UM-8068

User Manual for Ranger USBL System

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1 About This Manual

In this section...

This section contains the following sub-sections:

1.1 Purpose

This manual is for the Sonardyne Ranger USBL System. It provides important information concerning the installation and use of the Ranger USBL hardware and software, and offers advice on how to operate Ranger effectively during a USBL survey.

Electronic manual

This manual is supplied electronically as a PDF file, which allows easy navigation among related topics through hyperlinks, and supports the ability to search for words, optionally using advanced features such as ‘word stemming’ and ‘sounds like’. The manual also includes a more conventional index and table of contents.

If required, you can print any part of the manual. However, you cannot select, copy, or change any part of it. Copyright in this manual remains with Sonardyne International Limited at all times.

1.2 How this manual is arranged

This manual is arranged in a series of sections and appendices, each of which covers a major topic:

Section 1 "About This Manual" begins on page 1

Section 1 is about this manual and explains what it contains, who should read it, and how to use it. Section 1 also explains the conventions used throughout this manual.

Section 2 "Ranger USBL System Overview" begins on page 5

Section 2 describes the Ranger USBL System and explains how the sub-systems operate together for USBL navigation applications. Section 2 also explains the purpose of additional sub-systems, available from other manufacturers, that can be used with the system.

Section 3 "System Installation" begins on page 20

Section 3 provides installation instructions and advice for each of the hardware sub-systems of the overall Ranger USBL System, and explains how to interconnect them.

Section 4 "Software Installation" begins on page 34

Section 4 describes how to install the Ranger USBL software on the Navigation Computer if this operation ever becomes necessary.

Section 5 "Ranger Software Overview" begins on page 38

Section 5 describes the Ranger software installed on the Navigation Computer.

Section 6 "Software Configuration" begins on page 47

Section 6 explains how to configure the Ranger USBL software for use with the transceiver and with external Instruments and sensors. It also explains how to set important parameters within the software, such as the speed of sound.

Section 7 "Software Operation" begins on page 72

Section 7 explains how to use the software for tracking and data logging during a USBL survey operation. It introduces the various tools provided by the software, and explains when to use them. This section also explains the need for performing a system calibration before you start to acquire and record survey data.

Section 8 "Calibration" begins on page 78

Section 8 explains how to perform static and dynamic 'CASIUS' calibration procedures on the Ranger USBL System, and suggests a pattern of vessel manoeuvres that support these operations.

Section 9 "Frequently Asked Questions" begins on page 89

Section 9 includes some frequently asked questions on the subjects of interfacing, configuration, and tracking; and provides some guidance and answers to these questions. If you experience any difficulties in these areas with the Ranger USBL System, check whether there is any information to help you in this section first.

Section 10 "Troubleshooting" begins on page 90

Section 10 provides some guidance relating to fault finding and reporting software problems in the Ranger USBL System. You should refer to this section before you call on technical support from Sonardyne International Limited, so that you can supply a full description and other details relating to the problem. This section also provides contact information for Sonardyne's global support network.

Appendix A "USBL Theory of Operation" begins on page 95

Appendix A provides a simplified theory of operation for USBL systems, and explains the significance of depth aiding for enhancement of the navigation solutions.

Appendix B "Frames, Offsets and Corrections" begins on page 103

Appendix B gives an explanation of the conventions used for measuring linear offsets between the USBL transceiver, the Common Reference Point (CRP), and the sensors and Instruments associated with the Ranger USBL. It also explains the rotation conventions used when considering angles of roll, pitch and heading.

Appendix C "Navigation Control Unit Interface Cables" begins on page 108

Appendix C includes details of the various interface cables to be used with the Type 8020 Navigation Control Unit (NCU). The cables supplied will depend on the interface modules installed in the NCU and on the interface cable configuration required for the USBL transceiver.

Appendix D "Software Tools" begins on page 119

Appendix D describes the various software tools provided by the Ranger software in detail, and explains how to use them and interpret their results.

Appendix E "Report Formats" begins on page 132

Appendix E lists the various data telegram formats available for use as inputs to the Ranger USBL System and as outputs from it.

Appendix F "MRAMS" begins on page 149

Appendix F contains information on the configuration, calibration and operation of the Marine Riser Angle Monitoring function

Appendix G "Simulation" begins on page 158

Appendix G contains information on the configuration, and use of the integrated simulator.

Appendix H "Analogue VRUs" begins on page 160

Appendix H contains important information and warnings that should be considered when using analogue VRUs.

Who should read this manual

This manual should remain available for electronic or hard-copy access by anyone who has any involvement with the Ranger USBL System. All users of the system should ensure they read the relevant sections. If you have a printer connected to the computer that holds this electronic manual, you can print any part of it.

Updates to the manual

The electronic files for this manual are installed automatically when you install the Ranger software on a computer.

If necessary, contact Sonardyne International Limited to check whether you have the latest revision of the manual, or to request printed copies. The document reference number for this manual is **UM-8068** and this is issue **A - Rev 5**.

1.3 Conventions used in this manual

To help you use this manual we have adopted certain conventions throughout.

CAUTION

Cautions alert you to hazards that could cause damage or file corruption on the computer that you use to run Ranger, or to equipment connected to it, and give instructions to reduce or eliminate those risks.

You MUST follow these instructions.

Note

Notes provide additional or background information that you may find useful.

1.4 Navigating the manual

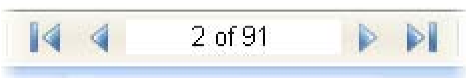
The electronic version of this manual is a PDF file read using Adobe® Acrobat® Reader. Acrobat Reader provides a number of features to help you navigate through the manual, and to find the information you are looking for conveniently.

Note

You will not be able to use the electronic version of this manual unless the computer on which it is installed has the Adobe Acrobat Reader software installed. Visit the Adobe website www.adobe.com to download the Reader software if necessary.

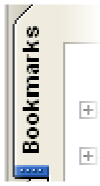
Navigation buttons

- You can use the Acrobat navigation buttons to move to the beginning or the end of the manual, or forwards and backwards by a single page. You can also click the page number field and type the number of the page you wish to see.



Bookmarks

- You can click on a section or sub-section title listed in the **Bookmarks** tab to the left-hand side of the Acrobat screen. Alternatively, you can select the **Pages** tab and then click on one of the page thumbnails to take you to that page.

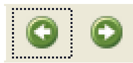


Links

Throughout the manual you will find cross-references that refer to section or sub-section titles, page numbers, figures or tables. For example "See "Navigating the manual" on page 3." These are hyperlinks. When you hover the mouse pointer over them in Acrobat, the pointer changes to a pointing finger. Click on the link with the mouse to jump to the relevant location in the manual.

The Table of Contents, Table of Figures, Table of Tables, and Index sections all include hyperlinks to the locations listed. Click on the listed page number to make the jump.

Click on the **Previous View** or the **Next View** button to go backwards or forwards through the sequence of pages you have already viewed.



Slider control

You can click and drag the button on the vertical slider at the right-hand side of the display to move forwards and backwards through the pages.

Search

Acrobat Reader includes a powerful facility to find specific words in the text. Click the **Search** button and then type the word that you need to find. The software will then display the first occurrence of that word after the current location.

Hold the **[Ctrl]** key and press **[G]** to find the next and subsequent occurrences of the search word.

Printing

You can print part or all of the manual if you wish. To do this, choose **File** > **Print** from the Acrobat menu bar.

2 Ranger USBL System Overview

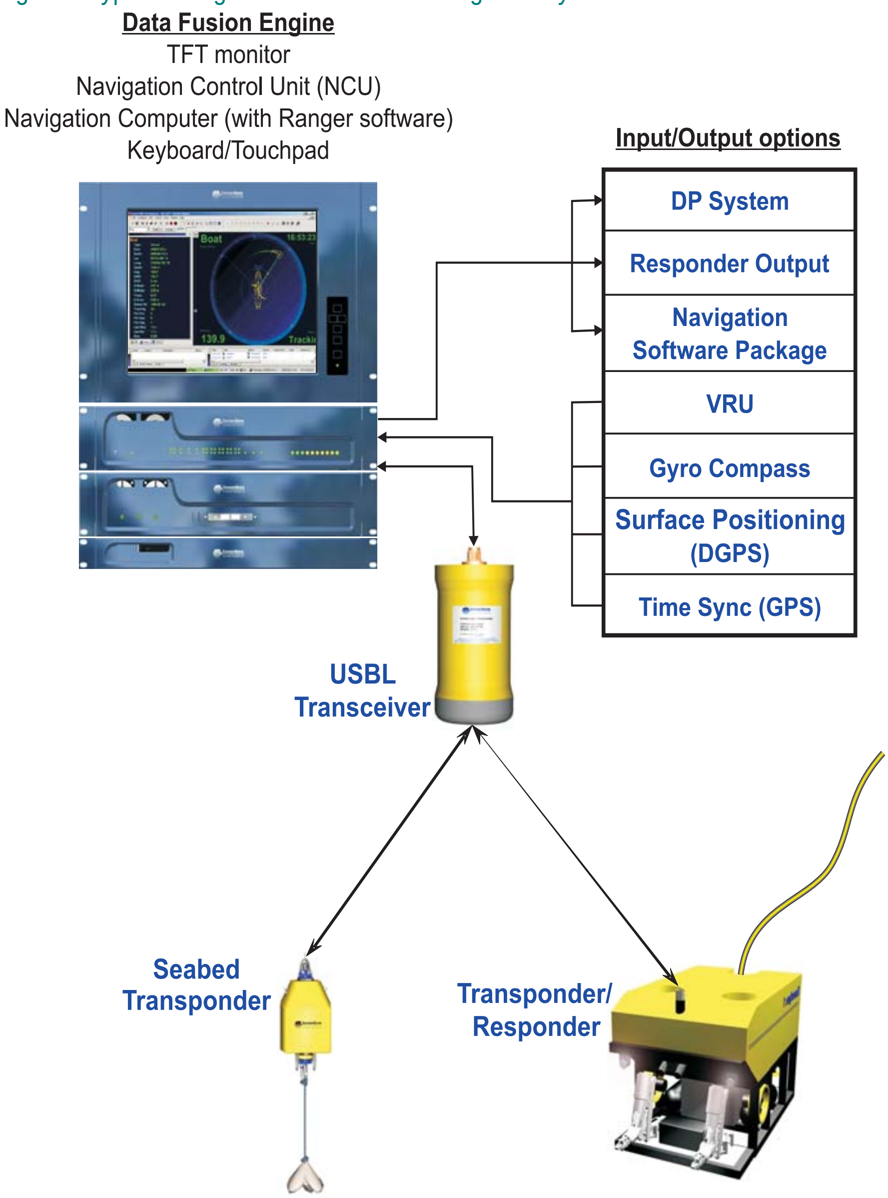
In this section...

This section contains the following sub-sections:

2.1 Introduction

This section explains what is included as standard with the Ranger USBL System, and what auxiliary sub-systems, Instruments and sensors can be used with the system.

Fig 1 Typical Ranger USBL Acoustic Navigation System



2.2 Ranger USBL System Overview

The Ranger USBL System comprises four main components:

1. a rack-mountable or portable Data Fusion Engine
2. the Ranger control software
3. an acoustic transceiver, and
4. the seabed- or vehicle-mounted transponder or responder units.

Data Fusion Engine

The Data Fusion Engine is an integral PC and acoustic processor running the Ranger software, and is the central component of the overall Ranger USBL System. Its design incorporates all the on-board hardware requirements of a USBL system, making it unnecessary to install and set-up separate systems to support the requirements of different acoustic positioning operations.

As your requirements for USBL functionality expand, the Data Fusion Engine will allow you to upgrade the Ranger system through to a deep-water Fusion USBL system or to a Fusion LBL system that can undertake complex sub-sea construction survey tasks.

Refer to section 2.3 “Data Fusion Engine” beginning on page 8 for more information about the Data Fusion Engine.

Navigation Control Unit

The Navigation Control Unit (NCU) provides the interface between the acoustic instruments, the external sensors, and the Navigation Computer. In addition to providing the power and communication connections for ship-borne acoustic transducers, the NCU accurately time-stamps incoming data from external Instruments such as GPS receivers, Vertical Reference Units (VRUs), and gyrocompasses.

Refer to “Navigation Control Unit” beginning on page 8 for more information about the NCU.

Navigation Computer

The Navigation Computer is a powerful, purpose-built PC running the Ranger software. It is used with the NCU to provide the user interface, system control, and logging features of the Ranger USBL System.

Refer to “Navigation Computer” beginning on page 9 for more information about the Navigation Computer.

Ranger Control Software

The Ranger USBL control software provides a condensed range of the primary features required for USBL operations and, as a result, is very easy to operate with only minimal training and familiarisation.

Tools and utilities

Although designed around the need for simplicity, the Ranger software includes a set of tools that you can use to optimise your USBL system’s performance. These tools include a utility to measure acoustic noise; a signal analyser to assess the transponder signal quality received by the transceiver; and a tool to measure distances on the Chart display. Refer to Appendix D “Software Tools” beginning on page 119 for a description of Ranger’s tools.

The software also includes Sonardyne’s CASIUS calibration tool, so that you can correctly calibrate and compensate for gyrocompass and VRU offsets and improve positioning accuracy. Refer to section 8 “Calibration” beginning on page 78 for a description of the calibration procedure.

Transceivers and targets

During set-up, the Ranger software automatically identifies the type of transceiver connected to the system and configures it automatically. When operating, the software allows you to simultaneously track up to four sub-sea targets as standard.

After configuration, you can select and deselect individual sub-sea target transponders for use in tracking, with a simple mouse click.

If a power failure occurs during tracking, the Navigation Computer will re-start automatically on power restoration and will continue to track the transponder it was tracking before the power failure occurred.

For advanced tracking up to ten targets (with the advanced software pack) using the maximum update rate, the Ranger USBL System uses Sonardyne's exclusive 'ping-stacking' technology, which was developed originally for operations in very deep water. This technique allows the system to transmit acoustic interrogations to transponders before it receives their previous reply.

Inputs and outputs

The Ranger software can accept multiple inputs from heading, attitude, and position measurement Instruments and sensors connected to the NCU, and supports any industry-standard Dynamic Positioning (DP) output telegram format.

System monitoring

A key feature of the Ranger software user interface is that it allows you to assess the overall system operation and performance easily, using simple colour-coding of displayed information to indicate its accuracy, validity or reliability. This feature extends to showing the operational status for all the system's inputs and outputs.

Refer to section 5 "Ranger Software Overview" beginning on page 38 for more information about the Ranger software and for instructions to use it.

Ranger USBL Transceivers

Ranger software works with Sonardyne's Type 8021, Type 8023 and Type 8024 transceivers, which support the majority of USBL operational requirements.

Refer to section 2.4 "USBL Transceivers" beginning on page 11 for more information about these transceivers.

Mounting arrangements

The performance of any USBL system depends heavily on the mounting arrangements used for the transceiver. Sonardyne has considerable experience in this area, both with 'through hull' and 'over-the-side' deployment, and can help you to choose the best solution for your specific requirements.

Transponders

Wideband Sub-Mini

The Wideband™ Sub-Mini (WSM) is a compact, rugged transponder/responder designed primarily to position ROVs, towfish and other small mobile targets.

It is available as a 1000 metre rated omni-directional unit, or as a 3000 metre rated directional unit. WSMs have the option of a depth sensor to improve positioning accuracy.

DP transponder

The Dynamic Positioning Transponder (DPT) is a full-sized transponder designed specifically for seabed deployment or large target tracking.

It is available in 3000 metre rated omni-directional or directional units.

DPTs have a simple on/off switch, and can be equipped with a rugged spring-assisted release mechanism, depth sensors, and advanced power and gain controls if required.

Refer to section 2.5 "Transponder Beacons" beginning on page 14 for more information about these transponder types.

2.3 Data Fusion Engine

The Data Fusion Engine comprises the Navigation Control Unit and the Navigation Computer running Ranger software under a Microsoft® Windows™ XP operating system.

Navigation Control Unit

The Navigation Control Unit (NC) provides the interface between acoustic transceivers, external Instruments and sensors, and the Navigation Computer on which the Ranger software operates.

The main functions of the NCU are to:

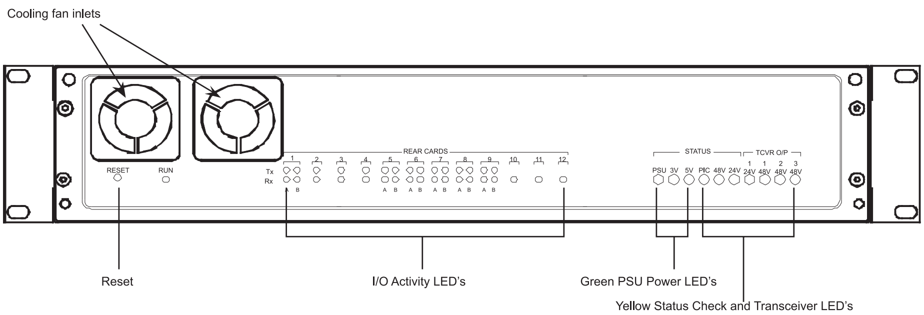
- provide a power, RS232, RS485, and current-loop serial communications interfaces for ship-borne acoustic transceivers
- provide responder beacon triggers
- provide external trigger capture, such as a 1PPS signal from GPS
- provide an analogue VRU interface
- provide a synchro gyrocompass interface, and
- attach an accurate time-stamp to data arriving from external sources such as Vertical Reference Units (VRUs), gyrocompasses and GPS receivers.

Options

Sonardyne offers a range of plug-in hardware interface cards for use with the NCU, to allow the specific system to be used with alternative Sonardyne transceivers and external Instrument and sensors.

Front panel features

Fig 2 Navigation Control Unit front panel

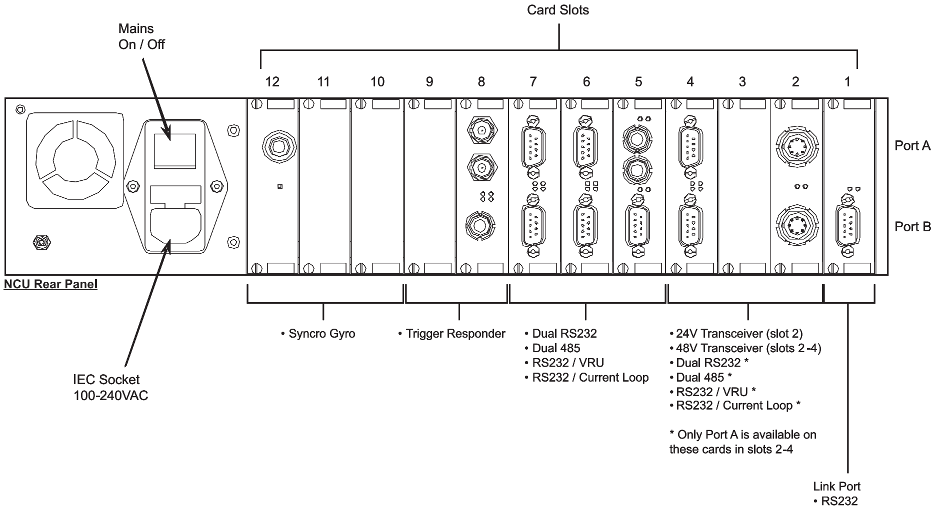


The front panel of the NCU houses the following:

- Chassis fans for internal cooling.
- Reset button.
- Indicator LEDs:
  - Twelve Tx/Rx rear-card LEDs to monitor all I/O activity through the rear-mounted interface cards.
  - Three green LEDs to confirm that the power supply unit (PSU) is receiving electrical power, and that the 3.3V and 5V DC power supplies are available for use in the NCU.
  - Three power-rail status LEDs to confirm that power rails are at the correct operating voltage and current.
  - Four transceiver output power LEDs to confirm that the transceiver power supplies are at the correct operating voltage and current.

Rear panel features

Fig 3 Navigation Control Unit rear panel features for a typical configuration



The rear panel of the NCU houses the following:

- Connectors (in Slot 1) for:
    - RJ-45 10BASE–T Ethernet.
    - Serial interface to the Navigation Computer.
- On/Off switch for the mains electrical power.
- IEC inlet socket for connection of mains electrical power in the range 100 to 240V 6.3A 50 to 60Hz.
- Cooling fan inlet for the electrical power supply.
- Transceiver communications and power output connector for 24V (Slot 2) and 48V DC (Slots 2 to 4).
- Specific interface cards for transceivers and sensors (Slots 5 to 12).

Interface cards

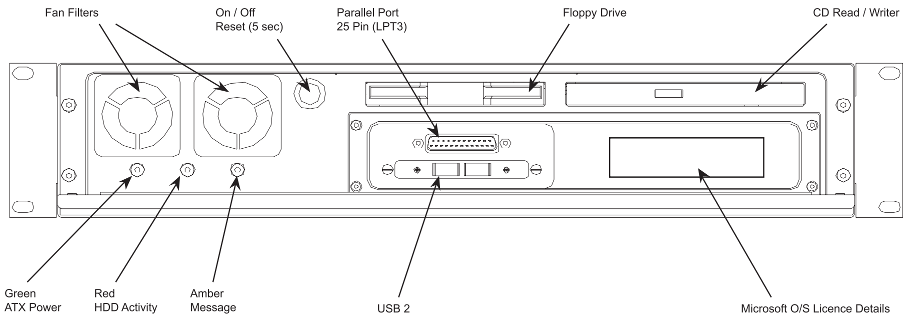
Table 8 on page 24 lists the types of interface cards that you can fit to the expansion slots on the rear panel of the NCU, together with the associated pin-out details.

Navigation Computer

The Navigation Computer is a PC purpose-built specifically for use with the Sonardyne Navigation Control Unit. It has been optimised to run Sonardyne's range of Fusion USBL, LBL and Ranger software applications.

Front panel features

Fig 4 Navigation Computer—Front-panel view



The font-panel of the Navigation Computer, shown in Fig 4, has the following main features:

- CD–RW drive.
- 3½–inch disk drive.
- Connectors:
    - Two 4-pin USB 2.0 ports.
    - Single parallel port for the front-mounted software security key.

Note

Sonardyne recommends that, when using 25-pin parallel port security key, you always connect the key to the parallel port LPT1 on the rear-panel of the Navigation Computer rather than to LPT3 on the front-panel.

- A power and reset button to power-on the system. The button also acts as a system reset button if held pressed for five seconds.
- Three LED system status indicators:
    - A green system power LED that illuminates when the system power is ON, and is extinguished when system power is OFF. The LED flashes green when the system is in Sleep mode.
    - A red hard-disk LED illuminates when the hard disk drive (HDD) is actively reading or writing data.

CAUTION

Switching off system power when the hard disk is reading or writing data can cause damage to the hard disk or corrupt data. Do not switch off system power when the hard disk indicator LED is illuminated.

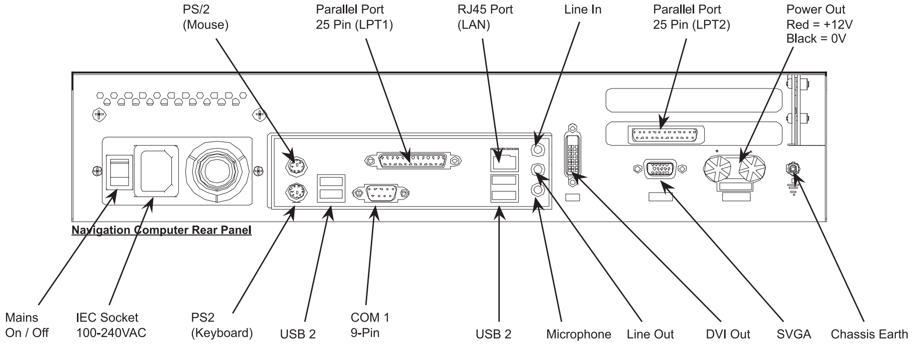
- An amber system manager indicator LED that flashes when data is being received from a modem.
- The Microsoft® XP Operating System (OS) licence.
- The Microsoft® Original Equipment Manufacture (OEM) licence details affixed to the Navigation Computer's front-panel.

Note

This licence is not transferrable to another computer.

Rear panel features

Fig 5 Navigation Computer—Rear-panel view



The rear-panel of the Navigation Computer, shown in Fig 5, has the following main features:

- Two PCI expansion card slots on a riser, of which one is free.
- Connectors:
  - Two PS/2 type 6-pin mini-DIN connectors—green for the mouse connector and purple for the keyboard connector.
  - Two25–pin parallel ports.
  - One 9-pin D-type serial port—COM1. This is UART 16550 compatible.
  - Audio connectors—Line In, Line Out, and microphone.
  - Four 4-pin USB 2.0 ports.
  - RJ-45 connector for Ethernet LAN.
  - Digital Video Interface (DVI) port for an external TFT monitor.
  - SVGA port

Note

Two SVGA monitors can be connected to the Navigation Computer and can be configured either as a single desktop display and repeater, or as two separate displays with the desktop extended across both.

  - Chassis ground.
- Rocker type ON/OFF power switch for electrical power.
- IEC inlet socket for connection of mains electrical power in the range 100 to 240V 6.3A 50 to 60Hz.
- Cooling fan inlet for the electrical power supply.
- 12V DC power output terminals to supply power for a flat screen monitor.

Ranger control software

Refer to section 5 “Ranger Software Overview” beginning on page 38 for a description of the Ranger control software that operates on the Navigation Computer.

2.4 USBL Transceivers

CAUTION

Sudden mechanical shocks will damage a transceiver's internal transducer elements and inclinometer components irreparably. Do not drop transceivers or subject them to sudden shock.

Always remove the protective transducer guard before you deploy the transceiver, and fit it again if possible on completion of operations.

Transceiver types

USBL transceivers are available in a variety of sizes for use in different environments and applications. Typical USBL transceivers supplied with the system can be the standard Type 8021, with or without a tilt adapter; the Type 8023 ‘Big Head’ transceiver; or the Type 8024 ‘Scout’ transceiver.

These digital ‘plane array’ transceivers are the latest designed by Sonardyne, and are distinguishable from earlier, analogue transceivers by their yellow casings. They support the use of modern broad-band spread-spectrum signals and provide improved noise immunity, increased dynamic range and greater accuracy.

Key features

Key features of these transceivers include:

- Support for Tone and Wideband ranging and telemetry.
- Can be used as transceivers for all LBL operations.
- Remote firmware upgrade capability through a serial interface.
- Non-Sonardyne frequencies supported—AODC.
- Tilted array adapter available—does not increase the transceiver diameter for through-hull deployment.

Type 8021

Fig 6Type 8021 Transceiver

The Type 8021 transceiver, shown in Fig 6, has a hemispherical pattern of acoustic coverage while continuing to ensure rejection of vessel noise. It allows tracking of targets below and to either side of the vessel, and is suitable for a wide variety of survey tasks such as towfish tracking and ROV positioning.

Type 8023

Fig 7Type 8023 Transceiver

The Type 8023 transceiver is optimised to receive signals arriving within a ±50° acoustic cone. Any noise generated outside this cone, for example by thrusters, is attenuated so that the signal-to-noise ratio (SNR) and therefore the positioning accuracy are both improved. Tests have proved that this allows accurate positioning when using the noisiest of vessels.

On quieter vessels, the effects of the acoustic cone make possible even greater operating depths.

Type 8024

Fig 8Type 8024 Transceiver

The Type 8024 ‘Scout’ transceiver has a lightweight aluminium housing that is easy to install for over-the-side or through-hull deployment. It offers high performance and has an integrated roll and pitch sensor, and a magnetic heading sensor.

Transceiver specifications

Table 1 below lists the specifications for the Types 8021, 8023 and 8024 transceivers. Note that, in this table, conversions to imperial measurements are rounded.

Table 1 Transceiver specifications

Detail	Type 8021	Type 8023	Type 8024
Operating frequency	MF (18 to 36kHz)		HF (35 to 55kHz)
Electrical: Voltage Maximum power	36 to 72V DC 25W continuous		
Communication: Protocol Baud rate	RS485 Switchable		
Operating range	Up to 7000 metres (22900 feet)		Up to 500 metres (1640 feet)
Acoustic coverage	±90°	±50° optimised for deep water operations from noisy vessels	±90°
Range accuracy	Better than 0.2m (0.7ft)		±2.5% of slant range (with integrated attitude sensor) ±0.5% of slant range with external attitude sensor
Positioning repeatability	All transceivers tested to better than 0.1% of slant range 1dRMS		
Weight: in air in water	28kg (61.7 lb) 13.5kg (29.8 lb)	41kg (90.4 lb) 20kg (44.1 lb)	10kg (22 lb) 2.2kg (4.9 lb)
Maximum dimensions Diameter Height	225mm (8.9 in) 456mm (18.0 in)	300mm (11.8 in) 486mm (19.1 in)	145mm (5.7 in) 19.7 in)

Mounting arrangements

The arrangements you use to mount your Ranger USBL System’s transceiver can have a significant effect on the system’s performance. Depending on circumstances, you could choose to use either a pole-mounted over-the-side arrangement, or a through-hull deployment machine.

Sonardyne can advise on the best solution for your specific survey requirements.

Refer to section 3.3 “USBL Transceiver Installation” beginning on page 26 for guidance and instructions to mount the transceiver.

2.5 Transponder Beacons

Principles

Transponder beacons return an acoustic ‘reply’ signal in response to an acoustic ‘interrogation’ signal from the transceiver. The transponder beacons send their reply following a short but accurately-timed and fixed delay period after receipt of the interrogation signal. This delay period is called turn-around-time (TAT).

The transceiver measures the total time delay between transmission of the interrogation signal and reception of the reply, and uses this information to calculate the slant range between the transceiver and the replying transponder.

Refer to Appendix A “USBL Theory of Operation” beginning on page 95 for a detailed explanation.

Compatibility

The Ranger USBL System is compatible with the following range of transponder beacons:

- Compatt 5
- Dynamic Positioning Transponder (DPT)
- Mk4 Compatt
- Wideband™ Sub-Mini (WSM)
- Super Sub-Mini
- Australian Oceanographic Data Centre (AODC) beacons
- Small Seismic Transponder (SST) beacons, and
- Ocean Bottom Cable (OBC) transponders.

Compatt 5

The Ranger USBL System is compatible with Sonardyne’s Compatt 5 wideband transponder beacons.

Fig 9Compatt 5 beacon

Compatt 5 beacons include Types 8000 omni-directional, 8003 directional, and 8102 deep directional variants, rated to 3000, 5000 or 7000 metres.

These beacons are suitable for a wide range of sub-sea operations, offering a good compromise between size, acoustic performance, and battery life.

They are available with optional lithium or alkaline battery packs, include inclinometers, and can provide power for some external sensors.

Table 2 Compatt 5 beacon specification

Feature	Type 8000	Type 8003	Type 8103
Depth rating	3000m	3000m or 5000m	7000m
Operating frequency		MF (18 to 36kHz)	
Transducer beamshape	Omni-directional	Directional	Directional
Transmit level (dB re 1µPa @ 1m)	185–192dB (3 levels)	190–202dB (3 levels)	190–202dB (3 levels)
Receive sensitivity (dB re 1µPa)	90–120dB (4 levels)	80–120dB (4 levels)	
Relative positioning accuracy		±5cm	
Number of unique addresses (Wideband)		224	
Number of unique addresses (Tone)		All Sonardyne/Simrad	
Battery life (Listening, Disabled)		833 days (alkaline) 1390 days (lithium)	
Dimensions (L × dia)	1035 × 135mm (40.7" × 5.31")	1005 × 135mm (39.6" × 5.31")	1012 × 135mm (39.8" × 5.31")
Weight In air	22.8kg (50.27lb)		26kg (57.3lb)
Weight In water	11.6kg (25.57lb)		13.6kg (30lb)
Temperature sensor(±0.1°C)		Standard	
Tilt switch (±30–45°)		Standard	
Strain gauge pressure sensor (±0.1%)		Standard	
Release mechanism		Standard	
Safe working load (4:1)		250kg (551.16lb)	

DPT beacons

The Ranger USBL System is compatible with Sonardyne's Dynamic Positioning Transponder (DPT) beacons Types 8124, 8126 and 8129.

Fig 10DPT beacon

These are all full-sized transponders designed specifically for seabed deployment or large target tracking.

They are available in 3000 metre depth-rated omni-directional or directional variants, have a simple on/off switch, and can be equipped with a rugged spring-assisted release mechanism, depth sensors and advanced power and gain controls if necessary.

DPTs support Sonardyne's Wideband signals, tone frequencies and all HPR 300/HiPAP® channels. They also support Sonardyne's command and control options.

Table 3 DPT beacon specifications

Feature	Type 8124	Type 8126	Type 8129
Depth rating	3000m	3000m	7000m
Operating frequency		MF (18 to 36kHz)	
Transducer beamshape	Omni-directional (±130°)	Directional (±45°)	Directional (±20°)
Transmit level (dB re 1µPa @ 1m)	185–192dB (3 levels)	190–202dB (3 levels)	195–207dB (3 levels)
Receive sensitivity (dB re 1µPa)	90–120dB (4 levels)	80–120dB (4 levels)	
Relative positioning accuracy		±5cm	
Number of unique addresses (Wideband)		224	
Number of unique addresses (Tone)		All Sonardyne/Simrad	
Battery life (Listening, Disabled)	833 days (alkaline) 1390 days (lithium)		417 days (lithium)
Dimensions (L × dia)	1034 × 135mm (40.7" × 5.31")	1031 × 135mm (40.6" × 5.31")	

Feature		Type 8124	Type 8126	Type 8129
Weight				
	In air	22.8kg (50.27lb)		
	In water	11.6kg (25.57lb)		
Temperature sensor(±0.1°C)			Standard	
Tilt switch (±30–45°)			Standard	
Strain gauge pressure sensor (±0.1%)			Standard	
Release mechanism		Standard		–
Safe working load (4:1)		250kg (551.16lb)		–

Mk4 Compatt

The Mk4 Compatt is a discontinued product. Refer to Sonardyne for information about it.

WSM beacons

The Ranger USBL System is compatible with Sonardyne's Wideband™ Sub-Mini Transponder/Responder (WSM) beacons Type 8070 and Type 8071.

Fig 11 Types 8070 and 8071 WSM beacons

Table 4 WSM beacon specifications

Feature		Type 8071	Type 8070
Depth rating		1000m	3000m
Operating frequency		MF (19 to 36kHz)	
Operating channels		All Sonardyne Wideband/Tone HPR300 and 400 channels	
Transducer beam shape		Omni-directional	Directional
Transmit level (dB re 1µPa @ 1m) (26 to 32kHz)			
	External power	190dB	202dB
	Battery–High power	188dB	199dB
	Battery–Low power	185dB	196dB
Receive sensitivity (dB re 1µPa)			
	High gain	<100dB	
	Low gain	<110dB	
Power supply		Long life NiMH battery or external 24V DC through ROV's umbilical.	
Number of replies (Responder)		Unlimited with external power.	
Depth sensor		Optional.	
Maximum update period		750ms	
Quiescent life		60 days.	
Dimensions (L × dia)		401mm × 75mm (15.8" × 2.95")	408mm × 87mm (16.1" × 3.42")

Feature		Type 8071	Type 8070
Weight			
	In air	2.7kg (5.95lb)	5.0kg (11.02lb)
	In water	1.4kg (3.09lb)	2.6kg (5.73lb)

Super Sub-Mini

Super Sub-Mini transponders are discontinued products. Refer to Sonardyne for information about them.

AODC

Sonardyne's AODC emergency transponder beacons have been designed to provide emergency relocation capabilities for fitting to diving bells. They also satisfy the need for small, medium-range transponders that can be handled and deployed easily.

Fig 12 Type 7192 AODC mini-transponder

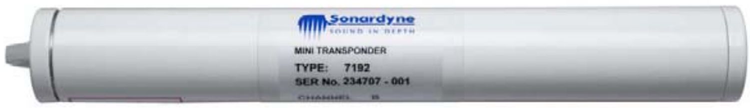


Table 5 Type 7192 AODC mini-transponder details

Feature		Types 7097 and 7192
Depth rating		300m
Operating frequency		36 to 44kHz
Individual emergency interrogation		Preset during manufacture to Channels A or B. Channel frequencies 38.5kHz and 39.5kHz Emergency reply frequency 37.5kHz
Beam shape		Hemispherical
Transmit level		185dB re 1µPa @ 1m
Turnaround delay (crystal controlled)		125.8ms
Power supply		Alkaline battery 6months (Type 7097) Lithium battery 18 months (Type 7192)
Number of replies (Responder)		900,000
Remote low battery indication		Listening life of 3 months and minimum reply life of 5 days.
Dimensions (L × dia)		533mm × 69.9mm (21" × 2.75")
Weight		
	In air	3kg (6.61lb)
	In water	1kg (2.2lb)

SST

Fig 13Type 8035 Small Seismic Transponder beacon

The Type 8035 Small Seismic Transponder (SST) beacon is designed for use in ocean bottom seismic operations, where high performance, small size, low cost and long-term reliability are important operational requirements.

This transponder can be used with most types of USBL system.

Table 6Type 8035 SST beacon details

Feature	Type 8035
Depth rating	1000m
Operating frequency range	MF (21 to 32kHz)
Transmit source level	185 to 190dB re 1µPa @ 1m
Receive sensitivity	100 to 105dB re 1µPa
Interrogation address	Programmable 1 to 410.
Reply channels	Programmable 1 to 16, continuous listening.
Quiescent life	12 months on alkaline battery.
Dimensions (L × dia)	350mm × 63mm (13.78” × 2.48”)
Weight in air	1.1kg (2.43lb)
Weight in water	0.75kg (1.65lb)

OBC

Fig 14 Type 7815 Ocean Bottom Cable Transponder beacon

The Type 7815 Ocean Bottom Cable Transponder (OBC) beacon enables the positions of seismic hydrophones to be determined with accuracy and efficiency. These transponders are small and lightweight, and have a standard depth rating of 500 metres. Each can have a unique acoustic address, enabling many units to be laid in a single deployment.

Table 7 Type 7815 OBC beacon details

Feature	Type 7815
Depth rating	500m
Operating frequency range	HF (35 to 50kHz)
Transmit source level	184 to 187dB
Receive sensitivity	105 to 115dB re 1µPa
Interrogation address	Programmable up to 3609.
Switch On	Continuously operating—there is no On/Off switch.
Battery life	Alkaline up to 18 months.
Dimensions (L × dia)	442mm × 63mm (17.4” × 2.4”)
Weight in air	1.1kg (2.43lb)
Weight in water	0.75kg (1.65lb)

Support

For current details about specific beacons supported, refer to:

support@sonardyne.co.uk.

3 System Installation

In this section... This section of the manual includes the following sub-sections:

3.1 Introduction

This section is concerned with all aspects of installing the hardware of a typical Ranger USBL System. Sonardyne ships the system with the most recent released version of the Ranger software already installed on the Navigation Computer.

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 generalised nature.

If necessary, contact Sonardyne for advice if your specific installation configuration raises some special obstacles to achieving a successful deployment. Refer to sub-section 10.5 “Getting technical support” beginning on page 92 for the relevant contact details.

3.2 Data Fusion Engine

‘Data Fusion Engine’ is the term used to describe the top-side equipment comprising the following units:

- The Navigation Control Unit (NCU).
- The Navigation Computer.
- A TFT colour monitor display.
- A combined mini-keyboard and touchpad.

In practice, it is usually necessary only to consider the hardware installation requirements. Software installation is necessary only if a later revision of that software has been supplied by Sonardyne, or if re-installation of the supplied software version is required for any reason. If it becomes necessary to install or upgrade the software, refer to section 4 “Software Installation” beginning on page 34 for more information.

Hardware installation You must install the Navigation Computer and the NCU, and then interconnect them using the supplied cables.

Before you begin Take the following steps before you begin to install the hardware of the Data Fusion Engine:

- Identify a suitable location for the Navigation Computer and the NCU where they can be installed close to each other.
- Ensure the installed location provides good ventilation for both units.
- For a fixed installation select a location, ideally in a 19-inch mounting 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 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 mains electrical 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.

What you will need

You will need the following items and tools to complete the installation:

- A mains electrical power cable.

  This has a ‘Y’-splice with two IEC electrical connectors for connection to the rear panels of the NCU and the Navigation Computer. The cable is supplied as standard with a 3–pin UK-style fused electrical plug. The cable is available fitted with either a Euro or a US mains electrical adaptor if requested.

- A null modem cable to provide an interface between the Navigation Computer and the NCU.
- An 8-pin Lemo to 48V cable to provide an interface between the transceiver and the NCU. See Fig 87 on page 115.
- A yellow primary key that indicates it is a Fusion system software security key—see “Security keys” beginning on page 36 for more information. The system will only operate in ‘demonstration’ mode without this key.

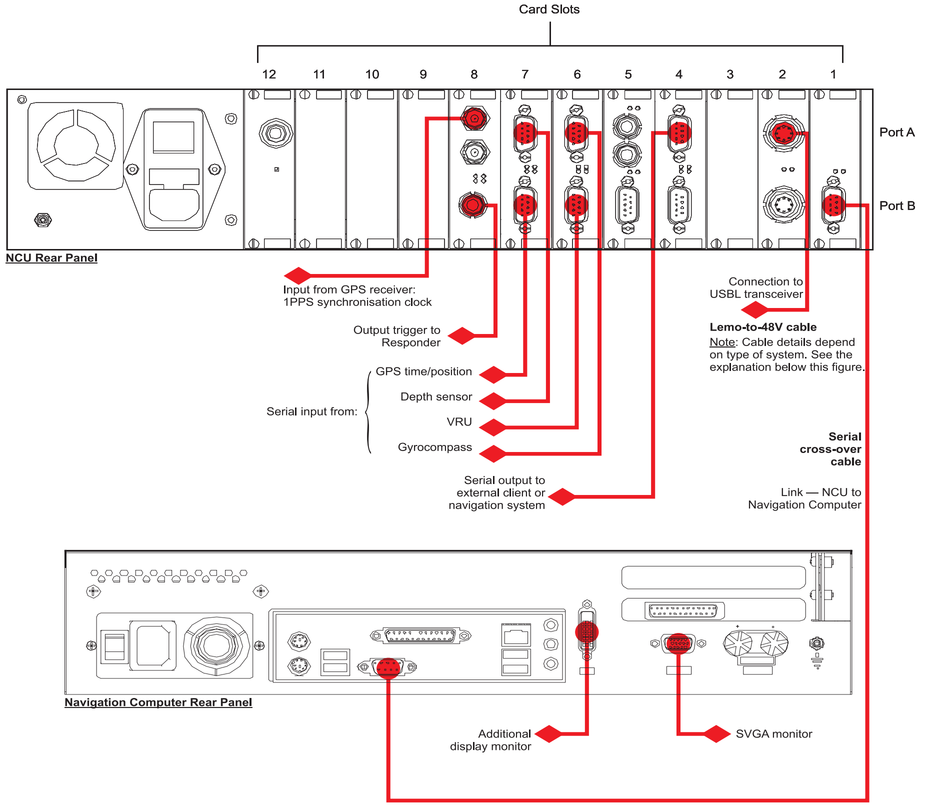
Installation

Follow the steps explained below to install the NCU and the Navigation Computer.

1. Ensure the power switches on the rear panels of both units are set to their OFF positions.
2. Secure the NCU and the Navigation Computer at the locations you have selected for them.
3. Make connections to the NCU as required within your system. Refer to Fig 15 below for guidance. Note that this figure does not show the power connections to both units.

   The NCU rear panel arrangement and serial connections required within your installation may be different from those shown. Refer to page 24 for instructions to install additional interface cards.

Fig 15 Typical interconnections—NCU and Navigation Computer



Note

Details for the 8-way transceiver cable from slot 2 on the Navigation Computer depend on whether the system is portable or rack-mounted:

- If the system is portable, the cable will be terminated with a suitable connector to be attached to the main cable from the USBL transceiver.
- If the system is rack-mounted, the cable will have open tails for connection to the vessel's junction box or a terminal strip in the rack.

See the cable drawings in Appendix C beginning on page 108.

- Connect the two IEC connectors on the supplied 'Y'-spliced electrical power cable to the IEC electrical power inlets on the rear panels of both units.
- Connect the mains electrical plug on the power cable to a convenient electrical supply outlet.
- Connect the supplied serial cross-over cable from COM1 on the Navigation Computer to the COM port (Port B) in slot 1 at the rear panel of the NCU. This cable can be connected either way around.
- Connect the Lemo end of the supplied 8–pin Lemo-to-48V cable to Port A in slots 2, 3 or 4 on the rear panel of the NCU.

Note

It is possible to fit 48V transceiver interface cards in any of the slots 2 to 4 on the NCU. The NCU can support a maximum of three USBL transceivers.

- Connect the other end of the Lemo to 48V cable to the USBL transceiver.

- Make whichever optional connections as are required within your Ranger USBL as follows:
  - Connect serial inputs from a GPS receiver, a gyrocompass, depth sensors, sound speed sensors and/or a Vertical Reference Unit as required to any of the serial ports located in slots 2 to 7 on the NCU.
  - Connect serial outputs from the Ranger USBL System, supplying information such as position reports for external client or navigation computer systems as required, to any of the serial ports located in slots 2 to 7 on the NCU.
  - Connect an external time synchronising signal, such as a 1PPS (pulse per second) clock from a GPS receiver to the top input trigger port (Port A) on the Responder/Trigger interface card located in slots 8 and 9 on the NCU.

    Connect the corresponding serial time message to one of the serial ports located in slots 2 to 7 on the NCU.
  - Connect an output trigger cable from the NCU to a Responder beacon, if you are using one, from the bottom port (Port B) on the Responder/Trigger interface card located in slots 8 and 9 on the NCU.

    Responder/Trigger interface cards are supplied with a ‘Y’-spliced cable for the NCU.

Note

Interface cards installed in slots 2 to 4 of the NCU will have only Port A available, even if a dual-channel RS232 interface card is fitted to the port.

Refer to the technical and user manuals supplied with the equipment in use for their specific installation and operating instructions.

4. Make a written note of which input/output device is connected to which port (A or B) on each interface card installed in the NCU.
5. Connect the yellow ‘primary’ security key supplied with the Ranger software to the 25-pin parallel port on the back of the Navigation Computer, or to a convenient USB port if the system has been supplied with a USB style key.

   Refer to page 36 for an explanation of the security keys.
6. Connect the mini keyboard and integrated mouse supplied by Sonardyne to either of the USB ports on the Navigation Computer’s front panel. Alternatively, make this connection to either of the USB ports on the Navigation Computer’s rear panel.
7. Connect the display monitor, if one has been supplied by Sonardyne, to the SVGA port on the Navigation Computer’s rear panel.

   The Navigation Computer can support a second external monitor. If necessary, connect a second monitor to the DVI port on the Navigation Computer’s rear panel using a DVI-to-SVGA adapter supplied by Sonardyne.
8. Set the Power switches on the rear panels of the NCU and the Navigation Computer to ON. It does not matter which of the units is switched on first.

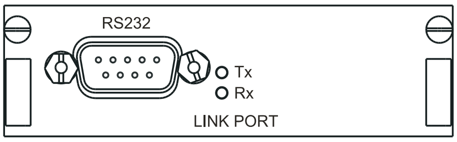
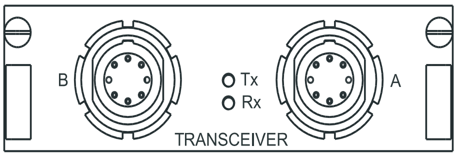
9. On the NCU check the following:
    - The three green indicator LEDs on the front panel should be illuminated to show that the power supply is receiving power and the 3.3V and 5V supplies are operating.
    - The three power-rail status LEDs should be illuminated to show that the transceiver power supplies are at the correct operating voltage.
10. Press the Power/Reset button on the Navigation Computer's front panel to start the Navigation Computer.
11. On the Navigation Computer check the following:
    - The green System Power LED illuminates to show that the system is receiving power.
    - The red HDD LED illuminates to show that the Navigation Computer is reading the hard disk and is booting.
12. Check that the Ranger software starts automatically.

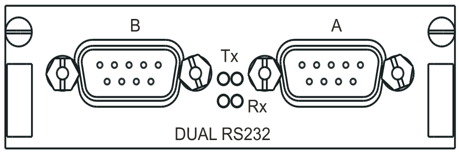
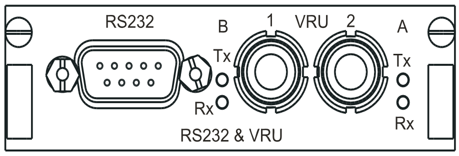
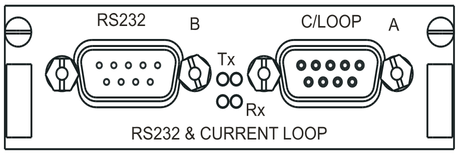
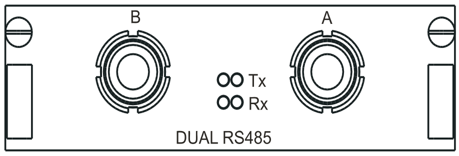
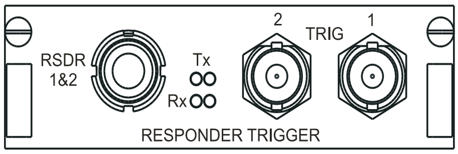
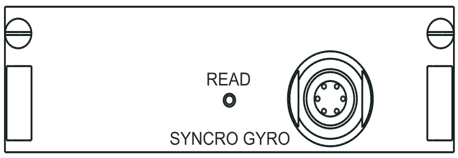
    If the Ranger software does not start automatically, use the mouse to double-click the Ranger Survey icon on the desktop.
13. While the Ranger software is starting, check that all the LEDs on the NCU front panel are flashing at the same time to indicate that the software has established communications with the NCU.

