Sonardyne
SOUND IN DEPTH

UM-8094
User Manual for Type 8094 Inverted HF USBL

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QUALITY MANAGEMENT CERTIFIED DNV

UM-8094

USER MANUAL

FOR THE

TYPE 8094 INVERTED HF USBL

ISSUE A

REVISION 0

IMPORTANT SAFETY INFORMATION OVERLEAF

This Document Contains Safety Precautions at Revision 5

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Date of Issue	:	24 April 2006

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SAFETY

It is essential that all personnel involved in the operation and servicing of this product are familiar with the details below.

This product contains hazardous voltages and must only be opened by qualified service personnel. There are no operator adjustable components inside.

SUBSEA EQUIPMENT GENERAL OPERATIONAL & SAFETY PRECAUTIONS

Operators and Service personnel must be familiar with the information below.

Not all sections will apply to all instruments.

Additional information, if applicable, is included in the relevant sections of the product operating and maintenance manuals

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1. HAZARD APPRECIATION

Subsea equipment remains safe in use when operated and handled within standard operating procedures and written guidelines, therefore in normal operation little threat is posed to the safety of individuals or instruments. However all subsea units are capable of posing a threat to personnel safety, particularly when pressure housings become internally pressurised. Great care must be taken when this happens, or is even suspected to have happened, since the pressures present within the instrument are likely to be **extremely** high. Internal pressure problems may also be aggravated by unknown chemical hazards if battery breakdown has also occurred.

The following non-exhaustive list gives examples of typical hazardous situations:

- a pressure housing becomes internally pressurised by water pressure, following a leak
- a pressure housing becomes internally pressurised due to battery malfunction
- attempts are made to charge non-rechargeable battery packs/cells
- using an instrument outside its design parameters
- using an instrument beyond its load bearing limits
- failing to maintain the equipment can reduce its load bearing capability
- using unauthorised components or inferior parts in critical assemblies, e.g. release systems

2. GENERAL HANDLING OF EQUIPMENT

Do not allow instruments to be dropped or exposed to shock damage which can cause sensitive internal components to fail. Note that minor damage to metal finishes often creates burrs which can present a hazard to unprotected hands or other parts of the body. Control the local environment by preventing personnel stepping into the bight of haphazardly laid ropes or cables which are attached to a unit. Do not allow an instrument to block an access or impede normal traffic flows in a gangway or on a stairway.

Water tightness of instruments depends on fine surface finishes, accurate dimensional tolerances and cleanliness of components. Generally when dismantling equipment care should always be taken, the disassembly process should be carried out in a well-ventilated area with as few personnel in the vicinity as possible. Servicing must always be carried out by competent personnel with appropriate training.

3. DISMANTLING SUB-SEA EQUIPMENT

3.1 INTRODUCTION

All sub-sea equipment fitted with pressure housings are subject to a vast range of externally applied pressures and are susceptible to internal pressure rise if, for example, a leak occurs or the unit's battery destructs. Internal pressure presents a **potentially dangerous situation** and all appropriate **safety measures must be enforced**. Note that fumes given off by deteriorated batteries, particularly lithium based types, pose a health hazard. Apply precautions as appropriate to the circumstances prevailing at the time.

Note (1) that there is likely to be *no prior indication of the presence of internal pressure*, first indications being that the endcap(s) of the unit are being forced out of the housing under pressure during the dismantling process. Symptoms that indicate a higher risk of internal pressure include:

- Equipment that failed when deployed, in transit or storage
- Equipment stored for a long time with batteries connected
- Equipment having suffered physical damage.

Note (2) that when a unit has leaked it often behaves like a valve, i.e. water pressure causes a rise in internal pressure which cannot then escape because the point of leakage becomes sealed. Complete removal of an endcap's retaining mechanism means that it becomes unconstrained and therefore free to be discharged from its housing under high internal pressure - **an uncontrolled and potentially dangerous situation**.

DO NOT TRANSPORT EQUIPMENT WHICH IS INTERNALLY PRESSURED

The following precautions & procedures are recommended.

3.2 INSTRUMENTS FITTED WITH SPRUNG VENT PLUGS

Pressure Vent Plugs are fitted into all subsea equipment housings containing batteries and incorporate a red or green bung with dual O rings and a vent hole behind the second O ring. The vent plug is designed so that it can be partially withdrawn using a M4 screw to the point where its relief hole, positioned inboard of the second O ring, becomes open to atmosphere and thus allows internal pressure to dissipate. The vent plug cannot be totally removed (and forgotten) because of a retaining spring holding the red or green bung in place.

A normal unit may emit an audible rush of air when the vent plug is retracted, but it will typically only last for 1 second maximum. A longer rush of air/gas indicates a pressurised unit, in which case ventilate the area, and let the remaining pressure out of the unit. Internal pressure dissipates to atmosphere in a very short time and may be accompanied by water, debris, noise etc. Do not allow unnecessary personnel to enter the vicinity of the work or to be anywhere near dissipating gases and debris.

3.3 PRECAUTIONS (INSTRUMENT FULLY FUNCTIONING)

The techniques for retaining endcaps in the pressure housings differ from product to product, and detailed instructions on opening the pressure housing are given in the servicing section of the individual product manuals.

To ease dismantling and release any slight internal pressure that may have built up during normal operation, the vent plug should be operated as described in 3.2.

When removing the endcap it is recommended to stand to one side, and not inline. This will avoid potential injury if the endcap is ejected by any remaining internal pressure.

3.4 PRECAUTIONS (INSTRUMENT KNOWN OR SUSPECTED TO BE PRESSURISED)

If an instrument is known, or suspected to be internally pressurised through water ingress or battery venting additional precautions must be taken.

Remove the instrument to a well - ventilated location away from other working personnel.

If the housing is hot, indicating recent or current active internal chemical action, do not attempt to open. Lower overboard into water for several hours minimum or into a secure area away from all personnel. Do not attempt to dismantle until it has cooled.

Wear protective clothing, safety glasses and gloves, and refer to battery manufacturer's material safety data sheet (MSDS).

Release the safety vent as described in section 3.2. If there is no significant pressure dissipation and no fumes indicating a battery malfunction, the unit can be dismantled using the precautions described in section 3.3 and the relevant product servicing manual.

If there are any chemical fumes when the vent plug is released, or signs of deposit around the vent exterior, these are signs that the battery has vented due to water ingress or electronic/battery malfunction. In these circumstances the battery pack and internal electronics may have been severely damaged.

Take extreme care when removing the end cap, using any additional precautions detailed in the individual product manuals. There may be a possibility of some residual pressure remaining, within the housing, if during operation of the vent valve, it becomes blocked with the products of the internal chemical reaction.

When the battery is removed it should be covered with dry sand, or preferably sodium carbonate, or a mixture of 1:1 soda ash and slaked lime. It should be placed in an approved container (after cooling if necessary) and disposed in accordance with local regulations.

The electronics, end caps and pressure housings should be thoroughly hosed down

4. ELECTRONIC HAZARDS

4.1 HIGH VOLTAGES

WARNING

High Voltages

Operation of this equipment does not present any danger to users in normal use. If the internal electronics chassis is removed from it's housing for maintenance, the user should be aware that high voltages are present, particularly on the transmitter PCB and transducer.

Storage Capacitors

Note that subsea equipment incorporates capacitors which are capable of storing large quantities of electrical energy. Avoid inadvertent discharge during dismantling.

4.2 HANDLING OF ELECTRONIC COMPONENTS

Most of the circuits in subsea equipment use CMOS logic, which is easily damaged by static discharge or excessive supply voltage. The best handling for electronics is NO HANDLING. Field servicing cannot compare in efficiency and accuracy with the original factory calibration and therefore field servicing should be limited to checking correct calibration/operation (within the limits of the test gear available) and repair by exchange of PCB's or modules.

