MARTLET MI-3

MULTI-MISSION TACTICAL MINI UAS

HEIGHT TECHNOLOGIES

USER MANUAL

User Manual Version: V3.1.0.22


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.

UNMANNED SYSTEMS AND COMPONENTS

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. We are proud to provide you with the MARTLET™ Mi-3 system. Our team is looking forward to your feedback and is ready to meet your current and future needs.

Best regards,
The MARTLET™ team at Height Technologies.

CONTACT

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

OFFICE ADDRESS

Street:	De iepenwei 14C
Postal code:	4191PD
City:	Geldermalsen
Country	The Netherlands

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 (10m 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-3 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-3 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-3 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-3 has been damaged by water then DO NOT USE and return the item to an authorized Atlas 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-3 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-3 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-3 to an authorized Height Technologies customer service provider. DO NOT ATTEMPT TO REPAIR THE AIRCRAFT YOURSELF, THIS WILL VOID THE WARRANTY.

THE MARTLET™ Mi-3 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.

CHECK AT FLIGHT LOCATION

- Recheck correlation off 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

- ☐ Check if all batteries are charged:
  - ☐ Flight battery voltage: **25.5V**
  - ☐ Radio module battery voltage: **12.5V**
  - ☐ Computer battery percentage: **100%**
- ☐ Remove the camera protection cover
- ☐ Visually examine the UAV:
  - ☐ Check carbon frame for any damage
  - ☐ Check that all screws are secure and in place
- ☐ Visually examine the battery:
  - ☐ Check battery surface for any damage
  - ☐ Check **BLUE** connectors for any dirt/dust/liquids
- ☐ Visually examine the proppelers
  - ☐ Check proppeler surface for any damage
- ☐ Match & connect proppeler connectors to motor adapter:
  - ☐ ORANGE [clockwise]
  - ☐ WHITE [counter-clockwise]
- ☐ Fix the proppellers by tightening the nuts with the torque wrench - unitl it clicks at 4 newton meter **(4NM)**
  - ☐ Check manually with additional wrench
- ☐ Power up GCS computer and radio module - **12.5V**
- ☐ Open HT-planner application
- ☐ Slide the battery in the UAV's battery compartment
- ☐ Connect **BLUE** battery connector to **BLUE** main plug
- ☐ Do not move the system while initiazing (beeping)
- ☐ Close battery door **after** camera is fully initialized

- » Press "connect"
- » Set "takeoff altitude" and "RTL altitude"
- » Optionally, set "Fence"
- » Check the following items:
  - » Home position
  - » Compass alignment
  - » Artificial horizon
  - » Battery voltage: ± 25V
  - » GPS: RTK FIXED / 3D DGPS / 3D FIX
  - » Link quality: 99-100%
  - » HDOP: < 2.5
- » Check flight modes:
  - » ALTHOLD
  - » LOITER
  - » RTL
  - » AUTO
- » Press TEST

- Listen for abnormal noises / vibrations
- Observe that all proppelers spin normally

- » Press ARM
  - » Check telemetry
- » Press LAUNCH
- » Switch to LOITER
  - » Check movements and verify UAV holding position
  - » Start mission

CONSTANTLY MONITOR YOUR FLIGHT PARAMETERS

AIRCRAFT OPERATING ENVELOPE

DIMENSIONS	L	W	H	
Frame size	80	80	43	cm
	55	55	40	
Proppeller size	29/74			inch/cm

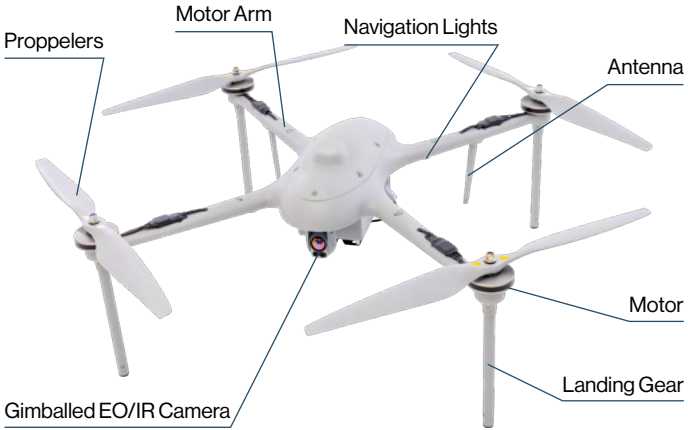
WEIGHTS		
Weight without battery	5.2	kg
Weight with battery	8	kg
Max payload weight	3	kg
Max take-off weight	11	kg

