Sonardyne

UM-8243

User Manual for Type 8243 Micro-Ranger Transceiver

Issue B1

Issue Date: 18 May 2021

920-0042

Third party and open source software used with this product is listed in *Appendix B.*

Contacting the Sonardyne Support Team

24-hour Emergency Telephone Helpline: +44 (0) 1252 877600

The Sonardyne 24-hour helpline is answered at the UK Headquarters during normal office hours (08:00 to 17:00). Outside these hours, your call is automatically transferred to an agency, which logs the details of your emergency and alerts the appropriate Sonardyne personnel.

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

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If you require non-emergency product support, please contact your nearest Sonardyne office. Alternatively, contact the Sonardyne Head Office:

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Note

Email and telephone support is available during normal UK office hours (08:00 to 17:00).

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Amendment History

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

Issue	Revision	Date	Comments	Section	Page
A	1	22/02/2018	First Issue	All	All
A	2	12/09/2018	Warnings and Cautions updated Definitions updated	2.2.1 2.2.2 Definitions	2, 3 42
A	3	14/01/2020	MRT to ESH cable assembly: Subconn connector pin numbers updated	12	31
B	1	18/05/2021	820-0447 topside cable drawing added MRT shown with new label throughout General update and formatted with new branding style	12.5 All All	40 All All

Section 1 – Introduction

1.1 About this Manual

This manual describes the safe installation, operation and maintenance of the Micro-Ranger Transceiver (MRT). The information and procedures within this manual are based on Sonardyne's experience and knowledge.

1.1 Purpose of this Manual

This manual contains information for personnel involved in USBL system operations. It includes technical information to configure, operate and maintain USBL systems, and specific information concerning USBL products supplied by Sonardyne.

1.2 Related Publications

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

Table 1-1 Related Publications

Publication	Title
Sonardyne Safety Manual	*Operational and Safety Precautions*
UM-8211	*User Manual for Ethernet Serial Hub (included with the ESH)*
UM-8262-V2	*User Manual for Nano Transponders and Transceivers (included with the Nano and AvTrak 6)*
UM-8241	*Micro-Ranger 2 USBL User Manual" (included with Micro-Ranger 2 software)*
UM-8300-099	*6G Terminal Lite User Manual*

1.3 Conventions

The following conventions are used in this manual.

Table 1-2 Conventions used in this Manual

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

Section 2 – Saftey

2.1 Introduction

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

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

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

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

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

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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

2.2 Safety Procedures

2.2.1 Warnings

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

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

⚠ **Internal Pressure Risk. Dismantling the MRT must only be carried out by Sonardyne personnel.**

⚠ **Hazardous Substance. Molykote 44 is a mild irritant. When lubricating connector faces, Personal Protective Equipment such as gloves and goggles must be worn.**

⚠ **Do not carry out maintenance on the transceiver if the housing is hot. Disconnect all power and wait for the housing to cool.**

2.2.2 Cautions

Compass safe distance. The transceiver should not be operated within 5 metres of a magnetic compass.

Loss of connector Integrity. Do not over apply grease to the female connector. Grease build up will affect connector integrity.

Damage to transceiver. The weight of the mounting pole must not be supported by the transceiver front face.

Damage to protective coating. Do not use any abrasive brushes or sharp tools to clean the transceiver and remove any marine growth, this will damage the protective coating and increase the risk of corrosion.

Section 3 – Technical Description

3.1 Introduction

The Sonardyne Wideband®2 6G® MRT is used as part of Sonardyne's USBL Systems.

The Wideband 2 technology uses a correlation reception technique with phase-encoded signals over a wide range of carrier frequencies. Signal coding allows for hundreds of channels enabling multiple users to work in the same area without interference.

3.2 Description

3.2.1 MRT Type 8243

The type 8243 MRT 6G USBL transceiver is a very small, light, Ethernet interfaced MF band USBL transceiver with a short range array optimised for shallow water and high elevation tracking in low noise environments up to 995 m.

The MRT contains an internal attitude sensor and magnetic compass. It is important to note that this is a magnetic compass and therefore requires a magnetic offset deviation value to be used between true north and magnetic north.

It is recommended to calibrate the internal compass when the MRT is first deployed; see *Section 4.2 "MRT Internal Compass Calibration"*.

Figure 3-1 Type 8243 MRT

3.3 USBL Transceiver Operation

The USBL transceiver is a complete digital signal processor controlled acoustic interrogator/receiver operating on a command from the Data Fusion Engine (DFE). In other applications the USBL transceiver can passively monitor acoustic activity.

The main functions of the USBL transceivers are as follows:

- Interpretation of commands from the DFE.
- Transmission of acoustic commands or transponder interrogation signals on any one of Sonardyne Wideband®2 signals.

- Reception of transponder reply signals can be on any one of Sonardyne Wideband®2 signals.
- Decoding acoustic telemetry.
- Measurement of time and bearing in the received transponder reply.
- Transmission of range, bearing, and telemetry data to the DFE.

The electronic components are as follows:

- Voltage regulations circuits.
- Analogue conditioning and digitisation.
- Digital signal processing module.
- Transmit circuit controlled by the processor.
- Communications module providing Ethernet communications.

The transducer head contains an array of ceramic receiver and transmit elements. The elements are encased in polyurethane to create a strong and well coupled acoustic interface to the water.

The electronics chassis is attached to a metal base plate of the transducer face assembly. A cylindrical housing slides over the electronics chassis to mate with the face of the metal base plate and is secured with six bolts. The endcap is constructed in stainless steel to resist corrosion and give sturdy mounting points for deployment.

The processor within the USBL transceiver runs a program stored in firmware which controls all the functions of the unit.

An underwater connector is provided in the top of the housing for connection with the interface cable.

Nominally 48 V power is supplied to the unit using a single pair of conductors. Communications is achieved by a 100BaseT Ethernet link.

3.4 Typical Type 8241 Micro-Ranger 2 System

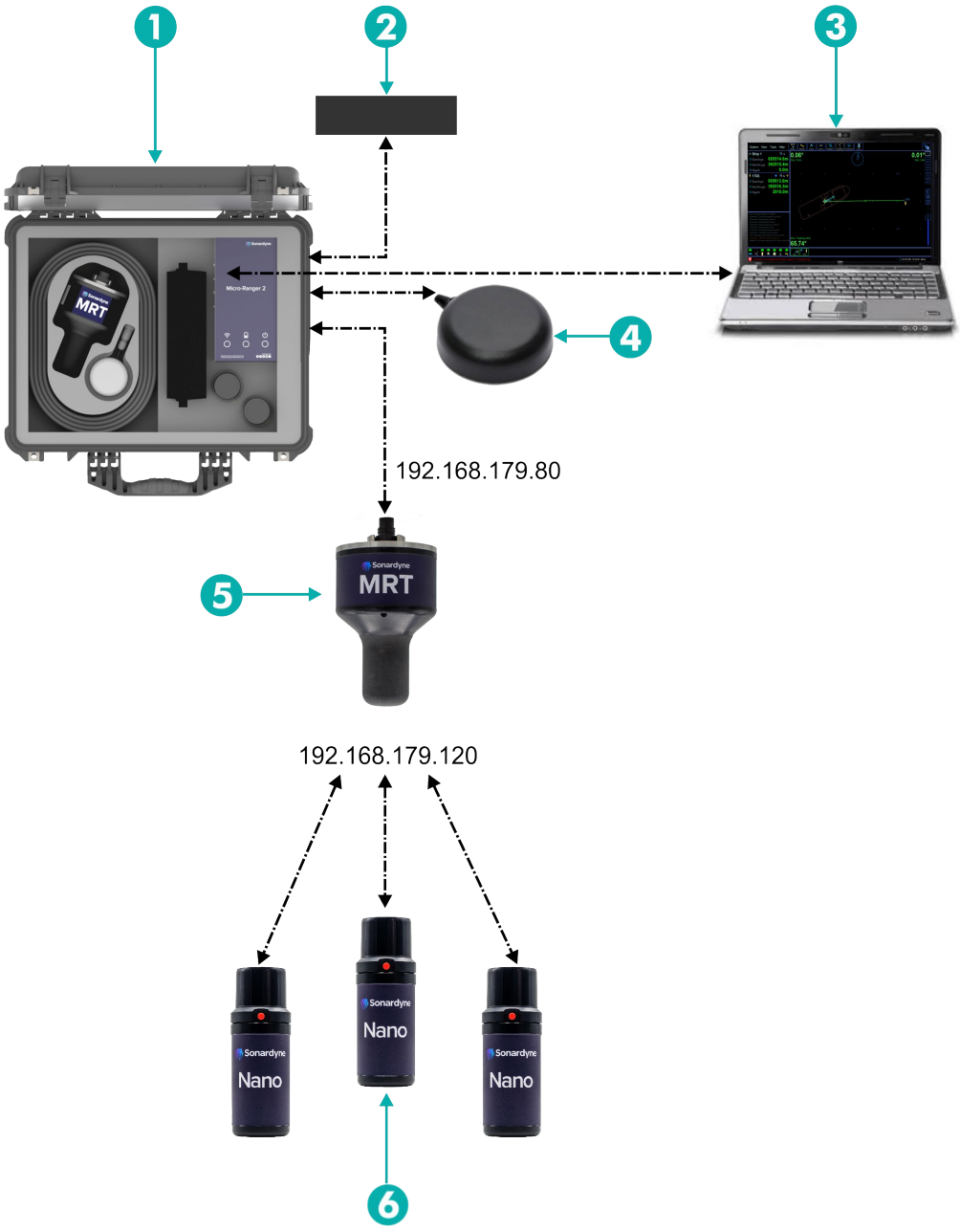
The MRT is intended to be used as part of the Micro-Ranger 2 system, typically consisting of:

- MRT
- Ethernet Serial Hub (ESH)
- Micro-Ranger 2 Software
- PC with interface to Micro-Ranger 2 software using UDP
- Nano/WSM 6+ or other 6G beacon

3.4.1 Typical System Description

The Micro-Ranger 2 system is configured using a PC with an Ethernet connection to the Portable System Control Hub/ESH. The Control Hub/ESH provides power and communications to the MRT. The Nano/WSM 6+ is typically mounted on a diver or ROV.

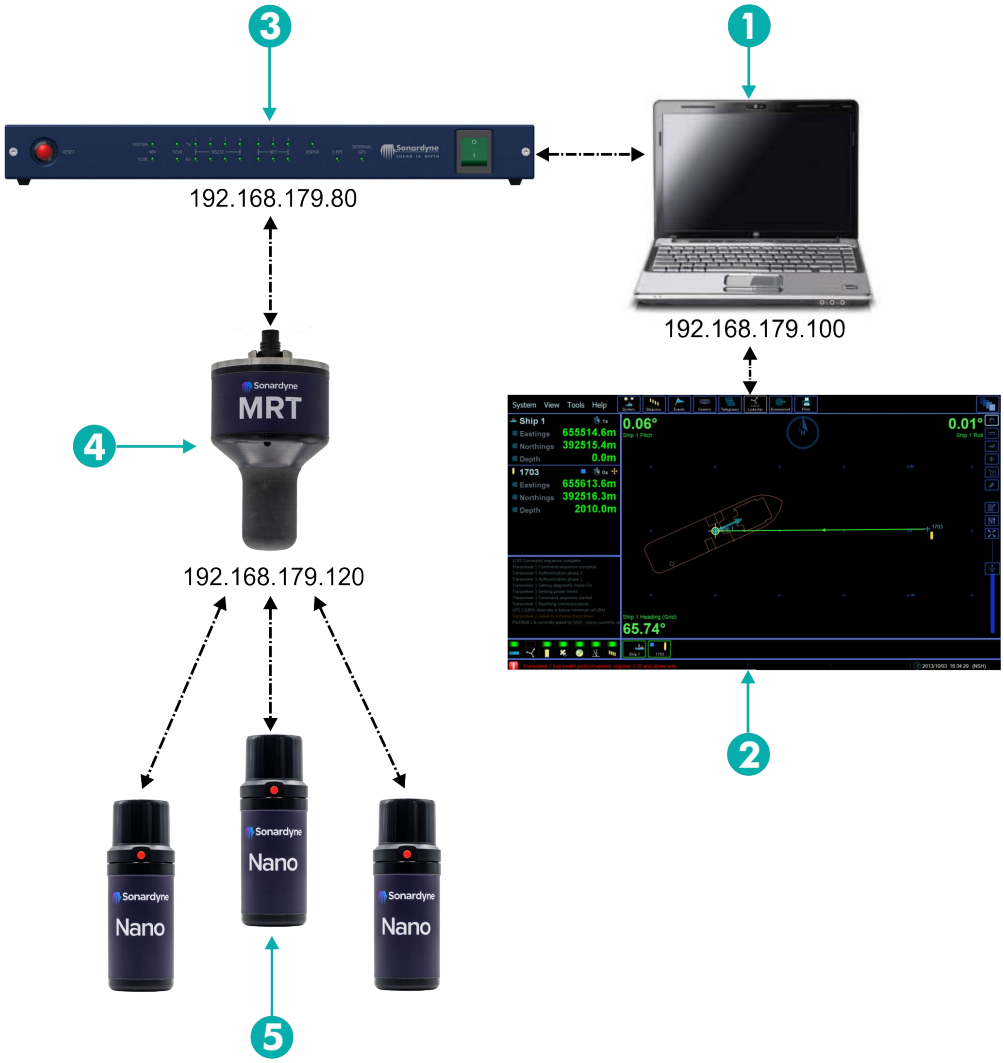
Figure 3-2 Typical Type 8241 Micro-Ranger 2 Portable System



1. Micro-Ranger 2 Portable Case
2. 24 V dc Power Supply
3. PC
4. GNSS Antenna
4. MRT
5. Nano Transponder

   Software Security Key (not shown)

Figure 3-3 Typical Type 8241 Micro-Ranger 2 Rack Mounted System



1. PC (not supplied)
2. Micro-Ranger 2 Software
3. ESH and Cable
4. Micro-Ranger Transceiver
5. Nano, WSM 6+ or other Sonardyne 6G Beacon

Software Security Key (not shown)

Section 4 – Installation and Deployment

4.1 Introduction

Before installing and deploying the MRT, make sure Section 2 – Safety is read and fully understood.

