WinFrog Device Group:	**INS**
Device Name/Model:	**Seatex MRU-5**
Device Manufacturer:	**NAVIA Maritime AS, Seatex Division** Pirsenteret, N-7462, Trondheim, Norway Tel: +47 73 54 55 00, Fax: +47 73 51 50 20 http://www.seatex.no **Seatex Inc.** 911 Western Avenue, Suite 302, Seattle, WA 98104-1031, USA Tel: +1 206 903 8393; Fax: +1 206 903 8394 **Seatex Ltd.** Suite 1, Old Skene Road Westhill, Aberdeen AB32 6RL Tel: ++44 1224 744625; Fax: ++44 1224 744626 Duty phone: +44 (0) 831 349277 e-mail: sales@seatex.demon.co.uk
Device Data String(s) Output to WinFrog:	Pitch, Roll (on channels A and B respectively) "Pitch %12.6lf " ; "Roll %12.6lf "
WinFrog Data String(s) Output to Device:	Nil
WinFrog .raw Data Record Type(s):	Type 413 (Attitude): Time, Pitch, Roll, Status

DEVICE DESCRIPTION:
The MRU-5 is one of seven different models of MRU's (Motion Reference Units) produced by Seatex Inc. The models include the MRU-1 through MRU-6 and the MRU-H. These units vary in capability (the higher the model number the more capable) and depending on model, can provide some or all of the following data:

- Pitch
- Roll
- Yaw
- Heave
- Surge and Sway
- Heading (Magnetic from Fluxgate Compass)

The MRU-5 is equipped with three angular rate sensors and three accelerometers, and is able to determine Pitch and Roll measurement accuracy of 0.03 ° RMS at a ±5° amplitude. The MRU-5 is also capable of Heave motion to a range of +- 50 meters, determined to an accuracy of 5 cm or 5%, whichever is higher.

The MRU-5 can be used for motion compensation in swathe bathymetric echo sounders, DP systems, ROVs, high-speed (high dynamics) vessel motion damping systems and tow-fish systems.

Seatex MRU-5

Although the MRU-5 offers 189 data output variables, the WinFrog driver only uses the Pitch and Roll data from the MRU-5. The MRU-5 comes with Seatex proprietary MRC configuration software that allows for programming via a series of menu prompts.
For two-way communication with the MRU 5, a proprietary binary serial protocol is used. The MRU-5 can output data in analog or digital format. For use with WinFrog, ensure that digital output is installed in the MRU.

Output variables are transmitted as IEEE 32 bit floats (recommended) or as scaled integers. In addition, ASCII-based NMEA 0183 proprietary sentences or various echo sounder formats may be selected as the data output protocol. WinFrog requires the ASCII telegram outputting the NMEA type string in floating point form.

The MRU 5 accepts external input of speed and heading information on separate serial lines for improved accuracy in heave, roll and pitch during turns and accelerations. WinFrog's MRU-5 driver does not provide this output.

Refer to Configuration Details below for information on the various MRU units and their compatibility with the WinFrog 'Seatex MRU-5' driver.

Seatex MRU's can be supplied either with a sub-sea bottle or wall-mounting bracket. A vibration damper may also be supplied with the unit. For use with WinFrog, the following Items are required:

- Seatex MRU (for models see Configuration Details Section)
- Seatex MRC configuration software
- Digital Output capability
- Control and Serial Cable
- Power Supply

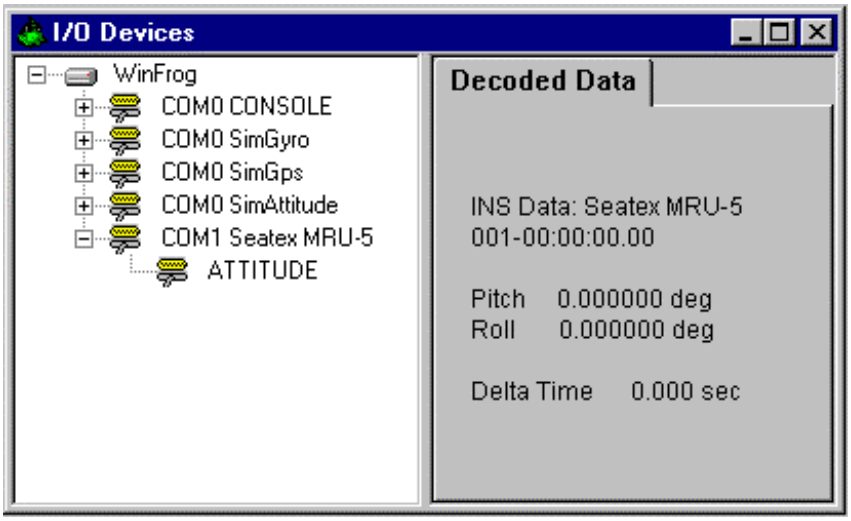
WinFrog can be configured to apply the attitude data to remove device and tracking offsets caused by the vehicle's pitching and rolling motion. These calculations include reducing the GPS antenna position to the Z datum zero reference, removing apparent vehicle wandering due to the vehicle's pitch and roll.

