LBL Acoustic Navigation Software

Getting Started

Document No: IM-8025-01
Issue No: B - Rev 1

Sonardyne
SOUND IN DEPTH

Document Information

DOCUMENT TITLE	Fusion LBL Getting Started	
DOCUMENT REFERENCE	**ISSUE**	**ISSUE DATE**
IM-8025-01	B - Rev 1	3/12/03

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Document History

Issue	Rev	Date	Comments	Section	Page
A	0	08/08/01	First Issue		
A	1	30/08/02	Changes made to reflect new software v1.04 - CN 7391	All	All
B	1	3/12/03	Changes made to reflect major changes in software v1.06 - CN 8033	All	All

Getting Started Contents

1 About This Manual

Getting Started is a guide and introduction to installing and setting up Pharos software as either a stand alone application or as part of a Fusion LBL system.

This manual is only intended as an introduction. For more detailed information about specific tasks in Pharos or Fusion LBL refer to the context sensitive online help in the software.

This manual is arranged as follows:

- Section 1. About This Manual

  Information on the contents of this guide.

- Section 2. Fusion LBL Overview

  A brief description of the Fusion LBL acoustic navigation system, its main features and the typical activities and instruments it supports.

- Section 3. System Requirements and Hardware

  The minimum hardware and software requirements your computer needs to run Pharos successfully and a review of the hardware required to operate a Fusion LBL navigation system.

- Section 4. Installing Pharos Software

  Instructions for running the Pharos software installation program.

- Section 5. The Pharos Software Desktop

  An outline of the Pharos software toolbars and information displays.

- Section 6. Using Pharos Software

  How to configure and run the Pharos software. Includes details on how to calibrate an array (baseline and box-in measurements), and two examples of the most common tracking scenarios.

- Section 7. Technical Support

  How to obtain technical support and contact details for local Sonardyne offices.

2 Fusion Overview

Fusion is a range of hardware and software products that can be matched and configured to provide comprehensive and flexible system solutions for underwater navigation and positioning.

Through the integration of acoustic positioning with GPS, Attitude and Doppler Velocity Log (DVL) data at the sensor level, Fusion systems can provide an optimised positioning solution for all offshore survey and construction scenarios.

With a wide range of different equipment options and support for different sensor technologies, Fusion offers an unsurpassed degree of flexibility and functionality.

Fusion equipment is compatible with existing hardware inventories to enable users to increase equipment utilisation. In addition it is easier to service, maintain and upgrade than previous equipment and is also designed to be upgraded without having to open subsea housings, i.e. downloadable firmware.

A range of Windows software packages with a common user interface is designed to simplify the operation of Fusion systems and to reduce operator training on different systems. The principal benefit of Fusion ownership is the elimination of the separate hardware systems normally needed to undertake USBL and LBL positioning. For example the same vessel equipment could be used to provide positioning for both general ROV tracking and precise structure installation operations. Importantly, equipment within the Fusion range can be upgraded to offer increased functionality as and when required, simply through the installation of new software or firmware.

2.1 Fusion LBL

A Fusion LBL system comprises a combination of hardware and software options to create a complete system. A typical system consists of a Data Fusion Engine, LBL transceiver, Pharos software, transponder(s) and various inputs from other sensor packages such as GPS and attitude sensors. (See Fusion LBL Acoustic Navigation System Figure 2-1).

2.2 Pharos Software

Pharos is the navigation and positioning software system developed by Sonardyne specifically designed for tracking multiple remotely operated vehicles (ROVs), sub-sea structures and vehicles. Pharos uses measurements from Sonardyne acoustic positioning equipment, GPS receivers and gyros to position a number of vehicles, structures and ROVs at the same time. (See Fusion LBL Acoustic Navigation System Figure 2-1).

Typical survey and construction activities supported by Pharos software include:

ROV Tracking	**Seabed Surveys**
Pipeline Inspections	**Salvage Assessment**
Subsea Structure Placement	**Total Field Development**
Relocation	**Archaeological Surveys**
Seabed and Debris Searches	**Mine / Ordnance Clearance**

There are currently two versions of Pharos software, Survey and Construction. Each version uses Long Baseline (LBL) methods to track mobile transponders and transceivers. Pharos has been designed with a flexible architecture that ensures compatibility with both existing acoustic hardware platforms and Sonardyne's new generation of hardware.

Pharos has a standard Windows™ user interface that allows the operator to configure a job quickly and easily and with a minimal amount of training. Wizards are used to guide the operator through the process of transponder configuration, array calibration and data collection.

The chart displays provide the operator with real-time information on vehicle and transponder positions within the array, range lines, error ellipses and the status of measurements being used to position the vehicle. Vehicle and mobile transponder co-ordinates are calculated using an extended Kalman filter that is responsible for de-skewing and error checking each measured range. Position data can also be passed to external navigation packages in the form of real-time output telegrams.

Array Calibration

Various calibration techniques are supported for determining the absolute or relative co-ordinates of the array reference transponders. Calibration data from the various methods can be processed independently or all together in a single adjustment to determine array co-ordinates. Calibration techniques include:

- Baseline
- Box-in
- Array box-in
- Extend array

Pharos - Key Features

- Surface vessel positioning (GPS, Gyro and VRU)
- Track up to four mobile vehicles acoustically
- Supports multiple mobile Compatt tracking on a single structure
- Noise monitoring tools (RovNav 5 and Digital USBL)
- Windows user interface
- On-line Help

2.3 Fusion LBL Acoustic Navigation System

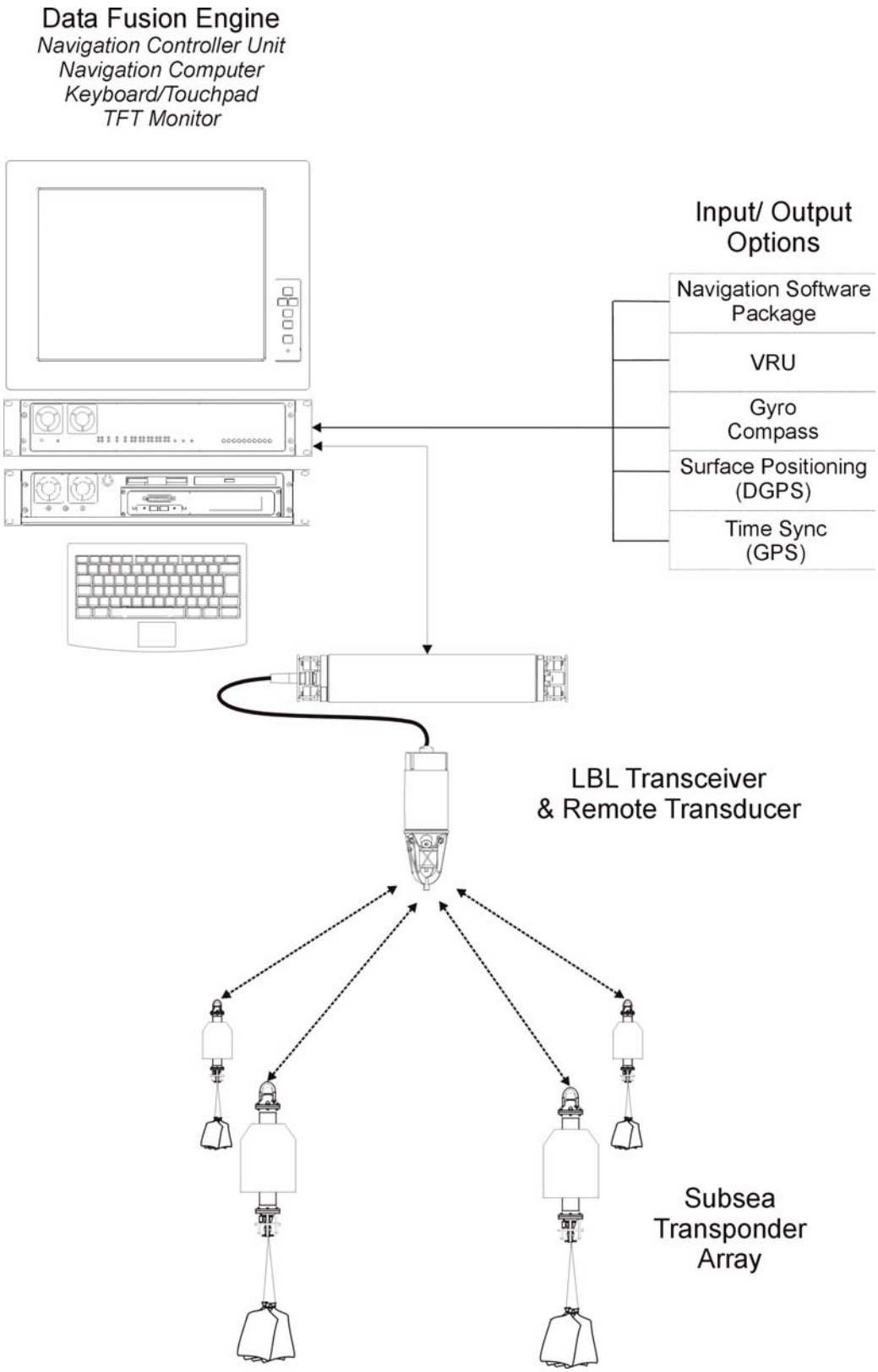


Figure 2-1 TYPICAL FUSION LBL ACOUSTIC NAVIGATION SYSTEM

2.4 Survey and Construction Versions

The following table details the major differences between Survey and Construction software versions. The differences relate to the number of vehicles that can be tracked at the same time and the number of acoustic instruments that can be attached to the same vehicle.

For a more detailed list of differences between the two versions, please contact Sonardyne.

	SURVEY	CONSTRUCTION
Arrays		
Number of EHF Arrays	1	1
Number of MF Arrays	1	1
Number of LF Arrays	1	1
Number of reference transponders in an Array	14	99*
Vehicles / Tracking		
Number of surface vehicles	2	4
Number of acoustic vehicles	2	6
Max. number of transceivers per vehicle	1	4
Max. number of transducers per vehicle	1	4
Max. number of mobile transponders per vehicle	1	4

* The maximum number of reference transponders that can be used in one positioning task is limited to the number of channels the selected transceiver is capable of receiving.

2.5 Instruments Supported by Fusion LBL

The Fusion LBL System currently supports the following instruments:

INSTRUMENT	TYPE
Digital USBL Transceiver - type 8021 and 8023 (*requires NCU*)	Transceiver
Mini RovNav	Transceiver
RovNav 5 (PAN emulation)	Transceiver
RovNav 5 (Adv) (*requires NCU*)	Transceiver
PAN	Transceiver
Mk4 RovNav	Transceiver
V6 USBL (PAN emulation)	Transceiver
Compatt 5 (Mk4 emulation mode) - Maxi, Midi and Mini	Transponder
Mk4 Compatt	Transponder
Dual Band Compatt	Transponder
UH (Underhull) Compatt	Transponder
NMEA GPS ($GGA, $GLL)	GPS
Eiva Input	Position & Heading
NMEA Heading ($HDT, $HDM)	Heading Instrument
Pisces ROV Compass	Heading Instrument
SG Brown (ASCII and binary)	Heading Instrument
Robertson SKR80/82	Heading Instrument
Syncro Gyro (*requires NCU*)	Heading Instrument
Seaeye ROV Compass	Heading Instrument
TSS 1 & 3	VRU Instrument
NMEA $PRDID	VRU Instrument
EM1000 / EM3000	VRU Instrument
Analogue VRU (*requires NCU*)	VRU Instrument
Generic Depth ($PSONDEP)	Depth Instrument
PSSIROV Depth	Depth Instrument
Seaeye Depth	Depth Instrument
RDI Workhorse (optional)	DVL Instrument
1PPS and ToD (NMEA $ZDA and Trimble UTC)	Time Synchronisation

2.6 Theory of Operation

LBL

Long-Baseline (LBL) or Range-Range acoustic navigation provides accurate position fixing over a wide area by ranging from a vessel, towed sensor or mobile transponder to three or more transponders deployed in an array at known positions on the seabed, (Fig 2-2). This type of positioning system provides accurate local control and high repeatability independent of water depth. With the range redundancy arising from three or more position lines, it is possible to make an estimation of the "quality" of each position fix. The line joining a pair of transponders is termed a "baseline". Baseline length varies with the water depth, seabed topography and frequency band being used, from more than 5 km to less than 100 metres.

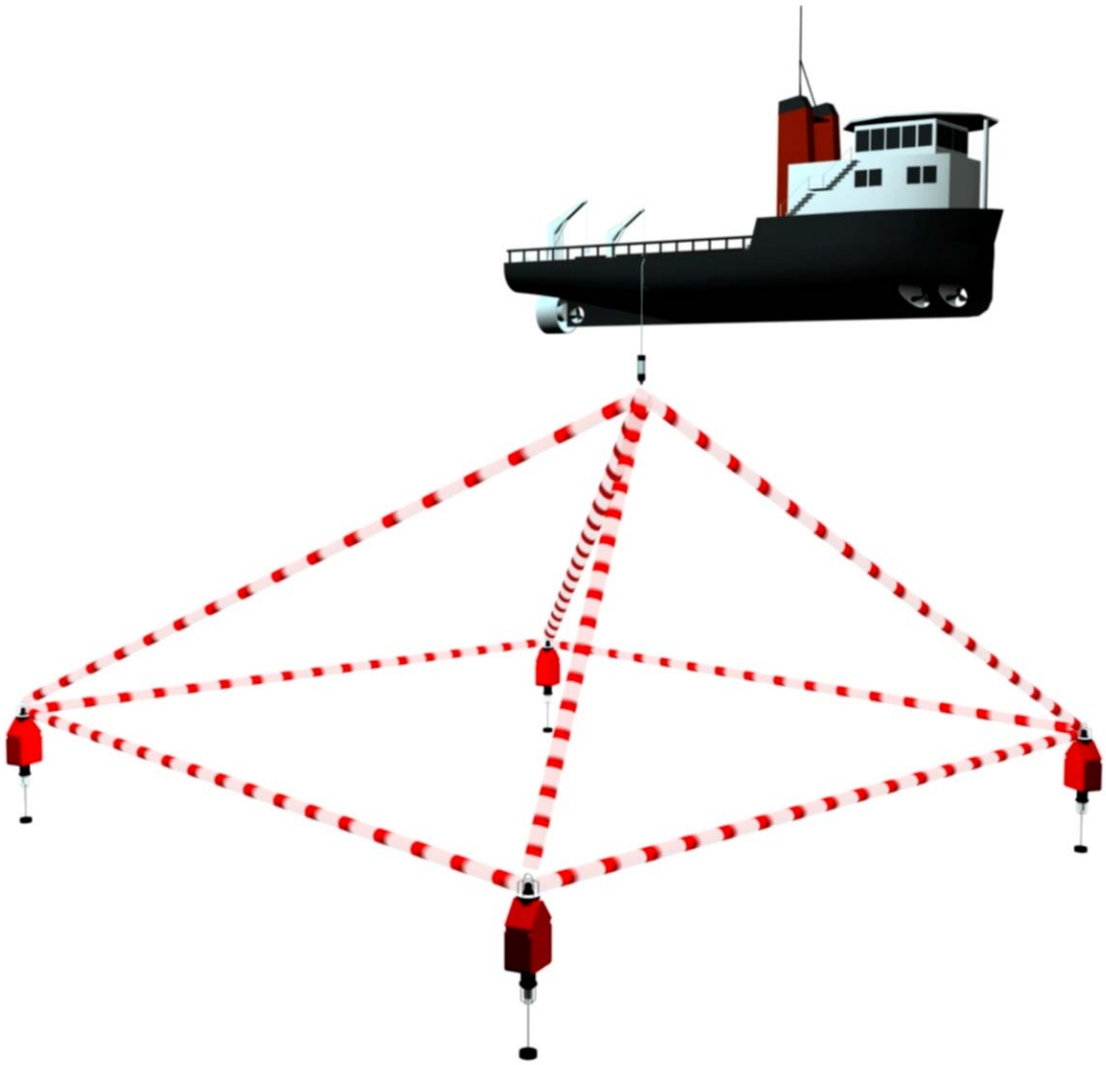


Figure 2-2 LBL Positioning Method

With LBL, three or more seabed transponders are deployed in an array around the area of interest. The array is calibrated by measuring the baselines between each of the seabed transponders in the array to determine relative co-ordinates of each transponder. Once the seabed transponder positions are known (relative or absolute), a mobile vehicle can be positioned relative to the array by interrogating all the transponders with a common interrogation

channel. All the seabed transponders reply after a fixed time delay on their individual reply channels. Using the fixed baseline lengths between the array transponders, the ranges received by the transceiver are corrected for turn-around time, two-way travel and sound speed to generate one-way ranges that are used in the best-fit position fix computation. With four or more ranges, the redundant information can be used to get a measure of consistency and therefore quality of the fix.

USBL

Ultra-Short BaseLine (USBL), or Super-Short BaseLine (SSBL) as it is sometimes referred to, is a development of the positioning techniques used in conventional Short BaseLine (SBL) systems.

With SBL, a number of acoustic transducers (at least three but typically four) are deployed to form a triangle or a square on the vessel hull. The distances between the transducers "baselines" are made as large as is practical, typically they are at least 10 metres long.

The system measures the elapsed time between an acoustic transmission from a single transducer to a transponder when all of the hull transducers receive a reply. By comparing the time differences between reception of the acoustic signals, the difference in the ranges to the individual transducers can be calculated and hence the position of the vessel computed.

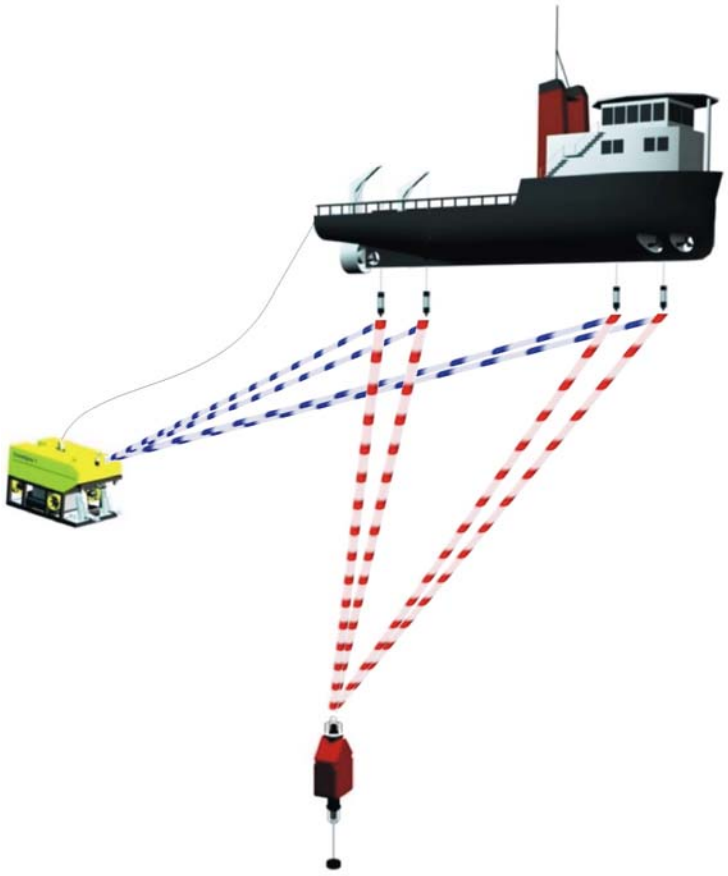


Figure 2-3 SBL Positioning Method

In a USBL system, the multiple hull transducers found in SBL systems are replaced with a single transceiver assembly that contains a dedicated transmit transducer and multiple receive transducers.

By acoustically interrogating a transponder, the transceiver is able to convert the delay until a reply is received into a range. In addition, the small differences in the time of arrival of the reply at different transducers in the transceiver array can be used to determine the direction of the source. Such small delays (microseconds) are analysed as 'time-phase' differences and this data processed to provide a best-fit solution. Because there are more than three receive transducers, the redundant information can be used to get a measure of consistency and therefore quality of the fix.

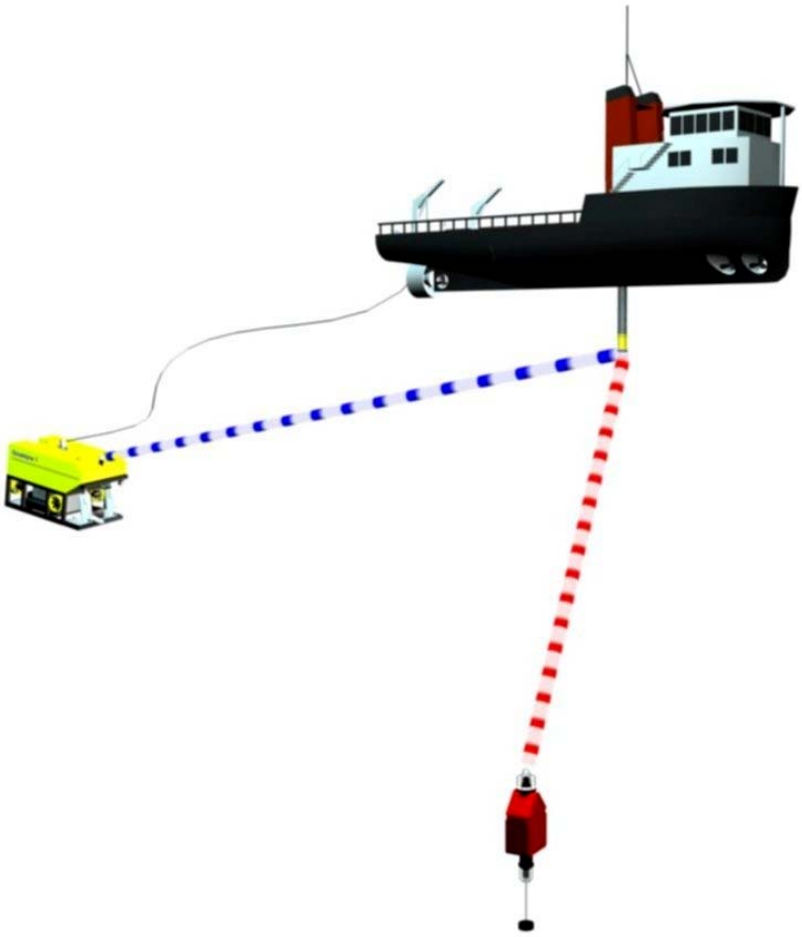


Figure 2-4 USBL Positioning Method

Although more convenient to install than an SBL system, the USBL solution is more complicated and requires careful adjustments and calibration. The stability of the acoustic data is dependent on the ambient noise and can be better than 0.2% of slant range when suitably accurate vertical reference units (VRU) and gyros are interfaced to the Navigation Controller. The overall system accuracy will be dependent in large part upon the quality of these external sensors. Sonardyne can advise on the selection and installation of appropriate systems for the measurement of vessel attitude and heading. We can also supply a custom deployment machine to permit the accurate and repeatable deployment of the USBL transducer below the hull.