4.2 MRT Internal Compass Calibration

It is recommended to calibrate the internal compass when the MRT is first deployed. The magnetic compass can be calibrated directly from the Mini-Ranger 2 software. To calibrate the internal magnetic compass using Mini-Ranger 2 software, see *UM-8241 "Micro-Ranger 2 USBL Manual".*

Note

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

4.3 Mounting and Deploying the MRT

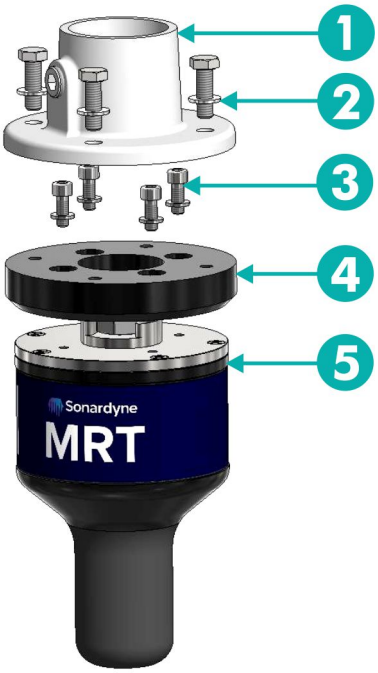
A simple cost-effective method for deploying the MRT USBL transceiver on small vessels is to use the included Sonardyne isolator plate mounted to a standard scaffold wall plate (with a 34 mm aperture). A steel scaffold pole (or similar) of suitable length can be secured into the scaffold wall plate.

The hole and bolt specifications for securing the scaffold wall plate to the isolator plate and MRT are shown below.

Fixing	Hole and Bolt Specification
Isolator plate to MRT	M6x1.00 pitch, equi-spaced on a 65 mm PCD
Scaffold wall plate to isolator plate	M8x1.25 pitch, equi-spaced on an 89 mm PCD

The MRT, isolator plate and scaffold wall plate assembly is shown in *Figure 4-1*.

Figure 4-1 MRT Standard Mounting Method

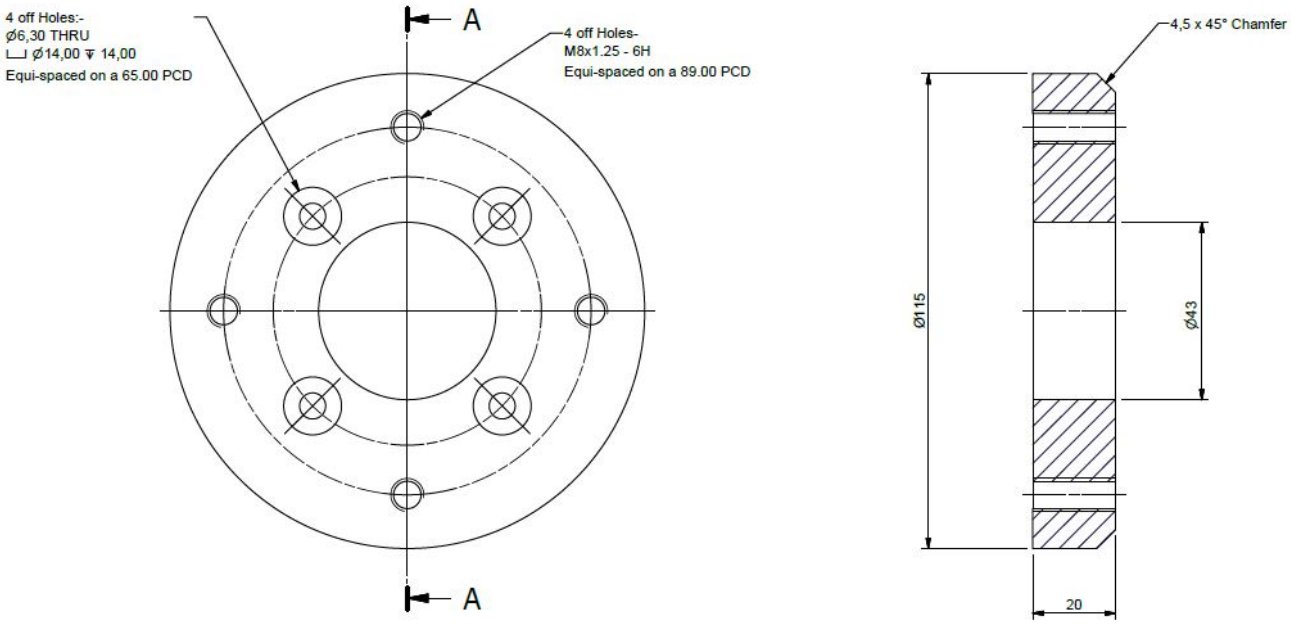


Item	Description	Item	Description
1	Scaffold wall plate with 34 mm aperture (not included)	2	Scaffold wall plate M8 fixing bolts (not included)
3	Isolator plate M6 fixing bolts (included)	4	Isolator plate 800-0383 (included)
5	MRT	-	-

4.3.1 MRT Isolator Plate

The supplied Isolator plate is bolted to the face of the MRT using M6 fixing bolts. A suitable mounting plate for example, a scaffold wall plate is then bolted to the isolator plate using M8 fixing bolts. The dimensions and bolt hole patterns are shown in *Figure 4-2*.

Figure 4-2 MRT Isolator Plate Dimensions



4.3.2 General Mounting Considerations

When installing and deploying the MRT, observe the following points:

- Ensure the method of deployment protects the sensitive acoustic transducer elements from damage at all times during installation, deployment, and demounting. Mount the USBL transceiver on a rigid pole to minimise vibration and reduce free movement of the transducer with respect to the vessel.

  The main sources of vibration that could affect the transducer are normal operation of the vessel's machinery and Vortex Induced Vibration (VIV) as the transducer's supporting pole moves through the water.
- Mount the USBL transceiver on a rigid pole to minimise vibration and reduce free movement of the transducer with respect to the vessel.
- Mount the USBL transceiver so that it is pointing vertically downwards, with the connector at the top and the black acoustic transducer at the bottom.
- Ensure the forward-pointing direction arrow on the label is pointing forward on the vessel.
- For best results, if possible deploy the USBL transceiver at least 1–2 metres below the lowest part of the vessel's hull.

  By increasing the separation distance between the transducer array and the hull in this way, you will reduce the risk of multipath reflections from the hull, reduce the amount of vessel noise received by the transducer, and reduce the chance of aerated water passing over the transducer's face.

  Note

  After installing the USBL transceiver, measure the vertical offset between the bottom face of the USBL transceiver and the vessel's waterline when the USBL transceiver is fully deployed. You will require this information later, to configure the USBL software.

- Deploy the transducer as far away as practical from any source of noise or bubbles, such as propellers, thrusters, moonpools, or other causes of aeration.

- Ensure the bottom face of the transducer is kept well clear of brackets, ropes, and other structures during deployment.
- To ensure correct 'wetting' of the transducer's polyurethane face, keep the USBL transceiver face clean and free from oil or grease.

4.3.3 Attitude Measurement Errors

The importance of correct USBL transceiver deployment is greater if you intend to use external attitude measurement equipment, such as a Vertical Reference Unit, with the USBL System. These instruments measure the roll, pitch and heading angles of the object they are attached to, which is usually the vessel. However, if the USBL transceiver is mounted on a pole that is capable of moving significantly with respect to the vessel, then the attitude measurements will relate to the vessel, but not to the USBL transceiver with any accuracy.

Pole movements can arise from different causes: Small quick movements are usually caused by water flowing past the pole, giving rise to VIV, and larger, slow movements can arise as the vessel pitches and rolls. Both effects can be reduced by ensuring the pole is mounted rigidly on the vessel.

In some cases, it is possible to mount the attitude measurement instrument on top of the pole so that it always measures the attitude of the USBL transceiver, even if the pole moves relative to the vessel.

4.3.4 Galvanic Isolation

The USBL transceiver endcap is made of stainless steel. The most common material used for the tube, pole and mounting frame is mild steel.

It is good practice to isolate the USBL transceiver and the mounting arrangement electrically to reduce the effects of galvanic corrosion on the housing.

Sonardyne provide an isolation adaptor within the installation kit.

Note

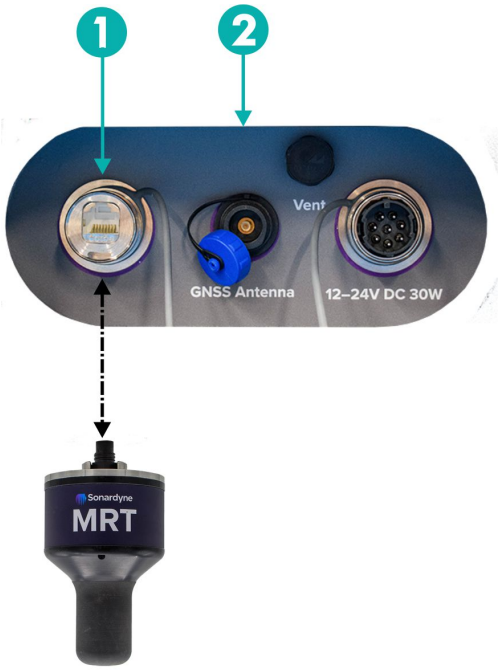
To avoid galvanic corrosion, never allow the endcap to remain in contact with a material more electro-chemically noble than itself.

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

4.4 MRT Interconnections

4.4.1 Portable Topside System

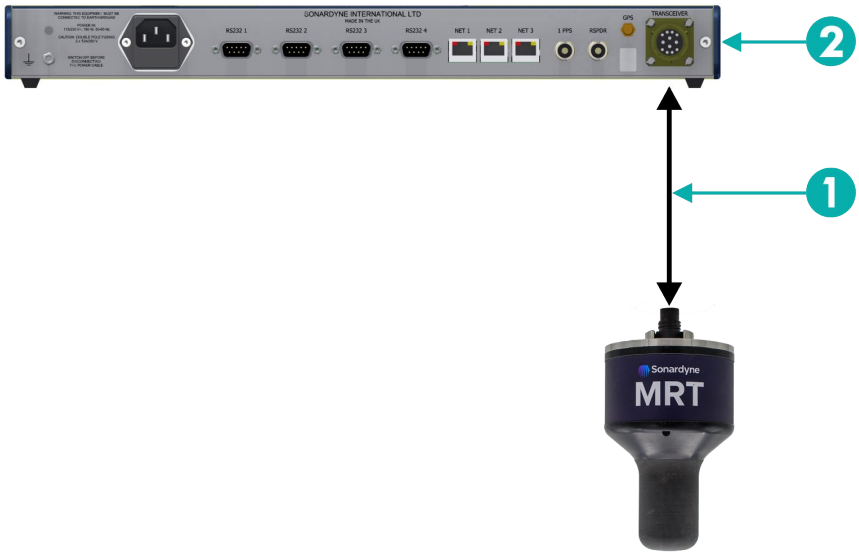
The MRT is connected to the external Ethernet port on the portable case as shown below.



1 MRT Ethernet Connection 2 Portable Topside Case

4.4.2 Rack Mounted System

The MRT is connected to the ESH with a 10 m Subconn to Amphenol cable (CPN 820-0373) as shown below. Longer lengths of this cable are available on request.



1 CPN 820-0373 (10 m) Cable Assembly 2 ESH

Section 5 – Operation

5.1 Operating Instructions

For Operating instructions refer to the appropriate user manual for the system in use.

5.2 End of Operations

When operations are complete the MRT can be retrieved from the water; see *Section 6 – Retrieval and Storage.*

Section 6 – Retrieval and Storage

6.1 Cleaning and Maintenance

On retrieval from the water, the following procedures must be carried out before the MRT is stored.

1. Clean the MRT; see *Section 7.2 "Cleaning".*
2. Inspect the MRT; see *Section 7.3 "Inspection".*
3. Lubricate the connector; see *Section 7.4.1 "Connector Maintenance and Lubrication".*

6.2 Storage

On completion of all procedures in the previous section the MRT can be placed in storage as described below. See *Table 6-1* for the recommended storage conditions.