4.3 SAFETY PRECAUTIONS FOR LITHIUM BATTERIES

WARNING

Lithium based batteries become hazardous (fire and corrosion) if exposed to air and water. If damaged they may also emit **thionyl chloride**. Consult battery manufacturer's Material Safety Data Sheets (MSDS) prior to operating lithium based battery products.

Additional information applicable to lithium cells (model LSH20) is available from:

SAFT Ltd
River Drive
South Shields
TYNE AND WEAR
NE33 2TR
UK

Tel: +44 (0) 191 456 1451
Web Site: www.saftbatteries.com

4.4 LITHIUM BASED BATTERIES, GENERAL

Special precautions and regulations apply to transport, handling and disposal of lithium based products.

Lithium batteries are powerful sources of electrical energy and should be handled with care to avoid short-circuiting.

Where a battery powered underwater instrument is suspected of flooding, extreme caution must be exercised in opening the instrument in case an internal pressure has developed, which might cause the components to fly apart, causing damage or injury. Release of cell contents within the pressure vessel is very unlikely to cause hazard but the following safety procedures should be followed.

4.5 LITHIUM BASED BATTERIES, STORAGE TEMPERATURE

Cells and batteries, and hence the whole Sonardyne instrument, should not be exposed to temperatures in excess of 70°C. Instruments should not be left on deck in strong sunlight such that they become hot to the touch.

Lithium battery packs should be stored at +20°C, and in a humidity-controlled atmosphere to prevent passivation developing, which can reduce actual operating life, and in extreme cases may cause the unit to malfunction once deployed.

Instruments should be cooled to normal room temperature or lower before being opened.

4.6 OPENING A LITHIUM POWERED INSTRUMENT

The normal procedure before opening any underwater instrument is to wash in fresh water, remove salt deposits and dry it. The instrument should only be opened in clean, well-ventilated, dry surroundings.

All **precautions outlined in paragraph 3.4 above** should be applied during dismantling processes if it is suspected that internal pressure is present.

4.7 FAULT PROCEDURES

If a cell or battery is shorted or starts to heat up, it should be disconnected from the transponder immediately and removed to the outdoors or to a well-ventilated area to cool down. Tongs, or a shovel, are recommended for this purpose. Once the temperature has dropped and it is deemed safe to do so, the cell or battery can be disposed of as below. Suitable protection clothing should be worn when handling suspect cells/batteries and if the skin has come into contact with the electrolyte, it should be washed thoroughly with water.

If a cell is ruptured, potentially flammable materials may be exposed.

WARNING

For Lithium battery packs, Class D fire extinguishers should be used. Water, CO2, Halon, dry chemical or foam extinguishers are not suitable.

4.8 DISPOSAL OF LITHIUM BASED BATTERIES

Cells and batteries in small quantities can be disposed of in a secured landfill. If a secured landfill is not immediately available then appropriate safety precautions should be taken to temporarily secure the items. Packaging suitable for the storage and transport of lithium cells/batteries must be used at all times when not installed in an instrument.

DO NOT DISPOSE OF LITHIUM BATTERIES IN A FIRE.

4.9 TRANSPORTING LITHIUM BASED PRODUCTS

The current regulations and information below is provided for guidance only. Note that data sheets concerning quantities of lithium per cell are available from cell manufactures and these may change without prior notice, therefore the quantities of lithium per battery pack cannot be verified by Sonardyne Ltd. When transporting lithium based products it is the operators responsibility to comply with local, national and international regulations in force at the time of transport.

By Road: ADR European Agreement concerning the International Carriage of Dangerous Good by Road Regulations.

By Sea: International Maritime Dangerous Goods Code

By Air: IATA Regulations UN 3090 and UN 3091

5. BATTERIES GENERAL

5.1 USE OF APPROPRIATE BATTERY TYPES

Sonardyne equipment uses a variety of battery types. In some instrument designs only one type of battery pack is authorised for use but others will accommodate NiCad rechargeable, alkaline or lithium based packs. Instruments must **NOT** be fitted with alternative battery pack types unless they are specifically designed to use them.

DO NOT FIT UNAUTHORISED BATTERY PACK TYPES INTO AN INSTRUMENT

NOTE THAT DAMAGE CAUSED BY USING BATTERY PACKS WHICH ARE NOT AUTHORISED OR ARE NOT CONSTRUCTED TO SONARDYNE'S BUILD STANDARDS INVALIDATES ANY WARRANTY

5.2 CHARGING OF BATTERIES IN SEALED CONTAINERS

Batteries/Cells may give off gases when recharged. As a general rule, sealed containers MUST be allowed to vent to atmosphere during the charging process.

Some instruments may be fitted with safety features which prevent the possibility of problems caused by gasses vented by batteries. Detailed charging procedures for the particular instrument should be carefully followed.

5.3 ATTEMPTING TO CHARGE NON-RECHARGEABLE BATTERY PACKS

DO NOT ATTEMPT TO CHARGE NON-RECHARGEABLE BATTERIES PACKS OR CELLS

All **PRIMARY BATTERIES**, i.e. alkaline-manganese dioxide, lithium-manganese dioxide, silver oxide, zinc air, zinc carbon and zinc chloride batteries are NOT designed to be charged.

Non-rechargeable cells exhibit a range of unpredictable characteristics if any attempt is made to charge them, **Very high pressures and temperatures** can occur in an instrument often some time after the attempt to charge them has terminated.

Attempts to charge a primary battery may lead to an imbalance within the cell potentially leading to gas generation and in extreme cases explosion.

Battery packs **MUST NOT** be reconfigured from one type to another, e.g. NiCad to alkaline or lithium. Alkaline or lithium cells may be inadvertently charged.

5.4 HANDLING OF USED BATTERIES

Batteries should not be discharged below their end point voltage. To do so can lead to internal corrosion and leakage of electrolyte in certain types of sulphur dioxide cells. Although there is very little gas to cause a pressure rise under these conditions, the electrolyte leakage will cause severe corrosion.

After recovering an instrument from the sea it should be opened, and the battery voltage(s) checked while still connected to see if above the end point voltage for that type of cell. Disconnect and mark as usable or not with date of disconnection noted both on the pack and in written records. Check the instrument for signs of corrosion, such as at solder joints, as a sign of any slight leakage.

The remaining life of a battery depends on both time and, for a transponder, the number of times it has been interrogated. Normally transponders keep their own record of battery usage, but users must maintain a separate record of time elapsed whilst battery is installed and connected, plus estimates of the number of interrogations.

5.5 RE-CONNECTING A PARTIALLY USED BATTERY

Calculate if the remaining battery life will allow your next mission to be safely accomplished. If so, note the date of re-connection, both on the battery label and in written records, against the serial number of the instrument.

5.6 FITTING A NEW BATTERY

Note the date it is connected and therefore starts to supply current. Write this date on the battery label and also in your written records.

5.7 BATTERY PACK FUSES

A number of Sonardyne battery packs have carefully selected, high-reliability fuses soldered onto the diode-board of the pack. These are "Littlefuse" devices. If you have blown a fuse due to mishandling, it may be replaced by an identical type, but the rating must not on any account be increased.

6. EQUIPMENT ENVIRONMENTAL LIMITATIONS

6.1 STORAGE TEMPERATURE LIMITS

Equipment may be stored at temperatures in the range -20 to + 60°C. It should be noted however that lines connecting pressure transducers to a transponder may become partly filled with seawater during service. This cannot easily be expelled and may therefore freeze if transponders are stored at sub-zero temperatures after recovery from the sea.

Spare battery packs should be stored at room temperature, in an environment with a controlled humidity level.

