DiveNET: GPS *Commercial* (GPS/C)

User Manual

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SECTION 1

General Overview

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Introduction

DiveNET: GPS Commercial (GPS/C) is a portable, self-contained and rapidly deployable wireless, wide-area underwater acoustic GPS navigation system based on a 4-buoy floating Long Base Line (LBL) array.

DiveNET: GPS/C provides absolute, 3D coordinate underwater positioning and true GPS navigation inside the area of coverage for an unlimited number of passive, compact acoustic GPS receivers.

For use by divers, an interactive display unit provides waypoint navigation, mark point setting 'on the fly', 8 hours of track recording and data exporting in KML/GPX format for post-dive analysis.

The DiveNET Acoustic GPS Receiver (AGR) is available in standalone configuration for integration with carrier systems using UART 9600 and NMEA 0183 compatible interfacing standards.

Key Features:

- True underwater GPS
- Portable, self contained and rapidly deployable
- Unlimited number of Acoustic GPS Receivers (AGR)
- Wide coverage area (30 - 700 m diameter)
- High precision (2DRMS 0.84 m)
- Robust and simple to own and operate
- Diver kit with interactive display for navigation and POI marking
- GPS emulation output
- Track recording
- Open architecture for integration with third party systems

***Note, some pictured components are optional**

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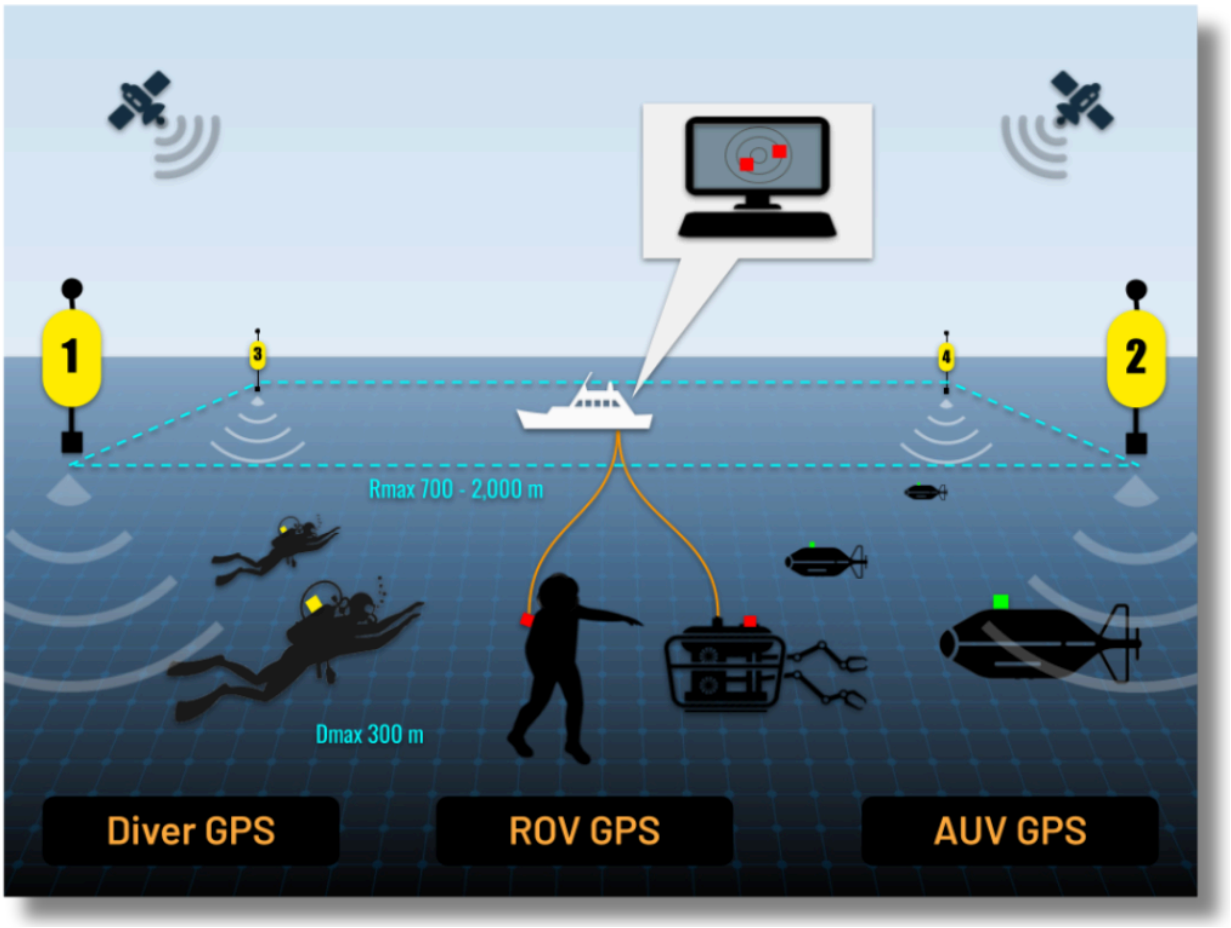
DiveNET: GPS/C is designed to provide positioning for a variety of underwater objects ("targets"), including:

- Remotely Operated Vehicles (ROV)
- Unmanned Underwater Vehicles/Systems (UUV/S)
- Manned submersibles
- Recreational, technical and commercial Divers

DiveNET: GPS/C is designed to emulate the function and purpose of surface based GNSS technology in the underwater environment. The system's four buoys relay their own coordinates obtained by standard RF satellite positioning into the water acoustically, thus in effect creating an acoustic satellite constellation on the surface and providing source navigation data to any number of passive DiveNET AGR modules within the coverage area and line of sight of all 4 buoys. Geographic coordinates are generated directly on the navigation receiver.

DiveNET: GPS/C utilizes state of the art digital broadband acoustic communication technology specifically designed to perform in difficult hydrological conditions, such as shallow bodies of water.

NOTE !
*For **topside monitoring**, DiveNET: GPS/C supports additional data output connectivity to the receiver module via **hardwire interface only**.*



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Primary Components

A standard DiveNET GPS/C set is comprised of the following primary components:

1. DiveNET GPS/C Acoustic GPS Buoy (AGB) - 4 units/set

Four portable DiveNET GPS/C GNSS-equipped Acoustic GPS Buoys (AGB) are deployed roughly around a dive site to establish a long baseline for precise positioning calculations. The **minimum** and **maximum** distances permitted between any two buoys are **30** and **700 meters**, respectively.

The buoys are positively buoyant with a GNSS module positioned atop the buoy to remain above the water surface. A battery section and free-hanging transducer with approximately 1.5 m of cable are positioned at the bottom end. Two floats are placed between the top and bottom sections for buoyancy control.

Each DiveNET GPS/C AGB is factory coded with an **ID** number from **1** to **4**. The buoys relay their own time-stamped coordinates into the water sequentially once every 4 seconds to provide a **1 Hz update rate** for the receiver.

DiveNET GPS/C AGBs are equipped with **LiFePO4** rechargeable batteries designed to provide up to **24 hours** of autonomous operation.

2. DiveNET GPS/C Acoustic GPS Receiver (AGR)

The DiveNET GPS/C Acoustic GPS Receiver (AGR) module is designed to emulate the purpose and functionality of traditional, land based GNSS receivers in the underwater environment. The AGR receives and processes

hydroacoustic signals transmitted by four GPS/C buoys and determines the receiver's absolute coordinate position. Additionally, the AGR's integrated temperature and pressure sensor provides precise depth, providing the user with **3D (X, Y, Z), absolute coordinate position**. The AGR outputs data over a serial interface using **NMEA 0183** compatible protocol with an update rate of **1 Hz**.

DiveNET GPS/C supports interfacing of AGR data with carrier systems either directly or via a second data output cable. A second data output cable can be used to provide the receiver data topside to a surface operator/dive supervisor ("Repeater Mode").

The navigation receiver connects to the standard DiveNET GPS/C Diver Display Unit (DDU) or a third party system via cable and 5 pin connector. When used on a diver, the following positions are recommended:

- **Tank:** Secured to the tank for minimal acoustic shading.
- **Handheld Panel:** Attached to a special panel held by the diver.
- **Shoulder:** Mounted directly on the diver's shoulder.

For optimal performance, ensure a clear line of sight between the navigation receiver and the acoustic transmitters of all four GPS/C AGB buoys.

Given the AGR is a passive device, any number of subsea target units can be used within a single system's coverage area, including divers, remote and autonomous vehicles operating simultaneously.

3. DiveNET GPS/C Diver Display Unit (DDU)

The DiveNET GPS/C Diver Display Unit (DDU) is designed to provide navigation data for divers and consists of a standard DIveNET GPS/C receiver coupled to a dedicated interactive display module. The DDU enables divers to navigate along a preloaded waypoint route and mark coordinates for Points of Interest (POI). The DDU additionally

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functions as a source of electrical power and data storage for the receiver, recording up to approximately 8 hours of coordinate solutions, which can be exported immediately upon surfacing as a diver track file.

Operating the display unit is generally similar to using other types of GPS/GLONASS trackers and navigators. The display unit's unique functionality and ease of use make it an ideal solution for recreational diving, as well as for search, archaeological, and other types of underwater operations.

4. (**Optional**) Surface Power and Interfacing (SPI) Station

The **DiveNET Surface Power and Interfacing (SPI)** station serves as a surface power supply and hardware interface between DiveNET GPS/C and the surface operator or dive supervisor's workstation.

The GPS/C navigation receiver connects to the SPI station via an RS-422 connector while the supervisor's PC connects to the SPI station via a USB-C connector.

The SPI station includes provision for external power input to operate on surface power and a charger connector for battery charging.

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Deployment Review

Deployment Considerations

Primary considerations for a deployment of DiveNET: GPS/C include:

- Ensuring that local site conditions are supportive of the system's performance envelope and normal operation, including **interpositional geometry, depth, water and current characteristics**
- Ensuring unobstructed access to the celestial hemisphere for the GNSS antennas on each buoy, avoiding obstructions and shadowing
- Ensuring all four AGBs are securely deployed within **700 m** of each other
- Mounting requirements and effects of a GPS/C AGR on a carrier diver or system
- AGR integration with a carrier system if required
- Ensuring a **clear underwater line of sight** between the AGR and **all four AGBs** for all dive segments intended to position using DiveNET: GPS/C

Operation

DiveNET GPS/C is designed for minimum hassle deployment, operation and ownership, including **automatic water activation** of the AGBs.

The AGR module is powered externally, either by a carrier system or the DiveNET DDU's built-in battery. In the latter case, the receiver is powered on automatically alongside the DDU. The DDU is operated by **two piezo control buttons** on either side of the device. For more information on operating the DDU, please refer to the DDU section of the manual.

Under normal operation and with all four AGBs transmitting coordinates, the AGR provides an **updated position at a rate of 1 Hz (1/sec)**. Whenever any one or more of the buoys are not received, no solution is provided. The solution is provided again once a series of 4 buoy positions is received.

Data

DiveNET AGR provides data output in **NMEA 1083** compatible protocol, including **RMC, GGA, WTW** and other messages. For a detailed description of the communications protocol, please see the *DiveNET GPS/C Communications Protocol* documenation.

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DiveNET: GPS/C dive track files stored on the DDU are exported in **.KML/GPX** format compatible with common mapping/charting software, such as *Google Earth*.

DiveNET AGR supports pairing over **RS-232** serial interface for asynchronous exchange (UART) with **3.3V** data line voltage. The connection is made using a four-wire cable with wires **Tx** (transmitter), **Rx** (receiver), **Vcc** (power) and **GND** (ground). Without the use of additional repeaters and interface converters, the maximum length of the data cable, for which the correct operation of the interface is guaranteed, is no more than **2** meters.

