WohnderDrone

WohnderDrone A10

Sprayer Drone

USER MANUAL

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2. Version control

Version	date	Author	Description	Reviewed by
v1.0	2023.04.06	Horváth Attila István Szabó Tamás Vásárhelyi Gábor	Documentation creation	Fehér Bálint
v1.1	2023.08.16	Fehér Bálint	addition, correction	dr. Szabó László Dénes Attila Fendrik Ármin

3. Introduction

WOHNDERDRONE A10 is part of the UAV series developed and manufactured by MOULDTECH SYSTEMS KFT. The drone was designed for professional use for agricultural applications.

You can direct your questions about the content of this manual to the following address:
Email: support@wohnderdrone.hu

This manual is for usage with the following software versions:

Drone software: 1.22.1-1-g7dc9cd7
Base station software: 2.14.0/1.0.1+2
Tablet software: V11

If your software version is different, please visit: https://wohnderdrone.hu, and download the user manual for your version, or contact WohnderDrone support at support@wohnderdrone.hu.

3.1 Use of markings and pictograms

Certain information is highlighted in this manual in the form of notes and warnings. In addition, other warning pictograms can be found in the manual and on the drone.

Note: It is used to highlight the treatment procedure, technique, etc.

Caution: An operating procedure, technique, etc., which may damage the equipment if not followed carefully.

Caution!: An operating procedure, technique, etc., that may cause personal injury or death if not followed carefully.

Poison, dangerous substance

The use of a facemask is mandatory

The use of protective clothing is mandatory

The use of protective gloves is mandatory

The use of safety glasses is mandatory

4. Main technical features of the WohnderDrone A10 drone

WEIGHT (WITHOUT BATTERIES)	12Kg
MAXIMAL ALLOWABLE TAKEOFF WEIGHT	25Kg
ALLOWABLE TANK CAPACITY	7.5 Litre (25Kg)
MAXIMAL TANK CAPACITY	11 Litre
DIMESNIONS (ARMS FOLDED)	730 X 550 X 490mm
DISTANCE OF MOTOR AXES	970mm
POSITIONING ACCURACY	VERTICAL: 0,2m HORIZONTAL: 0,2m
MAX. VELOCITY	10 m/s
MAX. WIND RESISTANCE	8 m/s
MAX. HOVERING TIME (EMPTY TANK)	24 perc
MAX. HOVERING TIME (FULL TANK)	12 perc
PROPELLER DIAMETER	29 inch
MOTORS	HOBBYWING X8
FLIGHT CONTROLLER	ORANGE CUBE+
GROUND CONTROL SOFTWARE	SKYBRUSH LIVE A10
MAX. DATASTREAM DISTANCE	1 Km (VLOS)
SPRAYING PERFORMANCE	10 ha / h (depending on settings)
COLLISION AVOIDANCE SENSOR	FRONT RADAR | 12V | 24-24.2 GHz
COLLISION AVOIDANCE DETECTION ANGLES	Horizontal: 41fok Vertical: 37fok
MAXIMAL COLLISION DETECTION DISTANCE	30m
ALTITUDE SENSOR	RADAR | 12V | 24 GHz

ALTITUDE SENSOR DETECTION ANGLES	Horizontal: 43fok Vertical: 30fok
MAXIMAL ALTITUDE SENSING DISTANCE	50m
RC FREQUENCY	2.4-2.5 GHz
RC TRANSMISSION POWER	CE: ≤ 20 dBm
WiFi FREQUENCY	5.725-5.850 GHz
WiFi TRANSMISSION POWER	CE: ≤ 20 dBm
DRONE GNSS	GPS: L1C/A L2C GLONASS: L1OF L2OF Galileo: E1-B/C E5b BeiDou: B1I B2I QZSS: L1C/A L2C SBAS: WAAS, EGNOS, MSAS, GAGAN and SouthPAN ANTENNA: 2dBi Helical, multiband
BASE STATION GNSS	GPS: L1C/A L2C GLONASS: L1OF L2OF Galileo: E1-B/C E5b BeiDou: B1I B2I QZSS: L1C/A L2C SBAS: WAAS, EGNOS, MSAS, GAGAN and SouthPAN ANTENNA: 2dBi multiband
TABLET GNSS	GPS, GLONASS, BEIDU
DRONE BATTERY TYPE	GENS ACE 12S 15C 16000mah 44.4V Compact version
DRONE BATTERY CHARGER	INPUT: 100-240V AC 50/60Hz OUTPUT: max 50.4V DC 60A
BASE STATION BATTERY TYPE	3S3P Li-ion 15000mAh 11.1V
BASE STATION BATTERY CHARGER	INPUT: 240V AC 50Hz OUTPUT: max 12.6V DC 2A
TABLET BATTERY TYPE	LiPo 20000mAH
TABLET CHARGER	INPUT: 100-240V AC 50/60Hz OUTPUT: DC 5V/3A or 9V/3A or 12V/2.75A
RC CONTROLLER BATTERY TYPE	2S1P SAMSUNG Li-ion 7.4V
FPV CAMERA	MAX. 1280x720px 15/25fps

5. Safety regulations

Please read this manual carefully before using your WohnderDrone drone. If you have any questions, contact WohnderDrone Kft.'s customer service before your first flight - contact details are at the end of this document. By using the drone, you confirm that you have read, understood, and accepted this disclaimer. You agree that from now on you are solely responsible for your actions with the machine and for any direct or indirect consequences resulting therefrom. You agree to use this machine only for purposes that comply with regulations, local and airspace regulations.

- ✓ WohnderDrone brand machines are NOT toys and should be used with great care. Improper use may cause damage to the drone or serious injury to you or others, including death. These machines can only be operated by qualified pilots.
- ✓ Batteries that are being charged must never be left unattended!

- ✓ DO NOT fly over or near people. Avoid operations near buildings or other obstacles.
- ✓ DO NOT fly near power lines because the electromagnetic interference they generate will cause the compass to malfunction.
- ✓ Ensure that your operations do not violate any applicable laws or regulations and that you have obtained all appropriate prior authorizations.
- ✓ DO NOT operate the drone indoors.
- ✓ Make sure the weather conditions are right before every flight. Do not fly in strong wind or rain. Spraying flights can only be carried out if the weather conditions prescribed by law are met.
- ✓ The obstacle detection sensor does not provide complete security for the detection of all obstacles!
- ✓ After using the drone, remove the battery. Never transport the drone with batteries inserted.
- ✓ The drone must be under control during the whole operation. Never rely solely on the A10 application
- ✓ Do not exceed maximal take-off weight
- ✓ During operations, environmental temperature must be above 5°C, and below 35°C
- ✓ The drone must always be visible to the pilot. Do not operate the device beyond the visual line of sight
- ✓ The no fly zones shown by the A10 applications may differ from the actual no fly zones. The user is responsible for inquiring the authorities about actual no fly zones before take-off.

6. Use of plant protection agents

- ✓ Use a mouth mask, protective gloves, protective glasses, and protective clothing when filling chemicals and cleaning the sprayer. It is necessary to read and observe the safety measures in the MSDS sheet of the chemicals.
- ✓ The operator must provide clean water for handling the equipment.
- ✓ Take care to avoid polluting the environment! Do not splash the chemical when mixing and filling the container. Planning the spraying operation helps to ensure that the correct amount of pesticide is mixed into the area to be treated, thus minimizing the excess amount. Collect the excess spray or washing liquid in the tank in a collection container.
- ✓ DO NOT pollute rivers and drinking water sources!
- ✓ Spraying can only be carried out if the boundary conditions prescribed by law are met!
- ✓ Mix the chemical with clean water and filter the mixed liquid before pouring it into the spray tank to avoid clogging the filters. Before using the equipment, remove any blockages.
- ✓ The holes of the filters in the tank are 0.25 mm. You can order a spare filter from the manufacturer.
- ✓ Effective use of sprays depends on spray density, spray rate, spray distance, aircraft speed, wind speed, wind direction, temperature, and humidity. Consider all factors when using sprays and DO NOT endanger the safety of people, animals, or the environment.
- ✓ Avoid using insoluble sprays such as wettable powders and fast settling sprays.
- ✓ When spraying, be sure to stay upwind to avoid bodily injury.

7. Sprayer settings

The spraying settings must be carried out based on the instructions for use of the plant protection products and on the instructions of a specialist.

In order to reduce drift, in windy weather it is recommended to set the drone's flight path parallel to the wind, choose a larger droplet size and choose a lower flight height if possible.

Spray setting ranges tested and recommended by the manufacturer:

flight speed: 3-8 m/s

flight height: 4-6m from the surface of the vegetation

work width (distance between turns): 3-6m

Core determination of the delivery performance of the spraying system:

flow rate ($\frac{\mathbf{ml}}{\mathbf{min}}$) = dosage ($\frac{\mathbf{l}}{\mathbf{ha}}$) * work width (m) * flight speed ($\frac{\mathbf{m}}{\mathbf{s}}$) * 6

<u>Example 1:</u> How should I set the flow rate if dosage is = 10 $\frac{\mathrm{l}}{\mathrm{ha}}$, work width = 4m, flight speed = 4 $\frac{\mathrm{m}}{\mathrm{s}}$?

Solution: flow rate ($\frac{\mathrm{ml}}{\mathrm{min}}$) = 10 $\frac{\mathrm{l}}{\mathrm{ha}}$ * 4m * 4 $\frac{\mathrm{m}}{\mathrm{s}}$ * 6 = **960** $\frac{\mathbf{ml}}{\mathbf{min}}$

<u>Example 2:</u> What should be the speed of the drone if the desired flow rate = 1000 $\frac{\mathrm{ml}}{\mathrm{min}}$, dosage = 10 $\frac{\mathrm{l}}{\mathrm{ha}}$, work width = 5m?

Solution: drone speed ($\frac{\mathrm{m}}{\mathrm{s}}$) = 1000 $\frac{\mathrm{ml}}{\mathrm{min}}$ / (10 $\frac{\mathrm{l}}{\mathrm{ha}}$ * 5m * 6) = **3,3** $\frac{\mathbf{m}}{\mathbf{s}}$

8. Description of the A10 spraying drone system

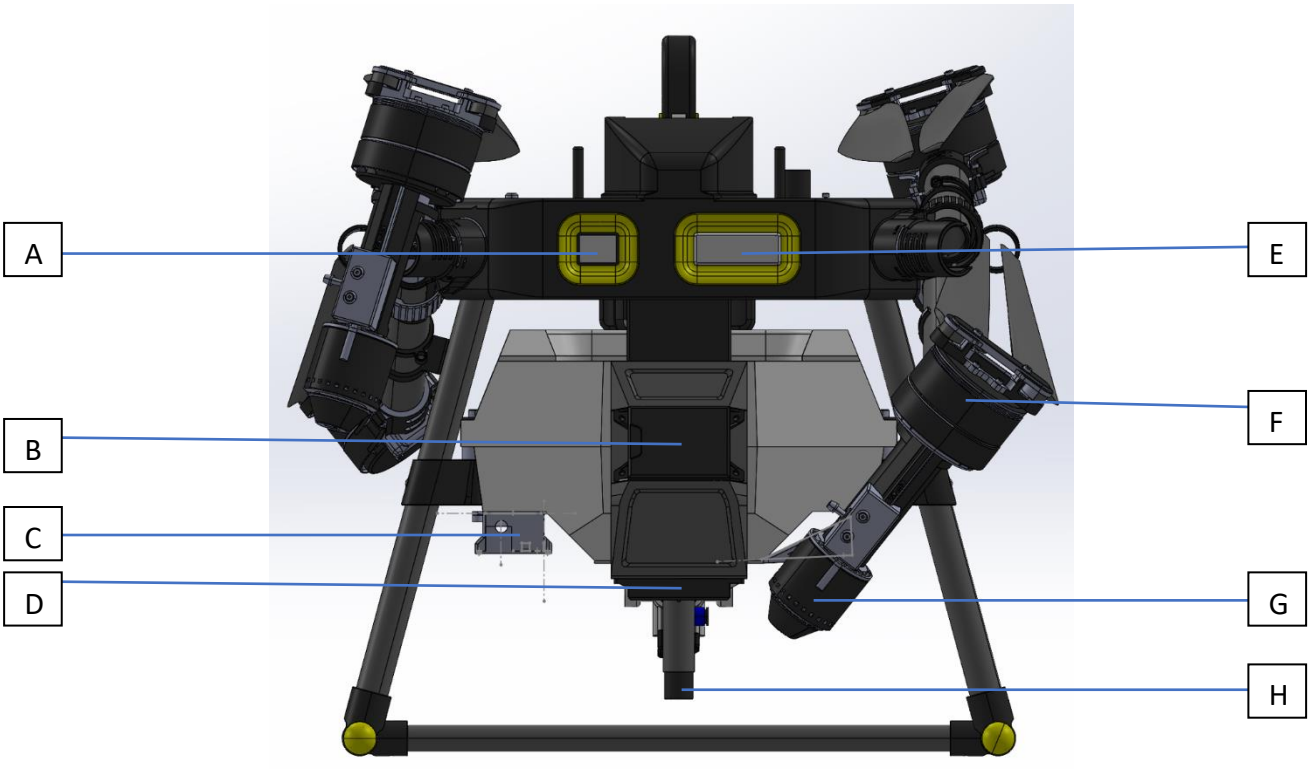
8.1 Drone

The A10 drone is a spraying drone specially developed and manufactured by MouldTech Systems Kft. The presentation of the parts of the drone and the parts necessary for its use are discussed in this chapter.

The rotor arms of the A10 drone can be folded in for easy transport and storage. The figures below show the arms of the drone in the open and closed position.

To fix the arm in the open state, push the locking ring onto the arm until it stops, then turn the ring in the "LOCK" direction indicated on the arm until the arrows point to each other.

ATTENTION! When fixing the arms, make sure that you push the locking ring onto the arm stub until it stops, then after closing rotate the locking ring until the arrows drawn on the elements of the closing mechanism point to each other. The correctly locked state is shown in the figure below.



