV Goggle Display Overview

The FPV Goggle Display System provides the operator with a real-time first-person view of the aircraft's payload during flight operations. The system supports aircraft navigation, situational awareness, and mission execution, as applicable to the operational environment.

The FPV Goggle Display System interfaces with the Radio Controller and aircraft video downlink to present live video and on-screen information to the operator. Configuration, video source selection, and display behavior are dependent on system setup and operational mode.

FPV Goggle Components, Controls, and Indicators

Figure 9: Goggle Display System – Complete Configuration (Front View)

Figure 10: Goggle Display System Controls

FPV Goggle Display Controls

1. Volume Level
2. DVR 5-way Switch
3. HT Button
4. Display 5-way Switch
5. Channel Selection
6. Band Selection (On Side)

Figure 11: Goggle Display Components (Goggles not pictured)

FPV Goggle Display Components

1. SMA Antenna Connector
2. CORE 155mm 90deg Antenna
3. X2-Air Goggle Antenna
4. Charging Cable
5. Goggle Battery
6. Module Bay Cover

FANG System Specifications

Table 1: FANG System Specifications

Category	Specification
System Name	FANG F7
System Type	First Person View (FPV) small Unmanned Aircraft System (sUAS)
Frame Size	7 in
Operational Control	Fully manual FPV operation
Dry Weight (Aircraft Only)	~550 g
Aircraft Weight (No Battery / No Payload)	~1.1 kg
Length	22.9 cm (9.0 in)
Width	25.4 cm (10.0 in)
Height	4.2 cm (1.7 in)
Motors	2806.5 brushless motors, 1300 kV (4x)
Electronic Speed Controllers (ESC)	55 A, 2–8S
Maximum Power Output	1,500 W
Maximum Thrust	>10 kg
Propeller Configuration	Reversible motor configuration; CW and CCW propellers supported
Maximum Recommended Payload	2.0 kg
Maximum Total Flight Weight	3.1 kg (aircraft + payload, excluding battery)
Flight Controller	Brave F7
Control System	ExpressLRS (ELRS) (915MHz)
Control Frequency Band	902–928 MHz (915 MHz nominal)
Maximum Control Range	~2–15 km (configuration and environment dependent)
Control Channels	Up to 14
Failsafe Behavior	Configurable RTB or automatic disarm on link loss
Camera	1200 TVL analog FPV camera (4:3)
Video Transmitter Output	Up to 2.5 W
Video Frequency Band	5.5–5.9 GHz
Video Latency	Low-latency analog FPV
Wind Operating Capability	Approx. 45–65 mph (operator skill dependent)

Temperature Operating Range	32°F to 110°F (0°C to 43°C)
Water Resistance	Light conformal coating; not rated for rain or immersion
Maximum Operating Altitude	~1,000 ft AGL (subject to approval and regulations)
Payload Integration	Modular payload support within approved weight and COB limits

Table 2: System Component Dimensions and Weights

Component	Length (cm/in)	Width (cm/in)	Height (cm/in)	Weight (g/lb)
FANG 7	22.9 / 9.0	25.4 / 10.0	4.2 / 1.7	580 / 1.28
FANG 7 RTF	36.4 / 14.3	39.9 / 15.7	15.5 / 6.1	1142 / 2.52
Drone Battery	14.3 / 5.6	4.0 / 1.6	4.0 / 1.6	524 / 1.155
Goggles Battery	7.9 / 3.1	5.7 / 2.2	2.9 / 1.1	228 / 0.50
Goggles	18.0 / 7.1	8.5 / 3.3	7.0 / 2.8	294 / 0.65
RM Pocket Controller	15.3 / 6.0	14.0 / 5.5	5.1 / 2.0	378 / 0.83
RM Pocket Controller (RTF)	15.3 / 6.0	24.5 / 9.6	17.2 / 6.8	408 / 0.91

Table 3: System Weight Summary

Configuration	Weight (g)	Weight (lb)
One Drone System	2072	4.58
Four-Drone System	5498	12.14

FANG Battery Specifications

Figure 12: Battery – GNB35006S110A

Table 4: Battery Specifications

Parameter	Specification
Nominal Voltage	22.2 V
Capacity	3500 mAh
Continuous Discharge Rate	110C
Dimensions	41 × 44 × 141 mm
Discharge Lead	85 mm, XT60
Balance Lead	40 mm, JST-XH
Weight	520 g (±15 g)

Battery Cell Composition

The GNB35006S110A is a 6S LiPo battery (22.2 V nominal, 25.2 V max charge) using $LiCoO_2$ cathodes and graphite anodes for high energy density and stable cycle performance. The battery includes $LiPF_6$ electrolyte, aluminum and copper current collectors, PE separators, and a PP casing for structural and thermal stability.

Battery Charger Specifications

Figure 13: Battery Charger (Left); Battery Charger Cable (Right)

Battery Charging Parameters

Table 5: Battery Charging Parameters

Parameter	Specification	Notes
Charging Method	USB-C; CC–CV (Constant Current – Constant Voltage)	Required for LiPo battery safety and longevity.
Standard Charge Current	900 mA (0.2C)	Recommended for routine charging.
Fast Charge Current	3500 mA (1C maximum)	Use only when necessary to reduce charge time.
Charging Temperature Range	0°C to 45°C	Do not charge outside this temperature range.
Maximum Charge Voltage	25.2 V	Never exceed 25.2 V total pack voltage.

Operational Limitations

Weather Limitations

The FANG system operates in varied weather conditions, with the following limitations:

- **Wind:** The aircraft is capable of operating in moderate to high winds (**approximately 45–50 mph**). Gusts, turbulence, or rapidly changing wind conditions may result in reduced stability or unexpected aircraft movement.
- **Water Resistance:** The airframe's electronics have a light water-resistant coating that provides limited protection against light precipitation.
    - The system is **not** designed for condensing moisture, rain, standing water, or flooding.
    - The Radio Controller is **not water-resistant** and must be protected from all moisture.
- **Temperature:** The aircraft is designed to operate in temperatures between **32°F and 110°F.**
    - **Cold temperatures** reduce battery performance, resulting in lower available power and shorter flight times.
    - **High temperatures** may cause the aircraft to overheat when stationary; airflow during flight helps maintain safe temperatures.

Altitude Above Ground Level (AGL) and Range Limits

- The FANG can operate at **AGL up to approximately 1,000 ft**, although local regulations may impose stricter limits.
- The effective control range depends on the 915 MHz link (250 W–1 W) and environmental conditions.
    - Under ideal conditions, the system may achieve **2–15 km** of range.
    - Actual performance varies with terrain, interference, antenna orientation, and weather.

PRE-FLIGHT OPERATIONS

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

Pre-Flight Operations

Pre-Flight Battery Procedure

Follow the steps below to prepare the battery for safe operation.

Battery Inspection (Before Charging)

Before connecting the battery to any charger:

- Examine the battery for swelling, punctures, discoloration, leaks, or loose wiring.
- Do not charge or use any battery showing signs of damage.
- Ensure the charging area is well-ventilated and free of flammable materials.
- Remove the battery from the fireproof LiPo bag before charging.

Charger Preparation

1. Verify the charger is supplied by a **stable power source** (AC 100–240 V or DC 7–30 V).
2. Connect the battery to the charger:
    - Plug the **XT-60 main connector** into the charger's XT-60 port.
        - *Avoid reverse polarity.*
    - Insert the **6S balance lead** into the appropriate balance port.
        - *Ensure the connector is fully seated.*
3. Confirm all cables and connectors are secure and not under tension.

Figure 14: Align the connector, then firmly insert the power cable into the charger.

Charging Process

During charging, monitor the battery and charger for the following:

- **Voltage Balance:** A cell imbalance greater than 0.05 V requires using Balance Charge Mode.
- **Temperature:** If the battery becomes hot to the touch, stop charging immediately and allow it to cool.

Continue monitoring until the charger indicates the battery has reached a safe, stable charge.

Figure 15: Connect the first battery connector point to the charger.

