Vision Aerial

Vector Flight Manual

Revision F.0 | September 2024

REVISION HISTORY

Revision	Date	Description
F.0	September 2024	Mark 2.5 Update
E.0	February 2022	Warranty Revision
D.0	November 2021	Flight Deck updates
C.0	July 2021	Mark 2 updates
B.0	May 2017	Transmitter manual and battery charger images updated
A.0	March 2017	Initial Release

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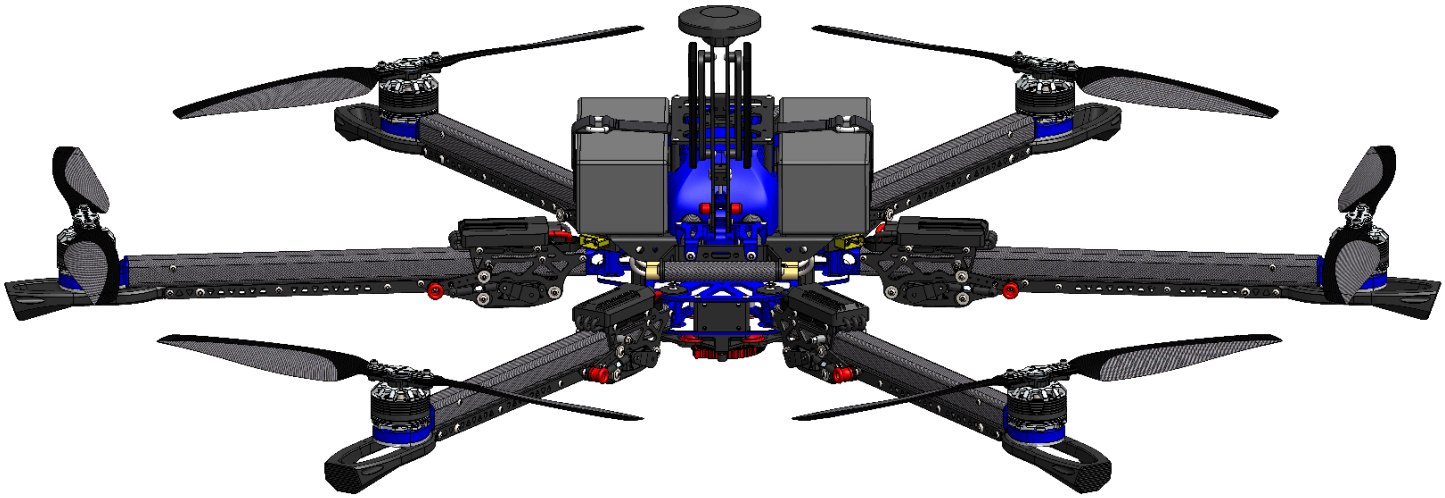


Vector Overview

DISCLAIMER AND WARNING

Please read this disclaimer and warning carefully and review the Vector manual prior to flight.

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

The Vector is not a toy and should be operated with extreme care, as improper operation can cause damage to property, serious personal injury, or death.

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

✔ Always check the Vector and its components prior to operation (see PREFLIGHT section).

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

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

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

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

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

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

✔ Only use rotors supplied by Vision Aerial that are designed for use on the Vector.

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

SAFETY

It is your responsibility to learn how to safely operate the Vector and to adhere to all applicable rules and regulations.

Fly at your own risk.

The Vector is a tuned system with custom components selected for each application. Modification to, removal, or substitution of Vector components will void the warranty and can lead to unsafe operating conditions.

Limitation of Liability:

IN NO EVENT SHALL VISION AERIAL BE LIABLE TO BUYER FOR ANY INDIRECT, CONSEQUENTIAL, PUNITIVE, INCIDENTAL, SPECIAL DAMAGES, OR ANY DAMAGES WHATSOEVER RESULTING FROM THE USE OF THE VISION AERIAL DRONES OR FOR LOSS OF USE, DATA OR PROFITS (HOWEVER CAUSED AND UNDER ANY THEORY OF LIABILITY), EVEN IF VISION AERIAL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL VISION AERIAL'S LIABILITY FOR A PRODUCT (WHETHER ASSERTED AS A TORT CLAIM, A CONTRACT CLAIM OR OTHERWISE) EXCEED THE AMOUNTS PAID TO VISION AERIAL FOR SUCH PRODUCT. NOTWITHSTANDING ANYTHING HEREIN, IN NO EVENT SHALL VISION AERIAL'S LIABILITY FOR ALL CLAIMS ARISING OUT OF OR RELATING TO THIS AGREEMENT EXCEED THE AMOUNTS PAID BY BUYER TO VISION AERIAL FOR PRODUCT IN THE LAST TWELVE (12) MONTHS. IN NO EVENT WILL VISION AERIAL BE LIABLE FOR COSTS OF PROCUREMENT OR SUBSTITUTE GOODS BY BUYER. THE LIMITATIONS SET FORTH HEREIN SHALL APPLY TO ALL LIABILITIES THAT MAY ARISE OUT OF THIRD-PARTY CLAIMS AGAINST BUYER. THESE LIMITATIONS SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

Vision Aerial shall not be liable for damages or injuries incurred directly or indirectly from maintenance and servicing including, but not limited to, the following situations:

- Failure of the pilot and/or technician to follow proper instructions and safety warnings.
- Failure of the pilot and/or technician to follow and comply with local rules and regulations.
- Failure of the pilot and/or technician to inspect the drone and its components prior to operation.
- Failure of the pilot and/or technician to properly maintain and/or service the drone through an authorized Vision Aerial service center with genuine Vision Aerial parts.
- Use of third-party products on the Vision Aerial drones.

- Use of the Vision Aerial drones in a physically or mentally impaired capacity.
- Use of or servicing of Vision Aerial drones without sufficient training.
- Use of or access of Vision Aerial drones advanced settings without proper written authorization from a representative of Vision Aerial.
- Use of the Vision Aerial drones in unsafe conditions, including but not limited to, bad or severe weather, such as rain, wind, snow, lightning, dust storms, etc., or in areas of magnetic or radio interference, such as power stations, broadcasting and cell phone towers, government prohibited airspace, etc.
- Improper operation, misjudgment, or risky behavior while using a Vision Aerial drone.
- Infringement of third-party data, audio, or video rights recorded when using the Vision Aerial drones.

Limited Warranty

Vision Aerial Inc. (“Manufacturer”) warrants to the original end user (“Purchaser”) that for one year following the date of delivery of our Product (“Warranty Period”), the Product (excluding (i) any third party made products and (ii) any third party software) will be free from defects in materials and workmanship when properly installed and used for its intended purpose and in its intended operating environment. This warranty does not apply to any Product that has been: (i) altered, repaired or modified or (ii) damaged or destroyed by accidents or similar events or by any intentional, reckless or negligent acts or omissions of any party other than Manufacturer. In the event of a defect, return the Product to the original place of purchase or Manufacturer, but only after instructed to do so by the Manufacturer. Purchaser shall ship and bear the cost of shipping the Product to Manufacturer and Manufacturer shall bear the cost of shipping the Product back to Purchaser after the completion of service under this limited warranty. Purchaser’s exclusive remedy and Manufacturer’s entire liability under this warranty will be for Manufacturer at its option to repair or replace the Product or refund purchase price less any rebates. Purchaser assumes all liability, and as such releases Manufacturer from any liability, for any accident, injury, damage, death, loss, illegal activity or any other claim that may occur resulting from or during use of the Product, whether or not such use is foreseeable by Manufacturer.

MANUFACTURER HEREBY DISCLAIMS ALL IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, OF MERCHANTABILITY, NON-INFRINGEMENT, OR FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO THE DURATION OF THE APPLICABLE EXPRESS WARRANTY. Some jurisdictions do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to Purchaser. This warranty gives Purchaser specific legal rights, and Purchaser may also have other rights which vary by jurisdiction.

All third party software provided with the Product is provided “AS IS”. Purchaser assumes the entire risk as to the quality, performance, accuracy and effect of such software, and should it prove defective, Purchaser, and not Manufacturer, assumes the entire cost of all necessary servicing or repair. TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL MANUFACTURER BE LIABLE FOR ANY LOST DATA, REVENUE OR PROFIT, OR FOR SPECIAL, INDIRECT, CONSEQUENTIAL, INCIDENTAL OR PUNITIVE DAMAGES, HOWEVER CAUSED REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF OR RELATED TO THE USE OF OR INABILITY TO USE THE PRODUCT, INCLUDING DAMAGE TO PAYLOAD, EVEN IF MANUFACTURER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT WILL MANUFACTURER’S LIABILITY EXCEED THE AMOUNT PAID BY PURCHASER FOR THE PRODUCT (EXCLUDING PAYLOAD OR OTHER COMPONENTS NOT MANUFACTURED BY MANUFACTURER).

The foregoing limitations will apply even if any warranty or remedy provided under this Agreement fails of its essential purpose. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to Purchaser.

Manufacturer Disclaimer: All purchasers, users, and any or all parties involved or engaging in the use of Products agree to the following:

- Manufacturer does not promote or endorse high risk, careless and/or dangerous actions when using its products.
- Manufacturer is not liable for any use or misuse of its products.

Governing Law and Arbitration. This Limited Warranty shall be governed by the laws of the State of Montana without giving effect to any conflict of laws principles that may provide the application of the law of another jurisdiction. Any claim or dispute in connection with this Limited Warranty shall be resolved in a cost effective manner through binding non-appearance-based arbitration. The arbitration shall be initiated through an established alternative dispute resolution provider mutually agreed upon by the parties. The alternative dispute resolution provider and the parties must comply with the following rules: a) the arbitration shall be conducted by telephone, online and/or be solely based on written submissions, the specific manner shall be chosen by the party initiating the arbitration; b) the arbitration shall not involve any personal appearance by the parties or witnesses unless otherwise mutually agreed by the parties; and c) any judgment on the award rendered by the arbitrator may be entered in any court of competent jurisdiction. If the foregoing arbitration clause does not apply for any reason, you agree to submit to the personal jurisdiction of the state courts located within Gallatin County, Montana for the purpose of litigating all such claims or disputes, which courts shall have exclusive jurisdiction of such claims or disputes. Notwithstanding the foregoing, Manufacturer may seek injunctive or other equitable relief to protect its intellectual property rights in any court of competent jurisdiction.

CAUTIONS AND WARRANTY

Repairing or Modifying: Never attempt to repair or modify any Product yourself. Disassembling a Product, including the removal of external components, may cause damage that is not covered under the warranty. The Product does not contain any user-replaceable parts, excluding, but not limited to; rotors and batteries.

USE OF THIS MANUAL

Warning: Failure to follow these safety instructions could result in injury or damage.

Scope
This manual provides the best operating instructions for most circumstances. It is not a replacement for sound judgment. The procedures outlined within are to provide the user with the best possible experience given a wide range of applications. This manual intends to inform and educate the user on how to properly and effectively control, fly, and utilize the full functionality of the Vector. It is ill-advised to operate and fly the Vector without first reading and understanding the information and guidelines presented in this document.

Order
The manual is written in such a manner to facilitate a logical flow of information as if the user was starting with a completely stored UAS and moving through progressions of flight use. The following has been an expansion of pilot pocket checklists and follows that continuity, The flight manual may expand on procedures and conditions that may not be fully described in the pocket checklists. Continuity may vary upon the circumstance and use case for the UAS.