Default port settings:

- Baud: 9600 bit/s
- Data bits: 8
- Stop bits: 1
- Parity: No
- Hardware flow control: No

WARNING !
Receivers are powered by a 12 V DC source, while the data line voltage is 3.3 V.

Limitations

- Positioning accuracy outside of the buoy perimeter is significantly reduced
- Vertical coverage is approximately equal to the horizontal base line up to the 300 m Pinger depth limit, e.g. a coverage area of 100 x 100 m will maintain coverage up to approximately 100 m of depth.
- The maximum recommended sea state for effective deployment is **1.5 points**. In case of sea state of **2** or more points, application of the system is **extremely discouraged** and the **manufacturer assumes no liability** for damage to individual devices of the system, their loss or malfunction, etc. under such conditions.

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SECTION 2

Deployment and Operation

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Pre-Deployment

Software

DiveNET: GPS/C supports two native applications, which may or may be supplied as part of a system package based on end user requirements. The system outputs data in common industry format designed for compatibility with common third party software.

- **DiveNET DDU Manager**
    - Native DiveNET utility application primarily used to configure system settings, set dive waypoints and download the dive track by establishing a connection between the user's PC and the Diver Display Unit.
- **DiveNET UGPS Hub**
    - Dedicated position tracking application available for dive supervisors/surface operators as a repeater of data generated by the AGR and relayed topside via hardwire data link.
- **External/third party software applications**

DiveNET GPS/C AGR provides a continuous data export stream in NMEA 0183 compatible format, including GNSS sentences for input to any common chart plotting software platform.

Regardless of the software platform used, ensure that it is properly installed, configured, tested and operating on the operator's workstation intended for deployment with the system prior to departure to the dive site.

NOTE !
When used with external chart plotting software, some features/data may be unavailable.

WARNING !
Ensure all system components are fully charged prior to deployment. Ideally, charging should occur no more than 1-2 days before deployment to prevent battery discharge during storage.

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Hardware

Buoy Check

A pre-deployment buoy check is designed to ensure the AGBs are in good working condition and ready for effective deployment.

- **Buoy Integrity**
    - Verify that all buoys in the kit are intact and free of any signs of significant damage, deformation or other visible marks of structural or electrical compromise, paying particular attention to the transducer cable
- **Buoy Functionality**
    - Power on each buoy by submerging the bottom of the unit in water to activate the water sensing automatic power switch
    - Verify operational status and ensure the battery is fully charged
- **Power Contacts**
    - Ensure that silicone grease is applied to the bronze contacts of the buoy's head module containing the GNSS receiver and power contacts

Buoy Indicator Light System

DiveNET GPS/C AGB are equipped with an LED indicator light system. Two LED indicator lights are contained in the upper part of the buoy's head section.

- **Power Indicator**
    - Flashes once per second to indicate the buoy's automatic water activation sensor is detecting the presence of water and the buoy is providing power to internal electronics
- **Status Indicator**
    - Flashes to indicate the buoy's system ID and state/status

Buoy System ID

Each buoy is factory coded with a system ID number 1 through 4 and will operate according to its designated system ID.

When powered on initially, the buoy reports its system ID using a rapid flash of the Status Indicator light a number of times equal to its system ID, e.g. AGB #3 will flash three rapid blinks of the Status Indicator light.

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Buoy Status Indication

- **Standby Mode**
    - After flashing its ID upon power activation, the Status Indicator light will illuminate continuously to indicate the AGB is in Standby mode and is acquiring satellite signal data. This typically takes 1 to 2 minutes.
- **Active Mode**
    - Once a sufficient GNSS signal is acquired, the buoy enters Active mode, its normal operational state. The Status Indicator light will flash the buoy ID every 4 seconds to indicate operation in Active mode.
- **Low Battery (<20%)**
    - The Status Indicator light will flash the buoy ID every second to indicate low battery state if the battery charge level is below 20%.
- **Battery Critical**
    - Both indicator lights will flash simultaneously once per second. In this state, it's critical to power down the buoy immediately by removing it from the water to recharge as soon as possible.
- **Battery Failure**
    - If the battery is in a state of critical discharge, the buoy will automatically shut down after a final ID flash. Both indicator LEDs will remain off.
    - Immediately recharge the buoy to prevent permanent power supply failure!

WARNING !
Continued operation under a critically discharged power supply is strictly prohibited!

Buoy Charging

- **Buoy charging SOP**
    - Ensure the buoy is powered down
    - Consult the charger documentation for specific operating mode indicators
    - Connect the charging dongle to the buoy, ensuring the contacts align correctly
    - Connect the charger to a main outlet
    - Once charging is completed, unplug the charger and disconnect the charging accessory from the buoy

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WARNING !
Only connect the buoy to a powered charger when the buoy is powered OFF!
Use only factory provided charging units and dongles!

Buoy Service Access Port*

The buoys are designed with provision for service via a dedicated access port. The service access port is used to:

- Change a buoy's system ID
- Extract serial numbers associated with the buoy
- Flash/update firmware

**Consult with the manufacturer for instructions.*

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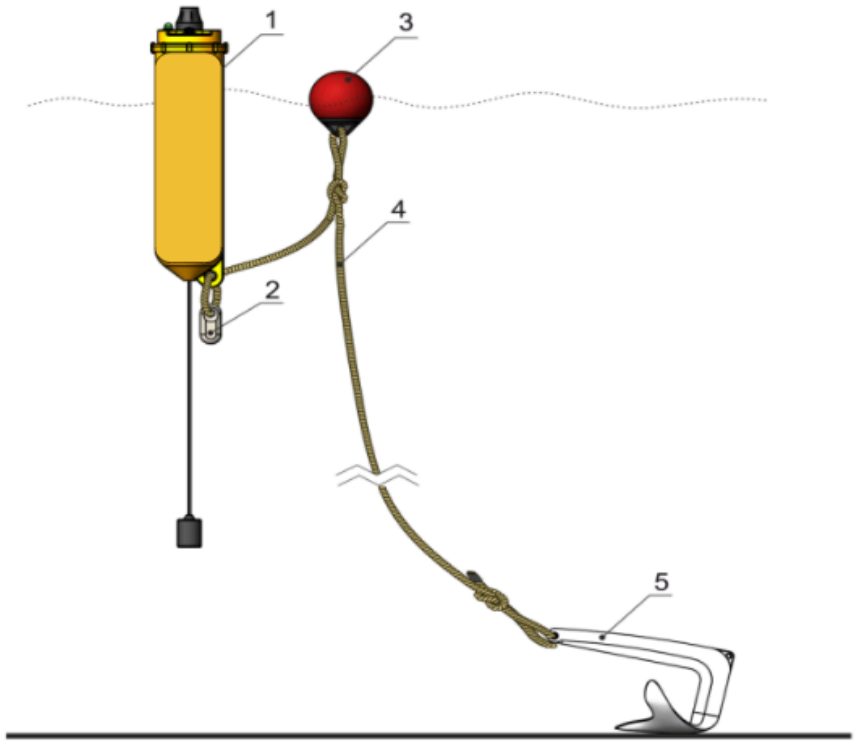
Deployment

Buoy Deployment and Operation

Be prepared to deploy the buoys on the water surface, taking care to avoid submersion and securing their position using anchors or weights to avoid loss due to current.

Buoy Anchoring

While the buoys have a slight positive buoyancy, they are not designed to be directly attached to the anchor rope. Use fender floats (or additional buoys) corresponding to the weight of the rope to prevent excessive strain on the buoy.



1 - DiveNET buoy, 2 - dead weight (optional), 3 - float, 4 - anchor rope, 5 - anchor

Buoy Deployment Considerations

Buoy Spacing

- Maintain a distance of **30** to **700** meters between buoys.

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Topside Line of Sight

- Ensure unobstructed access to the celestial hemisphere for the GNSS antennas on each buoy, avoiding obstructions and shadowing.

Subsea Line of Sight

- Ensure a clear line of sight is maintained between each buoy's underwater antenna and the underwater pinger carrier.

Placement Restrictions

- Avoid deploying buoys near shorelines, port infrastructure or vessels.

Navigation Base Size

- The size of the navigation base (the rectangle formed by the buoys on the water surface) should not be less than the maximum depth of the positioned object. The base should be slightly larger than the intended work area.

Deployment Technique

- Carefully lower buoys into the water. Ensure sufficient anchor rope length and that the fender floats properly support the weight of the rope. Verify the buoy is vertical and free of any additional strain.

NOTE !
Despite water tight design, DiveNET GPS/C buoys are not intended to withstand complete submersion for an extended period of time. Take care to avoid unnecessary submersion of the buoy's head section throughout the system's lifetime.

Receiver Module Deployment and Operation

Receiver Line Of Sight

The receiver should be mounted in a location that ensures a clear line of sight with the transmitters of all four buoys. It should be positioned as far away as possible from the outputs of propulsors, noisy mechanisms, sonars, and any equipment that generates strong electromagnetic interference, such as switching power supplies and motors.

When used by a diver, recommended locations for the receiver include the oxygen tank, shoulder, or dedicated navigation board designed to secure the DDU.

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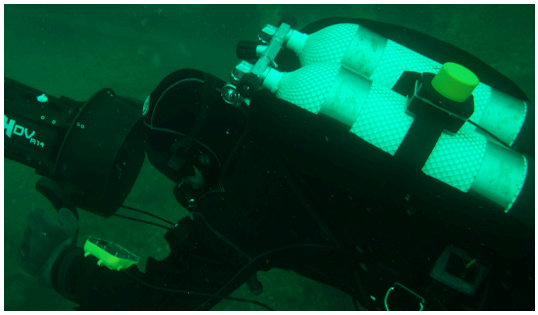


Physical Interfacing with Carrier Systems

When physically connecting the device to the vessel, ensure a secure and watertight cable entry that prevents water from entering through the cable's open end. When sealing the open end of the cable, avoid using aggressive sealants and compounds, such as acetic acid-based silicone sealant, as they can corrode the cable cores and lead to device failure.

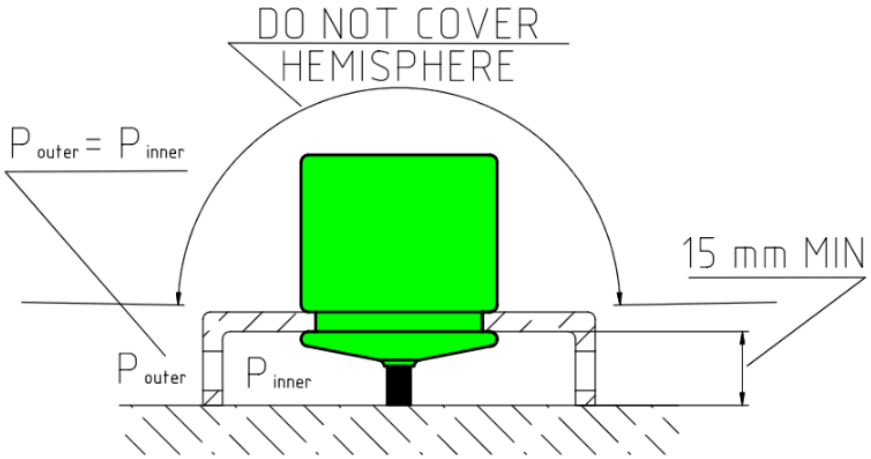
Epoxy resin-based compositions are not recommended for sealing cable glands. These materials often deteriorate and lose their properties when exposed to moisture for extended periods, and they also shrink significantly after curing.

Compounds and sealants based on polyurethanes are the most reliable and suitable options. If you have any questions regarding sealing, consult with the manufacturer.

