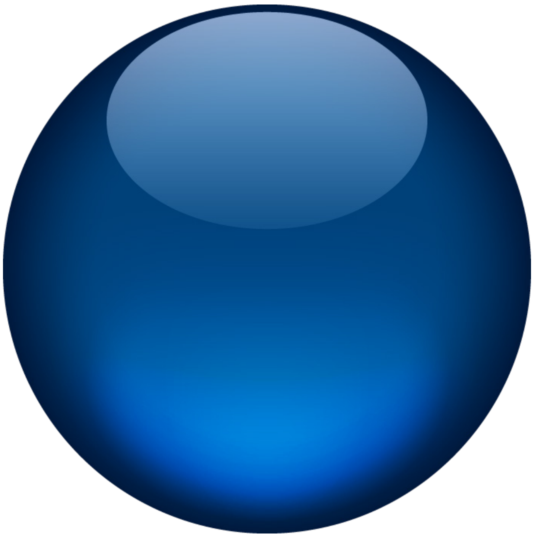


GAPS

Positioning System

User Manual

Revision History

Edition	Date	Comments
F	05/2016	Pack soft 6.

Copyright

Disclaimer

Warranty

iXBlue provides a standard warranty of one (1) year covering this product against any defect in materials or manufacture. The warranty starts from the date of shipment of the product from iXBlue's manufacturing premises to customer's location and its duration is indicated in the certificate of warranty delivered with the product. In the event that a defect in materials or manufacture becomes obvious during the stipulated warranty period, iXBlue will undertake, at its sole discretion, either to repair the defective product, bearing the cost of all parts and labor, or to replace it with an identical product.

In order to avail itself of this warranty, Customer must notify iXBlue of the defect before expiry of the warranty period and take all steps necessary to enable iXBlue to proceed. Customer shall be responsible for the packaging and the shipment of the defective product to the repair center notified by iXBlue, the cost of such shipment being borne by Customer. iXBlue agrees to bear the cost of return freight, based on CPT (Cost Paid To) Customer's airport location, import tax-free.

This warranty shall not be construed as covering defects, malfunctions or damages caused by improper use or inadequate maintenance of the product. Under no circumstances shall iXBlue be due to provide repair or replacement under this warranty in order a) to repair damage caused by work done by any person not representing iXBlue for the installation, repair or maintenance of the product ; b) to repair damage caused by improper use or connection to incompatible equipment, and specifically, the opening of the housing of the equipment under warranty shall cause the warranty to be automatically cancelled ; c) to maintain any product that has been modified or integrated into a larger configuration, if such modification or integration increases the duration or difficulty of the maintenance of said product.

This warranty covers the product hereunder and is provided by iXBlue in place of all and any other warranty whether expressed or implied. iXBlue does not guarantee the suitability of the product under warranty for sale or any specific use. iXBlue's liability is limited to the repair or replacement of defective products, this being the sole remedy open to Customer in the event the warranty becomes applicable. iXBlue cannot be held liable for indirect, special, subsequent or consequential damage, irrespective of whether iXBlue has or has not received prior notification of the risk of occurrence of such damage.

Export Regulation

Export of the products and services described in this document may be subject to different national rules and regulations related to export control.

iXBlue products and services shall not be exported, re-exported or used in the following countries (including their territorial waters): Cuba, Iraq, Iran, North Korea, Sudan and Syria.

The following export control guidelines shall apply as related to French rules and regulations.

Dual-use goods

Whenever the dual-use goods category applies, it has not been specifically developed for military applications but may be used in the scope of either civilian or military applications. It is then concerned by the dispositions of Regulation (EC) N° 428/2009 of the Council of 5th May 2009 as modified, directly applicable in French law.

As a consequence, this product or service is subject to the following dual-use goods export control procedures from France:

- It can be freely delivered to France or **any country within EU**.
- It can be exported under iXBlue's Union General Export Authorization n° EU001 **to the following countries (so called "bona fide"): Australia, Canada, USA, Japan, New-Zealand, Norway and Switzerland/Liechtenstein.**
- It can be exported to **other countries** but only through the preliminary issuance of an individual export license by the French authorities.

If an individual export license has to be issued by the French authorities, it is required that you provide a description of your usual activity (and the one of the end-user if different) and that the end-user fills in an end-user certificate (using a predefined format). This certificate includes the description and location of the intended application for the product or service as well as a commitment not to re-export the said product or service without the preliminary agreement of the French authorities.

Once the product or service has been delivered to its first destination, the following rules apply:

- From an EU country member, the good is free of movement as long as it remains within EU.
- From an EU country member, the good can only be re-exported to a non EU country member under the dual-use goods export control procedures set forth by the local national authorities.
- From a "bona fide" country, the good can only be re-exported under the dual-use goods export control procedures set forth by the local national authorities.
- From another country, the good can only be re-exported under both the conditions of the original export license from France (depending on its type and content) and the dual-use goods export control procedures set forth by the local national authorities.

Overview of GAPS User Guide

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

- **Part 1: Introduction –** This section contains a general and technical description of GAPS as well as the technical conventions that apply.
- **Part 2: Conventions and Specifications –** This section gathers all important information about reference center, reference axes, signs of attitude angles etc.
- **Part 3: Installing GAPS –** In this section you find the procedure for installation the GAPS system, to assess its geometrical configuration parameters, and to plan all connections to external systems.
- **Part 4: Configuring GAPS –** In this section you find the procedure for GAPS operation with the Web-based interface. It describes how to configure the GAPS and the transponders with all required parameters before operating the system.
- **Part 5: Setting GAPS to Work** – This section gathers all tasks that have to be gone through before the start of the survey.
- **Part 6: Visualizing USBL Data with DELPH RoadMap** – This section describes how to use of DELPH RoadMap software to visualize USBL data coming out of GAPS.
- **Part 7: Coupling GAPS and PHINS 6000** – This section describes the connection between GAPS and PHINS 6000 installed on an ROV.
- **Part 8: Dynamic Positioning Mode** – This section details the operation of GAPS in conjunction with a dynamic positioning system.
- **Part 9: Operating GAPS –** This section provides the full description of GAPS operation.
- **Part 10: Maintenance –** This section provides the preventative and corrective maintenance for GAPS.

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.
`Courier`	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.
Italic	Italic text is the result of an action in the procedures.

Icons

The **Note** icon indicates that the following information is of particular interest and should be read with care.

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

DGPS	Differential Global Positioning System
DP	Dynamic Positioning
FOG	Fiber Optical Gyroscope
GAPS	Global Acoustic Positioning System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IIF	Individual Interrogation Frequency
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
MFSK	Multi-Frequency Shift Keying
NA	Not Applicable
NIS	Noise Isotropic Spectrum
NMEA	National Marine Electronics Association
RTK	Real-Time Kinematics
SNR	Signal to Noise Ratio
TAT	Turn Around Time
USBL	Ultra Short Base Line

Table of Contents

1 INTRODUCTION

1.1 Principle

The Global Acoustic Positioning System GAPS is a portable Ultra Short Base Line (USBL) with integrated Inertial Navigation System (INS) and Global Navigation Satellite System (GNSS).

Plug and Play

The GAPS system is recommended for mobile or fixed installations. It can be combined with an additional hoisting system. It is a plug & play installation. No calibration is required before using GAPS.

Accuracy

The GAPS system is used to deliver:

- The position of one or more underwater objects or vehicles, which can maneuver at depth up to 3,000 meters. Deeper is possible depending on the type of beacon used.
- The accuracy is up to 0.2% accuracy of the Distance to Go (or DTG at 1σ) depending on environmental and operational conditions.
- The heading, attitude, motion and position of the support vessel or buoy.

Operation Principles

The underwater objects or vehicles are tracked using acoustic transponders, the GAPS antenna is deployed underwater and is usually mounted below the ship hull, see Figure 1.

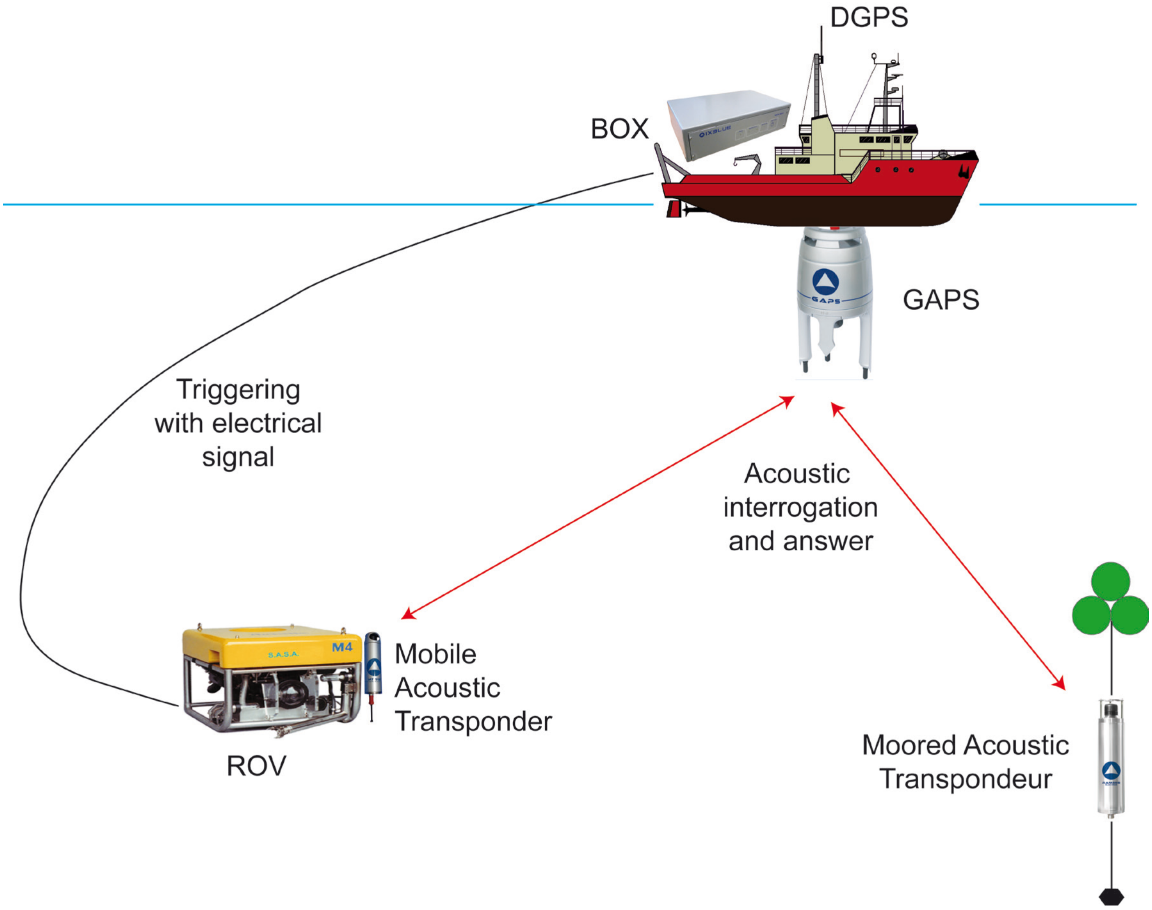


Figure 1 - GAPS typical mounting

The operation principle is based on a bi-directional exchange of underwater acoustic signals between the acoustic transponders and the GAPS that comprises one transducer for transmitting and four reception hydrophones.

The GAPS has an operating field over 200 degrees coverage below the ship. During the positioning operations it can be used at 3 or 4 knots or more depending on the expected performances and at 12 knots during the transit operations.

Positioning

The positioning of the acoustic transponder(s) is performed as follows:

- The transmitting transducer sends an interrogation signal to the transponder.
- The four receiver hydrophones of the GAPS receive the MFSK reply from the transponder.
- The GAPS processing unit detects the signal and measures the different phases of the signals arriving at the four hydrophones and the elapsed time between interrogation and reply.
- GAPS takes into account the attitude of the acoustic array (provided by the internal fiber-optic gyros at the exact moment of the reception of the signal). The processing unit deduces the transponder position relatively to the GAPS antenna.
- The INS sensor processes the data coming from the differential GPS antenna with its own gyros and acceleration sensors in order to accurately determine the absolute position of the acoustic array at the exact moment when the transponder signal has been received.
- The absolute position of GAPS is given by the GPS. The position of the transponder relative to GAPS position is computed. GAPS can then provide the accurate absolute position of the transponder.
- This absolute position feeds a Kalman filter, which is able to provide an estimation of the current position of the transponder in real-time.
- Additionally, the position, heading, roll and pitch of the acoustic array (or the ship) are available as output.

Dynamic Positioning

GAPS 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 to the GAPS, the LBL position may be input into the INS.

Remote Control

GAPS is also equipped with 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

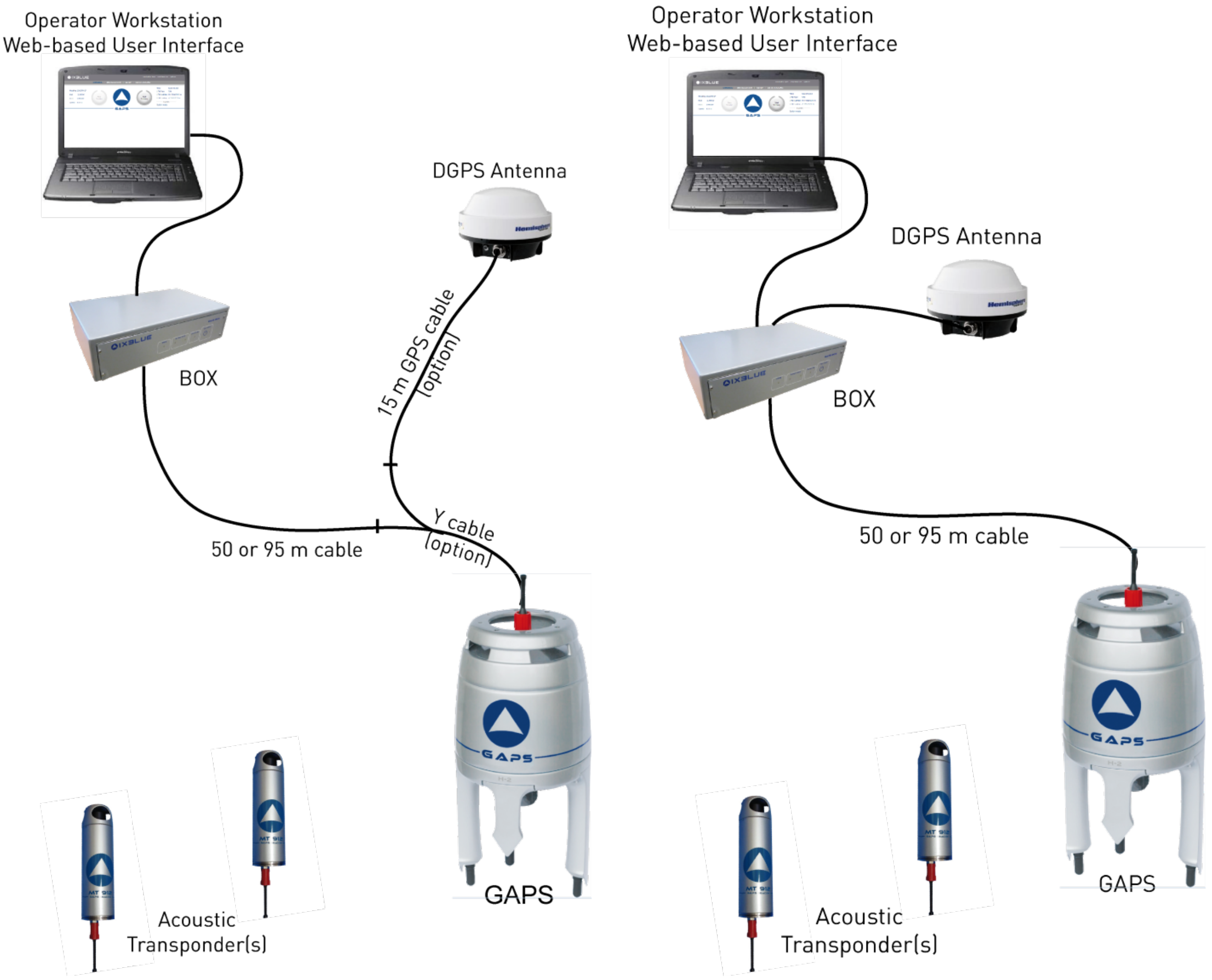


Figure 2 – GAPS System Components, two possible architectures

Elements The GAPS system consists of the following elements, see Figure 2:

- **GAPS head,** see section 1.2.2
- **GAPS BOX** connects GAPS and the other system elements, see section 1.2.3
- **Web-based User Interface** is used to configure (mandatory) and to monitor (optional) the real time data, see section 1.2.4
- Up to 40 moored or mobile **acoustic transponders**, see section 1.2.5
- Optional integrated **DGPS** antenna provides absolute positions of the ship to GAPS

Cables Three cables are used in the GAPS system:

- **Main cable** links GAPS to the BOX
- Optional **Y cable** connects the GPS and the BOX directly to the GAPS.
- Optional **GPS cable** links the Y cable to the GPS antenna.

User GPS If the expected accuracy of an external GPS is better than the GAPS integrated DGPS, it is possible to connect it to the BOX (through the External GPS RS 232 serial link) and to use its positioning data. **In that case, the “Y” cable is not used.**

1.2.2 GAPS HEAD

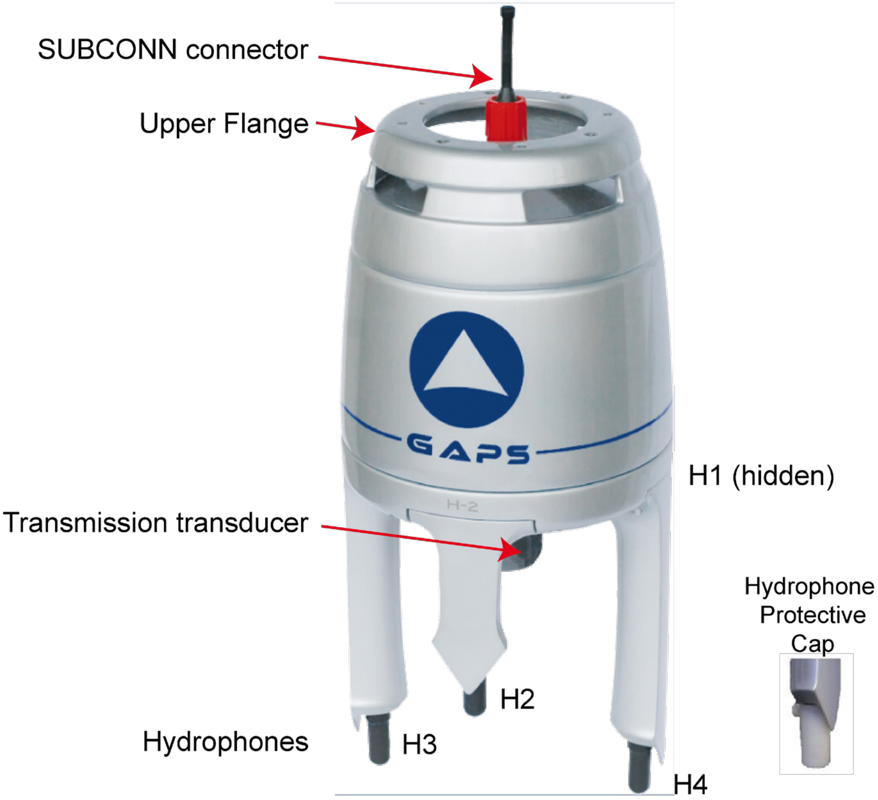


Figure 3 - GAPS Head

Description

The GAPS head is equipped with carbon housing. It is composed of (see Figure 3)

- An upper flange for handling and fastening
- A central transmission transducer
- Four reception hydrophones of different lengths to take 3D measurements
- The four hydrophones are protected by plastic caps
- A SUBCONN connection plug

Contents

The GAPS head contains:

- The acoustic electronics for reception based on the MSFK Chirp modulation technique
- An Inertial Navigation System (INS)
- The acoustic transmitter electronics

GAPS Head

The GAPS head ensures

- The acoustic transmission or electrical triggering signals to the Transponders
- The reception of the replies
- The processing taking into account the attitude provided by the fiber-optic sensor
- The transmission of the results

Maximum speed with deployed GAPS antenna: 12 knots.

1.2.3 GAPS BOX

The GAPS BOX connects together all the different elements of the system. The GAPS head and the external sensors (GPS, Synchronization) are directly connected to the BOX. The ship power supply is provided to the BOX. Ethernet and serial links connectors are available for data output. The GAPS BOX is necessary to the operation of GAPS.

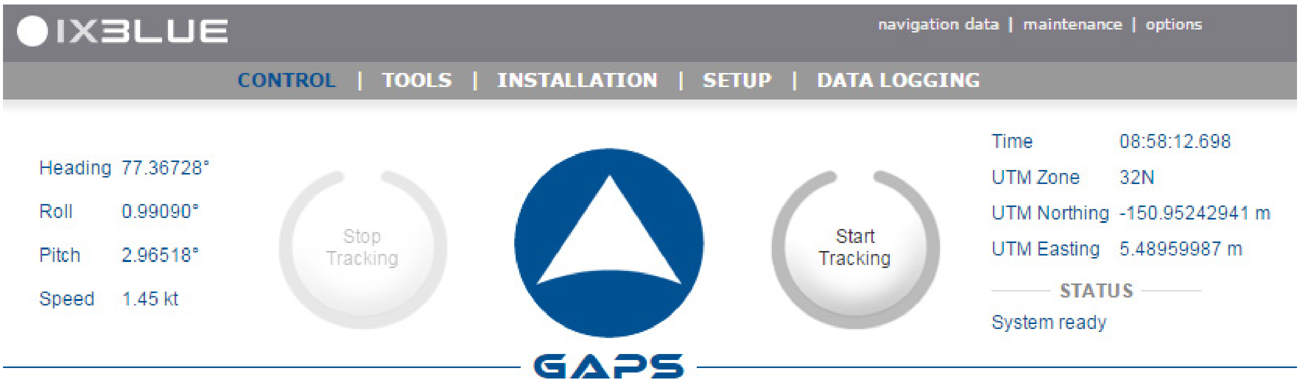
Figure 4 – GAPS BOX

BOX connectors

- Ethernet: control/command and four input and output links
- Four input and output serial links
- Two synchronization outputs and one synchronization input
- One PPS link
- Power supply VDC/AC

1.2.4 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 the data input 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.



Heading	77.36728°
Roll	0.99090°
Pitch	2.96518°
Speed	1.45 kt

Time	08:58:12.698
UTM Zone	32N
UTM Northing	-150.95242941 m
UTM Easting	5.48959987 m

STATUS

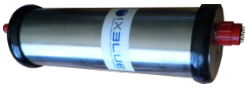
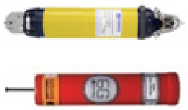
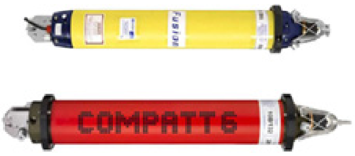
System ready

Figure 5 – Main window of the Web-based user interface

1.2.5 ACOUSTIC TRANSPONDERS

The transponders that are compatible with GAPS are listed in Table 1. Please report to specific User guides for full description of the acoustic transponder. This list is not exhaustive, contact iXBlue to know if compatibility exists with other models.

Table 1 – GAPS compatible transponders

iXBlue	MT8	
iXBlue	MT9	
iXBlue	RTAx2	
iXBlue	ZTA02C	
iXBlue	RAMSES	
Applied	1019 (software permitting*)	
Sonardyne	Mini beacons (5 & 6) Wideband® 1 compatible	
Sonardyne	COMPATT 5 COMPATT6 Wideband® 1 compatible	

* Only the “software permitting”. Make sure your Applied beacon has the Wideband@ 1 compatibility before operating.

1.2.6 OPTIONAL INTEGRATED DGPS

The optional integrated DGPS antenna is compatible with SBAS signals.

Figure 6 – Optional Integrated DGPS

The MMP26C-2212S1 connector is IP 67 (resists to immersion at 1 meter during 30 minutes).

1.2.7 OPTIONAL HISYS HOISTING SYSTEM

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

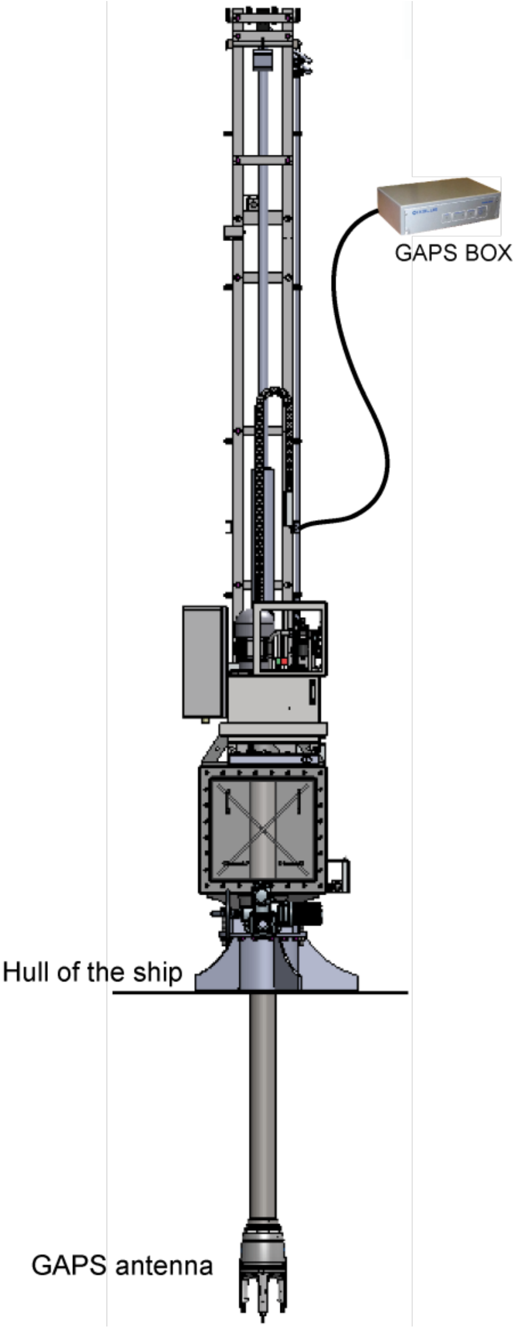


Figure 7 – HiSys hoisting system

2 CONVENTIONS AND SPECIFICATIONS

2.1 Conventions

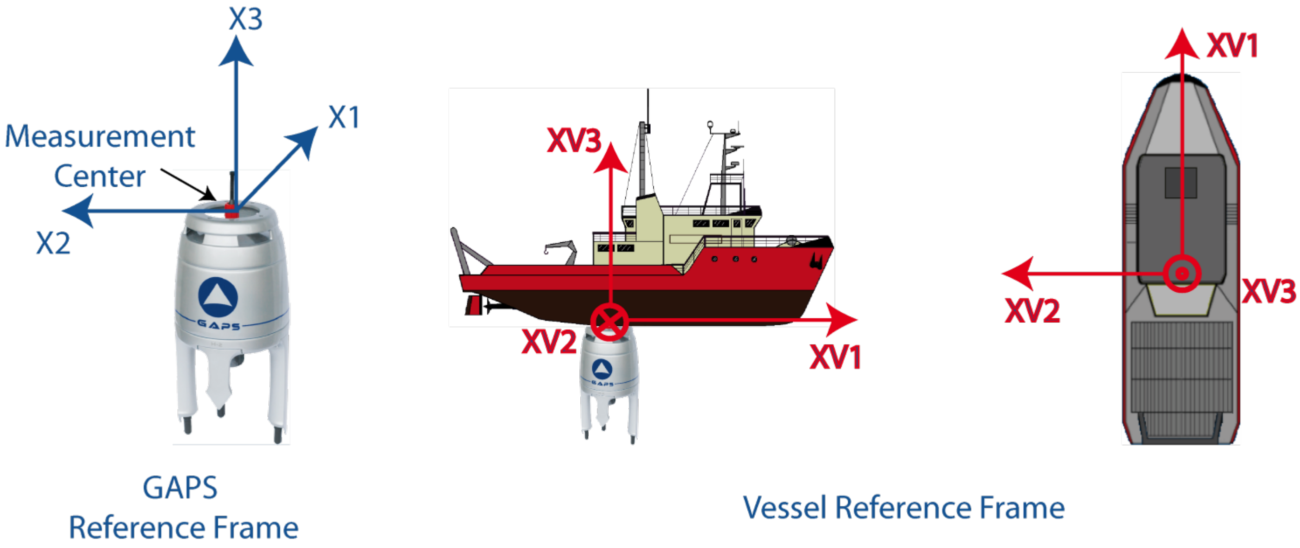
2.1.1 REFERENCE AXES AND MEASUREMENT CENTER

Center

The GAPS center of measurement is in the center of the mounting flange of the acoustic antenna. See Figure 8. In the Web-User Interface, the GAPS center of measurement is equivalent to the CRP (Common Reference point). The GAPS center of measurement is the reference point for the determination of external sensor (i.e., GPS) lever arms.

Reference frames

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



GAPS Reference Frame

Vessel Reference Frame

Figure 8 – Center of measurement and reference axes

Misalignment

The misalignments of the acoustic antenna are measured between the reference frame of GAPS 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 GAPS reference frame is based on the H1, H2, H3 and H4 hydrophones. H1 has to be directed towards the bow of the ship (see Figure 9). The names of the hydrophones are printed above the arms.

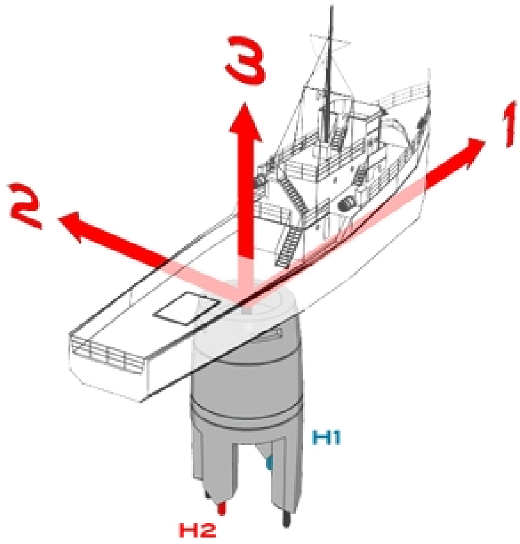


Figure 9 - H1 and H2 hydrophones

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 GAPS Acoustic Antenna

2.2.1 GENERAL CHARACTERISTICS

Positioning

Characteristics	Values
Coverage	200° below the acoustic array
Acoustic Level	191 +/-3 dB ref. 1 µPa/V
Operating frequency	22 to 30 kHz MFSK chirp modulation technique
Heading / Roll / Pitch accuracy	0.01°

Operating / Environment

Characteristic	Values
Power supply / Consumption	24 to 36 VDC / 35 W (45 W at starting up) 100-240 VAC
Operating temperature	-5 °C to 35 °C
Storage temperature	-40 °C to + 70 °C
Highest humidity	95% at 40°C
Vibration range	from 1 to 55 Hz at 1 mm / 10 m/s^2
Shock acceleration	15 m/s^2 for 15 ms, ½ sinus

2.2.2 MECHANICAL SPECIFICATIONS

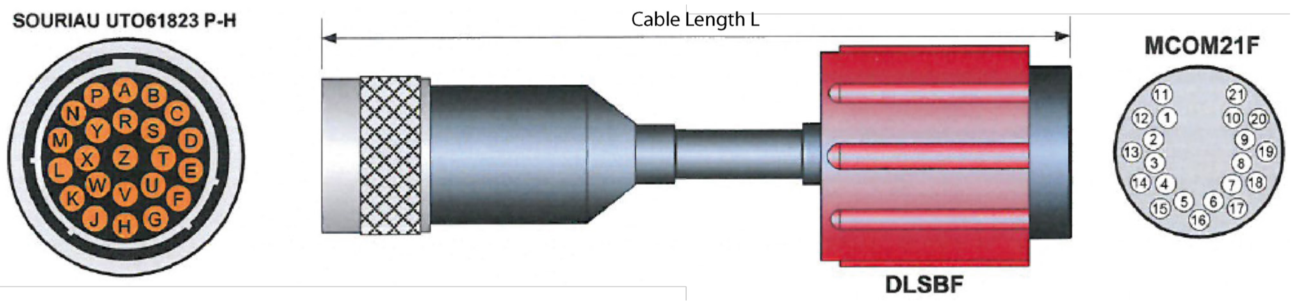
Characteristics	Values
Housing	Carbon
Weight in air / water	16 kg / -7 kg
Housing diameter x H (mm)	296 x 638 (fits in 12” gate valves)
Array depth-rating	Up to 25 m for nominal accuracy Up to 100 m non destruction
Maximum sailing speed	12 knots

2.2.3 ELECTRICAL SPECIFICATIONS

2.2.3.1 Main Cable

The main cable of GAPS (reference 930 0243A-xx) is connected to the acoustic antenna and to the BOX. You can find below a table describing the connections of all the 21 pins MCOM21F SUBCONN connector connecting the main cable to the BOX via the 23 pins UT061823P-H SOURIAU connector (see Table 2).

Length L:	50 m ± 1.5 m (option of 95 m ± 3 m)
Diameter:	15.0 mm +/- 0.8 mm
Minimal bending radius:	75 mm
Maximum pulling strength:	150 daN



Insulation Values

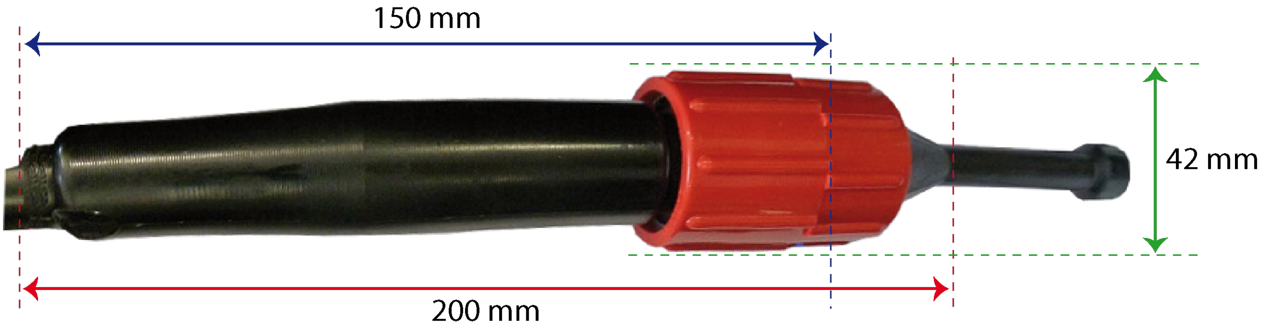
Tests are performed at 500 VDC for conductor to conductor, conductor to shield and conductor to body (SOURIAU). Accepted result above 200 MΩ. All measured values are above or equal to 500 MΩ.

SUBCONN Connector

Maximal diameter: 42 mm (diameter of the red locking)

Minimal rigid length <u>with</u> dummy plug: 200 mm

Minimal rigid length <u>without</u> dummy plug: 150 mm



SOURIAU Connector

Maximal diameter: 45 mm, molding diameter thicker than the plug

Minimal rigid length plug and molding: 170 mm

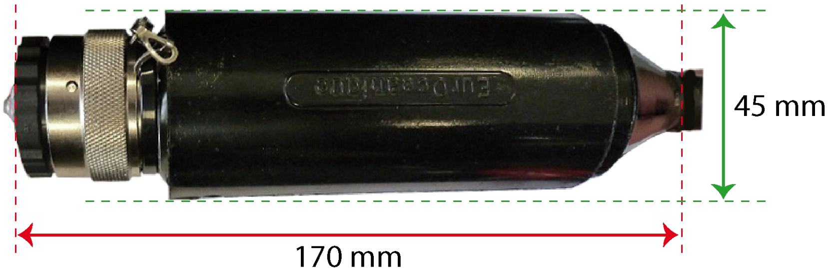
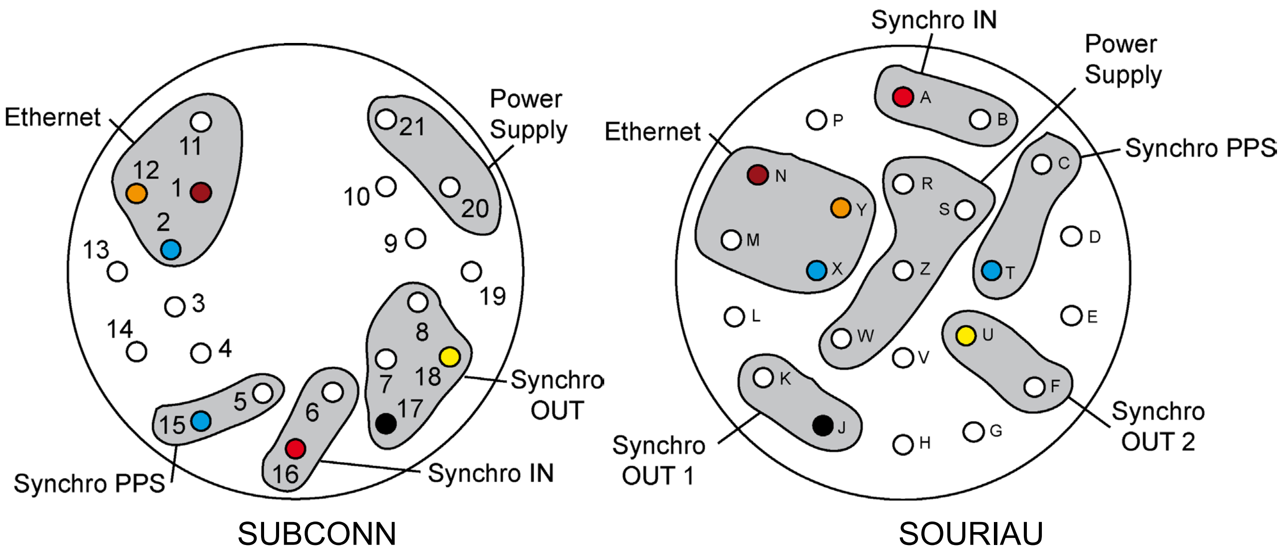


Table 2 - Wiring of the 23-pin SOURIAU and 21-pin SUBCONN connectors

SUBCONN (GAPS side)	SOURIAU (BOX side)	Signal
1	N	Ethernet TPFIN
2	X	Ethernet TPFON
3		Not Connected
4		Not Connected, used by iXBlue GPS
5	C	Sync PPS–
6	B	Sync IN 1–
7	K	Sync OUT 1–
8	F	Sync OUT 2–
9		Not Connected
10		Not Connected
11	M	Ethernet TPFIP
12	Y	Ethernet TPFOP
13		Not Connected
14		Not Connected, used by iXBlue GPS
15	T	Sync PPS+
16	A	Sync IN+
17	J	Sync OUT 1+
18	U	Sync OUT 2+
19		Not Connected
20	R, W	Power Supply –
21	Z, S	Power Supply +
	D, E, G	Ethernet and Synchro pairs shield
	H, L, P, V	Reserved for iXBlue



2.2.3.2 Optional Repeater Box for the Main Cable

The Repeater Box is necessary when two main cables (95 + 95 m or 95 + 50 m) are used simultaneously between the GAPS BOX and the GAPS unit. The Repeater Box realizes the junction between the two cables. Standard main cables are used so the connectors on the Repeater Box are similar to connectors on the GAPS BOX and on the GAPS antenna.

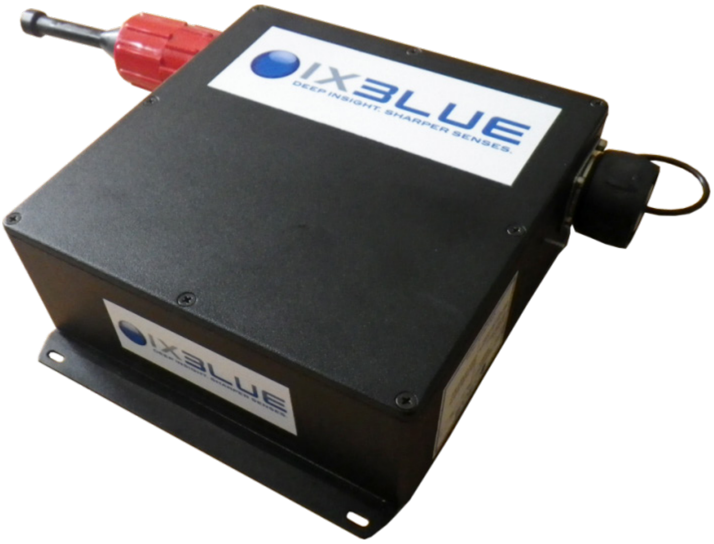


Figure 10 – GAPS Repeater Box

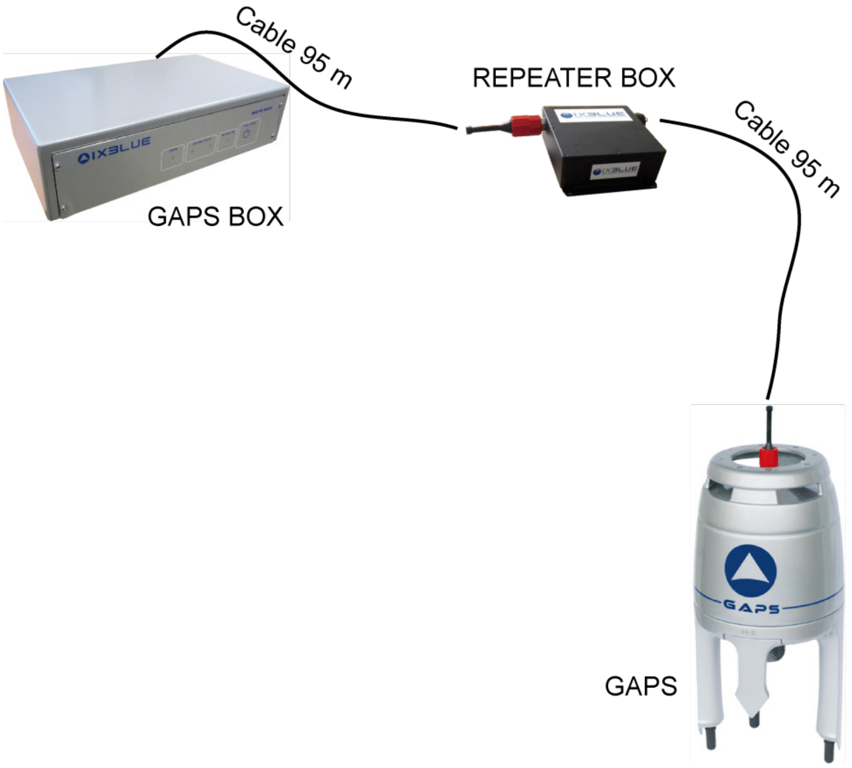


Figure 11 – GAPS Repeater Box operation principle (95 m + 50 m or 2 x 95 m)

Only one Repeater Box can be used with a GAPS unit.

Mechanical Specifications

The general characteristics of the Repeater Box are the following:

- Weight: 2.15 kg
- Size: 217 x 188 x 68.5 mm
- Operating temperature: -5°C / +50°C
- Storage temperature: -20°C / +80°C
- IP rating classification: IP65

The mechanical drawing of the Repeater Box is available in appendix K.

Power Supply

Power supply from GAPS BOX: 32 to 38.5 VDC (for 1 repeater box and two 95 m cables).

Connectors

The SOURIAU 23-points connector (SOURIAU UT01823SH6) and its wiring are the same as on the GAPS BOX. The wiring description is to be found in the GAPS user guide.

The SUBCONN 21-points connector (SUBCONN MCOM21M) and its wiring are the same as on the GAPS antenna. The wiring description is to be found in the GAPS user guide.

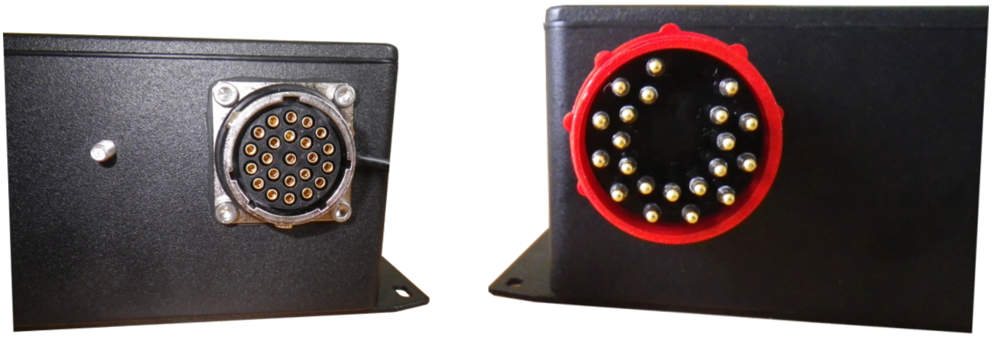


Figure 12 – SOURIAU (left) and SUBCONN (right) connectors

Installation

The Repeater Box is classified IP65. We recommend an indoor installation. The repeater box may be installed on any vertical or horizontal surface.

Electrical Ground

The Repeater Box must be connected to the electrical ground and shield via the threaded rod.

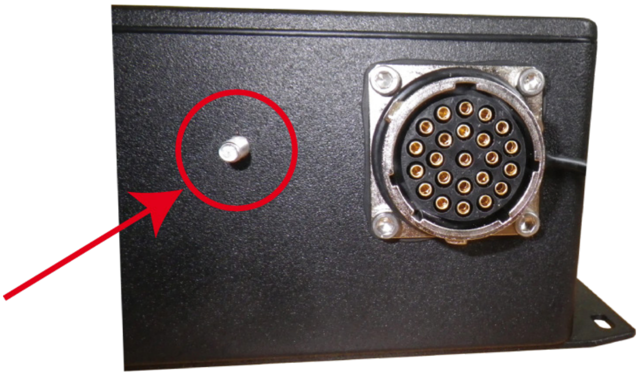


Figure 13 – Shield threaded rod

2.2.3.3 Optional GAPS Y Cable

The 1 m long Y cable (MP-FR10141 rev C) is used to connect the GPS unit and the BOX to the GAPS. The cable can be immersed for long period in 500 m water depth.