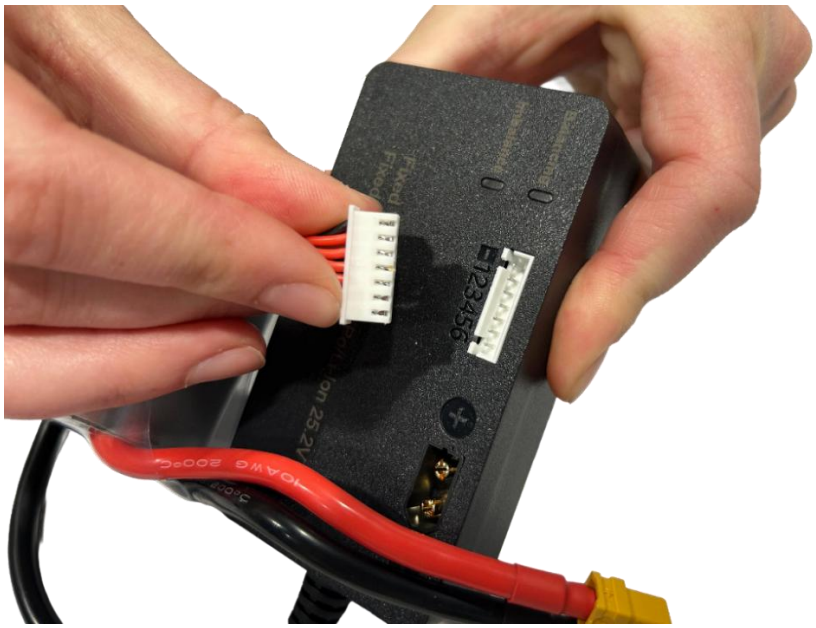

Figure 16: Connect the second battery connector point to the charger.

Figure 17: Battery fully seated on charger and charging.

Charge Completion and Disconnecting

Once the charger displays **“Charge Complete”**:

1. Unplug the balance lead first to prevent connector arcing.
2. Disconnect the XT60 main connector.
3. Allow the battery to cool to ambient temperature before installation in the aircraft.
4. Store charged batteries away from direct sunlight and heat sources until needed for flight.

Assembly

Battery Installation Procedure (FANG Aircraft)

Warning – Power on and Rotating Propellers

- Immediately upon connecting the battery, the aircraft will power ON.
- Always keep hands, clothing, and tools clear of the propellers.
- Never install the battery with the aircraft armed.

Caution – Heat Buildup

- The aircraft heats up quickly when powered on.
- Do not leave the aircraft powered on without flying.
- Disconnect the battery if the flight does not begin immediately.

Battery Installation (Aircraft)

Follow these steps to correctly install the battery on the FANG aircraft:

1. **Place** the aircraft on a flat, stable surface with propellers clear of all objects.
2. **Open** both battery Velcro straps fully.
3. **Position** the battery on the aircraft with the battery connectors facing toward the antenna.
4. **Thread** each Velcro strap through its corresponding strap ring.
5. **Pull** the straps snug, but **do not** fasten the Velcro closed yet.
6. **Tuck** the left battery wire into the left side of the Velcro strap to keep it clear of the propellers.
7. **Route** the remaining battery connector wire under the Velcro strap.
8. **Connect** the battery connector to the aircraft power port.
9. **Verify** that all loose wires are secured under the straps and cannot contact spinning propellers.
10. **Tighten** both Velcro straps fully and fasten them closed.
11. **Confirm** the battery is firmly secured and does not move when gently pushed.

Figure 18: Position the battery on the aircraft with the battery connectors facing toward the antenna.

Figure 19: Thread each Velcro strap through its corresponding strap ring.

Figure 20: Tuck the cables underneath the battery straps and secure with one hand before tightening the straps with the opposite hand.

Figure 21: Connected and secured battery cables before tightening straps – Top View

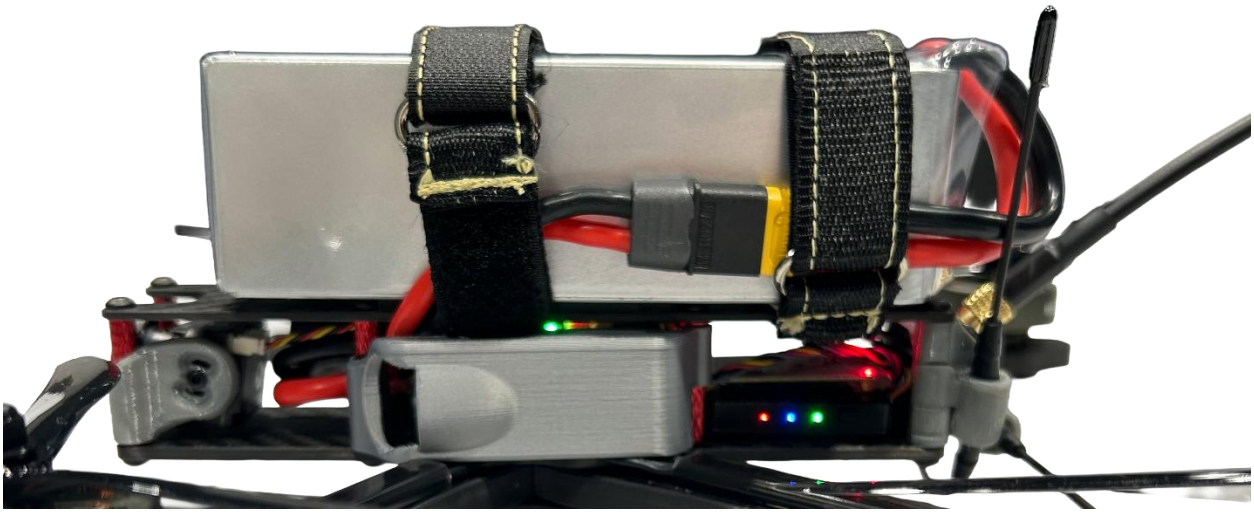

Figure 22: Tightened, connected, and secured battery cable – Connector Side

Figure 23: Tightened, connected, and secured battery cable – Free End

Battery Removal Procedure (FANG Aircraft)

Warning – Hot Surfaces

- Aircraft components may be hot immediately after flight.
- Avoid contact with hot components until they have cooled.

Caution – Battery Handling

- Do not pull on wires to disconnect the battery.
- Always grasp the connector housing when unplugging.
- Store batteries in accordance with approved battery handling procedures.

Battery Removal

Follow these steps to safely remove the battery from the FANG aircraft:

1. **Ensure** the aircraft is **disarmed,** and the propellers are not spinning.
2. **Place** the aircraft on a flat, stable surface with clear space around the propellers.
3. **Disconnect** the battery connector from the aircraft power port.
    - The aircraft will power OFF immediately once disconnected.
4. **Allow** the aircraft components to cool before handling.
    - The aircraft may be hot after operation.
5. **Loosen** both battery Velcro straps.
6. **Unthread** the Velcro straps from their strap rings.
7. **Remove** the battery from the aircraft.
8. **Inspect** the battery and wiring for damage before storage or recharging.