3 Fusion System Hardware

3.1 Fusion Hardware

Navigation Controller

The Navigation Controller is the interface between acoustic instruments, external sensors and the Navigation Computer. In addition to accurately time stamping incoming data from external devices such as GPS, the Navigation Controller also provides power and a communications interface for ship-borne acoustic transceivers. A range of hardware cards is available for interfacing Sonardyne transceivers and different external sensors. By simply plugging these cards into the rear of the unit, the role of the Navigation Controller can be transformed from supporting simple to complex acoustic operations.

Figure 3-1 Navigation Controller

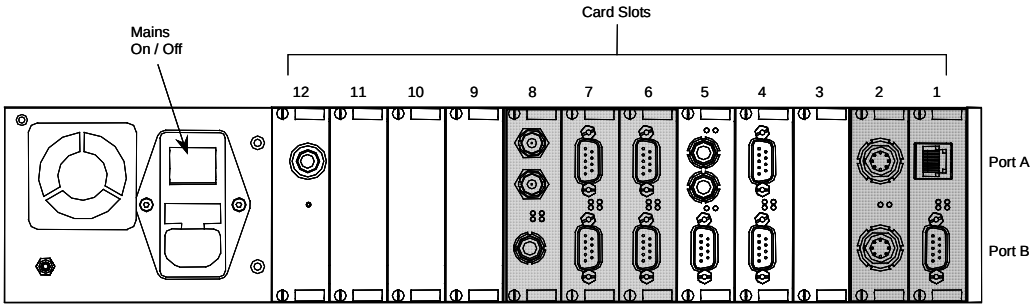


Figure 3-2 Navigation Controller Interface Cards

- Interfaces all sensors and acoustic transceivers to the outside world
- Controls the accurate time stamping required for the next generation of tracking methods
- Houses sensor specific interfaces
- Provides power and communications to acoustic transceivers
- Rack and portable configurations

Navigation Computer

The Navigation Computer is a powerful, purpose-built PC that is used in conjunction with the Navigation Controller. It has been optimised to run Sonardyne's family of Fusion LBL and Fusion USBL software applications.

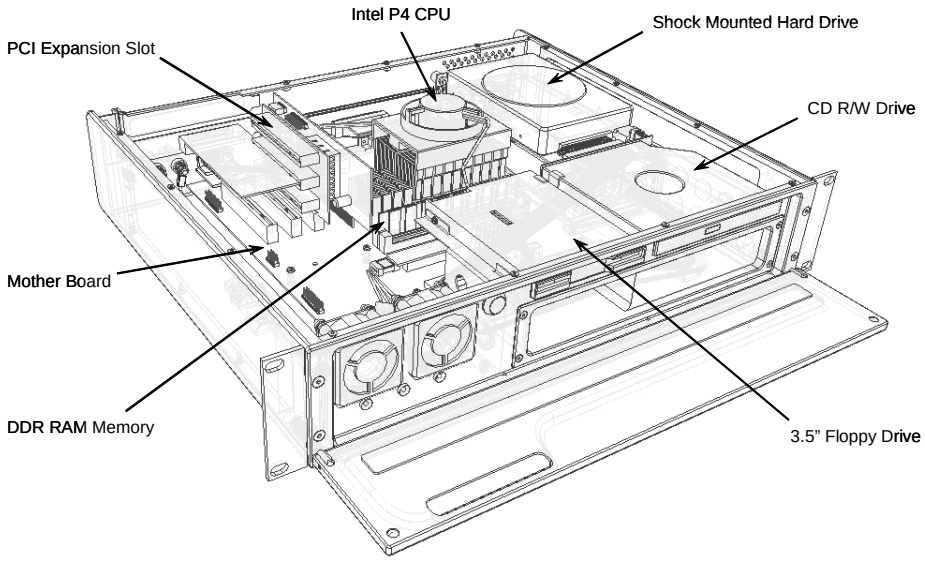


Figure 3-3 Navigation Computer

Key Features of the Navigation Computer:

- Ethernet or Serial interface to Navigation Controller
- Front mounted software key
- CD-ROM (with CD Write capabilities) and floppy drive
- Choice of TFT monitors: high brightness, touch screen, dual screen
- Rack and portable configurations
- Industrial PC to EN 60945:1997 standards

RovNav 5 Transceiver

The Type 8010 RovNav 5 transceiver is the latest Long BaseLine (LBL) transceiver from Sonardyne. Part of the Fusion family of products, the new transceiver supports the use of modern DSP, spread-spectrum signals, offering improved noise immunity, increased dynamic range and greater accuracy.

The RovNav 5 main bottle is frequency band independent allowing multiple transducers of different frequency bands (EHF, MF and LF) to be connected. The RovNav 5 can support up to four remote transducers.

Figure 3-4 RovNav 5 Transceiver with Remote Transducers

Key Features of the RovNav 5 Transceiver

- Main unit is frequency band independent allowing a choice of different transducers of different frequency band to be connected depending on type of operation, depth and vehicle
- Supports PAN command language interface
- Can be used as a responder for USBL operations (MF only)
- Remote firmware upgrade via serial interface
- Improved noise analysis

Digital USBL Transceiver

The Types 8021 (Omni-Directional) and 8023 (Directional) are the latest Ultra-Short BaseLine (USBL) transceivers from Sonardyne. Part of the Fusion family of products, the new transceivers support the use of modern DSP, spread-spectrum signals, offering improved noise immunity, increased dynamic range and greater accuracy.

Figure 3-5 Type 8023 and 8021 USBL Transceivers

Key Features of the Digital USBL Transceiver

- Choice of transceivers depending on operating environment, water depth and vessel
- Can be used as a transceivers for all LBL operations
- Remote firmware upgrade via serial interface
- Improved noise analysis
- Non-Sonardyne frequencies supported
- Future-orientated design yet backwards compatible
    - Broadband ranging
    - Broadband telemetry

4 System Requirements

The following section details the minimum and recommended system requirements if the Pharos software is to be installed as a stand-alone software system, i.e. not part of a Sonardyne supplied Fusion LBL system.

4.1 Hardware Requirements

The minimum PC specification needed to run Pharos successfully is as follows:

- Pentium 3 450MHz processor
- 128 MB of RAM
- Monitor (minimum 1024 x 768)
- Graphics Card 16-Bit colour at 1024 x 768
- CD-ROM drive
- 10 GB hard disk
- Parallel port
- Minimum 3 serial ports

The recommended PC specification is as follows:

- Pentium 4 2.0GHz processor
- 512 MB of RAM
- 17” monitor (minimum 1024 x 768)
- Graphics Card 32-Bit colour at 1024 x 768
- CD-ROM drive (read / write)
- 60 GB hard disk
- Parallel port
- Minimum 6 serial ports

4.2 Software Requirements

- Windows 2000 (Service Pack 2 or higher) or Windows XP (Service Pack 2 or higher)
- Microsoft Internet Explorer 5.0 (or higher)
- Microsoft Access (desirable)

5 Installing Pharos Software

All Fusion LBL systems are shipped from the factory with the Pharos software pre-installed. The following instructions should only be followed when installing a new version of the software supplied by Sonardyne or re-installation of the originally supplied version is required.

To Install Pharos Software in Windows XP.

Before Pharos software can be installed, any previous versions of the application must be uninstalled from the Navigation Computer. The latest version of the installer provides an automatic mechanism for identifying and uninstalling previous Pharos software installations. It is recommended that both Pharos software and the Data Logger component are uninstalled before installing a new Pharos software version.

1. Read the release notes included with the software.
2. Quit all applications in Windows XP.
3. Insert the Pharos (or Fusion LBL) software CD into your CD-ROM drive.
4. The CD's installation routine should start automatically. If it does not, click **Start** on the taskbar and then click **Run**. Type D:\Setup.exe (Replace D with your CD-ROM drive's letter if it is different).
5. Follow the set-up instructions. You will be prompted to select the set-up type.
   - Typical – This will install the most common options. Recommended for most users.
   - Compact – The program will be installed with the minimum required options. Use this option when available disk space is low.
   - Custom – You may choose the options to install. Only recommended for advanced users.
6. Restart the PC **if** prompted.

A Pharos or Fusion LBL software icon 

will now be visible on the desktop.

Note: The installer will automatically determine which prerequisite components need to be installed. Depending on the component, the Navigation Computer may need to be rebooted in order to continue with the next stage of the installation. For the latest information relating to the installation process refer to the Release Notes.

Security Key

The supplied security key should not be used in parallel or 'piggy backed' with other security keys from other applications or manufacturers at the same time. Always ensure that the Pharos or Fusion LBL software security key is the only key attached to either parallel port (front or back) on the Navigation Computer or operator supplied computer.

6 Desktop Overview

The key elements of the Pharos desktop are indicated below. The following section introduces the main features.

6.1 System Displays

The Pharos software desktop is made up of a number of displays which provide real-time information such as position, range lines, error ellipse and the status of measurements being used to position a vehicle or vehicles.

The following section introduces the key features of the Pharos software desktop.

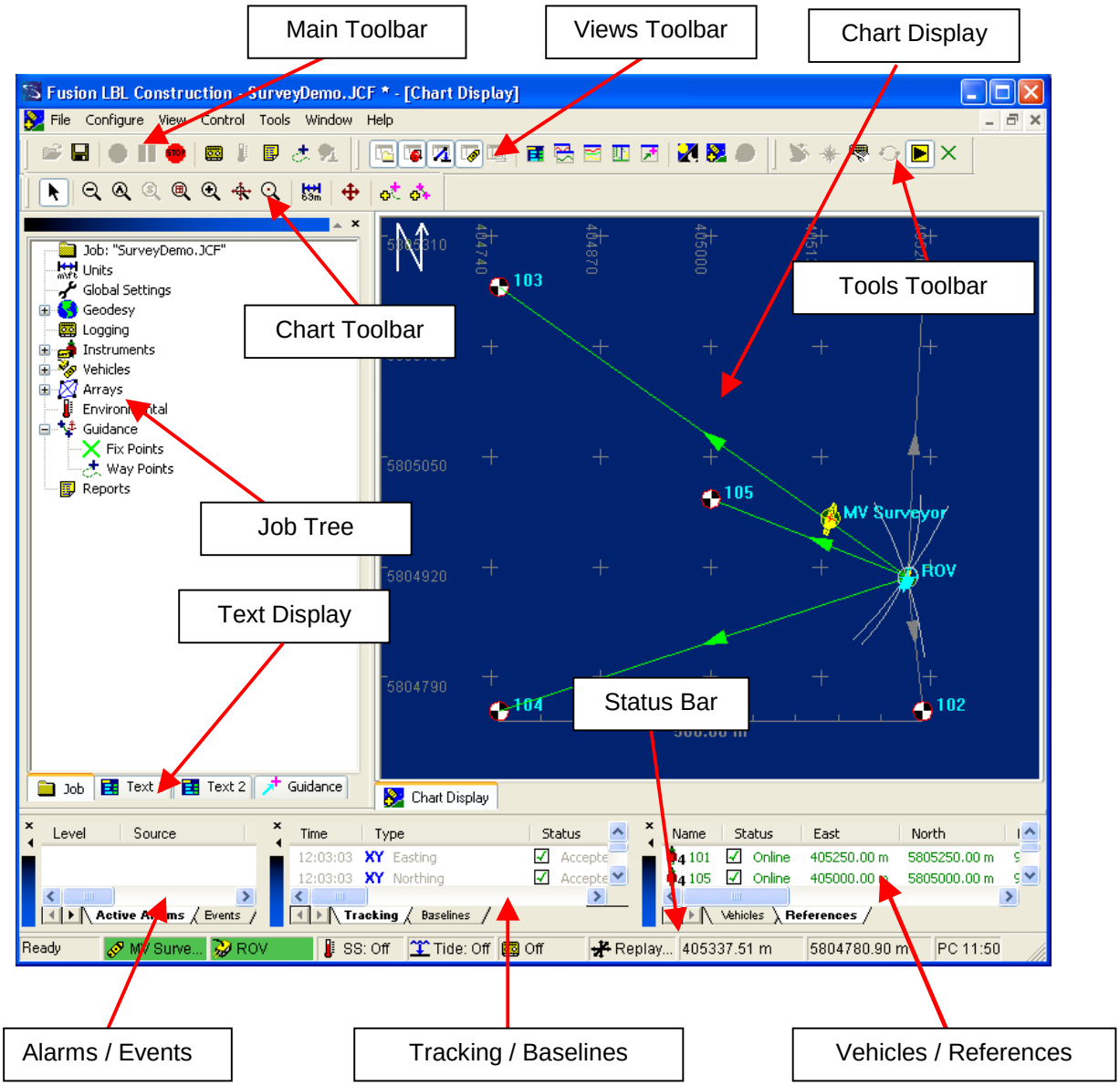
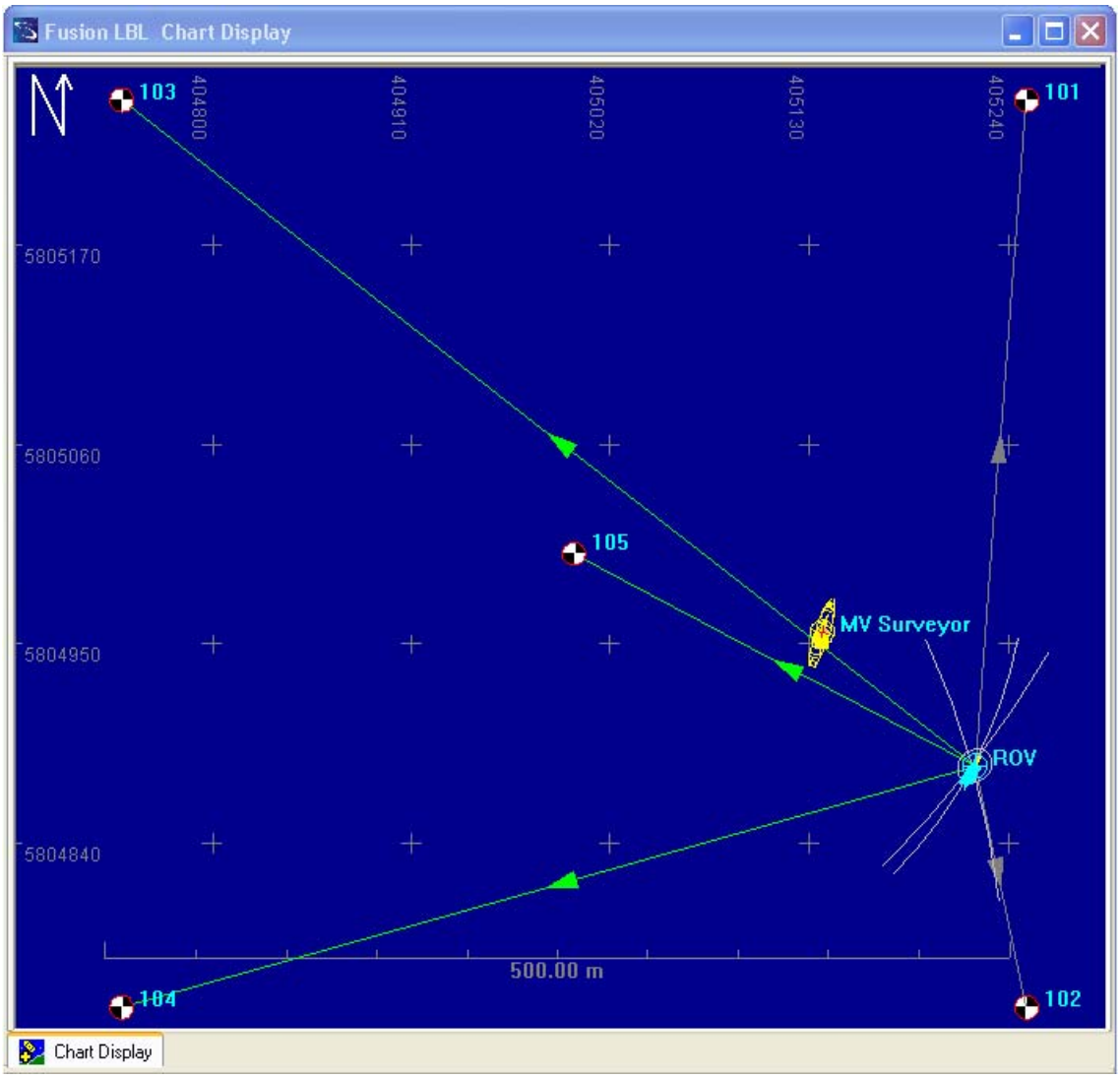


CHART DISPLAY

The Chart display shows the position of all surface vessels, mobile vehicles, reference transponders and waypoints in a Cartesian format. The chart can be configured by right clicking with the mouse cursor anywhere on the chart and selecting *Configure Chart* from the pop-up menu. The properties of any component displayed on the Chart (vehicles, reference transponders etc.) can be easily accessed by double clicking on the component.

The Chart Display appears by default and multiple displays can be created and displayed at the same time via the **Window** menu or the Chart Toolbar.



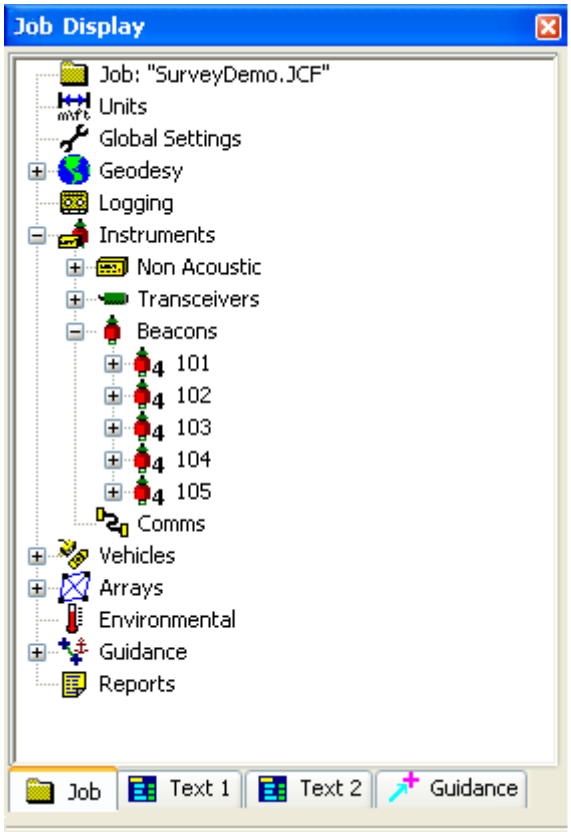
JOB TREE, TEXT AND GUIDANCE DISPLAYS

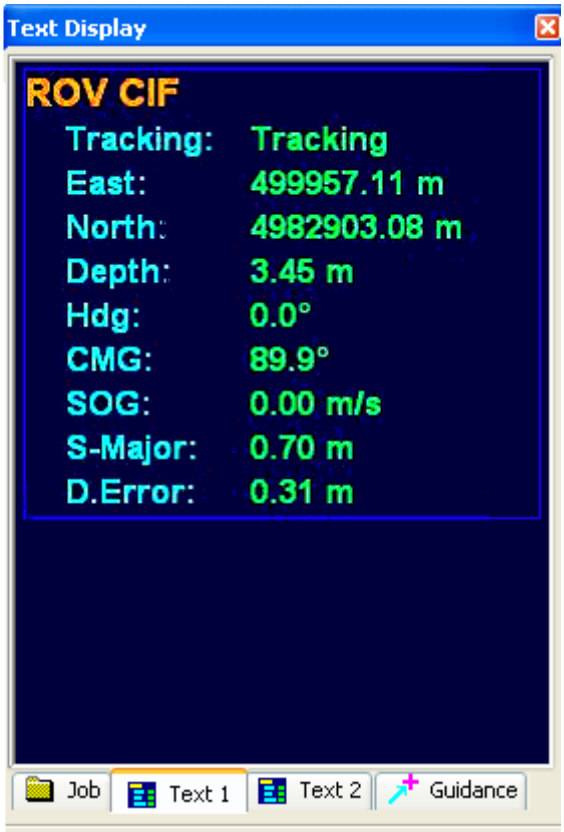
The Job Display consists of three elements - the Job Tree, two configurable Text Display tabs and a Guidance tab. The operator can switch between any of the display types using the tabs at the bottom of the display.

