VANTAGE ROBOTICS

Vesper UAS
Vision GCS

Operator's Manual

v1.8.2

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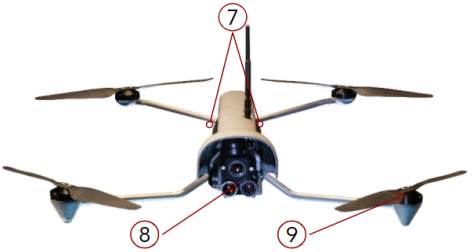
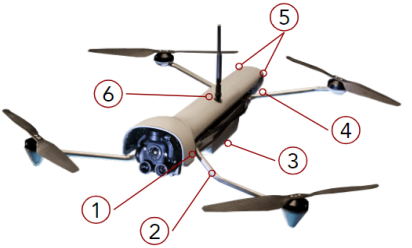
I. SYSTEM COMPONENTS & CONTROLS

VESPER

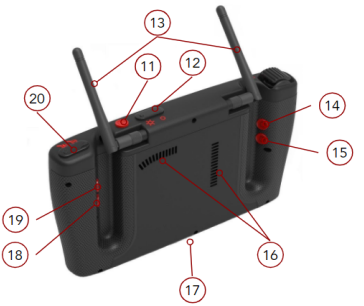




1. Rotor arm joint
2. Rotor arm
3. Battery
4. Tailboard assembly
5. Status LED windows

6. Radio antenna
7. Battery touch points
8. Gimbal
9. Rotor set

VISION GROUND CONTROL SYSTEM (VISION GCS)



1. Altitude/Yaw Joystick
2. Gimbal Pitch Joystick
3. Pitch/Roll Joystick
4. Return to Home
5. Camera Control
6. Flight Data Display
7. Camera Stream/Map
8. Map/Camera Stream PiP
9. QGC Settings
10. Vesper Battery Level
11. Power
12. Brightness +/-
13. Communication Antennas
14. User-definable Button
15. User-definable Button
16. Cooling inlets (do not block)
17. USB-C (charging, data, HDMI)
18. Take photo
19. EO/IR video stream select
20. Camera Zoom In/Out
21. Pairing Icon

II. SAFETY

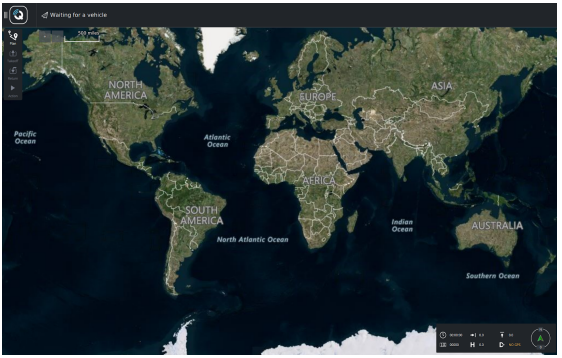
- Read the entire Vesper & Vision GCS Manual before operating Vesper.
- Always ensure Vesper is at least 20 feet away from people before takeoff.
- Be mindful of where your hands and other body parts are, especially when Vesper is powered on.
- Only launch Vesper from the operator's hand using the Safety Rotor Set. Never attempt to launch from, or land to, the operator's hand with the Recon Rotor Set.
- When using the Recon Rotor Set, keep Vesper at least 20 away from personnel. Never attempt to touch Vesper while it is in flight or while the propellers are in motion.
- Vesper does not have lateral obstacle avoidance. It is up to the operator to prevent collisions. Use caution when operating beyond line of sight. Comply with all relevant local regulations.
- Plan takeoff and landing to protect people and Vesper. Designate a launch and landing spot at a location clear of obstacles and people.
- Before using the Return to Home (RTH) feature, ensure settings are adjusted for an appropriate return altitude over terrain.
- Follow all pre- and post-flight operational guidelines and storage procedures described in this manual.

IMPORTANT:
WHEN VESPER IS CONFIGURED WITH THE RECON ROTOR SET,
NEVER HOLD VESPER BY HAND WHILE PROPELLERS ARE IN MOTION.

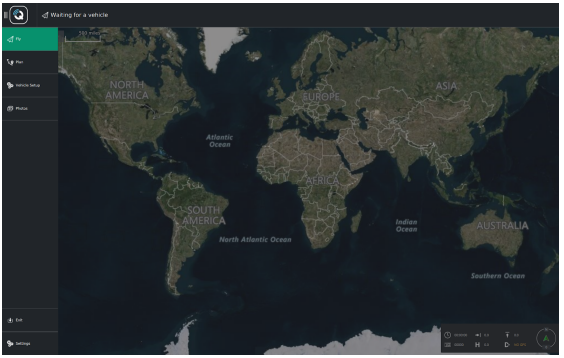
FAILSAFE TRIGGERS & EMERGENCY PROCEDURES

Before operating the Vesper aircraft, familiarize yourself with the software failsafes and have procedures in place in case of emergency. To program safe behavior for various scenarios:

- Click on the “Q” Ground Control logo on the top left-hand side



- Navigate to the Vehicle Setup menu at the top of the screen

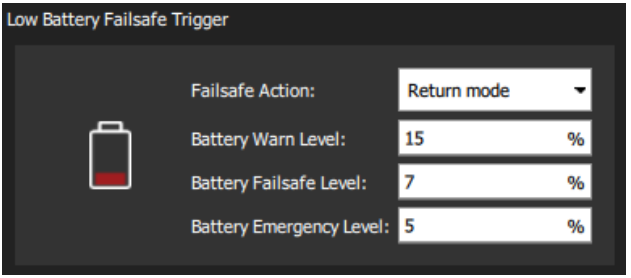


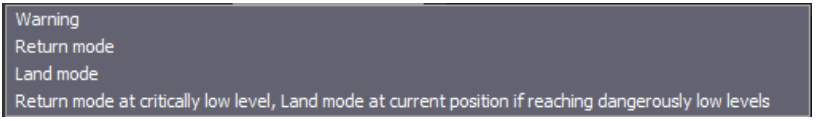
- Select the Safety option

The following pages deal with how the failsafe functions work and how to adjust their behavior.

LOW BATTERY AUTO-LAND/AUTO-RETURN

By default, Vesper will automatically land and shut off once the battery level reaches a failsafe level of 5%. The GCS will give multiple visual pop-up warnings in advance of the automatic landing. The failsafe behavior can be changed to RTH instead of landing in place, and this command is overridden if the user continues manually controlling the AV with the joysticks. Below the emergency level, Vesper will land in place.





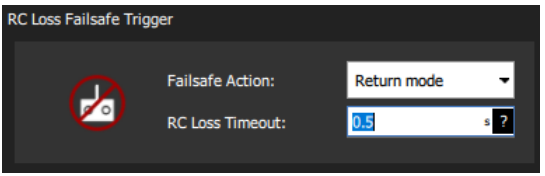
By clicking the Failsafe Action dropdown menu, the operator can select low battery behavior. In this menu, the operator can choose at what % battery level to send a warning notification, and manually set the failsafe and emergency state of charge thresholds.

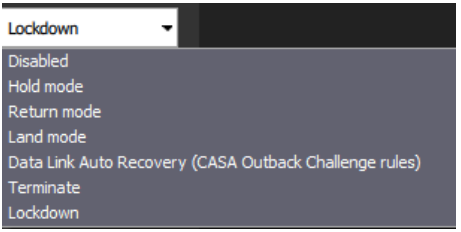
LOSS OF GPS BEHAVIOR

Vesper can maintain position using visual inertial odometry (VIO) and optical flow in the event of GPS loss as long as scene illumination is greater than 10 - 50 lux depending on ground reflectance (generally functional until shortly after sunset). If none of these features is usable and Vesper is unable to maintain position and has lost the radio control link, then. VIO will drift by approximately 7 meters for every 100 meters of travel.

RADIO CONTROL (RC) LOSS

Radio Control (RC) Loss means Vesper has lost connection to the Ground Control Station (GCS). In Q → Vehicle Setup → Safety, the operator can preemptively choose what actions Vesper will take should this scenario occur. By clicking the Failsafe Action dropdown menu, the operator can designate the best option for Vesper and determine how many seconds of data link loss will lead to time out. By default, Vesper will wait 15 seconds to regain link then initiate return to home/return to launch if not reconnected.





FAILSAFE LANDING LOCATION

By default, Vesper will return to its launch position when facing a critical condition, such as low battery or GPS loss. To modify these settings, select the Failsafe Trigger settings in Q → Vehicle Setup → Safety.

III. ENVIRONMENTAL CONDITIONS

RANGE OF USE:

- When possible, fly in open areas and stay clear of obstacles, people, power lines, trees, or bodies of water.
- Vesper's motors are partially sealed to minimize dirt ingress, but it is still best practice to avoid flying through excessive debris, sand, or dirt.
- Vesper can handle flying in heavy rain. However, Vesper should never be submerged in water. Allow Vesper to dry before storage.
- To minimize radio link and GPS interference, avoid high levels of electromagnetism such as power lines and electrical substations.
- When preparing to operate Vesper in very cold conditions, store Vesper's battery close to your body to maximize performance.
- Vesper uses a magnetometer for vehicle heading. Do not take off from any magnetic or steel structures.
- Vesper maximum operating temperature is lower on the ground than in the air, as Vesper uses forced convection from the propellers for cooling.

Operating environmental conditions are as follows:

Vesper Operating Conditions	Minimum	Maximum
Temperature Limits - Flight	-4° F	119° F
Temperature Limits - Ground Operation	-4° F	95° F
Temperature Limits - Storage	14° F	122° F
Wind	N/A	31 mph (50 kph)
Range from Vision GCS	N/A	5 km (3 mi)

IV. SETUP

IMPORTANT:
READ SAFETY INSTRUCTIONS & ENTIRE MANUAL BEFORE FLYING VESPER

UNPACKING AND POWERING

1. Remove Vesper from the field case and fully unfold all four arms.

2. Power on Vesper by grabbing the battery, making firm contact with the sides. The battery touch sensor is capacitive but will also trigger with a firm squeeze if wearing thick gloves. Vesper will emit a beep, followed by a series of tones and illuminated tail LEDs, indicating success. Vesper can also be directly power cycled by removing the battery for at least 3 seconds before reattaching.

3. The LED lights in the tail indicate flight readiness status starting with cyan/aqua. The boot process takes about 50 seconds, and GPS lock speed depends on conditions:

Color Pulse Pattern	Cyan	Cobalt Blue	Green
Blinking/ Breathing	Booting...	No GPS fix, unarmed	GPS lock OK, unarmed
Solid	Booting...	No GPS fix, armed for takeoff	GPS lock OK, armed for takeoff

4. Power on the Vision GCS by pressing the power button and unfold the antenna(s).

5. If Vesper has not yet been paired with Vision GCS, connect Vesper to Vision GCS by following the pairing instructions on the next page.

6. If Vesper has been paired previously with Vision GCS, telemetry and video should appear after approximately 85 seconds.

7. Once connection is established, place Vesper at chosen launch location.

PAIRING

1. Power on Vesper and Vision GCS.
2. Log in to Vision if necessary.
3. Tap the “Q” at the top left of the Vision screen.
4. Tap “Settings”.
5. Tap “OOB Pairing”.
6. Tap the “Regenerate OOB Pairing Details” button.
7. Tap “Continue” when prompted to continue or go back
8. Flip/invert the Vesper fuselage 180 degrees so that the battery points to the sky 3 times to put it in pairing mode. If successful a short chime will play.
9. Hold the tail end of Vesper up to the screen so the VIO sensor can scan the QR code. A short chime will play to verify that the scan was successful Note: The tail may need to be moved around slightly in order for the VIO camera sensor to successfully scan the QR code; lowering the Vison screen brightness may be helpful.

VIO Camera

Pairing Position

10. Move Vesper and Vision at least about 2m from each other to avoid radio saturation.
11. Tap “Q” at the top left of the Vision screen.
12. Tap “Fly” and verify that the Vesper camera view is visible on the Vision screen to verify that Vesper and Vision are paired.

PRE-FLIGHT CHECKLIST

1. Inspect propellers for loose screws and damage, replace as needed.

2. Inspect lenses for dirt, and clean as needed. The soft brush in the field repair kit is effective for most field cleaning needs. If more complete cleaning is required, gently apply 90+% isopropyl alcohol to the lens with a soaked Q-tip and immediately blow dry with dry compressed gas (shop air or blowing by mouth not recommended).

3. Ensure no people are within 20 feet of Vesper’s takeoff location.

4. Confirm battery capacity >20%. Vesper will beep once per second if battery capacity is below this threshold.

5. Confirm that Vesper tail LEDs are pulsing green, indicating GPS lock.

V. MANUAL FLIGHT

Manual Mode allows the operator to have full control over Vesper's path, using Vision GCS to direct all movement. You should only use Manual Mode if you are an experienced operator. When in Manual Mode ensure you are aware of your surroundings at all times, and whenever possible use the camera to view the flight direction.

