

UM-8245

Mini-Ranger 2 USBL MF/HF V6.04 User Manual

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Note



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Amendment History

The amendment history records all amendments and additions made to this manual.

Issue	Revision	Date	Comments	Section	Page
A	1	24-09-2015	First Issue	All	All
A	2	01-02-2016	Updated for V4.04 Revised throughout	All	All
A	3	10-07-2016	Updated for V4.05 Revised throughout	All	All
A	4	06-11-2017	Updated for V4.06 Revised throughout	All	All
B	1	23-08-2018	Updated for V6.00 Revised throughout	All	All
B	2	25-10-2019	Updated for V6.01 Revised throughout	All	All
B	3	01-09-2020	Updated for V6.03 Revised throughout	All	All
B	4	01-11-2020	Updated for V6.03.02 Revised throughout	All	All
C	1	27-07-2022	Updated for V6.04 Formatted with new branding Revised throughout	All	All

Section 1 – Introduction

1.1 Scope of this Manual

This manual refers to the Mini-Ranger 2 system, manufactured by Sonardyne International Limited. It provides important information about the system, and offers advice on how to use the system safely and effectively.

Sonardyne International Limited operates a series of training courses that explain the theory and practice of the system.

1.2 Purpose of this Manual

This manual contains information for anyone involved with installing, using or maintaining the system. It includes technical and user information to deliver the best performance from the system.

Anyone using this system must ensure they read and understand the relevant parts of this manual.

This manual may be printed in part or whole by the user but cannot be copied or changed. Copyright of this manual remains with Sonardyne International Limited at all times.

1.3 Related Publications

The following publications can be referred to in conjunction with this manual.

Table 1–1 Related Publications

Publication	Title
<i>Sonardyne Safety Manual</i>	<i>Operational and Safety Precautions</i>
<i>UM-8211</i>	<i>User Manual for the Type 8211 ESH</i> (supplied with the ESH)
<i>UM-8142</i>	<i>User Manual for the HPT</i> (supplied with the HPT 2000/3000)
<i>UM-8300-099</i>	<i>User Manual for 6G Terminal Lite</i>
<i>UM-8190</i>	<i>User Manual for the Type 8190 Wideband Mini Transponder</i> (supplied with the WMT)
<i>UM-8370</i>	<i>User Manual for Type 8370 WSM 6+ Transponder</i> (supplied with the WSM 6+)
<i>OM-7815</i>	<i>User Manual for Type TZ/OBC and Coastal Transponder</i> (supplied with the transponder)

1.4 Conventions

The following conventions are used in this manual.

Table 1–2 Conventions used in this Manual

Format	Conventions
Boldface Type	User Input, Menu Options, Keys, e.g. Click OK
<i>Italic Type</i>	References to Figures, Tables, Sections and other internal/external source
Arrow (>)	Selection of an additional menu item e.g. File > Save

Section 2 – Safety

2.1 Introduction

Before any activity is carried out on this system, it is recommended that the included Safety Manual and all warnings and cautions in this manual are read and understood.

It is recommended the operator complies with the Health and Safety Regulations applicable to the vessel and the region before operating this equipment.

Operators and service personnel must be familiar with the normal operating and safety procedures for subsea equipment.

Documentation must be consulted whenever a  or  warning symbol is found on the equipment, in order to determine the nature of the potential hazard and any actions which must be taken.

If any additional equipment is used, any warnings and cautions in the equipment user manual must be read and fully understood and the equipment must only be used as specified by the manufacturer.

The safety of any system incorporating this equipment is the responsibility of the assembler of the system.

2.2 Safety Procedures

Warning and Caution terms used in this manual are described below:

- Warning: indicates potential for property damage, personal injury or death.
- Caution: indicates potential for damage to hardware, malfunction or loss of data.

2.2.1 Warnings

 **Personal protection.** Appropriate protective equipment such as protective footwear, hard hat and gloves must be worn when handling or carrying out any procedures involving Sonardyne and other equipment.

 **Heavy Equipment.** Many Sonardyne products and equipment types, such as transponders, transceivers, cable drums etc. require Manual Handling Equipment (MHE) for lifting due to their heavy weight. If MHE is not available, it is the responsibility of the operator to perform a manual handling risk assessment prior to carrying out manual lifting/handling. Refer to the individual equipment documentation for weight specifications.

 **Risk of impact injury.** Do not stand in line with the end-cap when removing from the beacon. Any internal pressure could rapidly force the end-cap from the beacon like a projectile.

 **Risk of crush injury.** Do not stand underneath suspended equipment.

 **Risk of crush injury.** Do not place hands near a beacon Release Mechanism when in operation. The mechanism is opened with a high pressure spring which could trap fingers.

 **Risk of burns.** If the battery pack has been exposed to flooding, corrosive liquids may be present. Personal protective equipment, such as gloves and goggles, must be worn to handle the battery pack.

 **Risk of burns.** Do not carry out maintenance on the transceiver if the housing is hot. Lower the transceiver into cold water and wait for the housing to cool. Wear Personal Protective Equipment such as gloves.

 **Risk of electric shock.** Do not remove any panels from the ESH to gain access to internal

components, or operate the ESH with any of the panels removed.

 **Risk of Asphyxiation.** Only trained personnel must be allowed to work in confined spaces in general and in the sea-chest in particular. Make sure there is always an adequate supply of fresh air available inside the confined space.

 **Risk of fire.** Make sure the power rating of any cables used is not exceeded.

 **Molykote 44 is a mild irritant.** When lubricating the connector faces, personal protective equipment such as gloves and goggles must be worn.

2.2.2 Cautions

 **Compass safe distance.** The ESH and connecting cables should not be mounted within 5 metres of a compass.

 **Installation Recommendation.** It is recommended that hardware installations are located at least 10 metres from any VHF radio antennae operating in the 156-165 MHz band.

 **Installation Recommendation.** This equipment is intended to be used (and draw its power) within the Bridge and deck zone of the ship. The BS IEC 60533 -1999 standard, Electrical & Electronic Installations in Ships, makes certain recommendation [see emission limits Table 3] to help aid protection in this specific zone. It requests that an inline RFI filter is to be installed in the power supply circuit between this zone and all other general power distribution zones. This filter is to be capable of achieving a decoupling of about 30 dB in the frequency range of 10 kHz to 30 MHz. This is the normal, anticipated practice and is stated here to secure EMC installation integrity.

 **Installation Recommendation.** It is advisable to use a power outlet with a surge protector fitted. Preferably the ESH should be supplied with power from an Uninterruptible Power Supply (UPS) to prevent vessel power interruptions affecting the operation.

 **Loss of Data Risk.** Damage can occur to the hard disk or data corruption by switching off system power when the hard disk is reading or writing data. Do not switch off system power until after you have shut down the system correctly.

 **Network connection failure.** Connection of the ESH to anything other than a closed private network or approved Sonardyne devices is at the risk of the operator. Sonardyne International Limited accepts no responsibility for network connections and configurations.

 **Risk of equipment damage.** Make sure that the ESH chassis is correctly installed in a rack or a console with adequate fixings and support to avoid damage from vibration.

 **Risk of short-circuit/ESD risk.** Make sure the ESH has an earth lead connected to the chassis earth at the rear when rack mounted.

 **EMC risk.** High quality cables should always be used for connection to external equipment. It is the responsibility of the system integrator to check there is no practical EMC interference to, or by, the Sonardyne equipment caused by connection to external equipment.

 **Risk of damaging connectors.** Once installed, do not move the ESH with cables connected.

 **Risk of equipment damage.** Make sure the ESH chassis receives an adequate cool air supply to avoid damage caused by overheating.

 **Risk of equipment damage.** All instruments must be maintained according to their individual operating manuals. Failure to follow recommended procedures could result in instrument failure, and loss of system integrity.

 **Risk of equipment malfunction.** Do not operate multiple beacons on the same address in the

water at the same time. The address must be unique to any one beacon operating in the same acoustic area.

 **Risk of equipment malfunction.** Minimise any sources of high-level acoustic noise in the MF band. Examples of such noise sources include ROVs, vessel thrusters, and other vessels using acoustic positioning. High noise levels can disrupt the acoustic measurements and lead to loss of system integrity.

 **Risk of equipment malfunction.** This product makes use of Microsoft Windows which is not intended for use in any system where failure or fault of any kind of the Product could reasonably be seen to lead to death or serious bodily injury of any person, or to severe physical or environmental damage ("High Risk Use"). High Risk Use is **STRICTLY PROHIBITED**.

 **Risk of equipment malfunction.** Do not ignore a system alarm because this can lead to incorrect operation. Investigate the cause of any system alarms, and make appropriate corrections for them.

 **Risk of equipment malfunction.** Review the system event log periodically (particularly the Warnings and Alarms categories). Investigate any unexplained events, particularly repeated warnings, and make any appropriate corrections.

 **Risk of equipment malfunction.** Mandatory software and firmware update notices must be applied as soon as practically possible.

 **Risk of equipment malfunction.** It is recommended that hull gate valves are exercised at least once a month to prevent build-up of marine growth, etc. that could cause the mechanism to seize. A failed gate-valve prevents maintenance of the USBL transceiver being carried out.

 **Risk of equipment damage.** Acoustic transceivers contain delicate transducers and motion sensing elements. Take care to protect this equipment during and after installation by following all the instructions in the user manual.

 **Risk of equipment damage.** To avoid galvanic corrosion of the USBL transceiver housing, make sure it is electrically isolated from surrounding metalwork by following all the instructions in the installation manual.

Section 3 – System Overview

3.1 Introduction

This is the user manual for the Mini-Ranger 2 system developed by Sonardyne International Limited. The following topics are covered:

- A description of the system.
- Information to help you operate and setup the system correctly.
- A description of the software.
- Instructions to help you calibrate the system.
- Instructions to complete all the procedures you are likely to need during an operation.
- Information to help you recognise a possible fault condition and to help you solve it.

The manual also includes additional background information that you can refer to if necessary. This additional information is included in a series of appendix chapters:

- Instructions on how to use the electronic version of this manual and how to find the information you need quickly.
- A brief explanation of how the acoustic navigation system works.
- General guidance to help engineers install the system's hardware and software .
- Detailed descriptions of the individual dialog boxes included in the software.
- Information about the various error messages and alarms that you might experience when you are using the system.
- Additional reference information, including a glossary of terms used.

The software images shown in this manual are captured using Marksman software unless the item is specific to Mini-Ranger 2. The small identification logo in the top left of the window identifies the software type.

Note



Some features shown here may not be available, depending on the exact product and options purchased.

3.2 Typical System

Mini-Ranger 2 is a portable survey-grade Ultra-Short BaseLine (USBL) system designed for inter-coastal operations operated from any vessel type, where up to 10 targets can be tracked at up to 995 m range. Both HF and MF variants are available.

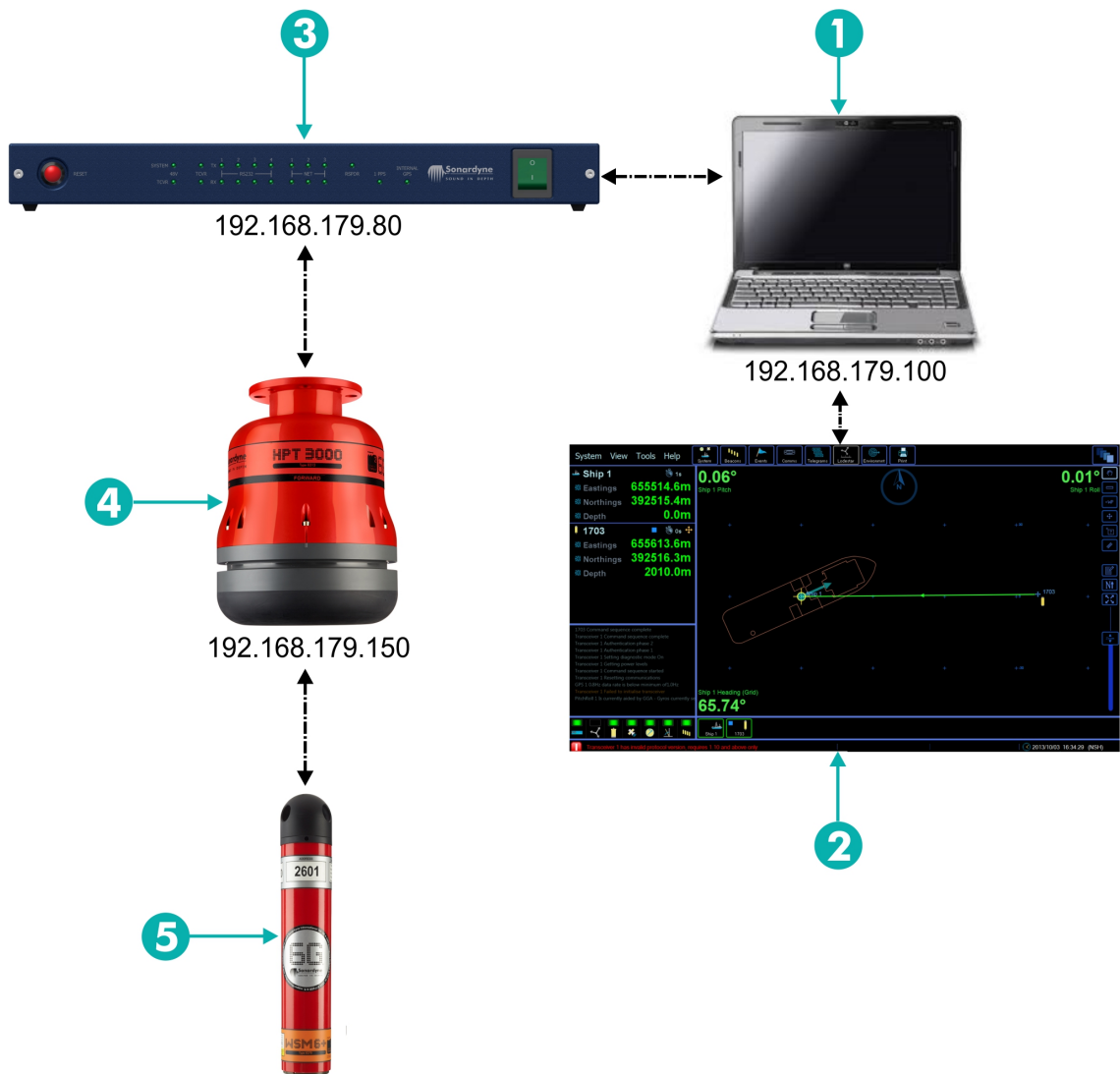
A typical supplied Mini-Ranger 2 system consists of:

- Ethernet Serial Hub (ESH)
- HPT 2000 (HF) Ethernet transceiver and TZ/OBC or LRT Sonardyne beacon, or
- HPT 3000 (MF) Ethernet transceiver and WSM 6+ or other Sonardyne 6G beacon

The Mini-Ranger 2 system consists of a PC installed with Mini-Ranger 2 software, Ethernet Serial Hub (ESH), HPT 2000/3000 USBL transceiver and beacon.

Figure 3–1 shows a typical system. The ESH uses the IP address 192.168.179.80 (other system devices must use the same subnet).

Figure 3–1 Mini-Ranger 2 Typical System



Item	Description	Item	Description
1	PC (not supplied)	4	HPT 2000/3000 USBL Transceiver
2	Mini-Ranger 2 Software	5	TZ/OBC, LRT, WSM 6+ or other Sonardyne 6G Beacon
3	ESH and Cables		

3.2.1 Ethernet Serial Hub

The ESH is the network interface between the in-water acoustic instrument, GNSS and the PC that runs the positioning software and provides power and communications for the acoustic transceiver. The ESH supports responder trigger and 1 PPS synchronisation across systems.

The ESH has the following features:

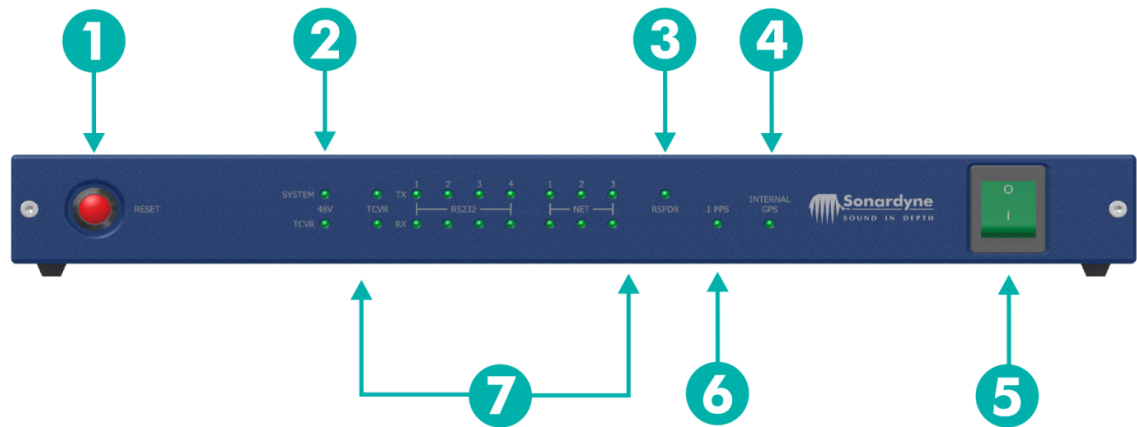
- 3 port network switch
- 10/100 fast Ethernet uplink

- 4 RS232 serial ports
- 1 Transceiver port providing 48 V DC power
- 1 Responder trigger port
- Internal L1 GNSS receiver (requires an antenna)

3.2.1.1 Front Features of the ESH

The front features of the ESH are shown in *Figure 3-2*.

Figure 3-2 Ethernet Serial Hub Front View

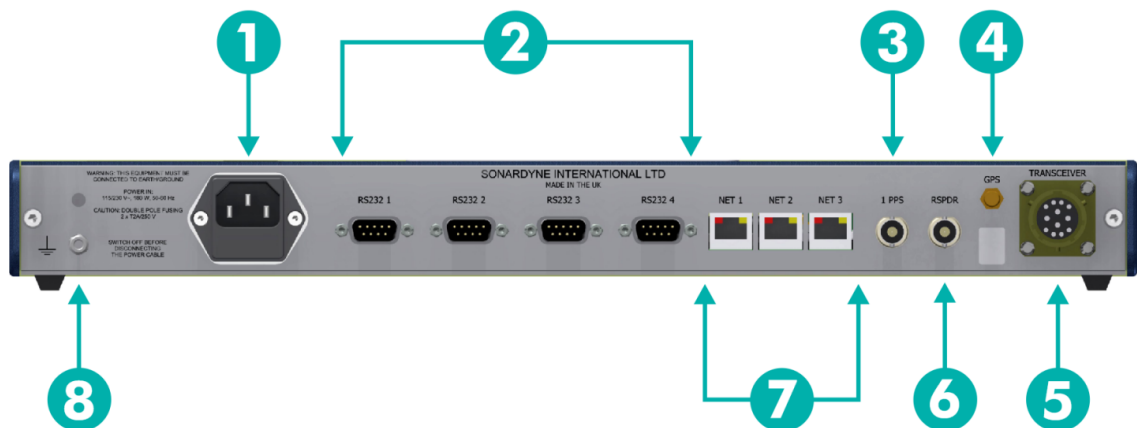


Item	Description	Item	Description
1	Reset Button	5	Power Button
2	Transceiver Supply Status	6	1 PPS Activity LED
3	Responder Activity LED	7	I/O Activity LEDs
4	Internal GNSS Activity	-	

3.2.1.2 Rear Features of the ESH

The rear features of the ESH are shown in *Figure 3-3*.

Figure 3-3 Rear Features of the ESH



Item	Description	Item	Description
1	IEC Socket 115/230 Vac Fuse Holder	5	48 V Transceiver Connector (Amphenol)

Item	Description	Item	Description
2	RS232 Serial Ports x 4	6	Trigger Responder
3	1 PPS Input	7	RJ45 Ethernet x 3
4	GNSS Antenna Connection	8	Chasis Earth

Note

 **Internal Port ESH/5A is hard-wired to a simple internal GNSS that can be used for time synchronisation and basic positioning.**

3.2.1.3 Installation, Operation, Maintenance

The ESH can either be installed in a 19" rack or used on a desktop.

For more information on the ESH, see *UM-8211 "User Manual for Type 8211 Ethernet Serial Hub"*.

3.2.2 Type 8221/8212 HPT 2000/3000 USBL Transceiver

Under software control, the transceiver emits acoustic interrogation or command signals into the water, and receive acoustic responses from the transponders. It then communicate these responses to the software for display and logging.

The Type 8221 (HF) and 8212 (MF) 6G transceiver is a small, light, Ethernet interfaced USBL transceiver with a short range array optimised for shallow water and high elevation tracking in low noise environments up to 2000 m.

The HPT 2000/3000 contains an internal attitude sensor and magnetic compass, mounted inside the head.

Note

 **It is highly recommended that a survey grade external heading device such as a Sonardyne Lodestar is used in the system. Magnetic Compasses are highly prone to interference and should not be relied on for precise survey work.**

The HPT 2000 and HPT 3000 are shown in *Figure 3–4*.

Figure 3–4 HPT 2000 and HPT 3000**3.2.2.1 HPT to ESH Connection**

The HPT is connected to the ESH using a cable assembly with Amphenol 62GB-57T14-12P to AGP-2108-M connectors as shown in *Figure 3–5*.

Figure 3-5 HPT to ESH Connection



Item	Description
1	CPN 820-6793 or 820-0331 (Amphenol 62GB-57T14-12P to AGP-2108-M)
2	ESH

3.2.2.2 Cable Assembly Wiring Details

For the cable assembly wiring details, see *Appendix C "Interface Cables"*.

3.2.2.3 Internal Attitude Sensor and Magnetic Compass Calibration

To calibrate the internal magnetic compass, see *Section A.9.6 "Advanced"*.

To configure the internal attitude sensor and calibrate the magnetic compass using the Radian2 tool, see *Appendix G "Radian2 Tool"*.

3.2.2.4 Installation, Operation, Maintenance, Functional Testing, Firmware Upgrade, Fault Diagnosis, Retrieval and Storage

For more information on the HPT, see *UM-8142 "User Manual for Type 8212, 8142 & 8091 HPT"*.

3.3 Beacons

Beacons (or transponders) listen for acoustic signals from the transceiver, and respond with a reply when required.

Several beacons can be assigned the same interrogation signal, often called a 'common interrogation' signal. They each reply on their 'individual reply' signal.

Depending on the nature of the interrogating signal, a beacon can either respond to a signal addressed to it individually, or can respond to a common interrogation signal that produces a response from all transponders in the system.

Depending on the application, the following beacons/release transponders are likely to be used with Mini-Ranger 2 in either an MF or HF system. Other Sonardyne beacons may be compatible; contact Sonardyne support for more information.

For more information on the beacons below, see the product user manual referred to in *Table 1-1*.

3.3.1 Wideband Sub-Mini 6 Plus Beacon

The Wideband Sub-Mini Plus (WSM 6+) is designed for use with Sonardyne Wideband Navigation Systems and in legacy mode with Kongsberg USBL systems.

- Type 8370-1111 – Omni-directional.



- Type 8370-4112 – Directional.



3.3.2 Type 8262 Nano Beacon

The Nano beacon is specially designed for short duration acoustic positioning of divers or small underwater vehicles. The small lightweight wireless rechargeable beacon design allows for easy, unobtrusive attachment to a diver or vehicle.

The Cabled Nano beacon features an industry standard Subconn connector allowing it to be permanently powered and can also be used in Responder mode.

The Cabled Nano beacon features an industry standard Subconn connector allowing it to be permanently powered.

- Type 8262



- Type 8262 Cabled



3.3.3 Type 8262 AvTrak 6 Nano

The AvTrak 6 Nano Transceiver is a specially designed variant of the established AvTrak 6 for small underwater vehicles. It combines the functions of transponder, transceiver and telemetry link for intelligent subsea operations.

The AvTrak 6 Nano features an industry standard Subconn connector allowing it to be permanently powered.



3.3.4 Type 7815 TZ/OBC Coastal Beacon (HF System)

The (Transition Zone/Ocean Bottom Cable (TZ/OBC) positioning beacon enables the positions of seismic hydrophone positions to be accurately and efficiently determined.



3.3.5 Type WMT

The Wideband Mini Transponder (WMT) are designed to be installed on a ROV providing two-way interrogation and reply.



3.3.6 Type 8327/8320/8321 RT 6-1000, 3000 & 6000 Release Transponders

The RT 6 family of ReleaseTransponders are designed for a wide variety of subsea applications and are fully compatible with Sonardyne's 6G® transceivers and USBL systems.

The RT 6-1000 can accurately position seismic receiver nodes. It has both receive and transmit functions, enabling release actuation to be confirmed and its position to be accurately determined.



The RT 6-3000 (MF) and RT 6-6000 (LMF) are rated to 3,000 and 6,000 metres respectively.



3.4 PC

Mini-Ranger 2 software is installed on the PC (not supplied with the system) and connected to the ESH using an Ethernet cable or Wi-Fi on a dedicated private network. To install Mini-Ranger 2 software, see *Section B.7 "Software Installation"Appendix B "Installation"*

The recommended minimum hardware requirements for the PC are:

- Intel® core i7 2.6 Ghz processor
- 8 GB RAM
- 10 GB free disk space
- Graphics card with DirectX® V10 or later (1280 x 1024 minimum resolution)
- Windows® 10 Professional (UK English version)

3.5 Peripheral Systems

Peripheral systems for use with the system can include:

- a GNSS.
- a vertical reference unit.
- a gyrocompass.
- an Attitude and Heading Reference System (AHRS).

Note



Refer to the technical documentation provided by the equipment manufacturer for installation and operating instructions for the peripheral devices you use with your system.

3.5.1 Vertical Reference Unit

A vertical reference unit (VRU) measures the roll and pitch angles of the vessel on which it is installed under the influence of waves and swell.

The system uses these measurements to compensate its position calculation for any changes in the vessel attitude. If this information were not available to the software, errors could be present in the position calculations, and these would become greater with increasing angles of roll and pitch.

3.5.2 Gyrocompass

A gyrocompass provides accurate heading information for use by the software. The system uses these measurements in its position calculations.

The HPT 2000/3000 transceiver has an internal combined magnetic compass/VRU, however it is recommended to use an external survey grade gyro sensor.

The Sonardyne Lodestar™ AHRS fills the combined role of gyrocompass and VRU (see above).

3.5.3 Data Formats

The software can accept the following range of data formats from external equipment:

- Heading inputs:
 - NMEA 0183 HDT
 - SG Brown ASCII or binary
 - Robertson SKR82
- Attitude:
 - SON2 (preferred Lodestar format)
 - TSS1

- TSS2
- TSS3
- EM1000
- EM3000
- JAVAD
- PRDID
- PHOCT
- STD1
- PASHR
- PSXN
- Position:
 - GPGGA
 - GPGLL
 - NMEA SSB
- Depth:
 - NMEA SDDPT
 - DBS
 - PSSIROV
 - SONDEP
 - DigiQuartz
 - Midas SVX2

3.6 Typical Navigation Cycle

In a typical navigation cycle:

1. The software commands the transceiver to transmit an interrogation signal.
2. Each beacon receives the interrogation signal and transmits a response, if necessary.
3. The transceiver receives the beacon responses and measures the time interval between the interrogation signal and the individual beacon responses.
4. The transceiver communicates these interval measurements to the software, which also receives information from the vertical reference unit and gyrocompass.
5. The software computes the position of each beacon relative to the transceiver and, if required, reports this information to a separate DP navigation system or survey computer.
6. The sequence continues automatically under software control.

Section 4 – Common Procedures

4.1 Introduction

Section 6 "*Application Procedures*" describes the specific procedures for a range of applications. However, before you can start to use these applications it is necessary to have a suitable setup already configured in the software.

4.1.1 New Setup

This section describe show to create a new setup. The common sequence to follow is:

1. Start the software.
2. Initialise the software using the required setup.
3. Add mobile objects such as ships and mobile beacons.
4. Add instruments to the mobile targets.
5. Configure the mobile targets.

This chapter describes these common procedures.

4.1.2 Instruction Format

To simplify the instructions included in this User Manual, where possible the procedures include example screen images with instructions. Perform the actions in the order indicated.

These procedures include only the instructions you need to complete the task — they do not include detailed descriptions of the dialog boxes or of the controls and features of the software. If you need detailed information about the software and its dialog boxes, see *Appendix A "User Interface"*.

In common with many Windows-based applications, there are many valid methods that you can use to complete a command. For example there are buttons to click, and there are right-click context menus. This chapter explains the simplest method, and sometimes provides alternatives.

4.2 Starting the Software

Starting the software for the first time.

1. Double-click the icon on the desktop to start the software.



2. The Mini-Ranger 2 window is displayed with the splash to show initialisation progress.

After initialisation has completed, Mini-Ranger 2 uses the setup that was active when you closed the program previously.

For a new software installation, Mini-Ranger 2 displays the **System Setup** window, which allows you to add objects to the initially empty setup.

3. Follow the instructions in *Section 4.3 "Initialisation"* to use the **System Setup** window to edit the setup.

4.3 Initialisation

Click **System > Setup** or the **System** shortcut button to add instruments to a setup, as described in *Section 4.4 "Adding Objects"*.



Note



An ESH, HPT 2000/3000 and GNSS are added automatically to the initial Setup.

4.4 Adding Objects

A mobile object can be added in one of two ways:

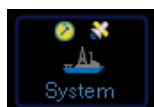
1. Clicking the **System > Setup** or the **System** shortcut button to open the **System Setup** window or,
2. Clicking the **Ports** and **Beacons** shortcut buttons to open the **Communications Port Table** and **Beacons Table** windows.

Both methods achieve the same outcome and are described in *Section 4.4.1*, *Section 4.4.2* and *Section 4.4.4*

4.4.1 Adding Objects from the System Setup Window

4.4.1.1 Adding Instruments

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.



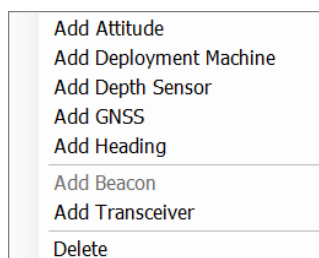
For a new setup, the **System Setup** window includes only the surface vessel that you defined when you created the setup. This is selected by default in the job tree, with the properties tabs showing the current properties for the object.

The job tree groups objects so that 'system' devices such as the ESH and SV Sensor remain together, and 'ship' devices such as gyros, VRUs and other mobile devices remain together.

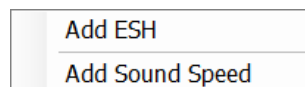
- a. To add a Mobile Object to the setup, right-click the **Mobile Objects** root in the job tree and select from the context menu.

If you select **Add Beacon**, the Add Beacon wizard runs to guide you (see *Section 4.4.4* for a description of the beacon wizard).

- b. To add an instrument or an object to a vessel, right-click the vessel and select from the context menu.



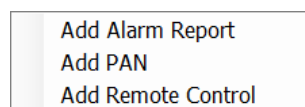
- c. To add a system object to the setup, right-click **System** in the job tree and select from the context menu.



- d. To add a Depth Alarm to the setup, right-click **Depth Alarms** in the job tree and select from the context menu.



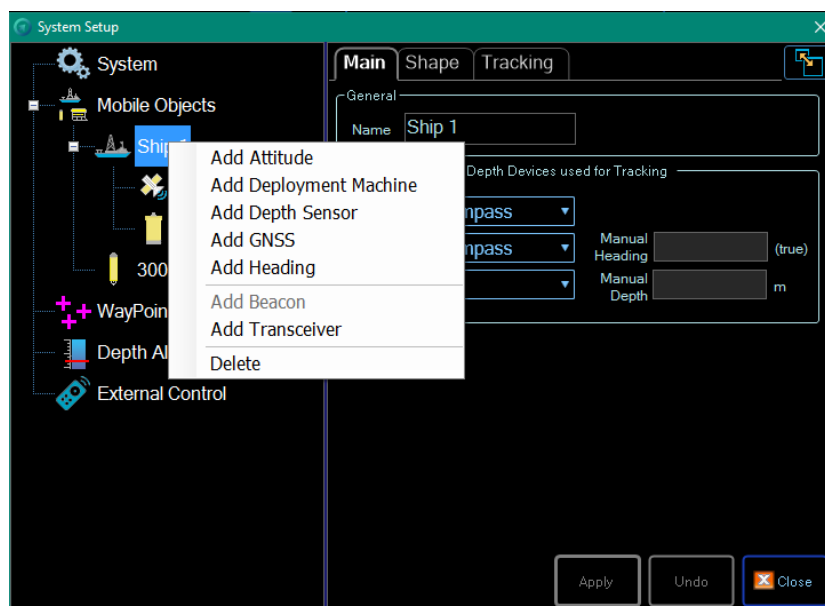
- e. To add an external control interface to the setup, right-click **External Control** in the job tree and select from the context menu.



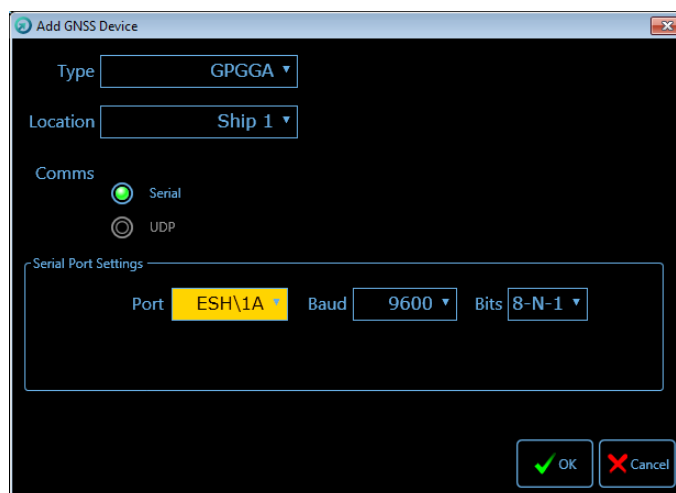
- f. Confirm the new object is included in the setup:
 - A mobile object appears as a new branch in the job tree
 - An instrument (for example a satellite navigation system) appears as a sub-entry under its associated Mobile Object in the job tree
 - A system object appears under the system branch of the job tree
- g. Confirm the object's properties are displayed.

For example, to add a GNSS:

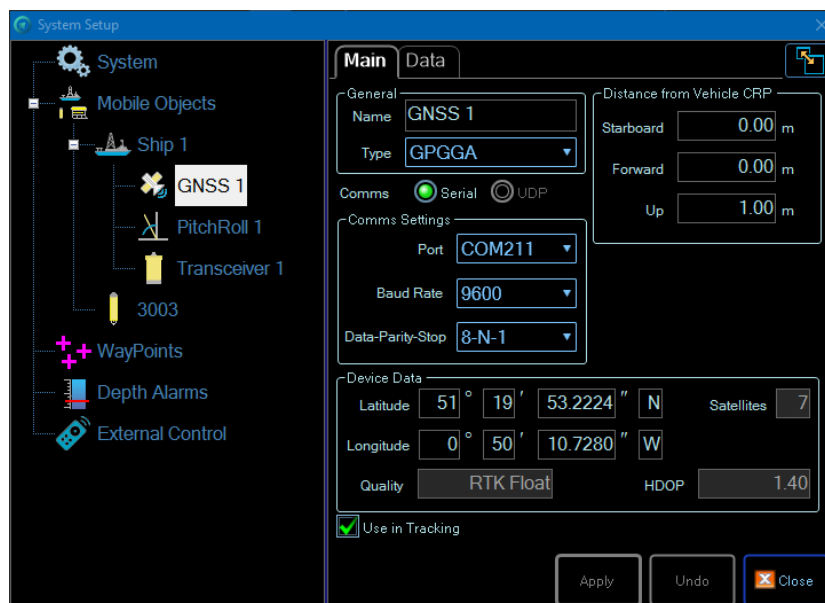
1. Right-click on the vessel (**Ship 1**) and select **Add GNSS**.



2. Select the **Type** and **Port** from the drop-down list.
3. Select the correct **Baud Rate** from the drop-down list e.g. **9600** and then click **OK**.



4. The **Longitude** and **Latitude** data will be automatically updated.



5. Add the **Starboard**, **Forward** and **Up** offsets for the GNSS antenna relative to the CRP and then click **Apply**.

Refer to *Section 4.7* through to *Section 4.14* to configure the other instruments.

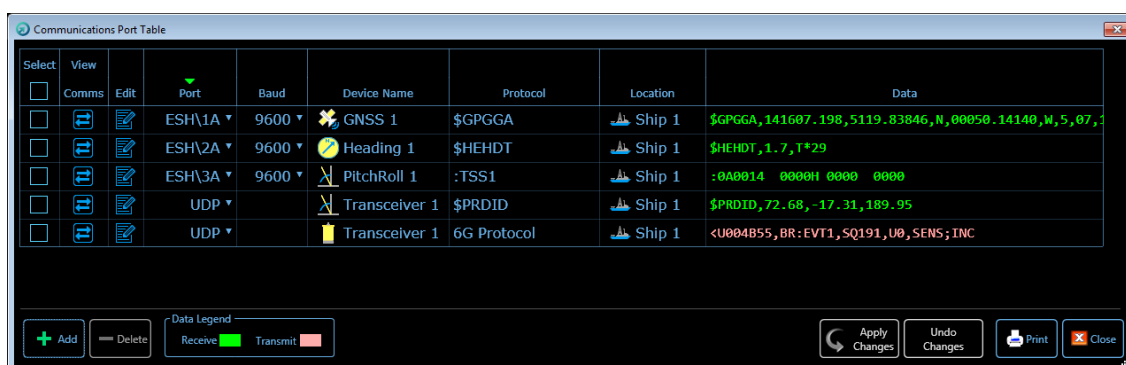
6. Repeat steps 1 to 3 to add other Mobile Objects and Instruments as required.

4.4.2 Adding Instruments using the Ports Table

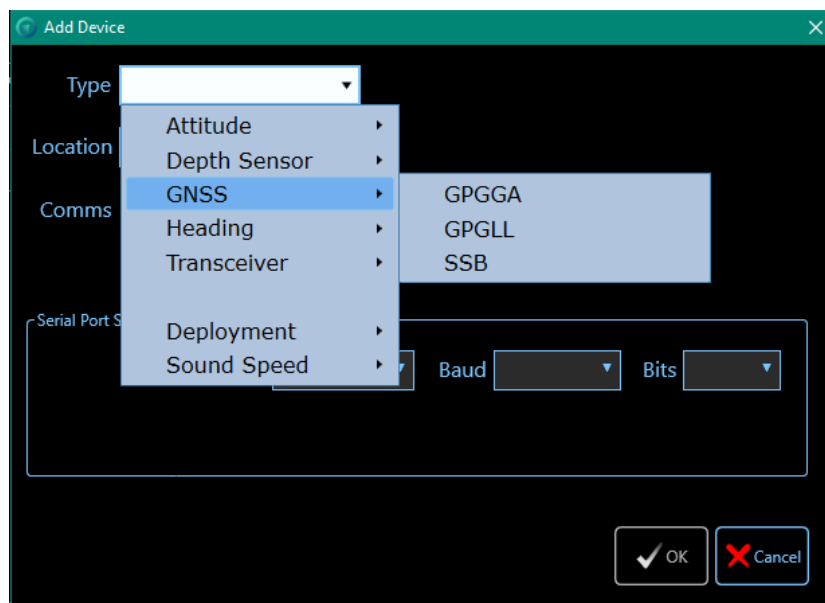
1. Click the **Ports** shortcut button to open the **Communications Port Table** window.



2. To add a new instrument, click **Add**.



3. Enter the **Type**, **Comms**, **Port** and **Location** settings (further configuration is available after clicking **OK**).



4.4.3 Adding Beacons using the Quick Track Tool

For simple jobs requiring a small number of 6G or PGT beacons, it will be easier and faster to add beacons to the job using the Quick Track tool. Quick Track uses the unique IIS interrogate signal for a 6G beacon.

For jobs with many beacons or where complex acoustic scheduling is required, it is recommended to add beacons to the job using the Beacons Table described in *Section 4.4.4*.

1. Click **Tools > Quick Track** or the **Q-Track** shortcut button.
2. Click the required address(es) on the **Quick Track** tool (clicking the same address again stops that beacon tracking and removes it from the job).
3. A 6G beacon with that address is added to the job and immediately begins to track (see **Options** below for beacon type).
4. An active Quick Track beacon is shown in green (beacon addresses already allocated are shown in pink).

5. A beacon output telegram is enabled (if there is a telegram setup).

Quick Track Tool

WB2

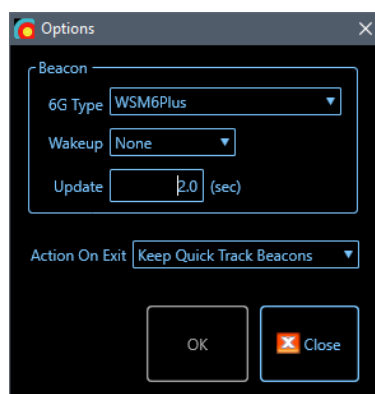
WB2+

Options

?

1701	1801	1901	2001	2101	2201	2301	2401	2501	2601	2701	2801	2901	3001	3101
1702	1802	1902	2002	2102	2202	2302	2402	2502	2602	2702	2802	2902	3002	3102
1703	1803	1903	2003	2103	2203	2303	2403	2503	2603	2703	2803	2903	3003	3103
1704	1804	1904	2004	2104	2204	2304	2404	2504	2604	2704	2804	2904	3004	3104
1705	1805	1905	2005	2105	2205	2305	2405	2505	2605	2705	2805	2905	3005	3105
1706	1806	1906	2006	2106	2206	2306	2406	2506	2606	2706	2806	2906	3006	3106
1707	1807	1907	2007	2107	2207	2307	2407	2507	2607	2707	2807	2907	3007	3107
1708	1808	1908	2008	2108	2208	2308	2408	2508	2608	2708	2808	2908	3008	3108
1709	1809	1909	2009	2109	2209	2309	2409	2509	2609	2709	2809	2909	3009	3109
1710	1810	1910	2010	2110	2210	2310	2410	2510	2610	2710	2810	2910	3010	3110
1711	1811	1911	2011	2111	2211	2311	2411	2511	2611	2711	2811	2911	3011	3111
1712	1812	1912	2012	2112	2212	2312	2412	2512	2612	2712	2812	2912	3012	3112
1713	1813	1913	2013	2113	2213	2313	2413	2513	2613	2713	2813	2913	3013	3113
1714	1814	1914	2014	2114	2214	2314	2414	2514	2614	2714	2814	2914	3014	3114

6. Click **Options** on the **Quick Track** tool to configure the default **Beacon** type, **Wakeup** tone and **Update** rate; see *Section A.9.5 "Quick Track"* for more details.

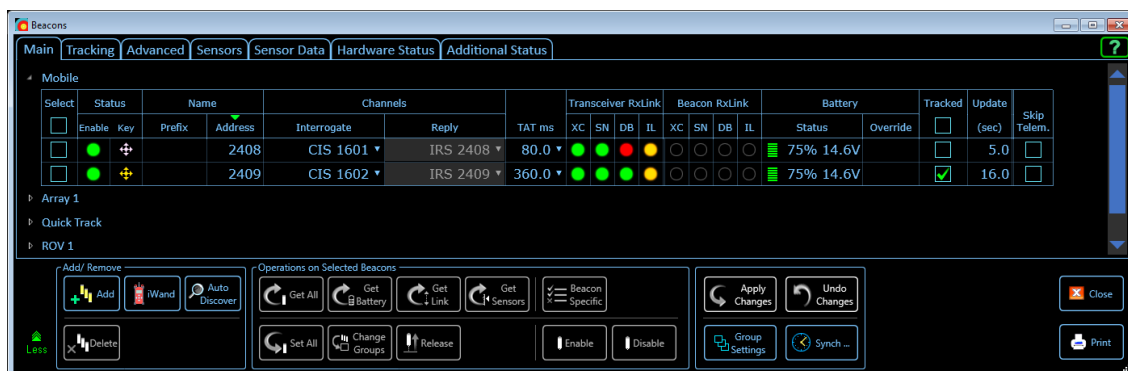


4.4.4 Adding Beacons using the Beacons Table

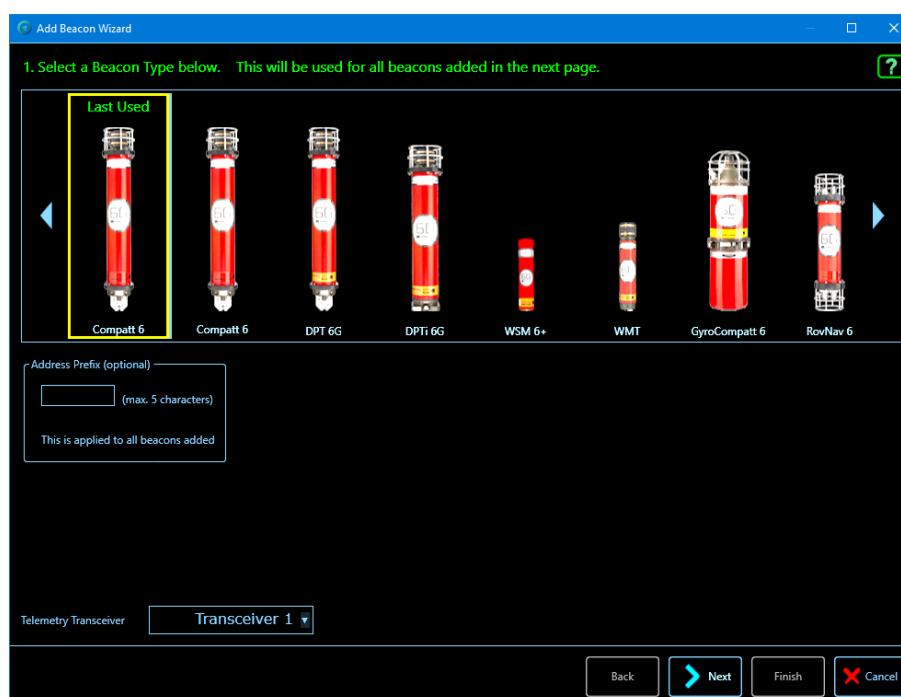
1. Click the **Beacons** shortcut button at the top of the main window to open the **Beacons Table** window.



2. Click **Add** to start the **Add Beacon Wizard**. A list of all configured beacons and their status can be viewed in this window.



3. The **Add Beacon Wizard** will start allowing one or more beacons to be configured.



4. The beacon(s) can be configured using the wizard and Beacons Table.

4.5 Deleting Objects

To delete an object from the setup, right-click the object in the setup tree and select **Delete** from the context menu.

To delete a port or beacon, select the port or beacon in the Port or Beacons Table and click the **Delete** button.

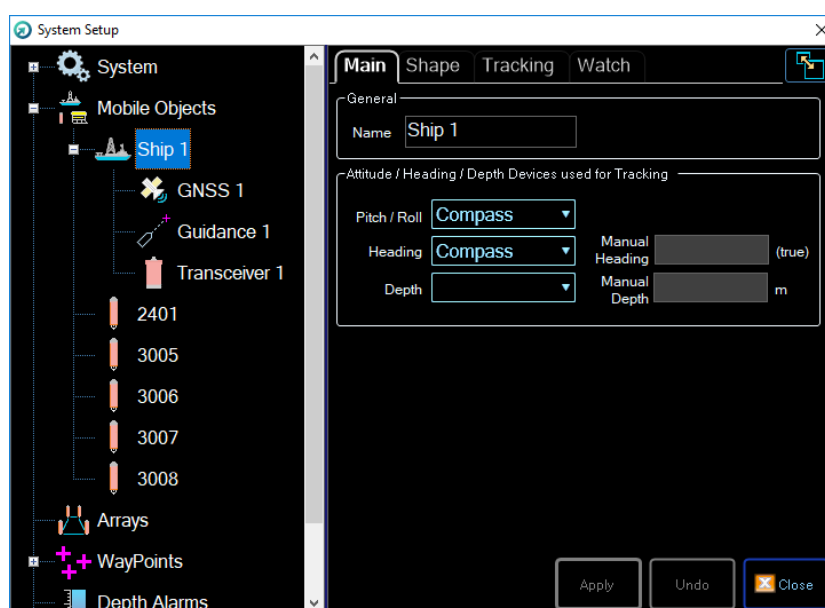
Note

 The software does not have an 'undo' feature — you cannot reverse a deletion. To re-insert a target that you have deleted accidentally you must insert and configure a new target.

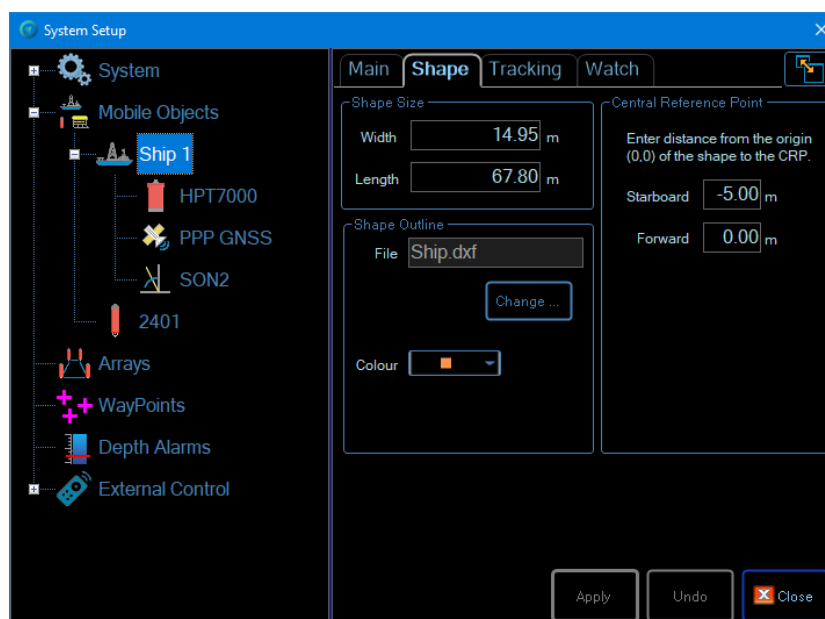
4.6 Configuring the Vessel

This procedure explains how to configure a basic setup for the vessel.

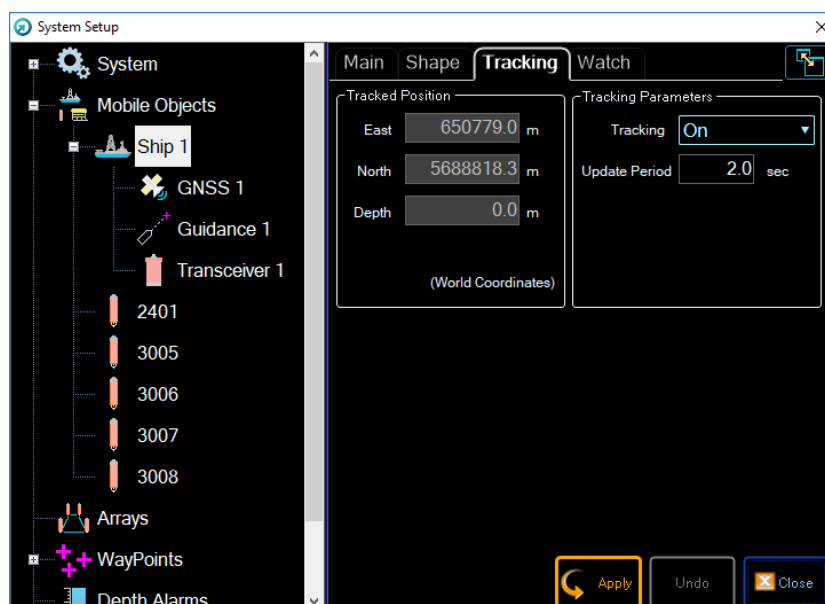
1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the vessel in the job tree.
3. Enter a **Name** for the vessel, if necessary, or use the default name.
4. Select the preferred **Pitch/Roll** and **Heading** sensors to use on the vessel if there are multiple sensors.
5. Select **Manual Heading** and enter a fixed value if there is no heading sensor to use.
6. Select **Manual Depth** and enter a fixed value if it is necessary to constrain the computed vessel depth.



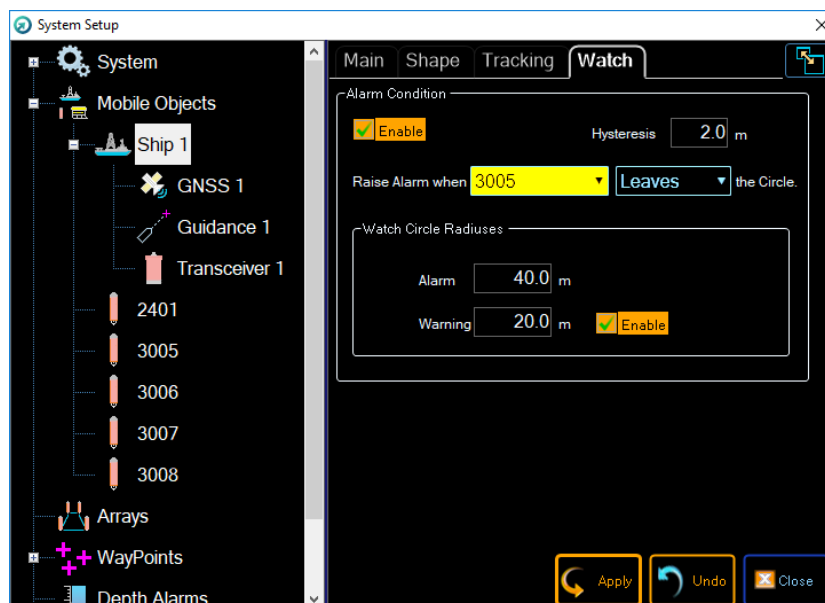
7. Select the **Shape** tab.
8. To change the vessel shape click **Change** and pick from the list of available shapes. You can add a custom shape file in DXF format (ensure the DXF file complies with the following rules):
 - a. contents must be exploded into polylines, (all splines and curves; ellipses should become polylines).
 - b. all visible layers must be collapsed to a single layer.
 - c. all hidden layers must be removed (document markups).
 - d. shape orientation must be bow up.
 - e. the (0,0) point of the shape must be at the centre of the shape (default).



9. Enter the vessel **Width** and **Length** as required.
10. If required, the central reference point can be adjusted from the origin of the graphical shape by entering a **Starboard** and **Forward** value in the **Central Reference Point**.
11. Select the **Colour** from the drop-down list for uniform colours that fade with the brightness setting.
12. Click **Apply**.
13. Select the **Tracking** tab, where the vessel's acoustic position **Update** time can be set.

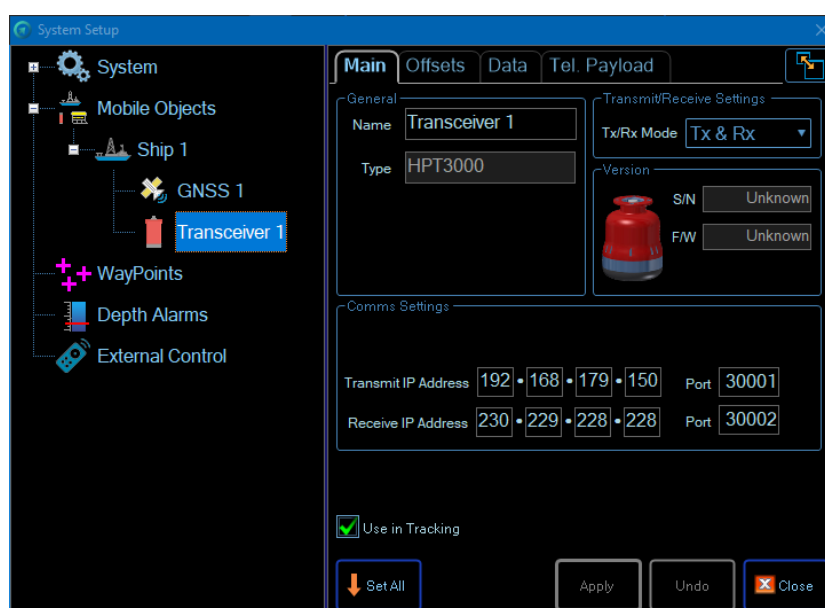


14. Select the **Watch** tab, where warnings and alarms can be configured when the vessel approaches a beacon's position.

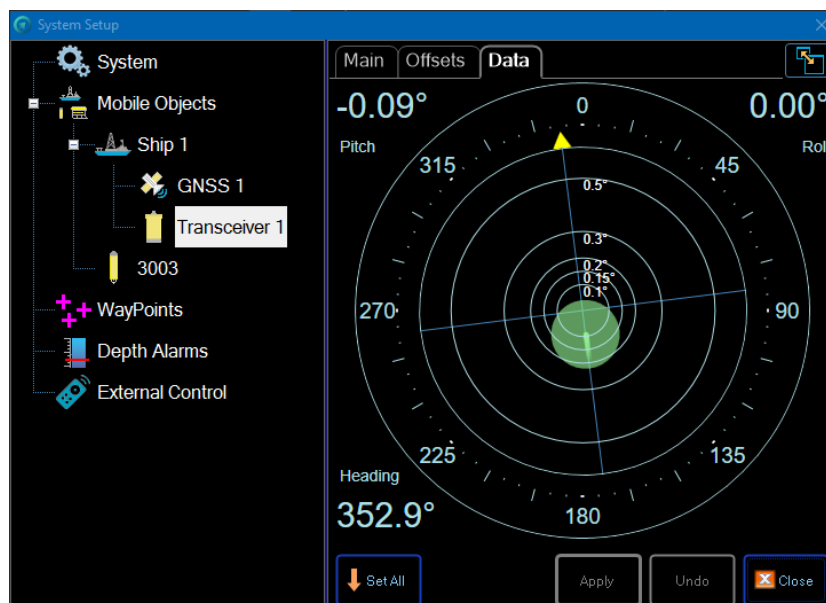


4.7 Configuring a Transceiver

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the transceiver in the job tree.
3. Type a **Name** for the transceiver, or use the default.
4. Type the **Transmit IP Address: 192.168.179.150** and **Port : 30001**
5. Type the **Receive IP Address: 230.229.228.228** and **Port : 30002**
6. Select the **Use in Tracking** check box.
7. Click **Apply**.



8. Select the **Data** tab and confirm that the attitude measurements are displayed.

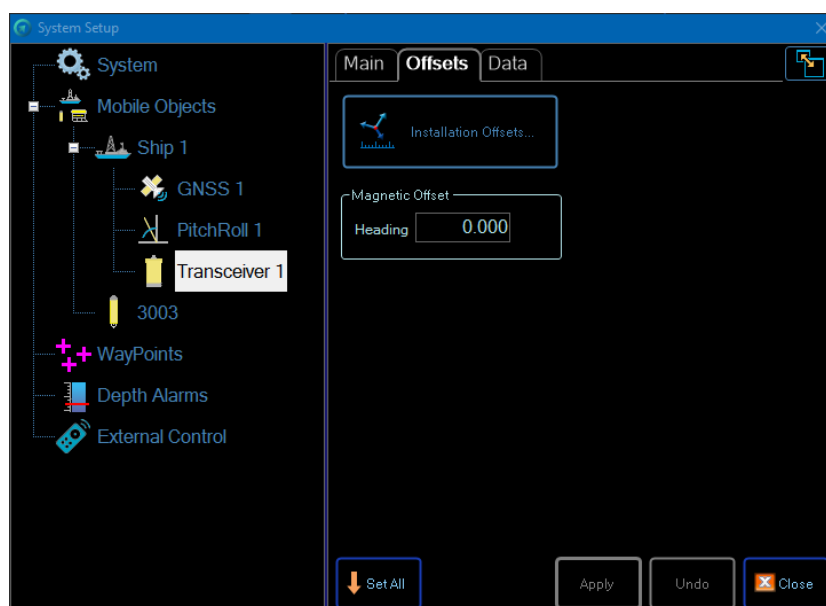


4.7.1 Offsets

The HPT 2000/3000 contains an internal attitude sensor and magnetic compass, mounted inside the head. It is important to note that this is a magnetic compass and therefore requires a Magnetic Offset deviation value to be entered between true north and magnetic north.

To apply the Magnetic Offset deviation to the internal compass:

1. Select the **Offsets** tab.
2. In the **Heading** box type the **Magnetic Offset** deviation value between true north and magnetic north.



Note

 If using the HPT 2000/3000 internal compass for pitch and roll compensation, it is highly recommended that a survey grade external heading device such as a Sonardyne Lodestar is used in the system. Magnetic Compasses are highly prone to interference and should not be relied on for precise survey work.

4.7.1.1 Calibrating the Internal Compass

It is recommended to calibrate the internal compass when the HPT 2000/3000 is first deployed.

To calibrate the internal magnetic compass refer to *Section A.9.6 "Advanced"*.

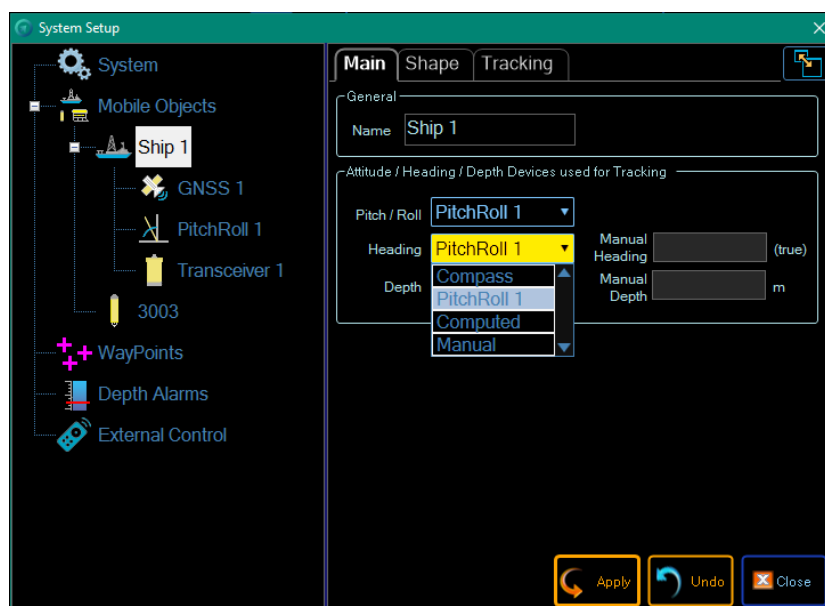
To configure the internal attitude sensor and calibrate the magnetic compass using the Radian2 tool refer to *Appendix G "Radian2 Tool"*.

4.8 Configuring an External Heading Device

Add the external heading device as described in *Section 4.4.1*.

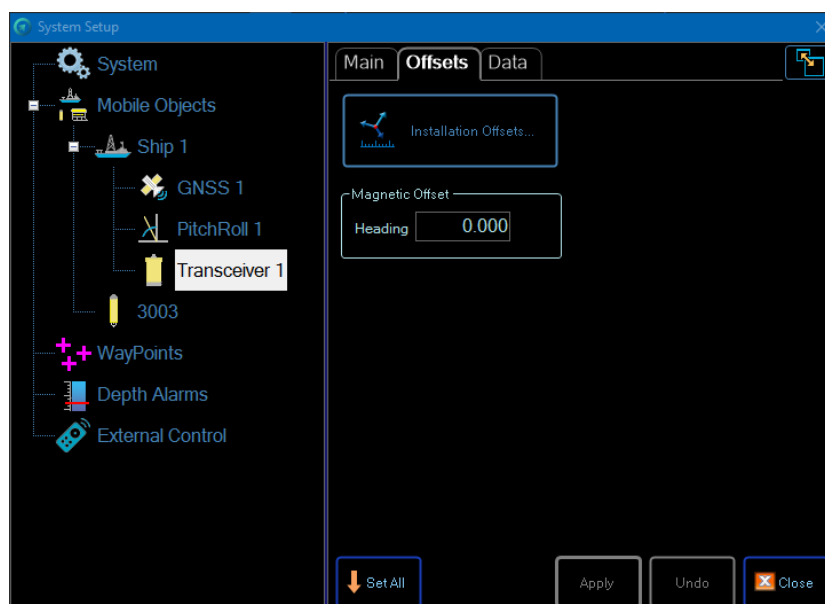
4.8.1 Select External Heading Device.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select **Ship** on the job tree.
3. On the **Main** tab select the appropriate sensor from the drop-down list for use in USBL computations.

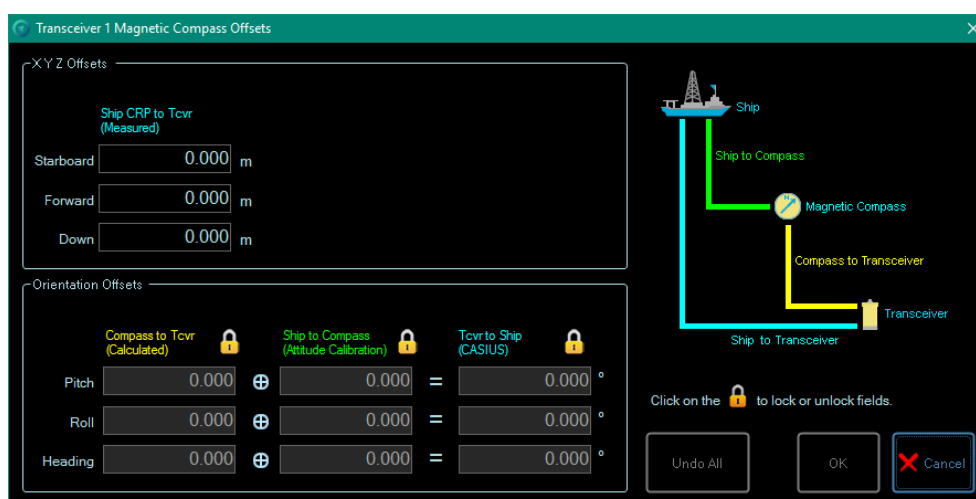
**4.8.2 Offsets**

The installation offsets between the transceiver and the ship must be configured. It is recommended that a CASIUS calibration is performed to align the transceiver to the external heading device (see *Appendix F "CASIUS Data Collection Methods"*)

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the transceiver in the job tree.
3. On the **Offsets** tab click **Installation Offsets**.



4. Enter the **Starboard**, **Forward** and **Down** values as required.



The **Orientation Offsets** are either completed automatically by the system, or they would normally be constant values. However, you can click on the padlock symbol to edit the values if necessary.

The diagram on the right of the **Installation Offsets** window illustrates the relationship between the offsets that the dialog box displays in each column. Entering data in any two columns allows the system to complete the third so that all of the values are consistent.

The encircled cross symbol between the columns in the **Orientation Data** region of the dialog box indicates that these columns are combined together, but are not simply added to each other. They are rotations in three dimensions, and so do not simply add — the transformations **Compass to Transceiver**, and **Ship to Compass** are combined (similar to adding) together to make a single **Transceiver to Ship** correction.

4.8.2.1 XYZ Offsets

The **XYZ Offsets** region at the top of the dialog box displays the transceiver lever arms. Enter the transceiver-to-ship offsets (established from accurate drawings, measurements or from CASIUS).

4.8.2.2 Orientation Offsets

The **Orientation Offsets** region at the bottom of the dialog box operates in a similar way to the XYZ offsets. However, Sonardyne strongly recommends that you allow the system to change these values.

When first commissioning an HPT 2000/3000 it is necessary to calibrate the alignment of the transceiver to the vessel attitude sensors using the CASIUS tool (**Tools>CASIUS**). When you then apply the CASIUS corrections, it sets the values in the Transceiver-to-ship column, and the system automatically completes the Compass-to-transceiver column, see *Appendix F "CASIUS Data Collection Methods"*.

4.9 Configuring a Sonardyne Deployment Machine

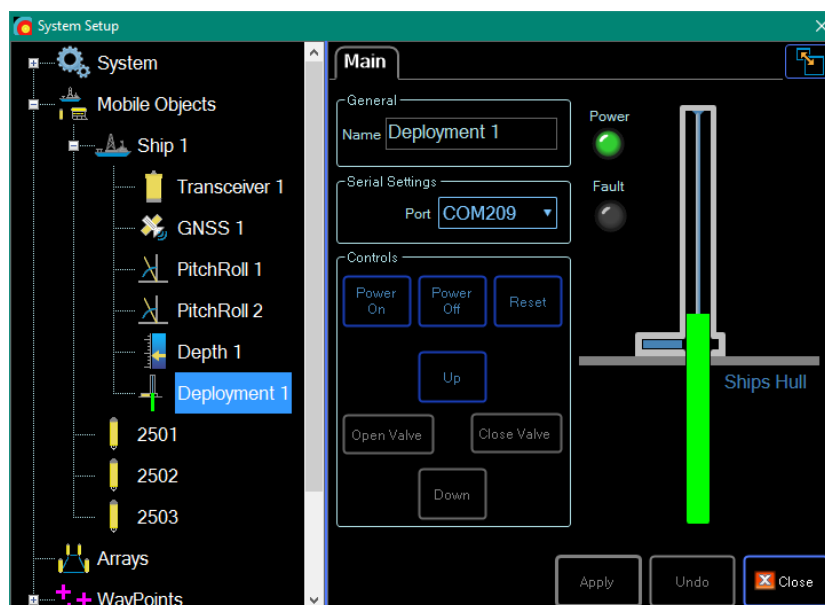
CAUTION

 The Sonardyne Deployment Machine and gate valve software control must only be configured once the Deployment Machine has been set to work by a suitably qualified person. Failure to do so may result in equipment and/or vessel damage.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select **Deployment Machine** in the job tree.
3. Enter a **Name**, if required.
4. Select the **Port**.

Note

 The Deployment Machine uses fixed port settings with no alternative choice available.



5. Click **Apply**.

4.9.1 Operating the Deployment Machine

The animated graphic (right hand side) displays the current status of the gate valve and Deployment Machine.

The **Power** LED indicates the Deployment Machine's power status.

The **Fault** LED indicates the Deployment Machine's fault status. The Deployment Machine faults if the oil level exceeds 70°C or the oil level drops below the required level. The Deployment machine and gate valve will not operate if there is a fault in the system. (see *UM-7950 User Manual for Through-Hull Transceiver Deployment Machine* for more information).

Once a fault has been rectified, click **Reset** to clear the fault condition.

To operate the Deployment Machine:

1. Click **Power On** and **Power Off** to power the Deployment Machine on or off.
2. Click and hold **Open Valve** or **Close Valve** to open or close the gate valve (the gate valve will not close if the deployment pole is deployed).
3. Click and hold **Up** or **Down** to raise or lower the Deployment Machine (the deployment pole will not deploy if the gate valve is closed).

Note

 **A warning is given if attempting to sail with the Deployment Machine in the Down position, or when operating the transceiver with the Deployment Machine in the Up position.**

4.10 Configuring a GNSS

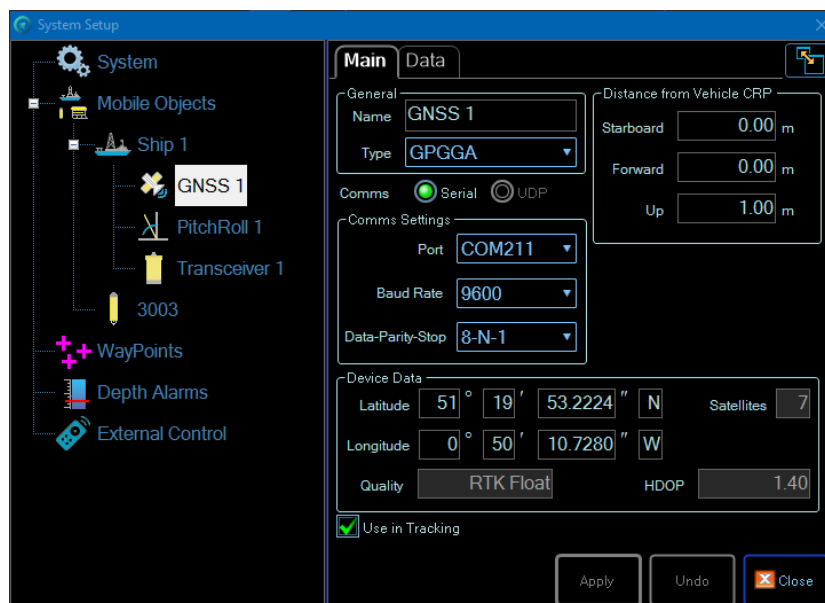
The ESH contains a simple internal GNSS that can be used for time synchronisation and basic positioning. An appropriate GNSS antenna should be connected to the antenna socket on the rear of the ESH.

Note

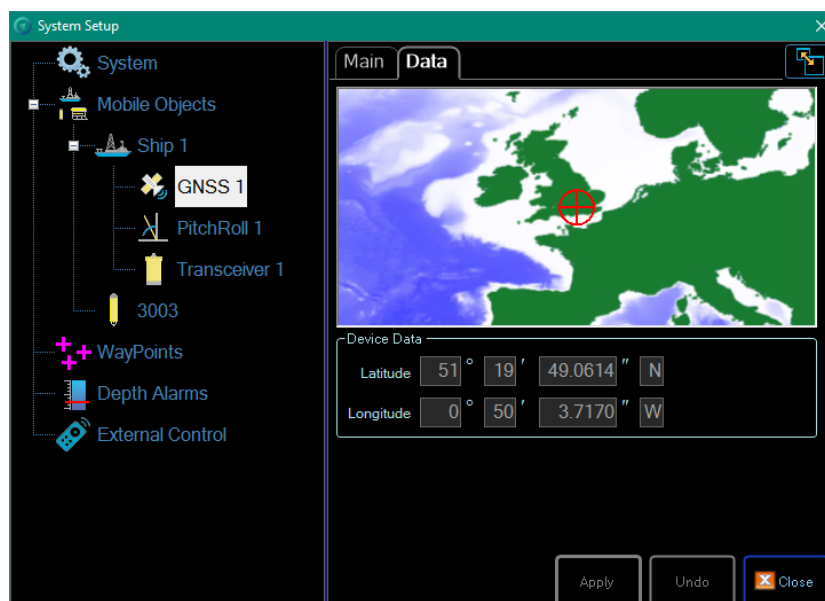
 **The ESH internal GNSS is configured with the following communication parameters and cannot be reconfigured: Port ESH/5A serial 115,200,8,n,1**

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the GNSS in the job tree .
3. Select the type of GNSS data string supplied by the receiver.
4. Select the **Port, Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the GNSS if required (if using the internal ESH GNSS, select Port **ESH/5A**).
5. Enter the location of the GNSS antenna relative to the vehicle's CRP.
6. Click **Apply**.