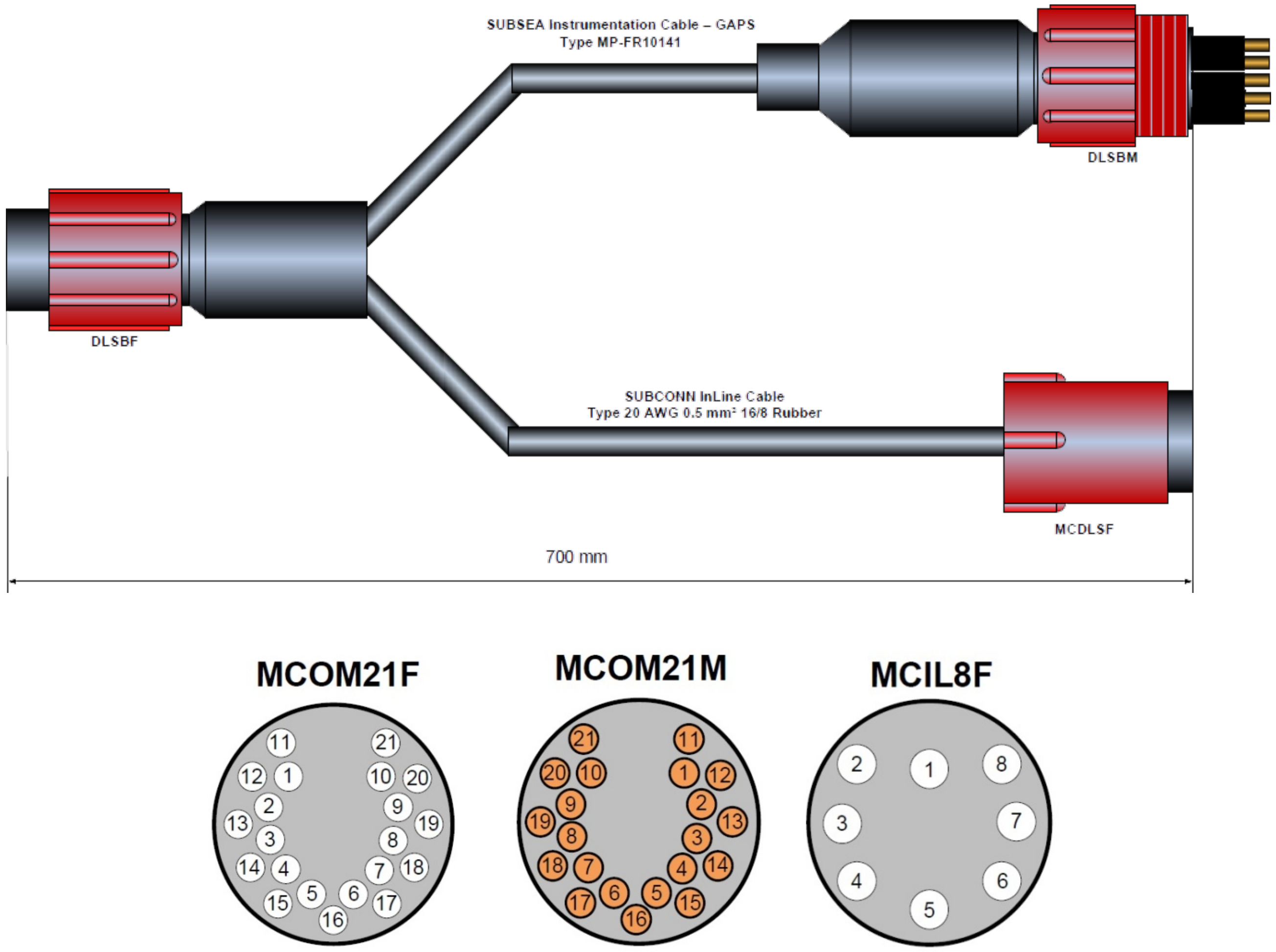
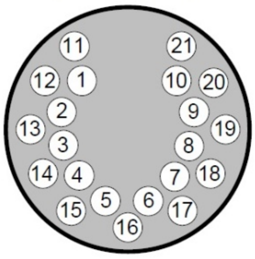
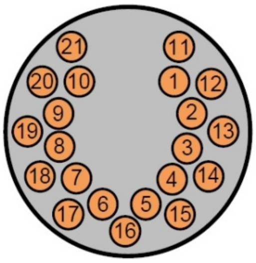
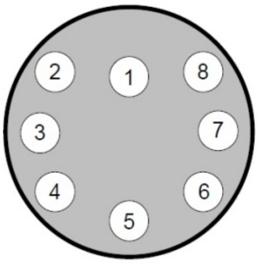


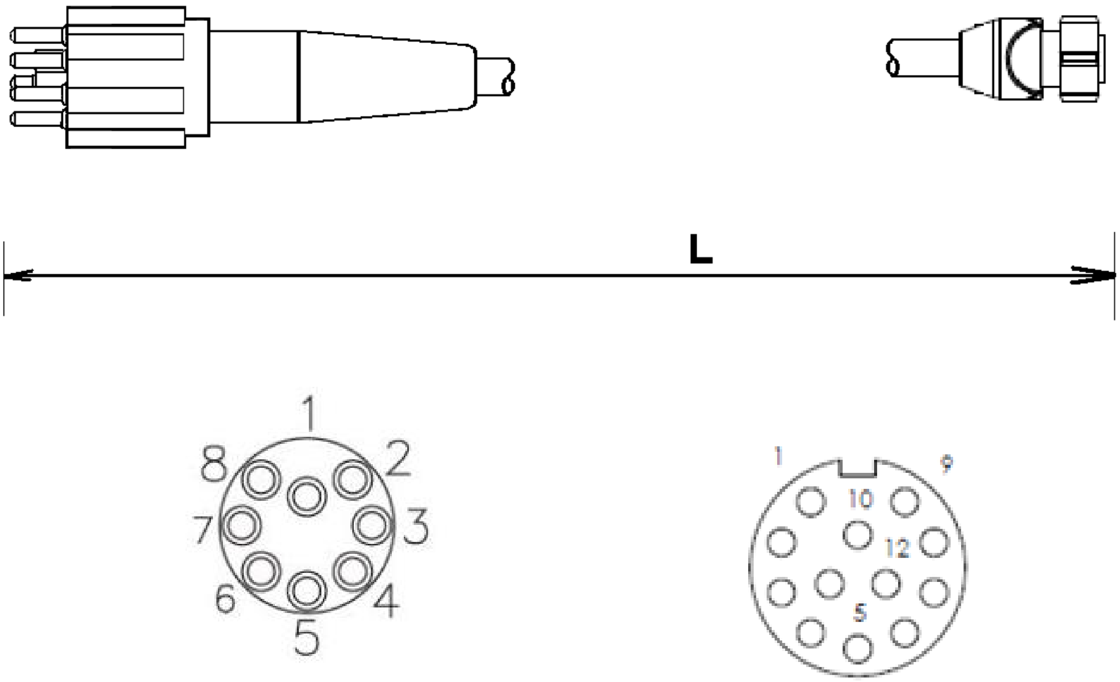
Figure 14 – Y Cable connectors

Table 3 - Wiring of the Y cable connectors

MCOM21F 	MCOM21M 	MCIL8F 	**Signal**
1	1		Ethernet TPFIN
2	2		Ethernet TPFON
3	3		Not Connected
4		7	GND Signal
5		7	GND Signal
6	6		Sync IN 1–
7	7		Sync OUT 1–
8	8		Sync OUT 2–
9	9		Not Connected
10			Shield
11	11		Ethernet TPFIP
12	12		Ethernet TPFOP
13	13		Not Connected
14		4	TxA GPS – RS232
15		8	Sync PPS+
16	16		Sync IN+
17	17		Sync OUT 1+
18	18		Sync OUT 2+
19	19		Not Connected
20	20	2	Power Supply –
21	21	1	Power Supply +
		3	RxA – GPS RS232
		5	RxB – GPS RS232
		6	TxB – GPS RS232

2.2.3.4 Optional GAPS GPS Cable

The 15 m GPS cable links the GPS antenna to the Y cable.



SUBCONN MCIL8M

DEUTSCH MMP C-2212S

Figure 15 – GPS Cable connectors

2.2.3.5 GAPS BOX

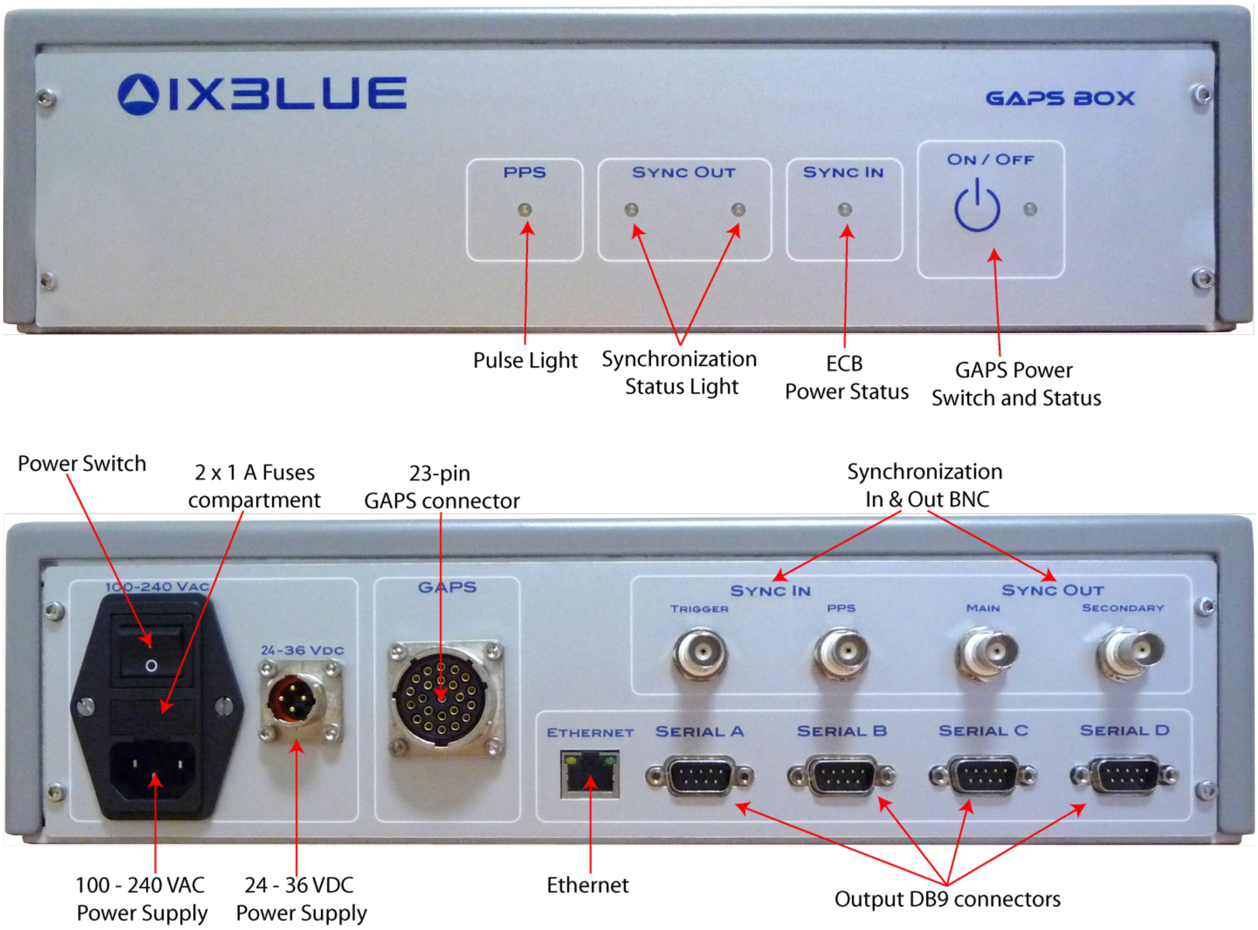


Figure 16 - BOX front face and back face

Table 4 - Operating / Environment Characteristics

Characteristic	**Values**
Power supply / Consumption	24 to 36 VDC / 5.6 W 100-240 VAC
Weight	4.6 kg
Operating temperature	-5 °C to 50 °C
Storage temperature	-20 °C to + 80 °C
Highest humidity	95% at 40°C
Vibration range	from 1 to 55 Hz at 1 mm / 10 m/s^2
Shock acceleration	15 m/s^2 for 15 ms, ½ sinus

Table 5 – GAPS BOX front face from left to right (see Figure 16)

Label	**Type**
PPS	
SYNC OUT	2 status lights
SYNC IN	Status light
ON/OFF	Status switch and light

Table 6 – GAPS BOX back face from left to right (see Figure 16)

Label	**Type**
Power supply	• **24 – 36 VDC**, 50 W (2 A) power supply • **100 – 240 VAC**, 50-60 Hz power supply, automatically detected, no adaptation needed • Compartment with 2 fuses (1 A, 5x20 mm) ref: D1 TD : REF SCHURTER 7030.332
GAPS	SOURIAU 23-pins connector for the Acoustic Array cable
ETHERNET	Access to network
SERIAL A, B, C, D	4 DB9 connectors for RS232 or RS422/485 serial links (use of straight cables)
SYNC IN, TRIGGER, PPS	2 BNC connectors to trigger the transponder in responder mode
SYNC OUT,MAIN, SECONDARY	acoustic recurrence triggered by an external device (side-scan sonar for example)

2.2.3.6 Power Supply

AC Power Supply

The whole system (GAPS + BOX + computer) must be powered by a 100 - 240 V / 50 Hz source (consumption: less than 50 W). The 100 – 240 VAC is converted into 36 VDC inside the BOX.

The 100 – 240 V socket-outlet shall be installed near the equipment and shall be easily accessible.

The BOX must be power supplied with either VAC or VDC but **not both simultaneously**.

DC Power Supply

GAPS is powered by a 24 to 36 V / 50 W DC source on a 4-pins SOURIAU connector. The DC connector is the only way to disconnect the DC power supply (no switch).

Figure 17 – 24 to 36 V power supply 4-pins UT000104PH SOURIAU connector

DC Cable

The GAPS BOX is supplied with a female connector on which can be welded a 24 – 36 VDC power supply cable of your own. The female connector is made of the following references (1 x UT06104SH, 4 x RC16SE4K, 1 x UTG10ST). The minimal wire section of DC power cable is 0.75 mm^2.

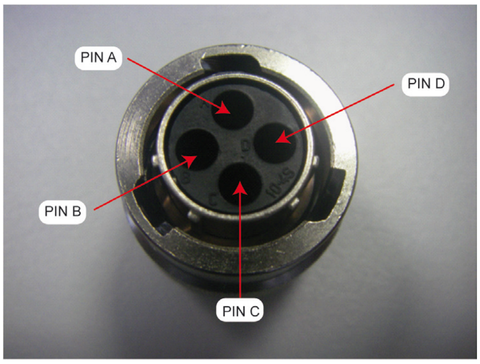
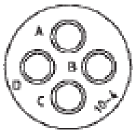


Figure 18 – Female connector for the 24 – 36 VDC power supply

Table 7 – Wiring of the SOURIAU UT000104PH external power supply connector

Face view of male SOURIAU	Pin #	Signal
	A	+VCC
	B	GND
	C	Not wired
	D	Earth

2.2.3.7 Synchronization Signals

SYNC OUT

The two **SYNC OUT** connectors are called **MAIN** and **SECONDARY**. Responder mode signal is sent to the transponder only if the responder mode is requested.

- Type: Differential
- Levels: 0 / +4.5 V
- Signal +: 0 / +4.5 V active high (0 / 2 V minimum if charge is 50 Ω)
- Signal -: 0 / +4.5 V active low (0 / 2 V minimum if charge is 50 Ω)
- Pulse length: 9 to 11 ms

SYNC IN

The two **SYNC IN** connectors are called PPS and TRIGGER. The external triggering signal is an active high pulse. The GAPS is triggered on the rising edge.

- Type: TTL
- Levels: 0 / 5 V in standard mode (maximum level 10 V) active high, rising edge
- Length:
  - ❑ Up to 35 µs (10 V, ridge to ridge) with flashing LED
  - ❑ Up to 1 µs (6 V, ridge to ridge) without flashing LED
- For the PPS input: configurable via the Web-based User Interface for the rising edge.

The LED flash is a copy of the incoming signal. If short PPS pulses are used, the LED may not flash but this doesn't mean that the system is not detecting the signals.

If GAPS is triggered in responder mode from the outside, with a transponder in responder mode triggered on the sync IN input (the triggering pulse length must be higher than 5 ms), the synchro shift between the recurrence and the transponder lasts 100 µs maximum. For this reason, it is strongly recommended to trigger the transponder on the Sync OUT.

External GPS

An optional external GPS may be connected to the external optional GPS message input serial link. Baud rate, parity and bit stop are adjustable from the Web-based User Interface. The message expected by GAPS is the standard NMEA $GPGGA message and GPZDA is automatically taken into account for the update of the GAPS internal time if available.

In case of an external GPS, the Y cable MUST NOT be used.

2.2.3.8 Serial Link Wirings

The four serial links are compatible with RS232 and RS422/485 protocols. The RS422/485 link is a simplex link working only in input or output. The wiring of the connectors is made as follows:

Table 8 – Wiring of RS232 and RS422/485

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

3 INSTALLING GAPS

Before installing GAPS for the first time, we recommend that you check all the parts in the delivery box, see section 3.1. The installation is then achieved in four steps:

- GAPS antenna, see section 3.2
- GAPS BOX, see section 3.3
- Optional DGPS Antenna, 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 GAPS System**. Check that all items are present on delivery and that none of them has been damaged during shipping.
Use the packing-list detailing all the shipped 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.

Never open the GAPS head.

3.2 Installing the Acoustic Antenna

3.2.1 RECOMMENDATIONS

Containing its own attitude sensor, GAPS can be installed at the location and in the position that best suit the operational constraints.
Nevertheless, some factors concerning the installation can **decrease** the final global performances of the system if they are not taken into account.

3.2.1.1 Environmental Noise

As every acoustic system, the noise generated by the environment lower the system performance. Positioning range and accuracy depend on the signal to noise ratio.
On a ship, it is recommended to install the GAPS head in the front third of the ship (in order to decrease the noise level from the propeller) and as far as possible from any water discharge system.

3.2.1.2 Reflective Surfaces

Even though the MFSK signal processing increases the multi-path immunity, there are situations where the direct signal detection is disturbed by reflective signals. To avoid such cases, we recommend keeping GAPS at least 1 m away from reflective surfaces.

The sea surface may be considered as a reflective surface depending on the depth of the transponder: if both the transponder and the acoustic array are close to the surface, there will be multi-path phenomenon at specific distances.

The transponder depth is usually an operational constraint and therefore difficult to change. In that case, it is recommended to increase the depth of GAPS. For deep-water applications (more than 250 m), a depth of 1 m is usually enough for the acoustic array.

3.2.1.3 Corrosion

GAPS is an electrical equipment that goes underwater. It may be submitted to differences of potential that can lead to the corrosion of the mechanical structure of the antenna.

It is your responsibility to minimize the differences of potential between the GAPS antenna and the surrounding structures. The GAPS antenna must benefit from the electrolytic protection of the vessel.

Contact iXBlue technical support if you notice corrosion damages on the 8 titanium screws holding the GAPS or directly on the antenna housing (ex: blisters of the paint).

3.2.2 PRINCIPLES

H1

When you set up GAPS on the ship, it is recommended to set **the hydrophone H1 towards the bow of the ship**. Positioning H1 towards the bow generates more drag but, in this position, the acoustic noise is reduced.

Electrical Insulation

In case GAPS is fixed on metallic plates of different materials (electro-chemical potential, aluminum for example) it is necessary to electrically insulate it in order to avoid any electro-galvanic reaction that will result in structure corrosion and GAPS acoustic array fouling.

Location and Dimensions

There must be enough space for the wire way on the connector side of GAPS. GAPS is fixed using the eight M8 screws.

The torque to mount the eight M8 screws must be from 15 Nm to 17 Nm. There is no need to use Loctite glue or similar.

The mechanical drawing of the antenna provides the dimensions of the antenna. The mechanical drawing is available in Appendix I.

Misalignment

You can intentionally tilt the GAPS antenna in any directions as long as you precisely measure the tilt angles. The angle values have to be entered into the Web-based User Interface during the configuration of the antenna. See section 4.3.

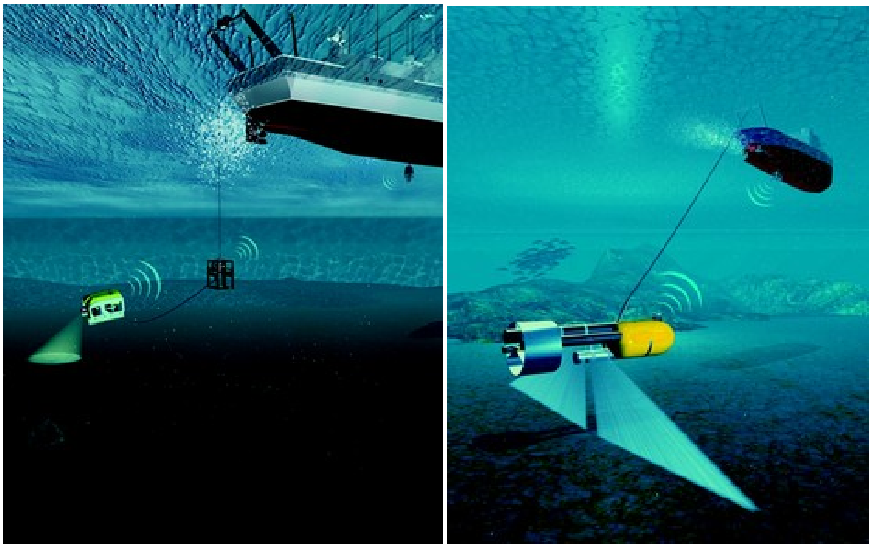


Figure 19- GAPS fixed on the hull and a transponder on a ROV or tow fish

Figure 20 - Transponder fixed on a scuba cylinder

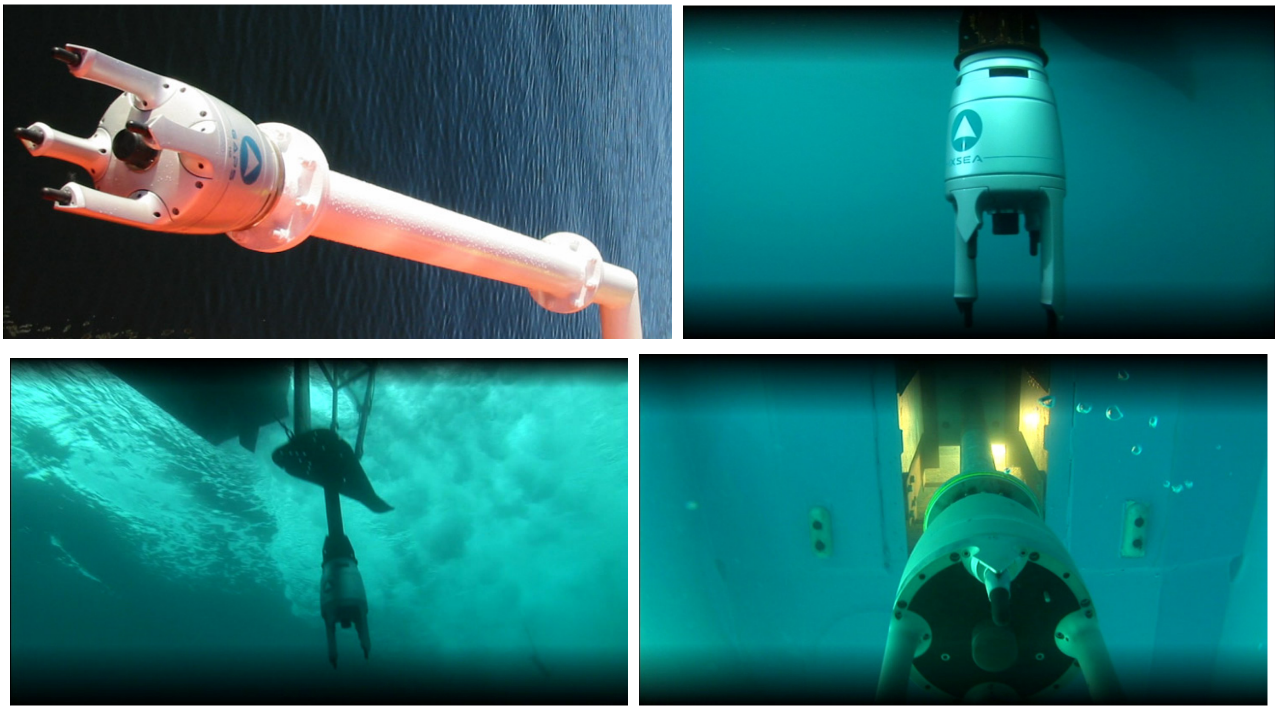


Figure 21 - GAPS antenna on a pole, underneath the keel or in a moon pool

3.3 Installing the GAPS BOX

The connections between the different devices can be set up through the GAPS BOX. See Figure 24. Set up all connections between the different devices of the system. The mechanical drawing of the BOX is available in Appendix J.

The GAPS BOX is classified as IP 51 (NF EN 60529 2000).
The GAPS BOX must be installed inside the ship. If you have to operate the GAPS BOX on the deck, make sure to use the appropriate protection for the GAPS BOX.

The exchange of one GAPS BOX by another requires that you reboot the computer on which runs the Web based User Interface before powering the new GAPS BOX.

3.3.1 ELECTRO MAGNETIC COMPATIBILITY RECOMMENDATIONS

GAPS system has been qualified with the following standards:

- EN 60945: 2002
- EN 61000-3-2: 2006 / A1: 2009 / A2: 2009
- EN 61000-3-3: 2008

It is recommended to install ferrite cores on the serial cables plugged on to the GAPS BOX. See Figure 22.

Figure 22 – Ferrite cores set up on the serial cables of the GAPS BOX

The recommended ferrite cores have the following references:

- WURTH 742 711 12 for Synchro coaxial cables
- WURTH 742 712 21 for serial link cables

3.3.2 CONNECTING THE BOX

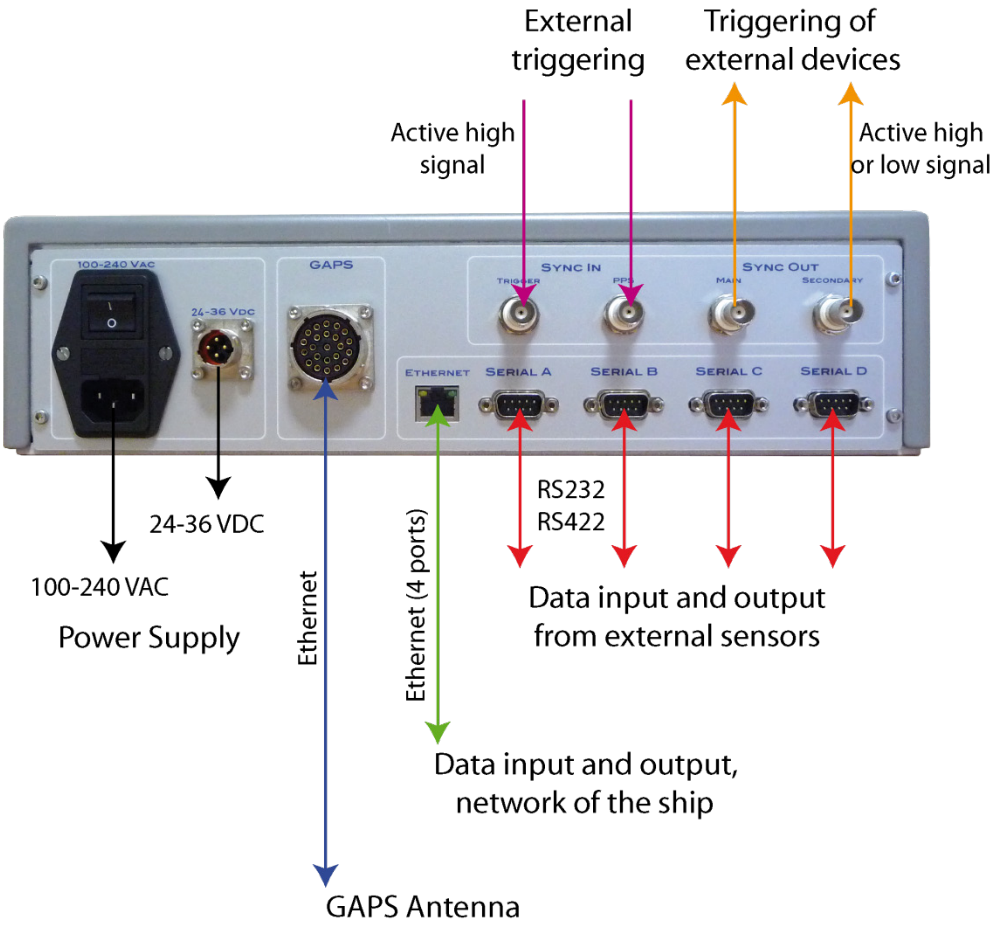


Figure 23 – Connection of the GAPS BOX and signal types

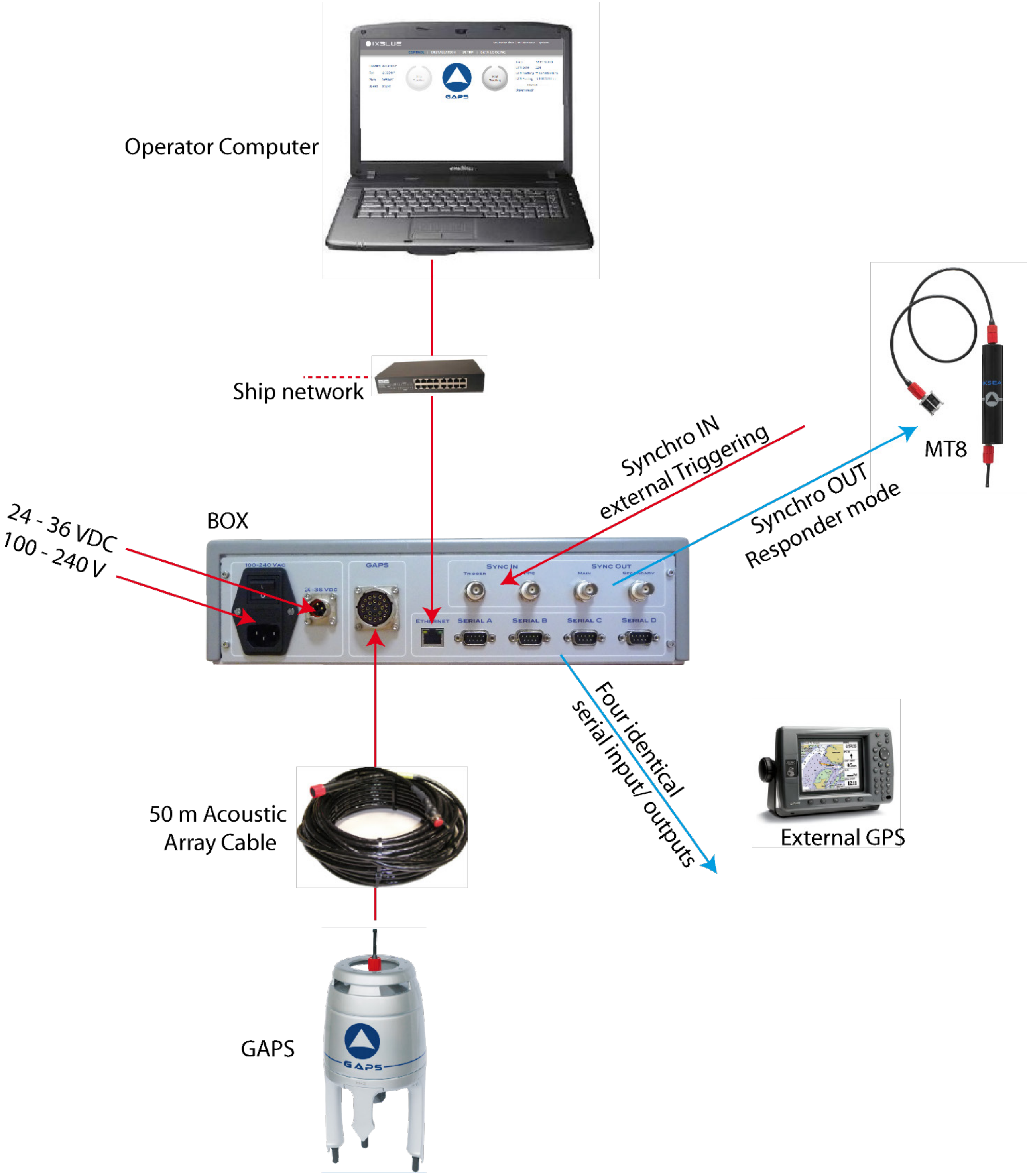


Figure 24- Architecture of the GAPS positioning system

3.4 Installing the GPS Antenna

Two configurations are possible (see Figure 24). You can use your own GPS or use the GPS provided by iXBlue. The integrated DGPS antenna has to be fixed in clear view from the sky (see Figure 25).

Figure 25 - DGPS antenna installation

3.4.1 INSTALLING AN EXTERNAL GPS

Connection In this case, you must not use the Y-cable to be plugged to the GAPS. Plug your GPS directly on the BOX via the GPS DB9 connector or on Ethernet.

Quality The GAPS takes into account the quality of the positioning of an external GPS up to mode 4. The mode 5 is taken by GAPS as a mode 4.

3.4.2 INSTALLING THE OPTIONAL IXBLUE DGPS

The DGPS DB9 connector of the BOX is not used in this case. Plug the 15 m GPS cable on the Y-cable and then plug the DGPS to the 15 m cable.

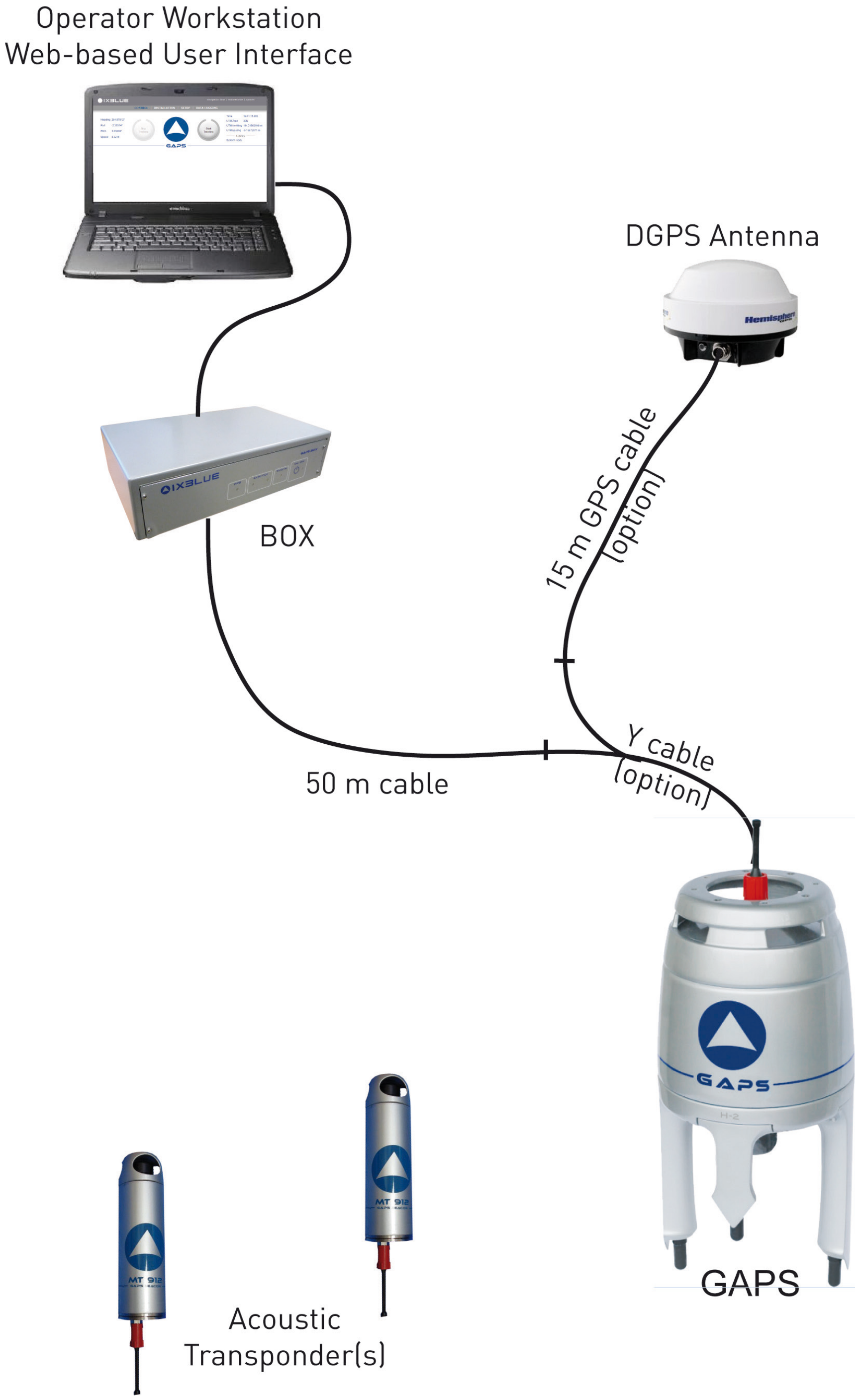


Figure 26 – Architecture of GAPS system with the use of the optional iXBlue GPS

3.4.3 IDENTIFYING THE GPS LEVER ARMS

Even though it is designed to work in the vertical position, GAPS acoustic array can be tilted if necessary and also be placed in the horizontal position or even upside down.

To calculate the absolute position of a transponder, GAPS needs to know its own absolute position. The GPS provide an absolute position. The offsets between the GPS antenna and the GAPS acoustic array allow the computation of the absolute position of GAPS.

If no misalignment offsets are entered, the reference axes are linked to the GAPS.

When GAPS is tilted, the three offsets between the GPS antenna and the acoustic array have to be entered accurately. When GAPS is in horizontal position, the axes are inverted and the attitude outputs are irrelevant.

There are 2 different solutions to install the GPS antenna with different implications on the mounting of the acoustic array:

- GPS antenna right above GAPS
- GPS antenna not above GAPS

3.4.3.1 GPS Antenna above GAPS

Rigid Link

This is typically when GAPS is mounted on a mast or held by a rigid pole with the GPS antenna installed on top of the mast. When GAPS is vertical, all the offsets between the GPS antenna and the acoustic array are set to 0 except the height (h) which must be entered accurately in order to calculate the position offset when the system attitude changes.

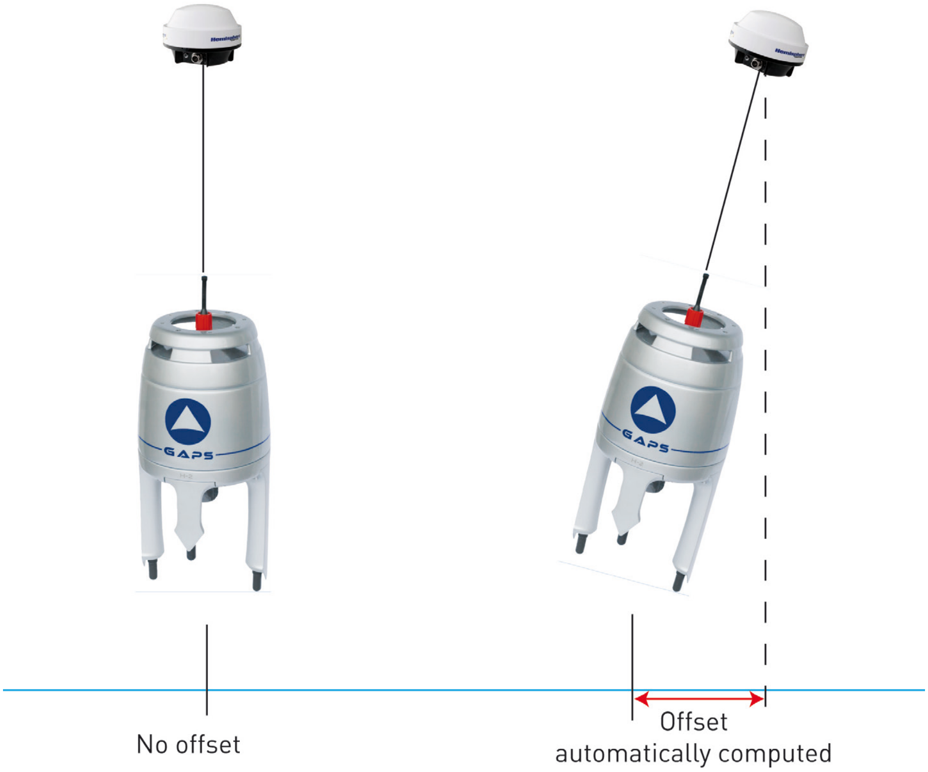


Figure 27 - Vertical GPS antenna lever arm

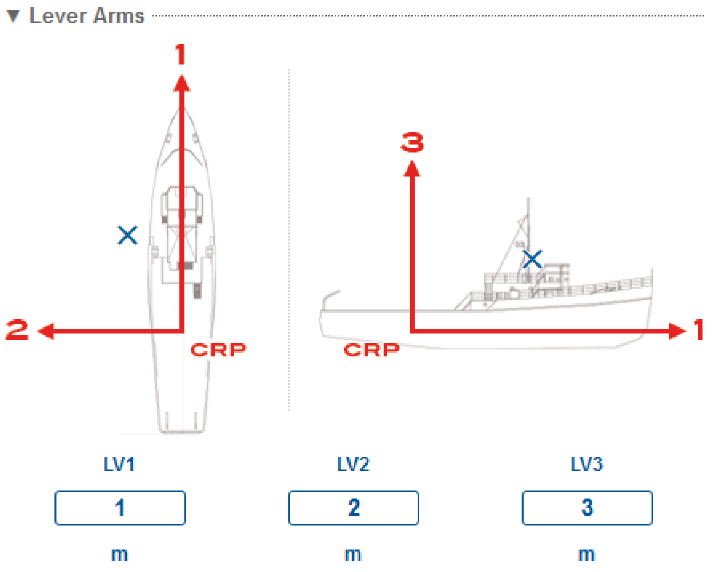
Flexible link

This is typically when GAPS is held by a rope. In that case, the height value (h) must also be set to 0 (to avoid the calculation of the offset). The accuracy of the positioning decreases if the position of GAPS relative to the GPS antenna changes.

Figure 28 - Vertical GPS antenna lever arm

3.4.3.2 GPS Antenna not above GAPS

When the GPS antenna is not located right above GAPS, its position in the CRP / GAPS frame has to be determined. The definition of these lever arms, LV1, LV2 and LV3 are given in Figure 29.



LV1 1 m

LV2 2 m

LV3 3 m

Figure 29 - GPS antenna lever arms (antenna not above GAPS)

The closer GAPS is to the GPS, the better is the accuracy of the measurement of the heading of the acoustic array.
The required precision on the lever arm is below 10 cm. See Figure 30.

Figure 30 – Measure of GPS lever arms with respect to GAPS

3.4.4 GPS TIME

GAPS automatically updates its internal time. No menu in the Web-based interface enables you to do it. Two cases can occur:

- ZDA is provided by the GPS: ZDA is the reference for time stamping the position and attitude delivered by the GAPS
- No ZDA: the last time recorded by GAPS is used

A PPS can be interfaced with the BOX In order to improve the time stamping.

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 POSIDONIA antenna

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

4 CONFIGURING THE GAPS

The configuration of GAPS 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 GAPS via the Ethernet link (see section 4.2). Once GAPS is inserted in the local network, you can launch the Web-based User Interface and you configure the installation parameters (sections 4.3 and 4.4) and the survey parameters (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 Ethernet link or through a local network. The communication is made in an http or https domain which includes encryption and secure identification of GAPS.

The Web-based User Interface is launched from the WEB browser hosted on the computer. You enter the IP address of GAPS in the browser. See GAPS default IP address in section 4.2.1.2.

4.1.3 MAIN WINDOW

The main window of Web-based user interface is made up of various elements (see Figure 31):

- Access to all data values (navigation data menu)
- Access to the maintenance tasks (maintenance menu)
- A choice of language selection (French, English 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.

Heading 309.863°
Roll 0.252°
Pitch 1.015°
Speed 0.00 kt
Noise 41.56 dB

Time 09:50:05
UTM Zone 30N
UTM Northing 5357802.46 m
UTM Easting 385280.82 m

STATUS
System ready

SYSTEM DETAILED STATUS

Antenna

INS
Navigation mode
Alignment
Fine alignment
GPS altitude
Heave Init
Fast alignment

External Sensors
GPS valid
Altitude valid
GPS reception
UTC synchro
Altitude reception

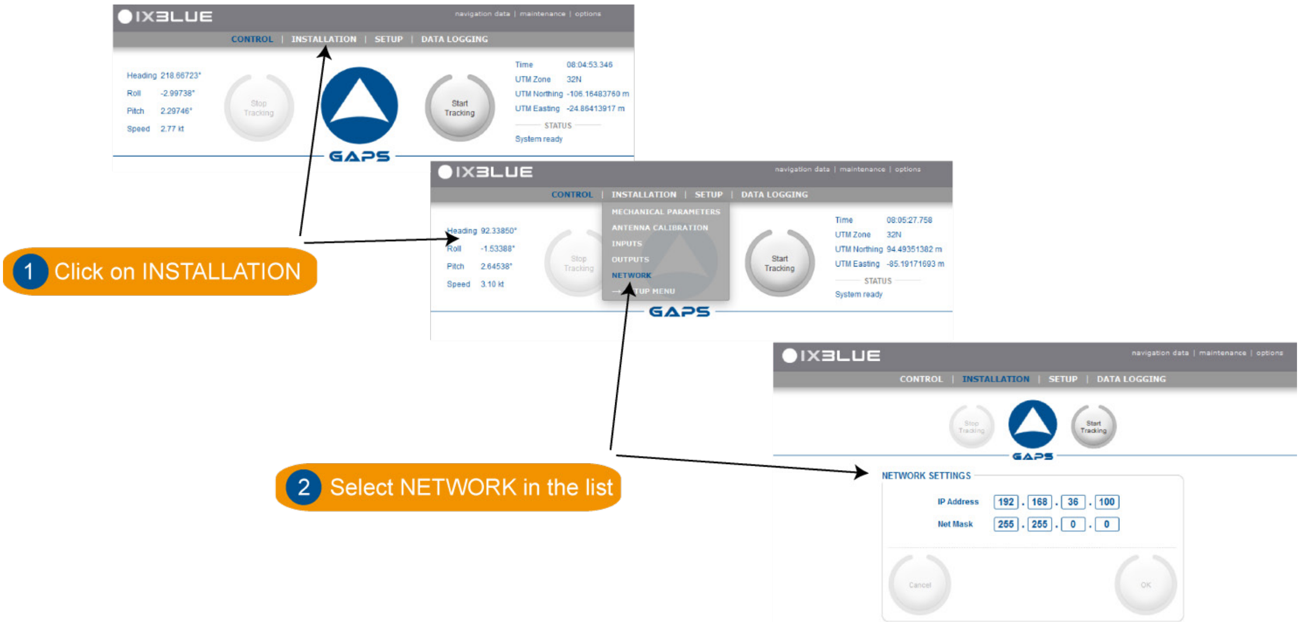
Electronic

Figure 31 – GAPS Web-based Interface main window

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 MENUS

Use the menu to navigate in the interface windows as shown in Figure 32.



