Sonardyne
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UM-8142

User Manual for Type 8142 HPT USBL Transceivers, Type 8182 HPT Modem/ Transceivers and HPT Variants

Issue B Rev 0

Date of Issue: 12 May 2014

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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	0	20/10/2010	Initial Issue	All	All
B	0	12/05/2014	Complete reformat to comply with new branding. Reviewed and updated.	All	All

Section 1 – Introduction

1.1 About This Manual

This User Manual describes the safe installation, operation and maintenance of HPT based transceivers. The information and procedures within this manual are based on Sonardyne's experience and knowledge.

To make sure the safety of the installer and operator is maintained it is important that all warnings, cautions and the Safety Section in this manual, as well as the warnings, cautions and Safety Section of any additional manuals are read and understood.

1.2 Intended Audience

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. **Appendix F** gives an overview on acoustic navigation principles.

1.3 Related Publications

To make sure the system is operated safely, a Safety Manual is supplied with this User Manual. It is important the Safety Manual is read and understood before proceeding with any activity on the equipment.

The related publications are:

Table 1–1 – Related Publications

Publication	Title
Safety Manual	Safety Manual
UM-8300-099	6G Terminal Lite User Manual
UM-8251	Ranger 2 User Manual
OM-8295	Monitor Manual

1.4 Conventions

Format	Convention
Boldface Type	User Input, Menu Options, Keys, References e.g. **Click OK**
Arrow (**>**)	Selection of an additional menu item e.g. **File > Save**

Section 2 – Safety

2.1 Introduction

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

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

Operators and service personnel must be familiar with the normal operating and safety procedures for Subsea Equipment.

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

If 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 Procedures

Before carrying out any procedure on the equipment, make sure all the following warnings and cautions are read and understood.

WARNINGS

⚠ **Heavy Equipment. The HPT5000 USBL Transceiver, when out of water, weighs 28 kilograms. The HPT7000 USBL Transceiver, when out of water, weighs 41 kilograms. HPT Variants, when out of water, weigh up to 41 kilograms. Manual Handling Equipment (MHE) must be used to move any HPT. If MHE is not available, a manual handling assessment must be carried out prior to carrying out manual lifting / handling. Personal Protective Equipment such as protective footwear and gloves must be worn before lifting the equipment.**

⚠ **Molykote 44 is a mild irritant. When lubricating the 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. Wear Personal Protective Equipment such as gloves.**

CAUTIONS

⚠ **Failure to clean sand or silt correctly could result in damage to the connectors and O-ring seals.**

⚠ **Do not over apply grease to the female connector. Grease build up will affect connector integrity.**

Section 3 – Technical Description

3.1 Introduction

The Sonardyne Wideband 2 Type 8142 6G Series of Ultra-Short-Baseline (USBL) High Performance Transceivers (HPT) are used as part of the USBL, Long-Ultra-Short-Baseline (LUSBL) Marine Riser Angle Monitoring System (MRAMS) and data retrieval 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.

This manual covers the Wideband 2 transceiver variants shown in **Table 3–1**.

Table 3–1 – HPT Type Variants

HPT Type	HPT Variant	Description	Reference
8142-000-01	HPT5000	Standard Array	Figure 3–1
8142-000-31	HPT5000	Standard Array 16-Way Connector	Figure 3–1
8142-000-11	HPT5000T	Standard Array 30º Tilt	Figure 3–3
8182-000-01	HPT5000M	Standard Array Modem Only	Figure 3–1
8091-000-10	iHPT5000	Standard Array iUSBL	Figure 3–5
8142-000-02	HPT7000	Large Array	Figure 3–2
8142-000-32	HPT7000	Large Array 16-Way Connector	Figure 3–2
8142-000-12	HPT7000T	Large Array 30º Tilt	Figure 3–4
8182-000-02	HPT7000M	Large Array Modem Only	Figure 3–2
8183-000-01	HPT7000L	Large Array LMF 14-20 kHz	Figure 3–2
8193-000-12	HPT7000LM	Large Array Modem Only LMF 14-20 kHz	Figure 3–2
8291-000-01	HPT	VLA Modem	Page 7

3.2 Description

3.2.1. HPT5000 Type 8142-000-01, 8142-000-31, 8182-000-01

The type 8142-000-01 HPT5000 6G transceiver is the standard USBL system with a standard array used for navigation and data retrieval.

The HPT5000 variants are described in **Table 3–2.**

Table 3–2 – HPT5000 Variant Description

Type	Variant	Description
8142-000-31	HPT5000	Allows both Ethernet and serial operation via a 16-way connector
8182-000-01	HPT5000M	Modem version operates as high data rate modem only, with almost the same functionality as Type 8142-000-01 series but does not present any bearing information.

Figure 3–1 – Type 8142-000-01 HPT5000
Type 8142-000-31 HPT5000 16-Way
Type 8182-000-01 HPT5000 Modem

3.2.2. HPT7000 Type 8142-000-02, 8142-000-32, 8182-000-02, 8183-000-01, 8193-000-12

The HPT7000 transceiver has the same functionality as the HPT5000. The type 8142-000-02 HPT7000 has a large array which has been optimised for deep water operations and delivers higher precision USBL measurements, required in deep water environments.

The HPT7000 variants are described in **Table 3–3**.

Table 3–3 – HPT7000 Variant Description

Type	Variant	Description
8142-000-32	HPT7000	Allows both Ethernet and serial operation via a 16-way connector.
8182-000-02	HPT7000M	Modem version operates as a high data rate modem only, with almost the same functionality as Type 8142-000-02 series but does not present any bearing information.
8183-000-01	HPT7000L	Has the same functionality as the standard 8142-000-02 but is designed to work with the LMF operating band (14 to 18.5 kHz).
8193-000-12	HPT7000LM	Modem version has the same functionality as the 8182-000-02 modem, but is designed to work with the LMF operating band (14 to 18.5 kHz).

Figure 3–2 – Type 8142-000-02 HPT7000
Type 8142-000-32 HPT7000 16-Way
Type 8182-000-01 HPT7000M Modem
Type 8183-000-01 HPT7000L LMF
Type 8193-000-12 HPT7000LM LMF Modem

3.2.3. HPT5000T Type 8142-000-11

The type 8142-000-11 is a standard HPT5000 6G transceiver with a 30º tilted array.

Figure 3–3 – Type 8142-000-11 HPT5000T, 30º Tilted Array

3.2.4. HPT7000 Type 8142-000-12

The type 8142-000-12 is a standard HPT7000 6G transceiver with a 30º tilted array.

Figure 3–4 – Type 8142-000-12 HPT7000T, 30º Tilted Array

3.2.5. iHPT5000 Type 8091-000-10

The type 8091-000-10 is a standard HPT5000 6G transceiver, depth rated to 4000 m for inverted applications.

Figure 3–5 – Type 8091-000-10 HPT5000, iUSBL

3.2.6. HPT Type 8291-000-01

The type 8291-000-12 is a modem version only. Contact Sonardyne for further information.

3.3 Transceiver Operation

The 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 transceiver can passively monitor acoustic activity.

The main functions of the 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 (Type 8142 only) in the received transponder reply.
- Transmission of range, (bearing, Type 8142 only) 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 RS485 and Ethernet communications.

The transducer face has an array of ceramic receiver and transmit elements. The elements are recessed into a high grade plastic and encased in polyurethane to form a strong smooth 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 housing is constructed in Aluminium Bronze to resist corrosion.

The processor within the 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. Primary communications is achieved by half duplex RS485 link. Diagnostics and additional data channels are provided using a secondary half duplex RS485 link. A signal ground is provided to make sure there are reliable communications for both RS485 channels.

The Type 8142-000-31 and 8142-000-32 variants allow both Ethernet and serial operation via a 16-way connector.

3.4 Typical System Setup

The equipment used in the USBL system is as follows (refer to **Figure 3**–6):

- Optional output to DP system
- VRU
- Gyro Compass
- DGPS
- Monitor / Keypad unit
- Acoustic Transponder
- Acoustic Transceiver

3.4.1. Type 8142 Transceiver

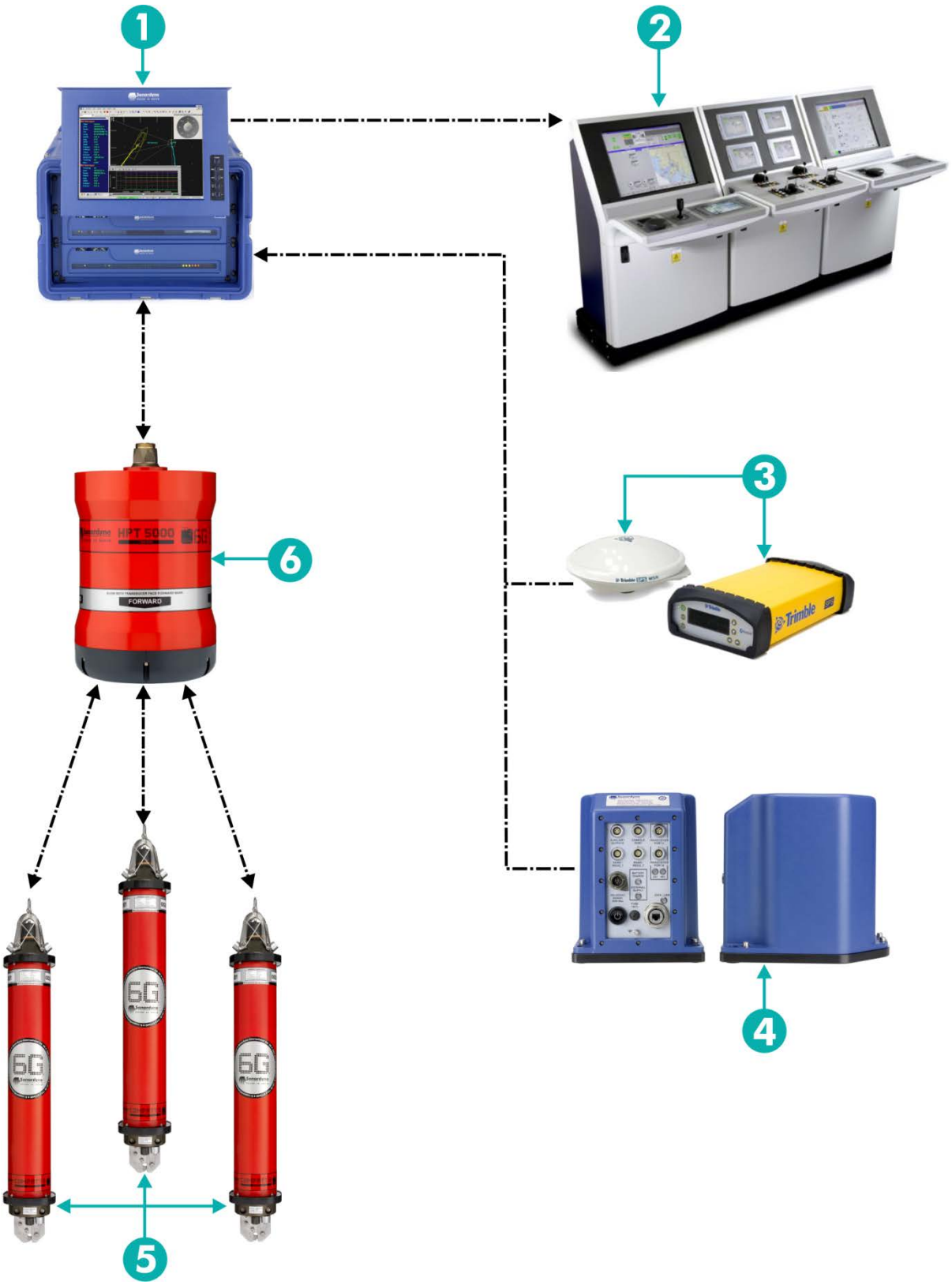
Refer to **Figure 3–6.** The system is controlled by the DFE. The operator uses the monitor/keypad unit to input data and run the Ranger or Marksman software. The processor commands the transceiver to send acoustic signals to the transponder(s) and then interprets the responses received by the transceiver.

The processor receives reference information from the VRU, DGPS and Gyro Compass and produces outputs to the DP system. The system measures the range and direction of a transponder relative to the known location and orientation of the transceiver housing.

The transponder range is calculated by measuring the elapsed time between the interrogation signal and the detection of the transponder reply.

The transponder bearing is calculated by using advanced signal processing on the received acoustic data on the multiple elements.

Figure 3–6 – Type 8142 USBL / LUSBL System



1. Data Fusion Engine
2. Dynamic Positioning System
3. Differential Global Positioning System
4. Vertical Reference Unit Gyro Compass
5. Acoustic Transponders
6. USBL/LUSBL Acoustic Transceiver

3.4.2. Type 8182 Transceiver

Refer to **Figure 3–7**. The use of the transceiver in the modem system will usually be in the form of the setup shown below. The top-side software is called Monitor and allows configuration of subsea transponders as well as uploading of data (refer to the Monitor user manual **OM-8295**).

The transceiver can be configured by users to act without top-side software, for this the modem protocol can be requested directly from Sonardyne.

Figure 3–7 – Type 8182 Modem System

1. Data Fusion Engine (DFE)
2. 8182 Acoustic Transceiver / Modem
3. Acoustic Transponder

Section 4 – Installation

4.1 Introduction

Before installing the equipment make sure the Safety Manual and all Warnings and Cautions in **Section 2 – Safety** of this manual, are read and understood. Make sure the equipment is inspected for any signs of damage to the array.

4.2 Pre-Installation

Refer to **Figure 4**–1. For a through-hull installation; make sure sea valve is closed and remove the sea chest door.

Figure 4–1 – Sea Chest with Door Removed

4.2.1. Vertical Tube Specifications

Type	Tube Specifications
8142-000-01 8142-000-31 8142-000-11 8182-000-01 8091-000-10	A vertical tube of at least 228.6 mm (9 ins) internal diameter is retrieved into the ship
8142-000-02 8142-000-32 8142-000-12 8182-000-02	A vertical tube of at least 305 mm (12 ins) internal diameter is retrieved into the ship

4.3 Transceiver Installation

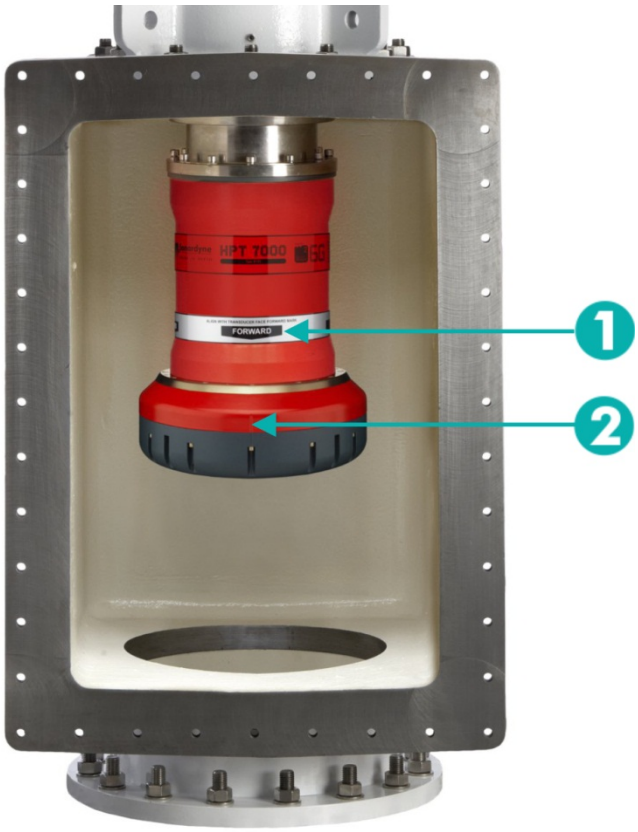
4.3.1. Transceiver Orientation

Refer to **Figure 4**–2. The transceiver should be installed vertically, with the **Forward** direction label and machined groove pointing forwards.

NOTE

In the absence of the Forward direction label use the machined groove as a reference.

Figure 4–2 – Forward Direction Marks



1 Forward Direction Label 2 Machined Groove

4.3.2. Mounting the Transceiver

The transceiver is mounted on a ship as follows:

1. Remove the transceiver from its transit container.
2. Remove the bolts securing the protection ring (store the ring and bolts).
3. Remove the plastic blank from the connector cap (store the blank).
4. Position the transceiver onto an applicable surface ready for connection to the pole.
5. Refer to **Figure 4**–3. Fit O-ring seals and anti-extrusion rings to the insulator flange ring (refer to the instructions in the installation kit).

Figure 4–3 – Insulator Flange Ring

1 O-Ring Grooves

6. Lubricate the O-rings with petroleum jelly.
7. Make sure the flange on the transceiver is clean and grease free.
8. Fit the insulator flange ring to the transceiver and line up the mounting holes.
9. Refer to **Figure 4–4**. Either lower from the top, or using a draw cord, pull the transceiver cable through the centre of the pole.

Figure 4–4 – Transceiver Cable Location

10. Fit the transceiver cable to the transceiver. A master pin makes sure the plug is located correctly.
11. Hand-tighten the locking sleeve on the transceiver cable.
12. Install applicable lifting equipment to the pole.
13. The crane should slowly lift the equipment until the weight of the pole registers on the crane instrumentation.

CAUTION

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

14. Lower the pole into position over the transceiver.
15. Lift the transceiver up to the pole.

NOTE

Alignment should be maintained to within 1 degree.

