Sonardyne
SOUND IN DEPTH

Construction Survey Positioning Systems

Wideband™ Fusion LBL and USBL

Contents

Wideband™ Fusion LBL and USBL
Precise, robust, low risk

Field Development
Fusion LBL and USBL is the proven solution for all positioning tasks from field-wide developments through to long range towfish tracking

Compatt 5
Faster set up and calibration, greater utilisation and reduced risk. Just some of the benefits of Compatt 5 transponders

Sonardyne Wideband™

Introduction
Fusion, the industry standard for all offshore acoustic survey operations, brings together the latest Wideband™ signal processing technology and trusted hardware platforms to provide the most advanced subsea navigation solutions available.

Fusion is designed to seamlessly integrate Long Baseline (LBL) and Ultra Short Baseline (USBL) data with position, attitude, heading and velocity to provide accurate, fast and robust subsea navigation.

Successfully utilised throughout the world, Fusion continues to develop and adapt to the ever-changing demands of the offshore industry.

Wideband™ Technology is the first 'step-change' in performance since acoustic positioning was introduced.

Wideband™ ranging uses phase modulated codes transmitted on one of many different carrier frequencies. This combination generates more than 400 truly independent wideband signals. Using Digital Signal Processing (DSP) dramatically improved ranging performance is achieved, at lower signal to noise ratios and in complex acoustic environments.

Key Benefits of Fusion
Fusion is modular, flexible and cost effective. It provides robust acoustic performance coupled with ease of operation. It is the low risk solution; building on Sonardyne's proven acoustic and engineering expertise.

Fusion ownership eliminates much of the separate hardware normally required to undertake the different positioning tasks.

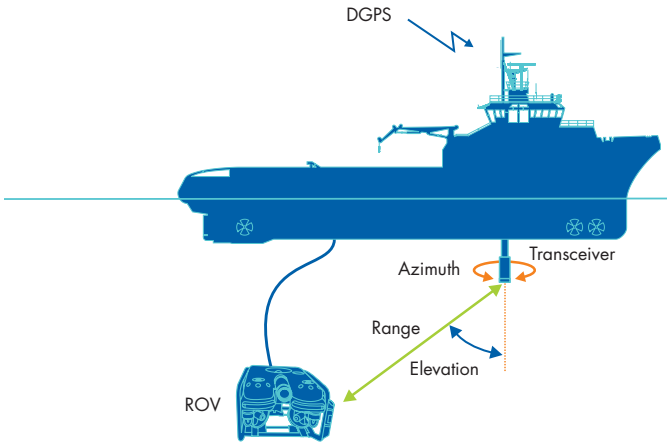
All operations are controlled through the Data Fusion Engine, a common topside processor platform that can undertake a USBL project one day and an LBL project the next. This 'one-box' approach generates cost savings through improved product utilisation and reduced mobilisation. In practice, a vessel equipped with a Fusion USBL transceiver can undertake LBL by simply switching software applications and deploying a seabed array. Traditionally this would have required the use of separate and dedicated systems.

For ease of operation and reduced training Fusion software has a common look and feel across all systems. Constantly evolving and improving Sonardyne's long-term commitment to Fusion has seen the system become easier to operate and perform more reliably. This development will continue to provide a more symmetrical solution allowing the inexperienced operator and expert alike to achieve the results expected.

Fusion USBL
Long range, deep water tracking

ROV Tracking
Accurate and reliable ROV positioning, just one of the applications for Fusion USBL

USBL Positioning
USBL systems calculate the position of a target by measuring the range and bearing of a transponder from the vessel



Introduction

Fusion USBL allows multiple subsea targets to be accurately positioned relative to a surface vessel. The system is particularly suited to tracking ROVs, AUVs and towfish or as a position reference input for vessels equipped with a Dynamic Positioning (DP) system.