Heading 218.66723°
Roll -2.99738°
Pitch 2.29746°
Speed 2.77 kt
Time 08:04:53.346
UTM Zone 32N
UTM Northing -106.16483760 m
UTM Easting -24.86413917 m
STATUS
System ready

Heading 92.33850°
Roll -1.53388°
Pitch 2.64538°
Speed 3.10 kt
Time 08:05:27.758
UTM Zone 32N
UTM Northing 94.49351382 m
UTM Easting -85.19171693 m
STATUS
System ready

NETWORK SETTINGS
IP Address 192 . 168 . 36 . 100
Net Mask 255 . 255 . 0 . 0

1 Click on INSTALLATION

2 Select NETWORK in the list

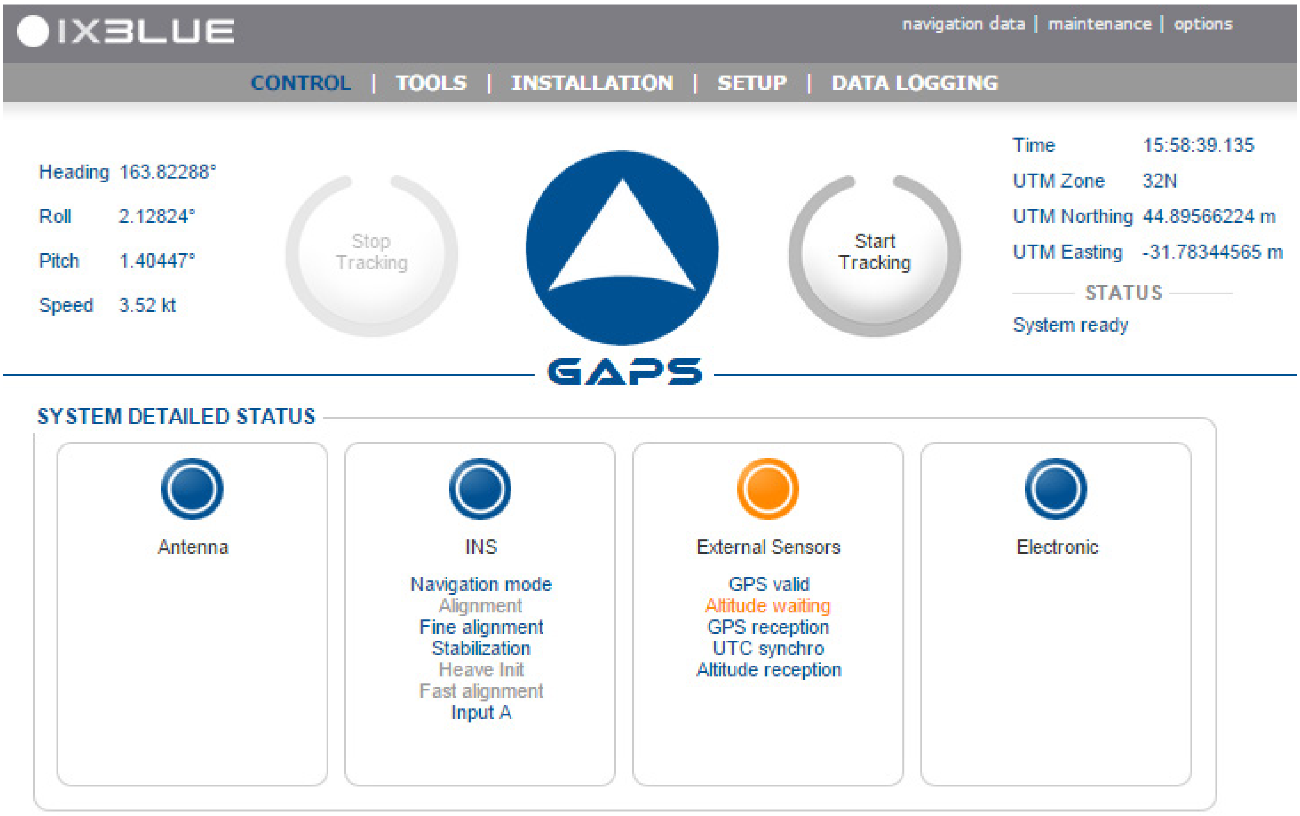
Figure 32 – Navigation through the interface pages

4.1.5 LOGO HANDLING

A click on the logo opens the status pop-up. The Figure 33 sums up the status of the

- Antenna
- INS
- 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.



Heading 163.82288°
Roll 2.12824°
Pitch 1.40447°
Speed 3.52 kt

Time 15:58:39.135
UTM Zone 32N
UTM Northing 44.89566224 m
UTM Easting -31.78344565 m

STATUS
System ready

Antenna

INS
Navigation mode
Alignment
Fine alignment
Stabilization
Heave Init
Fast alignment
Input A

External Sensors
GPS valid
Altitude waiting
GPS reception
UTC synchro
Altitude reception

Electronic

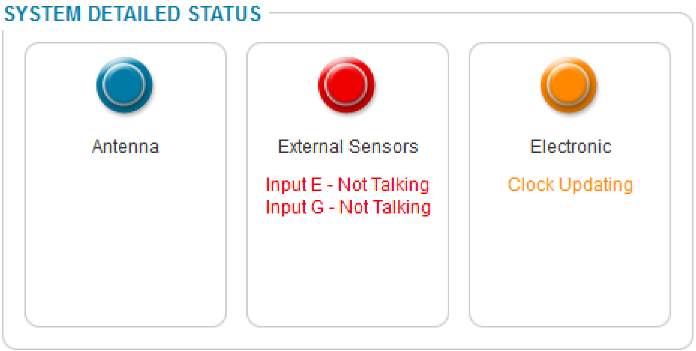
Figure 33 - Control page with the detailed status pop-up window opened

4.1.6 COLOR CODE

Valid for text labels, status indicators and logo, the color code is defined in the Table 9.

Table 9 - 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



Antenna

External Sensors
Input E - Not Talking
Input G - Not Talking

Electronic
Clock Updating

Figure 34 – 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:

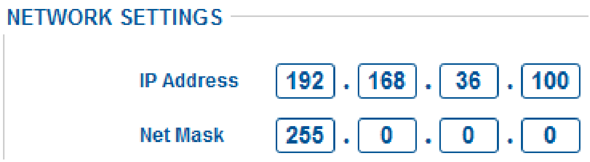
Scrolling list By selecting it directly in the scrolling list:

▼ Serial

Parity: None

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:



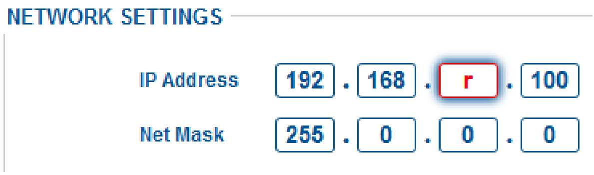
NETWORK SETTINGS

IP Address: 192 . 168 . 36 . 100

Net Mask: 255 . 0 . 0 . 0

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

An incorrect value is immediately indicated by red color:



NETWORK SETTINGS

IP Address: 192 . 168 . r . 100

Net Mask: 255 . 0 . 0 . 0

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

Language: English

Mode: Day

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 GAPS 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 (see Figure 35).

Click to open/close detailed status

Figure 35 - Example of a Tool tip

4.1.9 WEB-BASED USER INTERFACE OPTIONS

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

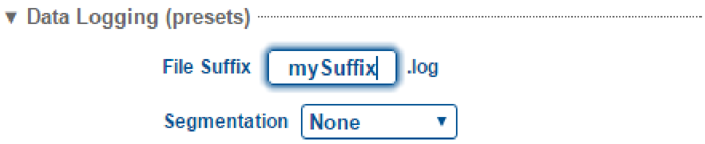
- **Language** (**French, English** or **Russian**)
- **Mode** of **Display** (**Day Mode** and **Night Mode**). The night mode is designed to prevent the light of the screen to disrupt the navigation of the ship.

Language: English
Mode: Day

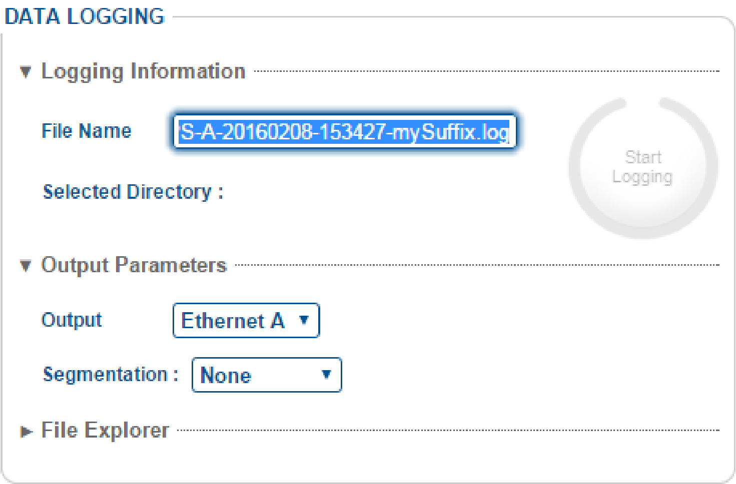
Language: English
Mode: Night

Figure 36 – 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 9.3.3.
- **Dynamic Positioning Mode**: See section 8.
- **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 to manually edit the file name and its suffix in the **DATA LOGGING** page:



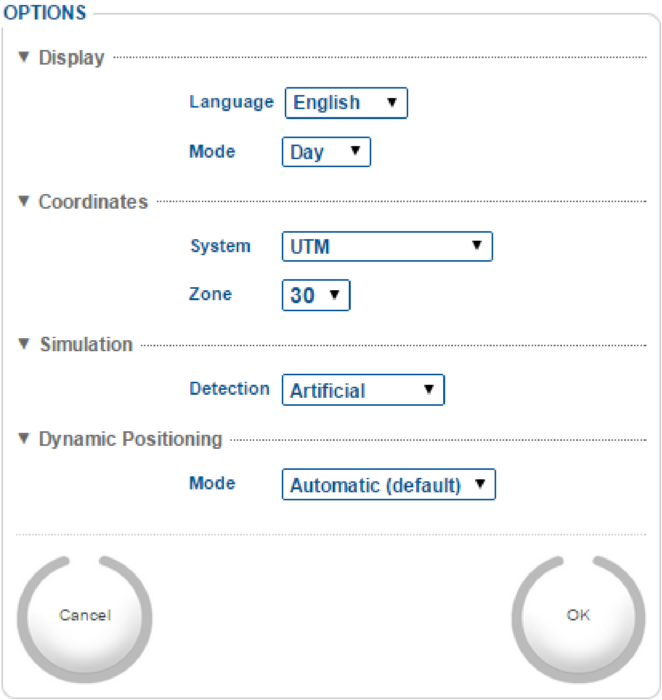
File Suffix: mySuffix .log
Segmentation: None



File Name: S-A-20160208-153427-mySuffix.log
Selected Directory :
Output: Ethernet A
Segmentation : None

Procedure

Step	Action
1.	Click on **options** in the upper right corner of the main window. *The **OPTIONS** page opens.*
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.



OPTIONS

▼ Display

Language: English

Mode: Day

▼ Coordinates

System: UTM

Zone: 30

▼ Simulation

Detection: Artificial

▼ Dynamic Positioning

Mode: Automatic (default)

4.1.10 SAVING AND RESTORING THE SETTINGS AND OPTIONS

This section describes how to make a backup of the

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

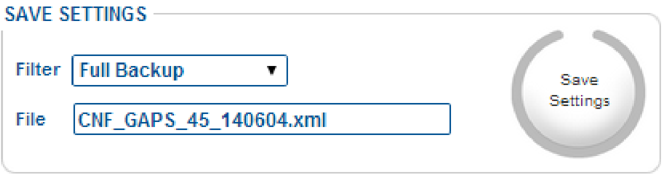
in a text file and how to restore previously saved product settings. In the settings file are stored all the different communication parameters as well as all the survey parameters. This tool can be used as a backup of a specific installation on a ship as well as a specific survey configuration.

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 GAPS.

4.1.10.1 Saving the Settings

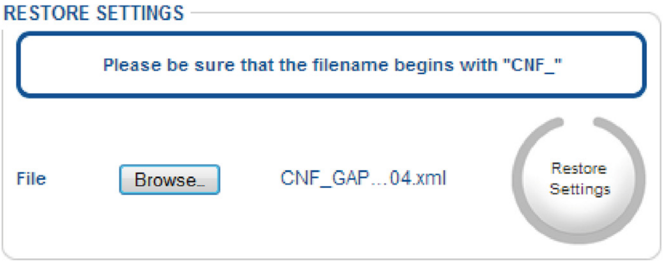
Saving

Step	**Action**
1.	Select the **SETUP > SETTINGS MANAGEMENT** menu item.
2.	In the **SAVE SETTINGS** frame, you may edit the default **File** name of the text file in which you want to save the product settings.  SAVE SETTINGS Filter: Full Backup File: CNF_GAPS_45_140604.xml
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. *The product settings are now saved in a text file at the chosen location.*
4.	End of Procedure.

4.1.10.2 Restoring the Settings or Loading Options

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.

Restoring

Step	Action
1.	Select the **SETUP > SETTINGS MANAGEMENT** menu item. *The page opens.*
2.	In the **RESTORE SETTINGS** frame, click on **Browse…** to select the “`CNF_`” file. *Once selected the name of the file appears in the* ***File*** *field.*
3.	Click on the button **Restore Settings**.  Please be sure that the filename begins with "CNF_" CNF_GAP...04.xml *A* ***Sending File*** *frame appears briefly. Once the frame has disappeared, the product settings or options are loaded in the Web-based User Interface.* *If you have loaded an option, then the new option is listed in the* ***maintenance*** *page inside the* ***SYSTEM OPTIONS*** *frame. See below for the Wideband@1 option:*  Wideband® 1 : Yes
4.	End of Procedure.

4.2 Configuring the Network

GAPS can only be configured via a Web Based User Interface from any computer. The purpose of this section is to explain how to connect GAPS to a computer that is part of a local network or not. You can be in one of the two situations:

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

4.2.1 CONNECTING GAPS DIRECTLY TO A COMPUTER

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

4.2.1.1 Overview of the Connections

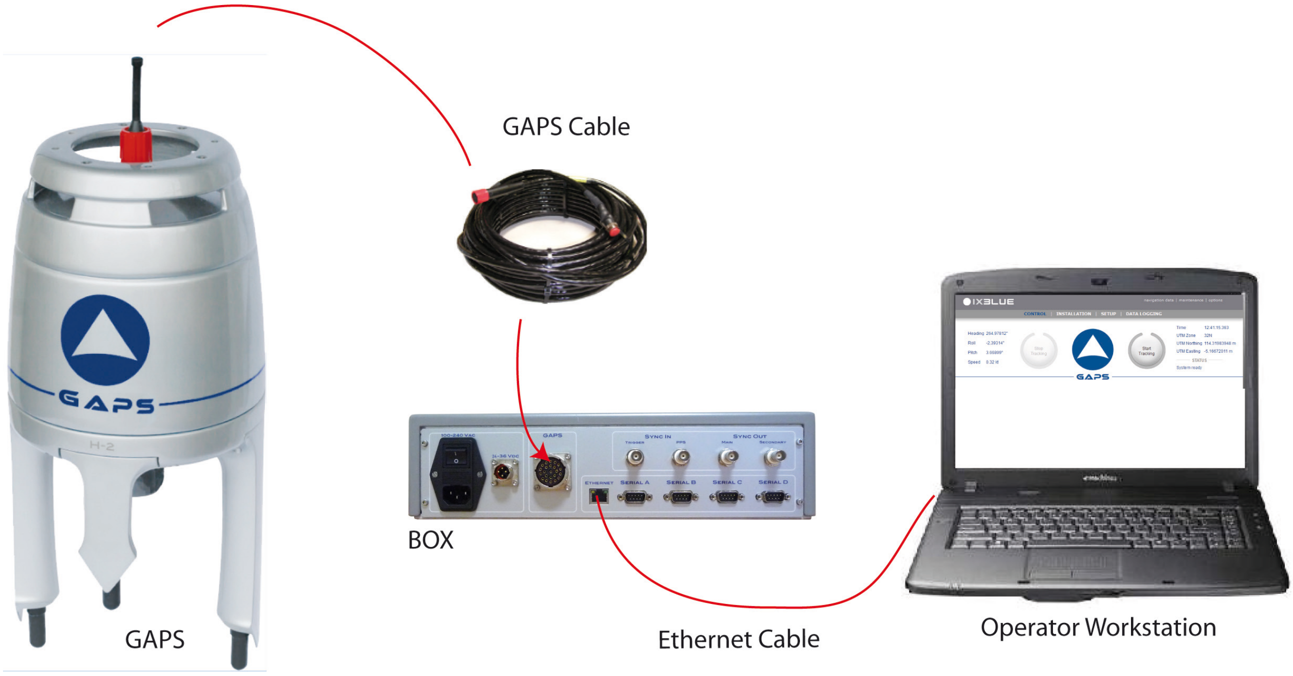


Figure 37 – Connecting a computer to edit the network configuration of to GAPS

Equipment Needed:

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

By default, the GAPS is already assigned with an IP address. When connecting only one computer to the GAPS, it is only necessary to adapt the computer to the GAPS configuration.

4.2.1.2 Default IP Address

The default IP address is:

http://192.168.36.1XX

XX being 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`.

If you have lost the GAPS 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 GAPS BOX. When you switch OFF and ON the GAPS BOX, the IP address of the GAPS 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 GAPS IP address is 192.168.64.**19**, and the subnet mask is 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 GAPS. In this example, 192.168.64.**20** is used for the computer IP address.

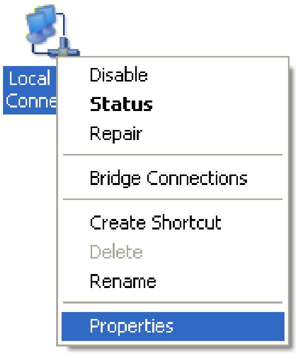
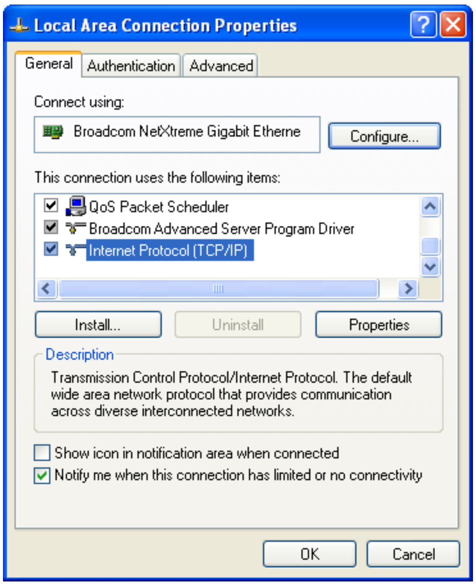
Subnet Mask

The subnet mask must be the same between GAPS and the computer.

Procedure

Step **Action**

1. 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** menu > **Settings** > **Control Panel**, then double click on the icon **Network Connections**.

Step	Action
2.	Right click on **Local Area Connection** icon and select **Properties**: *The Local Area Connection Properties window opens:*   Local Area Connection Properties General | Authentication | Advanced Connect using: Broadcom NetXtreme Gigabit Etherne Configure... This connection uses the following items: ☑ QoS Packet Scheduler ☑ Broadcom Advanced Server Program Driver ☑ Internet Protocol (TCP/IP) Install... Uninstall Properties Description Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks. ☐ Show icon in notification area when connected ☑ Notify me when this connection has limited or no connectivity OK Cancel
3.	Double click on **Internet Protocol (TCP/IP)** label text. *The Internet Protocol (TCP/IP) Properties window opens.*
4.	Select the option **Use the following IP address** and enter `192.168.64.20` for the **IP address** field and `255.255.255.0` for the **Subnet mask**.
5.	Leave the **Default gateway** and **DNS server** addresses blank.
6.	Click on **OK** button to validate the modifications. *You have set up the computer configuration to enable the Ethernet communication between the computer and GAPS.*
7.	End of procedure.

The computer IP address used here takes into account that GAPS 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 GAPS. In either case the subnet masks of both computer and GAPS must be the same.

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

4.2.2 CONNECTING GAPS TO A LOCAL NETWORK

In this section, you connect GAPS 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 GAPS network parameters. You edit these parameters to make GAPS 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

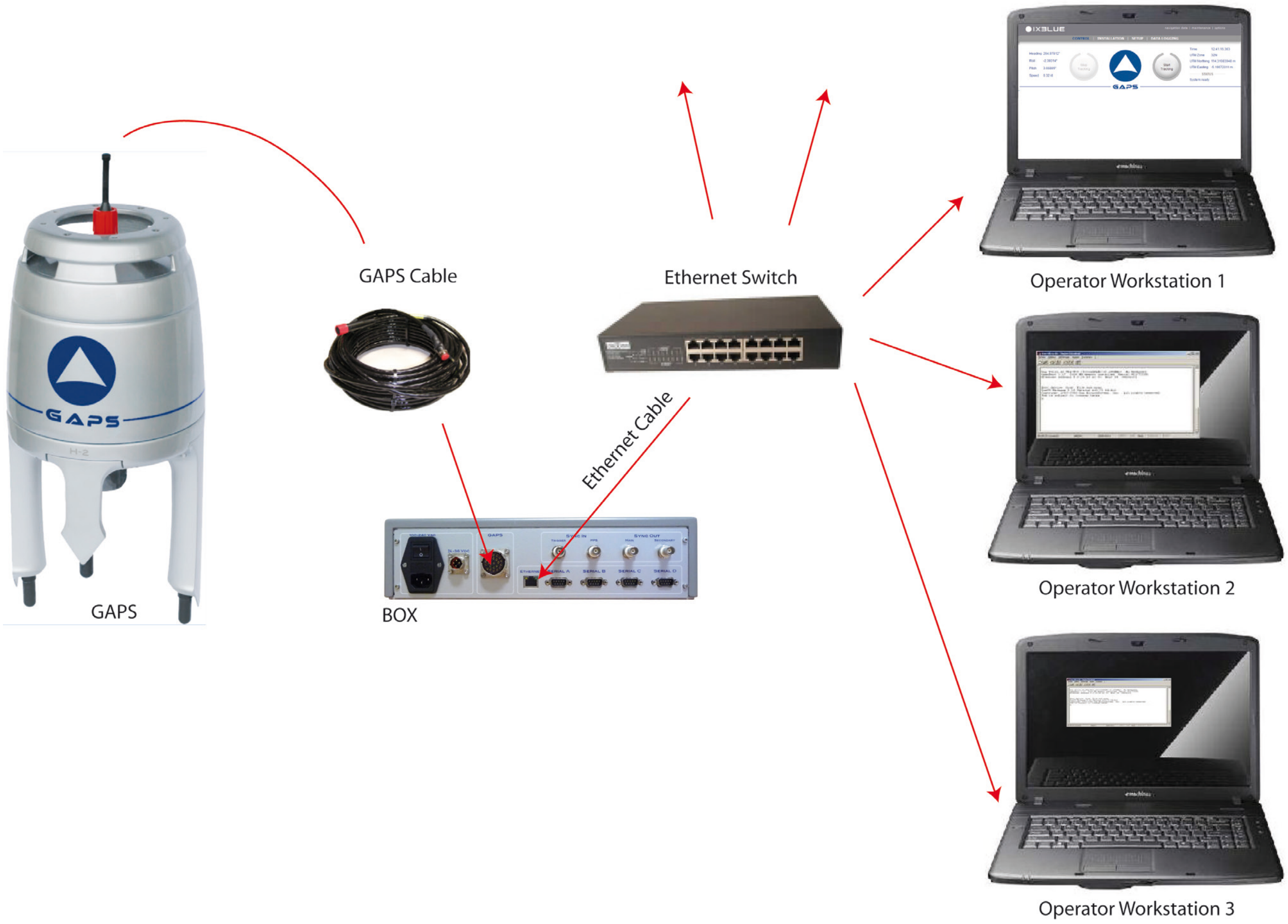


Figure 38 – GAPS connected to the local network

Equipment Needed:

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

You configure the GAPS to make it compatible to your local network.

4.2.2.2 Configuring the GAPS Network Interface

After connecting GAPS to a computer, with GAPS powered on, you can launch the Web-based User Interface on the computer and you can edit the GAPS network parameters. You can then make GAPS compatible to your local Ethernet network.

Every GAPS is assigned with its own IP address and a net mask. In order to insert the GAPS in your local network, you must edit the network parameters.

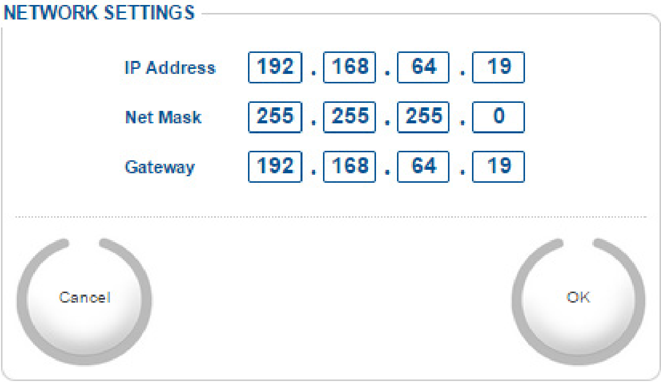
Important

Restrictions on the choice of the GAPS IP address and mask are detailed in annex B.

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

Turn GAPS on and off after every IP address edition.

Procedure

Step	Action
1.	Click on **INSTALLATION** in the menu and select **NETWORK**. *The **NETWORK SETTINGS** window opens.*  NETWORK SETTINGS IP Address 192 . 168 . 64 . 19 Net Mask 255 . 255 . 255 . 0 Gateway 192 . 168 . 64 . 19
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 GAPS.
7.	End of procedure.

4.2.2.3 Connection Procedure

Procedure

Step	Action
1.	Connect physically GAPS to the local network as shown on Figure 38. GAPS being in default network configuration that is not compatible with your local network, GAPS is not visible from any computer present in the network.
2.	Select one computer from which you are going to access and configure GAPS. 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 the computer to see GAPS from this computer. *GAPS is now visible from this computer.*
4.	Choose an IP address compatible to the local network. You are going to assign this address to GAPS.
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.
7.	See section 4.2.2.2 to edit the GAPS network parameters. Once the computer is configured and that you can see GAPS from the computer, assign the new IP address to GAPS. For the Net Mask, enter the local network mask.
8.	Configure back the computer in its original IP network configuration (before step 3). *Now all computers in the network can see GAPS.*
9.	End of procedure.

4.3 Configuring the Acoustic Antenna

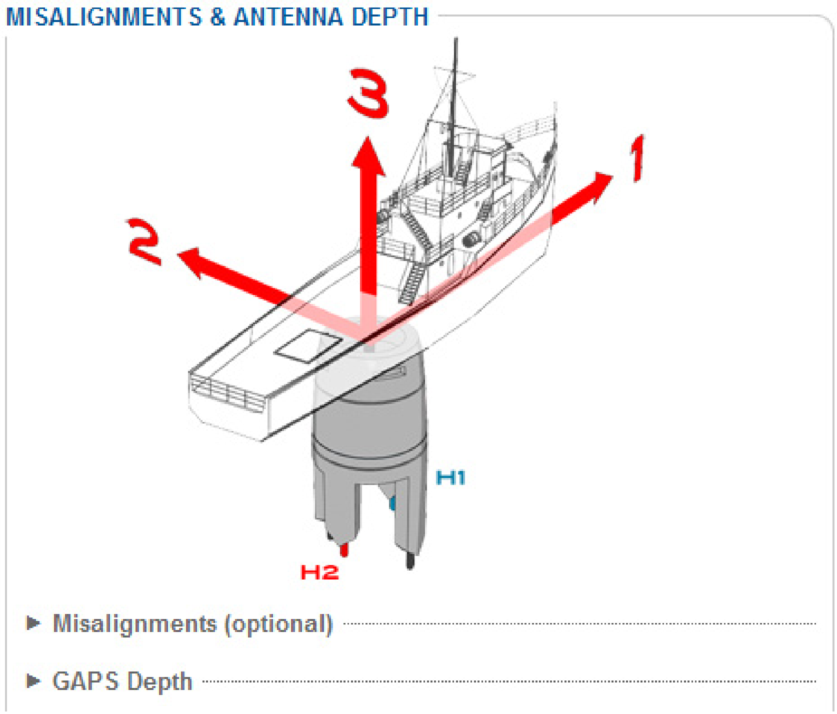
The center of the mounting flange of the GAPS acoustic antenna is taken as the position of the CRP. The misalignments and antenna depth are calculated just after installation and must be checked every time the vessel goes into dry dock. These parameters are:

- **Misalignments:** three angular offsets of the antenna's axes compared with the boat's axes. They are measured during the installation process.
- **GAPS depth:** the distance from the CRP to the sea level.

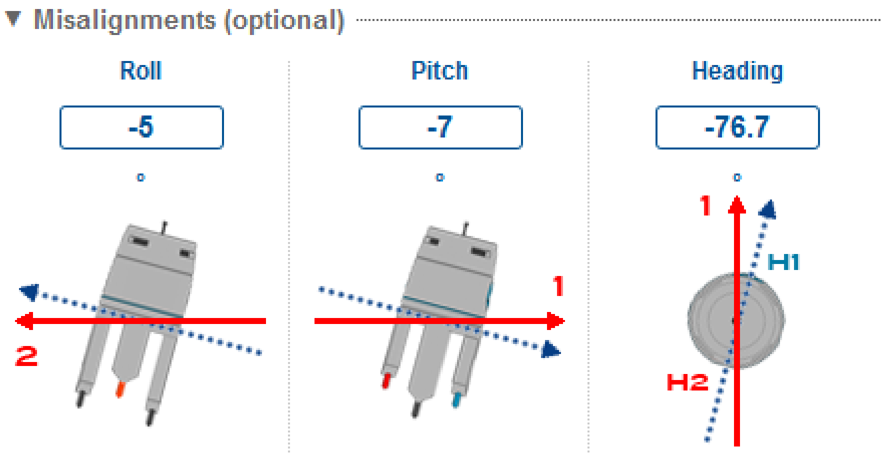
Procedure

Step **Action**

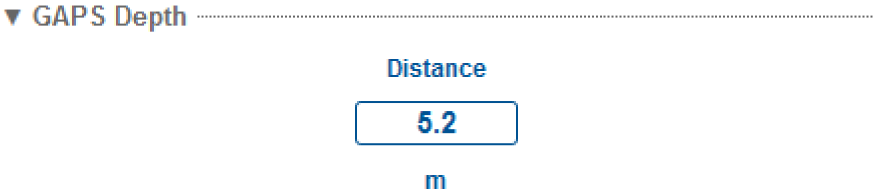
1. Click on the menu **INSTALLATION > MECHANICAL PARAMETERS**.



2. In Misalignments (optional), enter the values of Roll, Pitch and Heading.



Roll: -5 °
Pitch: -7 °
Heading: -76.7 °

Step	Action
3.	In **GAPS Depth**, enter the **Distance** of the flange of the antenna to the water surface (.  ▼ GAPS Depth Distance 5.2 m
4.	Click on **OK** to validate your input data configuration and send this data to the GAPS.
5.	End of procedure.

The heading of GAPS is different from the heading of INS inside the GAPS if you have entered an offset in the Web-based User interface. See section 4.3.

4.4 Configuring the Input and Output Parameters

This section describes the configuration of the communication between GAPS and the external sensors. These parameters are divided in input (see section 4.4.1) and output parameters (see section 4.4.2).

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

4.4.1 CONFIGURING THE INPUTS

Three inputs (**Position**, **UTC** and **Pressure**) can be configured here:

Position

Position data input comprises position, time and date. The GPS can be plugged directly to the GAPS antenna or to the BOX. The GPS antenna can broadcast its data on an Ethernet or serial link.

UTC

The external sensor delivering **UTC** time strings can be connected to a serial plug or via the Ethernet network.

Pressure

Pressure data input allows the computation of the immersion. The pressure data comes from any pressure sensor installed on the underwater vehicle that is being tracked by GAPS. The pressure can also be broadcasted to GAPS on an Ethernet or serial link.

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:

- **Input**: Choose the **Port** among the **Serial A, B, C, D** and **Ethernet A, B, C, D** ports. Select **Embedded** (for **Position** and **UTC**) if you use the iXBlue GPS. Select **None** if there is no external sensor to connect.
- **Protocol**: type of **Protocol** sent by the chosen sensor. The protocol may be accompanied by a synchronized **PPS** (for **UTC**) 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 **Timeout** (for **Pressure**) of the PPS below which it does not operate can also be recorded. See input protocols in appendix F.
- **Serial**: (only for **GPS**) if the chosen link is **Serial**, the link parameters are as follows:
  - ☐ **Parity**: None, Odd, Even
  - ☐ **Stop bits**: 1.0 or 2.0
  - ☐ **Standard**: RS422/485 or RS232
  - ☐ **Baudrate**: selected from a predefined list ranging from 1,200 to 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 (only TCP Client for the GPS case).
  - ☐ **IP**: the IP address of the target (only for a transport layer **TCP Client**)
  - ☐ **Port**: the number of the port
- **Lever arms** (only for **GPS**): 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.

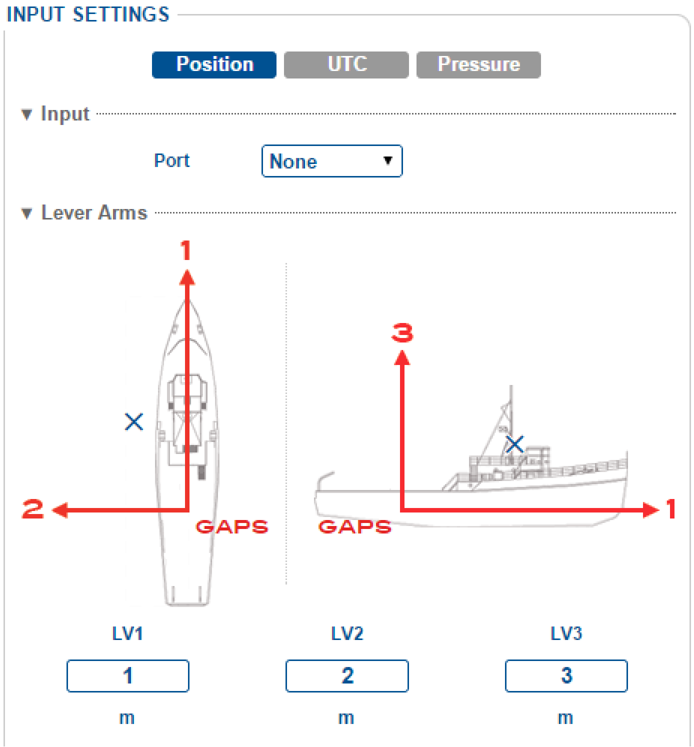
4.4.1.2 Configuring the Position Input

Procedure

Step **Action**

1. Click on the **INSTALLATION > INPUTS**.

2. Click on **Position** to display the parameters.



Port: None

LV1: 1 m

LV2: 2 m

LV3: 3 m

3. In **Input,** select the **Port** between **Serial A, B, C, D** or **Ethernet A, B, C, D** or select **Embedded** if you use the iXBlue GPS.
*Depending of your choice an additional section **Ethernet** or **Serial** is added.*

4. In **Protocol**, select the **Protocol** in the corresponding scrolling list.

5. If you have selected **Serial** in step 3, enter the following parameters:

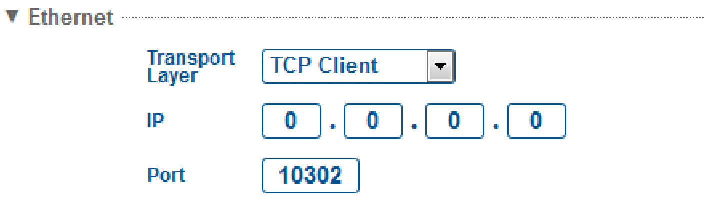
Parity: None

Stopbits: 1.0

Standard: RS422

Baudrate: 19200

6. If you have selected **Ethernet** in step 3, enter the following parameters:



Transport Layer: TCP Client

IP: 0 . 0 . 0 . 0

Port: 10302

Step **Action**

7. In **Lever Arms**, enter **LV1**, **LV2**, **LV3** separating the GPS from the CRP:

8. Click on **OK** to validate your input configuration and send this data to the GAPS.

9. End of procedure.

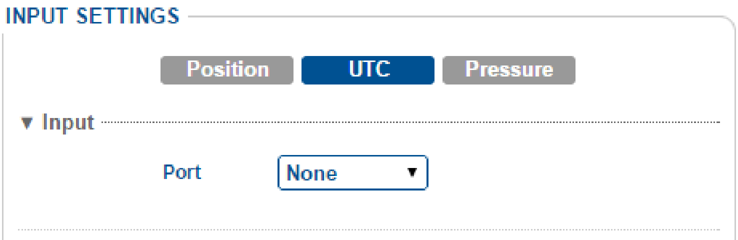
4.4.1.3 Configuring the UTC Input

Procedure

Step **Action**

1. Click on the **INSTALLATION > INPUTS**.

2. Click on **UTC** to display the parameters.

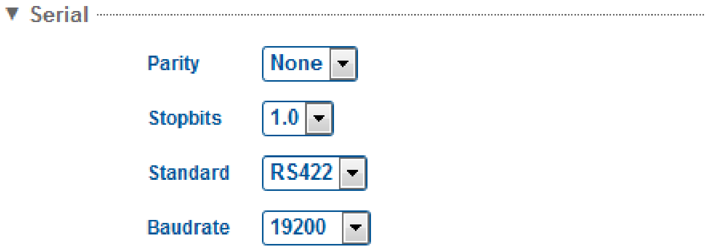


Port: None

3. In **Input,** select the **Port** between **Serial A, B, C, D** or **Ethernet A, B, C, D** or select **Embedded** if you use the iXBlue GPS.
*Depending of your choice an additional section **Ethernet** or **Serial** is added.*

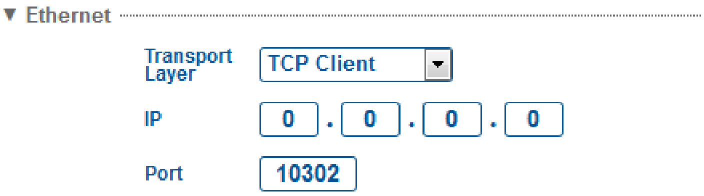
4. In **Protocol**, select the **Protocol** and the **PPS** in the corresponding scrolling lists.

5. If you have selected **Serial** in step 3, enter the following parameters:



Parity: None
Stopbits: 1.0
Standard: RS422
Baudrate: 19200

6. If you have selected **Ethernet** in step 3, enter the following parameters:



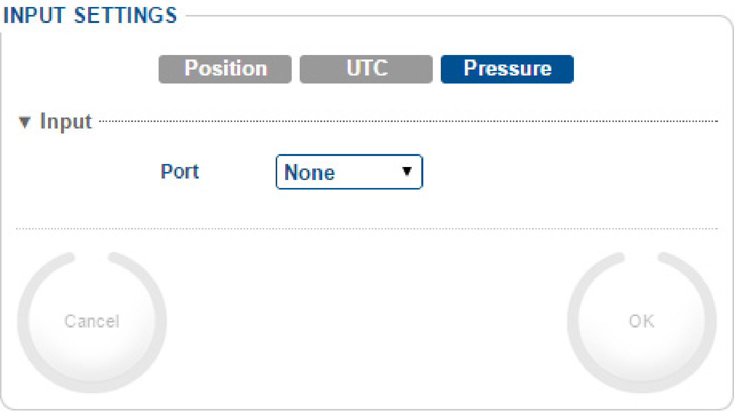
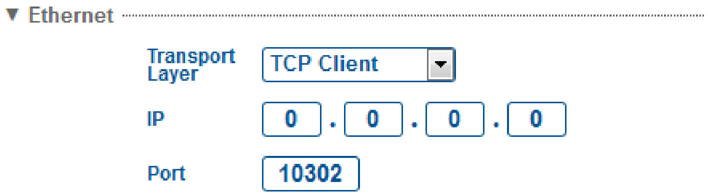
Transport Layer: TCP Client
IP: 0 . 0 . 0 . 0
Port: 10302

7. Click on **OK** to validate your input configuration and send this data to the GAPS.

8. End of procedure.

4.4.1.4 Configuring the Pressure Input

Procedure

Step	Action
1.	Click on the **INSTALLATION** menu and select **INPUTS**.
2.	Click on **Pressure** to have access to the pressure sensor parameters.  Port None
3.	In Input, select the **Port** between **Serial A**, **B**, **C**, **D** or **Ethernet A**, **B**, **C**, **D**.
4.	In **Protocol**, select the **Protocol** and the **Timeout** in the corresponding scrolling lists.
5.	If you have selected **Serial** in step 3, enter the following parameters:  Parity None Stopbits 1.0 Standard RS422 Baudrate 19200
6.	If you have selected **Ethernet** in step 3, enter the following parameters:  Transport Layer TCP Client IP 0 . 0 . 0 . 0 Port 10302
7.	Click on **OK** to validate your input data configuration and send this data to the GAPS.
8.	End of procedure.

4.4.2 CONFIGURING THE OUTPUTS

The GAPS 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 GAPS compatibility with other devices.

Each serial link and Ethernet link can be used simultaneously for input and output. Only the serial links 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 GAPS and other devices. See the protocols in Appendix F and G.
- **Frequency:** of the 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** and **Even**
    - **Stopbits**: **1.0** or **2.0**
    - Standard: RS422/485
    - **Baudrate**: selected from a predefined list ranging from 600 to 115,200 bauds (output from port A is permanently fixed at 115,200 bauds), see appendix G.1 for the minimum output recurrence with respect to baud rate and type of datagram
- **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

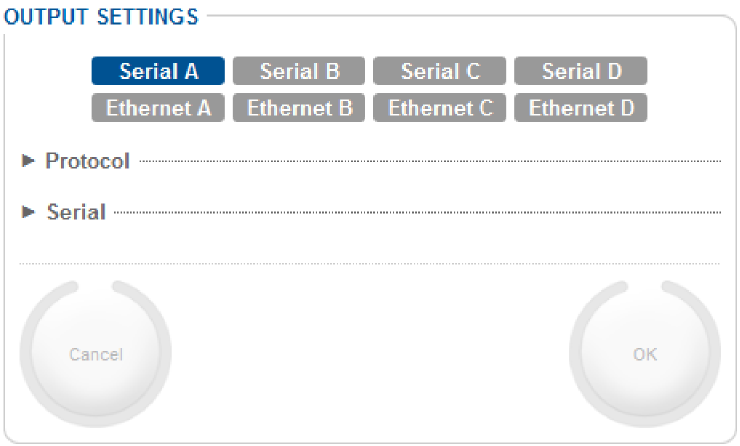
4.4.2.2 Configuration Procedure

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

Procedure

Step **Action**

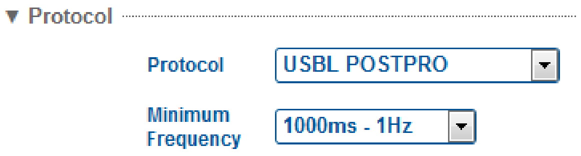
1. Click on the **INSTALLATION > OUTPUTS**.



2. Click on the port of your choice: **Serial A**, **B**, **C**, **D** or **Ethernet A**, **B**, **C**, **D**.

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

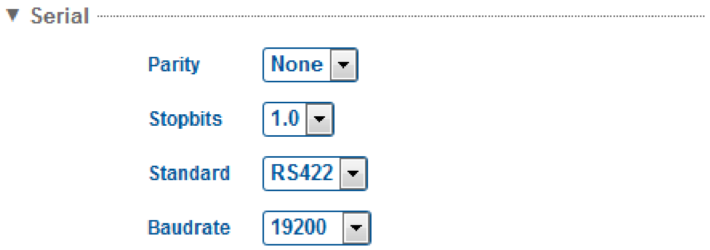
3. Select the **Protocol** and the **Rate** of your choice from the pull-down list:



Protocol: USBL POSTPRO

Minimum Frequency: 1000ms - 1Hz

4. If you have selected a **Serial** link, enter the parameters of this link:



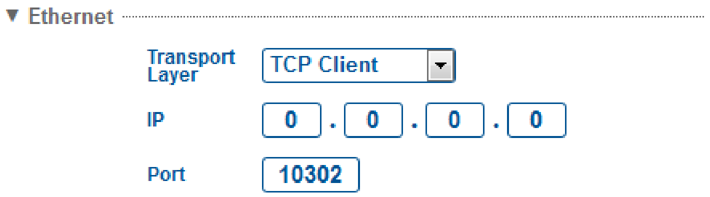
Parity: None

Stopbits: 1.0

Standard: RS422

Baudrate: 19200

5. If you have selected an **Ethernet** link, enter the parameters of the link:



Transport Layer: TCP Client

IP: 0 . 0 . 0 . 0

Port: 10302

6. Click on **OK** to validate your output configuration positioning data.

7. End of procedure.

5 SETTING GAPS 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

5.1 Defining the Tracking Parameters

5.1.1 SYNCHRONIZATION

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

- **Internal Synchronization**: The interrogation time for the transponder is automatically determined by GAPS. The internal recurrence is fixed. It is configured to a fixed value.
- **External Synchronization**: An external system generates a synchronization signal sent to GAPS.
- **External Synchronization with inhibition**: The GAPS minimum recurrence inhibits the short external recurrence after one received trigger. GAPS is triggered on the rising edge of the signal. This mode is described on the Figure 39.

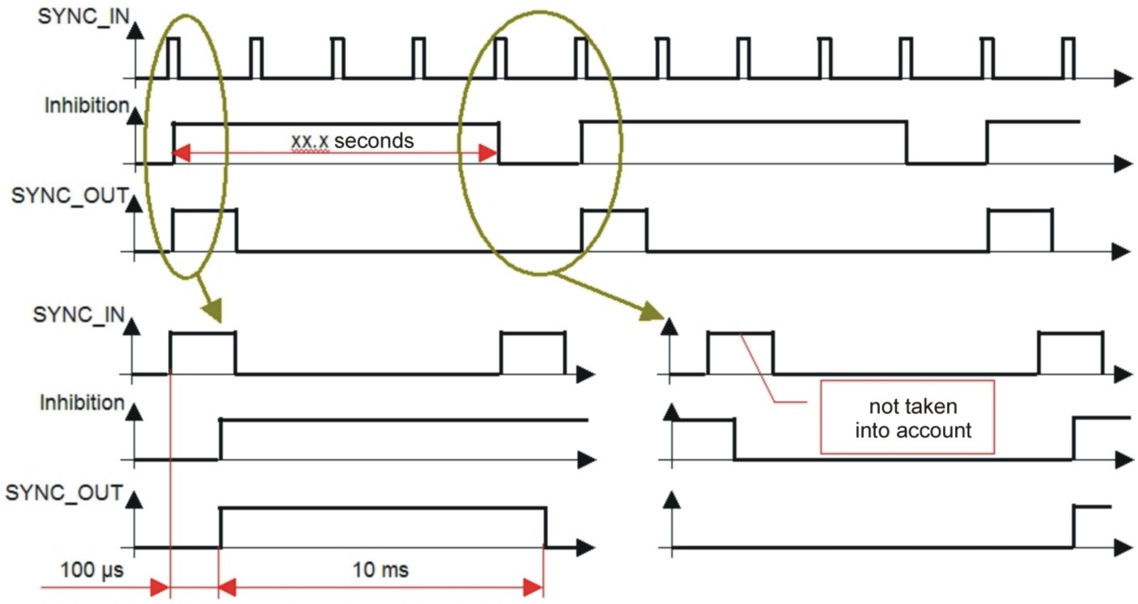


Figure 39 – Inhibition window during an external synchronization

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

5.1.2 RECURRENCE AND BLANKING TIME

The **recurrence** of GAPS sets the update rate of the transponders positions. The recurrence may be chosen in order to have approximately one second for each 750 meters traveled by the signal. The recurrence obeys the inequalities:

- $R > (D_{max} / 1{,}500) * 1 + TAT$ in responder mode
- $R > (D_{max} / 1{,}500) * 2 + TAT$ in transponder mode

R is the recurrence, Dmax is the distance between the antenna and the transponder and TAT is the turn around time (90 ms most of the time, 20 ms in deep water).