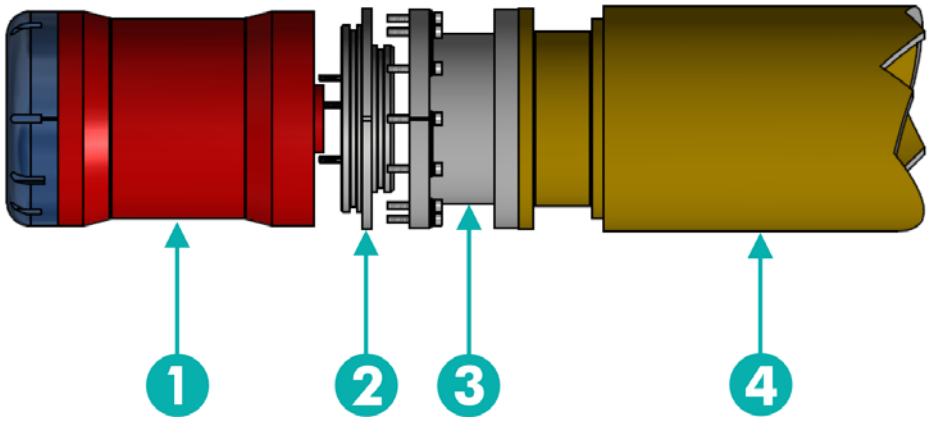
16. Refer to **Figure 4–5**. Bolt the transceiver to the mounting flange/adaptor on the pole using the bolts, insulation washers, dual washers and spring washers from the installation kit (refer to the instructions in the installation kit).

NOTE

The insulator flange ring must be used when mounting a transceiver to the pole.

The mounting flange adaptor type is dependent on individual installation. Sonardyne manufactured poles do not require an adaptor.

Figure 4–5 – Transceiver to Pole Connection



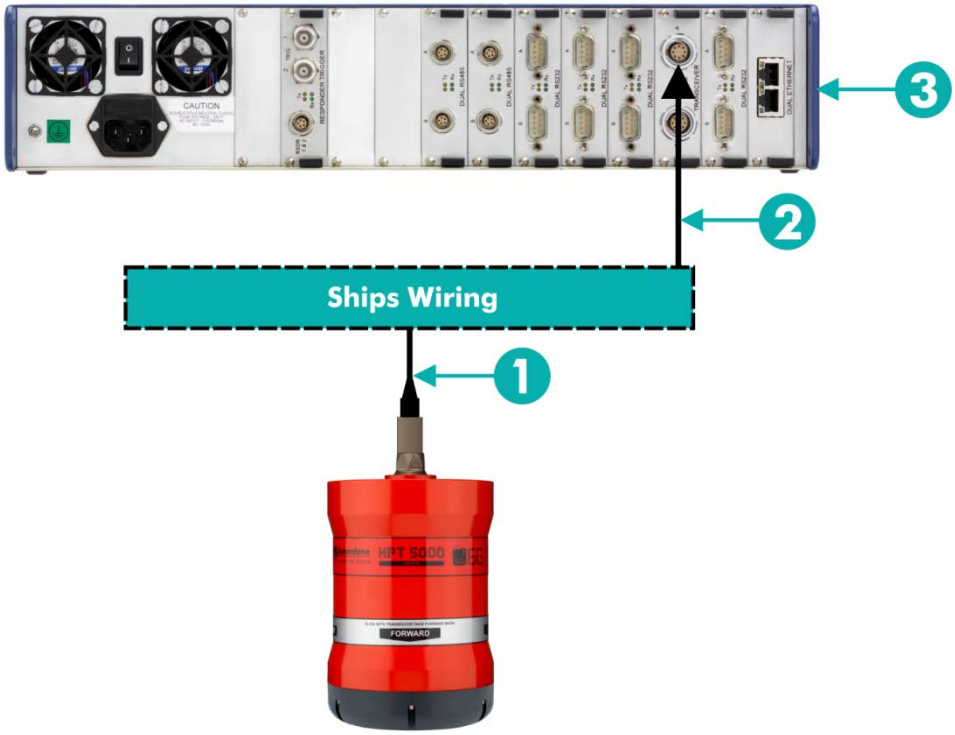
1 Transceiver
2 Insulator Flange Ring
3 Mounting Flange Adaptor
4 Pole

17. Hand-tighten the fixing bolts in a diagonal sequence with an Allen key to approximately 5 Nm.
18. Remove the red protective cover from the transceiver before deployment.
19. The pole should not change its vertical alignment with respect to the ship by more than 0.5 degrees.

4.4 Transceiver Interconnections

Refer to the following figures for a description of transceiver interconnections.

Figure 4–6 – Transceiver Interconnections – Command port only



1. CPN 820-3427 (See Note 1)
   (8-Way AGP Transceiver Connector and Tail)
2. CPN 820-6459
   (Lemo NSH Connector)
3. NSH

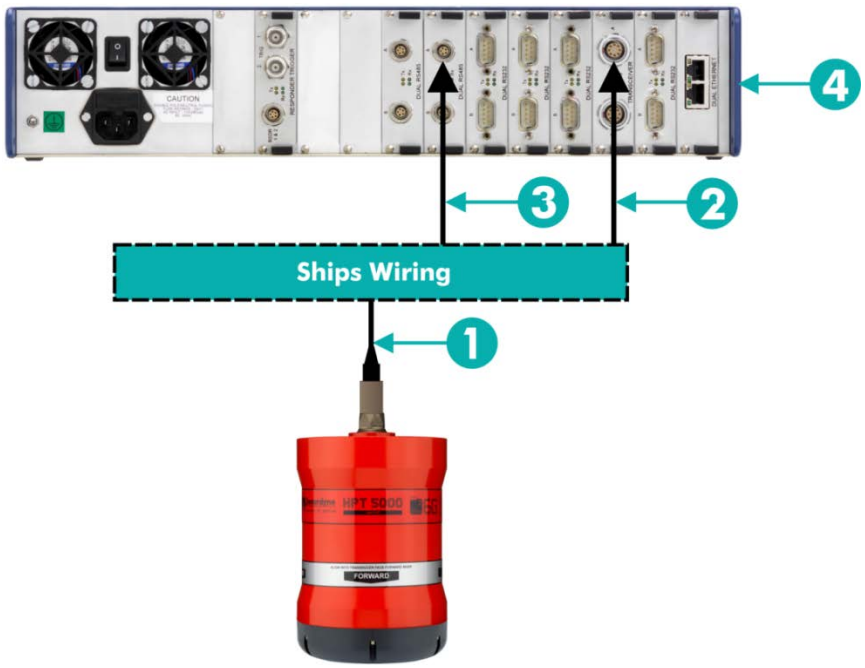
Table 4–1 – Transceiver Interconnections – Command Port Only

	Lemo NSH Connector CPN 820-6459 issue A3 and Above	Ships Wiring	AGP Transceiver Connector CPN 820-3427
TCVR_+48V (Pin 8)	Red		Red
TCVR_RTN Pins 6 & 7)	Pink and Blue Joined		Black
RS485+ (Pin 1)	White		White
RS485- (Pin 2)	Brown		Blue
Signal Gnd (Pins & 4)	Green and Yellow Joined		Green
Screen	Screen		Screen

NOTE 1

For type 8142-000-31 and 8142-000-32 transceivers:
1 CPN 312-8092 16-Way AGP Transceiver Connector.
See Figure 4–10 for AGP transceiver connector colours.

Figure 4–7 – Transceiver Interconnections – Command and Data Port (Modem or Special Applications)



1. CPN 820-3427 (See Note 2) (8-Way AGP Transceiver Connector)
2. CPN 820-6459 (Lemo NSH Connector)
3. CPN 820-3650 (Lemo IO Connector)
4. NSH

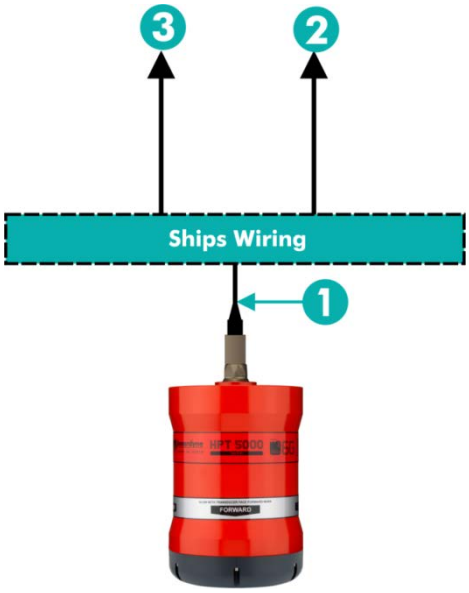
Table 4–2 – Transceiver Interconnections – Command and Data Port

	Lemo NSH Connector CPN 820-6459	**Ships Wiring**	**AGP Transceiver Connector CPN 820-3427**
TCVR_+48V (Pin 8)	Red		Red
TCVR_RTN (Pins 6 & 7)	Pink & Blue Joined		Black
RS485+ (Pin 1)	White		White
RS485- (Pin 2)	Brown		Blue
Signal GND (Pins 3 & 4)	Green and Yellow Joined		Green*
Screen	Screen		Screen
	Lemo NSH IO connector CPN 820-3650		
RS485+	Red and Blue		Orange
RS485-	Green and Black		Yellow
Signal GND	Yellow		Green* (same as above)

NOTE 2

For type 8142-000-31 and 8142-000-32 transceivers:
1 CPN 312-8092 16-Way AGP Transceiver Connector.
See Figure 4–10 for AGP transceiver connector colours.

Figure 4–8 – Transceiver Interconnections RS232 Configuration – Command and Data (Modem or Special Applications)



1. CPN 820-3427 (See Note 3) (8-Way AGP Transceiver Connector)
2. Users Data Port Connection
3. Users Command Port and Power Connection

Table 4–3 – Transceiver Interconnections RS232 Configuration – Command and Data

	Command Port Connection, and Power	**Ships wiring**	**AGP Transceiver connector CPN 820-3427**
TCVR_+48V (Pin 8)			Red
TCVR_RTN (Pins 6 & 7)			Black
RS232 RX (wrt transceiver – Pin 1)			White
RS232 TX (wrt transceiver – Pin 2)			Blue
Signal GND (Pins 3 & 4)			Green*
Screen	Screen		Screen
	Data port connection		
RS232 RX (wrt transceiver – Pin 1)			Orange
RS232 TX (wrt transceiver – Pin 2)			Yellow
Signal GND			Green* (same as above)

NOTE 3

For type 8142-000-31 and 8142-000-32 transceivers:
1 CPN 312-8092 16-Way AGP Transceiver Connector.
See Figure 4–10 for AGP transceiver connector colours.

Figure 4–9 – RS 485 Configuration – 8-Way AGP Connector

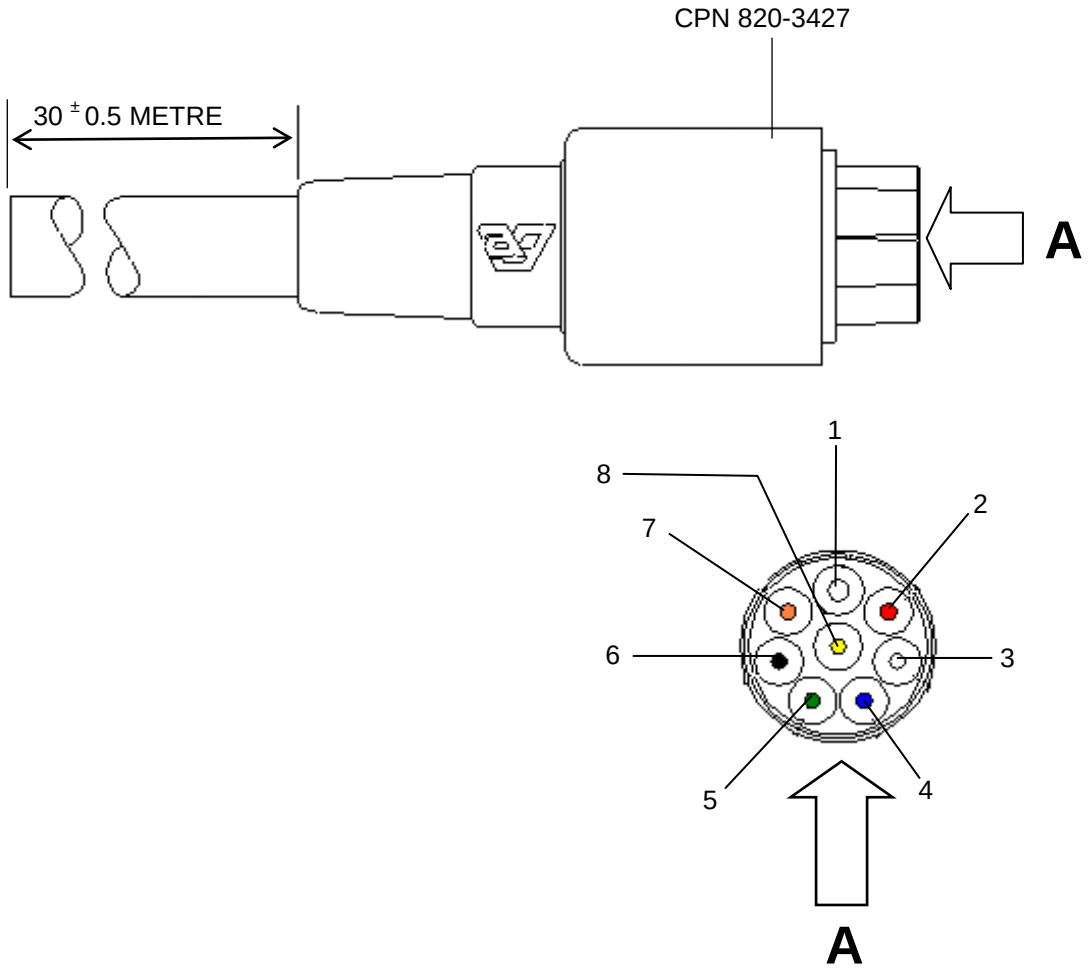


Table 4–4 – RS 485 Configuration – 8-Way AGP Connector

Connector Pin	Cable Colour	Function
1	Screen	Screen
2	Red	Power +
3	White	CHAN 0 RS 485+
4	Blue	CHAN 0 RS 485-
5	Green	Signal GND
6	Black	Power Return
7	Orange	CHAN 1 RS485
8	Yellow	CHAN 1 RS 485-

Figure 4–10 – RS 485 Configuration – 16-Way AGP Connector

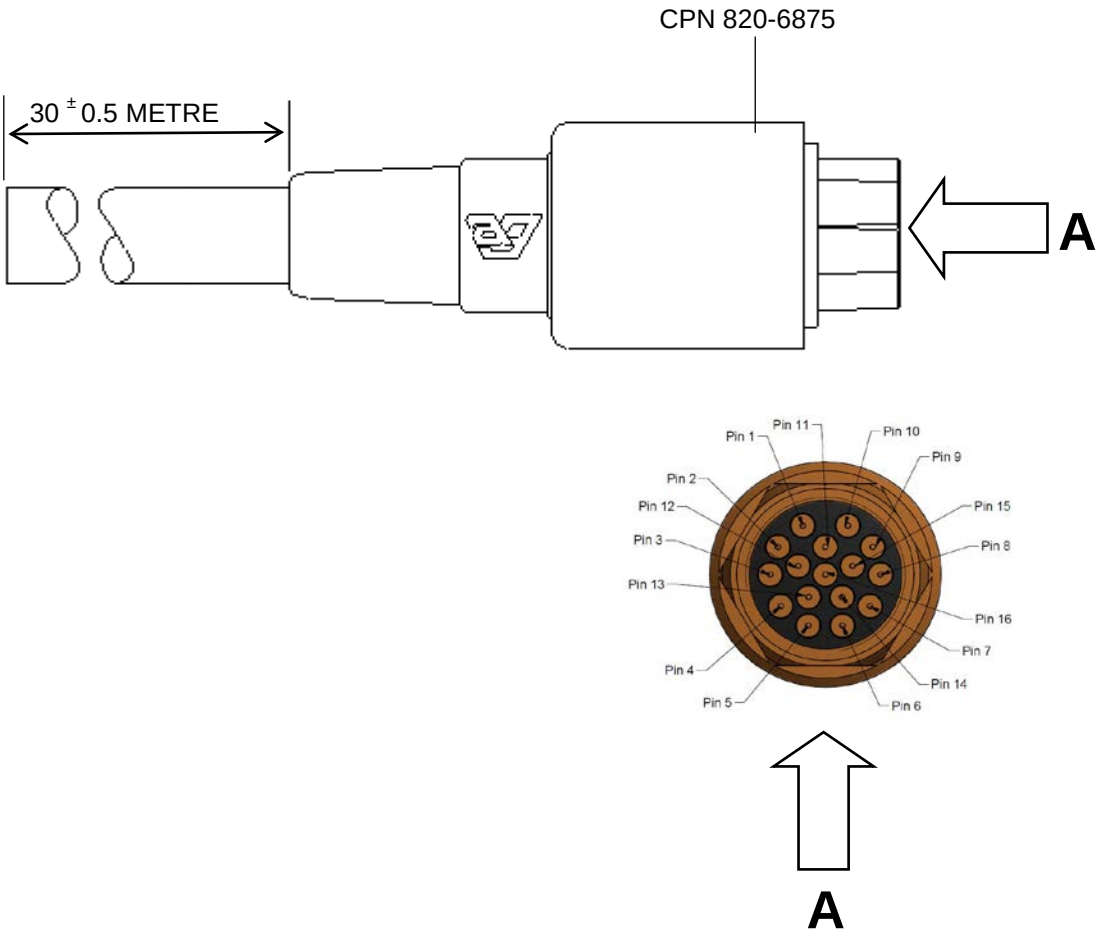


Table 4–5 – RS 485 Configuration – 16-Way AGP Connector

Connector Pin	Cable Colour	Function
1	Red	Trigger Output
2	Blue	COM GND
3	Orange (Cat6)	HPT CH1_TX+
4	White/Orange (Cat6)	HPT CH1_TX-
5	White/Green (Cat6)	HPT CH1_RX+
6	Green (Cat6)	HPT CH1_RX-
7	Yellow	HPT CH0_TX/RX+
8	Orange	HPT CH0_TX/RX-
9	White/Brown (Cat6)	ETH TX+
10	Brown (Cat6)	ETH TX-
11	–	Shield
12	White	Trigger Input
13	White/Blue (Cat6)	ETH RX+
14	Blue (Cat6)	ETH RX-
15	Green	HPT Power +
16	Black	HPT Power RTN

Section 5 – Operation

5.1 Introduction

Before proceeding with operation of this equipment, make sure the Safety Manual and all warnings and cautions in **Section 2 – Safety** of this manual, are read and understood.

