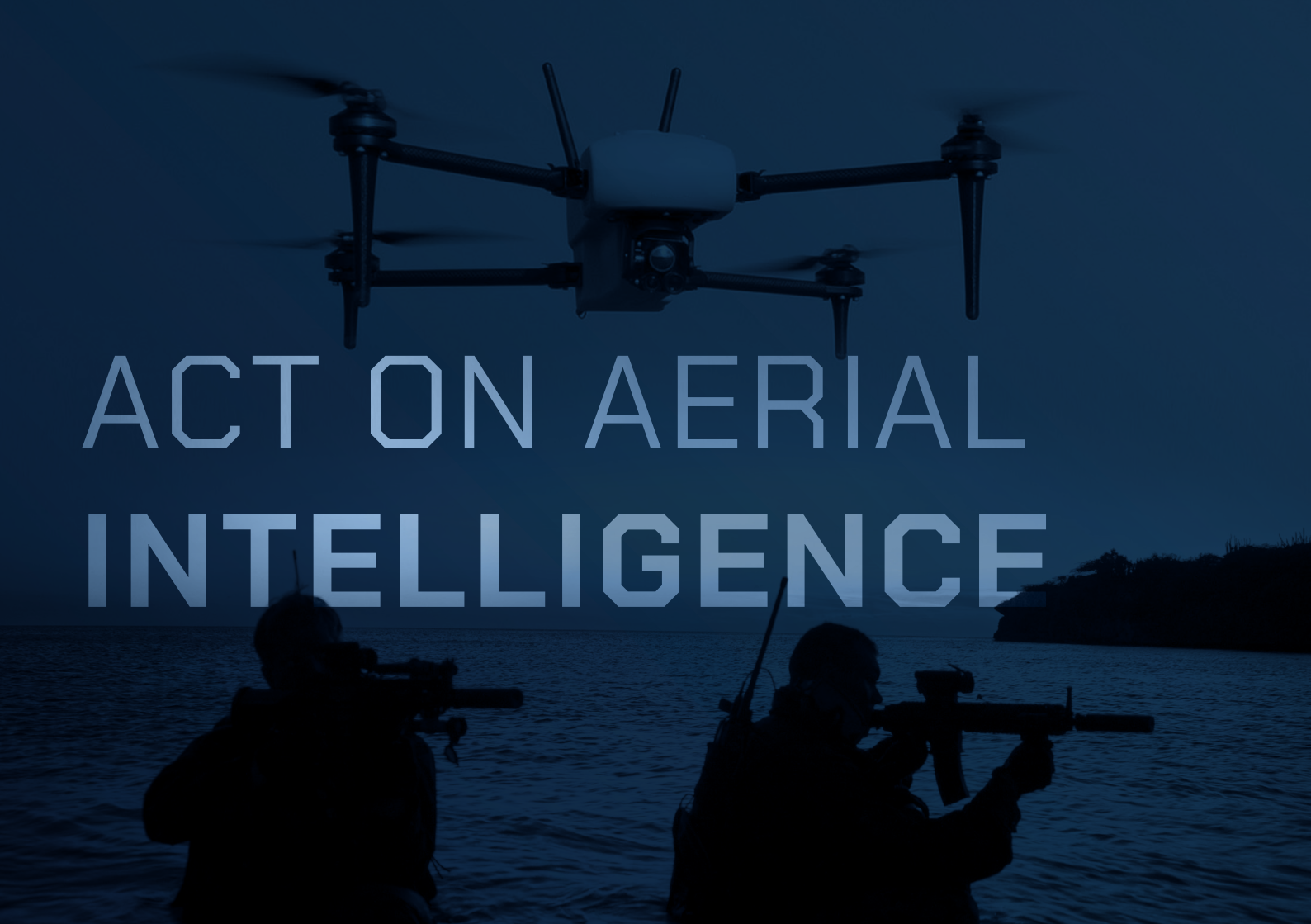
MARTLET MI-1

SHORT-RANGE TACTICAL MICRO UAS

HEIGHT TECHNOLOGIES

USER MANUAL

User Manual Version: v4


ACT ON AERIAL
INTELLIGENCE

CONTENTS

MESSAGE TO USERS

OUR MISSION

Height Technologies is an EU-based robotics company that develops and manufactures unmanned (aerial) systems in Geldermalsen, The Netherlands. Our mission is to save lives by sending out UAVs ahead of people, empowering our users to make safer, smarter, and faster decisions with aerial intelligence in demanding tasks and areas.

ACT ON AERIAL INTELLIGENCE

Today, military units understand the strategic & tactical need for unmanned aerial systems, making them an integral part of their arsenal. Our job is to serve government and military clients by actively working together in creating unmanned solutions that go beyond what is possible. Our passion for simple yet sophisticated unmanned technology drives us to deliver reliable and long-lasting UAS solutions that meet field requirements and MIL standards, reinforced with dedicated training and support programs.

MARTLET TACTICAL ISR DRONES

The Martlet is a mythical bird without feet. This bird always holds itself in the air and according to the myth, never touches the ground to land. Our Tactical ISR drone systems do have to come down for a landing, but they have an outstanding endurance for their class. The frame and propellers of the Martlet systems are all built with aviation-grade carbon composite, kevlar, and glass fiber materials.

CONTACT

For any questions or concerns,
contact us by mail: **support@heighttechnologies.com**
or give us a call: **+31 (0)344 607968**

USER MANUAL DETAILS

Unmanned aerial vehicle (UAV):	Martlet **MI-1**
Ground control station (GCS):	Martlet **S-GCS**
System serial number:	493
UAV firmware version:	v19.3
GCS software version:	v7.45

NOTICE TO USERS

DO NOT FLY OVER CROWDS * DO NOT FLY NEAR AIRPORTS. THE MAXIMUM FLYING ALTITUDE FOR THIS AIRCRAFT IS 3500M ABOVE THE SEA LEVEL. DO NOT FLY NEAR TALL BUILDINGS/OB-STRUCTIONS (25m MINIMUM CLEARANCE RECOMMENDED). KEEP CLEAR OF THE SPINNING PROPELLERS. DO NOT FLY IN WINDS THAT EXCEED 25 KNOTS (13 M/S). OBEY ALL LOCAL RULES AND REGULATIONS.

! NOTICE: If procedures are not properly followed it may cause damage to property, collateral damage and/or the possibility of serious physical injury.
! WARNING: Be sure to read and understand everything in this instruction manual to be familiar with the features of the aircraft before operation. Failure to operate the product correctly may result in damage to the product, property and/or cause serious injury.
! WARNING: This is a sophisticated professional product. It must be operated with caution, common sense, and requires some basic mechanical understanding. THIS PRODUCT IS NOT TO BE USED BY CHILDREN. Do not use with uncovered components or modify the aircraft by any means without the instructions provided by Height Technologies. It is essential to read and closely follow all of the instructions and warnings prior to assembly, setup and use in order to operate the product correctly and avoid the possibility of any damage or serious injury.

THE MARTLET MI-1 IS NOT TO BE USED WITHOUT A LICENCE OR THE OFFICIAL TRAINING THIS IS NOT A TOY!

! WARNING: Failure to use this product as instructed in the manual can result in damage to the product, outdoor property, and cause serious injury. A Radio Controlled (RC) multi-rotor aircraft, UAV platform, drone, etc. is not a toy! If it is not used properly, or as intended, it can cause serious bodily harm and damage property.
! WARNING: As the user of this product you are solely and wholly responsible for operating it in a manner that does not endanger yourself and others or result in damage to the product or the property of others. Be sure to understand the aviation laws governing the area in which you are operating the product and do not fly the Martlet MI-1 without the relevant licence. Do not fly the aircraft in any restricted airspace and be conscious of other aircraft that may be in the area and follow air traffic protocol. Failing to comply with the law may lead to prosecution and aircraft collisions can be fatal so be sure to follow all regulations carefully.

- Keep your hands, face and other parts of your body away from the spinning propellers/rotor blades and other moving parts at all times. Fly the aircraft away from objects that could impact or become entangled with the propellers/rotor blades. This includes debris, parts, tools, loose clothing, etc.