The **blanking time** of the transponders sets the acoustic reception windows of the transponders. These windows must be

- As short as possible in order to avoid multipath detections
- Long enough to allow the motion of the transponder between two interrogations of GAPS

The recurrence is to be defined before the blanking time.

Choice of the recurrence:

The choice for the recurrence is mainly made upon the maximal travel distance.

Table 10 – Maximum working distance versus recurrence with a TAT = 90 ms

		Maximum working distance (m)	
		Responder mode	**Transponder mode**
Recurrence (s)	1	1,365	682
	2	2,865	1,432
	3	4,365	2,182
	4	5,865	2,932
	5	7,365	3,682
	6	8,865	4,432

Choice of the blanking time

The choice of the blanking time depends on

- Recurrence of GAPS
- Number of different interrogation frequencies used for the active transponders
- Repetition factor

One rule might be to remove 200 ms to the interrogating rate of each transponder in order to find the blanking time. A series of examples is given in appendix E.

5.1.3 INTERNAL SYNCHRONIZATION

During internal synchronization, the GAPS antenna transmits according to the defined value of recurrence. In this mode, the GAPS can activate another acoustic appliance if the need arises.

Procedure

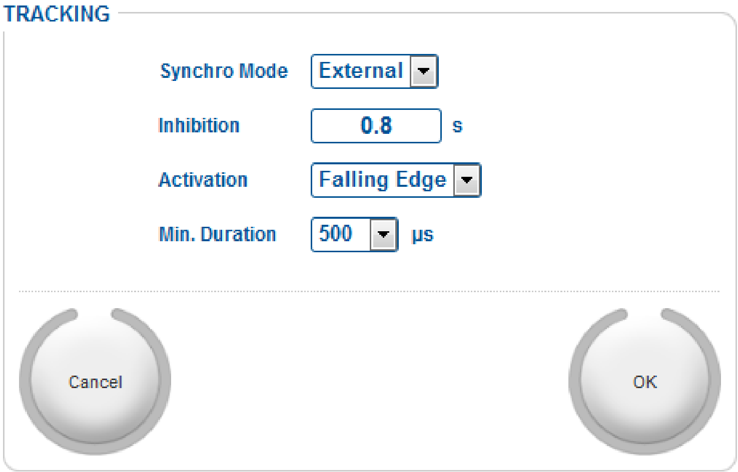
Step	Action
1.	Click on the menu **SETUP** and select **TRACKING**. *The **TRACKING** window opens.*
2.	Select **Internal** from the **Synchro Mode** scrolling list. *The **TRACKING** window shows the following parameters:*  TRACKING Synchro Mode: Internal Recurrence: 2 s
3.	Enter the value of **Recurrence**.
4.	Click on **OK** to validate the configuration of the internal synchronization mode.
5.	End of procedure.

5.1.4 EXTERNAL SYNCHRONIZATION

During external synchronization, the acoustic emission of GAPS antenna is set off by an external appliance. This mode is generally chosen when the GAPS is simultaneously operating with another acoustic appliance. A signal is sent to the GAPS 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 GAPS 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 µs to 1000 µs.

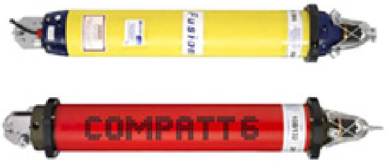
Procedure

Step	Action
1.	Click on the menu **SETUP** and select **TRACKING**. *The **TRACKING** window opens.*
2.	Select **External** from the **Synchro mode** pull-down list. *The **TRACKING** window shows the following parameters:*  TRACKING Synchro Mode: External Inhibition: 0.8 s Activation: Falling Edge Min. Duration: 500 µs
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 the configuration of the internal synchronization mode.
7.	End of procedure.

5.2 Setting Up the Transponders

GAPS is able to position iXBlue transponders and optionally transponders using Wideband® 1 signals. Interrogation and reply signals of compatible transponders is given in Table 11. Contact iXBlue to know if compatibility exists with other models.

Table 11 – Transponders compatible with GAPS

Transponder	**Interrogation**	**Reply**
iXBlue MT8 	F1, F2, F3 & F4 19.5 – 21, 0.5 kHz steps	MFSK 22 - 23
iXBlue MT9 	F1, F2, F3 & F4 19.5 – 21, 0.5 kHz step	MFSK 22 - 23 MFSK 00 - 09
RTAx2 	Tone pulses 19.5 – 30.5, 0.5 kHz MFSK 22 – 23, 0 – 45	Tone pulses 19.5 – 30.5, 0.5 kHz MFSK 22 – 23, 0 – 45
ZTA02C 	MFSK 0 – 44, 45 telemetry	MFSK 0 – 44, 45 telemetry
RAMSES 	Tone pulses 19.5 – 30.5, 0.5 kHz MFSK 22 – 23, 0 – 35	MFSK 22 – 23, 0 – 35
Applied 1019 	F1 – F14, CIF	28% (60) of WDB1 codes* (CRF and IRS)
Sonardyne Wideband® 1 Mini beacons (5 & 6) 		
Sonardyne COMPATT 5 COMPATT6 	F1 – F14, CIF 100% of WDB1 codes* (CIF & IIF)	

* See appendix B for a complete list of the WB1 codes.

The GAPS positions the immersed transponders. Before starting positioning, you have to list, configure and activate the transponders via the web user interface.

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 40.

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 GAPS 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. So when you use two transponders with two different frequencies, **make sure to have the correct settings in the transponder hardware**.

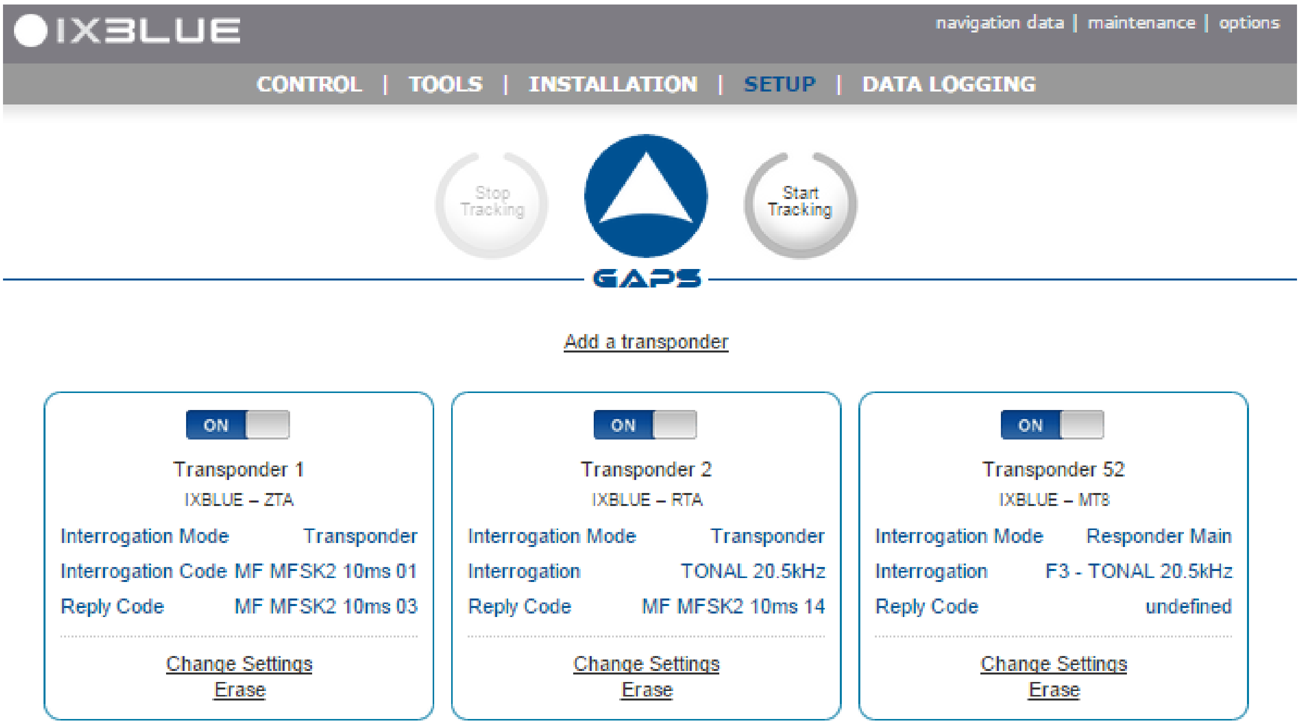
Codes

There are, as seen in Table 11, several families of interrogation/reply codes:

- Codes 22 / 23
- Codes 0 to 45
- Codes Wideband®1

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.

The Wideband® 1 transponders must be in ENABLE state in order to be interrogated by GAPS.



Transponder 1
IXBLUE – ZTA

Interrogation Mode	Transponder
Interrogation Code	MF MFSK2 10ms 01
Reply Code	MF MFSK2 10ms 03

Transponder 2
IXBLUE – RTA

Interrogation Mode	Transponder
Interrogation	TONAL 20.5kHz
Reply Code	MF MFSK2 10ms 14

Transponder 52
IXBLUE – MT8

Interrogation Mode	Responder Main
Interrogation	F3 - TONAL 20.5kHz
Reply Code	undefined

Figure 40 – Transponder Window

From this window, you can carry out the following tasks:

- 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 defined by an **Identifier**, a **Type** of transponder and a **Manufacturer**. The standard transponders being tracked by GAPS are the MT8, MT9, RTA, ZTA, RAMSES and Wideband® 1 transponders.

Procedure

Step **Action**

1. Click on the menu **SETUP** and select **TRANSPONDERS**.
   The management of transponders opens.
2. Click on **Add a transponder**.
   The window shows:

NEW TRANSPONDER

ID Number: 3

Type (optional): IXBLUE – ET/RTA

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.**

   If you have the Wideband® 1 option*, select **WB 1** for the **Type (optional)** in order to configure GAPS for a transponder using Wideband® 1 signals.
   The configuration window opens.
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

* You may check on the **maintenance** page if you have the Wideband® 1 option:

SYSTEM OPTIONS

Wideband® 1 : Yes

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. GAPS 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 GAPS 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 (GAPS in external synchronization mode).
- In **Transponder** mode, the interrogation and response are transmitted via acoustics.
- **Code**: defines a monochromatic signal, see Table 11 for all possible interrogation codes depending of the transponder type.

5.2.2.2 Reply

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

- **Code**: defines a medium frequency MFSK signal, see Table 11 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 8 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.

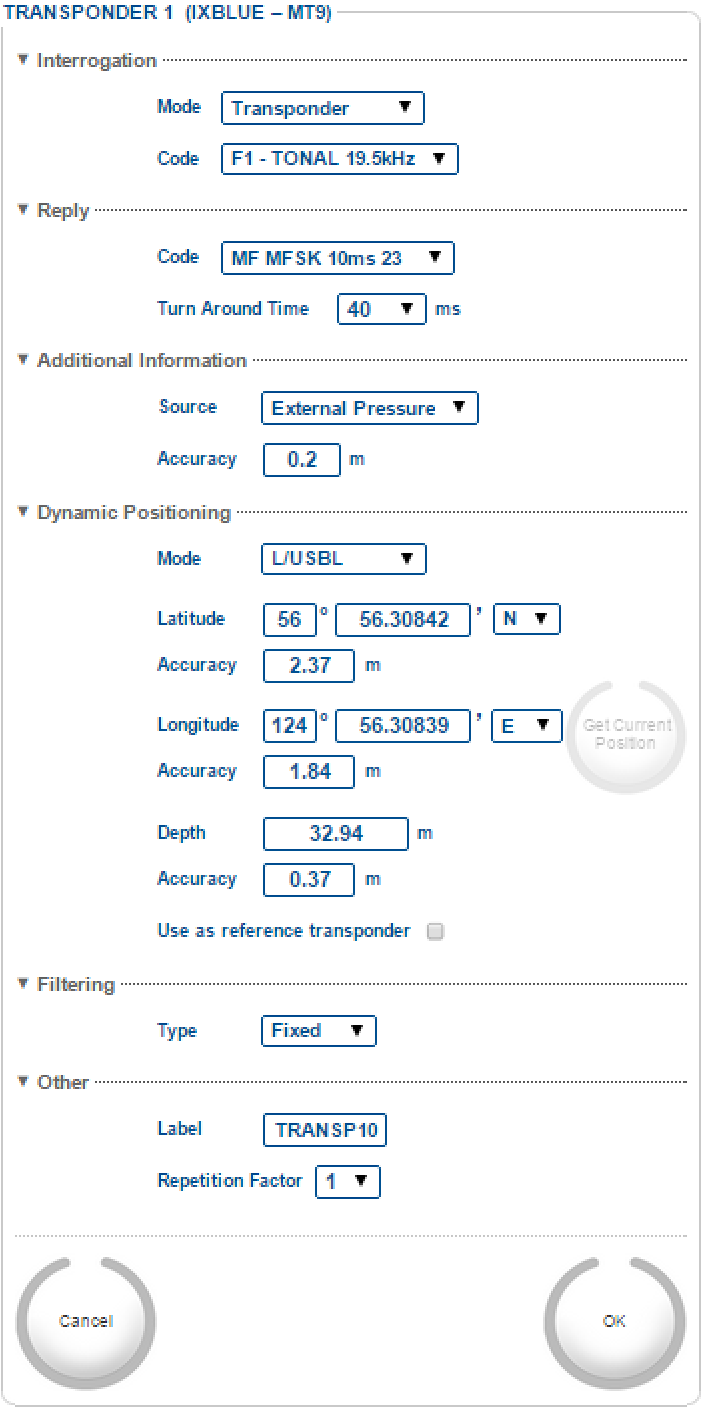
The **Repetition Factor** allows a different interrogation rate for each of the active transponders. GAPS interrogates each transponder the number of times (up to 5) defined by the **Repetition Factor** before interrogating another transponder.

Please refer to Appendix D for some information and examples on the configuration of the WB1 transponders.

5.2.2.7 Procedure

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 MT9 transponder.*



TRANSPONDER 1 (IXBLUE – MT9)

▾ Interrogation

Mode: Transponder

Code: F1 - TONAL 19.5kHz

▾ Reply

Code: MF MFSK 10ms 23

Turn Around Time: 40 ms

▾ Additional Information

Source: External Pressure

Accuracy: 0.2 m

▾ Dynamic Positioning

Mode: L/USBL

Latitude: 56 ° 56.30842 ' N

Accuracy: 2.37 m

Longitude: 124 ° 56.30839 ' E

Accuracy: 1.84 m

Depth: 32.94 m

Accuracy: 0.37 m

Use as reference transponder ☐

▾ Filtering

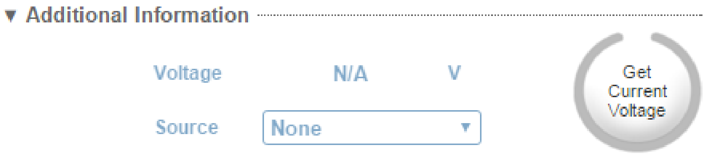
Type: Fixed

▾ Other

Label: TRANSP10

Repetition Factor: 1

Step	Action
3.	In **Interrogation**, select **Mode** and **Code** from the scrolling lists.
4.	In **Reply**, select **Code** and **Turn Around Time** from the scrolling lists.

Step	Action
5.	In **Additional Information**, select **Source** from the scrolling list. • If you select **External Pressure**, enter a pressure **Accuracy**. • If you select **Fixed Depth**, enter a **Depth** with the associated **Accuracy**. <u>In case of ZTA transponder</u> configuration a button **Get Current Voltage** appears grayed. This button is accessible while GAPS is in tracking mode. A click on the **Get Current Voltage** sends a signal to the transponder which returns the current available voltage. See section .  ▼ Additional Information Voltage N/A V Source None ▼
6.	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. Enter manually 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. 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.
7.	In **Filtering**, select the **Type** of filter from the scrolling list.
8.	In **Other**, select a **Repetition Factor** in the scrolling list and type in the **Label** of your choice (8 characters).
9.	Click on **OK** to validate your choices and to send the data to the GAPS.
10.	End of Procedure.

5.2.3 ACTIVATING A TRANSPONDER

A transponder present in the database must be activated before being positioned.

Procedure

Step	Action
1.	Select **SETUP > TRANSPONDERS**.
2.	Click on OFF depending on which transponder you would like to activate. *The button becomes* ON *. The transponder is activated.*
3.	End of Procedure

5.2.4 DELETING A TRANSPONDER

A transponder can be removed from the transponder list.

Procedure

Step	Action
1.	Select **SETUP > TRANSPONDERS**.
2.	Click on **Erase** depending on which transponder you wish to delete. *The transponder disappears. The transponder has been deleted.*
3.	End of Procedure

It is not possible to delete the last transponder.

5.3 Entering a Sound Velocity Profile

The GAPS measures the angle and the signal time between the acoustic antenna and the immerged 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 input manually or via a data file.

5.3.1 LOADING A PROFILE FROM A DATA FILE

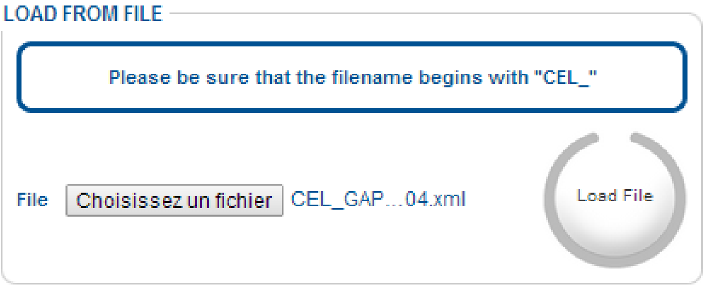
It is possible to load a file containing the sound velocity profile in the Web-based user interface. The format of this file must respect the following rules:

- 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.



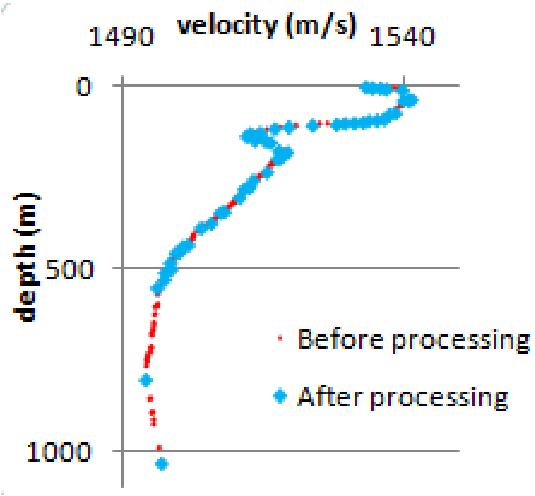
Please be sure that the filename begins with "CEL_"

CEL_GAP...04.xml

2. Click on **Send File**.
The file is read and the depth and velocity data are displayed in the table.

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 ENTERING MANUALLY A PROFILE

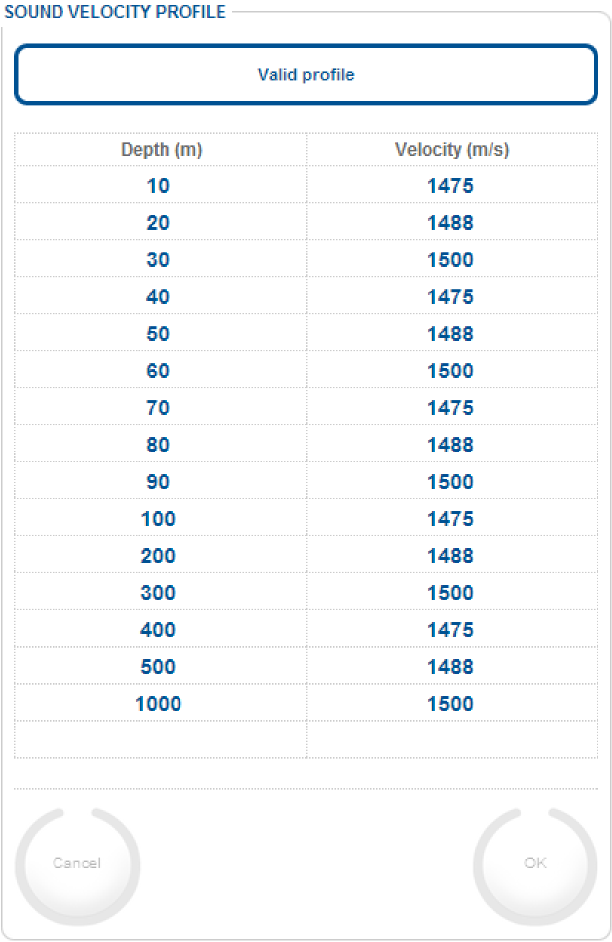
The depth and velocity couples are entered directly in the provided array. The [`tab`] key allows the user to move from one case to another. Messages, warnings and errors are displayed in order to provide guidance.

Table 12 – 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 > SOUND VELOCITY 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

Step	Action
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 GAPS.
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.

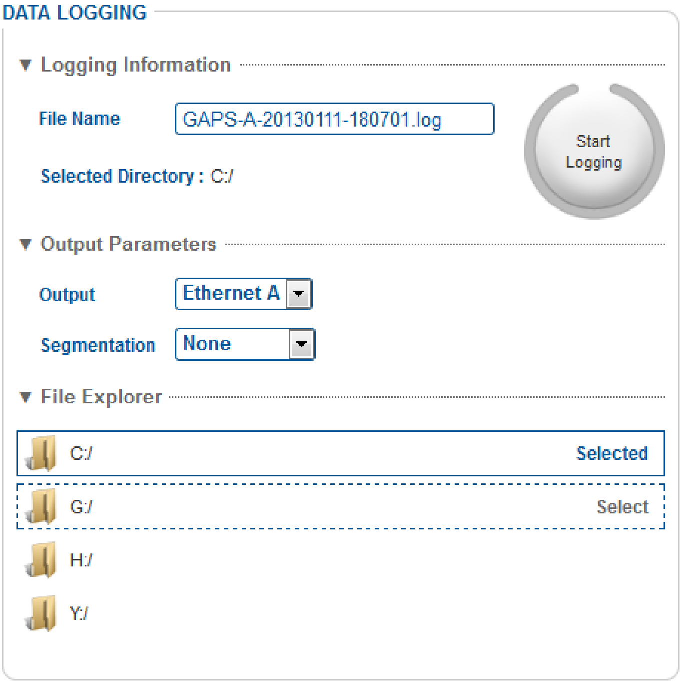
5.4 Logging Data

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 of 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.



DATA LOGGING

▼ Logging Information

File Name: GAPS-A-20130111-180701.log

Selected Directory : C:/

▼ Output Parameters

Output: Ethernet A

Segmentation: None

▼ File Explorer

C:/ Selected

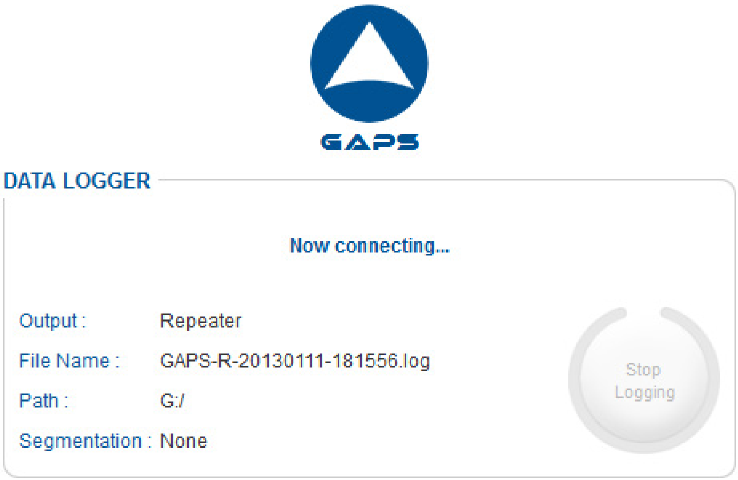
G:/ Select

H:/

Y:/

2. In **Logging Information**, 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. In **Logging Parameters**, click on **Selected Directory** or on **File Explorer** below 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), then click on the button **Select** to validate the chosen directory.
*The chosen directory appears below the **Selected Directory** field.*

Step	Action
4.	In **Output Parameters**, select the **Output** port. You can choose between **Repeater**, **Ethernet A**, **B**, **C** and **D**.
5.	In Output Parameters, for Segmentation, select; **Size (ko)** if you want to have data files with fixed size, enter the chosen size in the box.  Segmentation Time (min) 10 **Time (min)** if you want to have new data file at regular time interval, enter the chosen temporal length in minutes in the text box.  Segmentation Size (ko) 10
6.	Click on the **Start Logging** button to begin recording. *Recording starts and a separate* ***DATA LOGGER*** *window opens. 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.  DATA LOGGER Now connecting... Output : Repeater File Name : GAPS-R-20130111-181556.log Path : G:/ Segmentation : None *Do not close the DATA LOGGER window otherwise you stop the data recording.*
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 41.
- 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 42.
- Offline mode: the data is directly imported in DELPH RoadMap and all at once displayed in the main graphic area. See Figure 43.

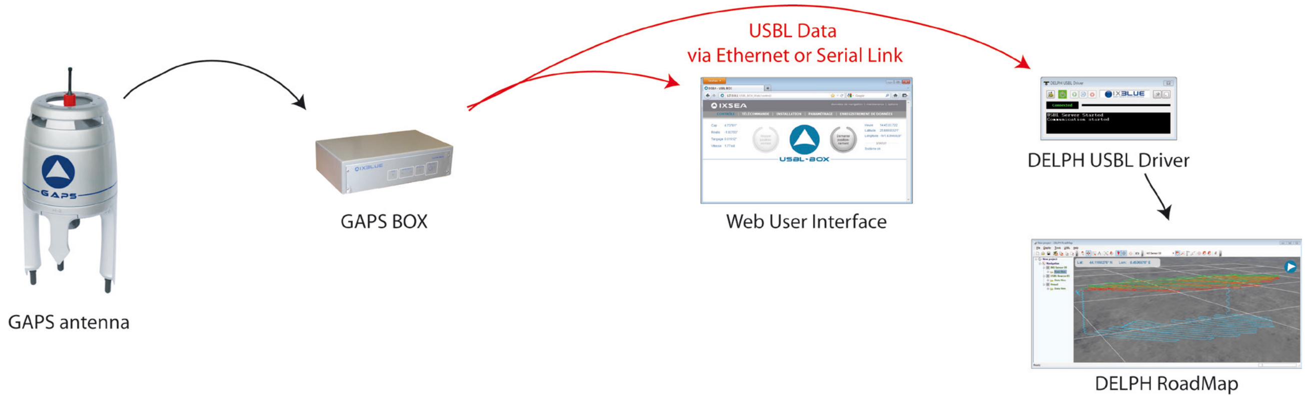


Figure 41 – Visualization of USBL data in real-time mode

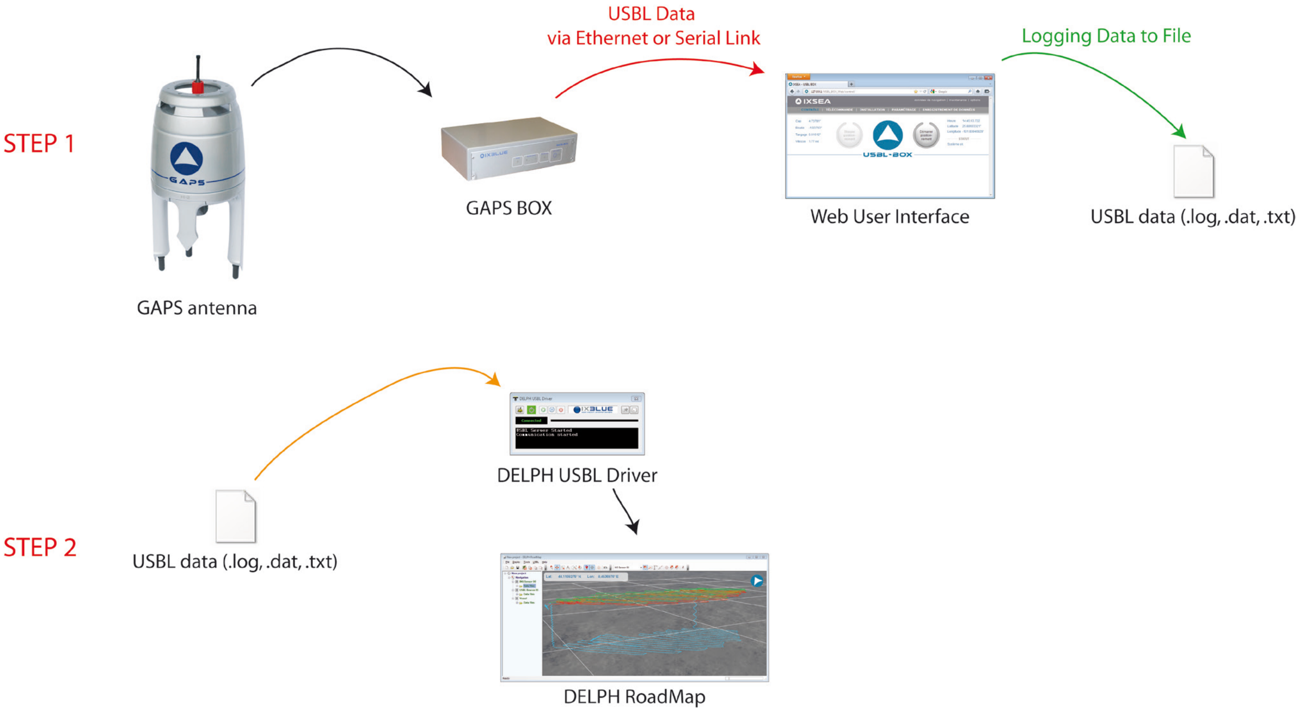


Figure 42 – Visualization of USBL data in replay mode

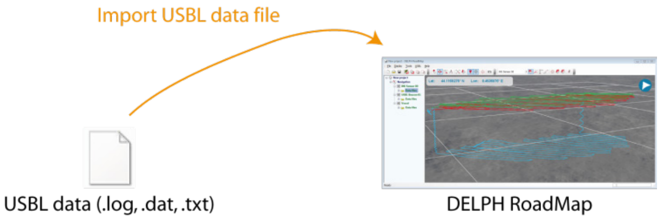


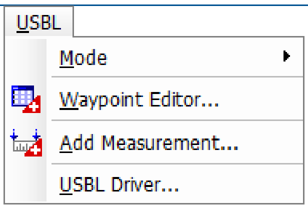
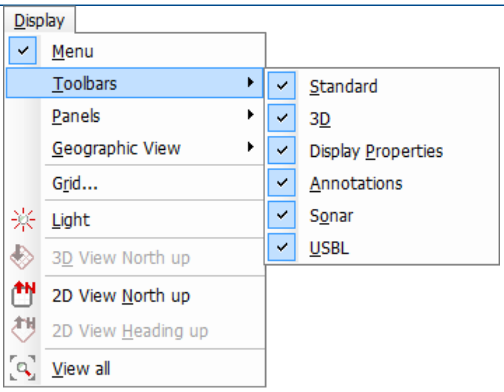
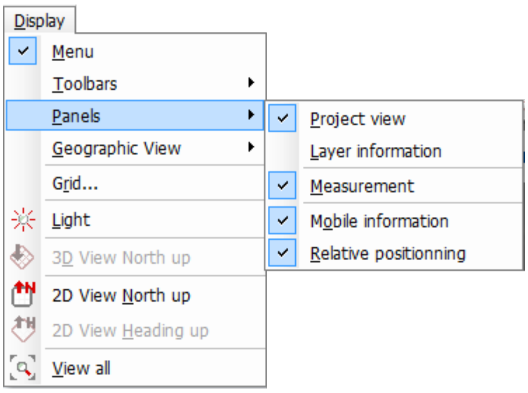
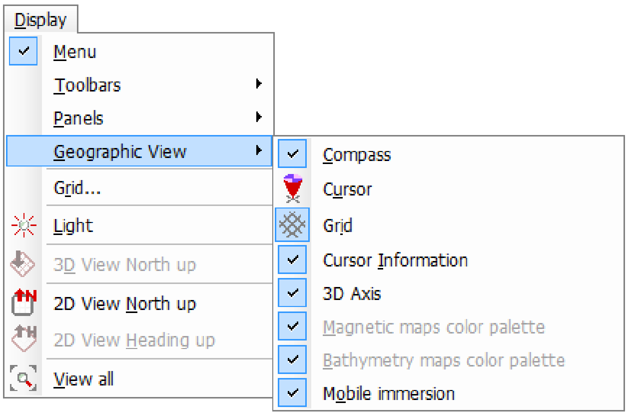
Figure 43 – Visualization of USBL data in offline mode

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 13.
- USBL toolbar (Figure 44) and its buttons with associated tasks are listed in Table 14.

Table 13 – Menus and associated tasks

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

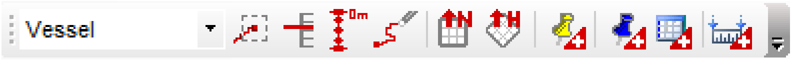
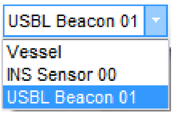


Figure 44 – USBL toolbar

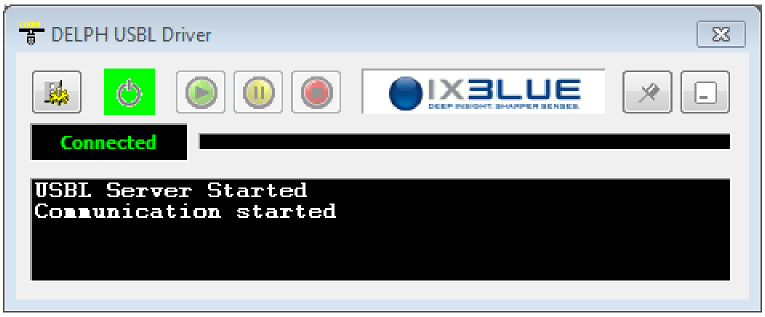
Table 14 – USBL toolbar

Button	Explanation
 USBL Beacon 01 Vessel INS Sensor 00 USBL Beacon 01	**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 45). DELPH USBL driver is accessible from DELPH RoadMap application.



```
USBL Server Started
Communication started
```

Figure 45 – DELPH USBL driver

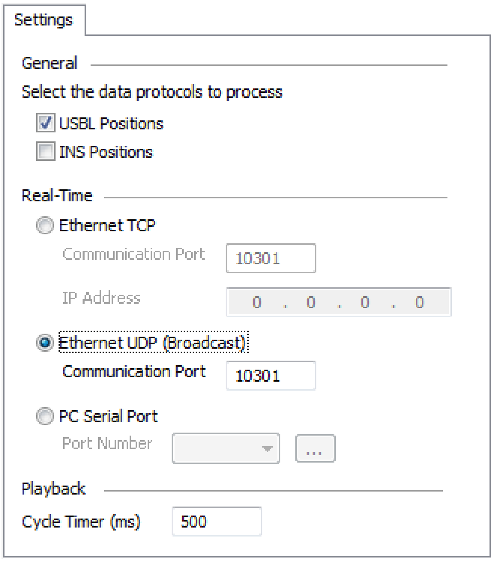
6.2.2 CONFIGURING DELPH USBL DRIVER

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 46.



Settings

General
Select the data protocols to process
☑ USBL Positions
☐ INS Positions

Real-Time
○ Ethernet TCP
Communication Port 10301
IP Address 0 . 0 . 0 . 0
● Ethernet UDP (Broadcast)
Communication Port 10301
○ PC Serial Port
Port Number

Playback
Cycle Timer (ms) 500

Figure 46 – 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.

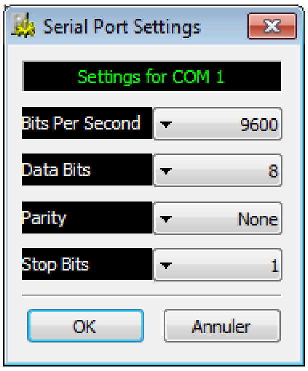
Cycle Timer (ms): value between 100 and 10000

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 45.
2. Click on to have access to the **Settings** window.
   *The **Settings** window opens. See Figure 46.*
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).
   The parameters related to the chosen communication mode become active and editable.
5. - 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:



Serial Port Settings

Settings for COM 1

Bits Per Second: 9600
Data Bits: 8
Parity: None
Stop Bits: 1

   - 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.
   You are now ready to launch the real-time display of USBL data in DELPH RoadMap. Refer to section 6.2.3.
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 45.*
2.	Click on ⚙ to have access to the **Settings** window. *The **Settings** window opens. See Figure 46.*
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. *You are now ready to launch the playback display of USBL data in DELPH RoadMap. Refer to section 6.2.4.*
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 45.*
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. *The message "Communication started" appears in the message log of the DELPH USBL driver.* *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.*
4.	End of Procedure.

6.2.4 LAUNCHING THE DISPLAY IN PLAYBACK MODE

Procedure

Step **Action**

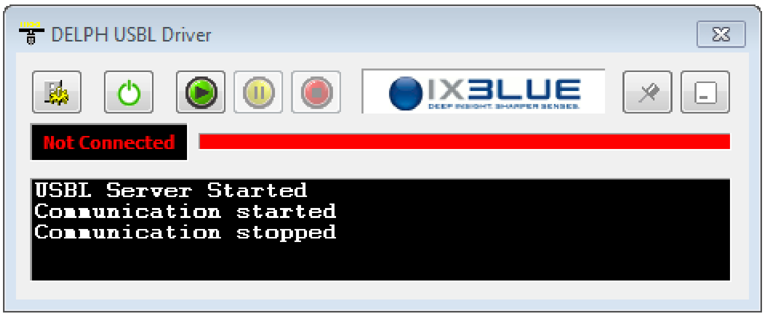
1. In DELPH RoadMap main window, select the menu **USBL > USBL Driver…**

   The window of the DELPH USBL Driver opens. See Figure 45.

2. Configure the playback mode of the DELPH USBL driver. See section 6.2.2.3.

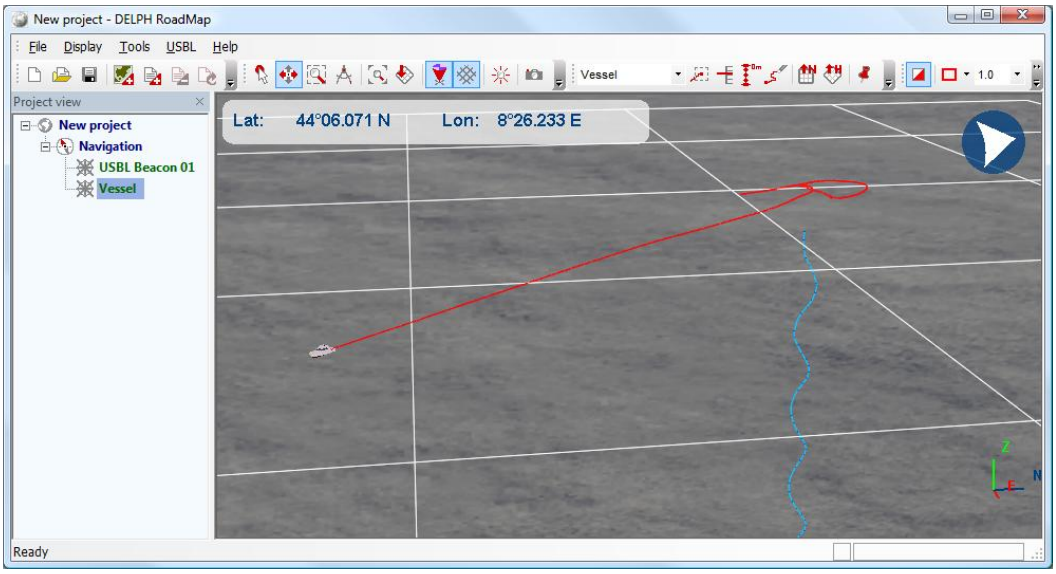
3. Click on the play button ▶. Select the data file (`.dat`, `.log`, `.txt`) in the browser that opens.

   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.*



Not Connected

```
USBL Server Started
Communication started
Communication stopped
```



Lat: 44°06.071 N Lon: 8°26.233 E

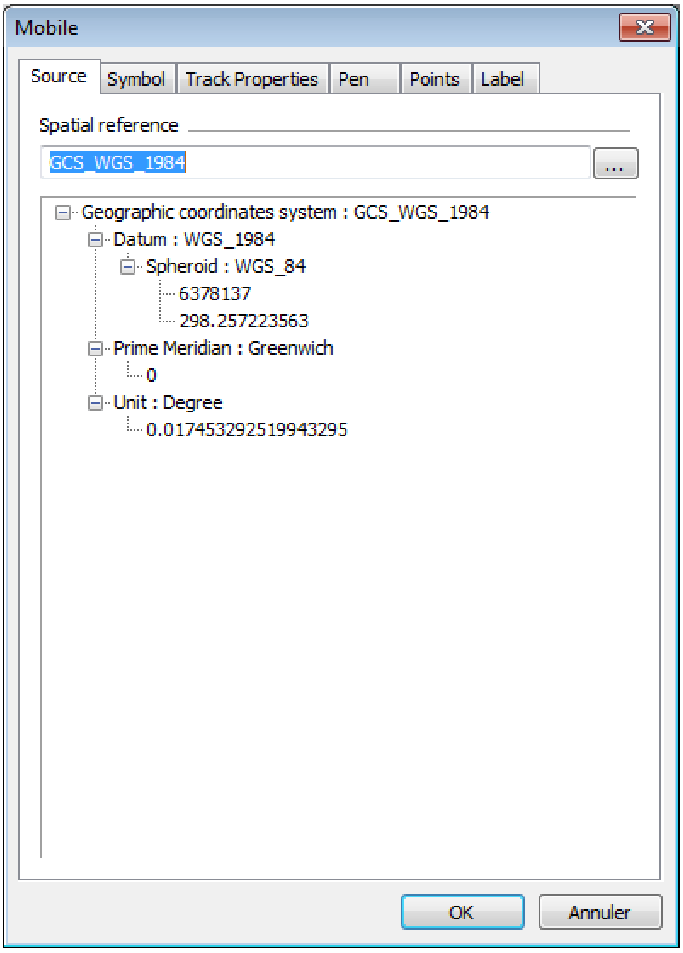
   You can at any time pause ⏸ *or stop* ⏹ *the replay.*

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)**



Spatial reference: GCS_WGS_1984

- Geographic coordinates system : GCS_WGS_1984
  - Datum : WGS_1984
    - Spheroid : WGS_84
      - 6378137
      - 298.257223563
  - Prime Meridian : Greenwich
    - 0
  - Unit : Degree
    - 0.017453292519943295

Figure 47 – 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. *The **Mobile** properties window opens.*
2.	In the **Source** tab, select the proper geodesy.
3.	Select the **Symbol** tab: • Select the **Style** in the scrolling list. If you select **User-Defined**, provide a `.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.
4.	Select the **Track Properties** tab: • 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.
5.	Select the **Pen** tab: • 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.	Select the **Points** tab: • 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.	Click on the button **OK** to validate your choices. *The result is right away visible on the graphic display.*
8.	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**

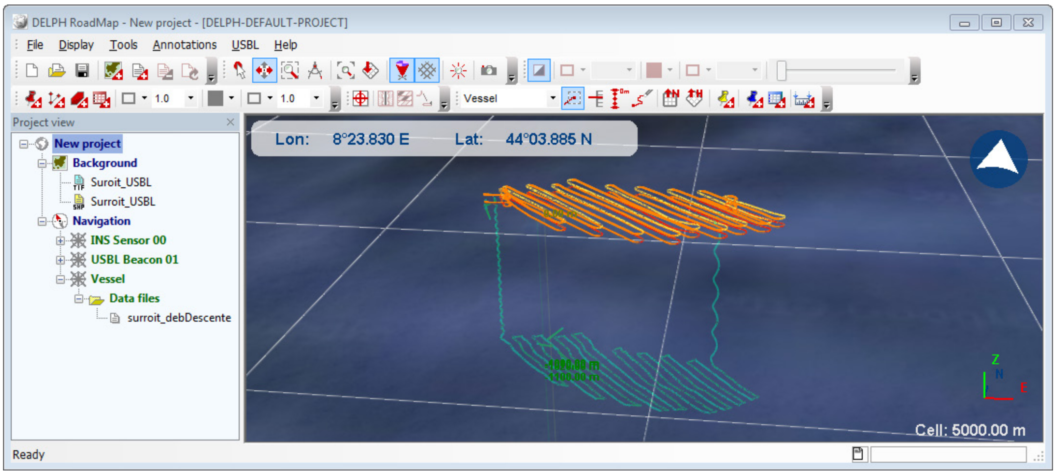
1. Click on the button or select the menu **File > Import > Data…**

   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.