Interface card details

The NCU can be configured with various interface cards depending on the sensor inputs required for the installation. Table 8 lists and describes the interface cards for use in the NCU.

Table 8 Interface cards

Slot	Notes	Part Number and Interface Card	
1	Link Port: • RS232 link to Navigation Computer	CPN 631–6958 	Drg 8020–050–02
2	RS485 communications and 24V power for the following transceivers: • 24VDC transceiver • ROVNAV 5 • ROVNAV 4 • Mini ROVNAV	CPN 631–6777 	Drg 8020–051
2, 3 & 4	RS485 communications and 48V power for the following transceivers: • 48VDC transceiver • USBL • Mini ROVNAV • ROVNAV 4		

Slot	Notes	Part Number and Interface Card
5, 6 & 7 *2, 3 & 4	RS232 communications with: • ROVNAV • DVL • Serial gyrocompass • GPS • Serial VRU	CPN 631–6782 Drg 8020–053 
5, 6 & 7 *2, 3 & 4	RS232 communications and Analogue VRU input	CPN 631–6794 Drg 8020–054 
5, 6 & 7 *2, 3 & 4	RS232 communications and Current Loop output to Dynamic Positioning system	CPN 631–6825 Drg 8020–055 
5, 6 & 7 *2, 3 & 4	RS485 communications	CPN 631–6825 Drg 8020–057 
8 & 9	Two responder outputs and two inputs for external triggers, such as 1 PPS from a GPS receiver	CPN 631–6819 Drg 8020–059 
10, 11 & 12	Gyro input with the following analogue input options: • 115V 400Hz • 115V 60Hz • 26V 400Hz	115V 400Hz CPN 631–7009 Drg 8020–058–01 115V 60Hz CPN 631–7024 Drg 8020–058–02 26V 400Hz CPN 631–7038 Drg 8020–058–03 

Notes concerning Table 8:

- Because the two ports on the transceiver card are connected in parallel, a separate card is required to operate each transceiver.
- Pin-outs, wiring and connector specifications for cable connections to the interface cards are detailed in Appendix C.

Interface card installation

Refer to Table 8 to identify which slots on the NCU's rear panel support which types of interface card, and plan which slots to use.

WARNING

Before you begin to add or remove interface cards in the NCU, power-off the NCU and disconnect it from the electrical power supply.

Follow the steps below to install or remove an interface card. To substitute one card for another already fitted to the NCU, follow the steps to remove an existing interface card and then install the new card in its place.

1. Power-off the NCU and disconnect it from the mains electrical supply.
2. Remove the NCU from its installed location, if necessary, to gain easy access to the unit's rear panel.
3. Either:
    - Identify the location to be used for the additional interface card, or
    - Identify the interface card you intend to remove from the NCU.
4. Use a medium flat-headed screwdriver either to release the blanking plate or to release the interface card.
5. Either:
    - Fit the new interface card into the slot vacated by the blanking plate, or
    - Withdraw the interface card from the NCU's rear panel.
6. Fit and tighten the two screws removed in step 4. to either:
    - Secure the new interface card into the NCU's rear panel, or
    - Fit and secure a blanking plate to the slot vacated by the removed interface card.
7. Return the NCU to its proper installed location.
8. Re-connect the NCU to the electrical power supply and power it on.
9. Conduct tests to ensure the NCU is operating correctly following the alterations made to the system.

Network connection

The Navigation Computer is supplied with an RJ–45 Ethernet LAN connection port. Any network configuration settings within the Windows XP Operating System are at the risk of the operator. Sonardyne International Limited accepts no responsibility for network connections and configurations.

3.3 USBL Transceiver Installation

The USBL transceiver can be deployed in a number of ways, depending on the type of vessel in use and on operational requirements.

CAUTION

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.

General requirements

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 transceiver to protect its transducer face during shipping. You MUST remove this protective sleeve before you deploy the transceiver; the transceiver will not perform correctly with this sleeve in place.

- Mount the transceiver on a rigid pole, supported so as to minimise vibration and reduce free movement of the transducer with respect to the vessel.

  The main sources of vibration that could affect the transducer are; normal operation of the vessel's machinery; and vortex-shedding as the transducer's supporting pole moves through the water.

- Mount the transceiver so that it is pointing vertically downwards, with the connector at the top and the black acoustic transducer at the bottom.
- Ensure the white forward-pointing direction arrow on the transducer is pointing forward on the vessel.
- For best results, if possible deploy the transceiver at least 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 you have installed the transceiver, measure the vertical offset between the bottom face of the transceiver and the vessel's waterline when the transceiver is fully deployed. You will require this information later, to configure the Ranger software.

- Deploy the transducer as far away as practical from any source of noise or bubbles, such as propellers, thrusters, 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 transceiver face clean and free from oil or grease.

Pole mounting

The design of any deployment mechanism should ensure that all unwanted movements of the transceiver with respect to the vessel are minimised.

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 transceiver deployment is greater if you intend to use external attitude measurement equipment, such as a Vertical Reference Unit, with the Ranger 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 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 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 vortex shedding, and larger, slow movements can arise as the vessel rolls or under the influence of tidal changes. 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 transceiver, even if the pole moves relative to the vessel.

Over-the-side deployment

If you intend to use an over-the-side deployment, attach the transceiver to a pole or frame designed so that 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 vortex induced vibration. Various methods can be used to reduce the effects of this type of vibration. Contact Sonardyne for further advice in this area.

Through-hull mounting

The recommended way to mount a USBL transceiver is on a pole through the vessel's hull.

In this arrangement the pole should be stiff, rigidly mounted and long enough to locate the transceiver at least 1 metre below the lowest point on the hull. The mounting arrangement used must minimise any movement of the transceiver with respect to the vessel, and ensure optimal tracking accuracy.

For the 'standard' transceiver, this mounting arrangement requires a vertical tube of at least 254mm or 10 inches internal diameter to be let into the ship.

For the 'Big Head' transceiver the vertical tube should be at least 350mm or 14 inches internal diameter.

Galvanic isolation

The 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 transceiver and the mounting arrangement both electrically and acoustically 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.

CAUTION

To avoid galvanic corrosion of the aluminium bronze transceiver housing, never allow the housing to remain in contact with a material more electrochemically noble than itself.

Note

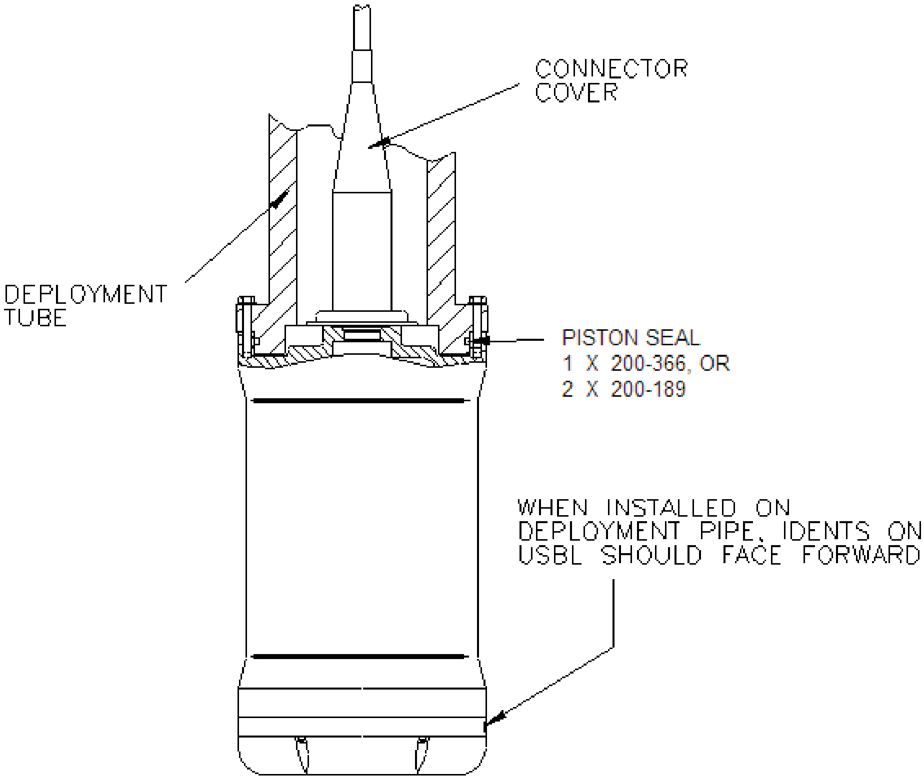
Before you mount the transceiver, always record the information detailed on the label on the outside of its housing. This information includes its serial number, the device serial number, and factory offsets for the internal inclinometer sensors.

Mounting considerations

The most common through-hull deployment method is the use of a gate-valve and sea chest assembly that can accommodate the transceiver. Above this sea chest is a deployment machine capable of raising and lowering the transceiver and stem.

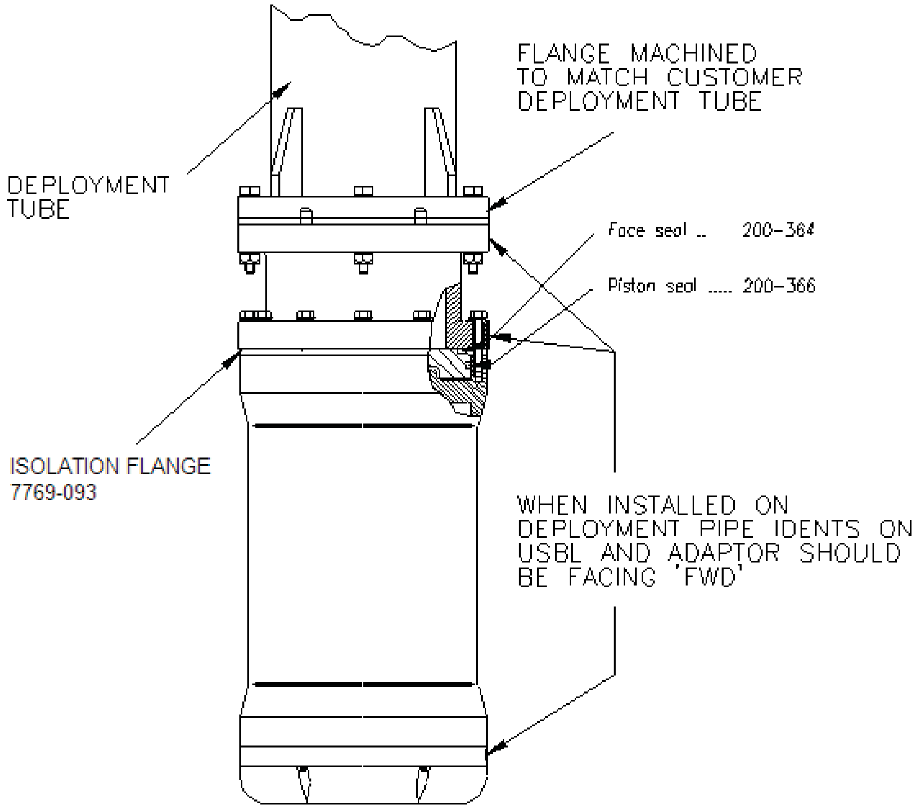
The USBL transceiver has been designed to fit to a type 7950 Sonardyne-supplied deployment machine, or to fit directly onto a fixed-head HPR deployment pole as shown in Fig 16.

Fig 16 Transceiver mounting—Arrangement 1



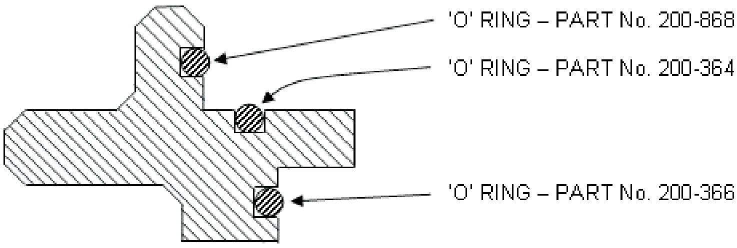
A second popular mounting arrangement is to mount the transceiver on the end of a flanged pole, using a purpose-designed flange adapter if necessary, as shown in the example in Fig 17. In this second arrangement, the pole will normally have a number of flanges, each of which has a compliant outer edge that contacts the inside wall of the deployment tube.

Fig 17 Transceiver mounting—Arrangement 2



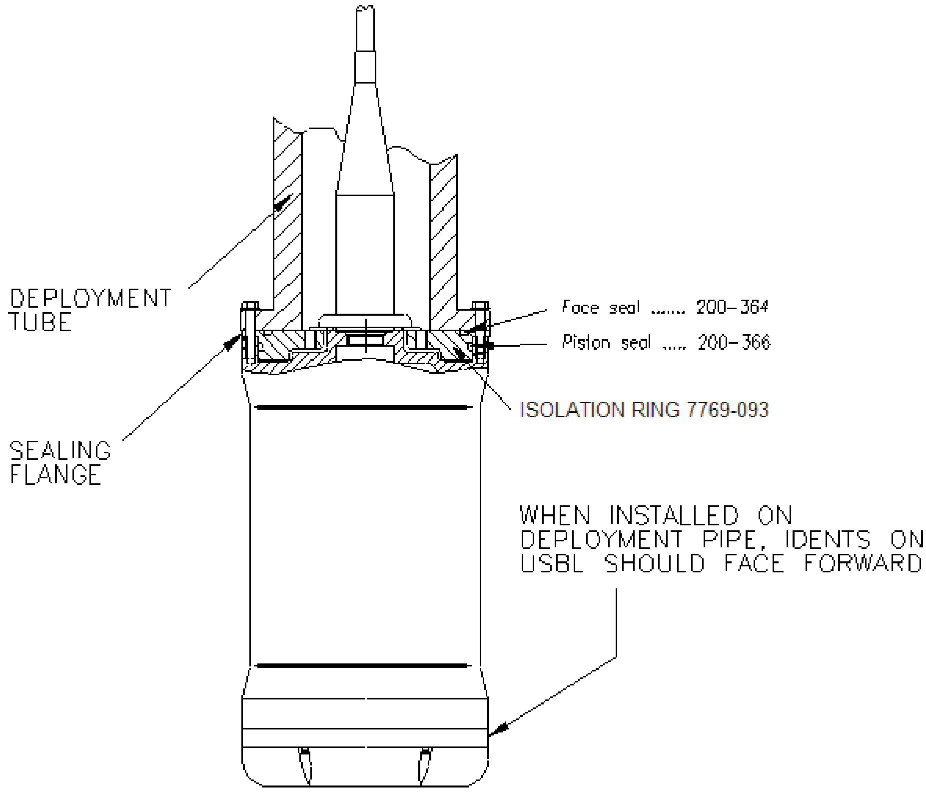
An alternative isolation flange is also available for Sonardyne-supplied deployment machines, as shown in Fig 18.

Fig 18 Alternative isolation flange



If the mounting flange already has the correct fixing holes, the transceiver can be bolted on without need of an adapter ring, as shown in Fig 19. Note, however, that you MUST use an isolation flange in this arrangement if there is any possibility of galvanic corrosion occurring.

Fig 19 Transceiver mounting—Arrangement 3



Alignment criteria

When mounting the transceiver you should ensure that the mounting arrangement has some mechanical means to maintain alignment between the 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 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.

Transceiver connection

Connection between the transceiver and the NCU rear panel is through the Lemo-to-48V cable supplied with the system. Connect the Lemo end of this cable to the top port (Port A) on the transceiver card in the NCU. Refer to “Hardware installation” beginning on page 20 for more information.

System calibration

You must perform a complete system calibration (CASIUS) when you deploy any transceiver for the first time in its mounting arrangement.Refer to section 8 “Calibration” beginning on page 78 for more information about the CASIUS calibration procedure.

3.4 External sensors

You should give careful consideration to the selection and installation of external sensors such as a Vertical Reference Unit (VRU), gyrocompass and GPS 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 Ranger USBL.

Connections between external sensors and the Ranger USBL System are through serial ports on interface cards located on the NCU rear panel. Refer to “Hardware installation” beginning on page 20 for more information.

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.

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 10Hz.
- Some VRUs allow aiding input of speed and course made good (CMG) from external equipment such as a GPS 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 Ranger.

- Ensure the conventions used for pitch and roll output from the VRU are the same as those used in Ranger, because some VRU manufacturers use a different convention.

Note

Ranger uses the convention for roll and pitch measurements as follows:

- Positive pitch is bow up, stern down.
- Positive roll is port side up, starboard side down.

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 0.05° 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 accuracy should be 0.01° or better, and the output rate should be at least 5Hz.
- Align the gyrocompass to be parallel with the vessel's centre line.

  Perform a gyrocompass calibration BEFORE you perform a calibration of the Ranger 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 Ranger 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.

GPS receiver system

- Mount the GPS 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 GPS 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 GPS antenna and the USBL transceiver. You will require these measurements later to configure the Ranger software.
- If possible, supply measurements from the GPS receiver directly to the Ranger software so as to minimise any position latency inherent with computer-based GPS solutions.
- Because the quality of the GPS solution has a direct effect on the quality of any real-world positions determined by the Ranger USBL, you should use only differential GPS (DGPS) or carrier-phase based (such as Real-Time Kinematic—RTK) corrected GPS inputs.

4 Software Installation

In this section...

This section of the manual includes the following sub-sections:

4.1 Introduction

All Ranger USBL systems are shipped from the factory with the software pre-installed on the Navigation Computer. It is not usually necessary for you to install the software unless a later revision of that software has been supplied by Sonardyne, or if re-installation of the supplied software version is required for any reason.

CAUTION

Viruses can destroy data held on a computer system. It is important to protect your system against such a threat. NEVER install unauthorised or inappropriate software on the Navigation Computer, and always ensure any connections made between the Navigation Computer and any local area network are guarded by a firewall and effective and up-to-date anti-virus software.

4.2 Software Installation

Before you begin

Before you begin to install the Ranger software on the Navigation Computer, you should do the following:

- Create a backup of any important data that you have saved on the Navigation Computer’s hard disk, such as logging files.
- Uninstall the previous software version on the Navigation Computer.

Note

The software installer identifies and removes previous versions of the Ranger software automatically during the installation process.

- Confirm that you have the installation disk supplied by Sonardyne International Limited for the required new software version.

Hardware requirements

If you want to install the Ranger software on a computer other than the Navigation Computer, be aware of the following:

- Ranger is licensed software—you must possess a licence and the associated security key to run the software after installation.
- The computer must be running Microsoft® Windows™ XP. Computers that are of sufficient standard to run Windows XP will be of sufficient standard to run the Ranger software.
- There must be a minimum 50MB of available disk space for the application files.

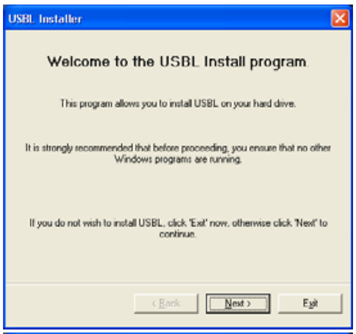
Procedure

Follow the steps listed below to install the Ranger software on the Navigation Computer.

1. Read the release notes supplied with the software.

   If necessary, contact Sonardyne with any questions you have over the suitability of the version of software you are planning to install.

2. Quit all applications in Windows XP.

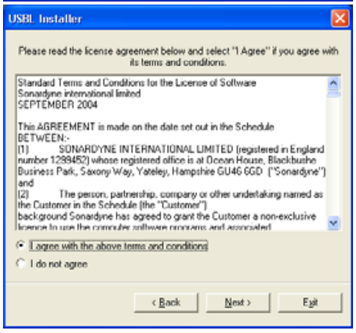


3. Insert the Ranger software CD in the Navigation Computer's CD ROM drive.

   The installation routine on the CD should start automatically. If it does not:

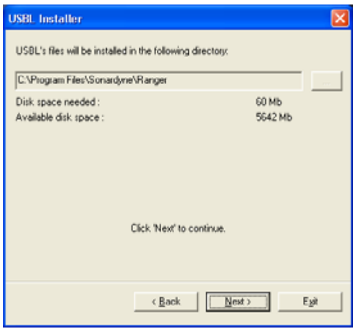
   - Click **Start > Run…** on the Windows taskbar.
   - Type ***d:\RangerInstaller.exe*** in the **Open** field (where *d* is the drive letter of the CD ROM drive).
   - Click **OK**.

     The installation routine will start, and will display the first of the installation dialogs. Click **Next** to continue.



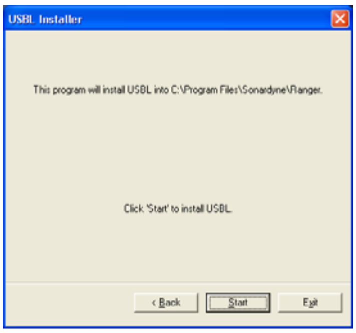
4. Read the terms of the license agreement and select the '**I agree…**' option button to enable the **Next** option button.

   Click **Next** to continue.



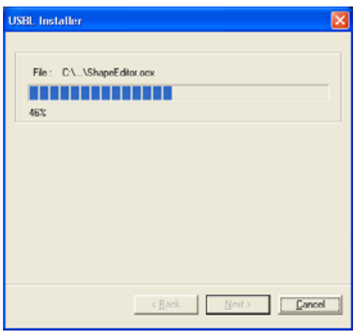
5. The installer identifies a default installation directory on the computer. You can change this by clicking the button to the right-hand side of the default location field and browsing to an alternative location.

   Click **Next** to accept the installation location shown in the text field and continue.



6. The installer confirms the installation location you have defined. Click **Back** to edit the location if necessary, or click **Start** to begin the installation.

7. A progress bar shows details of the installation process.



8. If this is the first time the Ranger software has been installed on the computer, a message will be displayed to inform you that Sentinel 3rd party software is installing MSXML, following which the installer will report that the software has been installed successfully.

   Click **Exit** to close the final dialog and complete the installation process.

The installation process places a new Ranger icon on the computer's desktop. This provides direct access to the Ranger software application described in this manual.

Security keys

Sonardyne supplies two security keys with the Ranger USBL System, which allow the Ranger software to run.

- 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. Remove the Emergency key from its sealed plastic bag only if you need to use it.

Note

Use the Emergency key in place of the Primary key **only** if the Primary key fails, expires, or is damaged or lost. It is necessary to contact Sonardyne International Limited in order to activate the Emergency dongle. It will not operate until this has been done.

CAUTION

To avoid possible damage to the Navigation Computer or corruption of the computer's software, never attach any security key for another application to the Navigation Computer.

Never attach more than one of the security keys to the Navigation Computer at the same time.

The supplied security keys will be either of two types:

- 25-pin parallel-port style

  If your system has a 25-pin parallel-port style of security key, you must attach it to the parallel port on the rear-panel of the Navigation Computer.

- USB key.

  If your system uses a USB security key, attach it to either of the two USB ports on the Navigation Computer's front panel.

Firmware upgrade

If you are upgrading the Navigation Computer with a new version of the Ranger software, you may also have to upgrade the firmware in the Navigation Control Unit and in any USBL transceivers that you intend to connect to the system.

Read through the software release notes for details of the compatible firmware versions required.

Contact Sonardyne for details on upgrading the Navigation Control Unit and transceiver firmware.

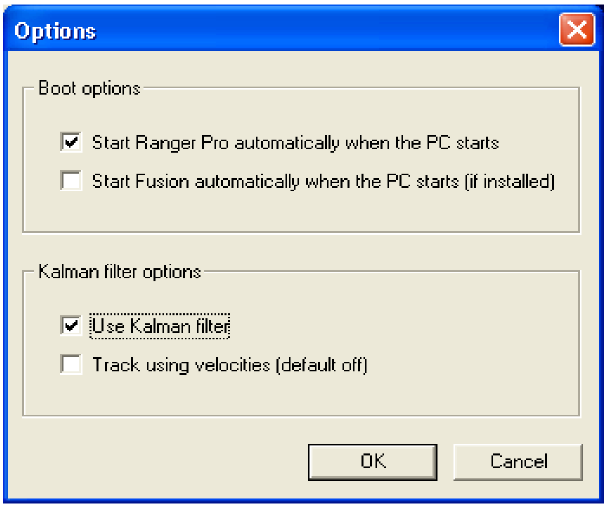
System Options

Once the software has been installed it is necessary to configure some basic options that change the way the Ranger USBL System operates regardless of the job that is loaded.

Start the application by double clicking on the Ranger USBL System desktop icon.

Once the application has started, select **Tools> Options...** to open the Options dialog which appears as follows.

Fig 20 The System Options Dialog



Boot Options

Selecting '**Start Ranger USBL System automatically when the PC starts**' will cause Ranger USBL to start automatically when the PC is booted. The application will then continue operating in the same way that it was before is was shutdown. If Ranger USBL was actively tracking transponders before it was shutdown then it will attempt to restore positioning when the application restarts.

Selecting '**Start Fusion automatically when the PC starts**' can be used to edit the auto boot of Sonardynes Fusion USBL software if it happens to be installed on the same PC. If Fusion USBL has been installed then it may be desirable to prevent it from automatically booting.

The default configuration is shown in the picture above.

Kalman Filter Options

Ranger USBL includes a simple Kalman filter that is used to reject USBL positions that are obviously wrong. The default state for the Kalman filter is turned on with velocities turned off. Sonardyne recommend this configuration for DP operations.

Default Job

The default job is used as a template job that all new jobfiles are created from. Whenever the user selects **File> New...** the new job is created as a copy of the default job.

The default job allows all instruments and offsets common to all jobs to be included automatically in newly created jobs. Typically the default job would include acoustic transceivers and offsets, GPS antennas and offsets, VRUs and Gyros.

To create a default job, configure Ranger USBL into the default state by adding and removing instruments. Delete all transponders that are not required. Then select **File> Save as default job...** A confirmation dialog will be displayed. Select OK to continue over-writing any existing default jobs. Any future new jobs will now be created using copy of the default job as a starting place.

5 Ranger Software Overview

In this section...

This section contains the following sub-sections:

5.1 Introduction

Sonardyne’s Ranger USBL System has been developed for use with the new Ranger Ultra Short Baseline (USBL) positioning system.

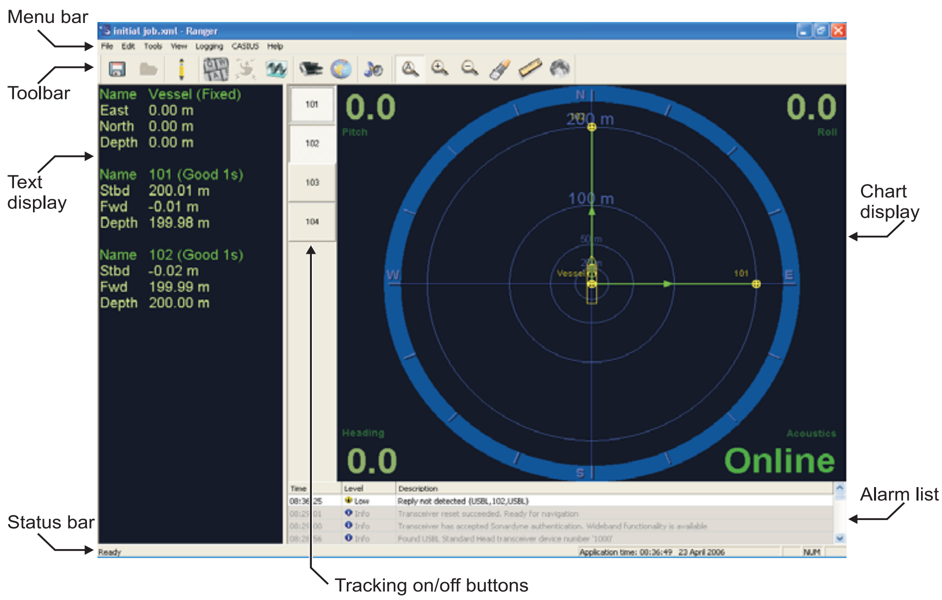
The software provides a condensed range of features designed around the need for simplicity in the configuration, control and monitoring of the Ranger USBL System. The design of the software makes it appropriate for use in applications where the extended capabilities of the Fusion USBL Survey software will not be needed.

Ranger USBL is simple to set-up, learn and operate, and will allow users to begin work on their survey without unnecessary delay, and to achieve immediate success whatever their level of prior knowledge or experience with USBL systems.

5.2 Quick Tour

The Ranger application’s main screen, shown in Fig 21, is the initial view displayed when you start the application, or when the application starts automatically after you power-on the Navigation Computer.

Fig 21 Ranger’s main screen



The main screen has the following features:

- a Menu bar
- a Toolbar
- the Text display
- the Chart display
- the Alarm list
- the Tracking On/Off buttons, and
- the Status bar.

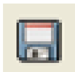
Note

Ranger remembers the screen configuration in use whenever you shut down the application, and restores the same configuration when you start it again. The main screen you see on your system may not be exactly as shown in Fig 21.

5.3 Menu bar and Toolbar

Many of the commonly-used menu items are also accessible through buttons on the toolbar. Table 9 lists the top-level and secondary level menu items, and shows the equivalent toolbar button if one is available. Descriptions of each of the functions are then included throughout the remainder of this sub-section.

Table 9 Summary of Menu and Toolbar items

Top level	Secondary	Toolbar button (if available)
File	New	
	Open...	
	Save	
	Save As...	
	Exit	
Edit	IO Ports...	
	Transponders...	
	Environmental...	
	Sounds...	
	Chart properties...	
	Chart shapes...	

Top level	Secondary	Toolbar button (if available)
Tools	Acoustic signal analyser…	
	Manual command window…	
	Transceiver calibration test…	
	Noise test…	
	Measure Chart Distances	
View	Toolbar	
	Status bar	
	Auto zoom	
	Zoom in	
	Zoom out	
	Erase Chart History	
	Night colours	
	Frequency map…	
Logging	Open logging folder	
	Delete logfiles	
	Start new acoustic logfile	
CASIUS	Do CASIUS calibration…	
	Start recording	
	Stop recording	
	End CASIUS calibration…	
Help	About	

File menu

Table 10 File menu items

Menu item	Description
New	Opens the Job Set-up Wizard, which guides you through the process of creating a new Job.
Open	Displays the **File Open** dialog so that you can select and open an existing Job.
Save	Saves the current Job.
Save As…	Saves the current Job under a different file name.
Save as default Job…	Saves the current Job as the new default job. See "Default Job" beginning on page 37.

Edit menu

Table 11 Edit menu items

Menu item	Description
IO Ports…	Displays the IO Ports dialog that allows you to set the parameters for each IO port on the Navigation Computer.
Transponders…	Displays the Transponders dialog, which allows you to add and configure Transponders to the Ranger USBL System.
Environmental…	Displays the Environmental dialog, which allows you to set the local speed of sound, use an existing sound speed profile, and set other environmental parameters.
Sounds…	Displays the Audio Configuration dialog, which allows you to set which conditions cause an alert sound from the Ranger system.
Chart properties…	Displays the Radar Chart Properties dialog, which allows you to set the default configuration for the main window's Chart pane.
Chart shapes…	Displays the Radar chart shapes dialog, which defines the current shapes used for the polar chart, and allows you to edit those shapes if necessary.
Waypoints	Displays the Waypoints dialog, which allows you to create, display and delete waypoints. See 7.5 “Waypoints” beginning on page 75

Tools menu

Table 12 Tools menu items

Menu item	Description
Acoustic signal analyser…	Displays the USBL Signal screen, which shows the acoustic signal quality received from Transponders in use with the system.
Manual command window…	Displays the Manual Command WIndow dialog, which allows you to issue manual commands to appropriate Transponders.
Transceiver calibration test…	Displays the Transceiver Calibration Test tool., described in Appendix D.4 “Transceiver Calibration Test” beginning on page 127.
Noise test…	Displays the Noise Test tool, described in Appendix D.5 “Noise Test” beginning on page 128.
Measure Chart Distances	Describes the Chart Measurement tool, described in Appendix D.7 “Measure Chart Distances” beginning on page 130
Average Transponder Position	Displays the average position of a selected transponder over a series of previous position fixes, described in Appendix D.6 “Average Fix” beginning on page 129.
Riser Angle Monitoring	Opens the Riser Angle Monitoring display, described in Appendix F.1 “Software Configuration” beginning on page 149.
Options...	Opens the Options dialog that allows boot-up and Kalman settings to be changed. See “System Options” beginning on page 36..
Simulate	Starts simulation mode, described in Appendix G.1 “Using the Simulator” beginning on page 158.

View menu

Table 13 View menu items

Menu item	Description
Toolbar	Toggles between showing and hiding the toolbar.
Status bar	Toggles between showing and hiding the status bar.
Auto zoom	Toggles Auto zoom on and off.
Zoom in	Zooms in the current window, showing a smaller area of the survey.
Zoom out	Zooms out the current window, showing a wider area of the survey.
Erase Chart History	Erases the current ‘snail trail’ that shows the chart history.
Night colours	Toggles the display colours between the standard settings and settings more suited to night time viewing.

Menu item	Description
Frequency map…	Displays a read-only image of the Sonardyne and Simrad MF band signal chart.

Logging menu

Table 14 Logging menu items

Menu item	Description
Open logging folder	Opens the **Ranger files** folder, and displays a list of the sub-directories that Ranger uses to store acoustic log files, job files and other information.
Delete logfiles	Allows you to permanently delete all logfiles from the logging directory.
Start new acoustic logfile	Closes the current acoustic logging file and starts a new one. The new file is given a unique name based on the month, date and time of creation.
Archive all data to Zipfile	Creates a zipfile that contains all log data and job configuration data. This file can be returned to Sonardyne for support.

CASIUS menu

Table 15 CASIUS menu items

Menu item	Description
Do CASIUS calibration…	Starts the CASIUS dynamic calibration procedure.
Start recording	Starts recording data for a CASIUS calibration.
Stop recording	Stops recording data during a CASIUS calibration.
End CASIUS calibration…	Ends the CASIUS calibration procedure.

Help menu

The Help menu includes an entry that displays information about your current installation of the Ranger software and the features enabled on your Ranger USBL System. You will need to know this information if you make a call on Sonardyne's technical support.

The second entry on the Help menu, called **Ranger Help**, opens this manual.

5.4 Text display

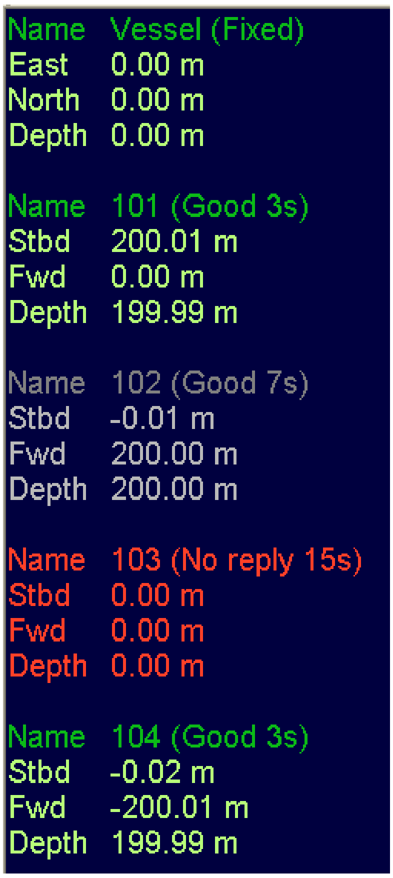


Fig 22Example text display

The Text display shows the current positions of the vessel and of all tracked vehicles in the current Job, and the latency of the most recent information from those targets.

Information displayed can be shown using any of four colours:

- **Green** information displayed for a target means a reply series is being received reliably from that target, the signal quality is good, and the data latency is within limits.
- **Grey** information displayed for a target means a reply series is being received from that target, but that data latency has exceeded a pre-defined limit.
- **Red** information displayed for a target means that the reply series from that target has been interrupted.
- **Orange** information means the system has measured a range to the target, but the USBL direction information was not of sufficient quality to be usable. The text display changes to show 'BAD SIGNAL' under these conditions.

For each target listed in the Text display, the information displayed includes the measurement quality and latency, the forward and starboard offset distances (which will be negative if the target is aft or to port of the vessel), and the depth of that target if this information is available.

If the Ranger USBL System is receiving heading information, the text display changes to show East and North offset distances instead of forward and starboard.

5.5 Chart display

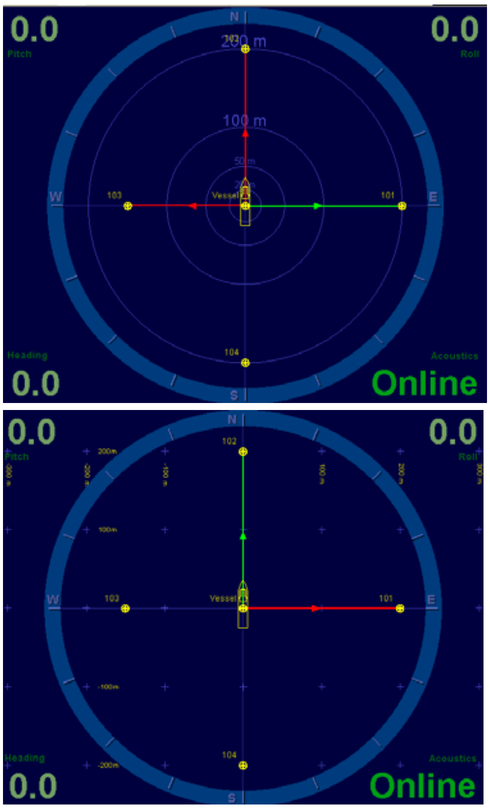


Fig 23Example Chart displays: Polar (top) and Cartesian (bottom)

The Ranger software has two chart styles available for use: the Polar display (or radar-style display) shown at the top left here, and the Cartesian (or X–Y display) shown at the bottom left.

Both types of chart show the vessel and the tracked targets using whichever chart shapes and colours have been set for them You can edit these using the Shape Editor, described in “Editing chart shapes” beginning on page 69.

The charts show acoustic ranging measurements between the transceiver and the tracked targets as straight lines whose colour matches the colour of their respective measurements in the text display. The ranging measurement lines are redrawn with each acoustic measurement cycle.

Individual targets on the chart are identified with their name, corresponding to the tracking on/off buttons.

Large figures around the edge of the chart present measurements of pitch, roll and heading, and the current online/offline status of the acoustic system. If there are no available measurements of attitude or heading, the display presents these as zero.

The charts can be zoomed automatically or manually. The automatic zoom adjusts the chart scale to retain the vessel and all tracked targets on display at the same time. A setting allows you to include or exclude all the waypoints in the auto zoom as required.

Both charts can be configured for any orientation, with the default being north-up. It is also possible to change the default colour scheme used for the chart and for features on the chart.

Polar display

The polar display shows a representation of the vessel and target positions using range and bearing from the datum. It includes ‘range rings’ and bearing markers at 45° intervals.

By default, the polar display’s range rings are centred on the vessel. It is possible to change the settings so that the display and range rings are centred on any tracked target.

Cartesian display

The cartesian display shows a representation of the vessel and target positions using relative offset distances in metres from the transceiver, along the north-south and the east-west datum. The north-south and the east-west datum have markers at regular intervals, dependent on the amount of chart zoom applied. Crosses mark the intersections of north-south and east-west markers.

For reference, the cartesian chart also includes bearing markers at 45° intervals from north around the edge.

5.6 Alarm list

Fig 24 Alarm list

Time	Level	Description
19:05:50	Low	Transponders 102 and 103 have conflicting travel times. Try changing the compatts TAT.
19:05:45	Low	Transponders 102 and 103 have conflicting travel times. Try changing the compatts TAT.
19:05:43	Low	Reply not detected {USBL,103,USBL}
19:05:42	Low	Reply not detected {USBL,104,USBL}

The Alarm list is located immediately beneath the Chart display. It includes a vertical scroll bar, so that you can scroll the list to show alarms that occurred earlier in the survey and which have now scrolled off the bottom of the visible list.

The list shows all alarms which require operator attention that have been generated by the Ranger software. The list updates only when a new alarm condition occurs, with the new alarm being added to the top of the list and previous alarms scrolling downwards below it.

Each row in the Alarm list includes columns that show, from left to right:

- the time of the alarm
- the urgency level of the alarm—high or low—or an icon to show that the row is for information only, and
- a description of the alarm, possibly including some suggested remedial actions to take.

You can configure the software to give an audible alert whenever a high- and/or low-level alarm occurs. Refer to section 6.7 “Configuring Sound Alerts” beginning on page 66 for instructions to do this.

5.7 Tracking On/Off buttons

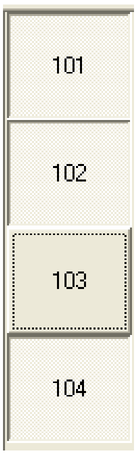


Fig 25Tracking On/Off buttons

After you have added a series of target transponders to the system, Ranger allows you to select or deselect individual transponders for use in tracking by a simple button click.

Ranger adds buttons to the main screen and identifies them with the transponder names you specified when you added them.

Buttons show as depressed when the transponder is in use for targeting, and show as released when they are not in use. In the example to the left here, transponder 103 is not being used for tracking.

These buttons can also display the following information:

- **Reference**—The transponder is being reported to the DP desk as a reference beacon.
- **Disabled**—The transponder has been disabled and cannot be tracked until it has been enabled again. The system will try to enable it automatically when you click the button.
- **Not Set**—The system is currently reprogramming the transponder. The transponder cannot be tracked until the command sequence has completed.

5.8 Status bar

The status bar, along the bottom of the main window, shows Ranger’s state of readiness, and the application’s current time and date.

6 Software Configuration

In this section... This section contains the following topics:

6.1 Introduction

The Ranger software provides all the important features you will need to conduct a USBL survey, presented simply and made easily accessible for both experienced and novice users.

Before you can begin to use the software for a survey, you must configure it for the specific survey conditions. After you have done this, Ranger will start automatically whenever you power-on the Navigation Computer, and will adopt the same configuration in use when you previously powered-off the computer.

6.2 Software Configuration

Software configuration comprises the following sequenced stages:

1. Open an existing job file or create a new one.
2. Add a transceiver to the job file.
3. Add transponders to the job file.
4. Set the environmental conditions for the survey.
5. Add external sensors as necessary and if available.

6.3 Opening or Creating a Job File

When first started, the Ranger software has no previous job file to use for its initial configuration and begins to operate offline. Before you can begin to use the software online, you must create a new job file and add transponders to the configuration.

Job files are created and saved as XML files. This means that you can open the files in Internet Explorer, and view their settings presented as a series of tables.

Open file

To open an existing job file:

1. Ensure the software has started and is showing **Offline** at the bottom right-hand corner of the Chart display.
2. Click the **Open** button on the toolbar, or select **File > Open…** from the menu bar to display the **Open** dialog.
3. Navigate to and select the job file to be opened, and click **Open**.

   Ranger opens the file and adopts the job configuration that it defines.

New file

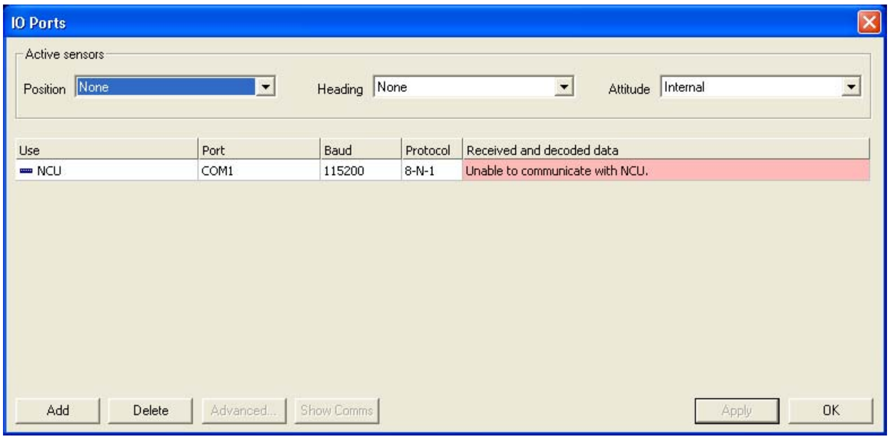
To create a new job file:

1. Ensure the software has started and is showing **Offline** at the bottom right-hand corner of the Chart display.
2. Select **File** > **New** from the menu bar.
3. Navigate to the drive and folder where you want to save the file.
4. Type a file name for the new file and click **Save**.

   If a file of that name already exists, you will be asked whether you want to replace it.
5. Select **Edit** > **IO Ports…** to display the **IO Ports** dialog.

   The dialog already includes an entry for the NCU on COM1 with default settings for the baud rate and communication protocol. You can change these if necessary.

Fig 26 IO Ports dialog



This initial configuration allows the Navigation Computer to communicate with the NCU, but does not include the transceiver link necessary for the system to work with sub-sea transponders. Neither does it include external Instruments and sensors such as a GPS receiver, gyrocompass or attitude sensor.

Refer to sub-section 6.5 “Adding Transponders” beginning on page 56 for instructions to add transponders to the system, and read the instructions below for instructions to add external Instruments and sensors.

6.4 Adding Instruments and Sensors

If you intend to use external Instruments and sensors with the system, you must add each of them individually. Depending on the needs of your survey, these Instruments and sensors could include a GPS receiver, a gyrocompass and/or an attitude sensor or Vertical Reference Unit (VRU).

Each of these external Instruments and sensors connects to a serial port on the NCU.

To add Instruments and sensors for use by Ranger:

1. Open the **IO Ports** dialog as described above.
2. Click **Add** to add an **?** **Unallocated** row to the **IO Ports** dialog.
3. Select the **Use** field in the row that currently shows **?** **Unallocated** and click the down arrow to display a list of Instruments.
4. Select **Transceiver** from the list to add the transceiver Instrument to the system.
5. Select the **Port** field in the row and click the down arrow to display a list of the available serial communication ports.
6. Select the correct port to use for the transceiver.

   Ranger immediately tries to establish communications with the transceiver using the port settings defined. The **Received and decoded data** field in the row changes colour from red to green, and shows current data when the software establishes successful communications with the transceiver. Note that, because the reset can take several seconds to complete, the row may not change colour to green immediately.
7. Repeat the sequence from step 2 for each of the Instruments or sensors that you want to add to the system.

Note

Note that, when you add GPS receiver Instruments, gyrocompasses and attitude sensors, you must select them by their output format used to supply data to the Ranger USBL System, not by their Instrument type.

Note also that you can add Instruments and sensors to Ranger's configuration subsequently if necessary, but to do this all transponder tracking must be disabled and the software must be offline first.

8. Click **OK** when you have finished adding Instruments and sensors, and follow the instructions in sub-section 6.5 "Adding Transponders" beginning on page 56 to add transponders to the system.

After you have added an Instrument or sensor to the system, you might need to apply advanced settings as described below. You should also conduct a communications check between the Instrument or sensor and the Navigation Computer, as described in sub-section 7.3 "Communication Check" beginning on page 74.

Advanced settings

To set advanced settings for an Instrument or sensor listed on the **IO Ports** dialog, select the relevant entry and click the **Advanced…** button to display the **Port properties** dialog. The options available for use on the **Port properties** dialog depend on the type of input selected.

This sub-section explains the advanced options you can set for:

- transceivers
- GPS receivers
- gyrocompasses, and
- attitude sensors.

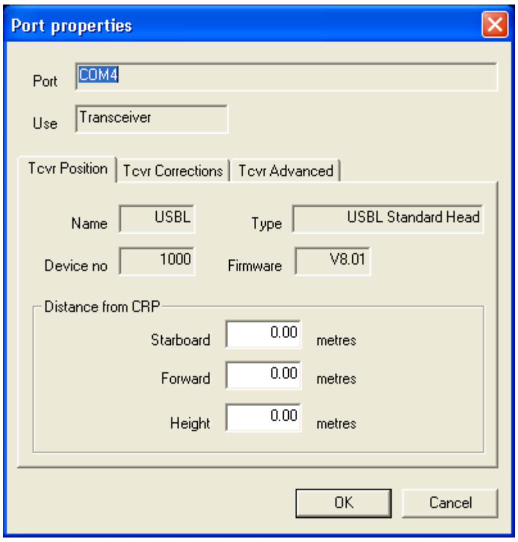
Transceiver settings

The dialog for advanced transceiver settings has three pages to allow entry of settings for:

- transceiver position
- transceiver corrections, and
- advanced transceiver options.

In each case, the dialog lists the communication port in use and confirms that the port has a transceiver connected to it.

