WinFrog Device Group:	LBL
Device Name/Model:	**Sonardyne Fusion**
Device Manufacturer:	Sonardyne International Limited Blackbushe Business Park Yateley, Hampshire GU46 6GD United Kingdom
Device Data String(s) Output to WinFrog:	ASCII: $PSONALL, $PSONPOS, $PSONOG, $PSONMEAS (for depth, altitude, heading and attitude sensors)
WinFrog Data String(s) Output to Device:	Nil
WinFrog .raw Data Record Type(s):	Type 303 POSITION Type 372 ELEVATION Type 375 ALTITUDE Type 408 HEADING Type 410 HEADING Type 413 ATTITUDE

DEVICE DESCRIPTION:

Sonardyne Fusion is an LBL/USBL software/hardware system from Sonardyne that utilizes the wideband Compatt 5. The full range of capabilities of the Compatt 5 is only available using Fusion. The use of Fusion and the Compatt 5 hardware to its fullest capability with WinFrog is limited to receiving and using processed data provided by Fusion.

DEVICE CONFIGURATION INSTRUCTIONS

WINFROG I/O DEVICES > EDIT I/O:

Following parameters are suggested.
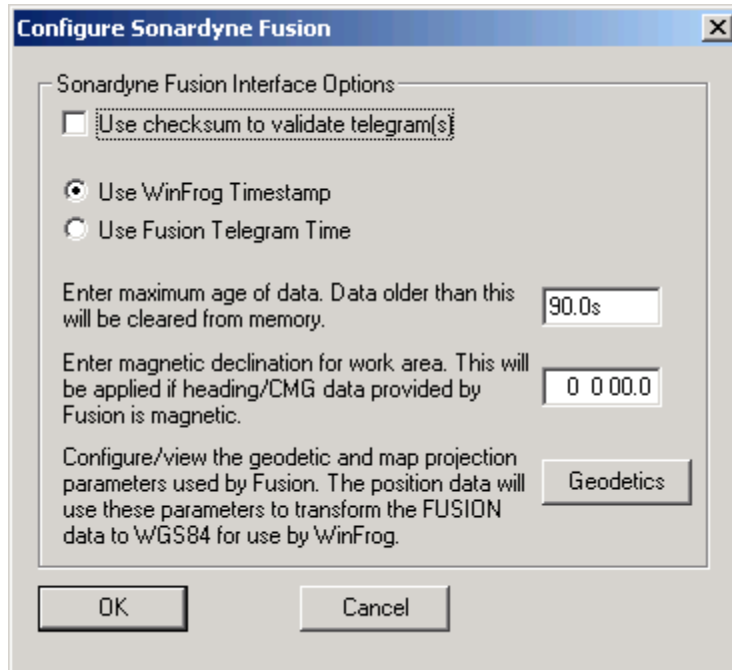Baud Rate: 9600 (or higher)
Data Bits: 8
Stop Bits: 1
Parity: None

WINFROG I/O DEVICES > CONFIGURE DEVICE:

The Sonardyne Fusion device is accessed via the LBL device types. The following configuration is available from the I/O Devices Window.

Checksum:
Fusion has the option to add a checksum to the end of the telegrams. This can be used to validate the telegram and assist checking against corrupted transmissions. When this box is checked, the incoming telegram must pass the checksum check in order to be processed.

Timestamp:
The telegrams supported all include the time (Fusion based) that the data is valid for. WinFrog supports the use of this encoded data epoch or the timestamp by WinFrog of the telegram when it is received as the data epoch within WinFrog. If the Fusion and WinFrog are both synchronized to the same time base (e.g. UTC 1PPS) it is recommended that the *Fusion Telegram Time* be used. Otherwise the *WinFrog Timestamp* is to be used.

Maximum Age of Data:
Each Fusion telegram includes a vehicle name that the data is associated with. All data for a given vehicle is stored in WinFrog's memory and indexed to that vehicle. In order to ensure that memory is not allocated to data that is no longer valid, WinFrog constantly checks the age of the data for each Fusion vehicle and if it exceeds the *maximum age of data* as entered here, that vehicle is removed from memory.