Propeller Assembly

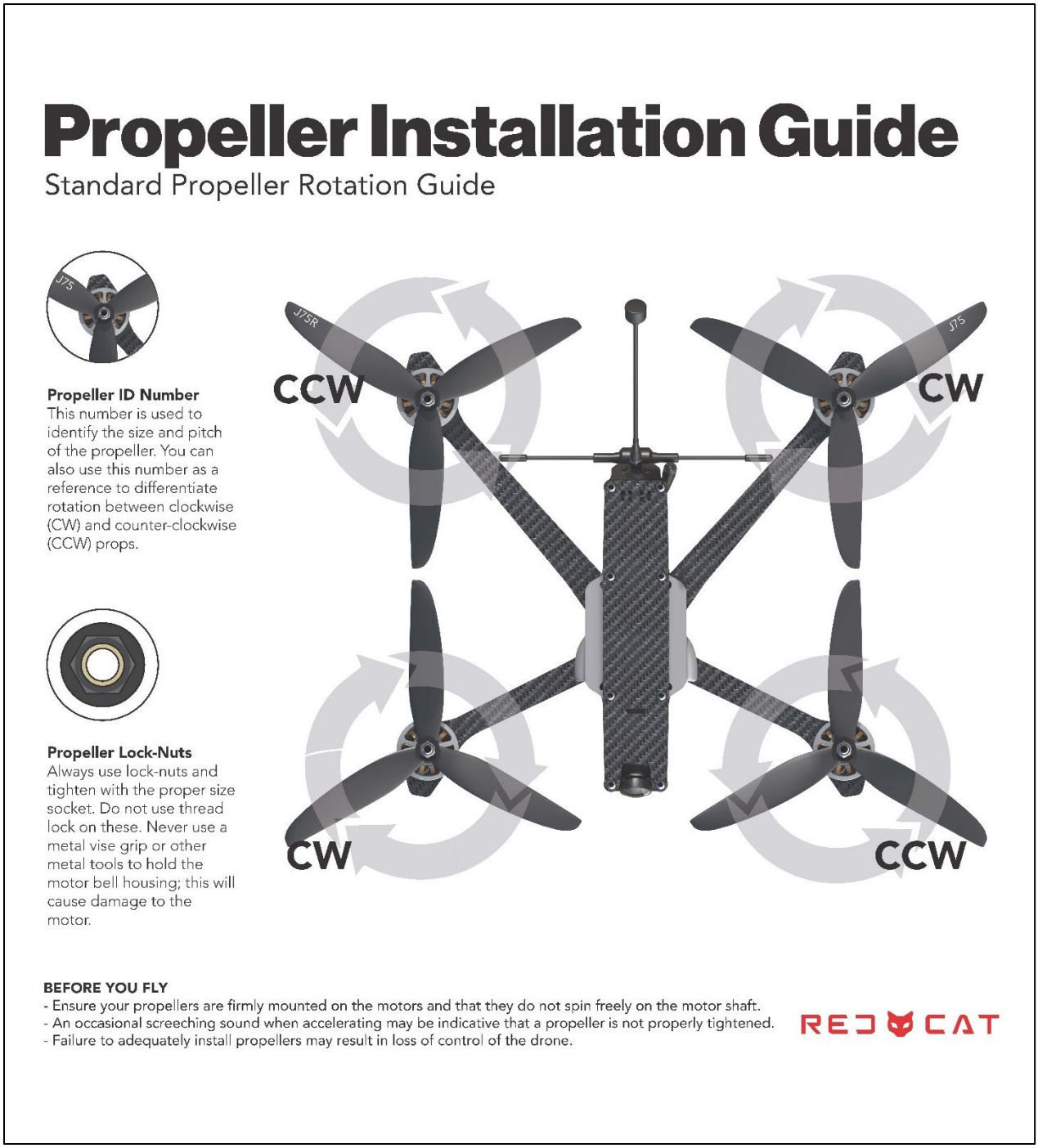

Figure 24: FANG Propeller Installation Guide

Antenna Assembly (FANG Aircraft)

1. **Obtain** the **CORE 5.8 RHCP SMA 160 mm antenna**.

Figure 25: CORE 5.8 RHCP SMA 160mm Antenna

2. **Align** the antenna connector with the antenna port on the rear of the aircraft.
3. **Thread** the antenna **clockwise (CW)** onto the connector.
4. **Tighten** the antenna by hand until snug.
    - Do not use tools.

Figure 26: Antenna Installed on Aircraft

Antenna Installation (Radio Controller)

1. **Identify** the **straight** antenna port on the Radio Controller.
2. **Thread** the **RadioMaster Pocket antenna** onto the straight antenna port.
3. **Tighten** the antenna by hand until secure.
4. **Locate** the **angled** antenna port on the controller face.
5. **Thread** the **BetaFPV Moxon V2 antenna** onto the angled antenna port.
6. **Tighten** the antenna by hand and verify it is secure.

Figure 27: (Left to right) Radio *Controller, RadioMaster Pocket Antenna, BetaFPV Moxon V2 Antenna*

Figure 28: Connect the RadioMaster Pocket Antenna to the angled antenna port.

Figure 29: Connect the BetaFPV Moxon V2 Antenna to the straight antenna port.

Goggle Assembly

Antenna Installation

1. **Identify** the lower antenna port on the front of the goggles.
2. **Thread** the X2-Air goggle antenna onto the **lower antenna port**.
3. **Tighten** the antenna by hand until secure.
4. **Orient** the antenna so the “X2” marking faces **downward** as shown.
5. **Locate** the upper antenna port on the goggles.
6. **Thread** the CORE 155 mm 90-degree antenna onto the **upper antenna port**.
7. **Tighten** the antenna by hand and ensure the antenna points upward.

Figure 30: (Left to right) Goggles, X2-Air antenna, CORE 155 mm 90-degree antenna

Figure 31: X2-Air Antenna Orientation

Figure 32: CORE Antenna Installation

Power Connection (Goggles)

1. **Locate** the USB-C power port on the goggles.
2. **Connect** the USB-C barrel connector from the battery to the goggles.
3. **Press** the main power button once to power on the goggles.
4. **Confirm** the goggles power on by listening for the fan and observing the display activate.

RapidFire Module Activation

1. **Locate** the RapidFire module power switch on the goggles.
2. **Move** the switch to the ON (I) position.
3. **Listen** for an audible beep confirming the module has powered on.
4. **Observe** static or video output on the goggle display.

Assembly Verification

1. **Confirm** both antennas are installed and finger-tight.
2. **Verify** no antenna is loose or cross-threaded.
3. **Ensure** the goggles remain powered on without error indications.

The goggles are now assembled and ready for pairing and operation.

Pre-Flight Checklist

The Pre-Flight Checklist provides a step-by-step guide to verify the FANG system's readiness before each flight. These procedures ensure the aircraft, payload, and operating environment meet all safety and performance requirements. Operators must complete this checklist before arming or launching the aircraft to confirm proper system configuration, secure payload installation, reliable communication links, and a safe flight environment. Failure to perform these checks may result in degraded performance, loss of control, or system damage.

Table 6: Pre-Flight Checklist

Checklist Category	Checklist Item	Verification / Notes
Aircraft Inspection	Inspect propellers for cracks, chips, or deformation.	All propellers are installed correctly and securely fastened.
	Check arms, motors, antennas, and fasteners.	No loose, missing, or damaged components.
	Verify the camera lens and airframe are clean and unobstructed.	Remove dirt, debris, or moisture before flight.
Payload & Battery Security	Verify all payloads, antennas, and batteries are securely mounted.	No movement during tilt or handling; proper balance confirmed.
	Confirm total takeoff weight is within limits.	Weight distribution adjusted for safe flight performance.
Control & Video Link Verification	Perform a 5.8 GHz video and 915 MHz control frequency scan.	No signal interference detected.
	Confirm control link and video feed stability.	Both systems verified functional before arming.
ESC / Hover Function Check	Power on the aircraft and listen for ESC initialization tones.	Confirms ESC-to-Flight Controller communication.

	Arm the aircraft and perform a brief hover test.	Stable hover; no vibration, drift, or payload movement.
Environmental Conditions	Check weather conditions and visibility.	No high winds, precipitation, or low-visibility conditions.
	Verify temperature is within operating limits.	Avoid extreme hot or cold environments when possible.
Airspace & Operational Awareness	Confirm required airspace approvals.	Compliant with local governing body rules.
	Identify nearby air operations and maintain right-of-way.	No conflicting air activity detected.
Signal & RF Interference	Scan the area for potential sources of radio interference.	No heavy RF congestion; safe environment for control and video link.
Hazard Identification	Identify physical obstacles (trees, buildings, power lines, terrain).	Sufficient clearance for launch, flight path, and landing.
	Note environmental hazards (wildlife, people, vehicles).	Launch area and operating zone kept clear.
Landing	Verify RTB Coordinates	Confirm the correct GPS coordinates for the designated Return-to-Base (RTB) location before each launch.
	Ensure Landing Zone Clearance	Ensure the home landing area is fully clear of personnel, equipment, and obstacles before initiating an automatic or manual RTB.

Pairing Procedures

Pairing the FANG Drone with the Radio Controller

The FANG aircraft, Radio Controller, and FPV goggle display system are paired prior to shipment. Re-pairing is not required for normal operation. The following procedures should only be performed if the original pairing is lost or components have been replaced.

