MANUAL

MariMag marine magnetometer

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INTRODUCTION

This Operation Manual (hereinafter referred to as Manual) is intended to study the device, principle of operation, and correct use of MariMag marine magnetometer (hereinafter referred to as the magnetometer / device / product).

This Manual contains information about configuration, design, principle of operation, technical characteristics of the magnetometer, and operational limitations; instructions for work preparation, use, transportation, and storage; safety instructions; disposal instructions and other information regarding the magnetometer necessary for its correct use, to maintain the operational reliability and safety of the instrument.

IMPORTANT: WARRANTY AND POST-WARRANTY REPAIRS OF MAGNETOMETER ARE ONLY CARRIED OUT IN MANUFACTURER'S FACILITY OR SPECIALIZED GEOPHYSICAL SERVICE FACILITY BY SPECIALISTS TRAINED AND CERTIFIED BY GEODEVICE.

The requirements of this Manual are mandatory for all persons involved in operation, storage, transportation, further disposal, and other manipulations with the magnetometer.

This manual should always be within reach from the place of operation of the device and be accessible to the users.

The operational reliability and safety of the magnetometer are only guaranteed if all of the following conditions are met simultaneously:

- the device is used strictly for the intended purpose;
- magnetometer is used in environment and conditions allowed by operational documentation;
- compliance with instructions for use, safety measures and all other recommendations and requirements of this manual.

IT IS FORBIDDEN TO OPEN / DISASSEMBLE THE MAGNETOMETER, AS WELL AS TO MAKE CHANGES IN DESIGN OF THE DEVICE, TO UPGRADE IT WITHOUT AGREEMENT OF THE MANUFACTURER.

In case of violation (non-compliance) of the requirements of this Manual, the Manufacturer GEODEVICE is not responsible for arising consequences (accidents, damage to property, injuries, etc.).

GEODEVICE is constantly upgrading its equipment and reserves the right to make changes to design, technical characteristics, and delivery set of magnetometer. In this regard, there may be insignificant differences between the magnetometer described in this manual and the supplied one, which do not affect the conditions of its operation.

1. DESCRIPTION AND WORK PRINCIPLES

1.1 Device description

1.1.1 Use

MariMag – a modern marine magnetometer operating on Overhauser effect designed to perform geophysical, geotechnical and prospecting surveys in shallow or deep water. The instrument is designed to measure magnetic field with high sensitivity and absolute accuracy.

1.1.2. Specification and dimensions

Table 1. Specification and dimensions of MariMag magnetometer

Specification	Value
Magnetometer	
Dynamic range	18 000 ÷ 120 000 nT
Absolute accuracy	0.1 nT
Sensor sensitivity	0.01 nT
Resolution	0.001 nT
Orientation error	0.1 nT (±180°)
Gradient tolerance	30 000 nT/m
Sample rates	5 Hz – 0.1 Hz
Interfaces	Ethernet
Power supply	24 ÷ 36 VDC or 100 ÷ 240 VAC
Dimensions (length/ diameter)	1 680 / 120 mm
Weight in air	13 kg
Built-in sensors	3C compass, accelerometer, leak detector, pressure and humidity sensors
Operation limitations	
Operating temperature	-20 ÷ +60 °C
Storage temperature	-40 ÷ +70 °C
Depth rating	300, 1 000 or 3 000 m
Tow cable	
Type	Twisted pair
Breaking strength	2 500 kg
Outer diameter	13 mm – standard / 20 mm – floating
Weight in air	125 g/m – standard / 250 g/m – floating
Weight in water	46 g/m – standard / -20 g/m – floating

1.1.3 Delivery set

The delivery set depends on the ordered type of marine magnetometer and additional options:

- MariMag magnetometer
- Tow cable
- Isolation transceiver
- Power supply
- Ethernet cable
- Deck cable
- Data acquisition, visualization & control software
- Operation manual
- Spare parts kit
- Shipping/storage case

Optional components:

- Altimeter
- Deck reel for tow cable
- Deck winch for tow cable

Figure 1 – Marine magnetometer MariMag

Transportation of the marine magnetometer MariMag is carried out in sealed, impact-resistant plastic cases.

1.1.4 Theory

To measure geomagnetic field the magnetometer uses the phenomenon of free precession of protons in a pre-polarized liquid under Earth's magnetic field impact. The polarization of the nuclei is enhanced by the Overhauser effect (dynamic polarization of the nuclei).

The Overhauser effect is a phenomenon that uses electron-proton interactions to achieve polarization of protons. To implement this effect, a specially developed liquid rich in protons that contains a free radical (an atom with an unbound electron) is used in the magnetometer. When exposed to radio frequency current unbound electrons transfer energy to neighboring protons. This allows protons' polarization without the need for a very strong magnetic field. Therefore, such sensors can generate high amplitude signals with a high signal-to-noise ratio, with only a few watts power consumption. Standard proton sensors cannot generate signals of such magnitudes and quality, even when consuming several hundred watts.

Each measurement cycle basically consists of two events:

1. Polarization - the proton rich fluid in primary transducer is affected by constant high-frequency magnetic field so that proton rotation axis turns orthogonally to the induction vector of the Earth's magnetic field.
2. Measurement - the polarization field is shut off and free precession of protons around the Earth's magnetic field vector begins. In low frequency coils of primary transducer, an electromotive force is induced in the shape of a damped sinusoid, the frequency of which is proportional to the induction of the Earth's magnetic field:

$$F = \frac{T}{\gamma},$$

where F —precession frequency,

T — magnetic field induction,

$\gamma = 23{,}4871985\ \frac{\mathrm{n}T}{Hz}$ — proton gyromagnetic ratio.

1.1.5 Packaging

The device is supplied in a shockproof plywood case. The packaging complies with safety requirements and ensures the device is water- and dust-protected.

1.2 Description of MariMag system components

Figure 2 – Equipment of the marine magnetometer MariMag

1 – Deck reel with slip ring;
2 – Tow cable;
3 – MariMag magnetometer;
4 – Weight;
5 – Shipping/storage case;
6 – Battery charger;
7 – Ethernet cable;
8 – Isolation transceiver with built-in GNSS receiver;
9 – Power cable;
10 – Adapter;
11 – Deck cable;
12 – Battery power supply;
13 – Power supply 100 ÷ 240 VAC.

MariMag Magnetometer

The magnetometer is used to direct measurement of the geomagnetic field module and is designed to receive a signal of free precession of protons of the working substance placed in the measured magnetic field. The magnetometer contains a glass ampoule with a working substance placed in a high-frequency circuit (HF-circuit), on top of which are wound LF-coils. LF-coils are designed to register the precession signal.

Weight

The weight serves to deepening the magnetometer to the required depth.

Isolation transceiver with built-in GNSS receiver;

The recorder is designed to exchange information between magnetometer and PC. Built-in receiver is used to receive GNSS signal to determine the current location of the device.

Battery power supply

It is used to power the electronic components of the magnetometer. A lead-acid battery with a voltage of 24 V and a capacity of 9 Ah is used as a power source.

Power cable

This cable is used to connection between battery power supply and isolation transceiver.

Battery charger

It is used to charge the battery power supply from AC network 220 V, 50 Hz.

Power supply 100 ÷ 240 VAC

It is used to power electronic components magnetometer from AC network 220 V, 50 Hz.

Ethernet cable

This cable serves to connection between isolation transceiver and PC.

Tow cable

This cable is serves to towing magnetometer and data transfer between the magnetometer and the isolation transceiver.

Deck cable

This cable is used to extend the tow cable on the deck of the vessel or connect between the deck reel and isolation transceiver.

Adapter

The adapter serves to connection between tow cable and deck cable during to working without reel.

Deck reel with slip ring

The reel serves to winding/unwinding tow cable for comfort work.

Data acquisition, visualization & control software

The software serves to control and acquisition marine magnetometer`s data. The software allows you to control all parameters of the magnetometer, graphically display the received data and geographically represent the movements of the vessel and the magnetometer on the terrain map.

Shipping/storage case

The case serves to storage and shipping of the magnetometer`s components.

2. INTENDED USE

2.1. Operational limitations

MariMag magnetometer is designed for operation in field conditions at ambient temperatures from - 20 to + 60° C.

Abrupt temperature fluctuations that could cause condensation should be avoided.

MariMag is a precision instrument and must be handled with care. Avoid drops and impacts when working with the device.

2.2. Preparing to use the device

2.2.1. The order of actions to prepare MariMag magnetometer for use

1. Examine all parts of the device and make sure that:
- the magnetometer kit is complete in accordance with the manual and the type of survey to be performed;
- there is no damage on the magnetometer blocks;
- there is no damage to connecting cables and connectors;
- there is no contamination of connectors and deck parts of the instrument.

IT IS **FORBIDDEN** TO USE THE MAGNETOMETER IF IT IS DAMAGED OR SIGNIFICANTLY CONTAMINATED OF CONNECTORS AND DECK PARTS OF THE INSTRUMENT.

2. If necessary, recharge the battery.
3. Place a weight on the magnetometer.
IMPORTANT: When installing the weight, orient it relative to the magnetometer towfish so that the pressure sensor downward and is aligned with the weight on the clamp (Figure 3).

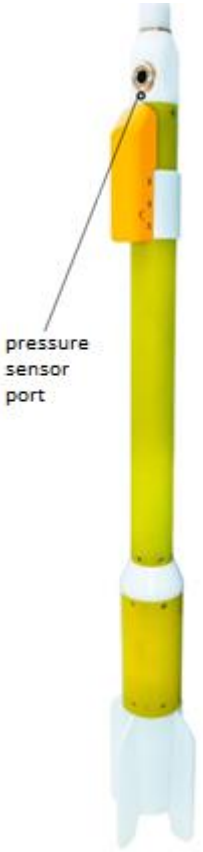


Figure 3 – Magnetometer with the weight

4. Plug tow cable into magnetometer socket.

Figure 4 – Tow cable connected to magnetometer socket

5. Plug deck cable into deck reel socket.

Figure 5 – Socket for connection between deck cable and reel

Figure 6 – Deck cable

When work is carried out without reel the connection of the deck and towing cables is made by adapter.

Figure 7 – Adapter tow and deck cables

6. Connect the deck cable to the appropriate socket on the isolation transceiver.

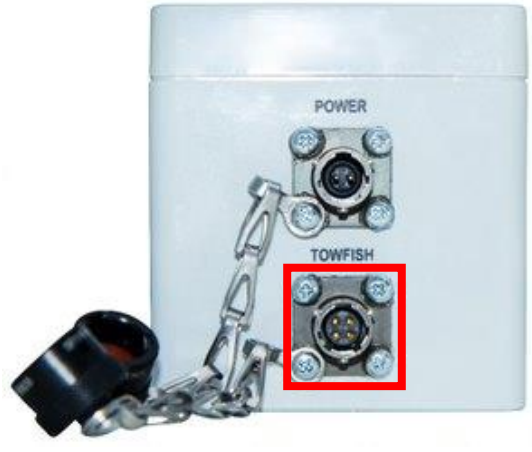


Figure 8 – Socket for connection between deck cable and isolation transceiver

Figure 9 – Deck cable

7. Connect the power supply to the appropriate socket of the isolation transceiver. The power supply can be a 100 ÷ 240 VAC power supply unit or a 24 VDC battery power supply unit with a power cable.

In case of using 100 ÷ 240 VAC power supply unit, connect it to the appropriate socket of the isolation transceiver and connect it to 220 V AC mains.

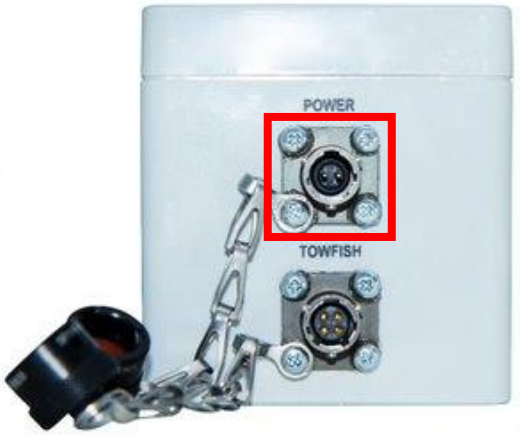


Figure 10 – Socket for connection between power supply and isolation transceiver

Figure 11 – Power supply 100 ÷ 240 VAC

If a battery power supply is used, connect it to the appropriate socket on the isolation transceiver using the power cable.