Magnetic Declination:
The $PSONALL and $PSONOG telegrams output heading and CMG data of type True, grid or magnetic. If the data is magnetic, a declination must be entered so that WinFrog can transform it to True for use.
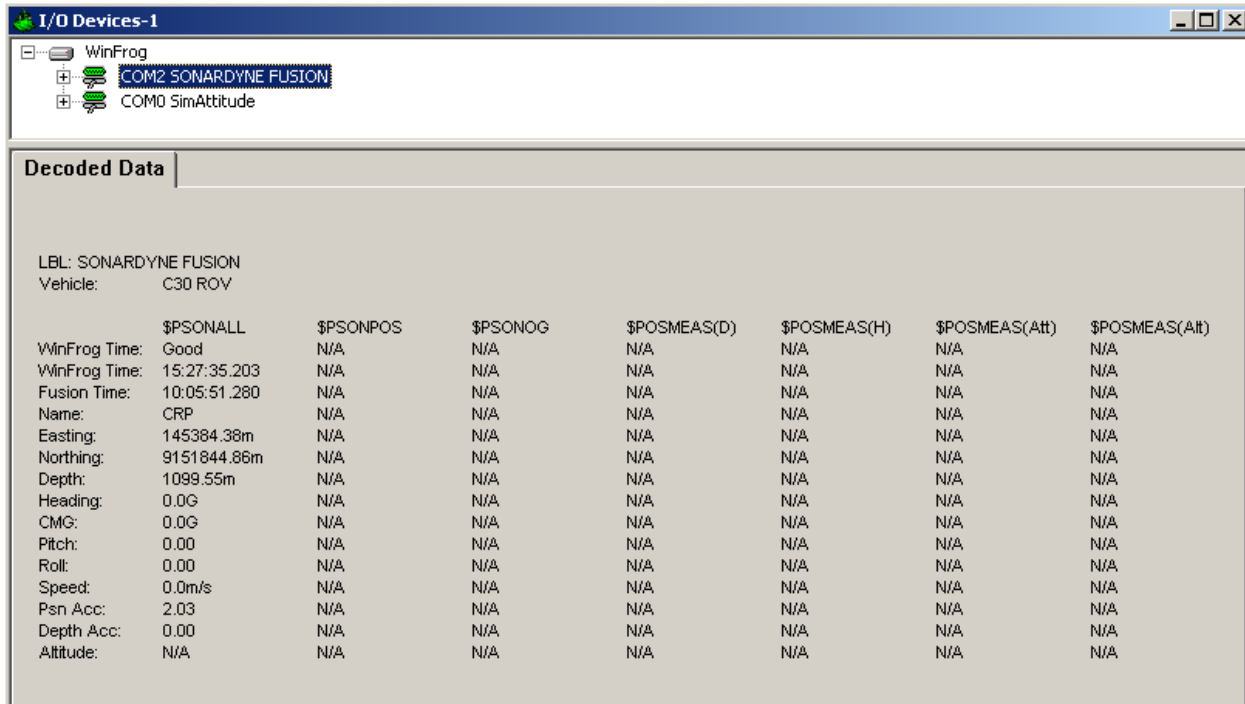
Geodetics:
The position data provided by Fusion is in map grid coordinates in metres. These coordinates must be transformed to WGS84 coordinates to be used as a POSITION data item in WinFrog. In order to do this, WinFrog must know the geodetic and map projection parameters used by Fusion. Clicking the Geodetics button allows you to configure the geodetics and map projection parameters associated with this device to match those used by Fusion. Refer to chapter 3 in the WinFrog User's Guide for more information on configuring geodetics.
Note: This geodetic and map projection parameter setting is local to this device only and does not affect the WinFrog geodetic and map projection configuration.
Note: The map coordinates in the Fusion messages are metric; therefore the map projection units setting in the geodetic and map projection parameter configuration has no affect.

WINFROG I/O DEVICES WINDOW:

The decoded data is displayed in the I/O Devices window. Each vehicle, and in the case of the PSONALL message vehicle and offset combination, is displayed as a separate *page* and can be selected by doing a right mouse button click from within the **Decoded Data** tab and selecting the desired vehicle or vehicle/offset from the list. The decoded data of each telegram is presented in a column with the data aligning with the respective description on the left. The **Status** term is based on successful validation of each data item in the given telegram.