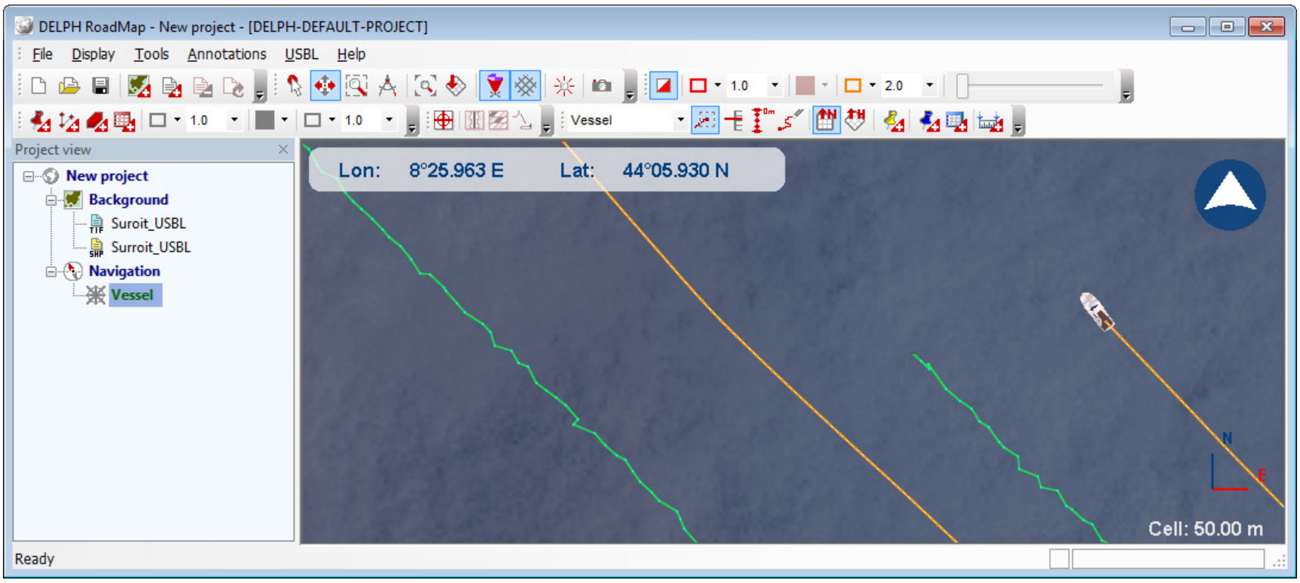
3. End of Procedure.

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 48 the orientation of the compass (in the top right corner) and the 3D axis in the bottom right corner.



Lon: 8°25.963 E Lat: 44°05.930 N

Cell: 50.00 m

Figure 48 – 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 49.

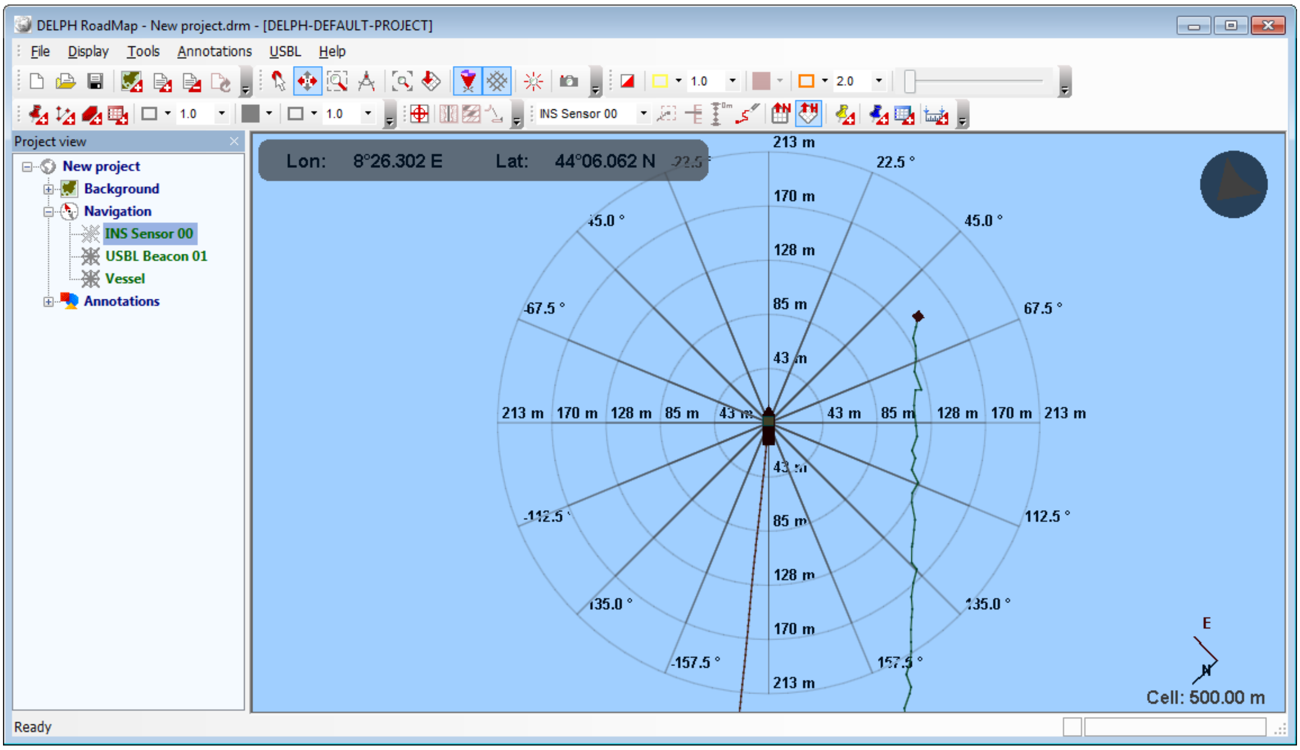


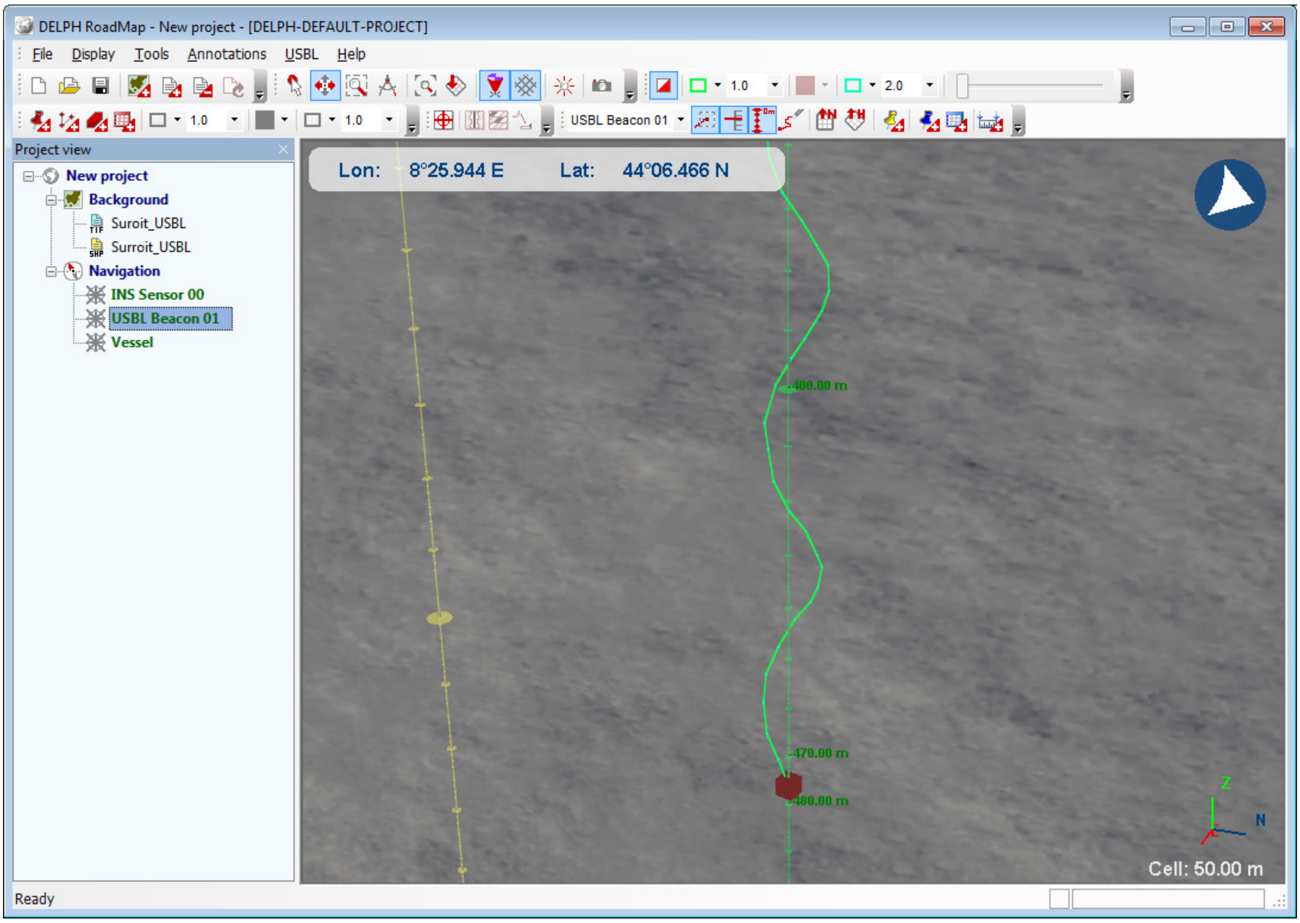
Figure 49 – Heading oriented view

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 50.



Lon: 8°25.944 E Lat: 44°06.466 N

Cell: 50.00 m

Figure 50 – 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.

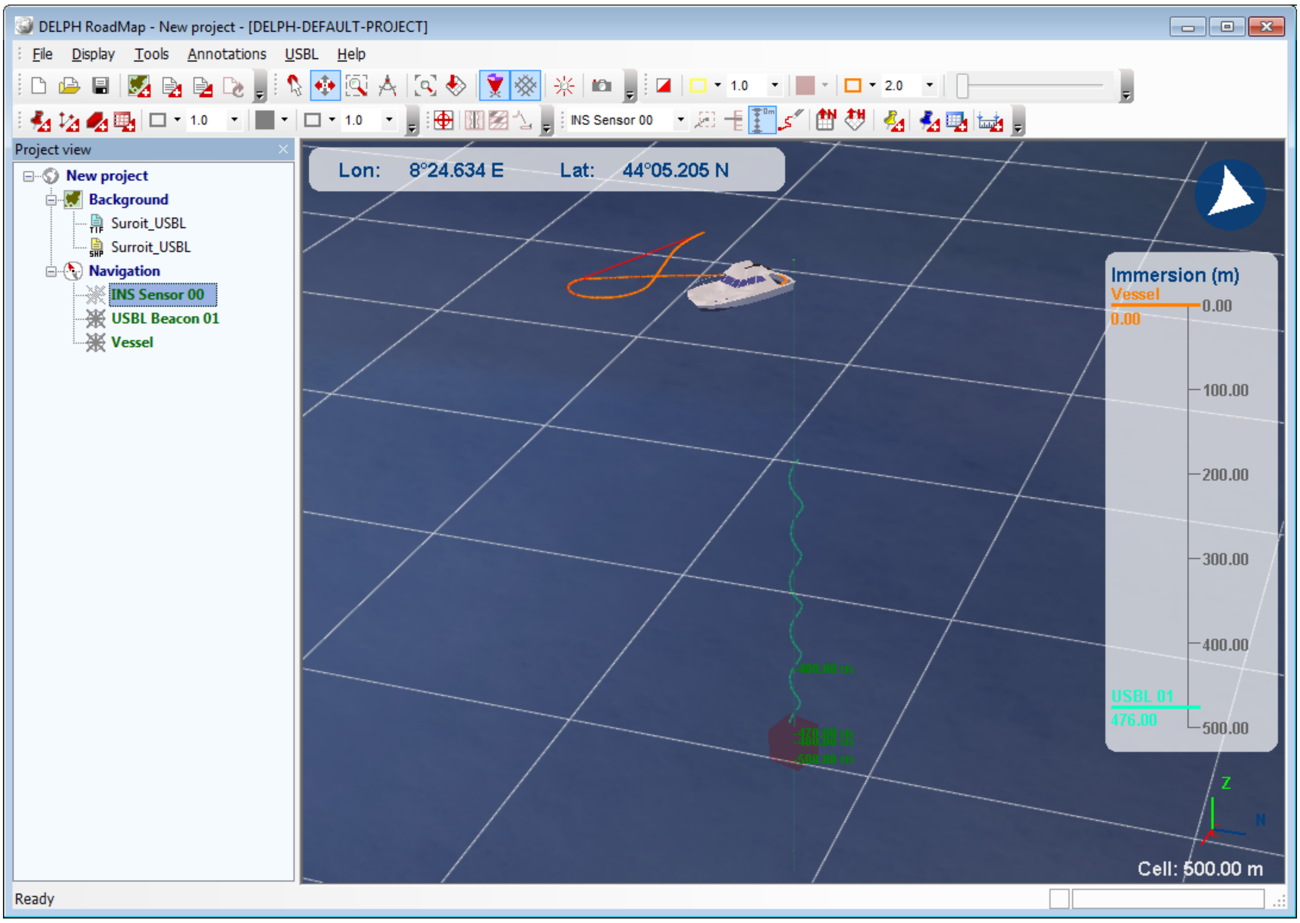
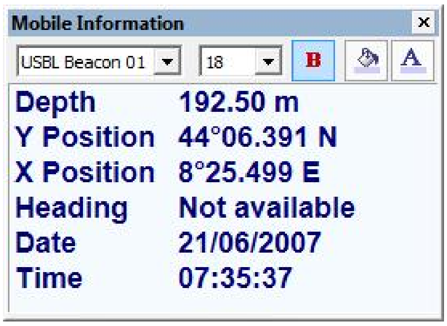


Figure 51 – Immersion panel

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.



Depth	192.50 m
Y Position	44°06.391 N
X Position	8°25.499 E
Heading	Not available
Date	21/06/2007
Time	07:35:37

Figure 52 - 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.

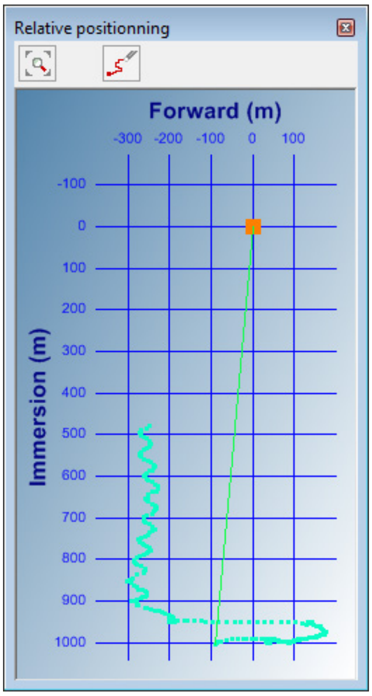


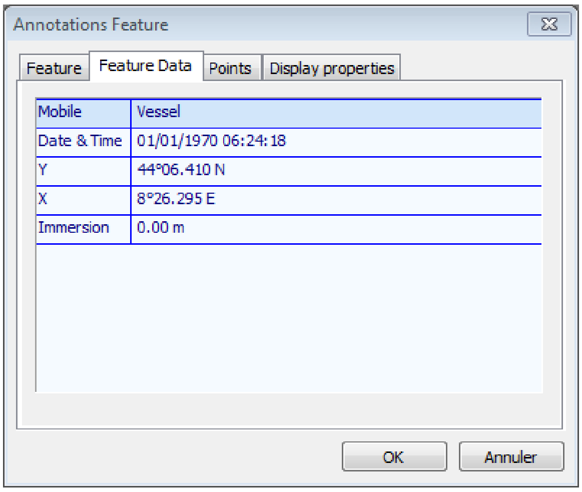
Figure 53 – Relative positioning panel

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 54.



Mobile	Vessel
Date & Time	01/01/1970 06:24:18
Y	44°06.410 N
X	8°26.295 E
Immersion	0.00 m

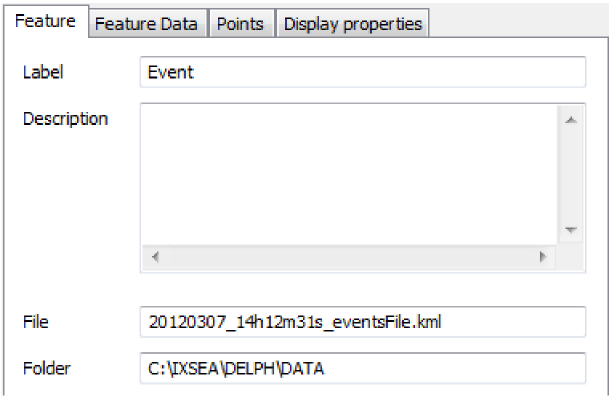
Figure 54 – Feature Data tab of the Annotation Feature window

Procedure

Step **Action**

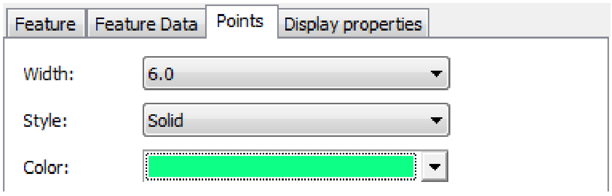
1. During real-time display, if an event occurs and you want to create a mark to keep track of this event, click on the button .
The Annotation Feature window opens.

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



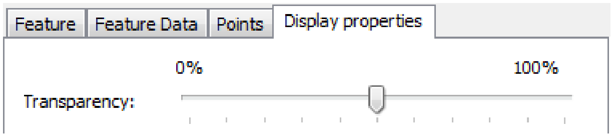
Label: Event
Description:
File: 20120307_14h12m31s_eventsFile.kml
Folder: C:\IXSEA\DELPH\DATA

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**.



Width: 6.0
Style: Solid
Color: 🟩

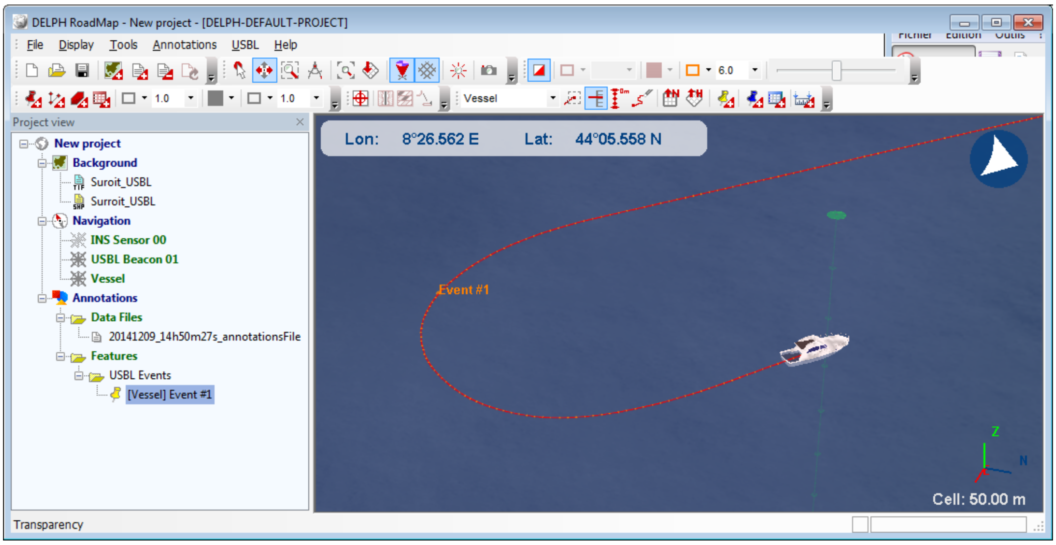
4. Open the **Display properties** tab and move the cursor along the **Transparency** scale to choose a value between 0 and 100%.



Transparency:

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:

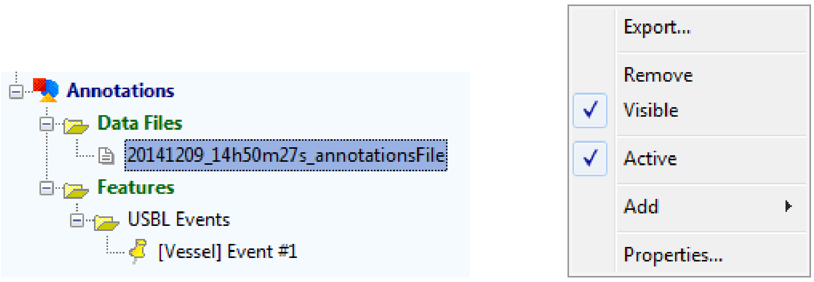


Figure 55 – Event mark data file and its pop-up menu

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:

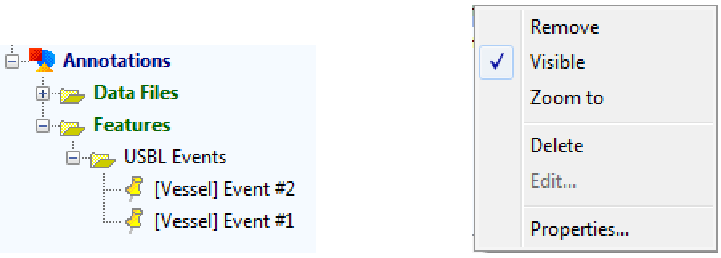


Figure 56 – Event mark pop-up menu

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.

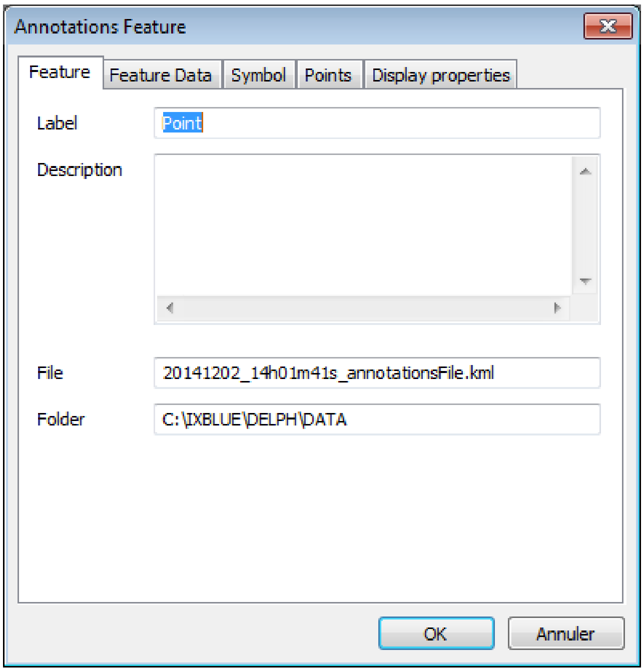
Properties: you edit the same parameters as explained during the event mark creation, see section 6.4.7.1.

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 %



Label: Point

Description:

File: 20141202_14h01m41s_annotationsFile.kml

Folder: C:\IXBLUE\DELPH\DATA

Figure 57 – Waypoint creation window

6.4.8.1 Creating Waypoints

Procedure

Step	Action
1.	Click on 📌 to select the waypoint mode. Move the mouse cursor at the location where you want to create a waypoint and double click. *The waypoint is created and the Annotation Feature window opens.*
2.	In the **Feature** tab, enter the **Label** of the waypoint. You may enter a **Description**. You may edit the associated KML **File** and **Folder**.
3.	In the **Feature data** tab, the coordinates of the waypoints are available. You may edit the **Immersion** value set to zero by default.
4.	In the **Symbol** tab: • Select a **Style** in the scrolling list. If you select **User-Defined**, provide the `.3ds` **File**. • Select a **Color** in the **Select color …** window that opens when you click. • Select a **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.	In the **Points** tab: • 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.	Open the **Display properties** tab and move the cursor along the **Transparency** scale to choose a value between 0 and 100%.
7.	Click on the button **OK** to validate your choices. *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.*
8.	End of Procedure.

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:

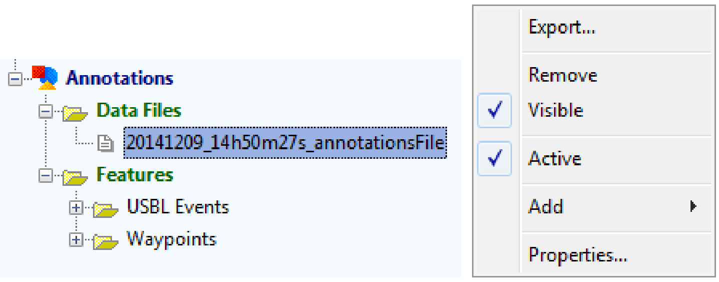


Figure 58 – Waypoint data file and its pop-up menu

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:

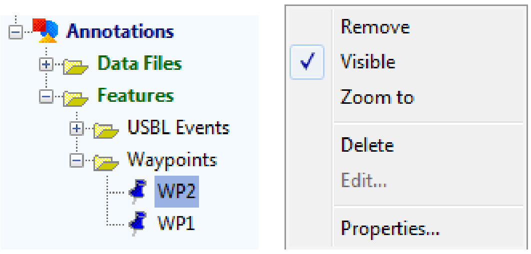


Figure 59 – Waypoint pop-up menu

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

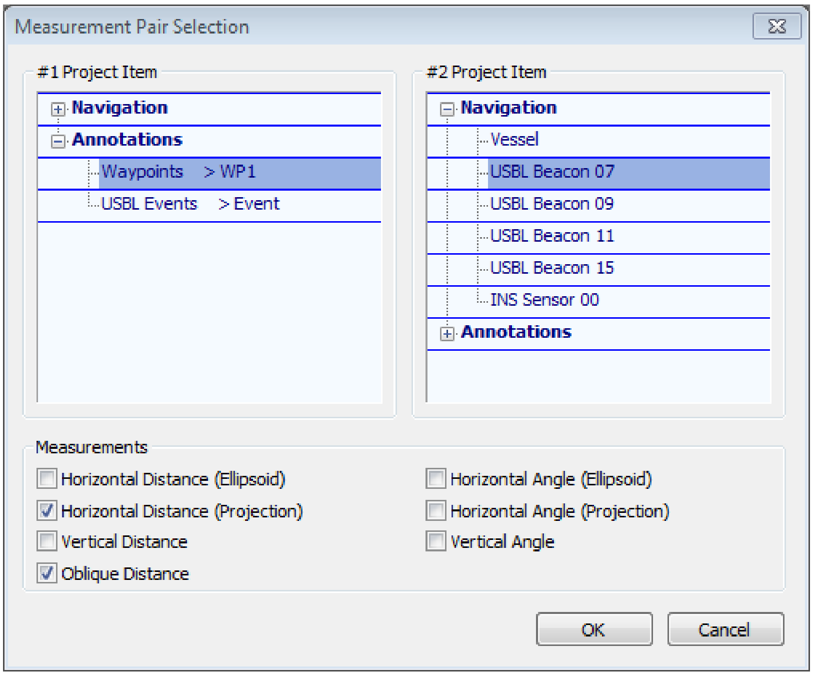
Access

The measurement tool is available from

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

The **Measurement Pair Selection** window (see Figure 60) 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**



Measurement Pair Selection

#1 Project Item
- Navigation
- Annotations
  - Waypoints > WP1
  - USBL Events > Event

#2 Project Item
- Navigation
  - Vessel
  - USBL Beacon 07
  - USBL Beacon 09
  - USBL Beacon 11
  - USBL Beacon 15
  - INS Sensor 00
- Annotations

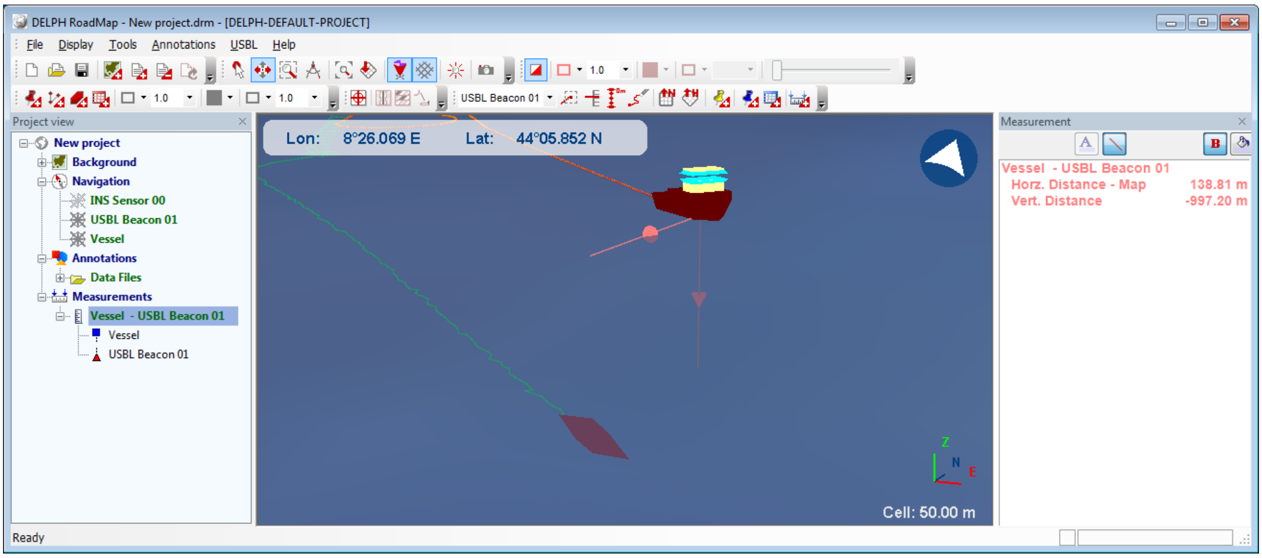
Measurements

☐ Horizontal Distance (Ellipsoid)
☑ Horizontal Distance (Projection)
☐ Vertical Distance
☑ Oblique Distance
☐ Horizontal Angle (Ellipsoid)
☐ Horizontal Angle (Projection)
☐ Vertical Angle

Figure 60 – Measurement Pair Selection window

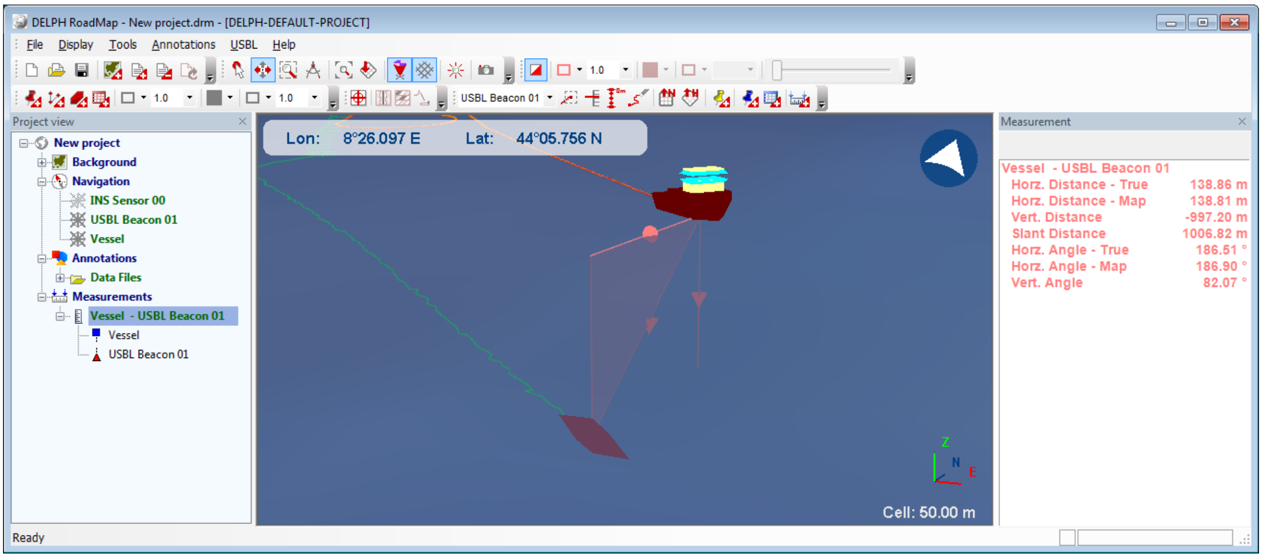
Drag and Drop

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.



```
Vessel  - USBL Beacon 01
  Horz. Distance - Map        138.81 m
  Vert. Distance             -997.20 m
```

Figure 61 – Measurement example with vertical and horizontal measurements



```
Vessel  - USBL Beacon 01
  Horz. Distance - True       138.86 m
  Horz. Distance - Map        138.81 m
  Vert. Distance             -997.20 m
  Slant Distance             1006.82 m
  Horz. Angle - True          186.51 °
  Horz. Angle - Map           186.90 °
  Vert. Angle                  82.07 °
```

Figure 62 – Measurement example with all measurement options selected

Procedure

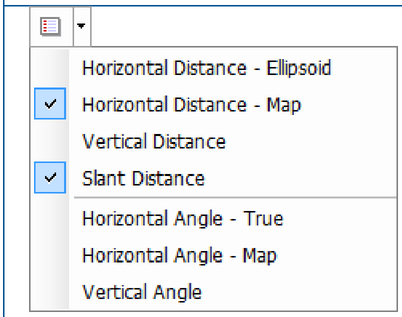
Step	Action
1.	Select the menu **USBL > Add Measurement…** or click on the measurement toolbar button. *The Measurement Pair Selection window opens.*
2.	Select a Navigation or Annotation item in the #1 Project Item list and another Navigation or Annotation item in the #2 Project Item list.
3.	Select which measurement(s) you want to monitor in the **Measurements** frame.
4.	Click on **OK** to validate your choice. *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.*
5.	End of Procedure.

6.4.9.2 Managing a Measurement

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

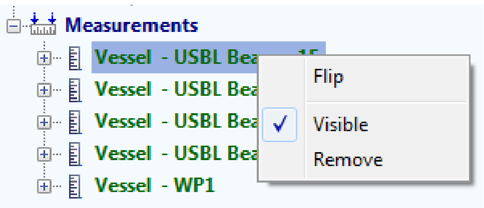
On the Measurement window are available the following buttons to edit the measurement:

Table 15 – Measurement window buttons

Icon	Task
	Select in the list the values to display.
⇄	Flip the objects between which the distance is measured
A	Change the item color and the displayed line
╲	Show or hide the measurement in the geographic display
14 ▾	Font size for the window
B	Set the list of measurement in bold
🪣	Set the color of the background

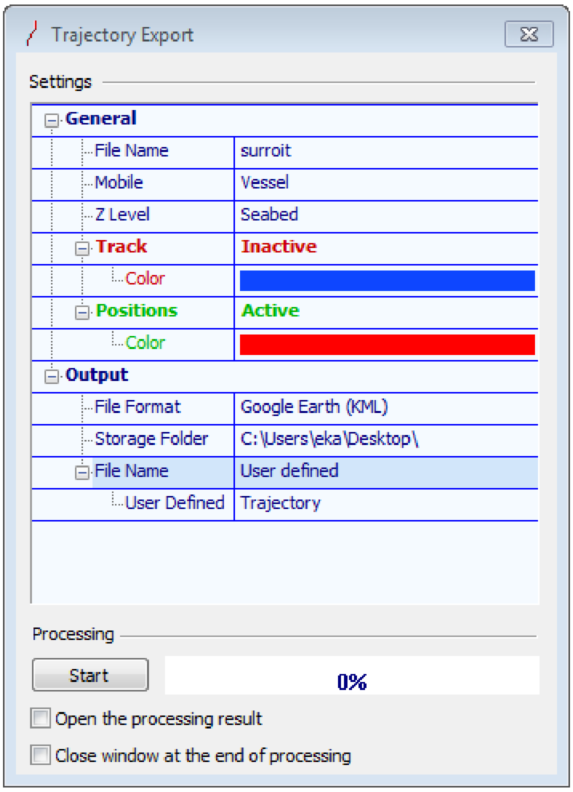
In the Project view the right click pop-up menu allows the user

- 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:



General	
File Name	surroit
Mobile	Vessel
Z Level	Seabed
Track	**Inactive**
Color	🟦
Positions	**Active**
Color	🟥
Output	
File Format	Google Earth (KML)
Storage Folder	C:\Users\eka\Desktop\
File Name	User defined
User Defined	Trajectory

0%

☐ Open the processing result

☐ Close window at the end of processing

Figure 63 – 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. *The Trajectory Export window opens.*
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.
4.	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.
5.	Expand the **Output** item and select a **File Format**, enter a **Storage Folder** path and choose a **File Name** type.
6.	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)**. *The completion state of the export process is displayed on the progress bar.*
7.	End of Procedure.

7 COUPLING GAPS AND PHINS 6000

7.1 PHINS 6000

PHINS 6000 is an inertial sensor providing a very precise positioning. PHINS 6000 must be connected to external sensors (GAPS, USBL-BOX etc.) in order to have references in absolute positioning. Please refer to PHINS 6000 user manual for complete description.

Figure 64 – PHINS 6000

7.2 Coupling Principle

The coupling GAPS with PHINS 6000 (+DVL) is the optimal solution for positioning a deep water vehicle. GAPS locates itself in a field of fix transponders and is bidirectionally coupled with PHINS 6000. The two devices exchange their own navigation and transponders positioning. They correct themselves respectively. The distances to the transponders provided by GAPS feed the Kalman filter of PHINS preventing the drift of the inertial navigation. The provided navigation is therefore very precise and drift free even with the use of a single transponder or depending of the trajectory of the vehicle among some sparse transponders (sparse array application, i.e. pipeline tracking).

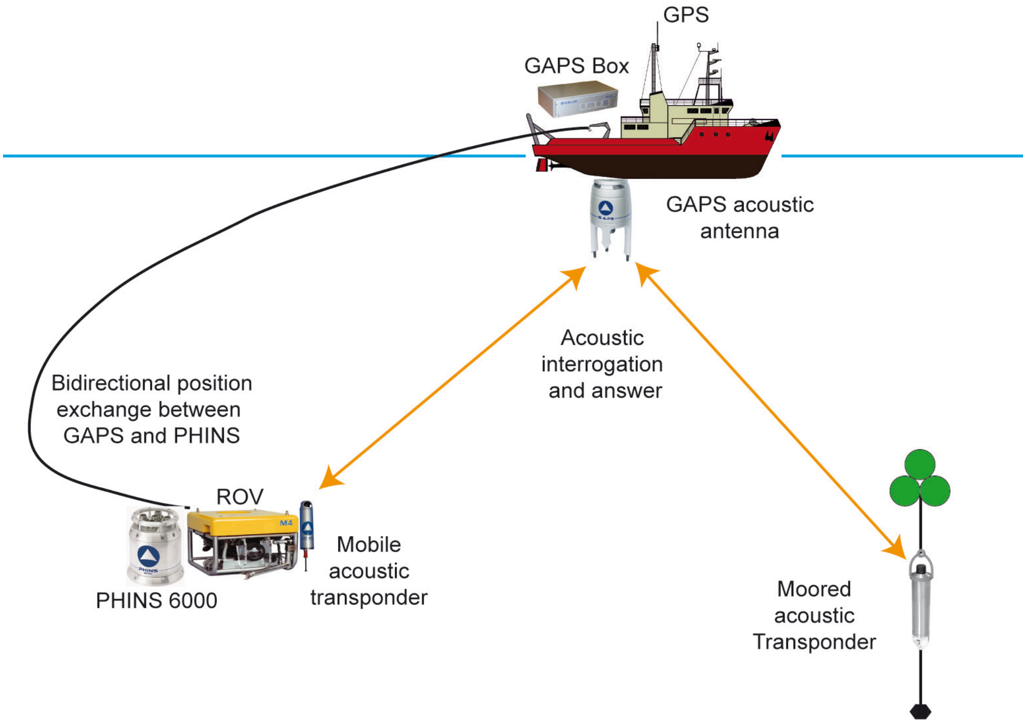


Figure 65 – Coupling GAPS and PHINS

In this section, is detailed how to connect GAPS to PHINS in order for GAPS to provide to PHINS 6000 the needed absolute positioning. GAPS must be configured to output data to PHINS 6000 and PHINS 6000 must be configured to input data coming from GAPS. The protocols that must be used are the following:

- **GAPS STANDARD**: this protocol has several drawbacks :
    - ASCII format (not optimal in term of bandwidth in an umbilical or acoustic modem)
    - Many telegrams are not used by the INS
    - Standard deviation is estimated in INS
    - Positions are time stamped so it is mandatory that PHINS and GAPS receives ZDA
- **IXSEA USBL INS 1**:
    - Binary (optimal in term of bandwidth in an umbilical or acoustic modem)
    - Positions are time stamped so it is mandatory that PHINS and GAPS receives ZDA
    - Standard deviation is estimated by USBL
- **POSIDONIA 6000**:
    - Binary (optimal in term of bandwidth in the umbilical or acoustic modem)
    - Age of the position (no requirement for ZDA synchronization)
    - Standard Deviation estimated by USBL
- **USBL POST PRO**:
    - Binary (optimal in term of bandwidth in the umbilical or acoustic modem)
    - Age of the position and time stamping (no requirement for ZDA synchronization)
    - Standard Deviation estimated by USBL

Figure 66 – Coupling GAPS to PHINS

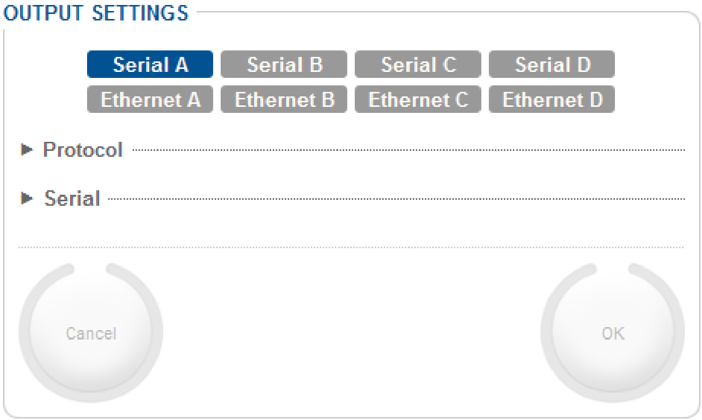
7.3 Procedures

7.3.1 OUTPUT CONFIGURATION IN GAPS WEB-BASED USER INTERFACE

Procedure

Step **Action**

1. Click on the **INSTALLATION > OUTPUTS**.



2. Click on the port of your choice: **Serial A**, **B**, **C**, **D** or **Ethernet A**, **B**, **C**, **D**.

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

3. Select **IXSEA USBL INS 1** or **POSIDONIA 6000** for the **Protocol** and the **Minimum Frequency** of your choice from the pull-down list:

Protocol: USBL POSTPRO

Minimum Frequency: 1000ms - 1Hz

4. If you have selected a **Serial** link, enter the parameters of this link:

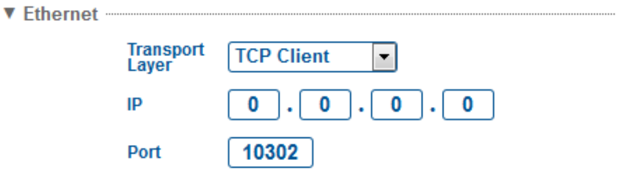
Parity: None

Stopbits: 1.0

Standard: RS422

Baudrate: 19200

5. If you have selected an **Ethernet** link, enter the parameters of the link:



Transport Layer: TCP Client

IP: 0 . 0 . 0 . 0

Port: 10302

6. Click on **OK** to validate your output configuration positioning data.

7. End of procedure.

7.3.2 INPUT CONFIGURATION IN PHINS 6000 WEB-BASED USER INTERFACE

The distance between PHINS 6000 and the GAPS transponder installed on the ROV along the three axis of PHINS 6000 reference frame must be known so PHINS 6000 can correct the positions provided by RAMSES 6000. The following values must be filled in:

- **LV1** signed distance from the center of PHINS 6000 to RAMSES 6000 on axis 1.
- **LV2** signed distance from the center of PHINS 6000 to RAMSES 6000 on axis 2.
- **LV3** signed distance from the center of PHINS 6000 to RAMSES 6000 on axis 3.

Procedure

Step **Action**

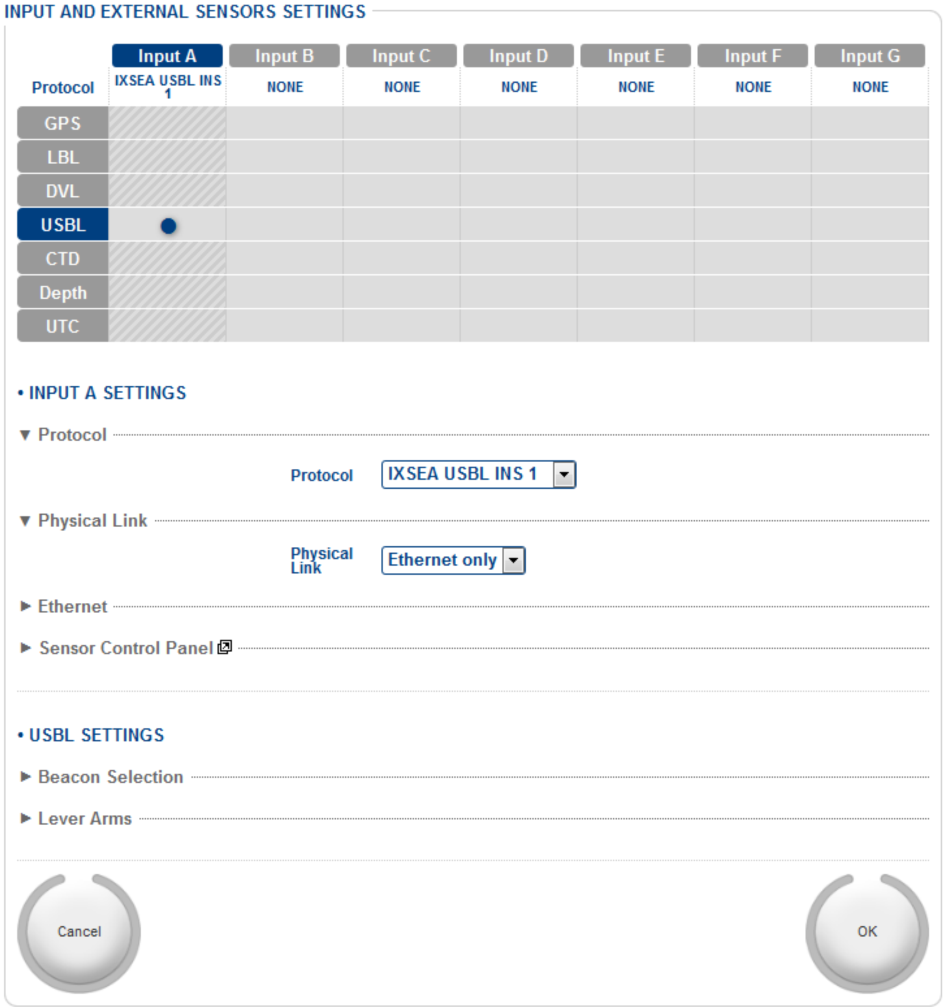
1. In PHINS 6000 select **INSTALLATION** > **INPUTS**.

   The INPUT AND EXTERNAL SENSORS SETTINGS opens.

2. Select a port among the ports A to E and click in the table, in the column of the selected port and in the USBL line.

   The selected table cell is highlighted.

3. Select IXSEA USBL INS 1 or POSIDONIA 6000 in the Protocol list.



INPUT AND EXTERNAL SENSORS SETTINGS

	Input A	Input B	Input C	Input D	Input E	Input F	Input G
Protocol	IXSEA USBL INS 1	NONE	NONE	NONE	NONE	NONE	NONE
GPS							
LBL							
DVL							
USBL	●						
CTD							
Depth							
UTC							

• INPUT A SETTINGS

Protocol: IXSEA USBL INS 1

Physical Link: Ethernet only

• USBL SETTINGS

The protocol appears now in the first line of the table. All the other cells of the selected port column are grayed because only USBL data will enter this port.