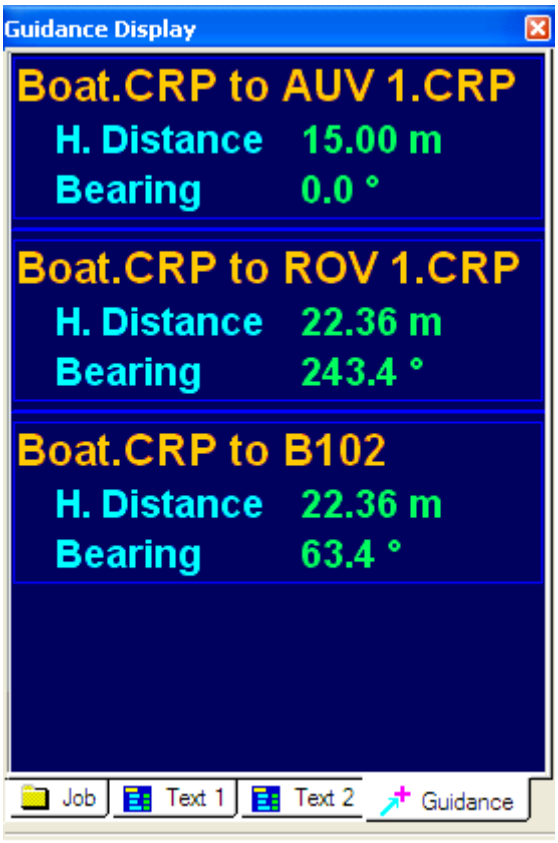
The Job Tree displays the current configuration of the system. Some Job Tree items have additional 'branches' that can be accessed by clicking on the cross symbol. The order of items in the Job Tree is the order in which the system should be configured.

The Job Tree Text displays allow the display of operator selectable properties for the system and vehicles in the current job. They are designed to display information that can change during tracking rather than semi-permanent properties within instruments.

The Job Tree Guidance display allows the display of operator selectable guidance information between any vehicle / offset to vehicle / offset or waypoint combination. The guidance information is provided to assist the operator in navigating a vehicle to another vehicle or known waypoint and is updated each navigation cycle.



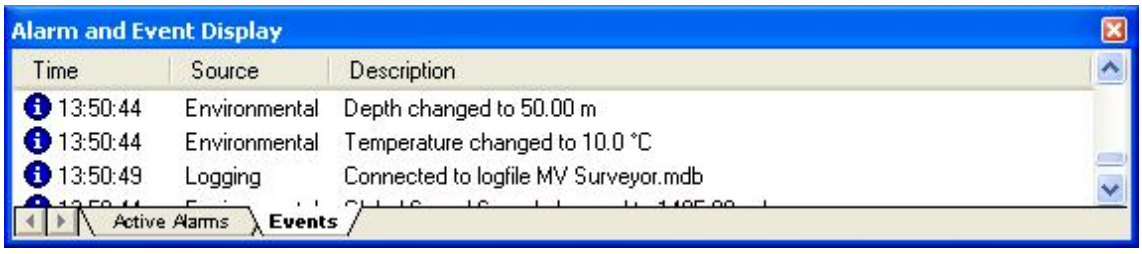




ALARMS / EVENTS DISPLAY

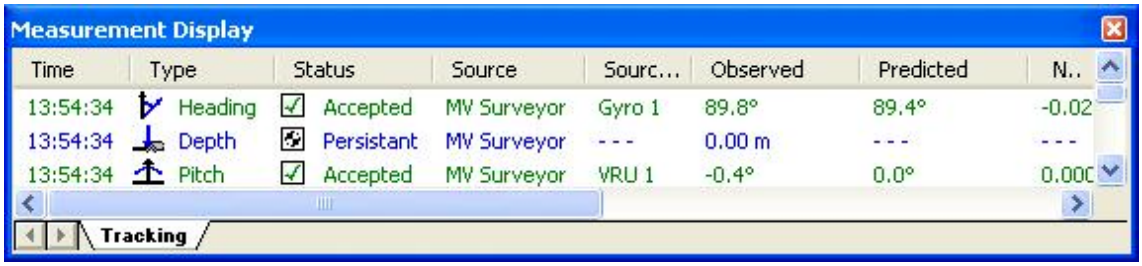
The Active Alarms list shows alarms that have been generated by the program, which require the attention from the operator. The Events display lists those events that have occurred within the program, including operator initiated events. Events are used to show what the program is doing.

The operator can control the number of active alarms and events that are kept and also manually clear the list at any time.



TRACKING

The Measurements list shows the raw and estimated values and the quality of each measurement being used for tracking vehicles as they are received. Co-ordinates are calculated using a mathematical optimal estimator which allows for the weight of predicted and measured positions to be set depending on vehicle dynamics. The appropriate quality information is also displayed.



VEHICLES / REFERENCES

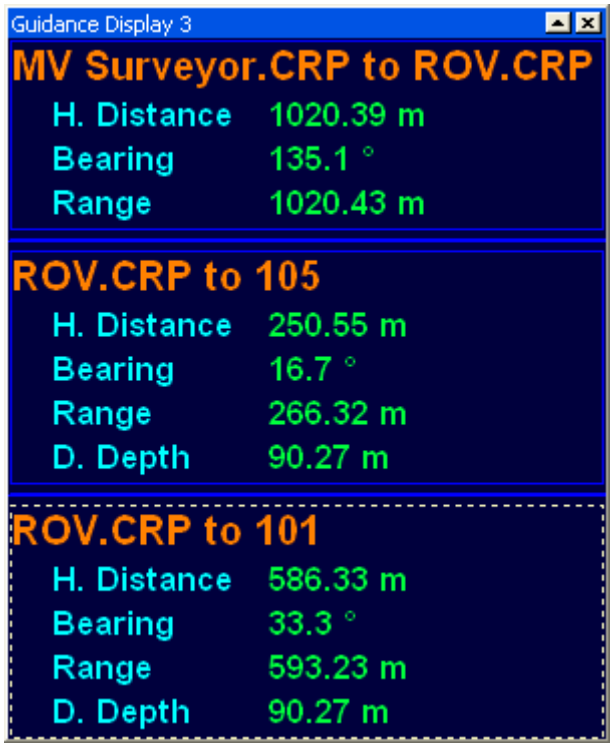
The Vehicles and References lists show the position and status for each vehicle (surface vessel and mobile vehicles) and the reference transponders used in tracking.

6.2 Configurable Displays

There are various optional display types available to the operator that can be configured to display different information in either a graphical or textual form.

FLOATING GUIDANCE DISPLAY

The Floating Guidance displays provide operator selected navigational information from a selected vehicle / offset combination to another vehicle / offset or waypoint during tracking. The operator can select what and how data is to be displayed. Configuration options include; font style and size, label and data colour, background colour and label text.

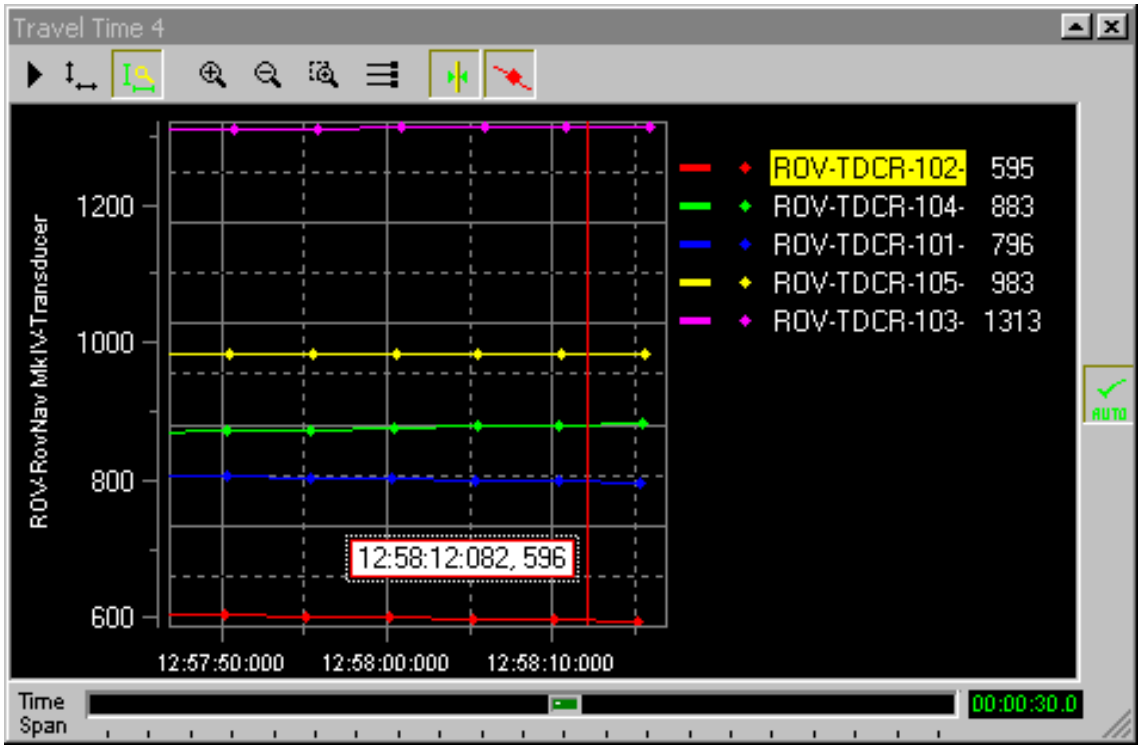


FLOATING TEXT DISPLAYS

The Floating Text displays show operator selected properties for the system and vehicles in the current job. The operator can select what and how data is to be displayed. Configuration options include; font style and size, label and data colour, background colour and label text.

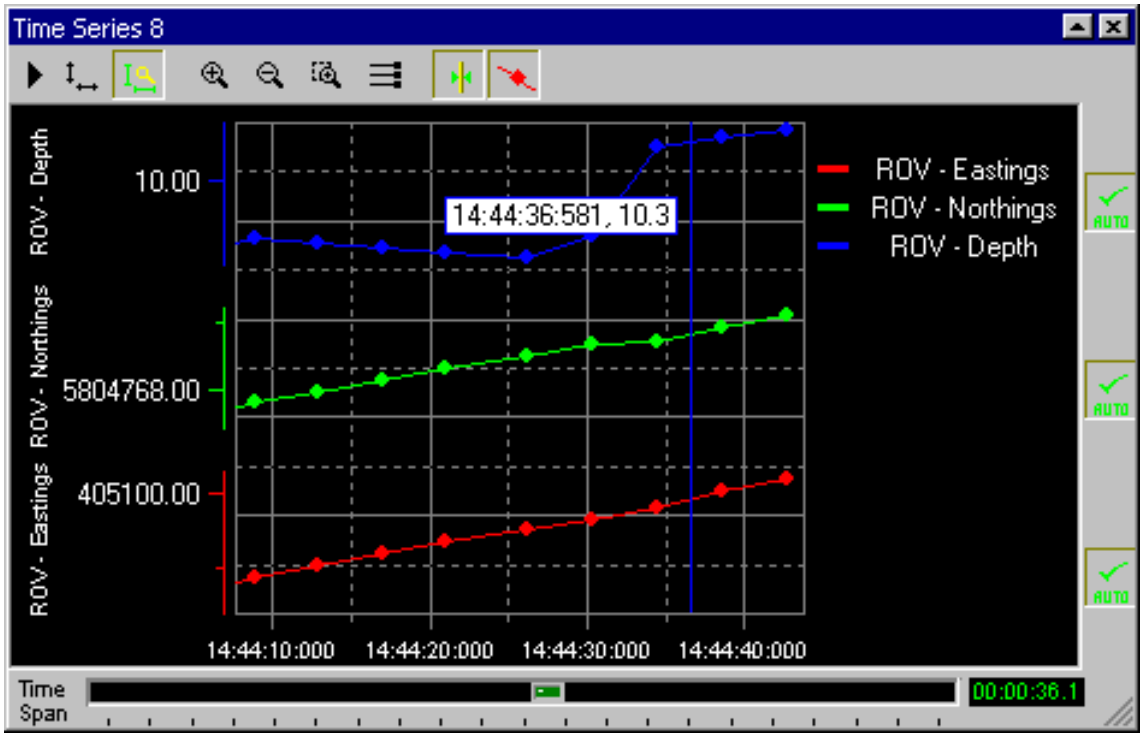
TRAVEL TIME DISPLAY

The Travel Time display is a real-time display that shows raw acoustic ranges from mobile and reference transponders to a selected transceiver on a vehicle. The display provides a graphical view of the time between the transmission of the interrogation pulse and the reception of the reply pulse. This information can be used to highlight a pulse overlap situation thereby assisting the operator with decisions on any transponder Turn-Around Time (TAT) changes that should be made before a problem occurs.



TIMES SERIES DISPLAY

The configurable Time Series display shows the operator selectable values for the system and vehicles in the current job. It is designed to display information that can change during tracking over time such as position and attitude.



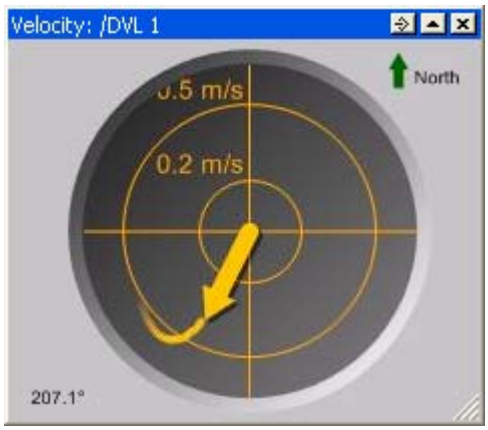
6.3 Instrument Displays

Various instrument-specific displays are available for heading, VRU and DVL instruments. These displays can be accessed directly from the specific Instrument Properties page or by right mouse clicking on the instrument in the Job Tree and selecting *Show Display* from the pop-up menu.

HEADING DISPLAY

VRU DISPLAY

DVL VELOCITY DISPLAY



6.4 Toolbars

MAIN

Provides access to a number of job related tasks.

Button	Function
	Open existing job
	Save current job
	Start Tracking Wizard
	Pauses tracking
	Stop tracking or replay
	Configure logging parameters
	Configure environmental parameters (sound speed & tide)
	Configure real-time Reports
	Configure waypoint parameters
	Start Measurement Only Updates Wizard

VIEWS

Allows a number of displays showing current job information to be displayed.

Button	Function
	Shows or hides the Job Display
	Shows or hides the Alarms and Events Display
	Shows or hides the Measurements Display
	Shows or hides the Vehicles / References Display

Button	Function
	Display Manual Depth / Headings Display
	Opens Text Display Editor where user selectable properties for the system and vehicles in the current job can be displayed
	Opens Time Series Plot Editor, which allows single data items (Northing, Easting, gyro, roll etc.) to be displayed on a time series plot
	Opens Travel Time Display Editor. The display provides a graphical display of how long ranges are taking to be transmitted and received from a selected transceiver during tracking
	Opens Differential Depth Display Editor where depths from different digiquartz and external depth inputs can be monitored from a selected reference depth
	Opens Guidance Display Editor, which allows navigation information between a vehicle and another vehicle or waypoint to be displayed textually
	Toggles between night and day display settings
	Creates a new Chart display
	Creates a new Radar Display (USBL versions only)

CHART

Gives access to a number of chart operations such as zoom or adding waypoints.

Button	Function
	Selects chart items / components
	Zooms out the current chart
	Zooms in the chart keeping all references and vehicles visible
	Zooms the selected vehicles and references on the chart keeping all selected references and vehicles in view
	Zooms in to a defined area of the chart. Click on a point on the chart and drag the zoom rectangle over the area required
	Zooms in the current chart

Button	Function
	Pans the chart. Click on chart and drag point to new position
	Re-centres the chart. Click on chart to set the centre point
	Runs the Measurement Tool to measure the distance and bearing between two user-defined points
	Moves selected vehicles or references
	Adds a waypoint. Click on chart to place way-point
	Adds a runline. Drag a line between two existing way-points

TOOLS

Gives access to a number of commonly used tools and utilities such as the Calibration Wizard and Replay.

Button	Function
	Start Calibration Wizard
	Opens the Average Fix dialog
	Opens the Manual Command Tool dialog
	Opens the Range Test Tool dialog
	Opens the Replay dialog
	Opens the Fixpoints dialog

FIX TOOL BAR

This toolbar is used to take position fixes of the selected vehicle or provide an average fix via the Average Fix Tool.

6.5 Status Bar

STATUS BAR

Displays the operating state of the program and the tracking status of each vehicle. It also shows if automatic environmental updates are active as well as the current position of the cursor on the chart and current application time. Individual vehicle, environmental and logging properties can be accessed by double clicking on the required status boxes. Double clicking on the Tracking status box can also access the Tracking Wizard.

Quick access to a vehicle's *Dynamics* and *Selected References* settings can be made by right mouse clicking over the required vehicle's status box and selecting the appropriate option from the pop-up menu.

7 Application Procedures

7.1 Introduction

These notes summarise the required procedures for both the initial configuration and setting up of Pharos software and the execution of a typical LBL array calibration task and positioning tasks. They should be read in conjunction with the context-sensitive online help for more detailed explanation of configuration options and settings.

All procedures assume that the system hardware has been installed correctly and that the transceivers, transponders and other positioning instruments (LBL transceiver, GPS, Gyro and VRU) required for the job have been deployed, calibrated and correctly configured.

7.2 Starting and Running Pharos Software

By default, Pharos software will start automatically when the Navigation Computer (or operator supplied computer) is powered-up or restarted.

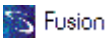
Note: The automatic starting option is configurable during the installation process.

If the Pharos software does not start automatically, proceed as follows.

To Start Pharos Software:

1. Ensure that the security key supplied with your Pharos software is attached to either parallel port (front or back) of the Navigation Computer.
2. Double click the Pharos software icon 

on the desktop to start Pharos software. If the icon is not present:

   - Select **Programs** from the **Start** menu on the taskbar.
   - Select the Sonardyne then Pharos directory.
   - Click Pharos 

to start the program. Alternatively, select the Pharos software program from the default installation location:

     C:\Program Files\Sonardyne\Pharos\System

To Quit Pharos Software:

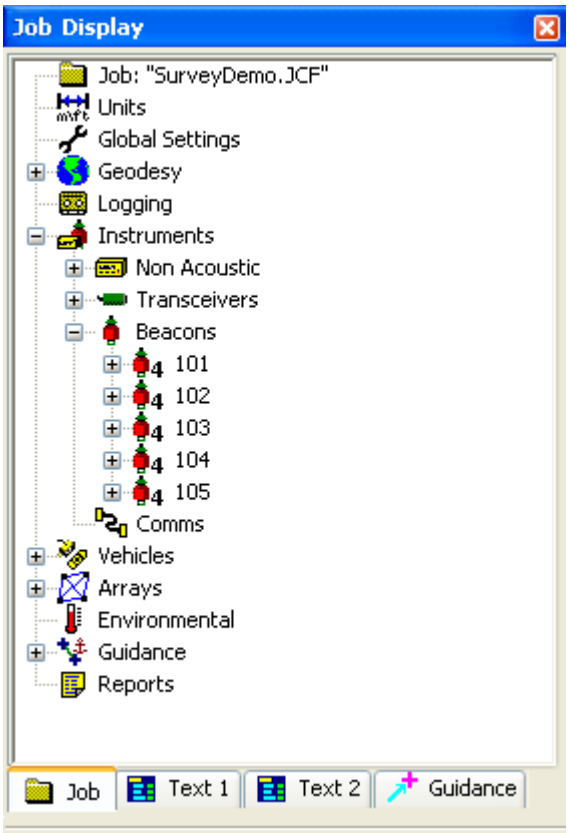
1. Save the current job in Pharos software by clicking **Save Job** on the **File** menu.
2. Click **Exit** on the **File** menu to quit Pharos software.

Initial System Configuration Procedures:

The following list details the procedures to be carried out in order to configure the Pharos system for tracking operations.

- Use the **New Job** option in the **File** menu to create a new Job Configuration File (JCF). Alternatively, use the **Open Job** option in the **File** menu to load an existing job configuration file.
- Use the Job Set-up Wizard or Job Tree to configure the following:
  - Job Information - Project folder and JCF name and description
  - Units - Set required display units for co-ordinates, depth and distance
  - Global Settings - Ensure that appropriate values for latitude, water density, gravity and atmospheric pressure fields are set in the Constants tab if a digiquartz depth sensor is to be used
  - Geodesy - Select required ellipsoid and projection parameters. System defaults to WGS84 datum and UTM projection

  Note: The Job Tree has been arranged such that options should be configured in the order in which they appear in the tree - start at the top and work downwards.



- Logging - Enter the log file name and folder location. Confirm that the *"Automatically change log files during tracking"* option is enabled on the **Advanced** tab.
  Note: Logging is automatic and always set to 'on'.

- Instruments / Non Acoustic - Create and configure a NCU instrument if you are using a Fusion LBL system and the LBL transceiver will be powered by the NCU.

  Note: The NCU should always be connected to Com 1 on the Navigation Computer.

- Instruments / Non-Acoustic - Create and configure GPS, heading and VRU instruments if they are to be interfaced to the system. Be sure to set the following:
    - Correct Comm port and parameters (baud rate etc.)
    - Correct instrument options (e.g. NMEA GPS - GGA or GLL, NMEA Heading - HDT or HDM)

- Instruments / LBL Transceiver – Create and configure a LBL transceiver. The transceiver may be installed on the surface vessel, e.g. PAN, or directly on the ROV as in the case of a RovNav 5 or Mini RovNav. Be sure to set the following:
    - Correct frequency band - EHF, MF or LF
    - Maximum range (always allow for 10-20% more than the required tracking slant range from the surface vehicle)
    - Transmit power and receive gain
    - Depth sensor type and range

- Instruments / Beacons - Create and configure all the Compatt beacons that are going to be deployed as reference transponders in the seabed array and those that are going to be tracked (simultaneous or fast simultaneous). Be sure to set the following:
    - Compatt name - once the instrument is created the name cannot be edited.

