SeaTrac PinPoint Tracking System
User Manual

Contents

1. Overview

For tracking the position of ROV's, AUV's, divers and other subsea assets, SeaTrac provides an out of the box solution that determines the positions of one or more X110/X010 transponder beacons, by sequentially interrogating them with an acoustic 'ping' from a single surface X150 USBL beacon.
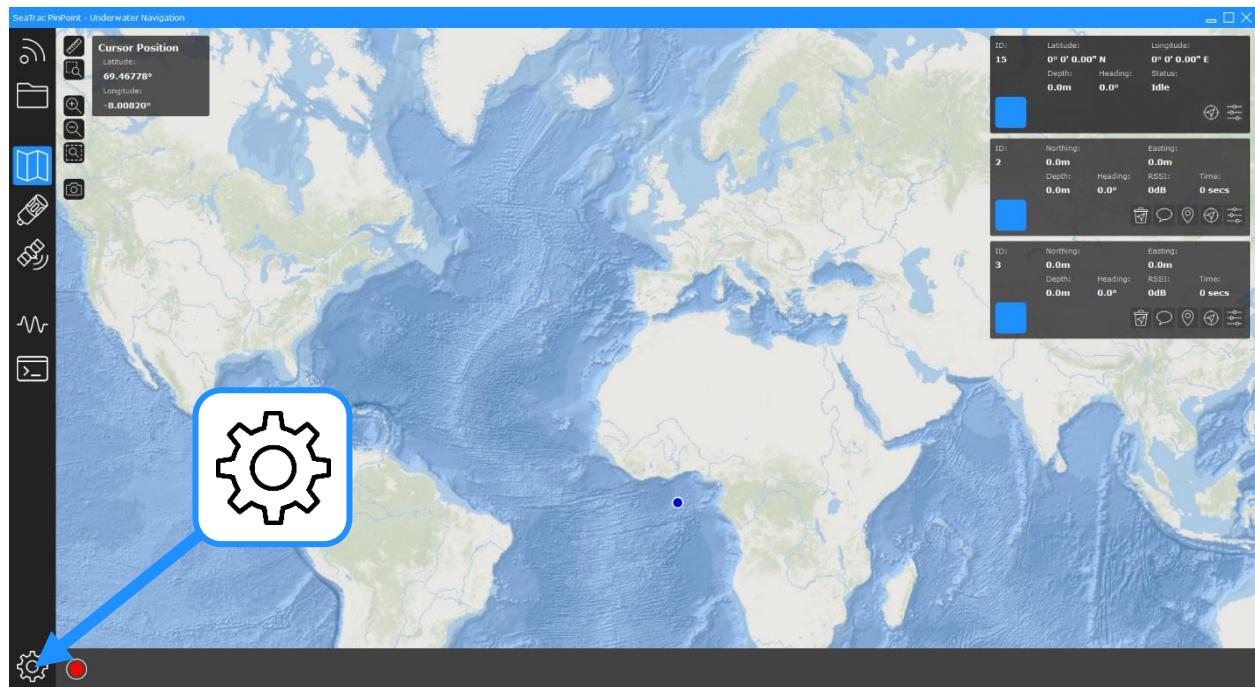
The system comprises the following distinct parts:

- **Remote Beacons** Each of the subsea assets to be acoustically tracked are called Remote Beacons, and should be fitted with either an X110 or X010 beacon and suitable power source.

- **Local Beacon** The surface beacon is an X150 USBL beacon and is referred to as the Local Beacon because it is usually hung/mounted just below the surface and is connected directly to the operator's computer using the supplied deck-lead (and optional RS232 to USB converter).

- **Surface Platform** The surface platform is the location where the operator is based, and the system is controlled from. This is usually a boat, pontoon or quayside that provides direct access to deep water (i.e. at least 2m to 3m minimum).
  The Surface Platform usually contains the following:
    - Operators computer (running the SeaTrac PinPoint application).
    - Power for the Local Beacon.
    - Mountings for the Local Beacon (either rigid pole or cable hanging arrangement)
    - Optional GNSS satellite positioning receiver.

The following sections of this manual discuss setting up and configuring each part of the tracking system…

2. Setting Up The SeaTrac System

Run the PinPoint application, then click on the **Settings** button (at the bottom left of the display) to show the configuration options…

In the Settings window, different pages of settings can be accessed by the buttons arranged along the top of the form…

Application Settings
The page contains general application settings, and allows you to change units of measurement, default storage locations, magnetic heading declinations and other values.

Beacon Setup
The page is used to tell the software how many acoustic SeaTrac beacons are to be tracked by the system and allows the settings of each one to be changed.

Hardware Setup
The page is used to specify what directly attached hardware is available to PinPoint – i.e. a SeaTrac X150 USBL head, GNSS receiver etc. (this does NOT include the beacons to be acoustically tracked).

Platform Setup
The platform setup page allows the operator to configure how the hardware is physically positioned on the vessel or platform from which they are working – i.e. the position of the GNSS receiver relative to the USBL head, vessel size etc.

Markers Setup

On the main Chart Display, markers can be placed to mark targets of interest, navigation references etc. This settings page allows markers positions to be added and edited by the operator, as well as exported and imported.

Chart Setup

The background of the main Chart Display can show images from a variety of sources, including Google, ESRI and OpenStreetMaps.

If you purchased an ENC license dongle with your SeaTrac system, connecting this will also allow S-57 and S-63 charts to be installed and displayed.
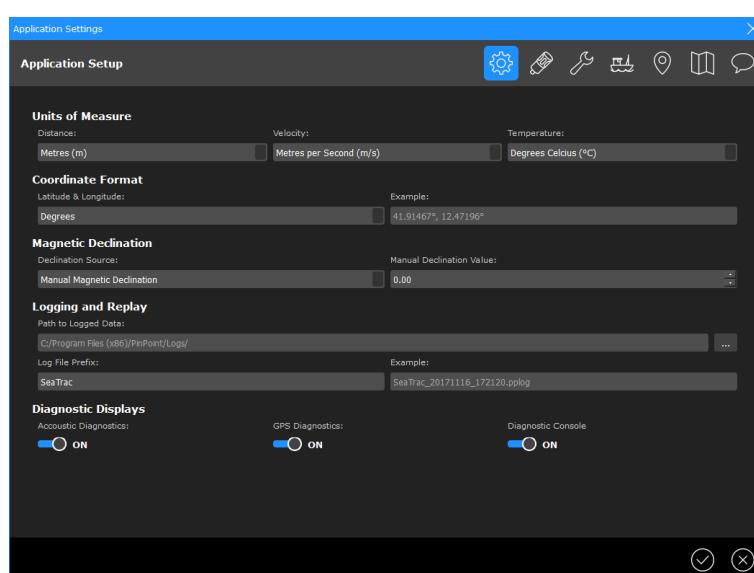
Messaging Setup

This page provides options for configuring diver text-messaging services to supported hardware platforms (such as ArtemisPRO).

2.1. Configuring The Application General Settings

When using PinPoint for the first time, you may want to setup how the application presents information to you, and where data is stored using the options on the **Application Setup** settings page.
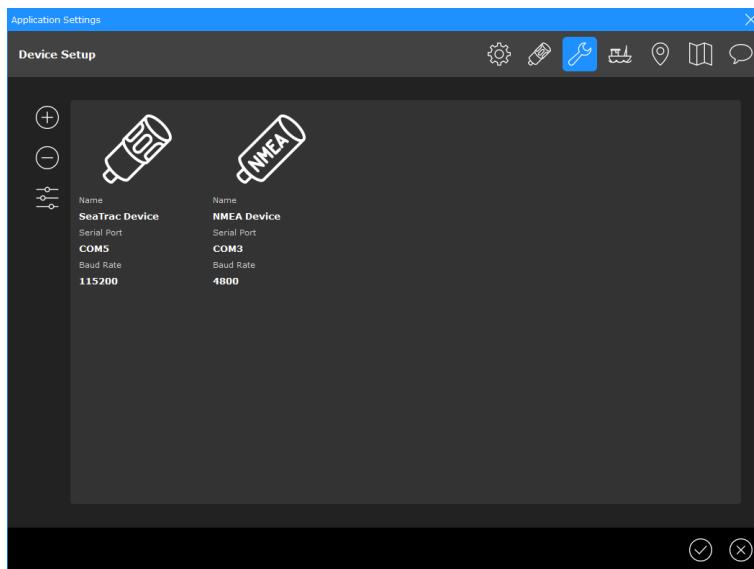
Settings include:

- **Units of Measure** – Use these drop-down lists to select the units you want distance, velocity and temperature to be displayed in.

- **Coordinate Format** – Choose how latitude and longitude coordinates should be displays (Decimal degrees, Degrees & Minutes, Degrees Minutes & Seconds etc.).

- **Magnetic Declination** – Choose how you want magnetic declinations to be computed and applied for converting Magnetic Headings into True North headings. Automatic will use the World Magnetic Model to dynamically compute and apply declination based on your measured position (from a GNSS receiver).