The power requirements are specified in the device's technical specifications. For information on data exchange with the device and configuration changes, refer to the *DiveNET GPS/C AGR Interfacing Protocol* documentation.

Receiver Mounting

Securely attach the pinger beacon to a special groove with a soft clamp. Ensure even pressure distribution to avoid uneven loading, excessive compression, or shielding the beacon body.



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Function Test

Lower the AGR module into the water. Once submerged and assuming hydrological conditions support near surface buoy contact, the receiver will begin to output position data to the DDU or another interfaced data reader.

Diver Display Unit Deployment and Operation

Components and Controls

The DDU consists of the following components:

- **LED display:** A screen to display navigation and service information.
- **Controls:** Two piezo buttons on the sides enable device control.
- **Built-in Battery:** Provides power for the unit.
- **Bluetooth Module:** Facilitates wireless communication.
- **DSP Unit:** Processes acoustic signals.
- **Wireless Charge Inductor:** Enables charging via wireless charging pads.
- **(Optional) Custom DDU 5-pin to USB Charging Cable:** Used to enter Service Mode when used with hardwire repeater function with a surface operator/supervisor workstation.

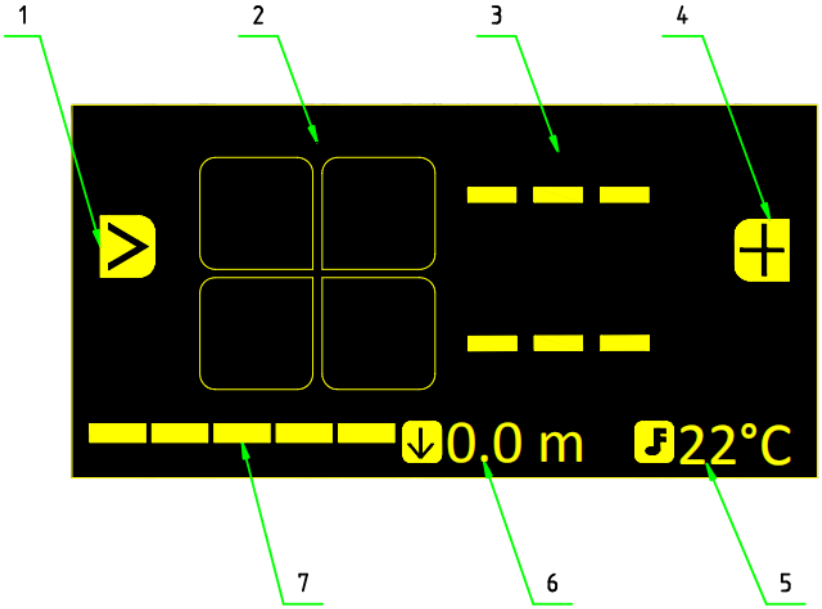
Operating Modes

Power On/Off

The DDU is powered up/down by a simultaneous short press of both the Left and Right push buttons.

Navigation Mode

Whenever powered up and NOT placed on a wireless charging pad or connected to a charging cable, the DDU enters primary **Navigation Mode**. Display indication prior to receiving any buoy navigation data is illustrated below:



1 - left push button icon "Cycle", 2 - AGB status, 3 - bearing and range to set waypoint, 4 - right push button icon (add POI), 5 - ambient temperature, 6 - depth, 7 - battery charge

NOTE !

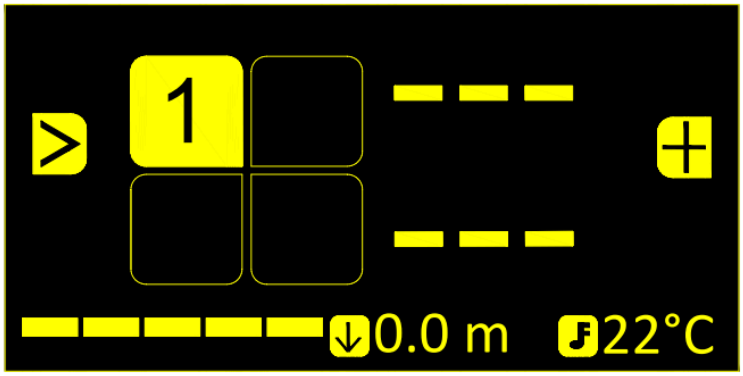
The DDU is equipped with piezo buttons to prevent water from entering the housing through mechanical button seals. Piezo buttons have unique operating characteristics, notably the lack of tactile feedback when pressed. They are sensitive to short pressure changes, so all presses to control the device should be momentary.

WARNING !

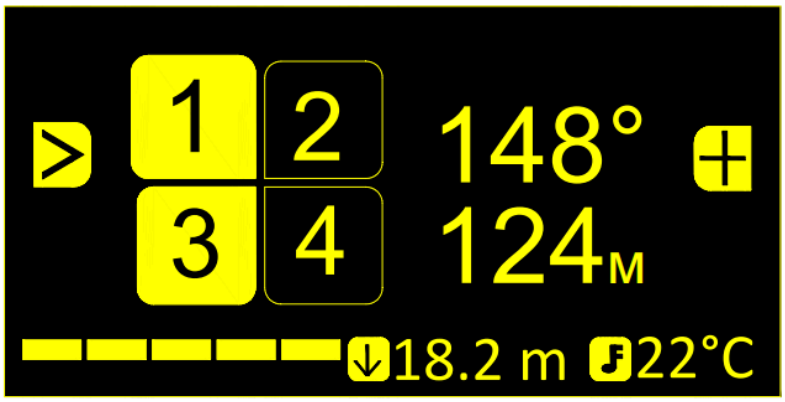
When powered on, the device will calibrate atmospheric pressure for 10 seconds to ensure accurate depth readings. Therefore it is recommended to only turn on the device outside of the water. If the hydrostatic pressure exceeds 1100 mbar at startup, atmospheric pressure calibration will not be performed and a standard value of 1013.25 mbar will be set automatically.

If buoy signals are not received (for example, immediately after turning on the device), the azimuth and distance to the target will not be displayed on the screen. This is because the navigation receiver's geographic location is either unknown or outdated. In this case, **button functions will also be unavailable.**

The illustration below demonstrates a scenario where the navigation receiver has received a signal from the first buoy, but its own location has not yet been determined. It's important to note that buoy signal transmission is time-divided, meaning the receiver awaits signals from each buoy sequentially. Therefore, if the receiver does not receive the signal from the first buoy, it will not proceed to receive signals from the second buoy, and so on.



The illustration below illustrates the display indication when signals from all four buoys are received and the coordinates of the navigation receiver are updated. In this example, AGB#1 is selected as the navigation target as indicated by the enlarged AGB box and AGB #2, 4 are indicating **Low Power** by showing a transparent AGB box.



NOTE !
Target bearing means the angular direction from the northern half-meridian clockwise to the line to the target.

NOTE !
When range to target is less than 3 meters, dashes "- - -" are displayed in place of the target bearing.

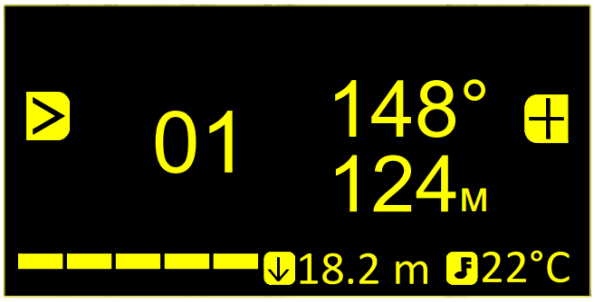
Whenever a solution is present (bearing and range to the selected target are displayed), the Left push button (>) cycles through the programmed waypoints/targets.

AGBs are automatically set as waypoints #1, 2, 3, 4, respectively. Additional waypoints can be programmed into the device from a PC/laptop prior to the dive.

When the user presses the Right push button (+), the current location is saved separately (the marked point is saved), which is placed at the end of the target list.

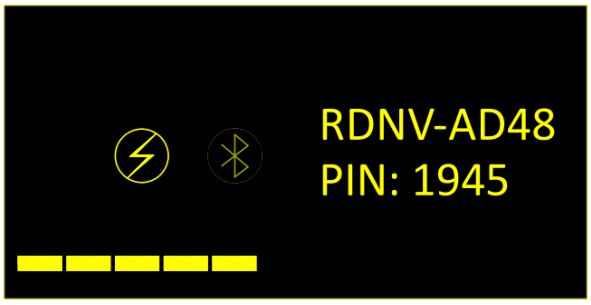
The preloaded and marked points are numbered, and when the user selects them as targets using the (>) button.

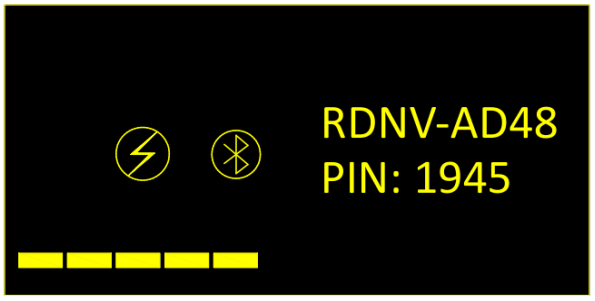
To turn off the device, the user must **simultaneously press both buttons**.



Service Mode

When placed on a wireless charging plate or connected to a power cable, the DDU enters Service Mode. This mode enables charging of the built-in power supply and BlueTooth connectivity for device configuration using the native DiveNET DDU Manager application once linked to a user PC.





After **5 minutes** of inactivity in Service Mode, the screen turns off in order to save energy and charge the built-in power supply faster. Pressing any button on the DDU again turns on the screen. When the unit is removed from the charging pad, the device automatically turns off.

Built-in Bluetooth module and PC connection

The diver's navigation receiver incorporates a Bluetooth module to facilitate:

- Device Configuration: configuration through a PC connection for seamless parameter adjustments.
- Real-Time Data Transfer: emulation of a Bluetooth GNSS receiver enables the real-time transfer of coordinates to external systems.

The Bluetooth module automatically activates upon device power-on, regardless of the operational mode. To conserve battery life, the module deactivates after 10 minutes of inactivity, provided no connection has been established within this timeframe.

Unique Device Identification

Each navigation receiver features a distinct Bluetooth device name in the format: DNET-XXXX. The "XXXX" component represents a unique identifier consisting of uppercase letters and numbers. For instance, a device might display "DNET-AD48" as its Bluetooth name.

Pairing and Security

To facilitate initial connection, a unique pin code is displayed under the Bluetooth device name. Example: the pin code "0101" - this pin code is essential for establishing a secure connection.

Real Time Data Output

When the device is in navigation mode, an active Bluetooth connection facilitates the transmission of essential navigation data, including **GGA, RMC and MTW** messages. This allows the diver's navigation receiver display unit to function as a Bluetooth GNSS receiver. The transmitted data enables real-time display of the diver's location on any compatible mapping device, such as a diver's tablet supporting external GNSS receiver connections via Bluetooth.

Bluetooth Operational Considerations

It is essential to note that radio waves, including Bluetooth signals, have limited penetration in water. To ensure stable Bluetooth connectivity underwater, the interface unit of the diver's navigation receiver and the mapping device should be positioned in close proximity to one another.

Configuration and DiveNET DDU Manager

When the device is placed on the charging pad and in service mode, a Bluetooth connection enables users to modify the settings of the diver's navigation receiver through the DiveNET DDU Manager. Detailed instructions for establishing a Bluetooth connection and operating the DiveNET DDU Manager are provided in the DiveNET DDU Manager section of this manual.

