

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. 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.



HPR400 Series Console

APOS - This software package can be run with the above systems plus the older HPR 300 series.

DEVICE CONFIGURATION INSTRUCTIONS:

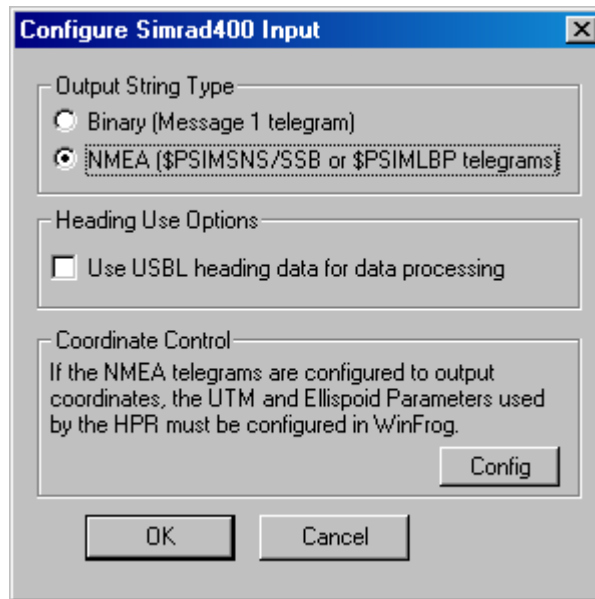
Following parameters are suggested.

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 > CONFIG OPTIONS:

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 telegram)* (USBL), the *NMEA \$PSIMSNS and \$PSIMSSB* combination (USBL) and the *NMEA \$PSIMLBP* telegram (LBL). The binary telegram is only supported only for the decode of XYZ data. The USBL ASCII telegrams are supported for the detection and decode of both XYZ, UTM coordinates and geographic coordinates (in radians) data. The LBL ASCII telegram is supported for the decode of UTM position data.

Note: When using/decoding XYZ data, the data must be in ship referenced Cartesian coordinate format.

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.

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). The disadvantage is that a gyro correction cannot be applied within WinFrog.

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 chapter 3 in the WinFrog User's Guide for more information on configuring geodetics.

WINFROG VEHICLE TEXT WINDOW > CONFIGURE VEHICLE DEVICES > DEVICE > EDIT OPTIONS:

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**.

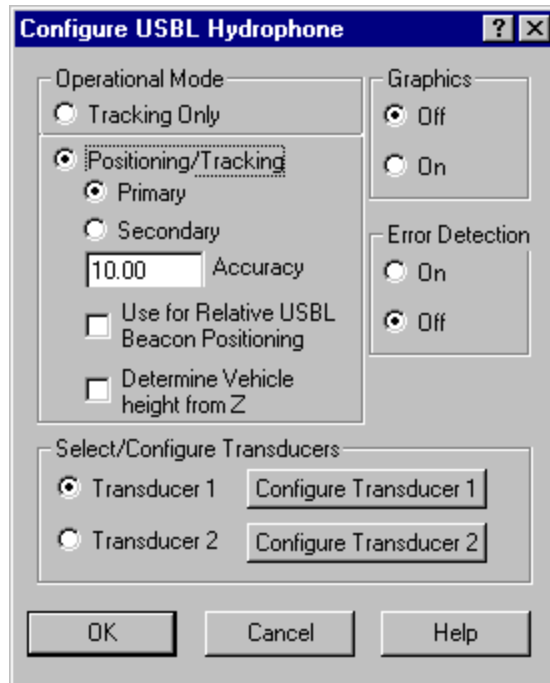
For remote vehicle tracking, the Hydrophone data item must be added to the device list of the vehicle to which the hydrophone has been physically attached (i.e. the main ship). The Beacon data item must be added to the vehicle to which the beacon has been physically attached (i.e. the ROV or towed vehicle).

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 chapter 5 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 on the Edit button to the right. The Configure USBL Hydrophone dialog window 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 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.