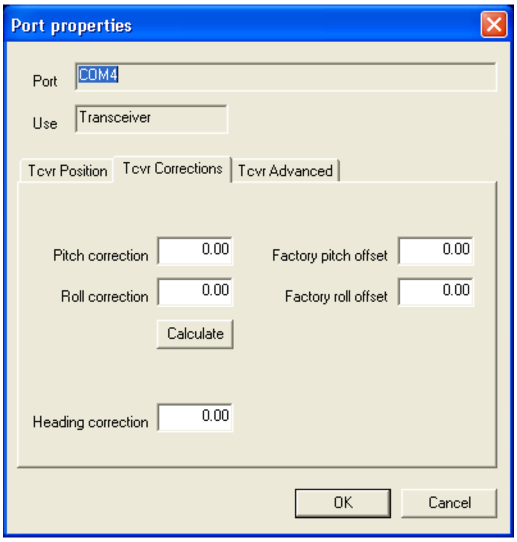
Fig 27 Port Properties—Tcvr Position page



The **Tcvr Position** page on the dialog lists the transceiver's name, device number, type and firmware version in read-only data fields.

Three text fields allow you to set the linear offset distance in metres from the vessel's Common Reference Point (CRP), separated into linear distances along the starboard, forward and up axes. If the transceiver is to port, aft of, or below the vessel's CRP, the relevant measurement will be negative.

Fig 28 Port Properties—Tcvr Corrections page



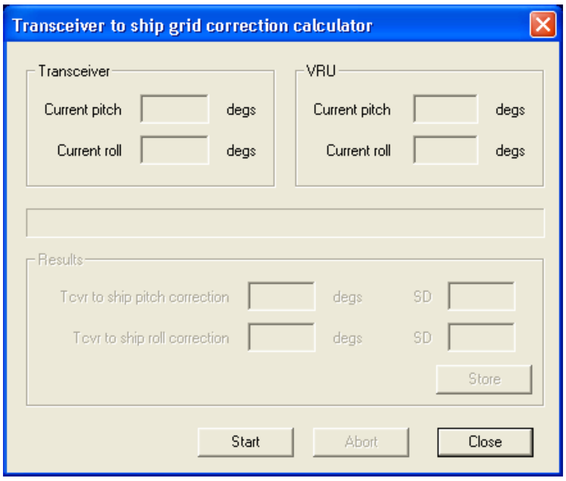
The **Tcvr Corrections** page on the dialog allows you to set the Pitch and Roll corrections to be applied within the system.

This procedure requires there to be an external VRU supplying attitude measurements to the Ranger USBL System.

To calculate the Pitch and Roll corrections:

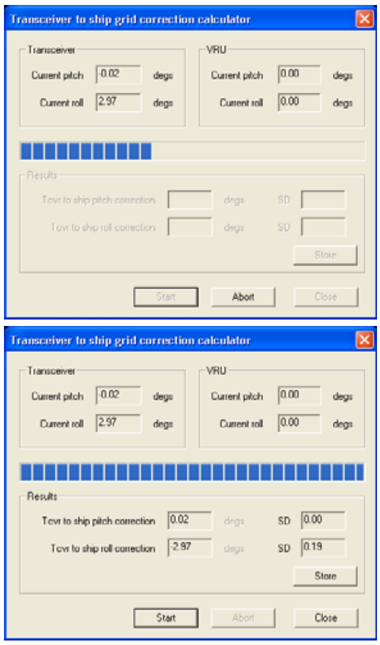
1. Type the Factory pitch offset and the Factory roll offset values stated on the transceiver's housing label into their respective fields on the dialog, and click **Calculate** to display the **Transceiver to ship grid correction calculator**.

Fig 29 Transceiver to ship grid correction calculator



2. Click **Start** to start the calculation process, which takes a series of measurements from the external VRU and the transceiver's attitude sensors over a period of time.

   By making the measurements over a period of time, the software can take an average reading to significantly reduce or remove the effects of residual vessel movements caused by swell.

   The dialog shows the pitch and roll measurements delivered by the transceiver's inclinometer and the external VRU in read-only data fields in the top half of the calculator, and a progress bar extends towards the right as the calculation process continues.

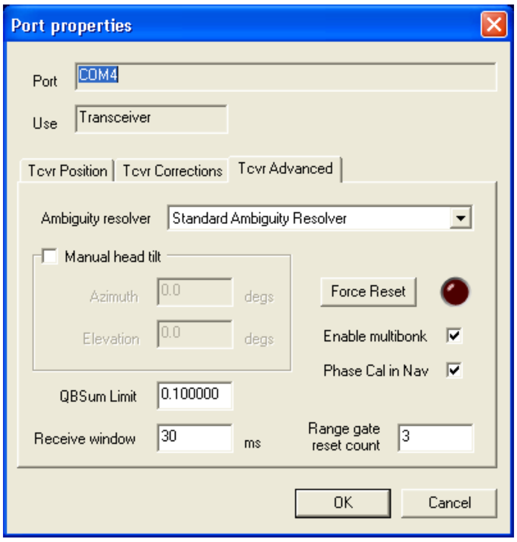
   On completion of the calculation process, read-only data fields in the **Results** frame in the bottom half of the calculator show the transceiver-to-ship pitch and roll corrections to be applied, and the standard deviation determined by the measurements process.

3. Click the **Store** button to save the new pitch and roll correction values, and click **Close** to close the calculator. These values will then be shown on the **Port Properties–Tcvr Corrections** dialog.

4. Type a heading correction for the transceiver heading to align the transceiver with the vessel's fore-aft line. This information can come from a CASIUS

calibration using the system, as described in section 8 “Calibration” beginning on page 78.

Fig 30 Port Properties—Tcvr Advanced page



The **Tcvr Advanced** page allows you to view and change the transceiver’s advanced settings.

CAUTION

These settings can have a significant effect on the system’s performance. Do not make any changes to the settings on this dialog unless you are advised to do so by Sonardyne. The information included here is for reference only.

1. **Ambiguity resolver**:
   - **No Ambiguity Resolver**—This setting will disable the transceiver’s ability to solve some USBL positions and could cause tracking problems.
   - **Standard Ambiguity Resolver**—This is the default operating mode and is appropriate for the majority of scenarios, allowing the transceiver to solve most USBL positions.
   - **Auto Head Tilt**—This mode is appropriate for use only in reverberant environments where the USBL signal may not be ‘clean’ throughout the entire pulse length. It uses the first of the eight samples to aid the remaining seven samples. This mode is rarely used.
2. **Manual head tilt**—This allows you to bias the transceiver’s field of operation in a particular direction defined by the **Azimuth** and **Elevation** fields. USBL signals coming from this direction are more likely to be solved correctly, but at the expense of signals coming from the opposite direction. This mode is rarely used.
3. **Force Reset**—This causes an immediate reset of the USBL transceiver.
4. **Enable Multibonk**—This option should nearly always be enabled. It allows the system to interrogate multiple beacons that are all on different interrogation channels in a single acoustic cycle, thereby improving the update rate for all beacons.
5. **Phase Cal in Nav**—Allows the transceiver’s phase calibrations to be performed when navigating. This option should always be enabled.

6. **QBSum Limit**—This number is a quality figure used for the acceptance of USBL position information. **Do not change this setting without instructions from Sonardyne.**
7. **Receive window**—This is the number of milliseconds either side of the predicted range that will be applied once the system locks onto a signal. If the travel time changes by more than this number between acoustic cycles, then the target will be temporarily lost. This feature is rarely used and should be changed only if instructed to do so by Sonardyne.
8. **Range gate reset count**—If no reply is received from a transponder for the number of cycles set by this field, then the predicted travel time is erased and the system begins a fresh search for the target. By increasing this number, it is possible to prevent a filter reset in difficult environments, but it can also slow down the filter reset if the system locks onto the wrong signal.

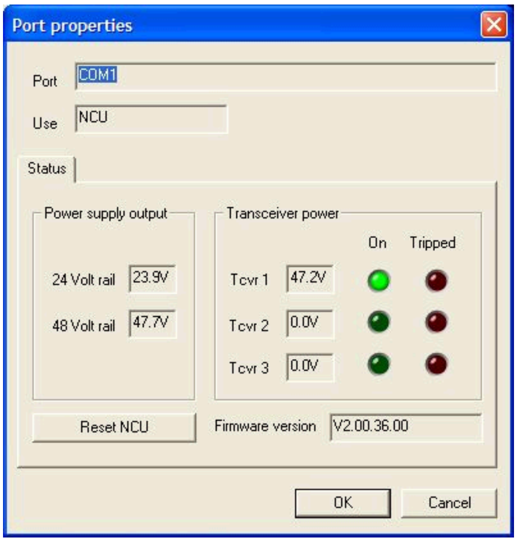
Click **OK** when you have completed all the advanced transceiver configuration tasks on these dialogs.

Note

There are additional transceiver settings that you can make, for example to set the transceiver's receive pulse length, transmit power, detection threshold and validation threshold. Refer to "USBL" beginning on page 60 for relevant details.

NCU settings

Fig 31 NCU Port properties dialog



This dialog displays information about the health of the connected NCU.

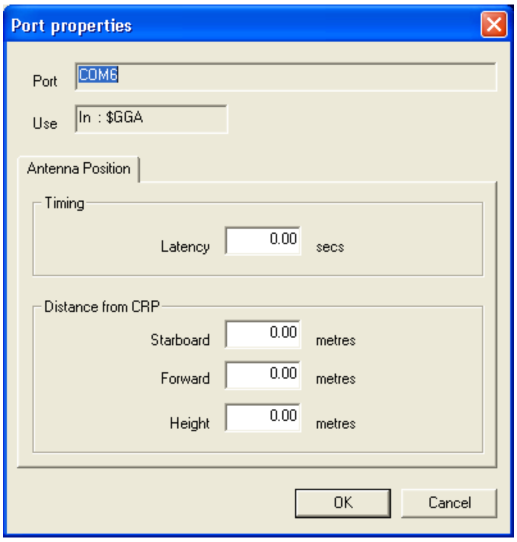
The left-hand side of the dialog includes information about the main power supply and the voltages it is currently supplying. These measured voltages should all be within ±2V of the specified 24V and 48V DC supplies.

The right-hand side of the dialog includes details of the power being supplied to the transceiver. The display includes 'LEDs' to show whether the power is on, and whether the power has been tripped. A power trip might occur if the transceiver draws too much current, or if there is a short-circuit in the transceiver's cable.

The bottom of the dialog shows the NCU's firmware version installed, and includes a button to force an NCU reset.

GPS settings

Fig 32 GPS Port properties dialog



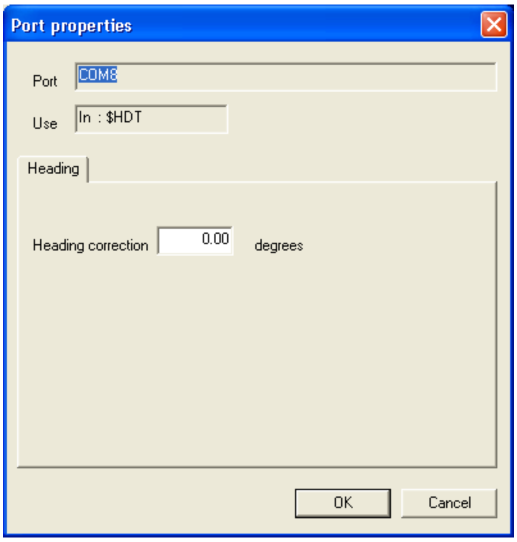
This dialog shows the serial port used for communications, and the data format selected in read-only data fields.

Fields on the dialog allow you to set the GPS timing latency, in seconds. This is the time interval between a position measurement being made by the GPS system and the results being output. Refer to the GPS system's documentation for this information.

Measure the offset distances from the vessel's CRP to the GPS antenna, in metres, along the starboard, forward and up axes, and enter these details in their respective fields. Enter any measurements to port or aft of the CRP as negative values. Negative height values are unlikely for a GPS antenna.

Gyrocompass settings

Fig 33 Gyrocompass Port properties dialog

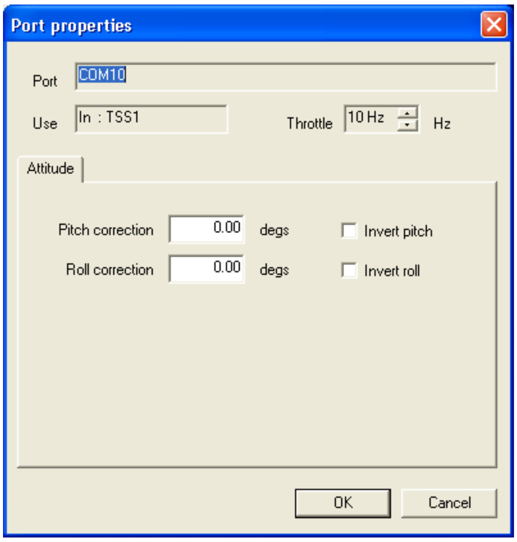


This dialog shows the serial port used for communications, and the data format selected in read-only data fields.

A single field on the dialog allows you to set the heading correction to be applied to the transceiver's measurements to align them correctly with the vessel's fore-aft line.

Attitude sensor settings

Fig 34 Attitude sensor Port properties dialog



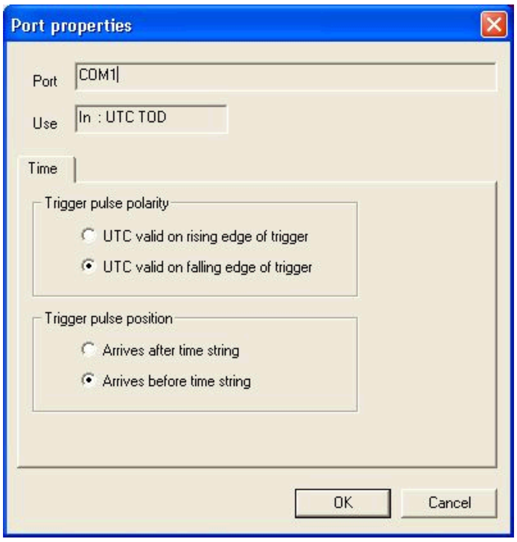
This dialog shows the serial port used for communications, the data format selected and the update rate in read-only data fields.

Fields on the dialog allow you to set the pitch and the roll correction angles between the vertical in the VRU's reference frame and the vertical in the vessel's reference frame. You can also set options to invert the pitch and roll angles if necessary, if the VRU delivers these measurements in the opposite sense.

Refer to Appendix B "Frames, Offsets and Corrections" beginning on page 103 for an explanation of reference frames.

UTC Time of Day settings

Fig 35 UTC TOD Port properties dialog



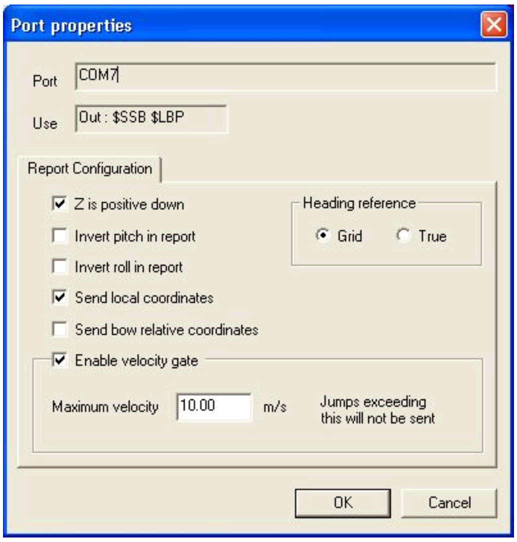
This dialog allows you to configure the UTC input to the Ranger USBL System.

The **Trigger pulse polarity** options determine whether the UTC time string is valid on the rising edge or the falling edge of the 1PPS input from the GPS receiver.

The **Trigger pulse position** options determine whether the 1PPS input arrives before the UTC time string or after it.

DP Output settings

Fig 36 DP Port properties dialog



This dialog allows you to configure all DP outputs such as the SSB, HPR309, HPR418, and so on.

The dialog includes the following controls and options:

- **Z is positive down**—This determines whether the Z-axis direction is positive in the down or the up direction. The effect of the control is to invert the sign on the Z output.
- **Invert pitch in report**—This control inverts the pitch reported in the DP telegram.
- **Invert roll in report**—This control inverts the roll reported in the DP telegram.
- **Send local coordinates**—If the system is positioning a transponder in real-world co-ordinates, when you select this option the position information in the DP output report will change to local co-ordinates, relative to the vessel, instead of real-world co-ordinates.
- **Send bow relative coordinates**—If the system is receiving heading information, when you select this option the position information in the DP output will be rotated to be relative to the vessel's bow instead of relative to north.
- **Enable velocity gate**—If you enable this option, positions that jump significantly between updates will not be included in the DP output.

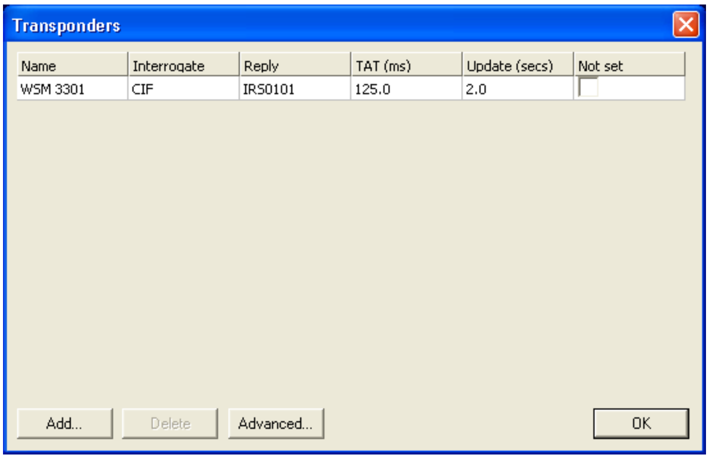
6.5 Adding Transponders

After you create a new file, the default configuration includes support for a single Sonardyne Wideband™ Sub-Mini (WSM) beacon. You can add support for a series of beacons as required within your system configuration.

To add the system's transponders to Ranger:

1. Select **Edit** > **Transponders…** from the menu bar, or click the Transponders button on the toolbar to display the **Transponders** dialog, which includes the default WSM 3301 transponder name.

Fig 37 Transponders dialog



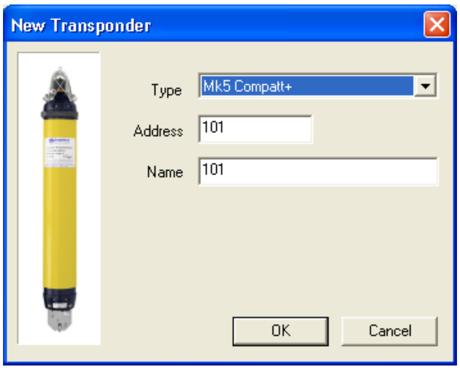
Note

If the **Not set** control on this dialog is selected, the transponder will be re-programmed from the beginning after you close the **Transponders** dialog. When you make a change to a transponder setting, such as the interrogate channel to use, **Not set** will be selected automatically. This control has no effect on transponders that cannot be reprogrammed acoustically.

If necessary, select the existing transponder name and click **Delete** to delete it.

2. Click **Add…** to display the **New Transponder** dialog.

Fig 38 New Transponder dialog



3. Select the type of transponder from the **Type** drop-down list.

   The dialog's picture changes to show an example of the selected transponder.

4. Type the address for this transponder in the **Address** field.

5. Type a name for the transponder in the **Name** field and click **OK** to add the transponder to the **Transponders** dialog.

6. Select the **Interrogate** field for the transponder and click the down arrow to display a list of valid interrogate channels.

   Select the appropriate interrogate channel for the transponder.

Note

If the new transponder is to be tracked as a responder then the interrogate channel should be set to a responder channel. Responder channels can be found at the bottom of the interrogate channel list. When an NCU is connected, available responder channels will be listed as RPDR xx which refers to the responder ports on the NCU. When an SIU is connected, the interrogate channel SCU RPDR will be available which refers to the connector on the rear of the SCU.

7. Select the **Reply** field for the transponder and click the down arrow to display a list of valid reply channels.

   Select the appropriate reply channel for the transponder.

8. Select the **TAT** field for the transponder and click the down arrow to display a list of valid turn-around times.

   Select the appropriate turn-around time for the transponder.

9. Type an update interval in seconds for the transponder in the **Update** field.

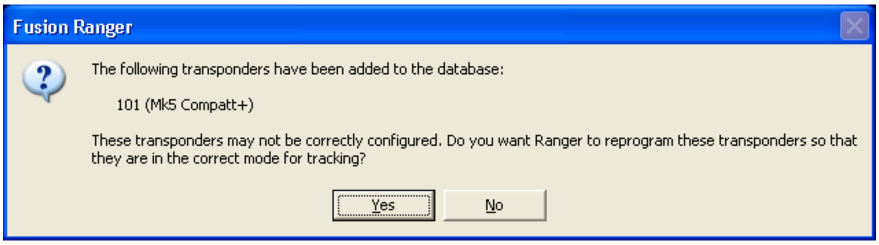
10. Repeat steps 1 to 9 for each of the transponders you want to add to the system.

    If you need to apply additional configuration settings for the transponders, these are available by clicking the **Advanced…** button on the Transponders dialog. Refer to the Transponder configuration sub-section below for details.

11. Click **OK** when you have finished adding and configuring all transponders within the Ranger USBL System.

    Ranger adds the transponders to the Job's database, and displays a message to ask whether you want the software to reprogram them automatically to establish the correct mode for tracking.

Fig 39 Transponder database message



12. Click **Yes** to allow Ranger to reprogram the transponders automatically.

Note

If you click No instead, then you will still have the option to open the Transponders dialog and select the Not set control to have the system reprogram the transponders.

Ranger sends the command sequence to reprogram the transponders, and the transponders become 'set'. This process can take about a minute to complete. Progress is displayed on the main screen's text display, described on page 43.

Ranger adds new Tracking On/Off buttons to the main screen, showing the names that you defined for each of the new transponders.

This leaves the Ranger software in a condition to use the transponders you have defined.

13. Follow the instructions in sub-section 6.6 "Configuring for the Environment" beginning on page 64 to configure the environmental configuration.

Transponder configuration

Ranger allows you to apply additional configuration settings to the system's transponders. These settings are accessible by clicking the **Advanced…** button on the **Transponders** dialog to display the **Transponder details**.

Fig 40 Transponder details dialog

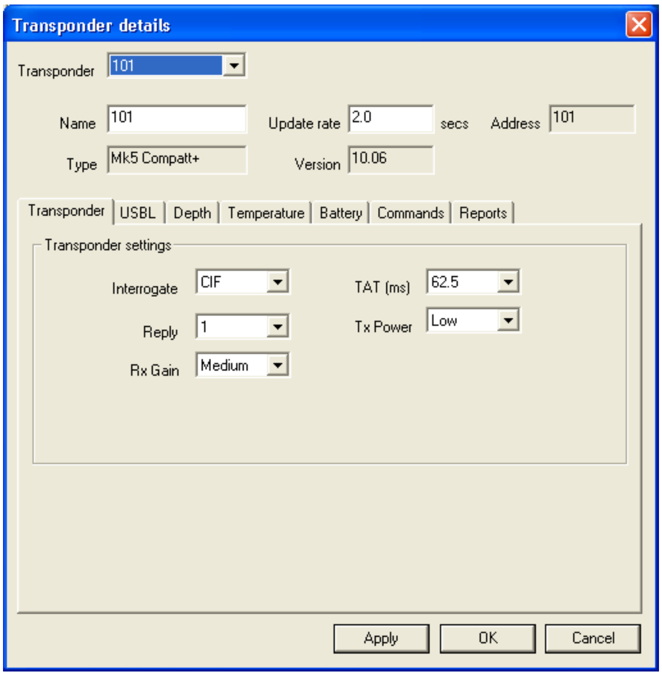


Table 16 lists and describes the purpose of controls in the top region of the **Transponder details** dialog.

Table 16 Transponder details dialog

Control	Purpose
Transponder	Select the name of the transponder whose details you want to set.
Name	Type a name for the transponder if you want to change its current name.
Update rate	Type the interval, in seconds, between successive updates required from the transponder.
Address	A read-only data field showing the selected transponder's address.
Type	A read-only data field showing the type of transponder selected
Version	A read-only data field showing the firmware version installed in the selected transponder. The field shows Unknown if this information is not available.

The following tables list and describe the purpose of the controls and features included in the bottom region of the dialog.

Transponder

This is the initial page to be viewed when you open the **Transponder details** dialog. It allows you to view and change the transponder's settings.

Fig 41 Transponder page

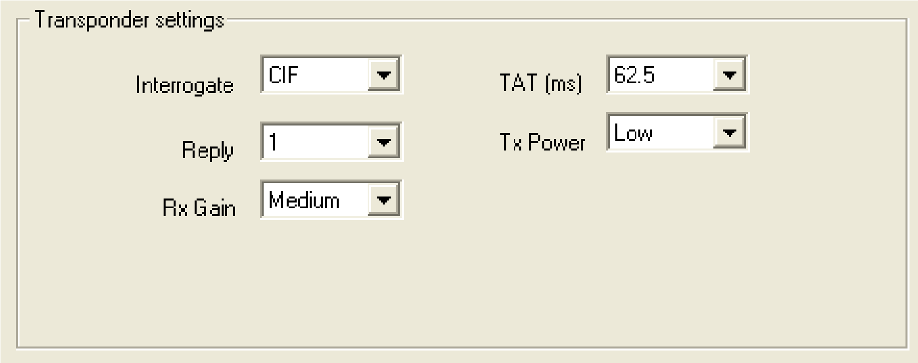


Table 17 Transponder page details

Control	Purpose
Interrogate	Displays the interrogate channel currently set for the transponder, and allows you to change it if necessary.
TAT (ms)	Displays the current setting for the transponder's turn-around time in milliseconds, and allows you to change it if necessary.
Reply	Displays the reply channel currently set for the transponder, and allows you to change it if necessary.
Tx Power	Displays the current setting for the transponder's transmit power, and allows you to change it if necessary. The options are **Low**, and **High**. The default setting is **Low**.
Rx Gain	Displays the current setting for the transponder's receiver gain, and allows you to change it if necessary. The options are **V Low**, **Low**, **Medium**, and **High**. The default setting is **Medium**.

USBL This page allows you to view and change transceiver settings.

Fig 42 USBL page

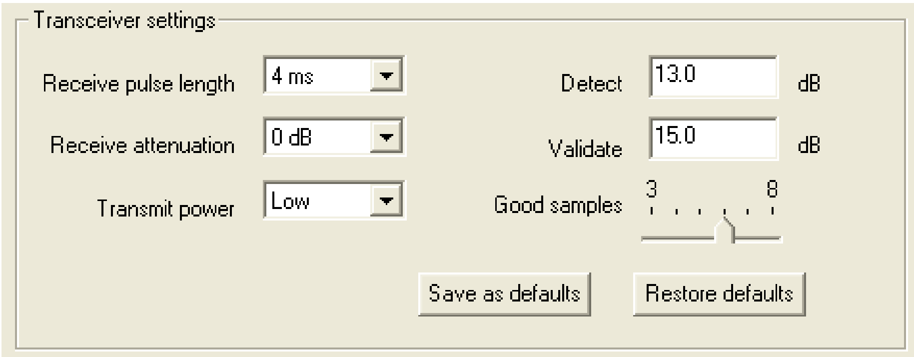


Table 18 USBL page details

Control	Purpose
Receive pulse length	Allows you to set the length of the received pulse that the transceiver uses from a transponder. You can reduce this setting to improve performance in the presence of multipath reflections. Avoid setting the received pulse length to less than 2ms. Refer to "Signal destruction (Multipath)" beginning on page 123 for a description of the multipath acoustic problem that may cause you to reduce the **Receive pulse length** setting.
Detect	This is a threshold level that sets the amount by which the received signal must exceed the background noise before the transceiver will start the detection process.
Receive attenuation	This sets how much receiver attenuation is used when receiving reply signals from a transponder.
Validate	This is a threshold level that sets the amount by which a receive signal must exceed the background noise before the transceiver will start the validation process. Validation can occur only after the detection threshold has been achieved. The validation threshold should always be 2dB higher than the detection threshold.
Transmit power	This sets the power to be used for the transceiver's interrogation signals. The options are **V Low**, **Low**, **Medium**, and **High**. The default setting is **Low**.
Good samples	This sets the number of samples taken of a received signal that must be classed as 'good' before the transceiver accepts the signal as being valid. The range is from 3 to 8, and the default setting is 6.

This page includes buttons that allow you to save the current settings as new defaults, and to restore the settings to their default.

Depth

This page allows you to view and change settings for the transponder's depth sensor, if fitted, and to set options for depth aiding. Refer to Appendix A.6 "Depth aiding" beginning on page 101 for an explanation of depth aiding.

Fig 43 Depth page

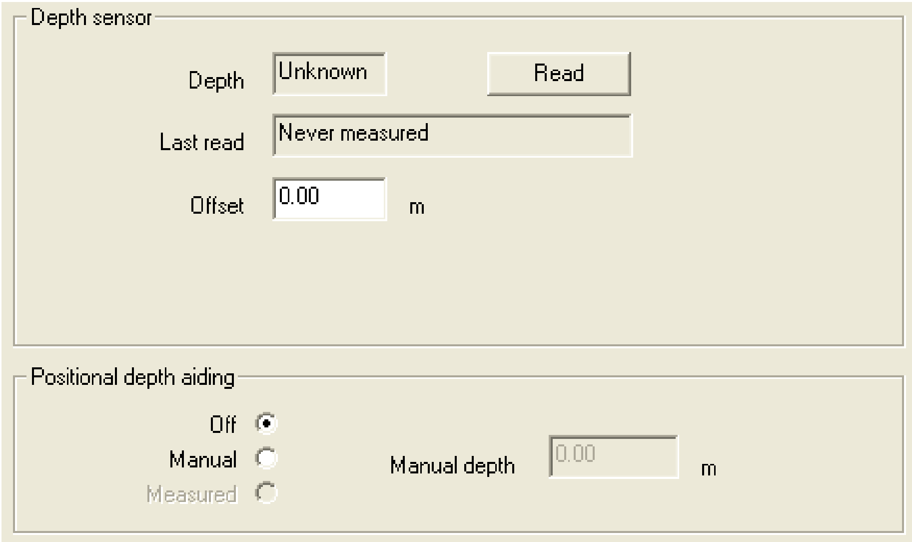


Table 19 Depth page details

Control	Purpose
Depth	A read-only data field that displays the current depth measured by the transponder, if this is known.
Read	A button that sends a command to read the depth from the transponder's depth sensor.
Last read	A read-only data field that indicates when a depth measurement was last made from the transponder.
Offset	Set an offset distance, in metres, between the transponder's depth sensor and the target's reference point.
Positional depth aiding	These option buttons allow you to set depth aiding to **Off**, **Manual**, or **Measured**. When using manual depth aiding, you can type a depth, in metres, for the transponder.

Temperature

This page allows you to view and change settings for the transponder's temperature sensor, if fitted.

Fig 44 Temperature page

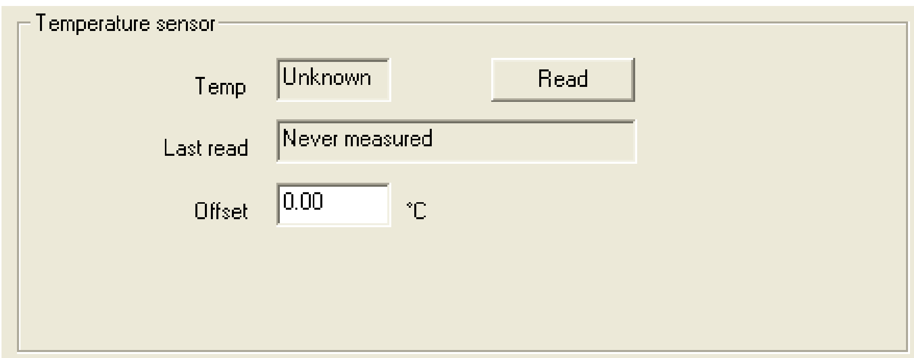


Table 20 Temperature page details

Control	Purpose
Temp	A read-only data field that displays the current temperature measured by the transponder, if this is known.
Read	A button that sends a command to read the temperature from the transponder's temperature sensor.
Last read	A read-only data field that indicates when a temperature measurement was last made from the transponder.
Offset	Set an offset temperature used to apply corrections for the transponder's temperature sensor.

Battery

This page allows you to view details about the transponder's battery condition.

Fig 45 Battery page

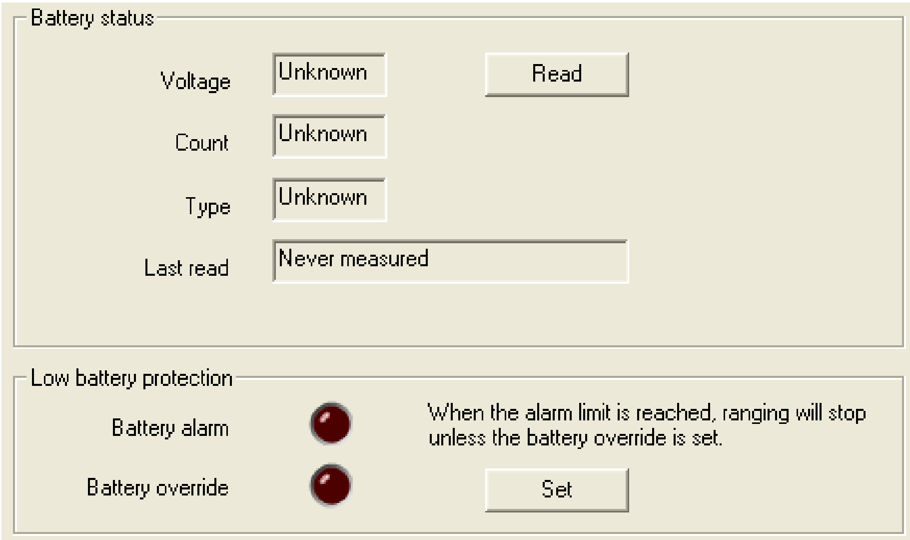


Table 21 Battery page details

Control	Purpose
Voltage	A read-only data field that shows the current battery voltage.
Count	When using Alkaline batteries with the Compatt, it is possible to determine a good estimate of the battery life remaining because the battery voltage falls slowly as the battery becomes exhausted. However, when using Lithium batteries this method cannot be used, because these batteries have a flat voltage characteristic. Instead, Compatt uses a software totaliser, which increments every time the Compatt transmits a pulse. This totaliser runs from zero when a new pack is manufactured, and extends upwards to a theoretical point at which certain functions will cut-out. At this point the unit is ready to have a new battery fitted. However, if the unit is in use, the cut-out can be overridden by sending the Compatt command 'OV'., although the unit will no longer be guaranteed to function normally, or to release, after the battery count limit has been exceeded. This read-only field shows the current battery totaliser count. Refer to the Compatt manual for details of the battery count limits.
Type	A read-only data field that shows the type of battery installed in the transponder.
Last read	A read-only data field that shows the date and time when the battery information was last read.
Read	A button that allows you to read the battery values and update the displayed information in the above fields.
Battery alarm	A red 'LED' indicator that illuminates when the battery capacity is low.

Control	Purpose
Battery override	A red 'LED' that illuminates when you have set the battery override. When the battery alarm limit is reached, ranging will stop using the affected transponder unless you have set the battery override.

Commands

Fig 46 Commands page

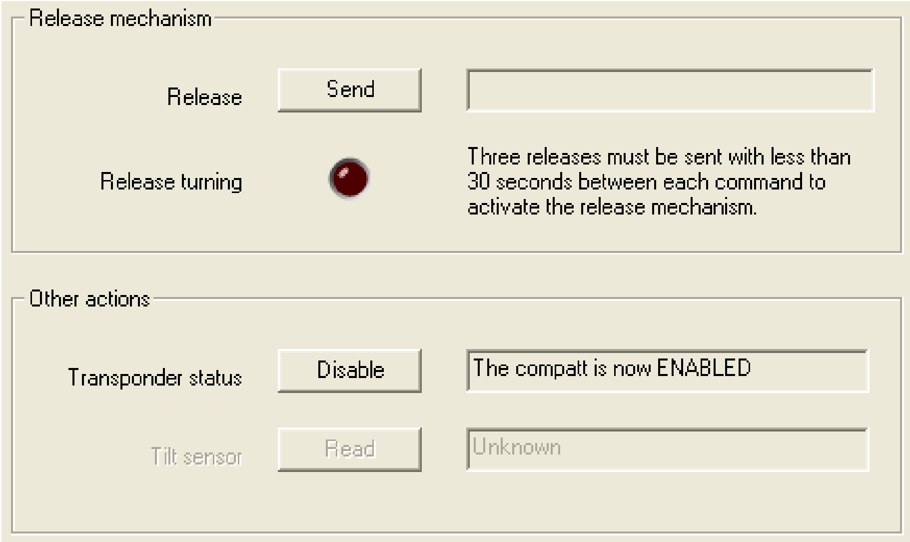


Table 22 Commands page details

Control	Purpose
Release	This button sends a single release command to the transponder. A data field to the right of the button shows the current status of issue for the release commands.
Release turning	A red 'LED' that flashes to indicate that the release command is being actioned by the transponder. The data field shows when the release has been completed, and confirms that 15 pings have been received from the transponder on release.
Transponder status	This button allows you to disable or enable the transponder. A data field to the right of the button confirms the transponder's current status.This setting is repeated on the main screen's Tracking On/Off button for the relevant transponder.
Tilt sensor	If the transponder includes an internal inclinometer or tilt sensor, this button allows you to read the current measurement from it in the adjacent data field. Otherwise the data field will show 'Unknown'.

Report

Fig 47 Reports page

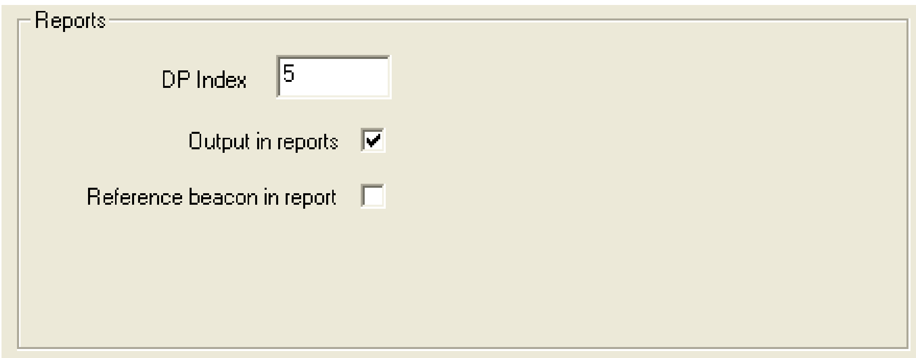


Table 23 Reports page details

Control	Purpose
DP Index	Allows you to view and set the index number used for the selected transponder when used in dynamic positioning (DP) operations. This number is included in Ranger's output reports.
Output in reports	Allows you to set whether or not the selected transponder's output is included in Rangers output reports. It is selected by default.
Reference beacon in reports	Allows you to set whether or not the selected transponder is used as a reference beacon in Ranger's output reports.

Note

Refer to Appendix E "Report Formats" beginning on page 132 for a description of the output reports available from Ranger.

6.6 Configuring for the Environment

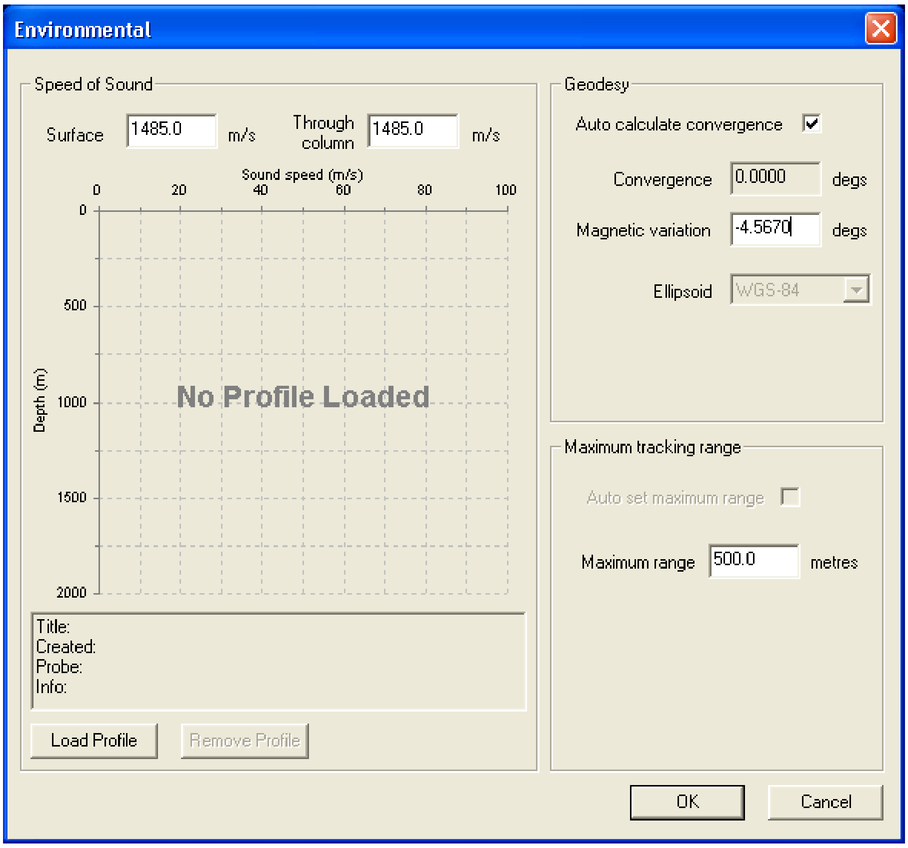
Depending on circumstances, you may have to change some of the default settings for the environmental configuration used by the Ranger software. These settings include the speed of sound, the maximum range to be used, and some geodetic conditions. It is also possible to load sound velocity profiles into Ranger.

Setting the environment

To load a Sound Speed Profile:

1. Select **Edit** > **Environmental…** from the menu bar, or click the Environmental button on the toolbar to display the **Environmental** dialog, which includes default settings.

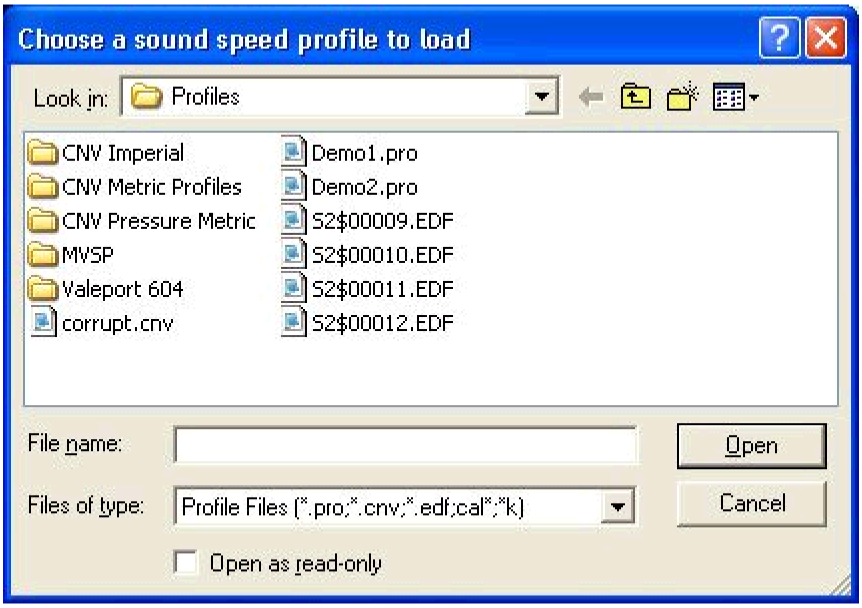
Fig 48 Environmental dialog



Sound speed profile

2. Click the **Load Profile** button to display a file dialog that allows you to choose and open a sound speed profile.

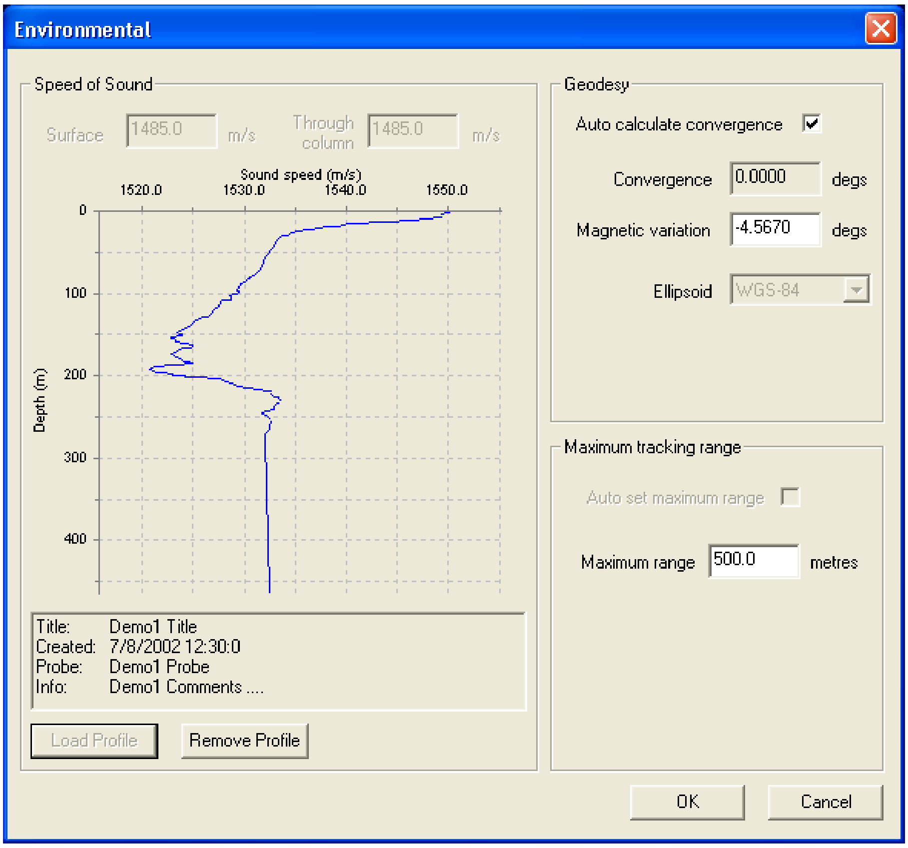
Fig 49 Open Profile dialog



3. Select the sound speed profile to use and click **Open**.

Ranger processes the file automatically and displays the profile on the dialog, as shown in Fig 50.

Fig 50 Sound speed profile display



When you load a sound speed profile, the profile overrides any information included previously in the **Surface** and the **Through column** fields. You can choose to enter information in these fields instead of using the profile by clicking the **Remove Profile** button, which becomes active after you have loaded a profile.

Maximum range

4. Set the maximum range at which you expect to track any transponders.

   You can select the **Auto set maximum range** check box to set this parameter automatically.

   For MF transponders the maximum range is limited to 2000 metres; for HF transponders it is limited to 750 metres.

Convergence and variation

5. Either select the **Auto calculate convergence** check box or enter a manual convergence for the vessel's current location.
6. Set the local magnetic variation.
7. Click **OK** to set the environmental configuration you have defined.

After you have completed the procedures described previously in this section the Ranger software's configuration will be in a state where you can begin to use it for a survey. Refer to section 7 "Software Operation" beginning on page 72 for instructions to use the software for a survey.

However, if necessary, you can continue to configure the software's sound alerts, chart properties and chart shapes, as described below.

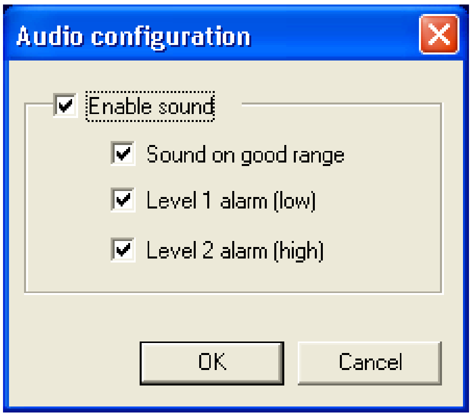
6.7 Configuring Sound Alerts

You can set the software's configuration to sound an alert tone when certain conditions apply during operation. This feature allows you to use the software without the need to keep a continuous watch on the display.

To set Ranger's sound alerts:

1. Select **Edit > Sounds…** from the menu bar, or click the **Audio configuration** button on the toolbar to display the **Audio configuration** dialog.

Fig 51 Audio configuration dialog



2. Ensure the **Enable sound** check box is selected if you want to use Ranger's sound alert feature.

   You can deselect this check box to disable all sound alerts from the software.

3. Select the sound alert check boxes as required:

   - **Sound on good range**—Sound an alert tone whenever the system measures good ranging information to a transponder.

If you select this option, Ranger will issue regular and frequent alert tones.

- **Level 1 alarm (Low)**—Sound an alert whenever a low-level alarm condition arises and is added to the alarm list.
- **Level 2 alarm (High)**—Sound an alert whenever a high-level alarm condition arises and is added to the alarm list.