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Operational Considerations

Factors Affecting System Performance

Buoy Interpositioning

The buoys are used to establish a long baseline for underwater positioning. As such, their interpositioning is a fundamental factor in overall system performance. Maintain recommended guidelines:

- Roughly **rectangular** coverage area with a length/width **ratio not exceeding 2:1**, ideally.
- Avoid **in-line positioning** of more than two boys.
- Avoid positioning of buoys adjacent to **reflective barriers and shallow water** whenever possible.
- Avoid **steep depth changes** between buoy positions whenever possible.
- Maintain the **min and max** buoy to buoy **distances of 30 and 700 m**, respectively.
- Ensure a clear view of the sky for successful GNSS capture

Receiver Positioning

After the buoys, the AGR module mounting and positioning considerations throughout the dive are the most critical factor affecting system performance.

- Attempt to mount the receiver such that it maintains a **level and stable** position as much as possible.
- Ensure the receiver has a **clear line of sight** with minimum diver/system shading.
- Ensure the receiver is mounted **securely** and in conformance to **mounting requirements**.
- Ensure that **relative velocity**, including the carrier's own velocity and water current, does not exceed the receiver **limit of 1.8 m/s.**
- Avoid receiver shadowing during the dive; **position is only provided when all four buoys are in contact.**

Hydrological Conditions

Natural and man-made noise can negatively impact system performance. Unfavorable underwater terrain and bottom vegetation can contribute to acoustic shadowing. **Ideal conditions include water that is clear, calm and open with an even, unobstructed bottom profile and sufficient operating depth of over 10 m.**

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Positioning Outside of the Coverage Area

DiveNET: GPS/C operates most effectively within the navigation base (the area formed by the buoys on the water surface). While the system can estimate the relative position of a diver outside the navigation base, accuracy decreases. Positions near or directly behind a buoy are also less optimal.

Large Vessels

Large ships, especially those with deep drafts, can interfere with the transmission of acoustic signals.

Sea State

It is not recommended to use the system with sea waves exceeding **1.5 points**. In case of sea waves **2** or more points, application of the system is **extremely discouraged** and the **manufacturer is not responsible** for damage to individual devices of the system, their loss or malfunction, etc.

It is important to remember that the buoys have a splash-proof design (that is, they are protected from atmospheric precipitation, rare wave coverings, etc.) and are not intended for complete immersion in water. The top of the buoy must always be above the water.

WARNING !
Use of only one complete GPS/C set is permitted per site, which may cover an area with a radius of up to 3,000 - 5,000 m around the dive location. Similarly adding more buoys beyond the four units required is not permitted and will lead to ineffective operation of the system.

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Troubleshooting

	Symptoms	Potential Cause	Solution
1	When installed on the charging pad, the service mode does not turn on, although the power indicator is on (power is being supplied to the charging pad)	1. The charging pad is not as close to the device as need 2. The charging pad is defective	1. Find the optimum position for the charging pad 2. Replace the charging pad
2	Positioning does not occur in navigation mode, although the device receives signals from all buoys properly	The system fails to estimate the location with sufficient accuracy in view of the wrong arrangement of buoys and the navigation receiver or adverse hydrological conditions	1. Make sure that the buoys form a convex quadrangle and start navigating inside the buoy figure, avoiding proximity to the buoys
3	In navigation mode, positioning does not occur due to the fact that buoy reception is unstable	1. One (or more) of the buoys does not work. 2. Sustainable receiving of buoy signals is prevented by hydrological conditions. 3. There is no direct line of sight between the buoy transducer and the navigation receiver	1. Check the performance of all buoys 2 and 3. Try to start navigation from another place, making sure that nothing prevents the propagation of the signal (parts of the underwater landscape and port infrastructure, dense thickets of algae, etc.)
4	The spread of points in the track is too large and amounts to more than 2-3 meters	One reason may be a significant speed of movement and/or strong currents. Although the system is designed to compensate for Doppler shift, the compensation only concerns communication, and the quality of navigation data may deteriorate.	Try to reduce the speed of movement. Provide a static position of buoys. If the currents are caused by tidal processes, try to work during stagnant water.

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Stowage and Maintenance

Buoys

- Remove the navigation buoys from their anchors at the end of operation.
- Clean the buoys of contaminants (silt, dirt, algae, etc.).
- Desalinate the buoys if they were not used in freshwater.
- Wipe the buoys with a soft cloth to remove moisture before storing them in the transport case.
- Do not store navigation buoys without desalination.
- Do not store navigation buoys with wet anchor ropes or other wet objects.

Receiver and Display Unit

- Remove the receiver module and DDU from the carrier diver/system.
- Wash the receiver module of contaminants (silt, dirt, algae, etc.).
- Desalinate the receiver module beacon if it was not used in freshwater.
- Wipe the receiver module beacon gently with a soft cloth and air dry for at least 30 minutes.

Surface Power/Interfacing Station

- Storage of the device is allowed only in the OFF state with the case lid closed and the connectors closed;
- During long-term (more than a month) storage, it is recommended to periodically check the condition of the built-in battery and, if necessary, charge it to prevent degradation of the built-in battery;
- Contaminants from the body of the device (case) can be removed with the lid closed using household soap solutions, followed by their thorough removal;
- Dirt on the front panel can be removed with a damp cloth, avoiding moisture and dirt getting into the connectors and fuse sockets;
- It is not allowed to use third-party chargers;

Battery Maintenance

- Avoid prolonged storage of the system (over 1 month) without periodic battery charging-discharging to maintain the battery life cycle.

Prohibited Sensor Practices

- **Do not apply mechanical force to the pressure sensor hole.**
- **Do not store the pinger beacon in a moist environment, especially around salt water.**
- **Do not allow the water in the pressure sensor hole to freeze.**

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SECTION 4

Surface Power/Interface Station

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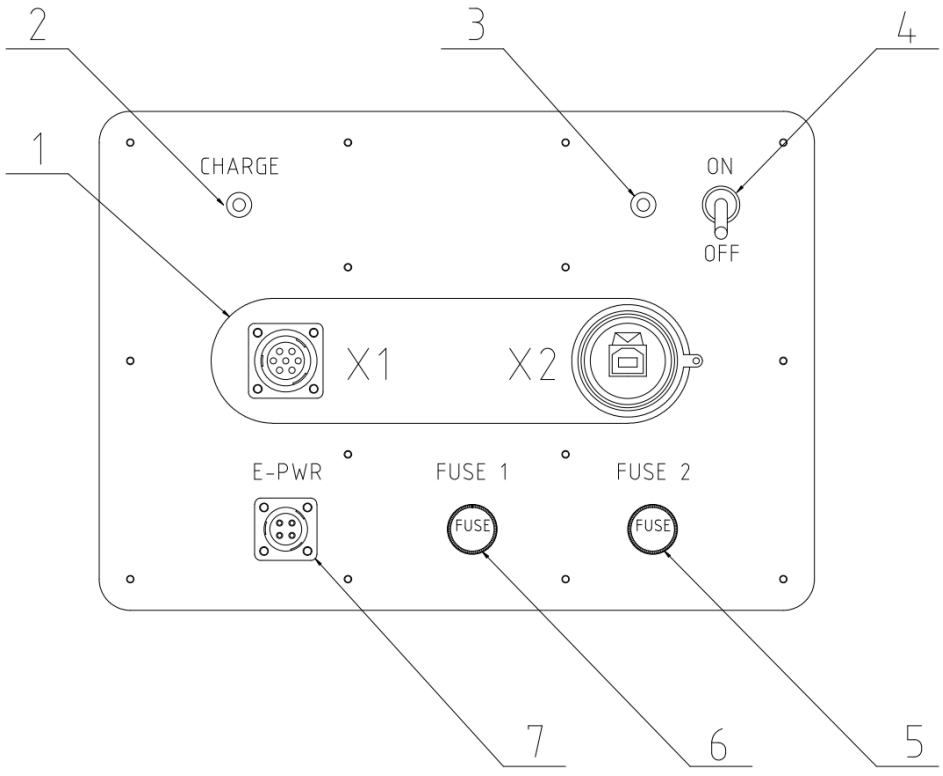
Introduction

The **DiveNET Surface Power/Interface (SPI) Station** combines the functions of an autonomous power source for the direction finding station MAST and a switching hub for interfacing the station with the user's PC, as well as for connecting data sources about the heading and position of the direction finding station. Contains protection circuits against polarity reversal and overvoltage of connected devices.

The device is housed in a small impact-resistant plastic case. Has the front panel from high-quality stainless steel. The modern lithium-iron phosphate batteries used in the device provide operation at negative temperatures and more than 3000 charge-discharge cycles. If necessary, it is possible to work from an AC source via included or compatible AC adapter.

Appearance and Controls

The appearance of the front panel of the device is shown below. In the center of the panel there are connectors for connecting devices that support communication via the **RS-422/485** interface and **USB-B** connectors. **X1** provides power to connected external devices. The USB-B connector **X2** is intended for connection to the USB port of a PC.



1 -"X1" RS-422/485 female power connector; 2 - Charging light; 3 - Power status light; 4 - Power switch; 5 - Battery line fuse; 6 - External power line fuse; 7 - Charger (AC/DC adapter) connector;

The **Charging light** (2) indicates when the built-in battery is being charged. The **Power Status light** (3) indicates the power status of the system and has multiple modes. The **Power switch** (4) is used to power the unit **ON** and **OFF**.

Fuses 5 and 6 protect the built-in battery and external power circuits, respectively.

Fuse specification: **5.2 x 20, 5A**

The **E-PWR connector** (7) is used to connect to an external power source to power the AC main power lines as well as charge the battery.

Color	State	Description	Action to be taken
Green	On	OK	-
Green	Flashing	Built-in battery low	Charge the battery
Red	On	Output short circuit	Power OFF; check all connected devices, cables, connectors
Red	Flashing	External power circuit error	Power OFF; check the AC/DC adapter, cables, connectors

Working with the device

Before use, the device must be placed on a stable horizontal base. When working on ships/boats and other types of moving objects, take care to secure the unit to prevent accidental slippage or falls.

Connecting and disconnecting connectors is recommended while the system is powered off.

Once all of the required external connectors are connected to the unit, the system can be powered on. The status of the device is indicated by the Power status light.

Connector pinouts

E-PWR		**X1**	
Pin number	Function	Pin number	Function
1, 3	+U CHARGE	1	+U
2	GND CHARGE	2	GND
4	RESERVED	3	Tx+
		4	NC
		5	Tx-
		6	Rx+
		7	Rx-

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SECTION 5

DDU Manager Software Application

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Introduction

The DiveNET DDU Manager software application is used to connect the GPS/C Acoustic GPS Receiver (AGR) and Diver Display Unit (DDU) to a PC to configure settings, load waypoint coordinates prior to diving, and download stored track data after diving.

PC system requirements for connecting the device:

- Windows 10 OS with installed .NET Frameworks 4.5
- Bluetooth-module

Establishing a Bluetooth Connection

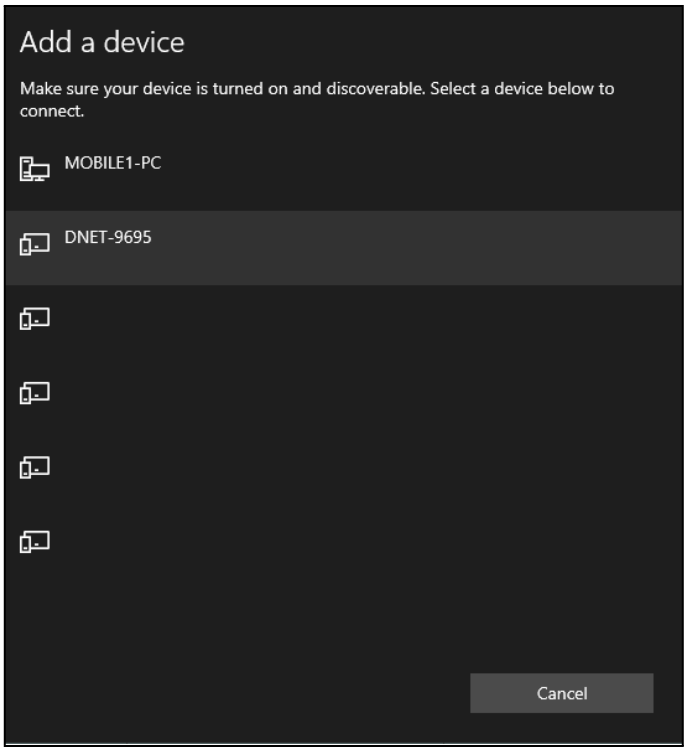
Place the display unit on top of an appropriately sized charging pad/plate, taking care to loosen or remove any obstructions to direct contact, including tie down straps.

