

USBL-BOX

POSITIONING SYSTEM

USER GUIDE

Revision History

Edition	Date	Comments
G	05/2016	Pack soft 6

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Overview of the USBL-BOX User Guide

This document is the User Guide for USBL-BOX. It must be read and understood prior to using the USBL-BOX acoustic navigation system. The manufacturer shall in no case be held liable for any application or use that does not comply with the stipulations in this guide. USBL-BOX User Guide is divided into several parts:

- **Part 1: Introduction** – This section gives a general overview of USBL-BOX and describes the architecture of the system.
- **Part 2: Conventions and Specifications** – This section lists all the useful information about the USBL-BOX.
- **Part 3: Installing USBL-BOX** – This section helps you to install USBL-BOX and to connect it to the different devices of the ship.
- **Part 4: Configuring the USBL-BOX** – This section gathers the configuration procedures of the USBL-BOX.
- **Part 5: Setting the USBL-BOX to Work** – This section lists the tasks to go through before the beginning of the survey.
- **Part 6: Visualizing USBL Data with DELPH RoadMap** – This section explains how to display the positioning data in real-time or in playback mode.
- **Part 7: Dynamic Positioning Mode** – This section details the operation of USBL-BOX in conjunction with a dynamic positioning system.
- **Part 8: Operating the USBL-BOX** – This section describes the system operating mode and the data monitoring.
- **Part 9: Maintenance** – This section lists all the maintenance operations that you can apply on USBL-BOX.

The abbreviations and acronyms used in this guide are listed hereafter.

A **Table of Contents** is available in the following pages to allow a quick access to dedicated information.

Text Usage

Bold	Bold text is used for items you must select or click in the software. It is also used for the field names used into the dialog box.
<i>Courier</i>	Text in this font denotes text or characters that you should enter from the keyboard, the proper names of disk Drives, paths, directories, programs, functions, filenames and extensions.
<i>Italic</i>	Italic text is the result of an action in the procedures.

Icons



The **Note** icon indicates that the following information is of interest to the operator and should be read.

Important

The **Important** mention indicates that the following information should be read to forbid or prevent a product dysfunction or a faulty operation of the equipment.



The **Caution** icon indicates that the following information should be read to forbid or prevent product damage.



The **Warning** icon indicates that possible personal injury or death could result from failure to follow the provided recommendation.

Abbreviations and Acronyms

AUV	Autonomous Unmanned Vehicle
CAF	Common Acknowledgment Frequency
CIF	Common Interrogation Frequency
CRF	Common Reply Frequency
CRP	Central Reference Point
DVL	Doppler Velocity Log
IIF	Individual Interrogation Frequency
INS	Inertial Navigation System
IRF	Individual Response Frequency
GPS	Global Positioning System
HRP	Heading Roll Pitch
LBL	Long Base Line
LED	Light Emitting Diode
MFSK	Multiple Frequency Shift Keying
MMI	Man Machine Interface
PHINS	PHotonic Inertial Navigation System
ROV	Remote Operated Vehicle
RT	Release Transponder
RTK	Real Time Kinematic
SLAM	Simultaneous Localization And Mapping
USBL	Ultra Short Base Line
UTC	Universal Time Coordinated

Table of Contents

1	INTRODUCTION	13
1.1	PRINCIPLE	13
1.2	EQUIPMENT DESCRIPTION	14
1.2.1	Overview	14
1.2.2	The Electronic Box	15
1.2.3	Web-Based User Interface	16
1.2.4	POSIDONIA Acoustic Antenna (Option)	17
1.2.5	Acoustic Transponders	18
1.2.6	Optional External Sensors	18
1.2.6.1	<i>Position External Data</i>	18
1.2.6.2	<i>Attitude External Data (HRP)</i>	18
1.2.6.3	<i>Time External Data (UTC)</i>	18
1.2.6.4	<i>Hoisting System</i>	19
2	CONVENTIONS AND SPECIFICATIONS	20
2.1	CONVENTIONS	20
2.1.1	Reference Axes and Measurement Center	20
2.1.2	Hydrophones and Reference Frame	21
2.1.3	Attitude	21
2.2	SPECIFICATIONS OF THE USBL-BOX	22
2.2.1	Mechanical Specifications	22
2.2.2	Electrical Specifications	22
2.2.2.1	<i>Plugs on the Front Face</i>	22
2.2.2.2	<i>Plugs on the Rear Face</i>	23
2.2.2.3	<i>Wiring of the Serial Links</i>	24
2.2.2.4	<i>Synchronization Signal Definition</i>	24
3	INSTALLING THE USBL-BOX	25
3.1	CHECKING THE DELIVERY	25
3.2	INSTALLING THE POSIDONIA ANTENNA	25
3.3	INSTALLING THE USBL-BOX	26
3.4	INSTALLING THE EXTERNAL SENSORS	27
3.5	INSTALLING THE TRANSPONDERS	27
4	CONFIGURING THE USBL-BOX	28
4.1	WEB-BASED USER INTERFACE GENERAL OVERVIEW	28
4.1.1	Environment	28
4.1.2	Starting the Web-based User Interface	28
4.1.3	Main Window	29
4.1.4	Handling the Windows and Tabs	30
4.1.5	Handling the Logo	30
4.1.6	Color Code	31
4.1.7	General Rules for Using Command Windows	32
4.1.8	Tool Tips	33
4.1.9	Web-Based User Interface Options	34

4.1.10	Saving and Restoring Settings	36
4.1.10.1	<i>Saving Settings</i>	36
4.1.10.2	<i>Restoring Settings</i>	37
4.2	CONFIGURING THE NETWORK	38
4.2.1	Connecting the USBL-BOX Directly to a Computer	38
4.2.1.1	<i>Overview of the Connections</i>	38
4.2.1.2	<i>Default IP Address</i>	39
4.2.1.3	<i>Configuring the Computer</i>	40
4.2.2	Connecting the USBL-BOX to a Local Network.....	42
4.2.2.1	<i>Overview of the Connections</i>	42
4.2.2.2	<i>Configuring the Network Interface of the USBL-BOX</i>	43
4.2.2.3	<i>Connection Procedure</i>	44
4.3	CONFIGURING THE ACOUSTIC ANTENNA.....	45
4.4	CONFIGURING THE INPUT AND OUTPUT PARAMETERS	47
4.4.1	Configuring the Inputs.....	47
4.4.1.1	<i>Input Stream Parameters</i>	48
4.4.1.2	<i>Configuration Procedure</i>	49
4.4.2	Configuring the Outputs	51
4.4.2.1	<i>Output Stream Parameters</i>	51
4.4.2.2	<i>Configuration Procedure</i>	52
5	SETTING THE USBL-BOX TO WORK.....	53
5.1	DEFINING THE TRACKING PARAMETERS	53
5.1.1	Synchronization Modes.....	53
5.1.2	Internal Synchronization	54
5.1.3	External Synchronization	55
5.2	SETTING UP THE TRANSPONDERS	56
5.2.1	Adding a Transponder	58
5.2.2	Configuring a Transponder	59
5.2.2.1	<i>Interrogation</i>	59
5.2.2.2	<i>Reply</i>	59
5.2.2.3	<i>Additional Information</i>	60
5.2.2.4	<i>Dynamic Positioning</i>	60
5.2.2.5	<i>Filtering</i>	60
5.2.2.6	<i>Other</i>	60
5.2.3	Activating a Transponder	62
5.2.4	Deleting a Transponder	63
5.3	ENTERING THE SOUND VELOCITY PROFILE.....	64
5.3.1	Loading a Profile from a File.....	64
5.3.2	Manually Entering a Profile.....	65
5.4	LOGGING DATA.....	67
5.5	CALIBRATING THE USBL-BOX.....	69
6	VISUALIZING USBL DATA WITH DELPH ROADMAP	70
6.1	INTRODUCTION.....	70
6.2	ACCESSING USBL DATA IN REAL-TIME AND REPLAY MODES.....	74
6.2.1	DELPH USBL Driver	74

6.2.2	Configuring DELPH USBL Driver	74
6.2.2.1	<i>Configuration Parameters</i>	74
6.2.2.2	<i>Real-Time Mode Configuration Procedure</i>	76
6.2.2.3	<i>Playback Mode Configuration Procedure</i>	77
6.2.3	Launching the Display in Real-Time Mode	77
6.2.4	Launching the Display in Playback Mode	78
6.2.5	Editing the Display in Real-Time and Playback Modes	79
6.3	ACCESSING USBL DATA IN OFFLINE MODE	81
6.4	USBL DATA VISUALIZATION TOOLS	82
6.4.1	North Oriented View	82
6.4.2	Heading Oriented View	83
6.4.3	Vertical Axis View	84
6.4.4	Mobile Immersion	85
6.4.5	Mobile Information	86
6.4.6	Relative Mobile Position	86
6.4.7	Event Mark	87
6.4.7.1	<i>Creating an Event Mark</i>	87
6.4.7.2	<i>Managing Event Marks</i>	90
6.4.8	Waypoints	91
6.4.8.1	<i>Creating Waypoints</i>	92
6.4.8.2	<i>Managing Waypoints</i>	93
6.4.9	Measurements	94
6.4.9.1	<i>Creating a Measurement</i>	94
6.4.9.2	<i>Managing a Measurement</i>	97
6.4.10	Exporting Trajectory	98
7	DYNAMIC POSITIONING MODE	100
7.1	DEFINITION	100
7.2	L/USBL MODE	101
7.3	PROCEDURE	102
8	OPERATING THE USBL-BOX	104
8.1	DEPLOYING THE TRANSPONDERS	104
8.2	LAUNCHING THE SURVEY	104
8.3	CONTROLLING THE DATA	105
8.3.1	Data Control Windows	105
8.3.1.1	<i>CONTROL Window</i>	105
8.3.1.2	<i>NAVIGATION window</i>	106
8.3.1.3	<i>DATA LOGGER Window:</i>	106
8.3.2	Deselecting a Channel for an USBL Computation	107
8.3.3	List of the Status in the Web-Based User Interface	108
8.3.4	Frequency Spectrum of the Hydrophones	111
8.4	RECOVERING THE EQUIPMENT	112
8.4.1	Operating Mode	112
8.4.1.1	<i>8-bits Commands</i>	112
8.4.1.2	<i>24-bits Commands</i>	114
8.4.1.3	<i>Procedure</i>	115

9	MAINTENANCE	116
9.1	MAINTENANCE FROM THE WEB-BASED USER INTERFACE	116
9.1.1	Updating the System.....	116
9.1.2	Resetting to the Factory Settings.....	117
9.1.3	Contacting iXBlue Technical Support	118
9.1.4	Gain Stop Mode	118
	IXBLUE CONTACT - SUPPORT	119
	IXBLUE CONTACT - SALES	119
	APPENDICES	120
A	HOW TO PREVENT JAVA SECURITY WARNING DIALOG BOX	120
B	RESTRICTIONS ON IP, GATEWAY AND MASK ADDRESSES	122
C	INPUT PROTOCOLS	123
C.1	\$xxGGA / \$xxVTG	123
C.2	\$xxZDA	124
C.3	\$ZQMTE.....	124
C.4	SIMRAD EM.....	125
C.5	HDMS THOMSON.....	125
C.6	GAPS BIN	127
C.7	\$PMEVL	128
C.8	\$WIMTW	128
D	OUTPUT PROTOCOLS	129
D.1	DATA STANDARD.....	129
D.2	DATA LIGHT	135
D.3	HIPAP HPR 400.....	136
D.4	HIPAP HPR 418 (fix and mobile).....	139
D.5	KONGSBERG BCD	143
D.6	iXSea USBL INS 1	148
D.7	iXSea USBL INS 2.....	150
D.8	NAUTRONIX ATS II.....	151
D.9	POSIDONIA 6000	152
D.10	USBLBOX_POSTPRO	153
D.11	PIFM-POPSN.....	161
E	WIRING OF THE POSIDONIA ANTENNA.....	162
F	MECHANICAL DRAWING.....	163

1 INTRODUCTION

1.1 Principle

Electronic box

The USBL-BOX is an electronic box driven by a Web-based user interface enabling precise information concerning the position of the immersed acoustic transponders. The USBL-BOX is completed by POSIDONIA, an acoustic antenna. Together, the two products make up a USBL positioning system. The box is installed on board the vessel on a rack and is connected to the network by one or several work stations where the operator manages the positioning via the Web-based user interface.

POSIDONIA antenna

The POSIDONIA antenna is installed underneath the hull of the vessel. It sends out acoustic signals via electric impulses generated by the box. The immersed acoustic transponders, either static (anchored) or dynamic (onboard underwater vehicles), receive and respond to these signals. The antenna receives all the responses through its four hydrophones. The box then decodes the received responses and estimates the relative transponder positions compared with the antenna. The antenna position is very precisely ascertained thanks to a GPS connected to the box. In this way the box is able to calculate the exact position of the transponders. Real-time information is forwarded to the USBL-BOX concerning the vessel's situation. This data enables the user to correct the position of the transponders and the antenna's movement.

USBL Positioning

The USBL-BOX system is used to supply information concerning one or several underwater objects or vehicles at a depth of up to 6,000 meters.

The system is based on a bidirectional exchange of acoustic signals between one or several fix or mobile acoustic transponders and an acoustic antenna installed underneath the vessel. The transponders can be moored on the seabed or mounted on vehicles.

Dynamic Positioning

The system can also feed a dynamic positioning system. The LBL position of the acoustic antenna is computed from the distance from the antenna to transponders with known positions. A reference transponder is chosen, the LBL position of the antenna is given with respect to the reference transponder. If an INS is coupled, the LBL position may be input into the INS.

Remote Control

The system is also equipped with a remote control function allowing functional orders to be sent to the transponders and to interpret responses and acknowledgement of receipt.

1.2 Equipment Description

1.2.1 OVERVIEW

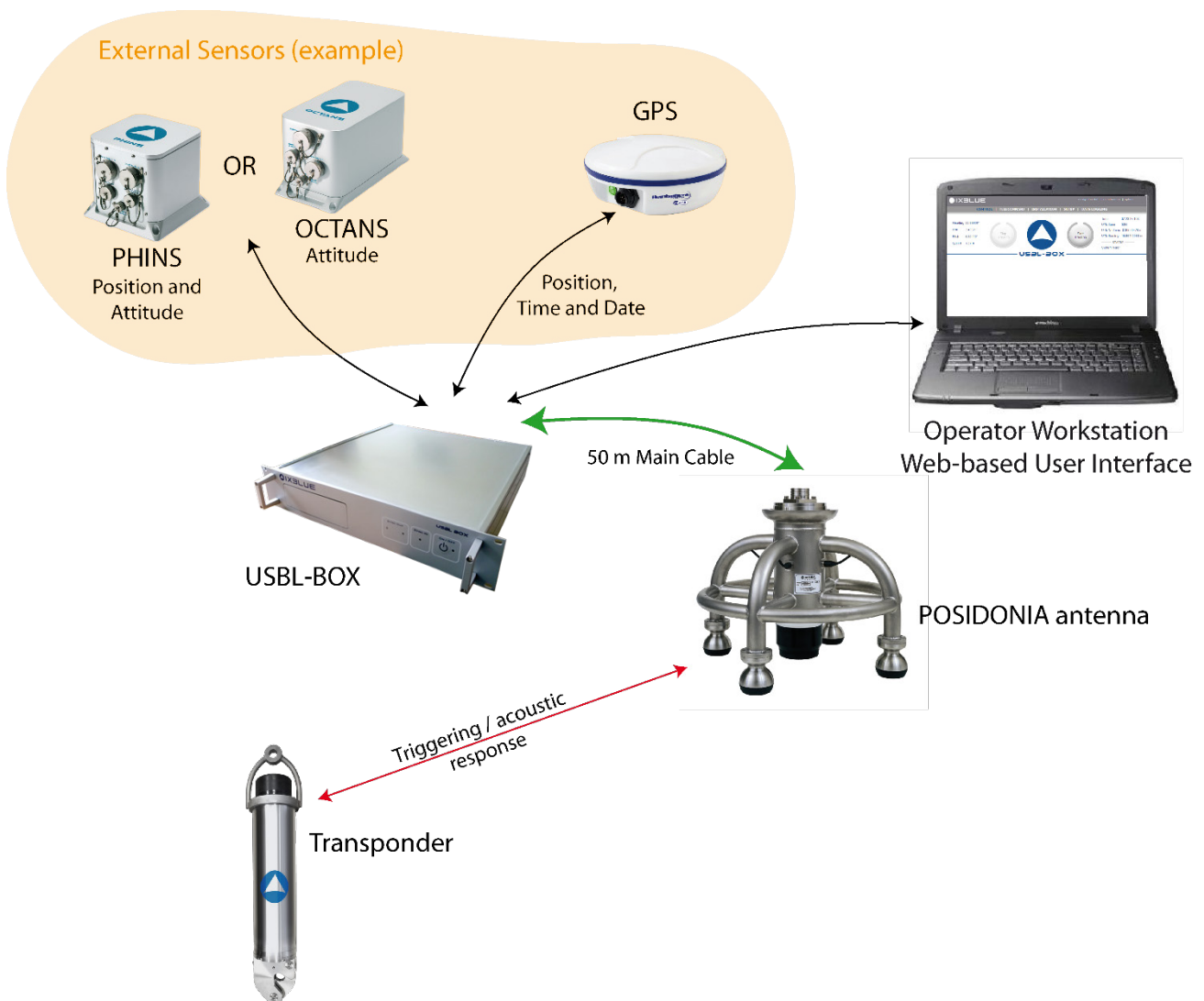


Figure 1 – USBL-BOX operating principle

Elements

The USBL-BOX system consists of the following elements, see Figure 2:

- **USBL-BOX** electronic rack, see section 1.2.2
- **Web-based User Interface** is used to configure (mandatory) and to monitor (optional) the real time data, see section 1.2.3
- **POSIDONIA antenna**, see section 1.2.4
- Moored or mobile **acoustic transponders**, see section 1.2.5
- A variety of **external sensors**, see section 1.2.6, providing position, attitude and time as well as a mechanical deployment

1.2.2 THE ELECTRONIC BOX

The USBL-BOX comes in a 19" 2U rack format. It consists of various connections at the front and also at the back which enables the various different elements of the system to be linked:

- Power supply
- POSIDONIA antenna
- Receiving and sending synchronization signals
- Serial receiving and sending, Ethernet port for external sensors and command control
- PPS entry for dating external sensor data



Figure 2 – USBL-BOX

For more information, go to section 2.2.2.

1.2.3 WEB-BASED USER INTERFACE

The Web-based user interface is a web application enabling configuration of the system (lever arms, management of connections, celerity profile, configuration and management of transponders) before each mission and checking of data during the mission. This application also enables recording of data and the sending of signals for the remote control. See use of Web-based user interface in section 4.



Figure 3 – Main window of the Web-based user interface

1.2.4 POSIDONIA ACOUSTIC ANTENNA (OPTION)

The acoustic antenna POSIDONIA (see Figure 4), is connected to the USBL-BOX via a specific cable. The antenna consists of four hydrophones and a transducer.

The transducer emits the signal generated by the USBL-BOX. The four hydrophones receive responses from the transponders with different phases. The differences phases enable the box to calculate the distance and the angle of emission of the response.

For further details see the POSIDONIA antenna user guide.



Maximum speed with deployed cage and flush antenna: 12 knots (mechanical limit).



Figure 4 – POSIDONIA antenna: cage (left), flush (middle) and its 50 m cable (right)

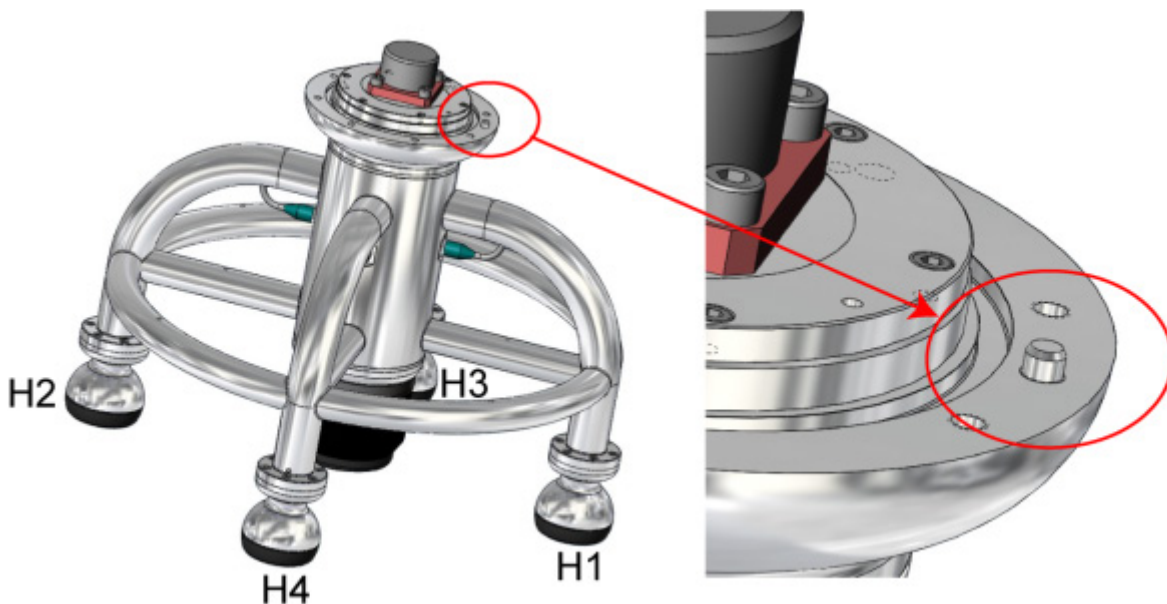


Figure 5 – Numbering of the antenna hydrophones and locating pin of hydrophone H1

1.2.5 ACOUSTIC TRANSPONDERS

The transponders that are compatible with USBL-BOX are listed in Table 1. Please report to specific User guides for full description of the acoustic transponder.

Table 1 – USBL-BOX compatible transponders

iXBlue	RTA61B2S / ETA61S	
iXBlue	RTT471	
iXBlue	RT861 / ET861	
iXBlue	RAMSES 6000	

The transponders respond to positioning signals and to commands generated by the USBL-BOX and transmitted by the POSIDONIA antenna. The transponders are made up of two interrogation channels (individual and common) together with two types of response (individual and common). See the respective transponder installation and configuration in sections 3.5 and 5.2.

1.2.6 OPTIONAL EXTERNAL SENSORS

1.2.6.1 Position External Data

In order to obtain the absolute geographical position of the immersed transponders, USBL-BOX must know the exact position of the POSIDONIA antenna. This position is given by the GPS and corrected by lever arms between GPS and POSIDONIA antenna.

1.2.6.2 Attitude External Data (HRP)

In order to correct the GPS antenna position with POSIDONIA lever arms, the USBL-BOX must know the three-axis attitude of the vessel the moment the transponder response is received. An attitude control system provides this information for the USBL-BOX. The PPS port of the USBL-BOX is used to the actual time of data measurement from the control system before actually receiving the data itself.

1.2.6.3 Time External Data (UTC)

An external clock can be used to standardize the time between several different acoustic appliances working together.

1.2.6.4 Hoisting System

The POSIDONIA acoustic antenna may be fastened to an iXBlue hoisting system. A connection between the hoisting system and the USBL-BOX allows the monitoring of the actual operating states of the hoisting system directly on the Web-based User Interface. Please refer to specific user guide for complete operational procedure.

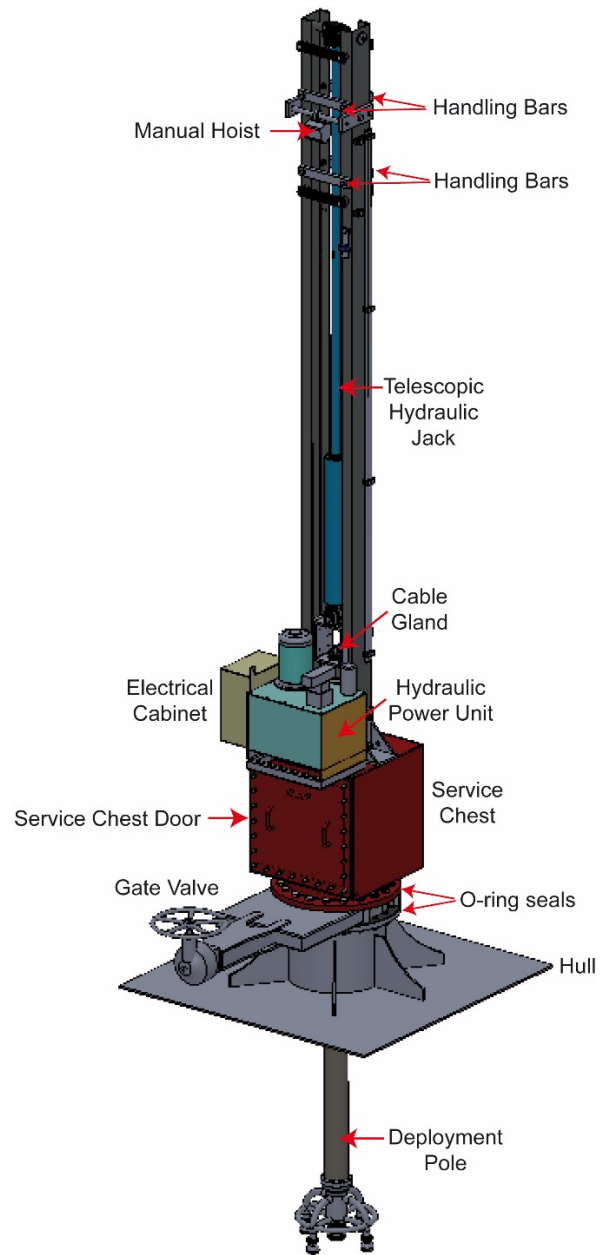


Figure 6 –Hoisting system

2 CONVENTIONS AND SPECIFICATIONS

2.1 Conventions

2.1.1 REFERENCE AXES AND MEASUREMENT CENTER

Center The USBL-BOX center of measurement is in the center of the mounting flange of the POSIDONIA acoustic antenna. See Figure 7. In the Web-User Interface, the center of measurement is equivalent to the CRP (Common Reference point). The center of measurement is the reference point for the determination of the external sensor (i.e., GPS) lever arms.

Reference frames The lever arms of the external sensor with respect to the POSIDONIA center of measurements is represented by three lengths LV1, LV2, LV3 defining the position of external sensor in the (XV1, XV2, XV3) vessel reference axes.

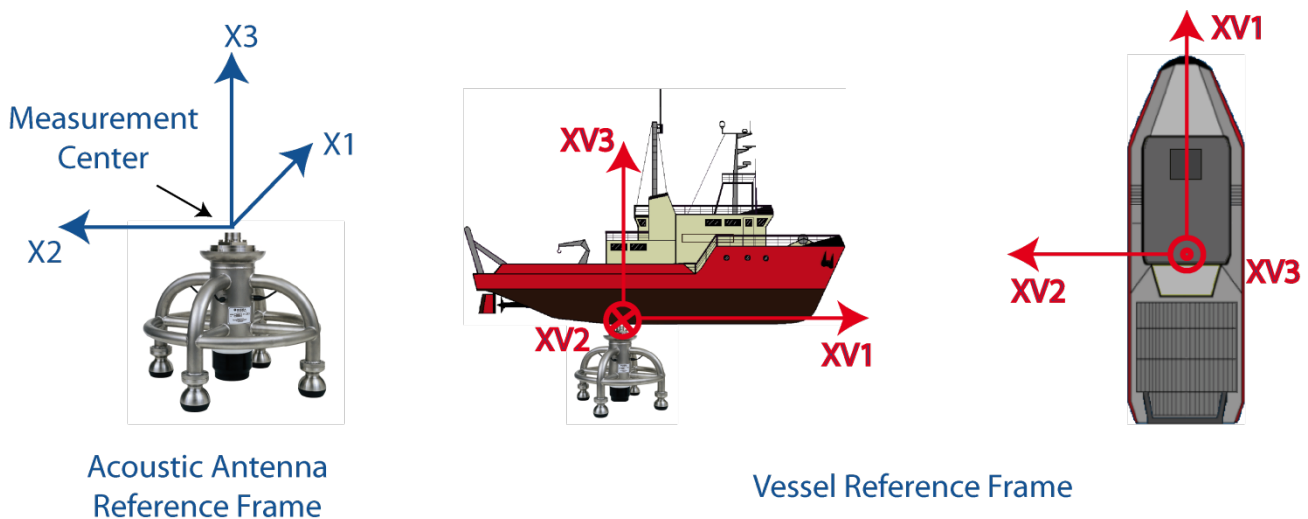


Figure 7 – Center of measurements and reference axes

Misalignment The misalignments of the acoustic antenna are measured between the reference frame of the USBL-BOX and the reference frame of the vessel. The three misalignment angles are entered by the operator in the Web-User Interface (**MECHANICAL PARAMETERS** menu).

2.1.2 HYDROPHONES AND REFERENCE FRAME

The reference frame of the POSIDONIA acoustic antenna is based on the H1, H2, H3 and H4 hydrophones. H1 has to be directed towards the bow of the ship. The names of the hydrophones are printed above the arms.

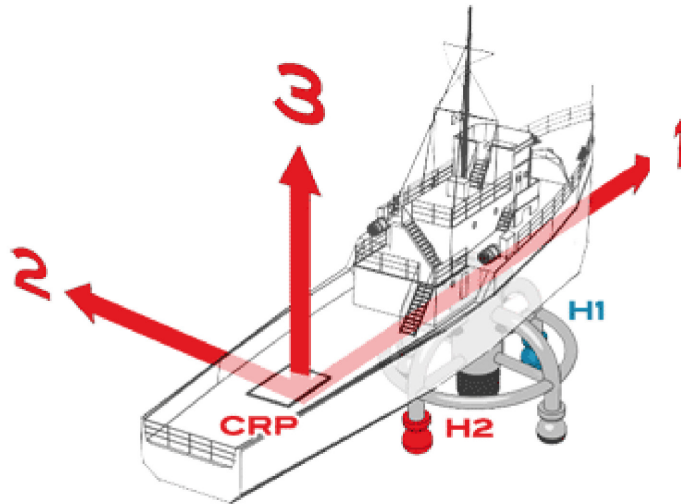


Figure 8 - H1 and H2 hydrophones

2.1.3 ATTITUDE

The attitude angles are defined as follows:

- Roll is positive when Port goes down.
- Pitch is positive when the bow is up.
- Heading is positive when it goes to Port.

2.2 Specifications of the USBL-BOX

2.2.1 MECHANICAL SPECIFICATIONS

Characteristics	Values
Weight	5.8 kg
Dimensions	483 mm / 89 mm
Temperature limits when storing	-20° to + 70 °C
Temperature limits in operation	0° to + 50 °C

A mechanical drawing is provided in Appendix E.

2.2.2 ELECTRICAL SPECIFICATIONS

- Force: 110 – 240 V / 50 – 60 Hz
- Power: below 15 W with impulses reaching up to 80 W

2.2.2.1 Plugs on the Front Face

The front of the USBL-BOX consists of four LEDs, the ON/OFF switch and a compartment containing the connections.



Figure 9 – Front face of the USBL-Box (door closed)

- The **ON/OFF** switch with its LED
- Three synchronizing LEDs:
 - 1 LED **SYNC IN** lasting up to 100 ms
 - 2 LEDs **SYNC OUT** lasting up to 100 ms

The following connections are installed in the compartment. They are dedicated to technical support operations:



Figure 10 – Opened compartment door

- **CONSOLE:** DB9 male for the test serial port RS232 or RS422/485
- 7 BNC female
 - **SYNCHRO_OUT MAIN** and **SYNCHRO_OUT SECONDARY:** isolated and duplicated on the front and the back
 - **SYNCHRO_IN:** isolated and duplicated on the front and the back
 - **HYDRO 1, HYDRO 2, HYDRO 3 and HYDRO 4:** hydrophone channels used in input to validate the system installation without an actual antenna and in output for the measurement of signals received by the antenna.

2.2.2.2 Plugs on the Rear Face



Figure 11 – Rear face of the USBL-BOX

- **110 - 240 VAC:** Power supply
- 4 BNC female
 - **SYNC OUT MAIN, SYNC OUT SECONDARY:** synchronized OUT isolated
 - **SYNC IN TRIGGER:** synchronized IN isolated
 - **SYNC IN PPS:** PPS input
- **REMOTE ON/OFF** 3.5 mm jack stereo three points dedicated to be wired to a push button switching on and off USBL-BOX
- **SERIAL A, SERIAL B, SERIAL C, SERIAL D:** 4 DB9 male for serial port input/output configurable 485/422/232 and isolated
- **ETHERNET** 1 Port Ethernet 10/100 Mbit/s RJ45
- **ACOUSTIC ARRAY:** Antenna Connector SOURIAU 41 points

2.2.2.3 Wiring of the Serial Links

Serial linking cords RS232 and RS422/485 feature in Figure 13 and Table 1.

Table 2 – Wiring of RS232 and RS422/485

PIN	RS232	RS422/485
1		Rx-
2	Rx	Rx+
3	Tx	Tx-
4		Tx+
5	Ground	

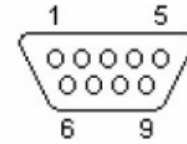


Figure 12 – DB9 Male

2.2.2.4 Synchronization Signal Definition

Synchro IN Synchro IN could be a high or low active signal lasting for minimum amount of time as defined in the Web-based user interface; tension is between 3 V and 24 V.

Synchro OUT Synchro OUT is a high active signal lasting for 10 ms; tension is 5 V.

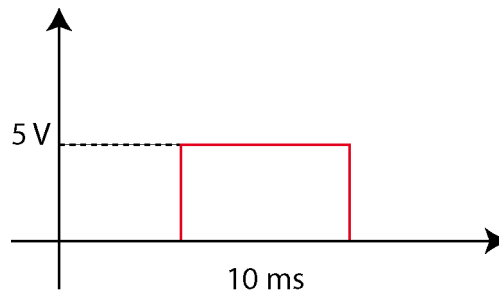


Figure 13 – Synchro OUT

3 INSTALLING THE USBL-BOX

Before installing your USBL-BOX for the first time, we recommend you check all the parts in the delivery box (see section 3.1). The installation is then achieved in four steps:

- POSIDONIA antenna, see section 3.2
- USBL-BOX, see section 3.3
- External sensors, see section 3.4
- Transponders, see section 3.5

3.1 Checking the Delivery

You have just received your equipment in protective boxes. Before starting the installation procedure, **we recommend that you check the contents of the pack and the equipment immediately on receipt of your system.** In particular, check that all items are present on delivery and that none of them have been damaged during shipping.

Use the packing-list detailing all the shipping items. This packing-list was compiled by iXBlue shortly before shipment.



On receipt of the equipment, its overall condition should be checked and iXBlue informed of any damage suffered during shipping. Check that every parcel shock label is still white. In the opposite case it is highly recommended to contact the insurance company.

3.2 Installing the POSIDONIA Antenna

Please refer to the specific POSIDONIA antenna user guide. The parameters for installation are to be input in the Web-based user interface, see section 4.3.

3.3 Installing the USBL-BOX

The USBL-BOX is assembled in a standard way into a 19" rack using four screws at either end of the front of the box.

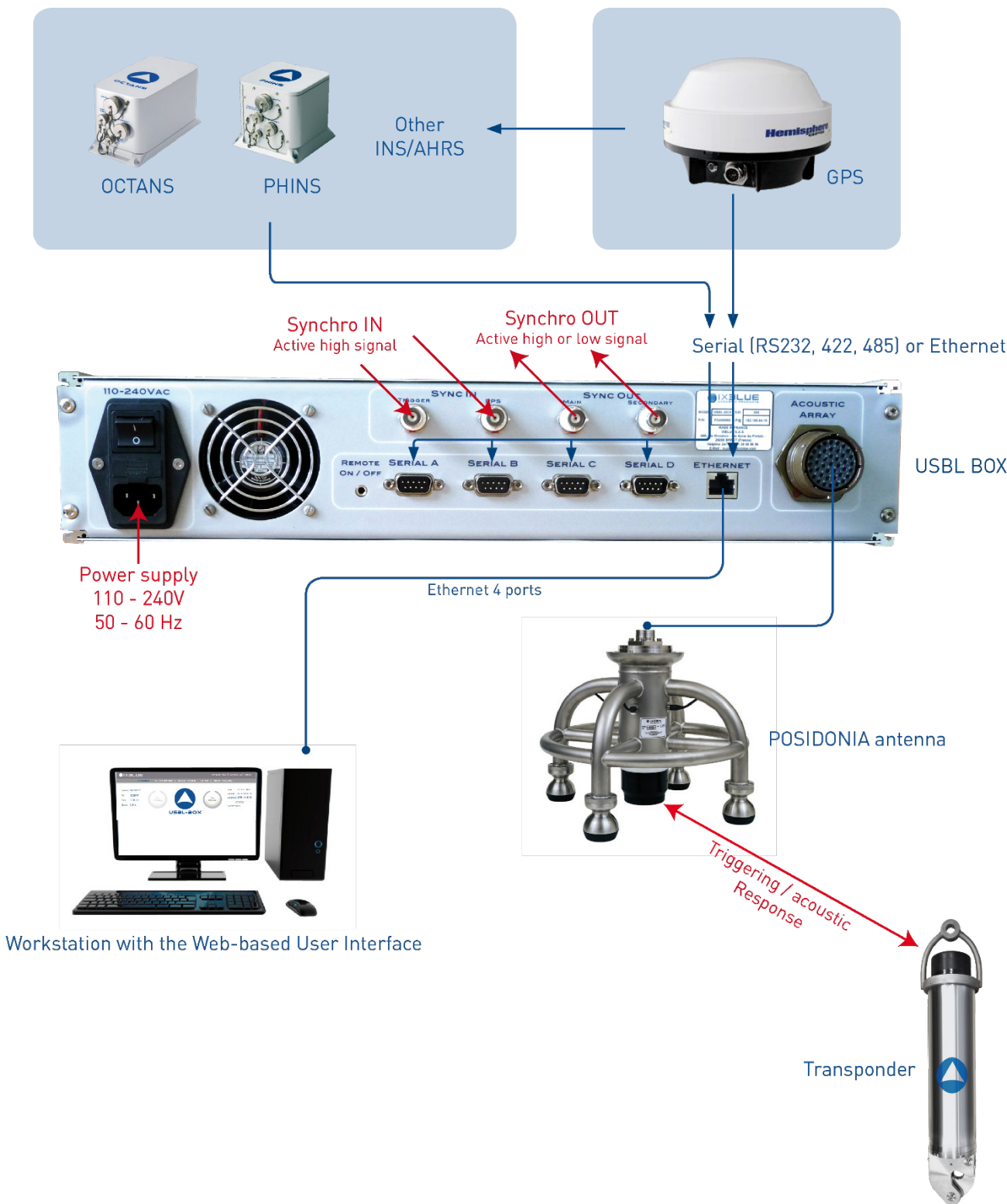


Figure 14 – Architecture of the USBL-BOX positioning system

3.4 Installing the External Sensors

The USBL-BOX functions with external sensors with supply data enabling positioning of the immersed transponders. The external sensors are:

- A GPS or an inertial system providing absolute positioning
- An attitude sensor providing information on the vessel's attitude the moment the acoustic signals are received
- A clock enabling the time stamping at the arrival of the data

The installation of these sensors depends on each sensor. Please refer to the specific user guides.