Use of Terminology
The following are descriptors used when describing procedures and conditions of the UAS.

Warning: Denotes an operating procedure, practice or condition that if not carefully followed may result in death or injury.

Caution: Denotes an operating procedure, practice or condition that if not carefully followed may result in damage to equipment.

Note: Denotes an operating procedure, practice or condition that is essential to emphasize.

Shall: Indicates application of a procedure is mandatory

Should: Indicates application of a procedure is recommended

May: Indicates application of a procedure is optional

Will: Indicates futurity

Land as soon as practicable: Extended flight is not recommended, duration is at the discretion of the operator

Land as soon as possible: Land at the nearest site where a safe landing can be made

Land immediately: Execute landing without delay

INTRODUCTION

The Vector is a hexacopter drone with powerful, efficient electric motors and cutting-edge flight components. Not only is the Vector easy to fly, it is also capable of lifting up to 11 pound payloads. It folds so it can be stowed in a case for easy transport. When you need to fly, you can transition from case to in the air in less than two minutes.

ITEMS INCLUDED

The Vector package includes:

1. (1) Vector Hexacopter
2. (1) Controller & Charger
3. (2) Batteries
4. (1) Battery Charger & Accessories
5. (1) Hard Transport Case
6. (1) Hardware and Tool Kit

SPECIFICATIONS

Aircraft Specifications

Arms	Carbon Fiber
Frame & Hardware	Aluminum / Stainless Steel
Body	Polycarbonate
Motors	360kv (1125W)
Rotors	Carbon Fiber, Folding and Precision Balanced
Flight Controller	Cube
Controller	Herelink
Flight Dimensions	1050 mm (41.34 in) diameter
Storage Dimensions	1087 x 264 mm (42.7 x 10.4 in)
Case Dimensions	147 x 48 x 28 cm (58 x 19 x 11 in)
Aircraft Weight (Without Battery)	12 kg (26.5 lb)
Aircraft Weight (With Battery)	15.8 kg (34.8 lb)

Battery / Charger

Flight Battery (Previous models)	16,000 mAh 6S Lithium Polymer (1.9 kg)
Flight Battery (2021 and newer)	22,000 mAh 6S Solid State Lithium Ion (1.9 kg)
Battery Charger	High Capacity AC dual battery charger

Flight Operations

Direct Control Range	20 km (12.4 miles)
Autonomous Flight Range (dependant on environmental conditions)	Over 25 km (16 miles)
Max Operational Wind Speed	32 kph (20 mph)
Max Operational Altitude	4500 m (14,800 ft) Above Sea Level
Operational Temperature Range	-15º C to 45º C (5º F to 113º F)
GPS Accuracy non-RTK corrected	±2.5 meters (± 8.2 feet), typically < ±1 meter
GPS Accuracy RTK corrected (Optional)	±0.1 meters (±0.33 feet)

Payloads

Max Payload	5 kg (11 lb)
Recommended Payload	
Payload Mounting: Vision Aerial - Payload Connection System	45 mm square bolt pattern 32 mm square bolt pattern 20 mm circle bolt pattern
Electrical Connections	See Payload Connection System Section
Center of Mass	Adjustable Using Battery Positioning

Vector Setup

SETTING UP THE VECTOR

Charge Flight Batteries

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

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

Hot Swapping Batteries

Under certain circumstances, you may want to “hot swap” batteries on a Vector. Some payloads will benefit from maintaining power while batteries are changed. To hot swap batteries on a Vector, simply replace one battery fully before disconnecting and replacing the second battery. As long as one battery is attached, power will be provided to the payload.

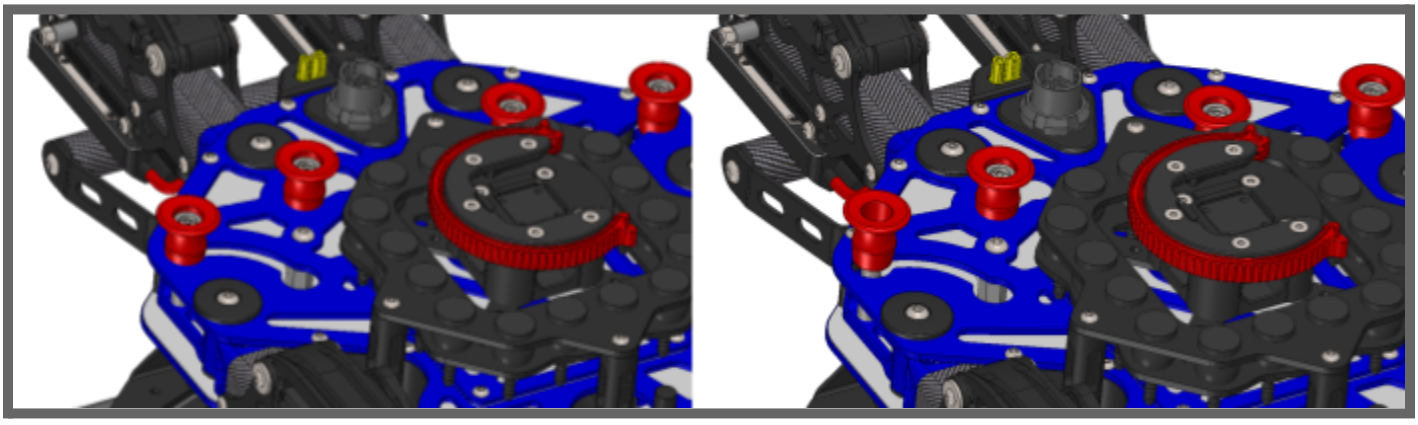
See Appendix for full instructions.

See Battery Safety for more information.

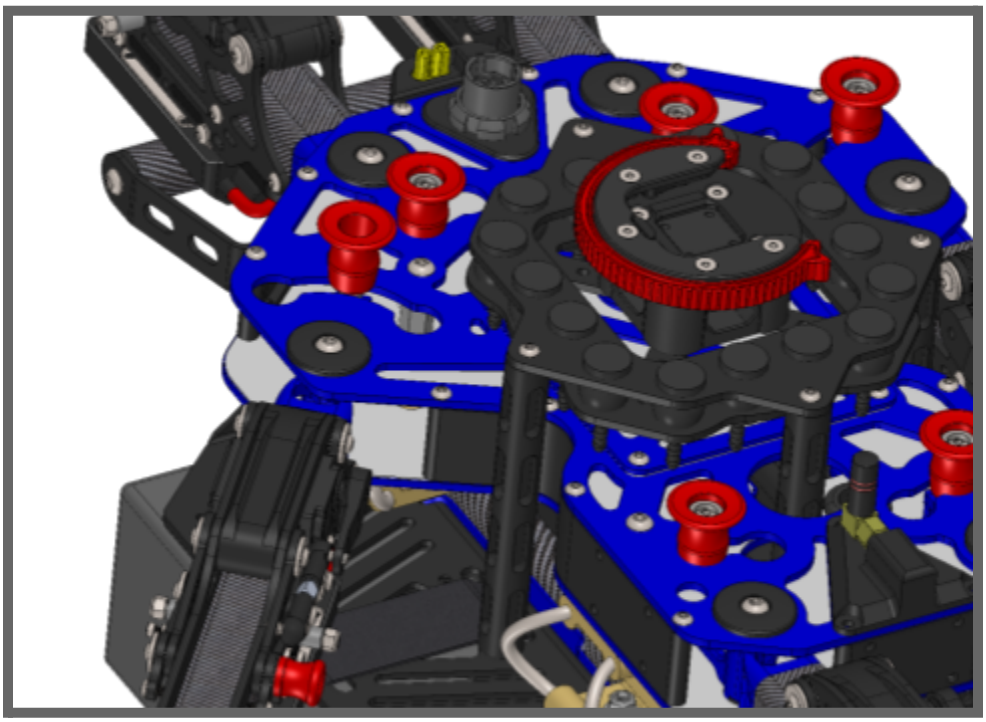
Extending the Arms

The Vector features two arms that fold in and lock for compact travel, protection, and safety. The arms are secured with red, spring-loaded pull knobs underneath the chassis.

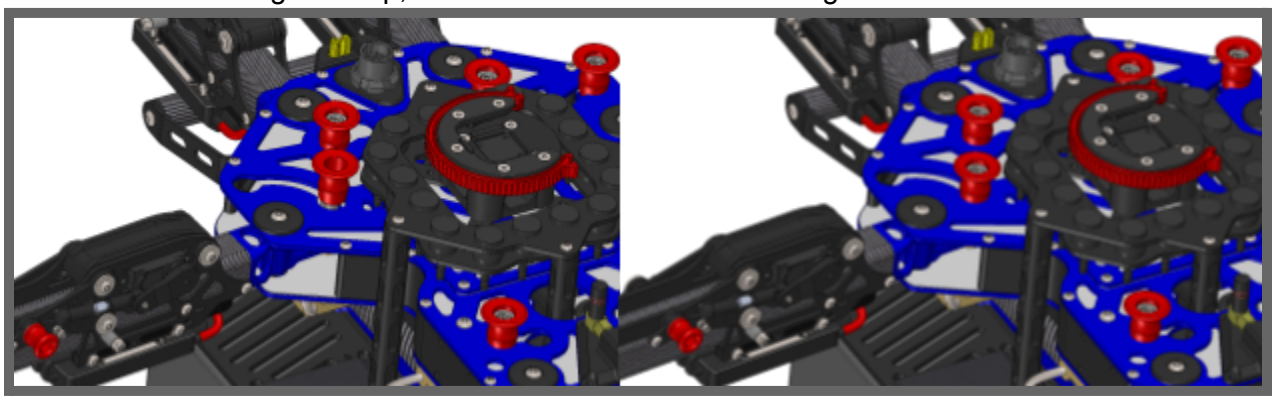
- Remove the Vector from its case.
- Select one arm and pull out on the corresponding red knob.



- Rotate the arm away from the body.



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

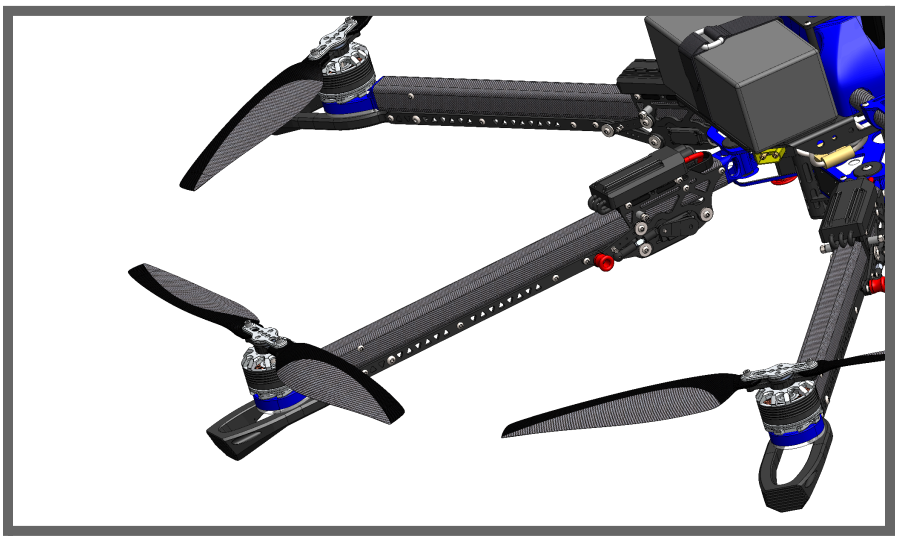


- Gently move the arm back and forth to verify the knob is engaged and seated thoroughly.
- Repeat the process with the other arms.

