UM-8068-008

User Manual for Scout 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 Scout USBL System. It provides important information concerning the installation and use of the Scout USBL hardware and software, and offers advice on how to operate Scout 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 "Scout USBL System Overview" begins on page 5

Section 2 describes the Scout 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 10

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

Section 4 "Software Installation" begins on page 15

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

Section 5 "Scout Software Overview" begins on page 19

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

Section 6 "Software Configuration" begins on page 28

Section 6 explains how to configure the Scout 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 54

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 60

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

Section 9 "Frequently Asked Questions" begins on page 71

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 Scout USBL System, check whether there is any information to help you in this section first.

Section 10 "Troubleshooting" begins on page 72

Section 10 provides some guidance relating to fault finding and reporting software problems in the Scout 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 77

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 85

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 Scout 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 90

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 100

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

Appendix E "Report Formats" begins on page 113

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

Contains information on the configuration, and use of the integrated simulator.

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 Scout 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 Scout 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-8068-008** and this is issue **A - Rev 3**.

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 Scout, 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

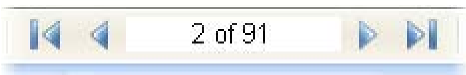
The electronic version of this manual is a PDF file read using Adobe® Acrobat® Reader. Acrobat Reader provides a number of features to help you navigate through the manual, and to find the information you are looking for conveniently.

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.

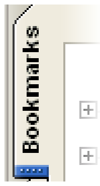
Navigation buttons

- 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.

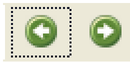


Links

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 Scout USBL System Overview

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

2.1 Introduction

Scout User and Maintenance Guide is a guide and introduction to installing, setting up and maintaining a Scout USBL acoustic tracking system.

Scout USBL is a high-performance, cost-effective underwater acoustic positioning system that can be used to track up to four acoustic beacons underwater.

- Scout USBL can be used to track subsea targets such as:
- Remotely Operated Vehicles (ROVs)
- Divers
- Towfish
- Autonomous Underwater Vehicles (AUVs)

Scout USBL can be used for operations such as:

- Underwater inspection
- Cable and pipe route surveys
- Harbour and dam inspection
- Inshore construction and salvage
- Marine biology surveys
- Marine archaeology

Scout USBL has been developed as a system that is simple to install, quick to set up as well as being easy and intuitive to operate. For dry operating environments Scout USBL can run on a laptop computer, for wet environments the waterproof Scout Command Unit can be used.

Scout is particularly useful for operators with little or no prior experience of USBL systems or those who want to arrive on location and begin tracking immediately.

As the Scout USBL transceiver includes its own internal motion reference unit Scout does not require extensive calibration before use. The system can track up to four targets in water depths from 5m to 500m. Positions for the targets can be relative to the vessel carrying the Scout system or if a GPS receiver is available the positions can be given in real world latitude and longitude or grid co-ordinates.

2.2 Scout and Scout+

Scout and Scout+ are part of the same family of Coastal systems. Scout+ includes all of the features of Scout but also supports:

- External gyro and motion reference units
- Wideband SubMini (WSM) beacon
- Pulse position depth telemetry from a WSM
- Responder beacons
- Attitude and heading sensor calibration using CASIUS
- Can track up to six acoustic beacons at the same time

Existing Scout systems can be upgraded to Scout+.

2.3 Scout USBL Tracking System Components

This section describes each of the components that make up a Scout USBL Tracking System.

A Scout USBL tracking system consists of the following components:

Fig 1 Scout System Configuration

The core components are:

- An acoustic transceiver
- A Surface Interface Unit (SIU) or Surface Command Unit (SCU)
- Acoustic beacons
- A computer running the Scout USBL software

The tracking system can also take data from a Global Positioning System (GPS) receiver, a ROV or diver depth instrument and an ROV compass instrument

Transceiver

The transceiver is the part of the system fitted to the boat that is deployed in the water. The transceiver can be deployed on a pole over the side of a ship or through a gate valve in the ship's hull.


SCOUT USBL Transceiver

The transceiver sends an acoustic (sound) interrogation signal to a transponder beacon through the water and can receive an acoustic reply signal back from the beacon. The acoustic signals are pulses of high frequency sound, they are too high to hear but a 'click' can often be heard when the transceiver is tested on deck. The transceiver can determine the distance away and direction from which a reply signal was received.

The connector on the top of the transceiver takes the cable that connects the transceiver to the Surface Interface Unit (SIU). At the other end is the transducer endcap that carries the delicate transducer elements used to transmit and receive acoustic signals. The transceiver is fitted with a grey plastic transducer guard secured with a hose clip, ensure that this protective guard is raised above the transducer endcap before deployment.

The transceiver contains a motion reference unit that continuously compensates for the motion of the transceiver when tracking.

CAUTION

Do not drop the transceiver otherwise damage may occur to the transducer elements and the motion reference unit. Ensure that the protective transducer guard is raised before deploying the transceiver

Surface Interface Unit (SIU)

The standard system has a Surface Interface Unit (SIU), this provides power and a communications link between the transceiver and the computer running the Scout USBL software. The SIU connects to the transceiver over a 30 metres cable fitted with a waterproof connector and to the computer using a USB link. Four additional serial ports are included that can be used to connect to external instruments.

Fig 2 Surface Interface Unit (SIU)

Surface Command Unit (SCU)

The portable system has a Surface Command Unit (SCU), this is a splash proof (IP65) box containing the Surface Interface Unit electronics, a computer and monitor. This is designed as a simple, portable USBL tracking system that can be easily deployed from a small boat. The unit includes an integrated keyboard, touch pad and touch screen all of which can be used to operate the Scout USBL software.

Fig 3 Surface Command Unit

The SCU can connect to an external GPS receiver and a navigation computer via the serial ports on the front panel. A USB connector on the front panel allows connection of any external USB device including hard drives, memory drives and CD drives.

The SCU can be powered from a normal AC mains power supply or from a 12-16V dc power supply such as a car battery. Onboard batteries will power the unit for at least 30 minutes from a full charge.

Beacons

A transponder beacon will send back an acoustic reply signal in response to an acoustic interrogation signal from the transceiver. The reply is sent after an accurately timed fixed delay so the transceiver can use the time delay between sending the interrogation and receiving the beacon's reply to work out how far away the beacon is.

Scout USBL is compatible with Sonardyne's Coastal family of High Frequency (HF) transponder beacons. These compact, rugged beacons can be deployed in a maximum depth of 500m.

Fig 4 Coastal Beacon

The Coastal transponder beacons have battery packs that can be replaced in the field and do not have to be sent back to Sonardyne. Standard alkaline batteries have a listening life of 1 year and can transmit approximately 1million replies. If the beacons are fitted with long-life lithium packs then they have a listening life of 4½ years, ideal for acting as long term markers.

Transponder beacons can be fitted with a release hook. These beacons can be deployed on the seabed with a sinker weight to hold them down and a buoy to keep them upright. By sending a special command from the transceiver to the beacons through the water the beacons can be told to let go of the sinker weight and float to the surface for recovery.

A responder beacon uses an electrical signal sent down a wire to trigger an acoustic reply signal. This type of beacon can be used where a cable connects the object being tracked to the surface, such as a Remotely Operated Vehicle (ROV). The advantage of using a responder is that only one acoustic signal is sent through the water, this improves position update rate, position accuracy and helps where the object being tracked is in a noisy environment.

Computer and Scout USBL Software

The computer running the Scout USBL software connects to the Surface Interface Unit (SIU) using two serial communications cables. The software talks to the transceiver via the SIU sending it commands to make it position beacons or send commands to them. The software also takes the range and angle measurements made by the transceiver and calculates the positions of the beacons from them. The boat, the beacons and a chart of the working area can be displayed on the computer's monitor.

Optional Instruments

To report positions of vehicles in real-world co-ordinates the Scout USBL system can connect to an external Global Positioning System (GPS) receiver. The quality of these co-ordinates is dependant on the quality of the GPS positions being given to Scout.

To improve tracking accuracy with Scout+, a better performing Motion Reference Unit (MRU) and gyrocompass than those installed in the transceiver can be used. For further information see 6.4 “Adding Instruments and Sensors” beginning on page 29.

3 System Installation

In this section...

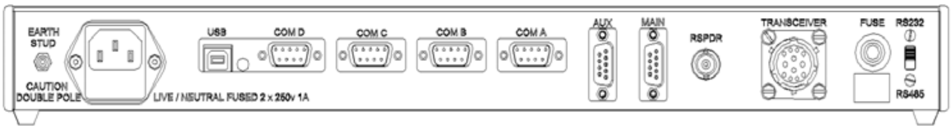
This section of the manual includes the following sub-sections:

3.1 Introduction

The following section gives information concerning the IO ports available on the different types of Scout system.

3.2 Hardware Connections for a Surface Interface Unit

1. Locate the Surface Interface Unit (SIU) in a suitable rack close to the computer that will be used to run the Scout USBL software
2. Ensure the power switch on the front of the SIU is set to off.
3. Connect the power cable to the power connector on the Surface Interface Unit backplate and the other end to a power socket.



4. Connect the USB port on the Surface Interface Unit to an unused USB port on the computer using a standard USB cable. The maximum usable cable length is about 3 metres.
5. Connect the transceiver cable to the Surface Interface Unit using the large green TRANSCEIVER connector on the backplate.
6. Check that the other end of the transceiver cable is connected to the transceiver.
7. Connect the transceiver data serial connector labelled MAIN to COM A and AUX to COM B on the Surface Interface Unit backplate using a standard serial cable.
8. If connecting a GPS receiver to the system then use a serial cable to connect the receiver preferably to a serial port on your computer. COM C on the Surface Interface Unit may be used dependent on the type of output string generated by the GPS receiver.
9. If connecting the Scout USBL to an external computer, use a serial cable to connect serial port COM D on the back of the Surface Interface Unit to a serial port on the external computer. A crossover or null modem serial cable is required.

10. Fit the yellow security key supplied with the Scout software to the parallel port or USB port on the computer that will be used to run the Scout USBL software. See note below.
11. Start the computer and run the Scout USBL software if it is not configured to start automatically.
12. The power switch on the front of the Surface Interface Unit can now be switched on, this will also power up the transceiver. On powering up the SIU, if the SIU has not been connected to the PC before then the four serial ports in the SIU will be installed by Plug and Play. See section 3.3.1 below.
13. Check that the transceiver's AUX port RECEIVE light is on or flashing on the front panel, this shows that the cable connection to the transceiver is correct.
14. The Transceiver Reset button can be used to send a hardware reset to the transceiver. After pressing the button please ensure that the transceiver is reconfigured, see section 6.3
15. If communications are established with the transceiver still on deck they should be checked again once the transceiver is deployed to ensure no damage was done during deployment.

The supplied security key should not be used in parallel or 'piggy backed' with other security keys from other applications or manufacturers at the same time. Always ensure that the Scout USBL security key is the only key attached to the parallel port on the computer.

CAUTION

The supplied security key should not be used in parallel or 'piggy backed' with other security keys from other applications or manufacturers at the same time. Always ensure that the Scout USBL security key is the only key attached to the parallel port on the computer.

3.3 Surface Interface Unit (SIU) Serial Ports

Serial Port Installation

The SIU contains four serial ports which connect to the PC via a USB cable. When first used each of the four serial ports are automatically installed by Plug and Play.

If during installation you are prompted for the serial port drivers then they can be found on the Quatech CD supplied with your Scout system. Put the CD into the CD drive on your PC and follow the instructions on the screen.

The serial ports on the SIU are labelled COM A to COM D. This is because the port number allocated to each port depends on the number of serial ports already installed in your computer. The ports are usually installed in sequence with COM A being the lowest port number and COM D being the highest.

It is recommended that you restart the computer after all four serial ports have been installed.

Port Allocation

The suggested serial port allocations for the SIU are:

Table 1 SIU IO Port allocation

Serial Port	Type	Use	Baud
Main	SIU	Transceiver Acoustics Out, connect to COM A	38400
Aux	SIU	Transceiver Sensors Out, connect to COM B	115200
Com A	SIU	Transceiver Acoustics In	38400
Com B	SIU	Transceiver Sensors In	115200
Com C	SIU	GPS (if it is not possible to connect to a computer COM port)	As GPS
Com D	SIU	External system	As required

It is recommended that COM A port be connected to the MAIN port; this is used by Scout to communicate with the transceiver itself. Ports B, C and D could be used instead.

It is recommended that COM B port be connected to the AUX port; this is used to feed heading and attitude data to Scout. Ports A, C and D could be used instead.

COM C port can be used to connect a GPS receiver however ports A, B and D could be used instead. It is recommended to plug the GPS receiver directly into a computer COM port if possible as some GPS receiver outputs can contain multiple telegrams which could overload the SIU.

It is recommended that COM D port be used to connect to an external navigation computer however ports A, B and C could be used instead.

3.4 Scout USBL Hardware Connections Through the Surface Command Unit

1. Place the Surface Command Unit (SCU) securely on a table or on the floor
2. Ensure the power switch on the front of the unit is set to OFF.
3. Connect the mains adapter power cable to the POWER connector on the Surface Command Unit and the adapter's other cable to a mains power socket.
4. OR connect the battery power cable to the POWER connector and put the clips on to a 12 volt battery. Ensure each clip is on the correct battery terminal.
5. Connect the orange transceiver cable to the large TRANSCEIVER connector.
6. Check that the other end of the transceiver cable is connected to the USBL transceiver.
7. If connecting the Scout USBL to an external computer, use a serial cable to connect serial port COM2 on the front panel to a serial port on the external computer. A crossover (null modem) serial cable may be required.
8. The power switch on the front of the Surface Command Unit can now be switched to ON.

9. The Scout USBL program will start automatically. Check that the transceiver's AUX port Receive LED is flashing; this shows that the cable connection to the transceiver is correct.
10. Instructions on using the SCU touch pad and touch screen can be found in section 4.9
11. If communications are established with the transceiver still on deck they should be checked again once the transceiver is deployed to ensure no damage was done during deployment.

CAUTION

Do not operate the SCU with an external USB mouse or any other USB device connected in an environment where the SCU can be splashed with water.

3.5 Surface Command Unit (SCU) Serial Ports

Some of the serial ports on the SCU are dedicated to specific uses while others are available for connecting other instruments.

Table 2 SCU IO Port allocation

Serial Port	Type	Use	Baud
Com 1	Front Panel	Com 1 GPS	as required
Com 2	Front Panel	Com 2 External computer	as required
Com 3	Internal	Transceiver sensors	115200
Com 4	Internal	Transceiver acoustics	38400
Com 5	Com 5	‘Aux 1’ ROV/ Diver depth	n/a
Com 6	Com 6	‘Aux 2’ ROV heading	As required

Serial port COM1 is available on the front panel of the SCU. It is recommended that this port be used to connect a GPS receiver however ports 2, 5 and 6 could be used instead.

Serial port COM2 is available on the front panel of the SCU. It is recommended that this port be used to connect to an external navigation computer however ports 1, 5 and 6 could be used instead.

Serial port COM3 is permanently connected to the transceiver's Sensors port that is used to feed heading and attitude data to Scout.

Serial Port COM4 is permanently connected to the transceiver's Acoustics port that is used by Scout to communicate with the transceiver itself.

Serial ports 5 and 6 are available on the front panel of the SCU and can be used to connect to other instruments such as ROV depth, Diver depth and ROV heading

4 Software Installation

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

4.1 Introduction

All Scout 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 Scout 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 Scout 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 Scout software on a computer other than the Navigation Computer, be aware of the following:

- Scout 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 Scout software.
- There must be a minimum 50MB of available disk space for the application files.

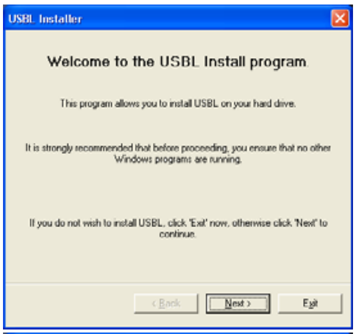
Procedure

Follow the steps listed below to install the Scout 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.



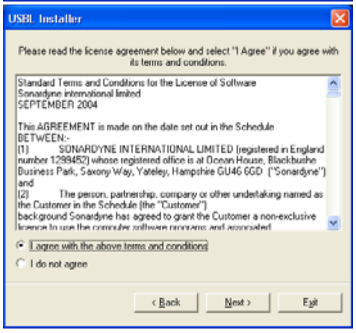
3. Insert the Scout software CD in the Navigation Computer's CD ROM drive.

   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**.

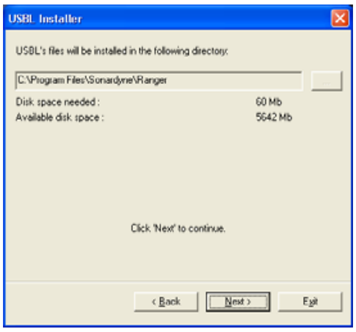
     The installation routine will start, and will display the first of the installation dialogs. Click **Next** to continue.

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



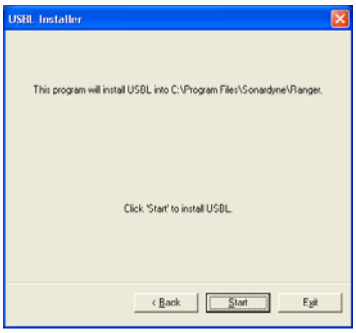
   Click **Next** to continue.

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.

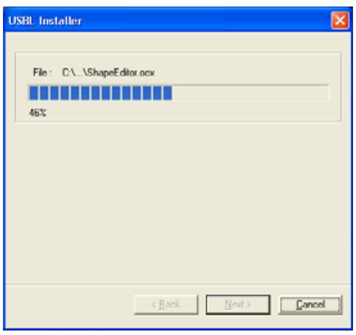


   Click **Next** to accept the installation location shown in the text field and continue.

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 Scout 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 USBL icon on the computer's desktop. This provides direct access to the Scout software application described in this manual.

Security keys

Sonardyne supplies two security keys with the Scout USBL System, which allow the Scout 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 Scout 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.

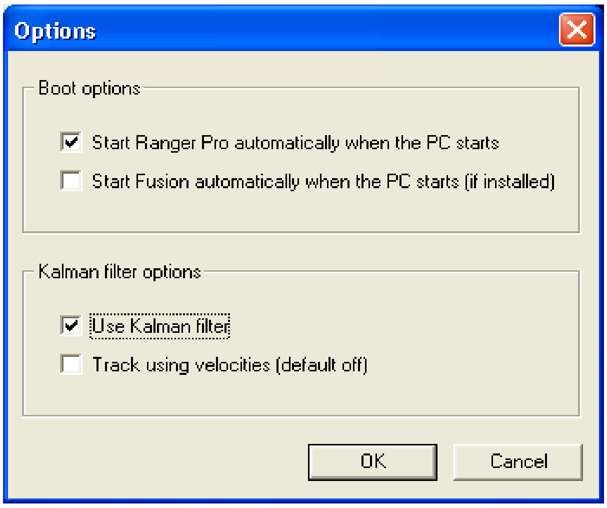
System Options

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

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

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

Fig 5 The System Options Dialog



Boot Options

Selecting '**Start Scout USBL System automatically when the PC starts**' will cause Scout 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 Scout 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

Scout 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 Scout 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 Scout Software Overview

In this section...

This section contains the following sub-sections:

5.1 Introduction

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

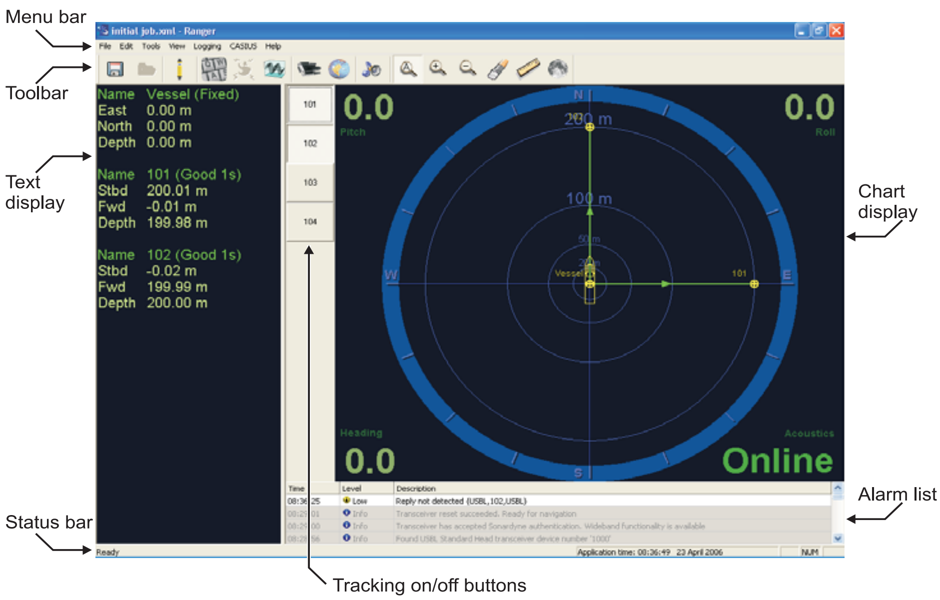
The software provides a condensed range of features designed around the need for simplicity in the configuration, control and monitoring of the Scout USBL System. The design of the software makes it appropriate for use in applications where the extended capabilities of the Fusion USBL Survey software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

Scout 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 Scout application’s main screen, shown in Fig 6, is the initial view displayed when you start the application, or when the application starts automatically after you power-on the Navigation Computer.

Fig 6 Scout’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.

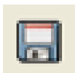
Note

Scout 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 6.

5.3 Menu bar and Toolbar

Many of the commonly-used menu items are also accessible through buttons on the toolbar. Table 3 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 3 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 4 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 18.

Edit menu

Table 5 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 Scout 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 Scout 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 57

Tools menu

Table 6 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 108.
Noise test…	Displays the Noise Test tool, described in Appendix D.5 "Noise Test" beginning on page 109.
Measure Chart Distances	Describes the Chart Measurement tool, described in Appendix D.7 "Measure Chart Distances" beginning on page 111
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 110.
Riser Angle Monitoring	Opens the Riser Angle Monitoring display, described in Appendix F.1 "Software Configuration" beginning on page 159.
Options...	Opens the Options dialog that allows boot-up and Kalman settings to be changed. See "System Options" beginning on page 17..
Simulate	Starts simulation mode, described in Appendix F.1 "Using the Simulator" beginning on page 130.

View menu

Table 7 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.
Frequency map…	Displays a read-only image of the Sonardyne and Simrad MF band signal chart.

Logging menu

Table 8 Logging menu items

Menu item	Description
Open logging folder	Opens the **Ranger files** folder, and displays a list of the sub-directories that Scout 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 9 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 Scout software and the features enabled on your Scout 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 **Help**, opens this manual.

5.4 Text display

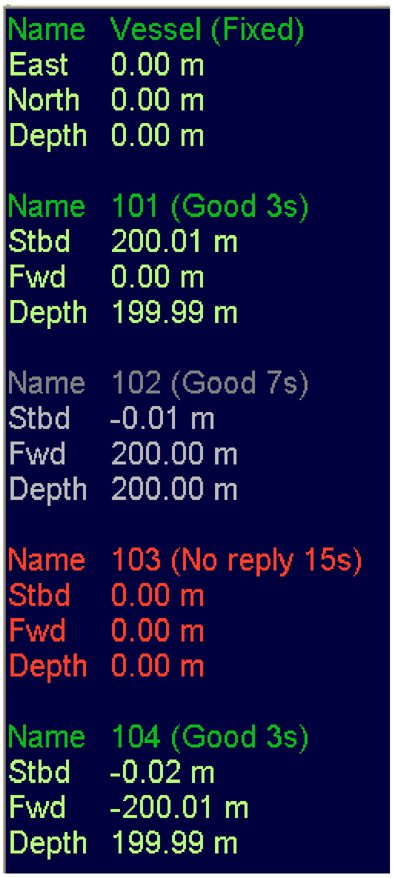


Fig 7Example text display

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 Scout 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

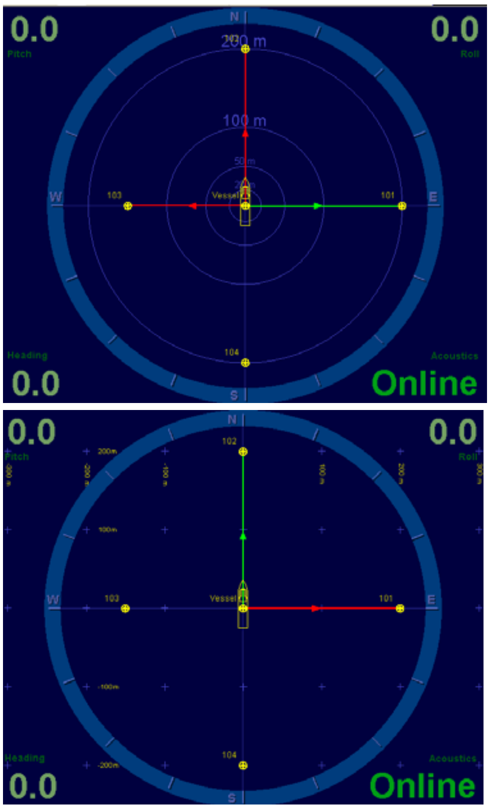


Fig 8Example Chart displays: Polar (top) and Cartesian (bottom)

The Scout 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 51.