Step	Action
4.	Select **Ethernet_only** or **Serial_only** in the **Physical Link**. *Once the physical link selected, the corresponding parameters appear below.*
5.	For a **Serial link**, set up the **Parity**, **Stopbits**, **Standard** and **Baudrate**.
6.	For an **Ethernet** port, select the **Transport Layer**, the **IP** address (in the case of a **TCP Client Transport Layer**) and the **Port** number.
7.	In **Beacon Selection** enter the **Beacon ID** and its corresponding **TP Code**.
8.	In **Lever Arms** enter the **LV1**, **LV2** and **LV3** values in meters.
9.	Click on **OK** to validate your choices and to send the configuration in RAMSES 6000.
10.	End of procedure.

8 DYNAMIC POSITIONING MODES

8.1 Definition

GAPS can be used as an external hydro acoustic position reference for the Dynamic Positioning (DP). The GAPS 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, GAPS can still simultaneously track mobile transponder in USBL.

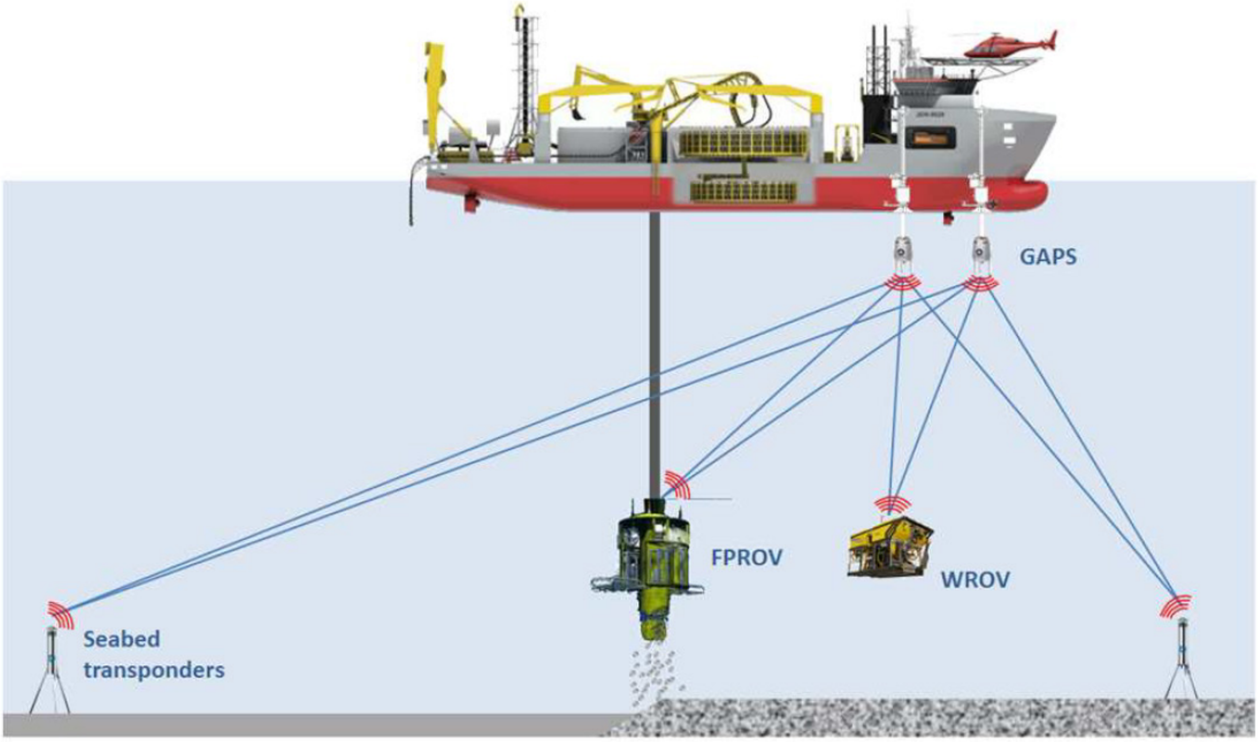
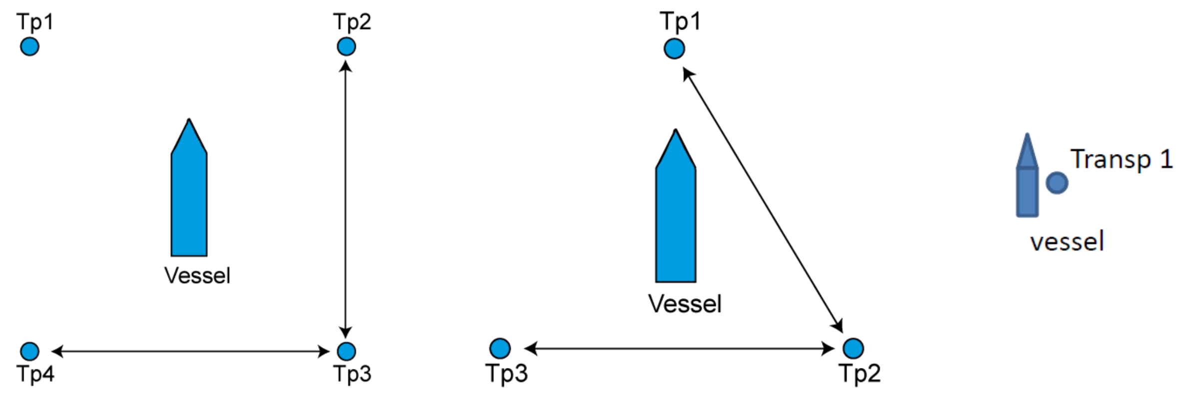


Figure 67 – GAPS in DP Mode and other operations

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 68.



4 transponders, L=30% of water depth   3 transponders, L=30% of water depth   transponder below vessel

Figure 68 – Geometry of the field of transponders

8.2 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 69).
- If at least three moored transponders are available then the positioning is provided by both USBL and LBL computations (see Figure 69 and Figure 70). The LBL computation is made from the travel distances of at least three moored transponders.

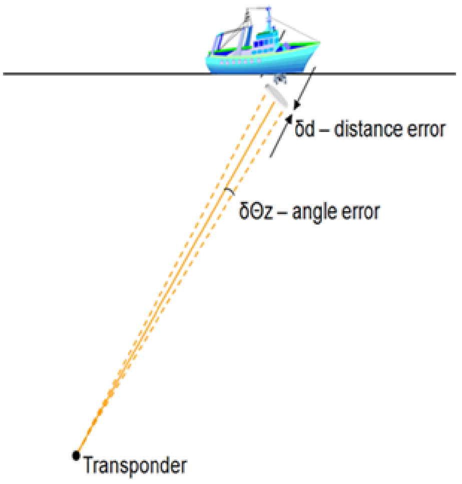


Figure 69 – USBL computation

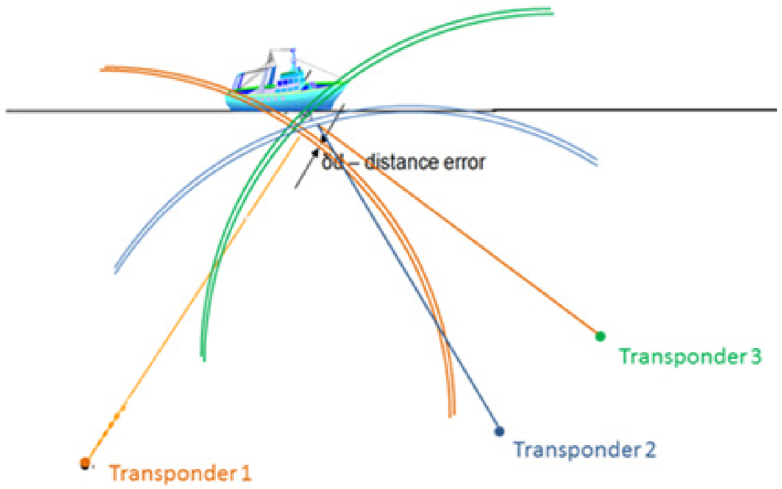


Figure 70 – LBL computation

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).

8.3 L/USBL/INS Mode

In this mode, the INS included in GAPS becomes the core component of the positioning system. The INS performs the fusion of all available sensors:

- Accelerometers and Gyroscopes of the INS
- LBL range from fixed moored transponders
- USBL position to a fixed moored transponder
- GNSS absolute position of the vessel

The INS provides the combined position of all above sensors. The INS improves the robustness, redundancy, reliability and accuracy of the global position.

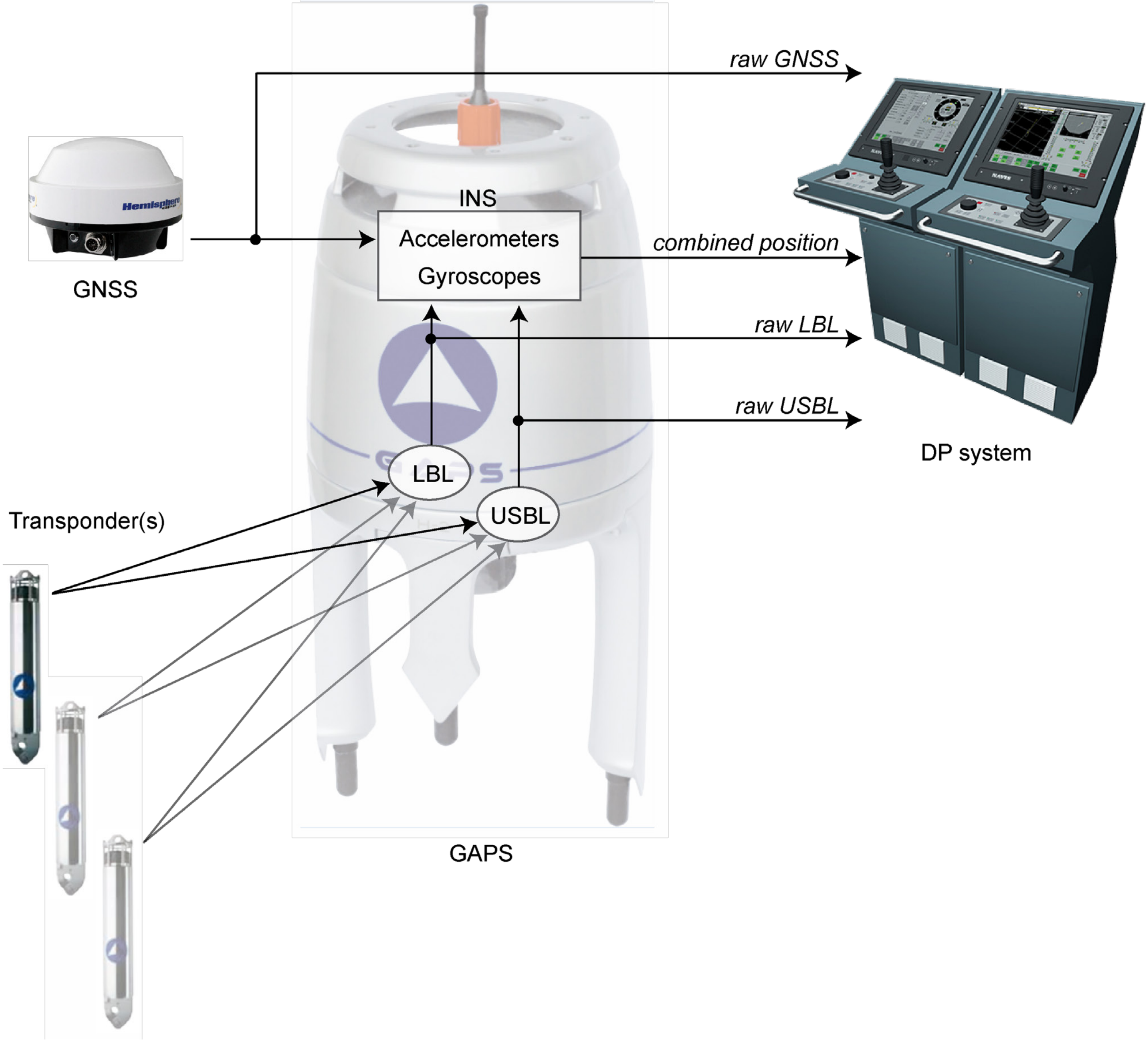
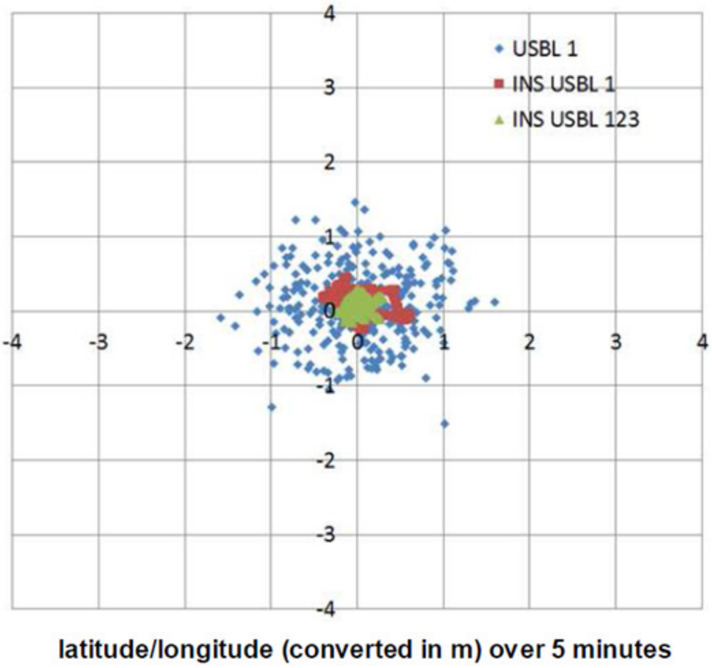
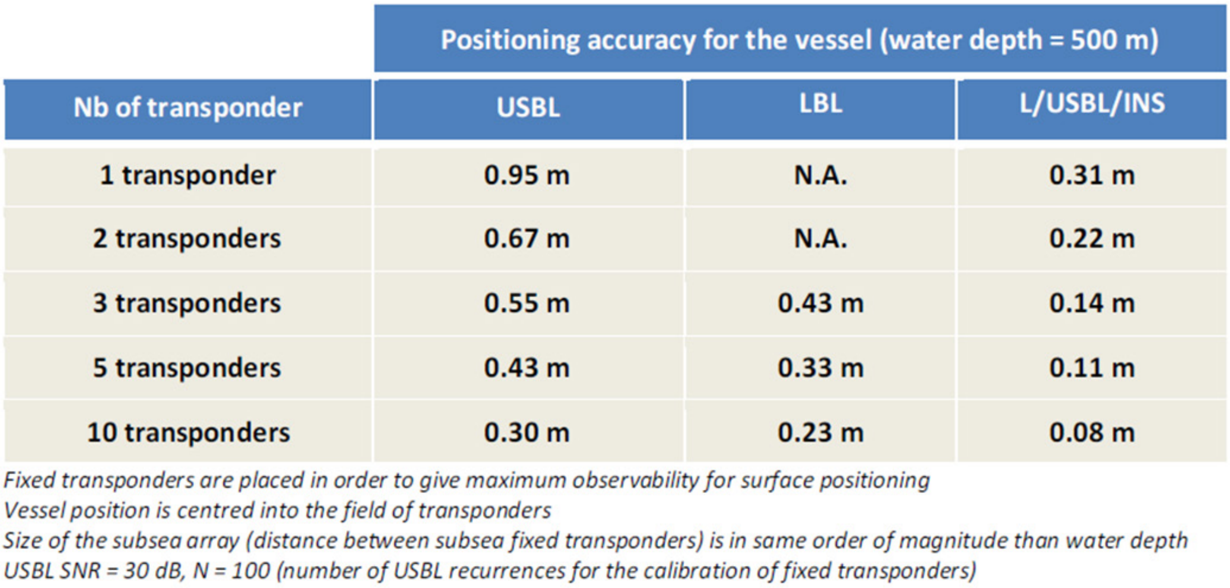


Figure 71 – Data fusion of GAPS INS

There is no constraint on the number of transponders to deploy. Only a single transponder can be used. The addition of several transponders increases the redundancy and accuracy of the final position. Figure 72 presents examples of performances that can be reached depending on the number of deployed transponders.



Blue: USBL computation with a single transponder on the seabed
Red: L/USBL/INS computation with a single transponder on the seabed
Green: L/USBL/INS computation with 3 transponders on the seabed



	Positioning accuracy for the vessel (water depth = 500 m)		
Nb of transponder	**USBL**	**LBL**	**L/USBL/INS**
1 transponder	**0.95 m**	**N.A.**	**0.31 m**
2 transponders	**0.67 m**	**N.A.**	**0.22 m**
3 transponders	**0.55 m**	**0.43 m**	**0.14 m**
5 transponders	**0.43 m**	**0.33 m**	**0.11 m**
10 transponders	**0.30 m**	**0.23 m**	**0.08 m**

Fixed transponders are placed in order to give maximum observability for surface positioning
Vessel position is centred into the field of transponders
Size of the subsea array (distance between subsea fixed transponders) is in same order of magnitude than water depth
USBL SNR = 30 dB, N = 100 (number of USBL recurrences for the calibration of fixed transponders)

Figure 72 – Performances of the various modes

8.4 Procedure

Prerequisite The INS of GAPS must be aligned (see section 9.2.1).

Calibration Once the transponders have been deployed, they must be calibrated. Calibration of one transponder typically requires 100 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

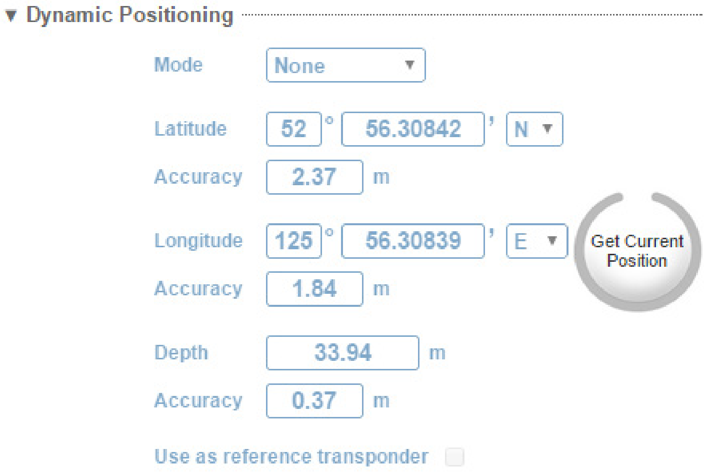
GAPS can be used without GPS.

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.	Moore the transponder(s) and sail the vessel to the center of the field of transponders. Run the next three steps for each or 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: None Latitude: 52° 56.30842' N Accuracy: 2.37 m Longitude: 125° 56.30839' E Accuracy: 1.84 m Depth: 33.94 m Accuracy: 0.37 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 entered manually 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 G.4).
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 9.2. Run the DP survey.
8.	End of procedure.

9 OPERATING GAPS

Every operation starts by the initialization and the survey configuration of the system (see section 5.1). During the survey, you can control the incoming data (see section 9.3).

Do NOT sail faster than 12 knots with the GAPS head in the water. It is the mechanical limit of the GAPS unit.

9.1 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.

9.2 Launching the Survey

9.2.1 INITIALIZING THE INS

Initialization

- During the first 5 minutes after powering-on, the system performs a **coarse alignment**:
    - Inertial sensor data (accelerometers and gyrometers) are computed to estimate heading, roll and pitch angles.
    - No estimation of position or speed, nor errors, are done by the INS during the rough alignment: the data provided by external sensors (lever arm compensated) are used directly.
- At sea, it is recommended that the system is kept as steady as possible during coarse alignment: oscillations around a mean position or smooth drift are permitted but accelerations should be avoided. Leaving the vessel adrift for 5 minutes would lead to satisfactory conditions for coarse alignment.
- After the coarse alignment phase, the GAPS is ready for navigation. Kalman filter is activated to compute and estimate position and speed with an optimal accuracy. The INS switches to the "**fine alignment**" phase to improve the accuracy of roll, pitch and heading estimations.
    - During the fine alignment phase, movements of the vessel are required. 90 degrees rotations are even recommended so that the Kalman filter assesses the sensors bias on different axes.
    - Error estimations from the INS Kalman filter are improved when optimal trajectories are performed. The optimal trajectory to achieve fast fine alignment is "staircase" shaped, as illustrated in Figure 73, with a typical duration of 3 to 5 minutes for each step. Such a trajectory allows the Kalman filter to assess all sources of errors of the system, to correct them and to achieve optimal performances at the end of the fine alignment process.
    - When a "staircase" shaped trajectory is performed, the fine alignment phase would typically last for less than 20 minutes.

- ☐ Fine alignment requires the GPS to provide valid data to the system. the INS uses both inertial sensors and external sensors to compute optimal estimates of position, speed, attitude and heading.
- ☐ Fine alignment ends automatically when the heading covariance is below 0.1 °.

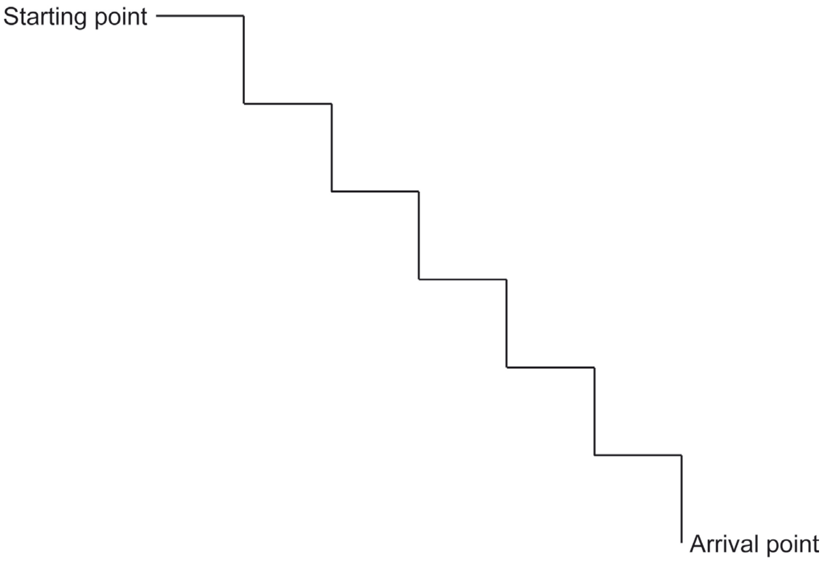


Figure 73 - Illustration of optimal trajectory for fine alignment

The inertial sensor status light turns green at the end of the coarse alignment. You can then start to operate with GAPS. The accuracy of the INS is optimal at the end of the fine alignment. At the end of the fine alignment, the message “fine alignment” disappears from the inertial sensor tool box.

9.2.2 INITIALIZING GAPS

If you turn off GAPS by pressing the GAPS power switch on the BOX, make sure to wait at least 20 s before turning it on again

Do NOT transmit acoustically with GAPS in the air.

Procedure

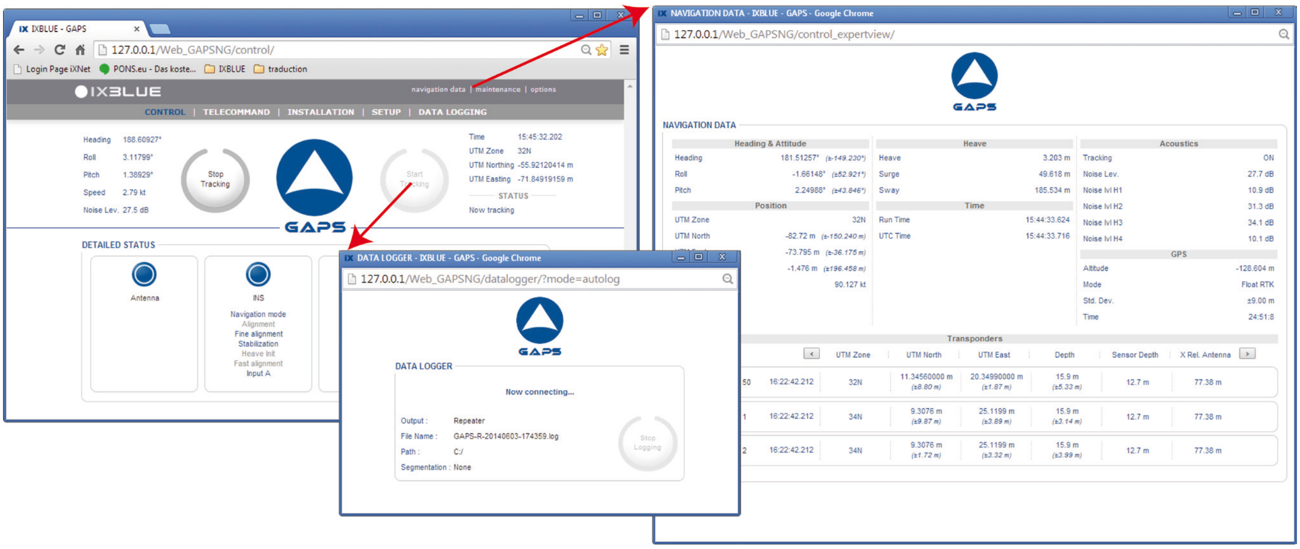
Step	Action
1.	Check the power supply (24/36 V DC, 100/240 V AC).
2.	Switch the BOX on. *GAPS is powered.*
3.	Launch your browser and enter the GAPS IP address `https://xx.xx.xx.xx` *The GAPS control web page opens.*
4.	Configure (or check if it has already been done) the GAPS network interface. See the section 4.2.
5.	No calibration is needed for GAPS before using it. Enter the misalignments and immersion of the antenna. See section 4.3.
6.	Configure the USBL system input and output if there are new sensors during this mission. See section 4.4.
7.	Configure the tracking parameters. See section 5.1.
8.	Configure the transponders which are going to be positioned during the mission. See section 5.2.
9.	Enter the speed profile. See section 5.3.
10.	Press **Start Tracking** button. *The **Start Tracking** button is grayed and the **Stop Tracking** button is not grayed anymore.* *GAPS starts its acoustic cycle. The INS needs 5 minutes to be operational.*
11.	Open the navigation window in order to check the acquired data. See section 9.3.
12.	Perform the alignment of the INS (see section 9.2.1). Remain in static position or drifting (no acceleration, no heading change) for the rough alignment (5 minutes). Perform the fine alignment if necessary (20 minutes while performing steps or eight-shaped trajectory).
13.	Start the survey.
14.	End of procedure.

9.3 Controlling the Data

9.3.1 DATA CONTROL WINDOWS

Controlling data from the GAPS is carried out via:

- Navigation window
- Control window
- Data logger window



Heading 188.60927°
Roll 3.11799°
Pitch 1.38929°
Speed 2.79 kt
Noise Lev. 27.5 dB

Time 15:45:32.202
UTM Zone 32N
UTM Northing -55.92120414 m
UTM Easting -71.84919159 m

STATUS
Now tracking

DETAILED STATUS

Antenna

INS
Navigation mode
Alignment
Fine alignment
Stabilization
Heave Init
Fast alignment
Input A

NAVIGATION DATA

Heading & Attitude
Heading 181.51257° (±-149.230°)
Roll -1.66148° (±52.921°)
Pitch 2.24988° (±43.846°)

Position
UTM Zone 32N
UTM North -82.72 m (±-150.240 m)
-73.795 m (±-36.175 m)
-1.476 m (±196.458 m)
90.127 kt

Heave
Heave 3.203 m
Surge 49.618 m
Sway 185.534 m

Time
Run Time 15:44:33.624
UTC Time 15:44:33.716

Acoustics
Tracking ON
Noise Lev. 27.7 dB
Noise lvl H1 10.9 dB
Noise lvl H2 31.3 dB
Noise lvl H3 34.1 dB
Noise lvl H4 10.1 dB

GPS
Altitude -128.604 m
Mode Float RTK
Std. Dev. ±9.00 m
Time 24:51:8

Transponders

		UTM Zone	UTM North	UTM East	Depth	Sensor Depth	X Rel. Antenna
50	16:22:42.212	32N	11.34560000 m (±8.80 m)	20.34990000 m (±1.87 m)	15.9 m (±5.33 m)	12.7 m	77.38 m
1	16:22:42.212	34N	9.3076 m (±9.87 m)	25.1199 m (±3.89 m)	15.9 m (±3.14 m)	12.7 m	77.38 m
2	16:22:42.212	34N	9.3076 m (±1.72 m)	25.1199 m (±3.32 m)	15.9 m (±3.99 m)	12.7 m	77.38 m

DATA LOGGER
Now connecting...
Output : Repeater
File Name : GAPS-R-20140603-174359.log
Path : C:/
Segmentation : None

Figure 74 – Data monitoring via CONTROL, NAVIGATION and DATA LOGGER windows

9.3.1.1 CONTROL Window

On the control window are displayed the following data:

- Heading, Roll, Pitch, Speed, Noise
- Time, UTM Zone, UTM Northing, UTM Easting or Time, Latitude, Longitude
- Messages shown under the heading **STATUS**
- While tracking, repetitive clicks on the main logo or on the **STATUS** label on the left of the main logo display alternatively the **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.

Heading 235.797°
Roll -0.494°
Pitch -0.678°
Speed 0.01 kt
Noise 28.61 dB

Time 08:43:53
Latitude 48°21.77880' N
Longitude 004°32.92902' W

STATUS
System ready

SYSTEM DETAILED STATUS

Antenna

INS
Navigation mode
Alignment
Fine alignment
GPS altitude
Heave Init
Fast alignment
Input UTC/GPS

External Sensors
GPS valid
Altitude valid
GPS reception
UTC synchro
Altitude reception

Electronic

Heading 235.799°
Roll -0.494°
Pitch -0.678°
Speed 0.02 kt
Noise 28.47 dB

Time 08:35:45
Latitude 48°21.77880' N
Longitude 004°32.92902' W

STATUS
System ready

TP 2
Mode : Transponder
Time 08:35:41.134 (~ 04")
Bearing 36.78°
Vertical Angle 0.84°
Slant Distance 995.76 m
Expected

TP 110 - SimTmr
Mode : Transponder
Time 08:35:41.134 (~ 04")
Bearing 36.78°
H. Distance 14.61 m
Depth 996.25 m
Expected

TP 1
Mode : Transponder
Time 08:35:31.128 (~ 14")
Bearing 36.78°
H. Distance 14.72 m
Depth 1003.79 m
Expected

Figure 75 – 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 (> 99”) for more than one minute.

Time 10:15:41.891 (~ 11")

9.3.1.2 NAVIGATION Window

On the navigation window are displayed the following data:

- Navigation data: Heading and attitude (Heading, Roll, Pitch), Position (UTM Zone, UTM North, UTM East, Depth, Speed), Heave (Heave, Surge, Sway), Time (Run Time, UTC Time), Acoustics (Tracking, Noise Lev., Noise lvl H1, Noise lvl H2, Noise lvl H3, Noise lvl H4), GPS (Attitude, Mode, Std. Dev, Time)
- Positioned transponder data: UTM Zone, UTM North, UTM East, Depth, Sensor Depth, X Rel. Antenna, Y Rel. Antenna, X Rel. North, Y Rel. North, Slant Distance, Horizontal Distance, Bearing, Azimuth, Vertical Angle, SNR, SNR H1, SNR H2, SNR H3, SNR H4, Travel Time.

9.3.1.3 DATA LOGGER Window

On the data logger window are displayed the following data:

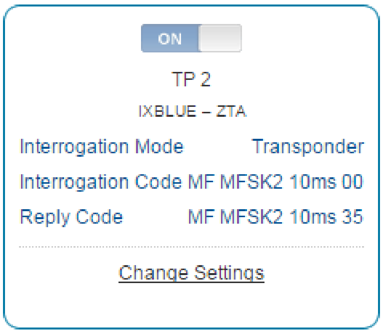
- The **Output** port, the **Path** and **File Name** which changes according to the chosen **Segmentation** method
- The recording status of the tracked transponders

9.3.2 CHECKING THE CURRENT VOLTAGE OF A ZTA02C TRANSPONDER

During the tracking, it is possible to interrogate each of the ZTA02C transponders in use on their current voltage.

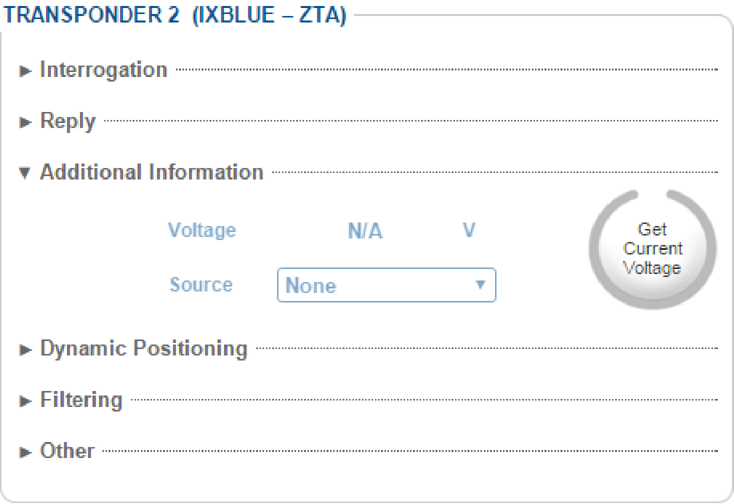
Procedure

Step	Action
1.	During tracking, select the **SETUP > TRANSPONDERS** menu.



Interrogation Mode Transponder
Interrogation Code MF MFSK2 10ms 00
Reply Code MF MFSK2 10ms 35

Step	Action
2.	Click on **Change Settings** for one of the active ZTA02C transponders.



Voltage N/A V
Source None

Step	Action
3.	Click on the **Get Current Voltage** button. *After a moment the current voltage of the transponder is displayed in the* ***Voltage*** *field.*
4.	End of procedure.

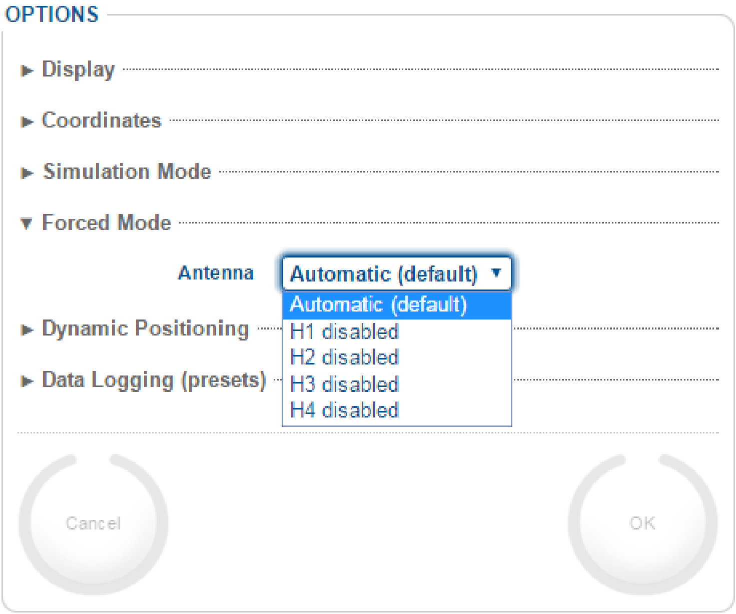
9.3.3 DESELECTING A CHANNEL FOR AN USBL COMPUTATION

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.



Step	Action
2.	Select **H*n* disabled** to exclude all detections made by the H*n* hydrophone.
3.	End of procedure.

9.3.4 LIST AND MEANINGS OF STATUS, WARNING AND ERRORS

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

Table 16 – Status, warnings and errors meanings and possible action

Message	**Meaning**	**Action**
SENSOR X (X being UTC/GPS, USBL, GPS, Emb. UTC, Emb. NAV …)		
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 turn it on again. If the problem remains, contact iXBlue.
DSP Configuration	Internal problem coming from the signal processing module.	Switch off the rack and turn it on again. If the problem remains, contact iXBlue.
Signal Processing	Internal problem coming from the signal processing module.	Switch off the rack and turn it 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.

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 or 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.	

BOX		
No GAPS BOX	Cannot find the GAPS BOX	
Network Configuration	Network configuration error	
Serial A/B/C/D Configuration	Serial input error	
Ethernet A/B/C/D Configuration	Ethernet input error	

9.3.5 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 76.

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.

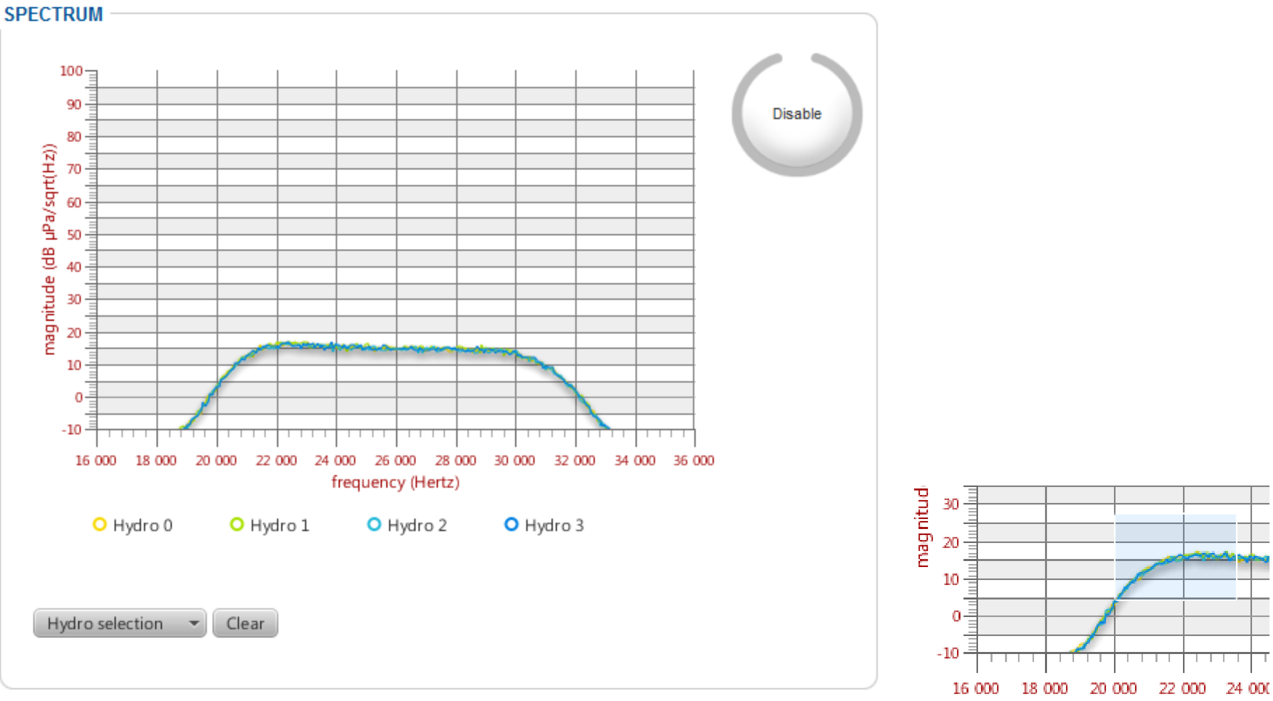


Figure 76 – SPECTRUM window and zoom effect

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**. *The graph of the selected data is displayed.*
4.	End of procedure.

9.4 Recovering the Equipment

9.4.1 RECOVERING GAPS

Procedure

Step	Action
1.	Click on the **Stop Tracking** button.
2.	Recover GAPS unit.
3.	Rinse GAPS unit with fresh water.
4.	Fasten the hydrophone caps back in place.
5.	End of procedure.

9.4.2 RECOVERING TRANSPONDERS WITH THE TELECOMMAND

The moored transponders are recovered with the use of the remote control function of GAPS which can be found in the **TELECOMMAND** menu. The iXBlue TT801 remote control can also perform this task.

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.

Click on the **Stop tracking** button before any recovery operation. The GAPS antenna must not be pinging while the remote control is operating.

GAPS can send commands to the transponders. In order to configure these commands, you need to input the following parameters:

- **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 45. These codes are expressed in hexadecimal format. The table below links the hexadecimal values to the code numbers.

Table 17 – Correspondence between frequencies and hexadecimal codes

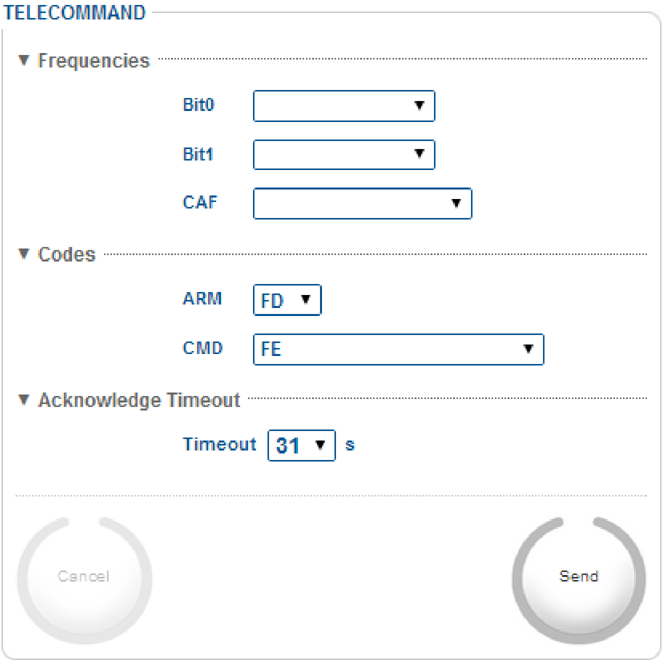
Code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Freq. kHz	19.5	20	20	21	21	22	22	23	23	24	24	25	25	26	26	27

Decoding the transponder build sheet:
The frequency FR0 (19.5 kHz) in the first column of Table 6 corresponds to the code 0.
The frequency FR1 (20.5 kHz) in the first column of Table 6 corresponds to the code 2.
The ARM/RANGING (0251) is made of 0 (FR0, 19.5 kHz), 2 (FR1, 20.5 kHz) and 51 which is the arming code.

Procedure

Step **Action**

1. Select the **TOOLS/TELECOMMAND** menu.



ARM FD
CMD FE
Timeout 31 s

2. Under **Frequencies**, select the **Bit0**, **Bit1** and **CAF** in the corresponding drop-down lists.

3. Under **Codes**, set the **ARM** and **CMD** codes (**RELEASE**) in the corresponding drop-down lists.
A description of the chosen instruction is displayed in the blue frame.

4. Under **Acknowledgment Timeout**, select the **Timeout**.

5. Click on **Send** to validate your choice and to send the parameters to GAPS.

6. End of Procedure.

10 MAINTENANCE

10.1 Preventive Maintenance

10.1.1 GENERAL RECOMMENDATIONS

GAPS has been designed to avoid as much as possible any preventive maintenance operation.

Nevertheless, GAPS has to be used with the usual precautions as for any other underwater equipment:

- **Rinsing**: Each time GAPS has been used in salted water, it must be thoroughly rinsed with fresh water.
- **Hydrophones caps**: GAPS must be handled with great care, especially concerning the hydrophones. Remove these caps before deploying GAPS antenna. As soon as GAPS is not any more in the water, the hydrophone protective caps must be put in place.
- **Hydrophones:**
  - ☐ Do not paint hydrophones with traditional painting
  - ☐ Do not use metallic instruments to clean hydrophones
  - ☐ Do not use water with pressure to clean hydrophones
  - ☐ Do not use solvent
  - ☐ To limit growth on hydrophones we recommend to use International TRILUX 33 or SigmaCoatings blue Sigma-glide (we didn't characterized yet the impact on reception but it should be limited)

⚠ Avoid transmitting acoustically with GAPS in the air.

- **Connector greasing**: Spray silicone grease LOCTITE 8021 must be regularly applied on the male and female part of the SUBCONN connector.
- **Dummy Plug**: When the cable is not connected to GAPS, make sure to use the dummy plug to protect the cable termination.

Figure 77 – GAPS cable dummy plug

- **Handling**: The best way to carry GAPS is to hold it by the upper disc in one hand and one of the arms in the other hand.

Figure 78 - Handling GAPS

⚠ Do not hold GAPS by its hydrophones.

When GAPS is not used, the four hydrophones must keep their protection caps. Remove them just before putting GAPS into water.

- The equipment must be placed back in its transport box and stored in a dry area until it is installed. The equipment must always be stored in its packaging. The limits of storage temperature are the following:

Item	Min T°	Max T°
Acoustic Array	- 40°C	+70°C
Acoustic Transponders	- 20°C	+70°C

⚠ Bad storage conditions may void certain clauses of the guarantee.

- Low Voltage Directive 2006/95/CE:

⚡ Only operate GAPS under water.

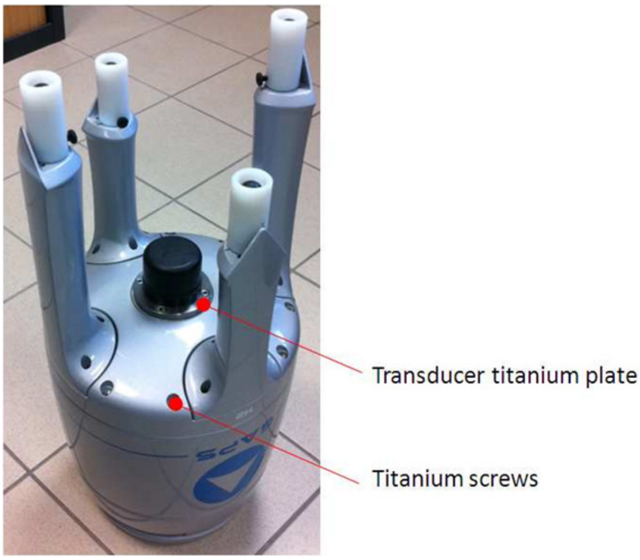
10.1.2 CHECKING THE ELECTRICAL GROUND CONTINUITY

You must ensure that the electrical installation is correct in order to prevent the antenna from corrosion. Before proceeding to the test, please make sure that you have:

- Installed the GAPS acoustic antenna
- Installed and powered the BOX
- Connected the cable between the BOX and the acoustic antenna

The test consists in measuring the voltage between the GAPS antenna and the hull of the ship with a multitester.

Procedure

Step	Action
1.	Put the first probe of the multitester on a conductive part of the housing of the GAPS antenna. It can be the transducer titanium plate or the titanium screws. 
2.	Put the second probe on a conductive part of the ship hull.
3.	Read the voltage between these two points. *The voltage must be below 1.0 V.*
4.	End of procedure.

If the voltage between the GAPS antenna and the hull of the ship is below 1.0 V, the system is electrically well installed.

If the voltage between the GAPS antenna and the hull of the ship is **greater than 1.0 V**, corrosion will impact your system. Contact iXBlue technical support.

10.1.3 CONNECTING A NEW GAPS BOX TO GAPS

The following procedure concerns the exchange of one GAPS BOX with another one.

