gemini

User Manual

Updated on September 21, 2023

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Introduction

Thank you for choosing Geoscan Gemini UAV!

This manual is designed to describe UAV structure and the operating rules.
We highly recommend to read the manual carefully before using Gemini.

If you have any questions about UAV, technical service and repair, please contact our support: *https://www.geoscan.ru/en/support*.

We always glad to help you and answer any questions.

The information, specifications and pictures in this manual are relevant at the time of publication. Geoscan Group may change the UAV design or specifications without prior notice.

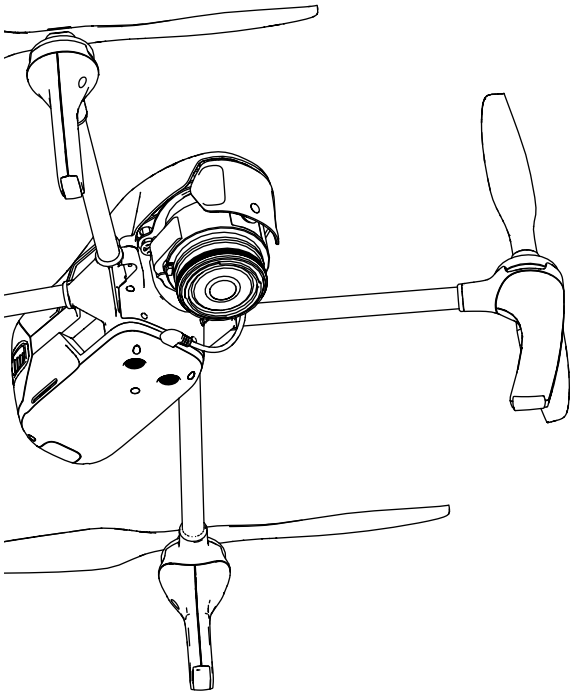
Do not make any changes to UAV structure by yourself. Any UAV damages or degraded specifications caused by structure changes are not covered by the warranty.

This mark highlights important information and recommendations. It is necessary to follow these instructions for people and UAV safety.

Abbreviations List

GNSS	Global Navigation Satellite System
IMU	Inertial Measurement Unit
OS	Operating System
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle

Main Information



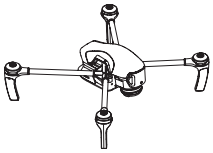
Geoscan Gemini unmanned aerial system is designed to perform aerial survey and produce the following spatial data:

- 3D point clouds
- Digital surface models
- Digital terrain models (DTM)
- Ortophoto mosaic maps
- Textured 3D polygon models

Fields of application:

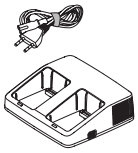
- Cadastral works
- Mining
- Mapping
- Construction
- Road facilities

In The Box



Geoscan Gemini UAV

Flight Battery — 2 pcs.



Battery Charger

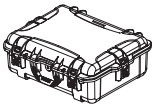
Propellers (pair) — 3 pcs.

Radio Modem

USB Type-C Cable

SD Card 32 GB

Documentation package



Transport Case

Service

After each flight visually inspect UAV for a damages.

If propellers are damaged, you can replace them by using spare parts.
If you detect any aircraft frame or system damages,contact our support for futher instructions.

After 160 hours total flight time we recommend you to send UAV to the manufacturer for a technical check and service.

Storage

UAV (without a Flight Battery) should be stored at the temperature from -20 to +60°C and relative humidity no more than 80%.

Range of the flight battery's temperature: from +5 to +25°C.

UAV with installed battery can be stored at the flight battery temperature range.

UAV service life — 3 years.

Flight battery service life — 1 year.

For a long time storage (14 days and more) you should always switch batteries in Storage mode by the battery charger. See *Storage Mode* section for details.

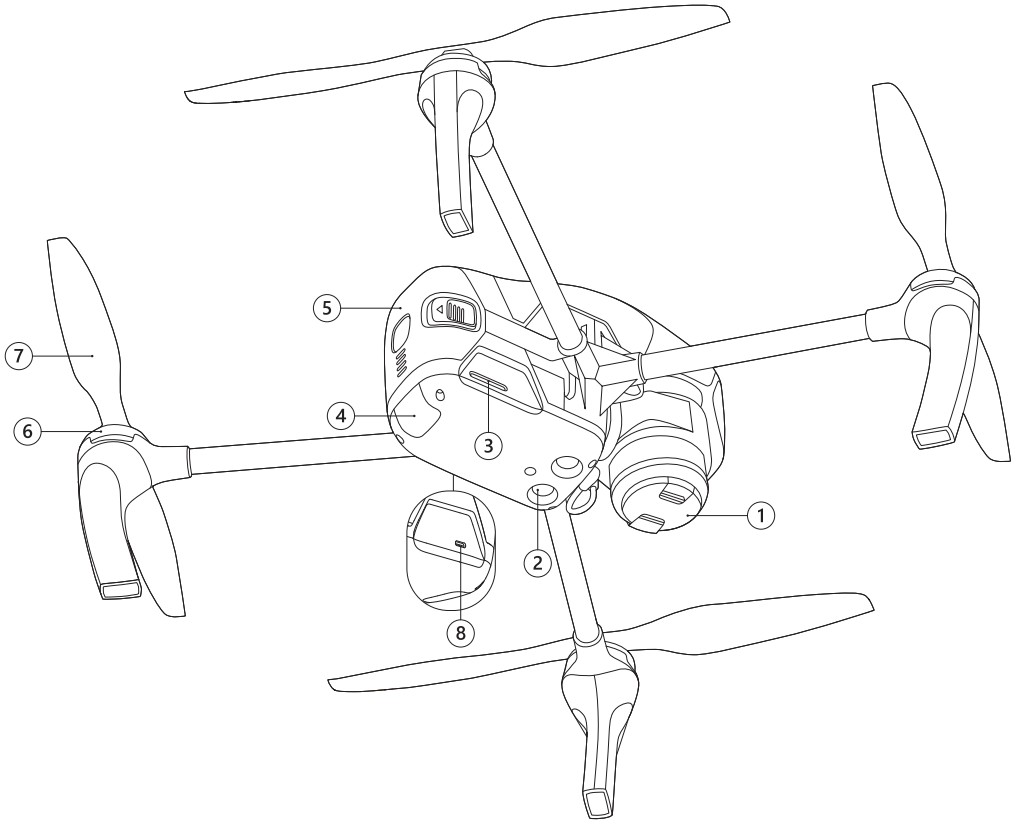
Safety Rules

Following rules must be observed:

- Only persons who have read this manual are allowed to use Geoscan Gemini UAV.
- Follow the dealer's and/or manufacturer's recommendations and instructions for use of the equipment, as given in this manual and received during operation period;
- Do not short-circuit flight battery's pins.
- Do not launch UAV or calibrate magnetic compass near large metal objects and reinforced concrete structures (transmission towers, bridges, overpasses, etc.). These objects can disrupt magnetic compass and GNSS signals.
- UAV magnetic compass is not adapted for work in the areas of magnetic anomalies. Use *Flight Without Using the Magnetic Compass* in such conditions.
- Avoid trees, water and crowds on the flight route.
- Gemini should be transported only in the transport case.
- Do not assemble, disassemble and transport UAV over long distances when power is on.
- Do not use the UAV at temperatures below -15°C and above +40°C.
- Do not use UAV in snow, rain and when wind speed is more than 10 m/s.
- Do not launch the UAV if any problem is detected.
- Do not modify the UAV.

Aircraft

Aircraft Diagram



1. Sony UMC-R10C Digital Camera
2. Precise Positioning Sensors
3. SD Card Slot
4. UAV Indicator
5. Flight Battery
6. Electric Motors
7. Propellers
8. USB Type-C Port

Key Features

This section contains a general description of Gemini's systems. For more information please see *Appendix* section.

Magnetic Compass
Built-in magnetic compass allows accurately keep an orientation.

GNSS Positioning
Built-in high-precision GNSS receiver is supports dual frequency GPS/GLONASS L1/L2 tracking. GNSS tracking allows you to get the coordinates of the camera centers in PPK mode with an 1.5 cm accuracy even at a long distance from the GNSS base unit.

Automatic UAV control
RC control is not needed for a flight. You can pre-create the flight task and load it into UAV memory directly before takeoff. The flight process control is automatic. The UAV operator can monitor the flight process using a laptop and can edit the flight task in a real time.

Precise Positioning System
The UAV is equipped with ultrasonic sensors and positioning camera that detect the UAV position in the air. The UAV autopilot automaticly corrects speed and direction during takeoff and landing by sensors data.

Internal and External Storage

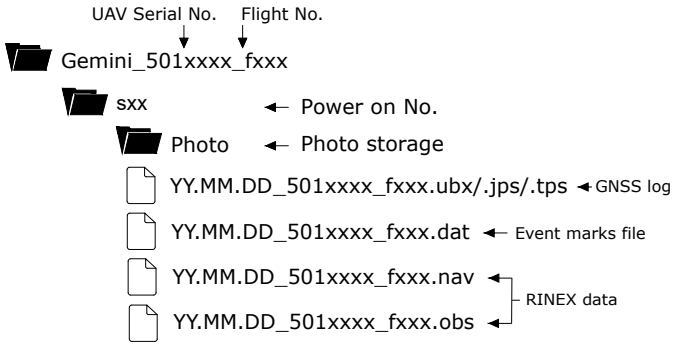
Aerial survey data is stored on a 32 GB internal drive.
There are two ways to copy them to an external storage:

- Connection with PC via USB Type-C cable
- Copy flight data to SD card

Install The Flight Battery in UAV slot (see *Battery Installing And Ejecting* section for details), turn the UAV power on (see *Battery Indication And Control* section for details). Plug USB cable in UAV USB Type-C port and USB port of your computer.

At the first connection your computer will detect a new device and automatically install drivers.
When the driver installation is complete, the internal drive will be shown in list of available devices on PC.
Select Gemini device to access UAV file system.

Internal file structure:



GNSS log file depends on board UAV GNSS receiver type:
*.ubx — U-Blox ZED F9 data; *.jps — JAVAD TR-2S data; *.tps — Topcon B111 data.

Make sure that you already installed last firmware update for successful automatic onboard GNSS log convertion to RINEX.

Data types of output RINEX files:
*.obs — GNSS observation data file.
*.nav — navigation message file with satellites (ephemeris) desctiption.

Current arieal survey data will be automatically copied to the SD card after passing the last point of a flight task and successful GNSS log conversion.

Press **Copy Data to SD** button in Geoscan Planner software to copy data of previous flights.

Please see *Geoscan Planner Software* section for more information.
See *SD Card Installation* section for more information about SD card preparing.

UAV Indication

Gemini has a LED indicator, which informs about UAV status.

The table describes LED indication:

	LED color	Description	Solution
	Glows solid red	Critical error	Contact support
	Flashes red	Critical battery charge level	Change or charge a flight battery
	Glows solid violet	Magnetic compass error	Contact support
	Flashes violet	UAV systems initialization	Wait until initialization is completed
	Glows solid yellow	Magnetic compass calibration	Complete the calibration process
	Flashes yellow	Magnetic compass calibration error	Distance UAV away from metal objects; calibrate the magnetic compass
	Glows solid blue	GNSS is not ready	Make sure that UAV is in an open area to receive GNSS signals; Wait until GNSS inizialization is completed
	Flashes blue	IMU initialization	Wait until initialization is completed
	Glows solid green	UAV is ready to fly	Launch Start Preparing Wizard in Geoscan Planner software
	Flashes green	Preflight system check	Wait until system check is completed
	Flashes cyan	Copying data to SD card	Wait until the process is completed
	Flashes orange	UAV firmware update is in progress	Wait until the update process is completed

Assembly

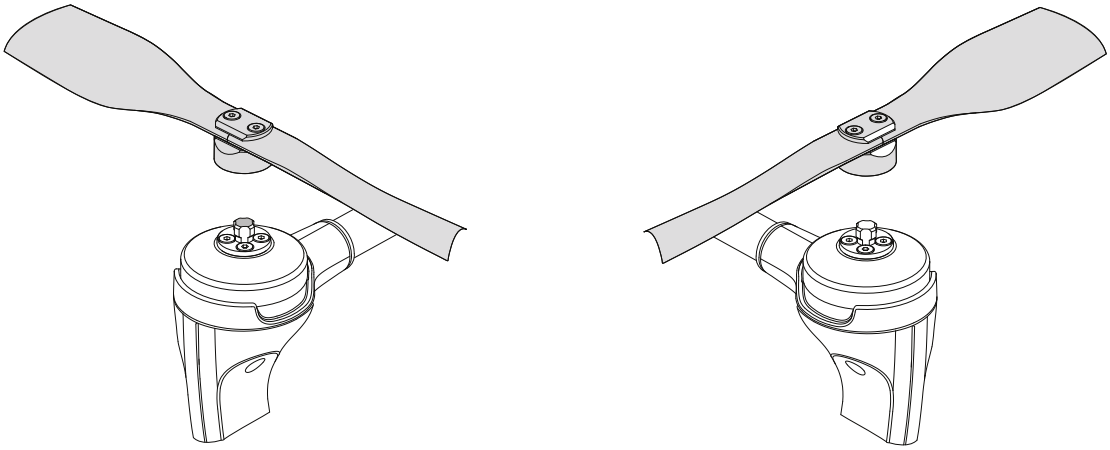
Propellers

Attach propellers to the motor shafts.