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.

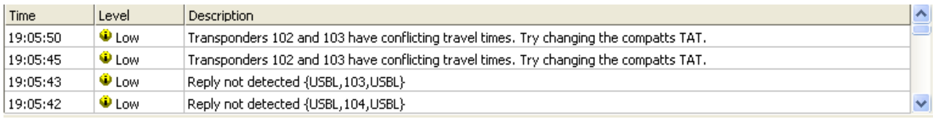
Cartesian display

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 9 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 Scout 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 48 for instructions to do this.

5.7 Tracking On/Off buttons

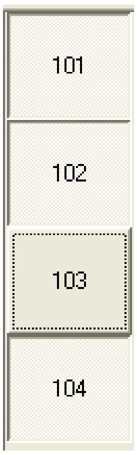


Fig 10Tracking On/Off buttons

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

Scout 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 Scout'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 Scout 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, Scout 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 Scout 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**.

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

New file

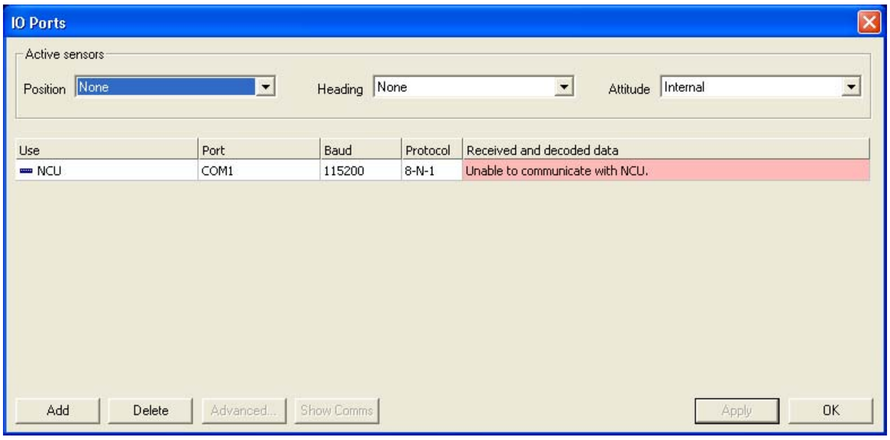
To create a new job file:

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 11 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 38 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 Scout:

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.

   Scout 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 Scout USBL System, not by their Instrument type.

Note also that you can add Instruments and sensors to Scout'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 38 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 56.

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.

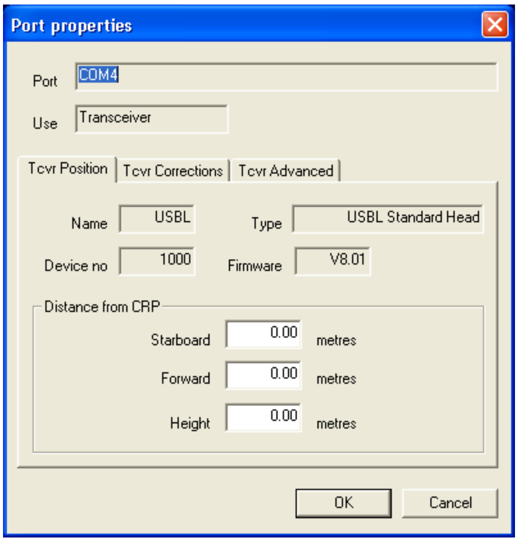
Transceiver settings

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.

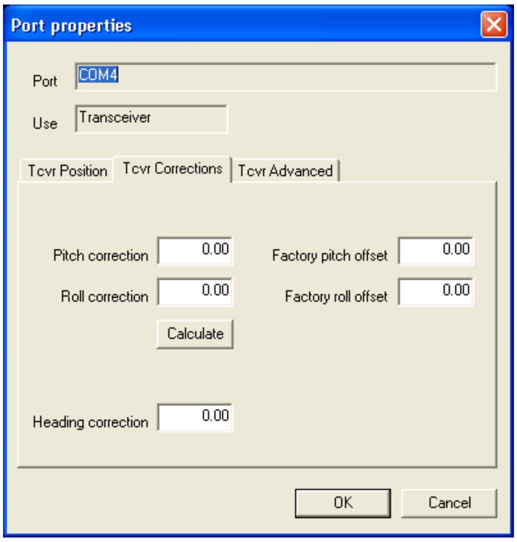
Fig 12 Port Properties—Tcvr Position page



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 13 Port Properties—Tcvr Corrections page



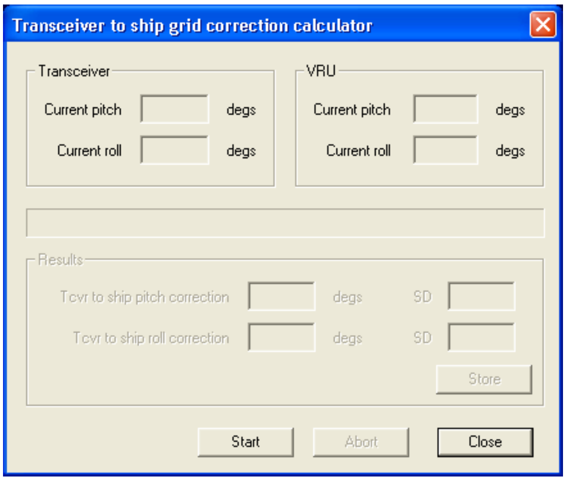
The **Tcvr Corrections** page on the dialog allows you to set the Pitch and Roll corrections to be applied within the system.

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

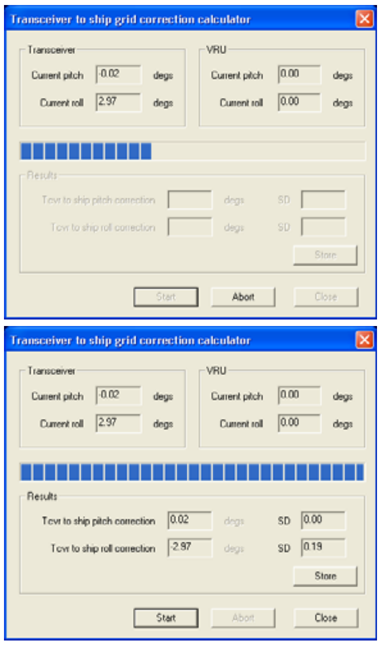
To calculate the Pitch and Roll corrections:

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 14 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.

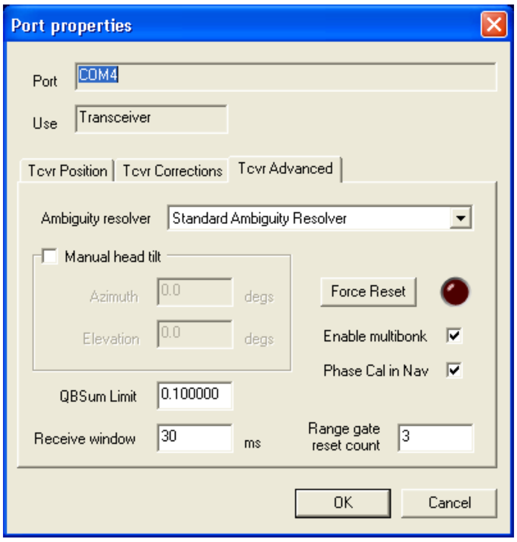
On completion of the calculation process, read-only data fields in the **Results** frame in the bottom half of the calculator show the transceiver-to-ship pitch and roll corrections to be applied, and the standard deviation determined by the measurements process.

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 60.

Fig 15 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.

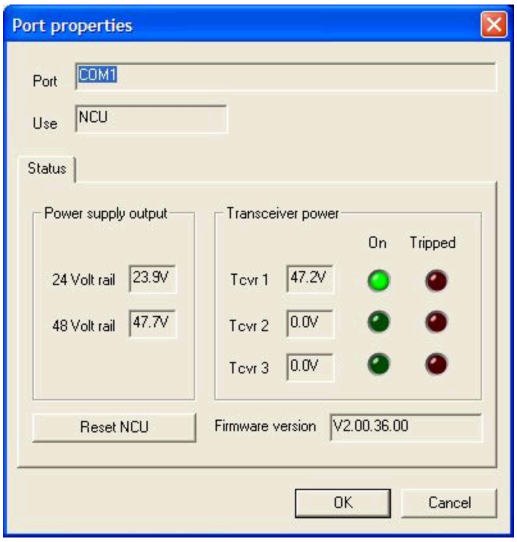
Click **OK** when you have completed all the advanced transceiver configuration tasks on these dialogs.

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 42 for relevant details.

NCU settings

Fig 16 NCU Port properties dialog



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

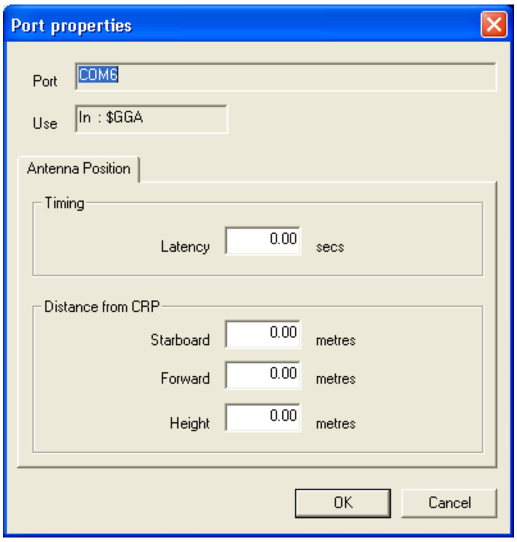
The left-hand side of the dialog includes information about the main power supply and the voltages it is currently supplying. These measured voltages should all be within ±2V of the specified 24V and 48V DC supplies.

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 17 GPS Port properties dialog



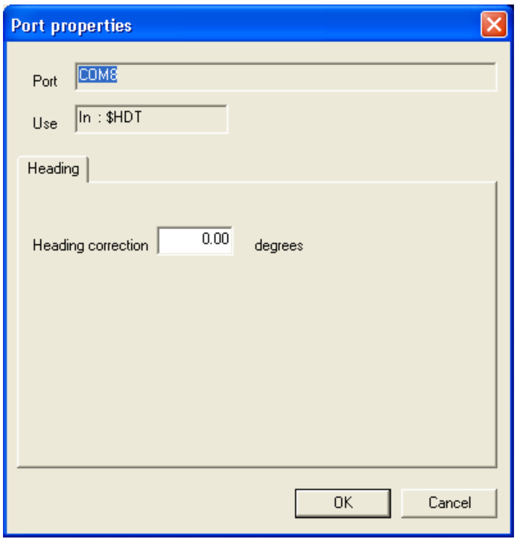
This dialog shows the serial port used for communications, and the data format selected in read-only data fields.

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 18 Gyrocompass Port properties dialog

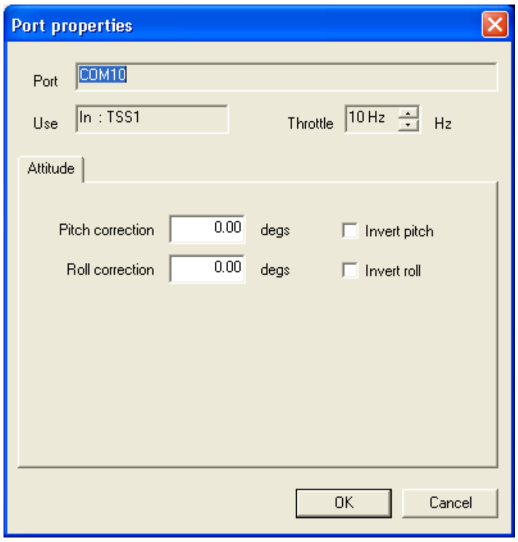


This dialog shows the serial port used for communications, and the data format selected in read-only data fields.

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 19 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.

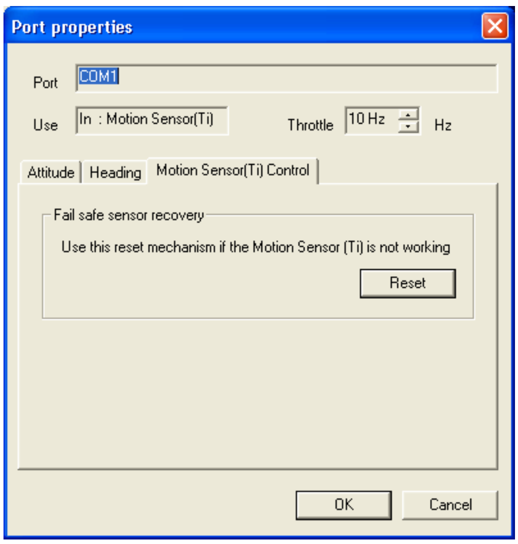
Fields on the dialog allow you to set the pitch and the roll correction angles between the vertical in the VRU's reference frame and the vertical in the vessel's reference frame. You can also set options to invert the pitch and roll angles if necessary, if the VRU delivers these measurements in the opposite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

Refer to Appendix B "Frames, Offsets and Corrections" beginning on page 85 for an explanation of reference frames.

Refer to Appendix G "Analogue VRUs" beginning on page 132 for important information if using analogue VRUs.

Motion Sensor (Ti) Settings

Fig 20 Motion Sensor(Ti) Port properties dialog



The Motion Sensor(Ti) attitude sensor built into the Scout transceiver has the advanced pages of an attitude sensor described in "Attitude sensor settings" beginning on page 36, but also has a **Motion Sensor(Ti) Control** dialog.

This dialog can be used to recover a Motion Sensor(Ti) that has stopped responding. The procedure for recovery is as follows.

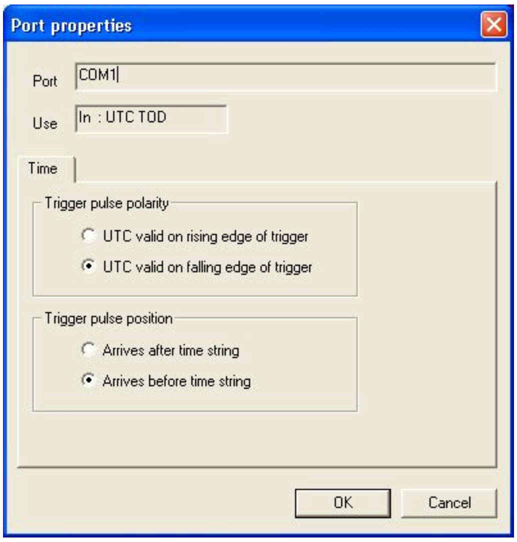
1. Press the **Reset** button on the **Motion Sensor(Ti) control** dialog.
2. A message box will appear asking the user to disconnect the Motion Sensor(Ti) from the system. Unplug the sensor from the communications port and press **OK** to continue.
3. A message box will then be displayed asking the user to re-connect the Motion Sensor(Ti) to the system. Re-connect the sensor to the communications port and press **OK** to continue.
4. A wait dialog will be displayed whilst the system attempts to recover the MTi Sensor. After a short delay a message box will be displayed that either reports the sensor as ‘working’ or ‘not found’.

If the sensor was recovered then close the port properties dialog and check that attitude information is being displayed on the polling page.

If the sensor was not found then check all cables and connections before trying the recovery mechanism again.

UTC Time of Day settings

Fig 21 UTC TOD Port properties dialog



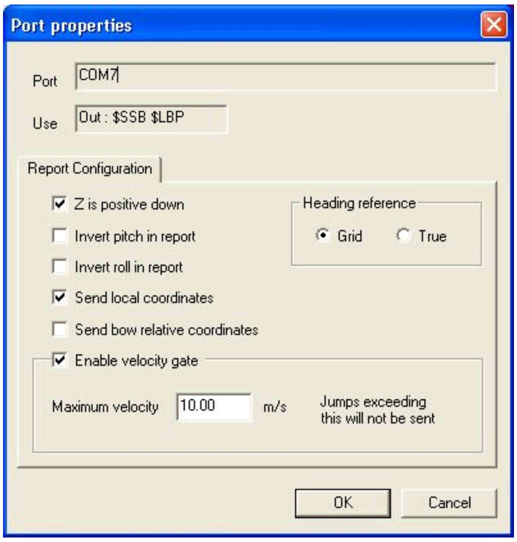
This dialog allows you to configure the UTC input to the Scout USBL System.

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 22 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.

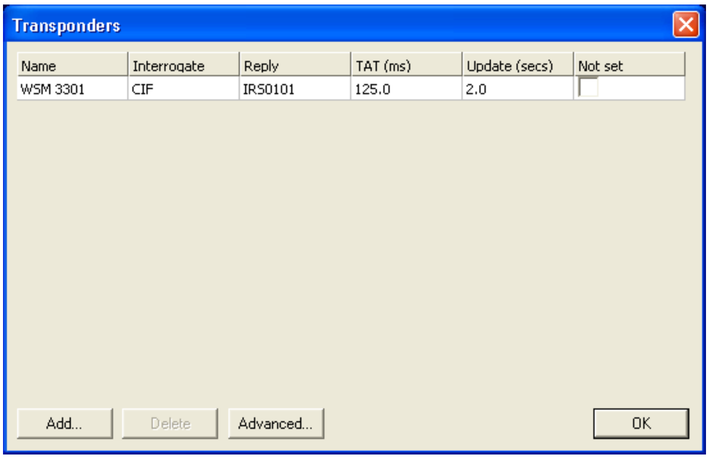
6.5 Adding Transponders

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 Scout:

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 23 Transponders dialog



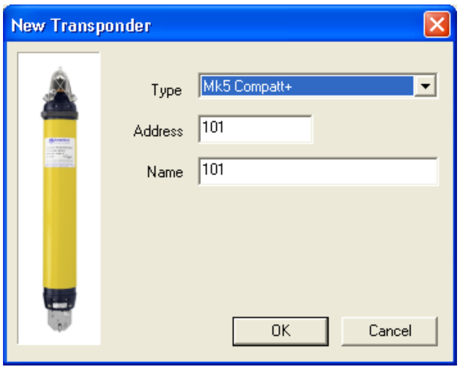
Note

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 24 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.

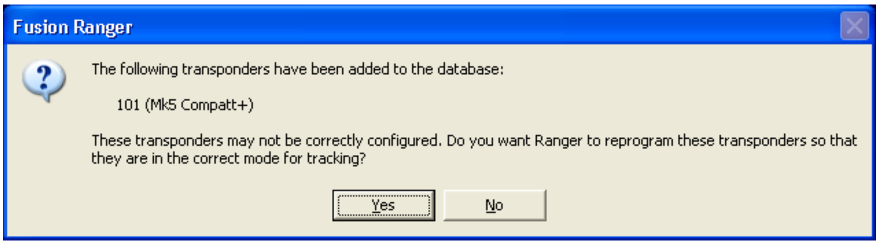
10. Repeat steps 1 to 9 for each of the transponders you want to add to the system.

    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 Scout USBL System.

    Scout 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 25 Transponder database message



12. Click **Yes** to allow Scout 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.

Scout 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 24.

Scout 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 Scout 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 46 to configure the environmental configuration.

Transponder configuration

Scout 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 26 Transponder details dialog

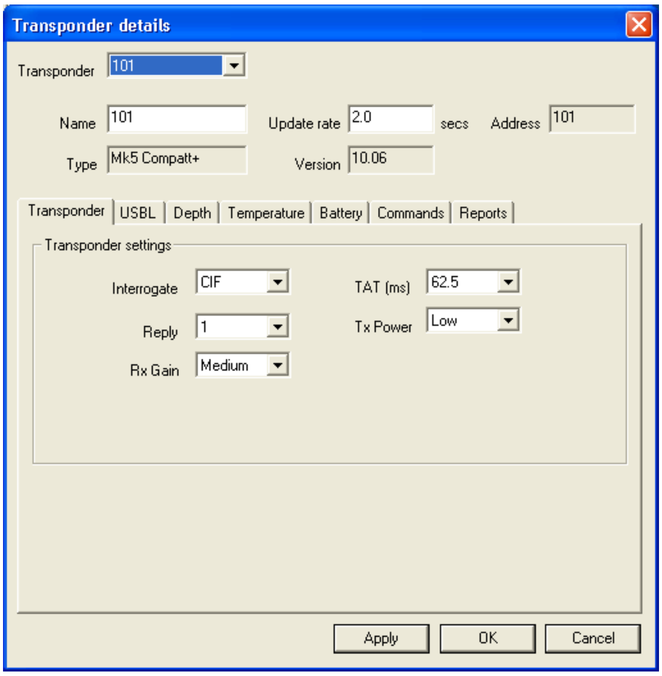


Table 10 lists and describes the purpose of controls in the top region of the **Transponder details** dialog.

Table 10 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 27 Transponder page

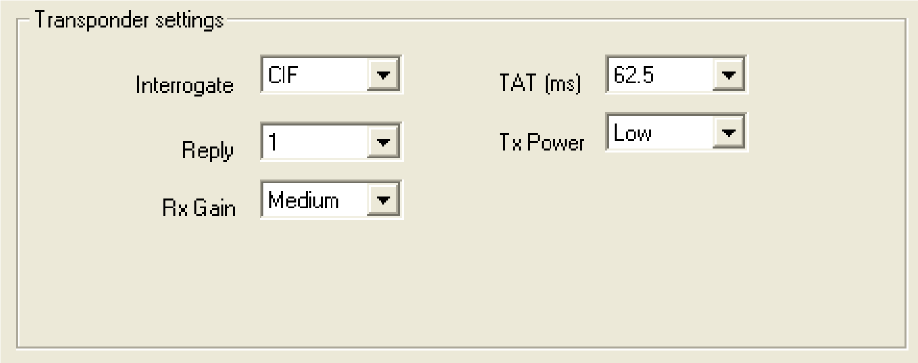


Table 11 Transponder page details

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 28 USBL page

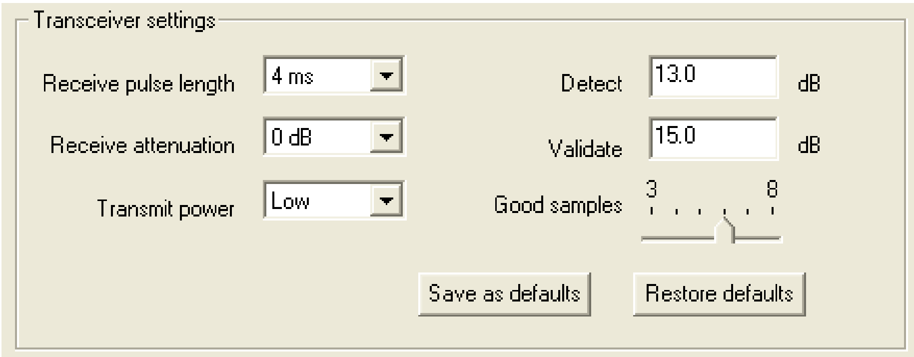


Table 12 USBL page details

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 104 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 83 for an explanation of depth aiding.