Key Features

- Survey accuracy tracking of targets in deepwater and over long laybacks
- Interfaces to most makes of DP system
- Builds on worldwide success of existing USBL and LBL systems from Sonardyne
- Efficient equipment utilisation; allows for USBL and LBL using common vessel hardware
- Compatible with existing MF frequency transponder inventories – Sonardyne, Wideband™, HPR and Hipap®

USBL systems calculate position by combining acoustic range and bearing data from a vessel transceiver with attitude, heading and GPS sensor information. One of the main advantages of the technique is that it does not require a seabed transponder array to be deployed before positioning can commence. Only the target to be tracked needs to be equipped with a transponder or responder.

Integrated Telemetry

In addition to providing high accuracy subsea positioning, Sonardyne's Fusion USBL technology offers additional benefits for surveys involving the deployment and recovery of data recording packages on the seafloor. By equipping each package with an acoustic transponder that is capable of data telemetry, such as Sonardyne's Compatt 5 or WSM, Fusion USBL can be used to perform multiple tasks.

As each recording package is deployed, Fusion can track its descent and position it accurately in up to 7,000 metres of water.

Once on the seabed, operators can use the system's high speed acoustic telemetry capabilities to command each seafloor package to report its status and battery voltage, set-up parameters and start data acquisition. During the survey, short sections of data can be transmitted to the surface for quality control purposes.

For recovery, a uniquely coded signal can be sent to each transponder to activate its release mechanism. This allows ballast weights to be dropped away so that the receiver package can float to the surface whilst simultaneously being tracked via USBL.

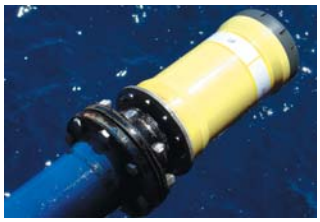
Fusion USBL
System Overview

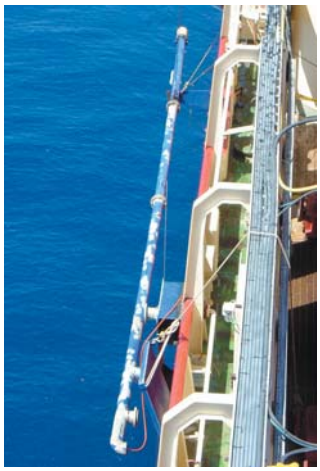
Data Fusion Engine
The Data Fusion Engine is the heart of the system and is an integrated PC and acoustic processor platform running Fusion software applications

AUV Positioning
Fusion USBL can also be used to send position updates to AUVs

Fusion USBL Transceiver
Fusion USBL transceivers support the use of modern Wideband™, spread-spectrum signals

Transceiver Deployment
Sonardyne USBL transceivers can either be deployed through a ship's gate valve or an over-the-side mount





System Overview
A Fusion USBL system configured for simple operations such as ROV tracking comprises a Data Fusion Engine, software, an acoustic transceiver and a vehicle-mounted transponder/responder.

Data Fusion Engine
The Data Fusion Engine is the heart of the system and is an integrated PC and navigation controller used to interface peripheral equipment such as GPS and attitude sensors, in addition to providing dedicated interface and power to transceivers.

This 'one-box' solution is designed to meet a complete onboard hardware requirement for any acoustic operation, thereby eliminating the need to install and set-up separate systems to provide for any acoustic positioning operation.

Fusion USBL Software
Fusion USBL software is a Windows based package that is responsible for collecting, processing, displaying and recording acoustic and associated data.

Fusion USBL software offers flexibility and ease of operation to a whole host of offshore positioning scenarios. Based on core acoustic principles and software modules Fusion USBL builds to provide a user interface that will guide the operator through set-up, calibration and into tracking.

All data is available both graphically and alpha numerically and is stored for later analysis and replay if required. Many tools are provided to assist in the optimisation of the system to operate in difficult environments.

