| | |
|---|---|
| **WinFrog Device Group:** | **Speed Log** |
| **Device Name/Model:** | **ISE Speed Log** |
| **Device Manufacturer:** | **International Submarine Engineering Limited**<br>1734 Broadway Street<br>Port Coquitlam BC Canada V3C 2M8<br>Tel: (604) 942-5223<br>Fax:(604) -942-7577<br>E-mail: info@ise.bc.ca |
| **Device Data String(s) Output to WinFrog:** | See below |
| **WinFrog Data String(s) Output to Device:** | Nil |
| **WinFrog .raw Data Record Type(s):** | Type: 402 Speed Log<br>Type: 408,409,410 Gyro<br>Type 413 Attitude<br>Type 411, 911 Water depth<br>Type 496 ROV data<br>See WinFrog manual appendix B for the format. |

**DEVICE DESCRIPTION:**

This device outputs data from an ROV that includes speed information, as well as altitude, depth, heading, pitch, roll and speed.

## *DEVICE CONFIGURATION INSTRUCTIONS:*

**WINFROG I/O DEVICES > EDIT I/O:**

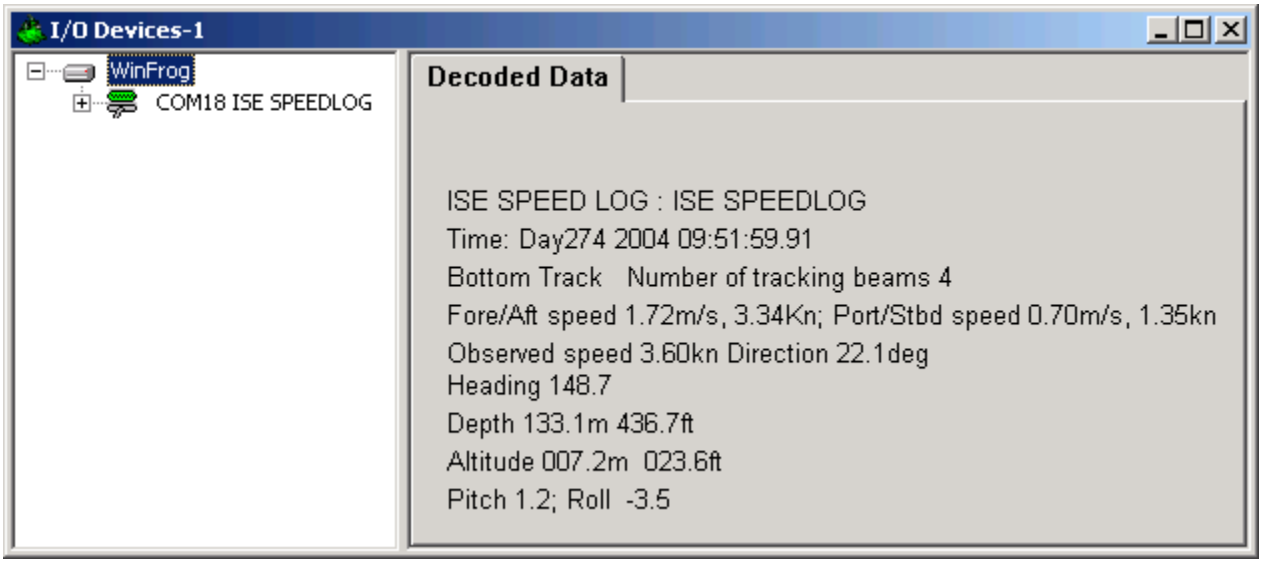
Serial
Configurable Parameters

**WINFROG I/O DEVICES > CONFIGURE DEVICE:**

The ISE Speed Log is added to WinFrog from the SPEED LOG device types. There is no configuration required or available from the Device Window.

