WinFrog Device Group:	**USBL**
Device Name/Model:	**SIMUSBL**
Device Manufacturer:	
Device Data String(s) Output to WinFrog:	NONE
WinFrog Data String(s) Output to Device:	NONE
WinFrog Data Item(s) and their RAW record:	USBL HYDROPHONE NONE BEACON 309 ATTITUDE 413 HEADING 409

DEVICE DESCRIPTION:

This is a device designed to provide simulated data similar to real time USBL devices. This device is typically used for simulation and training purposes and as such, many of the options are not typically used. However, since this device is typically used for training purposes, information has been included for all of the options regardless of whether or not they are used in the simulation/training.

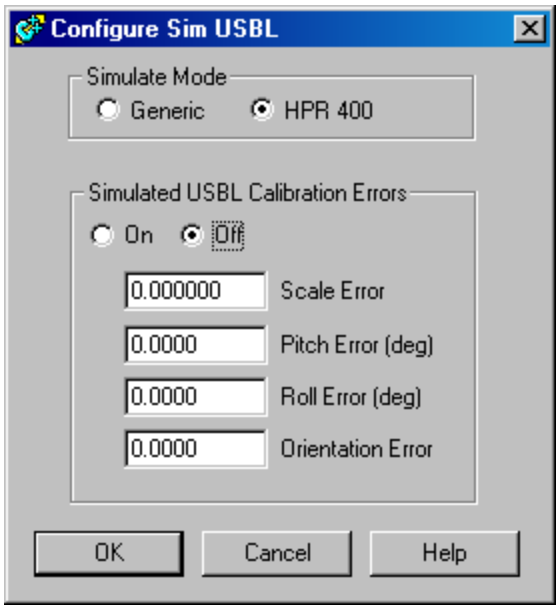
DEVICE CONFIGURATION INSTRUCTIONS

WINFROG I/O DEVICES > EDIT I/O:

No I/O parameters - Simulated Device

WINFROG I/O DEVICES > CONFIGURE DEVICE:

This device must be configured at the I/O Device window level. In the I/O Devices window, click the device name to select it, then right-click and select Configure Device. The Configure Sim USBL dialog box appears, as seen below.



Select the operational mode, either Generic (beacon codes are strictly integers) or HPR 400 (beacon codes reflect those that are used for the Kongsberg Simrad HPR 400 & 500 systems). Refer to the Simrad 400 section in this appendix for details.

Select whether the Simulate Mode is to be On or Off. Calibration Errors for Scale, Pitch, Roll and/or Orientation are entered to introduce simulated errors. Once the simulated calibration is complete, the results of the calibration routines should produce errors similar to the ones entered in this dialog box.

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

Adding the SIMUSBL device creates four data items: USBL HYDROPHONE, BEACON, ATTITUDE and HEADING.

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

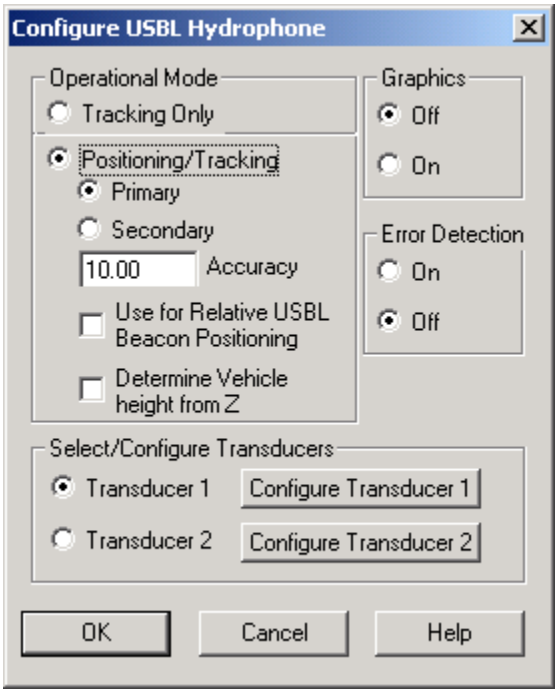
The SIMUSBL system can also be used for simulating the positioning of the main vessel. In a real-time situation, the USBL Beacon would be physically attached to some fixed point on the seabed or subsurface structure. For the sake of the simulation the beacon will simply be assigned a fixed position. 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 coordinates 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.

Once the data items have been added to the vehicles, they must be edited to suit the application.

Data item: USBL, SIMUSBL, USBL HYDROPHONE

Highlight the USBL HYDROPHONE data item in the vehicles device list and click the Edit button to open the Configure USBL Hydrophone dialog box as seen below.



Although many of the options may not typically be used during simulated USBL operations the following is included for information purposes.

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 beacon mounted on 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.