NOTICE TO USERS

- You must always operate your aircraft in open areas that are free from people, vehicles and other obstructions. Never fly near or above crowds, airports or buildings.
- In order to maintain proper operation and a safe performance, make sure to never fly your aircraft near buildings or other obstacles that obstruct a clear view of the sky and can block GPS reception.
- Never attempt to fly your aircraft in areas with potential magnetic and/or radio interference, such as near broadcast towers, power transmission stations, high voltage power lines, etc.
- Always keep a safe distance in all directions around your aircraft to avoid collisions and/or injury. This aircraft is controlled by a radio signal that is subject to interference from many sources outside your control. Interference can cause momentary loss of control and therefore should be avoided.
- For guaranteed safe operation, be sure to operate the aircraft in a position that is surrounded with at least 5 meters of clear or open space.
- You must not attempt to operate your aircraft with any worn and/or damaged components, parts, etc. (including, but not limited to: damaged propellers/rotor blades, old batteries, etc.).
- Be sure to inspect your aircraft before initiating any flight and check that all the components are not damaged or worn in any way.
- Never remove or attempt to repair any part of the aircraft without making sure that is it powered off.
- Beware that the propellers have sharp edges and therefore take precautions when changing or removing them - wear protective gloves if necessary.
- Never operate your aircraft in poor or severe weather conditions, including heavy winds, precipitation, lightning, etc.
- If you notice that severe drifting, loss of control or erratic behaviour is occurring in flight then land IMMEDIATELY.
- Never operate the Martlet MI-1 if you are under the influence of alcohol, drugs or if you are suffering from fatigue, nausea, dizziness or any other condition that would limit your ability to safely operate the aircraft.
- Always start any flight with a fully charged battery. Be sure to land as soon as possible after the first level low battery warning and land immediately after the second level low battery warning.
- Always operate your aircraft when the charge of the batteries in the Martlet GCS are in a safe range.
- Make sure the aircraft is always in clear line of sight and under control. Additionally, always keep the Martlet GCS powered on whilst the aircraft is operational.
- In the event of the propellers coming into contact with an object, be sure to move the throttle control stick fully down and turn off the motors (DISARM) to prevent any further damage.
- After use, allow the components and parts to cool before touching them or flying again.

NOTICE TO USERS

- Always be sure that the battery is not hot after use. If it is, remove it from the aircraft and allow it to cool it down.
- Keep all electronic components, parts, etc. that are not specifically designed/protected for use in water, away from contact with water. In addition, moisture can cause damage to electronic components and parts.
- If you are concerned that any part of the MARTLET™ MI-1 has been damaged by water then DO NOT USE and return the item to an authorized Martlet UAS customer service provider.
- Never place any parts or any related accessories in your mouth. Doing so could cause serious injury or death.
- Always keep chemicals, small parts and electronic components out of the reach of children.
- Be sure to carefully and attentively follow the instructions and warnings included in this manual about the Martlet MI-1 aircraft and any related accessories, components or parts (including chargers, rechargeable batteries, etc.).
- Retain this manual for future reference and never fly the Martlet MI-1 if you have any concerns that the above safety conditions are not being met.
- If at any point you are concerned about the performance of the aircraft or you notice that a part is damaged then return the Martlet MI-1 to an authorized Martlet UAS customer service provider. DO NOT ATTEMPT TO REPAIR THE AIRCRAFT YOURSELF, THIS WILL VOID THE WARRANTY.

THE MARTLET MI-1 IS A SOPHISTICATED UNMANNED AERIAL VEHICLE THAT IS DESIGNED TO BE USED AS A TOOL. IT IS NOT A TOY AND MUST NOT BE TREATED AS SUCH

The end user organization/operator is hereby advised that the local aviation authorities like EASA/FAA and other local governing authorities may have rules that limit or prohibit the use of Product(s) above certain altitudes or within certain ranges of the operator or airports for which the operator is responsible, as well as other restrictions and regulations which may be applicable. The end user organization is liable and responsible to ascertain appropriate use and to obtain required permissions, licenses, etc. as may be required. The local aviation authorities and other local governing authorities may have rules that prohibit or limit the use of video and/or radio communications equipment supplied with or discussed herein.

PRE-MISSION PREPERATION

CHECK AT HOME BASE

- Understand what exactly is expected as an outcome from the operation.
- Check and verify the area maps at the needed resolution.
- Plan similar scenario and check feasibility.
- Look for optimal take off location, estimated mission duration, obstacles, terrain geometry.
- If external power source needed prepare for it. [Flight batteries charge source / Computer & Radio module charge source]
- If expected to work in a hot location, prepare a small tent for the system storage while holding between extended missions.
- Check weather forecast for intended location.
- Coordinate activity with nearby similar UAV operators.

☐ Visually examine the flight battery
  ☐ Check battery surface for any damage
  ☐ Check YELLOW connectors for any dirt/dust/liquids

☐ Check if all batteries are charged:
  ☐ Flight battery voltage: **25.5V**
  ☐ Radio module battery voltage: **12.5V**
  ☐ Computer battery percentage: **100%**

CHECK AT FLIGHT LOCATION

- Recheck correlation of your home base preparation and actual location.
- Get updated weather info.
- Verify nearby UAV Drone activity.
- Relay to your Commander any out of the ordinary circumstances.
- Verify safety operation guidelines.
- Verify operational limitation guidelines.
- Follow checklist procedure.

- **FLIGHT SAFETY PRECAUTIONS**
- Preplan several potential emergency landing options
- Verify takeoff and landing points are clear
- Consider the wind direction while flying
- Consider potential obstacles near flight path
- Constantly monitor your flight parameters
- Climb to your preferred work altitude (eg. 100+ m) - aim to ascent in a 45° angle for optimal energy expenditure - and preferably stay in this altitude as climbing drains the battery.
- Aim to always keep a line of sight between the GCS and UAV
- Consider potential obstacles in between the GCS and UAV

PRE-FLIGHT CHECKLIST

- ☐ Power up the GCS computer
- ☐ Power up the GCS radio module - **12.5V**
- ☐ Take UAV + flight battery out of the case
- ☐ Unfold the motor arms (start with the top-level)
- ☐ Unfold the propellers
- ☐ Place UAV in an open area (±10m radius)
  - » UAV should be pointed towards the mission azimuth

- ☐ Open battery compartment and slide the flight battery in
- ☐ Connect battery YELLOW XT60 main connector plugs
- ☐ Do not move the UAV while initializing
- ☐ Verify camera initialization
- ☐ Close battery compartment

- » Open the HT-planner application on the GCS
  - » Press “connect”
  - » Set “takeoff altitude”
  - » Set “RTL altitude” according to mission terrain
  - » Verify video input and camera control (zoom out)
  - » Verify home position
  - » Verify compass alignment (check azimuth)
- » Check telemetry:
  - » Battery voltage: ± 25V
  - » GPS: > 9 sats
  - » Link quality: 99-100%
  - » HDOP: < 1.2
- » Check flight modes:
  - » ALTHOLD
  - » LOITER
  - » RTL
  - » AUTO
- » Perform motor TEST
  - » Listen for abnormal noises / vibrations
  - » Check if all proppelers spin normally
- » ARM the motors
- » Press LAUNCH
- » Switch to LOITER
  - » Check movements and verify UAV holding position
  - » Start mission

CONSTANTLY MONITOR YOUR FLIGHT PARAMETERS

AIRCRAFT OPERATING ENVELOPE

FORM FACTOR	L	W	H	
Frame size	40	40	15	cm
Frame size folded	20	28	15	cm
Proppeller size	13/33			inch/cm
Weight without battery	0.9			kg
Weight with battery	1.4			kg
Max payload weight	0.2			kg
Max take-off weight	1.6			kg
Center of gravity	Fixed			

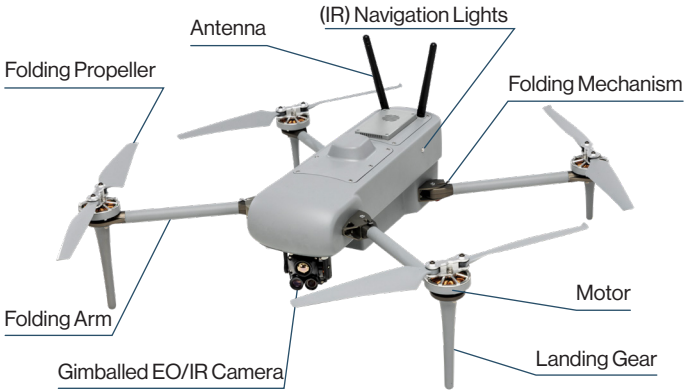
OTHER		
Operational temperature	-10 to +50	°C
IP rating	IPx3	
Environment	Day / Night	

SPEED		
Ascent speed	3.5	m/s
Descent speed	3	m/s
Wind speed limit	25	knots
Max airspeed	35	knots
Cruising speed	9	m/s
Max speed (ALT HOLD)	18	m/s

ALTITUDE LIMITS		
AGL	500	meter
AMSL	3500	meter

RANGE		
Theoretical range	45	km
Radio range	5	km

ENDURANCE		
Max flight time	50	min
FalconEye EO/IR payload	45	min
X80 EO payload	45	min



AIRCRAFT CONTROL SYSTEM

FLIGHT CONTROLLER

- The Martlet MI-1 is controlled by a flight controller that is configured to control and operate the UAV using preprogramming and free flight modes.
- Sophisticated hardware sensors and a dedicated software is used to achieve operation flexibility and precise control.
- The flight controller controls the motors thrust and the flight control system according to the navigational instructions of the mission plan.
- The autopilot constantly compares the actual flight parameters: position, speed, ground track, and altitude – to the required values by using several feedback loops.
- Feedback loops lead to alterations of electrical motor thrust to compensate for the changes and thus re-establishes the UAV at the desired flight altitude etc.
- The sensors associated with the autopilot provide it with the current values of various important parameters.
- The barometric altimeter provides the autopilot with the real time altitudes of the drone in regards to the take off point.