Follow these steps to connect (pair) the FANG drone with the Radio Controller:

Step 1: Get the Drone Ready

1. **Remove** the top cover of the FANG drone so you can see the inside. (Optional)
2. **Fully** plug the battery into the drone.
3. **Watch** for the red light on the top-rear left side of the drone to start flashing.
    - A steady red flash means the drone is ON but not connected.
4. **Find** the small pairing button inside the drone on the opposite side of the red light.
5. **Press and hold** the pairing button for **five (5) seconds**.
6. **Confirm** the red light changes to a **double flash**.
    - This means the drone is ready to pair.

Step 2: Turn On the Controller

7. **Press and hold** the power button on the controller.
8. **Wait** for the light around the power button to turn **green**.
    - Blue means it is starting up.
    - Red means there is a warning on the screen.

Step 3: Start Pairing on the Controller

9. **Press** the **SYS** button to open the tools menu.
10. **Push** the scroll wheel to open the menu.
11. **Scroll** down until you see **Bind**.

12. **Press and hold** the scroll wheel for **two (2) seconds**.
13. **Look** for the word **"Binding"** on the controller screen.

Step 4: Make Sure Pairing Worked

14. **Watch** the drone lights.
    - Red and yellow-green lights together mean pairing worked.
15. **Repeat** the drone pairing button step if the lights stop flashing before pairing finishes.

Step 5: Check the Connection

16. **Press** the **RTN (Return)** button on the controller.
17. **Scroll** to **Other Devices** and select it.
18. **Select** the **ModalAI** device (M0184).
19. **Confirm** pairing by checking that settings can be opened.
20. **Press RTN**, then scroll to **Exit**, and press **RTN** again.

Step 6: Final Check

21. **Look** at the main controller screen for the signal bars (RSSI).
    - If you see signal bars, the drone is paired.
    - If you do not see signal bars, the drone is not paired, or there is heavy interference.

Helpful Tips

- Pairing works best when you move quickly after the drone enters pairing mode.
- If pairing fails, repeat the process from **Step 4**.
- Keep the controller and drone close together during pairing.

Connecting FPV Goggles to the FANG Drone (FPV Video)

Caution – Video Transmitter Heat

- The drone's video transmitter (VTX) turns on at high power when the battery is connected.
- The VTX can overheat if the drone is powered on but not flying.
- Complete this process quickly.
- Disconnect the battery if you are not flying right away.

FPV goggles do not digitally bind to the drone; video connection is established by manually matching the receiver band and channel to the drone's video transmitter.

Follow these steps to view the drone's camera feed in the FPV goggles:

Step 1: Prepare the Drone

1. **Carefully** remove the protective cap from the drone's camera.
2. **Fully** connect the battery to the drone.
3. **Locate** the VTX control area on the drone.
    - Find the button labeled **KEY**.
    - Identify the three indicator lights:
        - **Red** = Power
        - **Blue** = Band
        - **Green** = Channel

Step 2: Power On the Goggles

4. **Connect** the Fat Shark battery to the goggles using the USB-C barrel connector.
5. **Insert** the connector into the goggles' power port.
6. **Press** the main power button once.
7. **Listen** for the internal fan to turn on.
    - This confirms the goggles are powered on.

Step 3: Turn On the Receiver Module

8. **Locate** the RapidFire receiver module power switch.
9. **Move** the switch to position **"1"**.
10. **Listen** for an audible beep.
    - This confirms the receiver module is active.
11. **Look** through the goggles.
    - You should see **static** at this stage.
    - Static means the goggles are on but not tuned to the drone yet.

Step 4: Find the Correct Video Channel

12. **Press and hold** the joystick **up or down** to change the **channel**.
13. **Press and hold** the joystick **left or right** to change the **band**.
14. **Slowly** scroll through band and channel combinations while watching the screen.
15. **Watch** for the static to change into a **live camera image**.
    - The image may appear suddenly.
    - The image may be dark or blurry at first.
    - Any visible camera image means the goggles are connected.

Step 5: Confirm Video Connection

16. **Verify** the video feed by moving the drone slightly and confirming the image responds.
17. **Proceed** to flight or disconnect the battery if not flying immediately.

Helpful Tips

- Keep the drone and goggles close together during setup.
- Ignore brief flashes or rolling images — keep adjusting until the picture stabilizes.
- If the drone is powered for more than a few minutes without airflow, disconnect the battery.
- If no image appears, restart the process and try again.

Routine Operations

This chapter describes normal operating procedures for safe, reliable performance.

Normal Flight Operations

Cut Risk: Arming the aircraft will engage the propellers. Propellers can cause serious cuts. Keep clear of rotating parts.

Burn Hazard: Power connectors, battery leads, and nearby aircraft surfaces may become hot during or after operation. Avoid contact until the aircraft has cooled.

Keep Out Zone: Keep all people, equipment, and obstacles at least 25 feet away from the takeoff, landing, and flight operations area. Maintaining a clear KOZ helps prevent accidental contact, signal issues, and unexpected aircraft movement, ensuring safe and controlled UAS operations.

Normal operation of the FANG sUAS begins after completing the **Pre-Flight Checklist**. The Radio Controller and AV must be assembled, paired, and powered on with fully charged batteries as described in this manual.

Quick Start Instructions

Launch – Arming

To arm the aircraft:

1. **Ensure** the FANG aircraft is powered **on**.
2. **Place** the aircraft on a level, clear surface.
3. **Allow** sufficient time for onboard sensors to complete calibration.
4. **Activate** the **ARM Switch** on the **Radio Controller**. (*See Figure 6*)
5. **Assume** full control of the aircraft as Pilot in Command (PIC).

Flight Controls

Flight controls are issued using the primary control sticks on the Radio Controller. These inputs directly command aircraft movement during flight.

The following table outlines the control inputs used to maneuver the aircraft.

Table 7: AV Control Functions Guide

Function	Control Input	Aircraft Response
Throttle	Left Stick – Up / Down	Increases or decreases altitude
Yaw	Left Stick – Left / Right	Rotates the aircraft left or right
Pitch	Right Stick – Up / Down	Moves the aircraft forward or backward
Roll	Right Stick – Left / Right	Moves the aircraft left or right

NOTE: This table reflects the Mode 2 stick configuration. In Mode 1, throttle and pitch functions are assigned to opposite sticks.

Flight Mode Controls

The FANG sUAS supports multiple flight modes that determine how the aircraft responds to pilot inputs. Flight modes affect stabilization behavior but **do not change stick assignments**.

Flight modes are selected using the assigned hard key on the Radio Controller.

Table 8: Flight Mode Controls Guide

Mode	Description	Operator Action
Angle	Automatically returns the aircraft to a level attitude when pitch and roll inputs are released	Select Angle mode
Horizon	Automatically levels the roll axis when released; pitch axis remains under pilot control	Select Horizon mode
Acro	Does not auto-level on any axis; aircraft maintains last commanded attitude	Select Acro mode

On-Screen Display (OSD)

The On-Screen Display provides real-time flight and system information to the PIC, including but not limited to:

- Battery Voltage
- Altitude
- RSSI (Received Signal Strength Indicator)
- LQ (Link Quality)

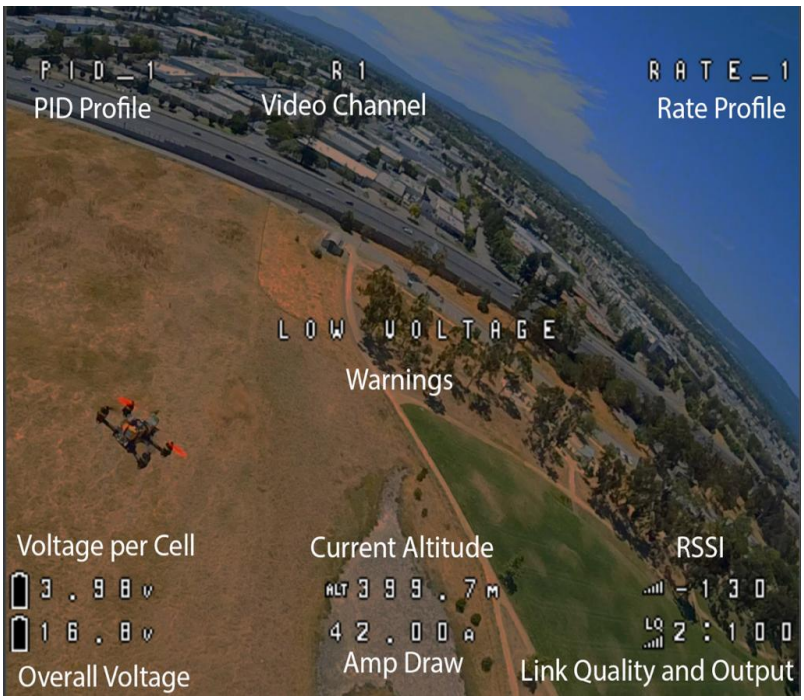

Figure 33: On-Screen Display Elements

EMI Avoidance: Band and Channel Switching

The PIC may change control and video link frequencies to mitigate electromagnetic interference (EMI). Performing a band scan allows the PIC to identify channels with optimal signal quality prior to or during operations.