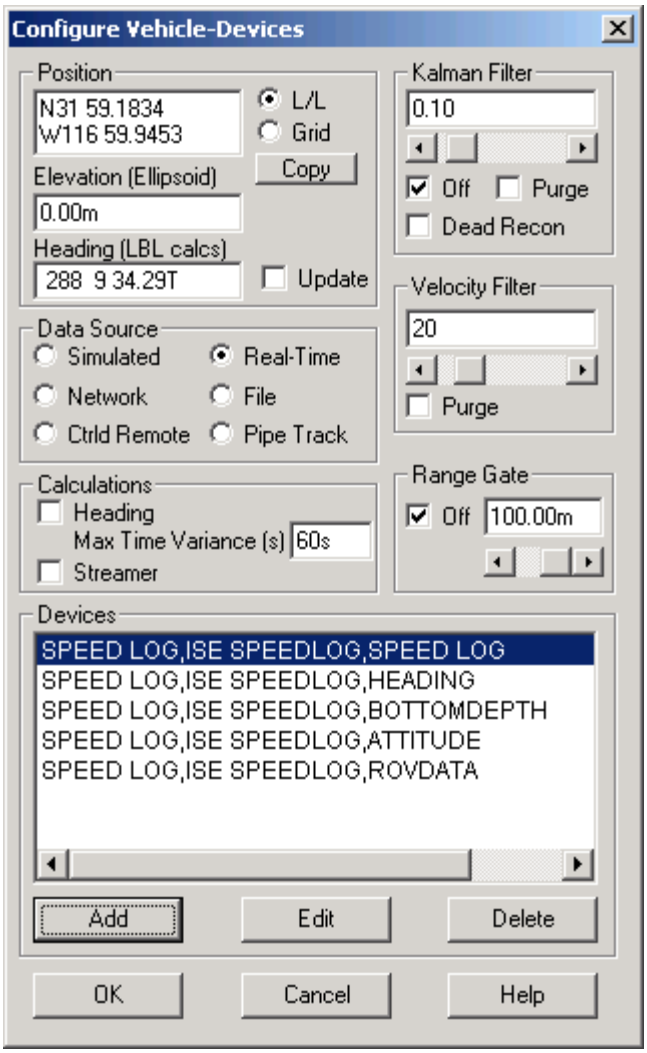
**WINFROG VEHICLE > CONFIGURE VEHICLE DEVICES > DEVICE DATA ITEM > EDIT:**

Upon adding ISE SPEEDLOG to WinFrog, five data items become available. SPEED LOG, HEADING, BOTTOMDEPTH, ALTITUDE and ROV DATA. Once added to the vehicle each item must be edited.



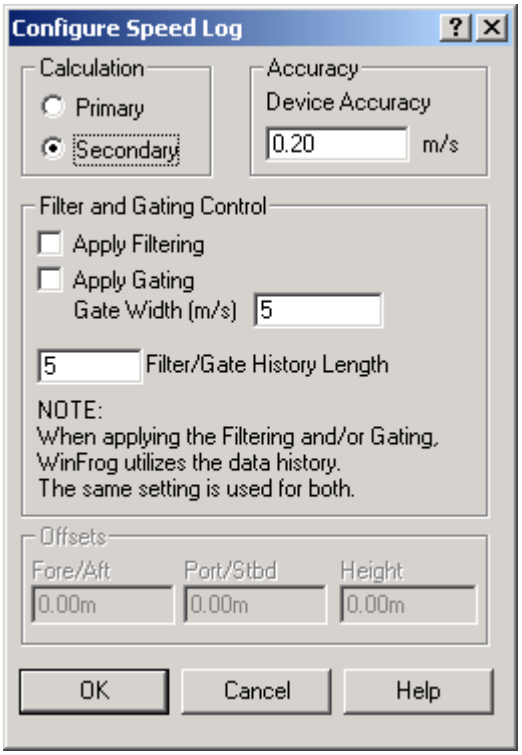

WinFrog is able to utilize the data from Doppler speed logs in the position Kalman Filter to enhance results, specifically for positioning an ROV with USBL. It is critical that the device is set-up correctly, and monitored, in order to ensure correct application of the data. It is also important to note that only the *Speed over Ground* data is used in the Kalman Filter. The Kalman Filter is under the position edit for each vehicle (the Configure Vehicle Devices dialog box). See Configuration Details below for information about combining the speed log with USBL.

**It is important to note that the values and limits stated here for any of the configurations discussed, are guidelines. The operator must evaluate the actual performance and make adjustments accordingly.**


Configure Vehicle-Devices
Position
N31 59.1834
W116 59.9453
L/L
Grid
Copy
Elevation (Ellipsoid)
0.00m
Heading (LBL calcs)
288 9 34.29T
Update
Kalman Filter
0.10
Off
Purge
Dead Recon
Velocity Filter
20
Purge
Data Source
Simulated
Real-Time
Network
File
Ctrld Remote
Pipe Track
Calculations
Heading
Max Time Variance (s)
60s
Streamer
Range Gate
Off
100.00m
Devices
SPEED LOG,ISE SPEEDLOG,SPEED LOG
SPEED LOG,ISE SPEEDLOG,HEADING
SPEED LOG,ISE SPEEDLOG,BOTTOMDEPTH
SPEED LOG,ISE SPEEDLOG,ATTITUDE
SPEED LOG,ISE SPEEDLOG,ROVDATA
Add
Edit
Delete
OK
Cancel
Help

## 1. SPEED LOG,ISE SPEEDLOG,SPEED LOG data item configuration

Configuration of the SPEED LOG data item brings up the Configure Speed Log dialog box.




**Calculation:**
Set to Primary if you wish the Doppler data to be used to assist the position of the vehicle.

**Accuracy:**
Accuracy of the Doppler speed logs in m/s. The default is 0.2. Change this only with caution and knowledge of the results.

**Apply Filtering:**
Controls the filtering of the raw Doppler data prior to its use in the Kalman Filter. If selected, a central tendency filter is applied to the data using the number of samples defined in the *Filter/Gate History Length*, the result of which is used for input to the Kalman Filter.