Fig 29 Depth page

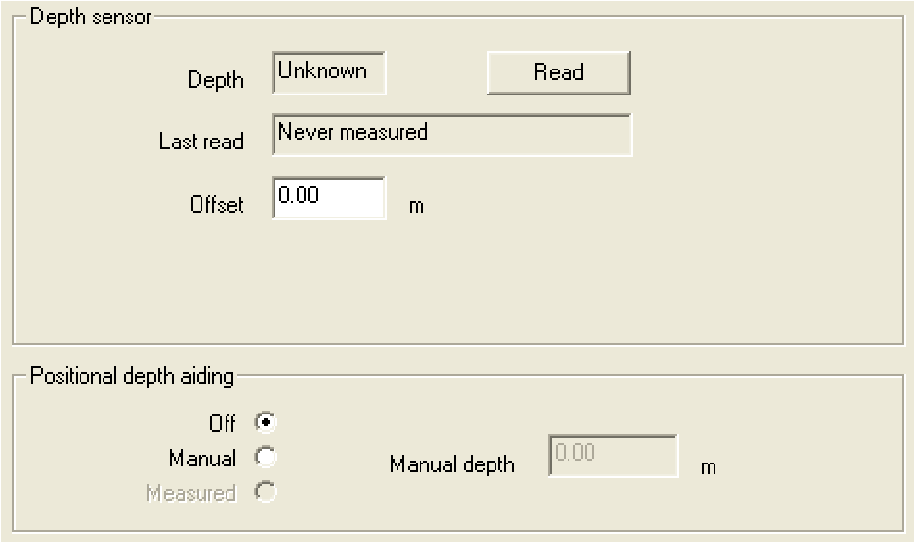


Table 13 Depth page details

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 30 Temperature page

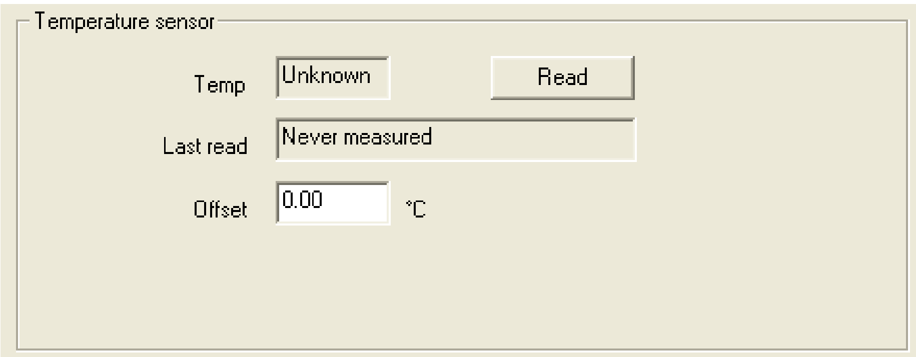


Table 14 Temperature page details

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 31 Battery page

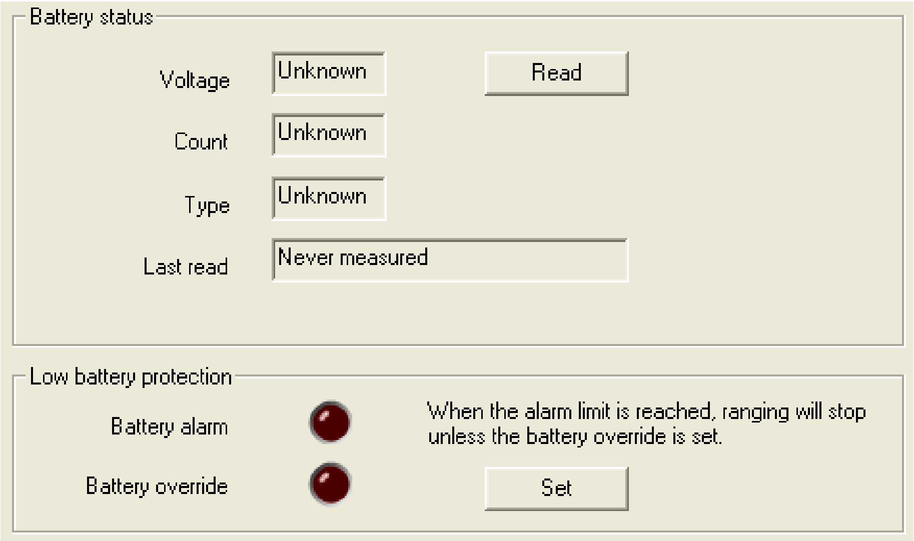


Table 15 Battery page details

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 32 Commands page

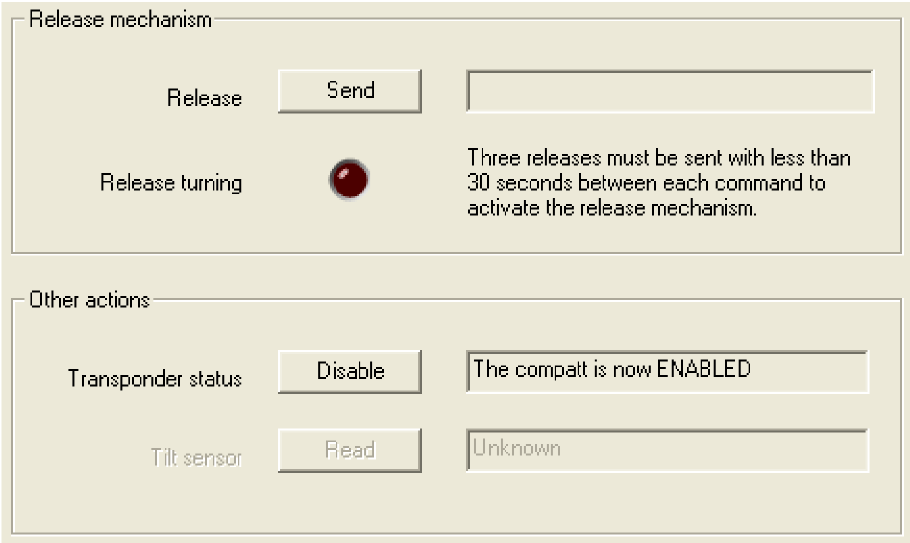


Table 16 Commands page details

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 33 Reports page

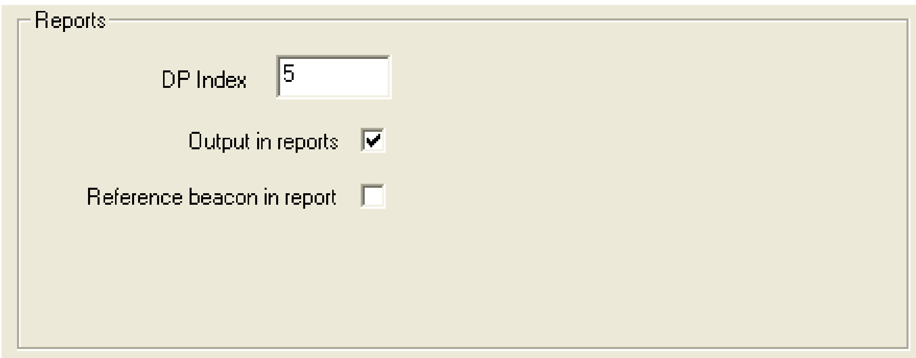


Table 17 Reports page details

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 Scout's output reports.
Output in reports	Allows you to set whether or not the selected transponder's output is included in Scouts 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 Scout's output reports.

Note

Refer to Appendix E "Report Formats" beginning on page 113 for a description of the output reports available from Scout.

6.6 Configuring for the Environment

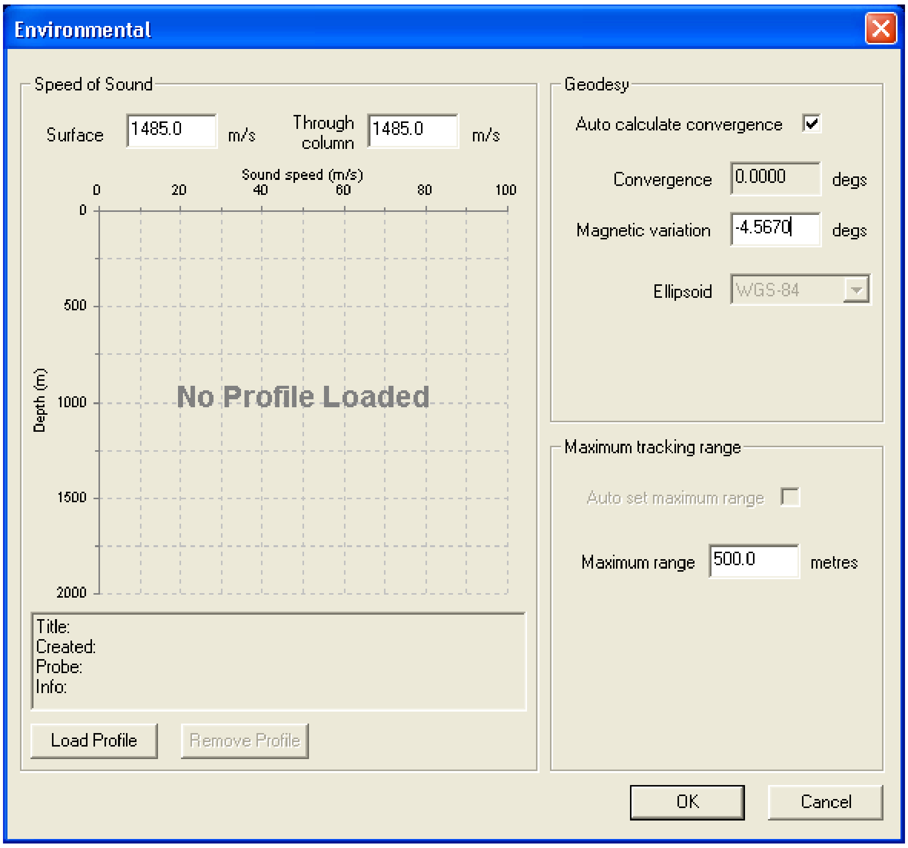
Depending on circumstances, you may have to change some of the default settings for the environmental configuration used by the Scout software. These settings include the speed of sound, the maximum range to be used, and some geodetic conditions. It is also possible to load sound velocity profiles into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

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.

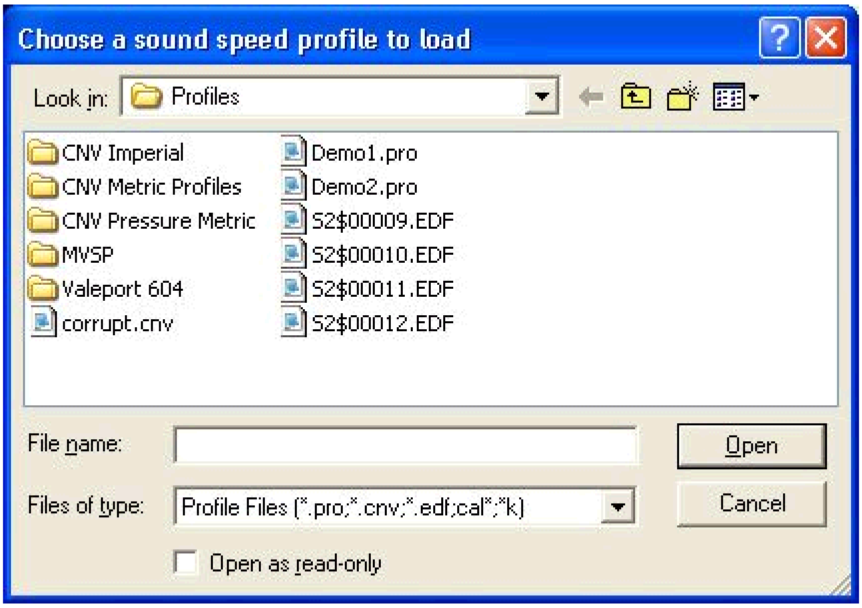
Fig 34 Environmental dialog



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.

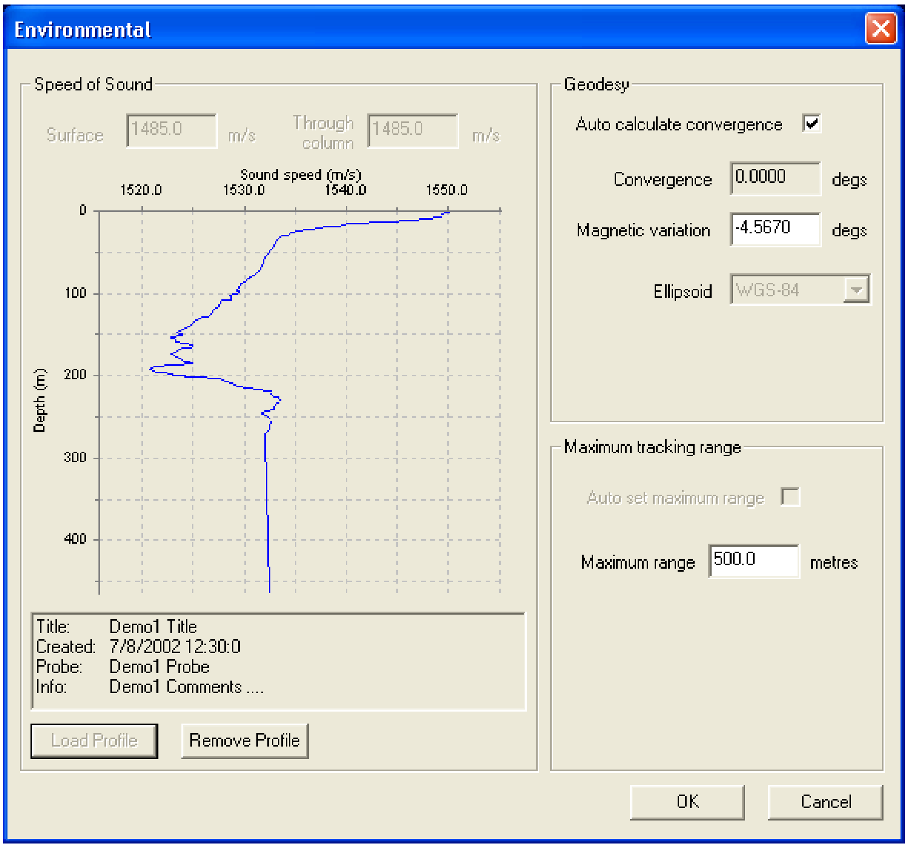
Fig 35 Open Profile dialog



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

Scout processes the file automatically and displays the profile on the dialog, as shown in Fig 36.

Fig 36 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 Scout 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 54 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.

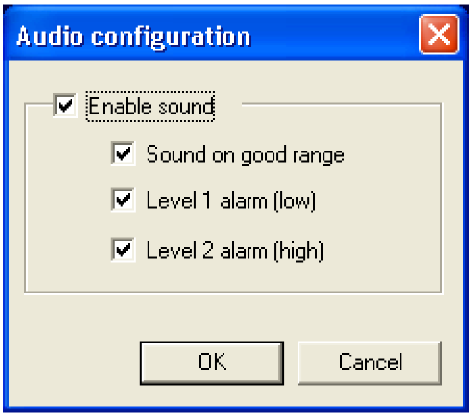
6.7 Configuring Sound Alerts

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 Scout'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 37 Audio configuration dialog



2. Ensure the **Enable sound** check box is selected if you want to use Scout'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, Scout 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.

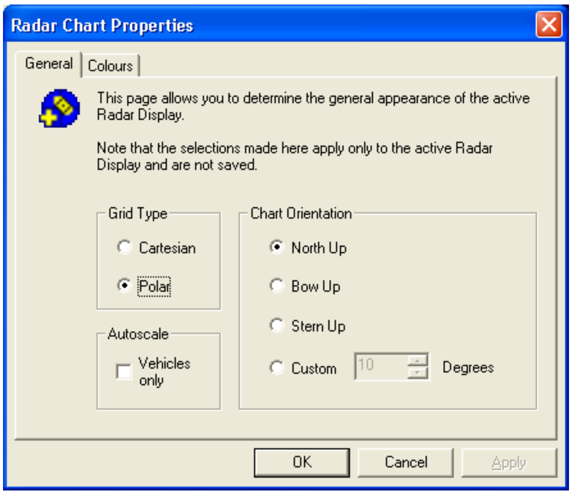
6.8 Configuring Chart Properties

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 38 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 25 for a description of these chart formats.

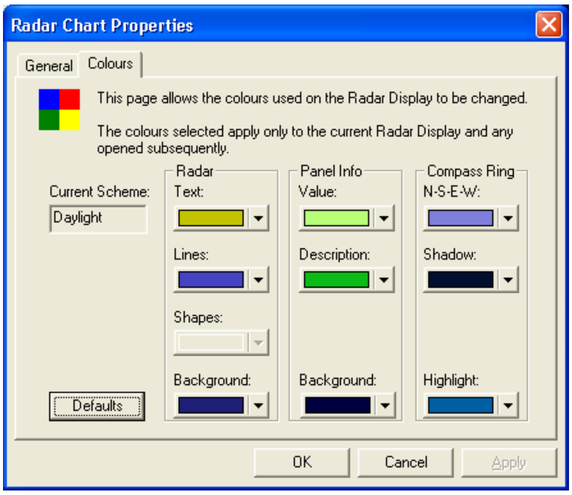
3. Select the **Autoscale**—**Vehicles only** check box if you want auto zoom to include only the vehicles being positioned. With this control deselected, auto zoom will include all waypoints —some of which may be at some distance from the vessel.

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 39 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.

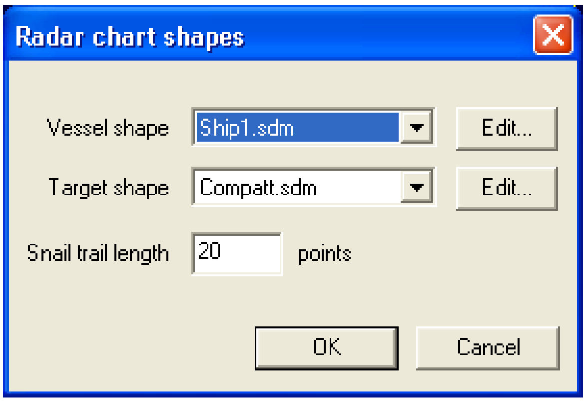
6.9 Configuring Chart Shapes

You can set the Scout 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 Scout.

To configure chart shapes:

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

Fig 40 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 Scout 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 41 Shape Editor dialog

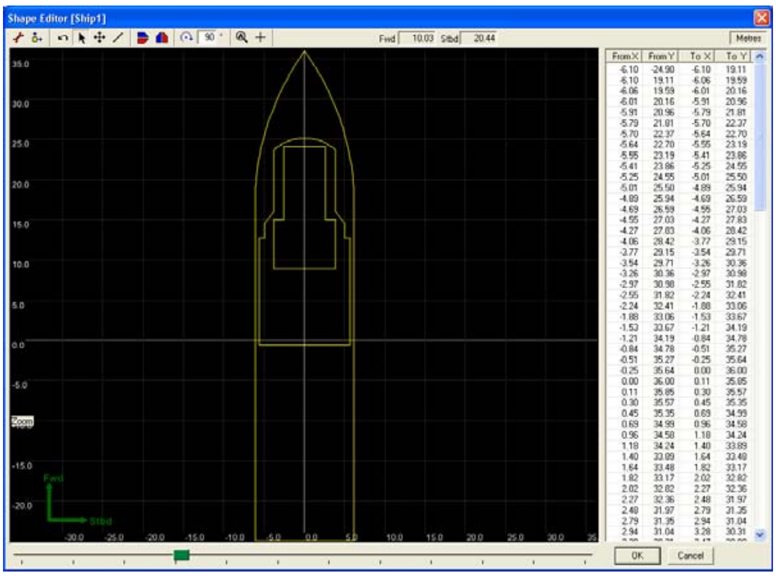
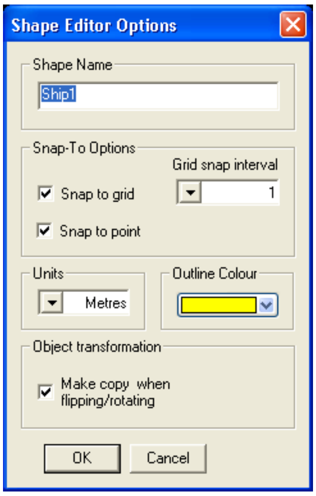


Table 18 Shape Editor toolbar buttons

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 Scout'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 42 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 Scout to be ready for use as described in section 6 "Software Configuration" beginning on page 28. 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 Scout 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 Scout 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 100 for a description of each of these software tools.

Acoustic signal analysis

Following deployment of the Scout 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 100 for a full description of this tool.

Manual commands

The manual commands tool, described in Appendix D.3 "Manual Command Window" beginning on page 106, 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 108 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 Scout 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 109 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 110 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 113 for a description of the formats accepted by the Scout software.

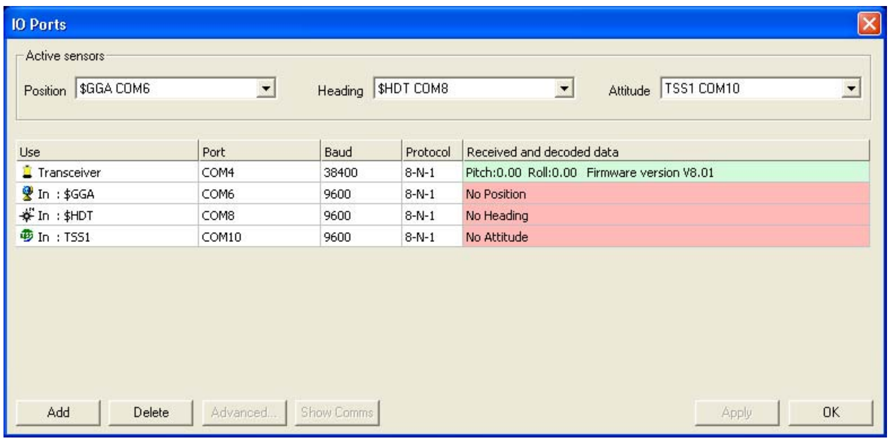
2. Select **Edit** > **IO Ports…** from the menu bar, or click the **Edit the IO Ports** button on the toolbar to display the **IO Ports** dialog.

   The example shown in Fig 43 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.

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

Fig 43 IO Ports dialog

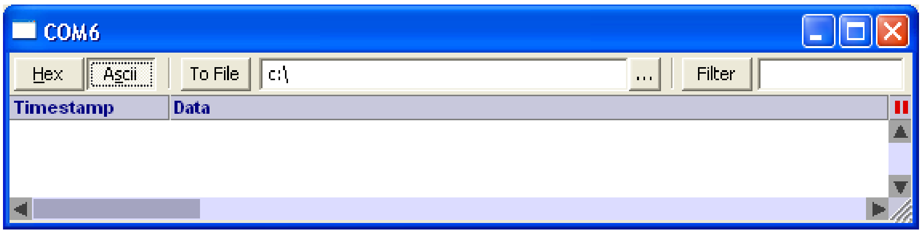


3. Set the configuration for the external Instruments and sensors in the Scout software as required for each communication channel. Refer to sub-section 6.4 “Adding Instruments and Sensors” beginning on page 29 for instructions to do this.

   The Scout 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 44 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 Scout USBL System and all external Instruments and sensors are reliable, continue the survey operation by performing a calibration.

7.4 System Calibration

The Scout 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 60 for detailed instructions to calibrate the system.

7.5 Waypoints

You can add waypoints to Scout. To do this, select **Edit** > **Waypoints** from the menu bar to display the Waypoints dialog, shown in Fig 45.

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 111. The example Chart display in Fig 46 shows two waypoints on the chart.

Fig 45 Waypoints dialog

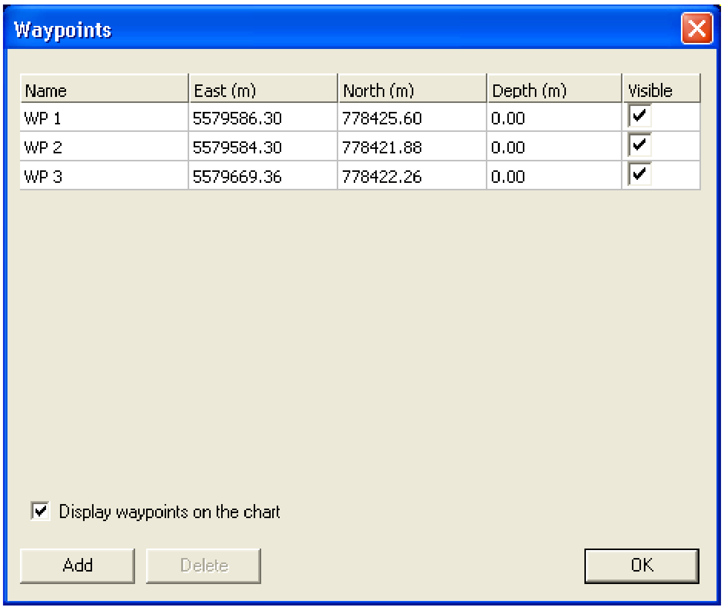


Fig 46 Waypoints on a chart

7.6 Tracking

Scout 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 Scout, 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, Scout re-acquires the target and continues tracking automatically when the signal returns.

7.7 Data Logging

For simplicity of operation, Scout 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.

Scout 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 Scout 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 Scout 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 Scout 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 Scout 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

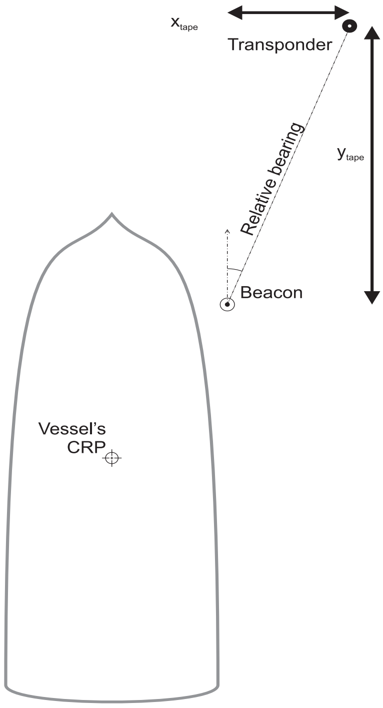


Fig 47Offset distances for static calibration

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:

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

where x_{tape} and y_{tape} are tape measurements, as shown on the diagram in Fig 47.

Note

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

Calculate transceiver bearing

Set Scout'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 13 on page 31.

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 Scout'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 61, and enter this value on the advanced transceiver properties dialog, as described in "Advanced settings" beginning on page 30.

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 Scout 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 Scout 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 Scout 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.

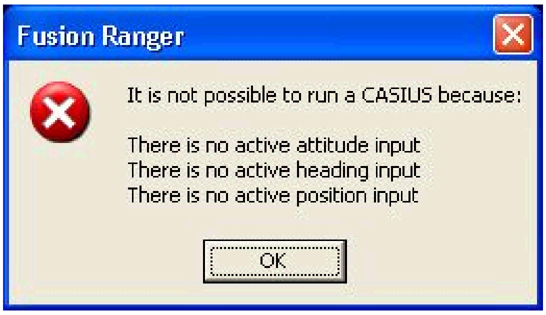
- Pitch, roll and alignment corrections to correct for the misalignment of the VRU and gyrocompass with respect to the USBL transceiver.

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 Scout USBL System is receiving and decoding valid information from the external sensors needed. Scout 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 Scout 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 31 for instructions to do this.