3.5 Installing the Transponders

The transponders are installed on the fixed or the mobile device that you intend to track. The installation depends mainly on your equipment. Keep in mind that the transponder head must be as much as possible

- Free from obstacles
- Directed towards the hydrophones of the GAPS antenna

Please refer to the specific transponder guide. The parameters for installation are to be input in the Web-based user interface, see section 5.2.2.

4 CONFIGURING THE USBL-BOX

The configuration of the USBL-BOX is carried out from the Web-based user Interface. Before having access to the interface described in section 4.1, you have to connect a computer to the USBL-BOX via the Ethernet link (see section 4.2). Once the USBL-BOX is inserted in the local network, you can launch the Web-based User Interface and you configure the installation parameters (see sections 4.3 and 4.4) and the survey parameters (see section 5.1).

4.1 Web-Based User Interface General Overview

4.1.1 ENVIRONMENT

The Web-based User Interface has been optimized and qualified based on the environment described on the release note delivered with your product. It is highly recommended to upgrade your computer with the provided CD.

4.1.2 STARTING THE WEB-BASED USER INTERFACE

On a Computer

The communication with the computer can be performed either directly through an Ethernet link or through a local network. The communication is made in an https domain so it includes encryption and secure identification of the USBL-BOX.

The Web-based user interface is launched from the WEB browser hosted on the computer. You enter the IP address of the USBL-BOX in the browser. See USBL-BOX default IP address in section 4.2.1.2.

4.1.3 MAIN WINDOW

The main window of the Web-based user interface is made up of various elements (see Figure 15):

- Access to all navigation data (navigation data menu)
- Access to maintenance tasks (maintenance menu)
- A choice of languages (English, French or Russian)
- A choice of operating mode (day mode or night mode)
- Menu bar
- Command buttons
- System status display
- Main data display

You can resize the page. Some elements disappear as you decrease the size of the page.

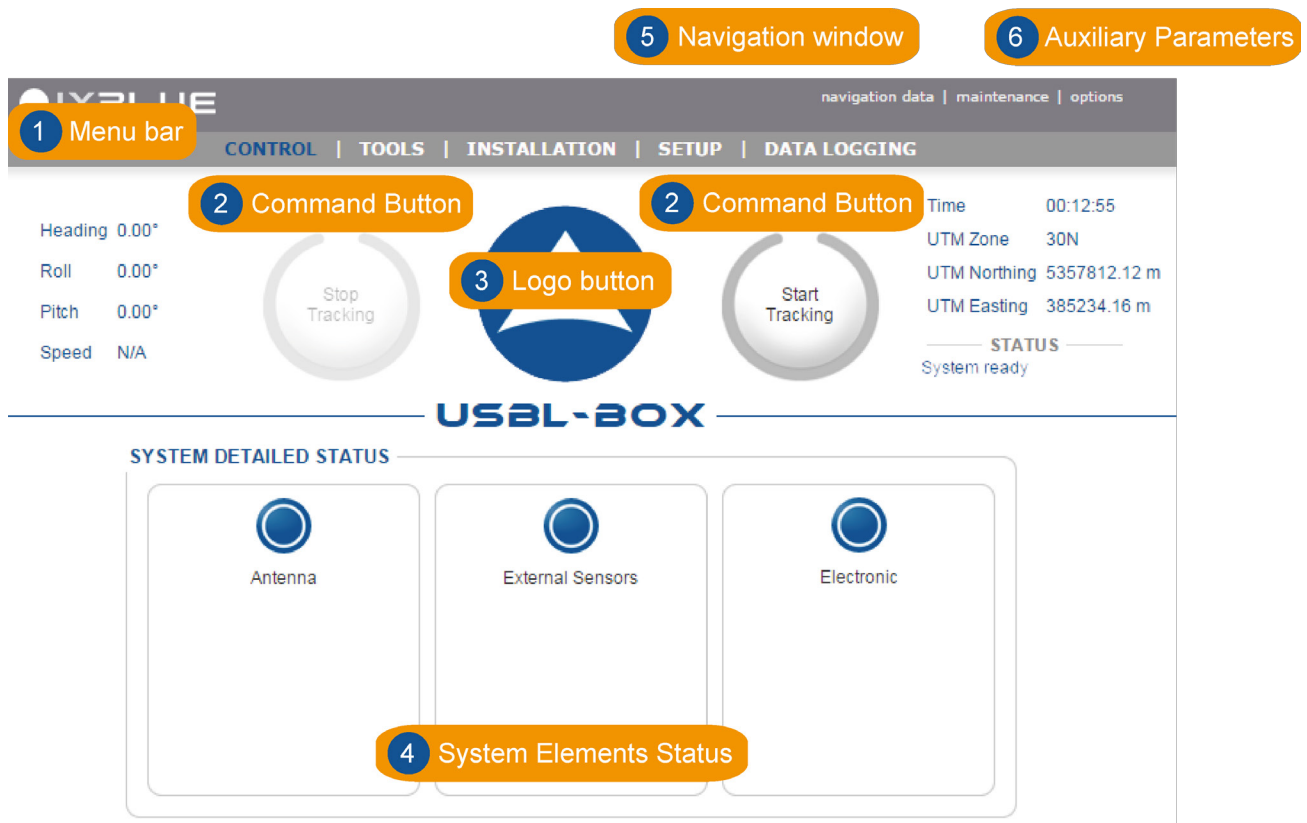


Figure 15 – Main window of the USBL-BOX Web-based user interface

Logo The logo appears on every page and tab of the Web-based user interface. It supplies you with visual information on the status of the system using an associated color coding system. By clicking on this you obtain a quick access to detailed status displays of the system's different elements.

4.1.4 HANDLING THE WINDOWS AND TABS

Use the menu to navigate in the interface windows as shown in Figure 17.

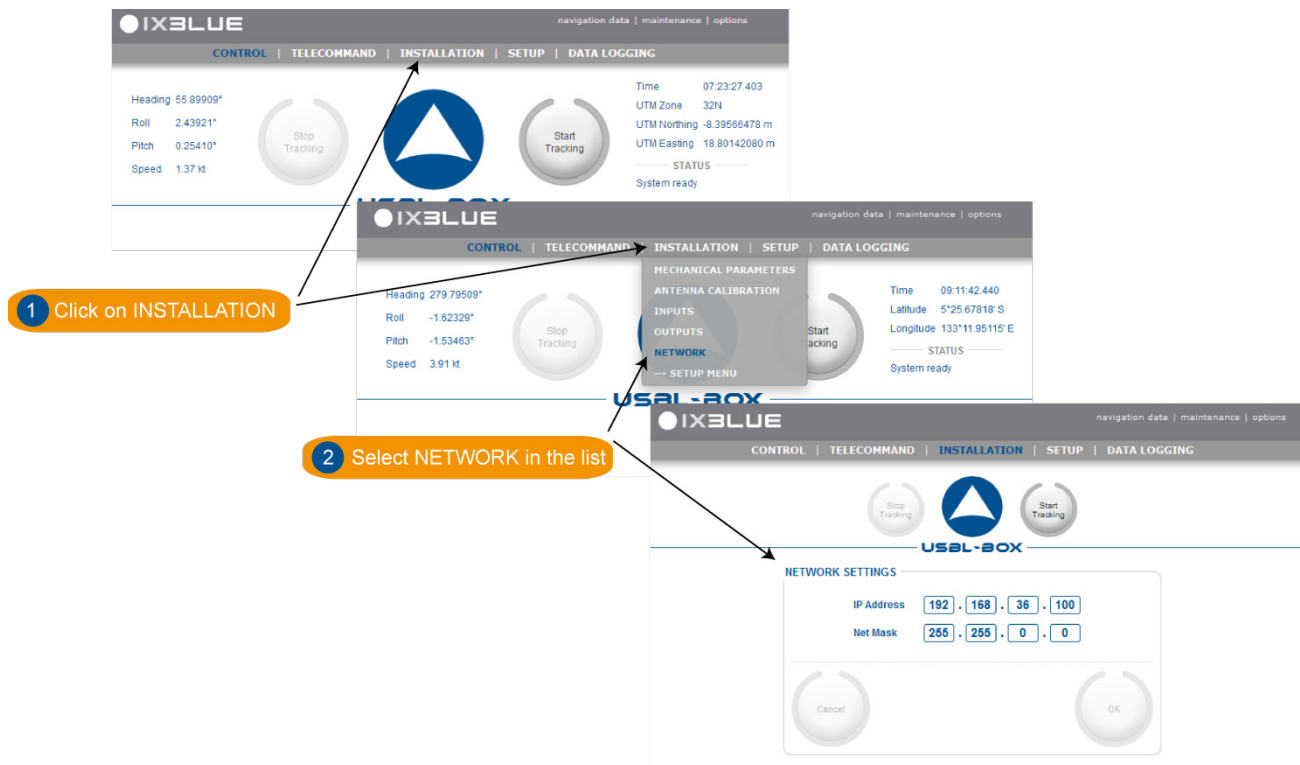


Figure 16 – Navigation through the interface pages

4.1.5 HANDLING THE LOGO

A click on the logo opens the detailed status pop-up. The Figure 18 sums up the status of:

- Antenna
- External Sensors
- Electronic

The color code applies for the indicators and text labels displayed in these pop-up windows. When a problem occurs, the color of the logo changes and these pop-up automatically appear showing immediately which equipment has raised the problem. Close the pop-up windows by clicking on the logo.

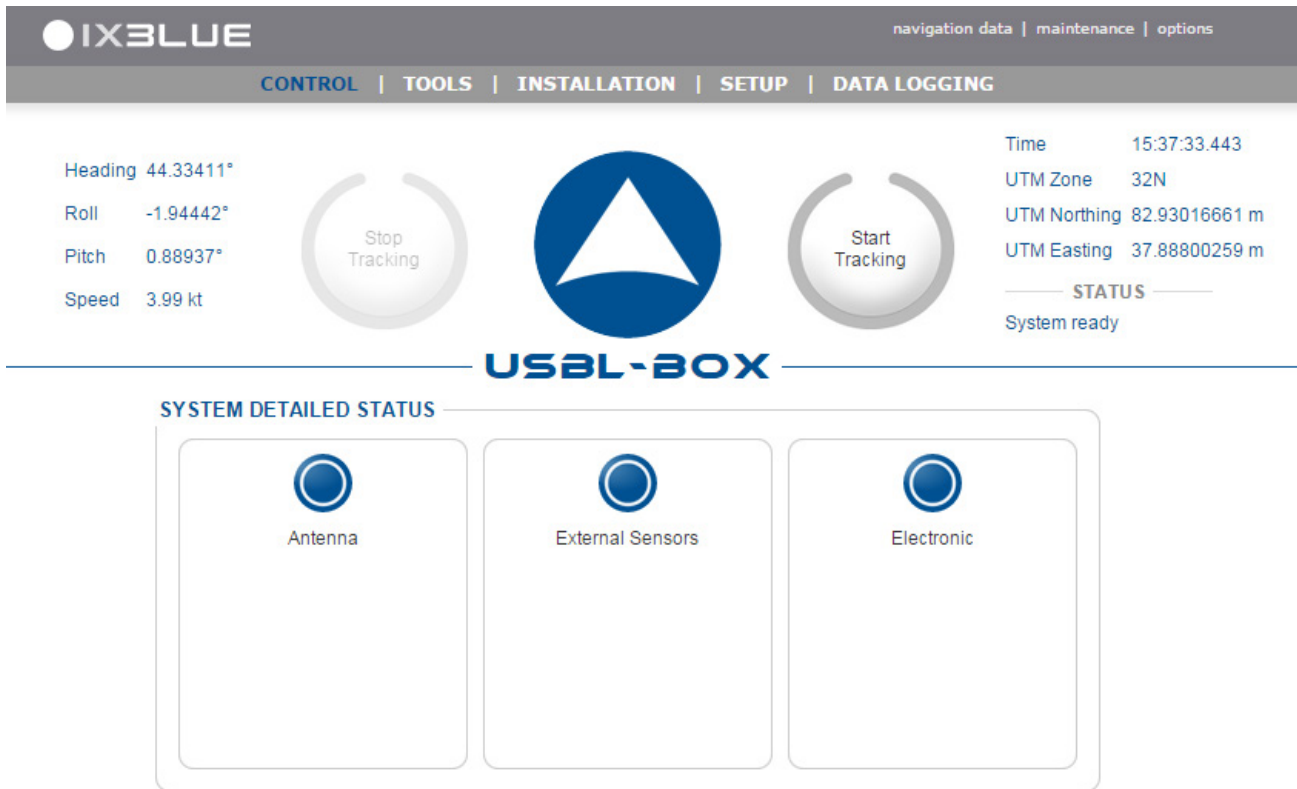


Figure 17 – Control page with detailed status (tracking switched on)

4.1.6 COLOR CODE

Valid for text labels, status indicators and logo, the color code is defined in the Table 2.

Table 3 - Color code definition

Color	Definition
Grey	Inactivity
Flashing Grey /Blue	System Configuration (during initialization)
Blue	Activity, nominal operation
Orange	Activity, warning, the system works with limited efficiency
Red	Activity, alarm, part of the system is not working correctly

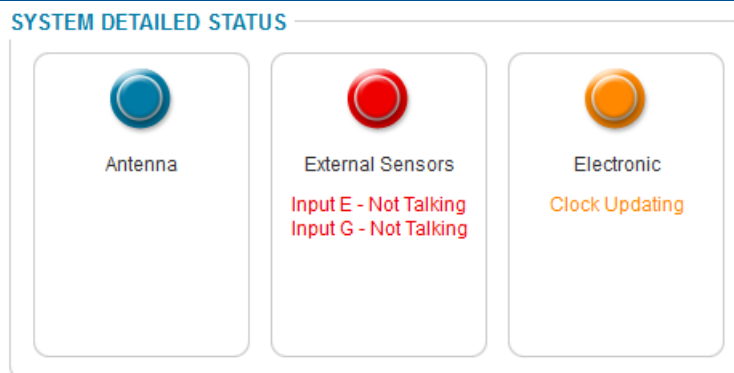


Figure 18 – Warning and alarm status examples

4.1.7 GENERAL RULES FOR USING COMMAND WINDOWS

The command windows allow you to display or modify the configuration parameters. At first delivery, these parameters are set to default values. You have to modify them to fit your needs:

Scrolling lists By selecting it directly in the drop-down list:



You can also use the up arrow ([↑]) and down arrow ([↓]) keys to increase or decrease the numerical values.

Text Box By typing it in the dedicated area:



You can also use the up arrow ([↑]) and down arrow ([↓]) keys to increase or decrease the numerical values.

Incorrect value is immediately indicated by red color:



Expanding hidden area

In order to keep each web-based page as small as possible, only the main parameters are default visible. You can expand the hidden area by clicking on its text label title:

Click on the text label to expand or hide



OK / Cancel buttons

Each command page contains the same buttons. The buttons appear as soon as a modification or a selection has been made in the command page:



To validate the new configuration and store it in the electronic.



To return to the previous entered values.

4.1.8 TOOL TIPS

By moving your pointer above some parameters and logo, you access its tool tip.



Figure 19 – Tool tip example

4.1.9 WEB-BASED USER INTERFACE OPTIONS

The **options** menu on the upper right corner of the main window allows you to edit:

- **Language (French or English or Russian)**
- **Mode of Display (Day Mode and Night Mode)**. The night mode is designed to prevent the light of the screen to disrupt the navigation of the ship.

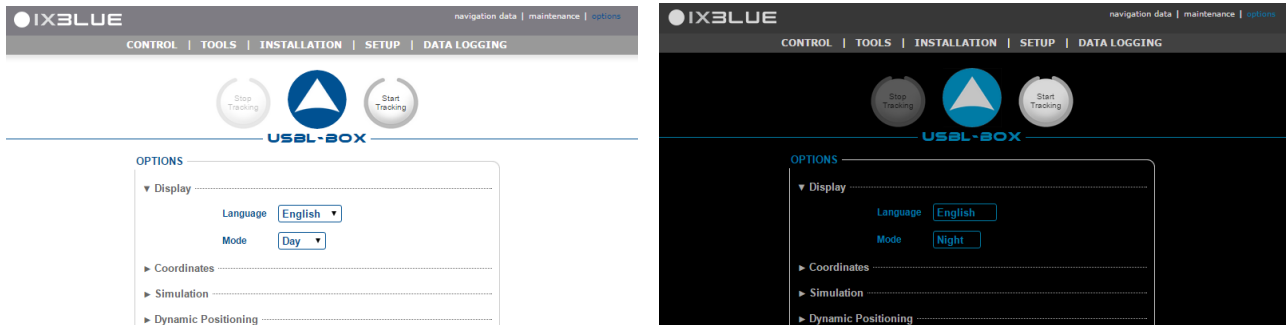


Figure 20 – Day and night modes

- **Coordinates** format in **UTM** or **Latitude/Longitude**
- **Simulation** mode **Real (default)** or **Artificial**. The artificial mode simulates an actual operating mode. It allows the user to validate beforehand the chosen configuration without the need to deploy the acoustic antenna into the water.
- **Forced Mode**: See section 8.3.2.
- **Dynamic Positioning Mode**: See section 7.
- **Data Logging (presets)**: You may enter and save a default suffix for the name of all logged data files as well as a type of segmentation. This suffix is saved in the configuration file and is recovered after closing and re-opening the Web-based User Interface. It is still possible for the user to edit the file name and its suffix in the **DATA LOGGING** page:

▼ Data Logging (presets)

File Suffix .log

Segmentation

DATA LOGGING

▼ Logging Information

File Name

Selected Directory :

▼ Output Parameters

Output

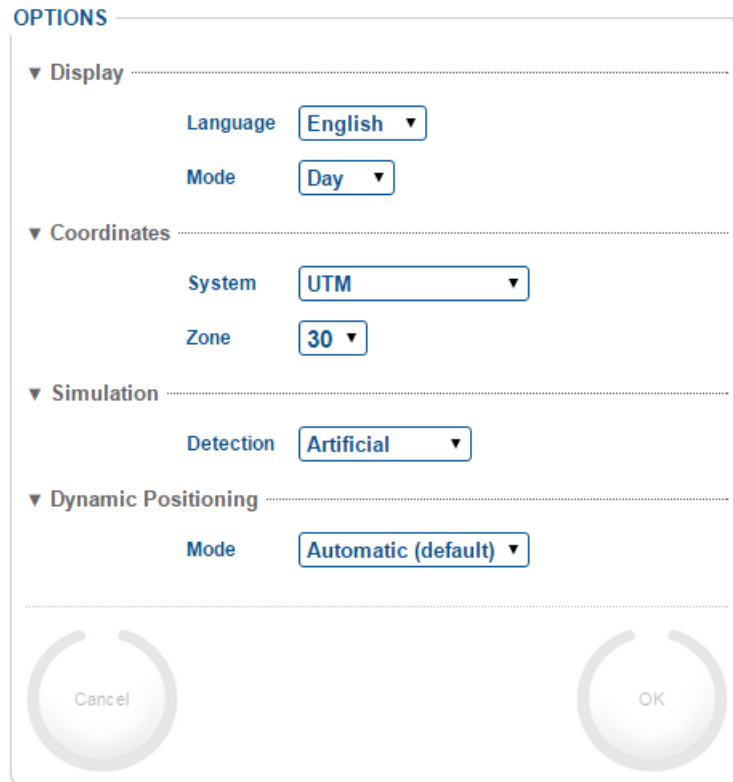
Segmentation :

► File Explorer

Procedure

Step	Action
------	--------

- | | |
|----|--|
| 1. | Click on options in the upper right corner of the main window.
<i>The OPTIONS page opens.</i> |
|----|--|



OPTIONS

- ▼ **Display**
 - Language: English ▼
 - Mode: Day ▼
- ▼ **Coordinates**
 - System: UTM ▼
 - Zone: 30 ▼
- ▼ **Simulation**
 - Detection: Artificial ▼
- ▼ **Dynamic Positioning**
 - Mode: Automatic (default) ▼

Cancel OK

- | | |
|----|---|
| 2. | In Display , select the Language type in the scrolling list. |
| 3. | In Display , select the Day or Night Mode in the scrolling list. |
| 4. | In Coordinates , select the System in the scrolling list (UTM or Latitude/Longitude).
If you have selected the UTM system select the Zone in the scrolling list.
If you have selected the Latitude/Longitude system in step 4, select the Notation in the scrolling list. |
| 5. | Select the Simulation in the scrolling list between Real (default) and Artificial . |
| 6. | Select the Dynamic Positioning Mode in the scrolling list between Automatic (default) ; GPS Only , LBL Only and USBL Only . |
| 7. | Click on OK to validate your choice and to apply it to the Web User Interface. |
| 8. | End of Procedure. |

4.1.10 SAVING AND RESTORING SETTINGS

This section describes how to make a backup of the

- Full settings (**Full Backup**)
- Transponder settings (**Transponders Only**)
- Celerity settings (**Celerity Only**)

in a text file and how to restore previously saved product settings. In the settings file are stored all the different communication parameters as well as all the survey parameters. This tool can be used as a backup of a specific installation on a ship as well as a specific survey configuration.



Make sure to ZIP the options files when sending them by mail in order to avoid any file corruption caused by mail applications.

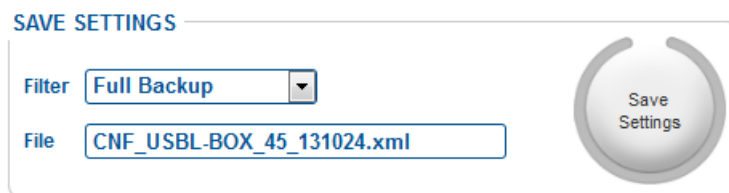
Make sure to UNZIP the options files that you have received by mail before loading them into USBL-BOX.

4.1.10.1 Saving Settings

Saving

Step	Action
------	--------

- | | |
|----|---|
| 1. | Select the SETUP > SETTINGS MANAGEMENT menu item.
<i>The page opens.</i> |
| 2. | In the SAVE SETTINGS frame, you may edit the default Filter and File name of the text file in which you want to save the product settings. |



- | | |
|----|--|
| 3. | Click on the button Save Settings . A window opens offering you to select the location where to store the file, choose this location and click on the OK button.
<i>The product settings are now saved in a text file at the chosen location.</i> |
| 4. | End of Procedure. |

4.1.10.2 Restoring Settings

The same procedure is used to restore the previously saved settings or to load newly acquired options. Settings and options are stored in “CNF_” files.

Saving

Step	Action
1.	Select the SETUP > SETTINGS MANAGEMENT menu item. <i>The page opens.</i>
2.	In the RESTORE SETTINGS frame, click on Browse... to select the file “CNF_” file. <i>Once selected the name of the file appears in the File field.</i>
3.	Click on the button Restore Settings .



*A **Sending File** frame appears briefly. Once the frame has disappeared, the product settings are loaded in the Web-based User Interface.*

- | | |
|----|-------------------|
| 4. | End of Procedure. |
|----|-------------------|

4.2 Configuring the Network

The USBL-BOX can only be configured via a Web-based user interface from any computer. The purpose of this section is to explain how to connect the USBL-BOX to a computer that is part of a local network or not. You can be in one of the two situations:

- Connect USBL-BOX to a single computer, section 4.2.1
- Connect USBL-BOX to the local network, section 4.2.2

4.2.1 CONNECTING THE USBL-BOX DIRECTLY TO A COMPUTER

In this section you connect the USBL-BOX to a single computer via an Ethernet cable. Then you configure the computer network parameters in order that the computer “sees” the USBL-BOX.

4.2.1.1 Overview of the Connections



Figure 21 – L’USBL-BOX connectée directement à une station de travail

Equipment Needed:

- 1 x computer or Laptop (with an Ethernet port)
- 1 x Cat 5 Crossover Ethernet Cable

By default, the USBL-BOX is already assigned with a default IP address. When connecting one computer to the USBL-BOX, it is only necessary to adapt the computer to the USBL-BOX configuration.

4.2.1.2 Default IP Address

The default IP address is printed on the label stuck on the rear of the small door of the front face of the USBL-BOX. By default, the URL is:

<http://192.168.36.1XX>

XX is the last two digits of the serial number of the product. The URL is redirected to <https://192.168.36.1XX/control/>.

For products delivered before 30 April 2016, the default IP address is:

<https://192.168.64.19>

The user name and password asked are: admin and admXI.

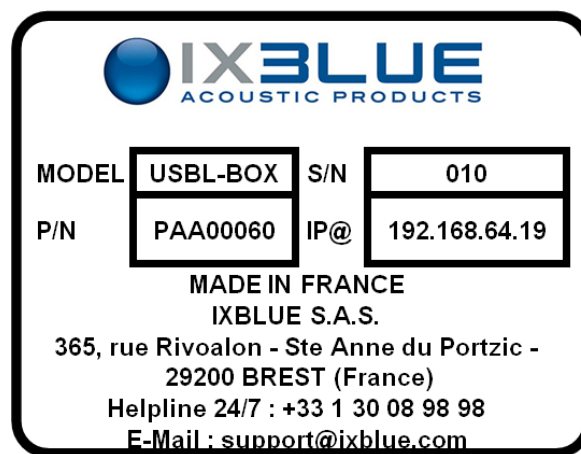


Figure 22 – Example of a label stuck on the small compartment door of the USBL-BOX



If you have lost the USBL-BOX IP address, you can easily recover this address by connecting an hyper terminal (115200, 8 bits, no parity, 1 stop) to one of the four serial links of the USBL-BOX. When you switch OFF and ON the USBL-BOX, the IP address of the USBL-BOX is displayed in the hyper terminal as well as the firmware version and the ID of the serial link.



192.xxx.xxx.xxx is an address of class C, the corresponding mask is by default 255.255.255.0.

4.2.1.3 Configuring the Computer

IP Address Assuming that the USBL-BOX IP address and the subnet mask are the default factory parameters: 192.168.64.19 and 255.255.255.0. Before configuring the computer, choose the computer IP address. This address must be taken from the same subset as the address configured in the USBL-BOX. In this example, 192.168.64.20 is going to be used for the computer IP address.

Subnet Mask The subnet mask must be the same between the USBL-BOX and the computer.

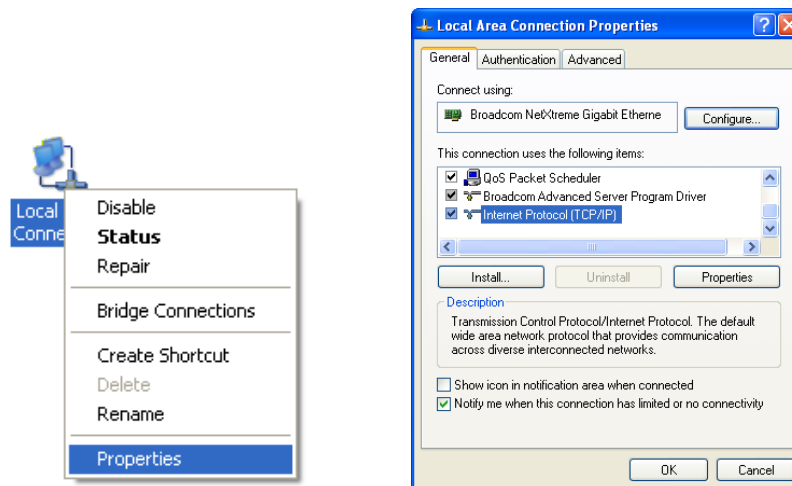
Procedure

Step	Action
------	--------

- Access on the computer to the **Network Connections** window:
 - Locate the icon “My Network Places” on the desktop screen of the computer, right click on the icon then select **Properties**
 - If you cannot locate this icon, you can still proceed by selecting **Start** menu > **Connect To** > **Show all connections**.
 - Select **Start** > **Settings** > **Control Panel**, double click on **Network Connections**.

- Right click on **Local Area Connection** icon and select **Properties**:

The Local Area Connection Properties window opens:



- Double click on **Internet Protocol (TCP/IP)** label text.

The Internet Protocol (TCP/IP) Properties window opens.

- Select the option **Use the following IP address** and enter 192.168.64.20 for the **IP address** field and 255.255.255.255 for the **Subnet mask**.

- Leave the **Default gateway** and **DNS server** addresses blank.

- Click on **OK** button to validate the modifications.

You have set up the computer configuration to enable the Ethernet communication between the computer and the USBL-BOX.

- End of Procedure.



The computer IP address used here takes into account that the USBL-BOX is using its default configuration with its default IP address (see section 4.2.1.2). You may change the IP address and subnet mask of the USBL-BOX. In either case the subnet masks of both computer and the USBL-BOX must be the same.



If you have no idea on which IP address USBL-BOX has been configured, you may recover this IP address by connecting a hyperterminal on the computer to one of the RS232 or RS422/485 connector and configuring the terminal to the following settings: 115200 bauds, 8, none, 1. The IP address is then being broadcasted by USBL-BOX on the hyperterminal.

4.2.2 CONNECTING THE USBL-BOX TO A LOCAL NETWORK

In this section, you connect the USBL-BOX to the local network via an Ethernet switch (see section 4.2.2.1). Then you set up a computer from the network to have access to the USBL-BOX network parameters. You edit these parameters to make the USBL-BOX compatible with the network (see section 4.2.2.2). The global procedure is explained in section 4.2.2.3.

4.2.2.1 Overview of the Connections

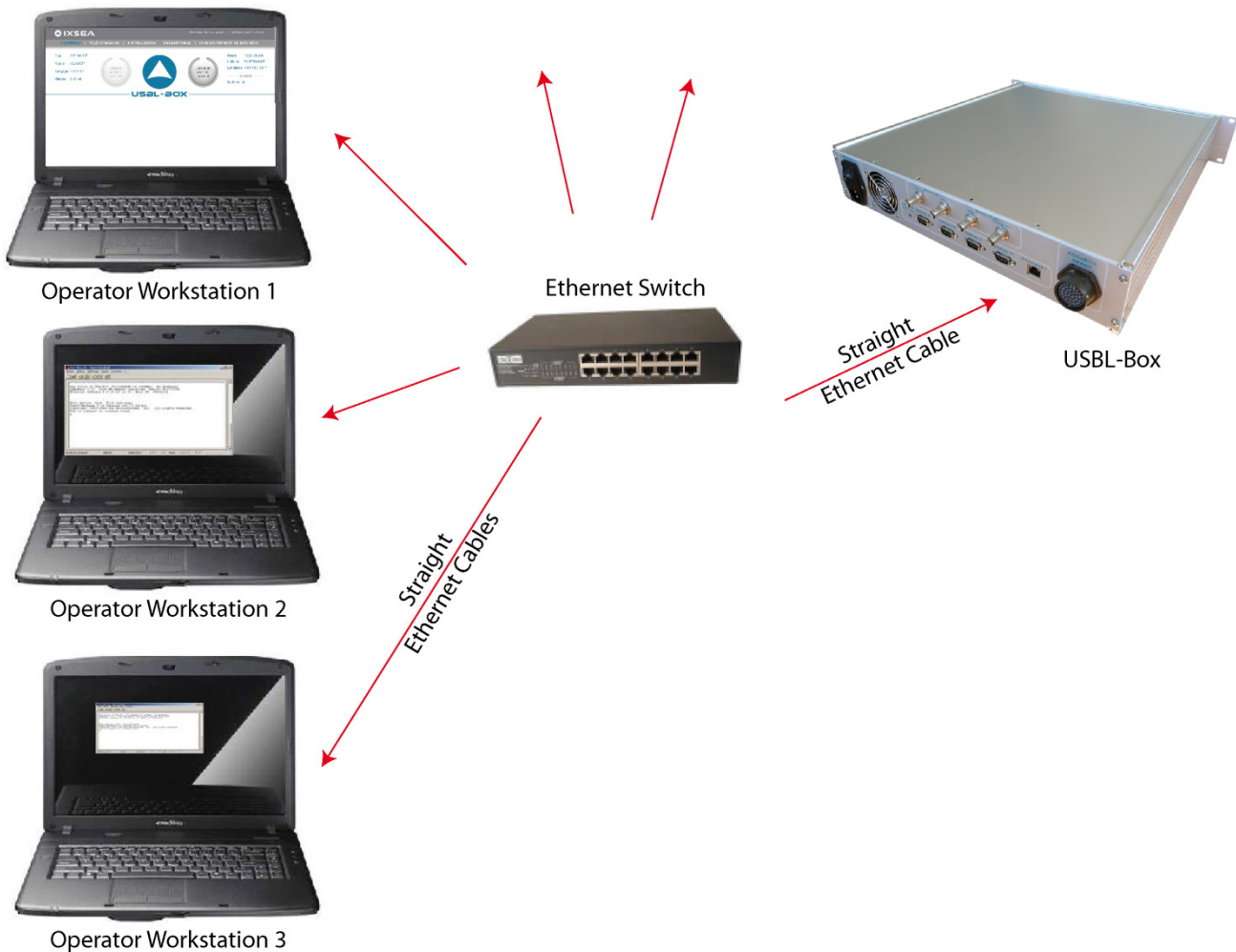


Figure 23 – USBL-BOX connected to the local network

Equipment Needed:

- One Cat 5 Straight Ethernet Cable to set between the USBL-BOX and the switch
- A free slot in the local network switch

You configure the USBL-BOX to make it compatible to your local network.

4.2.2.2 Configuring the Network Interface of the USBL-BOX

After connecting the USBL-BOX to a computer, with the USBL-BOX powered on, you can launch the Web-based user interface on the computer and you can edit the USBL-BOX network parameters. You can then make the USBL-BOX compatible to your local Ethernet network. Restrictions on the choice of the USBL-BOX IP address and mask are detailed in annex B.

Every USBL-BOX is assigned with its own **IP Address** and a **Net Mask**. In order to insert the USBL-BOX in your local network, you must edit the network parameters.

The **Gateway** IP address is the address of the computer which is connected to other networks of the vessel.

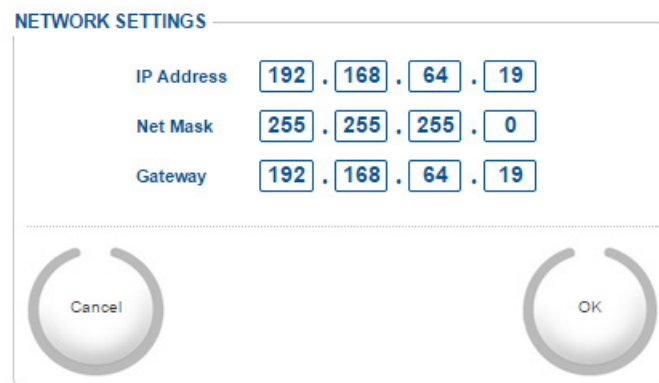


Turn the USBL-BOX on and off after every IP address edition.

Procedure

Step	Action
------	--------

- | | |
|----|---|
| 1. | Click on INSTALLATION in the menu and select NETWORK .
<i>The NETWORK SETTINGS window opens. The IP address and the mask fields are filled by the default values.</i> |
|----|---|



- | | |
|----|---|
| 2. | Edit the IP Address by clicking in the fields and entering new values. |
| 3. | Edit the Net Mask by clicking in the fields and entering new values. |
| 4. | Edit the Gateway by clicking in the fields and entering new values. |
| 5. | Click on OK to validate the input of the values. |
| 6. | Turn off and then on the USBL-BOX. |
| 7. | End of Procedure. |

4.2.2.3 Connection Procedure

Important

For unit delivered before February 2016, it is recommended to use a switch NETGEAR GS108GE 8 points between the USBL-BOX and the local network.

Procedure

Step	Action
1.	Connect physically the USBL-BOX to the local network as shown on Figure 24. The USBL-BOX being in default network configuration that is not compatible with your local network, the USBL-BOX is not visible from any computer present in the network.
2.	Select one computer from which you are going to access and configure the USBL-BOX. Note the IP address of this computer. You need this IP address in step 7.
3.	Follow the procedure of section 4.2.1 to set up the computer to be able to see the USBL-BOX from this computer. <i>The USBL-BOX is now visible from this computer.</i>
4.	Choose an IP address compatible to the local network. You are going to assign this address to the USBL-BOX to include it into the local network.
5.	Add this address to the list of IP addresses of the elements present in the local network.
6.	Launch the Web-based user interface. See section 4.1.
7.	See section 4.2.2.2 to edit the USBL-BOX network parameters. Once the computer is configured and that you can see the USBL-BOX from the computer, assign the new IP address to the USBL-BOX. For the Net Mask, enter the local network mask.
8.	Configure the computer in its original IP network configuration (before step 3). <i>Now all computers in the network can see the USBL-BOX.</i>
9.	End of Procedure.