5.2 Operating Instructions

If the following transceivers have been installed:

- Type 8142-000-01
- Type 8142-000-02
- Type 8142-000-31
- Type 8142-000-32
- Type 8142-000-11
- Type 8142-000-12
- Type 8091-000-10
- Type 8291-000-01

the system is monitored and controlled by the Marksman Ranger 2 software system.

For operating instructions refer to the Marksman Ranger 2 user manual (**UM-8251**).

If the following transceiver has been installed:

- Type 8182-000-01
- Type 8182-000-02

the system is monitored and controlled by Monitor software system.

For operating instructions refer to the Monitor operator manual (**OM-8295**).

Section 6 – Routine Maintenance

6.1 Maintenance

Before any maintenance activity is carried out make sure all warnings and cautions in **Section 2 – Safety** are read and the Safety Manual is fully read and understood.

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

6.2 Safety Precautions

WARNINGS

⚠ **Heavy Equipment. The HPT5000 USBL Transceiver, when out of water, weighs 26 kilograms. The HPT7000 USBL Transceiver, when out of water, weighs 41 kilograms. HPT Variants, when out of water, weigh up to 41 kilograms. Manual Handling Equipment (MHE) must be used to move any HPT. If MHE is not available, a manual handling assessment must be carried out prior to carrying out manual lifting / handling. Personal Protective Equipment such as protective footwear and gloves must be worn before lifting the equipment.**

⚠ **Molykote 44 is a mild irritant. When lubricating the 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. Wear Personal Protective Equipment such as gloves.**

CAUTIONS

⚠ **Failure to clean sand or silt correctly could result in damage to the connectors and O-ring seals.**

⚠ **Do not over apply grease to the female connector. Grease build up will affect connector integrity.**

6.3 Scheduled Maintenance Only

To make sure the transceivers provide 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 6–1 – Scheduled Maintenance and Recalibration Timetable

Maintenance Schedule					
Task	**6 month**	**Annually**	**2 years**	**3 years**	**5 years**
Clean Transceiver Face	X				
Run Bench Test		X			

6.3.1. Lubrication

The following lubricants are recommended for use to assist in the maintenance of the equipment.

Table 6–2 – Lubricants

Assembly	**Lubricants**
Subconn and Micro-Subconn connectors	Molykote 44 Medium
'O' ring seals	Petroleum Jelly

6.3.2. General Maintenance

On retrieval of the transceiver the following general maintenance must be carried out.

CAUTION

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

1. Thoroughly clean the transceiver in clean fresh water to remove all accumulation of salt, sand and silt.
2. Remove any accumulated marine growth.
3. Clean the anodes with a nylon brush.
4. Dry the transceiver with a lint free cloth.
5. Inspect the paint finish for any signs of corrosion such as flaking, cracking or delamination.
6. Inspect all cables and connections for signs of abrasion, cracks or splits.

Section 7 – Functional Test

7.1 Introduction

To make sure the transceiver functions correctly, functional testing can be carried out. Many functions can be tested via the NSH using 6G Terminal Lite. The NSH will power the transceiver if connected.

7.2 Functional Test

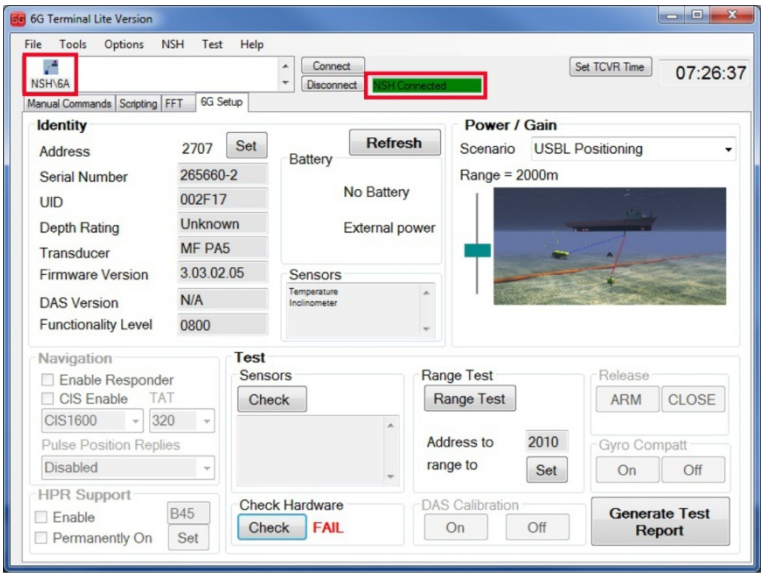
Before testing, make sure there is a serial connection from the NSH to the transceiver:

1. Double-click the **6G Terminal Lite** icon.

Figure 7–1 – 6G Terminal Lite Icon

2. Refer to **Figure 7–2**. The 6G Terminal Lite software should automatically connect to the NSH. Connection will be indicated by **NSH Connected** displayed green and the NSH connection port displayed in the communications window.

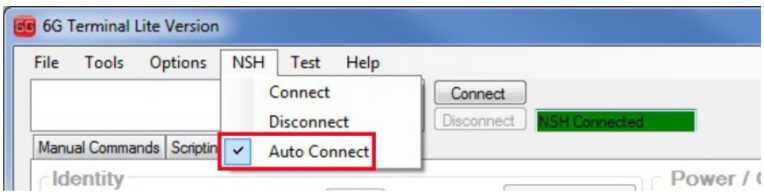
Figure 7–2 – 6G Terminal Lite NSH Connection



3. If the green **NSH Connection** indication does not appear, the NSH has not automatically connected. If the NSH has not automatically connected follow step **4** otherwise skip to step **6**.

4. Refer to **Figure 7–3**. To connect to the NSH, click **NSH**, and then check the **Auto Connect** check box.

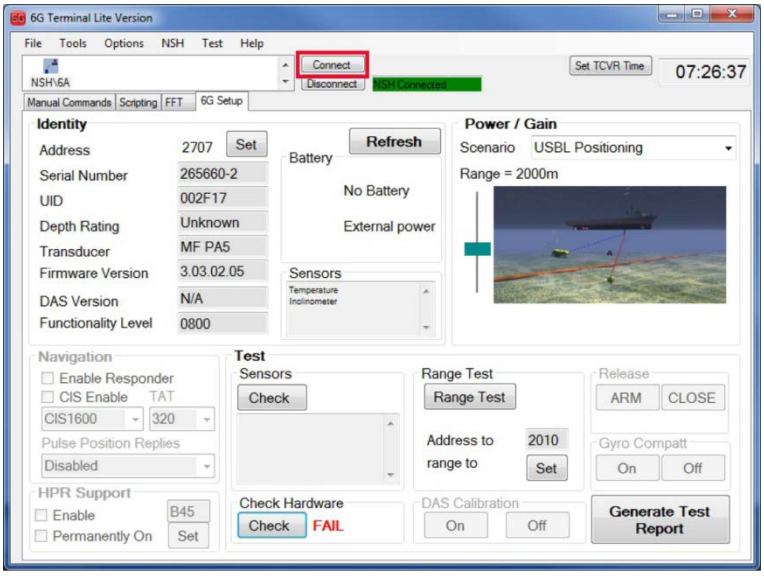
Figure 7–3 – Check Auto Connect



5. Wait until the green **NSH Connected** indication appears (this may take up to 20 seconds). If the **NSH Connected** label does not appear check the NSH connection and confirm it is switched on.

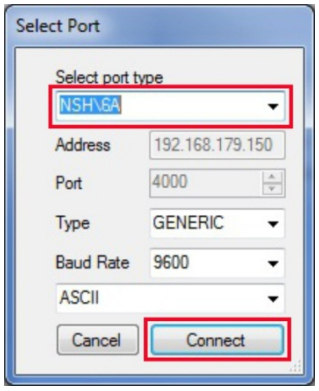
6. Refer to **Figure 7–4**. On the **6G Terminal Lite** dialog box, click **Connect**.

Figure 7–4 – Connecting the NSH



7. In the **Select Port Type** drop-down list, select the NSH connection port.

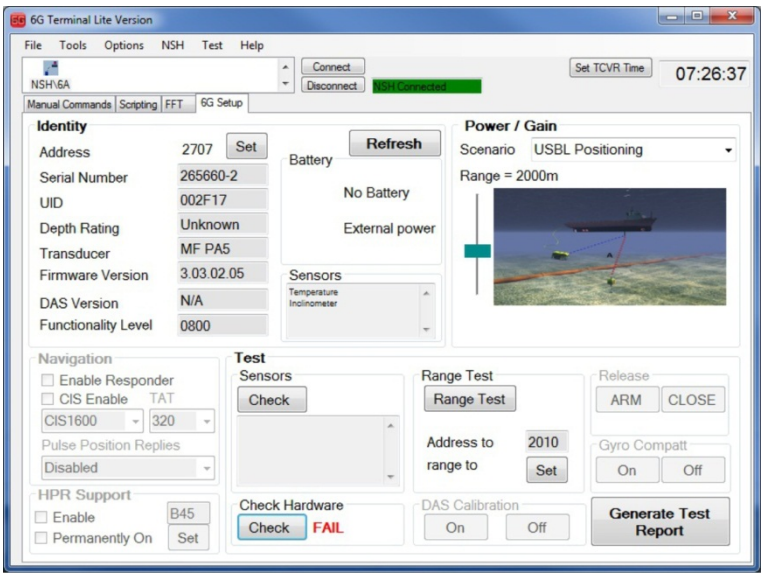
Figure 7–5 – Select Port



8. Click **Connect**.

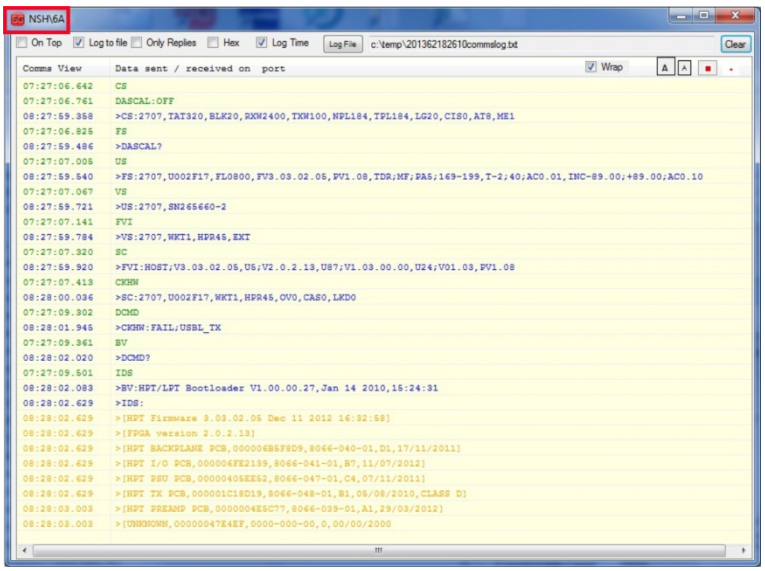
9. Refer to **Figure 7–6**. When the **6G Terminal Lite** software starts it populates with information about the transceiver, including address and firmware versions.

Figure 7–6 – 6G Terminal Lite Populated with Transceiver Information



10. Refer to **Figure 7–7**. A communications window opens displaying all communications between the transceiver and the NSH. The transceiver NSH COM port is displayed at the top of the window. This window can be left open.

Figure 7–7 – Communications Window

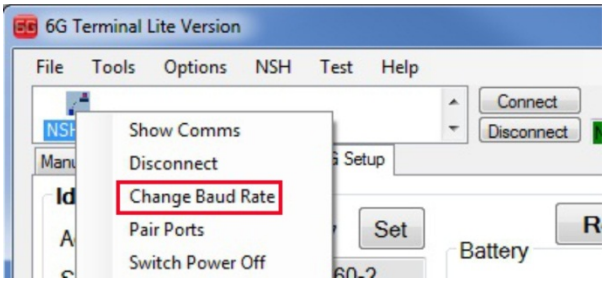


11. If the 6G Terminal Lite window does not populate or if no communication between the NSH and the transceiver appears in the communication window it may be necessary to change the baud rate. Refer to steps **12** to **16,** otherwise skip to step **17**.

12. Refer to **Figure 7–8**. On the **6G Terminal Lite** dialog box, double-click the **NSH** icon in the connection window.

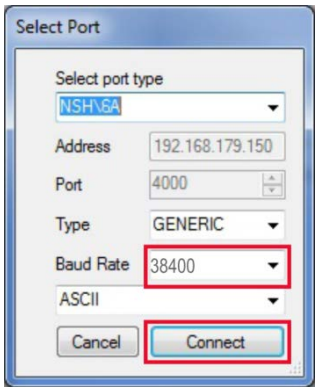
13. In the drop-down list select **Change Baud Rate**.

Figure 7–8 – Change Baud Rate Icon



14. Refer to **Figure 7–9**. In the **Baud Rate** drop-down list select **38400**.

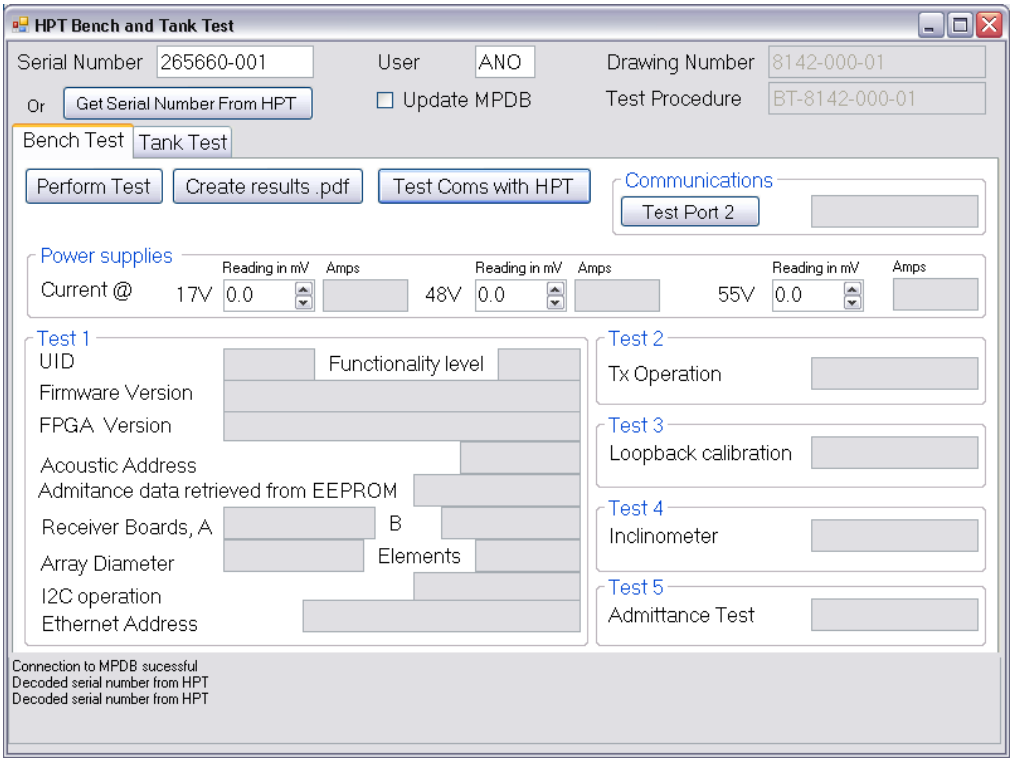
Figure 7–9 – Change Baud Rate



15. Click **Connect** to accept the baud rate and return to the main **6G Terminal Lite** dialog box.
16. The **6G Terminal Lite** dialog box populates and communication between the NSH and the transceiver appears in the communications window.
17. On the **6G Terminal Lite** menu click **Test** > **Bench Test**.

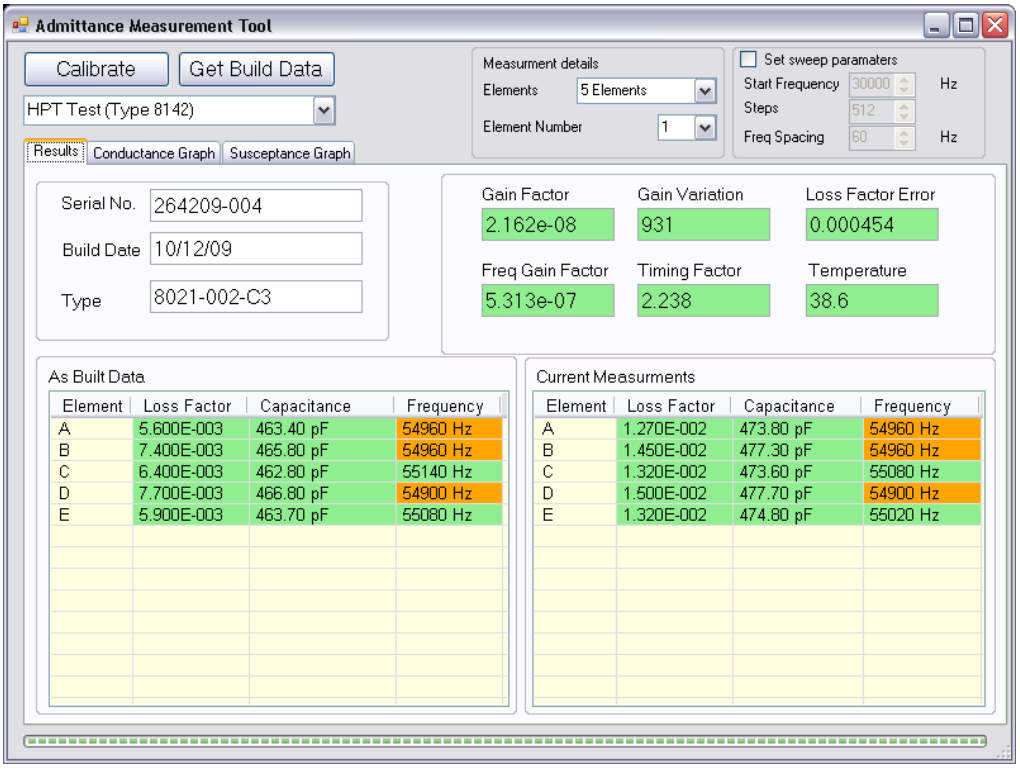
18. Refer to **Figure 7–10**. The **HPT Bench and Tank Test** dialog box will open.