USBL Transceiver
Sonardyne Wideband™ USBL transceivers are optimised to operate with Compatt 5 and DPT transponders and are compatible with HPR and Hipap® beacons. The transceiver also functions as an LBL transceiver removing the need for additional vessel hardware.

There are two transceivers to choose from depending on the vessel and the operational environment. Type 8021 or Standard Head is an all purpose transceiver best suited to general survey and DP operations where tracking could be straight up and down or at shallow angles i.e. towfish tracking. The Type 8023 or Big Head is a specialised design for ultra-deep water or particularly noisy vessels.

To optimise tracking of targets at shallow angles, such as long range towfish tracking, a tilt adaptor can be used with both types of transceiver. The advantage of this is that the target being positioned remains within the optimal operating envelope of the transceiver thereby maintaining positioning performance.

Transceiver Deployment Machine
Sonardyne have extensive experience in both through hull and over-the-side deployment and can assist clients with the selection of the right solution for you.

Fusion USBL
Transponder Options

Wideband™ Sub-Mini (WSM)
The WSM is Sonardyne's new sub-mini transponder and incorporates the latest Wideband™ acoustic signalling technology

Dynamic Positioning Transponder (DPT)
The DPT is a full size transponder designed for DP reference and large target tracking

Transponder Options
Fusion USBL systems are compatible with the vast majority of medium frequency transponders currently in use worldwide. However, optimum performance is attained when using transponders that have been designed with Sonardyne's Wideband™ Technology.

Wideband™ Sub-Mini (WSM)
The Wideband™ Sub-Mini (WSM) is a new compact, rugged transponder/responder designed primarily to position ROVs, towfish and other small mobile targets. Available as a 1,000 metre rated omni-directional unit or 3,000 metre rated directional unit, WSMs have the option of a depth sensor for improved positioning accuracy.

In addition, WSMs support intelligent charging of its long-life NiMH battery, Windows-based set-up software, Sonardyne Wideband™ signals, tone frequencies and all HPR 300/HiPAP® channels. For applications requiring an acoustic release function, for example releasing a clump weight on a seabed instrument package, WSMs can be connected to an external mechanical release mechanism or conventional burn-wire release via their charging socket.

Dynamic Positioning Transponder (DPT)
The Dynamic Positioning Transponder (DPT) is a full sized transponder designed specifically for seabed deployment or large target tracking. Available in 3,000 metre rated omni-directional or directional transducers, DPTs are equipped with a simple On/Off switch, rugged spring assisted release mechanism, depth sensors and advanced power and gain controls if required. Deeper rated and short housing units are also available. Battery options are Alkaline and Lithium.

DPTs support Sonardyne Wideband™ signals, tone frequencies and all HPR 300/HiPAP® channels. DPT also supports Sonardyne command and control options.

Compatt 5
Compatt 5 is Sonardyne's most advanced Wideband™ transponder featuring high speed telemetry, release mechanism and long life duration. Compatt 5s are described in detail in the Long BaseLine section of this brochure (Page 07).

Transponder Floatation Collars
Sonardyne supply a range of subsurface floatation collars that are compatible with Compatt, DPT and WSM transponders.

Manufactured from high performance materials specific to the depth rating required, Sonardyne floats are designed for ease of handling on the back deck and come in bright colours to ensure high visibility both under the water and during recovery on the surface.

Fusion USBL
System Specifications

System Performance

General	
Operating Range	7,000 Metres
Acoustic Coverage	±90° or ±50° (Depending on transceiver type)
Accuracy	0.27% 1 Drms Slant Range (63% of fixes within 2.7 metre radius in 1,000 metres water depth) or 0.20% 1 Sigma Slant Range (39.4% of fixes within 2 metre radius in 1,000 metres water depth) (Note: The absolute accuracy of the system is dependent upon the quality of attitude and heading sensors, beacon source level, vessel noise, water depth, the mechanical rigidity of the transceiver deployment machine and proper calibration of the total system using CASIUS)
Tracking	Supports tracking of one surface vessel and multiple subsea targets