4.3 Configuring the Acoustic Antenna

The position of the POSIDONIA acoustic antenna either in built-in or cage version must be very accurately known. This is calculated just after installation and must be checked every time the vessel goes into dry dock. These parameters are the following:

- **Misalignment:** three angular offsets of the antenna's axes compared with the boat's axes. They are roughly measured during the installation procedure. A not so precise installation can be here corrected. A well installed antenna (H1 towards the bow and H4 towards the port) has offsets equal to (0, 0, 0).
- **CRP to Sea:** is the position of the sea surface on the vertical axis of the ship. For example if the CRP is 2.5 meters below sea surface, then the position of the sea surface on the vertical axis is +2.5 meters.

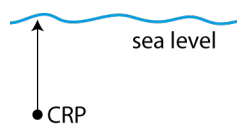


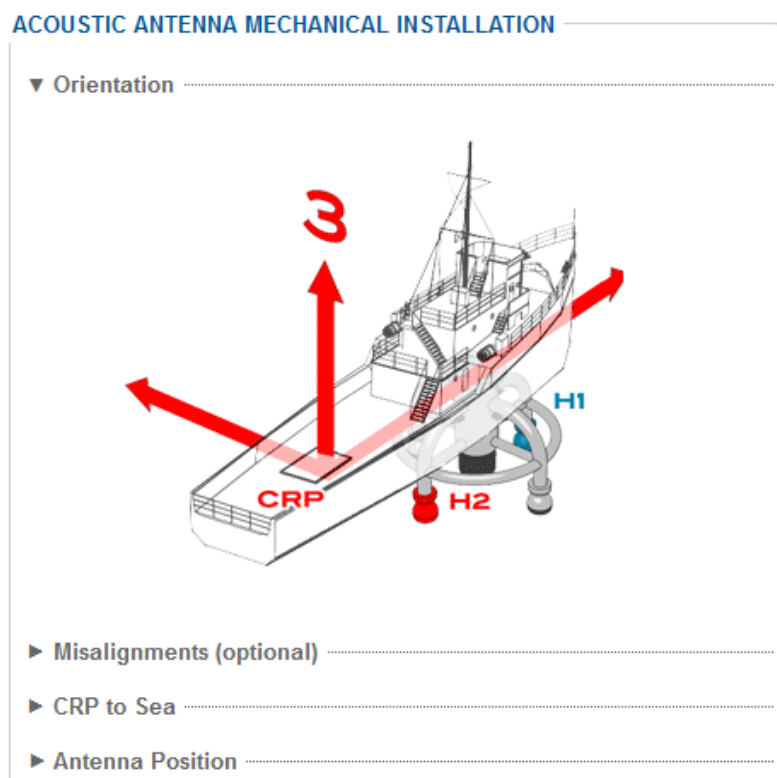
Figure 24 – How to compute the CRP to sea value

- **Lever arms:** the three distances between the CRP and the antenna's mounting flange along the three axes of the boat. See the definition of the axes and the CRP in section 2.1.

Procedure

Step	Action
------	--------

1. Click on the menu **INSTALLATION** and select **MECHANICAL PARAMETERS**.



Step Action

- In **Misalignments (optional)** enter (0, 0, 0) for a well installed antenna (H1 towards the bow, H4 on port side).

▼ Misalignments (optional)

Roll	Pitch	Heading
5.5	2.05	4

- In **CRP to Sea**, enter the value of **Distance**.

▼ CRP to Sea

Distance
65.8
m

- In **Antenna Position**, enter the LV1, LV2 and LV3 values.

▼ Antenna Position

LV1	LV2	LV3
46.4	34.7	6.9
m	m	m

- Click on **OK** to validate and send this data to the USBL-BOX.

- End of Procedure.

4.4 Configuring the Input and Output Parameters

This chapter describes the communication between the USBL-BOX and the external sensors. These parameters are divided into input parameters (see paragraph 4.4.1) and output see paragraph 4.4.2).

The parameters are in the **INPUTS** and **OUTPUTS** items of the **INSTALLATION** menu.

4.4.1 CONFIGURING THE INPUTS

Liaisons

Four serial links and an Ethernet link limited to four ports are available to transmit this data to the USBL-BOX.

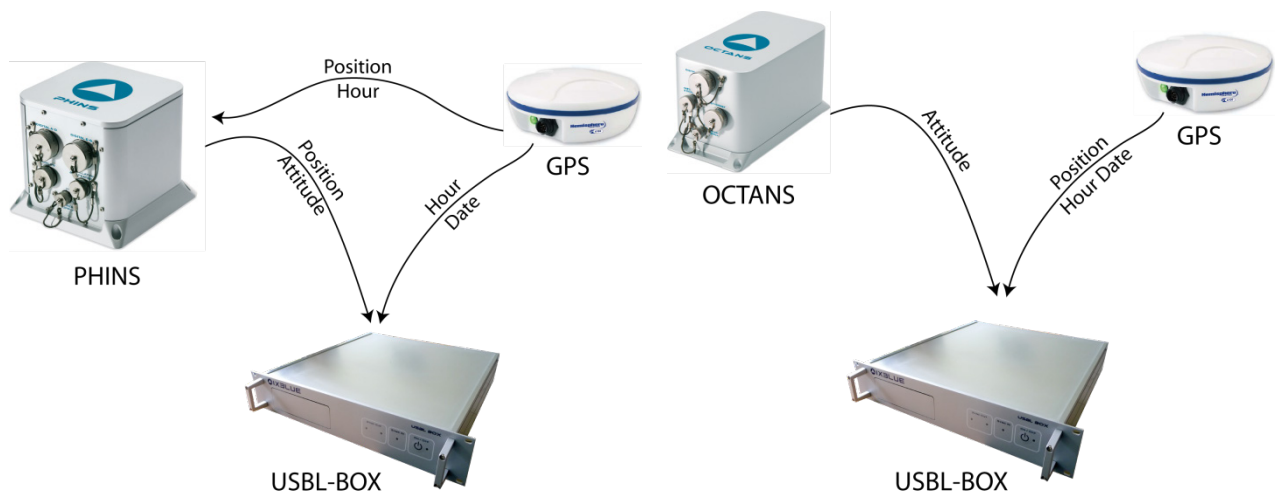


Figure 25 – Example of external sensors connected to the USBL-BOX



Each serial link and each Ethernet link can be used simultaneously with input and output. Only the serial link configuration must absolutely be the same for input and output. This is not the case for Ethernet links.

Data

The input data for the USBL-BOX is as follows:

- **Position:** the geographical position of the vessel is typically supplied by GPS or by an inertial system likewise connected to a GPS.
- **HRP:** the vessel's heading, roll and pitch data is typically given via an appliance supplying information on attitude and orientation.
- **Pressure:** pressure can be supplied by serial link through a transponder equipped with a pressure sensor operating in responder mode.
- **Temperature:** variations in temperature are given by the temperature sensor situated close the antenna allowing you to estimate the speed of sound via the hydrophones and the transducer.
- **UTC:** time and date information is supplied in order to record what the system is doing. An external clock or a GPS can supply this data.
- **Hoisting System:** the different states (**hoisting system up**, **hoisting system down**, **gate valve open**, **gate valve closed**, **hoisting system fault**) of the connected hoisting system are displayed as status of the antenna in the **CONTROL** menu.

4.4.1.1 Input Stream Parameters

Below, you find the various parameters that you have to set up:

- **Sensor:** type of sensor supplying position data.
- **Input:** type of port containing information on position, a choice of four **serial ports** (A, B, C, D) and four **Ethernet** links (E, F, G, H).
- **Protocol:** type of **protocol** sent by the chosen sensor. The protocol may be accompanied by a synchronized **PPS** used to record incoming data. There is a choice of four options for the **PPS**, operated on a rising or falling edge, before or after the data has been given. The **Min. Duration** of the PPS below which it does not operate can also be recorded. See the protocols in Appendix A and B.
- **Serial:** if the chosen link is **serial**, the link parameters are as follows:
 - Parity:** None, Odd, Even
 - Stop bites:** 1.0 or 2.0
 - Standard:** RS232 or RS422/485
 - Baud output:** selected from a predefined list ranging from 600 to 115,200 bauds (output from port D is permanently fixed at 115,200 bauds)
- **Ethernet:** if the chosen link is **Ethernet**, the link parameters are as follows:
 - Transport layer: may be TCP Server, TCP Client or UDP Broadcast.
 - IP:** the IP address of the target (only for a transport layer **TCP Client**)
 - Port:** the number of the port
- **Lever arms:** the lever arms represent the distance along the vessel's three reference axes between the position of the sensor and the position of the CRP. See the CRP agreements in sections 2.1.1 and 2.1.2 for the vessel's reference axes. Let the values to 0.0 meters if the positioning sensor corrects itself the output positions by referencing them to the CRP.
- **Misalignments:** The correction given by the misalignments values allow to adapt the system to a sensor producing data in different reference axis. In the normal case you should enter (0, 0, 0).

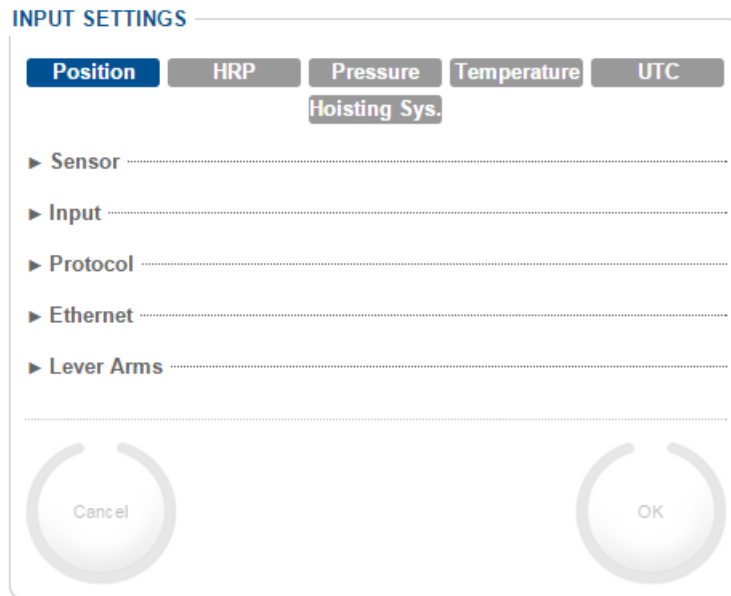
4.4.1.2 Configuration Procedure

The configuration procedure of input data is detailed in this paragraph.

Procedure

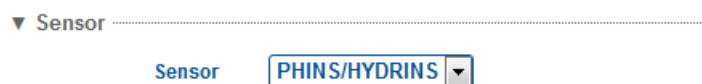
Step	Action
------	--------

1. Click on the **INSTALLATION** menu and select **INPUT**.
The CONFIGURATION OF INPUT window opens.



2. Click on **Position**, **HRP**, **Pressure**, **Temperature**, **UTC** or **Hoisting System**.
The different parameters to be configured are shown.

3. Only for **Position** and **HRP** data, in the **Sensor** component, select the type of sensor from the drop-down list.



4. In the **Input** component, select the type of **Port**.
*The type of link parameters are shown in the **Serial** or **Ethernet** component.*



5. In the **Protocol** component, select the **Protocol**, the **Timeout** and the type of **PPS** and its **Length of time (mins.)** (from 50 μ s to 1,000 μ s).



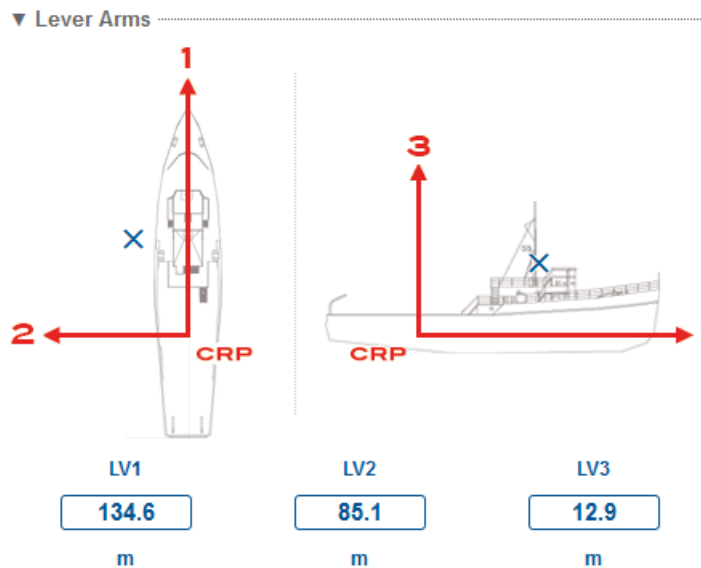
Step Action

6. If you have selected a **Serial Port** in step 4, enter the **Parity, Stopbits, Standard** and **Baudrate**.

7. If you have selected an **Ethernet Port** in step 4, enter the following parameters:
According to the layer chosen, there may be an IP address to enter.

Transport Layer	<input type="text" value="TCP Client"/>	Transport Layer	<input type="text" value="TCP Server"/>
IP	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>	Port	<input type="text" value="20000"/>
Port	<input type="text" value="20000"/>	Port	<input type="text" value="20000"/>

8. Only for **Position** data, in **Lever arms**, enter distances **LV1, LV2, LV3** separating the position sensor from the vessel's CRP. Let these values to 0.0 m if the position sensor corrects itself the output positions by referencing them to the CRP.



9. Click on **OK** to validate your input data configuration and send it to the USBL-BOX.

10. End of Procedure.

4.4.2 CONFIGURING THE OUTPUTS

The USBL-BOX calculates the various positions of the immersed transponders. Four serial links and a four-port Ethernet link are available to transmit these positions to other appliances. A certain number of formats are also available to enable USBL-BOX compatibility with other appliances.

Each serial link and Ethernet link can be used simultaneously for input and output. Only the serial link configuration must be the same for input and for output. This is not the case for Ethernet links.

4.4.2.1 Output Stream Parameters

For each outgoing link, the parameters to be configured are as follows:

- Port number and type of link: a chart shows the eight available ports and the associated link. This enables you to choose the port and the type of link.
- **Protocol**: a list of protocols is available which allows compatibility between the USBL-BOX and other appliances. See the protocols in Appendix A.
- **Frequency**: the frequency of outgoing data is configurable. Values are presented in ms and Hz and range from **20 ms / 50 Hz** to **10,000 ms / 0.1 Hz**.
- **Serial**: if chosen link is **Serial**, the link parameters are as follows:
 - ❑ **Parity**: None, Odd, Even
 - ❑ **Stopbits**: 1.0 or 2.0
 - ❑ **Standard**: RS232 or RS422/485
 - ❑ **Baud output**: selected from a predefined list ranging from 600 to 115,200 bauds (output from port D is permanently fixed at 115,200 bauds)
- **Ethernet**: if the chosen link is **Ethernet**, the link parameters are as follows:
 - ❑ **Transport layer**: may be TCP Server, TCP Client or UDP Broadcast.
 - ❑ **IP**: the IP address of the target (only for a transport layer **TCP Client**)
 - ❑ **Port**: the number of the port

4.4.2.2 Configuration Procedure

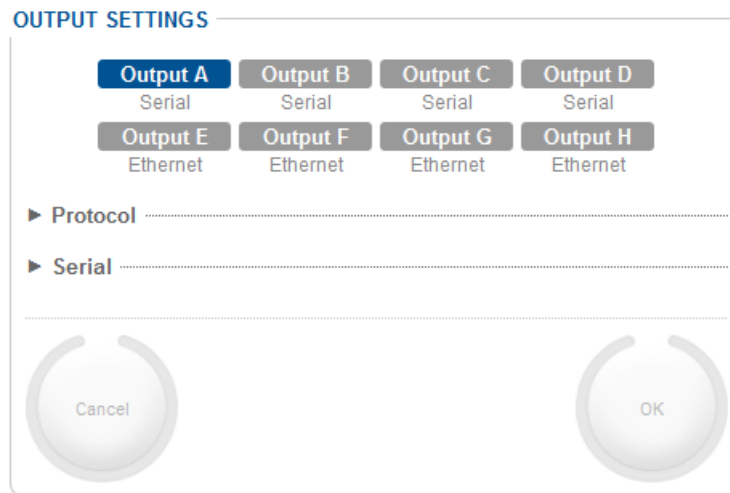
The configuration procedure of output data is detailed in this section.

Procedure

Step	Action
------	--------

1. Click on the **INSTALLATION** menu and select **OUTPUT**.

The CONFIGURATION OF OUTPUT window opens.



2. Click on the port of your choice: **OUTPUT A, B, C, D, E, F, G** or **H**

The selected port is highlighted in blue. According to the type of link, the **Serial** or **Ethernet** component appears below.

3. In **Protocol**, Select the **Protocol** and the **Frequency** from the pull-down list.
4. If you have selected a **Serial Port**, enter the **Parity**, **Stopbits**, **Standard** and **Baudrate**.
5. If you have selected an **Ethernet** link, enter the parameters of the link:

Transport Layer	<input type="text" value="TCP Client"/>		Transport Layer	<input type="text" value="TCP Server"/>
IP	<input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/> . <input type="text" value="0"/>		Port	<input type="text" value="20000"/>
Port	<input type="text" value="20000"/>		Port	<input type="text" value="20000"/>

According to the transport layer chosen, there may be an IP address for more information.

6. Click on **OK** to validate your output configuration positioning data.
7. End of Procedure.

5 SETTING THE USBL-BOX TO WORK

This chapter concerns the actions and procedures to be carried out just before starting positioning operations. These actions are as follows:

- Definition of the tracking parameters, see section 5.1
- Configuration of transponders (USBL and L/USBL modes), see section 5.2
- Measurement and input of profile celerity of sound, see section 5.3
- Configuration and recording of data, see section 5.4
- Calibration of the USBL-BOX, see section 5.5

5.1 Defining the Tracking Parameters

5.1.1 SYNCHRONIZATION MODES

The parameters described in this section enable the acoustic cycle of the USBL-BOX to be defined. The main parameter is the synchronization mode where the USBL-BOX is. Two synchronization modes are possible:

- **Internal Synchronization:** The interrogation time for the transponder is automatically determined by the USBL-BOX. The internal recurrence is fixed. It is configured to a fixed value.
- **External Synchronization:** An external system generates a synchronization signal sent to the USBL-BOX.

The configuration of positioning parameters is carried out in the **TRACKING** component from the menu **SETUP**.

5.1.2 INTERNAL SYNCHRONIZATION

During internal synchronization, the USBL-BOX activates POSIDONIA’s antenna emissions according to the defined value of recurrence. In this mode, the USBL-BOX can activate another acoustic appliance if the need arises.

Procedure

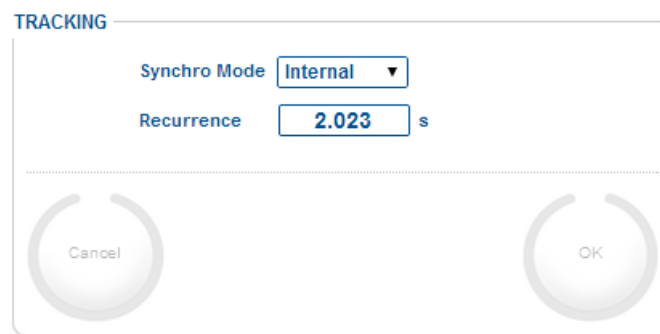
Step	Action
------	--------

- | | |
|----|---|
| 1. | Click on the menu SETUP and select TRACKING . |
|----|---|

*The **TRACKING** window opens.*

- | | |
|----|---|
| 2. | Select Internal from the Synchro Mode pull-down list. |
|----|---|

*The **TRACKING** window shows the following parameters:*



- | | |
|----|--|
| 3. | Enter the value of Recurrence . |
|----|--|

- | | |
|----|--|
| 4. | Click on OK to validate the configuration of the internal synchronization mode. |
|----|--|

- | | |
|----|-------------------|
| 5. | End of Procedure. |
|----|-------------------|

5.1.3 EXTERNAL SYNCHRONIZATION

During external synchronization, the acoustic emission of POSIDONIA's antenna is set off by an external appliance. This mode is generally chosen when the USBL-BOX is simultaneously operating with another acoustic appliance. A signal is sent to the USBL-BOX by one of the two specially designed BNC links situated at the front and at the back. The parameters associated with external synchronization are as follows:

- **Inhibition:** this is the time after setting off during which the USBL-BOX cannot receive other signals which could activate it at an untimely moment.
- **Activation:** this is the part of the signal where, on reception, the setting off takes place. Two options are possible: a rising edge or a falling edge of the signal.
- **Min. Duration:** this is the minimum length of time necessary for the setting off after activation by a rising or falling edge during which the signal must remain stable (high after a rising edge or low after a falling edge). Its values range from 50 μ s to 1000 μ s.

Procedure

Step	Action
1.	Click on the menu SETUP and select TRACKING . <i>The TRACKING window opens.</i>
2.	Select External from the Synchro mode pull-down list. <i>The TRACKING window shows the following parameters:</i>
	
3.	Enter the Inhibition value.
4.	From the Activation pull-down list, choose the type of edge on which the acoustic emission is to be set off.
5.	Select the value of the Min. Duration from the associated pull-down list.
6.	Click on OK to validate your choices and to send this data to the USBL-BOX.
7.	End of Procedure.

5.2 Setting up the Transponders

USBL-BOX is able to position iXBlue transponders. The list of the compatible transponders and their interrogation and reply signals is given in the Table 4.

Table 4 – Transponders compatible with USBL-BOX

Transponder	Interrogation	Reply
iXBlue ET/RTA	8.5 – 16, 0.5 kHz steps	POSIDONIA 16 – 23
iXBlue RT8	8.5 – 16, 0.5 kHz steps	POSIDONIA 16 - 23
iXBlue - RTT4	8.5 – 16, 0.5 kHz steps	POSIDONIA 16 - 23
iXBlue - RAMSES	8 – 17.5, 0.5 kHz steps RAMSES 00 – 23	POSIDONIA 16 - 23

The USBL-BOX positions immersed transponders. Before starting positioning, you have to list, configure and activate the transponders via the Web-based user interface.

You can access the management of transponders in the **TRANSPONDER** component from the **SETUP** menu. Transponders which are already present in the data base are listed in this window and you can see at a glance how these transponders were configured and whether they are still active or not. See the transponder window in Figure 27.

Multi Transponders

Several transponders can be simultaneously interrogated. The interrogation then takes place on as many cycles as there are various frequencies. The transponders are separated thanks to different MFSK reply codes and Individual Interrogation Frequencies (IIF). Two transponders cannot have the same interrogation frequency and reply codes. If different interrogation frequencies are used simultaneously, the USBL-BOX makes a recurrence for each interrogation frequency. We can also mix responder and transponder modes to interrogate the transponders. In addition the repetition factor parameter can be used to increase the acoustic update rate for one specific interrogation frequency.

Below is listed the limitations of the system in terms of multi transponder configuration:

- 500 transponders simultaneously configured (not activated)
- 18 recurrences per cycle
- 40 activated transponders
- 15 different response codes per cycle
- 15 different response codes per recurrence

You can interrogate transponders in transponder mode and in responder mode in the same configuration.



When the two interrogation frequencies are different, the blanking time is higher than the acoustic recurrence. In a single transponder mode, you cannot have a blanking time higher than the acoustic recurrence. In the MMI you cannot set up a blanking time higher than the recurrence. So when you use two transponders with two different frequencies, **make sure to have the correct settings in the transponder hardware** and let a blanking time lower than the recurrence in the MMI. Only the blanking time set in the hardware is taken into account.

Codes

There are, as seen in Table 4, several families of interrogation/reply codes:

- Tonal Signals 8.5 to 17.5 kHz, 0.5 kHz steps
- POSIDONIA 16 23

It is recommended to use codes from only one family in the frequency plan. iXBlue guarantees the intercorrelation properties only within the same family of codes.

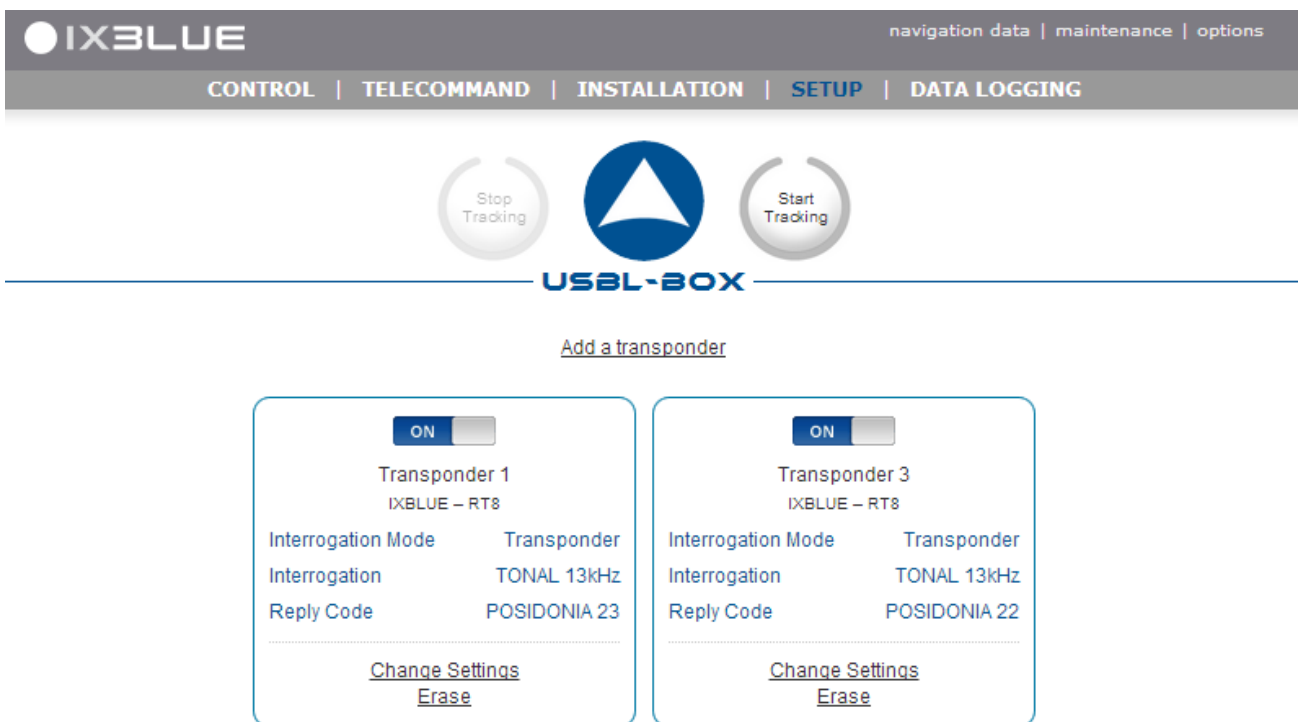


Figure 26 – Transponder window


From this window, you can carry out the following:

- Add a transponder to the list
- Configure a transponder (interrogation, reply, dynamic positioning mode, filtering)
- Activate a transponder
- Remove a transponder from the list

5.2.1 ADDING A TRANSPONDER

Each transponder is identified by an **Identifier**, a **Type** of transponder and a **Manufacturer**.

Procedure

Step	Action
1.	Click on the menu SETUP and select TRANSPONDERS . <i>The management of transponders opens.</i>
2.	Click on Add a transponder . <i>The window shows:</i>
	
3.	Type an ID Number from 1 to 9999 in the corresponding field. Unavailable identifiers appear in orange.
4.	Select one of the transponders listed under Type (optional) and click on Create . <i>The configuration window opens.</i>
5.	Configure the transponder. See section 5.2.2.
6.	Once the transponder is configured, click on Go back to transponders list .
7.	End of Procedure.

5.2.2 CONFIGURING A TRANSPONDER

The configuration parameters are classified under the following headings:

5.2.2.1 Interrogation

Interrogation comprises the **Mode** of acoustic positioning and the **Code** of interrogation that has been assigned to the transponder.

- In **Responder Mode** the transponder is set off by an electrical signal and the transponder responds via acoustics. Two different responder modes (**Responder Prim.** and **Responder Sec.**) can be selected for two series of transponders. These two modes correspond to the two BNC connectors on the rear face of the BOX. USBL-BOX does not transmit any acoustic interrogation signal. This mode has the following characteristics:
 - ❑ The position update is twice faster in responder mode than in transponder mode because there is only one acoustic travel in this mode. The first travel is electric. There are two acoustic travels in transponder mode.
 - ❑ The transponder cannot be accidentally triggered by any parasitic sound source.
 - ❑ The transponder is always triggered even in a noisy environment (ROV propellers for example).
 - ❑ Depending on the environmental conditions, the maximum range of the system is sometimes limited by the reception of the acoustic triggering signal by the transponder. This is no more limitation in responder mode and the maximum range is only limited by the reception of the reply by the POSIDONIA acoustic array.
 - ❑ The drawback is that the electrical signal has to be transmitted up to the transponder usually through an electrical or a fiber optic wire or by using synchronous clocks (USBL-BOX in external synchronization mode).
- In **Transponder** mode, the interrogation and response are transmitted via acoustics.
- **Code**: defines a monochromatic signal from 8 kHz to 16 kHz by steps of 0.5 kHz or for RT9 and RAMSES 6000, a 10 ms MFSK low frequency signal from 0 to 23.

5.2.2.2 Reply

The heading **Reply** comprises acoustic parameters characterizing the response of the transponder.

- **Code**: defines a low frequency MFSK signal, see Table 4 for all possible reply codes depending of the transponder type.
- **Turn Around Time**: there is a period of inactivity between the interrogation signal first being received and the beginning of sending out the response emission. This time period is between 20 ms and 200 ms.

5.2.2.3 Additional Information

Additional information can be none, an external pressure, a fixed depth or an acoustic pressure.

- **None:** If there is no additional information to be notified, you can select a **Station Keeping** option. In this case, you have to enter the position and depth with associated accuracy.
- **External Pressure:** This is pressure transmitted by a serial link through a pressure sensor. This sensor might be the one that equips the transponder or is already installed on the vehicle on which the transponder is to be loaded. A corresponding **Accuracy** is to be entered.
- **Fixed Depth:** Enter the corresponding **Depth** and **Accuracy**.

5.2.2.4 Dynamic Positioning

See section 7 for more details.

5.2.2.5 Filtering

The **filtering** heading enables you to apply a filter on positional data. The available options are: **None**, **Fixed** and **Mobile**.

The filtering heading enables you to apply a filter for positional data. Two options **Fixed** and **Mobile** are available depending on whether the transponder's position is static (anchored) or moving (on an underwater vehicle).

5.2.2.6 Other

The **Label** is a name (eight characters) associated to the transponder.

The **Repetition Factor** allows a different interrogation rate for each of the active transponders. USBL-BOX interrogates each transponder the number of times (up to 5) defined by the **Repetition Factor** before interrogating another transponder.

Procedure

Step	Action
------	--------

1.	Select SETUP > TRANSPONDERS .
----	---

2.	Click on Change Settings for the appropriate transponder to be configured.
----	---

The configuration window opens. The image shown corresponds to an RT9 transponder.

TRANSPONDER 2 (IXBLUE – RTA)

▼ **Interrogation**

Mode: Transponder ▼

Code: TONAL 13kHz ▼

▼ **Reply**

Code: POSIDONIA 22 ▼

Turn Around Time: 20 ▼ ms

▼ **Additional Information**

Source: None ▼

▼ **Dynamic Positioning**

Mode: None ▼

Latitude: 48 ° 0 ' N ▼

Accuracy: 1 m

Longitude: 5 ° 0 ' W ▼

Accuracy: 1 m

Depth: 100 m

Accuracy: 1 m

Use as reference transponder:

▼ **Filtering**

Type: None ▼

▼ **Other**

Repetition Factor: 1 ▼

Cancel
OK

3.	In Interrogation , select Mode and Code from the drop-down lists.
----	--



4.	In Reply , select Code and Turn Around Time from the drop-down lists.
----	--

Step	Action
5.	<p>In Additional Information, select Source from the drop-down list.</p> <ul style="list-style-type: none"> • If you select External Pressure, you must input a Pressure value. • If you select Fixed Immersion, you have to enter the value of Immersion together with the associated Pressure.
6.	<p>In Dynamic Positioning, set the Mode to L/USBL if you intend to use the current transponder to compute the position of the USBL antenna.</p> <p>Manually enter the position and accuracy (Latitude, Longitude, Immersion and their Accuracies) of the transponder or click on Get Current Position to do it automatically with the current USBL position of this transponder.</p> <p>If no transponder has yet been chosen as a reference, you may select the Use as reference transponder check box to select the current transponder as a reference. The position of the antenna is computed with respect of the reference transponder.</p>
7.	In Filtering , select the Type of filter from the drop-down list.
8.	In Other , select a Repetition Factor in the scrolling list.
9.	Click on OK to validate your choices and to send the data to the USBL-BOX.
10.	End of Procedure.

5.2.3 ACTIVATING A TRANSPONDER

A transponder present in the database must be activated before tracking.

Procedure

Step	Action
1.	<p>Click on the menu SETUP and select TRANSPONDERS.</p> <p><i>The transponders management window opens.</i></p>
2.	<p>Click on  depending on which transponder you would like to activate.</p> <p><i>The button becomes . The transponder is activated.</i></p>
3.	End of Procedure.

5.2.4 DELETING A TRANSPONDER

A transponder can be removed from the transponder list.

Procedure

Step	Action
------	--------

-
- | | |
|----|--|
| 1. | Click on the SETUP menu and select TRANSPONDERS .
<i>The transponders management window opens.</i> |
| 2. | Click on Erase depending on which transponder you wish to delete.
<i>The transponder disappears. The transponder has been deleted.</i> |
| 3. | End of Procedure. |
-



It is not possible to delete the last transponder.

5.3 Entering the Sound Velocity Profile

The USBL-BOX measures the angle and the signal time between the acoustic antenna and the immersed transponder. In order to convert the data into distance time, you have to know the speed of the sound in the entire water column. An operator equipped with a sounding line takes this measurement at the beginning of the mission. The corresponding values are then entered into the system via the Web-based user interface so that the necessary calculations can be carried out as accurately as possible. These values comprise data concerning both depth and speed. They can be manually input or via a data file.

5.3.1 LOADING A PROFILE FROM A FILE

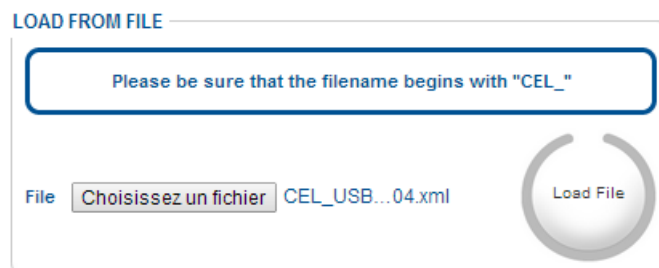
It is possible to load a file containing the sound velocity profile in the Web-based user interface. The format of this file must respect the following rules:

- The file is in ASCII format.
- The name of the file must start by "CEL_".
- The two first numbers of each line of the file are read like the depth and velocity. The other numbers after these first two are ignored.
- Any separator can be used to separate the two values of depth and velocity.
- The depth must be in meters and the velocity in meters per second.
- The depth must be strictly increasing from one line to the other. If it is not the case, the file is sorted out to have a strictly increasing series of depth.
- The data over limits are ignored.

Procedure

Step	Action
------	--------

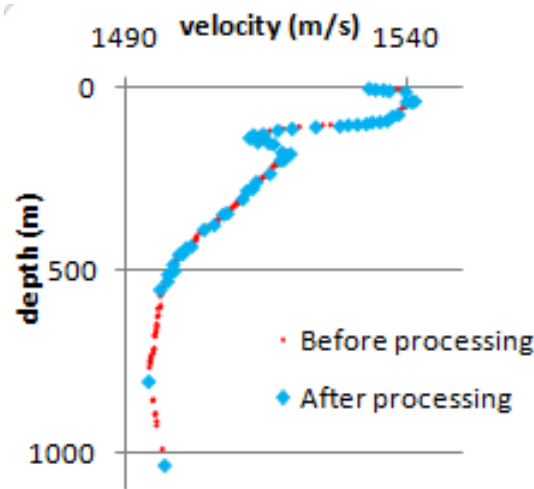
- | | |
|----|--|
| 1. | Click on Browse... and select the file containing the sound velocity profile. |
|----|--|



- | | |
|----|--|
| 2. | Click on Send File .
<i>The file is read and the depth and velocity data are displayed in the table.</i> |
| 3. | End of Procedure. |



The speed profile is pre-processed when uploaded. This processing removes outliers and duplicated values, sorts the data in a depth growing order and optimizes the number of couples to 55 for computing purposes without altering the accuracy of the profile.



5.3.2 MANUALLY ENTERING A PROFILE

The depth and velocity couples are entered directly in the provided array. The [tab] key allows the user to move from one case to another. Messages, warnings and errors are displayed in order to provide guidance.