Figure 12 – Battery power supply

Figure 13 – Power cable

8. Connect the Ethernet cable to the appropriate socket on the isolation transceiver.

Figure 14 – Socket for connection between Ethernet cable and isolation transceiver

Figure 15 – Ethernet cable

2.2.2. The order of actions to prepare magnetometer software for use

1. Turn on your computer (Windows 10 PC is required for correct operation) and connect the isolation transceiver to it with Ethernet cable.
2. Set the Ethernet network settings manually, for this purpose:
Click on the "Status" field in the "Network and Internet" section in the left side menu of the network settings;

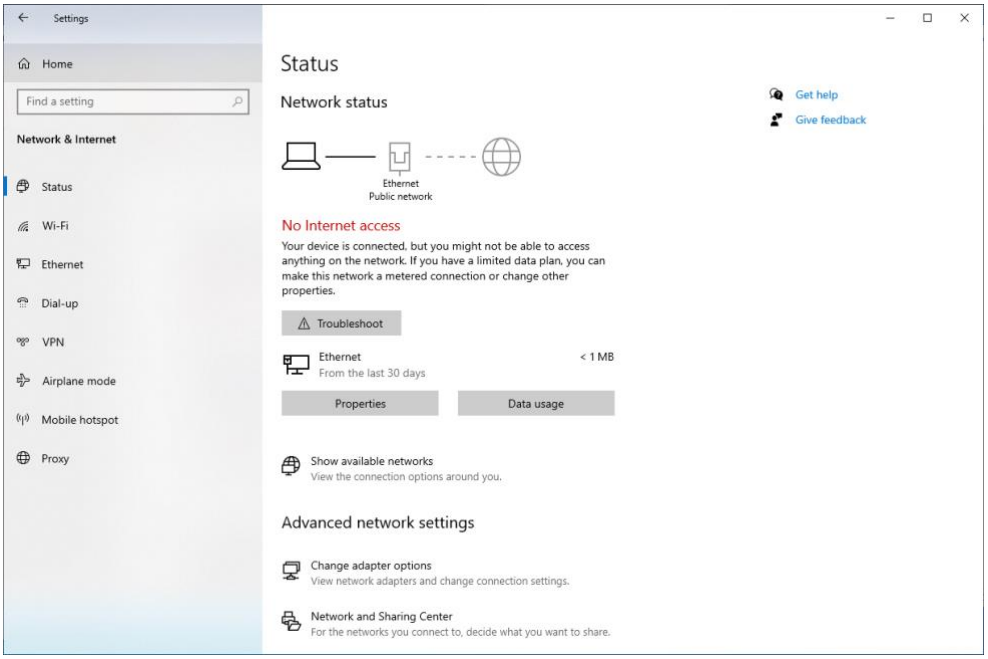


Figure 16 – Status tab in the Network and Internet section

Select “Change adapter options”.

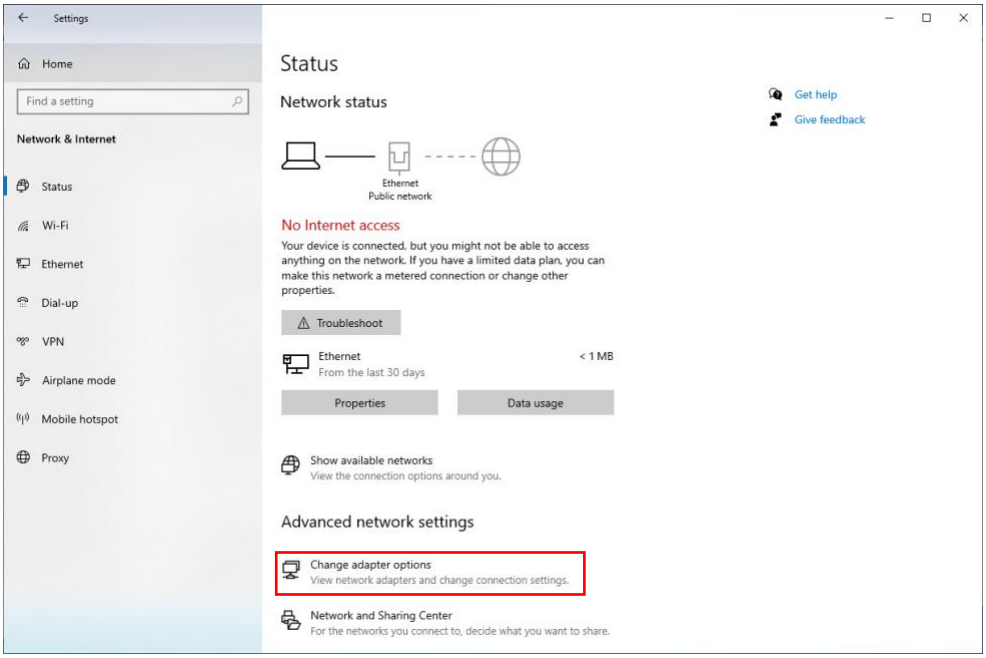


Figure 17 – Choose “Change adapter options”

Right click on the unrecognized network and select "Properties".

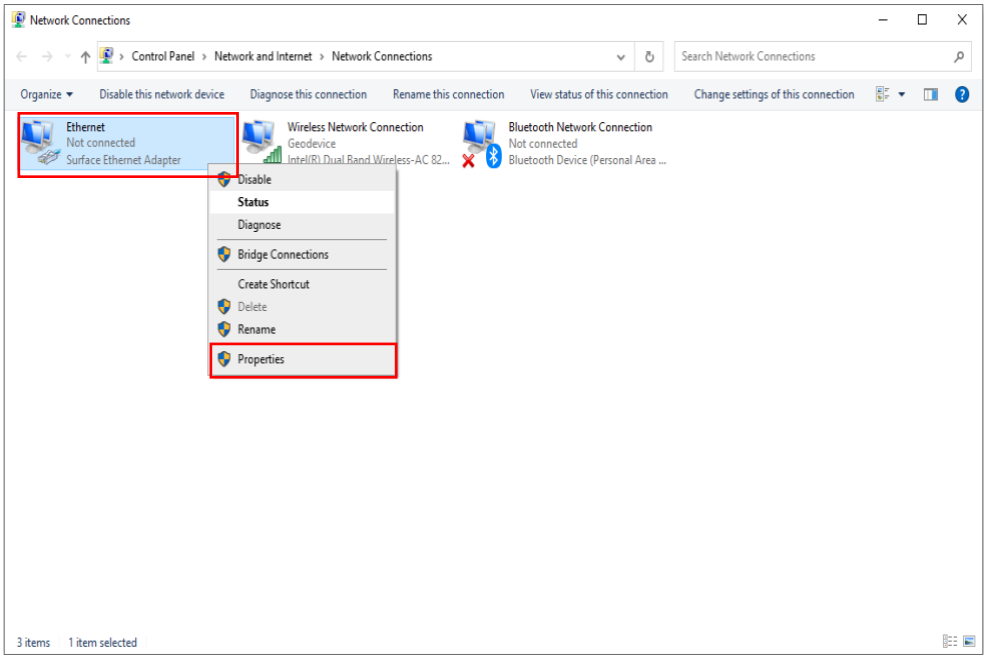


Figure 18 – Adjusting the adapter settings

Select the protocol version "IP version 4 (TCP/IPv4)" and click "Properties".

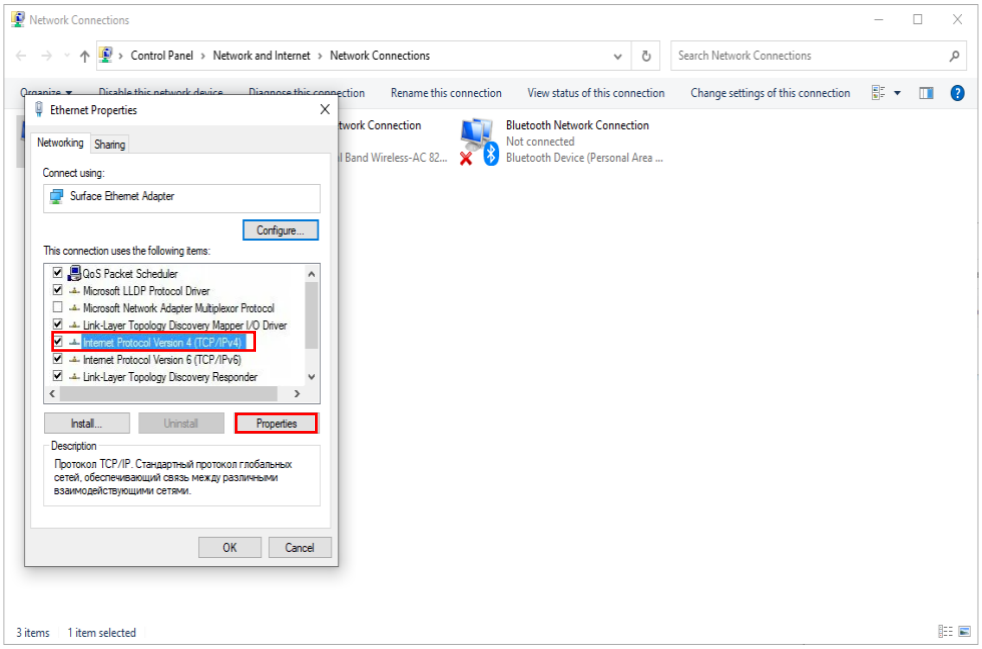


Figure 19 – Selecting the protocol version "IP version 4 (TCP/IPv4)" and its "Properties"

Click "Use the following IP address" and enter in the field:
IP-address: 192.168.1.1,
Subnet mask: 255.255.255.0,
Default gateway: 192.168.1.254.

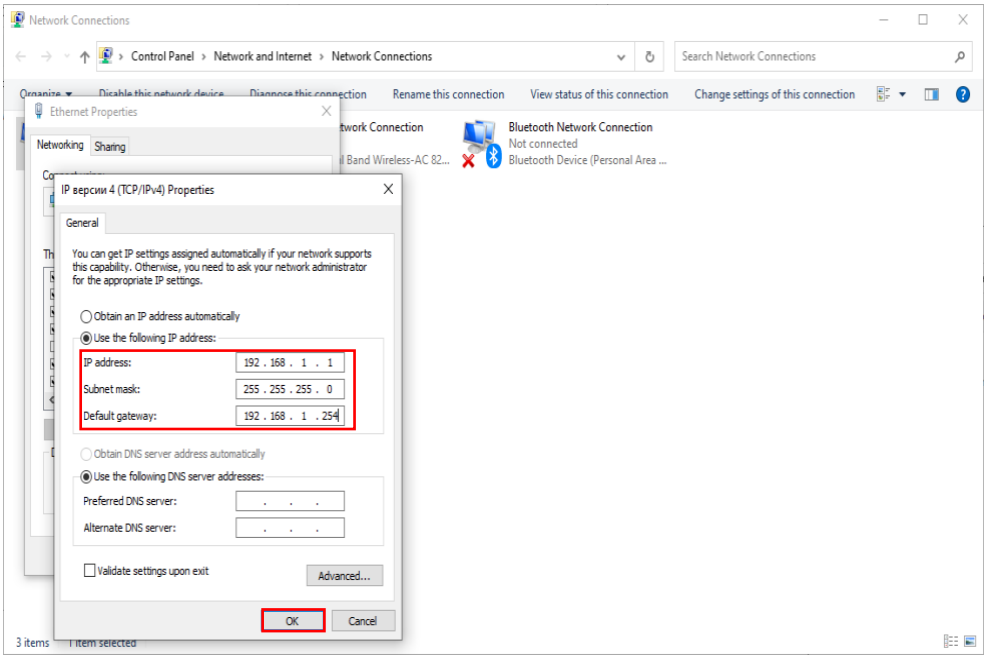


Figure 20 – Entering the required network settings

Press «OK».

2. You must disable "Windows Defender Firewall" for the software to work properly. Click on "Windows Security" under "Update and Security" in the left side menu.

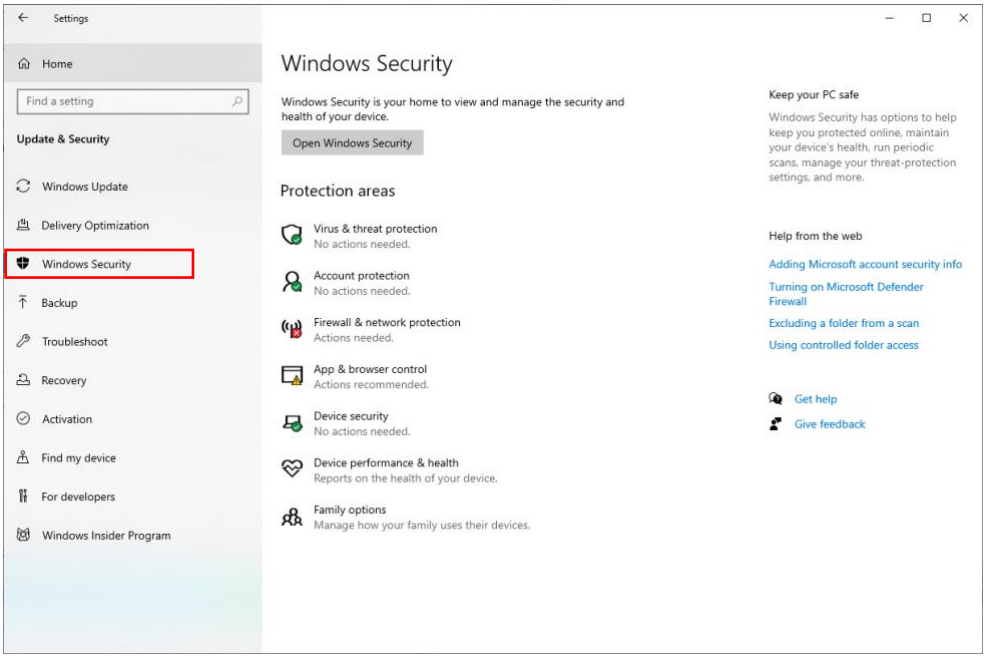


Figure 21 – Selecting the "Windows Security" window

Select “Firewall & network protection”.

