WinFrog Device Group:	**USBL**
Device Name/Model:	**SIMRAD400**
Device Manufacturer:	**Kongsberg Simrad AS** P.O. Box 483 3601 Kongsberg Norway E-mail: WebOffice@kongsberg.simrad.com Phone: 47 32 28 50 00 Fax: 47 32 73 59 87
Device Data String(s) Output to WinFrog:	ASCII: "$PSIMSSB" with “PSIMSNS” or “$PSIMLBP” Winfrog decodes these strings to: Code, error check, X,Y,Z, travel time, data status, heading, pitch, roll and data age. Note: For $PSIMSSB, the USBL must be configured to output the data in ship referenced Cartesian coordinates (metres), UTM coordinates (metres) or Geographic coordinates (radians). Binary: Binary message 1. Transponder position data. Winfrog decodes these strings to: Code, error check, X,Y,Z, data status, heading, pitch and roll.
WinFrog Data String(s) Output to Device:	Nil
WinFrog .raw Data Record Type(s):	Type 309 (USBL Beacon) Type 312 (USBL Hydrophone)

DEVICE DESCRIPTION:
The Hydroacoustic Position Reference (HPR) systems are based on long, short and super short baseline principles or a combination of all. The HPR 400 family consists of the following models:

HPR 406 - an SBL System with three to four hull mounted transducers. The system is used in conjunction with subsea transponders.

HPR 408 - an LBL system for positioning within a transponder array. Different beam-forming transducers are available for use with this system. The position calculation is based on range measurements to three or more transponders.

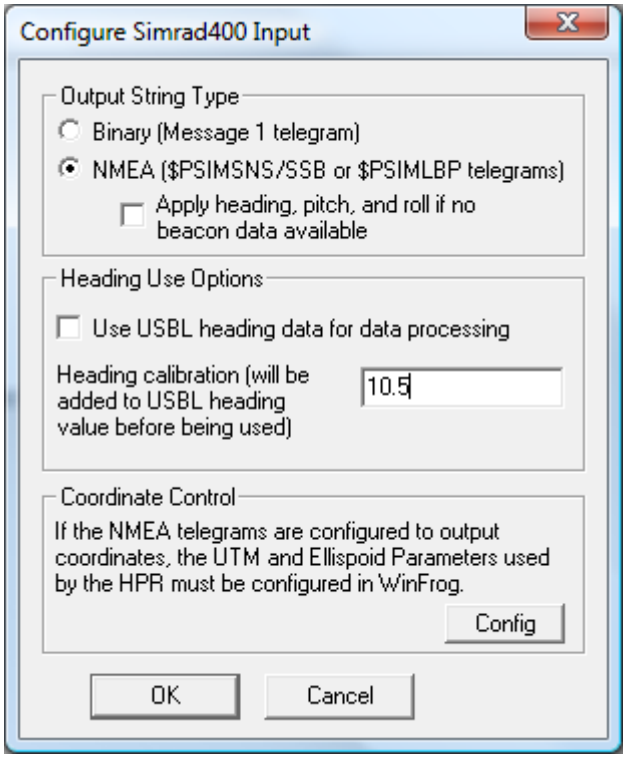
HPR 410 - an SSBL (Super Short Base Line) system with possibilities to interface different types of transducers with beam-forming technique for optimum performance in difficult and noisy environments.

HPR 418 - This system is a combination of the HPR 408 and HPR 410, and can operate in SSBL, LBL and combined SSBL/LBL modes.

DEVICE CONFIGURATION INSTRUCTIONS:
Following parameters are suggested.
Baud Rate: 9600
Data Bits: 8
Stop Bits: 1
Parity: None

Standard RS-232C or RS-422 serial communication is used to output data to external devices. Refer to the Configuration Details section for detailed I/O string telegrams.

WINFROG I/O DEVICES > CONFIGURE DEVICE:
The Simrad400 is accessed via the USBL device types. The Hydrophone, Beacon, Attitude, Heading, and Position sub-devices are added to WinFrog when the Simrad400 is added. The following configuration is available from the I/O Devices Window.