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:

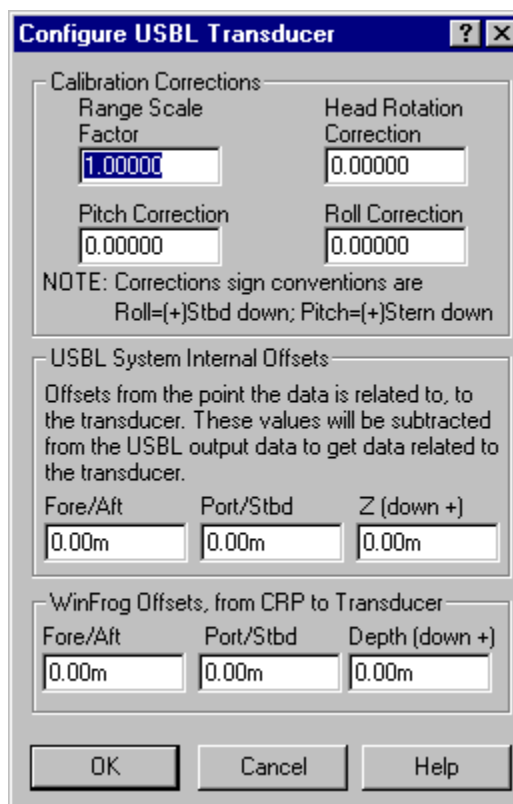
Select On to have WinFrog display the device name and a square at the location of the hydrophone, within the Graphics and Bird's Eye windows.

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.



The image shows a Windows-style dialog box titled "Configure USBL Transducer". It contains several sections for configuring transducer data. The "Calibration Corrections" section has four input fields: "Range Scale Factor" (set to 1.00000), "Head Rotation Correction" (set to 0.00000), "Pitch Correction" (set to 0.00000), and "Roll Correction" (set to 0.00000). Below these is a note: "NOTE: Corrections sign conventions are Roll=(+)Stbd down; Pitch=(+)Stern down". The "USBL System Internal Offsets" section has a text description and three input fields: "Fore/Aft" (0.00m), "Port/Stbd" (0.00m), and "Z (down +)" (0.00m). The "WinFrog Offsets, from CRP to Transducer" section also has three input fields: "Fore/Aft" (0.00m), "Port/Stbd" (0.00m), and "Depth (down +)" (0.00m). At the bottom are "OK", "Cancel", and "Help" buttons.

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.

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

As mentioned above, 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 brings up the Configure USBL Beacon dialog box, as seen below.

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: B67

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.

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. A04 for low frequency beacons, B67 for medium frequency beacons and C18 for high frequency beacons. 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.

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:

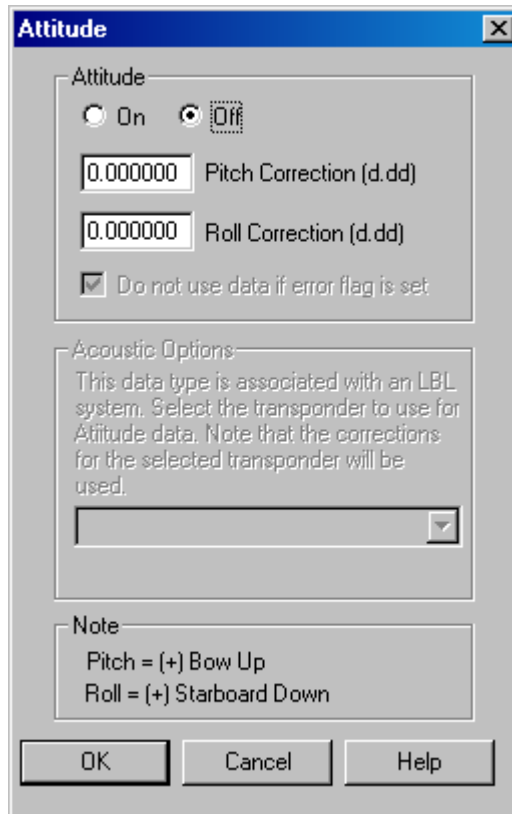
This portion of the dialog box is used to enter Offsets that relate the beacon's location to the vehicle's Common Reference Point (CRP). These values are set similar to values that would be applied to any device offset within Winfrog, with values entered as measured from the CRP to the device. A heading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

3. Configuration of the Attitude

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.

