FARO

Faro Manager

User's Guide

Content

Basics 1

1.1 Introduction

FaroManager is the remote interface of FaRo processor. With FaroManager it is possible to configure, personalize and monitor the FaRo system. Moreover, FaroManager acts as plug-in for the more popular navigation software, allowing Deckman, Expedition and Adrena software to use FaRo as instruments system.

Faro is a powerful, versatile and fully customizable instrument system. FaroManager, reflecting these characteristics, can be personalized to adapt itself to an individual Faro's configuration. As a consequence, menus and settings described in this manual may differ from the ones you may see for your configuration.

 Faro and FaroManager are evolving very quickly and new features are being added every month. Please, be sure you always have the latest version installed. Check periodically for updates on our website www.faroadv.com

1.2 Features

FaroManager comes in two different versions:

- A standalone version

- A host software integrated version, ie DFW Add-In.

The standalone executable software (FaroManager.exe) provides the interface for any computer connected to the Faro processor and it allows Expedition and Adrena to communicate with Faro.

The dynamic link library (FaroForDeckman.dll) is the special version developed for Deckman, called from the menu “addin”. This ensures a smooth integration of Faro’s features inside Deckman.

The two versions feature the same functions; they differ only on the way some variables are used to communicate with the supported navigation software.

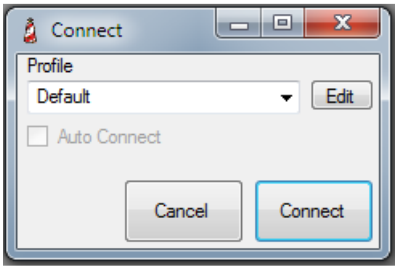
The main features of FaroManager are:

- Configure and monitor the Faro hardware.
- Define and configure serial and network instruments.
- Define and configure analog and pulse sensors.
- Manage any supported displays.
- Create variables and their relations within Faro.
- Monitor in real time the value of all Faro’s variables.
- Calibrate any attached sensor and apply correction values.
- Manage correction tables and polars.
- Create custom tools for analysis.
- Manage logs, up to 100Hz, within Faro.
- Define and manage filters.
- Toggle between sensors.
- Map the variables required to use Faro with navigation software.
- Replay the moments of interest from logged data.
- Simulate scenarios by altering the maths, filters and calibrations.

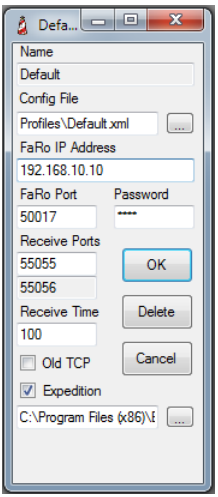
1.3 Starting FaroManager

FaroManager can connect to different Faro processors and every individual connection is managed through the use of a profile. For this reason, when FaroManager starts, there aren't many menus defined on the main window: menus and functions are loaded once the connection is established.

From the **Faro** menu, click on **Connect,** to open the connect dialog box.



A default connection is pre-configured at time of shipping. It is better to verify the connection settings before connecting for the first time. Click the **Edit** button to advance to the Edit form



1. The Config File is an xml file with all the definitions for the associated profile. To change config file, click on ...
2. Verify the **IP address** of your Faro processor.
3. Leave unchanged the **FaRo Port** and **Password** fields, unless you have changed them inside the Faro's processor internal configuration file.

By default, the password is *Faro*. The password is defined only for the TCP connection and it doesn't have anything to do with the Windows' logon password of the

4 Enter the **UDP Port** number. Usually it isn't necessary to change the default value, unless multiple instances of FaroManager are running on the same computer.

To receive more information about running multiple instances of FaroManager, contact the technical support at support@Faroadv.com

5 **UDP Time** and **UPD Size** are parameters controlling the flow of variables exchanged between Faro and FaroManager. The default values usually work fine for any connection. **UDP Time** is the interval (in milliseconds) at which the variables are sent. The default value of 100 means that variables are exchanged at 10 Hz. **UDP Size** is the number of variables sent in the same UDP frame. If the number of variable sent is bigger than UDP Size, more frames are sent.