Output String Type:
WinFrog supports both binary and ASCII telegram decode, specifically the *Binary Message 1* (USBL), the *NMEA $PSIMSSB* by itself and in combination with *$PSIMSNS* (USBL) and the *NMEA $PSIMLBP* telegram (LBL). WinFrog also supports the $PSIMSNS telegram when received with no acoustic position; the heading, pitch, and roll can be applied to the vehicle. Check the box to apply this data when no beacon data is available.

The USBL binary telegram is supported for ship referenced Cartesian XYZ coordinates in metres only.

The USBL ASCII telegrams are supported for the following coordinate type options only:

- Ship referenced Cartesian XYZ coordinates in metres
- UTM coordinates in metres
- Geographic coordinates in radians

The LBL ASCII telegram is supported for UTM position data only.

For USBL applications, the $PSIMSSB/SNS telegram combination should be used. The SNS telegram provides an age of data that allows WinFrog to more accurately time stamp the data.

See CONFIGURATION DETAILS for more details.

Heading Use Options:
This device can be configured to pass the decoded heading data through to the vehicle for use when processing the XYZ data to derive a beacon position (check the *Use USBL heading data for processing* check box). The benefit of this is that the heading is for the specific epoch that the data is valid for and thus is a more correct value to use than the vehicle heading at the time of the telegram reception. (This heading data is also then passed to the calibration file as the vehicle heading at the calibration data epoch).

Note: This is independent of the use of the heading data as a HEADING data item and is applicable only for the calculation of beacon positions and being logged to the USBL calibration file.

The calibration value for the heading source input to the USBL system and ultimately output to WinFrog can also be entered. This calibration value is added to the heading data decoded from the USBL message. The corrected heading is logged to the respective raw records. In addition, if the HEADING data item is utilized, the heading value passed to the vehicle is the corrected heading.

Coordinate Control:
When using the SSB or LBP telegram to output UTM or geographic coordinates, this device must be configured for the Working Ellipsoid and UTM Projection Parameters used by the USBL system (click the *Config* button). This allows WinFrog to correctly transform the input coordinates to the WinFrog Working Ellipsoid and Map Projection. The configuration operator interface and options are the same as those for the configuration of the WinFrog Geodetics. Refer to the Configuring Geodetics & Units chapter in the Winfrog User's Guide for more information on configuring geodetics.

WINFROG VEHICLE > CONFIGURE VEHICLE DEVICES > DEVICE DATA ITEM > EDIT:
As mentioned above, adding the Simrad 400 device to WinFrog creates five separate data items: the **USBL,SIMRAD 400,USBL HYDROPHONE,** the **USBL,SIMRAD 400,BEACON,** the **USBL,SIMRAD 400,ATTITUDE,** the **USBL,SIMRAD 400,HEADING** and the **USBL,SIMRAD 400,POSITION.**

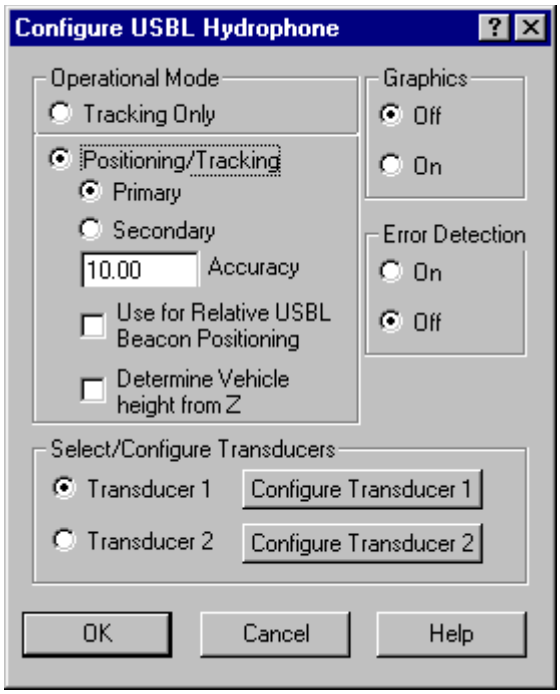
For remote vehicle tracking, the Hydrophone data item must be added to the device list of the vehicle to which the hydrophone has been physically attached (i.e. the main ship). The Beacon data item must be added to the vehicle to which the beacon has been physically attached (i.e. the ROV or towed vehicle).