A: FPV camera

B: Obstacle detection sensor

C: Flow meter

D: Terrain follow sensor

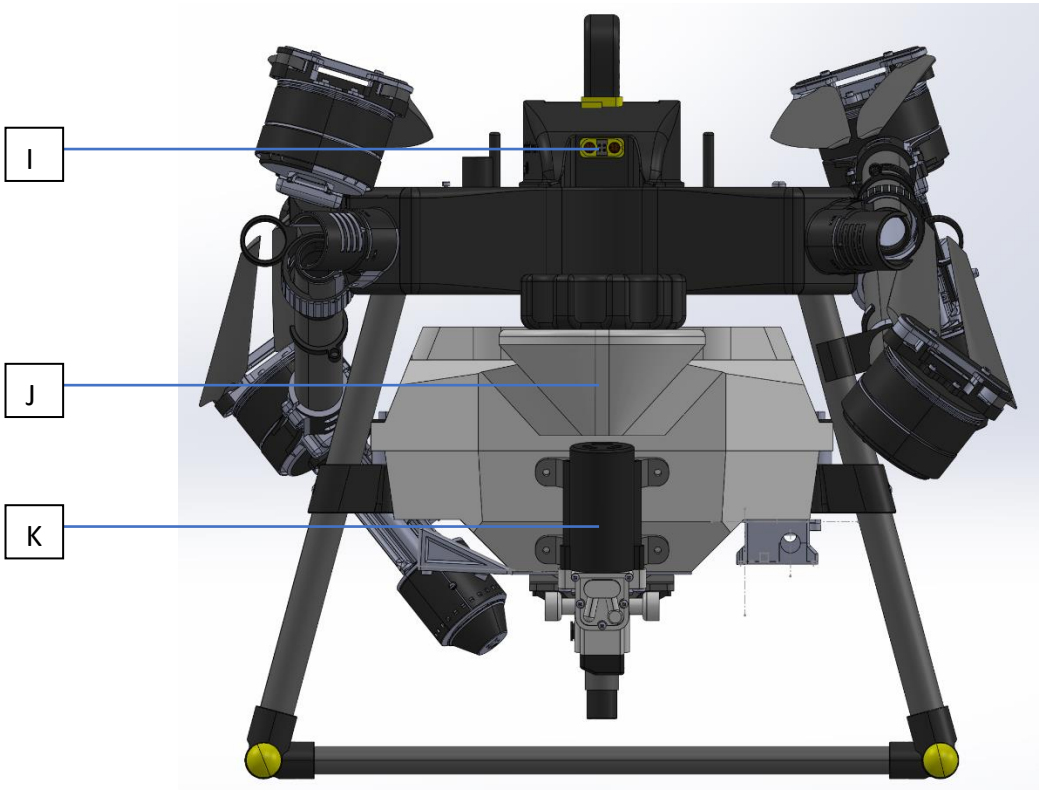
E: LED Search Light

F: Motors (4pcs)

G: Nozzle (4pcs)

H: Lower WiFi antenna

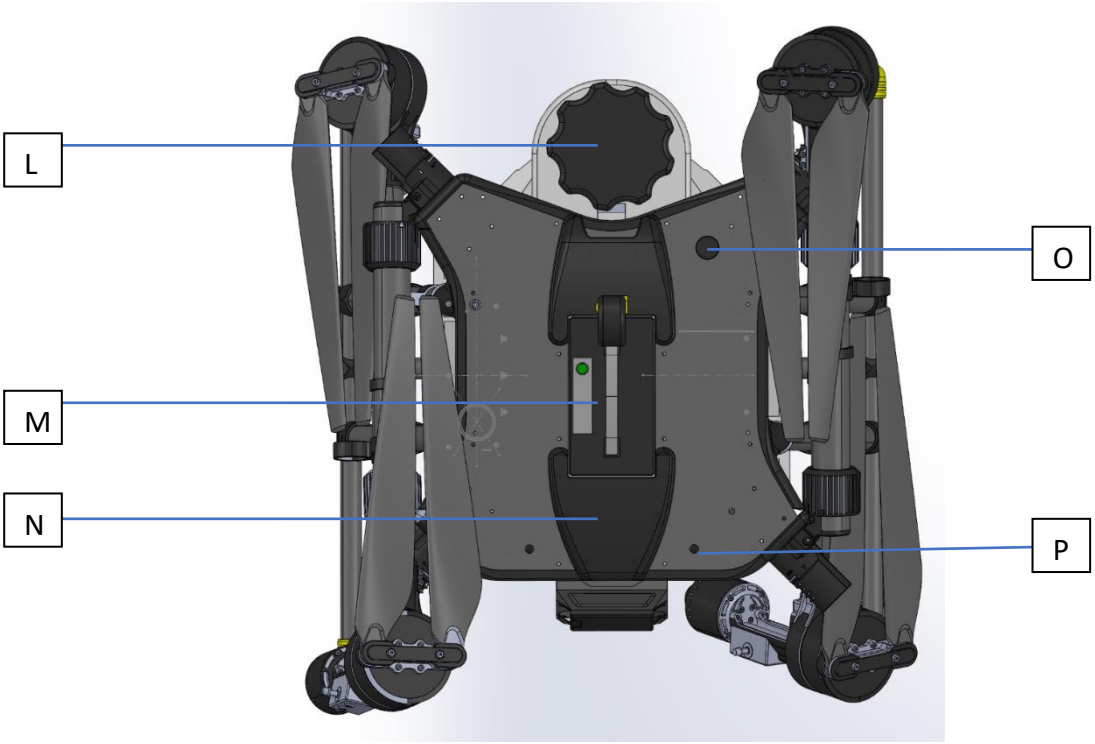
Note: The front arms of the drone have a green, the rear arms have blue LEDs below the motors, which help with recognizing the flight direction mid-flight.



I: Battery connector

J: Tank

Q: Pump



L: Tank filler opening

M: Battery

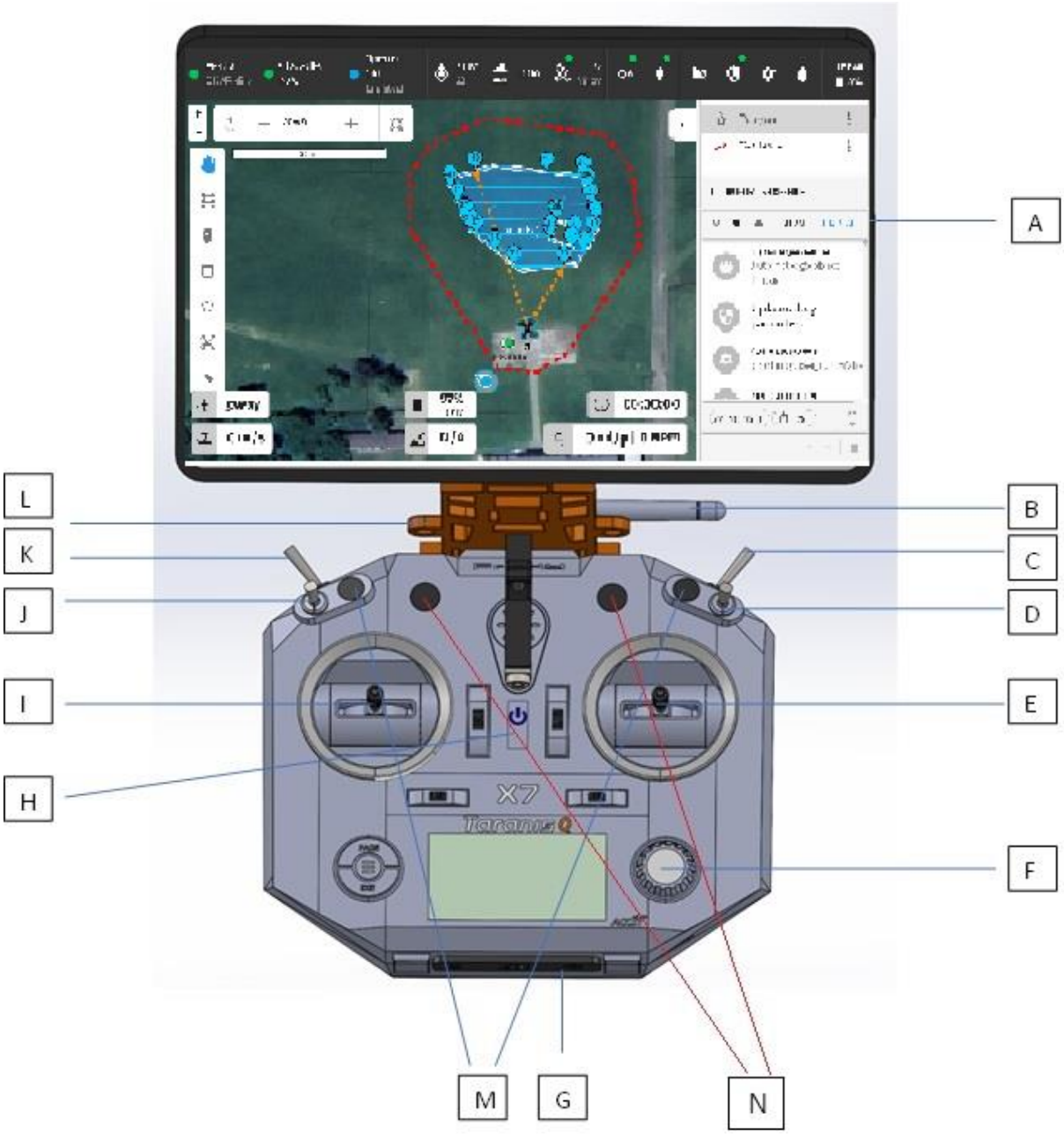
N: GPS antenna

O: Top WiFi antenna

P: Remote control RC antenna (2pcs)

8.2 Remote control and control interface

The control of the WohdnerDrone A10 spraying drone is realized by a specially developed combination of a modified FR Sky Taranis QX7 remote control and a 10.1-inch drop-resistant tablet with a large battery capacity. The main functional elements of the devices are shown in the figures below.



A: Control interface

B: Remote control antenna

C: Drone search light switch (2 positions)

D: Flight mode selector switch (3 positions)
|upper position – ALT HOLD| |middle position – Loiter| |lower position – GUIDED|

E: Right remote control lever

F: Enter key

G: USB port, charging connector

H: Remote control power button

I: Left remote control lever

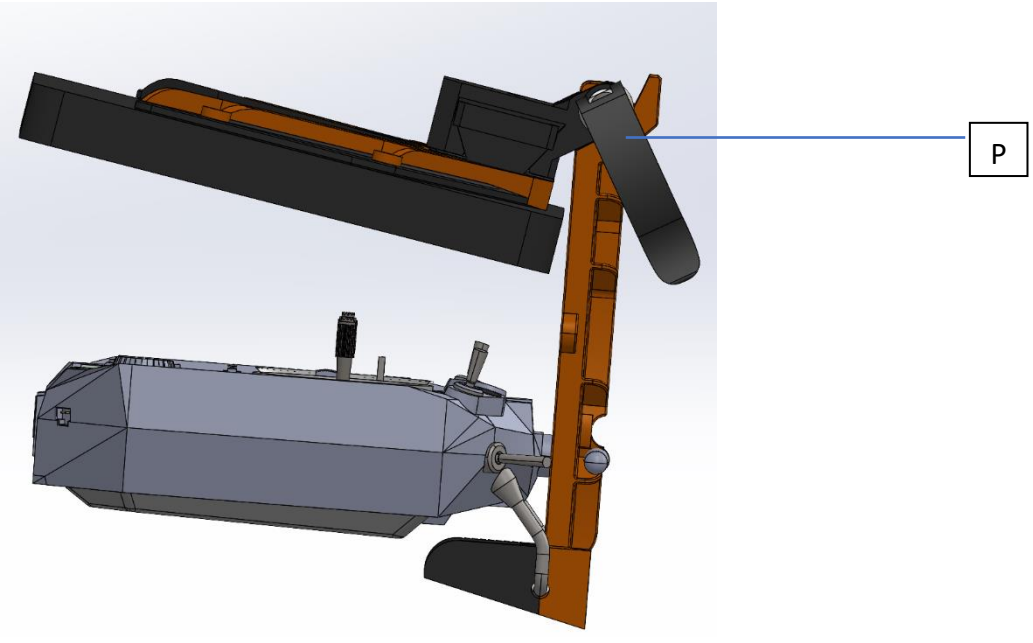
J: RTH mode switch (2 positions)

K: Spray enable switch (2 positions)

L: Shoulder strap connection point

M: Empty, no function

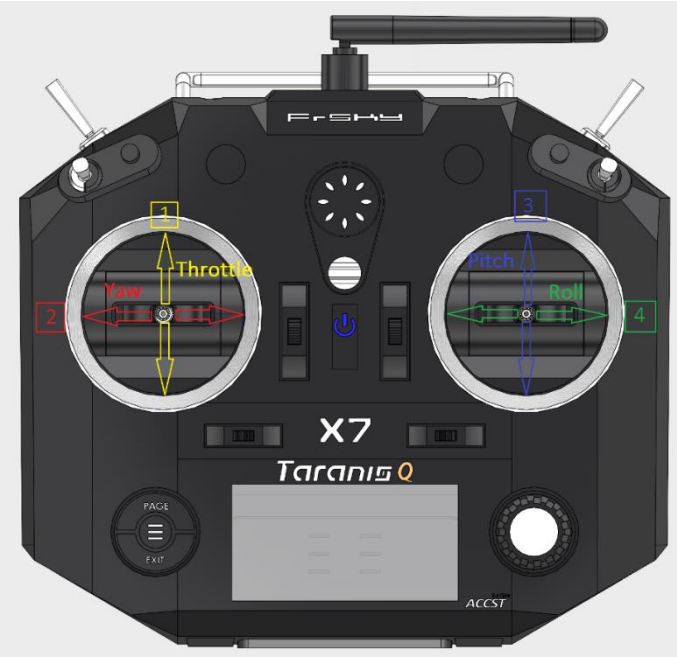
N: Emergency stop buttons. To conduct an emergency stop, keep both buttons simultaneously pushed.



P: Quick release

The opening angle of the tablet can be adjusted using the quick release (P); the tablet can be folded over the remote control for storage and transport.

8.2.1 Remote control sticks (joystick)



1. **Throttle:** Increasing, or decreasing the drone altitude
2. **Yaw**: Rotating the drone along its vertical axis
3. **Pitch:** Moving the drone forwards, or backwards
4. **Roll:** Moving the drone to the left, or right.

Starting the motors (arming the drone) is done by pulling Yaw, and Throttle to the bottom right at the same time. In manual mode, let the Yaw, Pitch, and Roll to the centre, then after the motors are started, begin the take-off

In GUIDED mode, let the control sticks to the centre. The drone will start its mission automatically.

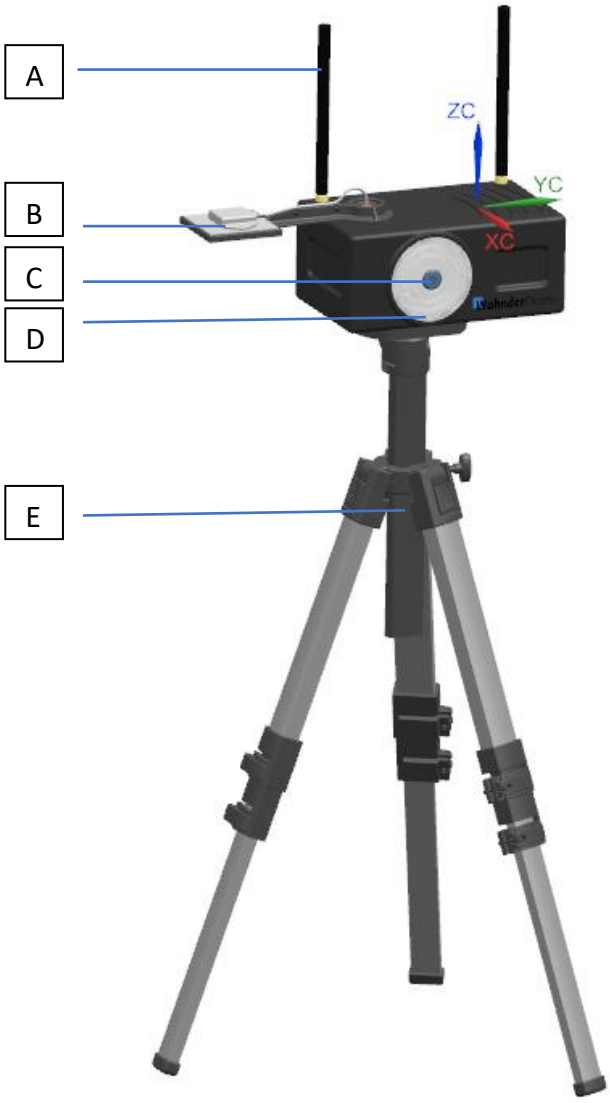
Name: Always select A10_001 for the drone specific settings
Charge indicator: Check if the controller is charger up before every flight.
Signal strength : Shows the signal strength between the drone, and the RC controller. If connection is lost, the remote controller shakes, signals it with an alarm. Make sure, that the RC connection is not interrupted. If the connection is interrupted, raise the controllerhigher, and carefully approach the drone.