OTHER		
Operational temperature	-20 to +50	°C
IP rating	IP53	
Environment	Day / Night	

ENDURANCE		
Max flight time	95	min
FalconEye	95	min
X80	95	min
NightHawk 2	90	min
NightHawk 2-UZ	85	min
Raptor	75	min
Max payload	50	min

ALTITUDE LIMITS		
AGL	500	meter
AMSL	3500	meter

SPEED		
Ascent speed	2	m/s
Descent speed	2.5	m/s
Wind speed limit	25	knots
Max airspeed	35	knots
Cruising speed	9	m/s
Max speed (ALT HOLD)	17	m/s



AIRCRAFT CONTROL SYSTEM

FLIGHT CONTROLLER

- The Martlet Mi-3 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

30 SECONDS POST TAKE-OFF CHECK/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 battery (old/weak). The pilot will receive a warning of the voltage drop so he must keep track of the volt measurements during the flight.

BINGO TIME:
The Bingo parameter keeps the mission safe and calculates the remaining mission time every minute. This allows the pilot to fully focus on the mission. The system always ensures a timely flight back to the home point.

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 against strong wind gusts that it measures.

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).
- Issues can occur due to a failed calibration, configuration or bad sensor data. These checks help prevent crashes and loss of control over the system.
- The pilot will be unable to arm and launch the UAV, and a warning will pop up in the “Report” section of the telemetry window in the HT-Planner software.

COMPASS WARNINGS:
Compass Not Healthy: barometer abnormality detected
Compass Not Calibrated: the compasses haven’t been calibrated - either the compass offsets for XYZ read zero or the number of compasses connected have changed since last calibration.
Compass Offsets Too High: the primary compass offsets are higher than 500 - potentially due to magnetic interference.
Check Mag. Field: the sensed magnetic field is 35% higher or lower than the expected value.
Compasses Inconsistent: the internal and external compasses are facing different directions (off by >45°).

AIRCRAFT SAFETY FEATURES

BAROMETES WARNINGS:
Baro Not Healthy: barometer abnormality detected
Alt. Disparity: the measured height is more than ±2m from that of the inertial navigation (barometer + accelerometer)
NOTE: calibrate the accelerometer if these warnings reappear

GNSS RELATED WARNINGS:
GPS Glitch: GNSS abnormality detected
Need 3D Fix: not enough satellites to establish “3D fixed” location
Bad Velocity: according to the inertial navigation system (INS) the UAV’s velocity is above 50cm/s.
High GPS Hdop: the position accuracy is above 2.5m (for takeoff must be less than 1.5) - either wait a moment or reposition the UAV to resolve. If the Hdop remains above 2.5, check the area for potectial GNSS interferences.

INERTIAL NAVIGATION SYSTEM (INS) WARNINGS:
INS not calibrated: accelerometers need calibration
Accels Not Healty: abnormality detected on 1 (or more) of the 3 axes
Accels Inconsistent: accelerometer senses accelerations different by at least 1m/s - accelerometer need to be recalibrated.
Gyro Unhealthy: abnormality detected on 1 (or more) of the 3 axes
Gyro Cal. Failed: the calibration failed to capture offsets - possibly due to UAV movement during calibration (reboot to fix).

Gyros Inconsistent: two gyroscopes are reporting UAV’s rotation rates differing by more than 20°/sec - likely due to bad gyro calibration.

VOLTAGE BOARD WARNING:
Check Board Voltage: the boards’ internal voltage is below 4.3 or above 5.8 volts

BATERY RELATED WARNINGS:
Check Battery Voltage: the boards’ internal voltage is below 4.3 or above 5.8 volts

IN ANY CASE OF FAILSAFE OR WARNING DO NOT FLY AGAIN UNTIL THE REASON HAS BEEN FOUND AND A REBOOT TO CLEAR THE WARNING HAS BEEN PERFORMED

IN CASE OF A FAILSAFE THE UAV WILL ACTIVATE RTL MODE 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

FLIGHT BATTERY

MARTLET™ MI-3 FLIGHT BATTERY

Capacity:	18000 mAh
Voltage:	22.2V
Battery type:	Lithium-polymer
Energy:	400 Wh
Weight:	1.4 kg
Operating temperature:	-20°C – +50°C
Storage temperature:	-20°C – +60°C
Charging temperature:	0°C – +50°C
Max charging current:	8.0A / hour