**Apply Gating:**
Controls the gating of the raw data prior to its use in the Kalman Filter. If selected, the new data is tested against the data history based upon the number of samples defined in the *Filter/Gate History Length*. If it exceeds the gate limits, the data is rejected.

**Gate Width:**
Defines the gating limits in m/s, the value must be determined by monitoring the data.

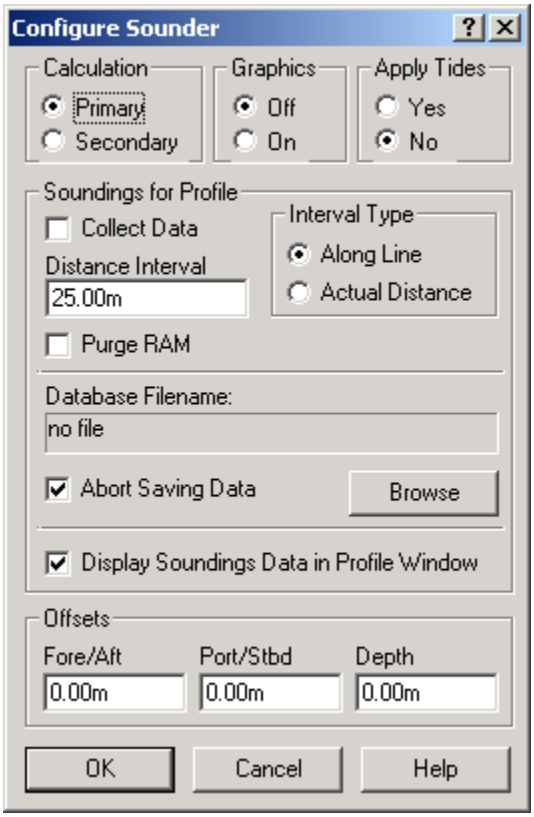
**Filter/Gate History Length:**
Defines the number of samples (minimum 3, maximum 30) to be used for both the central tendency filtering and the gating. This setting must reflect the application, environment and the Doppler performance. It depends upon balancing the need to smooth the data and the required responsiveness to real changes in the data. The longer the filter, the smoother the result; however, the result will be less responsive to the actual dynamics of the vehicle. The shorter the filter, the less smooth the results, and the more responsive to the actual dynamics of the vehicle.

**Offsets:**
Not applicable for this operation.

It should be noted that if the *Apply Filtering* option is selected, but not the *Apply Gating* option, a default gating value of 10m/s is used for the purpose of utilizing the filtering function.

## 2. SPEED LOG,ISE SPEEDLOG,BOTTOMDEPTH data item configuration

Configuration of the BOTTOM DEPTH data item brings up the Configure Sounder dialog box. Configuration for this item is the standard Primary (used) / Secondary (not used), the Graphics Off/On, Applied Tides Yes/No.

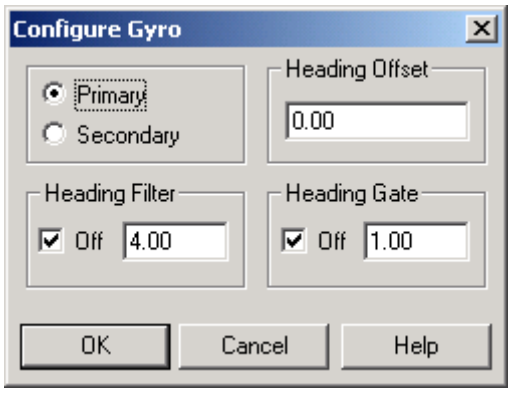


**Soundings for Profile:**
The option exists to collect data at different Intervals (either 'Along Line' or 'Actual Distance'), and the interval can be specified. If the Collect Data checkbox is selected, the soundings are collected for the Profile Window. The Data can also be saved to file for later processing.

Note: If the Applied Tides radio button is turned on, a Tide Device must be added to the WinFrog system and the specific Vehicle.

## 2. SPEED LOG,ISE SPEEDLOG,HEADING data item configuration

Highlighting the HEADING data item and clicking Edit opens the Configure Gyro dialog box.




**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 heading information. 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.