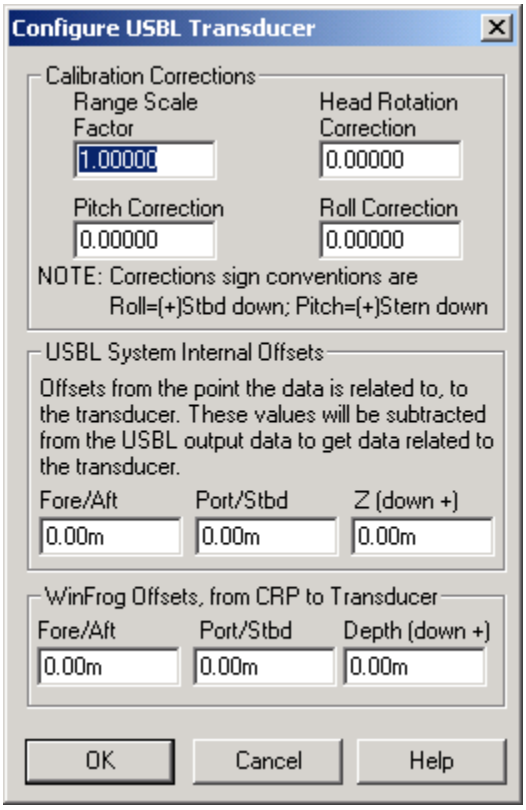
If Positioning/Tracking is selected, you can also specify Use for Relative USBL Beacon Positioning. This feature controls the use of the USBL positioning of the hydrophone from a fixed beacon for application to relative USBL Beacon positioning. In this mode, the difference between the hydrophone position, as determined directly from observation to the 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 SIMUSBL's output data strings and to have WinFrog include error detection codes in the Raw Files. 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.



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.

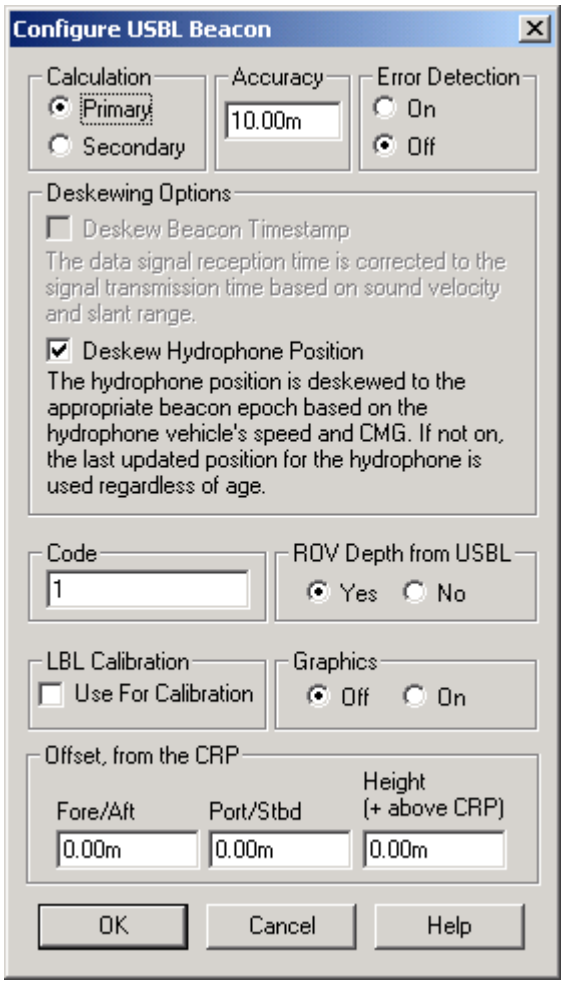
USBL System Internal Offsets:
As mentioned above, many options do not apply to a SIMUSBL device. However for the purposes of training, the information below is included.

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 USBL console.
The upper fields are used to remove any offsets that have been entered into the USBL 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 USBL console, nullifying the offsets in the console. As these values are subtracted from the received data, ensure that values are entered using the same sign as internal USBL console 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, SIMUSBL, BEACON

Highlight the BEACON data item in the vehicles device list and click the Edit button to open 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 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 or structure. Note that if the Simulate Mode has been set to HPR 400, the beacon codes emulate those of the Kongsberg Simrad HPR 400 and 500 systems and the APOS software. See section Simrad 400 in this appendix for details.