FLIGHT BATTERY CHARGING PROCES

1. Connect the battery charger to a power source (DC 10-30V)
2. Connect battery plug + balancing connector to charger
3. Press the center button for the options to pop up
4. Check if the right battery type is selected:
   Task Settings > Chemistry > HVLiPo
5. Check max voltage per cell:
   Task Settings > Condition > 4.30V
6. Check if the right charging power is selected:
   Task Settings > Current > 5.0A / hour (max)
7. Start charging sequence:
   Task Settings > Startv

CHECK FLIGHT BATTERY CHARGE LEVEL

Press **TYPE** button to navigate and select the type of battery
Press **CELL** to scroll through the voltage of each of the 4 cells
Press **MODE** to check the differences in Voltage between de cells

MEASURING INTERNAL RESISTANCE

Every 20 battery cycles / 2 weeks the internal resistance of the flight battery must be checked using a full battery on room temperature:

- Ideally a great battery is if all of the cells have an internal resistance of 10Ω or less
- Once even one cell has reached an internal resistance of 20Ω or more, the battery should become for practice only (is no longer dependable for longer flight times)
- Make sure that the difference between the smallest and largest resistance is not greater than 10Ω
- If so, consider making the battery for practice only
- Once a battery has been deemed as practice only - check the internal resistance every week to make sure it doesn't continue to deteriorate.

FLIGHT BATTERY

FLIGHT BATTERY GENERAL INFORMATION

- Lithium polymer batteries are rechargeable batteries.
- Martlet Flight Batteries are **HVLiPo** batteries.
- LiPo batteries are usually composed of several identical secondary cells in a serial connection to increase the voltage, a 6S battery means: 6 cells in a serial connection.
- Cells sold today as polymer batteries are flexible, foil-type (polymer laminate) case.
- The voltage of a Li-poly cell varies from about 3.0V (discharged) to about 4.3 V (fully charged), to protect from overcharging limit the applied voltage to no more than 4.35V per cell.
- LiPo batteries are gaining favor in the world of Aviation, where the advantages of lower weight, increased capacity, and high power delivery play an important factor.
- LiPo batteries are efficient in temperatures between 20°C – 60°C.
- The battery should be around room temp before usage.

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]

GENERAL SPECIFICATIONS

Certification	MIL-STD 810G	
IP rating	IP65	
Encryption	128-bit AES / 256-bit AES	
Operating frequency	2300 - 2700	MHz
Max transmitting distance	15	km
Computer	T800 G2 / Toughbook G1	
Ports	USB, HDMI	
Latency	100	m/s
Battery	30	Whr
Charging (radio module)	**12V** adapter	**!**
Charging (computer)	**16V** adapter	**!**
Operating temperature	-20 – +50	°C
Battery life	5	hours

GCS GENERAL INFORMATION

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

Updates will be send 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.