1. Store the MRT in its transit case.
2. Equipment must be kept in a dry, non-condensing atmosphere (20% to 80% humidity), free from corrosive agents and isolated from sources of vibration.
3. The packaging should be stored on solid, level and damp-proof floors. It must not be stored directly on damp or dirt floors or areas prone to flooding. In this case suitable shelving raised off the floor should be used.
4. It is recommended to visually inspect the equipment at least annually.
5. When equipment is taken from low temperature storage for immediate use its temperature should be raised to normal operating temperature before use.

Table 6-1 Storage Conditions

Item	Specification
Storage Temperature	-20 to 55°C
Relative Humidity	20 to 80% (non-condensing)

Section 7 – Maintenance

Before any maintenance activity is carried out, make sure Section 2 – Safety is read and fully understood.

7.1 Retrieval from the Water

See *Section 6 – Retrieval and Storage*.

7.2 Cleaning

Note

Do not use any abrasive brushes or sharp tools to remove marine growth when cleaning the instrument as this will damage the protective coating and increase the risk of corrosion.

1. Thoroughly wash the MRT in warm clean fresh water to remove accumulations of salt, sand or silt, paying particular attention to electrical connectors.
2. Remove any attached cabling or dummy plugs and wash the external socket.
3. Dry the MRT and any attached cabling with a clean lint free cloth.
4. Replace any dummy plugs and protective caps.

7.3 Inspection

Inspect the MRT for the following:

1. Inspect the housing for signs of damage.
2. Inspect the connectors and cables for signs of abrasion, damage or corrosion.
3. Check the security of the connector by fitting the locking sleeve from the mating half of the connector, and check for movement. Any movement will require attention and the connector to be secured.

7.4 Scheduled Maintenance

To make sure the MRT provides long and effective service, it is important to carry out scheduled maintenance and recalibration processes.

The following table identifies the scheduled maintenance and the frequency of the activity.

Table 7-1 Scheduled Maintenance and Recalibration Timetable

Task	Occurance
Clean and Lubricate Connectors	Prior to each mating
Clean USBL Transceiver Array Face	6 months
Functional Test	Prior to deployment

7.4.1 Connector Maintenance and Lubrication

The connectors should be cleaned and lubricated using the manufacturer's recommended lubricant "Molykote 44 Medium" before each mating.

The connector should not be exposed to extended periods of heat or direct sunlight. If a connector becomes very dry, it should be soaked in fresh water before use.

To clean and lubricate the connectors:

1. Clean the connectors using a spray-based contact cleaner (isopropyl alcohol).
2. Apply a layer of grease to the female connector corresponding to a minimum 1/10th of socket depth.
3. The inner edge of all sockets should be completely covered, and a thin layer of grease left visible on the face of the connector.
4. After greasing, fully mate the male and female connector to optimise distribution of the grease on pins and in sockets.
5. Confirm that the grease has been sufficiently applied by de-mating and checking that grease is present on every male pin.
6. Re-mate the connectors.

7.4.2 Adaptor Flange O-Ring Seals

The adaptor flange O-rings should be checked and lubricated before each deployment.

1. Make sure the adaptor flange and the O-rings are clean and dry.
2. Inspect the O-rings for imperfections or damage.

7.4.3 Cleaning the USBL Transceiver Array Surface

The USBL transceiver array surface should be regularly cleaned to allow the transceiver array to function correctly; see *Section 7.4.3.1* below.

After continued use, hard and soft biofouling can cause degradation in positioning performance, as it will alter the way in which acoustic waves propagate across the face of the array. Hard biofoul can imbed in the array changing the physical properties of the array and soft biofoul can trap air close to the array face, both impacting the acoustic signal. Paint contamination of the front face of the array could cause significant life reduction due to incompatibility between the chemical composition of the paint and the array face material. In both cases it is recommended to remove the unwanted materials as quickly as possible; see *Section 7.4.3.2* below.

7.4.3.1 Routine Cleaning

On a six month cycle (or more frequent If needed) the following steps should be followed to maximise the operational life of the USBL transceiver.

1. Wash the transceiver array face in fresh clean water using a soft non-abrasive cloth.
2. Rinse the transceiver face with fresh clean water.
3. Dry the transceiver face using a non-abrasive towel.

Note

After cleaning, prior to immersion it is recommended that a wetting agent be applied to the face of the transceiver, such as a weak solution of washing up liquid and fresh water.

7.4.3.2 Removing Marine Growth and Overspray of Anti-Fouling Coatings

On a six month cycle (or more frequent depending on the operating conditions) the following steps should be followed to maximise the operational life of the USBL transceiver.

1. Wash down the transceiver and array surface with clean water and remove any loose biofouling or debris using a soft non-abrasive cloth.
2. Use a soft plastic scraper to remove stubbornly attached marine life such as barnacles, keeping the motion of the scraper flat across the surface (the array face does not have to be perfectly smooth when the process is finished).
3. Leave small pieces of very well attached biofouling in-situ (e.g. the rim of a limpet shell) and so avoid the risk of damaging the transceiver array.
4. Lightly sand the transceiver array using abrasive paper (such as 240 grit wet & dry) with lots of clean water to remove the final signs of biofouling or paint coating.

Note

Ensure the sanding is even and uniform across the whole face of the transceiver array.

5. Lightly wipe the transceiver array using an alcohol wipe to remove any final oil or grease residues.
6. Carefully examine the transceiver face for damage, such as small cracks which typically occur around the edges of where barnacles had been attached. If there are any defects deeper than 1 mm or you have any doubt about damage to the face, send a photograph to Sonardyne support for further advice.

Note

After cleaning, prior to immersion it is recommended that a wetting agent be applied to the face of the transceiver, such as a weak solution of washing up liquid and fresh water.

7.4.4 Functional Test

Before each deployment it is recommended to perform a functional test to confirm the transceiver is configured and functioning correctly; see *Section 8 – Functional Testing*.

Section 8 – Functional Testing

8.1 Introduction

To ensure the MRT functions correctly the following functional tests can be carried out:

- Connection between ESH and MRT
- Perform a system check using 6G Terminal Lite and produce a test report.

8.2 Test Equipment

8.2.1 6G Terminal Lite

6G Terminal Lite software is supplied on the 6G Utilities media; see *UM-8300-099-User Manual for 6G Terminal Lite*.

Testing of the transceiver can be carried out with an ESH using 6G Terminal Lite. The ESH will power the USBL transceiver if connected.

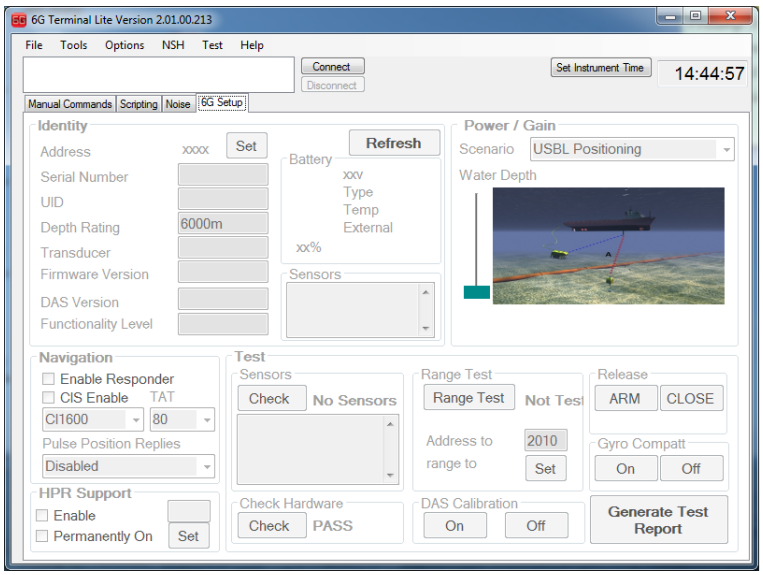
8.3 Connecting to the MRT

A socket (Ethernet) connection must be established for testing using 6G Terminal Lite.

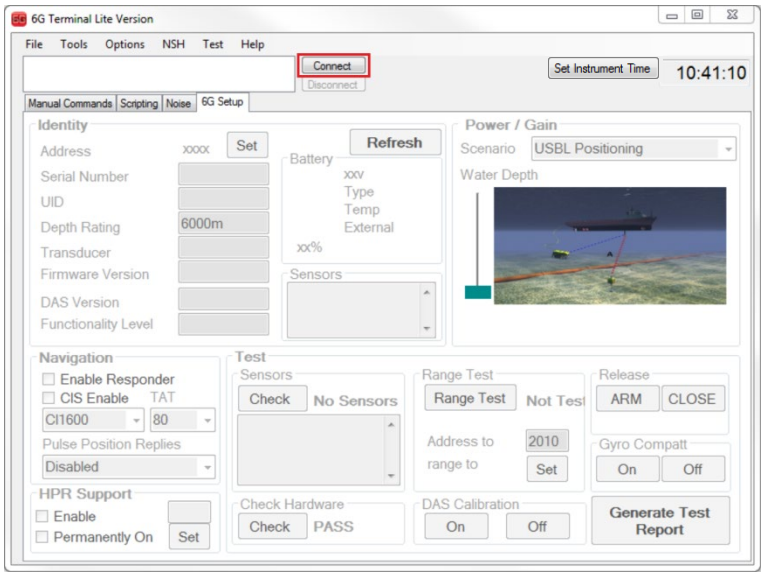
To connect to the MRT:

1. Double-click the **6G Terminal Lite** desktop icon to start the software.

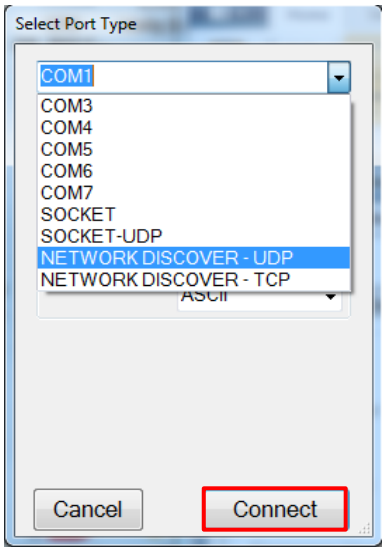
2. The 6G Terminal Lite dialog box will open on the **6G Setup** tab.



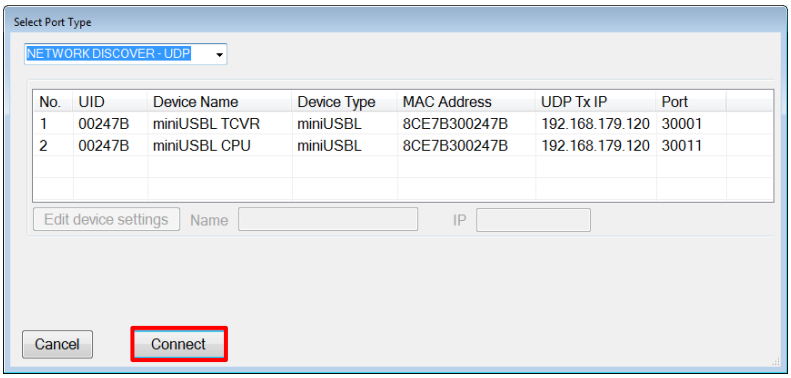
3. Click **Connect**.



4. On the drop-down list Select **NETWORK DISCOVER – UDP** and then click **Connect.**

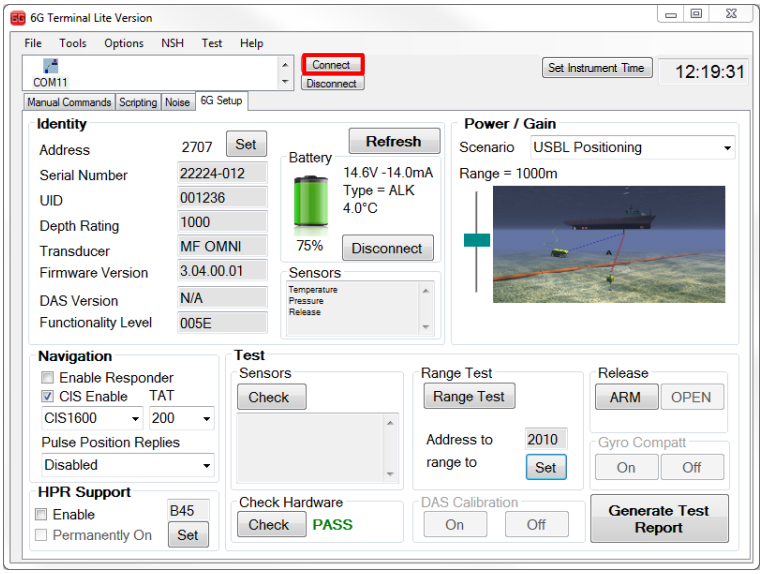


5. The device connected to the Ethernet port will be discovered as shown below:



6. Select the name with TCVR in the title, in the example above the device name is miniUSBL TCVR.

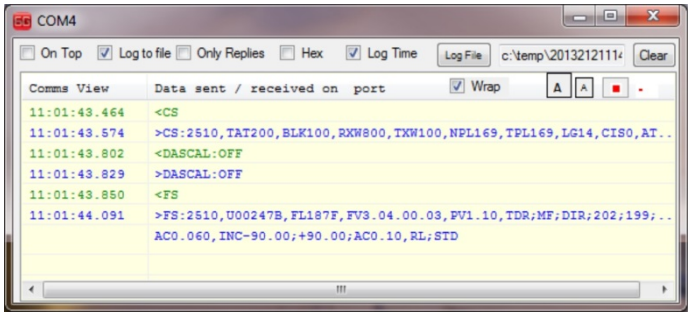
7. Click **Connect** (the **6G Setup** tab displays information on the connected USBL transponder including address, serial number, depth rating and battery status).