Return to Base

Return-to-Base procedures may be initiated manually by the PIC or automatically depending on system configuration and flight conditions.

Keep Out Zone (KOZ) for UAS Home Station Landing

For home station landings, maintain a Keep Out Zone (KOZ) of 25–50 ft around the landing area. Establish an additional 100 ft buffer to account for emergency or unplanned return scenarios.

Verbal Landing Announcements

To ensure situational awareness, the UAS pilot or ground control should announce key phases of the return identified in the following table:

Table 9: Verbal Landing Announcements

Announcement	When It Is Stated
“Returning to Home (RTH) – Clear the landing zone.”	Announced as the UAS begins the return phase.
“Final Approach – Keep Out Zone Active.”	Stated when the UAS is within 50 feet of the landing area.
“Landing in Progress – Maintain Clear Area.”	Declared when the UAS is in the final descent.
“UAS Landed – KOZ Clear.”	Confirmed once the UAS is safely on the ground.

Disarm Procedures

To disarm the aircraft:

1. Press the **DISARM** button on the controller. (*See Figure 6*)
2. Disarming occurs instantly.

EMERGENCY OPERATIONS

This chapter describes emergency procedures to ensure safe recovery and system protection.

Emergency Procedures

Operations in extreme weather conditions will reduce system performance and flight profiles.

This section covers common emergency conditions and provides guidance for operating the UA under unusual or degraded conditions that could affect performance or reliability.

Emergency Redirect and Landing

Use the steps below if the original launch point cannot be used due to obstacles, personnel, or unsafe conditions. Following these steps, along with clear communication and KOZ awareness, ensures safe, controlled landings even in unexpected or emergency conditions.

1. **Select an Alternate Landing Site**

   Choose the nearest safe location with clear ground space and minimal hazards.

2. **Announce Emergency Redirect**

   Communicate: “Emergency RTB — redirecting to alternate landing.”

   Ensure all personnel clear the new landing area.

3. **Monitor Critical Telemetry**

   Continuously monitor battery level, wind conditions, link quality, and flight data during the approach.

4. **Execute a Controlled Landing**

   If landing manually, use the same shallow approach angle as a normal landing.

   Avoid steep or rapid descents.

5. **Maintain KOZ Discipline**

   Keep the KOZ clear for the entire landing sequence.

Loss of Control Link

The following table outlines the aircraft's automated actions during a loss of control link and provides the operator with a quick reference to the expected emergency landing behavior.

Table 10: Loss Link Landing Procedure

Procedure	Action	Notes
1	Allow the system to execute its programmed failsafe behavior.	On loss of control link, the aircraft will either: a) Return to origin using GPS and barometric altitude, or b) Disarm after 1.5 seconds, depending on configuration.

Electromagnetic Interference (EMI) Avoidance: Band & Channel Management

The FANG system allows the operator to manage radio frequencies to reduce interference and maintain reliable control and video links.

- **Control Link (ELRS – 915 MHz)**
    - The ELRS control link automatically hops within the 915 MHz band to select the clearest available channel.
    - The system can be configured to adjust transmit power automatically based on link quality.
    - If needed, the PIC may manually adjust the transmit power on the radio controller.
- **Video Link (5.5–5.9 GHz Analog)**
    - The analog video transmitter does not automatically change channels or bands.
    - The PIC can perform a Band Scan to identify clear frequencies.
    - Video channel and power level (up to 1.0 W) can be manually adjusted through the Betaflight OSD.

Fail-Safe Behavior

The following table summarizes how the system responds during a complete loss of control link and provides operator actions for both GPS-equipped and non-GPS configurations.

Table 11: Fail-Safe Behavior (GPS RTH or Disarm)

Procedure	Action	Notes
1	Allow GPS-equipped systems to initiate Return-to-Base (RTB).	Occurs after 1.5 seconds of complete control link loss.
2	Take back manual control once the link is restored.	PIC may resume normal flight after exiting RTH mode.
3	Allow the system to disarm if the control link is not restored.	System descends and disarms at the origin point.
4	Re-arm and continue flight only if the link is restored.	Applies to non-GPS systems; otherwise, the aircraft remains disarmed.

System Failures

The table below outlines required operator actions for motor, ESC, or other onboard system failures to ensure safe recovery or termination of flight.

Table 12: System Failures

Procedure	Action	Notes
1	Land immediately if motors or ESCs show signs of failure.	Indicators include shuddering, dipping to one side, or uncontrolled vibration.
2	Disarm the system immediately in the event of total motor/ESC failure.	Prevents further damage or unsafe behavior.
3	Attempt to fly back to the origin if a non-motor system fails.	If using FPV goggles, remove them and switch to Line of Sight (LoS) if necessary for safety.

Crash Recovery Procedures

Crash recovery procedures should be evaluated based on the payload. The above protocols are recommended for training, flights with no payload, or flights with a non-lethal payload.

Use the following table as a quick reference for safe and correct crash recovery procedures when the aircraft contacts the ground or an obstacle.

Table 13: Crash Recovery Procedures

Procedure	Action	Notes
1	Disarm the aircraft immediately after contact with the ground or an obstacle.	Prevents uncommanded motor activity.
2	Activate the crash recovery switch if the aircraft is upside down and the links are intact.	Reverses motor direction to flip the aircraft upright.
3	Use crash recovery only when the aircraft is free of obstructions.	Avoid using repeatedly; excessive use may damage components.

Communication Link Recovery Procedures

Use the following table to quickly identify the steps required when control or video link quality begins to degrade during flight.

Table 14: Communication Link Recovery Procedures

Procedure	Action	Notes
1	Fly the aircraft closer to the launch/origin point.	Attempt to regain link stability.
2	Orient the ground antennas correctly.	Correct antenna alignment often restores control/video signal.
3	Continue flying toward the origin if the GPS Return-to-Home is not available.	Maintain control until the system failsafe activates or the link is restored.

Emergency Battery Operations

Table 15: Emergency Battery Operations

Emergency	What NOT to Do	Proper Action
Battery on fire	Do **NOT** use water	Extinguish using a **Class D fire extinguisher**
Battery overheating	Do **NOT** keep charging	Move the battery to a **fireproof, ventilated area** and monitor
Battery leaking	Do **NOT** touch with bare hands	Wear **protective gloves** and place the battery in a **sealed, fire-safe container**

AFTER OPERATIONS

This chapter describes emergency procedures to ensure safe recovery and system protection.

Post-Flight Procedures – Checklist

The post-flight procedures ensure the aircraft is safely powered down, all mission data is properly retrieved, and the system is inspected for any signs of damage or wear. Completing this checklist after every flight helps maintain airworthiness, prevents equipment failures, and supports accurate maintenance records.