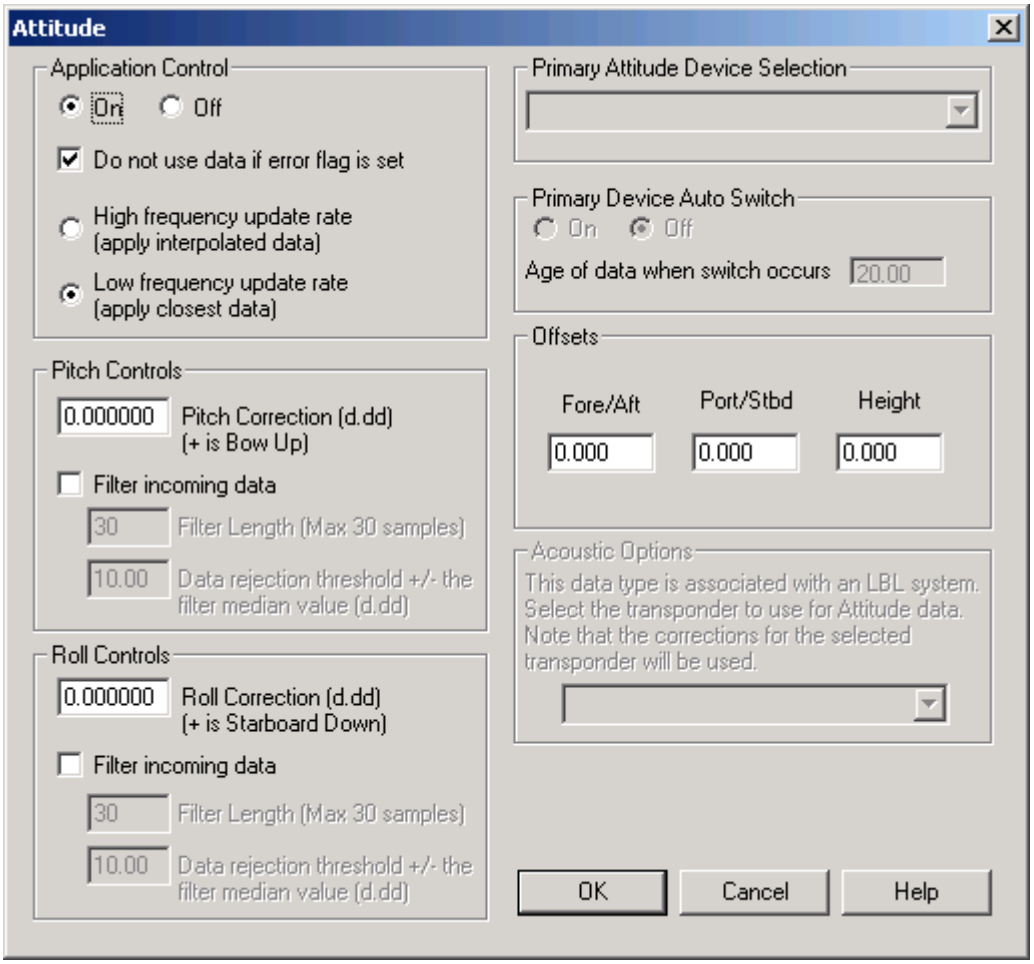
**Heading Offset:**
A correction value (as determined from a gyro calibration) can be input in the Heading Offset box. This value is added to the heading value from the device to provide a corrected heading for the vehicle. Note that positive or negative values can be entered.

**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.

## 3. SPEED LOG,ISE SPEEDLOG,ATTITUDE data item configuration

When the Attitude data item is edited, the Attitude dialog box appears 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.

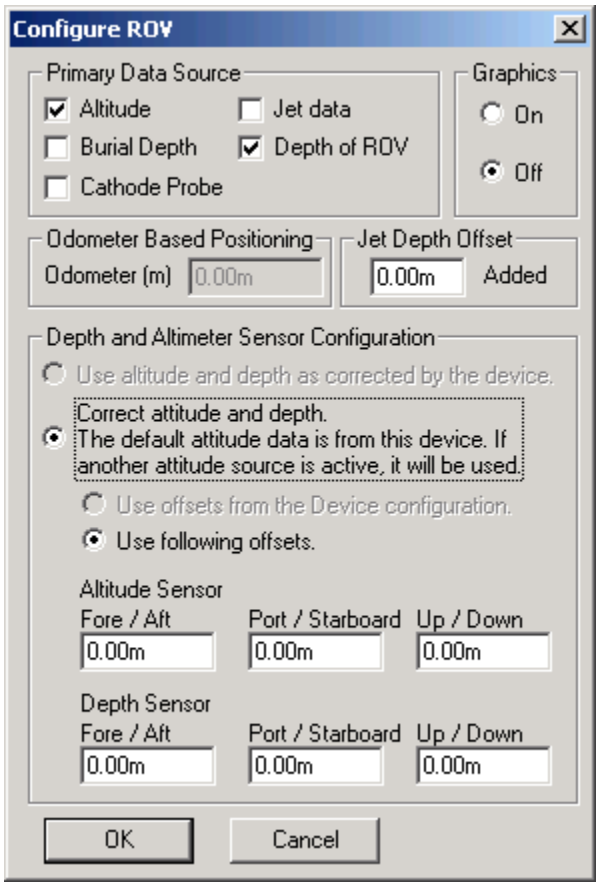
**Auto Switch Feature Usage**
To use this feature first turn the sensor on as described in the Attitude section above. Next, select the attitude device that you wish to be primary from the drop down list box. Then turn the primary device auto switch on and enter the time out time. Then edit all the other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

## 4. SPEED LOG,ISE SPEEDLOG,ROVDATA data item configuration

This data item is designed to read specific ROV type data from this device. Highlight this data item in the vehicle's device list and click the Edit button to open the Configure ROV dialog box as seen below.