- **Logging & Replay** – Use these settings to choose where log files will be recorded, and how they will be named.
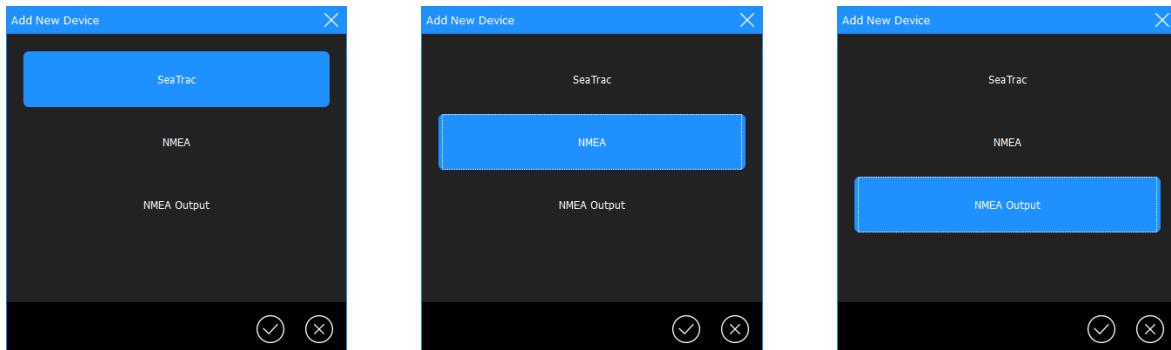
2.2. Configuring Hardware Devices

The next step in configuring PinPoint for your SeaTrac beacons is to configure the attached hardware devices. In the Settings window, switch to the **Hardware Setup** settings page…

Click the **Add (+)** button at the side of the Window to add a new hardware device, then choose which type of device you want to add…
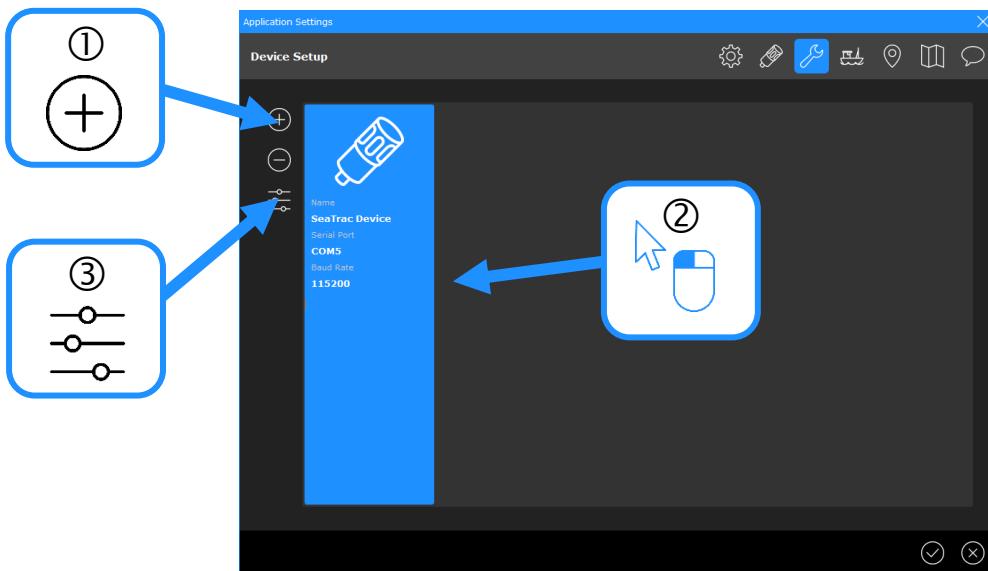
Types of devices are:
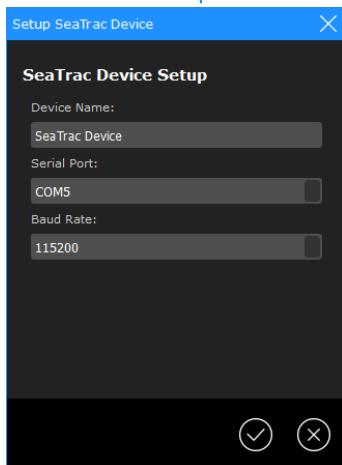
- **SeaTrac** – This tells PinPoint that there is a physically connected SeaTrac beacon attached to the computer (by a serial port). Usually this will be an X150 USBL head to allow tracking.

- **NMEA** – This tells PinPoint that there is a device capable of producing NMEA compatible sentence outputs attach to the computer (by a serial port). Typically, NMEA devices include GPS/GNSS satellite positioning receivers producing RMC or GLL positioning data.

- **NMEA Output** – This creates a serial output port that real-time NMEA sentences are sent out of. This is used when the PinPoint software needs to be connected to a third-party system (such as Olex) – by ②③connecting a serial null-modem cable between the output port on the computer running PinPoint and the external system, SeaTrac beacon positions can be fed into the external system.

    Note: A NMEA Output device only supports data for a single tracked beacon, as NMEA standards do not provide fields to allow beacon ID numbers to be specified.

Once a device has been added, or to configure an existing device, select it from the list, then click the **Properties** button to show its settings window…
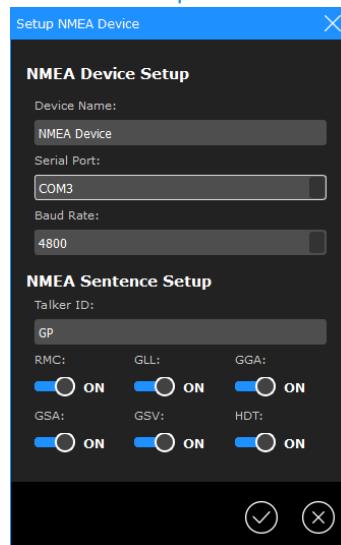
SeaTrac Device Properties

Use these properties to choose the Serial COM port that the SeaTrac beacon is attached to.

By default, the baud rate should be 115200.

NMEA Device Properties
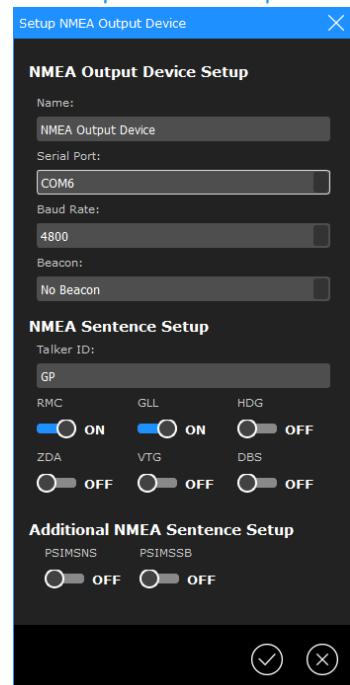
Choose the COM port and baud rate of the attached NMEA device. Typically, NMEA devices a 4800 baud, but sometimes 9600.

If required, you can choose a more suitable name that will be shown for the device, such as "GPS Receiver" etc.

Use the On/Off switches to determine which type of NMEA sentences will be decoded and processed.

NMEA Output Device Properties

Choose the COM port and baud rate that NMEA data will be output from.

Use the "Beacon" drop down list to choose which acoustic tracked beacon data is output for.

Use the On/Off switches and talker ID to configure what information is output.

2.3. Configuring The Acoustic Beacons To Track

Once the attached hardware has been configured, the next stage is to setup the remote acoustic beacons that PinPoint will track, using the **Beacon Setup** settings page.

To track beacons, you must have attached and configured a SeaTrac X150 USBL beacon to the computer running PinPoint using the previously described Hardware Setup procedure.

For tracking to operate correctly, each SeaTrac Beacon in the system must be assigned a UNIQUE identification (ID) address between 1 and 15 before it can be used. By default, PinPoint will configure the attached X150 USBL head as ID 15.

During normal operation, the USBL head with "PING" and interrogate all the other beacons sequentially by their ID code. If several beacons share the same ID code, then they will attempt to respond at the same time and lead to unpredictable behaviour.