TAKEOFF

1. Once ready, select "Takeoff" on the Vision GCS screen. Use the lateral slider to confirm Vesper takeoff.

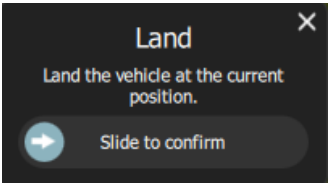
2. Vesper will hover at a preset height and maintain position automatically.

LAND

1. Ensure no people are within a 20-foot perimeter around the landing area.

2. To land Vesper at its current location, press the Land button

. A prompt will appear at the bottom of the screen to confirm.



3. Once the command is confirmed, Vesper will descend and land.

RETURN TO LAUNCH LOCATION (RTL)

Command Vesper to return to the launch location by pressing the RTL button on Vision GCS. Vesper will respond by first ascending to 200 feet above takeoff altitude, or up to a cone extending up at 45° from the takeoff site, whichever is lower. Then Vesper will traverse until it is directly above the takeoff point. When above the RTL location, Vesper will descend quickly, and then will hover for 15 seconds once 10 feet above the ground, before descending the final 10 feet slowly. Once Vesper lands it will power off.

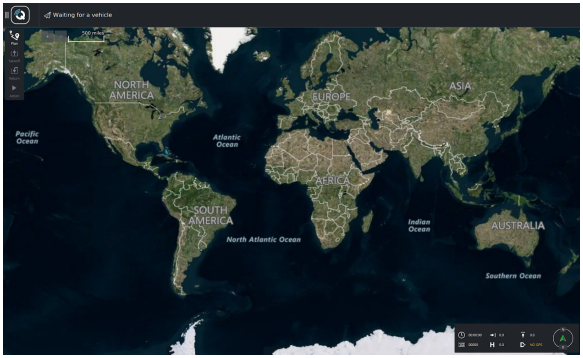
FLIGHT CONTROLS

VI. AUTOMATED FLIGHT

Automated flight modes allow the operator to create a flight plan and have Vesper fly the entire route autonomously. Use-cases for Automated Flight Mode include: (a) rapidly flying to a predetermined location, (b) creating a photo dataset for 3D models, (c) creating a photo dataset for orthomosaics, and (d) automated search grids.

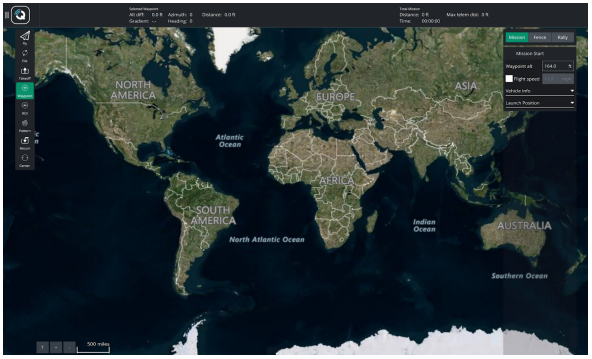
PREPARING AN AUTOMATED FLIGHT PLAN

1. Select the Plan View icon at the top of the screen.

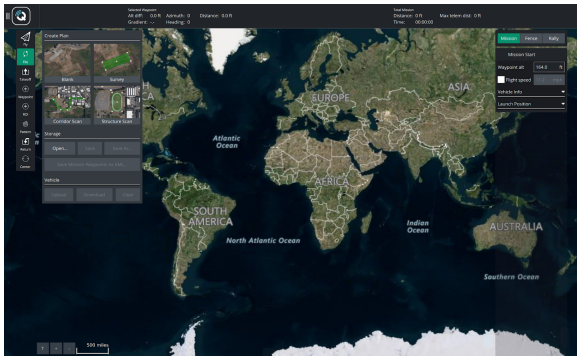


2. Select the Waypoint setting tool

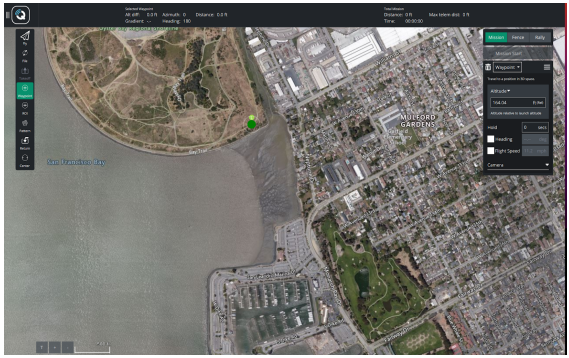
in the upper left menu.



3. Select Mission Mode.

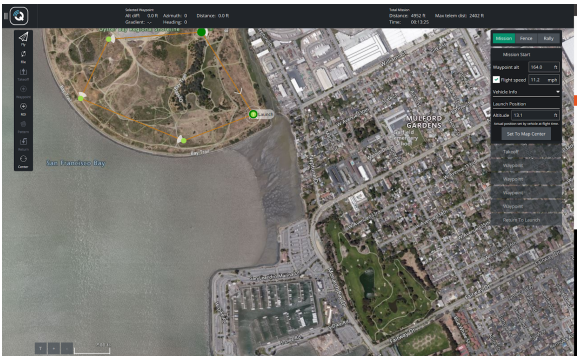


4. Add waypoints* by selecting areas on the map.



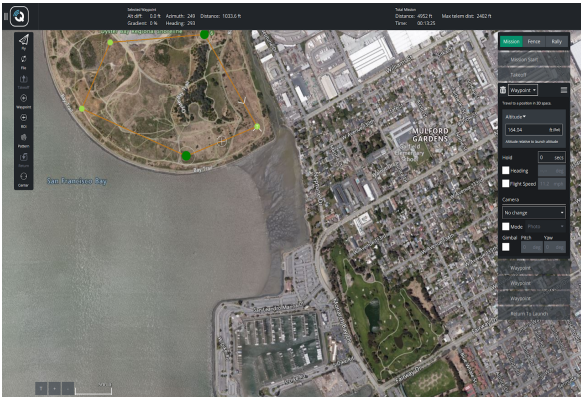
***Note:** A waypoint is a point in three-dimensional space that the drone flies to as part of a mission. Each mission consists of a series of coordinated waypoints. The operator can choose just one, or set multiple, waypoint(s).

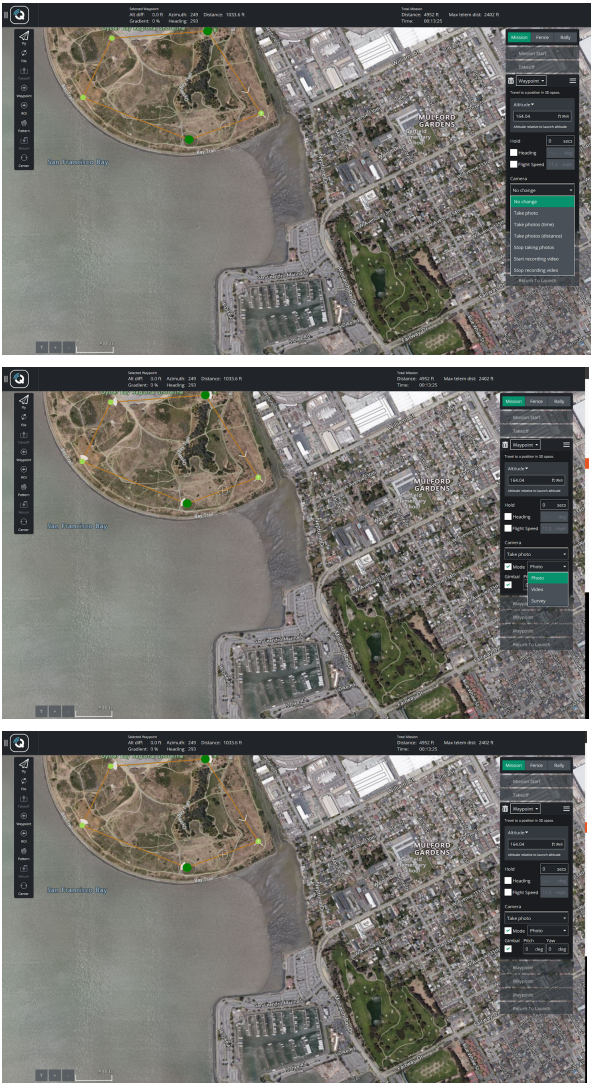
IMPORTANT: Set the first wappoint as close to the mission starting position as possible- this waypoint can mark the takeoff point.



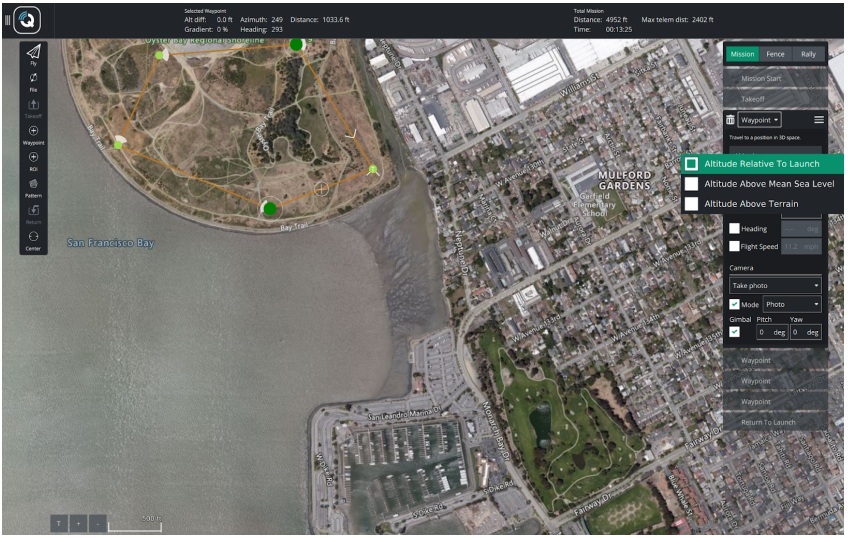
After plotting the route, the operator can set specific directions for Vesper at each waypoint, such as altitude, flight speed and camera.

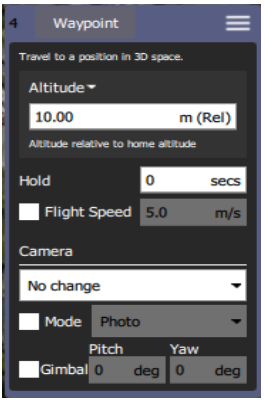
5. <u>To automatically take photos on a mission</u>, set directions for the camera at each waypoint. Select the desired photo setting: one photo, multiple photos over time, or photo(s) specified by distance. Specify options for setting the gimbal pitch and yaw.



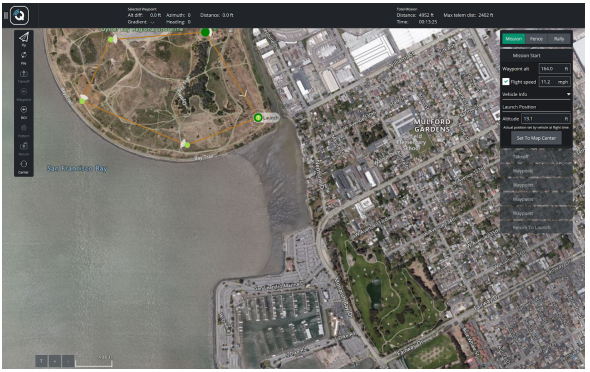


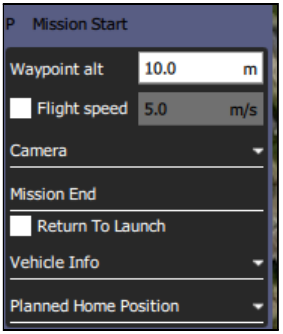
6. Set specific altitude directions for Vesper at each waypoint, as desired. By default, the altitude is set relative to home. The operator can change the altitude to be relative to sea level or relative to terrain.



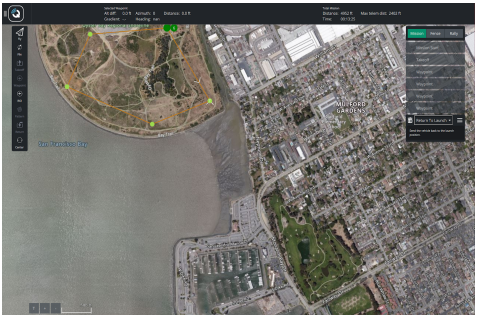


7. Set the <u>flight speed</u> from the Mission Start position.
    - Operator MUST check the box next to “flight speed” and set the flight speed, otherwise Vesper will not proceed to the first waypoint upon takeoff.