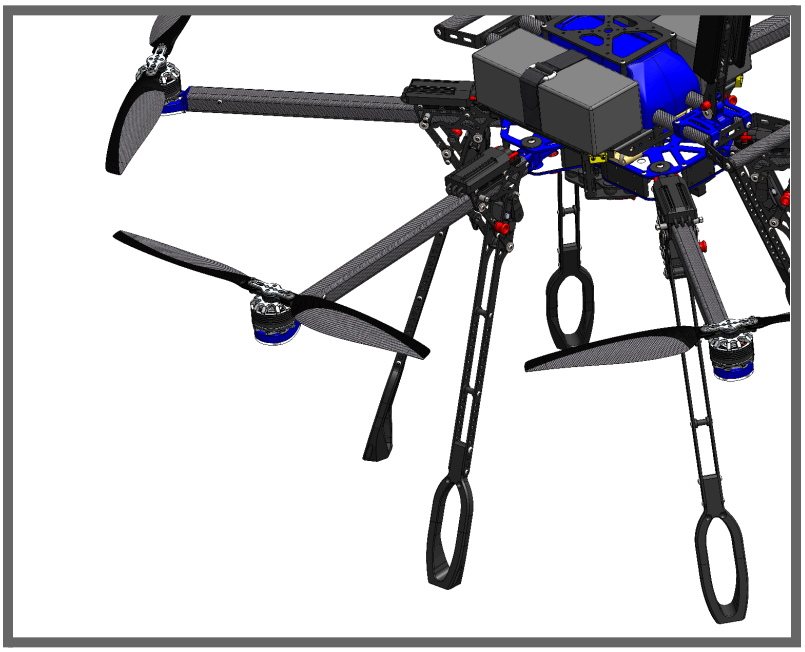
Deploy the landing gear

The Vector features six retractable landing gear arms that fold in and lock for compact travel, protection, and safety. The landing gear can be manually extended/retracted or extended and retracted by electromechanical means via the GCS.

1. Securely hold the drone. Gently pull the red knob located on the retract away from the arm.



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

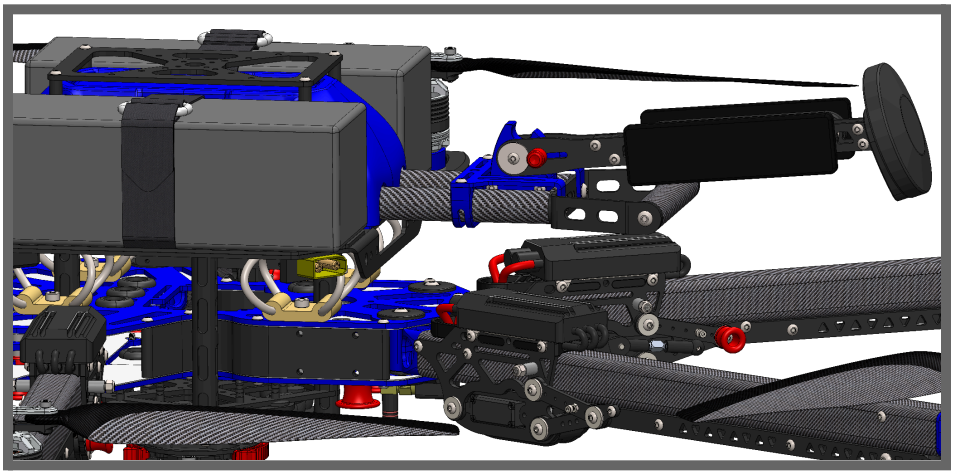


⚠ ***CAUTION: The landing gear arms shall not be extended while the vehicle is powered. Damage to the servos may occur.***

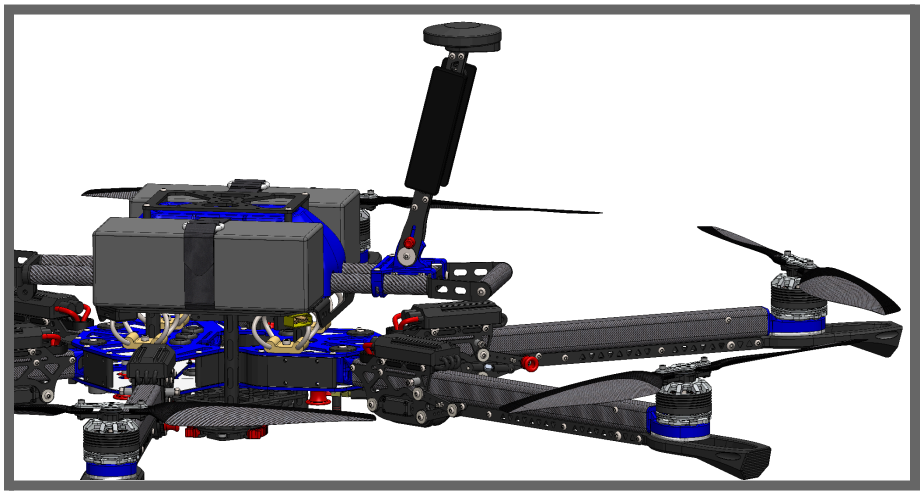
⚠ **CAUTION**: ***The landing gear remains functional while the vehicle is on the ground. Extension or retraction of the landing gear while the vehicle is grounded may cause damage to the servos and/or an attached payload.***

Raise and secure the GPS mast.

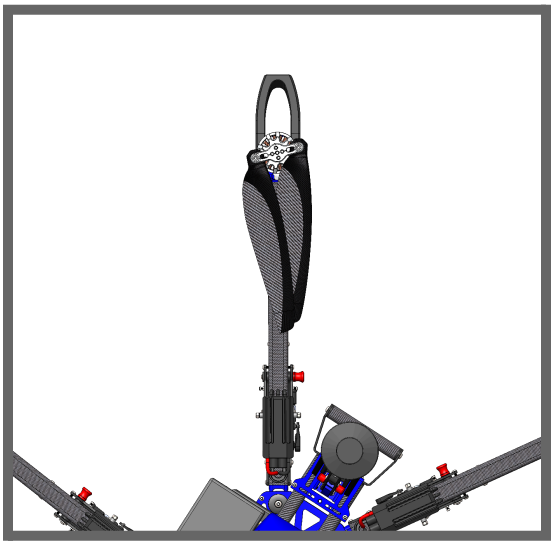
1. Slide the red pins back to unlock them from the stowed position.



2. Once the pins are released, gently lift the mast to raise it into an upright position. The red pins will lock into place once the mast is properly seated.



Extend Rotors



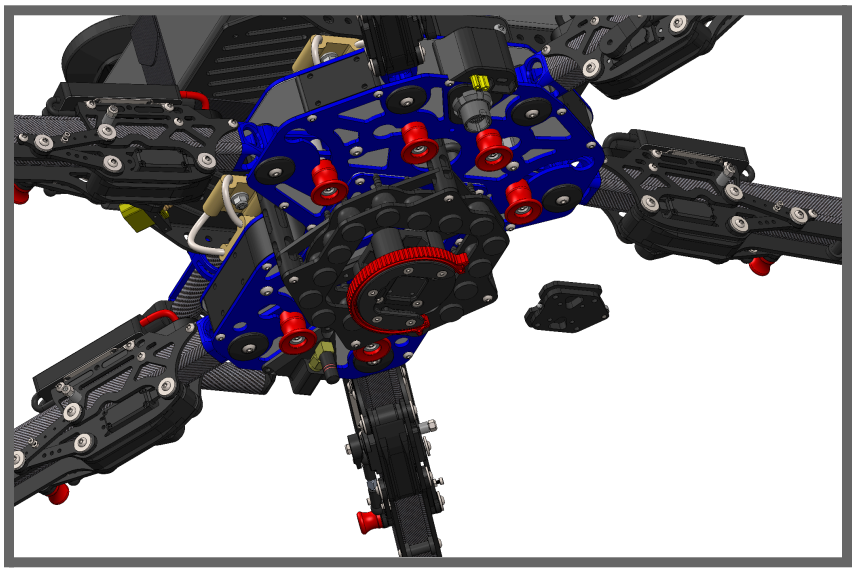
1. Unfold each rotor so the blades point in opposite directions along the long dimension of the blade mount for all six rotors. Verify that the rotor hub tension is correct. See Maintenance section for proper hub tension and servicing of rotor system.
2. Remove protective blade sleeves before flight.

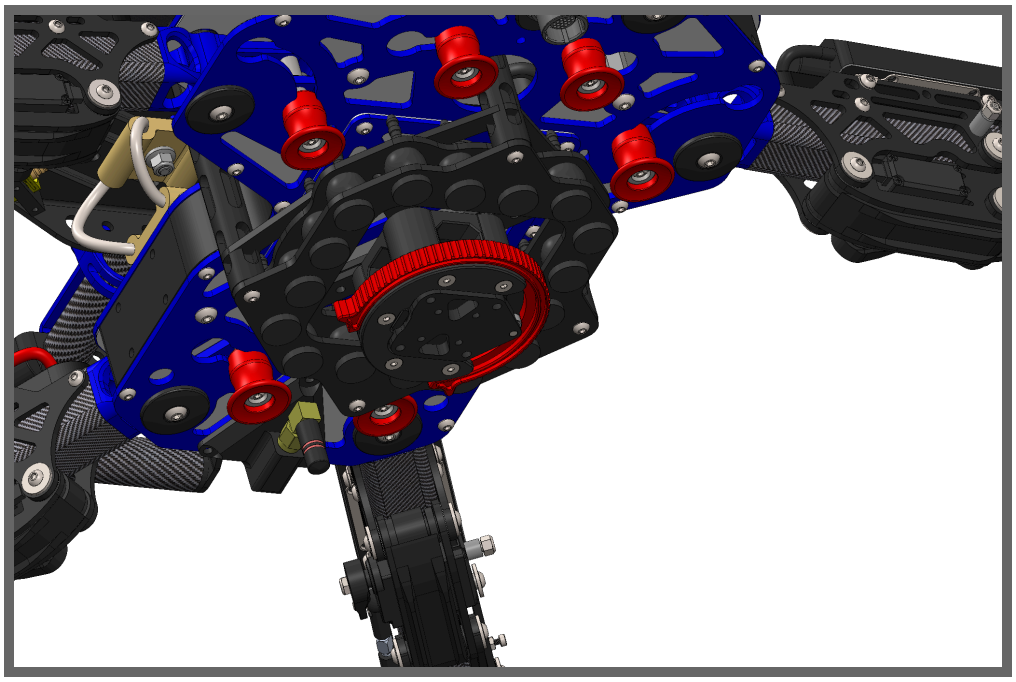
Attach Payloads Using the Payload Connection System (PCS)

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

Inspect the PCS by visually verifying the secure attachment of the mounting plate to the vehicle. Use a “Heavy Touch” for verification of component integrity and security. Inspect rubber dampers for tears, displacement or leaking fluid.