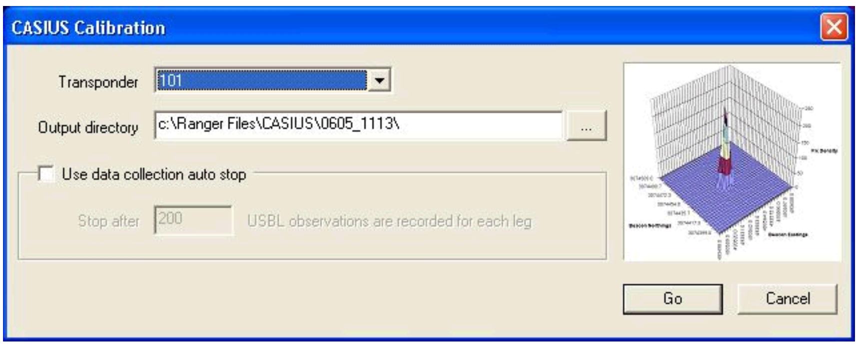
Performing CASIUS

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.

   Scout 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 48 CASIUS calibration dialog

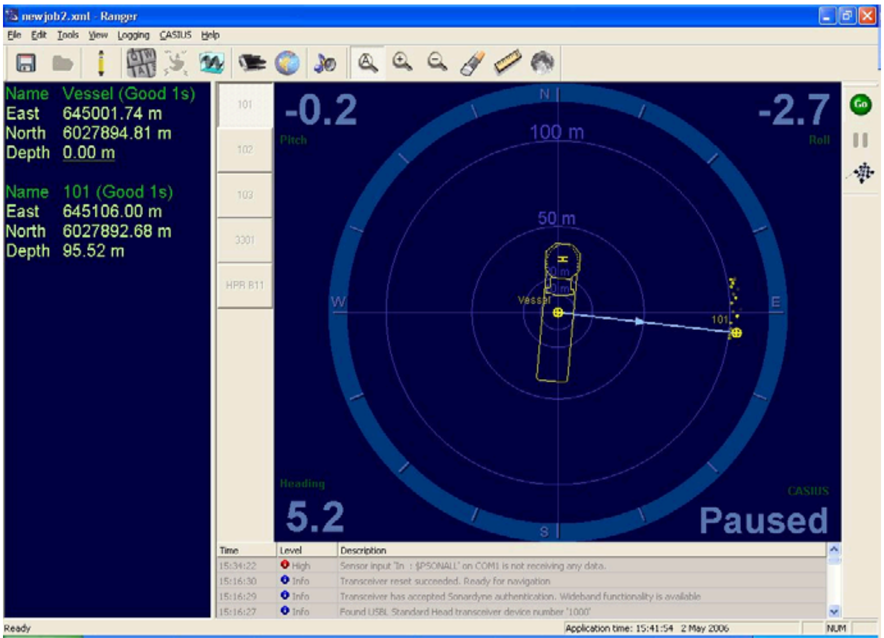


The **Use data collection auto stop** option on this dialog automatically pauses data collection after it has recorded a defined number of good USBL positions. You can use this option instead of timing data collection at each cardinal point.

3. Select the transponder to be used in the CASIUS calibration, and click **Go** to close the dialog and set Scout 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, Scout's main screen includes an additional tool-bar, to the right of the Chart display.

Fig 49 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 67 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 50 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.

   Scout 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.

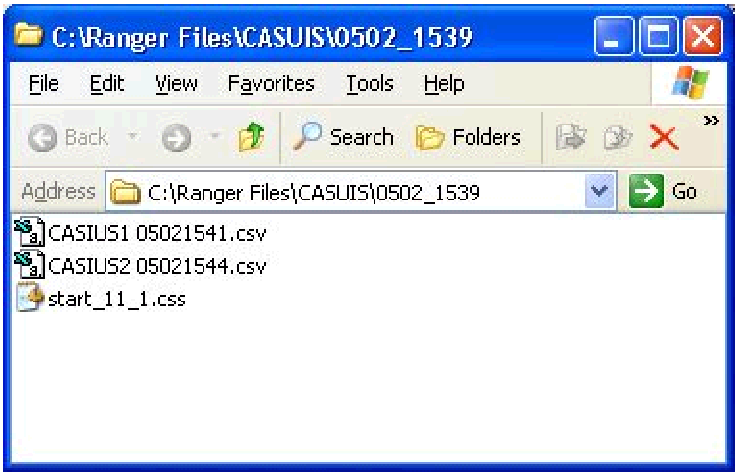
8. When you finished recording all data for the CASIUS calibration, select **CASIUS > End CASIUS Calibration…** from the menu bar or click the **End calibration** button on the new toolbar.

   Scout 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 Scout 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 51 Directory for CASIUS data



Scout'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 Scout 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.

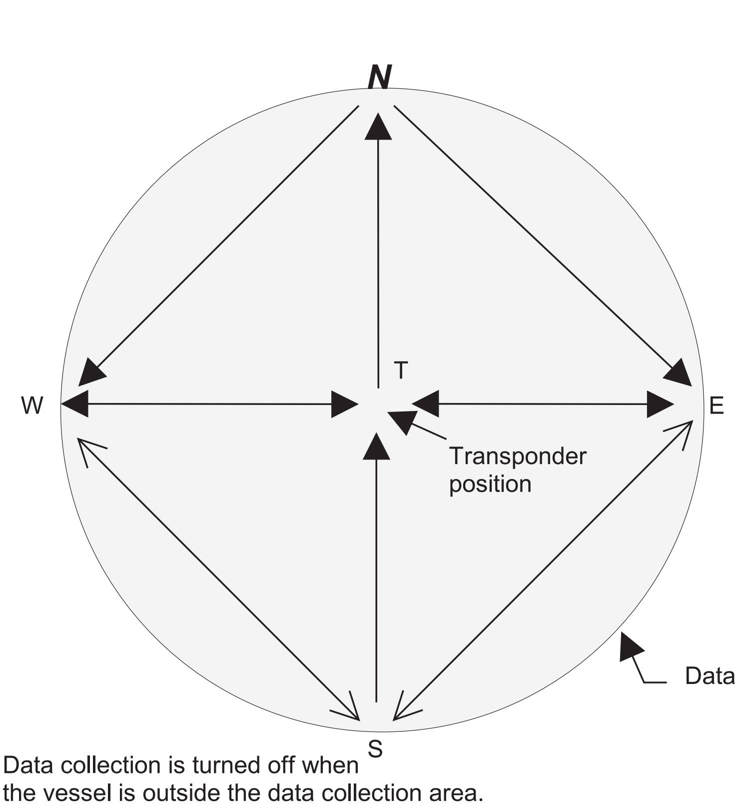
  It is preferable to be stationary if possible because this minimises any DGPS lag problems. However, if the vessel has no DP capability then this will not be a realistic option and, in these cases, you should collect data during a series of straight run lines over and to either side of the beacon.

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 52 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 52 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 68.

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 53 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.

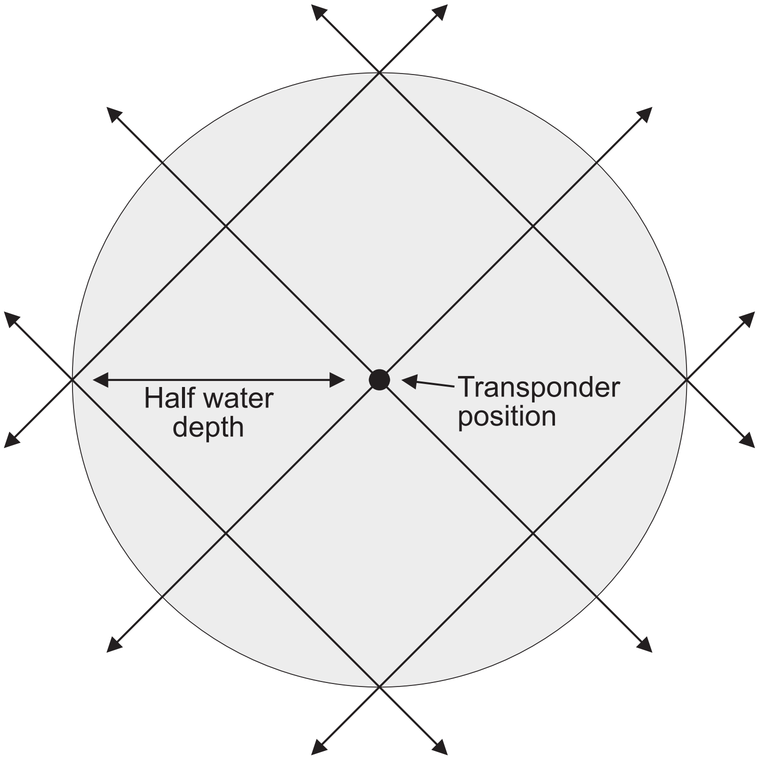
The radius of the circle centred on the beacon defines the data collection area. This would normally be equal to half of the water depth, or a maximum of 500 metres.

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 53.

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 53 CASIUS pattern for moving vessel

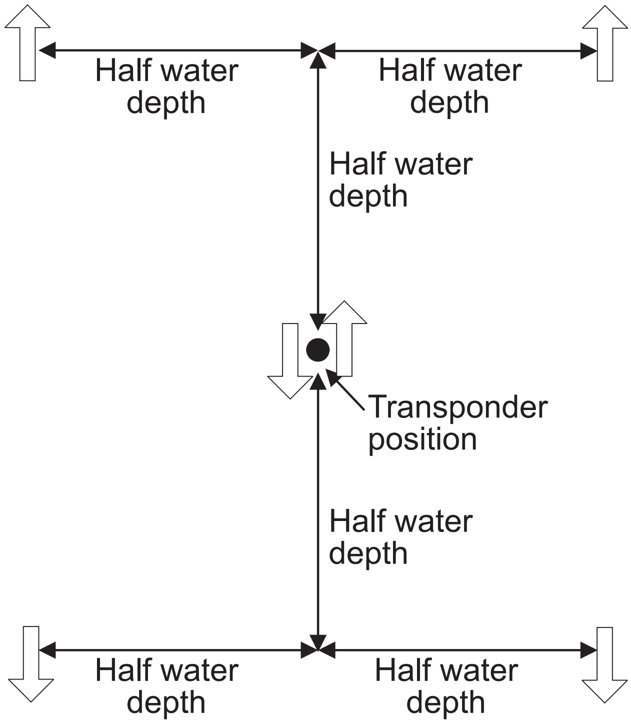


Stationary data collection with a tilted transceiver

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

Fig 54 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 Scout and gives answers to those questions. The subjects are divided into convenient headings for each of the issues covered:

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 113.

9.2 Configuration Issues

1. I am setting up Scout 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 Scout USBL System.

Before you call on technical support from Sonardyne International Limited, you should make some preliminary checks on the Scout 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 Scout 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?

Scout 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 Scout 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 Scout software crash should result in a dialog stating that Scout 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.

10.5 Getting 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.

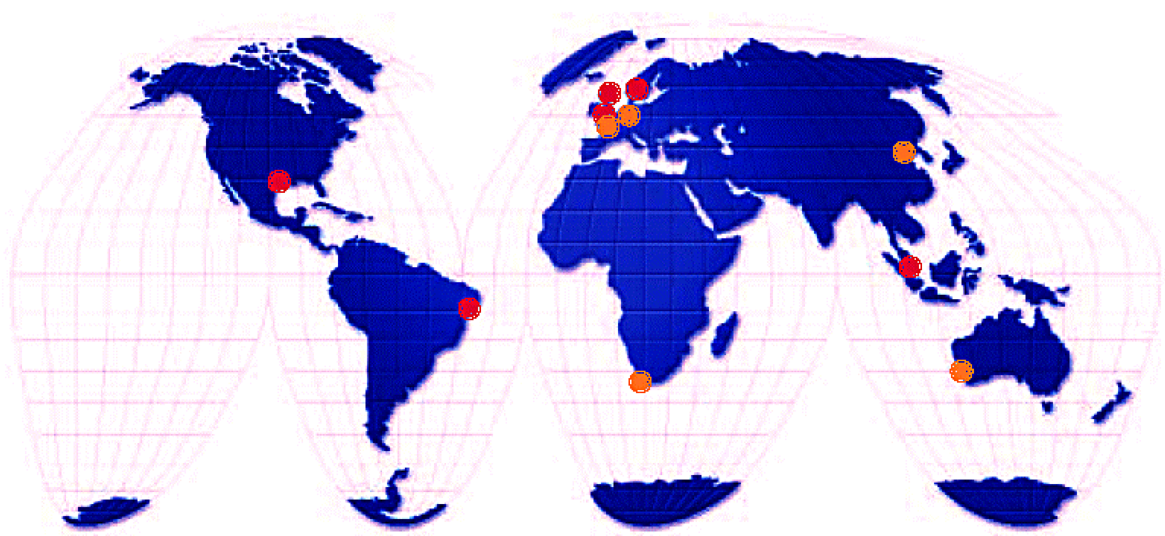
Table 19 Support email address

Product Family	Support e-mail Address
Scout 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 55 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

Scout 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

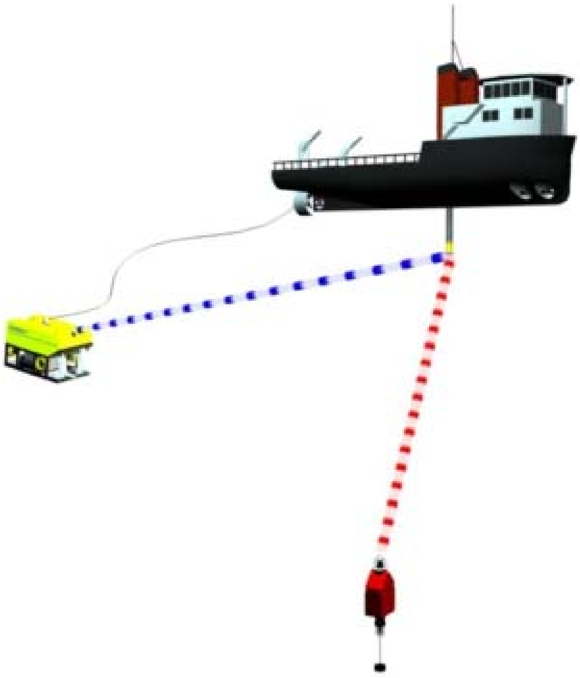
Scout can also measure the differences in arrival time of the transponder’s response signal at each of the multiple receive transducers in the transceiver, and these slight differences make it possible to determine the relative direction of the transponder from the transceiver.

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 56 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 56 USBL positioning method



Effects of tilt and rotation

Because Scout 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 Scout 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 Scout 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 Scout 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 60 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.

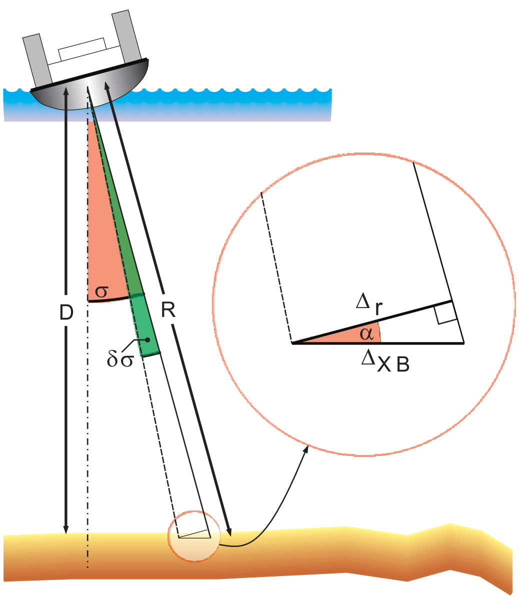


Fig 57Roll error example

Fig 57 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 57) is a function of the depth of the beacon on the seabed, **D**, and the angular error in roll, δσ.

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).

$$R = \frac{D}{\cos\sigma} \tag{1}$$

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

where $\delta\sigma$ is in radians.

Since angle α = angle σ:

$$\Delta_r = \frac{D\delta\sigma}{\cos\sigma} \tag{3}$$

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

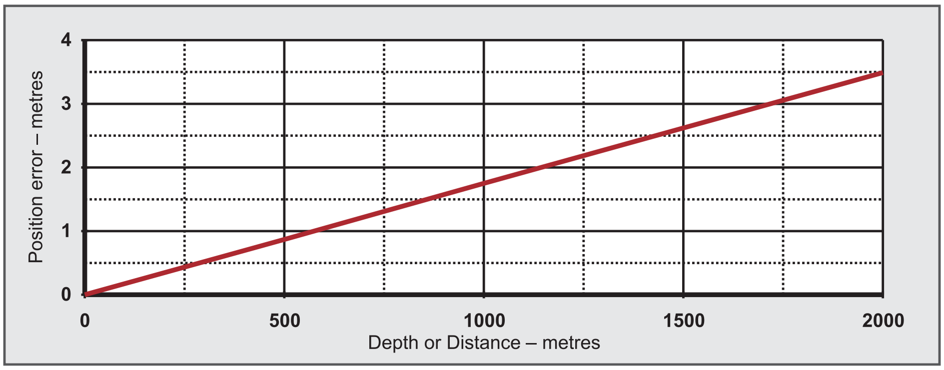
$$= \frac{D\delta\sigma}{\cos^2\sigma} \tag{4}$$

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).

$$\Delta_{XB} = D\delta\theta \tag{5}$$

To simplify the task of estimating position errors attributable to errors in VRU attitude measurements, Fig 58 shows the error in positioning that results from a 0.1° error in measuring the vessel's attitude.

Fig 58 Position error arising from 0.1° attitude measurement error

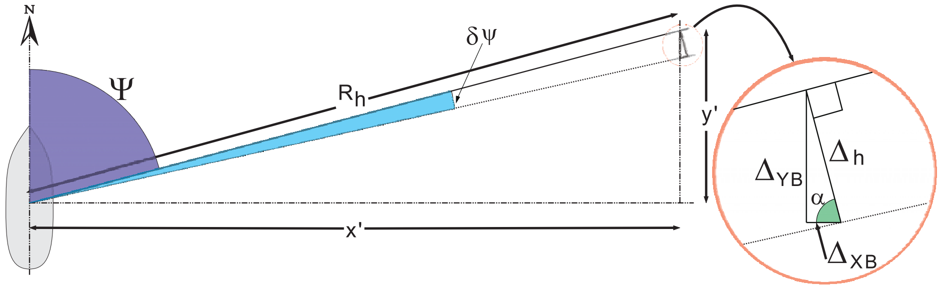


A.4 Gyrocompass Errors

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 59 below, Ψ is the vessel's heading angle, $\delta\psi$ 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 59 Heading error impact



From Fig 59:

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

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

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

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 58 on page 80 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 Scout 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 60 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 60 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 Scout 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 Scout 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 Scout 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 Scout software. See sub-section 6.6 "Configuring for the Environment" beginning on page 46 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. Scout 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

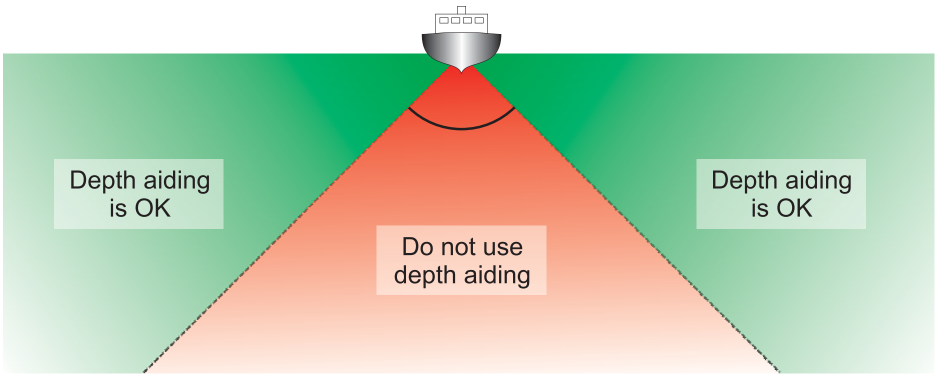
In common with other USBL tracking systems, the Scout USBL System calculates beacon depth most reliably when the beacon is directly below the transceiver.

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 61 below indicates the regions where depth aiding is appropriate for use.

Fig 61 Depth aiding regions



A.7 Positioning Scenarios

Tracking relative to the vessel

You can use the Scout 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 Scout 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 Scout. The Scout 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 Scout with non-differential GPS, because the error in the positions is too large for useful tracking operations.

Tracking towfish

You can use the Scout 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 Scout 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 Scout 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

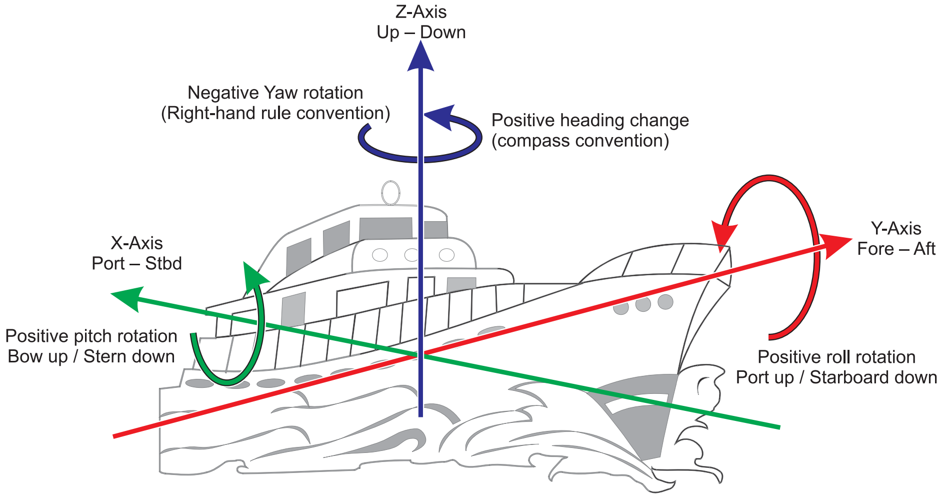
Rotations

As shown in Fig 62, the Scout 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 Scout 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 62 Rotation conventions in the Vessel’s Reference Frame



Grid conventions

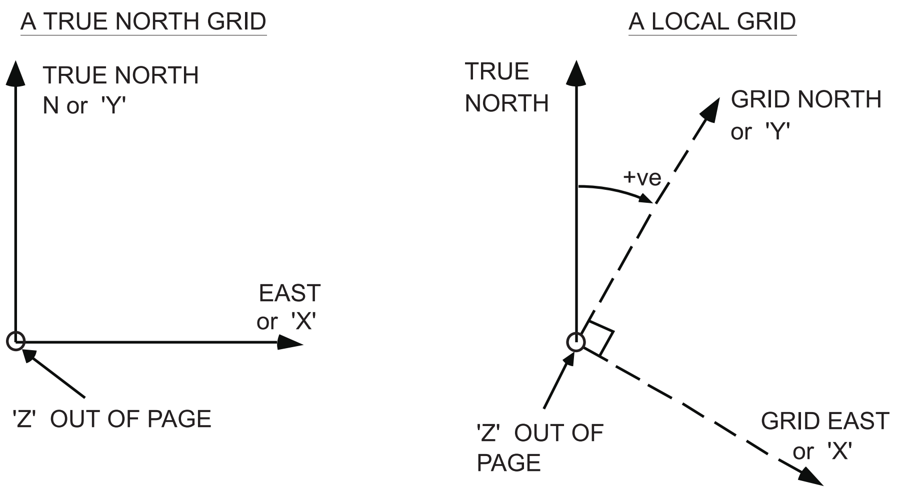
In conventional grid situations, shown in Fig 63:

- 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 63 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.

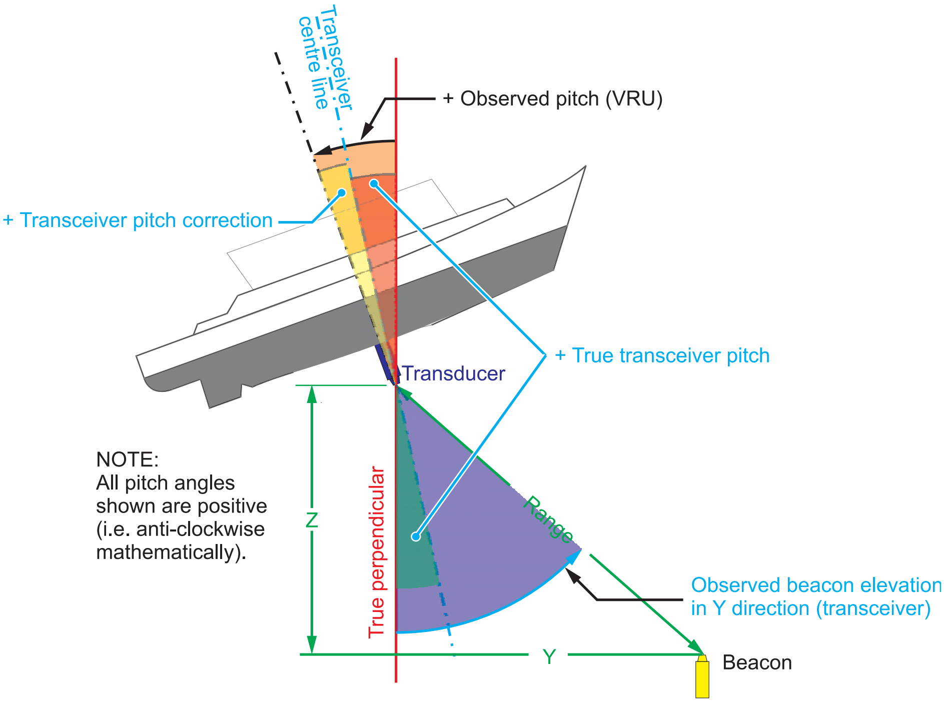
B.2 Sign Conventions for Sonardyne Corrections

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 64 Pitch axis correction



The Transceiver Pitch Correction is used as follows:

True Transceiver Pitch = Observed Pitch – Transceiver Pitch Correction

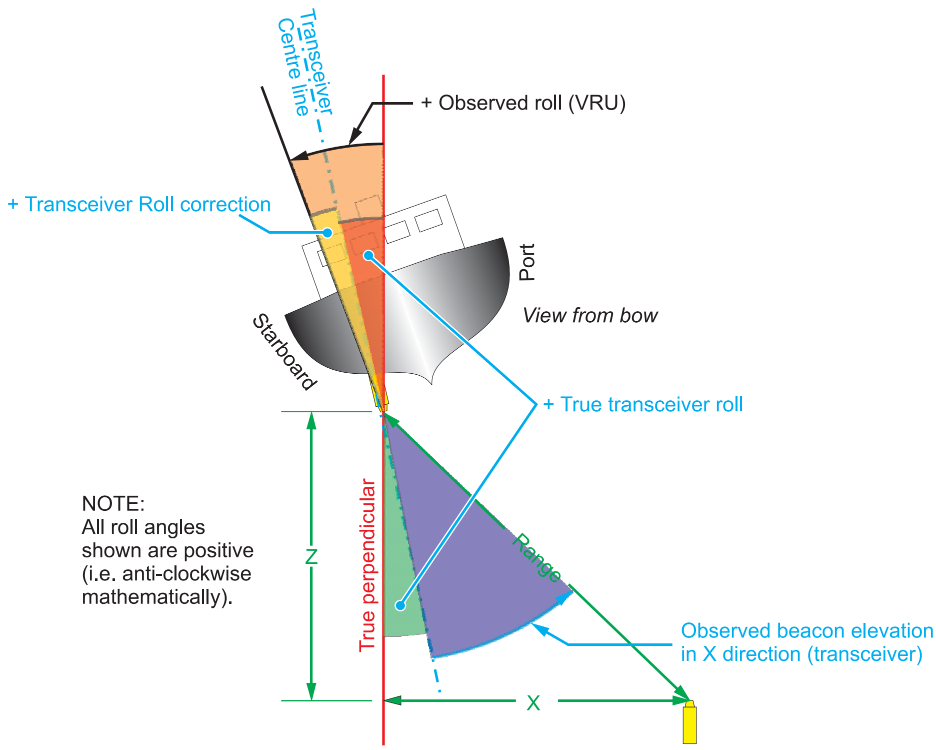
True Beacon Elevation = Observed Beacon Elevation + True Transceiver Pitch

$$Z = \text{Range} \times \cos(\text{True Beacon Elevation})$$

$$Y = \text{Range} \times \sin(\text{True Beacon Elevation})$$

Roll axis corrections

Fig 65 Roll axis corrections



The Transceiver Roll Correction is used as follows:

True Transceiver Roll = Observed Roll – Transceiver Roll Correction

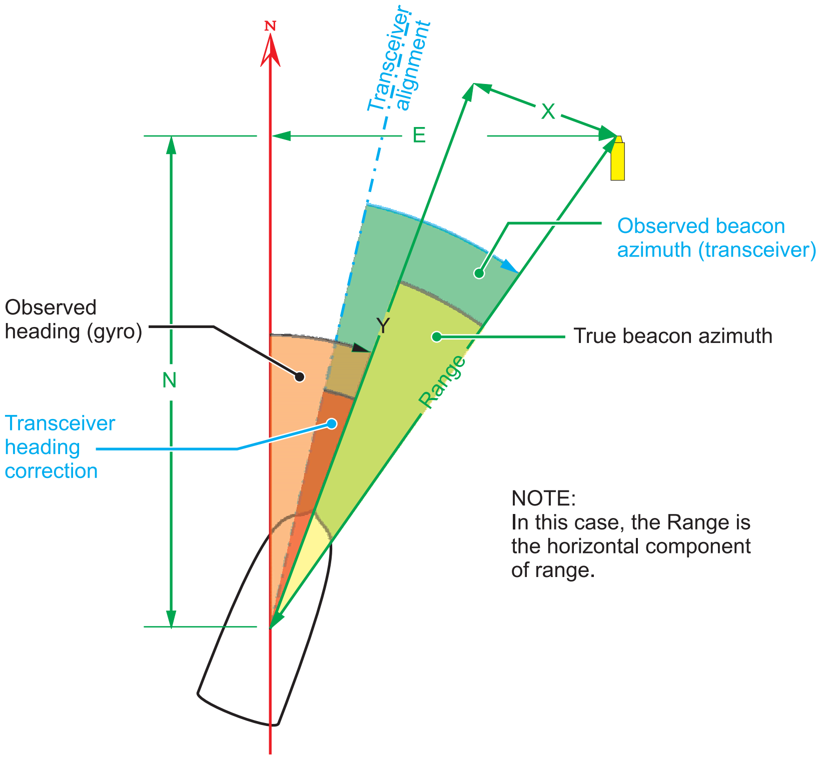
True Beacon Elevation = Observed Beacon Elevation + True Transceiver Roll

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

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

Azimuth corrections

Fig 66 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)

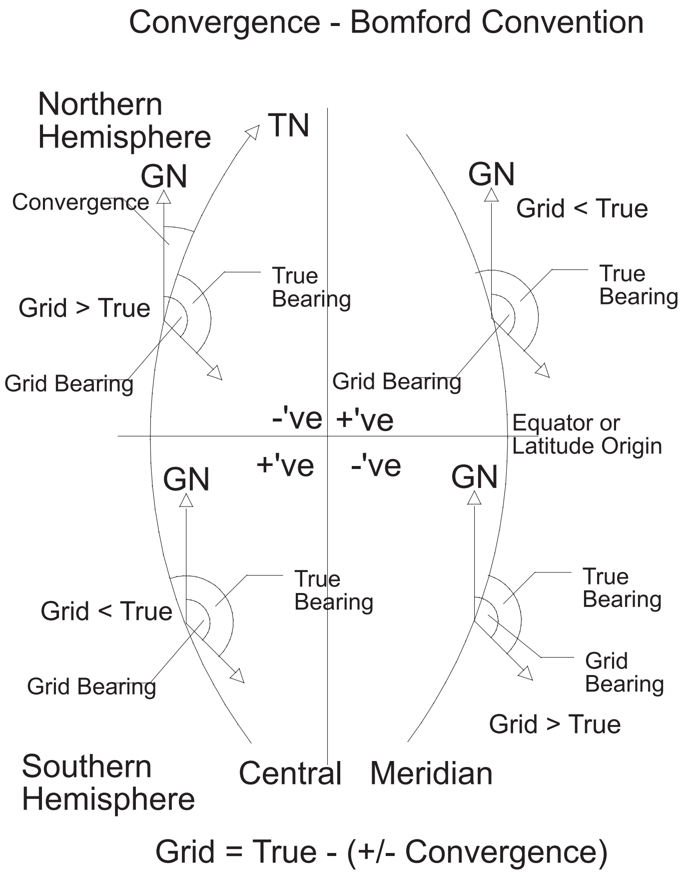
N = Range × *cos* (True Beacon Azimuth)

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

B.3 Convergence Convention

Sonardyne follow the Bomford convention illustrated below.

Fig 67 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. 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 20 List of cable diagrams

CPN	Type	Notes
820-6608	RS232 serial data cable to open flylead	
8020-6459	8-pin Lemo to open flylead	Transceiver interface cable

CPN	Type	Notes
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 68 Serial Data Cable to Flylead – CPN 820-6608

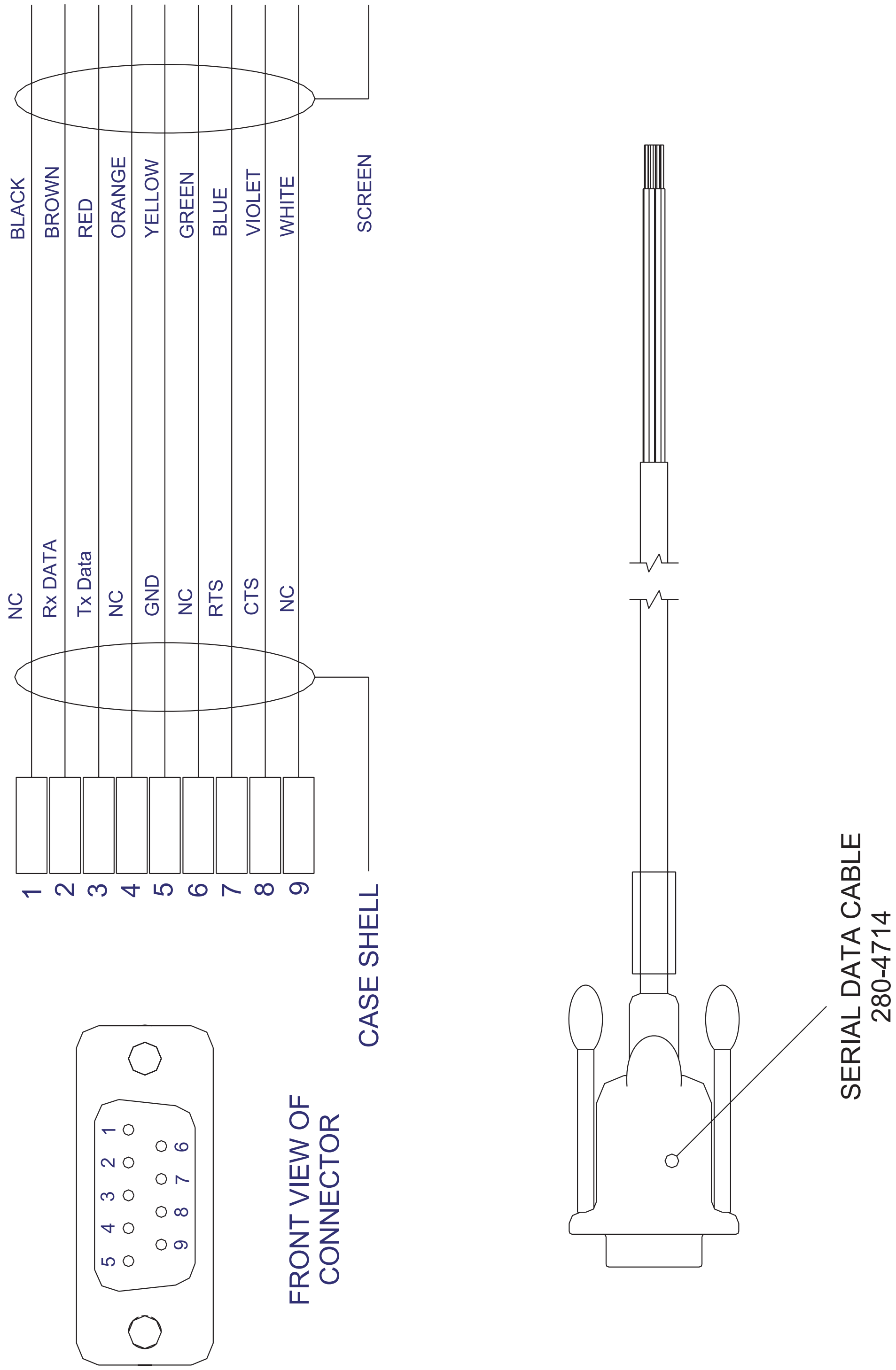


Fig 69 8-Pin Lemo to Flylead – CPN 8020-6459

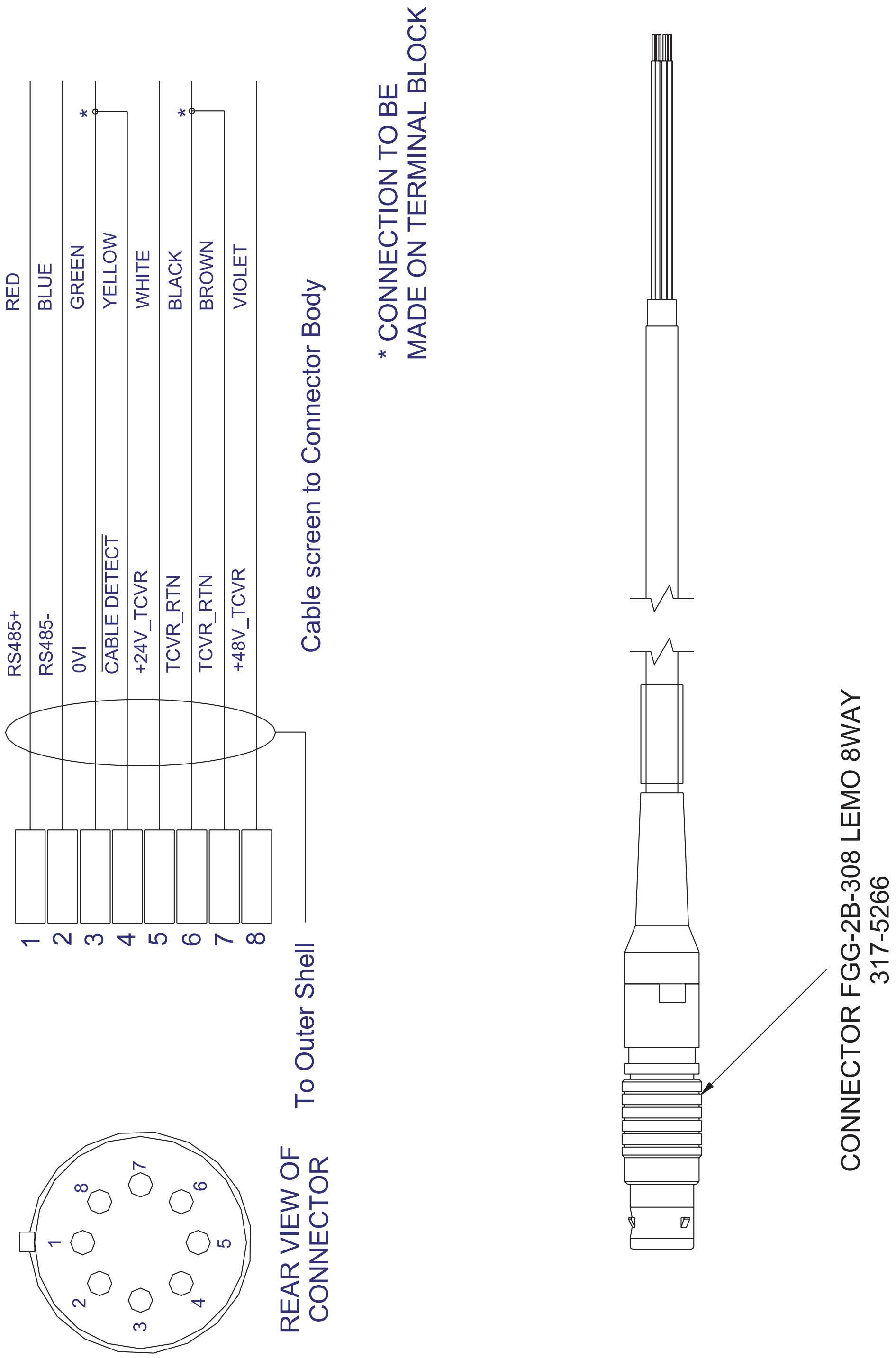
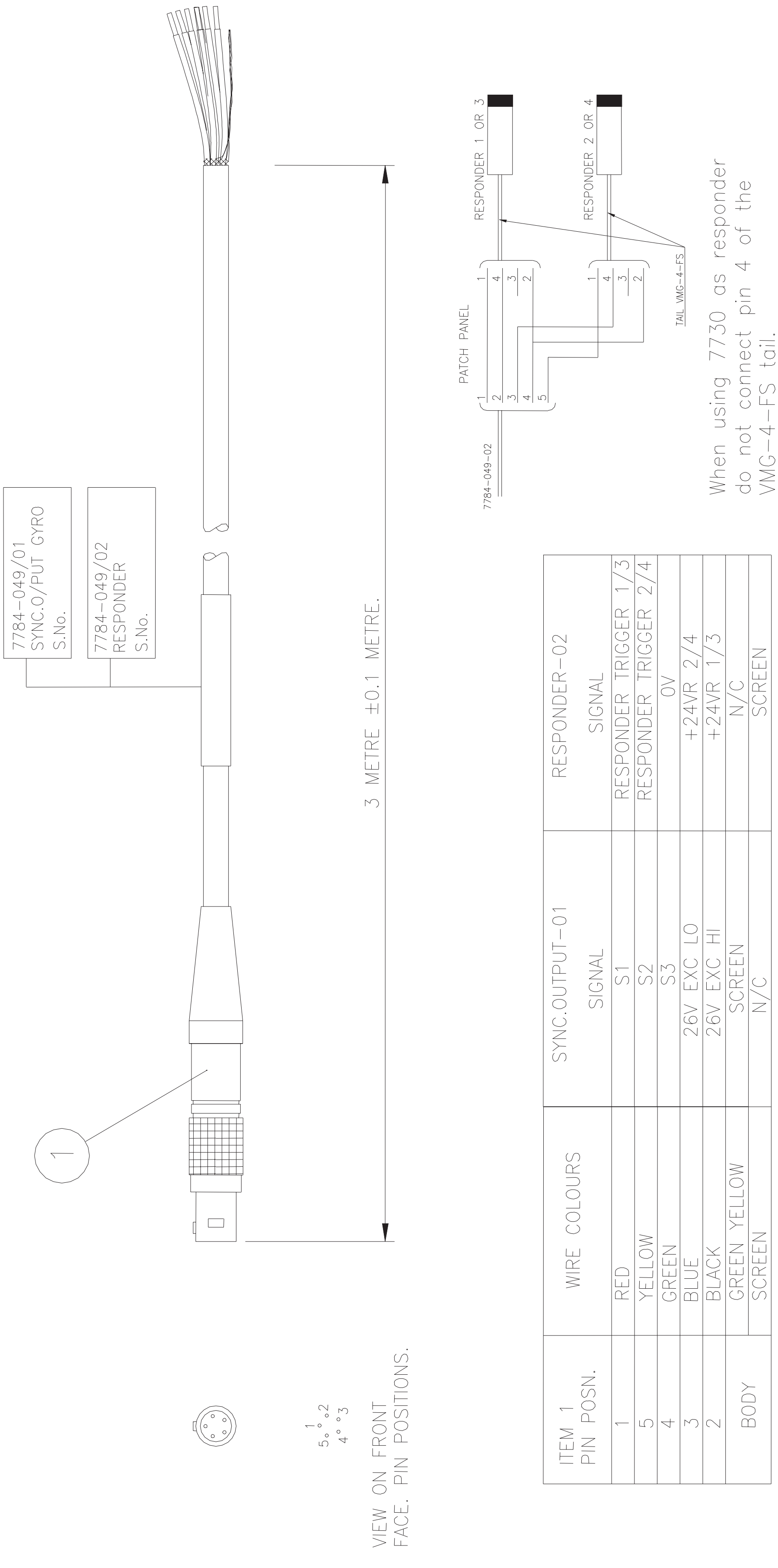