4. Click **OK** to set the audio configuration you have defined.

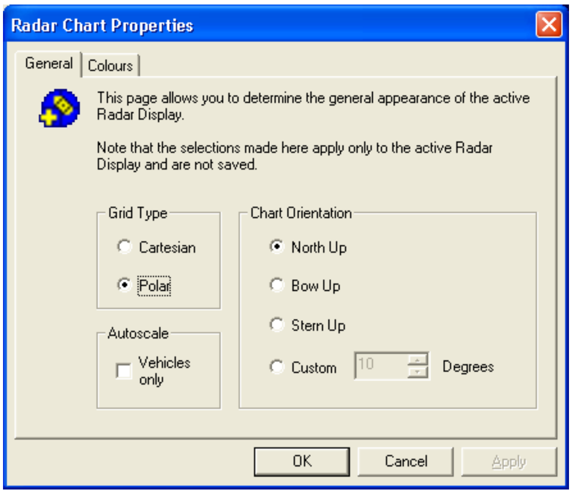
6.8 Configuring Chart Properties

You can set the properties of the Chart display to define the grid type, the chart orientation and the chart colours.

To configure the chart properties:

1. Select **Edit > Chart properties…** from the menu bar, or right-click on the chart and select **Properties** from the context menu to display the **General** tab of the **Radar Chart Properties** dialog.

Fig 52 Radar Chart Properties dialog—General tab

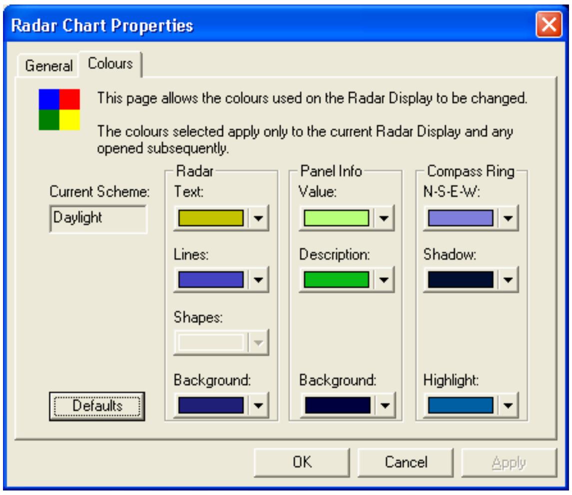


2. Set the **Grid Type** option button either to **Cartesian** or **Polar** as required.

   Refer to sub-section 5.5 “Chart display” beginning on page 44 for a description of these chart formats.

3. Select the **Autoscale**—**Vehicles only** check box if you want auto zoom to include only the vehicles being positioned. With this control deselected, auto zoom will include all waypoints —some of which may be at some distance from the vessel.
4. Set a **Chart Orientation** option button as required to **North Up**, **Bow Up**, **Stern Up**, or to a **Custom** orientation that you define.
5. Click **OK** to accept the chart properties you have defined, or continue the following steps to set the chart colours.
6. Select the **Colours** tab.

Fig 53 Radar Chart Properties dialog—Colours tab



7. Set your preferred colours for elements on the current chart display by clicking the down arrow on each control.

   Click the **Apply** button to apply the colours you have set to the chart while leaving the dialog open. This allows you to see the effects of your changes, and to make further changes if necessary.

   You can reset the colours to their default settings by clicking the **Defaults** button.

8. Click **OK** when you have finished setting the chart colours.

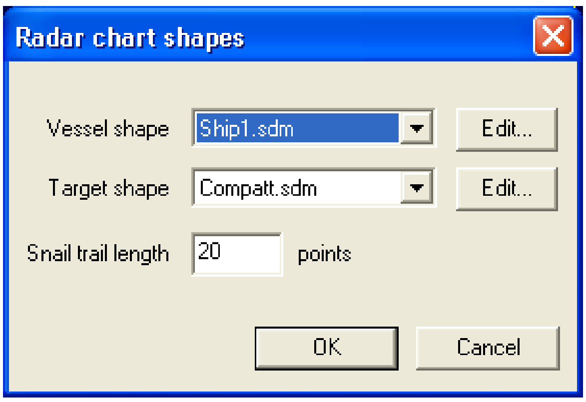
6.9 Configuring Chart Shapes

You can set the Ranger software to use a variety of supplied, pre-defined shapes for the various vessels and targets on the Chart display. If necessary you can create new shapes to add to those supplied with Ranger.

To configure chart shapes:

1. Select **Edit > Chart shapes…** from the menu bar to display the **Radar chart shapes** dialog.

Fig 54 Radar chart shapes dialog



2. Select a shape for the vessel from the **Vessel shape** drop-down list.

   The list includes a range of pre-defined shapes for barges, rigs, templates and other structures. If none is suitable, you can create a new shape by modifying an existing one. Refer to **Editing chart shapes** below for instructions to do this.

3. Select a shape for the target from the **Target shape** drop-down list.
4. Type a value for the length of the snail trail that Ranger will apply to shapes when they move.

   Longer snail trails will more clearly show the relative movement of the vessel and tracked targets, but could cause the display to become cluttered. Set a value that represents a good compromise for your purposes. You can clear all snail trails on the chart by clicking the **Clear chart trails** button on the toolbar.
5. Click **OK** when you have finished setting the chart shapes.

Editing chart shapes

You can edit existing chart shapes to create new ones if an existing vessel or target shape is not suitable for your purposes.

Note

Note that editing shapes to create new ones can take some time, and you should seriously consider whether the effort is of value—the charts shapes in use affect only the chart display and have no effect on the survey itself or on data logging. You might find it easier to identify one of the supplied, pre-defined shapes that nearly matches your requirements, and to use that.

To edit chart shapes:

1. Open the Radar chart shapes dialog as described in **Configuring Chart Shapes** above.
2. Open either the **Vessel shape** or the **Target shape** drop-down list, and select a shape that most closely matches the one you want to create.
3. Click **Edit…** against the selected shape to display the **Shape Editor** window, with the selected shape open for editing.

   The Shape Editor window has its own toolbar, with buttons for editing the image.

Fig 55 Shape Editor dialog

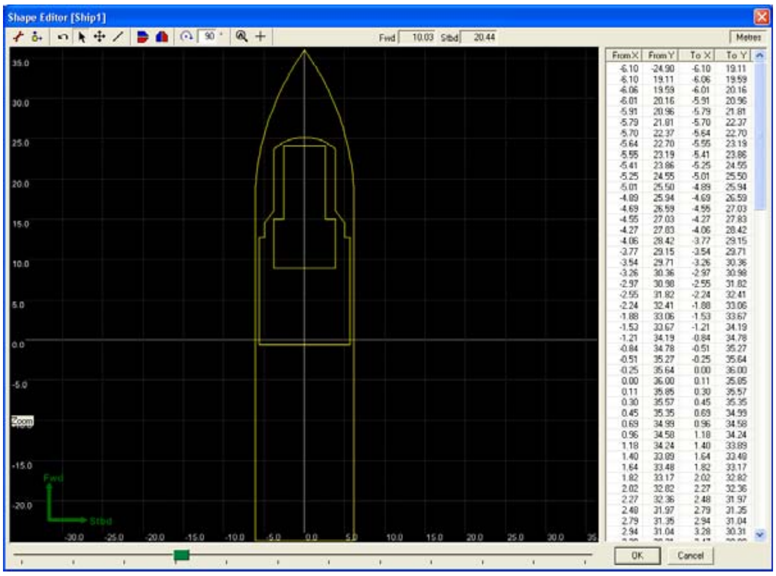
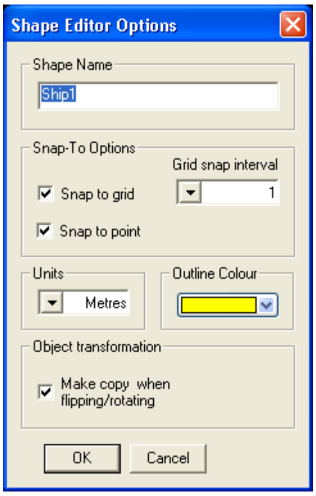


Table 24 Shape Editor toolbar buttons

Button	Description
Editor Options	Displays the **Shape Editor Options** dialog.
Apply Global Offset/Scale	Allows you to set offsets or a scale factor for the shape. **Offsets** move the shape in the forward and starboard direction relative to its current location with respect to the to the drawing's 0, 0 reference point, marked by the intersection of the horizontal and vertical cross-hairs. Negative values move the shape to port or aft of its current location. This feature allows you to create a shape that will appear on Ranger's Chart display with a constant, pre-defined offset. **Scale factors** allow you to scale the shape's dimensions either along the fore-aft or the port-starboard axes.
Undo (Ctrl + Z)	Undoes only the previous action. If clicked a second time it 'undoes the undo', meaning that the button toggles between undoing an action and re-doing the action.
Select Tool	Select the shape object that you click, so that you can use the other tools to edit it.
Pan Tool	Allows you to click and drag the drawing to pan the viewing window in the direction dragged.
Line Tool	Draws a line on the shape. Click at the line's starting point and drag the cursor to the line's end point before you release the mouse button. Use the **Fwd** and **Stbd** coordinate fields to the right of the toolbar buttons to place the start and end points of the line at precise positions relative to the 0, 0 reference point. The coordinates list to the right of the drawing pane lists the starting and ending X–Y coordinates for all line segments on the drawing. Click an entry in the list to select the associated line on the shape.
Flip Selection Vertically	Flips the selected shape object vertically about its horizontal axis, creating a vertical mirror image of the object. You can set the Editor Options either to make or to not make a copy when you flip the object.
Flip Selection Horizontally	Flips the selected shape object horizontally about its vertical axis, creating a horizontal mirror image of the object.
90 ° Rotate Selection Clockwise (Ctrl + R)	Rotates the selected chart object by the amount specified in the adjacent text box. The rotation angles are always in the clockwise direction, in the range 1 to 359. To rotate an object anticlockwise, subtract the desired anticlockwise rotation angle from 360° and use this as the clockwise rotation angle. You can set the Editor Options either to make or to not make a copy when you rotate the object.
Zoom All (Ctrl + L)	Zooms the drawing to see all objects in the shape. You can zoom the drawing manually by dragging the green button on the zoom scale beneath the black drawing pane. Dragging to the right causes the drawing to zoom out, showing a larger area of the shape.
Centre Display (Ctrl + C)	Centres the display on the 0, 0 reference point. This button allows you to centre the drawing easily after you have panned it to an area where the reference point is not visible.

4. Click the **Editor Options** button to display the **Shape Editor Options** dialog.

Fig 56 Shape Editor Options dialog



This dialog allows you to set options for the current drawing, including:

- its name
- the snap options when adding and moving objects
- the units used for measurements
- the shape's outline colour, and
- whether or not to make a copy of the selected object when you flip or rotate it.

5. Type a name for the shape that you are creating.
6. Set other options as required for the Shape Editor and click **OK**.
7. Use the tools on the toolbar to edit the displayed shape to your requirements.
8. Click **OK** when you have finished editing the shape to display the **Save As** dialog.
9. Type a name for the new shape file, and click **Save**.

7 Software Operation

In this section...

This section contains the following topics:

7.1 Introduction

This section requires you to have configured Ranger to be ready for use as described in section 6 “Software Configuration” beginning on page 47. If you have not completed all necessary configuration tasks yet, do so now.

This section describes the following operations:

- Use of the software tools.
- System calibration.
- Data logging.

7.2 Software Tools

Introduction

The Ranger software provides a series of tools that allow you to:

- analyse the signal quality received from transponders
- issue manual commands to transponders
- test the transceiver calibration
- measure local noise in the operating area
- measure an average fix position for the transponders, and
- measure the distance between features on the Chart display.

When to use the tools

The signal analysis and noise measurement tools are there to help you establish the best operating conditions for your survey, and you should use them before you begin operations.

The manual command tool allows you to issue commands manually to a Compatt transponder. It is unlikely that you will need to use this tool, because the Ranger software handles all these command functions automatically. You should also note that this tool requires a detailed working knowledge of Compatt transponders, and you should not use it unless you have this knowledge.

The average fix tool allows you to select each of the transponders being tracked and to calculate an average fix position for them over a series of measurements.

The chart measurement tool allows you to measure the range and relative bearing from a tracked target or the vessel to some other feature on the Chart display.

Refer to Appendix D “Software Tools” beginning on page 119 for a description of each of these software tools.

Acoustic signal analysis

Following deployment of the Ranger USBL System and before you start survey operations, you should use the acoustic signal analyser tool to analyse the quality of signals received from the various transponders used by the system.

You should also use this tool during a survey if you suspect that the system's performance has dropped.

The acoustic signal analyser allows you to identify some common problems that can affect system performance, including:

- false signal detection
- multipath signal effects, and
- fouling of the transceiver.

To use the acoustic signal analyser select **Tools** > **Acoustic signal analyser…** from the menu bar. Refer to Appendix D.2 "Acoustic Signal Analyser" beginning on page 119 for a full description of this tool.

Manual commands

The manual commands tool, described in Appendix D.3 "Manual Command Window" beginning on page 125, allows you to send commands manually to Compatt beacons.

Note

Only experienced operators should use this tool. Sending commands to a Compatt beacon using this tool does not guarantee that the information for the Compatt in the Job database will be updated. Use this tool with caution.

Transceiver calibration

The transceiver performs a calibration test on itself automatically at 15 minute intervals. You can use the transceiver calibration tool to perform the test on demand, and to display the results for reference. The test sequence continues automatically after you start it, and shows the results in a read-only table with clear, pass/fail indications.

Use this tool if you suspect there is a fault on the transceiver.

Refer to Appendix D.4 "Transceiver Calibration Test" beginning on page 127 for a description of this tool.

Noise test

The noise test tool allows you to assess the severity of ambient noise in the operating area across a range of frequencies. It helps you to choose operating frequencies and channels for the Ranger USBL System that avoid bands where there are sustained high levels of noise or acoustic spikes.

Refer to Appendix D.5 "Noise Test" beginning on page 128 for a description of this tool.

Average fix

This tool allows you to select each of the transponders being tracked, and to display average fix positions with related statistical information for those transponders over a number of previous position fixes. The system is calculating this information continuously, even when this tool is not being used.

Refer to Appendix D.6 "Average Fix" beginning on page 129 for a description of this tool.

Chart measurements

You can use this tool at any time during a survey to measure the range and relative bearing from a tracked target or the vessel to another feature or waypoint on the chart.

7.3 Communication Check

Introduction

A communication check confirms successful communications are established between the Navigation Computer, the Navigation Control Unit (NCU) and external Instruments and sensors such as a GPS receiver, gyrocompass and attitude sensor connected to serial ports on the NCU.

When to perform

You should perform a communication check with all equipment connect to serial communication ports on the NCU before you deploy the system for a survey operation. By performing this check before deployment, you can identify any communication problems and correct them before they have a negative impact on your survey operation.

Checking communications

To check communications:

1. Ensure all external Instruments and sensors are connected to their correct ports on the NCU and are powered-on and operating.

   For Instruments and sensors that provide alternative output formats, set them to the output format to be used during the survey operation. Refer to Appendix E “Report Formats” beginning on page 132 for a description of the formats accepted by the Ranger software.

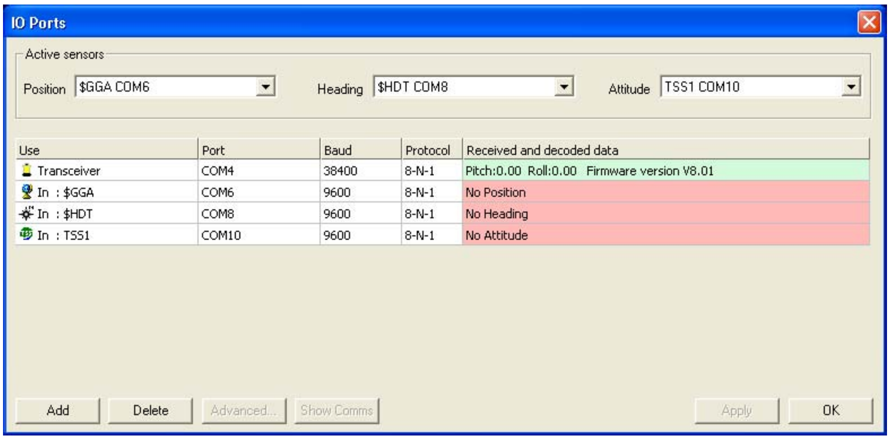
2. Select **Edit** > **IO Ports…** from the menu bar, or click the **Edit the IO Ports** button on the toolbar to display the **IO Ports** dialog.

   The example shown in Fig 57 below shows:

   - a GPS receiver delivering NMEA 0183 GGA sentences connected to COM6
   - a gyrocompass delivering NMEA 0183 HDT sentences connected to COM8, and
   - a Vertical Reference Unit (VRU) delivering TSS1 data packets connected to COM10.

   Ranger is not receiving or decoding information from any of the external Instruments and sensors in this example.

Fig 57 IO Ports dialog

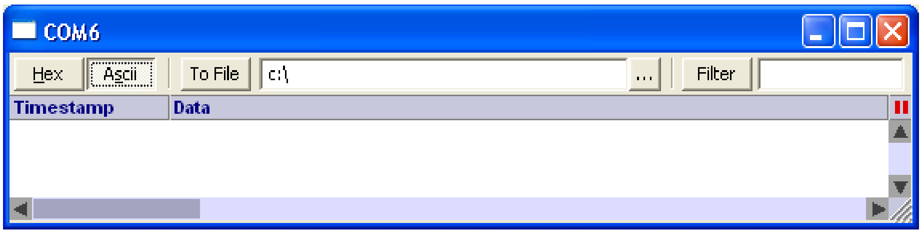


3. Set the configuration for the external Instruments and sensors in the Ranger software as required for each communication channel. Refer to sub-section 6.4 “Adding Instruments and Sensors” beginning on page 48 for instructions to do this.

   The Ranger settings must match the settings on the Instrument or sensor.

4. Select an Instrument or sensor on the **IO Ports** dialog and click the **Show Comms** button to display the communications for that serial port.

Fig 58 COM dialog



The **COM** dialog allows you to select whether to display communications in Ascii (the default) or Hex, and allows you to specify an external file where you want to save the communications.

The dialog is resizeable, allowing you to click and drag the borders to display more or less information at the same time, and scroll bars at the right-hand side and along the bottom allow you to see information that has scrolled off the display.

You can pause and restart the display by clicking the button  near the top right-hand corner.

The **Filter** button searches each received line and turns that whole line red if it finds a match for the string you have entered.

5. When you are satisfied that communications between the Ranger USBL System and all external Instruments and sensors are reliable, continue the survey operation by performing a calibration.

7.4 System Calibration

The Ranger USBL System is required to determine the horizontal positions of beacons with respect to the vessel on which the transceiver is deployed. This requires both that the USBL system corrects for pitch and roll of the transceiver, and that the transceiver is aligned accurately with the vessel's centre line.

In practice it is unlikely that perfect alignment will be achieved between the transceiver and the vessel's centre line during installation and deployment, making it necessary for a calibration procedure to measure the residual misalignment so that you can apply appropriate corrections.

The calibration operation is a very important part of any operation, and must be performed before you start to log the survey data. Refer to section 8 "Calibration" beginning on page 78 for detailed instructions to calibrate the system.

7.5 Waypoints

You can add waypoints to Ranger. To do this, select **Edit > Waypoints** from the menu bar to display the Waypoints dialog, shown in Fig 59.

This dialog displays each of the waypoints and allows you to add or delete waypoints when required.

The **Display waypoints on the chart** allows you to hide all waypoints.

The **Visible** tick box allows you to display or hide individual waypoints on the chart.

If you display waypoints, you can use a software tool to measure distances against them, as described in Appendix D.7 “Measure Chart Distances” beginning on page 130. The example Chart display in Fig 60 shows two waypoints on the chart.

Fig 59 Waypoints dialog

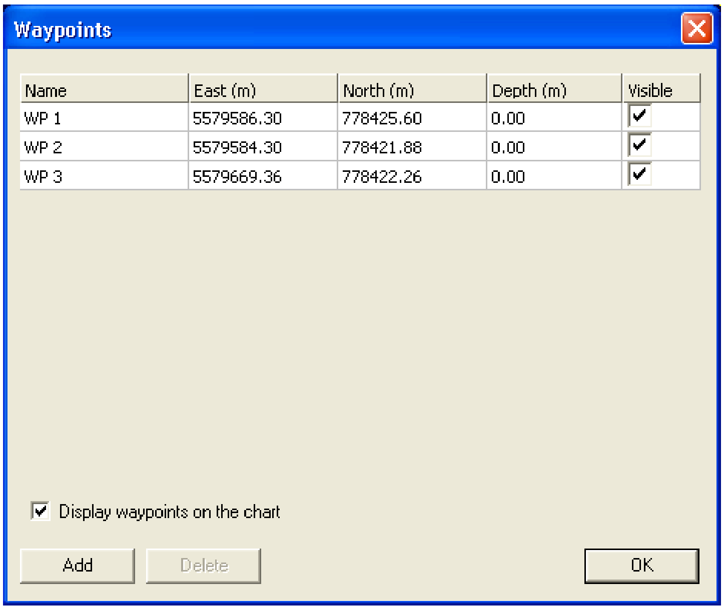


Fig 60 Waypoints on a chart

7.6 Tracking

Ranger begins to track a target as soon as you select the target’s Tracking button on the main screen. You can select multiple targets to track from among those configured in Ranger, and the software displays information about each of the targets’ positions in the Text display and on the Chart display.

Tracking continues automatically on each target until you deselect its Tracking button, or until it loses the target’s signal for some reason. In cases where a target's signal is lost temporarily, Ranger re-acquires the target and continues tracking automatically when the signal returns.

7.7 Data Logging

For simplicity of operation, Ranger opens a new logging file automatically whenever it starts, and closes that file automatically when it shuts down. The log file format is Comma Separated Variable (CSV), which can be read by a spreadsheet program.

Ranger names log files automatically using a sequential number and an identification number that includes the day, month and time of creation. For example, the log file called **Obs16 04231223.csv** is the 16th log file in sequence, created on 23 April at 12:26 as determined by the system clock in the computer on which the software is running.

There are three commands that you can use for logging operations:

- Select **Logging > Open logging folder** from the menu bar to open the **C:\Ranger files** folder. This folder contains the **AcousticLogFIles** folder, where Ranger stores the log files.You can open this folder and copy individual log files to another location for processing.
- Select **Logging > Delete logfiles** from the menu bar to delete all log files in the **AcousticLogFiles** folder. If you select this option you will be given the opportunity to confirm or cancel the deletion. Note that, if you delete these files, you cannot recover them unless you have copied them to another location first.
- Select **Logging > Start new acoustic logfile** from the menu bar to close the current logging file and start a new one.
- Select **Logging > Archive all data to Zipfile** from the menu bar to create a single zipfile that contains all logged data and job configuration files. This can then be sent to Sonardyne for support.

When you start a new survey operation, consider starting a new acoustic logfile at the same time so that it includes only the tracking data from the survey. Otherwise, the logfile will contain data starting from the time when Ranger started the current session.

8 Calibration

In this section...

This section contains the following sub-sections:

8.1 Introduction

The USBL system is required to determine the horizontal positions of beacons with respect to the vessel on which the USBL transceiver is deployed. This requires both that the USBL system corrects for pitch and roll of the transceiver and that the transceiver is aligned accurately with the vessel’s centre line.

In practice, it is unlikely that perfect alignment will be achieved between the transceiver and the vessel’s centre line during installation and deployment, making it necessary for a calibration procedure to measure the residual misalignment so that you can configure the software to apply appropriate corrections.

The system can use approximate pitch and roll information from the transceiver’s internal inclinometer, or it can accept significantly more accurate measurements from an external attitude sensor such as a Vertical Reference Unit (VRU).

Factory calibration procedures measure any misalignment between the internal inclinometers with respect to the transducer face, and these details are included on a label fixed to the transceiver housing.

Because it is usually impractical to install the transceiver in perfect alignment with the vessel’s centre line, it is always necessary to determine the transceiver misalignment by using some form of calibration. The method used will depend on the ability of the vessel to conduct manoeuvres and on the procedures required for a full dynamic calibration.

- Static calibration

  This simple but less accurate method involves positioning transponders at a number of known positions around the vessel.

  For example, the first position is directly forward of the transceiver; a second is abeam of the transceiver.

  Calibration then involves a comparison of the observed bearing determined by taped measurements from the vessel’s centre line to each transponder, and the bearing as determined by the Ranger USBL System.

- Dynamic Calibration

  This second method involves performing the more rigorous CASIUS calibration.

  CASIUS involves manoeuvring the vessel both near to and over a stationary reference beacon deployed on the seabed to determine the transceiver offsets and the pitch, roll and heading corrections that should be applied to the Ranger USBL System.

8.2 Static calibration

This sub-section describes the static calibration procedures necessary to measure the transceiver misalignment.

Procedure

Suspend a beacon over the side of the vessel on a pole, taking care to clamp the pole so that it is parallel with the vessel's Z-axis (the up-down axis relative to the vessel) as accurately as possible.

Measure static calibration distances

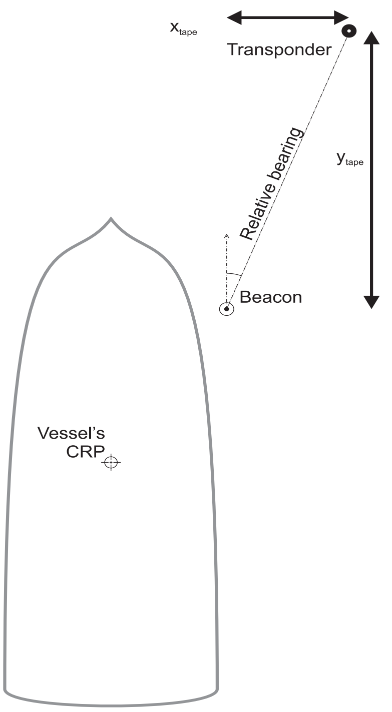


Fig 61Offset distances for static calibration

Measure the distances from the beacon to the transponder, split into the two components:

- the x_{tape} measurement is the separation distance measured along a line parallel with the vessel's port-starboard (X) axis, and
- the y_{tape} measurement is the separation distance measured along a line parallel with the vessel's fore-aft (Y) axis.

Make these measurements as accurately as possible.

You can then calculate the relative bearing of the transponder from the beacon's transceiver as follows:

$$\text{Actual bearing } \alpha = \operatorname{atan}\left(\frac{x_{tape}}{y_{tape}}\right)$$

where x_{tape} and y_{tape} are tape measurements, as shown on the diagram in Fig 61.

Note

Before you use this information, ensure there are no offsets entered for the transceiver on the vessel.

Calculate transceiver bearing

Set Ranger's Chart display to Cartesian and ensure all measurements are centred on the transceiver. Note the Stbd and the Fwd distances displayed for the target in the Text display and use them in the following calculation to determine the USBL transceiver version of the bearing:

$$\text{USBL bearing}\beta = \operatorname{atan}\left(\frac{\text{Stbd distance}}{\text{Fwd distance}}\right)$$

Calculate the correction angle

You can now calculate the correction to be applied as follows:

$$\text{Correction Angle} = \alpha - \beta$$

Enter this value as the Heading correction on the **Port properties—Tcvr Corrections** dialog, shown in Fig 28 on page 50.

Check the results

Recalculate the USBL Bearing, β, as explained above. It should now be very close to the Actual Bearing, α, as determined from the tape measurements.

If it is not, repeat the correction procedure.

Alternative method

You can apply correction for transceiver alignment errors more conveniently by positioning the beacon, on its pole, either directly forward of the transceiver or, if this is difficult for some reason, directly athwartships of the transceiver.

For this procedure to work, the forward position of the beacon must lie on a line from the transceiver parallel to the lubber line (or the athwartships position must lie on a similar line at right angles to the lubber line). As before, you must clamp the transponder pole parallel to the vessel's up-down axis as accurately as possible.

To achieve greater accuracy, position the transponder pole as far as possible away from the transceiver. For this reason, the forward position is probably better than the athwartships position.

For the forward position, the actual bearing will be 0° and this should be shown by Ranger's display if you have set up the transceiver correctly. If the displayed bearing is not zero, calculate the correction angle again as described in "Calculate the correction angle" beginning on page 79, and enter this value on the advanced transceiver properties dialog, as described in "Advanced settings" beginning on page 49.

Repeat the process as necessary to achieve an acceptably small error.

If you use the athwartships position the procedure will be the same, but the bearing value will be 90°.

8.3 Dynamic calibration procedures (CASIUS)

In a Ranger USBL System, sensors used to measure the pitch, roll, heading and position of the vessel are not usually mounted immediately adjacent to the USBL transceiver. However, for accurate operation of the Ranger USBL System, the measurements delivered by these sensors must be corrected so that they apply for the USBL transceiver. For this to be achieved, the system must be calibrated to determine the mounting offsets that exist between the USBL transceiver and the external sensors mounted on the vessel.

You should conduct the calibration procedure in water of a depth that is close to the depth where you will use the Ranger USBL System. For optimal acoustic tracking it is recommended to select a reply channel of 32kHz or higher.

To conduct a CASIUS calibration procedure you will need a beacon deployed in a fixed position on the seabed and navigation input from the differential GPS (DGPS) receiver. You must then navigate the surface vessel around the beacon in a defined pattern while you record GPS, attitude and acoustic observations. You can then process this recorded information by using the Sonardyne CASIUS utility.

What is CASIUS?

CASIUS is an acronym that stands for **C**alibration of **A**ttitude **S**ensors **I**n the **U**SBL **S**ystem manufactured by Sonardyne International Limited. It is an add-in for use with a Microsoft Excel spreadsheet.

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 GPS antenna.

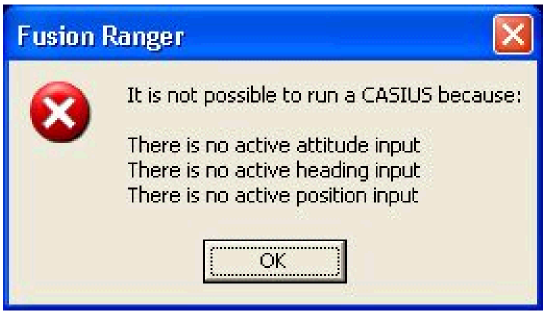
- Pitch, roll and alignment corrections to correct for the misalignment of the VRU and gyrocompass with respect to the USBL transceiver.

In general, pitch and roll alignment errors will 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 will help you to achieve significantly better results when you are positioning acoustic beacons. You should perform such a calibration regularly during each operation, so that you can detect any long-term drift in gyrocompass and VRU sensors, and apply appropriate corrections.

Preparation

Before you begin a CASIUS calibration you must ensure the Ranger USBL System is receiving and decoding valid information from the external sensors needed. Ranger will display an error message after you start the calibration procedure if it is not receiving all the required inputs.



The required inputs are:

- transceiver
- pitch and roll
- heading, and
- GPS position.

You must also ensure the corrections have been applied in Ranger for any misalignment between the transceiver and external sensors, and that you have entered the Starboard, Forward and Depth offsets for both the GPS and the Transceiver. Refer to “Transceiver settings” beginning on page 50 for instructions to do this.

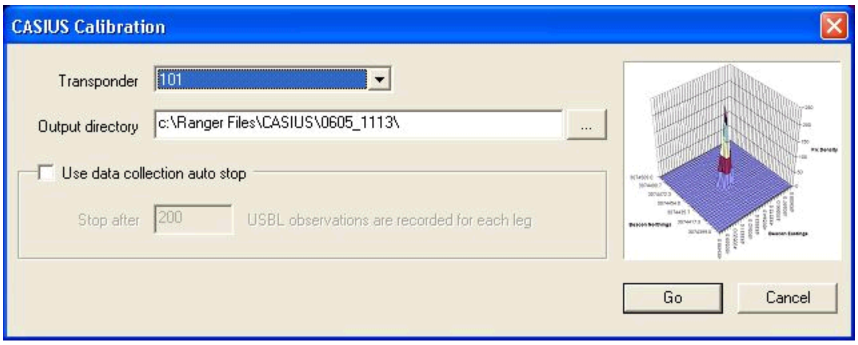
Performing CASIUS

To perform a CASIUS calibration:

1. Complete all preparations for the CASIUS calibration
2. Select **CASIUS** > **Do CASIUS calibration…** from the menu bar to display the **CASIUS calibration** dialog.

   Ranger creates a default directory name where it will store the CASIUS data. This name is based on the date and time, but you can change it if necessary.

Fig 62 CASIUS calibration dialog

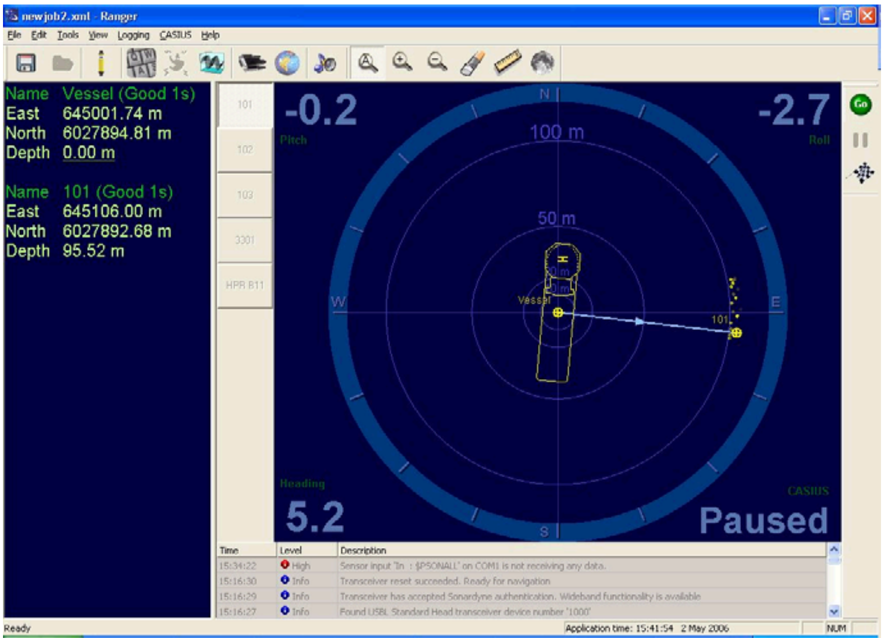


The **Use data collection auto stop** option on this dialog automatically pauses data collection after it has recorded a defined number of good USBL positions. You can use this option instead of timing data collection at each cardinal point.

3. Select the transponder to be used in the CASIUS calibration, and click **Go** to close the dialog and set Ranger to the CASIUS tracking mode using the beacon specified in step 2, with data recording paused. All other beacons are locked out from tracking during CASIUS calibrations.

   During CASIUS tracking, Ranger's main screen includes an additional toolbar, to the right of the Chart display.

Fig 63 Main screen during CASIUS tracking



The buttons on the new toolbar are:

to start data recording.

 to pause data recording, and

 to end the CASIUS calibration.

4. Move the vessel to the first CASIUS data collection point and confirm that the system is positioning the beacon correctly.

   Refer to sub-section 8.5 "CASIUS Data Collection Methods" beginning on page 85 for some advice on CASIUS manoeuvring patterns for the vessel.

5. Select **CASIUS** > **Start recording** from the menu bar or click the **Start recording** button on the new toolbar to begin recording CASIUS calibration data. The main screen confirms that data is being recorded.

Fig 64   Main screen during data recording

6. When you have collected sufficient data, click the **Pause** button on the new toolbar.

   Remember that you can use the **Data collection auto stop** control to stop the data collection automatically when sufficient measurements have been made.

   Ranger displays a message box that allows you to save or delete the data you have collected.

   Save the data, or delete it if necessary.

   The system is continuing to track the beacon, but data recording is now paused.

7. Move the vessel to the next position and repeat steps 5 to 7 as many times as required for the CASIUS calibration.

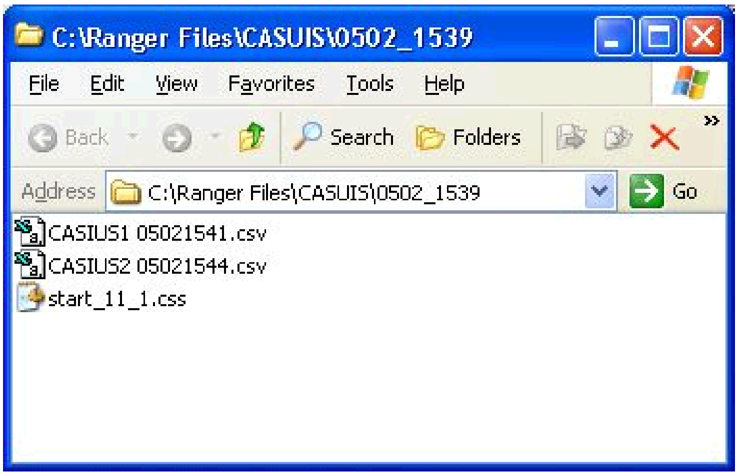
8. When you finished recording all data for the CASIUS calibration, select **CASIUS > End CASIUS Calibration…** from the menu bar or click the **End calibration** button on the new toolbar.

   Ranger displays a message box that allows you to confirm that you want to end the calibration.

9. Click **Yes** on the confirmation message box to open the directory where Ranger stores the recorded data, showing the files that have been stored there.

   This directory includes a CASIUS start sheet and the logfiles previously recorded. These all use the CSV data format.

Fig 65 Directory for CASIUS data



Ranger's main screen returns to the normal operating mode, allowing the use of normal beacon tracking.

8.4 Verifying the Results

After you have entered the CASIUS results into the Ranger software you should conduct a series of tests to confirm that the software is applying derived pitch, roll and heading corrections correctly. You should also repeat these tests if you observe an apparent degradation in system performance.

Both these tests require a beacon deployed in a fixed position on the seabed.

Heading test

To conduct a heading test:

1. Track the beacon on the seabed with the vessel directly over the target.
2. Take a position fix.
3. Move the vessel away from the beacon in any direction and at a constant speed up to a maximum distance of 500m.
4. Monitor the real-time position of the mobile target compared to the position fix taken with the vessel directly over the target.

   If the position of the mobile target moves perpendicular to the vessel's course made good this indicates that there is a heading alignment error between the USBL transceiver's centre line and the vessel or the gyrocompass centre line.

Pitch and Roll test

To conduct a pitch and roll test:

1. Track the beacon on the seabed with the vessel directly over the target.
2. Slowly rotate the vessel over the top of the beacon, if possible while rotating the vessel about the USBL pole. At the same time, watch the snail trail on the Chart display for the mobile target.

   If the trail inscribes a doughnut shape around the centre point this indicates a small error in the pitch and roll installation corrections.

   Depending on the water depth where you conduct the test, and the size of the doughnut shape and the accuracy of the VRU Instrument, you may need to repeat the CASIUS calibration procedures.

8.5 CASIUS Data Collection Methods

Manoeuvring guidelines

When collecting data during the CASIUS calibration procedure you should consider the following:

- You should collect some of the data with the vessel above or nearly above the reference beacon in order to maximise the effects of any pitch and roll offsets.
- You should collect some of the data with the vessel at some distance from the reference beacon in order to maximise the effect of any gyrocompass offset.
- You should collect data with the vessel on opposite headings to maximise information used to determine GPS antenna offsets.
- Ideally you should collect data with the beacon passing through the full range of azimuth directions.
- You should collect data no further than the water depth from the beacon's position, or a maximum of 500 metres from the beacon's position whichever is the smaller.
- Ideally the manoeuvres that the vessel undergoes while collecting data should reflect the way the vessel will be used operationally.

  For example, if the vessel is expected to be stationary for a significant proportion of the time during operation then it should also be stationary for each data collection phase of CASIUS.

  Similarly, if the vessel will be moving past the beacon under operational conditions then you should collect the CASIUS data while moving.

  If it is not a DP vessel that you are using it will be difficult to keep the vessel stationary, which means that you are most likely to use the second of these two methods.
- Heading changes are known to cause some VRU units to misread. Refer to the VRU manufacturer's documentation for guidance on how long the VRU takes to settle after various rates of turn.

  Because of these effects and because you need to collect data from more than one heading, you may have to break up the vessel manoeuvring into a series of constant-heading data collection passes. You should maintain a constant vessel heading for a short time before and during each data collection pass.
- An important decision you need to make concerns whether to collect the data while moving or stationary.

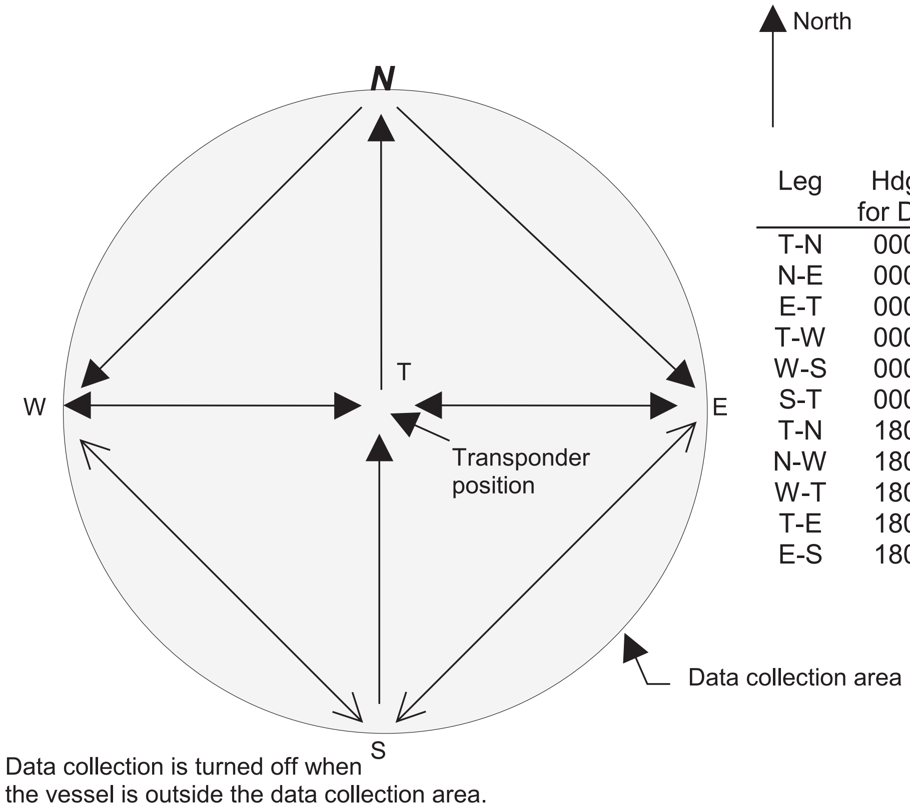
  It is preferable to be stationary if possible because this minimises any DGPS lag problems. However, if the vessel has no DP capability then this will not be a realistic option and, in these cases, you should collect data during a series of straight run lines over and to either side of the beacon.

Stationary data collection

Stationary data collection is a realistic possibility only on a DP vessel, which is able to move in any direction while remaining on a constant heading. A suggested pattern is shown in Fig 66 below. When following this pattern, pause at each of the cardinal points and when directly above the reference beacon.

Collect the CASIUS data while the vessel is stationary.

Fig 66 Suggested pattern for DP vessel



Leg	Hdg for DP
T-N	000
N-E	000
E-T	000
T-W	000
W-S	000
S-T	000
T-N	180
N-W	180
W-T	180
T-E	180
E-S	180

You can also collect data during transits between cardinal points if the vessel's heading is maintained. This is the same data that you would obtain for a constantly moving vessel as explained in "Data collection while moving" beginning on page 86.

Sonardyne recommends that you use separate log files for each section of the data logging and as an aid to subsequent processing. You should also try to collect an equal amount of data at each cardinal point to avoid skewing the results.

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 half the water depth in the operating area, or a maximum of 500 metres. The data collection points are then at 90° to one another and at an equal distance from the beacon as well as immediately above the beacon.

You can rotate the pattern in any direction to accommodate wind or currents.

Data collection while moving

Data collection on a constantly moving vessel—'run lines'—is very similar to the method already described for stationary data collection, except that the vessel is not expected to stop at the cardinal points. Instead, data collection will occur through the transits between cardinal points while the vessel maintains a good heading.

The pattern involves running 12 lines, with 8 transits between adjacent cardinal points in both directions together with a run line across the top of the beacon in each direction.

As before, you can rotate the example in Fig 67 to allow for current and wind directions where required.

The length of the run lines to be followed by the vessel are dependent on the water depth as before for stationary data collection.

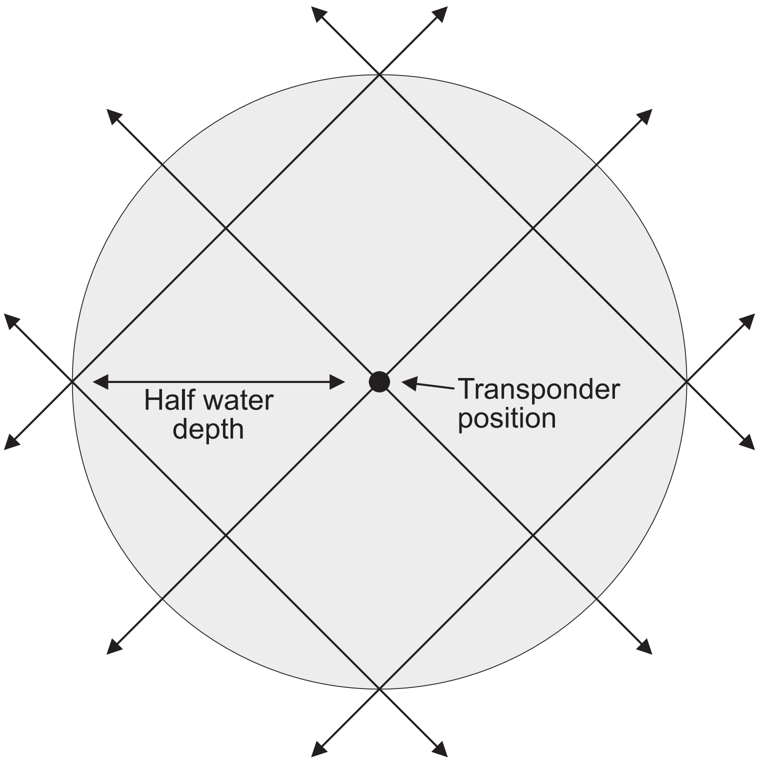
The radius of the circle centred on the beacon defines the data collection area. This would normally be equal to half of the water depth, or a maximum of 500 metres.

Sonardyne recommends that you extend these lines by an appropriated distance to ensure that the vessel has a chance to stabilise its heading before beginning the data collection within the area as shown in Fig 67.

To keep the lines straight in the data collection area, the vessel may turn outside the area between the runs. In addition, before starting to collect data the heading should have been constant for a minute, although this time will depend on the VRU and the rate of heading change prior to this.

Make passes between the points and the beacon at the centre of the circle, slowing as much as possible each time over the beacon to collect more measurements there, although maintaining speed at the outer end of the run lines.

Fig 67 CASIUS pattern for moving vessel

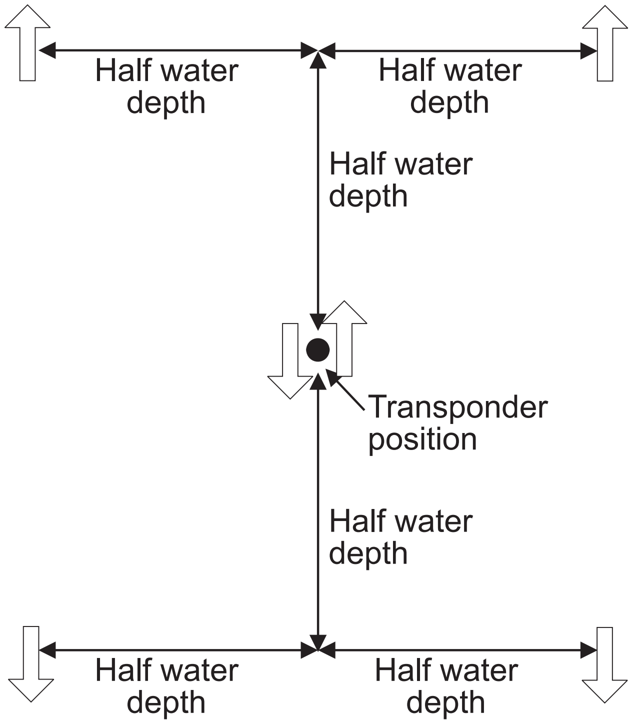


Stationary data collection with a tilted transceiver

The stationary data collection process when on a DP vessel with a 30° tilted transceiver is the same as for a non-tilted transceiver, except the points where you collect the data must be moved by 30° when using a tilted transceiver.

Fig 68 shows a suggested data collection pattern and the heading of the vessel at each position, assuming the transceiver is tilted backwards.

Fig 68 Calibration pattern on stationary DP with 30° tilted transceiver



9 Frequently Asked Questions

In this section...

This section lists some of the common questions concerning Ranger and gives answers to those questions. The subjects are divided into convenient headings for each of the issues covered:

- 9.1 “Interfacing Issues” beginning on page 89.
- 9.2 “Configuration Issues” beginning on page 89.

9.1 Interfacing Issues

1. I am trying to configure for HPR 418 telegram, but how do I choose between **HPR 418 BCD** and **HPR 418 Rev F**?

If you are configuring the output for a DP desk, then the decision as to which HPR 418 telegram to use is determined by the DP console and what format it can accept. You should refer to the DP console manual for more advice.