Slide the payload into place. The payload mounting bracket on the top slides into the opening on the payload connection system on the belly of the aircraft. (Note: Payload is not shown in this illustration for clarity.)

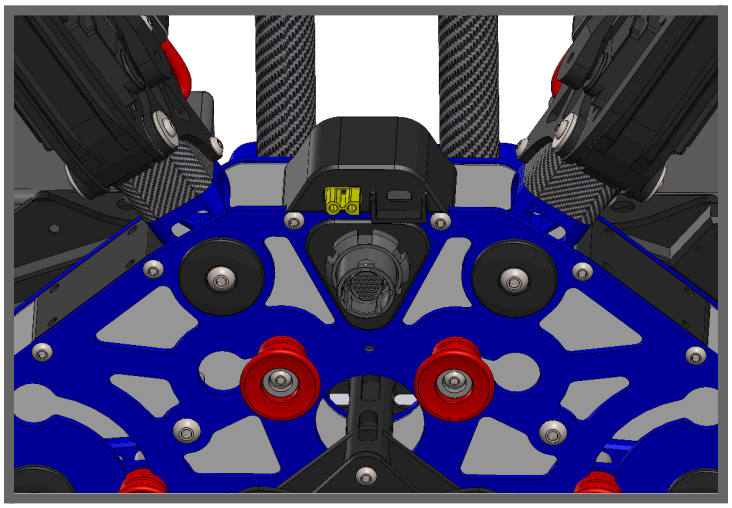




Once the payload is seated, rotate the red ring to secure it.

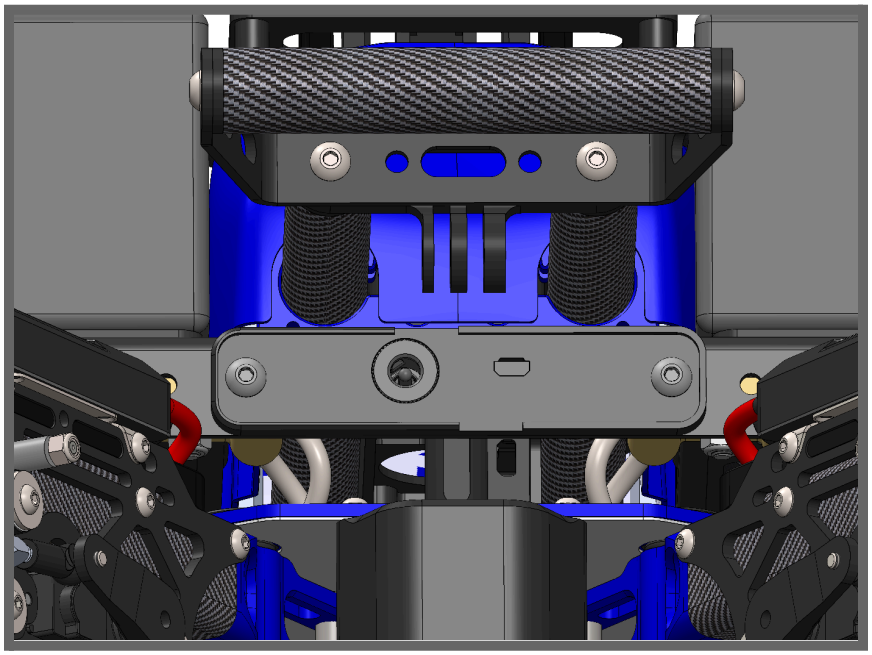
Plug in the payload to the Connector Interface. Any Vision Aerial payload will come with one or more of the appropriate connector(s) listed below.

- For low power and data, connect the primary payload connector.
- For video, connect the HDMI connector from your payload to the EPCS.
- For high power, connect the XT-30 connector from your payload to the EPCS.



Turn on your payload (if applicable)

Pull back cover and plug in payload power and video into the Secondary Interface for nose-mounted payloads (if applicable)



⚠ **NOTE**: ***Payloads cannot be hot swapped. Power shall be removed for payload changes.***

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

Install vehicle battery

Place the battery into the battery cradle on top of the vehicle with the rubber side of the battery down. Secure the battery in place tightly with the attached velcro strap.

⚠ **NOTE:** ***Users should power the vehicle after the GCS is powered and proper applications are open.***

Visual PreFlight

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

See Appendix for Checklists

Power up the Ground Control Station (GCS)

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

Select the “Flight Deck” application and open the program with the soft key,

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

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

Power up the vehicle

Power up the aircraft by plugging the battery connector in. Leave the aircraft motionless for 10 seconds to allow the gyroscopes to calibrate. (Indicator light will flash red/blue during calibration.)

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

- **Pulsing Blue-Disarmed, No GPS Lock:** Similar to above, but your vehicle is disarmed. This means you will not be able to control motors, but all other subsystems are working.
- **Solid Blue-Armed, No GPS Lock:** Indicates vehicle has been armed and has no position lock from a GPS unit.
- **Pulsing Green-Disarmed, GPS Lock:** Similar to above, but your vehicle is disarmed. This means you will not be able to control motors, but all other subsystems including GPS position lock are working.
- **Fast Flashing Green-Armed, GPS Lock:** Indicates vehicle has been armed and has a valid position lock from a GPS unit with more than DGPS signal attained.
- **Solid Green-Armed, GPS Lock:** Indicates vehicle has been armed and has a valid position lock from a GPS unit.
- **Solid Purple-Failsafe Mode:** This mode will activate whenever a vehicle encounters an issue during flight, such as losing link with GCS, a critically low battery, or an internal error. In the event of a critically low battery or loss of GPS signal, default failsafe settings will execute a landing sequence (user definable).
- **Solid Amber-Low Battery Warning:** Indicates your vehicle's battery is running dangerously low. After a certain point, the vehicle will go into failsafe mode. However,

this mode should signal caution that it's time to end this flight.

- **Blinking Red-Error / Setup Required:** Indicates that your autopilot needs to be configured or calibrated before flying.

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

GROUND CONTROL STATION (GCS)

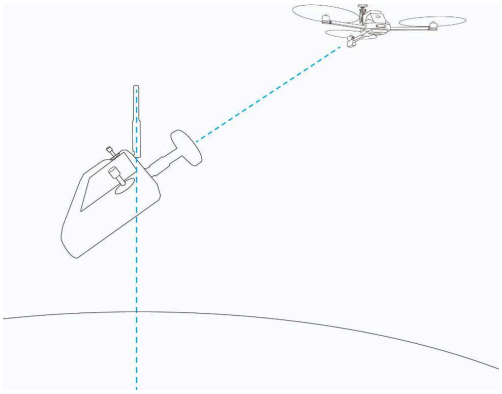
The Vector comes with a GCS ground control station. To charge the controller, plug the included charger into a power source and the other end into the charging socket on the back of the controller (Micro USB port).

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

For additional information see Appendix.

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

Controller Antenna Configuration



For the strongest connection to the Vector, position the Omni-Directional antenna so its vertical axis is in alignment with the center of the earth, or perpendicular to the ground. Position the Directional antenna so it points at the aircraft.

Vehicle Battery Selection

The user should select the proper battery chemistry in the Flight Deck Application. When the user selects the soft battery key icon in the top middle menu of the Flight Deck application a drop down menu will appear. The user will then select Solid State (SS) or LiPo chemistry.

CAUTION: ***Failure to select the proper battery chemistry will render the “percentage of battery charge” indicator inaccurate.***

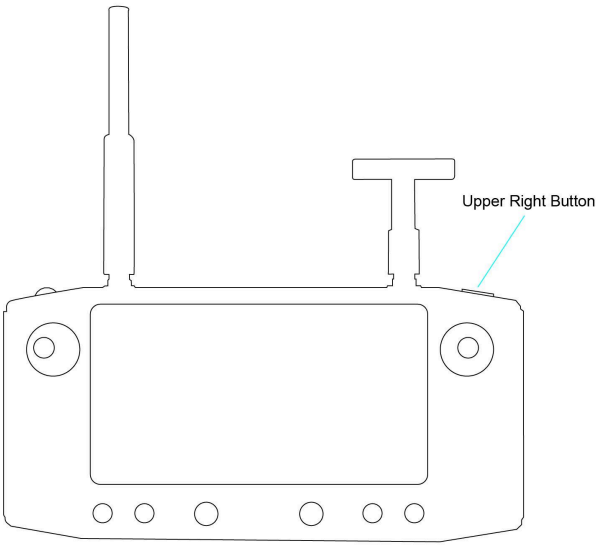
FLIGHT MODES

The Vector comes programmed standard with six different flight modes:

- **MANUAL**: Vehicle responds to user inputs. Altitude and GPS functions augment a stable vehicle response.
- **BRAKE**: Vehicle holds position, joysticks deactivated (Prevents unintentional user input)
- **AUTO**: Engages pre-programmed autonomous mission (User adjustable)
- **GUIDED:** Autonomous mode directing to user selected waypoint.
- **RTL**: **R**eturn-**T**o-**L**aunch site at pre-programmed altitude (User adjustable)
- **LAND**: Land vehicle at current location

Manual Mode

The active flight mode, Manual Mode, is adjusted by tapping the upper right button on the GCS Controller. MANUAL mode allows for user inputs but



⚠ **NOTE**: ***In Manual Mode, the joystick movements are directly proportional to the ground speed of the Vector.***

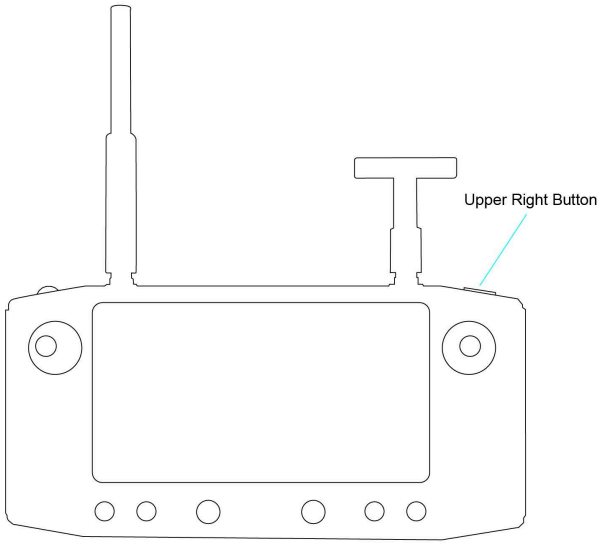
⚠ **NOTE:** ***If the roll joystick is moved left to half of its travel, the Vector will choose its roll angle to achieve 50% of the programmed max ground speed for that direction***.

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

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

Brake Mode

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



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

This mode is activated by tapping the upper right button on the GCS.

Autonomous Flight (AUTO)

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

How to use Auto Flight Mode:

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

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

To learn more about Mission Planning, see Flight Deck Manual

Guided flight mode

The GUIDED mode is used when it is desired for the aircraft to fly to a specific waypoint on the map without setting up a mission. After the vehicle flies to the specified point the mode will switch to Manual awaiting further direction from the user.