Table 5 – Messages for Manual Input of Sound Velocity

Message	Action
Valid Profile	You may validate the profile by clicking OK
Thin Slice (< 1 m)	Low interval between two depths, you may validate the profile by clicking OK
High Gradient	High interval between two velocities, you may validate the profile by clicking OK
Missing Depth	Enter a new depth value
Missing Velocity	Enter a new velocity value
Velocity out of Bounds (1375 – 1900)	Enter a new velocity inside the validity interval
Depth not Increasing	Enter a new depth value respecting the increasing order

Procedure

Step Action

1. Select **SETUP >SPEED PROFILE**.

SOUND VELOCITY PROFILE

Valid profile

Depth (m)	Velocity (m/s)
10	1475
20	1488
30	1500
40	1475
50	1488
60	1500
70	1475
80	1488
90	1500
100	1475
200	1488
300	1500
400	1475
500	1488
1000	1500

Cancel

OK

2. Click on the first line of the **Depth (m)** column.
3. Enter the valid depth value (between 0 and 10,000m).
4. Click on [Tab].
The velocity corresponding to the depth value entered is highlighted.
5. Enter the new velocity value (between 1,375 and 1,900m) matching the entered depth.
6. Click on [Tab].
The depth value of the following line is highlighted.
7. Go back to step 3 until you have entered all the depth and velocity data from your profile.
8. Click on **OK** to validate your choices and to send this data to the USBL-BOX.
9. End of Procedure



One value which is outside validity appears in **red**. It will be impossible for you to validate the speed profile before having replaced these values with valid data.

5.4 Logging Data

In this section, the recording of data coming from an **Output** (set up in section 4.4.2) port is configured. Choose the **Name of the File**. You can choose to create a new file after a certain time or after a certain size that the previous file has reached (**Segmentation**). Choose the **selected directory** on your hard disk where the data is stored.

The name of the file is automatically generated with the date and time

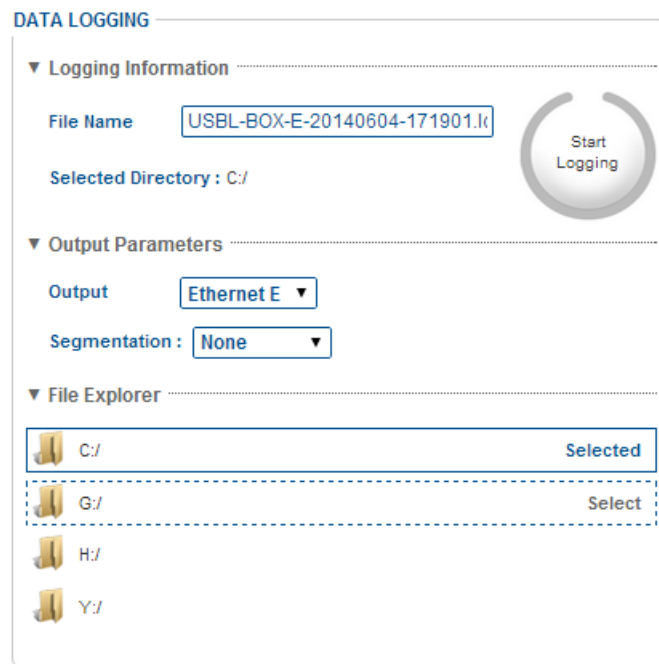
USBL_BOX-aaaammjj_hhmmss.log

(aaaa: year, mm: month, jj: day, hh: hour, mm: minute, ss: second)

Procedure

Step	Action
------	--------

1. Click on **DATA LOGGING**. A security window may open, select **I accept the risk and want to run this app** and **Do not show this again for this app** checkboxes and click on the **Run** button. See Appendix A for more details on how to prevent this warning dialog box to appear again.



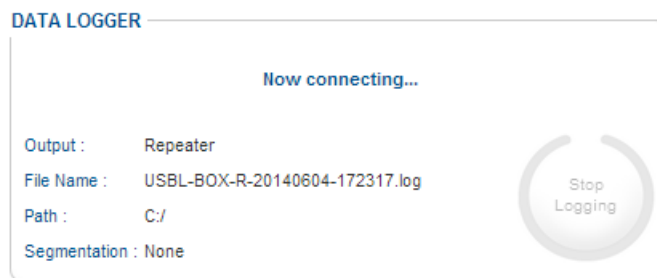
2. You can change the **File Name** which is automatically generated by typing the new name directly in the dedicated field. This name must consist of alphanumeric characters (inverted commas “ _ ” is accepted) with no space between the characters.
3. Click on **Selected Directory** to explore and select the directory where you would like to record the selected data (at any time you can go back to the original directory). Under **File Explorer** click on the button **Select** besides the chosen directory to select it. *The **Select** button becomes **Selected** and the chosen directory appears besides **Selected Directory**.*
4. Select an **Output** port in the scrolling list.

Step Action

5. You can choose to have the following kind of files:
 Fixed size: choose **Size (ko)** from **Segmentation** and enter the size in the text box.
 Temporal fixed length: choose **Time (min)** from the **Segmentation** field and enter the chosen temporal length in minutes in the text box to the right of the **Segmentation** field.
-

6. Click on the **Start Logging** button to begin recording.
*Recording starts and a separate **DATA LOGGER** window open. This shows the file name, together with the directory where the file is recorded and the chosen **Segmentation**.*

At any time you can stop the recording by clicking the **Stop** button.



Do not close the **DATA LOGGER** window otherwise you stop the data recording.

7. End of Procedure.
-

5.5 Calibrating the USBL-BOX

The calibration procedures of the POSIDONIA acoustic antenna can be found in the specific user guide of the POSIDONIA acoustic antenna.

Once the calibration parameters have been computed, you need to input these offsets in the USBL-BOX Web-based user interface.


You may also

Procedure

Step	Action
------	--------

1. Click on the **INSTALLATION** menu and select **ANTENNA CALIBRATION**.

For expert users only.
Click to unlock parameters.



ANTENNA CALIBRATION				
	X Distance (mm)	Y Distance (mm)	Z Distance (mm)	Phase (°)
H1-H2	152.87	826.99	425.52	2.523
H2-H3	153.67	826.91	405.52	1.523
H3-H4	15.87	26.99	5.52	-0.523

2. Click on **Unlock** to make the input possible.
3. Select the **Antenna Type** in the scrolling list. **CAGE** or **FLUSH**.
4. For each line **X Distance**, **Y Distance**, **Z Distance**, input the three distances between **H1-H2**, **H2-H3** and **H3-H4**.
5. Let the **Phase** to zero. This parameter is dedicated to a future use.
6. Click on **OK** to validate your choice and to send this data to the USBL-BOX.
7. End of Procedure.

6 VISUALIZING USBL DATA WITH DELPH ROADMAP

6.1 Introduction

DELPH RoadMap

This section describes the visualization of USBL data in DELPH RoadMap application. For a complete description of the DELPH RoadMap application and of all its generic functionalities, please refer to the specific DELPH RoadMap User Guide.

Visualization

DELPH RoadMap is designed to visualize in three dimensions all kinds of geographical data. You can visualize in DELPH RoadMap the USBL geographic positions in real-time as well as in post-processing. DELPH RoadMap displays the USBL data with the navigation of the ship as well as any background images and coastlines.

Visualization modes

There are three ways to visualize USBL data in DELPH RoadMap, two using DELPH USBL Driver and one only with DELPH RoadMap:

- Real-time mode: the position data is output via the Ethernet or serial link, DELPH USBL Driver transmits the real-time data to DELPH RoadMap and the data is displayed in DELPH RoadMap main display area. See Figure 27.
- Replay mode: the data has already been acquired in a first step and the data file is in a second step progressively read at a certain rate by DELPH USBL Driver and displayed in DELPH RoadMap main display area. See Figure 28.
- Offline mode: the data is directly imported in DELPH RoadMap and all at once displayed in the main graphic area. See Figure 29.

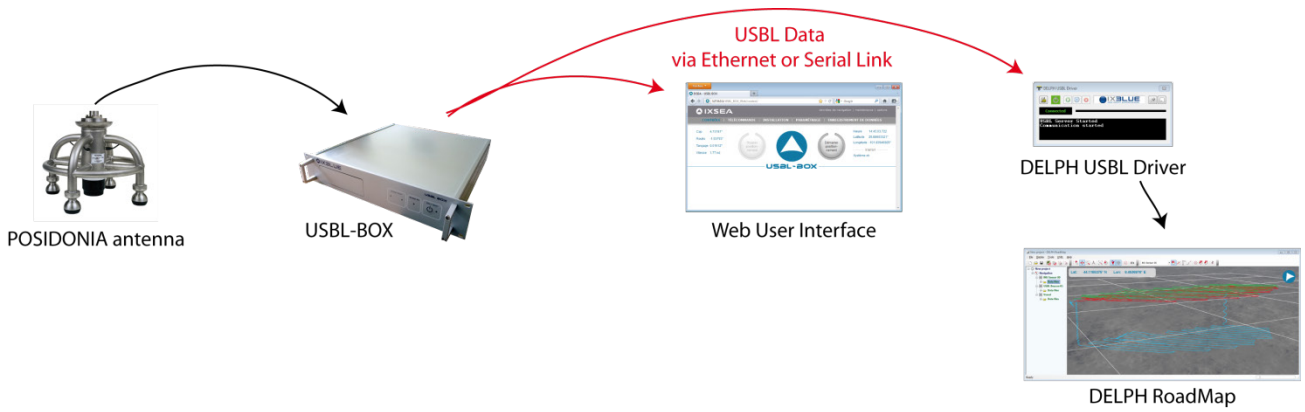


Figure 27 – Visualization of USBL data in real-time mode

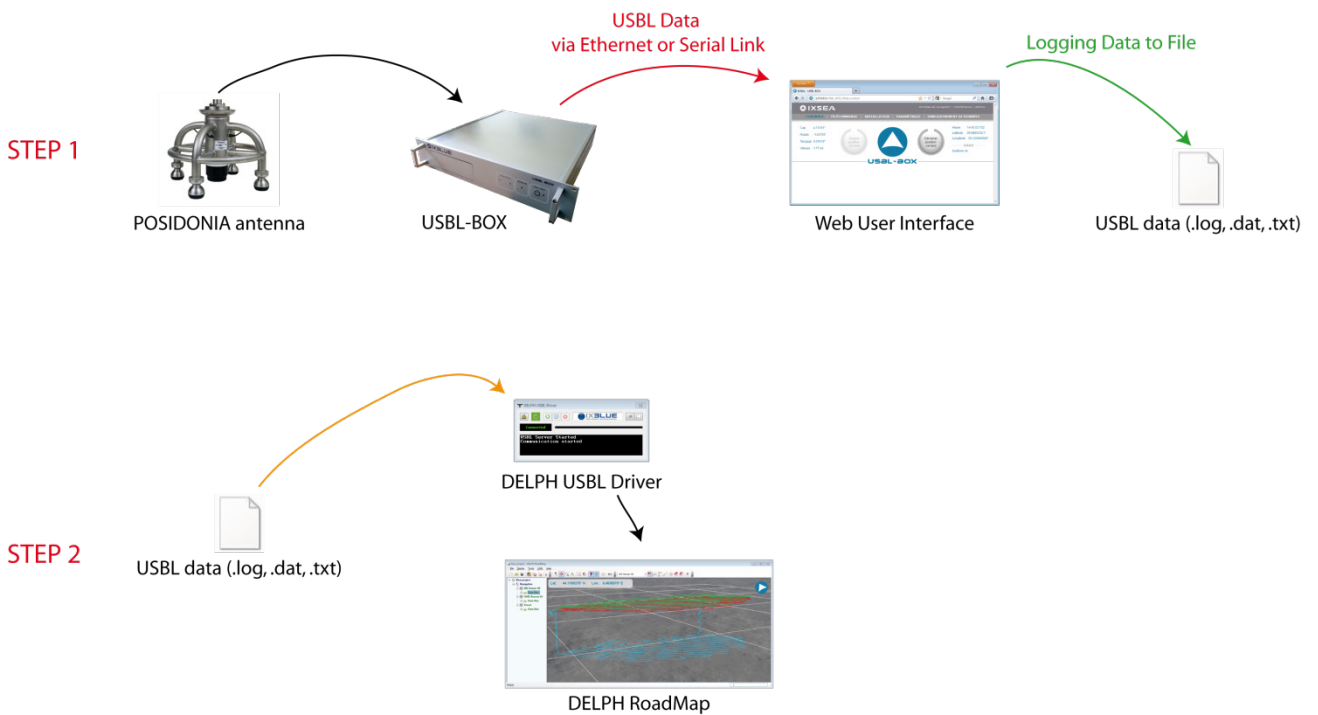


Figure 28 – Visualization of USBL data in replay mode

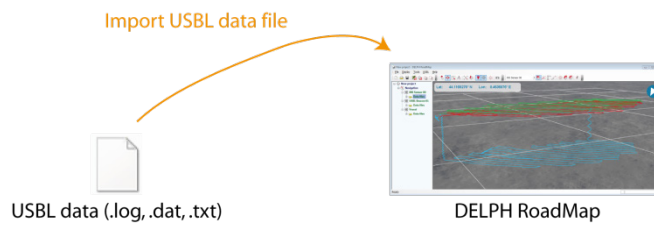


Figure 29 – Visualization of USBL data in offline mode

Tools List Here are all the tools that concern the USBL data visualization:

- Menus and their specific USBL items with associated task are listed in Table 6.
- USBL toolbar (Figure 30) and its buttons with associated tasks are listed in Table 7.

Table 6 – Menus and associated tasks

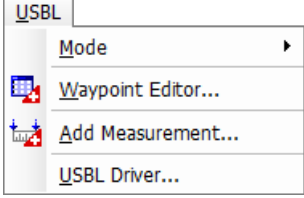
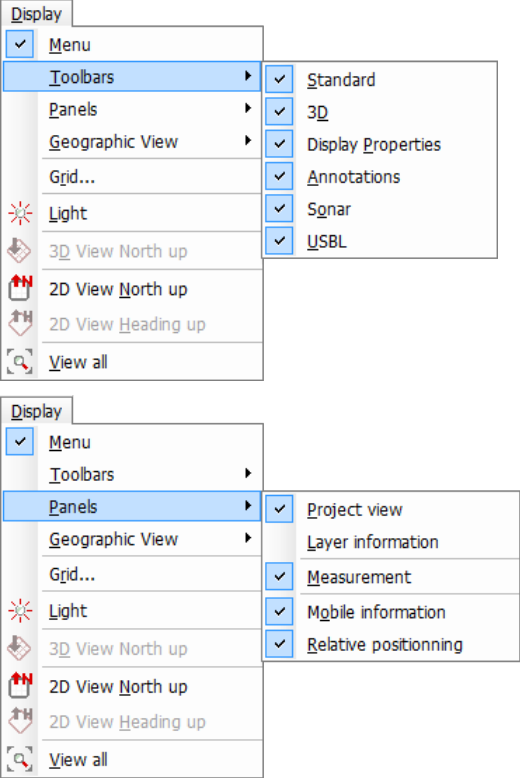
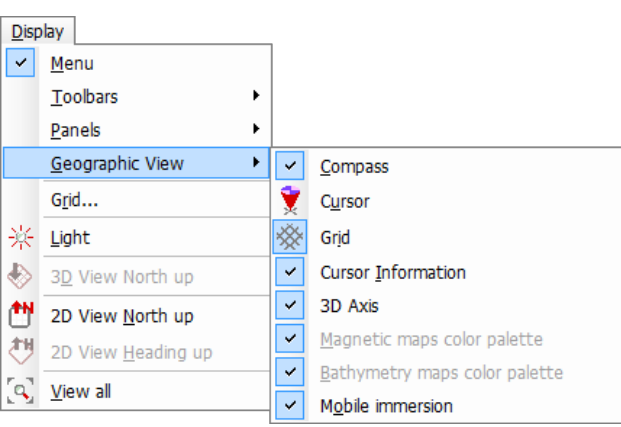
Menus	Tasks
	<p>Mode > Waypoint Switches to Waypoint mode and allows the creation of a new waypoint by a double click.</p> <p>Waypoint Editor... Opens the editor of waypoints</p> <p>Add Measurements... Opens the measurement pair selection window</p> <p>USBL Driver... : Launches the USBL driver</p>
	<p>Display > Toolbars > USBL : hides and displays the USBL toolbar</p> <p>Display > Panels > Measurement: allows the measurement of the all kinds of distances between two navigation or waypoints</p> <p>Display > Panels > Mobile Information: hides and displays the mobile information panel listing depth, X and Y positions, date and time of the selected position source</p> <p>Display > Panels > Relative positioning: hides and displays the graphic of the last 1000 positions in a forward and vertical plane</p> <p>Display > Geographic view > Mobile immersion: hides and displays a vertical axis referencing the depth of the active position sources</p> <p>Display > 2D View North up : switches to 2D North-oriented view</p> <p>Display > 2D View Heading up : switches to a 2D heading-oriented (heading of the selected mobile) view (only in real time mode)</p>
	



Figure 30 – USBL toolbar

Table 7 – USBL Toolbar

Button	Explanation
	Select a mobile: selects in the scrolling list the position source from which you want to edit the display of the trajectory.
	Enable and disable automatic tracking of the selected position source: centers the map on the current position of the selected position source and the centering is updated as the position changes. Only in real time mode.
	Show or hide the mobile in the immersion panel: the immersion of the different sources of position are gathered in the immersion panel so their evolutions are compared one to the other, you can choose with this button which source of position to display in the immersion panel.
	Show or hide the vertical axis: the vertical axis is displayed at the current position of the selected position source. Only in real time mode and in 3D view.
	Clear the track history for the selected mobile: removes all displayed past positions of the selected position source. The track keeps being displayed starting at the position where you have clicked on the button. Only in real time mode.
	3D View North up: Switches the current view to a view which is seen from above and in which the North is oriented to the top.
	2D View Heading up: Switches the current view to a heading-oriented (computed course over ground of the selected position source) view which is seen from above. Only in real time mode.
	Create an event mark: Keeps track of a particular event and display a sign in the geographic view at the location of the selected position source. All related information is recorded in a KML data file. Only in real time mode.
	Activate the annotation waypoint tool: Creation of waypoints directly in the main display by a double click.
	Waypoint Editor: Opens the waypoint editor window. Creation of waypoints by their longitude/easting, latitude/northing, altitude, name.
	Add a measurement: Computes and displays the measurement between two navigation and/or annotations.

6.2 Accessing USBL Data in Real-Time and Replay Modes

6.2.1 DELPH USBL DRIVER

The USBL positions (real-time data flow or logged data file) are read by DELPH RoadMap via DELPH USBL driver (see Figure 31). DELPH USBL driver is accessible from DELPH RoadMap application.

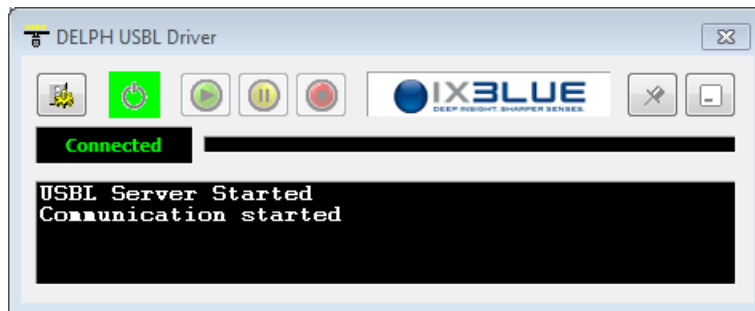


Figure 31 – DELPH USBL driver

6.2.2 CONFIGURING DELPH USBL DRIVER

6.2.2.1 Configuration Parameters

DELPH USBL Driver must be configured in real-time mode with the strictly identical communication parameters as the output settings of the USBL system Web-based user interface (see section 4.4.2).



The Protocol to choose in section 4.4.2.2 step 3 can be either **DATA Light** or **DATA standard**.

See the **Settings** window in Figure 32.

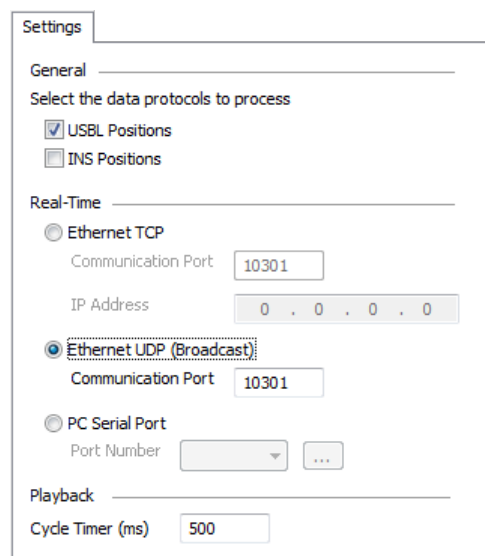


Figure 32 – Settings window of DELPH USBL driver

The parameters are organized in three different groups:

General

In this group, you select which position source(s) to display in DELPH RoadMap.

- **USBL Positions**
- **INS Positions**

Real-Time

In this group, you select the communication mode and its associated parameters

- **Ethernet TCP** with its **Communication Port** and its **IP Address**
- **Ethernet UDP (Broadcast)** with its **Communication Port**
- **computer Serial Port** with its **Port Number** and associated parameters:
 - Bits Per Seconds** (from 110 to 921600)
 - Data Bits** (5, 6, 7 or 8)
 - Parity (None, Even, Odd or Mark)**
 - Stop Bits** (1, 1.5 or 2)



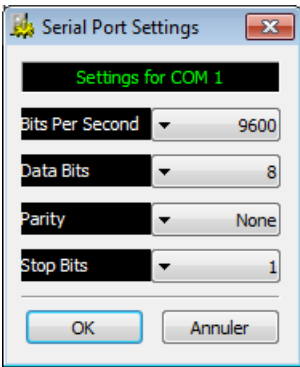
Playback

In this group, the playback of already acquired USBL data with the DELPH USBL driver can be configured. The data packets are displayed at a certain time rate that you can choose.

Cycle Timer (ms): value between 100 and 10000


6.2.2.2 Real-Time Mode Configuration Procedure

Procedure

Step	Action
1.	In DELPH RoadMap main window, select the menu USBL > USBL Driver... The window of the DELPH USBL Driver opens. See Figure 31.
2.	Click on  to have access to the Settings window. <i>The Settings window opens. See Figure 32.</i>
3.	In the General section, select the check boxes (USBL Positions and/or INS Positions) corresponding to the data you want to display in DELPH RoadMap.
4.	In the Real-time section, select the communication mode (Ethernet TCP , Ethernet UDP (Broadcast) or computer Serial Port). <i>The parameters related to the chosen communication mode become active and editable.</i>
5.	<ul style="list-style-type: none"> • If you have selected Ethernet TCP, enter the Communication Port and the IP Address. These parameters must match the similar parameters entered in section 4.4.2.2, step 5. • If you have selected Ethernet UDP (Broadcast), enter the Communication Port. This parameter must match the similar parameter entered in section 4.4.2.2, step 5. • If you have selected computer Serial Port, select the Port Number (matching the choice made in section 4.4.2.2, step 4) in the scrolling list and click on  to open the Serial Port Settings window:
	
	<ul style="list-style-type: none"> • In the Serial Port Settings window, select the Bits Per Second, Data Bits, Parity and Stop Bits in the corresponding scrolling lists. These parameters must match the similar parameters entered in section 4.4.2.2, step 4. Click on OK to validate your choice.
6.	Click on OK to validate the settings. <i>You are now ready to launch the real-time display of USBL data in DELPH RoadMap. Refer to section 6.2.3.</i>
7.	End of Procedure.


6.2.2.3 Playback Mode Configuration Procedure

Procedure

Step	Action
1.	In DELPH RoadMap main window, select the menu USBL > USBL Driver... The window of the DELPH USBL Driver opens. See Figure 31.
2.	Click on  to have access to the Settings window. <i>The Settings window opens. See Figure 32.</i>
3.	In the General section, select the check boxes (USBL Position and/or INS Positions) corresponding to the data you want to process and display in DELPH RoadMap.
4.	In the Playback section, enter the Cycle Timer (ms) .
5.	Click on OK to validate the settings. <i>You are now ready to launch the playback display of USBL data in DELPH RoadMap. Refer to section 6.2.4.</i>
6.	End of Procedure.

6.2.3 LAUNCHING THE DISPLAY IN REAL-TIME MODE


Procedure

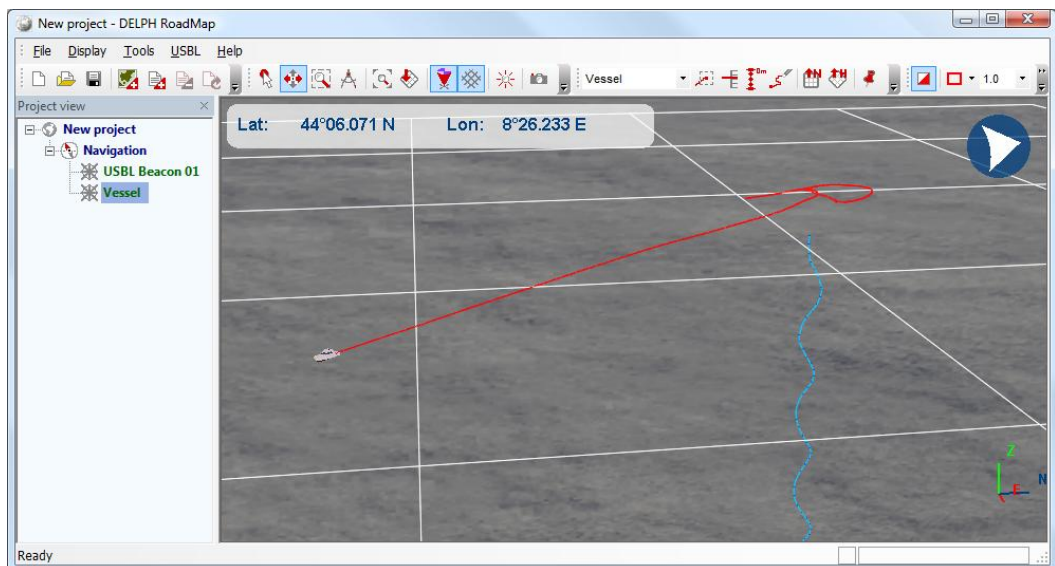
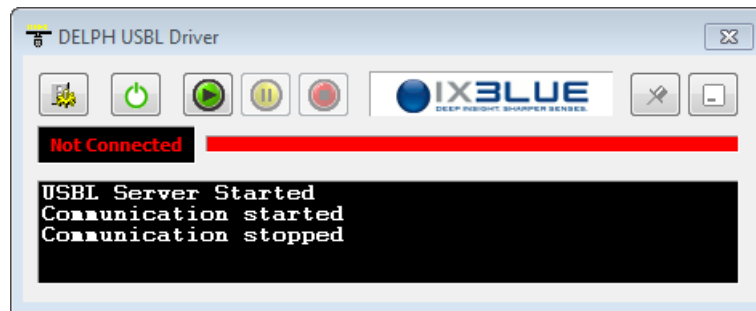
Step	Action
1.	In DELPH RoadMap main window, select the menu USBL > USBL Driver... The window of the DELPH USBL Driver opens. See Figure 31.
2.	Configure the real-time mode of the DELPH USBL driver. See section 6.2.2.2.
3.	Click on the button  to connect the driver to the real-time USBL data flow. <i>The message “Communication started” appears in the message log of the DELPH USBL driver.</i> <i>The data starts to be displayed in DELPH RoadMap. All the different sources of positions output by the USBL system are listed in the Project view panel under Navigation and the tracks of the positions start to be displayed the main graphic display.</i>
4.	End of Procedure.

6.2.4 LAUNCHING THE DISPLAY IN PLAYBACK MODE

Procedure

Step	Action
------	--------

- | | |
|----|--|
| 1. | In DELPH RoadMap main window, select the menu USBL > USBL Driver...
The window of the DELPH USBL Driver opens. See Figure 31. |
| 2. | Configure the playback mode of the DELPH USBL driver. See section 6.2.2.3. |
| 3. | Click on the play button  . Select the data file (.dat, .log, .txt) in the browser that opens.
<i>The data starts to be displayed in DELPH RoadMap. All the different sources of positions output by the USBL system are listed in the Project view panel under Navigation and the tracks of the positions start to be displayed in the main geographic display.</i> |



You can at any time pause  or stop  the replay.

- | | |
|----|-------------------|
| 4. | End of Procedure. |
|----|-------------------|

6.2.5 EDITING THE DISPLAY IN REAL-TIME AND PLAYBACK MODES

The display in real-time and playback modes of the position source can be edited. Here are the parameters that you can edit:

- **Source:** Spatial reference, geodesy
- **Symbol** (3D image describing the mobile or device producing the positions)
 - ❑ **Appearance (Style, Color, File and Wireframe display option):** the file defining the style of the mobile is a .3ds file present in the folder \DELPH RoadMap
 - ❑ **Model Size tab: User defined symbol size option, Size (Length (m), Width/Radius (m) and Height (m))**
 - ❑ **Offsets tab: Offset X, Y and Z** in meters and degrees of the three dimensions model with respect to the incoming navigation. These offsets are computed in the DELPH RoadMap reference frame (X positive on starboard, Y forward and Z downwards, roll positive leaning to starboard, pitch to the back, yaw to the right).
- **Track Properties**
 - ❑ **History (Maximum number of points, Maximum duration)**
 - ❑ **Scale (Display vertical axis)**
- **Pen (Width, Style and Color)**
- **Points (Width, Style and Color)**

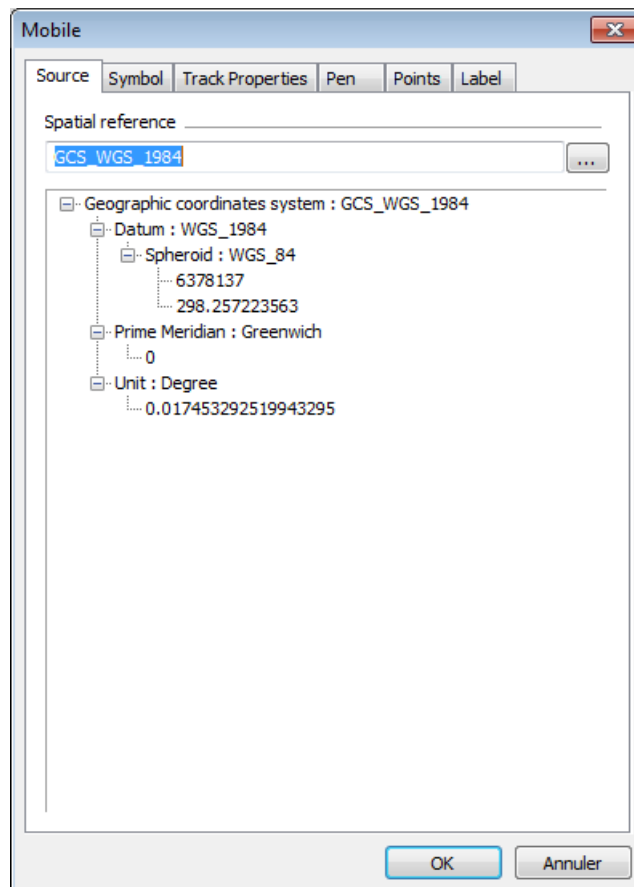


Figure 33 – Mobile Properties

Procedure

Step	Action
1.	Right click on a mobile under Navigation in the Project view panel and select Properties in the pop-up menu that opens. <i>The Mobile properties window opens.</i>
2.	In the Source tab, select the proper geodesy.
3.	Select the Symbol tab: <ul style="list-style-type: none"> • Select the Style in the scrolling list. If you select User-Defined, provide the .3ds File. • Select the Color in the Select color ... window that opens when you click. • Select the File to define the style of the mobile. This option is only active when the User-Defined Style is selected. • You may check the optional Wireframe display option. • In the Model Size tab, you may select the User-defined symbol size (if you chose the User-Defined Style) or enter a value for the Width/Radius (m), Length (m) and Height (m). • In the Offsets tab, enter the optional Offsets X, Y, Z in meters and/or degrees.
5.	Select the Track Properties tab: <ul style="list-style-type: none"> • Activate the Maximum number of points option if you wish to enter such a value. • Activate the Maximum duration option if you wish to enter such a value. • You can activate the Display vertical axis option.
6.	Select the Pen tab: <ul style="list-style-type: none"> • Select a Width in the scrolling list. • Select a Style in the scrolling list. • Select the Color in the Select color ... window that opens when you click.
7.	Select the Points tab: <ul style="list-style-type: none"> • Select a Width in the scrolling list. • Select a Style in the scrolling list. • Select the Color in the Select color ... window that opens when you click.
8.	Click on the button OK to validate your choices. <i>The result is right away visible on the graphic display.</i>
9.	End of Procedure.

6.3 Accessing USBL Data in Offline Mode

In offline mode, the USBL file is directly loaded into DELPH RoadMap. DELPH RoadMap reads the data file (.dat, .log, .txt) logged by the Web-based user interface of the USBL system and displays the positions all at once.

Procedure

Step	Action
------	--------

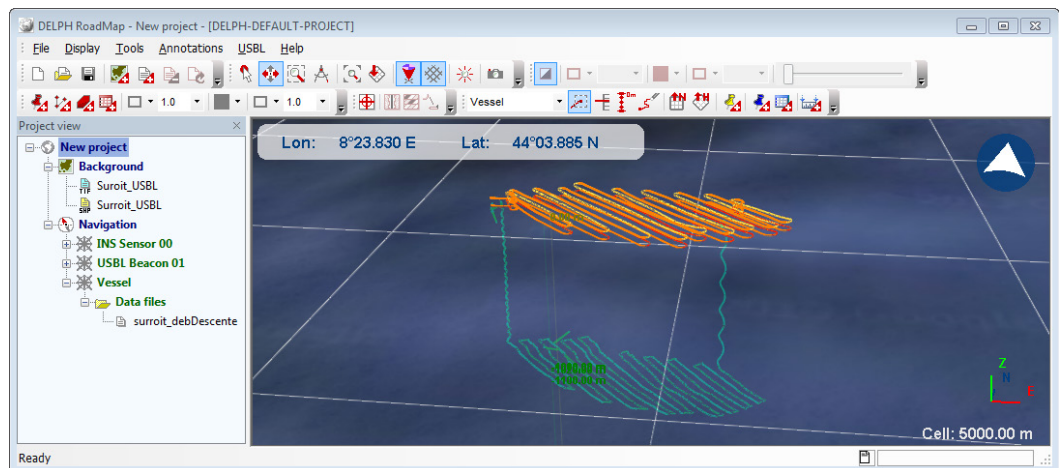
1. Click on the button  or select the menu **File > Import > Data...**

A browser opens. Select the USBL data file to import.

2. Click **Open**.

*In the **Project view** panel, under **Navigation**, all the position tracks are added.*

All the position tracks present in the data file are displayed in the main graphic display.




3. End of Procedure.

6.4 USBL Data Visualization Tools

6.4.1 NORTH ORIENTED VIEW

This tool is available in both real-time, playback and offline modes.

You can at any time switch from the current view to a 2D North-oriented view by clicking

on the button  or by selecting the menu **Display > 2D View North up**. This view is a 2D view in which the top side is oriented to the North. See on Figure 34 the orientation of the compass (in the top right corner) and the 3D axis in the bottom right corner.

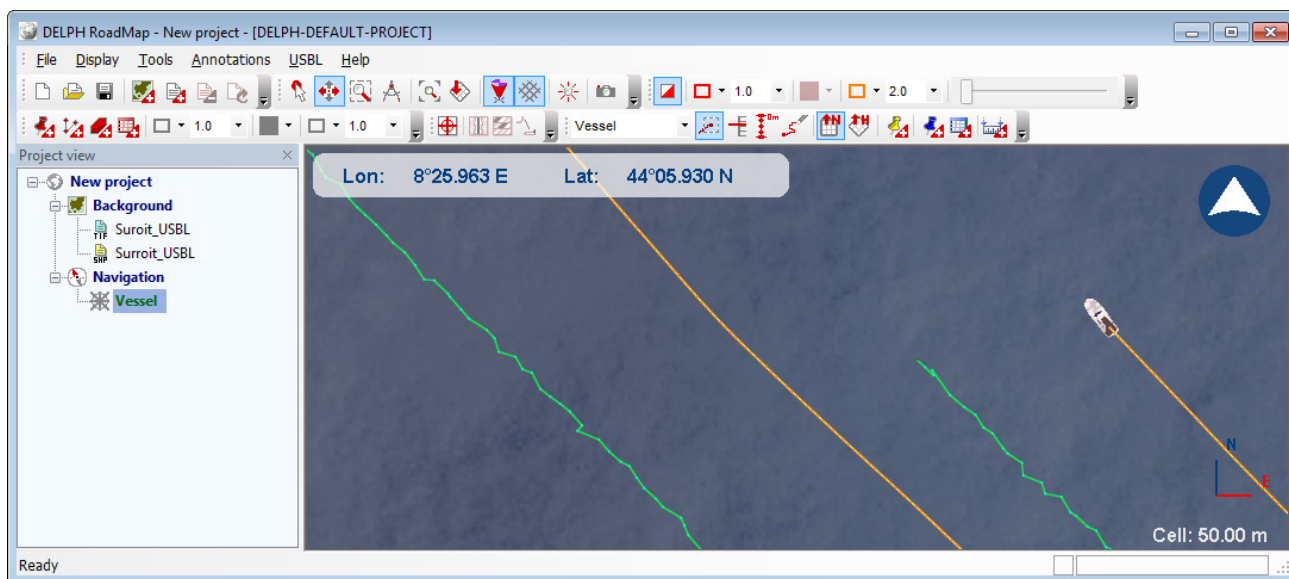



Figure 34 – North Oriented view

6.4.2 HEADING ORIENTED VIEW

This tool is available in real-time and replay modes.

You can at any time switch from the current view to the heading-oriented view by clicking

on the button  or by selecting the menu **Display > 2D View Heading up**. This view is centered on the selected mobile. The heading of the position source stays always directed to the top of the display. Equidistant concentric circles are drawn to indicate the distance to the tracked mobile. Rays of these circles are drawn at regular angular intervals to indicate the angle with respect to the heading of the mobile. See an example of such a display on Figure 35.

