

WinFrog Device Group:	USBL
Device Name/Model:	NAUTRONIX RS/916
Device Manufacturer:	Nautronix Ltd. Nautronix House Howe Moss Avenue Kirkhill, Dyce Aberdeen AB21 0GP Scotland T: +44 (0)1224 775 700 F: +44 (0)1224 775 800 E: aberdeen@nautronix.co.uk
Device Data String(s) Output to WinFrog:	
WinFrog Data String(s) Output to Device:	
WinFrog Data Item(s) and their RAW record:	USBL DATA 309 GPS ATTITUDE DATA 413 HEADING 910

DEVICE DESCRIPTION:

Nautronix RS/916 is an ultra short baseline (USBL) underwater acoustic tracking system, which is used to either determine the position of Remotely Operated Vehicles (ROV's), towed equipment, etc or to position the ship relative to a fixed beacon.

To track a remote vehicle, an acoustic beacon (responder or transponder) operating at a set frequency, is attached to the equipment that is to be tracked. By interrogating the beacon and subsequently receiving an acoustic response, the Nautronix RS/916 accurately determines the position of the beacon relative to the hydrophone. This data is then output to external equipment for final determination of the beacon's real world coordinates.

In order to position the ship from a fixed beacon, the beacon is attached to either the sea bottom or a subsurface structure and the position of the hydrophone is calculated relative to the fixed beacon's position.

DEVICE CONFIGURATION INSTRUCTIONS

WINFROG I/O DEVICES > EDIT I/O:

Serial

Configurable Parameters

WINFROG I/O DEVICES > CONFIGURE DEVICE:

No configuration is required at the I/O Device window level.

WINFROG VEHICLE > CONFIGURE VEHICLE DEVICES > DEVICE DATA ITEM > EDIT:

Adding the Nautronix RS/916 device creates four data items: USBL HYDROPHONE, BEACON, ATTITUDE and HEADING. Once the data items have been added to the vehicle, they must be edited to suit the application.

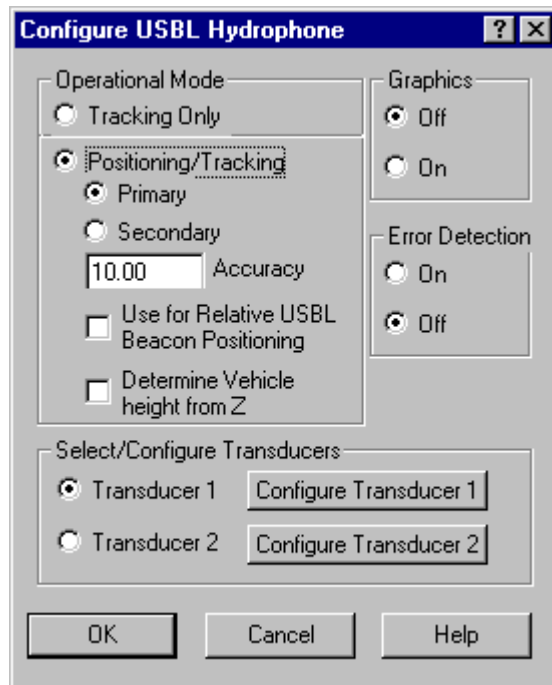
Data item: USBL, Nautronix RS/916, USBL HYDROPHONE

For vehicle tracking, the **USBL, Nautronix RS/916, USBL Hydrophone** data item must be added to the device list of the vehicle to which the hydrophone has been physically attached (i.e. the main ship).

USBL systems can also be used for positioning of the main vessel. In this type of operation, the USBL Beacon must be physically attached to some fixed point on the seabed or subsurface structure. The Hydrophone position (i.e. vehicle position) is derived from measurements made to the fixed beacon. For this type of positioning, you must define a working Xponder File (*.XPT) in WinFrog, and enter the fixed coordinates of the Beacon into that file. The Hydrophone must be added to the ship's device list and configured for positioning/tracking as opposed to tracking mode. See chapter 5 of the WinFrog User's Guide for more information on setting up *.XPT files.