The ID currently in use by each beacon can be found by counting the number of <u>short</u> flashes of the green status LED on the beacon (after the long 1 second 'starting' flash).
For example:
- **LONG-SHORT-PAUSE would represent the ID code of 1.**
- **LONG-SHORT-SHORT-SHORT-PAUSE would represent the ID code of 3.**
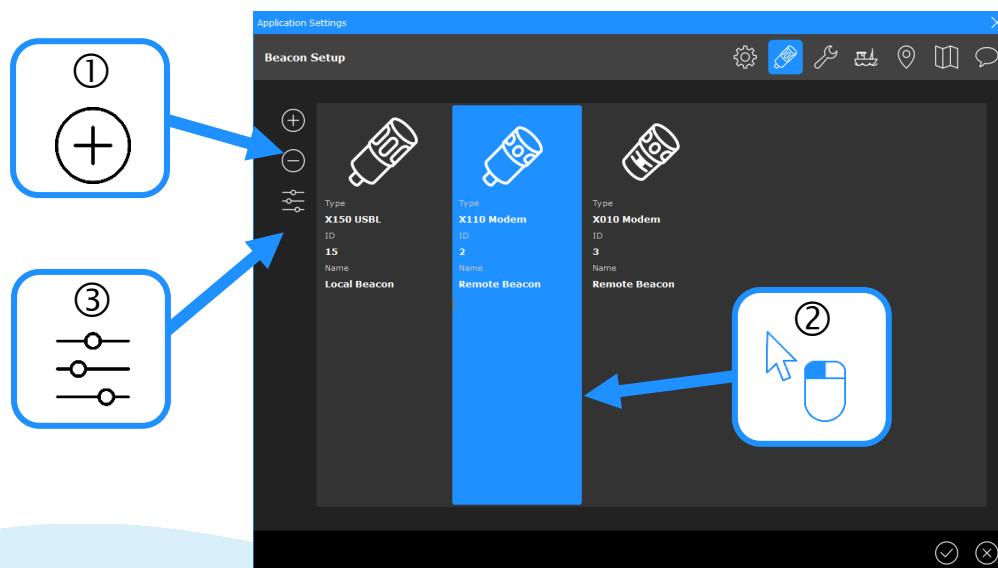
To change the ID code of a SeaTrac beacon, it must be attached separately to the PC via a serial connection and configured using the separate SeaTracTools utility application. Once an ID code has been set, the beacon will use it each time it is powered up until it is reprogrammed.
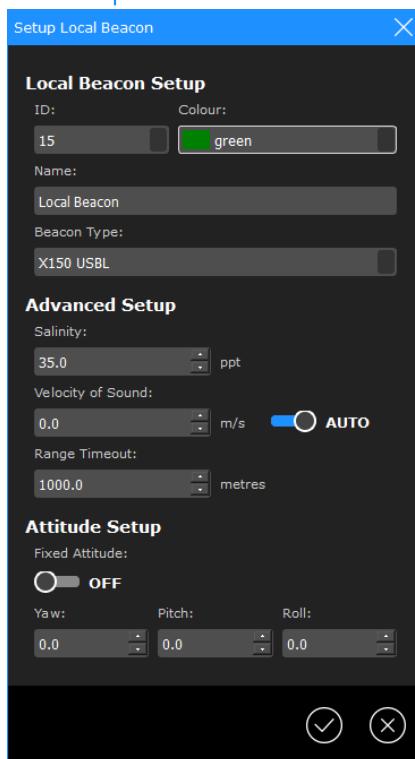
During normal operation, the USBL head with "PING" and interrogate all the other beacons sequentially by their ID code. If several beacons share the same ID code, then they will attempt to respond at the same time and lead to unpredictable behaviour.

To add a beacon to track, click the **Add (+)** button at the side of the Window then select it and click the **Properties** button to configure it…

Local Beacon Properties

For the Local Beacon (the attached X150 USBL head), you can use the properties to configure the colour its position and track appears as on the display.

Additionally, you can configure the water **Salinity** here, for automatic calculation of Velocity-Of-Sound (VOS), or choose to manually enter the VOS.
For accurate ranging, it is important that the VOS is correct.
Generally, use a salinity of:
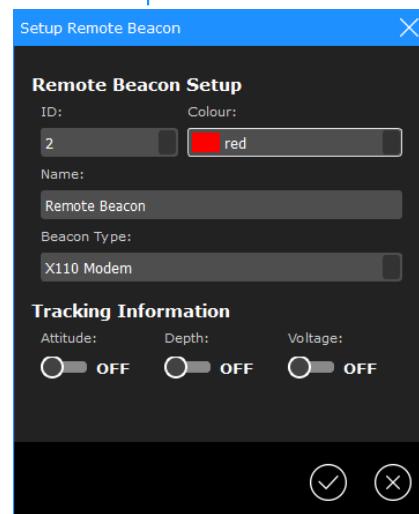
- Fresh-Water, 0ppm
- Sea-Water, 35ppm
- Note that some sea's, such as the Baltic etc are brackish and have a different salinity depending on location.

The **Range Timeout** determines how long the beacon will wait for a response to arrive back after sending a PING request. If you are working at close ranges, you can reduce this value to speed up the system ping rate when timeouts occur.

The **Attitude** settings allow you to choose to use the X150's in built AHRS pitch/roll/heading sensors (setting is OFF), or manually specify an orientation (for better accuracy in fixed platform installations).

Remote Beacon Properties

For the Remote Beacons, use the properties window to associate each Beacon with its ID code **(as described previously).**

You may also change the colour the beacon position and tracking history is shown at one the display and assign a more relevant name to the Beacon for display purposes (i.e. "Diver-1", "Fred", "Minisub" etc).

The **Beacon Type** list allows you to specify the type of beacon, and this will enable further supported settings for that beacon to be configured.

Additional **Tracking Information** can be requested from each ping from Seatrac beacons – this includes:

- **Depth** (X110 and X010) – send back the depth reading from the beacons pressure sensor to a resolution of 0.1m (rather than 1m standard).
- **Attitude** (X110 only) – sends back the remote beacons Pitch/Roll/Heading values.
- **Voltage** (X110 and X010) – sends back the supply voltage of the remote beacon.

Using the above settings causes more data to be transmitted acoustically, and this will slow the position update rate of the overall tracking system.

2.4. Configuring The Operator Platform

The "Platform" is the term used to describe the installation that the USBL head and GNSS (satellite) receiver are mounted on. This is usually a boat, pontoon or quayside.

The **Platform Setup** settings page has two buttons on the left-hand side allowing the overall Position and USBL parameters to be entered…
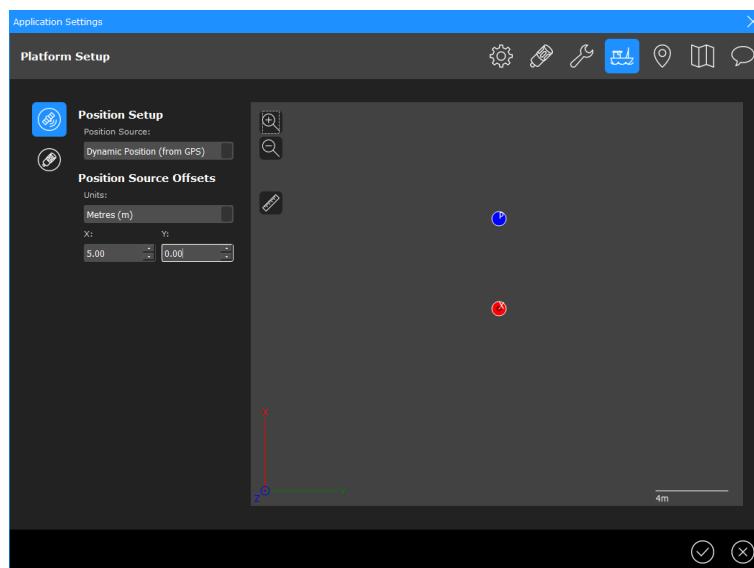
2.4.1. World Position Setup

These settings control how the overall "world" position of the tracking system is determined. The Position Source drop down list allows two choices:

- **Fixed Position** – Use this option to specify the Latitude/Longitude position reference point.
- **Dynamic Position (from GNSS)** – Use this option to determine the Latitude/Longitude of the position reference point from a GNSS satellite receiver.

When **Fixed Position** is chosen, use the Latitude and Longitude text boxes to enter the coordinates of the position reference point (usually the operator's computer).

When **Dynamic Position** is chosen, the position will be obtained from any attached Hardware Devices (such as a satellite receiver producing RMC or GLL NMEA sentences).
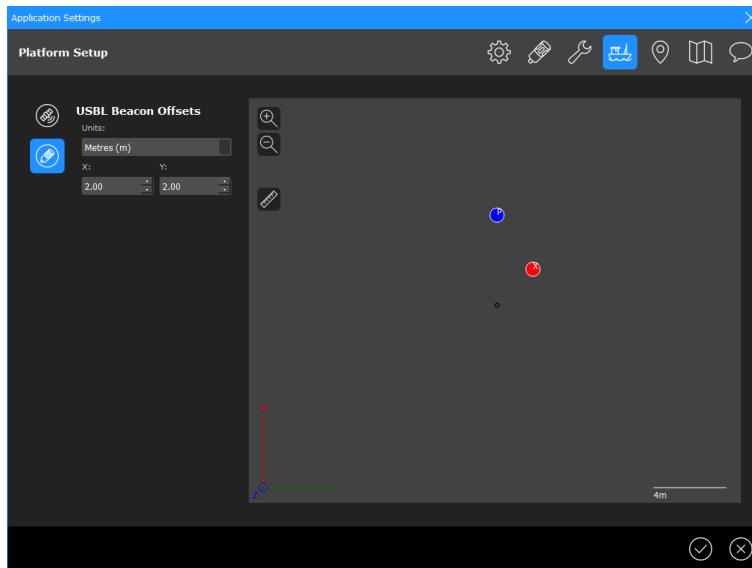
The position reference point's location is shown by the Blue circle (●) relative to the origin (○) at the centre of the display. Use the **Position Source Offsets** to specify the location of the position reference point relative to the origin – i.e. the location of the GNSS antenna relative to the operator's computer.