      Hint: As a starting point, use the Compatt address as the name of the instrument
    - Frequency band
    - Compatt address (defaults to 101 but will be set automatically if the Compatt name includes a valid address)
    - Transducer type
    - Depth sensor type and rating (defaults to 1350m rated strain gauge)
    - Additional Compatt sensors - inclinometer, salinity sensor etc.
    - Telemetry transceiver

- Create and Configure Vehicles.

  Note: By default, when a new job is created a surface vessel called 'Boat' and ROV vehicle called 'ROV' are created automatically.
    - General - Add, rename or delete vehicles as required. Enter the initial position and depth, if known, and uncheck the *"Auto set initial position"* box.

      Note: Select the appropriate vehicle type for the target to be tracked. Each vehicle type is associated with defined dynamics characteristics within the program.
    - Instruments / Offsets – Add the GPS, heading and VRU (optional) instruments as required to the surface vehicle(s). If the LBL transceiver is to be mounted on the surface vessel then it should be added as required. Ensure that the correct offsets for each instrument or sensor are entered. Add the transceiver or Compatt beacon instrument to the ROV or target vehicle
    - Positioning - Set required position update rate and measurement source for heading and depth (if required)
    - Chart - Select or create new shape for the Chart display for each vehicle. Set snail trail limits and other chart display options as required

-  Arrays - Create an array. By default, an array called 'Seabed' is automatically created when a new job is created. Add the Compatts that are available for deployment as reference transponders to the list in the **Array** dialog. Be sure to set the following:
    - Approximate co-ordinates (East, North and depth) for each of the references. This can be done graphically via the Chart display (move tool) or via the **General** tab on the Compatt Properties dialog by double clicking on each Compatt in the Array dialog.

      Note: Ensure that the *"Is Calibrated"* checkbox is disabled
    - Telemetry transceiver

  Note: Only one array can be created for each frequency band (low, medium or extra-high)

-  Environmental - Set the global sound speed value. Alternatively if you have a sound speed profile then this should be imported via the Sound Speed Profile Wizard.

Before we can commence tracking operations, we have to deploy and calibrate the array Compatts - see section 7.3. If the array Compatts are to be deployed in frames which have been previously calibrated, then these co-ordinates need to be entered for each reference and the *"Is Calibrated*" flag checked. We are now ready to set the system up for tracking - see section 7.4.

Once this initial set-up procedure has been completed, the system configuration can be saved to the job file. The most recent job will start automatically when the Pharos software is started.

More detailed information on these procedures are available in the Pharos Online Help which can be accessed from the Help menu in Pharos software.

7.3 Array Calibration

To be able to track with an LBL system, the baselines between the reference transponders must be either measured or calculated based on the position of the deployed transponders.

There are various ways in which an LBL array can be calibrated. The calibration method(s) used can be dependent on various factors. These include:

- Water depth
- Frequency band in use
- Transceiver type available
- Surface vessel type and manoeuvrability
- Required array positioning accuracy
- Array size (dimension)
- Number of Compatts in the array

The most common method of calibrating an array is to measure all the baselines between the reference transponders in both directions to determine the relative size and shape of the array. The result is a relative calibrated array. If absolute (real-world) co-ordinates are required, then the next step is to box-in two or more of the Compatts to determine the absolute position and orientation of the array whilst holding the relative size and shape.

Pharos allows data from various calibration types and sessions to be processed in a single adjustment, thereby giving the operator greater flexibility.

Pharos supports the following calibration types:

Baseline Calibration

Range measurements are made between each of the seabed references and recorded for later processing.

Box-in

Surface positions and acoustic ranges are combined to compute the position of a single reference.

Array Box-in

Surface positions and acoustic ranges are combined to compute the position of multiple references simultaneously.

To help the operator run through all the stages required to calibrate an array, Pharos has a Calibration Wizard tool that provides a step-by-step guide starting with planning, configuration set-up, data collection and then ending with data processing.

Two typical calibration scenarios are considered:

- Baseline Calibration

  In this scenario, the Pharos software is required to set-up and collect baseline measurements between each of the array transponders. The data is then processed via a least squares adjustment to determine the optimum relative array co-ordinates.

- Box-in Calibration

  In this scenario, the Pharos software is required to determine the absolute co-ordinates of a single reference transponder. The computed position and associated position error is then used with the Baseline data to determine absolute co-ordinates for the array. Generally, a minimum of two reference transponders within an array are 'box-in' so as to provide absolute position and orientation for the array. A third transponder can be boxed-in as a check.

The following sections outline how to use the software to complete these calibration tasks. Additional detailed information on configuration options is also contained in the On-line Help files.

7.3.1 Baseline Calibration

It is assumed that the initial job configuration has been completed as detailed in section 7.2 above and that the seabed array has been deployed and that the Compatts have been assigned to an array as references. Approximate or drop co-ordinates for the references should have also been determined and entered into the system.

Calibration Planning

1. Double-click the Calibration Wizard icon  on the *Tools* toolbar or select Calibration Wizard from the Tools menu. The Introduction page of the Calibration Wizard appears. Click **Next >** to continue.

2. Next select the *"Plan an Array Calibration"* option. Click **Next >**. Note: If you have not created an array and assigned references to it at this stage, you cannot continue past this point. Cancel out of the Calibration Wizard and create an array as detailed in section 7.2.

3. Select the *"Baseline Calibration"* option. Click **Next >**.

4. If you have more than one array, select the array to be calibrated from the *"Array"* drop down list. Also ensure that the reference transponders to be calibrated are listed in the *"Selected References"* box on the right hand side. Click **Next >**.

5. All the selected reference transponders to be calibrated are displayed graphically. By default, all baseline combinations between the references are displayed. Use the tools in this page to:

   - Add / remove baselines graphically
   - Select baselines to measure based on maximum range or to the nearest 'n' references
   - Set the number of measurements to be made in each direction. By default this is set to 10.

   Note: This page can be resized by dragging the lower right side of the dialog. There are also various controls for zooming, panning etc.

   Click **Next >** to continue.

6. Set the environmental options to be used during data collection. Set the *"Global Sound Speed"* type to be used (global value, measure or sound speed profile). Also set *"Tidal Updates"* if required.

   Note: The sound speed value associated with each baseline measured can be edited during post processing if the incorrect value is entered at this stage.

   Click **Next >** to continue.

7. Modify the calibration file (*.mdb) and folder location as required. By default the calibration file name will include the name of the Job Configuration File (JCF), the type of calibration file and the date / time that the file was created. Enter a description in the *"Description"* file as required. Click **Next >** to continue.

8. A report of the calibration configuration can be saved or printed out as required. There are various printing options including text (*.txt) and HTML. Click **Next >** to continue.

9. This is the end of the Planning Phase of the Calibration Wizard. You can either finish at this point or return to the Calibration Wizard at a later stage, or continue to the data collection phase by clicking **Next >**.

Collect Measurements

10. Select the *"Collect Measurements"* option. Click **Next >** to continue.

11. Select the calibration file that the measurements will be stored to. By default the Calibration Wizard will remember the last calibration file was created during the planning phase. Click **Next >** to continue.

12. Select and configure the LBL transceiver that will be used to collect the baseline measurements. If the status of the transceiver is indicated as *"Not Set*", then use the **Quick Set** or **Full Set** buttons to initialise the transceiver. Click **Next >** to continue.

    Note: Full Set makes no assumptions about the instrument's status and sends all the required configuration commands to determine the status. **Quick Set** sends only those commands that are necessary based on the program's knowledge of the current instrument settings.

13. Check the status of all the reference transponders. The Calibration Wizard will identify any individual interrogate (IIF) channel conflicts as well as turn-around time (TAT) duplications and other inappropriate power and gain settings. Use the **Full Set** or **Quick Set** buttons to obtain the status of any of the references that have been identified as *"Unknown"* or *"Not Set"*. Select **Next >** when complete.

    Note: Explanatory notes appear at the bottom of the dialog for transponders identified as *"Not Set"*.

14. Measure the depths of all the reference transponders using the **Get Depths** button. Any depths measured here can be used during data processing to improve the calibration result. You can opt to measure none, one or all the transponder depths. Select **Next >** when complete.

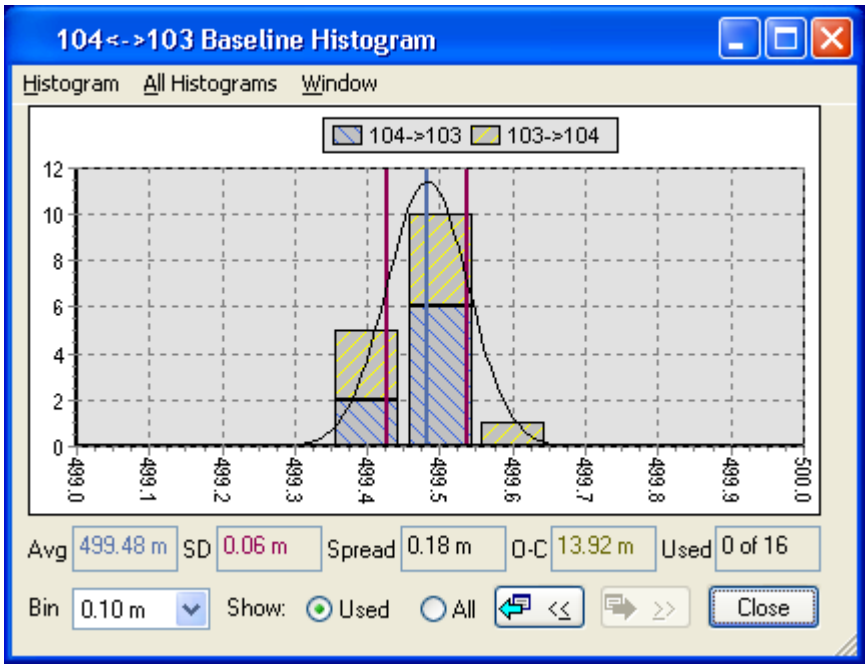
15. A message dialog appears indicating that you are about to start collecting baseline measurements. Select **Next >** to continue.

16. The Calibration Wizard dialog will disappear and you will be presented with the Baseline Calibration Toolbar. The Chart display will show all the select array transponders as well as the baselines to be measured. To start the baseline collection process, click the Go  icon on the Baseline Calibration toolbar.

    The Baseline Calibration toolbar will indicate the current baseline combination that is being measured and how many measurements that have been made so far. It will also indicate the overall progress for the total number of baselines to be measured.

The Chart display indicates which baseline is currently being measured and the quality of measurement (red = failed, green = OK).

The baseline measurements are displayed in the Measurement display as they are collected. The baseline measurements can be viewed graphically via the Histogram display by clicking the Histogram icon on the Baseline Calibration toolbar.



The data collection process can be paused at any time by clicking the Pause icon.

17. Once all the baselines have been measured, click the Calibration Wizard icon to return to the Calibration Wizard.

18. A message dialog appears indicating that the data collection process is now complete. This is the end of the data collection phase of the Calibration Wizard. You can choose finish at this point and return to the Calibration Wizard at a later stage to process the data, or continue to the data processing phase by clicking **Next >**.

Data Processing

19. Select the *"Compute Positions"* option. Click **Next >** to continue.

20. A message dialog appears indicating that you are about to start computing Reference Positions from the baseline measurements. Select **Next >** to continue.

21. Select the baseline calibration file (*.mdb) that you want to process. Note that multiple calibration files can be selected and loaded at the same time. Use the **Add** button to add the selected the calibration file (or files) to be included in the adjustment. Select **OK** to continue.

22. The Calibration Wizard dialog will disappear and each of the selected files will be loaded into the Calibration Processing tool. Once the files have been loaded, you will be presented with the Baseline Calibration Toolbar.

    Options available via the Calibration Processing toolbar include:

Button	Function
	Histograms - Use the Histograms to view all the baseline measurements between two transponders. Measurements from opposite directions are displayed in different colours. Use the vertical sliders at each end of the display to exclude measurements from the adjustment
	Open Files - Select additional calibration files to be included in the adjustment
	Manual Measurements - Use this tool to manually add two-way range (ms), distance, depth and position observations into the adjustment. You can also import computed Box-in positions from an exported CSV file
	Processing Options - Use the Processing Options tool to control the error applied to artificial depths and to export computed position or measurements to a CSV file
	Auto-rejection - Toggle auto-rejection on / off (defaults to off)
	Compute Reference Position - starts the least squares adjustment
	Calibration Report - Generate a calibration report which can be printed or saved as a text (*.txt) or HTML file
	Save New Calibration File - Save all the measurement data currently loaded into a new Calibration file
	Expand toolbar - Expand the Processing toolbar to view how the different measurement types were used in the adjustment. Indicates the number of measurements that are available, accepted, manually rejected, auto rejected or not used in the adjustment

23. The data logged during the data collection phase appears in the Measurement display. The sound speed, measurement error and turn-around time of individual or multiple selected observations can be edited prior to an adjustment.

24. When you are happy with the adjustment and resultant computed reference positions, click the Finish button  icon in the processing toolbar. Upon selecting this button, you will be asked whether you want to keep the adjusted positions. If you select *"Yes"*, the computed positions will be assigned to the selected references and the *"Is Calibrated"* flag will be set. If you select *"No"*, the computed positions will be lost and the reference positions will not be updated.

    Note: The baseline measurement data can be reprocessed at any time to compute new reference positions. For further information on baseline calibration processing, refer to the detailed sections in the online help.

7.3.2 Box-in Calibration

It is assumed that the initial job configuration has been completed as detailed in section 7.2 above and that the seabed array has been deployed and that the Compatts have been assigned to an array as references. Approximate or drop co-ordinates for the references should have also been determined and entered into the system.

Calibration Planning

1. Double-click the Calibration Wizard icon  on the Tools toolbar or select Calibration from the Tools menu. The Introduction page of the Calibration Wizard appears. Click **Next >** to continue.

2. Next select the *"Plan an Array Calibration"* option. Click **Next >**. Note: If you have not created an array and assigned references to it at this stage, you cannot continue past this point. Cancel out of the Calibration Wizard and create an array as detailed in section 7.2

3. Select the *"Box-in Calibration"* option. Click **Next >**.

4. If you have more than one array, select the array that the reference transponder to be calibrated has been assigned to from the 'Array' list. Also ensure that the reference transponder to be calibrated is listed in the *"Selected References"* box by highlighting the transponder in the *"Available References"* box on the left and using the **<< >>** button to move the transponder across. Click **Next >**.

   Note: Only one reference transponder can be selected for Box-in calibration at a time.

5. Select the **Vehicle** and **Interrogator** to be used to carry out the Box-in calibration. If there are no options, then the surface vessel has not been configured correctly. As a minimum, a GPS instrument and LBL transceiver must be configured on the vessel and set for *"Use in Tracking"*. If the GPS antenna and LBL transducer are not co-located, i.e. do not have the same X and Y offset values, then a heading instrument is also required to be configured on the vessel. If the vessel is not configured correctly, use the **Configure Vehicles** button to access the vehicle properties dialog. Click **Next >** to continue.

6. Set the environmental options to be used during data collection. Set the *"Global Sound Speed"* type to be used (global value, measure or sound speed profile). Also set *"Tidal Updates"* if required. Note: The sound speed value associated with each two-way travel time measurement can be edited during post processing if the incorrect value is entered at this stage. Click **Next >** to continue.

7. Modify the calibration file (*.mdb) and folder location as required. By default the calibration file name will include the name of the Job Configuration File (JCF), the type of calibration file and the date / time that the file was created. Enter a description in the *"Description"* file as required. Click **Next >** to continue.

8. A report of the box-in calibration configuration can be saved or printed out as required. There are various printing options including text (*.txt) and HTML. Click **Next >** to continue.

9. This is the end of the Planning Phase of the Calibration Wizard. You can either finish at this point or return to the Calibration Wizard at a later stage or continue to the data collection phase by clicking **Next >**.

Collect Measurements

10. Select the *"Collect Measurements"* option. Click **Next >** to continue.

11. Select the calibration file that the box-in measurements will be stored to. By default the Calibration Wizard will remember the last calibration file was created during the planning phase. Click **Next >** to continue.

12. Select and configure the LBL transceiver that will be used to collect the box-in measurements. If the status of the transceiver is set to *"Not Set"*, then use the **Quick Set** or **Full Set** buttons to initialise the transceiver. Click **Next >** to continue.

13. Check the status of all the reference transponders in the selected array. The Calibration Wizard will identify any individual interrogate (IIF) channel conflicts with respect to the transponder to be calibrated. Use the **Full Set** or **Quick Set** buttons to obtain the status of any of the references that have been identified as *"Unknown"* or *"Not Set"*. Select **Next >** when complete.

14. Measure the depth of all the reference transponder using the **Get Depth** button. The depth measurement can be used during data processing to improve the calibration result. Select **Next >** when complete.

15. A message dialog appears indicating that you are about to start collecting box-in measurements. Select **Next >** to continue.

16. The Calibration Wizard dialog will disappear and you will be presented with the Box-in Calibration Toolbar. The Chart display will show the current position of the surface vessel based on the GPS instrument. Navigate the vessel to the nominated start position. Once into position, click the Go  icon on the Box-in Calibration toolbar to start the data collection process.

    As the box-in ranges are being measured, the position of the reference transponder is being computed in real-time. Use the Vehicles / Reference display to monitor the current position and quality metrics for the reference transponder.

    The Chart display indicates when a box-in range has been measured and the quality of measurement (red = failed, green = OK).

    The data collection process can be paused at any time by clicking the Pause  button. Once you have collected enough data, use the Pause button to stop data collection. Use the Export Reference Positions  button to export the real-time computed reference transponder position and position error to a CSV file. Use the Calibration Report  button to generate a text (*.txt) or HTML report of the real-time computed position. Note that this report does not contain all the box-in range measurements.

Note: A good indication that you have enough box-in range data is the real-time computed position of the reference transponder and associated position errors have stabilised i.e. no longer decreasing or moving.

17. Once you are happy that you have collected enough box-in range measurements, click the Calibration Wizard icon  to return to the Calibration Wizard.

18. A message dialog appears indicating that the data collection process is now complete. This is the end of the data collection phase of the Calibration Wizard. You can choose finish at this point and return to the Calibration Wizard at a later stage to process the data, or continue to the data processing phase by clicking **Next >**.

Data Processing

19. Select the *"Compute Positions"* option. Click **Next >** to continue.

20. A message dialog appears indicating that you are about to start computing Reference Positions from box-in measurements. Select **Next >** to continue.

21. Select the box-in calibration file (*.mdb) that you want to process. Note that multiple calibration files can be selected and loaded at the same time. Use the **Add** button to add the selected the calibration file (or files) to be included in the adjustment. Select **OK** to continue.

22. The Calibration Wizard dialog will disappear and each of the selected files will be loaded into the Calibration Processing tool. Once the files have been loaded, you will be presented with the Box-in Calibration Toolbar.

    Options available via the Box-in Calibration Processing toolbar include:

Button	Function
	Open Files - Select additional calibration files to be included in the adjustment
	Manual Measurements - Use this tool to manually add two-way range (ms), distance, depth and position observations into the adjustment. You can also import computed Box-in positions from an exported CSV file
	Processing Options - Use the Processing Options tool to set binning options to control the volume of data as well as range filtering options to remove 'long' ranges. By default, binning is set to 4 ranges per 10° bin. Also use the Export Positions option to export the box-in position and error to a CSV file which can be later imported into a baseline calibration session
	Auto-rejection - Toggle auto-rejection on / off (defaults to off)
	Compute Reference Position - starts the least squares adjustment

Button	Function
	Calibration Report - Generate a calibration report which can be printed or saved as a text (*.txt) or HTML file. The report contains a list of all the measurements used in the adjustment
	Save New Calibration File - Save all the measurement data currently loaded into a new Calibration file
	Expand toolbar - Expand the Processing toolbar to view how the different measurement types were used in the adjustment. Indicates the number of measurements that are available, accepted, manually rejected, auto rejected or not used in the adjustment

23. When you are happy with the adjustment and resultant computed reference position, click the Finish button  icon in the processing toolbar. Upon selecting this button, you will be asked whether you want to keep the adjusted positions. If you select *"Yes"*, the computed positions will be assigned to the selected reference and the *"Is Calibrated"* flag will be set. If you select *"No"*, the computed positions will be lost and the reference positions will not be updated.

Note: The box-in measurement data can be reprocessed at anytime to compute new reference positions. For further information on calibration processing in general, refer to the detailed sections in the online help.

7.4 Typical LBL Positioning Scenarios

Two typical operating scenarios are considered:

- ROV Positioning

  In this scenario, the Fusion LBL system is required to report the position of a ROV fitted with a transceiver and remote transducer, relative to the seabed array.

- Mobile Compatt Positioning

  In this scenario, the Fusion LBL system is required to report the position of the structure (e.g. pile, manifold or laydown head) fitted with a Compatt or multiple Compatts.