Transceiver

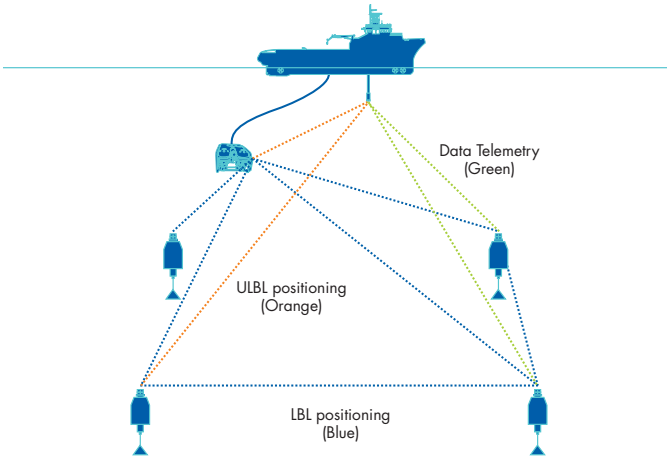
Type Numbers	8021 (±90°)	8023 (±50°)
Operating Frequency	MF (18-36kHz)	MF (18-36kHz)
Range Accuracy	Better than 0.2 metres	Better than 0.2 metres
Positioning Repeatability	Better than 0.1% of slant range 1 Drms	Better than 0.1% of slant range 1 Drms
Deployment Method	Through-hull or Over-the-Side	Through-hull or Over-the-Side
Dimensions (LxDia)	410mm (16.14") x 225mm (8.86")	486mm (19.14") x 300mm (11.81")
Weight in Air	28kg	41kg
Weight in Water	13.5kg	20kg

Fusion USBL Transponders

Type	Wideband™ Sub-Mini (WSM)	Dynamic Positioning Transponder (DPT)
Description	A small size transponder with some limited downlink capability and optional release outputs	A full size transponder designed for seabed deployment and large target tracking
Depth Rating	1,000 Metres (Omni-Directional Transducer) 3,000 Metres (Directional Transducer)	3,000 Metres (Omni or Directional Transducer)
Positioning	USBL compatible • Sonardyne Wideband™ and Tone • HRP400	USBL compatible • Sonardyne Wideband™ and Tone • HRP400
Telemetry	Configurable command downlink • Enable/Disable • Release 1,2 etc Equipment status uplink via serial port	High-speed up and downlink (1,500bit/s)
Serial Interface	Test and set-up	Test and set-up
Sensors	None	Tilt
Optional Sensors	Depth	Depth Temperature
Release Options	Separate Sonardyne release mechanism output via connector Burn-wire release output	Integrated mechanical release mechanism Separate release output via connector Burn-wire release output
External On/Off Switch	Yes	Yes
Battery Life (Listening, Disabled)	60 days Ni-MH rechargeable	833 days Alkaline 1390 days Lithium
Dimension (LxDia)	Omni = 399mm x 69mm Directional = 407mm x 89mm	1035mm x 135mm

Fusion LBL
High accuracy, multi user operations

Integrated Positioning and Telemetry
LBL positioning of ROV and seafloor transponders, USBL positioning of ROV and seafloor transponders, data telemetry from seafloor transponders



Template Installation
Gyro frame and Compatt 5 transponders installed on a template ready for deployment

Introduction

Fusion LBL is designed to position multiple subsea targets and structures with the highest attainable levels of accuracy.

The Long BaseLine (LBL) method provides accurate positioning over a wide area by measuring ranges to three or more transponders deployed at known locations on the seabed or on a structure. The technique offers the highest degree of positioning repeatability available and with range redundancy, an estimation of the position quality can also be made.