LBL: SONARDYNE FUSION
Vehicle: C30 ROV

	$PSONALL	$PSONPOS	$PSONOG	$POSMEAS(D)	$POSMEAS(H)	$POSMEAS(Att)	$POSMEAS(Alt)
WinFrog Time:	Good	N/A	N/A	N/A	N/A	N/A	N/A
WinFrog Time:	15:27:35.203	N/A	N/A	N/A	N/A	N/A	N/A
Fusion Time:	10:05:51.280	N/A	N/A	N/A	N/A	N/A	N/A
Name:	CRP	N/A	N/A	N/A	N/A	N/A	N/A
Easting:	145384.38m	N/A	N/A	N/A	N/A	N/A	N/A
Northing:	9151844.86m	N/A	N/A	N/A	N/A	N/A	N/A
Depth:	1099.55m	N/A	N/A	N/A	N/A	N/A	N/A
Heading:	0.0G	N/A	N/A	N/A	N/A	N/A	N/A
CMG:	0.0G	N/A	N/A	N/A	N/A	N/A	N/A
Pitch:	0.00	N/A	N/A	N/A	N/A	N/A	N/A
Roll:	0.00	N/A	N/A	N/A	N/A	N/A	N/A
Speed:	0.0m/s	N/A	N/A	N/A	N/A	N/A	N/A
Psn Acc:	2.03	N/A	N/A	N/A	N/A	N/A	N/A
Depth Acc:	0.00	N/A	N/A	N/A	N/A	N/A	N/A
Altitude:	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The data is checked for validity, including minimum and maximum allowed values for all terms. If a problem is found with a value, it is indicated with an asterisk after it. If bad

data is found in a telegram, that telegram is not available for passing to a vehicle. The minimum and maximum ranges for each term are as follows:

Term	Minimum	Maximum
Time	0	236000
Easting	-10000000	10000000
Northing	-20000000	20000000
Depth	0	100000
Heading	0	360
CMG	0	360
Heading Type	'T' or 'G' or 'M'	
Pitch	-90	90
Roll	-90	90
Speed	0	30
Position Accuracy	0	100
Depth Accuracy	0	100
Altitude	-100	10000

WINFROG VEHICLE TEXT WINDOW > VEHICLE PRESENTATION:

The Fusion telegrams supported all include the name of the vehicle that the data is associated with. WinFrog uses this name to index the decoded data. A WinFrog vehicle that is to use data from the Fusion interface must have the exact same name (including case) as it has in Fusion. The WinFrog vehicle name is configured from the Vehicle Presentation dialog. See the Vehicle Presentation section of the Vehicles chapter for details of configuring the vehicle name.

WINFROG VEHICLE TEXT WINDOW > CONFIGURE VEHICLE DEVICES:

Fusion telegrams provide processed positions and speed. It is therefore recommended that these not be further processed in WinFrog, i.e. the Kalman Filter not be used and a minimum velocity filter be used (4). Dead reckoning can be used with caution as it is best tailored for use with the Kalman Filter.

The exception to this is the case of associating multiple POSITION data items with a single vehicle with the intention of using all as primary positioning sources (e.g. $PSONALL for different offsets). In order to best apply multiple POSITION data items, it is recommended that the Kalman Filter be used. In this case, the acceleration factor should be increased to minimize the actual filtering of the data.

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

WinFrog provides the means to apply all the data provided by the supported telegrams in order to provide the greatest flexibility. However, care should be exercised when applying data that has already been processed.

Edit of POSITION Data Item:

When the POSITION data item is edited, the Configure Position dialog box appears as seen below.
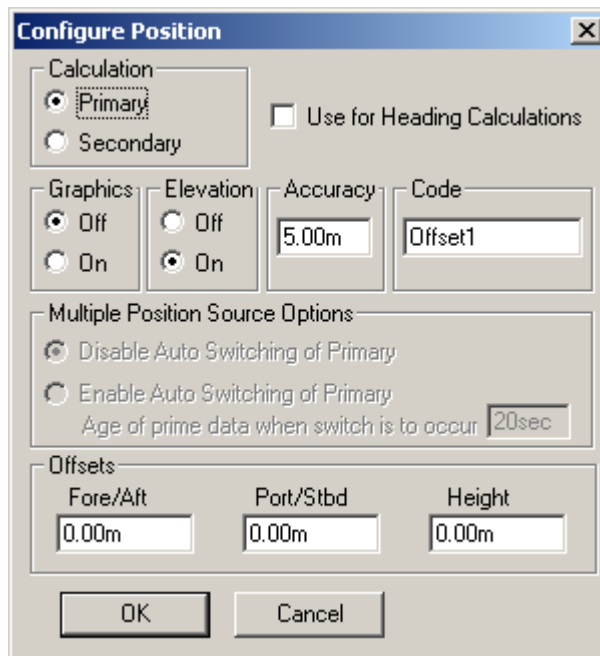
Calculation:
Set the Calculation selection to Primary or Secondary. Devices set to Primary calculation are used to provide a vehicle position. Note that more than one Primary positioning device can be added to a vehicle's device list; data from these devices will be combined in a weighted mean solution. (See the paragraph on Accuracy below for more on the weighting of Primary calculation device data).