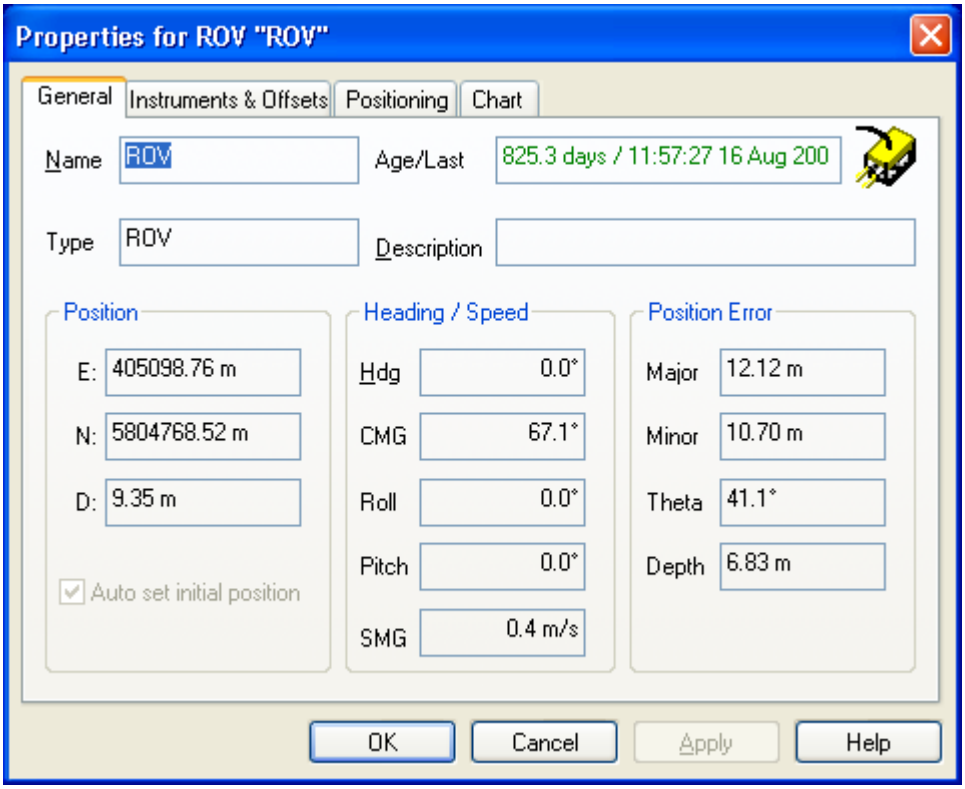
For both cases, the output position can be reported in terms of absolute or relative East, North and depth relative to the seabed array. The output may be provided to a DP system and or a survey package.

The following sections outline how to use the software to complete these tasks. Additional detailed information on configuration options is also contained in the On-line Help files.

7.4.1 ROV Positioning

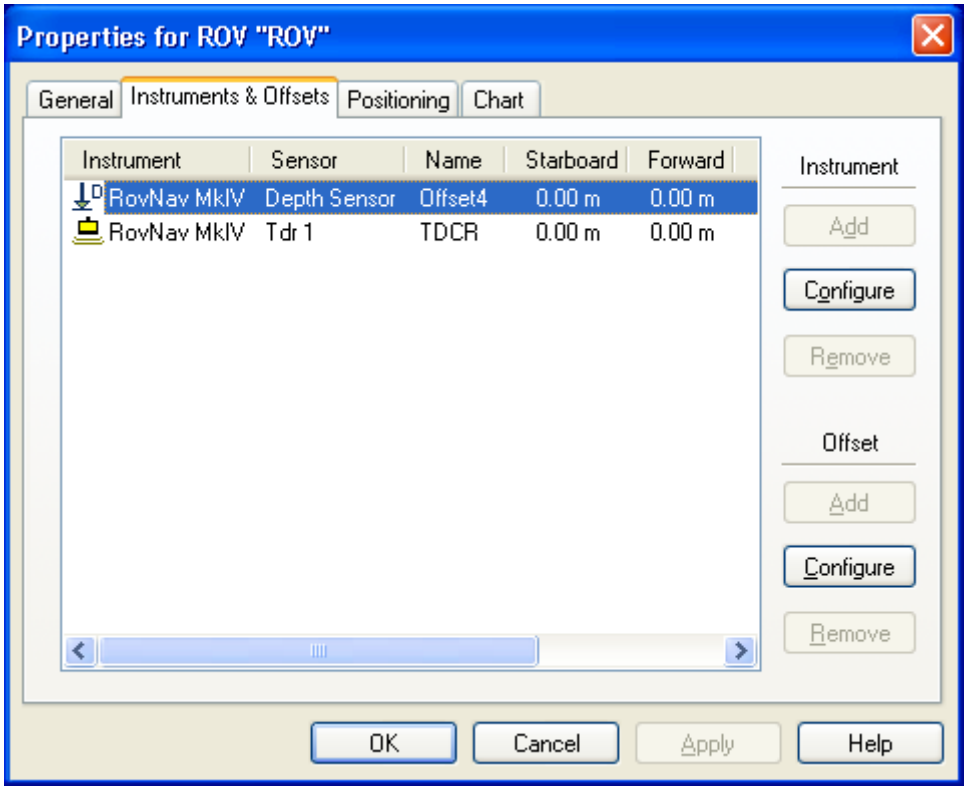
It is assumed that the initial job configuration has been completed as detailed in section 7.2 above and that the seabed array has been calibrated (absolute or relative) as detailed in section 7.3.

1. Double click on the ROV vehicle in the Job Tree or Chart display to open Vehicle Properties where you can enter the name and description and the initial start position of vehicle under the **General** tab.



Note: Enable the *"Auto set initial position"* checkbox if you don't know where within the array or at what depth you will start tracking the ROV. For large arrays where the ROV's start position might be known, you should disable this option and enter appropriate trial co-ordinate and depth values.

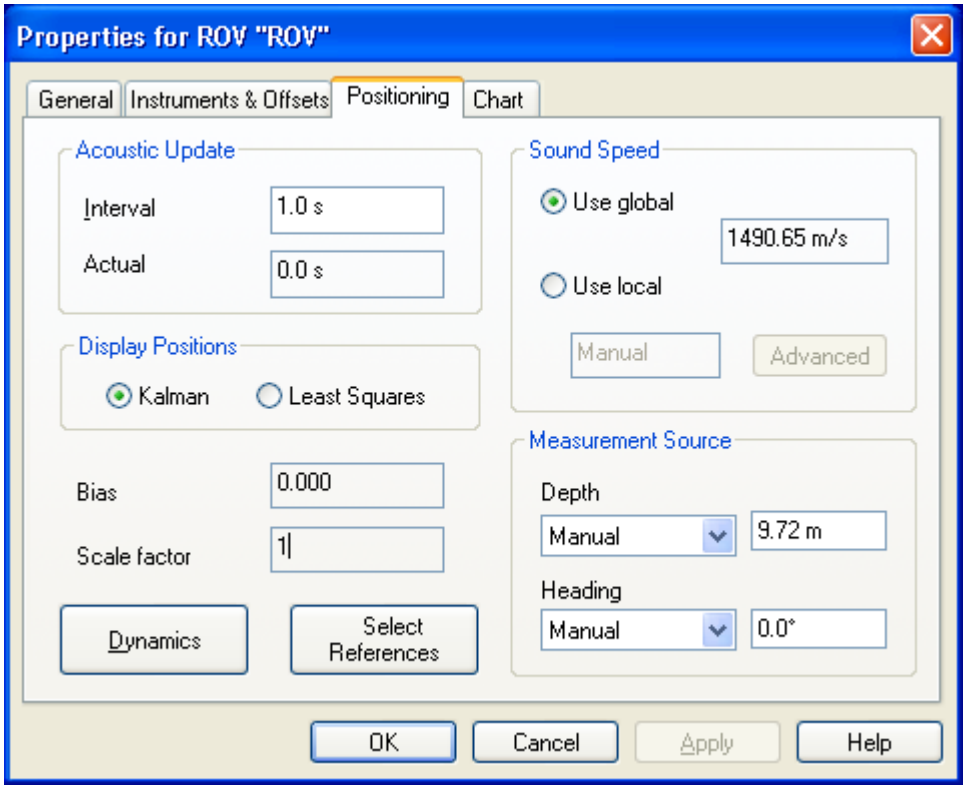
2. Click the **Instruments & Offsets** tab to confirm that the transceiver's transducer and depth sensors have been added correctly to ROV vehicle. Check the XYZ offset values are different if the sensors are not co-located.



Notes:

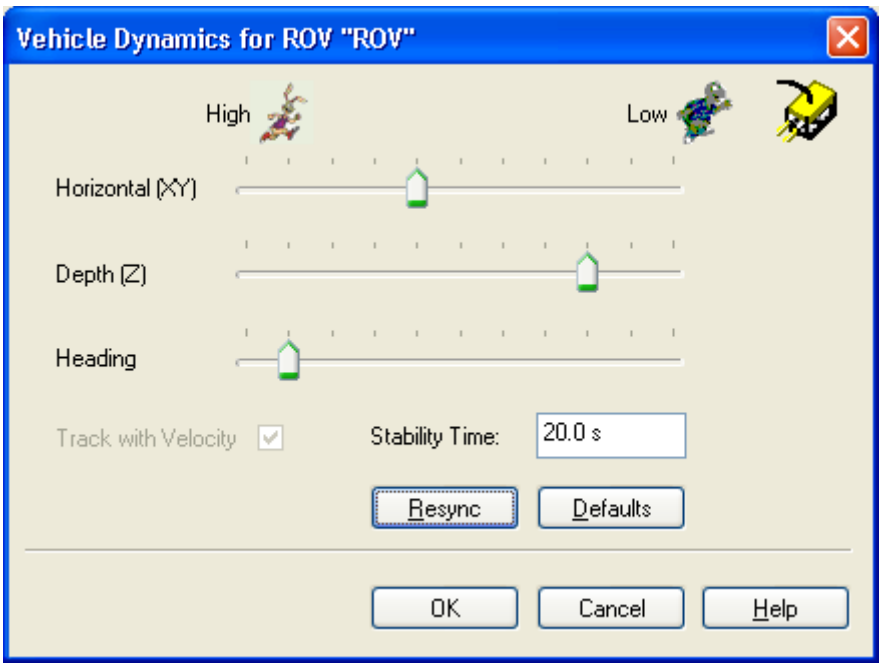
- Confirm that the transceiver's depth sensor has been enabled for tracking by clicking on the **Depth Sensor** tab in the transceiver's property page and ensuring that the *"Use in tracking"* checkbox is enabled. For a Mini RovNav, the *"Update every n seconds"* value should be zero (0). For a RovNav 5 or Mk4 RovNav, this value should be 1 second or greater (default 10 seconds).
- When using a Digiquartz depth sensor, be sure to set the appropriate values in the latitude, water density, gravity and atmospheric pressure fields in the Constants tab in Global Settings.
- If you are using a strain gauge depth sensor, be sure to determine the surface correction for the depth sensor before the ROV is deployed.

3. Click the **Positioning** tab to confirm or modify the required position update rate and the depth and heading measurement settings. You can also switch between Kalman and Least Squares position updates being displayed and output. Set the Depth option to *"Measured"* if you wish to use a depth sensor to the ROV.

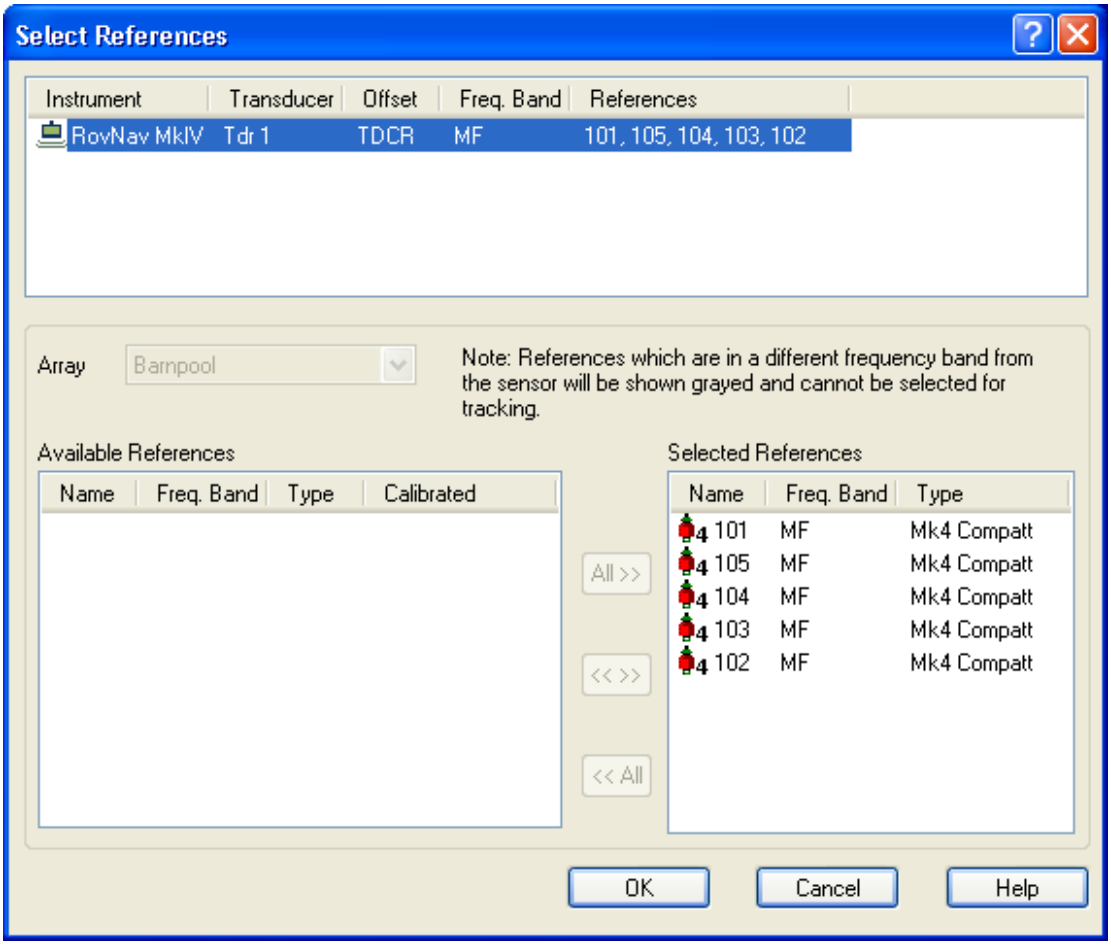


Note: The Kalman and Least Squares option allows you to select which position computation is displayed graphically in the Chart display and textually in the Text Display(s) and the Measurements Display. It will also effect the position type output in any active real-time reports.

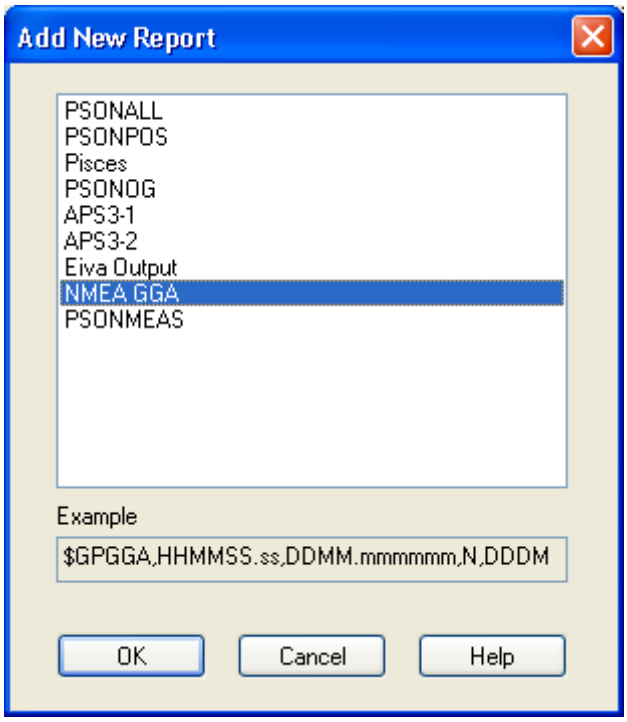
4. Click the **Dynamics** button to confirm or modify these settings. Use the **Defaults** button if you are unsure of the appropriate dynamic settings to start with.



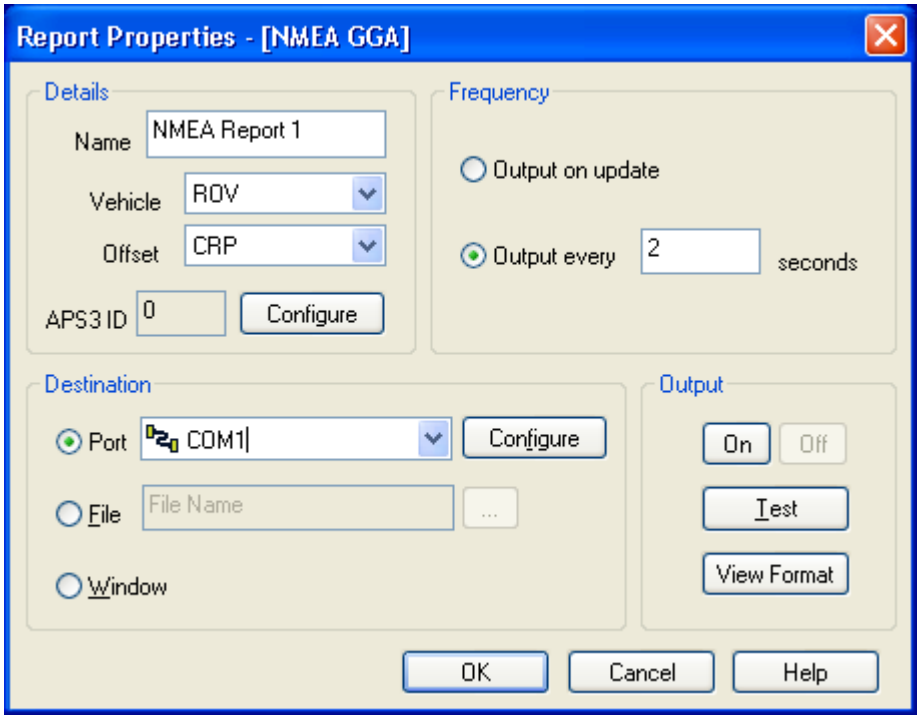
5. Click the **Select References** button and confirm that the correct references have been assigned to the transceiver / transducer for tracking. Ensure that a minimum of four references are assigned.



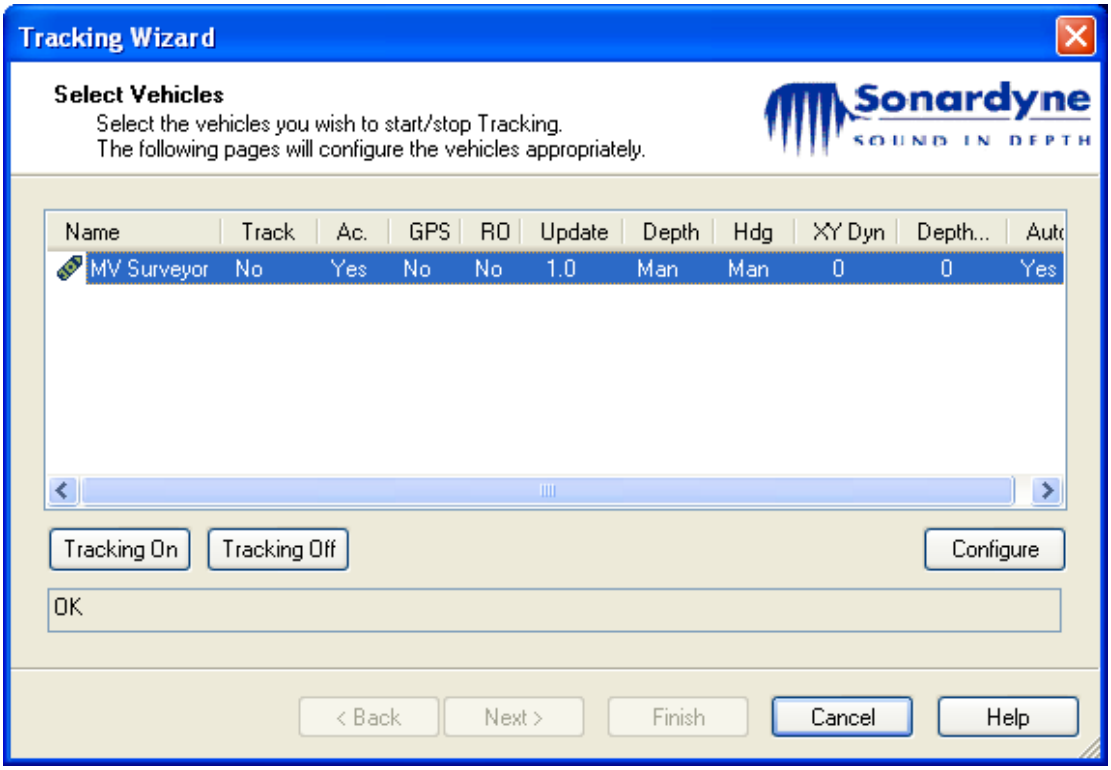
6. Double click on **Reports** in the Job Tree to create (add) an output report (e.g. NMEA GGA or PSONPOS) if this is required.