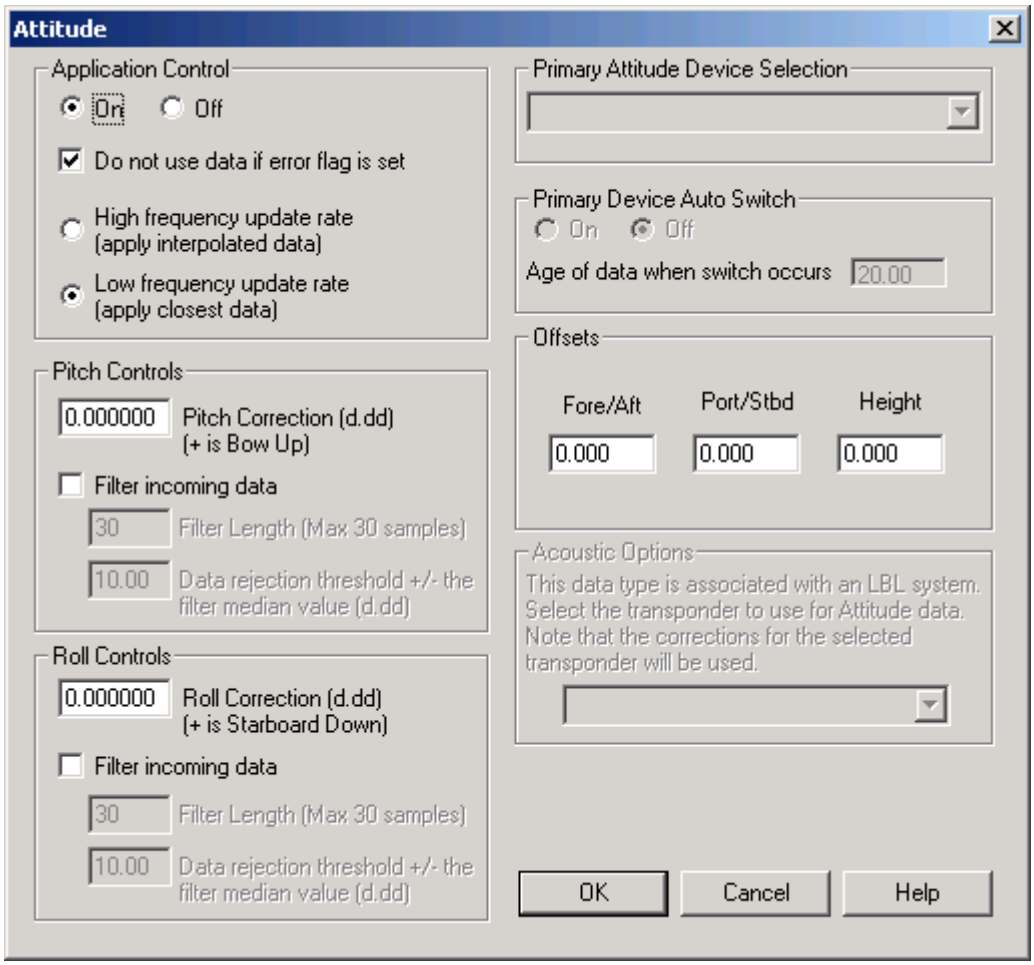
ROV Depth from USBL:
If Yes is selected, the ROV's depth will be set to the calculated USBL beacon depth.

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

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

Data item: USBL, SIMUSBL, ATTITUDE

Highlight the ATTITUDE data item in the vehicles device list and click the Edit button to open the Attitude dialog box as seen below.



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.

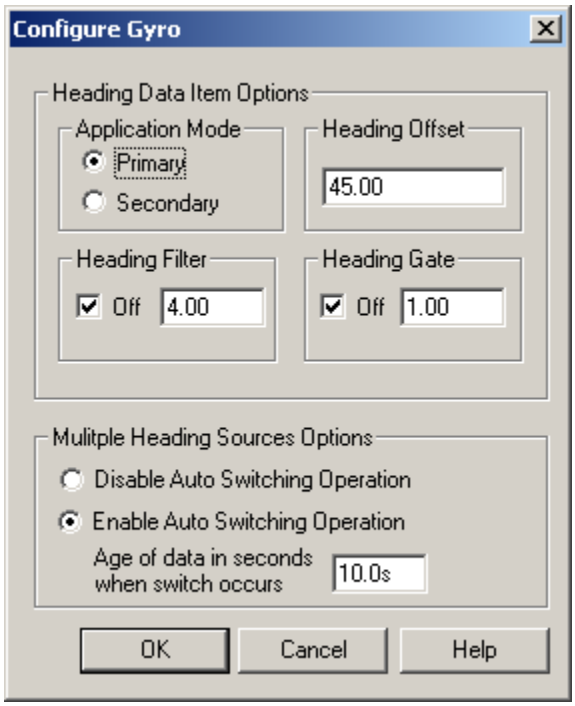
Auto Switch Feature Usage
To use this feature first turn the sensor on as described in the Attitude section above. Next, select the attitude device that you wish to be primary from the drop down list box. Then turn the primary device auto switch on and enter the time out time. Then edit all the other 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. See chapter 17 for more information.

Data item: USBL, SIMUSBL, HEADING

Highlight the HEADING data item in the vehicles device list and click the Edit button to open the Configure Gyro dialog box as seen below.



Heading Data Item Options:
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 SIMUSBL device to provide a corrected heading for the vehicle. Note that positive or negative values can be entered. Also in the case of a simulated device the vehicle can be oriented to any desired heading by applying an offset in this dialog box.

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.