If the Calculation type is set to Secondary, WinFrog will simply monitor the device's data. WinFrog will not use the data from a secondary device in the final solution of the vehicle's position.

Use For Heading Calculations:
Select this checkbox if the device is to be used in conjunction with another position source (e.g. $PSONALL for another offset point on the same vehicle) for determination of the heading of the vessel.

Graphics:
If On is selected, a labeled square will show the raw (offset but unfiltered) location of the POSITION source sensor in the Graphics and Bird's Eye windows. This provides a means of comparing raw device and filtered vehicle positions.

Elevation:
Setting the Elevation option to On will result in the depth that is available in the $PSONALL, $PSONPOS and $PSONOG telegrams to be applied to the vehicle. Note that depth data provided by the $PSONMEAS telegram can only be applied using the ELEVATION data item.

Accuracy:
The Accuracy value entered provides WinFrog with the expected accuracy of the position from this device. This value is used in the weighting of this device compared to other positioning devices that may be added to the vehicle's device list. The smaller the value entered, the more accurate it is considered to be, and hence the more weight that will be applied to the device's data.

The Accuracy parameter can be changed from the suggested values. Changes should be made with caution, however, as they will affect the final filtered position of the vehicle.

Code:
The position data provided in the $PSONPOS and $PSONOG telegrams is always referenced to the Fusion vehicle's CRP. If these telegrams are used as a source for this vehicle, the Code field must be blank. The position data provided in the $PSONALL telegram can be referenced to an offset position. This offset is included in the telegram. In order to use the position data for a $PSONALL telegram, the Fusion offset name must be entered in the Code field.

Multiple Position Source Options:
This option is not available for Fusion position data.

Offsets:
Enter the offsets of the sensor with respect to the vehicle CRP. Note that the position data is provided in the $PSONALL, $PSONPOS and $PSONOG telegrams. However, for all but the $PSONALL, the data is referenced to the CRP as defined within Fusion. It is recommended that the Fusion and WinFrog CRP be the same – that is, configure WinFrog to match Fusion. With common CRPs, offsets need only be entered here if the position data is from the $PSONALL telegram for a point other than the CRP. In this case, the offsets must match those in Fusion for this point.

Edit of HEADING Data Item:

When the HEADING data item is edited, the Configure Gyro dialog box appears as seen below.
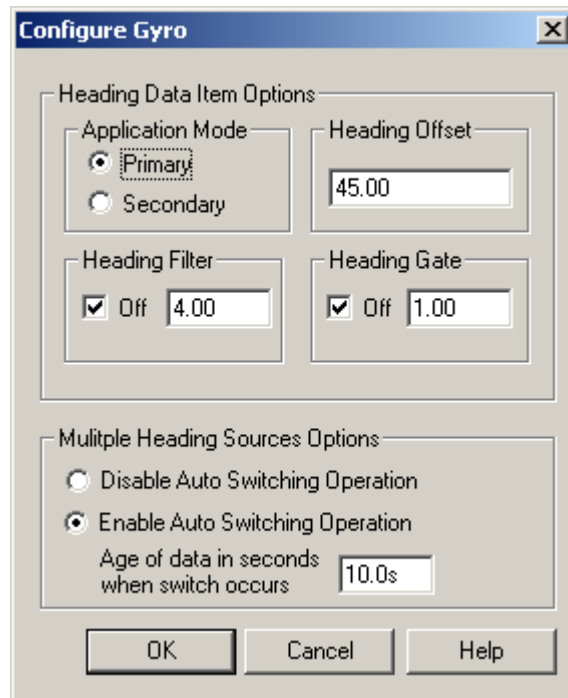
Application Mode (Primary/Secondary):
Set the type of calculation to Primary or Secondary by selecting the appropriate radio button. Devices set to Primary are used to provide the vehicle heading information. Devices set to Secondary are simply monitored, and are not used in the vehicle's calculations.