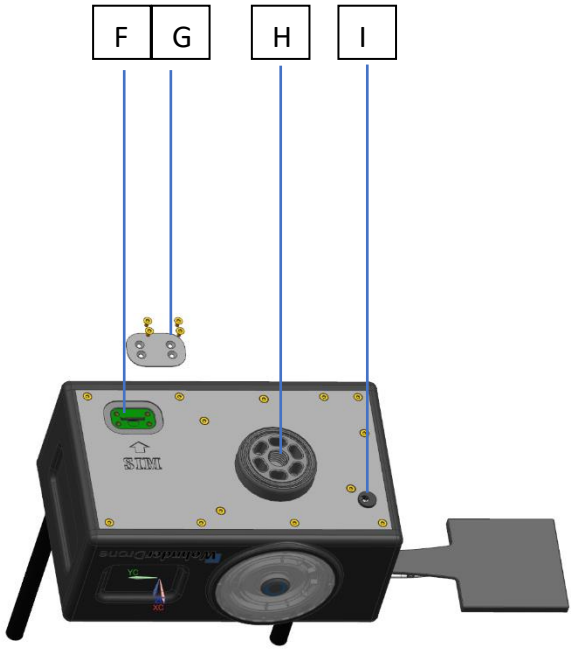
8.3 Base station

The base station plays a central role in the operation of the WohnderDrone A10 spraying drone. The base station provides the following functionalities:

- Creating a local WiFi network through which the drone and control software communicate
- Operating a computer responsible for ensuring a communication connection
- Sending RTK correction signals
- LED status display
- Connection to the LTE WiFi network with a SIM card (not implemented yet)

Introduction of the Base station:





A: WiFi antenna

B: RTK antenna

C: Power button

D: LED status display

E: Stand

F: SIM card slot

G: SIM card cover

H: Stand mount

I: Charging socket

Setting up the Base station:

1. Prepare the tripod for the Base Station as follows:
   - extend the legs until they stop
   - secure the legs in the extended position
   - open the legs and push the sleeves into the ground so that the stand is stable
   - set up the stand so that its top is horizontal

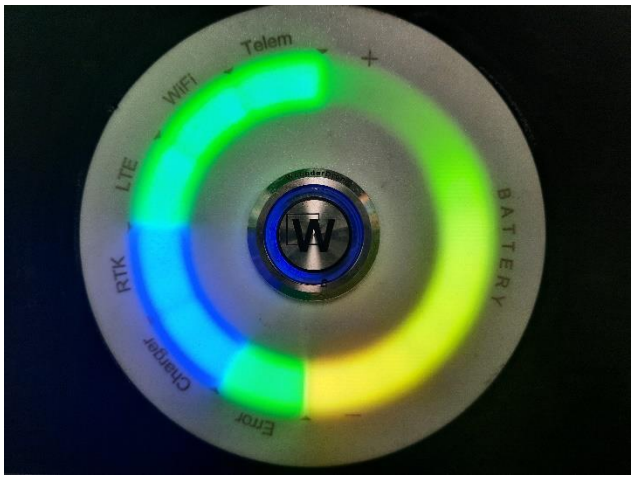
2. Attach the Base Station to the stand using the handle screw on the stand
3. Switch on the base station by pressing the button (marked witch C on the picture). After switching on, the status display LEDs change to the colour corresponding to the status after a short initialization (see below)
4. 

   Attention!
   During operation, the base station must not be moved, because it leads to interference with the RTK data and affects the perceived position of the drone

5. To charge the Base station, connect the charger to the charging socket

Status LEDs on the base station

The base station has the following status LEDs:



Telem: Shows the connection between the base station and the drone.

- Green: Connected
- Red: No connection

WiFi: Shows the connection between the base station and the control tablet

- Green: Connected
- Red: No connection

LTE: In the case of a SIM card inserted in the base station, it shows the LTE connection of the base station

- Green: Connected
- Red: No connection

RTK: Displays the status of the RTK

- Blue: RTK is not activated
- Yellow: RTK is on, but the accuracy has not yet reached the set value
- Green: RTK is on and the accuracy has reached the set value

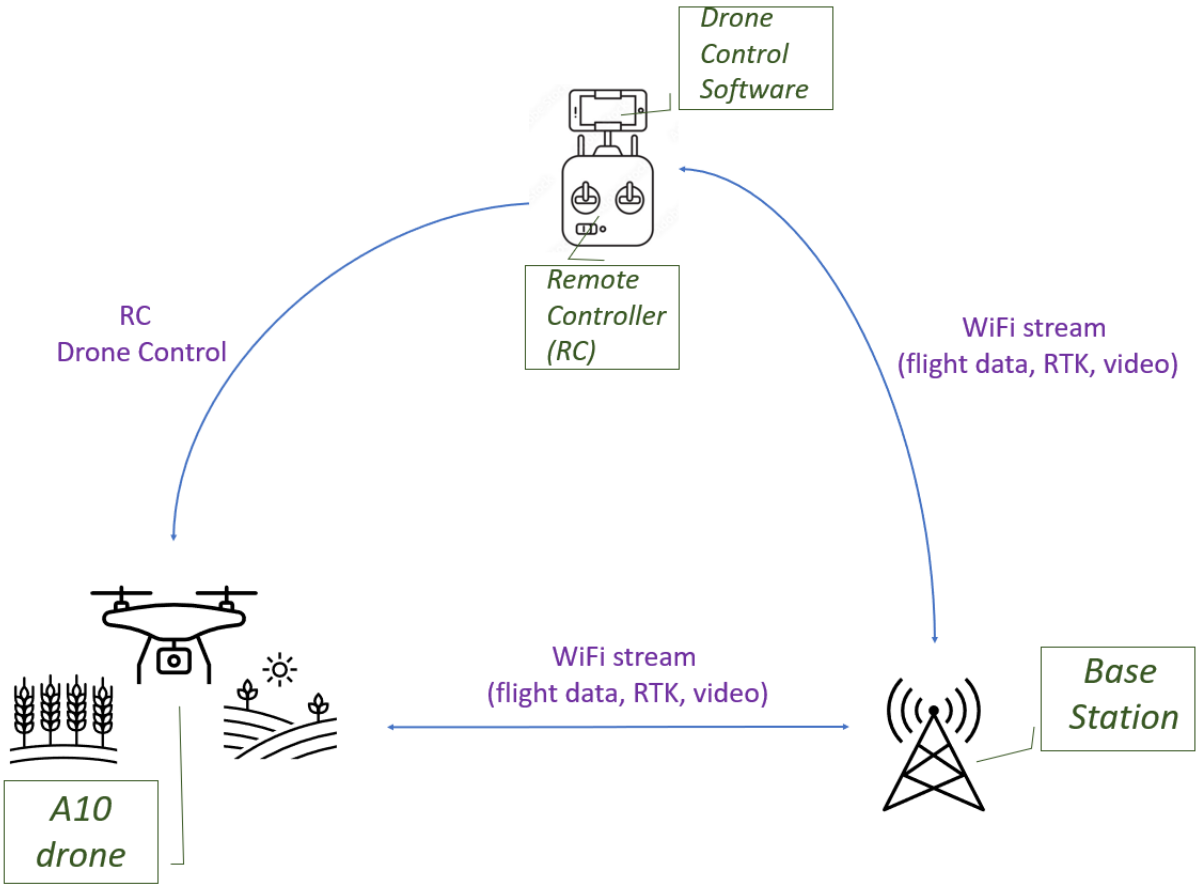
Charger: Shows whether the base station is connected to the charger

- Blue: Not charging or taking more charging current
- Green: Charging

Error: If it lights up red, check the error messages in the tablet application

Battery: Indicates the charge level of the base station's battery.

8.4 A10 communication system

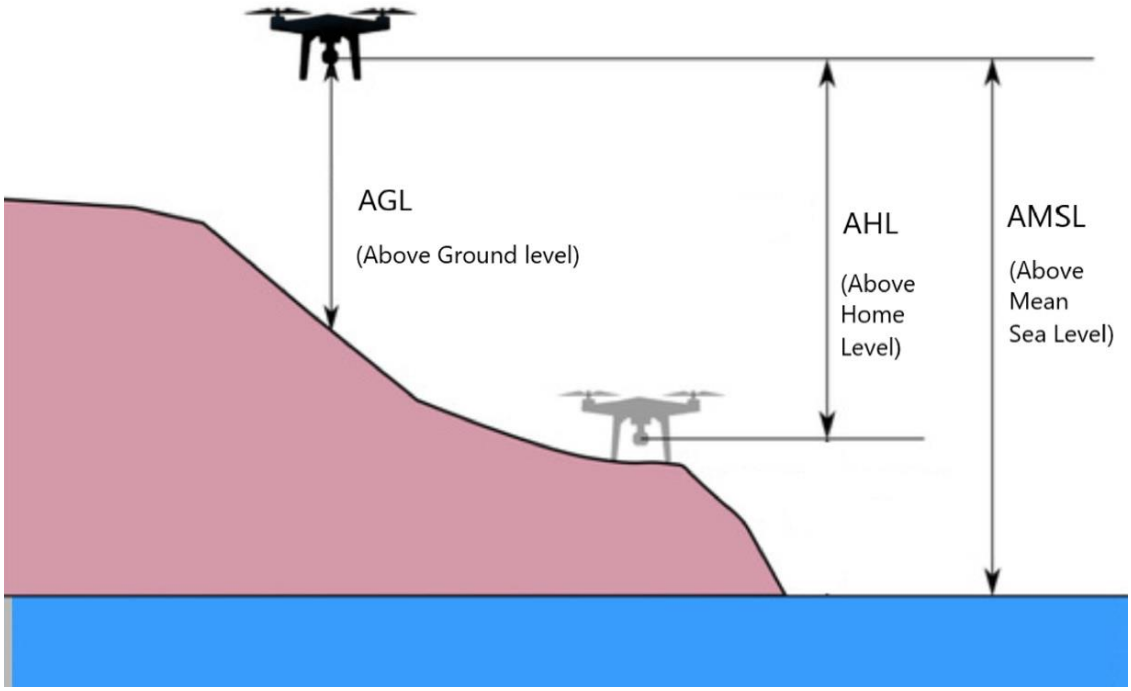


The communication system of the A10 drone is illustrated in the figure above.

Explanation:

- The RC remote controller is directly connected to the drone. As a result, if the base station is switched off and, as a result, telemetry is lost, the pilot's control over the drone does not cease. The RC operates in the 2.4-2.5GHz frequency range.
- You can monitor the telemetry data using the A10 application on the tablet. The telemetry data and the video feed are transmitted from the drone to the base station, and from there to the tablet. The connection between the tablet - base station and the drone - base station is realized trough a WiFi network operating in the frequency range of 5.7-5.8 GHz.
- Settings and data sent from the tablet using the A10 application are also uploaded to the drone via the base station.
- The RTK correction data is transmitted from the base station directly to the drone. RTK can be turned on/off using the A10 application on the tablet.
- The name of the WiFi network (SSID) is the same as the serial number of the drone, you can find the corresponding password in the packaging.

8.5 AGL, AHL, AMSL explanation



It is important, that the user is familiar with the AGL, AHL, and AMSL expressions. These expressions are commonly used in this user manual.

AGL: the vertical distance between the drone and the ground. It is used when the terrain following radar is turned on.

AHL: The vertical distance between the drone and the take off position ground level. It is used, when the terrain following radar is turned off. The system uses the GNSS, and the barometric sensors to determine this altitude. As such, accurate AHL requires accurate GNSS lock.

AMSL: The vertical distance between the drone and the sea level. This is determined by using the GNSS, and the barometric sensor. As such, accurate AMSL requires an accurate GNSS lock.

8.6 Battery and battery charger

8.6.1 Battery

Battery type exclusively compatible with the drone:

Tattu Plus 1.0 Compact version 16000mAh 12S 15C 44.4V Lipo

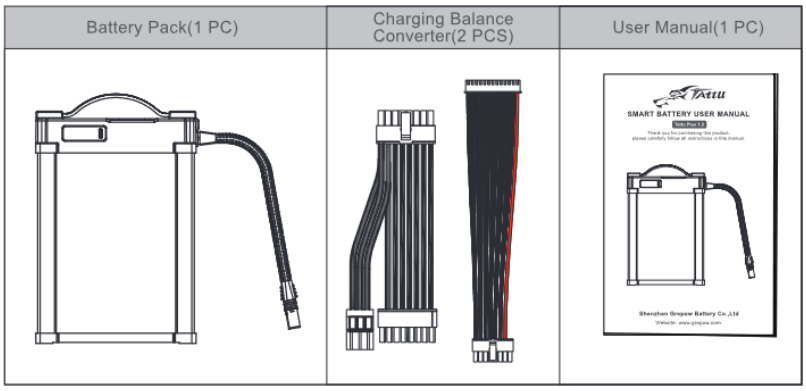
Attention! Only use batteries purchased from WohnderDrone!
You can return the unusable battery to WohnderDrone for disposal.

Battery specification

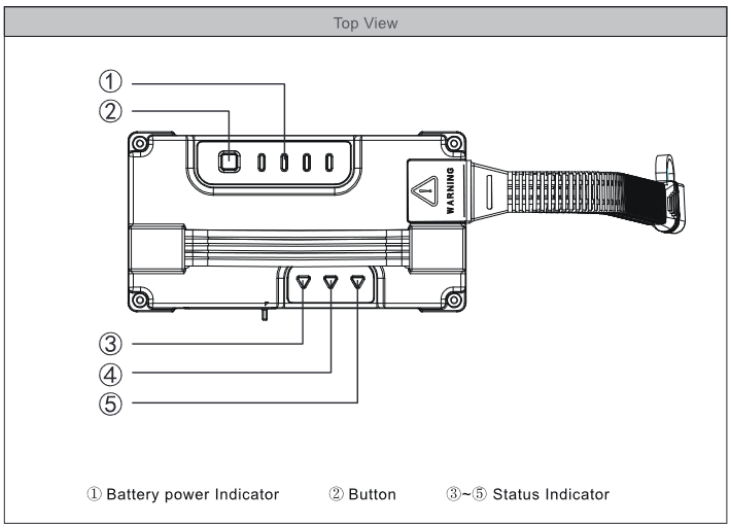
Minimum Capacity	16000mAh
Configuration	12S1P / 44,4V / 12 Cella
Discharge Rate	15C
Max Burst Discharge Rate	30C
Net Weight(±20g)	4250g
Dimensions	217x150x80mm (L x W x H)
Charge Plug	Micro USB+JST-XHR
Discharge Plug	XT90-S

Description of the battery

The package of the battery contains:



Presentation of the battery (top view):



Attention! In order to avoid accidental discharge, always put the closing cap of the connector on the connector when the battery is not in use!

Attention! Do not use the battery for more than 400 charge-discharge cycles.

Attention! Read the user manual attached to the battery before use.

8.4.2 Battery charger

Type of battery charger:

Sky RC PC3000H

Specifications of the battery charger:

Size	294mmx139mmx282mm
Weight	6Kg
Battery Type	LiPo / LiHV
Charging Mode	Fast charge /Standard Charge/ Charge / Storage
AC220V Output Power	3000W
Fast Charge Current	max. 60A single channel
Standard Charge Current	max. 30A single channel, max 60A Dual channels in total
Slow Charge Current	max. 20A single channel; max. 60A multi channels in total
Discharge Power	60W
Working Temperature	0℃-40℃
Working Humidity	0%-75%
Storage Temperature	-10℃-70℃
Storage Humidity	0%-75%

8.4.3 Use of the battery charger

The WohnderDrone A10 drone comes with 1 SkyRC PC3000H type charger, to which you can simultaneously connect 4 batteries for charging. The complete user manual for the charger can be found in the box of the SkyRC PC3000H charger.

Attention! Please read this section carefully before using the batteries.

Proper use and maintenance of batteries is important to limit wear, loss of capacity, loss of drone performance, and consequential direct damage.

How you control your drone, wind, temperature, other environmental factors, and the use of old batteries can all affect your drone's flight time.

Batteries reach their maximum capacity in moderate temperature conditions. A reduction in flight time in cold weather is normal (depending on the temperature, the loss can be up to 20%). In this case, it is advisable to store the batteries in a warmer place before use.

The WohnderDrone A10 is powered by a single 12-cell battery. The voltage of each cell can vary between 3.2 V and 4.2 V, depending on its charge. A battery is considered healthy if all of its cells operate within these aforementioned voltages, and voltage difference between cells is close to 0V. It is important to never drain the battery below 20% or 3.2V per cell.