GNSS RECEIVER & MAGNETIC COMPASS

- The Global Navigation Satellite System (GNSS) receiver antenna is installed in the UAV's dome (canopy) in order to avoid electro-static interferences. The magnetic compass is inside the same package.
- The UAV will not take off without locking on at least 6 satellites. Therefore, notice that the initial start is not in proximity to potential interferences such as metal objects / roof, (blocked sky).
- The autopilot uses a magnetic compass based on the magneto resistive effect; it has no moving parts. – Make sure that there are no visible interferences such as: magnets, antennas, communications, high power lines nearby.

BAROMETRIC ALTIMETER

- Static pressure is measured inside the UAV's body by an altitude pressure transducer located in the flight controller. The transducer generates a DC voltage which is proportional to the UAV's altitude above sea level at the moment of initialisation.
- During flight, a small altitude error may occur (up to 5m) due to the change in the ambient atmospheric conditions.
- Take notice that if the mission area and terrain change, the altitude will still be calculated according to the take off point.

V/A VOLTMETER AND CURRENT SENSOR

- This sensor measures the actual voltage and current of the battery pack in real time.
- Threshold levels are preset to alert operator to take action in case of low voltage level or excessive current draw.
- The UAV will automatically go for an immediate landing when power is insufficient (< 18.0V) for flight continuation.

AIRCRAFT SAFETY FEATURES

PRE-ARM CHECKS:
The HT-Planner software includes a range of pre-arm safety checks. This prevents the UAV from arming the motors if any issues are discovered after the system is powered on (before take-off).

BATTERY VOLTAGE DROP WARNING:
The system will check the voltage drop, if the volt drop exceeded 1.3V - it could mean that there is a problem with the flight battery. The pilot will receive a warning of the voltage drop so he must keep track of the volt measurements during the flight. After two (2) voltage drop warnings, the UAV will automatically activate RTL mode, meaning that it will return back to the launch location.

BATTERY DISCHARGE CHECK/WARNING:
During the flight, the system will frequently check if the battery discharge is regular in comparison to the nominal discharge. If there is a deviation of 5% - the software will warn the operator, and the BINGO will be changed accordingly.

WIND SPEED CHECK/WARNING:
The system will warn the operator if the wind speed is going beyond 10 m/s, indicating a strong wind. In addition, it will also give a warning once the system measures strong wind gusts.

AFTER TAKE-OFF CHECKS:
- While flying, the system checks all INS sensors and compare values- in any case of malfunction or inconsistency, the drone will give a warning.
- Non-critical situations: UAV will go into FAILSAFE mode and will Return To Launch (RTL/DRL)
- Critical situations: UAV will go into FAILSAFE mode and will LAND

SYSTEM DISARM
To turn off the motors, pull down the throttle and disarm switch for 1-2 seconds.
NOTE: that even during a flight this procedure will turn off the motors if this is necessary in an emergency.

THE PILOT CAN ALWAYS OVERRIDE RTL/DRL/LAND BY ACTIVATING LOITER/ALTHOLD MODE, BUT WILL THEN BE FULLY RESPONSIBLE IN THE EVENT OF A FLIGHT BATTERY FAILURE.

IF THE SYSTEM IS IN FAILSAFE MODE, DO NOT FLY UNTIL THE REASON HAS BEEN FOUND AND UAV HAS BEEN REBOOTED. IF THE OPERATOR SWITCHES TO LOITER/ALTHOLD TO OVERRULE THE MODE ACTIVATED BY THE FAILSAFE (RTL/DRL/LAND) - THE OPERATOR OR HIS COMMANDER TAKE FULL RESPONSIBILITY FOR WHAT WILL HAPPEN TO THE UAV AND ITS SURROUNDINGS

Message	*Description*	*Solution*
Gyro still settling	Gyroscope initialization delayed due to movement during drone startup.	Reboot the drone to allow the gyroscope to initialize properly.
Bad AHRS	Indicates problems with the Attitude and Heading Reference System (AHRS), affecting drone orientation due to issues like GPS signal problems, compass errors, or sensor calibration.	Check surroundings for magnetic interference, ensure GPS has a clear view of the sky, and try rebooting the drone (disconnect battery for 5 seconds).
GPS and AHRS differ by x.xx m	Indicates a discrepancy between the positions reported by the GPS and the Attitude and Heading Reference System (AHRS), suggesting a potential issue with sensor alignment or calibration.	Check surroundings for magnetic interference, ensure GPS has a clear view of the sky, and try rebooting the drone (disconnect battery for 5 seconds).
GPS glitch	Indicates a temporary disruption or inaccuracy in GPS signal, affecting drone position data.	Ensure the GPS module has an unobstructed view of the sky (avoid angles less than 25 degrees) to maintain signal integrity.
Fence need 3D fix	GPS signal not strong enough to activate the geofence feature.	Ensure the GPS module has an unobstructed view of the sky (avoid angles less than 25 degrees) to obtain a stronger signal.
HDOP too high	GPS signal quality is poor.	Ensure the GPS module has an unobstructed view of the sky (avoid angles less than 25 degrees) to improve signal quality.
Compass variance	Compass health is compromised due to electromagnetic interference.	Switch to Alt-Hold mode if possible and relocate to an area with less magnetic interference to recalibrate compass readings.
Ground mag anomaly, YAW realigned	Compass is detecting anomalies, often noticed during takeoff due to magnetic interference from the ground.	Fly cautiously as compass readings may be inaccurate; consider choosing a different takeoff location with less magnetic interference.
Battery voltage drop	Indicates a significant drop in battery voltage beyond expected levels, possibly due to battery health, high power consumption, or weather conditions.	Check battery health, reduce power consumption (e.g., lower speed), and ensure batteries are fully charged before flight.
Battery capacity difference	Drone is consuming more energy than expected, possibly due to flight behavior, battery health, or a battery that is insufficiently charged.	Reduce power consumption (e.g., by adjusting flight speed), regularly check batteries and system for abnormalities.
Wind too strong	Wind speed exceeds safe operational limits.	Monitor wind speed indicators and respect drone operational limitations to ensure safe flight.
Air speed too high	Drone is flying faster than the maximum safe speed limit.	Reduce speed to stay within safe operational limits, monitor system indicators, and respect drone specifications.

FLIGHT BATTERY

MARTLET™ MI-1 FLIGHT BATTERY

Battery type:	Lithium-polymer
Capacity:	7200 mAh
Nominal voltage:	14.8V
Energy:	106.5 Wh
Max charging current:	3.6A
Max cell voltage:	4.20V
Weight:	510 grams (±50g)
Dimensions:	42 x 42 x 147 mm
Charging temperature:	+10°C – +45°C
Discharge temperature:	-20°C – +60°C

BATTERY STATE OF CHARGE INDICATOR

1. Press the button, one red and four white indicator lights will be succesively on and keep lightning up for 1-2 seconds to show state of charge. If any exceptional situation, the fault light will be on.

2. The state of charge (SOC) of the battery is indicated as below

RED LED	WHITE LED	WHITE LED	WHITE LED	WHITE LED	SOC
ON	FLASH	OFF	OFF	OFF	0% ~ 9%
ON	ON	OFF	OFF	OFF	10% ~ 39%
ON	ON	ON	OFF	OFF	40% ~ 59%
ON	ON	ON	ON	OFF	60% ~ 84%
ON	ON	ON	ON	ON	85% ~ 100%

FLIGHT BATTERY CHARGER

OPERATING THE FLIGHT BATTERY CHARGER

Power on the IMARS DUAL charger and connect the battery main plug and balance connector.

1. Use the "CH/Back" (□) button to select the channel (CHA or CHB) in which the battery is plugged in.
   Press □ to select CHA or CHB

2. Once the right channel is selected, press the "Enter/Setting" (○) button to enter the Task Setting.
   Press ○ > CHA or CHB Task Setting

3. **Verify task (Charge or Storage) settings** as shown below.