Note that WinFrog supports automatic switching from a designated Primary to a Secondary in the event 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 one 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.

Edit of ATTITUDE Data Item:

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.

Edit of ELEVATION Data Item
When the ELEVATION data item is edited, the Configure Elevation dialog box appears as seen below. Note that though the data item is ELEVATION, it can be used to pass vehicle depth as well (a negative elevation).
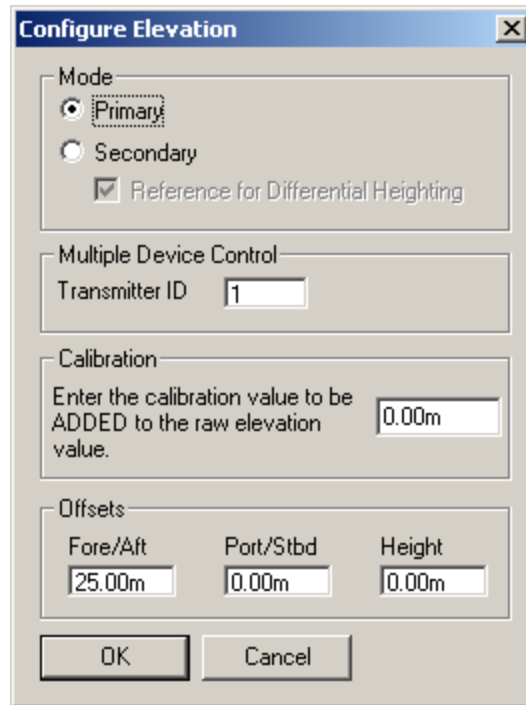
Mode
Select Primary if the elevation/depth data is to be applied to the respective vehicle. Select Secondary if it is associated for comparison to another elevation/depth source or just for raw data logging. In the case of selecting Secondary, the Reference for Differential Heighting is enabled but is not applicable for this application.

Multiple Device Control
This is not applicable for this data item as supported by Fusion.

Calibration
If the elevation/depth data is known to be in error, a calibration value that is to be added to the raw sensor data can be entered. It is expected that any calibration would have already been applied within Fusion.

Offsets
Enter the offsets of the sensor with respect to the vehicle CRP. Note that the elevation/depth data is provided in the $PSONALL, $PSONPOS, $PSONOG and the $PSONMEAS (for depth) telegrams. However, for all but the $PSONALL, the data is referenced to the CRP as defined within Fusion. It is recommended that the Fusion and WinFrog CRP be the same – that is, configure WinFrog to match Fusion. With common CRPs, offsets need only be entered here if the elevation/depth data is from the $PSONALL telegram for a point other than the CRP. In this case, the offsets must match those in Fusion for this point.

Edit of ALTITUDE Data Item

When the ALTITUDE data item is edited, the Configure Altitude dialog box appears as seen below.
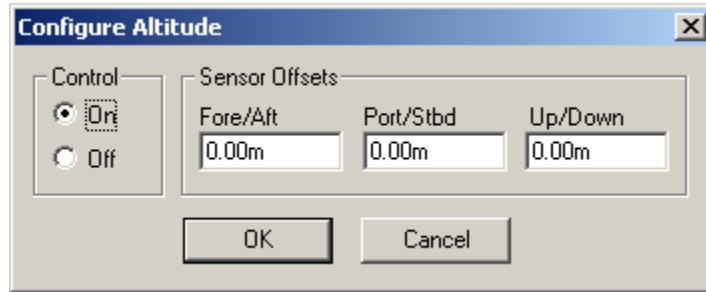
Control
Select On to pass the altitude data to the vehicle. Selecting Off results in the altitude data being available for raw data logging but not applied to the vehicle.

Sensor Offsets
The altitude data provided by Fusion is relative to the Fusion vehicle's CRP. Only enter offsets here if the Fusion vehicle's CRP is not the same as the respective WinFrog vehicle's CRP.