The SkyRC PC3000H charger automatically checks the voltage of each cell before charging. It is not possible to charge them if even one cell is not healthy. The charger balances the voltage difference between the cells during charging. If the charger detects an abnormality, it sounds an alarm and charging stops.

The batteries supplied by WohnderDrone Kft. can be charged with the SkyRC PC3000H device. WohnderDrone Kft. does not guarantee the consequences of the use of other chargers or the incorrect use of the SkyRC PC3000H. Using an incorrectly adjusted charger or a charger for other types of batteries can cause permanent damage to the batteries or even cause a fire.

If the batteries are not used for a long time (more than 2 months), you can use the charger to carry out a storage procedure (STORAGE). This procedure is described later in this chapter (Battery Storage).

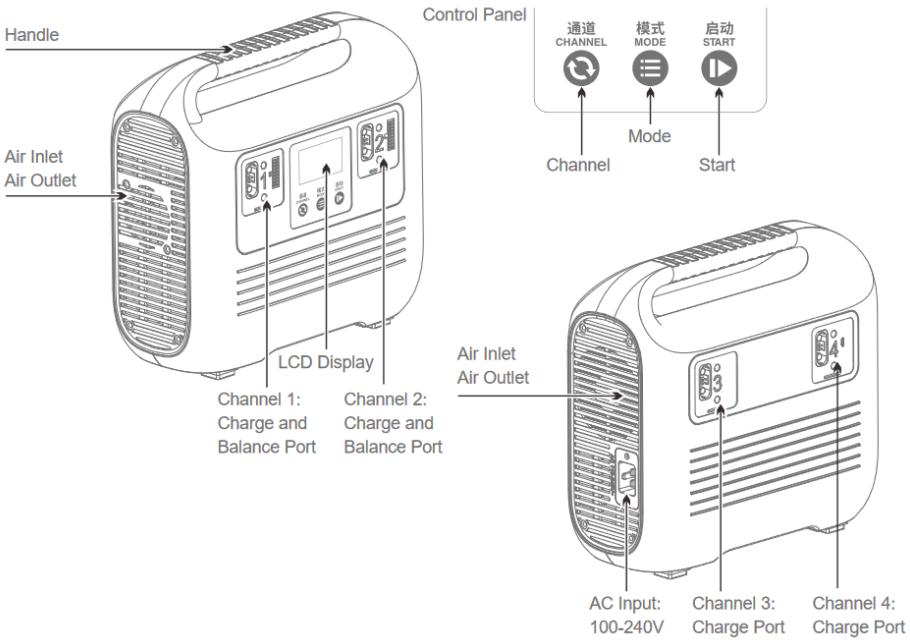
In the event of an accident, it is recommended to charge and store the batteries in a Li-Po bag to prevent the fire from spreading further. If necessary, these bags can be purchased from WohnderDrone Kft. When the batteries are not in use, store them in a Li-Po bag in a dry environment. Do not expose them to strong sunlight.

DO NOT attempt to charge a damaged or overdischarged battery. Charging a damaged battery may cause a fire.

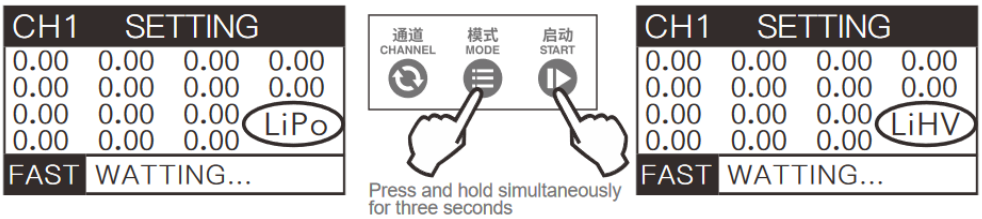
Disposal of used batteries

All batteries contain toxic and/or hazardous products. Do not throw them out into nature. Never attempt to puncture the battery, submerge it in water, put it in fire, or expose it to moisture. To find out more about the rules for used batteries, read the law on the disposal of batteries and its elements: 2006/66/CE the directive on batteries. All measures are important to protect our environment.
You can return the unusable battery to WohnderDrone for disposal.

Charging process of Tattu Plus 1.0 16000mAh 12S battery with SkyRC 3000H charger

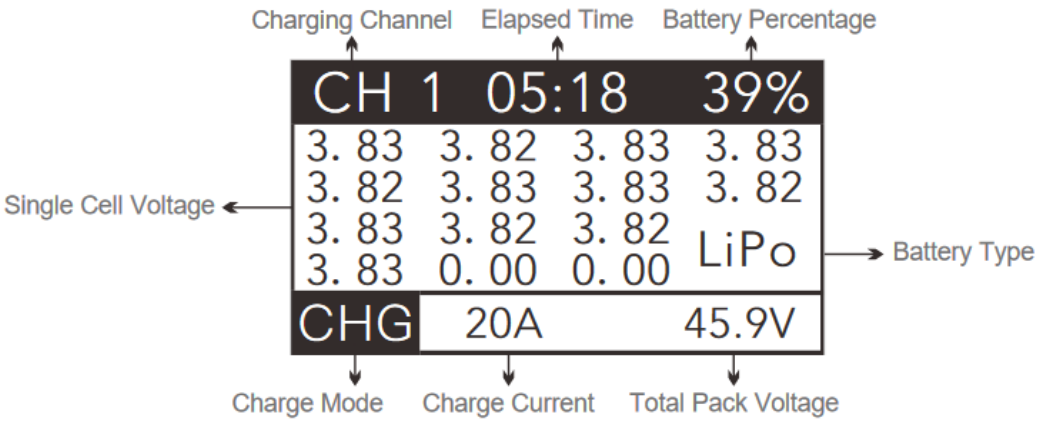


1. Switching on: Connect the device to the 100-240V mains socket using the supplied mains cable.
2. Language selection: Long press the Mode button, select the desired language, and then long press the Start button.
3. Battery type selection: Press the Mode and Start button simultaneously for 3 seconds to select between LiPo and LiHV types. Choose LiPo to charge the Tattu Plus 1.0 16000mAh 12S battery.



4. Connect the battery to the yellow input of any channel. Normally, it is not necessary to connect the balance cable to charge the Tattu Plus 1.0 16000mAh 12S battery.
5. Select the desired charging mode by repeatedly pressing the Mode button:
    a. Fast Charge Mode (FAST): Fastest charging mode (max. 60A charging current). If several batteries are connected, the battery with the least discharge will be charged first.
    b. Standard Charge Mode (STD): More gentle but slower charging mode (max. 30A/channel). If multiple batteries are connected, the batteries connected to channels 3 and 4 will first be charged simultaneously; after that, the batteries on channels 1 and 2 are charged simultaneously.
    c. Charge Mode (CHG): Gentlest but slowest charging mode (max. 20A/channel). If multiple batteries are connected, it will charge the battery with the lowest voltage first until the voltage of all four batteries is equal. After that, all batteries are charged simultaneously.
    d. Storage Mode (STO): charge to storage voltage, see later (Storage of batteries)

6. Long press the Start button to start charging. The display shows the following information:



7. When charging is complete, the charger will beep, and the display will show DONE

Battery Storage

If the batteries are not used for an extended time (more than 2 months), it is recommended to store the batteries in STORAGE mode at room temperature in order to extend their life.

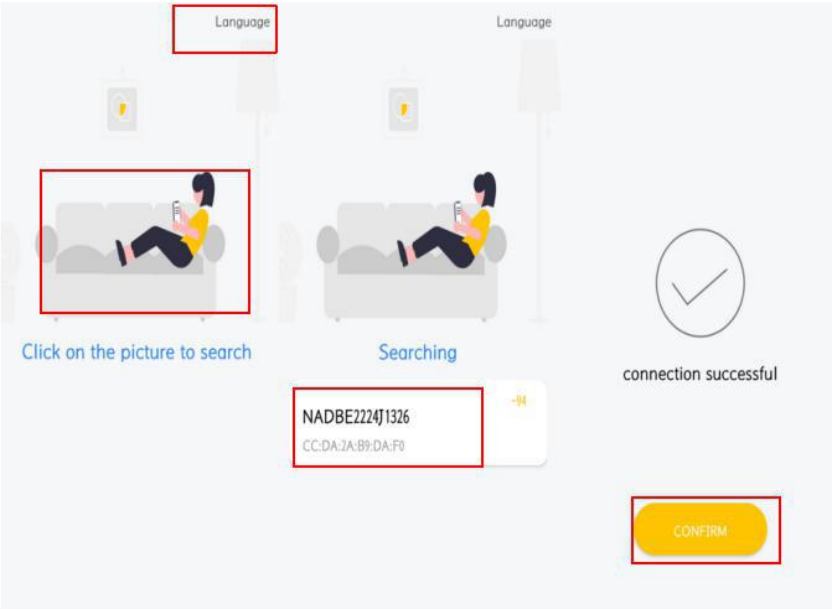
1. Connect the battery to the charger (based on the description of the normal charging process)
2. Press the Mode button again to select the Storage (STO) mode.
3. Long press the Start button.
4. When the process is complete, the charger will beep, and the display will show DONE

Checking the condition of batteries

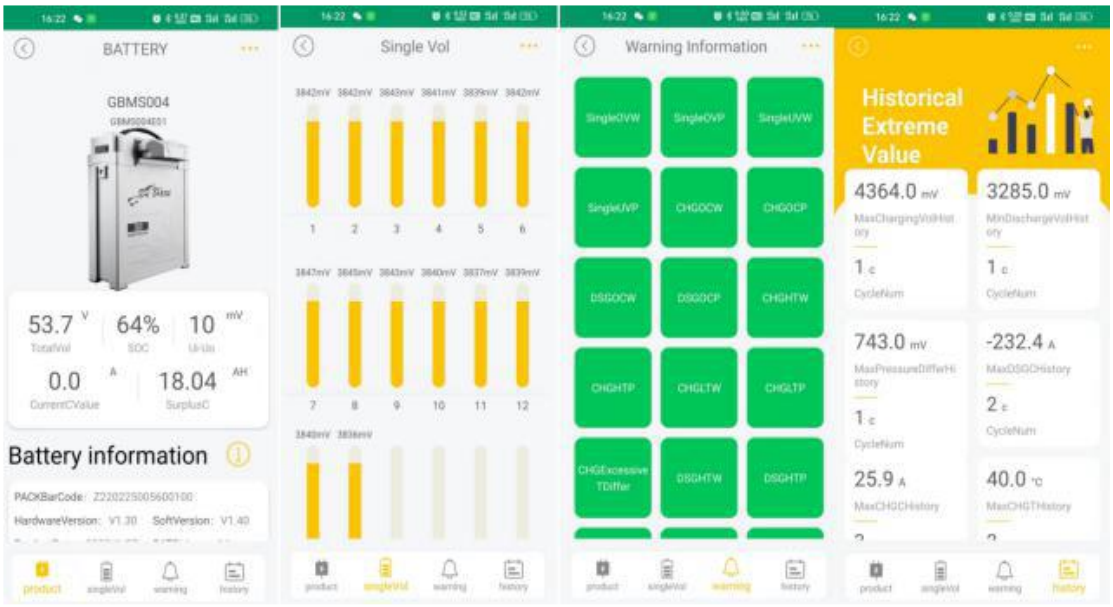
The "smart" battery used in the A10 drone stores in its memory all the data related to charges and dives during its life cycle. The current state of the battery and the information collected about its use can be checked using a phone application. The application can be downloaded to a smartphone using the following QR code:

NewBMS

1. After downloading, install the app on your phone and allow the Bluetooth and location access requested by the app
2. Start the application
3. Long press the power button of the battery you want to test until the status LEDs start to light up
4. The phone must be near the battery (2 meters)
5. Click on the image on the application and wait until the phone finds the battery via Bluetooth connection: the battery's 16-character factory number appears in the list of found devices
6. Click on the displayed serial number of the battery and the application will connect to the battery



7. After connection, the basic properties of the battery are visible in the application. Additional device properties can be accessed by clicking on the icons at the bottom of the screen.



9. Use of flight control software

The flight control system of the A10 drone is a special professional version of the open-source Skybrush software developed by CollMot Kft., adapted to the task of agricultural spraying of the A10 drone system. The website doc.collmot.com provides detailed information on the basic operation of the Skybrush software. Below we review the functionality optimized for the A10 drone.

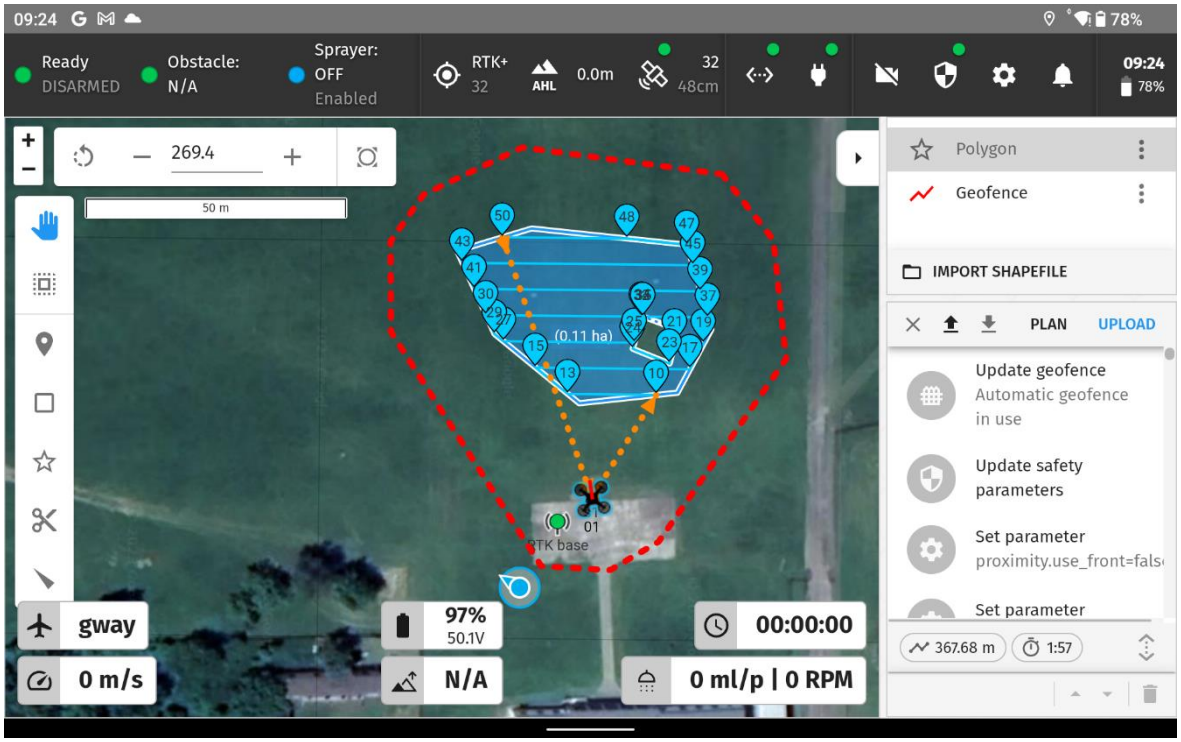
9.1 Tools, panel and dialog boxes

The user interface displayed on the screen of the A10 drone's remote control consists of two main parts. You can see devices arranged in a row on the header above, and panels with a fixed layout below. The tools and panels provide detailed, thematic information about the status of the drone, as well as the possibility of controlled interaction with the drone, sometimes through additional pop-up dialog windows.

The common features of the devices are as follows:

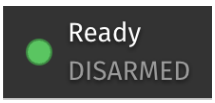
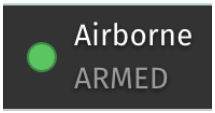
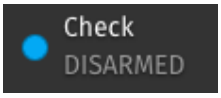
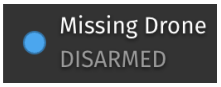
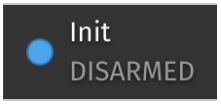
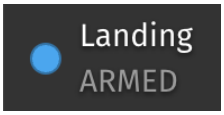
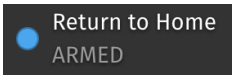
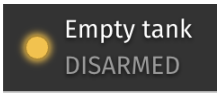
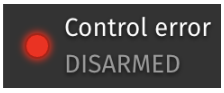
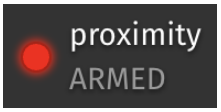
- • The devices indicate the status of the given component with a coloured status light (**green** = OK, **blue** = information, **yellow** = warning, **red** = error).
- The tools are for status display on the header, a short touch provides interaction options, a long touch provides a detailed status display.