Features and Benefits

- Allows multiple targets to be positioned simultaneously with centimetric precision independently of water depth
- Operational efficiency is significantly increased through faster set-up and faster array calibration
- Compatible with existing, worldwide inventories of LBL transponders
- Hundreds of acoustic channels allow multiple vessels to operate in close proximity without interference

Fusion LBL can be configured to support simple tracking tasks through to the most multifaceted, deepwater construction project. Complex operations might involve positioning multiple subsea vehicles working in close proximity to each other as well as streaming sensor data from gyros, DigiQuartz depth sensors, inclinometers and the like. All this and more is possible with the required data being displayed in a highly graphical and non-ambiguous manner.

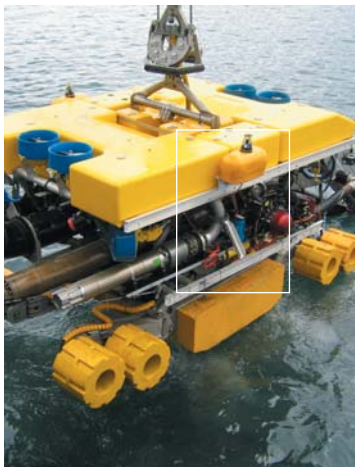
All aspects of the operation can be controlled through the use of intuitive software wizards built into Fusion LBL software, array planning, system configuration, calibration and most importantly execution.

At the heart of Fusion LBL is Compatt 5. This is Sonardyne's latest generation 'intelligent' transponder that can be used to create the seabed navigation network in which targets can be positioned. Crucially, these networks can offer position accuracies of better than 3cm independent of water depth.

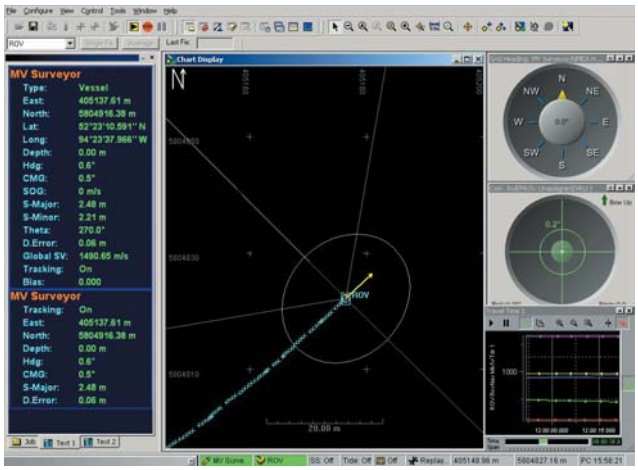
Fusion LBL, like Fusion USBL systems are controlled by the Data Fusion Engine. This package of Navigation Controller and Navigation Computer is common through both systems. By simply loading different software one becomes the other, transceiver allowing. This allows multi-tasking vessels to operate more effectively,

Fusion LBL
System Overview

RovNav 5
(Below and Middle) A RovNav LBL transceiver shown installed on a trenching vehicle



Fusion Software
Fusion software enables Sonardyne acoustic system to be used to their optimum whilst allowing complex positioning tasks to be carried out quickly and easily



with less equipment and common training programs.

A Fusion LBL System
A Fusion LBL system configured for simple LBL operations such as ROV tracking, comprises a Data Fusion Engine (refer to Page 03), Fusion LBL software, a RovNav 5 transceiver on the vehicle and a seabed array of Compatt 5 transponders operating in Wideband™ mode.

Fusion LBL Software
Fusion LBL software shares many features with Fusion USBL software. The common look and feel allows those operators familiar with one to pick the other up quickly. LBL survey is inherently complicated but the graphical Windows interface and use of software wizards simplifies everyday tasks and leads the operator through more complex tasks to a successful conclusion.

The system can be configured to support simple tracking tasks through to complex, deepwater construction projects with multiple surface vessels and subsea vehicles working in close proximity to each other. Fusion LBL software will grow with your requirement and equipment pool to provide low risk, high performance solutions.