DEVICE CONFIGURATION INSTRUCTIONS:

Baud Rate: Software configurable between 1200 and 56000 baud
Data Bits: 8
Stop Bits: 1
Parity : None
Handshake: None

WINFROG I/O DEVICES > CONFIG OPTIONS:

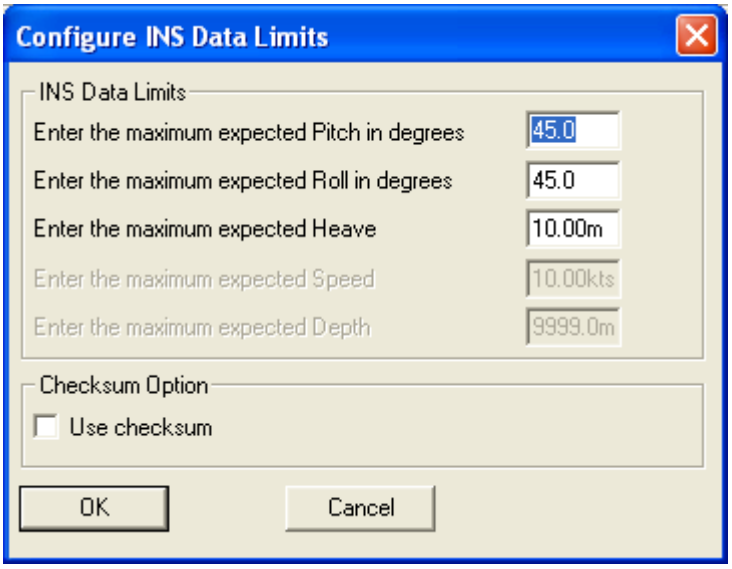
The Seatex MRU-5 is added to WinFrog from the INS device category. Adding an MRU-5 creates an Attitude data item, as seen in the I/O Devices window below.



In the Decoded Data display shown above, you can view the raw pitch and roll from the MRU-5. The time difference between readings is also displayed.

Note: In WinFrog, the Pitch angle is positive for Bow up. The Roll angle is positive for Starboard Down.

The MRU-5 must be configured at the “generic” I/O Devices level. Highlight the MRU-5 in the I/O Devices window and then right-click and select Configure Device. The Seatex MRU-5 INS Configuration dialog box appears as seen below.

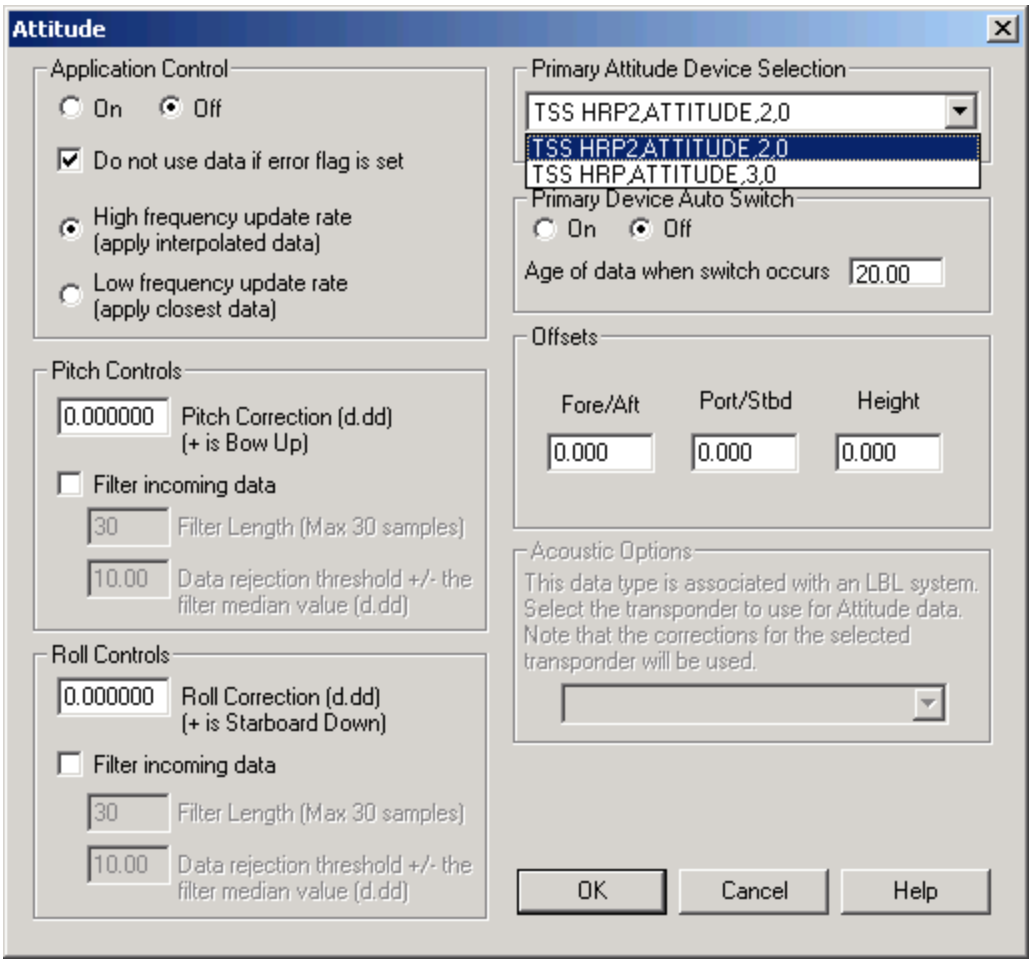


INS Data Limits:
You can enter the maximum expected value for pitch, roll and heave. If the absolute value of the decoded pitch, roll or heave, in a given message is greater than the respective entered maximum expected value, the data is flagged and none of the data in that message is passed to the vehicle. The heading is also checked to be >= 0 and < 360. The status is shown in the I/O Device window with an asterisk next to the specific data that failed the test.

The data is also checked for correct message type, valid characters and input buffer overruns and the status displayed in the I/O Device window.

Checksum Option:
If the MRU has been configured (via Seatex's MRC software) to include a checksum in its telegram, WinFrog can be set to check this value. If the MRU 5 is not including the check sum, this box must not be checked otherwise WinFrog will ignore the telegram.

WINFROG VEHICLE TEXT WINDOW > CONFIGURE VEHICLE DEVICES > DEVICES > EDIT OPTIONS:
When the MRU-5's Attitude data item is added to a vehicle's device list, it must be edited to suit the application. To edit the device, in the vehicle's devices list highlight the INU,Seatex MRU-5, Attitude data item and click the Edit button. The Attitude dialog box appears as seen below.



Attitude

By default, the sensor mode is off, meaning that data from the attitude 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 offsets are used to calculate remote heave (leaver arm). It is expected that these values are the offset from the center of gravity of the sensor. Then using the observed pitch, roll, and heave, the heave at the center of gravity will be calculated and assigned to the vehicle, which may then be output using the INSIX output device. However, it is recommended that the sensor be placed at the center of gravity. If this is not possible, it is better to enter the lever arm offsets into the sensor and have the sensor make the correction, then have the sensor output the corrected values with respect to the center of gravity. The INSIX output device expects that the heave assigned to the vehicle is with respect to the center of gravity.

WinFrog records the attitude data to a type 413 raw data record. This record contains observed Heave, Pitch, Roll, status, accuracy, and a time stamp to indicate precisely when the data was observed. See Appendix B: WinFrog File Formats in the WinFrog User's Guide for details on the Type 413 raw data record.

Acoustic Options
This applies to long base line acoustic transponders that have inclinometers. See chapter 17 for more information.

CONFIGURATION DETAILS:

Ideally, the MRU should be mounted at the vessel's center of gravity (COG). A control cable connects the unit to the power supply where the serial cable is connected.

WinFrog only decodes Pitch and Roll from the MRU. All MRU products, with Pitch and Roll output should be capable of interfacing to WinFrog. Following is a list of Seatex MRU's and their differences:

MRU-1: Measurement of vertical and transverse motion. No pitch or roll.
MRU-2: 3-axis fluxgate magnetometer only.
MRU-3: Static pitch and roll angles, plus heave at small pitch and roll variations. (Capable of interfacing to WinFrog).
MRU-4: Same as MRU-3 with fluxgate compass, heading and yaw.

MRU-5: Same as MRU-3 with angular rate sensors for dynamic pitch and roll. The angular rate sensors can be turned off for output of static pitch and roll. Heading and speed log can be input externally, however these items are not supported in WinFrog.
MRU-6: Same as MRU-5 with magnetic North seeking fluxgate compass.
MRU-H: A less accurate version of the MRU-5.

Data string format required by WinFrog;

$PSXN,[Data Status],[User Defined token],pitch,roll,ignored*<check sum><CR><LF>
Where:
Data Status = 10 if Stable, 11 if the data is unstable
User Defined token = Ignored
Pitch and roll in radians
WinFrog will ignore all other fields except the check sum if checking is enabled.

Note if a different format is output use the other Seatex driver MRU 4 & 6.