7. Select the **Use in Tracking** check box.



8. Select the **Data** tab.
9. Confirm the position is displayed as a flashing red circle and cross on the map, with **Longitude** and **Latitude** data.

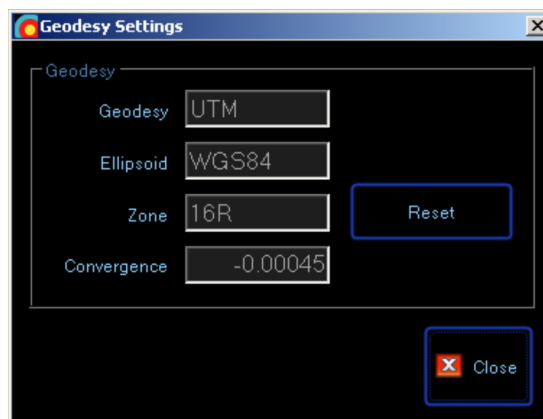


4.11 Geodesy Tool

The geodesy tool provides a visual indication of:

- The current geodetic projection
- The ellipsoid
- The zone
- The convergence

These four fields are read-only.



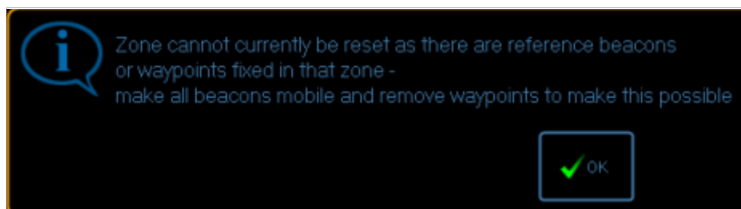
4.11.1 UTM Zone Reset

When the vessel moves across a UTM zone boundary to a new location, the software raises a zone alarm to warn of the increasing convergence error.

In order to avoid tracking discontinuity, the system does not automatically change zones. Click the zone **Reset** button to set the UTM zone for the new location.

Note

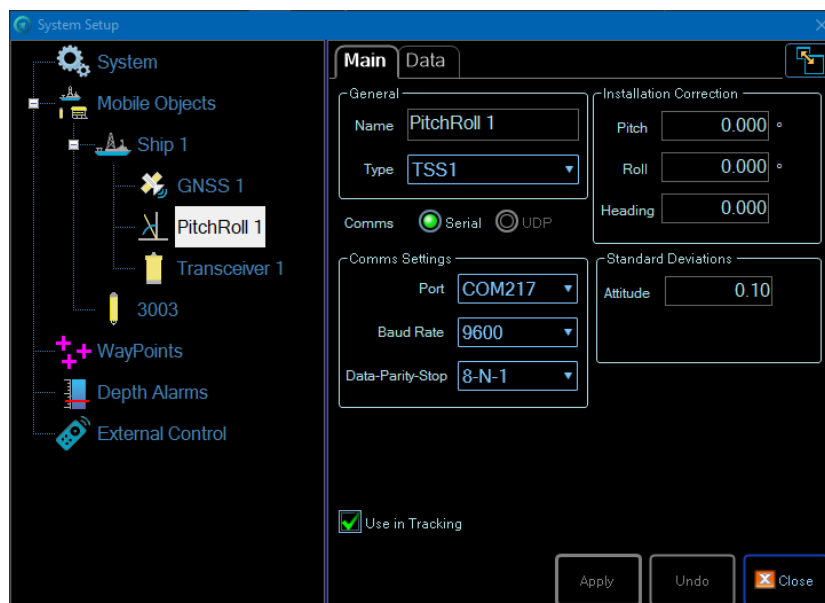
 **You must delete any waypoints or fixed references for the old UTM zone/location before the reset can be completed successfully.**



4.12 Configuring a Vertical Reference Unit (VRU)

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the VRU in the job tree.
3. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the VRU, if required.
4. Enter the **Pitch**, **Roll** and **Heading** correction angles necessary to align the VRU reference frame with the vessel's reference frame.
5. Select the **Use in Tracking** check box.
6. Normally, leave the Use heading check box selected, unless you know the heading is uncalibrated or unavailable.

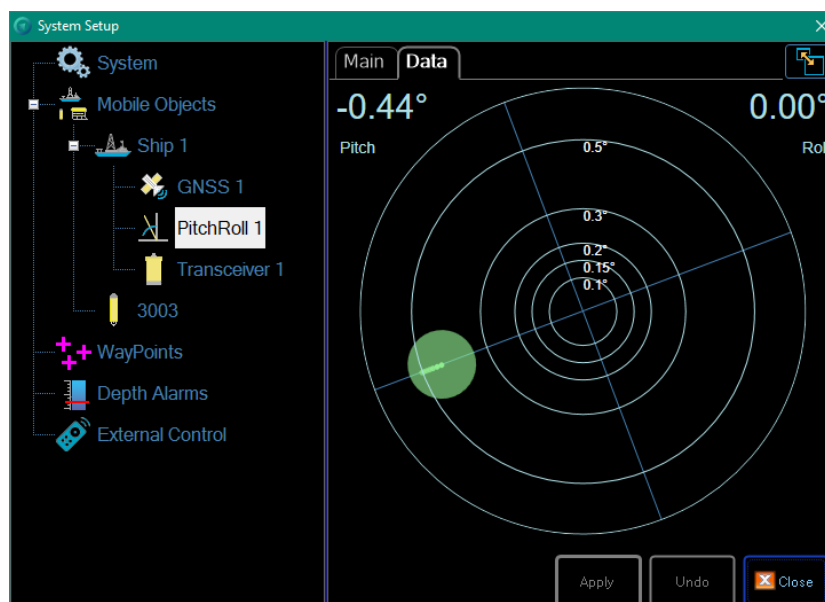
- Click **Apply**.



Note

The Standard Deviation value is an important quality assessment on this and on the Gyrocompass settings, see *Section 4.14 "Configuring a Gyrocompass"*. The software uses this information to rank multiple instruments of the same type so that instruments providing a higher quality solution (that is, with a lower standard deviation) are more highly weighted.

- Select the **Data** tab and confirm the VRU's measurements of **Pitch** and **Roll** are displayed.



4.13 Configuring a Depth Device

- Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
- Select the **Depth** device in the job tree.
- Select the name, if required.

- Select the sensor type from the **Type** drop-down list.



- For pressure devices (DigiQuartz and Midas SVX2), select the pressure Units, and whether Atmospheric Pressure compensation is required or not.

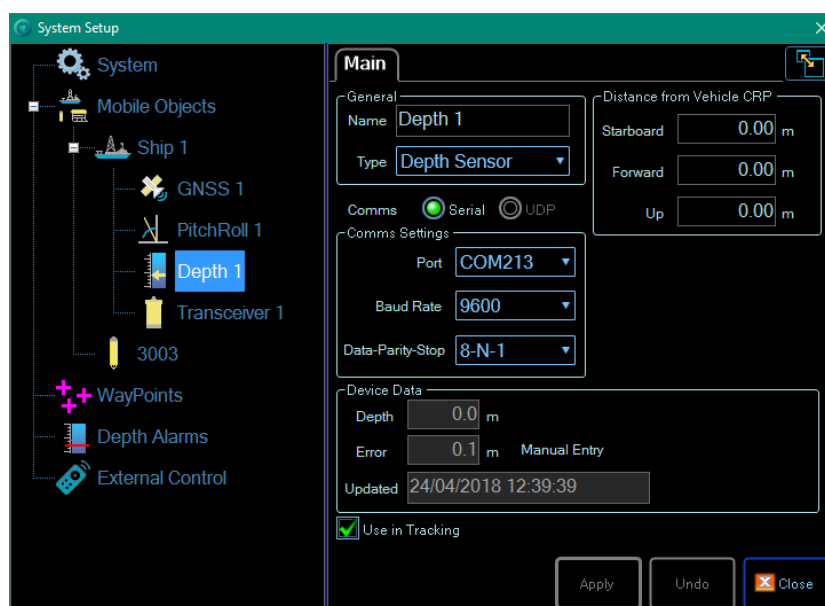
Note

 The generic 'Depth Sensor' type supports four standard depth string types automatically with no user intervention:

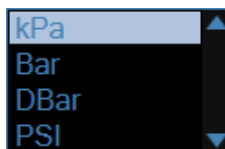
- Perry Slingsby depth – \$PSSIROV
- Sonardyne proprietary depth – \$SONDEP
- NMEA depth – \$SDDPT
- Seaeye depth – \$DBS

(units of depth in all string types are metres)

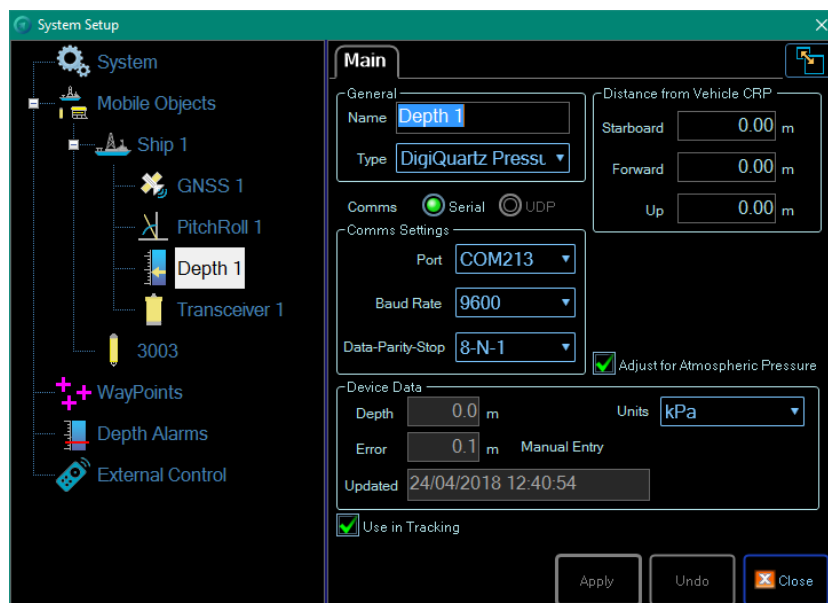
- Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the Depth device if required.
- Enter the **Starboard**, **Forward** and **Up** offsets with respect to the vehicle's CRP.



- For pressure sensor devices only, select the **Units** of pressure to match the sensor.



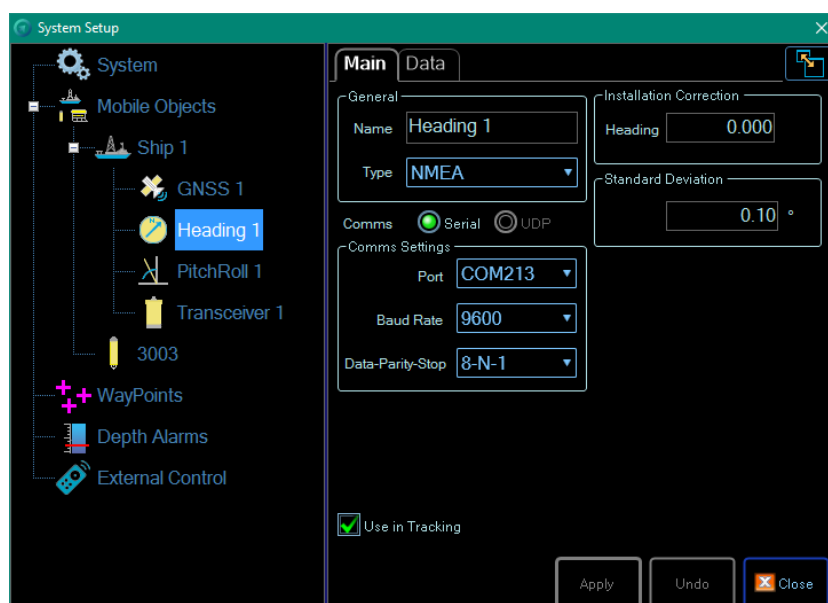
9. For pressure sensor devices only, select **Adjust for Atmospheric Pressure**, if required.



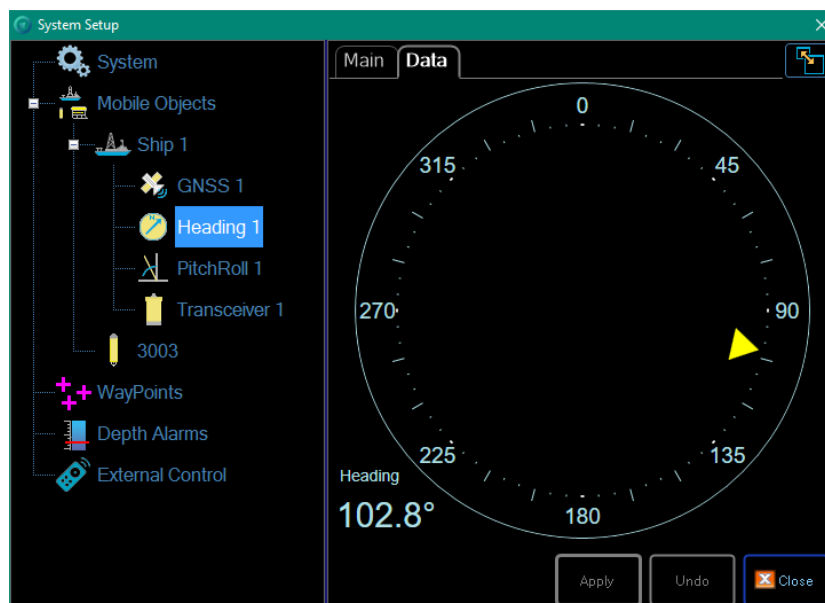
10. Click **Apply**.

4.14 Configuring a Gyrocompass

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the Gyrocompass in the job tree.
3. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the Gyrocompass if required..
4. Enter the **Heading Correction** angle necessary to align the gyrocompass reference frame with the vessel's reference frame.
5. Select the **Use in Tracking** check box.
6. Click **Apply**.



7. Select the **Data** tab and confirm the heading is displayed.



Transceiver/Lodestar mounting configuration

4.15 Configuring System Devices

Devices are grouped under **System** and **External Control** in the job tree.

Note

 To configure an "External Control" device, see [Section 4.16 "Configuring External Control Devices"](#).

- The Ethernet Serial Hub (ESH)
- The Sound Speed sensor

System devices are displayed in the job tree under **System**.

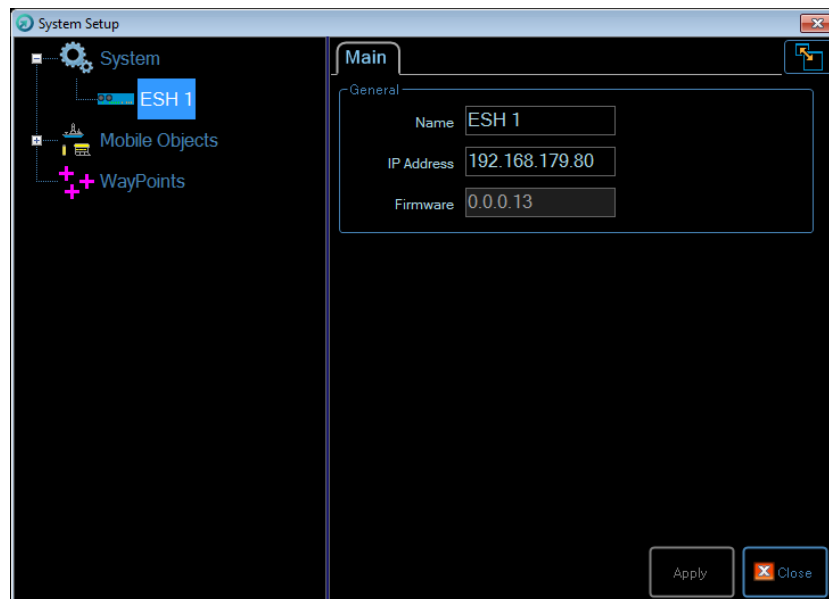
1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click **System** and select the device to add.

Add ESH
Add Sound Speed

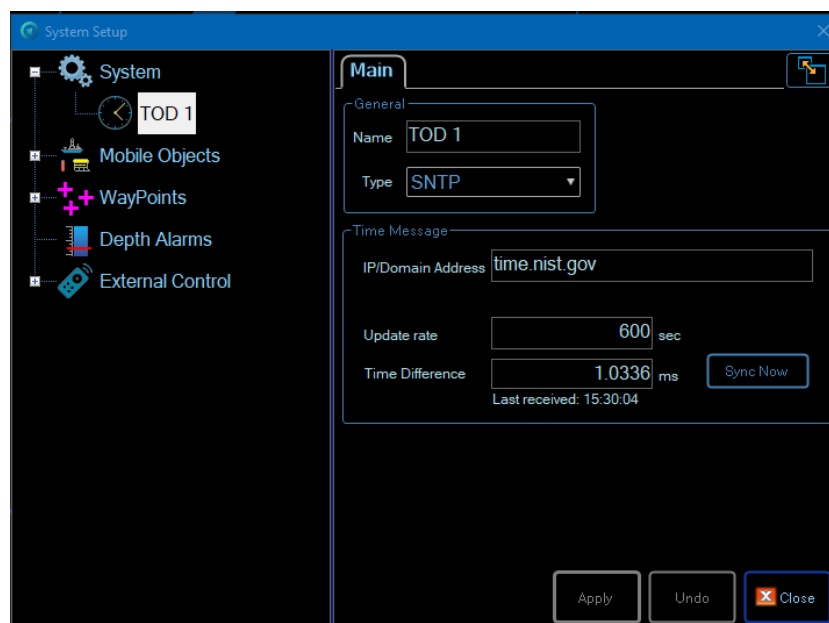
4.15.1 Ethernet Serial Hub (ESH)

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the ESH in the job tree.
3. Enter a **Name** for the ESH, if necessary.
4. Enter the **IP Address** to connect the ESH to the Computer (default is 192.168.179.80).

5. Click **Apply**.

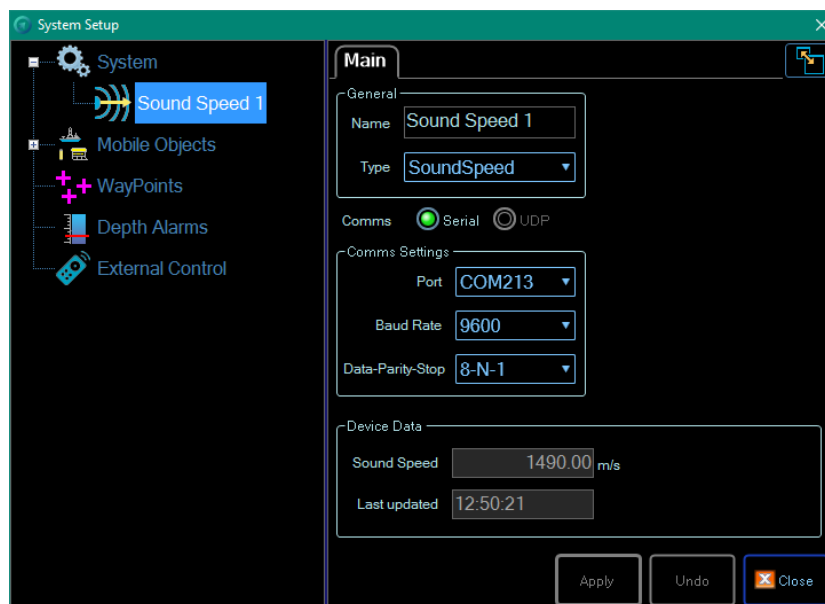


The software indicates a connection to the ESH by displaying a firmware version.



4.15.2 Sound Speed Sensor

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click **System** and select **Add Sound Speed**.
3. Enter a **Name**.
4. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
5. Click **Apply**.



4.15.2.1 Sound Speed Device Formats

The sound speed device supports two standard string types automatically, requiring no user intervention to select the correct type:

- **Valeport** – Valeport proprietary sound speed string.
- **\$PSONSS** – Sonardyne proprietary sound speed string.

4.16 Configuring External Control Devices

Note



To configure a System device, see **Section 4.15 "Configuring System Devices"**.

External Control devices are displayed in the job tree under **External Control**.

- The Alarm Report
- The PAN device
- The Remote Control device

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click **External Control** and select the device to add.

Add Alarm Report
Add PAN
Add Remote Control

4.16.1 NMEA Alarm Report

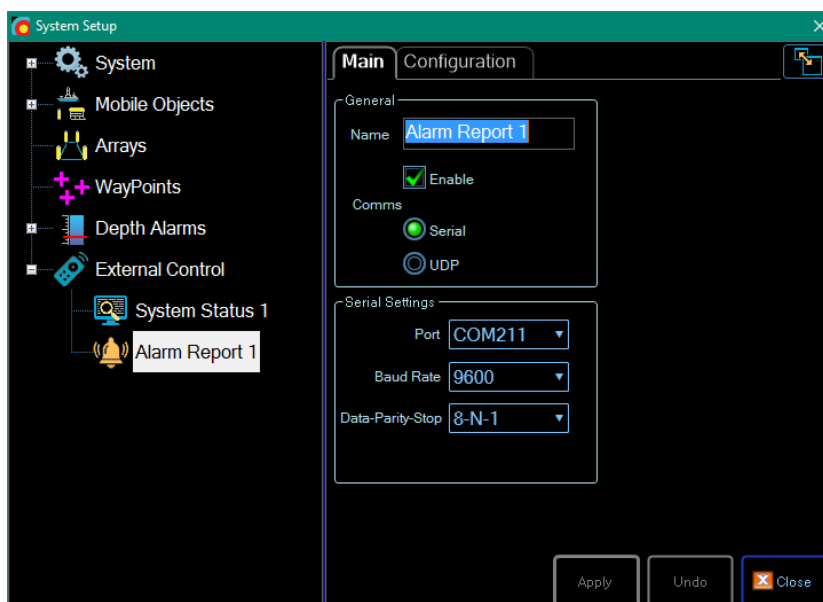
The Alarm Report device allows a remote system, e.g. HMI, to display active alarms and to send alarm acknowledgements according to the NMEA-0183 standard.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select **Alarm Report** in the job tree.
3. Enter the **Name** for the Alarm Report.
4. Depending on the connection type, select either **Serial** or **UDP**.

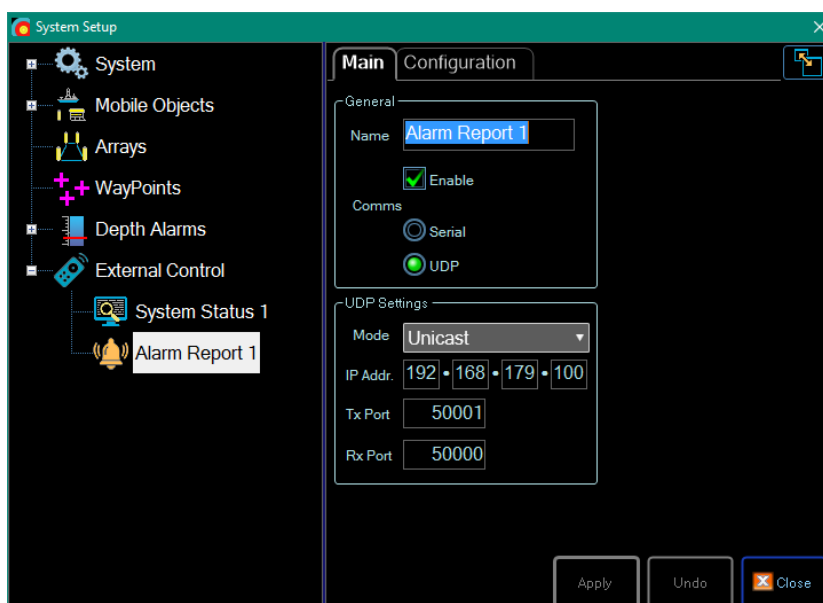
Note

 **Only UDP Unicast mode is currently supported**

- a. For a Serial connection: select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters.



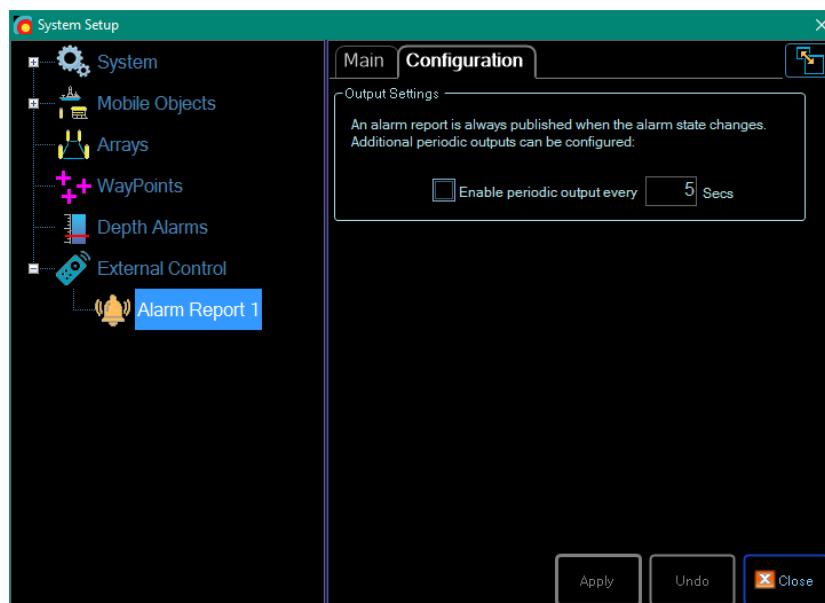
- b. For a UDP connection: select the **Mode**, enter the **IP Address**, **Tx Port** and **Rx Port**.



5. Click **Apply**.

4.16.1.1 Configuring the Alarm Report

Select **Enable Periodic Output** and set the required update period, if required. If this is left unselected, alarm messages are only sent on state changes.



4.16.1.2 Operating the Alarm Report

Once the Alarm Report device is added, for each new alarm the system automatically sends an ALR alarm state message to the defined port, in addition to alerting the user through the main user interface. To acknowledge the alarm, the external system sends an ACK message into the define port or the user can respond through the Alarm Viewer in the usual way. The alarm is only cleared when the cause of the alarm condition is removed.

The ALR and ACK strings follow the NMEA format shown below.

ALR - Set Alarm State

Local alarm condition and status. This sentence is used to report an alarm condition on a device and its current state of acknowledgement.

\$--ALR,hhmmss.ss,xxx,A,A,c--c*hh<cr><lf>

Table 4-1 ALR - Set Alarm State Formatting

Field	Description
\$--ALR,hhmmss.ss	Time of alarm condition change, UTC
xxx	Unique alarm number (identifier) at alarm source
A	Alarm condition A = threshold exceeded V = not exceeded
A	Alarm's acknowledge state A = acknowledged V = unacknowledged
c--c	Alarm's description text
*hh	Terminator and checksum

Table 4–1 ALR - Set Alarm State Formatting (continued)

Field	Description
<cr><lf>	Return plus linefeed

ACK - Acknowledge Alarm

Acknowledge device alarm. This sentence is used to acknowledge an alarm condition reported by a device.

```
$--ACK,xxx*hh<cr><lf>
```

Table 4–2 ACK - Acknowledge Alarm Formatting

Field	Description
xxx	Unique alarm number (identifier) at alarm source
*hh	Terminator and checksum
<cr><lf>	Return plus linefeed

For example, the system sends the active alarm state:

```
$SNALR,095021.71,006,A,V,System is operating outside of its UTM Zone*6A
```

The remote system acknowledges the alarm:

```
$SNACK,006*4E
```

The system now sends alarm acknowledged state:

```
$SNALR,095031.62,006,A,A,System is operating outside of its UTM Zone*7E
```

The cause of the alarm is removed, and the system now sends alarm cleared state:

```
$SNALR,095041.72,006,V,A,System is operating outside of its UTM Zone*6F
```

4.16.2 Programmable Acoustic Navigator (PAN)**Note**

 A PAN port allows an external system direct access to a Sonardyne transceiver. This feature is reserved for Sonardyne approved products only because unexpected behaviour can result.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the PAN in the job tree.
3. Enter a **Name** for the PAN, if necessary and then select the **Tcvr** transceiver.
4. Depending on the connection type, select either **Serial** or **UDP**.
 - a. For a **Serial** connection : select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters.
 - b. For a **UDP** connection: select the **Mode**, enter the **IP Address**, **Tx Port** and **Rx Port**.

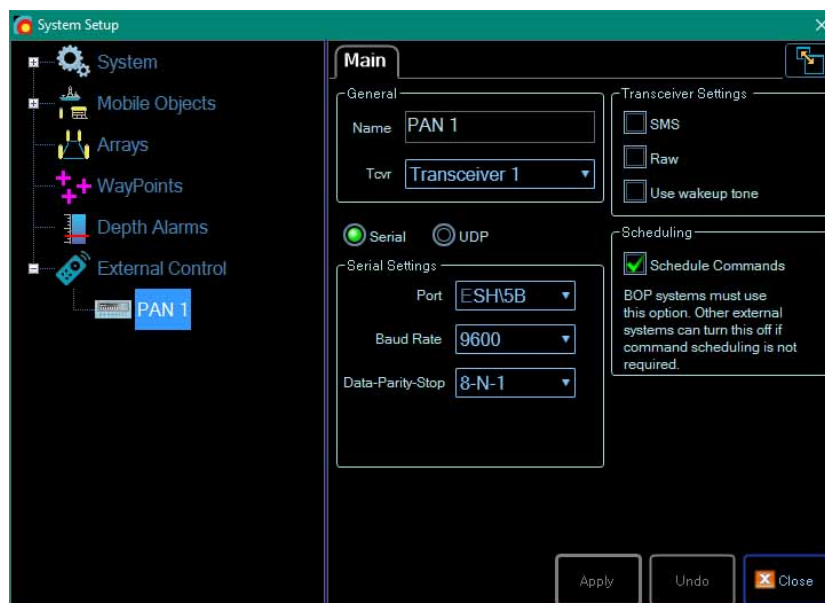
Note

 Only UDP Unicast mode is currently supported.

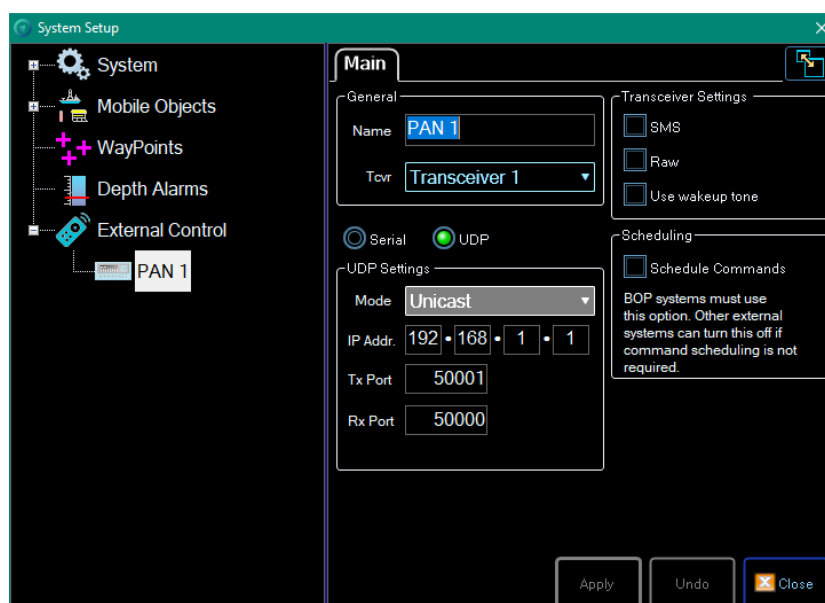
5. Select **SMS** to have incoming SMS messages routed to the PAN port. This is particularly used for AUV Telemetry tracking combined with asynchronous SMS data transfer.

6. Select **Raw** if the external client needs to take full control of the transceiver, or leave blank for the system to use default transceiver Power, Gain, Tx/Rx Telemetry and Wakeups, as defined in **Tools > Options > General, Acoustic** tab.
7. Select the **Use wakeup tone** if using Sonardyne Compatt beacons that have long activity timeouts.
8. Click **Apply**.
9. Use the **Comms Viewer** to confirm the PAN communications are correctly sent and received.

Serial Connection



UDP Connection



4.16.3 Remote Control Interface

The Remote Control interface becomes available when the optional 'Robotics pack' has been purchased. It allows an External System to control and monitor the system. Typical uses for the Remote Control interface include:

- Adding and deleting beacons.
- Starting or stopping acoustic tracking.
- Setting the sound speed.
- Interrogating the system status.
- Controlling depth aiding.

Note

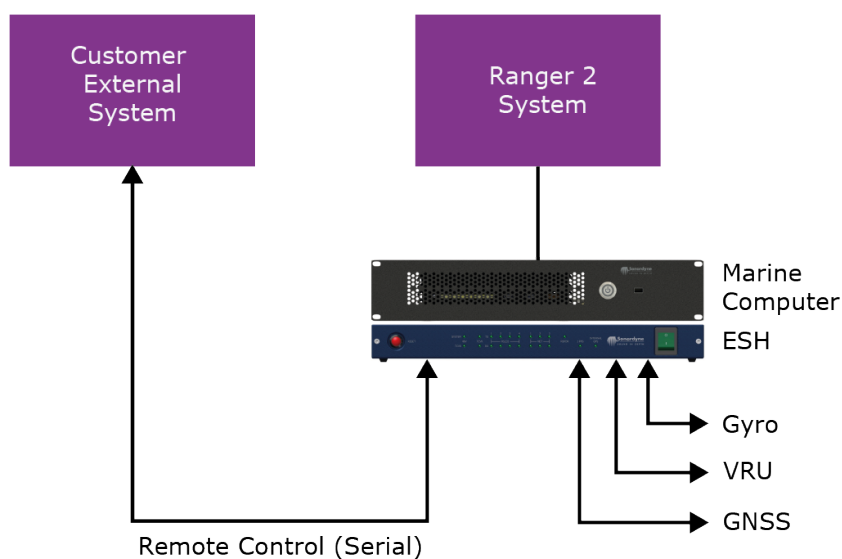
 Sonardyne cannot be held responsible for the operation or debugging of any external system, and can only offer limited support for the use of the Remote Control feature.

4.16.3.1 Hardware Interface

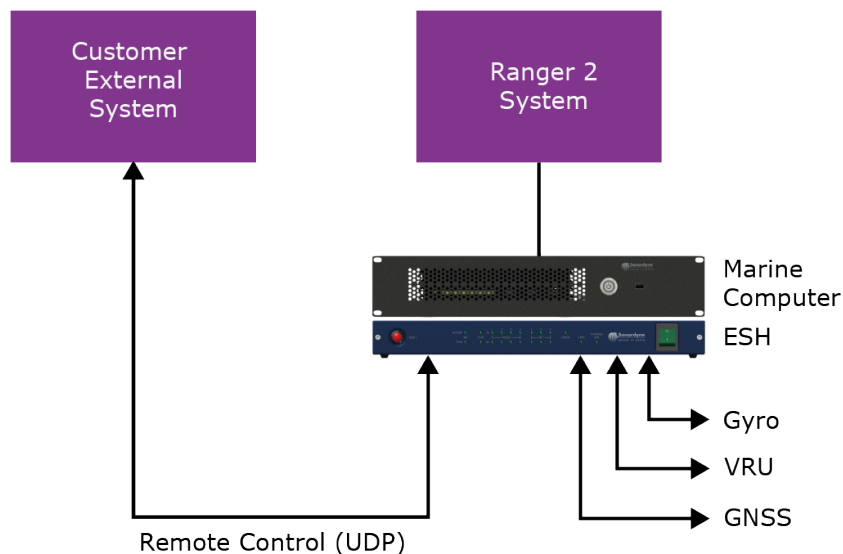
The remote control link consists of either:

- a serial connection from an external system to either the PC or to its attached ESH, or
- a UDP connection through ESH, or Ethernet to the PC's port.

Figure 4–1 Remote Control Interface – by Serial Port



RS485 permits higher baud rates over longer distances than RS232; hence the choice between these two protocols may depend on system deployment.

Figure 4–2 Remote Control Interface – by UDP (Ethernet) Port

4.16.3.2 Software Protocol

All commands to and responses from the external system are encoded using standard XML. This enables a robust interface to which future commands and features can easily be added without affecting previous versions of the protocol.

4.16.3.3 Client Software

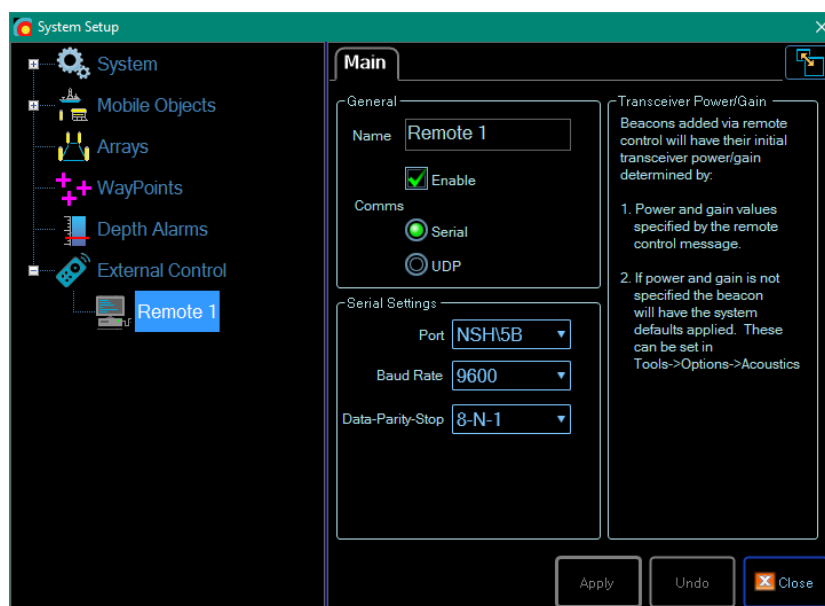
Client software can be written in any programming language and run on any operating system capable of sending and receiving XML via a serial port. A full Remote Control interface specification and sample C# .NET code is available on request from Sonardyne Support.

4.16.3.4 Operating the Remote Control Interface

A Remote Control interface can be added to a system, just like any other device.

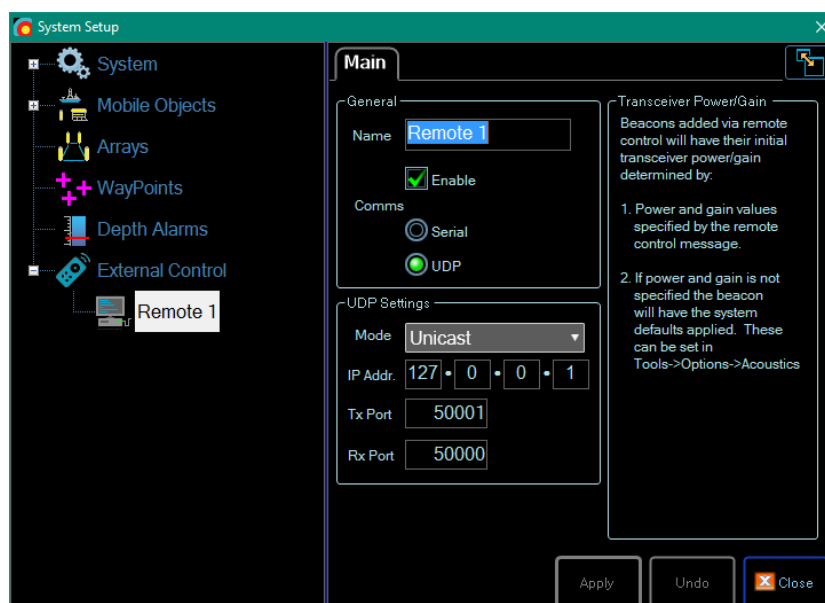
For serial connections:

1. Connect an available ESH serial port to the external system.
2. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
3. Right-click **System** and select **Add Remote Control**.
4. Enter a **Name** and select **Serial**.
5. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
6. Click **Apply**.



For UDP Ethernet clients:

1. Connect the external system to the ESH, or PC's second port.
2. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
3. Right-click **System** and select **Add Remote Control**.
4. Enter a **Name** and select **UDP**.
5. Enter the **IP Address**, **Tx Port** and **Rx Port**.
6. Click **Apply**.



Notes

 Do not attempt to share the private network that connects the Marine Computer to the ESH with external systems. System malfunction is likely to occur if you do this.

 Firewall settings may need to be adjusted to enable UDP comms.

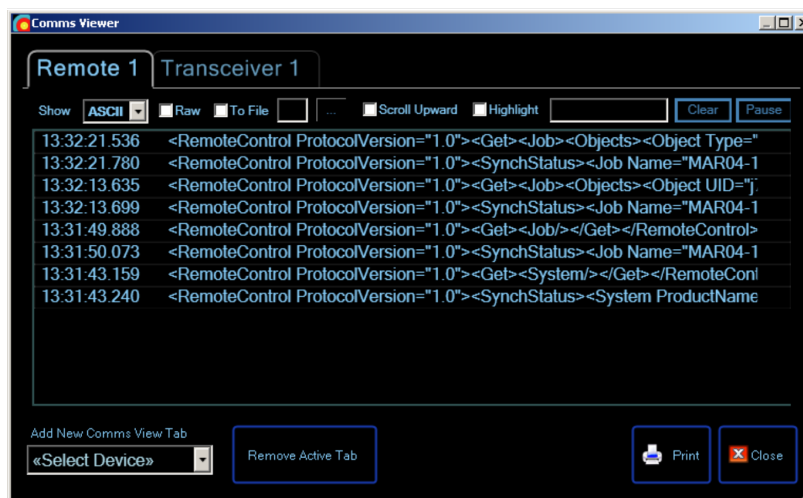
For all connections:

Run the external system's client software and establish communications.

Select the **Enable** check box and tick to enable or untick to disable the Remote Control. When Remote Control is enabled, an indicator appears at the bottom of the user interface.

**Note**

 Use the Comms Viewer to view and debug the Remote Control commands and responses: To get started, use the Sonardyne sample Remote Control application from a Windows PC to prove the basic setup.



4.17 Configuring a Waypoint

With an active GNSS in the system, click the **Add WayPoint** button on the main window. Move the cursor on the chart and then click at the location for the new waypoint.



4.17.1 Waypoint Main Tab

From the **System Setup** window, select the required waypoint. The **Main** tab shows the current position of the waypoint and allows you to edit the position by changing the Easting and Northing values.

The screenshot shows the 'Main' tab of a waypoint configuration window. It has two tabs: 'Main' and 'Watch'. Under the 'Main' tab, there is a 'General' section with a 'Name' field containing 'WayPoint 1'. Below that is a 'Location' section with 'East' and 'North' coordinates. The 'East' field contains '500012.5' m and the 'North' field contains '2986250.2' m. There is an 'Edit' checkbox which is currently unchecked. An 'Apply' button is located at the bottom right of the window.

4.17.2 Watch Circle

A watch zone is an optional guard zone centred on a waypoint. The **Watch Circle** tab allows you to set the parameters for the guard zone.

1. Select the **Enable** check box to enable the watch circle alarm for the selected waypoint.
2. Select the **Warning Enable** check box if a warning circle is required.
3. In the **Watch Circle Radiuses** box Set the radius for the alarm and warning watch circles.
4. In the **Hysteresis**¹ box set the hysteresis for the watch circle.
5. In the **Raise Alarm when** and **the Circle** drop-down lists select which target will raise the alarm, and whether the alarm occurs when the target **Enters** or **Leaves** the watch circle.

The screenshot shows the 'System Setup' window with a tree view on the left containing 'System', 'Mobile Objects', 'Arrays', 'WayPoints', 'Depth Alarms', and 'External Control'. 'WayPoint 1' is selected under 'WayPoints'. The main panel shows the 'Watch' tab. It has an 'Alarm Condition' section with an 'Enable' checkbox checked, a 'Hysteresis' field set to '2.0' m, and a 'Raise Alarm when' dropdown set to 'Ship 1' and a 'the Circle' dropdown set to 'Enters'. Below this is a 'Watch Circle Radiuses' section with 'Alarm' set to '20.0' m and 'Warning' set to '40.0' m, with an 'Enable' checkbox checked. At the bottom are 'Apply', 'Undo', and 'Close' buttons.

¹ Hysteresis is used to prevent false watch-circle alarms when the target vessel or object is positioned near the edge of the circle. Some trial and error may be required in choosing the best value to suit the conditions.

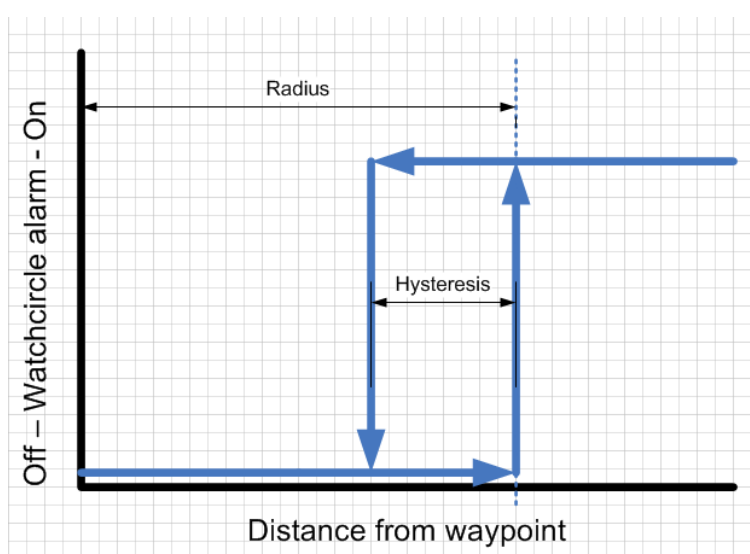
For **leaving the circle** type alarms:

- alarm is raised when the target position $>$ radius
- alarm is cleared when the target position $<$ radius - hysteresis

For **entering the circle** type alarms:

- alarm is raised when the target position $<$ radius
- alarm is cleared when the target position $>$ radius + hysteresis

Figure 4–3 Effect of Hysteresis on the Watch-Circle Alarm



4.17.3 Importing Waypoints

While tracking is active, **Tool > Waypoints** is greyed out to prevent critical changes taking place that could affect the system outputs.

To import a file containing multiple waypoints:

1. Ensure that tracking is not active by clicking vessel tracking off.
2. Click **Tools > Waypoints > Import**.
3. Navigate to and select the Sonardyne NAV, or CSV file.

The NAV file contains one line per waypoint. Each line is made up of:

Name,WAYPOINT,Easting,Northing,Depth.

Note



The file must be named with the file extension .NAV

The CSV file contains one title row:

Location Name,EPSON Code,Geodetic latitude,Geodetic longitude,Depth

followed by one line per waypoint. Each line is made up of a name, followed by an EPSG code that must be set to 4326 to indicate that the co-ordinates are in World Geodetic System 1984 and the co-ordinate itself.

Note

The file must be named with the file extension .CSV

4.17.4 Exporting Waypoints

While tracking is active, **Tool > Waypoints** is greyed out to prevent critical changes taking place that could affect the system outputs.

To export a file containing multiple waypoints:

1. Ensure that tracking is not active by clicking **Vessel Tracking Off**.
2. Click **Tools > Waypoints > Export**.
3. Navigate to the required destination and select the CSV, or NAV file.

Note

The CSV file is compatible with Sonardyne's Fusion 2 software.

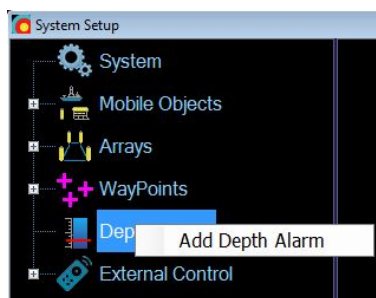
4.17.5 Removing All Waypoints

To remove all waypoints:

1. Ensure that tracking is not active by clicking vessel tracking off, and then select the menu option **Tools > Waypoints > Remove All** (a confirmation will be displayed). Note that the **DP Ref** waypoint will not be affected.
2. Ensure that none of the waypoints are being used as the reference for any required chart measurements, or telegrams, and then click **Yes**.

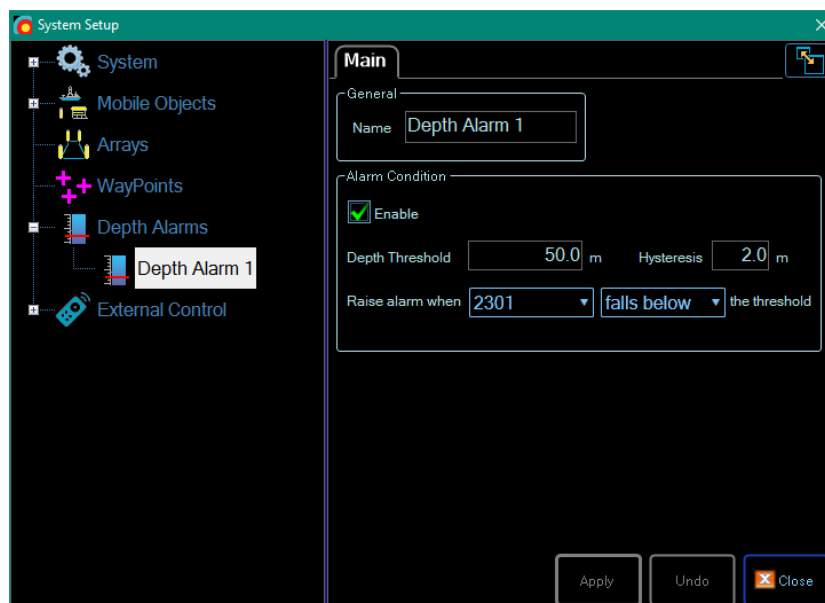
4.18 Configuring a Depth Alarm

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click **Depth Alarms** in the setup tree, and select **Add Depth Alarm**.



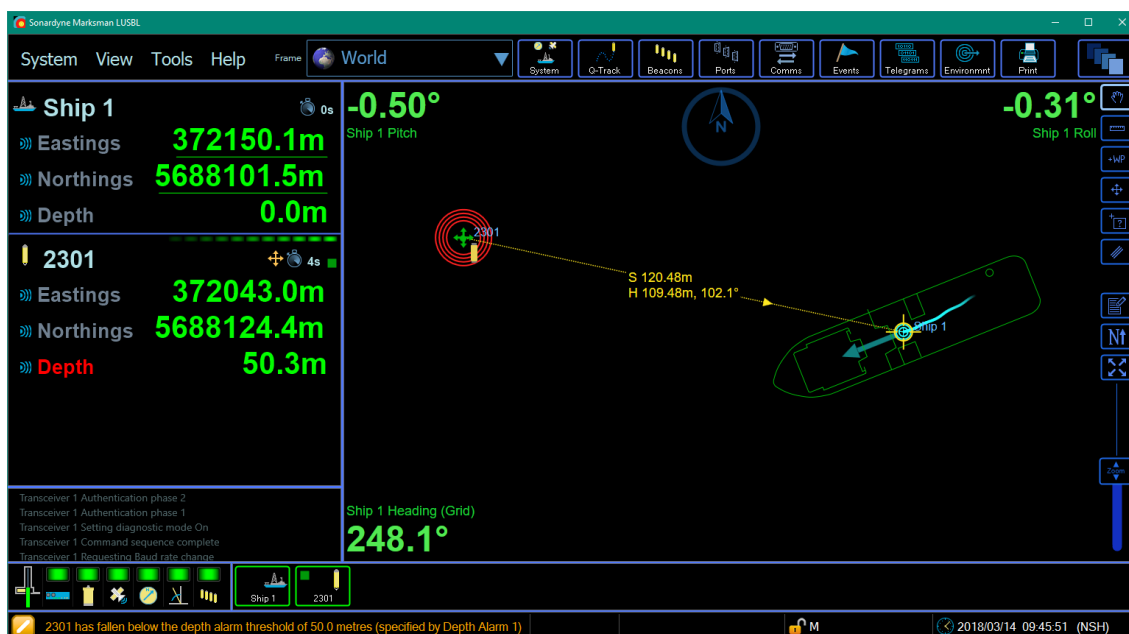
3. Select the required object from the **Raise alarm when** drop-down list.
4. Select **falls above** or **falls below** from the **threshold** drop-down list.

5. Enter the required **Depth Threshold** and **Hysteresis** values; see *Hysteresis* on page 46.



4.18.1 Operating a Depth Alarm

If the depth alarm is triggered, a system alarm is raised but also the object's depth reading is flashed in red and a flashing red highlight is drawn around the object on the main chart.

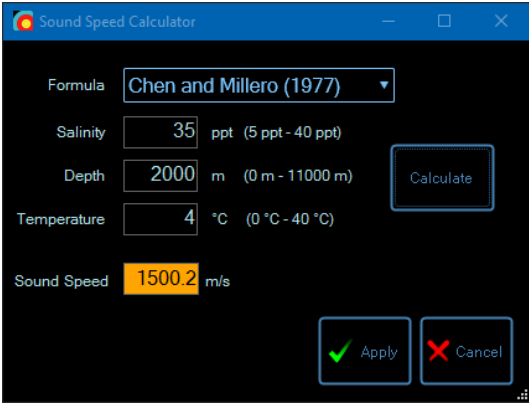


4.19 Environmental Settings

4.19.1 Configuring the Sound Speed

1. Click **Tools > Environmental** to display the **Environmental Settings** dialog box.
2. Perform one of the following three options:
 - Select **Sound Speed Profile**, and either click **Load** or **Estimated Profile** and then skip to *Step 3*, or

- If the salinity, depth and temperature are known, select **Fixed Values** and click the **Sound Speed Calculator**  to calculate and then enter the **Mean** and **Transceiver** (surface) sound speed values as follows:
 - Select the **Formula** (Chen and Millero, Del Grosso, Mackenzie or Medwin).
 - Enter the **Salinity**, **Depth** and **Temperature**.
 - Click **Calculate** to see the calculated **Sound Speed**.
 - Click **Apply** to automatically enter the calculated figures.



Sound Speed Calculator

Formula: **Chen and Millero (1977)**

Salinity: **35** ppt (5 ppt - 40 ppt)

Depth: **2000** m (0 m - 11000 m)

Temperature: **4** °C (0 °C - 40 °C)

Sound Speed: **1500.2** m/s

Buttons: Calculate, Apply, Cancel

or,

- Select **Sound Speed Sensor** (if fitted).



Environmental Settings

Sound Speed

Select one of the following methods to determine sound speed.

☐ Fixed Values

Mean Ranging Sound Speed: **1490.0** m/s

Transceiver Sound Speed: **1490.0** m/s

☒ Sound Speed Profile

Buttons: Load ..., Estimated Profile

Graph: Depth vs Speed

Text box: Sound speed profile taken from location: Latitude: 51.330376, Longitude: -20.834318, Profile taken at: 13/03/2018 16:03:47, Max depth: 3900 m, Mean Sound Speed: 1501.1 m/s

☐ Sound Speed Sensor

N/A

Pressure to Depth

Atmospheric Pressure: **100.00** kPa

Latitude: **51.33**° ☒ Use GNSS

Operating Range: **2500** m

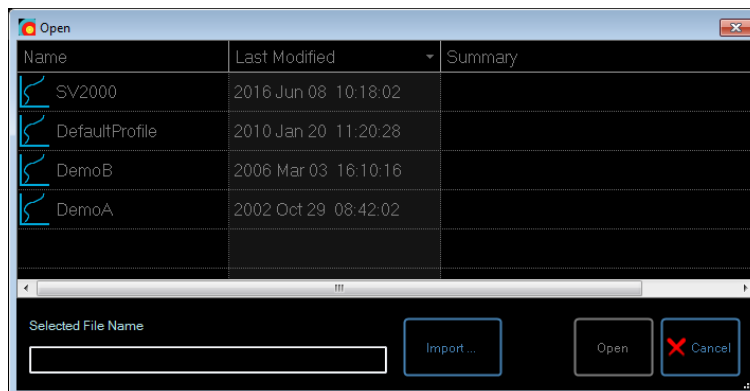
Buttons: OK, Cancel

3. Perform one of the following:

Either click **Load** and select a profile.

Note

 If a sound speed profile has not been previously loaded, selecting the "Sound Speed Profile" option will open the profiles window without having to click "Load".



If the profile you need is not included in the displayed list, click **Import**, navigate to the location of a different saved profile, and import it into the list.

The profile (.PRO) file is a plain text file with the following format:

Title

Date

Time

ProbeType

Comments

DepthValue SpeedValue SalinityValue TemperatureValue1

DepthValue SpeedValue SalinityValue TemperatureValue2

DepthValue SpeedValue SalinityValue TemperatureValue3

...

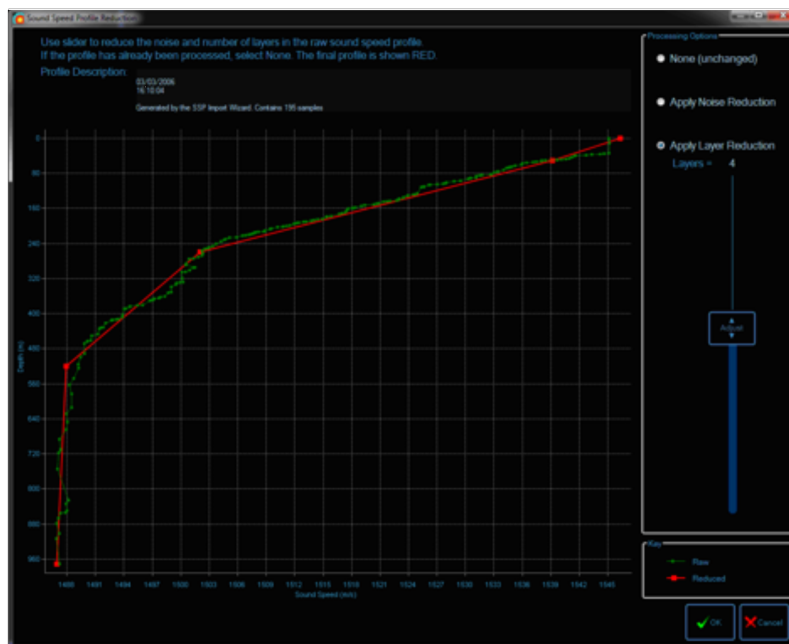
or,

Click **Estimated Profile** to load an estimated profile to suit the location and time of year.

4. After the profile is selected, the software displays the Sound Speed Layer Reduction tool.

This tool gives you the option to eliminate any noise in the data, and also to reduce the number of profile points for the software to process.

For example, selecting the **DemoB.pro** file results in the following:



The green points show the original raw data in the **DemoB.pro** file.

There are three options shown in the right hand panel:

1. **No changes**

This option allows you to import the raw (green) SSP data unchanged.

Use this option if the data has already been simplified (for example, by an external program).

2. **Apply Noise Reduction**

This option performs a fixed noise reduction algorithm on the raw SSP data. It should not change the number of points in the profile. The filtered points are shown in red.

Use this option if you want to retain all the points in the original data, but want to eliminate noisy outliers.

3. Apply Layer Reduction

This option allows you to interactively simplify the SSP data so that there are fewer points in the resulting profile. It also effectively reduces noise.

When you select this option, a vertical slider appears in the right hand panel. Move the slider up and down to change the number of layers (points) that the simplified profile will have (shown in red). The final position chosen will depend on the original data, but should have approximately 10 layers to give a reasonable fit.

Click **OK** to accept the option you have chosen and then return to the **Environmental Settings** dialog box.

Note

The changes will not be applied until you click the OK button on the Environmental Settings dialog box.

4.19.2 Optimising Pressure to Depth Measurements

Atmospheric Pressure is used to compensate pressure measurements when converting pressure to depth. The default value is equivalent to 1 atmosphere.

Latitude is the approximate current latitude and is also used in the pressure sensor-to-depth calculations. This can be set automatically if a GNSS sensor is available. Select the **GNSS** check box to use this option.

4.19.3 Setting the Maximum Operating Range

Maximum Range is the maximum range from which the system can accept acoustic signals before it times out waiting for acoustic replies. Best practice is to set this to a value just larger than the expected maximum range for the job, in order to achieve the best system performance.

Note

The maximum allowed range is determined by the Product type, as defined in the Security Key.

4.20 Configuring Output Telegrams

There are three main groups of users of output telegrams:

- DP systems
- Survey systems
- Miscellaneous other tools

The software supports several telegram types, but in practice the choice of telegram is usually governed by the third-party equipment that is to receive the telegram – the choices are often limited. Please consult the third-party equipment's user manual and/or the manufacturer's support group if in any doubt.

Table 4-3 lists the available telegram types, and gives basic choices of trackable targets, reference frames, etc.

Notes

By default vehicle positions are flagged as invalid when GNSS is active. This is intended to prevent GNSS data accidentally being routed through the Ranger 2 system. This behaviour can be overridden. Contact Sonardyne Support for details.



Measurement telegrams PSONEAS are also available (see *Appendix D "Output Telegram Formats and Interfaces"* for details).

Table 4–3 Position Out Telegrams

Telegram	Object	Valid Indices	Sim Flag Supp	Telegram Output with respect to the CRP of:		Supports User Assignments Mobile / Fixed Transponder Flag	Comments
				Valid Frames of Ref	Valid Frames of Orient		
HPR 309	Trans	1-16	Yes	SHIP/RIG/ROV	NorthUp BowUp	Yes	All positions are sent in ship reference frame. Telegram supports north, or bows up. Can include MRAMS data in telegram
	Vehicle	1-16				No	Vessel position is sent by reporting position of DP_REF waypoint with respect to the ship.
HPR 400 (481D, F)	Trans	B0 1-99 (see comment)	Yes	SHIP/RIG/ROV	NorthUp BowUp	Yes	Kongsberg apply an offset to the index number to indicate the frequency band. For MF, 100 is automatically added, and so B01-B87 are reported as indices 101 to 187 in the telegram. Can include MRAMS data in the telegram.
	Vehicle	0 = Vessel 1-16 = ROV1 to ROV16 17 = Position of Relay 1 18 = Position of Relay 1 19 = Position of Relay 1 20 = Position of Relay 1	Yes	WORLD	N/A	No	
				BEACON WAYPOINT	NorthUp		
HPR BCD (418)	Trans	B0 1-99 (see comment)	Yes	SHIP/RIG/ROV	BowUp	Yes	Kongsberg apply an offset to the index number to indicate the frequency band. For MF, 100 is automatically added, and so B01-B87 are reported as indices 101 to 187 in the telegram. Can include MRAMS data in the telegram.
	Vehicle	0 = Vessel 1-16 = ROV1 to ROV16 17 = Position of Relay 1 18 = Position of Relay 1 19 = Position of Relay 1 20 = Position of Relay 1 (see comment)		BEACON WAYPOINT	NorthUp	No	Kongsberg apply an offset of 300 in the sequence telegram to indicate LBL vehicle positions.

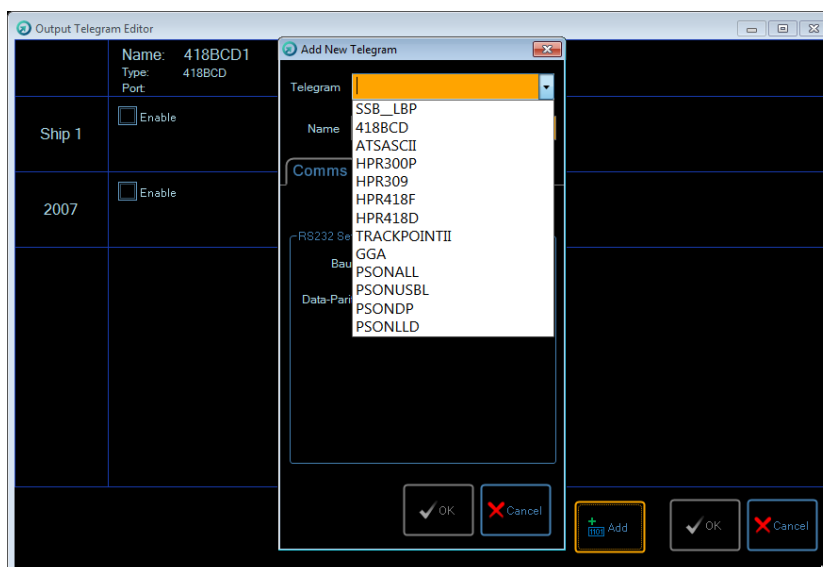
Table 4–3 Position Out Telegrams (continued)

Telegram	Object	Valid Indices	Sim Flag Supp	Telegram Output with respect to the CRP of:		Supports User Assignments Mobile / Fixed Transponder Flag	Comments
				Valid Frames of Ref	Valid Frames of Orient		
NMEA	Trans (SSB)	B01 to B99	Yes	WORLD	N/A	No	Can Carry MRAMS data.
				SHIP	NorthUp BowUp		
	Vehicle (LBP)	Ve or R1 to R4		WORLD	N/A	No	-
				BEACON WAYPOINT	NorthUp		
ATS ASCII	Trans	1 to 10	No	SHIP/RIG/ROV	BowUp	No	-
	Vehicle	0 = The Vehicle		WORLD	N/A	No	-
				BEACON WAYPOINT	NorthUp		
GGA	Trans	0-255	No	WORLD	N/A	No	WGS 8 4 latitude and longitude co-ordinates
	Vehicle	0-255		WORLD	N/A	No	WGS 84 latitude and longitude co-ordinates
HPR 300P	Trans	1 to 99	Implied	SHIP/RIG/ROV	NorthUp BowUp	No	Very rarely used
	Vehicle	-	-	-	-	-	Not supported
Track-point II	Trans	1 to 9.0 is simulating	Yes	SHIP/RIG/ROV	NorthUp BowUp	No	Very rarely used
	Vehicle	-	-	-	-	-	Not supported
PSON ALL	Trans	Uses name of vehicle / offset (or some other meaningful string)	No	WORLD	N/A	No	-
				WAYPOINT	NorhUp		
				SHIP/RIG/ROV	NorthUp BowUp		
	Vehicle	Uses name of vehicle / offset (or some other meaningful string)		WORLD	N/A	No	-
				BEACON WAYPOINT	NorthUp		
				SHIP/RIG/ROV	NorthUp		
PSON USBL	Trans	1 to 999	No	SHIP/RIG/ROV	NorthUp BowUp	No	-
	Vehicle	-	-	-	-	-	Not supported
PSON DP	Trans	-	-	-	-	-	Not supported
	Vehicle	1 to 9	Yes	WORLD	N/A	No	WGS 84 latitude and longitude co-ordinates
PSON LLD	Trans or Vehicle	Object Name	No	WORLD	N/A	No	WGS 84 latitude and longitude co-ordinates

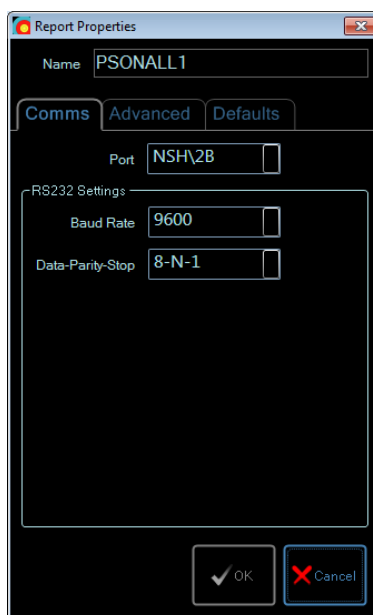
4.20.1 Configuring an Output Telegram

Open the Output Telegrams Editor and follow the steps below to configure a telegram.

1. Click **Add**.
2. Select the telegram type from the list.
3. Click **OK**.



4. Select the **Communications** tab.
5. For a serial connection select the **Port**, **Baud Rate** and **Data-Parity-Stop** and click **OK**.

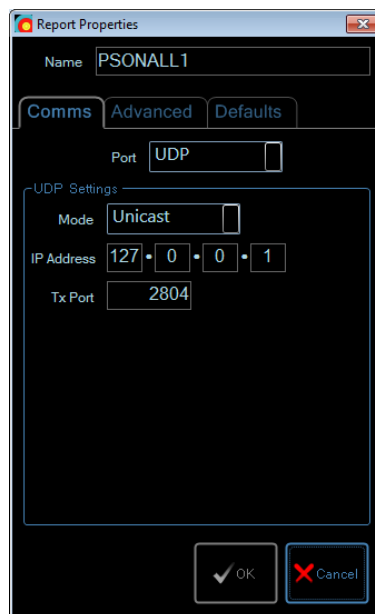


6. For a UDP connection, select **UDP** from the **Port** drop-down and then select:
 - The **Mode**: Unicast, Multicast, or Broadcast.
 - The **IP Address**.
 - The **Tx Port** and **Rx Port**.

7. Click **OK**.

Note

Firewall settings may need to be adjusted to allow UDP comms.



8. Select the **Advanced** tab and set the following as required:
 - For DP Use:
 - **Spacing**: The time between telegrams. Normally this parameter should be left at the zero, except in the case of the HPR418D and HPR418F telegrams, which are binary telegrams without unique terminators. The specified gap between these telegrams is 40 ms. Some older systems might require a gap between other telegrams to allow processing one telegram before the next arrives. Set this parameter in accordance with the requirements of the system receiving the data.
 - **Max Repeat Count**: The number of times a telegram can be re-sent. By default this field is set to zero to disable any repeating of telegrams. However, it might be necessary to enable data repetition in some cases. This field limits the number of times a given telegram will be repeated.
 - **SD Limit**: The system will not send a telegram for a position estimate where the predicted error ellipse is larger than this value. The default is zero, which disables this check. Set a non-zero value to enable the limit. This feature is useful for inertial telegrams to prevent free inertial data being delivered beyond a chosen confidence limit.
 - **Error Scale Factor**: This value scales-up or scales-down the error ellipse radius as required. Leave the scale factor at its default value of 1.0 except where it must be adjusted to suit a specific DP system. The valid range is 0.1 to 10.0.
 - **Invert Pitch**: inverts the sign of the reported Pitch.
 - **Invert Roll** : inverts the sign of the reported Roll.
 - **Allow Duplicate Indices** : allows the user to select the same telegram index
 - **Use SSB for subsea vehicle** : enables an NMEA SSB telegram rather than an LBP to be sent for a subsea vehicle.

- **Send 0.00 for blank fields** : sends 0.00 for fields that would normally be sent as empty fields in a telegram string. (Some applications do not accept nulls)

Report Properties

Name: SSB_LBP1

Comms | **Advanced** | Defaults

Spacing: 0 ms

Max. Repeat Count*: 0

SD Limit*: 0.00 m

Error Scale Factor: 1.00

Invert: ☐ Pitch ☐ Roll

Allow duplicate indices: ☐

Use SSB for subsea vehicle: ☐

Send 0.00 for blank fields: ☐

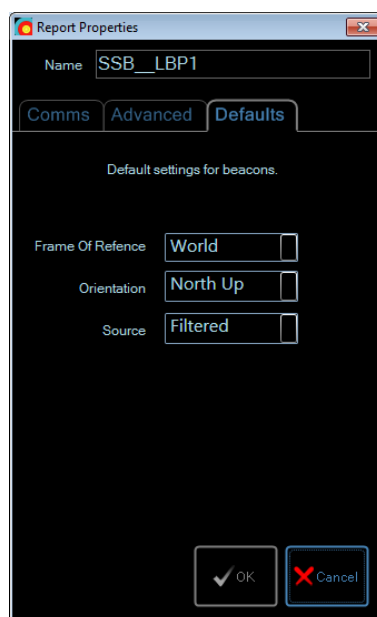
* Applies to Ship/Rig telegrams only

OK Cancel

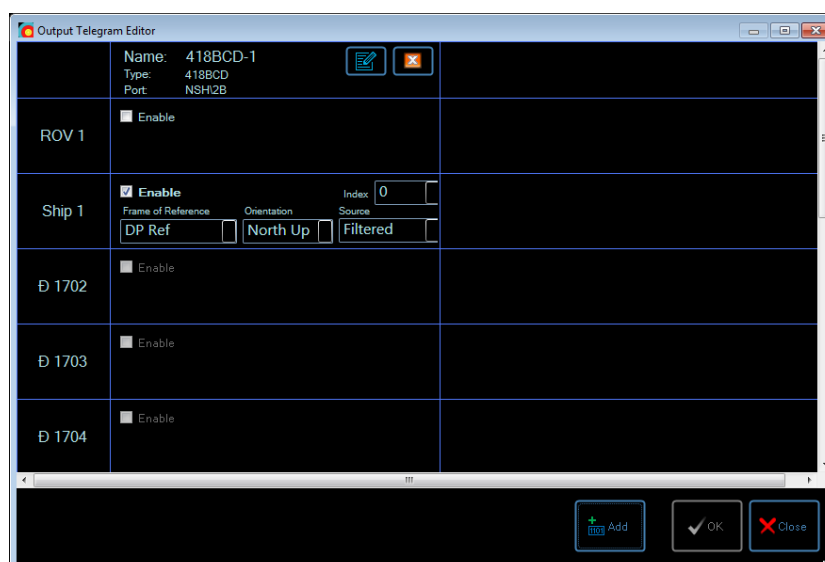
9. Select the **Defaults** tab to set the telegram parameters when beacons are added using the Add Beacon wizard, Quick Track or Remote Control.

Set the following as required:

- **Reference frame**: Position is sent with respect to the DP Ref waypoint, the Ship, a subsea vehicle such as ROV, or Structure.
- **Orientation**: Coordinates sent: North or Bow up.
- **Source**: Filtered, Raw, INS or SPRINT.
 - **Filtered**: Uses a Kalman filter to identify and exclude outliers (default).
 - **Raw**: Uses a least squares to estimate new position (Note: does not estimate velocity, and so computed position is not compensated for movement during the time that the acoustic signals were in the water).
 - **INS**: Uses the DP-INS solution (only available for the vessel).
 - **SPRINT**: Use when interfacing with SPRINT systems to supply position valid at the time that the beacon is interrogated, rather than at the time that the reply signal arrives at the vessel.