**Primary Data Source Group Box**
Checking any of the checkboxes in this group causes the particular data to be assigned to the vehicle. The only data available in the ISE telegram considered ROV data are the altitude and depth.

**Altitude:**
Checking this will result in this vehicle's altitude being determined from the observed altitude value found in the telegram from this device minus the altitude offset also found on this dialog. This value can be displayed in the Vehicle Text window as ROV Alt.

Unchecked will result in no calculation or assignment of the vehicle's altitude from this device. The raw data is still always recorded.

**Burial Depth:** Not applicable.

**Cathode Probe:** Not applicable.

**Cathode Probe:** Not applicable.

**Depth of ROV:**
Checking this will cause the depth of this vehicle's CRP to be determined from the observed depth value found in the telegram from this device plus the depth offset below. This vehicle's elevation will be the negative of this value. This value may be used to calculate the bottom depth.

The bottom depth will be determined as:
Observed depth + Depth Offset + observed altimeter - altitude Offset
The offsets (see below) are not corrected for pitch and roll when determining the water depth.

Leaving this unchecked will result in this device obtaining the depth of the CRP from the vehicle itself, as opposed to assigning it to the vehicle as above. You must assign another device to determine the depth of the vehicle (e.g. USBL and assigning it as the source for depth).

Note: The observed altimeter value is always used for depth determination regardless of the primary/secondary altimeter setting.

**Graphics:**
Select the On radio button to display the device name and a square at the location of the tracked offset, within the Graphics and Bird's Eye windows.

**Odometer Based Positioning:** Not applicable.

**Jet Depth Offset:** Not applicable.

**Depth and Altimeter Sensor Configuration:**
For all ROV devices except Deep Blue ROV, the radio button settings cannot be changed. See the Deep Blue ROV device documentation for information on setting these radio buttons.

Vertical offsets of the altitude and depth sensors, relative to the CRP, can be entered here. The Altitude Offset is the vertical distance (positive up) from the ROV's CRP to the acoustic beacon tracking the seafloor. The Depth Offset is the vertical distance (positive up) from the ROV's CRP to the sensor that provides depth information of the ROV.

The offset position will be corrected for pitch and roll then the vertical offsets will be applied to determine the depth of the ROV and height of the ROV above the bottom.

## CONFIGURATION DETAILS:

Under this section we will attempt to provide further information of the devices that may benefit from the Speed Log input.

### Background on Filtering and Gyro Input

#### General Kalman Filtering:

The Kalman Filtering performed by WinFrog allows the direct input (to the filter) of position and velocity data. The application of this data within the filter is a balance between:

- The accuracy attributed to each individual data type, and,
- The Kalman Filter setting itself.

The former is the accuracy entered by the operator for each data item when configuring its use as attached to a vehicle. The latter is the Kalman Filter setting controlled with the slider bar in the Configure Vehicle Devices dialog box.

It is important to realize that the correct application of the Kalman Filter requires careful consideration of the actual accuracy of each data item, and, the relative accuracy between data items utilized. If the accuracy relationship is unbalanced, the Kalman Filter will be biased towards the data item with the overly optimistic accuracy setting.

The Kalman Filter setting itself controls how reactive to new data the filter will be. The default setting of 0.1 is applicable for many situations. The impact that the new data has in the filter is also affected by the accuracy setting for that data item. Note that the lower the value, the more smoothing that is applied.