Transceivers
RovNav 5 is the only LBL transceiver presently capable of Wideband™ LBL operations when used in conjunction with Fusion LBL software and a Data Fusion Engine. Depth rated to 3,000 metres, it can be equipped with two transducers and optionally a DigiQuartz depth sensor.

Its primary use is for operation with Remotely Operated Vehicles (ROVs) or other towed bodies. Used within an array of calibrated seabed transponders, its function is to position the ROV in LBL mode accurately and rapidly.

Alternatively, the RovNav can remain on the vessel, fitted with a dunking transducer and used to assist with the calibration of arrays, to position the vessel or simply to command transponders in the water.

Compatt 5
Faster set-up and calibration, greater equipment utilisation and reduced risk. These are just some of the cost saving benefits of the latest range of Wideband™ Compatt 5 transponders from Sonardyne.

All Medium Frequency Compatt 5s now incorporate Sonardyne Wideband™ Technology which uses advanced digital signaling techniques to dramatically improve the performance of acoustic positioning, navigation and telemetry systems.

Wideband™ Compatt 5 transponders have been validated in an extreme range of operational environments. This has confirmed that the faster and more rugged wideband signals provide the highest accuracy and therefore the lowest risk for all subsea acoustic positioning tasks, regardless of water depth.

Fusion LBL
System Overview – continued

Compatt 5 Transponders
(Left to Right) Mini Compatt 5, Midi with release, Standard Omni, Deep Directional and Heavy Load Compatt 5

Remote Inclinometer Option
External, high accuracy inclinometer for precise subsea positioning tasks. Data is telemetered via the Compatt to the surface

Back Deck Testing
Compatt 5 and DPT transponders can be tested on the back deck with dedicated test units

Key Features

- Incorporates Sonardyne's latest Wideband™ Technology
- Depth rated to 3,000 Metres (Options for 5,000 Metres and 7,000 Metres)
- Multiple operating modes; tone burst and Wideband™
- Hundreds of operating channels allowing truly independent acoustic operations
- Offers integrated positioning and telemetry
- Faster remote tracking of seabed structures
- Options for release and inclinometer endcaps
- Easy to upgrade

Through-life costs are reduced by greater flexibility in the utilisation of the transponders in different system configurations and for different applications. In addition, true multi-operation capability enables cost savings through more efficient use of subsea arrays.

Standard features include highly reliable acoustic release mechanism, depth rating to 3,000 metres with options for 5,000 metres and 7,000 metres, four different housing lengths (Mini, Midi, Standard and Max), dual axis inclinometers with DigiQuartz depth sensors, direct measurement sound velocity sensor and the capability to interface to and even power external equipment for data telemetry to the surface.

The Heavy Load Compatt 5 combines the features of an advanced subsea navigation transponder with the heavy lift capabilities of an acoustic release transponder.

The transponder introduces valuable cost savings by allowing a structure or load to be precisely tracked using an LBL or USBL navigation system and then once in position, released on command from a vessel or ROV. This eliminates the need for a separate acoustic release transponder and back deck command unit which not only saves money but also simplifies subsea operations themselves.

Back Deck Testing

Pocket Test Terminal is a new truly portable Compatt 5 test tool. Running on a dedicated iPAQ PDA platform, the Pocket Test Terminal software offers all the main features of the PC-based Compatt 5 Test Terminal software but from a small, portable, splash proof device.

Also available is a Deck Test Unit (DTU). Supplied in a rugged portable case, the DTU is used initially to program the channel of the transponder, acoustically test the transponder in air and then load the acoustic release mechanism.