Configuration of the USBL Hydrophone

Once the NAUTRONIX RS/916 Hydrophone has been added to the appropriate vehicle's device list it must be edited to suit the application. In the vehicle's Devices list, highlight the USBL, Nautronix RS/916, USBL Hydrophone data item then click the Edit button. The Configure USBL Hydrophone dialog box appears as seen below.



Operational Mode:

As mentioned above, USBL systems can be used for tracking of subsurface vehicles or for positioning of the main vehicle to which the hydrophone is attached. Select **Tracking Only** if relative tracking of a structure/vessel is desired.

Select **Positioning/Tracking** and **Primary** if you want to position the Master Vessel relative to a stationary (fixed) beacon. The beacon must be fixed at a stationary (fixed) location, as defined in a working XPONDER (.XPT) file. Select the **Secondary** radio button if this is not the primary positioning source (i.e. if this is a comparison position), or if you are setting up for a USBL Calibration. Note as well that if you are setting up for a USBL Calibration, the Hydrophone should also be specified as a Secondary positioning device. See chapter 20 of the WinFrog User's Guide for more information on USBL Calibrations.

If Positioning/Tracking is selected, you can also specify **Use for Relative USBL Beacon Positioning**. This feature controls the use of the USBL positioning of the hydrophone from a fixed beacon for application to relative USBL Beacon positioning. In this mode, the difference between the hydrophone position as determined directly from observation to fixed beacon is compared to the hydrophone position determined from other positioning sources (e.g. DGPS). This difference is then applied to the position determined for any tracked beacon. The concept is that any inherent errors due to local conditions, both environmental and mechanical, are cancelled out. This is independent of the Primary/Secondary setting.

Determine Vehicle height from Z

Select this checkbox if the USBL system is to be used to determine the height of the vehicle. This is independent of the Primary/Secondary setting.

Graphics:

Select On to have WinFrog display the device name and a square at the location of the hydrophone within the Graphics and Bird's Eye windows.

Error Detection:

Select On to have WinFrog analyze the error codes included in the Nautronix RS/916's output data strings and to have WinFrog include error detection codes in the Raw Files for post project QC analysis. If an error code is recognized, WinFrog will not utilize that particular data string in its calculations of the beacon position.

Select/Configure Transducers:

Some USBL systems can be configured with two hydrophones. Before configuring a transducer, ensure that it is the correct one and that the values entered refer to that device. Click Configure Transducer 1 or Configure Transducer 2 as required. The Configure USBL Transducer dialog box appears as seen below.

Configure USBL Transducer ? X

Calibration Corrections

Range Scale Factor	Head Rotation Correction
1.00000	0.00000
Pitch Correction	Roll Correction
0.00000	0.00000

NOTE: Corrections sign conventions are
Roll=(+)Stbd down; Pitch=(+)Stern down

USBL System Internal Offsets

Offsets from the point the data is related to, to the transducer. These values will be subtracted from the USBL output data to get data related to the transducer.

Fore/Aft	Port/Stbd	Z (down +)
0.00m	0.00m	0.00m

WinFrog Offsets, from CRP to Transducer

Fore/Aft	Port/Stbd	Depth (down +)
0.00m	0.00m	0.00m

OK Cancel Help

Calibration Corrections:

WinFrog allows you to enter Range Scale, Heading, Pitch and Roll correction values to correct raw USBL measurements. Note that the Heading, Pitch and Roll values are entered in degrees and decimal degrees. These values can be determined by using WinFrog's USBL calibration utility. See chapter 20 of the WinFrog User's Guide for detailed information on calibration of USBL systems.

USBL System Internal Offsets:

This section of the Configure USBL Transducer dialog box is for the entry of X,Y and Z offsets that will be applied to the raw observations received from the Nautronix RS/916 console.

The upper fields are used to remove any offsets that have been entered into the Nautronix RS/916 console. This may come into use particularly when USBL systems are used for vessel positioning, where the ship's DP system needs positional information to relate to the vessel's center of gravity as opposed to just at the USBL hydrophone. WinFrog however requires all XYZ offsets to relate to the USBL hydrophone. These upper fields are then used to enter the same offsets as are entered in the Nautronix RS/916 console, nullifying the offsets in the Nautronix RS/916. As these values are subtracted from the received data, ensure that values are entered using the same sign as internal Nautronix RS/916 offsets.