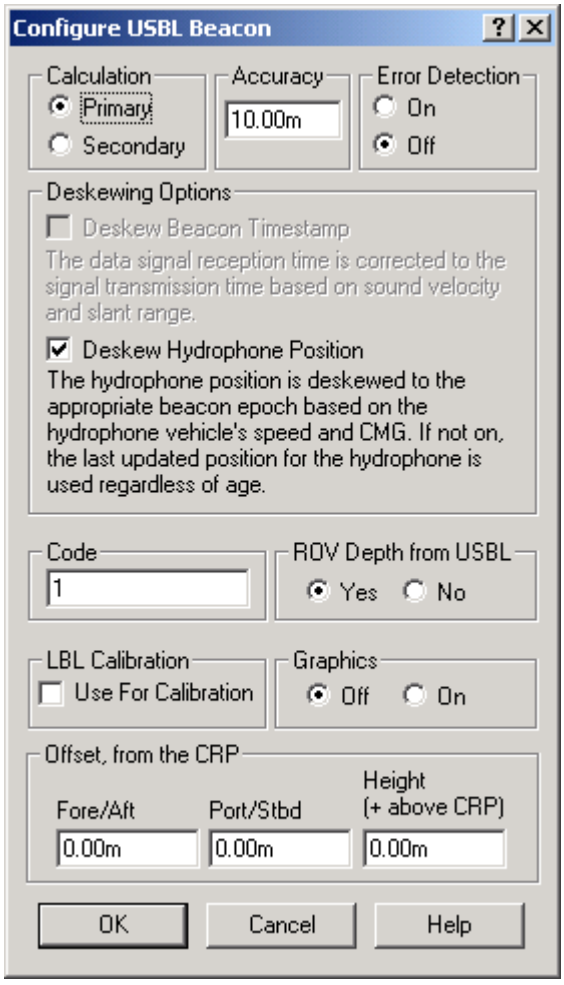
If the Kalman Filter is set to OFF, the Velocity Filter is used. The Velocity Filter is a ‘central tendency’ filter, which seeks the median of the input values. The Velocity Filter does not affect position (i.e. the position of the vehicle will be the resultant of the raw data from the positioning sensors). The velocity filter will ‘smooth’ the velocity only. This is good for use when minor changes in velocity need to be monitored (e.g. Cable Lay Vessels and Vessel Tows where estimated time of arrival is important).

#### Gyro Requirements:

An ISE speed log unit provides WinFrog with speed and direction of the vehicle. For use in the Kalman Filter, these are converted to Northing and Easting velocity vectors. The heading data used is that which is configured for the vehicle, including any offsets applied in the associated HEADING data item configuration.

The correct use of the SPEED LOG data item is dependent upon the correct use of associated data items and the configuration of the associated vehicle Position Calculations. In a typical situation, the Doppler speed log is mounted on an ROV being positioned with USBL, so this is the setup that will be examined here.

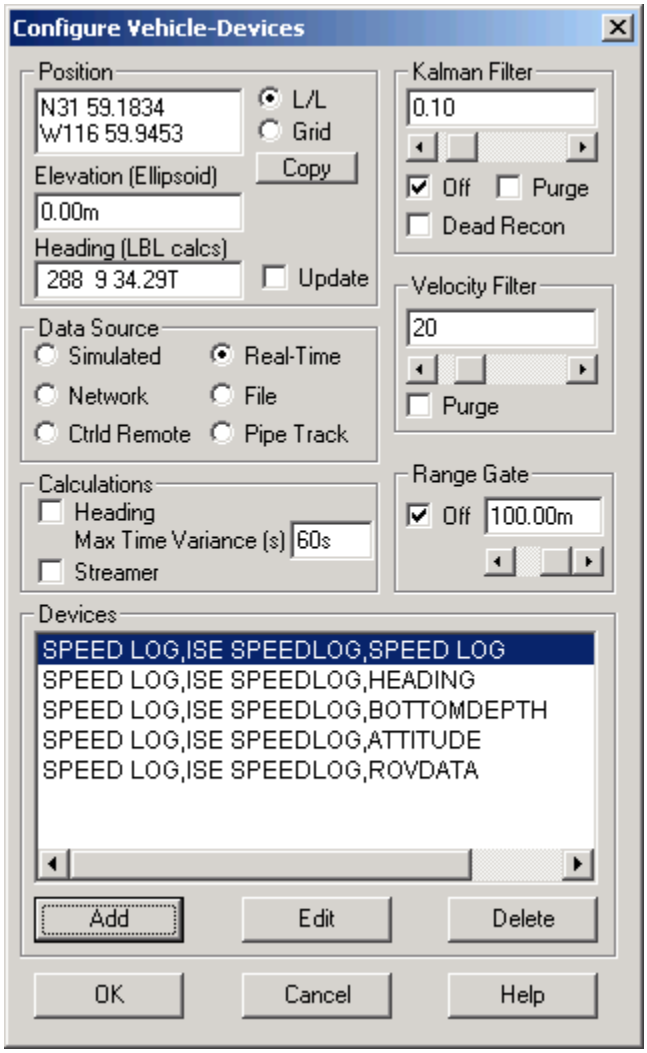
**USBL BEACON Data Item Configuration:**
The ROV will be positioned using a USBL BEACON data item.




The *Accuracy* is the critical setting. This is generally between 7-15m, depending upon the performance of the USBL system. The lower the value, the greater the influence of the USBL data in the Kalman Filter. The higher the value, the less the influence of the USBL data in the Kalman Filter.

Note. If the USBL system does not provide depth then set the ROV Depth from USBL to No. The depth can then be obtained from this device. Be sure that only one device is providing depth.

**Vehicle Calculations Configuration - Kalman Filter:**
The Configure Vehicle Devices dialog box enables the operator to configure the Kalman Filter and the Position Gating.




In order to utilize the SPEED LOG data in the determination of the vehicle position, the Kalman Filter must be on, i.e. not checked *Off*.