7. INSTRUMENT LOAD BEARING CAPABILITY

Navigational Transponders are NOT normally designed to take in-line loads greater than the maximum upthrust applied by the floatation equipment. The carrying straps, if fitted, are for ease of manual handling and the range of transducer guards selected for their acoustic properties.

The Safe Working Load (SWL) capability of the release mechanism, built into most instruments, can only be used for in-line lifting operations if a suitably - rated, approved, lifting strap, transducer guard, buoyancy collar eyes or other safe method is selected.

It is the operators responsibility to ensure the condition of the equipment and that a safe lifting method has been devised for any particular operation.

Sonardyne's range of Oceanographic Release Transponders have been designed specifically for in-line lifting operations.

Appropriate shackles must be used in release systems to ensure freedom from corrosion. It is important to note that instruments, their release mechanisms and shackles form part of an integrated and complete system.

8. FLOATATION EQUIPMENT

8.1 INTRODUCTION

Floatation equipment is fitted to subsea transponders in order to aid their recovery once a deployment is complete. A nett upthrust requirement is given in manuals and technical data for any particular instrument. The following guidelines are given to assist operators in their understanding of the general requirements.

8.2 MINIMUM NETT BUOYANCY OF FLOATS

Floats are described as having a minimum nett buoyancy in seawater and this is the figure quoted in Sonardyne Float Technical Data and by the float manufacturer. Total upthrust can be calculated by knowing this figure, e.g., a float with 30kgs nett buoyancy in sea water supporting a load with weight in sea water of 30kgs would result in neutral buoyancy, i.e. no nett upthrust.

8.3 FLOAT INSERTS

Float collar Inserts are used to allow floats of larger internal bore to be used with housings of nominal 6" diameter. The weight *in water* of an insert is usually slightly positive and this will be additional to the weight of the instrument being supported by the float. Two inserts will result in approximately 0.5kg reduction in nett upthrust.

8.4 NETT UPTHRUST

The difference between the nett buoyancy of the float and the total weight of an object, or objects, in water that it is supporting, e.g.

Nett Upthrust =

(Minimum nett buoyancy of the Float) - (the weight of the instrument + inserts in water)

e.g. 30 kgs - (11.2+ 0.5) kgs = 17.3 kgs nett upthrust

8.5 FLOAT STORAGE CONDITIONS

Special storage conditions are not called for if due care and attention is applied to a float. Floats are not hygroscopic and should not therefore be affected by moisture in air.

8.6 FLOAT OVER-PRESSURE

The maximum water depth quoted for a float must not be exceeded. Over-pressured floats are forced to absorb water and their weight in air thus increases. All floats should be weighed prior to use to check that they are maintaining their original manufactured weight.

9. DEFINITIONS OF VARIOUS LOADS AND LOADING TERMS

9.1 A STATIC LOAD

An unvarying long term load.

9.2 A DYNAMIC LOAD

A time varying load resulting from the motion and inertia of connected masses and forcing functions such as wave action on the vessel. This may include transient and steady state harmonically alternating loads.

9.3 MAXIMUM ULTIMATE STATIC LOAD OR BREAKING LOAD OR PARTING LOAD

The load that induces structural failure in one or more parts of the instrument causing the load to part with the release.

9.4 MAXIMUM PROOF STATIC LOAD OR MAXIMUM RATED STATIC LOAD

The maximum in-line static load the instrument can bear without suffering an unacceptable degree of permanent deformation. Ideally this should correspond with the load at which the maximum stress at any point in any component is the 0.2% proof stress for the material used in that component (in the condition that it is used).

9.5 SHOCK LOAD OR SNATCH LOAD

A time transient load generally caused by the sudden acceleration (positive or negative) of the load. Examples are the sudden snatch of a load off the deck or a sudden arrest of a load falling under gravity.

9.6 SAFE WORKING LOAD

A load set as a proportion of the Ultimate Static Load to allow for factors such as corrosion, fatigue, shock loads, harmonic loads, manufacturing defects, material defects etc. Various figures may be adopted according to the practise of the industry, risk to health and applicable legislation. Typical factors are $^{1}/_{6}$ to $^{1}/_{3}$ of the Ultimate Load.

9.7 PROOF LOAD

Normally a Load that is periodically applied to the load bearing device to demonstrate that it is still safe. Generally this is 2 times the Safe Working Load.

9.8 RELEASE LOAD

The maximum in-line load the instrument can withstand and successfully release without overloading any part of the release mechanism or demanding an unsupportable quantity of energy from the battery supply (at its specified end point).

10. IF IN DOUBT

Contact Sonardyne for advice.

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AMENDMENT RECORD

All amendments and additions will be issued with a copy of this sheet, recording the history of amendments.

Revision	Date	Comments
1	26.10.96	Initial Issue
2	21.03.02	
3	19.04.02	CN 7167 Modified to allow transponders to be charged in a closed environment provided safety features are provided
4	14.03.03	CN 7699 Updated to ensure safety precautions cover more general equipment
5	24.02.04	CN 8104. Transportation regulations updated. Dismantling method removed and refers to unit manual. Carrying strap not to be used for mechanical lifting.

Authorised : P V Williams

Date of Issue : 24 Feb. 2004

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AMENDMENT RECORD

All amendments and additions will be issued with a new copy of this sheet, recording the history of amendments.

Issue	Revision	Date	Comments	Section	Page
A	0	24.04.06	Initial Issue	All	All

SECTION 1

1. INTRODUCTION AND OPERATING PRINCIPLES

1.1 STRUCTURE OF MANUALS

This manual is divided into four sections, each dealing with a different aspect.

1. INTRODUCTION AND OPERATING PRINCIPLES. Provides a general introduction and a brief description of the operating principles.

2. INSTALLATION AND CONNECTIONS - Contains all necessary details for installing and connecting up the Transceiver

3. TECHNICAL SPECIFICATIONS - Full technical specifications of the iUSBL Transceiver variant

4. TRANSCEIVER COMMAND LANGUAGE – Full details of the command language for use of the transceiver as a stand alone instrument

1.2 PURPOSE OF THE TRANSCEIVER

The Sonardyne 8094 iUSBL Transceiver provides the ability to measure both range and direction to the following Sonardyne Transponders from a sub-sea vehicle:

- Type 7815 OBC Transponder / Coastal Beacon / Prospector Beacon
- Type 7986 Lightweight Release Transponder
- Type 7835 Deep Marker Transponder
- Type 8044 Lightweight Actuation Transponder
- Type 8070 Wideband Sub-Mini (Omnidirectional) [FUSION systems only]
- Type 8071 Wideband Sub-Mini (Directional) [FUSION systems only]
- AODC Beacons [FUSION systems only]

The transceiver also incorporates a motion sensor which provides Heading, Roll and Pitch data (see Appendix B for details of use).

The transceiver may either be used as part of a FUSION system (see FUSION system manuals for further details), or used as a stand alone instrument, which is described in this manual.

1.3 BRIEF SYSTEM DESCRIPTION

The equipment comprising a typical iUSBL system will be a Transceiver, Power Supply and Serial Communications links from the User's Navigation Processor.

Operation of the transceiver is controlled by the User's Navigation Processor. This must first configure the transceiver with appropriate power and gain settings and estimated sound velocity. The transceiver can then be commanded to range to a specific transponder, and the response will contain range and, if available, direction information for the specific transponder relative to the location and orientation of the Transceiver housing:-

- Transponder range is calculated by measuring the elapsed time between the interrogation signal and the detection of the reply, making allowance for the transponder's Turn-around-Time (TAT).

- Transponder direction is calculated by measuring the difference in "time-phase" between the reply signal in a number of acoustic receiving elements on the front face of the Transceiver. (This is sometimes referred to as the Interferometer method).

SECTION 2

2. INSTALLATION AND CONNECTIONS – HARDWARE

2.1 MOUNTING THE TRANSCEIVER

Outline drawings of the 8094 Transceivers can be found in Section 3, Fig 3.1.