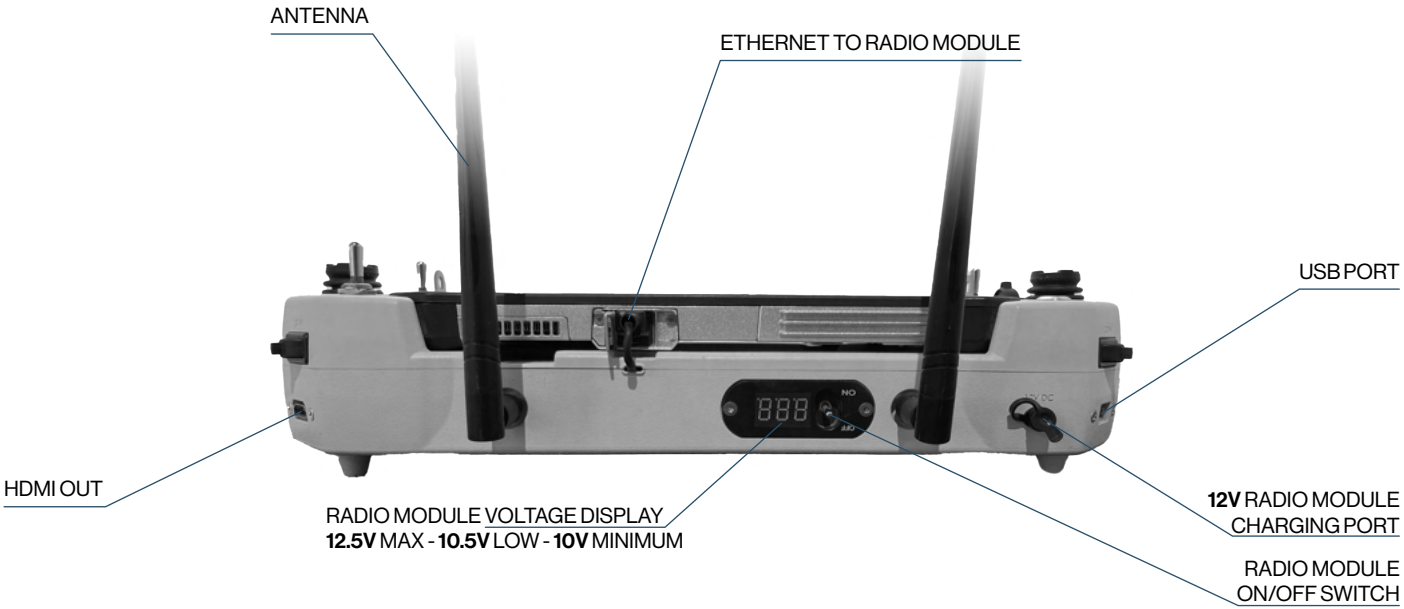
CHARGING THE GCS

- 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.

BACKSIDE


ANTENNA
ETHERNET TO RADIO MODULE
USB PORT
HDMI OUT
RADIO MODULE VOLTAGE DISPLAY
12.5V MAX - 10.5V LOW - 10V MINIMUM
12V RADIO MODULE CHARGING PORT
RADIO MODULE ON/OFF SWITCH

LEFT SIDE

RIGHT SIDE

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

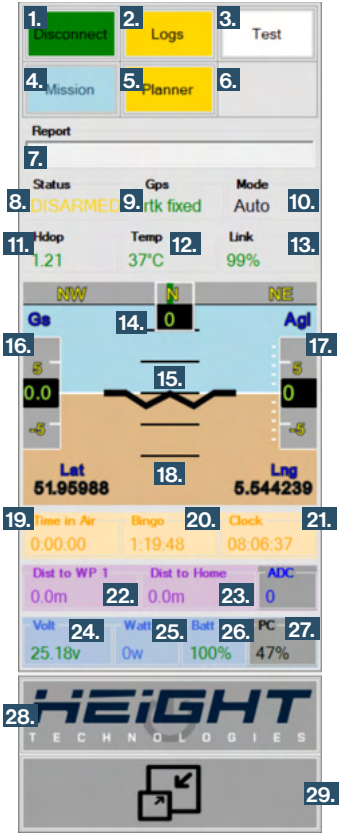
TELEMETRY

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

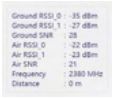
19. TIME IN AIR: press to see accumilated flight time
20. BINGO: time left before PONR
21. CLOCK: current time
22. DIST TO WP1: distance to next waypoint
23. DIST TO HOME: distance to take-off location
24. VOLT: voltage of flight battery
25. WATT: real-time energy expenditure
26. BATT: UAV battery in %
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: 3D dgps/3D fix
10. MODE: active flight mode
11. HDOP: GPS accuracy **[max 2.5]**
12. TEMP: internal temperature **[max 72°C]**
13. LINK: datalink health



press on the Link / % to open the datalink monitor pop-up

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

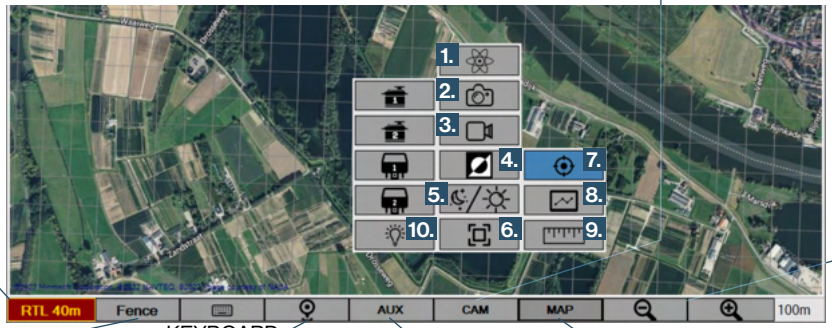
RTL:

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

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

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



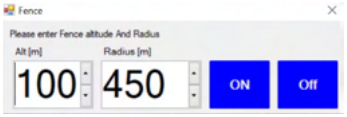
MAP ZOOM IN / OUT

KEYBOARD

FENCE:

Restrict UAV to fly within fence only

Fence can be breached in ALT HOLD mode



POI:

Open Point Of Interest toolbar

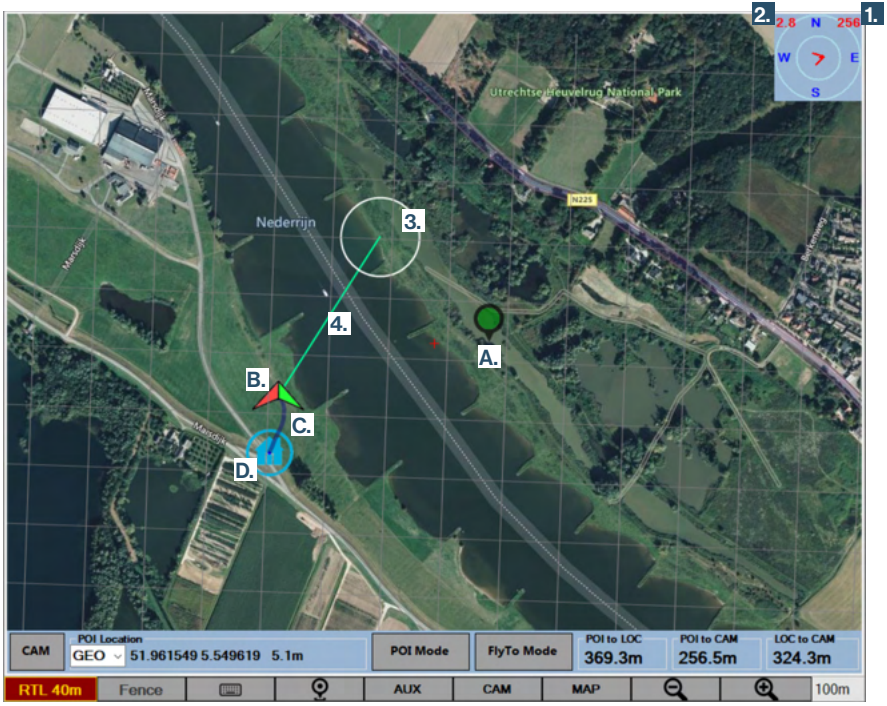
MAP: open map tools

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



A. POI: Point Of Interest

B. UAV ICON: L/R

C. FLIGHT PATH

D. HOME POINT: takeoff / RTL location

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)

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

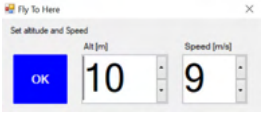
MEASUREMENTS: all ground distances

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)

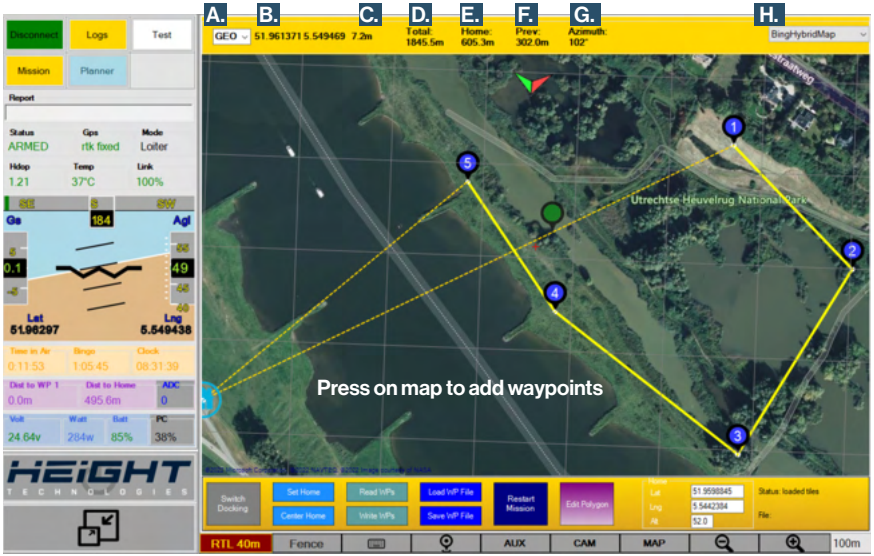
8. ALT: set default altitude (AGL relative to take-off location)

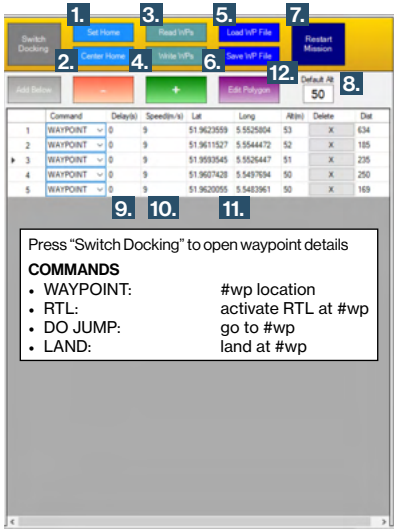
9. DELAY: time in seconds to hover (position hold) at waypoint

10. SPEED: set default GS (ground speed)

11. LAT/LNG: coordinates of each waypoint

12. POLYGON mode

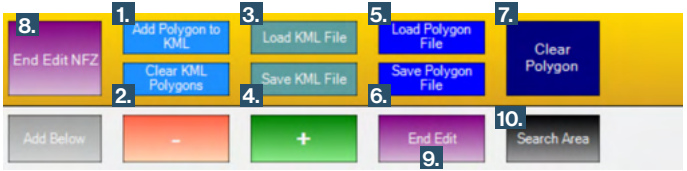




POLYGONS

Polygons can be used in two ways:

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

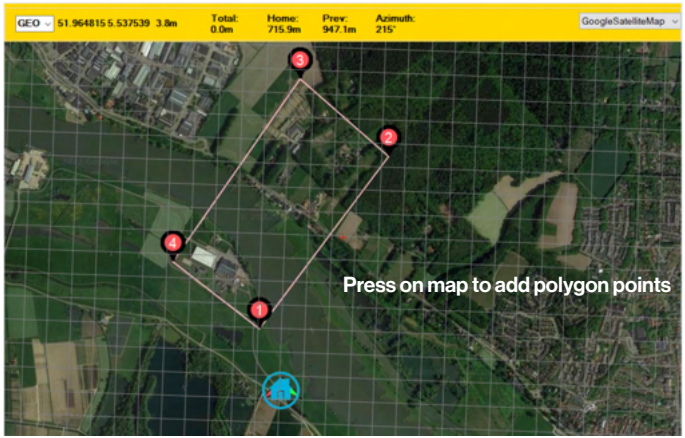


1. Add Polygon to KML: convert Polygon to **Area Of Interest**
2. Clear KML Polygons: clear all **Areas Of Interest** on the map
3. Load KML File: load a predefined **Area Of Interest**
4. Save KML File: save current **Area Of Interest** as **AOI.kml**
5. Load Polygon File: load a predifined Polygon
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.

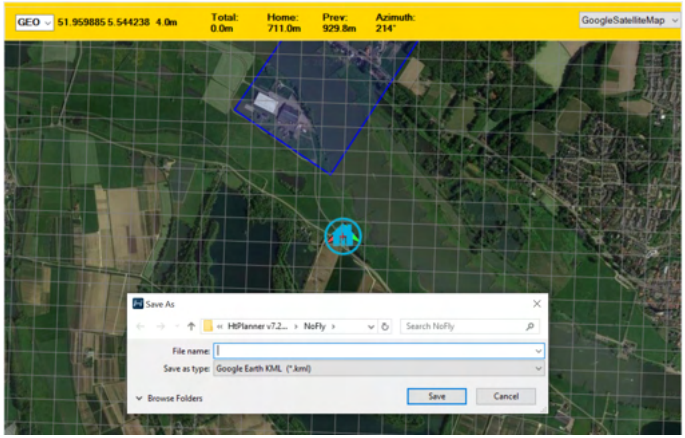
1. In the Planner, press "Edit Polygon" to enter the "Polygon mode"
   Planner > Edit Polygon



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

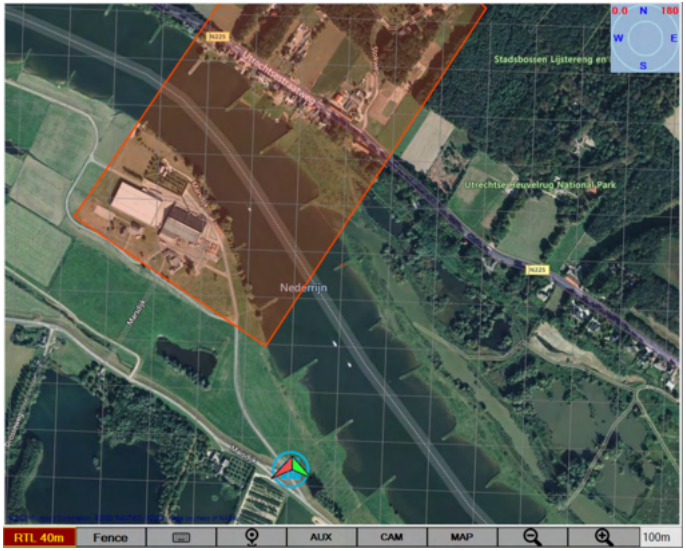
NO FLY ZONE

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

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. When the drone goes into RTL mode at a distance of less than 10 meters away from the home point, it will LAND.

There are multiple scenarios when RTL is activated:

1. When the UAV's altitude is **above** the predefined RTL altitude. UAV maintains its altitude while flying to the home location, once UAV approaches the home location it will descent at a 45° angle to the defined RTL altitude, after which it lands.

2. When the UAV's altitude is **below** the predefined RTL altitude.

A. UAV is **0 - 60 meters** from home location (ground distance): UAV will ascent to an altitude that 50% of the ground distance (eg. 40 meters from home location = 20 meter altitude)

B. UAV is **+60 meters** from home location (ground distance): UAV will ascent to the predefined RTL altitude

FAILSAFE

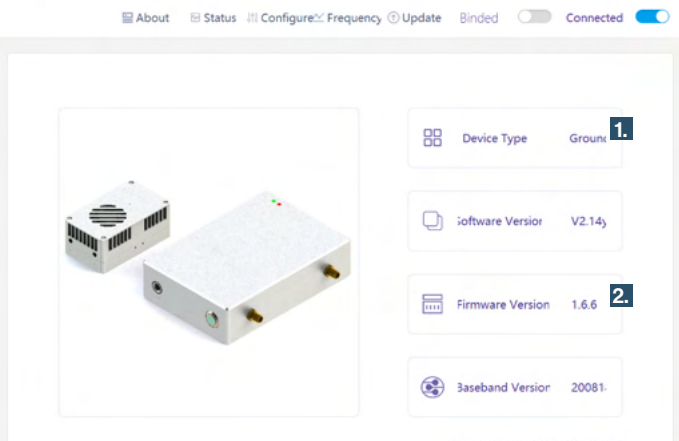
HOW FAILSAFE WORKS

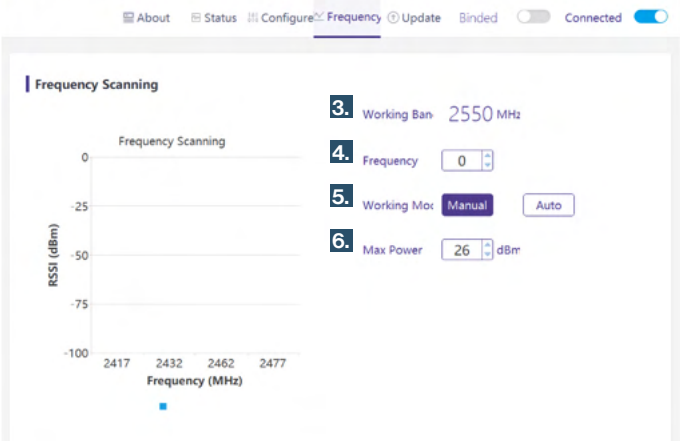
- FAILSAFE occurs when the system activates "return to launch" (RTL) due to a failure, not because the pilot instructed it to do so.
- In case of GNSS signal loss or high HDOP - DRL is activated.
- DRL is overruled when operator switches to LOITER: DRL LOITER.
- During DRL the GNSS based modes won't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

WHEN TO EXPECT FAILSAFE

- Loss of GNSS signal = DRL
- Low Voltage, **19.5V** = RTL
- Low Voltage, **18V** = LAND
- BINGO has reached **00:00** = RTL
- Loss of Communication w/ GCS = RTL

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

Working Mode:

Select “Manual” to define frequency within 2.3 - 2.7 GHz

NOTE: frequency must be set in **MHz (**2400 - 2700 GHz)

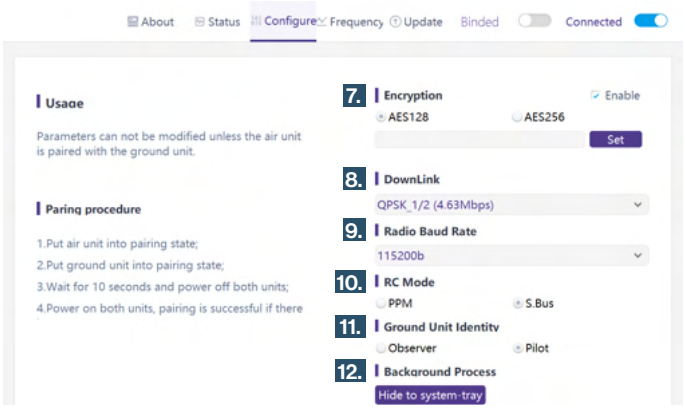
Select “Auto” to enable frequency hopping in 2.4 - 2.5 GHz

5. 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_2/3 (4.63Mbps)”**

9. Baut Baud Rate: N/A

10. RC Mode: set to S.Bus

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

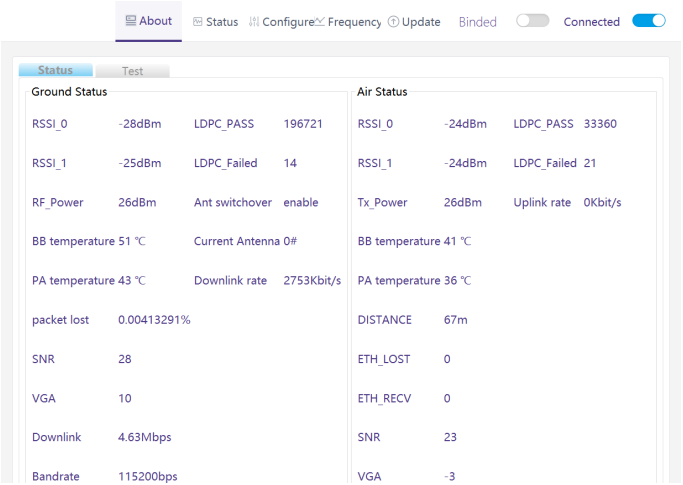
15. Downlink rate: data sent from UAV to GCS

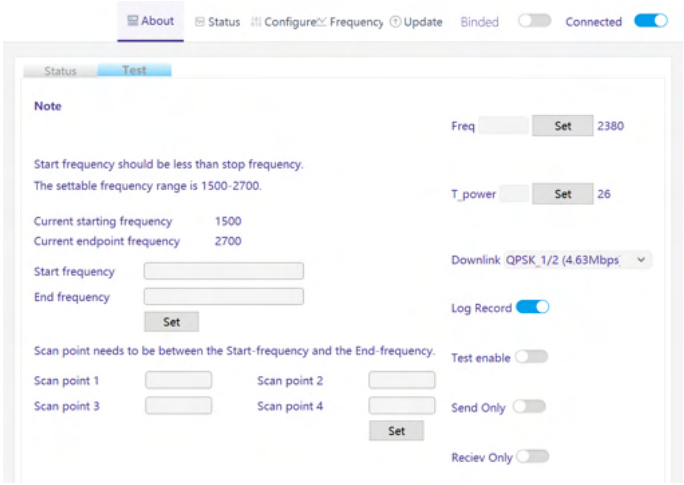
16. Distance: distance between GCS and UAV

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”

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.

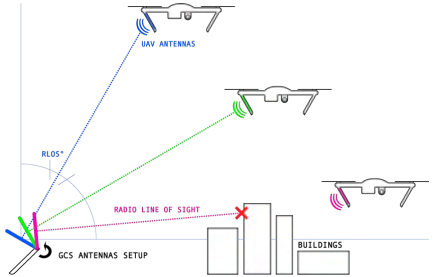
CAUSES OF FREQUENCY INTERFERENCE

- 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 loose or twisted wires, motor-to-ESC connections, 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 **without the propellers connected** and watch for unusual noises when the engines are idling.
- Rotate the motors by hand to check that the motors run smoothly.
- 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 threads in the propeller and on the motors are not worn out.
- In case of damage: replace the silver/red connector on propeller/motor.

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.
- Perform an inner resistance check after 20 battery cycles 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.

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User Manual Version: V3.1.0.22

HEIGHT TECHNOLOGIES

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