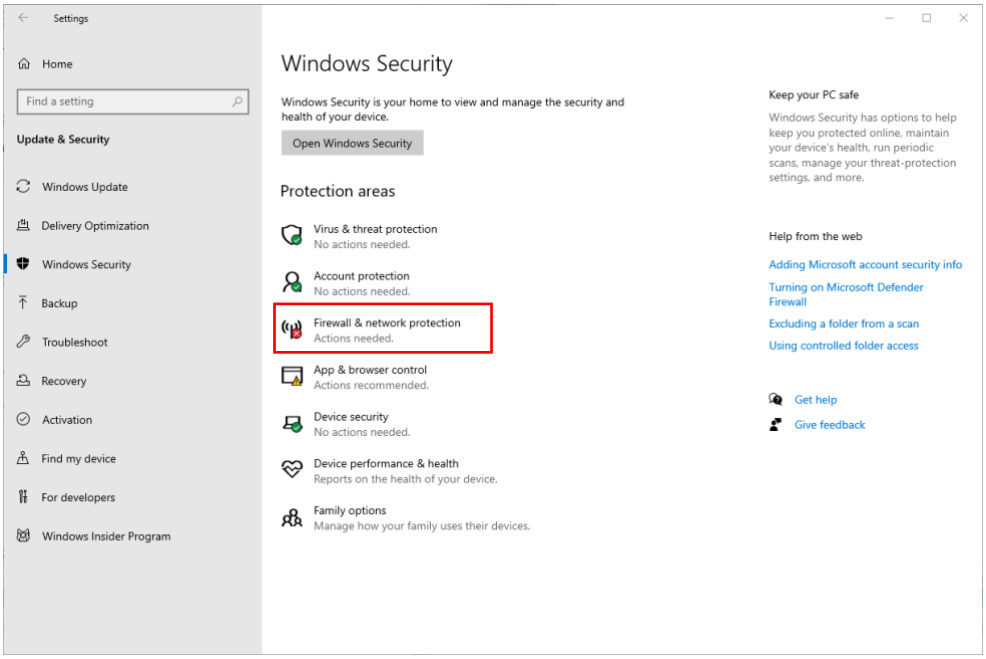


Figure 22 – "Firewall & network protection"

Click on "Private Network".

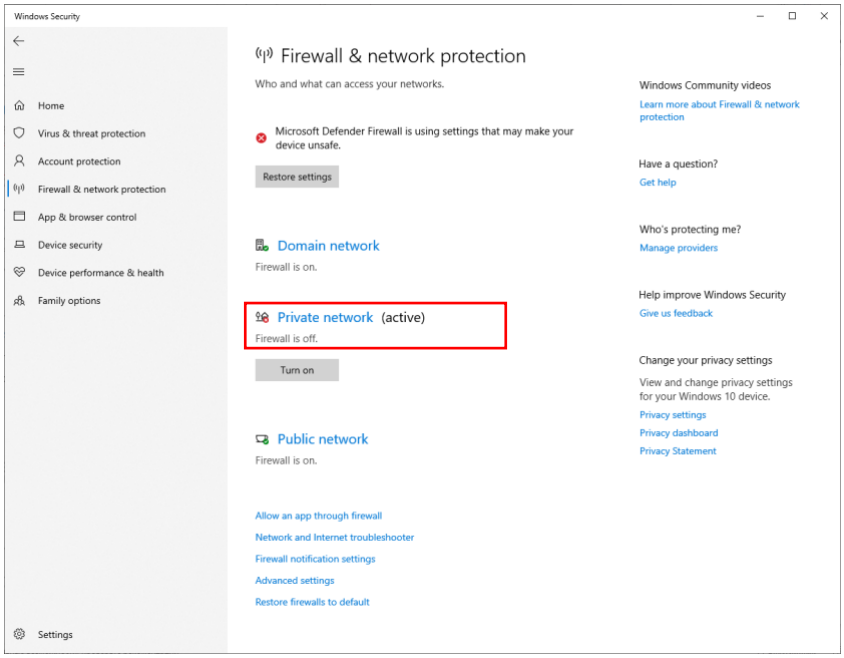


Figure 23 – Select "Private network"

Disable protection by dragging the slider to the left.

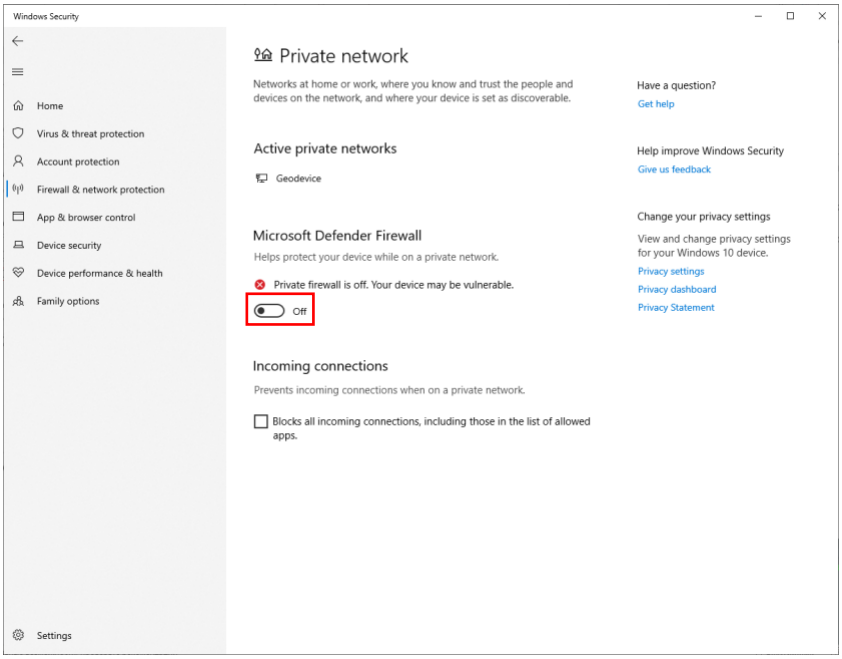


Figure 24 – Protection shutdown

3. Download the archive with the magnetometer data acquisition and visualization software from the page https://geodevice.co/product/marimag/ in the "Download" section.
4. Unpack the archive.

2.3. Use

Extract the downloaded archive and open the folder. Run the data acquisition and visualization program ***marimag_setup.exe*** (Figure 25).

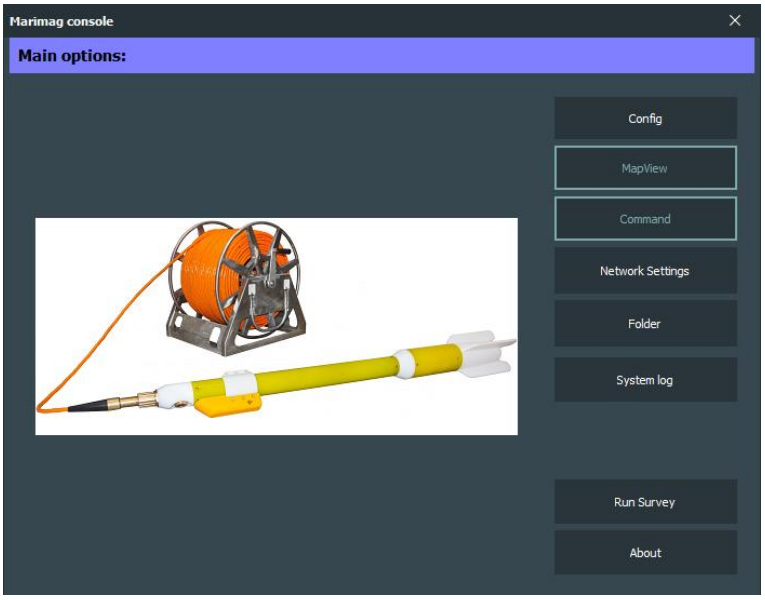


Figure 25 – Main window of the data collection and visualization program

2.3.1. Data collection and visualization software

2.3.1.1. Specifying a shooting title and selecting a data storage directory

To set the survey title, click the "Config" button in the main program window (Figure 25). This will open a window (Figure 26) with the possibility to enter the survey title (Title), survey location (Origin), organization name (Surveyor) and additional comments (Comments).
All data recorded during fieldwork is saved to a separate "measurements" folder, which is in the "workspace" folder in the same directory as the software (Figure 27).

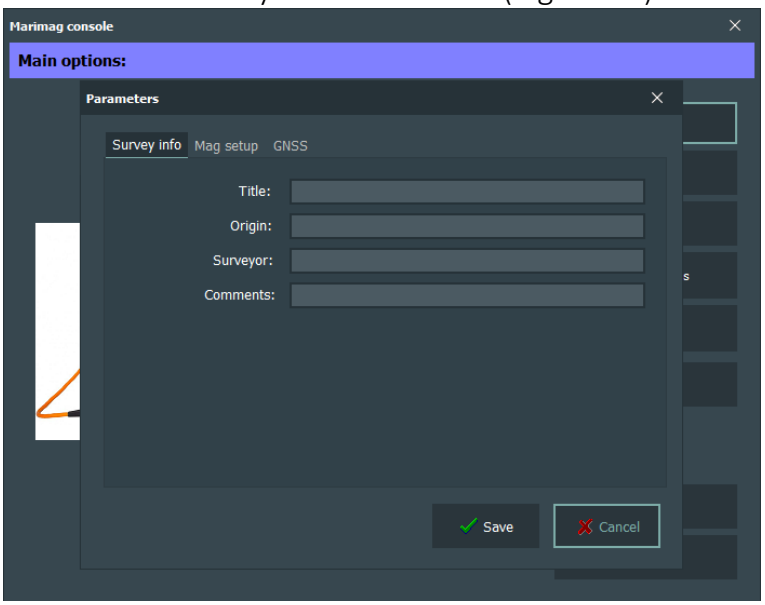


Figure 26 – Survey name setting window

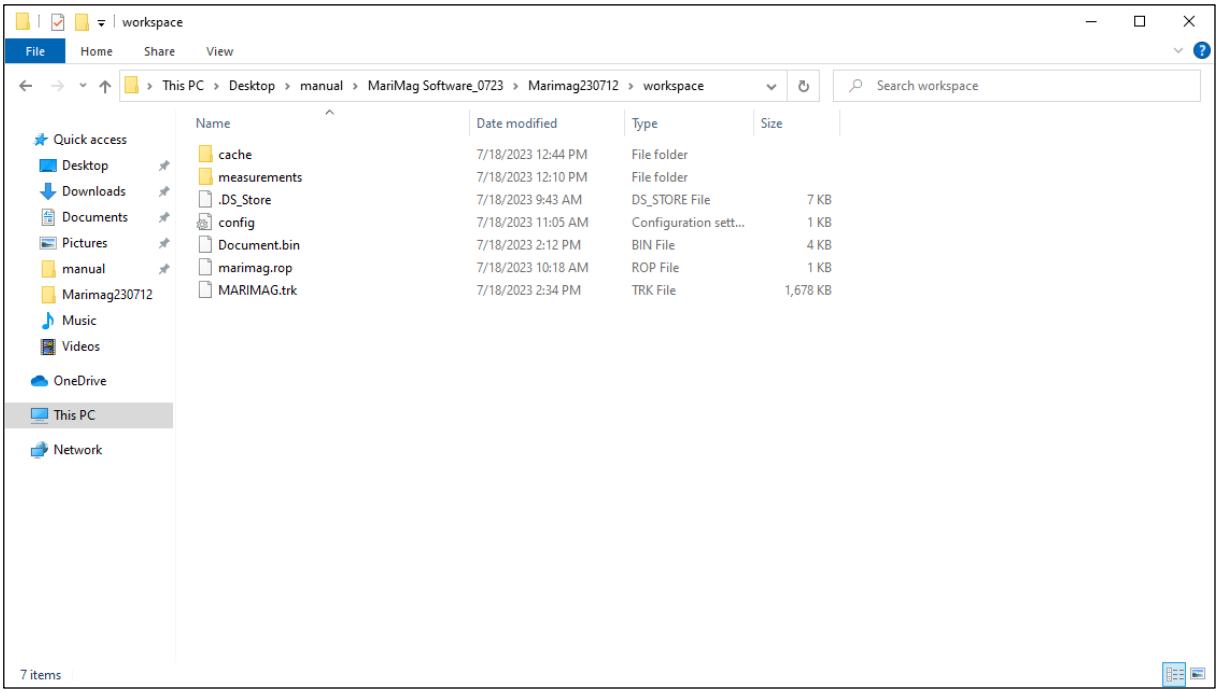


Figure 27 – Storage directory window

2.3.1.2. Setting the device configuration

To select the magnetometer configuration click the "Config" button in the main program window (Figure 25). This will open a window (Figure 26), where you should select the "Mag setup" tab (Figure 28) with the possibility to select the type of device (single magnetometer, longitudinal gradiometer or transverse gradiometer) (Figure 29), setting of the device distance from the reel or tow point in meters (Layback), as well as the distance between the GNSS receiver position and the reel/towing point (GNSS receiver offset).