The transceiver has fixing holes at the top end of the housing, allowing the transceiver to be mounted on the end of a flanged pole or to a flat plate. The fixing holes take 6 x M8 threads, to a minimum depth of 12mm, on a 146mm PCD.

The transceiver housing also has 4 flat surfaces, one of which is marked with the transceiver's XYZ coordinate frame. These flat surfaces may be used to key the transceiver into suitable retaining clamps.

2.2 TRANSCEIVER CONNECTIONS

At the top end of the housing is a 10 pin MINK FCR Bulkhead connector (MINK10-FCR/L).

The wiring to this connector is as follows:

MINK10-FCR/L PIN	Signal	Use	Cable Recommendation
1	V+	48VDC Input	
2		Not Used	
3	RS232 Out	Motion Sensor Output	
4		Not Used	
5	RS232 In	Motion Sensor Input	
6	RS485-	Transceiver Comms	Pins 6 & 7 should terminate to a twisted pair
7	RS485+	Transceiver Comms	Pins 6 & 7 should terminate to a twisted pair
8	RS232 0V	RS232 Comms Return	
9	Shield	Terminated to V- via cap	
10	V-	48VDC return	

TABLE 2.1 TRANSCEIVER CONNECTIONS

SECTION 3

3. TECHNICAL SPECIFICATIONS

3.1 SPECIFICATION FOR TYPE 8094-000 INVERTED USBL TRANSCEIVER

3.1.1 Mechanical

Diameter (main body)	5.7 ins	144 mm
Diameter (over transducer)	6.4 ins	162 mm
Overall length	22.9 ins	582.5 mm
Full Depth Rated version		
Depth Rating	22,965 ft	7000m
Weight in air	*TBC* lbs	*TBC* kgs
Weight in water	*TBC* lbs	*TBC* kgs
De-rated version		
Depth Rating	13,123 ft	4000m
Weight in air	37.5 lbs	17.0 kgs
Weight in water	14.1 lbs	6.4 kgs

3.1.2 Electrical

Power Supply	36-50VDC 1.5A Max	48VDC nominal 0.5A Quiescent at 48V
Communications	RS485 baud rate switchable	9600 - 115200

3.1.3 Acoustic

Operating Frequency	33-55 kHz

Transmitting:

Directivity Index	8 dB approx.
Power	50 watts acoustic
Maximum Source Level	189 dB//1μPa·@ 1m

Receiving:

Operating envelope	±80° (160 deg) min
Sensitivity Threshold	95 dB ref 1μPa
Directivity Index	10 dB
Repeatability	±0.5% of Slant Range for a signal/noise ratio (SNR) of 25dB in the receiver bandwidth.
Accuracy	Better than 1% of Slant Range

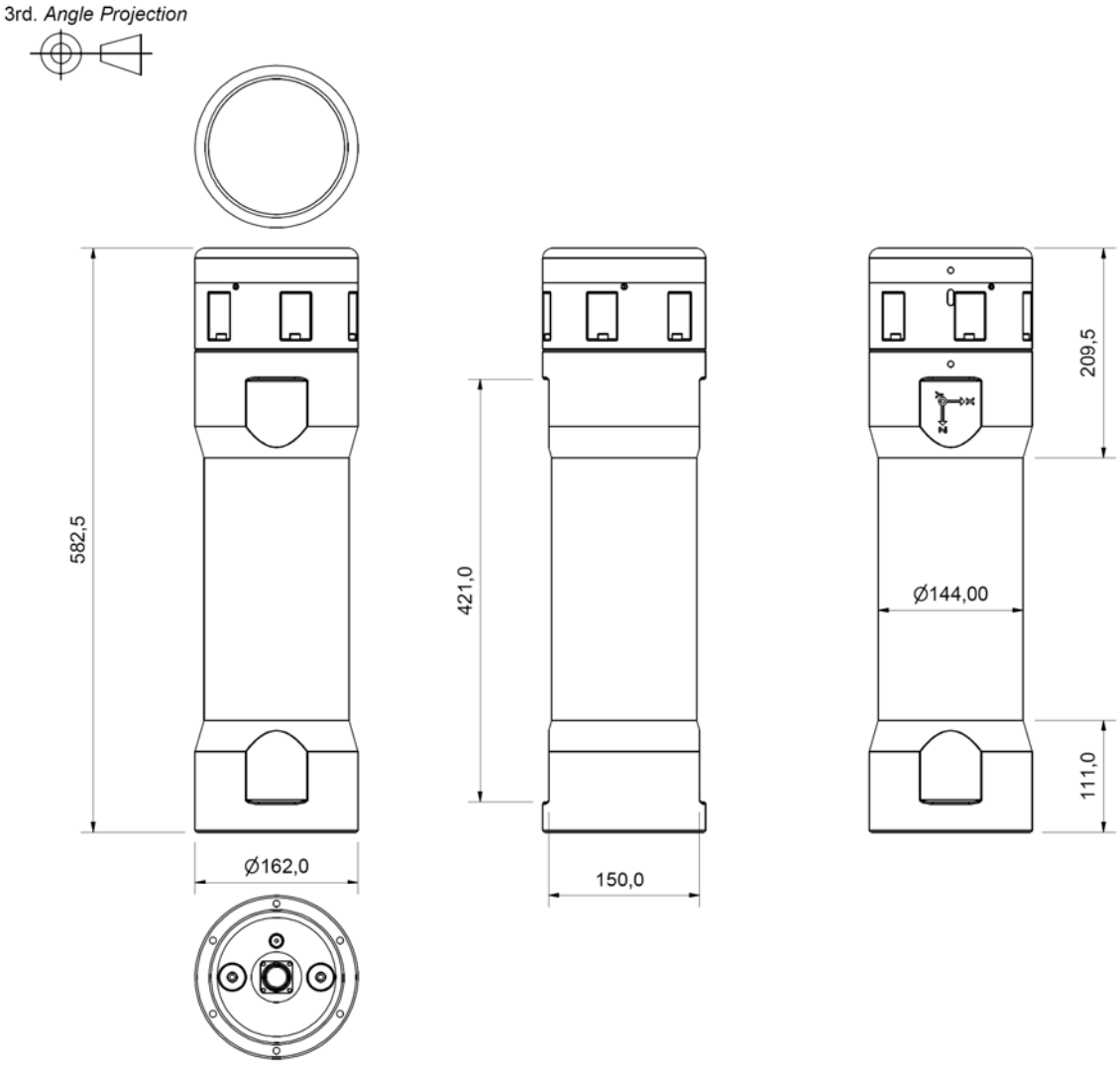
3.1.4 Motion Sensor

Magnetic Heading	0.5 degrees
Pitch / Roll	0.25 degrees

3.1.5 Environmental

Operating Temperature:	-1 to 45°C in water

FIG 3.1 OUTLINE DRAWING TYPE 8094-000 INVERTED USBL



SECTION 4

4. TRANSCEIVER COMMAND LANGUAGE

Transceiver commands and replies use 9600 baud with 8 data bits, no parity and 1 stop bit.

4.1 COMMAND AND REPLY TERMINATORS

All transceiver commands consist of ASCII printable characters with a terminator sent at the end of every command. The essential terminator on command inputs is the ASCII "line feed" character <LF>, although a carriage return, line feed (<CR> <LF>) combination is also acceptable.

Terminators on output messages consist of ASCII carriage return/line feed character pair.

Examples of commands are given throughout this section. Characters in bold type are the command sent to the transceiver. Characters in plain type are those returned as the reply. Note that the command characters are always echoed as a prefix to the reply.

4.2 STANDARD SETUP COMMANDS

4.2.1 Reset (RS)

4.2.1.1 **Description**

The "RS" command will reset the transceiver to its default (power-up condition).