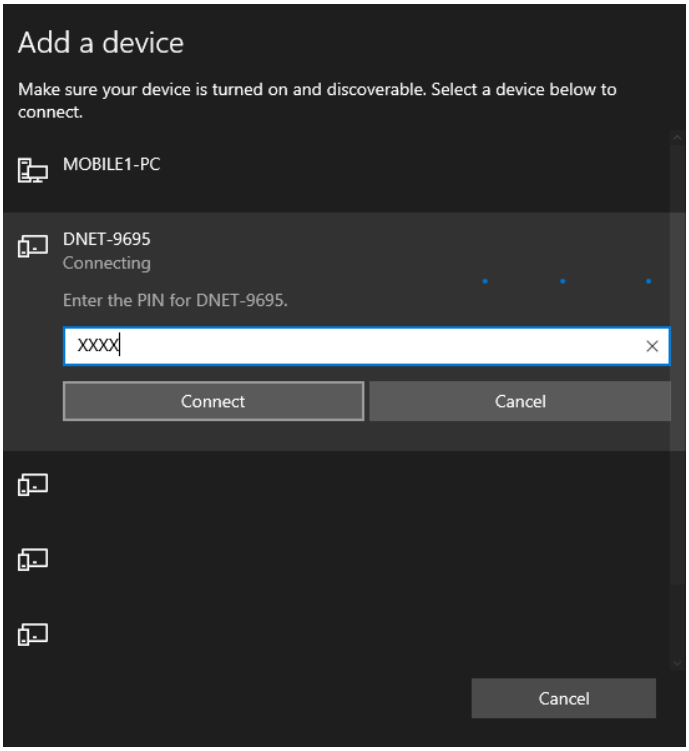
Make sure the charging pad is connected to a power source.

Enable Bluetooth on your PC: navigate to the Windows settings (click the Start Menu and select "Settings") and access the "Bluetooth & other devices" section. Ensure Bluetooth is switched "On."

- Open the menu Start -> Settings -> Devices
- Verify that the Bluetooth switch is On
- Press + Add Bluetooth or other device

After the system detects a new device, it will be displayed in the list.





The list shows the name of the device, which is visible on the screen of the device itself (in the example "DNET-CFBB"). Further, when the user clicks **Pair**, the system prompts the user to enter a PIN code.

To connect to the device, follow these steps:

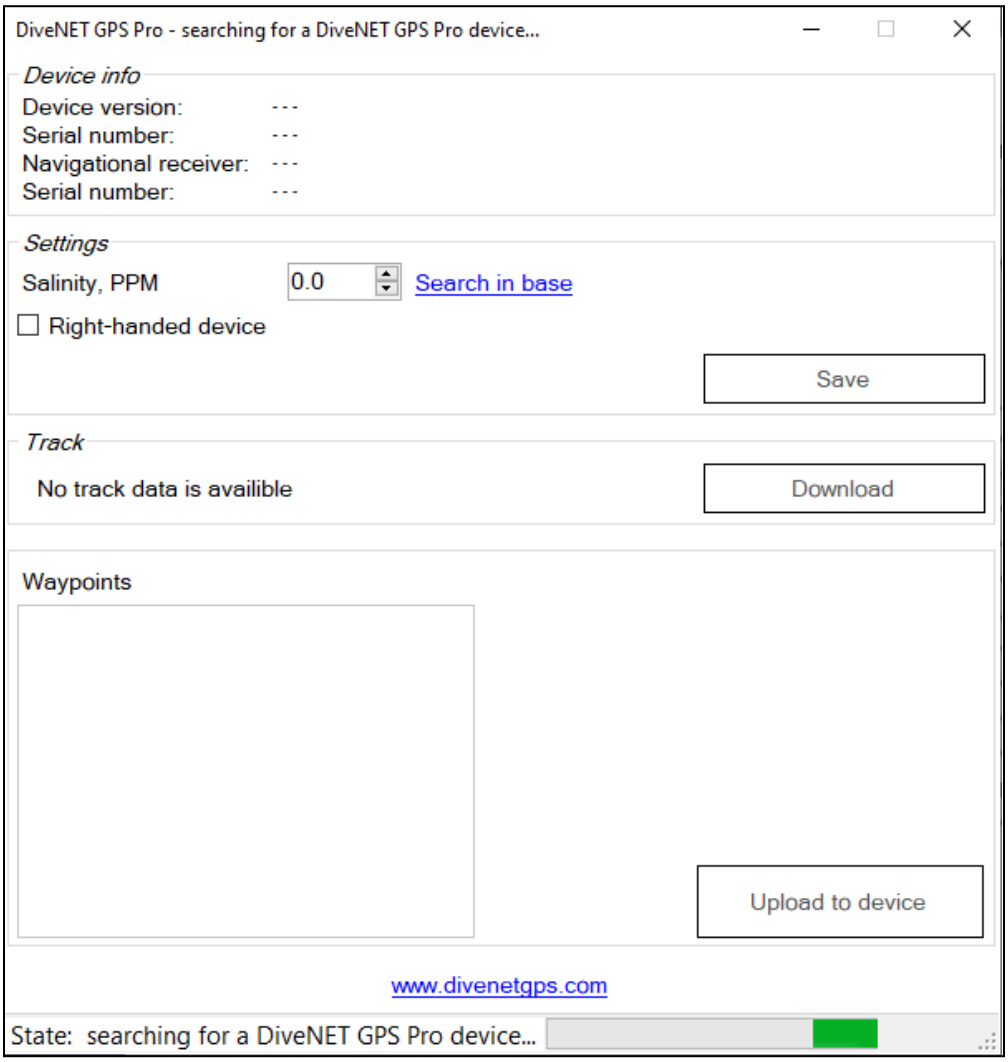
- Locate the PIN code: The device screen will display a unique PIN code (e.g., 1234).
- Enter the PIN code: Input the displayed PIN code into the designated field within the application.
- Confirm: Press the "Next" button to initiate the connection process.
- Await Connection: The system will attempt to establish a connection with the device. This may take a few moments.
- Confirmation: Once the connection is successful, the dialogue box will update to reflect the status "Device Status: Connected".

This process ensures a secure and reliable connection between your device and the application.

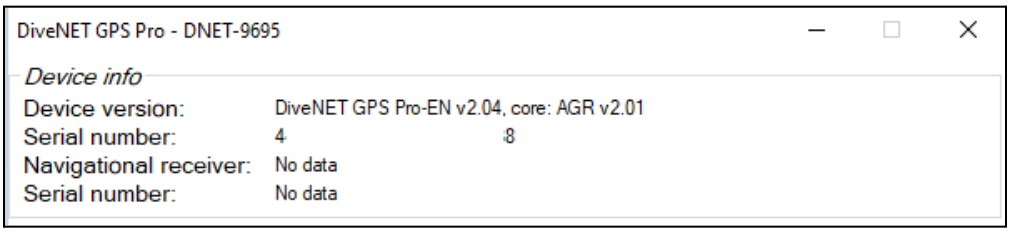
A successful pairing message should appear once the connection is established. At this stage, communication with the device is active and ready for use as indicated by the lighting of the Bluetooth icon on the DDU.

Using DDU Manager

After connecting the device the user can start the DiveNET GPS/C Software application and it will establish a connection with the device automatically. If the connection is successful, the "Connected" status will be displayed in the application window in the status bar. The device name appears in the window title.



The upper lines display information about the device version and its serial number. Information on the version of the navigation receiver and its serial number is displayed below. This information is only available if the device has been put into service mode from the state "On".



The diver navigation receiver offers a streamlined settings interface for optimal performance. While the device features a minimal number of configurable parameters, the water salinity value is crucial for accurate operation.

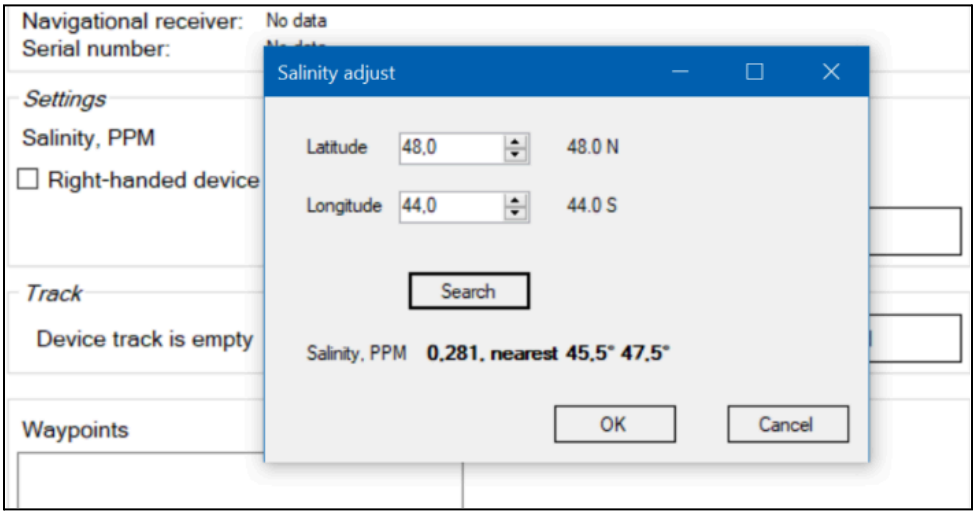
Freshwater Operations

For diving in freshwater environments, the default salinity value of 0 PSU (Practical Salinity Units) is recommended.

Seawater Salinity Lookup

to facilitate convenient salinity adjustment for saltwater dives, the application includes a comprehensive database of global ocean salinity values. This database provides salinity data for locations with a 1° resolution in both latitude and longitude.

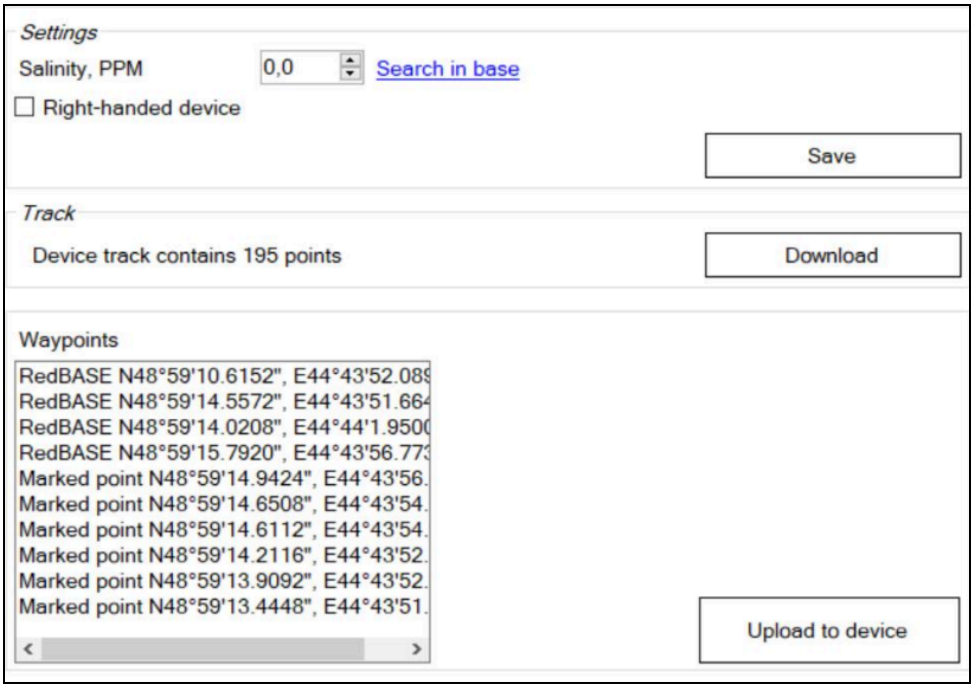
To retrieve the appropriate salinity value for a specific dive site, users can conveniently access the database via the "Search in the base" link located in the main application window. Simply enter the geographical coordinates (latitude and longitude) of the desired dive location within the designated dialogue box.