The responsiveness of the filter to new data is controlled with the untitled numerical entry in the *Kalman Filter* panel. This value can be entered directly in this box, or controlled with the slider. The smaller the number, the less responsive to new data the filter is. Again, the default is 0.10 and this is appropriate for the majority of applications. In noisy environments on a vehicle with a low dynamics, this can be reduced. Similarily, with good data on a vehicle with high dynamics, this can be increased. However, changes to this value should be made and monitored carefully to ensure that an inappropriate filter is not used. In general, this value will not be less than 0.05, or greater than 0.4. For ROV operations, a range of 0.10 to 0.30 is reasonable.

**Vehicle Calculations Configuration: Range Gate:**
The *Range Gate* setting is used not just for gating ranges, but position data also. It is an invaluable tool when positioning with USBL. This should be set to a value in keeping with the performance of the USBL system. The default of 100m is much too large to be of any use with the USBL. A value of 20m is a reasonable initial setting to use.

**Resetting of the Vehicle's Position:**
Based upon the monitoring of the aforementioned *ghost vehicles*, the operator will be able to determine if the actual ROV position has been overly and incorrectly biased by either the doppler or the USBL to the point where it requires correction. This can be accomplished in several ways.

**Purging the Kalman Filter:**
From the *Configure Vehicle Devices* dialog box, select the *Purge* checkbox in the Kalman Filter panel and exit this dialog with *OK*. This will reset the Kalman Filter and purge the *history*. The positioning will start fresh with the input of new data of any type currently configured to *Primary* for that vehicle.

**Update the Vehicle Position:**
Enter or copy a new initial position in the *Configure Vehicle Devices* dialog box and select the *Update* checkbox. This will force the vehicle to this position and the Kalman Filter will take over.

**Disabling a Data Source:**
Either the SPEED LOG or USBL BEACON data item can be removed from the solution by setting them to *Secondary*. The affect of the data will remain for a short period due to the fact that the Kalman Filter uses history to predict the future.

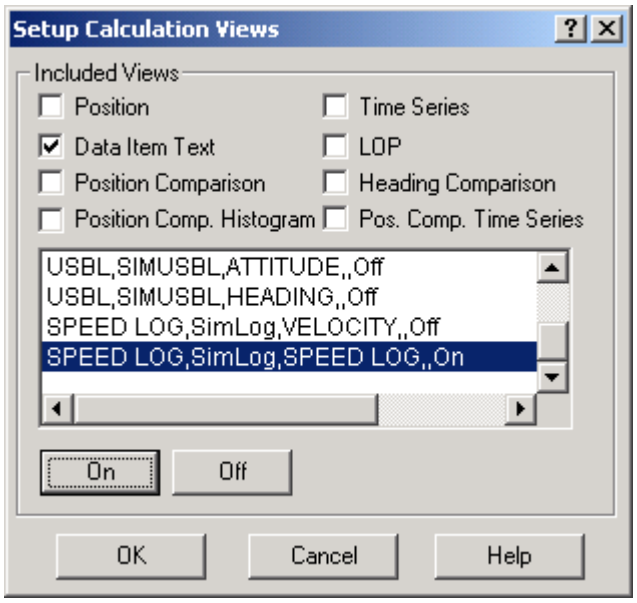
**Monitoring the Application of the Speed Log:**
The monitoring of the speed log device falls into 3 categories:

1. Input of data.
2. Filtering and gating of the speed log data, prior to use in the Kalman Filter.
3. Affect of the speed log data on the position.

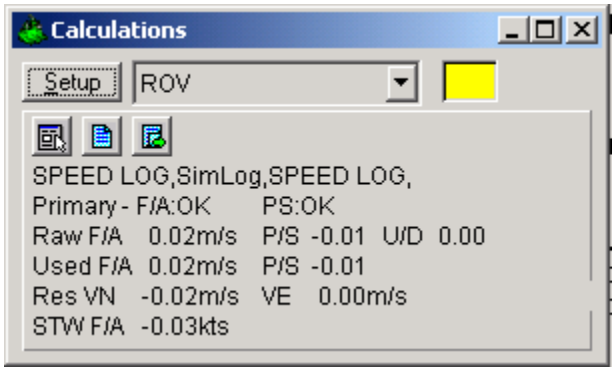
**Monitoring Device Input:**
WinFrog does not provide alarms when a device stops updating. Therefore, the device input should be checked at the Device Window regularly. The time of data displayed for every device will indicate if data is being received.

**Monitoring the Filtering and Gating of the SPEED LOG Data Item**
To monitor the actual use of the speed log data as attached to the vehicle, a Calculation Window should be opened. In this window, select the appropriate vehicle

from the drop-down list. Then using the *Config* button to the left of the vehicle drop-down list, access the Setup Calculation Views dialog box.




Check the *Data Item Text* box, highlight the SPEED LOG item and then click the *On* button. Exit with *OK*. The speed log data can then be monitored in this Calculation Window.