8. A **COM log** window will also open. The green writing indicates the commands sent from the software to the transponder, the blue writing is the transponders response.

Note

This window automatically logs all communications when open and should be left open to ensure communications are logged for diagnostic purposes.



8.3.1 No Communication between the PC and the USBL Transceiver

If the 6G Terminal Lite window does not populate or if no communication between the PC and the USBL transceiver appears in the communication window it may be necessary to check the network IP address.

Note

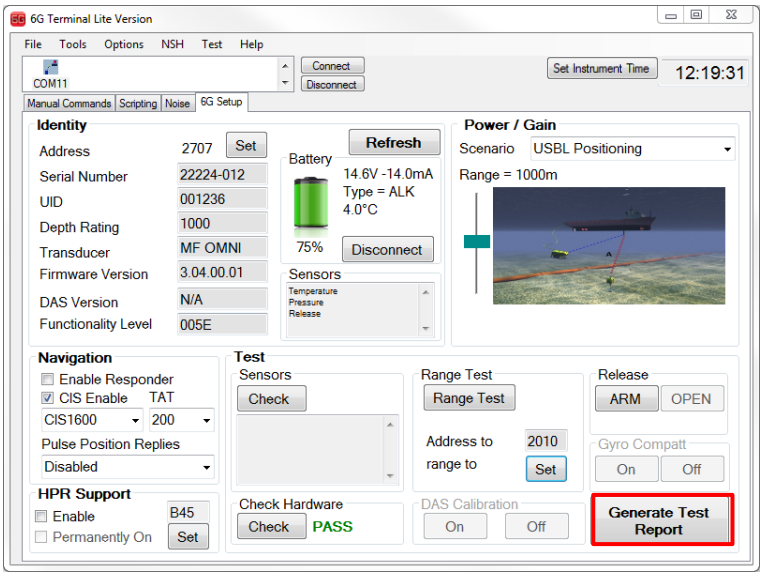
The Ethernet adaptor must be on the same subnet as the USBL transceiver: 192.168.179.x (where x is any number between 1–255 except 1,50, 51, 80, 120,150 & 200 as these are used by other Sonardyne instruments).

8.4 Testing

8.4.1 6G Test Report

Click **Generate Test Report** to generate a pdf report. The test report contains the following information:

- Hardware/Range/Sensor/Release tests, confirmation of tests performed and results; pass/fail.
- Unit status
- Settings
- Hardware identification
- Comms



Section 9 – Firmware Update

9.1 Introduction

The MRT can be updated by installing new versions of the firmware (the Sonardyne Support Team informs customers of any required firmware updates).

The MRT contains two processors that can both accept firmware updates

- TCVR
- CPU

The USBL transceiver can accept firmware updates via connections made to the ESH. The firmware can be updated in two ways:

- Using 6G Terminal Lite software
- Using Micro-Ranger 2 software

The two procedures are described in *Sections 9.2* and *9.3* below.

Note

Micro-Ranger 2 software can only update the TCVR firmware at this time

9.2 Updating USBL Transceiver Firmware using 6G Terminal Lite

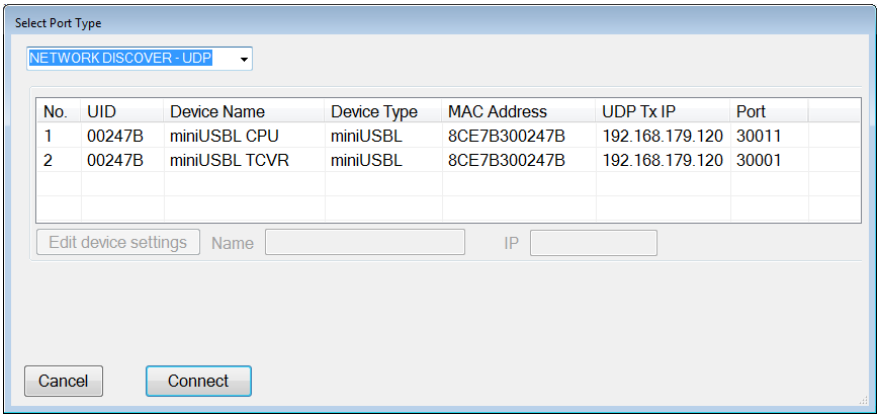
9.2.1 Prerequisites

Before updating the firmware, make sure the following is available:

- The new firmware file
- A 6G Terminal Lite software installation

9.2.2 Updating the Firmware

1. Connect to the MRT; see Section 8.3 “Connecting to the MRT”.
2. Select the processor to update
   - 1 = CPU
   - 2 = TCVR

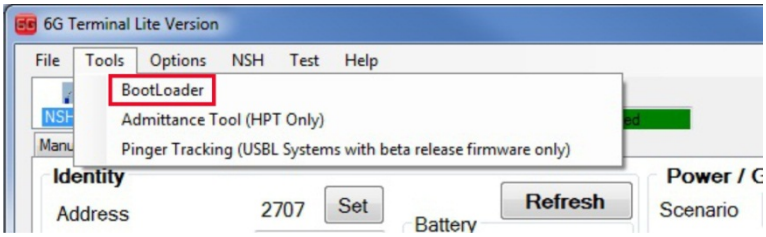


Notes

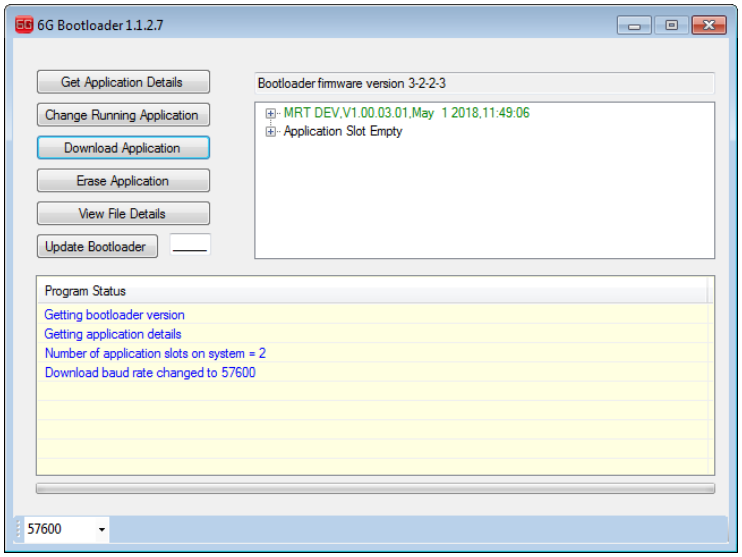
If using Ethernet device discovery and the unit cannot be discovered, the instrument cannot be upgraded until the connection issue is resolved.

If communications do not appear in this window the 6G bootloader can still be started (see the following step).

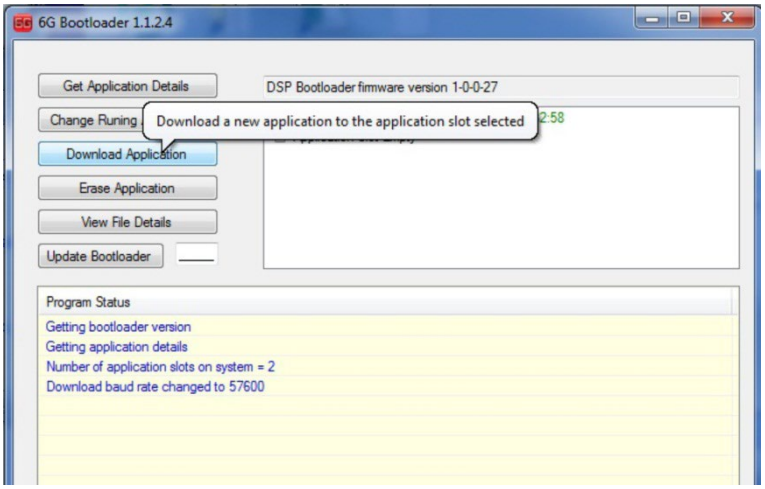
3. On the **Tools** menu, click **Bootloader**.



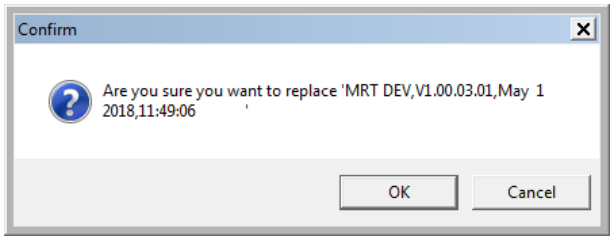
4. The **6G Bootloader** window displays the current firmware installed in the USBL transceiver.



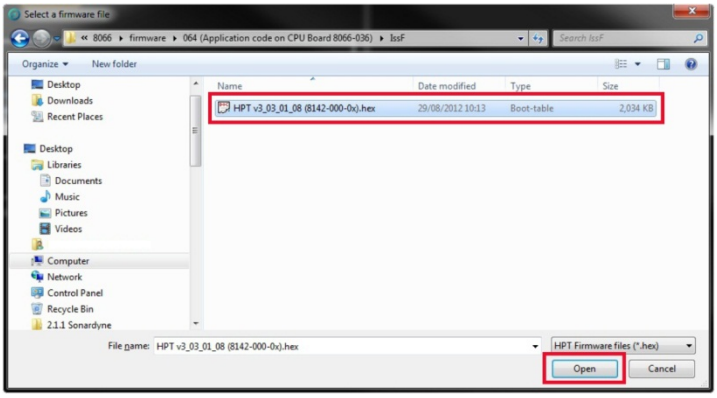
5. Click **Download Application.**



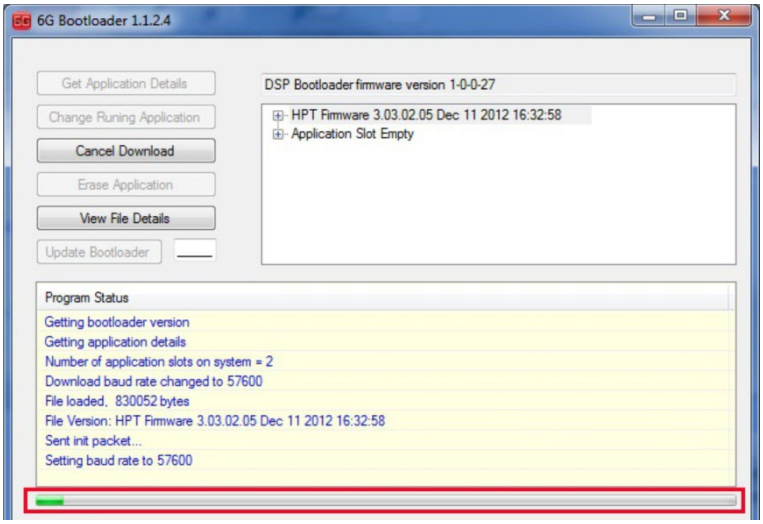
6. A warning dialog box will appear to confirm that the firmware will be replaced; Click **OK** to proceed.



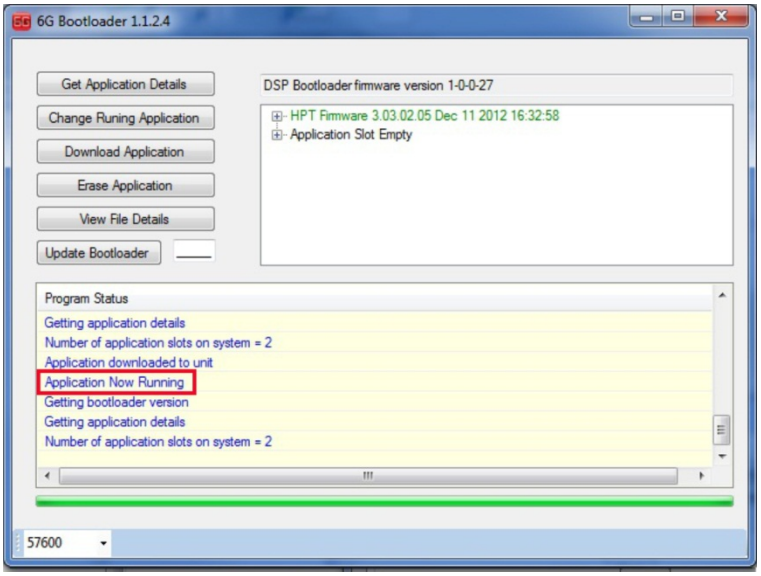
7. On the **Select a firmware file** dialog box, navigate to and select the new firmware file and then click **Open**.