2.4.2. USBL Beacon Offsets
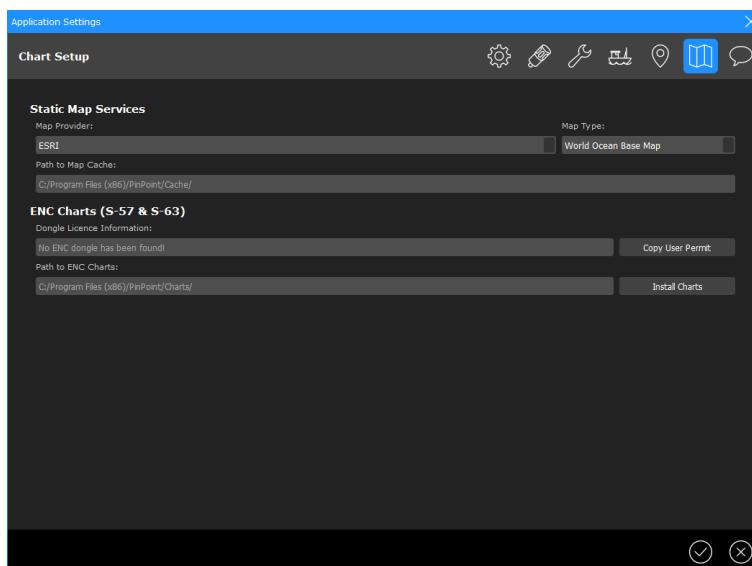
Once the above Position Setup has been complete, the system can determine the latitude and longitude coordinates of its reference origin point from received satellite position. However, the system also needs to take into account the position of the USBL head relative to this origin as well.

The USBL reference point's location is shown by the Red circle (●) relative to the origin (○) at the centre of the display. Use the **USBL Beacon Offsets** to specify the location of the position reference point relative to the origin – i.e. the location of the GNSS antenna relative to the operator's computer.

2.5. Configuring The Chart Background

The Chart Setup settings page allows you to configure the geo-referenced background images shown on the main chart display.

Use the **Map Provider** drop-down list to choose which supported service you'd like to provide the map data. Options include…

- None
- Google Maps
- Open Street Maps
- ESRI

Once you've selected a mapping provider, use the **Map Type** drop-down list to choose the specific map view/style that you'd like to use.

As you move around the Chart Display during normal use of the software, map tiles are downloaded and stored into the Map Cache folder location as needed by the software. Map tile are cached for up to 30-days before being automatically cleaned.

2.5.1. Using ENC (S-57 and S-63) Charts

To use vector based Electronic Navigation Charts (ENC's) such as those in S-57 and S-63 formats, you will require the additional USB hardware license Dongle (that can be purchased at the same time or after your SeaTrac system), and must be plugged into the computer to enable this functionality.

For S-63 charts, the Dongle contains a unique 28-character "User Permit" code required that is required by chart suppliers to generate the necessary "Chart Permits" for decrypting the chart data.

The User Permit code will be supplied to you on a paper certificate at the same time as the Dongle, and you should keep this in a safe place as you may need it when purchasing charts.
Alternately, when the Dongle is attached, click the **Copy User Permit** button to copy the code from the Dongle onto your computers clipboard, and you can then paste this into emails, other documents etc as required.

To install electronic S-57 and S-63 format charts:

- Plug the USB ENC Dongle into you PC before running PinPoint, or click the **Refresh** button after attaching the Dongle if PinPoint is already running.

    The **Dongle License Information** should be shown on the Chart Setup settings page.

- For S-63 encrypted charts, give the User Permit code to your chart supplier along with a list of Cell Codes for the charts you require (i.e. GB100160, GB201121 etc.).
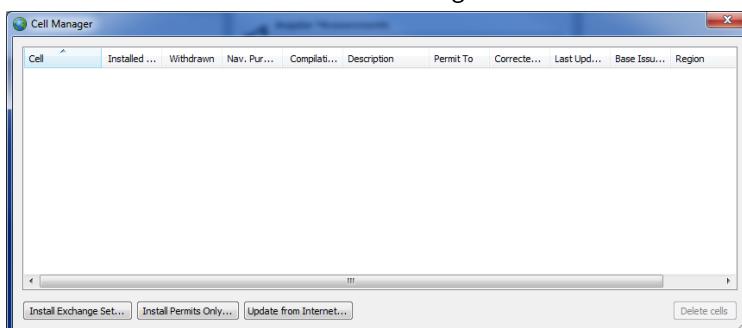
    Online tools (such as the Admiralty Digital Catalogue) can help create a chart list.

    Click the **Copy User Permit** button to copy the User Permit code onto the computers clipboard, then paste this as needed into emails to chart providers etc.

- The chart supplier will generate a Chart Permit file (PERMIT.TXT) with decryption codes for each of the required ENC Cells you are currently licensed for.

For Multiple S-57 or S-63 Charts (Exchange Set, or NOAA Zip File)

- Use the **Install Charts** button to start the "Cell Manager" …
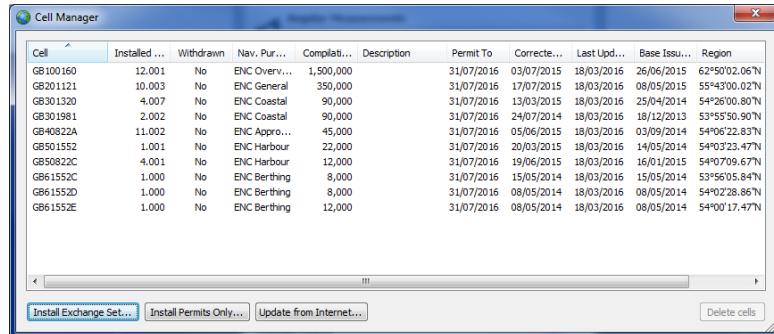
- To use S-63 encrypted charts, in the Cell Manager click "**Install Permits Only**" to start the wizard that allows you to update or add the list of chart permits licensed to the attached Dongle.

- S-57 or S-63 chart data can be added or updated by clicking either…

    "**Install Exchange Set**" - You will need to obtain the required Chart data in an Exchange Set, which is usually supplied on media such as DVD or USB-Drive from your chart provider. In the case of NOAA S-57 charts, data can be downloaded as a ZIP file from the internet.
    The media should contain a folder structure with a file called SERIAL.ENC and sub-folder called ENC_ROOT with Cell data stored hierarchically in further sub-folders.

   o "**Update from Internet**" – This will start a wizard that allows you to connect to an online chart data service (such as AVCS or Primar) and download the updated or new chart data that matched the licensed permits that have been previously installed.

- When complete, the Cell Manager should display the available charts…
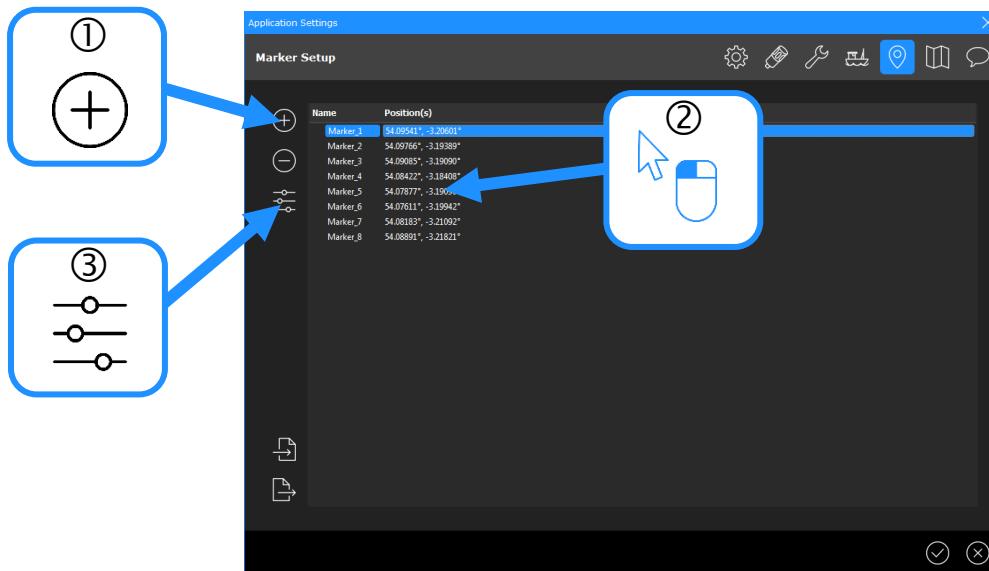
For Single S-57 Charts (A '.000' File Extension)

- Click the Install 000 File button, and then when prompted locate the chart file with the ".000" file extension and click OK.

2.6. Configuring Markers

Markers are shown on the main Chart Display and can be used to identify points of interest, mark locations, as navigation waypoints and paths. Markers can be added graphically on the main Chart Display, or by clicking the Add (+) button in the **Marker Setup** settings page.
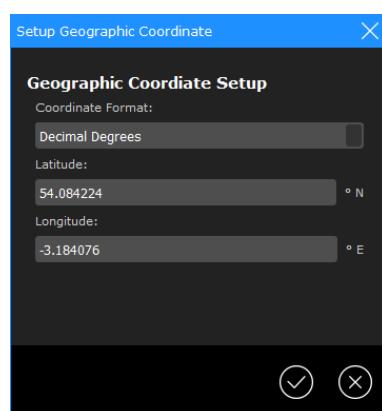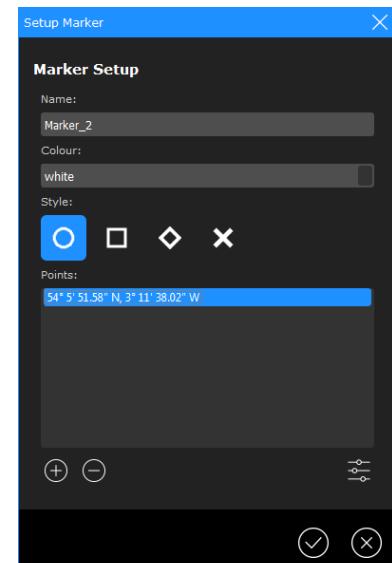
To edit an existing marker, click the marker details in the list, then click on the **Properties** button (or double click the marker entry).