Pay attention that propellers and shafts are different in their directions of rotation. Propellers and shafts with the same rotation are marked with the same silver or black marks.
Icons on the centers of propellers indicate the direction of rotation for their installation.

Hold the motor's rotor and screw every propeller on shaft with same mark.

Unscrew propellers in the opposite direction to detach them.

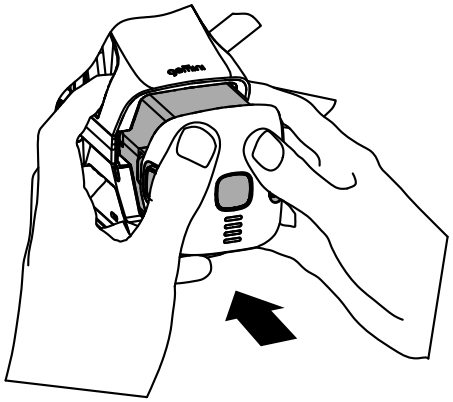


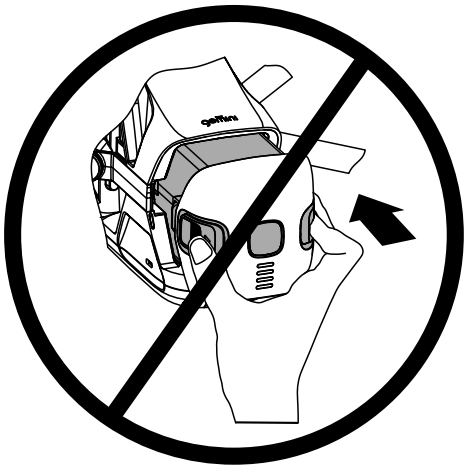
Propellers attaching

Battery Installing

Install flight battery in UAV slot until the fixing mechanism will click.

DO NOT push ejecting buttons, when you are installing flight battery in UAV slot!
Battery installing with pushed buttons may provide problems with attachment, battery disconnect during the flight and UAV fall!
Make sure that you place the flight battery securely before flight!





Press battery control button once, again, and hold for 2 seconds to turn UAV on.
To eject flight battery press ejecting buttons and pull the battery out.

Do not remove the flight battery when UAV power is on!
It can damage UAV systems!

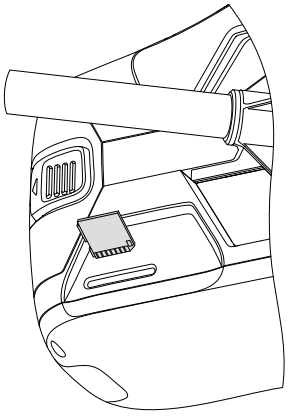
SD Card Installing

Format SD card in FAT32 file system and install it in SD Card Slot.

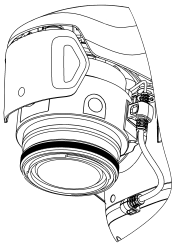
Make sure that SD card is securely locked in slot and can be removed by pressing again only.

Flight task also can be performed without a SD card. In this case, the aerial photo data of current flight will not be copied to the SD card after passing last point of flight task and will be saved on UAV internal storage only.

Use **Clear memory** command in Geoscan Planner software to clean UAV internal memory.



Sony UMC-R10C Digital Camera

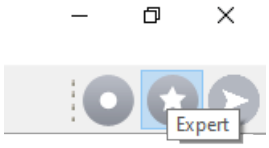


Geoscan Gemini has onboard Sony UMC-R10C camera with a 20.1 megapixel APS-C sensor and 20 mm lens f/2.8, that provides less noise level and high dynamic range. This features allow to take high-quality pictures even in low light conditions.

Camera Settings

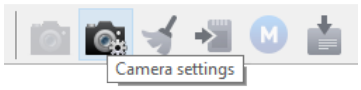
Camera can be configured in Geoscan Planner software. UAV must be connected to the laptop. See *Connection Settings* section for more information. How to change camera settings in Geoscan Planner:

- Click **Expert** button to select expert mode.



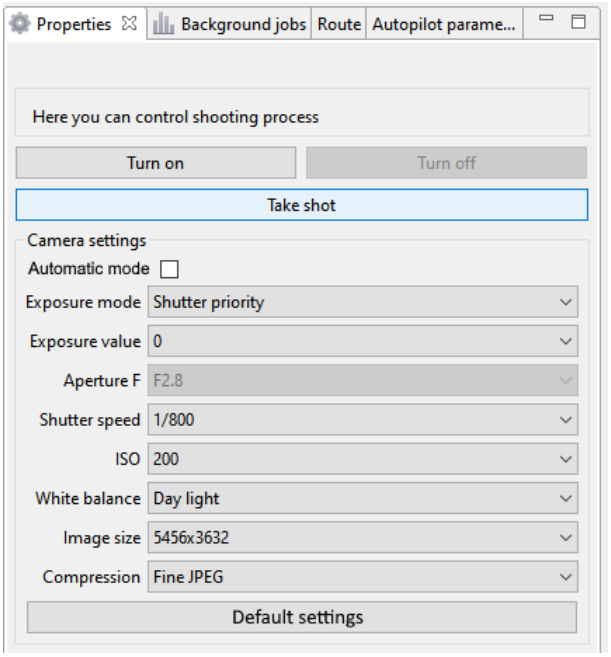
Expert mode button

- Press **Camera settings** button.



Camera settings button

Camera settings will be shown in the **Properties** window.



Camera settings

Camera is activated directly during the camera stage of Start preparing check. The settings you have set in the Properties window will be automatically loaded. Shooting is performed automatically during the flight task.

The camera also can be used in manual mode (to set image quality, for example). Press **Turn on** or **Turn off** button to turn camera on or off. **Take shot** button allows to take photos manually.

We recommend to use default quality settings in daylight conditions, but camera settings can be changed manually.

Automatic mode option provides automatic camera's aperture control by analysis of previous photo ISO results. First photo makes with automatic settings. After that camera checks ISO results and correct aperture to reach optimum light sensitivity. If ISO > 200, the aperture opens, if less — it closes. The aperture value varies from F/4.5 to F/11 to minimize optical distortions.
Also you can change shutter speed manually (recommended value: 1/800) and set the compression method for images.
Exposure mode — allows to change the present of pictures exposure.
Options:

- **Manual** — manual setup of aperture value and shutter speed.
- **Auto** — camera automatically sets the aperture value and shutter speed.
- **Aperture priority** — automatic shutter speed mode according to the aperture value that sets manually.

- **Shutter priority** — automatic setup of aperture value depends on the light intensity measurement in the shooting area. The shutter speed is set manually.
- **Exposure value** — value that defines light sensitivity of the camera. Affects on the shutter speed in Shutter priority exposure mode.

Aperture F — sets intencity of light that passing through the camera lens. Option is available in Aperture priority and Manual Exposure modes. **f/16** value is a lower amount of light, **f/2.8** — is higher. Recommended values in bright light: **f/8** — **f/6.3**
Shutter speed — the time during which the shutter is open to light. For example: **1/400** of second — slow shutter speed, **1/4000** — fast shutter speed. Recommended value: **1/800**.
ISO — light sensitivity. A lower value leads to lower light sensitivity and less noise on photos. ISO can be set in the range from **100** to **3200**. In the normal light conditions it is recommended to set the value to no more than **400**.
White balance — correction to reduce color distortions.
Presets:

- **Day light** — normal light.
- **Incandescent** — incandescent lamps as light sources.
- **Fluor cool** — cool fluorescent lighting.
- **Fluor day light** — fluorescent lighting.
- **Cloudy** — cloudy weather.
- **Color temp filter** — cold light.

Image size — sets output resolution of images in pixels.
Compression — images compression level.

Presets:

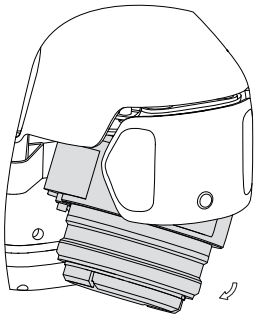
- **Fine JPEG** — high JPEG quality.
- **JPEG** — normal JPEG quality.

Image size on a storage will be smaller because the compression level is higher. This allows save more files, but image quality will be less lower than in Fine JPEG mode.
Click on **Default settings** button to set the recommended settings. Default settings option will activate **Automatic mode** and set:

- **Exposure** — Manual
- **ISO** — Auto

Camera Rotation

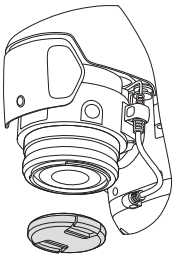
Geoscan Gemini allows to take not only planned survey, but also perspective shooting. In this case, the accuracy of 3D models are based on images will be much higher due to more accurate determination of object contours during photogrammetric processing.



To rotate the camera to a fixed angle (24 or 48°), place the UAV on a flat hard surface with the right side facing you. Turn the camera to the opposite direction to change back camera position.

Lens Protection

The lens cap provides camera lens protection from dirts and scratches. The cap should be removed immediately before the Start prepararing. Press cap's spring-loaded clips to remove it.



Be sure that you remove the lens cap from the camera lens before the flight. If the cap will not be removed, warning will be displayed at the launch preparing camera stage. Always attach the lens cap to camera lens directly after UAV take off.

JAVAD TR-2S Check and Update

This chapter only applies for UAVs with in-built JAVAD TR-2S GNSS receiver. Make sure that JAVAD TR-2S GNSS receiver is installed in your UAV before make settings. You can check it by UAV serial number decryption (please see *Equipment Identification* section and Geoscan Gemini UAS Data Sheet for more information). Gemini UAVs with other GNSS receivers does not require to update the factory settings.

Connection

Download the latest NetView & Modem software from JAVAD website *http://javad.com/jgnss/products/software/netview.html* and install it.

Download and install GNSS receiver's driver to make settings:
http://storage.javad.com/downloads/drivers/usb/jgnssusb.zip

To access GNSS receiver measurements and settings:
1. Turn UAV power on and then connect UAV to PC via USB Type-C cable.

Wait until the LED indicator of UAV will change color to green (all systems ready to work).

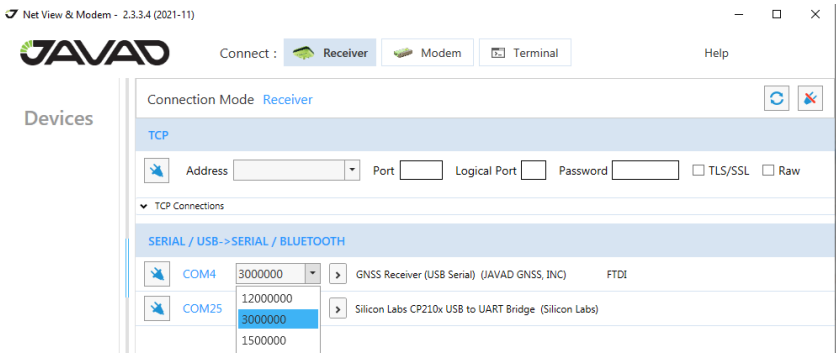
2. Open **NetView & Modem** software.
3. Select **Receiver** in **Connect** field.

Connect field

The GNSS receiver should be displayed in **Serial /USB->Serial /Bluetooth** list (see the picture on the next page).

If the GNSS receiver does not showed in the list of available devices, press **Refresh Ports** button in the right corner of program window.