When the **OK** button is clicked, the found value will be placed in the settings field of the main window.

In addition, it is possible to adjust the flip of the device screen by exchanging the functions of the buttons. This function is designed to enable the device to be mounted on the right hand. To enable this function, the Screen flip check-box in the main application window should be checked.

To download the settings to the device, the **Save** button should be clicked. The button **Download** serves for downloading tracks, buoy positions and saved points from the device.



After pressing the **Download** button, while the tracks are downloading from the device, the other buttons will become unavailable, and the operation progress will be displayed in the application status bar.

After the download is completed, the application will offer to save the downloaded data using the standard system dialogue. At the same time, a **name composed of the current system time and date** will be offered as the file name. The application allows saving tracks in **Keyhole Markup Language (KML)** format.

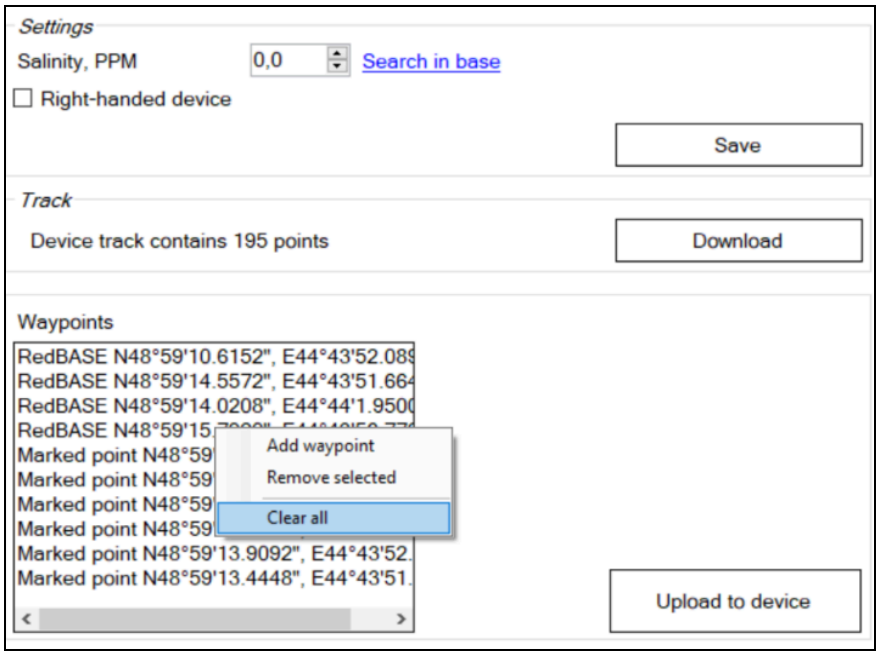
Saving Data

When saving/exporting a stored track file, the application will prompt the user to confirm whether they wish to clear the current track from the device.

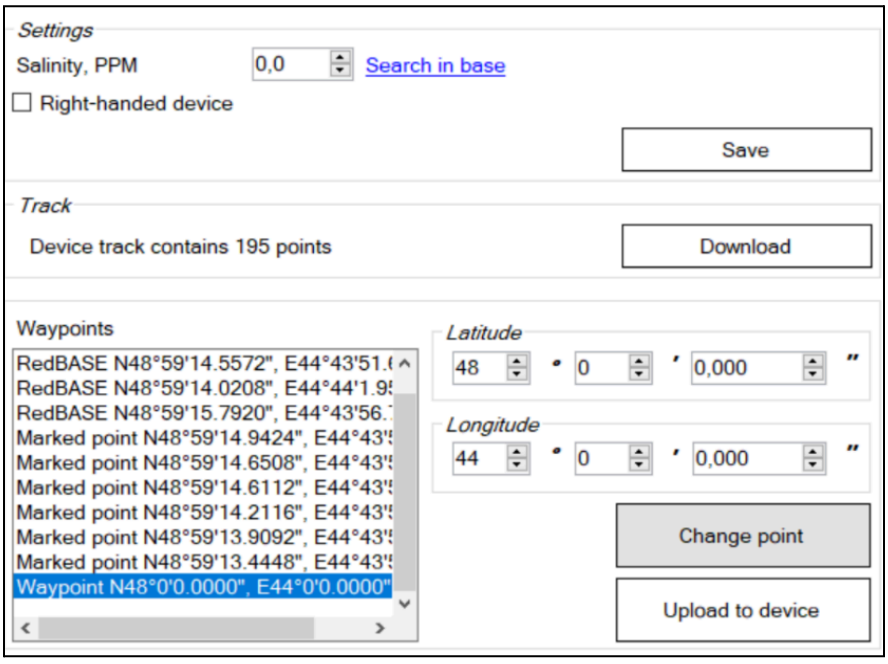
WARNING !
Clearing tracks from the device is an irreversible action. Data will be permanently deleted and cannot be recovered.

Waypoint Management:

Waypoints can be managed using the context menu accessible by right-clicking on the "**Waypoints**" group. This menu provides options for working with waypoints.



Manually added waypoints can be edited using the panel on the right when the added point is selected.



To synchronize the list in the panel **Waypoints** with the device click the Download to device button. To clear all waypoints in the device:

- Delete all items in the list
- Click the **Upload to Device** button
- Answer "yes" to the application's prompt

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SECTION 6

UGPS Hub Software Application

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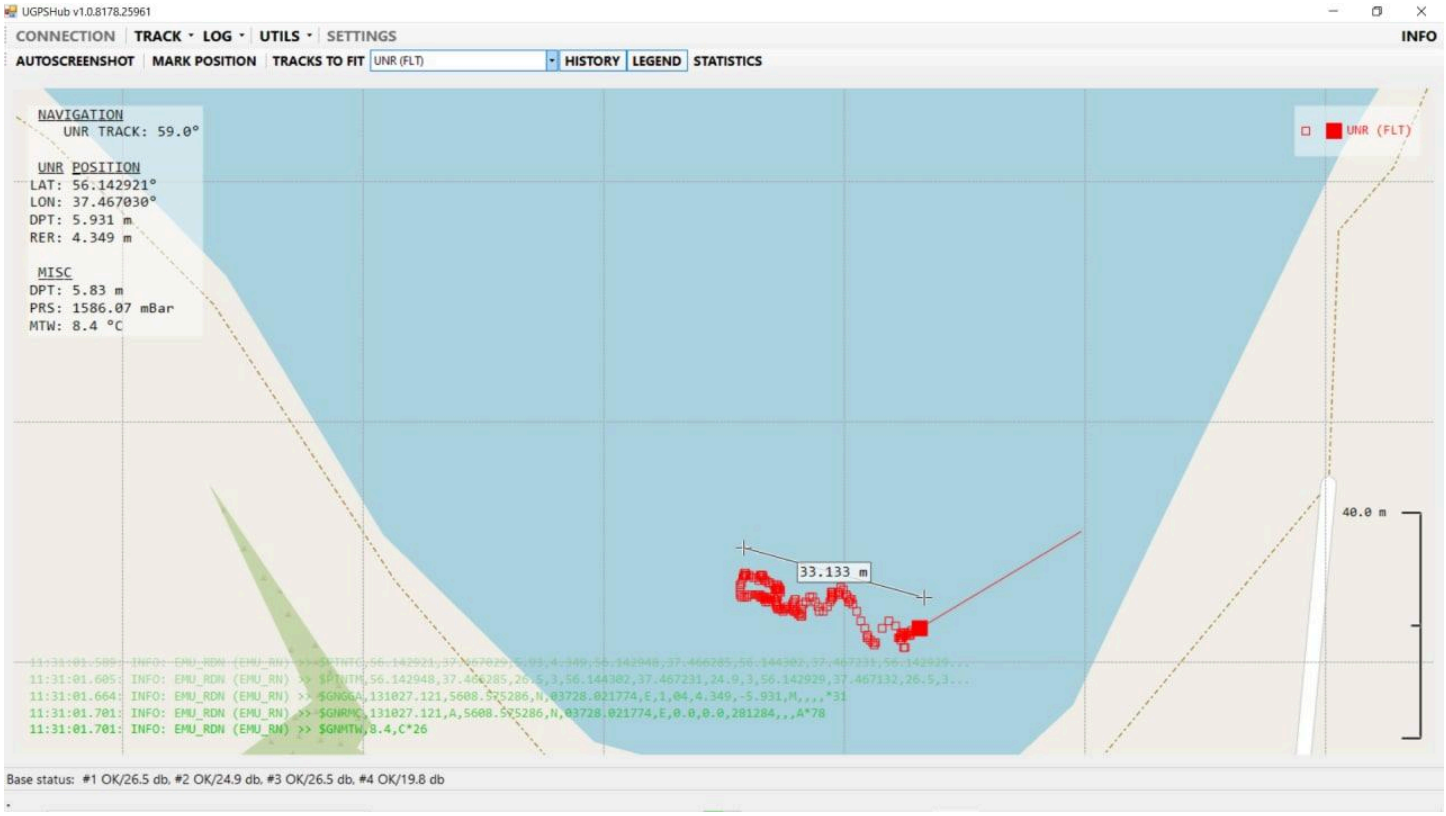
Introduction

DiveNET UGPS Hub is a dedicated software application designed to provide a surface operator/dive supervisor with the ability to monitor the position of a hardwired underwater DiveNET Acoustic GPS Receiver.

No installation is required; simply unzip the archive and place it in a convenient location. The application utilizes the .NET Framework and is compatible with Windows 10 and later operating systems.