The base cycle inside Faro is 1 millisecond. This means that the fastest processes in Faro run up to a frequency of 1 KHz. When not explicitly specified, all the parameters related to the Time are a multiple of 1 millisecond.

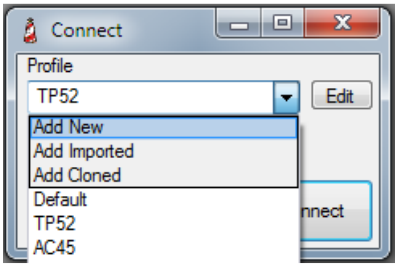
6 Tick the **Old TCP** box if you are running an old version of Faro (prior 2012)

7 Tick the **Expedition** box if you have Expedition installed on your computer. Click on  to look for the file ExpDLL.dll and to add it to the libraries to use with FaroManager

8 Click **Ok** if you made any change, or click **Cancel** to close the form. Clicking **Delete,** you will erase the config file from the list of the profiles

1.4 Creating a new profile

From the connect form it is possible to create new profiles. On the **Profile** drop-down menu there are 3 different options



- **Add New** creates a new profile with the default menu and variables configured
- **Add Imported** imports an existing config file that will be used for the new profile. This is useful when switching to a new navigation PC and transferring the settings from the previous pc
- **Add Cloned** creates a copy of an existing config file and it creates a cloned new profile. This is useful for creating a new profile starting from a personal configuration

1.5 Connecting With Faro

Once connected to FaRo, the menu bar populates with new voices and sub-menus, as defined in the profile file. The grey circle on the top left corner of the main window will become green. When FaroManager closes, it saves the layout of the open windows. When restarts, FaroManager will reopen the same windows in the same position .

There are four different status in which the Faro Manager can be in. Check the circle on the upper left corner inside the main application window:

-> A manual connection is required. Click on the menu **Faro>Connect.**

-> Faro Manager has successfully connected with the Faro processor.

-> Connection with the Faro processor is temporarily missing. Check the connection. In case this doesn't change automatically to the green state within a few seconds, disconnect and try a new connection.

->Faro Manager has lost the connection with the Faro processor. A manual reconnection is required. Click on **Faro>Reconnect.** If it does not connect, close Faro Manager and try again. If the problem persists, check your configuration.

Troubleshooting:

- If there is no network connection or Faro Manager can't find the Faro processor at the IP provided, a new window with the message **"Remote Host Not Found"** will appear.
- If there is a connection (it finds the processor) but you can't establish a connection with Faro, a new window with the message **"Remote host denied the connection"** will appear. In that case, check the IP address, and verify that the FaRo shell is up and running in the processor (this is easily achievable connecting with Remote Desktop). If the error persist, try restarting the FaRo processor
- If the connection seems working for a brief period and it stops (and the **circle turns yellow**), it might be a defender software (like a firewall or an anti-virus) that is blocking the communication port. To verify it, temporary disable all the anti-virus and firewall software (including windows firewall) and try again, if the connection succeeds, verify in your connection form which ports need to be authorized by the protecting software (by default 50017, 55055 and 55056). There is also the unlikely possibility that another software is already using one of the ports (or another instance of is already open)

1.5.1 Local Mode

The FaRo software runs on Windows OS and it can easily installed on any PC. It is a common procedure to copy the FaRo software and files from the processor to a PC, in order to have a local working FaRo for modifications or post analysis (replay and simulation). The local is unregistered and has limited

functionality, but it can communicate with FaroManager, it can be modified and afterward uploaded to the processor.
In order to have a running version of FaRo on a PC, it is necessary to copy the whole directory c:\Data\Faro from the processor to a local directory. Three more files need to be copied in the local Faro folder (ask the technical support or check the website www.faroadv.com):

- TcAdsDll.dll
- TCATAdsAms.dll
- TCatIoDrv.dll

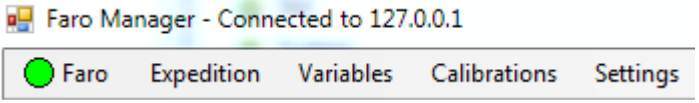
Double click on the Faro.exe file to launch the faro software: a "DOS shell" like window will appear. The software will be up and running after the prompt "FARO>" appears in the shell.