Return to Launch (RTL)

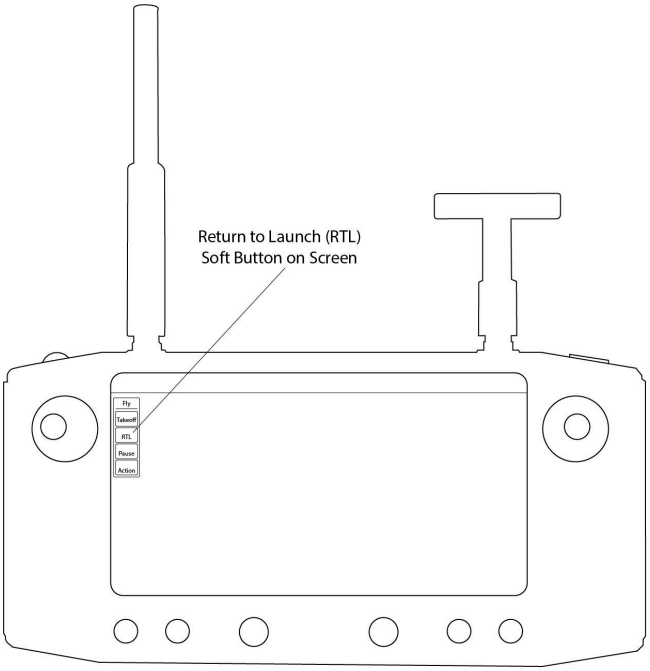
When RTL is activated (and the vehicle has GPS lock), the Vector will autonomously climb to 50 meters by default (user adjustable in Flight Deck) or maintain altitude if above 50 meters. The vehicle will then return to the launch location on a direct path, hover for 5 seconds, deploy its landing gear,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

There are three ways RTL Mode can be activated:

1. RTL is initiated automatically when battery voltage drops below 30% for 10 continuous seconds (Factory preset). The GCS will produce an audible “Low Voltage” warning followed by a “Return to Launch” audible warning.

2. RTL can also be manually activated by selecting the “RTL” soft button on the main menu of the Flight Deck. The user will need to verify this action by the “Slide to confirm” soft key. The GCS will also produce an audible “Return to Launch” cue.

3. Return to Launch can also be activated as a final stage in Mission Planning. See Flight Deck Manual.



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

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

Return to Launch (RTL) Mode as a Failsafe Protocol
Return to Launch will be activated automatically if the Vector loses communication with the controller. To learn more about failsafe modes, see Emergency Procedures.

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

NOTE: ***During the descent portion of the landing sequence the landing cycle can be aborted by holding the throttle at 100%.***

Land Mode

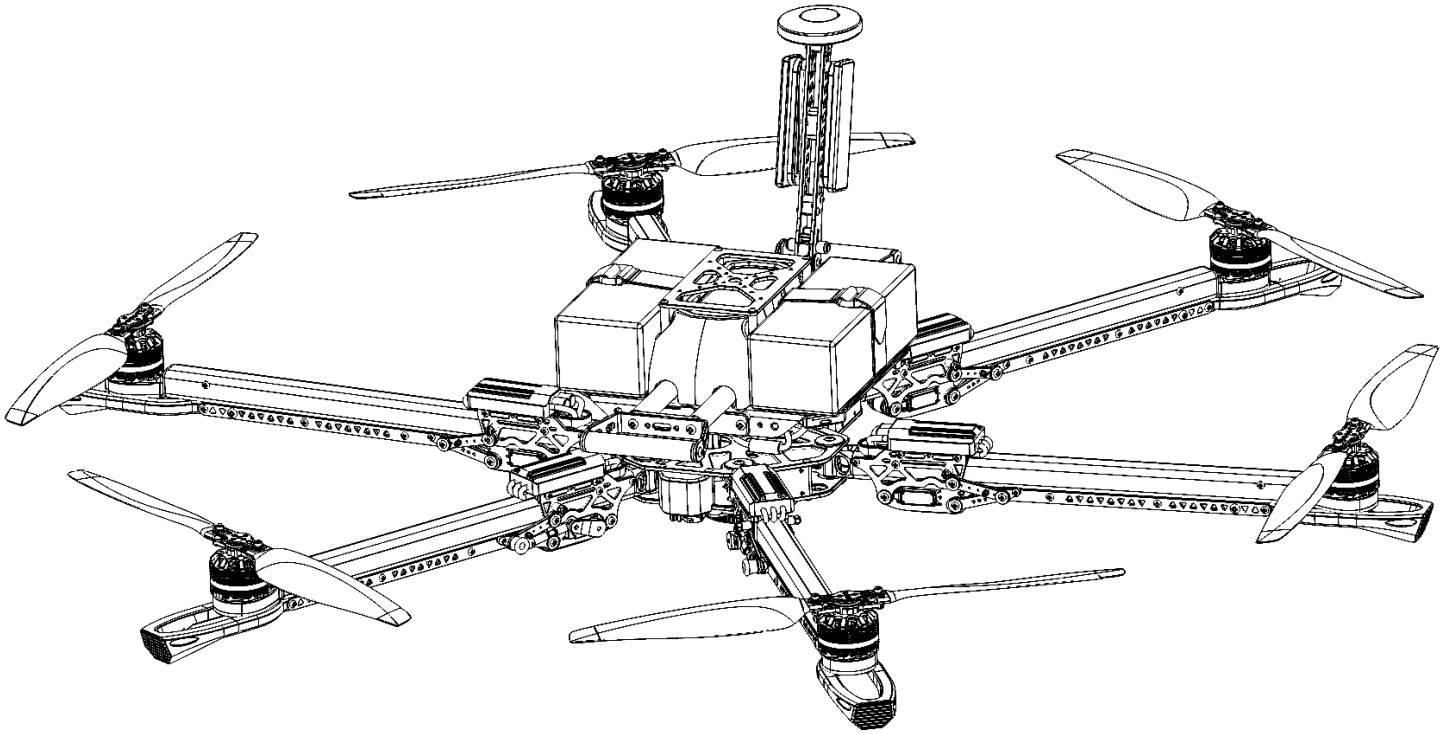
When Land Mode is activated, the Vector will deploy its landing gear and begin a gentle descent over its current position. It is recommended to use a 6 meter diameter or larger landing environment, as the accuracy of the GPS can vary up to ±2.5m.

Land Mode is initiated by pressing “Land” on the GCS screen and sliding to confirm.

Land Mode as a Failsafe Protocol
Land Mode will automatically be activated if the battery becomes critically low. In most situations, this failsafe will prevent the aircraft from uncontrolled descents from altitudes of <10m. It is not recommended to fly the Vector when it has less than 20% of its available battery capacity, to ensure an adequate margin of safety.

To learn more about failsafe modes, see Emergency Procedures.

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



Operating Procedures

PREFLIGHT CHECKLIST

The first step for any flight is to make sure the environment is safe for flight.

> ⚠ **WARNING:** ***Do not fly the Vector indoors. Always fly outside in clear, open areas at a safe distance from yourself, other people, power lines, obstacles, and buildings. As the pilot, you are responsible for navigating the Vector to avoid obstacles.***
>
> ⚠ **CAUTION:** ***Do not fly within 5 miles of an airport or any airspace restricted by your local, state, or national airspace authority without proper authorization. As the pilot, you are responsible for knowing and understanding the regulations that govern small unmanned aircraft like the Vector in your jurisdiction (check resources like the B4Ufly app).***
>
> ⚠ **CAUTION:** ***Don't fly the Vector in extreme weather conditions such as rain, high winds, snow, or fog. Extreme weather conditions can permanently damage the Vector or cause instability in flight.***
>
> ⚠ **CAUTION:** ***Determine safe flight boundaries at your location. Be aware of any risks, including bodies of water, structures, trees, power lines, etc, and designate a few areas where you can land the Vector in case of an unsafe situation. Throughout your flight, be prepared to recover the Vector manually or use an emergency procedure if the Vector flies outside the safe flying area.***

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

ARMING / TAKEOFF

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

Arming for Takeoff

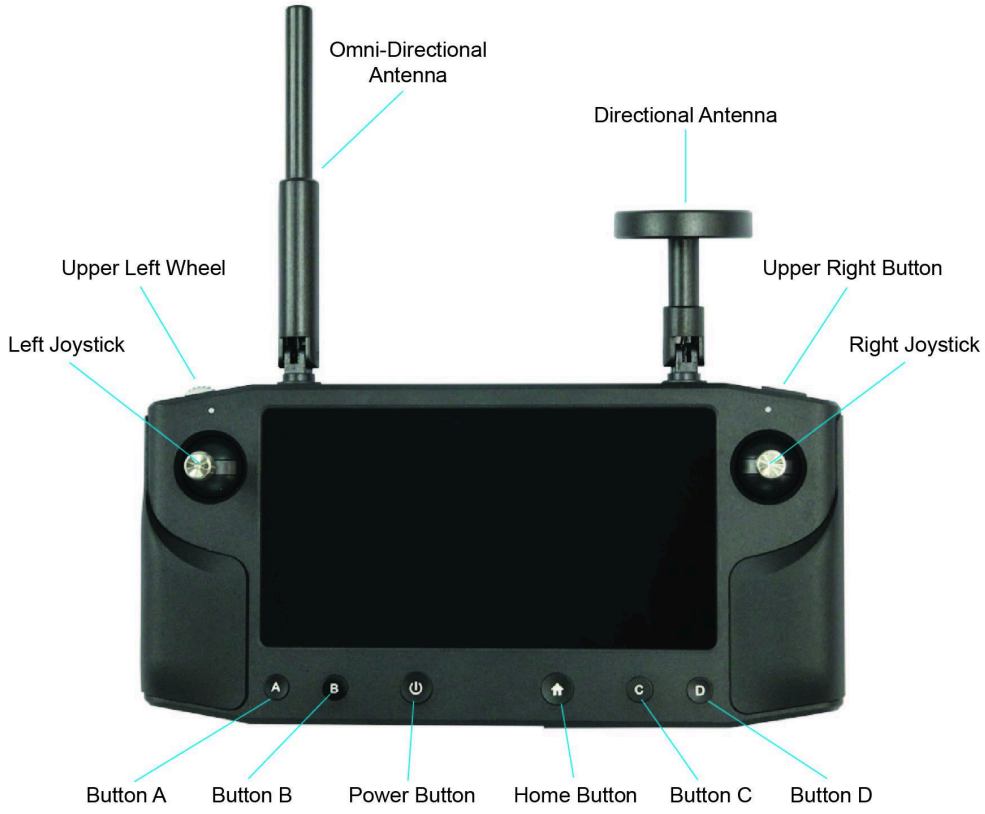
CONTROLS

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

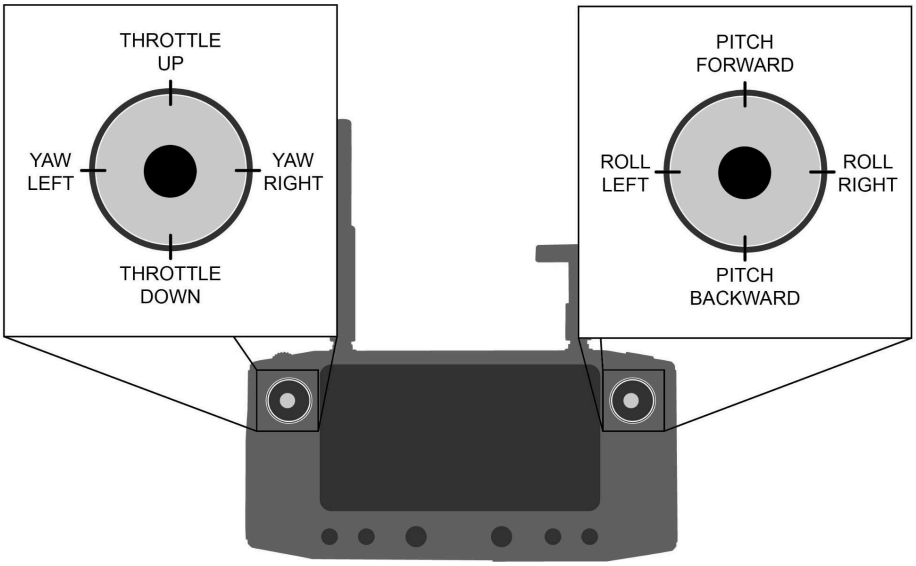
CAUTION: ***The Vector is a precision machine designed to be controlled with very disciplined and smooth inputs. During familiarization of the aircraft, small subtle inputs result in a smooth flight.***

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

The controller features and control inputs are shown below.