CHARGE TASK		STORAGE TASK	
• Select Task:	**Charge**	• Select Task:	**Storage**
• Battery Type:	Lipo	• Battery Type:	Lipo
• TargetVoltage:	**4.20V**	• TargetVoltage:	**3.80V**
• Cell Count:	4S	• Cell Count:	4S
TargetCurrent:	3.6A	• TargetCurrent:	3.6A

4. To start the task, select "Start Task" and press the ○ button.
   Start Task > Press ○ to start task

5. To stop the task, long-press the □ or ○ button.
   Long-press □ / ○ to make channel A and B idle (inactive).

SAFETY INSTRUCTIONS

- Charging must be done with a charger authorized by Height Technologies
- Charge the battery only with a suitable balancing system.
- Never leave the battery un-supervised during the charging process.
- Do not disassemble and reconstruct the battery.
- Do not short-circuit the battery. – Do not connect the plus ("+") and the minus ("-") terminals with metal objects (such as wires)
- Do not carry or store the battery with metal objects (such as wires, electrical items, etc.)
- Do not use near flammable liquids or gas.
- Do not use the battery in a location where static electricity is rich.
- Do not use or leave battery nearby heated sections (more than 80ºC) or direct sunlight.
- Do not submerge the battery in water and avoid getting it wet.
- Do not inflict structural loads on the battery.
- Do not connect the Lithium polymer battery pack with other packs using different technology/voltage/capacity
- Do not use a leaking battery
- Do not use an abnormal battery. If the battery smells bad, changes color or becomes deformed - do not use it.
- Do not drop, strike or throw the battery.
- Do not reverse-charge or reverse-connect the battery's polarity
- Dispose the battery according to applicable disposal regulations of the Environmental Protection Agency.

GROUND CONTROL STATION [GCS]

The Ground Control System (GCS) consists of an integrated Panasonic or Getac computer/tablet and a customized radio module with standalone power supply.

GENERAL SPECIFICATIONS

Computer	RuggON LUNA3	
Ports	USB-C	
Certification	MIL-STD 810H & 461G	
Ingress protection code	IP65	
Operating temperature	-20 – +50	°C
Battery capacity	51.8	Whr
Battery life	3	hours

SOFTWARE DEFINED RADIO

Encryption	128-bit AES / 256-bit AES	
Operating frequency OPTION 1	2025 – 2500	MHz
Operating frequency OPTION 2	2300 – 2700	MHz
Max transmitting power	500	mW
Max transmitting distance	5	km
Latency	100	m/s

UPDATES

Updates are delivered in a file-format, operators or maintenance personnel need to overwrite the HT-planner and HT-setup directory with the right files in the supplied update folder.

CHARGING THE GCS

- Charging the tablet needs to be done with the **16V** charger.
- Charging the radio module needs to be done with the **12V** charger.

! NOTICE

This GCS must be operated in accordance with the accompanying instructions. The hardware can only be used with the antennas provided for the integrated radio module on this GCS. The antennas must be attached before turning on the radio. End users and other interested parties are trained on how to handle the antennas and data link settings under certain circumstances, so that the RF quality is maximized at all times.

GCS HARDWARE

Hardware control joycticks and buttons are divided into 2 sides:

- Left side: payload control + UAV throttle[1] & auto launch[2]
- Right side: UAV control

RADIO MODULE

RADIO MODULE VOLTAGE DISPLAY
MAX: **12.5V**
LOW: **10.5V**
MIN: **10V**

RADIO MODULE ON/OFF SWITCH

12V RADIO MODULE CHARGING PORT

GCS:

UAV AND PAYLOAD CONTROL

ZOOM
2-way dial = zoom in/out

LAUNCH
for takeoff only

CAMERA CONTROL
4-way stick = up/down - left/right

POI CENTRE CAMERA VIEW
press button on stick = make POI

THROTTLE
altitude control

DAY / NIGHT
switch UP = eo/ir view

IR - HOT BLACK / HOT WHITE
switch DOWN = black/white

STOW / RATE
center the camera/unlock camera

YAW
2-way dial = left/right

ARM / DISARM
switch up/down = arm/disarm

ROLL - PITCH
4-way stick = left/right - up/down

ALT HOLD
altitude hold mode (NO position hold)

LOITER
switch UP = free flight (position hold)

AUTO
switch DOWN = auto takeoff/mission

RTL
return to launch mode

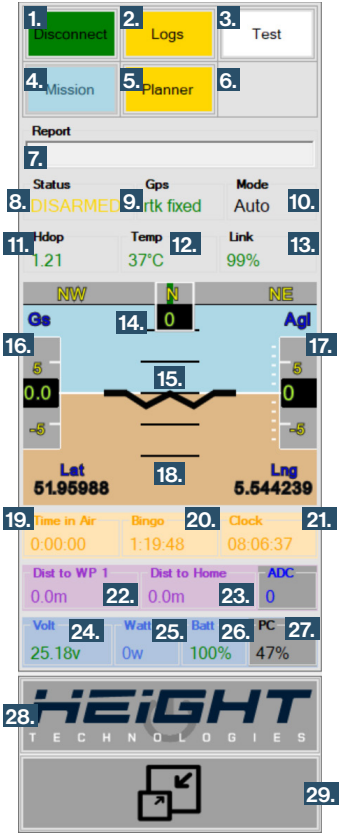
TELEMETRY

1. DISCONNECT / CONNECT
2. LOGS: flight history log files
3. TEST: arming motors for 5 seconds
4. MISSION: main/ operational work window
5. PLANNER: mission planning window
6. VIDEO: video window - OFF/SMALL/BIG

19. TIME IN AIR: press to see accumilated flight time
20. BINGO: time left before PONR
21. CLOCK: current time
22. DIST TO WP1: distance to next waypoint
23. DIST TO HOME: distance to take-off location
24. VOLT: voltage of flight battery
25. WATT: real-time energy expenditure
26. BATT: UAV battery in %
27. PC: tablet battery in %

28. Press to exit HT-Planner

29. Press to enlarge map + video and scale down telemetry window



7. REPORT: system warnings
8. STATUS: ARMED/DISARMED/FAILSAFE
9. GPS: number of satellites **[> 9]**
10. MODE: active flight mode
11. HDOP: GPS accuracy **[< 1.2]**
12. TEMP: internal temperature **[< 72°C]**
13. LINK: datalink health

Ground RSSI_0 : -35 dBm
Ground RSSI_1 : -27 dBm
Ground SNR : 28
Air RSSI_0 : -22 dBm
Air RSSI_1 : -23 dBm
Air SNR : 21
Frequency : 2380 MHz
Distance : 0 m

press on Link ...% (**13.**) to open the datalink monitor

14. HEADING: azimuth direction
15. HORIZON: roll and pitch movements
16. GS: ground speed in m/s
17. AGL: altitude in meters
18. LAT / LNG: coordinates of UAV position

FLIGHT MODES

AUTO:	take-off and to start/continue missions
LOITER:	free flight
RTL:	return to launch
FLYTO:	auto mission to POI-waypoint with defined GS and AGL
POI:	lock UAV heading towards POI direction to orbit around it
ALT HOLD:	free flight mode without GNSS - altitude hold only
DRL LOITER:	free flight mode without GNSS - calculated position hold
DRL:	return to launch without GNSS - calculated flight path
LAND:	land at current location (in case of final battery failsafe)

TOOLBAR

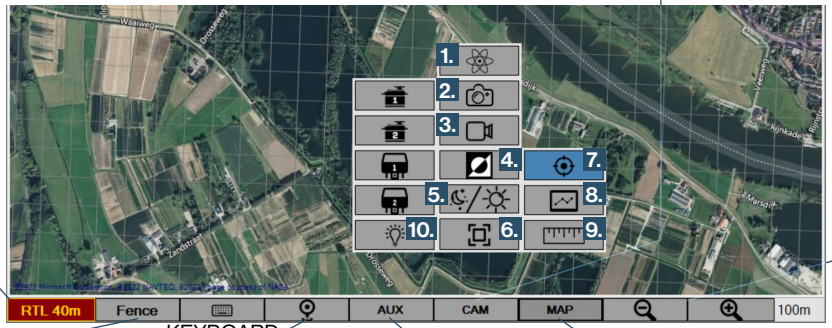
CAM: open camera tools

1. NUC: thermal camera calibration
2. SNAPSHOT: takes photo from video feed
3. RECORD: start recording video
4. IR SWITCH: thermal hot black/hot white
5. CAM SWITCH: camera IR/EO view
6. SPREAD: enlarge camera view

RTL:

Press **prior** to take-off to change RTL altitude

Press **during** flight to activate Return To Launch

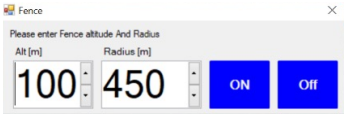


MAP ZOOM IN / OUT

FENCE:

Restrict UAV to fly within fence only

Fence can be breached in ALT HOLD mode



POI:

Open Point Of Interest toolbar

MAP: open map tools

7. CENTER: keep UAV in center map view
8. FLIGHT PATH: clear flight path on map
9. RULER: measure distances on map

AUX: custom commands & lights

10. LIGHTS: navigation lights ON/OFF

MAP

1. WIND DIRECTION:
   azimuth of where wind is coming from

2. WIND SPEED in m/s

3. CAMERA VIEWPORT:
   overall aera of what is in sight, most accurate when camera LOS* is 45°

   *Line Of Sight

4. CAMERA LINE OF SIGHT:
   straight line form center camera to ground (center viewport)

A. POI: Point Of Interest

B. UAV ICON: L/R

C. FLIGHT PATH

D. HOME POINT: takeoff / RTL location

POINT OF INTEREST [POI]

A. Change between CAM / POI location info

B. Change between GEO / UTM / MGRS

C. PRESS to change coordinates (Lat - Lng) of POI

D. AMSL elevation info of POI

MEASUREMENTS: all ground distances

1. POI to LOC: distance between UAV and POI location
2. POI to CAM: distance between center camera view and POI location
3. LOC to CAM: distance between UAV and center camera view location

FLY TO MODE: create waypoint of POI, pop-up will appear to set GS and AGL

POI MODE: lock UAV heading towards POI direction to orbit around it

MISSION PLANNING

Press “Planner” to open mission planning window

A. Change between GEO / UTM / MGRS

B. Coordinates of waypoint

C. AMSL elevation info of waypoint

D. Total mission distance + DO JUMPs + from and back to home location

E. Distance from current waypoint to home

F. Distance from current waypoint to previous

G. Azimuth of waypoint relative to North

H. Choosemap

1. Set Home: set home position when planning mission

2. Center Home: center map on home location

3. Read WPs: receive mission commands from UAV

4. Write WPs: send mission commands to UAV

5. Load WP file: open saved mission file from PC

6. Save WP file: save current mission as a file

7. Restart Mission: repeat current mission (written in UAV)

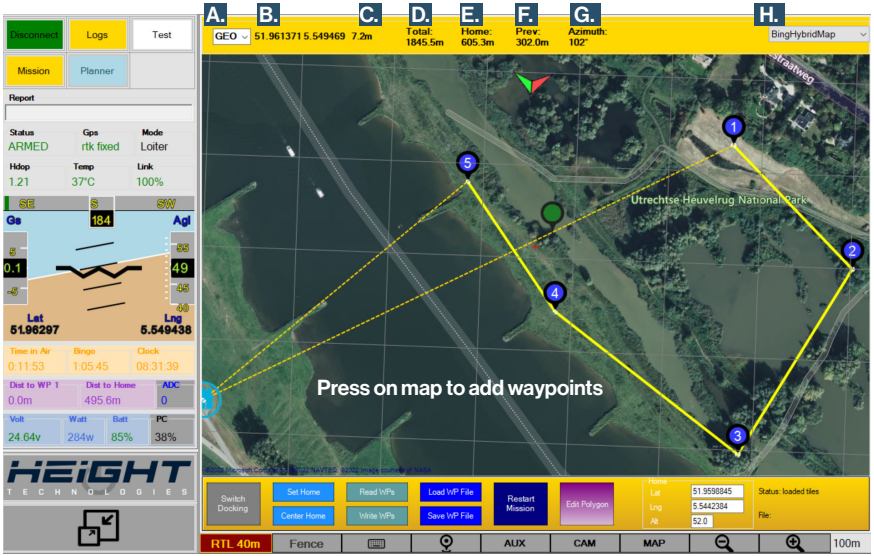
8. ALT: set default altitude (AGL relative to take-off location)

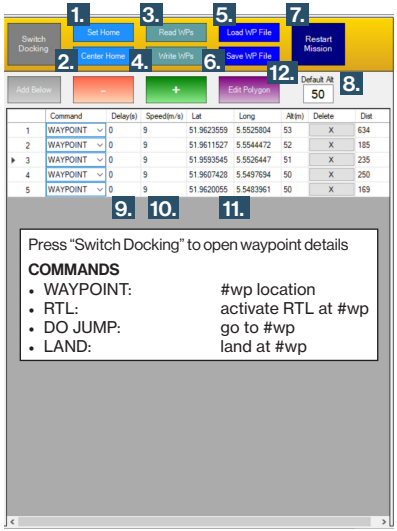
9. DELAY: time in seconds to hover (position hold) at waypoint

10. SPEED: set default GS (ground speed)

11. LAT/LNG: coordinates of each waypoint

12. POLYGON mode

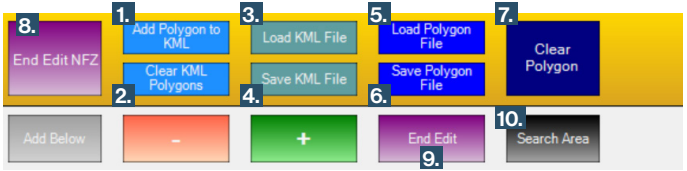




POLYGONS

Polygons can be used in two ways:

- Area Of Interest (AOI) - **BLUE**
- No Fly Zones (NFZ) - **RED**
- Search Areas - Polygon + Waypoints

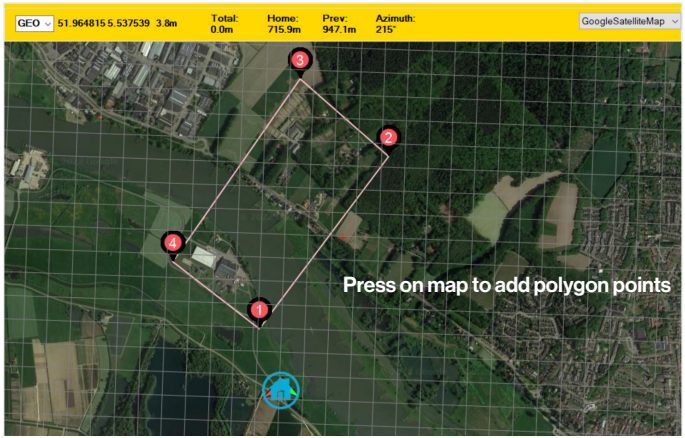


1. Add Polygon to KML: convert Polygon to **Area Of Interest**
2. Clear KML Polygons: clear all **Areas Of Interest** on the map
3. Load KML File: load a predefined **Area Of Interest**
4. Save KML File: save current **Area Of Interest** as **AOI.kml**
5. Load Polygon File: load a predifined Polygon
6. Save Polygon File: save current Polygon
7. Clear Polygon: clear current Polygon
8. End Edit NFZ: save Polygon as **NFZ.kml** -> and exit "Polygon mode"
9. End Edit: exit "Polygon mode"
10. Search Area enter "Search Area" settings

NO FLY ZONES

Adding a No Fly Zone or NFZ is done in the **POLYGON** mode.

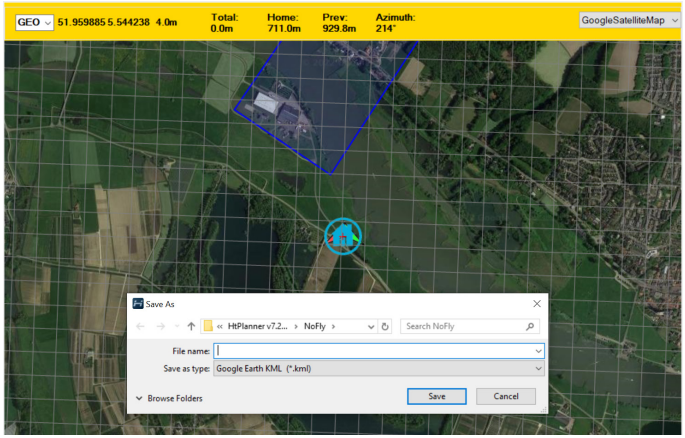
1. In the Planner, press "Edit Polygon" to enter the "Polygon mode"
   Planner > Edit Polygon