Use the Marker Properties window to configure the marker, including its **Name**, **Colour** and graphical **Style**.

Markers can represent a single point, or a chain of points that are connected to create a 'path' or define an outline of an area.

Additional points can be added to a marker by clicking the Add (+) button, or existing points can be modified by selecting the point and clicking the Properties button (or double clicking the point entry) …

14

3. Using The PinPoint Software

Once the SeaTrac system has been configures (see the previous section for Hardware and Acoustic setup), you can then start tracking the position of acoustic beacons from the USBL head.

Click the **Connect** button to connect to the USBL head and start tracking.

When a successful connection is made, the Connect icon will turn blue – click the Connect icon again to disconnect from the USBL head and stop tracking.

If the USBL head is in air, you should be able to faintly hear it start "chirping" as it transmits acoustic information sequentially to each configured remote beacon and waits for the reply.

You can test the functionality of the system and remote beacons in air by placing them approximately 20-30cm away from the USBL head (in direct line of sight) – ranging and positioning information will be incorrect (because of the different way sounds travels in air compare to water), but you should be able to see on the PinPoint display (and hear) the responses occurring from each beacon.

3.1. Live Data, Recording and Playback Controls

Connect / Disconnect
Click this button to connect to the Local Beacon (the SeaTrac X150 USBL head). This will start tracking using the current hardware and system setup specified in the Settings Window.

Record Logfile
Click this button (at the bottom of the display window) to start recording a Log File, where all raw sensor data is recorded for subsequent playback and review. Log Files are automatically names and stored into the folder specified in the Application Setup settings window.

Open and Replay Logfile
Click this button to choose a Log File to replay. When the file is opened, playback controls will be displayed along the bottom of the application window.

3.2. Display Selection Controls

Chart Display
Click this button to show the main Chart and tracking display.
Icons down the left side of the screen allow for panning and zooming operations as well as measurements to be made from the screen, and the display contents to be snapshotted to image files.

Beacon Status Display
Click this button to show the status information being output by the Local Beacon, including current Velocity-Of-Sound, Depth, Temperature, Pitch, Roll and Heading values.

15
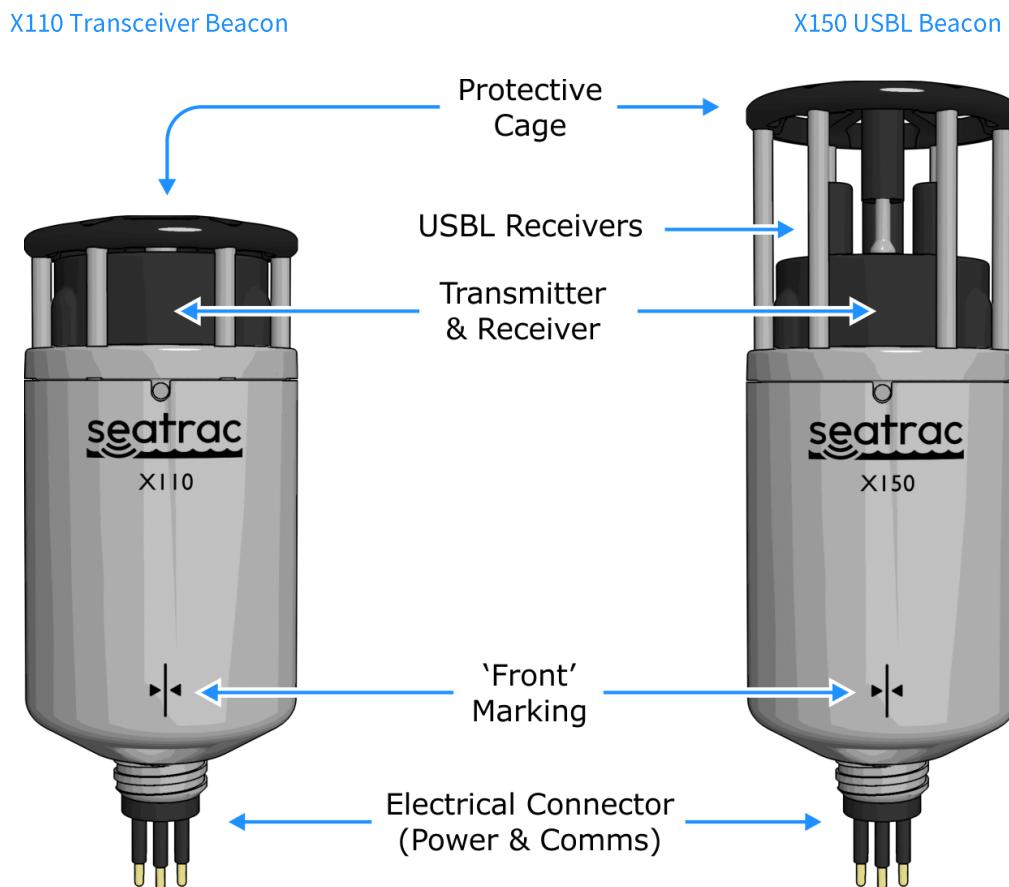
Acoustic Diagnostics Display

Choose this button to see the Acoustic Diagnostics display.
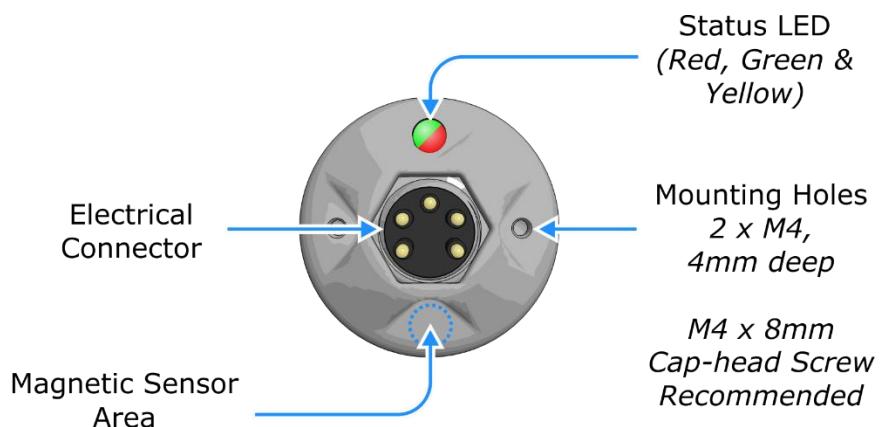
This screen contains tools to allow the software to manually ping individual remote beacons acoustically, and examine the quality of the response (helping diagnose acoustic connection issues).

4. Using The SeaTrac Beacons

4.1. Beacon Features

X110 Transceiver Beacon

X150 USBL Beacon

Protective Cage

USBL Receivers

Transmitter & Receiver

'Front' Marking

Electrical Connector (Power & Comms)

(NB: Beacons are shown in the 'upright' position, as referenced in the following sections)

Status LED
(Red, Green & Yellow)

Electrical Connector

Mounting Holes
*2 x M4,
4mm deep*

*M4 x 8mm
Cap-head Screw
Recommended*

Magnetic Sensor Area

17

4.1.1. Status LED

When powered up, the current operating state of the beacon is shown by the colour and flashing style of the Status LED positioned on the bottom end of the beacon housing…

	• Green 2s flash followed by short pulses and 2s off period	Beacon is operating normally. After the 2 second on period, the Beacon Identification code is flashed on the LED by a sequence of short ¼ second pulses (i.e. 5 short flashes mean the beacon is configured as Id 5).
	• Red Slow Flashing	Beacon is in 'bootloader mode' and will only respond to basic status request and firmware update commands.
	• Red Fast Flashing	A reset magnet is over the magnetic sensor, after 5 seconds the LED will become continuous and defaults applied.
	• Red Continuous	Beacon settings will be restored to factory default values when the reset magnet is removed.
	• Yellow Continuous	Firmware update is in progress – typically takes 5-10 seconds.

4.1.2. Mounting holes

The base of the X110 and X150 beacons housing has two 4mm deep M4 threaded holes. These allow the beacon to be easily attached to the supplied pole-mounting bracket or other asset attachment points.

X010 beacons have no mounting holes.

4.1.3. Magnetic (Reset) Sensor Area

The magnetic 'reset' sensor is situated below the flat area on the bottom bulkhead of the beacon housing.
When the south pole of a magnet is placed against the housing, the status LED should flash red quickly turning to continuous red after 5 seconds, and at this time factory default settings will be restored when the magnet is removed.