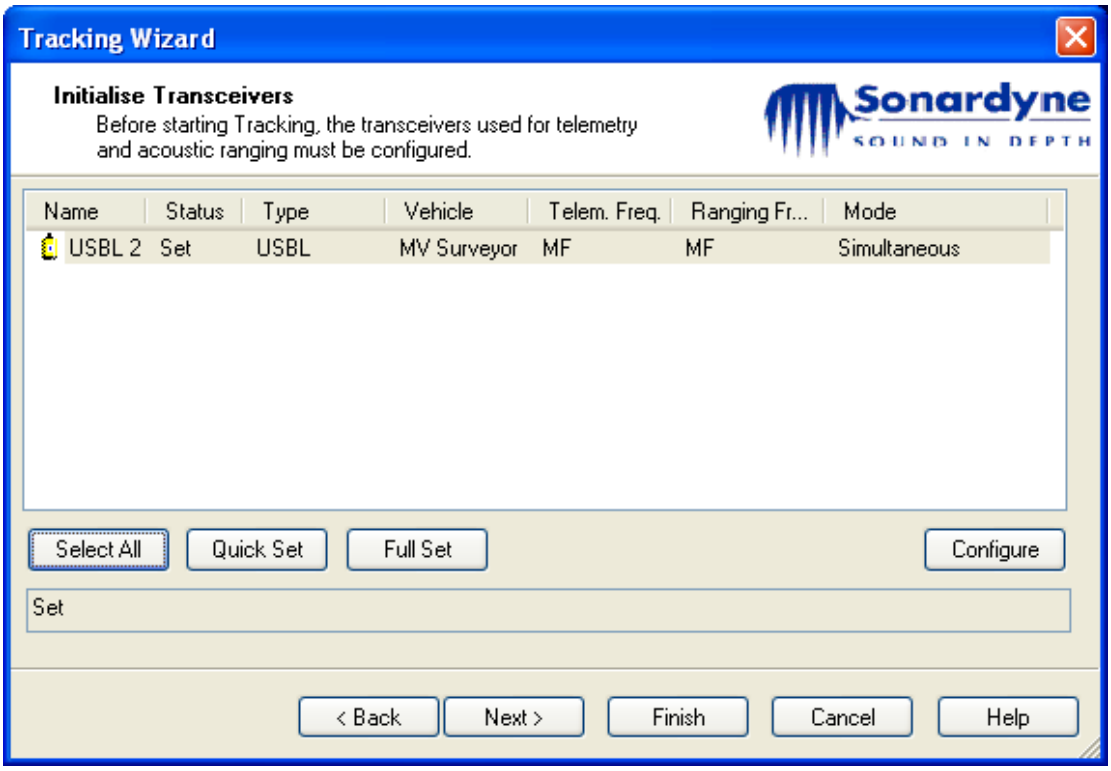
7. Configure the output report options such as output frequency and Com port.



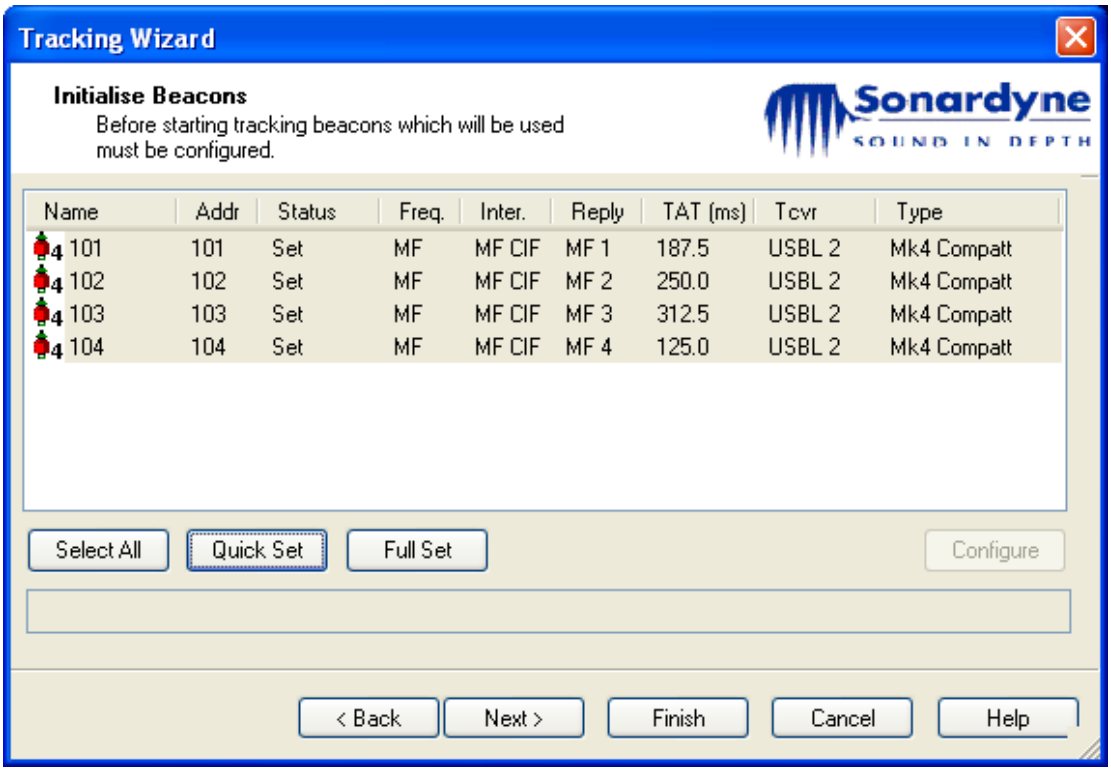
8. Start tracking by selecting the Tracking Wizard icon on the toolbar or the clicking on the Tracking field in the Status Bar. Select the vehicles to track using the **Tracking On** button and select **Next >** when complete. Alternatively, if you know that the references have been configured correctly and that all the other parameters are correct, you can select the **Finish** button directly to start tracking, otherwise proceed through the Wizard.



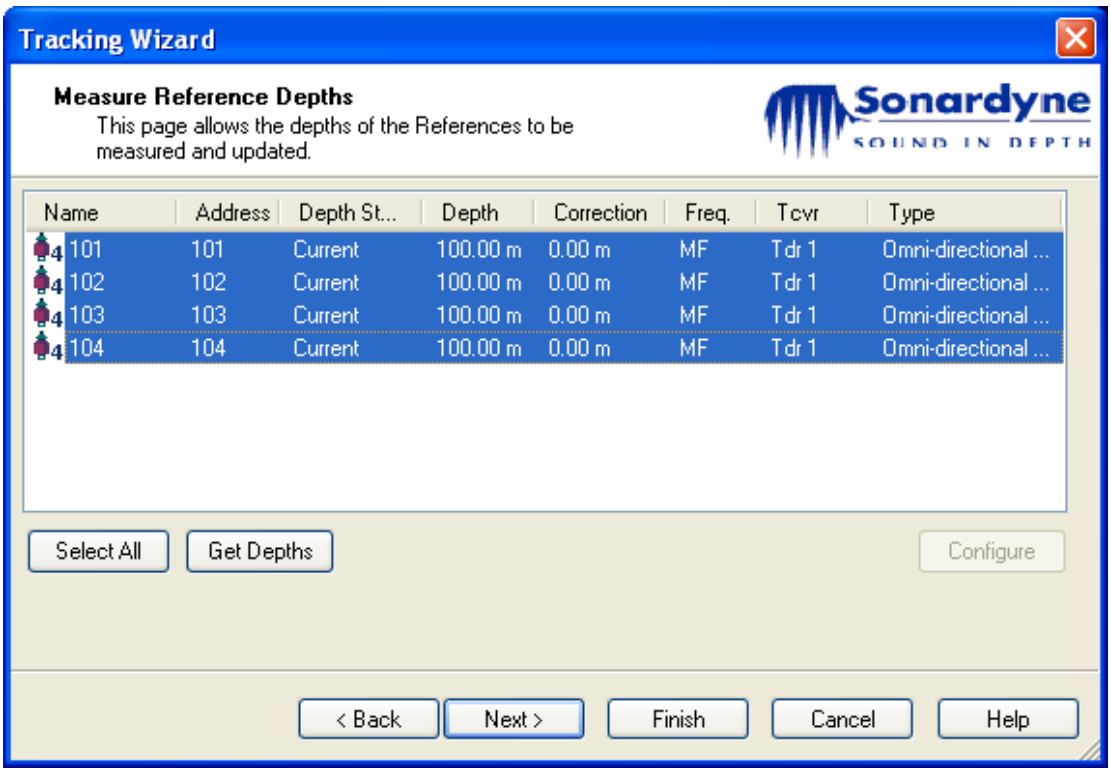
9. Initialise the transceiver if this hasn't already been done. To optimise the tracking update rate, check that the maximum range value set in the Ranging tab for the transceiver is appropriate. Select **Next >** when complete.



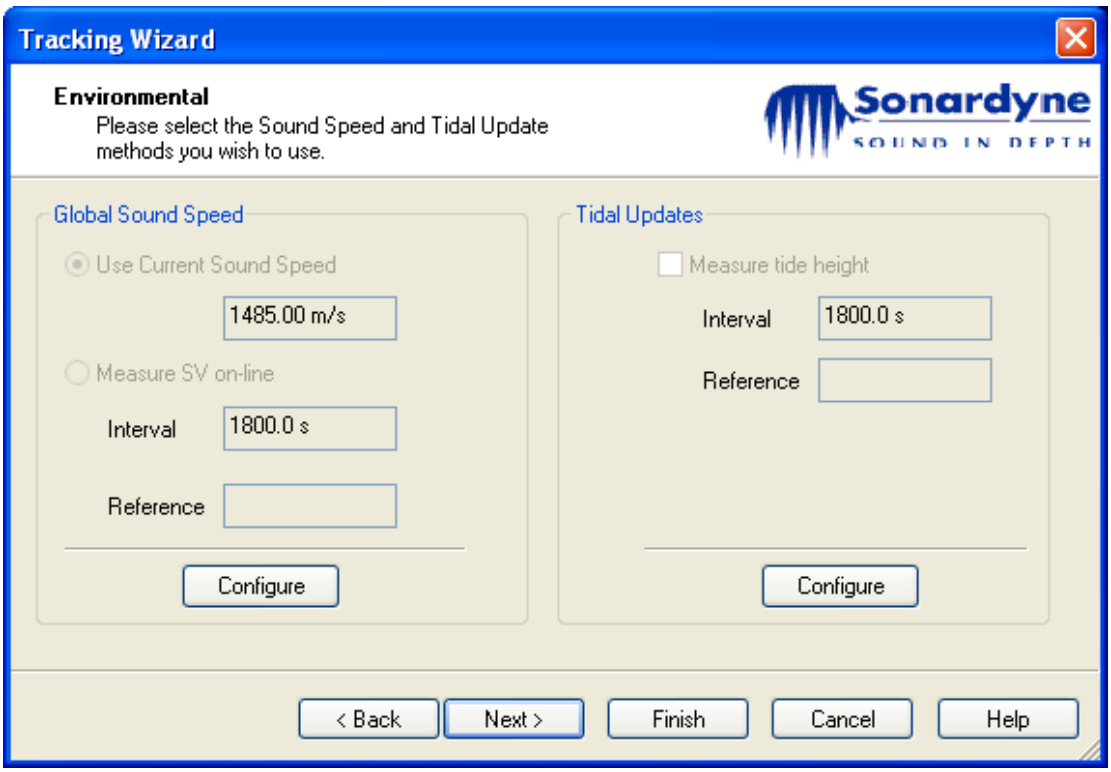
10. Check the status of all the reference transponders. The Tracking Wizard will identify any reply channel conflicts as well as Turn-Around Time (TAT) duplications. Use the **Full Set** or **Quick Set** buttons to obtain the status of any of the references that have been identified as "*Unknown*". Once the status of the references has been determined and any reply channel and TAT conflicts resolved, there is no need to check these values other than periodically or unless something has changes since the last you started tracking. Select **Next >** when complete.



11. Check the depth values of all the assigned reference transponders. Update as required. Select **Next >** when complete.



12. Check the environmental properties and update as required. Check that the correct sound speed value has been entered. Select **Next >** when complete.



13. Check the log file name and current size and modify as required. Select **Finish** when complete. The system will now commence tracking and initiate the various commands via the transceiver to interrogate the reference transponders. Measurements will be updated and displayed in the Measurement display and the vehicle field will be highlighted in the Status Bar (red = unable to track or warning, green = tracking OK). Position, range and error ellipse information will be update in the Chart and Text displays.

14. Tracking can be stopped at any time by the following methods:

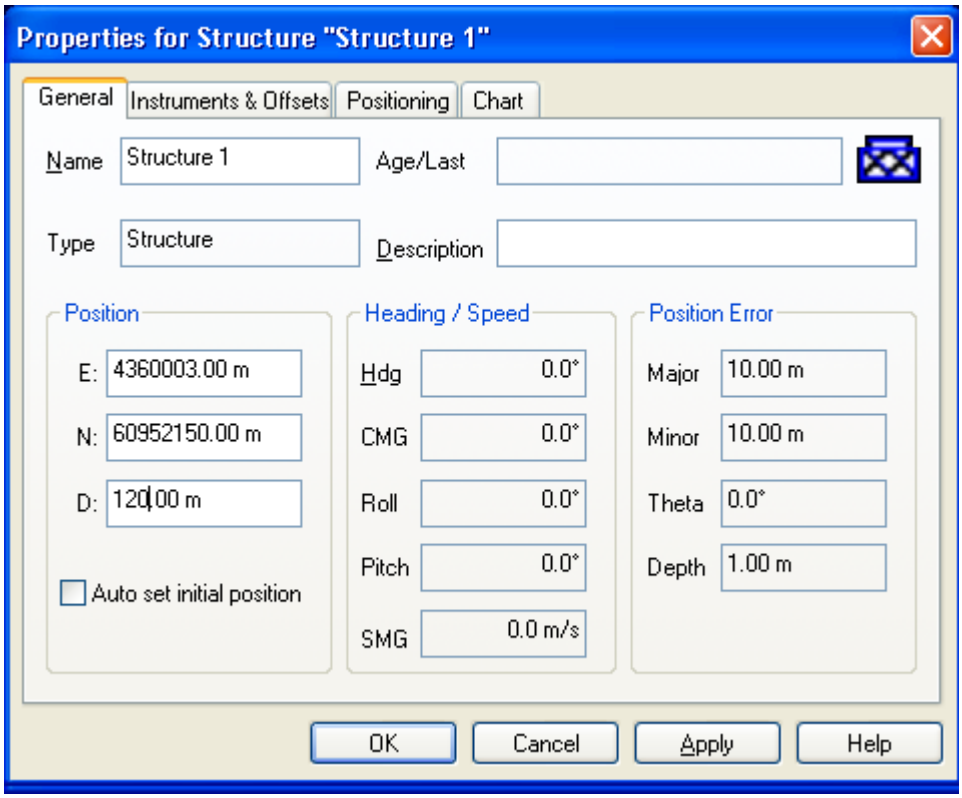
    - Selecting the Stop Tracking  icon on the toolbar. This will stop all vehicles being tracked.
    - Via the Tracking Wizard  , select the vehicles you want to stop tracking using the **Tracking Off** button and select **Finish** when complete.
    - `CTRL+ALT+SHIFT+S`. This will stop all vehicles being tracked.

    Alternatively, you can pause tracking at any time by selecting the Pause  icon on the toolbar.

7.4.2 Mobile Compatt Positioning

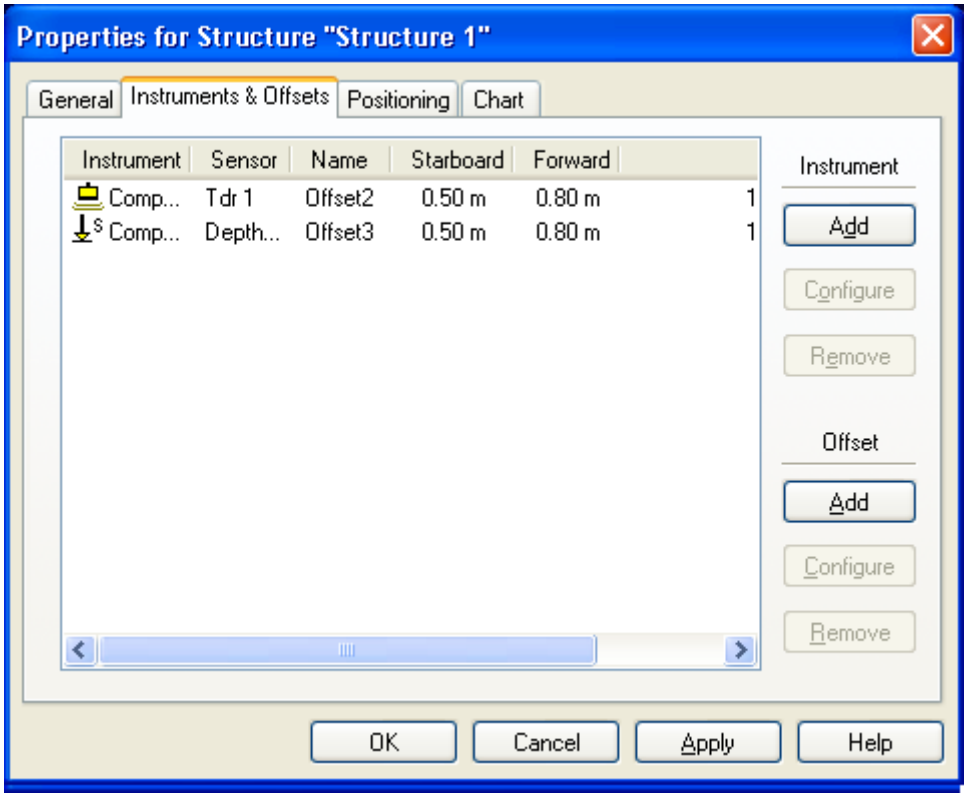
It is assumed that the initial job configuration has been completed as detailed in section 7.2 above and that the seabed array has been calibrated (absolute or relative) as detailed in section 7.3.

1. Create a 'structure' vehicle by double clicking on **Vehicles** in the Job Tree and selecting the **Add** button. Select the 'structures' type and enter a vehicle name. In Vehicle Properties, enter the description and the initial start position of the vehicle under the **General** tab.



Note: Enable the *"Auto set initial position"* checkbox if you don't know where within the array you will start tracking the structure. For large arrays where the structures approximate start position and depth is known you should disable this option and enter appropriate trial co-ordinate and depth values.

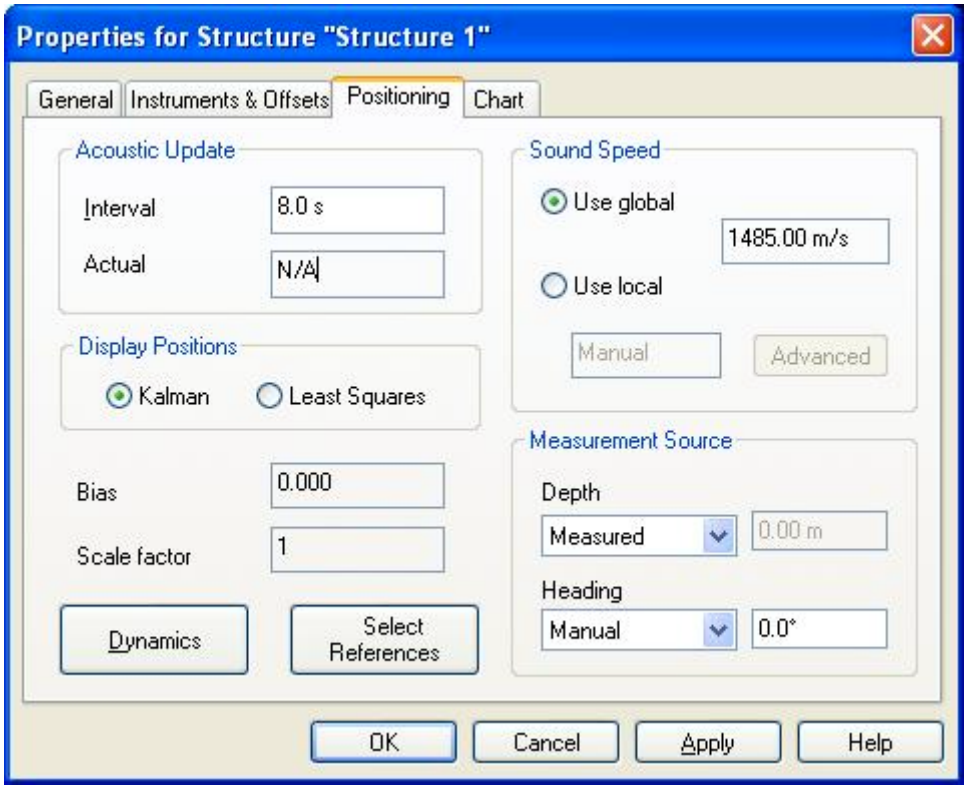
2. Click the **Instruments & Offsets** tab to confirm that the Compatt's transducer and depth sensors have been added correctly to structure. Check the XYZ offset values are the same for each sensor as, by default, the depth sensor reading is always corrected to the transducer offset position for a Compatt.



Notes:

- Confirm that the Compatt's depth sensor has been enabled for tracking by clicking on the **Depth Sensor** tab in the Compatt's properties page and ensuring that the *"Use in tracking"* checkbox is enabled. Check that the *"Update every n seconds"* value is set to zero (0). When set to 0, the depth returned in the simultaneous (SI) reply from the Compatt will be used automatically.
- When using a Digiquartz depth sensor, be sure to set the appropriate values in the latitude, water density, gravity and atmospheric pressure fields in the **Constants** tab in **Global Settings**.
- If the Compatt is fitted with a strain gauge depth sensor, be sure to determine the surface correction for the Compatt depth sensor before the structure is deployed.
- To enable Fast Simultaneous positioning, select this mode under the **Advanced Ranging Options** under the **Ranging** tab in the Compatt properties dialog.

3. Click the **Positioning** tab to confirm or modify the required position update rate and the depth and heading measurement settings. You can also switch between Kalman and Least Squares position updates being displayed or output. Set the Depth option to *"Measured"* if you have attached a depth sensor to the structure.