2. Press on map to add points and create a Polygon
   Planner > Edit Polygon ***> Create Polygon***

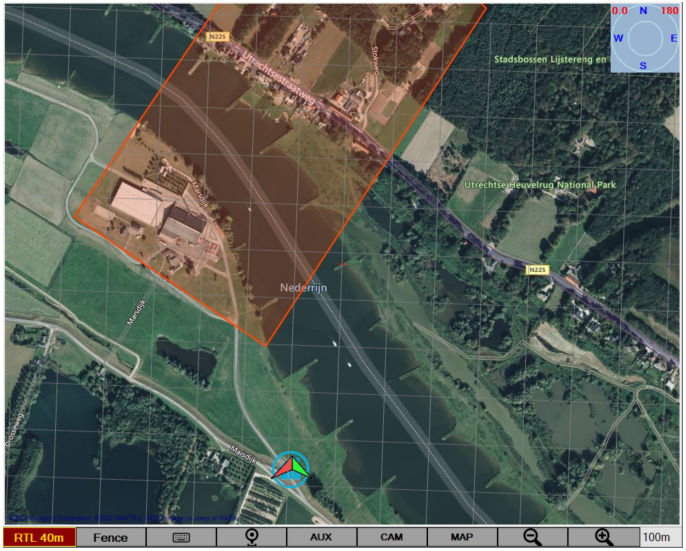
NO FLY ZONE

3. Press “End Edit NFZ” to save the Polygon as a No Fly Zone
   Polygon will change its color to **blue** = Area Of Interest (AOI)
   Planner > Edit Polygon > Create Polygon ***> End Edit NFZ > Save***



4. Press “Write WPs” to send the new mission commands to UAV
   Planner ***> Write WPs***

5. Press ‘Read WPs” to verify if data has been written in UAV
   Polygon will change its color to **red** = No Fly Zone (NFZ) active
   Planner ***> Read WPs***



SEARCH AREA

AUTOMATIC AREA SEARCH

Adding a Search Area is done in the **POLYGON** mode.

1. Press “Edit Polygon” to enter the “Polygon mode”
   Planner > Edit Polygon

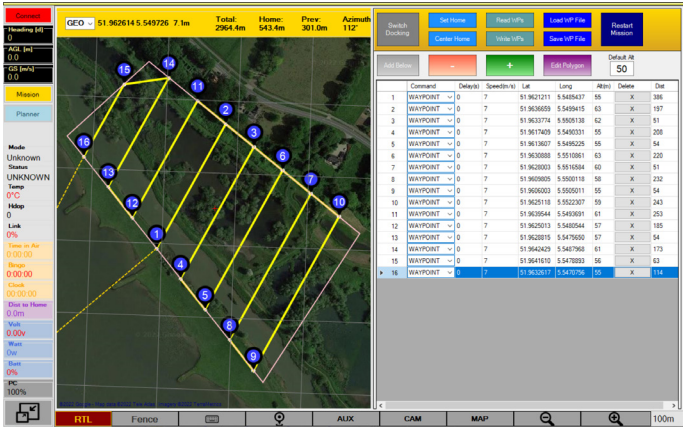
2. Press on map to add points and create a Polygon
   Planner > Edit Polygon ***> Create Polygon***

3. Press “Search Area” to setup a flight plan within the Polygon
   Planner > Edit Polygon > Create Polygon ***> Search Area***

4. Press “Accept” to save the “Search Area”
   Planner > Edit Polygon > Create Polygon > Search Area ***> Accept***

5. Press “Write WPs” to send the new mission commands to UAV
   Planner ***> Write WPs***

6. Press ‘Read WPs” to verify if data has been written in UAV
   Planner ***> Read WPs***

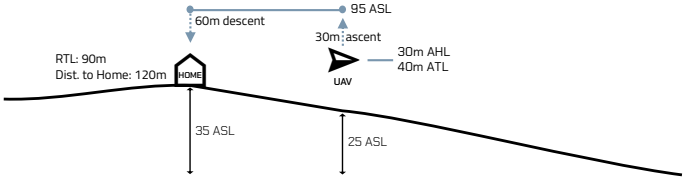


RTL MODE & FAILSAFE

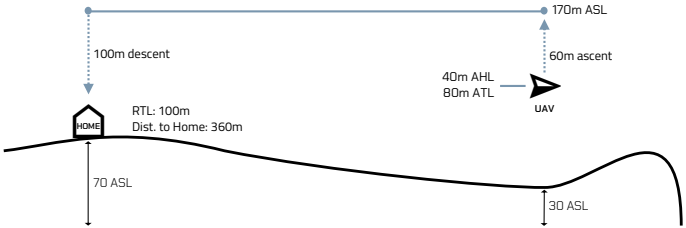
HOW RTL MODE WORKS

The RTL altitude is determined by the UAV's current flight altitude, distance from home and predefined RTL altitude before take-off. There are three (3) different scenarios when RTL is activated:

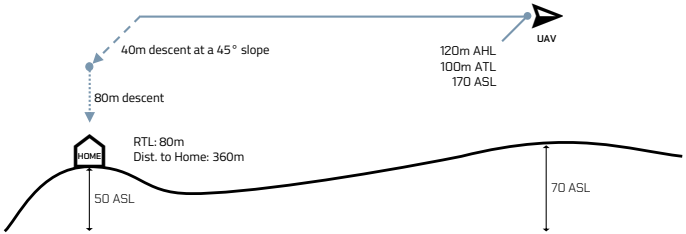
1. **Dist. to Home is <u>less than 2x RTL altitude</u>:** The UAV aims for a minimum altitude that is equal to 50% of its ground distance from the home point (Dist. to Home).



2. **UAV is <u>below RTL altitude</u>:** The UAV ascends to the RTL altitude before flying back to the home point.



3. **UAV is <u>above RTL altitude</u>:** The UAV aims for a minimum altitude that is equal to 50% of its ground distance from the home point (Dist. to Home).



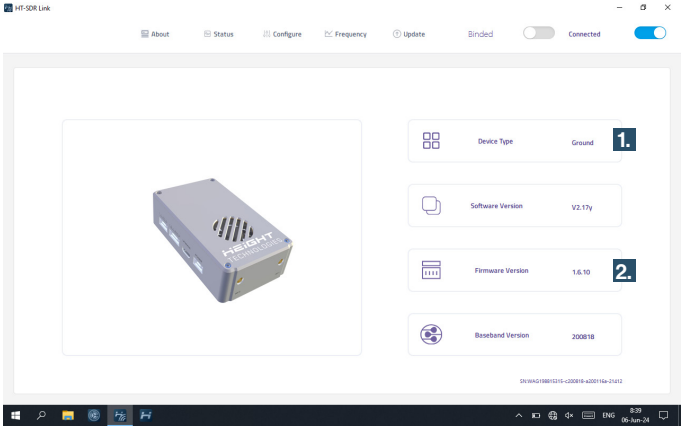
HOW FAILSAFE WORKS

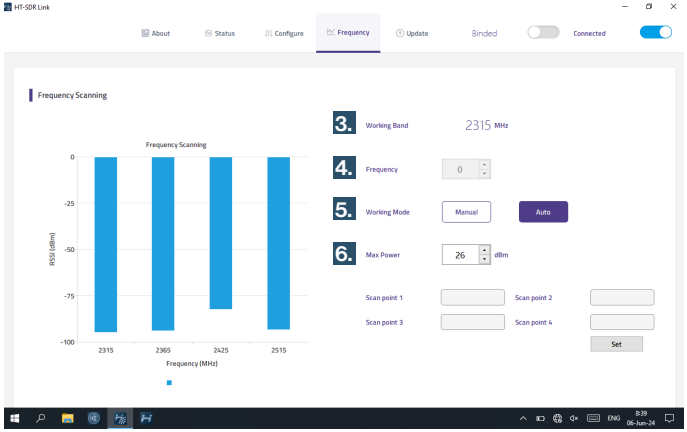
- FAILSAFE occurs when the system activates "return to launch" (RTL) due to a failure, not because the pilot instructed it to do so.
- In case of GNSS signal loss or high HDOP - DRL is activated.
- DRL is overruled when operator switches to LOITER: DR-LOITER.
- During DRL the GNSS based modes won't work and the UAV will use the sensors of the barometer, compass, and wind calculations.

WHEN TO EXPECT FAILSAFE

- Comm loss = RTL
- Compass error: = ALTHOLD + comm loss = LAND
- Bad GNSS signal = DRL <200m from home = ALTHOLD
- Low Voltage, **19.5V** / BINGO **00:00** = RTL
- Low Voltage, **18V** = LAND

SETTINGS





Open the **HT Link** application and switch **ON** the GCS radio module.