Left Joystick	Controls altitude and yaw.
Right Joystick	Controls pitch and roll.
Upper Left Wheel	Controls camera tilt.
Upper Right Button	Toggle between MANUAL and Brake Mode.
Button A	No function.
Button B	Payload-specific functions.
Power Button	Controller Power Button. Press and hold for 5 seconds to turn on or off. Tap to put it into power save (sleep) mode.
Home Button	No function.
Button C	Payload-specific functions.
Button D	Payload-specific functions.



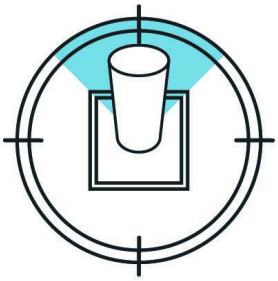
The left stick controls the altitude (throttle) and rotation (yaw) of the Vector.

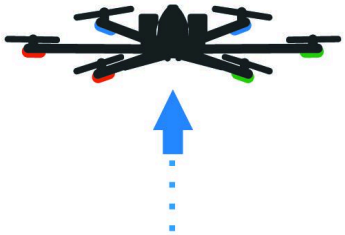
Use the right stick to fly the Vector forward, back, left, and right. These movements are relative to the Vector's tail-in orientation, so always maintain awareness of Vector’s forward-facing direction before inputting control.

Left Stick (Throttle)

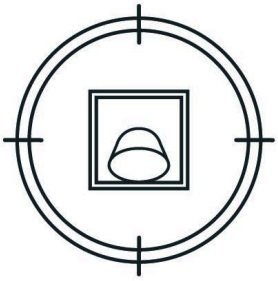
Move the left stick vertically to control the Vector's altitude and vertical acceleration.

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

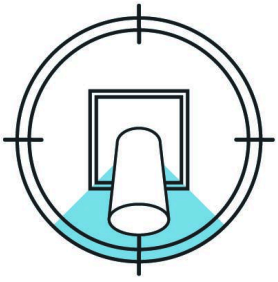


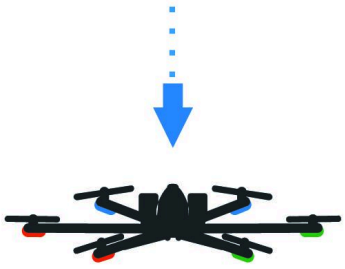


Set the throttle to center to maintain current altitude.

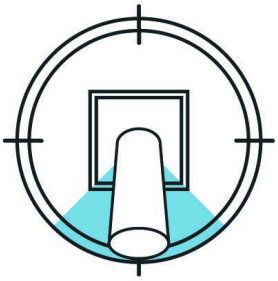


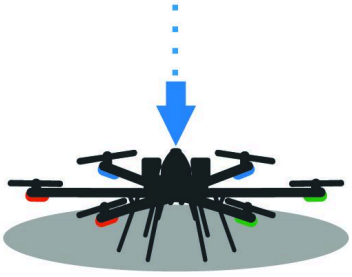
Move the throttle below center to decrease altitude.





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

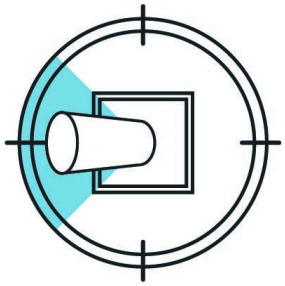




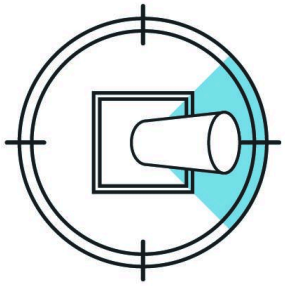
Left Stick (Yaw)

Move the left stick horizontally to rotate or "yaw" the Vector and control orientation.

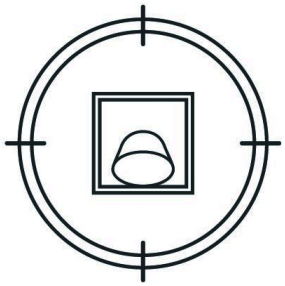
Move the stick to the left
to rotate counter clockwise.
(As viewed from above.)



Move the stick to the right
to rotate clockwise.
(As viewed from above.)



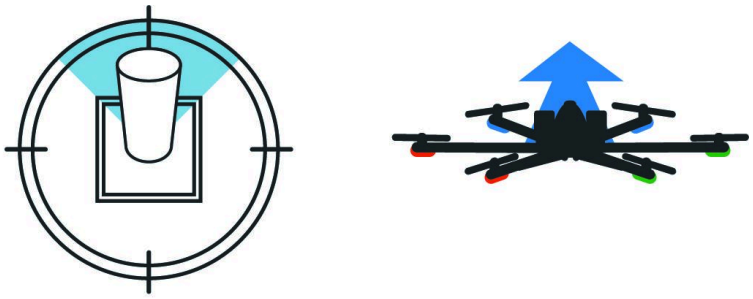
Release the stick to stop
rotating and maintain the
current orientation.



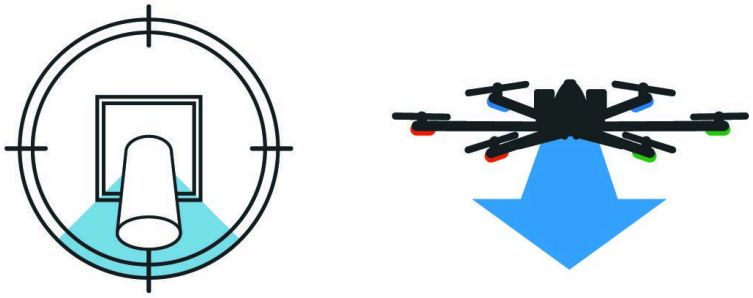
Right Stick (Pitch)

Move the right stick vertically to control pitch.

Move the stick up
to fly forward.



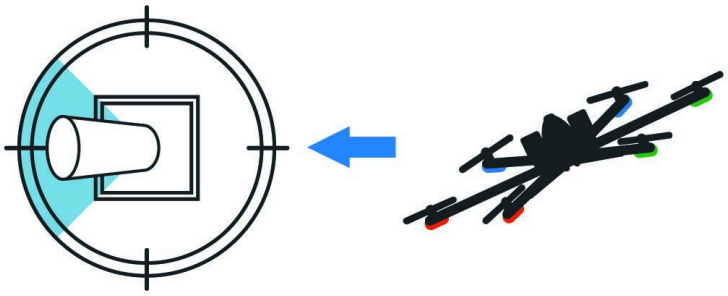
Move the right stick down
to fly backward.



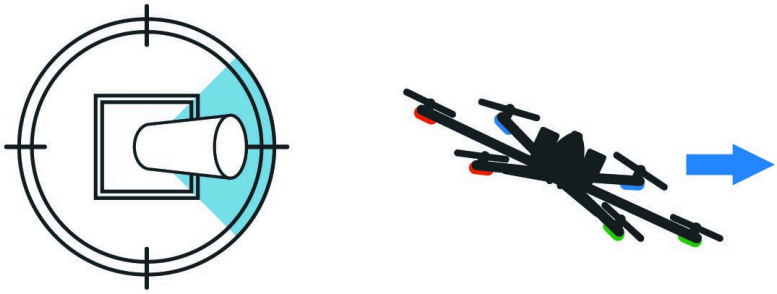
Right Stick (Roll)

Move the right stick horizontally to control roll.

Move the stick left
to fly left.



Move the right stick right
to fly right.



FLIGHT

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

Systems Checks (50/50 checks)

Systems checks are an overall health and status check for the drone and may be viewed as a universal general check of the vehicle. Systems checks may be embedded or used in conjunction with other flight checks.

Systems checks should be accomplished at multiple phases of flight. Take-off/departure, mission and approach/landing phases should be preceded by systems checks. Completing the system check at approximately 50’ AGL and 50’ distance from the user prior to continuing the mission or approach/landing ensures proper vehicle configuration and health for the given phase of flight.

Components of the system check should include:

- Vehicle configuration to include landing gear and payload status
- Battery health to include percentage of battery remaining and current draw
- Flight environment

LANDING / DISARMING

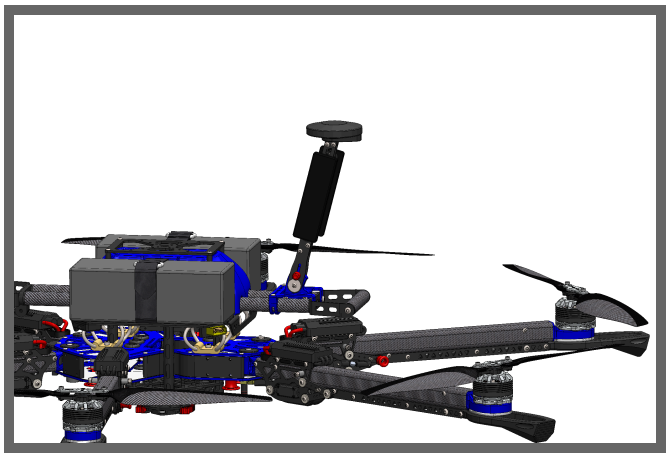
- Before landing the aircraft, check the landing site environment to ensure it is clear of power lines, people, animals, etc.
- If landing manually, deploy the landing gear. See Landing Checklist.
- Land the aircraft (ideally on a level surface).
- Disarm by holding the left joystick in the bottom left position.
- If carrying a payload, remove it. See Payload Connection System.