In the case where the unit has locked up sending a Break sequence of 30ms on the serial line will cause the unit to reset, however some ROV umbilical systems do not support break sequence functionality. Alternatively, sending the string <DLE> <STX> UNLK <LF> at 9600 Baud will also cause the unit to reset.

4.2.1.2 **Example**

Command : **RS**
Reply : (Note - there is no reply to the reset command)

4.2.1.3 **Timing**

The transceiver takes up to 5 seconds to perform the complete reset and be ready for further commands irrespective of the reset method used.

4.2.2 Firmware Version (FV)

4.2.2.1 **Description**

The “FV” command retrieves the current Firmware Version of the transceiver, along with the frequency band (e.g. HMF – High Medium Frequency band) and other capabilities (e.g. USBL capable).

4.2.2.2 **Example**

Command : **FV**
Reply : **FV** `V8.01 HMF,XC,LB,USBL(GDT)`

4.2.2.3 **Timing**

The transceiver will reply within 100ms

4.2.3 Programmable Gain (PG)

4.2.3.1 **Description**

The “PG” command sets and/or retrieves the Programmable Acoustic Navigation (PAN) Gain setting of the transceiver. The optional parameter can be set to 0,1,2 or 3 to configure for standard gain settings of Very Low, Low, Medium and High respectively. Alternatively, the parameter can be set to a value between 80 and 180 to indicate the anticipated Signal Level in dB//1uPa, allowing the transceiver to optimise its gain setting accordingly.

On reset, the Gain Level is set to High.

4.2.3.2 **Examples**

Command : **PG**↵
Reply : **PG** PAN TDR GAIN: HIGH↵

Command : **PG2**↵
Reply : **PG2** PAN TDR GAIN: MEDIUM↵

Command : **PG107**↵
Reply : **PG107** PAN TDR GAIN: 107 dB re 1uPa↵

4.2.3.3 **Timing**

The transceiver will reply within 100ms

4.2.4 Power Level (PL)

4.2.4.1 **Description**

The “PL” command sets and/or retrieves the Power Level setting of the transceiver. The optional parameter can be set to 0,1,2 or 3 to configure the transceiver to Very Low, Low, Medium or High Power Level respectively[1]. On reset the Power Level is set to Very Low (VLOW) power.

4.2.4.2 **Examples**

Command : **PL**↵
Reply : **PL** PAN POWER: VLOW↵

Command : **PL3**↵
Reply : **PL3** PAN POWER: HIGH↵

4.2.4.3 **Timing**

The transceiver will reply within 100ms

4.2.5 Sound Velocity (SV)

4.2.5.1 **Description**

The “SV” command sets and/or retrieves the estimated Sound Velocity to be used by the transceiver when calculating range and bearing. The optional parameter after the

[1] Prior to V8.03 firmware, only two Power Levels were selectable – 0 or 1 configuring Low or High Power Level respectively.

command is interpreted as the Sound Velocity in m/s. On reset, the estimated Sound Velocity is set to 1485m/s.

4.2.5.2 **Examples**

Command : **SV1490.3**↵
Reply : **SV1490.3** SOUND VELOCITY: 1490.3↵

4.2.5.3 **Timing**

The transceiver will reply within 100ms

4.2.6 Long baseline Wait (LW)

4.2.6.1 **Description**

The "LW" command sets the Long baseline Wait time, in seconds, which defines how long the transceiver waits for a Transponder reply. On reset, and after an LW command with no parameter, the Long baseline Wait time is set to a default time of 3s.

The maximum range this allows for to a Transponder can be determined to be (LW – TAT) x SV / 2, where TAT is the Transponder Turn-around-Time (in seconds) and SV is the Sound Velocity (in m/s).

4.2.6.2 **Examples**

Command : **LW6**↵
Reply : **LW6**↵

4.2.6.3 **Timing**

The transceiver will reply within 100ms

4.2.7 Range Gate (RG)

4.2.7.1 **Description**

The "RG" command sets the Range Gate time, in ms, which defines when to start listening for Transponder replies. On reset, and after an RG command with no parameter, the Range Gate is set to 125ms.

The minimum range this allows to a Transponder can be determined to be (RG – TAT) x SV / 2000, where TAT is the Transponder Turn-around-Time (in ms) and SV is the Sound Velocity (in m/s).

4.2.7.2 **Examples**

Command : **RG300**↵
Reply : **RG300**↵

4.2.7.3 **Timing**

The transceiver will reply within 100ms

4.3 POSITIONING COMMAND

4.3.1 POSition (POS)

4.3.1.1 **Description**

The "POS" command initiates a ranging cycle to position a specific Transponder. The command requires details of the specific Transponder's interrogation address and reply channel.

All Transponders supported by the 8094 transceiver use interrogation addresses defined for Sonardyne's VLCT (Very Low Current Transponder) family. Therefore all can be interrogated by a VLCT address, which is prefixed with a V in the POS command, and can have one of nine reply channels.

The following table shows how to determine the Interrogation Address and Reply Channel for the different Transponder types supported:

Type	Description	Configuration / Label	Interrogation Address	Reply Channel
7815, 7986, 8044	OBC Transponder, LRT, LAT	Programmable : Address : *aaa* (1 - 401) Reply : *r* (1 - 9)	*aaa*	*r*
7815, 7815	Coastal Beacon, Prospector Beacon	A B C D	4 5 6 7	1 3 5 7
7835	Deep Marker Transponder	ID *xy* (*x* : 1 - 9, *y* : 0 - 9)	*y*+4	*x*

After transmitting the Interrogation Address specific interrogation pulses, the transceiver will wait for the Range Gate (RG) time before starting to listen for the Reply Channel. It will stop listening either after detecting the Reply Channel or reaching the Long baseline Wait (LW) time.

4.3.1.2 **Examples**

Command : **`POS V5,3`**↵

If the Reply is not detected:

Reply : **`POS V5,3`** `R0.00`↵

If Only Range (i.e. No Direction) can be determined:

Reply : **`POS V5,3`** `R100.00`↵

If Range and Direction have been determined:

Reply : **`POS V5,3`** `R100.00,X80.00,Y0.00,Z-60.00`↵

The command example used a VLCT Interrogation Address of 5 and a Reply Channel of 3, which would be used in the case of interrogating an *OBC Transponder set to Address 5 / Reply 3*, a *Prospector Beacon 'B'* or a *Deep Marker Transponder ID 31*.

The reply contains the following data: R = range (m), XYZ is position in the transceiver's coordinate frame as indicated on the housing of the transceiver. For a vertically mounted transceiver this equates to X = starboard (m), Y = forward (m), Z = up (m).

4.3.1.3 **Timing**

The reply will be generated exactly 50ms after the time of receiving the reply signal. In the case of no reply signal being detected, the reply will be generated at LW + 50ms.

4.4 DIAGNOSTIC COMMANDS

4.4.1 POSition Diagnostics (POSD)

4.4.1.1 Description

The “POSD” command returns diagnostic information from a preceding POS command. It reports the estimated Signal Level, S (dB re 1uPa), the SNR, N (dB in Receiver Bandwidth), Doppler offset, D (Hz), USBL Acceptance, U (0-8 – see UAL command for details) and USBL Quality check (<0.025 required).

The estimated signal level, S, is prefixed with a ‘+’ if the received signal has been clipped. The value can be used as the anticipated signal level in a PG command to optimise the transceivers gain setting.

4.4.1.2 Examples

Command : **POSD**↵
Reply : **POSD** S154.3,N18.6,D0,U8,Q0.000045

4.4.1.3 Timing

The transceiver will reply within 100ms

4.5 ADVANCED SETUP COMMANDS

The following commands are advanced setup options which should only need to be used if operational problems have been encountered.