ABOUT

1. Device Type: indicates wheter GROUND or AIR unit is binded
2. Firmware Version: indicates the firmware version of the binded unit. **NOTE:** that units with different versions can **NOT** be binded

BINDING PROCEDURE

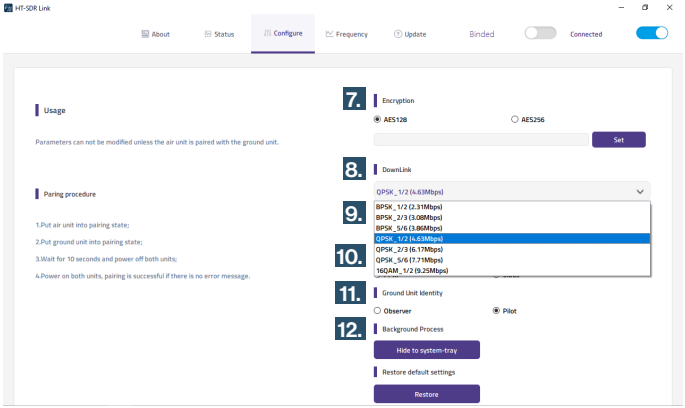
» Power up UAV and activate the toggle next to “Binded”

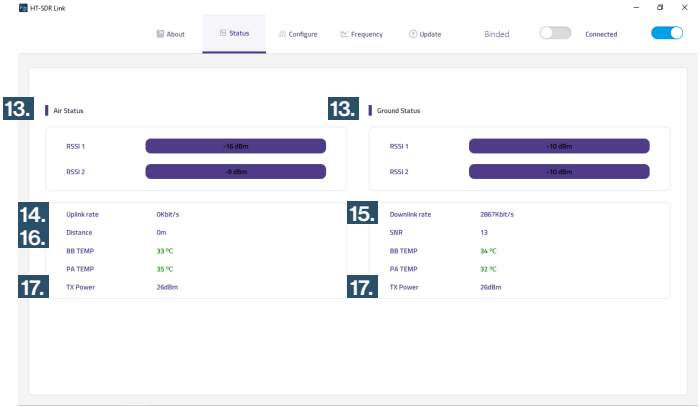
» Press button marked with arrow on the UAV’s radio module until the progress bar on the HT Link application starts running.

FREQUENCY SETTINGS

3. Working Band: current frequency (MHz)
4. Frequency: press to set new frequency - press enter or deselect in order to change the working band
5. Working Mode:
   Select “Manual” to define frequency within 2.3 - 2.7 GHz
   NOTE: frequency must be set in **MHz (**2300 - 2700 GHz)
   Select “Auto” to enable frequency hopping.
6. Max Power: output power of communication to both units.
   Max: 28dBm
   Min: 15dBm

SETTINGS





CONFIGURE SETTINGS

7. Encryption: change AES 128 / AES 256
press “Set” to save own encryption key

8. Downlink: set to **“QPSK_1/2 (4.63Mbps)”**

9. Baut Baud Rate: N/A

10. RC Mode: N/A

11. Ground Unit Identity: used when RVT* module is deployed

12. Background Process: press “Hide to system-tray” to access HT-Link in HT-planner (Alt + 1)

STATUS

13. Air/Ground Status: received signal strength

14. Uplink rate: data sent from GCS to UAV

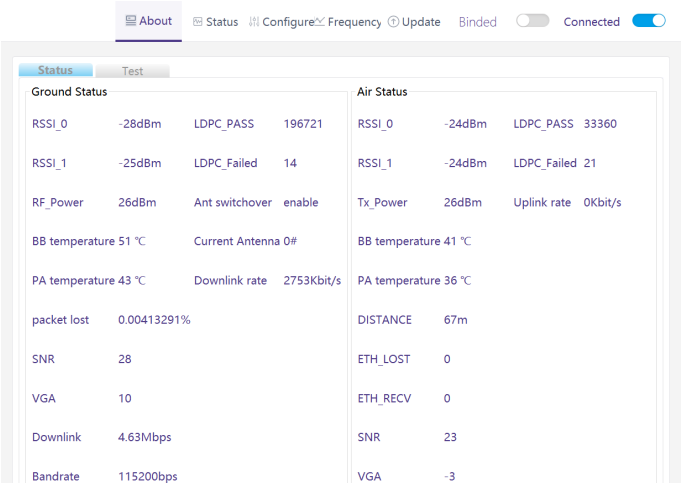
15. Downlink rate: data sent from UAV to GCS

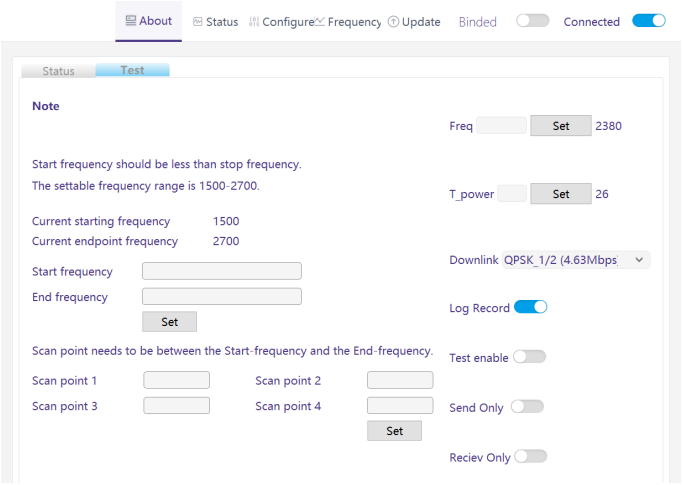
16. Distance: distance between GCS and UAV

17. TX Power: output power (15dBm - 28dBm)

*Remote Video Terminal

FREQUENCY SCAN





STATUS (ADVANCED)

Open the **HT Link** application, switch **ON** the GCS radio module and **power up** the UAV.

Select the “About” tab from the HT-link application.

- Open Keyboard (A2) and press “crtl + t”

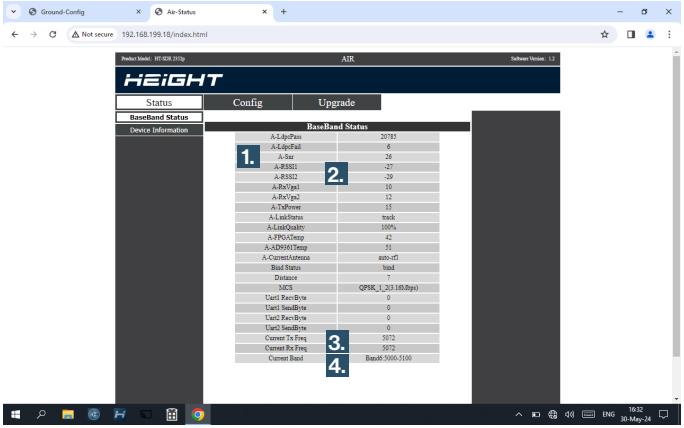
TEST (ADVANCED)

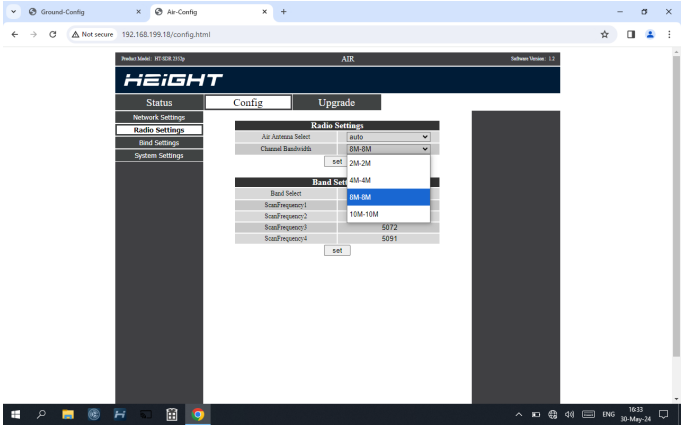
Open the **HT Link** application and switch **ON** the radio module.

select the “About” tab from the HT-link application.

- Open Keyboard (A2) and press “crtl + t”
- Select “Test”
- Open Keyboard (A2) and press “crtl + r”

STATUS & CONFIG





STATUS -> BASEBAND STATUS

1. SNR: Signal to Noise Ratio measures how strong the signal is compared to the noise in the area of operation.
   > 20 = Good | < 15 = Bad
2. RSSI: Receiving Signal Strength Indicator measures the quality of the connection between AIR and GROUND units.
   -110 = minimum (comm-loss) | < -90 = bad signal
   A healthy difference between RSSI values is below +/- 10.
3. Current TX/RX Freq: the operating frequency (MHz)
4. Current Band: the operating frequency band