4.1.4. Front Marking

The front marking indicates the reference position on the beacon from which incoming signal angles and headings are computed. When the front marking is pointing to magnetic north, the yaw angle reported by the AHRS sensors will be 0°.

4.1.5. Acoustic Transducers

All SeaTrac beacons transmit and receive data messages using the large 40mm diameter ring transducer mounted on the upper bulkhead of the beacon housing.
The beacon is designed to allow the ring area to free-flood, enabling maximum transfer of acoustic energy from the transducer into the surrounding water. However, for best performance, when submerging the beacon ensure that no large air bubble remain trapped in this area otherwise operating range may be impacted.

Additionally, the X150 USBL beacons feature 4 additional small receiver elements mounted above the main transmitter ring. The position and spacing between each receiver element is critical for the accurate operation of the USBL system.

To achieve optimal performance, the acoustic transceiver elements are manufactured from a ceramic material and encapsulated by a thin rubber coating. The elements may be damaged by sharp impacts or sustained point-pressure loads if care is not taken when handling or mounting beacons correctly. Avoid mounting the beacons in situations where impacts in the transducer area may be likely, otherwise damage may occur.

4.1.6. Pressure and Temperature sensor

The pressure transducer is mounted on the upper bulkhead of the beacon within the area of the main transducer ring. It is slightly recessed and has a corrugated surface from with the water temperature is also measured.
The beacon depth reading (in metres) is computed from the measured pressure (in Bar), and this value combined with the water temperature and user specified salinity can be used to auto-compute the current velocity-of-sound value, constantly calibrating the measure ranges to other interrogated beacons.

Do not touch or attempt to depress the diaphragm of the pressure transducer as it may be marked and permanently damaged, causing inaccurate readings.

The pressure transducer is temperature compensated over the 0° to 50° Celsius range. Within this range its output is specified to be within ±0.5% of it's full scale reading at any given value.

4.2. Important Considerations

Before using your SeaTrac product, please read and follow these safety considerations…
If you have any other safety or operational queries, please contact Technical support (see page 27).

4.2.1. Operation

- Do not rely on this product or its sensors as a primary means of life-support. SeaTrac products are designed as a position aiding tools, and not as an alternative or replacement for dive-computers or similar critical navigation apparatus.

- Do not use this product if any housings or cabling appear to be damaged or compromised for the ingress of water (where required to be watertight).

- Do not attempt to disassemble or service this product yourself (outside the scope described in this manual). Contact Artemis technical support for any maintenance, spares or repair work required.

- Ensure the acoustic transducers are protected from image and damage during use but a protective cage or other suitable means.

- SeaTrac Beacons are designed for use in water. Where possible avoid periods of prolonged transmitter use in air (i.e. greater than 15 minutes) as the main transmitter transducer ring may experience heating due to un-dissipated acoustic energy. Larger current consumption and current surges may also be observed on power supplies during transmission in such situations.

4.2.2. Maintenance and Cleaning

When you have finished using your SeaTrac product, you should…

- Wash the housing in fresh water if it has been used in salt-water, to prevent corrosion and degradation of rubber mouldings.

- Remove any weed, or other detritus, that may have been collected during its operation.

Additionally, please observe the following precautions for cleaning and maintenance…

- Do not clean with solvents, and only use a damp cloth on the exterior surfaces of the unit.

- Do not undertake maintenance of the unit, outside the scope of that defined within this manual, unless instructed to do so by technical support.

- Do not insert extraneous objects (metal or otherwise) into the unit or any of its connector apertures.

- Take care when cleaning the pressure sensor diaphragm to ensure it is not damaged or marker.

4.2.3. Storage

When storing or shipping SeaTrac products, please observe the following…

- Do not store the unit in direct or strong sunlight, as this may cause surfaces or transparent windows to discolour, perish cable insulation and other rubber mouldings.

- To prevent corrosion, remove any salt or other residues from the product before storage.

- Store in the recommended temperature range and avoid excessive and large fluctuations in temperature.

- Store in a well-ventilated enclosure after use, to allow any moisture on system components to evaporate naturally.

- Do not store battery packs in a discharged state, as this may reduce operational life or cause premature ageing of the cell. When storing batteries for more than one year, charge at least once a year to prevent leakage and deterioration of performance due to self-discharging.

- Do not leave battery packs in the battery housing for long periods of storage, and cells may leak and damage the seals and interior of the housing.

4.3. Calibrating the Magnetic Heading (AHRS)

The Attitude and Heading Reference System (AHRS) monitors the on-board sensors (comprising accelerometers, magnetometers and rotational rate gyroscopes) to compute the heading, pitch and roll angles of the X150 USBL Beacon relative to the direction of gravity and the magnetic north direction.

The X150 Beacon then uses the AHRS angles and received Azimuth/Elevation angles to compute the relative Northing/Easting/Depth coordinates of each remote beacons as it receives it acoustic response to a ping.

If the received positions are incorrect, the magnetic heading sensors (magnetometers) in the USBL AHRS may need recalibrating with the following procedure:
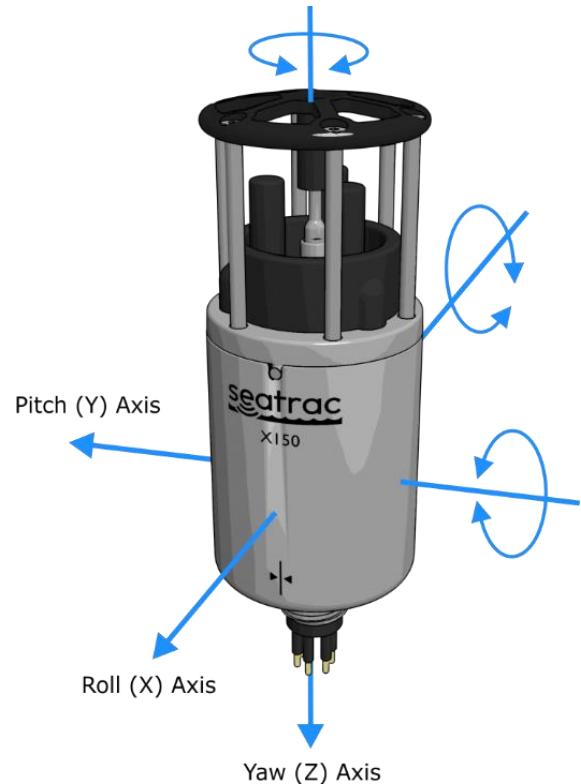
- In PinPoint, connect to the X150 USBL Beacon and switch to the Beacon Status Display.

- Under the "Magnetometer Calibration" heading, click the "Clear Buffer" button. This will clear all previous magnetic reading and should reset the "Buffer Level" progress bar value back to 0%.

  Start <u>slowly</u> rotating the beacon around its three axis (yaw, pitch and roll). It helps if you imagine the beacon to be inside a sphere, and during rotation the top of beacon is painting the inside of the sphere as you move it around.

  The aim is to rotate and roll the beacon through as many orientations as possible in three-dimensional space, and as you do so the magnetometer is attempting to measure the magnetic field for each orientation.

  The figure opposite gives an indication as to the types of movements you should make around the axes, and this should be done in as many combinations of orientations as possible (i.e. horizontally, vertically, upside down etc) …

- As you rotate the beacon, the "Buffer Level" progress bar will slowly increase. Keep rotating the beacon until the Buffer Level reaches 100%.

- Finally, with the Buffer Level at 100%, click the "Calibrate" button to compute the calibration and store the values into permanent memory.

4.4. Mounting Beacons

Beacons can be attached to platforms in a variety of different ways. However, regardless of mounting method, please ensure the following points are observed…

- Always ensure the transducers are suitably protected and will not be damaged by contact or impact with other objects and structures.

- Ensure there is good "acoustic visibility" around the transducers. Like light, all objects can cast acoustic shadows, and the closer objects are to the transducer arrays the more pronounced this effect will be. For best performance ensure each beacon has good all-round visibility and line-of-sight clearance to other beacons it will communicate with.