The USBL Hydrophone is usually added to the master vehicle. The Attitude, Heading and Position are optional but also usually added to the master vehicle when initiated.

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. In this type of operation 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 position of the Beacon into that file. The Hydrophone must be added to the ship's device list and configured for positioning as opposed to tracking mode. See the Working Files chapter of the WinFrog User's Guide for more information on setting up *.XPT files.

1. Configuration of the USBL Hydrophone

Once the SIMRAD 400 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,SIMRAD 400,USBL HYDROPHONE 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 remote 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 located on the stationary (fixed) object, 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 the USBL Calibration chapter 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.

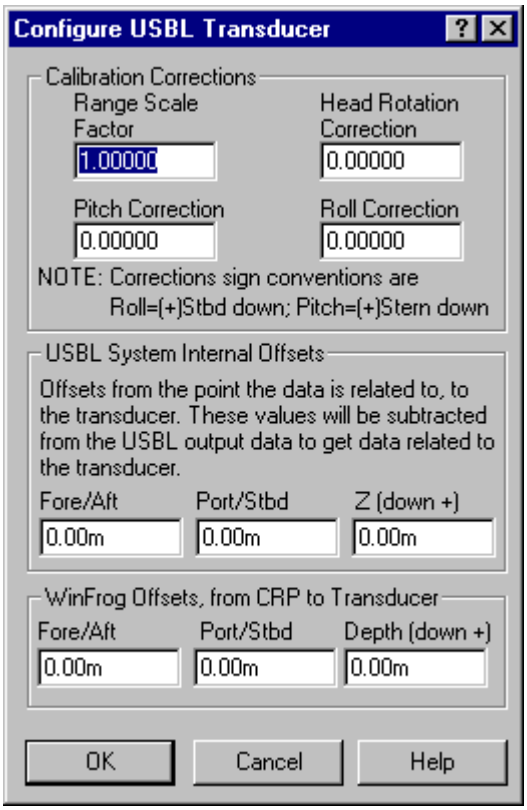
Note: the default value for the Positioning Accuracy is 10m. It is not recommended to set this value below 7m. In Tracking Mode, the accuracy setting is in the Beacon configuration dialog.

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:
By enabling this option, error detection codes are included in the Raw Files. This option is mainly for post project QC analysis and future development.

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.



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 the USBL Calibration chapter of the WinFrog User's Guide for detailed information on calibration of USBL systems.

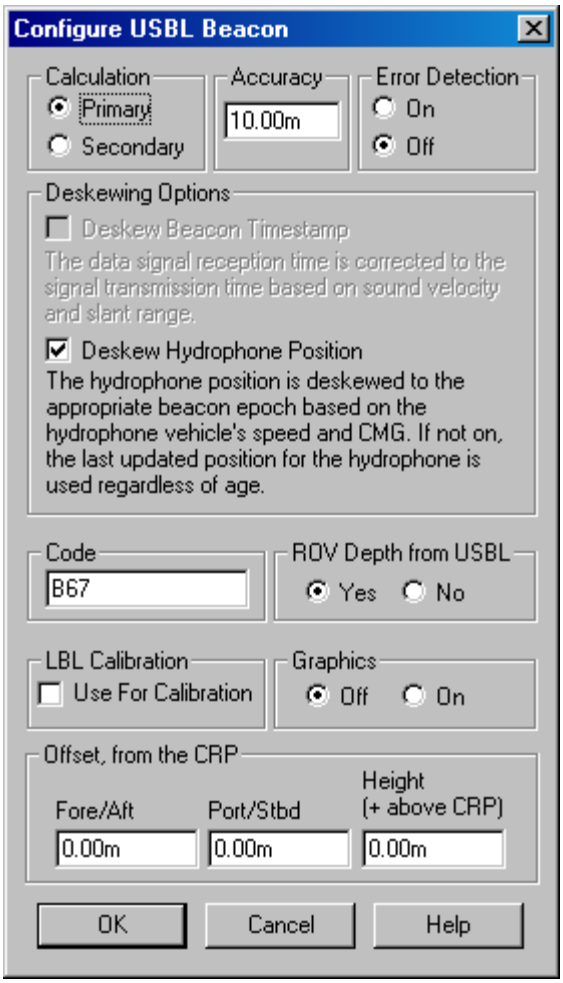
Offsets:
This section of the Configure USBL Transducer dialog box is for the entry of X,Y and Z offsets that will be applied to the raw observations received from the SIMRAD 400 console.