10. Set the following as required (with reference to *Table 4-3*).



Ship or specific beacons (as position feeds are required).

- Reference frame: Position is sent with respect to a waypoint, the Ship, or a subsea vehicle such as ROV, or Structure.
- Telegram index.
- Source: Filtered, Raw, INS or SPRINT; for a description, see *Source: Filtered, Raw, INS or SPRINT*. on the previous page
- Orientation: North or Bow up.

If necessary, you can set up more than one output telegram. Use the Comms viewer to check the output telegram.

To delete a telegram, click the red X button in the top right of that telegram's window.

4.20.2 Operating an Output Telegram

No user intervention is necessary. Output telegrams are generated as soon as the position data is available.

4.20.3 Vehicle Guidance Reports

A guidance report can be added to a vehicle, providing guidance from the current vehicle position to a destination waypoint. Distances are computed along the great circle path (rather than the rhumb line). Details of the reports are provided in *Appendix D "Output Telegram Formats and Interfaces"*.

The following sections describe the reports and how to create them.

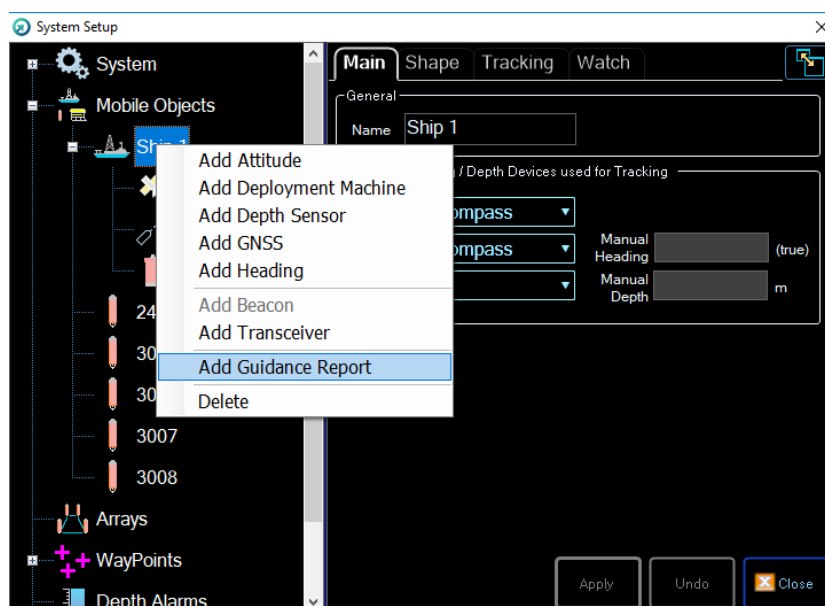
4.20.3.1 NMEA RMB Report

This is an NMEA-0183 report providing the 'Recommended Minimum Navigation' information. It provides cross track error from the path between the origin and destination waypoints, the direction to steer, and distance to destination.

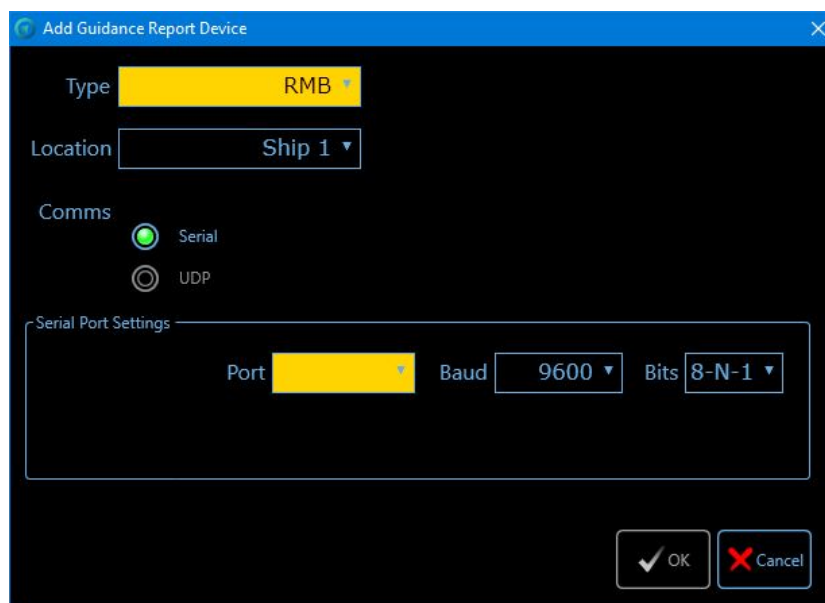
To create the report:

Set up the required origin and destination waypoints in the usual way; see *Section 4.17 "Configuring a Waypoint"*.

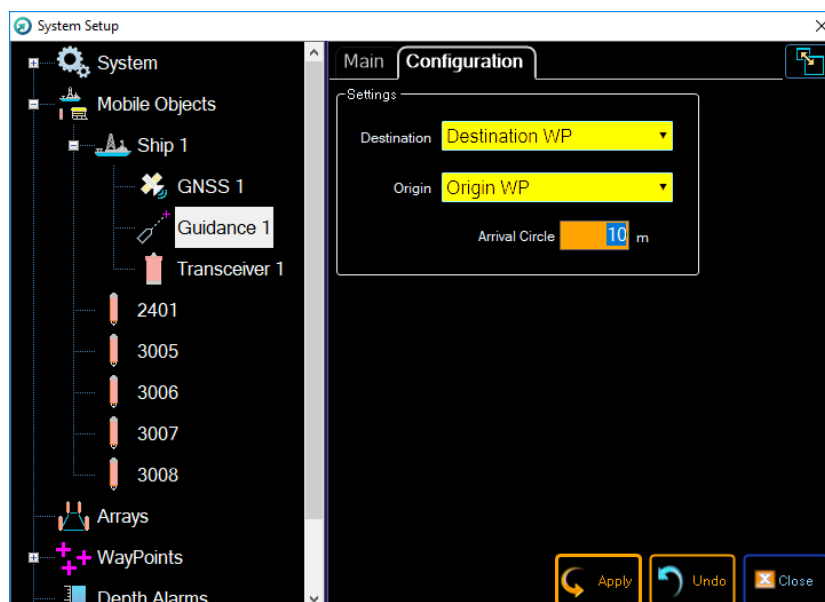
1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click **Ship** and select **Add Guidance Report**.



3. Select **RMB** as the **Type**.
4. Select the required **Port** in the **Serial Port Settings** and then click **OK**.



5. After the report has been added, select the **Configuration** tab, and set the **Destination** and **Origin** waypoints.
6. Set the **Arrival Circle** to the required precision to judge arrival at the destination waypoint and then click **Apply**.



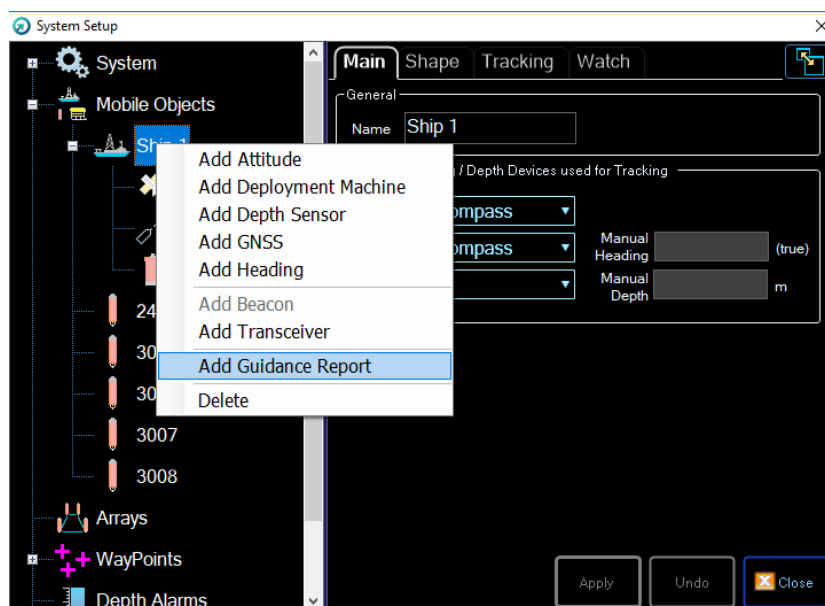
4.20.3.2 NMEA BWC Report

This is a NMEA-0183 report providing the 'Bearing and distance to Waypoint (great Circle)' information. It provides bearing, and distance along the great circle path between the current vessel position and the destination waypoint.

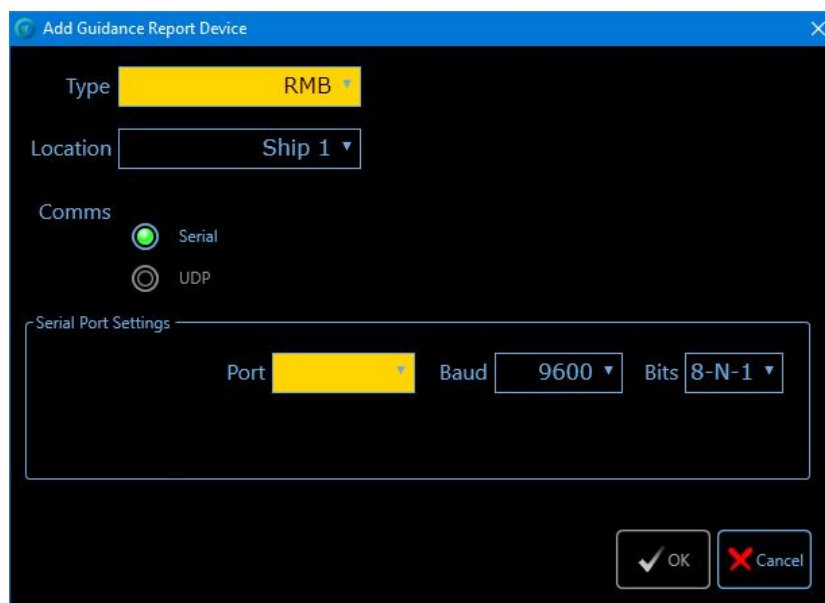
To create the report:

1. Set up the required origin and destination waypoints in the usual way; see *Section 4.17 "Configuring a Waypoint"*.

2. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
3. Right-click **Ship** and select **Add Guidance Report**.



4. Select **BWC** as the **Type**.
5. Select the required **Port** in the **Serial Port Settings** and then click **OK**.



6. After the report has been added, select the **Configuration** tab, set the **Destination** waypoints and then click **Apply**.

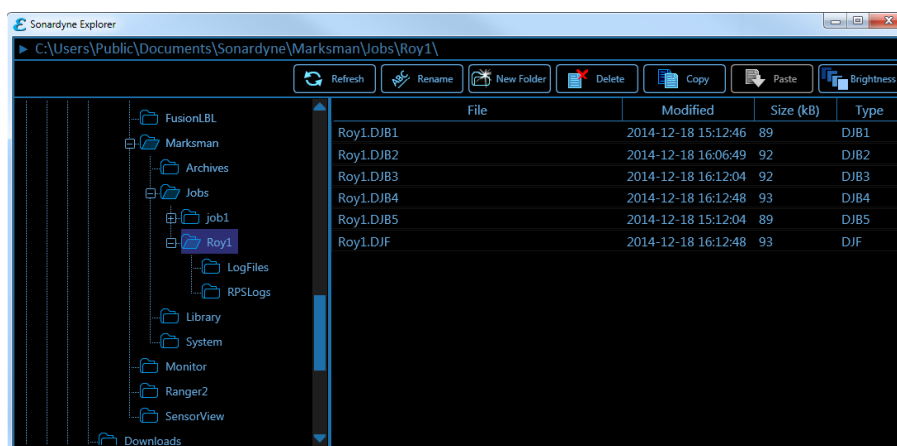
4.21 Viewing Setup Files Offline

The software saves each setup in an XML-format setup (job) file with the filename extension .DJF. Each file is stored in its own folder.

The path to the jobs folder is:

C:\Users\Public\Documents\Sonardyne\Ranger 2\Jobs\

An XSL stylesheet called **Denovo.xsl** is installed automatically in the Jobs folder.



Double-click on the setup .DJF file of interest to launch a simplified view in the default browser. For example:

Figure 4–4 Example Report of System Setup

Report for MarksmanJob "MAY08-1"

Description: ""

Created from template : true

All dimensions are in metres, angles are in degrees

Vessels and vehicles

Vessel	State	ManualHdg	ManualHdg (deg)	ManualDepth	ManualDepth
Ship 1	Tracked	false		false	

Beacons

Name	Type	TAT (ms)	Tx Power	Rx Gain	Rx Attn	Range Power	Interrogate	Reply	Tracking	Calibration	Update (secs)	Easting	Northing	Depth	UTMZone
101 - BOP	DPTi	125	High	High		High	CIS 0000	IRS 0101	NotTracked	Mobile	15				
102 - LFI	DPTi	250	High	High		High	CIS 0002	IRS 0102	Tracked	Mobile	6				
1702 - Compatt6	80	High	High			High	CIS 1600	IRS 1702	Tracked	Fixed	3	655513.458	392516.017	1899.999	32N
1703 - Compatt6	80	High	High			High	CIS 1600	IRS 1703	Tracked	Fixed	3	655613.272	392516.178	2010.050	32N
1704 - Compatt6	160	High	High			High	CIS 1600	IRS 1704	Tracked	Fixed	3	655513.278	392616.028	1999.985	32N
1705 - Compatt6	200	High	High			High	CIS 1600	IRS 1705	Tracked	Fixed	3	655413.421	392515.913	2099.977	32N
1706 - Compatt6	240	High	High			High	CIS 1600	IRS 1706	Tracked	Fixed	3	655513.502	392416.058	1999.985	32N

Battery checks

Name	LastCheckTime
101 - BOP	2013-06-14 15:43:00 (00:00:00)

This simplified view of the system setup allows the user to perform important tasks, for example:

- View all the installation offsets for ship's instruments, transceivers, and so on.
- Check beacon settings.
- View battery check data.
- View beacon array positions.
- View waypoint locations.
- Check software and firmware versions.

4.22 Sending Log files to Sonardyne Support

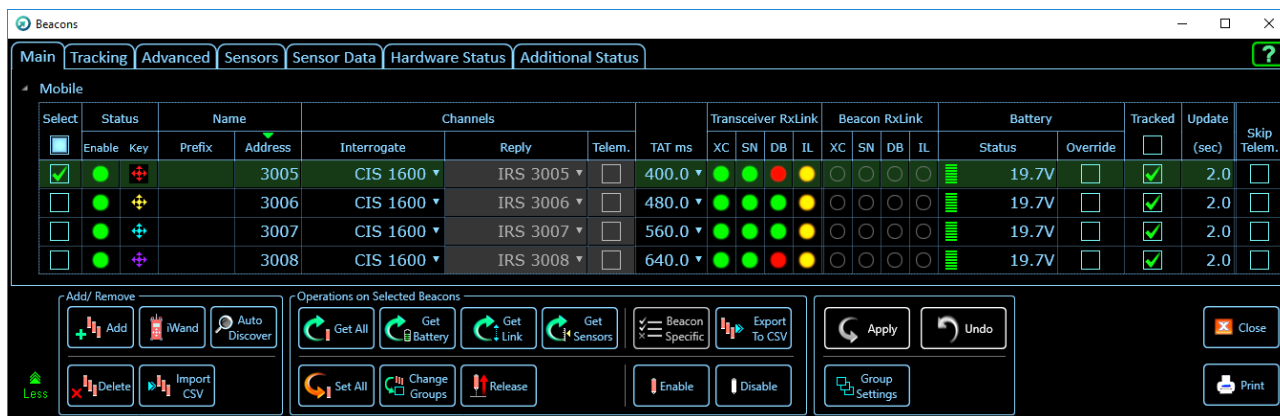
In the event of an error or system malfunction, system configuration data and log files can be appended into a compressed zip file and sent to Sonardyne Support for evaluation.

Click **Help>Sonardyne Support** to use the Sonardyne Support tool; see *Section A.10 "Help Menu"*.

Section 5 – Beacons

5.1 Beacons Table

The Beacons Table brings the management of all the beacons in the system together in one integrated tool. It contains six tabs: Main, Tracking, Advanced, Sensors, Hardware Status and Additional Status.



Note

The beacons shown in the following examples are for illustration purposes only; the exact types and features available depend on the product type.

5.1.1 Common to all Tabs

Table 5–1 Beacon Controls Common to all Tabs

Item	Function	Control Type
Select	Selects a beacon row	
Status/Enable	Current Beacon 'enabled' state.	(green circle = enabled)
Status/Key	Graphic symbol / colour used on chart to represent the beacon.	= mobile = reference = calibrating (The colour is unique for each beacon. The symbol rotates constantly.)
Name/Prefix	Beacon Name Prefix	Text Edit Box (Maximum 5 characters.)
Name/Address	Beacon Address	Text Label

5.1.2 Main Tab

The **Main** tab, shown below, displays the most important details about each of the beacons included in the setup, including its Name, Address, Interrogate and Reply, TAT, Acoustic Link Status, Battery status and Update period.

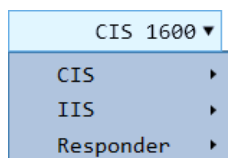
Table 5–2 Beacons Table - Main Tab Description

Item	Function	Control type
Channels/Interrogate	Interrogate channel	 Drop-down List
Channels/Reply	Reply channel	 Drop-down List
Telem	Enables Telemetry Tracking	
TAT ms	Turn Around Time (ms)	 Drop-down List
Transceiver RxLink	Transceiver Rx Link diagnostics	 Note that this will be disabled if no tracking has been done on the beacon. Tool tips over each LED to show description, values and the most recent update time, for example: Beacon 3003 Cross-Correlation = 99% Advice: Decrease the Transceiver gain. Last Updated: 2021/12/15 12:00:20
Beacon RxLink	Beacon Rx Link diagnostics	 Note that this will be disabled if the beacon does not support ALS, or no Get Link has been done on the beacon. Tool tips over each LED to show description, values and the most recent update time, for example: Beacon 3003 Signal to Noise Ratio = 27.00dB Advice: Decrease the Beacon gain. Last Updated: 2021/12/15 12:08:38
Battery/Status	Battery charge state – a Low battery status can be temporarily overridden	  
Tracked	Tracking controls	
Update (sec)	Tracking update rate	Numeric edit box (single decimal)
Skip Telem	Skip sending telemetry for any commands to this beacon	

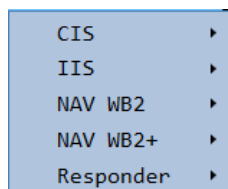
5.1.3 Interrogate and Reply

Depending on the beacon type, clicking on the **Interrogate** drop-down list presents the following menus:

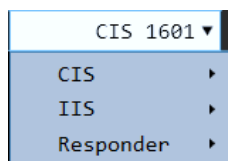
- For 6G beacons with functionality level that excludes multi-user NAV Channels: **CIS**, **IIS** and **Responder**.



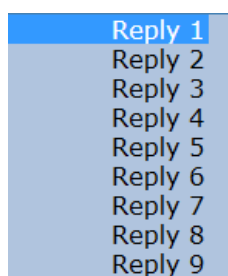
- For 6G beacons with functionality level that includes multi-user NAV channels: **CIS**, **IIS**, **NAV WB2**, **NAV WB2+** and **Responder**.



- For SST 6 nodal beacons, only the Unique Interrogation Signal (UIS) is currently offered.
- For AvTrak 6: **CIS**, **IIS** and **Responder**.



- For OBC/LRT beacons, the interrogate signal is fixed according to the address, but the reply channel can be selected.



5.1.4 Interpreting Link Status Information

The Link Status information from a transceiver or beacon provides four data values that can be useful in determining the status of the acoustic channel. These values are:

- Cross-Correlation (XC)
- Signal-to-Noise Ratio (SNR)
- Amplitude (dBV)
- Interference Level (IFL)

Several of these parameters are linked together. For example, changing the receiver gain (LG) may improve the XC and SNR in cases where the acoustic signal is saturating the receiver.

Wherever possible, it is important to ensure that the system is not saturating. This can be done by adjusting the LG parameter in the CS command to bring the DBV level to within the 'good' range indicated in the table below.

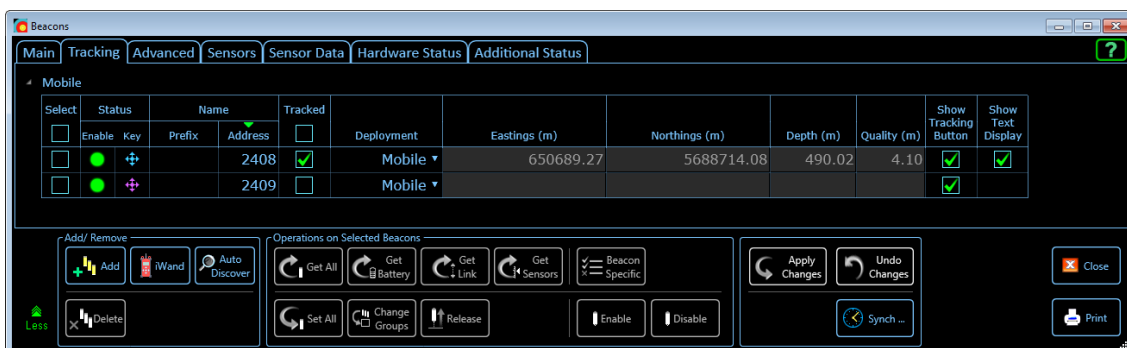
The table below shows a 'traffic light' interpretation and bounds for each of the parameters. The aim is to have all of the parameters within the 'Good' or 'Okay' bounds. Mainly this can be achieved by adjusting the gain of the instrument under test conditions.

Table 5-3 Parameter Bounds for Link Status Information

Parameter	Good	Okay	Difficult	Description
XC WBv1 WBv2 WBv2+	>70 >60 >50	>55 >50 >40	<55 <50 <40	The XC parameter shows how well the received signal matches a replica held inside the instrument. This value will be reduced by a strong multipath environment, for example in shallow water. There is no direct way of improving this figure, except environmentally, but ensure the other parameters are within their "Good" operation ranges.
DBV	-3 to -26	>-36 & >-3	<-6 or >=0	If the signal is either too large (>-3 dB) or too small (<-36) then the system is not optimal. If the dBV value is greater than -3 dB then reduce the gain (increase attenuation). The opposite is true of a signal below -36 dB.
SNR	>12	>6	<6	Signal to noise ratio, the higher the better. Ensure that the system is not saturating (DBV) as this will degrade the SNR. Increase the beacon power level to increase SNR, as long as the DBV value shows the system is not saturating.
IFL	<20	<40	>40	Interference level, maximum correlation level prior to detection. Mainly this will not affect the system performance, but if very high means the likelihood is there are other signals in the water column.

5.1.5 Tracking Tab

The **Tracking** tab, shown below, displays the major tracking parameters, including Deployment, Easting, Northing and Depth positions.



You can use the **Tracking** tab to switch Tracking on or off for one or more beacons, and to select whether or not to show each Tracking button and position display on the main window.

Table 5–4 Beacons Table – Tracking Tab Description

Item	Function	Control Type
Tracked	Controls tracking	
Deployment	Where the beacon is currently situated or attached.	 Drop-down List [Mobile]
Eastings (m)	Easting (local or world)	Numeric Label (2 decimals)
Northings (m)	Northing (local or world)	Numeric Label (2 decimals)
Depth (m)	Depth	Numeric Label (2 decimals)
Quality (m)	Tracker Quality	Numeric Label (2 decimals)
Show Tracking Button	If this is a Mobile beacon this field is visible. Allows control over the visibility of the Tracking button for this beacon on the Main UI.	
Show Text Display	If this is a Mobile or Calibrating (not Fixed) beacon this field is visible. Allows control over the visibility of the Position Text Block for this beacon on the Main UI.	

5.1.6 Advanced Tab

The **Advanced** tab includes beacon parameters that should rarely need to be adjusted, including: Power, Gain and Telemetry scheme for one or more beacons.

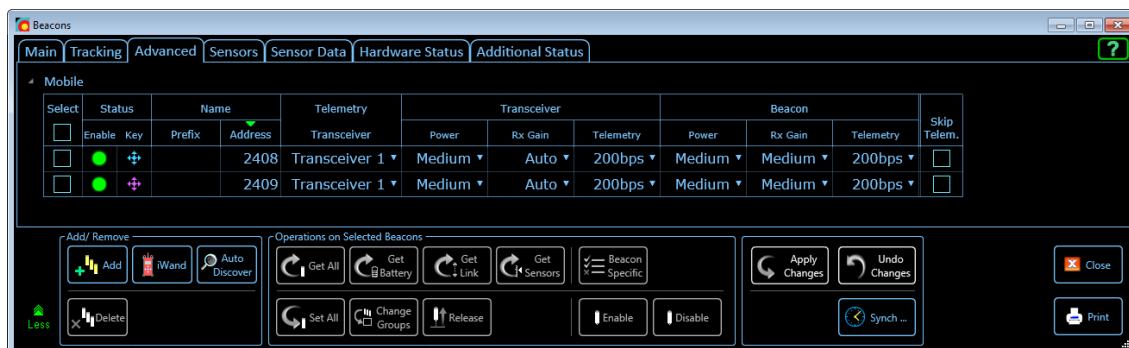


Table 5–5 Beacons Table – Advanced Tab Description

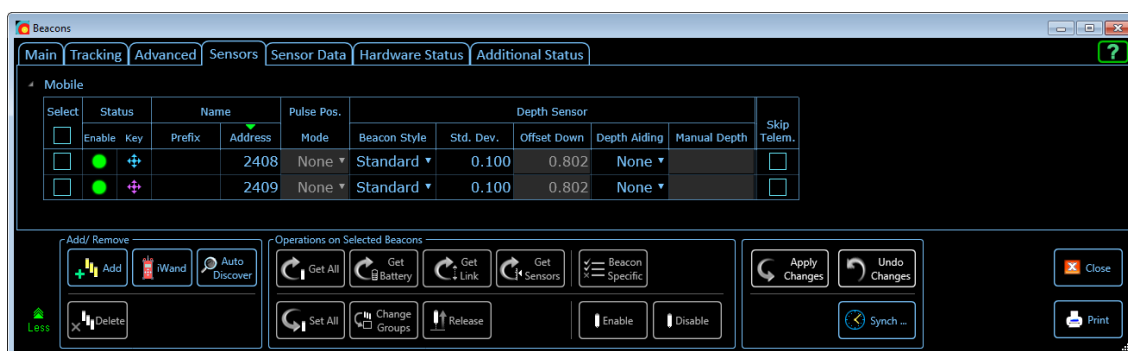
Item	Function	Control Type
Telemetry Transceiver	Transceiver assigned for performing telemetry to this beacon (if applicable)	 Drop-down List
Transceiver/ Power	Transceiver Tx Power	 Drop-down List
Transceiver/ Rx Gain	Transceiver Rx Gain	 Drop-down List
Transceiver/ Telemetry	Transceiver Telemetry Scheme	 Drop-down List
Beacon/ Power	Beacon Tx Power	 Drop-down List
Beacon/ Rx Gain	Beacon Rx Gain	 Drop-down List

Table 5–5 Beacons Table – Advanced Tab Description (continued)

Item	Function	Control Type
Beacon/Telemetry	Beacon Telemetry Scheme	
Skip Telem.	Skip sending telemetry for any commands to this beacon.	

5.1.7 Sensors Tab

The Sensors tab displays the sensor parameters of each beacon, including Pulse Position mode (depth or attitude), depth sensor style/offset/aiding mode. The Sensors tab is used to configure the depth and attitude sensors for one or more beacons.



Note

 Some 6G+ beacons support delivering depth using Wideband 3 telemetry when they are interrogated. Other beacons support delivering sensor data by Pulse Position Telemetry.

Table 5–6 Beacons Table – Sensors Tab Description

Item	Function	Control Type
Collection Mode	Collection Mode to be used during ranging cycles. Select Depth or Angle from the Collection Mode drop-down list if sensor measurements are to be integrated into ranging cycles.	 Drop-down List [None, Depth, Angle]
Depth Sensor/Beacon Style	Depth Sensor offset style – allows offset to be adjusted for tilted beacons	 Drop-down List [Manual, Standard]
Depth Sensor/Std. Dev.	Standard Deviation (quality) of depth sensor	Numeric Label (3 decimals)
Depth Sensor/Offset Down	Depth Sensor Offset to acoustic transducer	Numeric Label (3 decimals)
Depth Sensor/Depth Aiding	Selects the type of depth aiding to be used when tracking this beacon. When set to Manual, the Manual Depth field (below) is visible	 Drop-down List [Manual, Sensor, None]
Depth Sensor/Manual Depth	Manual depth value editable by the user when the Depth Aiding field is set to Manual	Numeric Label (1 decimal)

5.1.8 Sensor DataTab

The Sensor Data tab displays the sensor values retrieved from each selected beacon when the **Get Sensors** button is clicked (see *Section 5.1.15 "Beacon Operations"*).

Note

 This feature is only offered for Sonardyne beacons that are configured for telemetry.

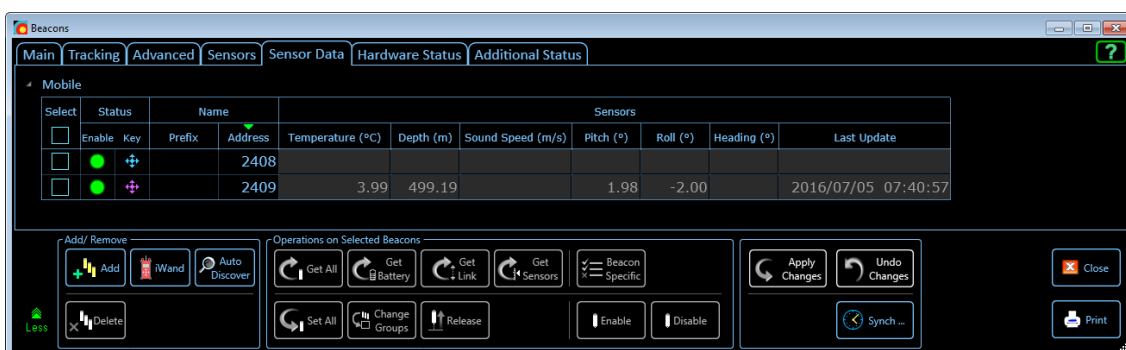


Table 5–7 Beacons Table – Sensor Data Tab Description

Item	Function	Control Type
Temperature	Temperature sensor value	Numeric label (2 decimals)
Depth	Depth sensor value	Numeric label (2 decimals)
Sound Speed	Sound Speed sensor value	Numeric label (2 decimals)
Pitch	Pitch sensor value	Numeric label (2 decimals)
Roll	Roll sensor value	Numeric label (2 decimals)
Heading	Heading sensor value	Numeric label (2 decimals)
Last Update	Date-time of last successful sensor data retrieval	Date-time label

5.1.9 Hardware Status Tab

The Hardware Status tab displays the fixed parameters of each beacon, including: UID, Firmware version and Transducer type.

If a beacon does not support telemetry, most fields are blank.

If a beacon supports telemetry but has not yet been involved in a telemetry transfer, fields might show 'Unknown'.

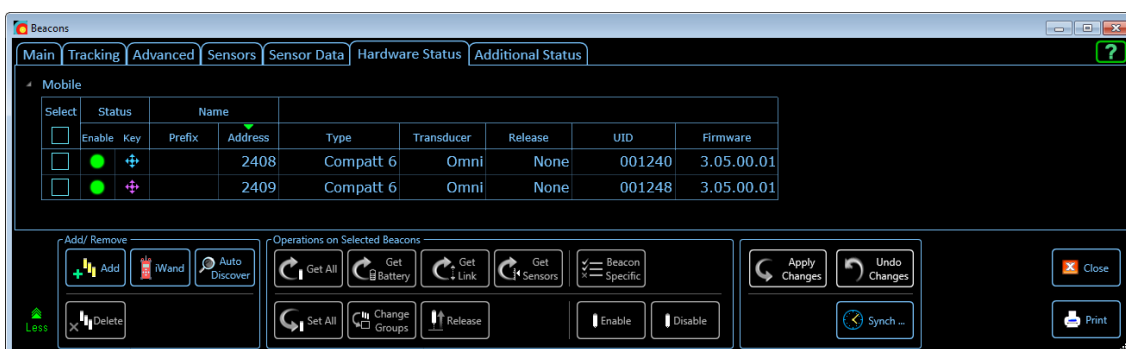


Table 5–8 Beacons Table – Hardware Status Tab Description

Item	Function	Control Type
Type	Beacon type name (e.g. Compatt 6)	Static Label
Transducer	Transducer type (Omni or Directional)	Static label
Release	Acoustic release type	Static Label
UID	Beacon UID	Static Label
Firmware	Firmware version	Static Label

5.1.10 Additional Status Tab

The Additional Status tab displays the additional parameters specific to certain types of beacon, e.g. Activity Time and Gyro Compatt status.

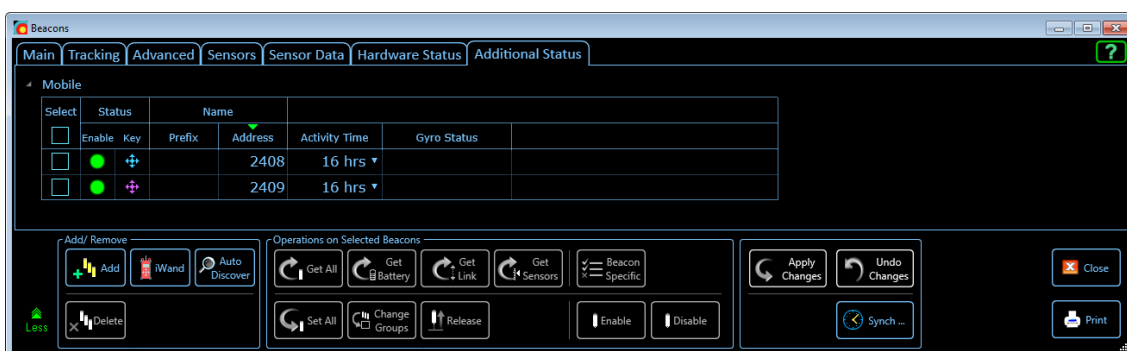


Table 5–9 Beacons Table – Additional Status Tab Description

Item	Function	Control Type
Activity Time	Allows selection of the desired stay-awaketime of the beacon	Drop-down List Range from 2 Secs to 32 days or Always on
Status	Shows the current status of the Lodestar Gyro. Applicable only when the beacon is a Gyro Compatt	Static Label: On, Off, UnSettled

5.1.11 Common Commands

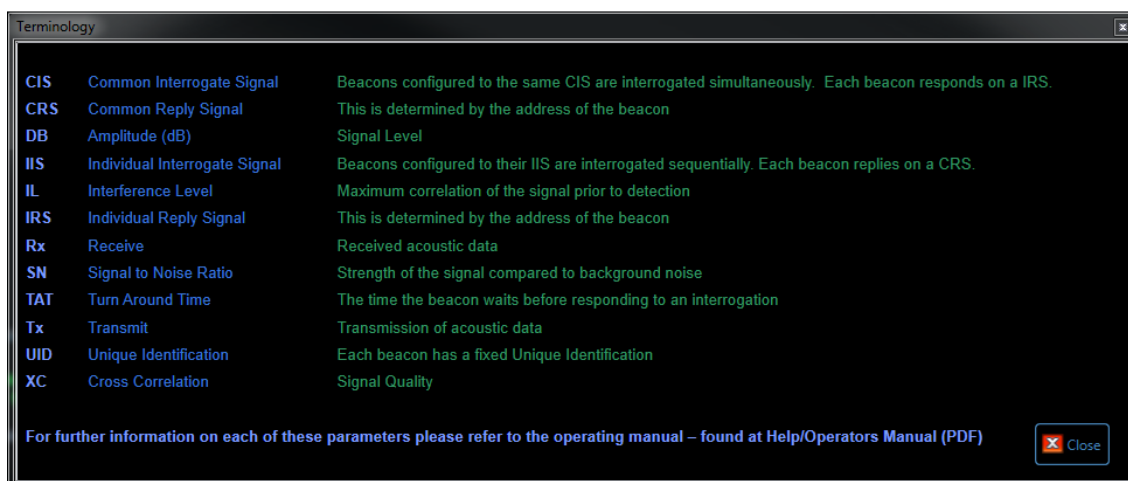
Clicking the button at bottom left exposes the second row of buttons along the bottom of the window as shown below.



Clicking the button at bottom left hides the second row of buttons along the bottom of the window.



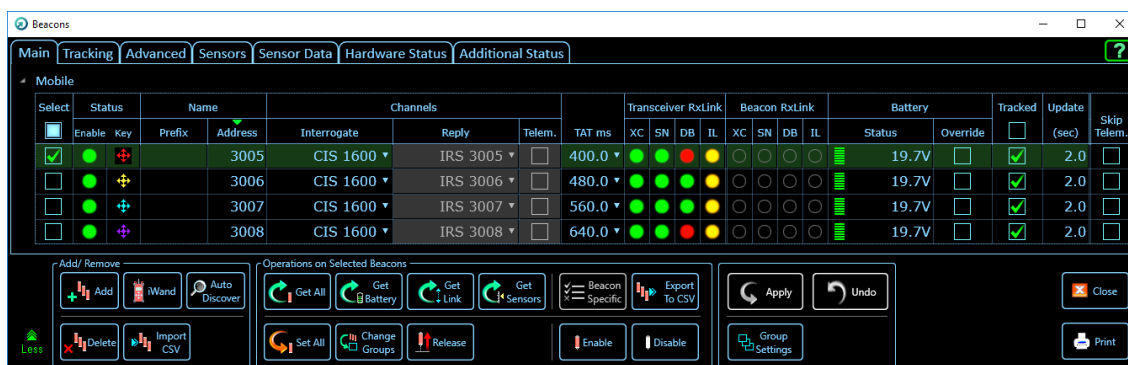
- Clicking **Add** launches the Add Beacon Wizard; see *Section 5.2 "Add Beacon Wizard "*.
- Clicking **iWAND** launches the iWAND tool; see *Section 5.4 "iWAND Tool "*.
- Clicking **Auto Discover** launches the Beacon Discovery Tool; see *Section 5.5 "Beacon Discovery Tool"*.
- Clicking **Import CSV** launches the file explorer to select the appropriate CSV file; see *Section 5.6 "Beacon Import/Export"*.
- Clicking **Group Settings** allows you to set special behaviour for a beacon group.
- Clicking **Sync** launches the **Acoustic Time Synchronisation** window.
- Clicking **Print** launches the Windows Print dialog box. This is a standard system dialog box that allows you capture and print out the Beacons Window.
- Clicking  shows the Beacon Terminology help window.



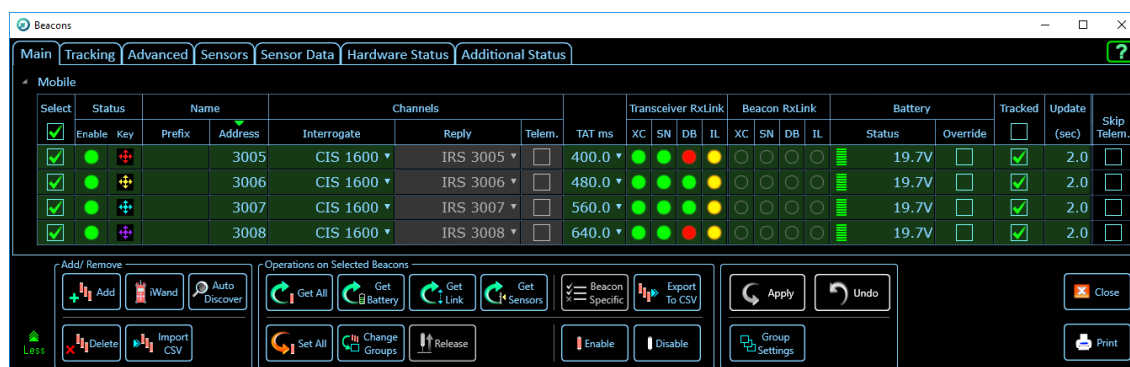
- Clicking on **Close** closes the window.

5.1.12 Beacon Selection

The **Select** column in each tab contains a check box to select beacons. When selected the entire row is highlighted in dark green, except for disabled fields which are shown greyed out. Using this method to select any beacon in any tab automatically results in the beacon being selected in all other tabs (see below).



The uppermost check box toggles all rows to be selected/cleared in all tabs (see below).



When at least one beacon is selected by its selection check box, the following buttons are enabled on the button panel, otherwise they are disabled:

- Get All
- Get Battery
- Get Link
- Get Sensors
- Beacon Specific
- Export To CSV
- Set All
- Change Groups
- Release
- Enable
- Disable
- Delete
- Import CSV



5.1.13 Sorting Columns

Columns that have data that can be usefully sorted do allow sorting (see the examples below showing where this feature can be used). To sort the columns, click on a column header that contains sortable data results so that a green chevron (as shown below) appears above the header text. Only one column is sortable at a time, but it is applied to all tables on all tabs (as applicable).

Select	Status	Name	Tracked	Deployment	Eastings (m)	Northings (m)	Depth (m)	Quality (m)	Show Tracking Button	Show Text Display
☐	Enable Key	Prefix Address	☐							
☐	☒		☒	Mobile ▼	650689.15	5688713.83	489.99	4.11	☒	☒
☐	☒		☒	Mobile ▼	650688.64	5688723.23	499.96	4.18	☒	☒

Clicking on the chevron reverses the sort order.

Select	Status	Name	Tracked	Deployment	Eastings (m)	Northings (m)	Depth (m)	Quality (m)	Show Tracking Button	Show Text Display
☐	Enable Key	Prefix Address	☐							
☐	☒		☒	Mobile ▼	650689.09	5688723.63	499.99	4.19	☒	☒
☐	☒		☒	Mobile ▼	650689.41	5688713.65	490.00	4.12	☒	☒

5.1.14 Beacon Groups

All tabs show separate collapsible tables for Mobile, Array, ROV, etc. Each table is independently collapsible by clicking on the chevron next to the table title, as shown below.

Mobile				
Array 1				
Select	Status		Name	
	Enable	Key	Prefix	Address
☒				2001

5.1.15 Beacon Operations

Assuming at least one beacon has been selected in the table then these buttons are enabled:

- Get All
- Get Battery
- Get Link
- Get Sensors
- Beacon Specific
- Export To CSV
- Set All
- Change Groups
- Release
- Enable
- Disable
- Delete

Depending on what beacon(s) have been selected, the following action occurs when a specific operation button is pressed:

1. If all selected beacons are capable of the operation, the operation is performed. A confirmation dialog box may be displayed if the operation makes fundamental changes to beacons.
2. If some selected beacons are capable of the operation and others are not, the operation is performed on those that support the operation. The user is not informed that some of the beacons were not capable. A confirmation dialog box may be displayed if the operation makes fundamental changes to beacons that support the operation.
3. If all selected beacons are NOT capable of the operation, the operation is NOT performed. A dialog box is displayed to explicitly tell the user that nothing happens.
4. If all selected beacons allow telemetry but have their **Skip Telemetry** check box selected, a dialog box is displayed to inform that no telemetry will occur (that is, the change will be a local UI change only).

5.1.15.1 Beacon Buttons

- **Get All.** This sends commands via telemetry to request all configuration data from all selected beacons to populate appropriate columns across all tabs of the Beacons Table.

- **Get Battery.** This requests battery status from all selected beacons and populates the Battery Status column appropriately.
- **Get Link.** This requests ALS link status from all selected beacons and populates the **Beacon RxLink** column appropriately. 'Traffic lights' are shown:

Transceiver RxLink				Beacon RxLink			
XC	SN	DB	IL	XC	SN	DB	IL

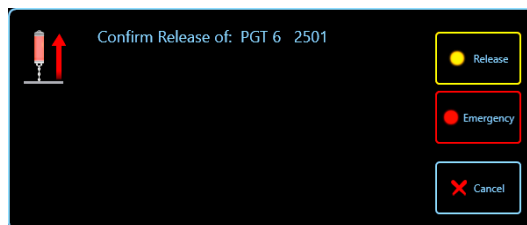
Hover the mouse cursor over each LED to reveal a tooltip giving values and last update time, for example:

Beacon 2005
Interference Level = 25%
Last Updated: 2014/11/28 14:18:23

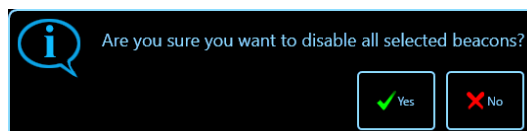
- **Get Sensors.** This sends commands via telemetry to request all sensor data from all selected beacons and populates the Sensor Data columns appropriately.
- **Beacon Specific.** Clicking on this button launches the **Beacon Specific Properties** dialog box; see *Section 5.1.17*.
- **Export To CSV.** This allows configuration of one of more beacons to be saved to a CSV file; see *Section 5.6 "Beacon Import/Export"*.
- **Set All.** This sets all fields across all tabs to all selected beacons, some of which may require telemetry.
- **Change Groups.** This launches the **Change Groups** dialog box; see *Section 5*.
- **Release.** If more than one beacon is selected, a dialog box is display to tell the user that only one beacon can be released at a time. If only one beacon is selected, a second release confirmation window is shown:



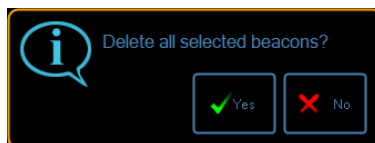
For beacons that require emergency release, the following window is shown instead:



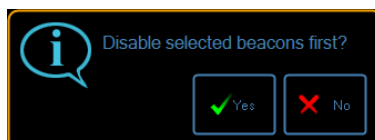
- **Enable.** This enables all selected beacons. The user must confirm the action. The green LED shows the beacon is enabled, the red LED shows that the beacon is disabled
- **Disable.** This disables all selected beacons. The user must confirm the action.



- **Delete.** This deletes all selected beacons from the system setup. A confirmation dialog box is displayed as follows:



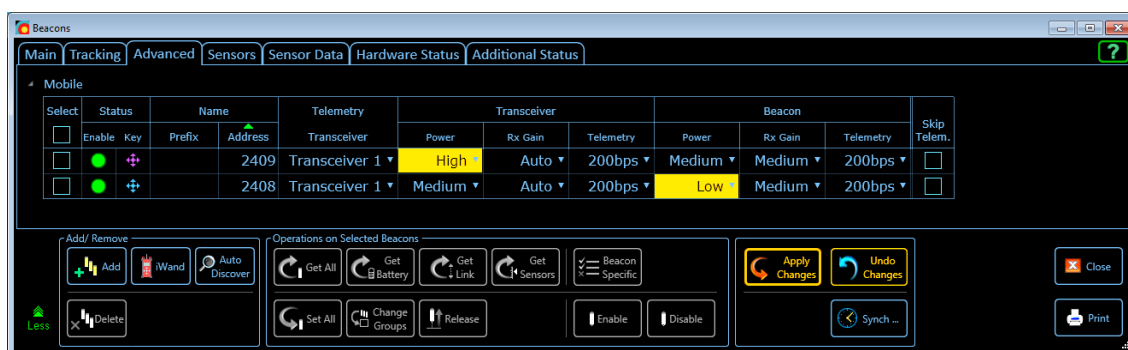
If at least one of the beacons to be deleted supports telemetry, then the following dialog box is shown.



- **Import CSV.** This allows configuration of one or more beacons to be imported from a CSV file; see *Section 5.6 "Beacon Import/Export"*.

5.1.15.2 Changing Field Values

If you edit one or more fields in the Beacons Table across one or more tabs, the background colour of the edited fields changes to orange and the **Apply Changes** and **Undo Changes** buttons are enabled (see below).



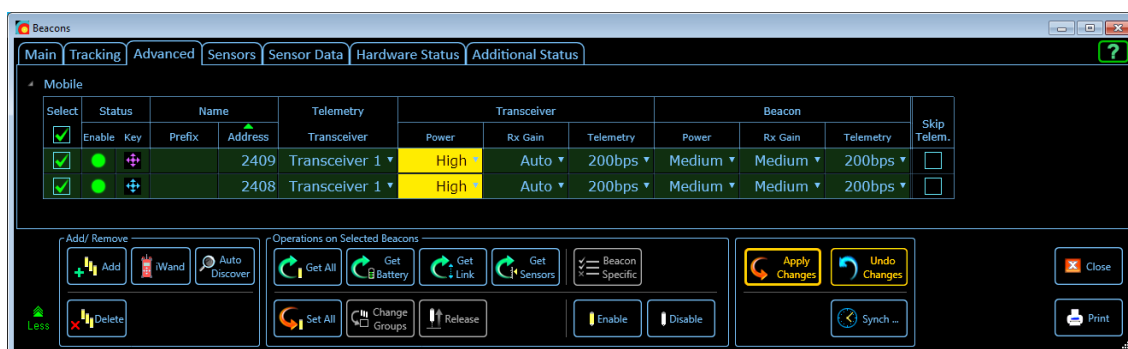
- Click the **Undo Changes** button to revert all modified (orange) fields to their original values. The **Apply Changes** and **Undo Changes** buttons become disabled and all the orange field backgrounds revert to black.
- Click the **Apply Changes** button to apply all modified (orange) fields to their respective beacons. The **Apply Changes** and **Undo Changes** buttons become disabled, the table reflects the changes, and the orange backgrounds revert to black.

When applying changes, if the **Skip Telemetry** check box is selected for a beacon that is to be updated, then the physical beacon is not updated. Only the software representation of the beacon is changed.

5.1.16 Bulk Changes

The following example of the bulk change feature shows the transceiver power for selected Mobile beacons changed to **High**.

1. On the **Advanced** tab, select the check box for the appropriate beacons.
2. Change the **Power** of the selected beacons to **High**.



3. Click **Apply Changes**.

Note

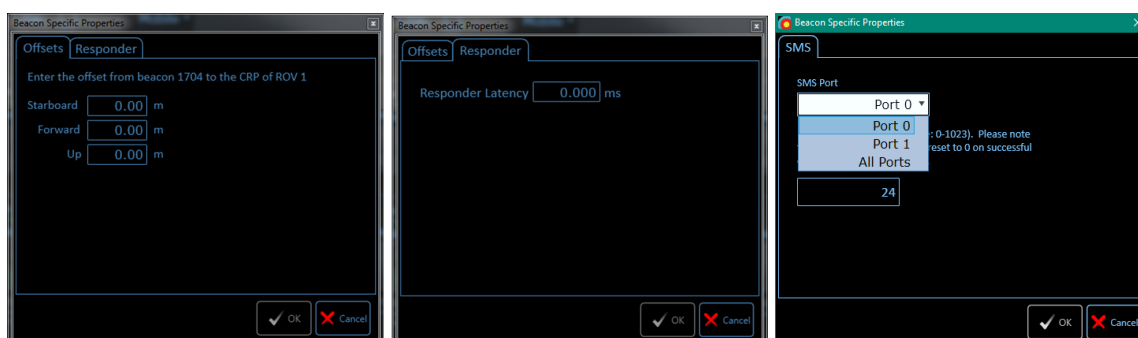
 Bulk editing is only available on certain table fields.

5.1.17 Beacon Specific Properties Dialog Box

Clicking on the **Beacon Specific** button launches the **Beacon Specific Properties** dialog box (shown below) for editing special parameters that are rarely used and very specific to certain types of beacon. The following beacon types are examples that require this feature:

- Gyro Compatt (5 & 6).
Requires enable / disable buttons for the Gyro, and also display current status of the Gyro.
- Any beacon attached to a subsea vehicle (e.g. ROV).
Requires Starboard, Forward and Up numeric fields to define the offset of the beacon to the CRP of the vehicle.
- Beacon using Responder Trigger
Requires a numeric field to define Responder latency (ms).
- Beacon using Telemetry Tracking, e.g. AvTrak 6
Offers user control of SMS port and spare SMS bits when using Telemetry Tracking.

Since a beacon can fall into one or more of the above categories, the dialog box provides tabs for each of the beacon type specific features above. Tabs that do not apply are hidden.



5.2 Add Beacon Wizard

5.2.1 Beacon Type

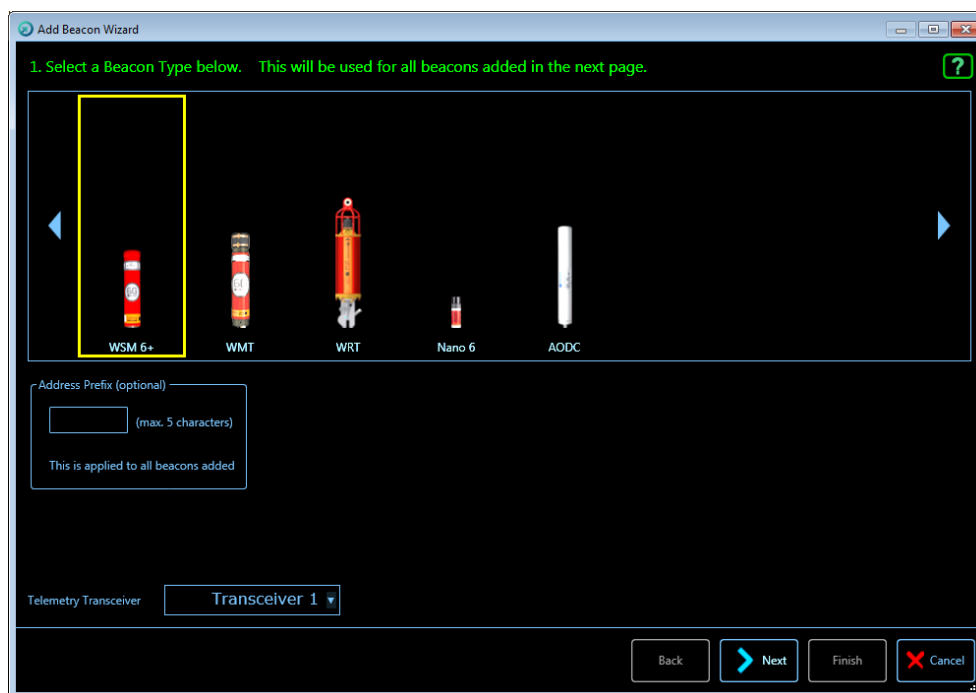
Click the **Add** button on the **Beacons** window to display the **Add Beacon Wizard**. This wizard allows you to add multiple beacons of the same type to the current setup.

Note

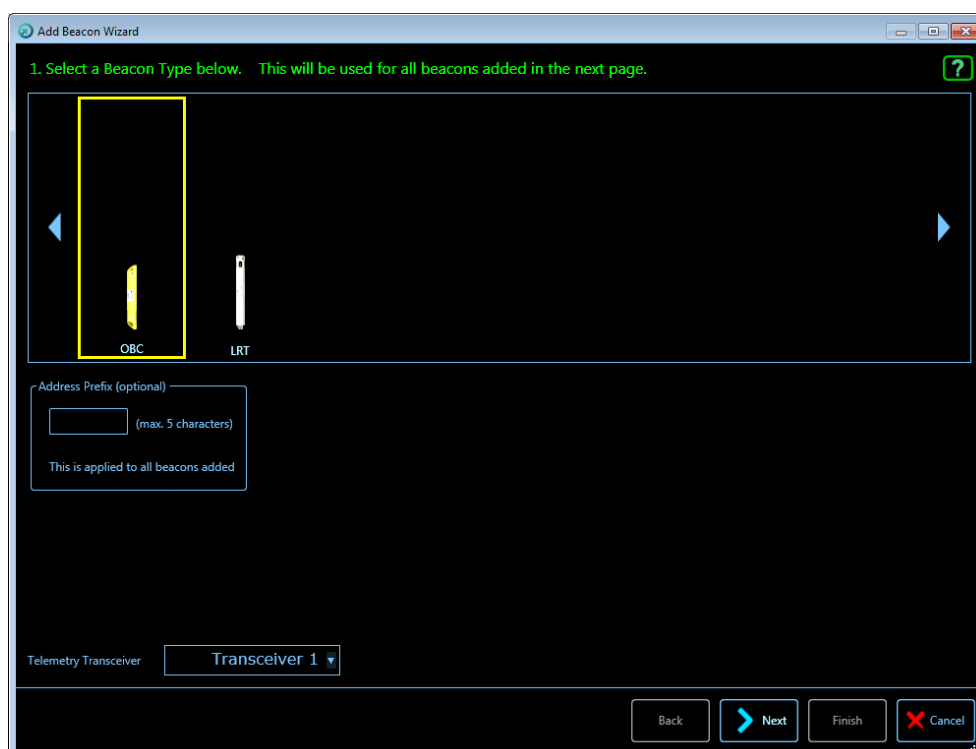
 Depending on the configuration, the Beacon Address table may open at this stage; see *Section 5.2.2*.

The **Cancel** button at bottom right is always enabled. This allows you to cancel the add beacon operation and return to the main **Beacons** window.

With a Type 8212 (MF) transceiver the following window will open:



With a Type 8221 (HF) transceiver the following window will open:



The first window of the wizard, shown above, allows you to select:

- **Beacon Type** - You can scroll the beacon type selector left and right with the mouse, and click on a beacon to select it. Note that the list of beacons available is determined by the settings in the security key.
- **Beacon Address Prefix** is an optional user-defined three-character prefix for naming the beacon. This applies to all beacons added.
- **Telemetry Transceiver** allows the user to choose which telemetry transceiver to use for all beacons being added.

Click **Next** to proceed to the Beacon Address window. The **Next** button is enabled only after you have selected a beacon type.

The **Finish** and **Back** button on the wizard are always disabled on this first window.

5.2.2 Beacon Address

With a Type 8212 (MF) transceiver the following window will open:

Add Beacon Wizard

2. You can add several Compact 6 beacons in one go by selecting address cells below.

WB1 WB2 WB2+

Wideband 2 is the default for 6th Generation (6G) instruments

1701	1801	1901	2001	2101	2201	2301	2401	2501	2601	2701	2801	2901	3001	3101
1702	1802	1902	2002	2102	2202	2302	2402	2502	2602	2702	2802	2902	3002	3102
1703	1803	1903	2003	2103	2203	2303	2403	2503	2603	2703	2803	2903	3003	3103
1704	1804	1904	2004	2104	2204	2304	2404	2504	2604	2704	2804	2904	3004	3104
1705	1805	1905	2005	2105	2205	2305	2405	2505	2605	2705	2805	2905	3005	3105
1706	1806	1906	2006	2106	2206	2306	2406	2506	2606	2706	2806	2906	3006	3106
1707	1807	1907	2007	2107	2207	2307	2407	2507	2607	2707	2807	2907	3007	3107
1708	1808	1908	2008	2108	2208	2308	2408	2508	2608	2708	2808	2908	3008	3108
1709	1809	1909	2009	2109	2209	2309	2409	2509	2609	2709	2809	2909	3009	3109
1710	1810	1910	2010	2110	2210	2310	2410	2510	2610	2710	2810	2910	3010	3110
1711	1811	1911	2011	2111	2211	2311	2411	2511	2611	2711	2811	2911	3011	3111
1712	1812	1912	2012	2112	2212	2312	2412	2512	2612	2712	2812	2912	3012	3112
1713	1813	1913	2013	2113	2213	2313	2413	2513	2613	2713	2813	2913	3013	3113
1714	1814	1914	2014	2114	2214	2314	2414	2514	2614	2714	2814	2914	3014	3114

(19kHz) ← Longer Range → High Elev. USBL* → (33kHz)

Key:
 Already in use
 Reserved for Pulse Position Mode
 Addresses not recommended

On finish, perform the following action:

☐ Get None
 ☒ Get Beacon Identity
 ☐ Get All Beacon Parameters

Back Next Finish Cancel

With a Type 8221 (HF) transceiver the following window will open:



The Beacon Address selection window allows you to choose the beacon address.

Addresses are shown as a table with tabs:

- Each tab presents addresses for a specific address band.
 - WB1 for Sonardyne Wideband 1
 - WB2 for Sonardyne Wideband 2
 - WB2+ for Sonardyne Wideband 2+
 - Nodal for Sonardyne nodal
 - OBC/LRT for Sonardyne OBC
- Depending on the beacon type selected, more than one tab may be accessible because some beacons support multiple band types.
- Pre-existing beacon addresses are permanently highlighted in pink.
- Addresses reserved for pulse position mode of pre-existing beacons are permanently highlighted in light brown as shown in the example above. One extra cell is used for pulse-position depth; two extra cells are used for pulse-position angle.
- Select new beacon addresses within the active tab by clicking on the address cells of the beacons you wish to add. The cell changes to green when selected.
- Clicking on a selected (green) cell deselects it.
- Certain address ranges are not recommended for new jobs (e.g. WB2 1801...1814, 1901...1914 and 3101...3114). These address cells are shown with a dark red background with an appropriate key that warns the user of their use.

Final beacon settings are carried out within the Beacons Table and using the Beacon Specific Properties dialog box.

It is not possible to select pre-existing address cells (beacon addresses or pulse position mode cells). If the tab is changed and new cells are selected, the selected cells on the previous tab become deselected.

Three radio buttons are provided at the bottom of the window to specify what should happen after the beacons are created:

1. **Get None** – Don't do any telemetry to the beacon after creation.

On returning to the Beacons Table, all fields will show normal colour (not amber).

2. **Get Beacon Identity** (default selection) – If the beacon supports telemetry, obtain the identity of the beacon after creation.
 - a. For Sonardyne 6G beacons the transceiver sends an FS command (and possibly a SUB command) to the physical beacon.
 - b. All fields that have not been updated by the above commands show a User Modified state (AMBER).
 3. **Get All Beacon Parameters** – If the beacon supports telemetry, retrieve all beacon parameters from the physical beacon and update all relevant fields in the table.
 - a. For Sonardyne 6G this results in FS, VS, CS commands being sent.
 - b. All fields are updated in the table, so all cells for the created beacons should be in normal state (not AMBER).
- The **Clear** button clears all selected cells.
 - The **Back** button on the wizard is always enabled, so you can go back to the previous window and edit its contents.
 - When the **Finish** button is clicked, the beacon(s) is created according to the settings provided, and the Wizard closes.

Refer to the Frequency Chart (see *Figure 5-1*) for guidance on optimising USBL accuracy vs. range and avoidance of other acoustic systems operating in the vicinity.

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5.3 Optimum Choice of Wideband Signals for USBL

Note

 This section is not relevant for the Type 8221 (HF) transceiver.

5.3.1 Overview

In Sonardyne Wideband systems, the carrier frequency of coded reply signals is linked to the beacon address. Choosing the most appropriate address to use for USBL tracking is always a compromise between competing factors. The most important factor is to ensure that there is good signal compared to the noise (SNR), but the frequency of the Wideband carrier is also important to get the best performance. In general, higher frequencies provide both better precision, and accuracy; however, higher frequencies also suffer greater absorption, and therefore reduced SNR.

5.3.2 Wideband Choices

Wideband2 signals, which are available in all 6G instruments, should be used unless there are specific operating circumstances that require another option. In situations where there is likely to be significant reverberation, high noise or at extremely long range, then Wideband2+ may be useful (Wideband2+ signals have twice the duration of a Wideband2 signal, and so use twice the battery power). Wideband1 signals should only be used for compatibility with 5G systems. When adding a new beacon in Mini-Ranger 2 the address selector lays out beacon addresses that use the same carrier frequency in columns.

A range of addresses at the top and bottom of the band that are not generally recommended for use are shaded in red below.

WB1WB2WB2+

Wideband 2 is the default for 6th Generation (6G) instruments

1701	1801	1901	2001	2101	2201	2301	2401	2501	2601	2701	2801	2901	3001	3101
1702	1802	1902	2002	2102	2202	2302	2402	2502	2602	2702	2802	2902	3002	3102
1703	1803	1903	2003	2103	2203	2303	2403	2503	2603	2703	2803	2903	3003	3103
1704	1804	1904	2004	2104	2204	2304	2404	2504	2604	2704	2804	2904	3004	3104
1705	1805	1905	2005	2105	2205	2305	2405	2505	2605	2705	2805	2905	3005	3105
1706	1806	1906	2006	2106	2206	2306	2406	2506	2606	2706	2806	2906	3006	3106
1707	1807	1907	2007	2107	2207	2307	2407	2507	2607	2707	2807	2907	3007	3107
1708	1808	1908	2008	2108	2208	2308	2408	2508	2608	2708	2808	2908	3008	3108
1709	1809	1909	2009	2109	2209	2309	2409	2509	2609	2709	2809	2909	3009	3109
1710	1810	1910	2010	2110	2210	2310	2410	2510	2610	2710	2810	2910	3010	3110
1711	1811	1911	2011	2111	2211	2311	2411	2511	2611	2711	2811	2911	3011	3111
1712	1812	1912	2012	2112	2212	2312	2412	2512	2612	2712	2812	2912	3012	3112
1713	1813	1913	2013	2113	2213	2313	2413	2513	2613	2713	2813	2913	3013	3113
1714	1814	1914	2014	2114	2214	2314	2414	2514	2614	2714	2814	2914	3014	3114

(19kHz)

← Longer Range

High Elev. USBL*

USBL →

(33kHz)

5.3.3 Address Choices

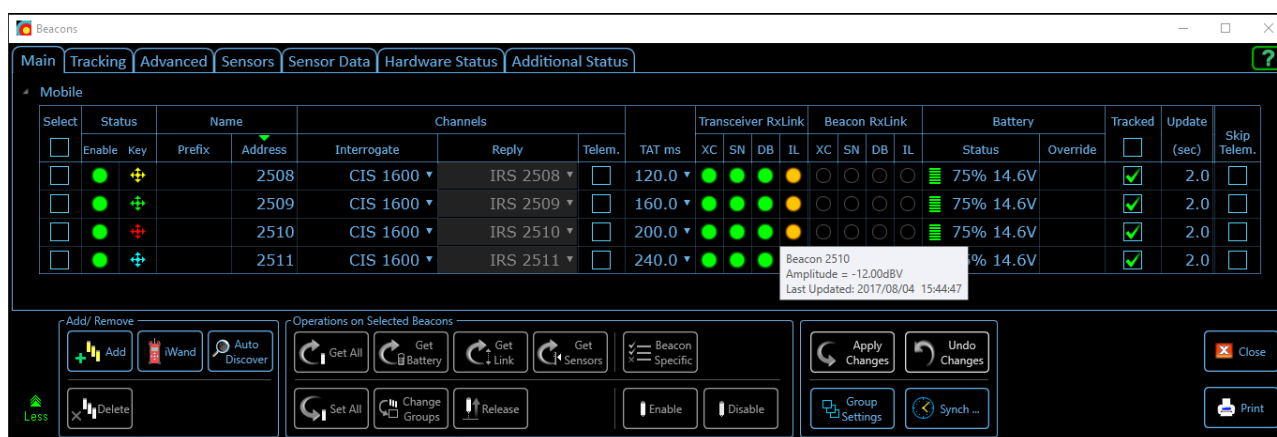
It can be difficult to predict what the SNR is going to be before deploying a beacon, and currently Mini-Ranger 2 does not provide an automatic way to reconfigure a beacon's address after it has been deployed, and so it is sometimes necessary to select an address that will give best performance based on the application, and the expected operating depth. As a general rule, high elevation tracking applications (such as towfish tracking) ought to use addresses in the range 20xx-24xx, and USBL applications tracking beacons mostly below the vessel should aim to use addresses between 27xx and 30xx. Omni-directional beacons should provide sufficient signal level to use Wideband address

families with higher frequency carriers to operating depths of 1500 m or more, and directional beacons track up to 2500 m. If the expected operating depth is more than these limits, then lower address families may give better SNR. Refer to individual beacon operating manual for instructions on how to change the address.

5.3.4 Diagnostics

The Beacons Table in Mini-Ranger 2 provides useful received signal diagnostic 'traffic light' indicators from the transceiver on every update, and from the beacon on request (select the check box on the left of a row, and click **Get Link**). The traffic light indicators include the amplitude (DB), and SNR (SN) of signals being received from each beacon. Green is good, amber is okay, but red indicates that performance may be difficult. By hovering the cursor over the traffic light indicators, a readout popup shows the current levels (see below).

Assuming that the received signal level is not saturating the USBL transceiver's receiver (check DB light is not red), SNR can be improved by increasing the output power of the beacon. If the transceiver's DB light is red, which indicates that the receiver is being saturated, check the transceiver gain, and consider reducing it to avoid saturation. It is possible to tune the transceiver power, and beacon gain in the same way – adjust beacon gain and transceiver output power so that the DB light is not red, and the SNR is good.



5.4 iWAND Tool

Note

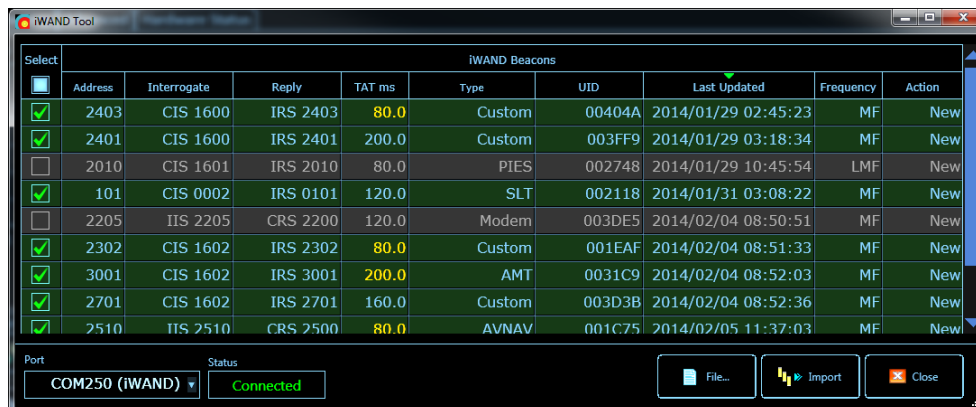
This section is not relevant for the Type 8221 (HF) transceiver.

Clicking the **iWAND** button on the **Beacons** window launches the **iWAND Tool** as shown below. This tool allows multiple beacon data to be imported into the current setup.



If no iWAND is connected the **Port status** field shows **Connecting**.

When an iWAND is connected through RS232 or USB to the Marine Computer, the **Port** field automatically updates, and after a short time shows the status **Connected**. The available beacons for import are listed in the table, for example as shown below.



If there are conflicting beacon addresses or TATs in the imported data, a warning message is shown:

If there are conflicting beacon Addresses in the imported data, the relevant row(s) are enabled but the **Select** check box is only selected for one of the conflicting addresses (see **2101** below). The remaining conflicting addresses are highlighted in red. A tooltip indicates the problem if the mouse cursor is hovered over it.



If there are conflicting TATs in the imported data, the relevant rows(s) are enabled. The conflicting TAT is highlighted in orange (see below). A tooltip indicates the problem if the mouse cursor is hovered over the relevant row.



Beacons that are not supported, or are not enabled in the security key, are disabled (greyed out) in the table as shown above. It is not possible to Select these beacons for import.

All other supported, non-conflicting beacons have their **Select** check box automatically selected as shown above. You can use the **Select** column to select/clear beacons for import.

You can click on the header area of any column to sort the whole table by the data in that column. The sorted column is indicated by a green chevron in the column header. Clicking on the green chevron toggles the sort order.

Clicking the **Import** button imports all beacons that have their **Select** check box selected. The **iWAND Tool** closes and the **Beacons** window updates with the new beacons that have been imported.

When a beacon is created by using iWAND Import, only key beacon settings are specified by the iWAND. The rest are defined by system defaults. Specifically, the telemetry transceiver defaults to the first available 6G transceiver that is in the setup.

Clicking the **File** button launches a dialog box that allows you to select an iWAND data file (XML). When this is done, data from the file appears in the table in exactly the same way as if it came from the iWAND itself (see previous figures).

Click the **Close** button at any time closes the **iWAND Tool** and returns control to the **Beacons** window.

The prefix for all imported iWAND beacons in the Beacons Window defaults to:

iW.

You can edit this prefix if necessary.

5.5 Beacon Discovery Tool

Note



This section is not relevant for the Type 8221 (HF) transceiver.

Clicking on the **Auto Discover** button on the **Beacons** window launches the **Beacon Discovery Tool** window. This allows the acoustic discovery of any Sonardyne 6G beacon within the current Environmental Operating Range of a selected transceiver.

On launch, all controls are enabled (buttons/ combo boxes, and so on), except for the **Identify** and **Import** buttons.



Click **Transceiver** and select the preferred transceiver to use for the discovery. Only 6G transceivers are listed, and the first available one is automatically selected as default.

Click on the **Signal Set** control and choose the -Sonardyne signal set to use when discovering beacons. The default signal set is Wideband 2.

The workflow order is:

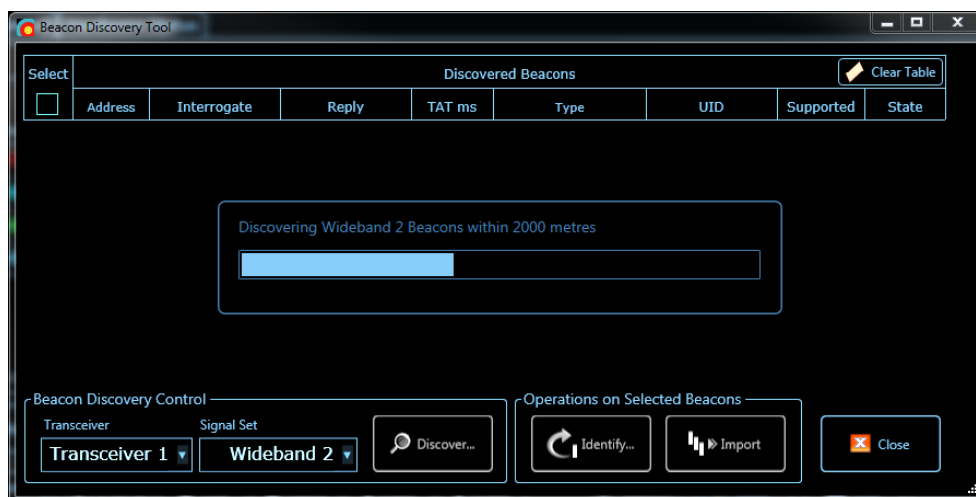
1. Discover the beacon(s).
2. Identify the beacon(s).
3. Import the beacon(s) to the setup.