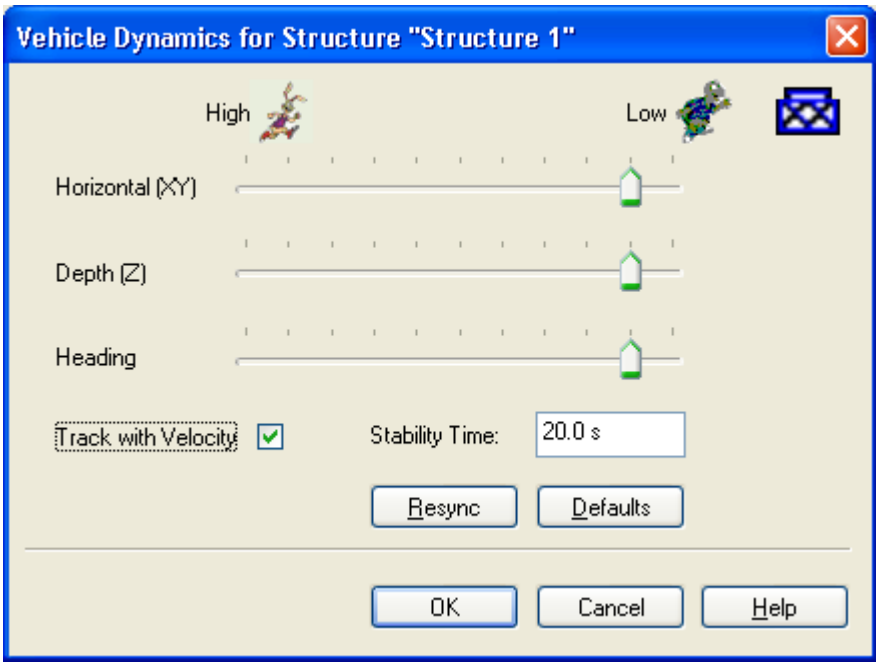


Note: The Kalman and Least Squares option allows you to select which position computation is displayed graphically in the Chart display and textually in the Text Display(s) and the Measurements Display. It will also effect the position type output in any active real-time reports.

Set the Heading option to "*Computed*" if you have two (or more) Compatts attached to the vehicle and you want to compute the heading of the vehicle based on the ranges received at both Compatts. This option will only be available if the Compatts have different horizontal offsets.

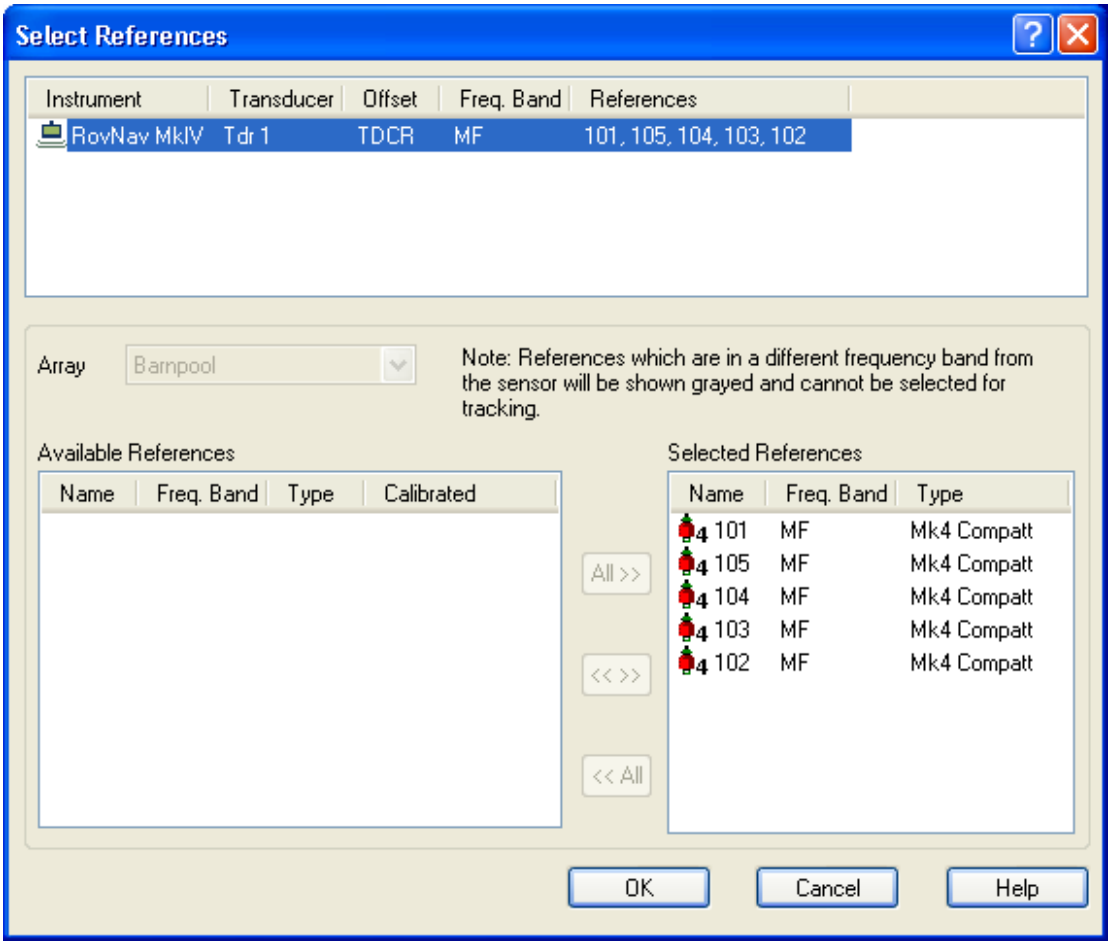
4. Click the **Dynamics** button to confirm or modify these settings. For mobile Compatt tracking, the Dynamics settings should always be in the range as follows:

    - Horizontal (XY) - 8 to 10 (i.e. low)
    - Depth (Z) - 8 to 10
    - Heading - 8 to 10.

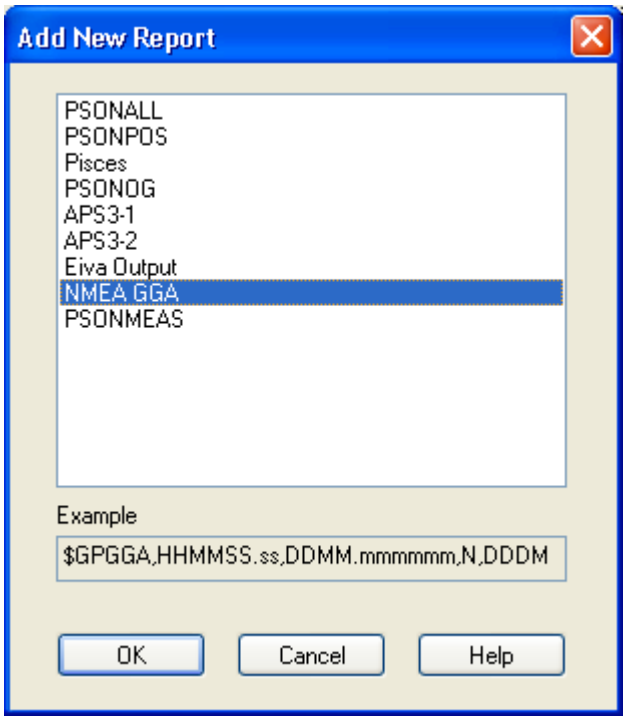


Note: If in doubt, click the **Defaults** button to force the appropriate settings for the vehicle type.

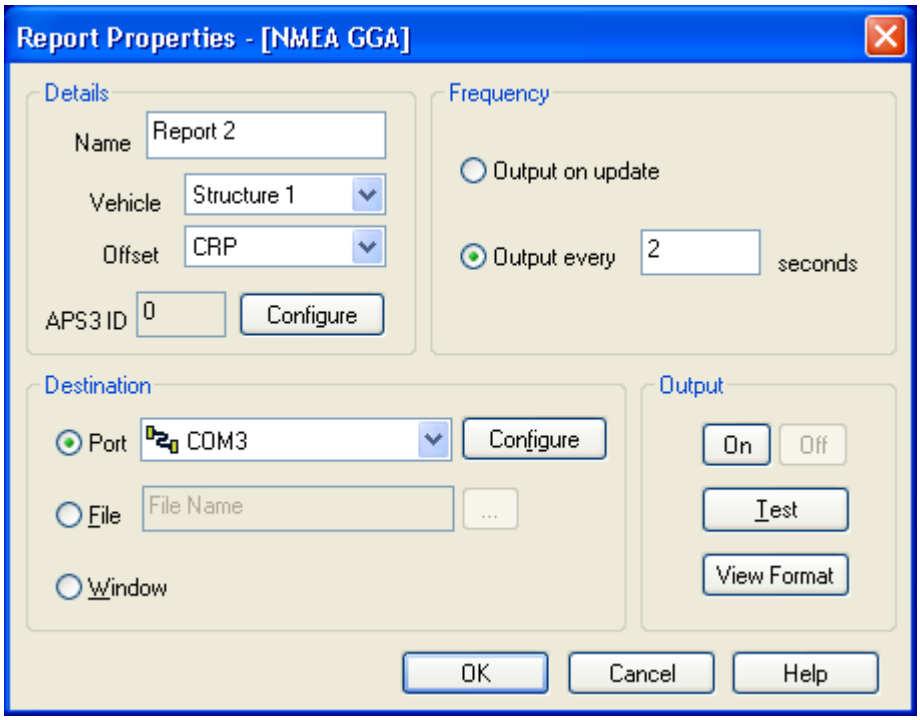
5. Click the **Select References** button and confirm that the correct references have been assigned to the transponder / transducer for tracking. Ensure that a minimum of four references are assigned.



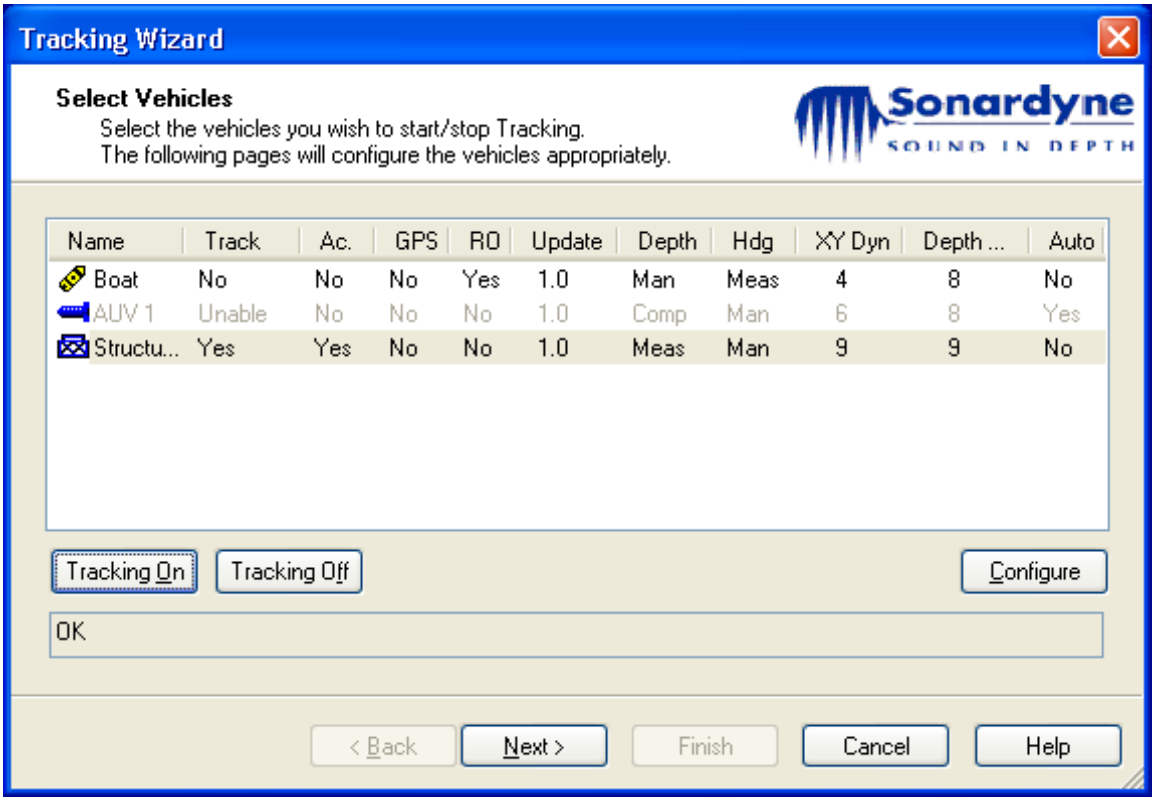
6. Double click on **Reports** in the Job Tree to create (add) an output report (e.g. NMEA GGA or PSONPOS) if required.



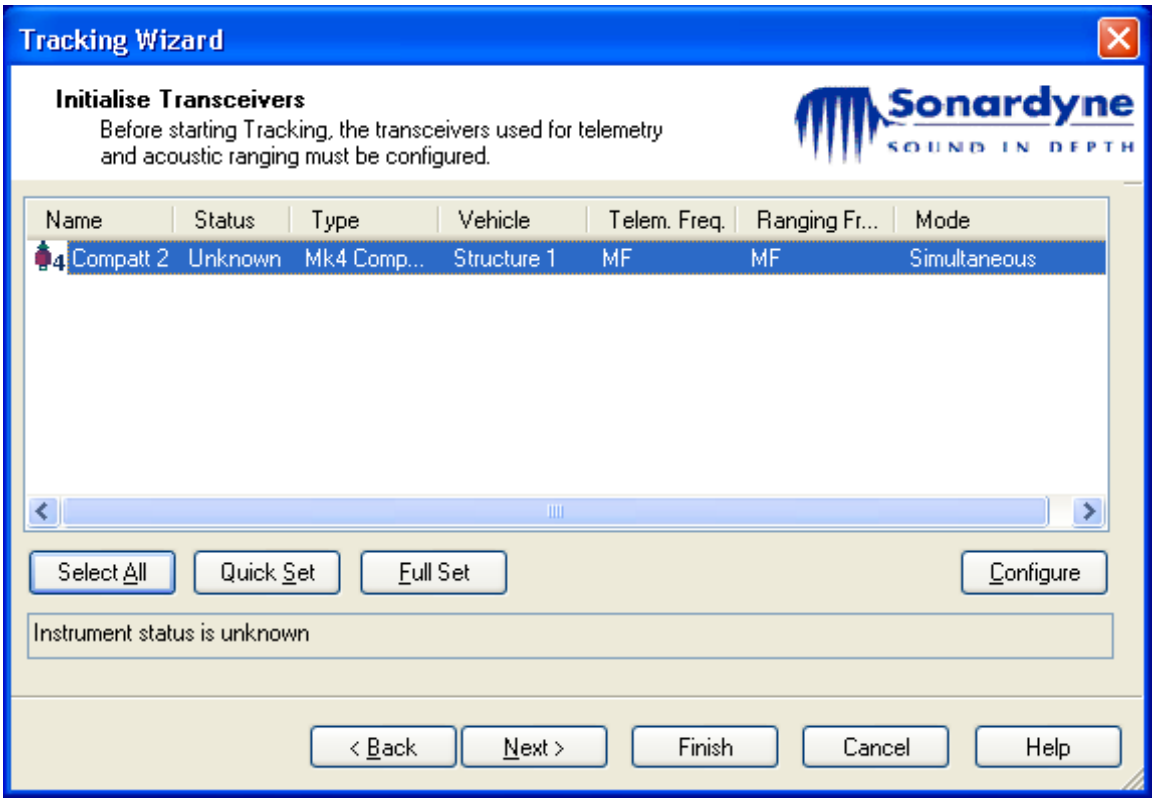
7. Configure the output report options such as output frequency and Com port.



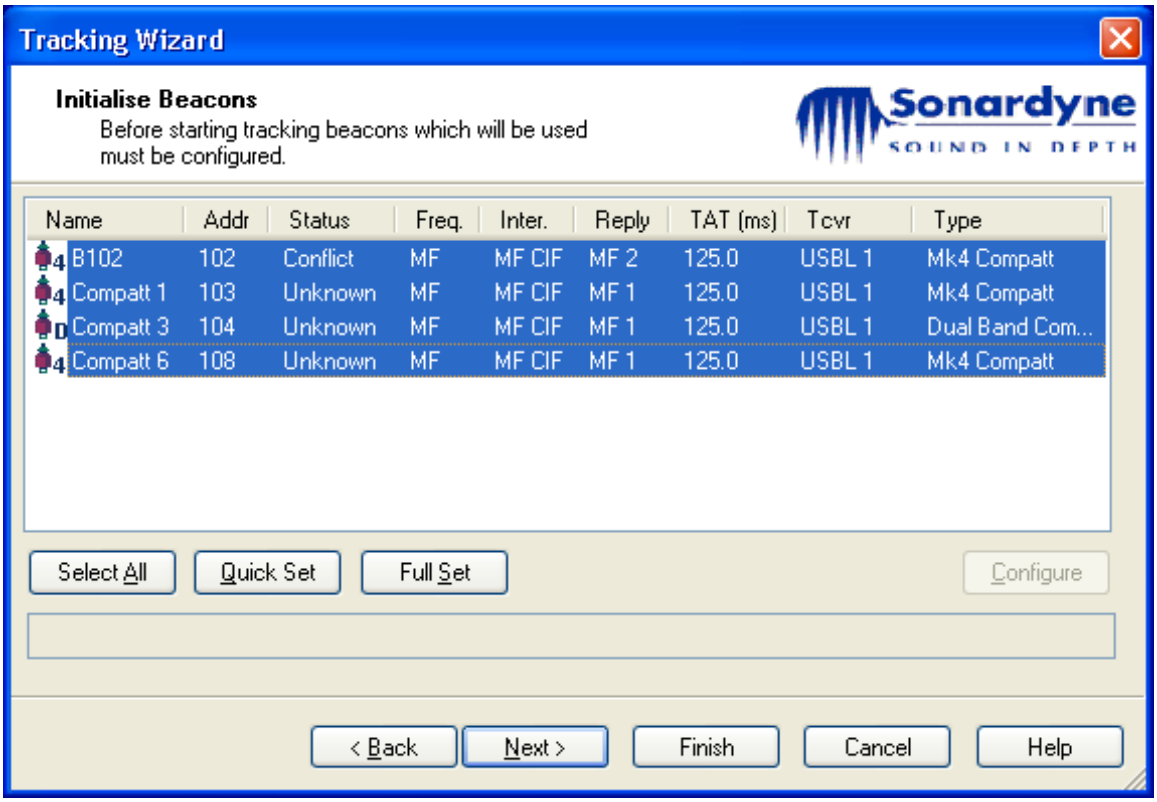
8. Start tracking by selecting the Tracking Wizard icon on the toolbar or the clicking on the Tracking field in the Status Bar. Select the vehicles to track using the **Tracking On** button and select **Next >** when complete. Alternatively, if you know that the references have been configured correctly and that all the other parameters are correct, you can select the **Finish** button to start tracking directly and exit the Wizard at this point.



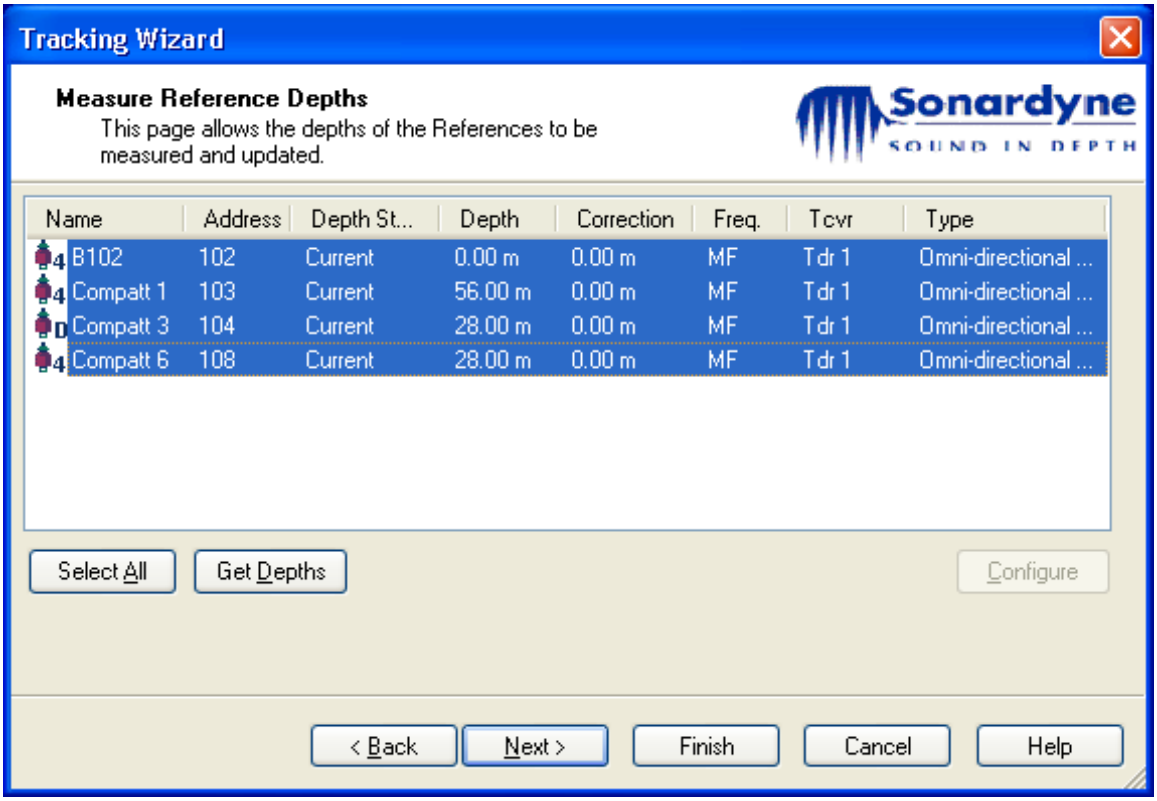
9. Initialise the telemetry transceiver and mobile Compatt if this hasn't already been done so. The Tracking Wizard will identify if the settings (CWR and CWT values) in the mobile Compatt are not optimised for tracking based on the position of the selected references. Use the **Full Set** or **Quick Set** buttons to optimise the set-up of the mobile Compatt. Use the Select **Next >** when complete.