The upper fields are used to remove any offsets that have been entered into the SIMRAD 400 console. This may come into use specifically 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 SIMRAD 400 Console, nullifying the offsets in the SIMRAD 400. As these values are subtracted from the received data, ensure that values are entered using the same sign as internal SIMRAD 400 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.

2. Configuration of the USBL Beacon

For subsurface vehicle positioning, the USBL beacon must be added to the appropriate vehicle's device list. Once added to the device list, it must be edited to suit the application. Editing the **USBL,SIMRAD 400,Beacon** device opens the Configure USBL Beacon dialog box, as seen below.



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.

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. Note that if the $PSIMSNS telegram is used, WinFrog does not have to apply any deskewing because the age of the data allows accurate time stamping of the data epoch.

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. The code should match the Kongsberg Simrad format, e.g. Axx for low frequency beacons, Bxx for medium frequency beacons, Cxx for high frequency beacons, and Mxx for Cymbal codes.

For backwards compatibility, WinFrog will also accept the integer value used in previous versions of WinFrog (e.g. 161 for B61) and convert it accordingly.

For new codes that are not in use or published at time of writing, WinFrog will treat the transponder code as a pure integer (no letter prefix), in which case just enter the integer here that corresponds to the decoded value as displayed in the decoded data window. For example, should a new beacon type be manufactured that uses transponder codes Qxx, say Q47, in the decoded data window WinFrog may see it as 4047, in which case enter 4047 here. Since we cannot anticipate the letter code you must just use the number. This will only work for the binary data telegram as the NMEA telegram uses the letter and we can't anticipate future letters and their binary mapping.

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.

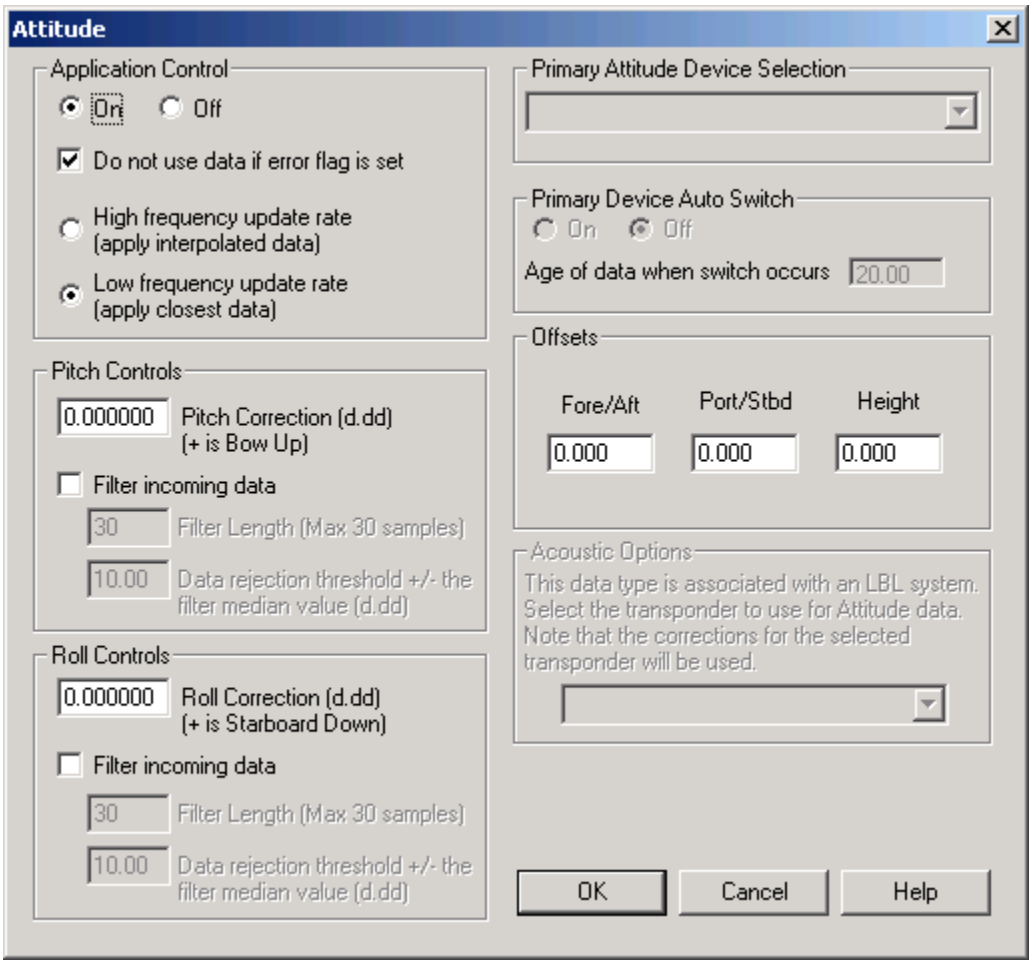
Offsets:

This portion of the dialog box is used to enter Offsets that relate the beacon's location to the 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 device must also be added to the vehicle's device list to ensure the correct application of the offsets.

3. Configuration of the Attitude

The Attitude can be enabled (turned on) within the Attitude Window shown below. By enabling the Attitude, vessel and sensor offsets (except USBL HYDROPHONE) are corrected for the pitch and roll.



Attitude

By default, the sensor mode is off, meaning that data from the device 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.

Error flag testing

The error flag check box is applicable to those devices that output a code indicating the data is either good or bad. If checked and the device supports such a code in its telegram, WinFrog will look at the code and if the data is indicated as bad, WinFrog will not use the data.

Sensor Update Frequency Rate
If the associated attitude sensor has a high frequency update rate (e.g. 10Hz and higher) it is appropriate to extract attitude data for application by either interpolating or extrapolating for a given epoch. In this case, the *High frequency update* option should be selected. Some attitude sensors have slow update rates, in particular those installed in acoustic transponders that require interrogation. For these sensors interpolation/extrapolation can produce a bad value as there is insufficient information to determine the correct shape of the curve (aliasing). Thus the most current attitude needs to be used. In this case, select the *Low Frequency update* option. This option applies to the use of the attitude data by the following data items:

- POSITION
- ELEVATION
- ALTITUDE
- XPONDER
- LBL TRANSCEIVER
- PROFILE

Pitch and Roll
There are two control groups, one for each of pitch and roll. Correction values can be added in this section of the window. The correction values (entered in units of degrees-decimal degrees) are added to the raw pitch and roll values received from the device 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.

Filtering
Additionally you may filter the incoming values to remove extraneous noise or spikes – check boxes are provided to switch this feature on or off. A filter length (up to 30 samples) and a threshold value (applied to the median of the samples in the filter to obtain lower and upper bounds) can be entered. Any pitch or roll values outside of the bounds are rejected and not used in the vehicle calculations, but will be recorded in the RAW files. If either one of pitch or roll is rejected, both values are ignored, although you may set up the filtering parameters for them separately. The status of the filters, including the current valid range for each of pitch and roll, and the percentage of values rejected, can be viewed in the calculations window, selecting the appropriate ATTITUDE data item.

> ***Important:***
> Do not enable filtering unless there is a high enough data rate (say 10hz) to correctly determine the shape of the curve. Essentially, if the low frequency update rate is selected above, do not enable filtering.

Primary Attitude Device Selection
If more than one attitude device is present, you may select one of them to be primary and the others to be secondary and allow WinFrog to automatically switch between them should the primary system stop sending data or has bad data. There must be at least two attitude data items added to the vehicle to use this feature. (Note: The attitude and offset data displayed in this dialog is for the attitude device corresponding to the data item that is being edited. Selecting a Primary Attitude Device from the drop down list does not affect these values for any attitude device in the list. Every attitude device needs to be set up for its own corrections and offsets.)