Figure 7–10 – HPT Bench and Tank Test



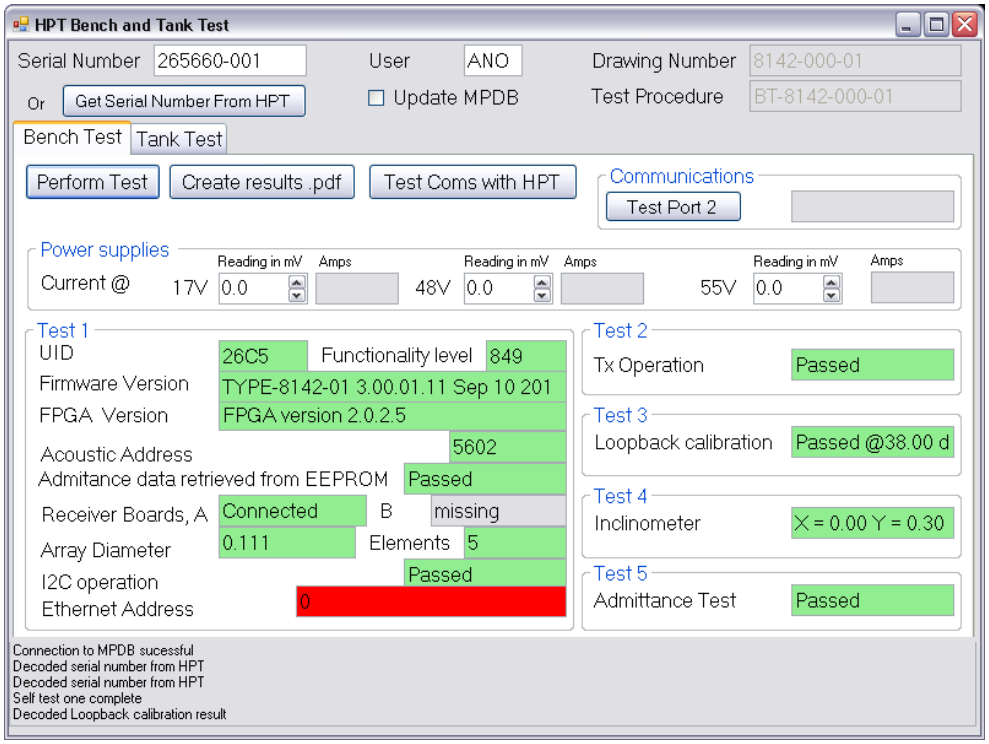
19. Refer to **Figure 7–10**. Uncheck the **Update MPDB** check box.
20. Refer to **Figure 7–10**. Click **Get Serial Number From HPT**. The serial number will be displayed in the **Serial Number** field.
21. Refer to **Figure 7–10**. Click **Perform Test**.
22. Refer to **Figure 7–11**. An admittance test is performed on the unit. Admittance test windows will appear on the screen during the test. The results will be marked red, orange or green.

Figure 7–11 – Admittance Measurement Tool



23. Refer to **Figure 7–12**. If any results appear marked red, click **NO** when prompted for a "successful test". **Figure 7–12** indicates a system without a functioning Ethernet connection.

Figure 7–12 – HPT Bench and Tank Test Results



24. Refer to **Figure 7–13.** When the test is complete click **Create results pdf**.

NOTE

The tests 1.01 through 1.03 are not run during this procedure, and do not qualify as a failure of the unit.

Figure 7–13 – Bench Test Report

HPT Bench test report

Test Procedure: BT-8142-000-01 **Drawing Number:** 8142-000-01
Serial number: 265660-001 **Operator:** ANO

Test Results

Test 1 Results			
1.01	17V Supply Current	Current not measured	FAILED
1.02	48V Supply Current	Current not measured	FAILED
1.03	55V Supply Current	Current not measured	FAILED
1.1	UID of device	26C5	PASS
1.2	Firmware version	TYPE-8142-01 3.00.01.11 Sep 10 2010 12:23:28	PASS
1.3	CPU FPGA version	FPGA version 2.0.2.5	PASS
1.3a	Acoustic Address	5602	PASS
1.4	Admitance data retrieved from EEPROM	Passed	PASS
1.5	Rx board A	Connected	PASS
1.6	Rx board B	missing	PASS
1.8	Array diameter	0.111	PASS
1.9	Number of elements	5	PASS
1.10	I2C operation	Passed	PASS
1.11	Ethernet IP address	0	FAILED
1.12	Functionality level	849	PASS

Test 2 Results			
2.0	Transmit operation	Passed	PASS

Test 3 Results			
3.0	Loopback calibration	Passed @38.00 degrees	PASS

Test 4 Results			
4.0	Inclinometer operation	X = 0.00 Y = 0.30	PASS

Test 5 Results			
5.0	Admitance Test	Passed	PASS

24 September 2010 14:53:58 1 of 2 HPT Bench Test Results

25. If the test is unsuccessful the test results should be sent to Sonardyne International Ltd.

Section 8 – Firmware Upgrade

8.1 Introduction

The transceiver can be updated by installing new versions of the firmware. The Sonardyne Support Team will inform customers of any required firmware updates.

8.2 Transceiver Firmware Update

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

- Using 6G Terminal Lite software
- Using the Ranger 2 and Marksman software

The two procedures are described in **Sections 8.2.1**, and **8.2.2**.

8.2.1. Updating Transceiver Firmware using 6G Terminal Lite

8.2.1.1 Prerequisites

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

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

8.2.1.2 Connections

- A serial connection from the NSH to the transceiver

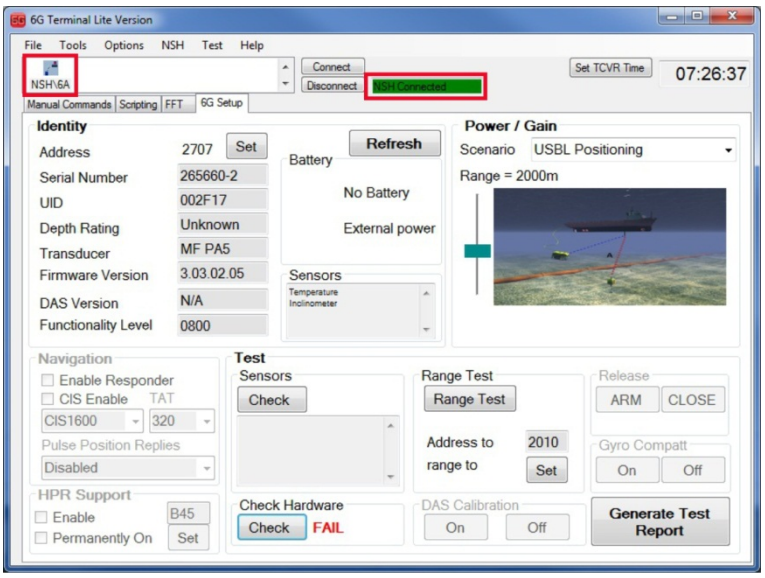
8.2.1.3 Firmware Upgrade

1. Double-click the **6G Terminal Lite** icon.

Figure 8–1 – 6G Terminal Lite Icon

2. Refer to **Figure 8–2.** The 6G Terminal Lite software should automatically connect to the NSH. Connection will be indicated by **NSH Connected** displayed green and the NSH connection port displayed in the communications window.

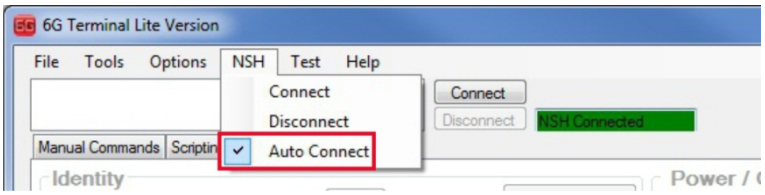
Figure 8–2 – 6G Terminal Lite NSH Connection



3. If the green **NSH Connected** indication does not appear, the NSH has not automatically connected. If the NSH has not automatically connected follow step **4** otherwise skip to step **10**.

4. Refer to **Figure 8**–3. To connect to the NSH, click **NSH**, and then check the **Auto Connect** check box.

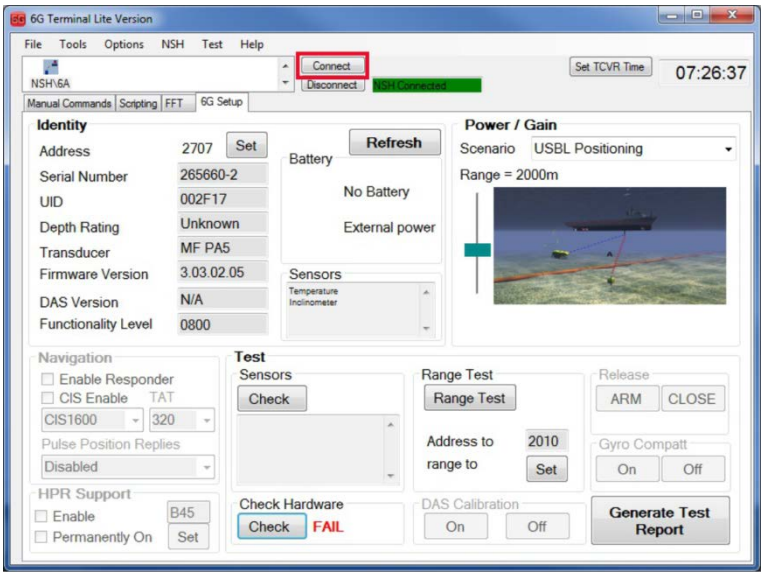
Figure 8–3 – Check Auto Connect



5. Refer to **Figure 8–4**. Wait until the green **NSH Connected** indication appears (this may take up to 20 seconds). If the **NSH Connected** label does not appear check the NSH connection and confirm it is switched on.

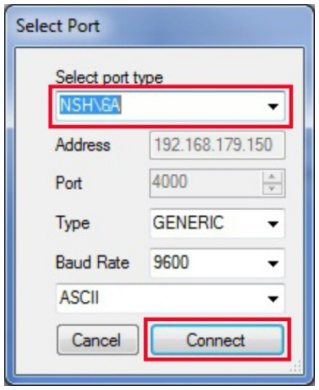
6. Refer to **Figure 8–4**. On the **6G Terminal Lite** dialog box, click **Connect.**

Figure 8–4 – Connecting the NSH



7. In the **Select Port Type** drop-down list, select the NSH connection port.

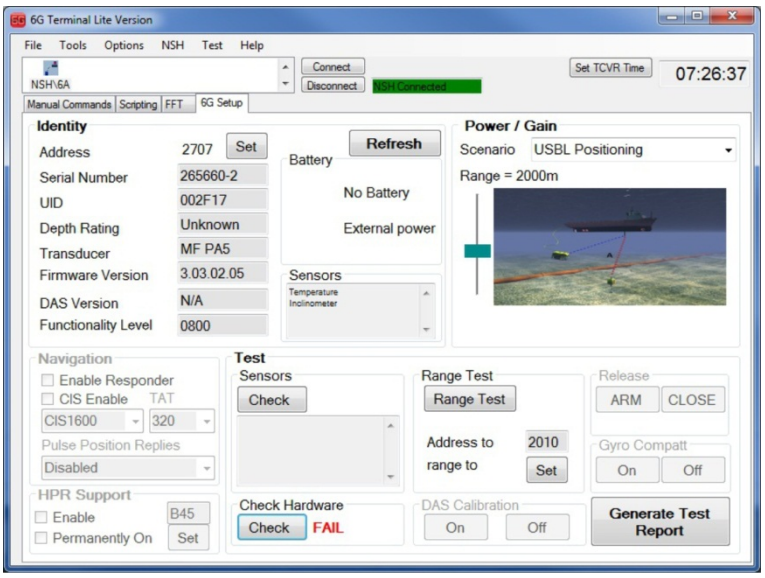
Figure 8–5 – Select Port



8. Click **Connect**.

9. Refer to **Figure 8–6**Figure 3–1. When the **6G Terminal Lite** software starts it populates with information about the transceiver, including address and firmware versions.

Figure 8–6 – 6G Terminal Lite Populated with Transceiver Information



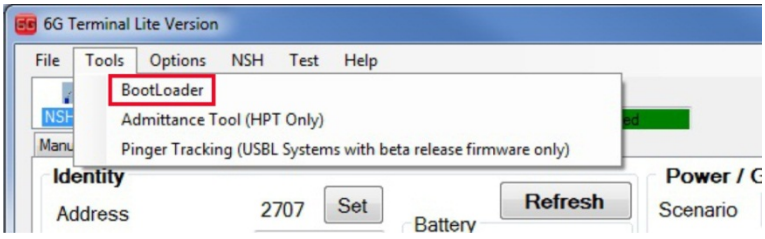
10. A communications window opens displaying all communications between the transceiver and the NSH. The transceiver NSH COM port is displayed at the top of the window. This window can be left open.

NOTE

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

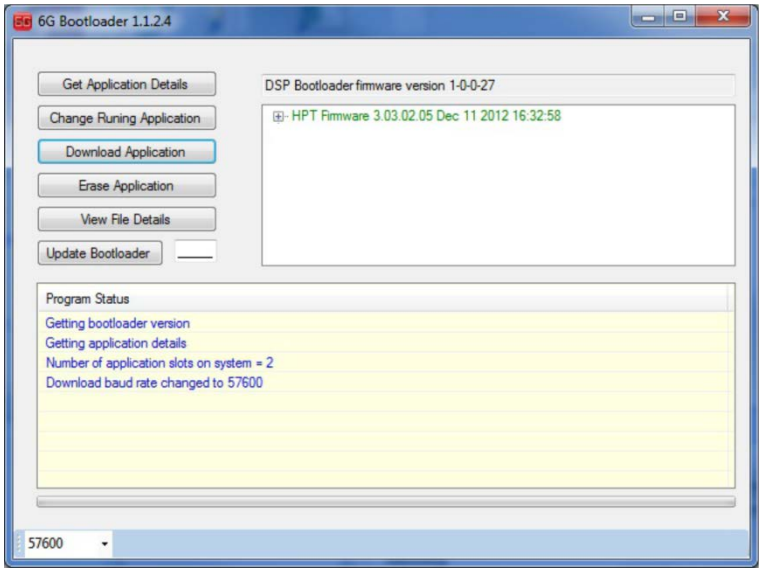
11. Refer to **Figure 8–7**. Start **6G Bootloader** to update the firmware. In the **6G Terminal Lite** dialog box, click **Tools > Bootloader**.

Figure 8–7 – Bootloader Selection



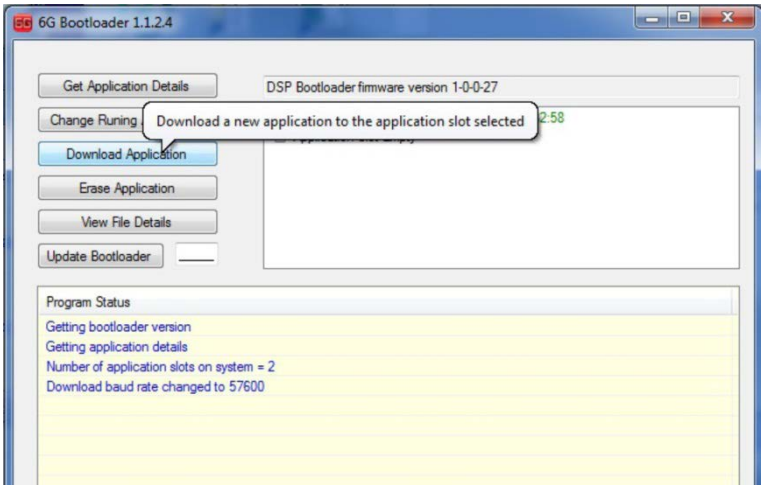
12. Refer to **Figure 8–8**. The **6G Bootloader** window displays the current firmware installed in the transceiver.

Figure 8–8 – 6G Bootloader Window Displaying Current Firmware



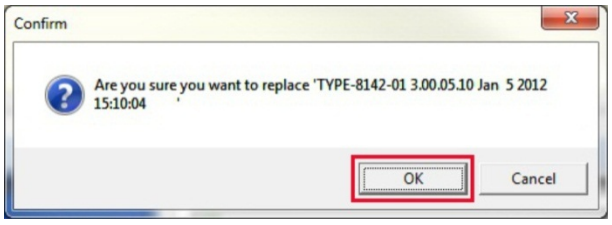
13. Refer to **Figure 8–9**. Click the **Download Application** button.