Procedure

Step	Action
1.	Switch off the GAPS BOX and disconnect it.
2.	Connect the new GAPS BOX to the GAPS. See section 3.3.
3.	Turn on the GAPS BOX. *GAPS starts the configuration of the GAPS BOX.*
4.	Wait 30 seconds until the configuration of the GAPS BOX is completed.
5.	Turn off and then on the GAPS BOX. *The GAPS is ready for operation.*
6.	End of procedure.

10.2 Maintenance from the Web-Based User Interface

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

- Updating the system
- Checking the options that are currently installed
- Resetting to factory settings
- Contacting iXBlue technical support

10.2.1 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 GAPS via the present procedure.

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

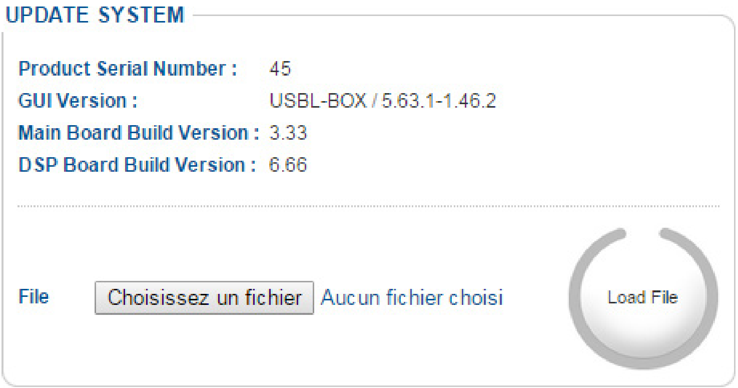
Make sure to ZIP the update files when sending them by mail in order to avoid any file corruption caused by mail applications.

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

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 GAPS.

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.  UPDATE SYSTEM Product Serial Number : 45 GUI Version : USBL-BOX / 5.63.1-1.46.2 Main Board Build Version : 3.33 DSP Board Build Version : 6.66
3.	In front of **File**, click on the **Browse** button.
4.	Select the update file "`.srec`" that iXBlue sent to you.
5.	Click on **Update**. *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.*
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.

10.2.2 CHECKING THE CURRENTLY INSTALLED OPTIONS

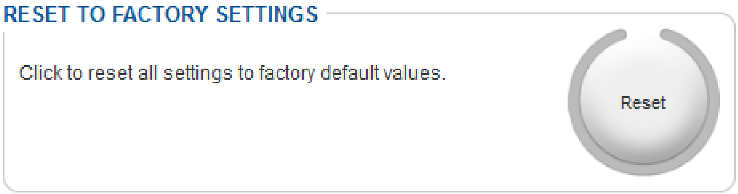
In the **maintenance** page, you may check which options are currently installed. In the SYSTEM OPTIONS frame are listed all the options and their status (active: yes or no).

SYSTEM OPTIONS

Wideband® 1 : Yes

10.2.3 RESETTING THE SYSTEM TO FACTORY SETTINGS

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



RESET TO FACTORY SETTINGS

Click to reset all settings to factory default values.

Figure 79 – Reset to factory settings

10.2.4 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.

CONTACT SUPPORT

Click to create a support ticket.

To join the system configuration, click here and attach the file to the support ticket email.

Figure 80 – 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.

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:

North America / NORAM
+1 508 975 4640 Ext 1

Europe Middle-East Africa Latin-America / EMEA-LATAM
+33 1 30 08 98 98

Asia Pacific / APAC
+65 6747 7027

iXBlue CONTACT - SALES

North America / NORAM
+1 508 975 4640
iXBlue Inc Boston area US
11 Erie Drive, Natick, MA 01760, US

Europe Middle-East Africa Latin-America / EMEA-LATAM
+33 1 30 08 88 88
iXBlue SAS France
34 rue de la Croix de Fer, Saint-Germain-en-Laye, F-78100, France

Asia Pacific / APAC
+65 6747 4912
iXBlue Pte Limited Singapore
15A Changi Business Park Central 1#04-02 Eightrium Singapore 486035

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.

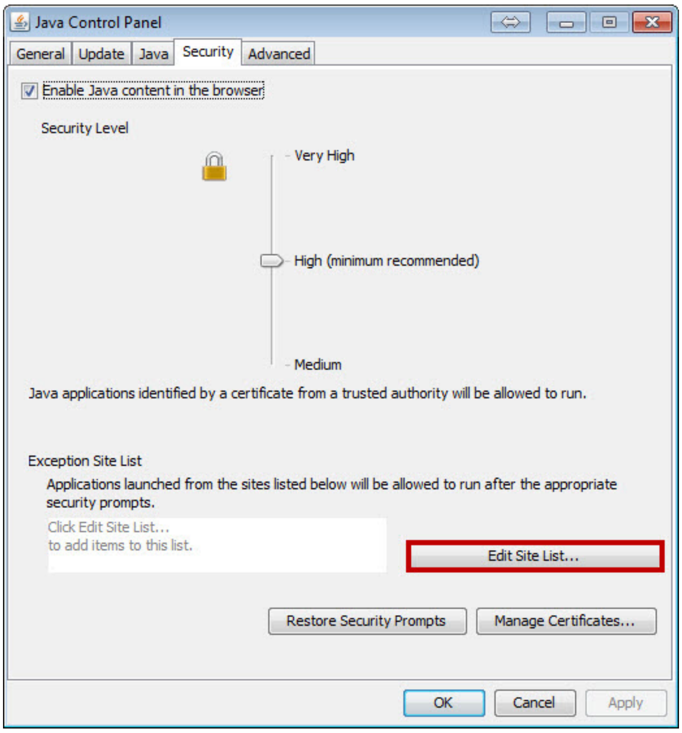
Windows 7, Vista

- 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.



☑ Enable Java content in the browser

Security Level: High (minimum recommended)

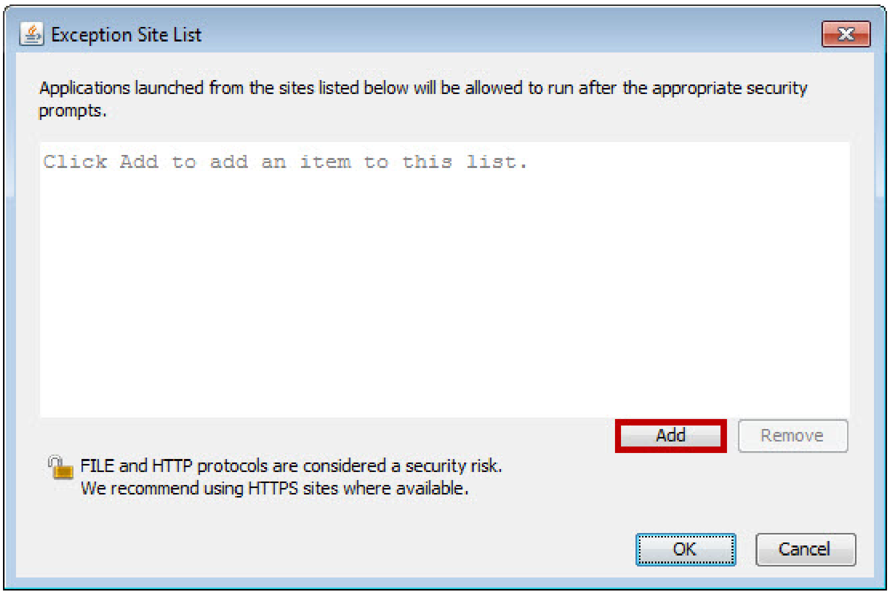
Java applications identified by a certificate from a trusted authority will be allowed to run.

Exception Site List

Applications launched from the sites listed below will be allowed to run after the appropriate security prompts.

Click Edit Site List...
to add items to this list.

Step	Action
3.	Click on **Edit Site List…** *The Exception Site List window opens:*



Applications launched from the sites listed below will be allowed to run after the appropriate security prompts.

`Click Add to add an item to this list.`

FILE and HTTP protocols are considered a security risk.
We recommend using HTTPS sites where available.

4.	Enter the IP address of GAPS Web-based User Interface.
5.	Press `Enter` 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

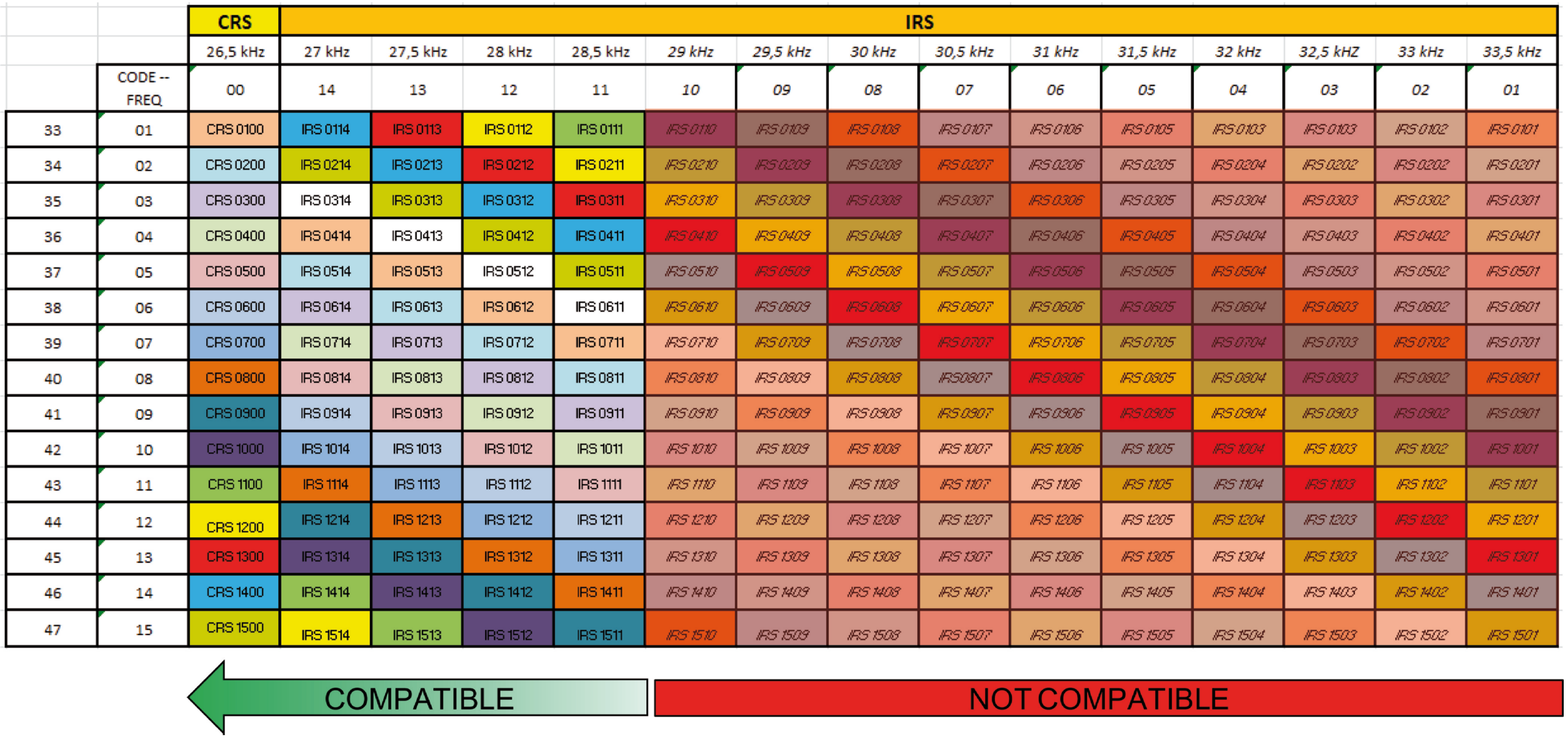
Only the listed values below are allowed

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. THIRD PARTY TRANSPONDERS CODES

The Table 18 gathers all reply codes from Wideband® 1 transponders that are partly compatible with GAPS. Note the area where reply codes are compatible with GAPS.

Table 18 – Wideband® 1 reply codes and compatibility with GAPS

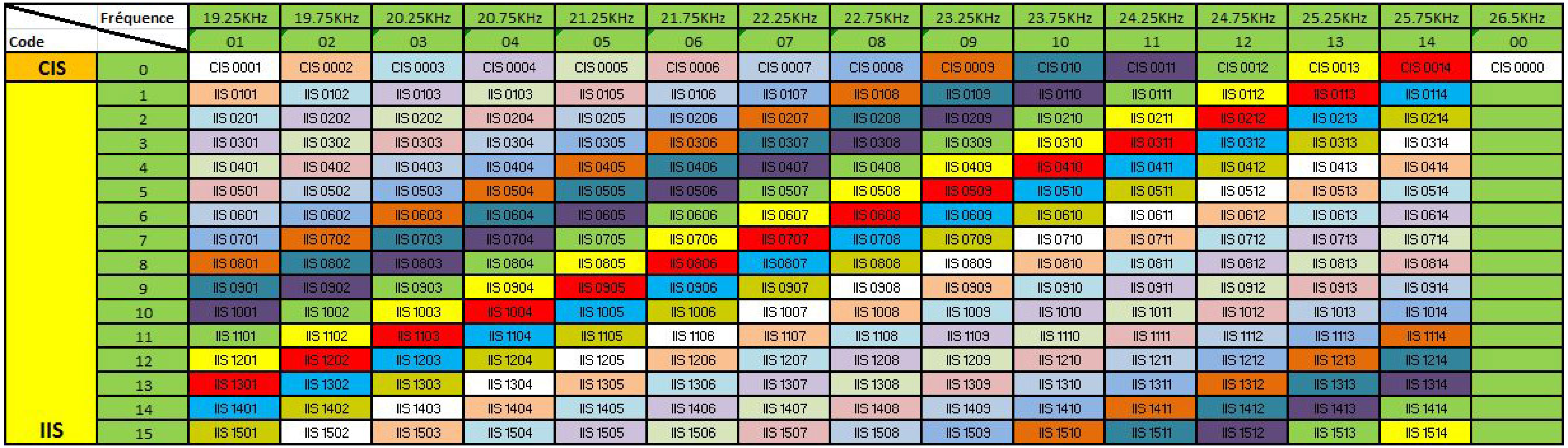


		CRS	IRS													
		26,5 kHz	27 kHz	27,5 kHz	28 kHz	28,5 kHz	29 kHz	29,5 kHz	30 kHz	30,5 kHz	31 kHz	31,5 kHz	32 kHz	32,5 kHZ	33 kHz	33,5 kHz
	CODE -- FREQ	00	14	13	12	11	10	09	08	07	06	05	04	03	02	01
33	01	CRS 0100	IRS 0114	IRS 0113	IRS 0112	IRS 0111	IRS 0110	IRS 0109	IRS 0108	IRS 0107	IRS 0106	IRS 0105	IRS 0103	IRS 0103	IRS 0102	IRS 0101
34	02	CRS 0200	IRS 0214	IRS 0213	IRS 0212	IRS 0211	IRS 0210	IRS 0209	IRS 0208	IRS 0207	IRS 0206	IRS 0205	IRS 0204	IRS 0202	IRS 0202	IRS 0201
35	03	CRS 0300	IRS 0314	IRS 0313	IRS 0312	IRS 0311	IRS 0310	IRS 0309	IRS 0308	IRS 0307	IRS 0306	IRS 0305	IRS 0304	IRS 0303	IRS 0302	IRS 0301
36	04	CRS 0400	IRS 0414	IRS 0413	IRS 0412	IRS 0411	IRS 0410	IRS 0409	IRS 0408	IRS 0407	IRS 0406	IRS 0405	IRS 0404	IRS 0403	IRS 0402	IRS 0401
37	05	CRS 0500	IRS 0514	IRS 0513	IRS 0512	IRS 0511	IRS 0510	IRS 0509	IRS 0508	IRS 0507	IRS 0506	IRS 0505	IRS 0504	IRS 0503	IRS 0502	IRS 0501
38	06	CRS 0600	IRS 0614	IRS 0613	IRS 0612	IRS 0611	IRS 0610	IRS 0609	IRS 0608	IRS 0607	IRS 0606	IRS 0605	IRS 0604	IRS 0603	IRS 0602	IRS 0601
39	07	CRS 0700	IRS 0714	IRS 0713	IRS 0712	IRS 0711	IRS 0710	IRS 0709	IRS 0708	IRS 0707	IRS 0706	IRS 0705	IRS 0704	IRS 0703	IRS 0702	IRS 0701
40	08	CRS 0800	IRS 0814	IRS 0813	IRS 0812	IRS 0811	IRS 0810	IRS 0809	IRS 0808	IRS0807	IRS 0806	IRS 0805	IRS 0804	IRS 0803	IRS 0802	IRS 0801
41	09	CRS 0900	IRS 0914	IRS 0913	IRS 0912	IRS 0911	IRS 0910	IRS 0909	IRS 0908	IRS 0907	IRS 0906	IRS 0905	IRS 0904	IRS 0903	IRS 0902	IRS 0901
42	10	CRS 1000	IRS 1014	IRS 1013	IRS 1012	IRS 1011	IRS 1010	IRS 1009	IRS 1008	IRS 1007	IRS 1006	IRS 1005	IRS 1004	IRS 1003	IRS 1002	IRS 1001
43	11	CRS 1100	IRS 1114	IRS 1113	IRS 1112	IRS 1111	IRS 1110	IRS 1109	IRS 1108	IRS 1107	IRS 1106	IRS 1105	IRS 1104	IRS 1103	IRS 1102	IRS 1101
44	12	CRS 1200	IRS 1214	IRS 1213	IRS 1212	IRS 1211	IRS 1210	IRS 1209	IRS 1208	IRS 1207	IRS 1206	IRS 1205	IRS 1204	IRS 1203	IRS 1202	IRS 1201
45	13	CRS 1300	IRS 1314	IRS 1313	IRS 1312	IRS 1311	IRS 1310	IRS 1309	IRS 1308	IRS 1307	IRS 1306	IRS 1305	IRS 1304	IRS 1303	IRS 1302	IRS 1301
46	14	CRS 1400	IRS 1414	IRS 1413	IRS 1412	IRS 1411	IRS 1410	IRS 1409	IRS 1408	IRS 1407	IRS 1406	IRS 1405	IRS 1404	IRS 1403	IRS 1402	IRS 1401
47	15	CRS 1500	IRS 1514	IRS 1513	IRS 1512	IRS 1511	IRS 1510	IRS 1509	IRS 1508	IRS 1507	IRS 1506	IRS 1505	IRS 1504	IRS 1503	IRS 1502	IRS 1501

COMPATIBLE

NOT COMPATIBLE

Table 19 – Wideband® 1 interrogation codes and compatibility with GAPS



	Fréquence	19.25KHz	19.75KHz	20.25KHz	20.75KHz	21.25KHz	21.75KHz	22.25KHz	22.75KHz	23.25KHz	23.75KHz	24.25KHz	24.75KHz	25.25KHz	25.75KHz	26.5KHz
Code		01	02	03	04	05	06	07	08	09	10	11	12	13	14	00
CIS	0	CIS 0001	CIS 0002	CIS 0003	CIS 0004	CIS 0005	CIS 0006	CIS 0007	CIS 0008	CIS 0009	CIS 010	CIS 0011	CIS 0012	CIS 0013	CIS 0014	CIS 0000
IIS	1	IIS 0101	IIS 0102	IIS 0103	IIS 0103	IIS 0105	IIS 0106	IIS 0107	IIS 0108	IIS 0109	IIS 0110	IIS 0111	IIS 0112	IIS 0113	IIS 0114	
	2	IIS 0201	IIS 0202	IIS 0202	IIS 0204	IIS 0205	IIS 0206	IIS 0207	IIS 0208	IIS 0209	IIS 0210	IIS 0211	IIS 0212	IIS 0213	IIS 0214	
	3	IIS 0301	IIS 0302	IIS 0303	IIS 0304	IIS 0305	IIS 0306	IIS 0307	IIS 0308	IIS 0309	IIS 0310	IIS 0311	IIS 0312	IIS 0313	IIS 0314	
	4	IIS 0401	IIS 0402	IIS 0403	IIS 0404	IIS 0405	IIS 0406	IIS 0407	IIS 0408	IIS 0409	IIS 0410	IIS 0411	IIS 0412	IIS 0413	IIS 0414	
	5	IIS 0501	IIS 0502	IIS 0503	IIS 0504	IIS 0505	IIS 0506	IIS 0507	IIS 0508	IIS 0509	IIS 0510	IIS 0511	IIS 0512	IIS 0513	IIS 0514	
	6	IIS 0601	IIS 0602	IIS 0603	IIS 0604	IIS 0605	IIS 0606	IIS 0607	IIS 0608	IIS 0609	IIS 0610	IIS 0611	IIS 0612	IIS 0613	IIS 0614	
	7	IIS 0701	IIS 0702	IIS 0703	IIS 0704	IIS 0705	IIS 0706	IIS 0707	IIS 0708	IIS 0709	IIS 0710	IIS 0711	IIS 0712	IIS 0713	IIS 0714	
	8	IIS 0801	IIS 0802	IIS 0803	IIS 0804	IIS 0805	IIS 0806	IIS0807	IIS 0808	IIS 0809	IIS 0810	IIS 0811	IIS 0812	IIS 0813	IIS 0814	
	9	IIS 0901	IIS 0902	IIS 0903	IIS 0904	IIS 0905	IIS 0906	IIS 0907	IIS 0908	IIS 0909	IIS 0910	IIS 0911	IIS 0912	IIS 0913	IIS 0914	
	10	IIS 1001	IIS 1002	IIS 1003	IIS 1004	IIS 1005	IIS 1006	IIS 1007	IIS 1008	IIS 1009	IIS 1010	IIS 1011	IIS 1012	IIS 1013	IIS 1014	
	11	IIS 1101	IIS 1102	IIS 1103	IIS 1104	IIS 1105	IIS 1106	IIS 1107	IIS 1108	IIS 1109	IIS 1110	IIS 1111	IIS 1112	IIS 1113	IIS 1114	
	12	IIS 1201	IIS 1202	IIS 1203	IIS 1204	IIS 1205	IIS 1206	IIS 1207	IIS 1208	IIS 1209	IIS 1210	IIS 1211	IIS 1212	IIS 1213	IIS 1214	
	13	IIS 1301	IIS 1302	IIS 1303	IIS 1304	IIS 1305	IIS 1306	IIS 1307	IIS 1308	IIS 1309	IIS 1310	IIS 1311	IIS 1312	IIS 1313	IIS 1314	
	14	IIS 1401	IIS 1402	IIS 1403	IIS 1404	IIS 1405	IIS 1406	IIS 1407	IIS 1408	IIS 1409	IIS 1410	IIS 1411	IIS 1412	IIS 1413	IIS 1414	
	15	IIS 1501	IIS 1502	IIS 1503	IIS 1504	IIS 1505	IIS 1506	IIS 1507	IIS 1508	IIS 1509	IIS 1510	IIS 1511	IIS 1512	IIS 1513	IIS 1514	

D. CONFIGURATION OF WB1 TRANSPONDERS

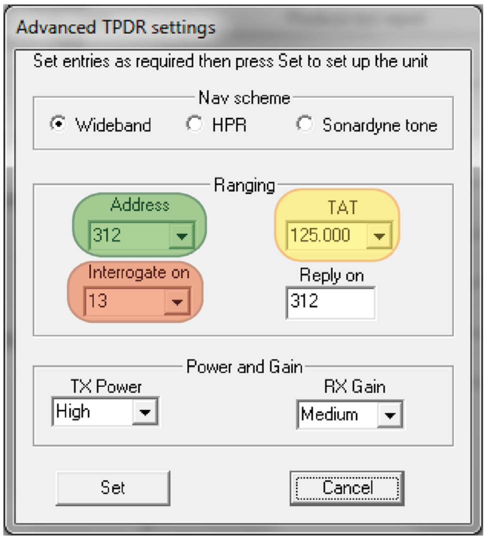
Figure 81 gathers screen shots of the windows dedicated to the configuration of a WB1 transponder in different software interfaces.

The interrogation and reply codes, the turn around time (TAT) and the name of the transponder are highlighted.

When a WB1 transponder is interrogated by a CIS signal, it replies with a IRS signal.

When a WB1 transponder is interrogated by a IIS signal, it replies with a CRS signal.

Test Terminal



Advanced TPDR settings

Set entries as required then press Set to set up the unit

Nav scheme: ● Wideband ○ HPR ○ Sonardyne tone

Ranging

Address: 312

TAT: 125.000

Interrogate on: 13

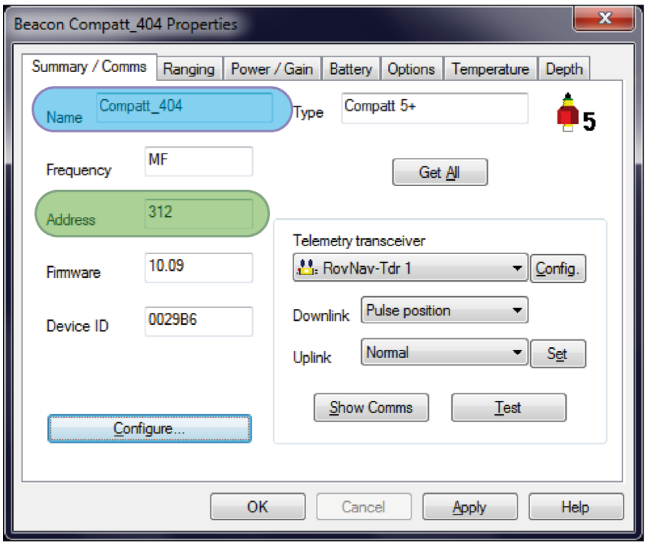
Reply on: 312

Power and Gain

TX Power: High

RX Gain: Medium

iXBlue Web-based User interface



Beacon Compatt_404 Properties

Name: Compatt_404

Type: Compatt 5+

Frequency: MF

Address: 312

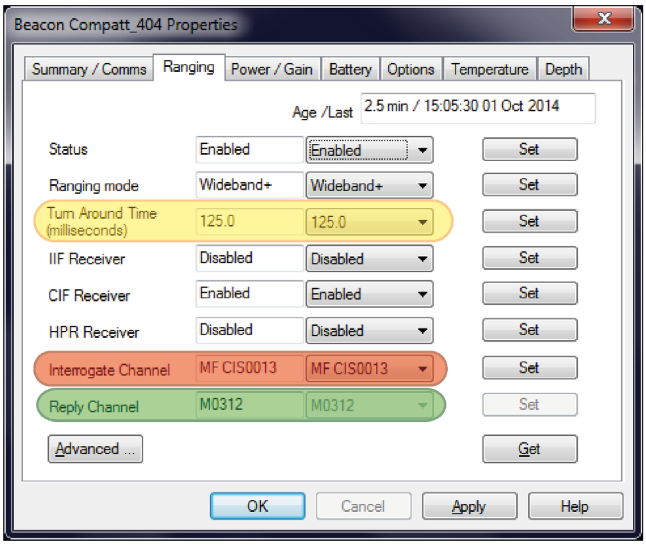
Firmware: 10.09

Device ID: 0029B6

Telemetry transceiver: RovNav-Tdr 1

Downlink: Pulse position

Uplink: Normal

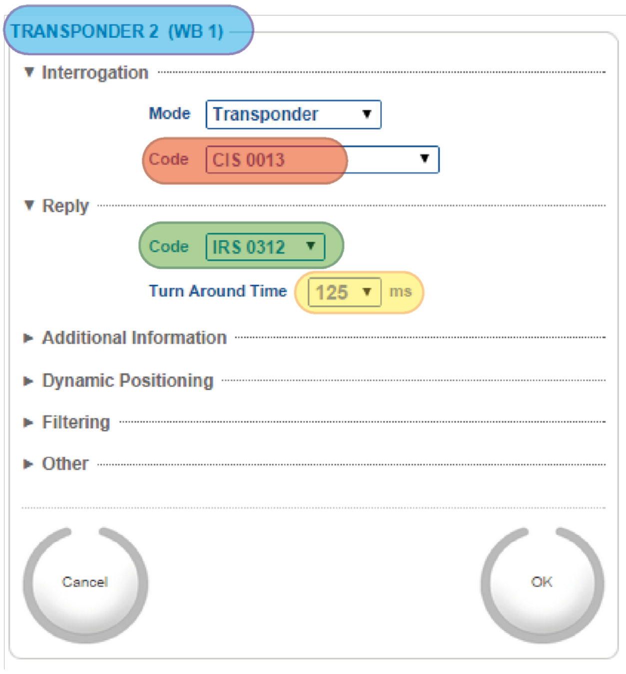


Beacon Compatt_404 Properties

Age /Last: 2.5 min / 15:05:30 01 Oct 2014

Status	Enabled	Enabled	Set
Ranging mode	Wideband+	Wideband+	Set
Turn Around Time (milliseconds)	125.0	125.0	Set
IIF Receiver	Disabled	Disabled	Set
CIF Receiver	Enabled	Enabled	Set
HPR Receiver	Disabled	Disabled	Set
Interrogate Channel	MF CIS0013	MF CIS0013	Set
Reply Channel	M0312	M0312	Set

iXBlue Web-based User interface



TRANSPONDER 2 (WB 1)

▼ Interrogation

Mode: Transponder

Code: CIS 0013

▼ Reply

Code: IRS 0312

Turn Around Time: 125 ms

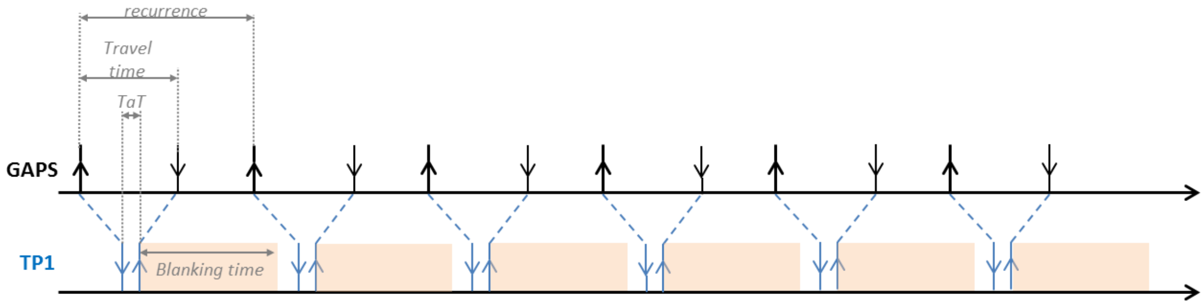
Figure 81 – Location of the transponder characteristics in different software interfaces

E. EXAMPLES OF RECURRENCE AND BLANKING TIME SETTINGS

E.1 One Transponder

TP	Interr. code	Reply code	TaT	Rep. factor
TP1	1	22	90 ms	x1

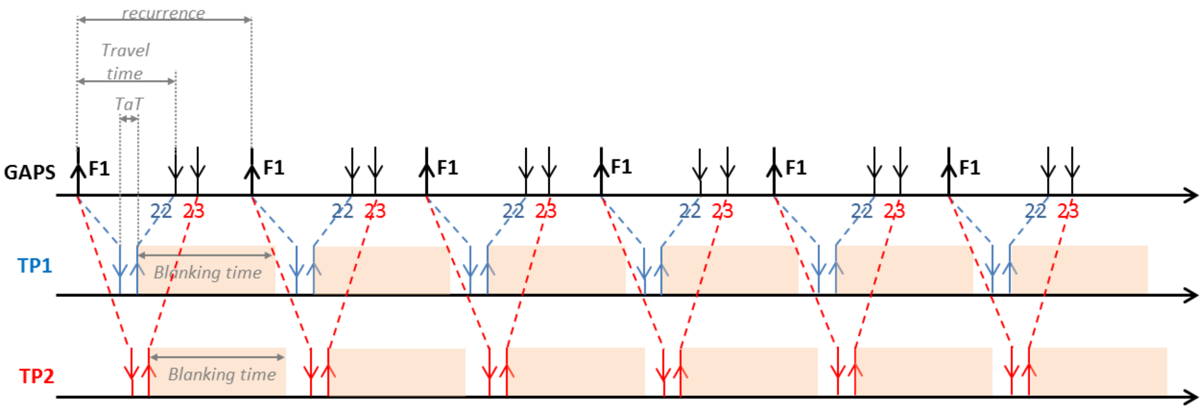
Distance max (m)	< 682	< 1432	< 2182	< 2932	< 3682	< 4432
Recurrence	1 s	2 s	3 s	4 s	5 s	6 s
Blanking time TP1	0.8 s	1.8 s	2.8 s	3.8 s	4.8 s	5.8 s



E.2 Two Transponders with the same Interrogation Code

TP	Interr. code	Reply code	TaT	Rep. factor
TP1	1	22	90 ms	x1
TP2	1	23	90 ms	x1

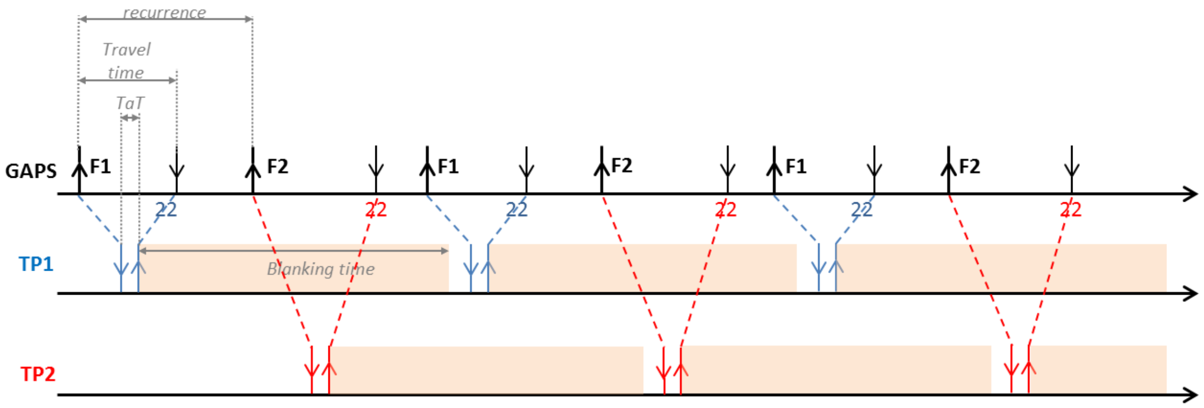
Distance max (m)	< 682	< 1432	< 2182	< 2932	< 3682	< 4432
GAPS recurrence	1 s	2 s	3 s	4 s	5 s	6 s
Blanking time TP1	0.8 s	1.8 s	2.8 s	3.8 s	4.8 s	5.8 s
Blanking time TP2	0.8 s	1.8 s	2.8 s	3.8 s	4.8 s	5.8 s



E.3 Two Transponders with Different Interrogation Codes

TP	Interr. code	Reply code	TaT	Rep. factor
TP1	1	22	90 ms	x1
TP2	2	22	90 ms	x1

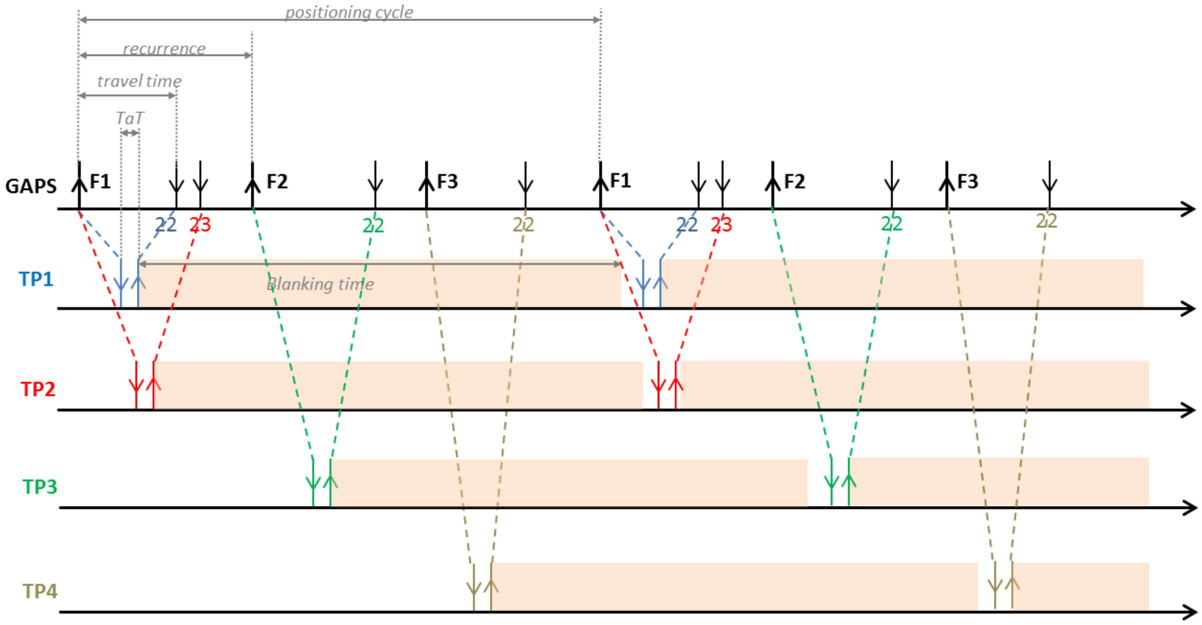
Distance max (m)	< 682	< 1432	< 2182	< 2932	< 3682	< 4432
GAPS recurrence	1 s	2 s	3 s	4 s	5 s	6 s
Blanking time TP1	1.8 s	3.8 s	5.8 s	7.8 s	9.8 s	11.8 s
Blanking time TP2	1.8 s	3.8 s	5.8 s	7.8 s	9.8 s	11.8 s



E.4 Four Transponders with Three Different Interrogation Codes

TP	Interr. code	Reply code	TaT	Rep. factor
TP1	1	22	90 ms	x1
TP2	1	23	90 ms	x1
TP3	2	22	90 ms	x1
TP4	3	22	90 ms	x1

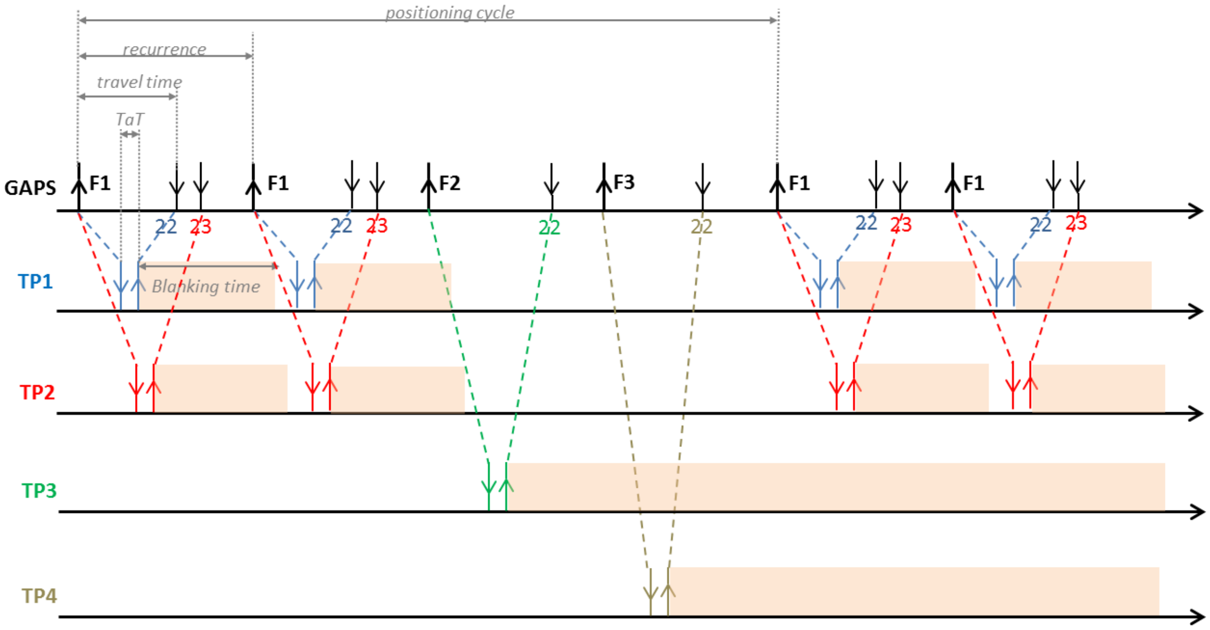
Distance max (m)	< 682	< 1432	< 2182	< 2932	< 3682	< 4432
GAPS recurrence (s)	1	2	3	4	5	6
Blanking time TP1 (s)	2.8	5.8	8.8	11.8	14.8	17.8
Blanking time TP2 (s)	2.8	5.8	8.8	11.8	14.8	17.8
Blanking time TP3 (s)	2.8	5.8	8.8	11.8	14.8	17.8
Blanking time TP4 (s)	2.8	5.8	8.8	11.8	14.8	17.8



E.5 Four Transponders with Different Interrogation Codes and Repetition Factors

TP	**Interr. code**	**Reply code**	**TaT (ms)**	**Rep. factor**
TP1	1	22	90	x2
TP2	1	23	90	x2
TP3	2	22	90	x1
TP4	3	22	90	x1

Distance max (m)	< 682	< 1432	< 2182	< 2932	< 3682	< 4432
GAPS recurrence (s)	1	2	3	4	5	6
Blanking time TP1 (s)	0.8	1.8	2.8	3.8	4.8	5.8
Blanking time TP2 (s)	0.8	1.8	2.8	3.8	4.8	5.8
Blanking time TP3 (s)	3.8	7.8	11.8	15.8	19.8	23.8
Blanking time TP4 (s)	3.8	7.8	11.8	15.8	19.8	23.8



F. INPUT PROTOCOLS

F.1 GPS

Standard	Input ASCII
Data received	Time, latitude, longitude, altitude, hemisphere, quality factory, number of satellites, HDOP, depth, Geoidal separation, Checksum NMEA The ZDA is not taken any more into account when screens UTC are received. If one does not receive any more a screen UTC during 60 seconds, the ZDA could again be taken into account.
$__GGA	**Data frame**:

$--GGA,hhmmss.ss,llmm.mm,a,LLLmm.mm,b,q,ss,y.y,x.x,M,g.g,M,a.a,zzzz*hh<CR><LF>

hhmmss.ss	UTC of position
llmm.mm	Latitude in degrees (ll) and in minutes (mm.mm)
a	Hemisphere N: North S: South
LLLmm.mm	Longitude in degrees (LLL) and in minutes (mm.mm)
b	Longitude sign E: East W: West
q	GPS quality indicator 0 and ≥ 6 fix invalid 1 = GPS SPS Mode, fix valid 2 = Differential GPS, SPS Mode, fix valid 3 = GPS PPS Mode, fix valid 4 = RTK. Satellite system used in RTK mode with fixed integers 5 = Float RTK. Satellite system used in RTK mode with floating integers
ss	Number of satellites
y.y	Horizontal dilution of precision. (NOT USED)
x.x	Antenna altitude
M	Units of antenna altitude (meters)
g.g	Geoidal separation. (NOT USED)
M	Units of geoidal separation (meters) (NOT USED)
a.a	Age of differential GPS data. (NOT USED)
zzzz	Differential reference station ID. (NOT USED)
***hh**	Checksum

$__ZDA

$--ZDA,hhmmss.ss,, *hh <CR><LF>	
hhmmss.ss	UTC of the last PPS
***hh**	Checksum

$__GST

$--GST,hhmmss.ss,x.x,. x.x,. x.x,. x.x,. x.x,. x.x,. x.x,*hh<CR><LF>	
hhmmss.ss	UTC time of the GGA fix associated with this sentence
x.x	RMS value of the standard deviation on pseudo-ranges
x.x	Standard deviation of semi-major axis of error ellipse
x.x	Standard deviation of semi-minor axis of error ellipse
x.x	Orientation of semi-major axis of error ellipse
x.x	Standard deviation of latitude error, in meters
x.x	Standard deviation of longitude error, in meters
x.x	Standard deviation of altitude error, in meters
hh	Checksum

UTC

UTC yy.mm.dd hh:mm:ss ab <CR><LF>	
UTC	Fixed text header
yy.mm.dd	Year month and date
hh:mm:ss	UTC time not GPS time.
a	Integer number representing the position-fix type: (NOT USED) 1 = time only 2 = 1D & time 3 = currently unused 4 = 2D & time 5 = 3D & time
b	Number of GPS satellites being tracked. (NOT USED) **Note**: If the receiver is not tracking satellites, the time tag is based on the receiver clock. In this case, a and b are represented by “??”. The time readings from the receiver clock are less accurate than time readings determined from the satellite signals.

$__RMC

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,ddmmyy,x.x,a,a *hh<CR><LF>	
hhmmss.ss	UTC time of the position
A	Status: A=data valid, V= Navigation receiver warning
llll.ll	Latitude, (NOT USED)
a	N/S (NOT USED)
yyyyy.yy	Longitude, (NOT USED)
a	E/W (NOT USED)
x.x	Speed over ground, in knots (NOT USED)
x.x	Course over ground, in degrees true (NOT USED)
ddmmyy	Date (NOT USED)
x.x	Magnetic variation (NOT USED)
a	=E: easterly variation substracts from True course or =W: westerly variation adds to true course (NOT USED)
a	Mode indicator (NOT USED)
hh	Checksum

$__GLL

$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>	
llll.ll	Latitude
a	N : North S : South
yyyyy.yy	Longitude
a	E : East W : West
hhmmss.ss	UTC time of position
A	A= data valid; V= data invalid
***hh**	Checksum

Important notes

- Very often for TRIMBLE GPS the 1PPS signal must be associated to the UTC telegram and not the ZDA. If the iXBlue inertial navigation system receives at the same time ZDA, UTC and RMC time telegram it uses the telegram with the following priority: UTC, ZDA, RMC.
- If no GST string is received, the quality factor is interpreted by INS as follow. At input INS converts quality factor to standard deviation on position according to correspondence table.