These are described in detail in the next sections.

Clicking the **Close** button when the tool is not busy performing a Discover or Identify operation causes the window to close. Control is then returned to the **Beacons** window.

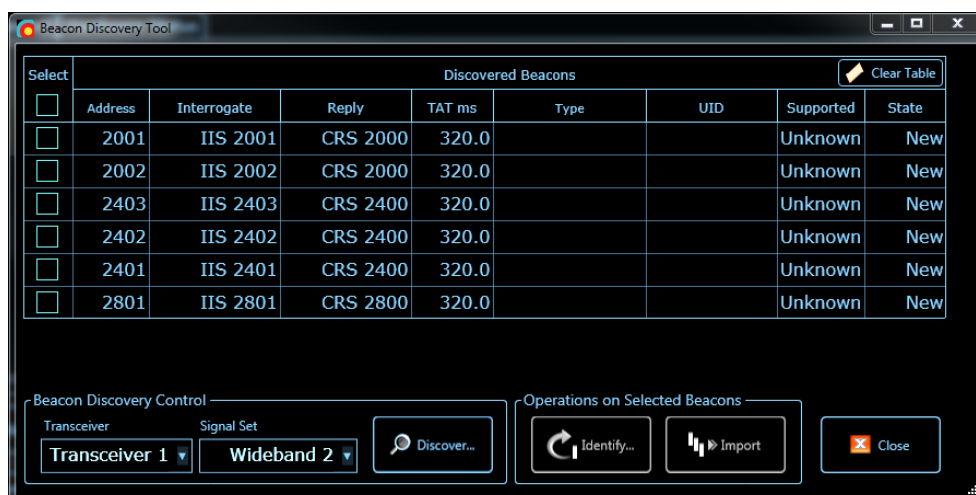
5.5.1 Beacon Discovery Operation

Click **Discover** to start the beacon discovery process using the selected transceiver and the selected signal set. A dialog box shows a progress bar and **Cancel** button (see below). The discovery process uses the **Max Operating Range** value as defined in the Environmental settings.



When the beacon discovery progress bar reaches the end, the progress window closes, and the **Discovered Beacons** table updates with all 6G beacons discovered during that cycle (see below).

Repeated clicking of the **Discover** button merges any newly found beacons with results of those discovered on previous tries. That is, discovery is cumulative over successive discovery cycles.



Newly discovered beacons that already exist in the setup are shown as completely greyed out rows in the table (see above). Additionally:

- The **Select** field is disabled. No operations can be performed on existing beacons.
- The **Address** field is the discovered address.
- The **State** field shows **Exists**.
- The Supported field shows **Yes**.
- All other fields are filled in (as in the main **Beacons** window).

Newly discovered beacons that do not yet exist in the setup are shown with the row not greyed out (see above). Additionally:

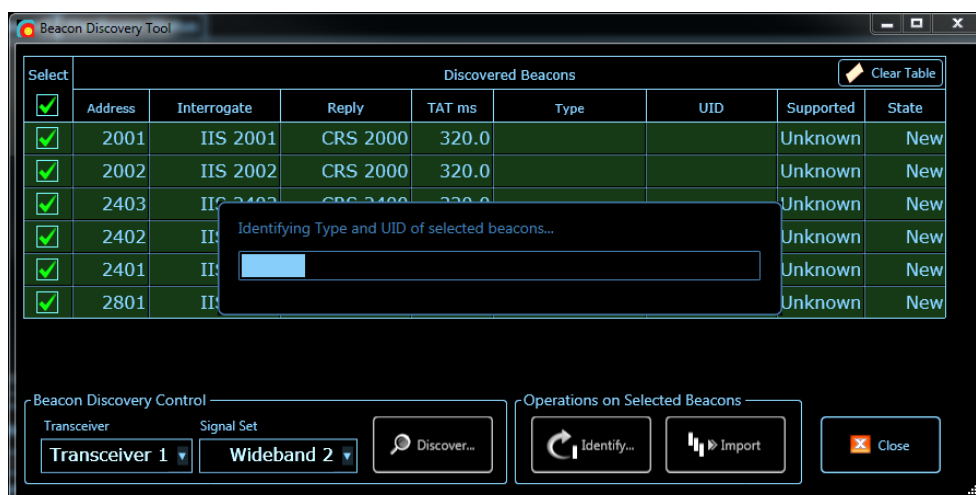
- The **Select** field is enabled, so that Identify and Import operations can be performed.
- The **Address** field is the discovered address.
- The **State** field shows **New**.
- The **Supported** field shows **Unknown**.
- The **Interrogate*** field shows an IIS signal for the discovered address.
- The **Reply*** field shows a CRS signal for the discovered address.
- The **TAT ms*** field shows 320 because of the IIS
- The **Type** field is empty at this stage
- **The** UID field is empty at this stage

* The **Interrogate**, **Reply**, and **TAT ms** fields default to IIS/CRS values to avoid the need to send any telemetry to the beacons in order to start tracking immediately.

Clicking the **Clear Table** button clears all data from the **Discovered Beacons** table.

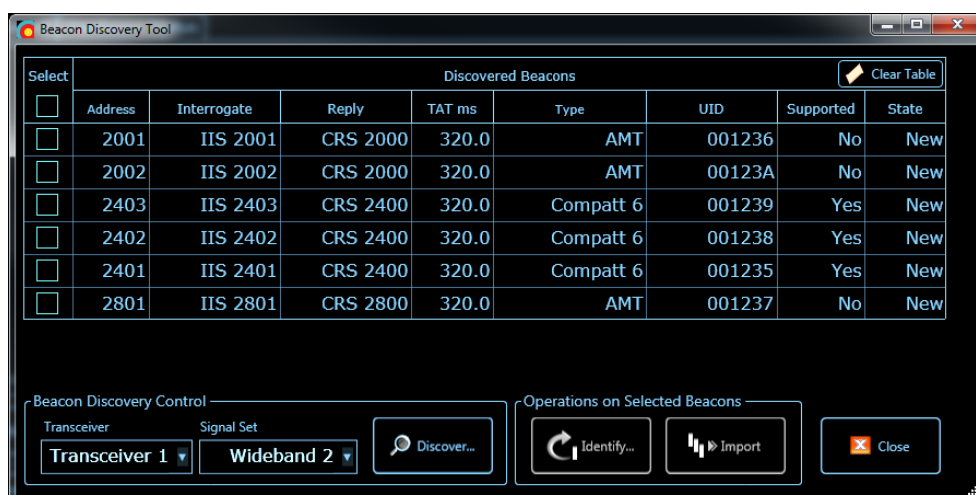
5.5.2 Beacon Identification.

You may optionally select specific beacons, and click the **Identify** button. A dialog box shows a progress bar and **Cancel** button (see below). This causes an FS telemetry command to be sent sequentially to each selected beacon that has a current Supported status of Unknown. Note that if the Supported status is Yes/No, then it implies that the beacon has already been identified (no need to repeat). The reply from the FS is used to update the Type and UID columns of the respective beacons in table.



When the progress bar reaches the end, the progress dialog box closes and the **Discovered Beacons** table updates with the **Type** and **UID** fields filled in for all beacons that were selected. The **Supported** field updates to:

1. **Yes** if the beacon is supported (as shown below).
2. **No** if it is not supported (as shown below).



If an error occurs in identifying any beacon, the **Type** and **UID** fields remain blank, and the **Supported** field remain **Unknown**.

5.5.3 Beacon Import

Beacon import is possible on any selected beacon in the **Discovered Beacons** table, regardless of whether or not the **Identify** process has been done.

Note

 **Beacons whose State is set to Exists, are not selectable, and so are not importable.**

Certain assumptions are made when importing a beacon, depending on whether **Identify** has been performed and whether the identified beacon is **Supported** by the application. These are as follows:

- If the **Identify** process has not been performed on a beacon, then it is always imported as a generic **Compatt 6**. A warning message is displayed to indicate this.

- If the **Identify** process has been performed on a beacon, but its type is not supported, then it is always be imported as a generic **Compatt 6**. A warning message is displayed to indicate this.
- If the **Identify** process has been performed on a beacon, and its type is supported, then it is always imported as the type indicated without any message to the user.
- If a mixture of **Identified** / **Non-Identified** / **Supported** / **Unsupported** beacons are selected for import, a message is displayed to indicate that at least one beacon will be imported as a **Compatt 6** for the appropriate reason.

After the Import has completed, the **Beacon Discovery Tool** window closes and the imported beacons are shown in the **Mobiles** section of the **Beacons** window.

The prefix for all discovered beacons in the **Beacons** window defaults to the **D** character. You can edit this subsequently if necessary.

All imported beacons have their Skip Telemetry check box clear in the **Beacons** window.

5.6 Beacon Import/Export

Importing and Exporting beacons is a useful way of maintaining an inventory of beacons, and their current state, as well as moving beacons between systems.

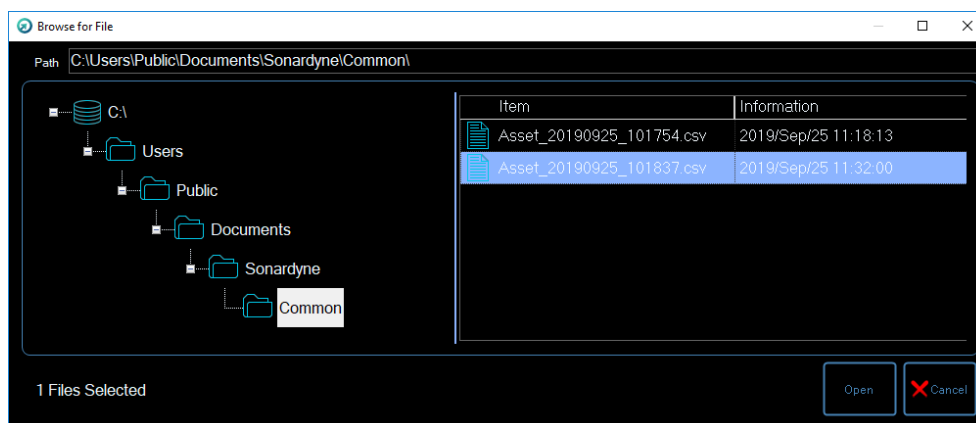
Note

 The import/Export CSV format is compatible with Sonardyne's Fusion 2 software, and so can be used for moving assets between systems.

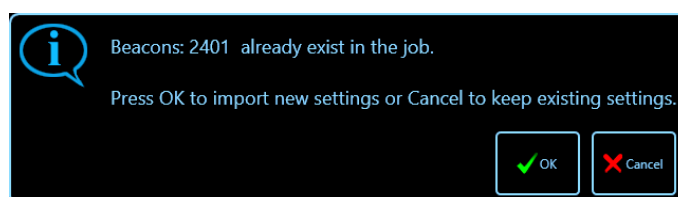
5.6.1 Importing Beacons

To import beacons to the current job:

1. Click **Import CSV** and select the file to import.



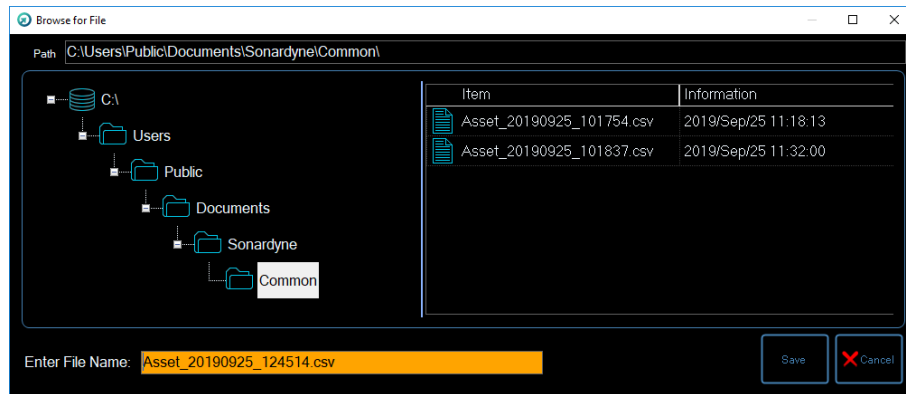
2. Click **Open** to automatically add the beacons in the CSV to the job.
3. A warning prompt is given prior to overwriting existing beacons that already exist in the job.



5.6.2 Exporting Beacons

To export beacons from the current job:

1. Select the required beacon in the **Beacons Table**, and then click **Export To CSV**.
2. Enter a filename and then click **Save** to save the file to the default folder.



Section 6 – Application Procedures

6.1 Introduction

This chapter includes a series of procedures for performing common acoustic positioning tasks with the system. Each procedure in this chapter includes the instructions you need to set up the system and to perform the specific procedure.

Note

There are certain set-up tasks that are common to many of the procedures included in this chapter. Section 4 "Common Procedures" explains and describes these common set-up tasks.

The software is able to manage communications between multiple transceivers and multiple target objects. This gives much improved operational flexibility when the system is being used in a complex configuration. Some of the procedures described in this chapter take advantage of this flexibility.

For simplicity, the descriptions in this chapter are limited to include only the information needed to perform each procedure. If you require more information about the software dialog boxes, see *Appendix A "User Interface"*.

6.1.1 Before you begin

All the procedures in this chapter assume that:

- the system has been installed correctly
- you are starting each of these applications with a new setup that contains no targets or Instruments
- you have made a written record of the addresses for each of the beacons to be used in the setup, and
- you have arrived on station and deployed all the transceivers, transponders, and targets required for the application.
- The alignment of the USBL transceiver has been properly calibrated to the attitude and heading sensors (see *Appendix F "CASIUS Data Collection Methods"* or calibration checks).

If any of these prerequisites is not true it should be resolved.

All these procedures also assume that the system operator is familiar with the rules and methods for selecting menu items, moving the cursor around the dialog boxes and is familiar with the options and controls on the dialog boxes.

Switch on the system and wait until the main window is displayed.

Note

Depending on the way your Marine Computer has been configured and which software version you are running, the software may appear slightly different when you use it. However, the controls will function as described in this manual.

6.2 USBL Mobile Beacon Tracking

6.2.1 Application Summary

In this scenario a USBL system is required simply to report the position of a mobile beacon (typically installed on an ROV). Position is reported in terms of eastings, northings and depth with respect to the

vessel datum. If GNSS position and gyrocompass heading reports are available to the system, the positions of both the vessel datum and of the mobile beacon are reported in absolute co-ordinates.

The output can be made available to a dynamic positioning system and to a survey package.

There are two types of beacon available in the system:

- **Transponder** — the mobile beacon is completely remote. It is interrogated acoustically and replies acoustically.
- **Responder** — the beacon is triggered by an electronic interrogation through a hard-wired link or umbilical, and replies acoustically.

6.2.2 Navigation Set-up

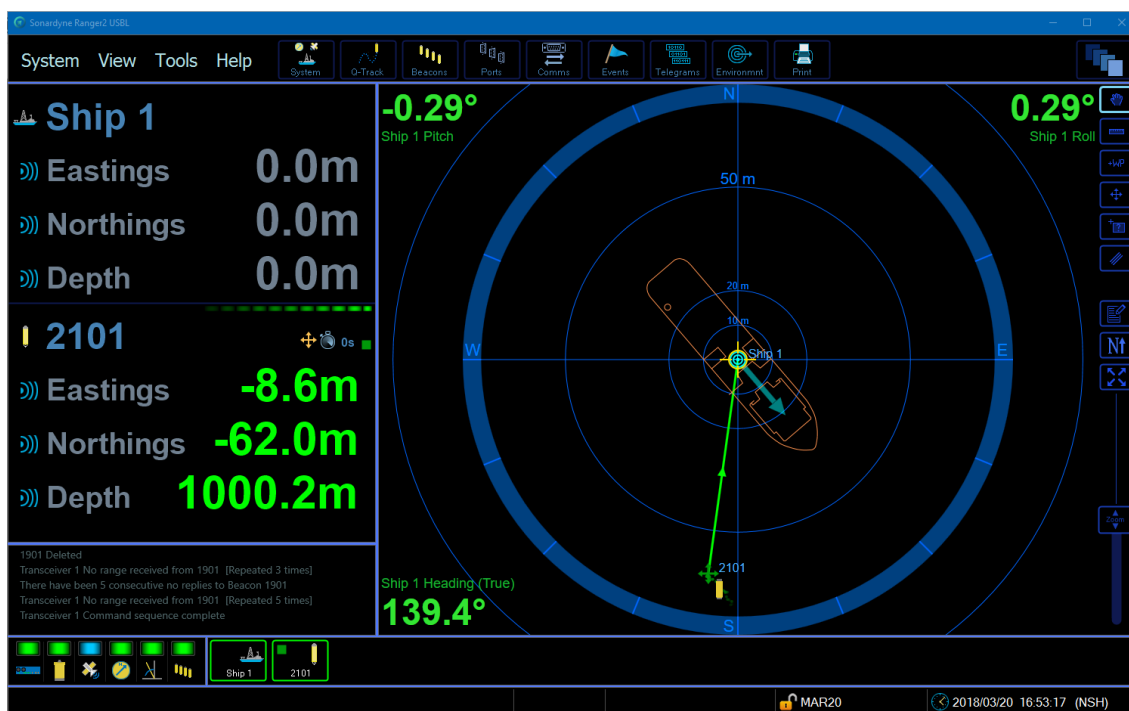
If a template exists, use it to create the setup.

If there is no template, select **System > Setup** to display the **System Setup** window and refer to *Section 4 "Common Procedures"* to add the instruments used in the setup.

6.2.3 Navigate

Select the main screen and follow the callout instructions below.

1. Select the Ship frame for vessel-relative tracking.
2. Enable the Instruments on the ship for use in tracking.
3. Click to enable beacon tracking.
4. Wait for a short time while a series of measurement cycles complete and the vessel and beacon positions are displayed. In this example the system has no GNSS input and shows the beacon position relative to the vessel.



Note

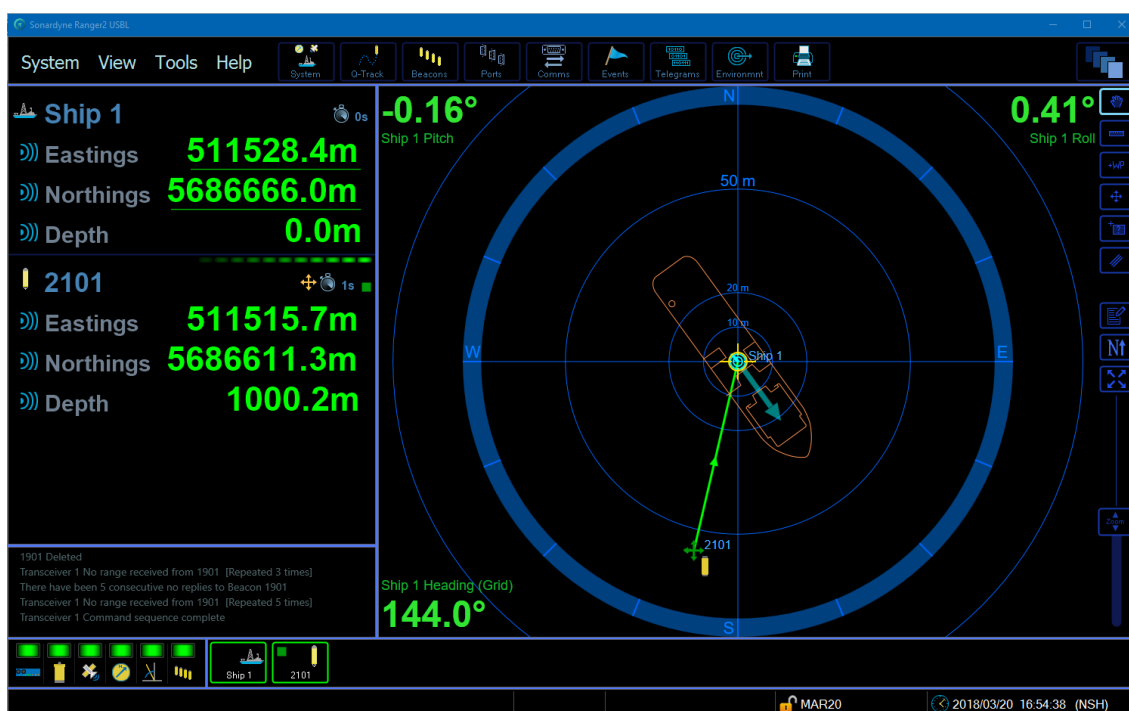
 The intermittent radial line from the vessel to the beacon that represents the measurement cycle is green when range measurements are successful, and red when range measurements are in error. Also note that the position information shown is in green figures when the measurements are fresh, but decay towards orange figures if the measurements are not updated.

Refer to the description of the main window in *Appendix A "User Interface"* to set the options for north/bow up, centring or pinning an object on the chart, measuring distances on the chart, zooming the chart, and switching between day and night mode.

6.2.4 GNSS Input

The example shown above uses input from a gyrocompass but not from a GNSS system, and provides only basic tracking information for the beacon relative to the vessel's datum. You can add a GNSS Instrument to the setup to provide more detailed position reports.

When the system receives input from a GNSS receiver, the display shows the vessel and beacon positions using real-world co-ordinates, for example in the following screen the frame is set to World.



In this operating mode, the tracked targets show a 'snail trail' to indicate a history of the target position over the previous updates; see **Position History Length** in the **Chart Properties** (*Section A.2.1 "Chart Properties"*). This trail fades with time so that the display does not become cluttered.

6.3 AUV Tracking (requires 'Robotics pack' option)

In this application, an AvTrak 6 or other SMS capable beacon is mounted on an AUV with one of its serial ports connected to the AUV control system. The transceiver sends SMS messages to the AvTrak 6, and computes its USBL position from the acknowledgment. The computed position is then sent to the AvTrak 6 as the payload of the next SMS message.

Note

 Contact Sonardyne Customer Support for detailed guidance on the AvTrak 6 position message string format.

This technique can be used to either track an individual AUV using an IIS interrogation, or groups of AUVs using multiple beacons on the same CIS.

If multiple different interrogation signals are enabled in SMS telemetry mode, the system will schedule the interrogations in a round robin fashion.

Note

 **This technique uses telemetry for tracking, and is exclusive of normal ranging. When one, or more AvTrak 6s are put into Telemetry tracking mode, tracking of all other beacons is automatically turned off.**

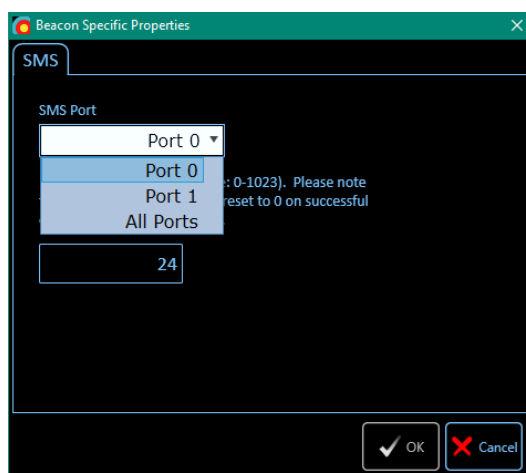
1. Select the AvTrak 6 and choose whether individual interrogation (IIS) or common interrogation (CIS) is required; see *Section 5 "Beacons"*
2. Select the **Telem** checkbox to enable the Telemetry tracking mode.

Channels			
Interrogate	Reply	Telem.	TAT ms
CIS 1607 ▾	IRS 2401 ▾	☒	120.0 ▾
CIS 1607 ▾	IRS 2705 ▾	☒	240.0 ▾
CIS ▸	CIS 1600		
IIS ▸	CIS 1601		
Responder ▸	CIS 1602		
	CIS 1603		
	CIS 1604		
	CIS 1605		
	CIS 1606		
	CIS 1607		
	CIS 1608		
	CIS 1609		
	CIS 1610		
	CIS 1611		
	CIS 1612		
	CIS 1613		
	CIS 1614		

3. To set up a serial connection to the AUV, select the checkbox of the AUV's AvTrak 6 and click the **Beacon Specific** button.



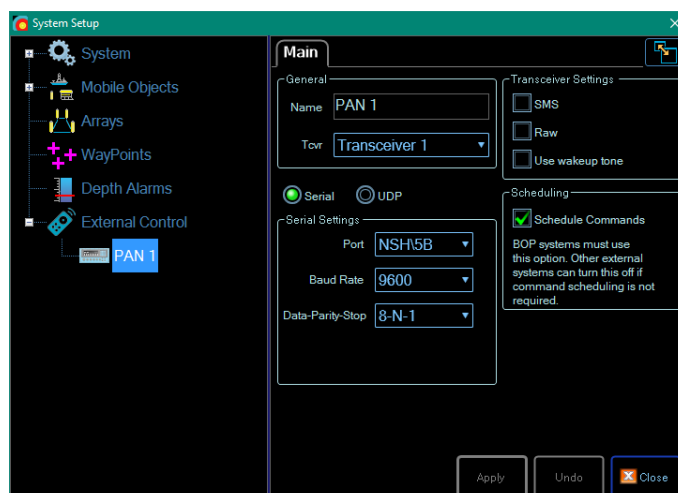
4. Select the AvTrak 6 serial port on the drop-down list.

**Note**

 The spare three digits on this dialog box can be set, and will be encoded into the following SMS messages sent to the beacon. They can be used by an external system to send command numbers or status requests to the vehicle.

If the AUV control system needs to send occasional status messages, it can send these to the AvTrak 6 as SMS messages, which will be sent as the acknowledgement to the next incoming position message from the surface.

If a PAN port is added to the system, and **SMS** is selected, then the SMS messages received from the AvTrak6 will be routed out of that port. In the same way, SMS commands can be sent into the PAN port and these will be interleaved with the normal SMS traffic.



Since this tracking technique uses telemetry messages for tracking, it is important to optimise the telemetry settings for best performance. In particular, it is recommended that the fastest reliable transmit speed is used (see **Tools > Options** and select the **Acoustics** tab for default settings).

6.4 Towfish Tracking

6.4.1 Application Summary

The system can be used to position a towfish while a vessel is towing it.

Towfish are commonly tracked at high elevations. This can make the signals difficult to detect, and make the estimated depth less precise.

The following recommendations apply when using this application:

- Use depth aiding in this application. Sonardyne beacons can be configured to report depth using a second reply signal, or a manual depth can be used.
- For very long layback tracking, it is sometimes necessary fit an adaptor flange to a standard transceiver so that it angles the transceiver face towards the target. Although this technique can be helpful in increasing the signal level received from the beacon when tracking a target directly astern of the vessel, it can also result in the introduction of additional noise from the vessel, and so limit the transceiver's ability to track targets.
- Use GNSS input. Generally a towfish is towed a fixed distance behind the vessel, and so does not appear to move very much with respect to the vessel. Using GNSS to track the vessel allows the system to compensate the towfish measurements for the true velocity of the beacon through the water.

6.5 Diver Tracking

For high-elevation diver tracking, it is recommended to use depth aiding by WB3 Depth mode on the beacon.

6.6 OBC Tracking

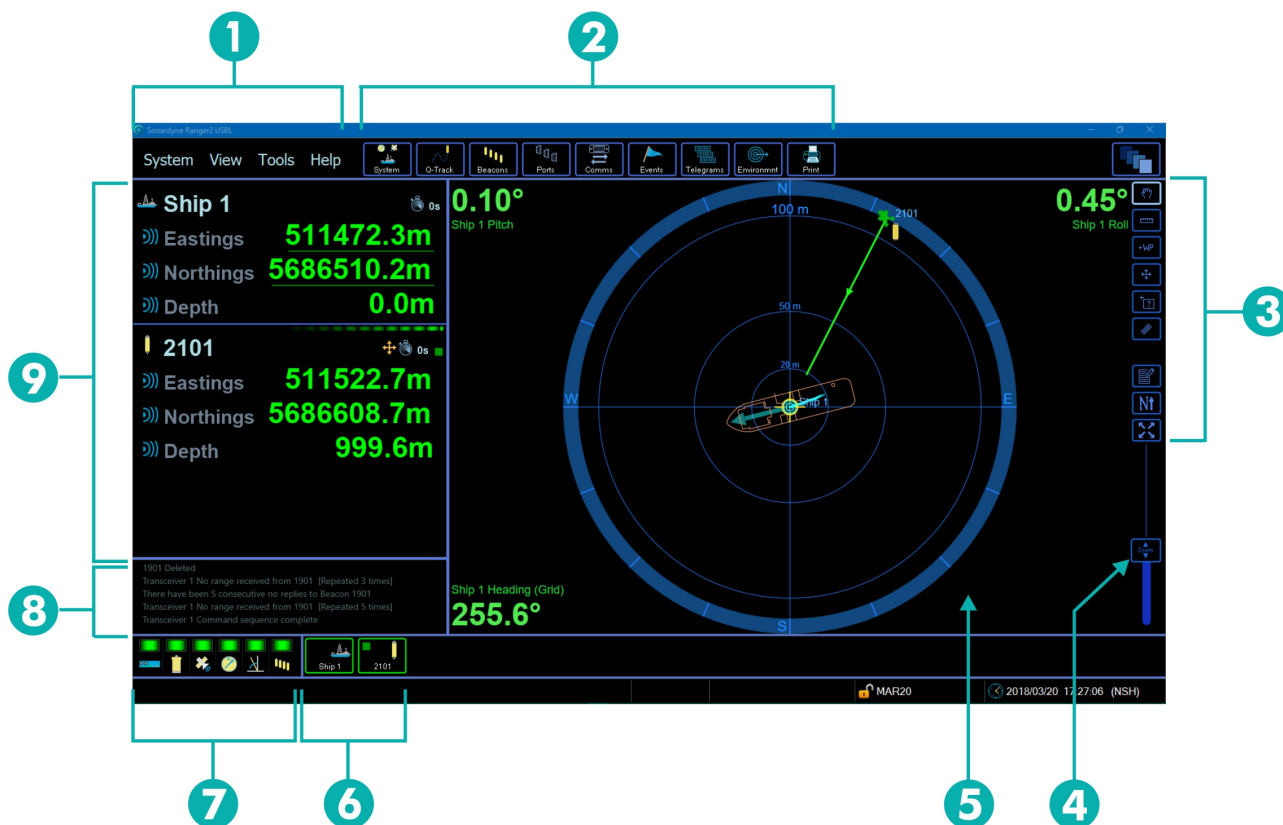
In this application, TZ beacons are deployed attached to seismic cables and are tracked to the seabed by the USBL system. The USBL system is typically driven remotely by an external navigation package such as Sonardyne Hydropos through the remote control interface.

1. Setup the 'Remote Control Device' to connect to Hydropos (or equivalent); see *Section 4.16.3 "Remote Control Interface "*.
2. Setup the required position output telegram to report beacon positions to Hydropos (or equivalent); see *Section 4.20 "Configuring Output Telegrams"*.
3. Hydropos adds beacons, starts tracking, stops tracking and deletes beacons through the remote control.
4. While Remote Control is active, the user interface is locked to prevent accidental operation.

Appendix A – User Interface

A.1 Mini-Ranger 2 Main Window

This section references and describes the Mini-Ranger 2 user interface.

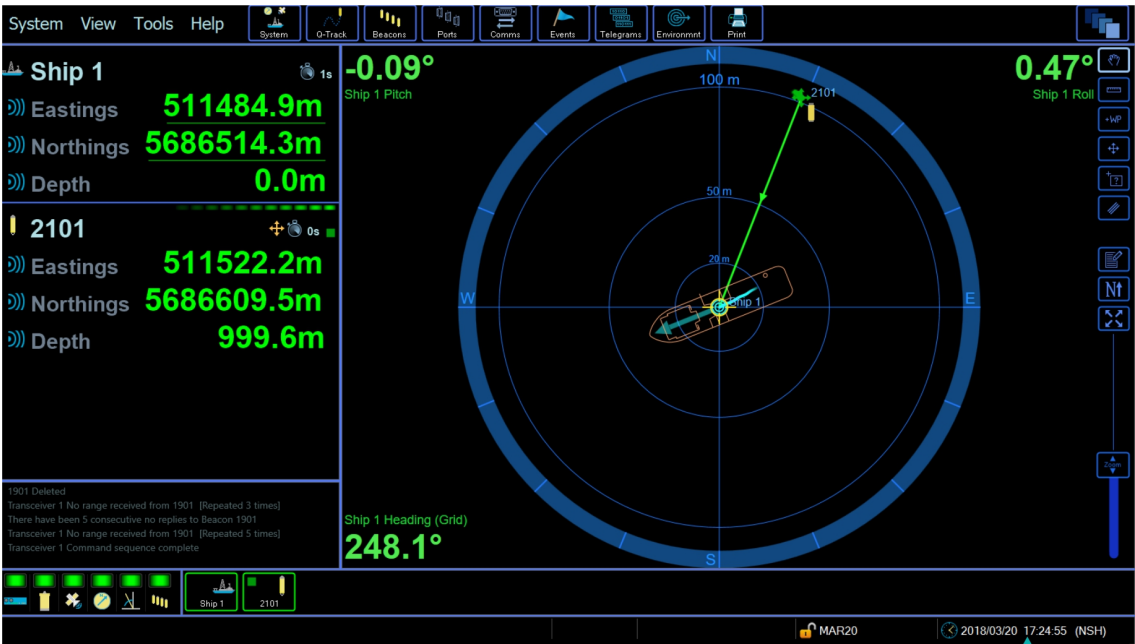


Item	Description
1	Menu Bar
2	Shortcut Buttons
3	Button Controls
4	Zoom Control
5	Navigation Chart
6	Target Selection Buttons
7	Instrument Status LEDs:  Green: All sensors are operating correctly  Blue: At least one sensor is not being used in tracking  Amber: At least one sensor is non-operational  Red: All sensors are non-operational Note: Double-click an LED to jump to the setup for that sensor.
8	Information Messages
9	Tracking Pane

The status bar at the bottom of the Mini-Ranger 2 main window shows the name of the current setup, and the current time and its source (either UTC or PC).

The status bar also shows information about the most recent active alarm condition, with the alarm icon flashing.

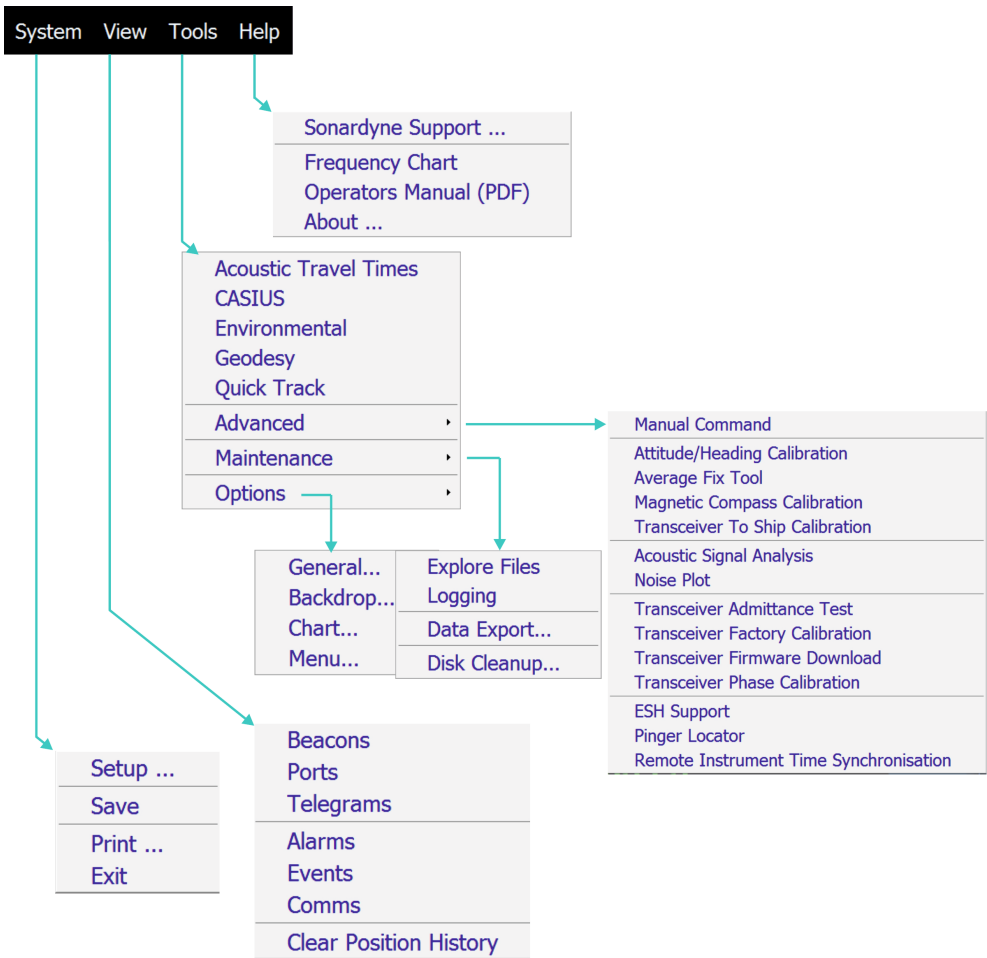
There is an option to display the main window of the software in full-screen mode. Refer to *Section A.9.8 "Options"* for instructions to set this option. The figure below shows an example of the main screen in frameless mode.



Item	Description
1	Current Time

The menu system (shown below) provides access to all the features needed to use the software.

Figure A–1 Menu System

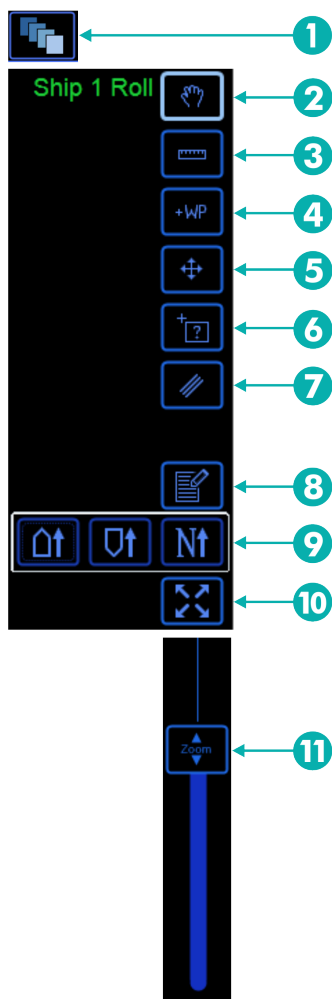


Note

 For clarity, all the menu entries are shown. During operation, some menu entries will not be available and will be greyed out.

A.2 Button Controls

The button controls on the main window control how the chart displays navigation information. They change their appearance when selected, as shown in the examples below:



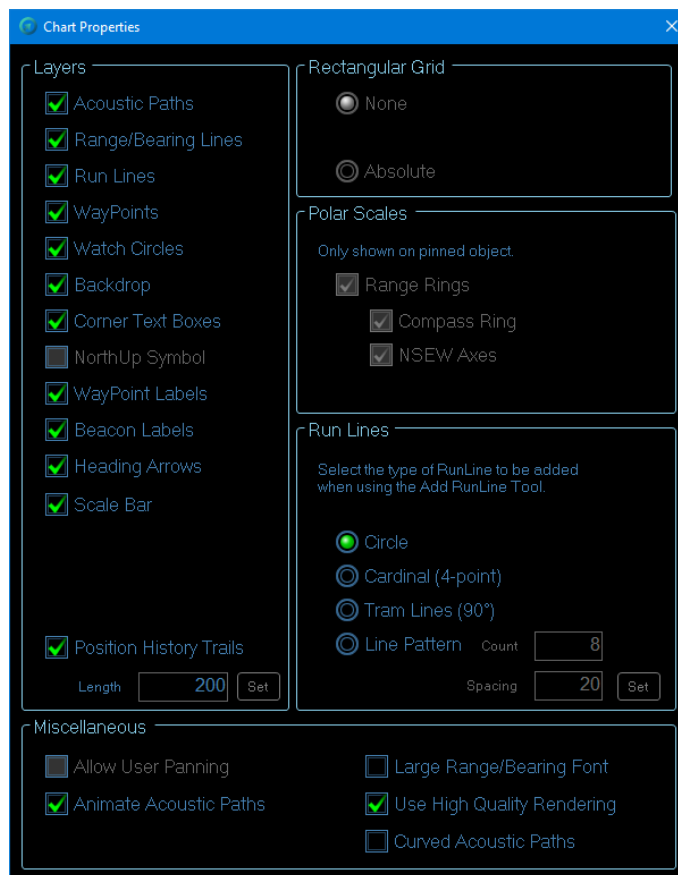
Item	Description
1	Cycle the display through four levels of brightness.
2	Chart pan mode - drag the chart with the mouse.
3	Measure distance tool. Click a starting point and move the mouse to a second point. A circle is drawn on the screen showing the horizontal and slant range and bearing to the second point.
4	Click to add a waypoint to the chart at the current location.
5	Move waypoint – click and drag with the mouse.
6	Show mouse position coordinates.
7	Create run lines – click and drag from a beacon or waypoint to position; see the information about Chart Properties in <i>Section A.4 "Navigation Chart Pane"</i> for Run Line choices.
8	Navigation Chart Properties; see <i>Section A.2.1 "Chart Properties"</i> .
9	Select north-up, ship's head up, or ship's head down mode for the main display.
10	Click to set the chart scale automatically to include all active targets.
11	Click and drag the slider control to set the zoom level of the main display.

A.2.1 Chart Properties

The **Chart Properties** are shown below.

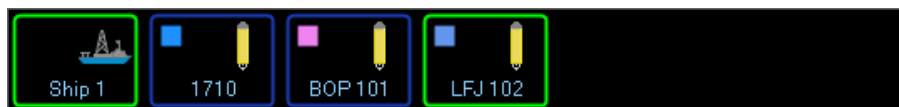
Note

 Properties shown below are dependent on the software options purchased.



A.3 Target Selection Buttons

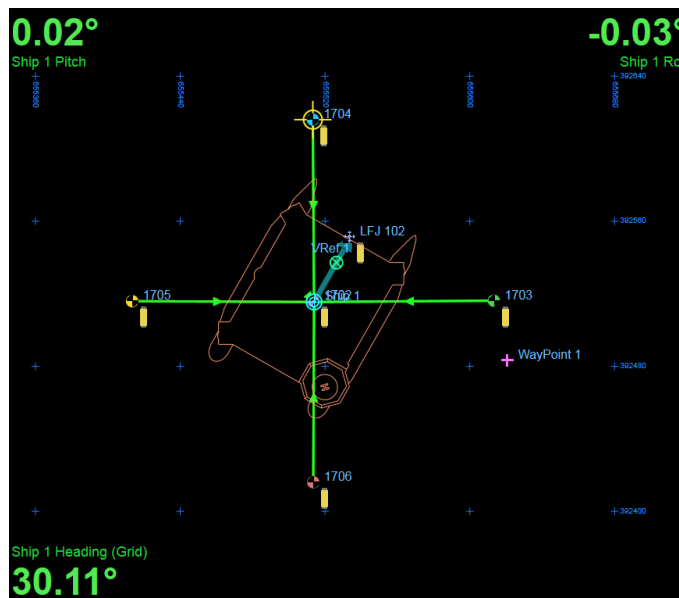
The target selection buttons allow you to select the targets to be tracked and displayed. The buttons available depend on the targets in the current setup.



The buttons show green borders for targets that are being tracked, or blue borders if the target is not being tracked. The button can be clicked to toggle the tracking status.

A.4 Navigation Chart Pane

The navigation chart pane displays a graphical representation of the relative positions of all items in the setup.



You can use the Chart Controls and the Chart Properties to:

- zoom the display
- pin a particular target
- measure distances between items
- add Run Lines
- add Waypoints
- Configure Position History Trails

'Range' lines indicate each active acoustic ranging to each tracked target. Range lines are green when tracking is successful.

The current ship's Pitch, Roll and Heading are displayed in the corners of the pane.

Mobile beacons are shown using the icon:



Mobile

A.5 Tracking Pane

The tracking pane lists all the tracked targets and shows information about their status and position. As the position data ages, the display colour fades from green through to brown or red. The icon used is:



Mobile beacon

Depending on the **Position Display Format** setting defined in **Tools > Options**, positions of the tracking pane can be show using any of the following formats:

- UTM grid with 1 decimal point precision
- Latitude/longitude degrees to 7 decimal points
- Latitude/longitude minutes to 5 decimal points
- Latitude/longitude seconds to 3 decimal points
- Horizontal Range and Bearing

See *Section A.9.8 "Options"* for details of how to choose the display format.

Ship 1 1s Eastings <u>650779.0m</u> Northings <u>5688818.4m</u> Depth <u>0.0m</u>	Ship 1 0s Latitude <u>51° 19' 50.308" N</u> Longitude <u>0° 50' 8.484" W</u> Depth <u>0.0m</u>	Ship 1 H. Range <u>0.0m</u> Bearing <u>n/a</u> Depth <u>0.0m</u>
2001 2s Eastings <u>650778.3m</u> Northings <u>5688817.7m</u> Depth <u>1000.0m</u>	2001 1s Latitude <u>51° 19' 50.296" N</u> Longitude <u>0° 50' 8.541" W</u> Depth <u>1000.0m</u>	2001 0s H. Range <u>153.8m</u> Bearing <u>329.9°</u> Depth <u>99.8m</u>
2002 2s Eastings <u>650781.9m</u> Northings <u>5688918.4m</u> Depth <u>1000.0m</u>	2002 1s Latitude <u>51° 19' 53.328" N</u> Longitude <u>0° 50' 8.422" W</u> Depth <u>1000.6m</u>	2002 1s H. Range <u>99.7m</u> Bearing <u>15.9°</u> Depth <u>100.3m</u>

Positions shown are relative to the transceiver if there is no GNSS data available to the software. If the software receives GNSS information, positions shown can be in real-world co-ordinates.

For each entry in the tracking pane, there is a target selection button that allows you to toggle tracking on or off for the associated target.

Note that tracking is disabled in the software unless there is a valid security key fitted.

When acoustic tracking is not active, GNSS-based positions are shown in blue cyan colour to distinguish them from acoustically-derived positions.

Ship 1 0s
Latitude <u>51° 19' 50.308" N</u>
Longitude <u>0° 50' 8.484" W</u>
Depth <u>0.0m</u>

Note

 **Vessel GNSS position is automatically displayed when acoustic tracking is stopped, assuming GNSS is available.**

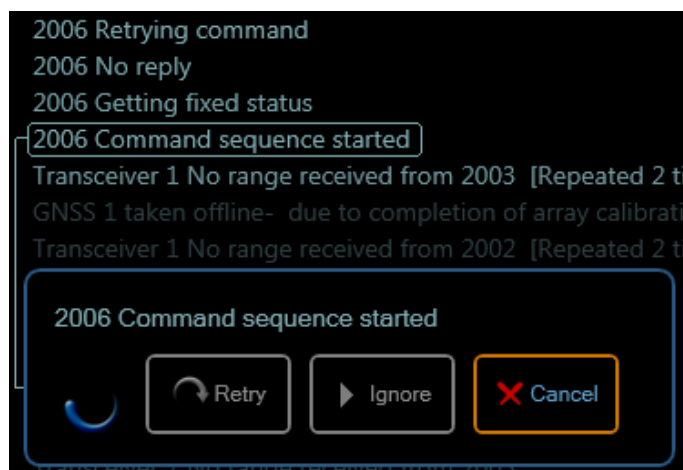
When a position is 'aided' by GNSS or depth sensor, it is displayed with an underscore. In this example, the Ship Easting and Northing were calculated using GNSS input, and the beacon 2001 depth was calculated using the beacon's depth sensor.

A series of moving dashes above the position indicates the status of the acoustic cycle.



A.6 Message Pane

The Message Pane displays information about what the system is doing. Each message fades out over time.



Double-click anywhere on the Message Pane to launch the Events Viewer, which shows a more detailed view of the message system.

When a command sequence starts, **Retry**, **Ignore** and **Cancel** buttons are overlaid on the Message Pane. These buttons allow you to interact with the command sequence:

- Click **Retry** to retry a failed command.
- Click **Ignore** to ignore a failed command.
- Click **Cancel** to cancel a failed or running command.

Note

 Cancelling a running command might leave a part of the system in an unknown state. For example, a beacon might not be set up ready for use.

A.7 System Menu

The **System** menu gives access to all the system-related functions of the software.

Setup ...
Save
Print ...
Exit

A.7.1 Setup

Launches the **System Setup** window so that you can edit the settings for the current setup.

A.7.2 Save

Saves the current setup under its current name. If you have not already supplied a name for the setup, you are prompted for one.

A.7.3 Print

Prints the screen or saves the screenshot to a file.

A.8 View Menu

The dialog boxes that are accessible through the View menu display important information about the system and its operating parameters.

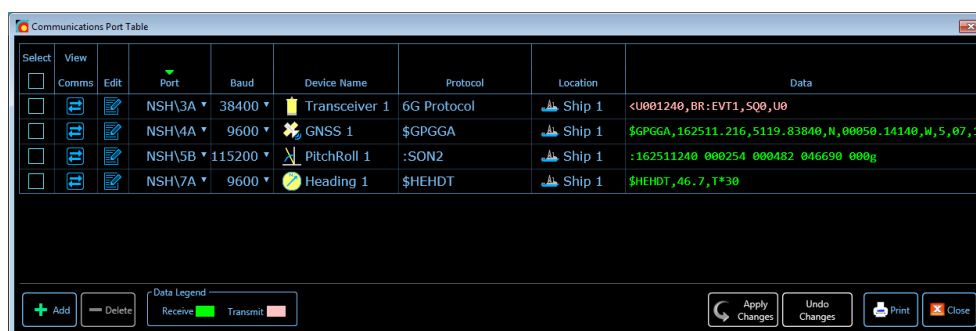
Beacons
Ports
Telegrams
Alarms
Events
Comms
Clear Position History

A.8.1 Beacons

For a detailed description of the Beacons options, see *Section 5 "Beacons"*.

A.8.2 Ports

The **Communications Port Table** lists all comms ports currently in use, allows editing of the port settings and gives a quick view of the live comms.



Select	View	Comms	Edit	Port	Baud	Device Name	Protocol	Location	Data
☐				NSH\3A	38400	Transceiver 1	6G Protocol	Ship 1	<U001240,BR:EVT1,SQ0,U0
☐				NSH\4A	9600	GNSS 1	\$GPGGA	Ship 1	\$GPGGA,162511.216,5119.83840,N,00050.14140,W,5,07,1
☐				NSH\5B	115200	PitchRoll 1	:SON2	Ship 1	:162511240 000254 000482 046690 000g
☐				NSH\7A	9600	Heading 1	\$HEHDT	Ship 1	\$HEHDT,46.7,T*30

Data Legend: ■ Receive ■ Transmit

- Click **Add** to add a new device; see the **Add Device** dialog box below.
- Clicking **Print** launches the Windows Print dialog box. This allows the capture and print out the Communications Port Table.
- Clicking **Close** closes the Communications Port Table.

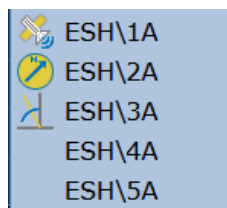
The columns within the Communications Port Table are described in the following table.

Description	Function	UI Control Type
Select	Selects a beacon row for a subsequent operation	
View Comms	Open the Comms Viewer with the tab for this device. If tab doesn't exist, open a new tab	
Edit	Opens the appropriate editor for the device. Responder Beacons open the Beacons Table, Reports open Output Telegram editor, all other devices open the System Editor	
Port	Serial port assigned to this device/ output telegram. Populated with ESH\xxx and/or COMxxx	 Drop-down list
Baud	Baud Rate of port (110 to 115200)	 Drop-down list
Device Name	Name of device/output telegram	Static label field with device type icon on LHS
Protocol	Serial Comms Protocol used for device/output telegram. Responder Beacons shall show "Responder Beacon" in this field	Static label field indicating device or telegram protocol
Location	Where the device is located. (Ship, ROV, Structure, System, Mobile). Output Telegrams show "System"	Static label field with location type icon on LHS
Data	Last decoded data to/from the device/output telegram. Outgoing data shown in different colour to incoming	Static label field

Note that the Serial port selection is restricted for the following device types:

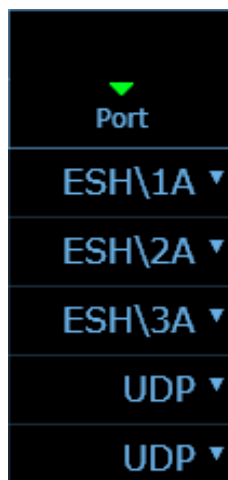
- Responder Beacons – Only the dedicated ESH Responder port can be selected for a responder trigger.
- If UDP is selected as a port for a device type, then the UDP settings are only accessible within the System Setup. The port column (as shown above for the Remote Control device) will simply show "UDP".

The serial port drop-down list shows a device type icon beside each port that is already in use (as shown below):



A.8.2.1 Sorting the Table

To sort a table column (that contains sortable data), clicking on a column header will toggle the green chevron (as shown below) to sort ascending or descending. Only one column is sortable at a time.



A.8.2.2 Delete

When at least one table row is selected via its check box, the **Delete** button is enabled, except when:

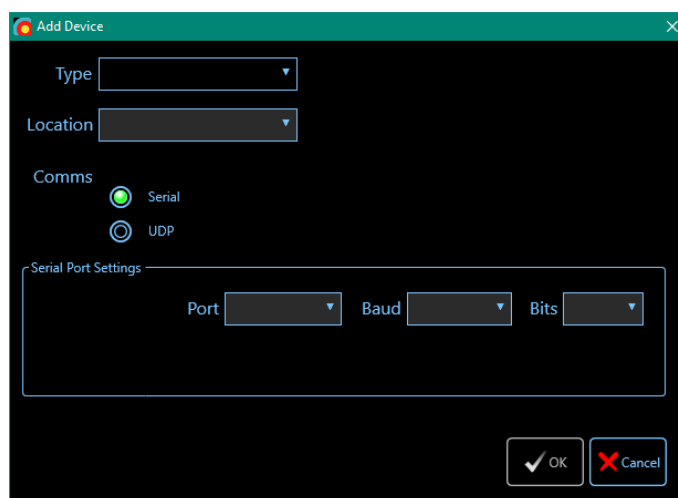
- One of the selected items is a Responder Beacon. It is only possible to create/edit/delete any beacon via the Beacons Window.
- One of the selected items is an Output Telegram. It is only possible to create/edit/delete any output telegram via the Output Telegram Editor.

When the Delete button is enabled, clicking on it deletes all selected devices. Confirmation is required when more than one device is being deleted.

A.8.2.3 Add Device Dialog Box

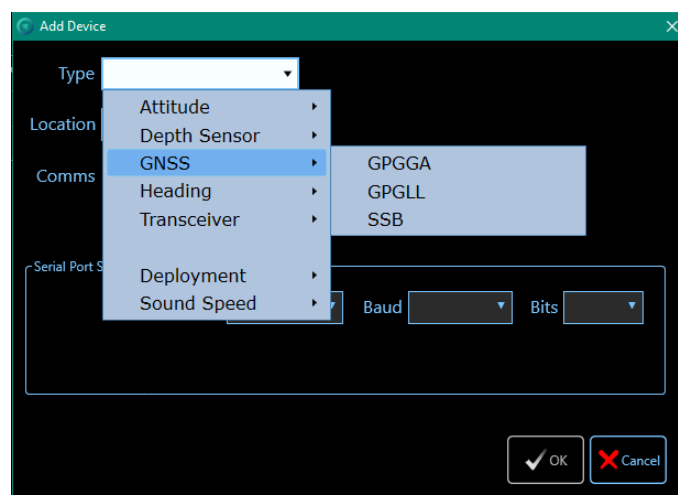
Clicking **Add** opens the **Add Device** dialog box. This dialog box is shown whenever a serial communication device is to be created, excluding the addition of beacons and output telegrams as they have their own more sophisticated editors.

Any device type, location and port can be added, as shown below:

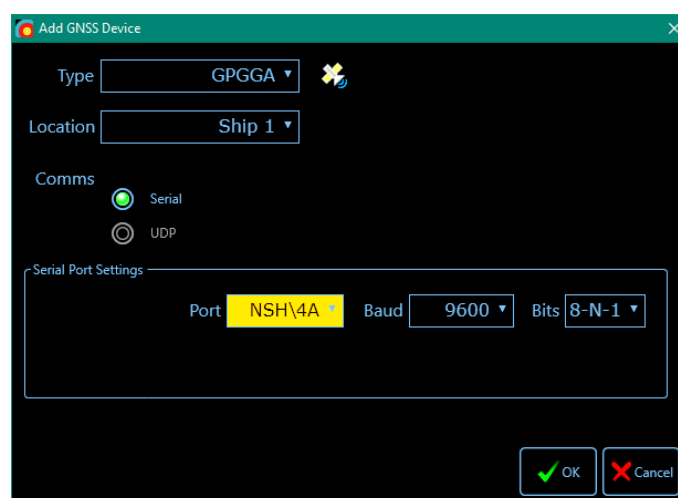


Type

The following devices can be added:



For example, selecting **GNSS > GPGGA** populates the dialog box as follows:



Location

The **Location** drop-down list allows selection of where the device is located.

- If the selected device type is an Attitude, Depth Sensor, GNSS, Heading or Transceiver, then the drop-down list displays all Vehicles in the job.
- If the selected device type is a TOD, Remote Control, Sound Speed then the drop-down list only displays System. No vehicles are offered.

Serial Port Settings

The **Serial Port Settings** consists of primary (and optional secondary) serial port controls, consisting of:

- **Port** – A drop-down list that allows selection of the serial communications port to which the device is connected.
- **Baud** – A drop-down list that allows selection of the port baud rate. In the case of devices that only use CTS or Trigger functionality, this will be disabled.
- **Bits** – A drop-down list that allows selection of Data-Parity-Stop bits. In the case of devices that only use CTS or Trigger functionality, this will be disabled.

By default, the following Data-Parity-Stop combinations are enumerated in the drop-down list:

- 8-N-1
- 8-N-2
- 7-O-2

Where:

E = Even parity

N = No parity

O = Odd parity

UDP Settings

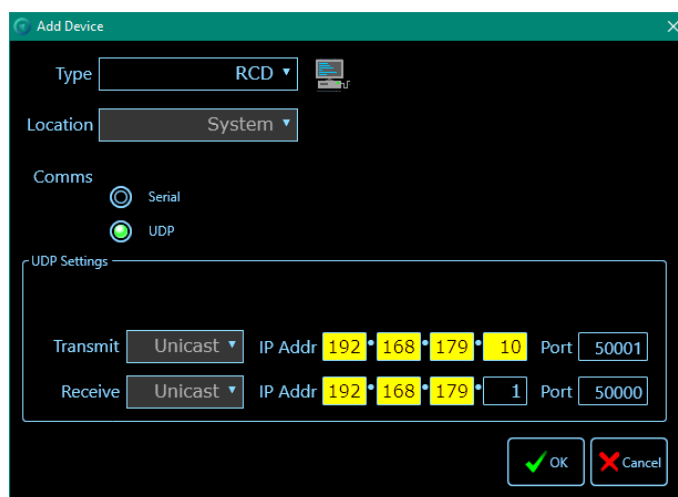
Note

 This option is currently only available for devices which are not time-sensitive, e.g. Remote Control, or which carry strings with a time-of-validity, e.g. GPGGA.

If the **UDP** radio button is selected, the normal Serial Settings group box is hidden and the **UDP Settings** group box is shown.

The **UDP Settings** group box contains controls to specify UDP parameters, as follows:

- **Mode** – Set to Unicast, Multicast or Broadcast.
- **IP Address** – Specifies the source/destination IP address of the UDP comms.
- **Tx Port** – Specifies the source/destination Port number for UDP Transmit comms.
- **Rx Port** – Specifies the destination Port number for UDP Receive comms.

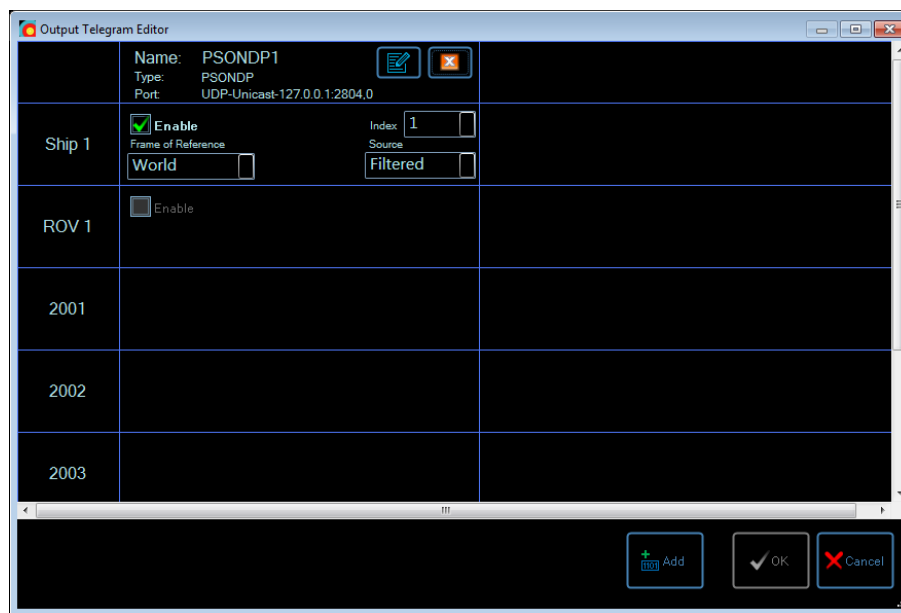


The screenshot shows the 'Add Device' dialog box with the following settings:

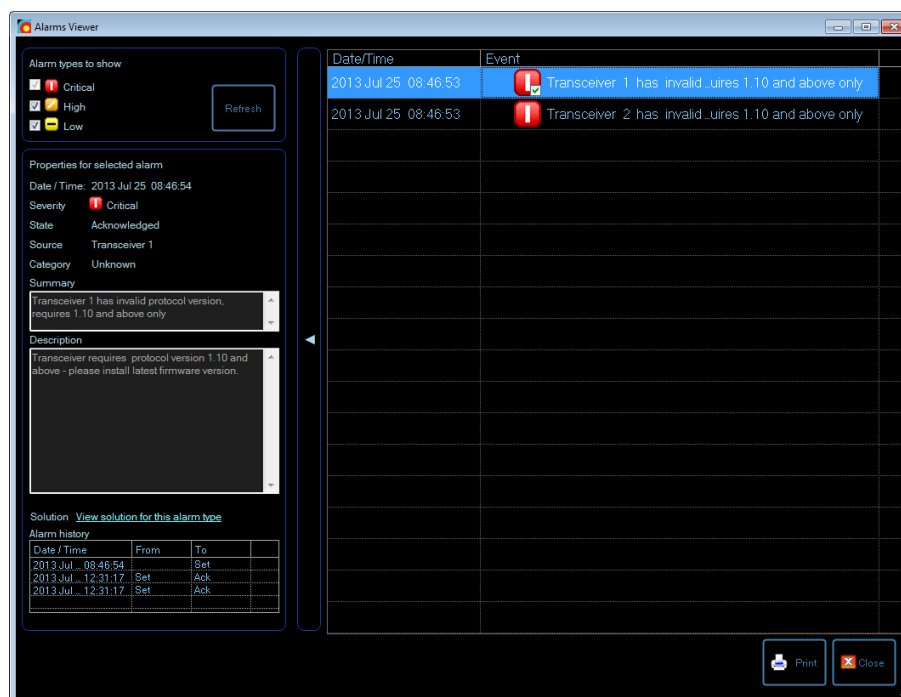
- Type:** RCD
- Location:** System
- Comms:** UDP (selected)
- UDP Settings:**
 - Transmit:** Unicast, IP Addr: 192.168.179.10, Port: 50001
 - Receive:** Unicast, IP Addr: 192.168.179.1, Port: 50000
- Buttons:** OK, Cancel

A.8.3 Telegrams

The **Telegram Table** shows the current settings for Telegrams sent to the vessel's DP system or survey system, and allows you to edit and add Telegrams. See *Section 4.20 "Configuring Output Telegrams"* for a description of the **Telegram Table**, and for instructions on how to use it.

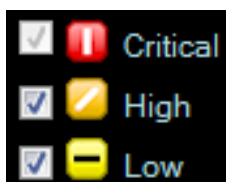


A.8.4 Alarms



There are three main panes of the **Alarms Viewer**:

- **Alarm list** – a list of all the current alarms, showing details of the date and time when each alarm occurred and details of the event that caused the alarm condition. Clicking on an alarm in the list acknowledges the alarm, and temporarily silences the alarm sounder.
- **Alarm properties** – detailed properties about the alarm selected in the alarm list.
This pane includes a **View solution for the alarm type** link, which opens a file containing user guidance in a browser window. These HTML files can be modified locally, if required.
- **Alarm category** – alarm categories (**Low**, **High** and **Critical**) indicate the priority, and are used for sorting the list into priority order.



The **Print** button allows you to send the alarm list view to the default printer. You can hide or display the **Alarm properties** and **Alarm category** panes by clicking a control, which provides more space to display the alarm list.

System alarms can be in one of the following states:

Clear (no alarm)



Set, unacknowledged (a fault exists, the user has not acknowledged)



Set, acknowledged (a fault exists, the user has acknowledged)

When an alarm is set, a Summary of the alarm condition is displayed at the bottom-left of the main screen, a flashing red Alarm button is displayed at the bottom-right of the main screen, and a siren audio output starts.

When the user acknowledges an alarm, the audio (siren) output is silenced for a short period, but this will resume if the fault is not cleared.

An alarm can be cleared only by clearing the cause of the fault. See the alarm description and solution for help on this. When an alarm is cleared, the audio output is silenced, and the alarm text and red button are removed.

Alarm suppression – repeated nuisance alarms can be suppressed if absolutely necessary by making a system configuration change. An example of where this may be permissible is for a GNSS HDOP alarm triggered whenever the GNSS antenna's view of the sky is obscured. Please contact Sonardyne Support for guidance.

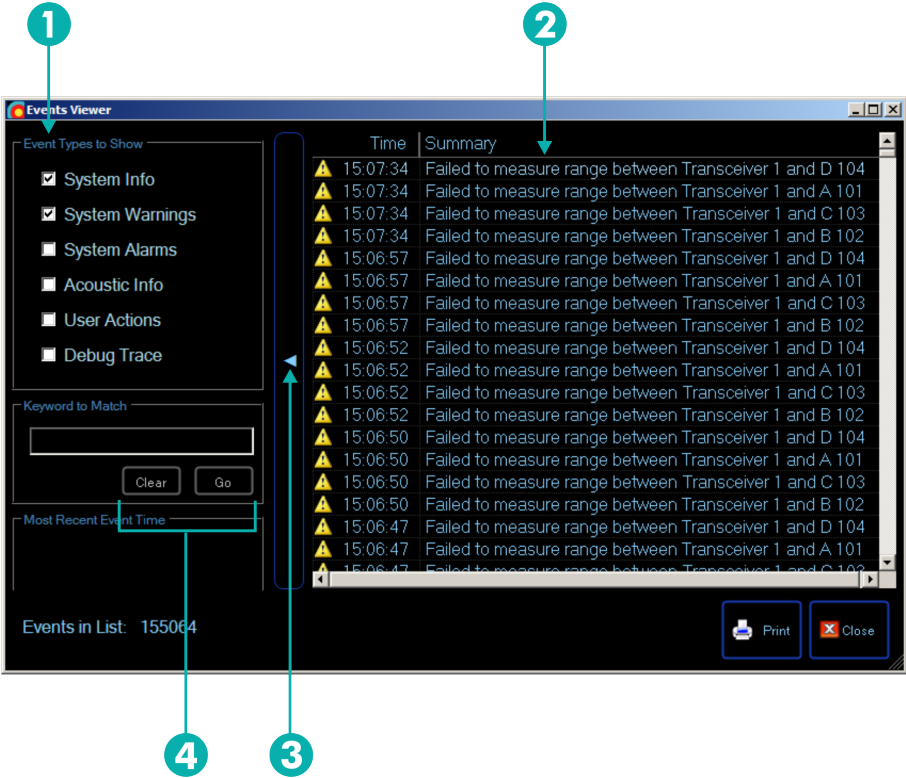
Note



Do not ignore a system alarm as this can lead to incorrect operation.

All alarm state changes and user actions are logged to the system event log for later review.

A.8.5 Events



Item	Description
1	Event Catagory Filter
2	Event List
3	Display/Hide Pane
4	Event Search Buttons

The main features of the **Events Viewer** are:

- **Event list** – a list of all events, showing details of the date and time when each event occurred and details of the event.
- **Event category** – select the event categories to display in the event list, and you can filter the list to include only events that occurred during a defined interval.

The **Events Viewer** also allows you to search for particular events, print the event list, and close the **Events Viewer**.

You can hide or display the **Event category** panes by clicking a control, which provides more space to display the event list.

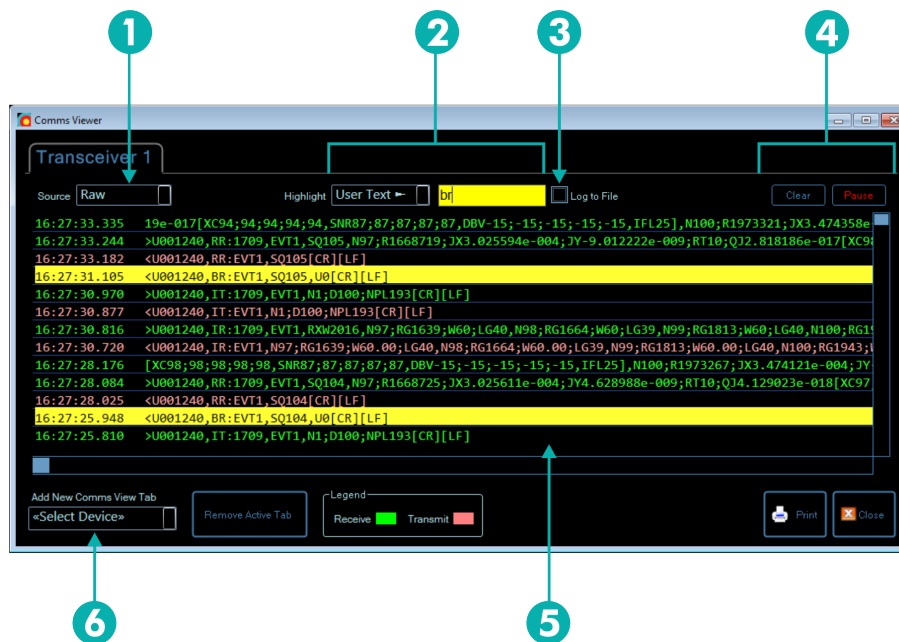
Note

 The system event log should be periodically reviewed (particularly the Warnings and Alarms categories). Unexplained events, particularly repeated warnings, should be investigated, and the cause understood and corrected.

A.8.6 Comms

The **Comms Viewer** shows communications between the system and the various Instruments in the setup. You can select any device in the current setup and add a tab to display its communications.

- Output strings are shown in pink.
- Input strings are shown in green.



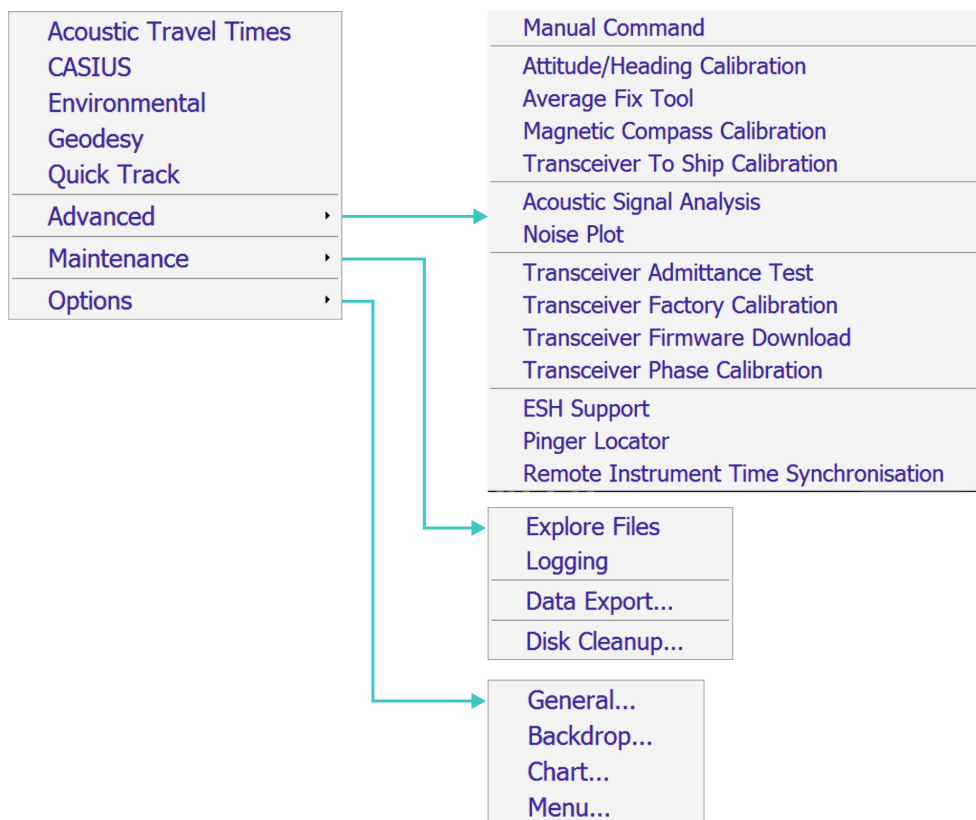
Item	Description
1	If necessary, change the communication Source to display: - Raw for text with control characters - Decoded for normal text - Observation for additional diagnostics (where available)
2	If necessary, select Highlight/User Text and enter text in the adjacent box. The system identifies any string in the communications that includes this text and highlights the string in yellow.
3	If necessary select the Log to File check box and identify the location and name of a file on the computer where the software can store the communications as a text file.
4	Use the Clear and Pause buttons to control the flow of data strings.
5	Review the communications.
6	Select a device in the current setup. A tab is added for the device you select. If necessary, click Remove Active Tab to remove a selected tab from the Comms Viewer.