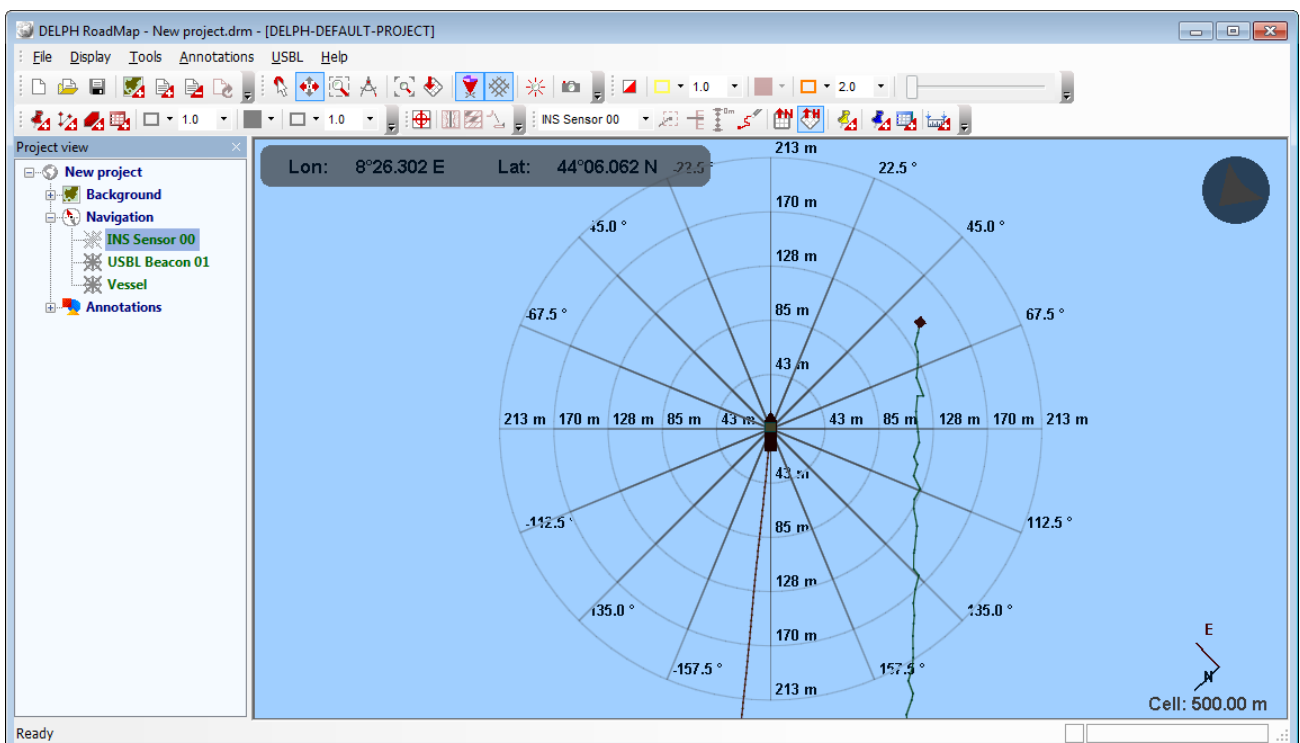



Figure 35 – Heading oriented view

You can center the view on another mobile by selecting this mobile in the scrolling list of the USBL toolbar and activating the automatic tracking mode for this mobile. The automatic tracking can also be activated from the **Project View** panel. Right click on the mobile and select **Automatic tracking** from the popup menu.

6.4.3 VERTICAL AXIS VIEW

This tool is available in real-time and replay modes.

You can display a vertical axis for a specific mobile by clicking on the button  after having selected the mobile in the scrolling list. This axis helps you to visualize the depth of a mobile. The vertical axis has an automatic scaling in order to optimize the visualization. See an example of such a display on Figure 36.

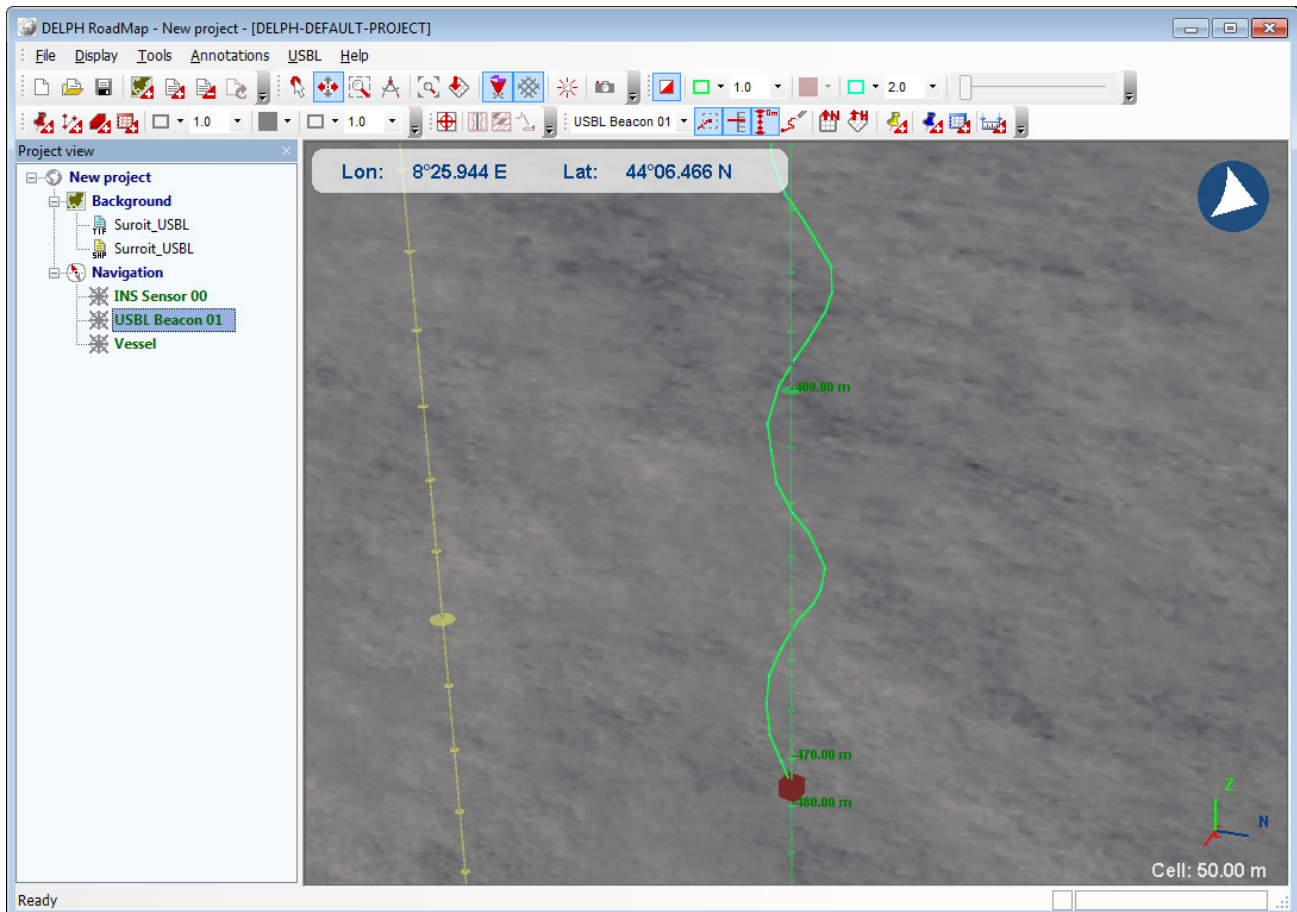


Figure 36 – The vertical axis displays the immersion of the selected mobile

The vertical axis can also be activated by following the procedure:


Procedure


Step	Action
1.	In the Project View panel, right click on the mobile and select Properties .
2.	In the Properties window, select the Track Properties tab and activate the Display vertical axis option.
3.	End of Procedure.

6.4.4 MOBILE IMMERSION

This tool is available in real-time and replay modes.

This panel is accessible from the menu **Display > Geographic view > Mobile immersion**. This panel displays the immersion of the mobile(s) on a vertical scale. All the

mobiles for which you have clicked on the button  are present in the **Mobile Immersion**. The panel is automatically rescaled as data come in to optimize the visualization of the immersions of the last position sources. You can add or remove a

mobile by selecting it and by clicking on the button .

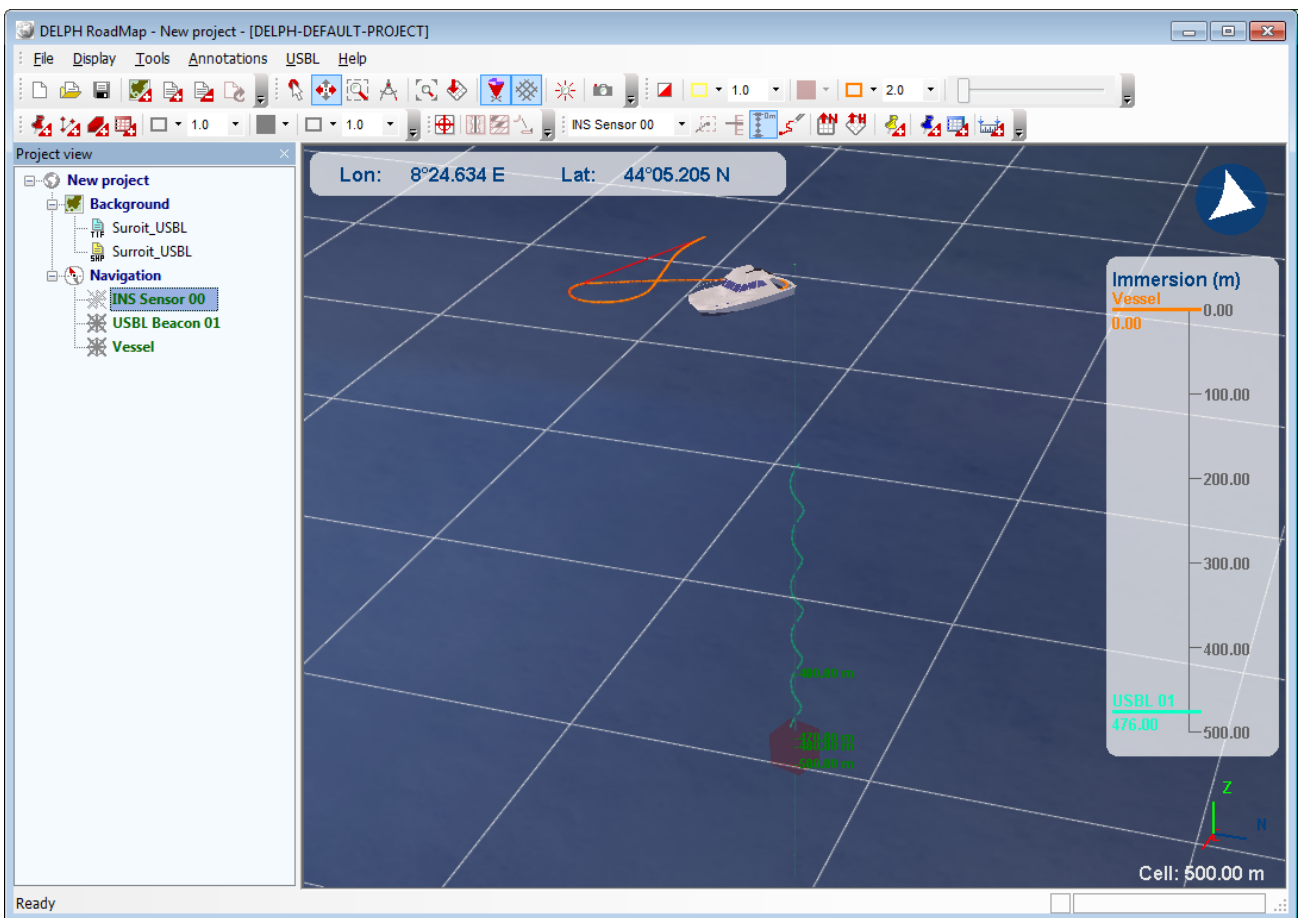


Figure 37 – Immersion panel

6.4.5 MOBILE INFORMATION

This tool is available in real-time and replay modes.

This panel is accessible from the menu **Display > Panels > Mobile information**. This panel displays some strategic values (**Depth, X and Y Positions, Heading, Date and Time**) for each position source. Select the position source in the scrolling list, edit the font size, the background and text colors of the displayed text.






Figure 38 - Mobile Information panel

6.4.6 RELATIVE MOBILE POSITION

This tool is available in real-time and replay modes.

This panel is accessible from the menu **Display > Panels > Relative Mobile Position**. This panel displays the history of the positions of the USBL beacons (only the beacons set to visible) in the plane defined by the **Forward (m)** and **Immersion (m)** axis centered on the vessel. The last 1,000 points of the tracks are displayed.

- Click on the button  to auto scale the display of the mobile track.
- Click on the button  to hide or show the link between the vessel (0) and the current position of the mobile.
- Click on the button  to remove all the already displayed history.



Important

Keep in mind in this graph that the vessel is moving. The displayed track(s) includes, without showing it, the motion of the vessel.

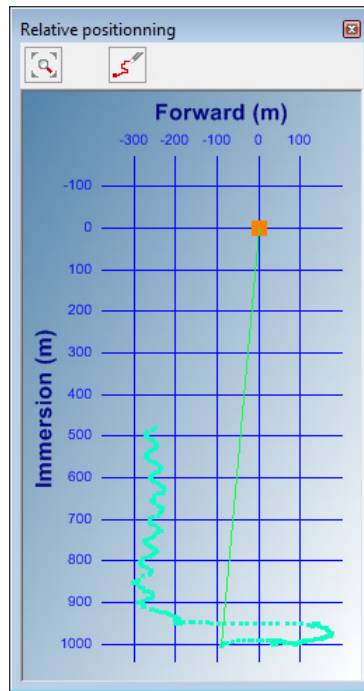



Figure 39 – Relative positioning panel

6.4.7 EVENT MARK

This tool is available in real-time and replay modes.

6.4.7.1 Creating an Event Mark

You can create a mark for an event by clicking on the button . The mark is displayed at the current location of the selected position source at the time when the button was clicked. A KML file is created. This file can contain several marks. Another file can be created to store other marks. The mark can be labeled (the label appears on the display), described and its width, style, color and transparency can be edited. The date, time, position and immersion of the mark are in the **Feature Data** tab of the **Annotation Feature** window. See Figure 40.

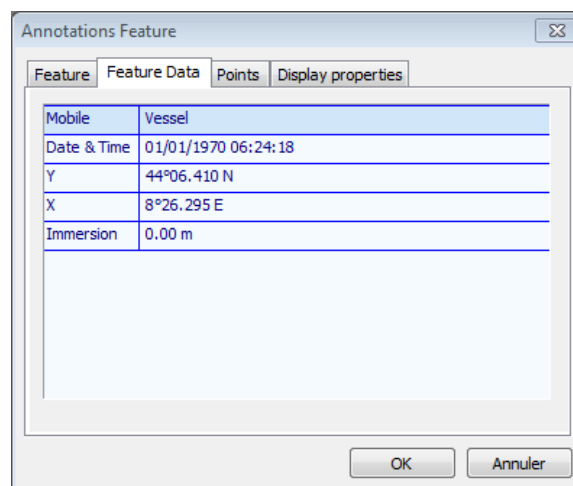



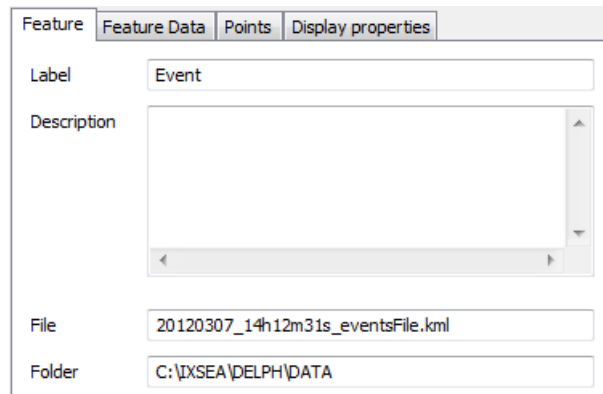
Figure 40 – Feature Data tab of the Annotation Feature window

Procedure

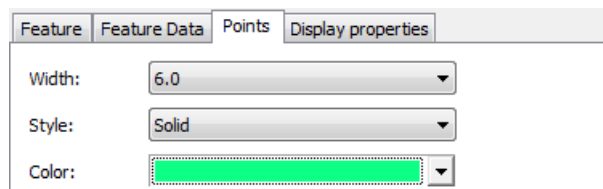
Step Action

1. During real-time display, if an event occurs and you want to create a mark to keep track of this event, click on the button . *The Annotation Feature window opens.*

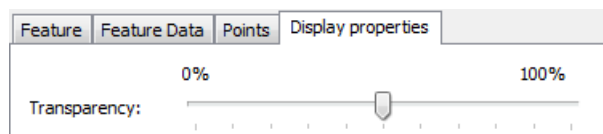
2. In the **Feature** tab (the default tab at the event mark creation) enter a **Label** and a **Description** for the mark.



3. Open the **Points** tab. Select the **Width** and the **Style** of the mark in the corresponding scrolling lists. Click on the downward arrow in front of **Color** to open the **Select Color...** window. Select the color and click **OK**.

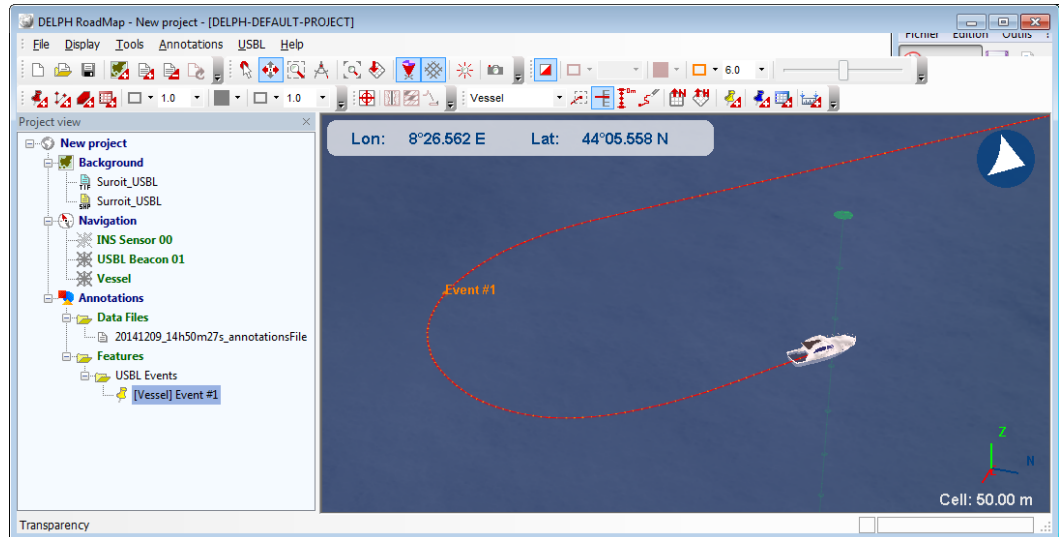


4. Open the **Display properties** tab and move the cursor along the **Transparency** scale to choose a value between 0 and 100%.



5. Click **OK** to validate the creation of the event mark.

*The event mark is created and displayed on the position track. A data file and an event are added to the **Annotations** folder in the **Project view** panel. The event can look like this on the display:*



6. End of Procedure.

6.4.7.2 Managing Event Marks

Event Mark Files

When an event mark is created, it is added to a KML file. If no KML file exists at the time of the event creation, then a KML file is automatically created, inserted under the **Annotations / Data Files / Features / USBL Events** directory and set by default to **Active**. You can edit the file properties by right clicking on the event file in the **Project view panel**:

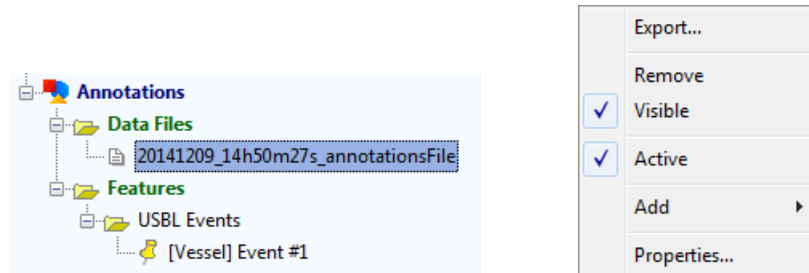


Figure 41 – Event mark data file and its pop-up menu

If you do not want the next created event mark to be written in the same file, unselect **Active** in the pop-up menu. At the creation of the next event mark, a new KML file is created.

If you remove an event mark data file, all the event marks written in the data file are also removed from the **Project view panel**.

Event Mark Edition

You can perform a few operations directly on an event mark. In the **Project view panel**, under **Annotations** and under **Features**, if you right click on one event mark, a pop-up menu opens:

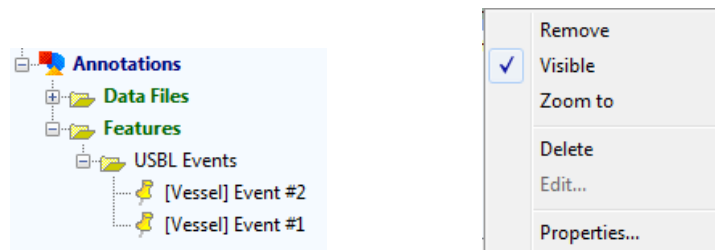


Figure 42 – Event mark pop-up menu

From the event mark pop-up menu you have access to the following items:

Remove: the mark does not appear anymore in DELPH RoadMap.


Visible: you can hide or show the mark.

Zoom to: you can set the view of the main graphic display to focus on the event mark.

Delete: Event is deleted from the KML file and from the application.

Properties: you edit the same parameters as explained during the event mark creation, see section 6.4.7.1.

6.4.8 WAYPOINTS

You can create a waypoint by clicking on the button . The waypoint is displayed at the current location of the mouse cursor. A KML file is created. This file can contain several waypoints. Another file can be created to store other waypoints.

The waypoint is defined by the following parameters:

- **Feature:**
 - Label:** name of the waypoint that will appear in the display.
 - Description**
 - File:** KML storage file
 - Folder:** location of storage of the KML file
- **Feature Data:**
 - X, Y:** coordinates of the waypoint, not editable
 - Immersion:** editable
- **Symbol** (3D image describing the mobile or device producing the positions)
 - Appearance (Style, Color, File and Wireframe display option):** the file defining the style of the mobile is a .3ds file present in the folder \DELPH RoadMap
 - Model Size tab: Size (Length (m), Width/Radius (m) and Height (m))**
 - Offsets tab: Offset X, Y and Z** in meters and degrees
- **Points (Width, Style and Color)**
- **Display Properties: Transparency** in %

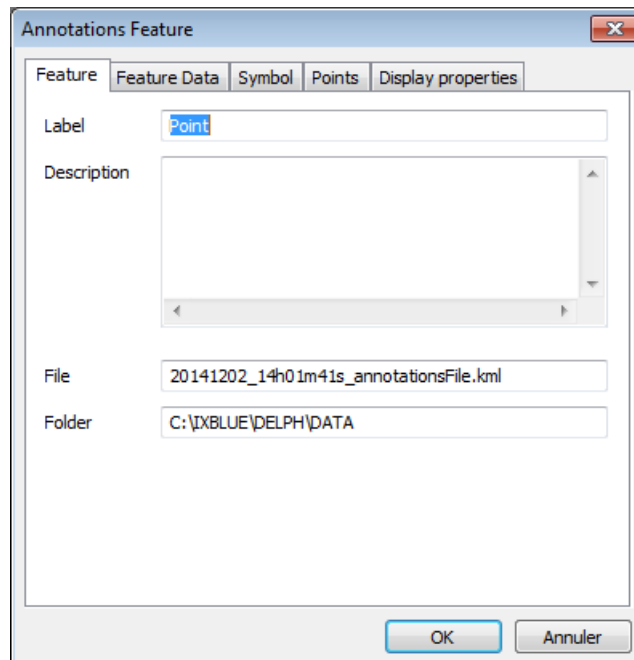



Figure 43 – Waypoint creation window

6.4.8.1 Creating Waypoints

Procedure

Step	Action
1.	<p>Click on  to select the waypoint mode. Move the mouse cursor at the location where you want to create a waypoint and double click.</p> <p><i>The waypoint is created and the Annotation Feature window opens.</i></p>
2.	<p>In the Feature tab: Enter the Label of the waypoint. You may enter a Description. You may edit the associated KML File and Folder.</p>
3.	<p>In the Feature data tab, the coordinates of the waypoints are available. You may edit the Immersion value set to zero by default.</p>
4.	<p>In the Symbol tab:</p> <ul style="list-style-type: none"> • Select the Style in the scrolling list. If you select User-Defined, provide the .3ds File. • Select the Color in the Select color ... window that opens when you click. • Select the File to define the style of the mobile. This option is only active when the User-Defined Style is selected. • You may check the optional Wireframe display option. • In the Model Size tab, enter a value for the Length (m), the Width/Radius (m) and the Height (m). • In the Offsets tab, enter the optional Offsets X, Y, Z in meters and/or degrees.
5.	<p>In the Points tab:</p> <ul style="list-style-type: none"> • Select a Width in the scrolling list. • Select a Style in the scrolling list. • Select the Color in the Select color ... window that opens when you click.
6.	<p>Open the Display properties tab and move the cursor along the Transparency scale to choose a value between 0 and 100%.</p>
7.	<p>Click on the button OK to validate your choices.</p> <p><i>The waypoint is created and displayed on the mouse cursor position. A data file and an event are added to the Annotations/Features/Waypoints folder in the Project view panel.</i></p>
8.	<p>End of Procedure.</p>

6.4.8.2 Managing Waypoints

Waypoint Files

When a waypoint is created, it is added to a KML file. If no KML file exists at the time of the creation, then a KML file is automatically created, inserted under the **Annotations / Data Files / Features / Waypoints** directory and set by default to **Active**. You can edit the file properties by right clicking on the event file in the **Project view** panel:

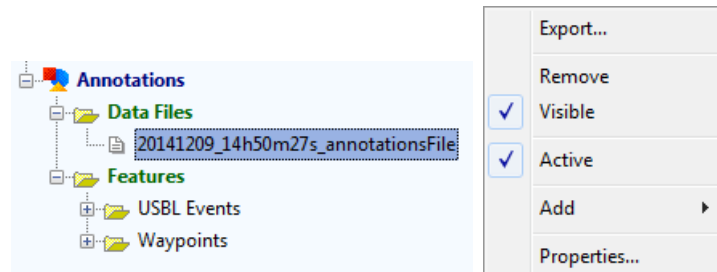


Figure 44 – Waypoint data file and its pop-up menu

If you do not want the next created waypoint to be written in the same file, unselect **Active** in the pop-up menu. At the creation of the next event mark, a new KML file is created. If you remove a waypoint data file, all the waypoints written in the data file are also removed from the **Project view** panel.

Waypoint Edition

You can perform a few operations directly on a waypoint. In the **Project view** panel, under **Annotations** and under **Features**, if you right click on one waypoint, a pop-up menu opens:

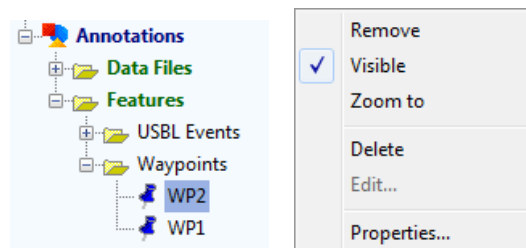


Figure 45 – Waypoint pop-up menu

From the waypoint pop-up menu you have access to the following items:

Remove: the mark does not appear anymore in DELPH RoadMap.

Visible: you can hide or show the waypoint.

Zoom to: you can set the view of the main graphic display to focus on the waypoint.

Delete: Waypoint is deleted from the KML file and from the application.

Properties: you edit the same parameters as explained during the waypoint creation, see section 6.4.8.1.

6.4.9 MEASUREMENTS

The measurement window is used to follow the distance between two displayed objects. These objects may be mobile or not. All items in the Navigation or Annotation folders may be selected to compute measurements among them.

6.4.9.1 Creating a Measurement

Access The measurement tool is available from

- The menu **USBL > Add Measurement...**
- The toolbar button

The **Measurement Pair Selection** window (see Figure 46) allows the selection of a pair of object between which may be monitored several kinds of distances and angles:

- **Horizontal Distance (Ellipsoid or Projection)**
- **Vertical Distance**
- **Oblique Distance**
- **Horizontal Angle (Ellipsoid or Projection)**
- **Vertical Angle**

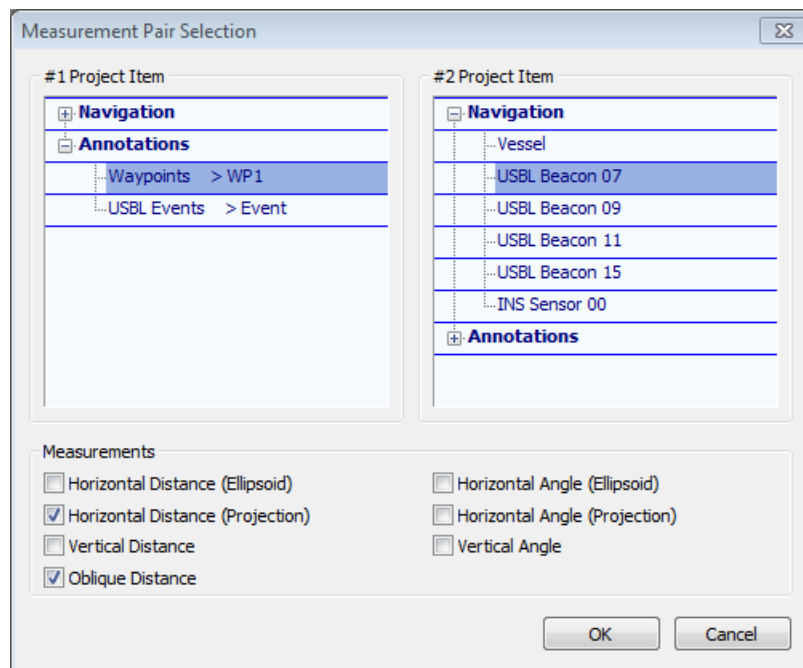


Figure 46 – Measurement Pair Selection window

Drag and Drop

In the **Project view**, in the **Navigation** folder, a simple drag and drop from one object onto the other also adds a measurement in the list displayed in the Measurement window. By default, the measurement drawn in the geographic display has the color from the source item color. The last selected measurements from the pair selection window are also used by default.

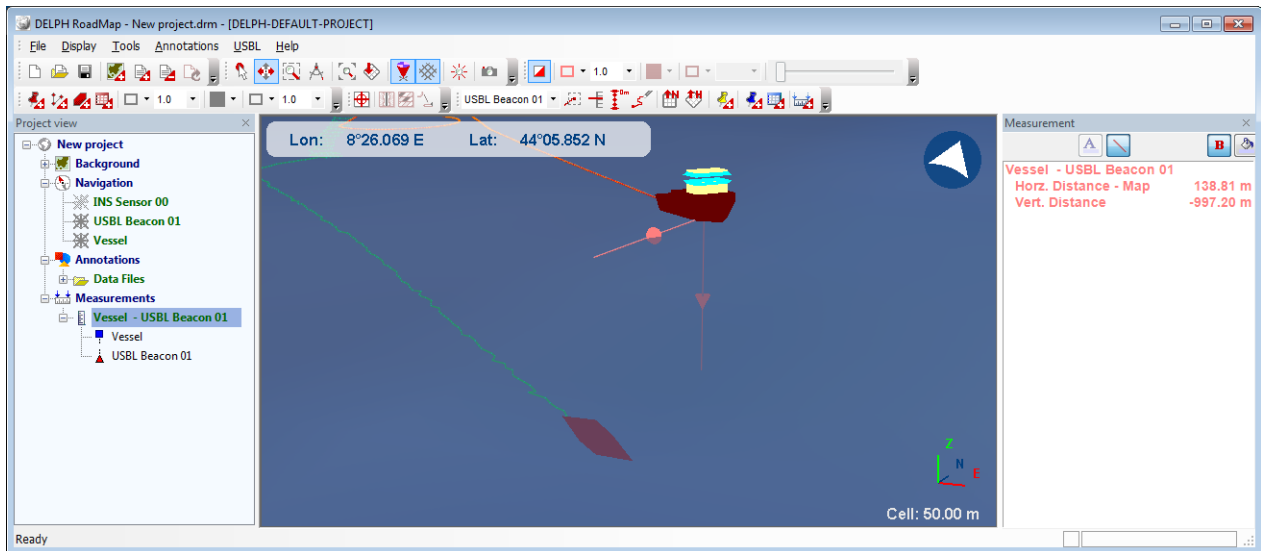


Figure 47 – Measurement example with vertical and horizontal measurements

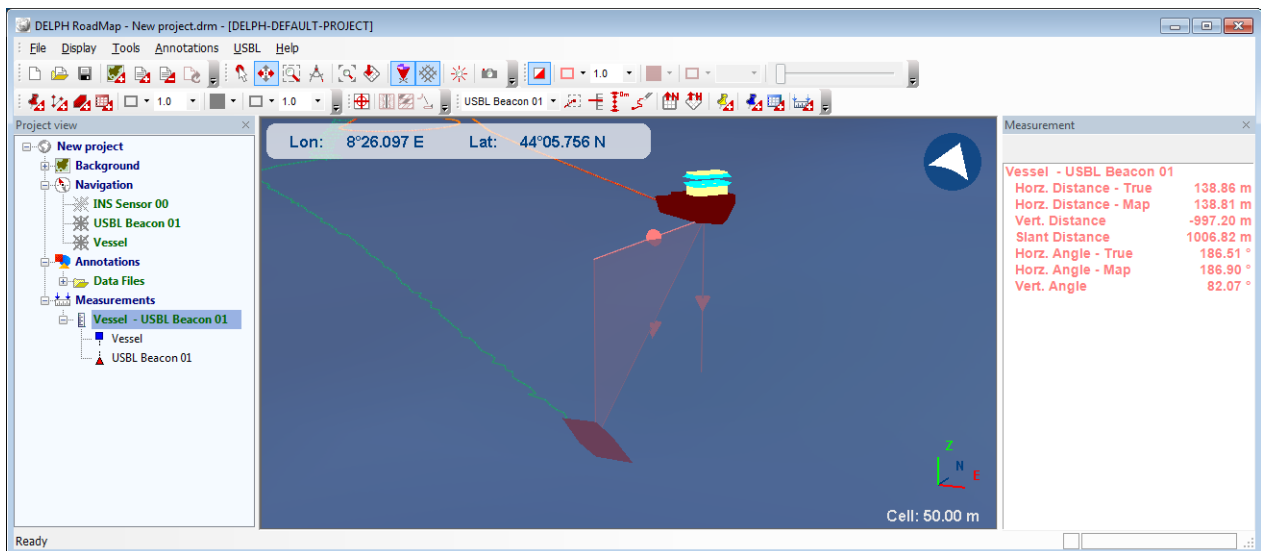



Figure 48 – Measurement example with all measurement options selected

Procedure







Step	Action
1.	Select the menu USBL > Add Measurement... or click on the  measurement toolbar button. The Measurement Pair Selection window opens.
2.	Select a Navigation or Annotation item in the #1 Project Item list and another Navigation or Annotation item in the #2 Project Item list.
3.	Select which measurement(s) you want to monitor in the Measurements frame.
4.	Click on OK to validate your choice. <i>The Measurement window opens if it was not opened yet. The measurement you configured appears now in this window with the actual measurement value(s) on the right hand side. A solid line is drawn on the geographic display between the two selected objects. The values are updated in real time or in playback modes. The configured measurement appears also now in the Project view under New Project > Measurements. It is possible to edit the measurement from both places.</i>
5.	End of Procedure.

6.4.9.2 Managing a Measurement

A measurement may be edited from the Measurement window or the Project view.