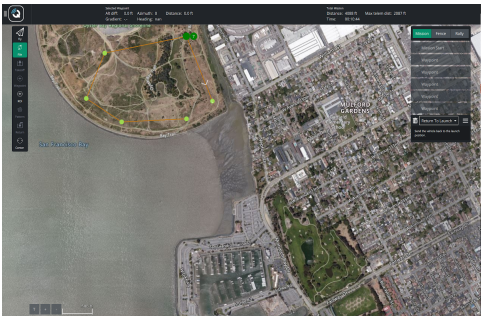


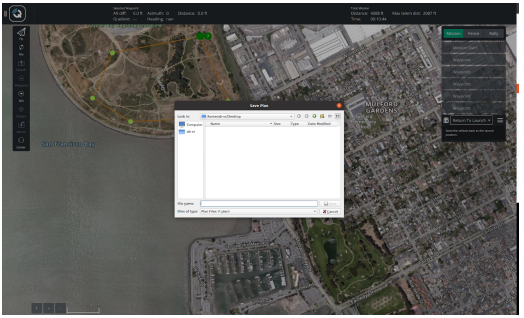
8. From the mission sidebar, the operator may choose “Return to Launch” to automatically direct Vesper to return to the mission starting position.



9. Once waypoint(s) and additional directions are set, the operator can save the flight plan for future use by pressing the File

button in the Plan menu.



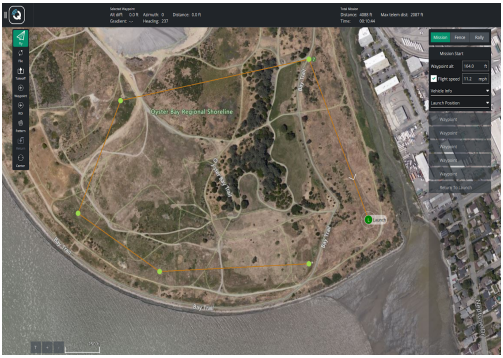


10. The operator can see the Total Mission distance, time, and max range in the top information bar of QGC. The details are based on the chosen settings and directions and update in real time in response to the mission settings.

11. When Vesper is ready to be sent on its flight path, press Upload Required in the upper right corner

.

12. After upload to Vesper is complete, switch to Fly view by pressing the icon in the upper left .

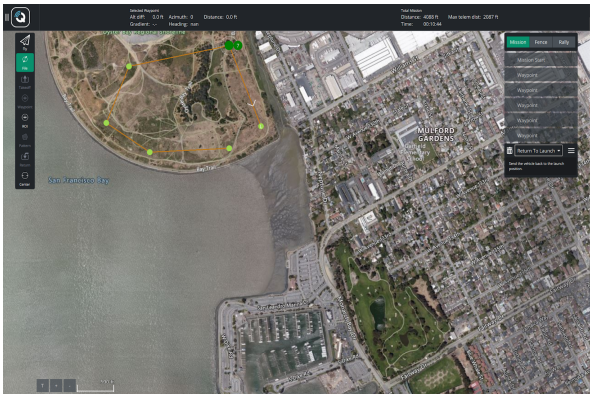


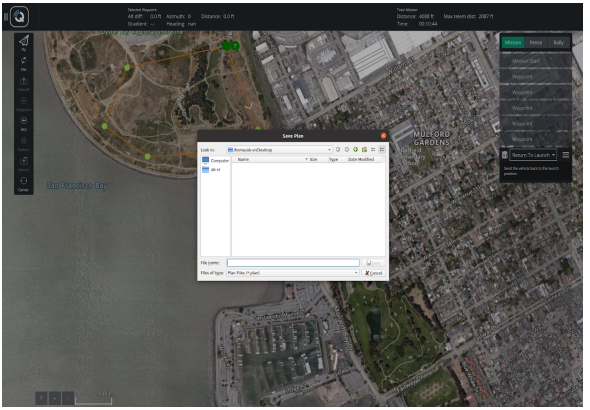
13. From the Fly view, begin the mission. To do so, follow the *Flying a Mission Flight Path* instructions (below).

USING FLIGHT PLAN FILES

Flight Plans that have been created and saved, or loaded onto the GCS, are located in the Plan view under the File icon.

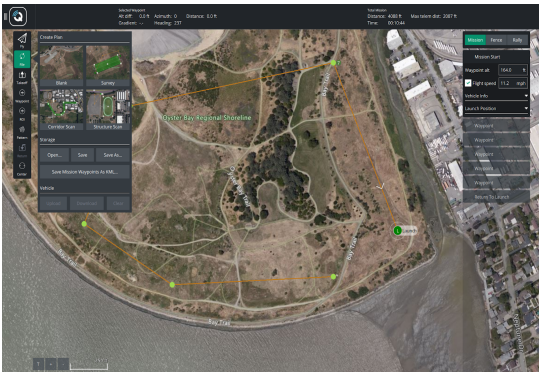
Note: Flight Plan files are saved as ".plan" files.



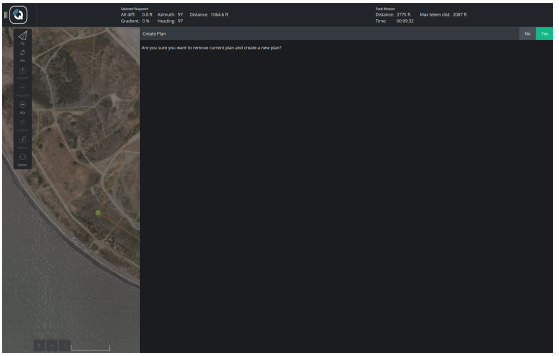


CREATING A NEW FLIGHT PLAN FILE:

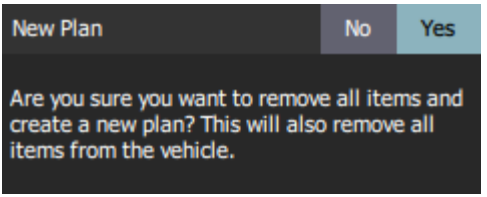
1. Under the File menu, select “New File” to create a new Flight Plan.



2. If there is already a Flight Plan open, a prompt will appear on the right side of the screen to ensure you want to remove any preselected commands. Select “Yes” to clear commands.

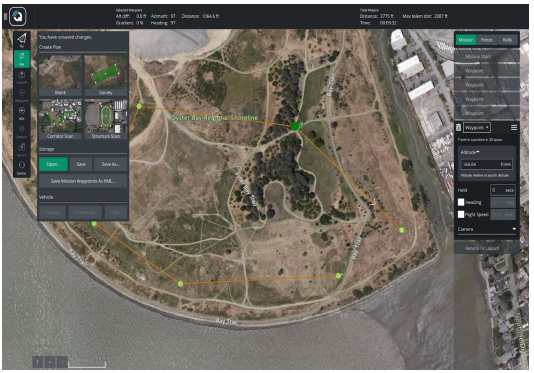


3. The operator can then program a new Flight Plan.

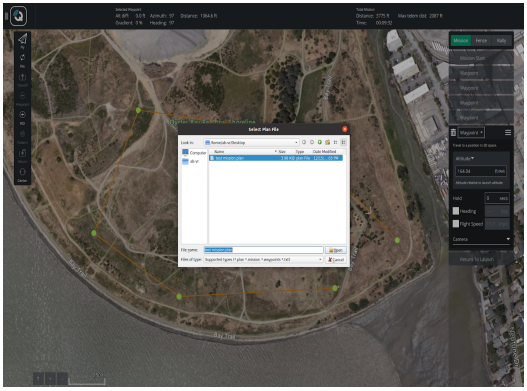


LOADING A FLIGHT PLAN FILE:

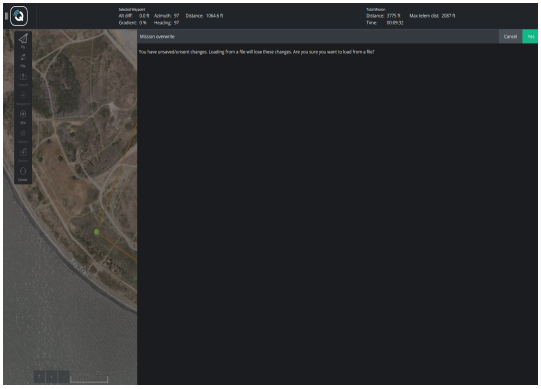
1. Under the File menu, select “Open…”



2. A prompt will appear to open a Flight Plan file from storage.

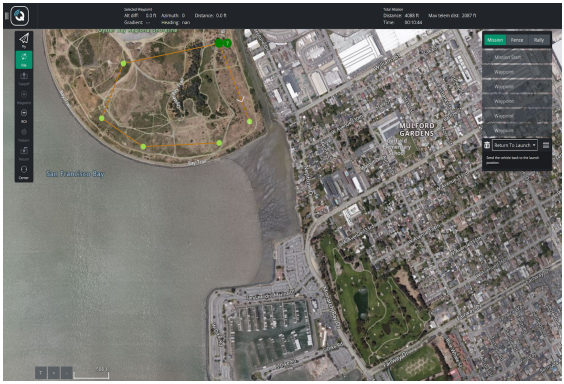


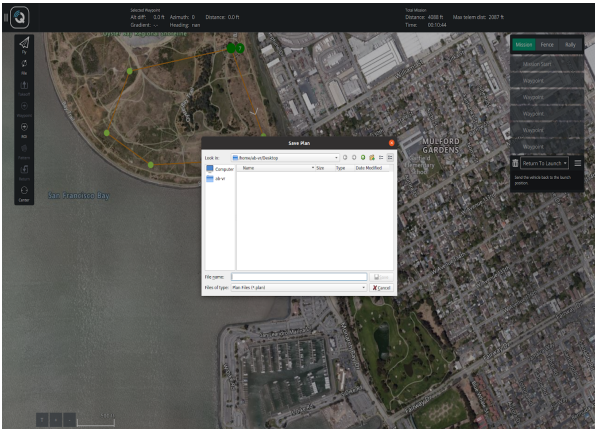
3. If a Flight Plan is already open, a prompt will appear on the right side of the screen to ensure the operator wants to clear the existing file in order to open a new file.



SAVING A FLIGHT PLAN FILE:

1. Go to the File menu and select “Save” or “Save as”:
    a. “Save” will write over the current file;
    b. “Save As” will allow the operator to create a copy of the file and to designate a new name for the file.

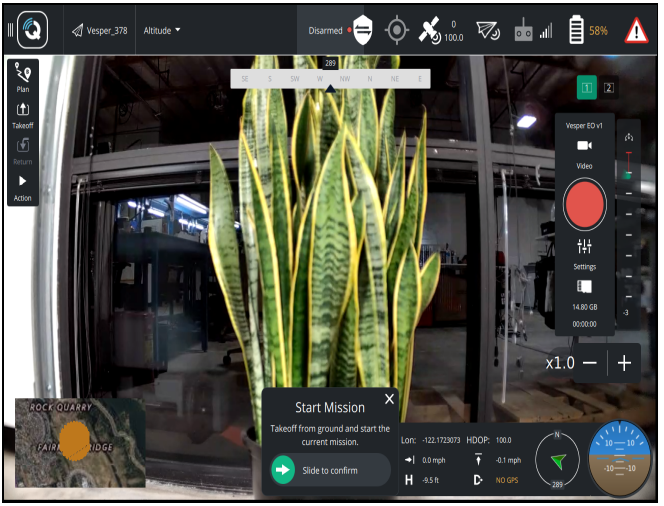




FLYING A MISSION FLIGHT PLAN

1. Once a flight path has been programmed and uploaded from the Plan view, navigate to the Fly view.

2. A prompt to Start Mission will pop up at the bottom of the screen. Slide the blue arrow to confirm.



3. The Ground Control Station (GCS) will display Vesper on the map:
    - The red arrow indicates Vesper's location.
    - The line indicates where Vesper has traveled.

4. If desired, the operator can make Vesper pause (suspended in the air) in its current location by using the control sticks on the GCS or by simply pressing the Pause button on the Fly menu.

RETURNING VESPER AFTER FLIGHT

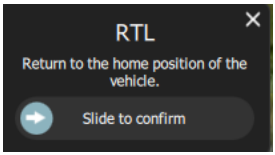
- If Vesper was set to “Return to Launch” upon ending the mission, Vesper will fly directly to that point, rather than retrace the plotted course.

- If “Return to Launch” was not set when the flight plan was created, Vesper will stay at the last waypoint until instructed to return to its launch location.

- The operator can initiate “Return to Launch” by following these direction:

    1. Press the RTL button

 in the Fly menu.
    2. The GCS display will receive a prompt at the bottom of the screen.
    3. Swipe “Slide to confirm.”



    4. Vesper will then ascend and fly directly to the Mission Start location.

- Vesper will default to a 60 meter altitude for “Return to Launch” to ensure obstacle- and detection-avoidance. This pre-set altitude can be changed in Settings.