To connect to the local Faro, create a new profile ("Add imported") or edit the connection options of the existing profile and enter the IP address **127.0.0.1**.

Now it is possible to modify the FaroManager profile and/or the settings in Faro. Please, refer to the "Update Manager" session, later in this manual, to commit the changes into the FaRo processor

1.6 Understanding the main window

The main window contains important information about the connection with FaRo. On the top left, besides the circle indicating the connection status, it is visible the IP address of the connected processor

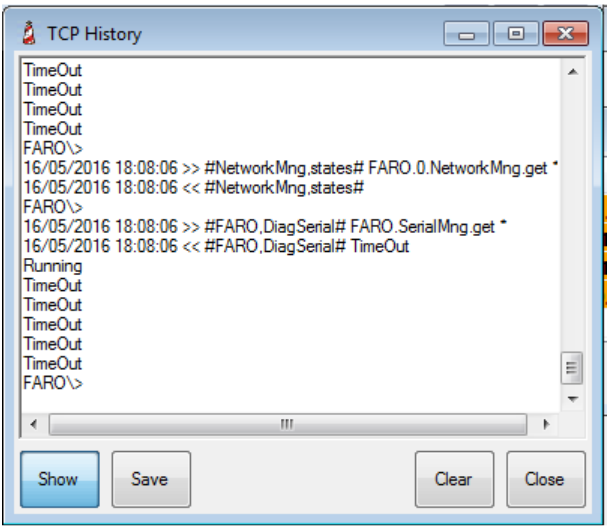


Just above the bottom frame, a tab menu is displaying the name of the windows currently open in FaroManager. Just click on one tab in order to bring in front the selected window.

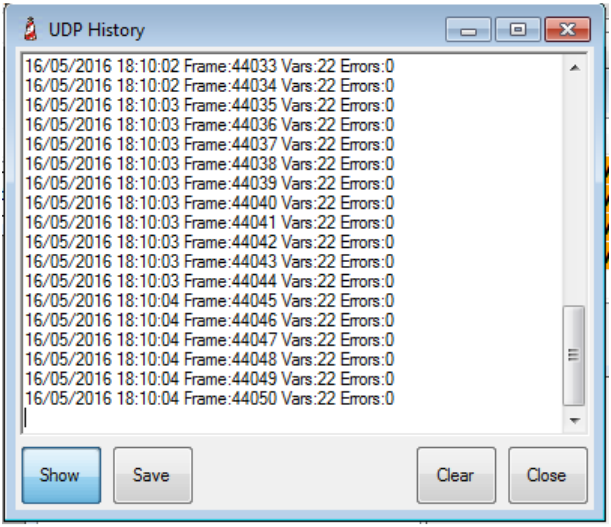
On the bottom left, there are 3 diagnostic messages about the connection:

- The **IP address** with the TCP/IP port used for the connection
- The **UDP port** used for exchanging variables
- The **status message**, which represent the last message received from FaRo following a FaroManager request

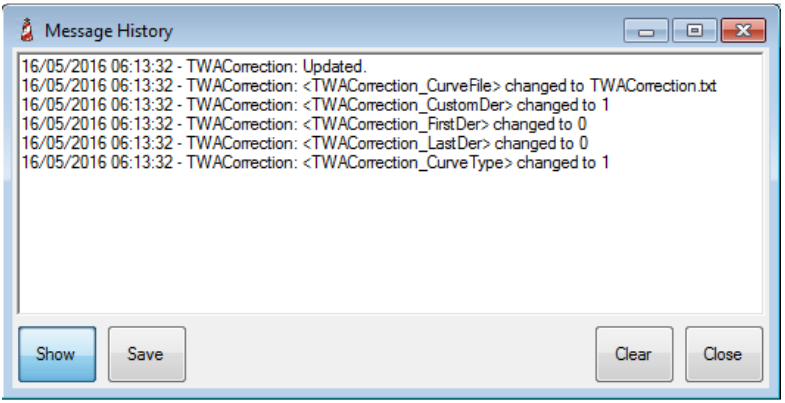
Double-clicking on any of the messages will open a diagnostic window from where it is possible to display real-time information about the connection



You need to push the **Show** button in order to display the information.