- If using the X150 USBL AHRS, mount the beacon as far away from sources of magnetic interference as possible (i.e. ferrous materials), and perform a calibration if necessary.
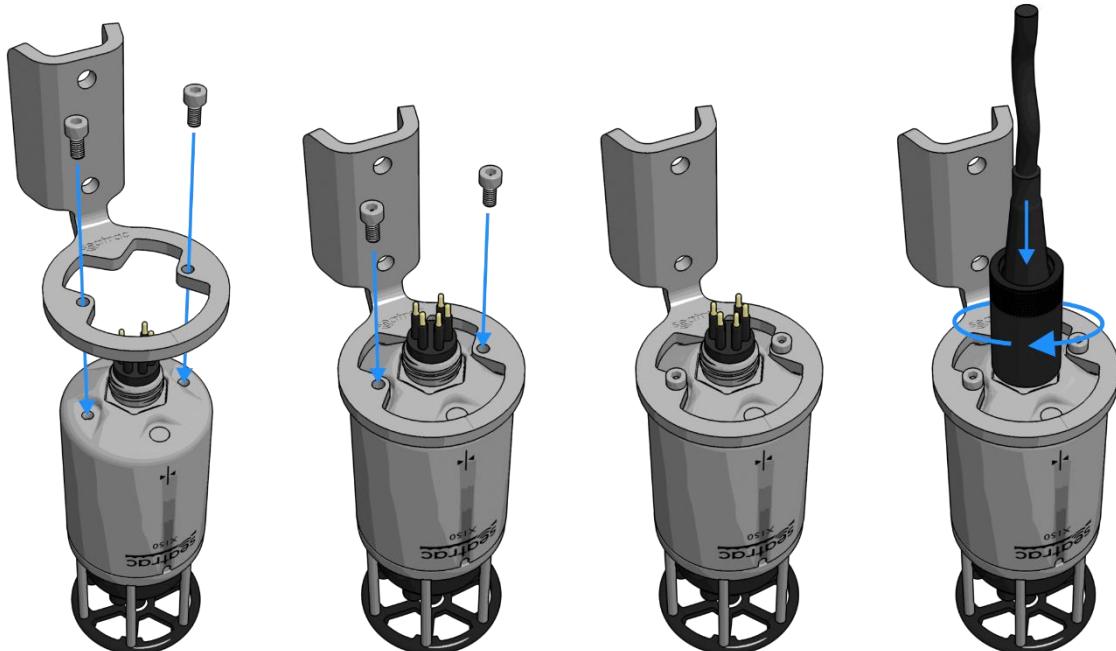
4.4.1. Pole Mounting Bracket (X110/X150 only)

The pole mounting bracket allows the beacon to be rigidly attached to its operating platform.

Typically, this may involve mounting an X150 onto a pole or an X110 modem beacon onto an ROV, AUV or equipment platform.

To attach the bracket…

- Orient the bracket such that the two holes align with the M4 threaded holes in the beacon housing and the Status LED is visible through the bracket.

- Use M4 × 8mm cap-head screws to secure the bracket onto the beacon.

- Plug the external cable loom onto the beacon connector and tighten the securing collar.
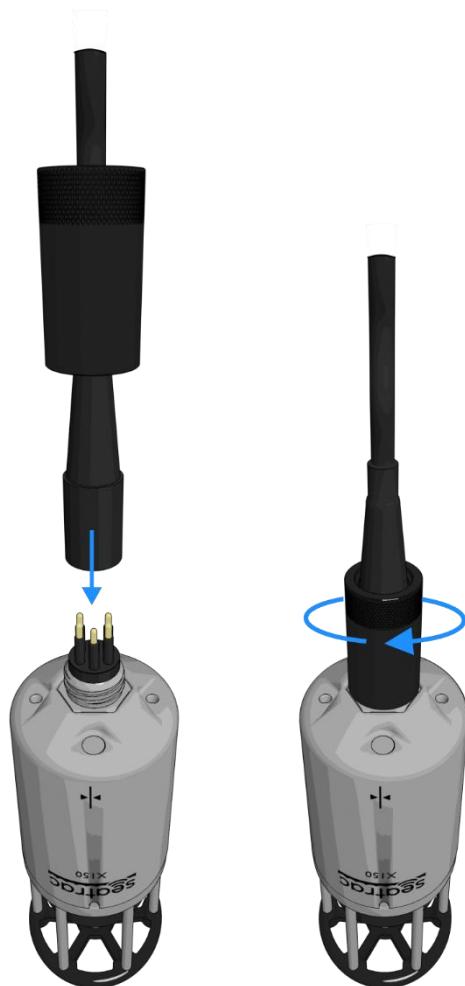
4.4.2. Cable Mounting (X110/X150 only)

For the X150 USBL system, it may be desirable to hang the beacon over the side of the surface vessel by the supplied cable alone.

This has the advantage of allowing the beacon to be mechanically decoupled from the vessel and less susceptible to position measurement errors introduced when small movements and vibrations are amplified down a pole-mount.

To mount the beacon on the cable…

- Plug external cable loom onto the beacon connector and tighten the securing collar.

- Ensure the other end of the cable is securely fastened to the vessel in a way that will not damage the outer cable insulation or damage the inner conductors if the bend radius is too small.

5. Troubleshooting

This section covers some of the commonly encountered problems when setting up the SeaTrac system and PinPoint software.

Before proceeding with trouble shooting it is always worth checking you have the latest version of the PinPoint software installed on your PC. This can be downloaded from the SeaTrac website support pages at…

<div align="center">

https://www.blueprintsubsea.com/seatrac/support.php

</div>

It is also worth double checking your system configuration by following the sequential steps highlighted in section 2 ("Setting Up The SeaTrac System") from page 4 onwards of this manual.

5.1. No Sensor Data From The Local Beacon

When PinPoint first connects to the attached X150 USBL head, it sends a configuration message to set up sensor data and operational parameters.

If no sensor information is being received from the X150 (such as pitch, roll, heading, depth, water temperature), or the beacon is making no audible sound (in air) as it tries to 'ping' the remote beacons, then try the following actions:

- Check the X150 USBL Beacon has power and the Green status LED on it housing is flashing (it should be showing one long flash and 15 short flashes to indicate an ID code of 15).

  If the LED is Red, the Beacon has started in "Bootloader" mode and may indicate a problem with corrupt firmware or hardware.

  If the status LED is rapidly flashing Red, check there is no magnet near the reset-sensor area on the base of the Beacon as this could cause the Beacon to start in Bootloader mode, or reset to defaults.

- If the status LED is green, it is likely that the serial port ('COM x') has been incorrectly specified in the Device Setup page for the Local Beacon – see section 2.2 on page 6.

  You can view available serial ports on your system by pressing the "Windows Key" or clicking on the Start Menu icon and then typing "*Device Manager*" (or running "*devmgmt.msc*"). This will show the PC's Device Manager window and expanding the "Ports (COM and LPT)" sub-heading will then show all available COM ports.

  If you are using a USB-to-Serial adapter for connection to the X150 Local Beacon, the corresponding COM ports will appear and disappear in this list as they are connected and disconnected and doing do should help identify which one is being used.

  If you do connect or disconnect an adapter while PinPoint is running it may then cease to work properly until the PinPoint application is closed and restarted (or sometimes Windows may need to be rebooted in extreme cases).

5.2. No Positions From Remote Beacons

If you are not seeing any positions being reported in the PinPoint software for the remote beacons you have configured, then try working through the following steps:

- Follow the steps above to check the local X150 USBL beacon is correctly attached and functioning. In air you should be able to hear it send an 'acoustic ping' about once every one to three seconds.

- Each SeaTrac beacon should be setup with a unique acoustic Id – this is a number from 1 to 15 and each beacon indicates this by showing short pulses of its green status LED

   The X150 USBL beacon should be set by PinPoint to have an ID of 15, while the remote beacons will probably be number 1, 2, 3 etc. Section 2.3 (page 8) of this manual has more details on this, but you will need to know this remote ID code when you come to configure PinPoint to ping the remote beacon (i.e. if PinPoint is trying to ping beacon 1, but the actual beacon ID code is 2 then it will get no response and a 'timeout' will occur).

- Test the system first in air by placing two beacons relatively close together (about 30 cm apart). This won't give accurate ranging or positioning (as speed of sound is configured for water), but it should show when a response has been received and you should be able to hear both the Local X150 do its transmit and the Remote Beacon do its response if you listen closely (about once per second).

   If you can't hear either beacon make its transmission noise then it check power and status LED's on all beacons are flashing Green. Typically, Remote Beacons only need power (serial communications on Remote Beacons are only optionally required for additional application specific functions).

- Once the system working in air then you should be able to transfer it over to the water knowing the setup and configuration is correct. If it stops working after getting it wet, then it is more likely to be problems with acoustic reflection and the underwater environment.

   It is recommended to ensure the Local USBL X150 beacon is positioned at least 1m away from any other object (and ideally 2m if possible – sometimes up to 10m depending on the area and depth of water you are operating in), as these object objects can reflect sound back if they're too close and the beacon can't tell the difference between the message it should receive and reflections.

   You should also ensure there is a clear acoustic path directly between the Local and Remote Beacons. If anything blocks this "line of sight" (i.e. obstacle, part of an ROV, divers head etc), it will either stop the sound arriving or fool the local beacon into thinking it's coming in from a different direction (leading to an incorrect position).

5.3. Ranges To Remote Beacons Are Wrong

SeaTrac beacons are capable of very accurate line-of-sight ranging between beacons (reported to a resolution of 0.1m) regardless of the USBL positioning functions.

To compute range, the beacon measures the time interval between sending a 'request' message and receiving the 'response' back from the remote beacon. This time is combined with the 'velocity-of-sound' (VOS) for the water conditions to produce a range.

However, if the reported range is wrong, check the following:

- The VOS is derived using the on-board pressure sensor to measure the submerged depth of the beacon and water temperature, but the user is required to manually enter the salinity of the water the beacon is in. Further details on how to do this are under 'Local Beacon Properties' on page 9.

   Typically, a salinity value of 0ppt (parts per thousand) is used for fresh water and 35ppt for 'standard' sea-water. However, there are areas where the value will be somewhere in between (such as the Black Sea, Baltic Sea, Red Sea, Caspian Sea and various salt lakes).