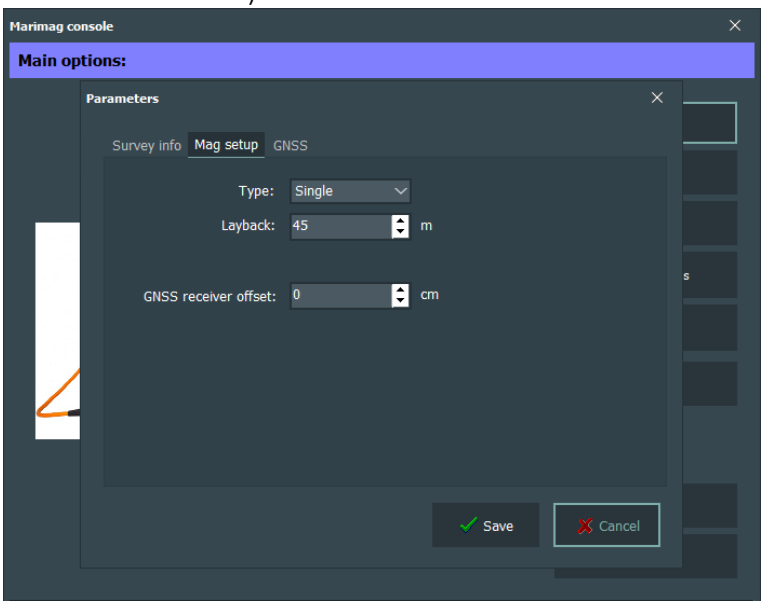


Figure 28 – Survey configuration setting window

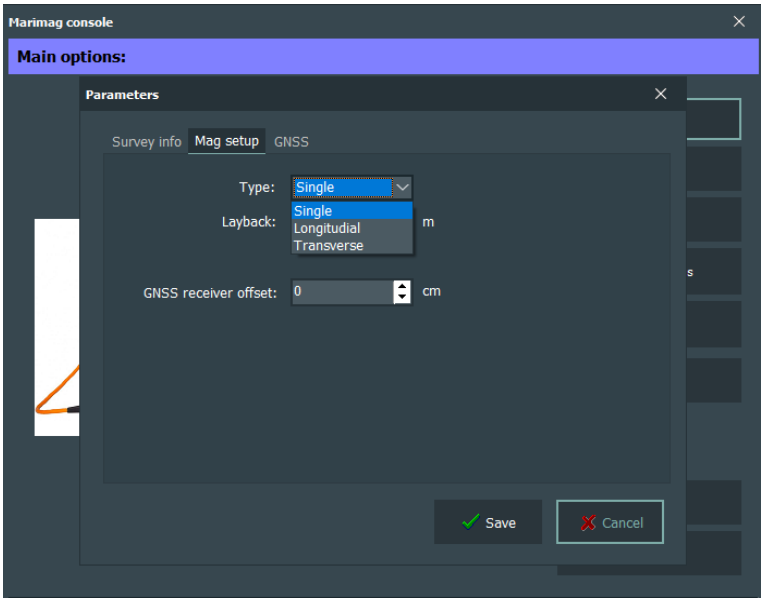


Figure 29 – Device configuration selection window

2.3.1.3. Selection GNSS receiver

To select the GNSS receiver, click the "Config" button in the main window of the program (Figure 25). This will open a window (Figure 26), in which you must select the "GNSS" tab (Figure 30) with the option to select the receiver (Internal or External) (Figure 31).

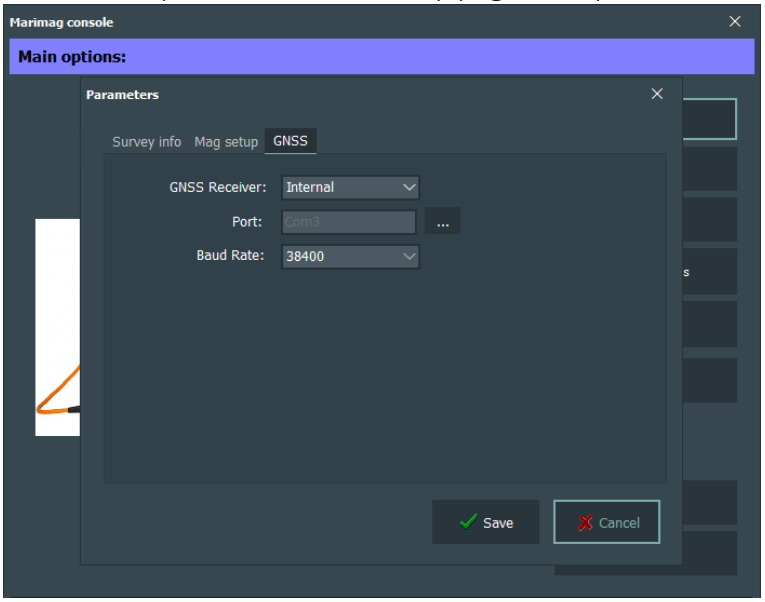


Figure 30 – GNSS receiver selection window

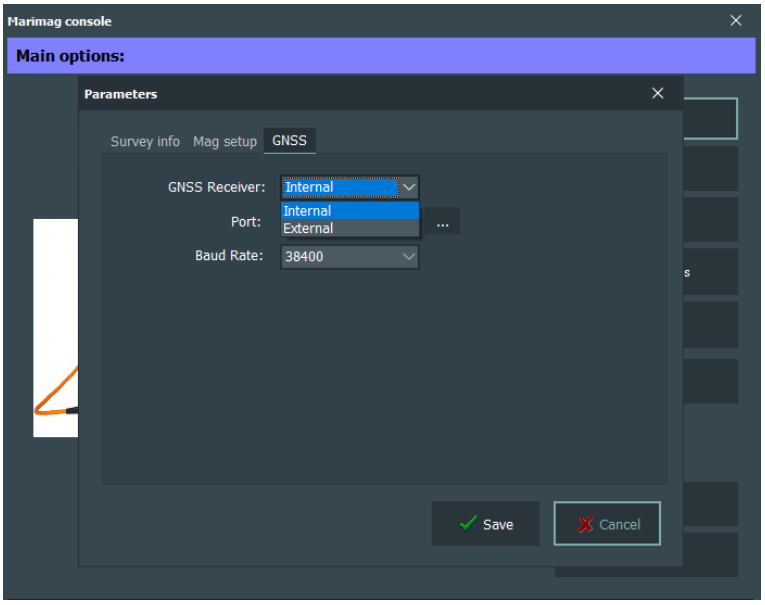


Figure 31 – GNSS receiver selection

When using an internal GNSS receiver, select "Internal".
When using an external GNSS receiver, select "External" (Figure 32), then select the connection port (Figure 33) and baud rate (Figure 34). To select the port, click on the "..." button, then a window will open (Figure 33), where you can select the desired port, and then click on the "Apply" button.

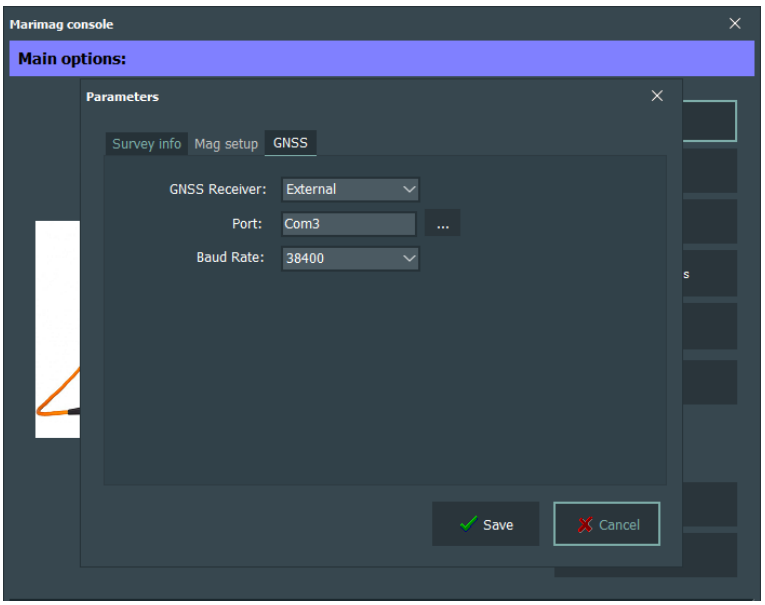


Figure 32 – External GNSS receiver setting

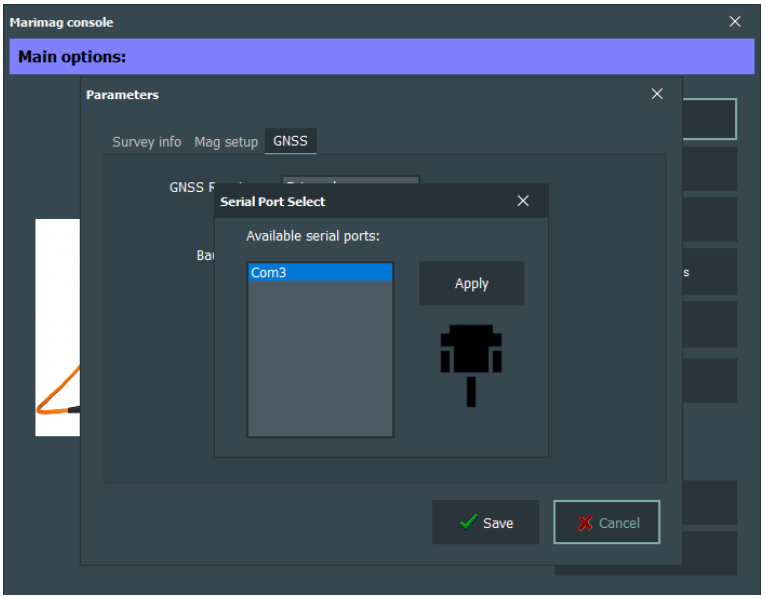


Figure 33 – Selecting the connection port of the external GNSS receiver

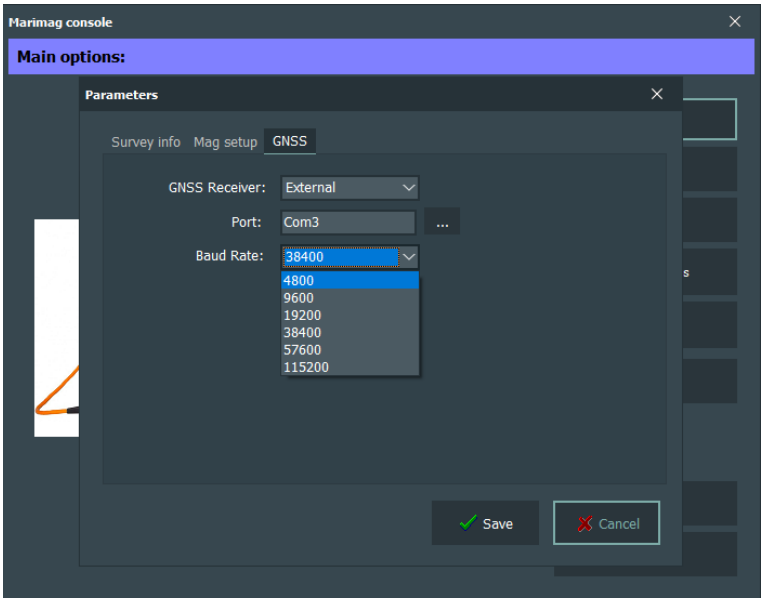


Figure 34 – Selecting the baud rate of the external GNSS receiver

2.3.1.4. Command window

The "Command" window opens the Windows PC console to execute various commands (for example, you can check communication with the isolation transceiver by writing the word "ping" in this window).

2.3.1.5. Network setting window

When you click the "Network Settings" button in the main program window (Figure 24), a window with adapter settings will open (Figure 18).

2.3.1.6. Folder window

This window opens the directory folder where field survey data is saved. Using this window, you can delete/copy/archive (etc.) field data recording.

2.3.1.7. System log window

This window allows you to open the system log (log window) to view information about field data recording.

2.3.2. Operating with the major window of the visualization and data acquisition program

In the program window (Figure 25) click the "Run survey" button. After that the major program window will appear (Figure 35) and the GNSS data server window (Figure 36) and the survey design map window (Figure 37) will appear automatically.

In the upper part of the main window of the data acquisition and visualization program will be updated pitch (Pitch, grad), altitude (Alt, m), roll (Roll, grad), depth (Depth, meters), length of the magnetometer output (Layback, meters) and the value of the measured field (Field, nT). In the middle part of the main window of the acquisition program the visualization of the spatial position of the magnetometer will be updated.