Below, we present the tools, panels and pop-up dialog boxes that appear on the screen one by one.



9.2 Drone status tool

The Drone status tool provides quick feedback on the general status of the A10 drone on the left side of the header. The feedback icon can assume the following states:

	Ready to fly
	Flying
	Under check
	The drone is not connected to the base station / not found
	Initialization
	Landing in progress
	Return to home in progress
	Sprayer tank is empty
	Control error
	Proximity sensor does not provide any data, or failed

ARMED: rotors are spinning

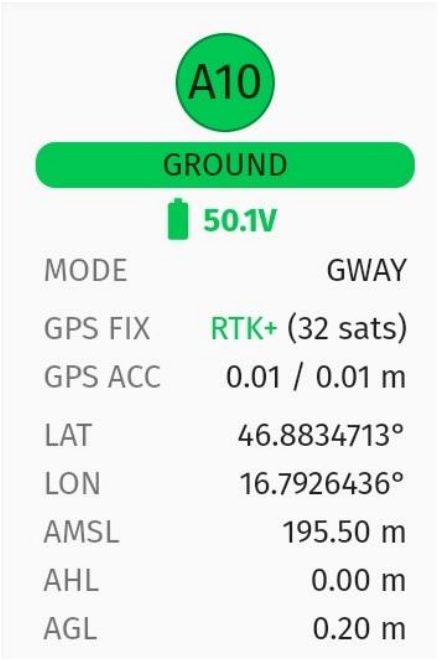
DISARMED: rotors are not spinning

By touching the Drone status tool, the Properties dialog box opens, which shows a more detailed status and provides an opportunity to interact with the drone. The following chapter provides information on this.

9.3 Properties dialog box

The Properties dialog allows unique interaction with a specific drone. The dialogue window can be brought up by clicking on the drone status tool in the upper left corner of the screen.

The left side of the Properties dialog box provides general information about the status of the drone:

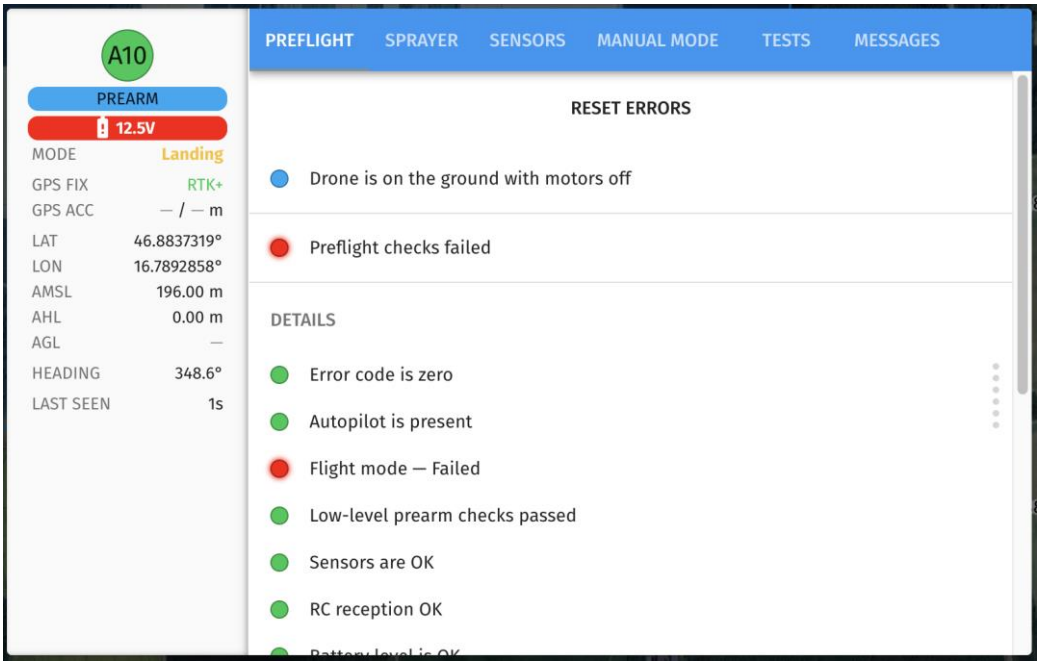


MODE	It provides information on the control mode of the drone: ALT HOLD Loiter Return to Home GWAY GRET GEME Landing
GPS FIX	GPS, DGPS, RTK, RTK+
GPS ACC	The perceived accuracy of the GPS in the horizontal / vertical direction
LAT	The LAT coordinate of the drone's position
LON	LON coordinate of drone position
AMSL	Altitude (calculated by GPS and barometer)
AHL	Altitude relative to Home point (calculated by GPS and barometer)
AGL	Height of the drone relative to the ground (calculated by the ground tracking sensor)
HEADING	The direction which the front of the drone is facing

On the right side of the Properties dialog box, you can interact with the drone on different tabs according to the topic of the tabs:

9.3.1 Preflight tab

On the preflight tab, you can see the list of pre-flight checks, in which the success of the test can be seen with a circular icon in front of the list items.

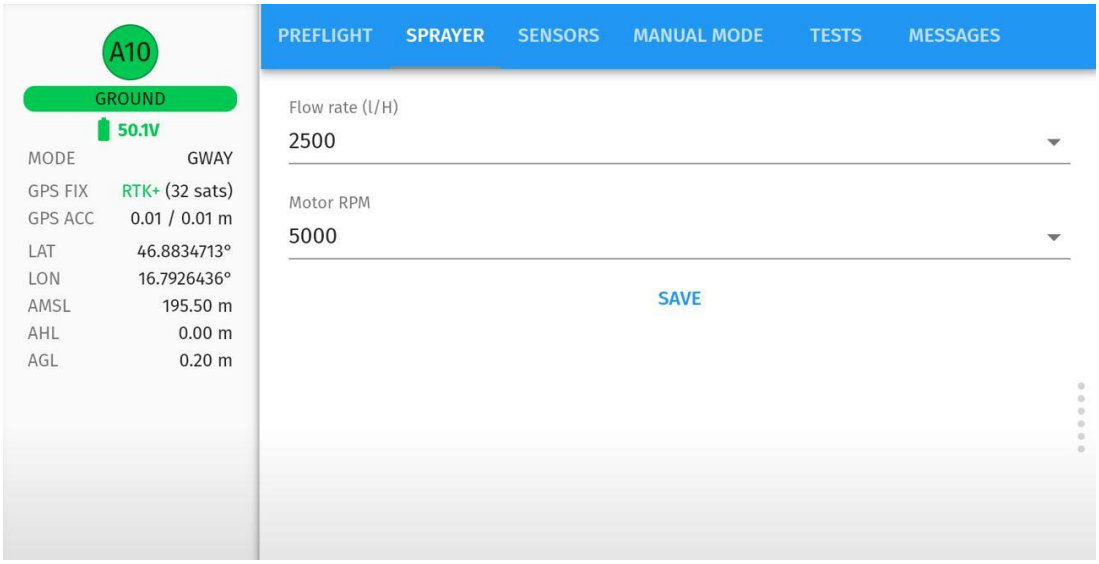


RESET ERRORS: Clicking this, the error messages are cleared. If they appear again, contact support.

REBOOT: Restart – clicking this restarts the low level, ang high level control of the drone.

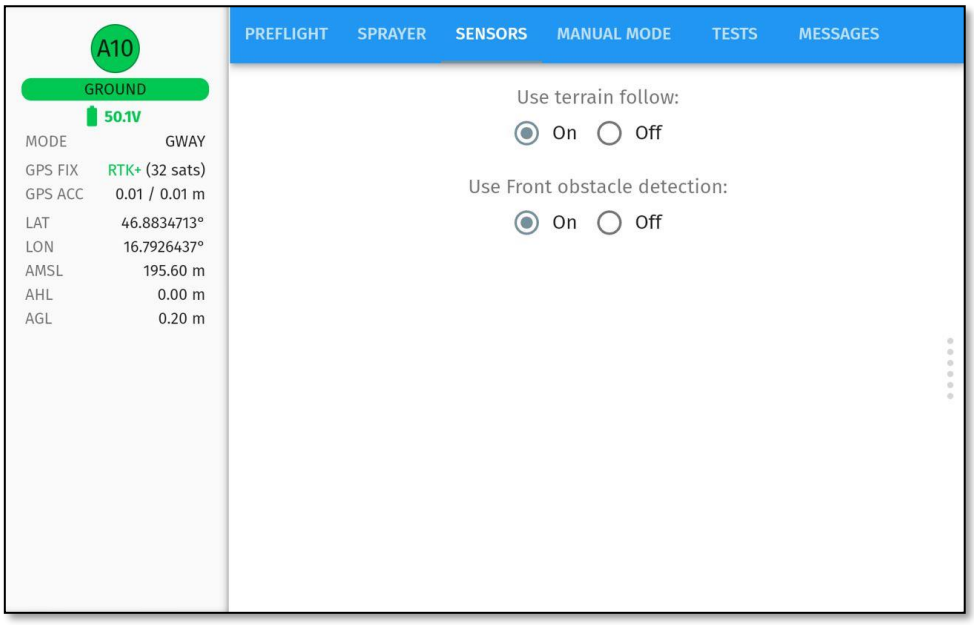
9.3.2 Sprayer tab

The spray parameters used during manual flight can be set on the Sprayer tab.



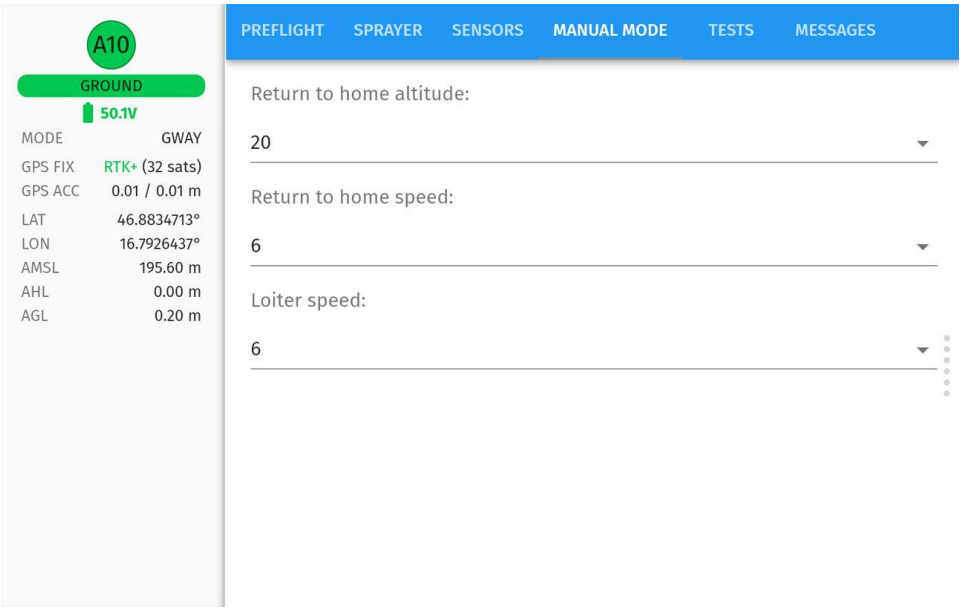
9.3.3 Sensors tab

On the Sensors tab, you can set whether the drone uses the terrain follow sensor (Terrain follow) and the obstacle detection sensor (Obstacle detection) during manual flight. Also, if you want to use these sensors in automated flight you need to turn them on here as well.



9.3.4 Manual mode tab

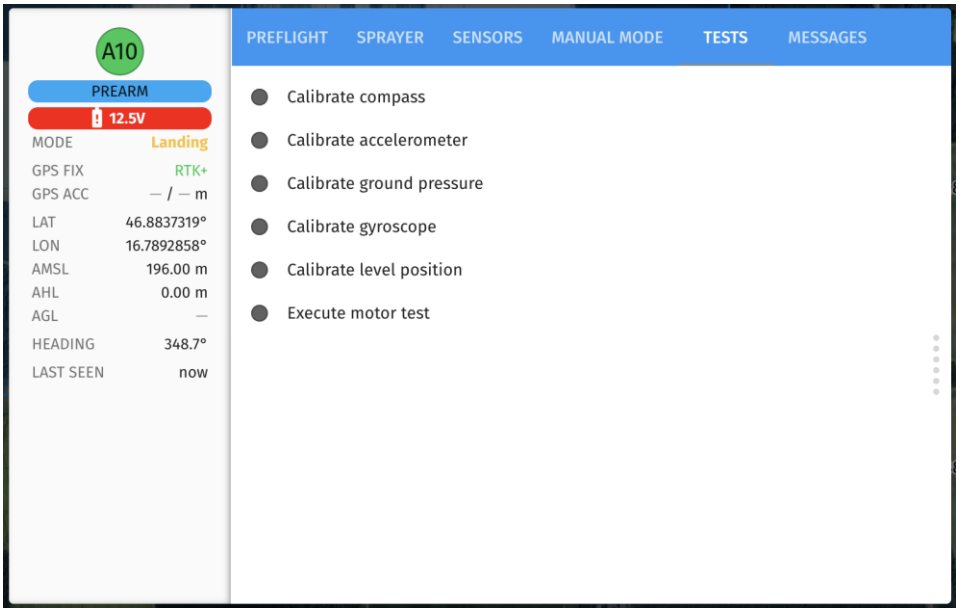
Here you can set the values of the individual flight parameters in the case of manual flight. The Return to home values set here refer to RTH switched from manual mode.



9.3.5 Tests tab

The Tests tab gives you the opportunity to calibrate individual components of the drone, as well as perform a powertrain test. Each step can be started by touching the row.

Approval is required to start the powertrain test.



Calibrate compass: Unfold the arms and lock them in opened position. Start compass calibration. Rotate the drone 720° (two full rotations) with the drone rotated to each side. Pay attention to the calibration progress. If the calibration process is not finished after the aforementioned process, rotate the drone around its vertical axis, while tilting it +-20 degrees around its horizontal axes. Restart the drone after the calibration is successfully finished.

Make sure, that the battery stays in place during the calibration process.

Make sure, that the calibration is done away from ferromagnetic objects, and electromagnetic radiation. While calibrating, one shall not carry ferromagnetic materials, cell phones, or other electric devices.

If the calibration fails, restart the drone, and start over the process.

Calibrate accelerometer: Start the calibration on a level surface. Follow the instructions displayed. When the requested position is reached, do not move the drone. Restart the drone after a successful calibration. If calibration fails, restart the drone, and start over the process.

Calibrate ground pressure: Click calibration while on the ground at the take-off site.

Calibrate gyroscope: Always start the calibration on a level surface. Do not move the drone when clicking the calibrate button.

Calibrate level position: Always start the calibration on a level surface. Do not move the drone when clicking the calibrate button.