Figure 8–9 – Bootloader Download Application



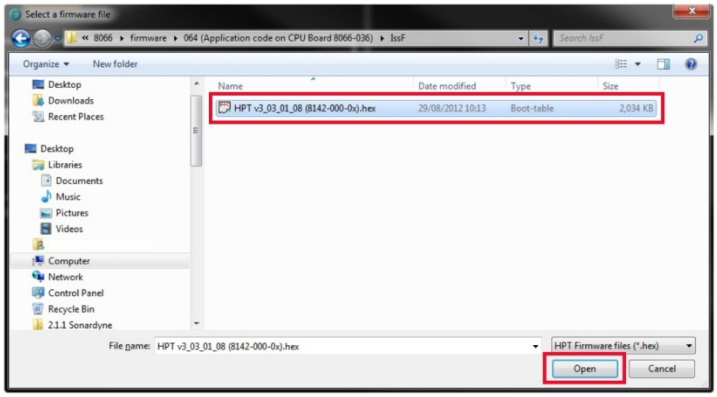
14. Refer to **Figure** 8**–10**. A warning dialog box will appear to confirm that the firmware will be replaced. To proceed, click **OK**.

Figure 8–10 – Confirmation Warning Window



15. Refer to **Figure 8–11**. In the **Select a firmware file** dialog box, navigate to the location of the new firmware.

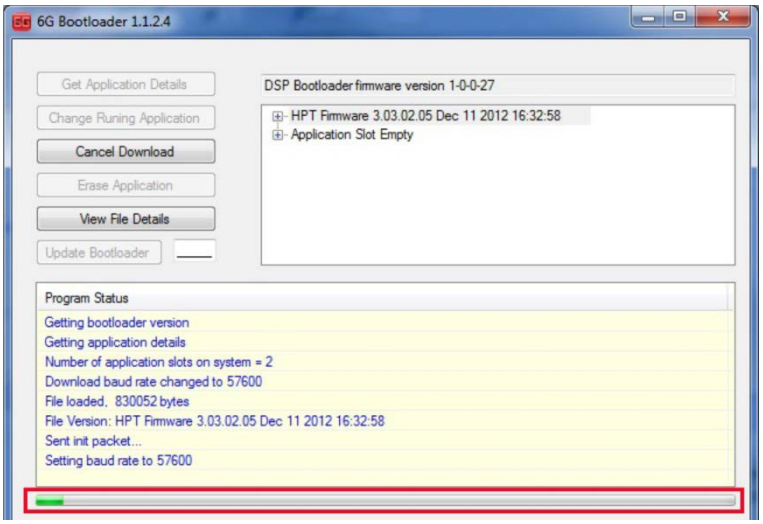
Figure 8–11 – New Firmware



16. Select the new firmware version and then click **Open**. The **Select a firmware file** dialog box will close.

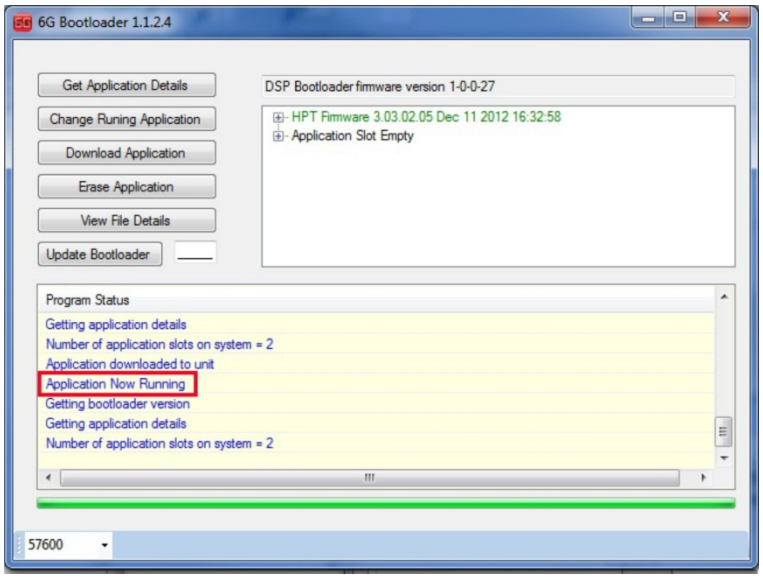
17. Refer to **Figure 8–12**. The **6G Bootloader** dialog box shows the progress of the firmware installation.

Figure 8–12 – New Firmware Progress



18. Refer to **Figure 8–13**. The firmware installation will be complete when the progress bar is completely green and **Application Now Running** appears in the **Progress Status** list.

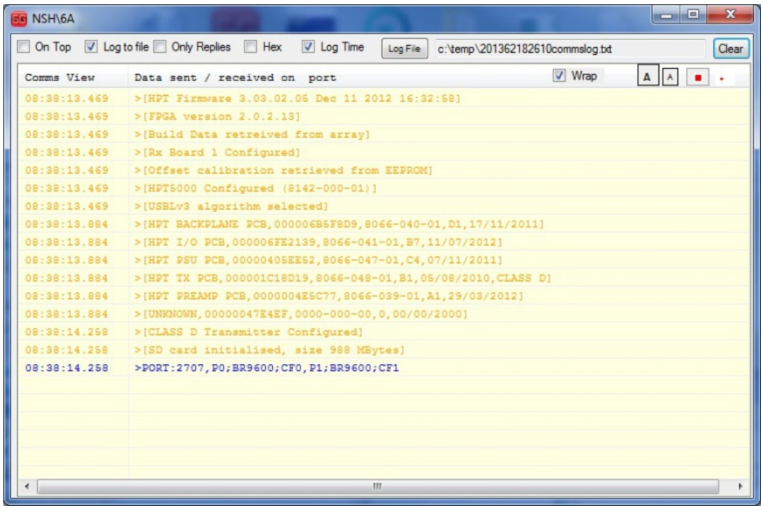
Figure 8–13 – 6G Bootloader Firmware Update Complete



19. Close the **6G Bootloader** dialog box and return to the **6G Terminal Lite** dialog box.

20. Refer to **Figure 8–14**. After a short pause, communication between the transceiver and the NSH will begin. This can be viewed in the communications window.

Figure 8–14 – New Firmware Communication



21. Communication indicates the firmware upload has been successful.

8.2.2. Upgrading Transceiver Firmware using Marksman/Ranger 2

8.2.2.1 Prerequisites

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

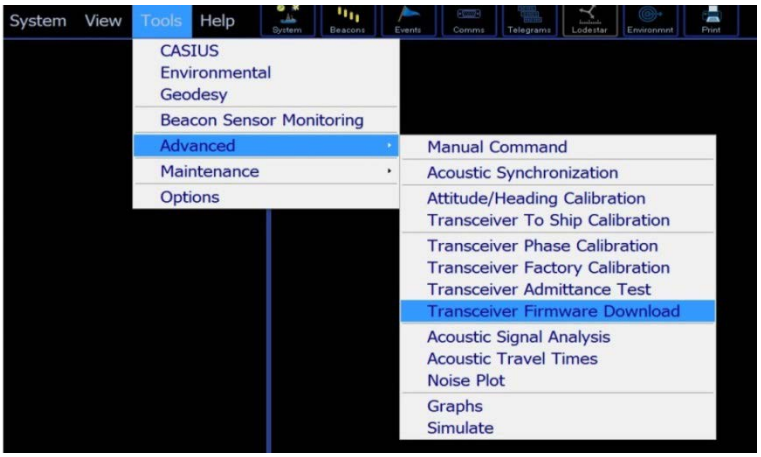
- The new firmware file

8.2.2.2 Firmware Update

Make sure the Marksman or Ranger 2 software is started.

1. Refer to **Figure 8–15.** On the **Tools** menu, click >**Advanced**>**Transceiver Firmware Download**.

Figure 8–15 – Firmware Download

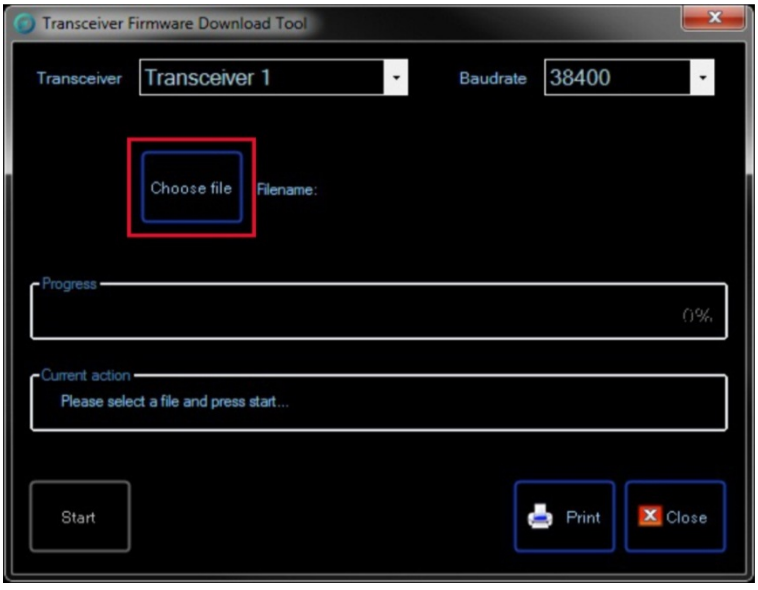


2. Refer to **Figure 8–16**. In the **Transceiver Firmware Download Tool** dialog box, select the current transceiver and baud rate From the **Transceiver** and **Baud rate** drop-down lists and then click **Choose file.**

NOTE

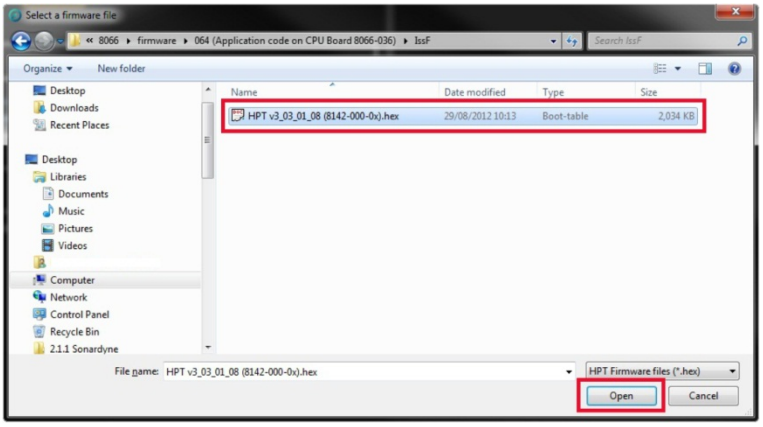
If performing a default upgrade the transceiver and baud rate do need to be changed.

Figure 8–16 –Transceiver and Baud Rate



3. Refer to **Figure 8–17**. In the **Select a firmware file** dialog box, navigate to the location of the new firmware.

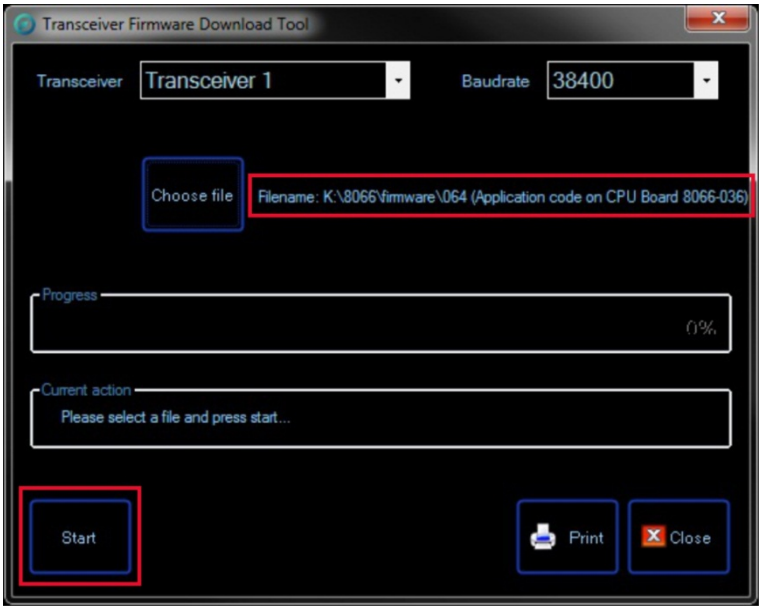
Figure 8–17 –New Firmware



4. Select the new firmware version and then click **Open**. The **Select a firmware file dialog box** will close.

5. Refer to **Figure 8–18.** On the **Transceiver Firmware Download Tool** dialog box, the firmware location will be displayed. Click **Start** to begin the download.

Figure 8–18 –Firmware Location



6. A progress bar indicates the rate of download.

7. Once the download has completed, the **Transceiver Firmware Download Tool** can be closed.

Section 9 – Fault Diagnosis

9.1 Introduction

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

9.1.1. No Communication from the Transceiver

Use the following fault diagnosis table to help diagnose the fault (refer to Section 4.4 for the interconnection details).

Table 9–1 – Fault Diagnosis Table

Fault	Possible Cause	Action
No communication from the Transceiver	Wiring connections	Check all LEDs on the Navigation Sensor Hub to confirm power is available to the transceiver (if power is available refer to **AGP Connector**).
	No power	Check all transceiver connections (refer to Error! Reference source not found.).
		Make sure the Marksman software is running correctly on the attached PC and the transceiver has been added to the correct port.
		Make sure the power supply is available and connected securely.
	AGP Connector	Unplug the AGP connector and check the 48 V pin outs of the AGP connector (refer to **Section 12 – Technical Specifications**).
	Continuity of RS485 Connection	To check RS485 connection: turn off power to the system and unplug the topside wiring. Connect RS485 pins 3 and 4 together. Use a multi-meter to check continuity of the RS485 + / RS485 – on the amphenol connector. If no fault is found the wiring is correct (refer to **Section 12 – Technical Specifications**).
		Check the polarity of the RS485 wiring. It is not easy to check the polarity of the RS485 connection apart from checking the wiring carefully against the wiring diagram. If needed a separate RS485 to RS232 converter can be used top-side, then 6G Terminal can be used to connect directly to the serial port to ensure correct operation.

Section 10 – Retrieval and Storage

10.1 Introduction

Before any Retrieval activity is carried out make sure all warnings and cautions in **Section 2 – Safety** are read and the Safety Manual is fully read and understood.

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

10.2 Retrieving Transceiver from Through Deck Pole or Over Side Mount

1. Install applicable lifting equipment to the pole.
2. The crane should slowly lift the lifting equipment until the weight of the pole registers on the crane instrumentation
3. Refer to **Figure 10–1**. Lift the pole out of the deck tube.

Figure 10–1 – Transceiver on Pole

4. Place protective foam matting or suitable material on the surface that the transceiver is to be placed onto.
5. Refer to **Figure 10–2**. Position and lower the transceiver for removal from the pole.

Figure 10–2 – Transceiver Lowered above Protective Material

CAUTION

⚠ **The weight of the pole must not be supported by the transceiver front face.**

6. Using an Allen key, remove the bolts, insulation washers, dual washers and spring washers securing the transceiver to the pole.
7. Discard the spring washers.
8. If the transceiver will not separate from the pole, gently tap around the pole with a hide face hammer so the transceiver gently drops onto the protective surface.
9. The crane should slowly lift the pole.
10. Disconnect the transceiver cable from the transceiver.
11. Blank the connection with the connector cap.
12. Remove the transceiver cable from the pole.
13. Clean, dry and store the transceiver cable in a dry secure environment.
14. Remove and store the pole to the applicable storage area.
15. Remove applicable lifting equipment from the pole.
16. Clean the transceiver (refer to **Section 6 – Maintenance**).
17. Blank all connections.
18. Clean the inside of the protective boot and place onto the transceiver.
19. Store the transceiver in the original transit case or an applicable container in a dry secure area.

Section 11 – Spares

11.1 Introduction

When ordering spare parts, you must provide:

1. The parts number
2. The drawing number
3. The 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 are as follows:

Sonardyne International Ltd
Blackbushe Business Park
Yateley, Hampshire
GU46 6GD
United Kingdom
T: +44 (0) 1252 872 288
F: +44 (0) 1252 876 100
E-mail: support@sonardyne.com
www.sonardyne.com

Sonardyne International Ltd
Units 12 – 14, The Technology Centre
Claymore Drive, Bridge of Don
Aberdeen AB23 8GD
T: +44 (0) 1224 707875
F: +44 (0) 1224 707876
E-mail: sales@sonardyne.com

Sonardyne Inc
8280 Willow Place Drive North
Suite 130, Houston
Texas 77070
USA
T: +1 281 890 2120
F: +1 281 890 7047
E-mail: usa.sales@sonardyne.com

Sonardyne Asia Pte Ltd
34 Loyang Crescent
Block B
Singapore
508993
T: +65 6542 1911
F: +65 6542 6937
E-mail: asia.sales@sonardyne.com

Sonardyne Brasil Ltda
Rio das Ostras, Brasil
Av. Zen lotes 05 e 06
Quadra D
Zen, Rio das Ostras – RJ
CEP 28.890-000, Brasil
T: +55 22 2123 4950
F: +55 22 2123 4951
brasil.sonardyne.com

11.2 Recommended Spares

The following is a list of available spares.