4.5.1 Programmable Detection Threshold (PDT)

4.5.1.1 Description

The “PDT” command sets and/or retrieves the Programmable Detection Threshold (dB). The threshold defines the SNR (dB) in the receive channel bandwidth at which a signal is classified as being detected. The value can be raised up to a maximum of 20dB if interference is suspected from other active acoustic devices, or lowered to a minimum of 10dB if it is suspected that detections are failing due to poor acoustic conditions, perhaps due to noise or multi-path.

On reset, the Programmable Detection Threshold is set to 14dB.

4.5.1.2 Examples

Command : **PDT16.0**↵
Reply : **PDT16.0** DET: 16.0↵

4.5.1.3 Timing

The transceiver will reply within 100ms

4.5.2 Maximum Receive Pulse Length (MRPL)

4.5.2.1 **Description**

The “MRPL” command sets and/or retrieves the Maximum Receive Pulse Length (ms). In cases where multi-path may cause interference within the pulse length of the reply signal, such as 8ms pulses from AODC beacons in shallow water, the MRPL setting can be used to force the transceiver to only detect and analyse the beginning of the reply signal. It should be noted, though, that this will reduce detection performance against noise.

On reset, the Maximum Receive Pulse Length is set to 8ms.

Note that the transceiver will match to the shorter of the actual reply pulse length (e.g. 2ms for all HF Beacons) or the MRPL – i.e. it will never attempt to match to a pulse length longer than the actual reply pulse.

4.5.2.2 **Examples**

Command : **MRPL1**↵
Reply : **MRPL1** MAX USBL REPLY PULSE LENGTH: 1.0↵

4.5.2.3 **Timing**

The transceiver will reply within 100ms

4.5.3 USBL Acceptance Level (UAL)

4.5.3.1 **Description**

The “UAL” command sets and/or retrieves the USBL Acceptance Level (1-8). USBL processing generates an acceptance quotient (0-8) which is used as a confidence factor for acceptance of the USBL result.

On reset, the USBL Acceptance Level is set to 6. This level is readily achieved in a clean acoustic environment with a good SNR, where no multi-path interference is corrupting the direct path signal. In noisy environments it may prove necessary to lower this acceptance level, otherwise in multi-path environments it is preferable to reduce the MRPL.

4.5.3.2 **Examples**

Command : **UAL4**↵
Reply : **UAL4** USBL ACCEPTANCE LEVEL: 4↵

4.5.3.3 **Timing**

The transceiver will reply within 100ms

4.5.4 VLCT Jitter Suppression Enable / Disable (VJSE / VJSD)

4.5.4.1 **Description**

The “VJSE” and “VJSD” commands respectively enable and disable Jitter Suppression for VLCT interrogations. VLCT interrogations consist of a minimum of two pulses whose timing defines the address. In poor acoustic conditions, especially multi-path, the beacon may experience significant jitter on these interrogation pulses and fail to be interrogated. To mitigate this, the transceiver can be set to add off-frequency pre-pulses to each interrogation pulse in a technique known as jitter suppression.

On reset, the transceiver will maintain the current VLCT Jitter Suppression setting. The setting is only lost, and set to disabled, by a download of firmware.

4.5.4.2 **Examples**

Command : **VJSE**↵
Reply : **VJSE** ENABLED T0.5,F33.000↵

Command : **VJSD**↵
Reply : **VJSD** DISABLED↵

4.5.4.3 **Timing**

The transceiver will reply within 100ms

APPENDIX A

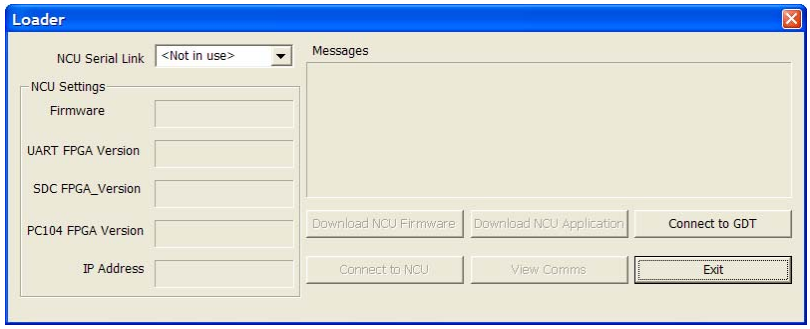
A. TRANSCEIVER UTILITY "LOADER"

Accompanying this manual on the CD is an installer for a Windows XP application called Loader (found on the CD in the "Loader" Folder), which can be used to upgrade any Generic Digital Transceiver (GDT) firmware and also provides advanced transceiver diagnostic utilities.

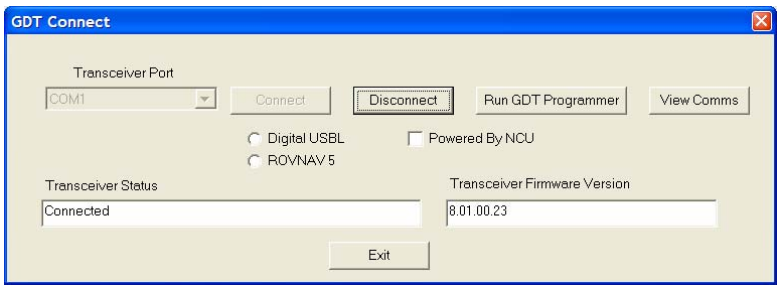
The Loader application should be installed from the Transceiver Manual CD, and is then accessible through an icon on the desktop (or alternatively from its default installation location C:\Program Files\Sonardyne\Loader\Loader.exe).

To use the Loader application, the PC must have a serial connection to the transceiver. In Fusion systems, this is provided via a Navigation Controller Unit (NCU). In non-Fusion systems, this will need to be provided via a PC serial port.

After launching the Loader application, if an NCU is not being used leave the NCU Serial Link as <Not in use> and click "Connect to GDT":



Select the appropriate PC COM port, then click Connect:



After a successful connection, the Transceiver Status will display Connected, and the current transceiver firmware version will be shown.

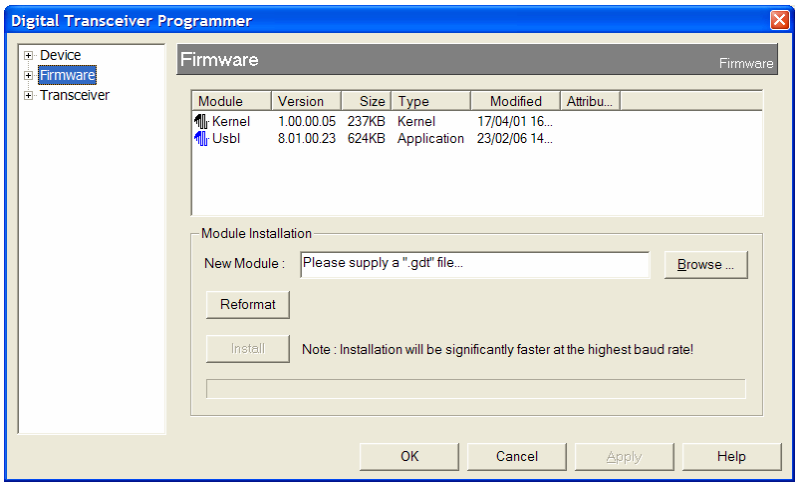
Click **Run GDT Programmer** to launch the main **Digital Transceiver Programmer** utility which allows for firmware upgrades and advanced diagnostics.

A.1 TRANSCEIVER FIRMWARE UPGRADE

Transceiver firmware is distributed in a ***.gdt** file. Sonardyne recommends that you obtain the latest version ***.gdt** file from Sonardyne International Limited, and save it to the C: drive of the computer on which you are running the Loader application.