Table 16: Post-Flight Procedures – Checklist

Task Category	Checklist Item	Verification / Notes
Shutdown Sequence	Power off the Radio Controller. Press and hold the power button until it shuts off.	Ensures aircraft remains safely disarmed.
	Disconnect the aircraft battery promptly.	Prevents heat buildup and component stress.
Data Retrieval	Blackbox log data is stored on the flight control board within the airframe. Select “Log Blackbox Data” to retrieve the stored data from the airframe.	Save according to mission or organizational requirements.
	Retrieve DVR video recordings from the goggles or the monitor.	Verify files saved before clearing storage.
Physical Inspection	Inspect propellers for cracks, chips, or deformation.	Replace any damaged propellers before the next flight.
	Check the camera and airframe for damage or debris.	Confirm the lens is clean and unobstructed.
	Inspect the battery for swelling, damage, or abnormal heat.	Do not reuse damaged batteries.
	Spin each motor by hand to verify smooth rotation.	No grinding, wobbling, or resistance present.
	Check for loose hardware, antennas, or components.	Tighten or secure as needed.

Post-Flight Battery Discharge Procedure

Battery Discharge

Discharge the battery only in the following situations:

- **Storage Prep:** When preparing the battery for long-term storage.
- **Voltage Reduction:** When the battery is overcharged.
- **Balancing:** When cell voltages show an imbalance.

Set Up the Charger for Discharge

1. Turn on the Q6AC charger.
2. Select **Discharge Mode**.
3. Enter the **required** settings:

Table 17: Battery Charger – Discharge Settings

Setting	Value
Discharge Mode	Select on Q6AC
End Voltage	18.0 V
Discharge Current	2.25 A (0.5C)

4. Connect the XT-60 main connector and 6S balance lead.
5. Start the discharge cycle.

Monitor the Battery

- Ensure the battery does **not overheat**.
- Stop immediately if swelling, odor, or abnormal behavior occurs.
- Keep the battery inside a **LiPo-safe bag** during discharge.

Completion

1. Wait until the charger reaches **18.0 V** and stops automatically.
2. Unplug the **balance lead first**, then disconnect the **XT-60 connector**.
3. Allow the battery to **cool before storage**.

Advanced Operations

This chapter explains advanced system features and flight operations.

Advanced Operations

Payload Integration – Installation Guidelines

When installing a payload on the FANG, ensure that it is mounted securely and does not shift during flight. Verify that all mounting points are clear of the propellers, motors, and any part of the powertrain.

Key Safety Considerations

1. **Weight Limits**
   Excessive payload weight can reduce maneuverability, cause instability, or lead to uncommanded aircraft behavior.
   - Conduct a test flight using a dummy payload of similar weight before operational use.

2. **Weight Distribution (Center of Balance)**
   Changing the aircraft's center of balance (COB) can negatively affect handling and flight performance.
   - Perform a controlled test flight after adjusting COB or adding a new payload.

3. **Secure Mounting**
   Improperly secured payloads can detach during flight or interfere with aircraft components.
   - Confirm that all fasteners, straps, or mounts are fully tightened and cannot shift.

4. **Takeoff Stability**
   Added payloads may prevent the aircraft from sitting level or may alter its lift characteristics.
   - Ensure the aircraft is stable on a flat surface before arming and takeoff.

5. **Flight Tuning Adjustments**
   Changes in payload weight or positioning may require tuning adjustments to maintain stable flight.
   - Tune the aircraft's settings as needed for optimal flight performance.

Payload Weight Restrictions

The maximum recommended payload weight is 2.0 kg. The maximum total flight weight is 3.1 kg, consisting of the aircraft (1.1 kg) plus payload (up to 2.0 kg).

Operation beyond the recommended payload weight or maximum total flight weight has not been evaluated and may result in degraded flight performance or reduced controllability.

The payload center of balance (COB) should remain within the main body of the airframe. Payloads with a COB located outside the primary airframe envelope may adversely affect aircraft stability and flight performance.

Configurations of Frames and Components

Configurations approved are based on the OEM's recommendation that safe and adequate testing has been performed. The approval to fly such recommended configurations will come from the users' governing bodies for flight clearance and airworthiness.

Table 18: Configurations of Frames and Components

TESTED / APPROVED		FANG (7")
CAMERA		
FATSHARK	AURORA	X
RADIO LINK		
ModalAI	ELRS	X
FLIGHT CONTROL		
ROTOR RIOT	BRAVE F7	X
ELECTRONIC SPEED CONTROL		
ROTOR RIOT	BLUE UAS ESC	X

Radio Controller Firmware Setup & Update Procedures

The Radio Controller ships with factory-installed custom firmware, programmed at Red Cat's facility in Salt Lake City, Utah. The transmitter includes a default binding phrase, which operators may change as needed. The following procedures describe how to flash or reflash the ModalAI M0193 ELRS transmitter module using ExpressLRS tools.

What you'll need:

- A computer (Win/macOS/Linux) with admin rights.
- Your radio handset (EdgeTX/OpenTX) with the M0193 connected/installed (or the M0193's own USB-UART if flashing by cable).
- A known-good USB data cable.
- (Windows) CP210x / FTDI drivers if your USB enumerates as such.
- ExpressLRS Configurator v1.7.8+. (ModalAI Technical Docs)

Step 1: Install ExpressLRS Configurator

1. Download and install ExpressLRS-Configurator (v1.7.8 or newer). Launch it once to verify it opens. (ModalAI Technical Docs)

Step 2: Get the ModalAI ELRS firmware locally

ModalAI maintains a fork of ELRS with targets for M0184/M0193.

1. In a terminal:
2. git clone https://github.com/modalai/ExpressLRS
3. (Optional but recommended) Check out a specific ModalAI tag (ModalAI tags have a fourth version number, e.g., vX.Y.Z.modalai-N), which include M0193 patches:
4. cd ExpressLRS
5. git tag # browse tags
6. git checkout <your_chosen_modalai_tag>
7. You'll use this repo as a Local source in the Configurator. (ModalAI Technical Docs)

Step 3: Prep your radio for EdgeTX Passthrough (serial passthrough)

This lets the PC talk to the TX module through the radio's USB, so you don't have to open the module.

1. Update EdgeTX on your radio to a current release (EdgeTX 2.8.x+ strongly recommended for reliable passthrough). (expresslrs.org)
2. Plug the radio into your PC via USB.
3. On the radio, load the ExpressLRS Lua script (TOOLS → *ExpressLRS*). Make sure the internal/external module is enabled and the script loads cleanly. (expresslrs.org)

Note: EdgeTX Passthrough is an official flow supported by ExpressLRS/EdgeTX; it shows up as a "Flashing Method" in the Configurator on radios with internal ELRS or when passthrough is supported. (expresslrs.org)

Step 4: Configure a build for M0193 in ELRS Configurator

1. Open ExpressLRS Configurator.
2. Click the gear icon (Settings) and enable Expert Mode. (ModalAI Technical Docs)
3. Go to the Local tab and set Local path to the src directory of the ModalAI repo you cloned (e.g., …/ExpressLRS/src). (ModalAI Technical Docs)
4. In the main flashing panel:
    - Device Category: ModalAI 900 MHz
    - Device Target: ModalAI M0193 TX (the M0184 RX is listed too—make sure you pick the TX). (ModalAI Technical Docs)
    - Flashing Method: EdgeTX Passthrough (for serial passthrough via the radio). If you are cabled directly to the module's USB-UART, choose UART (Serial) instead. (ModalAI Technical Docs)
    - Serial Port: pick the COM/tty that appeared when you plugged in the radio.

5. In Firmware Options (same page):
    - Regulatory Domain: set to your country/region.
    - Binding Phrase: set a phrase (must match on the receiver later).
    - (Optional) Set Packet Rate, TLM Ratio, etc. See ELRS docs if unsure. (ModalAI Technical Docs)

Step 5: Build & Flash

1. Click Flash. The Configurator will build and then flash the module over the selected serial port. Let it finish; don't unplug anything. (ModalAI Technical Docs)
2. When it says Success, unplug/replug USB or power-cycle the radio.
3. On the radio, open the ExpressLRS Lua script again and verify the version and options reflect what you just flashed. (expresslrs.org)

Alternative: Direct UART-over-USB flash (no passthrough)

If you prefer not to use the radio:

1. Connect the M0193 directly to your computer with its USB-UART (or via a USB-UART adapter if required).
2. In Configurator, select:
    - Device Category: ModalAI 900 MHz
    - Device Target: ModalAI M0193 TX
    - Flashing Method: UART (Serial)
    - Choose the correct COM/tty port → Flash. (ModalAI Technical Docs)

Step 6: Pairing Verification

When you flash your receiver (e.g., ModalAI M0184 on the aircraft), use the same ELRS version, the same binding phrase, and a matching regulatory domain. Then power both ends and verify the link. (ModalAI's docs group M0184/M0193 together under the ELRS Modems section.) (ModalAI Technical Docs)

MAINTENANCE

This chapter outlines routine maintenance to ensure safety, reliability, and performance.