4. Select connection speed - **3000000** and press **Connect** button near COM port name.



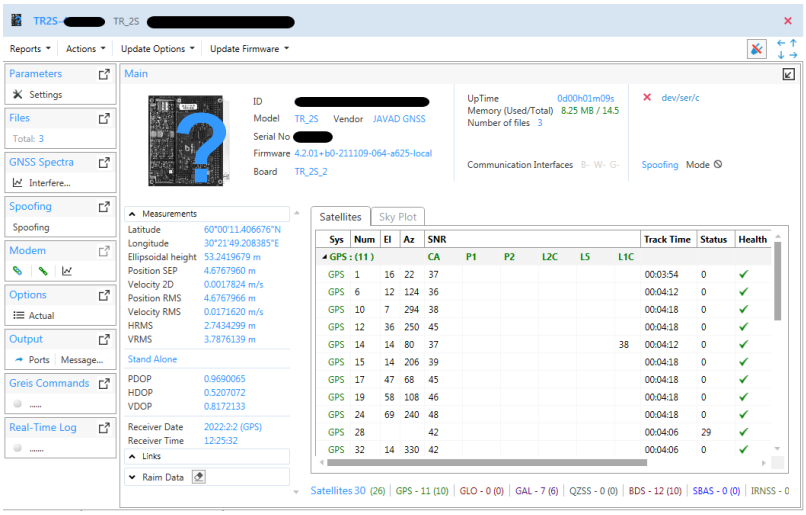
Connection speed setup

After successful connection **Main** tab will be opened automatically.

Functional Description of NetView & Modem Software

TR2S window contains several expandable tabs (Parameters, Files, GNSS Spectra...).
Use **Expand** buttons to switch them.

Main tab provides the information about GNSS receiver, captured satellite singals and positioning. Here you can check functioning of GNSS receiver and satellites capture.



Main tab in TR2S window

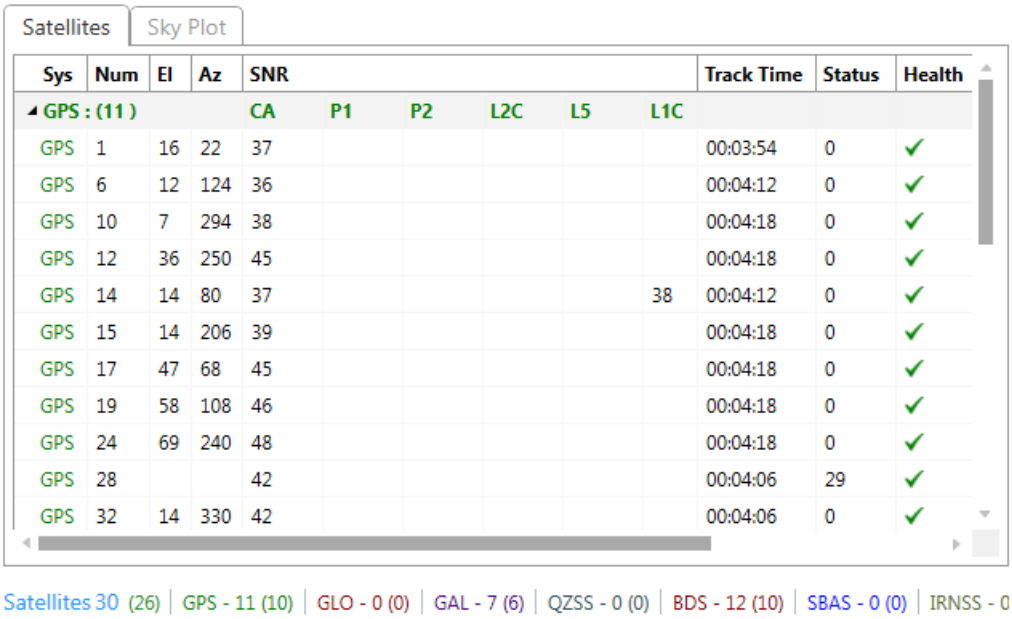
Measurements list displays the basic tracking information. It shows the receiver target point, current position, receiver coordinates and time-frequency parameters describing the behavior of the receiver's local oscillator.

Latitude, Longitude, Ellipsoidal height - geodetic coordinates
Position SEP - spherical error probable
Velocity 2D - geodetic velocity
Position RMS - position RMS error
Velocity RMS - velocity RMS error
HRMS - horizontal RMS error
VRMS - vertical RMS error

PDOP - position dilution of precision
HDOP - horizontal dilution of precision
VDOP - vertical dilution of precision

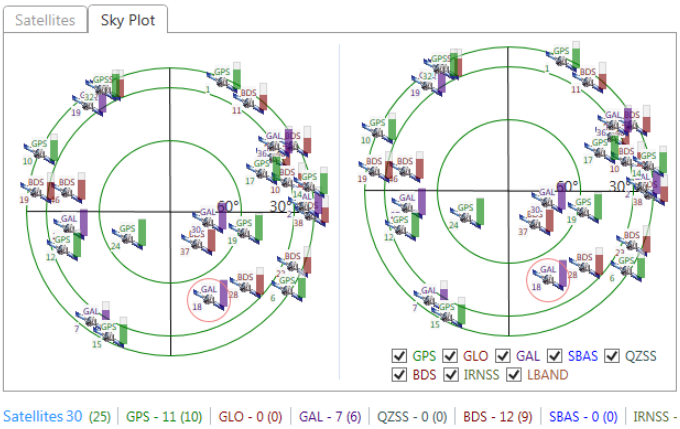
Receiver Date - «date» part of the full receiver time representation
Receiver Time - shows the receiver's current time within day

Satellites tab shows the information about captured satellites and their health status.

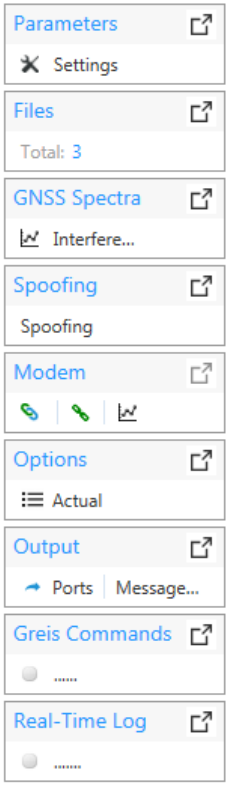


Satellites tab

Sky Plot tab shows a graphic representation of the satellites' positions in the sky.



Sky Plot tab



Parameters tab allows to configure measurements settings. We do not recommend changing of the factory settings to avoid disturbing of GNSS receiver measurements.

Flies tab allows to operate with files on internal storage. After completion of flight task the files are automatically copied from GNSS receiver memory to UAV memory.

GNSS Spectra tab allows to plot spectra graphs for all captured satellites.

Spoofing tab allows to track spoofing information.

Modem tab is not available for TR-2S.

Options tab allows to update settings and firmware of GNSS receiver. Please see *JAVAD TR-2S Options Update* section for more information.

Output tab shows output port messages.

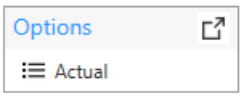
Greis Commands tab provides manual command mode for GNSS receiver's channels.

Real-Time Logging tab allows to start real-time recording of GNSS log.

This User Manual covers only general scenario for options update and using in-built JAVAD TR-2S GNSS receiver with Gemini UAV. Please see full *NetView & Modem Software Manual* on JAVAD website for more information.

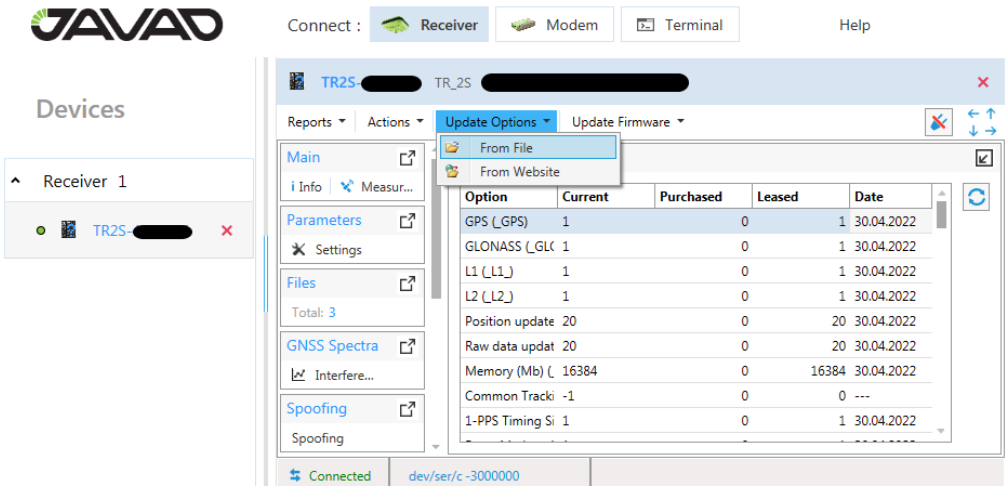
JAVAD TR-2S Options Update

Press **Expand** button in **Options** block to open parameters.



Options block

The options tab will be opened.
Current options and relevance dates will be displayed in the window.
There are two ways to update options: from *.jpo file or via the internet (from website).
Press **Update Options** button and select a path of update.



Options update paths

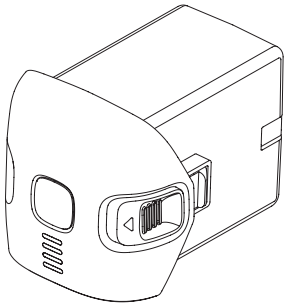
Click on **From File** option and select *.jpo update file or use **From Website** option to get the last updates from JAVAD web source. Confirm update, NVRAM clear and GNSS receiver reboot.
The options will be updated and GNSS receiver will reboot.
Update and initialization status will be showed at the bottom of program window.

«File System initialization» status

Wait until initialization of systems will be completed.

Firmware update is also available in options tab. Please contact *Geoscan support* to check a compatiblity status of the latest JAVAD GNSS receiver update with Gemini UAV. Otherwise, the latest update may result incompatibility between GNSS receiver and UAV firmwares.

Flight Battery



Flight Battery is designed for use with Geoscan Gemini UAV only.

Flight Battery should be charged only by using a battery charger designed for Geoscan Gemini battery.

Fully charge the battery before the first usage (see *Charge mode* section for details).

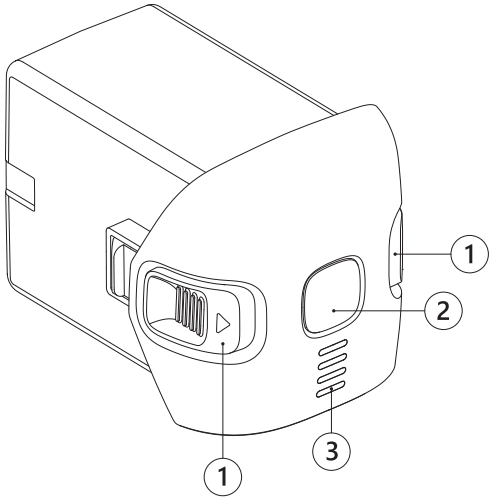
Operating Rules

- Battery should be stored 24 hours at the temperature of +5 to +25 °C before flight, which is at the temperature below 0°C. Keep the battery in a warm place, when you transport UAV to the start point. Lithium-ion batteries may lose up to 30% of its capacity at low temperatures. This fact should be taken into account when you create the flight task.
- Do not depressurize or deform battery cells (do not drop, do not punch or break).
- Do not overheat the flight battery above 60°C.
- Do not fully discharge the flight battery.
- Do not store the flight battery fully discharged.

Failure to follow the above instructions may result flight battery damage or fire!

Battery Indication and Control

.



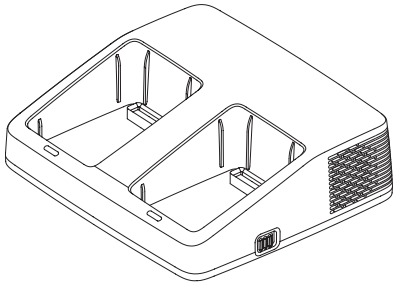
1. Ejecting Buttons
2. Control Button
3. LEDs

Press the Control Button to turn the Flight Battery on. LED indicators will show the battery charge level.
The battery LEDs are indicating charge level. Each turning on LED is a 25% of charge. Flashing LED is a 12,5% of charge.
Press the Control Button once, again, and hold until all LEDs are lights first time (2 seconds), to turn UAV on or off.
Wait for initialization of systems. The UAV Status Indicator will change the color to green, when all the systems are ready.
UAV turning off may require up to 1 minute. There is no need to keep the button pressed all this time.
The table shows battery the charge level:

100–87,5%	87,5–75%	75–62,5%	62,5–50%	50–37,5%	37,5–25%	25–12,5%	12,5–0%	0%

– LED is on; – LED is flashing; – LED is off.