11.2.1. Transceiver type 8142 and 8182

Part No.	Dwg No	Description	Qty
640-6792	7769-063	Transceiver Installation Kit (USBL)	1
		This kit contains the following parts:	
206-064C		Insulation Bush 015-0986 M8.0 Nylon	12
230-1462		Washer Spring S/S M8 Din 7980 small O/D	12
212-1362		Screw Socket Cap S/S M8 X 50	12
755-1409	7769-117-B	Insulator Flange Ring	1
200-3661	200-366-5570	Seal 'O' Ring	1
200-3647	200-364-5570	Seal 'O' Ring	1
820-4808	7009-304-A3	Test Cable Assy	1
200-8088	200-868-5570	Seal 'O' Ring	1
800-4889	7769-118-A	Washer Plate	6
212-133B		Screw Socket Cap S/S M8 X 30	6
200-1896	1895:30-043	Seal 'O' Ring Nit	2
200-4399	200-439-5570	Seal 'O' Ring	1

11.2.2. Assemblies

Part No.	Dwg No	Description	Qty
620-7181	8142-000-01	Transceiver Assembly	1
641-2020	8021-002-01	Transducer Assembly	1
620-7230	8142-000-02	Transceiver Assembly	1

11.2.3. Cables

Part No.	Dwg No	Description	Qty
820-3427	7769-038-C3	AGP Tail – 30m (Subsea Cable)	1
820-6459	A3-8020-061	8 Pin Lemo to Flylead (Topside Cable)	1
820-3650	A3-7784-159	Serial I/O Cable Assembly (Topside Cable)	1

Section 12 – Technical Specifications

12.1 Technical Specification for 8142-000-01, 8142-000-02, 8142-000-31, 8142-000-32, 8142-000-11, 8142-000-12, 8182-000-01, 8182-000-02, 8091, 000-10 and 8291-000-01 Transceivers

12.1.1. 8142-000-01, 8142-000-31, 8142-000-11 Transceivers

Mechanical	
Parameter	**Specifications**
Diameter (Max)	225 mm (8.9 in)
Overall Length	370 mm (14.6 in)
Note: An additional 180 mm (7 in) should be allowed for flange and connector to fit onto a sea chest.	
Weight in Air (Standard Version)*	28 kg (62 lb)
Weight in Water (Standard Version)*	15 kg (33 lb)
Electrical	
Maximum Power	15 W Standby
	120 W Max
Voltage	24 or 48 V DC
Communication	2 x RS485 Half Duplex COM
	or Ethernet 100 base T (Standard on Type 8142-000-11)
	or 1 x RS485 Full Duplex COM
Acoustic	
Transmitting	
Directivity Index	8 dB Approx
Source Level	169 to 199 dB ref: 1 µPa @ 1 m
Receiving	
Operating Envelope	±80° (160 deg) min
Sensitivity Threshold	80 dB ref 1 micro pascal
Repeatability (8142 Only)	Better Than 0.1% of Slant Range Given a SNR of 35 dB in Equivalent Signed Bandwidth
Range Precision	Better Than 0.015 m
Environmental	
Operating Temperature	-5° to 45° C (23° to 113°F)

* Estimated Weights

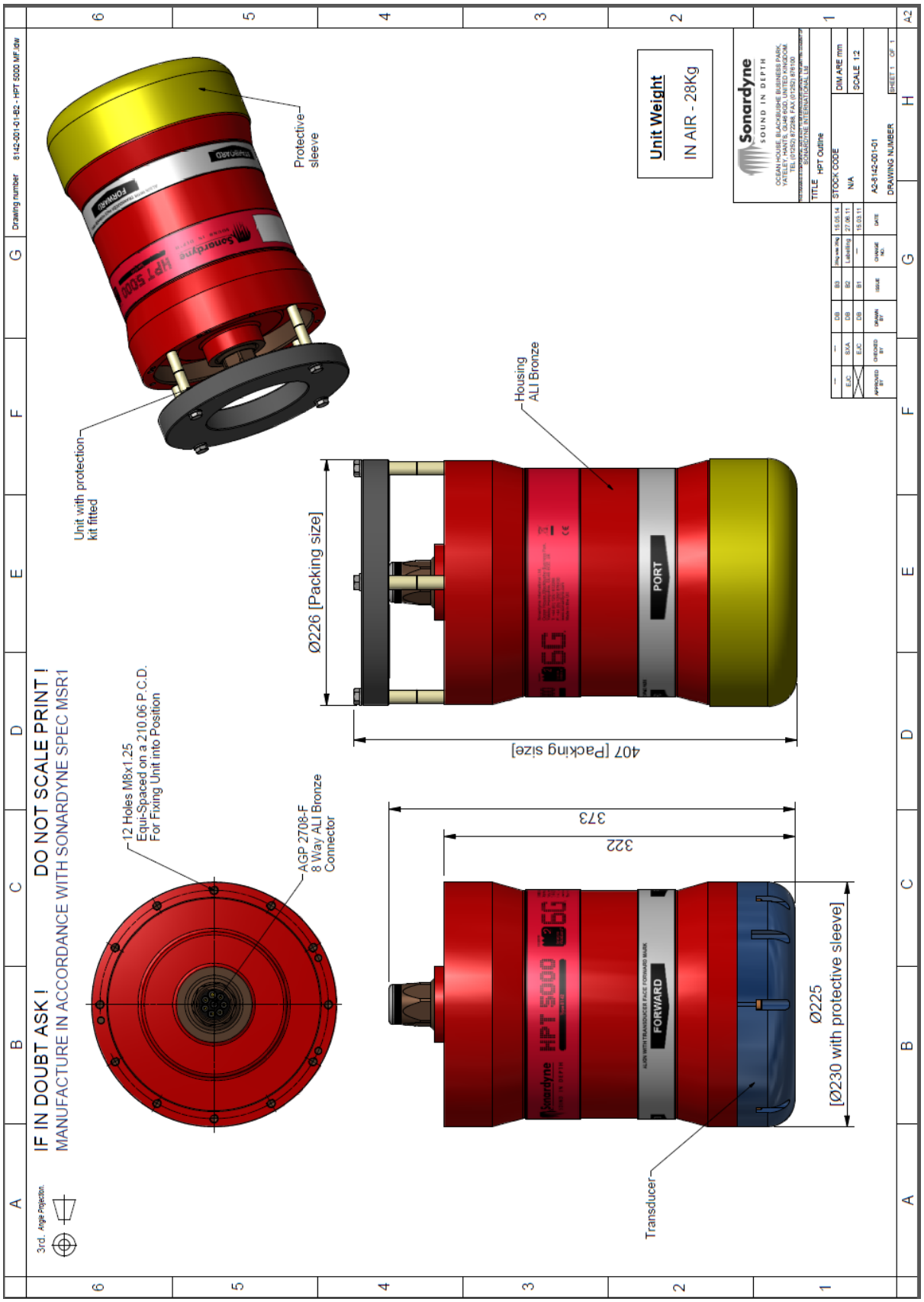
12.1.2. 8142-000-02, 8142-000-32, 8142-000-12 Transceivers

Mechanical	
Parameter	**Specifications**
Diameter (Max)	310 mm (12.2 in)
Overall Length	433 mm (17 in)
Note: An additional 180 mm (7 in) should be allowed for flange and connector to fit onto a sea chest.	
Weight in Air (Standard Version)*	41 kg (91 lb)
Weight in Water (Standard Version)*	20 kg (44 lb)
Electrical	
Maximum Power	15 W Standby
	120 W Max
Voltage	24 or 48 V DC
Communication	2 x RS485 Half Duplex COM
	or Ethernet 100 base T (Standard on Type 8142-000-12)
	or 1 x RS485 Full Duplex COM
Acoustic	
Transmitting	
Directivity Index	8 dB Approx
Source Level	169 to 199 dB ref: 1 µPa @ 1 m
Receiving	
Operating Envelope	±80° (160 deg) min
Sensitivity Threshold	80 dB ref 1 micro pascal
Repeatability (8142 Only)	Better Than 0.07% of Slant Range Given a SNR of 35 dB in Equivalent Signed Bandwidth
Range Precision	Better Than 0.015 m
Environmental	
Operating Temperature	-5° to 45° C (23° to 113°F)

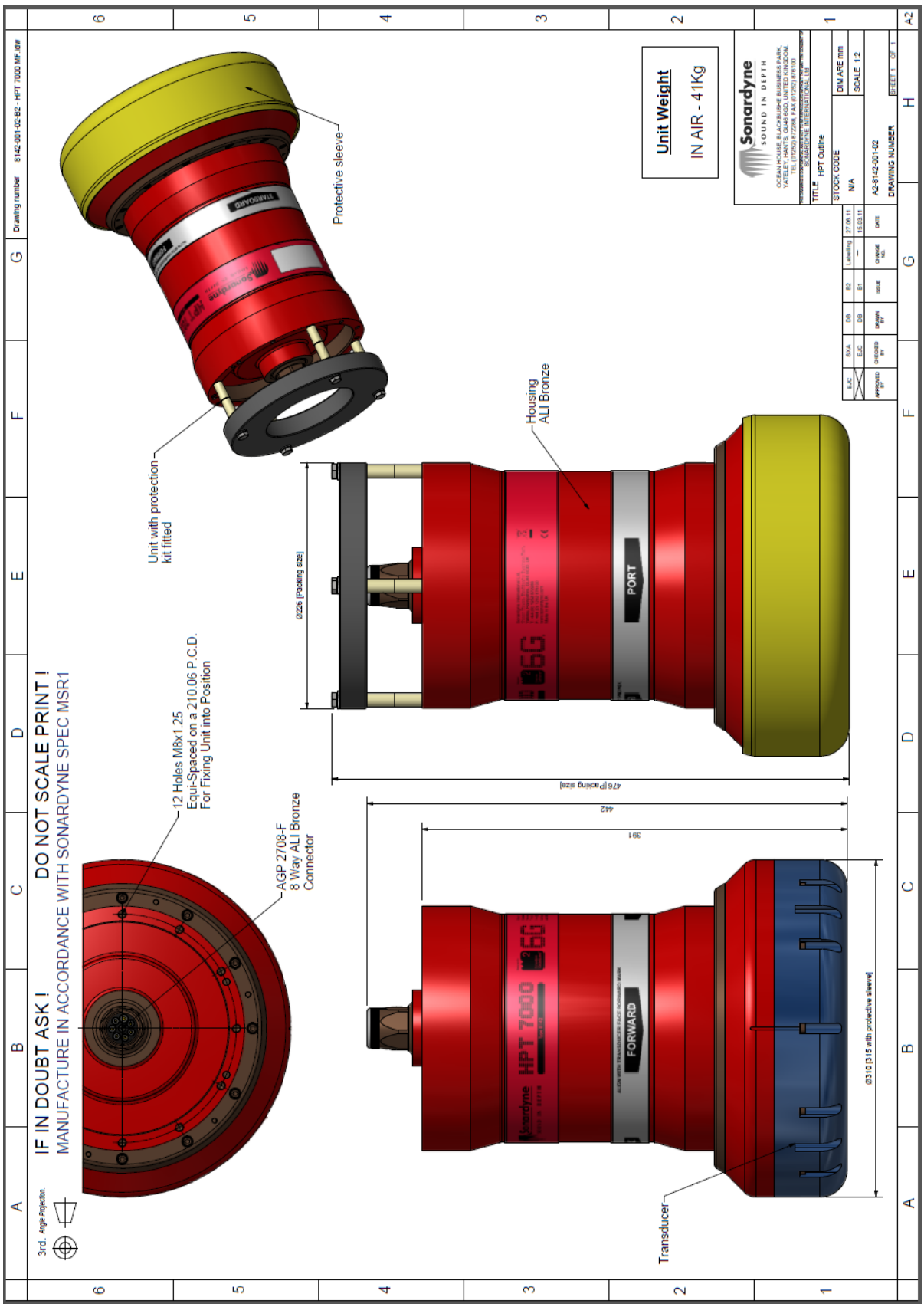
* Estimated Weights

Appendix A – Type 8142/8182 Drawings

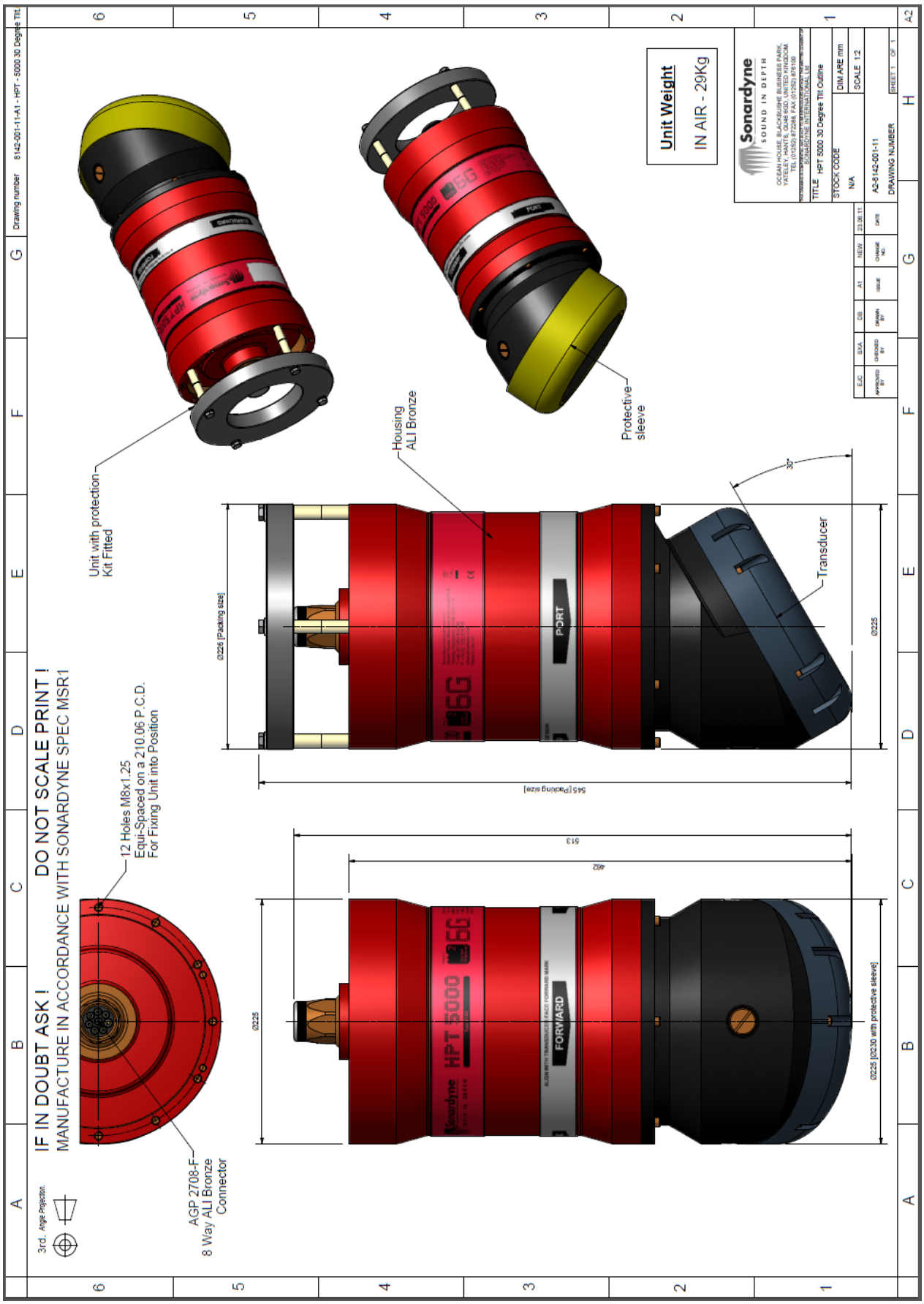
A.1 8142-000-01, 8142-000-31, 8182-000-01 HPT5000 Dimensions



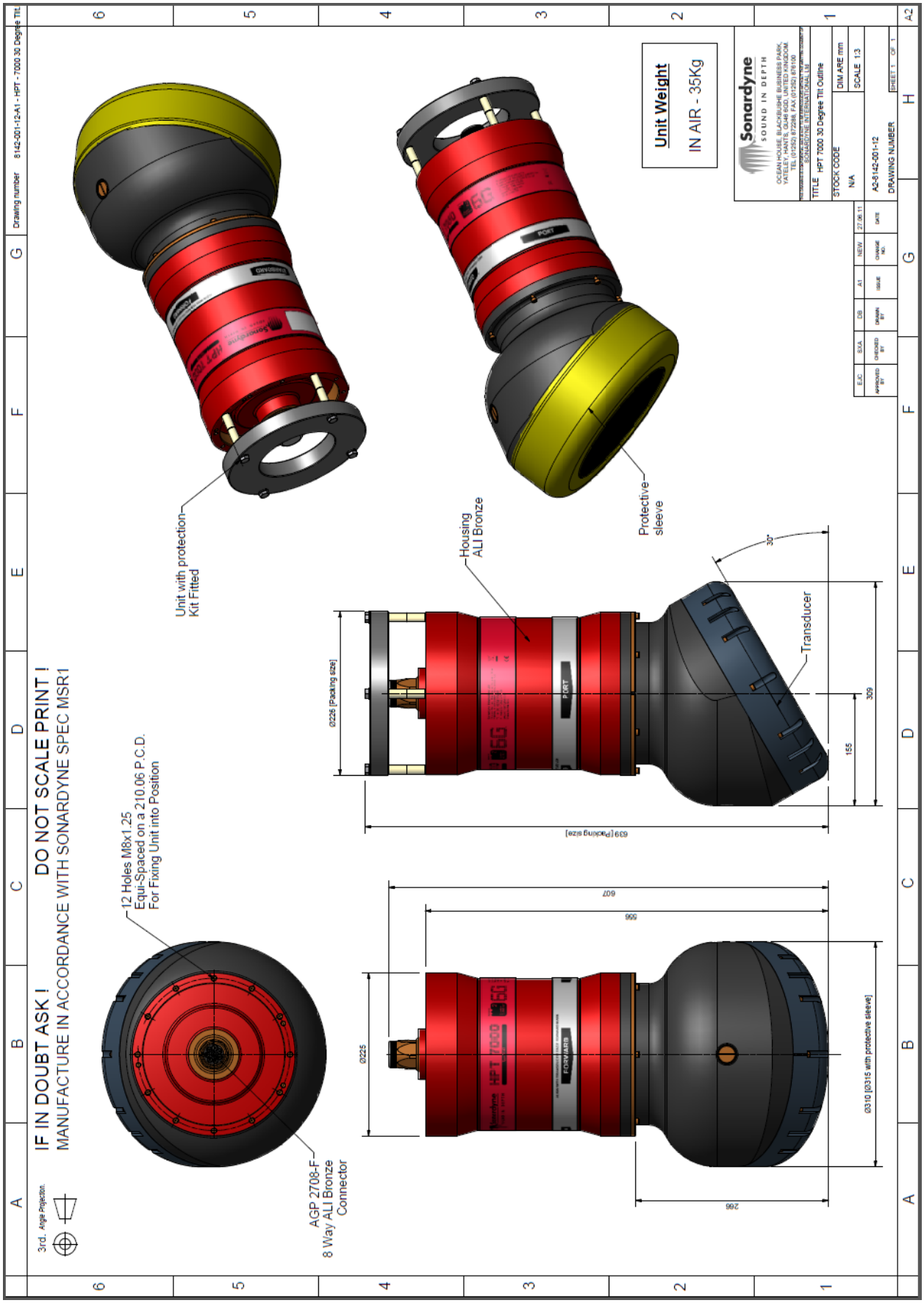
A.2 8142-000-02, 8142-000-32, 8182-000-02 HPT7000 Dimensions