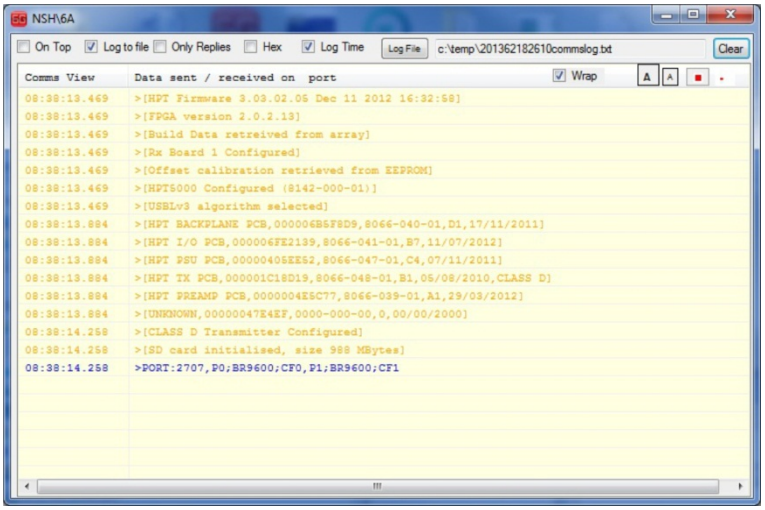
8. The **Select a firmware file** dialog box will close.
9. The **6G Bootloader** dialog box displays the progress of the firmware installation.



10. The firmware installation will be complete when the progress bar is completely green and **Application Now Running** appears in the **Progress Status** list.



11. Close the **6G Bootloader** dialog box and return to the **6G Terminal Lite** dialog box.
12. After a short pause, communication between the USBL transceiver and the software will begin (this can be viewed in the communications window).



13. Communication indicates the firmware upload has been successful.

9.3 Updating USBL Transceiver Firmware using Micro-Ranger 2

Note

Micro-Ranger 2 software can only update the TCVR firmware at this time.

9.3.1 Prerequisites

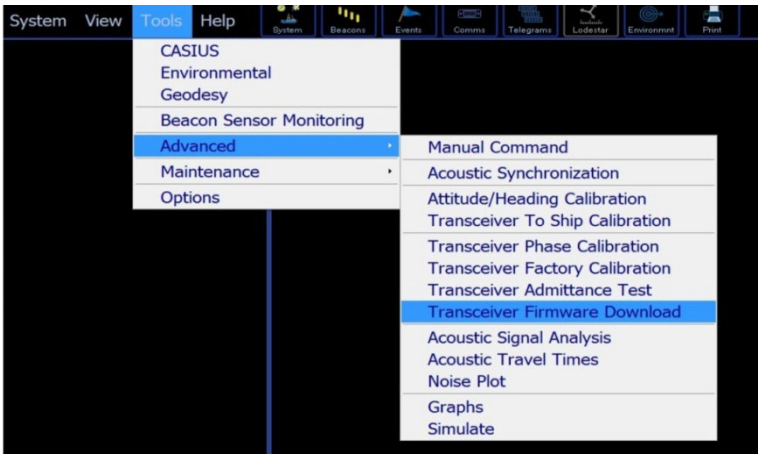
Before updating the firmware, make sure the following are available:

- The new firmware file
- A Micro-Ranger 2 Software Installation

9.3.2 Updating the Firmware

Start the Micro-Ranger 2 software.

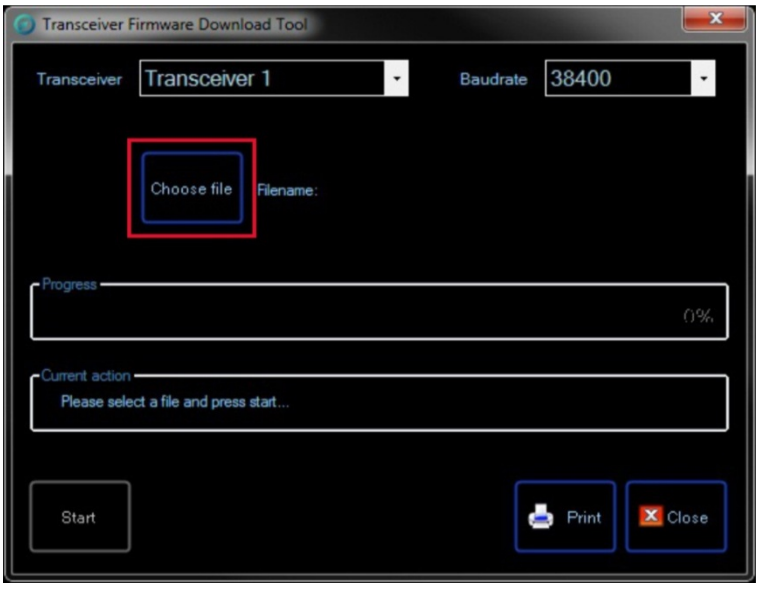
1. On the **Tools** menu, click **Advanced>Transceiver Firmware Download**.



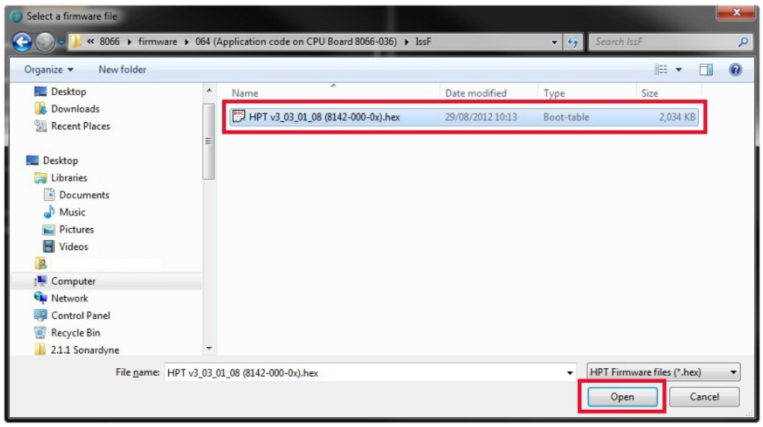
2. On the **Transceiver Firmware Download Tool** dialog box, select the current USBL transceiver and baud rate from the **Transceiver** and **Baud rate** drop-down lists and then click **Choose file.**

Note

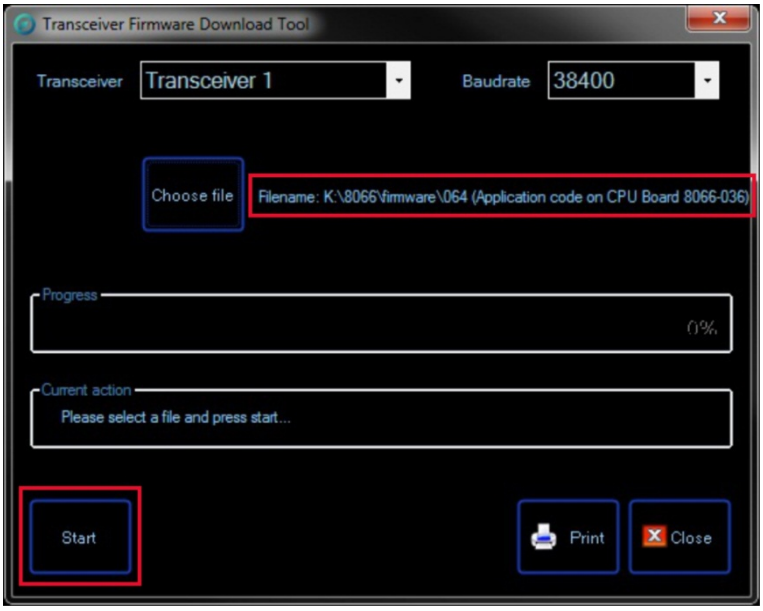
If performing a default update, the USBL transceiver and baud rate need to be changed.



3. On the **Select a firmware file** dialog box, navigate to and select the new firmware file and then click **Open**.



4. The **Select a firmware file** dialog box will close.
5. On the **Transceiver Firmware Download Tool** dialog box, the firmware location will be displayed. Click **Start** to begin the download.



6. A **Progress** bar displays the rate of download.
7. Once the download has completed, the **Transceiver Firmware Download Tool** can be closed.
8. If the USBL transceiver doesn't re-connect this could indicate the firmware update was unsuccessful; see *Section 10 – Fault Diagnosis*.

Section 10 – Fault Diagnosis

10.1 Introduction

If the USBL transceiver system fails to operate refer to the following fault diagnosis to determine the possible cause and the action to take. If the USBL transceiver fails to operate after following the fault diagnosis below, contact Sonardyne Support.

10.1.1 No Communication from the USBLTransceiver

Use the following fault diagnosis table to help diagnose the fault (see *Section 12.4 "MRT to ESH Cable CPN 820-0373"* for the interconnection details).

Table 10-1 Fault Diagnosis Table

Fault	Possible Cause	Action
No communication from the USBL Transceiver	Wiring connections	Check all LEDs on the ESH to confirm power is available to the USBL transceiver (if power is available refer to Subconn Connector).
	No power	Check all USBL transceiver connections (see *Section 4.4 "MRT Interconnections"*).
		Make sure the Micro-Ranger 2 software is running correctly on the attached PC and the USBL transceiver has been added to the correct port.
		Make sure the power supply is available and connected securely.
	Subcon 8-way connector	Unplug the Subcon connector and check the 48 V pin outs of the pins.
	Ethernet Adaptor Subnet (for Ethernet connected USBL transceiver)	Check that the Ethernet adaptor is on the same subnet as the USBL transceiver: 192.168.179.x (where x is any number between 1–255 except 1, 50, 51, 80, 120, 150 & 200 as these are used by other Sonardyne instruments).

Section 11 – Spares

11.1 Introduction

When ordering spare parts, please provide:

1. The part number
2. The drawing number (if known)
3. A description

Enquiries about, or orders for spare parts should be directed to your local Sonardyne office or agent. Local agents contact details can be viewed at www.sonardyne.com and contact details are shown at the end of this manual:

11.2 Recommended Spares

The following is a list of available spares.

11.2.1 MRT

CPN	Drawing No	Description	Qty
800-0383	8243-014	Isolator plate	1

11.2.2 Cables

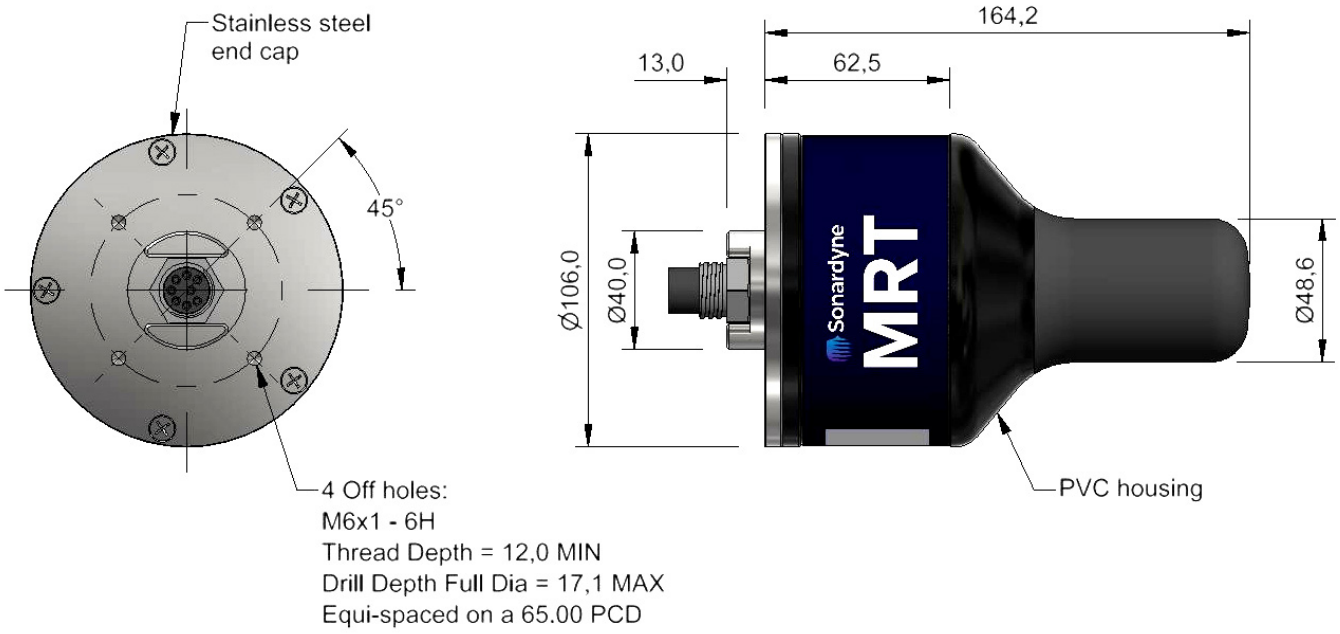
CPN	Drawing No	Description	Qty
820-0373	8243-061	MRT to ESH cable 10 m	1
820-0375	8243-061	MRT to ESH cable 30 m	1
820-0376	8243-061	MRT to ESH cable 50 m	1
820-0447	8243-080	MRT to Micro-Ranger 2 Portable Topside	1