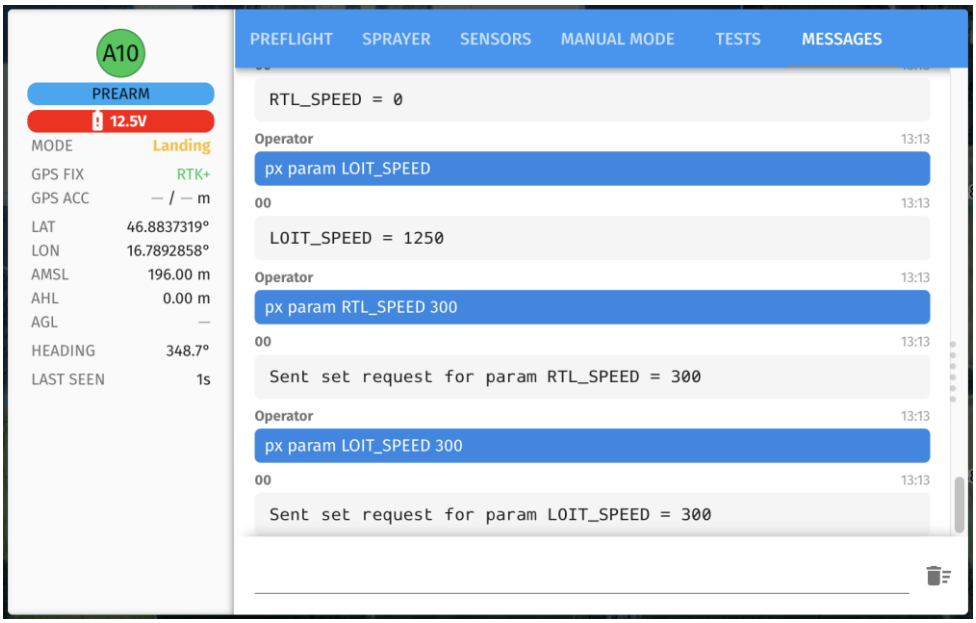
Execute motor test:

Make sure a sufficient safety distance is kept from the drone, no humans, animals, or other obstacles are in the way of rotating propellers.

After starting the test, observe that all motors are rotating at a low speed, in the correct direction, in the correct order. If all motors spin in the correct direction, with an uninterrupted speed, and no “strange” noises are observed coming from the motors, the test is successful.

9.3.6 Messages tab

On the messages tab, it is possible to view the commands sent to the drone controller, and you can also send a custom command using the text field (Advanced option!).



9.4 Radar status tool

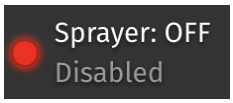
The radar status tool provides a real-time report on the status of the forward-looking radar and the distance of detected obstacles to the drone.


10 meters or longer


between 5 and 10 meters


under 5 meters

9.5 Sprayer status tool



The sprayer status tool provides a real-time status report on the status of the sprayer unit.

After enabling on the remote control, it is possible to turn the spray unit on and off by touching the button.

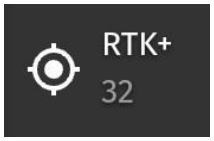
Disabled: The use of the spray system on a remote control is not permitted. In this case, during automatic flight, the drone waits at the waypoint until the authorization takes place.

Enabled: The use of the sprayer is permitted by remote control.

9.6 Altitude status tool

The altitude status tool provides real-time information about the current height of the drone measured in different reference systems. By touching the button, you can change which reference system height to display (AMSL, AHL).

9.7 Drone GNSS device



This displays the number of satellites detected by the drone, and the estimated positioning accuracy. If RTK is used, make sure the icon displays RTK+. Accuracy classes from less accurate to most accurate: GPS – DGPS - RTK – RTK+

9.8 RTK tool

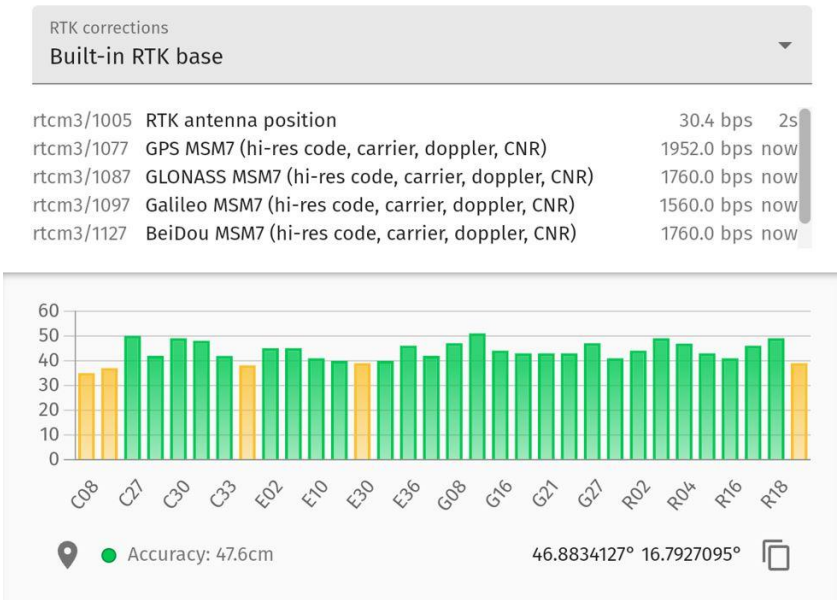
The RTK tool can be used to configure and monitor the RTK-capable GNSS device in the base station, which sends continuous correction data to the drone in order to achieve precision positioning at the centimeter level.

The RTK device appearing on the header shows the number of GNSS satellites seen by the base station and indicates the status of sending RTK corrections with a status light.

9.8.1 Providing RTK correction data

1. Make sure that the base station is switched on, firmly fixed in its final location, i.e. it does not move and will not be moved by anyone or anything.
2. Tap the RTK tool icon on the header to turn on RTK corrections
3. In the pop-up window, select the base station as the source of RTK corrections
4. Make sure that the correction messages from the base station are visible in the dialogue window and are continuously coming
5. Make sure that, based on the indicators in the dialog window, the base station sees the right number of satellites and with the right quality.
6. Optionally, set the desired standard deviation accuracy and minimum measurement time of the base station's own position determination and press the "Start survey" button.
7. The base station starts automatic configuration, and as soon as it has measured its own location with the set accuracy, it starts broadcasting the RTK correction data to the drone.
8. Make sure that the status light of the RTK device is green, i.e. the configuration of the base station is complete and its operation is uninterrupted.
9. Make sure that the drone indicates that it is in RTK or RTK+ state (Properties dialog window, GPS FIX or upper index ribbon).

Attention! If the Wi-Fi connection with the drone is lost due to distance or topography, the RTK correction signals will not reach the drone either. This can lead to inaccurate route tracking, which may even result in a collision.



9.9 Connections tool

The connections tool provides information on the status of the base station's communication channels (e.g. WiFi network).

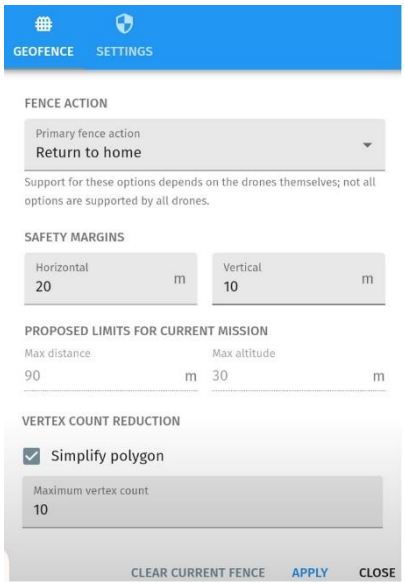
9.10 Server connection tool

The Server Connection tool indicates the status of the connection to the Skybrush Server software running on the base station. The Skybrush Server creates the connection between the drone, the base station and the remote control interface.

9.11 Flight safety tool

The Flight Safety tool can be used to configure the flight safety settings for the drone. By touching the device, a dialog window with two tabs pops up. On one tab (Geofence) we can configure the flight safety zone settings, on the other tab (Settings) we can configure the general security settings.

9.11.1 Geofence



Geofence means the safety zone outside which the drone is not allowed to fly. This zone surrounds the area designated for work during the flight plan and is automatically generated based on the values set here.

Attention! In manual modes, if the Geofence security zone is crossed, the application only sends a warning, the drone will not react to the fence action parameter.

FENCE ACTION: Here you can set what action the drone should perform when the safety zone is reached:

- Keep current action: no intervention, the drone continues to fly even if the zone border is reached
- Report only: send a message, the drone will continue flying even if the zone border is reached
- Return to Home: upon reaching the border of the zone, the drone returns to the take-off point (default setting)
- Land: in case of reaching the border of the zone, the drone will land at the place where it reached the border of the zone

SAFETY MARGINS:

- Horizontal: Here you can set how far the border of the safety zone should be from the border of the planned flight area.
- Vertical: Here you can set the maximum height above which the drone is not allowed to stay.

PROPOSED LIMITS FOR CURRENT MISSION: The values displayed here are automatically generated. They provide information about the distance and height at which the drone is allowed to fly based on the current flight plan and the set safety zone values.

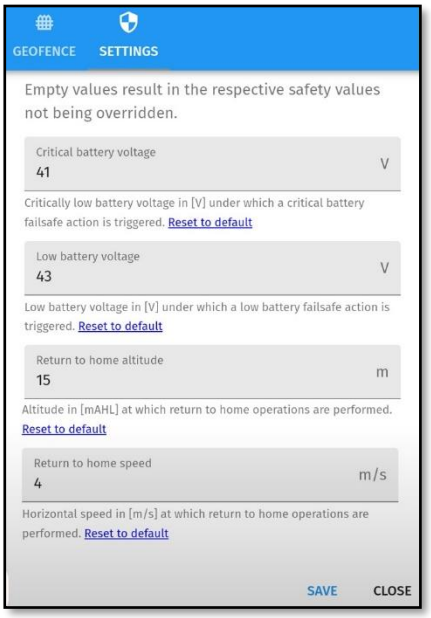
VERTEX COUNT REDUCTION: A setting that can be used to smooth the border of the Geofence

SAVE: Save and apply the set values

The set values, together with the flight plan and safety settings, are only applied if you upload them to the drone with the upload icon.

Attention! In both manual and automatic modes, the maximum reachable height is AHL 120 meters. If this height is exceeded, the drone will switch to RTH mode. If the drone exceeds this altitude, it switches to RTH. Try to avoid operations over AHL100m

9.11.2 Settings



On the Settings tab, you can configure the safety settings for Guided (automatic) flight:

- Critical battery voltage: If the drone's battery voltage reaches this value, it will automatically switch to Land mode.
- Low battery voltage: If the drone's battery voltage reaches this value, it will automatically switch to Return to Home mode.
- Return to Home altitude: The flight altitude of the drone's guided return to home (GRET) mode. Set the height according to the terrain of the each mission. Make sure that there are no objects in this height.
- Return to Home speed: The flight speed of the drone's GRET operating mode

SAVE: Save the set values. The set values will be taken into account by the drone if **"Upload"** also happens after saving! (see 9.18 Task planning panel)

Attention! In the case of manual modes, the RTH threshold is always 43V, regardless of the value set on the Safety-Settings tab.

Attention! Never set the Low battery voltage below 43V.
Attention! Never set the Critical battery voltage below 41V.
Attention! If the drone switches to Land, RTH or Gret mode due to the battery voltage level, you can change the flight mode with the flight mode switches, but this can be dangerous because it can cause the battery to completely drain, which leads to a fall.
Attention! Always chose the low battery voltage value in such way, that the drone has sufficient charge to return home.

9.12 Preferences tool

The user interface of the application can be configured using the Preferences tool.

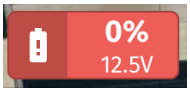
9.13 Audible alerts tool

With the help of the Audible alerts tool, you can listen to or mute the warnings of the user interface.

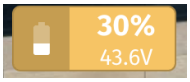
9.14 Battery status tool

The Battery status tool shows the current status and charge level of the drone's battery.

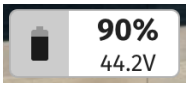
Attention: the display warning level is informative, independent of the critical and low battery voltage level settings that can be configured in the Security settings.



Below 43.5 Volts (Critical)



43.5 – 44 Volts (Low)



Above 44 Volts (Good)

9.15 Camera panel

On the camera panel, we can follow the real-time image of the front-facing camera fixed on board the drone. The display of the camera image can be switched on and off.

9.16 Map panel

The Map panel supports flight planning and execution with a 2D overhead view and additional tools. The drone's position and various other status information, as well as the current status of the flight task, can be followed on the map view. The designated area of the flight task can be created and edited using the icon column on the left side of the map view.

View

Select

Marker

Draw rectangle

Draw polygon

Cut hole into polygon

Edit feature

9.16.1 Creating flight zone

1. Select the “Draw rectangle” or “Draw polygon” tool from the icon column on the left
2. Touch the screen in the corners of the desired flight area to create the circumscribed flight area
3. If we also want to create an internal area to be avoided, select the "Cut hole into polygon" i.e. cutout drawing tool from the icon row on the left and create polygons of the cutouts at the desired points within the created flight area, similar to the previous points.
4. If you want to make changes to the area or the cutouts, select the "Edit feature", i.e. editing tool and move the individual corner points as desired.
5. Select the "View" tool so that the flight area can no longer be accidentally modified or moved away. If more polygons are present, use “Select” to choose the one that shall be used.

Attention! All obstacles in the flight plan must be cut from the plan with sufficient safety margins.

Attention! The removed obstacle areas are in reference to the generated flight plan. If, during operation, due to any reason the drone deviates from this plan, there is a chance for the drone to cross such an area. A common example for this behaviour is, when the pilot interrupts the automatic (Guided) flight mode, then, after some operations switches the system back to automatic (Guided) mode. In this case, the drone continues the flight plan, however if there are any obstacle areas between the first waypoint, and the drone, the drone will cross these areas.

A: Position of the tablet. The circle around it is the uncertainty region of the position. The smaller this circle, the worse the positioning accuracy.

Attention! The position of the tablet is only for reference. The accuracy of this device is insufficient for use for flight planning.

B: RTK base position. It will be displayed when the station reaches the preset accuracy. This data can be used for accurate spray planning.

Attention! A When moving the base station containing the RTK base, always switch the station off first. Then move the base station to its desired location, and switch it on afterwards. Then enable RTK in the A10 control application, and wait for it to reach the requested accuracy.

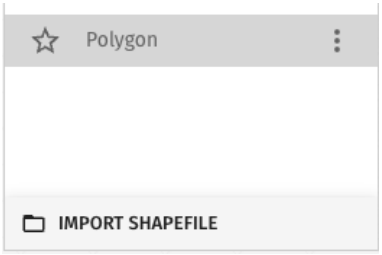
C: Drone position.

D: Generated Geofence zone.

E: Generated flight plan. The numbers are the waypoints, connected by a straight line. These will be executed in an increasing order.

Attention! The Google map is not accurate. If you plan your flight plan based on a google map, pay special attention to the boundary edges. You can check the correctness of the boundary edges by manual flight before the automatic flight.

9.17 Shapes panel



The Shapes panel helps you navigate between the shapes, forms, place markers and other elements drawn on the map. We see them in list view, provided with type and name. Next to each list item, four buttons allow further interaction with each shape:

- Magnification of the map to the given shape
- Switching the visibility of the given shape on/off
- Editing the properties of the given shape
- Delete the given shape

Using the Shapes panel, you can also import external shapes (accepted format: related .shp shapefile compressed into a .zip file).