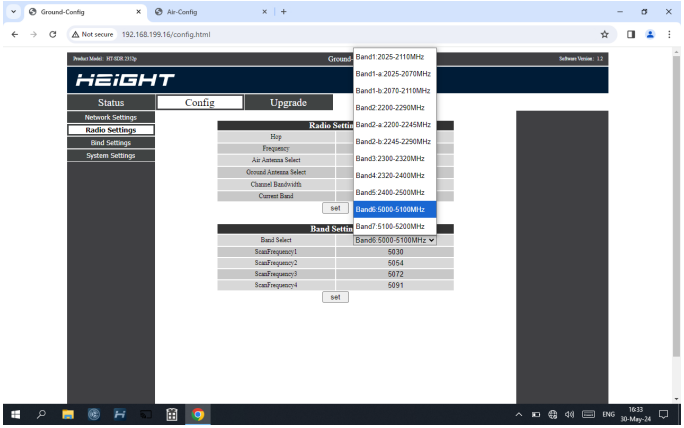
CONFIG -> RADIO SETTINGS

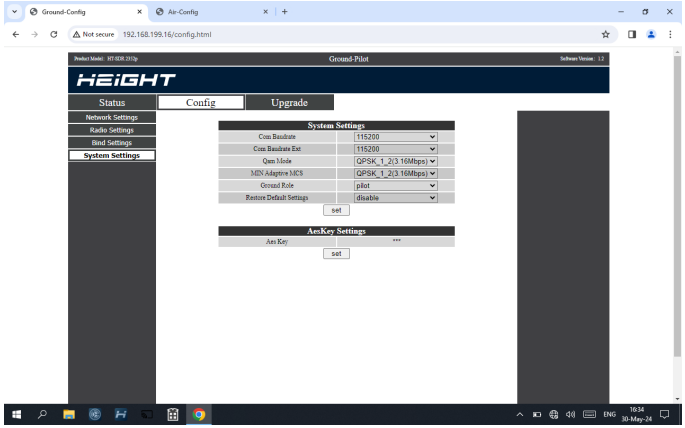
- Air Antenna Select: make sure that “auto” is selected.
- Channel Bandwidth: make sure that 10M (MHz) is selected. other bandwidths are optional in consultation with HEIGHT

! ALWAYS PRESS SET ON **AIR FIRST** - GROUND SECOND

! ONLY CHANGE THE BANDWIDTH WHEN UAS STATUS IS **DISARMED**

BAND & SYSTEM SETTINGS





CONFIG -> RADIO SETTINGS -> BAND SETTINGS

- Band Select: Select a band in the drop-down menu the ScanFrequencies will be default or as set previously.

  ScanFrequency1/2/3/4: Make sure that the ScanFrequencies of the AIR-unit match exactly with the ScanFrequencies of the GROUND-unit before pressing “set”

! ALWAYS PRESS SET ON **AIR FIRST** - GROUND SECOND

CONFIG -> SYSTEM SETTINGS

! MAKE SURE THAT THE SYSTEM SETTINGS OF THE GROUND-UNIT ARE SET EXACLTY AS SHOWN IN THE PICTURE ABOVE

DATALINK OPTIMIZATION

RADIO FREQUENCY INTERFERENCE

Radio Frequency interference originates from an external source that produces undesired “noise” in the signal path of the datalink between UAV and GCS. Examples of external sources: other UAV’s, radio/radar signals, Wi-Fi etc.

NEVER CHANGE THE RADIO FREQUENCY WHILE UAV IS IN THE AIR!

STANDARD OMNI ANTENNAS: The GCS is equipped with standard omni antennas, mounted directly on the GCS.
Frequency range: 2.3 - 2.7 GHz
Gain: 3dB

LONG-RANGE OMNI ANTENNAS: The long-range omni antennas are used for long range missions because of their higher Gain [dB].
Frequency range: 2.4 - 2.55 GHz
Gain: 8dB

HOW TO DETECT FREQUENCY INTERFERENCE

- Worsening of video quality: pixelization, blurred lines across video.
- Decrease in communication: link will drop below 80%.
- In case of complete communication loss (0%) the drone will go into failsafe RTL.
- Once communication is restored, the operator can switch back to loiter to abort RTL.

CAUSES OF FREQUENCY INTERFERENCE

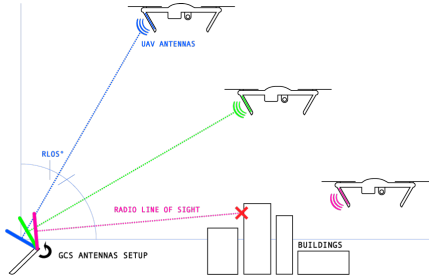
- Communication unit on UAV/GCS faulty - contact technical support
- Faulty antennas - contact technical support
- Frequency interference - other instruments are operating on the same or similar frequency.
- Environment - signal deflection from buildings/mountains etc.
- Altitude/Orientation of UAV in relation to the GCS (antennas)
- HT Planner app malfunction - reboot the application.

HOW TO FIX FREQUENCY INTERFERENCE

BEFORE FLIGHT: Perform a frequency scan before takeoff to find the most stable frequency.

DURING FLIGHT: In certain situations, the angle of the Radio Line-Of-Sight can cause under/over-shoot of the signal path between UAV and GCS antennas.

- Turn the UAV’s heading so the system’s back faces GCS (UAV antennas are located in the back landing legs).
- Change direction of the GCS’ omni-directional antennas to make a straight Radio Line Of Sight, see illustration:



PREVENTIVE MAINTENANCE

A UAV is a flying platform experiencing significant mechanical loads, and operates with an ongoing vibrating force. These factors can cause various parts to come loose, screws to unwind and soldered joints to disconnect.

VISUAL INSPECTION

Visually inspect all components of the UAV to detect potential cracks or mechanical damage.

- Pay special attention to propeller edges, and UAV's legs and motor arms.
- Verify that the gold-plated connectors of the UAV's battery cable are clean - if not, clean with alcohol on a cotton cloth.

MOTOR INSPECTION

Clean the engines every 10 flight hours or after use in a dusty environment with air pressure to remove any dust/liquid from the engines.

- Run a test or arm the UAV and watch for unusual noises when the engines are idling.
- Rotate the motors by hand to check that the motors run smoothly and do not show any slack.
- In case of damage: motor needs to be replaced by a certified person.

PROPELLERS AND ADAPTERS

- Visually inspect to ensure that the propellers are not broken and have no cracks/ridges.
- Make sure the propeller mounts does not show any slack at the folding mechanism.
- In case of damage: propeller needs to be replaced.

SCREWS & LOCKTITE

- Check that all screws are tight and in place, if any screw is loose it should be tightened with locktite.
- Pay particular attention to the screws on the propellers and motors.

BATTERY INSPECTION

- Visually inspect the battery, the battery cable, and balancer cable.
- Verify that the gold plated connectors are clean - if not, clean with alcohol on a cotton cloth.
- Regularly perform an inner resistance check using a full battery on room temperature - Verify that there's no cell with a resistance above 20Ω, the difference between cell's should not exceed 10Ω.

WARRANTY

INTRODUCTION

Height Technologies warrants their UAV products against defects in material or workmanship for a period of one year from the original date of purchase of the product (the “Warranty Period”).

The manufacturer’s warranty covers manufacturer’s defects. During the warranty period, the product must be used as intended by the manufacturer as described in the training course, and in the product literature, and given proper use including manufacturer’s maintenance procedures.

Damage caused by user error included but not limited to any of the following is not covered under warranty:

1. Crash or damage caused by non-manufacturing factors.
2. Unauthorized modification, disassembling or shell opening which did not follow the instruction of official manuals.
3. Improper installation or incorrect use of operation despite the guidance of manuals.
4. Unauthorized modification of circuit, mismatch or misuse of battery and charger.
5. Unauthorized Operator and certified personnel by Height Technologies.
6. Operation exceeding weather limits enlightened in Height Technologies specs and course.
7. Operating the unit in an high electromagnetic interference environment.
8. Operating the unit with a weight greater than the safe takeoff weight enlisted in Aircraft Operating Envelope.
9. Forced flight when components have been aged or damaged.
10. Reliability or compatibility issues when using unauthenticated third-party parts.
11. Operating the unit with a low charged or defective battery

UAV LIABILITY DISCLAIMER

Height Technologies is not responsible for any damage, injury, or warranty claim that occurs with or in connection with any of the UAV’s. The systems require careful training and preparation to use safely. The user may not operate the UAV, if not properly certified and trained or qualified.

Purchaser/operator assumes all liability and responsible for:

1. Damages to property and persons from the equipment.
2. Improper use of the equipment.
3. Any indirect or consequential damage related to the use of a UAV.
4. Ensuring proper configuration and maintenance of the equipment established by manufacturer.

WARRANTY

WARRANTY CLAIM

In order to make warranty effective for damage or loss, the claimer must supply Height Technologies the following material in order to proceed with the reclamation:

1. Copy of camera video flight prior and trough the “accident”.
2. Logs of GCS in order to retrieve information regarding the accident.
3. Log + maintenance schedule including notes of the equipment.
4. Operator annotations of the accident must be supplied (the operator must be certified by a Martlet UAS trainer that is authorized by Height Technologies.

NOTES

NOTES

NOTES

NOTES

HEIGHT TECHNOLOGIES

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ACT ON AERIAL

INTELLIGENCE