A.8.7 Clear Position History

Clears the Position History Trails from the chart.

A.9 Tools Menu

The **Tools** menu includes a set of software tools that help you to optimise the performance of the system. The following sections describe the dialog boxes accessible through this menu.



The image above shows the **Tools menu, with the Advanced, Maintenance and Options** sub-menus detailed.

Some options on the Advanced sub-menu may be greyed out, depending on the system's tracking status.

A.9.1 Acoustic Travel Times

The Acoustic Travel Times tool display shows the two-way acoustic travel times for each beacon in the setup plotted against time. Overlapping travel times can make it difficult for the transceiver to separate the responses from individual beacons, leading to longer intervals between updates.

This tool ensures reply signals from beacons on the same interrogation signal do not overlap. If they do, you should adjust the beacon turnaround time (TAT) to separate the travel times.

Note

 **Pulse-position mode beacons supply a double pulse reply (for depth) or triple pulse reply (for pitch and roll).**

The following acoustic diagnostic types can be displayed by clicking on the buttons listed below:

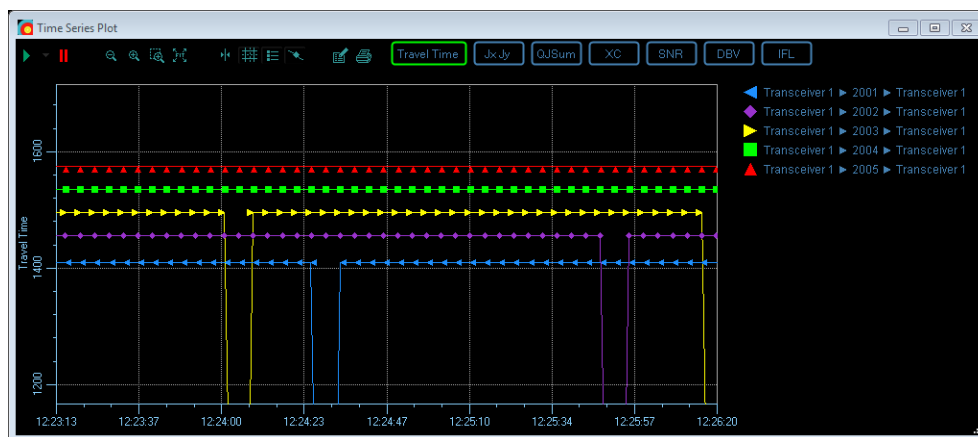
- Travel Time
- Jx Jy
- QJSum
- XC

- SNR
- DBV
- IFL

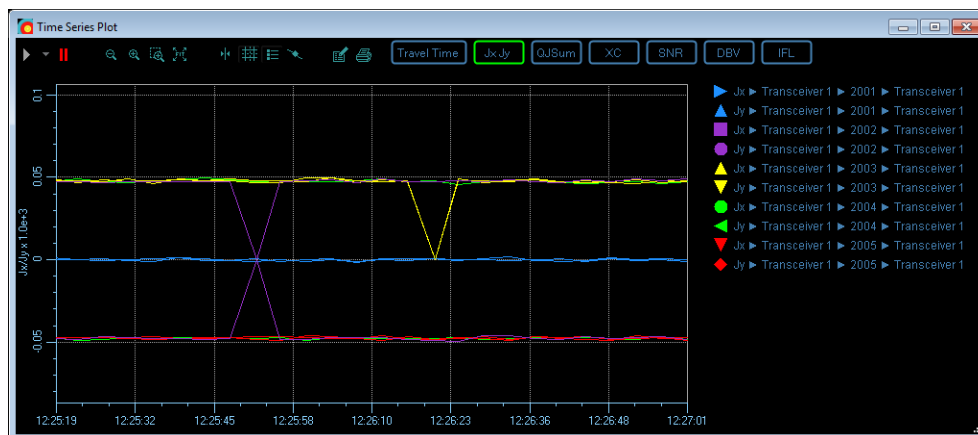
An example of each graph type is shown below.

A.9.1.1 Travel Time

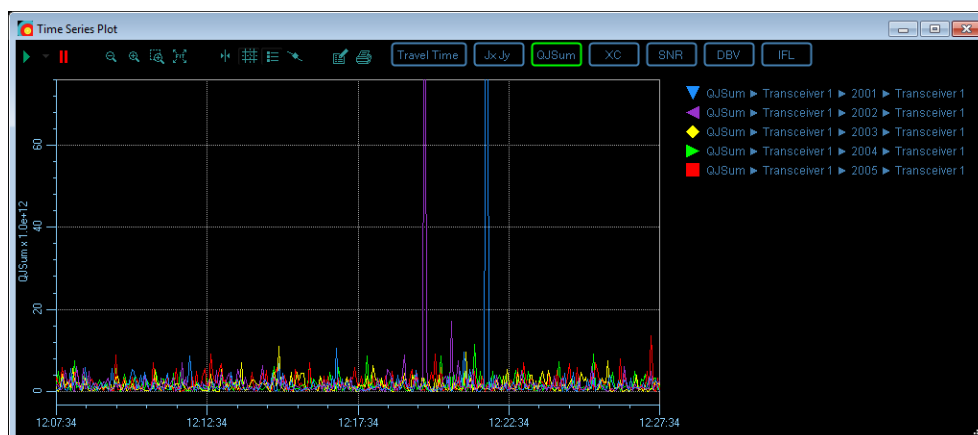
The Travel Time graph below shows an example of an acoustic travel times display. In this example, the travel times for 2003 (yellow) and 2004 (green) are too close together, so one of the beacon TAT values requires adjustment.



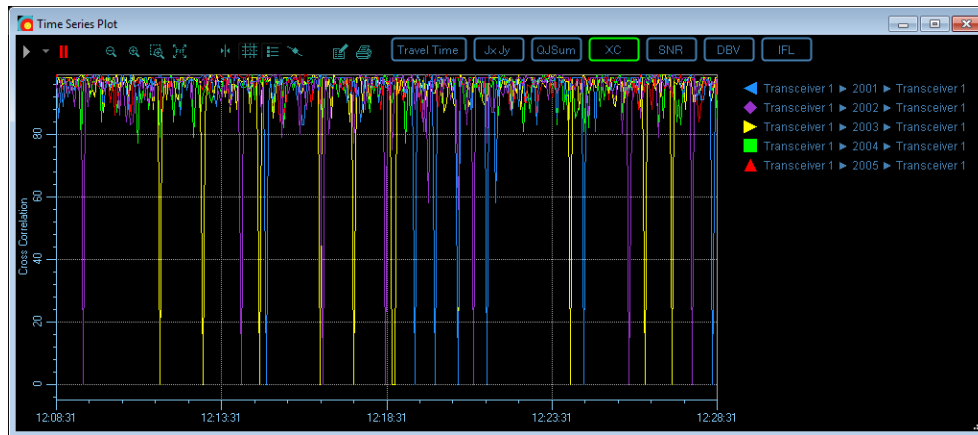
A.9.1.2 Jx Jy



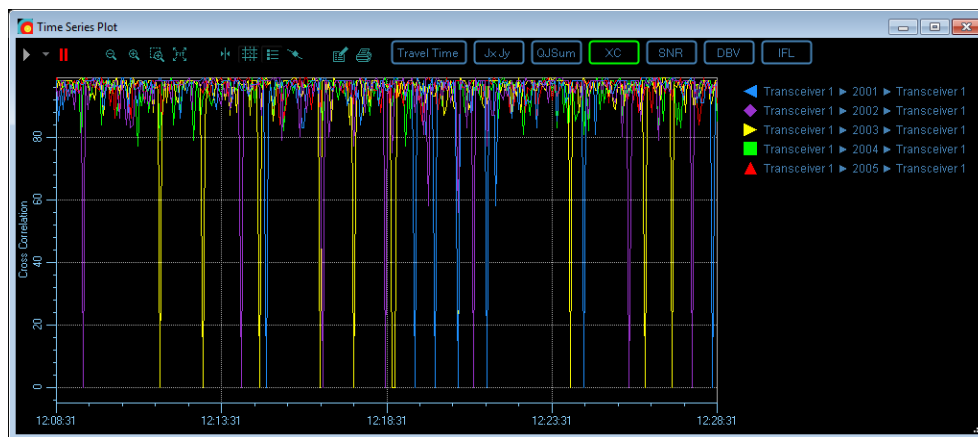
A.9.1.3 QJSum



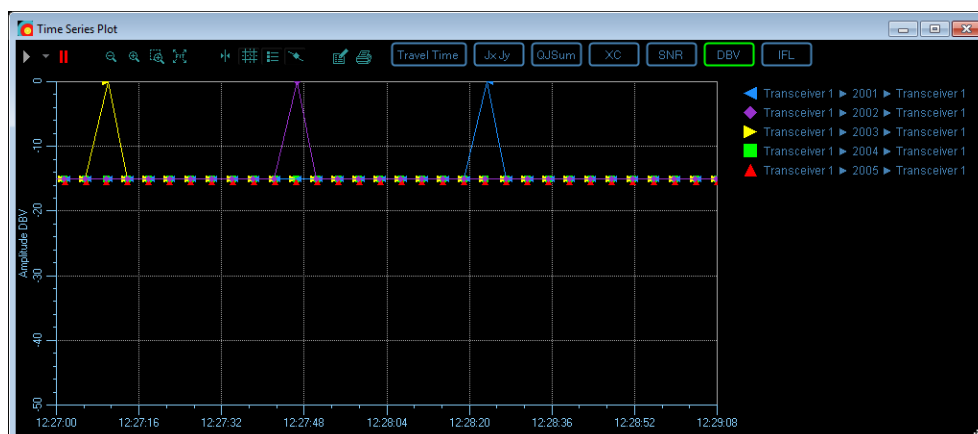
A.9.1.4 XC



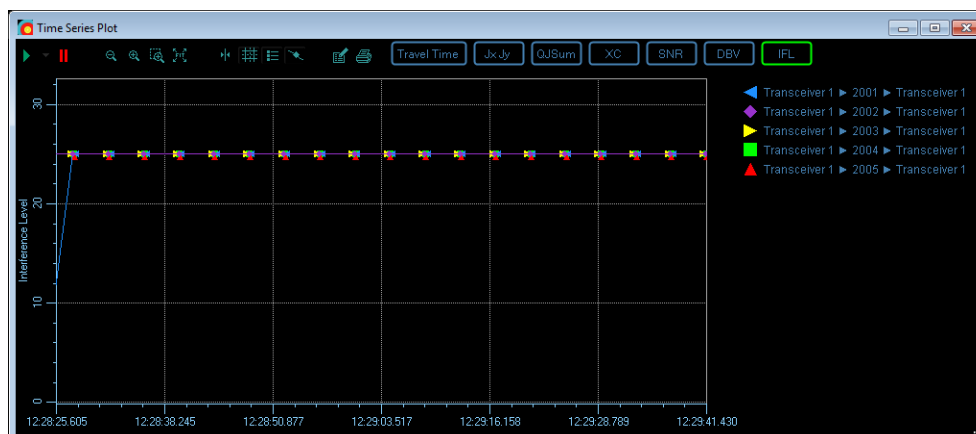
A.9.1.5 SNR



A.9.1.6 DBV



A.9.1.7 IFL



A.9.2 CASIUS

The CASIUS tool menu contains two tabs:

- CASIUS **Data Collection**
- CASIUS **Data Export**

CASIUS is an acronym that stands for Calibration of Attitude Sensors In the USBL System manufactured by Sonardyne International Limited.

By manoeuvring near a stationary beacon deployed on the seabed and recording DGPS positions and acoustic positions relative to the beacon, you can use CASIUS to compute:

- The precise position and depth of the beacon.
- The mean sound speed through the water column.
- USBL transceiver offsets from the GNSS antenna.
- Pitch, roll and alignment corrections to correct for the misalignment of the attitude and heading sensor (AHRS) and gyrocompass with respect to the USBL transceiver.

In general, pitch and roll alignment errors have a greater effect on beacons directly under a vessel (especially in deep water), and heading errors will have a greater effect at horizontal offsets from a beacon.

The correction values for pitch, roll and heading that you obtain by performing a CASIUS calibration help you to achieve significantly better results when you are positioning acoustic beacons. You should check the calibration regularly during each operation, so that you can detect any long-term drift in gyrocompass and AHRS sensors, and apply appropriate corrections; see *Section F.6 "USBL Transceiver Alignment Calibration Check"*.

See *Appendix F "CASIUS Data Collection Methods"* for instructions to perform a CASIUS calibration using this tool.

Before starting a CASIUS data collection run:

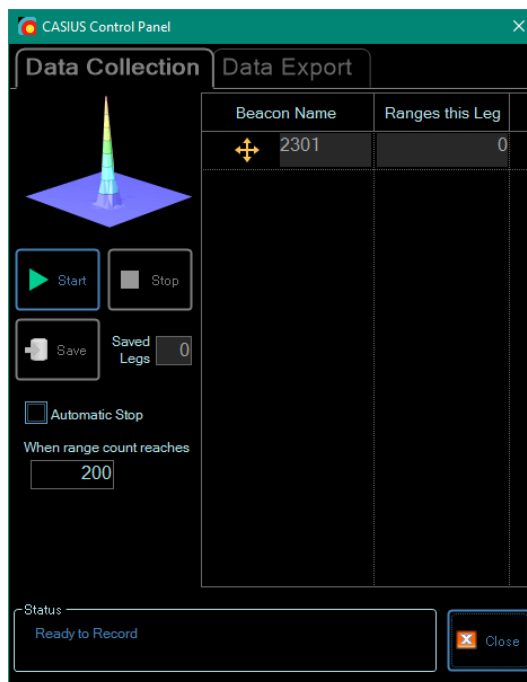
- Ensure that tracking of the CASIUS beacon is reliable and stable.
- Ensure the sound speed has been set correctly.
- Ensure a high quality GNSS position is available and enabled. The status field should say **Ready to record**.

Select the **CASIUS Data Collection** tab. If you prefer to use auto mode, click **Automatic stop** and set the number of ranges required. Otherwise, data collection will continue until stopped manually.

Procedure:

1. Click **Start** to begin data collection.
2. Click **Stop** when the required number of ranges has been acquired if in manual mode.
3. Click **Save** to store the collected data set.

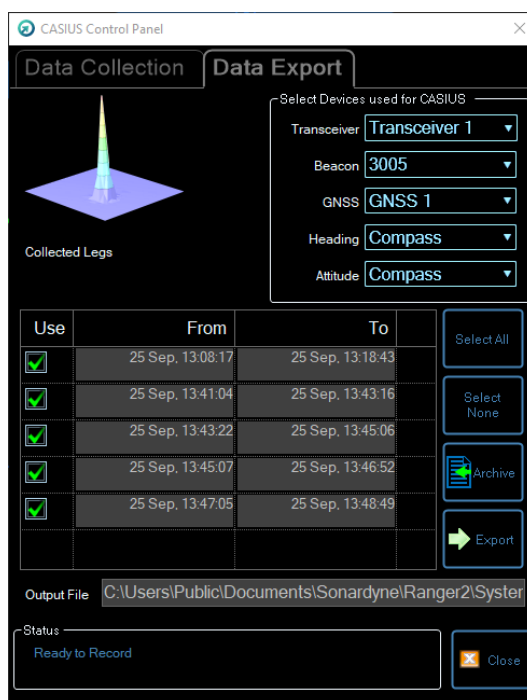
Repeat *Steps 1* to *3* above for each leg of the CASIUS data collection.



When data has been successfully collected for all CASIUS legs, select the **Data Export** tab.

Select the transceiver, beacon, GNSS, heading and attitude sensor to be used for the CASIUS calibration from the drop-down lists, then select the data sets for CASIUS processing by selecting the **Use** check boxes.

Click **Export** to process the CASIUS data.



Clicking **Archive** generates an archive of the data collected during the selected CASIUS legs. This can be useful for analysis and support.

A.9.3 Environmental

The Environmental Settings dialog box allows you to set the default sound speed, and to import a sound speed profile, if one is available for the operating area. This is one of the system's common operating procedures and is described fully in *Section 4.19 "Environmental Settings"*.

A.9.4 Geodesy

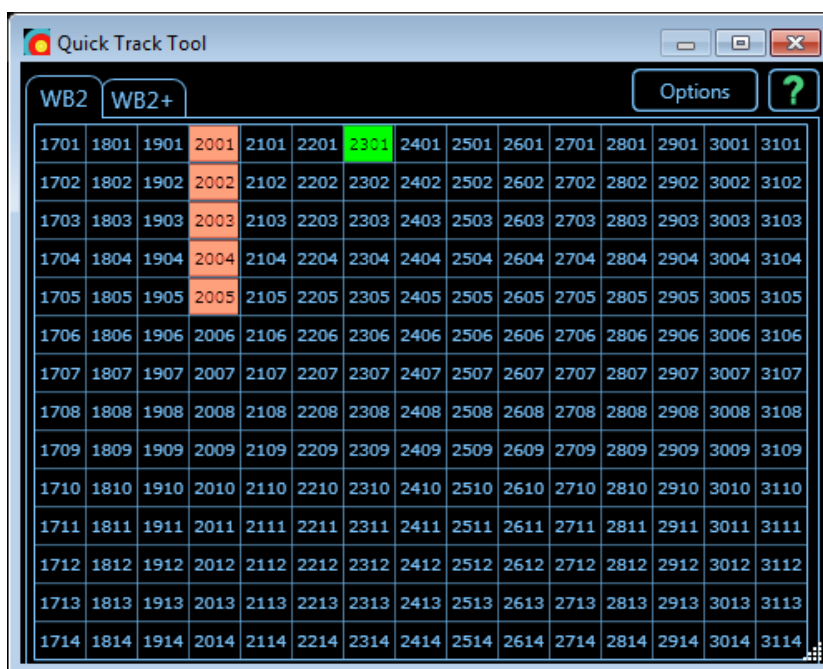
See *Section 4.11 "Geodesy Tool"*.

A.9.5 Quick Track

The Quick Track tool is used for simple jobs requiring a small number of 6G or PGT beacons. Quick Track tool. Quick Track uses the unique IIS interrogate signal for a 6G beacon.

Clicking on the beacon address in the Quick Track tool :

- Adds a 6G beacon with that address to the setup.
- Starts the beacon tracking.
- Enables a beacon output telegram (if there is a telegram setup).
- Clicking the address again stops that beacon tracking and removes it from the setup.
- An active Quick Track beacon is shown in green. Other beacon addresses already allocated are shown in pink.

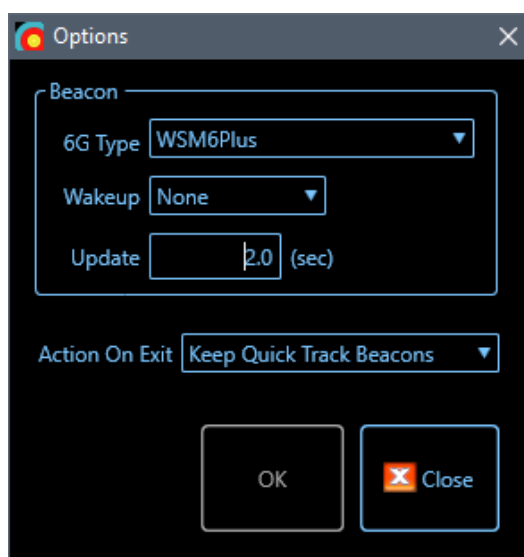


The screenshot shows the 'Quick Track Tool' window. It has a title bar with standard Windows controls. Below the title bar, there are tabs for 'WB2' and 'WB2+', and an 'Options' button with a question mark icon. The main area is a grid of 14 rows and 14 columns of numbers. The first column contains numbers from 1701 to 1714. The second column contains numbers from 1801 to 1814. The third column contains numbers from 1901 to 1914. The fourth column contains numbers from 2001 to 2014. The fifth column contains numbers from 2101 to 2114. The sixth column contains numbers from 2201 to 2214. The seventh column contains numbers from 2301 to 2314. The eighth column contains numbers from 2401 to 2414. The ninth column contains numbers from 2501 to 2514. The tenth column contains numbers from 2601 to 2614. The eleventh column contains numbers from 2701 to 2714. The twelfth column contains numbers from 2801 to 2814. The thirteenth column contains numbers from 2901 to 2914. The fourteenth column contains numbers from 3001 to 3014. The grid is scrollable, as indicated by a scrollbar on the right side.

1701	1801	1901	2001	2101	2201	2301	2401	2501	2601	2701	2801	2901	3001	3101
1702	1802	1902	2002	2102	2202	2302	2402	2502	2602	2702	2802	2902	3002	3102
1703	1803	1903	2003	2103	2203	2303	2403	2503	2603	2703	2803	2903	3003	3103
1704	1804	1904	2004	2104	2204	2304	2404	2504	2604	2704	2804	2904	3004	3104
1705	1805	1905	2005	2105	2205	2305	2405	2505	2605	2705	2805	2905	3005	3105
1706	1806	1906	2006	2106	2206	2306	2406	2506	2606	2706	2806	2906	3006	3106
1707	1807	1907	2007	2107	2207	2307	2407	2507	2607	2707	2807	2907	3007	3107
1708	1808	1908	2008	2108	2208	2308	2408	2508	2608	2708	2808	2908	3008	3108
1709	1809	1909	2009	2109	2209	2309	2409	2509	2609	2709	2809	2909	3009	3109
1710	1810	1910	2010	2110	2210	2310	2410	2510	2610	2710	2810	2910	3010	3110
1711	1811	1911	2011	2111	2211	2311	2411	2511	2611	2711	2811	2911	3011	3111
1712	1812	1912	2012	2112	2212	2312	2412	2512	2612	2712	2812	2912	3012	3112
1713	1813	1913	2013	2113	2213	2313	2413	2513	2613	2713	2813	2913	3013	3113
1714	1814	1914	2014	2114	2214	2314	2414	2514	2614	2714	2814	2914	3014	3114

The Quick Track defaults can be configured by clicking the **Options** button.

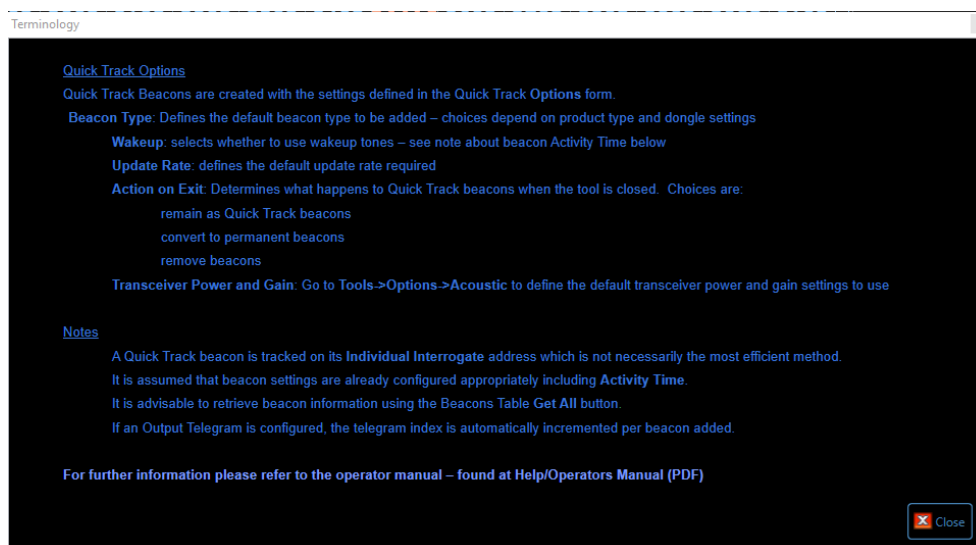
- **6G Type** – Defines the type of beacon to be added to the setup (choices offered depend on the product and security key settings).
- **Wakeup** – Selects whether to use a wakeup tone – this depends on the beacon configuration.
- **Update Rate** – Defines the acoustic update time.
- **Action on Exit** – Determines what happens to Quick Track beacons when the tool is closed.
 - Remain as Quick Track beacons
 - Convert to permanent beacons
 - Remove beacons



Note

 Default Transceiver power and gain are defined in Tools/Options/Acoustics.

Guidance notes are displayed by clicking  on the Quick Track Tool.



A.9.6 Advanced

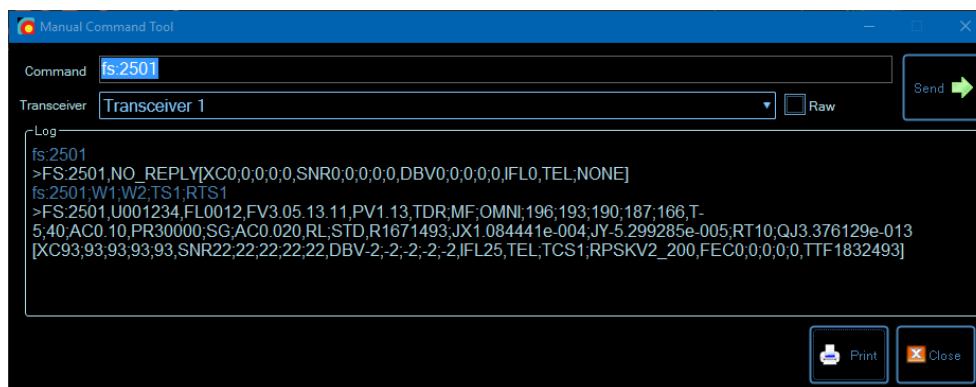
The **Advanced** menu provides the following features:

- Manual Command
- Attitude and Heading Calibration
- Average Fix Tool
- Magnetic Compass Calibration
- Transceiver To Ship Calibration
- Acoustic Signal Analysis
- Noise Plot
- Transceiver Admittance Test
- Transceiver Factory Calibration
- Transceiver Firmware Download
- Transceiver Phase Calibration
- ESH Support
- Pinger Locator
- Remote Instrument Time Synchronisation

Note

 **When tracking, only the Manual Command, Average Fix Tool and the Acoustic Signal Analysis options are available on the Advanced menu.**

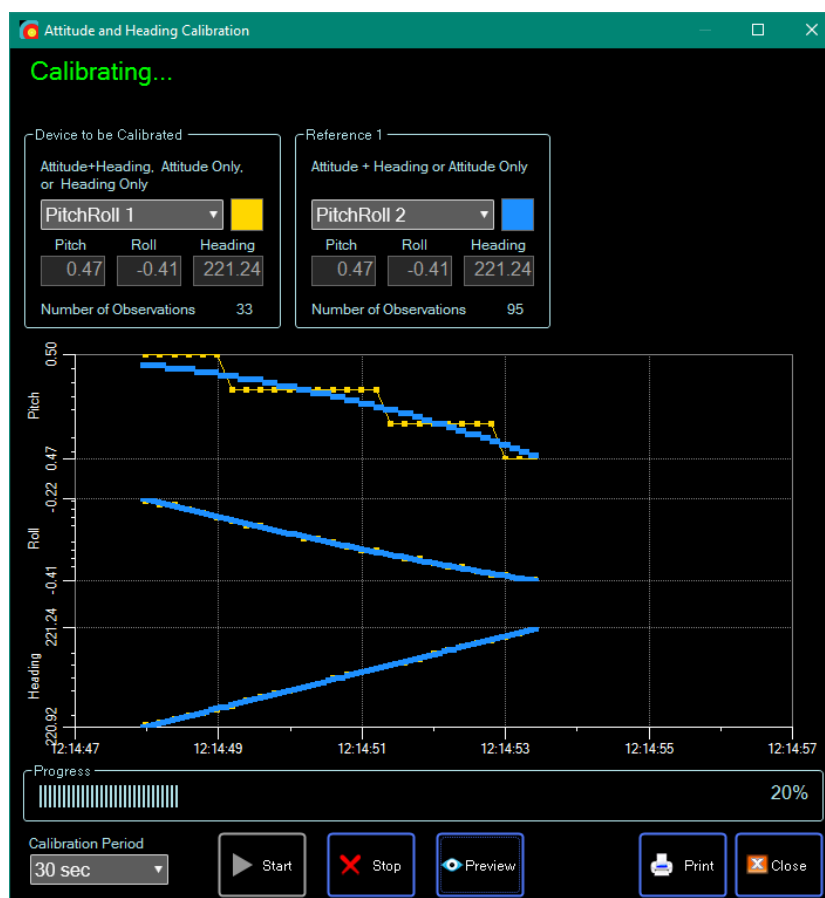
A.9.6.1 Manual Command



The **Manual Command Tool** allows you to type and send it to a selected transceiver. The centre pane displays communications with the selected transceiver as the command is issued and the replies received.

Select **Raw** to force commands to be sent 'as-is', or leave blank for the system to use default transceiver Power, Gain, Tx/Rx Telemetry and Wakeups, as defined in *Section A.9 "Tools Menu"* *Section A.9.8A.9.8.4 "Acoustic Tab"*.

A.9.6.2 Attitude and Heading Calibration

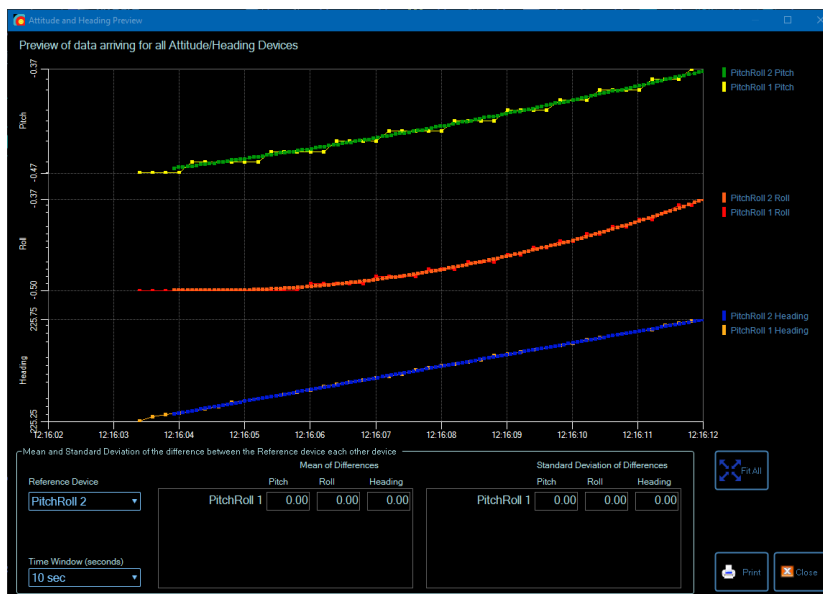


This tool allows you to calibrate a gyro or AHRS device against a 'reference' device (shown as **Device to be Calibrated** and **Reference 1** above).

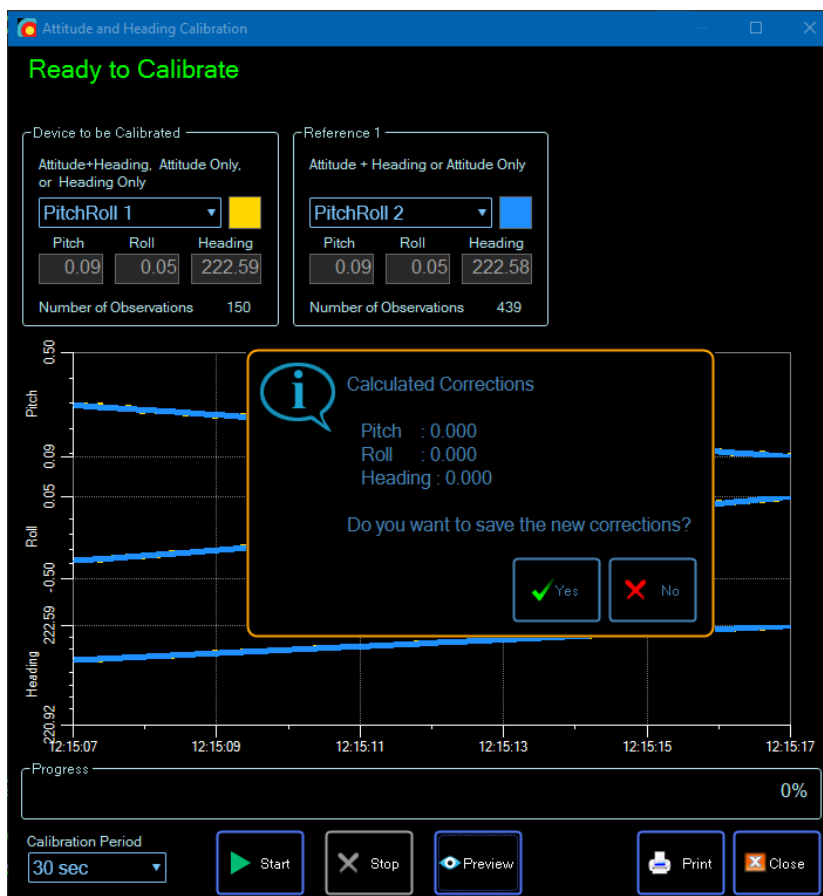
The charts show the measurements of Pitch, Roll and Heading for the data sources, using the colours shown in the top control groups to identify them.

Buttons at the bottom of the tool dialog box allow you to **Start** and **Stop** the calibration.

The **Preview** button allows attitude and heading inputs to be compared. The running Mean and Standard Deviation for Heading, Pitch and Roll are shown for the Time Window selected.



At the end of the calibration an option allows you to apply the calculated offsets to the device.

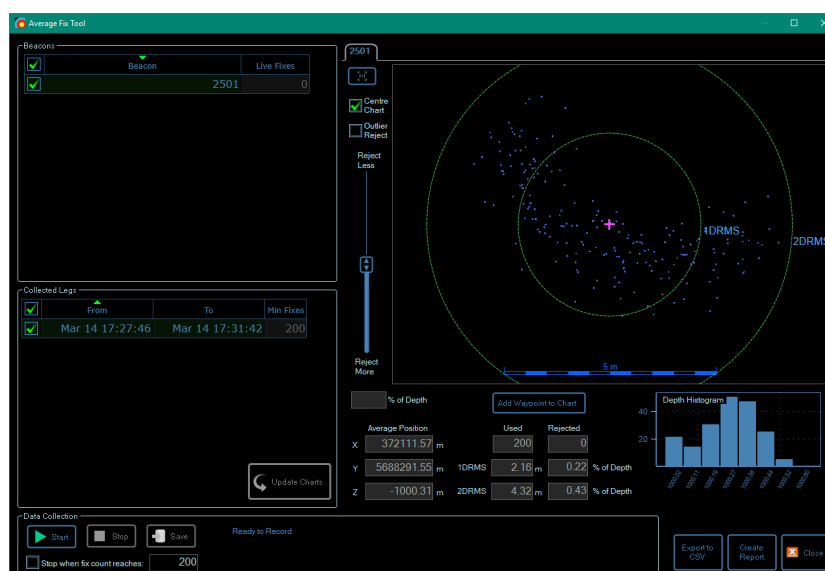


A.9.6.3 Average Fix Tool

The Average Fix tool is used to calculate an average of a set of positions for one or more beacons, together with statistics that indicate the quality of the position fix.

Note

 The tool can also be used as a pre- or post-CASIUS calibration check; see *Section F.6 "USBL Transceiver Alignment Calibration Check"*.



The tool includes:

- **Beacons** available for tracking, with ability to select beacons of interest (top-left pane)
- **Collected Legs**, with **From** and **To** times and number of **Min Fixes** (left middle pane)
- Position chart showing the cloud of collected position fixes for each beacon, together with **1DRMS** and **2DRMS** range rings and dimension scale (top right pane). The chart can be zoomed using the mouse wheel, or use the auto-zoom control 
- **Outlier Reject** slide control (centre pane)
- Summary statistical data for each beacon's **Average Position (X,Y,Z, 1DRMS, 2DRMS, Used and Rejected counts)**, and **Depth Histogram** (bottom right pane)
- **Data Collection** to **Record, Stop, and Save** (bottom left pane)

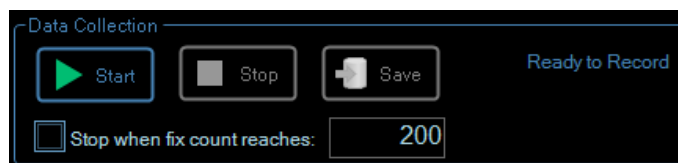
Operating the Average Fix Tool

1. Ensure that the beacon(s) are tracking reliably before starting (correct any tracking problems).
2. Select the beacons of interest from the **Beacons** list.
3. Carry out vessel manoeuvres while collecting data; for each manoeuvre,
 - a. Click **Start** to start collecting data
 - b. Click **Stop** when sufficient data has been collected

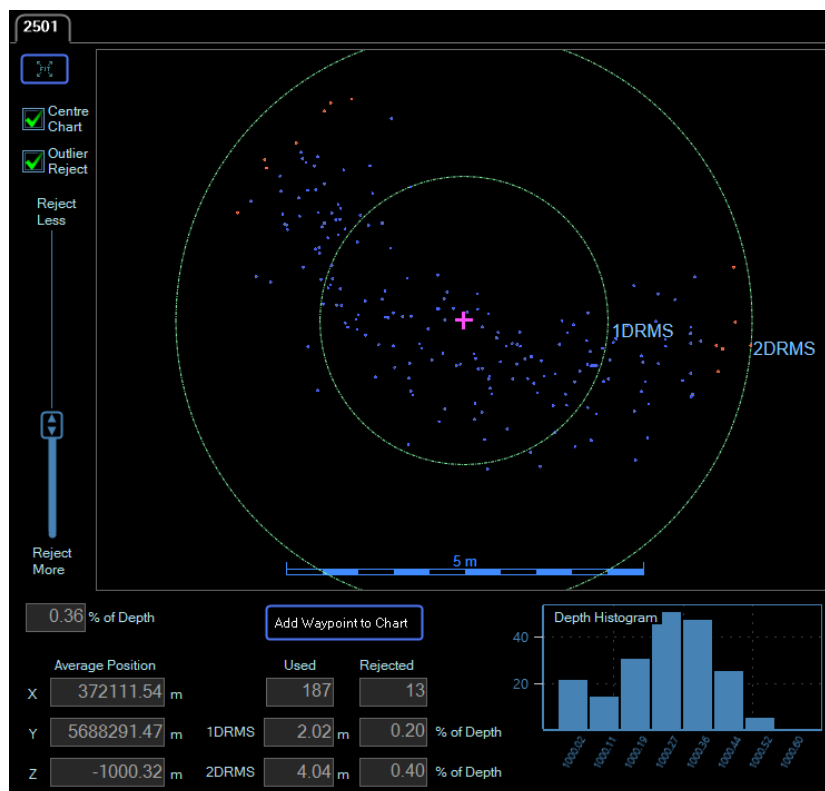
Note

 Select "Stop when fix count reaches" feature to stop automatically at any chosen fix count value.

- c. Click **Save** to save the data.



4. Review the summary statistical data for each beacon (if necessary, use **Outlier Reject** to reject obvious outliers).



5. Click **Add Waypoint to Chart** to drop a waypoint at the beacon's average position onto the main system chart.
6. Select **Export to CSV** to export the collected data to a CSV file for further processing.
7. Select **Create Report** to create a PDF report.

Average Fix Report



Vessel(s): Ship 1

Date/Time (UTC): 2018-03-15 16:52:22

Results:

Beacon	Eastings	Northings	Depth	Use/Reject	1DRMS	2DRMS
2501	372111.54m	5688291.47m	-1000.32m	187 / 13	2.02m/0.20%D	4.04m/0.40%D

Selected Fix Point Legs:

From	To	Minimum Fixes
Mar 14 17:27:46	Mar 14 17:31:42	200

A.9.6.4 Magnetic Compass Calibration

The HPT 2000/3000 contains an Xsens MTi-30 internal attitude sensor and magnetic compass which works by measuring the earth's magnetic field to determine the direction of north. A locally distorted (warped) magnetic field (caused by ferromagnetic materials in close proximity to the sensor) can result in an error in orientation that can be quite substantial. Further information on the Mti-30 sensor can be found at: www.Xsens.com.

Note

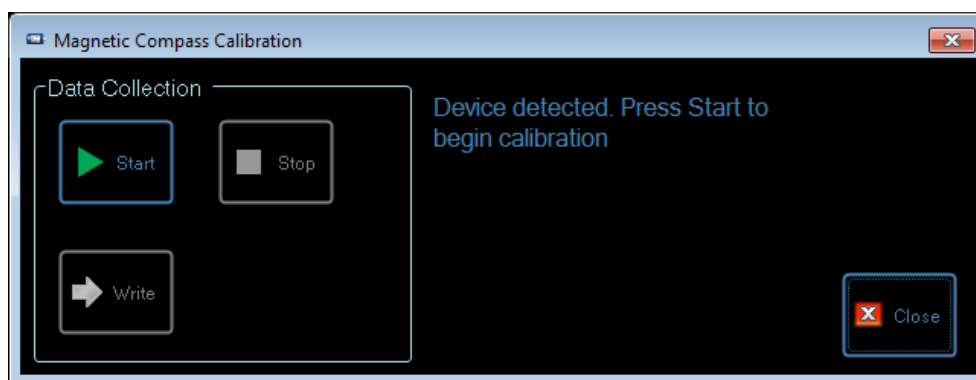
 **The Radian2 Tool is used to configure the internal attitude sensor but can also be used to calibrate the magnetic compass (see Appendix G "Radian2 Tool").**

To correct for possible disturbances it is necessary (when the HPT 2000/3000 is first deployed) to run the following calibration procedure to correct for the disturbance to the magnetic field.

Calibration Procedure

1. Click **Tools>Advanced>Magnetic Compass Calibration** to open the Magnetic Compass Calibration Tool.
2. Click **Start** to start the calibration process.

Figure A-2 Magnetic Compass Calibration Tool

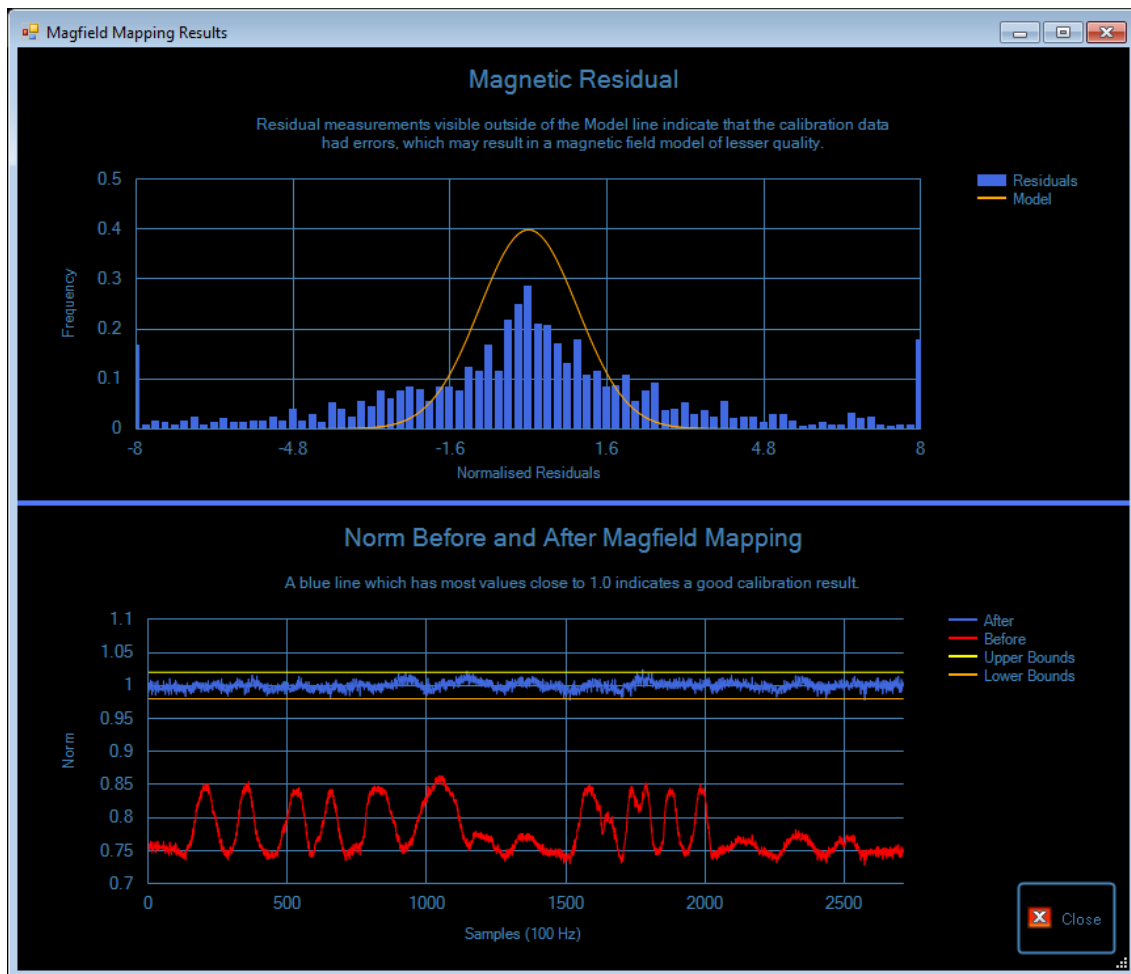


3. The device will switch to calibration mode and the tool will begin collecting data. Data collection should continue for at least two minutes, during which time, the vessel should be slowly rotated through 360 degrees.
4. Click **Stop** to end the measurement process and to start the data analysis procedure. If the tool is able to produce results from the collected data, the MagField Mapping Results form will be displayed as shown in *Figure A-3*.

Calibration Results

By examining the graphs in *Figure A-3*, a judgement can be made as to the quality of the Magfield Mapping.

Figure A-3 MagField Mapping Results



Magnetic Residual

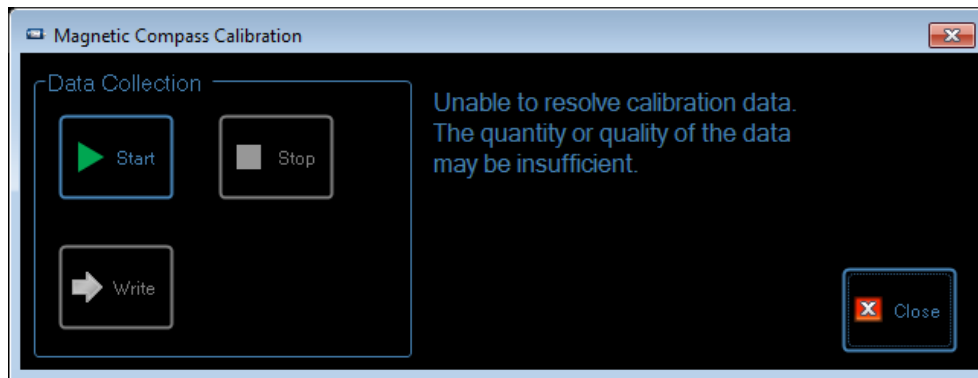
This graph shows the residuals of the corrected magnetic field vector of the measurement with respect to the new magnetic field model. If measurements are visible outside the Gaussian distribution, the collected data has errors, which may result in a magnetic field model of lesser quality.

Norm Before and After Magfield Mapping

This graph shows the norm of the magnetic field before and after Magnetic Field Mapping. The blue line should be relatively flat and close to one; ideally within narrow upper and lower limits.

If both graphs show acceptable results, the calibration process can be completed by clicking **Write**. This will update the sensor's non-volatile memory with the new correction data.

If the tool is not able to produce results from the collected data, the following error message will be displayed and it will be necessary to re-run the calibration.



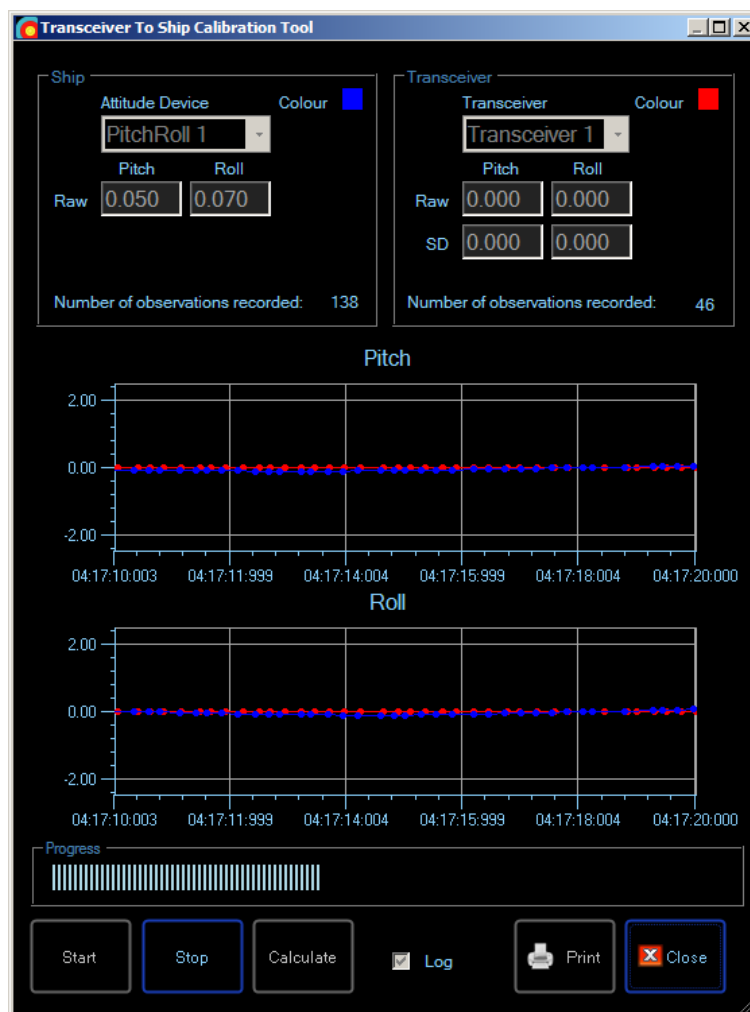
Troubleshooting

The Magnetic Compass Calibration Tool should be pre-configured to automatically connect to the transceiver. If the following error is displayed it will be necessary to close the tool and check all connections.

Unable to detect device. Please
check the connection settings

If you encounter further problems calibrating the sensor, refer to the manufacturer's website support pages for guidance (www.xsens.com/support)..

A.9.6.5 Transceiver To Ship Calibration



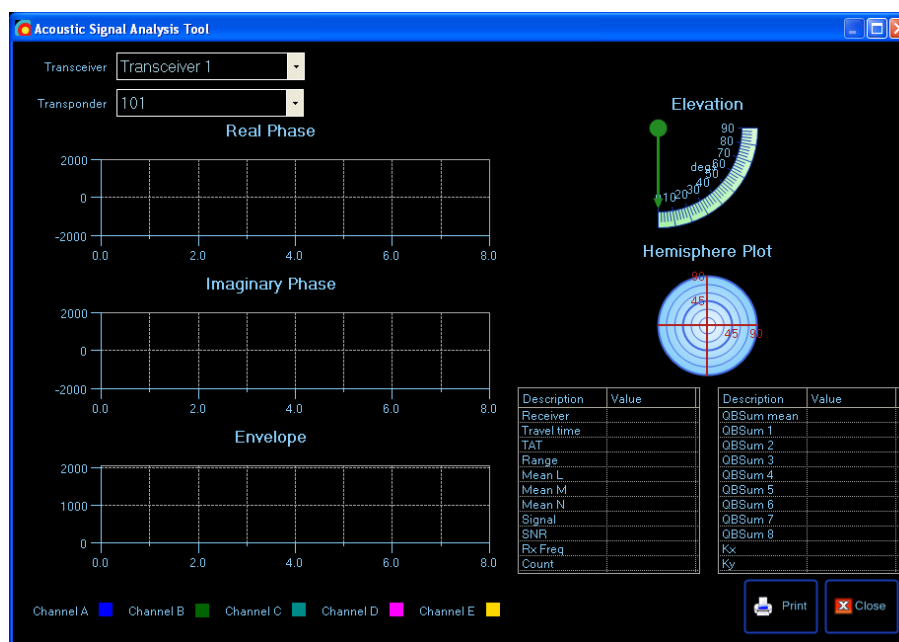
The two control groups **Ship** and **Transceiver** show real-time data for the AHRS Instrument and for the transceiver's internal inclinometer. They also show the correction necessary to align the inclinometer and AHRS measurements, and the standard deviation (SD) error in the inclinometer measurements.

Two charts show the measurements of Pitch and Roll for the two data sources, using the colours set in the top control groups to identify them.

A series of buttons at the bottom of the tool dialog box allow you to control the calibration and to log and print the results.

A.9.6.6 Acoustic Signal Analysis

The Acoustic Signal Analysis Tool allows you to assess the condition of the acoustic signal. This tool provides a large amount of detailed information that you can use to diagnose acoustic problems that may affect system performance.



The **Real Phase** and **Imaginary Phase** graphs show the phase of the signal received on each of the transceiver's receiving transducers relative to a local reference signal generated within the transceiver.

- **Real Phase** represents the component of received signal that is in phase with the reference signal.
- **Imaginary Phase** represents the component of the received signal that is in quadrature with the reference signal.

This is information about the difference in received signal phase between the five transducers, and the graphs show information from each of the transducer channels as a different colour.

Each line in the graph includes eight points, to represent the eight samples taken of the acoustic pulse. They rise in amplitude as the signal strength rises.

The graph's horizontal axis is the time into the received pulse, in milliseconds, over which the eight samples are taken.

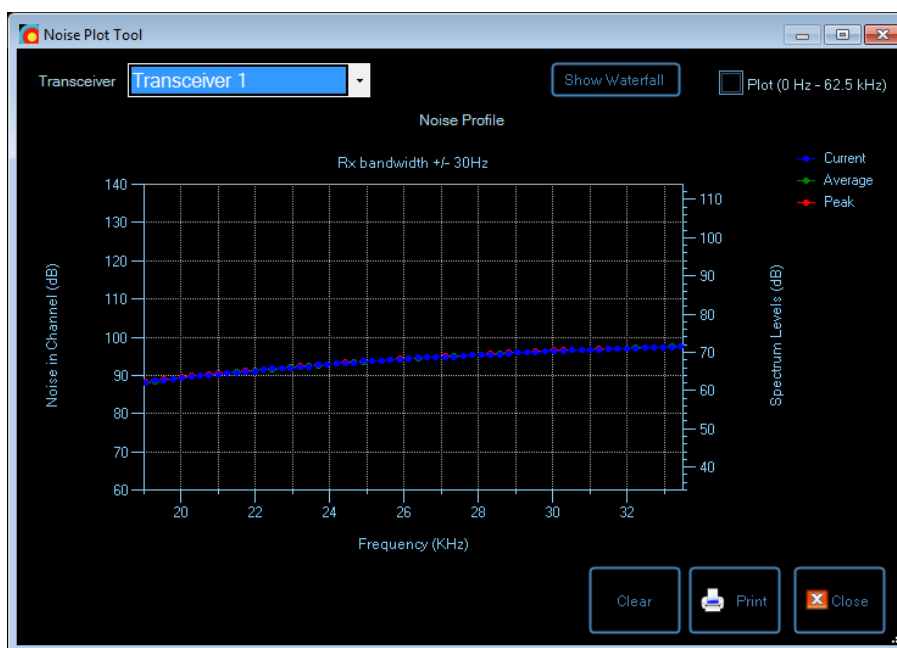
The **Envelope** graph displays the absolute magnitude of the acoustic signal as seen at each of the five transducers. The absolute magnitude is:

$$\text{Magnitude} = \sqrt{(\text{real}^2 + \text{imaginary}^2)}$$

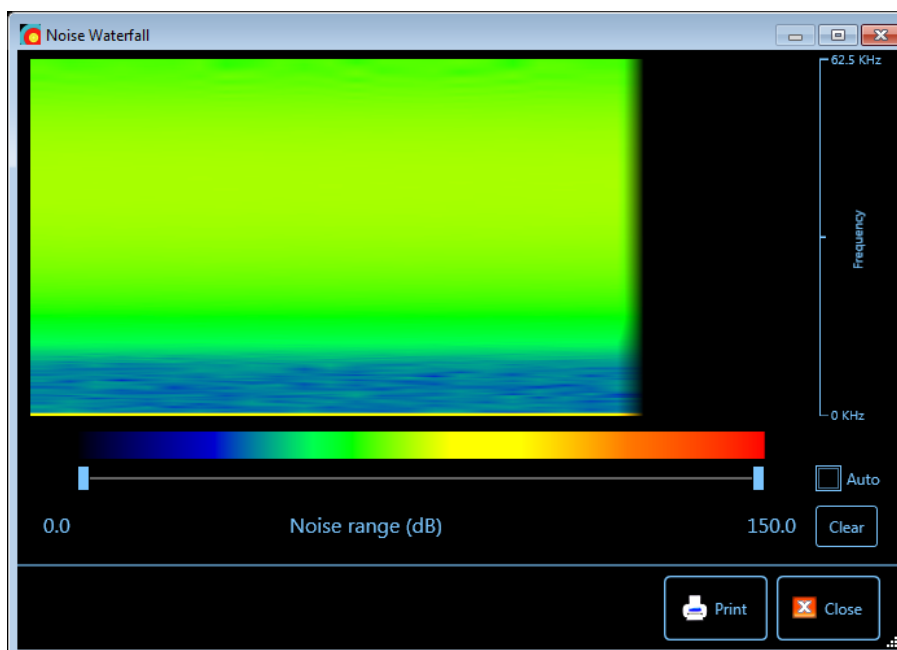
The **Envelope** graph also includes five lines, with one for each transducer. However, because they are all of the same magnitude, the graph shows them superimposed on top of each other. This is normal—the signal magnitude should always be the same at all five transducers.

A.9.6.7 Noise Plot

The noise plot tool is a fault finding tool that you can use to analyse the amount of background noise to which the transceiver is exposed. You can use it to take various noise profiles of the vessel under different operating configurations — for example with thrusters on and off; with the echo-sounder on and off. These profiles will give you an good idea of the power and gain settings to use; the maximum range you will achieve; and the power setting required in the beacon.



Click **Show Waterfall** to display a waterfall plot.



A.9.6.8 Transceiver Admittance Test

This procedure performs a transceiver admittance test and health check.

The health check works only on transceivers that have a device serial number that is higher than 1560, because these units were fitted with all the necessary components when shipped as new. It may be possible that older transceivers could have had both an array and a pre-amp upgrade performed at some time, in which case this health check will work.

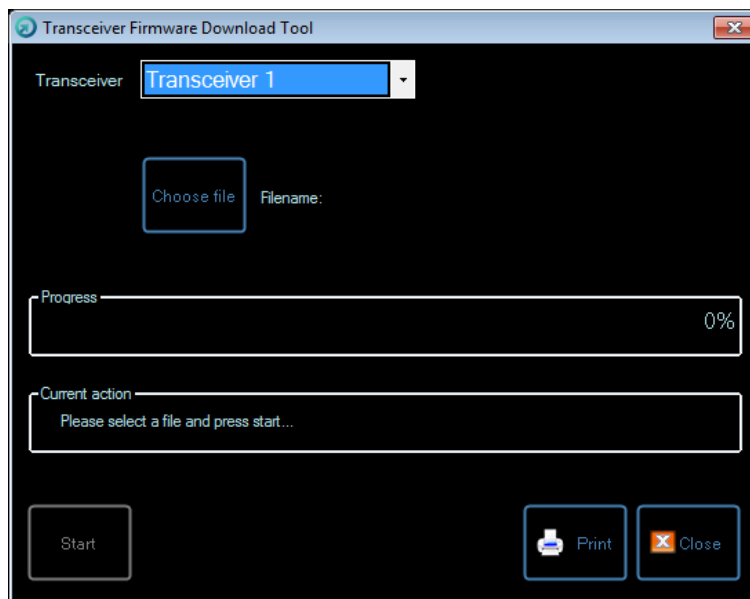
On completion of the check, a CSV file is created. You should send this file to Sonardyne for analysis.

Note



You can perform these operations only if tracking is off-line.

1. Make certain the transceiver is connected and is working correctly. Use System Setup to do this.
2. Select **Tools > Advanced > Transceiver Admittance Test** to display the Transceiver Admittance Test Tool.



3. Select the correct **Transceiver** and click **Choose file** to select the folder and file name for the output CSV file.
4. Click **Start** to begin the check.
A progress bar shows progress as the test is performed and data collected.
5. When the test finishes, send the CSV file to Sonardyne for analysis (email address: **usbl.support@sonardyne.com**).

A.9.6.9 Transceiver Factory Calibration

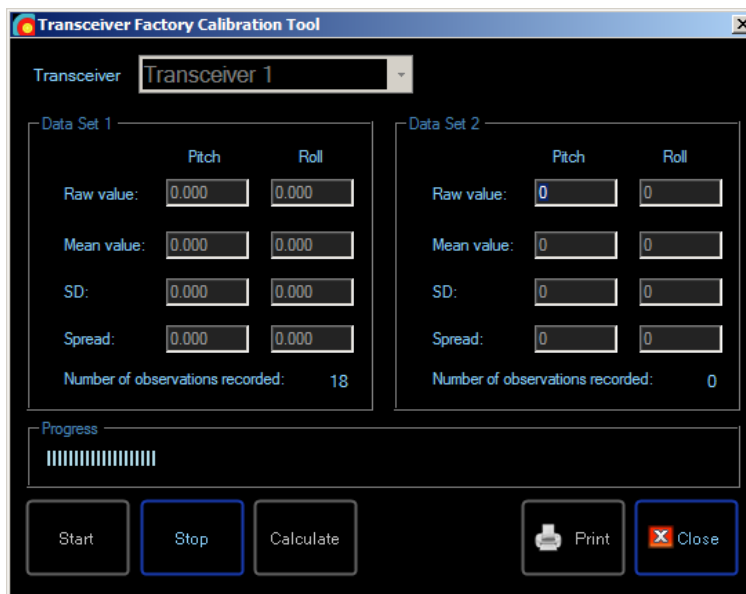
The **Transceiver Factory Calibration Tool** performs a coarse calibration on the internal roll and pitch sensors.

Place the transceiver on a flat and level surface and display the Transceiver Factory Calibration Tool and follow the instructions below.

1. Click **Start**.

The transceiver takes and stores a series of measurements from the internal roll and pitch sensors.

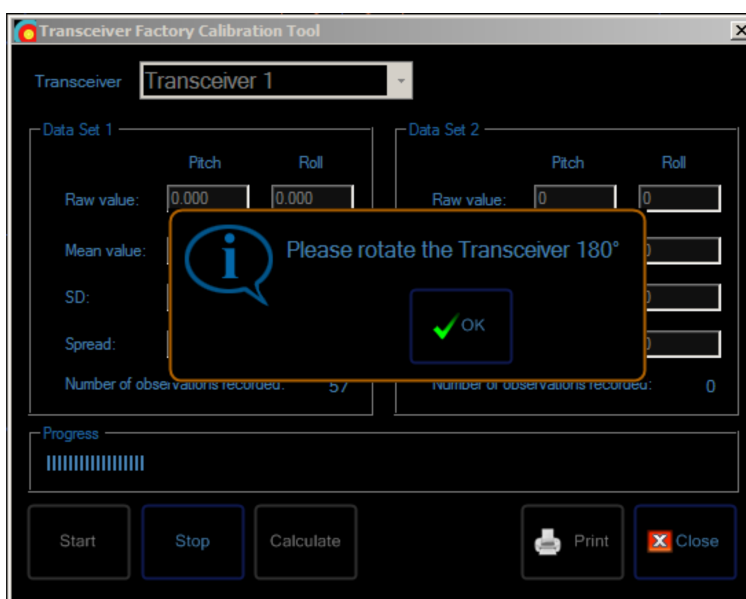
2. Turn the transceiver through 180° when prompted.



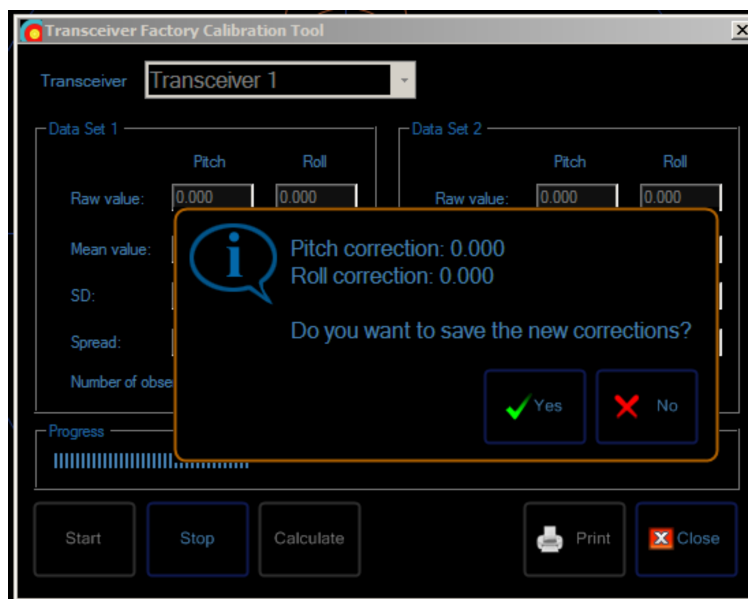
3. Click **OK**.

The transceiver takes another series of measurements from the internal roll and pitch sensors. A progress bar shows progress of the calibration.

On completion of the measurements, the calibration details are displayed.



4. Click **Yes** to save the results of the sensor calibration, or click **No** to discard the results.



Note

 You can choose to export the results of the internal sensor calibration (see *Section A.9.7.3 "Data Export"*).

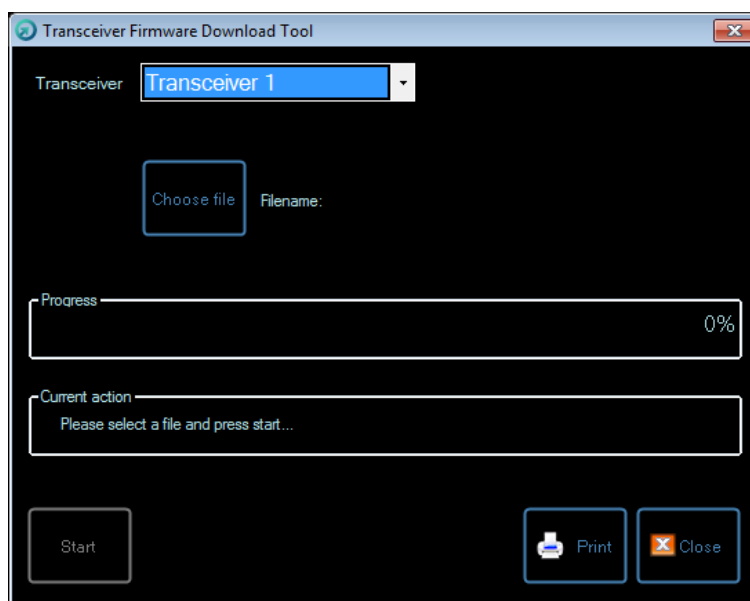
A.9.6.10 Transceiver Firmware Download

Sonardyne recommends that you obtain the latest version of firmware and that you save it to the C: drive of the computer that you use to run the software.

Note

 You can perform these operations only if tracking is off-line.

1. Make certain the transceiver is connected to the computer correctly.
2. Add a transceiver device to the system setup of the correct type, and confirm that communications to the transceiver is working correctly
3. Select **Tools > Advanced > Transceiver Firmware Download** to display the Transceiver Firmware Download Tool.



4. Select the correct **Transceiver** to use for the firmware download.
5. Click **Choose file** and select the file to download.
6. Click **Start** to begin the download.

A progress bar shows the download progress.

Notes



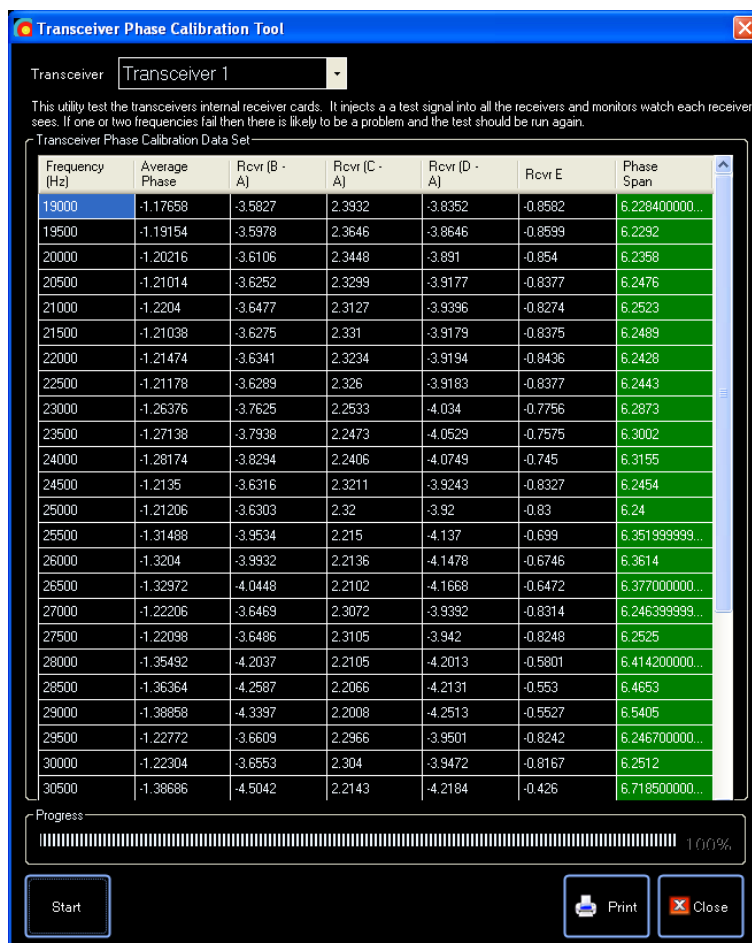
Avoid using the PC for other purposes while the download progresses.

7. Return to the System Setup for the transceiver and click **Set All**.
8. Confirm the firmware version is now set to the new version you have downloaded.

A.9.6.11 Transceiver Phase Calibration

The Transceiver Phase Calibration test tool is available only when all beacons are offline and set to not tracking.

To perform a transceiver phase calibration test select **Tools > Advanced > Transceiver Phase Calibration** from the menu.



This tool tests the transceiver's internal receivers by injecting a test signal across a range of frequencies, and measuring the differences (using receiver A as the reference). The results are shown with a colour coding:

- red indicates a large difference (typically more than 8 degrees).
- green indicates a small differences.

If only one or two frequencies fail, it is unlikely that there is a problem because the test can be disturbed by external noise. In this case, repeat the test to try to gain a successful result.

The system runs this calibration test automatically at 15 minute intervals, and sends warning messages if a problem is detected. You should use this tool if you suspect there is something wrong with the transceiver.

Note



Large ring buffers can appear to make the user interface unresponsive.

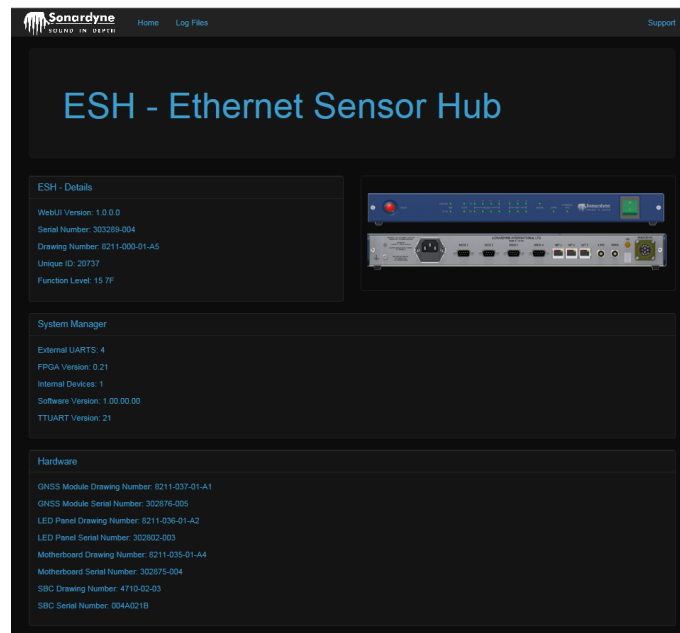
A.9.6.12 ESH Support

ESH Manager displays the current operational status of the ESH in a web browser. In the event of a problem log files can be retrieved and sent to Sonardyne Support for analysis. ESH Manager provides the following information and functions:

- ESH ID and status information
- ESH hardware information
- ESH firmware information

- ESH user manual
- ESH firmware updater
- ESH log files
- Sonardyne Support contact details

Click **Tools** > **Advanced** > **ESH Support** to open ESH Manager and follow the on-screen instructions.



For more information see *UM-8211 "User Manual for the Type 8211 ESH"*.

A.9.6.13 Pinger Locator

The Pinger Locator tool provides the ability to detect acoustic Underwater Locator Beacons (ULBs) and display the estimated range and direction. Most ULBs transmit a 10 ms pulse once per second at 37.5 kHz $\pm$ 1 kHz.

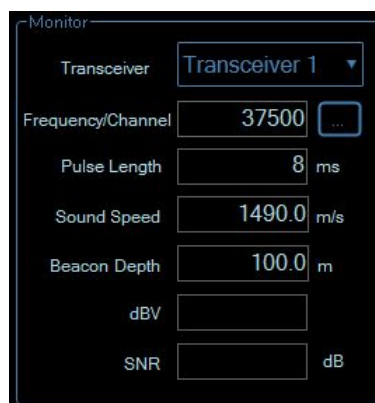


Operating the Pinger Locator

Note

 All normal USBL tracking must be stopped before starting pinger tracking.

1. In the **Monitor** pane, enter the **Frequency/Channel** of the ULB or,



- Click ... and select the appropriate beacon type (**AODC** is the default beacon, which also responds on 37.5 kHz).

Monitor

Transceiver: Transceiver 1

Frequency/Channel: AODC A

Pulse Length: 8 ms

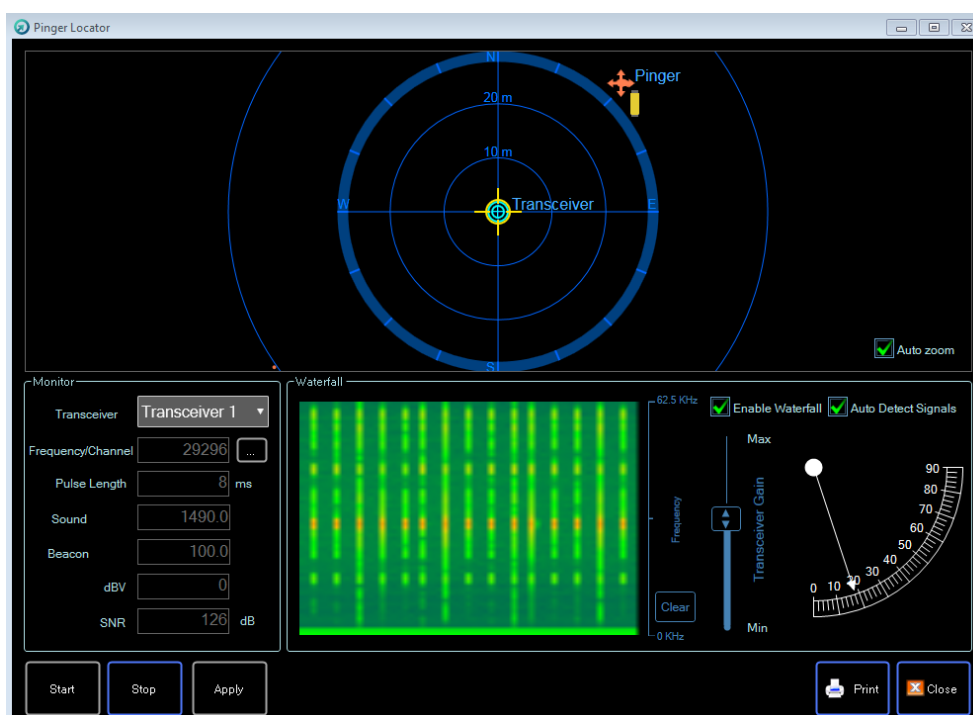
Sound Speed: 1490.0 m/s

Beacon Depth: 100.0 m

dBV:

SNR: dB

- Enter the ULB's transmit **Pulse Length**, the estimated average **Sound Speed** for the location, and the estimated **Depth**.
- Click **Start** to change the transceiver to pinger receive mode.
- When an acoustic ping in the selected frequency band is received, the Pinger Locator plots the elevation angle of the incoming signal (bottom right), and the beacon's estimated range and direction on the top of the chart.



- The **dBV** and **SNR** values give an indication of signal strength and signal-to-noise ratio.
- Use the **Transceiver Gain** slider control to adjust for best dBV and SNR—the gain should be as high as possible without introducing significant false detection (sometimes, it can be helpful to reduce the **Pulse Width** to improve the probability of signal detection, but this comes at the cost of increased false detection).
- Select **Enable Waterfall** to display the moving acoustic noise plot (high background noise will tend to mask the pinger's signal and reduce the SNR value).

9. Select **Auto Detect Signals** to receive a prompt if a significant signal is found in another part of the band (this could be just noise, so the **Transceiver Gain** may need to be reduced to minimise false-triggering).
10. Select **Auto Zoom** on the chart to switch between manual-zoom (mouse wheel) and auto-zoom.
11. Click **Stop** to return the transceiver to normal USBL mode.

A.9.6.14 Remote Instrument Synchronisation

The Remote Instrument Synchronisation tool provides the ability to time-synchronise acoustic beacons to UTC time, for example where an accurately time-stamped data log is required. This is not required for normal USBL tracking operations.

Select the **Select** checkbox for beacons to be time synced.

Select	Name		Transceiver to Beacon Time Offsets		Beacon to Transceiver Time Offsets		Last Updated (UTC)	Doppler Compensation
	Prefix	Address	Previous (s)	Current (s)	Previous (s)	Current (s)		
☐		2503						☒
☐		2504						☒

Note

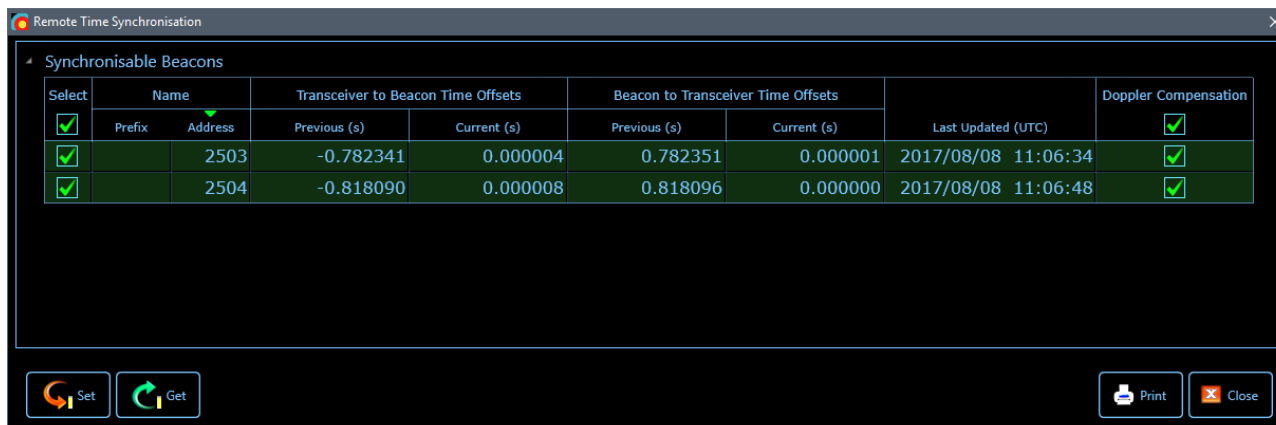


It recommended to keep the Doppler Compensation checkbox selected.

Click **Get** to read the beacon time offsets. The **Transceiver to Beacon** and **Beacon to Transceiver Time Offsets** are displayed in the **Current(s)** columns, together with the time stamp in the **Last Updated (UTC)** column.

Select	Name		Transceiver to Beacon Time Offsets		Beacon to Transceiver Time Offsets		Last Updated (UTC)	Doppler Compensation
	Prefix	Address	Previous (s)	Current (s)	Previous (s)	Current (s)		
☒		2503		-0.787382		0.787390	2017/08/08 11:05:49	☒
☒		2504		-0.813856		0.813859	2017/08/08 11:05:56	☒

Click **Set** to synchronise the beacon time clocks to the transceiver time clock (each beacon may take a few seconds to synchronise).



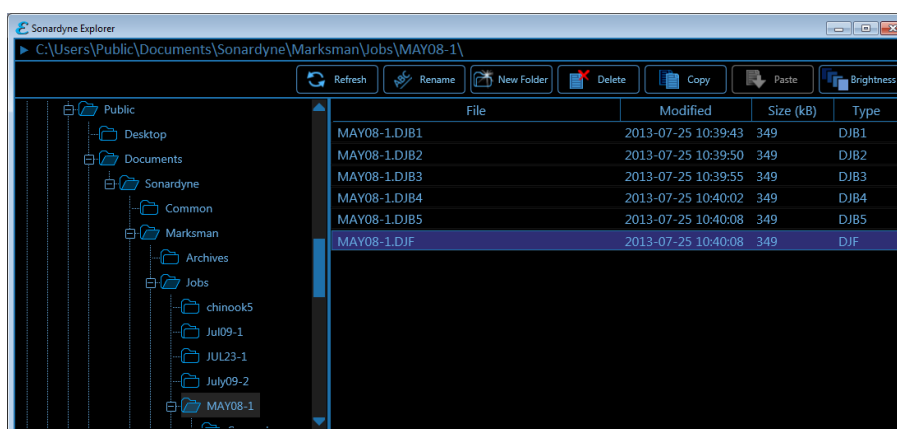
A.9.7 Maintenance

The Maintenance menu allows you to manage data logging, to explore the files, and to import or export set-up files.

A.9.7.1 Explore Files

The software's file explorer quickly navigates the user to the most commonly used system folders. Using this Explorer, the user can:

- **Copy** and **Paste** files between the system folders and removable backup media, such as USB memory sticks.
- **Rename** file, such as exported data files. Note that this option must not be used to rename system files otherwise unexpected behaviour might occur.
- **Delete** files.
- Create **New Folders**.
- **Refresh** the file list.
- Change the viewer **Brightness**.



A.9.7.2 Logging

The log file system is managed automatically by the software, but the **Logging** user interface allows you to make manual changes, if necessary.

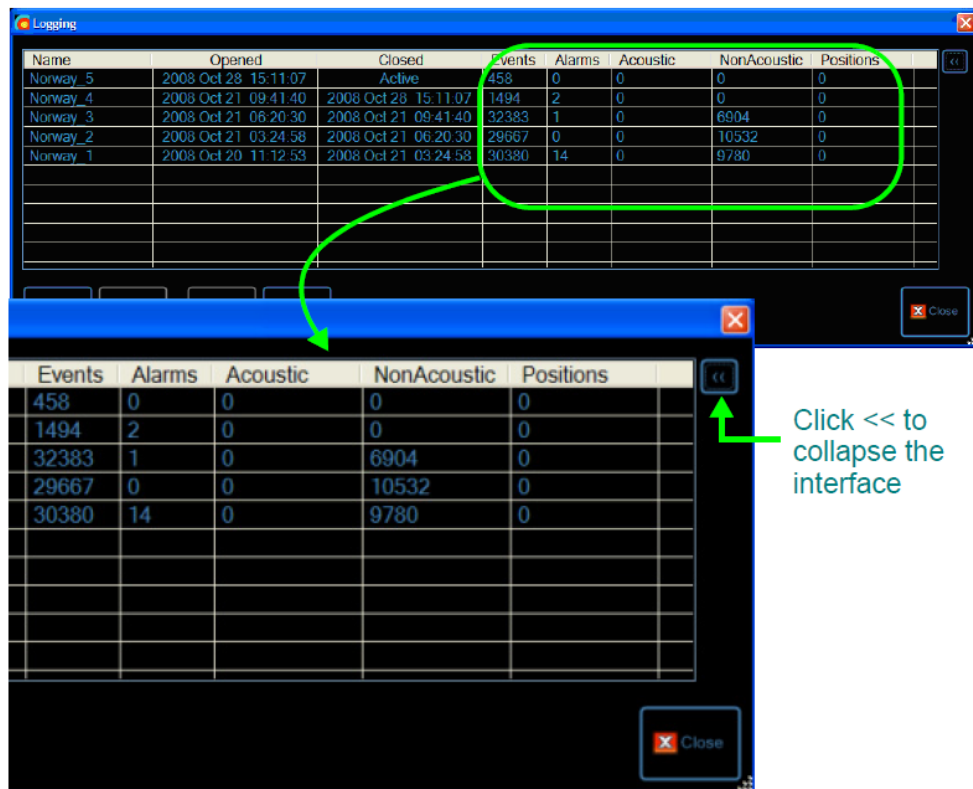
Figure A-4 Logging User Interface



Click >> to expand the interface

The Logging user interface (UI) is shown in *Figure A-4*. It shows a list of the log files, together with details of the dates and times when the files were opened and closed, or their current status. Normally, log files are created and purged entirely automatically without user intervention. Occasionally, operator assistance may be required, but this should be done under the guidance of Sonardyne Support.

Click the >> button (near the top right-hand corner) to expand the interface to show more information about each file, for example:



Click << to collapse the interface

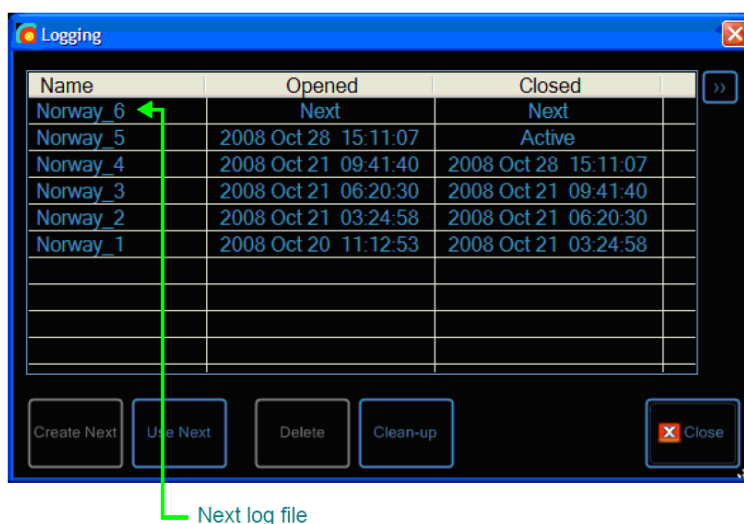
The Logging interface allows the following operations:

- Create Next
- Use Next

- Delete
- Clean-up

Create Next

The **Create Next** button is enabled if there is no 'next' log file already available. Click the **Create Next** button to create the next log file to which the system logs data. The application takes several seconds to create the next log file, after which the display updates, for example:



The status indicator **Next** in the **Opened** and **Closed** columns for the **Norway 6** entry shows that this is the next log file to be ready for use by the system to log data. However, in this example the active file is still **Norway 5**.

After you create the next log file as described, the **Create Next** button is disabled and the **Use Next** button is enabled.

Use Next

The **Use Next** button is enabled only if there is a 'next' log file available for use.

Click the **Use Next** button to stop logging to the log file that is currently active, and start logging to the next log file. The Opened and Closed fields are updated, for example:



The **Use Next** button is disabled, and the **Create Next** button is enabled, ready for you to create the next log file.

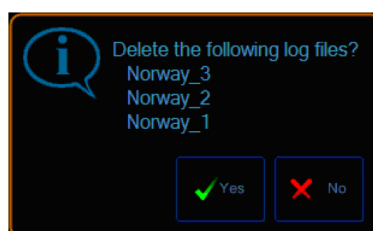
Delete

This option allows you to delete a continuous sequence of one or more log files, always beginning from the oldest log file in the list and ending at the log file you select. The **Delete** button is enabled only when you select a file in the list.

To delete a selection of files, click the most recent file that you want to delete, and click **Delete** to delete the selected file and all log files in the list that are older than the selected file, for example:



The software displays a prompt for confirmation, for example:



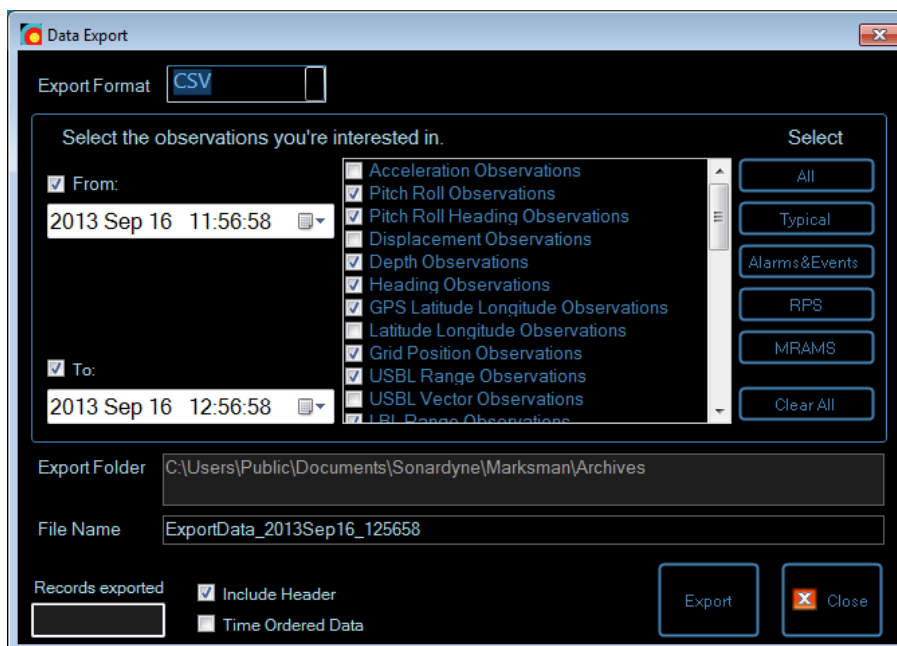
Click **Yes** to confirm the deletion. The interface is then updated to show the new list of log files, and the **Delete** button is disabled, for example:



Clean-up

The Clean-up button starts a house-keeping session that deletes any old log files as specified in the **House Keeping** section of the Options – Logging tab.

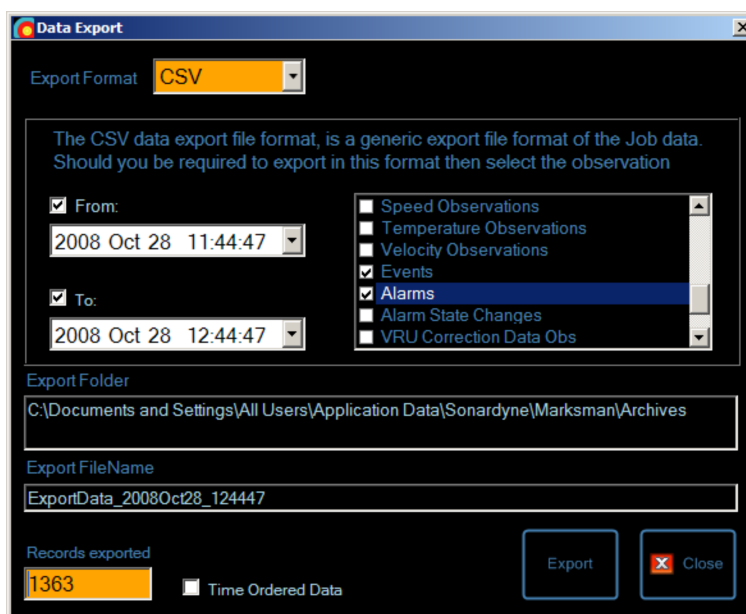
A.9.7.3 Data Export



The data export mode uses **CSV**, which you select through the **Export Format** control on the dialog box.

The CSV export mode is a general purpose exporter.

1. Select **CSV** in the **Export Format** control.
2. Set the **From** and the **To** dates between which to export observations.
 - To select all observations after a particular date, set the **From** date and then clear the check box for the **To** date.
 - To select all observations before a particular date, set the **To** date and then clear the check box for the **From** date.
3. Select the observations to include in the export.
4. Click **Export**.



A.9.7.4 Disk Cleanup

This option allows selected folders to be "cleaned", removing the contents from the hard drive to free up space on your PC.



The following folders and their associated file types can be cleaned:

- \Ranger2\Archives (Archived .CEF/.ZIP files)
- \Ranger2\System\CASIUS Data Files (.CAS,/.CRS files)
- \Ranger2\Library\ENvironment\Sound Speed Profiles (.PRO files)
- \Snapshots (.PNG files)
- \UserCommsLogs (.txt files)

Select the content you want to delete or select the top check box to select all and then click **Clean Selected Folders**.

Windows temporary files can be "cleaned" by selecting **Windows Temporary files** and then clicking **Clean Selected Folders**.

A.9.8 Options

The **Options** menu contains the **General**, **Chart** and **Menu** items.

A.9.8.1 Options > General (Options)

The **General(Options)** dialog box contains the **General**, **Logging** and **Acoustic** tabs.

A.9.8.2 General Tab

Main chart options:

- Select **Show raw acoustic positions** to see the unfiltered position points.
- Select **Show...the following vessel** to choose the primary vessel for the display chart.

Position Display Formats

- Select **World Frame** to choose **UTM** or **Latitude/Longitude**
- Select **Relative Frame** to choose **East/North/Depth** or **Range/Bearing/Depth**

Other Options

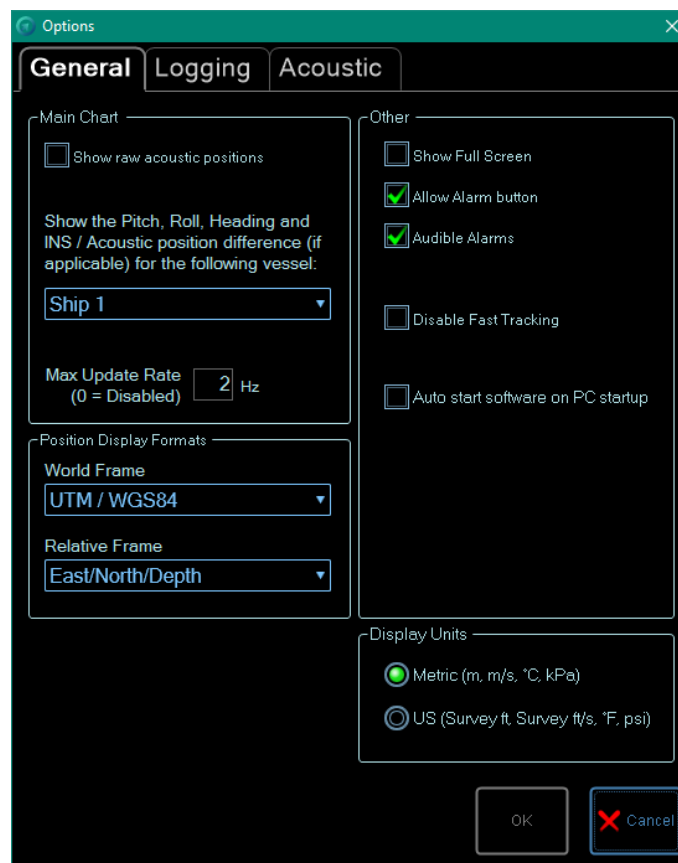
- Select **Show Full Screen** to remove the Windows title bar.
- Select **Allow Alarm Button** to display the on-screen alarm button.
- Select **Audible Alarms** to enable the alarm audio output.

- Select **Disable Fast Tracking** to stop interleaved ranging cycles (ping stacking); the system will send a command and wait for a response before sending another.
- Select **Auto start software on PC startup** to automatically start the software when the PC starts.

Display Units

Select Metric to display all measurements in SI units.

Select US to display in US survey feet, degrees Fahrenheit, and so on.



A.9.8.3 Logging Tab

Normally, you should leave the data logging options in their default settings. Refer to Sonardyne for advice before changing settings.

To keep logged data for:

- 1 week – set **Housekeeping Offline** to 168 with **Change Log File** at 1 hour.
- 1 month – set **Housekeeping Offline** to 720 with **Change Log File** at 1 hour.



A.9.8.4 Acoustic Tab

Transceiver Power/Gain

When using Beacons Table Add Beacon, QuickTrack, 6G Discovery or Remote Control, beacons are added with default transceiver power and gain levels, unless specified otherwise.

1. Select **Operating Range** to have the system select the best power and gain according to the maximum range set, or
2. Select **Manual setting** to set the power and gain with specific values.
3. Set the default **Transmit Speed**, **Receive Speed** and **Wait time** for robust telemetry, according to the vessel conditions and requirements of the job.



A.9.8.5 Options > Backdrop

A chart backdrop may be used to reference the positions of vessels or beacons to seabed assets or topography.

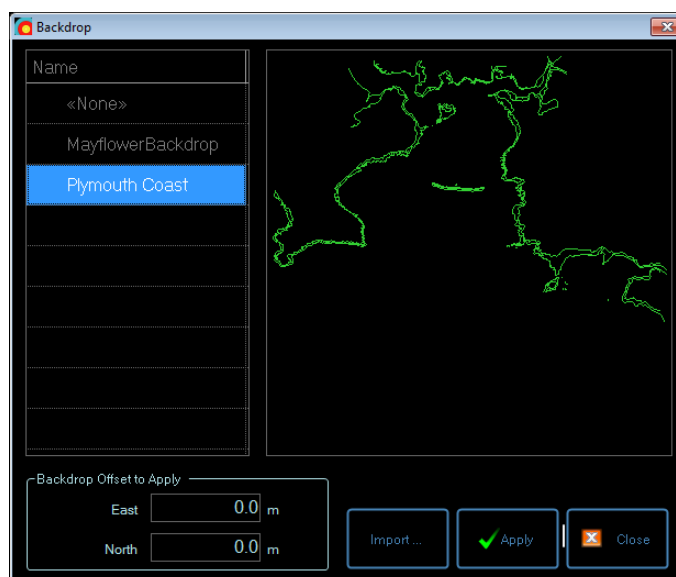
Backdrop image files must be of type DXF. Ensure that the following actions are applied and confirmed for DXF files:

- contents must be exploded into polylines, (all splines and curves; ellipses should become polylines).
- all visible layers must be collapsed to a single layer.
- all hidden layers must be removed (document markups).
- shape orientation must be bow up.
- the (0,0) point of the shape must be at the centre of the shape (default).

Select the appropriate backdrop from the named list and click **Apply**. Select **None** to work without a backdrop.

Multiple backdrop files may be **Imported** and stored on the system.

The DXF backdrop should normally have its Easting/Northing origin already defined, but an **Offset** may be applied if necessary.

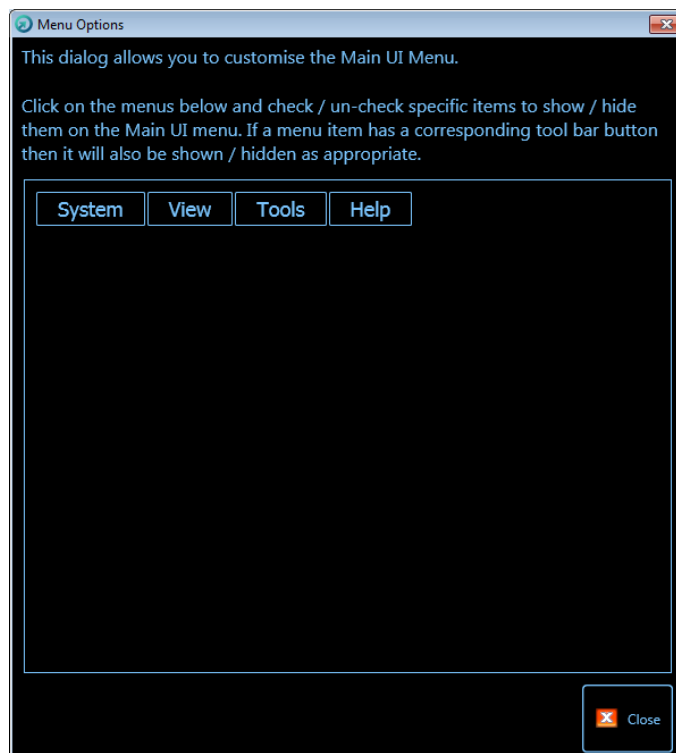


A.9.8.6 Options > Chart

See Section A.2.1 "Chart Properties".

A.9.8.7 Options > Menu

The Menu dialog box allows you to customise the Main UI menu. Clicking a menu item allows you to show or hide that item in the Main UI. If the menu has a corresponding toolbar button then it will also be shown/hidden as appropriate.



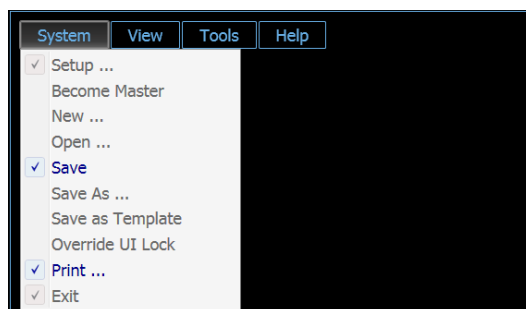
The four menu items are shown expanded below.

Note

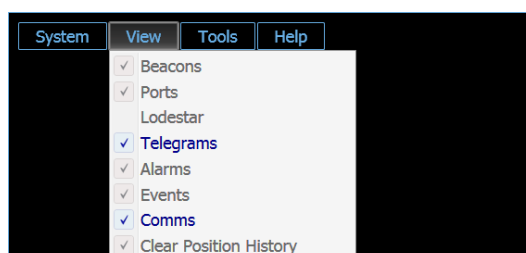


Menu items displayed below are dependent on the product and options purchased.

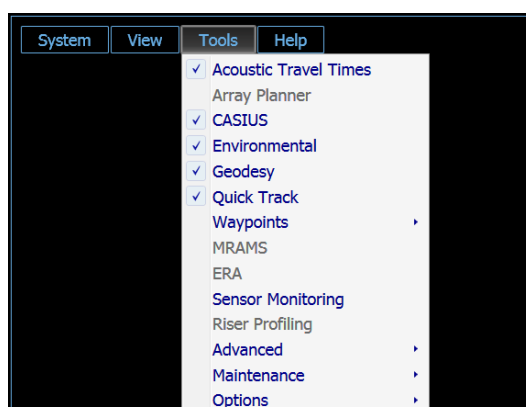
A.9.8.8 System



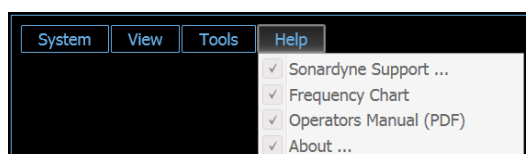
A.9.8.9 View



A.9.8.10 Tools



A.9.8.11 Help



Note

 When a system is upgraded to include new features, the new menu items must first be enabled (selected) in this menu to enable them to appear in the Main UI.

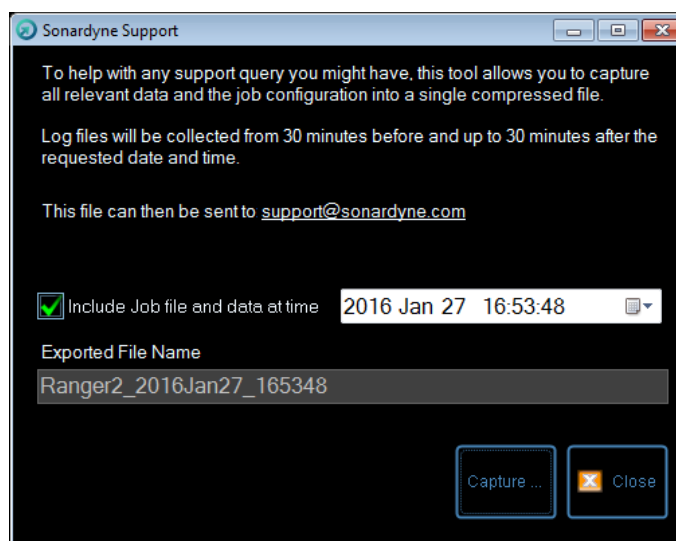
A.10 Help Menu

The **Help** menu options are described below:

A.10.1 Sonardyne Support

This option allows you to export relevant data and configuration to a compressed file, so that you can send the file (.CEF extension) to Sonardyne as part of a support request.

1. Select the date and time the event occurred and then click **Capture...**
2. Browse to the desired folder for the output file and then click **OK**.
3. A support log file will be created containing logged data from 30 minutes before to 30 minutes after the target time. The support log file can be sent to Sonardyne Support for analysis.



A.10.2 Frequency Chart

The frequency chart can be referred to for guidance on optimising USBL accuracy vs. range and avoidance of other acoustic systems operating in the vicinity (see *Figure 5–1 "Sonardyne Frequency Chart"*).

A.10.3 Operators Manual

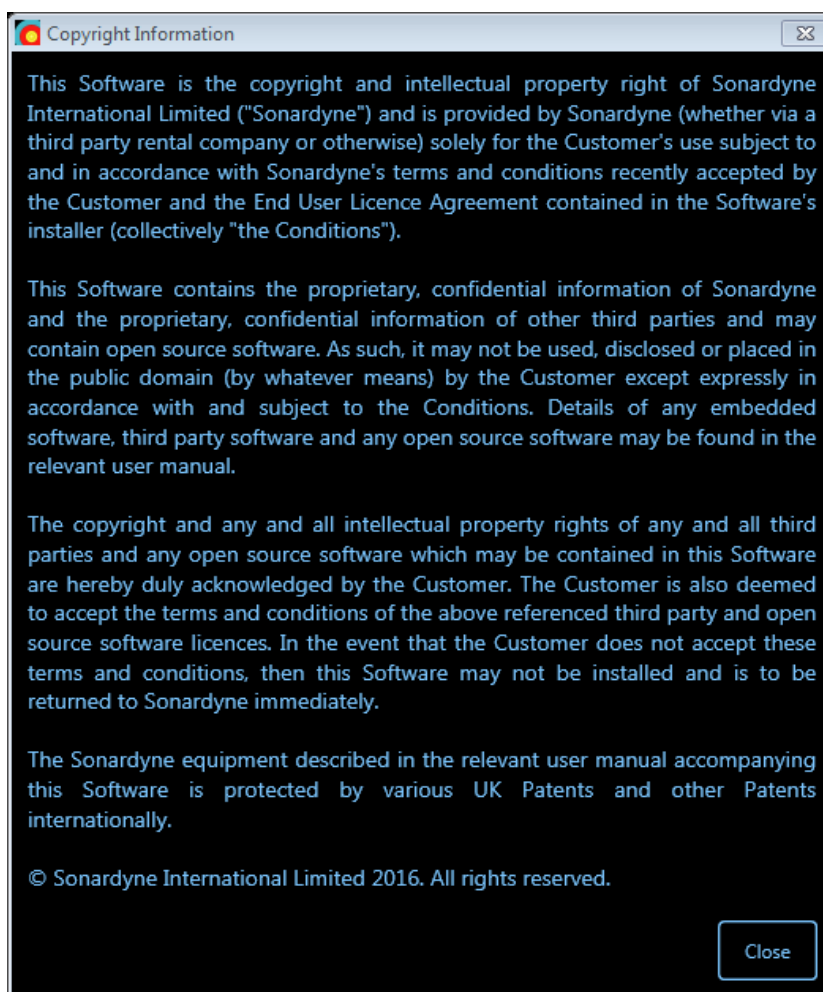
This option opens the User Manual (this manual) so that you can refer to it easily.

A.10.4 About

This option displays information about the system options which the security key has enabled, the primary software version number and the copyright statement. A detailed copyright notice is also provided.

If you experience a problem with the software, make a note of the version number on this dialog and supply this information to Sonardyne International Limited when you report the problem.

Contact Sonardyne International Limited for advice and information about updates to the software.



Appendix B – Installation

B.1 Introduction

Note

 This software is supplied under licence for use with Mini-Ranger 2 systems only. This software is the intellectual property of Sonardyne International Limited and is subject to the usual copyright restrictions.

Sonardyne ships the system and includes the most recent released version of the Mini-Ranger 2 software. The software installation instructions allow you to install the Mini-Ranger 2 software and if necessary, upgrade the software to a later release.

When the software is running, Click **Help > About** in the menu bar to see information about the version number of the installed software. Contact Sonardyne for upgrade details.

B.2 System Installation

Note

 Risk of equipment malfunction or interference with other systems. This system has been carefully designed to comply with the relevant Electro-Magnetic Compatibility (EMC) standards for marine use. In order to maintain EMC compliance, the system must be installed according to the Sonardyne User Manual and only Sonardyne approved parts may be used. Use of unapproved parts, such as unscreened cables, may put EMC compliance at risk. Please contact Sonardyne Support for further guidance.

This section is concerned with all aspects of installing the hardware of a typical system.

Inevitably, because of the nature of applications that use USBL systems, each installation is likely to be unique and characterised by its own specific set of difficulties and special requirements. The guidance included here can therefore only be of a general nature.

If necessary, contact Sonardyne for advice if your specific installation configuration raises some special obstacles to achieving a successful deployment.

B.2.1 Hardware Requirements

Ranger 2 recommended computer hardware specifications are shown below.

Item	Minimum Specification	Recommended Specification
CPU	i5 2.8 GHz	i7 2.8 GHz
Memory (RAM)	8 GB	8 GB
Hard Drive	240 GB SSD or Hard Disk Drive	500 GB SSD
Graphics	32-bit colour, Direct-X V10 or later	32-bit colour, Direct-X V10 or later
Monitor Resolution	1280 x 1024	1920 x 1080
USB Ports	4	4
Operating System	Windows® 10 Professional x64	Windows® 10 Professional x64

B.3 Hardware Installation (Rack Mount)

To install the hardware you must first install the PC and the ESH and interconnect them using the supplied cables.

B.3.1 Before you Begin

Take the following steps before you begin to install the hardware of the Navigation Processor:

- Identify a suitable location for the PC and the ESH where they can be installed near to each other.

Note

It is recommended that hardware installations are located at least 10 metres from any VHF radio antennas operating in the 156–165 MHz band.

- Ensure the installed location provides good ventilation for both units.
- For a fixed installation, you should ideally used a 19-inch rack.
- For transportable installations, select a location for both units on a secure desk or bench that allows convenient connection of power and data cables without causing a hazard or obstruction to users or to other personnel in the area.
- Ensure the installation location does not subject either of the units to extremes of vibration, temperature or humidity.
- Secure both units against movements of the vessel.
- Ensure there is a convenient ac power outlet near to the installed location, and sufficient space at the back of both units to allow easy access for connection of the power and signal cables and to operate the main power switches on the backs of both units.

Note

It is recommended that ac power feeds are clean and stable, and are suitable for use with IT equipment. If in doubt, then an external surge suppressor conforming to UL1449 (or equivalent) must be installed.

B.3.2 What you will Need

You will need (as a minimum) the following items and tools to complete the installation:

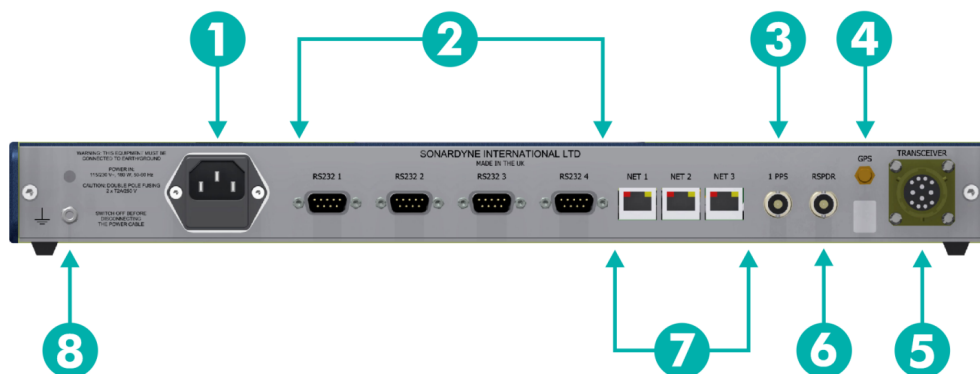
- A PC or ruggedised laptop that meets the minimum recommended specifications (see *Section 3.4 "PC"*).
- Appropriate cables for the PC and ESH.
- A transceiver cable to connect the HPT 2000/3000 to the ESH (see *Figure C-2 "HPT to ESH Amphenol to AGP Cable Assembly – CPN 820-6793"*).
- Cables to connect the GNSS, gyro, VRU etc (if used).
- A yellow primary USB security key; see *Section B.7.1 "Security Keys"* for more information. The system will not operate without this key.

B.3.3 Installation

Follow the steps below to install the ESH and the PC.

1. Ensure the power to both units is turned off.
2. Secure the ESH and the PC at the locations you have selected for them.
3. Make the connections to the ESH as required within your system; see *Figure B-1*) below.

Figure B–1 ESH Interconnections



Item	Description
1	IEC Socket 115/230 V ac and Fuse Holder
2	RS232 Serial Ports x 4
3	1 PPS Input
4	External GNSS Antenna Connection
5	48 V Transceiver Connector (Amphenol to AGP Cable Assembly)
6	Trigger Responder
7	RJ45 Ethernet x 3
8	Chassis Earth

See the ESH user manual *UM-8211 "User Manual for the Ethernet Serial Hub"* for more information.

B.3.4 Network Settings

Notes

 All network settings must be chosen to suit the other network devices and connection to existing networks must be performed in consultation with local IT staff.

The Sonardyne instrument network used for connection to ESH, transceiver, LodeStar and other devices, must be kept private to guarantee performance and reliability.

Public network connections for Remote Control, Output Telegrams, PAN, etc should be routed via a separate sub-net (to the 2nd network port if using a Sonardyne Computer).

B.3.4.1 IP Address

An IP address is a unique numeric label assigned to each device in a computer network that uses the Internet Protocol for communication. It is defined as a 32-bit number in Internet Protocol Version 4 (IPv4) and is usually written in a human-readable notation, e.g. the ESH default address is 192.168.179.80 and so the PC IP address must be on the same subnet, e.g. 192.168.179.100 (only static/fixed IP addresses are supported).

B.3.4.2 Port

A port is associated with an IP address and the protocol type of the communication and is defined as a 16-bit number, e.g. ESH default port is 4000.

B.4 USBL Transceiver Installation and Deployment

Note

 USBL transceivers contain delicate transducers and motion sensing elements. Take care to protect the transceiver during and after installation by following all the instructions in this section.

B.4.1 Internal Compass Calibration

It is recommended to calibrate the internal compass when the transceiver is first deployed. The magnetic compass can be calibrated from directly from the Mini-Ranger 2 software or using the Radian2 Tool.

To configure the internal attitude sensor and calibrate the magnetic compass directly from the Mini-Ranger 2 software see 4.7.1.1 "Calibrating the Internal Compass" on page 14.

To configure the internal attitude sensor and calibrate the magnetic compass using the Radian2 tool see Appendix G "Radian2 Tool".

B.4.2 Deployment Methods

The Type 8221/8212 transceiver can be mounted and deployed on a NB Class 150 standard flanged pole as well as any of the Sonardyne systems for deploying USBL transceivers described in *Table B-1*. Contact Sonardyne for more information on deployment systems.

Table B-1 USBL Deployment Methods

Deployment Method	Description	Reference
Type 7950 Through-Hull	The Type 7950 consists of a hydraulically operated pole, a sealed bearing section and a sea chest service section with inspection door. The whole machine sits on a gate valve which in turn is mounted on the flange of a through-hull penetration pipe. The USBL transceiver is deployed by the hydraulic operation of the pole to the required depth and can be controlled locally or from a remote control panel.	See <i>Section B.4.5</i>
Type 8097 Over-the-Side	The Type 8097 is a modular, transportable, over-the-side deployment pole, designed for vessels where through-hull deployment or through-tube options are not available or practical. Once deployed the pole is locked into place by a hydraulically operated mechanism that is welded to the vessel's hull.	See <i>Section B.4.6</i>
Type 8169 Through-Tube	The Type 8169 is a modular, transportable, through-tube deployment, designed for vessels where through-hull deployment or over-the-side options are not available or practical. The pole is scalable to fit through an existing tube or a new tube installation. Once deployed the pole is held in place by a flange at the top of the tube and a hydraulically operated clamp mechanism near the bottom.	See <i>Section B.4.7</i>
Non-Standard Deployment Pole	The transceiver can be fitted to a non-standard deployment pole using a purpose-designed flange adapter if necessary. Contact Sonardyne for details on installing USBL transceivers onto non-standard deployment poles. Sonardyne also offer a range of adaptors to fit	See <i>Section B.4.8</i>

Table B–1 USBL Deployment Methods (continued)

Deployment Method	Description	Reference
	other deployment poles.	

B.4.3 General Requirements

Depending on the deployment type, observe the following general requirements when you install the USBL transceiver:

- Ensure the method of deployment protects the sensitive acoustic transducer elements from damage at all times during installation, deployment, and demounting. A red sleeve is supplied fitted to the USBL transceiver to protect its transducer face during shipping. You **MUST** remove this protective sleeve before you deploy the USBL transceiver; the USBL transceiver will not perform correctly with this sleeve in place.

The main sources of vibration that could affect the transducer are; normal operation of the vessel's machinery; and Vortex Induced Vibration (VIV) as the transducer's supporting pole moves through the water.

- Mount the USBL transceiver on a rigid pole to minimise vibration and reduce free movement of the transducer with respect to the vessel.
- Mount the USBL transceiver so that it is pointing vertically downwards, with the connector at the top and the black acoustic transducer at the bottom.
- Ensure the forward-pointing direction arrow on the transducer is pointing forward on the vessel.
- For best results, if possible deploy the USBL transceiver at least 2–3 metres below the lowest part of the vessel's hull.

By increasing the separation distance between the transducer array and the hull in this way, you will reduce the risk of multipath reflections from the hull, reduce the amount of vessel noise received by the transducer, and reduce the chance of aerated water passing over the transducer's face.

Note



After installing the USBL transceiver, measure the vertical offset between the bottom face of the USBL transceiver and the vessel's waterline when the USBL transceiver is fully deployed. You will require this information later, to configure the USBL software.

- Deploy the transducer as far away as practical from any source of noise or bubbles, such as propellers, thrusters, moonpools, or other causes of aeration.
- Ensure the bottom face of the transducer is kept well clear of brackets, ropes, and other structures during deployment.
- To ensure correct 'wetting' of the transducer's polyurethane face, keep the USBL transceiver face clean and free from oil or grease.

B.4.4 Deployment Considerations

The design of any deployment mechanism should ensure that all unwanted movements of the USBL transceiver with respect to the vessel are minimised.

B.4.4.1 Attitude Measurement Errors

To achieve best USBL performance it is necessary to use a high accuracy attitude sensor so that the system can adjust the measured direction of arrival of the acoustic signal to compensate for the vessel's motion. If the attitude sensor is installed on the vessel, then it is particularly important to minimise movement of the USBL transceiver with respect to the vessel.

The importance of correct USBL transceiver deployment is greater if you intend to use external attitude measurement equipment, such as a Vertical Reference Unit, with the USBL System. These instruments measure the roll, pitch and heading angles of the object they are attached to, which is usually the vessel. However, if the USBL transceiver is mounted on a pole that is capable of moving significantly with respect to the vessel, then the attitude measurements will relate to the vessel, but not to the USBL transceiver with any accuracy.

Pole movements can arise from different causes: Small quick movements are usually caused by water flowing past the pole, giving rise to VIV, and larger, slow movements can arise as the vessel pitches and rolls. Both effects can be reduced by ensuring the pole is mounted rigidly on the vessel.

In some cases it is possible to mount the attitude measurement instrument on top of the pole so that it always measures the attitude of the USBL transceiver, even if the pole moves relative to the vessel.

B.4.4.2 Galvanic Isolation

The USBL transceiver housing is made of aluminium bronze. The most common material used for the tube, pole and mounting frame is mild steel.

It is good practice to isolate the USBL transceiver and the mounting arrangement electrically so as to reduce the effects of galvanic corrosion on the housing.

Sonardyne provide an isolation adapter within the installation kit. On no account should the aluminium bronze be in contact with a material more noble than itself (electro-chemically) — because galvanic corrosion will result.

Note



To avoid galvanic corrosion of the aluminium bronze USBL transceiver housing, never allow the housing to remain in contact with a material more electro-chemically noble than itself.

Before you mount the USBL transceiver, always record the information detailed on the label on the outside of its housing. This information includes its serial number, the device serial number, and factory offsets for the internal inclinometer sensors.

B.4.5 Through-Hull Mounting (Type 7950 Deployment Machine)

The Type 7950 is a through-hull deployment method using a gate-valve and sea chest assembly that can accommodate the USBL transceiver. Above the sea chest is a deployment machine that hydraulically raises and lowers the USBL transceiver to the optimal depth.

Figure B-2 Through-Hull Mounting (Type 7950 Deployment Machine)

B.4.6 Over-the-Side (Type 8097)

The Type 8097 is a modular, transportable, over-the-side pole. The USBL transceiver is attached to a pole or frame designed so that USBL transceiver alignment can be maintained or re-established on subsequent deployments.

The pole or frame should be aligned vertically with respect to the vessel as far as is possible and, ideally, should be adequately braced against the hull to limit movement during operation.

Long poles can be susceptible to VIV. Various methods can be used to reduce the effects of this type of vibration. Contact Sonardyne for more information.

Figure B-3 Over-the-Side (Type 8097)

B.4.7 Through-Tube Mounting (Type 8169)

The Type 8169 is a modular, transportable, through-tube deployment. The pole is scalable to fit through an existing tube or a new tube installation.

In this arrangement the pole should be stiff, rigidly mounted and long enough to locate the USBL transceiver at least 1.5 metres below the lowest point on the hull (2–3 metres is recommended for best results). The mounting arrangement used must minimise any movement of the USBL transceiver with respect to the vessel, and ensure optimal tracking accuracy.

Figure B-4 Through-Tube Mounting (Type 8169)



B.4.8 Non-Standard Deployment Pole

Sonardyne offer a range of adaptors to fit other deployment pole types. Contact Sonardyne for details on how to install the USBL transceiver on non-standard deployment poles.

B.5 USBL Transceiver Mounting Methods

B.5.1 Type 8221/8212

The Type 8221/8212 (HPT 2000/HPT 3000) USBL Transceiver can be mounted and deployed using a number of deployment poles and methods. The bolt hole arrangement allows the transceiver to be installed on an ANSI 2" Nominal Bore (NB) Class 150 flanged pole as shown in *Figure B-5*.

This transceiver can also be mounted and deployed using the mounting methods as shown in *Figure B-6* (in order of the most commonly used mounting method, from left to right).

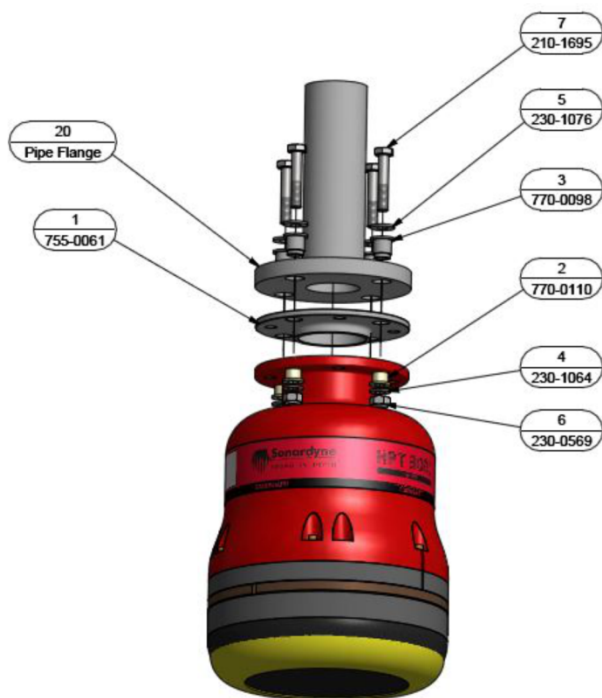
B.5.1.1 NB Class 150 Standard Flanged Pole

The primary method of mounting the Type 8221/8212 USBL Transceiver is on the end of an ANSI 2" NB Class 150 standard flanged pole. The transceiver mounting face uses two sets of mounting holes, 11 mm and 16 mm diameter, equally spaced on a 121 mm Pitch Circle Diameter (PCD).

An HPT 2000/3000 Isolation Kit (part number 650-0143) must be used to isolate the USBL transceiver from the pole. The kit contains fixings, O-rings and an isolation flange.

Figure B-5 Type 8221/8212 NB Class Standard Pole Mounting

NB Class Standard Flanged Pole



PARTS LIST			
ITEM	QTY	PART NO	DESCRIPTION
1	1	755-0061	8212-026 - Isolation flange
2	4	770-0110	M10 Nylon Insulating bush
3	4	770-0098	8212-027 - Flange bush
4	4	230-1064	Washer M10 Plain A4 S/S
6	4	230-0569	Nut M10 Nyloc A4 S/S
20	1	Pipe Flange	2\" NB Class 150 Flange
5	4	230-1076	Washer M10 S-S Large form C BS4320
7	4	210-1695	Bolt Hex S,S M10x55 A4-70

B.5.1.2 Non-Standard Flanged Pole

The type 8221/8212 USBL Transceiver can be mounted to any non-standard flanged pole with the use of an adaptor flange. When the HPT 2000/3000 Isolation Kit (part number 650-0143) is used, the flange must have mounting holes either 11 mm or 16 mm in diameter, equally spaced on a 121 mm Pitch Circle Diameter (PCD).

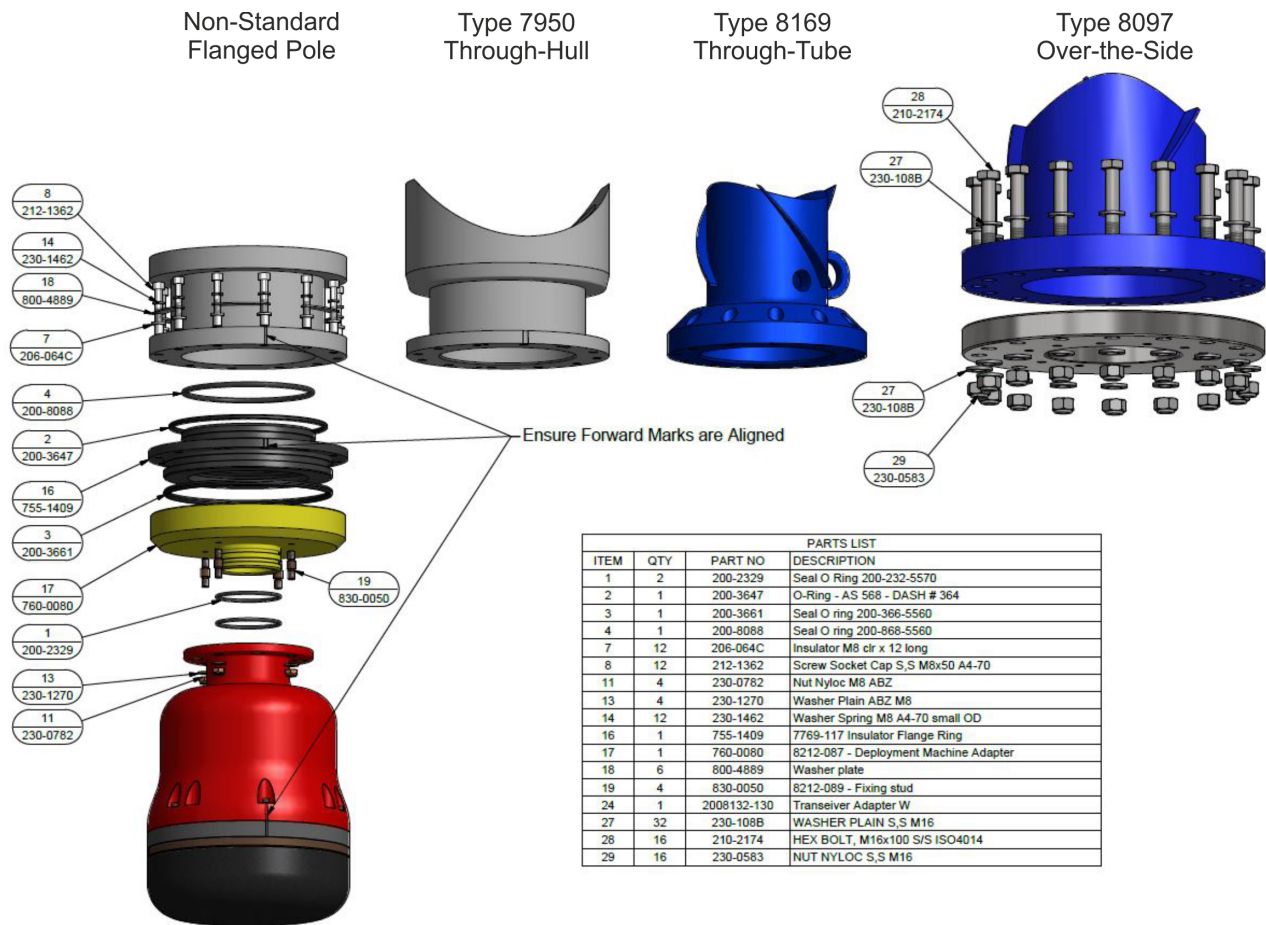
When installing the transceiver using the Deployment Pole Mounting Kit (part number 650-0154) the flange must have mounting holes 10.5 mm in diameter equally spaced on a 210 mm PCD.

B.5.1.3 Type 7950 Through-Hull, Type 8169 Through-Tube, Type 8097 Over-the-Side

The Type 8221/8212 USBL Transceiver has been designed to be mounted to a Sonardyne supplied Type 7950 through-hull Deployment Machine, Type 8169 Through-Tube deployment pole and Type 8097 and Over-the-Side deployment Pole.

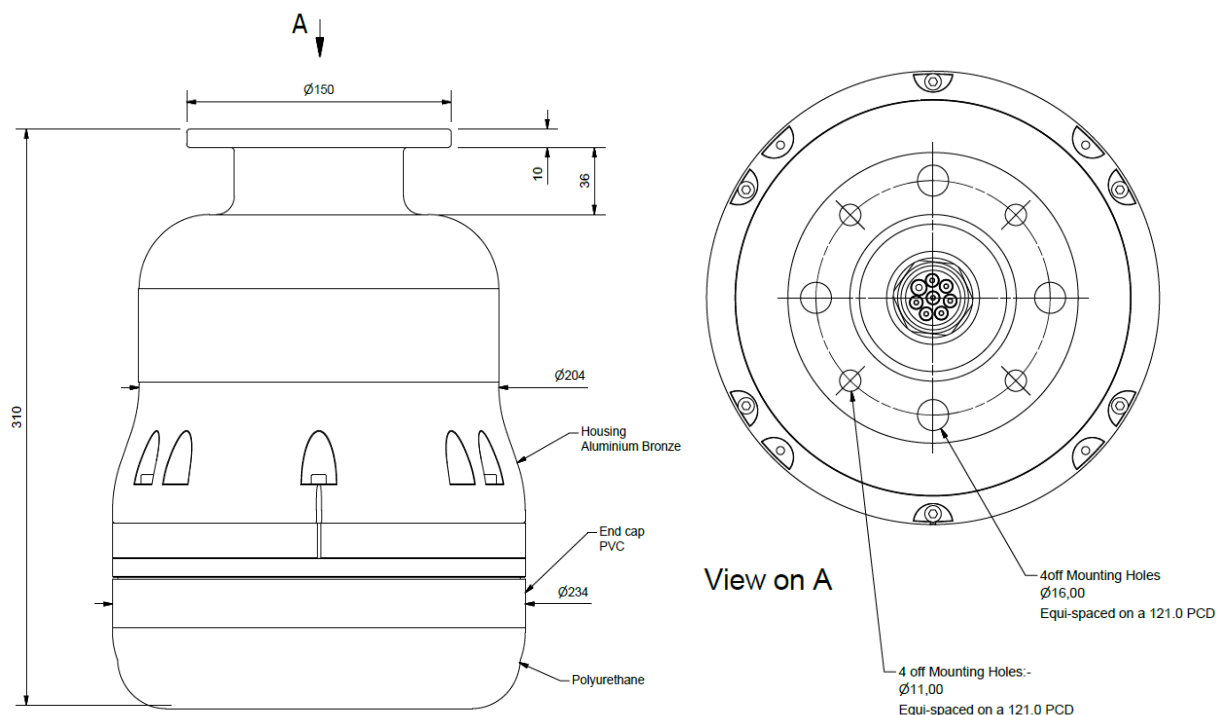
A Deployment Pole Mounting Kit (part number 650-0154) must be used to isolate the USBL transceiver from the pole. The kit contains fixings, O-rings and an isolation flange.

Figure B-6 Type 8221/8212 Standard Mounting Methods



B.5.2 USBL Transceiver Bolt Hole Pattern

B.5.2.1 Type 8221/8212



B.5.3 Alignment Criteria

When mounting the USBL transceiver, ensure that the mounting arrangement has some mechanical means to maintain alignment between the USBL transceiver's centre line and the vessel's centre line. Adapters supplied as an option by Sonardyne have provision for two dowel pins to meet this requirement.

Accurate horizontal and vertical alignment between the USBL transceiver and the vessel is not critical. However, it is important that the deployed alignment angles are repeatable to a much greater precision than the measurement sensors in use so as to avoid the need to recalibrate the deployed angles every time the pole is retracted and redeployed.

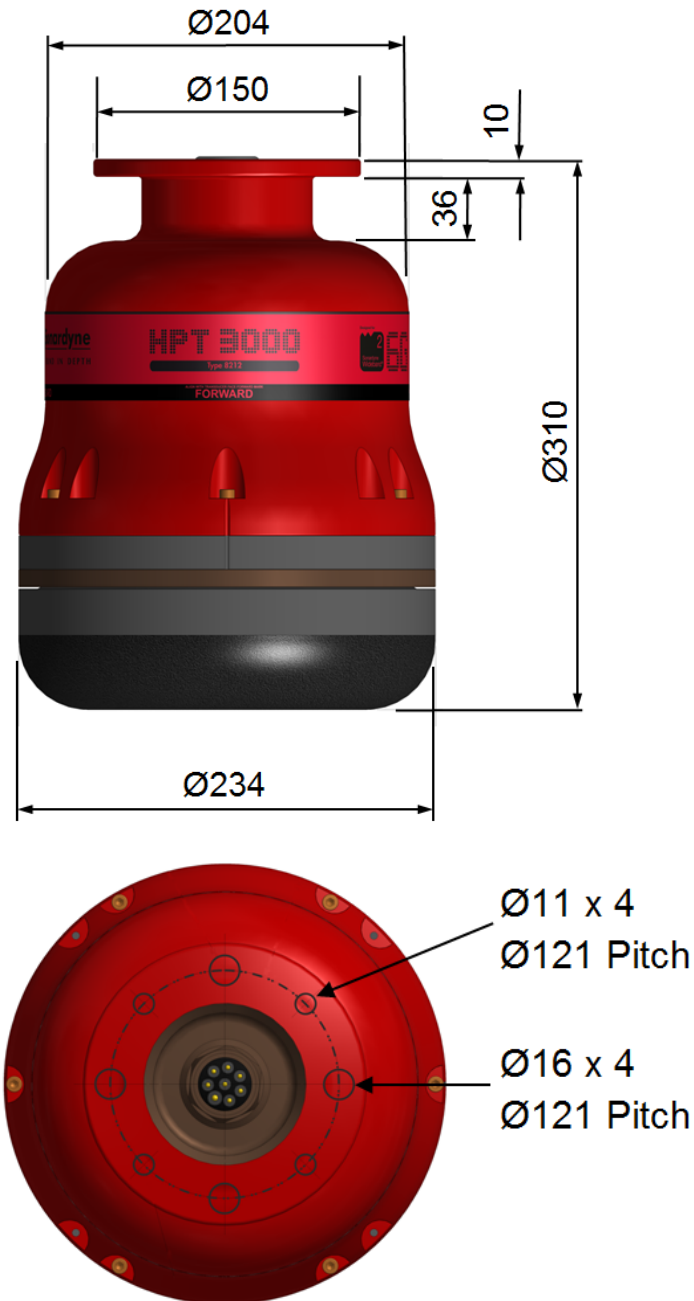
B.5.4 System Calibration

You must perform a complete system calibration (CASIUS) when you deploy any transceiver for the first time in its mounting arrangement. See *Appendix E "System Calibration"* for more information about the CASIUS calibration procedure.

B.5.5 USBL Transceiver Dimensions

B.5.5.1 Type 8221/8212

Figure B-7 Type 8221/8212 Dimensions



B.6 External Sensors

You should give careful consideration to the selection and installation of external sensors such as a Vertical Reference Unit (VRU), gyrocompass and GNSS antenna. In particular, the installation and calibration of the VRU and the gyrocompass will have a direct impact on the overall position measurement accuracy of the USBL.

The guidelines below will help you to establish the best installation location for the external sensors. However, you should also refer to the installation instructions supplied by the manufacturer of the external sensors for detailed installation instructions.

B.6.1 VRU

- Use a survey quality VRU providing dynamic roll and pitch measurement accuracy better than 0.05° for deep water operations.
- Ensure the VRU is fastened securely to prevent any movement with respect to the vessel or the USBL transceiver.
- Align the VRU to be parallel with the vessel's centre line by following the manufacturer's installation instructions.
- Install the VRU on the vessel's centre line if possible.
- If you have to install the VRU away from the vessel's centre line, measure and enter the relevant lever arm offsets into the VRU's configuration, as detailed in the manufacturer's instructions.
- Install the VRU as close as possible to the vessel's centre of gravity (CoG), or as close as possible to the USBL transceiver.
- Ensure the VRU configuration provides a serial output of the vessel's roll and pitch angles to the highest accuracy available and at the highest possible baud rate to minimise the effects of data latency.
- Ideally the measurement accuracy should be 0.01° , and the output rate should be at least 10 Hz.
- Some VRUs allow aiding input of speed and course made good (CMG) from external equipment such as a GNSS receiver. This enhancement improves the accuracy of VRU measurements in dynamic environments, and should be used if it is available.
- Complete all the manufacturer's recommended installation and calibration procedures.

Note



Sonardyne recommends that any manufacturer-recommended installation offsets should be entered into the VRU's configuration software, not into the USBL software.

- Ensure the conventions used for pitch and roll output from the VRU are the same as those used in the USBL software, because some VRU manufacturers use a different convention.

B.6.2 Gyrocompass

- For survey and towfish tracking operations in particular, it is essential to use a survey-quality gyrocompass that provides heading measurements with an accuracy of 0.1° or better.
- Ensure the gyrocompass is configured to output serial heading data to the highest accuracy available and at the highest possible baud rate to minimise the effects of data latency. Ideally the measurement precision should be 0.01° or better, and the output rate should be at least 5 Hz.
- Align the gyrocompass to be parallel with the vessel's centre line.
- Perform a gyrocompass calibration BEFORE you perform a calibration of the USBL System to measure any alignment offsets that may exist between the gyrocompass mounting arrangements and the vessel's centre line. Any offsets measured should be entered into the USBL software.

- Make regular and frequent checks of the gyrocompass against any other gyrocompass systems installed on the vessel, to detect and correct any long-term drift.

B.6.3 GNSS System

- Mount the GNSS antenna so that it has a clear and unobstructed view of the sky.
- For short-term operations where an over-the-side pole is used to mount the USBL transceiver, consider mounting the GNSS antenna over the top of the pole to minimise any effects arising from antenna offsets.
- Accurately measure and record the X, Y and Z offset distances between the GNSS antenna and the USBL transceiver. You will require these measurements later to configure the USBL software.
- If possible, supply measurements from the GNSS receiver directly to the USBL software so as to minimise any position latency inherent with computer-based GNSS solutions.
- Because the quality of the GNSS solution has a direct effect on the quality of any real-world positions determined by the USBL, you should use only differential GNSS (DGNSS) or carrier-phase based (such as Real-Time Kinematic — RTK) corrected GNSS inputs.

B.7 Software Installation

B.7.1 Security Keys

Sonardyne supplies a USB security key with the system that allows the software to run.

Insert the USB security key into an available USB port on the PC.

- The yellow key is the 'primary' key, which you should always use with the system.
- The red key is the 'Emergency' key and is supplied in a sealed plastic bag.

Note



The Emergency security key is time limited and is intended to provide cover while problems with the primary key are dealt with.

Remove the Emergency security key from its sealed plastic bag only if you need to use it.

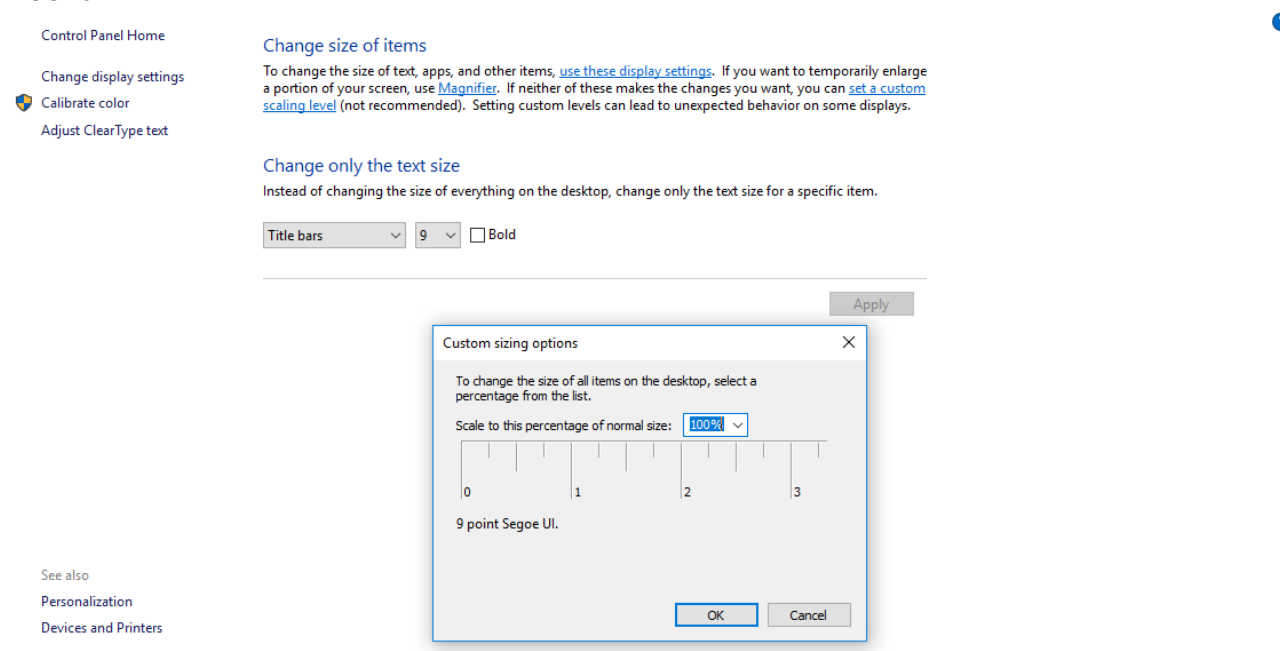
Use the Emergency key in place of the Primary key only if the Primary key fails, expires, or is damaged or lost.

Contact Sonardyne Support immediately if you have to use the Emergency key.

B.7.2 Font Scale

Notes

 **This Software is designed to display using an operating system text size of 100%. In Windows 10 this can be set as follows: Control Panel > Display > Set a Custom Scaling Level > 100%.**



B.7.3 Non-Sonardyne Computer Installations

Note

 **If you are upgrading an existing software installation, use the Add or Remove Programs facility accessible through the Windows Control Panel to remove the previous software version first.**

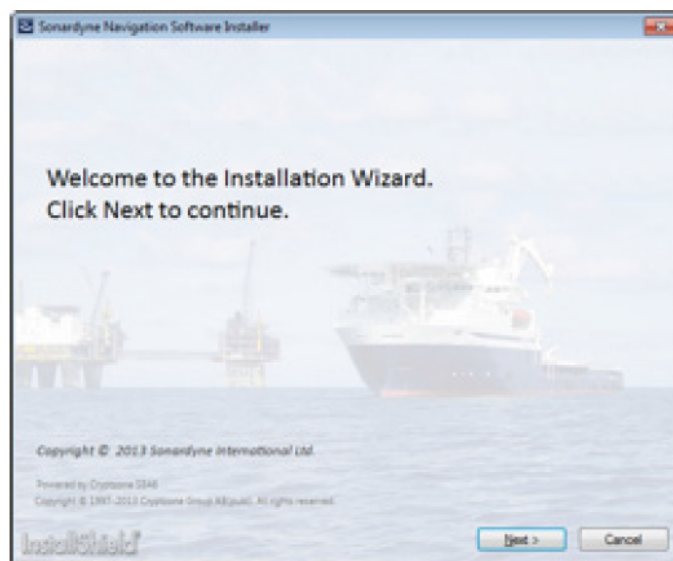
1. For installations using media including a USB memory stick:
 - Insert the USB media into an available USB port and use Windows Explorer to navigate to the drive and run the setup executable file; skip to *Step 3*.

2. For FTP users:

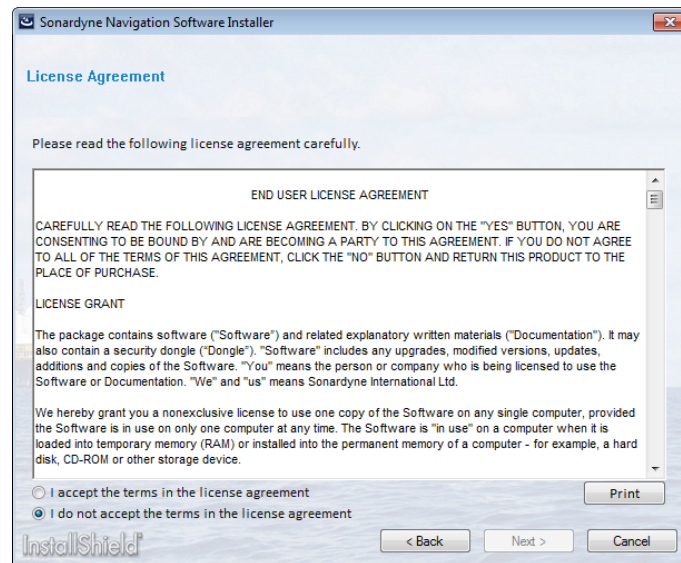
- Download the ISO image, right-click on the ISO image file to mount it, and use Windows Explorer to navigate to the drive and run the setup executable file.



3. Wait for the wizard to unpack the files needed for the installation and to display the installation welcome screen.



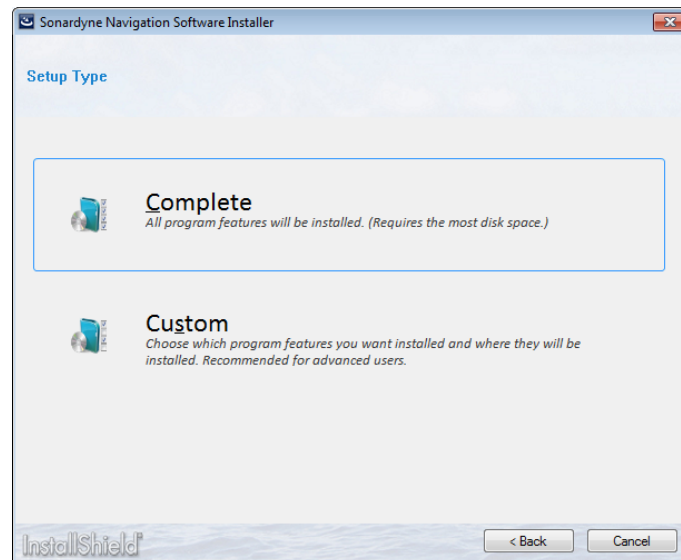
4. Click **Next** to start the installation.
5. Read the licence agreement under which the software is supplied, and click **Yes** to accept the agreement.