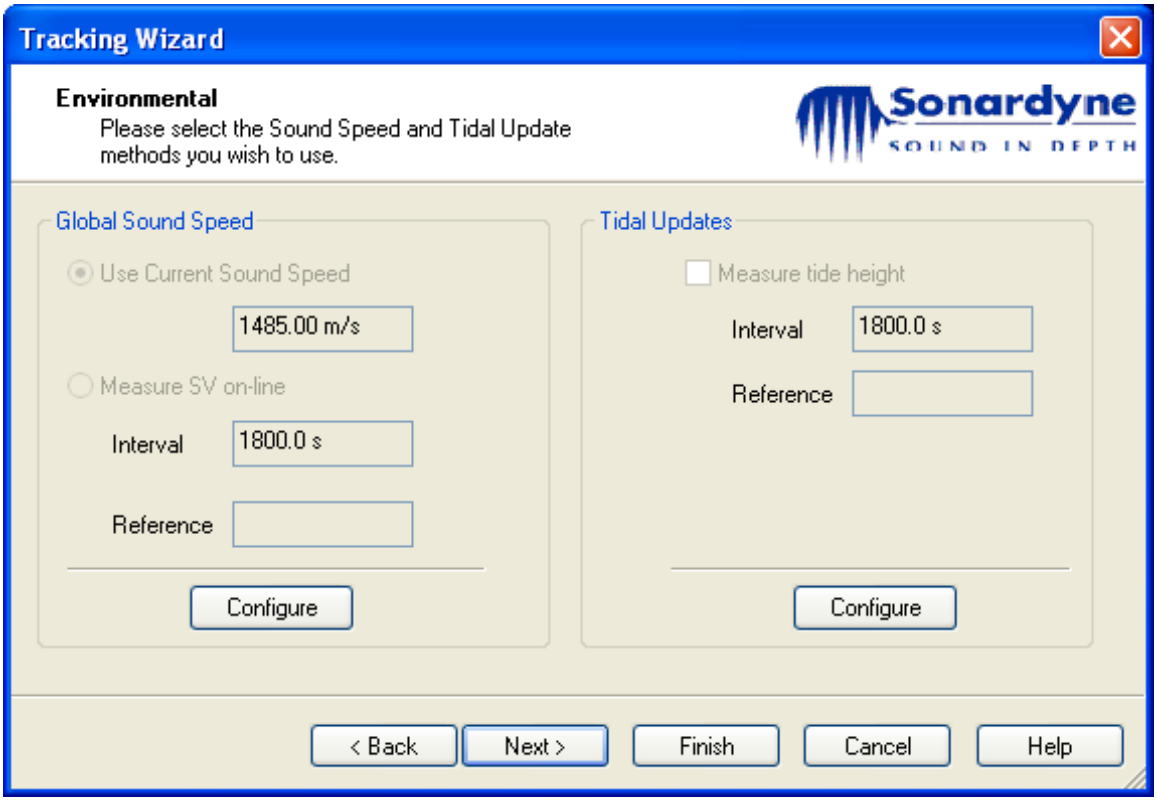
10. Check the status of all the reference transponders. The Tracking Wizard will identify any reply channel conflicts as well as Turn-Around Time (TAT) duplications. Use the **Full Set** or **Quick Set** buttons to obtain the status of any of the references that have been identified as *"Unknown"*. Once the status of the references has been determined and any reply channel and TAT conflicts resolved, there is no need to check these values other than periodically or unless something has changes since the last you started tracking. Select **Next >** when complete.



11. Check the depth values of all the assigned reference transponders. Update as required. Select **Next >** when complete.



12. Check the environmental properties and update as required. Check that the correct sound speed value has been entered. Select **Next>** when complete.



13. Check the log file name and current size and modify as required. Select **Finish** when complete. The system will now commence tracking and initiate the various commands via the telemetry transceiver for the mobile Compatt to interrogate the reference transponders. Measurements will be updated and displayed in the Measurement display and the vehicle field will be highlighted in the Status Bar (red = unable to track or warning, green = tracking OK). Position, range and error ellipse information will be update in the Chart and Text displays.

14. Tracking can be stopped at any time by the following methods:

    - Selecting the Stop Tracking icon on the toolbar. This will stop all vehicles being tracked.
    - Via the Tracking Wizard, select the vehicles you want to stop tracking using the **Tracking Off** button and select **Finish** when complete.
    - `CTRL+ALT+SHIFT+S`. This will stop all vehicles being tracked.

Alternatively, you can pause tracking at any time by selecting the Pause icon on the toolbar.

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7.5 Demo Data

A demo project containing tracking and calibration data is included as part of the Fusion LBL installation. Using the Replay Tool, vehicle positions logged in the data file can be replayed, displayed and output. During Replay, the same controls and displays that are active during Tracking are available. This allows an operator to familiarise themselves with the various displays and configuration options.

Note: The Replay Tool is always available, regardless of whether the security key is attached to the parallel port of the Computer.

The supplied calibration data can also be processed in the Calibration Wizard if the security key is attached. The demo project contains a baseline calibration file as well as box-in calibration files for two of the reference transponders in the array.

Open the SurveyDemo Project

- From the **File** menu select **Open**. If a job is currently open, you will be asked to close this job first.
- From the Open dialog, select the Demo Data folder. During a default installation of Fusion LBL, is the demo data is stored in:

  `C:\Program Files\Sonnardyne\Pharos\Projects\Demo Data\Configuration`

  Select `SurveyDemo.jcf`

Replay Tracking Data

- Ensure that the SurveyDemo log file is selected. From the **Control** menu, select **Logging…** and check that the `SurveyDemo.mdb` log file is selected. During a default installation of Fusion LBL, is the demo data is stored in:

  `C:\Program Files\Sonnardyne\Pharos\Projects\Demo Data\Log Files`

- From the Tools menu, select **Replay**. The Replay Control dialog will appear. Press the **Play** button  to start replaying the data. The Replay Control dialog allows to control the playback speed and to select the start and stop times in the log file from which to replay data.
- During replay, the following functionality or information is available:
  - Chart Display
  - Text Display
  - Time Series Display
  - Guidance Display
  - Travel Time Display
  - Measurement Display
  - Vehicles / References Display

Baseline Calibration Data

The supplied baseline calibration file can be loaded into the Calibration Wizard as detailed in section 7.3.1

The demo baseline calibration file is:

```
SurveyDemo Baseline Calibration @ 15.08.2001 1806.mdb
```

The calibration files are by default located at:

```
C:\Program Files\Sonnardyne\Pharos\Projects\Demo Data\Log Files
```

Box-in Calibration Data

The supplied box-in calibration files can be loaded into the Calibration Wizard as detailed in section?

The demo box-in calibration files are:

```
SurveyDemo Box-In Calibration 102 @ 16.08.2001 0752.mdb
SurveyDemo Box-In Calibration 104 @ 16.08.2001 0723.mdb
```

The calibration files are by default located at:

```
C:\Program Files\Sonnardyne\Pharos\Projects\Demo Data\Log Files
```

8 Getting Technical Support

Sonardyne 24Hr Emergency Helpline

Tel : + 44 (0) 1252 877600

Our 24-hour helpline is answered at Blackbushe during normal office hours - 08:30 - 17:30 UK time. Outside these hours, the call is automatically transferred to a local agency who will log the details of your emergency and alert the appropriate Sonardyne personnel.

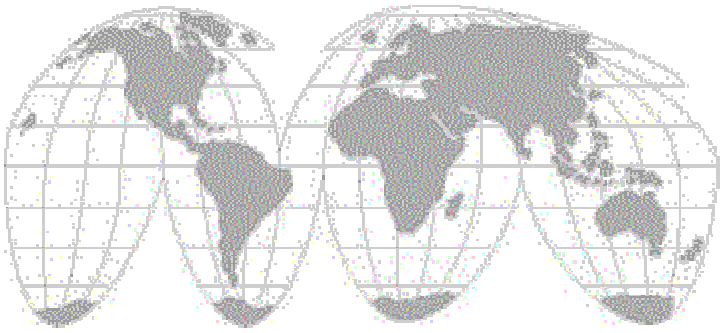
Our aim is to ensure that emergency requests are dealt with immediately during office hours and are responded to within 30 minutes at all other times.

Please note that the helpline is for emergency use only - it should not be used for general enquiries. These should be directed to your local Sonardyne office.

Alternatively, you can use one of the dedicated e-mail groups. Please note that e-mails are only answered during normal office hours- 08:30 - 17:30 UK time.

Product Family	Support e-mail Address
Pharos software	pharos.support@sonardyne.co.uk
All other Sonardyne products	support@sonardyne.co.uk

8.1 Sonardyne Offices



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Appendix A

A.1 Compatt Operational Modes

A Compatt (**Comp**uter and **T**elemetering **T**ransponder) is an intelligent transponder that can be commanded to operate in a number of modes depending on the application and task. The section below details the various Compatt operational modes.

CIF/IRF

In this mode, the transceiver transmits on the Common Interrogation Frequency (CIF) and Compatts with their CIF receiver enabled will reply each on their own Individual Reply Frequency (IRF). In this way, provided that replies at the transceiver do not conflict in time or frequency, the transceiver can analyse multiple replies individually and without any ambiguity.

Any potential problem with reply overlap can be eliminated by commanding a Compatt to change its Turn-Around Time (TAT) - thus delaying the time at which it transmits its reply back to the transceiver. This ensures that the arrival times of all the replies from the individual Compatts are staggered at the transceiver. Similarly, the IRF frequency for a Compatt can be changed from the surface by command should there be another Compatt on the same IRF.

Some Compatts are able to respond to other channels (nominated to the Compatt by the system) as though they were “alternative” CIFs - thus enabling operation with multiple vessels and multiple arrays.

IIF/CRF

In this mode, the transceiver transmits to a particular Compatt on the Individual Interrogation Frequency (IIF) peculiar to that Compatt. The IIF for a Compatt is defined by the last two digits in the Compatt address e.g. 106 = IRF 06. The Compatt will then reply on the Common Reply Frequency (CRF). The transceiver interprets the incoming CRF signal as being from the selected Compatt with a high certainty that this interpretation will be correct unless the operation is taking place in an acoustically noisy environment. The limitation with this method is that only one beacon may be tracked in this mode at any one time.

IIF/IRF

In an acoustically noisy environment, this mode is the most secure method of ranging between the USBL transceiver and a Compatt.

In this mode, the transceiver transmits to a particular Compatt on the Individual Interrogation Frequency (IIF) peculiar to that Compatt. The Compatt will reply on the channel to which it has been commanded to reply on.

Note: This mode is not yet fully supported in the current version of Fusion USBL. However, a Compatt with firmware version 7.12 and above with the multi-user option, which includes support for Alternative CIF, can be set-up to emulate this mode.

HPR

This refers to the Hydro-acoustic Positioning Reference system developed by Simrad. Two standards are available - HPR 300 Series and HPR 400 Series. When a Compatt is used in HPR mode, a unique pair of interrogation (SIF) and reply (SRF) frequencies are used which match the HPR channel. A Compatts default HPR channel can be found on the main housing label, but this can also be changed acoustically.

See Appendix A.3 for a list of the Sonardyne and Simrad HPR 300 and 400 channel frequencies.

A.2 Compatt Commands

A Compatt is an intelligent transponder beacon that is managed by a micro-controller. It can decode acoustic telemetered commands from a transceiver and can send telemetered data to the transceiver. It can measure the distance between itself and other Compatts and then telemeter the data back to a transceiver.

By default, a Compatt is capable of measuring its depth and the temperature of the water. It can also be used to measure parameters from a variety of sensors such as conductivity, inclination, and water current and telemeter this information back to the surface. In most cases, a Compatt is fitted with a release mechanism allowing it to be returned, on command, back to the surface at the end of a mission or project (even if battery power is low).

The Compatt may also be used as a remotely operated transceiver, i.e. mobile Compatt tracking as supported in LBL systems.

A.3 Frequency Charts

Frequency clashes between LBL and USBL systems operating simultaneously in the same area can be avoided by prudent choice of interrogate and reply channels for the Compatts and transponder beacons being interrogated by each system. This is particularly true in the case of an LBL system (which tends to utilise more Compatts) and where other acoustic systems are in use in the same area.

The general rule is “choose frequencies which are well separated from those being used by other beacons in the vicinity”. For a USBL required to track four Compatts, it is safest to pick four separate interrogation channels (IIFs) and four different reply channels (IRFs). However, in many cases, it is possible to economise on interrogation frequencies and still achieve sufficient discrimination by setting one common interrogation channel (CIF) and four different IRFs together with four different Turn-Around Times. Note that, for Compatts supplied with the appropriate firmware, alternative CIF frequencies may be assigned if the normal CIF is already being used by another system on a job nearby.

The diagrams that follow summarise the range of Sonardyne and Simrad frequencies associated with HPR 300 Series telegram transmissions (Figure A 1.) and HPR 400 Series transmissions (Figure A 2.). Assuming other frequencies being used in the area are known, it is possible, using these diagrams, to select frequencies for the current job which are well separated from each other and other transponders / responders in use in the area.

A.3.1 Sonardyne and Simrad Channel Frequencies – HPR 300 Series

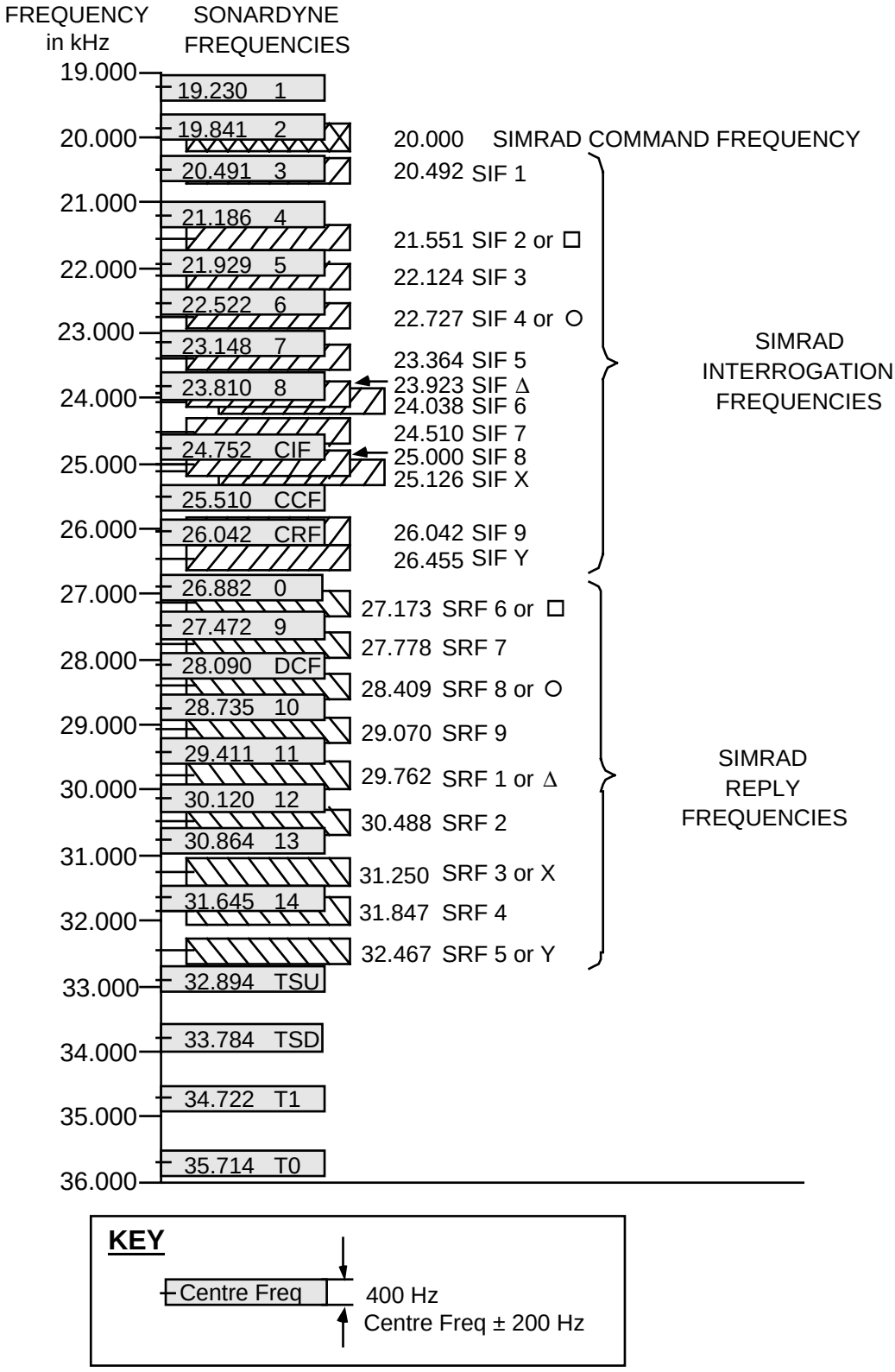

FIGURE A 1. CHANNEL FREQUENCIES – HPR 300 SERIES

A.3.2 Sonardyne and Simrad Channel Frequencies – HPR 400 Series

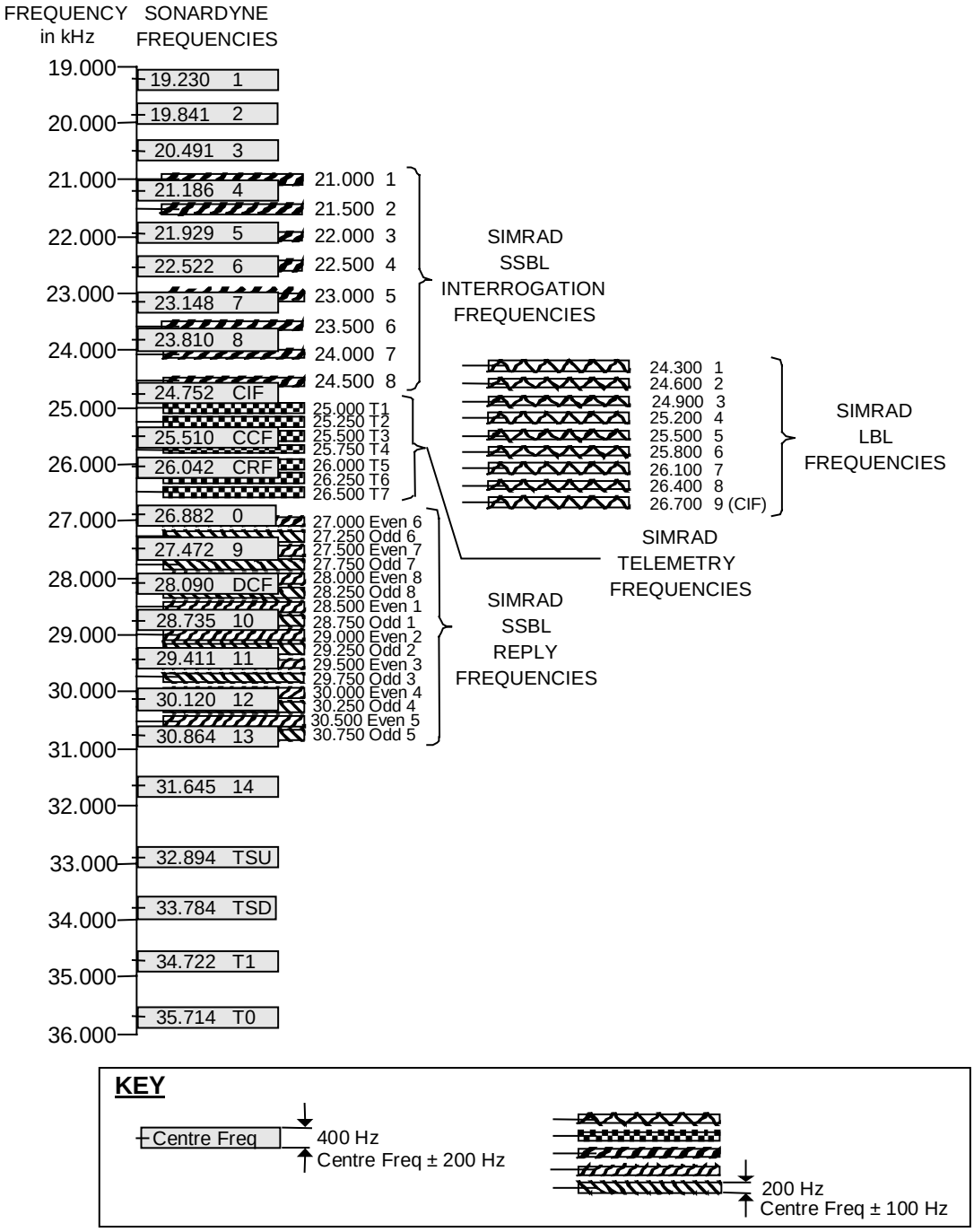

FIGURE A 2. CHANNEL FREQUENCIES – HPR 400 SERIES