Hardware Maintenance and Servicing Instructions

Maintenance Tracking and Documentation

Pre-flight, post-flight, and routine inspection findings must be recorded. Tracking when failures occur and comparing them to documented system conditions helps establish accurate maintenance and replacement schedules.

Battery Installation and Charging (Radio Controller)

Radio Controller Battery Power

The Radio Controller is powered by two (2) 18650 lithium-ion cells, operating within a 6.6–8.4 V DC voltage range. Batteries are not included.

Table 19: Radio Controller Charging Parameters

Parameter	Specification
Charging Method	USB-C
Battery Chemistry	3.7 V Li-Ion only
Max Charge Voltage	4.2 V

Radio Controller Battery Installation

1. **Verify** that two (2) batteries are provided with the Radio Controller.
2. **Invert** the controller to access the battery compartment.
3. **Remove** the two rear battery covers.
4. **Identify** the positive battery terminal by the black rubber ring.
5. **Insert** each battery with the positive terminal oriented toward the clip.
6. **Seat** the negative terminal against the spring.
7. **Reinstall** both battery covers securely.

Figure 34: Battery Compartment

Figure 35: Battery Orientation

Charging the Radio Controller

1. **Connect** the USB-C end of the charging cable to the Radio Controller.
2. **Connect** the USB-A end of the cable to a powered USB source.
3. **Observe** the power button illuminate red to confirm charging.
4. **Disconnect** the charging cable once charging is complete.

Figure 36: Controller Charging Port

Cleaning and Lubrication

Do not immerse the system in liquid. After cleaning, allow the aircraft to **dry completely** before flight.

Do not apply grease or lubricants to any part of the UA. Use of Petroleum, Oil, and Lubricant products (POL) can damage plastic components and lead to premature failure of electrical systems.

Wipe down the UA after each mission to maintain optimal performance. The UA should be cleaned using **ONLY** mild soap and water.

A Microfiber Cloth can be used as a lint-free, streak-free, dust and dirt removal material to clean the following:

- Radio Controller Screen
- UA Camera Lenses

Voltage and Resistance Checks

Table 20: Voltage and Resistance Checks

Check Type	Specification
Nominal Voltage	22.2 V
Max Charge Voltage	25.2 V (Do not exceed)
Min Discharge Voltage	18.0 V
Internal Resistance	15 mΩ or less
Replacement Note	Replace if resistance increases significantly.

System Storage Guidelines

Temperature and Humidity Considerations

Store the FANG and all ground equipment in a temperature- and humidity-controlled environment. Avoid exposure to extreme heat, cold, or moisture, as these conditions may damage sensitive components.

Table 21: Recommended FANG Storage Temperature Parameters

Condition	Specification
Temperature	23 ± 2°C (long-term storage)
Humidity	65% RH ± 20%
Storage Charge Level	30–50% (approx. 22.0 V)

Battery Storage

- Dispose of batteries according to local hazardous waste rules.
- Never incinerate, puncture, or crush batteries.
- Replace batteries that experience a significant voltage drop under load.

Table 22: Battery Storage Parameters

Factor	Optimal Condition
Storage Voltage	22.8V (3.8V per cell)
Temperature	23°C ±2°C
Humidity	65% RH ±20%
Storage Location	Fireproof LiPo Bag!

Battery Hazards Table

Table 23: Comprehensive Safety Table: Charging, Discharging, and Storage Hazards & Prevention

Hazard	Extreme Risk Example	How to Avoid It
Overcharging	Above 4.2V per cell (25.2V for 6S) can cause battery swelling, fire, or explosion.	Always use Balance Charge Mode and set the correct cell count and voltage.
Charging Unattended	Fire can spread in seconds if overheating occurs.	Never leave charging batteries unattended; monitor the entire process.
Charging Near Flammable Materials	Paper and wood ignite at 451°F (233°C), but LiPos can exceed 1000°F (538°C) during thermal runaway.	Charge on a fireproof surface, in a LiPo-safe bag, away from paper, cloth, or chemicals.
Using the Wrong Charger	Applying incorrect voltage (e.g., 30V instead of 25.2V) can instantly overheat cells.	Use a LiPo-compatible charger, such as the Q6AC, with the correct settings.
Overcharging a Dead Battery	Attempting to recharge a battery with a voltage below 2.5V per cell can cause internal plating and potentially lead to fire.	Slow charge at 0.1A until the voltage recovers above 3.0V, then proceed to normal charging.
Over-discharging	Below 3.0V per cell (18.0V for a 6S battery) permanently damages the battery, increasing internal resistance and heat buildup.	Stop using it if the voltage drops too low. Check the voltage after each flight/use.
Short Circuits	Sparks, internal short leading to thermal runaway at 600-1000°F (315-540°C).	Never allow terminals to touch; always inspect cables for exposed wires.
Overheating During Use	If a battery exceeds 140°F (60°C), chemical breakdown can start inside the cell.	Monitor battery temperature during use and avoid heavy loads or extended full-throttle runs.
Extreme Cold Discharge	At -10°F (-23°C), internal resistance increases sharply, leading to severe voltage sag and excessive heat.	Keep batteries warm before use by keeping them in insulated bags or preheating if necessary.

Excessive Current Draw	Drawing more than the rated C-rating (e.g., 200A on a 100C 3500mAh pack) can cause overheating.	Use a battery with a high enough C-rating to handle your system's power demand.
Using a Damaged Battery	Swelling of more than 2mm, electrolyte leakage, or a burnt smell can indicate imminent failure.	Discard any battery that is swollen, leaking, punctured, or has frayed wires.
Incorrect Storage	Leaving a LiPo at full charge (25.2V) for more than two (2) days increases fire risk.	Store at 3.8V per cell (22.8V for 6S) in a fireproof bag away from metal objects.
Storage in a Hot Car	Interior temperatures can reach 150°F (65°C) on a sunny day, exceeding safe limits.	Never leave batteries in a car or a closed area exposed to sunlight.
Rapid Temperature Changes	Charging a frozen battery (<32°F or 0°C) can cause internal plating, leading to failure.	Allow batteries to return to room temperature (65-75°F or 18-24°C) before use.
Improper Transportation	Stacking LiPos together or carrying loose batteries can cause accidental shorts.	Transport in a padded, fireproof case with terminals covered.
Incorrect Battery Disposal	Thrown-away LiPos can ignite if punctured by trash compactors.	Fully discharge the battery before disposal and take it to a certified battery recycling center.

Contact Support

Contact Teal Drones Technical Support, Program Manager, or other point of contact for further information.

Technical Support: +1 (385) 281-8415 | support@tealdrones.com

Troubleshooting

Listed below are some basic troubleshooting tips for common system problems. This list is not all-inclusive. Basic troubleshooting may not be sufficient after an incident (e.g., a failure in flight), or damage may be hidden inside the aircraft after a hard landing.

All issues should be recorded. Capture all flight logs to assist in diagnosing the system failure.

Issue: Battery Charger Warning

- **Battery Not Detected:** Check XT60 and balance connections and reseat firmly.
- **Cell Imbalance:** Battery may be aging or misconnected. Use Balance Mode and verify the balance lead.
- **Overvoltage Error:** Incorrect cell count or voltage setting. Stop charging and correct the charger parameters.

Issue: Communication Failure (Control or Video Link Issues)

1. **Inspect** all antennas to confirm they are installed correctly, fully seated, and undamaged.
2. **Scan** the RF environment to identify possible interference or jamming on current frequencies.
3. **Verify** that the aircraft and controller are bound and tuned to the **same** frequencies.
4. **Adjust** transmit power to match mission needs and improve link stability.
5. **Move** closer to the aircraft to regain link quality if signal degradation occurs.
6. **Reorient** the antennas on both the aircraft and controller for optimal alignment.