Primary Device Auto Switch
Select the On radio button to turn on this feature. Then enter the time out time in the edit box. If WinFrog does not receive data from the primary attitude device, or if it receives bad data for this length of time, it will switch to the next secondary that is enabled and has good data.

Auto Switch Feature Usage
To use this feature first turn the sensor on as described in the Attitude section above. Next, select the attitude device that you wish to be primary from the drop down list box. Then turn the primary device auto switch on and enter the time out time. Then edit all the other attitude data items and enable them in the Attitude group box. Note that the same selected primary will be displayed for all attitude data items; similarly, the automatic feature will be turned on and the time out time will be the same. However, you must individually enable each attitude device in the Attitude group box.

Offsets
These are not applicable in this case.

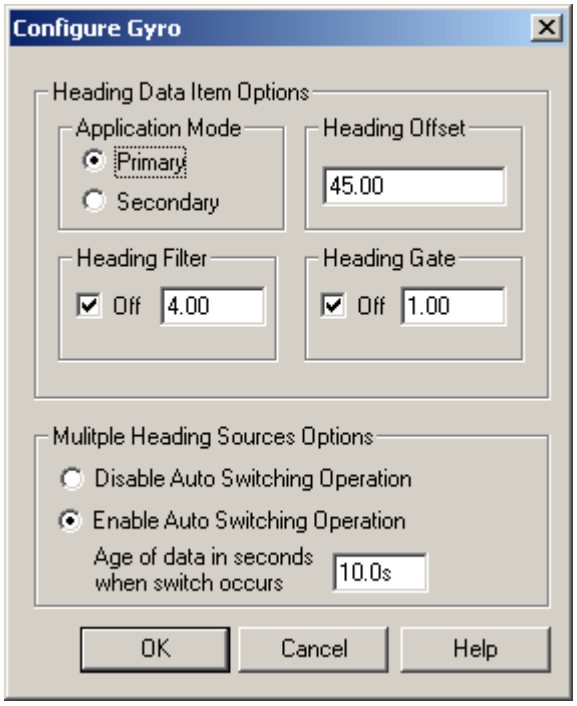
Acoustic Options
This applies to long base line acoustic transponders that have inclinometers.

4. Configuration of Heading

The configuration of the Heading is similar to the Gyro Input to WinFrog. If there is a heading sensor input to WinFrog, such as a survey gyro, this device can be set to secondary and used as a back up heading.

Note: The update rate of this device does not adequately support the use of this data item as a vehicle's HEADING data item for anything other than a secondary heading source for comparison only.

Note: The heading value passed to the vehicle is the corrected heading based on the calibration value entered in the device configuration. Therefore, it is most likely that a Heading Offset value will not be required here.



Application Mode (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 heading information. Devices set to Secondary are simply monitored, and are not used in the vehicle's calculations.

Note that WinFrog supports automatic switching from a designated Primary to a Secondary in the case that data from the Primary fails (see Multiple Heading Sources Options).

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.

Multiple Heading Sources Options:
WinFrog supports automatic switching from a designated Primary source to an alternate Secondary source in the event that the Primary fails. The first Secondary source to receive data after the Primary has failed becomes the alternate Primary providing the heading for the vehicle. When the designated Primary is detected as active again, the alternate Primary source reverts to Secondary and the designated Primary provides the heading data to the vehicle.

If an alternate Secondary fails and there are additional Secondary sources, it in turn is detected by the first of the remaining operational Secondary sources to receive data after the failure at which time this Secondary becomes the alternate Primary.

Note that this option is only available if more than 1 HEADING source is associated with the respective vehicle. Changes made to the Auto Switching options for any one of the HEADING data items are automatically assigned to the others upon exiting this dialog with OK. If the Auto Switching option is enabled and the respective HEADING source has been set to Primary, all others are automatically set to Secondary. The exception to this is when configuring a WinFrog Controlled Remote (WinFrog with a Remote module) from a Controller. In this case, changes made to one HEADING source are not automatically made to other HEADING sources. The operator must explicitly make them for each HEADING source.