For greater detail concerning what information is included in the HPR 418 Rev F and HPR 418 BCD telegrams, please refer to Appendix E “Report Formats” beginning on page 132.

9.2 Configuration Issues

1. I am setting up Ranger for tracking a subsea vehicle. What settings should I use for the transceiver Power, Gain, and Detection Threshold?

The default settings for a USBL transceiver are High Power, High Gain and 12db Detection Threshold.

The actual settings you use depend entirely upon the environment where you are working and the ranges to which you want to track.

If working in a highly reverberant, shallow water environment, you should consider using lower power and gain settings. This reduces the amount of signal that is subject to reflections, and the sensitivity of the transceiver to multipath. Low Gain settings are also recommended when working in the presence of noise, because it reduces the amount of noise detected by the system, improving the quality of the tracking solution.

If multipath is believed to be a significant issue then try raising the Detection Threshold to attempt to eliminate false detections.

The validation threshold will always be an automatic 2dB above the Detection Threshold.

When working at long ranges High power and High gain are advisable to ensure there is enough signal at the source for the beacon to detect, and that the gain is suitably set to detect the presence of a response.

Also the Maximum range should be set to accurately reflect the operational limit you expect to be working in.

You should note that these settings CAN be changed while tracking is online. This allows you to try various settings while observing their effect in a real-time solution. However, once you have made a change you should wait for a few acoustic cycles to observe their true effect (if any) and to allow for anomalous results.

10 Troubleshooting

In this section...

This section contains the following sub-sections:

10.1 Introduction

This section provides some guidance relating to fault finding and reporting software problems in the Ranger USBL System.

Before you call on technical support from Sonardyne International Limited, you should make some preliminary checks on the Ranger USBL System first, as explained in this section, so that you can supply a full description and other details relating to the problem.

If you are requesting help by email, you should also attach copies of the appropriate system and configuration files to assist in solving the problem.

10.2 Check list

The following lists, separated into information needed and actions to take, prompt you when you are trying to identify the problem in detail. Make a note of the answers to each bullet point, referring to the relevant sub-section for more details.

Information needed

The following bullet points all relate to general information about the Ranger USBL.

Refer to the detailed explanations for each bullet point in the list. If you are viewing this manual as a PDF, click the bullet point to jump to the explanation.

General information

- Date and time of the problem.
- General description of problem.
- Description of operation being performed.
- Events leading up to the problem.
- Is the problem repeatable?
- Does the problem occur at regular intervals?
- Is it a software problem or a computer crash?

Ranger USBL information

- What version of software is running?
- What version of hardware are you using?

10.3 General Information

- **Date and time of the problem.**

  What was the date and time that the problem occurred?

With the approximate date and time of the problem, we will be able to cross-reference this with additional sources of information.

- **General description of problem.**

  The more information you supply about the nature of the problem you are experiencing, the easier it will be for us to provide fast and effective support.

- **Description of operation being performed.**

  Provide a general description of the field operation that you were using the software to perform.

  The Job file will tell us how the system was configured but not what Instruments were in use at the time of the problem. Knowledge of the type of operation that you are trying to perform will help us to eliminate parts of the software as a potential cause of the problem.

- **Events leading up to the problem.**

  What were you doing that led to the problem?

  Provide details about the steps that you took before you observed the problem. The more details you provide, the more likely we are to be able to either reproduce the problem or to isolate one particular part of the application for analysis.

- **Is the problem repeatable?**

  A repeatable problem allows us to quickly isolate down to a particular part of the software. A problem that we can reproduce on a development computer is far easier to fix than one we cannot!

- **Does the problem occur at regular intervals?**

  If the problem seems to occur at a regular interval, what is that interval?

  Knowledge of the interval between repetitive problems dictates the approach we take to isolating the problem.

- **Is it a software problem or a computer crash?**

  Is this a software or operating system problem? A crash occurring in the operating system will probably result in a ‘blue screen’ and an automatic reboot of the computer.

  Because the default installation of Ranger is set to run automatically it is possible to miss an operating system crash unless you happen to be watching the computer at the time it occurs.

  A Ranger software crash should result in a dialog stating that Ranger has had a problem. However, there have been occurrences where the software has simply disappeared from the screen with no warning or information displayed.

10.4 System Information

- **What version of software is running?**

  Identify the full version number of the software running.

  To identify the version number, select **Help** > **About…** from the menu bar.

- **What version of hardware are you using?**

  Identify the firmware version numbers for the NCU, GDT head and so on.

  Although Sonardyne makes every effort to maintain compatibility between versions of software and firmware, there may be occasions when this is not possible. Any mismatch between firmware and software could be the cause of problems in the software.

10.5Getting technical support

- Sonardyne 24-hour Emergency Helpline

  Tel: + 44 (0) 1252 877600

  Our 24-hour Emergency Helpline is answered at Blackbushe during normal office hours, which are 08:30 to 17:30 UK time.

  Outside these hours, the call is automatically transferred to a local agency who will log the details of your emergency and alert the appropriate Sonardyne personnel.

  Our aim is to ensure that emergency requests are dealt with immediately during office hours and are responded to within 30 minutes at all other times.

  Please note that the helpline is for emergency use only. Do not use it for general enquiries. General enquiries should be directed to your local Sonardyne office. Alternatively, you can use one of the dedicated e-mail groups. Please note that e-mails are only answered during normal office hours, which are 08:30 to 17:30 UK time.

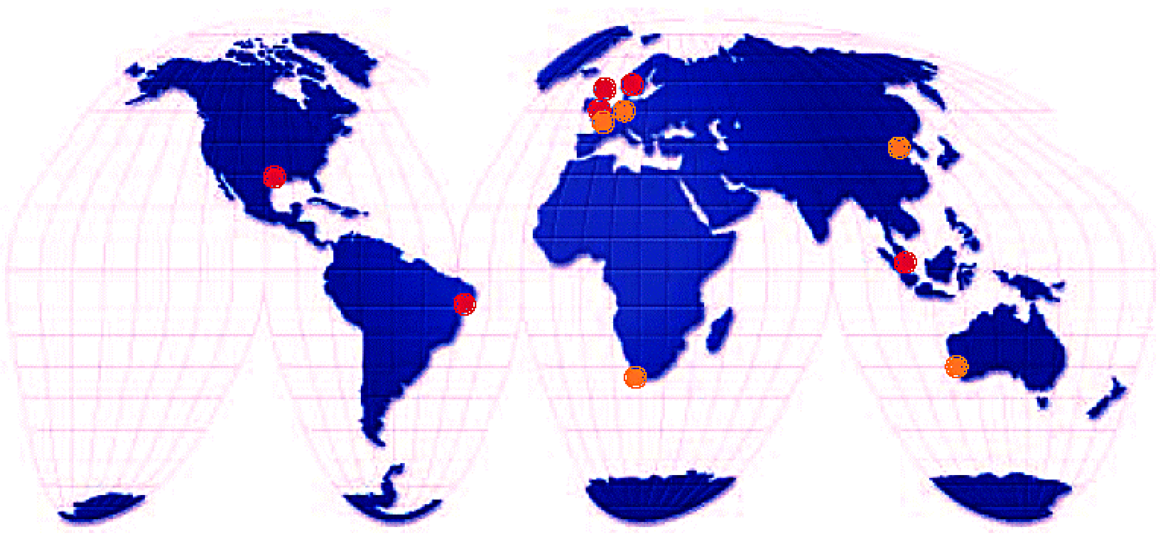
Table 25 Support email address

Product Family	Support e-mail Address
Ranger USBL software	support@sonardyne.com
All other Sonardyne products	support@sonardyne.com

A more effective response will be obtained when requesting technical support via email, if you send the appropriate system and configuration files as attachments to assist in solving the problem.

10.6 Sonardyne Offices and Agents

Fig 69 Sonardyne office locations World-wide



Sonardyne offices are shown as red bullets. Agencies are orange bullets.

Sonardyne Office locations

Sonardyne International Limited has offices in the following locations:

UK—Headquarters

Sonardyne International Limited.
Ocean House
Blackbushe Business Park
Yateley
Hampshire
GU46 6GD
UK

Tel: +44 (0)1252 872288
Fax: +44 (0)1252 876100
e-mail: sales@sonardyne.com

UK—Aberdeen

Sonardyne International Limited
Unit 12-13, The Technology Centre
Claymore Drive
Bridge of Don
Aberdeen
AB23 8GD
UK

Tel: +44 (0) 1224 707875
Fax: +44 (0) 1224 707876
e-mail: sales@sonardyne.com

USA—Houston

Sonardyne Inc.
11210 Steeplecrest Drive
Suite 360
Houston
Texas 77065
USA

Tel: +1 281 890 2120
Fax: +1 281 890 7047
e-mail: usa.sales@sonardyne.com

Singapore

Sonardyne Asia Pte. Ltd.
Second Floor
35 Loyang Crescent
Singapore 509012

Tel: +65 6542 1911
Fax: +65 6542 6937
e-mail: asia.sales@sonardyne.com

Brasil (Macaé)

Sonardyne Brasil Limitada.
Avenida Nossa Senhora da Glória
No 1365 - sala 101
Praia Campista
Macaé - RJ - Brasil, 27920-360

Tel: +55 24 2763 7216
Fax: +55 22 2765 4355
e-mail: brasil.sales@sonardyne.com

Appendix A USBL Theory of Operation

In this appendix...

This appendix contains the following sub-sections:

A.1 Introduction

This appendix provides a simplified theory of operation for USBL systems, and explains the significance of depth aiding for enhancement of the navigation solutions.

A.2 Basis

Development from SBL

Ultra-Short BaseLine (USBL), or Super-Short BaseLine (SSBL) as it is sometimes referred to, is a development of the positioning techniques used in conventional Short BaseLine (SBL) systems.

In a USBL system, the multiple hull transducers found in SBL systems are replaced with a single transceiver assembly that contains a single dedicated transmit transducer and multiple receive transducers.

Acoustic interrogation

Ranger relies on an acoustic interrogation technique to measure the range between the vessel-mounted transceiver and a transponder at some unknown range from that transceiver.

To do this, the transceiver sends an acoustic signal from its transmit transducer and then 'listens' for a transponder response using its receive transducers. The delay between the transmission of an interrogating acoustic signal and reception of the response depends on the following primary factors:

- the straight-line (slant range) distance between the transceiver and the transponder
- any delay introduced by the transponder between the instant when it received the interrogation signal and the instant when it transmitted a response, and
- the speed of sound through the water in the operating area.

Note

Other factors, such as the effects of noise and multipath reflections of the acoustic signals, affect the accuracy of the measurement. However, for simplicity this appendix ignores these effects.

Directional measurement

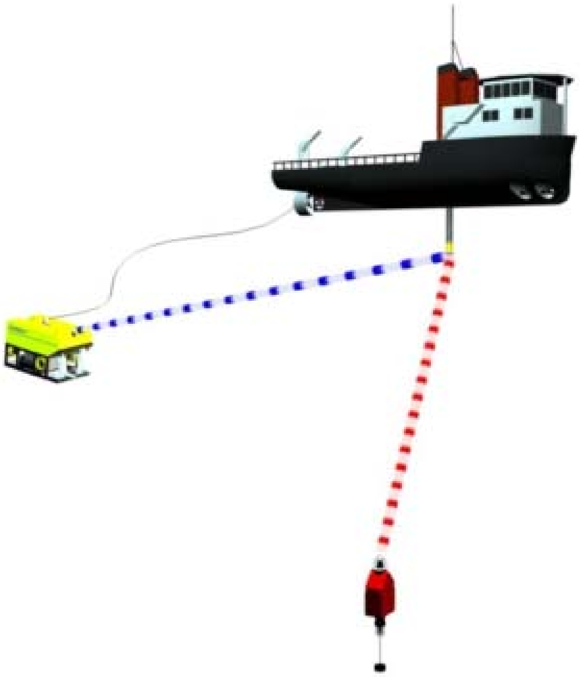
Ranger can also measure the differences in arrival time of the transponder's response signal at each of the multiple receive transducers in the transceiver, and these slight differences make it possible to determine the relative direction of the transponder from the transceiver.

The differences in arrival time of a response signal at each of the transducers is very small—of the order of microseconds—requiring the use of time–phase difference analysis to quantify, and are processed to provide a 'best-fit' solution.

Because the transceiver includes more than the three transducers needed to determine the relative direction, the additional information supplied by other transducers allows a measure of the consistency and quality of the solution.

Fig 70 shows the principle used to measure the range and relative bearing between the transceiver and two separate transponders, one fixed on the sea-bed and the other mounted on an ROV.

Fig 70 USBL positioning method



Effects of tilt and rotation

Because Ranger calculates the direction of the transponder's response signal relative to the transceiver, the measurements of source direction will change significantly with any tilt or rotation of the transceiver. For this reason, in these circumstances where the transceiver's attitude in the water is changing dynamically under the influence of weather and sea conditions, the transponder will appear to move.

Motion compensation

To compensate for the effects of dynamically changing attitude at the transceiver, it is necessary to use an attitude sensor such as a Vertical Reference Unit (VRU). The VRU measures the angles of roll and pitch continuously and supplies them to the Ranger USBL System, where they are used in the calculation of transponder direction.

Similarly, measurements from a gyrocompass allows compensation for the effects of transceiver rotation relative to the transponder.

The algorithm that handles this overall motion compensation in Ranger is sophisticated enough to apply the appropriate compensation even when the transceiver's attitude changes during the delay between sending an interrogation signal and receiving a response.

Performance

Although a USBL system is more convenient to install than an SBL system, the USBL solution is more complicated and requires careful adjustments and calibration to achieve the required degree of accuracy.

The stability of the acoustic data depends upon on the ambient noise and, in ideal conditions, can be better than ±0.2% of slant range when the system receives attitude information from a survey-grade VRU and gyrocompass.

A.3 Impact of Attitude Errors in USBL Positioning

The overall accuracy of a USBL system will depend heavily upon the quality of the external VRU and gyrocompass attitude sensors. Sonardyne can advise on the selection and installation of appropriate systems for the measurement of vessel attitude and heading.

The following section details the impact of VRU and gyrocompass errors on the position calculation for a sub-sea beacon. When you are installing a new Ranger USBL, it is very important that you calibrate the VRU and the gyrocompass in relation to the USBL transceiver.

Refer to section 8 “Calibration” beginning on page 78 for information about the appropriate calibration procedure.

VRU errors

Errors in the VRU’s measurement of the vessel’s attitude will lead to errors in the USBL system’s computation of beacon position. In practice, errors in roll measurements will lead to errors in the X co-ordinate of beacon position, and errors in pitch measurements will lead to errors in the Y co-ordinate of beacon position.

The following example describes how errors in roll measurement affect the position measurement, although pitch measurement errors have a similar form.

Note

This example is a simplified analysis. In practice, the situation is complicated by the interaction of roll, pitch and heading.

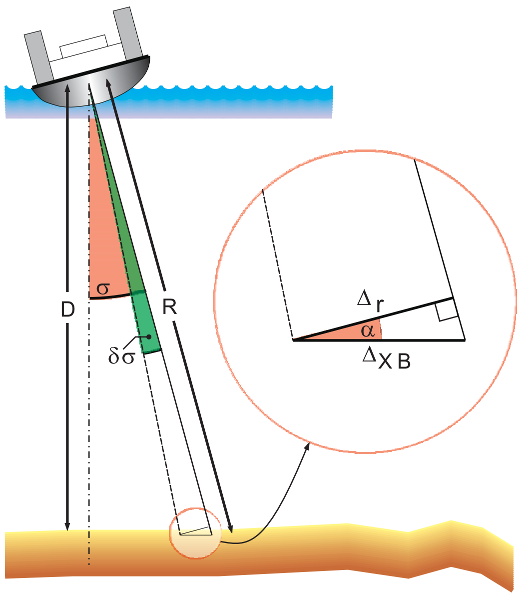


Fig 71Roll error example

Fig 71 illustrates a vessel with an angle of list, σ, and a beacon at range, **R**.

It can be shown that the seabed X co-ordinate error (Δ_{XB} in Fig 71) is a function of the depth of the beacon on the seabed, **D**, and the angular error in roll, $\delta\sigma$.

The full expression for the seabed X co-ordinate error is complex if the vessel’s angle of list, σ, is large. However, for small angles of list, a simplified expression may be used, as explained in equation (1).

$$R = \frac{D}{\cos\sigma} \quad (1)$$

Roll error $\Delta_r = R\delta\sigma = \frac{D\delta\sigma}{\cos\alpha}$ (2)

where $\delta\sigma$ is in radians.

Since angle α = angle σ:

$$\Delta_r = \frac{D\delta\sigma}{\cos\sigma} \quad (3)$$

Seabed X error $\Delta_{XB} = \frac{\Delta_r}{\cos\alpha} = \frac{\Delta_r}{\cos\sigma}$

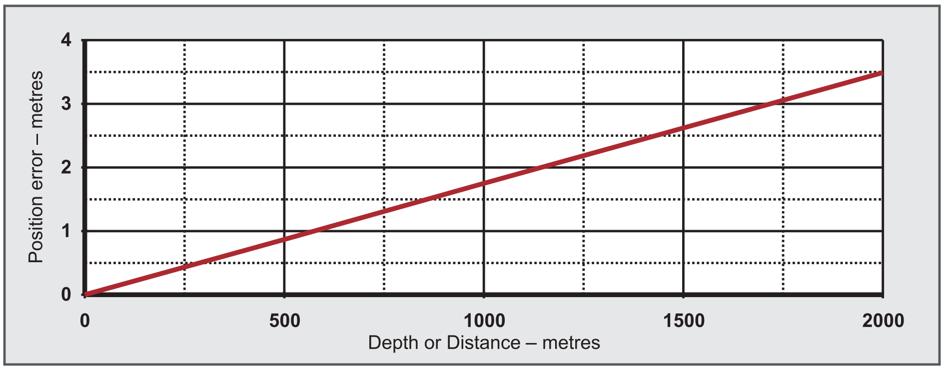
$$= \frac{D\delta\sigma}{\cos^2\sigma} \quad (4)$$

A similar argument for the VRU pitch output leads to the following expression for the seabed Y co-ordinate error, Δ_{YB}, attributable to a VRU pitch error, $\delta\theta$, as defined in equation (5).

$$\Delta_{XB} = D\delta\theta \quad (5)$$

To simplify the task of estimating position errors attributable to errors in VRU attitude measurements, Fig 72 shows the error in positioning that results from a 0.1° error in measuring the vessel's attitude.

Fig 72 Position error arising from 0.1° attitude measurement error

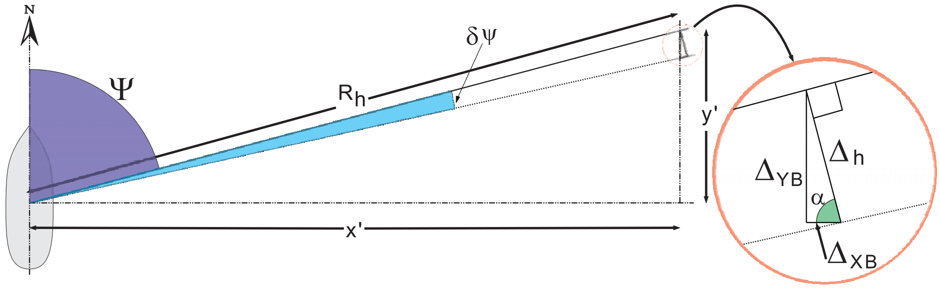


A.4 Gyrocompass Errors

In the case of a gyrocompass error, there is an impact on computation of beacon position in both the X and the Y axis.

In Fig 73 below, Ψ is the vessel's heading angle, δψ is the error in that angle, and x' and y' are the sea-bed x, y co-ordinates of the beacon's position relative to the vessel.

Fig 73 Heading error impact



From Fig 73:

$$\sin\Psi = \frac{x'}{R_h} \tag{6}$$

$$\text{and } \cos\Psi = \frac{y'}{R_h} \tag{7}$$

$$\text{Also } \Delta_h = R_h\delta\psi \tag{8}$$

where $\delta\psi$ is in radians.

$$\Delta_{XB} = \Delta_h\cos\alpha = \Delta_h\cos\Psi \tag{9}$$

Since $\alpha = \psi$,

$$= R_h\delta\psi\frac{y'}{R_h}$$

$$\therefore \Delta_{XB} = y'\delta\psi \tag{10}$$

A similar argument for the Y co-ordinate leads to the following result for Δ_{YB}:

$$\Delta_{YB} = x'\delta\psi \tag{11}$$

Fig 72 on page 98 illustrates the position error arising in the appropriate seabed co-ordinate (Δ_{XB} and/or Δ_{YB}) for each 0.1° error in attitude angle (roll, pitch or heading) over a range of depths (D) or distances (x' or y').

A.5 Factors that Affect the Accuracy of Acoustic Observations

The Ranger USBL System positions an acoustic beacon by sending interrogation signal(s) to the beacon and measuring how long it takes to receive the reply signal. For this to work correctly it is necessary to consider the following issues:

- Signal frequency
- Line of sight
- Signal strength, quality and noise, and
- Speed of sound in water.

Signal frequency

There are many different interrogation signals available for use. It is essential that the signal sent to the beacon must be the correct one to use with that beacon.

There are also many different reply signals that the beacons could use to respond to the interrogation signal, and it is equally essential for the transceiver to 'listen' for the correct one.

Depending on the type of beacon in use, the default interrogate and reply signals are usually written on the side of the beacon, or are manually set using the dials on the bottom of the beacon.

Always check the dial settings before you deploy a beacon.

Line of sight

Tracking is generally possible only if there is clear acoustic 'line of sight' between the transceiver and the beacon.

ROV beacon mounting

Inappropriate beacon mounting on towfish and ROVs can easily compromise performance by introducing obstacles in this line of sight. The mounting of the yellow mini beacon, highlighted in Fig 74 below, is not optimal because it is mounted too far down within the ROV's bodywork. Although this position provides good protection for the beacon, it also introduces obstacles to the line of sight acoustic path as the ROV manoeuvres. In this case, the mounting arrangements limited the USBL system's tracking performance.

Fig 74 Inappropriate beacon mounting

Transceiver deployment

Aerated water is particularly effective as an obstacle to the acoustic line of sight, and therefore in degrading the USBL system's tracking performance. For this reason, it is important that you deploy the transceiver so that it is deep enough to reduce or eliminate the possibility of aerated water passing across the transducer face.

Turbulence

It is equally important to ensure that both the beacon and the transceiver are kept away from bubbles and turbulence caused by thrusters, propellers, moonpools, divers and airlifts.

If possible it is always good practice to introduce 'bar zones' for any thrusters that are in close proximity to a vessel-mounted transceiver, so that they never point directly towards the transceiver. This will also help to reduce noise from the thrusters.

Signal strength, quality and noise

The maximum range at which the Ranger USBL System can position a beacon depends upon signal strength, the integrity of the received signal, and the relative strength of background noise compared with the beacon's signal strength received by the transceiver.

The Ranger USBL System can position a beacon only if the beacon receives the interrogation signal correctly and the strength of the reply signal from the beacon exceeds a threshold value above the noise level at the transceiver.

The lack of directionality of acoustic signals makes them particularly prone to reverberation. Signals reflected from the sea's surface, from vessel hulls, or from the seabed can interfere with the system's operation by corrupting the direct signal path.

You will achieve the best results if you set the transceiver's transmit power and its receiver gain to as low a level as possible for the prevailing operating conditions.

Speed of sound in water

The Ranger USBL System uses the speed of sound in water to convert measured travel times to distances.

The speed of sound in water depends on the salinity, temperature and depth of the water between the transceiver and the beacon. For survey and positioning operations, it is essential to measure the speed of sound in water and to enter the correct value in the Ranger software. See sub-section 6.6 "Configuring for the Environment" beginning on page 64 for relevant information.

Variations in sound speed

In situations where the speed of sound varies with depth, ray bending will affect the acoustic signals. Here the acoustic signal path is not a straight line between transceiver and beacon; it is bent by diffraction. Ranger can partially compensate for this effect if you measure a sound speed profile through the water column and enter the results into the software.

A.6 Depth aiding

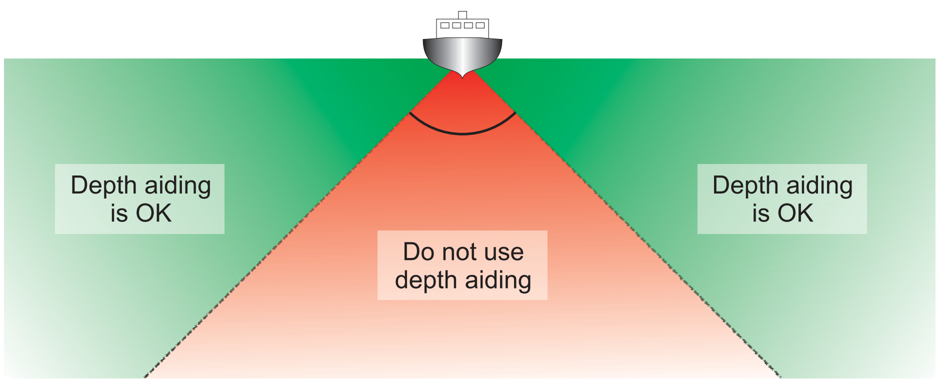
In common with other USBL tracking systems, the Ranger USBL System calculates beacon depth most reliably when the beacon is directly below the transceiver.

As the elevation angle of the beacon with respect to the beacon increases from zero (directly below the transceiver), the accuracy of the computed depth solution will degrade. This is an effect caused by changing phase angles in the response signal as detected by the different receiver transducers in the transceiver head.

Above elevation angles of about 30°, the depth of a beacon derived from pressure sensors will generally be more accurate than the beacon's depth as computed using acoustic angle observations.

The use of direct as opposed to derived depth observations is referred to as 'depth aiding'. Fig 75 below indicates the regions where depth aiding is appropriate for use.

Fig 75 Depth aiding regions



A.7 Positioning Scenarios

Tracking relative to the vessel

You can use the Ranger USBL System to position a tracked target, such as an ROV or diver, relative to the vessel. The system gives the position of the target relative to the vessel, not in any real-world co-ordinates.

To track a target relative to the vessel, select only the sub-sea target for tracking.

Tracking using Differential GPS

Where positions from a Differential GPS (DGPS) receiver are available, you can use the Ranger USBL System to position a target in real-world co-ordinates.

The quality of the DGPS positions will directly affect the quality of positions given by Ranger. The Ranger USBL System positions targets relative to a transceiver mounted on the vessel. Therefore, any errors in the position of the vessel will be transferred directly to the position of the target being tracked.

To achieve accurate real-world positions for sub-sea targets, it is essential that you use real-world position solutions delivered by high quality DGPS or RTK systems.

Note

You should not use Ranger with non-differential GPS, because the error in the positions is too large for useful tracking operations.

Tracking towfish

You can use the Ranger USBL System to position a towfish towed behind the vessel.

For optimal performance in this type of operation, you can fit an adaptor flange to a standard transceiver so that it angles the transceiver face towards the target. Although this technique is helpful in increasing the signal-to-noise ratio when tracking a target directly astern of the vessel, it can also result in the introduction of additional noise and limit the transceiver’s ability to track targets that are not astern of the vessel.

You can position the towfish relative to the vessel or in real-world co-ordinates if DGPS positions are available.

Tracking multiple targets

The Ranger USBL System can track up to ten targets at the same time, and can show the position of each of these targets on the Chart display.

You can configure Ranger to output a telegram sentence or ‘Report’ for each individual target, and can feed them to an external navigation system or client system.

When you are outputting multiple position Reports from the system, you should use one of the proprietary sentences rather than the NMEA 0183 ‘GGA’ sentence, because the proprietary sentences include the name of the target being tracked.

The interrogation scheme set in each of the beacons to be tracked will dictate the update rate. By using individual interrogation signals unique to each beacon, the system positions each target in turn. This means that the position update rate for each target will decrease as you increase the number of targets tracked.

If you are using a common interrogation signal—applicable only with Sonardyne channels—you can position each target using a single interrogation cycle. In this case it is important that you set the appropriate turn-around-time for each of the beacons.

Appendix B Frames, Offsets and Corrections

In this appendix... This appendix contains the following sub-sections:

B.1 Co-ordinate Frame Conventions

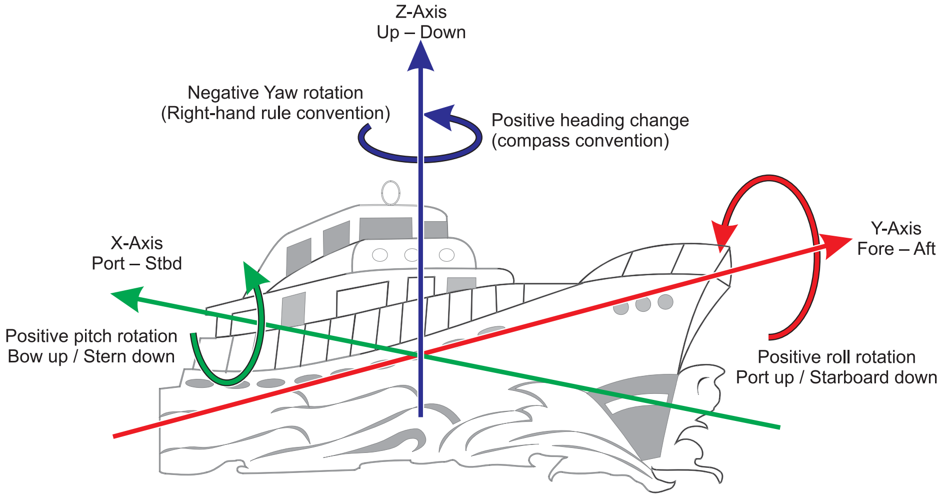
Rotations

As shown in Fig 76, the Ranger USBL System operates in three dimensions and the co-ordinate frames use three orthogonal (mutually at right-angles) axes. The axes are labelled X, Y, Z as shown.

In a right-handed system such as Ranger USBL, the following rotations are positive:

- **Positive Yaw rotation**—the X-axis rotates towards the current Y-axis direction.
- **Positive Pitch rotation**—the Y-axis rotates towards the current Z-axis direction.
- **Positive Roll rotation**—the Z-axis rotates towards the current X-axis direction.

Fig 76 Rotation conventions in the Vessel’s Reference Frame



Grid conventions

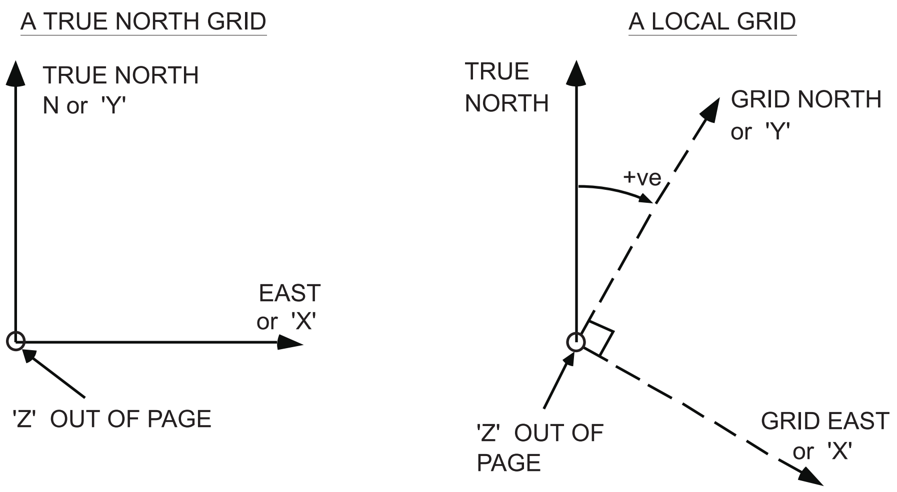
In conventional grid situations, shown in Fig 77:

- The X direction is reserved for the true east direction; for any grid east direction; or for the ‘logical’ east direction of an object such as the starboard direction of a vessel.
- The Y direction is reserved for the true north direction; for any grid north direction; or for the ‘logical’ north direction of an object-based frame, such as the lubber line (fore/aft axis) of a vessel.

  In the construction industry, the ‘logical’ north is called ‘plant north’.
- The Z direction is reserved for the true vertical direction or, in the case of an object, the ‘logical’ vertical direction.

  Depth is in the negative Z direction.

Fig 77 Grid conventions



Some exceptions

The convention for the heading of a vessel conflicts with the convention for right-handed systems (which are also used for mathematical trigonometric functions). Vessel heading rotation is in the wrong sense—it is 0 to 360 degrees instead of plus and minus 180 degrees, and the zero is in the Y direction instead of the X direction.

Note

Everything works mathematically if you ignore the zero direction problem (imagine that the x-axis is displaced) and make the heading negative.

Examples

- Positive Pitch of a vessel is when the bow end of the vessel rises with respect to the aft end.
- Positive Roll of a vessel is when the starboard side of the vessel drops with respect to the port side.
- Positive displacements and velocities are in the Y or north direction, X or east direction or in the Z or vertically up direction.

Local grid

Charts provide a two-dimensional representation of the Earth’s three-dimensional surface. One consequence of this is that, in most places, the local representation or local grid does not align perfectly with True North. The angle between these is called the local convergence.

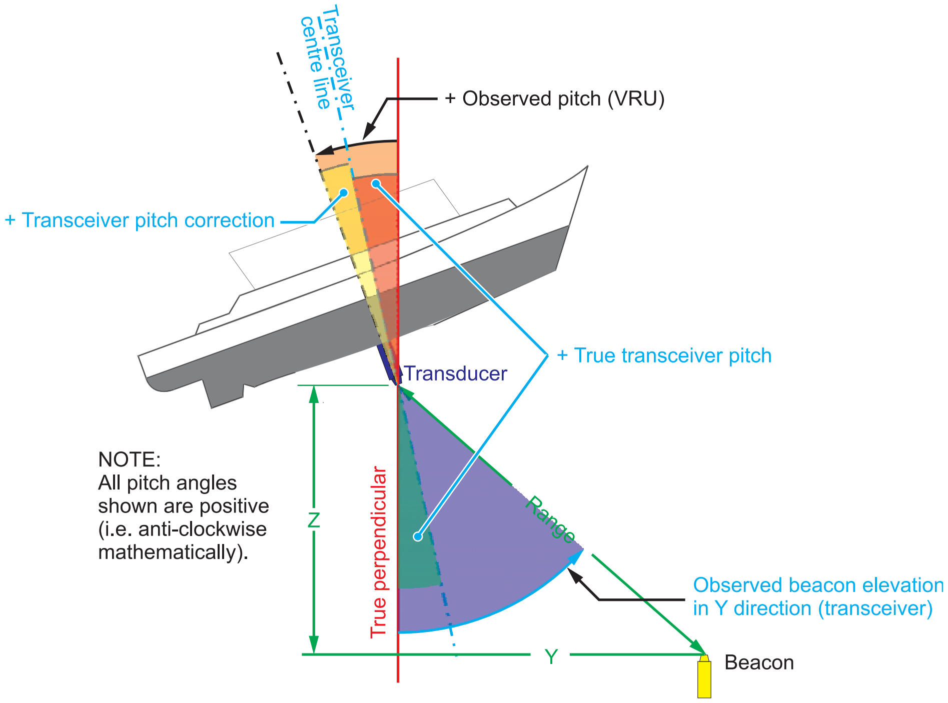
B.2 Sign Conventions for Sonardyne Corrections

The following explanation assumes that alignment errors in the VRU and the gyrocompass have been corrected by some means external to the Sonardyne system. In other words, if the vessel’s Z-axis is aligned precisely with the local perpendicular, then the VRU will output 0° roll and 0° pitch and, if the vessel is heading exactly due North, the gyrocompass will output 0°.

The need for corrections within the Sonardyne USBL system arises because the transceiver, as deployed, may not be exactly aligned with the vessel’s reference grid. These misalignments will be measured during the installation phase of a Job, and corrections applied to all calculations made by the system. Details of these correction calculations are given in the following.

Pitch axis corrections

Fig 78 Pitch axis correction



The Transceiver Pitch Correction is used as follows:

True Transceiver Pitch = Observed Pitch – Transceiver Pitch Correction

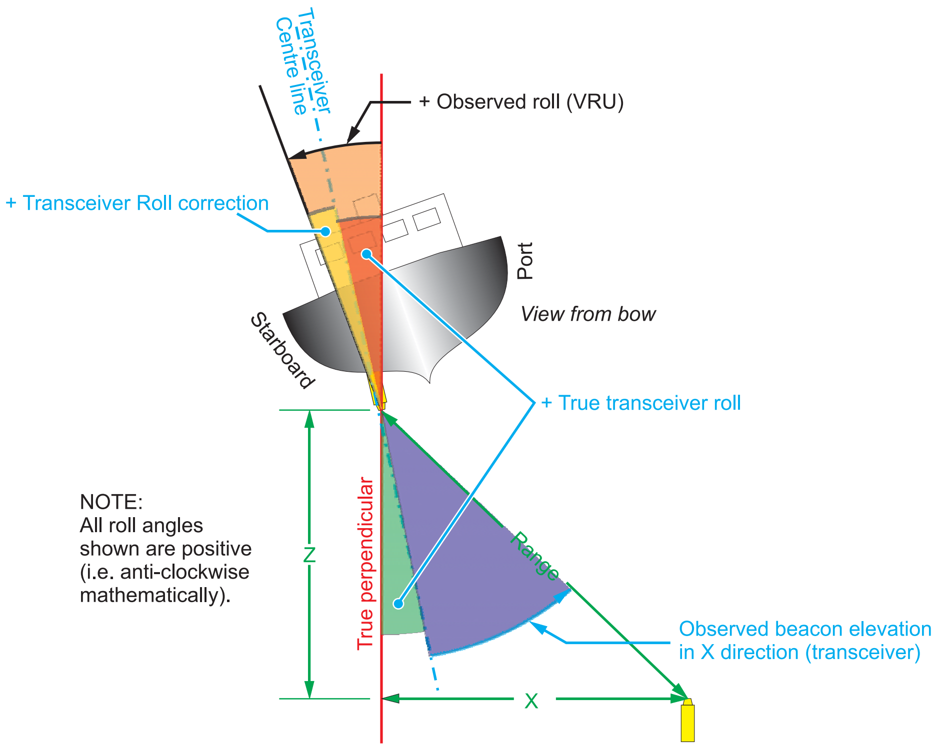
True Beacon Elevation = Observed Beacon Elevation + True Transceiver Pitch

Z = Range × *cos*(True Beacon Elevation)

Y = Range × *sin* (True Beacon Elevation)

Roll axis corrections

Fig 79 Roll axis corrections



The Transceiver Roll Correction is used as follows:

True Transceiver Roll = Observed Roll – Transceiver Roll Correction

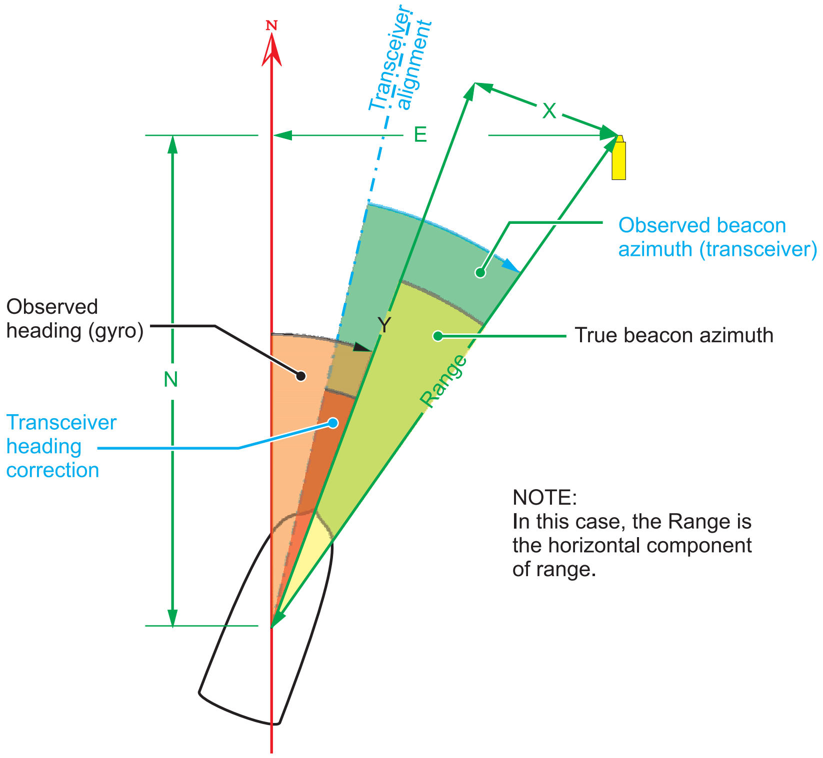
True Beacon Elevation = Observed Beacon Elevation + True Transceiver Roll

Z = Range × *cos* (True Beacon Elevation)

Y = Range × *sin* (True Beacon Elevation)

Azimuth corrections

Fig 80 Azimuth corrections



The Transceiver Heading Correction is used as follows:

True Tncvr Heading = Observed Heading – Transceiver Heading Correction

Rel Beacon Azimuth = Observed Beacon Azimuth – Transceiver Heading Correction

True Beacon Azimuth = Observed Beacon Azimuth + True Transceiver Heading

Y = Range × *cos* (Relative Beacon Azimuth)

X = Range × *sin* (Relative Beacon Azimuth)

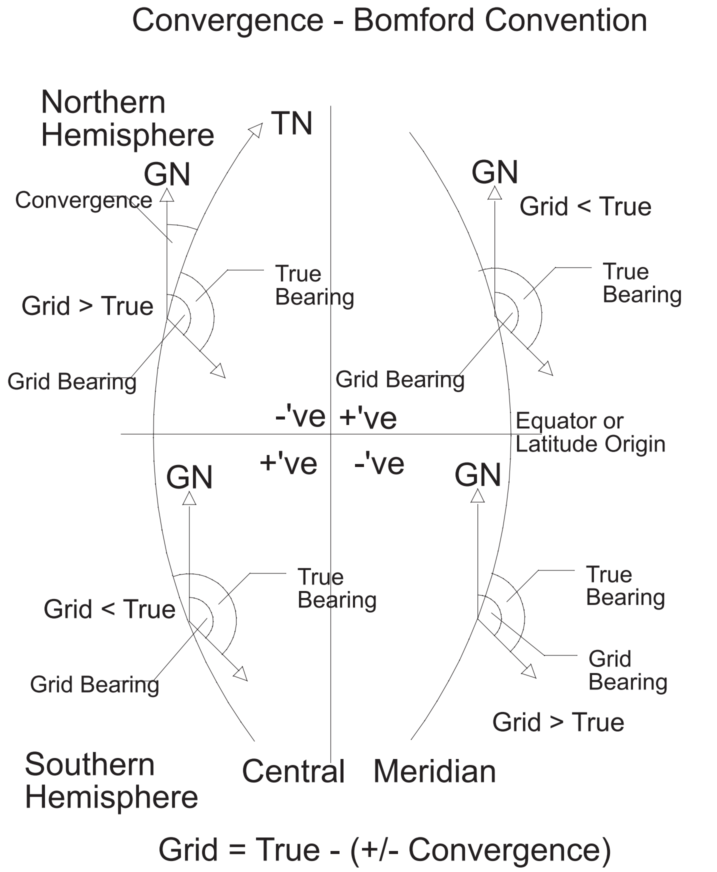
N = Range × *cos* (True Beacon Azimuth)

E = Range × *sin* (True Beacon Azimuth)

B.3 Convergence Convention

Sonardyne follow the Bomford convention illustrated below.

Fig 81 Bomford's Definition of Convergence



Bomford's definition

At any point the convergence is the angle between the meridian as represented on the plane and the North grid line. It is positive when Grid North lies east of True North. Convergence is clockwise from meridian to N axis.

Appendix C Navigation Control Unit Interface Cables

This appendix includes details the various interface cables to be used with the Type 8020 Navigation Controller Unit (NCU). The cables supplied will depend on the interface modules installed in the NCU and on the interface cable configuration required for the USBL transceiver.

In this appendix...

This appendix contains the following sub-section:

C.1 Transceiver Interface

Note

Details for the 8-way transceiver cable from slot 2 on the Navigation Computer depend on whether the system is portable or rack-mounted:

- If the system is portable, the cable will be terminated with a suitable connector to be attached to the main cable from the USBL transceiver.
- If the system is rack-mounted, the cable will have open tails for connection to the vessel’s junction box or a terminal strip in the rack.

The transceiver interface cable connects the transceiver to the NCU, usually through a deck cable extension. The cable is supplied on a drum when supplied as part of a portable system, and must pass along or through the deployment pole for connection to the deck cable at a suitable junction point.

The NCU has an 8-pin Lemo to 48V cable assembly (CPN 820-6484) for connection to the deck cable.

If your system has a transceiver cable with open cores at one end instead of a cable on a drum, you will require a section of the vessel’s cable to make the connection to the NCU. In this case, the NCU will require an 8-pin Lemo to open ended cable (CPN 8020-6459).

C.2 Serial Interfaces

Serial interfaces to the NCU are either RS232 or RS422 (RS485).

The configuration of the modules in the NCU will define what connections are available. Refer to Fig 15 on page 22 for a typical system configuration. Sonardyne supplies appropriate serial cables with each system.

Modules are available to connect to synchro gyros and analogue VRUs. These are not supplied as standard—you must order them from Sonardyne with the appropriate modules if you need them.