Issue: Configurator Does Not List ModalAI Targets

1. **Enable** Expert Mode in the ExpressLRS Configurator.
2. **Select** the correct Local Path pointing to the cloned ModalAI repo's **/src** directory.
3. **Restart** the Configurator and check again.

Issue: No Serial Port Appears

1. **Replug** the USB cable into the computer and radio/module.
2. **Use** a known good USB *data* cable (not a charge-only cable).
3. **Install** any required USB drivers (CP210x / FTDI if applicable).
4. **Check** Device Manager (Windows) or ls /dev/tty* (macOS/Linux) for the port.

Issue: Passthrough Fails Mid-Flash

1. **Update** EdgeTX on the radio to the latest supported version.
2. **Retry** the passthrough flashing process.
3. **Switch** to UART (Serial) flashing using a direct cable if passthrough continues to fail.

Issue: Lua Script Stuck at “Loading…”

1. **Verify** the module is flashed with a matching major ELRS version as the radio.
2. **Enable** the internal/external ELRS module in the radio model.
3. **Re-launch** the ExpressLRS Lua script after confirming module settings.

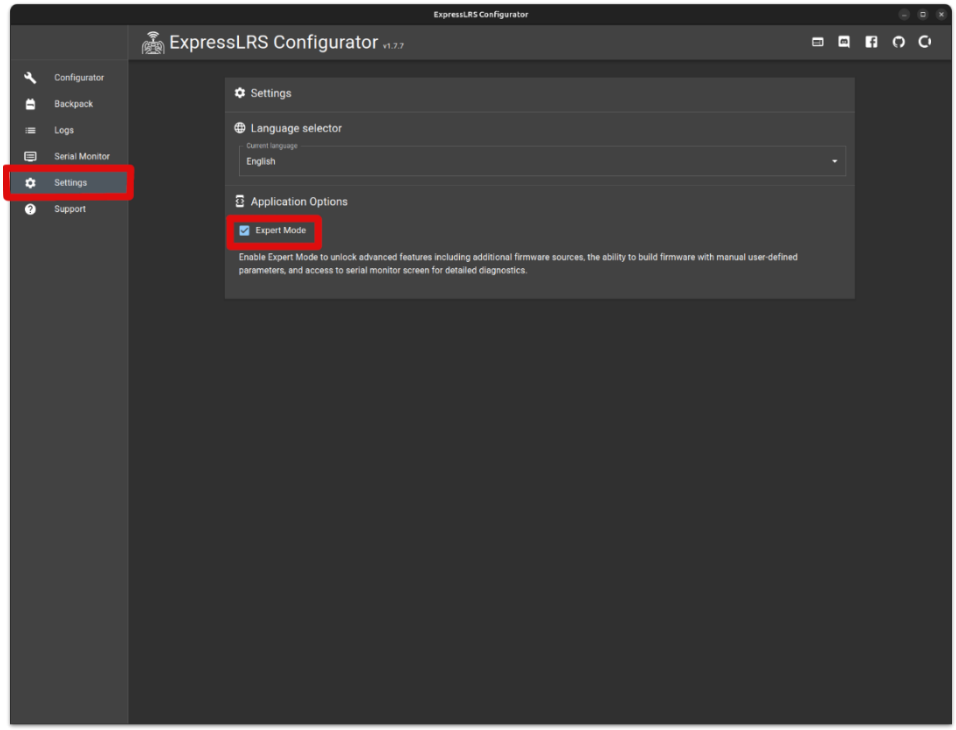

Figure 37: ExpressLRS Configurator » Settings » Expert Mode

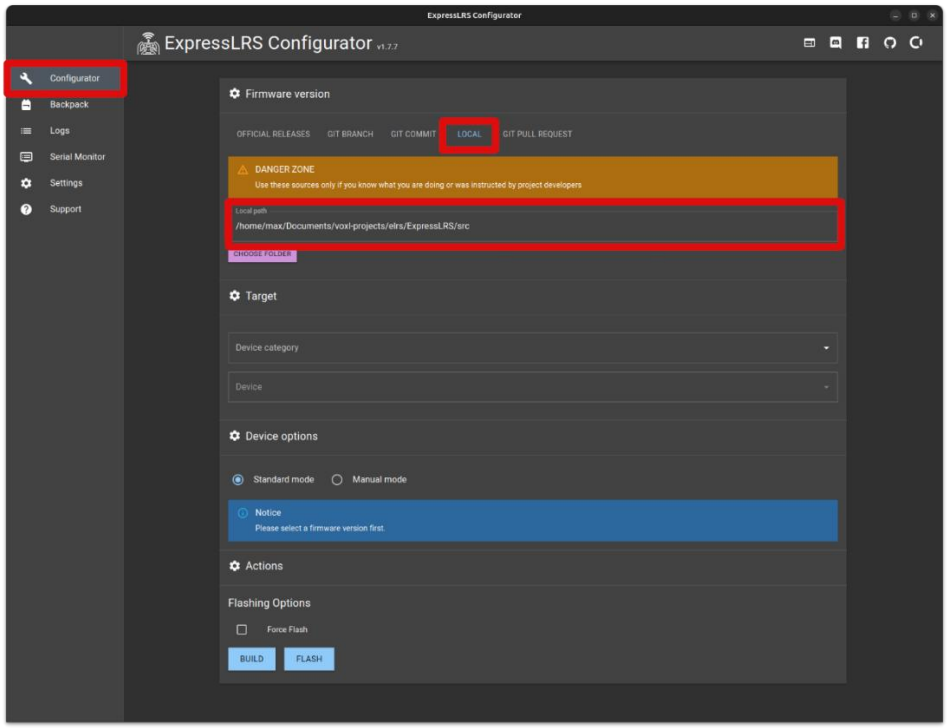

Figure 38: ExpressLRS Configurator » Configurator » LOCAL

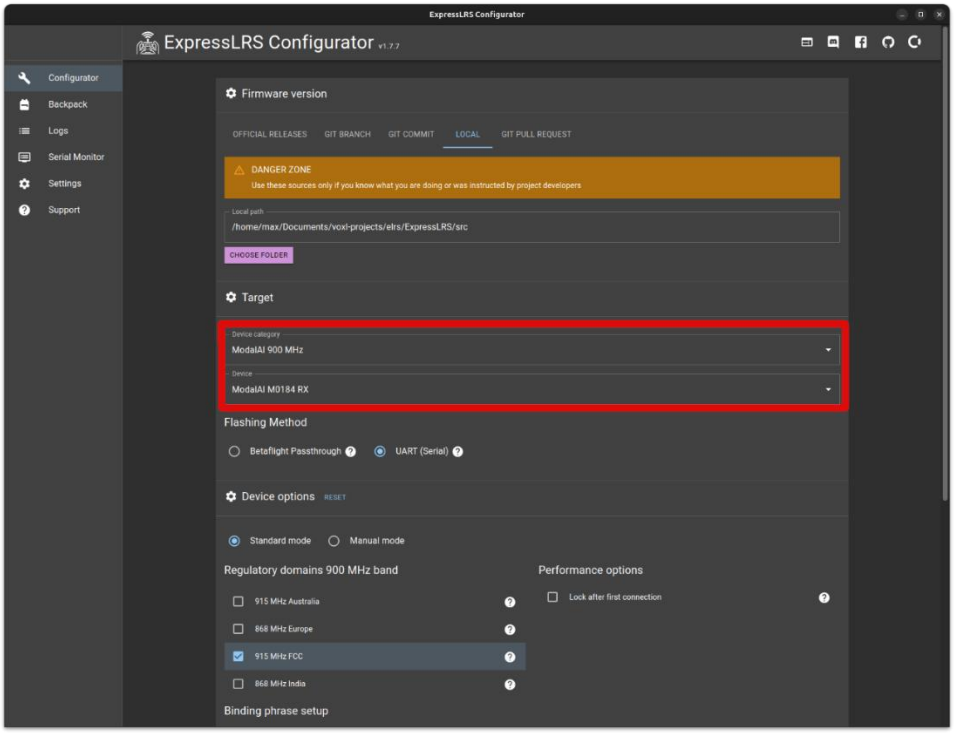

Figure 39: ExpressLRS Configurator » Configurator » LOCAL » Target

END OF MANUAL