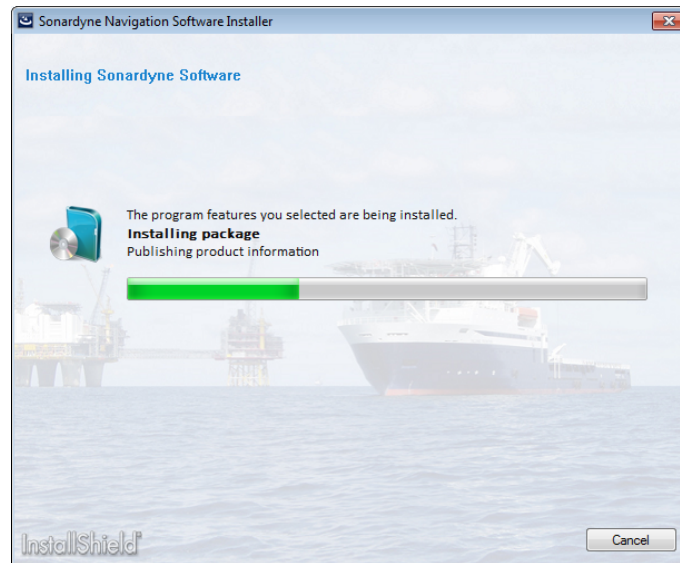
Note

The licence agreement can be printed by clicking "Print".

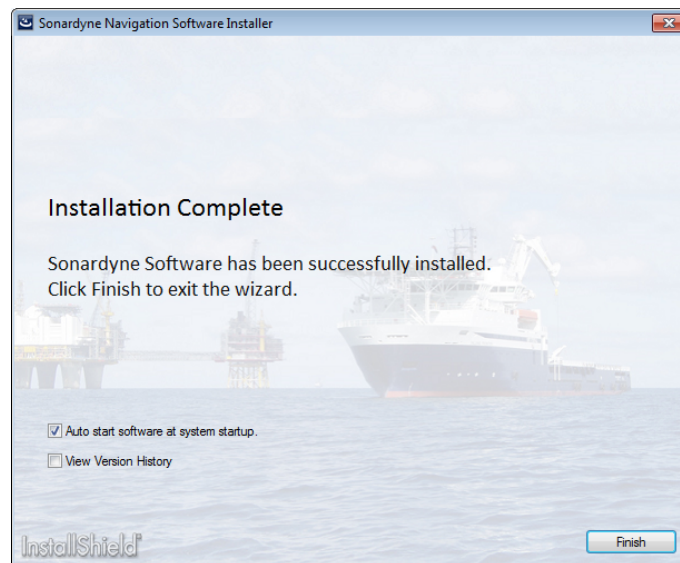
6. Select either:
 - **Complete** for a complete, regular installation, or
 - **Custom** to override the default contents for the installation.



7. Click **Next** to begin the installation process. A progress bar indicates the installation progress.



8. The final dialog allows you to:
- select whether to start the software automatically when the system starts, and
 - read the software release notes.
9. Select the options you want to use and click **Finish** to complete the installation.



Appendix C – Interface Cables

C.1 Cable Diagrams

Note

 The following cable diagrams are for guidance only and are subject to change without notice.

Table C–1 Cable Diagrams

CPN	Drawing No.	Type
820-6608	8020-060	RS232 Serial Data Cable to Open Flylead
820-6793	8024-044	ESH Transceiver Cable
820-0331	8212-061	ESH Transceiver Cable (Cat 6 for long cable routes)

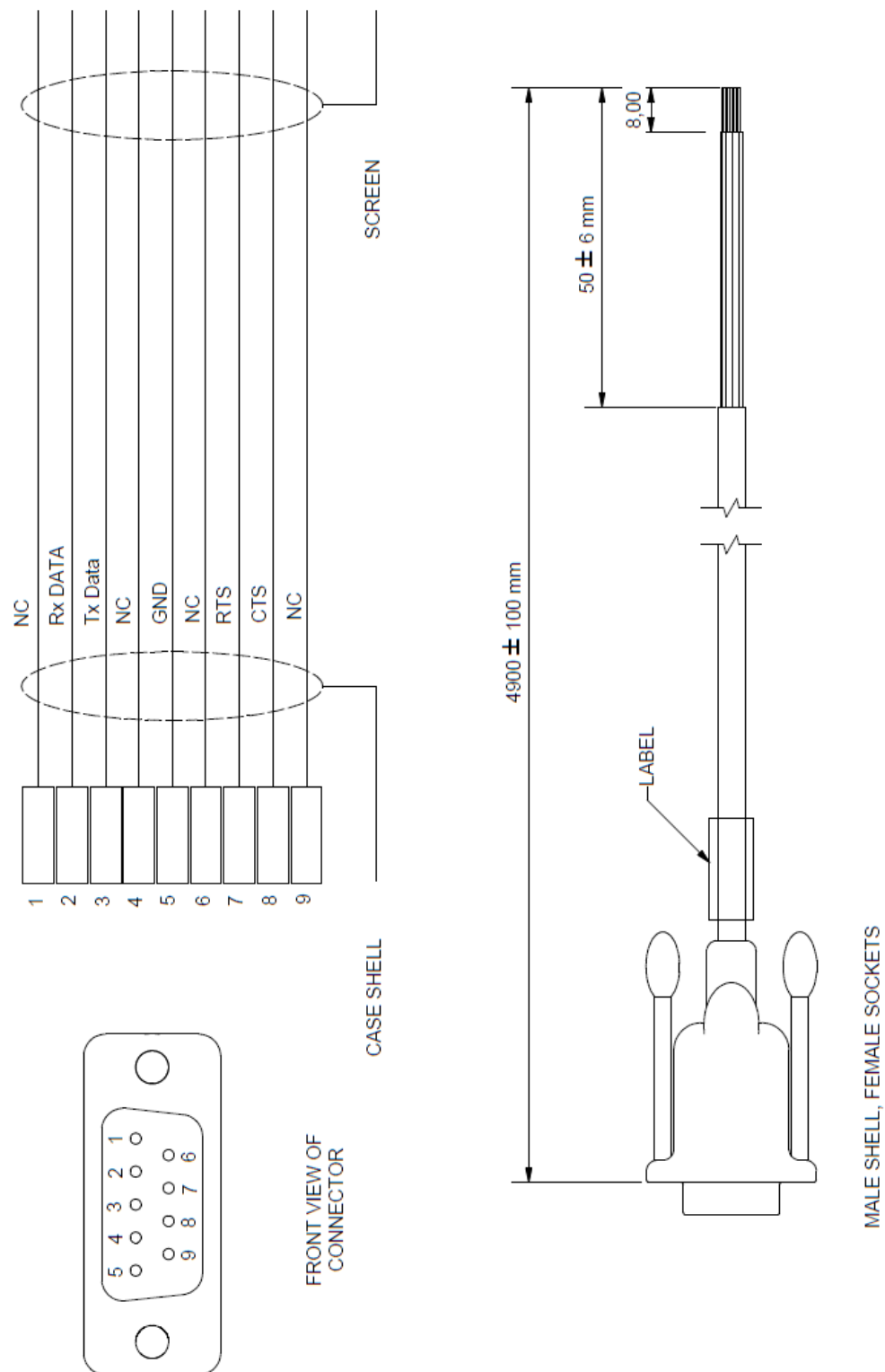
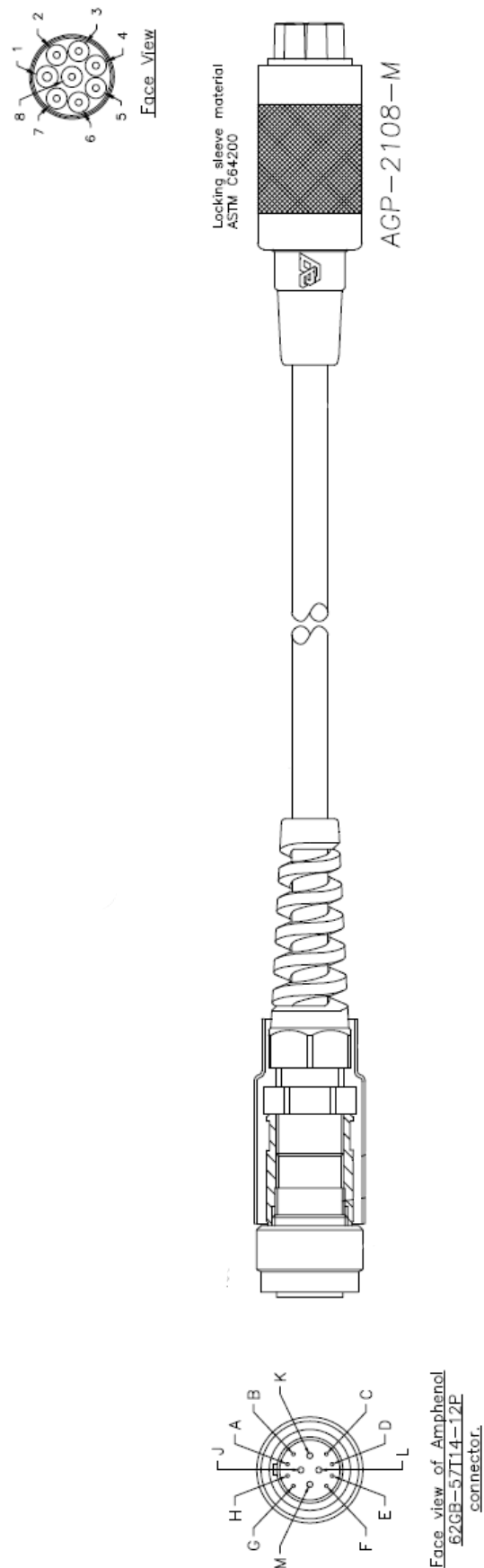
Figure C-1 RS232 Serial Data Cable to Flylead – CPN 820-6608/DWG 8020-060

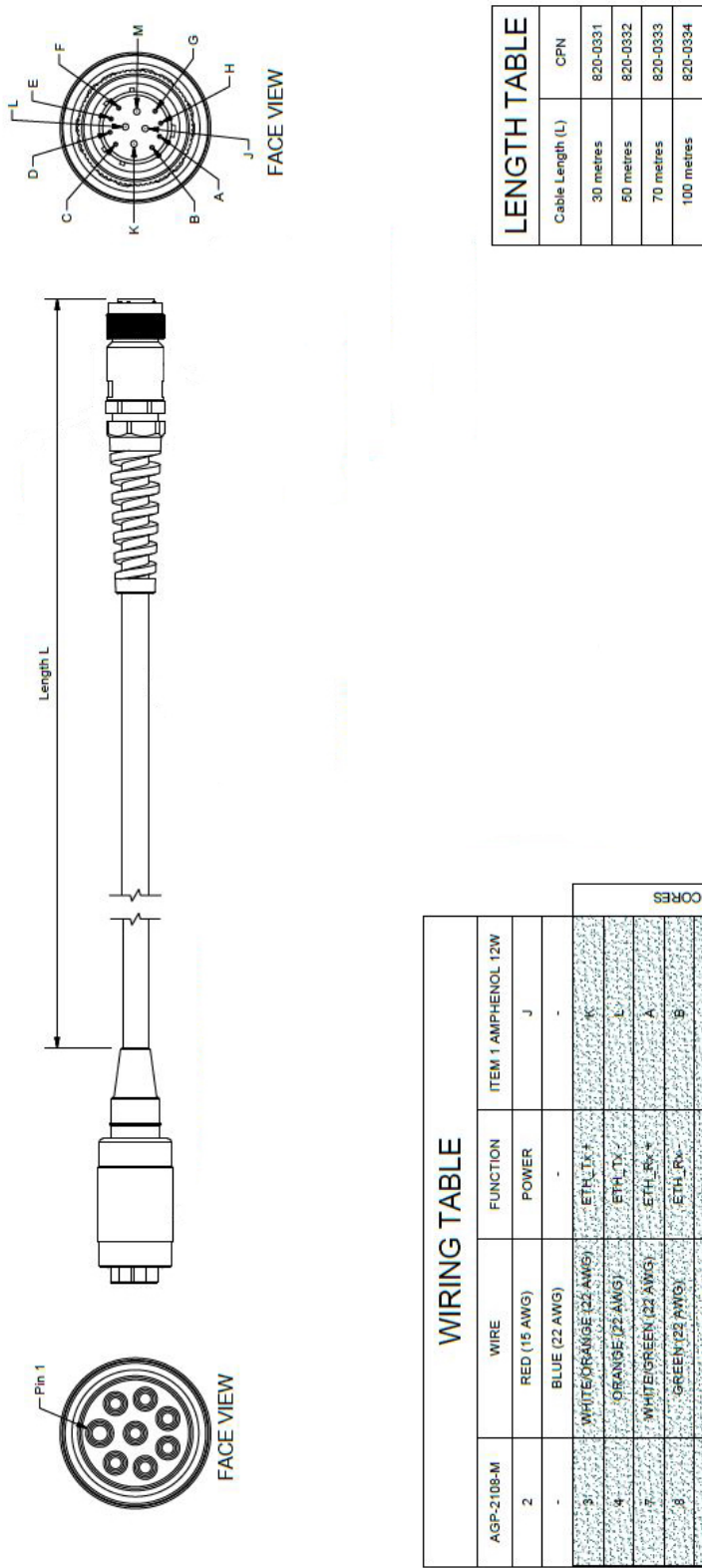
Figure C-2 HPT to ESH Amphenol to AGP Cable Assembly – CPN 820-6793



The HPT to ESH Amphenol to AGP cable assembly pin details for CPN 820-6793 are shown below.

Amphenol Pin Number	Cable Core Colour	AGP Pin Number	Function
F	Screen and Drains	1	Screen
Earth Ring			
J	Red	2	Power +
K	White	3	Ethernet Tx Data +
L	Blue	4	Ethernet Tx Data -
G	Green	5	Trigger
M	Black	6	Ground and Power Return
A	Orange	7	Ethernet RX Data +
B	Yellow	8	Ethernet Rx Data -
H	Brown	No Connection	N/A

Figure C-3 HPT to ESH Amphenol to AGP Cable Assembly – CPN 820-0331



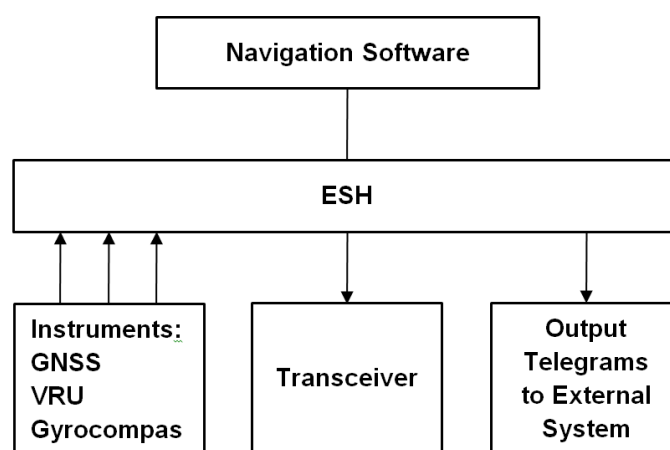
Appendix D – Output Telegram Formats and Interfaces

D.1 Introduction

Output Telegrams are used to send Reference Beacon or Mobile Vehicle position information to the Dynamic Positioning (DP) Desk or to the Navigation Package. *Table 4–3 "Position Out Telegrams"* lists the Output Telegrams supported by the system.

The HPR 309, HPR 418 BCD and HPR 418 F Output Telegrams are all industry standard formats used by DP vessels for the transfer of Hydro-acoustic Position Reference (HPR) beacon data.

Figure D–1 Interface Block Diagram



CAUTION

 **Risk of equipment malfunction. For DP applications, ensure that the DP Control System accepts the Position Estimate and Quality Factors published by the Acoustic Positioning Reference System in the Output Telegram, and that it weights the Estimate appropriately. Failure to do so can result in incorrect vessel positioning.**

D.2 HPR 309

D.2.1 Description

The HPR 309 Telegram is the output telegram from the HPR 309 DP.

D.2.2 Format

Table D–1 Field description of the HPR 309 Telegram

Field	Size (Bytes)	Byte Offset
Head	1	0
Roll	2	1
Pitch	2	3
Heading	2	5
Transponder Index	1	7
X Position	3	8
Y Position	3	11
Z Position	3	14

Table D–1 Field description of the HPR 309 Telegram (continued)

Field	Size (Bytes)	Byte Offset
Position Status	1	17
Time Out	1	18
Transponders in Sequence	3	19
Not Used (Tracking TD Angle)	2	22
Not Used (Test)	1	24
Transponder Type	1	25
Transponder Specification	1	26
Not Used (Transducers)	1	27
Not Used (Transducer Status)	1	28
Kalman Filter Window	1	29
Checksum	1	30
End of Telegram	1	31

D.2.2.1 Notes

- This telegram will be sent only if the status shows OK.
- The co-ordinate frame for vessel position is the sea-bed LBL array co-ordinate frame.
 - Positive X is North.
 - Positive Y is East.
- Bits 0 to 5 contain data.
- Bit 6 is only ever set on the last byte of the telegram.
- If there is a bit 7, it is zero.

D.2.3 Definition of Field Names:**D.2.3.1 Head**

This is the telegram header that defines the mode of operation.

- Bit 0 is set for normal acoustic navigation.
- Bit 1 Test mode is set in DP_test mode and Simulate mode.
- Bit 2 is not supported by Sonardyne.
- Bit 3 is set if the Cartesian Y direction is North.

The bit is cleared if the Cartesian Y direction is the vessel forward direction (ship relative co-ordinates).

- Bit 4 is set if the data is smoothed by a filter.
- Bit 5 is set if the position reference point is the spare reference point.

D.2.3.2 Roll

This is the roll of the ship or the differential roll for a Riser Angle Monitoring System (MRAMS).

- Positive direction is port side up.
- Scaled integer, 12 bit, 2's complement.
- Resolution = $360.0 / 4096$ degrees. (= 0.0878906 degrees).
- Min = 800000 h = -2048 which relates to -180.0 degrees.
- 0 which relates to 0.0 degrees.
- Max = 7fffffh = 2047 which relates to (180 – resolution) degrees.

The first byte of this field in the telegram contains the six most significant bits, and the next byte contains the six least significant bits.

D.2.3.3 Pitch

This is the pitch of the ship or the differential pitch for a Riser Angle Monitoring System (MRAMS).

- Positive direction is bows up.
- Scaled integer, 12 bit, 2's complement.
- Resolution = $360.0 / 4096.0$ degrees
- Min = 800000h = -048 with relates to -180.0 degrees
- 0 which relates to 0.0 degrees.
- Max = 7fffffh = 2047 which relates to (180 – resolution) degrees.

The first byte of this field in the telegram contains the six most significant bits, and the next byte contains the six least significant bits.

D.2.3.4 Heading

- This is the vessel's heading.
- Positive direction is clockwise.
- Zero is north.
- Scaled integer, 12bit, 2's complement.
- Resolution = $360.0 / 4096.0$ degrees.
- Min = 800000h = -2048 which relates to -180.0 degrees.
- 0 which relates to 0.0 degrees.
- Max = 7fffffh = 2047 which relates to (180 – resolution) degrees.

The first byte of this field in the telegram contains the six most significant bits, and the next byte contains the six least significant bits.

D.2.3.5 Transponder Index

Zero means that the position is invalid. Otherwise, this field contains the index of the transponder.

- 1 to 9 = HPR Channels 1 to 9
- 10 to 14 = HPR Channels, □, △, ○, X, Y
- 15 to 63 = Undefined.

D.2.3.6 X Position

This is the X position of the transponder with respect to the vessel's datum.

- The positive direction is starboard.
- Valid when "transponder index" is not zero and when 'Status' is not zero.
- Scaled integer, 16-bit (sign-extended to 18 bits), 2's complement.
- Resolution = $8192.0 / 65536$ metres. (= 0.125 m).
- Min = 8000h which relates to -4096.0 metres.
- 0 which relates to 0.0 degrees.
- Max = 7fffh which relates to (4096.0 – Resolution) metres.

The first byte of this field in the telegram contains the six most significant bits, the next byte contains bits 6 to 11 and the next byte contains the six least significant bits.

D.2.3.7 Y Position

This is the Y position of the transponder with respect to the vessel's datum.

- The positive direction is forwards.
- Valid when 'transponder index' is not zero and when 'Status' is not zero.
- Scaled integer, 16-bit (sign-extended to 18 bits), 2's complement.
- Resolution = $8192.0 / 65536$ metres. (= 0.125 m).
- Min = 8000 h which relates to -4096.0 metres.
- 0 which relates to 0.0 degrees.
- Max = 7fffh which relates to (4096.0 – Resolution) metres.

The first byte of this field in the telegram contains the six most significant bits, the next byte contains bits 6 to 11 and the next byte contains the six least significant bits.

D.2.3.8 Z Position

This is the Z position of the transponder with respect to the vessel's datum.

- The positive direction is down.
- This is not depth. Depth is with respect to the surface of the water.
- Valid when 'transponder index' is not zero and when 'Status' is not zero.
- Scaled integer, 16-bit (sign-extended to 18 bits), 2's complement.
- Resolution = $8192.0 / 65536$ metres. (= 0.125 m).
- Min = 8000 h which relates to -4096.0 metres.
- 0 which relates to 0.0 degrees.
- Max = 7fffh which relates to (4096.0 – Resolution) metres.

The first byte of this field in the telegram contains the six most significant bits, the next byte contains bits 6 to 11 and the next byte contains the six least significant bits.

D.2.3.9 Position Status

This telegram will be sent only if the status shows OK.

Flags:

- Bit 0 is set when the position data is invalid.
- Bit 1 is set when the telegram has come from a Slave on a Dual Redundant system.

- Bit 2 is not used.
- Bit 3 is set when the riser angle data is not valid.
- Bit 4 is not used.
- Bit 5 is not used.

Watchdog telegrams do not contain valid position data, and bit 0 is therefore set. The roll pitch and heading data is valid in a watchdog telegram.

D.2.3.10 Time Out

Bit 1 is set when the riser angle data is not valid. 0 = Standard Transponder.

D.2.3.11 Transponders in sequence

These are flags to indicate which transponders are being used.

Table D–2 HPR Channel Flags

	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	undefined	undefined	undefined	undefined	U	C
2nd byte	D	O	o	9	8	7
3rd byte	6	5	4	3	2	1

Bits are set for the transponders in use.

All other bits are cleared (including those whose meaning is undefined).

D.2.3.12 Not Used (Tracking TD Angle)

Zero.

D.2.3.13 Not Used (Test)

Zero.

D.2.3.14 Transponder Type

0 = Standard transponder.

6 = Differential angles from Riser Angle Monitoring System (MRAMS).

D.2.3.15 Transponder Specification

Flags.

Bit 0: Set for a mobile transponder, Cleared for a reference transponder.

Bits 1 to 5: Unused, all cleared.

D.2.3.16 Not Used (Transducers)

Zero.

D.2.3.17 Not Used (Transducer Status)

Zero.

D.2.3.18 Kalman Filter Window

This is the horizontal position quality, rounded to the nearest metre.

D.2.3.19 Checksum

This is the result of performing an exclusive-OR on all bytes in the telegram up to but not including this byte.

D.2.3.20 End of Telegram

This byte marks the end of a telegram. It is always 40h.

This byte is the only byte of the telegram with bit 6 set.

D.3 HPR 418 – Message 1 (USBL / SSBL)**D.3.1 Description**

This sub-section describes the format and contents of the HPR 418 Rev. F Message 1 SSBL transponder position output telegram. REAL format and REAL_64 format as referred to in the 'Message Definition of Field Names' below are structured as follows:

- REAL = 32-bit floating point data
- REAL_64 = 64-bit floating point data

Both of these formats conform to IEEE standard 754. The 32-bit data uses the single precision data format; the 64-bit data uses the double precision format.

Table D–3 Field description of the HPR418 Telegram

Field	Byte	Byte Offset
Start character	1	0
Block length	2	1
Message type	1	3
Destination	1	4
Tp_index	2	5
Operation_mode	1	7
Sync_mode	1	8
Tp_type	1	9
TP_operation	1	10
Pos_data_form	1	11
Reply_status	1	12
Filt_X_pos	4	13
Filt_Y_pos	4	17
Filt_Z_pos	4	21
X_pos	4	25
Y_pos	4	29
Z_pos	4	33
Slant_range	4	37
P_course	4	41
P_roll	4	45
P_pitch	4	49

Table D–3 Field description of the HPR418 Telegram (continued)

Field	Byte	Byte Offset
Td_beam	1	53
Td_type	1	54
Td_num	2	55
Diagnostic	2	57
Stand_dev	4	59
Instr_data	4*n	63
Sumcheck	2	63+4*n
Stop character	1	64+4*n

D.3.1.1 Notes

The co-ordinate frame for SSBL transponder position data is relative to the vessel datum point.

- Positive Y is forward.
- Positive X is starboard.
- Positive Depth is down.

D.3.2 Definition of Field Names**D.3.2.1 Start Character**

This is a single byte start character 55 hex.

D.3.2.2 Block length

A 2-byte block length number from 0 to 65536 defining the number of bytes after Destination field and before Sumcheck. It is 8 less than the message length.

In this case it is set to 3A hex plus the number of bytes of Instrument Data. There will usually be 0 bytes of Instrument Data. The number of Instrument Data bytes depends upon the type of transponder.

D.3.2.3 Message type

A single byte defining a number from 0 to 255 to indicate the type of message transmitted.

In this case it is 1.

D.3.2.4 Destination

A single byte number from 0 to 255 defining the device to which the message is transmitted.

This is not used by Sonardyne, but is set to 30 hex.

D.3.2.5 Tp_index

Two bytes defining the transponder channel.

On the -Sonardyne L/USBL it is possible to use a different Tp_index number from the acoustic channel in use. This is done to allow for the -Sonardyne Compatt transponders, which would not fit within the Simrad DP index system. An additional advantage is that, if a DP desk requires 418 telegrams and a survey desk requires 309 telegrams, by setting the index to a number between 1 and 16, both systems will work.

The selection of 9 as the Tp_index on the -Sonardyne L/USBL prior to V6.04 would cause 009 to be transmitted, which would be displayed as A09 on a DP desk. From V6.04 onwards, when index 9 is set, 109 is transmitted and the DP desk would display B09. The default value for DP_test is 1.

D.3.2.6 Operation_mode

A single byte containing the operation mode of the transceiver.

- 00 = standard navigation mode
- 01 = simulated position test mode. (Training)

D.3.2.7 Sync_mode

A single byte containing the synchronisation mode of the transceiver. It is not used. It is not used by -Sonardyne.

- 0 = no synchronisation

D.3.2.8 Tp_type

- 000 = transponder
- 003 = transponder with Riser Angle Monitoring System (MRAMS)

D.3.2.9 Tp_operation

A single byte defining the operation mode of the transponder:

- 000 = fixed standard transponder
- 001 = mobile standard transponder

D.3.2.10 Pos_data_form

A single byte defining the position co-ordinate format:

- Bit 0 = 0 vessel oriented, Cartesian
- Bit 0 = 1 North oriented, Cartesian

D.3.2.11 Reply_status

A single byte defining the transponder reply status:

- 000 = reply OK
- 001 = timeout 1 pulse (used as general data rejection status by -Sonardyne)

D.3.2.12 Filt_X_pos

A value in REAL format.

The filtered X – position co-ordinates of the transponder. Transponder's horizontal athwart ship distance from reference point in metres.

D.3.2.13 Filt_Y_pos

A value in REAL format.

The filtered Y – position co-ordinates of the transponder. Transponder's horizontal fore and aft ship distance from reference point in metres.

D.3.2.14 Filt_Z_pos (Depth)

A value in REAL format.

The filtered Z – position co-ordinates of the transponder. Transponder's vertical distance from reference point in metres.

D.3.2.15 X_pos

A value in REAL format.

The raw X – position co-ordinates of the transponder. Transponder's horizontal athwart ship distance from reference point in metres.

D.3.2.16 Y_pos

A value in REAL format.

The raw Y – position co-ordinates of the transponder. Transponder's horizontal fore and aft ship distance from reference point in metres.

D.3.2.17 Z_pos (Depth)

A value in REAL format.

The raw Z – position co-ordinates of the transponder. Transponder's vertical distance from reference point in metres.

D.3.2.18 Slant_range

A value in REAL format.

The direct raw slant range from the vessel's CRP to the transponder in metres.

Note



Simrad standard is from the Transducer to the Beacon. -Sonardyne deviate from this standard because the solution may be the result of measurements to more than one transducer.

D.3.2.19 P_course

A value in REAL format.

The vessel's course at the time of transponder position measurement; 0 to 360 degrees.

D.3.2.20 P_roll

A value in REAL format.

The vessel's roll at the time of transponder position measurement +/-180 degrees.

D.3.2.21 P_pitch

A value in REAL format.

The vessel's pitch at the time of transponder position measurement +/-180 degrees.

D.3.2.22 Td_beam

A single byte defining the transducer beam.

- 0 = wide
- 1 = narrow.

D.3.2.23 Td_type

Defines the transducer type.

Sonardyne uses value 0 (30kHz wide beam only).

D.3.2.24 Td_num

A 16-bit word that defines the transducer number.

Sonardyne do not differentiate between transducers and transceivers and always use the value 1. This is because all positions are reported relative to the CRP, and because the solution may be the result from more than one transducer.

D.3.2.25 Diagnostic

Sonardyne do not use this field because it is specific to Simrad hardware. The value is always 0 (no errors).

D.3.2.26 Stand_dev

A value in REAL format.

This is the horizontal position quality in metres.

D.3.2.27 Instr_data (*)

If Tp_type = 3 then 8 bytes of differential riser angle (MRAMS) data are added: 4 bytes of differential roll in REAL format, followed by 4 bytes of differential pitch in REAL format.

D.3.2.28 Sumcheck

Sumcheck of the contents of the entire telegram except for the sumcheck itself and the stop character. The sumcheck is a 16-bit integer calculated by normal byte + byte addition.

D.3.2.29 Stop character

This is a single byte stop character AA hex.

D.4 HPR 418 – Message 2 (LBL / LUSBL)**D.4.1 Description**

This describes the format and contents of the HPR 418 Rev F Message 2 LBL vessel position output telegram.

The LBL position contains the vessel's position relative to the origin at the LBL transponder array, which is transmitted after each position calculation. If the transponder array is north-oriented, the co-ordinates are relative to true North, otherwise they are relative to local North.

REAL format and REAL_64 format as referred to in Format: Message 2 LBL Vessel Position Data below are structured as follows:

- REAL = 32-bit floating point data
- REAL_64 = 64-bit floating point data

Both of these formats conform to IEEE standard 754. The 32-bit data uses the single precision data format and the 64-bit data uses the double precision format.

Table D-4 Field Description of the HPR418 Telegram Message 2

Field	Byte	Byte Offset
Start character	1	0
Block length	2	1
Message type	1	3

Table D-4 Field Description of the HPR418 Telegram Message 2 (continued)

Field	Byte	Byte Offset
Destination	1	4
Sequence_number	2	5
Time_header (7)	7	7
Interrogation_age	2	14
Tp_array	1	16
Td_num	1	17
Pos_east	8	18
Pos_north	8	26
Depth	4	34
Hor_err_ellipse_direction	4	38
Hor_err_ellipse_major	4	42
Hor_err_ellipse_minor	4	46
Z_standard_deviation	4	50
Pos_type	1	54
Pos_status	1	55
P_course	4	56
P_roll	4	60
P_pitch	4	64
Diagnostic	2	68
Sumcheck	2	70
Stop character	1	72

D.4.2 Notes

- This telegram will be sent only if the status is OK.
- The co-ordinate frame for vessel position is the seabed LBL array co-ordinate frame.
 - Positive X is North
 - Positive Y is East

D.4.3 Definition of Field Names

D.4.3.1 Start character

This is a single byte start character 55 hex.

D.4.3.2 Block length

A 2-byte block length number from 0 to 65536 that defines the number of bytes after the Destination field and before Sumcheck. It is 8 less than the message length. In this case it is set to 36 hex.

D.4.3.3 Message type

A single byte defining a number from 0 to 255 to indicate the type of the message transmitted.

In this case it is 2.

D.4.3.4 Destination

A single byte number from 0 to 255 that defines the device to which the message is transmitted.

This is not used by -Sonardyne, but is set to 30 hex.

D.4.3.5 Sequence_number

This number is set to zero when navigation starts and is incremented for each LBL interrogation. The range is from 0 to 65535 and will wrap around to 0 when 65535 is reached.

D.4.3.6 Time_header (7)

Defines the clock when the position is valid.

Table D-5 describes the format of the time_header.

Table D-5 Time_header format

Block Content	Size	Index	Resolution	Range
Day	Byte	0	1 Day	1 to 31
Month	Byte	1	1 Month	1 to 12
Year	Byte	2	1 Year	0 to 99
Hours	Byte	3	1 Hour	0 to 23
Minutes	Byte	4	1 Minute	0 to 59
Seconds	Byte	5	1 Second	0 to 59
1/100th seconds	Byte	6	1/100th Second	0 to 99

D.4.3.7 Interrogation_age

Time interval since the previous interrogation of the array. The time resolution is 1ms.

D.4.3.8 Tp_array

A single byte that defines the number of the transponder array in use. Its value can be 0, 1, 2 or 3. - Sonardyne sets this to 0.

D.4.3.9 Td_num

A 16-bit word that defines the transducer number.

Sonardyne do not differentiate between transducers and transceivers and always use the value 1. This is because all positions are reported relative to the CRP, and because the solution may be the result from more than one transducer.

D.4.3.10 Pos_east

A value in REAL_64 format.

East co-ordinates in metres, with a positive value meaning East. Negative values indicate West.

The co-ordinates are either local co-ordinates or global UTM co-ordinates.

D.4.3.11 Pos_north

A value in REAL_64 format.

North co-ordinates in metres, with a positive value meaning North. Negative values indicate South.

The co-ordinates are either local co-ordinates or global UTM co-ordinates.

D.4.3.12 Depth

A value in REAL format.

The depth co-ordinate with a positive value meaning downwards.

For the vessel, the depth is the vertical distance from the sea level to the vessel's CRP. For ROVs and relay transponders, the depth is the depth below the sea surface of the transducer on the unit.

D.4.3.13 Hor_err_ellipse_direction

Each LBL position measurement has a likelihood ellipse associated with it. It is based on 1δ in each of the axes. The direction is the angle in degrees between the North axis and the major axis of the ellipse. It is a value in REAL format.

D.4.3.14 Hor_err_ellipse_major

The major axis of the likelihood ellipse in metres. A value in REAL format.

D.4.3.15 Hor_err_ellipse_minor

The minor axis of the likelihood ellipse in metres. A value in REAL format.

D.4.3.16 Z_standard_deviation

The standard deviation (δ) of the depth in metres.

D.4.3.17 Pos_type

A single byte with value:

- 0 = Vessel position
- 1 = ROV 1 position
- 16 = ROV 16 position
- 17 = Relay 1 position
- 20 = Relay 4 position

Bit 7 acts as a switch for local co-ordinates or UTM co-ordinates:

- 0 = local
- 1 = UTM

Sonardyne currently only set this bit to zero. However, if large numbers appear in the **Pos_east** and **Pos_north** fields then they are very likely to be UTM values because local numbers tend to be less than 3000 m.

D.4.3.18 Pos_status

A single byte with value 0.

This variable tells the status of the position calculation. It will always show 0 to indicate the status of the position calculation, because the telegram will not be sent unless this status is OK.

- 0 = OK position

D.4.3.19 P_course

A value in REAL format.

The vessel's course at the time of transponder position measurement; 0 to 359.9°.

D.4.3.20 P_roll

A value in REAL format.

The vessel's roll at the time of transponder position measurement $\pm 180^\circ$.

D.4.3.21 P_pitch

A value in REAL format.

The vessel's pitch at the time of transponder position measurement $\pm 180^\circ$.

D.4.3.22 Diagnostic

Sonardyne do not use this field because it is specific to Simrad hardware. It is always set to zero to indicate no errors.

D.4.3.23 Sumcheck

Sumcheck of the contents of the entire telegram except for the sumcheck itself and the stop character. The sumcheck is a 16-bit integer calculated by normal byte + byte addition.

D.4.3.24 Stop character

This is a single byte stop character AA hex.

D.5 HPR 418 BCD – Message 1**D.5.1 Description**

This sub-section describes the format and contents of the HPR 418 BCD Message 1 SSBL transponder position output telegram. This is a condensed 418 telegram form designed to fit within the length of a 309 telegram so as to overcome hardware buffer size constraints on older DP desks.

D.5.1.1 BCD

BCD stands for Binary Coded Decimal, and requires 4 bits (a 'nibble') to encode a single character.

In conventional BCD the values 0 to 9 inclusive are the only valid characters. However some of the bytes in the Simrad specification allow the use of alpha Hexadecimal (hex) characters A to F inclusive. The most common use among these is D, because it is used as a negative indicator in the most significant nibble of a 3-byte field.

The Start- and End-of-Message fields include fixed alpha hex values in both nibbles. The Status bytes, which are assembled bit-by-bit, can in some conditions also include alpha hex characters. The checksum byte is also likely to contain alpha hex characters.

Table D-6 Field Description of the HPR418BCD Telegram Message 1

Field	Byte	Sample BCD Data
SOT (Start of Telegram)	1	DF
Head Byte	2	01
Status Byte 1	3	01
Status Byte 2	4	00
Transponder Type	5	02

Table D-6 Field Description of the HPR418BCD Telegram Message 1 (continued)

Field	Byte	Sample BCD Data
Transponder Index	67	0133
X Position Raw	8910	001234
Y Position Raw	111213	D05678
Z Position Raw	141516	012345
Heading	1718	3599
Optional Data 1	192021	000003
Optional Data 2	222324	D00075
Horizontal Error Ellipse Direction	2526	0000
Horizontal Error Ellipse Major	2728	0000
Horizontal Error Ellipse Minor	2930	0000
Checksum	31	XX
EOR (End of Record)	32	FF

D.5.1.2 Notes

- The co-ordinate frame for SSBL transponder position data is relative to the vessel datum point.
 - Positive Y is forward
 - Positive X is Starboard
 - Positive Depth is down

D.5.2 Definition of Field Names**D.5.2.1 SOT (Start of Telegram)**

This is a single byte start character DF hex.

D.5.2.2 Head Byte

This byte indicates the message type and is always 01 hex for a transponder message type 1.

D.5.2.3 Status Byte 1

- Bit 0 set = position measurement OK
- Bit 1 set = position is filtered
- Bit 2 not used by Sonardyne. Bit set to 0
- Bit 3 not used by Sonardyne. Bit set to 0
- Bit 4 not used by Sonardyne. Bit set to 0
- Bit 5 set = data from Slave system; clear = data from Master system
- Bit 6 set = BCD conversion error
- Bit 7 not used by Sonardyne. Bit set to 0

D.5.2.4 Status Byte 2

- Bits 0 to 1 = Transducer number. Not used by Sonardyne. Bits are set to 01 — Tdr 1
- Bits 2 to 3 = Transceiver number. Not used by Sonardyne. Bits are set to 01 — Tcvt 1

- Bit 4 set = Simulate mode
- Bit 5 set = Mobile transponder
- Bit 6 not used by Sonardyne. Bit set to 0
- Bit 7 set = data from Slave system; clear = data from Master system

D.5.2.5 Transponder Type

A single byte defining the transponder type.

- 00 = standard transponder
- 03 = Riser Angle Monitoring System (MRAMS) transponder

D.5.2.6 Transponder Index

Two bytes that define the transponder channel.

The software allows you to use a different TP_index number from the acoustic channel in use. This is done so as to cater for the Sonardyne COMPATT transponders, which would not fit within the Simrad DP index system. This also has another advantage in that if a DP desk requires 418BCD telegrams and a survey desk requires 309 telegrams, by setting the index to a number between 1 and 16, both systems will work.

The selection of 9 as the Tp_index on the -Sonardyne L/USBL prior to V6.04 would cause 00 09 hex to be transmitted, which would be displayed as A09 on a DP desk. From V6.04 onwards, when index 9 is set, 01 09 hex is transmitted and the DP desk would display B09. The default value for DP_test is index 1.

D.5.2.7 X Position Raw

Three bytes used for the beacon athwartship position.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

D.5.2.8 Y Position Raw

Three bytes used for the beacon along-ship position.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

D.5.2.9 Z Position Raw

Three bytes used for the beacon depth.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

D.5.2.10 Heading

Two bytes used for the vessel heading.

The LSB is 1/10th of a degree.

D.5.2.11 Optional Data 1 (Vessel Roll)

Three bytes used for the vessel roll or differential roll for a Riser Angle Monitoring System (MRAMS).

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

D.5.2.12 Optional Data 2 (Vessel Pitch)

Three bytes used for the vessel pitch or differential pitch for a Riser Angle Monitoring System (MRAMS).

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

D.5.2.13 Horizontal Error Ellipse Direction

Each position measurement has a likelihood ellipse associated with it. It is based on 1 σ in each of the axes.

Two bytes are used to indicate the direction of the major axis in degrees between the North axis and the major axis of the ellipse. The LSB is 1/10th of the unit.

D.5.2.14 Horizontal Error Ellipse Major

Two bytes used to indicate the major axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit.

D.5.2.15 Horizontal Error Ellipse Minor

Two bytes used to indicate the minor axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit.

D.5.2.16 Checksum

The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte. Bit 7 is always zero.

D.5.2.17 EOR (End of Record)

This byte marks the end of a telegram. It is always FF.

D.6 HPR 418 BCD – Message 2**D.6.1 Description**

This sub-section describes the format and contents of the HPR 418 BCD Message 2 LBL position output telegram. This is a condensed 418 telegram form designed to fit within the length of a 309 telegram so as to overcome hardware buffer size constraints on older DP desks.

D.6.1.1 BCD

BCD stands for *Binary Coded Decimal* and requires 4 bits (a 'nibble') to encode a single character.

In conventional BCD the values 0 to 9 inclusive are the only valid characters. However some of the bytes in the Simrad specification allow the use of alpha Hexadecimal (hex) characters A to F inclusive. The most common use among these is D, because it is used as a negative indicator in the most significant nibble of a 3-byte field.

The Start- and End-of-Message fields include fixed alpha hex values in both nibbles. The Status bytes, which are assembled bit-by-bit, can in some conditions also include alpha hex characters. The checksum byte is also likely to contain alpha hex characters.

Table D-7 Field Description of the HPR418BCD Telegram Message 2

Field	Byte	Sample BCD Data
SOT (Start of Telegram)	1	DF

Table D-7 Field Description of the HPR418BCD Telegram Message 2 (continued)

Field	Byte	Sample BCD Data
Head Byte	2	02
Status Byte 1	3	01
Status Byte 2	4	00
Object Type	5	02
Transponder Array	6	01
X Position Raw	7891011	0000123456
Y Position Raw	1213141516	D000098765
Z Position Raw	171819	122345
Heading	2021	3599
Not Used	222324	000000
Horizontal Error Ellipse Direction	2526	0000
Horizontal Error Ellipse Major	2728	0000
Horizontal Error Ellipse Minor	2930	0000
Checksum	31	XX
EOR (End of Record)	32	FF

D.6.1.2 Notes

- This telegram will be sent only if the status is OK.
- The co-ordinate frame for vessel position is the sea-bed LBL array co-ordinate frame.
 - Positive X is North
 - Positive Y is East

D.6.2 Definition of Field Names**D.6.2.1 SOT (Start of Telegram)**

This is a single byte start character DF hex.

D.6.2.2 Head Byte

This byte indicates the message type and is always 02 hex for an object message type 2.

D.6.2.3 Status Byte 1

- Bit 0 set = position measurement OK
- Bit 1 set = position is filtered
- Bit 2 not used by Sonardyne. Bit set to 0
- Bit 3 not used by Sonardyne. Bit set to 0
- Bit 4 not used by Sonardyne. Bit set to 0
- Bit 5 set = data from Slave system; clear = data from Master system
- Bit 6 set = BCD conversion error
- Bit 7 not used by Sonardyne. Bit set to 0

Status Byte 2

- Bits 0 to 1 = Transducer number. (not used by Sonardyne. Bit are set to 01 - Tdr 1)
- Bits 2 to 3 = Transceiver number. (not used by Sonardyne. Bit are set to 01 - Tcvt 1)
- Bit 4 set = Simulate mode.
- Bit 5 Not used by Sonardyne. Bit set to 0
- Bit 6 LBL co-ordinates in UTM
- Bit 7 set = data from Slave system; clear = data from Master system

D.6.2.4 Object Type

A single byte defining the object type.

- 00 = Vessel position
- 01 = ROV position
- 16 = ROV 16 position
- 17 = Relay 1 position
- 18 = Relay 2 position
- 19 = Relay 3 position
- 20 = Relay 4 position

D.6.2.5 Transponder Array

Sonardyne fix this byte to 01 hex.

D.6.2.6 X Position Raw

Five bytes used for the object position in Northings.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/100th of the unit.

D.6.2.7 Y Position Raw

Five bytes used for the object position in Eastings.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/100th of the unit.

D.6.2.8 Z Position Raw

Three bytes used for the beacon depth.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

D.6.2.9 Heading

Two bytes used for the vessel heading. The LSB is 1/10th of a degree.

D.6.2.10 Not Used

Three bytes filled with 00 hex.

D.6.2.11 Horizontal Error Ellipse Direction

Each position measurement has a likelihood ellipse associated with it. It is based on 1δ in each of the axes.

Two bytes are used to indicate the direction of the major axis in degrees between the North axis and the major axis of the ellipse. The LSB is 1/10th of the unit.

D.6.2.12 Horizontal Error Ellipse Major

Two bytes used to indicate the major axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit

D.6.2.13 Horizontal Error Ellipse Minor

Two bytes used to indicate the minor axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit.

D.6.2.14 Checksum

The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte. Bit 7 is always zero.

D.6.2.15 EOR

This byte marks the end of a telegram. It is always FF.

D.7 NMEA 0183 SSB – (USBL / SSBL Position)**D.7.1 Description**

The maximum length of the NMEA 0183 SSB Telegram is 82 characters, including the start character <\$> and the termination characters <CR> and <LF>. However the telegram will typically be less than this and will be of variable length, because leading zeros are suppressed.

Table D-8 Field Description of the SSBL Telegram

Field	Data Format	Sample Data
Start Character	\$	\$
Address	PSIMSSB	PSIMSSB
Time	,hhmmss.ss	,130700.43
Tp_code	,ann	,B22
Status	,a	,A (Always)
Error_code	,aaa	,
Coordinate_system	,a	,C
Orientation	,a	,H
SW_filter	,a	,M
X_coordinate	,x.x	,-100000.40
Y_coordinate	,x.x	,-100000.89
Depth	,x.x	,4329.10
Expected_accuracy	,x.x	,3.16
Additional_info	,a	,I

Table D–8 Field Description of the SSBL Telegram (continued)

Field	Data Format	Sample Data
First_add_value	,x.x	, -12.3
Second_add_value	,x.x	, -14.0
Checksum	*hh	*hh
Termination	<CR><LF>	<CR><LF>

D.7.1.1 Notes

- This telegram will be sent only if the status is OK.
- The co-ordinate frame for SSBL transponder position data is relative to the vessel datum point.
 - Positive Y is forward
 - Positive X is Starboard
 - Positive Depth is down

D.7.2 Definition of Field Names**D.7.2.1 Start_character**

The single ASCII character <\$>.

D.7.2.2 Address

The ASCII character string <PSIMSSB> to indicate that the telegram is a Simrad SSBL message.

D.7.2.3 Time

The time at which the fix was valid.

An ASCII character string preceded by a comma, indicating the time in hh (hours) mm (minutes) ss (seconds). (decimal point) ss (hundredths of seconds)

<,hhmmss.ss>

Example: <,035623.19>

Alternatively the field may be left blank, for example <,>.

D.7.2.4 Tp_code

The index of the transponder used.

B01 to B99 = MF channels

Examples: B05, B55, B58

The format is three ASCII characters preceded by a comma <,ann>, for example <,B17>

D.7.2.5 Status

This will always show OK because this telegram is sent only if the status is OK.

D.7.2.6 Error_code

This is always blank because the telegram will not be sent if there is an error code (meaning that the status is not OK).

D.7.2.7 Coordinate_system

A single ASCII character preceded by a comma <,a>

C = Cartesian co-ordinates, U = UTM, R = Radians.

D.7.2.8 Orientation

A single ASCII character preceded by a comma <,a>

H = Vessel head up, or N = North up.

D.7.2.9 SW_filter

A single ASCII character preceded by a comma <,a>

F = filtered, or M = measured.

D.7.2.10 X_coordinate

When no position has been calculated the field will be empty and only the comma field separator will be sent <,>

When data is present the field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed (see Table D-9 "Supported options for NMEA SSB Telegram").

D.7.2.11 Y_coordinate

When no position has been calculated the field will be empty and only the comma field separator will be sent <,>

When data is present the field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed (see Table D-9 "Supported options for NMEA SSB Telegram").

Table D-9 Supported options for NMEA SSB Telegram

Coordinate system	Orientation	X_coordinate	Y_coordinate
C	H	Starboard	Forwards
C	N	North (m)	East (m)
U	N	Northings (m)	Eastings (m)
R	N	Latitude (radians)	Longitude (radians)

D.7.2.12 Additional_info

A single ASCII character preceded by a comma <,a>

I = inclinometer, T = time, D = depth and N = none <,N>

D.7.2.13 First_add_value

- When the **Additional_info** field is I then the field will represent differential roll for a Riser Angle Monitoring System (MRAMS).
- When the **Additional_info** field is T then the field will represent range time in seconds.
- When the **Additional_info** field is D then the field will represent measured depth in metres.

The data field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed.

D.7.2.14 Second_add_value

When the Additional_info field is N then this field will be empty and only the comma field separator will be sent <,>

When data is present its meaning is controlled by the Additional_info field. The only option supported by -Sonardyne is differential pitch for a Riser Angle Monitoring System (MRAMS).

The data field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed.

D.7.2.15 Checksum

The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte. Bit 7 is always zero.

D.7.2.16 Termination

The ASCII for Carriage Return followed by Line Feed are sent <CR><LF>.

D.8 NMEA 0183 – LBP (LBL / LUBSL Position)**D.8.1 Description**

The maximum length of the NMEA 0183 LBP Telegram is 82 characters, including the start character <\$> and the termination characters <CR> and <LF>. However, the telegram will typically be less than this and will be of variable length, because leading zeros are suppressed.

D.8.2 Field Description**Table D-10 Field Description of the LBP Telegram**

Field	Data Format	Sample Data
Start_character	\$	\$
Address	PSIMLBP	PSIMLBP
Time	,hhmmss.ss	,130700.43
Tp_array	,c--c	,1
Type	,a_	,Ve
Status	,A	,A
Coordinates	,a_	,C
X_coordinate	,x.x	123.45
Y_coordinate	,x.x	678.90
Depth	,x.x	456.78
Major	,x.x	1.23
Minor	,x.x	1.32
Direction	,x.x	0.00
Res_rms	,x.x	0.97
Checksum	*hh	*hh
Termination	<CR><LF>	<CR><LF>

D.8.3 Definition of Field Names

D.8.3.1 Type

Ve = vessel.

R1 to R4 = ROV 1 to ROV 4.

D.8.3.2 Status

The Status field is A when the measurements are OK. The possible statuses are as shown below:

- A OK
- ??? Simulating or error condition

D.8.4 X_coordinate, Y_coordinate, Coordinate_system

The contents of the **X_coordinate** and the **Y_coordinate** fields are controlled by the settings in the **Configure** dialog box.

The **Coordinate_system** field should be used to decode the X_ and Y_coordinate fields as shown in *Table D-11*.

Table D-11 NMEA 0183 LBP Coordinate Fields

APOS Configure Setting	Coordinate system	X_coordinate	Y_coordinate
Cartesian N/E	C	North	East
UTM N/E	U	Northings	Eastings
Radians	R	Latitude	Longitude

Depth - the depth in meters

Major, Minor, Direction - the major axis, minor axis and direction of the error ellipse.

D.9 PSONALL – Sonardyne General Position Report

D.9.1 Description

The PSONALL telegram is an extended version of a standard PSONOG grid co-ordinate position telegram for use when transferring vehicle positions to client navigation systems. The included co-ordinates use the selected projection system defined in software.

D.9.2 Format

The PSONALL telegram format shown below consists of a single string, separated across two lines here for clarity.

```
$PSONALL,Name,Offset,HHMMSS.ss,EEEEEEEE.ee,NNNNNNNN.nn,
DDDD.dd,HHH.hh,CCC.cc,T,PP.PP,RR.RR,VVV.vv,AAA.AA,BBB.BB*hh<CR><LF>
```

D.9.3 Field Descriptions

Table D-12 Field Description for the PSONALL Telegram

Field	Description
\$PSONALL	Header to identify the telegram.

Table D-12 Field Description for the PSONALL Telegram (continued)

Field	Description
Name	The name of the vehicle the string relates to.
Offset	Offset on vehicle the position relates to.
HHMMSS.ss	The valid time of the sentence.
EEEEEEEE.ee	Grid Easting.
NNNNNNNN.nn	Grid Northing.
DDDD.dd	Depth.
HHH.hh	Heading ¹
CCC.cc	Course made good (CMG) ¹
T	Heading type: G = grid T = True M = Magnetic
PP.PP	Vehicle Pitch ¹
RR.RR	Vehicle Roll ¹
VVV.vv	Velocity ¹
AAA.AA	Position accuracy (95%).
BBB.BB	Depth accuracy.
*hh	Checksum.
<CR><LF>	Termination characters, carriage return plus linefeed.

¹ Empty fields are null by default as shown above, or replaced with '0.00' values (see *Section 4.20 "Configuring Output Telegrams"*).

D.9.3.1 Checksum

The Checksum value is the resultant XOR of all characters in the report string, excluding the <CR><LF> termination characters.

D.9.3.2 Example

\$PSONALL,Rangeaster,Dunker,123443.56,419876.56,5567887.45,
6789.07,234.56,235.67,T,15.12,17.34,2.4,1.22,0.39*hh<CR><LF>

With null fields:

\$PSONALL,2404,Transducer,085741.262,650883.02,5688721.58,999.91,,,G,,,,7.858,0.806*05<CR><LF>

With 0.00 replacing null fields:

\$PSONALL,2404,Transducer,085227.318,650816.89,5688781.67,372.58,0.00,0.00,G,0.00,0.00,0.00,32
60605850.979,22753659635.223*2B<CR><LF>

D.10 PSONUSBL – Sonardyne USBL Report

D.10.1 Description

This sentence is intended to include all of the information necessary to provide USBL position and attitude/heading information to an external system.

Null fields with their delimiters can have the following appearance, depending on where they are located in the sentence: ",", " ", "*"

The ASCII NULL character (HEX 00) shall not be used as the null field.

D.10.2 Format

The PSONUSBL telegram format shown below consists of a single string, separated across two lines here for clarity

\$PSONUSBL,HHMMSS.ss,ddd,C,aaaa.aa,bbbb.bb,dddd.dd,pp.pp,srr.rr,hhh.hh, qq.q*hh<CR><LF>

D.10.3 Field Description

Table D–13 Field Description for the PSONUSBL Telegram

Field	Description
\$PSONUSBL	Header to identify the telegram.
HHMMSS.ss	The valid time of the sentence.
ddd	Beacon index - the index of the beacon that the string relates to (valid range 1 to 999 with 0 not valid).
C	Co-ordinate frame orientation: H = vehicle head up N = North up
aaaa.aa	Vehicle-centred East or Starboard co-ordinate.
bbbb.bb	Vehicle-centred North or Forward co-ordinate.
dddd.dd	Depth.
pp.pp	Pitch.
rr.rr	Roll.
hhh.hh	Heading (true).
qq.q	1 sigma position accuracy (39.4 %).
*hh	ASCII Hex checksum (XOR of all characters between, but not including, the \$ and * characters).
<CR><LF>	Termination characters, carriage return, line feed.

D.10.4 Example

\$PSONUSBL,123456.12,101,H,-1234.56,-1234.56,1234.56,-12.34,
-12.34,123.45,12.3*70 <CR><LF>

D.11 PSONDP - Sonardyne DP Report

D.11.1 Description

This sentence includes all of the information necessary to provide position, velocity and attitude/heading information to a DPS. In addition to the positional information it also provides error metrics that allow the DPS to determine that the data is valid, and the correct weight to give to the data.

Null fields with their delimiters can have the following appearance depending on where they are located in the sentence: ",", " ", "*"

The ASCII NULL character (HEX 00) shall not be used as the null field.

This telegram is subject to change, although additions will only be made immediately before the '*' that marks the beginning of the checksum.

D.11.2 Format

```
$PSONDP,HHMMSS.ss,0000,M,Q,DDMM.mmmmmm,N,DDDMM.mmmmmm,E,A.aa,A.aa,AAA.aa,D.dd,
S.ss,C.c,A.aa,A.aa,AAA.aa,P.ppp,R.rrr,
HHH.hhh,A.aa,CCC,N,,,,*hh<CR><LF>
```

D.11.3 Field Description

Table D-14 Field Description for the PSONDP Reports

Field	Description
\$PSONDP	Header (fixed)
HHMMSS.ss	The valid time of the contents. See Note 1.
0000	Target ID.
M	Status: M:Master, S:Slave.
Q	Quality Indicator (0:No Data, 1:Degraded Data, 2:Full Accuracy.
DDMM.mmmmmm	Latitude. See Note 2.
N	Direction of latitude (N or S).
DDDMM.mmmmmm	Longitude. See Note 2.
E	Direction of longitude (E or W).
A.aa	Position accuracy error ellipse major axis (metres). See Note 3.
A.aa	Position accuracy error ellipse minor axis (metres). See Note 3.
AAA.aa	Position accuracy error ellipse direction (True - degrees). See Note 3.
D.dd	Depth below sea surface (metres), see Note 4.
S.ss	Speed over ground (m/s).
C.c	Course over ground (True - degrees). 0.0-359.9
A.aa	Speed over ground accuracy error ellipse major axis (m/s). See Note 3.
A.aa	Speed over ground accuracy error ellipse minor axis (m/s). See Note 3.
AAA.aa	Speed over ground accuracy error ellipse direction (True - degrees). See Note 3.
P.ppp	Pitch (degrees). Bow up: positive. See Note 5
R.rrr	Roll (degrees). Port up: positive.
HHH.hhh	Heading (True - degrees). 0.0 - 359.999
A.aa	Heading accuracy (Standard deviation - degrees)
CCC	Aiding: N:None,U:USBL,L:LBL,G:GNSS,D:DVL,P:Pressure. See Note 6.
A,x.xxx,x.xxx,x.xxx	Additional data: N: None. TBD See Note 7.
*hh	Checksum. See Note 8.
<CR><LF>	Terminator, return plus linefeed .

D.11.3.1 Notes

1. The DP-INS system time for which the data is valid. If the system is connected to a GNSS time source this will be UTC time.
2. Latitude and longitude values are always displayed in the degrees, minutes, decimal minutes (DDMM.mmmmm) format. All values are relative to the WGS-84 datum. Leading zeros are not required. Latitude range (DD) = 0 - 89, longitude range (DDD) = 0 - 179.
3. The accuracy values contain the length of the vehicle's error ellipse axes and direction of the major axis. Error ellipse values are always displayed to 2 DPs.
4. The depth value is always displayed in metres and fixed to 2 DPs. Negative depth indicates the target is above the water surface.
5. Pitch and roll angles are defined as the angle between the gravity vector and the deck plane in the direction of the roll and pitch axes of the vessel.
6. The Aiding source indicates what type of aiding data is currently in use.
7. Additional data is reserved to contain data received from the target instrument. Empty data slots will be left null when no data is present.
8. The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters, between but not including the "\$" and the "*" delimiters. The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first.

D.11.4 Modifications

The maximum number of characters in a normal NMEA sentence should be 82, consisting of a maximum of 79 characters between the starting "\$" and the terminating <CR><LF>. This telegram currently could be as long as 180 characters.

D.11.5 Example

```
$PSONDP,123456.43,0010,M,2,5020.234502,N,12345.324576,E,12.34,12.34,123.45,1234.56,12.34,35
9.9,0.45,0.23,123.45,-12.345,-12.345,359.999,1.23,UP,N,,,*2E
```

D.12 NMEA 0183 GGA**D.12.1 Description**

The NMEA GGA telegram is a simulation of a standard NMEA GGA string and is used to show fix-related data for a GNSS receiver.

You should use this sentence only where the receiving installation does not support a more suitable sentence.

D.12.2 Format

The NMEA GGA telegram format shown below consists of a single string, separated across two lines here for clarity.

```
$GPGGA,HHMMSS.ss,DDMM.mmmmm,N,DDMM.mmmmm,
E,2,0,A,A,Z.ZZZ, M,0.0,M,0.0,0000*hh<CR><LF>
```


D.12.3 Field Description

Table D–15 Field Description for the NMEA GGA Telegram

Field	Description
\$GPGGA	Header to identify the report (fixed).
HHMMSS.ss	The valid time of the position.
DDMM.mmmmm	Latitude. See Note 1.
N	Direction of latitude (N or S).
DDDMM.mmmmm	Longitude. See Note 1.
E	Direction of longitude (E or W).
2	Quality. See Note 2.
0	Number of satellites (not used). See Note 3.
A.A	Accuracy (semi-major axis). See Note 4.
Z.ZZZ	Height. See Note 5.
M,0.0,M,0.0,0000	Fixed values.
*hh	Checksum. See Note 6.
<CR><LF>	Termination characters, carriage return, linefeed.

D.12.3.1 Notes

- Latitude and longitude values are always displayed in the DDDMM.mmmmm format.
All values are relative to the WGS84 datum. Leading zeros are not required. Latitude range (DD) = 0 to 89; Longitude range (DDD) = 0 to 179.
- Quality will be '2' or '0' (invalid).
- Number of satellites will always be '0'.
- The accuracy value is the semi-major axis value for the vehicle. It is always displayed in metres and is fixed to one DP.
- The height value is always displayed in metres and fixed to three DPs.
Because this string format has no concept of depth, depth values for the vehicle should be displayed as negative values so that, for example when depth = 56.7 m, depth is formatted as – 56.7.
- The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters, between but not including the "\$" and the "*" delimiters.
The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0 to 9, A to F) for transmission. The most significant character is transmitted first.

The maximum number of characters in a sentence is 82, consisting of a maximum of 79 characters between the starting "\$" and the terminating <CR><LF>.

D.12.3.2 Example

```
$GPGGA,123456.43,5020.23450,N,134.32457,E,2,0,6.7,
-56.789,M,0.0,M,0.0,0,0000*hh
```

D.13 ATS ASCII

D.13.1 Description

The ATS ASCII Telegram is used by Nautronix ATS-S02 S04 and S08 Systems. Each line of the data contains position data for one object terminated by a <LF> then <CR>

D.13.2 Format

The ATS ASCII format shown below consists of a single string, separated across two lines here for clarity.

```
dd mmm yy hh:mm:ss B:d X:ddd.d Y:ddd.d D:ddd.d P:d.d R:d.d H:ddd.d E:d A:ddd.d C:ddd.d
E:d<LF><CR>
```

D.13.3 Field Description

Table D–16 Field Description for the ATS ASCII Telegram

Field	Description
dd mmm yy hh:mm:ss	Date and time of receipt or the acoustic reply.
B:d	Beacon Index 0 = Ship, 1-10=beacons 1 to 10
X:ddd.d	X Coordinate in metres.
Y:ddd.d	Y Coordinate in meters.
D:ddd.d	Depth in metres.
P:d.d	Ships pitch in degrees. Positive pitch is bow up +/-9,9
R:d.d	Ships roll in degrees. Positive roll is port up +/-9,9
H:ddd.d	Ships heading relative to North in degrees 0-360
A:ddd.d	(Optional) Riser angle monitoring – Lower flex joint pitch in degrees.
C:ddd.d	(Optional) Riser angle monitoring – Lower flex joint roll in degrees.
E:d	Error code: bit 0 = simulating; bit 2 = position data is invalid.
<LF><CR>	Line feed, Carriage return.

D.13.3.1 Notes

- The co-ordinate frame for beacon position data is relative to the ship datum point.
 - Positive Y is forward
 - Positive X is starboard
 - Positive depth is down

D.13.3.2 Example

```
30 Sep 04 13:47:55 B:0 X:-84.2 Y:-11.6 D:31.0 P:0.0 R:0.0 H:189.1 E:0<LF><CR>
```

D.14 Trackpoint II

D.14.1 Description

The Trackpoint II Telegram is a fixed length 66 character ASCII based transponder position telegram. Each line of the data contains position data for one object terminated by a <CR> then <LF>.

D.14.2 Field Description

Table D–17 Field Description for the Trackpoint II Telegram

Field	Description
d	Index of the transponder.
hh:mm:ss	Time of receipt or the acoustic reply.
ddd	Ships heading relative to North in degrees 0-360
ddd.d	Bearing to target in degrees 0-360
d.d	Slant range to target in metres.
d.d	X Coordinate in metres.
d.d	Y Coordinate in meters.
d.d	Depth in metres.
d	Error code (0 indicates good position).
<CR>	Carriage return.
<LF>	Line feed.

D.14.2.1 Notes

- The co-ordinate frame for beacon position data is relative to the ship datum point.
 - Positive Y is forward
 - Positive X is starboard
 - Positive depth is down

D.14.2.2 Example

1 15:53:53 12 104.9 141.1 97.9 -26.0 98.2 0<CR><LF>

D.15 HPR 300P

D.15.1 Description

The HPR 300P Telegram is a 66 character ASCII based transponder position. Each line of the data contains position data for one object terminated by a <CR> then <LF>.

D.15.2 Field Description

Table D–18 Field Description for the HPR 300P Telegram

Field	Description	Position
dd	Index of the transponder.	1-2
c	Space.	3
d	Transducer number (Always 1).	4
cc	Spaces.	5-6
c	Beam used (Always W).	7
cc	Spaces.	8-9
ccc	Reply status. OK=Good position. NRY=No reply.	10-12
c	Space.	13

Table D–18 Field Description for the HPR 300P Telegram (continued)

Field	Description	Position
dddd.d	Vessel course 0-359.9 (degrees).	14-19
c	Space.	20
dddd.d	X Coordinate in metres.	21-26
c	Space.	27
dddd.d	Y Coordinate in meters.	28-33
c	Space.	34
dddd.d	Z Coordinate in metres or Depth.	35-40
c	Space.	41
ddd.d	QUA. Position quality.	42-46
cc	Spaces.	47-48
ccc	Riser angle status. Always NRY.	49-51
c	Space.	52
dddd.d	Riser X-angle or tilt with sign.	53-58
c	Space.	59
dddd.d	Riser Y-angle or azimuth with sign.	60-65
<CR>	Carriage return.	66
<LF>	Line feed.	67

D.15.2.1 Notes

- The co-ordinate frame for beacon position data is relative to the ship datum point.
 - Positive Y is forward
 - Positive X is starboard
 - Positive depth is down

D.15.2.2 Example

```
33 1 W OK    0  18.9  40.5  30.0  0.1 NRY 0.0 0.0<CR><LF>
```

D.16 PSONMEAS – Sonardyne Measurements Report**D.16.1 Description**

This report is a custom sentence for outputting measurement data from peripheral sensors.

D.16.2 Format

```
$PSONMEAS,hhmmss.ss,I,A,B,X.X,Y.Y,Z.Z*hh <CR><LF>
```

D.16.3 Field Description**Table D–19 Field Description for the PSONMEAS Format**

Field	Description
\$PSONMEAS	Header.
hhmmss.ss	Valid time of the position.

Table D–19 Field Description for the PSONMEAS Format (continued)

Field	Description
I	Information source.
A	Name of Instrument Or Source.
B	Name sensor or Destination.
X.X	Data Field 1.
Y.Y	Data Field 2.
Z.Z	Data Field 3.
*hh	Check Sum.
<CR><LF>	Terminator - carriage return, line feed.

D.16.4 Definition of Field Names

D.16.4.1 Information Source

INCINT for Inclinator with Heading

INCEXT for Inclinator without Heading

DEPTH for depth sensor

TEMP for temperature sensor

RNG for range measurement

Table D–20 Format Data field 1, Data Field 2, Data Field 3 for PSONMEAS Format

	Data Field 1	Data Field 2	Data Field 3
INCINT	Grid Heading.	Roll	Pitch
INCEXT	0.00	Roll	Pitch
DEPTH	Depth.	0.00	0.00
TEMP	Temperature.	0.00	0.00
RNG	Distance in meters.	0.00	0.00

D.17 PSONLLD – Sonardyne Lat, Long, Depth Report

D.17.1 Description

This report is a custom sentence for outputting latitude, longitude and depth information.

D.17.2 Format

\$PSONLLD,hhmmss.sss,id,status,lat,long,depth,hor_err_major,hor_err_minor,
hor_error_dir,depth_error,optional_spec,opt1,opt2,opt3*hh<CR><LF>

D.17.3 Field Description

Table D–21 Field Description for the PSONLLD Format

Field	Description
\$PSONLLD	Header.
hhmmss.sss	Time of validity.

Table D-21 Field Description for the PSONLLD Format (continued)

Field	Description
id	id of tracked object; in the case of a beacon, the beacon's Address.
status	A = valid, V = invalid.
lat	Latitude in decimal degrees, +ve value indicates North, -ve value indicates South.
long	Longitude in decimal degrees, +ve value indicates East, -ve value indicates West.
depth	Depth in metres, with respect to the water surface. +ve = down.
hor_err_major	Horizontal error ellipse major axis in metres (1 S.D.).
hor_err_minor	Horizontal error ellipse minor axis in metres (1 S.D.).
hor_err_dir	Direction of Horizontal error ellipse major axis in decimal degrees relative to true North.
depth_error	Depth error in metres (1 S.D.).
optional_spec	Optional fields specifier, a code denoting what the optional fields contain or blank for no optional data.
opt1	Optional field 1.
opt2	Optional field 2.
opt3	Optional field 3.
*hh	NMEA style checksum.
<CR><LF>	Carriage return & line feed.

D.18 RMB Report

D.18.1 Description

This is a NMEA-0183 report providing the 'Recommended Minimum Navigation' information. It provides navigation information to get from the current position to the Destination waypoint.

D.18.2 Format

\$SNRMB,A,x.x,a,c c,c,llll.ll,a,yyyyy.yy,a,x.x,x.x,x.x,A,a*hh<CR><LF>

Table D-22 Field Description for the RMB Format

Field	Description
\$SNRMB,	Header (fixed).
A,	Data Status - A=data valid, V=invalid
x.x,	Cross-track error - distance from line between origin and destination waypoints (nautical miles). See Note 1.
a,	L = left, R = right
c--c,	Name of origin waypoint
c--c,	Name of destination waypoint
DDMM.mmmmm,	Latitude of destination waypoint. See Note 2.
N,	Direction of latitude (N or S)
DDDMM.mmmmm,	Longitude of destination waypoint. See Note 2.
E,	Direction of longitude (E or W)

Table D-22 Field Description for the RMB Format (continued)

Field	Description
x.x,	Range to destination, nautical miles. See Note 3.
x.x,	Bearing to destination, degrees (true)
x.x,	Destination closing velocity, knots
A,	Arrival status, A=arrival circle entered or perpendicular passed, V=not entered/-passed
a	Mode Indicator – Autonomous (fixed value)
*hh	Checksum. See Note 4.
<CR><LF>	Termination.

D.18.2.1 Notes

1. The cross-track error is limited to 9.99NM
2. Latitude and longitude values are always displayed in the DDDMM.mmmmm format. All values are relative to the WGS-84 datum. Latitude range (DD) = 0 – 89, longitude range (DDD) = 0 – 179.
3. The range to destination is a great circle distance limited to 999.9NM.
4. The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including “,” delimiters, between but not including the “\$” and the “*” delimiters. The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first.

D.18.2.2 Modifications:

The normal maximum number of characters in a sentence shall be 82, consisting of a maximum of 79 characters between the starting “\$” and the terminating <CR><LF>. This may be exceeded if names of waypoints are too long.

D.18.2.3 Example

```
$SNRMB,A,0.0056,R,Origin WP,Destination WP,5119.84950,N,00050.16615,W,0.01905,305.7,0.000,V,A*38<CR><LF>
```

D.19 BWC Report**D.19.1 Description**

This is a NMEA-0183 report providing the distance and bearing to a specified waypoint. The distance is computed along the great circle path from the current position rather than along the rhumb line.

D.19.2 Format

```
$SNBWC,hhmmss.ss,lll.lll,a,yyyyy.yy,a,x.x,T,x.x,M,x.x,N,c c,a*hh<CR><LF>
```

Table D-23 Field Description for the BWC Format

Field	Description
\$SNBWC,	Header (fixed).

Table D-23 Field Description for the BWC Format (continued)

Field	Description
A,	Data Status - A=data valid, V=invalid
hhmmss.ss,	The UTC valid time of the position
DDMM.mmmmm,	Latitude of destination waypoint. See Note 1.
N,	Direction of latitude (N or S)
DDDMM.mmmmm,	Longitude of destination waypoint. See Note 1.
E,	Direction of longitude (E or W)
x.x,	Bearing to destination, degrees (true)
T,	T=True
,	Bearing to destination, degrees (magnetic) – not used
,	M=Magnetic – not used
x.x,	Distance to destination
N,	N=nautical miles
c--c,	Name of destination waypoint
a	Mode Indicator – Autonomous (fixed value)
*hh	Checksum. See Note 2.
<CR><LF>	Termination.

D.19.2.1 Notes

1. Latitude and longitude values are always displayed in the DDDMM.mmmmm format. All values are relative to the WGS-84 datum. Latitude range (DD) = 0 – 89, longitude range (DDD) = 0 – 179.
2. The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including “,” delimiters, between but not including the “\$” and the “*” delimiters. The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first.

D.19.2.2 Modifications:

The normal maximum number of characters in a sentence shall be 82, consisting of a maximum of 79 characters between the starting “\$” and the terminating <CR><LF>. This may be exceeded if names of waypoints are too long.