C.3 Cable Diagrams

Table 26 List of cable diagrams

CPN	Type	Notes
820-6608	RS232 serial data cable to open flylead	

CPN	Type	Notes
8020-6459	8-pin Lemo to open flylead	Transceiver interface cable
7784-049/02	Responder cable	
820-6463	8-pin Lemo to 24V Mk4 RovNav	Mk4 RovNav only
820-6475	8-pin Lemo to 24V RovNav 5	RovNav 5 only
820-6484	8-pin Lemo to 48V USBL	Digital USBL transceivers only
820-6615	4-pin Lemo to VRU open flylead	
	6-pin syncro gyro to open flylead	
	RS422 serial data cable to open flylead	

Fig 82 Serial Data Cable to Flylead – CPN 820-6608

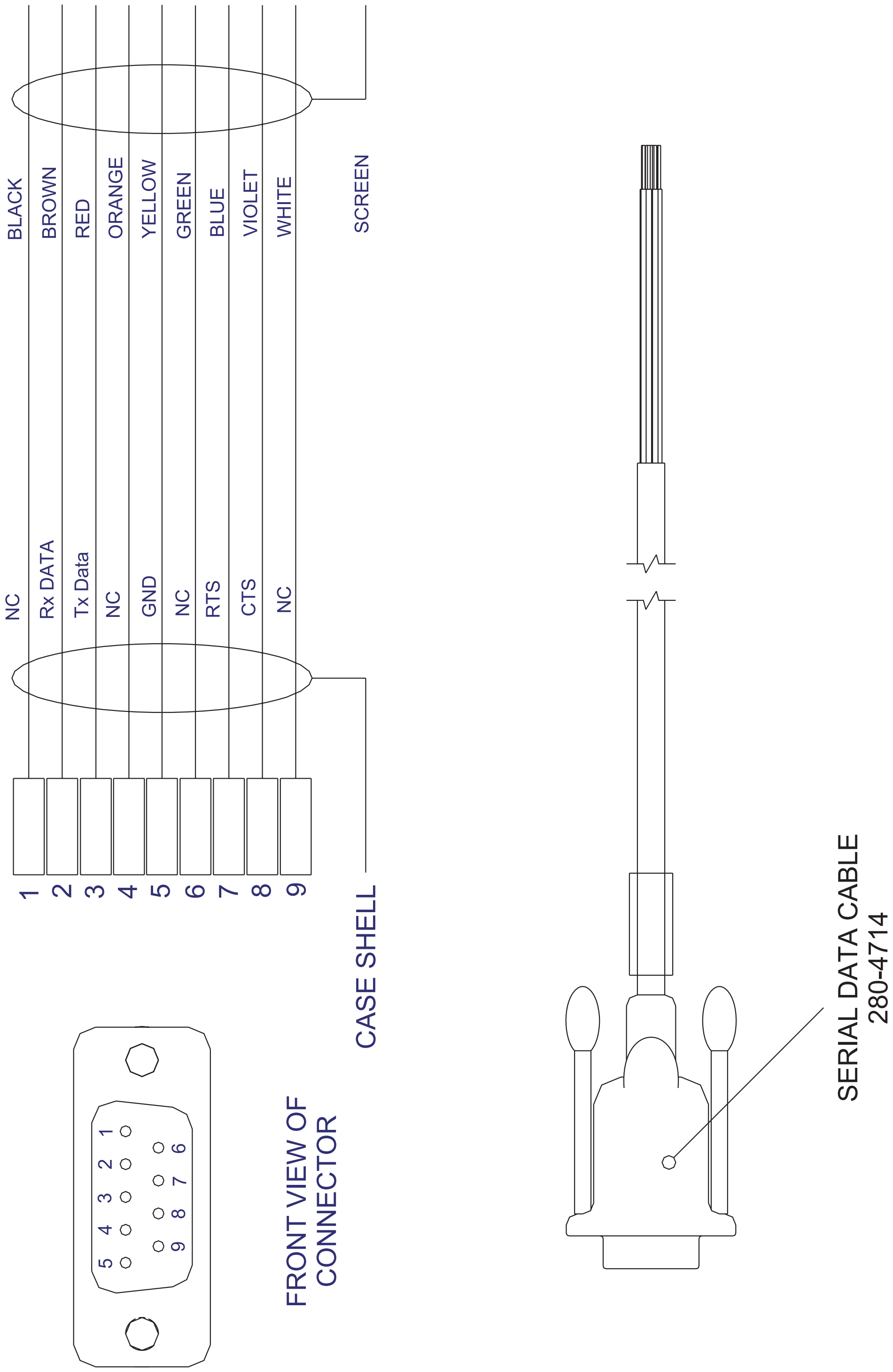


Fig 83 8-Pin Lemo to Flylead – CPN 8020-6459

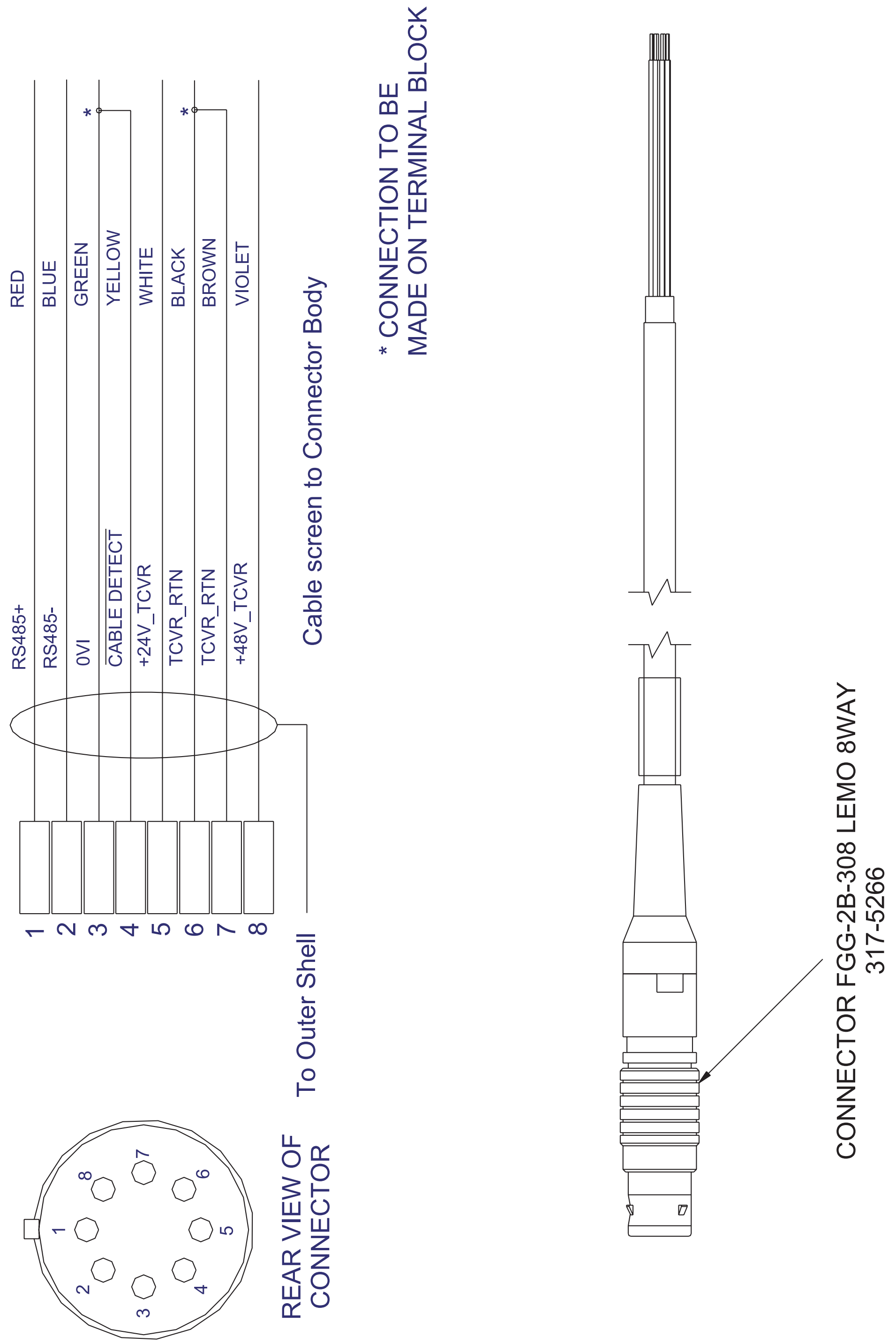
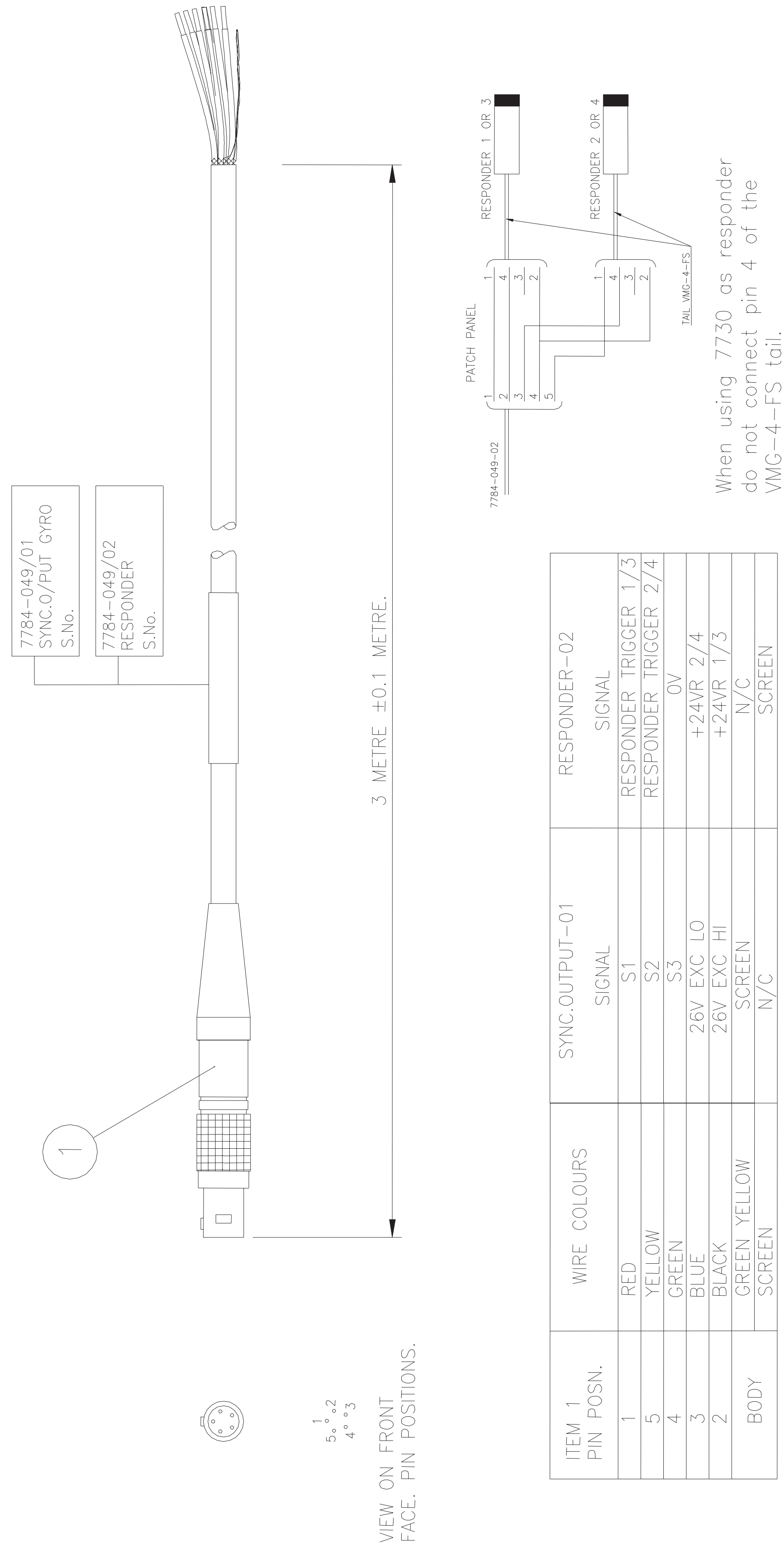


Fig 84 Responder Cable – CPN 7784-049/02



ITEM 1 PIN POSN.	WIRE COLOURS	SYNC.OUTPUT-01 SIGNAL	RESPONDER-02 SIGNAL
1	RED	S1	RESPONDER TRIGGER 1/3
5	YELLOW	S2	RESPONDER TRIGGER 2/4
4	GREEN	S3	0V
3	BLUE	26V EXC LO	+24VR 2/4
2	BLACK	26V EXC HI	+24VR 1/3
	GREEN YELLOW	SCREEN	N/C
BODY	SCREEN	N/C	SCREEN

Fig 85   8-Pin Lemo to 24V RovNav 4 – CPN 820-6463

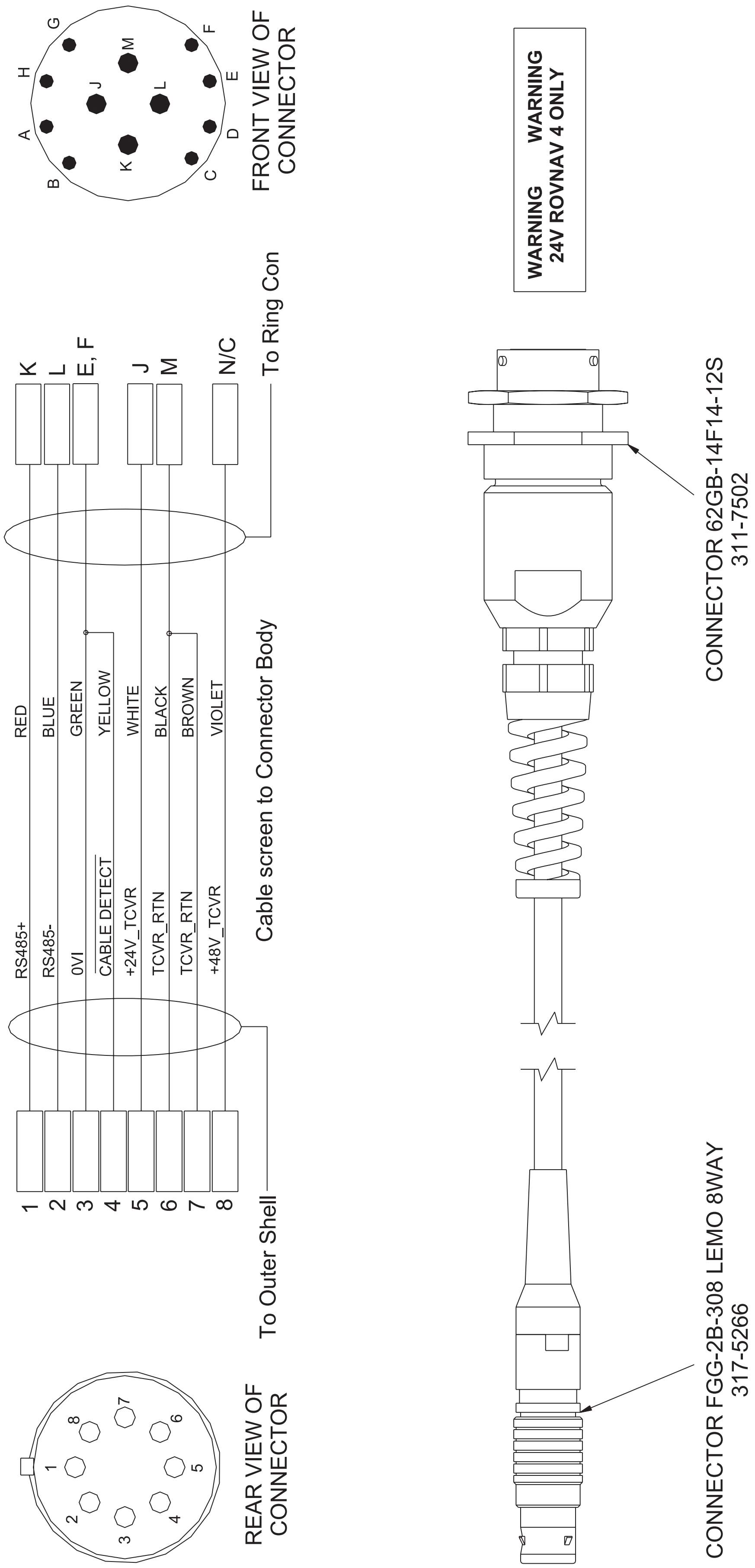


Fig 86 8-Pin Lemo to 24V RovNav 5 – CPN 820-6475

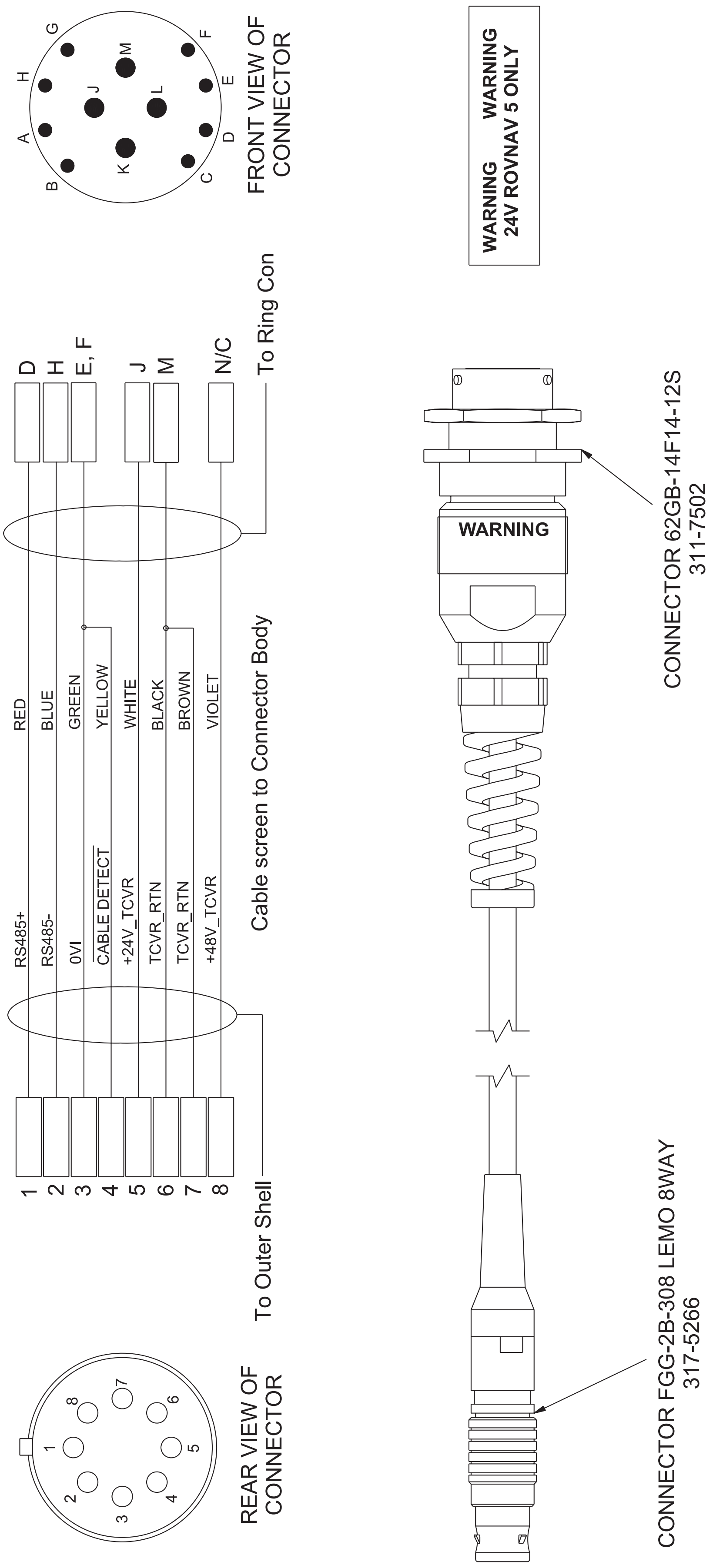


Fig 87 8-Pin Lemo to 48V USBL Transceiver – CPN 820-6484

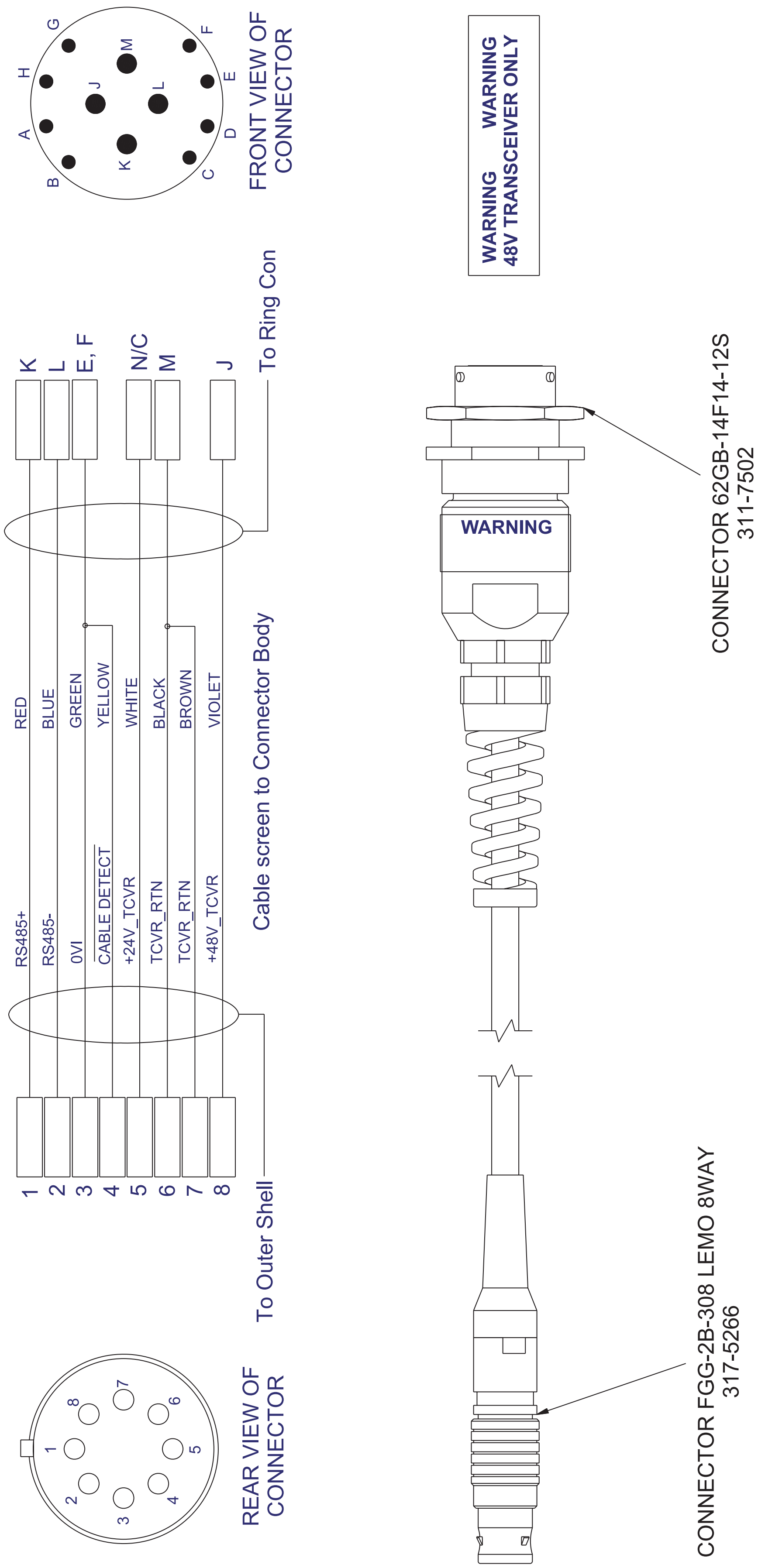


Fig 88 4-Pin Lemo to VRU Flylead – CPN 820-6615

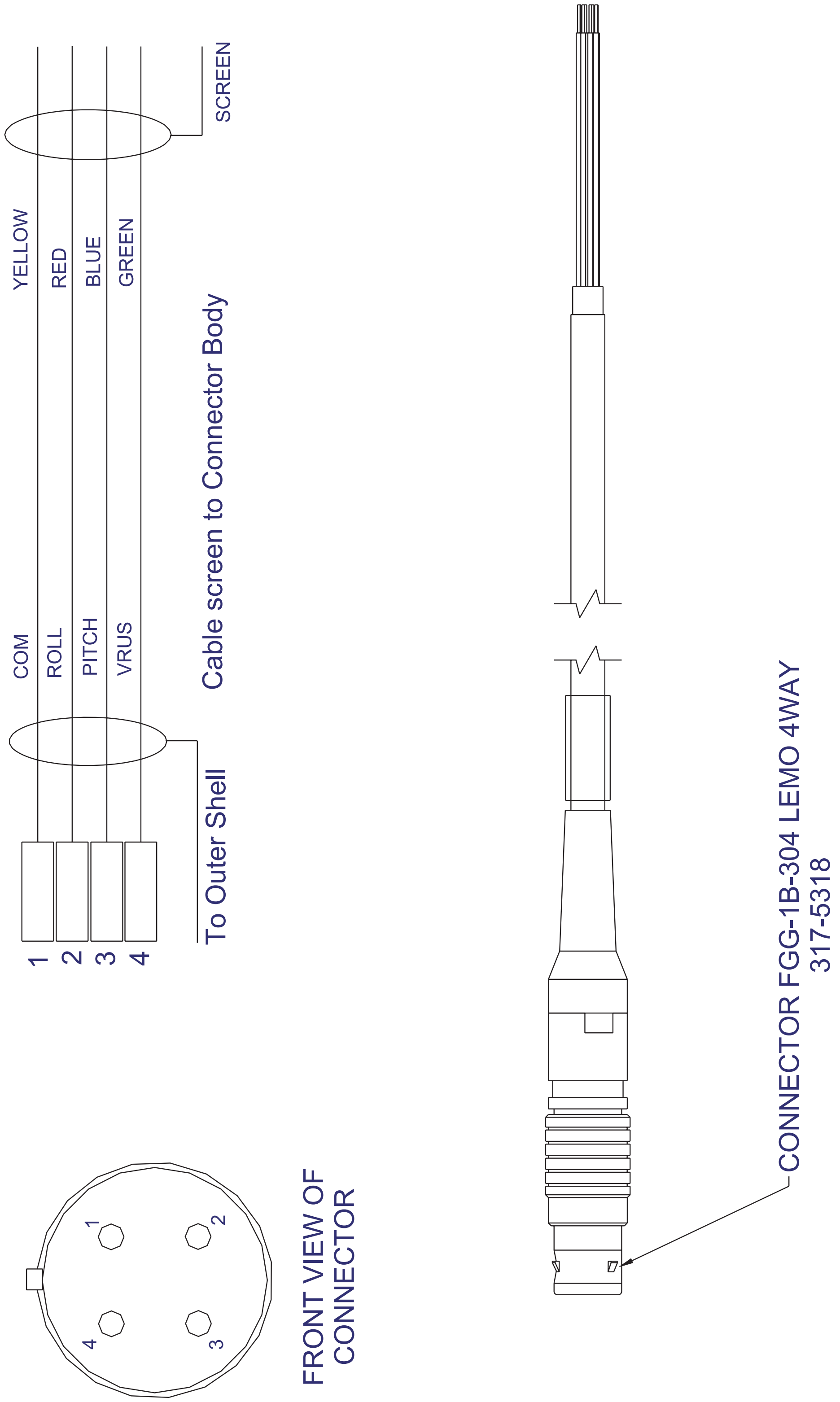


Fig 89   6-Pin Syncro to Flylead

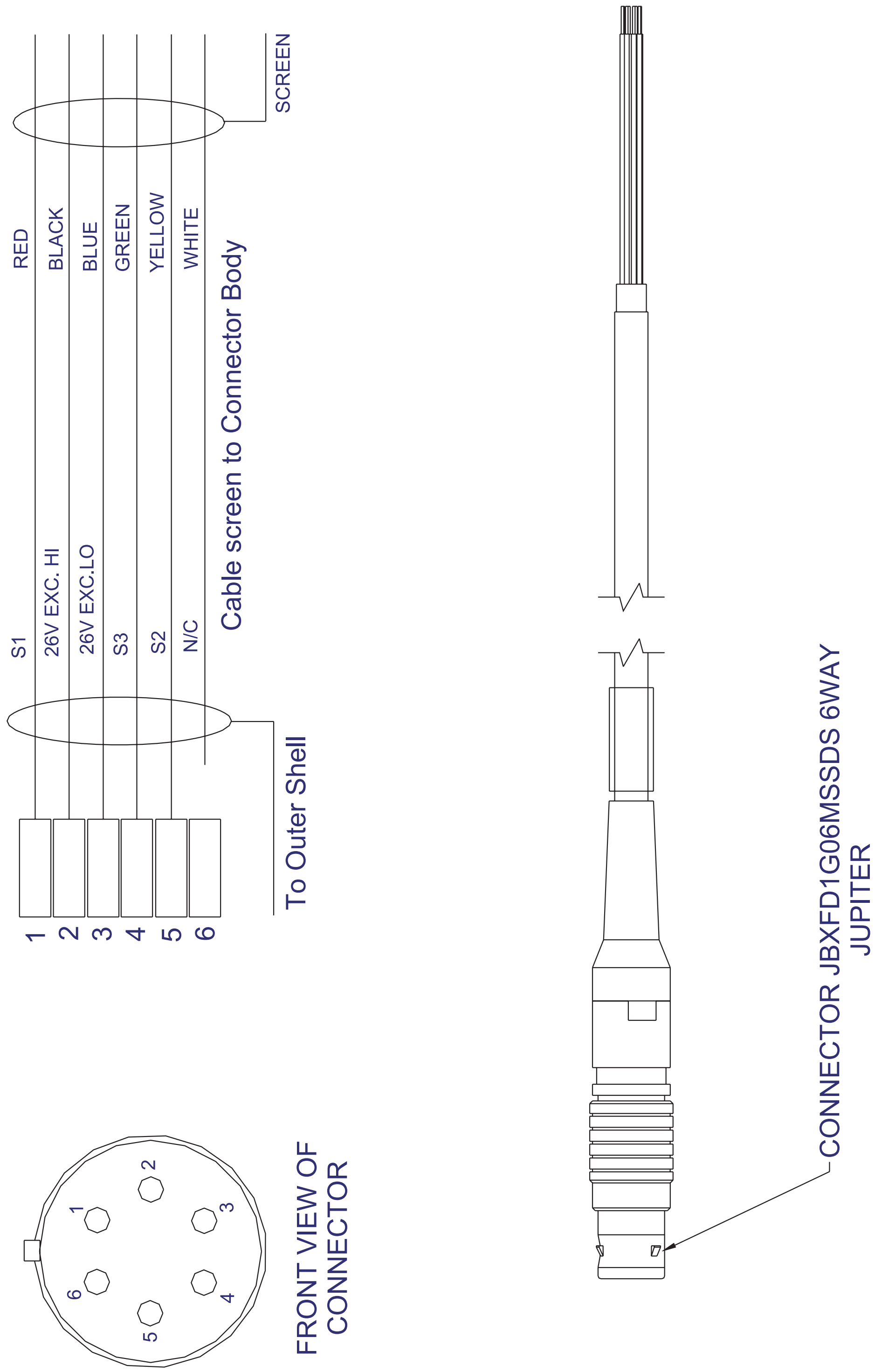
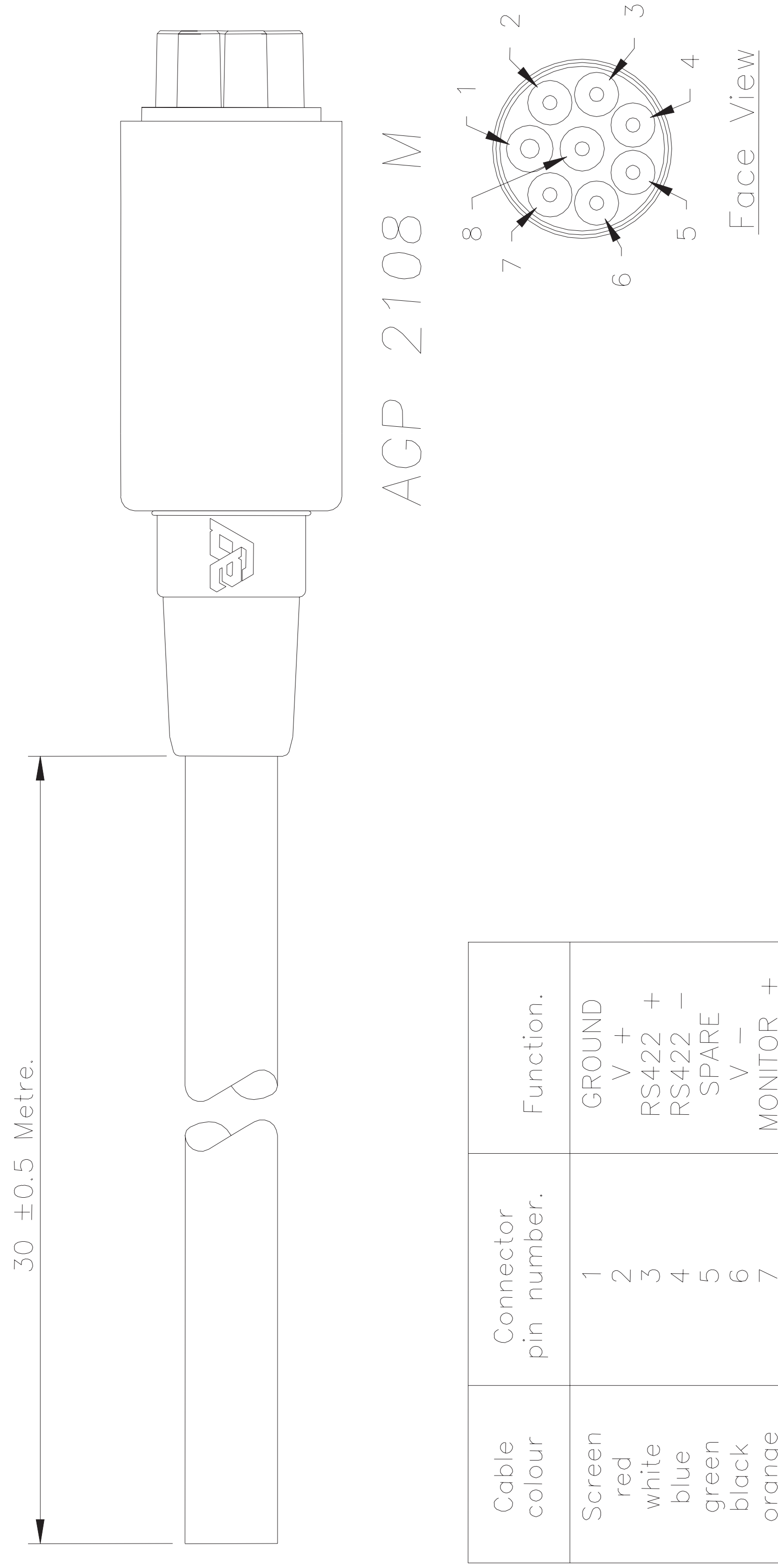


Fig 90 Transceiver Cable (Typically 30 metres)



Cable colour	Connector pin number.	Function.
Screen	1	GROUND
red	2	V +
white	3	RS422 +
blue	4	RS422 −
green	5	SPARE
black	6	V −
orange	7	MONITOR +
yellow	8	MONITOR −

Appendix D Software Tools

In this appendix...

This appendix contains the following sub-sections:

D.1 Introduction

The Ranger software provides a condensed set of diagnostic and utility tools that are there to help you achieve a successful survey. These are all accessible through the **Tools** item on the menu bar.

D.2 Acoustic Signal Analyser

Introduction

The acoustic signal analyser allows you to assess the quality of signals received from the system’s transponder beacons. To use the acoustic signal analyser select **Tools** > **Acoustic signal analyser…** from the menu bar or click the **Acoustic signal response** button on the toolbar.

Transducer arrangement

The USBL transceiver has six transducers built into the acoustic front face: Five of them are receiving transducers arranged in a pentagon, and the sixth is a transmitting transducer, located at the centre of the pentagon.

All five receiving transducers are involved in deriving measurements from the received acoustic signals.

Signal measurement

The USBL transceiver looks at the difference in phase of the beacon’s response signals as measured by the five receive transducers, and uses this information to determine the azimuth and elevation of the signals.

The transceiver samples the received signals eight separate times throughout each pulse, and uses the samples to check and confirm the validity of the signal’s derived azimuth and elevation. A defined number of these eight samples must agree before Ranger considers the azimuth and elevation to be valid.

USBL signal analysis

To help assess the condition of the acoustic signal, the Ranger software provides a USBL Signal Analysis display. This display provides a a large amount of detailed information about the pulse that you can use to diagnose acoustic problems that may affect the system. You can access this display by selecting the **Tools** > **Range Test tool** from the menu bar, or directly from the **Transducer** tab of the USBL transceiver’s properties dialog.

Display Components

Fig 91 shows an example of the USBL Signal analysis display.

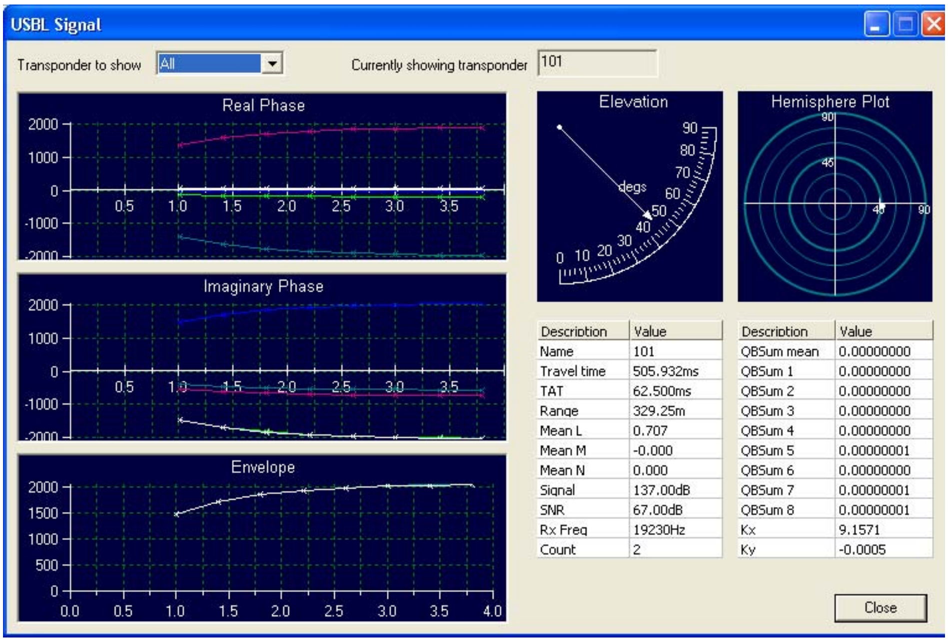
The USBL Signal analysis display comprises a number of smaller graphs and plots, all of which need to be viewed in context with each other to determine the quality of the received USBL signal. The smaller graphs and plots include:

- Real and Imaginary Phase graphs

- an Envelope graph
- an Elevation plot, and
- a Hemisphere Plot.

The USBL Signal analysis display also includes two lists showing the values measured.

Fig 91 USBL Signal analysis display



Real and Imaginary Phase graphs

These graphs show the phase of the signal received on each of the five receive transducers relative to a local reference signal generated within the transceiver.

- The **Real Phase** graph shows the component of the received signal that is in phase with the reference signal.
- The **Imaginary Phase** graph shows the component of the received signal that is out of phase, or in quadrature, with the reference signal.

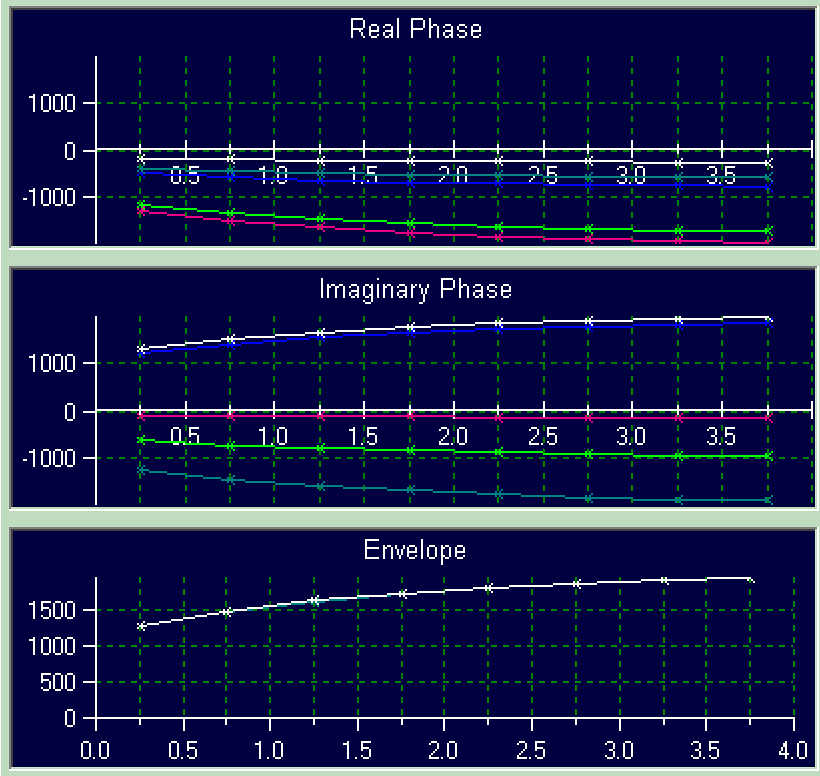
The Real and Imaginary Phase graphs show information about the difference in phase between the transducers. This is why there are five lines on each graph, each of a different colour to allow easy discrimination between them.

The eight points on each line are the eight samples taken of the acoustic pulse. They rise in amplitude as the signal strength increases.

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

The pulse length is determined by the beacon type. However, if destructive interference is affecting the end of the received pulse you can change the pulse length to a smaller value in the **USBL Transceiver Advanced** options for each transponder or beacon. See “Advanced settings” beginning on page 49 for a description of the Advanced options.

Fig 92 Good USBL signal of 4ms pulse length



Envelope graph

The **Envelope** graph displays the magnitude of the acoustic signal as seen at each of the five transducers. Ranger calculates the magnitude as follows:

$$\text{Magnitude} = \sqrt{(\text{real}^2 + \text{imaginary}^2)} \quad (12)$$

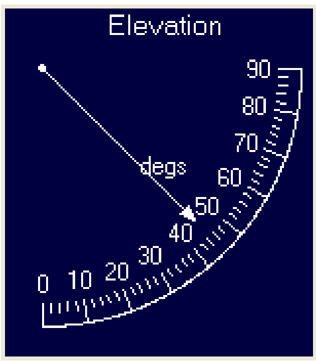
The **Envelope** graph also includes five lines, with one for each transducer. However, because they are all of the same magnitude, the graph shows them superimposed on top of each other. This is normal—the signal magnitude should always be the same at all five transducers.

Elevation plot

The **Elevation** plot is an indication of the elevation of the processed USBL signal. It gives no indication of range, only of direction using a unit-length vector.

The white arrow swings around a 90° arc from vertically straight down (0°) to horizontally out to the side (90°).

Fig 93 Elevation plot



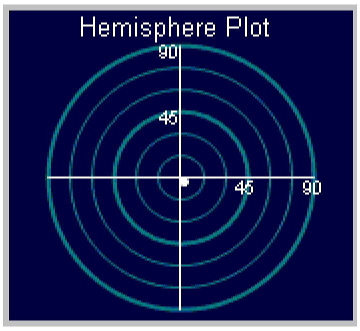
Hemisphere Plot

The **Hemisphere** plot is a plan view of the processed USBL signal, presented using the transceiver's frame of reference.

The plot includes all eight samples, which should all be in a similar place on the plot.

Fig 94 shows an example in which the signal came from almost directly underneath the transceiver, but slightly aft and to starboard of the vertical with respect to the transceiver's reference frame.

Fig 94 Hemisphere plot



Typical Acoustic Problems

The following sub-sections describe some of the typical acoustic problems that you might encounter, and include some advice to help you overcome them using the USBL Signal analysis display. The topics covered are:

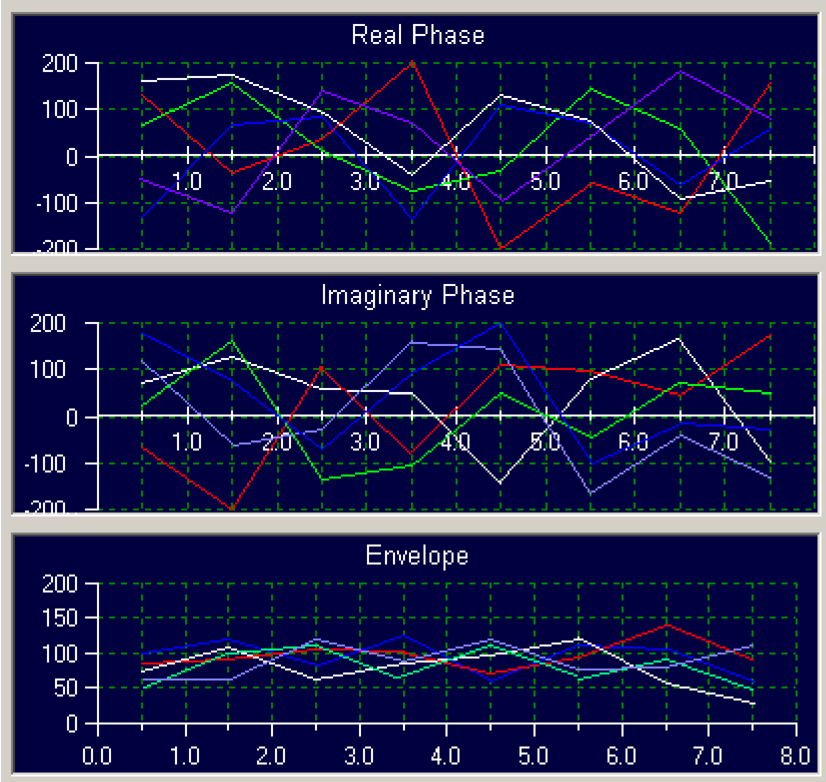
- False Detection
- Signal destruction (Multipath), and
- Fouling of transducer face.

False Detection

In this scenario, the USBL transceiver is sometimes detecting the correct acoustic signal, and at other times it is detecting random acoustic signals.

The USBL Signal analysis display might include graphs similar to the example in Fig 95. In this example, erratic signals are interspersed with normal signal plots.

Fig 95 False detection graphs



The explanation for this is that the USBL transceiver is finding 'rogue' signals in the water that have sufficient energy to be detected, but that did not come directly from the transponder. These rogue signals usually have lower signal strengths than the real signals.

In the plots of Fig 95, it can be seen that the real and imaginary phases are random, as is the envelope plot. These signals are often from other sources, or are echoes from other transmissions that may have bounced off a nearby structure.

Solution:

The key to solving this problem is in the fact that the rogue signals have a lower signal level than the real signals.

Try raising the USBL transceiver's detection and validation levels, and perhaps reducing the receiver gain. Eventually the system will no longer detect the rogue signals.

Signal destruction (Multipath)

The USBL transceiver relies on accurate measurement of the difference in signal phase between the five receive transducers. This is possible only when there is no distortion of the signal.

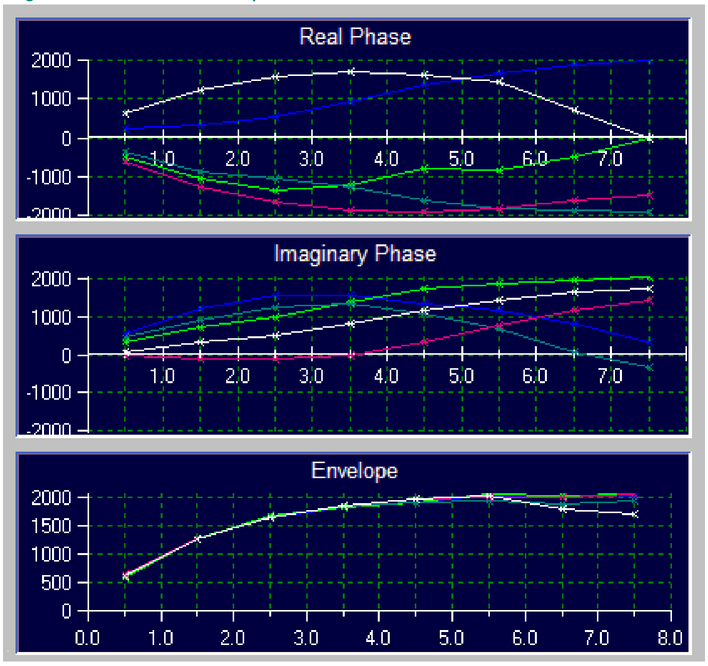
Multipath occurs when the transceiver receives two response signals from the transponder, each of which follows a different path:

- The direct signal follows a line-of-sight path from the transponder directly to the transceivers.
- The secondary signal follows an indirect path, bouncing off a solid surface and arriving at the transceiver a few milliseconds after the start of the direct signal.

When multipath occurs, only the start of the direct reply signal from the transponder will be clean. A few milliseconds into the reply, the arrival of multipath signals will cause the USBL transceiver to experience difficulty in determining the signal's direction.

Fig 96 below shows a classic example of the USBL Signal analysis display in the presence of multipath. The transponder's reply signal has bounced off a nearby object or the vessel's hull and has arrived at the transceiver just a few milliseconds after the start of the direct path signal.

Fig 96 Effects of multipath



In the example of Fig 96, the signal remains good until about 2.5ms into the reply, at which point the phases begin to drift around.

In these conditions, the Hemisphere plot will also show the transponder's position erratically.

Solution:

There are two ways to solve this problem:

1. One option is to eliminate the cause of the multipath by relocating the transponder away from the reflective surface. However, this is not always possible.

2. The second option is to change the length of reply that the USBL system is looking for.

   Despite the fact that the transponder is transmitting an 8ms pulse, the USBL transceiver can be told to only look at the first 1, 2 or 4ms of the reply pulse. The remainder of the reply from the transponder will then be ignored.

   No matter how much of the pulse is sampled, 8 dedicated samples are observed.

Note

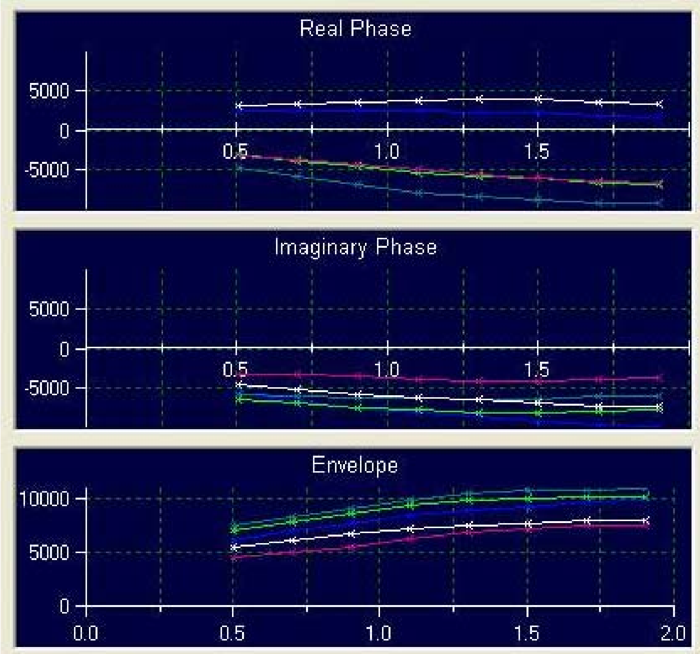
It is not advisable to sample less than 2ms of a pulse.

You can set the received pulse length and the acceptance threshold on a per beacon basis by using the **Transponder details** dialog, described on page 59.

Fouling of transducer face

A less common cause of signal distortion occurs when there is not a clean interface between the transducer face and the water. Fig 97 shows how transducer fouling can affect the USBL Signal analysis display.