Launch the **Loader** application and connect to the transceiver as described in the introduction to get to the main **Digital Transceiver Programmer** utility.

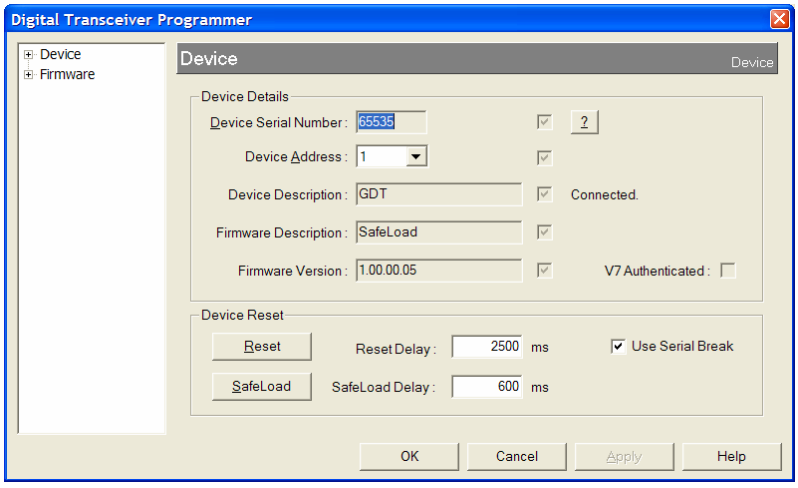
Click **Firmware** in the left-hand pane to display the Firmware window.



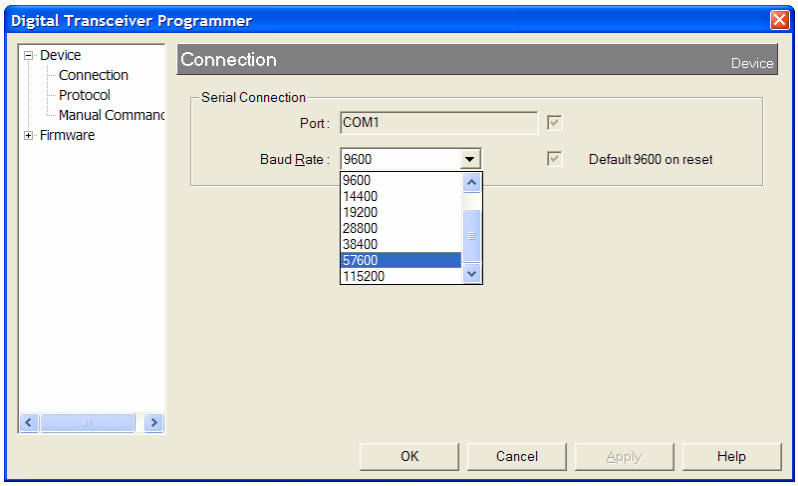
Click **Reformat** and choose **Yes** from the resulting **Confirm Flash Erase** message.

Click **Device** in the left-hand pane to display the **Device** window.

Click **Reset** and wait until the **Firmware Description** field shows **SafeLoad**:



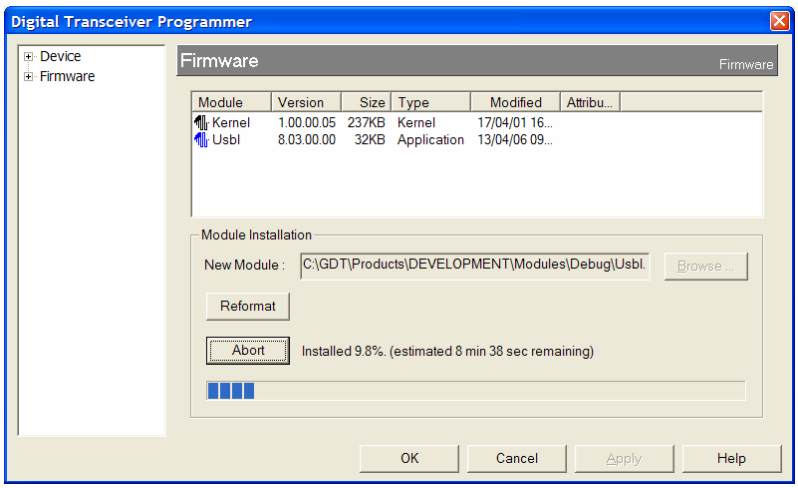
Click the plus symbol in front of the **Device** entry in the left-hand pane and select **Connection** to display the **Connection** window, which allows you to set the **Baud Rate** option - 57600 baud is recommended:



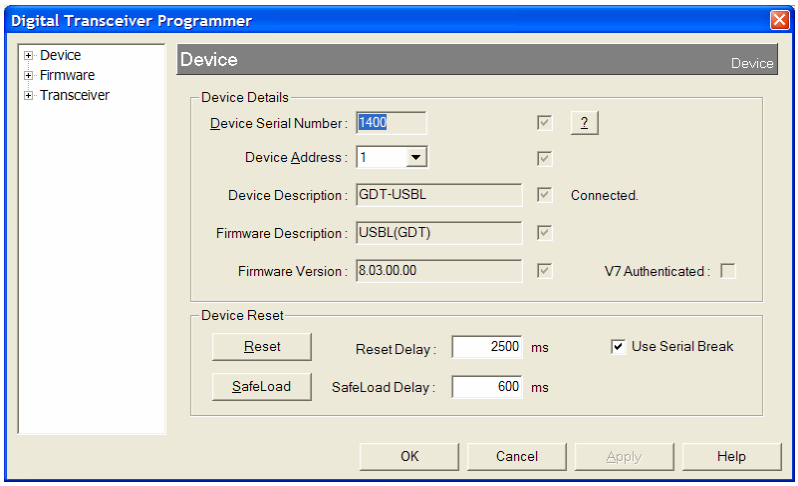
Click **Firmware** in the left-hand pane to display the **Firmware** window.

Click **Browse**, navigate to the folder that holds the ***.gdt** file and select the file.

Click **Install** to begin the installation. A progress bar indicates the active status of the installation and gives an estimate for the time to completion. The **Abort** button is now active is you need to use it.



When the installation is complete, the transceiver will be reset and the display will revert to the Device window where the new firmware will be displayed in the Firmware Description field:



Click **OK** to return to the **GDT Firmware Loader**, then click **Exit** to return to the main **Loader** menu, then **Exit** to quit the application.

The transceiver should be power cycled prior to subsequent use.

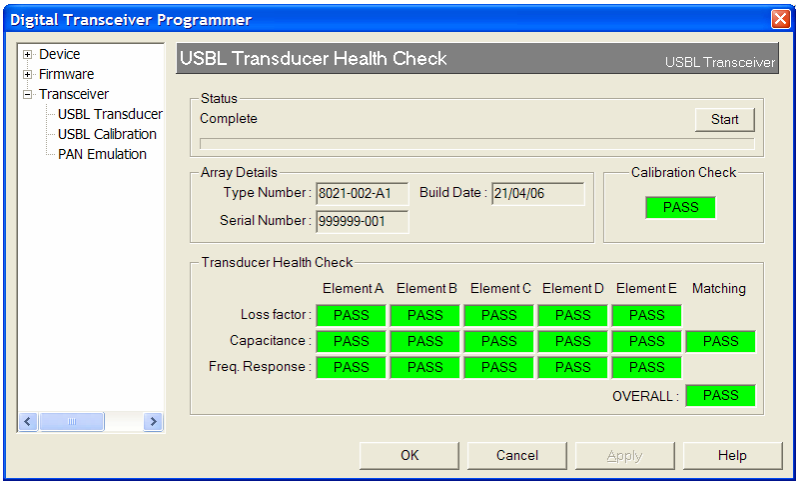
A.2 USBL TRANSDUCER HEALTH CHECK

If there is any damage to the USBL array, its performance can be severely compromised. The transceiver therefore has a built in USBL Transducer Health Check capability, which can be accessed through the **Loader** application.