D.19.2.3 Example

```
$SNBWC,080737.22,5119.84950,N,00050.16615,W,305.7,T,,,0.01905,N,Destination WP,A*45<CR><LF>
```


Appendix E – System Calibration

E.1 Introduction

This section explains how certain factors external to the system can have an impact on system performance.

By following appropriate calibration methods it is possible to take control of these external factors by quantifying their effects, and then compensating for them in software.

E.2 Sound Velocity

An accurate knowledge of sound velocity, and of the way that the sound velocity varies with water depth, are both very important factors in making an estimation of acoustic range underwater.

E.2.1 Background

The system estimates ranges from a knowledge of the elapsed time between the transmission of an interrogation signal and the reception of a reply. To convert this time measurement to a range estimate, the system requires an accurate knowledge of sound velocity:

$$\text{Range} = (\text{ElapsedTime} - \text{TurnAroundTime}) * \text{SoundVelocity} / 2$$

Note

 **The divide-by-two element of this calculation allows for the two-way acoustic path — from the interrogating transceiver to the beacon and then back to the transceiver again.**

Because of the linear relationship between sound velocity and estimated range, a 1% error in the measurement of sound velocity causes a 1% error in the range estimate.

For L/USBL applications, the **Through the Water Column** sound velocity value is usually the most important.

Note

 **Provided the sound velocity is set to the average sound velocity in water between the transceiver and the working depth, the USBL software compensates automatically for ray refraction.**

E.2.1.1 Checks on Sound Velocity

You should make regular checks on the sound velocity during an operation. The frequency with which you make these checks depends on circumstances. You should make the checks more frequently in areas where you suspect the temperature profile with depth may change significantly during the operation.

Update the software whenever you note any changes in the value of sound velocity. Depending on circumstances, these changes can occur over the course of a full day, or can occur more rapidly.

It is possible to make a simple check on the **Through the Water Column** sound velocity by observing the vessel's depth value shown on the **Chart** display. If this is not zero, then it is likely that the 'through water' sound velocity requires correction.

If there is no other method available to measure the sound velocity, it is possible to use the value of the vessel's apparent depth, indicated on the **Chart** display, together with a knowledge of the beacon's depth in water to calculate a new value for sound velocity as follows:

$$NSV = OSV \times \left[\frac{WD + SD}{WD} \right]$$

where:

NSV=new value for Through the Water Column sound velocity

OSV=old sound velocity value

WD=water depth to beacon

SD=apparent depth for the vessel

Save the new value for sound velocity and, having done this, check that the apparent depth of the vessel is now zero.

E.2.2 Measurement of Sound Velocity

You can use a sound velocity profiler to measure sound velocity directly. Alternatively, you can read the acoustic range from a beacon directly below the transceiver and compare the indicated value with the known water depth. Adjust the sound velocity value to make the two measurements equal.

There are a number of velocimeter instruments available for measuring the speed of sound directly. These devices use the 'sing-around' principle where high-frequency acoustic pulses emitted by a transducer reflect back from a target at a known distance from the transducer.

By knowing the round-trip distance and measuring the round-trip time to great accuracy, these devices are capable of delivering direct sound speed measurements to an accuracy of ± 0.1 m/s or better.

E.3 Transceiver Alignment Calibration

If absolute position accuracy is important (as distinct from good position repeatability), it is necessary to determine what corrections must be applied to the vessel's attitude sensors so that the system can calculate the correct L/USBL directions.

Note



The system uses measurements from an external vertical reference unit and gyrocompass to apply corrections to its directional and positional calculations. For these corrections to be accurate, the misalignment between the vessel's vertical reference unit (VRU) and the system's transceivers must be known.

Before accurate and reliable measurements can be taken from the system it is important to measure and compensate for any misalignment that exists between the transceiver's frames of reference and the VRU's frame of reference.

Appendix F – CASIUS Data Collection Methods

Note



See Section A.9.2 "CASIUS" for information about the software interface for CASIUS.

F.1 Manoeuvring Guidelines

There are no specific manoeuvres required, but data collected should conform to the following guidelines:

- Some of the data must be taken with the vessel above or nearly above the beacon, so as to maximize the effects of any pitch and roll offsets.
- Some of the data must be taken with the vessel at some distance from the beacon so as to maximize the effects of any gyrocompass offset.
- Data must be taken at opposite headings so as to maximize information used to determine any antenna offsets.
- Ideally, data should be taken through the full range of azimuth directions.
- Data should be collected at a horizontal distance from the beacon that is no greater than one third the water depth at the beacon position, or a maximum of 500 metres from the beacon's position, whichever is the smaller.
- Ideally, the manoeuvres done while collecting data should reflect the way the vessel is used operationally.

If the vessel is expected to be largely stationary during operation then it should be stationary for each data collection phase. Similarly if the vessel is expected to be moving past the beacon operationally then the data should be collected while moving.

If the vessel is not capable of dynamic positioning, then it will be difficult to keep the vessel stationary, so the latter method will almost inevitably be used.

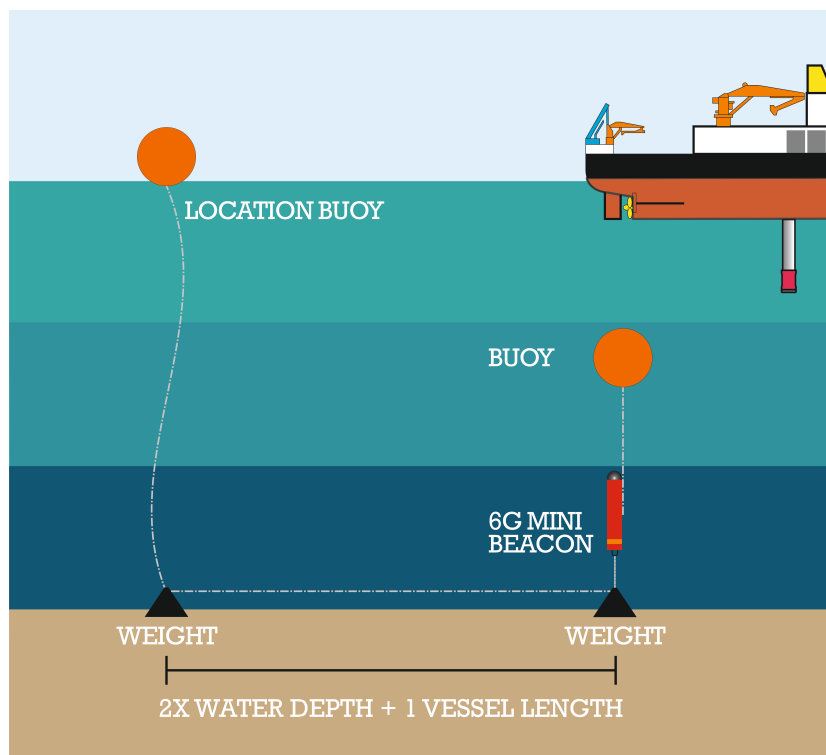
- Heading changes are known to cause some VRU units to misread. Refer to the VRU documentation for details of how long the VRU takes to settle down after various rates of turn.

Because of this effect, and because data is needed at more than one heading, the vessel manoeuvring may need to be broken up into a series of data collection passes or phases, each at a constant heading. A constant heading should be maintained for a short time prior to and during each pass.

- An important decision to be made is whether the data will be collected while moving or stationary. It is preferable to be stationary if possible as this minimises any DGPS lag problems. If the vessel has no DP capability then this will not be a realistic option and in this case data should be collected during a series of straight run lines over and to the side of the beacon.

F.2 Beacon Deployment Without an ROV

To perform a USBL verification in shallow water without a ROV present to deploy or recover the transponder, the following procedure can be followed.



The beacon, for example a WSM 6+, must be held vertical by a small float about 10 m above its transducer to prevent acoustic masking, with a (approximately) 1 m strop length from the beacon to a 20 kg clump weight (the strop length is important to reduce the possibility of the beacon hitting the weight and sustaining damage when it is lowered but not too long that the beacon 'waves' above it).

A second 20 kg clump weight approximately twice the water depth away acts as the tether point for a larger location buoy which will be at the surface well clear of the vessel's turning circle. The surface float's strop should be long enough to compensate for tidal variations to prevent it from being pulled below the surface.

F.3 Data Collection

A dynamic positioning vessel is able to move in any direction while maintaining a constant heading. - Sonardyne suggests that you use the manoeuvring pattern shown in *Figure F-1* below, pausing at each of the cardinal points and also directly above the beacon.

Note



CASIUS data is collected while stationary.

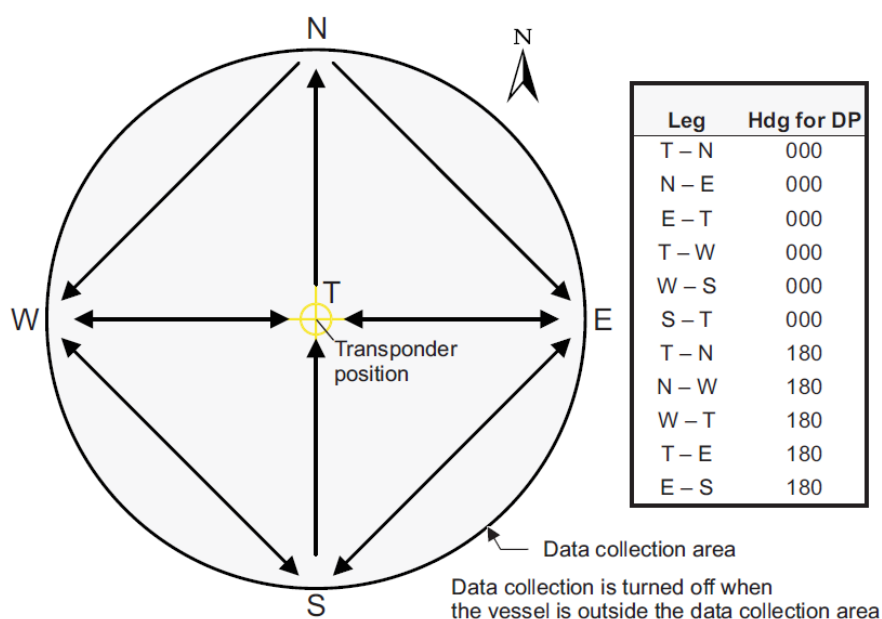
Sonardyne suggests that you collect an equal amount of data at each cardinal point to avoid skewing the data.

Note that a reciprocal heading is used for the second half of the data collection.

The radius of the circle centred on the beacon defines the data collection area. This would normally be equal to one third of the water depth at the beacon, or a maximum of 500 metres. The data collection points are then at 90 degrees to one another at equal distance from the beacon, as well as immediately above the beacon.

The pattern may be rotated in any direction to accommodate wind or currents.

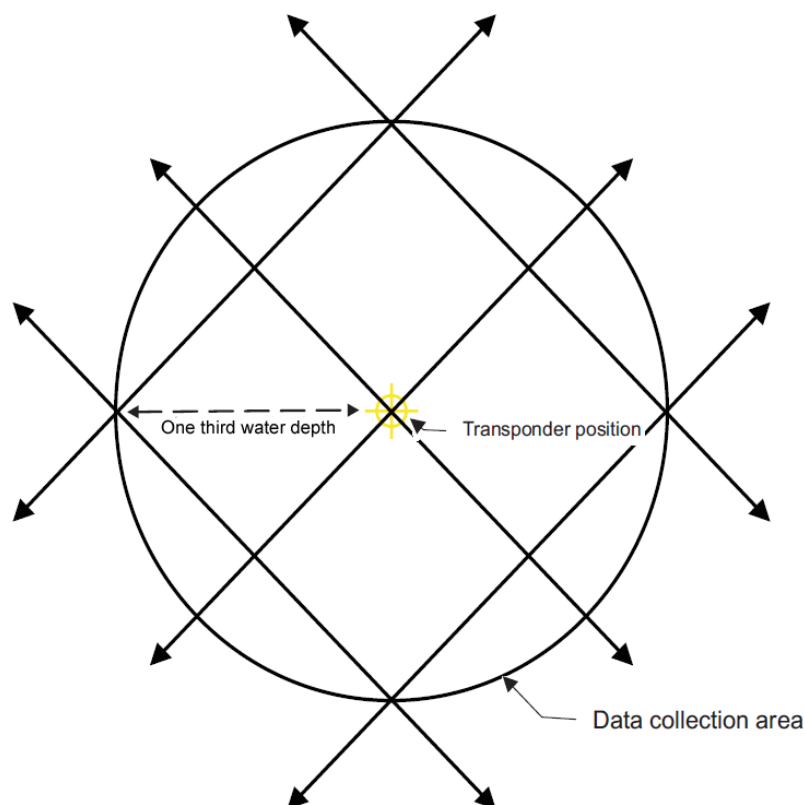
Figure F-1 Manoeuvring Pattern for a DP Vessel



F.4 Data Collection – Constantly Moving Vessel

This data collection method is very similar to the one outlined in *Section F.3 "Data Collection"* for stationary collection of data, except that the vessel is not expected to stop at the cardinal points to log the data but only to collect data on the transits between cardinal points whilst maintaining good heading.

This method requires the vessel to run 12 lines, with eight transits between adjacent cardinal points (in both directions). The pattern includes a run line in both directions passing directly over the beacon, as shown in *Figure F-2*.

Figure F-2 Manoeuvring Pattern – Constantly Moving Vessel

As before, the pattern can be rotated to allow for current and wind directions where required. The length of the run lines for data collection depend on the water depth as before for the stationary data collection example.

The radius of the circle centred on the beacon defines the data collection area. This would normally be equal to half of the water depth, or a maximum of 500 metres.

Sonardyne suggests that you extend these lines by an appropriated distance to ensure the vessel has a chance to stabilize its heading before beginning data collection within the area, as shown in the example.

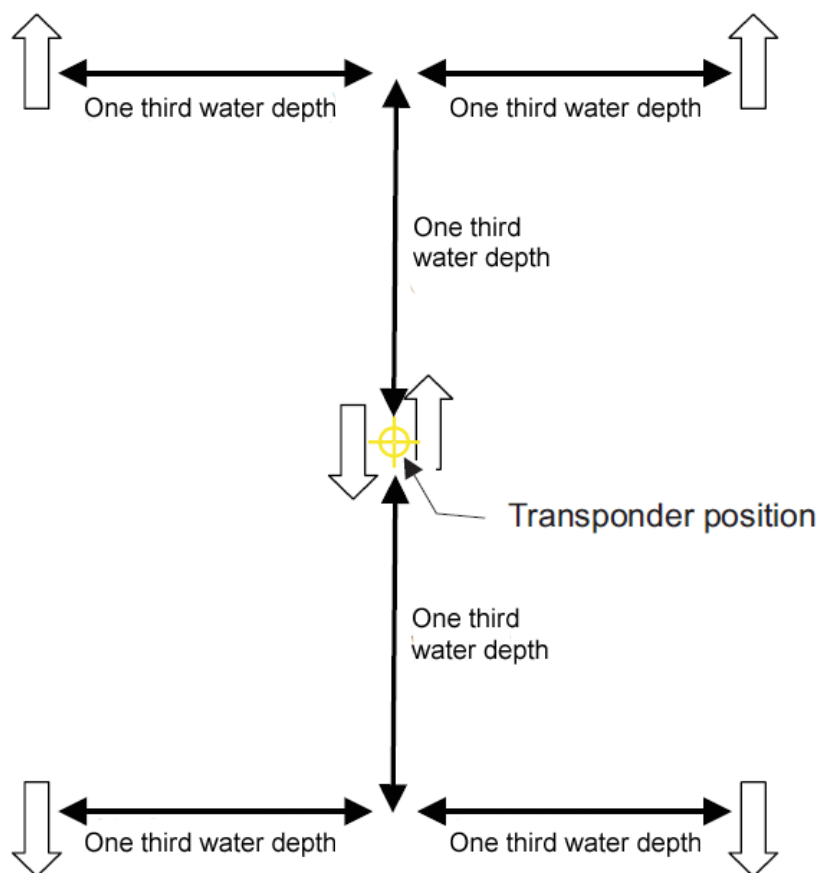
To keep the lines straight in the data collection area, the vessel should move outside the data collection area before making a turn for the next run line. Also, the heading should be stable for a period before starting to collect data (the length of this period depends on the VRU's characteristics and on the rate of heading change prior to achieving a stable heading).

The vessel should reduce speed while passing over the beacon, to acquire more readings there. The vessel's speed should be maintained at the outer ends of the run lines.

F.5 Data Collection – DP Vessel with Tilted Transceiver

The data collection process is the same as for a non-tilted transceiver, except the points where the data is collected must be moved by 30° when collecting data with a tilted transceiver.

Figure F-3 shows a suggested data collection pattern and the heading of the vessel at each position, (assuming the transceiver is tilted backwards).

Figure F-3 Manoeuvring pattern – Tilted Transceiver

F.6 USBL Transceiver Alignment Calibration Check

An existing USBL CASIUS calibration can be quickly verified using the Average Fix tool, thus avoiding the need to spend valuable vessel time re-calibrating the system unnecessarily. The tool allows a report of current system settings and performance to be produced, which when compared to the result of the previous CASIUS calibration can be used to decide whether a new calibration is required.

This verification test can be performed using either the same seabed beacon used for the CASIUS calibration or any other convenient seabed beacon that can be tracked with good acoustic performance

F.6.1 Before You Begin

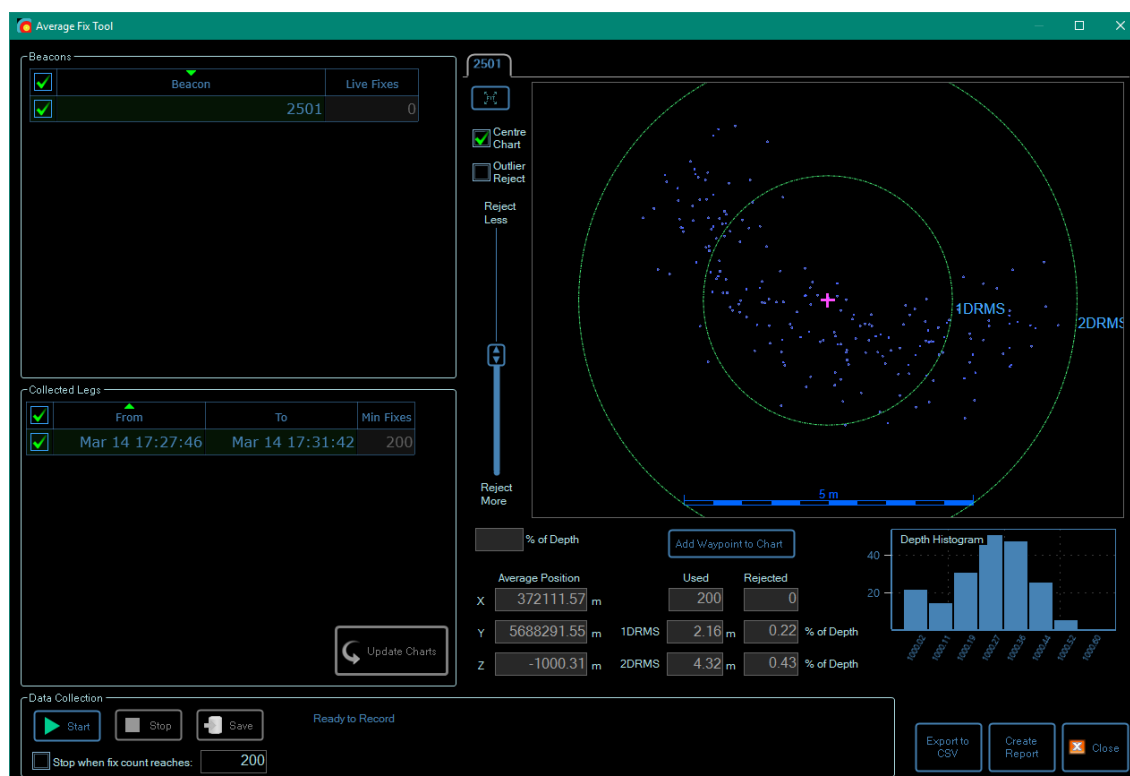
Check that:

- the VRU and heading sensors that were used in the CASIUS calibration are selected as the active sensors in the vessel properties dialog box
- the GNSS is enabled for use in tracking
- the alignment corrections from the CASIUS are correctly entered in the USBL transceiver's offsets dialog box
- the correct average through-water sound speed is set, or a current sound speed profile has been imported into the system
- If the system uses multiple heading and attitude sensors, Sonardyne recommends that you align them using the **AHRS Alignment** tool provided in the **Tools** menu

F.6.2 Alignment Check

1. Manoeuvre the vessel so that the USBL transceiver is as close as possible over the top of the nominated beacon on the seabed.
2. Ensure that the beacon is tracking reliably for several minutes (correct any tracking problems, if necessary).
3. Carry out vessel manoeuvres while collecting data (see *Step 4* below). Sonardyne recommends the following two manoeuvres as a minimum, but any manoeuvres are possible, depending on vessel capabilities and customer requirements.
 - a. Rotate the vessel slowly around the beacon, attempting to keep the transceiver as near as possible over the top of the beacon.
 - b. Starting with the transceiver as close as possible over the top of the beacon, move the vessel by a distance of one third the water depth, or 500 metres (whichever is less) away from the beacon.
4. For each manoeuvre, collect and save data using the **Average Fix Tool**:
 - a. Click **Start** to start collecting data.
 - b. Click **Stop** to stop collecting data.
 - c. Click **Save** to save the data.

The Average Fix Tool produces an estimate of the position of the beacon position with respect to the GNSS, and the position spread. The **Average Position** and the **1DRMS** values can be compared to those produced by the CASIUS calibration.



5. Click **Create Report** to generate a report that provides the installation settings that were used, and the achieved position performance.

This report can be either used as evidence of the performance of the system following a fresh calibration, or as evidence that the existing calibration achieves the required survey performance, and so a new calibration was not necessary.

Average Fix Report



Vessel(s): Ship 1

Date/Time (UTC): 2018-03-15 16:52:22

Results:

Beacon	Eastings	Northings	Depth	Use/Reject	1DRMS	2DRMS
2501	372111.54m	5688291.47m	-1000.32m	187 / 13	2.02m/0.20%D	4.04m/0.40%D

Selected Fix Point Legs:

From	To	Minimum Fixes
Mar 14 17:27:46	Mar 14 17:31:42	200

2018-03-15 16:52:22

1 of 2

Version 6.0.0.5773

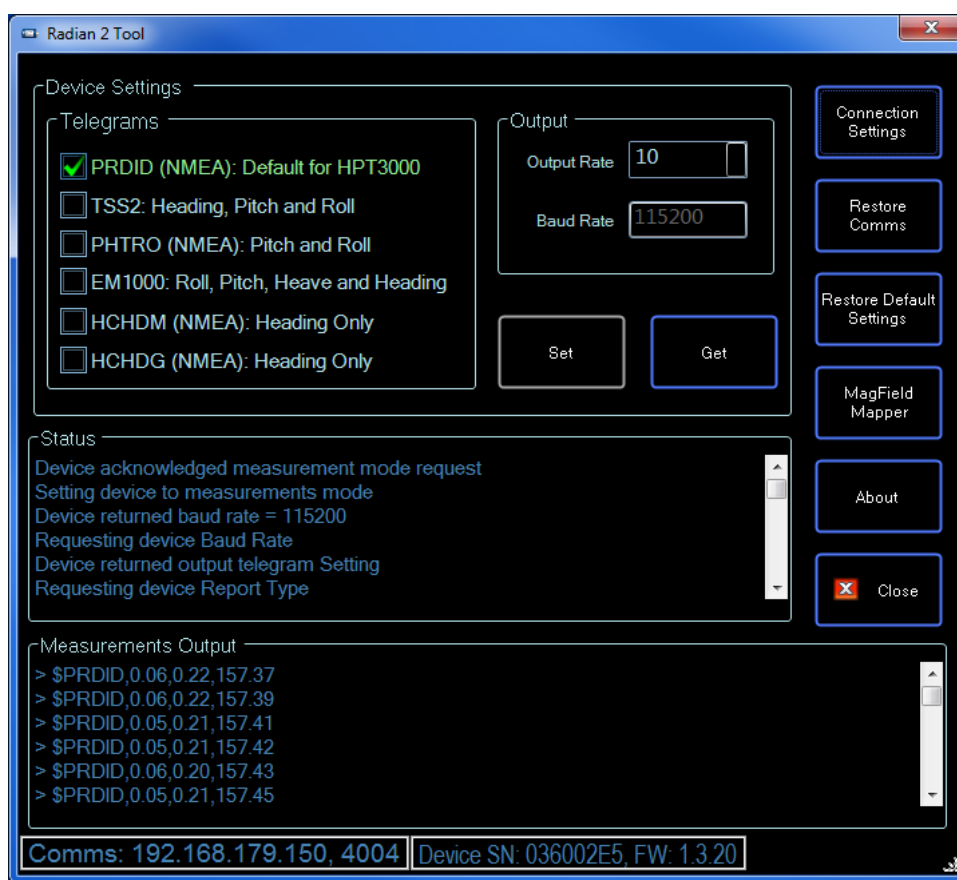
Appendix G – Radian2 Tool

G.1 Introduction

The Sonardyne Radian2 Tool can be used to configure and calibrate the HPT 2000/3000's internal attitude sensor and magnetic compass. The sensor is an Xsens MTi-30 magnetic compass which works by measuring the earth's magnetic field to determine the direction of north. A locally distorted (warped) magnetic field (caused by ferromagnetic materials in close proximity to the sensor) can result in an error in orientation that can be quite substantial. Further information on the Mti-30 sensor can be found at: www.Xsens.com.

G.2 Radian2 Tool Description

1. Click **Start>All programs>Sonardyne>Ranger2>Radian2Tool** to open the Radian2 Tool.

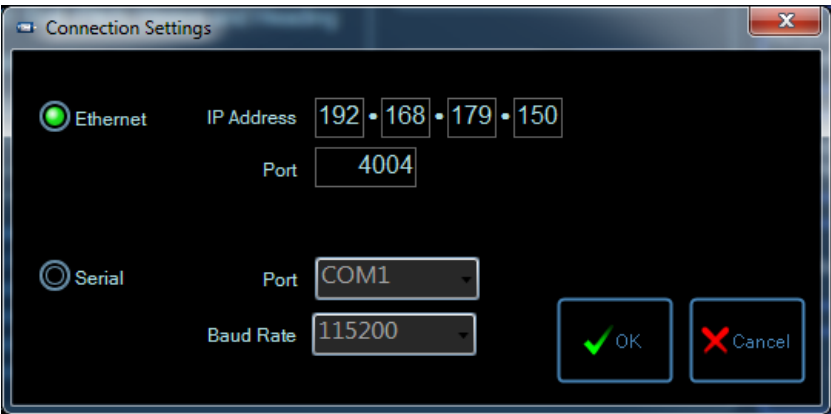


2. Click **Connection Settings** and select the **Ethernet** radio button.
3. Type the **IP Address 192.168.179.150** and **Port 4004** and then click **OK**.

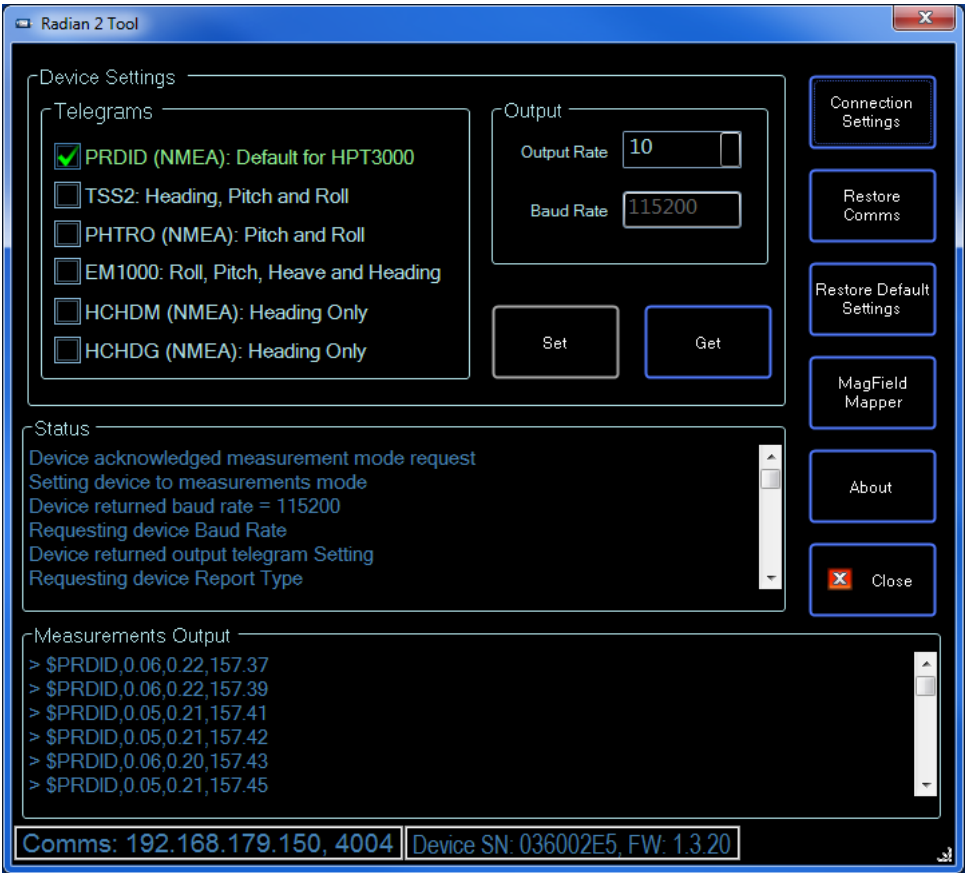
Note



When this is connected the attitude data will be unavailable in the Mini-Ranger 2 software.



The default settings are configured to work with a HPT 2000/3000 system. If the parameters are not as displayed below then the internal sensor may not perform correctly when used in Mini-Ranger 2 software.



The table below describes the button functions on the main window.

Button	Function
	Opens the Connections Setting window.
	Sends a break over a serial line to reset the unit (this is not possible using an Ethernet connection).

Button	Function
	Restores the default settings on the sensor (PRDID (NMEA) telegram at an output rate of 10 hz).
	Opens the same Magnetic Compass Calibration window that is accessed through Mini-Ranger 2 software (Tools>Advanced>Magnetic Compass Calibration) for calibrating the local magnetic field disturbances (see <i>Section G.3</i>).

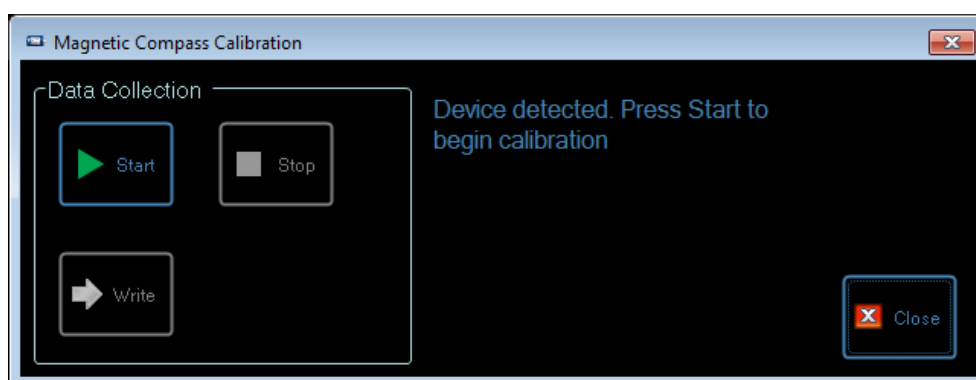
G.3 Magnetic Compass Calibration

The magnetic compass works by measuring the earth's magnetic field to determine the direction of north. A locally distorted (warped) magnetic field (caused by ferromagnetic materials in close proximity to the sensor) can result in an error in orientation that can be quite substantial.

To correct for possible disturbances it is necessary (when the HPT 2000/3000 is first deployed), click **Magfield Mapper** to run the following calibration procedure to correct for the disturbance to the magnetic field.

G.3.1 Calibration Procedure

Figure G–1 Magnetic Compass Calibration Tool

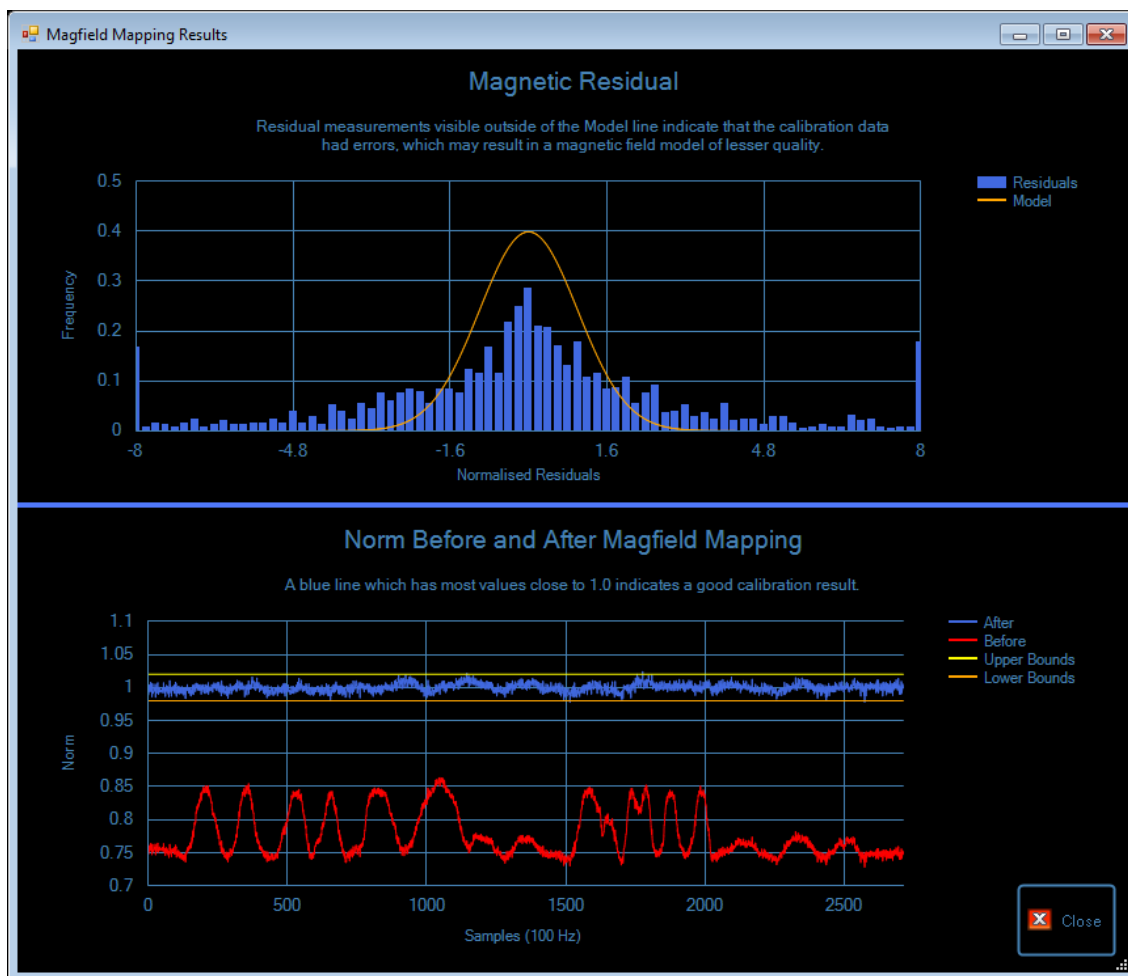


1. The device will switch to calibration mode and the tool will begin collecting data. Data collection should continue for at least two minutes, during which time, the vessel should be slowly rotated through 360 degrees.
2. Click **Stop** to end the measurement process and to start the data analysis procedure. If the tool is able to produce results from the collected data, the MagField Mapping Results form will be displayed as shown in *Figure G–2*.

G.3.2 Calibration Results

By examining of the graphs in *Figure G–2*, a judgement can be made as to the quality of the Magfield Mapping.

Figure G-2 MagField Mapping Results



G.3.2.1 Magnetic Residual

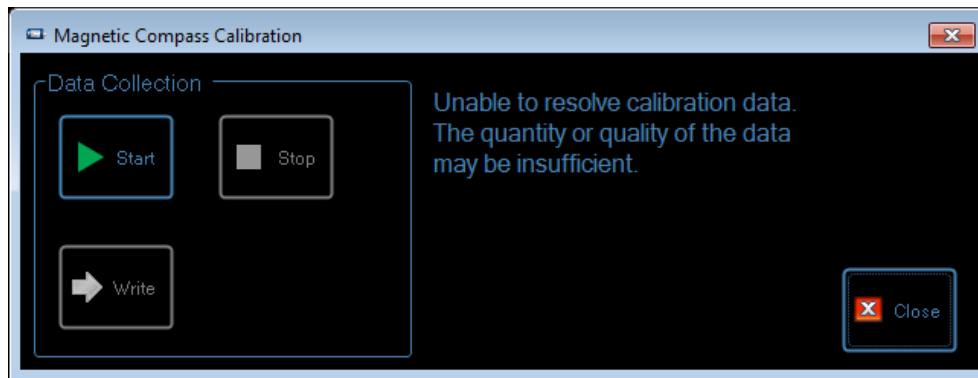
This graph shows the residuals of the corrected magnetic field vector of the measurement with respect to the new magnetic field model. If measurements are visible outside the Gaussian distribution, the collected data has errors, which may result in a magnetic field model of lesser quality.

G.3.2.2 Norm Before and After Magfield Mapping

This graph shows the norm of the magnetic field before and after Magnetic Field Mapping. The blue line should be relatively flat and close to one; ideally within narrow upper and lower limits.

If both graphs show acceptable results, the calibration process can be completed by clicking **Write**. This will update the sensor's non-volatile memory with the new correction data.

If the tool is not able to produce results from the collected data, the following error message will be displayed and it will be necessary to re-run the calibration.



G.3.3 Troubleshooting

The Magnetic Compass Calibration Tool should be pre-configured to automatically connect to the HPT 2000/3000. If the following error is displayed it will be necessary to close the tool and check all connections.

Unable to detect device. Please check the connection settings

If you encounter further problems calibrating the sensor, refer to the manufacturer's website support pages for guidance (www.xsens.com/support).

Appendix H – Frames of Reference

H.1 Introduction

When studying the relative positions and movements between two or more bodies, it is important to set and follow rules that define the references to be used for the resulting measurements. In considering these relationships for the system there are several definitions that apply:

- geographical co-ordinate frame
- local grid co-ordinate frame
- vessel body frame
- VRU or attitude sensor body frame
- gyrocompass or heading sensor body frame, and
- body frames of the system's transceivers.

In a practical, well-surveyed navigation installation, the body frames of the vessel, the gyrocompass and the VRU will align with each other, and can be considered as being the same.

This appendix explains each of the reference frames (also called co-ordinate frames) mentioned in this manual.

H.2 Geographical (World) Co-ordinate Frame

The geographical co-ordinate frame is fixed with respect to the earth's surface and aligns with the north-south, east-west and up-down directions.

Absolute positions can be defined within this co-ordinate frame by using conventional latitude, longitude and depth notations. Positions can also be defined relative to another fixed location either in Cartesian co-ordinates (through eastings and northings) or in polar co-ordinates (as an offset distance, bearing and depth relative to the reference point).

H.3 Seabed Frame

A frame with its z axis vertical and stationary with respect to the seabed is known as a seabed frame or an inertial frame. Normally, and for convenience in this reference frame, the x,y plane where $z = 0$ is at or just below the lowest point on the seabed in the area. Positions above this plane have a positive z co-ordinate or height. Depth is considered as negative height and is measured from the sea-surface or from a height close to it.

H.4 Local Grid Co-ordinate Frame

A local grid co-ordinate frame is also fixed with respect to the earth's surface, but it does not need to align with it, and can have its origin at any convenient location.

Again, it is possible to express positions within the local frame by using Cartesian co-ordinates or polar co-ordinates, with respect to a fixed location within the frame.

When using this type of reference frame, it is necessary to define the frame's origin (co-ordinate 0, 0, 0) and its orientation with respect to the geographical co-ordinate frame before it is possible to translate positions measured in the local frame into geographical co-ordinates.

H.5 Vessel, VRU and Gyrocompass Body Frames

These reference frames are fixed relative to the body to which they refer. They move and rotate relative to the geographical co-ordinate frame as the body moves.

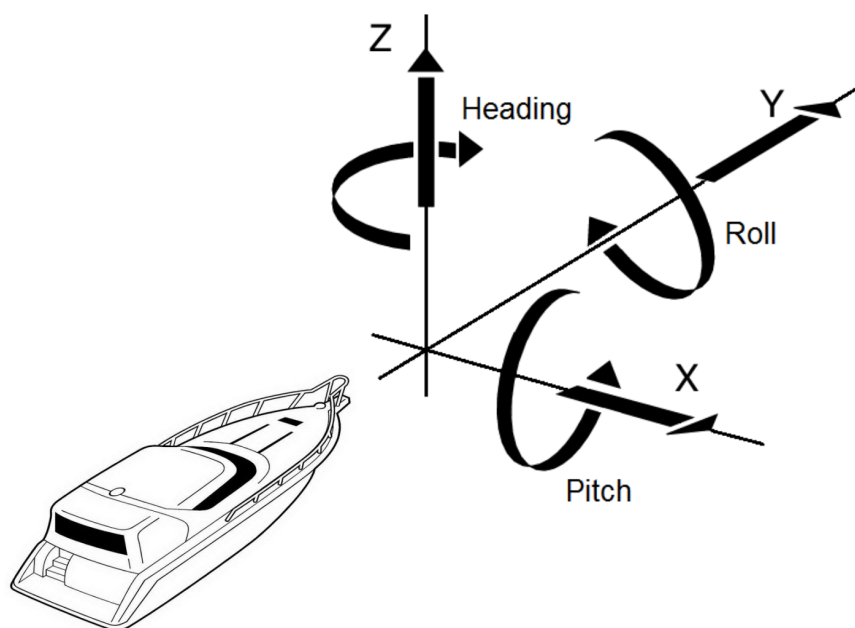
Note

 In this explanation the term 'vessel body frame' could refer equally to a surface vessel, an ROV, or any other body.

There are different conventions available to define the various body frames in use, and all are equally valid. Differences exist particularly among the manufactures of vertical reference units. These differences should have been addressed during installation so that they can be ignored for the purposes of normal system operation, but you should make yourself aware of the differences so that you can identify problems arising from incorrect corrections if they occur.

Also, during installation the various attitude and heading instruments should have been aligned with the vessel, so that their measurements are valid for the vessel and for all the various sensors installed on it. Residual misalignment between the instruments can usually be compensated for in software.

The figure below shows the convention used by Sonardyne to define the vessel body frame.



In this convention:

- The X axis aligns with the vessel's port-starboard direction, with positive co-ordinates being to starboard of the axis origin.
- The Y axis aligns with the vessel's fore-aft direction, with positive co-ordinates being forward of the axis origin.
- The Z axis aligns with the vessel's vertical, with positive co-ordinates being above the axis origin.
- Under positive Pitch rotation the Y axis rotates towards the current +Z direction.
- Under positive Roll rotation the Z axis rotates towards the current +X direction.
- Under positive Heading rotation the Y axis rotates towards the current +X direction.

H.5.1 Origins

The origin of a co-ordinate frame is the point where the X, Y and Z offsets are all zero (0, 0, 0).

The origin of the vessel frame is called the vessel's common reference point (CRP). The position of the vessel's CRP is arbitrary and can be at any convenient location on the vessel.

The origin of the vertical reference unit is usually at the centre of the internal inclinometer, at a location inside the VRU defined by the VRU manufacturer.

The origin of the gyrocompass is at the centre of the gyro, with the fore-aft direction defined by the compass lubber line.

H.5.2 Compensated frame

An RPH (Roll, Pitch and Heading) compensated vessel frame is a frame sharing the same origin as the vessel frame but with the z-axis vertical and the y-axis parallel with a meridian passing through the origin (points true north).

H.6 Transceiver Co-ordinate Frame

The system's transceiver co-ordinate frames follow the same convention described above for the vessel frame. The origin is at the centre of the transducer.

H.7 Corrections Between Co-ordinate Frames

Corrections between the transceiver and the vessel body frame are estimated by the CASIUS calibration tool. This tool uses simultaneous observations of position from GNSS, attitude from the VRU, and heading from the gyro, combined with acoustic observations from a beacon on the seabed, to estimate the alignment angles of the transceiver and its position relative to the GNSS antenna.

Appendix I – 6G Command Configuration

The following acoustic commands can be used to change the configuration of Sonardyne 6G beacons using the manual command tool.

CAUTION



These parameters should be changed with caution as incorrect commands may limit or stop the beacon communicating.

I.1 Address change

The Secure Command (SC) can be used to change the address of the beacon to alter the frequency for the operating environment. To ensure changes are only made to one instrument at a time the Unique device ID (UID) must be entered as part of the command. The UID is displayed in the Beacons Table.

<SC:2014,U1ABC,AD2013

>SC:2401,U001ABC,WKT1,HPR45,OV0,CAS0,LKD0

Where:

2014 is the address of the beacon you wish to change

1ABC is the unique device ID

2013 is the address you want to change the beacon to.

Advised address range is:

WB2: 2001 -3014

WB2+: 5201 - 6214

I.2 HPR Address change

The secure command can also be used to change the HPR address on the beacon.

<SC:2014,U1ABC,HRP78

>SC:2401,U001ABC,WKT1,HPR78,OV0,CAS0,LKD0

Where:

2014 is the 6G address of the beacon you wish to change

1ABC is the unique device ID

78 is the new HPR address you want to change the beacon to.

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J.2.6 Open Hardware Monitor V0.8.0 WinRing0

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Source code is available for download from <http://openhwaremonitor.org/>.

J.2.7 World Ocean Atlas

Contains World Ocean Atlas 2013 version 2 information.

<https://www.nodc.noaa.gov/about/disclaimer.html>

Definitions

The following tables are included in this section:

Table No	Title
Table 1	Sonardyne Abbreviations/Terms and Definitions
Table 2	Signal Processing and Communication Terms

Sonardyne Abbreviations, Terms and Definitions

Abbreviation/Term	Definition
1DRMS	Distance Root Mean Square (DRMS) is a single number that expresses 2D accuracy. 39.4% of fixes are expected to lie within 1DRMS of the true position
2DRMS	Distance Root Mean Square (DRMS) is a single number that expresses 2D accuracy. 98.2% of fixes are expected to lie within 2DRMS of the true position
6+	Sonardyne instruments that can use Wideband 3 enabling sensor data to be embedded in navigation range replies e.g. Compatt 6+
6G [®]	Sonardyne's sixth generation technology hardware platform
AAINS	Acoustically Aided Inertial Navigation System
Accelerometer	A sensor that measures changes in velocity (acceleration)
Acoustic Pinger	A specific type of "beacon" that emits signals regularly without an interrogating signal A Synchronous pinger can be synchronised to an external master signal A Precision pinger contains an accurate internal time standard
Acoustic Responder	A specific type of "beacon" that emits an acoustic signal in response to an electrical trigger signal carried to it by cable
Acoustic Signal	Sonardyne Wideband acoustic signals are discrete signals containing a carrier frequency encoded with identification information. Acoustic signals are used for purposes such as measuring the time of flight between acoustic instruments
Acoustic Synchronous Precision Pinger	See <i>Acoustic Pinger</i>
Acoustic Telemetry	An acoustic message containing data that is sent between acoustic instruments
Acoustic Transceiver	An instrument that emits and receives acoustic signals, and extracts information from them. Transceivers can measure the time it takes a signal to travel from its transducer to a transponder and return. Some can encode and send data in a message and extract digital data from a message (Acoustic Telemetry). Used on a surface vessel or to mark a point on the seabed, or fixed to a mobile vehicle for tracking or positioning
Acoustic Transducer	A device that converts electrical signals into acoustic signals and vice versa. A hydrophone is a device used to convert acoustic signals into electrical signals only Note: The term is often applied to describe a complete instrument that contains pre-amplifiers, matching networks etc.

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation / Term	Definition
Acoustic Transponder	A specific type of “beacon” that emits an acoustic signal when it detects an interrogating acoustic signal
Acoustic Transponder (Intelligent Transponder)	A transponder that is managed by a micro-controller. Examples include the COMPATT (COMPUting And Telemetry Transponder) and the WMT (Wideband Mini Transponder). Depending on supported functionality it can: - decode acoustic telemetered commands from a transceiver and can send telemetered data to the transceiver - measure the distance between itself and other transponders and then telemeter the data to a transceiver - measure its depth and the temperature of water - measure a variety of underwater parameters and telemeter these back to the surface - be used, as an intelligent angle-measuring device, in a Riser Angle Monitoring System - be fitted with a release mechanism so it can return, on command, back to the surface e.g. if battery power is low
ACPI	Advanced Configuration and Power Interface Specification providing an open standard for device configuration and power management by the operating system
Addr	The address of a local or remote instrument
AHRS	Attitude and Heading Reference System An inertial sensor that provides outputs of heading, pitch and roll
ALS	Acoustic Link Status
AMS	Autonomous Monitoring System A completely autonomous system enabling a network of monitoring transponders to be deployed over a large area for long term (3 years+) monitoring
AMT	Autonomous Monitoring Transponder
ASV	Autonomous Surface Vehicle See <i>USV</i>
AUV	Autonomous Underwater Vehicle See <i>UUV</i>
AvTrak	Acoustic navigation and communications instrument designed to form part of an integrated AUV tracking and navigation system
Beacon	The term “beacon” is a generic term that covers “transponders”, “responders” and “pingers”. The term “beacon” is used in Sonardyne documentation and in subsea positioning literature when the specific type of beacon is not important See <i>Acoustic Transponder</i>, <i>Acoustic Responder</i> and <i>Acoustic Pinger</i>
BlueComm	A wireless, subsea high-speed optical communications system
BOP	Blowout Preventer A blowout preventer is a large, specialised valve or similar mechanical device, used to seal, control and monitor oil and gas wells to prevent blowout, the uncontrolled release of crude oil and/or natural gas from a well

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation / Term	Definition
Bore-sight	The axis about which the transducer maximum power gain is being directed
Box-in	A box-in calibration combines vehicle positions and acoustic ranges to compute the position of one or more reference locations in real-world co-ordinates
CASIUS	Calibration of Attitude Sensors in a USBL System CASIUS is the Sonardyne recommended USBL calibration tool for the determination of accurate transceiver offsets (X, Y and Z) in relation to the GPS antenna and the transceiver Pitch, Roll and Heading alignment errors. It also determines accurate 'through water' sound velocity calculation
CIS	Common Interrogation Signal Multiple transponders can be set to reply to a single common interrogation signal - this can increase the efficiency of tracking operations as it reduces the number of acoustic interrogations in the water. When transponders are set to respond to a common interrogate signal they will respond on their Individual Reply Signal
COMPATT	COMPUting and Telemetry Transponder <i>See Acoustic Transponder (Intelligent Transponder)</i>
Control Hub	The Control Hub is integrated into the Micro-Range 2 portable topside case and performs a similar function to the ESH
Cordinate Frame	A reference system used to define the position of a body in space. Sonardyne use right-handed Rectangular Cartesian co-ordinate systems in three dimensions, where the three axes used are orthogonal. Co-ordinate frames are also called 'reference frames'
CPN	Computer Part Number
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRP	Common Reference Point The origin of the vessel frame is called the vessel's CRP. The position of a vehicle's CRP is arbitrary and can be at any convenient location on the vehicle
CRS	Common Reply Signal A reply signal common to a complete family of addressed transponders
CS	Configuration Status
DAS	A micro-controlled data acquisition and logging sub-assembly located within a transponder
Database	An organised collection of data stored in a computer memory or other media
dB	Decibel A logarithmic unit used to express the ratio of one value of a physical property to another, and may be used to express a change in value or an absolute value
dBV	Decibels reference to Volt dBV specifies a relative voltage level without regard for impedance and is used to measure input and output levels for electronic audio equipment 1 V = 0 dBV

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation/Term	Definition
Depth Status	The transponder can be fitted with an optional depth sensor to send depth information at each interrogation
DFE	Data Fusion Engine Acts as the system controller, generates the display signals for the monitor, processes the data from the transceiver for the display to the operator and output to a DP system talks to various "attitude" sensors and other navigation systems
DGPS	Differential Global Positioning System A differential GPS receiver uses corrections from land based receivers to compensate the signals received from satellites with a view to increasing accuracy GPS is a specific type of GNSS; see <i>GNSS</i>
Directivity Index	The ratio of the radiation intensity in the direction of interest compared with an isotropic radiator
DNV	Det Norske Veritas International accredited registrar and classification society
DORT	Deep water Oceanographic Release Transponder
DP Reference	Dynamic Positioning Reference The acoustic positioning system reports changes in the vessel position so that the DPS can maintain position
DPS	Dynamic Positioning System Automatically maintains a vessel with a constant heading, and in a fixed position without an anchor and provides more flexibility in operation Normally such a system uses a number of position inputs such as GNSS receivers, taut wire sensors, LBL, SBL or USBL acoustic positioning sensors, wind speed indicators and so on. The system controls thrusters on the vessel to maintain position and attitude in yaw
DPT	Dynamic Positioning Transponder
DSP	Digital Signal Processing The representation of signals by a sequence of numbers or symbols and the processing of these signals. DSP includes subfields like: audio and speech signal processing, sonar and radar signal processing, sensor array processing
Dual-Independent LUSBL System	Two complete sets of LUSBL equipment working in independently. The two sub-systems are usually time synchronised to prevent interference. Each system independently estimates the position of the vessel so that the output of each system can be used in the DPS
Dunker 6	An LBL and telemetry transceiver specifically designed for vessel deployment. The super duplex stainless steel housing with shock and vibration isolated electronics makes for an extremely rugged dunking system
DVL	Doppler Velocity Log Uses acoustic measurements to capture bottom tracking velocity measurements and can be used to calculate distance travelled
Dynamic Positioning Message	DP Message The message an acoustic positioning system sends to a DP system

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation/Term	Definition
EHF	Extra-High Frequency (50–110 kHz)
EMC	Electro-Magnetic Compatibility A branch of electrical engineering concerned with the unintentional generation, propagation and reception of electromagnetic energy which may cause unwanted effects such as electromagnetic interference (EMI) or even physical damage in operational equipment
EMI	Electro-Magnetic Interference A disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction (definition from Wikipedia)
ESH	Ethernet Serial Hub The ESH is the interface between the in-water acoustic instruments, sensors and the computer that runs the acoustics positioning software
False Alarm	An invalid signal which has satisfied all of the detection criteria and the detection process incorrectly declares a valid signal
False Alarm Number	Predicts the average number of possible decisions between false alarms
False Alarm Probability	The resultant probability of all the false alert probabilities
False Alarm Rate	Predicts the number of false alarms what will occur in a specified time
False Alert	An invalid signal has satisfied one detection criteria and the detection process incorrectly declares a valid signal
False Alert Rate	Predicts the number of false alerts that will occur in a specified time
FEC	Forward Error Correction A technique used for correcting errors in data transmission over unreliable or noisy communication channels
FETCH	Fetch is a long-life subsea sensor logging node that enables data to be wirelessly extracted via its integrated high speed acoustic modem
Firmware	The firmware installed in an instrument Firmware updates can be installed via 6G Terminal
Flotation Collar	Allow transponders to be deployed, moored on the seabed and then recovered to the surface
FS	Fixed Status
FTAT	Fixed Turn Around Time (320 ms)
Fusion	Long BaseLine (LBL) acoustic positioning system. Provides the most accurate method for installing subsea structures, tracking ROVs and conducting acoustic metrology
GCS	Global Command Signal
Geodetic Co-ordinates	The earth is modelled by a reference spheroid (of which there is a large selection). The position of any point on or near the earth surface is defined by an angle of latitude and an angle of longitude. For a point on the spheroid P: - Latitude is defined as the angle between the normal plane at P and the plane of the earth's equator

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation/Term	Definition
	- Longitude is defined as the angles between the meridians plane through P and the defined zero meridian plane or "Greenwich" plane (see Geodesy, fourth edition, Bomford, Oxford, sections 2.03 and 4.10(d) for more precise definitions)
GNSS	Global Navigation Satellite System A multi-user, 24-hour, worldwide radio navigation system using a constellation of satellites. GNSS receivers are capable of tracking and decoding data from the satellites and using it to compute the position and velocity of a vehicle
GNSS attitude sensor	A system based on a GNSS receiver using three or more antennas with known baselines. It is able to compute the instantaneous attitude of a vessel about the roll, pitch and yaw axes
GPS	Global Positioning System GPS is a specific type of GNSS; see <i>GNSS</i>
Gyrocompass	A north-seeking gyroscope uses the properties of a gyroscope when its spin axis is maintained horizontal. The gyroscope senses the spin axis of the earth and will align itself with true north. Precision gyrocompasses, such as that in the Sonardyne Lodestar Attitude and Heading Reference System (AHRS) use ring laser gyros, which have no moving parts
Gyro Compatt 6+	Combines a Compatt 6+ transponder and a Lodestar Attitude and Heading Reference System (AHRS)/Inertial Navigation System (INS) in a single housing
Gyro iUSBL	Combines inverted HPT USBL transceiver and a Lodestar Attitude and Heading Reference System (AHRS)/Inertial Navigation System (INS) in a single housing, usually deployed for subsea operations
Gyro USBL	Combines HPT USBL transceiver and a Lodestar Attitude and Heading Reference System (AHRS)/Inertial Navigation System (INS) in a single housing
HF	High Frequency (34–40 kHz)
Homer-Pro	Diver held positioning and relocation instrument
HPR	Hydro acoustic Position Reference A system comprising both a transmitter (transducer) and a receiver (transponder). A signal (pulse) is sent from the transducer, and is aimed towards the seabed transponder. This pulse activates the transponder, which responds immediately to the vessel transducer. The transducer, with corresponding electronics, calculates an accurate position of the transponder relative to the vessel
HPT	High Performance Transceiver
HRP	Heading, Roll and Pitch A compensated vessel frame. This is a frame sharing the same origin as the vessel frame but with the z axis vertical and the y axis parallel with a meridian passing through the origin (points true north)
IEEE	Institute of Electrical and Electronic Engineers
IIS	Individual Interrogation Signal

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation/Term	Definition
	A signal used to uniquely address a transponder, based on the transponders acoustic address
IMU	Inertial Measurement Unit
Inclinometer	An analogue device, which measures the angle of the transponder.
INS	Inertial Navigation System A navigation aid that uses a computer, motion sensors and rotation sensors to continuously calculate the position, orientation and velocity of moving object without the need for external references
IOPG	International association of Oil and Gas Producers
iRelease	A hand held instrument that interacts with a Lightweight Command Unit (LCU) acoustic transceiver to acoustically release Oceanographic Release Transponders (ORTS)
IRS	Individual Reply Signal Signal used to uniquely identify a reply from a transponder
iWand	A hand held acoustic transponder test and configuration device for use with Sonardyne's 6G product range
Janus	Quality Control and post-processing INS software for SPRINT. A simple user interface allows quick and easy data editing, post-processing and data export to enhance real time navigation
Kalman Filter	An adaptive filter what provides optimum filtering of a signal that has been subjected to a non-stationary environment (i.e. when the data is significantly changing during the filter convergence time)
LBL	Long BaseLine A system where two or more transponders are on the seabed. The positions of the transponders are established by a calibration process in a seabed frame. The distances from a transducer to each transponder are measured using a transceiver. The position of the transducer can be computed in the seabed frame. The name comes from the "baselines" joining each transponder
LCH	Lodestar Communication Hub
LMF	Low-Medium Frequency (14–19 kHz)
Lodestar	Lodestar is a combined solid state Attitude and Heading Reference System (AHRS), which is upgradable to SPRINT Acoustically Aided Inertial Navigation System [AAINS]
Lodestar-Nav	Lodestar-Nav is an all-in-one subsea navigation instrument for underwater vehicles, combining AHRS and Syrinx Doppler Velocity Log (DVL) in a single housing
LUSBL	Long Ultra Short BaseLine A hybrid of an LBL and USBL system, utilising USBL equipment in an LBL configuration
Marksman	LUSBL dynamic positioning system. Primarily suited to deep water mobile drilling units, well intervention and heavy lift construction vessels, where the system calculates position relative to a seabed deployed transponder array

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation / Term	Definition
MEMS	Micro-Electro-Mechanical-Systems
MF	Medium Frequency (19–34 kHz)
Micro-Ranger 2	USBL subsea tracking and positioning system designed for inshore shallow water applications for tracking divers, remotely operated and autonomous underwater vehicles
Mini-Ranger 2	USBL subsea tracking and positioning system designed for inshore shallow water applications for tracking remotely operated and autonomous underwater vehicles
MIR	Measure Individual Range
MR	Measure Range (TCVR + NAV)
MRAMS	Marine Riser Angle Monitoring System Used for measuring the angle between the Blow-Out Preventer (BOP) on the seabed and the Riser
MRT	Micro-Ranger Transceiver
MSR	Measure Slant Range (TCVR + NAV)
MTBF	Mean Time Before Failure A measure of how reliable a hardware product or component is
Navigation Processor	Controls the system; processes data from the transceiver into a form suitable for display to the operator and output to a DP system and interfaces to various 'attitude' sensors and other navigation systems
NSH	Navigation Sensor Hub The NSH is the interface between the in-water acoustic instruments, sensors and the Navigation Computer that runs the acoustics positioning software
NTAT	Navigation Turn-Around Time (programmable 80 to 640 ms)
OEM	Original Equipment Manufacturer OEMs are manufacturers who resell another company's product under their own name and branding
ORT	Oceanographic Release Transponder
PAN	Programmable Acoustic Navigator Acoustic transceiver dedicated to the transmission and decoding of subsea acoustic signals
PCD	Pitch Circle Diameter The diameter of the circle which passes through the centre of all the studs, wheel bolts or wheel rim holes
Pinger	See <i>Acoustic Pinger</i>
POSD	Position Data
PSU	Power Supply Unit
RAMS/MRAMS	Riser Angle Monitoring System/Marine Riser Angle Monitoring System

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation / Term	Definition
	A system used for measuring the differential angle between a BOP (Blow-Out Preventer) on the seabed and the Riser, connecting the BOP to the rig. Comprises a COMPATT type Transponder, which is normally mounted rigidly to the BOP, and an external inclinometer unit normally mounted on the Riser and connected by cable to the COMPATT. On command, the system measures the angle of the BOP with respect to the local vertical and reports this back to the surface. It can then repeat this process for the Riser using the external inclinometer
Ranger 2	USBL subsea tracking and positioning system
REL	Release Command
Remote	Commands relating to a remote instrument that are communicated via an acoustic transmission
Responder Beacon	See <i>Acoustic Responder</i>
RLG	Ring Laser Gyroscope A sensor that measures rotation
ROV	Remotely Operated Vehicle A vehicle controlled and powered by a cable connection so it can travel between the sea surface and seabed
ROVNav 6+	Remotely Operated Vehicle Navigation 6 ROVNav 6+ is a 6G® Wideband®3 ranging LBL ROV Transceiver and telemetry transceiver specifically designed for installation on work class ROVs
RPSK	Robust Phase Shift Keying.
Rx	Receive
SBL	Short BaseLine System A system where three or more transducers are fixed to a vessel and connected to a single transceiver. The position of each transducer is measured and co-ordinated in the vessel frame. By measuring the time of arrival of the signal from a beacon at each transducer the position of the beacon in the vessel frame can be computed
SC	Secure Configuration
SDM	Structure Deflection Monitoring
SENS	Sensor Measurement
Serial Communications Wait	The maximum time allowed for the Transponder to reply to an RS232 command
SI	Simultaneous Interrogation
SLAM	Simultaneous Localisation and Mapping In robotic mapping and navigation, simultaneous localisation and mapping is the computational problem of constructing or updating a map of an unknown environment while simultaneously keeping track of an agent's location within it. While this initially appears to be a chicken-and-egg problem there are several algorithms known for solving it, at least approximately, in tractable time for certain environments
SLT	Sensor Logging Transponder
SMS	Sonardyne Messaging Service

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation / Term	Definition
	Short Message Service SMS (also called texting or text messaging). Messages or 'texts' are usually sent from one mobile phone to another
SNR	Signal to Noise Ratio This is the ratio of the signal power to noise power in unit bandwidth generally quoted in dB. Effective operation requires that the strength of a transmitted signal is sufficient to be detected above the noise level at the receiver
Sonardyne	Sonardyne International Limited and its affiliates
Sonardyne Wideband®2 (WB2)	6G® transponders and transceivers use Sonardyne Wideband® 2 ultra-wide bandwidth signals giving a faster and robust transmission of data, more precise ranging and mitigation from multipath in shallow water and amongst steel structures in deep water
Sonardyne Wideband®3 (WB3)	Telemetry protocol available with 6G "+" devices that enables sensor data to be embedded in navigation range replies
Sound Speed	If seawater is at a constant temperature, salinity and pressure the speed at which sound travels in seawater is constant. Sound speed can be derived from values of conductivity, temperature and depth, or it can be measured directly using time-of-flight instruments
Sound Speed Profile	At different depths the temperature, salinity and pressure vary, so the local sound speed varies. Depth cannot be measured directly. So pressure measurements are taken, and the depth calculated, using knowledge of density and local gravity. Derivation of density requires knowledge of temperature and salinity. Salinity cannot be measured directly but conductivity can be measured. A method of measuring the sound speed profile is from a profile of pressure, temperature and conductivity and a formula to compute depth and sound speed
Sound Velocity	The speed with which sound pressure waves propagate through water. Sound velocity varies with properties such as water temperature, salinity and pressure. This is a core parameter in the accurate operation of acoustic positioning systems
Sound Velocity Profile	Variations of sound velocity with water depth caused by varying temperature, salinity and pressure In practice the depth cannot be measured directly. Therefore pressure measurements are made, and depth computed, using a knowledge of density. Derivation of density requires a knowledge of temperature and salinity. Salinity is measured indirectly through a measurement of water conductivity. Therefore a popular method of measuring the sound velocity profile is from a profile of pressure, temperature and conductivity and the use of empirically derived formulae to compute depth and sound velocity Sound velocity can be measured directly using a dedicated and calibrated instrument called a sound velocimeter, although it is still necessary to have the relevant depth measurements available

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation /Term	Definition
Spread Spectrum	Spread-spectrum techniques are methods by which a signal (e.g. and electrical, electromagnetic, or acoustic signal) generated in a particular bandwidth is deliberately spread in the frequency domain, resulting in a signal with a wider bandwidth. These techniques are used for a variety of reasons, including the establishment of secure communications, increasing resistance to natural interference and jamming, to prevent detection, and to limit power flux density
SPRINT	Subsea Precision Reference Inertial Navigation An Acoustically aided inertial navigation system for subsea vehicles. The system extends the operating limits of USBL and improves the operational efficiency of LBL by using sparse arrays
SPRINT-Nav	Subsea Precision Reference Inertial Navigation Technology-Navigation SPRINT-Nav is an all-in-one subsea navigation instrument for underwater vehicles, combining Sonardyne's SPRINT INS sensor and a Syrinx Doppler Velocity Log (DVL) in a single housing
SSM	Super Sub-Mini Transponder (WSM predecessor)
Submersible	A vehicle that operates below the sea surface and can carry a pilot and other personnel in a one atmosphere environment. It carries a supply of air for life support, and power for propulsion and other demands. It is capable of operating autonomously away from its support vessel for a limited time
Syrinx DVL	Syrinx Doppler Velocity Log A Doppler Velocity Log (DVL) for surface and subsea vehicle navigation
Target	Object to be tracked by an acoustic system
TAT	Turn-Around Time; see <i>NTAT</i>
TCP	Transmission Control Protocol A connection-oriented, reliable protocol to exchange data between networked hosts (e.g. computers). TCP is used extensively by many applications available by internet, including the World Wide Web (WWW), E-mail, File Transfer Protocol, Secure Shell, peer-to-peer file sharing, and streaming media applications
TCVR	See <i>Acoustic Transceiver</i>
TPDR	See <i>Acoustic Transponder</i>
Transceiver	See <i>Acoustic Transceiver</i>
Transducer	See <i>Acoustic Transducer</i>
Transponder	See <i>Acoustic Transponder</i>
True North	The direction of the shortest line that can be drawn, across the surface of the earth, from the observer and the north pole
Tx	Transmit
UDP	User Datagram Protocol
UID	Unique ID Number Each product contains a unique 24 bit address electronically coded into the firmware. It is denoted by 6 hexadecimal characters
ULB	Underwater Locator Beacon

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation / Term	Definition
	A beacon that emits a "ping" to enable location such as an aircraft black box recorder (aircraft black box recorders normally operate on 37.5 kHz)
USBL	Ultra-Short BaseLine A system similar to an SBL system except the system uses three or more elements in a single transducer array. The measurements it makes are the differences in "time-phase" of the signals from each element. The co-ordinate frame is fixed to the transducer array which must be oriented in the vessel frame to the equivalent to the SBL
USV	Unmanned Surface Vehicle A vehicle that operates on the surface of the water without a human occupant Also referred to as an Autonomous Surface Vehicle (ASV)
UTC	Universal Time Co-ordinate The primary time standard by which the world regulates clocks and time. Closely related successor to Greenwich Mean Time (GMT)
UTM	Universal Transverse Mercator A projection system that is used to transform geodetic co-ordinates into an orthogonal two dimensional system suitable for representation on a plane such as a chart
UUV	Underwater Unmanned Vehicle A vehicle that operates under the surface of the water without a human occupant Also referred to as an Autonomous Underwater Vehicle (AUV)
VRG	Vertical Reference Gyroscope A gyroscopically stabilised VRU
VRU	Vertical Reference Unit Measures the instantaneous roll and pitch of a vessel. The origin of the VRU is usually at the centre of the internal inclinometer at a location inside the VRU defined by the VRU manufacturer
VS	Volatile Status
WDT	Watch Dog Timer count A watchdog timer is a piece of hardware that is used to detect any software anomalies and asserts a processors reset signal A watchdog timer, in general is a counter that counts down from some initial value, set by an embedded software, to zero. The counter's initial value is periodically restarted by the embedded software If the counter reaches zero before the software restarts it, the embedded software is presumed to be malfunctioning and the processor's reset signal is asserted
Wideband [®] 2 (WB2)	6G transponders and transceivers use Sonardyne Wideband 2 ultra-wide bandwidth signals giving a faster and robust transmission of data, more precise ranging and mitigation from multipath in shallow water and amongst steel structures in deep-water
Wideband [®] 3 (WB3)	Telemetry protocol available with 6G "+" devices that enables sensor data to be embedded in navigation range replies

Sonardyne Abbreviations, Terms and Definitions (continued)

Abbreviation / Term	Definition
WRT 6	Wideband Release Transponder 6
WSM	Wideband Sub-Mini Transponder
WSM 6+	Wideband Sub-Mini Transponder 6 Plus
Yaw (Heading)	Twisting or oscillation of a moving ship about a vertical axis

Signal Processing and Communication Terms

Term	Definition
Bore-Sight	The axis about which a transducer's maximum power gain is being directed.
Capture Area	The effective aperture size of the array. It is directly related to the array gain.
Carrier-to-Noise Density	The ratio of the signal power (C) to noise power (No) in unit bandwidth (C/No); generally quoted in dBHz.
Directivity Index	The ratio of the radiation intensity in the direction of interest compared with an isotropic radiator.
False Alarm	Occurs when an invalid signal has satisfied all of the detection criteria and the detection process incorrectly declares the presence of a valid signal.
False Alarm Number	Prediction of the average number of possible decisions between false alarms.
False Alarm Probability	The resultant probability of all the false alert probabilities.
False Alarm Rate	Prediction of the number of false alarms that will occur in a specified time.
False Alert	Occurs when an invalid signal has satisfied one detection criterion and the detection process incorrectly declares the presence of a valid signal.
False Alert Rate	Prediction of the number of false alerts that will occur in a specified time.
Front-to-Back Ratio (for a transducer)	The ratio of power transmitted in the forward hemisphere of the transducer's polar diagram to that transmitted in the reverse hemisphere of the polar diagram.
Kalman Filter	An adaptive filter that provides optimum filtering of a signal that has been subjected to a non-stationary environment (that is, when the data is changing significantly during the filter convergence time).
Least Squares (LSQ)	Used to generate a raw estimate of position based on a single set of measurements. The solution computed minimises the sum of the squares of the differences between the measurements and their estimates based on the solution. Each solution is independent of those that were computed from previous sets of measurements, and so is vulnerable to the effect of undetected errors in the current set of measurements.
Middleton Noise	This noise is impulsive in nature and is described by a Middleton probability density function. The three classes of noise description are A, B and C: Class A: Typically narrower spectrally than the receiver bandwidth in question and, as such, generates ignorable transients in the receiver's front end (initial linear stages) when source emission terminates. Class B: The bandwidth of the incoming noise is larger than that of the receiver's front end stages, so that transient effects occur both in the build up and in the decay; the latter predominates. To varying degrees, the receiver is 'shock excited', particularly for inputs of very short duration; the receiver is said to 'ring'. Class C: The sum of Class A and Class B interference.

Signal Processing and Communication Terms (continued)

Term	Definition
Rayleigh Fading Channel	The fading characteristics of the propagating channel are in accordance with a Rayleigh Probability Density function. Such a channel does not support constant signals. The phase of the signal is uniformly distributed between 0 and 2 radians.
Rayleigh Probability Density Function	A Rayleigh Probability Density function is the instantaneous vectorial addition of two independent zero mean-time variant Gaussian processes. The phase of the resultant vector is uniformly distributed between 0 and 2 radians.
Rician Fading Channel	The fading characteristics of the propagating channel are in accordance with a Rician Probability Density function. Such a channel does support a constant signal level. Associated with this signal is a non-coherent Gaussian signal of lower strength.
Rician Probability Density Function	A Rician Probability Density function is the instantaneous vectorial addition of two independent zero mean-time variant Gaussian processes where one of the designated signal vectors is not only consistently larger than the other but remains so during the observation time.
Translinear Mode	The system operates in linear mode for signals within specified dynamic range. Once the input signal level is larger than the upper limit set by the input dynamic range, hard limiting occurs.

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