Battery Charger

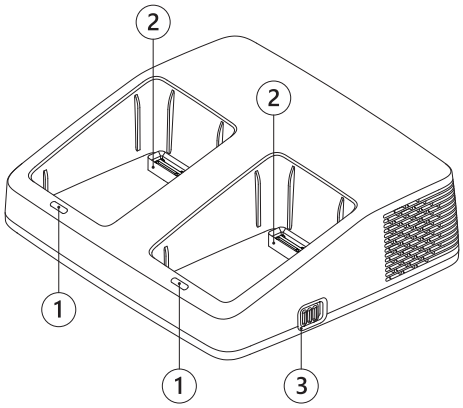


Battery charger is allows to charge up to 2 flight batteries and charge or discharge them up to 60% capacity, which is required for a long-time storage.

Safety Rules

- The battery charger should be operated at temperatures between 0 and +40°C without direct sunlight.
- Connect the battery charger to a power outlet 100—240 V ~50/60 Hz before installing the battery by using the power cable from the package content.
- Visually inspect charger slots and the power cable for damages before each use. Do not use damaged chargers or cables.
- Do not leave turned on charger unattached.
- The battery charger is designed for charging Gemini flight batteries only.

Charger Diagram



1. Port LED
2. Battery Port
3. Mode Switcher

LED Indication

	LEDs status	Description	Solution
	LEDs flash green one by one	The charger is ready	Install the batteries in the battery charger's slots
	Port LED glows red	Battery charging is in progress	Wait until the battery charging process is complete
	Port LED pulses red	Battery charge level correction for a storage is in progress	Wait until LED color changes to green
	Port LED glows green	In Charge mode: battery charge is 95 %. In Storage mode: charge correction is complete.	In Charge mode: The battery is ready for a flight up to 30 minutes. Wait until the battery charge indicators are off to reach 100% charge level. In Storage mode: The battery can be ejected and stored for a long time.
	Port LED flashes orange	Critical battery error or a temperature is out from range of operation	Eject the battery. In case of overheating, wait until it cools down. In case of overcooling, place the battery in a warm place until the operating temperature is reached.
	LEDs flash red one by one	The charger is broken	Contact support

Operating Modes

The battery charger can work in two operating modes: **Charge** and **Storage**.

> **Charge** mode allows to charge up to 2 flight batteries.
> If 2 batteries are installed, battery with a large charge level will start charge first.
>
> **Storage** mode allows to automatically charge or discharge batteries up to 60% of batteries capacity, that needed to store the batteries for 14 days or more.

Use the mode switcher to switch mode.
A short red flashing of the charger's LEDs (without flight batteries) indicates, that the charger is broken.
In this case, unplug power cable from outlet, wait when LEDs turn off and then turn the charger on again.
If the charger is still not working, please, contact our technical support.

Charge Mode

Follow these steps to charge batteries:

- Connect the power cable to the battery charger.
- Connect the battery charger to a power outlet (100 — 240 V, ∼50/60 Hz).
- Switch the mode switcher in **Charge** position.
- Install flight batteries in battery charger's slots.

The charging process will start. Battery's LEDs will shows a current charge level.
The charger's LED indicator will change color from red to green at the battery charge level 95%. Charger LEDs will be turned off at 100 %.
Charging time of discharged battery up to 95% at the temperature +25°C is ∼75 minutes.
Charging time to 100% is ∼105 minutes. Battery cells will be balanced at the last 5%.

Storage Mode

If you do not plan use batteries for next 14 days or more, switch them in storage mode.
Switch the mode switcher to **Storage** position.
Make sure that charger's LEDs are flashing green and insert batteries into ports of the charger.
The charger LEDs should start pulsing red smoothly.
The battery charger will automatically charge or discharge batteries up to 60% capacity, which is required to store them correctly for 14 days or more.
Storage balancing time from 100% charge level is approximately 22-23 hours.

Firmware Update

Use this download link to get latest firmware update: *https://download.geoscan.ru/gemini/latest/update.gsc*.

Copy firmware *update.gsc* file to root directory of SD card.

UAV will automaticly detect firmware file and will start the update process, when the power is turned on.

UAV and Flight Battery firmwares will be updated. UAV LED indicator will be flashing orange during the updating process.

The duration of update process can be up to 5 minutes.

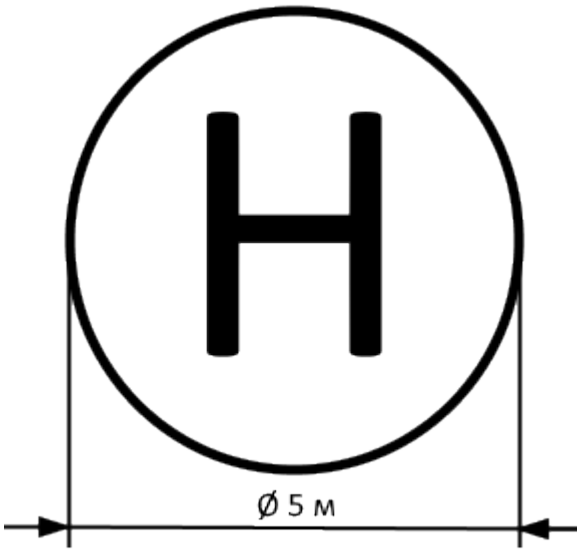
After successful update UAV will be rebooted, automatically will check all systems and will switch in ready to flight mode.

When the update is completed, firmware update file will be automatically renamed to *success_update.gsc*.

In order to update a firmware of more than one battery, you should turn UAV power off, remove updated battery, replace a battery with an older firmware version and repeat upgrade process by renaming the file to *update.gsc*.

Also you can copy the file and use it for update another Geoscan Gemini UAVs.

Launch Area Requirements



The launch area should have a diameter of 5 meters without any barriers and must be magnetic compatible.

There should be no massive metal objects, power lines and other high-rise structures nearby that may affect GNSS signal.

There must be no objects on the launch pad that could block the take-off and landing of UAV.

Geoscan Planner Software

Geoscan Planner software allows to configure UAV and create flight tasks for aerial survey of areas and single objects.

System Requirements

Minimum System Requirements

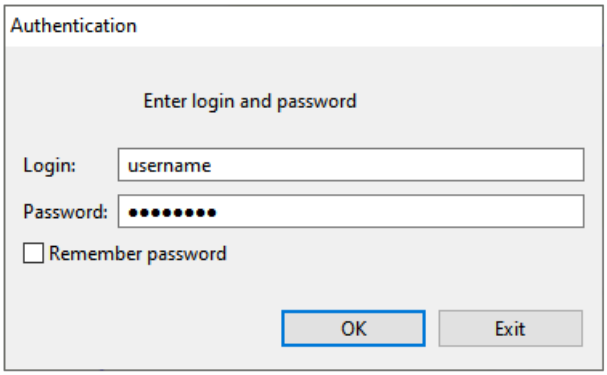
Operating system	MS Windows 7,8,10
CPU	Intel Core i3
RAM	4 Gb
GPU Type	Dedicated
GPU Model	Nvidia GeForce GT620M, GT630M, 710M, GT720M; AMD Radeon HD 7670M

Recommended System Requirements

Operating system	MS Windows 7,8,10
CPU	Intel Core i5, i7
RAM	8 Gb
GPU Type	Dedicated
GPU Model	Nvidia GeForce GT645M, GT745M, 845M, GT720M, 940M and higher

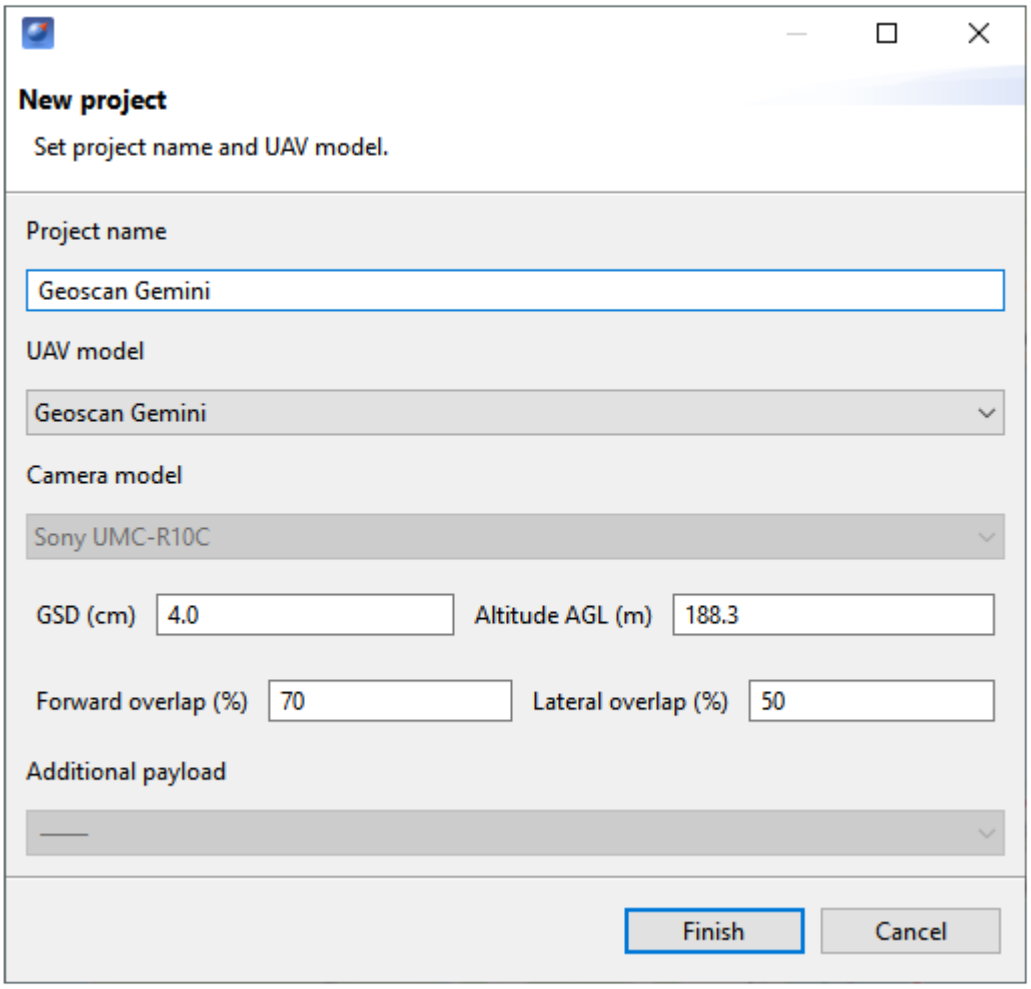
New Project

1) Install and launch **Geoscan Planner** software.
2) Enter your login and password in authentication window.



3) Click **New project** button.

4) Enter a project name and shooting parameters in new project window.

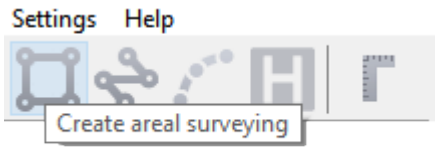


New project window

Aerial Surveying

Aerial surveying is a polygon surveying. User sets vertices of the polygon (more than 3) and the software will automatically calculates a flight route.

1) Press **Create aerial surveying** on the toolbar.



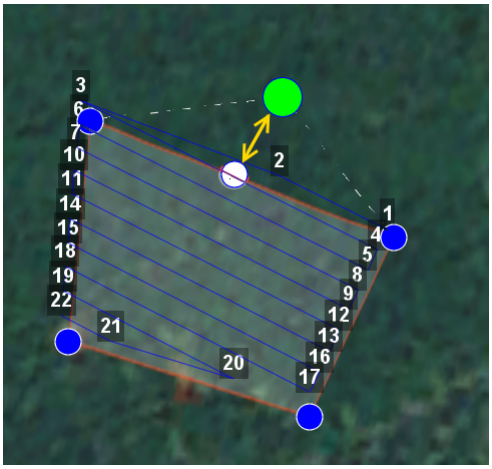
Create aerial surveying

2) Click on the map to set vertexes of aerial survey area. The program will automatically calculate the flight route.

Adding and Removing of Polygon Vertexes

You can add vertices to polygon.

1) Hold left mouse button and move middle point of a polygon side.

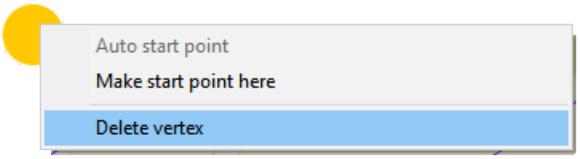


Vertex adding

The vertex will be created automatically. A floating window will display location of the vertex.

To remove the vertex:

1) right click on the vertex;
2) select *Delete vertex*.

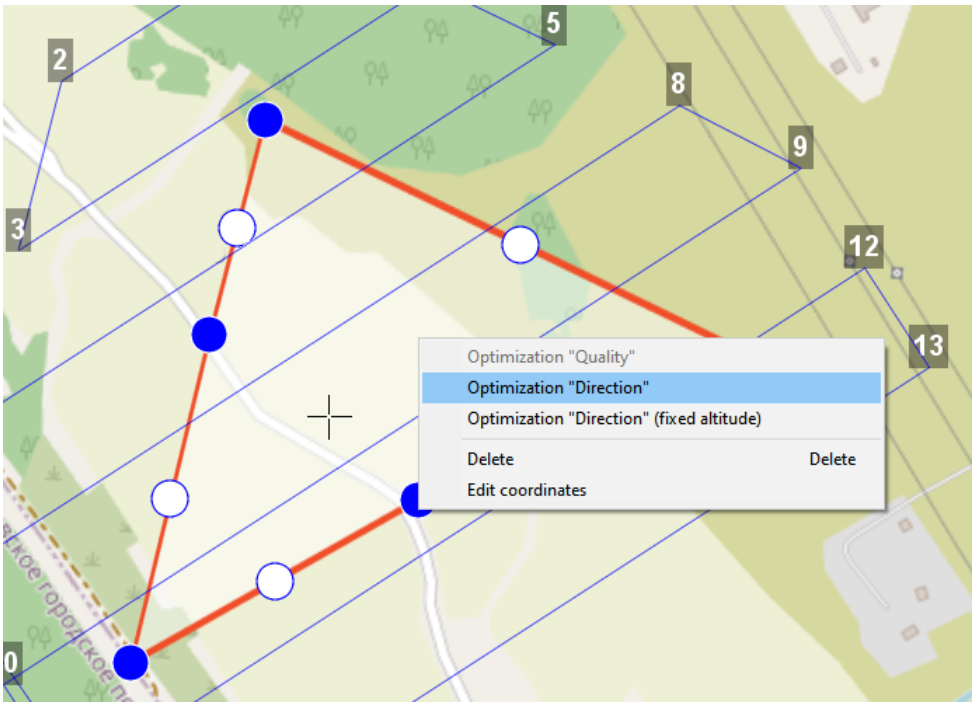


Delete vertex

Change Flight Route Direction

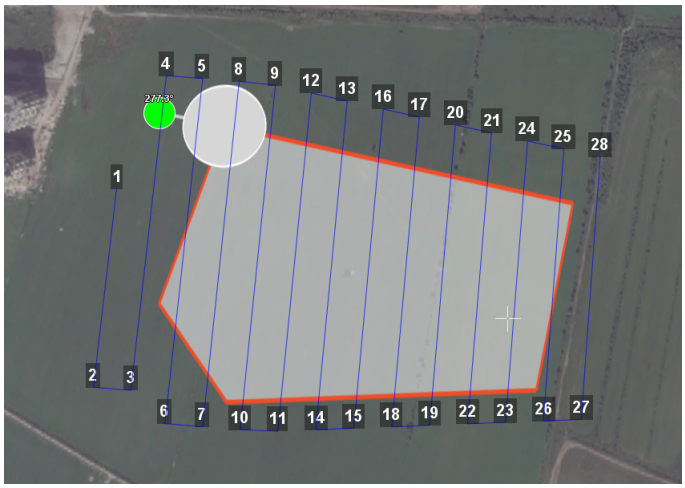
The need to change a flight route may be caused, if the force and direction of the wind are unfavorable (strong wind along the flight route of the polygon).

Right-click on the polygon and select the option *Optimization «Direction»* in context menu to change the direction of flight route.



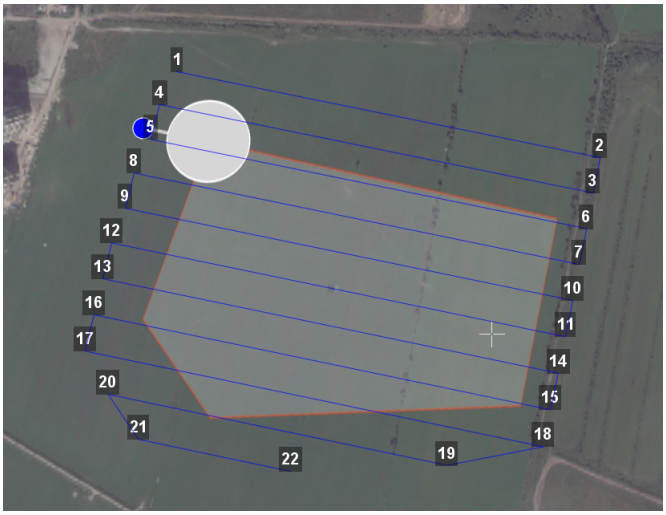
Optimization by direction

One of the vertices of the polygon will be colored gray. Use the point's slider to set the flight route direction.



Correction of the flight direction

A new flight route through the polygon in a selected direction will be generated automatically.

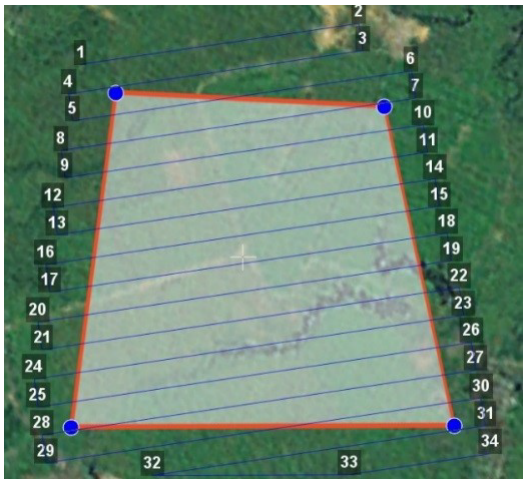


Changed flight route

Start Point Changing

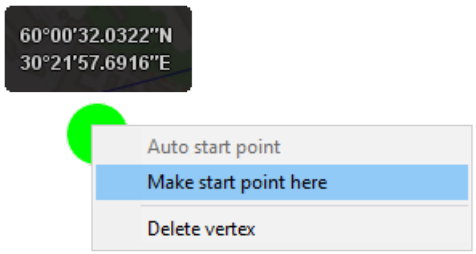
To change the polygon entry point, follow these steps:

1) Select a polygon.



Selected polygon

2) Select vertex, right click and choose *Make start point here*.



Context menu of a point

The selected point will be marked with a flag

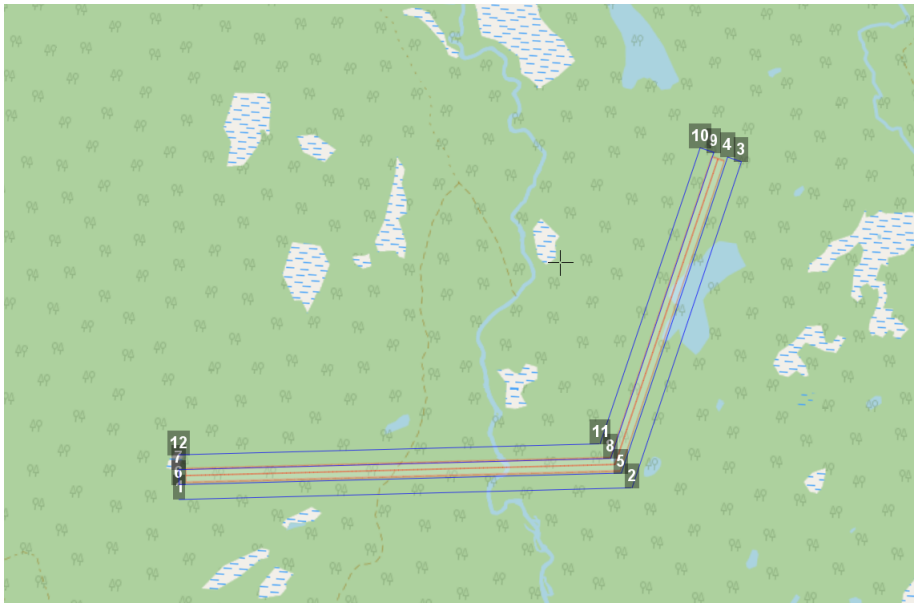
Linear Surveying

Create linear surveying tool allows to create a flight route along linear objects, such as: rivers, roads, oil pipelines, etc. .

1) Press **Create linear surveying** button on the toolbar.

Create linear surveying button

2) Single clicks to set a path around an object. The program will automatically generate flight route.

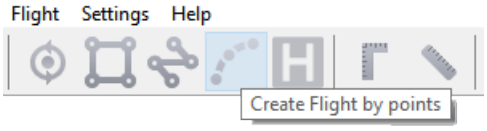


Linear survey example

Flight By Points

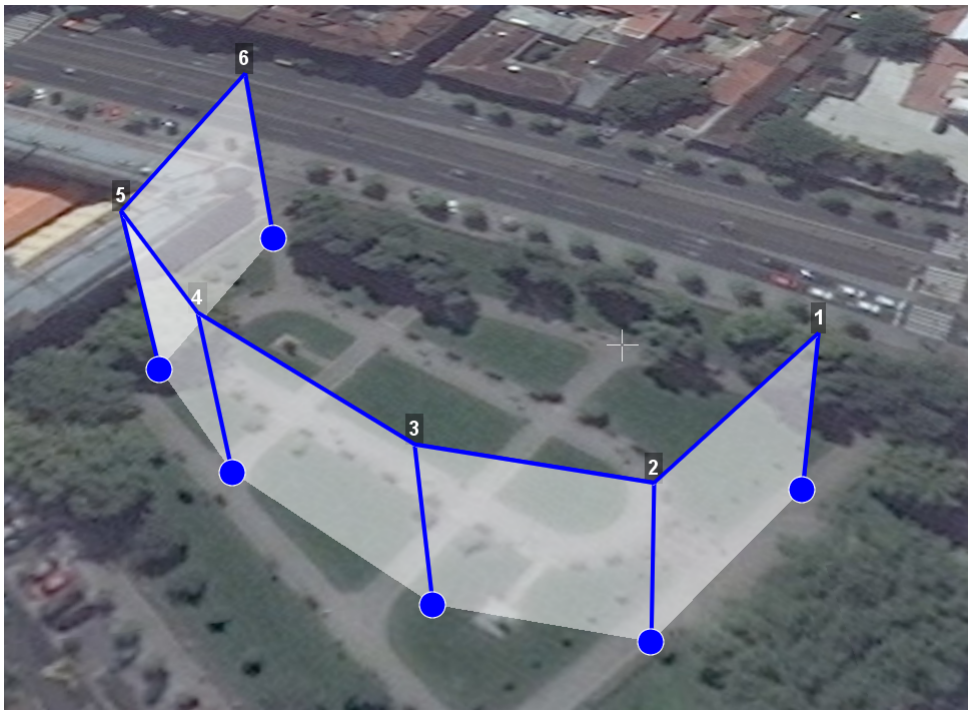
Create flight by points tool can be used for inspection of territories and overflights of high-rise objects.

1) Press **Create flight by points** button on the toolbar.



Create flight by points button

2) Single clicks to select flight route points.



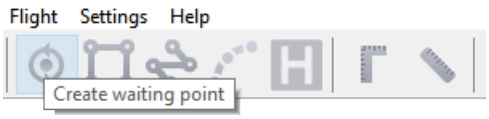
Flight by points

By default, aerial survey is not performed during the flight by points. Set up **Photo mode** in **Properties** window, if you need aerial survey photos.
Click right mouse button to set delay time.
Select **Set delay in point** and set time of waiting (in seconds).

Waiting Point

Create waiting point tool allows to hold UAV on selected map point.

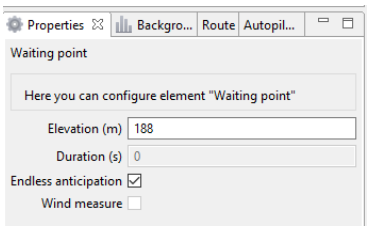
1) Press **Create waiting point** on the toolbar.



Waiting point button

2) Click mouse button on the map to set waiting point.

UAV will hold the point on the set height during the specified time, and then go back to the flight route. You can activate more options an expert mode: set delay point height, waiting time, direction, wind measurement and endless devay functions.



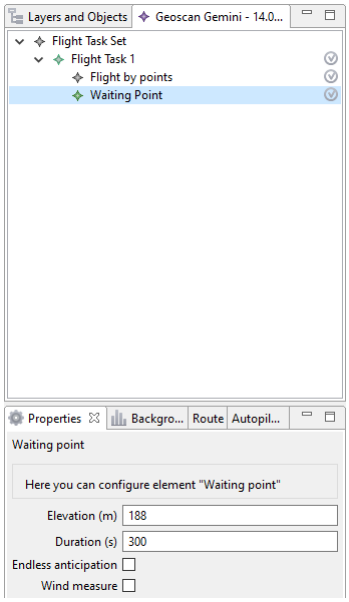
Waiting point

In **Wind measure** mode the waiting point will be colored yellow, and the duration will change to 15 seconds. UAV will take into account a wind mesurements when performing a flight task.

The waiting point option sets holding point in the air (point will be hold until the low battery charge will trigger automatic return to start point). The waiting point color will change to deep blue.

We recommend to set the waiting point with wind measurement before each flight element at the height of the flight element, especially if they are located a large distance from each other.

Geoscan UAVs are not certified instruments of wind measurement. It cannot be used as a precise tool.

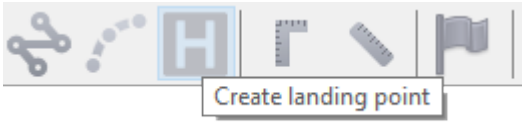


Waiting point in wind measure mode

Landing Point

Create landing point tool is used to set the UAV landing point. If there is no specified landing point, UAV will return to the starting point at the end of the flight task.

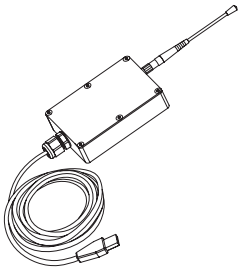
1) Press **Create landing point** button on the toolbar.



Create landing point button

2) Click on the map to select landing point for UAV.

Connection Settings



The radio modem is used to load a flight task into the autopilot memory, set up and control UAV flight at up to 5 km distance. This section describes how to set up wireless connection between UAV and laptop with installed Geoscan Planner software.

Geoscan Gemini is equipped with one of two types of radio modem: 868 MHz or 2.4 GHz. The section describes their connection settings. The equipment is identified according to the decryption of serial number. For more information about included type of radio modem, please see *Equipment Identification* section and Geoscan Gemini UAS Data Sheet.

868 MHz Radio Modem Connection

1. Connect the radio modem to laptop's USB port.
   Radio modem drivers will be installed automatically.
   Use these drivers, if operating system is not detect radio modem device:
   CP210x VCP(for Windows 7-8) and *CP210x(for Windows 10)*.

2. Install **MdmDisp** and **NetTopology** software.

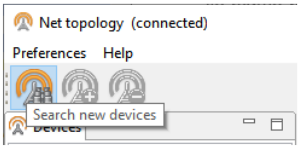
3. Turn UAV power on.

4. Launch **MdmDisp** utility.

   The antenna icon and the number of connected UAVs will be displayed in a right corner of the laptop screen.

4.1 At the first time you need to configure connection with UAV:

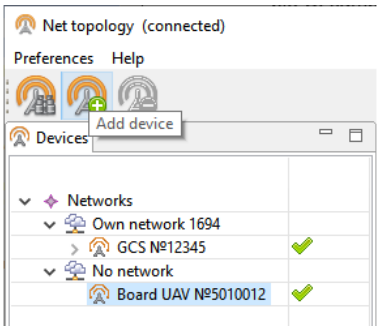
1) Run the **NetTopology** utility.
2) Press **Search** button.



The program will show the list of detected devices. The search will continue until the **Search new devices** button will be pressed again.

3) Select UAV №501xxxx and press **Add device** button.

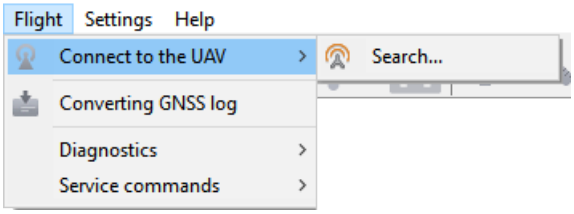
The utility saves the list of added devices automatically.
Before the next flights just run MdmDisp and check the successful connection.



Adding a new device

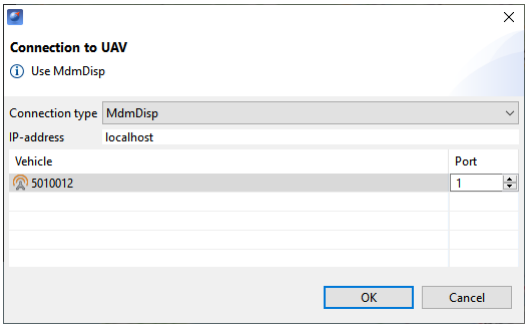
If UAV is not detected, reconnect the radio modem by right-click on the MdmDisp icon and select **Reconnect**. in the context menu.

1. Select **Connect to the UAV — Search...** in **Flight** tab.



UAV connection

2. Select **Connection type** - **MdmDisp**, **IP-adress — localhost**, **UAV — Port 1**.



Connection settings

The settings will be automatically saved. At the next connections turn on the UAV power and use **Connect UAV** button on the toolbar.

Connect UAV button

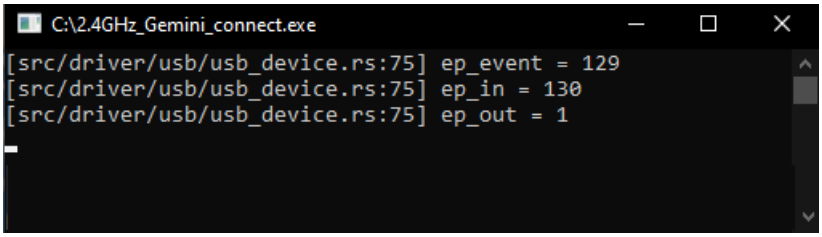
The receiver will automatically detect UAV coordinates and display a position on the map.

If connection is failed:

- Check connection of the radio modem to laptop's USB socket.
- Check network settings in NetTopology.
- Set COM-port of the radio modem manually. Right click on the MdmDisp antenna icon and select textbfSettings in the context menu. Set **Connection type — Serial** and select COM-port of the radio modem.
- Right click to MdmDisp icon and select **Reconnect**.

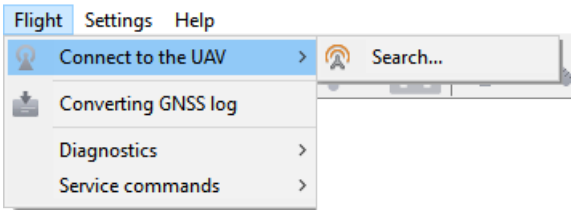
2.4 GHz Radio Modem Connection

1. Connect the radio modem to laptop's USB port.
2. Turn UAV power on.
3. Extract and launch *2.4GHz_Gemini_connect.exe* as administrator.
The command prompt window will be opened.



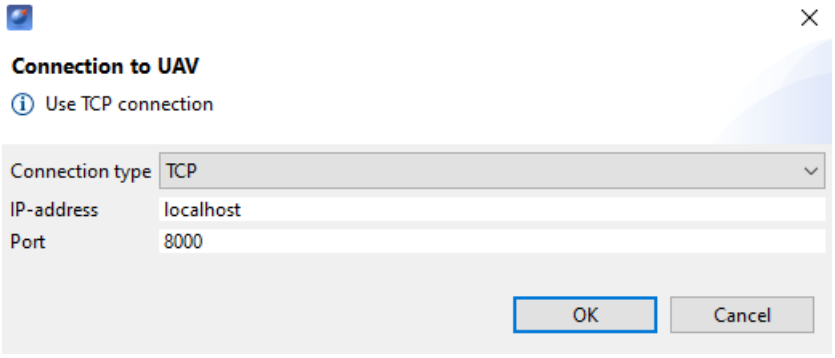
Command prompt window

4. Launch Geoscan Planner software.
5. Select **Connect to the UAV — Search...** in **Flight** tab.



UAV connection

6. Select **Connection type — TCP**, **IP-adress — localhost**, **Port — 8000** and press **OK** button.

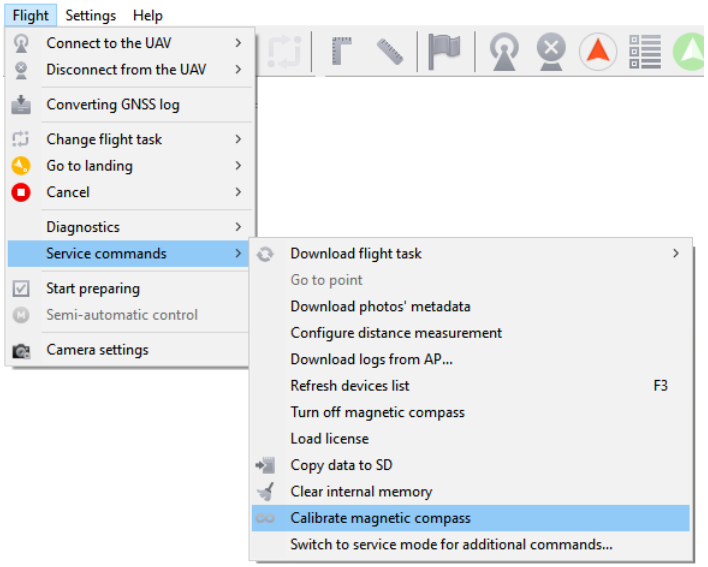


TCP connection

The connection with UAV will be initialized.

Magnetic Compass Calibration

Calibrate the UAV magnetic compass before flying over a new exploring area by select **Flight — Service — Calibrate magnetic compass**.

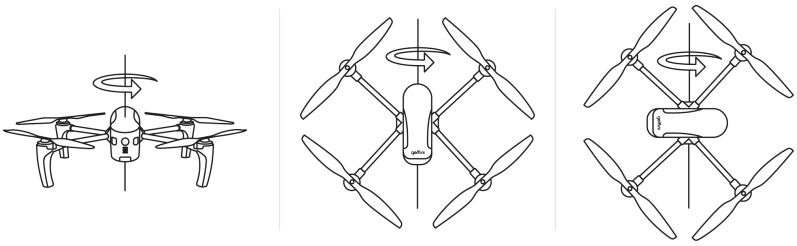


Calibrate magnetic compass

State on the thelemetry panel in **Errors** bar will change to **Mag calib**. The UAV LED indicator will lights yellow.

Errors bar

Rotate UAV in 360° on three-axises to calibrate the magnetic compass.

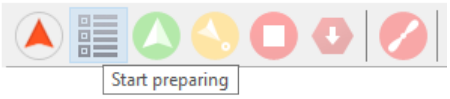


Magnetic compass calibration

After successful calibrating state in errors section will changed to **No**, and UAV LED will change color to green.

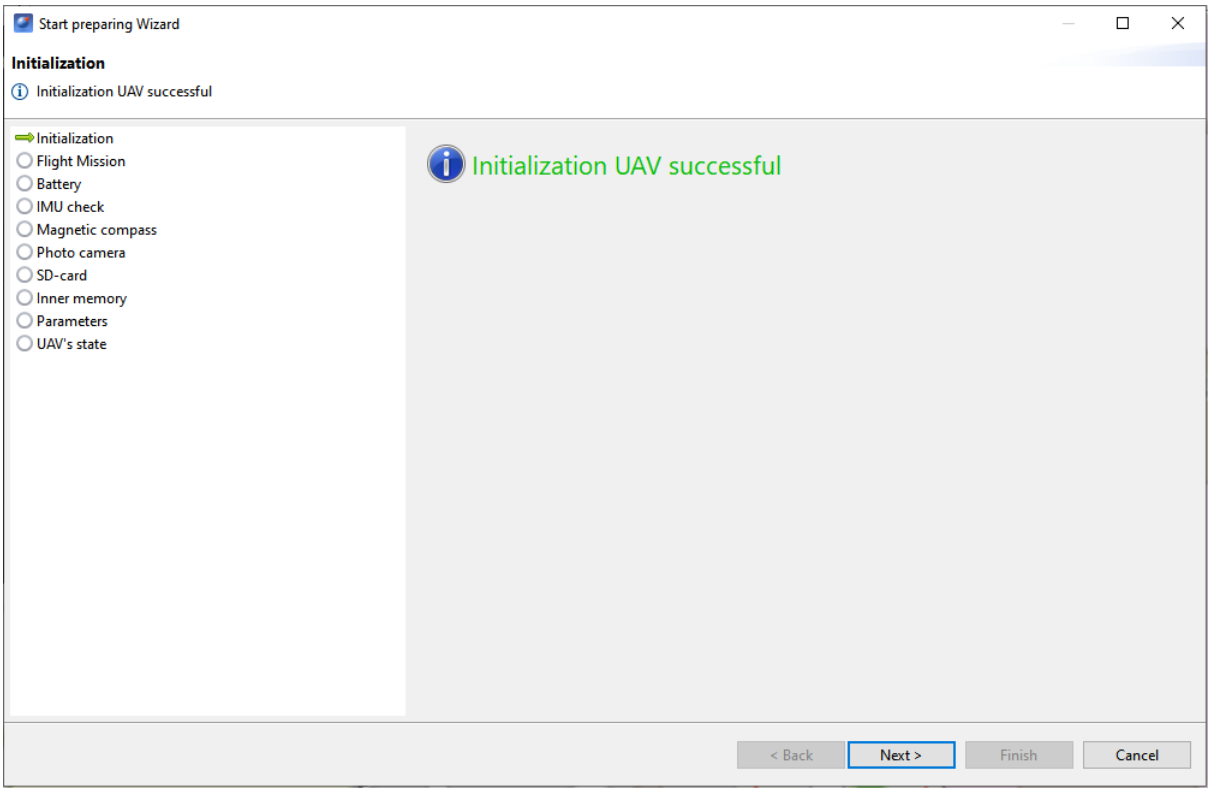
Start Preparing

Launch *Start Preparing Wizard*.



Start preparing button

Start preparing wizard window will be opened. Most checks are performed automatically. Follow instructions in the window.



Start Preparing Wizard

Preparing stages:

Initialization — Initialization of UAV systems.

Flight mission — flight task checking and sending into UAV memory.

Battery — battery life cycles, temperature and charge test.

IMU check — inertial measurement units (gyroscope and accelerometer) check.

Magnetic compass — magnetic compass check.

UAV orientation — manual setting of UAV start position without using a magnetic compass. Available when the magnetic compass is off.

Photo camera — Camera check. A test photo will be taken for testing.

SD card — SD card and file system check.

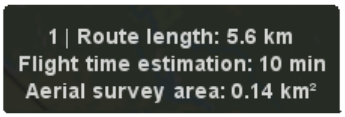
Inner memory — test of free space in UAV memory. The amount of required free space is calculated by flight route leight and calculated number of photos.

Parameters — allows to set an autonomous flight time (the time after which UAV will return to the start point after losing the connection) and the height of return flight. The return height must be appropriate to secure UAV from any flight barriers.

UAV's state — finish system check, which allows start UAV.

Errors description:

- **Flight task cannot be performed** — change a flight task.
- **Battery is not fully charged** — The flight may be performed, but be aware that the battery capacity may not be enough for a full-time flight. A fully charged battery can provide up to 40 minutes of flight time. Calculated flight time you can see on an aerial survey calculation bar at the bottom right corner.



Aerial survey calculation bar

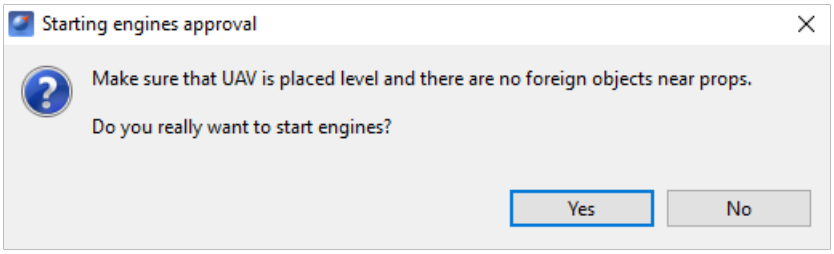
- **Compass error** — Calibrate the UAV magnetic compass. See *Magnetic Compass Calibration* section for details.
- **Camera error** — check the camera connector is plugged correctly. Contact our technical support if it doesn't help.
- **Low light image** — check the lens cap, light conditions and press **Repeat** button after that.
- **No SD card** — flight can be performed without SD card. In this case, internal memory synchronization with SD card will not be available after flight.
- **Not enough internal memory** — clear the UAV memory by pressing the **Clear memory** button or by USB Type-C connection.

Flight

Press **Start** button to launch UAV.

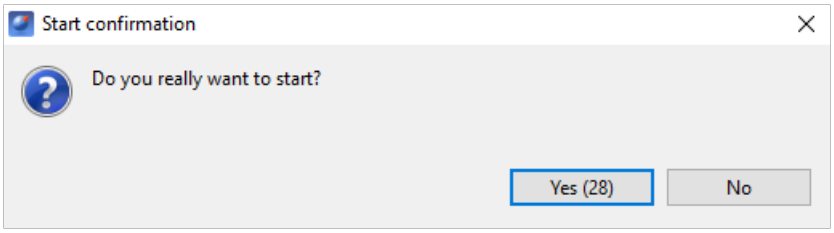
Start button

Make sure that nothing is blocking propellers' rotation and confirming the engines' start.



Starting engines approval

Autopilot will check engines. Approve take-off confirmation window will be shown on the laptop screen. Approve the take-off.



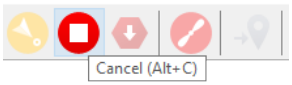
Start confirmation

UAV will take off.

UAV performs the flight in automatic mode, but the operator should monitor the flight process to aviod any deviations. All-time radio link connecton is not necessary for a successful flight.

Cancel Tool

Cancel tool directs the UAV to starting point. After reaching the starting point, UAV will perform the landing.
Press the **Cancel** button.

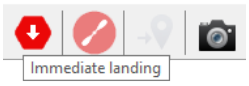


Cancel button

UAV will start flying to the starting point and and will land on it.

Immediate Landing

Immediate landing tool is used to perform immediate landing on the current flight point.
Press **Immediate landing** button.

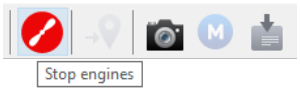


Immediate landing button

UAV will start landing.
Automatic landing is triggered by barometric height measurements. It's not recommend to land immediately at the point with the big difference in terrain compared to the takeoff point.

Engines Stop

Stop engines button provides manual UAV motors stop.



Engines stop button

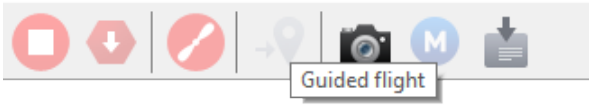
Press this button to stop low speed rotation of UAV propellers after safety landing.

Do not use this button for immediate UAV landing!
Engines stop at the flight provides UAV fall and damage!

Guided Flight

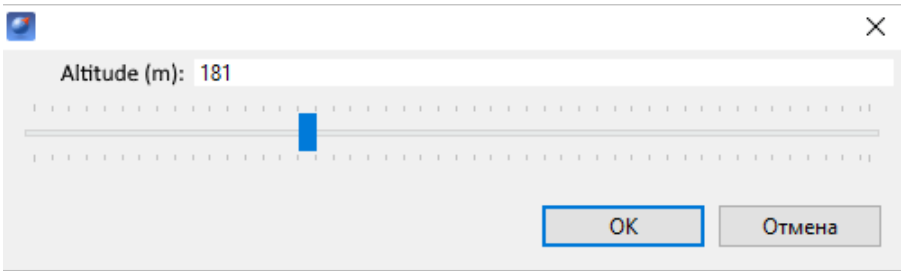
Guided flight option sets a destination point on the map and height. UAV will reach the point and start point holding until flight confirmation or until the automatic return is triggered by the battery low charge.

1) Press **Guided flight** button.



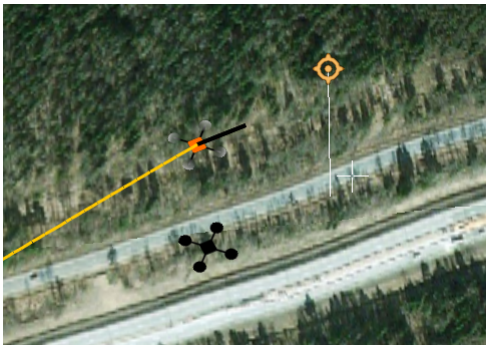
Guided flight button

2) Click a point on the map and set the flight height above the ground (Elevation).



Flight height setting

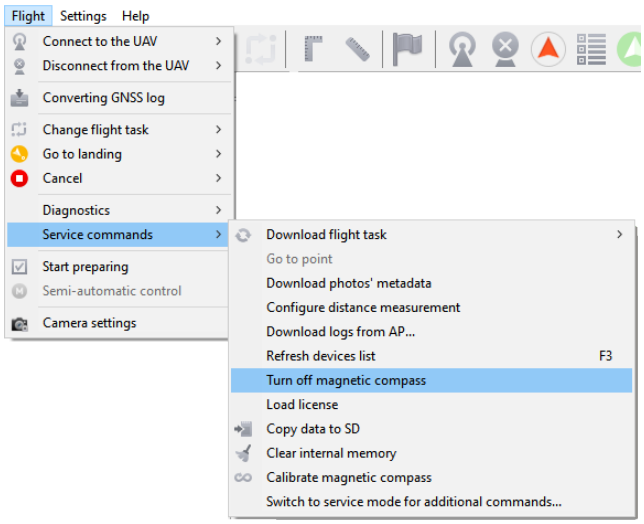
UAV will hold the point when it is reached.



Guided flight example

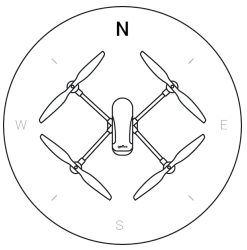
Flight Without Using Magnetic Compass

UAV can be used with turned magnetic compass off to avoid distortions of magnetic data (aerial survey in polar latitudes, metal structures near the flight route).
Select **Flight — Service commands — Turn off magnetic compass** to turn magnetic compass off.



Turn off magnetic compass

The UAV camera must be pointed to the north with an error no more than ± 10° when passing a start preparing.

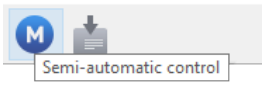


UAV positioning without using magnetic compass

In this case, damages are not covered by warranty, because UAV pilot is responsibile for a correct UAV positioning.

Semi-Automatic Control

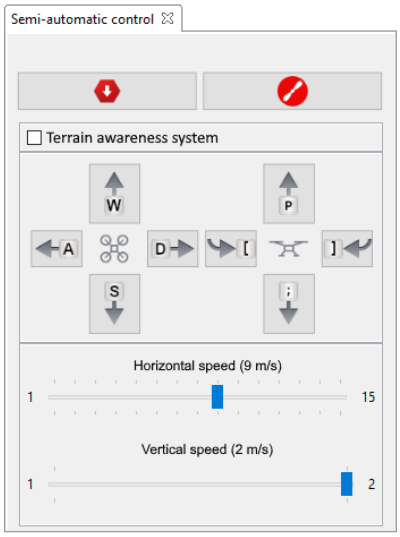
Semi-automatic control mode is possible after UAV pre-flight check and take-off.
Press **Semi-automatic control** button.



Semi-automatic control button

The UAV control will be switched to semi-automatic mode.
If the semi-automatic mode is activated, UAV autopilot will paused linear or aerial survey and will wait control commands (by screen buttons or keyboard) from UAV operator.
Immediate landing and *Stop Engines* buttons are placed on the top of semi-automatic control tab.

Stop engines button will trigged full motors' stop!
Make sure, that UAV is safety landed before use!



Terrain awareness system – higlights areas with high elevation differences on the map.

UAV control provided by navigation keys (on the screen or keyboard).

W – Forward

A – Left

S – Back

D – Right

P – Up

; – Down

[– Left rotation

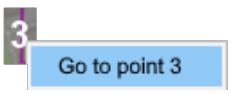
] – Right rotation

Use speed settings to correct UAV speeds:

Horizontal speed – UAV horizontal speed manual control

Vertical speed – UAV vertical speed manual control

Press Semi-automatic control button again to turn mode off.
After you turining semi-automatic mode off, UAV will hold flight position.
Set flight mission point by right mouse button click on the route point and select **Go to point** to continue flight mission from this point.



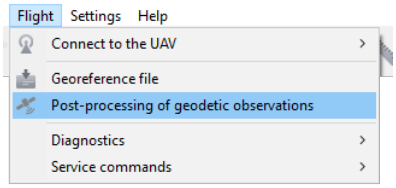
GNSS Data Post-Processing

Onboard geodetic observations and GNSS raw data post-processing are available for last firmware updates. Make sure that you installed last versions of Geoscan Planner software and UAV firmware updates. You also need GNSS base coordinates file for post-processing (GNSS base is not included in Geoscan Gemini kit).