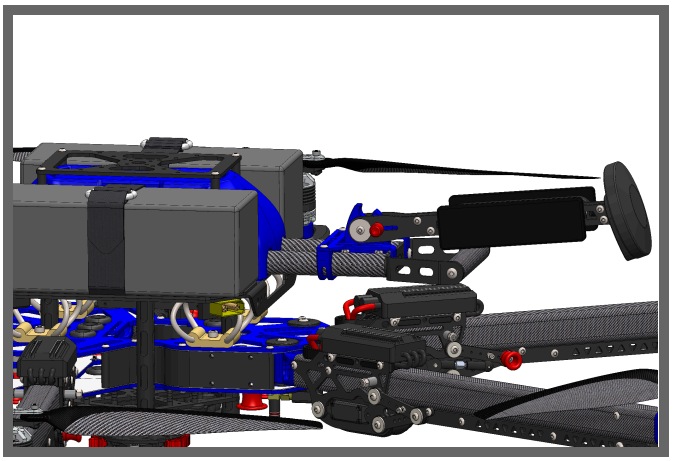
Disarm

POST FLIGHT AND STORAGE

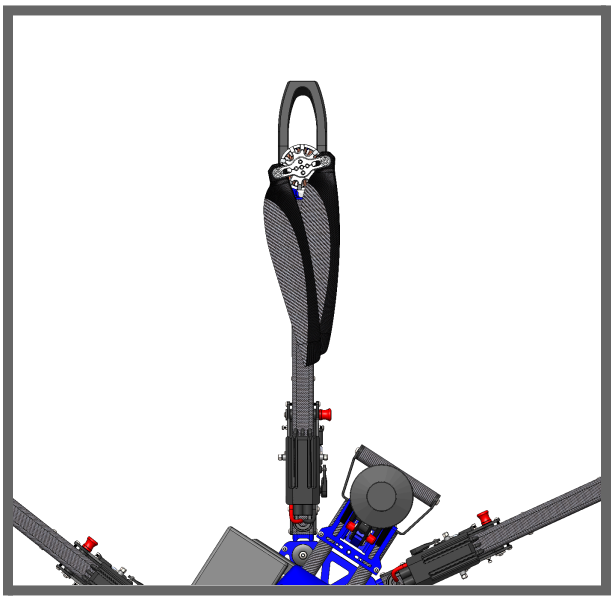
- Disconnect the battery from the aircraft.
- Power down the GCS.
- Visually survey all electrical and mechanical connections.
- Using the red knobs, manually retract the landing gear.

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

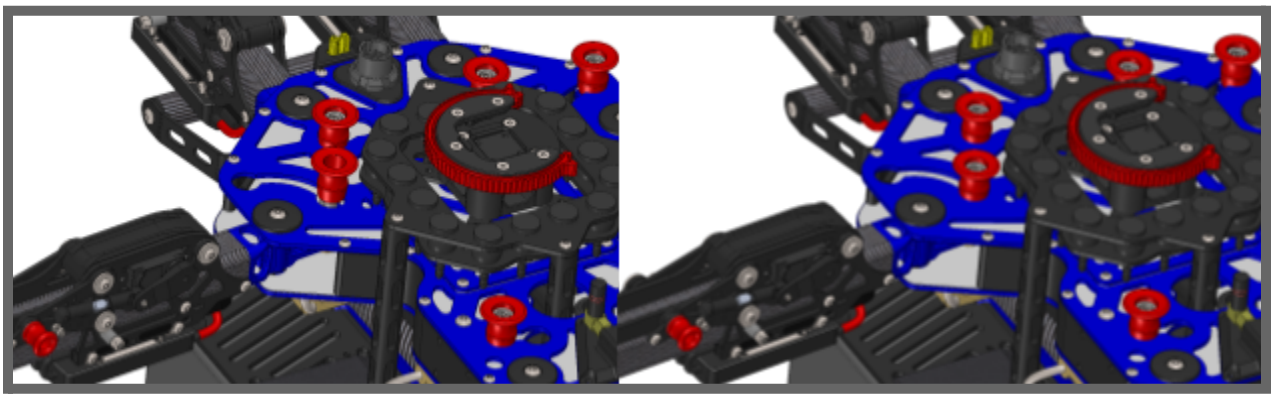




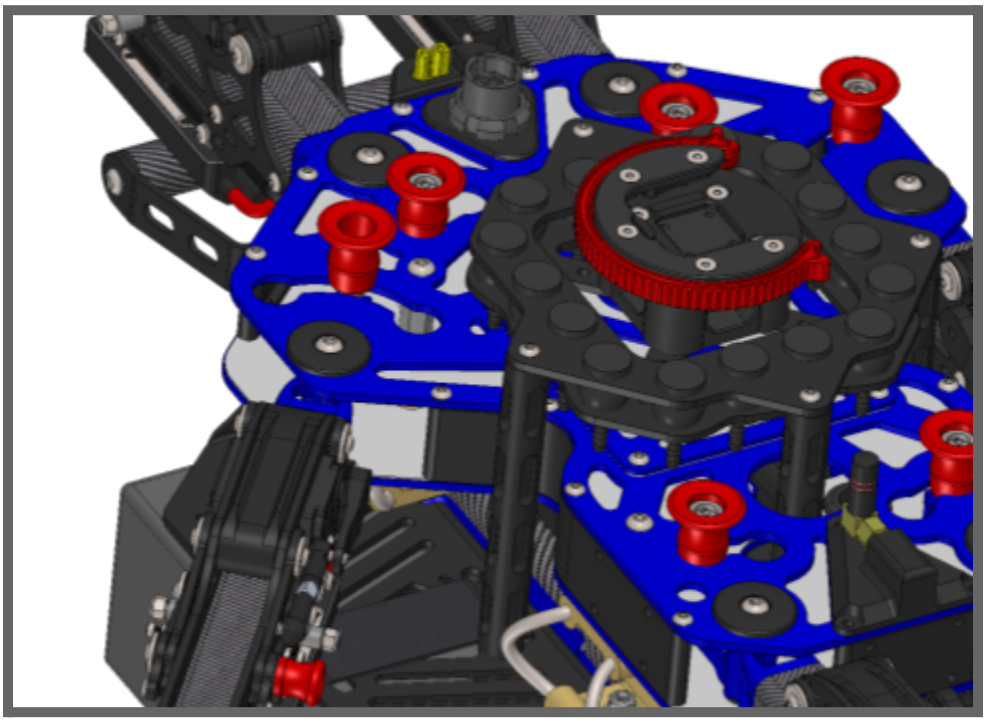
- Fold in the tail rotors so the blades point forward.



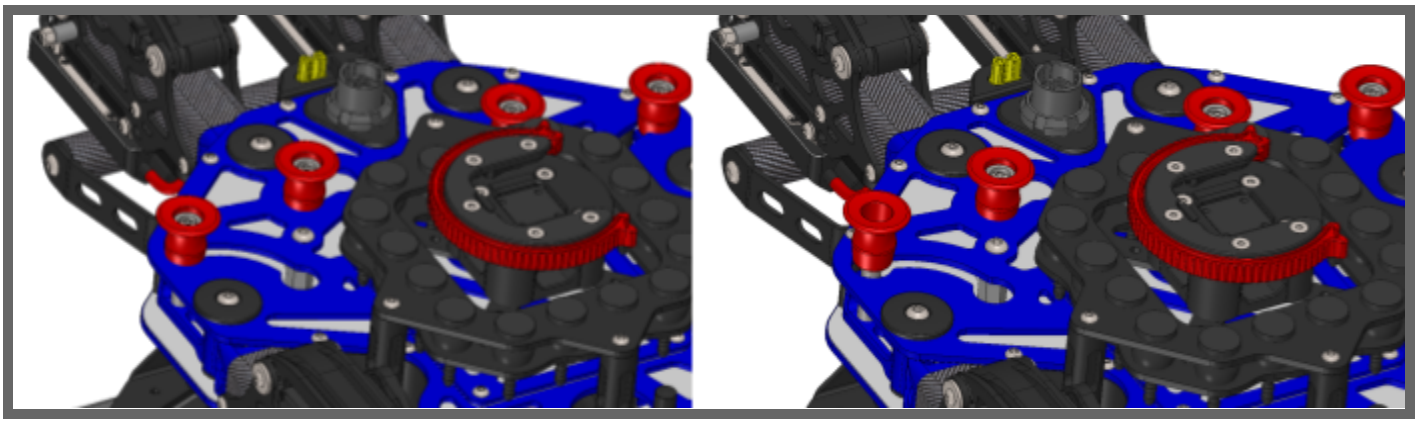
- Select one arm and pull out on the corresponding red knob.



- Rotate the arm towards the body.



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



- Gently move the boom back and forth to verify the knob is engaged and seated.
- Repeat this process with the other arms.
- Place aircraft in its case and secure latches.

BATTERY SAFETY

Use caution when handling the lithium batteries as they can cause a fire if handled incorrectly.

✔ Never alter, puncture, throw, bend, or impact the battery.

✔ Keep the battery away from liquids, fire, microwaves, and other hazardous or combustible materials.

✔ Don’t expose the battery to extreme temperatures.

✔ If the battery is hot to the touch, wait for it to cool before using or charging.

Damaged Batteries

The battery shall be inspected before and after each flight. Batteries can be damaged in shipping, use, or charging. Any abnormal features such as damage to the exterior shell, swelling, deformation of the battery, abnormal smell, leakage, or other unexpected behavior, indicate the battery may be compromised and shall not be used! Serious damage may result in the battery catching fire. To prevent a hazard in case of fire or explosion:

- Disconnect the battery, then place it in a safe area outside of any buildings or vehicles and away from flammable materials.

- Do not dispose of the battery in the trash; dispose of the battery at a local battery recycling center as soon as possible. In the US and Canada, visit call2recycle.org to find a recycling location.

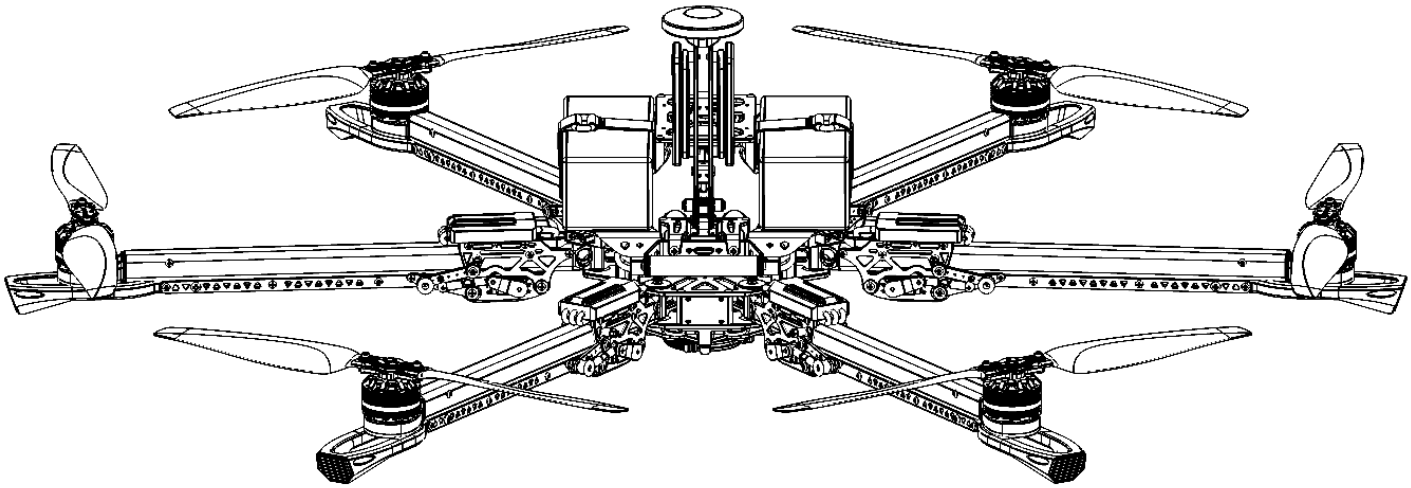
Proper Battery Storage

For long term storage, the following conditions are recommended:

- Environmental temperature range of 18º C to 28º C (64° F to 82° F)
- 45-85% relative humidity
- Storage charge level (approximately 50% charge)
- Ensure the battery won't be exposed to extreme temperatures or direct sunlight

Battery Voltage Testing

Battery voltage can be checked with a voltage tester. For additional information see Appendix.