RovNav 5 LBL Transceiver

Feature	Type 8010
Depth Rating	3,000, 5,000 or 7,000 Metres
Operating Frequency	MF, EHF
Remote Transducer Ports	2 Standard (4 Maximum)
Operating Voltage	24V (22-28V)
Serial Communications	RS232 (Full-Duplex) or RS485 (Half-Duplex)
Mechanical Construction	Aluminium Alloy, Hard Anodised, S/Steel Guards and Connectors
Dimensions (LxDia)	749mm (29.4") x132.8mm (5.2")
Weight in Air	13.5kg
Weight in Water	6.5kg
Sensor Options	Temperature compensated Strain Gauge, Paroscientific DigiQuartz, Platinum Resistance, Thermometer and Vale port Sound Speed Sensor

RovNav 5 Remote Transducers

Transducer Type	8012	8013	8014
Depth Rating	3,000 Metres	3,000 Metres	2,500 Metres
Operating Frequency	MF (18-36 kHz)	MF (18-36 kHz)	EHF (50-110kHz)
Transducer Beamshape	Semi-Directional	Omni-Directional	Omni-Directional
Range Accuracy	±3cm	±3cm	±3cm
Transmit Source Level – Vertical	195-202dB	185-192dB	183-190dB
Receiver Threshold	90-120dB	90-120dB	90-120dB
Connector Type	Burton FCR 5506-2008	Burton FCR 5506-2008	Burton FCR 5506-2008
Mechanical Construction	Aluminium Alloy, Hard Anodised, Plastic Sleeve, S/Steel Guard and Connector		
Dimensions (LxDia)	353.5mm x 10.5mm	353.5mm x 10.5mm	353.3mm x 10.5mm

Compatt 5 LBL Transponders

Transponder Type	Mini	Midi	Standard
Description	A small lightweight transponder with integrated positioning and high speed telemetry	Offers all the performance of a Standard Compatt 5 but in a shorter housing for easy ROV deployment and installation	A full size seabed transponder suited to a wide range of subsea applications and long life duration
Depth Rating	3,000 Metres	3,000 Metres (Omni or Directional Transducer) 5,000 Metres (Directional Transducer)	3,000 Metres (Omni or Directional Transducer) 5,000 Metres (Directional Transducer) 7,000 Metres (Directional Transducer)
Range Accuracy	±3cm	±3cm	±3cm
Number of Unique Simultaneous Addresses Wideband: Tone:	 224 All Sonardyne and Simrad	 224 All Sonardyne and Simrad	 224 All Sonardyne and Simrad
Operating Frequency	MF (18-36kHz)	MF (18-36kHz)	MF (18-36kHz)
Positioning LBL: USBL:	 • Wideband™ and Tone • Wideband™ and Tone • HPR400	 • Wideband™ and Tone • Wideband™ and Tone • HPR400	 • Wideband™ and Tone • Wideband™ and Tone • HPR400
Telemetry	High-speed up and downlink (1,500bit/s)	High-speed up and downlink (1,500bit/s)	High-speed up and downlink (1,500bit/s)
Sensors	Tilt	Temperature, Tilt, Strain Gauge	Temperature, Tilt, Strain Gauge
Optional Sensors	–	DigiQuartz, Internal and Remote Inclinometer, Sound Velocity	DigiQuartz, Internal and Remote Inclinometer, Sound Velocity
Release Options	–	Integrated mechanical release mechanism Separate Sonardyne release mechanism Burn-wire release output via connector	Integrated mechanical release mechanism Separate Sonardyne release mechanism Burn-wire release output via connector Heavy duty release
Battery Life (Listening, Disabled)	– 417 days Lithium	– 417 days Lithium	833 days Alkaline 1390 days Lithium
Dimensions (LxDia)	546mm x 135mm	784mm x 135mm	1035mm x 135mm

Sonardyne
SOUND IN DEPTH

Head Office

Sonardyne International Limited
Blackbushe Business Park
Yateley, Hampshire
GU46 6GD United Kingdom

T. +44 (0) 1252 872288
F. +44 (0) 1252 876100
E. sales@sonardyne.com
www.sonardyne.com

Agent ID: