WinFrog Device Group:	**USBL**
Device Name/Model:	**NMEA TTM**
Device Manufacturer:	Generic
Device Data String(s) Output to WinFrog:	NMEA 0183 $--TTM sentence. See NMEA 0183 manual for format.
WinFrog Data String(s) Output to Device:	Nil
WinFrog .raw Data Record Type(s):	Type 309: Beacon data Type 312: Hydrophone data See the WinFrog manual appendix B for the format.

DEVICE DESCRIPTION:

This device driver decodes the NMEA $--TTM telegram. Several different types of equipment may use this particular message (e.g. radar) but this device driver expects that the telegram provides a range and bearing to underwater objects (i.e. a USBL device). The only data WinFrog uses from the telegram are the target number, target distance, target bearing and code, and target status.

The target number in the telegram is used as the beacon code. Since WinFrog does not allow a beacon code of 0, which is an acceptable target code, if a target number of 0 is received, WinFrog will change it to 100. To use this beacon, put 100 in the BEACON data item configuration dialog (see below).

You cannot perform a USBL calibration using the data from this telegram. This is because the depth of the beacon is not available in the telegram.

DEVICE CONFIGURATION INSTRUCTIONS

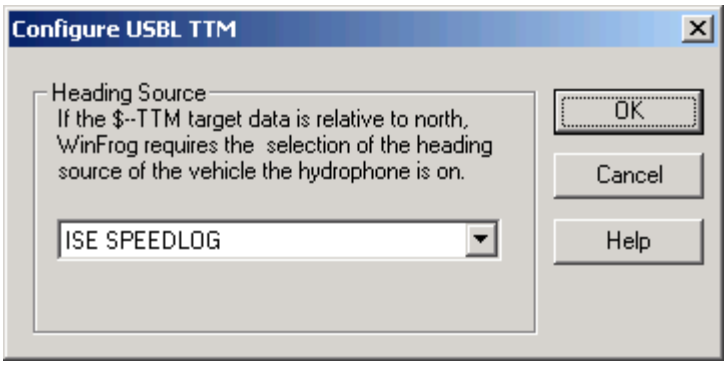
WINFROG I/O DEVICES > EDIT I/O:

Serial
Configurable Parameters

WINFROG I/O DEVICES > CONFIGURE DEVICE:

The device is added to WinFrog from the USBL device category. Adding this to WinFrog creates two data items: a Hydrophone and a Beacon.

The device must be configured at the I/O Device window level. In the I/O Devices window, highlight the NMEA TTM device then right-click and select Configure Device from the menu. The Configure USBL TTM dialog box appears as seen below.



Heading Source
The reference for the target bearing in the TTM telegram may be either ship relative or true (North) and is indicated by one of the fields within the telegram. If the reference is true or if it may become true, then you must select the heading source for the ship. This is because offsets and calibration values need to be applied with respect to the ship. Note: *Even if no calibration values and offsets are entered, if the bearing reference is true you must still select the heading source. Otherwise the target coordinates will be wrong.*

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

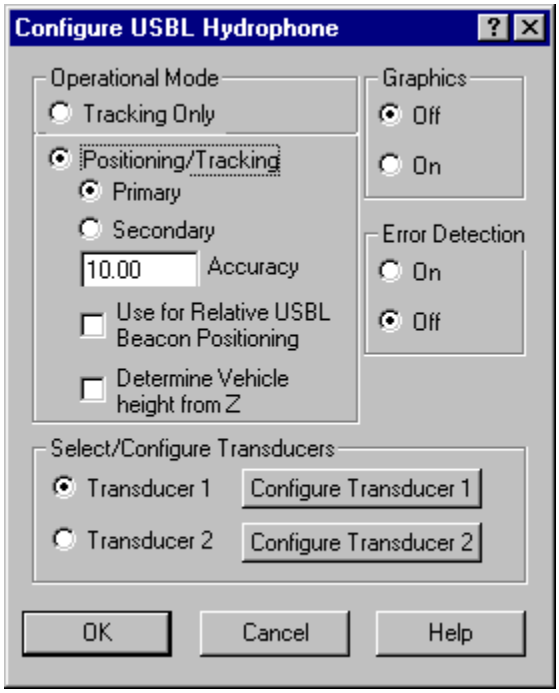
As mentioned above, adding this device to WinFrog creates two separate data items: the USBL, NMEA TTM, USBL HYDROPHONE and the USBL, NMEA TTM, BEACON.

Vehicle Tracking
The USBL, NMEA TTM, 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. ROV, submersible, or towed vehicle).

Surface Vehicle Positioning
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 known 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 transponder File (*.XPT) in WinFrog, and enter the coordinates of the Beacon into that file and set the beacon as fixed. The Hydrophone must be added to the ship's device list and configured for positioning as opposed to tracking. See chapter 5 of the WinFrog Users Guide for more information on setting up *.XPT files.

Configuration of the USBL Hydrophone

Once the Hydrophone has been added to the appropriate vehicle's device list it must be edited to suit the application. In the vehicle's device list, highlight the USBL, NMEA TTM, USBL HYDROPHONE and click the Edit button. The Configure USBL Hydrophone dialog box appears as seen below.



Operational Mode:
As mentioned above, USBL systems can be used for tracking of subsurface vehicles or for positioning of the main vehicle to which the hydrophone is attached. Select **Tracking Only** if relative tracking is desired.

Select **Positioning/Tracking** and **Primary** if you want to position the Master Vessel relative to a fixed beacon. The beacon must be at a stationary location, as defined in a working transponder (.XPT) file. Select the **Secondary** radio button if this is not the primary positioning source (i.e. if this is a comparison position). Note: If data from more than one beacon is available, WinFrog will use all the beacon records that have corresponding entries in the transponder file where the beacons are set to fixed to position the surface vehicle. (See chapter 5 of the WinFrog Users Guide for more information on setting up *.XPT files.)

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 a fixed beacon is compared to the hydrophone position determined from other positioning sources (e.g. DGPS). This difference is then

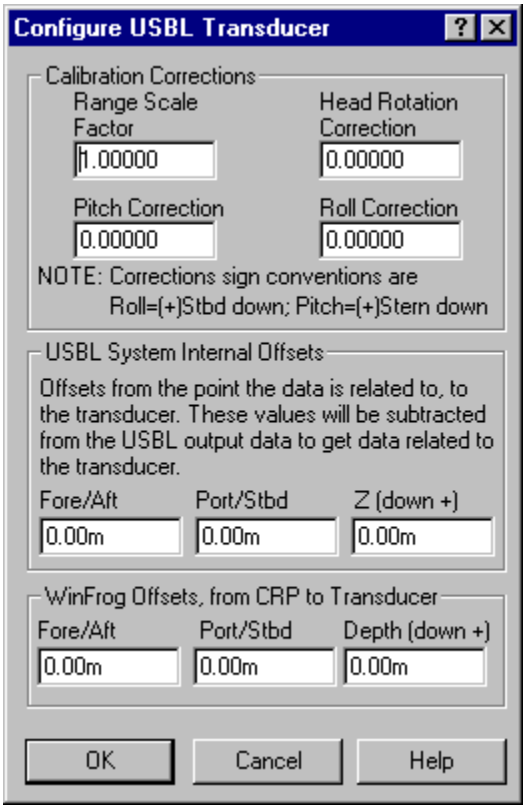
applied to the position determined for any tracked beacon. The concept is that any inherent errors due to local conditions, both environmental and mechanical, are cancelled out. This is independent of the Primary/Secondary setting.

Determine Vehicle height from Z:
Leave unchecked, as this information is not available in the $--TTM telegram.

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 use the target status flag in the telegram. If the flag is "T" the data will be used, otherwise it will be rejected. The error code displayed in the data decode window and calculations window is 0 if the flag is "T" or 6 if it is "L" or "Q".

Select/Configure Transducers:
Some USBL systems can be configured with two hydrophones. However, since there is no transducer information in the $--TTM telegram, only Transducer 1 is used. Click Configure Transducer 1. The Configure USBL Transducer dialog box appears as seen below.



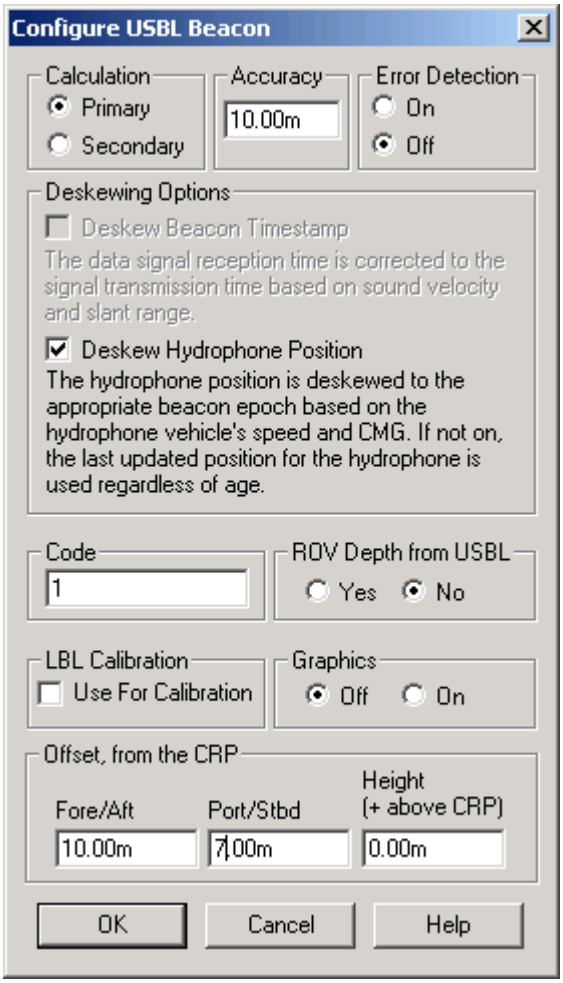
Calibration Corrections:
WinFrog allows you to enter Range Scale, Heading, Pitch and Roll correction values to correct raw USBL measurements. Note that the Heading, Pitch and Roll values are entered in degrees and decimal degrees.

USBL System Internal 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 NMEA TTM device. The upper fields are used to remove any offsets that have been entered into the acoustic device sending the $--TTM telegram. WinFrog requires the range and bearing to relate to the USBL hydrophone. These upper fields are used to nullifying any offsets in the acoustic system. If the range and bearing is already with respect to the hydrophone, enter zeros. After the range and bearing found in the telegram are reduced to Cartesian coordinates, the values entered here are subtracted to obtain the Cartesian coordinates of the beacon with respect to the hydrophone. Since depth is not part of the telegram always enter 0 for the depth offset.

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**.**

Configuration of the USBL Beacon

As mentioned above, for subsurface vehicle positioning, the USBL beacon must be added to the appropriate subsurface vehicle's device list. Once added to the device list, it must be edited to suit the application. Editing the USBL, NMEA TTM, BEACON device brings up 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.

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 reject the telegram if the target status field is not set to "T". See error detection above.

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 target number of the telegram corresponding to the tracked vehicle's beacon. **Note:** WinFrog does not allow a code of 0. If a target number of 0 is detected, WinFrog will change it to 100. Thus, if the target number of the vehicle you want to track is 0, enter a code of 100 in this edit box.

ROV Depth from USBL:
Since the telegram does not contain the depth, always set this to No. The depth must be obtained from another device.

LBL Calibration:
Select the **Use for Calbration** 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 section of the dialog box is used to enter Offsets that relate the beacon's location to the subsurface 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 (i.e. gyro) device must also be added to the vehicle's device list to ensure that the offsets are applied in the correct direction.

CONFIGURATION DETAILS:

It is preferable to configure the NMEA TTM to output ship relative data. WinFrog requires beacon numbers/target numbers be greater than 0. WinFrog will track up to ten beacons/targets at one time.