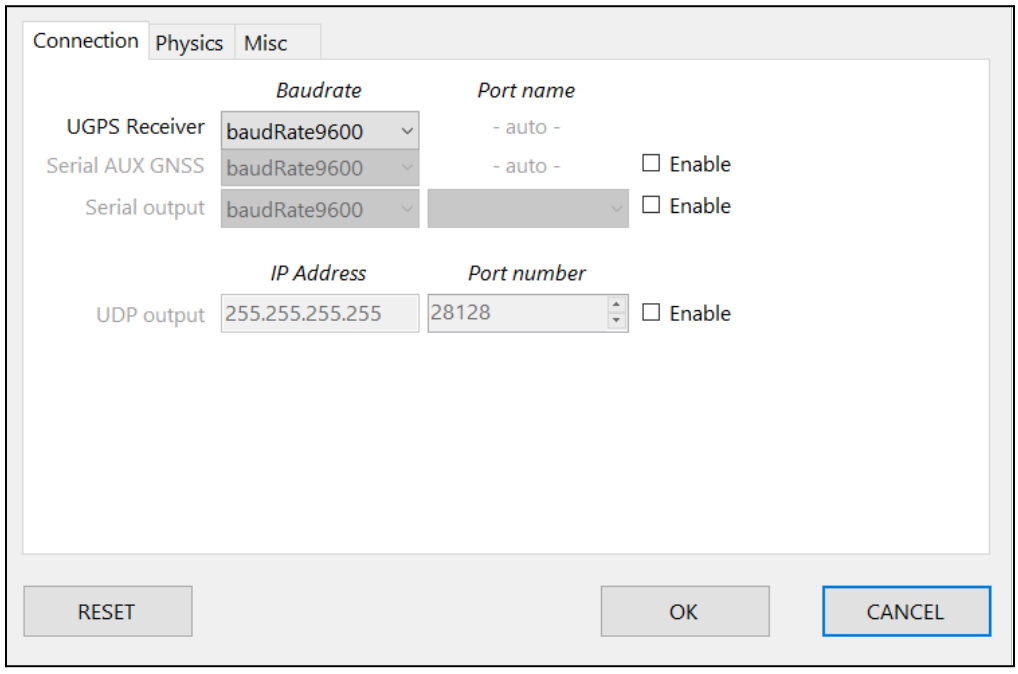


Interface and Functions

Main Menu Bar

- **LINK –** enable/disable real time connectivity
- **SETTINGS –** application settings
- **LOG –** load and replay log files
- **UTILS –** additional functions/features
- **INFO –** additional information about the application and resource links

SETTINGS MENU



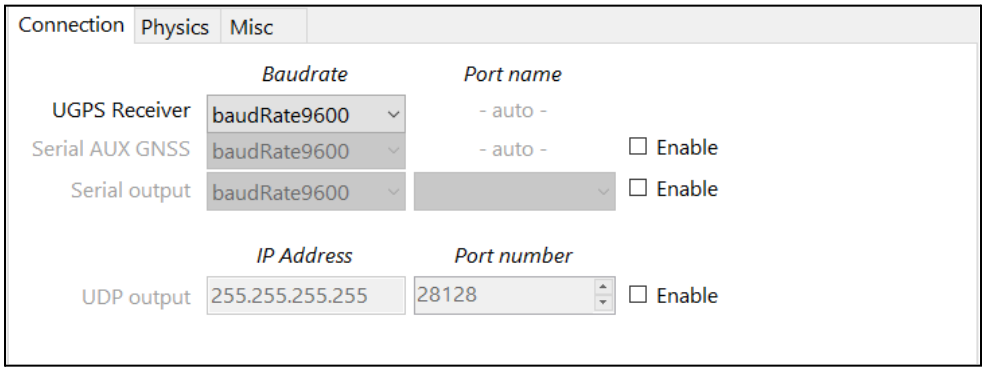
The application settings editor is available via the **SETTINGS** button in the main application menu bar. Settings are grouped into three tabs:

- **CONNECTION –** connectivity settings
- **PHYSICS –** environmental and calculation variables
- **MISC –** additional settings related to display indication, data and other configuration parameters

In addition to the tabs, the settings editor features three buttons:

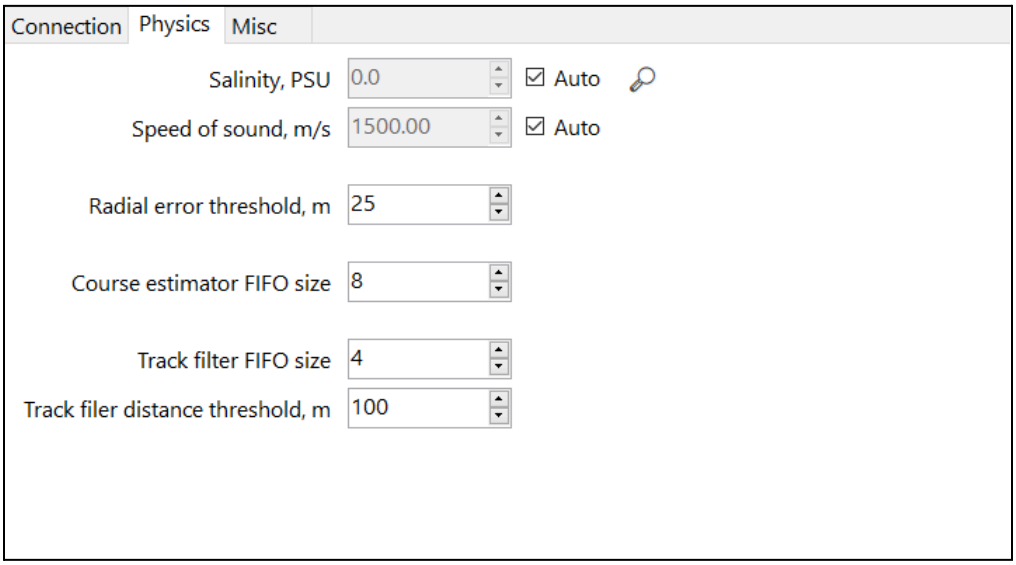
- **RESET –** reset to default settings
- **OK –** save changes and close the settings editor
- **CANCEL –** close the settings editor without saving changes

SETTINGS / CONNECTION



- **Baud rate**
  - Connection speed
  - **Must match output system's settings to establish communication with external systems**
- **Port name**
  - Port selection field
  - **Preset "Auto" to allow the application to scan for port connectivity automatically**
- **UGPS Receiver**
  - Baud rate and Port name for the navigation receiver
- **Serial AUX GNSS**
  - Baud rate and Port name for external GNSS input
- **Serial output**
  - Baud rate and Port name for UART data export to third party platforms
- **UDP output**
  - IP address and Port name for UDT data export to third party platforms
- **Enable checkbox**
  - Enable/disable associated input/output

SETTINGS / PHYSICS

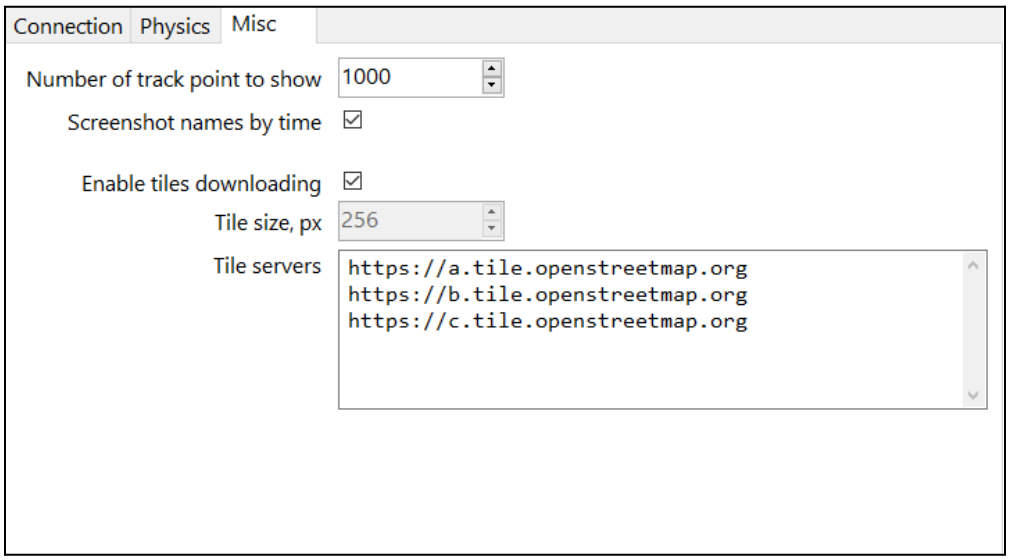


- **Salinity, PSU**
    - Field for entering water salinity. Salinity is required to accurately calculate the speed of sound.
    - If **Auto** is checked, the application will try to find salinity from the geographic location database. The auto salinity detection function is recommended for use only for seas, oceans and other large bodies of water for which reference data is available. Do not use this function when working in small inland bodies of water such as rivers, lakes, ponds, etc. Salinity can also be found manually in the database by clicking on the Search link.
- **Speed of sound, m/s**
    - If you have a directly measured sound speed value, enter its value in this input field.
    - In other cases, it is recommended to check the **Auto** checkbox on the right - the speed of sound will be calculated automatically based on geolocation reference data.
- **Radial error threshold, m**
    - It is not recommended to change this value.
    - Default setting: 25 m
- **Course estimator FIFO size**
    - It is not recommended to change this value.
    - Default setting: 8
- **Track Filter FIFO size**

- It is not recommended to change this value.
- Default setting: 4

- Track filter distance threshold, m
  - The distance between adjacent measurements of the location of the positioned object, at which the smoothing filter will be reset.
  - Default setting: 100 m

SETTINGS / MISC



- **Number of track points to show**
  - This input field specifies the maximum number of track points to display.
- **Screenshot name by time**
  - When checked, the application will save auto-generated screenshots with time stamps in the file name.
- **Enable tile download**
  - When checked, the application will try to download the necessary tiles from the specified servers.
- **Tile size, px** - sets the size of map tiles in pixels. This parameter depends on the tile server.
- **Tile servers** - list of tile server addresses for downloading map tiles.

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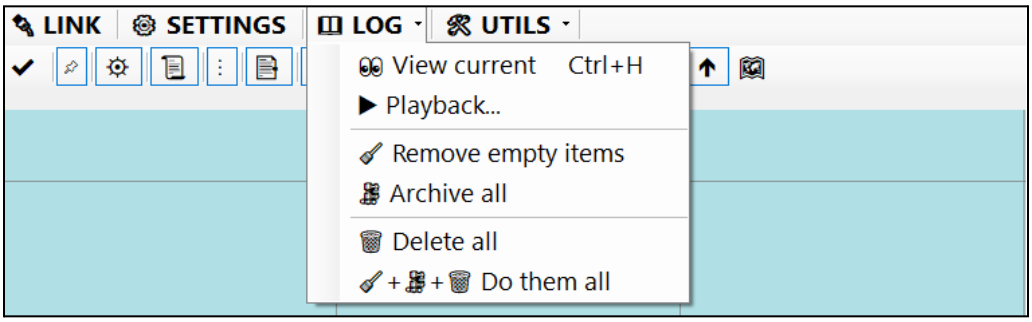
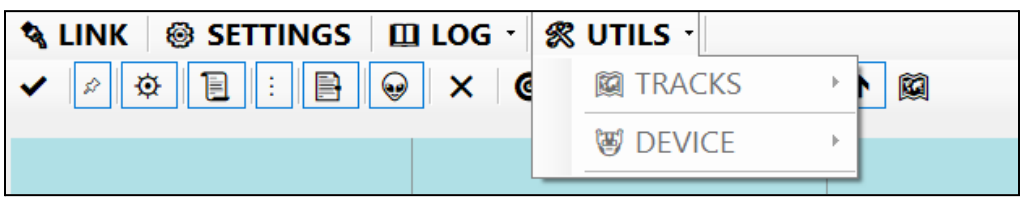
LOG MENU



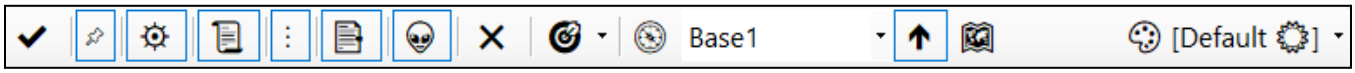
- **View current**
  - Opens the current log file (typically Windows Notepad).
- **Playback...**
  - This function is designed to play back a log file. During the playback process, the application will repeat all the work that was recorded in the log file, including the time intervals. If the log file is already playing, this line changes to: ⏹ **Stop playback**
- **Remove empty entries**
  - The procedure for deleting all log files that are less than 2 KB in size, as well as empty folders.
- **Archive all**
  - Archive all log files. After creating the archive, a link to it will appear in the status line.
- **Delete all entries**
  - Delete all contents of the log folder.
- **Do them all**
  - Automatically performs the above three steps: delete log files with a size of less than 2 kb, place the rest in an archive, and delete all contents of the LOG folder.