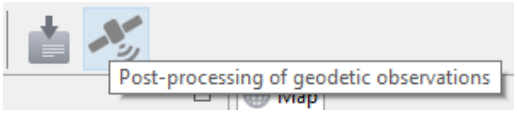
UAV will start GNSS data converting process and SD card data copying (if SD card installed) after finish of the flight mission. UAV LED indicator will blink blue during data copying and processing. Wait for the end of copying process. The LED will change color to green.
After that, you can copy data form SD card or internal memory and export them in Geoscan Planner post-processing tool.

With the latest Gemini firmware update, the GNSS log is converted to RINEX automatically after flight mission end, but GNSS log of base should be converted in RINEX by software that recommended by the manufacturer of GNSS base.

Follow these instructions after GNSS base data converting and data coping to PC:
1) Select **Post-processing of geodetic observations** in **Flight** tab.
Also post-processing button is available on the toolbar in Player mode.

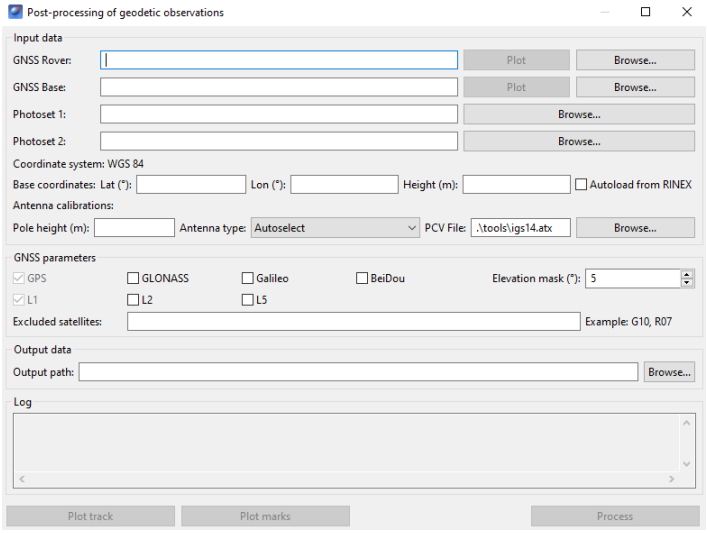


Post-processing of geodetic observations



Post-processing button in Player mode

Post-processing input window will be opened:



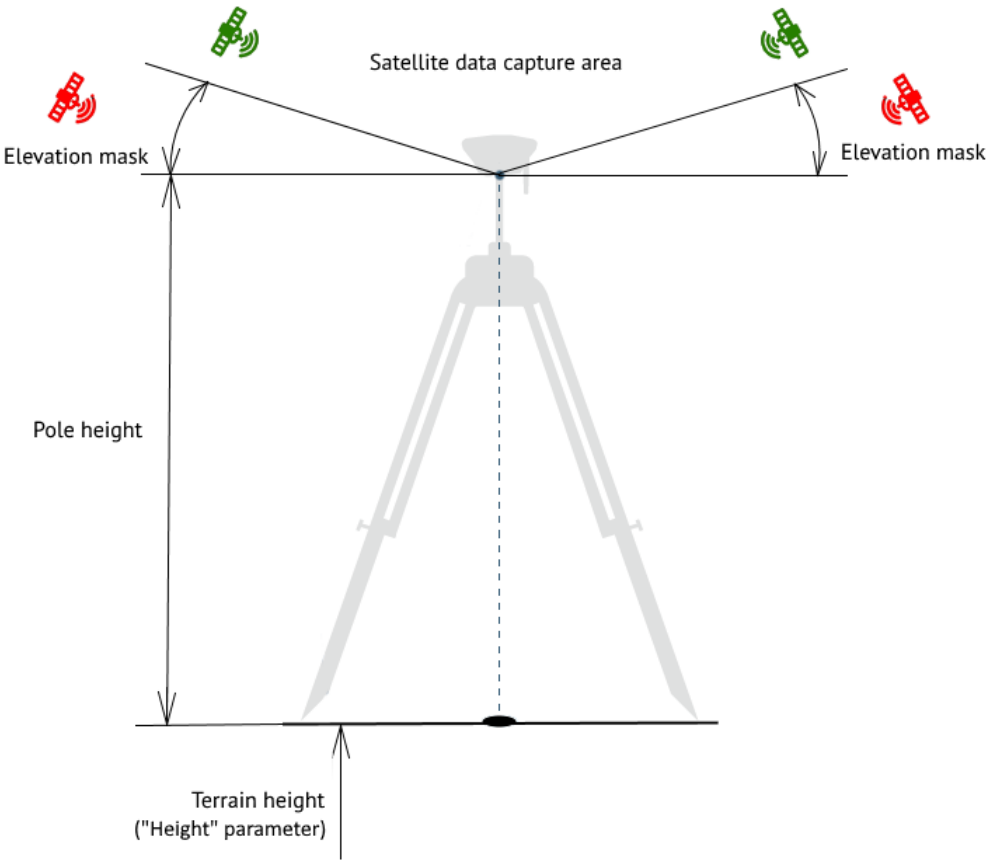
Post-processing input window

2) Set the path to UAV rinex *.obs file in **GNSS rover** field.
3) Set the path to RINEX file of base in **GNSS base** field.
Use the Plot buttons to see data's graphs.
4) Set the path to aerial photos in **Photoset 1** field.

Note: **Photoset 2** field is used for UAVs with 2 cameras. No need to be specified for the Gemini.

5) Set the base coordinates and height (terrain height in GNSS base position). This data can be imported from RINEX, but not always registered by GNSS bases.
6) Set antenna's **Pole height** (the distance from the terrain to base internal GNSS receiver) and **Antenna type**.
Antenna type field depends on loaded from *.PCV file data. Geoscan Planner software uses igs14.atx file, which located in Geoscan Planner directory and contains commonly GNSS bases offsets. The path can be changed in **PCV file** field.
7) Set GNSS signals in **GNSS Parameters** section and **Elevation mask** (the angle, that uses for GNSS signals ignoring). The Elevation mask parameter serves to provide better satellite data quality, because objects at a small elevation angle can be case for distortions in satellites signals.

The picture shows GNSS base parameters, with requires for post-processing:



GNSS base parameters

Also you can set ignored satelites' signals (G01,G02...) in **Excluded satelites** field.

8) Set the path for output data in **Output data** field.

9) Press **Process** button after specifing all settings.

During the processing GNSS track coordinates will be exported in photos' metadata (EXIF-tags) with time tags connection. The results will be structed and stored in *.pos file.

Use **Plot track** and **Plot mark** buttons to see data graphs.

Post-processing is based on open source RTKlib package.
More information about data analysis you can see in RTKlib documents:
http://www.rtklib.com/rtklib_document.htm

Launch

Use this section to check pre-flight actions.

1) Charge the flight battery (see *Charge mode* section for more details).
2) Create a flight task in Geoscan Planner
   (see *Geoscan Planner Software* section for more details).
   Save the project to quickly load a flight task before the flight.
3) Attach propellers to motor shafts and install the flight battery in UAV battery slot.
   (see *Assembly* section for more details).
4) Format SD card in FAT32 file system and install it to SD card slot.
5) Remove the lens cap from the camera.
6) Install UAV on the launch pad and make sure, that the propellers are rotates without any problems.
7) Press the battery control button once, again, and hold until all LEDs are lights first time (2 seconds), to turn UAV on and wait for system initialization.
8) Open a project in Geoscan Planner. Connect the UAV. Launch the Preparing wizard. Make sure, that pre-launch check is successful.
9) Press *Start* button in Geoscan Planner.

UAV will take off and start the flight task.

After completion of the flight task, UAV will automatically land to the start point, if another landing point is specified (see *Landing point* section for more details).
The *Cancel* tool also sends the UAV to land at the starting point.

UAV Disassembly

1) Disable UAV in the same way as you turn it on (Press the battery control button once, again, and hold until all LEDs are lights first time).
2) Attach the lens cap to the camera lens.
3) Press ejecting buttons of the battery and eject remove it from UAV battery slot.

Always turn UAV off before removing the battery!

4) Hold the motor's rotor and remove each propeller by rotating it in the opposite direction to what is indicated on the propeller's icon.. Place propellers in the transport case.
5) Eject SD card from SD card slot.

Appendix

Specifications

Aircraft

Aerial vehicle type	multirotor
Motors	electric brushless motors, 4 PCs
Weight (battery & propellers included)	1,9 kg
Diagonal size (excluding propellers)	550 mm
Max. flight time	40 min
Max. flight speed	vertical: 5 m/s, horizontal: 15 m/s
Max. flight altitude (ASL)	4000 m
Max. flight altitude (AGL)	500 m
Max. wind resistance	10 m/s
Operating temperature	from -15 to +40 °C

Flight Battery

Battery type	Li-Ion
Voltage	21,6 V
Weight	710 g
Capacity	6700 mA·h
Energy	144,7 W·h
Operating temperature	from -15 to +40 °C

Sony UMC-R10C Camera

Max. resolution	5456 × 3632 (20.1 MP)
Sensor size	APS-C (23.2 × 15.4 mm)
Shutter type	mechanical, shutter speed, focal-plane
Focal length	20 mm
Max. aperture	f/2,8
ISO range	100 – 16000
Mechanical shutter speed	1/4000 – 30 sec
Camera center offset (relative to the phase center of the onboard GNSS antenna)	X: 0 m Y: -0,0721 m Z: 0,0953 m

JAVAD TR-2S GNSS Receiver *

Number of channels	874 universal tracking channels
Acquisition time (hot/cold start)	<5/<35 sec
Signals tracked	GPS: L1/L2/L5; GLONASS: L1/L2/L3; Galileo: E1/E5A/E5B/ALTBOC/E6; BeiDou:B1/B1C/B2A/B2B/ALTBOC/B3
Positioning accuracy (PPK)	horizontal: 10 mm + 1 ppm × baseline length; vertical: 15 mm + 1 ppm × baseline length

U-blox ZED-F9 GNSS Receiver *

Number of channels	184 universal tracking channels
Acquisition time (hot/cold start)	<2 / <25 sec
Signals tracked	GPS: L1/L2; GLONASS: L1/L2; Galileo: E1B/E1C/E5c; BeiDou: B1I/B2I
Positioning accuracy (PPK)	horizontal: 10 mm + 1 ppm × baseline length; vertical: 10 mm + 1 ppm × baseline length

Topcon B111 GNSS Receiver *

Number of channels	226 universal tracking channels
Acquisition time (hot/cold start)	<15 / <44 sec
Signals tracked	GPS: L1/L2; GLONASS: L1/L2
Positioning accuracy (PPK)	horizontal: 5 mm + 0.5 ppm × baseline length; vertical: 10 mm + 0.8 ppm × baseline length

868 MHz Radio Modem *

Operating frequency	867.75 – 872.25 MHz
Transmitting power	<100 mW
Max. bandwidth	500 kb/s
Max. delay	20 ms
Duplexing mode	TDD
Max range	5 km

2.4 GHz Radio Modem *

Operating frequency	2402 – 2480 MHz
Transmitting power	<100 mW
Max. bandwidth	125 kb/s
Channel separation method	FDK
Duplexing mode	TDD
Max range	5 km

Battery Charger

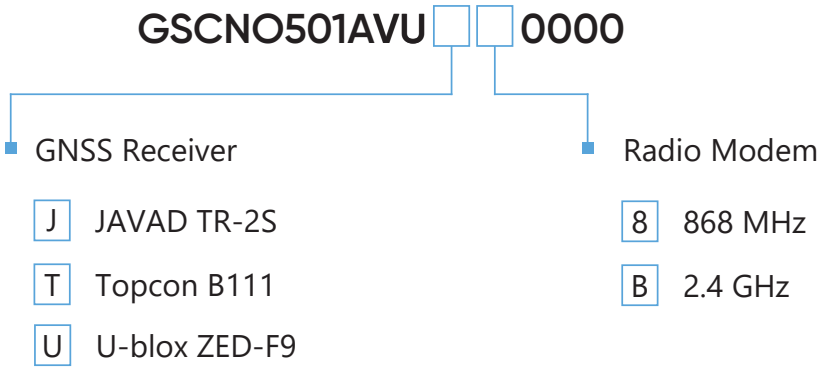
Input voltage	100-240 V
Max. input current	2 A
Max. charge current	6 A
Max. discharge current	120 mA
Charging time	105 min
Operating temperature	from 0 to +40°C

Transport Case

Dimensions	638 × 505 × 224 mm
Weight (including all parts of the system)	10 kg
Protection class	IP67
Wheeled	no

* — Radio modem and GNSS reciever type depends on delivery package

Equipment Identification



Geoscan, LLC, 2021