9.18 Taks planner panel

The task planner panel can be used to create the sprayer flight task. The following options are available by pressing the buttons on the panel header:

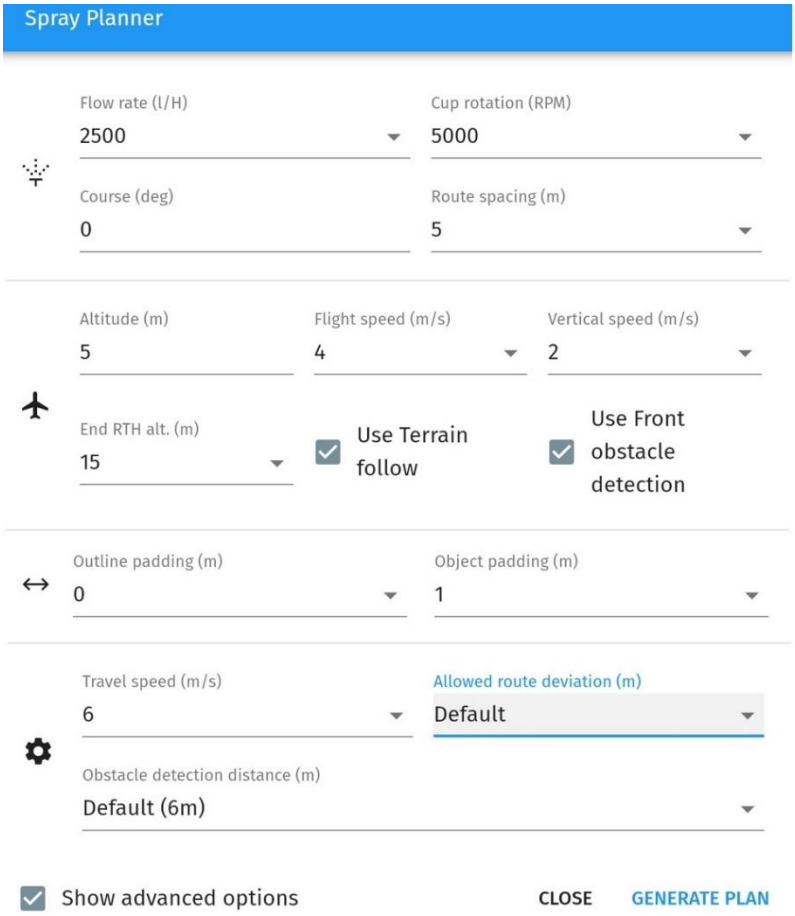
- **CLEAR**: Delete current flight mission
- **IMPORT**: Import earlier made flight mission
- **EXPORT**: Save current flight task for later use (The task is saved in the Documents folder of the tablet with the current date)
- **PLAN**: Automated flight task planning
- **UPLOAD**: Uploading the current flight task and Geofence and changes to the safety settings (see 9.11.2.) to the drone

The body of the panel contains an ordered list of the current flight task broken down into elementary instructions. This list is created by the automatic flight planning, its appearance is for informational purposes only, it cannot be edited with a few exceptions. The exceptions are:

- By clicking on the “Update safety settings” command, you can edit the general safety settings, which are also uploaded to the drone when you press the “UPLOAD” button
- By clicking on the "Update geofence settings" command, you can edit the settings of the flight safety zone (geofence). The created geofence is also visible on the map view and is also uploaded to the drone when the "UPLOAD" button is pressed.

9.18.1 Automated mission planning and uploading

1. Create the appropriate flight area using the Map panel.
2. Select the flight area you want to use for the flight task on the map panel.
3. Press the PLAN button to select the type of flight task required for spraying.



4. Set the desired input parameters according to the flight task. The description of the individual parameters is included in the pop-up design window itself. The general parameters to be set are:
    a. Sprayer flow rate
    b. Sprayer cup rotation (rpm)
    c. Course (deg)
    d. Route spacing
    e. Flight altitude
    f. Flight speed
    g. Vertical speed
    h. Return to home altitude after the drone finishes the flight plan.

    Attention! End RTH alt must not be confused with Gret, or RTH modes. This setting is only used for returning to home after executing the last waypoint.

    i. Should we use the terrain-follow radar for altitude control?
    j. Should we use front radar for obstacle detection during the task?

k. Outline paddings
l. Object pading
m. Travel speed between the Home point and first / last waypoint (special parameter)
n. Maximum allowed route deviation (special parameter)
o. Obstacle detection distance (If Front obstacle detection is selected)

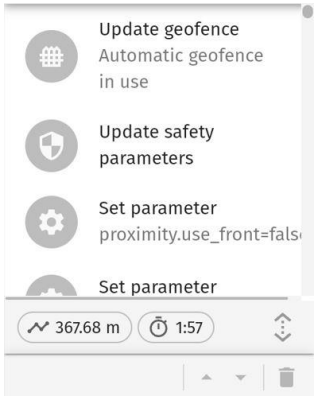
5. Press the “GENERATE PLAN” button at the bottom of the dialog window to create the flight plan
6. Double check the plan on the map view and in the task list of the Mission Item panel.
7. Upload the flight task to the drone by pressing the "UPLOAD" button
8. Start the upload by pressing the "START UPLOAD" button in the pop-up window
9. Wait until the upload is completed successfully

9.18.2 Redesign flight mission

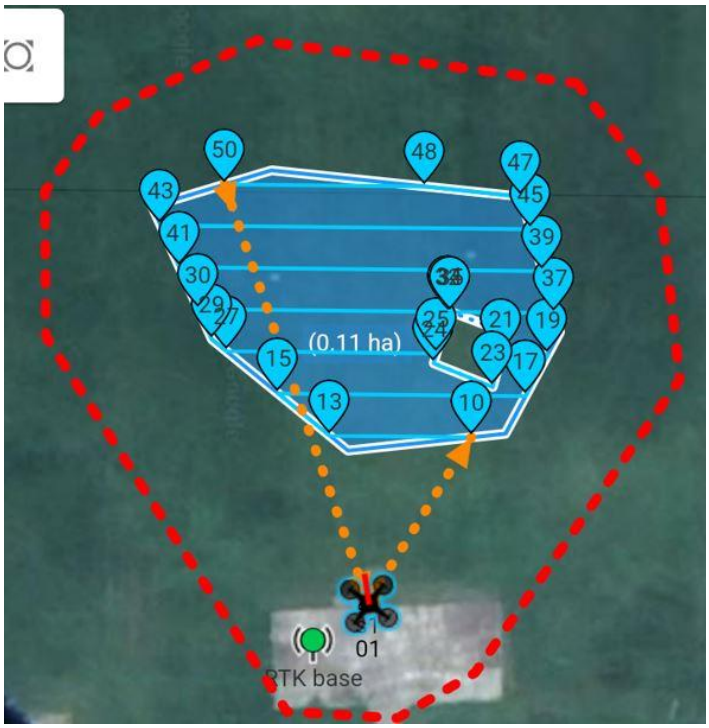
During the execution of the flight task, we can also monitor the status of the completion of the flight task in the Map panel and the Task Planner panel. If the completion of the flight task is interrupted for some reason (e.g. the sprayer runs out, the battery runs out, other unexpected drone error or manual interruption), we have the opportunity to re-plan and continue the flight in the following way:

1. Press the PLAN button again to select the “RESUME” option
2. Check the modified plan on the map view and in the task list of the Task Planner panel.
3. Upload the modified flight task to the drone by repeatedly pressing the "UPLOAD" button and carrying out the uploading process as before.

9.19 Mission Item



The generated flight plan can be observed here on a mission item basis. These orders will be executed sequentially. Make sure to check these items before flight. If it is necessary, mission items can be deleted, or reordered. To delete a mission item, select it, and click the bin icon on the bottom right corner. To reorder the items, select it, and use the up/down facing arrows in the bottom right corner. If no changes to the plan are desired, do not move, or delete any mission items. When the flight plan is regenerated, the already executed mission items will be deleted automatically. If the spray tank goes empty, or the system changes from Gway to any other mode, a new waypoint appears. This will be the first waypoint of the new flight plan.



The figure above shows the way the A10 software generating the flight plan inside the hand drawn polygon. The yellow dashed lines are connecting the take-off site to the first, and last waypoint. The blue lines are the flight movements.

If the drone is moved to a new position after generating the flight plan, the flight plan must be regenerated for the new take-off site.

9.20 Generating custom routes

If the flight plan generated by the A10 software is not satisfactory, it is possible to create a custom flight route.

To do this, the following steps must be followed:

1. Draw a polygon around the desired flight area
2. After this, generate a flight plan on the flight plan tab. The waypoints generated will be deleted later, but make sure to give the following data accurately, as this can not be modified later: atomizer disk rotational speed, spay flow rate, altitude, horizontal velocity, vertical velocity, sensor usage, and travel speed.
3. Delete all waypoints, and mission items, except the first, and the last one.
4. The empty flight plan must look like this:
    i. Update Geofence
    ii. Update Safety
    iii. Set parameter(front proximity)
    iv. Set parameter(down proximity
    v. Set parameter (sprayer flow)
    vi. Set parameter (sprayer motor rpm)
    vii. Change speed
    viii. Takeoff
    ix. Change heading
    x. Marker (Mission has started)
    xi. Set payload (sprayer on)
    xii. Set payload (sprayer off)
    xiii. Marker (Mission has ended)
    xiv. Return to home

5. Generate the waypoint mission items. One can do this by long pressing the desired place on the map. After the long press, a pop-up window appears, chose the “Add point to mission” option. This generated a new waypoint. The new waypoint will always be added to the bottom of the mission item list. If the mission item is in the incorrect place, it can not be modified, and must be removed, and readded.

6. After placing the waypoint, it must be moved to the correct place.
    a. The first waypoint must be moved after the ix. (Change heading) and before the x. (Mission has started) mission items
    b. The next waypoints must be moved after the xi. Set payload (sprayer on) in the correct order.

7. The finishes flight plan must look like the following:
    i. Update Geofence
    ii. Update Safety
    iii. Set parameter(front proximity)
    iv. Set parameter(down proximity
    v. Set parameter (sprayer flow)
    vi. Set parameter (sprayer motor rpm)

vii. Change speed
viii. Takeoff
ix. Change heading
x. 1. Waypoint
xi. Marker (Mission has started)
xii. Set payload (sprayer on)
xiii. 2. Waypoint
xiv. 3. Waypoint
xv. ….
xvi. Last Waypoint
xvii. Set payload (sprayer off)
xviii. Marker (Mission has ended)
xix. Return to home

Attention! When creating a custom route, care must be taken to follow the upper format. Creating the wrong format leads to the potential crash of the drone.

10. Checklist before flight

Make sure all items on the pre-flight checklist are completed:

- ✓ Weather and other flight conditions are suitable for drone and sprayer operation.
- ✓ The remote control and aircraft batteries are fully charged.
- ✓ The propellers are in good condition; are properly and securely mounted on the motors.
- ✓ The rotor arms are securely attached, the motors work normally, and their direction of rotation is correct.
- ✓ The cables are properly connected.
- ✓ Rotor arms are properly opened and secured
- ✓ The pilot is not under the influence of alcohol, drugs or any substance that may impair his cognitive abilities
- ✓ The pilot knows the selected flight mode and understands all safety features and warnings.
- ✓ The number of satellites detected by the drone is correct, the compass works properly.
- ✓ Drone starts from a horizontal surface and is located away from people and metal objects.
- ✓ The appropriate flight plan and spray settings are ready and uploaded to the drone
- ✓ Heading of the drone is verified and correct
- ✓ Base station antennas has good coverage over drone' flight path
- ✓ The status in the A10 application must be „Ready".
- ✓ The velocity displayed in the A10 application must be 0m/s before take-off
- ✓ GNSS signal is deteriorated by trees, buildings, cars, power lines, and larger natural, or artificial objects. Make sure that the base station is set up away from these, and the drone does not approach these objects.

11. Execution of automated flight

The A10 drone's low-level autopilot runs an open-source Skybrush-compatible firmware version of the open-source ArduCopter codebase.

All forms of automatic flight are performed in the GUIDED flight mode of the autopilot. In this case, an additional high-level on-board computer provides the low-level flight controller with flight control instructions. The high-level flight controller intervenes in the course of the flight if and as long as the drone's low-level flight controller remains in GUIDED mode. All other low-level modes run their own original flight controls from the ArduCopter codebase.

Three modes of high-level flight control are possible:

- **GWAY**: “Guided Waypoint”, normal operation automatic flight (spraying). The drone will behave according to the items set up on the Plan tab.
- **GRET** “Guided Return To Home”, high level homecoming. The drone will behave according to the settings on the Safety-Settings tab.
- **GEME**: “Guided Emergency”, high level emergency management, homecoming. The drone will behave according to the settings on the Safety-Settings tab.
- **LAND**: In this mode, the drone will descend with 0.5m/s vertical velocity, and does not respond to throttle changes. Yaw, Roll, and Pitch commands can be issued during LAND mode. At the end of GRET, and GEME modes the drone will automatically change to LAND mode until reaching 10m AHL. At this point, the pilot has the chance to modify the landing.

11.1 Execution of automated spraying task

1. Turn on the remote control: long press the power button, then answer the pop-up questions by pressing the circular enter button.
2. Switch on the base station.
3. Turn on the tablet, start the application. Check if google map is available and loaded for the area.
4. Connect with tablet to the WiFi network of the base station.
5. Turn on the drone by connecting the battery.
6. Enable the operation of the RTK in the application (see chapter 9.8) and wait until the RTK reaches the set accuracy.
7. Prepare the flight plan, review the safety settings and upload it to the drone.
8. Also check the manual flight settings (see 9.3.4) in case the automatic flight has to be interrupted for some reason. if you plan to use any of the radars, make sure they are turned ON (see 9.3.3)
9. Test that flight modes are changing on the control screen accordingly to the switch on the RC.
10. Test the spray system with water:
    a. Check that the Spray enable switch is in the enabled position on the RC.
    b. Start the spraying system by pressing the Sprayer status tool (see 9.5) button and make sure it is working correctly
11. Check the proper operation of the drone motors and the emergency stop switch:
    a. Flip the Flight Mode selector to LOITER
    b. Make sure that no one is near the drone, the rotation of the drone's rotors can be done in a free environment

    c. Start the drone's motors by pulling the left remote control stick down and right (assuming Mode 2 setting). Check that the motors are rotating properly.
    d. Press the two emergency stop switches at the same time and make sure the motors stop.
12. Set the remote control flight mode switch to “GUIDED”.
13. Check on the display that the drone has switched to "GWAY" i.e. "Guided Waypoint" flight mode.
14. The drone records the Home position coordinates when the switch is flipped. Do not move the drone for a few seconds.
15. Check that the displayed status of the drone is correct,:
    a. passed all automatic pre-flight self-checks
    b. The height of AHL and AGL is close to 0, and the height of AMSL corresponds to its field position. Note that you can set the AHL to 0 by switching the flight mode to LOITER then back to GWAY.
    c. The status of your GPS receiver is RTK or RTK+
16. Wait until the status tool in the upper left corner of the display changes to "Ready" with a green status light. Wait 10 seconds.
17. Make sure that there is no one near the drone, the drone can be taken off in a clear environment
18. Start the drone's motors by pulling the left remote control lever to down and right (assuming Mode 2 setting).
19. Watch as the drone's motors rev up, the drone takes off and begins automatic flight.
20. Monitor both the drone and the remote control display, where the status of the flight can be followed in real time.
21. If you enabled the use of the obstacle detection sensor, the drone will stop in front of detected obstacles. In this case, the spraying stops, but the automatic flight resumes as soon as the obstacle disappears. In guided mode, the distance from the obstacle can be set by the user. The drone starts using the Obstacle detection sensor over 2m when the Terrain follow sensor is turned on.
22. If you enabled the Terrain Follow sensor, the drone will fly according to AGL, not AHL height, i.e. it will track landmarks.
23. If necessary, the trajectory of the automatic flight can be shifted to a certain extent with the appropriate arms of the remote control. In this case, the automatic flight will not be interrupted until, as a result of the shift, the drone remains within the specified maximum tolerance distance from its desired position (see 9.18.1 – Allowed route deviation setting). When the tolerated deviation threshold is exceeded, the drone gives a high-level error signal and switches to GEME (“Guided Emergency”) mode and tries to return home.
24. If you experience an error that cannot be handled by shifting or if you feel danger, abort the flight by changing the flight mode to GRET (high-level return) or LOITER / ALT HOLD manual flight modes.
25. The drone performs the spraying task independently, returns home and lands after the task is completed. When the drone is Landing, under 10m AHL the pilot can correct the landing path and position of the drone with the remote controller joysicks.
26. If the mission consists of multiple take-offs redesign the flight plan according to chapter 9.17.2.
27. Make sure the drone's motors turn off when landing. If not, turn off the motors by moving the left arm of the remote control down (assuming Mode 2 setting).
28. Save the flight plan and administer the flight.