VII. CAMERA CONTROL

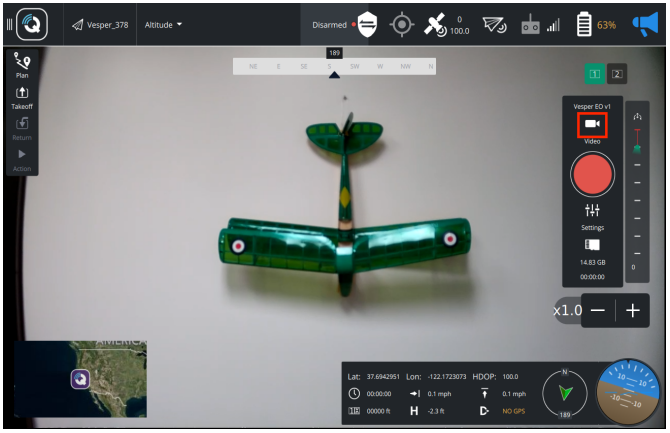
TAKE PHOTOS MANUALLY

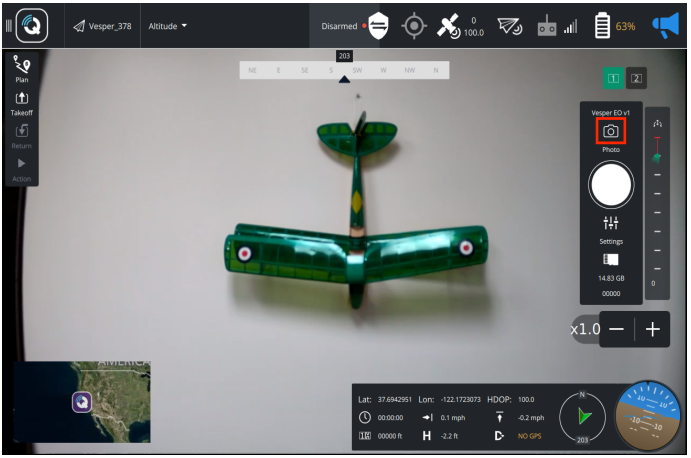
Note: *see directions on Page 13 to automatically take photos on a mission.*

To take photos manually, touch the camera trigger (big circle) on the screen. The on-screen indicator will spin while photo capture is processing.

SWITCH CAMERA MODES:

- Toggle the video/photo icon to switch camera control modes between video and photograph by tapping the icon outlined in red below.





SWITCH CAMERA SENSORS:

- Use button (19) on the GCS to toggle between Electro Optical (EO) and Thermal (LWIR) cameras.
- Alternatively,:
    - To select EO, tap the 1 Icon on the right edge of the screen, above the camera control; or
    - To select LWIR, tap the 2.
- Note: switching camera sensors may take up to 5 seconds.

CAMERA PITCH CONTROL:

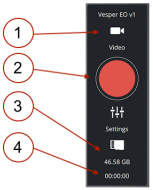
- Joystick (2) controls the camera pitch.
- Alternately, camera pitch can be controlled with the slider on the far right of the screen.

RECORD VIDEO:

- Select Video mode in the side-panel.
- Press the round red Start icon to start video recording.
- The icon will switch to a red square, indicating the camera is recording.
    - While recording, the elapsed recording time and available storage space are presented and updated periodically.

- To stop recording, press the square icon.

Camera controls for recording video:



1. Video/Photo control select
2. Record Start/Stop
3. Available storage space
4. Elapsed recording time

Note: EO video recording continues even when switching to IR view mode (in which case both EO and IR streams are saved and available post flight).

ZOOM CONTROL

- Six levels of zoom are available: 1X, 2X, 4X, 8X, 12X and 18X.
- Each press of the +/- icons will change the zoom level ONE step. The indicator next to the +/- icons will read out the zoom level. You may also use the hardware buttons located on the top right of the GCS as shown below:

- Switching between zoom levels may take up to 2 seconds. Repeated presses are not required and may cause unintended zooming. Zoom will stabilize on what the indicator is set to within a few seconds.

- Zoom is achieved through a combination of optical and digital zoom. When capturing photos after zooming, photos are saved in the full resolution of the sensor and may appear less tightly zoomed than the view on the GCS.

- Zoom is only available on the optical cameras; the thermal camera does not have zoom.

- When switching to IR and back, the previously selected zoom level will be maintained.

VIII. POST FLIGHT

POWER DOWN

- Vesper will automatically shut off 5 minutes after the radio link is powered down.
- If the radio link to the GCS is active, Vesper will remain powered on until the battery is removed.

POST-FLIGHT INSPECTION

Inspection after every flight will help maintain Vesper and minimize safety risks. Specifically:

1. Inspect the propellers for loose screws and damage. Replace propellers if damage is discovered.
2. Inspect the lens for dirt/debris. Follow cleaning instructions, as necessary.
3. Keep batteries charged at full capacity whenever possible.

STORAGE

To insert Vesper into its field case:

1. Hold Vesper at the fuselage,
2. Gently press the rotor arms inwards towards the body.
    - Propellers should be parallel to the length of the fuselage.
3. Rear rotors tuck under the rotor set frame slightly and may need a

stronger push.

4. Once rotors are collapsed, slide Vesper into the field case first, tail first and with the antenna pointing up.
    - The gimbal faces outward when Vesper is in the field case correctly.

TRANSFERRING VIDEOS

Videos (and photos) may be stored to SD card or on the internal flash memory:

- If an SD card is installed, videos and photos will automatically be stored to it.
- If an SD card is not installed, videos and photos will be stored on the internal flash memory and can be downloaded or transferred to an SD card as described below.

BATTERY USAGE AND CHARGING

BATTERY OPTIONS:

Vesper is compatible with two types of batteries:

Battery Type	Use & Compatibility	Description
Endurance	● Maximum endurance and speed ● Compatible with Recon Rotor Set	Black Plastic housing 4C 14.4 V/4900 mAh lithium-ion cells

INSTALLING THE BATTERY:

1. Hold the battery in hand, touching both sides of the casing, with the magnets facing upward.
2. Verify a minimum of two green LEDs lit up, indicating the battery's life is at least 50%.
3. Attach the battery to the underside of Vesper's Fuselage:
    - Match up the battery lights with the camera end of the fuselage.
    - Once lined up the magnets will snap the battery in place.

4. Power verification tones will sound once the battery is successfully connected to Vesper's fuselage.

CHARGING THE BATTERY:

1. Assemble AC/DC adapter, AC cable, and red charge adapter.
2. Plug AC cord into an electrical outlet.
3. Attach the charge adapter to the battery.
4. Battery indicator light will pulse when charging begins.

5. All four indicator lights will turn off when charging is complete.
6. To confirm charge state, grasp the battery by its sides - all four LEDs should illuminate to indicate 100% charge.

IX. VISION GROUND CONTROL STATION

Vision Ground Control Station (GCS) controls Vesper while in flight. Vision GCS also programs flight paths, missions, and functions.

1. Altitude/Yaw Joystick
2. Gimbal Pitch Joystick
3. Pitch/Roll Joystick
4. Return To Home
5. Camera Control
6. Flight Data Display
7. Camera Stream/Map
8. Map/Camera Stream PiP
9. QGC Settings
10. Vesper Batter Level
11. Power On/Off
12. Brightness +/-
13. Communication Antennas
14. User-definable Button
15. User-definable Button
16. Cooling Inlets (do not block)
17. USB-C (charging, data, HDMI)
18. Take Photo
19. EO/LWIR Video Stream Select
20. Camera Zoom In/Out
21. Pairing Icon

POWERING ON & OFF

1. Press the Power button once to turn Vision GCS on.
    a. The Vantage Robotics logo will appear.
    b. Then the login screen will appear.
2. Login using the on-screen keyboard to type in default password “Vantage1”.
3. Press the Power button to power off.
    a. A pop-up window will appear, asking for the operator to select Cancel, Restart, or Power Off.
4. Pair the GCS to Vesper by following the steps in the PAIRING section below.

PAIRING

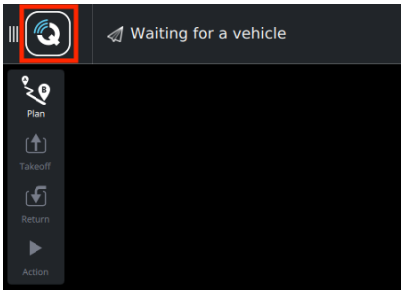
“Pairing” refers to the successful exchange of security keys between Vesper and Vision GCS. Pairing allows the hardware to communicate securely.

This process does not need to be repeated for subsequent flights if using the same Vesper & Vision GCS.

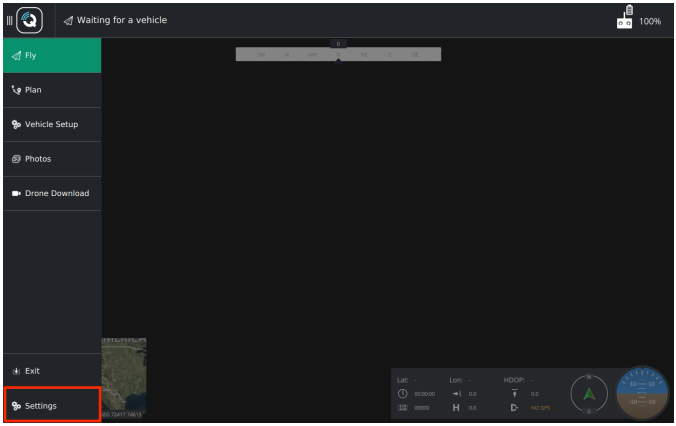
PAIRING AND RE-PAIRING

The operator can pair or re-pair Vesper and Vision GCS by following the steps below:

1. Power up Vesper and Vision GCS.
2. Log in to Vision if necessary.
3. Tap the “Q” at the top left of the Vision screen.



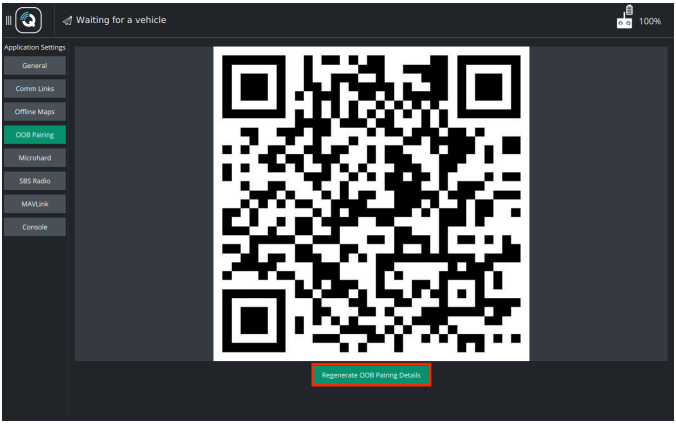
4. Tap “Settings”.



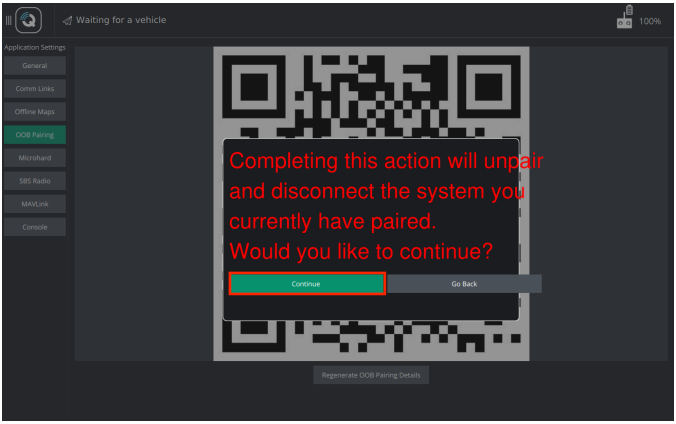
5. Tap “OOB Pairing”.

.

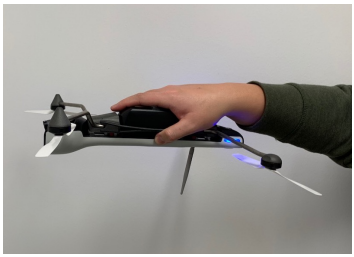
6. Tap “Regenerate OOB Pairing Details”.



7. Tap “Continue” when prompted to continue or go back



8. Flip/invert the Vesper fuselage 180 degrees so that the battery points to the sky 3 times to put it in pairing mode. If successful a short chime will play.



9. Hold the tail end of Vesper up to the screen so the VIO sensor can scan the QR code. A short chime will play to verify that the scan was successful Note: The tail may need to be moved around slightly in order for the VIO camera sensor to successfully scan the QR code; lowering the Vision screen brightness may be helpful.

VIO Camera

Pairing Position

10. After the pair scan completes, move Vesper and Vision at least about 2m from each other to avoid radio saturation. Wait until you see the Vesper camera view on the GCS screen to verify successful pairing.

11. Tap “Q” at the top left of the Vision screen.

12. Tap “Fly” and verify that the Vesper camera view is visible on the Vision screen to verify that Vesper and Vision have been paired.