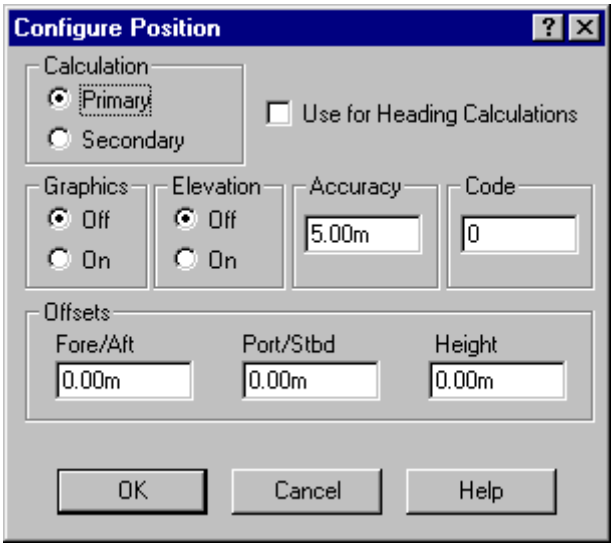
This option is not available in the WinFrog Remote package.

Disable/Enable Auto Switching Operation:
Select the mode you wish to operate WinFrog.

Age of data in seconds when switch occurs:
Enter the age of data that is permitted before the source is considered to have failed.

5. Configuration of Position

The position output can be configured similar to a standard positioning sensor in WinFrog. The figure below shows the dialog box for NMEA position data.



Calculation/Position Information:
Choose whether the input should be the Primary or Secondary positioning source for the Vehicle. Select the Use for Heading Calculations checkbox if this input is to be used for heading input. Set the accuracy to a realistic accuracy as this value is used in the filtering routines of the vessel.

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.

Code:
If the source of the POSITION data is a USBL telegram, enter the beacon code. If the source is an LBL telegram, then enter the code for the transponder being positioned.

The code entered is to match those given in the Kongsberg Simrad manual, specifically

- Ann for low frequency beacons (USBL)
- Bnn for medium frequency beacons (USBL)
- Cnn for high frequency beacons (USBL)
- Rn for ROV 1 through 4
- Tn for TPs 1 through 4
- Ve for the vessel position

For backwards compatibility, WinFrog will also accept the integer value used in previous versions of WinFrog and convert it accordingly. The conversions are as follows:

- Ann: Low frequency beacon, code = nn
- Bnn: Medium frequency beacon, code = 100 + nn
- Cnn: High frequency beacon, code = 200 + nn
- R1 - R4: ROV, code = 301 - 304
- T1 - T4 TP, code = 401 - 404
- Vel: Vessel, code = 500

Elevation
Set this value if the Z/depth component of the USBL or LBL data is to be used as the elevation of the vehicle.

Offsets:
Offsets should be input for the sensor's position similar to all sensor offsets input to WinFrog.

Graphics:
Select On to have WinFrog display a square in the Graphics and Bird's Eye windows.

CONFIGURATION DETAILS:
The Simrad HPR 400 accepts Binary or ASCII data. The following sentences can be output from the HPR400:

File Name	Contents
LBL_ARR	$PSIMKBD, $PSIMLBL, $PSIMLBG, $PSIMLGQ, $PSIMLBO, $PSIMLOQ
LBL_POS	$PSIMLBP, PSIMLBM
SSBL_POS	$PSIMSSB, $PSIMSNS

Note: Only $PSIMLBP, $PSIMSSB and $PSIMSNS are supported in WinFrog, under the ASCII option. In the case of the SSB telegram, WinFrog supports the data in either ship referenced Cartesian coordinates, UTM coordinate or geographic coordinate (in radians) formats.

The following Binary Information is transmitted across when the Binary Option is Chosen:

File Name	Contents
LBL_ARR	Message Type 5 (Location Data) and 6 (Base Lengths)
LBL_POS	Message Type 2 (LBL Position) and 4 (LBL Ranges)
SSBL_POS	Message Type 1 (Transponder Position Data)

Note: Only Message Type 1 is supported in WinFrog. Refer to the HPR400 manual for the contents of these messages. The format must be ship referenced Cartesian coordinates.