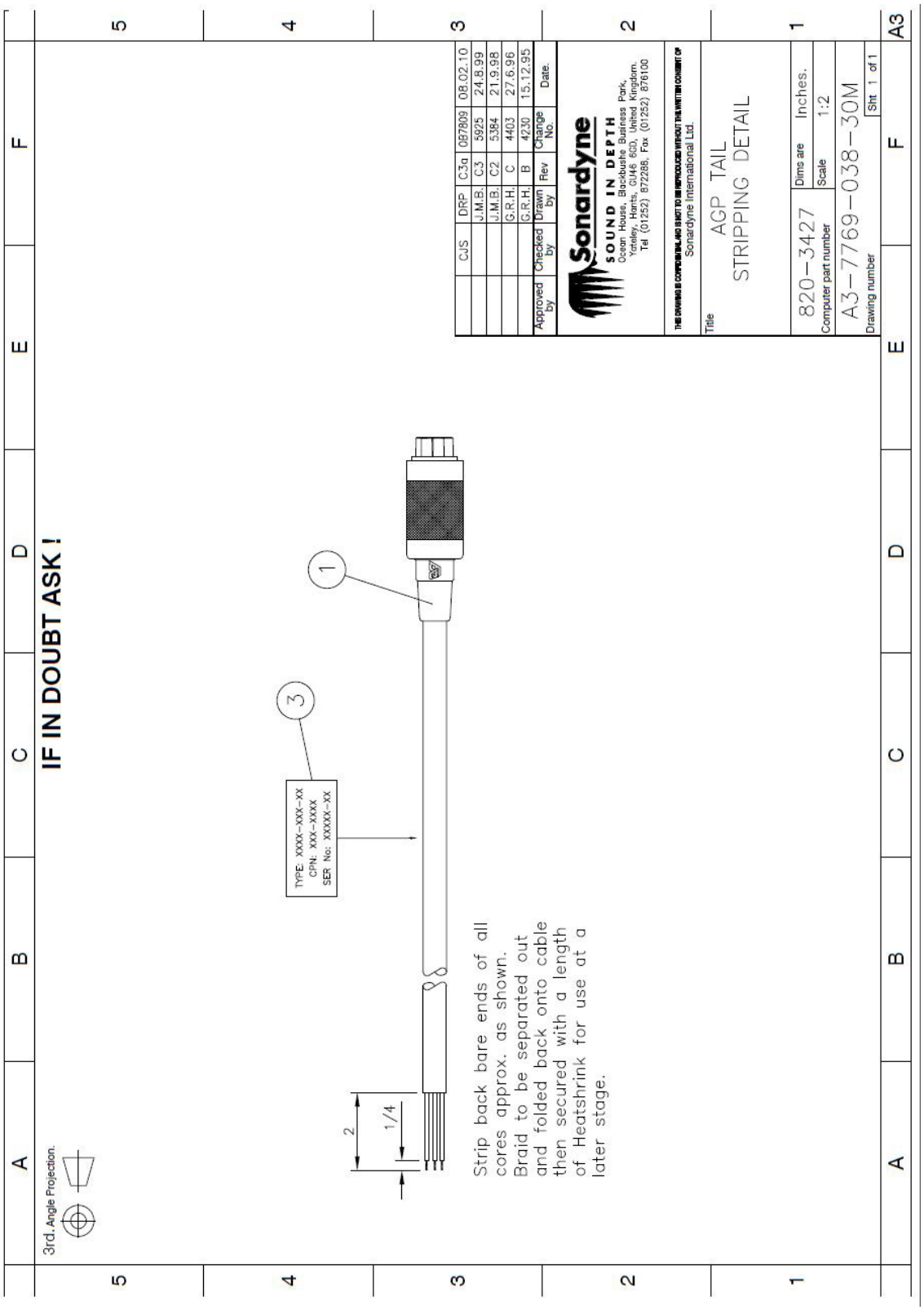
A.3 8142-000-11 HPT5000 Dimensions



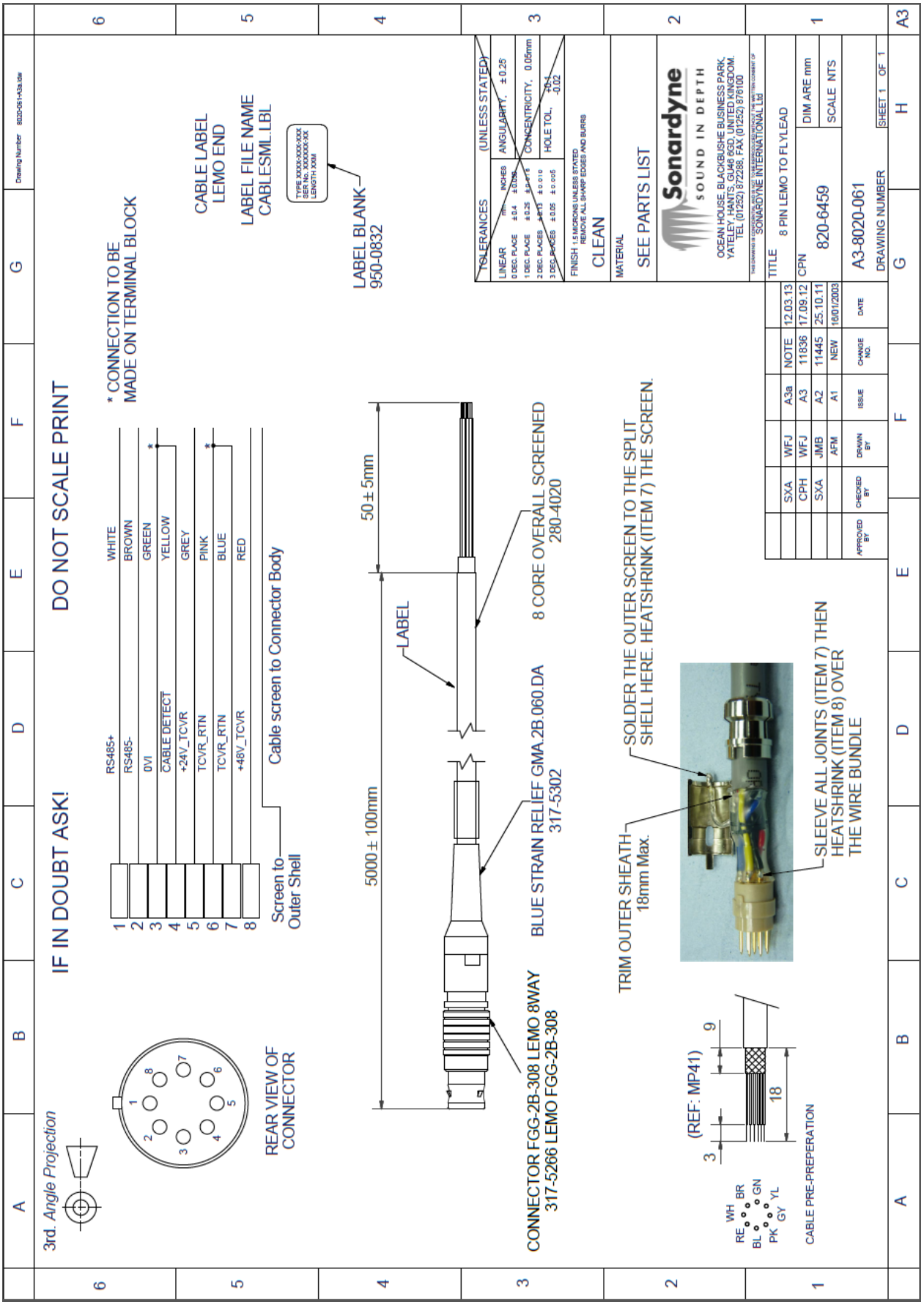
A.4 8142-000-12 HPT7000 Dimensions



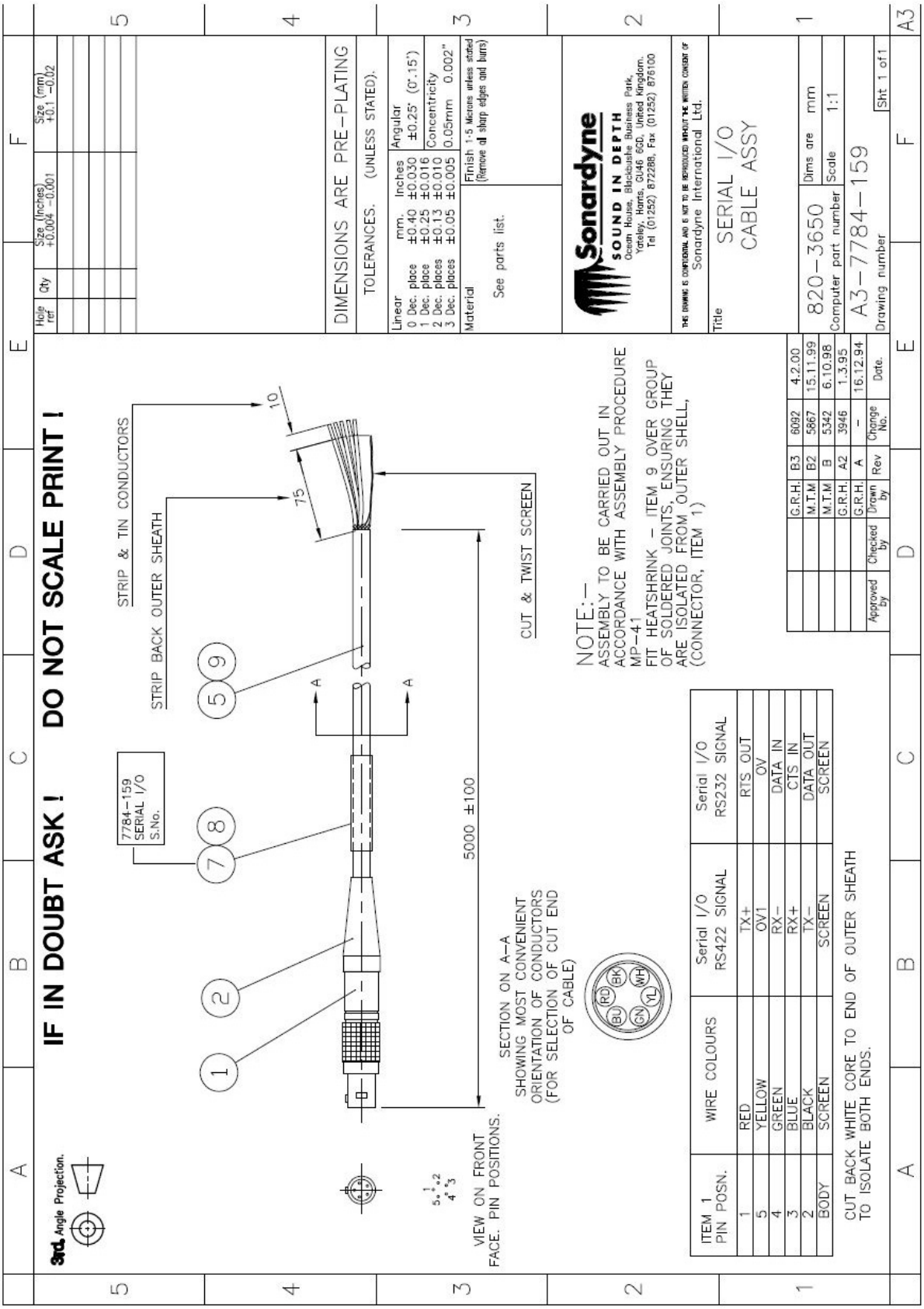
A.5 AGP Tail Stripping Detail



A.6 8 Pin Lemo to Flylead



A.7 Serial I/O Cable Assembly



Appendix B – Deployment and Recovery Log Book

	Date	Time	Sea State	Name Sign/Print
Deployed				
Recovered				
Deployed				
Recovered				
Deployed				
Recovered				
Deployed				
Recovered				
Deployed				
Recovered				
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Recovered				

Appendix C – Repairs Log Book

Date	Time	Reason for Repair	Name Sign/Print

Appendix D – Servicing Log Book

Date	Time	Type of Servicing	Name Sign/Print

Appendix E – Sea State Table

Wave Height (metres)	Wave Height (feet)	Characteristics
0m	0ft	Calm (glassy)
0 to 0.1m	0 to 0.32ft	Calm (rippled)
0.1 to 0.5m	0.3281 to 1.64ft	Smooth (wavelets)
0.5 to 1.25m	1.64 to 4.10ft	Slight
1.25 to 2.5m	4.10 to 8.20ft	Moderate
2.5 to 4m	8.20 to 13.12ft	Rough
4 to 6m	13.12 to 19.68ft	Very Rough
6 to 9m	19.68 to 29.52ft	High
9 to 14m	29.52 to 45.93ft	Very High
Over 14m	Over 45.93ft	Phenomenal

Appendix F – Acoustic Navigation Principles

F.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.

F.1.1 Positioning

Positioning involves an acoustic cycle. The transceiver sends a Sonardyne Wideband®2 signal to the transponder. This activates the transponder which sends back a Sonardyne Wideband®2 signal to the transceiver. The 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 transceiver to transmit an interrogation signal.
- The transponder replies are detected by the 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.

F.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 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.

F.1.3 Data Exchange

The acoustic data exchange between 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 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.

F.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).

F.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.

F.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 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.

F.3 LUSBL

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

F.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 transceiver measures the range and bearing to multiple transponders in one ranging cycle, and reports the results.

F.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.

F.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 L/USBL screen while in Navigation mode. The MRAMS constantly measures the angle between the Blow-Out Preventer (BOP) and the riser.

F.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 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.

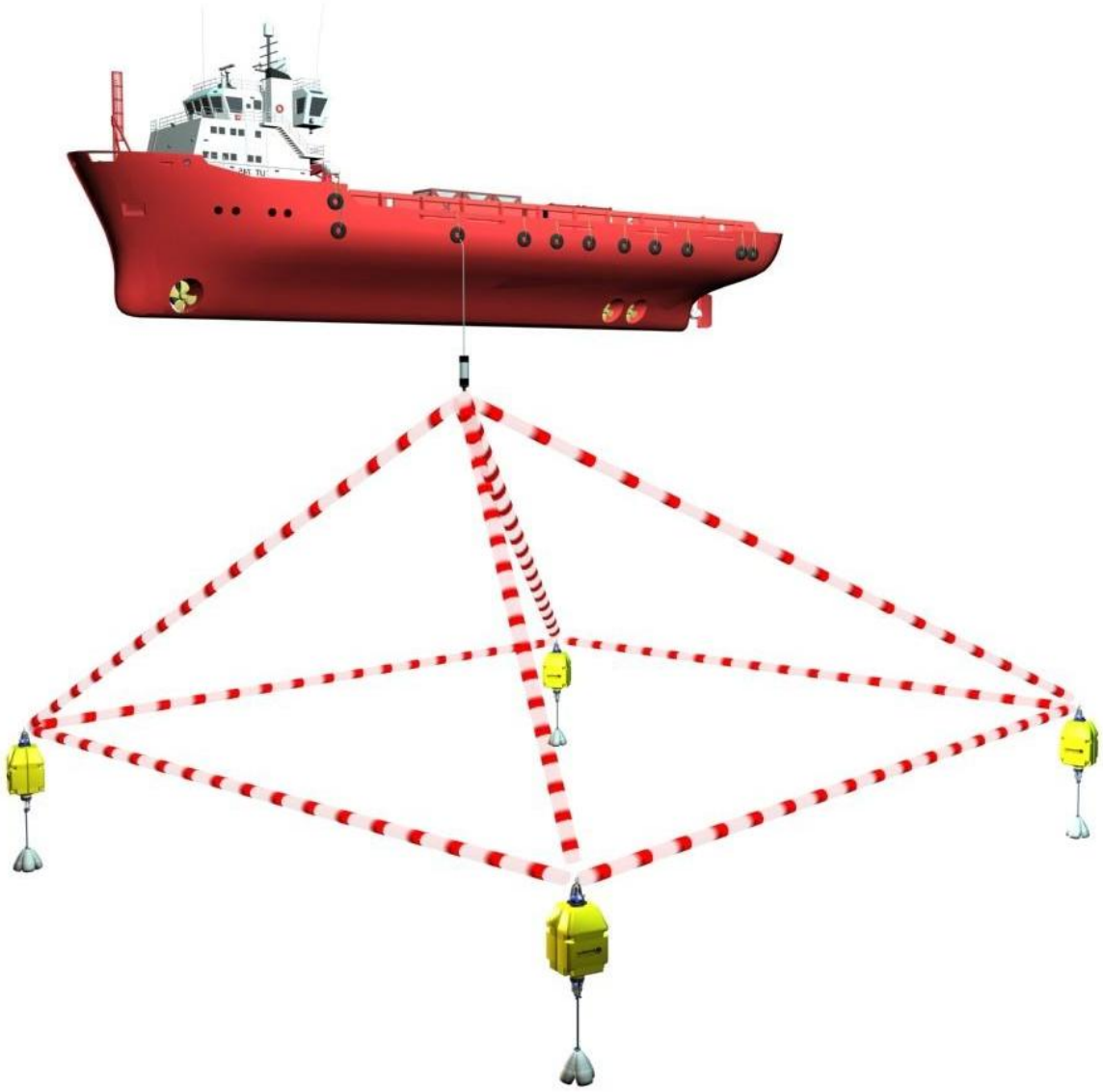
Three transponders is the minimum required for certain navigation in three dimensions. Four is the minimum number required for some degree of redundancy—which is useful for checks on the quality of navigation.