The Pitch and Roll correction values are added to the attitude data.

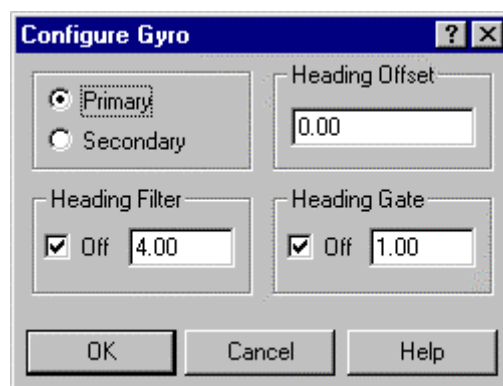


The 'Attitude' dialog box is a standard Windows-style window with a title bar containing a close button. It is divided into several sections. The top section, titled 'Attitude', contains two radio buttons: 'On' and 'Off', with 'Off' being selected. Below these are two text input fields, both containing '0.000000'. The first is labeled 'Pitch Correction (d.dd)' and the second is labeled 'Roll Correction (d.dd)'. A checkbox labeled 'Do not use data if error flag is set' is checked. The middle section, titled 'Acoustic Options', contains a paragraph of text explaining that this data type is associated with an LBL system and that corrections for the selected transponder will be used. Below this text is an empty dropdown menu. The bottom section, titled 'Note', contains two lines of text: 'Pitch = (+) Bow Up' and 'Roll = (+) Starboard Down'. At the very bottom are three buttons: 'OK', 'Cancel', and 'Help'.

Note that the update rate of this device does not adequately support the use of this data item as a vehicle's ATTITUDE data item and should not be used.

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.

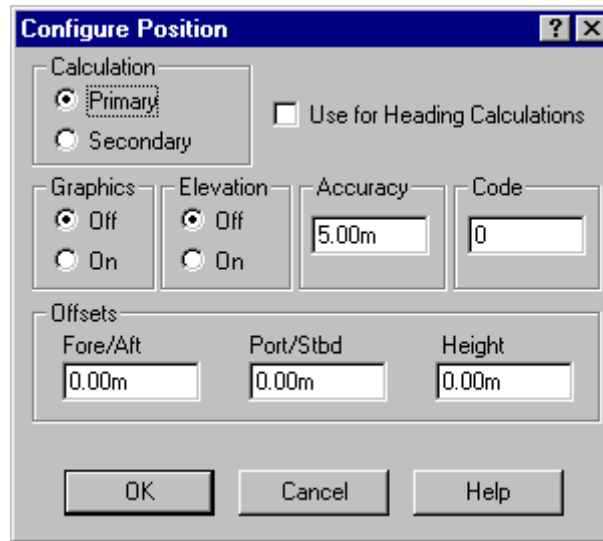


The 'Configure Gyro' dialog box has a title bar with a question mark icon and a close button. It is divided into four main sections. The top-left section contains two radio buttons: 'Primary' and 'Secondary', with 'Primary' being selected. The top-right section, titled 'Heading Offset', contains a text input field with '0.00'. The bottom-left section, titled 'Heading Filter', contains a checked checkbox labeled 'Off' and a text input field with '4.00'. The bottom-right section, titled 'Heading Gate', contains a checked checkbox labeled 'Off' and a text input field with '1.00'. At the bottom are three buttons: 'OK', 'Cancel', and 'Help'.

Note that 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.

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.