NOTE : Transducer Health Check tests must be conducted with the transceiver **In Air** for the results to be valid when compared against the in-built test criteria.

Launch the **Loader** application and connect to the transceiver as described in the introduction to get to the main **Digital Transceiver Programmer** utility.

Expand the **Transceiver** branch in the left-hand pane by clicking on the **+** in front of **Transceiver**. Click **USBL Transducer Health Check** under the **Transceiver** branch. Testing will begin automatically:



The **Loss Factor**, **Capacitance** and **Frequency Response** of each receive element is tested against in-built test criteria. When prompted, you can save a record of the results as a ***.csv** file. Should the Health Check report any WARNINGs or FAILs, you are advised to contact Sonardyne (usbl.support@sonardyne.co.uk) and send the ***.csv** file for further analysis.

APPENDIX B

B. MOTION SENSOR UTILITIES

To interface to the Motion Sensor using the utilities provided requires a PC running Windows XP, with a serial connection to the RS232 Tx / Rx lines of the transceiver.

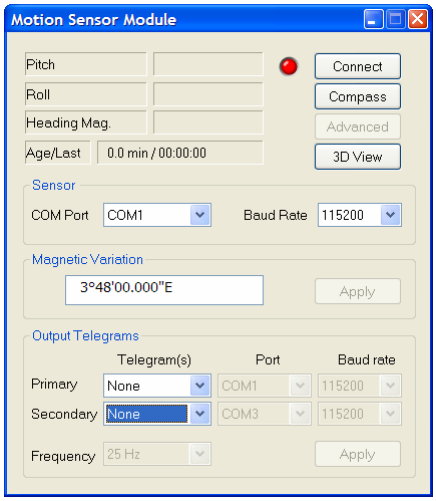
Note : **The utilities provided will only work with a vertically mounted transceiver (the typical ship installation). For any other use, please consult Sonardyne for further details.**

B.1 MOTION SENSOR MODULE

Accompanying this manual on the CD is an installer for an application called Motion Sensor Module (MSM), which can be found on the CD in the “MotionSensorModule” folder.

The MSM application should be installed from the Transceiver Manual CD, and is then accessible through the “MotionSensor” icon on the desktop (or alternatively from its default installation location:
C:\Program Files\Sonardyne\MotionSensor\MotionSensorModule.exe).

The MSM application provides an interface to the motion sensor fitted inside the transceiver, interpreting the proprietary data stream format into heading, roll and pitch data (**assuming a vertically mounted transceiver**) and allowing generation of the following open standard output telegram formats; HDM, HDT, TSS1, TSS2 and PRDID.



B.2 MAG FIELD MAPPER

Accompanying this manual on the CD is an installer for an application called Mag Field Mapper (MFM), which can be found on the CD in the “MagFieldMapper” folder.

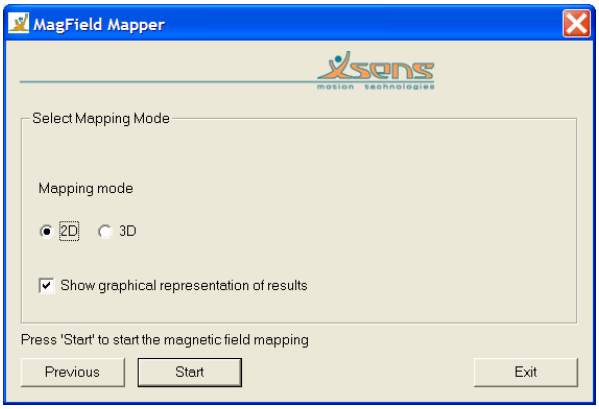
The MFM application should be installed from the Transceiver Manual CD and is then accessible through the “Mag Field Mapper” icon on the desktop (or alternatively from its default installation location: C:\Program Files\Sonardyne\MFM\MagField Mapper.exe).

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

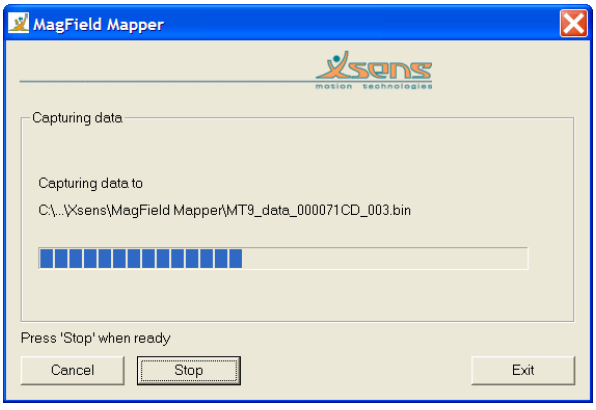
To calibrate the sensor measurements have to be recorded from the sensor while the transceiver is deployed in its vertical working position. Measurements have to be made at all orientations so the simplest procedure is to sail the vessel in a circle while collecting measurements.

To calibrate the motion sensor:

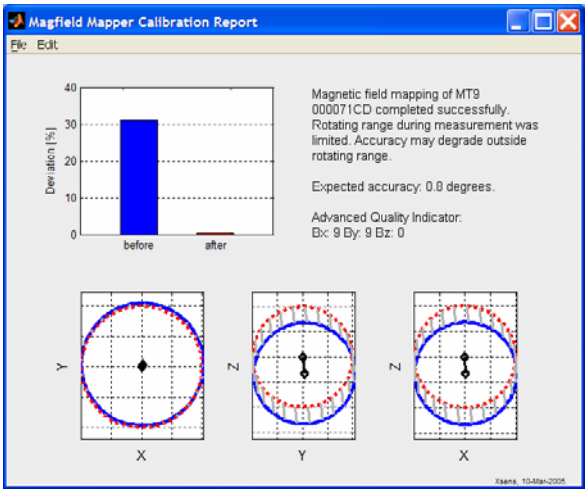
1. From the **Desktop**, double-click the **MagField Mapper** icon**.** The MagField Mapper program will appear.
2. Set the baud rate to be 115200 baud
3. Click the **Scan** button. If the motion sensor is found click **Next**
4. If the motion sensor has not been found then the button will still say **Scan**. Check all cabling and connectors to the transceiver then click the **Scan** button again.
5. Click **Next**.
6. In the **Select Output Directory** page use the default directory offered.
7. In the **Select Mapping Mode** Page select **2D** mapping mode and select **Show graphical representation of results.**



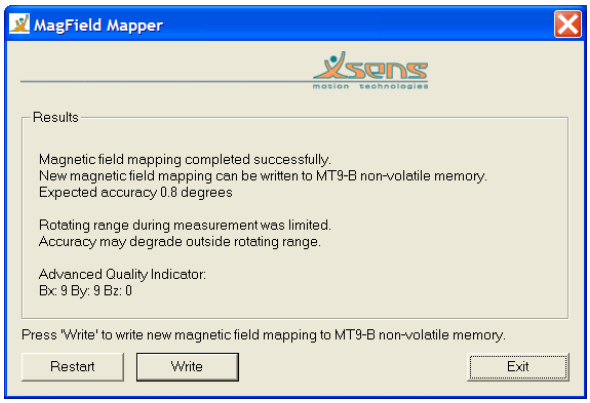
8. Press **Start** to start recording measurements
9. Sail the vessel in a complete circle at slow speed. The circle should be a small diameter.



10. When the circle is complete press the **Stop** button. The measurements will then be processed and a Calibration Report
11. Close the Calibration Report Dialog



12. If the results are acceptable press **Write** to save the results in the transceiver.
13. Click **Exit** to close the MagField Mapper program.



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