F.2 Pressure Datagram PMEVL

$PMEVL Data received: Pressure value

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

G. OUTPUT PROTOCOLS WITH TRANSPONDER(S) POSITION

G.1 Minimum Output Recurrence vs. Baud Rate

Table 20 – Minimum output recurrence

Baud rate (bps)		600	1200	2400	4800	7200	9600	14400	19200	28800	38400	57600	115200
Messages	**Size (number of characters)**												
GAPS Std	**764**	21010	10510	5260	2630	1760	1320	880	660	440	330	220	110
GPGGA	**57**	1570	790	400	200	140	100	70	50	40	30	20	10
HiPap	**15**	420	210	110	60	40	30	20	20	10	10	10	10
Nautronix	**76**	2090	1050	530	270	180	140	90	70	50	40	30	20
Gyrocompass	**72**	1980	990	500	250	170	130	90	70	50	40	30	20
Haliburton	**233**	6410	3210	1610	810	540	410	270	210	140	110	70	40
Navigation	**113**	3110	1560	780	390	260	200	130	100	70	50	40	20
HEHDT	**16**	440	220	110	60	40	30	20	20	10	10	10	10
PHINS Std	**498**	13700	6850	3430	1720	1150	860	580	430	290	220	150	80
SIMRAD	**6**	170	90	50	30	20	20	10	10	10	10	10	10
Autosub	**29**	800	400	200	100	70	50	40	30	20	20	10	10
Post Processing	**14**	390	200	100	50	40	30	20	20	10	10	10	10
Posidonia 6000	**26**	720	360	180	90	60	50	30	30	20	20	10	10
USBL-INS 1	**26**	720	360	180	90	60	50	30	30	20	20	10	10

G.2 Blanking Time and Recurrence Configuration Examples

				GAPS recurrence = 1 s		GAPS recurrence = 2 s	
	Interrogation frequency	Reply code	Turn around time	Blanking time	Positioning rate	Blanking time	Positioning rate
1 beacon							
TP #1	F1 (19.5kHz)	22	90ms	0.8s	1s	1.8s	2s
2 beacons (option 1: highest rate)							
TP #1	F1 (19.5kHz)	22	90ms	0.8s	1s	1.8s	2s
TP #2	F1 (19.5kHz)	23	20ms	0.8s	1s	1.8s	2s
2 beacons (option 2: lowest rate)							
TP #1	F1 (19.5kHz)	22	90ms	1.8s	2s	3.8s	4s
TP #2	F2 (20kHz)	22	90ms	1.8s	2s	3.8s	4s
3 beacons (option 1: highest rate)							
TP #1	F1 (19.5kHz)	22	90ms	1.8s	2s	3.8s	4s
TP #2	F1 (19.5kHz)	23	20ms	1.8s	2s	3.8s	4s
TP #3	F2 (20kHz)	22	90ms	1.8s	2s	3.8s	4s
3 beacons (option 2: lowest rate)							
TP #1	F1 (19.5kHz)	22	90ms	2.8s	3s	5.8s	6s
TP #2	F2 (20kHz)	22	90ms	2.8s	3s	5.8s	6s
TP #3	F3 (20.5kHz)	22	90ms	2.8s	3s	5.8s	6s
4 beacons (option 1: highest rate)							
TP #1	F1 (19.5kHz)	22	90ms	1.8s	2s	3.8s	4s
TP #2	F1 (19.5kHz)	23	20ms	1.8s	2s	3.8s	4s
TP #3	F2 (20kHz)	22	90ms	1.8s	2s	3.8s	4s
TP #4	F2 (20kHz)	23	20ms	1.8s	2s	3.8s	4s
4 beacons (option 2: lowest rate)							
TP #1	F1 (19.5kHz)	22	90ms	3.8s	4s	7.8s	8s
TP #2	F2 (20kHz)	22	90ms	3.8s	4s	7.8s	8s
TP #3	F3 (20.5kHz)	22	90ms	3.8s	4s	7.8s	8s
TP #4	F4 (21kHz)	22	90ms	3.8s	4s	7.8s	8s

G.3 Contents of the Various Datagrams

This section describes the following output data protocols that contain the transponder(s) position. The protocols and their contents are listed in the Table 21.

Table 21 – Contents of the output protocols

	PTSAG	PTSAX	PTSAY	PTSAZ	PTSAH	HIPAP HPR 400	HIPAP HPR 418	IXSEA USBL INS 1	IXSEA USBL INS 2	NAUTRONIX ATS II	POSIDONIA 6000	USBL POSTPRO	PFIM-POPSN
Ship ID					X								X
Transponder ID	X	X	X				X	X	X	X	X	X	X
Number of recurrence	X	X	X	X				X				X	X
Time	X	X	X	X		X		X	X	X		X	X
Date	X	X	X	X						X			X
Latitude	X			X		X		X	X		X	X	X
Longitude	X			X		X		X	X		X	X	X
Forward relative position X		X	X							X			
Starboard relative position Y		X	X							X			
Accuracy of Position						X	X	X	X		X	X	
Depth of transponder	X	X	X					X	X	X	X	X	X
Depth of sensor	X	X	X			X	X						X
Accuracy of Depth											X	X	
Roll				X						X		X	
Pitch				X						X		X	
Heading				X	X		X			X		X	X
Roll correction				X								X	
Pitch correction				X								X	
Heading correction				X								X	
Speed					X							X	X

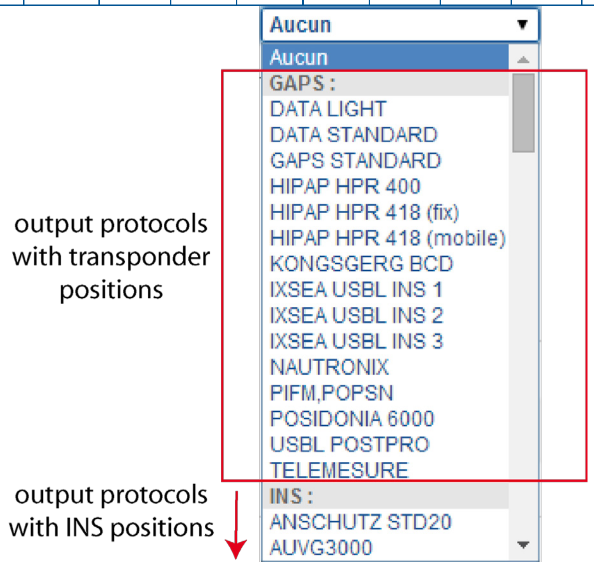


Figure 82 – Output protocols containing the transponder position and the INS positions

G.4 DATA STANDARD

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

PTSAG

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	Time in hours, minutes, seconds ,milliseconds
jj	Day (jj = 0 to 31)
mm	Month (mm =1 to 12)
aaaa	Year
BBB	Transponder No. or ship's No 0: Ship 1 to 128: Transponder -128 to –1: Unknown Transponder
DDMM.MMMMM	Latitude degrees, minutes and 1/100000
H	Hemisphere (N: North, S: South)
DDDMM.MMMMM	Longitude degrees, minutes and 1/100000
D	Longitude direction (E: East, W: West)
A	Validity of the four reception channels 0 to F: binary coding of acoustic hydrophone validity
MMMM.MM	Calculated depth in meters
A	Depth validity (0: None 1: Calculated 2: Sensor)
MMMM.MM	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 knows 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 Calculated / Sensor depth is the depth of the acoustic center (barycenter of the hydrophones). The **GAPS Depth** field in the **INSTALLATION > MECHANICAL PARAMETERS** tab of the Web-based user interface is the depth of the top flange of the GAPS unit. The distance between the top flange and the acoustic center is approximately 0.6 m (589.3 mm).

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

$PTSAX,#NNNNN, hhmmss.sss,jj,mm,aaaa,BBB, XXXXX.X, YYYYY.Y,A,PPPP.P,A,CCCC.C *CK	
#NNNNN	Recurrence frame Number
hhmmss.ss	Time in hours, minutes, seconds ,milliseconds
jj	Day jj = 0 to 31
mm	Month mm =1 to 12
aaaa	Year
BBB	Transponder No. 1 to 128: Transponder -128 to –1: Unknown Transponder
XXXXX.X	X coordinate (+ forward) in meters
YYYYY.Y	Y coordinate (+ starboard) in meters
A	Position validity (X, Y, Z) 0 to F: binary coding of acoustic channel validity
PPPP.PP	Calculated depth in meters
A	Depth validity (0: None 1: Calculated 2: Sensor)
CCCC.CC	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 knows 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.

PTSAY 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	Time in hours, minutes, seconds ,milliseconds
jj	Day jj = 0 to 31
mm	Month mm =1 to 12
aaaa	Year
BBB	Transponder No. 1 to 128: Transponder -128 to –1: Unknown Transponder
XXXXX.X	X coordinates (positive northwards) in meters
YYYYY.Y	Y coordinates (positive eastwards) in meters
A	Position validity (X,Y, Z) 0 to F: binary coding of acoustic channel validity
PPPP.PP	Calculated depth in meters
A	Depth validity 0: None 1: Calculated 2: Sensor
CCCC.CC	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 knows 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

PTSAZ

Message	**$PTSAZ,#NNNNN,HHMMSS.SSS,JJ,MM,AAAA,#PTSAW,R,C.CCC,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

PTSAH

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

This string **$PIXOG,CONFIG,TIME** 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			

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
```

G.5 DATA LEGACY

Message	**$PTSAX,BB,HHMMSS.SSS,JJ,MM,AAAA,#PTSAW,R,C.CCC,R.RRR,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
```

G.6 GAPS STANDARD

Definition GAPS Standard protocol is composed of three iXBlue POSIDONIA positioning messages $PTSAG, $PTSAX and $PTSAY and all messages of PHINS Standard protocol.

PTSAG 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.sss	Time in hours, minutes, seconds ,milliseconds
jj	Day (jj = 1 to 31)
mm	Month (mm =1 to 12)
aaaa	Year
BBB	Transponder No. or ship's No 0: GAPS antenna 1 to 128: Transponder -128 to –1: Unknown Transponder
DDMM.MMMMM	Latitude degrees, minutes and 1/100000
H	Hemisphere (N: North, S: South)
DDDMM.MMMMM	Longitude degrees, minutes and 1/100000
D	Longitude direction (E: East, W: West)
A	Validity of the four reception channels, 0 to F: binary coding of acoustic hydrophone validity
MMMM.M	Calculated depth in meters
A	Depth validity, 0: None 1: Calculated 2: Sensor
MMMM.M	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. GAPS can still output valid positions even if the validity is not 1111 (three channels are enough). All output positions are valid.
- **Calculated depth / Sensor depth**: The GAPS 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 four last fields are set to zero.

PTSAX Transponder relative Positioning Message relative to GAPS array - GAPS orientation (Relative coordinates and depth).

$PTSAX,#NNNNN,hhmmss.sss,jj,mm,aaaa,BBB,XXXXX.X,YYYYY.Y,A,PPPP.P,A,CCCC.C,NNNN.N*CK	
#NNNNN	Recurrence frame Number
hhmmss.sss	Time in hours, minutes, seconds ,milliseconds
jj	Day, jj = 1 to 31
mm	Month, mm =1 to 12
aaaa	Year,
BBB	Transponder: 1 to 128, Unknown Transponder: -128 to –1
XXXXX.X	X coordinate (+ forward) in meters
YYYYY.Y	Y coordinate (+ starboard) in meters
A	Position validity (X, Y, Z), 0 to F: binary coding of acoustic channel validity
PPPP.P	Calculated depth in meters
A	Depth validity: 0: None 1: Calculated 2: Sensor
CCCC.C	Sensor depth in meters
NNNN.N	Altitude of the transponder

- **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 GAPS 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 GAPS Acoustic Array.

PTSAY Transponder Relative Positioning Message relative to GAPS – 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.sss	Time in hours, minutes, seconds ,milliseconds
jj	Day: jj = 1 to 31
mm	Month: mm =1 to 12
aaaa	Year
BBB	Transponder 1 to 128, Unknown Transponder -128 to –1
XXXXX.X	X coordinates (positive northwards) in meters
YYYYY.Y	Y coordinates (positive eastwards) in meters
A	Position validity (X,Y, Z), 0 to F: binary coding of acoustic channel validity
PPPP.P	Calculated depth in meters
A	Depth validity, 0: None 1: Calculated 2: Sensor
CCCC.C	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 GAPS 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.

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

GPGGA Latitude, Longitude of the ship or GAPS, GPS quality

$GPGGA,hhmmss.ss,ddmm.mmmmm,a,dddmm.mmmmm,b,q,ss,...,…,.,…,.,…,….*hh<CR><LF>	
hhmmss.ss	UTC of position
ddmm.mmmmm	Latitude in degrees and in minutes and 1/100000
a	Hemisphere (N: North, S: South)
dddmm.mmmmm	Longitude in degrees and in minutes and 1/100000
b	Longitude sign (E: East, W: West)
q	GPS quality indicator • 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	is the number of satellites
*hh	is optional

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

GPVTG Course Over Ground and Ground Speed

$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

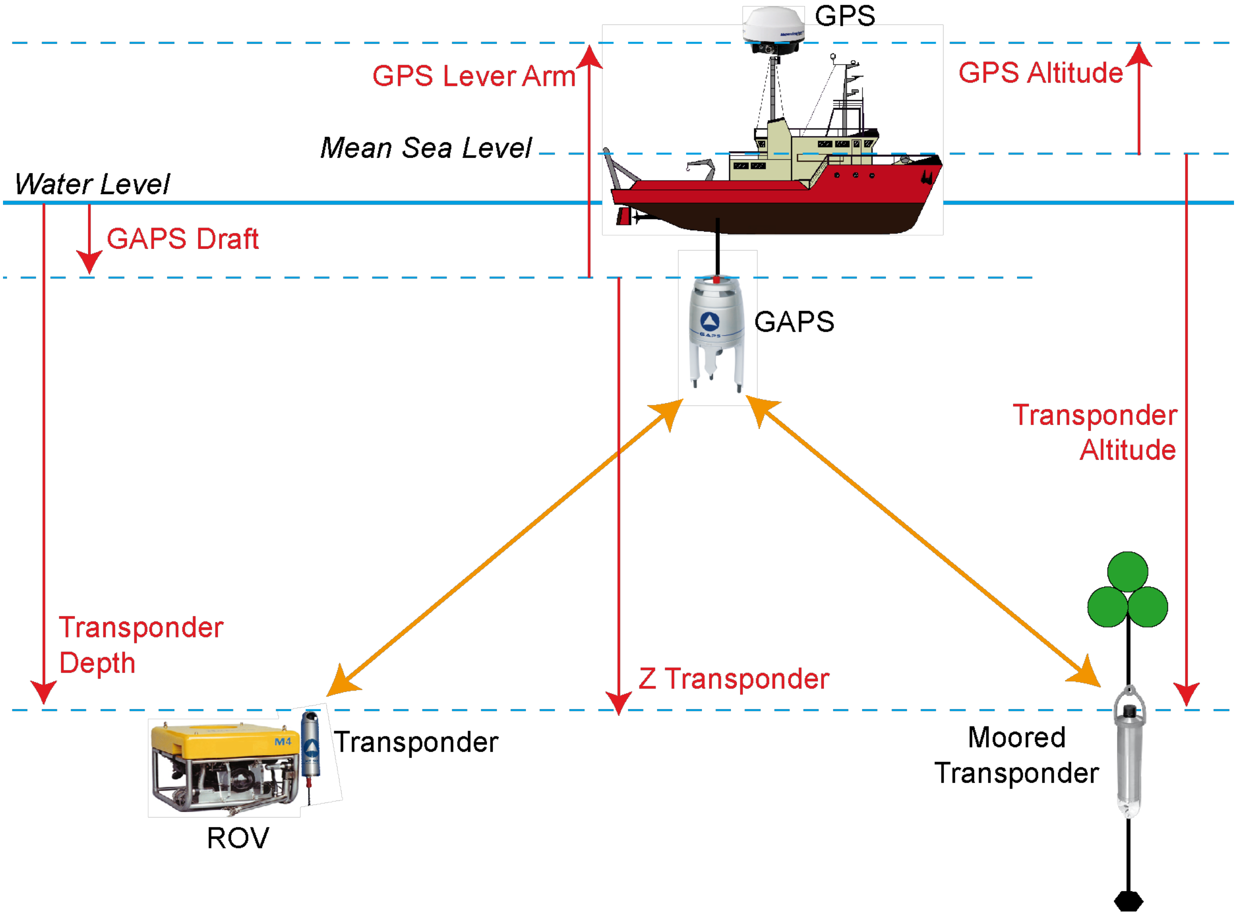
G.7 GAPS STANDARD ALTITUDE

Definition

GAPS Standard Altitude is identical to **GAPS Standard** protocol (see section G.6) except the field Transponder Altitude that is added at the end of the protocols PTSAG, PTSAX and PTSAY.

The transponder altitude is computed as described in the picture below:

- Transponder Depth = Z Transponder + GAPS Draft + Heave
- Altitude GAPS = GPS Lever Arm + GPS Altitude
- Transponder Altitude = Altitude GAPS - Z Transponder



PTSAG 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,NNNN.N*CK	
#NNNNN	Recurrence frame Number
hhmmss.sss	Time in hours, minutes, seconds ,milliseconds
jj	Day (jj = 1 to 31)
mm	Month (mm =1 to 12)
aaaa	Year
BBB	Transponder No. or ship's No 0: GAPS antenna 1 to 128: Transponder -128 to –1: Unknown Transponder
DDMM.MMMMM	Latitude degrees, minutes and 1/100000
H	Hemisphere (N: North, S: South)
DDDMM.MMMMM	Longitude degrees, minutes and 1/100000
D	Longitude direction (E: East, W: West)
A	Validity of the four reception channels, 0 to F: binary coding of acoustic hydrophone validity
MMMM.M	Calculated depth in meters
A	Depth validity, 0: None 1: Calculated 2: Sensor
MMMM.M	Sensor depth in meters
NNNNN.N	Altitude of the transponder

PTSAX Transponder relative Positioning Message relative to GAPS array - GAPS orientation (Relative coordinates and depth).

$PTSAX,#NNNNN,hhmmss.sss,jj,mm,aaaa,BBB,XXXXX.X,YYYYY.Y,A,PPPP.P,A,CCCC.C,NNNN.N*CK	
#NNNNN	Recurrence frame Number
hhmmss.sss	Time in hours, minutes, seconds ,milliseconds
jj	Day, jj = 1 to 31
mm	Month, mm =1 to 12
aaaa	Year,
BBB	Transponder: 1 to 128, Unknown Transponder: -128 to –1
XXXXX.X	X coordinate (+ forward) in meters
YYYYY.Y	Y coordinate (+ starboard) in meters
A	Position validity (X, Y, Z), 0 to F: binary coding of acoustic channel validity
PPPP.P	Calculated depth in meters
A	Depth validity: 0: None 1: Calculated 2: Sensor
CCCC.C	Sensor depth in meters
NNNN.N	Altitude of the transponder

PTSAY Transponder Relative Positioning Message relative to GAPS – NORTH orientation (Relative coordinates and depth)

$PTSAY,#NNNNN,hhmmss.sss,jj,mm,aaaa,BBB,XXXXX.X,YYYYY.Y,A,PPPP.P,A,CCCC.C,NNNN.N*CK	
#NNNNN	Recurrence frame Number
hhmmss.sss	Time in hours, minutes, seconds ,milliseconds
jj	Day: jj = 1 to 31
mm	Month: mm =1 to 12
aaaa	Year
BBB	Transponder 1 to 128, Unknown Transponder -128 to –1
XXXXX.X	X coordinates (positive northwards) in meters
YYYYY.Y	Y coordinates (positive eastwards) in meters
A	Position validity (X,Y, Z), 0 to F: binary coding of acoustic channel validity
PPPP.P	Calculated depth in meters
A	Depth validity, 0: None 1: Calculated 2: Sensor
CCCC.C	Sensor depth in meters
NNNN.N	Altitude of the transponder

G.8 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.

G.9 HIPAP HPR 400

Field	**Name**	**Kongsberg Explanation**	
$	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 inclimeter, 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

G.10 HIPAP HPR 418 (fix and mobile)

Please refer to the Kongsberg document HPR418BCD_revC.doc.

Transponder position message: the frame contains 32 bytes in binary format.

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

The difference between the **mobile** and **fixed** protocols is made in the Byte 3 Bit 5. The bit is equal to 1 in the mobile case and 0 in the fixed case.

Message			
Byte 0	0xDF	Start of message	
Byte 1	0x01	Head byte 1- SSBL position	
Byte 2	0xSS	Status Byte 1 Bit 0: Position Measurement OK Bit 1: Position measurement filtered Bit 2: Position measurement predicted (always 0 for USBL-BOX) Bit 3: Optional data SSBL OK (pressure sensor only for USBL-BOX TP) Bit 4-6: Always 0 Bit 7: Transceiver error (opposite of Bit 0)	
Byte 3	0x20	Status Byte 2 Bit 0-1: Transducer number (MSB s/n USBL-BOX) Bit 2-3: Transceiver number (LSB s/n USBL-BOX) Bit 4: Training mode (always 0 for USBL-BOX) Bit 5: Mobil TP (SSBL) Rov TP (LBL) (0 fixed, 1 mobile) Bit 6: LBL co-ordinates in UTM (always 0 for USBL-BOX) Bit 7: Master 0, Slave 1 (always 0 for USBL-BOX)	
Byte 4	0x01	TP. Inf. 0 - TP (Transponder) 1 - Depth TP Optional Data 1 2 - Inclinometer TP Optional Data 1&2 /* not used here 3 - Diff.in.TP Optional Data 1&2 /*not used here 4 - Compass TP Optional Data 1 /* not used here 5 - Acoustic control transponder /* not used here 6 - Beacon /* not used here 7 - Depth Beacon /* not used here 10 -Responder driver 1 /* not used here 13 - Responder driver 4	
Byte 5	0x00	TP ID	
Byte 6	0xTT		From 1 to 127
Byte 7	0xsY	Y position	s = 0 if Y positive (X HIPAP)
Byte 8	0xYY		s = D if Y negative
Byte 9	0xYY		BCD coded, LSB = 1/10 of unit
Byte 10	0xsX	X position	s = 0 if X positive (Y HIPAP)
Byte 11	0xXX		s = D if X negative
Byte 12	0xXX		BCD coded, LSB = 1/10 of unit
Byte 13	0xsZ	Z position	s = 0 if Z positive
Byte 14	0xZZ		s = D if Z negative
Byte 15	0xZZ		BCD coded, LSB = 1/10 of unit
Byte 16	0xHH	Heading MSB	0° to 359.9° LSB=0.1°
Byte 17	0xHH	Heading LSB	BCD coded
Byte 18	XsD	Sensor Depth	Meters
Byte 19	0xDD	Optional Data 1	S = 0
Byte 20	0xDD		BCD coded

Byte 21 Byte 22 Byte 23	0x00 0x00 0x00	Optional Data 2	Always 0
Byte 24 Byte 25	0x00 0x00	Horizontal error Ellipse direction	Always 0
Byte 26 Byte 27	0x00 0x00	Horizontal error Ellipse major	Always 0
Byte 28 Byte 29	0x00 0x00	Horizontal error Ellipse minor	Always 0
Byte 30	0xXX	Checksum	
Byte 31	0xFF	End of frame	

Transponder position message: the frame contains 32 bytes in binary format. This message is sent every 20 seconds and if any change in the sequence.

Message			
Byte 0	0xDF	Start of message	
Byte 1	0x03	Head byte	TP sequence Telegram
Byte 2	0xSS	Number of transponder in use	From 1 to 13
Byte 3 Byte 4	0xTT 0xTT	Number of TP 1	From 1 to 127
Byte 5 Byte 6	0xTT 0xTT	Number of TP 2	From 1 to 999
Byte 7 Byte 8	0xTT 0xTT	Number of TP 3	From 1 to 999
Byte 9 Byte 10	0xTT 0xTT	Number of TP 4	From 1 to 999
Byte 11 Byte 12	0xTT 0xTT	Number of TP 5	From 1 to 999
Byte 13 Byte 14	0xTT 0xTT	Number of TP 6	From 1 to 999
Byte 15 Byte 16	0xTT 0xTT	Number of TP 7	From 1 to 999
Byte 17 Byte 18	0xTT 0xTT	Number of TP 8	From 1 to 999
Byte 19 Byte 20	0xTT 0xTT	Number of TP 9	From 1 to 999
Byte 21 Byte 22	0xTT 0xTT	Number of TP 10	From 1 to 999
Byte 23 Byte 24	0xTT 0xTT	Number of TP 11	From 1 to 999
Byte 25 Byte 26	0xTT 0xTT	Number of TP 12	From 1 to 999
Byte 27 Byte 28	0xTT 0xTT	Number of TP 13	From 1 to 999
Byte 29	0x00	Dummy byte	Filled with 0
Byte 30	0xXX	Checksum	Bytes OR exclusive (except Checksum and End of frame). Bit 7 of the Checksum is always 0.
Byte 31	0xFF	End of frame	

G.11 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			
16	PP$_{hex}$	8	Reserved			

Byte Nb	Field	Nb of bits	Definition	Value		
				LSB	Min	Max
17, 18	rrrrrrrrrrrrrrrrrrrrrr$_{bin}$ (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						
	Bits 7 and 6 of byte19	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.

G.12 HPR BCD

Position Telegram SSBL

Example data:

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

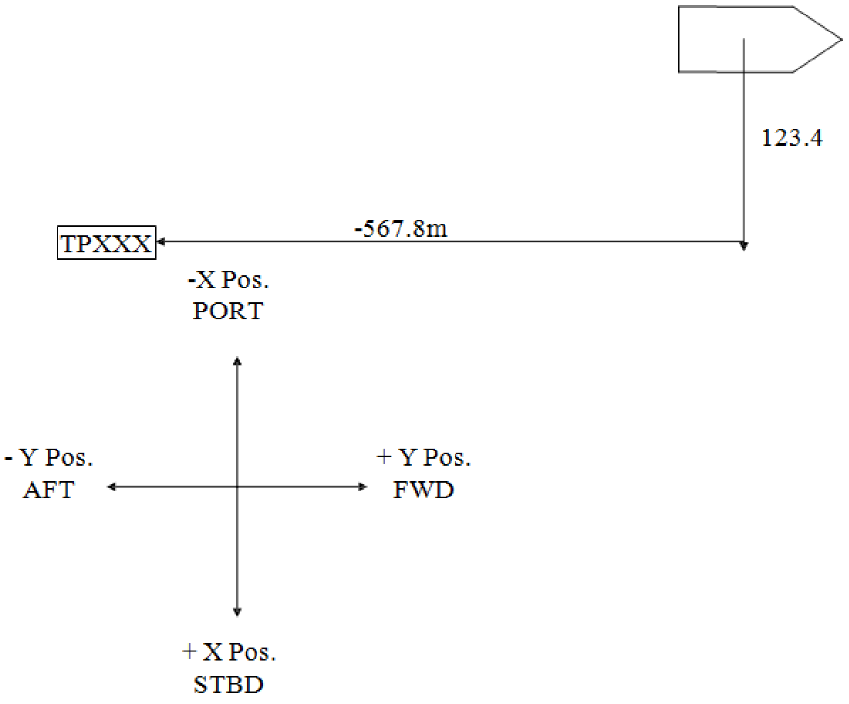
Heading = 359.9° TD 1 in use Wide beam Dif.Inc X = 0.3°.Y = -7.5°.

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: 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
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 15 16	01 23 45	**9: Z POS RAW** LSB is 1/10 of the unit. 1234.5 m depth.
17 18	35 99	**10: HEADING** LSB is 1/10 of the unit. 359.9°
19 20 21	00 00 03	**11: OPTIONAL DATA 1** MSB used for sign LSB is 1/10 of the unit. 0.3°
22 23 24	D0 00 75	**12: OPTIONAL DATA 2** MSB used for sign. (“D” is negative) LSB is 1/10 of the unit. -7.5°
25 26	00 00	**13: Horizontal error ellipse direction** LSB is 1/10 of the unit.
27 28	00 00	**14: Horizontal error ellipse major** LSB is 1/10 of the unit.
29 30	00 00	**15: Horizontal error ellipse minor** 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 = 1234.56 m Y = -987.65 m Depth 1234.5 m 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	

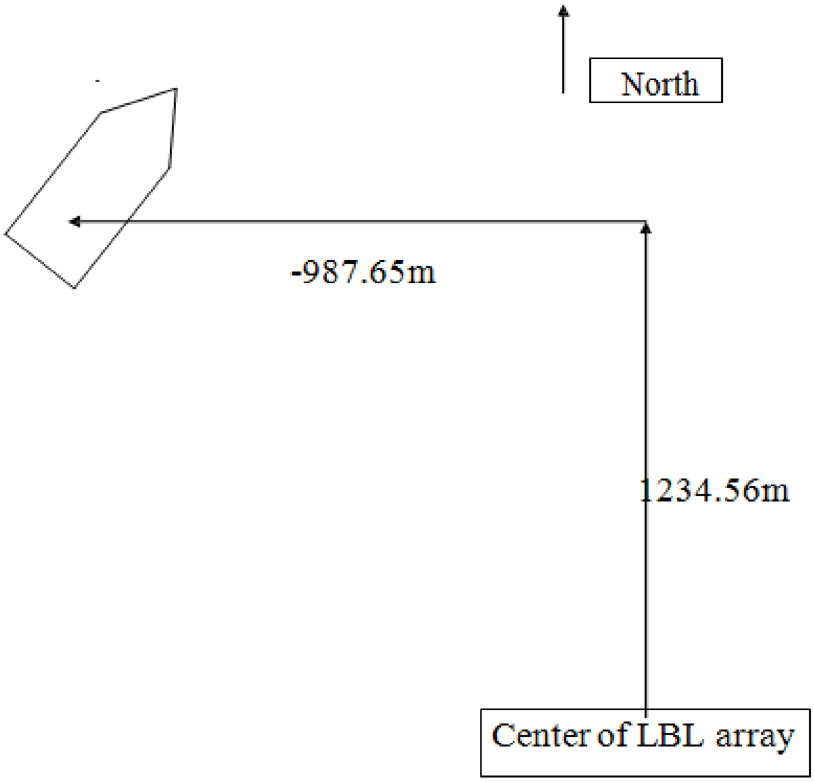
[2] Slave = 1 only when Slave Transmit enabled, otherwise no data from Slave

Byte no.	BCD	INF.
17 18 19	01 23 45	**9: Z POS RAW (raw or estimated)** LSB is 1/10 of the unit. 1234.5 m
20 21	05 99	**10: HEADING** 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 24	00 09	**12: RMS of residuals** LSB is 1/10 of the uni: 000.9
25 26	00 00	**13: Horizontal error ellipse direction** LSB is 1/10 of the unit.
27 28	00 00	**14: Horizontal error ellipse major axis** LSB is 1/10 of the unit.
29 30	00 00	**15: Horizontal error ellipse minor axis** 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.

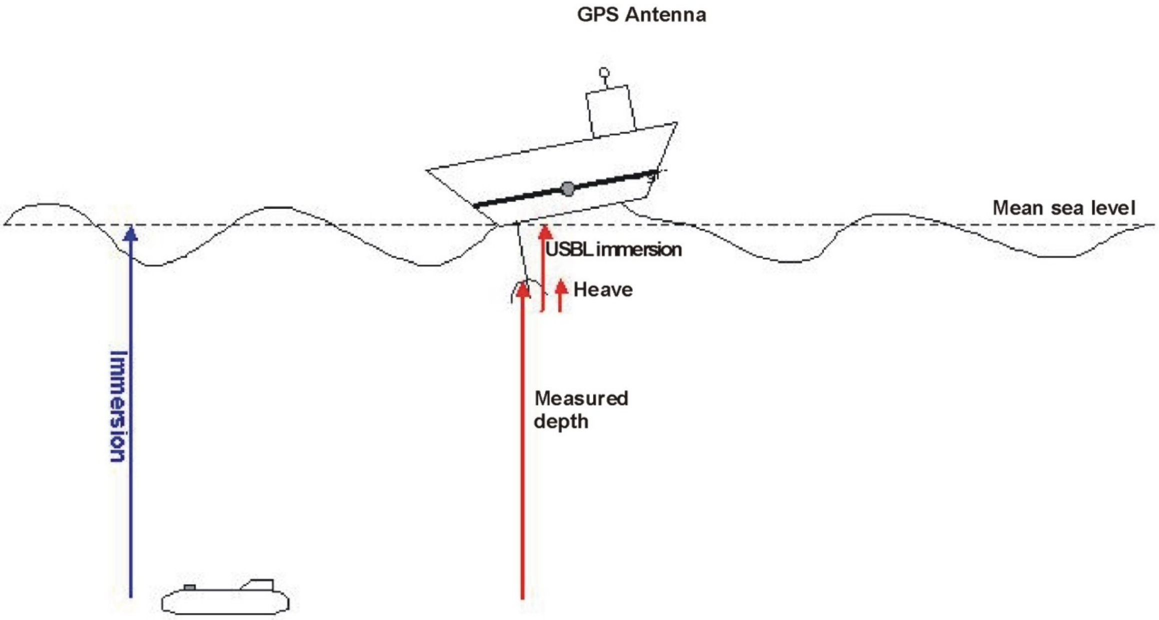
Byte no.	BCD	INFO.
1	DF	**1: SOT**
2	03	**2: Head byte.** 3 - TP in sequence telegram
3	05	**3: No of TP in use.**
4 5	00 01	**4: TP 1.** TP 1
6 7	01 03	**5: TP 2.** TP 103
8 9	02 07	**6: TP 3.** TP 207
10 11	01 33	**7: TP 4.** TP 133
12 13	03 00	**8: TP 5.** TP 300
14 15	00 00	**9: TP 6.**
16 17	00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

G.13 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 to deduce the absolute position as there is no compensation for tide.



Immersion = Measured depth (by the USBL acoustic array)
- Heave
+ USBL immersion

G.14 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)

G.15 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	Warning: 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 11	Transponder depth	IEEE floating point format , meters Warning: Not used by the INS
Data Field 5 Bytes 12 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. Warning: 2 characters

G.16 USBL_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_POSTPRO protocol comprises all necessary data for post processing:

- Configuration data (supposed invariant)
  - ❑ System characteristics
  - ❑ Beacon characteristics
- Operational environment data
  - ❑ 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 Ox7FC00000

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 MSB LSB LLSB	implementation major release minor release correction
	Firmware DSP	ulong			
	FPGA Mother board	ulong			
	Firmware Mother board	ulong			
	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 characteristics

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		[-231..+231] ≡ [-180..+180]
		Longitude	long		[-231..+231] ≡ [-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		[-231..+231] ≡ [-180..+180]
		Longitude	long		[-231..+231] ≡ [-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		[-231..+231] ≡ [-180..+180]
		Longitude	long		[-231..+231] ≡ [-180..+180]
		Immersion	float	meter	Not tide corrected
	Covariance position	North / North	float	meter2	
		North / East	float	meter2	
		North / Depth	float	meter2	
		East / East	float	meter2	
		East / Depth	float	meter2	
		Depth / Depth	float	meter2	
	Checksum		ushort		

G.17 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]

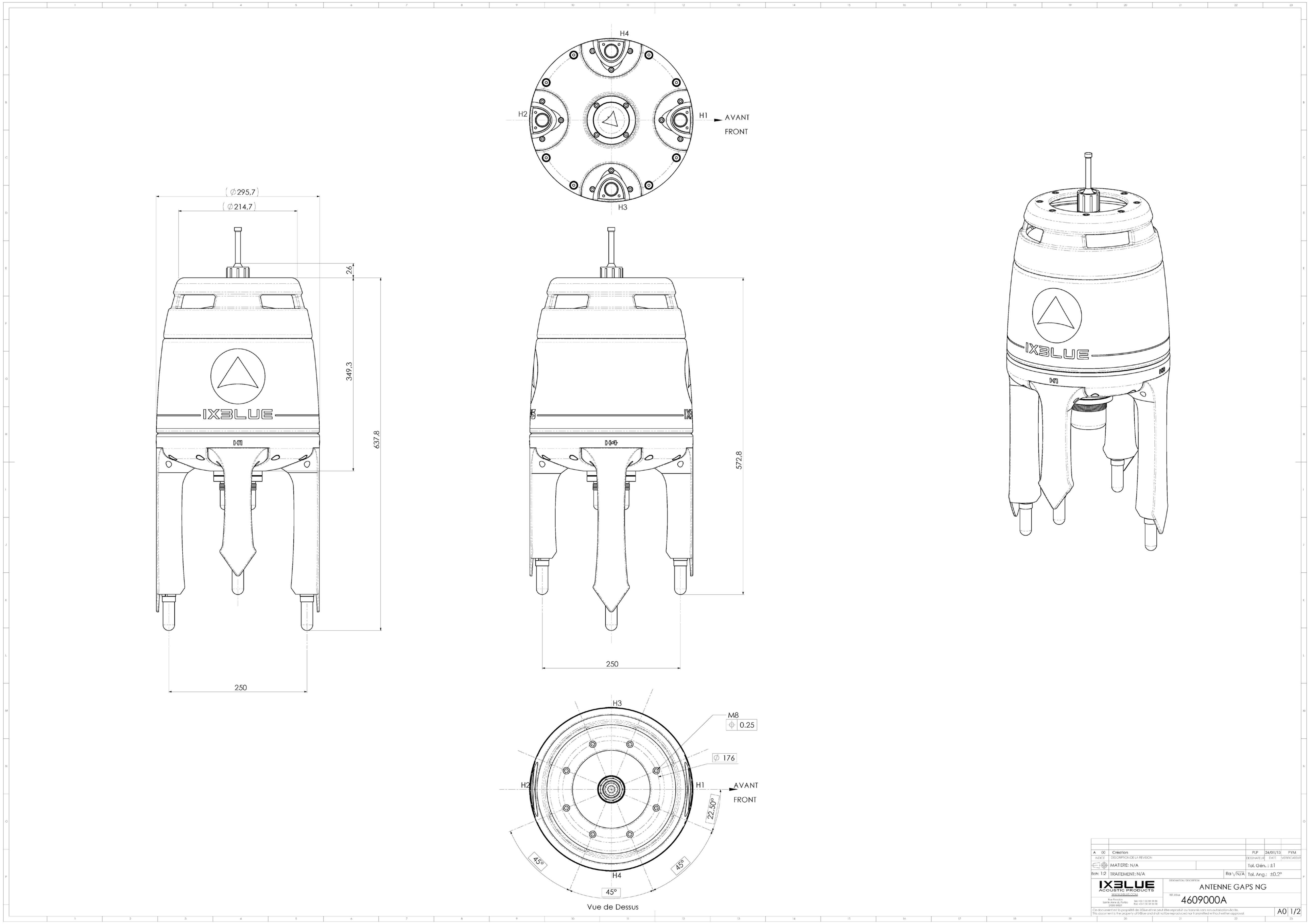
Message		**Format**	**Bytes**
Header	ID	$PIFM,POPSN,	12
	Date	JJ/MM/AAAA,	11
	Time	HH:MM:SS,DDD,	13
Heading, Speed	Heading (0 à 360), degrees	ddd.dd,	7
	Speed X, knots	±vv.vv,	7
	Speed Y, knots	±vv.vv,	7
Transponder or other Mobile Device Position	Transponder or mobile device ID *	4 characters,	5
	Transponder 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 »)

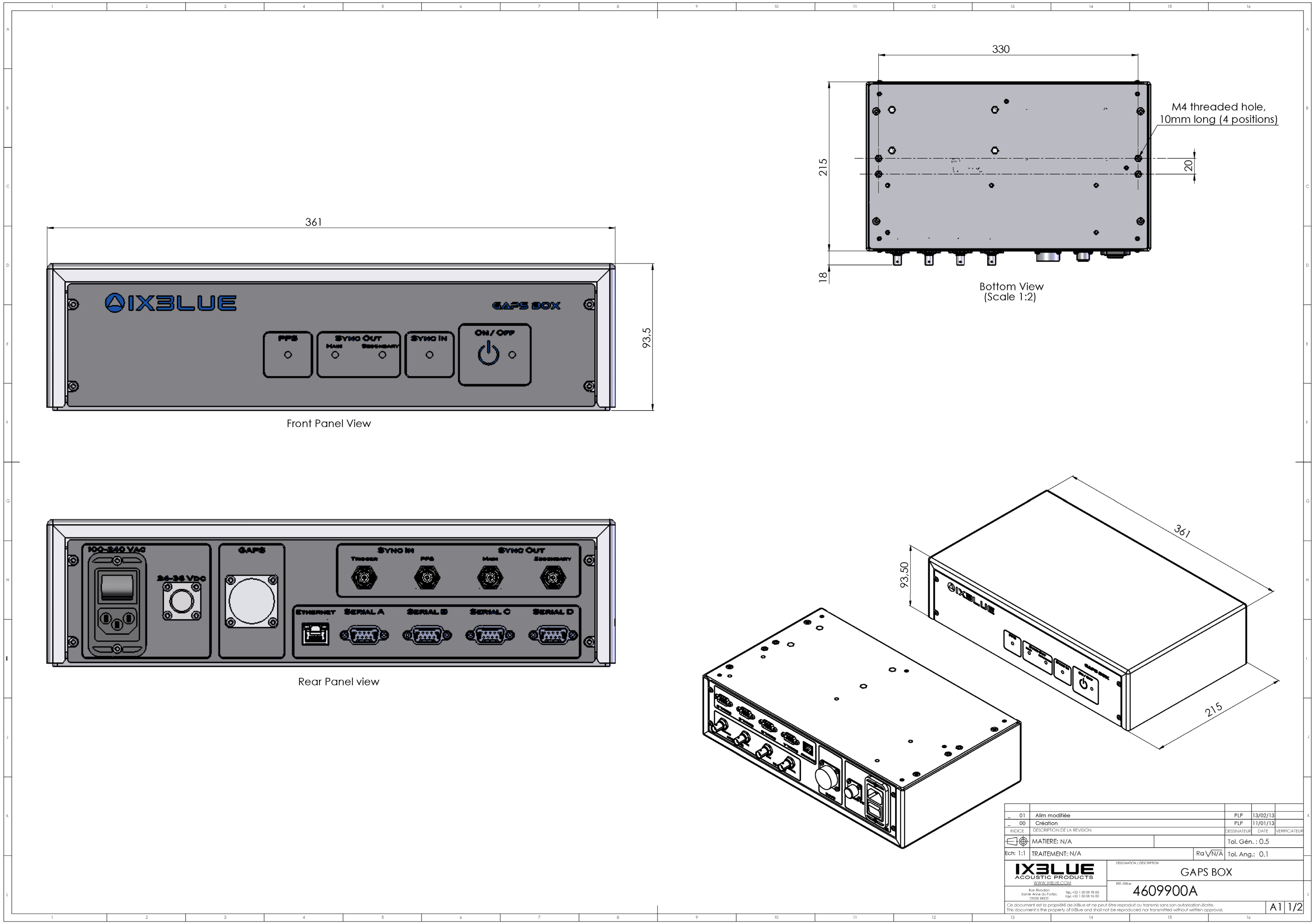
H. OUTPUT PROTOCOLS WITH INS POSITION

The output data protocols that contain the INS position are to be found in PHINS User Manual.

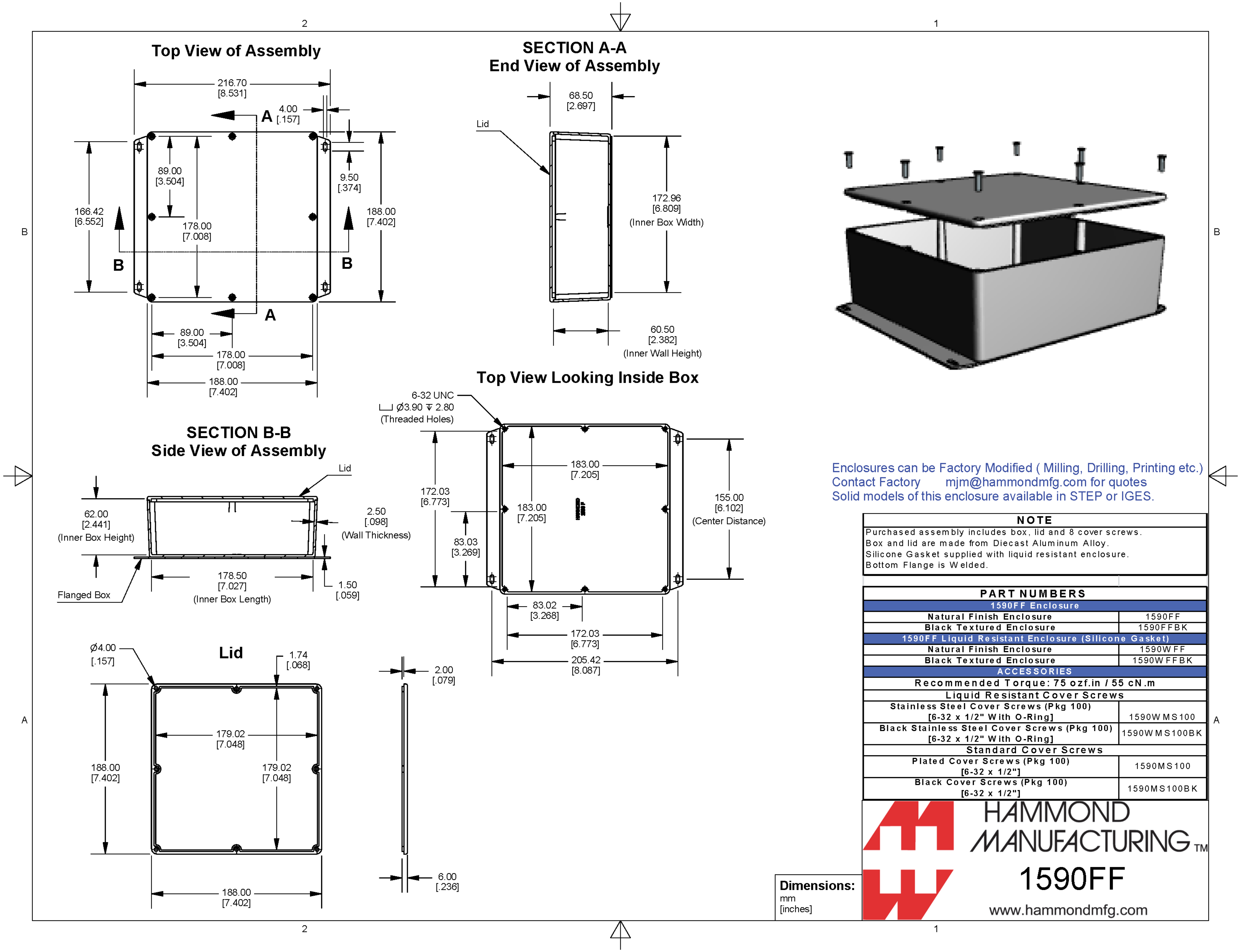
I. GAPS ANTENNA MECHANICAL DRAWING



J. GAPS BOX MECHANICAL DRAWING



K. MAIN CABLE REPEATER BOX MECHANICAL DRAWING



Enclosures can be Factory Modified (Milling, Drilling, Printing etc.)
Contact Factory mjm@hammondmfg.com for quotes
Solid models of this enclosure available in STEP or IGES.

NOTE

Purchased assembly includes box, lid and 8 cover screws.
Box and lid are made from Diecast Aluminum Alloy.
Silicone Gasket supplied with liquid resistant enclosure.
Bottom Flange is Welded.

PART NUMBERS	
1590FF Enclosure	
Natural Finish Enclosure	1590FF
Black Textured Enclosure	1590FFBK
1590FF Liquid Resistant Enclosure (Silicone Gasket)	
Natural Finish Enclosure	1590WFF
Black Textured Enclosure	1590WFFBK
ACCESSORIES	
Recommended Torque: 75 ozf.in / 55 cN.m	
Liquid Resistant Cover Screws	
Stainless Steel Cover Screws (Pkg 100) [6-32 x 1/2" With O-Ring]	1590WMS100
Black Stainless Steel Cover Screws (Pkg 100) [6-32 x 1/2" With O-Ring]	1590WMS100BK
Standard Cover Screws	
Plated Cover Screws (Pkg 100) [6-32 x 1/2"]	1590MS100
Black Cover Screws (Pkg 100) [6-32 x 1/2"]	1590MS100BK