Section 12 – Technical Specifications

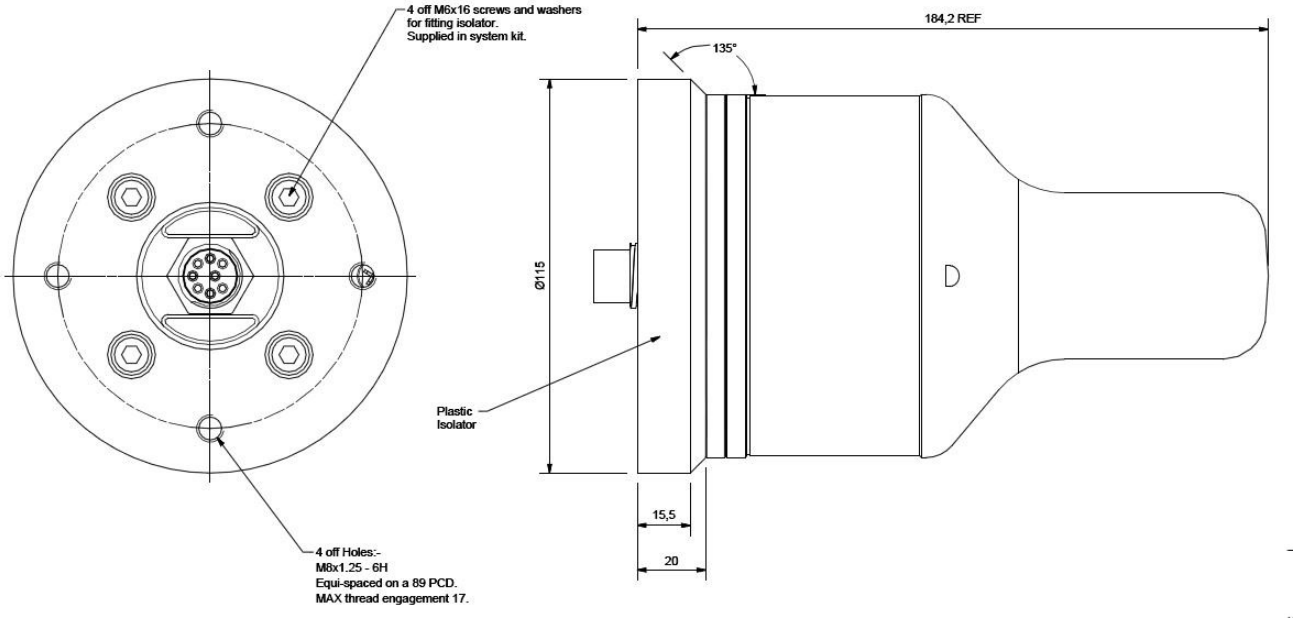
12.1 Type 8243 MRT Specifications

Feature	Type 8243
Operational Frequency	MF (19–34 kHz)
Operating Range	Up to 995 metres
Depth Rating	25 metres
Acoustic Coverage	Greater than 200º
Range Accuracy*	Better than 15 mm
Angular Accuracy*	±3º
Transmit Source Level (re 1 uPa @ 1 m)	184 dB
Electrical	48 V dc (±10%) typical 1.5 W, Max 25.5 W
Communication	Ethernet 100 Mbps
Operating Temperature	-5 to 40ºC
Storage Temperature	-20 to 55ºC
Mechanical Construction	Stainless steel 316, PVC and polyurethane
Dimensions; Height x Diameter	177 mm x 106 mm (excluding connector)
Weight in Air/Water	1.84/0.99 kg
*Note: The absolute accuracy of the system is dependent upon the quality of internal attitude and heading sensor which can be influenced by outside sources such as magnetic material, beacon source level, vessel noise, water depth, mechanical rigidity of the transceiver deployment, sound velocity knowledge and proper calibration of the system.	

12.2 Type 8243 MRT Outline Drawing



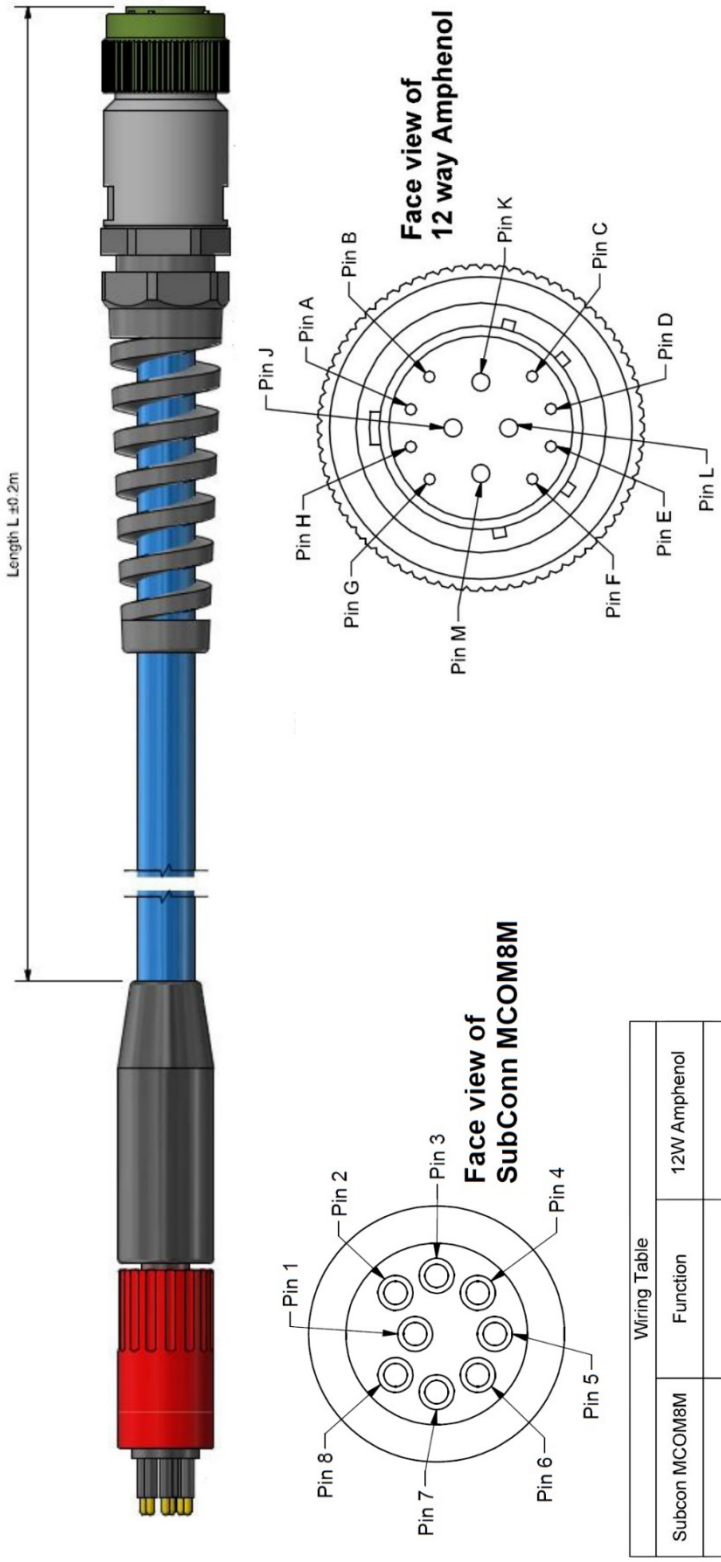
12.3Adaptor Flange Isolator Outline Drawing



12.4 MRT to ESH Cable Assembly – CPN 820-0373

The MRT to ESH cable and pin details are shown below.

Figure 12-1 MRT to ESH Cable CPN 820-0373

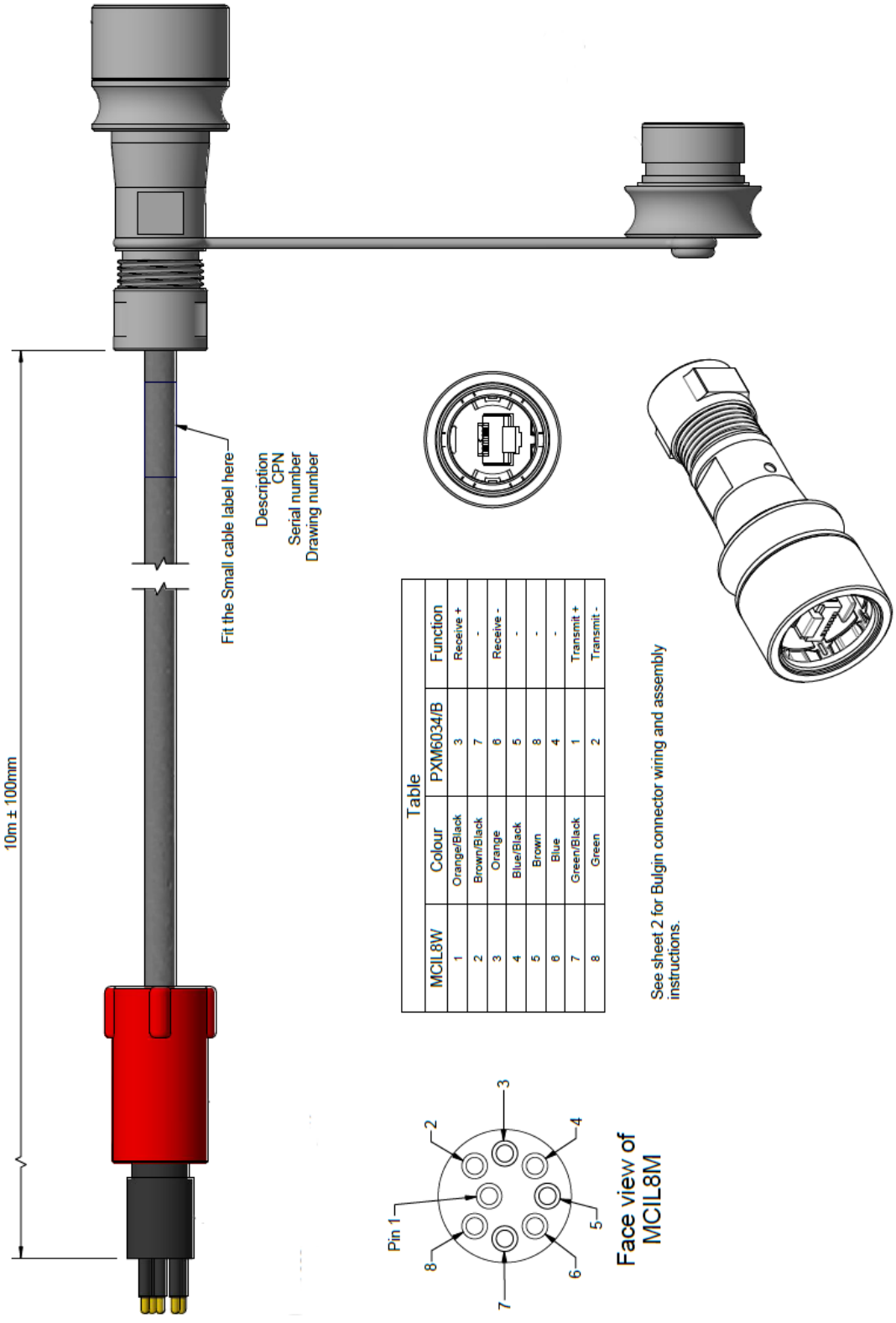


Stock Code Table		
Length L	Item 10	Assembly CPN
10 m	312-6573	820-0373
30 m	312-6572	820-0375
50 m	312-6571	820-0376
100 m	312-6570	820-0378

Wiring Table		
Subcon MCOM8M	Function	12W Amphenol
4	Power	J
1	ETH_Tx +	K
3	ETH_Tx -	L
7	ETH_Rx +	A
8	ETH_Rx -	B
2	Power return	M

12.5 MRT to Micro-Ranger 2 Portable Topside Cable Assembly – CPN 820-0447

The MRT to Micro-Ranger 2 Portable Topside cable and pin details are shown below.



Table

MCIL8W	Colour	PXM6034/B	Function
1	Orange/Black	3	Receive +
2	Brown/Black	7	-
3	Orange	6	Receive -
4	Blue/Black	5	-
5	Brown	8	-
6	Blue	4	-
7	Green/Black	1	Transmit +
8	Green	2	Transmit -

Appendix A – Acoustic Navigation Principles

A.1 Acoustic Processing Principles

The two tasks the USBL transceiver performs in the acoustic domain are as follows:

- Positioning
- Data Exchange

Although these functions may seem like separate tasks, precise positioning information is always available as a result of the data exchange.

A.1.1 Positioning

Positioning involves an acoustic cycle. The USBL transceiver sends a Sonardyne Wideband®2 signal to the transponder. This activates the transponder which sends back a Sonardyne Wideband®2 signal to the USBL transceiver. The USBL transceiver will process the information received from the transponder as follows:

- Range
- Azimuth
- Elevation

Other parameters which are available as a result of the processing are as follows:

- Signal strength
- Signal to Noise Ratio (SNR)
- Doppler
- Detailed channel estimate which allows multipath to be tracked

The DFE cycle goes through the stages that follow:

- The DFE commands the USBL transceiver to transmit an interrogation signal.
- The transponder replies are detected by the USBL transceiver which measures the elapsed time and bearing.
- The data is reported to the DFE; at the same time the DFE will have received the vessel's Heading, Roll and Pitch (HRP) data.
- The DFE computes the position of the transponders relative to the vessel and reports the data to the DP system.
- If heading data is present, the processor can compute the position of the vessel (in a North referenced grid) relative to the transponder fixed to the seabed.
- Without heading data, vessel position would only be known in terms of range, bearing and elevation from the transponder.