Fig 70 Responder Cable – CPN 7784-049/02



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
BODY	GREEN YELLOW	SCREEN	N/C
	SCREEN	N/C	SCREEN

Fig 71 8-Pin Lemo to 24V RovNav 4 – CPN 820-6463

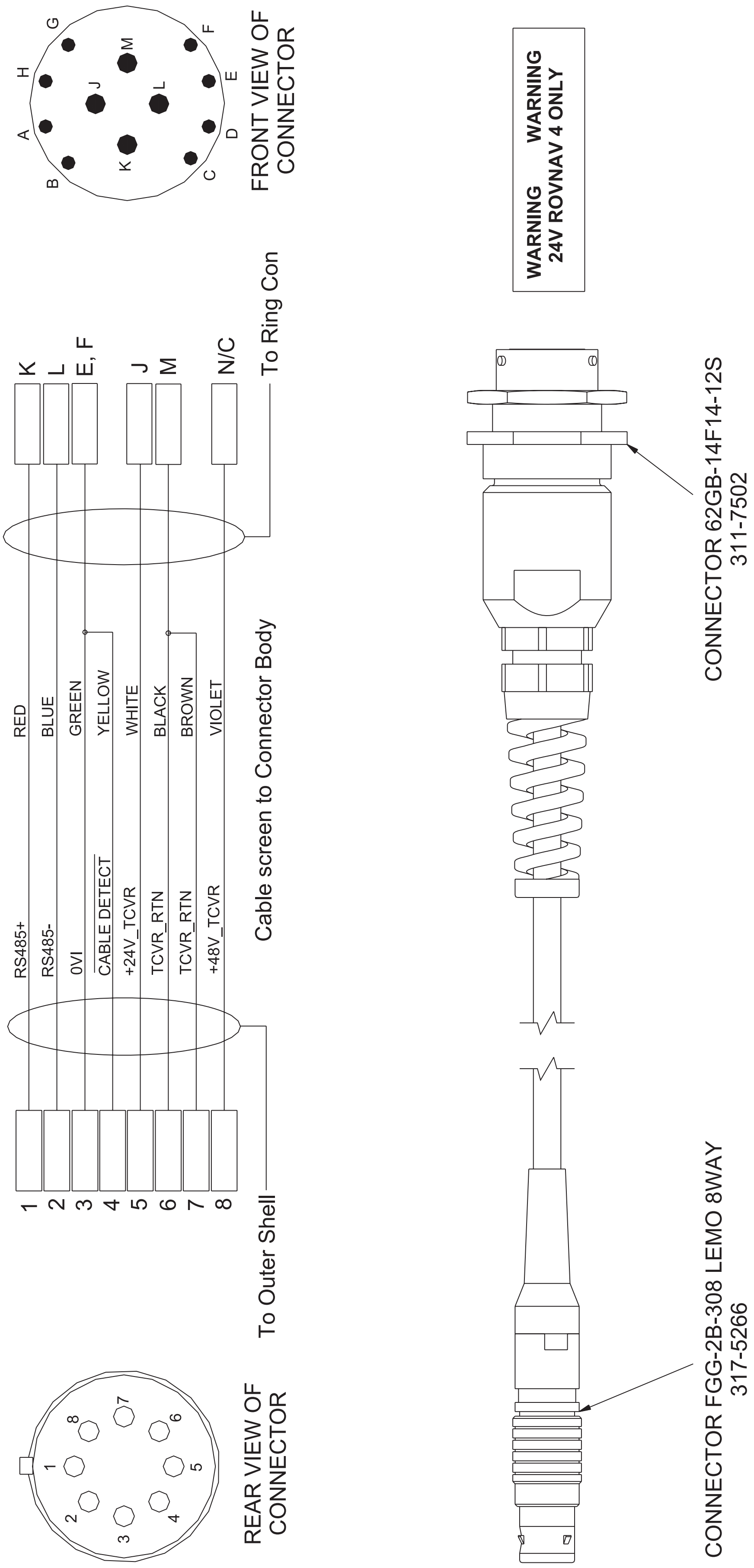


Fig 72 8-Pin Lemo to 24V RovNav 5 – CPN 820-6475

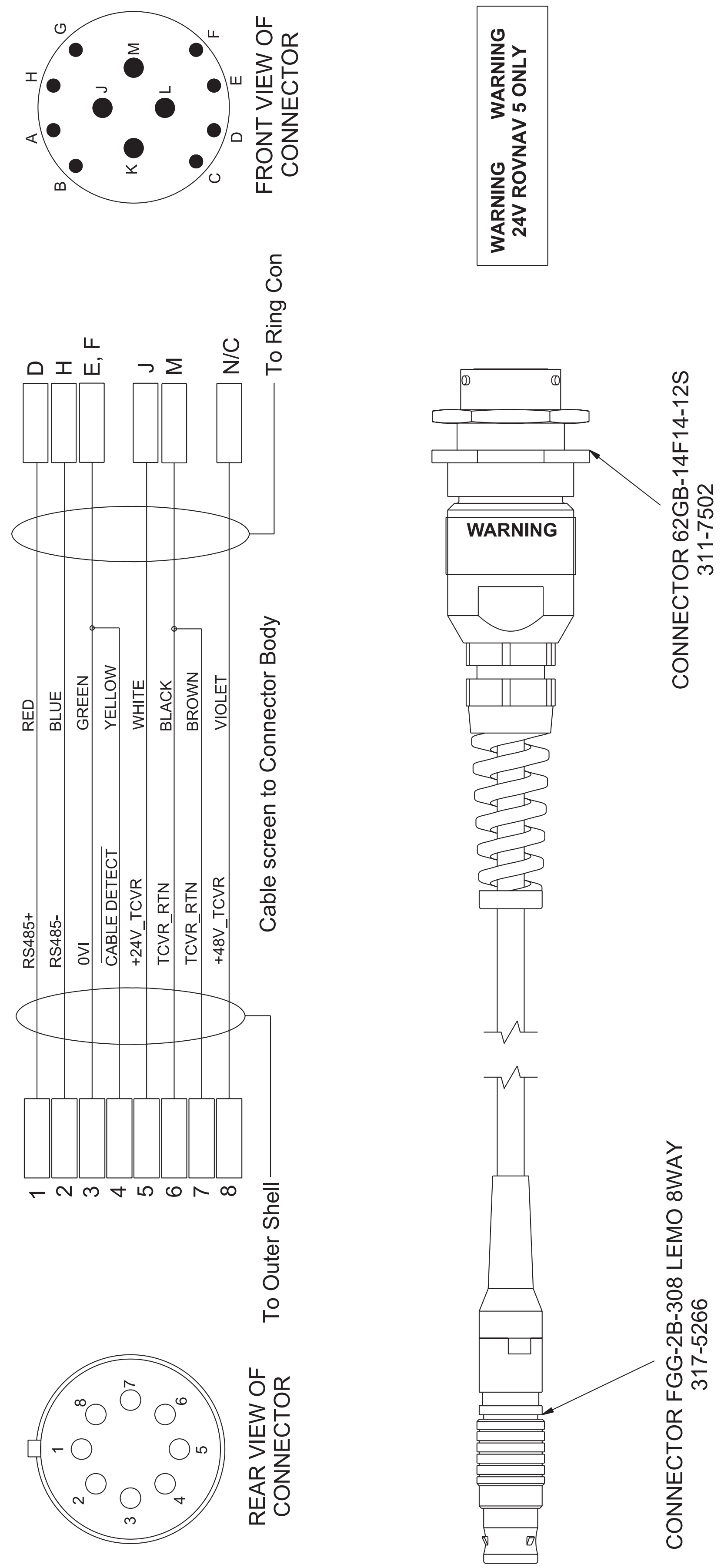


Fig 73 8-Pin Lemo to 48V USBL Transceiver – CPN 820-6484

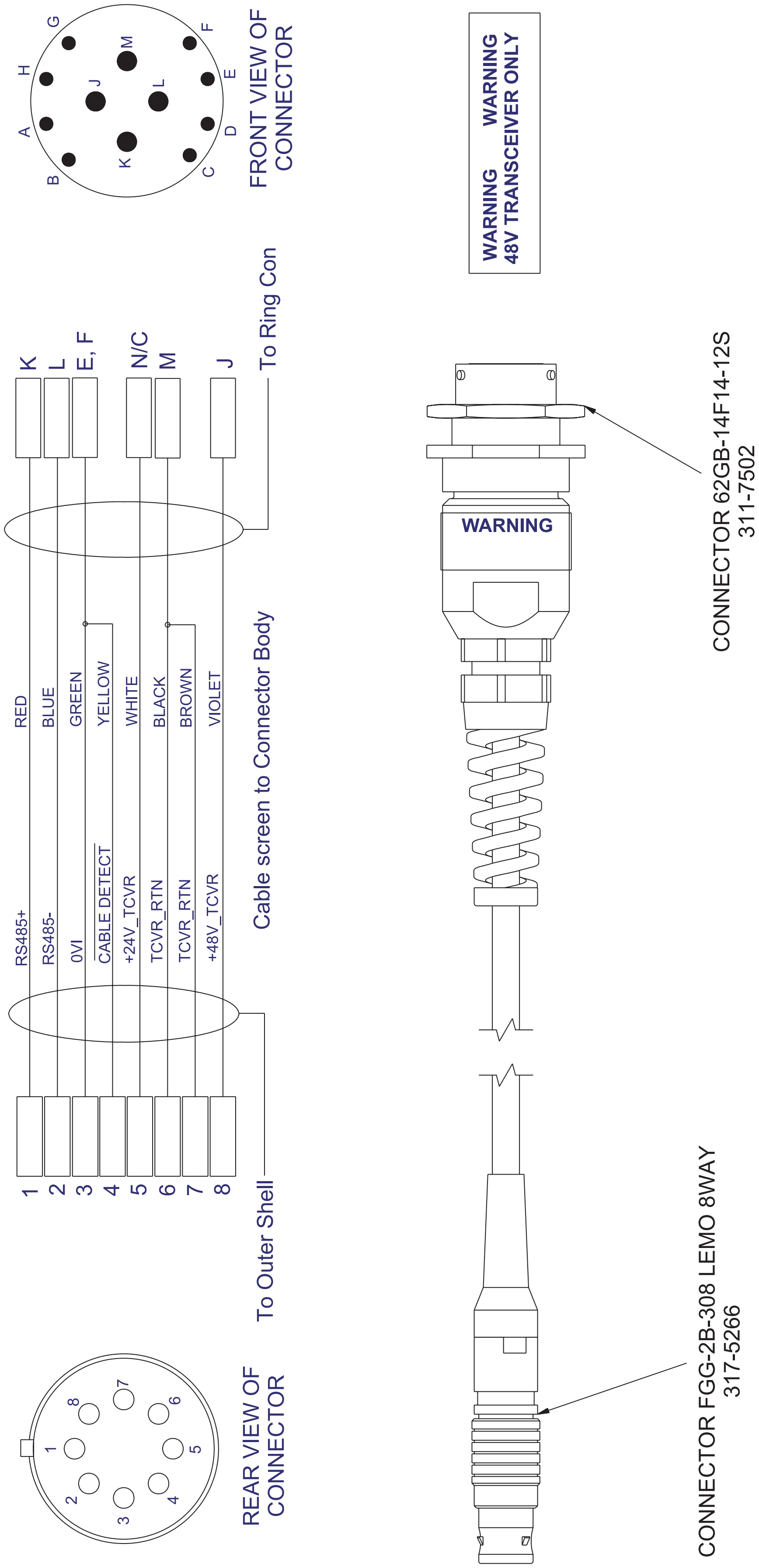


Fig 74 4-Pin Lemo to VRU Flylead – CPN 820-6615

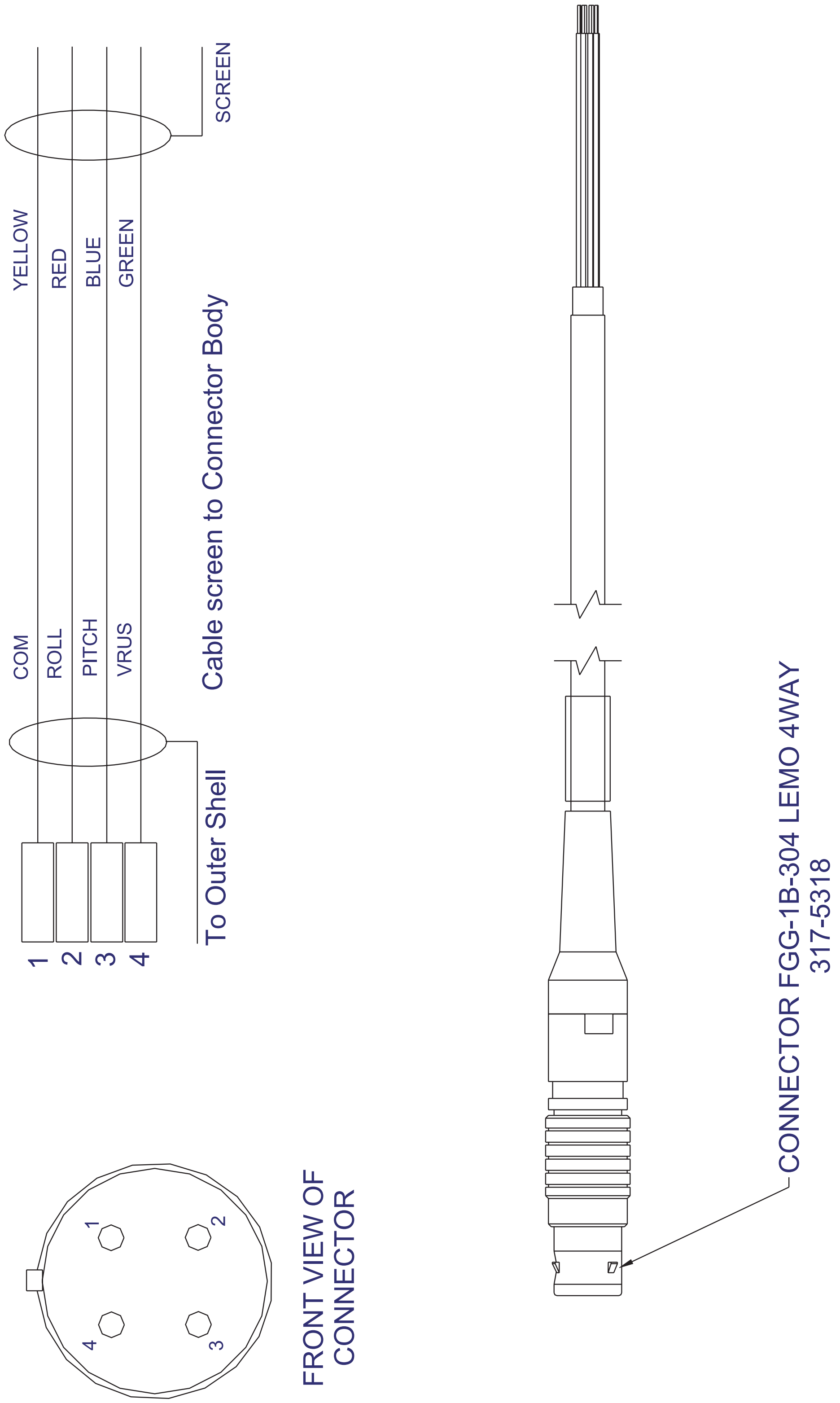


Fig 75   6-Pin Syncro to Flylead

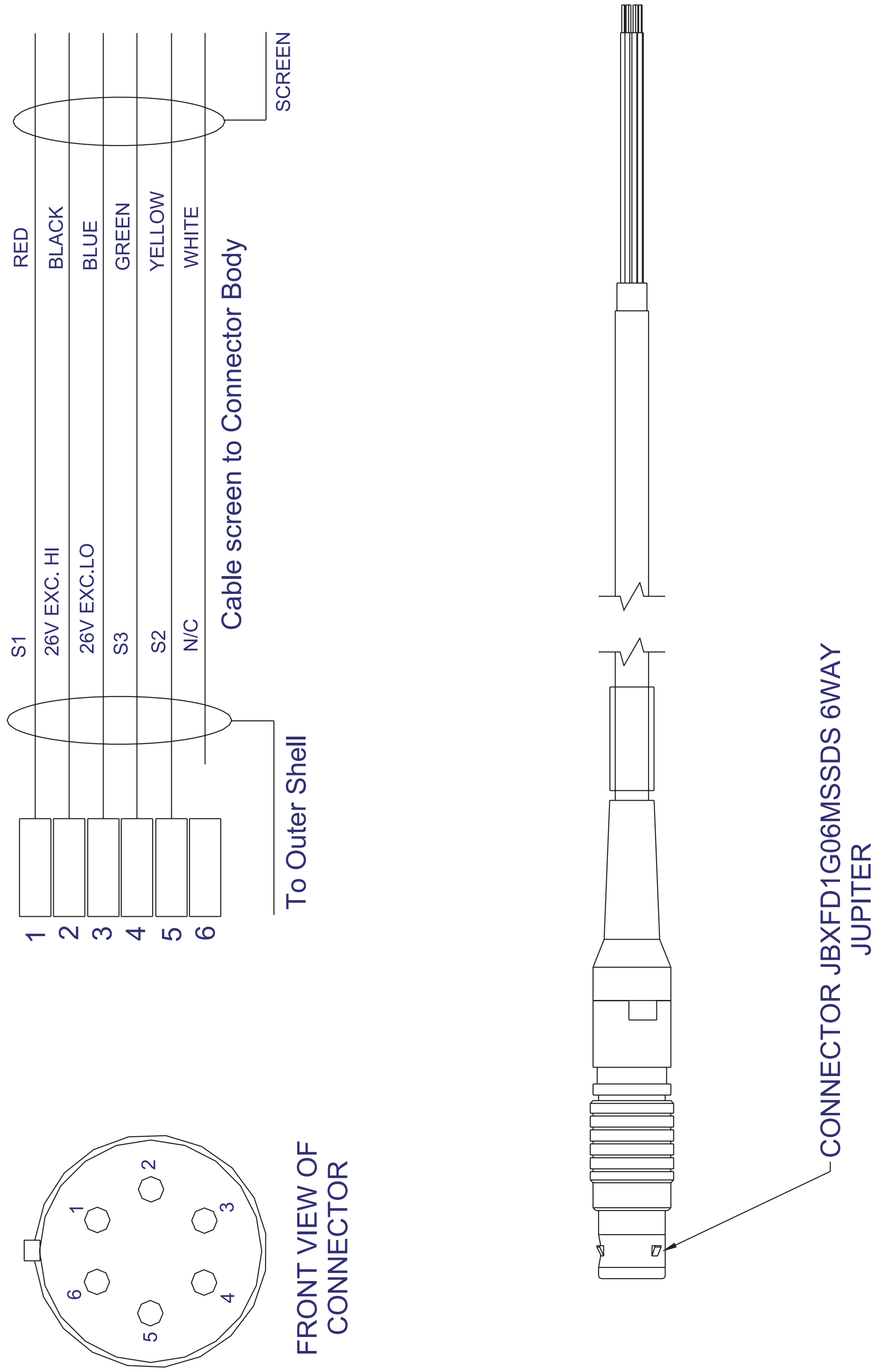
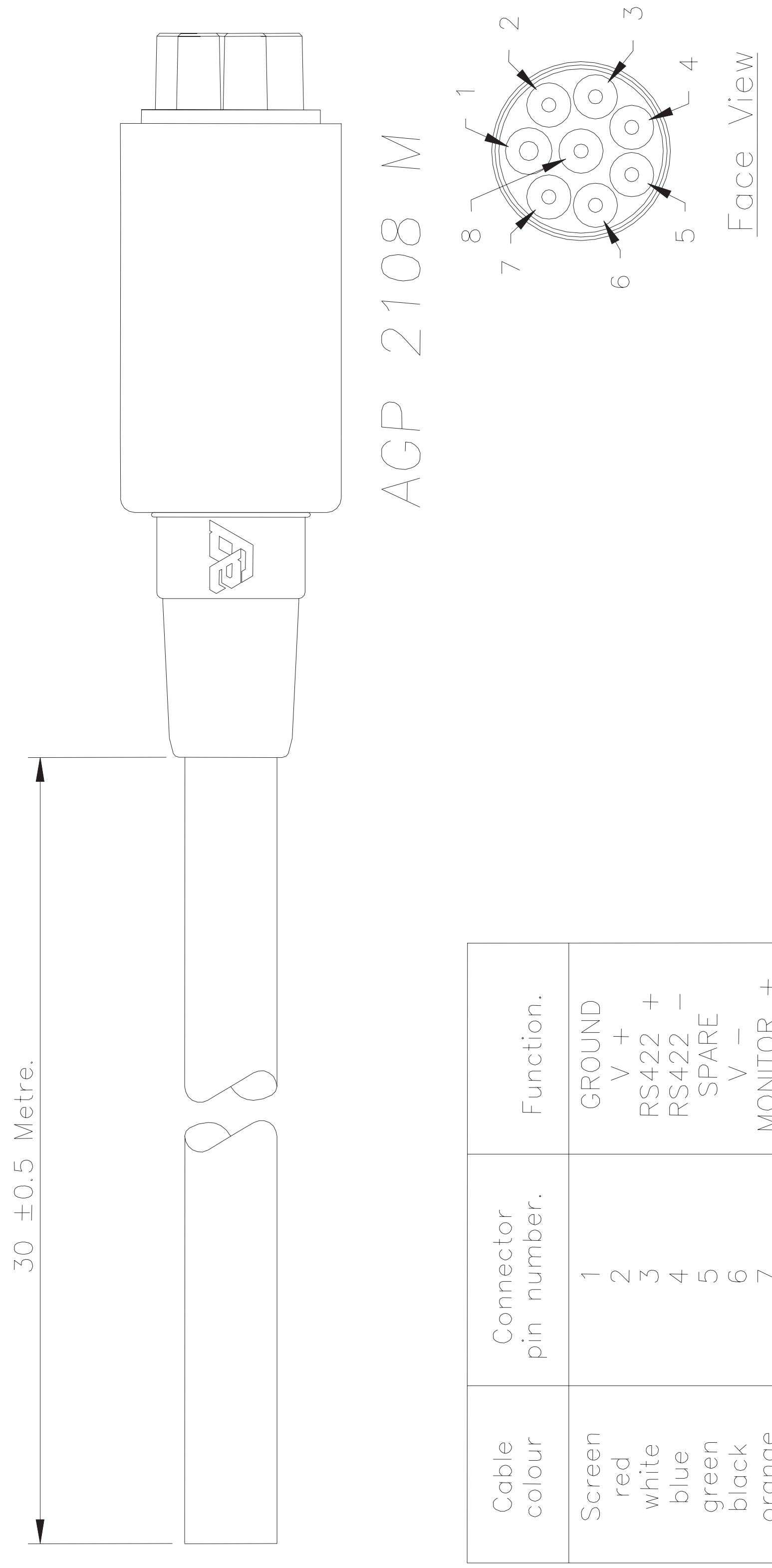


Fig 76 Transceiver Cable (Typically 30 metres)



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 Scout 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 Scout considers the azimuth and elevation to be valid.

USBL signal analysis

To help assess the condition of the acoustic signal, the Scout 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 77 shows an example of the USBL Signal analysis display.

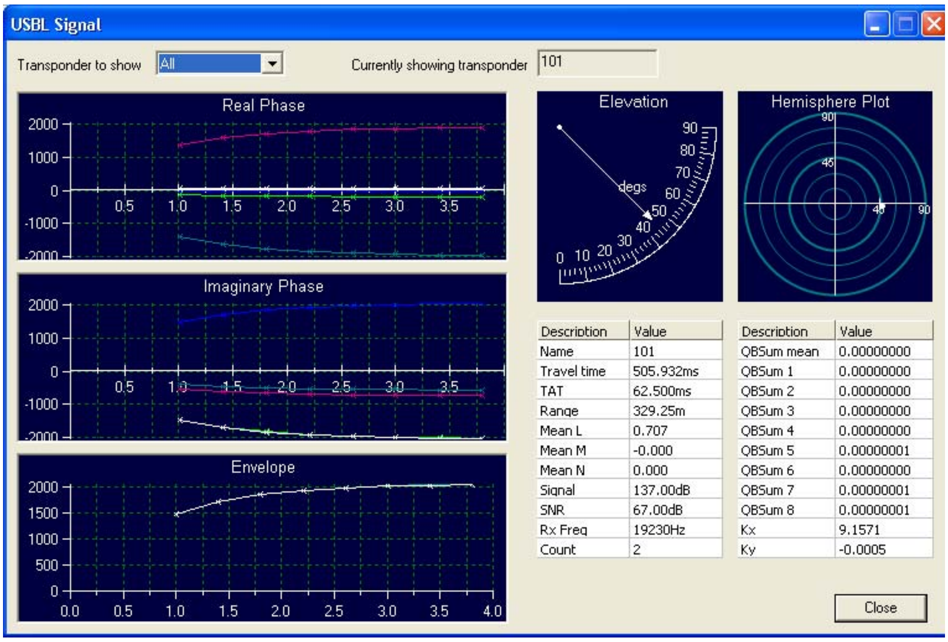
The USBL Signal analysis display comprises a number of smaller graphs and plots, all of which need to be viewed in context with each other to determine the quality of the received USBL signal. The smaller graphs and plots include:

- 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 77 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.

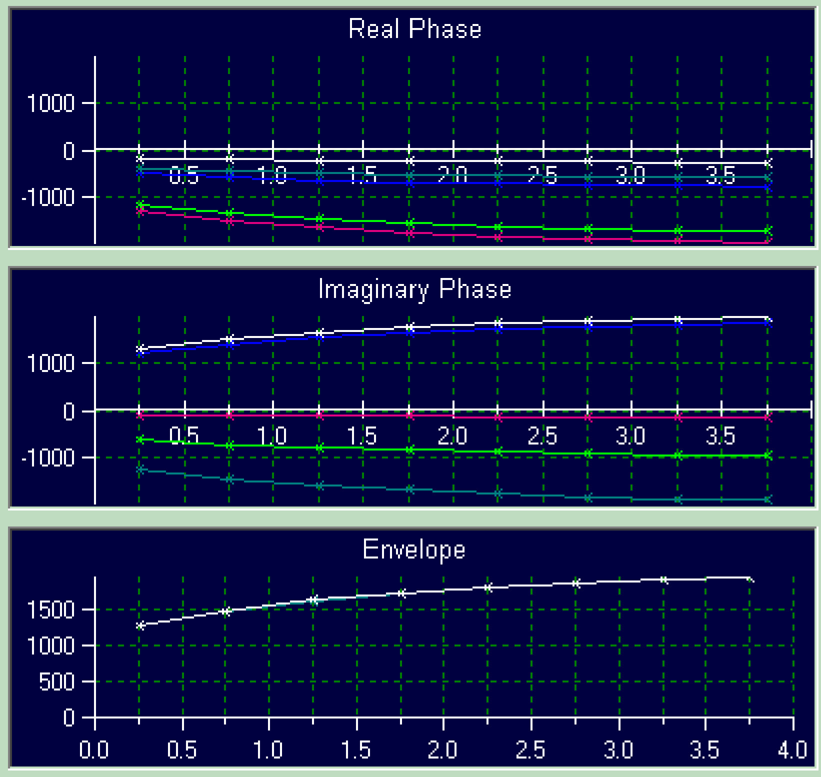
The Real and Imaginary Phase graphs show information about the difference in phase between the transducers. This is why there are five lines on each graph, each of a different colour to allow easy discrimination between them.

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 30 for a description of the Advanced options.

Fig 78 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. Scout calculates the magnitude as follows:

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

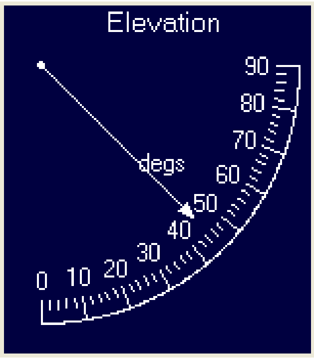
The **Envelope** graph also includes five lines, with one for each transducer. However, because they are all of the same magnitude, the graph shows them superimposed on top of each other. This is normal—the signal magnitude should always be the same at all five transducers.

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 79 Elevation plot



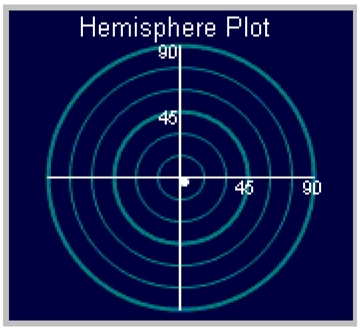
Hemisphere Plot

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 80 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 80 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:

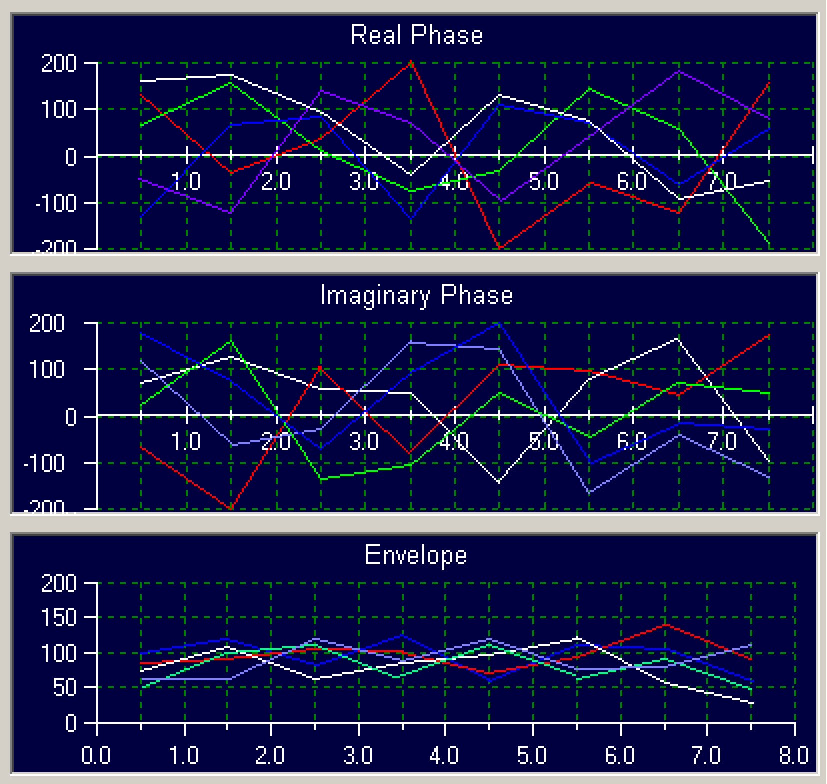
- False Detection
- Signal destruction (Multipath), and
- Fouling of transducer face.

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 81. In this example, erratic signals are interspersed with normal signal plots.

Fig 81 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 81, 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.