Fig 97 Effects of a fouled transducer face



D.3 Manual Command Window

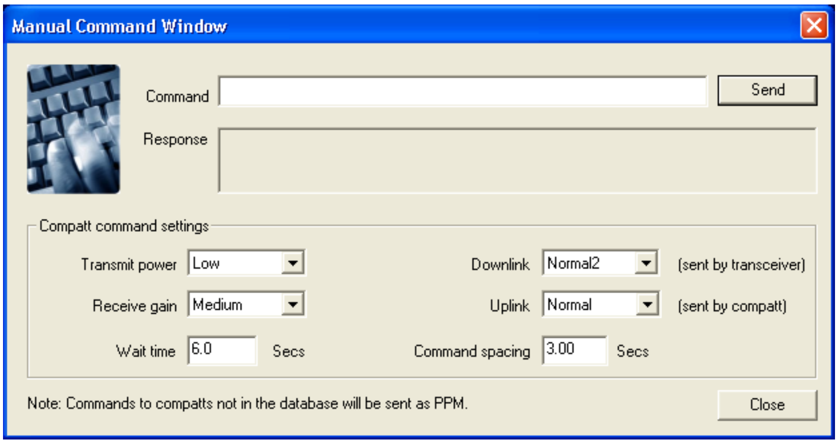
Note

Only experienced operators should use this tool for Compatt beacons. Sending commands to a Compatt beacon using this tool does not guarantee that the information for the Compatt in the Job database will be updated. Use this tool with caution.

Introduction

The **Manual Command Window** allows you to send commands manually to Compatt beacons. To access the Manual Command Window, select **Tools** > **Manual command window…** on the menu bar or click the **Manual commands** button on the toolbar.

Fig 98 Manual Command Window



Valid commands

Table 27 to Table 31 below list the valid commands that you can send. Note that not all of these commands will be applicable for use within your survey operation.

Table 27 Transceiver commands

Command	Meaning
FV	Firmware version.
RS	Reset.
PL	Set power.
PG	Set gain.
TW	Set telemetry wait.
LW	Set LBL window.
P	Set port.

Table 28 Compatt general commands

Command	Meaning
TS	Set general status. Append the relevant Compatt address to this command to direct it to the appropriate Compatt, for example TS101.
CF	Set reply frequency. Append the relevant reply channel number to this command to make the setting, for example CF5.
TT	Set turn-around time.
NM	Set Normal mode.
FM	Set Fast Simultaneous.
FE	Set IIF Reply.
ACIF	Set interrogation frequency.

Table 29 Compatt measurement commands

Command	Meaning
BC	Get battery count.
EL	Get elapsed time.
CT	Get elapsed time.
CD	Get depth.
CQ	Get DQ depth.
TQ	Get DQ temperature.
AN	Get analogue voltage.

Table 30 Compatt enable commands

Command	Meaning
ES	Enable slow.
EN	Enable normal.
EF	Enable fast.
EC	Enable CIF.
EI	Enable IIF.
EU	Enable USBL.
DS	Disable all.
DC	Disable CIF.
DI	Disable IIF.
DU	Disable USBL.
CWC	Set cycle wait.

Command	Meaning
CWT	Set transmit wait.
CWR	Set receive wait.

Table 31 Compatt power and gain commands

Command	Meaning
PS	Get power status.
CPL	Set LBL power.
CPS	Set telemetry start.
CPT	Set telemetry word.
CPU	Set USBL power.
CPA	Set all powers.
CG	Set gain.
RD	Reset defaults.
RL	Release.

Command settings

Six controls and fields on the **Manual Command Window** allow you to set the Compatt configuration used for exchanging commands and responses. Table 32 lists and describes these controls and fields.

Table 32 Compatt command settings

Control/Field	Description
Transmit power	Sets the power level used to transmit the manual command.
Receive gain	Sets the receiver gain used to receive the transponders' responses.
Wait time	The length of time that Ranger waits between sending a command and receiving a reply.
Downlink	Sets the mode used for the downlink that carries commands from the transceiver to the transponders.
Uplink	Sets the mode used for the uplink that carries responses from the transponders to the transceiver.
Command spacing	Sets the minimum allowable interval between consecutive manual commands.

Responses

The **Manual Command Window** displays responses to manual commands in a read-only **Response** field. There will be an obvious delay between the moment when you click **Send** to transmit the command you have entered in the **Command** field, and the transponder's reply appearing in the **Response** field.

If the transponder does not recognise the command that you send, the **Response** field will show the command code followed by a question mark.

D.4 Transceiver Calibration Test

The Transceiver Calibration Test tool is available only when all transponder beacons are offline. To perform a transceiver calibration test select **Tools > Transceiver calibration test…** from the menu bar.

This tool tests the transceiver's five internal receiver cards by injecting a signal into all of them and monitoring the difference that each receiver sees.

If only one or two frequencies fail, it is unlikely that there is a problem. In these cases, repeat the test to try to gain a successful result.

The transceiver runs this calibration test automatically at 15 minute intervals. You should use this tool if you suspect that there is something wrong with the transceiver.

The transceiver calibration test results are presented as a read-only table that shows the phase response for each of the five receivers across a range of measurement frequencies. The **Phase Span** column in the table shows successful results against a green background, and failed results against a red background.

Fig 99 Transceiver phase calibration display

Transceiver phase calibration

This utility tests the transceivers 5 internal receiver cards. It injects a test signal into all 5 receivers and monitors the difference that each receiver sees. If one or two frequencies fail then there is unlikely to be a problem and the test should be run again.

Frequency	Average Phase	Rcvr A	Rcvr B	Rcvr C	Rcvr D	Rcvr E	Rcvr F	Phase Span
19000 Hz	-1.20	1.20	2.05	0.44	-2.02	-2.87	1.20	4.92
19500 Hz	-1.80	1.80	1.80	-0.36	-2.53	-2.53	1.80	4.33
20000 Hz	-2.19	2.19	1.34	-1.12	-2.73	-1.87	2.19	4.92
20500 Hz	-2.32	2.32	0.71	-1.75	-2.60	-1.00	2.32	4.92
21000 Hz	-2.17	2.17	-0.00	-2.17	-2.17	-0.00	2.17	4.33
21500 Hz	-1.75	1.75	-0.71	-2.32	-1.46	1.00	1.75	4.07
22000 Hz	-1.12	1.12	-1.34	-2.19	-0.59	1.87	1.12	4.07
22500 Hz	-0.36	0.36	-1.80	-1.80	0.36	2.53	0.36	4.33
23000 Hz	0.44	-0.44	-2.05	-1.20	1.27	2.87	-0.44	4.92
23500 Hz	1.20	-1.20	-2.05	-0.44	2.02	2.87	-1.20	4.92
24000 Hz	1.80	-1.80	-1.80	0.36	2.53	2.53	-1.80	4.33
24500 Hz	2.19	-2.19	-1.34	1.12	2.73	1.87	-2.19	4.92
25000 Hz	2.32	-2.32	-0.71	1.75	2.60	1.00	-2.32	4.92
25500 Hz	2.17	-2.17	0.00	2.17	2.17	0.00	-2.17	4.33
26000 Hz	1.75	-1.75	0.71	2.32	1.46	-1.00	-1.75	4.07
26500 Hz	1.12	-1.12	1.34	2.19	0.59	-1.87	-1.12	4.07
27000 Hz	0.36	-0.36	1.80	1.80	-0.36	-2.53	-0.36	4.33
27500 Hz	-0.44	0.44	2.05	1.20	-1.27	-2.87	0.44	4.92
28000 Hz	-1.20	1.20	2.05	0.44	-2.02	-2.87	1.20	4.92
28500 Hz	-1.80	1.80	1.80	-0.36	-2.53	-2.53	1.80	4.33
29000 Hz	-2.19	2.19	1.34	-1.12	-2.73	-1.87	2.19	4.92
29500 Hz	-2.32	2.32	0.71	-1.75	-2.60	-1.00	2.32	4.92
30000 Hz	-2.17	2.17	-0.00	-2.17	-2.17	-0.00	2.17	4.33
30500 Hz	-1.75	1.75	-0.71	-2.32	-1.46	1.00	1.75	4.07
31000 Hz	-1.12	1.12	-1.34	-2.19	-0.59	1.87	1.12	4.07
31500 Hz	-0.36	0.36	-1.80	-1.80	0.36	2.53	0.36	4.33
32000 Hz	0.44	-0.44	-2.05	-1.20	1.27	2.87	-0.44	4.92
32500 Hz	1.20	-1.20	-2.05	-0.44	2.02	2.87	-1.20	4.92
33000 Hz	1.80	-1.80	-1.80	0.36	2.53	2.53	-1.80	4.33
33500 Hz	2.19	-2.19	-1.34	1.12	2.73	1.87	-2.19	4.92
34000 Hz	2.32	-2.32	-0.71	1.75	2.60	1.00	-2.32	4.92
34500 Hz	2.17	-2.17	0.00	2.17	2.17	0.00	-2.17	4.33
35000 Hz	1.75	-1.75	0.71	2.32	1.46	-1.00	-1.75	4.07
35500 Hz	1.12	-1.12	1.34	2.19	0.59	-1.87	-1.12	4.07
36000 Hz	0.36	-0.36	1.80	1.80	-0.36	-2.53	-0.36	4.33

Close

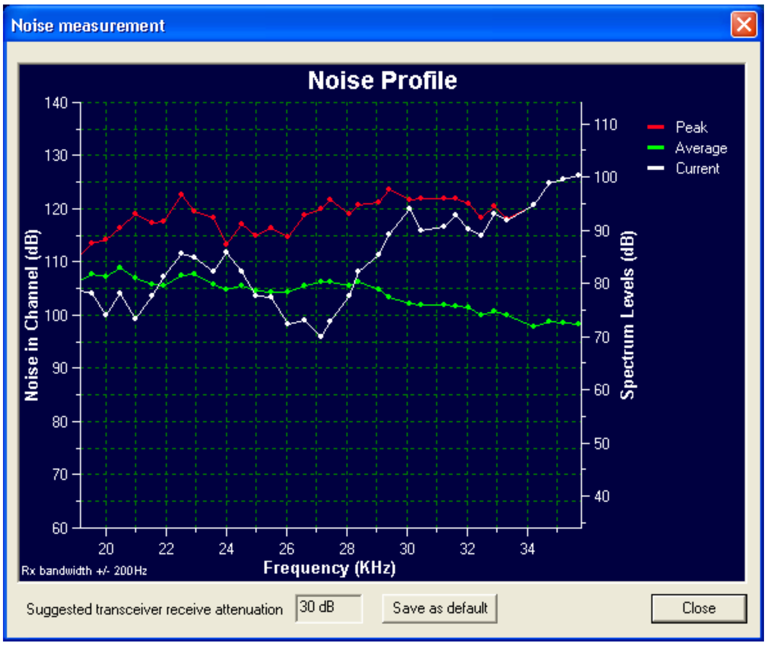
D.5 Noise Test

The Noise Test tool is available only when all transponder beacons are offline. To use the noise test tool select **Tools > Noise test…** from the menu bar.

The noise measurement display is a diagnostic tool that allows you to analyse the background noise to which the USBL 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 a good idea of the power and gain settings to use; the maximum range you can expect to achieve; and the power settings required in the beacons.

The display includes three plots, giving information about the peak, average and instantaneous noise levels.

Fig 100 Noise measurement display



You can use the noise measurement tool to identify any rogue signals or noise interference that occurs at about the same frequency as that used by the beacons you are trying to track, so that you can plan your channel and frequency allocations to avoid sections of the frequency band where there are consistently high levels of noise or where there are signal spikes.

The tool suggests a suitable transceiver receive attenuation setting for the ambient noise levels, and a button allows you to save the suggested value as the default.

D.6 Average Fix

Introduction

The Ranger USBL System calculates an average position continuously during operations, whether or not you are using the Average Fix tool. This tool displays the average fix and relating statistical data for a number of previous positions.

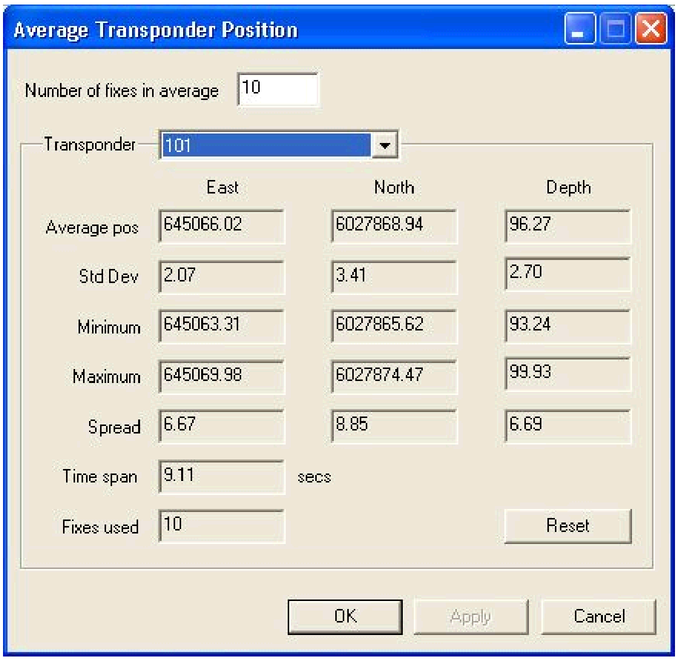
Display average fix information

Select **Tools** > **Average Transponder Position** to display the Average Transponder Position dialog, shown in Fig 101. This tool includes the following fields and controls:

- **Number of fixes in average**—This is the number of positions to be used in the average position calculation.
- **Transponder**—This shows which transponder the average position information relates to, and allows you to select the transponder whose average position information you want to display.
- **Average pos**—This is the mean average position in East, North, and Depth co-ordinates.
- **Std Dev**—This is the standard deviation of the positions in the average.
- **Minimum**—This is the smallest number in the average.
- **Maximum**—This is the largest number in the average.
- **Spread**—This is the difference between the smallest and the largest numbers.

- **Time span**—This is the difference in time between the newest and the oldest positions in the average.
- **Fixes used**—This is the number of positions actually used in the average.
- **Reset**—This button resets the average and clears the history for the selected transponder.

Fig 101 Average Transponder Position dialog



D.7 Measure Chart Distances

Introduction

This tool allows you to measure distances on the Chart display from any reference point to any other location on the display.

This is a 'sticky' tool—when you select it, the tool remains selected until you deselect it again by repeating the menu bar selection or clicking the toolbar button again. This allows you to make a series of consecutive chart measurements without the need to re-select the tool each time.

Measuring chart distances

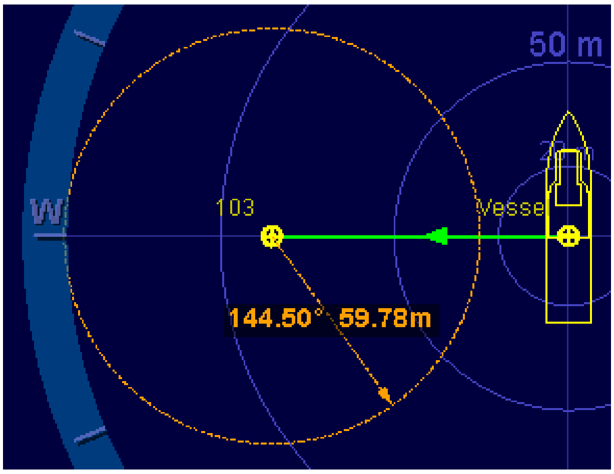
To measure chart distances:

1. Select **Tools** > **Measure Chart Distances** on the menu bar or click the **Measure distances on the chart** button on the toolbar.
2. Move the mouse pointer to the transponder, vessel or waypoint that you want to use as the measurement's reference point.

   The symbol for the transponder, vessel or waypoint changes colour to green with the symbol and name text appearing in bold.
3. Click the left mouse button on the reference point's symbol and drag the mouse cursor to the point whose distance you want to measure.

   As you drag away from the reference point, Ranger draws a circle and a radius from your chosen reference point to the cursor location, and displays the range and relative bearing from the reference point to the cursor in an accompanying text field.

Fig 102 Chart measurement display



4. Release the mouse button to remove the range and bearing information.
5. Repeat steps 2 to 4 if you want to continue measuring chart ranges.
6. Select **Tools > Measure Chart Distances** or click the **Measure distances on the chart** button to stop the chart measurement tool.

Appendix E Report Formats

In this appendix... This appendix contains the following sub-sections:

E.1 Summary

Output Reports are used to send Reference Beacon or Mobile Vehicle position information to the Dynamic Positioning (DP) Desk or to the Navigation Package. Table 33 lists the Output Reports supported by the Ranger USBL.

The HPR 309, HPR 418 BCD and HPR 418 F Output Reports are all industry standard formats used by DP vessels for the transfer of Hydro-acoustic Position Reference (HPR) beacon data.

Note

You will find a detailed description of these formats, and others, in the Report Output Formats section in the Ranger software Help files, which are embedded in the software.

Table 33 Supported output reports

Name	Description
PSONALL	Grid position output with pitch and roll.
NMEA GGA	Geographical output (based on WGS-84).
HPR 309	DP output telegram giving relative position between transducer and the transponder.
HPR 418 BCD	Gives SSBL transponder position data relative to vessel.
HPR 418 Rev F	Gives SSBL transponder position data relative to vessel.
NMEA 0183 DP	An implementation of Simrad NMEA output telegram formats. Supports the PSIMSSB SSBL transponder position sentence.
ATS ASCII	DP output telegram. Used by Nautronix ATS-S02, ATS-S04 and ATS-S08 systems.
TrackpointII	DP output telegram.

E.2 PSONALL Report

Description

The **PSONALL Report** is an extended version of a standard **PSONOG** grid co-ordinate position sentence for use when transferring vehicle positions to client navigation systems. The included co-ordinates use the selected projection system defined in the Ranger software.

Format

The PSONALL Report format shown below consists of a single string, separated across two lines here for clarity.

$PSONALL,Name,Offset,HHMMSS.ss,EEEEEEEE.ee,NNNNNNNN.nn.yy,
DDDD.dd,HHH.hh,CCC.cc,T,PP.PP,RR.RR,VVV.vv,AAA.AA,BBB.BB*hhCRLF

Field descriptions

Table 34 Field description for the PSONALL Report

Field	Description
$PSONALL	Header to identify the report.
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.
CCC.cc	Course made good (CMG).
T	Heading type: ● G = grid ● T = True ● M = Magnetic
PP.PP	Vehicle Pitch.
RR.RR	Vehicle Roll.
VVV.vv	Velocity.
AAA.AA	Position accuracy (95%).
BBB.BB	Depth accuracy.
*hh	Checksum.
CRLF	Termination characters, carriage return plus linefeed.

Checksum

The Checksum value is the resultant XOR of all characters in the report string, excluding the CRLF termination characters.

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>

E.3 NMEA GGA Report

Description

The NMEA GGA Report is a simulation of a standard NMEA GGA string and is used to show fix-related data for a GPS receiver.

You should use this sentence only where the receiving installation does not support a more suitable sentence.

Format

The NMEA GGA Report format shown below consists of a single string, separated across two lines here for clarity.

$GPGGA,HHMMSS.ss,DDMM.mmmmmm,N,DDDMM.mmmmmm,
E,2,12,A.AA,Z.ZZ, M,0.0,M,0.0,0000*hhCRLF

Field description

Table 35 Field description for the NMEA GGA Report

Field	Description
$GPGGA,	Header to identify the report (fixed).
HHMMSS.ss,	The valid time of the position. See Note 1.

Field	Description
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).
2,12,	Fixed values.
A.AA,	Accuracy (semi-major axis). See Note 3.
Z.ZZ,	Height, see Note 4.
M,0.0,M,0.0,0000	Fixed values.
*hh	Checksum. See Note 5.
CRLF	Termination characters, carriage return plus linefeed.

Notes

1. The fixed tail of characters appended to the end of the sentence is there as packing for string decoders that require a complete sentence.

   The numbers in the fixed tail show the vehicle tracking in the optimum configuration and quality.

2. Latitude and longitude values are always displayed in the DDDMM.mmmmmm 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.

3. The accuracy value is the semi-major axis value for the vehicle. It is always displayed in meters and is fixed to two DPs.

4. The height value is always displayed in meters and fixed to 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 = 56.7m, depth is formatted as –56.7.

5. 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>.

Example

$GPGGA,123456.43,5020.234502,N,134.324576,E,2,12,6.7,
–56.78,M,0.0,M,0.0,0000*hh

E.4 HPR 309 Telegram

Description

The HPR 309 Telegram report is the output telegram from the HPR 309 DP.

Format

Table 36 Field description of the HPR 309 Telegram

Field	Size (Bytes)	Byte Offset	Default for DP_Test
Head	1	0	1
Roll	2	1	As required.
Pitch	2	3	As required.

Field	Size (Bytes)	Byte Offset	Default for DP_Test
Heading	2	5	As required.
Transponder Index	1	7	As required.
X Position	3	8	As required.
Y Position	3	11	As required.
Z Position	3	14	As required.
Position Status	1	17	0
Not Used (Time Out)	1	18	0
Transponders in Sequence	3	19	[Automatic]
Not Used (Tracking TD Angle)	2	22	N/A
Not Used (Test)	1	24	N/A
Not Used (Transponder Type)	1	25	0
Transponder Specification	1	26	0
Not Used (Transducers)	1	27	0
Not Used (Transducer Status)	1	28	0
Kalman Filter Window	1	29	0
Checksum	1	30	[Automatic]
End of Telegram	1	31	[Automatic]

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.

Definition of field names:

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.

Roll

This is the roll of the ship.

- Positive direction is port side up.
- Scaled integer, 12bit, 2’s complement.
- Resolution = 360.0 / 4096 degrees. (= 0.0878906 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.

Pitch
This is the pitch of the ship.

- Positive direction is bows up.
- Scaled integer, 12bit, 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.

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.

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.

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. (= 0.125m).
- 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.

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. (= 0.125m).
- 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.

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. (= 0.125m).
- 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.

Position Status

This telegram will be sent only if the status shows OK.

Flags:

- Bit 0 is set when the position data is invalid.
- Bits 1 to 5 are not used and are all cleared.

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.

Not Used (Time Out)

Zero.

Transponders in sequence

These are flags to indicate which transponders are being used.

Table 37 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).

Not Used (Tracking TD Angle) Zero.

Not Used (Test) Zero.

Not Used (Transponder Type) Zero.

Transponder Specification Flags.

- Bit 0: Set for a mobile transponder, Cleared for a reference transponder.
- Bits 1 to 5: Unused, all cleared.

Not Used (Transducers) Zero.

Not Used (Transducer Status) Zero.

Kalman Filter Window This is the horizontal position quality, rounded to the nearest metre.

Checksum This is the result of performing an exclusive-OR on all bytes in the telegram up to but not including this byte.

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.

E.5 HPR 418 Rev. F Message 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 38 Format: Message 1 SSBL Transponder Position Data

Field	Byte	Byte Offset	Default for DP_Test
Start character	1	0	55 hex
Block length	2	1	3A+4*n hex (58+4*n dec)
Message type	1	3	1
Destination	1	4	30 hex
Tp_index	2	5	1
Operation_mode	1	7	0 (Std navigation mode)
Sync_mode	1	8	0 (No sync)
Tp_type	1	9	0 (Std transponder)

Field	Byte	Byte Offset	Default for DP_Test
TP_operation	1	10	0 (Fixed)
Pos_data_form	1	11	0 (Ship's head relative)
Reply_status	1	12	0 (OK)
Filt_X_pos	4	13	0.0 (Linked to raw)
Filt_Y_pos	4	17	0.0 (Linked to raw)
Filt_Z_pos	4	21	0.0 (Linked to raw)
X_pos	4	25	0.0
Y_pos	4	29	0.0
Z_pos	4	33	0.0
Slant_range	4	37	0.0
P_course	4	41	0.0
P_roll	4	45	0.0
P_pitch	4	49	0.0
Td_beam	1	53	0 (Wide)
Td_type	1	54	0 (Wide only)
Td_num	2	55	1 (tdr 1 on tcvr1)
Diagnostic	2	57	0 (No errors)
Stand_dev	4	59	0
Instr_data	4*n	63	0.0 (When required)
Sumcheck	2	63+4*n	[Automatic]
Stop character	1	64+4*n	[Automatic]

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.

Definition of field names

Start character

This is a single byte start character 55 hex.

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.

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.

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.

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.

Operation_mode — A single byte containing the operation mode of the transceiver.

- 00 = standard navigation mode
- 01 = simulated position test mode. (Training)

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

Tp_type — Not used by Sonardyne.

- 000 = transponder

Tp_operation — A single byte defining the operation mode of the transponder:

- 000 = fixed standard transponder
- 001 = mobile standard transponder

Pos_data_form — A single byte defining the position co-ordinate format:

- Bit 0 = 0 vessel oriented, Cartesian
- Bit 0 = 1 North oriented, Cartesian

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)

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.

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.

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.

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.

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.

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.

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.

P_course A value in REAL format.

The vessel's course at the time of transponder position measurement; 0 to 360 degrees.

P_roll A value in REAL format.

The vessel's roll at the time of transponder position measurement +/–180 degrees.

P_pitch A value in REAL format.

The vessel's pitch at the time of transponder position measurement +/–180 degrees.

Td_beam A single byte defining the transducer beam.

- 0 = wide
- 1 = narrow.

Td_type Defines the transducer type.

Sonardyne uses value 0 (30kHz wide beam only).

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.

Diagnostic Sonardyne do not use this field because it is specific to Simrad hardware. The value is always 0 (no errors).

Stand_dev A value in REAL format.

This is the horizontal position quality in metres.

Instr_data (*) Not currently supported.

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.

Stop character This is a single byte stop character AA hex.

E.6 HPR 418 BCD Message 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.

BCD

BCD stands for Binary Coded Decimal, and requires 4 bits (a 'nibble') to encode a single character.

In conventional BDC 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 indictor 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 39 Format: Message 1 SSBL Transponder Position Data

Field	Byte	Sample BDC Data	Default for DP_Test
SOT (Start of Telegram)	1	DF	DF
Head Byte	2	01	01
Status Byte 1	3	01	00
Status Byte 2	4	00	00
Transponder Type	5	02	0
Transponder Index	67	0133	1
X Position Raw	8910	001234	As Required
Y Position Raw	111213	D05678	As Required
Z Position Raw	141516	012345	As Required
Heading	1718	3599	As Required
Optional Data 1	192021	000003	As Required
Optional Data 2	222324	D00075	As Required
Horizontal Error Ellipse Direction	2526	0000	0
Horizontal Error Ellipse Major	2728	0000	0
Horizontal Error Ellipse Minor	2930	0000	0
Checksum	31	XX	[Automatic]
EOR (End of Record)	32	FF	[Automatic]

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

Definition of field names

SOT (Start of Telegram)

This is a single byte start character DF hex.

Head Byte

This byte indicates the message type and is always 01 hex for a transponder message type 1.

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. Bits are set to 01—Tdr 1
- Bits 2 to 3 = Transceiver number. Not used by Sonardyne. Bits are set to 01—Tcvr 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

Transponder Type

A single byte defining the transponder type. Sonardyne report all beacons as standard transponders so that this byte always contains 00.

- 00 = standard transponder

Transponder Index

Two bytes that define the transponder channel.

On the Ranger USBL it is possible 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.

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.

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.

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.

Heading

Two bytes used for the vessel heading.

The LSB is 1/10th of a degree.

Optional Data 1 (Vessel Roll)

Three bytes used for the vessel roll or Optional data 1.

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.

Optional Data 2 (Vessel Pitch) Three bytes used for the vessel pitch or Optional data 2.

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.

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.

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.

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.

Checksum The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte.

EOR (End of Record) This byte marks the end of a telegram. It is always FF.

E.7 NMEA 0183 DP Message 1

Description The maximum length of the NMEA 0183 DP Message 1 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 40 Format: Message 1 SSBL Transponder Position Data

Field	Data Format	Sample Data	Number of Characters
Start Character	$	$	1
Address	PSIMSSB	PSIMSSB	7
Time	,hhmmss.ss	,130700.43	10
Tp_code	,ann	,B22	4
Status	,a	,A (Always)	2
Error_code	,aaa	,	4
Coordinate_system	,a	,C	2
Orientation	,a	,H	2
SW_filter	,a	,M	2
X_coordinate	,x.x	,-100000.40	10
Y_coordinate	,x.x	,-100000.89	10
Depth	,x.x	,4329.10	8
Expected_accuracy	,x.x	,3.16	5
Additional_info	,a	,I	2
First_add_value	,x.x	,-12.3	6
Second_add_value	,x.x	,-14.0	6
Checksum	*hh	*hh	3
Termination	CRLF	CRLF	2

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

Definition of field names

Start_character The single ASCII character <$>.

Address The ASCII character string <PSIMSSB> to indicate that the telegram is a Simrad SSBL message.

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 <,>.

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 coma <,ann>, for example <,B17>

Status This will always show OK because this telegram is sent only if the status is OK.

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).

Coordinate_system A single ASCII character preceded by a coma <,a>

C = Sonardyne always output transponder data in Cartesian co-ordinates with respect to the vessel reference point.

Orientation A single ASCII character preceded by a coma <,a>

H = Vessel head up, or N = North up, for example <,H>.

SW_filter A single ASCII character preceded by a coma <,a>

F = filtered, or M = measured, for example <,F>.

X_coordinate When no position has been calculated the field will be empty and only the coma field separator will be sent <,>

This field contains the Cartesian X co-ordinate, with the orientation defined by the Orientation field. The options supported by Sonardyne are X = Athwartship positive to Starboard, and local frame X = positive to the North.

When data is present the field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed.

Y_coordinate When no position has been calculated the field will be empty and only the coma field separator will be sent <,>

This field contains the Cartesian Y co-ordinate, with the orientation defined by the Orientation field. The options supported by Sonardyne are Y = along-ship, positive to bow, and local frame Y = positive to the East.

When data is present the field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed.

Depth

When no position has been calculated the field will be empty and only the coma field separator will be sent <,>

When data is present the field represents depth in metres and takes the form <,xxx.xx>,. It is of variable length with leading zeros suppressed.

Expected Accuracy

The expected accuracy of the position based on the Major and Minor semi-axes of the error ellipse <,x.x>. It is of variable length with leading zeros suppressed.

Additional_info

A single ASCII character preceded by a coma <,a>

I = inclinometer and N = none <,N>.

First_add_value

When the **Additional_info** field is N then this field will be empty and only the coma 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 X inclination (roll) with leaning to Starboard being positive.

The data field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed.

Second_add_value

When the **Additional_info** field is N then this field will be empty and only the coma 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 Y inclination (pitch) with leaning forward being positive.

The data field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed.

Checksum

The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte.

Termination

The ASCII for Carriage Return followed by Line Feed are sent <CRLF>.

E.8 ATS ASCII

Description

The ATS ASCII report is used by Nautronix ATS-S02 SO4 and S08 Systems. Each line of the data contains position data for one object terminated by a LF then CR

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 Xddd.d Y:ddd.d D:
ddd.d P:d.d R:d.d H:ddd.d <LF><CR>

Table 41 Field description for the ATS ASCII report

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

Field	Description
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
LF CR	Line feed Carriage return

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

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<LF><CR>

E.9 Trackpoint II

Description

The Trackpoint II report 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.

Format

Table 42 Field descriptions for the Trackpoint II report

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.

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

Example 1 15:53:53 12 104.9 141.1 97.9 -26.0 98.2 0<CR><LF>

E.10HPR 300P

Description

The HPR 300P report 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.

Format

Table 43 Field descriptions for the HPR 300P report

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
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 (not used)	53-58
c	Space	59
dddd.d	Riser Y-angle or azimuth with sign (not used).	60-65
c	Carriage return	66
c	Line feed	67

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

Example

33 1 W OK 0 18.9 40.5 30.0 0.1 NRY 0.0 0.0<CR><LF>

Appendix F MRAMS

This appendix includes details of the utility in Ranger to support monitoring of the relative attitude of a Riser and a Blow Out Preventer (BOP) during drilling operations. When correctly configured the system will calculate the angular difference between the two elements and display a course to steer that will minimise the stress at the joint between riser and BOP.

In order to use the MRAMS option it is necessary to have 2 Sonardyne DPTi transponders, one attached to the Riser and the other attached to the BOP. Both transponders should have a clear line of sight to the transceiver on the surface and must both be aligned to the forward mark on the BOP.

Note

If the 2 transponders are not correctly aligned to the forward mark of the BOP then the course to steer indicated by Ranger will be incorrect.

In this appendix... This appendix contains the following sub-sections:

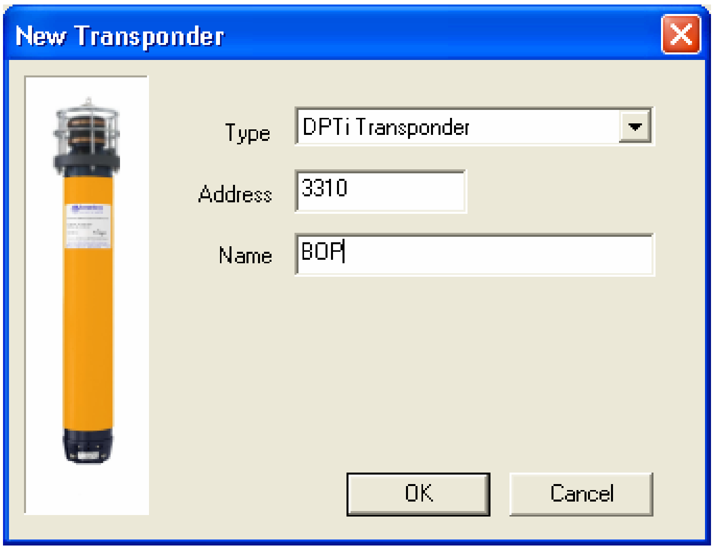
F.1 Software Configuration

Once it has been decided which transponders are to be assigned to the BOP and the Riser, the software should be configured as follows.

Adding the DPTi Transponders

1. Open the Transponder dialog by selecting **Edit> Transponders…** from the menu bar, or click the Transponders button on the toolbar.
2. Click **Add…** to display the New Transponder dialog shown below.

Fig 103 Add new DPTi transponder



3. Select **DPTi Transponder** from the **Type** drop down combo list.
4. Type the address for the transponder into the **Address** field.

5. Type a name for the transponder into the **Name** field and press **OK** to add the transponder to the **Transponders** dialog.
6. Add both the BOP and Riser transponders to the database.
7. Press OK to close the **Transponders** dialog and a message similar to the one below will be displayed.

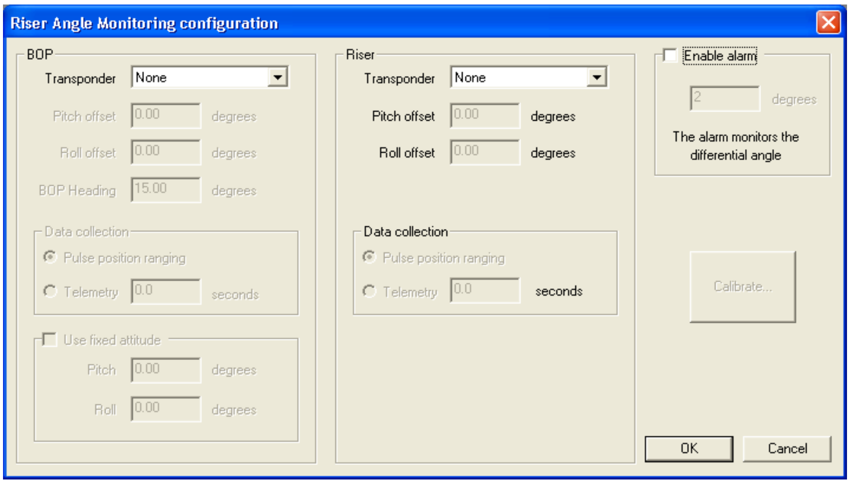
Fig 104 Information message following addition of DPTi transponders

Press **Yes** to have the system automatically configure the BOP and Riser transponders for use.

Configuring for Riser Angle Monitoring

1. Open the **Riser Angle Monitoring** dialog by selecting **Tools> Riser Angle Monitoring…** from the menu bar.
2. Drag the **Riser Angle Monitoring** dialog to the second screen and maximise it.
3. Press the **Configure…** button on the **Riser Angle Monitoring** dialog to open the **Riser Angle Monitoring Configuration** dialog shown below.

Fig 105 Riser Angle Monitoring Configuration Window



4. In the **BOP** frame, select the transponder assigned to the BOP from the **Transponder** combo.
5. In the **Riser** frame, select the transponder assigned to the Riser from the **Transponder** combo.
6. In the **Data Collection** frame for the BOP, select either **Pulse Position Ranging** or **Telemetry** as the data collection method for the BOP transponder. **Telemetry** is usually selected for the BOP because its attitude changes very slowly.

Note

Telemetry data collection is normally used when the update rate of a transponders pitch and roll data is slower than 1 minute. Pulse Position data collection is used for faster update rates. If Pulse Position data collection is used then pitch and roll measurements are collected every time the transponder is positioned by the USBL system. In this mode the data collection rate is determined by the Update Rate in the Transponder Dialog.

7. In the **Data Collection** frame for the Riser, select either **Pulse Position Rangin**g or **Telemetry** as the data collection method for the Riser transponder.

8. In the **BOP** frame select either Hi Resolution or Lo Resolution to determine the range of angles that the transponder can measure. Note that this only effects Pulse Position data collection.

9. In the Riser frame select either **Hi Resolution** or **Lo Resolution** to determine the range of angles that the transponder can measure. Note that this only effects **Pulse Position** data collection.

10. If it is desirable to have an alarm when the difference between the BOP attitude and the Riser attitude exceeds a defined limit then click the **Enable Alarm** tick box and enter an angular alarm limit in degrees.

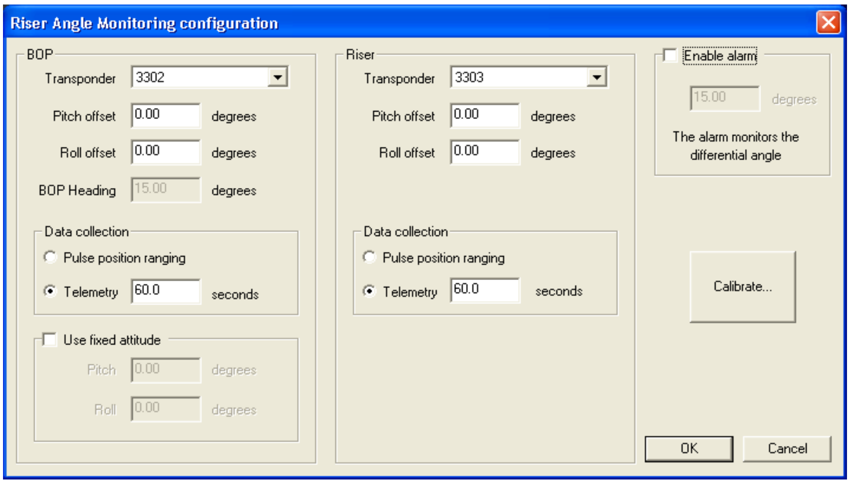
11. Press the **OK** button to close the **Riser Angle Monitoring** configuration dialog.

Using a Fixed Manually Entered BOP Attitude

In some circumstances it is necessary to enter a manual BOP attitude. In this scenario there is no transponder attached to the BOP. The user manually enters a BOP attitude. Only Riser attitude data is collected by Ranger. The guidance information displayed by Ranger depends upon the manual attitude being correct. A manual BOP attitude can be configured as follows.

1. Create transponders and configure Riser Angle Monitoring for both the BOP and the Riser as described in "Adding the DPTi Transponders" beginning on page 149. It is still necessary to create a BOP transponder even though the system will not be taking readings from it.

2. Open the **Riser Angle Monitoring** dialog by selecting **Tools> Riser Angle Monitoring…** from the menu bar.



3. Tick 'Use Fixed Attitude' under the BOP configuration. This will enable the manual Pitch and Roll fields. Enter manual values for the BOP pitch and roll and press OK to confirm. The system will now only measure the Riser transponders attitude and calculate a differential tilt based on the manual BOP attitude.

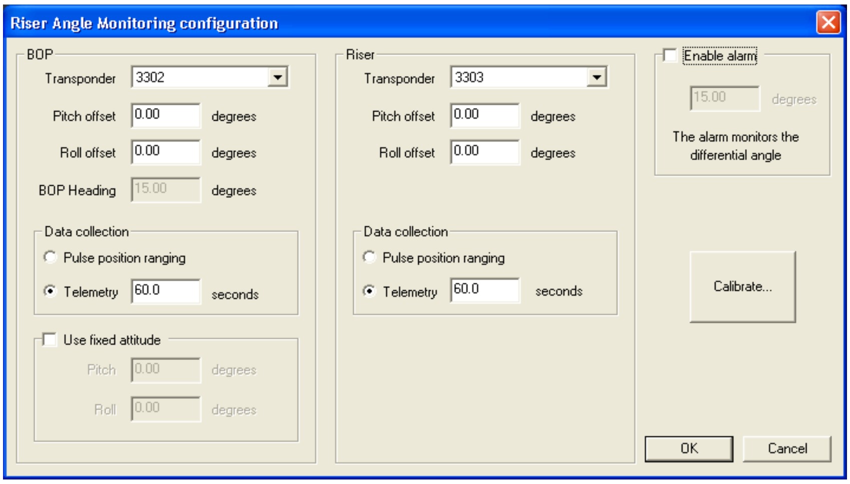
F.2 Calibration

To calibrate the BOP and Riser attitudes, the BOP should be hanging in the water under the vessel at a depth where there is a clear line of sight between the transceiver and the transponders.

The system may then be calibrated as follows.

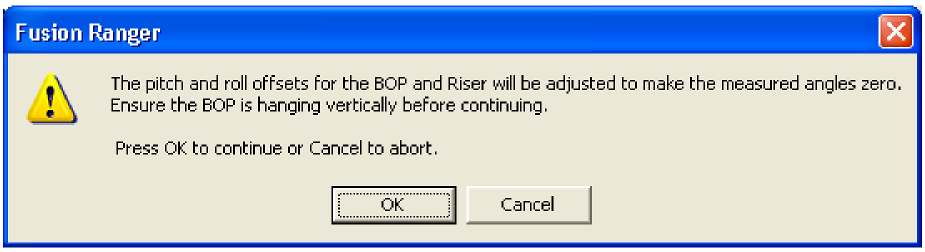
1. Press the **Configure…** button on the **Riser Angle Monitoring** dialog to open the **Riser Angle Monitoring Configuration** dialog as shown below

Fig 106 Riser Angle Monitoring Configuration



2. Press the **Calibrate…** button. A message box like the one below will appear.

Fig 107 BOP and Riser Calibration prompt



3. Press the **OK** button to begin the process of calibration. The following dialog will be displayed whilst the Riser and BOP angles are measured

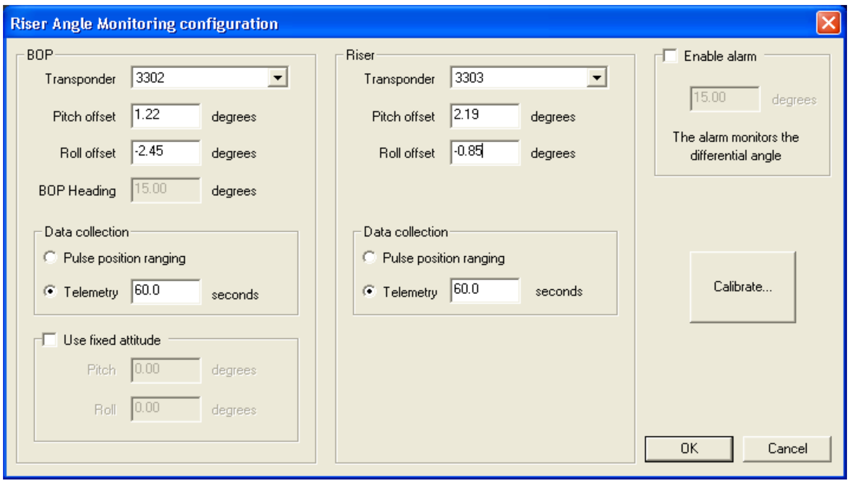
Fig 108 Calibration in progress dialog.

4. A message box like the one below will be displayed once data collection is complete. Press **OK** to continue.

Fig 109 Calibration confirmation dialog

5. The Pitch and Roll offsets for the BOP and the Riser will now have been updated to give measured angles of 0 degrees.

Fig 110 Configuration Window following calibration



6. Press the **OK** button to close the **Riser Angle Monitoring** configuration dialog.

The BOP can now be lowered to the sea-bed and connected to the well head. Once the BOP is connected it is necessary to enter the BOP heading into the Ranger so that it can correctly calculate the 'course to steer' for the vessel.

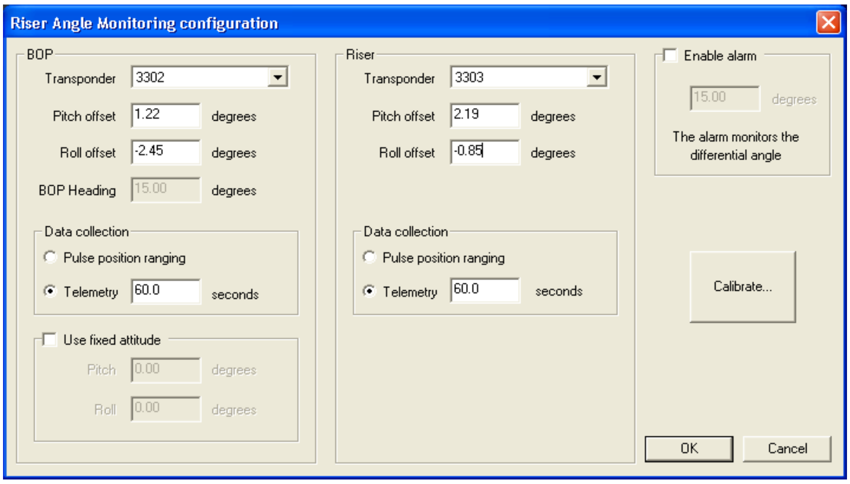
Note

Note: Failure to enter the heading of the BOP once it is latched on the sea-bed will cause Ranger to report an incorrect course to steer to minimise the differential angle.

The BOP heading should be entered as follows.

1. Press the **Configure…** button on the **Riser Angle Monitoring** dialog to open the **Riser Angle Monitoring Configuration** dialog as shown below.

Fig 111 Riser Angle Monitoring Configuration dialog - entry of BOP heading



2. Enter the heading of the BOP into the **BOP Heading** field.

3. Press the **OK** button to close the **Riser Angle Monitoring** configuration dialog.

F.3 Operation

Controlling Data Collection

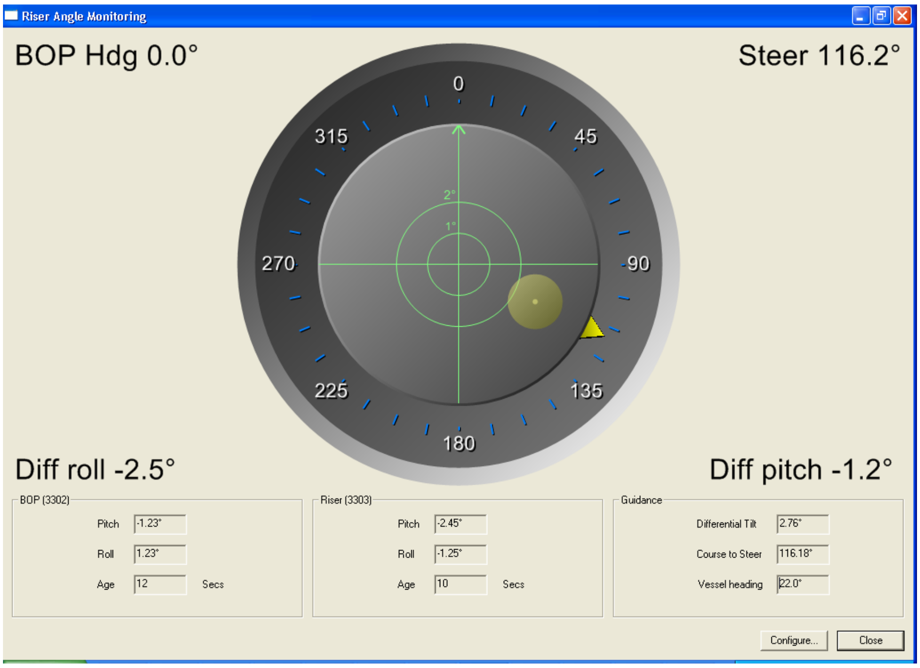
If the data collection technique is set to Telemetry then data is collected whenever the **Riser Angle Monitoring** window is open. In this mode it is not necessary to track the transponder in order to collect and display attitude data.

If the data collection technique is set to **Pulse Position Ranging** then data is collected whenever the **Riser Angle Monitoring** window is open and the transponder is being tracked. If the transponder is not being tracked then a warning is displayed in the **Riser Angle Monitoring** dialog. See section F.4 “Error Conditions” beginning on page 155 for more information.

The Riser Angle Monitoring Display

The riser angle monitoring display appears as follows.

Fig 112 Riser angle monitoring display



The Bubble Gauge in the centre of the screen shows the differential angle between the BOP and the Riser. The small green arrow indicates the heading of the BOP as entered into the **Riser Angle Configuration** dialog. The yellow dot indicates the current differential tilt and the yellow arrow on the outside of the bubble gauge shows the course to steer to reduce the angular difference between the BOP and the Riser.