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 F–1 – LBL System



F.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.

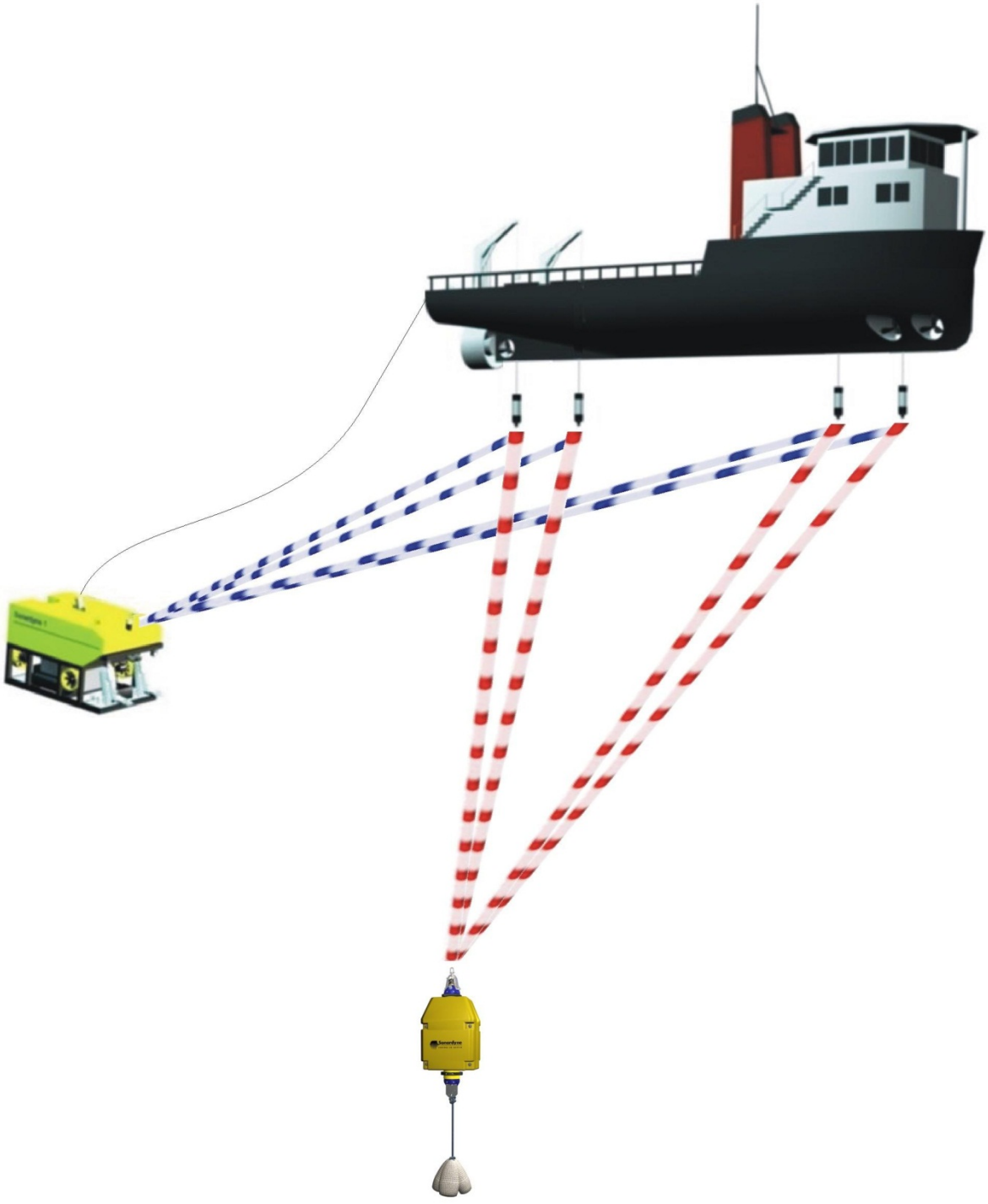
If the distance from the transducers to the transponders is measured as described for LBL, then the position of the transponders, within the vessel co-ordinate frame, can be computed. If redundant measurements are made, a best estimate can be determined which is, statistically, more likely to be more 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 Vertical Reference Unit (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 a Remotely Operated Vehicle (ROV), the system will calculate the position of the vessel and the ROV in a seabed-fixed frame.

Figure F–2 – SBL System



F.6 Ultra Short Base Line Principles

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

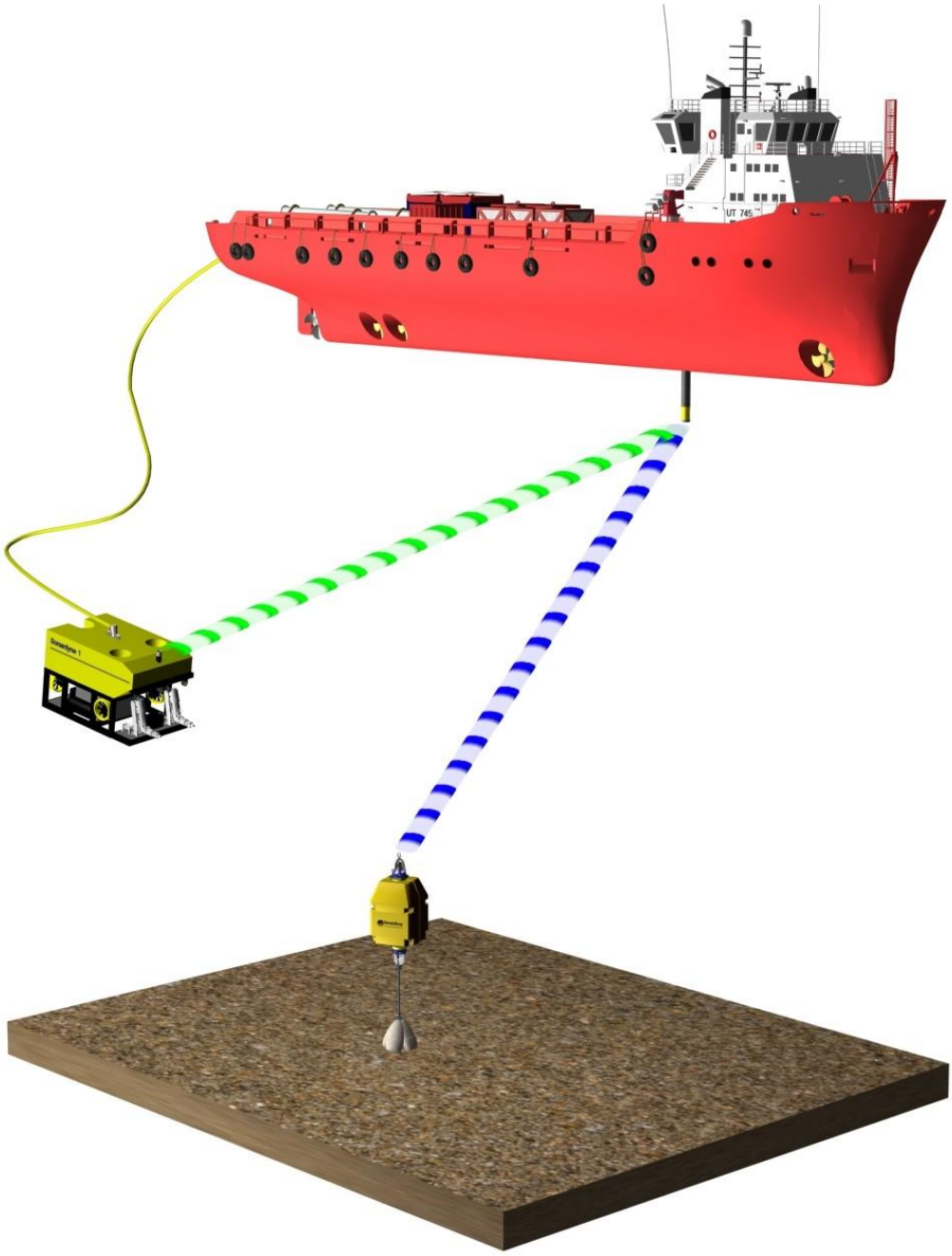
The distances or ranges are measured as they are in an SBL system but the time differences are now much less. Systems using sinusoidal signals measure the "time phase" of the signal in each element with respect to a reference in the receiver. The "time phase differences" between transducer elements are 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 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 transceiver assembly, not directly in a vessel-fixed frame as in the SBL case.

Figure F–3 – USBL System



F.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.

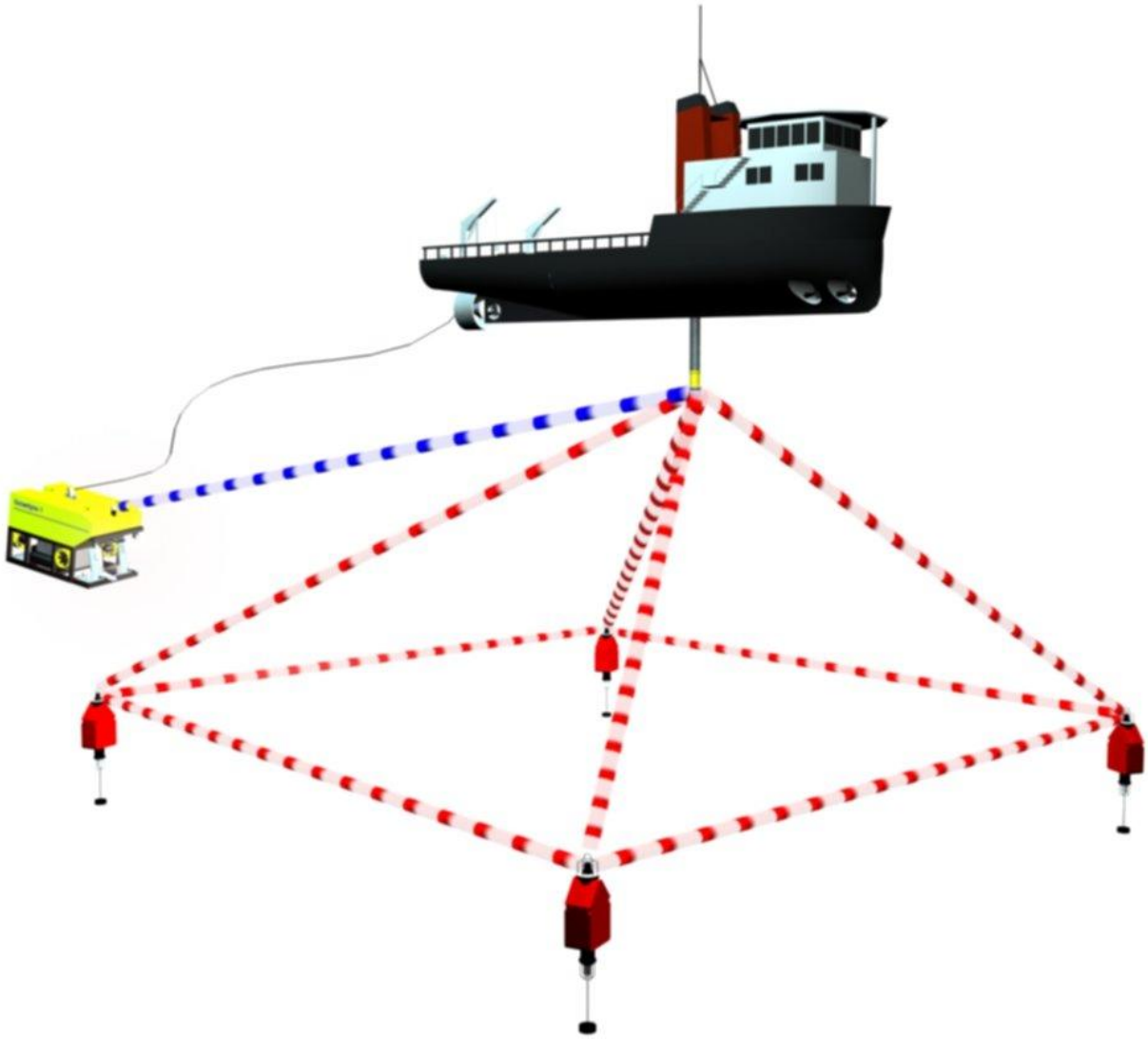
In a LUSBL system, the seabed array must be calibrated separately and the baseline data entered manually into the LUSBL navigation processor. If a radio navigation input is available to the LUSBL system, it is possible to locate each seabed transponder directly in an earth-referenced frame to an accuracy 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 F–4 – LUSBL System



Glossary of Terms

Term	Definition
Acoustic Responder	An instrument that emits an acoustic signal in response to an electrical signal carried to it by cable.
Acoustic Signal	Information carried by sound pressure waves through water. The Sonardyne acoustic signal has a finite length.
Acoustic Synchronous / Precision Pinger	An instrument that emits signals regularly without an interrogating signal. A SYNCHRONOUS Pinger can be synchronised to an external master signal. A PRECISION Pinger has an accurate internal time standard.
Acoustic Transceiver	An instrument that emits and receives acoustic signals, and extracts information from them. Transceivers can measure the time it takes a signal to travel from its transducer to a transponder and return. Some can encode and send data in a message and extract digital data from a message (Acoustic Telemetry). Used on a surface vessel or to mark a point on the seabed, or fixed to a mobile for tracking or positioning.
Acoustic Transducer	A device that converts electrical signals into acoustic signals and vice versa.
Acoustic Transponder	An instrument that emits an acoustic signal when it detects an interrogating acoustic signal.
Acoustic Transponder (Intelligent Transponder)	A type of transponder that is managed by a micro-controller. Examples include the COMPATT (COMPuting And Telemetry Transponder) and the WMT (Wideband Mini Transponder). Depending on supported functionality it can: Decode acoustic telemetered commands from a transceiver and can send telemetered data to the transceiver. It can measure the distance between itself and other transponders and then telemeter the data to a transceiver. It can be capable of measuring its depth and the temperature of the water. It can be used to measure a variety of underwater parameters and telemeter these back to the surface. It can be used, as an intelligent angle-measuring device, in a Riser Angle Monitoring System. It can be fitted with a release mechanism so it can return, on command, back to the surface e.g. if battery power is low.
ANT	Acoustic Navigation Tester
ANT serial port	Used for diagnostic checks.
Attitude and Heading Reference System (AHRS)	An inertial sensor that provides outputs of heading, pitch and roll.
CIF	Common Interrogation Frequency
CMOS	Complementary Metal Oxide Silicon. A major integrated circuit technology based on combinations of p-channel and n-channel field effect transistors fabricated on the same silicon substrate. Especially attractive in low-power applications since the basic CMOS logic gate only consumes significant power during switching.
COMPATT	COMPuting and Telemetry Transponder (see Acoustic Intelligent Transponder)
Common Reply Signal (CRS)	A reply signal common to a complete family of addressed transponders.
CPU	Central Processing Unit
CRF	Common Reply Frequency
DAS	A micro-controlled data acquisition and logging sub-assembly located within a transponder.

Term	Definition
Data Fusion Engine (DFE)	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.
Delay between commands	Provides a delay between adjacent commands.
Depth Status	The transponder can be fitted with an optional depth sensor to send depth information at each interrogation.
Differential Global Positioning System (DGPS)	A 24 hour, world-wide radio navigation system. GPS receivers track and decode the data from satellites and calculate the position and speed of a vehicle.
Dynamic Positioning reference (DP Reference)	Several position inputs e.g. GPS receivers, taut wire sensors, LBL, SBL or USBL acoustic positioning sensors, wind speed indicators etc.
Dynamic Positioning System (DPS)	Automatically maintains a vessel with a constant heading, and in a fixed position without an anchor and provides more flexibility in operation.
Dynamic Positioning telegram (DP Telegram)	The report an acoustic positioning system sends to a DP system over a serial interface.
Digital Signal Processing (DSP)	The representation of signals by a sequence of numbers or symbols and the processing of these signals. DSP includes subfields like: audio and speech signal processing, sonar and radar signal processing, sensor array processing.
Firmware	The firmware installed on the transponder. Firmware upgrades can be installed via WSM Terminal. The Tx firmware refers to the transmission signal synthesiser.
Global Positioning System (GPS)	A multi-user, 24-hour, worldwide radio navigation system using the NAVSTAR constellation of satellites. GPS receivers are capable of tracking and decoding data from the satellites and using it to compute the position and velocity of a vehicle.
HPR	Hydro-acoustic Position Reference
HPT	High-Performance Transceiver
Inertial Navigation System (INS)	A navigation aid that uses a computer, motion sensors and rotation sensors to continuously calculate the position, orientation and velocity of a moving object without the need for external references.
Long Base Line Positioning System (LBL)	A system where two or more transponders are on the seabed. The positions of the transponders are established by a calibration process in a seabed frame. The distances from a transducer to each transponder are measured using a transceiver. The position of the transducer can be computed in the seabed frame. The name comes from the “baselines” joining each transponder.
LUSBL	Long and Ultra Short Base-Line
PSU	Power Supply Unit
ROV	Remotely Operated Vehicle
Serial Communications Wait	The maximum time allowed for the Transponder to reply to an RS232 command.
SSM	Super Sub-Mini Transponder (WSM predecessor)
Ultra Short Base Line Positioning System (USBL\)	A system similar to an SBL system except the system uses three or more elements in a single transducer array. The measurements it makes are the differences in “time-phase” of the signals from each element. The co-ordinate frame is fixed to the transducer array which must be oriented in the vessel frame to be equivalent to the SBL.

Term	Definition
WSM	Wideband Sub-Mini Transponder

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