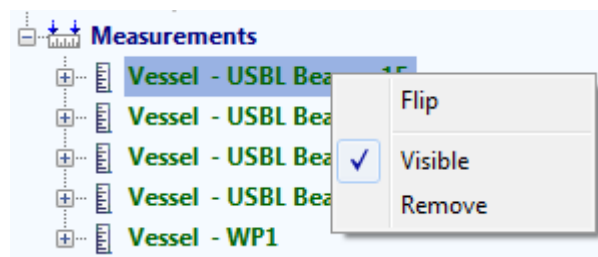
On the Measurement window are available the following buttons to edit the measurement:

Table 8 – Measurement window buttons

Icon	Task
 <ul style="list-style-type: none"> Horizontal Distance - Ellipsoid <input checked="" type="checkbox"/> Horizontal Distance - Map Vertical Distance <input checked="" type="checkbox"/> Slant Distance Horizontal Angle - True Horizontal Angle - Map Vertical Angle 	Select in the list the values to display.
	Flip the objects between which the distance is measured
	Change the item color and the displayed line
	Show or hide the measurement in the geographic display
<input type="text" value="14"/>	Font size for the window
	Set the list of measurement in bold
	Set the color of the background

In the Project view the right click pop-up menu allows the user

- To **Flip** the two objects between which the measurement is computed
- To make the measurement **Visible** or not
- To **Remove** the measurement



6.4.10 EXPORTING TRAJECTORY

The track of a mobile (from USBL imported data files, not from real time data files) is exported to be visualized in other geographic applications. The parameters are:

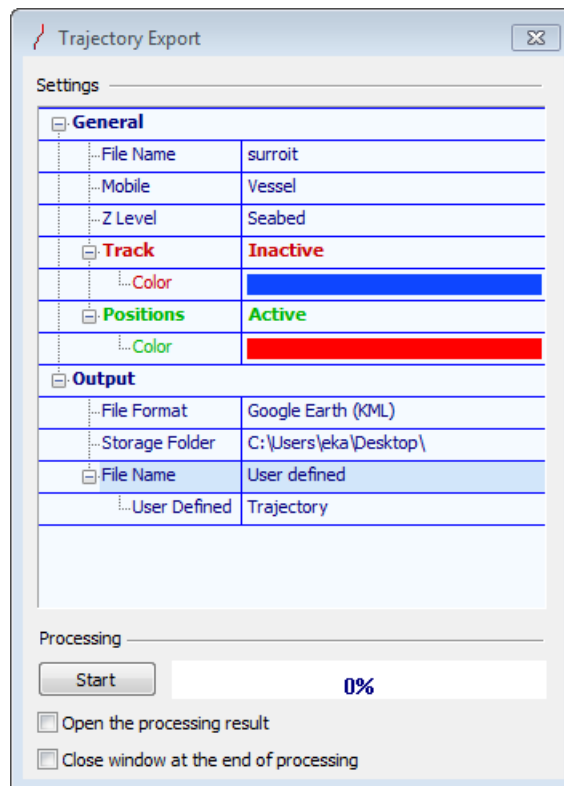


Figure 49 – Trajectory Export window

- **General**
 - ❑ **File Name:** the name of the file
 - ❑ **Mobile:** the type of the mobile
 - ❑ **Z Level:** if you have selected **Google Earth (KML)** as a **File Format**, you may select the source of the exported depth, the default value for other **File Formats** than **Google Earth (KML)** is **Surface**:
 - **Surface** the trajectory is displayed on the surface,
 - **Seabed** the trajectory is displayed on the seabed
 - **Sensor Depth** the trajectory is displayed relatively to the surface
 - **Sensor Altitude** the trajectory is displayed relatively to the seabed
 - ❑ **Track:** this option includes the track in the output, a **Color** may be selected (**Color** is set by default to white for other **File Formats**)
 - ❑ **Positions:** this option includes the positions in the output, a **Color** may be selected (**Color** is set by default to white for other **File Formats**)
- **Output**
 - ❑ **File Format:** three formats are available
 - **Google Earth (KML)** you may then choose the type of **Z Level** above
 - ESRI Shape File (SHP)
 - Autocad DXF File (DXF)

- ❑ **Storage Folder:** complete path of the storage folder
- ❑ **File Name:** three ways to build the file name
 - FileName_Mobile (line01_Vessel_trajectory)
 - FileName_FileFormat_Mobile (line01_dat_Vessel_trajectory)
 - **User defined:** your own file name

Procedure

Step	Action
1.	In the Project View panel, under Navigation , right click on the file from which you want to export the trajectory. <i>The Trajectory Export window opens.</i>
2.	Expand the General item and enter a File Name , a Mobile
3.	If the export File Format is Google Earth (KML) , select the Z Level in the corresponding scrolling list.
6.	You may activate the Track and/or Positions options. If the export File Format is Google Earth (KML) , select the Color of these two options.
7.	Expand the Output item and select a File Format , enter a Storage Folder path and choose a File Name type.
8.	Click on Start to run the export. You may select the Close window at the end of the processing option and/or the Open processing result option if the File Format is Google Earth (KML) . <i>The completion state of the export process is displayed on the progress bar.</i>
9.	End of Procedure.

7 DYNAMIC POSITIONING MODE

7.1 Definition

The USBL-BOX system can be used as an external hydro acoustic position reference for the Dynamic Positioning (DP). The USBL-BOX is directly interfaced to the DP and outputs the position of the vessel to the DP using referenced moored acoustic transponders.

The purpose of this mode is that DP cannot only trust the GNSS data. If there is a GNSS failure or outage, the hydro acoustic position reference still provides an accurate positioning of the surface vessel. These hydro acoustic position references are essential for DP class 2 and 3. The INS becomes the core component of the positioning system and achieves the data fusion of all available sensors (LBL, USBL and GNSS).

When L/USBL or L/USBL/INS mode is activated, the USBL-BOX can still simultaneously track mobile transponder in USBL.

Figure 50 – USBL-BOX in DP Mode and other operations

Definition The use of L/USBL mode requires calibrating the fixed transponders to precisely determine their positions. This is done by surveying the moored transponders using the USBL positioning. These transponders can then be used as LBL transponders to compute the position of the surface vessel. The optimal geometry for different numbers of transponders is described on Figure 51.

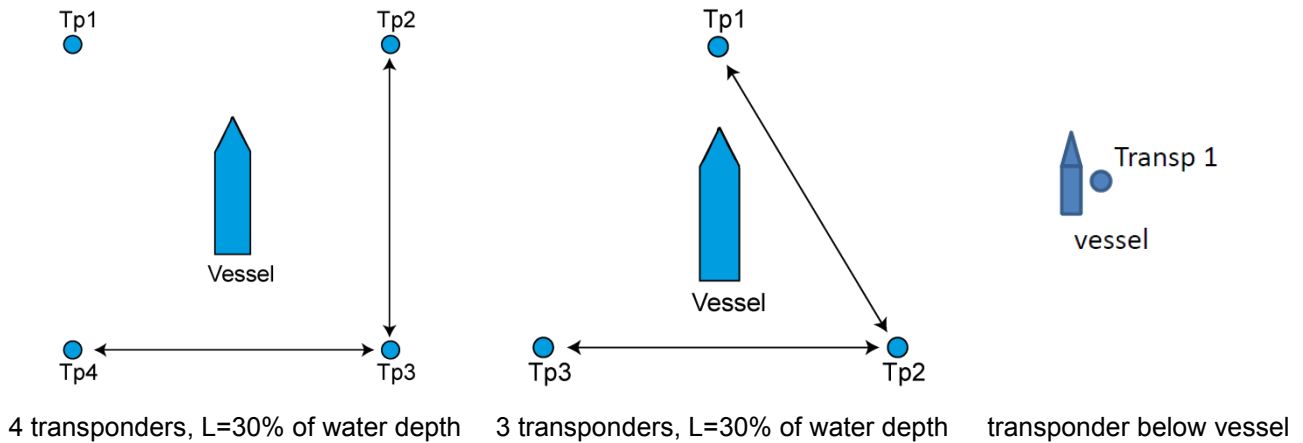


Figure 51 – Geometry of the field of transponders

7.2 L/USBL Mode

In L/USBL mode, the USBL system feeds a DP with the positions of the acoustic antenna.

- If less than three moored transponders are available then the position is computed by USBL (see Figure 52).
- If at least three moored transponders are available then the positioning is provided by both USBL and LBL computations (see Figure 52 and Figure 53). The LBL computation is made from the travel distances of at least three moored transponders.

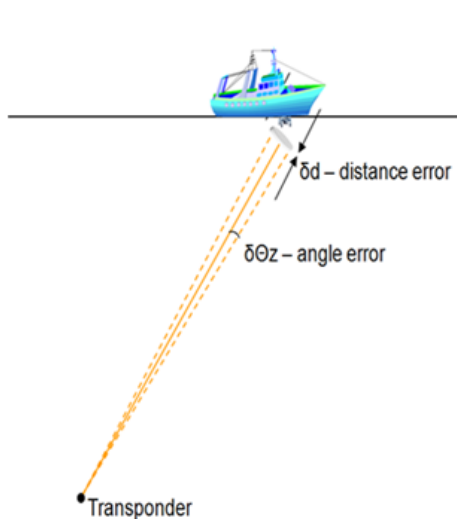


Figure 52 – USBL computation

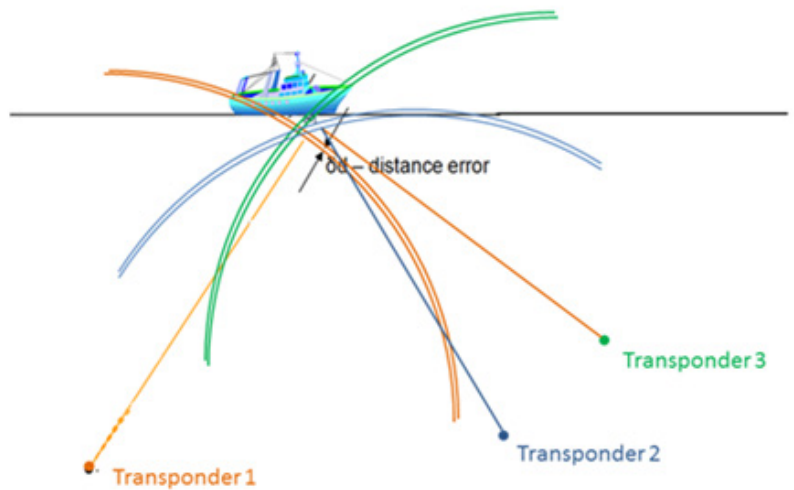


Figure 53 – LBL computation

Depending on the selected output protocol, the LBL computed position is either given with respect to the position of a reference transponder, or directly the absolute georeferenced vessel position (with GNSS data available).

7.3 Procedure

- Prerequisite** The INS must be aligned (see PHINS user guide).
- Calibration** Once the transponders have been deployed, they must be calibrated. Calibration of one transponder typically requires 100 of USBL fixes.
- Once calibrated, the positions of the fixed transponders have to be input in the dynamic positioning parameters. There are two ways to input these parameters:
- Recover these coordinates by clicking on the **Get Current Position** button (only available when the USBL system is tracking) to fill these fields automatically with the current USBL position of the transponder.
 - Input manually the position of the transponder in the dedicated fields.
- Only one transponder can be set as a reference at a time. The position of the USBL antenna is computed with respect to the position of the reference transponder.

- DP Protocols** The protocols to be selected in the output configuration and that can be read by a DP system are the following:
- HIPAP HPR 400
 - HIPAP HPR 418 fix or mobile
 - KONGSBERG BCD



USBL-BOX can be used without GPS.

- Options** Four different modes are available:
- **Automatic (default)**: the GPS, LBL or inverted USBL are used in the order:
 - Position sensor
 - LBL if no GPS available
 - Inverted USBL if no LBL and no GPS available
 - **GPS Only**: only data from GPS are used for DP
 - **LBL Only**: only data from LBL are used for DP
 - **USBL Only** : only data from USBL are used for DP

Procedure

Step	Action
1.	Click on options .
2.	Under Dynamic Positioning , select Automatic (default) , GPS Only , LBL Only or USBL Only .
3.	Click on OK to validate your choice.
4.	End of Procedure.

Step Action

1. Moored the transponder(s) and sail the vessel to the center of the field of transponders. Run the next three steps for each of the transponders.

2. In **SETUP > TRANSPONDERS**, click on **Change Settings** for a moored transponder. In the **Dynamic Positioning** section, let the **Mode** to **None**. In the **Filtering** section, set the **Type** of filter to **Fixed** to start the averaging process. Click on **OK** to exit the transponder settings and switch **ON** the transponder.

3. Click on **Start Tracking** and wait 100 USBL fixes without any filter reset status.

4. Select **SETUP > TRANSPONDERS**. Click on **Change Settings** of the corresponding transponder. In **Dynamic Positioning**, click on the **Get Current Position** button to recover the actual transponder position.

▼ **Dynamic Positioning**

Mode

Latitude ° ',

Accuracy m

Longitude ° ',

Accuracy m

Depth m

Accuracy m

Use as reference transponder

The displayed position is the average position of all USBL fixes (if no reset of the filter). For a more precise transponder position, the median of the positions of the transponders can be estimated and manually entered in the transponder window. To calculate the median, use the positions information given in the message starting with \$PTSAG of the log repeater document recorded during the tracking. Each transponder can be recognized by its transponder number included in the \$PTSAG message (description in the DATA STANDARD protocol in appendix D.1).

5. Select **INSTALLATION > OUTPUTS**, configure an output serial or Ethernet (see section 4.4.2) and select a DP **Protocol** (HIPAP HPR 400, 418 fix or mobile, KONGSBERG BCD). Click **OK** to validate your choice.

6. Configure the moored transponders as detailed in section 5.2.2. In **Dynamic Positioning**, select a **Mode**. Make sure one transponder is configured as a reference transponder (check box **Use as reference transponder** activated).

7. Finish configuring the survey as detailed in section 8.2. Run the DP survey.

8. End of procedure.

8 OPERATING THE USBL-BOX

8.1 Deploying the Transponders

The transponder to be positioned is either mobile on an underwater vehicle or attached to a mooring. The deployment of an underwater vehicle is specific to that particular vehicle. **Please refer to the specific User Guide of the transponder for more operational details.**

8.2 Launching the Survey

Procedure

Step	Action
1.	If this is the first mission, calibrate the POSIDONIA antenna after having installed it or after the vessel has passed through dry dock. See the antenna calibration procedure in section 5.5. Enter the non-alignments, immersion and lever arms from section 4.3.
2.	Configure (or check if it has already been done) the USBL-BOX network interface. See section 4.2.
3.	Configure the USBL-BOX input and output if there are new sensors during this mission. See section 4.4.
4.	Configure the synchronization mode and its associated parameters. See section 5.1.
5.	Ensure that the positioning mode is set on Automatic (default) , see section 5.1. The transponders that are going to be used as reference transponders must be set on L/USBL mode.
6.	Configure the transponders which are going to be positioned during the mission. See section 5.2. The dynamic positioning L/USBL mode may be set up during the configuration of the transponders.
7.	Enter the speed profile. See chapter 5.3.
8.	Configure the data acquisition. See section 5.4.
9.	Click on the Start Tracking button. <i>The data acquisition window opens and acquisition starts.</i>
10.	Open the navigation window in order to check the acquired data. See section 8.3.
11.	Start the mission.
12.	End of Procedure.

8.3 Controlling the Data

8.3.1 DATA CONTROL WINDOWS

Controlling data from the USBL-BOX is carried out via:

- Navigation window
- Control window
- Data logger window

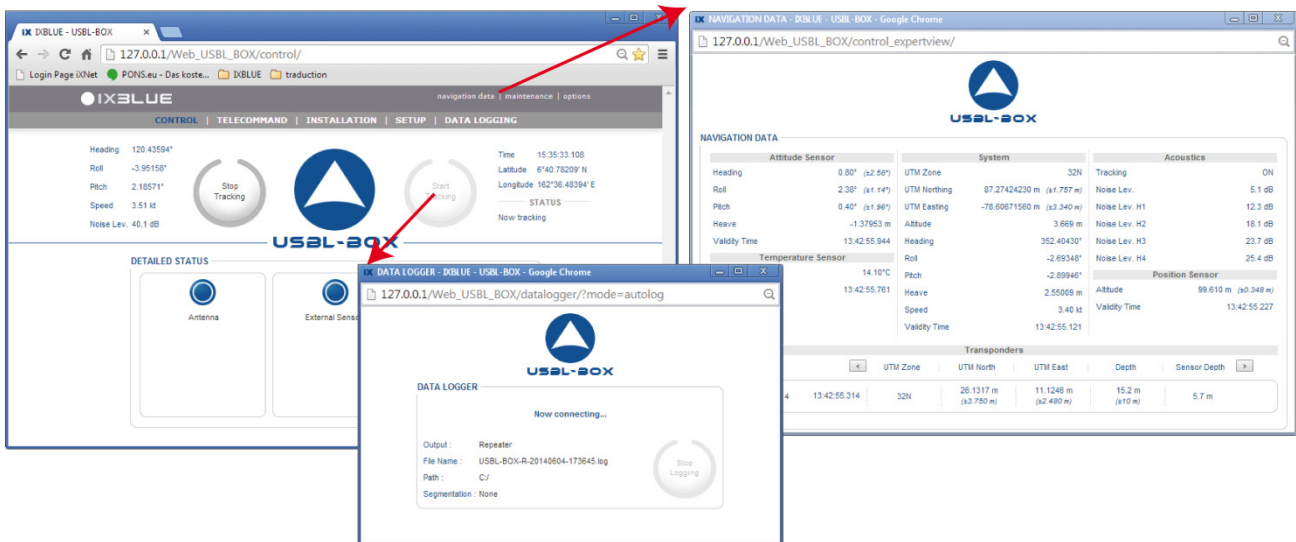


Figure 54 – Data monitoring via CONTROL, NAVIGATION and DATA LOGGER windows

8.3.1.1 CONTROL Window

- Heading, Roll, Pitch, Speed and Noise Lev.
- Time, Latitude and Longitude or UTM Zone, UTM Northing and UTM Easting
- Messages shown under the heading **STATUS**
- While GAPS is tracking, repetitive clicks on the main logo or on the **STATUS** label on the left of the main logo display alternatively the **SYSTEM DETAILED STATUS** and the list of the active transponders and their associated parameters. A click on the frame of a transponder of the list allows the display of another set of parameters of the transponder.

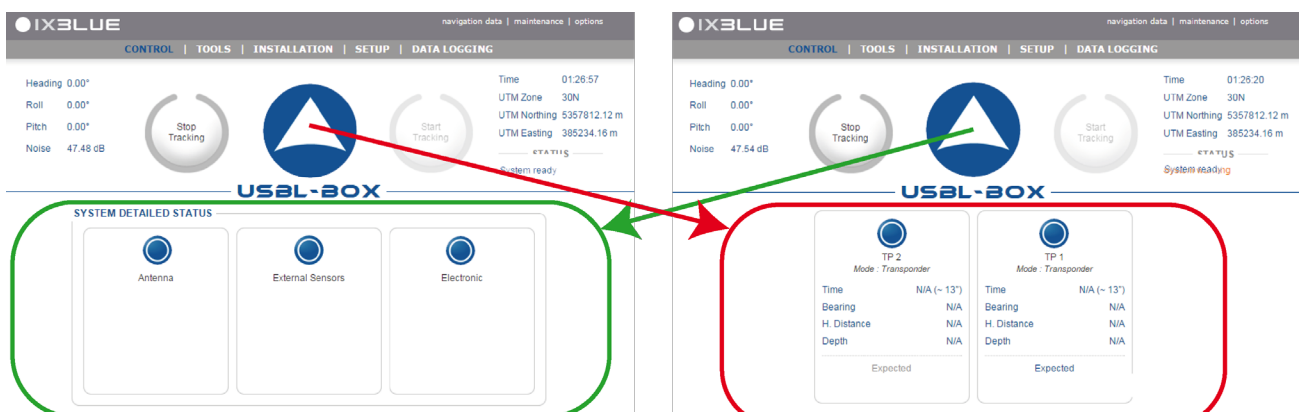


Figure 55 – Display managed by the logo



The time of last detection is displayed for each transponder in the figure above, note that the elapsed time since this last detection is also displayed between brackets: (<01”) for less than one second, (~xx”) for the number of seconds and (>60”) for more than one minute.

Time 10:15:41.891 (~ 11”)

8.3.1.2 NAVIGATION window

- Navigation data: Attitude Sensor (Heading, Roll, Pitch, Heave, Validity Time), Temperature Sensor (Temperature and Validity Time), System (Latitude, Longitude, Altitude, Heading, Roll, Pitch, Heave, Speed, Validity Time), Acoustics (Tracking, Noise Lev.), Position Sensor (Latitude, Longitude, Altitude, Validity Time)
- Positioned **Transponders** data (see Table 9)

Table 9 – Displayed data for each active transponder

Data	Definition
Latitude	Geographic coordinates of the transponder
Longitude	
Depth	Depth computed with acoustic data and data from optional external sensors
Sensor depth	Depth provided by optional external sensors
X Rel. Antenna	Transponder coordinates with respect to the frame centered on the antenna and to the antenna axes
Y Rel. Antenna	
X Rel. North	Transponder coordinates with respect to the frame centered on the antenna and to the geographical axes
Y Rel. North	
Slant Range	Traveled distance
H. Distance	Horizontal distance
Bearing	Transponder angle seen from the antenna with respect to the along track axe of the ship
Azimuth	Transponder angle seen from the antenna with respect to the North
Vertical Angle	Transponder angle seen from the antenna with respect to the vertical
SNR, SNR H1, SNR H2, SNR H3, SNR H4	Signal to noise ratio global and specific to each hydrophone
Travel Time	Travel time of the acoustic wave to reach the transponder

8.3.1.3 DATA LOGGER Window:

- The name of the current data file which changes according to the chosen segmentation
- The recording status of the tracked transponders

8.3.2 DESELECTING A CHANNEL FOR AN USBL COMPUTATION

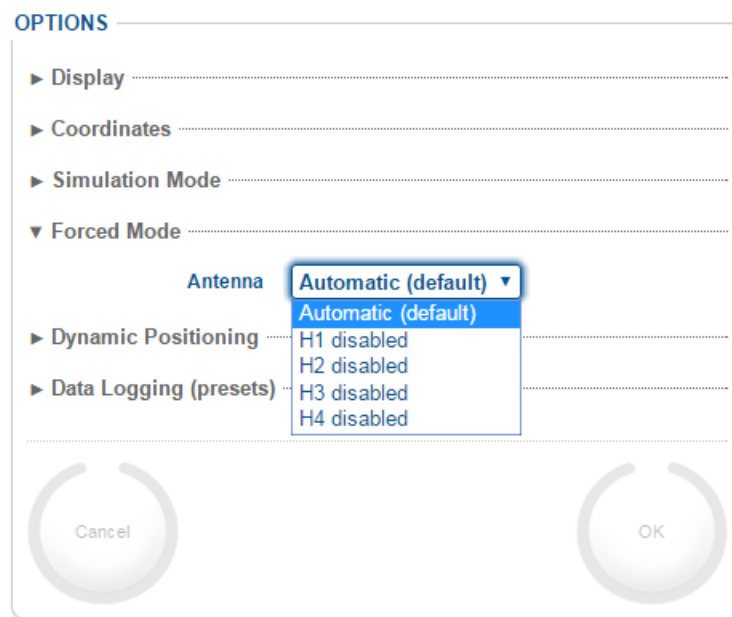
It is possible to exclude one channel of the USBL from the computation. In case of one faulty hydrophone, it improves greatly the positioning accuracy to be able to perform the positioning without this hydrophone. A faulty hydrophone may greatly decrease the quality of the positioning.

The **automatic (default)** mode rejects the erroneous detections of any hydrophone when it is the case.

Procedure

Step	Action
------	--------

1. Even during tracking, click on **options** in the top right corner of the application.



2. Select **H_n disabled** to exclude all detections made by the H_n hydrophone.
3. End of procedure.

8.3.3 LIST OF THE STATUS IN THE WEB-BASED USER INTERFACE

Blue Message: information, **Orange Message:** warning, **Red Message:** error

Message	Meaning	Action
SENSOR X (X being UTC/GPS, USBL, GPS, D ... N, O or P)		
Input X – Corrupted data	Data received but consistency and integrity tests fail.	Check the quality of serial links.
Input X – Data Timeout	Time interval too long.	

ELECTRONIC		
5 V analog supply	Internal electrical problem	Switch off the rack and contact iXBlue.
5 V digital supply	Internal electrical problem	Switch off the rack and contact iXBlue.
12 V analog supply	Internal electrical problem	Switch off the rack and contact iXBlue.
Clock updating	System time is not up to date	Configure a UTC sensor.
DSP communication	Internal problem coming from the signal processing module.	Switch off the rack and on again. If problem remains, contact iXBlue.
DSP configuration	Internal problem coming from the signal processing module.	Switch off the rack and on again. If the problem remains, contact iXBlue.
Signal processing	Internal problem coming from the signal processing module.	Switch off the rack and on again. If the problem remains, contact iXBlue.
DSP Overload	Data processing is overloaded.	
Profile consistency I, II	Too many layers or depth not strictly increasing	Correct the velocity profile
Transp. consistency I, II	At least 2 transponders with common interr. Parameters.	Check and correct the parameters of your transponders.
Interrogation Overflow	Too many interrogations by recurrence.	Reduce the number of interrogations per recurrence.
Transponders Overflow	Too many transponders by recurrence.	Reduce the number of transponders by recurrence.
Response Overflow	Too many answers in a recurrence.	Reduce the number of interrogated transponders by recurrence.
Transp./Int. Overflow	Too many transponders by interrogation.	Reduce the number of transponders by interrogation.
Response not supported	Unknown ID of acoustic response	

Outputs consistency	Too many output signals.	Reduce number of outputs.
Sensors consistency	Too many sensors in input.	Reduce number of sensors in input.
DP Base	Not enough transponders to have a DP base.	Add more transponders.
DP Triangulation	Wrong geometry of DP transponder field.	Inappropriate DP base to run DP operation.
DP Reference	No DP reference transponder.	Add a DP reference transponder.

USBL-BOX Antenna		
Transponder interrogation	The system is not triggered.	Check that the synchro is sent to the rack.
Sampling	Internal problem coming from the signal processing module.	Switch off the rack and turn it on again. If the problem remains, contact iXBlue.
Maximum range	One or several detections are close to the end of the acquisition period.	Increase the interrogation rate.
Channel 1/2/3/4 detection	The system does not detect the signal coming from the transponder on the channel 1/2/3/4	If the message appears for a short time, it may be due to the external environment. If the problem remains continuously, there might be a problem with the antenna or with the antenna cable. Contact iXBlue.
Channel 1/2/3/4 NIS Error	Error occurred on one of the four channels 1, 2, 3 or 4.	
Speed Limit (12 kt)	The ship sails too fast, the mechanical limit of the antenna might be reached.	Reduce speed.

ELECTRONIC		
Timeout Synchro IN PPS	Delay on incoming trigger pulse	
Hoisting Sys. UP	Antenna stored in service chest	
Hoisting Sys. DOWN	Antenna deployed	
Gate Valve CLOSED	Gate valve closed	
Gate Valve OPEN	Gate valve opened	
Hoisting Sys. Fault	Hoisting System out of service	

TRANSPONDERS		
Expected	Transponders than are expected in the next interrogation.	
No Detection	Less than 3 hydrophones providing data.	
No Position	Impossible to compute a position.	
Pressure Received	Data collected from pressure sensor.	
Pressure Used	Pressure data required by transponder and used.	
Antenna not calibrated	The antenna is not calibrated.	
Simulated Detections	The delivered positions are coming from simulated detections.	
Ping Navigation	No navigation at interrogation time.	
Detected Navigation	No navigation at detection time.	
3 Hydros. Forced mode	One hydro deactivated.	

8.3.4 FREQUENCY SPECTRUM OF THE HYDROPHONES

This tool is designed to help the user to control the operating state of the four transponders. The control is made via a frequency graph for each hydrophone. Such a display is shown on Figure 56.

For each hydrophone you may display the actual magnitude, the mean of the magnitude over time or the max of this magnitude over time.

Zoom

A few graphical tools are available from the mouse:

- **Zoom** on the graph with the **scroll wheel** of your mouse.
- Draw a **zoom rectangle** with **left mouse button**.
- **Unzoom back to normal** display with the **right mouse button**.



The range of the measurement is precise between 60 and 100 dB. Any noise measurement outside this range may have degraded accuracy.

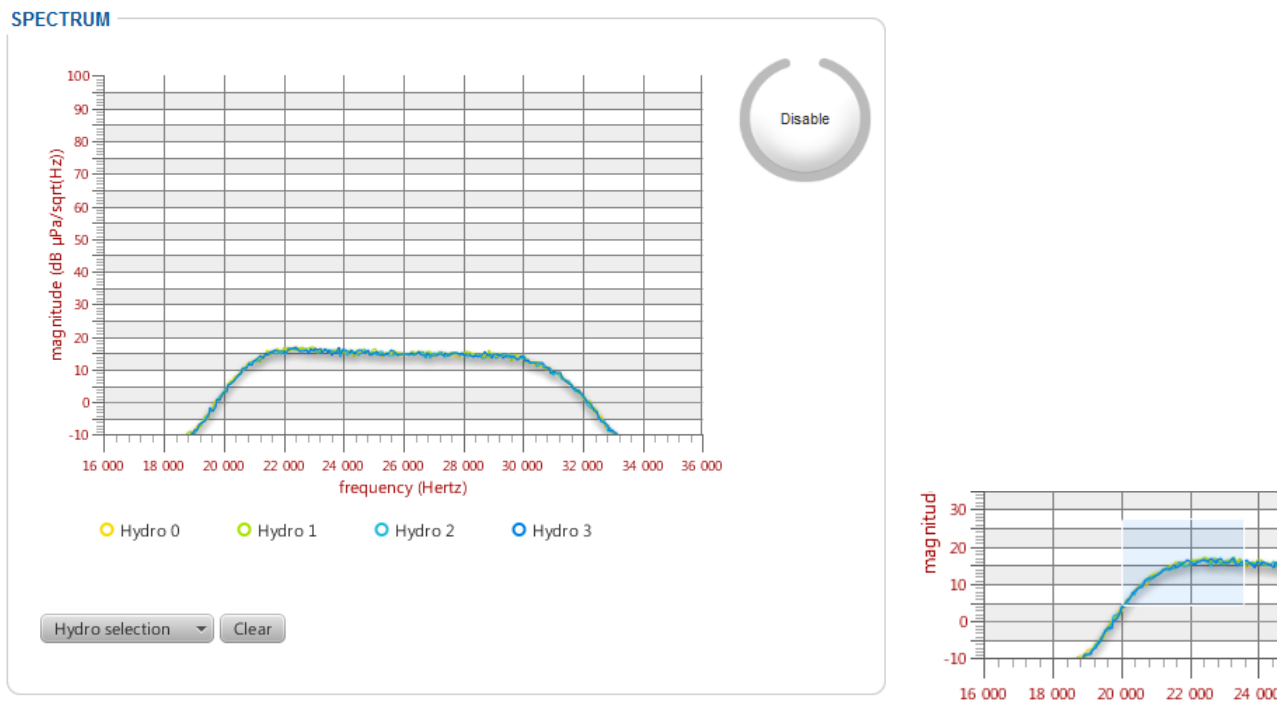


Figure 56 – SPECTRUM window and zoom effect

Procedure

Step	Action
1.	Select TOOLS > SPECTRUM .
2.	Click on the Enable button.
3.	Click on the Hydro selection button to select which hydrophone you want to display the frequency spectrum. You may select Hydro x , Hydro mean x or Hydro max x . <i>The graph of the selected data is displayed.</i>
4.	End of procedure.

8.4 Recovering the Equipment

Telecommand This section describes the recovery of the transponders. The moored transponders are recovered with the use of the remote control function of the USBL-BOX system. The IXBlue TT801 remote control can also perform this task.

8.4.1 OPERATING MODE

Recovering The remote control transmits a signal to the transponders. Once the signal received by the transponder, the transponder answers by an acknowledgment signal (CAF). The hook engine rotates, freeing the release ring and the weight. Another acknowledgement signal is transmitted by the transponder after the complete rotation of the engine. The transponder starts to go up towards the surface carried by the buoys. The upward speed is typically 1 to 2 m/s. The transponders can now be recovered at the sea surface.



Before any recovery operation, click on the **Stop tracking** button. The POSIDONIA antenna must not be pinging while the remote control is operating.

The USBL-BOX can send commands to the transponders. Two types of commands exist and are coded respectively in 8 and 24 bits. **The 24-bits coded commands are exclusively dedicated to the RTT400.** In order to configure these commands, you need to input the following parameters, see sections 8.4.1.1 and 8.4.1.2.

8.4.1.1 8-bits Commands


- **Bit0** and **Bit1**: two frequencies defining the 0 and 1 values of the coded signals
- **CAF**: acknowledgment signal send by the transponder
- **ARM**: hexadecimal value of the arming command that wakes the transponder up
- **CMD**: hexadecimal value of the command
- **Acknowledgment Timeout**: from 1 to 60 s in which the device waits for an acknowledgement signal of the command from the transponder

Transponder Label

The codes of the commands can be found on the manufacturer label stuck on the transponder. See an example of such a label on Figure 57. These codes are expressed in hexadecimal format. The Table 10 links the hexadecimal values to the code numbers.

Table 10 – Correspondence between frequencies and hexadecimal codes

Code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Freq. kHz	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16



MODEL	RTA61B2S	S/N	021
DEPTH	6000 m	SWL / RL	2.5T / 2.5T

FUNCTION	CODE	
TRANSP. CIF ⇒ IRF		RAMSES00 ⇒ RAMSES21
TRANSP. IIF ⇒ CRF		13.0 kHz ⇒ Posi23
ACKNOWLEDGE CAF		12.0 kHz
PINGER FREQ. PFR		12.0 kHz
ARM / RANGING	025C	⇒ CAF
RELEASE	ARM + 0255	⇒ CAF ⇒ CAF
RELEASE WITH PINGER	ARM + 0256	⇒ CAF ⇒ CAF ⇒ PFR ...
TRANSP. IIF - TRANSP. CIF	ARM + 0241	⇒ CAF
INHIBITION IIF & CIF	ARM + 0242	⇒ CAF
TRANSP. IIF - INHIB. CIF	ARM + 0243	⇒ CAF
TRANSP. CIF - INHIB. IIF	ARM + 0244	⇒ CAF
PINGER ON	ARM + 0247	⇒ CAF ⇒ PFR
PINGER OFF	ARM + 0248	⇒ CAF
DIAGNOSTIC	ARM + 0249	⇒ CAF ₁ ⇒ CAF ₂
ACOUSTIC RESET	ARM + 024A	⇒ CAF

Other: Refer to A.T.R.
MADE IN FRANCE - May 2011

IXSEA S.A.S.
Rue Rivoalon - Ste Anne du Portzic - 29200 BREST (France)
Helpline 24/7 : +33 1 30 08 98 98
E-Mail : support@ixsea.com




Figure 57 – Transponder build sheet example of a RTA61B2S



Decoding the build sheet from Figure 57:

The frequency FR0 (8.5 kHz) in the first column of Table 10 corresponds to the code 0.

The frequency FR1 (9.5 kHz) in the first column of Table 10 corresponds to the code 2.

The ARM/RANGING (0251) is made of 0 (FR0, 8.5 kHz), 2 (FR1, 9.5 kHz) and 51 which is the arming code.

8.4.1.2 24-bits Commands

The specific characteristics of the 24-bits commands are the following:

- Synchronization impulse frequency (**Synchro**) adding itself to the **Bit0**, **Bit1** and **CAF**, emitted before the actual transmission of the 24 bits.
- The command message itself comprises three bytes:
 - ❑ An address to assign the transponder to be ordered, **Beacon**
 - ❑ An information defining the task to be achieved, **Instruction**
 - ❑ A parameter, **Parameter**

The figure displays two side-by-side screenshots of the 'TELECOMMAND' interface, one for 8 bits and one for 24 bits.

8 bits window (left):

- Buttons: 8 bits (selected), 24 bits
- Frequencies:
 - Bit0: (0) TONAL 8.5kHz
 - Bit1: (3) TONAL 10kHz
 - CAF: POSIDONIA 17
- Codes:
 - ARM (03): FD
 - CMD (03): 41 : Transp. IIF Transp. CIF
- Acknowledge Timeout:
 - Timeout: 31 s
- Buttons: Cancel, Send

24 bits window (right):

- Buttons: 8 bits, 24 bits (selected)
- Frequencies:
 - Bit0: (0) TONAL 8.5kHz
 - Bit1: (3) TONAL 10kHz
 - Synchro: TONAL 12.5kHz
 - CAF: POSIDONIA 17
- Codes:
 - Beacon: \$FD : 253
 - Instruction: \$FE : N/A
 - Parameter: \$FF : 255 : 11111111
- Acknowledge Timeout:
 - Timeout: 31 s
- Buttons: Cancel, Send

A summary box in the 24 bits window shows:

INSTRUCTION	N/A
PARAMETER	N/A

Figure 58 – 8 bits and 24 bits TELECOMMAND window

8.4.1.3 Procedure

Procedure

Step	Action
1.	Select the TOOLS > TELECOMMAND menu. <i>The TELECOMMAND window opens. See Figure 58.</i>
2.	Choose the type of command to be sent, the 24-bits coded commands are exclusively dedicated to the RTT400 transponders.
3.	Under Frequencies : In 8 bits , select the Bit0 , Bit1 and CAF in the corresponding drop-down lists. In 24 bits , after the Bit0 , Bit1 and CAF parameters, select the Synchro frequency.
4.	Under Codes : In 8 bits , select the codes ARM and CMD in the corresponding drop-down lists. In 24 bits select the Beacon , Instruction and Parameter in the corresponding drop-down lists. <i>A description of the chosen instruction is displayed in the blue frame.</i>
5.	Under Acknowledgment Timeout , select the Timeout .
6.	Click on OK to validate your choice and to send the parameters to the USBL-BOX.
7.	End of Procedure.

9 MAINTENANCE

9.1 Maintenance from the Web-Based User Interface

You have access to a series of four maintenance tasks from the Web-Based user interface. These tasks are:

- Update the System
- Reset to factory settings
- Contact iXBlue technical Support
- Gain Stop mode to perform analogical tests on the antenna

9.1.1 UPDATING THE SYSTEM

You update your system with an update file that iXBlue provides to you when a new version is available. The update file names have:

- “.srec” or “.sre” extension
- “TQ_” prefix for the mother board
- “G4W_” for the signal processing board

You upload this file from your computer directly inside USBL-BOX via the present procedure.

If you have two successive updates to perform, you may reboot the USBL-BOX between the two updates but it is not necessary.



Make sure to ZIP the update files when sending them by mail in order to avoid any file corruption caused by mail applications.

Make sure to UNZIP the update files that you have received by mail before loading them into the USBL-BOX.



If both TQ and G4W firmware have to be updated: make sure that you download the Gen4Ways (G4W) firmware **before** the PowerPC (TQ) firmware into the USBL-BOX.



Do not forget to save your current configuration before performing the update.

Procedure

Step	Action
------	--------

- | | |
|----|--|
| 1. | Save your current configuration. See section 4.1.10.1. |
| 2. | Click on maintenance in the upper right corner of the window. |



- | | |
|----|--|
| 3. | In front of File , click on the Browse button.
<i>A browser opens.</i> |
| 4. | Select the update file “.srec” that iXBlue sent to you. |
| 5. | Click on Update .
<i>The logo flashes alternatively gray and blue. A Sending file label appears in the UPDATE SYSTEM area. After a while the file is uploaded and the updating is complete.</i> |
| 6. | Check that all the versions numbers listed above the Load File button are updated. |
| 7. | Empty the cache of your current browser and reload the page before using the Web-based User Interface. |
| 8. | End of Procedure. |

9.1.2 RESETTING TO THE FACTORY SETTINGS

Sometimes it can be useful to reset the system to the factory settings. These settings are set as default settings when the USBL-BOX unit is shipped to you by iXBlue. You just have to press the **Reset** button in the **RESET TO FACTORY SETTINGS** area.