Navigation cycles may contain multiple replies to allow many transponders to be tracked simultaneously.

A.1.2 Sonardyne Wideband® 2 Signals

There are more than 600 Sonardyne Wideband 2 signals. The different signals means the system can be adjusted to various environmental conditions e.g. deep or shallow water and allow accurate Doppler estimates of the target being tracked.

The latest processing techniques allow range accuracies of millimetres (excluding error contributions' from environmental effects).

Using the Sonardyne Wideband 2 signals the USBL transceiver will also provide a precise position estimate. This estimate is then passed to the surface controller as a direction cosine allowing an X, Y, Z position to be computed by the navigation controller.

A.1.3 Data Exchange

The acoustic data exchange between USBL transceiver and transponder is in the form of setting up the transponder. The acoustic data exchange is also used for data retrieval from the transponder. This could be a 'real time' retrieval of a sensor measurement or an upload of stored data.

The USBL transceiver has many options of acoustic telemetry. It ranges from a secure Spread Spectrum (SS) wideband telemetry at 100 bps to a High Data Rate (HDR) transmissions of 6000 bps (user data). The unit has many levels to allow the system to adapt to the most efficient and robust data exchange.

A.2 USBL

The USBL system can be used to track Remotely Operated Vehicle (ROV), Tow fish and divers relative to the vessel. It can also be used as a position sensor for a vessel during Dynamic Positioning (DP).

A.2.1 ROV/Tow Fish Tracking

A transponder is placed on an ROV, tow fish or diver as applicable. The USBL system will track the depth and bearing of the ROV, tow fish or diver relative to the vessel.

A.2.2 Dynamic Positioning

Dynamic Positioning (DP) control of a vessel removes the need to anchor the vessel. The DP system receives information from the DFE. The DFE receives information from the Vertical Reference Unit (VRU), Gyro Compass and Digital Global Positioning System (DGPS). A DP vessel is fitted with a number of thrusters located in the hull, in addition to the main propellers. The thrusters and propellers are managed by the DP system to keep the vessel on a constant heading and in a constant position whatever the forces from wind, current and wave action.

For the DP application to function with USBL a reference transponder is placed on the seabed and the position of the transponder or array in the vessel frame is reported to the DP control system. This is done by using the repeating acoustic ranging cycles from the USBL transceiver.

Another method is to place a transponder on a ROV following a line feature such as a pipeline. The USBL/DP system will then control the vessel to follow the ROV. This can be referred to as "the dog on a lead" or "follow the sub" principle.

A.3 LUSBL

The USBL transceiver can be used in a LUSBL configuration to provide a higher degree of accuracy in DP applications.

A.3.1 Dynamic Positioning

For the DP application to function with LUSBL, an array of transponders is placed on the seabed and the position of the transponders or array in the vessel frame is reported to the DP control system. The USBL transceiver measures the range and bearing to multiple transponders in one ranging cycle, and reports the results.

A.3.2 Underwater Positioning

The greater accuracy of the LUSBL system is required, when the position of an underwater structure needs to be known more accurately than can be achieved by any other method. By deploying more than one transponder, the LUSBL is able to use statistical filtering techniques to reduce the impact of system errors.

A.3.3 Marine Riser Angle Monitoring

Setup and control functions for a Marine Riser Angle Monitoring System (MRAMS) are built into the L/USBL system. The MRAMS alarm levels can be displayed on the LUSBL screen while in Navigation mode. The MRAMS constantly measures the angle between the Blow-Out Preventer (BOP) and the riser.

A.4 Long Base Line Principles

Refer to *Figure F–1*. A Long-Base-line (LBL) system has two parts or segments.

The first segment comprises a number of acoustic transponders moored in fixed locations on the seabed. The positions of the transponders are described in a co-ordinate frame fixed to the seabed. The distances between them form the “baselines” used by the system.

The second segment comprises an acoustic transducer on a USBL transceiver which is temporarily installed on the vessel, or on a Tow Fish. The distance from a transducer to a transponder can be measured by causing the transducer to transmit a short acoustic signal which the transponder detects and causes it to transmit an acoustic signal in response. The time from the transmission of the first signal to the reception of the second is measured. As sound travels through the water at a fixed speed, the distance between the transducer and the transponder can be estimated.

The process is repeated for the remaining transponders and the position of the vessel relative to the array of transponders is then calculated or estimated.

Navigation can be achieved using just two seabed transponders but in doing this there is a possible doubt as to which side of the baseline (a line drawn between the transponders) the vessel may be on, also the depth or height of the transducer has to be assumed.

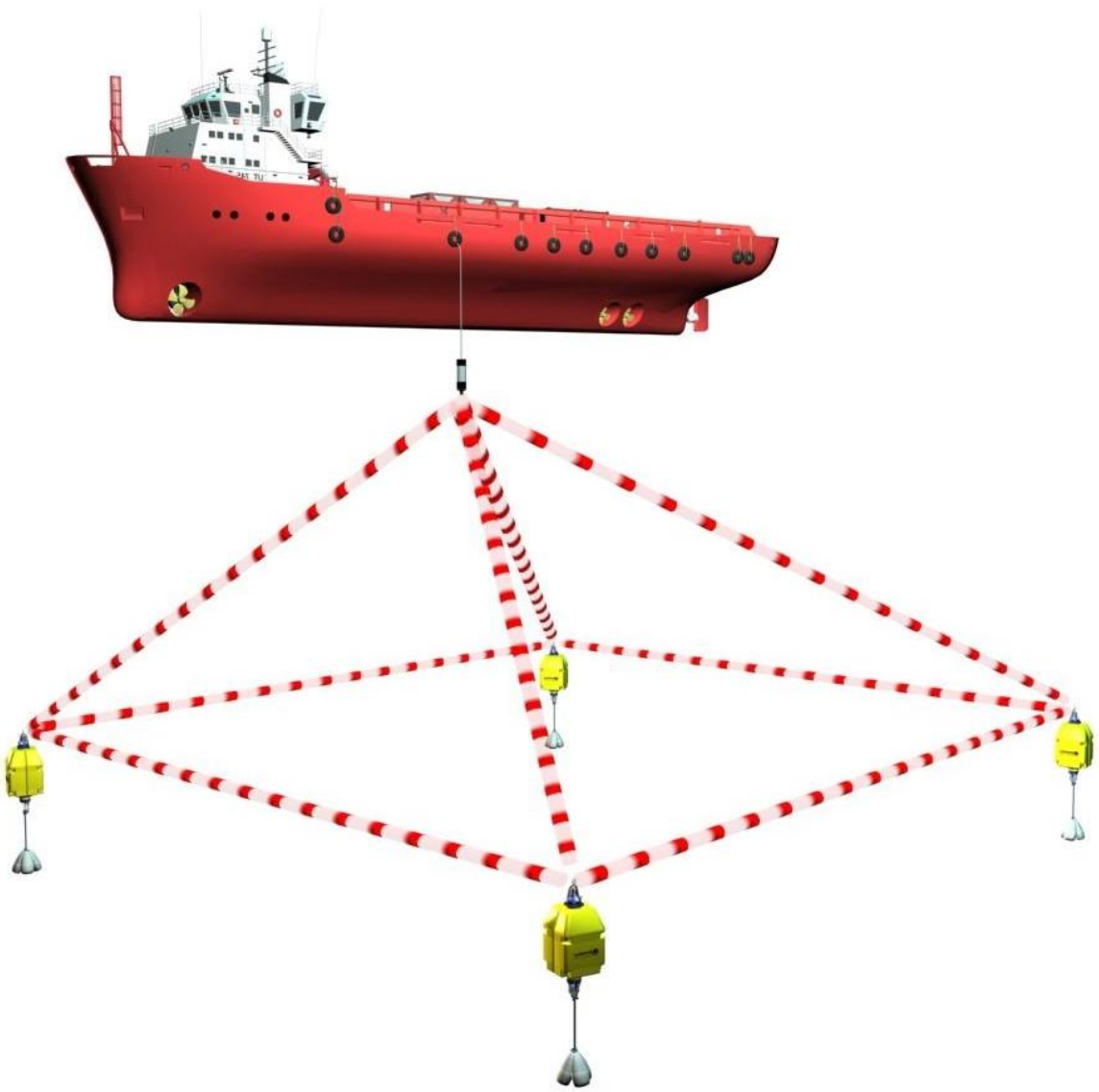
Three transponders is the minimum required for certain navigation in three dimensions. Four is the minimum number required for some degree of redundancy—which is useful for checks on the quality of navigation.

LBL baselines are much larger, so an LBL system is very accurate compared with the Short Base Line (SBL) and Ultra Short Base Line (USBL) versions and also has the advantage of positioning the vessel (or any other object) directly in a "fixed" or an inertial frame. This removes most of the problems associated with vessel motion.

The array of seabed transponders needs to be calibrated and there are several techniques to do this. The applicable technique depends on the requirements of the task or job and the available hardware.

With the continuing integration of LBL, SBL and USBL systems, intelligent transponders (that measure baselines directly) and satellite navigation systems, the calibration of seabed arrays is becoming a quick and simple operation. The operator will be free to choose the techniques applicable to the task requirements.

Figure A-1 LBL System



A.5 Short Base Line Principles

Refer to *Figure F–2*. A SBL system is can be fitted to a vessel such as a barge, semi-submersible or a large drilling vessel. A number of at least three or four acoustic transducers are fitted in a triangle or a square on the lower part of the vessel. The distance between the transducers is made as large as is practical, and it is this distance that is known as the base line.

The position of each transducer within a co-ordinate frame fixed to the vessel is determined by conventional survey techniques or from the "as built" survey of the vessel.

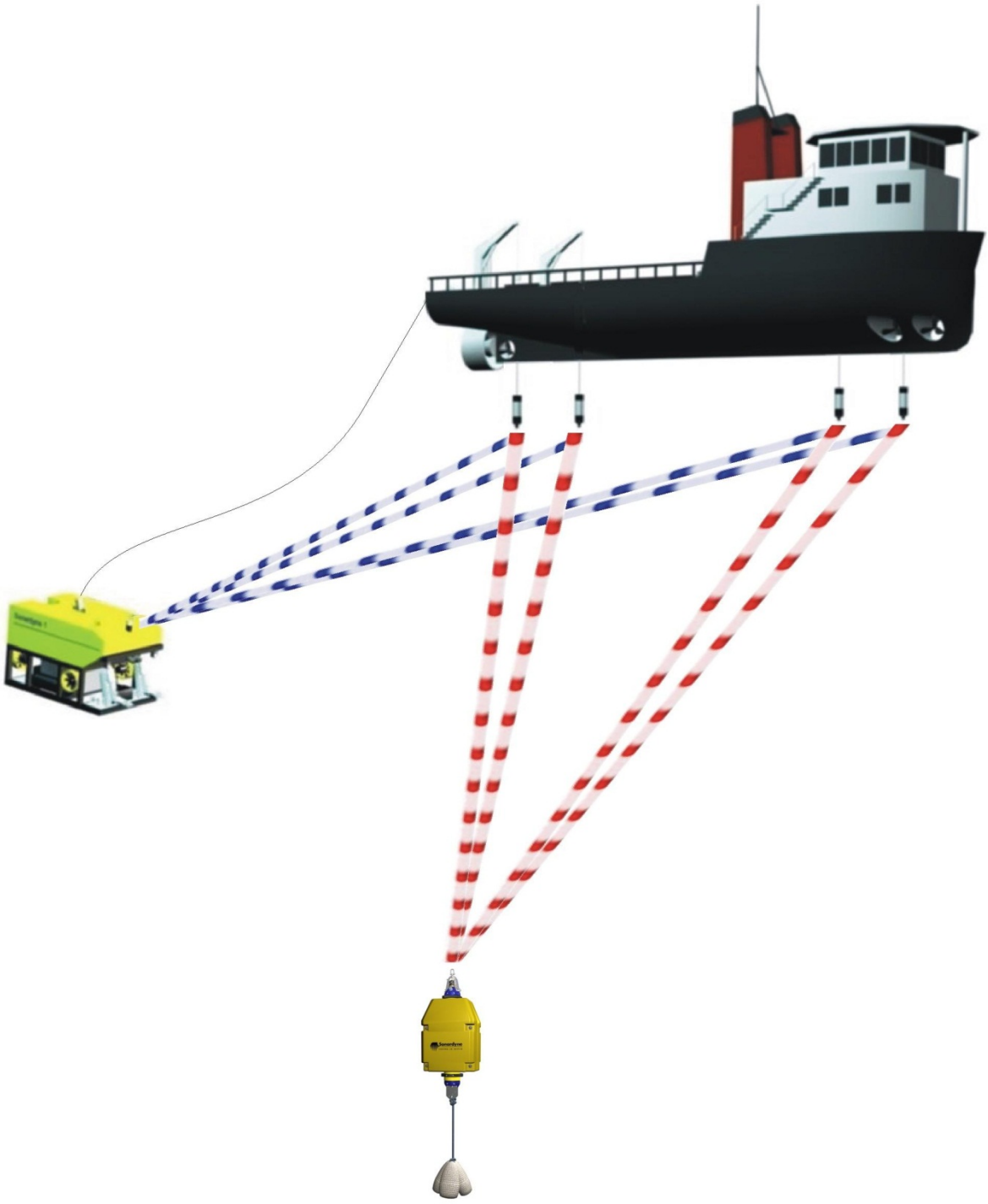
If the distance from the transducers to the transponders is measured as described for LBL, then the position of the transponders, within the vessel co-ordinate frame, can be computed. If redundant measurements are made, a best estimate can be determined which is, statistically, more likely to be more accurate than the basic position calculation.