CONNECTING:

Once pairing steps have been completed, the operator should proceed with the following steps to connect Vesper and Vision GCS:

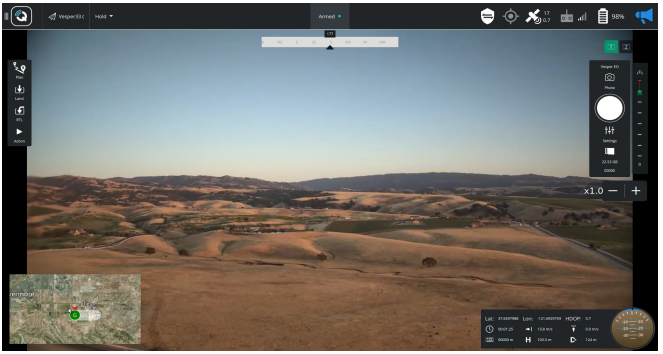
1. Power on Vesper and Vision GCS.
2. For 1.8 GHz units, ensure Vesper is at least 15 feet from Vision GCS (does not apply to 2.4GHz units).
3. Telemetry and video will appear in QGC after about 50 seconds - after Vesper emits startup tune.
4. If video does not appear after 60 seconds, see “Connecting with GCS” in the Troubleshooting section.

USER INTERFACE

VISION GCS VIEW MENU:

Vision GCS’ user interface has multiple modes, called “Views,” each in its own tab.

Views are displayed on the upper left navigation bar of the screen, whether or not Vesper is connected. To change views, the operator can tap each icon and access different features.



Settings – configure the application

Setup – configure and tune Vesper

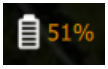
Plan – create pre-planned (autonomous) missions

Fly – monitor Vesper while flying

VESPER STATUS ICONS:

Once Vesper is connected to Vision GCS, The Vesper status bar will show at the top of the screen.

Vesper status icons include:

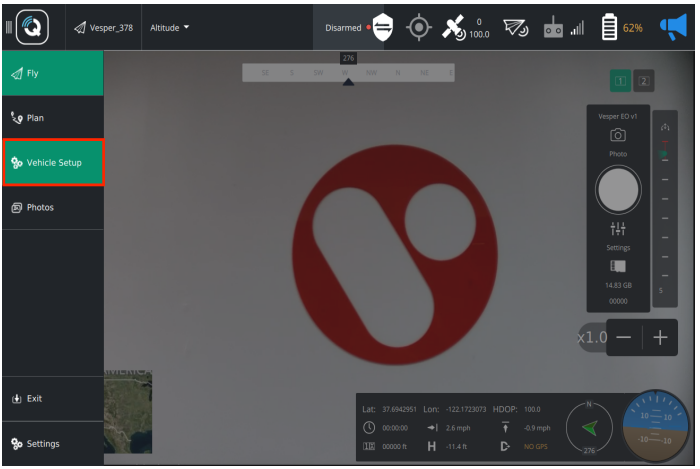
- **Vehicle messages** – click to show a dropdown of messages.
    - If there is a critical message, icon will change to a **yield sign** .
- **GPS Status –** satellite count, current Horizontal Dilution of Precision (HDOP) and other GPS information.
- **Radio Connection Strength**
-  **Vesper Power Level** – displays battery life percentage.
    - Pressing this icon will tell you the voltage and accumulated consumption.

NOTE: The status bar is not displayed while in Plan mode.

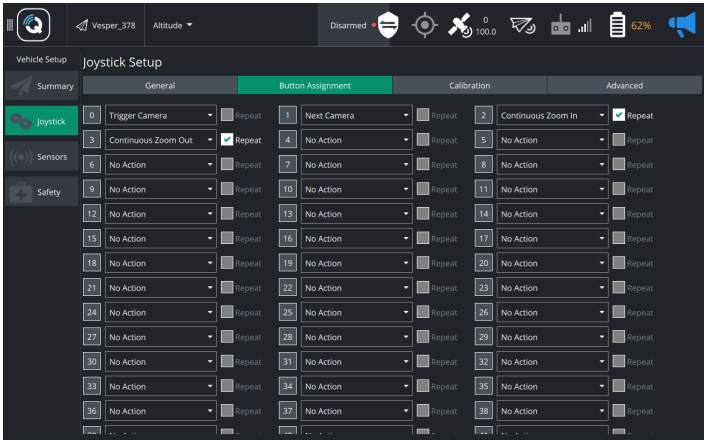
ASSIGNING CONTROL BINDINGS:

The operator can assign button controls by navigating to the Button Assignment tab in the Joystick menu under Vehicle Settings.

1. Tap the ‘Q’ icon in the top left of QGC and go to the Vehicle Settings menu. This is only accessible when the GCS is connected to a Vesper.



2. Tap on the Joystick menu and then navigate to the Button Assignment tab.



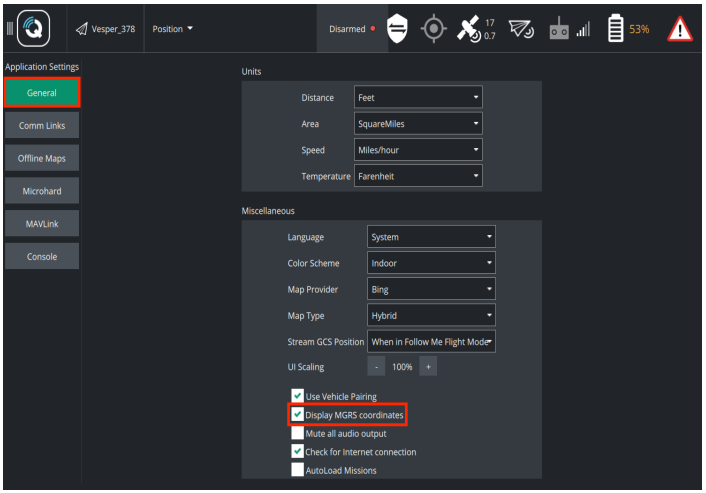
3. Press a physical button on the GCS and see which button lights up in green on the Button Assignments page.

4. Use the dropdown menu next to the selected button to assign a function.

DISPLAYING MGRS COORDINATES

INSTRUCTIONS FOR DISPLAYING MGRS COORDINATES:

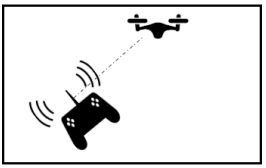
1. Navigate to the “General” tab in the Application Settings menu and select “Display MGRS coordinates.”



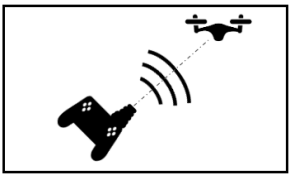
VISION GCS ANTENNAS

The GCS has two antennas, Omni Antenna and Directional Antenna, that can be attached for different use cases:

1. **The Omni Antenna** is a thin rod and strong at all ranges.
    - The Omni Antenna should be pointed sideways, flat sides towards Vesper for the most reliable signal.



2. **The Directional Antenna** is foldable, wide and cone-shaped and is best for long distance and non-line-of-sight flight.
    - The Directional Antenna should be pointed directly towards Vesper for the most reliable signal.



The operator can deploy the antenna by rotating the inner ring counter-clockwise with the palm of a hand. To pack, reverse the process for deployment.

Note: the Directional Antenna should be handled with care.

- When opening the Directional Antenna, be sure to release it slowly.
- In storage, ensure the Directional Antenna is not in a position where it could be crushed.

GCS CHARGING

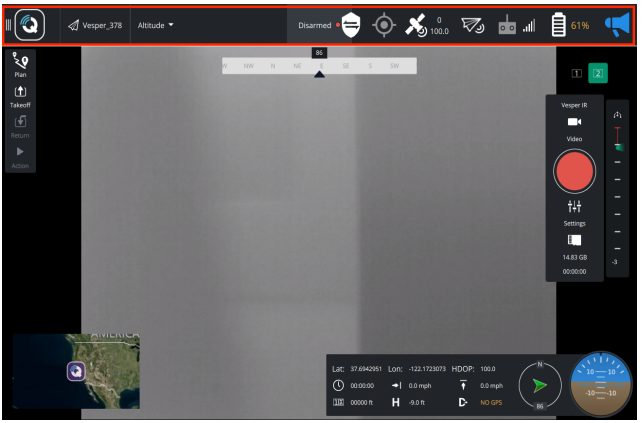
Vision GCS is charged through the USB Type C port on the bottom of the unit.

- Vision GCS charges at 45 Watts when turned off.
- Vision GCS charges 7.5 Watts when powered on.
- When the GCS is streaming video, it will charge very slowly.

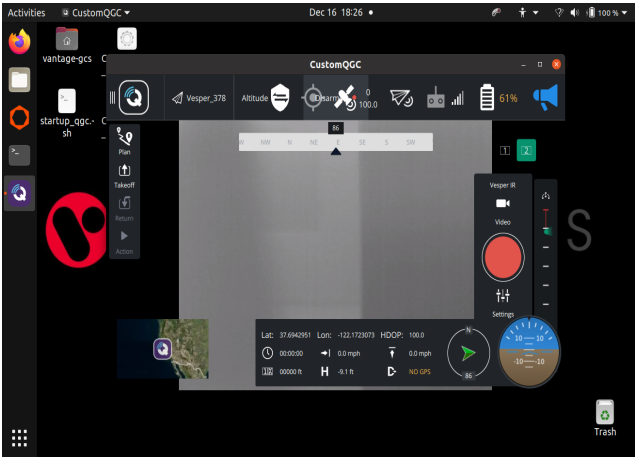
IMPORTANT: only use the USB-C charger and cable provided.

NAVIGATING UBUNTU

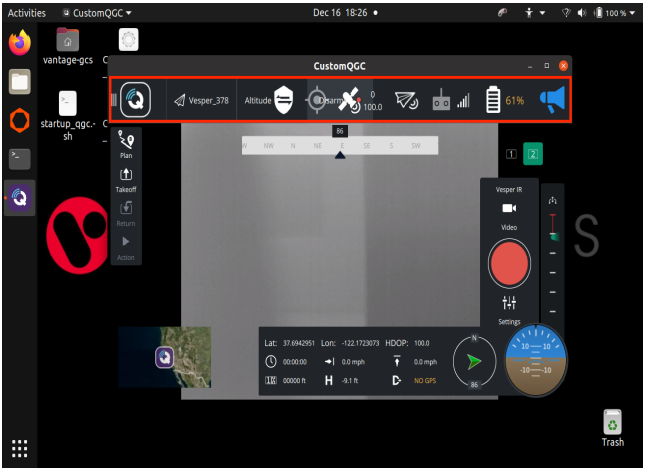
1. Triple tap the menu bar to exit fullscreen mode in QGC.



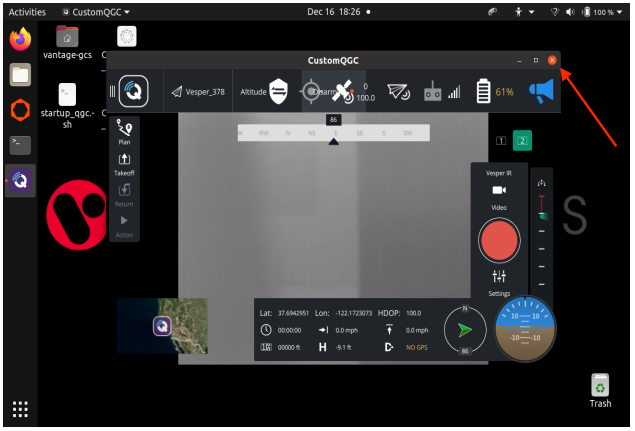
Note: screen below captures screen after fullscreen mode is exited.



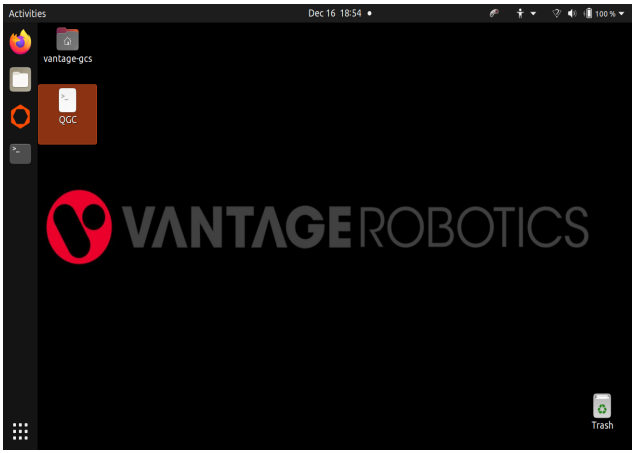
2. To go full screen double tap top menu bar.