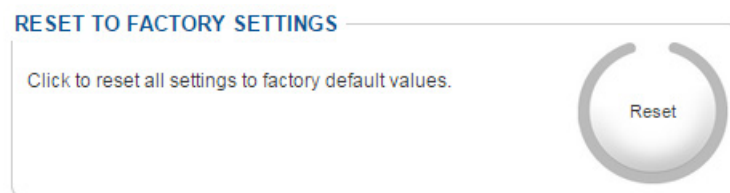


Figure 59 – Reset to factory settings

9.1.3 CONTACTING IXBLUE TECHNICAL SUPPORT

You can always contact iXBlue by your own ways with the coordinated listed at the end of this document. However, the Web-based user interface offers to you a more convenient way to contact iXBlue technical support.

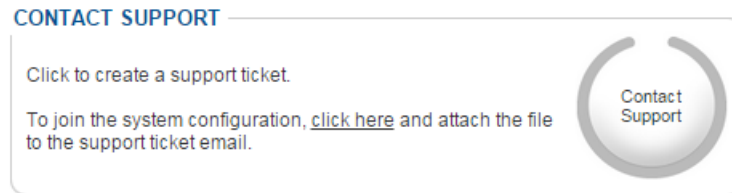


Figure 60 – Contact support

E-mail By clicking on the **Contact Support** button in the **CONTACT SUPPORT** area, you send an e-mail to iXBlue technical support with all related information of your system (Product name and serial number and other information that you can fill in the corresponding fields).

Configuration File If you click on the **click here** link, you save a file configuration that you can add to the e-mail that you send to iXBlue technical support. This tool gives to the iXBlue technical support as much information as possible to help you to answer a question or to overcome an eventual problem.

9.1.4 GAIN STOP MODE

You can adapt the gain to make analog measurements on the antenna. This tool can only be used when the tracking is stopped.

Enter a **Gain** value going from 0 to 80 dB and click on **Apply**.

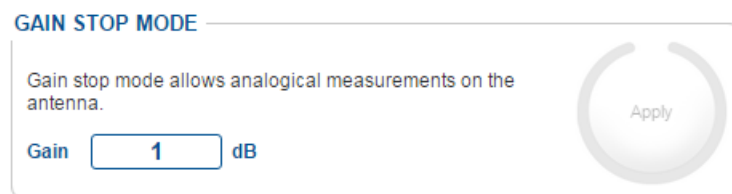


Figure 61 – Gain adjustment in Gain Stop mode

iXBlue CONTACT - SUPPORT

FOR NON-URGENT SUPPORT:

BY EMAIL: support@ixblue.com

USING THE FORM ON THE IXBLUE WEB SITE www.ixblue.com

FOR 24/7 URGENT SUPPORT:

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Appendices

A HOW TO PREVENT JAVA SECURITY WARNING DIALOG BOX

Here is detailed a procedure to follow in order to prevent the security warning box from Java to appear when you click on the **Data Logging** menu.

Procedure

Step	Action
------	--------

1. Open the **Java Control Panel** on your computer:

Windows XP

Click on the Start button and then click on the Control Panel option.

Double click on the Java icon to open the Java Control Panel.

Windows 7, Vista

Click on the Start button and then click on the Control Panel option.

In the Control Panel Search enter Java Control Panel.

Click on the Java icon to open the Java Control Panel.

Windows 8

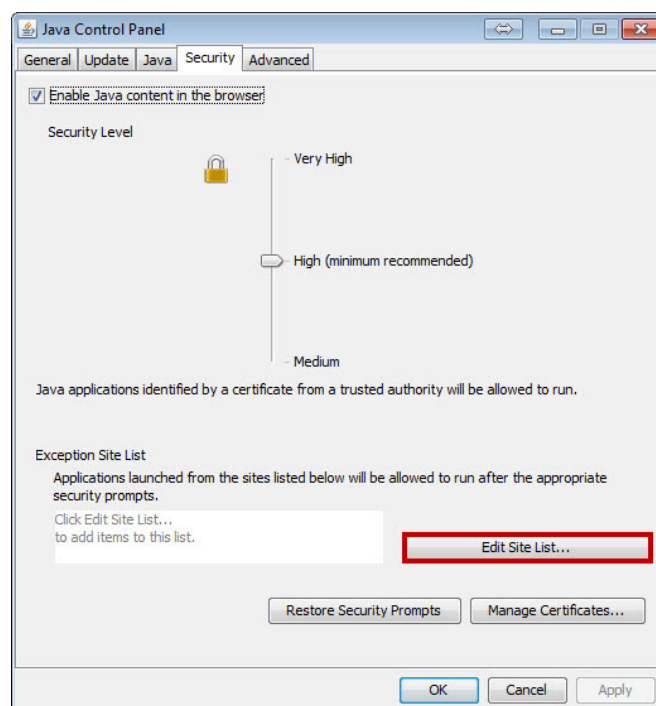
Use search to find the Control Panel

Press Windows logo key + W to open the Search charm to search settings
OR drag the Mouse pointer to the bottom-right corner of the screen, then click on the Search icon.

In the search box enter Java Control Panel

Click on Java icon to open the Java Control Panel.

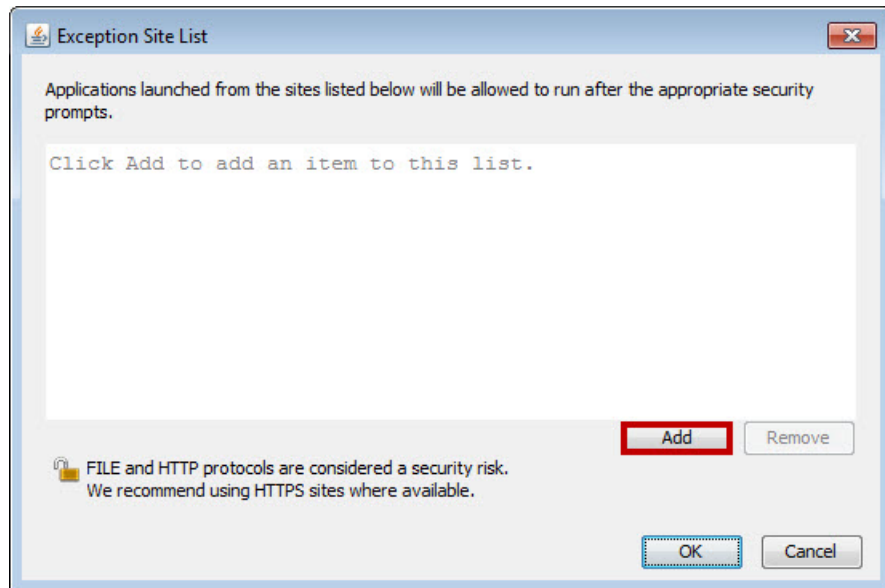
2. Select the **Security** tab.



Step	Action
------	--------

- | | |
|----|----------------------------------|
| 3. | Click on Edit Site List . |
|----|----------------------------------|

*The **Exception Site List** window opens:*



- | | |
|----|--|
| 4. | Enter the IP address of the USBL-BOX Web-based User Interface. |
|----|--|

- | | |
|----|---|
| 5. | Press <code>Enter</code> or click on Add . |
|----|---|

- | | |
|----|---|
| 6. | Click on OK to validate your choice and to close the window. |
|----|---|

- | | |
|----|-------------------|
| 7. | End of Procedure. |
|----|-------------------|

B RESTRICTIONS ON IP, GATEWAY AND MASK ADDRESSES

IP and Gateway

A few restrictions rule on the choice of an IP and Gateway addresses:

- 255 is not allowed for any of the four fields
- 0 is not allowed for fields 1 and 4
- 10 and 20 are not allowed for field 1
- 0.0.0.0 is allowed for a Gateway address

Mask

Only the listed values below are allowed

0.0.0.0
128.0.0.0
192.0.0.0
224.0.0.0
240.0.0.0
248.0.0.0
252.0.0.0
254.0.0.0
255.0.0.0
255.128.0.0
255.192.0.0
255.224.0.0
255.240.0.0
255.248.0.0
255.252.0.0
255.254.0.0
255.255.0.0
255.255.128.0
255.255.192.0
255.255.224.0
255.255.240.0
255.255.248.0
255.255.252.0
255.255.254.0
255.255.255.0
255.255.255.128
255.255.255.192
255.255.255.224
255.255.255.240
255.255.255.248
255.255.255.252
255.255.255.254
255.255.255.255

C INPUT PROTOCOLS

C.1 \$xxGGA / \$xxVTG

Data received: Latitude, Longitude of the ship or USBL-BOX, GPS quality

\$GPGGA,hhmmss.ss,ddmm.mmmmm,a,dddmm.mmmmm,b,q,ss,.....* hh<CR><LF>	
hhmmss.ss	is the UTC of position
ddmm.mmmmm	is the latitude in degrees and in minutes and 1/100000
a	is the hemisphere N: North S: South
dddmm.mmmmm	is the longitude in degrees and in minutes and 1/100000
b	is longitude sign (E: East, W: West)
q	is the GPS quality indicator <ul style="list-style-type: none"> • 0 Fix not valid • 1 GPS SPS Mode fix valid • 2 Differential Mode, SPS Mode, fix valid • 3 GPS PPS Mode, fix valid • 4 RTK • 5 Float RTK
ss	
*hh	is the number of satellites is optional

GPVTG is not mandatory for the good operating state of the USBL-BOX.

\$GPVTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>	
x.x,T	Course over ground, degrees True
x.x,M	Course over ground, degrees Magnetic
x.x,N	Speed over ground, knots
x.x,K	Speed over ground, km/h
a	Mode Indicator (A autonomous mode, D differential mode, E estimated mode, M manual input mode, S simulator mode, N Data not valid, never null)
*hh	Checksum

GPGBA(TP#1) This output protocol only includes a GPGBA string corresponding to the position of the transponder with ID = 1.

GPGLL (TP#1) \$GPGLL,4821.77993,N,00432.94054,W,100532.436,A,A*4A

Where:

GLL Geographic position, Latitude and Longitude

4821.77993,N Latitude 48 deg. 21,77993 min. North

00432.94054,W Longitude 432 deg. 32.94054 min. West

100532.436 Fix taken at 10:05:32.436 UTC

A Data Active or V (void)

*iD checksum data

This output protocol only includes a GPGBA string corresponding to the position of the transponder with ID = 1.

C.2 \$xxZDA

Data received: the Universal Time information

\$GPZDA,hhmmss.ss,dd,mm,yyyy,xx,yy*cc<CR><LF>	
hhmmss.ss	is the UTC time in hours, minutes, seconds of the GPS position
dd	is the day dd = 0 to 31
mm	is the month mm =1 to 12
yyyy	is the year
xx	is the local zone description in hours xx = -13 to 13
yy	is the local zone description in minutes yy = 0 to 59
*cc	is the checksum

C.3 \$ZQMTE

\$GPZDA, jj/mm/aa, hh : mm : ss.s		
Function	Hour	
Field1	Date	Day, Month, Year
Field 2	Time	Hour, Minute, Seconds and tenths of seconds

C.4 SIMRAD EM



This protocol must have a rate of 20 Hz.

- Standard: SIMRAD specified format
- Data received: Heading, Roll, Pitch, Heave and status

10 bytes binary data protocol

Message	SS 90 RRRR PPPP hhhh HHHH		
byte 0	0xSS	Sync byte	0x90 ⇒ OK
		Sensor status	0x9A ⇒ alignment
byte 1	0x90	Sync byte	
byte 2	0xRRRR	Roll LSB	Roll ± 180°
byte 3		Roll MSB	LSB : 0.01° Sign “+” when port goes up
byte 4	0xPPPP	Pitch LSB	Pitch ± 180°
byte 5		Pitch MSB	LSB : 0.01° Sign “+” when stern goes up
byte 6	0xhhhh	Heave LSB	Heave ± 10 m
byte 7		Heave MSB	LSB : 0.01 m Sign “+” when OCTANS goes up
byte 8	0xHHHH	Heading LSB	Heading 0° to 360°
byte 9		Heading MSB	LSB : 0.01°

C.5 HDMS THOMSON



This protocol must have a rate of 20 Hz.

- Standard: Output HDMS system
- Data received: Heading, Roll, Pitch, Heave and status

10 bytes binary data protocol

Message	00 90 RRRR PPPP hhhh HHHH		
byte 0	0x00	Sync byte	
byte 1	0x90	Sync byte	
byte 2	0xRRRR	Roll LSB	Roll ± 180°

byte 3		Roll MSB	LSB : 0.01° Sign “+” when port goes up
byte 4	0xPPPP	Pitch LSB	Pitch ± 180°
byte 5		Pitch MSB	LSB : 0.01° Sign “+” when stern goes up
byte 6	0xhhhh	Heave LSB	Heave ± 10 m
byte 7		Heave MSB	LSB : 0.01 m Sign “+” when OCTANS goes up
byte 8	0xHHHH	Heading LSB	Heading 0° to 360°
byte 9		Heading MSB	LSB : 0.01°

C.6 GAPS BIN



This protocol must have a rate of 20 Hz.

Data	Format	Units
Header	8 bit unsigned integer	Value : '\$'
Time tag of data	64 bit unsigned integer	See Note 1
INS interface status 1	32 bit unsigned integer	See [M-SP-POP-099]
INS algorithm status 2	32 bit unsigned integer	See [M-SP-POP-099]
Heading	32 bit IEEE Float	Rad
Roll	32 bit IEEE Float	Rad
Pitch	32 bit IEEE Float	Rad
Latitude	32 bit signed integer $\pm 2^{31} = \pm \frac{\pi}{2}$	Rad
Longitude	32 bit signed integer $\pm 2^{31} = \pm \pi$	Rad
Altitude (positive up)	32 bit IEEE Float	m
North speed	32 bit IEEE Float	m/s
West speed	32 bit IEEE Float	m/s
Vertical speed (positive up)	32 bit IEEE Float	m/s
Heave on selected lever arm	32 bit IEEE Float	m
Latitude standard deviation	32 bit IEEE Float	rad
Longitude standard deviation	32 bit IEEE Float	rad
Altitude standard deviation	32 bit IEEE Float	m
Heading standard deviation	32 bit IEEE Float	Rad
Roll standard deviation	32 bit IEEE Float	Rad
Pitch standard deviation	32 bit IEEE Float	Rad
CRC	16 bit unsigned integer	
Fin de trame	8 bit unsigned integer	Value : '#'

Time Tag

The 64 bits time tag is described hereafter:

Bit [63..56] spare

Bit [55..52] x 10 days (0 à 3)

Bit [47..44] x 10 hour (0 à 2)

Bit [39..35] x 10 minutes (0 à 5)

Bit [31..28] x 10 seconds (0 à 5)

Bit [23..20] x 1/10 seconds (0 à 9)

Bit [15..12] x 1000 µseconds (0 à 9)

Bit [7..4] x 10 µseconds (0 à 9)

Bit [51..48] days (0 à 9)

Bit [43..40] hours (0 à 9)

Bit [34..31] minutes (0 à 9)

Bit [27..24] seconds (0 à 9)

Bit [19..16] x 1/100 seconds (0 à 9)

Bit [11..8] x 100 µseconds (0 à 9)

Bit [3..0] µseconds (0 à 9)

C.7 \$PMEVL

Data received: Pressure value

\$PMEVL,XP,MEA,C,VVVV*cc<CR><LF>	
XP	is the transponder ID (from 001 up o 128)
MEA	is a mnemonic
C	is the analog channel, C = 8
VVVV	is the Pressure value VVVV = 0 to 65535 dBars (integer)
*cc	or VVV.V = 0.0 to 9999.9 dbars (float) is the checksum

C.8 \$WIMTW

This protocol is used to know the water temperature at the face of the antenna.

\$WIMTW,x.y,C*xx	
x, y	Temperature en Celsius degrees The C is mandatory and means Celsius

D OUTPUT PROTOCOLS

D.1 DATA STANDARD

The DATA Standard protocol is composed of the POSIDONIA positioning messages \$PTSAG, \$PTSAX, \$PTSAY, \$PTSAH and \$PTSAZ.

Transponder Absolute Positioning Message (geographical coordinates and depth)

**\$PTSAG,#NNNNN,
hhmmss.sss,jj,mm,aaaa,BBB,DDMM.MMMMM,H,DDDMM.MMMMM,D,A,MMMM.
M,A,MMMM.M *CK**

#NNNNN	Recurrence frame Number
hhmmss.ss	is the time in hours, minutes, seconds ,milliseconds
jj	is the day (jj = 0 to 31)
mm	is the month (mm =1 to 12)
aaaa	is the year
BBB	is the Transponder No. or ship's No 0: Ship 1 to 128: Transponder -128 to -1: Unknown Transponder
DDMM.MMMMM	is the latitude degrees, minutes and 1/100000
H	is the hemisphere (N: North, S: South)
DDDMM.MMMMM	is the longitude degrees, minutes and 1/100000
D	is the longitude direction (E: East, W: West)
A	is the validity of the four reception channels 0 to F: binary coding of acoustic hydrophone validity
MMMM.MM	is the calculated depth in meters
A	is the depth validity 0: None 1: Calculated 2: Sensor
MMMM.MM	is the sensor depth in meters

- Position validity: The value represents the acoustic hydrophone validity on 4 bits (from 0000 to 1111). 0 means that the channel is not valid and 1 that the hydrophone operates properly.
- Calculated depth / Sensor depth: The antenna know only one depth that is the fusion of both depths (Calculated and sensor). This “optimized” depth is in the “Calculated depth” field.
- Sensor depth: if the Acoustic Transponder has no sensor, the value is 9999.
- In case of ship, the three last fields are set to zero.

Transponder relative Positioning Message relative to the acoustic array (Relative coordinates and depth)

\$PTSAX,#NNNNN, hmmmss.sss,jj,mm,aaaa,BBB, XXXXX.X, YYYYY.Y,A,PPPP.P,A,CCCC.C *CK	
#NNNNN	Recurrence frame Number
hmmmss.ss	is the time in hours, minutes, seconds ,milliseconds
jj	is the day jj = 0 to 31
mm	is the month mm =1 to 12
aaaa	is the year
BBB	is the Transponder No. 1 to 128: Transponder -128 to -1: Unknown Transponder
XXXXX.X	is the X coordinate (+ forward) in meters
YYYYY.Y	is the Y coordinate (+ starboard) in meters
A	is the position validity (X, Y, Z) 0 to F: binary coding of acoustic channel validity
PPPP.PP	is the calculated depth in meters
A	is the depth validity 0: None 1: Calculated 2: Sensor
CCCC.CC	is the sensor depth in meters

- Position validity: The value represents the acoustic Channel validity on 4 bits (from 0000 to 1111). 0 means that the channel is not valid and 1 that the channel operates properly.
- Calculated depth / Sensor depth: The sensor know only one depth that is the fusion of both depths (Calculated and sensor). This “optimized” depth is in the “Calculated depth” field.
- Sensor depth: if the Acoustic Transponder has no sensor, the value transmitted is 9999.



The X and Y positions are relative to the Acoustic Array.

Transponder Relative Positioning Message relative to the sensor – NORTH orientation
(Relative coordinates and depth)

\$PTSAY,#NNNNN,hhmmss.sss,jj,mm,aaaa,BBB,XXXXX.X, YYYYY.Y,A,PPPP.P,A,CCCC.C *CK	
#NNNNN	Recurrence frame Number
hhmmss.ss	is the time in hours, minutes, seconds ,milliseconds
jj	is the day jj = 0 to 31
mm	is the month mm =1 to 12
aaaa	is the year
BBB	is the Transponder No. 1 to 128: Transponder -128 to -1: Unknown Transponder
XXXXX.X	is the X coordinates (positive northwards) in meters
YYYYY.Y	is the Y coordinates (positive eastwards) in meters
A	is the position validity (X,Y, Z) 0 to F: binary coding of acoustic channel validity
PPPP.PP	is the calculated depth in meters
A	is the depth validity 0: None 1: Calculated 2: Sensor
CCCC.CC	is the sensor depth in meters

- Position validity: The value represents the acoustic Channel validity on 4 bits (from 0000 to 1111). 0 means that the channel is not valid and 1 that the channel operates properly.
- Calculated depth / Sensor depth: The sensor know only one depth that is the fusion of both depths (Calculated and sensor). This “optimized” depth is in the “Calculated depth” field.
- Sensor depth: if the Acoustic Transponder has no sensor, the value transmitted is 9999.



The X and Y positions are relative to the Acoustic Array

This message is used for antenna calibration.

Message	\$PTSAZ,#NNNNN,HHMMSS.SSS,JJ,MM,AAAA,#PTSAW,R,C.CC C,R.RRR,T.TTT,L.LLLL,L.LLLL,X.XXX,Y.YYY,Z.ZZZ, *CK	
Wording	Ship's Attitude	
#NNNNN	Ethernet frame number	
HHMMSS.SSS	Hour	hour, minute, second, milliseconds
JJ	Day	0 to 31
MM	Month	1 to 12
AAAA	Year	
#PTSAW	Message header for attitude values during a reception	
R	R = Request	
C.CCC	Heading	rad
R.RRR	Roll	rad
T.TTT	Pitch	rad
L.LLLL	Latitude	rad
L.LLLL	Longitude	rad
X.XXX	Heading correction	rad
Y.YYY	Roll correction	rad
Z.ZZZ	Pitch Correction	rad

Example:

\$PTSAZ,#00038,224357.921,19,05,2011,#PTSAW,R,0.012,0.025,-0.004,0.5929326,-
2.0820059,0.004,-0.056,0.044*78

This message is used to transmit the heading to applications such as DELPH RoadMap.
This message is sent at the same rate as the PTSAG ship.

Message	\$PTSAH,0,DDD.DD,SS.SS*CK	
Wording	Heading and speed	
0	Ship's number	Always 0
DDD.DD	Heading	deg
SS.SS	Speed over ground	m/s

Example:

\$PTSAH, 0, 38.22, 1.77*78

\$PIXOG,CONFIG,TIME

This string carries the time of the last interrogation

Example: \$PIXOG,CONFIG,TIME,083629.276,16,12,2010*4A

Example	Meaning	Type	Unit	Note
\$PIXOG,	USBL			
CONFIG,				
TIME,		Integer		Reserved
08	Interrogation time	Integer	Hour	
36		Integer	Minute	
29.276,		Float	Second	
16,	Interrogation date	Integer	Day	
12,2010*4A		Integer	Month	
2010		Integer	Year	
*4A	Checksum			

\$PIXOG,DBG,2,1,PTLBL

Example	Meaning	Type	Unit
\$PIXOG,	USBL		
DBG,	Advanced measurement		
2,		Integer	
1,		Integer	
PTLBL,	Message title		
08		Integer	Hour
36		Integer	Minute
29.362,		Float	Second
16,		Integer	Day
12,		Integer	Month
2010,		Integer	Year
3	Nb of used beacons for the LBL		
2,	Transponder ID	Integer	
1248.32,	Slante range	Float	m
4,	Transponder ID	Integer	
845.78,	Slante range	Float	m
19,	Transponder ID	Integer	
568.12,	Slante range	Float	m
4812.12345	LBL latitude of acoustic antenna	Float	deg, min, 1/100000
N,	Hemisphere (N: North, S: South)	Character	
00512.12345	LBL longitude of acoustic antenna	Float	deg, min, 1/100000
W,	Direction (E: East, W: West)	Character	

2.24,	LBL depth of acoustic antenna	Float	m
4.25,	Latitude std dev	Float	m
2.14,	Longitude std dev	Float	m
1.54	Depth std dev	Integer	m
*3E	Checksum		

\$PTSAQ

Message	\$PTSAQ,hhmmss.sss,jj,mm,aaaa,BBB,XX.XX,YY.YY,AAA.A,ZZ.ZZ*CK<CR><LF>	
Description	Ellipse error of USBL positions	
HHMMSS.SSS	Hour	hour, minute, second, milliseconds
JJ	Day	0 to 31
MM	Month	1 to 12
AAAA	Year	
BBB	Transponder ID	1 to 999: Transponder -999 to -1: Unknown Transponder
XX.XX	Major axe XY: long axe (in m) of the error ellipse representing the standard deviation on the position in the XY plane	m (float)
YY.YY	Minor axe XY: small axe (in m) of the error ellipse representing the standard deviation of the position in the XY plane	m (float)
AAA.A	Angle between the North and the major axe of the XY error ellipse	Deg (float) – 0 to 360°
ZZ.ZZ	Standard deviation of the Z(m) position	m (float)
CK	Checksum	

Example:

```

$PTSAH,0,46.967,0.000*78
$PTSAG,#01396,000352.028,01,01,1970,0,4819.27243,N,06725.63359,E,F,0000.6,1,9999.0*22
$PTSAZ,#01397,000352.029000,1,1,1970,#PTSAW,R,-
0.8197,0.0122,0.0003,0.84336416,1.17682711,0.03,0.0017,0.0017,1*52
$PTSAG,#01398,000352.029,01,01,1970,1,4819.34848,N,06725.62896,E,F,0101.1,1,9999.0*21
$PTSAX,#01399,000352.029,01,01,1970,1,100.37,99.12,F,0101.1,1,9999.0*30
$PTSAY,#01400,000352.029,01,01,1970,1,140.95,-5.72,F,0101.1,1,9999.0*24
$PTSAQ,000352.029,01,01,1970,1,1.40,5.72,192.5,1.54*7E
  
```

DATA LEGACY

Message	\$PTSAX, BB, HHMMSS.SSS, JJ, MM, AAAA, #PTSAW, R, C. CCC, R. R RR, T. TTT, L. LLLL, L. LLLL, X. XXX, Y. YYY, Z. ZZZ, *CK
Wording	Ship's Attitude
BB	Transponder No. or ship's No. 0: Ship 01 to 15: Transponder
XXXXX X	coordinates m
YYYYY Y	coordinates m
A	Position validity (XYZ) 0 to F: binary coding of acoustic
PPPP	Depth BUC in meters
A	Depth validity 0: none 1: BUC 2: Sensor
CCCC	Sensor depth m

Example:

```
$PTSAX, 01, 00100, 00199, F, 0301, 1, 9999*16
$PTSAX, 01, 00100, 00199, F, 0301, 1, 9999*16
...
$PTSAX, 04, -0010, 00004, F, 1135, 1, 9999*0F
$PTSAX, 04, -0010, 00004, F, 1135, 1, 9999*0F
```

D.2 DATA LIGHT

The DATA LIGHT protocol contains only the strings PTSAG, PTSAX, PTSAY, PTSAH and PTSAZ that are already present in the DATA STANDARD protocol.

D.3 HIPAP HPR 400

Field	Name	Explanation of Kongsberg	
\$	Start Character		\$
PSIMSSB	Address	Prop. Simrad address for SSBL	PSMSSB
,hhmmss.ss	Time	Empty or Time of reception	
,cc	Tp_code	Example: B01, B33, B47	%03d
,A	Status	A for OK and V for not OK	A/V
,cc	Error_code	Empty or a three character error code	ExD/ExM
,a	Coordinate_system	C for Cartesian, P for Polar, U for UTM coordinates	C
,a	Orientation	H for Vessel head up, N for North, E for East	N
,a	SW_filter	M means Measured, F Filtered, P Predicted	M
,x.x	X_coordinate	See table below	Northing
,x.x	Y_coordinate	See table below	Easting
,x.x	Depth	Depth in meters	depth
,x.x	Expected_accuracy	The expected accuracy of the position	Sqrt(Tx2+ty2)
,a	Additional_info	N for None, C Compass, I inclinometer, D Depth, T Time	
,x.x	First_add_value	Empty, Tp compass or Tp x inclination	
,x.x	Second_add_value	Empty or Tp y inclination	
*hh	Checksum	Empty or Checksum	*ck
CRLF	Termination		CRLF

Example: \$PSIMSSB,,B01,A,,P,H,M,111.80,63.43,48.50,0.00,N,,*5E

	PSIMSSB fields		PSIMSSB coordinates of TP	
CO-ORD	Coord. system	Orientation	X_coordinate	Y_coordinate
Polar	P	H	Horizontal range	Bearing in °
Cartesian X/Y	C	H	Starboard	Forwards
Cartesian N/E	C	N	North	East
Cartesian E/N	C	E	East	North
UTM N/E	U	N	Northings	Eastings
UTM E/N	U	E	Eastings	Northings

Field	Name	Explanation of Kongsberg
\$	Start Character	
PSIMLBP	Address	The address of the LBL position
,hhmmss.ss	Time	The real time of the measurement. Given as hour, minutes and seconds. The time format is either local time or UTC time, depending on the selection in the menu.
,c- -c	Tp_array	The TP array for which the origin is valid
,a_	Type	The type of the item positioned
,A	Status	The status of the position. A is OK
,a_	Coordinates	
,x.x	X_coordinate	
,x.x	Y_coordinate	
,x.x	Depth	The depth of the position
,x.x	Major	The major axis of the error ellipse
,x.x	Minor	The minor axis of the error ellipse
,x.x	Direction	The direction of the major axis of the error ellipse
,x.x	Res_rms	The rms value of the normalized residuals
*hh	Checksum	Empty or checksum
CRLF	Termination	

Field	Name	Explanation of Kongsberg
\$	Start Character	
PSIMLBL	Address	The address for LBL location
,aa_	Type	C when calibrated, I when initial coordinates
,aa_	Coordinates	L when the coordinates are in local coordinates U when the coordinates are in UTM O when the coordinates are in UTM and define the UTM center to be used
,x	Location_no	Location number 1 to 99
,x	Serial_no	The serial number of the TP at the location
,x.x	North	North coordinate
,x.x	East	East coordinate
,x.x	Depth	Depth
,x.x	Major	The major axis of the one sigma error ellipse
,x.x	Minor	The minor axis of the one sigma error ellipse
,x.x	Direction	The direction of major axis
,x.x	Depth_std_dev	The one sigma standard deviation in depth
*hh	Checksum	Empty or checksum
CRLF	Termination	

D.4 HIPAP HPR 418 (fix and mobile)

Position telegram SSBL

Example

SSBL TP 133. X=123.4m Y=-567.8m Depth 1234.5 m One TP in use.

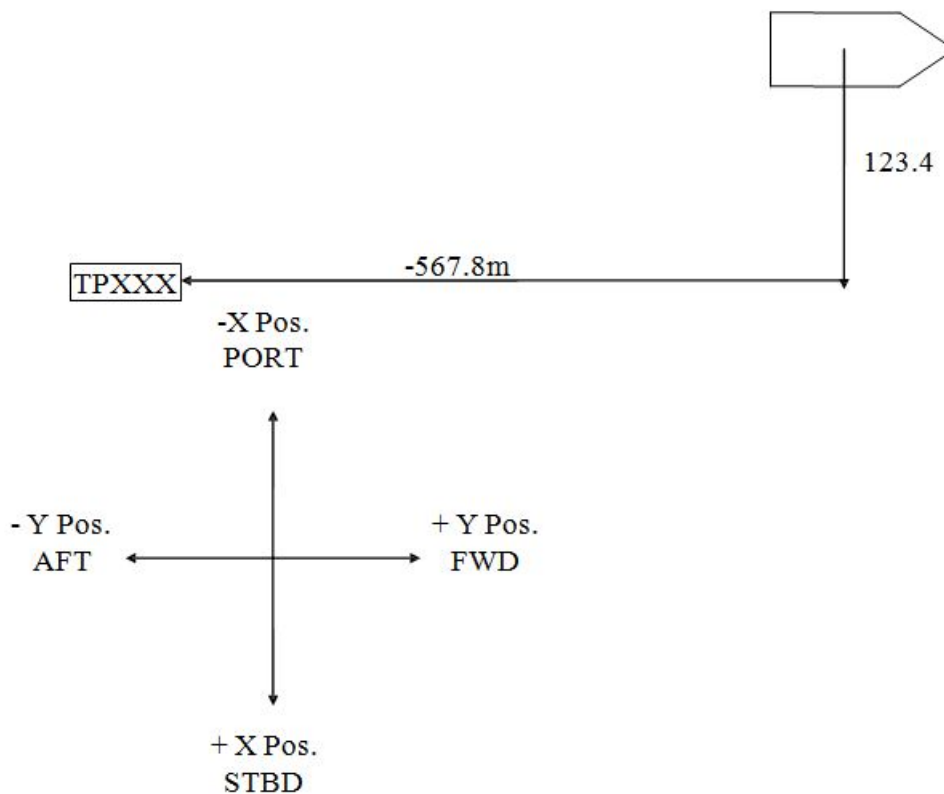
Heading = 359.9Deg TD 1 in use Wide beam Dif.Inc X=0.3Deg.Y=-7.5Deg.

Byte no.	BCD	INF.
1	DF	1: SOT
2	01	2: Head byte. 1 - SSBL position 2 - LBL position 3 - TP in sequence telegram
3	01	3: Status byte 1. (bit orientated) Bit 0: Position measurement OK. Bit 1: Position measurement filtered. Bit 2: Position measurement predicted. Bit 3: Optional data SSBL OK. Bit 4: Narrow beam. Bit 5: Spare Bit 6: BCD Conversion error Bit 7: Transceiver error.
4	00	4: Status byte 2. (bit orientated) Bit 0-1:Transducer number. Bit 2-3:Transceiver number. Bit 4: Training mode Bit 5: Mobil TP(SSBL) Rov TP (LBL) Bit 6: LBL Co-ordinates in UTM Bit 7: Master: 0; Slave: 1 ¹
5	02	5: TP. inf. 0 - Transponder 1 - Depth TP Optional Data 1 2 - Inclinometer TP Optional Data 1&2 3 - Diff.inc.TP Optional Data 1&2 4 - Compass TP Optional Data 1 5 - Acoustic control transponder 6 - Beacon 7 - Depth beacon 10 - Responder driver 1 13 - Responder driver 4
6	01	6: TP ID
7	33	TP from 1 to 299
8	00	7: X POS RAW
9	12	MSB used for sign. (“D” is negative)
10	34	LSB is 1/10 of the unit. 123.4 m stbd of vessel

¹ Slave=1 only when Slave Transmit enabled, otherwise no data from Slave

11	D0	8: Y POS RAW
12	56	MSB used for sign. (“D” is negative)
13	78	LSB is 1/10 of the unit. -567.8 m aft of vessel
14	01	9: Z POS RAW
15	23	LSB is 1/10 of the unit.
16	45	1234.5 m depth.
17	35	10: HEADING
18	99	LSB is 1/10 of the unit. 359.9 Deg
19	00	11: OPTIONAL DATA 1
20	00	MSB used for sign
21	03	LSB is 1/10 of the unit. 0.3Deg.
22	D0	12: OPTIONAL DATA 2
23	00	MSB used for sign. (“D” is negative)
24	75	LSB is 1/10 of the unit. -7.5Deg
25	00	13: Horizontal error ellipse direction
26	00	LSB is 1/10 of the unit.
27	00	14: Horizontal error ellipse major
28	00	LSB is 1/10 of the unit.
29	00	15: Horizontal error ellipse minor
30	00	LSB is 1/10 of the unit.
31	XX	16: CHECK SUM
32	FF	16: EOR

Example SSBL X-pos. 123.4m, Y-pos. -567.8m



Position telegram LBL

Example data

X=1234.56m Y=-987.65m Depth 1234.5m Heading 359.9Deg Pos. to ROV 15.