The lower fields, **Winfrog Offsets, from CRP to Transducer**, are similar to all other positional device offsets entered in WinFrog. These offsets must be entered to relate the hydrophone's position to the vessel's Common Reference Point (CRP). All offsets are entered with signage referring to the distance *from* the CRP *to* the hydrophone.

Data item: USBL, Nautronix RS/916, BEACON

As mentioned above, for subsurface vehicle positioning, the USBL beacon must be added to the appropriate subsurface vehicle's device list. Once added to the device list, it must be edited to suit the application. Editing the **USBL, NAUTRONIX RS/916, Beacon** data item brings up the Configure USBL Beacon dialog box, as seen below. The Beacon data item must be added to the vehicle to which the beacon has been physically attached (i.e. the ROV or towed vehicle).

Configure USBL Beacon

Calculation: ☒ Primary ☐ Secondary

Accuracy: 10.00m

Error Detection: ☐ On ☒ Off

Deskewing Options:

- ☒ Deskew Beacon Timestamp
The data signal reception time is corrected to the signal transmission time based on sound velocity and slant range.
- ☒ Deskew Hydrophone Position
The hydrophone position is deskewed to the appropriate beacon epoch based on the hydrophone vehicle's speed and CMG. If not on, the last updated position for the hydrophone is used regardless of age.

Code: 1

ROV Depth from USBL: ☒ Yes ☐ No

LBL Calibration: ☐ Use For Calibration

Graphics: ☒ Off ☐ On

Offset, from the CRP:

Fore/Aft	Port/Stbd	Height (+ above CRP)
0.00m	0.00m	0.00m

OK Cancel Help

Calculation:

Set Calculation to **Primary** if the beacon is to be used for positioning the vehicle to which it is attached. Multiple beacons can be added to the same vehicle's device list, each configured as Primary. WinFrog will calculate a weighted mean position using the Accuracy value entered as the basis for the relative weighting.

Setting the calculation to Secondary will result in the Beacon's position being monitored but not used in the vehicle's position calculation. Note that in case of Primary data item failure WinFrog will not automatically use the data item(s) designated as Secondary. You must change the calculation to Primary in order for the data item to be used in position calculations.

Accuracy:

This value is used by WinFrog to weight the use of different positioning devices in solving a single vehicle's position. The lower the accuracy value entered, the more accurate it is deemed to be, and hence the more weight that will be applied to it in comparison to the other devices.

Error Detection:

Setting Error Detection to 'On' instructs WinFrog to identify error codes received in the USBL data string and disable the use of bad data. USBL systems include various error codes in the data string when the beacon is not within the optimum "cone of operation" or other operational parameters have been exceeded.

Deskewing Options:

Deskew Beacon Timestamp: This option is for future development.

Deskew Hydrophone Position:

When positioning the beacon, WinFrog uses the last calculated position for the associated USBL Hydrophone to determine the tracked beacon's position. Depending on the vehicle's Kalman filter and Dead Reckoning settings, the position of the hydrophone may be up to 1 second old.

It is recommended that this deskewing option be enabled to remove positional inaccuracies associated with this latency.

Code:

Enter a value matching the code of the beacon attached to the vehicle.

ROV Depth from USBL:

If Yes is selected, the ROV's depth will be set to the calculated USBL beacon depth.

LBL Calibration:

Select the Use for Calibration checkbox if the beacon is to be used in an LBL Calibration.