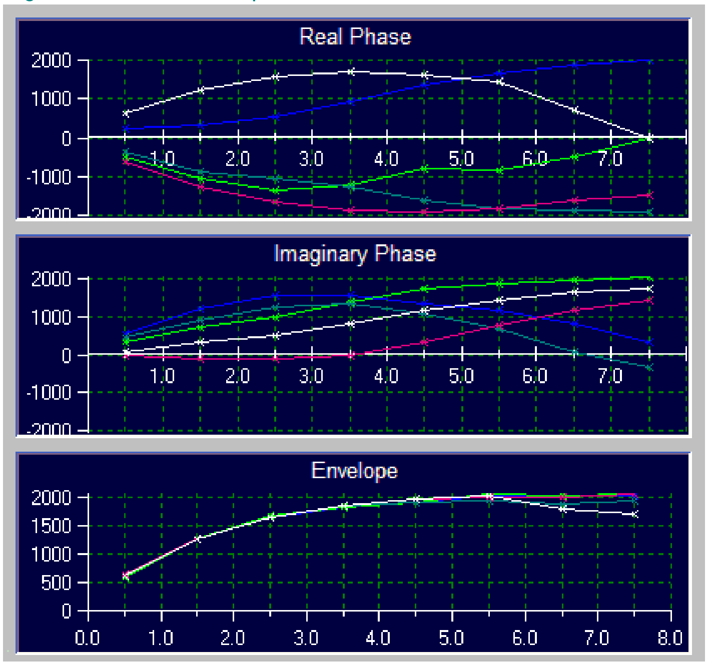
Multipath occurs when the transceiver receives two response signals from the transponder, each of which follows a different path:

- 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 82 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 82 Effects of multipath



In the example of Fig 82, 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

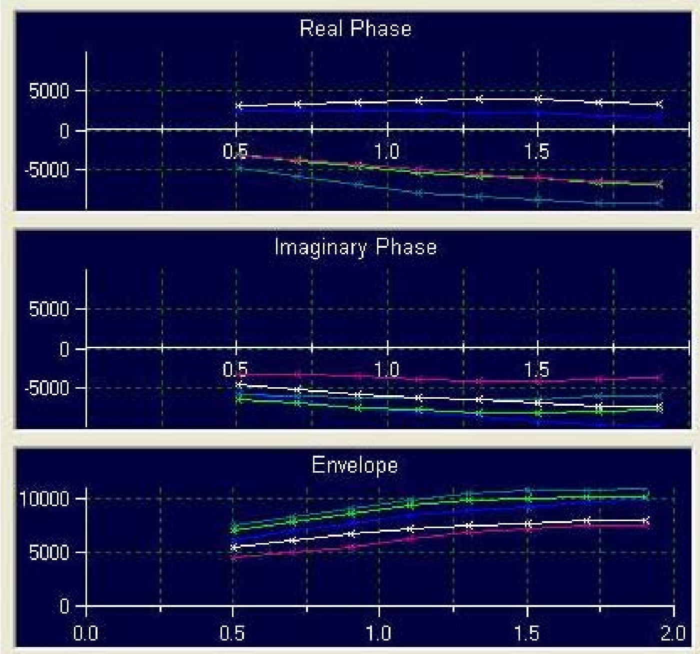
It is not advisable to sample less than 2ms of a pulse.

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 41.

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 83 shows how transducer fouling can affect the USBL Signal analysis display.

Fig 83 Effects of a fouled transducer face



D.3 Manual Command Window

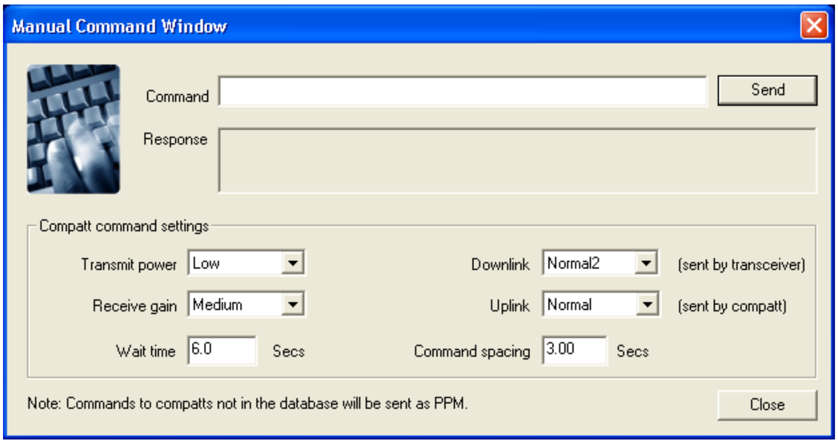
Note

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 84 Manual Command Window



Valid commands

Table 21 to Table 25 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 21 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 22 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 23 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 24 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 25 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 26 lists and describes these controls and fields.

Table 26 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 Scout 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.

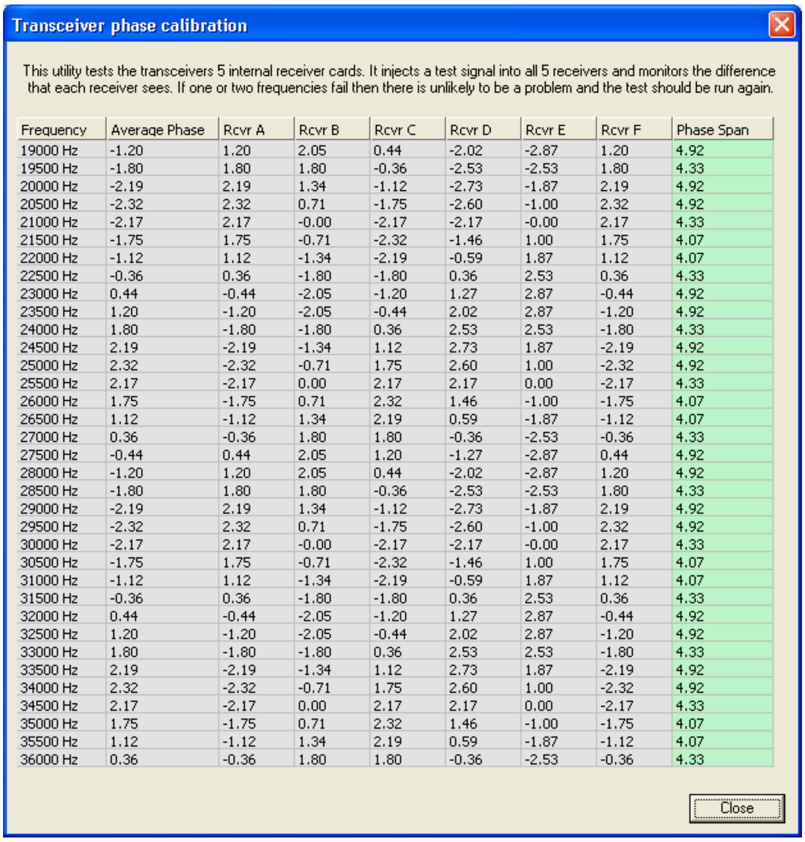
This tool tests the transceiver's five internal receiver cards by injecting a signal into all of them and monitoring the difference that each receiver sees.

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 85 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

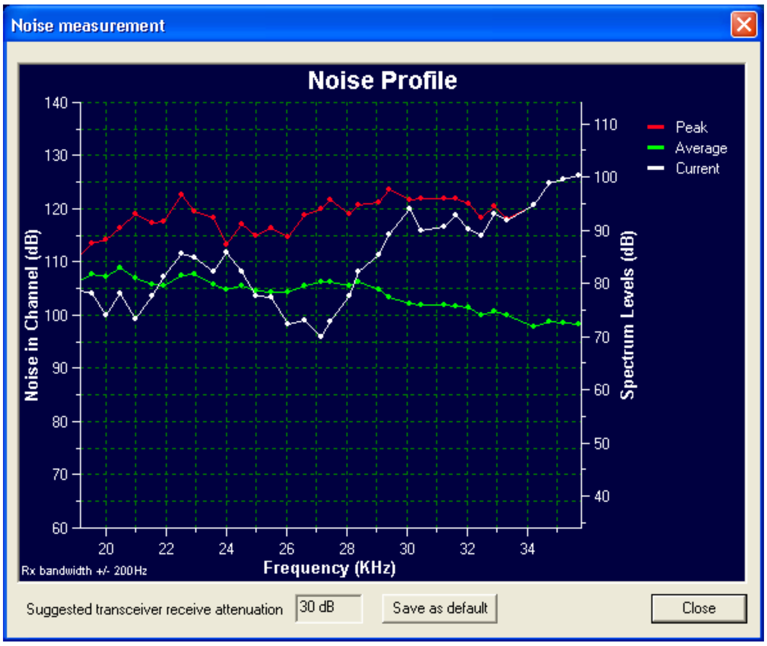
D.5 Noise Test

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 86 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 Scout 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.

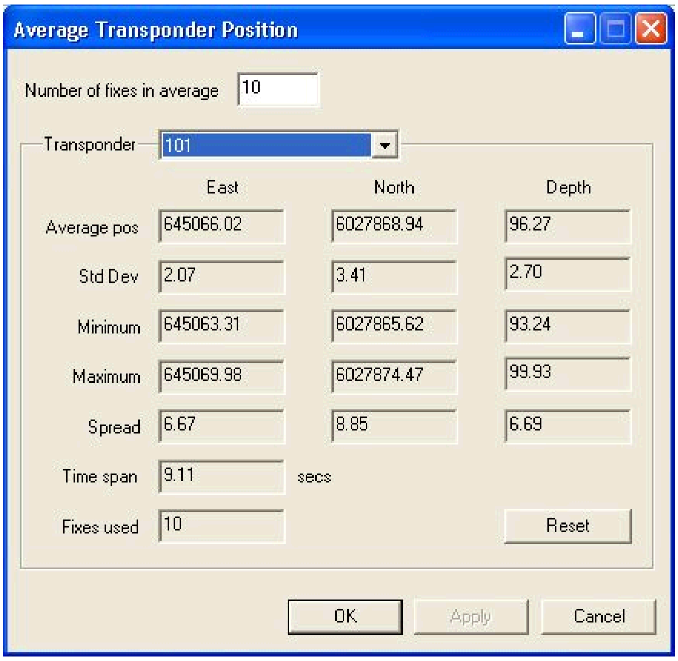
Display average fix information

Select **Tools** > **Average Transponder Position** to display the Average Transponder Position dialog, shown in Fig 87. 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 87 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

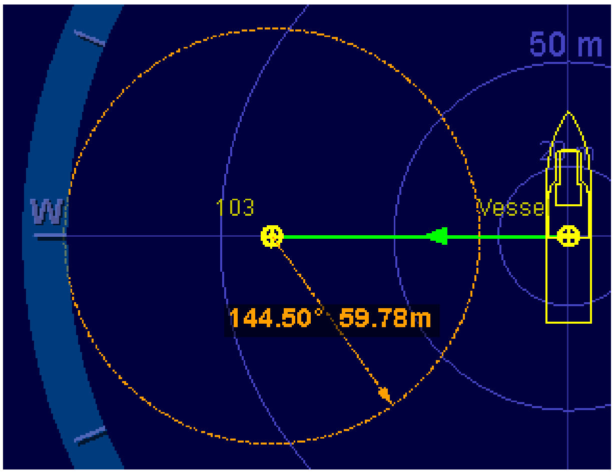
To measure chart distances:

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, Scout 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 88   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 27 lists the Output Reports supported by the Scout 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 Scout software Help files, which are embedded in the Fusion software.

Table 27 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 or LBL position data for the vessel or other object relative to an array. Selectable from the HPR 418 BCD report configuration dialog.
HPR 418 Rev F	Gives SSBL transponder position data relative to vessel or LBL position data for the vessel or other object relative to an array. Selectable from the HPR 418 Rev F report configuration dialog.
NMEA 0183 DP	An implementation of Simrad NMEA output telegram formats. PSIMSSB SSBL transponder position sentence or the PSIMSNS LBL position data for the vessel or other object relative to an array. Selectable from the NMEA 0183 DP report configuration dialog.
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 Scout 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 28 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 29 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.
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 30 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.
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 31 HPR channel flags:

	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	undefined	undefined	undefined	undefined	U	C

	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
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 32 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

Field	Byte	Byte Offset	Default for DP_Test
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)
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 33 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 Scout 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 SSB Message

Description

The maximum length of the NMEA SSB Message 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 34 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

Field	Data Format	Sample Data	Number of Characters
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 35 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
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 36 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 37 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 Simulation

This appendix includes details of the simulator that is built into Scout USBL. The simulator allows the application to track transponders without a working transceiver or NCU.

In this appendix...

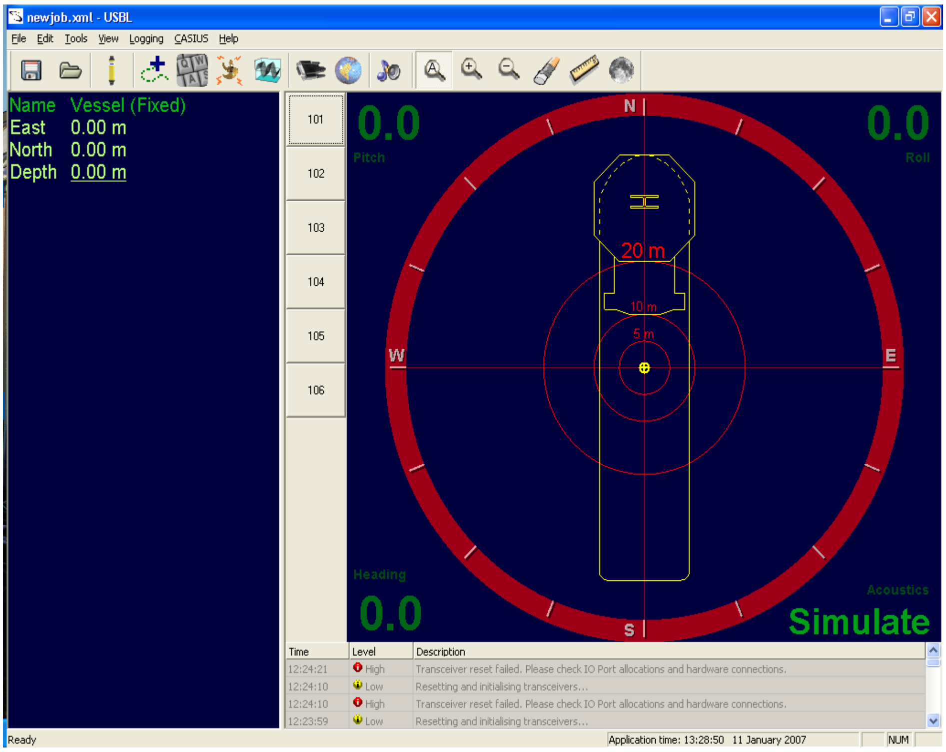
This appendix contains the following sub-sections:

F.1 Using the Simulator

Once the application has been started, Scout 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 89 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

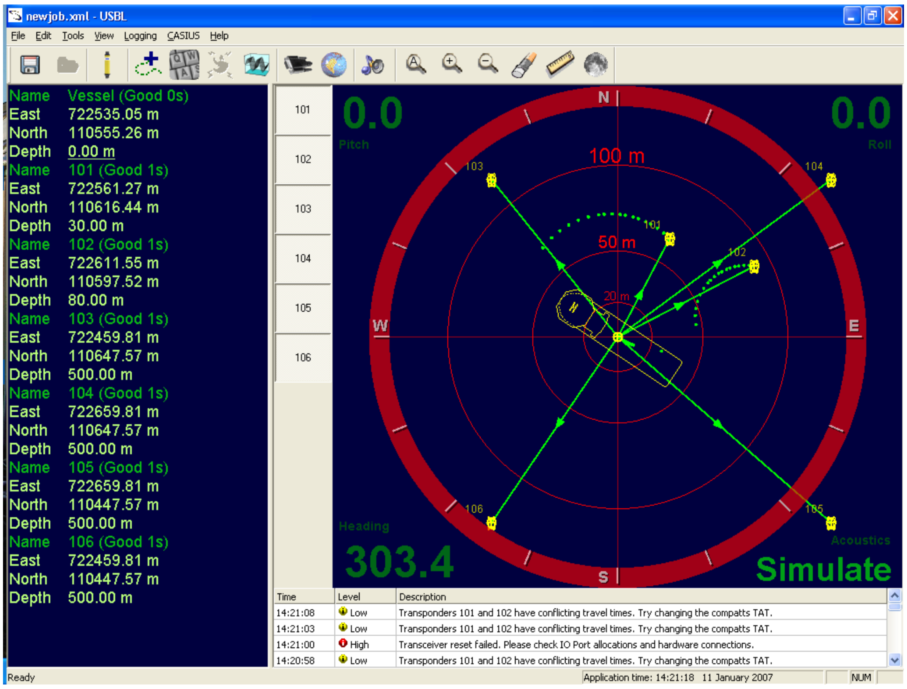
A DP desk may not be able to tell the difference between a simulated position and a real position. If a DP desk is connected to Scout USBL then check that it will not respond to a simulated position.

F.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 90 Advanced Simulation



Appendix G 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:

G.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 H Motion Sensor Calibration Tool - MagField Mapper

This appendix explains the procedure for calibrating the Motion Sensor (Ti) using the MagField Mapper tool installed with Scout.

In this appendix...

This appendix contains the following sub-sections:

H.1 Introduction

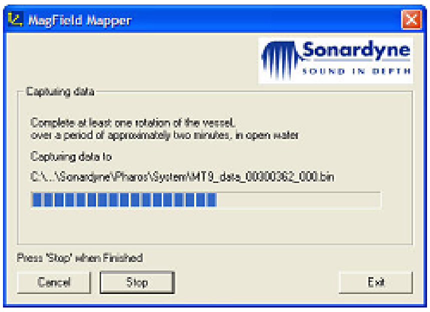
The motion sensor in the USBL transceiver can be used to accurately record its orientation in three dimensions. However, when the sensor is mounted close to an object that contains ferromagnetic materials this causes errors in the measured orientation. These errors can be removed by calibrating the sensor using the Motion Sensor Calibration Tool. The calibration only has to be performed once during the period in which the transceiver is deployed.

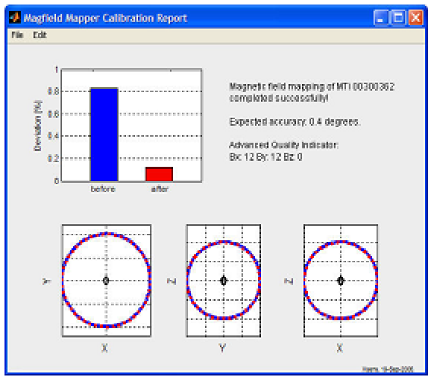
To calibrate the sensor measurements have to be recorded from the sensor while the transceiver is deployed in its working position. Measurements have to be made at all orientations so the simplest procedure is to sail the boat in a circle while collecting measurements.

H.2 Calibrating the Motion Sensor

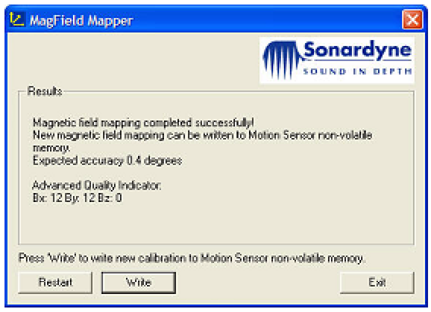
1. Ensure the USBL transceiver is connected and working correctly.
2. Close the Scout program
3. From the Desktop, double-click the **MagField Mapper** icon. The MagField Mapper program will appear.

4. Set the **Baud rate** to be 115200 baud
5. Click the **Scan** button. If the motion sensor is found click **Next.**
6. If the motion sensor has not been found then the button will still say **Scan**. Check all cabling and connectors to the transceiver then click the **Scan** button again.
7. On the **Change Input Type** page select the **Use XXXX** on **COMY** option, where XXXX is the serial number of the sensor in the transceiver and Y is the serial port number the transceiver is connected to. Click **Next**.
8. In the **Select Output Directory** page use the default directory offered.
9. In the **Select Mapping Mode** page select **2D** mapping mode and select **Show graphical representation of results**.
10. Press **Start** to start recording measurements





11. Navigate the boat in a complete circle at slow speed. The circle should be a small diameter but should take at least two minutes to complete.
12. When the circle is complete press the **Stop** button. The measurements will then be processed and a **Calibration Report** will be displayed.



13. Close the **Calibration Report** dialog.
14. If the results are acceptable press **Write** to save the results in the transceiver.
15. Click **Exit** to close the **MagField Mapper** program.
16. To re-start Scout, double-click the Scout icon on the Desktop.

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 38 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 39 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 Scout Surface Command Unit BIOS Recovery

In some instances the Plymouth issue Scout Surface Command Module (SCM) has been known to fail to power up. This appendix describes a procedure to restore operation.

In this appendix...

This appendix contains the following sub-sections:

J.1 BIOS Recovery Procedure

The problem

The reason the SCU fails to power up is due to an issue with the BIOS having been reset, which is caused by either a large power spike or a temporary drain on the mother board power. This has, on occasion been caused by the insertion of the dongle into the incorrect USB port, and also by other unknown factors.

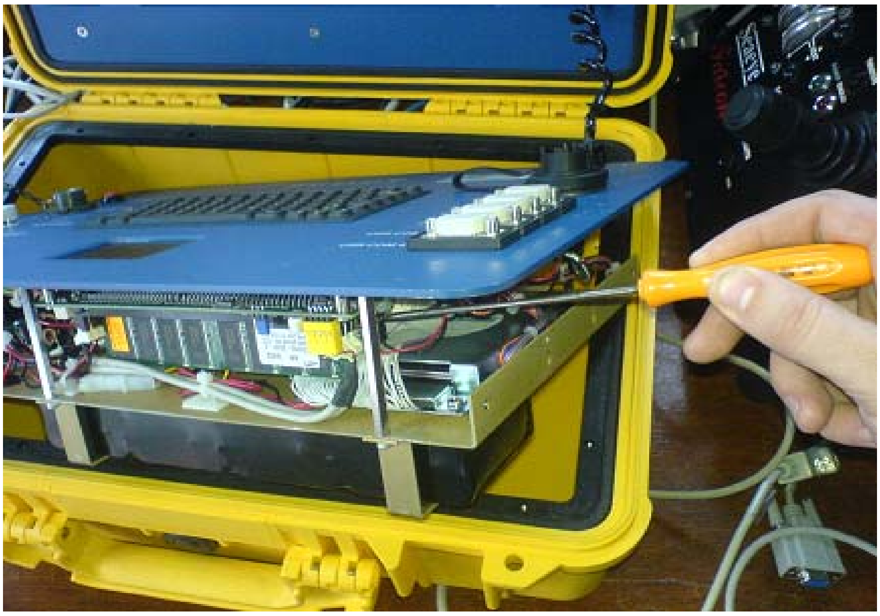
The Solution

A temporary workaround has been found that allows the user to force the unit to power up and restart the BIOS, and should ensure that all further attempts to power up the SCU are successful (until another failure of the BIOS may be caused).

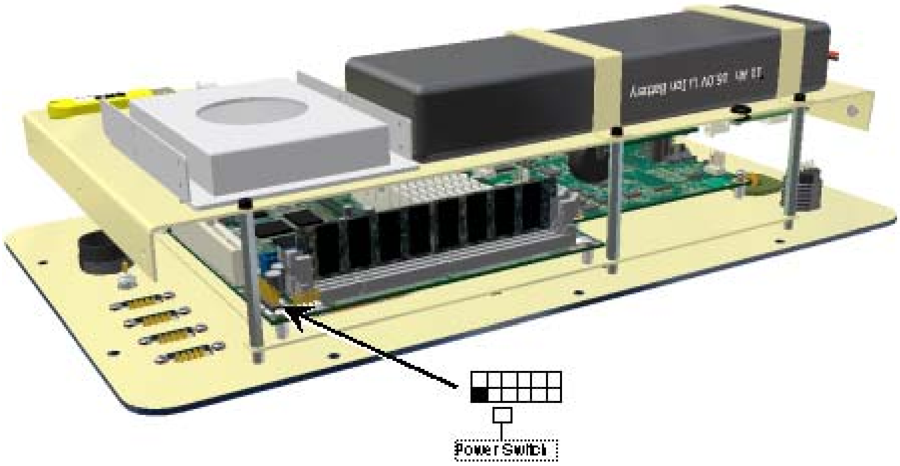
To do this, the user is required to first open up the SCU and short 2 pins together, while simultaneously powering up the unit. The following images serve as a guide as to how the user can carry out this procedure. But if presented with this problem, it is advised that contact is first made with either AFM or PRH to ensure that this procedure is needed and also to alert them of the problem, as it has only been experienced with the Plymouth prototype SCM.