Attention! If the drone is switched from Gway to any other mode, and is switched back to Gway, the drone restarts the actual flight plan from the first mission item.

11.2 Execution of high level guided return to home task (GRET)

1. Even before uploading the flight task, make sure that the Return to home altitude (AHL) and Return to home speed are properly configured in the safety settings tab of the Flight Safety tool (9.10.2)
2. During flight, if necessary, switch the flight mode to GRET i.e. “Guided Return To Home” mode.
3. Wait for the drone to rise to Return to home height and returns home from there at the preset speed, then land.
4. If you enabled the forward-looking radar when planning the flight task, the drone will stop in front of detected obstacles. In this case, the return to home stops, only resumes when the obstacle disappears.
5. If you enabled the Terrain follow sensor when planning the flight task, during the GRET task the drone will not go below the preset Return to home altitude in AGL altitude even if the given altitude in AHL would justify it at that point. In other words, the drone returns home using the Terrain follow sensor if AHL is less than AGL. Otherwise the drone returns on AHL height.
6. If necessary, you can intervene in the return route by moving the arms of the remote control accordingly. In this case, the automatic return to home does not cease, it is only shifted by the addition of manual control.
7. If you wish to abort the high level return, switch to manual flight mode.

11.3 Execution of high-level emergency task (GEME)

A high-level emergency task is performed when the drone detects an error and switches to this mode on its own.

When the high-level emergency mode is activated, it checks what the drone is expected to be able to do depending on the current error code, and based on this, it either tries to return the drone home with an emergency return or tries to force it to make an immediate emergency landing. The high-level emergency algorithm can also decide to force the drone to land during the emergency return, for example, if it detects that the drone has not started to return home after all, or the return home is taking too long, or other high-level error codes have come into effect. In the event of activation of the high-level emergency mode, the following actions take effect:

1. Even before uploading the flight task, make sure that the Return to home altitude (AHL) and Return to home speed are properly configured in the safety settings tab of the Flight Safety tool (9.10.2) These values also apply to emergency return home.
2. The high-level emergency mode (GEME) is activated by the drone, and the control interface warns of the danger with a red error code and sound signal
3. Wait for the drone to land in high emergency mode or return home and land.
4. If you enabled the forward-looking radar when planning the flight task, the drone will stop in front of detected obstacles. In this case, the return to home stops, only resumes when the obstacle disappears.
5. If you enabled the Terrain follow sensor when planning the flight task, during the GRET task the drone will not go below the preset Return to home altitude in AGL altitude even if the given altitude in AHL would justify it at that point. In other words, the drone returns home using the Terrain follow sensor if AHL is less than AGL. Otherwise the drone returns on AHL height.
6. If necessary, you can intervene in the emergency return route by moving the arms of the remote control accordingly. In this case, the automatic return to home does not cease, it is only shifted by the addition of manual control.
7. If you wish to abort the high level emergency return, switch to manual flight mode.
8. After landing, thoroughly investigate and document the cause and circumstances of the error, as well as any flight incidents.
9. After landing, the error code can be deleted by pressing the "Reset errors" button (Properties dialog window - Preflight tab). If an error code remains, the error is reactivated.

Attention! If you interrupt GEME mode due to low battery level during automatic (GUIDED) flight, i.e. switch to Loiter or ALTHOLD mode, the low level RTH operation is activated.

12. Performing manual flight

The control surface of the A10 sprayer drone allows manual flight settings and control of the drone.

Before starting manual flight, make sure that the safety settings for manual flight are suitable for the execution of the flight task (Properties dialog window - Sensors and Manual mode tabs, see chapter 9.3)

Three modes of manual flight control are possible:

- **ALT HOLD**: “Altitude Hold”, altitude hold without GPS
- **LOITER**: hold altitude and position with GPS
- **RTH**: “Return To Home”, return tot he take-off point
- **LAND**: Can not be freely switched. In this mode, the drone will descend with 0.5m/s vertical velocity, and does not respond to throttle changes. Yaw, Roll, and Pitch commands can be issued during LAND mode. At the end of GRET, and GEME modes the drone will automatically change to LAND mode until reaching 10m AHL. At this point, the pilot has the chance to modify the landing.

12.1 Performing manual flight task

1. Turn on the remote control: press and hold the power button, then answer the pop-up questions by pressing the circular enter button.
2. Switch on the base station.
3. Turn on the tablet, start the application.
4. Turn on the drone by connecting the battery.
5. Enable the operation of the RTK in the application (see chapter 9.8) and wait until the RTK reaches the set accuracy.
6. Prepare a flight plan of your choice for the area where you will perform the manual flight. This is necessary in order to create a security zone (geofence) around the planned flight area. Upload the flight plan to the drone.
7. Make the desired settings on the relevant tabs of the Properties dialog box (chapter 9.17).
8. To do a system check, set the flight mode switch on the remote control to “GUIDED”.
9. Check on the display that the drone has switched to "GWAY" i.e. "Guided Waypoint" flight mode.
10. Check that the displayed status of the drone is correct:
    a. passed all automatic pre-flight self-checks
    b. The height of AHL and AGL is close to 0, and the height of AMSL corresponds to its field position
    c. The status of your GPS receiver is RTK or RTK+
11. Wait until the status tool in the upper left corner of the display changes to "Ready" with a green status light.
12. Set the remote control flight mode switch to “LOITER” or “ALT HOLD” to select the manual flight mode.
13. Check on the display that the drone has switched to the selected flight mode.
14. If you want to use the sprayer during manual flight, make sure that the Spray Enable switch on the remote control is in the enable state.

15. Make sure that there is no one near the drone, the drone can be taken off in a clear environment.
16. Start the drone's motors by pulling the left remote control lever to down and right (assuming Mode 2 setting).
17. Watch the drone's motors rev up
18. Begin manual flight.
19. Monitor both the drone and the remote control display, where the status of the flight performance can be followed in real time.
20. You can turn the sprayer on and off using the Sprayer status tool button on the display.
21. If you have enabled the use of the obstacle detection sensor, the drone will stop in front of detected obstacles. In manual mode, the distance from the obstacle is 6m. The drone starts using the Obstacle detection sensor over 3m when the Terrain follow sensor is turned on.

Attention! The drone maintains its distance from the obstacle even if the obstacle approaches the drone. In this case, the drone makes a reversing movement, which can lead to an unexpected collision!
When the drone performs a sideways movement (roll) and an obstacle is placed in front of the drone, the drone interrupts the sideways movement and starts reversing until it reaches a safety distance of 6m

22. If you have enabled the use of the terrain follow sensor, the drone will fly according to AGL, not AHL height, i.e. it will track landmarks.
23. Administer the flight after landing.

Attention! If the drone is switched to Guided mode during manual flight, it will start the last mission uploaded!

12.2 Execution of RTH (Return To Home) task

1. Before starting the flight make sure that the Return to home altitude (AHL) and Return to home speed are properly configured under the Properties dialog window - Manual mode tab (9.3.4)
2. During manual flight, if necessary, switch the flight mode to RTH i.e. “Return To Home” mode.
3. Wait for the drone to raise to the set height and returns home from there at the preset homing speed, then land.
4.

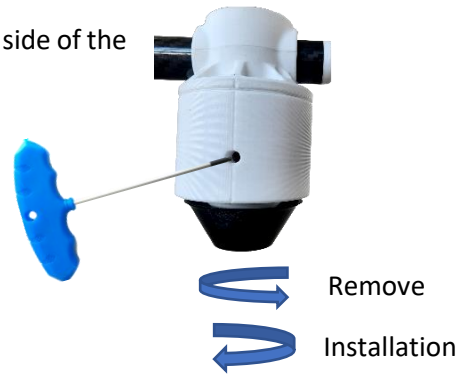
Attention! In the RTH mode switched on during manual flight, the drone does not take into account the signals of the obstacle detection radar and the obstacles in the flight plan, so there is a risk that the drone will hit an obstacle when returning home.

5. If you want to interrupt the return, switch to "LOITER" or "ALT HOLD" flight mode.

13. Cleaning and maintenance of the drone

Cleaning tasks to be performed after each use

1. Remove and clean the spreader discs as follows:
   A) Insert the motor support rod through the mounting hole on the side of the nozzles, which prevents the motor from rotating
   B) Keeping the stick pushed in, unscrew the disc from the motor shaft in a counter-clockwise direction
   C) After disassembly, wash the disc with clean water and clean the inner surface of the disc with a soft-bristled brush. d
   Be careful not to damage the toothing of the disc!
   Place the disc after washing the tank.



2. Wash the spray tank and PU pipes
3. Reassemble the spreader discs based on point 1, reversing the direction of rotation.
4. Clean the lower and upper filter of the tank.
5. Remove dirt from the sprayer with a soapy, wet cloth.

Interim maintenance, and cleaning

1. The auxiliary devices of the drone (remote controller, tablet, base station, charger, batteries) shall be cleaned with a dry cloth.

2. Under normal circumstances, the drone is resistant to spraying water, and dust. As such, it can be cleaned with a maximal 0.3bar pressure water jet, from a 3m distance. Additional cleaning shall be carried out with a wet cloth. For cleaning with a water jet, all arms must be locked in an unfolded position, and the battery must be removed. Before cleaning, always ensure that no fractures, or holes are apparent on the frame. Despite its IP rating, components of the drone, including seals are deteriorating with time, as such warranty is void if fluids get into the electronics compartment.

Splash protection is decreased by the following:

- The aging of materials used
- Using spraying agents that are reactive to the frame of the drone
- Collision, crash of the drone
- Loosening of fasteners
- Cracks on the frame due to unintended usage

Attention! If fluids get into the frame, warranty is voided.
Attention! Insufficient maintenance leads to early failure of the system.

14. Guarantee conditions

By using WohnderDrone's products, software and systems, you fully and unconditionally agree to WohnderDrone's terms and conditions of warranty and liability and any other terms and conditions agreed between you and WohnderDrone.

In the case of a purchaser who is a consumer, we warrant for a period of three (3) years against defects in the Wohnderdrone that can be proven to have occurred during the warranty period due to a manufacturing or material defect. For non-consumer customers, the warranty period is one (1) year. The warranty shall commence on the date of purchase by the first owner. The date of the original purchase receipt is authoritative.

Claims under the warranty cannot be transferred. This warranty is also not valid for Products purchased second-hand.

During the warranty period, the Manufacturer agrees to repair at its option any defects in material or workmanship, or to provide a repaired or refurbished Product of equal value, free of charge (excluding shipping, handling, packaging, return postage, and insurance, which shall be borne by the customer). Such repair or replacement shall be valid upon proof of defect or failure and proof of purchase, which must be evidenced by the serial number on the original dated sales receipt.

Warranty Services do not extend or renew the Product's manufacturer warranty period.

In addition to the provisions of these manufacturer's warranty terms and conditions, the Buyer shall have no other warranty claims under the manufacturer's warranty, and in particular the Buyer shall not be entitled to a replacement during the repair period.

Any attempt to modify the device, either in whole or in part, or to modify the software or firmware, will void the warranty immediately!

Product - The Manufacturer offers a one-year warranty on the airframe and airframe components against defects in workmanship and materials.

Electronics - The Manufacturer provides a one-year warranty on electrical components.

Firmware - The Manufacturer warrants the firmware for one year.

The Guarantee does not cover:

Damage that occurs while users are under the influence of alcohol, intoxicants, narcotics, strong anesthetics, dizziness, fatigue, nausea or any other physical or mental condition that may impair the safe operation of the product.

Damage caused by improper operation.

Damage caused by improper operation.

Damage caused by failure to follow the instructions in the manual for the assembly or operation of the product.

Damage caused by the reassembly or replacement of non-WohnderDrone accessories and parts.

Damage caused by operation without a functioning data link.

Damage caused by knowingly flying a damaged or otherwise malfunctioning product.

Damage resulting from improper use of battery and battery chargers supplied by WohnderDrone.

Damage caused when the product is in the following situations: collision, fire, explosion, flood, tsunami, sinking, ice flying, avalanche, debris flow, landslide, earthquake, etc.

Damage caused by the operation of an product in weather conditions outside the flight limit, such as heavy rain or strong winds, snow, hail, lightning, tornadoes, hurricanes, etc.

Damage caused in flight, in particular but not limited to:

- Flying in magnetic interference areas, radio interference areas, no-fly zones regulated by a State.
- Damage caused by operation of the product in an environment subject to interference from other wireless devices (e.g. transmitters, video downlink, Wi-Fi signals, etc.).
- Lack of a clear view of the product due to backlighting, visibility, limited or poor visibility conditions unsuitable for operation, and other conditions that prevent safe operation of the product.
- Damage caused by the product flying in an abnormal condition, for example:
- Water, oil, soil, sand and other unknown substances entering the product;
- Defective or incomplete assembly;
- In case of faulty or incomplete assembly;

In the event of flight despite obvious defects or deficiencies in major components:

- Damage caused by continued flight following a low voltage protection alarm.
- Damage caused by unauthorized modification, disassembly or opening of the enclosure not in accordance with the instructions or manuals.
- Water damage or other damage caused by improper installation, misuse or operation not in accordance with official instructions or manuals.
- Damage caused by an unauthorized service provider.
- Damage caused by unauthorized modification of circuits, improper fitting or misuse of the battery and charger.
- Damage caused by flights not following the recommendations in this manual.
- Damage caused by operation in adverse weather conditions (e.g. strong winds, rain, sandstorms, dust storms, etc.).
- Damage caused by operating the Product above the safe take-off weight specified in the instructions for use.
- Damage caused by operating the device with a low or defective battery.
- In case of loss or damage to your data.
- Failure or damage caused by third party products, including those that Wohnderdrone provides or integrates with the Wohnderdrone Product at your express request.

Scope of guarantee

The Manufacturer makes no express warranties or conditions, whether written or oral, and the Manufacturer expressly disclaims all warranties and conditions not expressly stated in this Limited Warranty. To the extent permitted, the Manufacturer disclaims all implied warranties or conditions, including implied warranties of merchantability and fitness for a particular purpose. Some states or

countries do not allow limitations on the duration of implied warranties or the exclusion of limitations on the recovery of damages for negligent or intentional damage caused by consumer products. In such country or countries, certain exclusions or limitations of the limited warranty may not apply to Buyer. In the case of a Purchaser transaction, the limited warranty terms contained in this Disclaimer, except to the extent permitted by law, do not exclude, limit or modify, but are in addition to, any mandatory statutory requirements applicable to the sale of the Product to the Purchaser.

The Buyer must submit all warranty claims to the Product Manufacturer for warranty returns or replacements, so please keep your invoice(s) for at least one year for warranty reasons.

The duration of the guarantee may vary according to the laws and regulations of each country.

This warranty gives you specific legal rights. You may have other rights that vary from state to state.

Enforcement procedures

Complaints about defective goods must be made in writing.

Any claim for the return of defective goods must be packed in the original packaging.

We reserve the right to determine whether items must be returned to the original warehouse for inspection or be inspected by our on-site representative. You will be responsible for the shipping cost and risk.

To make a claim, photographs, flight plan saved from the tablet, shapefile (if used), orthophoto (if used) and a flight log are required, along with a copy of the original invoice.

The warranty can only be claimed if the user saves the flight plan from the tablet immediately, and the request includes the shapefile, and orthophoto (if used)

If the claim is justified, the item(s) or part(s) will be corrected or replaced. Our policy is to replace parts whenever possible.

General information:

Avoid flying over people and keep clear of obstacles and power lines as these cause electromagnetic interference.

All use of WOHNDERDRONE products must comply with the regulations of the country in which you are flying. All flying is the sole responsibility of the pilot!

You must be aware of the weather conditions before each flight. The drone cannot fly in heavy rain or wind. Refer to the local weather forecast, including wind estimates near the flight zone.

Please note that winds are generally stronger at higher altitudes. In addition, no firm conclusion can be drawn from winds near the ground to estimate winds at higher altitudes.

Damage resulting from improper cleaning is not covered by the warranty!

15. Manufacturer

8900 Zalaegerszeg, Fuvar utca 7.

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