Graphics:

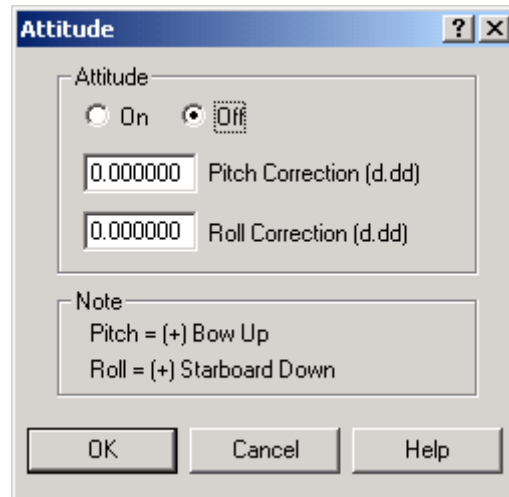
Select On to have WinFrog plot a square and label to represent the beacon location in the Graphics and Bird's Eye displays.

Offsets:

This portion of the dialog box is used to enter Offsets that relate the beacon's location to the subsurface vehicle's Common Reference Point (CRP). These values are set similar to values that would be applied to any device offset within WinFrog, with values entered as measured *from* the CRP *to* the device. A heading (i.e. gyro) device must also be added to the vehicle's device list to ensure that the offsets are applied in the correct direction.

Data item: USBL, Nautronix RS/916, ATTITUDE

The Attitude data item must also be edited once it is added to a vehicle's device list. Highlight the **USBL, Nautronix RS/916, Attitude** data item in the vehicle's device list, then click the **Edit** button. The **Attitude** dialog box appears as seen below.

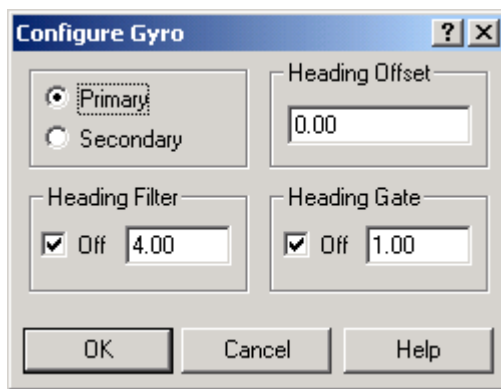


By default, the sensor mode is off, meaning that data from the NAUTRONIX RS/916 will not be used in the vehicle's calculations. To turn the sensor on and begin using the inclination corrections in the position output, click the 'On' radio button. Correction values can also be added in this section of the dialog. The correction values (entered in units of degrees-decimal degrees) are added to the raw pitch and roll values received from the NAUTRONIX RS/916 before the data is applied to the vehicle's calculations.

Ensure that entered values adhere to the sign convention used by WinFrog. You can verify that the corrections are entered properly by viewing the pitch and roll values in the I/O Device window and the Vehicle Text window.

Data item: USBL, Nautronix RS/916, HEADING

The Heading data item must also be edited once it is added to a vehicle's device list. Highlight the **USBL, Nautronix RS/916, HEADING** data item in the vehicle's device list, then click the **Edit** button. The **Configure Gyro** dialog box appears as seen below.



Calculation (Primary/Secondary):

Set the type of calculation to Primary or Secondary by selecting the appropriate radio button. Devices set to Primary are used to provide the vehicle with heading information. However unlike the Position data items, WinFrog does not calculate a weighted mean solution for multiple Heading data items. If more than one Heading data item is set to primary, the vessels heading, in WinFrog, will jump back and forth between the two. Devices set to Secondary are simply monitored, and are not used in the vehicle's calculations.

In the case of Primary device failure, WinFrog will not automatically use the Secondary device(s). You must manually change a Secondary device to Primary status in order for it to be used in the vehicle's calculations.

Heading Offset:

A correction value (as determined from a gyro calibration) can be input in the Heading Offset box. This value is added to the heading value from the Device to provide a corrected heading for the vehicle. Note that positive or negative values can be entered.

Heading Filter/Heading Gate:

The Heading Filter is used to "smooth" heading values used by the vehicle. The value entered in the Heading Filter indicates the number of headings that will be used to predict the next heading value. The larger the value entered, the "heavier" the filter will be – i.e. the slower the vehicle's heading will respond to changes.

The heading gate defines a tolerance value to limit the use of anomalies in gyro readings. If the next observed gyro value received falls outside the specified range of predicted values (i.e. plus or minus the entered value), the value will not be used.