The information provided in this window is as follows:

- Data type and device name
- Calculation setting (Primary/Secondary) and the status of the F/A and P/S velocity data. The status can be *OK*, *Gate* or *Bad*. *OK* indicates that the data is valid and used. *Gate* indicates that the data has been gated and is not used. *Bad* indicates that the data as received from the speed log was either invalid, or not an *Over Ground Speed*.
- The raw F/A, P/S and Up/Down Over Ground velocities in m/s.
- The F/A and P/S velocities used in the Kalman Filter. If the speed log data filtering is turned on, these will be the results of the filter. If not, these will be the raw data repeated.

- The Northing and Easting velocity vector residuals in m/s. The residuals are the Kalman Filter results minus the used data.
- The *Speed Through Water*, if the device also provides (or only provides) this value.

This window provides the operator with the means to observe the results of the gating and filtering. If excessive gating occurs, or the filtered data does not reasonably represent the raw data, changes to the SPEED LOG data item configuration are therefore required.

It should also be noted that a time series plot of the *used* fore/aft velocity (and *Speed Through Water* if available) can be displayed by checking the *Time Series* box in the Setup Calculation Views dialog box.

**Monitoring the Impact of the SPEED LOG Data Item:**
The monitoring of the impact of the SPEED LOG data item on the positioning of the vehicle requires the setting up of *ghost* vehicles.

To monitor the performance of the SPEED LOG data only, add a vehicle to WinFrog, add the appropriate HEADING and SPEED LOG data items. Make sure to configure the vehicle's positioning parameters (i.e. Kalman Filter and Range Gating) and the data items, exactly as configured on the actual ROV Vehicle. When running with only a SPEED LOG data item as a source of positioning data, the vehicle must be given a starting positioning. Do this by copying the current ROV vehicle's position into the appropriate edit box in the *Configure Vehicle Devices* dialog box and select the *Update* checkbox. Though the vehicle's position will always appear as yellow in the Vehicle Window, it will position based upon the doppler speed log data.

To monitor the performance of the USBL BEACON data only, add a vehicle to WinFrog, add the appropriate HEADING and USBL BEACON data items. Make sure to configure the vehicle's positioning parameters (i.e. Kalman Filter and Range Gating) and the data items exactly as configured on the actual ROV Vehicle.

To minimize the distraction of the *ghost vehicles* on actual navigation and tracking, the operator may wish to do the following: from the *Vehicle Presentation* configuration option for the ghost vehicles, turn *Vehicle Window Data to* ***off*** to prevent the display of the vehicle data in the Vehicle window(s). The operator may also wish to limit the vehicle shape to a simple cross in a different color to make graphical comparison easier.

The difference in positioning between these vehicles and the actual vehicle will illustrate the affect the use of the SPEED LOG data is having in the Kalman Filter.

**Resetting of the Vehicle's Position:**
Based upon the monitoring of the aforementioned *ghost vehicles*, the operator will be able to determine if the actual ROV position has been overly and incorrectly biased by either the doppler or the USBL (to the point where it requires corrective actions). This can be accomplished in the following ways:

**Purging the Kalman Filter**
From the *Configure Vehicle Devices* dialog box, select the *Purge* checkbox in the Kalman Filter panel and exit this dialog with *OK*. This will reset the Kalman Filter and purge the *history*. The positioning will start fresh with the input of new data of any type currently configured to *Primary* for that vehicle.

**Update the Vehicle Position**
Enter or copy a new initial position in the *Configure Vehicle Devices* dialog box and select the *Update* checkbox. This will force the vehicle to this position and the Kalman Filter will take over.

**Disabling a Data Source**
Either the SPEED LOG or USBL BEACON data item can be removed from the solution by setting them to *Secondary*. The affect of the data will remain for a short period due to the fact that the Kalman Filter uses history to predict the future.

## ISE Proprietary NMEA sentence

```
$PISE,PRM,h.h,T,a.a,p.p,r.r,d.d,v.v,m.m,b,n*hh<CR><LF>
```

where

| | |
|---|---|
| $PISE,PRM | identifies a Proprietary message and the Remote Vehicle |
| h.h | is the Heading in degrees |
| T | indicates True |
| a.a | indicates altitude, feet |
| p.p | indicates pitch in degrees |
| r.r | indicates roll in degrees |
| d.d | is Depth |
| v.v | indicates speed, knots |
| m.m | indicates direction of velocity with respect to True North, degrees |
| b | 'B' indicates velocity-over-bottom, 'C' indicates velocity with respect to the water-column. |
| n | indicates the number of DVL Beams providing valid altitude readings [0..4] |
| hh | is ASCII checksum |
| <CR> | is the Carriage Return ASCII character |
| <LF> | is the Line Feed ASCII character |

The depth d.d is assumed to be feet (per com Mike MacDonald). The speed and heading data will only be considered valid if the bottom is tracked (B) and the number of beams tracked is 3 or 4.