Four numeric values are shown around the bubble gauge. At the top left is the **BOP heading** as entered into the **Riser Angle Configuration** dialog. At the top right is the **Course to Steer** in degrees relative to north. At the lower left is the Differential Roll in degrees and at the lower right is the **Differential Pitch** in degrees.

There are 3 data boxes in the lower half of the display.

The **BOP** data box shows the corrected pitch and roll of the BOP and the age of the measurement in seconds.

The **Riser** data box shows the corrected pitch and roll of the Riser and the age of the measurement in seconds.

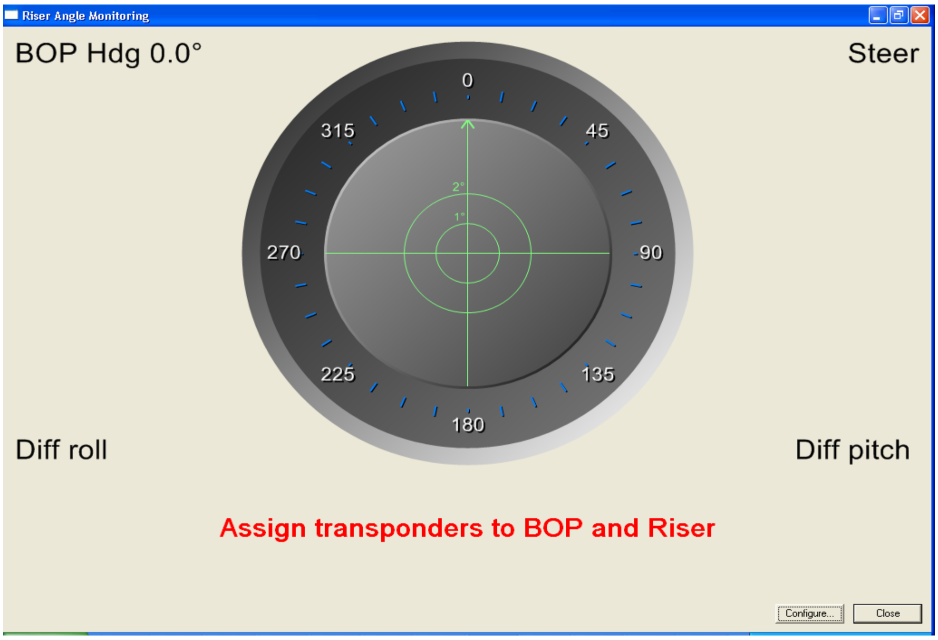
The **Guidance** data box shows the total differential tilt in degrees, the course to steer and the current vessel heading.

F.4 Error Conditions

Incorrect configuration

The following is displayed when there is not a transponder assigned to both the BOP and the Riser. To correct the problem follow the setup sequence in section F.1 “Software Configuration” beginning on page 149 and section F.2 “Calibration” beginning on page 152.

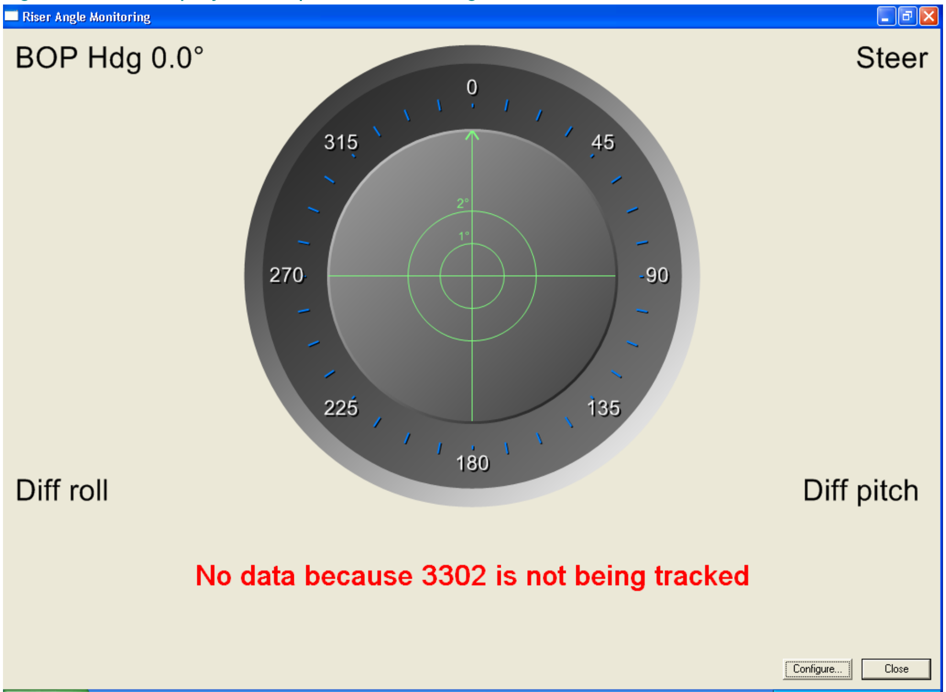
Fig 113 Error message if transponders un-assigned



Pulse Position Ranging Transponder Offline

The following is displayed when a transponder has been configured for **Pulse Position Ranging** data collection but the transponder is not currently being tracked. To correct the problem press the transponders **track** button on the main USBL display.

Fig 114 Error display - transponder not being tracked

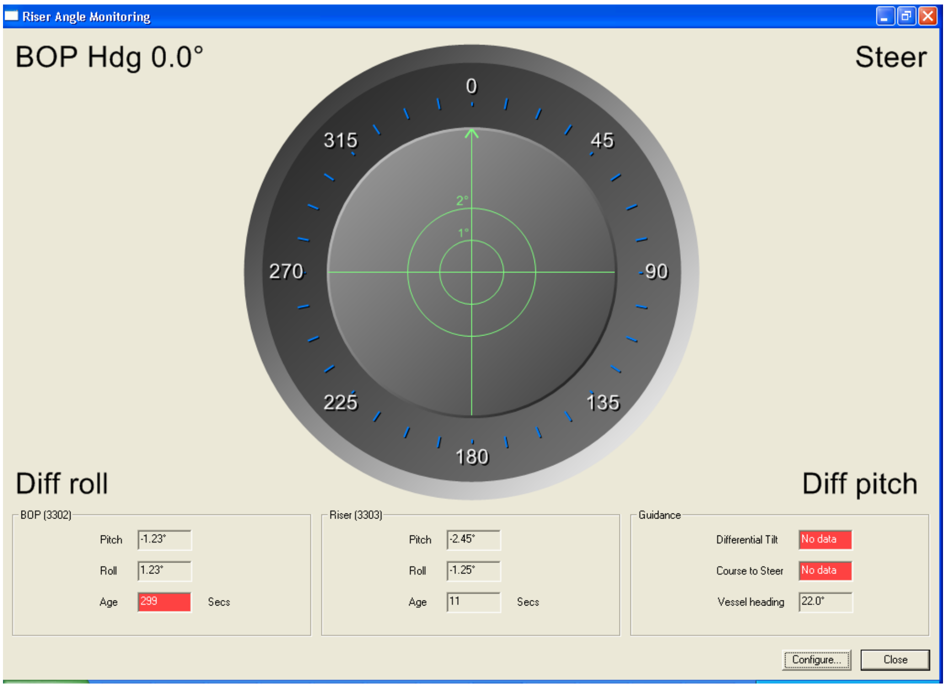


No Data is Being Received

The following is displayed when data collection has not been successful for more than 30 seconds beyond the requested data collection rate. The system will continue trying to collect data until it is successful.

When the data is older than 30 seconds beyond the requested update rate all guidance is considered invalid and is removed from the display. When new data is received the guidance is restored.

Fig 115 Error display - No data being received

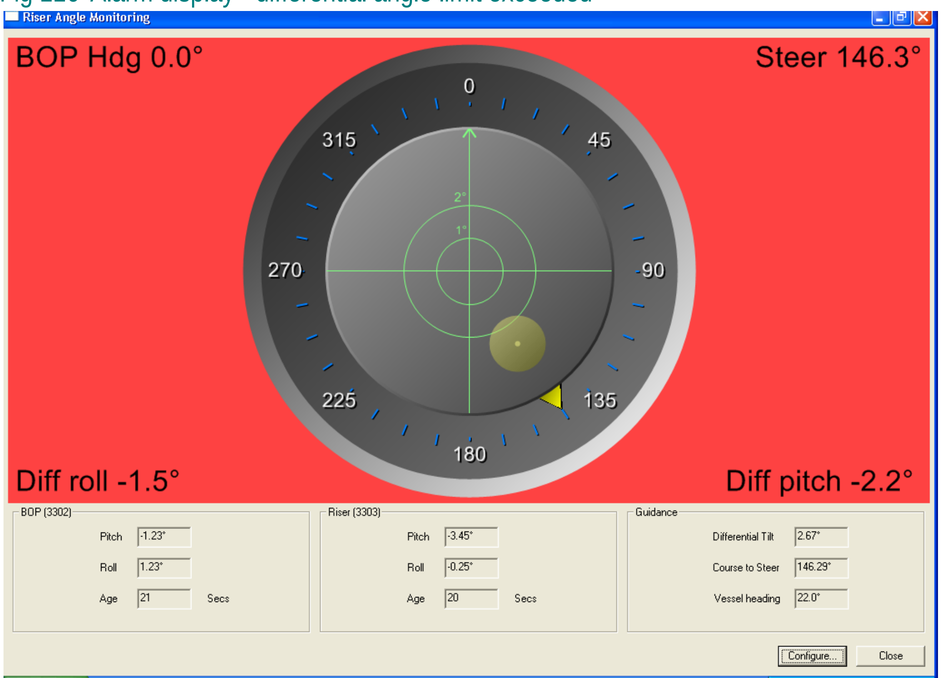


Differential Limit Exceeded

The following is displayed when the differential angle alarm is enabled and the differential angle has exceeded the user-defined limit.

The background of the Riser Angle Monitoring display flashes red once per second. An audible alarm is also sounded if audible alarms are enabled in the **Audio Configuration** dialog and a speaker is attached to the Navigation PC. The alarm will continue until the differential angle reduces to within the alarm limit.

Fig 116 Alarm display - differential angle limit exceeded



Appendix G Simulation

This appendix includes details of the simulator that is built into Ranger USBL. The simulator allows the application to track transponders without a working transceiver or NCU.

In this appendix...

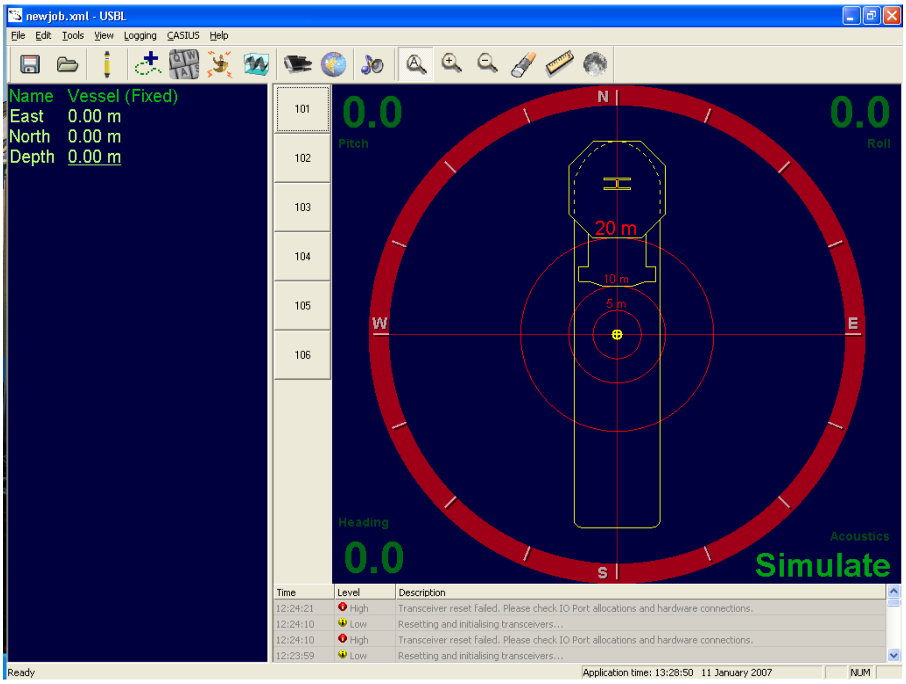
This appendix contains the following sub-sections:

G.1 Using the Simulator

Once the application has been started, Ranger USBL can be switched into and out of Simulation mode by selecting **Tools> Simulate**.

When in simulation mode the radar chart turns red and displays **Simulating** at the bottom right of the screen as shown below.

Fig 117 Simulation Mode



It is now possible to add new transponders to the system and track them. The first 2 transponders in the database are simulated as ROVs and will move around in circles underneath the vessel. The remaining transponders in the database will be simulated in fixed positions around the vessel.

Any output telegrams defined in the IO Ports page will be sent for simulated transponder positions.

CAUTION

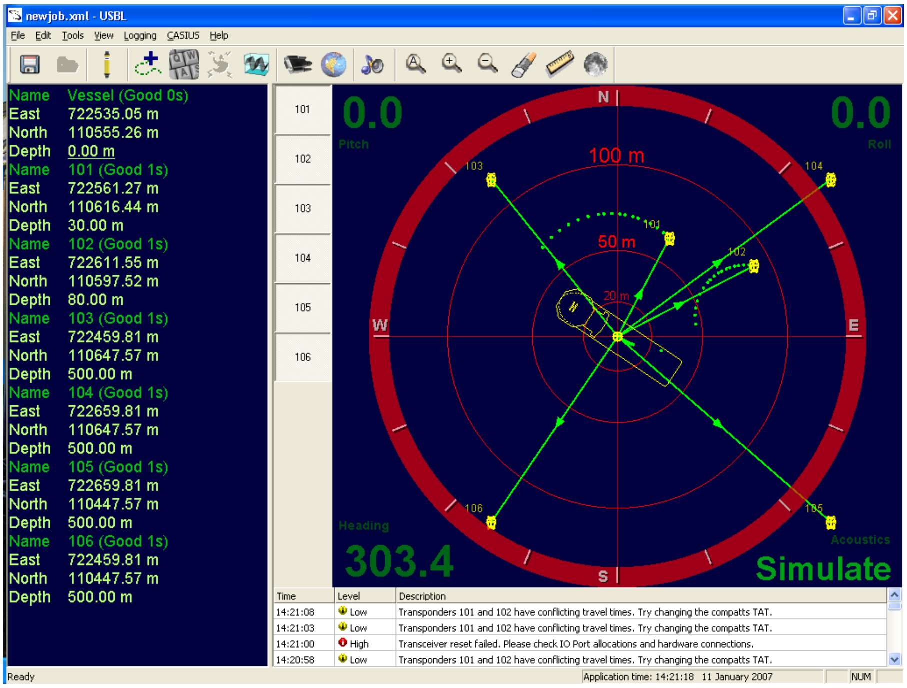
A DP desk may not be able to tell the difference between a simulated position and a real position. If a DP desk is connected to Ranger USBL then check that it will not respond to a simulated position.

G.2 Advanced Simulation

It is possible to feed GPS and heading changes into the simulation. If GPS is interfaced to the system then GPS position movements will be used to move the vessel around whilst the simulator is running. The ranges to the transponders change as the vessel moves around.

Below can be seen a simulation using an external GPS and heading source.

Fig 118 Advanced Simulation



Appendix H Analogue VRUs

This appendix explains some common problems encountered when interfacing analogue VRUs to acoustic positioning systems.

In this appendix...

This appendix contains the following sub-sections:

H.1 Using Analogue VRUs

At one time, most VRUs were analogue devices where the tilt of the sensor was proportional to the voltage on the output terminals. USBL systems required analogue to digital converters to be able to read angle data. This had the advantage to the USBL system that there was no ambiguity about when the data was valid - there was very little latency.

This type of VRU is now a thing of the past. The majority of VRUs in use today process the tilt data internally, and supply a serial output string. For compatibility with older systems, many VRU suppliers supply a digital to analogue converter that takes the serial string, and converts it to analogue, to that it looks like the output of an analogue VRU. This provides backward compatibility, but inevitably introduces latency, which defeats the main advantage of the analogue interface.

Several other issues exist when dealing with analogue VRU interfaces that can degrade the performance of the sensor, and therefore all systems relying on it:

Scaling

In some VRUs (such as TSS and Watson) the angle is linearly proportional to the voltage, in others (such as Datawell) the voltage is proportional to the sine of the angle. The full scale angle of the sensor also varies between sensors, and in some sensors (such as TSS) is actually configurable. The application using the sensor has no way to determine the settings of the sensor, and so the onus is on the operator to correctly configure the appropriate full scale of the sensor, and the scaling scheme. Errors in configuring the scaling are very common.

Sign Convention

There are different conventions for the direction of tilt representing positive roll and pitch angles. The operator needs to set up whether to invert the sensor reading at the input of the system to get roll and pitch into Sonardyne's roll and pitch sign convention. Getting this wrong will cause the position error due to tilt of the USBL transceiver to be doubled, rather than reduced - it is better to have no tilt correction at all rather than correcting the error in the wrong direction!

Noise

Often, the analogue signals are quite small and subject to noise. There have been instances, particularly where the sensor has been positioned a long way from the USBL system on a boat, where the analogue cables have been routed close by high voltage cables, and pick up has been seen.

Fault Tolerance

There have been cases where the analogue input from the VRU has not been plugged in, or plugged in to the wrong port and no one has noticed. There is no way for the system to distinguish between no data and 0V.

Loading

Mismatching input/output impedances, particularly where there are several client systems connected to the VRU, can result in the VRU reading be dragged down.

For all of the above reasons, Sonardyne strongly recommend using digital/serial interfaces to connect VRUs to USBL systems or where not possible to ensure that extreme care is taken to ensuring the VRU is correct set-up and that the output is independently verified.

Appendix I QuickSet Wideband Channels

This appendix includes details of the Sonardyne Quicket Wideband channels that are available in the latest WSM and DPT transponders.

Quickset channels have been created to allow operators to easily select interrogate and reply channels that are suitable for most acoustic tracking operations.

In this appendix... This appendix contains the following sub-sections:

I.1 WSM Quickset Wideband Channels

Table 44 WSM Quickset Channels

Preset	Interrogate channel	Reply channel	Depth Reply	Address	TAT (ms)
A1	9	1501	1502	4701	250
A2	9	1503	1504	4703	375
A3	9	1505	1506	4705	500
B1	10	1401	1402	4601	250
B2	10	1403	1404	4603	375
B3	10	1405	1406	4605	500
C1	0	1301	1302	4501	250
C2	0	1303	1304	4503	375
C3	0	1305	1306	4505	500

Note that the interrogation channel used for a WSM transponder is a tone channel whereas the reply is a wideband signal.

The WSM transponder should be programmed to use a Quickset channel by using WSM terminal V2.00.05 or newer.

I.2 DPT Quickset Wideband Channels

The following quickset channels are available for the latest DPT transponder. The rows shown in red are only available in the DPTi riser angle transponder.

Table 45 DPT Quickset Channels

Preset	Interrogate channel	Reply channel	Depth/ Roll Reply	Pitch Reply	Address	TAT (ms)
A1	CIS 6	1501	1502	none	1507	250
A2	CIS 6	1503	1504	none	1503	375
A3	CIS 6	1505	1506	none	1505	500
A4	CIS 6	1507	1508	none	1507	625
MA	CIS 6	1201	1202	1203	1201	125
B1	CIS 7	1401	1402	none	1401	250
B2	CIS 7	1403	1404	none	4603	375
B3	CIS 7	1405	1406	none	4605	500
B4	CIS 7	1407	1408	none	1407	625
MB	CIS 7	1204	1205	1206	1204	125

Preset	Interrogate channel	Reply channel	Depth/ Roll Reply	Pitch Reply	Address	TAT (ms)
C1	CIS 8	1301	1302	none	4501	250
C2	CIS 8	1303	1304	none	4503	375
C3	CIS 8	1305	1306	none	4505	500
C4	CIS 8	1307	1308	none	1307	625
MC	CIS 8	1207	1208	1209	1207	125

The DPT or DPTi transponder should be programmed to use a Quickset channel by using the C5 terminal program supplied with the transponder.

Appendix J UTC Time Synchronised Acoustics

This appendix explains the operation of UTC time synchronised acoustic transmissions.

In this appendix...

This appendix contains the following sub-sections:

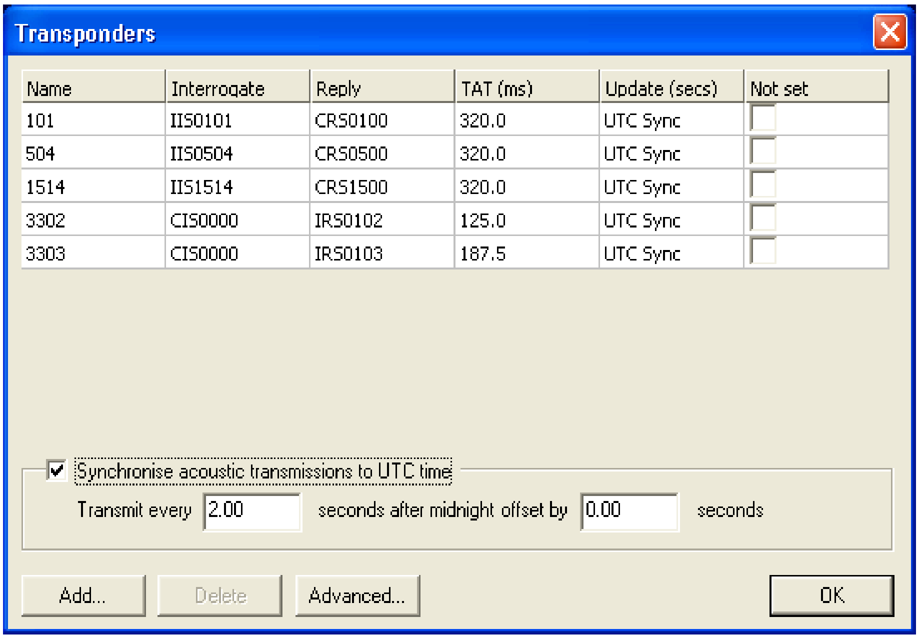
J.1 Using Time Synchronised Acoustics

It is possible to configure Ranger to transmit it synchronisation with UTC time. This is only possible when a Ranger is beign supplied with UTC time from a GPS receiver.

Time synchronised acoustic transmissions allow multiple acoustic systems to share the same transponders by ensuring that only one system is interrogating the transponders at a given time.

In order to us time synchronised acoustics it is first necessary to enter a transmission window and an offset into that window as explained below.

The transponder page will change its appearance to that shown below when Ranger has a UTC input assigned.



There is now an option to synchronise to UTC time at the bottom of the page. Click the check box and the **Update (secs)** for all transponders will change to say **UTC Sync**.

It is now possible to enter a transmission window and an offset into that window. The transmission window determines the rate in seconds at which Ranger will send out an acoustic interrogation. If the transmission window is set to 5 seconds then Ranger will transmit every 5 seconds.

The offset can be used to shift the acoustic transmissions. For example if there were 2 Sonardyne systems on a vessel that wanted to share the same transponders then **System A** might have a transmission window of 5 seconds with an offset of 0, whilst **System B** would have a window of 5 seconds with an offset of 2.5 seconds. In this scenario **System A** will interrogate the transponders every 5 seconds after midnight whilst **System B** will interrogate the transponders 7.5 seconds after midnight and every 5 seconds thereafter.

Appendix K Upgrading Firmware

In this appendix...

This appendix contains the following sub-sections:

K.1 Loader

Firmware upgrades require the Loader application. Loader is a software application for upgrading the firmware of the Navigation Controller Unit (NCU) and Generic Digital Transceiver (GDT) Instruments such as the USBL transceiver.

The application is installed automatically with the Ranger software and is accessible through an icon installed on the desktop.

This appendix includes a step-by-step guide for firmware upgrades. The Loader application is compatible ONLY with the following software and firmware generations:

Table 46Loader compatibility

Hardware	Version
NCU	2.00. +
GDT	8.00. +

K.2 NCU Firmware upgrade

NCU firmware is written to a ***.S19** file. Sonardyne recommends that you obtain the latest ***.S19** file from Sonardyne International Limited and save the file to the C: drive of the computer on which you are running the Loader application.

Note

The latest and previous NCU firmware versions are available on the Ranger USBL System installation CD. Always use the latest NCU firmware unless recommended otherwise by Sonardyne.

Procedure

To upgrade the NCU firmware:

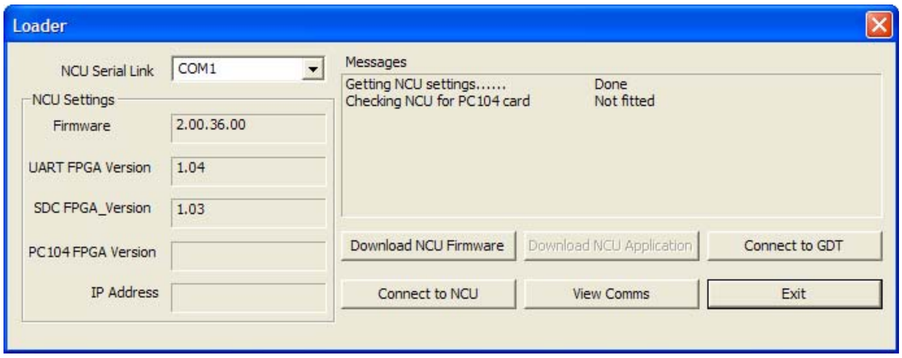
1. Close the Ranger software application if it is running.
2. Connect the NCU's serial link port to a suitable communications port on the computer by using the null modem cable supplied.

   If possible, use the COM1 port on the computer. Make sure there are no other applications using the communication port you use.
3. Double-click the Loader icon on the desktop to start the Loader application.

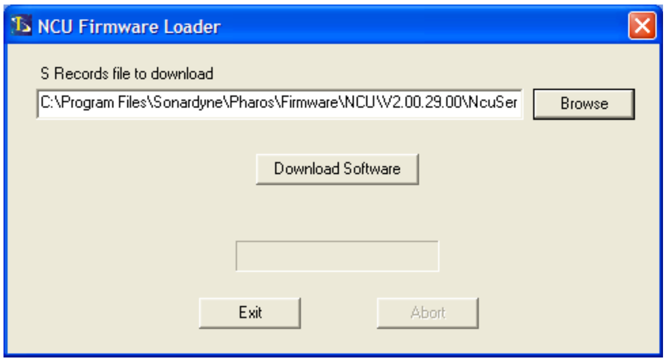
   Alternatively, run the application from its default installation location at:

   C:\Program Files\Sonardyne\Ranger\Loader.exe
4. Select **COM 1** from the **NCU Serial Link** drop-down list to initialise communications with the NCU.

If communications failure occurs, click **Connect to NCU** to update the NCU settings display.



5. Click **Download NCU Firmware** to display the **NCU Firmware Loader** dialog.



6. Click **Browse** and select the folder that holds the new *.S19 file.
7. Click **Download Software** to start the download process.

   The download takes approximately three minutes to complete, with the status displayed by a green progress bar and status messages.

   Error messages will be displayed if problems arise during the download process. These messages will help with troubleshooting.
8. Click **Exit** to return to the main Loader window when the download has completed.

K.3 GDT Firmware Upgrade

GDT firmware is written to a ***.gdt** file. Sonardyne recommends that you obtain the latest version ***.gdt** file from Sonardyne International Limited, and save it to the C: drive of the computer on which you are running the Loader application.

Note

The Ranger installation CD includes the latest and the previous GDT firmware versions. Always use the latest GDT firmware unless recommended otherwise by Sonardyne.

Procedure

Steps 1 to 6 are necessary only if you are interfacing the NCU with the GDT Instrument.

To upgrade the GDT firmware:

1. Close the Ranger software application if it is running.

2. Connect the NCU’s serial link port to a suitable communications port on the computer by using the null modem cable supplied.

   If possible, use the COM1 port on the computer. Make sure there are no other applications using the communication port you use.

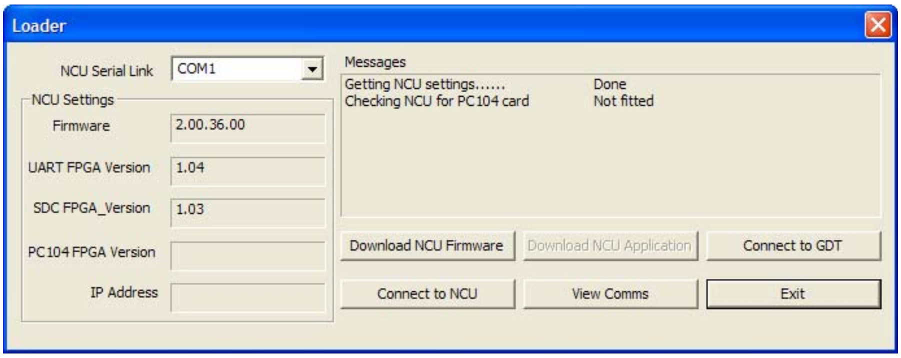
3. Double-click the Loader icon on the desktop to start the Loader application.

   Alternatively, run the application from its default installation location at:

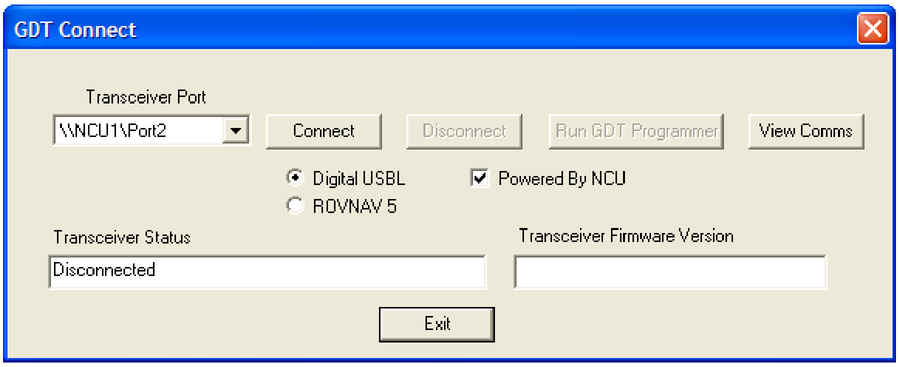
   C:\Program Files\Sonardyne\Ranger\Loader.exe

4. Select **COM 1** from the **NCU Serial Link** drop-down list to initialise communications with the NCU.

   If communications failure occurs, click **Connect to NCU** to update the NCU settings display.



5. Click **Connect to GDT** to display the **GDT Connect** dialog.

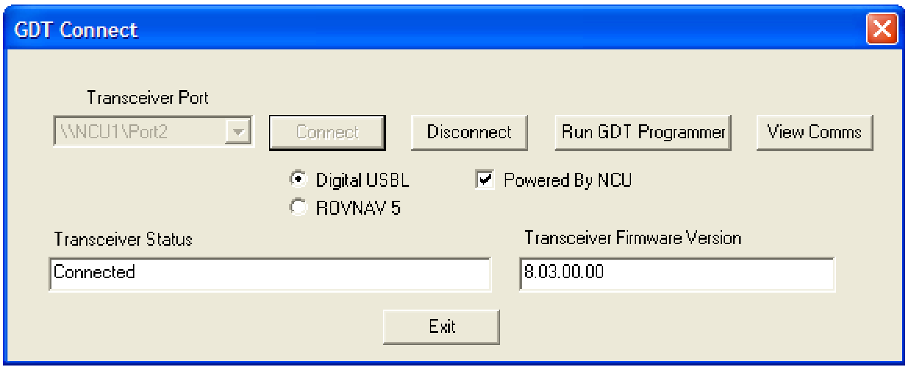


6. Select the relevant **Transceiver Port** from the drop-down list.

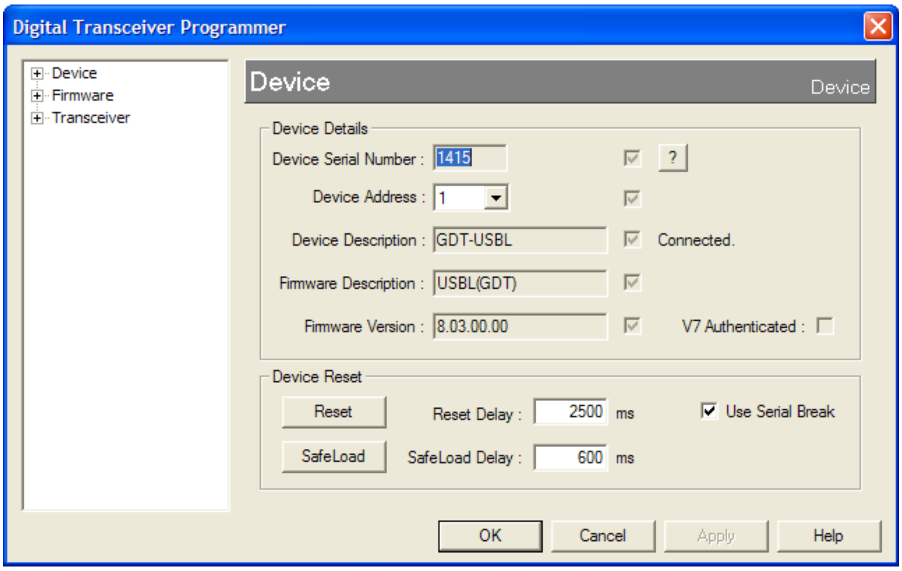
   This port can be an NCU port or a computer port, depending on the interface configuration.

   Identify the transceiver type and the power source and select the relevant options on the dialog. Generally, transceivers on **\\NCU1\Port2** and on **\\NCU1\Port3** will be powered by the NCU, and others must be powered externally.

7. Click **Connect** to update the **Transceiver Status** and the **Transceiver Firmware Version** fields and to enable the **Run GDT Programmer** button.



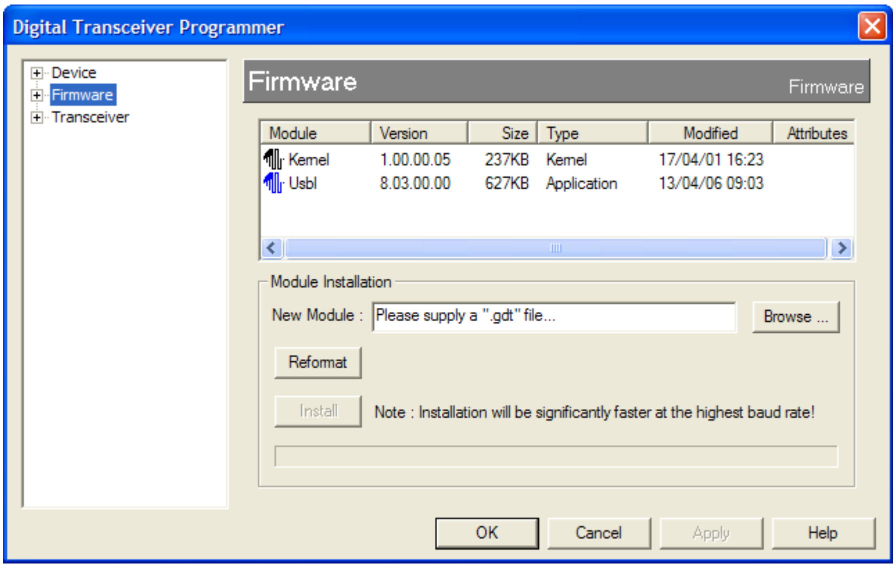
8. Click **Run GDT Programmer** to display the **Digital Transceiver Programmer** dialog’s **Device** window.



At first this window shows the message *Connecting*. This message will change to *Connected* after connection has been successful, and the window will display the installed firmware details.

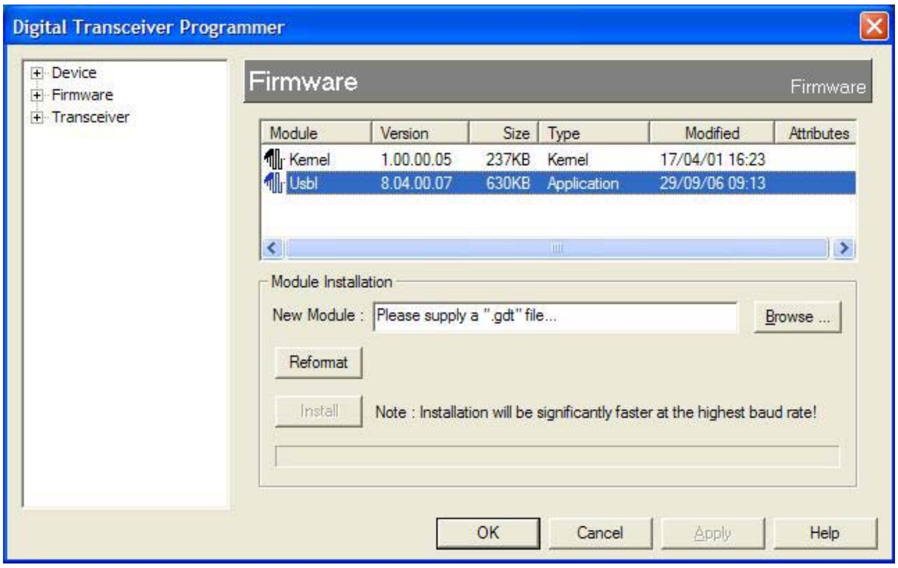
If the message continues to display *Connecting*, or if it changes to *Not Connected*, click **Reset**.

9. Click **Firmware** in the left-hand pane of the **Digital Transceiver Programmer** window to display the **Firmware** window.



10. Select the GDT Instrument entry, which is under the **Module** heading.

    Depending on the transceiver type, this entry will be either USBL or RovNav.



CAUTION

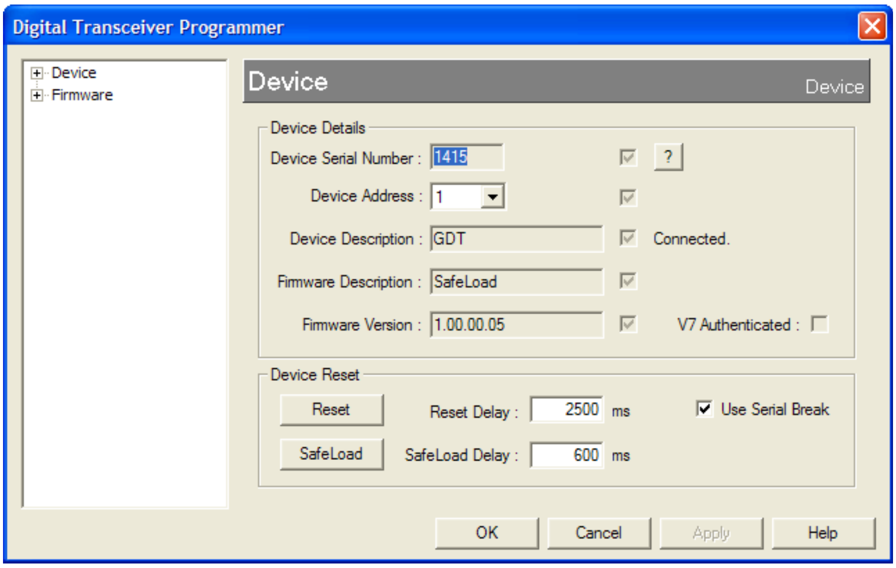
Do not under any circumstances select the Kernel file.

11. Click **Reformat** and choose **Yes** from the resulting **Confirm Flash Erase** message.

12. After a short pause, the **Device** page will be displayed in the **Digital Transceiver Programmer** window.

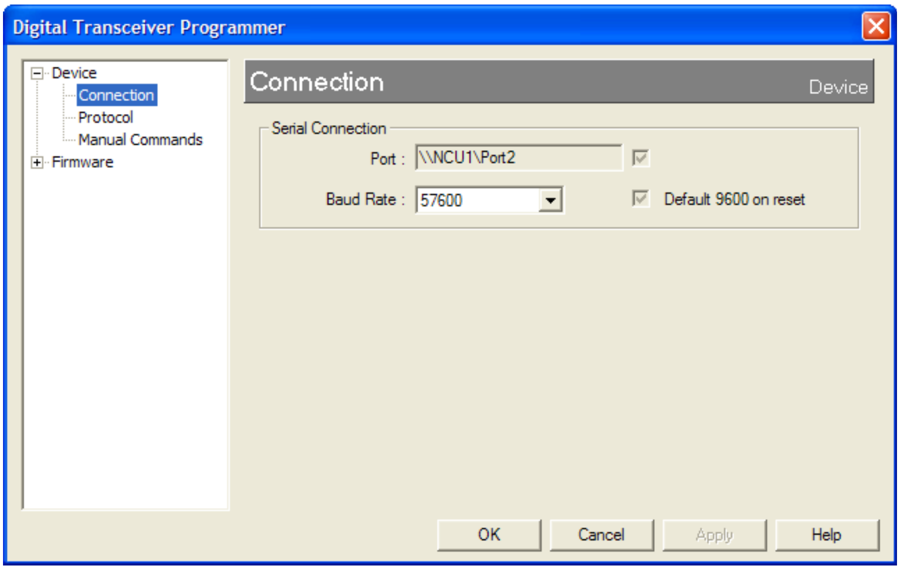
Note

If after two minutes the screen has not reverted back to the Device window, click Device in the left-hand pane of the Digital Transceiver Programmer.



13. The **Device** window should display **Safeload** in the Firmware Description. If this is not the case, click **Reset** and wait until the window updates.

14. Click the plus symbol for the **Device** entry in the left-hand pane of the **Digital Transceiver Programmer** window and select **Connection** to display the **Connection** window, which allows you to set the baud rate options.

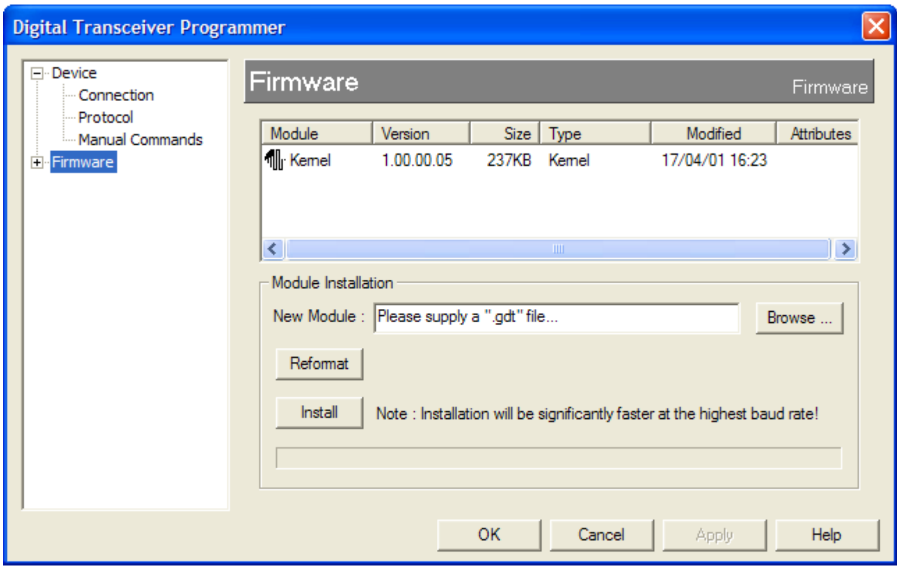


15. Select the appropriate baud rate to use based on the guidelines in Table 47 below.

Table 47Baud rate guidelines

Hardware Configuration	Baud Rate	Approx. Install Time
RovNav5 powered via NCU	57600 recommended	13 minutes
RovNav5 externally powered	9600 maximum	30 minutes
GDT USBL powered via NCU	57600 recommended	13 minutes

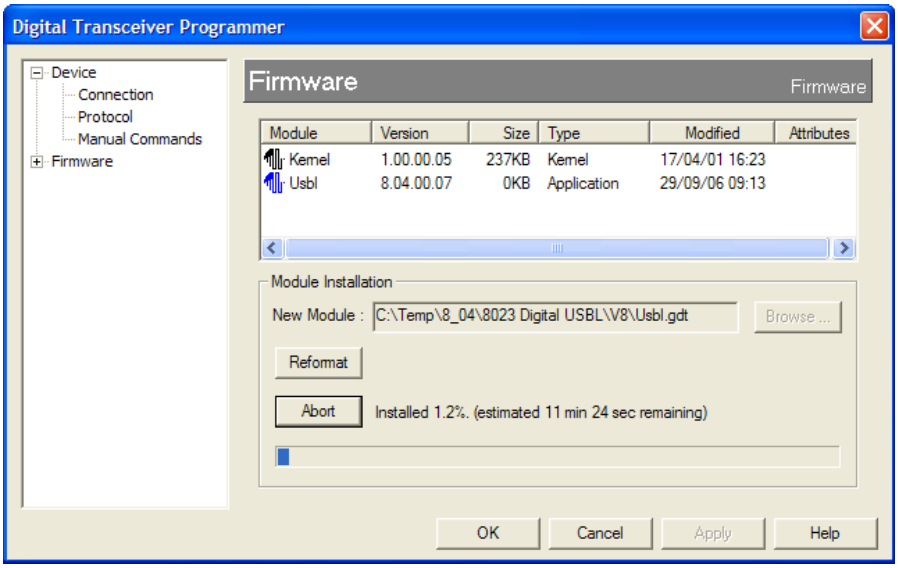
16. Click **Firmware** in the left-hand pane of the **Digital Transceiver Programmer** window to display the **Firmware** window.



17. Click **Browse**, navigate to the folder that holds the ***.gdt** file and select the file.

18. Click **Install** to begin the installation.

    A progress bar indicates the active status of the installation and gives an estimate for the time to completion. The **Abort** button is now active if you need to use it.



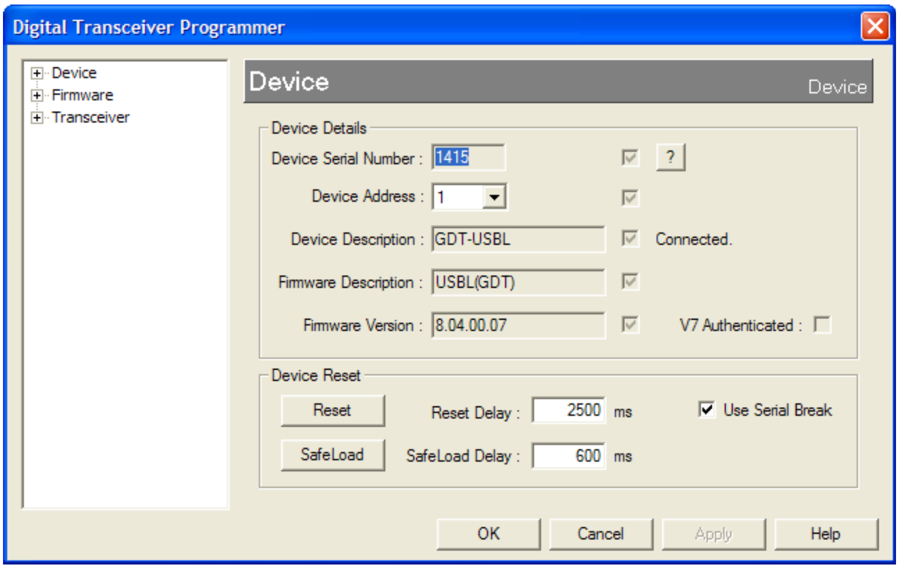
CAUTION

Avoid using the computer actively with any other applications while the download is continuing.

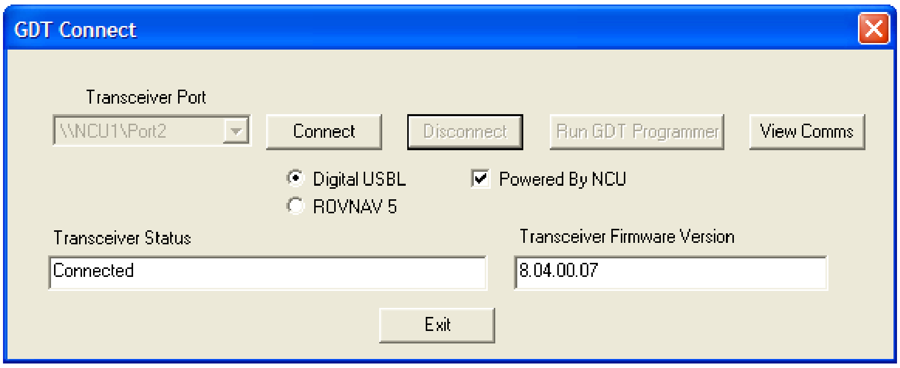
When the installation is complete, the program will automatically revert to the **Device** window where the new firmware will be displayed in the **Firmware Description** field.

CAUTION

After Installation is complete, there may be a two minute pause before the software returns to the Device window. Do not press any other buttons in Loader until this time has passed. If after two minutes the window has not updated, click Device in the left-hand pane of the Digital Transceiver Programmer window.



19. Click **OK** to return to the GDT Firmware Loader.
20. Click **Disconnect**.



21. Click **Exit** to return to the main Loader menu.
22. Click **Exit** to complete the upgrade process.

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