Training mode

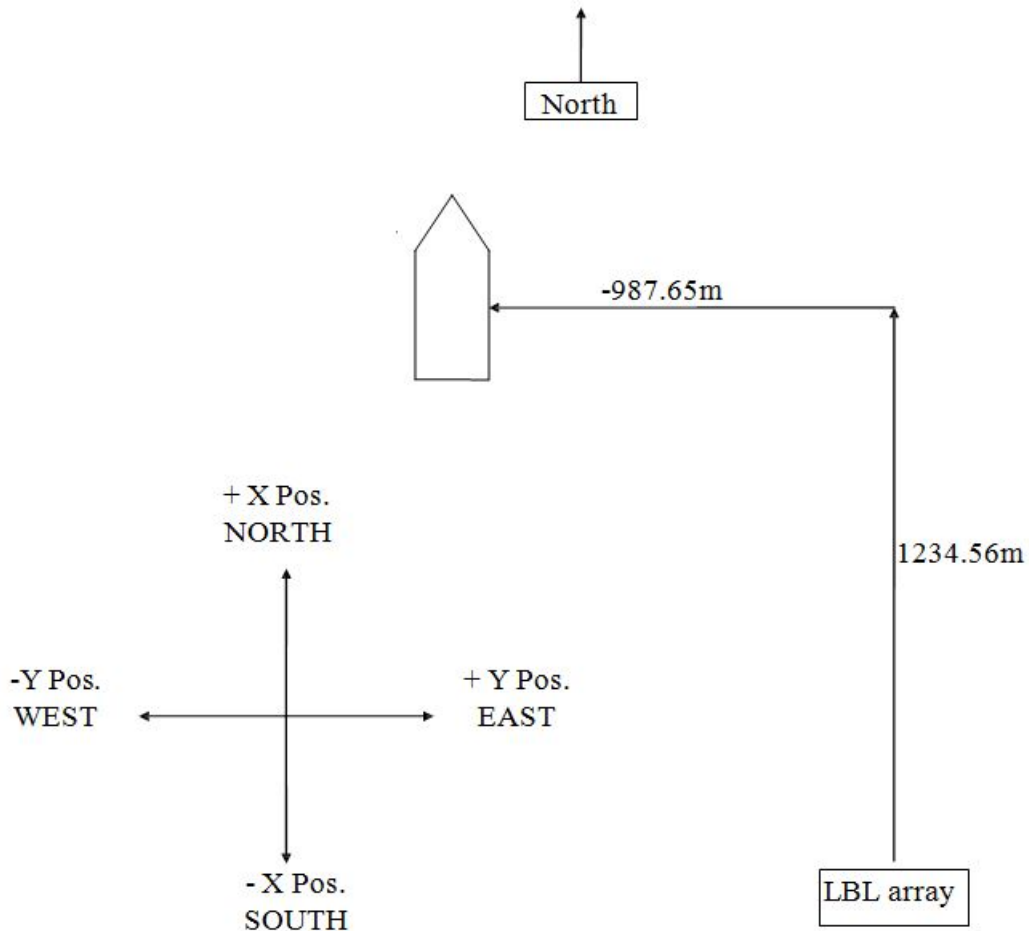
Byte no.	BCD	INF.
1	DF	1: SOT
2	02	2: Head byte. 1 - SSBL position 2 - LBL position 3 - TP in sequence telegram
3	01	3: Status byte 1. (bit orientated) Bit 0: Position measurement OK. Bit 1: Position measurement filtered. Bit 2: Position measurement predicted. Bit 3: Optional data SSBL OK. Bit 4: Narrow beam. Bit 5: Spare Bit 6: BCD Conversion error Bit 7: Transceiver error.
4	00	4: Status byte 2. (bit orientated) Bit 0-1: Transducer number. Bit 2-3: Tranceiver number. Bit 4: Training mode Bit 5: Mobil TP(SSBL) Rov TP (LBL) Bit 6: LBL Co-ordinates in UTM Bit 7: Master: 0; Slave: 1 ²
5	15	5: TP. inf. 0 - Position of Vessel 1 - Position of ROV 1 : : 16 - Position of ROV 16 17 - Position of Relay 1 18 - Position of Relay 2 19 - Position of Relay 3 20 - Position of Relay 4
6	01	6: TP. array 1 - Array 1 : : 4 - Array 4
7	00	7: X POS (raw or estimated)
8	00	MSB used for sign. (“D” is negative)
9	12	LSB is 1/100 of the unit.
10	34	
11	56	1234.56m north of LBL array

² Slave=1 only when Slave Transmit enabled, otherwise no data from Slave

12	D0	8: Y POS (raw or estimated)
13	00	MSB used for sign. (“D” is negative)
14	09	LSB is 1/100 of the unit.
15	87	
16	65	-987.65m east of LBL array
17	12	9: Z POS RAW (raw or estimated)
18	23	LSB is 1/10 of the unit.
19	45	1234.5 m
20	35	10: HEADING
21	99	LSB is 1/10 of the unit. 359.9 Deg
22 > 24		11: NOT IN USE (Filled with zero)
25	00	12: Horizontal error ellipse direction
26	00	LSB is 1/10 of the unit.
27	00	13: Horizontal error ellipse major
28	00	LSB is 1/10 of the unit.
29	00	14: Horizontal error ellipse minor
30	00	LSB is 1/10 of the unit.
31	XX	15: CHECK SUM
32	FF	16: EOR

Vessel position relative to LBL array.

Example LBL X-pos. 1234.56m, Y-pos. -987.65m



D.5 KONGSBERG BCD

Position Telegram SSBL

Example data:

SSBL TP 133. X=123.4m Y=-567.8m Depth 1234.5 m One TP in use.

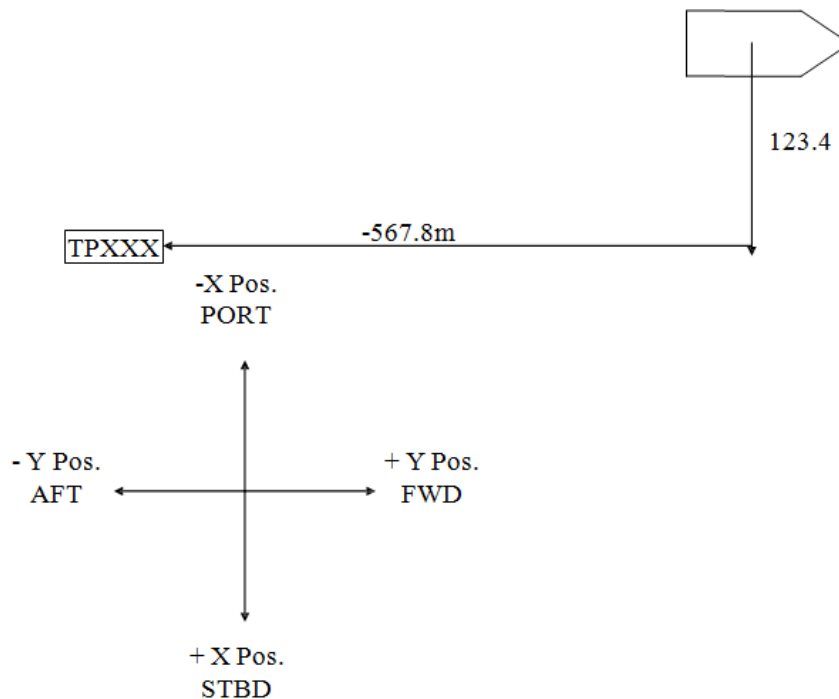
Heading = 359.9° TD 1 in use Wide beam Dif.Inc X=0.3°.Y=-7.5°.

Byte no.	BCD	INF.
1	DF	1: SOT
2	01	2: Head byte. 1 - SSBL position
3	01	3: Status byte 1. (bit orientated) Bit 0: Position measurement OK. Bit 1: Position measurement filtered. Bit 2: Position measurement predicted. Bit 3: Optional data SSBL OK. Bit 4: Narrow beam. Bit 5: Spare Bit 6: BCD Conversion error Bit 7: Transceiver error.
4	00	4: Status byte 2. (bit orientated) Bit 0-1: Transducer number. Bit 2-3: Transceiver number. Bit 4: Training mode Bit 5: Mobil TP(SSBL) Rov TP (LBL) Bit 6: LBL Co-ordinates in UTM Bit 7: Master: 0; Slave: 11
5	02	5: TP. inf. 0 - Transponder 1 - Depth TP Optional Data 1 2 - Inclinator TP Optional Data 1&2 3 - Diff.inc.TP Optional Data 1&2 4 - Compass TP Optional Data 1 5 - Acoustic control transponder 6 - Beacon 7 - Depth beacon 10 - Responder driver 1 13 - Responder driver 4
6	01	6: TP ID
7	33	TP from 1 to 299
8	00	7: X POS RAW
9	12	MSB used for sign. ("D" is negative)
10	34	LSB is 1/10 of the unit. 123.4 m stbd of vessel
11	D0	8: Y POS RAW
12	56	MSB used for sign. ("D" is negative)
13	78	LSB is 1/10 of the unit. -567.8 m aft of vessel

¹ Slave=1 only when Slave Transmit enabled, otherwise no data from Slave

Byte no.	BCD	INF.
14	01	9: Z POS RAW
15	23	LSB is 1/10 of the unit.
16	45	1234.5 m depth.
17	35	10: HEADING
18	99	LSB is 1/10 of the unit. 359.9°
19	00	11: OPTIONAL DATA 1
20	00	MSB used for sign
21	03	LSB is 1/10 of the unit. 0.3°
22	D0	12: OPTIONAL DATA 2
23	00	MSB used for sign. (“D” is negative)
24	75	LSB is 1/10 of the unit. -7.5°
25	00	13: Horizontal error ellipse direction
26	00	LSB is 1/10 of the unit.
27	00	14: Horizontal error ellipse major
28	00	LSB is 1/10 of the unit.
29	00	15: Horizontal error ellipse minor
30	00	LSB is 1/10 of the unit.
31	XX	16: CHECK SUM
32	FF	16: EOR

Example: Transponder position relative to vessel: X. 123.4m, Y. -567.8m



Position Telegram LBL

Example data

X=1234.56m Y=-987.65m Depth 1234.5m Heading 59.9° Pos. to ROV 15. Training mode

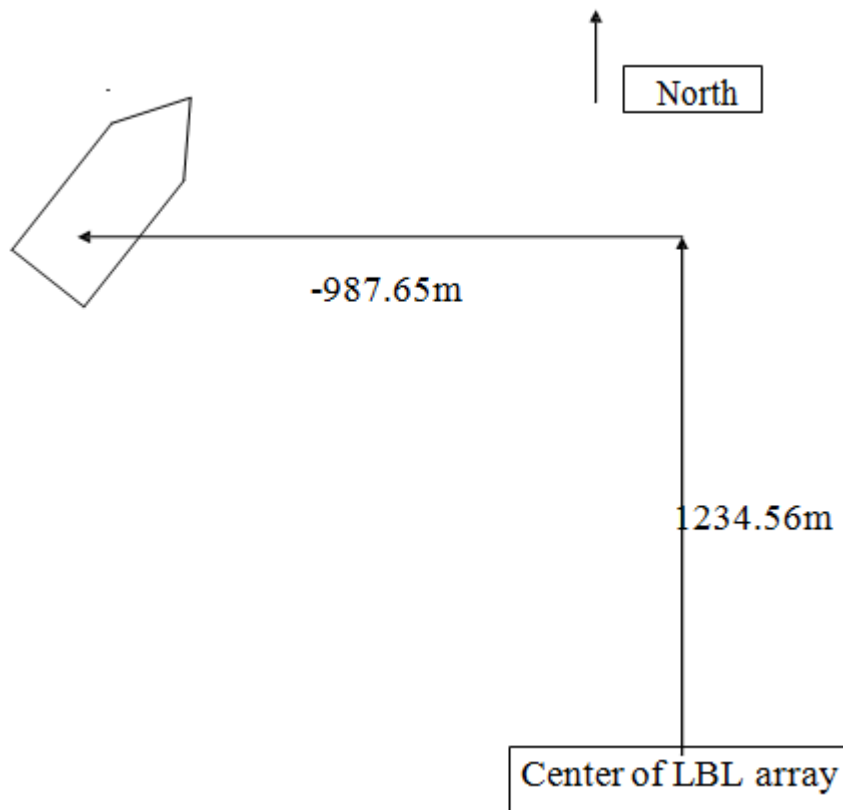
Byte no.	BCD	INF.
1	DF	1: SOT
2	02	2: Head byte. 2 - LBL position
3	01	3: Status byte 1. (bit orientated) Bit 0: Position measurement OK. Bit 1: Position measurement filtered. Bit 2: Position measurement predicted. Bit 3: Spare. Bit 4: Narrow beam. Bit 5: Spare Bit 6: BCD Conversion error Bit 7: Transceiver error.
4	00	4: Status byte 2. (bit orientated) Bit 0-1: Transducer number. Bit 2-3: Tranceiver number. Bit 4: Training mode Bit 5: Rov TP (mobile) Bit 6: LBL Co-ordinates in UTM Bit 7: Master: 0; Slave: 1 ²
5	15	5: TP. inf. 0 - Position of Vessel 1 - Position of ROV 1 : : 16 - Position of ROV 16 17 - Position of Relay 1 18 - Position of Relay 2 19 - Position of Relay 3 20 - Position of Relay 4
6	01	6: TP. array 1 - Array 1 : : 4 - Array 4
7	00	7: X POS (raw or estimated) MSB used for sign. (“D” is negative) LSB is 1/100 of the unit. 1234.56m north of LBL array
8	00	
9	12	
10	34	
11	56	
12	D0	8: Y POS (raw or estimated) MSB used for sign. (“D” is negative) LSB is 1/100 of the unit. -987.65m east of LBL array
13	00	
14	09	
15	87	
16	65	

² Slave=1 only when Slave Transmit enabled, otherwise no data from Slave

Byte no.	BCD	INF.
17	01	9: Z POS RAW (raw or estimated)
18	23	LSB is 1/10 of the unit.
19	45	1234.5 m
20	05	10: HEADING
21	99	LSB is 1/10 of the unit. 059.9°
22	55	11: Number of Tp in Array
		Bit 0-3: Total number of Tp in Array Bit 4-7: Number of ranges used Total: 5, Used: 5
23	00	12: RMS of residuals
24	09	LSB is 1/10 of the uni: 000.9
25	00	13: Horizontal error ellipse direction
26	00	LSB is 1/10 of the unit.
27	00	14: Horizontal error ellipse major axis
28	00	LSB is 1/10 of the unit.
29	00	15: Horizontal error ellipse minor axis
30	00	LSB is 1/10 of the unit.
31	XX	16: CHECK SUM
32	FF	17: EOR

The local coordinates are relative to the center (i.e. the origin) of the LBL array. For vessels, the position is normally the position of the CG. For ROVs, the position is normally the position of the transducer.

Example:
N. 1234.56m
E. -987.65m



TP in sequence telegram

To be sent every 20 s, and if any changes in the sequence. List of active transponders to be packed. Tp ID 300 is used to identify an LBL position. HAIN positions are not included in the transponders in sequence telegram.

Example: TP 001/103/ 207/133/300 in use.

Byte no.	BCD	INFO.
1	DF	1: SOT
2	03	2: Head byte. 3 - TP in sequence telegram
3	05	3: No of TP in use.
4	00	4: TP 1.
5	01	TP 1
6	01	5: TP 2.
7	03	TP 103
8	02	6: TP 3.
9	07	TP 207
10	01	7: TP 4.
11	33	TP 133
12	03	8: TP 5.
13	00	TP 300
14	00	9: TP 6.
15	00	
16	00	10: TP 7.
17	00	
18	00	11: TP 8.
19	00	
20	00	12: TP 9.
21	00	
22	00	13: TP 10.
23	00	
24	00	14: TP 11.
25	00	
26	00	15: TP 12.
27	00	
28	00	16: TP 13.
29	00	
30	00	17: Dummy byte (filled with zero).
31	XX	17: CHECK SUM.
32	FF	18: EOR.

D.6 iXSea USBL INS 1

Byte Nb	Field	Nb of bits	Definition	Value		
				LSB	Min	Max
1	GG _{hex}	8	header	55 _{hex}		
2	Bits 2 to 0	3	Message number	001 _{bin}		
	Bits 7 to 3	5	Transponder ID	NA	0	31
3, 4, 5, 6	LLLLLLLL _{hex}	32	Latitude (deg) (Two-complement coded)	180/2 ³²	- 90 °	90x(1-2 ³²) °
7, 8, 9, 10	NNNNNNNN _{hex}	32	Longitude (deg)	360/2 ³²	0 °	360.(1-2 ³²) °
11 to 12	ZZZZZ _{hex} (8+8+4 bits: - byte11, - byte12, - bits 3 to 0 dof byte 13)	20	Z (m), immersion	0,01 m	0 m (00000 _{hex})	+10485,75 m (FFFFF _{hex})
13	Bit 4	1	Reserved			
	Bits 7 to 5	3	Major axe XY: long axe (in m) of the error ellipse representing the standard deviation on the position in the XY plane 000: 0 m < standard deviation < 0,5 m 001: 0,5 m < standard deviation < 1,5 m 010: 1,5 m < standard deviation < 3 m 011: 3 m < standard deviation < 6 m 100: 6 m < standard deviation < 12 m 101: 12 m < standard deviation < 25 m 110: 25 m < standard deviation < 50 m 111: standard deviation > 50 m			
14	Bit 0	1	Reserved			
	Bits 3 to 1	3	Minor axe XY: small axe (in m) of the error ellipse representing the standard deviation of the position in the XY plane 000: 0 m < standard deviation < 0,5 m 001: 0,5 m < standard deviation < 1,5 m 010: 1,5 m < standard deviation < 3 m 011: 3 m < standard deviation < 6 m 100: 6 m < standard deviation < 12 m 101: 12 m < standard deviation < 25 m 110: 25 m < standard deviation < 50 m 111: standard deviation > 50 m			
	Bits 7 to 4	4	Angle between the North and the major axe of the XY error ellipse l	180/2 ⁴	0 °	15/16 x180 °
15	Bit 0	1	Reserved			
	Bits 3 to 1	3	Standard deviation of the Z(m) position 000: 0 m < standard deviation < 0,5 m 001: 0,5 m < standard deviation < 1,5 m 010: 1,5 m < standard deviation < 3 m 011: 3 m < standard deviation < 6 m 100: 6 m < standard deviation < 12 m 101: 12 m < standard deviation < 25 m 110: 25 m < standard deviation < 50 m 111: standard deviation > 50 m			
	Bits 7 to 4	4	Reserved			

Byte Nb	Field	Nb of bits	Definition	Value		
				LSB	Min	Max
16	PP _{hex}	8	Reserved			
17, 18	rrrrrrrrrrrrrrrrrrrrrrrrrr _{bin} (8+8+6 bits of: - byte 17, - byte 18, - bits 5 to 0 of byte 19)	22	It is the truncation of the absolute time provided by the GPS to the USBL-BOX, keeping only the minutes, seconds, and milliseconds. It is coded in milliseconds number.	1 ms	0 ms	(3 599 999 ms, i.e. 1h - 1ms The largest values of this field do not have any meaning
19		2	Reserved			
20	KK _{hex}	8	Status byte Bits 0 to 8 - Reserved			
21	SS _{hex}	8	Checksum exclusive OR by byte for the whole 20 first bytes thus header included.			

Immersion definition

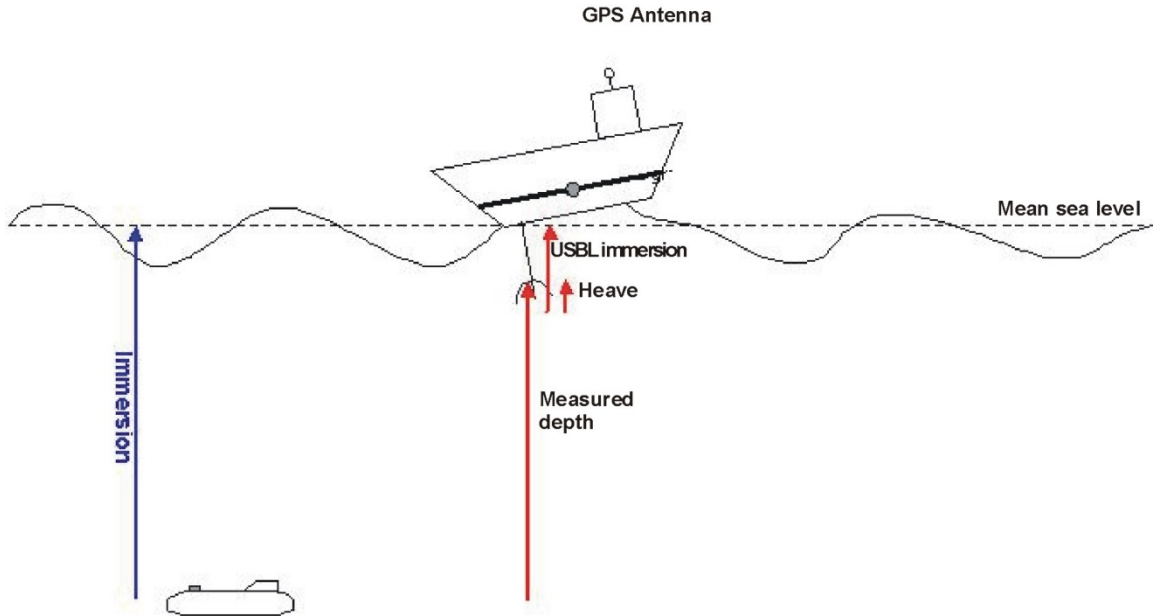
The immersion corresponds to the mobile depth with respect to the mean sea level (thus heave corrected). This data is coherent with the one that would be given by a depth sensor on the underwater mobile. But it does not allow to deduce the absolute position as there is no compensation for tide.

D.7 iXSea USBL INS 2

Message	\$PXUI2,id,lat,lon,imm,maj,min,ang,dev,tim*CK	
Field 1	Transponder ID	
Field 2	Latitude (deg)	Resolution: 180/232 Domain: [-90 .. 90 x (1-232)]
Field 3	longitude (deg)	Resolution: 360/232 Domain: [-90 .. 360 x (1-232)]
Field 4	Immersion (m)	Resolution: 0,01 m Domain: [0 .. +10485,75]
Field 5	Major axe XY (m) Long axe of the error ellipse representing the standard deviation on the position in the XY plane	0: 0 m < standard deviation < 0,5 m 1: 0,5 m < standard deviation < 1,5 m 2: 1,5 m < standard deviation < 3 m 3: 3 m < standard deviation < 6 m 4: 6 m < standard deviation < 12 m 5: 12 m < standard deviation < 25 m 6: 25 m < standard deviation < 50 m 7: standard deviation > 50 m
Field 6	Minor axe XY (m) Small axe of the error ellipse representing the standard deviation of the position in the XY plane	0: 0 m < standard deviation < 0,5 m 1: 0,5 m < standard deviation < 1,5 m 2: 1,5 m < standard deviation < 3 m 3: 3 m < standard deviation < 6 m 4: 6 m < standard deviation < 12 m 5: 12 m < standard deviation < 25 m 6: 25 m < standard deviation < 50 m 7: standard deviation > 50 m
Field 7	Angle between the North and the major axe of the XY error ellipse	Resolution: 180/24 Domain: [0 .. 15/16 x 180]
Field 8	Standard deviation of the Z(m) position	0: 0 m < standard deviation < 0,5 m 1: 0,5 m < standard deviation < 1,5 m 2: 1,5 m < standard deviation < 3 m 3: 3 m < standard deviation < 6 m 4: 6 m < standard deviation < 12 m 5: 12 m < standard deviation < 25 m 6: 25 m < standard deviation < 50 m 7: standard deviation > 50 m
Field 9	Truncation of the absolute time provided by the GPS to the USBL-BOX, keeping only the minutes, seconds, and milliseconds. It is coded in milliseconds number.	Resolution: 1ms Domain: [0 .. 3 599 999] The largest values of this field do not have any meaning

Immersion definition

The immersion corresponds to the mobile depth with respect to the mean sea level (thus heave corrected). This data is coherent with the one that would be given by a depth sensor on the underwater mobile. But it does not allow deducing the absolute position as there is no compensation for tide.



$$\begin{aligned} \text{Immersion} &= \text{Measured depth (by the USBL acoustic array)} \\ &- \text{Heave} \\ &+ \text{USBL immersion} \end{aligned}$$

D.8 NAUTRONIX ATS II

Message	Date Time B: Transp E: Status X: PosX Y: PosY D: psoZ H: Heading P: pitch R: roll <CR><LF>	
Field 1	Date	dd month AAAA
Field 2	Time	HH:MM:SS:mmm
Field 3	Transponder number	From 1 to 127
Field 4	Status	0
Field 5	X coordinate	In meters ('+' when directed to starboard)
Field 6	Y coordinate	In meters ('+' when directed to the bow)
Field 7	Z coordinate	In meters ('+' when directed to the bottom)
Field 8	Heading	In degrees ('+' clockwise)
Field 9	Pitch	In degrees ('+' when bow up)
Field 10	Roll	In degrees ('+' when starboard up)

D.9 POSIDONIA 6000

- Data received: Transponder number, Transponder latitude, Transponder longitude, Transponder depth, Latitude standard deviation, Longitude standard deviation, Depth standard deviation, Delay
- Data frame: Binary format (32 bytes)

Message	<Sync><F1><F2>.....<F8><Ch1Ch2>	
Byte 0	0x24	Synchronization byte
Data Field 1 Byte 1	Transponder number	<u>Warning</u> : The first received number is used as a synchronization byte for all the other inputs
Data Field 2 Bytes 2 to 5	Transponder latitude	+/-2 ³² = +/-Pi signed 32 bits
Data Field 3 Bytes 6 to 9	Transponder longitude	+/-2 ³² = +/-Pi signed 32 bits
Data Field 4 Bytes 10 to 13	Transponder depth	IEEE floating point format , meters <u>Warning</u> : Not used by the INS
Data Field 5 Bytes 14 to 17	Latitude standard deviation	IEEE floating point format , meters
Data Field 6 Bytes 18 to 21	Longitude standard deviation	IEEE floating point format , meters
Data Field 7 Bytes 22 to 25	Depth standard deviation	IEEE floating point format , meters
Data Field 8 Bytes 26 to 29	Delay	IEEE floating point format , seconds
Bytes 30 to 31	Checksum	Addition of all the bytes from 0 to 29. <u>Warning</u> : 2 characters

D.10 USBLBOX_POSTPRO

Terminology

- CRP: Common Reference Point
- BRD: Acoustic Antenna Mounting Flange
- CAC: Acoustic center of the acoustic antenna
- RIXI: iXBlue Reference Frame
 - ❑ X+: towards the bow (axis of the ship)
 - ❑ Y+: towards starboard
 - ❑ Z+: upward
 - ❑ Roll+: port goes down
 - ❑ Pitch+: bow goes down
 - ❑ Heading+: Bow goes to port.
- RANT: Acoustic antenna reference frame
 - ❑ X+ towards H1
 - ❑ Y+ towards H4
 - ❑ Z+ downwards
- RIXI o CRP : iXBlue reference frame centered on common reference point
- RANT o BRD : Acoustic antenna reference frame centered on the center of the mounting flange
- RANT o Hx : Acoustic antenna reference frame centered on hydrophone x

Overview

USBL REJEU protocol comprises all necessary data for playback:

- Configuration data (supposed invariant)
 - ❑ System characteristics
 - ❑ Beacon characteristics
- Operational environment data
 - ❑ Antenna calibration
 - ❑ System Installation
 - ❑ Sound speed profile
- Input data
 - ❑ Time
 - ❑ Raw navigation data
 - ❑ Detection characteristics
 - ❑ Ancillary data

Protocol Structure

The protocol comprises binary datagrams produced by the equipment. It contains the sufficient and necessary data for playback of the applied real time processing.

The datagrams comprise :

- Header for identification and characterization
- Main body of data described in the header
- Checksum (bytes sum)

Data Type The following conventions are applied:

Type	Description
byte	Unsigned 8 bits integer
short	Signed 16 bits Integer
ushort	Unsigned 16 bits Integer
long	Signed 32 bits Integer
ulong	Unsigned 32 bits Integer
float	Float IEEE 754 32 bits

- 16 and 32 bytes encoded data are described with the Big endian convention (strong weight byte sent first)
- NaN have a value of 0x7FC00000

System Identification

This datagram gathers the configuration elements of the system.

	Description	Format	Unit	Observation	
Header	Synchronization	byte		'\$'	
	Total Size	byte		30	
	Datagram ID	byte		\$80	
	Datagram release number	byte		\$01	
Identification	Equipment Type	ushort		0	Inconnu
				1	GAPS - TITAN – CL
				2	GAPS - CARBON – ML
				3	GAPS - TITAN – ML
				4	(U-BOX) - FLUSH
				5	(U-BOX) - CAGE
	Serial Number	ushort			
Version	FPGA DSP	ulong		MMSB	implementation
	Firmware DSP	ulong		MSB	major release
	FPGA Mother board	ulong		LSB	minor release
	Firmware Mother board	ulong		LLSB	correction
	Algorithms	ulong			
	Checksum	ushort			

System Characteristics

This datagram gathers the identification elements of the system.

	Description	Format	Unit	Observation
Header	Synchronization	byte		'\$'
	Total Size	byte		16
	Datagram ID	byte		\$81
	Datagram release number	byte		\$01
Parameters	Demodulation frequency	float	Hertz	
	Maximum phase error	float	radian	
	Maximum phase jumps	short		
	Checksum	ushort		

Transponders Characteristics

This datagram gathers the transponder configuration elements.

	Description	Format	Unit	Observation	
Header	Synchronization	byte		'\$'	
	Total Size	byte		35	
	Datagram ID	byte		\$82	
	Datagram release number	byte		\$01	
Ctrl	Transponder number	short		Positif, Base 0	
	Total number of transponder	short		Positif, max 50	
Transponder	Transponder ID	short			
	Transponder type	short		-1	Générique
				0	RT8 ^{MF}
				1	Monotonal ^{MF}
				2	RT9 ^{MF}
				3	MT9 ^{MF}
				4	BT8 ^{MF}
				5	RT9 ^{BF}
				6	RAMSES 6000 ^{BF}
				7	ET9 ^{BF}
				8	RTT4 ^{BF}
	9	RT8 ^{BF}			
	Code / interrogation frequency	ushort	- / Hz	< 8000 : code MFSK	
	Code / response frequency	ushort	- / Hz	>= 8000 : frequency	
Operational behavior	byte		0	None	
			1	Fixed transponder	
			2	Mobile transponder	
Interrogation mode	byte		0	Transponder	
			1	Primary responder	
			2	Spontaneous (pinger)	
			3	Secondary Responder	

	Turn around time	short	ms		
	Reply signal	float	Hertz		
	Depth management	byte		0	No known depth
				1	Pressure sensor
				2	Not used
				3	Acoustic telemetry
				4	Configuration depth
Accuracy of the configuration depth	float	meter			
Accuracy of the depth by pressure measurement	float	meter			
Checksum	ushort				

Antenna Calibration

This protocol gathers the acoustic antenna characteristics (theoretical and measured)

	Description	Format	Unit	Observation	
Header	Synchronization	byte		'\$'	
	Total Size	byte		102	
	Datagram ID	byte		\$83	
	Datagram release number	byte		\$01	
Theoretical antenna	Pair H1 / H2	Delta X	float	meter	RANT o H1
		Delta Y	float	meter	RANT o H1
		Delta Z	float	meter	RANT o H1
		Delta Phase	float	radian	
	Pair H2 / H3	Delta X	float	meter	RANT o H2
		Delta Y	float	meter	RANT o H2
		Delta Z	float	meter	RANT o H2
		Delta Phase	float	radian	
	Pair H3 / H4	Delta X	float	meter	RANT o H3
		Delta Y	float	meter	RANT o H3
		Delta Z	float	meter	RANT o H3
		Delta Phase	float	radian	
Measured antenna	Pair H1 / H2	Delta X	float	meter	RANT o H1
		Delta Y	float	meter	RANT o H1
		Delta Z	float	meter	RANT o H1
		Delta Phase	float	radian	
	Pair H2 / H3	Delta X	float	meter	RANT o H2
		Delta Y	float	meter	RANT o H2
		Delta Z	float	meter	RANT o H2
		Delta Phase	float	radian	
	Pair H3 / H4	Delta X	float	meter	RANT o H3
		Delta Y	float	meter	RANT o H3
		Delta Z	float	meter	RANT o H3
		Delta Phase	float	radian	
Checksum		ushort			

System Installation

This protocol gathers all the elements describing the system geometry.

	Description	Format	Unit	Observation	
Header	Synchronization	byte		'\$'	
	Total Size	byte		62	
	Datagram ID	byte		\$84	
	Datagram release number	byte		\$01	
Misalignments	Attitude sensor	Delta Heading	float	degree	RIXI
		Delta Roll	float	degree	RIXI
		Delta Pitch	float	degree	RIXI
	Mounting flange	Delta Heading	float	degree	RIXI
		Delta Roll	float	degree	RIXI
		Delta Pitch	float	degree	RIXI
Offsets	Position sensor	Delta X	float	meter	RIXI o CRP
		Delta Y	float	meter	RIXI o CRP
		Delta Z	float	meter	RIXI o CRP
	Mounting Flange	Delta X	float	meter	RIXI o CRP
		Delta Y	float	meter	RIXI o CRP
		Delta Z	float	meter	RIXI o CRP
	Sea Level	Delta Z	float	meter	RIXI o CRP
	Acoustic center	Delta Z	float	meter	RANT o BRD
	Checksum	ushort			

Sound Velocity Profile Pair

The sound velocity profile comprises depth/velocity pairs.

	Description	Format	Unit	Observation
Header	Synchronization	byte		'\$'
	Total Size	byte		18
	Datagram ID	byte		\$85
	Datagram release number	byte		\$01
Ctrl	Pair number	short		>0, Base 0
	Total number of pairs	short		>0, Maximum 55
Pair	Depth	float	meter	>0
	Velocity	float	m/s	between 1400 and 1600
	Checksum	ushort		

Detection and detection context

This datagram gathers all elements describing detections and their contexts.

	Description		Format	Unit	Observation
Header	Synchronization		byte		'\$'
	Total Size		byte		219
	Datagram ID		byte		\$86
	Datagram release number		byte		\$01
	Transponder ID		short		
Time	Interrogation	Seconds	ulong	s	Base 01/01/1970 (time_t)
		Micro seconds	ulong	µs	
	Detection	Seconds	ulong	s	Base 01/01/1970 (time_t)
		Micro seconds	ulong	µs	
Interrogation raw position	Position	Latitude	long		$[-2^{31}..+2^{31}] \equiv [-180..+180]$
		Longitude	long		$[-2^{31}..+2^{31}] \equiv [-180..+180]$
		Altitude	float	meter	
	Position accuracy	Latitude	float	meter	
		Longitude	float	meter	
		Altitude	float	meter	
	Attitude	Heading	float	degree	
		Roll	float	degree	
		Pitch	float	degree	
		Heave	float	meter	
	Attitude accuracy	Heading	float	degree	
		Roll	float	degree	
		Pitch	float	degree	
		Heave	float	meter	
	Speed	North	float	m/s	
		East	float	m/s	
Vertical		float	m/s		
Detection raw position	Position	Latitude	long		$[-2^{31}..+2^{31}] \equiv [-180..+180]$
		Longitude	long		$[-2^{31}..+2^{31}] \equiv [-180..+180]$
		Altitude	float	meter	
	Position accuracy	Latitude	float	meter	
		Longitude	float	meter	
		Altitude	float	meter	
	Attitude	Heading	float	degree	
		Roll	float	degree	
		Pitch	float	degree	
		Heave	float	meter	
Attitude accuracy	Heading	float	degree		
	Roll	float	degree		

		Pitch	float	degree			
		Heave	float	meter			
	Speed	North	float	m/s			
		East	float	m/s			
Vertical		float	m/s				
Acoustic detection (49)	Arrival time	H1	float	S	interrogation		
		H2	float	S	interrogation		
		H3	float	S	interrogation		
		H4	float	s	interrogation		
	Phase	H1	float	radian			
		H2	float	radian			
		H3	float	radian			
		H4	float	radian			
	Noise Signal Ratio	H1	float	dB			
		H2	float	dB			
		H3	float	dB			
		H4	float	dB			
	Validity	H1	byte		Bit 0	[0, 1] ≡ [invalid, valid]	
		H2			Bit 1	[0, 1] ≡ [invalid, valid]	
		H3			Bit 2	[0, 1] ≡ [invalid, valid]	
		H4			Bit 3	[0, 1] ≡ [invalid, valid]	
Auxiliary data	Known depth		float	meter			
	Origin of known depth		byte		0	Invalid known position	
					1	Pressure sensor	
					2	Not used	
					3	Acoustic telemetry	
					4	Configuration depth	
	Known CAC velocity		float	m/s			
Origin of the known CAC velocity		byte		0	Unknown CAC Velocity		
				1	Speed profile		
				2	Temperature data		
	Checksum		ushort				

Raw Transponder Position

This datagram contains the result of position computation made in real time.

	Description	Format	Unit	Observation	
Header	Synchronization	byte		'\$'	
	Total Size	byte		56	
	Datagram ID	byte		\$87	
	Datagram release number	byte		\$01	
	Transponder ID	short			
	Age de la position	ulong	µs	Since emission	
Time	Emission	Seconds	ulong	s	Base 01/01/1970 (time_t)
		Micro seconds	ulong	µs	
Transponder	Position	Latitude	long		$[-2^{31}..+2^{31}] \equiv [-180..+180]$
		Longitude	long		$[-2^{31}..+2^{31}] \equiv [-180..+180]$
		Immersion	float	meter	Not tide corrected
	Covariance position	North / North	float	meter ²	
		North / East	float	meter ²	
		North / Depth	float	meter ²	
		East / East	float	meter ²	
		East / Depth	float	meter ²	
		Depth / Depth	float	meter ²	
	Checksum	ushort			

D.11 PIFM-POPSN

\$PIFM,POPSN,JJ/MM/AAAA,HH:MM:SS,DDD,ddd.dd,±vv.vv,±vv.vv,CCCC,nn,
 JJ/MM/AAAA,HH:MM:SS.DDD,s,dd,mm.mmmm,s,ddd,mm.mmmm,mmmm,c,c,
 mmmm,[CR][LF]

Message		Format	Bytes
Header	ID	\$PIFM,POPSN,	12
	Date	JJ/MM/AAAA,	11
	Time	HH:MM:SS,DDD,	13
Heading and Speed	Heading (0 à 360), degrees	ddd.dd,	7
	Speed X, knots	±vv.vv,	7
	Speed Y, knots	±vv.vv,	7
Transponder or other Mobile Device Position	Transponder or mobile device ID *	4 characters,	5
	Transponder number	nn,	3
	Position date	JJ/MM/AAAA,	11
	Time position	HH:MM:SS.DDD,	13
	Latitude in degrees, s is the sign of the latitude	s,dd,mm.mmmm,	13
	Longitude in degrees, s is the sign of the longitude	s,ddd,mm.mmmm,	14
	Depth, meters	mmmm,	5
	Validity X, Y (F valid and 0 for invalid)	c,	2
	Validity Z (0: invalid, 1: computed value, 2: measure)	c,	2
	Depth sensor data, meters	mmmm,	5
Message End	End	[CR][LF]	2

* ID: transponder ID in 4 characters (example for transponder 1: « 0001 », for transponder 26: « 0026 »)

E WIRING OF THE POSIDONIA ANTENNA

First column: Definition of the connection point on the connector

Second column: Description of the function of the transmitted signal

Pin	Function
A	Power Supply +12V
B	Ground +12V (GND B)
D	Gain+
G	Gain-
H	Gain-
K	Channel 1 +
L	Channel 1 -
N	Channel 2 +
P	Channel 2 -
S	Channel 3 +
T	Channel 3 -
V	Channel 4 +
W	Channel 4 -
b	Transmission HOT (brown)
c	Transmission COLD (yellow)
e	Power supply -12V
f	Ground -12V (GND B)
p	Contact hydro +
q	Contact hydro -

F MECHANICAL DRAWING