3. To exit QGC when not in fullscreen mode, tap the red X icon in the top right corner of the window..

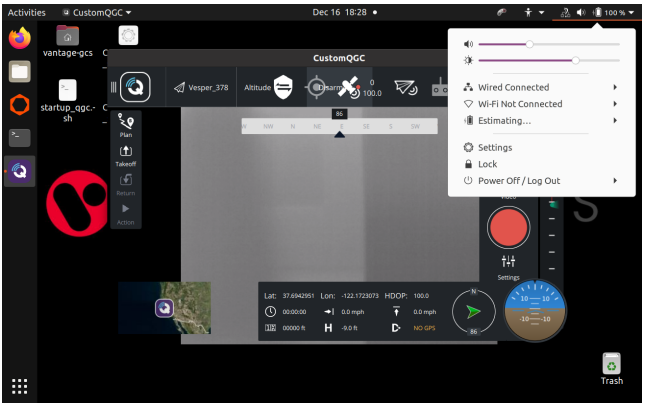


4. To re-open QGC, double tap the QGC file on the desktop as shown below.

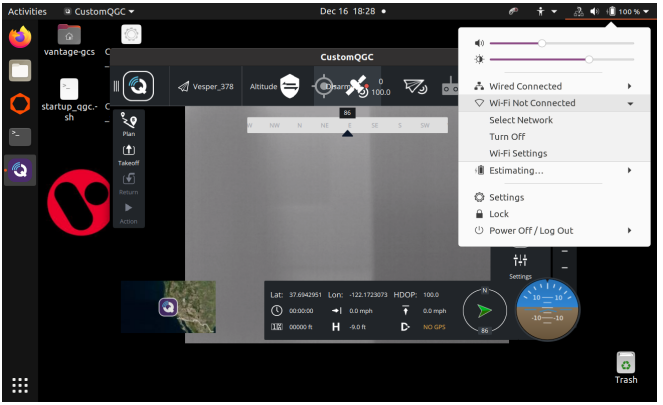


CONNECTING TO A WIFI NETWORK.

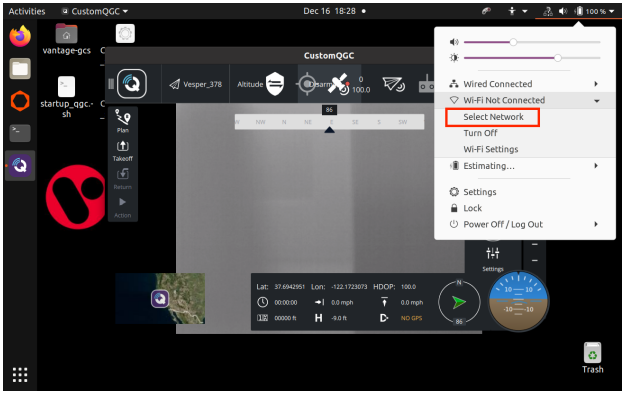
1. Exit fullscreen mode by following instructions on p.48.
2. Tap the menu bar in the top right to access the quick settings menu.

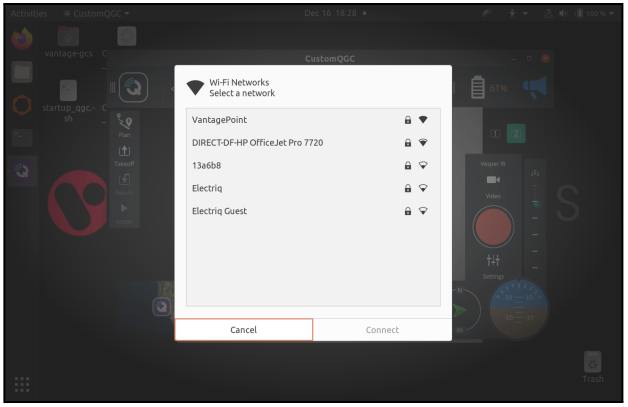


3. Tap the Wifi icon to access the wifi quick settings menu.

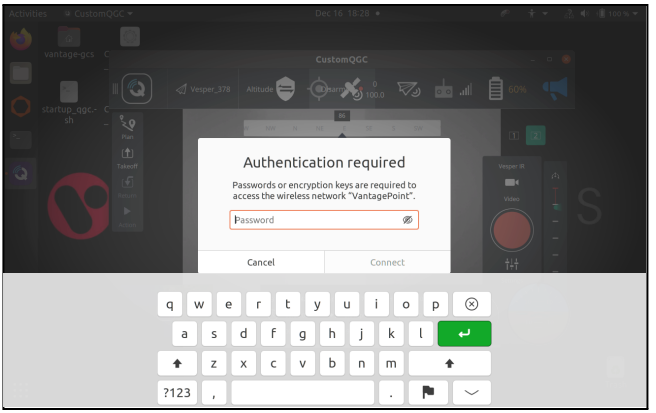


4. Tap select network to show all available wifi networks.



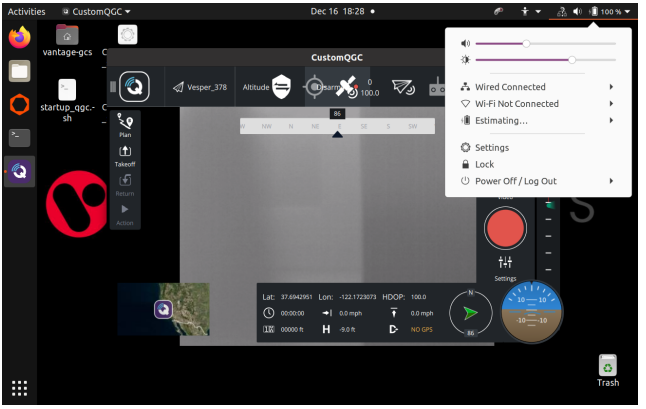


5. Select the network you would like to connect to and enter the passphrase using the on-screen keyboard. Tap ‘Connect’ when done.

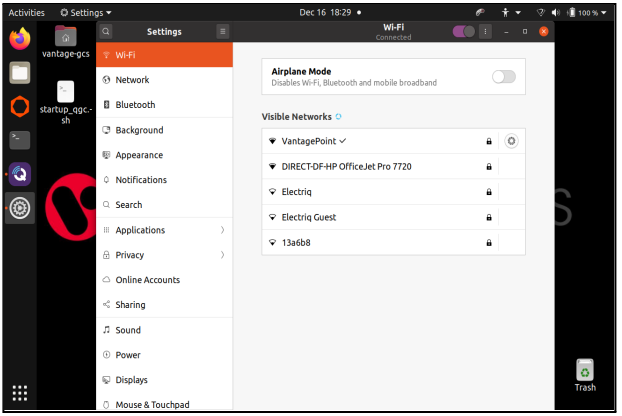


ACCESSING UBUNTO SYSTEM SETTINGS:

1. Tap the menu bar in the top right to access the quick settings menu.

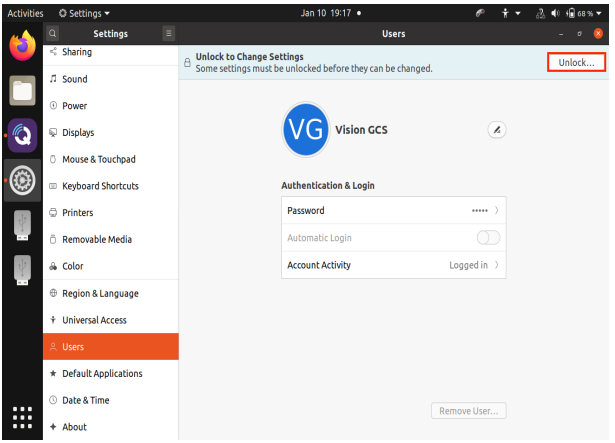


2. Tap Settings to access Ubuntu System settings. We recommend that you do not change anything here as it may affect system performance.

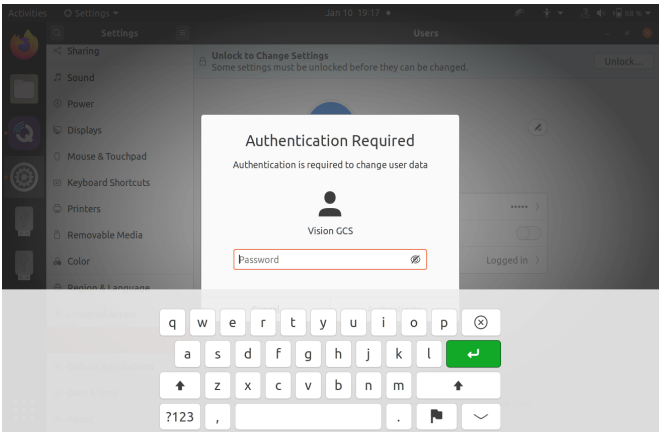


Disabling the lock screen:

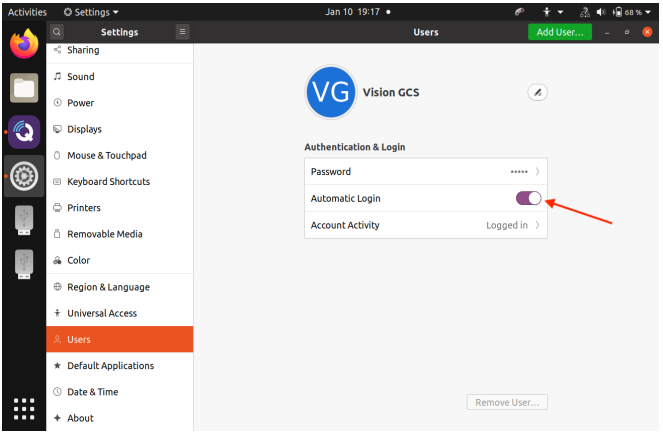
1. Access the settings menu as shown above
2. Select Users in the Sidebar



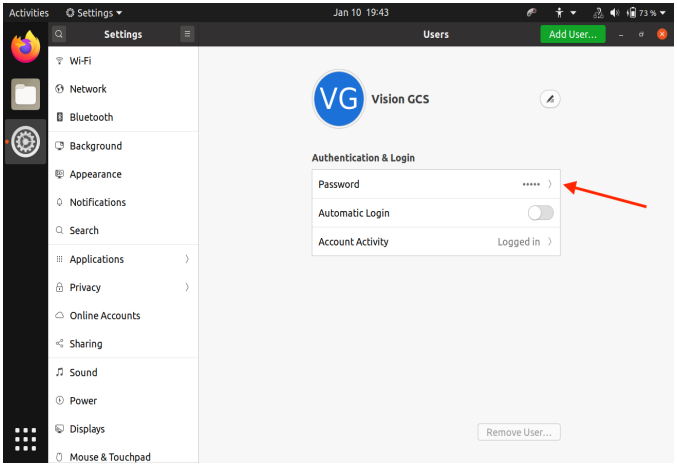
3. Tap Unlock in the top right corner of the screen. The authentication window will pop up. Enter the default password: Vantage1



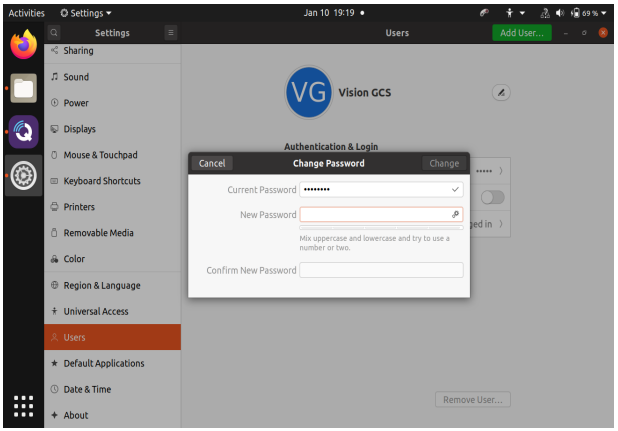
4. Toggle the Automatic Login switch to disable the lockscreen on boot.



5. You can change the GCS password by selecting the Password Menu.

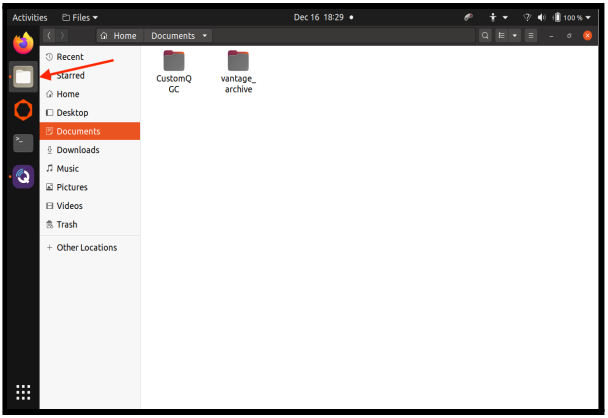


6. Enter the default password ‘Vantage1’ and then enter a new password. Tap Change to complete the change



Accessing files:

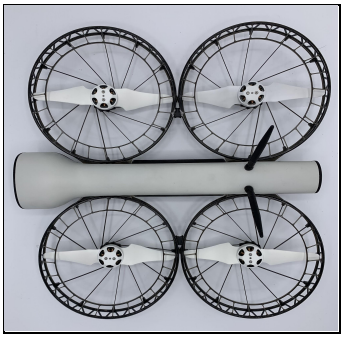
1. Exit full screen mode by following the instructions above.
2. Tap the Folder icon in the dock on the left side to open the file browser.