   VOS values are typically around 1475 ms^{-1} to 1525ms^{-1} for normal operation.

- If there is a physical obstruction/object in line between the USBL beacon on the surface and the remote beacon, it may be possible that the sound cannot directly travel between the two – instead it may be reflecting off another object before being received by either beacon. This additional travel distance of

the sound is called a "multipath" and will be reported as an incorrect range and position (as incoming angle of arrival of the sound will also be wrong).

5.4. Position Of Remote Beacons Are Inaccurate

The X150 USBL beacon determines the positions of remote beacons by measuring the incoming sounds angle of arrive (as azimuth and elevation), then combining it with its own orientations (pitch, roll and heading) to determine a relative offset of the remote beacon from itself (as a northing, easting and depth).
Finally, PinPoint combines the relative coordinate with the GNSS satellite derived position of the USBL head to compute actual real-world latitude and longitudes of each beacons position.

If reported positions are inaccurate, then there are several sub-systems that could be incorrectly configured, so try:

- First, check there are no "multipath" reflections being received (as described above). These are usually caused by an obstruction blocking the direct line-of-sight path between the USBL head and the remote beacon being 'pinged' – obstructions are usually caused by rocks or part of the terrain, parts of the ROV or platform the remote beacon is mounted on, the boat hull (X150 not deep enough to clear the keel), diver-head (if beacon is mounted on a Scuba air tank) etc.

  In such cases, it is likely that other paths are created as the acoustic signal bounces and reflects of other surfaces (the seabed, water surface, boat hull, dock wall etc). When it arrives at the receiver is will have travelled further and arrived at a different angle of incidence to the USBL head leading to an incorrectly reported position.

- The X150 USBL head contains an Attitude Heading Reference System (AHRS) that measures the pitch, roll and magnetic heading of the beacon. It is possible that the magnetic heading sensors may need calibrating to account for any variations in different environments.

  To calibrate the AHRS refer to the procedure described on page 21.

- Rigidly mount or reduce movement on the X150 USBL beacon will help improve the quality of acoustic position fixes.

- Be aware of Thermoclines as these temperature layers in the water can scatter and refract the path of sound travelling through them – it can become a complex subject but there may be situations where acoustically it is impossible to transmit sound through certain water conditions and situations over a particular range (less than the 1km stated maximum operating range) because of the temperature gradient in the water column bending the sound pulses downwards and into the sea-bed.

5.5. Working/Testing In A Swimming Pool (Or Other Confined Space)

Swimming pools or other confined spaces are a challenge to undertake acoustic positioning in due to the reflective walls and bottom of the tank and small size coupled with high-power and long-duration transmission signals.

In these situations, the beacon receiver can often become saturated by the 'loud' acoustic signals bouncing around the tank and making differentiation of the main signal from 'multipath' reflections difficult. The SeaTrac acoustic signals use a data encoding scheme and checksum to ensure validity of the message – incorrectly received data bits will also invalidate the messages and cause positioning to fail.

If positioning is intermittent when operating in a small enclosed tank or pool, it is recommended to undertake further testing in a larger area of water where the sound has more space to dissipate and reflections are reduced.

6. Product Support

6.1. Website

For the latest software and firmware updates, as well as production information, manuals and datasheets, visit

www.blueprintsubsea.com

We welcome any feedback you may have about our product, from bug reports to ideas for new features or hardware to support – please use the contact details on the website (or shown below) to get in touch.

6.2. Technical Support

If your product is not operating properly, please consult the 'Troubleshooting' section of this manual and further information on the support section of the website to see if the problem can be easily remedied.

However, if you need further support, you can contact us via your distributor or directly at…

- Web   *www.blueprintsubsea.com*
             (for access to on-line resources and technical support)

- Email   *enquiries@blueprintsubsea.com*

- Telephone   +44 (0)1539 531536
             (9:00am to 5:00pm, Monday to Friday, UK Time)

For all the above please provide the following information to help us with your technical support request…

- Part and Serial Numbers of the system components. These are located on the labels of each item, and are in the form "BPxxxxx.xxxxxx".

- Version numbers of any software and firmware you are using.

- The operating system name, version, type (32 bit or 64 bit) and service pack upgrade your computer is using.

- Brand and model of your computer (processor type and memory configuration is also useful if known).

- Name of the distributor where the system was purchased from.

If you need to return your product for servicing or repair, please…

- Contact us (using the details above) for returns information and shipping details.

- Pack your sonar back in the original packaging (or other suitable container), and include written documentation including your contact details (including contact phone number), a description of the problem and any symptoms occurring.

- If your product is still under warranty, please include a copy of your receipt (showing proof and date of purchase).

- To protect our staff, please ensure the product has been suitably decontaminated and cleaned prior to return such that it is safe to handle.

- Please return the product back to Blueprint Subsea, using an insured courier and delivery confirmation.

7. Limited Warranty Policy

The manufacturer, Blueprint Design Engineering Limited (trading as Blueprint Subsea and hereafter after referred to as Blueprint), warrants that at the time of shipment all products shall be free from defects in material and workmanship and suitable for the purpose specified in the product literature.

Conditions

Unless other terms are specifically requested and mutually agreed in writing prior to dispatch, the conditions of the warranty include, but are not limited to:

- The warranty is only deemed to be valid if the equipment was sold through Blueprint or one of its approved distributors.

- The warranty commences immediately from the date of customer acceptance and runs for a period of 365 days. Customer acceptance will always be deemed to have occurred within 72 hours of delivery.

- The equipment must have been installed and commissioned in strict accordance with approved technical standards and specifications and for the purpose that the system was designed.

- The warranty is not transferable.

- Blueprint must be notified immediately (in writing) of any suspected defect and if advised by Blueprint, the equipment subject to the defect shall be returned by the customer to Blueprint, via a suitable mode of transportation and shall be freight paid.

- The warranty does not apply to defects that have been caused by failure to follow the recommended installation or maintenance procedures, or defects resulting from normal wear & tear, incorrect operation, fire, water ingress, lightning damage or fluctuations in vehicles supply voltages, or from any other circumstances that may arise after delivery that is out with the control of Blueprint. (Note: The warranty does not apply in the event where a defect has been caused by isolation incompatibilities.)

- The warranty does not cover the transportation of personnel and per diem allowances relating to any repair or replacement.

- The warranty does not cover any direct, indirect, punitive, special consequential damages or any damages whatsoever arising out of or connected with misuse of this product.

- Any equipment or parts returned under warranty provisions will be returned to the customer freight prepaid by Blueprint

- The warranty shall become invalid if the customer attempts to repair or modify the equipment without appropriate written authority being first received from Blueprint.

- Blueprint retains the sole right to accept or reject any warranty claim.

- Each product is carefully examined and checked before it is shipped. It should therefore be visually and operationally checked as soon as it is received. If it is damaged in anyway, a claim should be filed with the courier and Blueprint notified of the damage.

- Any customer acceptance testing (if applicable) must be performed at either Blueprint premises or at one of their approved distributors unless mutually agreed in writing prior to despatch.

Blueprint reserve the right to change specifications at any time without notice and without any obligation to incorporate new features in instruments previously sold.

If the system is not covered by warranty, or if it is determined that the fault is caused by misuse, repair will be billed to the customer, and an estimate submitted for customer approval before the commencement of repairs.

8. Notices

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Disclaimer

Neither Blueprint Design Engineering Limited, or their affiliates shall be liable to the purchaser of this product, or third parties, for losses, costs, damages or expenses incurred by the purchaser or third parties as a result of accident, misuse, abuse, modification of this product or a failure to strictly comply with the operating and maintenance instructions.

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Specifications & Content

All information in this document is believed to be correct at the time of going to press, Blueprint Design Engineering Ltd cannot be held responsible for any inaccuracies or omissions. If you find an error or feel we have missed important or useful information, please contact us. The latest version of the manual is always available to download from the website.

Specifications and information contained in this document are subject to change without notice, and does not represent a commitment on the part of Blueprint Design Engineering Ltd.

Handling Recommendations

The product contains sensitive electronic components that may be damaged by an Electrostatic Discharge (ESD) if handled incorrectly. To minimise risk of damage, users should avoid dismantling the unit, touching any exposed electrical contacts on external connector, or inserting anything other than the recommended cabling into the connectors.

Waste Electrical & Electronic Equipment Statement

Under the European Union (EU) directive on 'Waste Electrical & Electronic Equipment' (Directive 2002/96/EC), from August 13, 2005, products categorised as electrical or electronic equipment cannot be discarded as municipal waste by placing in landfill, dumping in the sea or incineration. SEPARATE collection is mandatory.
At the end of its life, you should either return this system and its associated leads & accessories (if appropriate) to Blueprint Design Engineering Ltd with a certificate of decontamination (we reserve the right to protect our staff from the effects of any contamination) or it should be sent to an appropriate treatment or recycling agency.

Restriction of Hazardous Substances Statement

Under the European Union (EU) directive on the 'Restriction of Hazardous Substances' (Directive 2002/95/EC), from July 1, 2006, electrical and electronic equipment cannot contain lead ("lead free"), mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).
All components of the Oculus system, sold by Blueprint Design Engineering Ltd, fully comply with this legislation where applicable.

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Distributor…