UTILS MENU



- **Tracks**
  -
- **Device**
  - View information about the device: name, firmware version, serial number.

Map Toolbar



- **Mark current location**
  - Saves the last calculated position of an object into a separate track (Marked). This function allows you to mark the current point on the motion track.
- **Show/Hide marked points**
  - Enables/disables the display of marked points on the map.
- **Show/Hide buoys**
  - Enables/disables display of buoy tracks.
- **Show/Hide history**
  - Enables/disables display of the log panel
- **Show/Hide legend**
  - Enables/disables display of the legend field
- **Show/Hide notes**
  - Enables/disables display of comments
- **Show/Hide extra info**
  - Enables/disables display of additional information field
- **Reset view**
  - Clears the displayed tracks. This action will not affect the recorded tracks or the log file.
- **Accuracy measurement utils**
  - Start or stop the accumulation of statistical data (CEP, DRMS).

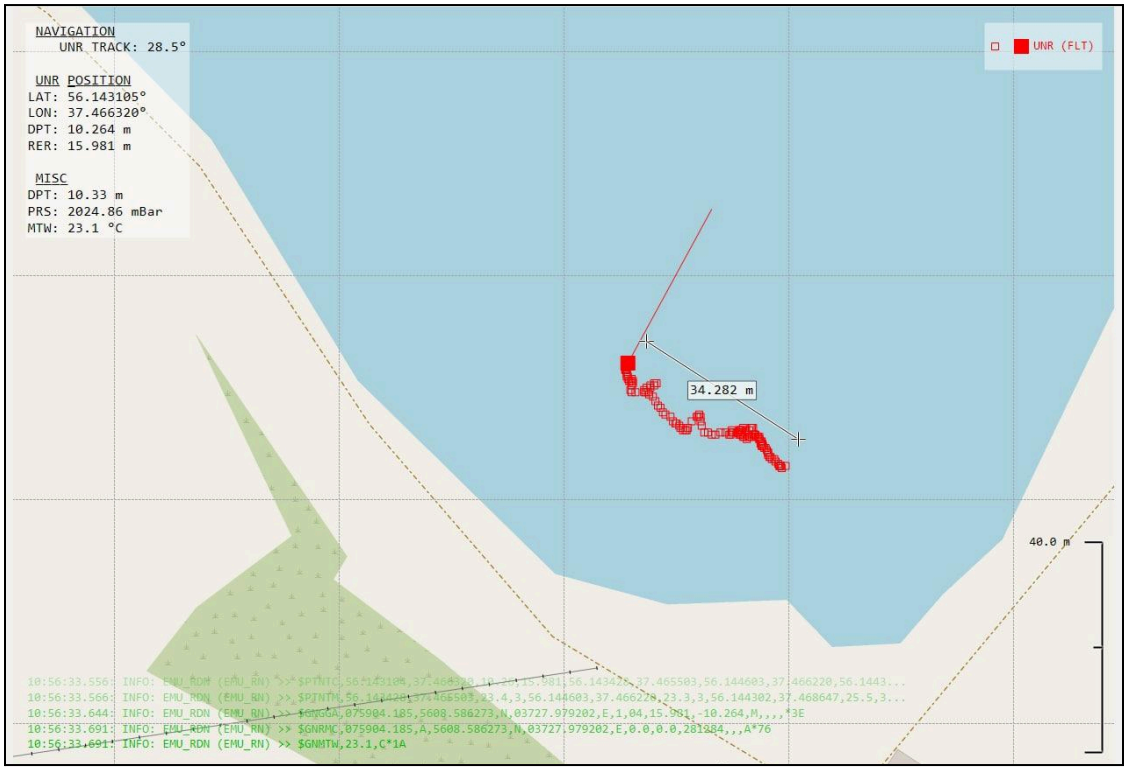
- Contains functions for statistically assessing the accuracy of the system. **These functions can only be activated when the positioned object is stationary in the water column (for example, standing on the bottom).** Otherwise it will lead to incorrect calculation. As statistical parameters, the following values are calculated: CEP (Circular Error Probable) - the radius of the circle in which with 50% probability the next measurement of the object's location should be expected, and DRMS (Distance Root Mean Square), 2DRMS, 3DRMS, corresponding to the radii of the circle, where to expect the next location measurement with 65%, 95% and 98% probability, respectively.
- The calculation proceeds as follows. After activating the function, each new calculated location of the positioned object is placed in a buffer for which the standard deviations σx and σy are calculated along the X (longitude) and Y (latitude) axes, respectively .

  CEP = 0.62 · σy + 0.56 · σx DRMS = $\sqrt{}$(σx2 + σy2)

  - ⏺️ Start/⏹️ Stop
    - Start/Stop accuracy estimation
  - ⏪ Reset
    - Reset accuracy test
    - Clears the set of measurements for which CEP and DRMS are calculated.

- **Reference point**
  - Drop-down list allowing you to select a reference point. The course to this point from the positioned object, the course from this point to the positioned object and the distance between them will be calculated. Own position, one of four buoys or a user-defined point can be selected as a reference point.
- **Follow target**
  - Enables/Disables centering the map relative to the current position of the positioned object.
- **Show/Hide tiles**
  - Enables/disables the display of map tiles. Tiles will only be displayed when available.

Main Window



The main (map) window is used to indicate the relevant data to view positioned objects and other system information.

- calculated position of the positioned object
- buoy positions
- own position
- saved (marked) positions
- The length of the track of the positioned object, i.e. the maximum number of points that make up a track is set in the application settings.

The map panel also contains:

- additional information panel
- journal panel
- legend field
- scale ruler

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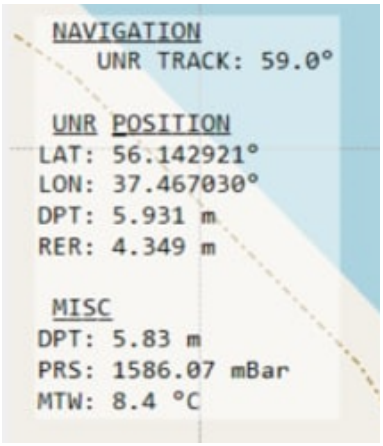
Data Panel



The Data Panel is enabled by clicking the 👽 **Show/Hide Extra Info** button on the map toolbar. This panel displays various system parameters in text form. To the right of each value you can see how long ago that value was updated. For clarity, all possible parameters are summarized in the tables below.

TGT (Target)

ID	Description
LAT	Geographic latitude of the object in °, negative values for the southern hemisphere
LON	Geographical longitude of the object in °, negative values for the Western Hemisphere
RER	Radial error in m
CRS	Heading in °, ranging from 0 to 360, clockwise from north
DPT	Depth of the positioned object in m.
LEC	Last error code received from the positioned object

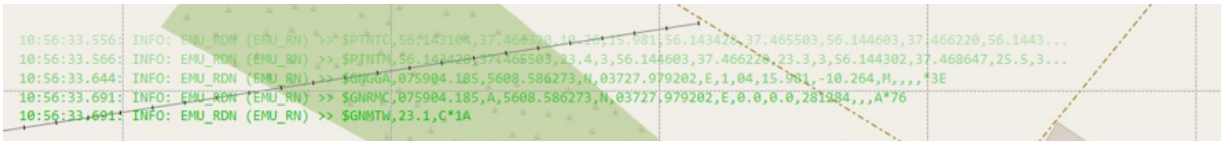
REF (Reference Point)

ID	Description
REF	Reference point type
DST	Distance between the positioned object and the reference point in m
AZM	Azimuth - direction from the positioned object to the reference point in °, in the range from 0 to 360, clockwise from the north direction
RAZ	Back azimuth - the direction of the reference point to the positioned object in °, in the range from 0 to 360, clockwise from the direction north

GNSS (data from internal GNSS module)

ID	Description
LAT	Geographic latitude of the object in °, negative values for the southern hemisphere
LON	Geographical longitude of the object in °, negative values for the Western Hemisphere
CRS	Heading in °, ranging from 0 to 360, clockwise from north
SPD	Travel speed, m/s and km/h

History Panel



The History Panel is selected by clicking the 📜 **Show/Hide History** button on the map toolbar. This element displays the last few lines of the application log: data exchange with the device, errors that occur, etc.

View Toolbar

The panel contains a notepad field for note taking and buttons for zooming in and out of the map display.

The input field on the left side of the panel is intended for creating records while working: the user can quickly type explanatory text and press Enter, after which the comment will appear at the top of the map field and will be saved to the current log file. When playing the log, this comment will also be displayed at the appropriate time.

The 🔍➖ (Ctrl -) and 🔍➕ (Ctrl +) buttons are designed to increase (zoom out) and decrease (zoom in) the map scale, respectively.

The 📸 button (Ctrl + P) allows you to take a snapshot of the application window and save it in the SNAPSHOTS subfolder in the application root folder. After saving the snapshot, a link to it will appear in status line.

Status line

The bottom left side of the status bar displays the connection status. The middle section displays links to the last screenshot you saved or the log archive you created.

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Legend field

A list of tracks with sample markers that correspond to them is displayed here. You can turn on or off the display of the legend field using the ⁞ button on the map toolbar.

Scale bar

The vertical ruler is used to display the map scale. The upper part of it shows the level (Z) of the scale and the size of the ruler in meters on the map.

If necessary, the user can take measurements between arbitrary points on the map using the right mouse button: to mark the starting point, press and release the right mouse button. After this, the tape measure will be displayed with the specified starting point. Clicking the right mouse button again will set the end point of the measurement. A subsequent right-click will reset the measurement.

The measurement is also reset when the map center is moved, so before taking a measurement, you must disable automatic centering of the map relative to the current position of the positioned object, if it is enabled. The (Ctrl + F) button on the map toolbar is used to turn on/off automatic map centering.

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Warranty, Liability and Disclaimer

Warranty and Replacement

The manufacturer provides a two-year warranty on this product, starting from the date of purchase. This warranty covers defects in materials and workmanship that arise during normal use, as outlined in this user manual. The manufacturer guarantees to repair or replace, free of charge, any faulty equipment from the delivery set that fails due to a factory defect within the warranty period.

Exclusions from Warranty Coverage: the following conditions are not covered by the warranty and will result in the refusal of free repair or replacement:

- Mechanical Damage: damage caused by external forces, including but not limited to:
  - Impact or dropping
  - Excessive force applied to the device
  - Damage to wires and cables, including insulation violations
- Environmental Damage: any damage caused by exposure to:
  - Moisture (e.g., water damage) & dust, dirt, or other contaminants
  - Extreme temperatures or humidity
- Improper Use: any damage resulting from:
  - Using the device for purposes other than those intended
  - Failure to follow instructions in this user manual
  - Using unauthorized or non-original accessories
- Unauthorized Modifications: Any alterations or repairs performed by individuals or entities not authorized by the manufacturer.

By using this product, you acknowledge and agree to the terms and conditions outlined in this warranty policy.

Disclaimer of the Manufacturer

This delivery set, including its individual components and the system as a whole, is not intended for, tested as, or certified as rescue equipment.

The manufacturer declares that the supplied equipment is safe when used in accordance with these instructions. The manufacturer is not responsible for any consequences arising from the use of this equipment for purposes other than its intended use or for failure to adhere to these instructions.

This equipment is not intended for use in emergency or rescue situations. Any attempt to use it for such purposes may result in serious injury or death.

For emergency and rescue situations, please consult with qualified professionals and utilize certified equipment.

By using this equipment, you agree to assume full responsibility for its use and any potential consequences.

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