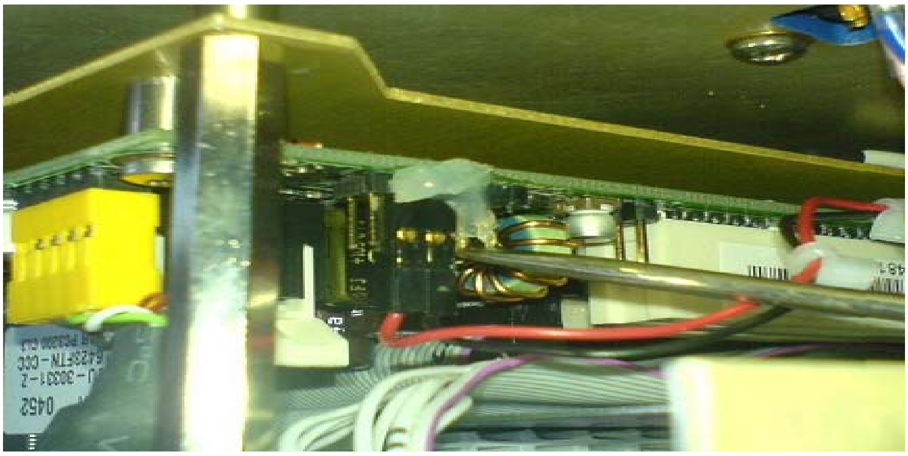
1. First the user must Remove all the fastening screws (16 total) and then lift out the Scout Computer, and rest it on the Yellow housing as shown. Being careful not to strain the black monitor lead.

2. Secondly, the user must identify the 2 pins that require shorting together. These are located on the bottom right corner of the Scout unit as indicated in the image (tip of screwdriver).



3. Finally, the user must then short the 2 pins together (using wire, or tip of screwdriver as shown) while simultaneously turning on the Power to the unit, and allowing the system to boot into windows. The short can be removed once the BIOS has activated.





Once the unit has been booted up, the user must enter the BIOS to alter some settings.

To do this the user must immediately press the "Del" key to enter the BIOS, then go to:

>Integrated Peripherals

>Super IO Device

>PWRON After PWR-Fail - Change OFF to ON

The user should then save their settings, exit the BIOS and re-boot the unit.

The user can then place the unit back in the housing and replace all screws. The SCM is now ready for use.

Appendix K 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:

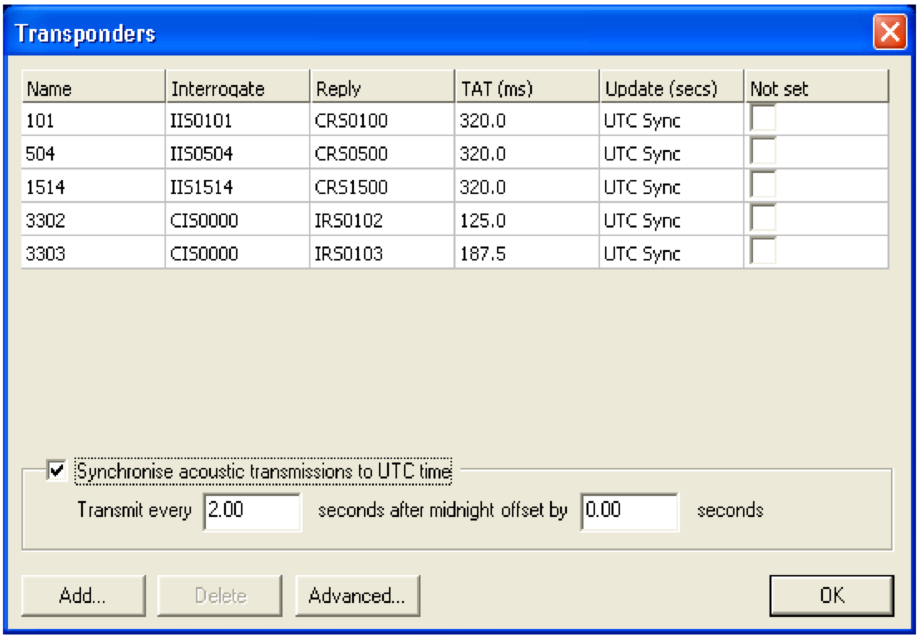
K.1 Using Time Synchronised Acoustics

It is possible to configure Scout to transmit it synchronisation with UTC time. This is only possible when a Scout 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 Scout 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 Scout will send out an acoustic interrogation. If the transmission window is set to 5 seconds then Scout 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 L Upgrading Firmware

In this appendix...

This appendix contains the following sub-sections:

L.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 Scout 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 40Loader compatibility

Hardware	Version
NCU	2.00. +
GDT	8.00. +

L.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 Scout USBL System installation CD. Always use the latest NCU firmware unless recommended otherwise by Sonardyne.

Procedure

To upgrade the NCU firmware:

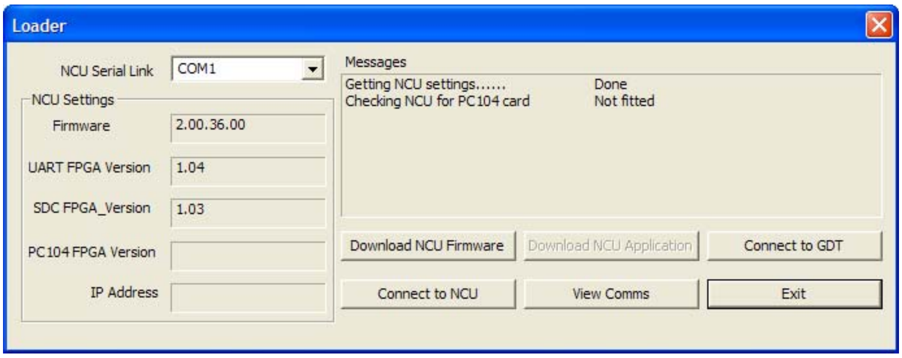
1. Close the Scout software application if it is running.
2. Connect the NCU's serial link port to a suitable communications port on the computer by using the null modem cable supplied.

   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.

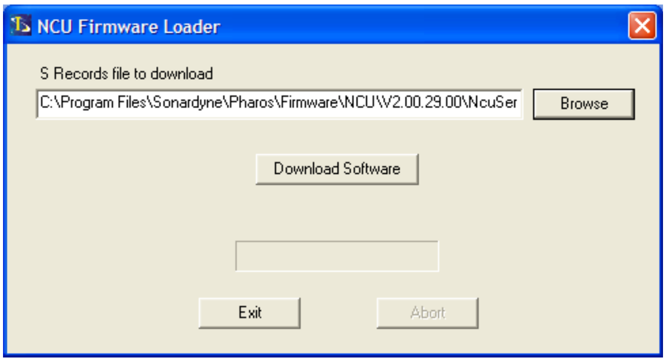
   Alternatively, run the application from its default installation location at:

   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.

L.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 Scout 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 Scout 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.

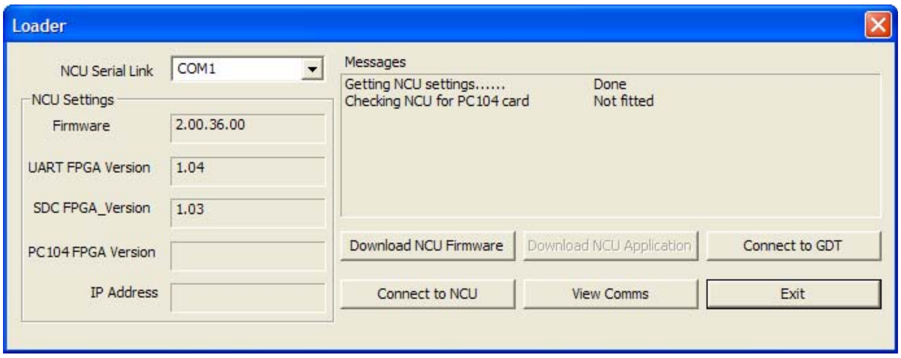
3. Double-click the Loader icon on the desktop to start the Loader application.

   Alternatively, run the application from its default installation location at:

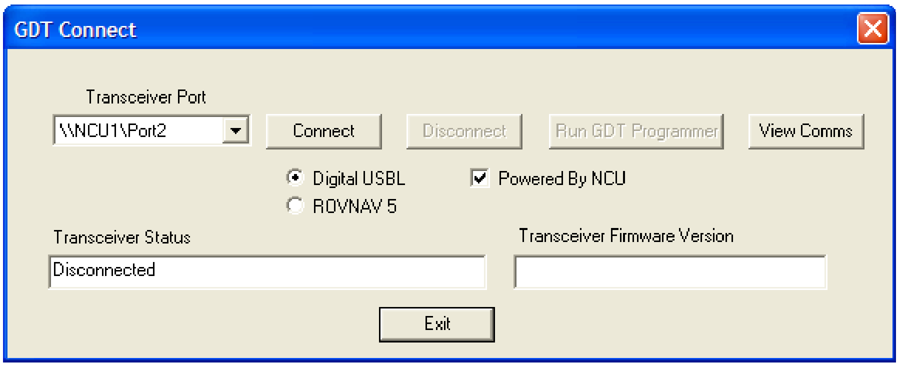
   C:\Program Files\Sonardyne\Ranger\Loader.exe

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.

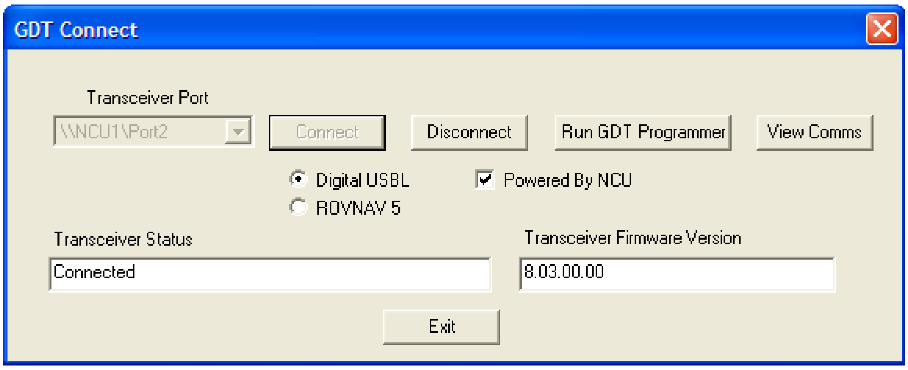


6. Select the relevant **Transceiver Port** from the drop-down list.

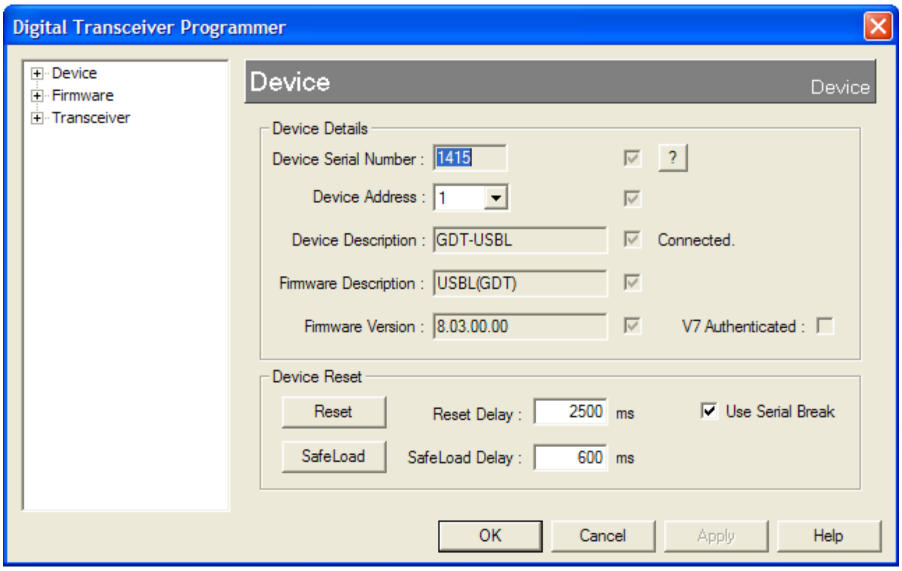
   This port can be an NCU port or a computer port, depending on the interface configuration.

   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.



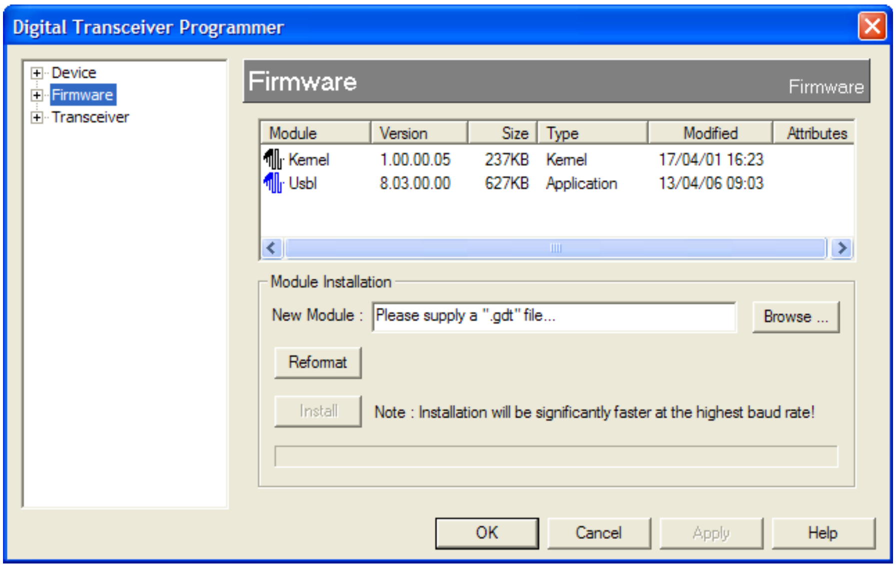
8. Click **Run GDT Programmer** to display the **Digital Transceiver Programmer** dialog's **Device** window.



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.

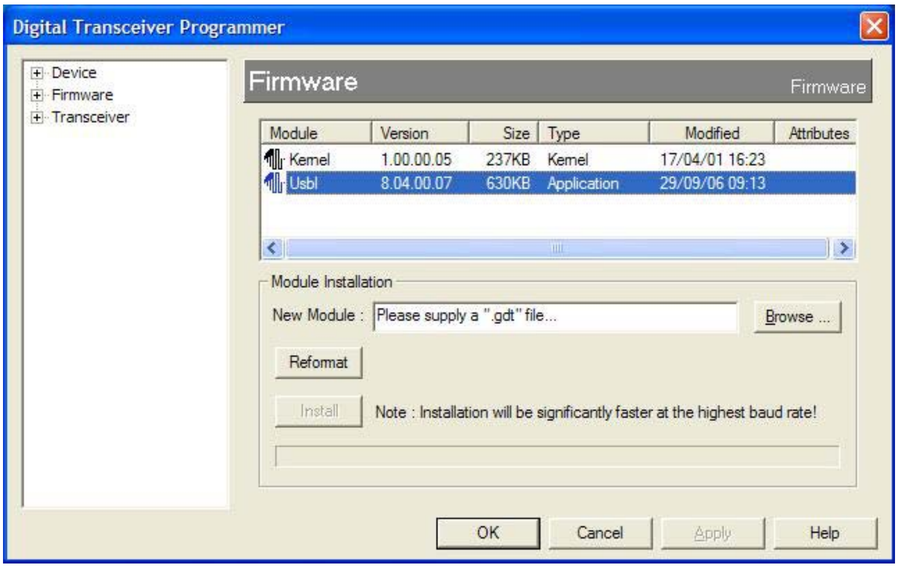
If the message continues to display *Connecting*, or if it changes to *Not Connected*, click **Reset**.

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

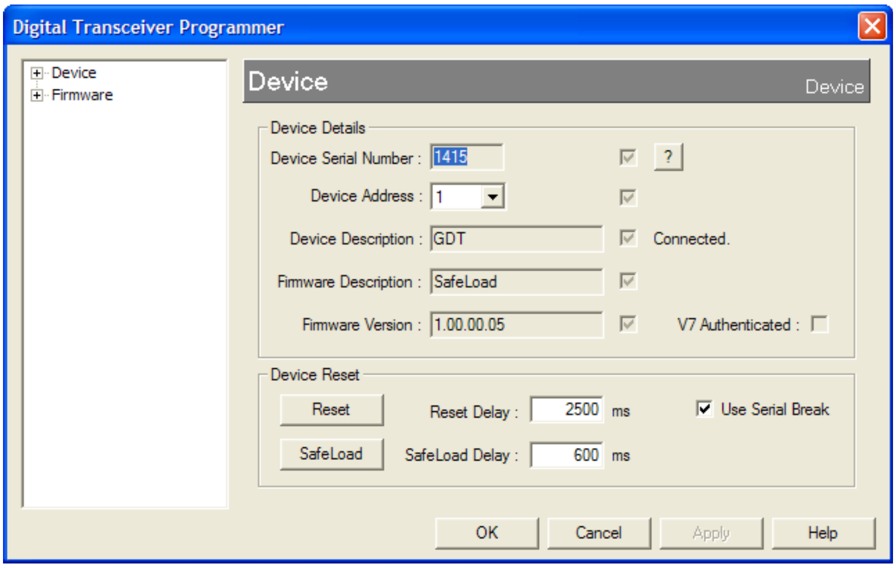
Do not under any circumstances select the Kernel file.

11. Click **Reformat** and choose **Yes** from the resulting **Confirm Flash Erase** message.

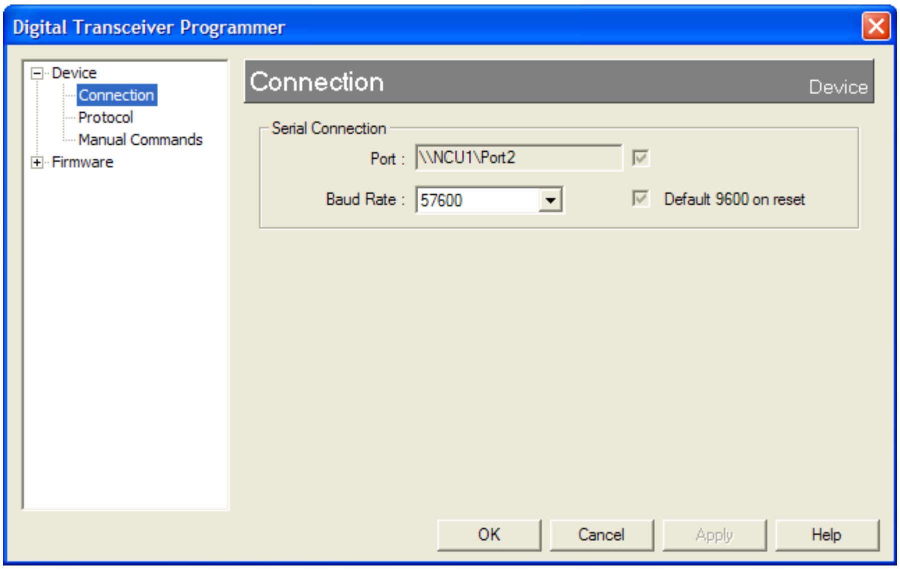
12. After a short pause, the **Device** page will be displayed in the **Digital Transceiver Programmer** window.

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.

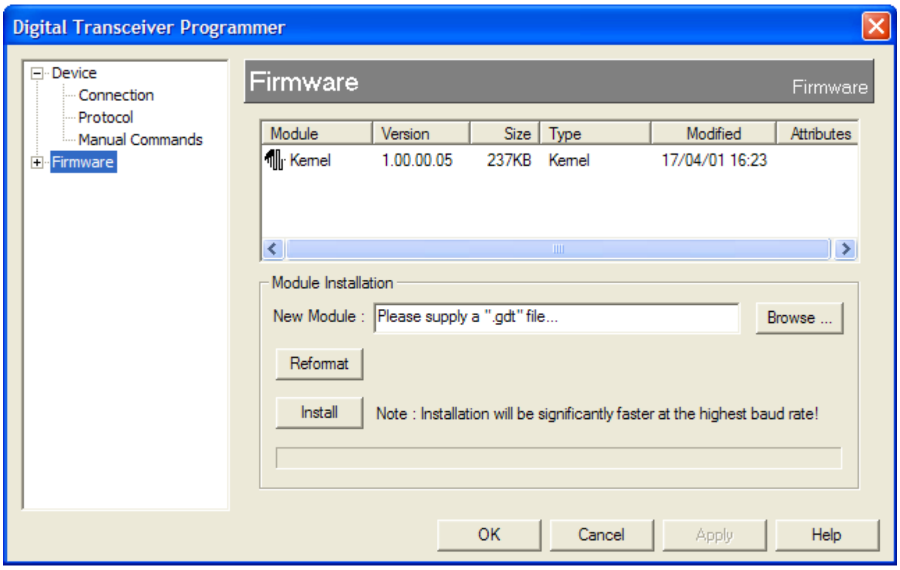


15. Select the appropriate baud rate to use based on the guidelines in Table 41 below.

Table 41Baud rate guidelines

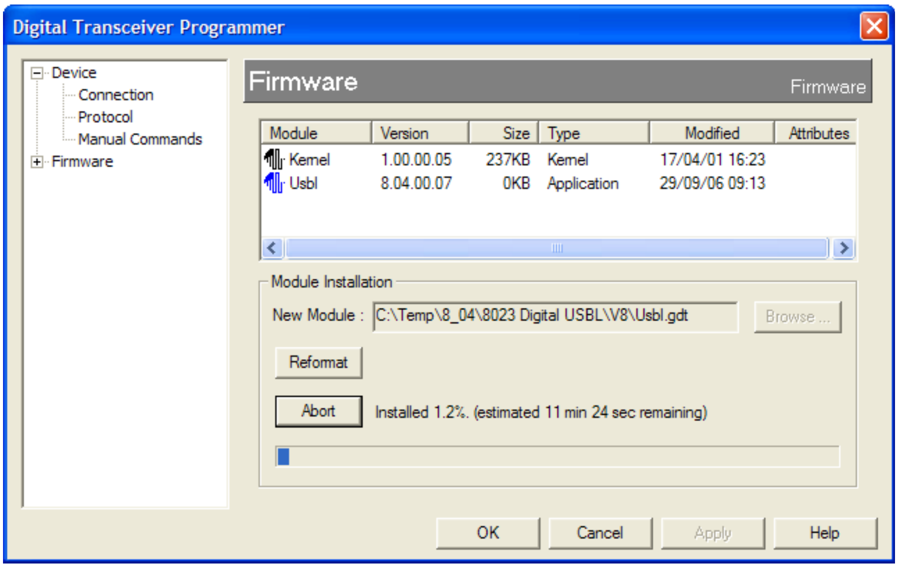
Hardware Configuration	Baud Rate	Approx. Install Time
RovNav5 powered via NCU	57600 recommended	13 minutes
RovNav5 externally powered	9600 maximum	30 minutes
GDT USBL powered via NCU	57600 recommended	13 minutes

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.



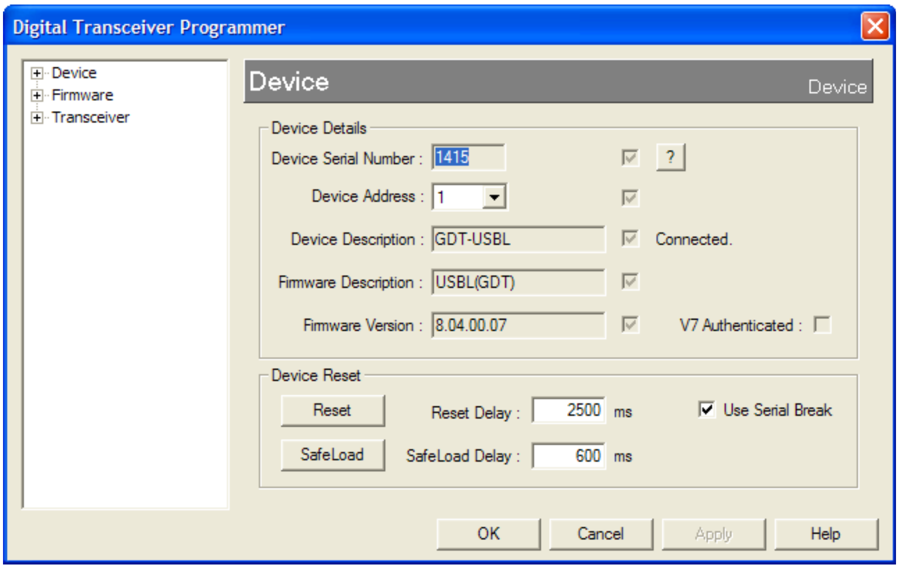
CAUTION

Avoid using the computer actively with any other applications while the download is continuing.

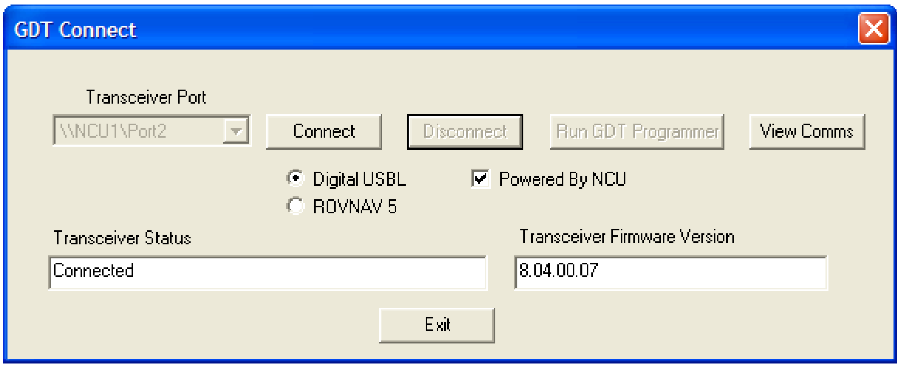
When the installation is complete, the program will automatically revert to the **Device** window where the new firmware will be displayed in the **Firmware Description** field.

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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