X. VESPER HARDWARE

ROTOR SETS

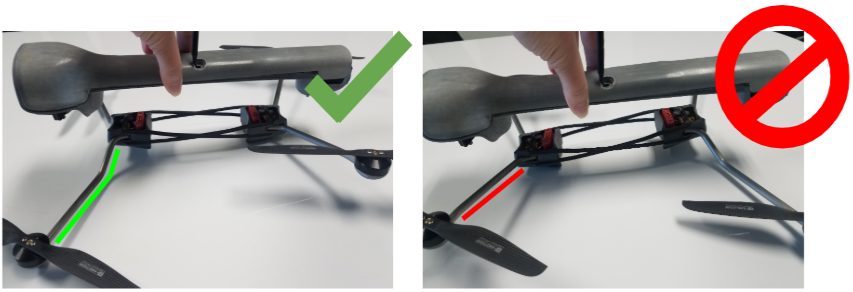
Vesper has two rotor set options: the Safety Rotor Set and the Recon Rotor Set.

Name	Use	Description
Safety Rotor Set	Use for: ● Training, ● Flights near or over people ● indoors / in other confined spaces.	 6 inch shrouded plastic propellers
Recon Rotor Set	Use for: ● Endurance ● Stealth ● Speed.	 8 inch open carbon propellers, titanium arms

Never attempt hand launching Vesper when using the Recon Rotor Set

INSTALLING THE RECON ROTOR SET:

1. Inspect the propellers for loose screws and damage.
2. Unfold the rotor arms so they are fully extended.
3. Confirm all magnets on Vesper's fuselage and rotor set are free of sand and other debris.
4. Orient the rotor set with the longer arms closest to the camera.
    - The longer bent arms should be on the front side of the fuselage (near the gimbal), and the shorter unbent arms should be on the rear end.
    - The polarity of the fuselage magnets will not allow the Recon Rotor Set to attach if aligned improperly (see picture below).
5. Attach the rotor set to the underside of Vesper's Fuselage by snapping magnets into place.
6. Confirm installation: when spun lightly with a finger, all four propellers should easily spin at least two full rotations.



TAKEOFF AND LANDING OPTIONS

Different takeoff and landing options can be used depending on the rotor set.

RECON ROTOR SET CONFIGURATION:

- **Ground Case Takeoff (use field case as a takeoff platform)**

    1. Place the case lid side down, with the lid open, on a flat/level surface.
    2. Place Vesper on top of the case, aligning the magnets on the bottom of the battery to the magnets on the case.
    3. Follow the standard takeoff procedure.
    4. The case may shift or be knocked over during takeoff, but Vesper will detach.

- **Hand Takeoff Using Case: (use in rough terrain/moving platform)**

    1. Close the lid of the case.
    2. Place the Vesper on top of the lid, aligning the magnets on the bottom of the battery to the magnets on the lid.
    3. Instruct a co-operator to hold the case overhead while following these safety precautions:
        a. Always hold the case from the bottom.
        b. Always wear eye, head, and arm protection.
        c. Look downwards as Vesper takes off.
        d. As soon as Vesper has cleared the case, quickly exit the takeoff area without looking upwards.

    CAUTION: the hand takeoff method is dangerous and should only be performed by experienced personnel who are trained and familiar with Vesper.

- **Ground Takeoff:**
    1. When a flat surface is available Vesper can take off directly from the ground.
    2. Always ensure blades have clearance to spin freely prior to takeoff.

  Note: ground takeoff mode is less desirable than the alternatives, since it increases the chance of dust/dirt getting on the camera lens.

SAFETY ROTOR SET CONFIGURATION:

All Recon Rotor Set launch/landing options apply to the Safety Rotor Set. Additionally, due to the reduced risk of laceration from the blades, hand takeoff/landing is also possible with the Safety Rotor Set.

- **Hand Takeoff:**
    1. Hold Vesper from above with one thumb and forefinger pressing against opposite sides of the battery.
    2. Set feet in an active stance, so you are prepared to exit the fly area quickly.
    3. When hands and feet are set, inform the operator you are ready for takeoff.
    4. Once the blades are spinning, quickly remove your hand away from the propellers vicinity, and jog 20 feet away from launch location.

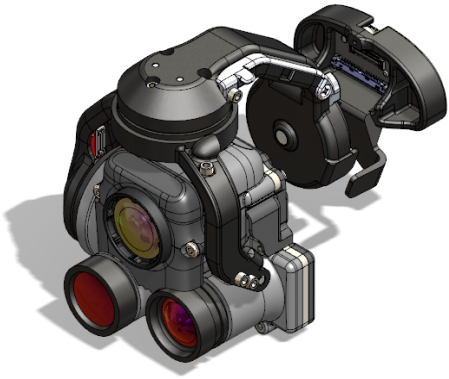
  CAUTION: the hand takeoff method can be dangerous and should only be performed by experienced personnel.

- **Hand Landing:**
    1. Push the Land button.
    2. Grab Vesper from waist level. Adjust hand until it is securely holding the battery.
    3. Once the co-operator or operator is securely holding the battery, lift Vesper upwards to shut off the propellers.

  Note: if the co-operator grabs Vesper in flight, the operator will need to push the altitude control stick downwards until blades power off

CAMERA AND GIMBAL

Vesper's modular gimbal is equipped with (a) a low light, wide angle navigation camera, (b) a zoom camera and (c) a thermal camera.



SENSOR SPECIFICATIONS:

	Lens Speed	Horizontal FOV	Resolution
Navigation	f1.0	63 degrees	3840x2160
Telephoto	f2.4	17 degrees	3840x2160
Thermal	f1.0	24 degrees	320x240

TRANSPORTING VESPER

VIsion GCS, Vesper, and Vesper accessories have customized cases and bags for storing and transporting properly.

FIELD CASE:

- Store Vesper in the field case with the battery still attached by folding the Recon Rotor Set arms into the fuselage.
- The Field Case lid can act as a landing and takeoff point.
- The Field Case is waterproof to up to 3ft, crushproof up to 250 lbs, and resists drops up to 6 ft.

TRANSPORTATION CASES:

- Transportation cases are used to store bundles & long distance travel.
- The larger case stores two Vesper units in Field Cases, two batteries, two battery bags, one Safety Rotor Set and charging accessories.
- A second, smaller, transportation case stores Vision GCS.

XI. MAINTENANCE

CLEANING & CARE ACCESSORY CASE

The Vesper Cleaning & Care Accessory Case is a water resistant and contains:

- Set of four replacement propellers for the Recon Rotor Set and the Safety Rotor Set;
- Lens cleaning brush;uju
- 1.5mm hex wrench for gimbal replacement.

VESPER & VISION GCS CLEANING

STEPS FOR CLEANING PARTS & SUBASSEMBLIES:

1. **Preparation:**
    a. Remove all components from the Field Case.
    b. Disassemble fuselage, battery and rotor set.

2. **Battery:**
    a. Remove any metal debris stuck to magnets.
    b. Recharge batteries with charging dock after use.
    Note: If a battery is cracked or otherwise unusable recycle it with other hazardous waste and replace it with a new battery.

3. **Rotor Set:**
    a. Remove any metal debris stuck to magnets.
    b. Inspect the propellers for loose screws and damage.
    c. Confirm that all motors spin freely.

4. **Fuselage:**
    a. Clean the underside of the fuselage.
    b. Remove any metal debris stuck to magnets.

5. **Gimbal:**
    a. If dirt or fingerprints are on the lens, gently wipe with the soft brush and lens cleaner provided in the cleaning kit.
        ■ **IMPORTANT**: Do not use fingers or hard material to wipe away particles blocking lenses.
6. **Vision GCS:**
    a. Use a dry, soft, microfiber cleaning cloth.
    b. If the casing becomes soiled it can be wiped down gently with soap and water.

STEPS FOR REASSEMBLY STORAGE:

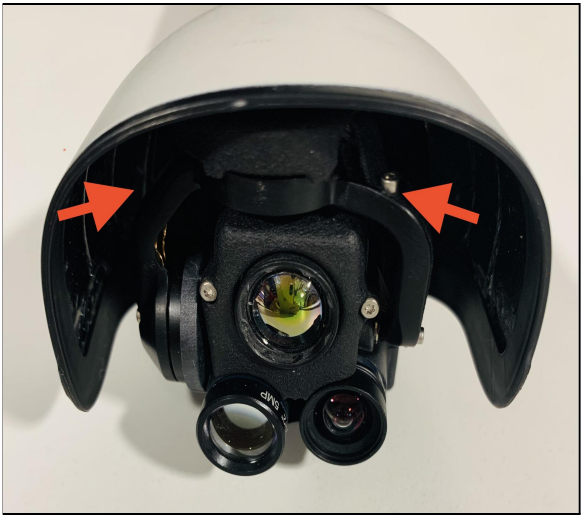
1. After the battery is charged, attach battery to the fuselage.
2. Attach fuselage and battery to the rotor set forming a complete UAS.
3. Fold the rotor set arms and insert into the field case.

VESPER MAINTENANCE

REPLACING / REMOVING THE GIMBAL:

The gimbal can easily be removed/replaced in cases where a lens or the whole unit is damaged beyond repair.

1. Unscrew the two screws located directly behind the gimbal using the 1.5 mm Allen head screwdriver provided, turning counter-clockwise.
2. Save the screws.
3. Gently remove the gimbal by pulling it away from the fuselage; set aside.
4. Place the new gimbal in the same position, and screw it into place using the same screws and screwdriver, turning clockwise.



REPLACING PROPELLERS:

- **Recon Rotor Set:**

    1. Gently pull the propeller directly off of the motor.
    2. Replace with a new propeller.
        - The new propeller will snap into place easily; listen for a click sound.
    3. Spin the blades with one finger to check that the new propeller is attached correctly; propellers should easily rotate.

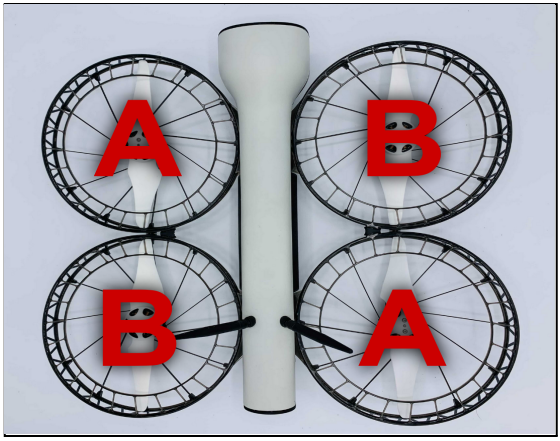
- **Safety Rotor Set:**

1. Remove the two screws attaching the propeller to the motor using a 1.5mm allen head screwdriver, turning screws counter-clockwise.

2. Set screws aside.
3. Ensure the new propeller is correct: for SRS → the white blades, and for RRS → the gray plastic blades.
4. Ensure the new propeller blades match the direction of the blade you are replacing.

5. The curves and direction of the slant must be the same as the previous blade used.

6. B blades move counter-clockwise & A blades clockwise
   Note: When oriented as the picture below, the layout is:



7. Place the new propeller over the holes and attach with the screws. Torque the screws to snug plus a quarter turn.
8. Spin the blade with one finger to check that the new propeller is attached correctly. The propeller should easily make two full rotations.

XII. TROUBLESHOOTING

Common issues will be reported on the Vision GCS display as a warning/error message. For example, a lost or low link strength will result in a message displayed on the GCS, indicating that action should be taken.

Below is a list of common issues, how to identify them, and troubleshooting steps to resolve them.

To change notifications or failsafe settings refer to section: PROGRAM FAILSAFE TRIGGERS & EMERGENCY PROCEDURE.

PAIRING

Problem	Indicator	Response
Cannot get Vesper into pairing mode	No tone indicating successful pairing	1. Disconnect battery, wait a few seconds, then reconnect. 2. Repeat pairing instructions (see page 12).
Gimbal clacks back and forth when turning Vesper upside down to pair	Gimbal clacking	Wait a full 60 seconds from startup before flipping upside down.
Pairing process gets stuck on “Searching” screen	Searching screen shown for > 60 seconds	1. Confirm Vesper is on by checking the gimbal is active. 2. Confirm radio connections are plugged in. 3. Cancel pairing attempt on QGC and redo the process to put Vesper and GCQ into pairing mode and wait another 60 seconds.

		4. If not successful, cancel pairing and try again. 5. If not successful, power cycle Vesper and repeat instructions. 6. If not successful, power cycle Vision GCS and repeat again.
Pairing process gets stuck on switch to high power	High power transition screen shown for > 60 seconds	1. Confirm Vesper is on by checking the gimbal is active. 2. Confirm Vesper is at least 15 ft away from Vision GCS. 3. Restart pairing process and try again.