Emergency Procedures

INTRODUCTION

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

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

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

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

1. Maintain aircraft control
   Small emergencies can quickly escalate if the pilot is distracted by attempting to troubleshoot the problem. Always maintain visual contact with the aircraft during an emergency to reduce the likelihood of losing orientation.

2. Analyze the situation
   Once the aircraft is stabilized, begin to assess the cause of the emergency if practical.

3. Take appropriate action
   In many cases, the appropriate action will be to land the aircraft as soon as possible. Always consider the safety of yourself and others before attempting to save the aircraft in an emergency.

EMERGENCY PROCEDURES

Aircraft Error

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

1. Neutralize controls
2. Select Brake Mode-as required
3. Analyze Situation and continue flight as required

Uncontrollable Environmental Change

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

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

If flight environment does not change or conditions warrant:

3. Select RTL (as required)

Lost Orientation

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

In the event of ***Lost Orientation*****:**

1. Reference telemetry on GCS

If telemetry is unavailable:

2. Reference FPV (if equipped)

If FPV is unavailable:

3. Orientation turns (Vector 2-second, SB-E 3-second turns)
4. RTL: Select manually

Lost Link

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

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

In the event of Lost Link:

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

In-Flight Battery Emergencies (RTL)

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

Low battery situation is triggered by battery percentage dropping below 30% continuously for 10 seconds (factory preset). The GCS will produce an audible “Low Voltage” warning followed by a “Return to Launch” audible warning.

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

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

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

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

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

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

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

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

Loss of GPS (Altitude Hold)

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

In the event of ***Lost GPS****:*

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

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

Failed Landing Gear

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

In the event of any landing gear malfunction:

1. Determine presence and type of payload
2. If no payload present: Belly land aircraft manually

NOTE: T*ype of payload will determine action taken for landing. Consideration should be given for survivability of payload over the vehicle.*

Partial failed landing gear

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

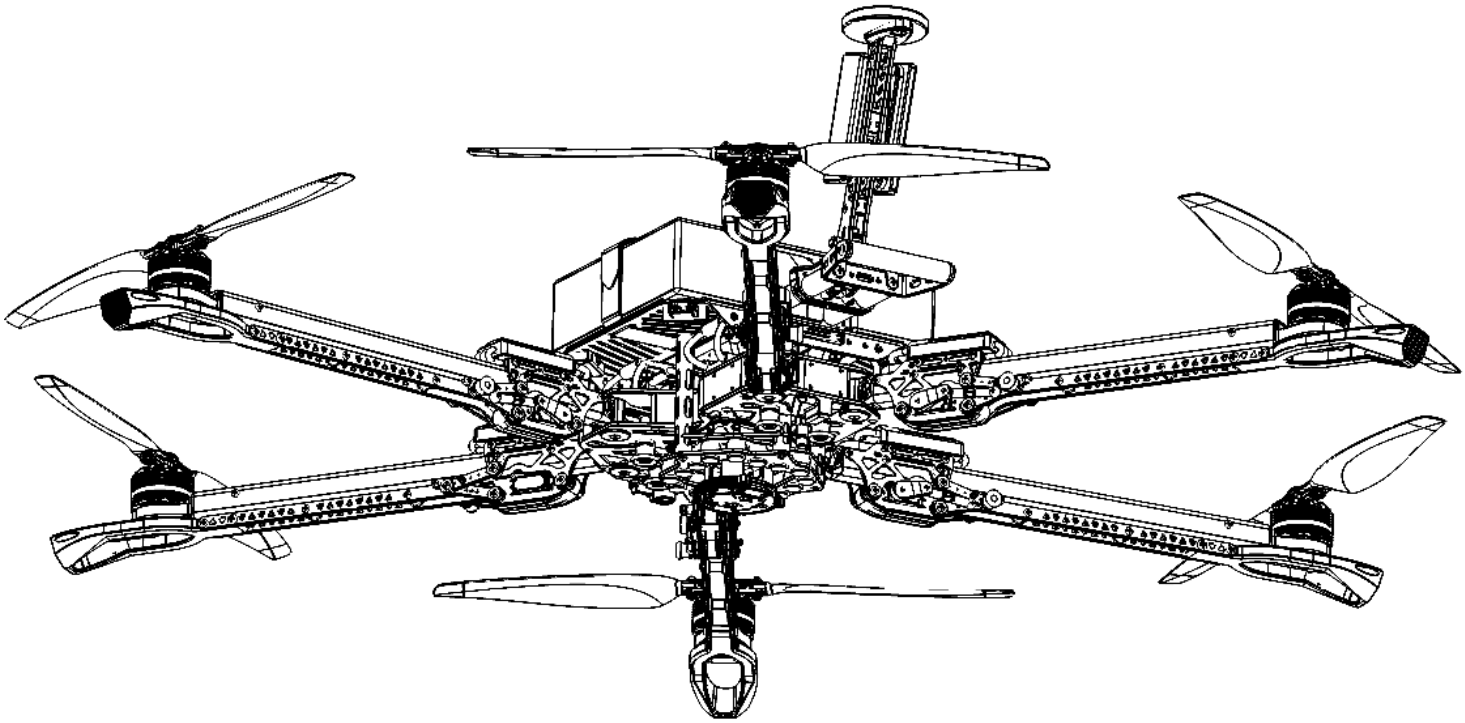
Full failed landing gear

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

Loss of thrust (Single motor failure)

WARNING: ***A loss of thrust may be indicated by an audible change in vehicle tone, erratic flight behaviors or fluctuations in current and voltage.***

1) **Control altitude-as required**
2) **Landing Checklist-Complete**
3) **Land as soon as possible**
4) ***Emergency Disarm*** **- as required**
5) **Discontinue flight until condition is corrected by a certified technician.**



Maintenance & Support

SUPPORT

Vision Aerial is here to help you get the most out of your Vector. If you have any questions, please contact us at info@visionaerial.com or call +1 (406) 333-1795. To submit a support request through our website, visit www.visionaerial.com/support.

MAINTENANCE

BEFORE EVERY FLIGHT

1. **Arm Locks**
    - The arm locks should move freely and lock solidly both in the storage and flight configurations.
2. **Rotors**
    - Inspect for chips, typically found on the leading edge. If chips greater than 1.5 mm are found, it is recommended the rotor be replaced.
    - Inspect for cracks and excessive flexibility. If significantly more flexibility in the rotor is detected, replace the rotor.
    - Inspect for proper hub tension. To test, unfold the rotor and hold the aircraft on its side. The rotor should be clamped just tightly enough to ensure adequate friction such that gravity does not cause the rotor to rotate on its hub, but loose enough to be comfortably rotated by hand.

    - An example of a healthy rotor is shown in the image.
    - Once preflight checks are complete, use the throttle to gently rotate the rotors and check that each prop is rotating in the correct direction.

Rotors

The Vector comes with six attached, folding rotors.

Attachment and removal of the blades is performed by tightening or loosening the two center bolts on the rotor.

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

All blades in folding rotors arrive from Vision Aerial at the correct attachment screw torque. A simple way to check if they have become loose is to hold up the rotor assembly vertically and see if the blades in the rotor sag due to gravity. Sagging is an indication that the blade screw needs to be tightened slightly until they do not sag.

The picture to the right shows rotors that are sagging due to the attachment screws being too loose.

The following picture shows no sag due to properly tightened screws.

⚠ **CAUTION:** ***Rotors should be <u>just</u> tight enough to not sag.***

 WARNING: ***Avoid contact with Vector's high-speed rotors***

✔ Always disarm the Vector before handling

✔ Before starting motors for takeoff, always ensure that the rotors are clear of any obstructions and at least 5 meters (16.5 feet) away from any people, animals, or property before activating

✔ Do not touch moving rotors or approach the Vector while the rotors are spinning

✔ Always disarm the Vector before picking it up

✔ Do not approach the Vector until the rotors stop spinning

EVERY 25 FLIGHTS

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

1. **Motors**
   With the aircraft unpowered, slowly rotate each motor feeling & listening for any grinding or rubbing; any significant grinding or rubbing warrants a motor replacement or rebuild.

2. **Batteries**
   Plug each battery pack into the charger and complete a full charge via the balance charging program. Once complete, compare the highest voltage cell to the lowest voltage cell. If the difference is greater than 50mV (0.05V), recycle the pack.

3. **Arms**
   Inspect carefully the carbon fiber arms & empennage for cracks and/or delamination. Small surface level delaminations of the clear coat pose no significant threat, however any crack or separation that is deeper than the clear coat warrants an immediate replacement of the arm.

APPENDIX

Additional Information

Checklists: Pre-Take Off, Take Off, Systems Check, Mission Checklist, Landing Checklist	https://visionaerial.com/support/#vector
Flight Deck Manual	https://visionaerial.com/docs/flight-deck-user-manual-archive/
Battery Charging Instructions	https://docs.google.com/document/d/e/2PACX-1vSBx8QDIR4LbspbqtFJPR2CWLtO_zYofEge5xwvP72eNJdu9cdhZBxElMFF3BR8G5g59scSiOzULqm8/pub
Herelink Controller Manual	https://docs.cubepilot.org/user-guides/herelink/herelink-user-guides
How to Download Flight Logs	https://docs.google.com/document/d/e/2PACX-1vT8Jbs6iAh1S2MB8V5toOe7BoGrCLTxdLBffzinFP3fyVQpvVQ4Bmoy4OGaEkaXm5gDGbwJpW8gHfIA/pub

Glossary of Terms, Acronyms, and Abbreviations

AS	Air Speed
APP	Application (Computing program)
AUTO	Autonomous Mode
C1	Broadcast feed for user controls. Also referred to as RC (Radio Control)
C2	Broadcast feed for soft controls. Also referred to as Telemetry
CG	Center of Gravity
Drone	Unmanned vehicle
EO	Electro-Optical
ESC	Electronic Speed Controller
FAM	Familiarization
Flight Deck	Vision Aerial Software
GCS	Ground Control Station (Herelink)
GPS	Global Positioning System
GS	Ground Speed
IOS	Internet Operating System
IR	Infrared
LED	Light Emitting Diode
Li-Po	Lithium Polymer
LOS	Line-Of-Sight
Mission	Use of GCS software to execute a preprogrammed route for vehicle
Nadir	Point on the celestial sphere directly below an observer
PC	Personal Computer
PCS	Payload Connection System
PDB	Power Distribution Board
PIDS	Proportional Integral Derivative
PITCH	Rotation around the horizontal axis
QC	Quality Control
RID	Remote Identification
ROLL	Rotation around the longitudinal axis
Rotor	Complete assembly of blades including hub
RPM	Revolutions per minute
RTL	Return to Launch

SB-E	Vector
Throttle	Left stick, vertical motion
UAV	Unmanned Aerial Vehicle
UAS	Unmanned Aerial System
YAW	Rotation around the vertical axis
V1	Video Broadcast feed-Channel 1
V2	Video Broadcast feed-Channel 2