It is impractical to transmit a signal from each SBL transducer in turn, so the systems that use transponders transmit from one transducer but receive simultaneously on all transducers. The result is one distance (or range) measurement and a number of range (or time) differences.

With an SBL system, the co-ordinate frame is fixed to the vessel. The vessel is subject to roll, pitch and yaw motion. This movement can be overcome by using additional equipment such as a VRU to measure roll and pitch and a Gyro-compass to measure yaw. The co-ordinates of the transponders can then be calculated mathematically to remove the effect of the movement.

To estimate the position of the vessel in a "fixed" or "inertial" frame such as one fixed to the seabed. Then at least one transponder should be in a fixed position on the seabed and used as a reference point. This principle is used for Dynamic Positioning (DP) of vessels. If a transponder is fixed to the seabed and a responder located on an ROV, the system will calculate the position of the vessel and the ROV in a seabed-fixed frame.

Figure A-2 SBL System



A.6 Ultra Short Base Line Principles

Refer to *Figure F–3*. USBL transducers are all built into a single USBL transceiver assembly—or the array of transducers is replaced by an array of transducer elements in a single USBL transceiver assembly.

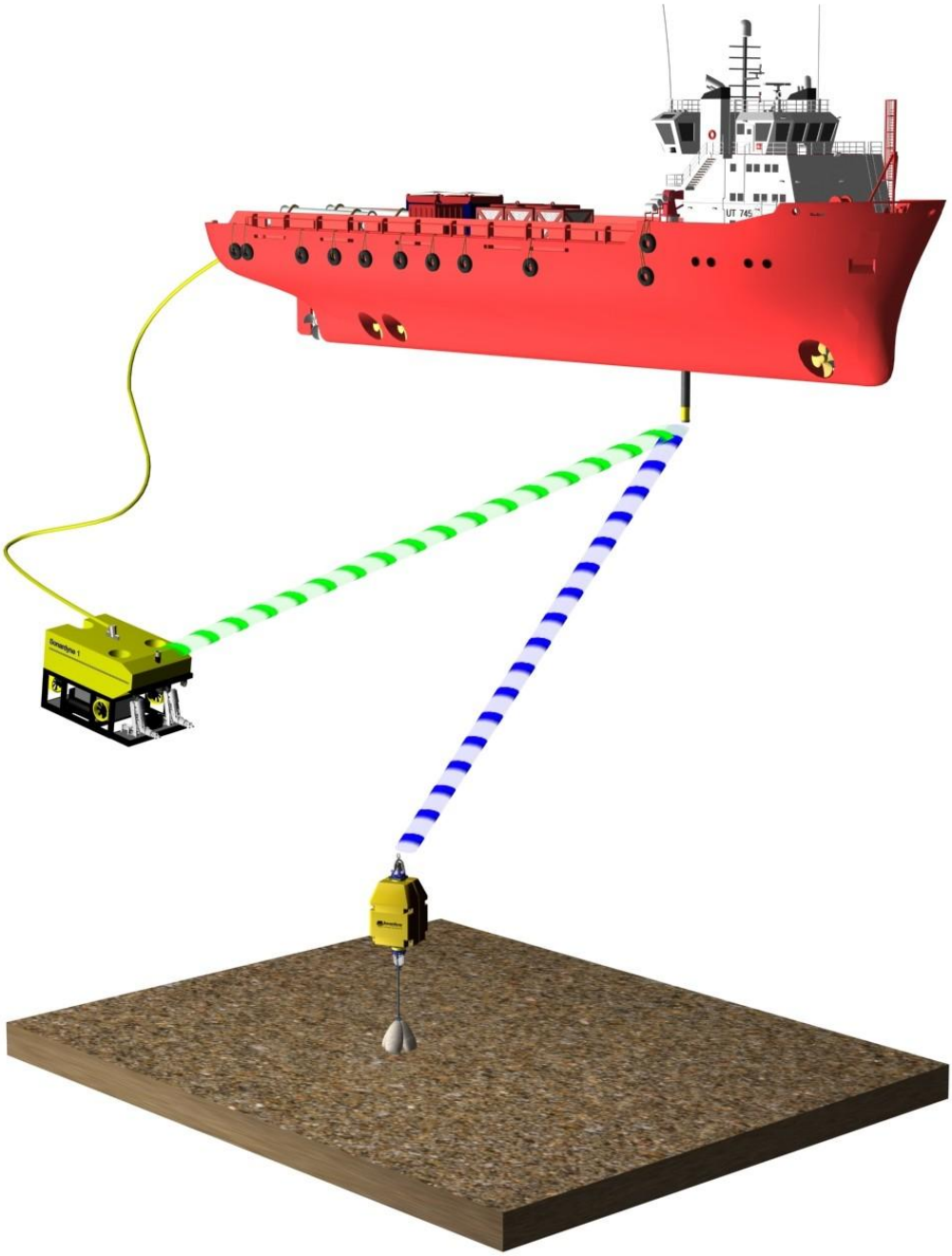
The distances or ranges are measured as they are in an SBL system but the time differences are now much less. Systems using sinusoidal signals measure the "time phase" of the signal in each element with respect to a reference in the receiver. The "time phase differences" between transducer elements are computed by subtraction and then the system is equivalent to an SBL system.

Similar rules apply in that systems using three elements (or groups of elements) have the same restrictions as SBL systems with three transducers. USBL systems using four elements have the same restrictions as SBL systems using four transducers and so on.

Another restriction is that if an unambiguous position within a hemisphere is required and there are only three elements or element groups in use, then the element spacing must be less than one-half wavelength of the signal. Alternatively, a prior set of measurements must have been made with an element spacing of less than one-half wavelength.

Another difference is that the transducer elements are in a USBL transceiver assembly that is placed somewhere in the vessel frame. The attitude of the assembly in the vessel frame must be measured during installation. A USBL system positions a transponder in a frame fixed to the USBL transceiver assembly, not directly in a vessel-fixed frame as in the SBL case.

Figure A-3 USBL System



A.7 Long Ultra Short Base Line Principles

Refer to *Figure F–4*. The Long Ultra Short Base Line (LUSBL) system is a variation of a USBL system. It uses USBL hardware in a configuration similar to the one described for the LBL system.

The range and bearing in a LUSBL system is measured as for a basic USBL system, but a larger number of transponders are deployed on the seabed, so a greater accuracy can be achieved.

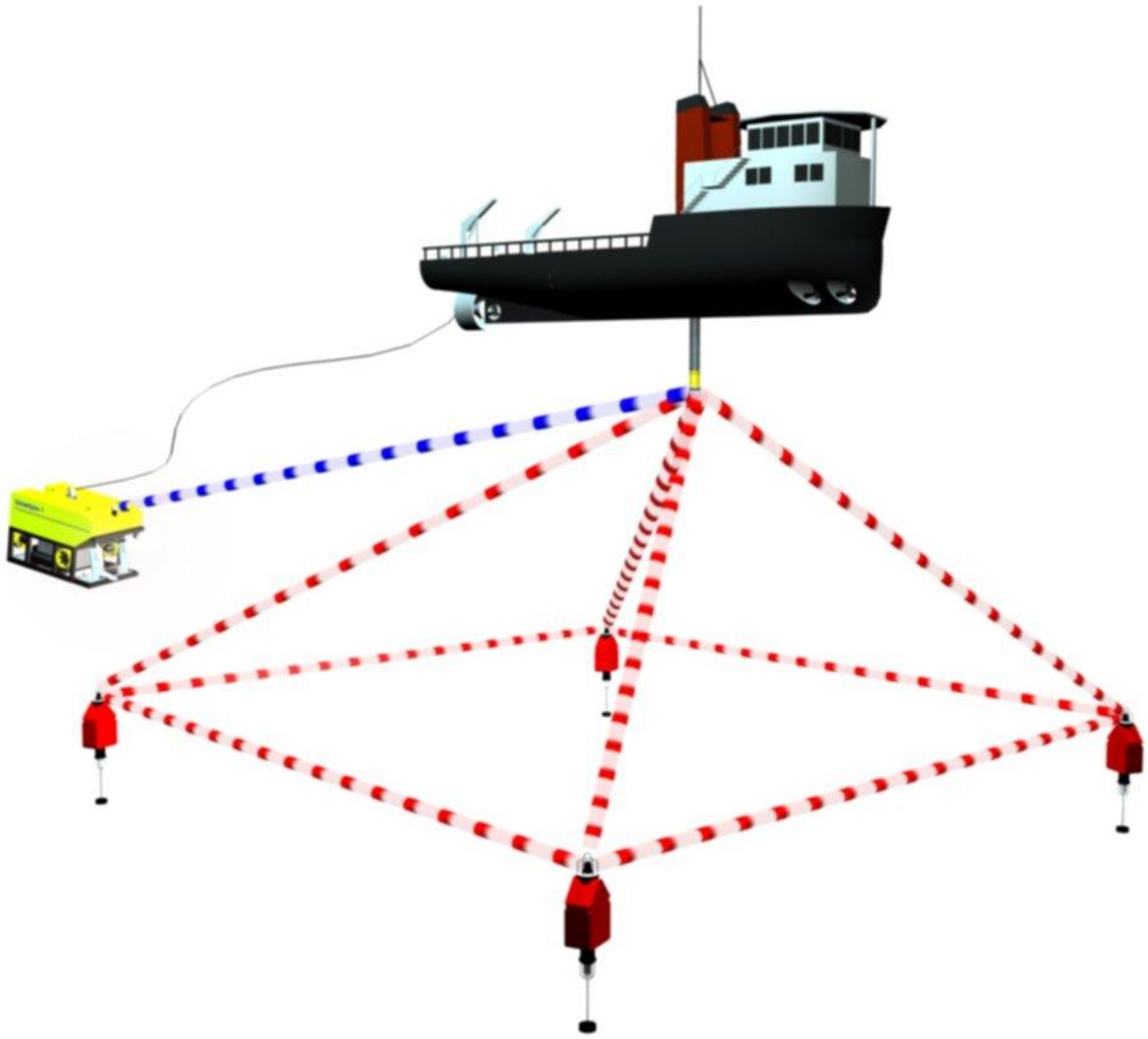
In a LUSBL system, the seabed array must be calibrated separately and the baseline data entered manually into the LUSBL navigation processor. If a radio navigation input is available to the LUSBL system, it is possible to locate each seabed transponder directly in an earth-referenced frame to an accuracy determined by the accuracy of the radio navigation system. Using this method removes the need for the separate calibration of the seabed transponder array.

If transponders of the COMPATT type are used on the seabed, it is possible for the seabed array, under command from the LUSBL system, to be self-calibrating. Using COMPATT transponders has the advantage of giving the system more flexibility so they can be commanded to respond to a variety of frequencies and with any delay time. As an operator, the COMPATT version of the system is simpler and faster to set up and use.

Two complete sets of LUSBL equipment (navigation processor, monitor/keypad and transceiver) may operate in tandem to form a dual-redundant version of the system. The two sub-systems are cross-linked in the event of a failure of any major element. The system operation will continue without operator intervention. As an operator, the operation of the dual-redundant version is almost the same as a standard version.

In operation, one of the sub-systems operates as the “master system” and performs all normal system functions. The second sub-system monitors the function of the “master system” and will take over system operation if it detects that the “master system” is not functioning.

Figure A-4 LUSBL System



Definitions

Term	Definition
6G®	Sonardyne's sixth generation technology hardware platform.
BOP	Blowout Preventer
COMPATT	COMPuting and Telemetry Transponder (see Acoustic Intelligent Transponder).
Control Hub	The Control Hub is integrated into the Micro-Range 2 portable topside case and performs a similar function to the ESH
CPN	Computer Part Number
CPU	Central Processing Unit
DFE	Data Fusion Engine. Acts as the system controller, generates the display signals for the monitor, processes the data from the transceiver for the display to the operator and output to a DP system and talks to various "attitude" sensors and other navigation systems.
DGPS	Differential Global Positioning System
DP	Dynamic Positioning
ESH	Ethernet Serial Hub
HRP	Heading, Roll and Pitch
LBL	Long Base Line
LUSBL	Long and Ultra Short Base-Line
MF	Medium Frequency
MRAMS	Marine Rise Angle Monitoring System
MRT	Micro-Ranger Transceiver
PC	Personal Computer
PCD	Pitch Circle Diameter
ROV	Remotely Operated Vehicle
SBL	Short Base Line
SNR	Signal to Noise Ratio
Sonardyne	Sonardyne International Limited and its affiliates.
Sonardyne Wideband®2	6G® transponders and transceivers use Sonardyne Wideband® 2 ultra-wide bandwidth signals giving a faster and robust transmission of data, more precise ranging and mitigation from multipath in shallow water and amongst steel structures in deep-water.
SS	Spread Spectrum
TCVR	Transceiver
UDP	User Datagram Protocol
USBL	Ultra-Short Base Line
VIV	Vortex Induced Vibration
VRU	Vertical Reference Unit

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