CONNECTING

Problem	Indicator	Operator Response
No telemetry or video appears after 60 seconds	No telemetry or video appears after 60 seconds	1. Confirm that Vesper is on by checking that gimbal is active. 2. Confirm that the radio is plugged in correctly. 3. If unsuccessful, power cycle Vesper and try 2x more times. 4. If unsuccessful, re-do the pairing process.
Telemetry appears but video does not appear	Telemetry is active, but video is not	1. Confirm that Vesper is at least 15 feet away from Vision GCS. 2. If unsuccessful, confirm that Vesper has a SD card inserted with at least 2 GB available. 3. If unsuccessful, power cycle Vesper and try again.
Connection quality is poor	Video comes and goes repeatedly, attitude updates in artificial horizon are not smooth	1. Confirm that Vesper is at least 15 ft away from Vision GCS. 2. If unsuccessful, confirm the antenna is correctly deployed. 3. If unsuccessful, confirm that Vesper has a SD card inserted with at least 2 GB available. 4. If unsuccessful, restart Vesper. 5. If unsuccessful, restart Vision GCS.

PRE-FLIGHT:

Problem	Indicator	Operator Response (P) / Cooperator Response (C)
Propeller(s) not rotating	Propeller does not freely make 2 rotations when spun with finger	1. (C) Check propellers for damage (i.e. cracks). 2. (C) Check for obstruction (dirt, sand, etc.) in the motor. 3. (C) Replace rotor set.
Launch conditions not met	Vision GCS feedback	1. (P) Click "!" in upper right on Vision GCS to learn more. 2. (C) If "Motor error", confirm that props are clear and spin freely. 3. If props do not spin freely, replace the rotor set. 4. (P) If there is no clear corrective action, try again 3x times. 5. (C) Power cycle Vesper. 6. (P) Try again.
Image blurry	Image blurry	1. (C) Clean lenses by using brush to remove dust or water.
Magnetometer issue	Error message on Vision GCS or general failure to launch	1. (C)/(P) Move Vesper and Vision GCS away from any magnetic or metal objects. 2. (C)/(P) Use the Field Case Takeoff method. 3. (C) Power cycle Vesper and Vision GCS (UPCI).
Interface frozen	Unresponsive to commands after repeated attempts	1. (P) Restart QGC. 2. (P) Restart Vision GCS. 3. (C) Restart Vesper.

Gimbal is not operating properly	Gimbal does not maintain level while rotating the fuselage	1. (C) Restart vesper while tilting/holding gimbal to the right (roll) of Vesper's flight direction for 25 sec. After being released the gimbal will auto calibrate and return to level position.
Warning upon connecting GCS to Vesper	Yellow warning indicator shows "One or more vehicle components require setup prior to flight"	1. (P) Tap X at the top right corner to disregard the pop-up.
SD Card show 0 GB Remaining	As indicated above camera button	1. (P) Power cycle and confirm the SD card on the underside of Vesper is inserted all the way. 2. (P) Follow instructions for removing video from the SD card, as the SD card may be full. 3. (P) Replace the SD card with one from another unit. 4. (P) Restart QGC.

FLIGHT

Problem	Indicator	Operator Response (P) / Cooperator Response (C)
Lost communication link	"No Video" shown, telemetry stops updating	1. (P) Confirm the antenna is pointing in the correct direction. 2. (P) Check antenna connections.
Lost video stream	"No Video" shown, telemetry continues to update	1. (C/P) Confirm the antenna is pointing in the correct direction. 2. (P) Wait 15 seconds. 3. (P) Switch to a different zoom level or sensor (EO/IR), and try 3x times. 4. (P) If there is no video feed after 60 seconds, try a higher altitude. 5. (P) If unsuccessful, return towards home until feed returns.
Operator cannot control gimbal pitch	Gimbal pitch not responsive	1. Restart QGC (see instructions below).
Drone does not command pitch in missions	Gimbal pitch does not change during missions	1. Turn off manual "Gimbal Pitch Control" option in camera settings.
Poor quality video stream	Video is pixelated or latency is high	1. (P) Climb to higher altitude if possible to regain line of sight. 2. (P) Confirm the antenna is pointed in the correct direction.
Lost GPS	Warning/error message on Vision GCS (low GPS strength)	1. (P) Maintain position manually, and fly to a lower altitude if possible to regain optical flow control.
Low Vesper battery	Message on Vision GCS of battery <8%	1. (P) Instruct Vesper to return to launch (RTL).

	and Vesper >1km away		
Downed Vesper (LoS, BLoS)	Unplanned landing or Vesper brought down	1. (P) Use the last known location on the map to locate Vesper. 2. (P)/(C) Go to the search location for Vesper recovery.	
Latency (command, data, or video)	Slow video feedback or response to commands	Early flight:	1. (P) Land. 2. (C) Power cycle. 3. (P)/(C) Restart flight mission.
		Mid flight:	1. (C) Adjust antenna. 2. (P) Move or increase altitude to re-establish LoS.
QGC/Vesper unresponsive to commands	Unresponsive to commands after repeated attempts	1. (P) Restart QGC. 2. (P) Restart Vision GCS. 3. (C) Detach and reattach radio power cable from Vision GCS.	

TAIL LED INDICATOR AND VEHICLE STATE REFERENCE

	Solid	Pulsing	Blinking
Blue	Armed No GPS	Ready No GPS	-
Green	Armed GPS	Ready GPS	-
Turquoise	Booting	-	-
Purple	Failsafe Mode (vehicle will RTL or land)	-	-
Amber	Low Battery	-	-
Red	-	-	Error, Critical Low Battery

RESTARTING QGC:

1. Tap the top of the QGC window three times to make the window smaller.
2. Tap the “Activities” button in the top left corner of the window.
3. Select the image of the QGC interface, and click the upper right arrow to quit.
4. Select the option to exit from the popup window when returning to the app.
5. Open activities → Files → Desktop.
6. Double tap VantageQGC.AppImage.

DISPOSAL OF BATTERIES AND ELECTRONICS:

1. Dispose of batteries and electronics according to local regulations

XIII. SPECIFICATIONS

AIRCRAFT

Vesper	
Dimensions (ready for flight)	19.3” x 19.3” x 6” 49cm x 49cm x 15.3cm
Dimensions (folded)	13.2” x 3.7” x 3.3” 33.5cm x 9.4cm x 8.4cm
Weight (max/empty)	985g/560-720g - depending on configuration
Flight Time - Recon Rotor Set	50 min
Flight Time - Shrouded Rotor Set	32 min
Max Flight Speed	43 mph (70 km/h)
Max Operational Wind Speed	31 mph (50km/h)
Max Service Ceiling	> 10000 ft (3049 m) MSL
Operational Temperature Range	-4°F(-20°C) - 119°F (48°C)
Max range from Vision GCS	3 mi (5km)
GPS Satelite Constellation	Redundant GPS, GNSS
Indoor Position Control	VIO and optical flow
Obstacle Avoidance	Downward facing sonar
Communications	Microhard 1.8 GHz or 2.4 GHz Radio
Ingress Protection	IP53
Security	AES-256 encryption (all comms and storage)

CONTROLLER

Vision	
Dimensions	5.5” x 9.6” x 1.4” 12.7cm x 24.4cm x 3.6cm
Weight	1.9 lbs (862g)
Input	Dual 2-axix joystick, single rocker and 10 buttons
Display	7”, 1080 p, 2500 NIT screen
Storage	500 GB
Operating Frequiencies	1.8 GHz or 2.4 GHz (depends on model)
Operating Temperature	14°F(-10°C) - 119°F (48°C)
Ingress Protection	IP54
Vehicle Control Ssoftware	QGroundControl
Operating System	Ubunto OS
Security	AES-256 encryption (all comms and storage)

GIMBAL AND CAMERA

Gimbal and Camera	
Gimbal	3-axis stabilized
Gimbal Pitch Control	User controllable +35° to -90°
Lens	Wide-angle - 6 mm @ f/1.0 Telephoto - 25 mm @ f/2.4
Camera Sensor Resolution/HFOV	Wide-angle - 4K 48° (HFOV) Tele - 4K 24° (HFOV) Thermal - 320 x 256 24° (HFOV)
Navigation Sensor	Color Sony IMX334
Telephoto Sensor	Color Sony IMX334
IR Sensor	Seek J3 - uncooled vanadium oxide - 65mK sensitivity
Still Image Resolution	3840 x 2160p x 8 MP
Video	1080 or 4K MPEG-4
Optical and Digital Zoom Range	48x combined (3.5° - 63° HFOV)

XIV. LEGAL

WARRANTY

Vantage Robotics, LLC (the "Company") warrants to the original purchaser that Company products ("Products") shall be free from manufacturing defects for a period of one (1) year from the original date of purchase, except that if you reside in the European Economic Area and you purchased Products in the European Economic Area, the warranty period is two (2) years from the original date of purchase. Company's sole obligation in the event of such defects during the applicable warranty period is to repair or replace the defective Product or component thereof with a comparable Product or component, at Company's sole discretion.

HOW TO OBTAIN WARRANTY SERVICE

To obtain warranty service, you must have a return authorization. To request a return authorization, please email support@vantagerobotics.com. The return authorization number must be included along with your returned Product. You must deliver the Product, in either its original packaging or packaging providing an equal degree of protection, to the address specified by Company. Except as otherwise required by applicable law, Company may require you to furnish proof of purchase details and/or comply with other requirements before receiving warranty service. Returns and/or replacements of Products may be subject to shipping, handling, replacement, and/or restocking fees. All Products that are returned to us become the property of Company. You agree that the Company is not responsible for any memory card, content, or information stored in any Product you return to the Company, whether under warranty return or not. Please make sure to save any content or information you wish to keep from your Product's memory card and erase any data thereon before returning your Product to the Company.

EXCLUSIONS AND LIMITATIONS

Notwithstanding the limited warranty above, you assume all liability for, and the Company has no obligation whatsoever to you or anyone else for, any of the following:

- damage caused by unauthorized modification, alterations, disassembling, or shell opening;
- damage as a result of attempting to affix anything to the Product or changing the Product weight;
- damage resulting from use of the product outside of procedures described in the User Manual;
- crash damage resulting from pilot error;
- use of the Product in combination with any third-party devices or products that the Company has not provided or recommended to you;
- damage caused by improper installation, or incorrect use or operation despite the guidance of manual;
- any damage to property or persons caused by your use of the Product that is not caused by a material defect, including your failure to understand the functionalities of the Product;
- damage caused by unauthorized modification of circuit, mismatch or misuse of battery and/or charger;
- charging the Product battery with any charger not provided by the Company;
- damage caused by operating the unit with a low charged or defective battery;

- failure to adhere to Federal Aviation Administration regulations and advisories, as well as any other relevant laws and local government rules; and

- any other improper use of the Product.

No Company reseller, distributor, agent, or employee is authorized to make any modification, extension, or addition to the foregoing Limited Warranty. If any term contained herein is held to be illegal or unenforceable, the legality or enforceability of the remaining terms shall not be affected or impaired.

EXCEPT FOR THE LIMITED WARRANTY ABOVE, COMPANY MAKES NO OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, AND TO THE MAXIMUM EXTENT ALLOWABLE UNDER APPLICABLE LAW, ANY IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT, ARE HEREBY DISCLAIMED. Some jurisdictions do not allow limitations on the duration of an implied warranty, so the above limitation on implied warranties may not apply to you.

TO THE MAXIMUM EXTENT ALLOWABLE UNDER APPLICABLE LAW, IN NO EVENT SHALL COMPANY BE LIABLE FOR INDIRECT, INCIDENTAL, CONSEQUENTIAL, EXEMPLARY, PUNITIVE, OR SPECIAL DAMAGES, INCLUDING LOST PROFITS, REGARDLESS OF THE FORM OR THE ACTION OR THE THEORY OF RECOVERY, EVEN IF COMPANY HAS BEEN ADVISED OF THE POSSIBILITY OF THOSE DAMAGES, AND LIMITS LIABILITY TO REPLACEMENT OR REPAIR, AT COMPANY'S OPTION. THIS DISCLAIMER OF LIABILITY FOR DAMAGES WILL NOT BE AFFECTED IF ANY REMEDY PROVIDED HEREIN SHALL FAIL OF ITS ESSENTIAL PURPOSE. SOME JURISDICTIONS DO NOT ALLOW LIMITATIONS OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. Some jurisdictions do not allow the exclusion or limitation of special, indirect, incidental, or consequential damages, so the above limitation or exclusion regarding such damages may not apply to you.

GOVERNING LAW

These Limited Product Warranties shall be governed by the laws of the State of California, USA, without giving effect to any conflict of laws principles that may provide the application of the law of another jurisdiction.

CONSUMERS IN SOME JURISDICTIONS MAY HAVE LEGAL RIGHTS UNDER APPLICABLE NATIONAL LEGISLATION GOVERNING THE SALE OF CONSUMER GOODS. THE FOREGOING DOES NOT LIMIT OR ALTER THOSE RIGHTS EXCEPT AS ALLOWED UNDER APPLICABLE LAW.