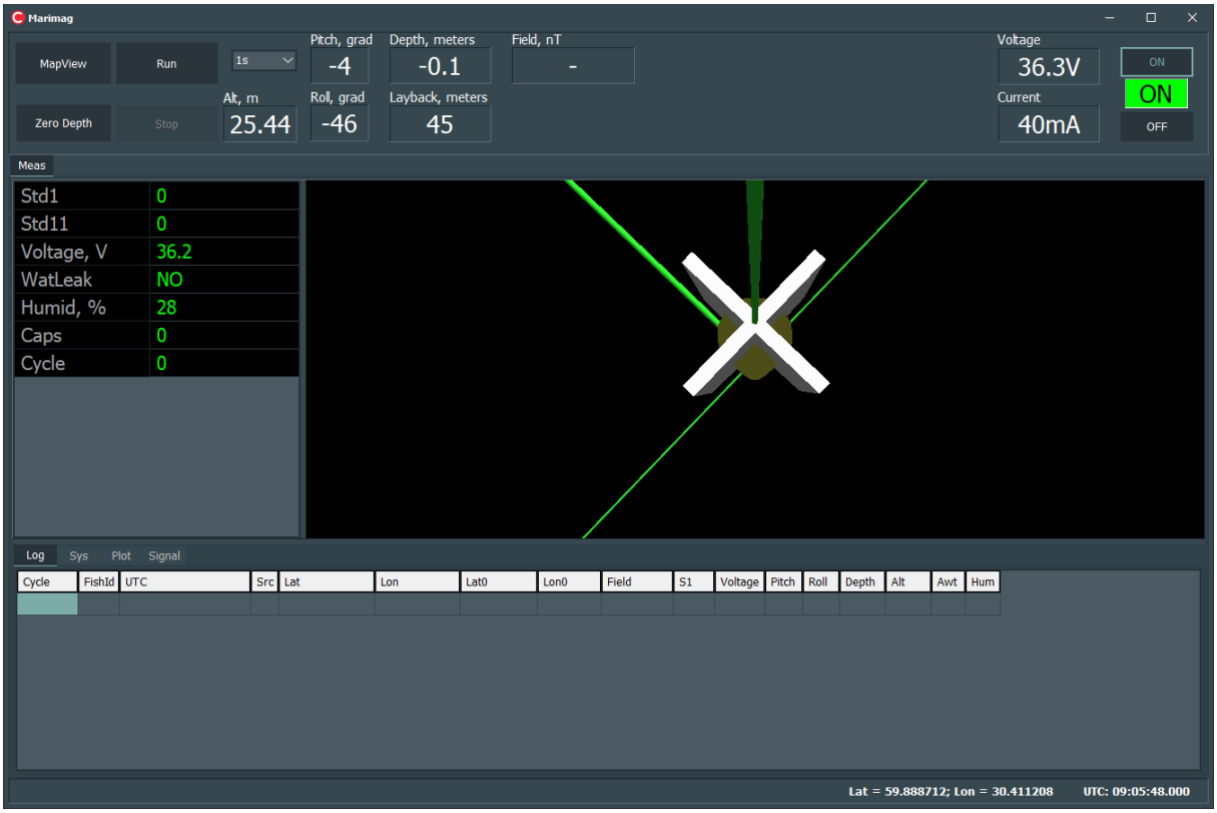


Figure 35 – Major window of the data collection and visualization program

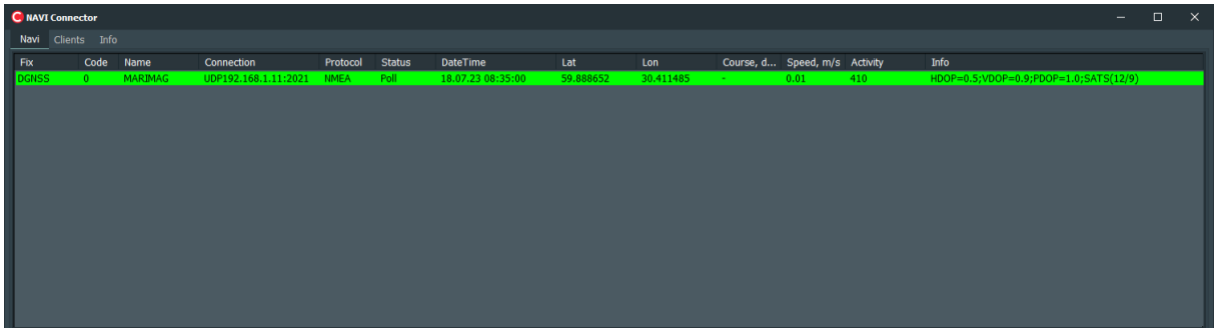


Figure 36 – GNSS data server window

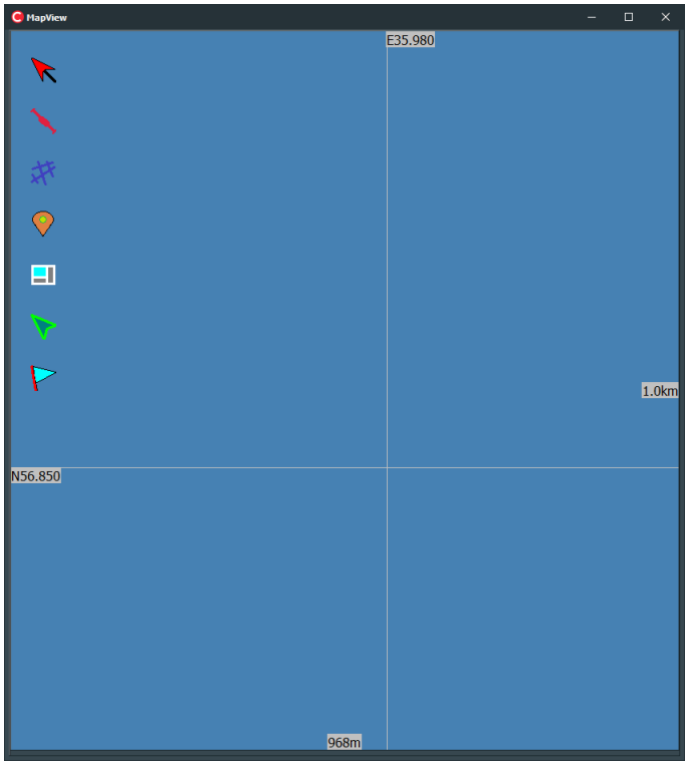


Figure 37 – Survey design map window

2.3.2.1. Magnetometer connection

To connect the magnetometer, press the "ON" button (Figure 38). At that "ON" will light up in the luminous field, and in the neighboring fields the voltage (Voltage, V) and current (Current, A) readings at the instrument input will be updated.

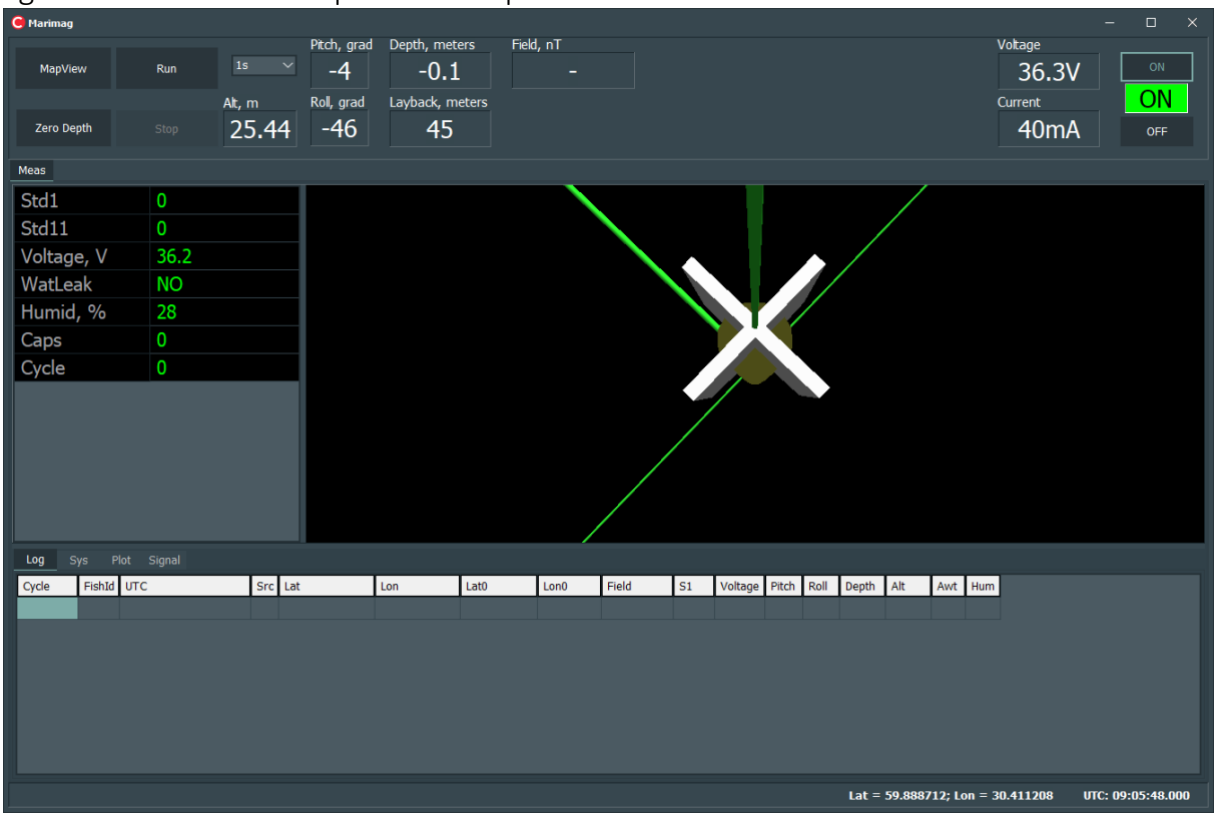


Figure 38 – Magnetometer connection window

2.3.2.2. Measurement cycle selection

The magnetometer has several measurement cycles: 0.2s (5 Hz), 0.25 (4 Hz), 0.5s (2 Hz), 1s (1 Hz), 2s (0.5 Hz), 3s (0.33 Hz) and 5s (0.2 Hz). To select a measurement cycle, press the "1s" button (Figure 39), where the desired measurement cycle is selected at the top of the screen.

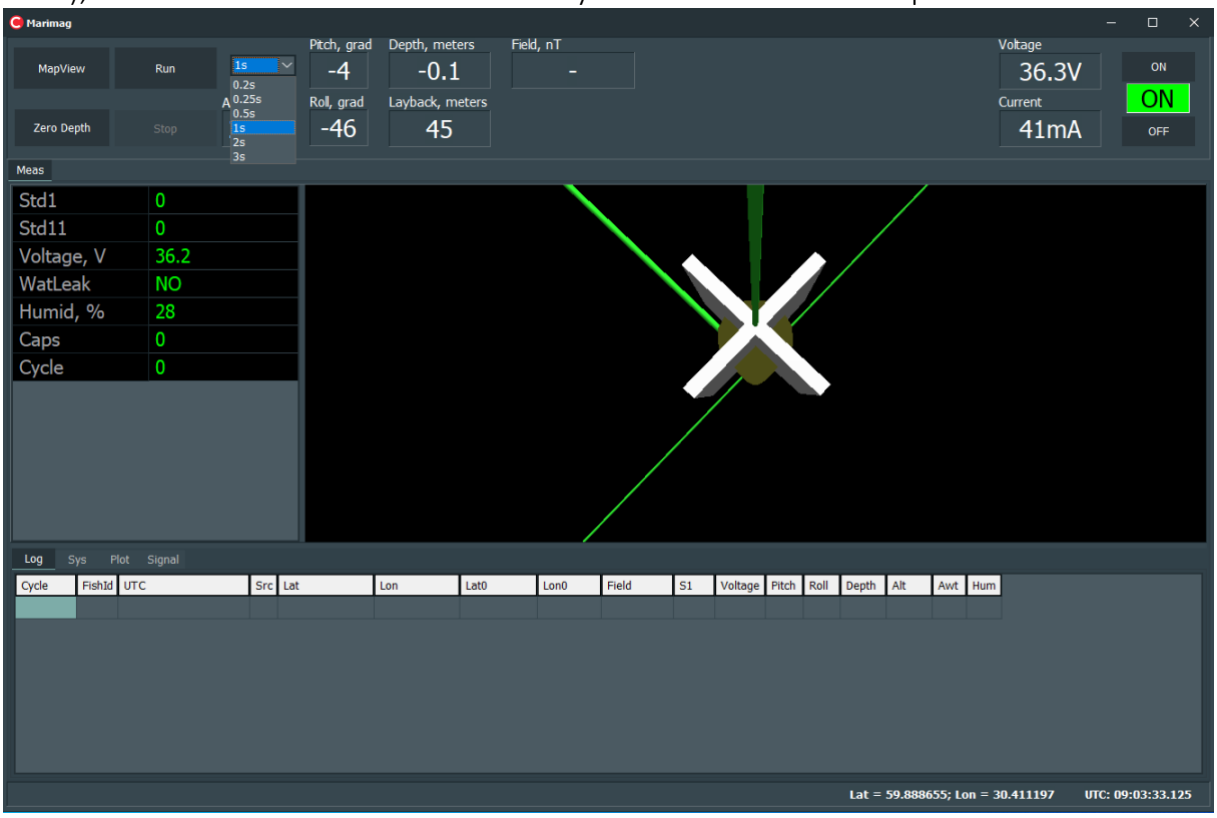


Figure 39 – Measurement cycle selection screen

2.3.2.3. Resetting the pressure sensor

The software can zero the pressure sensor readings (Depth, meters) in case of incorrect data display. To do this, lower the magnetometer to the water surface so that the holes of the pressure sensors (Figure 3) are in the water and press the "Zero Depth" button.
After pressing the button, a confirmation window will appear (Figure 40), in which you should press the "Yes" button.

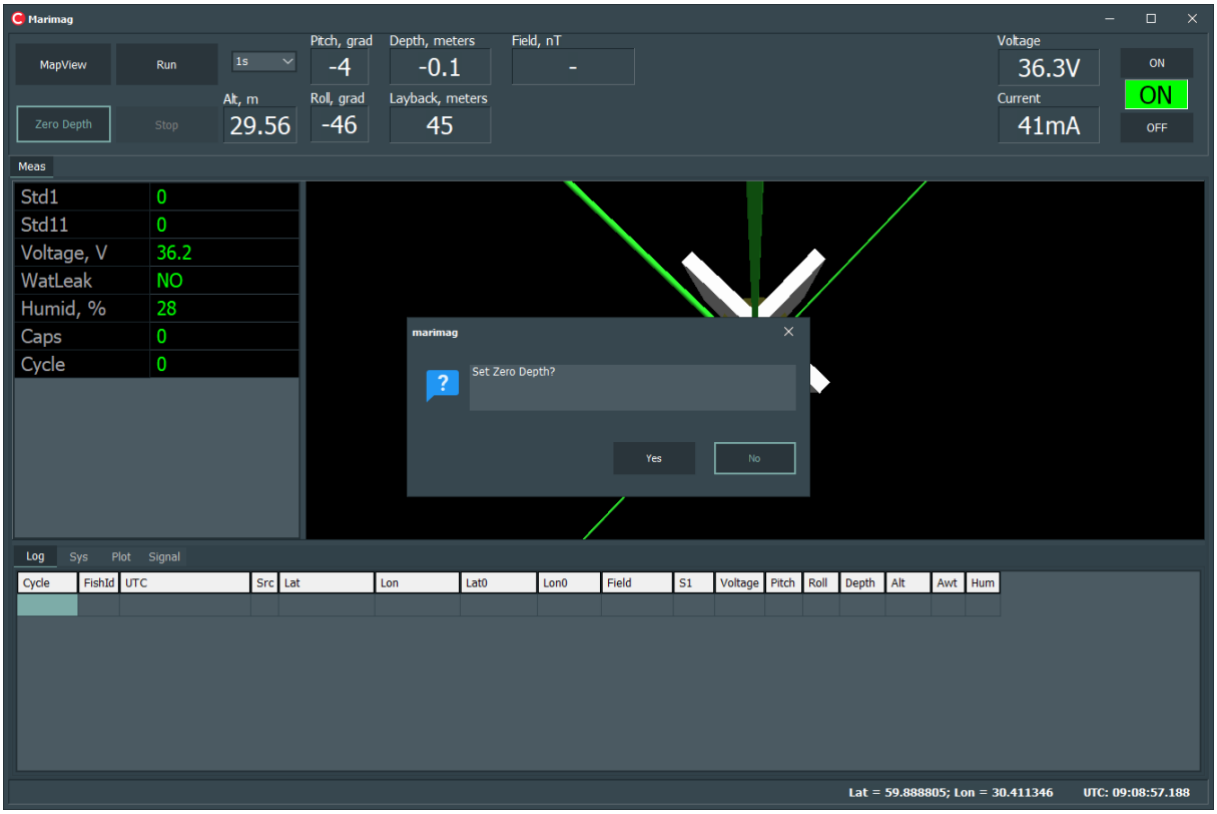
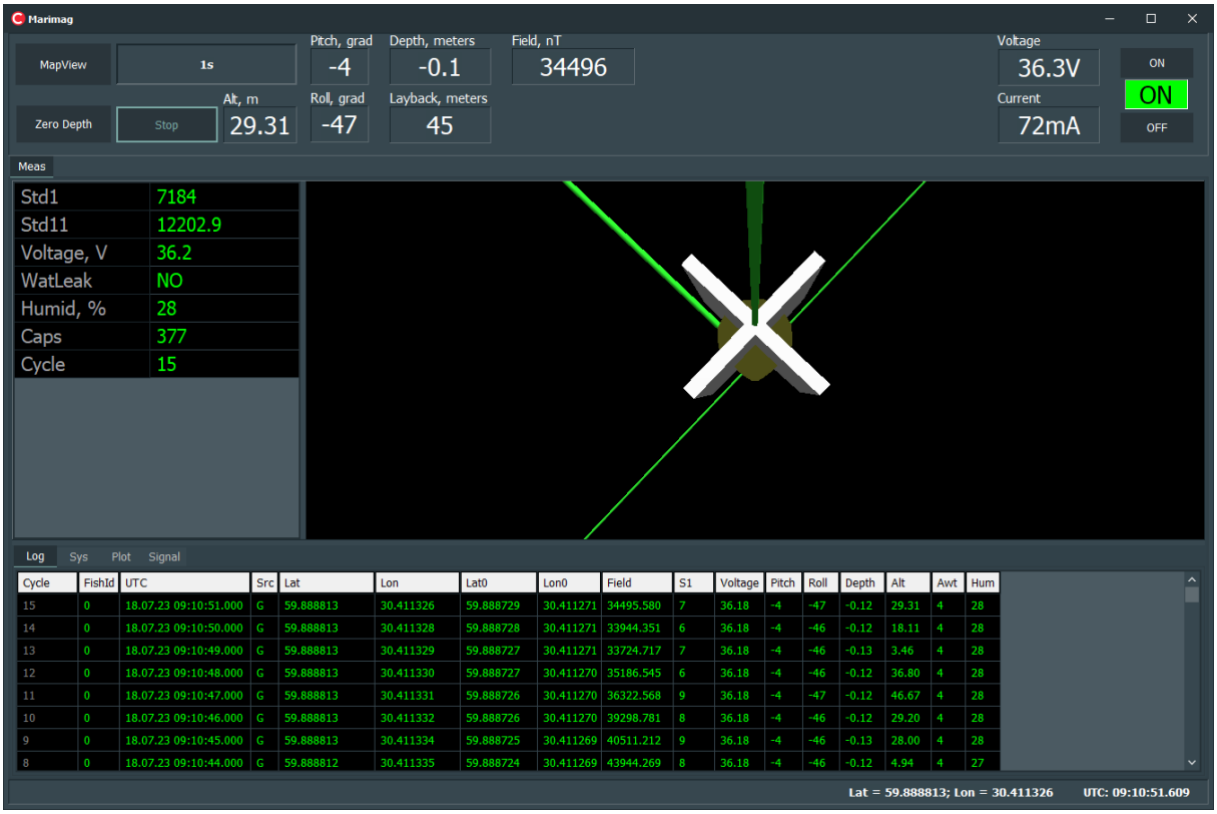


Figure 40 – Resetting pressure sensor window

2.3.2.4. Measurement starts and data measurement window

To start measurements, press the "Run" button, after which this button will become inactive, the magnetometer will automatically start measurements with the specified cycle. The upper part of the major program window with the measurement results will be updated, namely with the indication of field values in nT (Field, nT), pitch (Pitch, grad), altimeter (Alt, m), roll (Roll, grad), depth (Depth, M). Also the left part of the window with indication of the intra-cycle parameter of signal quality assessment (Std1, dimensionless value), standard deviation over a sliding window of 11 measurements (Std11, nT), voltage at the magnetometer nacelle input (Voltage, V), leakage (WatLeak), humidity (Humid, %), field range code (Caps) and measurement cycle number (Cycle). On the "Log" tab the table with measurement data will start to form (Figure 41).



Cycle	FishId	UTC	Src	Lat	Lon	Lat0	Lon0	Field	S1	Voltage	Pitch	Roll	Depth	Alt	Awt	Hum
15	0	18.07.23 09:10:51.000	G	59.888813	30.411326	59.888729	30.411271	34495.580	7	36.18	-4	-47	-0.12	29.31	4	28
14	0	18.07.23 09:10:50.000	G	59.888813	30.411328	59.888728	30.411271	33944.351	6	36.18	-4	-46	-0.12	18.11	4	28
13	0	18.07.23 09:10:49.000	G	59.888813	30.411329	59.888727	30.411271	33724.717	7	36.18	-4	-46	-0.13	3.46	4	28
12	0	18.07.23 09:10:48.000	G	59.888813	30.411330	59.888727	30.411270	35186.545	6	36.18	-4	-46	-0.12	36.80	4	28
11	0	18.07.23 09:10:47.000	G	59.888813	30.411331	59.888726	30.411270	36322.568	9	36.18	-4	-47	-0.12	46.67	4	28
10	0	18.07.23 09:10:46.000	G	59.888813	30.411332	59.888726	30.411270	39298.781	8	36.18	-4	-46	-0.12	29.20	4	28
9	0	18.07.23 09:10:45.000	G	59.888813	30.411334	59.888725	30.411269	40511.212	9	36.18	-4	-46	-0.13	28.00	4	28
8	0	18.07.23 09:10:44.000	G	59.888812	30.411335	59.888724	30.411269	43944.269	8	36.18	-4	-46	-0.12	4.94	4	27

Figure 41 – Data measurement window

2.3.2.5. Window with a plot of the measured field value for each magnetometer

To go to the window with the plot of the measured field value for each magnetometer it is necessary to open the "Plot" tab in the major window of the program (Figure 42).

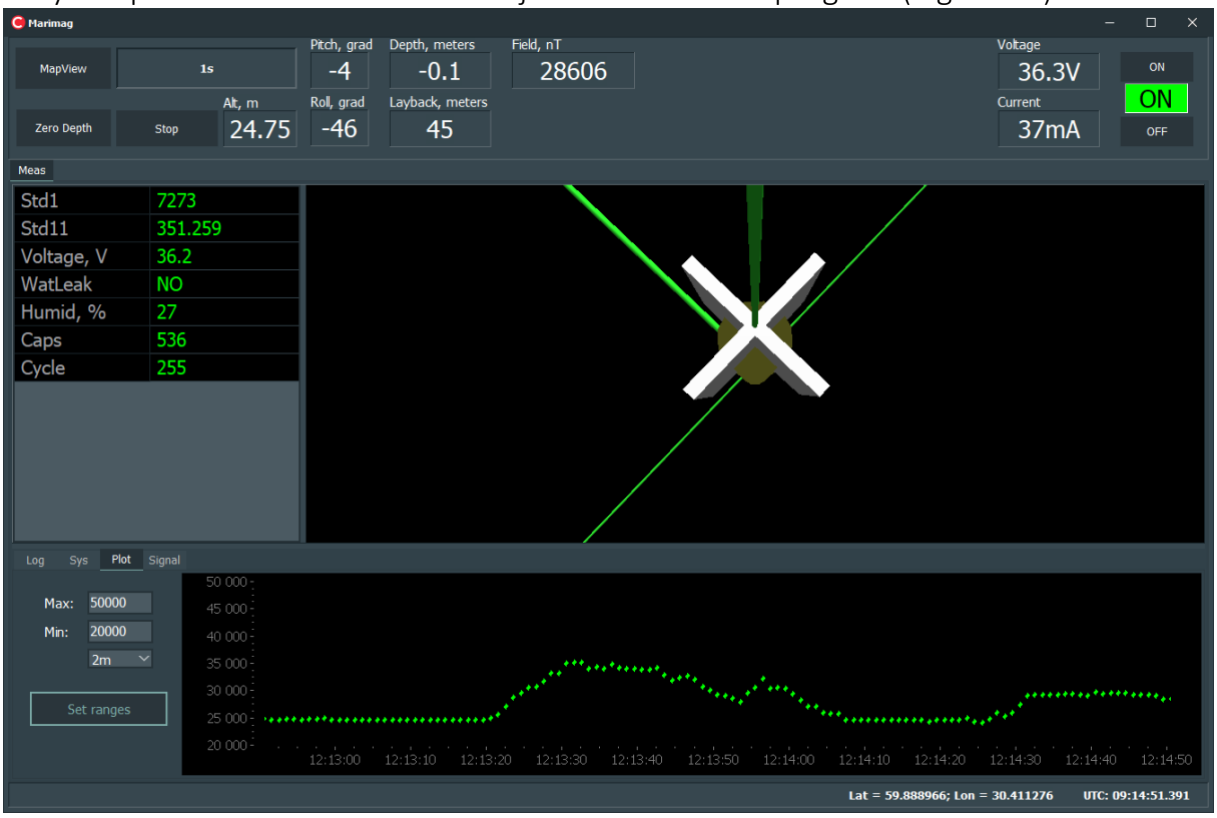


Figure 42 – Measured field value plot window

The measured field value in nT is displayed on the vertical axis, and the measurement time - on the horizontal axis.
In the left part of the window (Figure 42) there is a menu for working with the graph, where you can set the range of displayed field values. To do this, enter the maximum value of the field (Max), the minimum value of the field (Min) and click the "SetRanges" button.
To change the chart scale continuously, keep the left mouse button pressed on the chart and adjust the necessary size of the scaling window by moving the mouse to the right. To set the initial scale of the chart, hold the left mouse button down and move it to the left.
Also, by pressing the "2m" button, you can select the time interval for which the magnetic field change will be displayed in real time in the form of a graph.

2.3.2.6. Operating protocol window

To go to the operating protocol window it is necessary to open the "Sys" tab in the main program window (Figure 43).

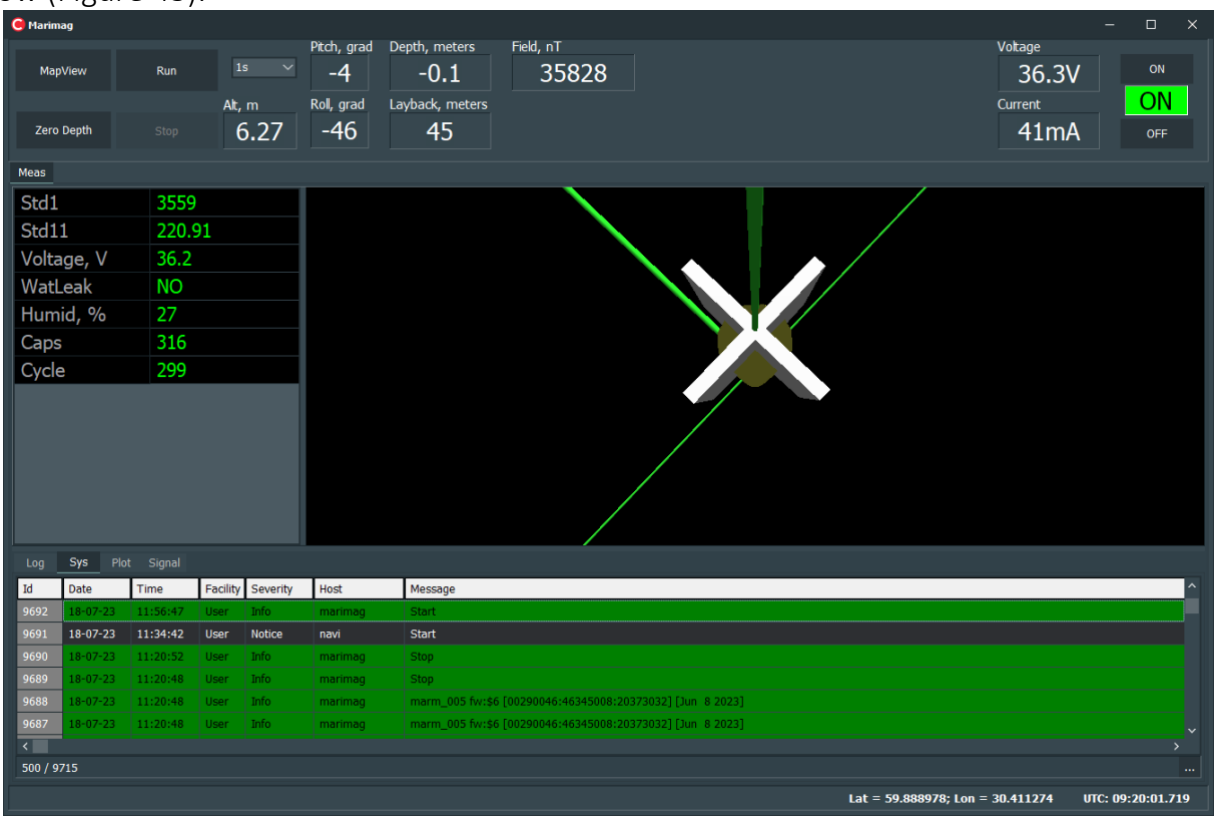


Figure 43 – Operating protocol window

2.3.2.7. Measurement end

To end measurements, press the "Stop" button in the main program window, after which this button will become inactive, and the magnetometer will automatically end measurements.
The measurement results are saved in the selected directory (see selection 2.3.1.1. Specifying a shooting title and selecting a data storage directory) as a text file containing several columns separated by tabulation. The data are presented in sixteen columns: FishId - fish identifier; DateTime - time and date; Src - time flag (G - time from GNSS receiver, L - computer time); Lat - latitude from GNSS receiver; Lon - longitude from GNSS receiver; Lat0 - calculated latitude of magnetometer; Lon0 - calculated longitude of magnetometer; Field - measured field value in nTl; S1 - root mean square error of one measurement; Voltage - voltage; Pitch - pitch; Roll - roll; Depth

- depth; Alt - altitude; Awt - leakage sensor value; Hum - humidity; Cycle - number of measurement cycle.

2.3.3. Survey design program

The map module is designed for creating an observation network, navigation and labeling.
The map module window includes several functional areas: button bar, object manager, property manager and map field. Buttons Panel, Object Manager and Property Manager can be hidden or displayed according to the user's wish by pressing the right mouse button in the map field and then pressing the corresponding menu items "Buttons Panel" / "Panel Bottom" / "Panel Right".
Description of the main buttons and fields of the map module window is presented in Figure 44 – Map module window.

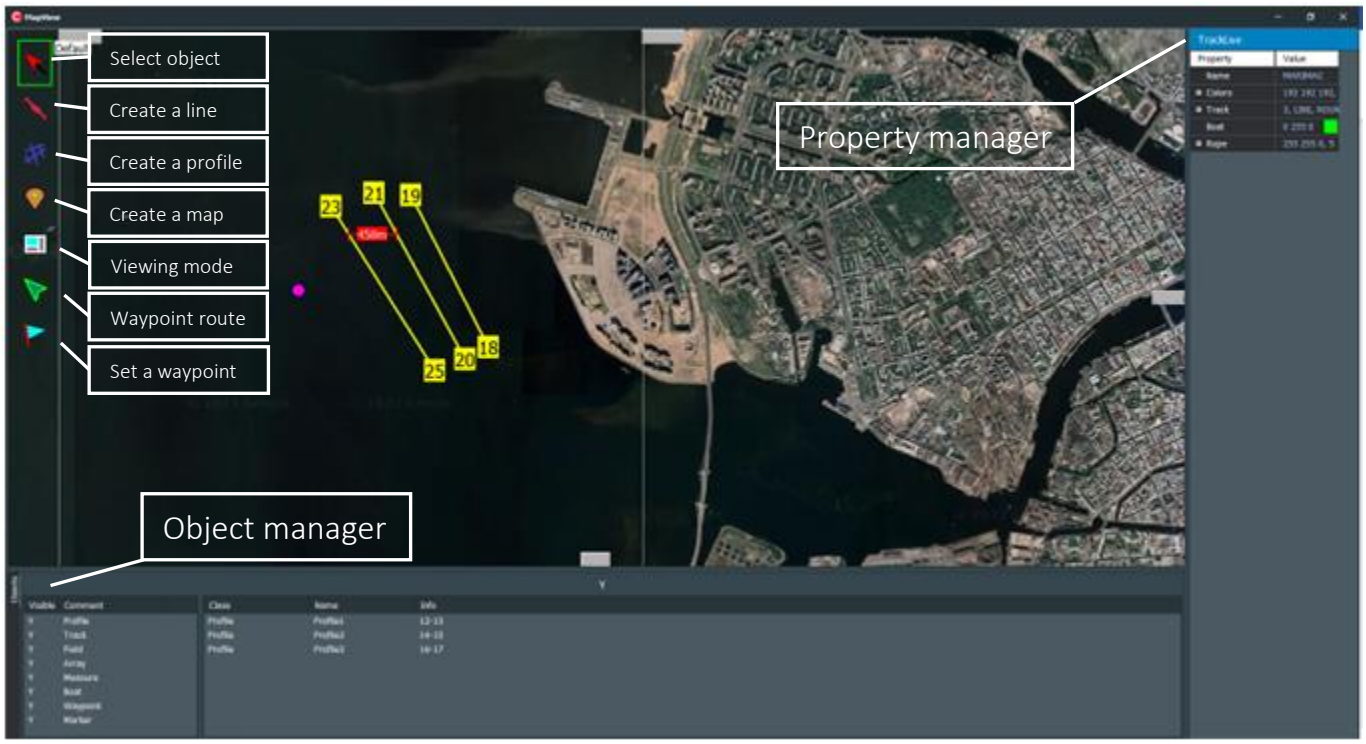


Figure 44 – Map module window

2.3.3.1. Zooming and moving around the map

You can zoom the map in several ways:

1. Use the mouse wheel.
2. Use the menu under the right mouse button. To do this, right-click in the map field and then select the menu items "Zoom plus" / "Zoom Minus".
3. use hotkeys F1 / F2.

The map scale can be monitored by the values on the right and at the bottom of the map field. The values show how many meters the vertical and horizontal sides of the map field are in meters, respectively.
You can move around the map in several ways:

1. using the mouse. Hold down the left mouse button and drag the map.
2. Use the menu under the right mouse button. To do this, right-click in the map field, select the menu items "Move" and then select "Left" / "Right" / "Top" / "Bottom".
3. In the object manager, double-click the left mouse button on the object of interest, and the map area containing this object will be automatically displayed.

2.3.3.2. Map loading, coordinate system and projections

You can download the map in several ways:

1. Load the map in KML format. To do this, right-click in the map field, select the menu item "Load" – "Import Map KML File", select the file with extension *.kml in Explorer and click the open button.
2. Load the map as a raster image. To do this, right-click in the map field, select the menu item "Load" – "Import Map from Raster Bitmap…", select the file with the extension *.jpg/ *.jpeg / *.bmp / *.ico / *.emf / *.wmf in the Explorer and click the open button.
3. Download Google satellite maps (you need to connect your PC to the Internet). To do this, click the left mouse button in the map field, holding CTLR. To download a more detailed image you need to zoom in and repeat the procedure in the map field, holding CTLR, click the left mouse button. To display the borders of the loaded sheets you should press CTLR+T or right-click in the map field and select the menu item "Tile Border".

In the map field and in the property manager, coordinates in degrees and fractions of a degree are used.

The map can be displayed in the following projections: WGS 84 and EPSG 3785.

2.3.3.3. Creating of an observation network

There are several ways to create an observation network:

1. Load observation profiles in KML format. To do this, right-click in the map field, select the menu item "Load" – "Import Profile…",, select the file with extension *.kml in File Explorer and click the open button.
2. Load profile start points in KML format and create profile lines on the map. To do this, right-click in the map field, select the menu item "Load" – "Import Profile…",, select the file with extension *.kml in the File Explorer and click the open button. Then click on the icon "Create Profile" on the button bar, place the cursor at the beginning of the profile, press the left mouse button and drag the mouse with the pressed left button to the end point of the profile.
3. Create profile lines on the map. To do this, click on the icon "Create profile" on the button bar, place the cursor at the beginning of the profile, click the left mouse button and drag the mouse with the left button pressed to the end point of the profile.

2.3.3.4. Objects delete and additional functions

You can delete an object on the map in several ways:

1. Select an object using the "Select object" icon and press SHIFT + Delete.
2. Right-click in the map field and select the Delete menu item.

You can create a label on the map in several ways:

1. Click on the "Create Label" icon, place the cursor in the desired position and click the left mouse button.
2. Set the cursor in the desired position, right-click and select the menu item "Set Marker here".

2.3.3.5. Profile navigation

The following options will be useful when navigating with the map module:

1. To enter a profile, it is necessary to set the length of the line of entry to the profile (WhiskLen) equal to the length of the magnetometer outrigger (Layback) in the profile

properties manager. To do this, click on the "Select object" icon on the button bar and select the required profile, then set the "Layback line length" in meters in the property manager.

2. To control the course following it is necessary to use the waypoint setting, for this purpose it is necessary to press the icon "Set waypoint" on the button bar, set the cursor and click the left mouse button in the place of the waypoint setting. You can also use a special button on the "TrackMode" panel to control the course (Figure 44).

2.4. Actions in extreme conditions

Geophysical surveys should be suspended when weather conditions degrade: visibility drops below 20 m, wind increases to stormy (over 20 m/s), severe icing, in extreme and emergency situations.
In case of emergency on site that threatens life and health of people, it is necessary to immediately evacuate to a safe place.
If smoke appears, cable sparks, unpleasant odor or signs of fire appear, immediately stop working and turn off the power of the device.

3. REPAIR

In the event of failure of device operation during warranty and post-warranty, the user should contact GEODEVICE representative.

Warranty and post-warranty repairs of magnetometer are only carried out in manufacturer's facility or specialized geophysical service facility by specialists trained and certified by GEODEVICE.

IT IS FORBIDDEN TO MAKE REPAIRS BY UNAUTHORISED PERSONELL.

IT IS FORBIDDEN TO OPEN / DISASSEMBLE THE MAGNETOMETER, AS WELL AS TO MAKE CHANGES IN DESIGN OF THE DEVICE, TO IMPROVE IT WITHOUT AGREEMENT WITH THE MANUFACTURER.

Otherwise, the manufacturer does not guarantee the operational reliability and safety of the device, and the manufacturer's warranty obligations are terminated.

4. STORAGE

The device should be stored in the manufacturer's packaging in a warehouse environment that excludes direct exposure to atmospheric precipitation (rain, snow, fog, etc.) at temperature from + 5 to + 35 ° C and humidity from 5 to 95%.

DO NOT STORE THE MAGNETOMETER TOGETHER WITH EVAPORATING LIQUIDS, ACIDS AND OTHER SUBSTANCES THAT COULD CAUSE METAL CORROSION AND DAMAGE INSULATION.

5. TRANSPORTATION

The magnetometer can be transported by any mode of transport at ambient temperature from -40 to 60 °C and relative humidity from 5 to 95%.
Transportation must be performed in the original manufacturer's packaging in closed transport in accordance with transportation rules, operating for this kind of transport.
Care must be taken during transportation. Avoid shocks and falls from heights.
After transportation, check the device for transport damage (damages caused in the transport of the device).
DO NOT OPERATE THE DEVICE IF TRANSPORT DAMAGE IS DETECTED.
If transport damage is detected, immediately inform the representative of the manufacturer to clarify the possibility of further operation of the device.

6. INFORMATION ABOUT DEVICE DISPOSAL

The buyer (user) is responsible for disposal of the device after loss of its consumer properties.
DO NOT DISPOSE MAGNETOMETER WITH HOUSEHOLD WASTE.
If possible, divide the device into parts depending on the materials (plastic, rubber parts, etc.) and recycle.
Materials to be disposed in special facilities should be hand over for disposal in accordance with legislation in force at the time of disposal.

7. APPENDIX

7.1. Maps of magnetic inclination and total intensity of the Earth's magnetic field

7.1.1. Magnetic inclination

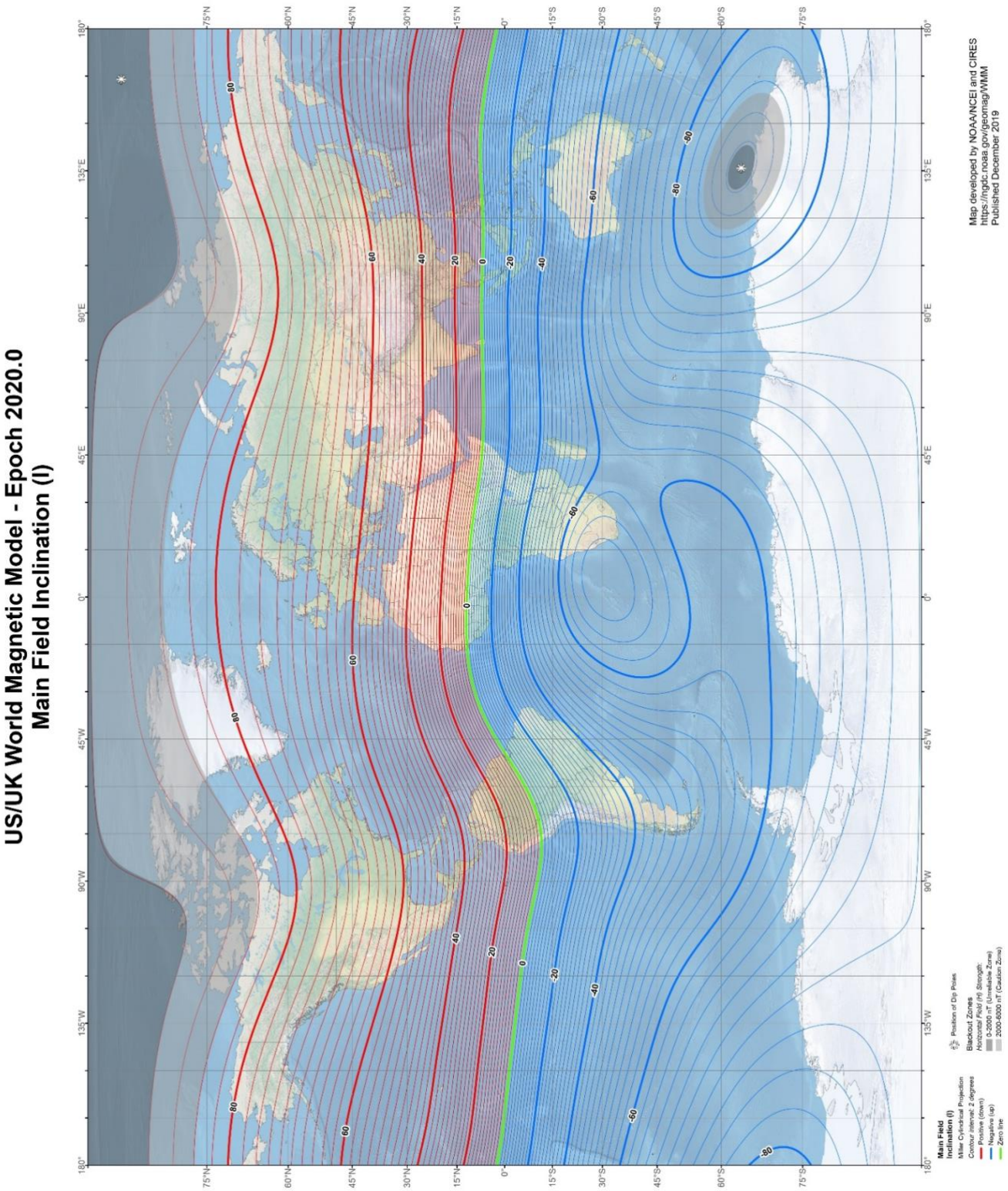


Figure 45 – Map of magnetic inclination. NOAA's National Centers for Environmental Information

7.1.2. Total intensity of the Earth's magnetic field

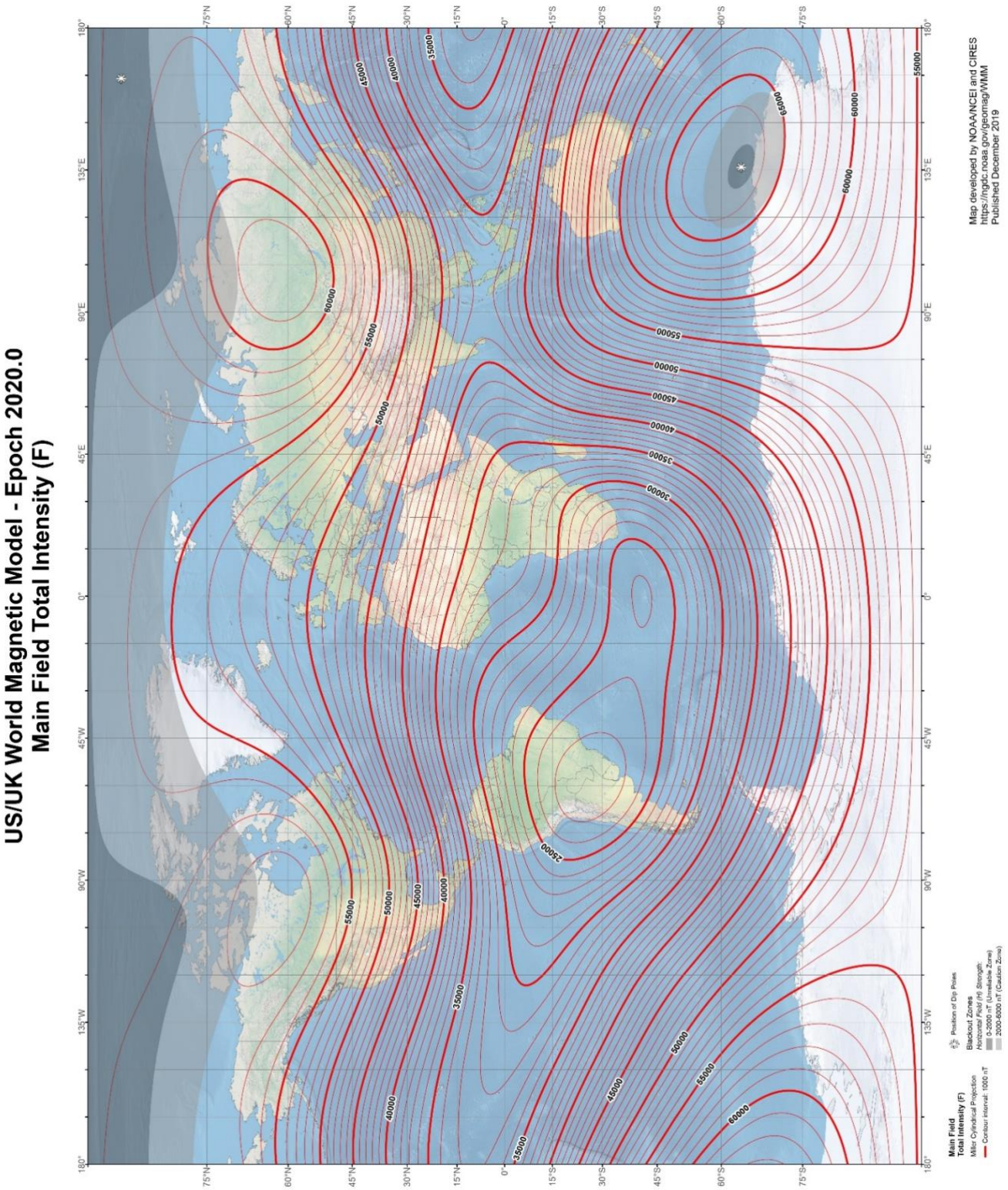


Figure 46 – Map of total intensity of the Earth's magnetic field. NOAA's National Centers for Environmental Information

7.2. Rechargeable battery manual

7.2.1. Rechargeable battery type

This MariMag marine magnetometer includes a lead-acid rechargeable battery with a voltage of 24 V and a capacity of 9 A·h.

Figure 47 – Rechargeable battery with power cable

Table 2. Specifications, parameters, and dimensions of the rechargeable battery

Name	Value
Rated battery voltage	24 V
Available capacity	9 A·h
Charge mode	• with a current of no more than 0.9 A up to final voltage of 29 V in the temperature range +10 ÷ +40 ° C • with a current of no more than 0,8 A in the temperature range -20 ÷ 0 °C and +60 ÷ +85 °C • with a current of no more than 0,2 A A in the temperature range -30 ÷ -20 °C
Discharge mode	with a current of no more than 4 A up to final voltage of 21 V
Dimensions (L x W x H)	240 × 198 × 109 mm
Weight	5.5 kg
Operating temperature range	+10 ÷ +40 °C — charge +10 ÷ +40 °C — discharge
Storage conditions	in dry, heated rooms, temperature of no more than 30 °C at 100% state of charge of the battery

7.2.2. Battery charge

It is recommended to charge the battery at a temperature of +10 ÷ +40 °C using an automatic charger included in the magnetometer set.
After the charger is disconnected, a fully charged battery should have a voltage of about 25 V (no load).

7.2.3. Precautions

The battery must be used in compliance with all precautions provided for the work with lithium-ion batteries.

1. Protect the battery from shock and do not drop it.
2. Protect the battery against short circuits.
3. Do not use the battery with obviously non-working chargers.
4. Do not charge the battery using a charger which is not designed for this battery.
5. Do not open the battery, it may break it!
6. If the battery leaks and the electrolyte get on the skin or in the eyes, immediately rinse the eyes and skin with clean water.
7. If you sense unpleasant smell coming from the battery, or if its color has changed, or if some special defects have appeared, unplug the charger from the mains, disconnect it from the battery, and stop using it.
8. Keep the battery away from direct sunlight, water, and various liquids.
9. Do not allow the battery contacts to meet metal objects during storage.
10. Store the battery in a dry place at room temperature and out of the reach of children.

7.3. Lead-acid battery charger manual

7.3.1. Charger type

This MariMag marine magnetometer includes a charger for lead-acid battery from 220 V, 50 Hz AC/DC.

Figure 48 – Charger

Table 3. Specifications, parameters, and dimensions of the charger

Name	Value
Input voltage	220 V AC/DC
Maximum current	0.8 A
Weight	285 g
Protection	Reverse polarity and short circuit

7.3.2. Battery charge

Connect the battery pack to the charger and then connect it to the AC mains 220 V, 50 Hz.

After the battery is connected, the device automatically detects the required voltage, and the charging process starts. The red LED is illuminated during this process. After charging is completed, the red LED turns off and the device switches to the maintenance charge mode. The battery is fully charged and ready for use.

7.3.3 Indication

Red LED signal is on: battery is charging.
Red LED signal is off: battery is charged / maintenance charge mode.
Green LED signal: once the battery is connected to the device, one of the four green LEDs indicates the battery voltage.
Green LED signal: "24V" is also lit if the battery is not connected.

7.3.4. Precautions

1. Use the charger indoors only and do not leave it in humid place or under the rain.
2. Unplug the charger when not in use.
3. Do not plug in the charger if damaged.
4. Do not disassemble the charger.
5. Make sure the batteries are charged at temperature range 0 ° - 60 ° C.
6. Batteries and chargers may become hot while charging. However, in case of excessive heating (when the surface is too hot to be touched with hands), as well as if there are signs of melting of the battery or the case of the charger, an unpleasant smell, or any signs of smoke, immediately disconnect the charger from AC/DC.
7. Do not place the charger on fluffy or soft surfaces.
8. Use and store the charger out of children reach. Improper handling can cause electric shock and fire.
9. Do not leave the charger or its adapter plugged in for a long time unattended, even after the end of charging.

7.4. Lead-acid Battery Material Safety Data Sheet (MSDS)

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