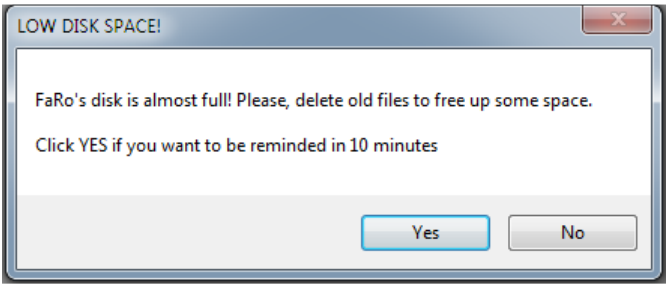
The content of the information is useful for debugging purpose. If requested by your technical assistant, you might need to save the displayed information. Push the **Save to** button to start logging a file in the folder "\Logs". The logging will be running until the **Save** button is pressed again.



Finally, on the bottom right of the main window, there are information about:

- The percentage of **used disk space** in the FaRo processor
- The current **CPU usage** of the processor
- The **Local Time** of the processor

Keep those numbers under control, to avoid problems with disk full or with excessive CPU usage.
When FaroManager connects to FaRo, if the free space left in the disk in FaRo is less than 10%, a warning message appears and the **used disk space** starts blinking.


LOW DISK SPACE!
FaRo's disk is almost full! Please, delete old files to free up some space.
Click YES if you want to be reminded in 10 minutes
Yes
No

Variables

2

There are thousands of variables defined in FaRo. FaroManager gives the tools to select, to organize and to manage all (and only) the variables the user needs.

When creating a new variable, the user has the option to assign any name to that variable. It is strongly recommend keeping the already established naming convention for the creation of new variables.

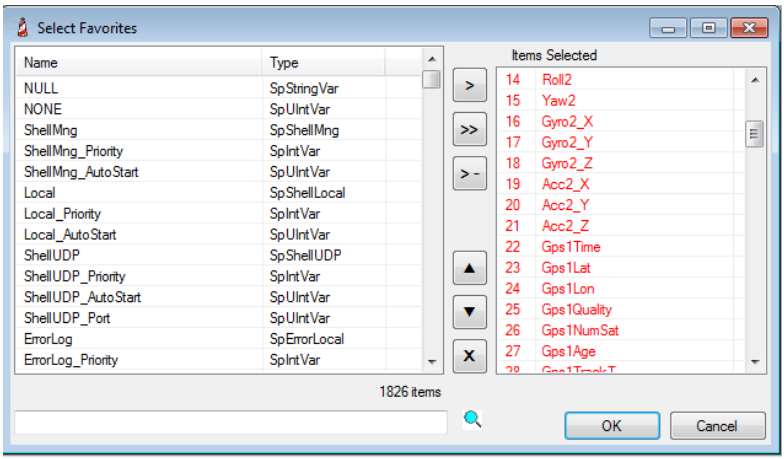
Faro variable naming convention:

Prefix	Description
AD_	Analog to Digital channel variables.
CNT_	Pulse channel variables.
COM(number)	Serial Port variables.
K_	Constants.

FK_	Fixed constants. Eg: FK_RadtoDeg = 57.29578.
K_Select	Constants that are used as inputs in Select functions. (For farther information check the chapter dedicated to the Math)
V_	Vectors
BG_	Variables for B&G displays
GRM_	Variables for Garmin displays
Calc_	Calculation process.

2.1 Select Favorites

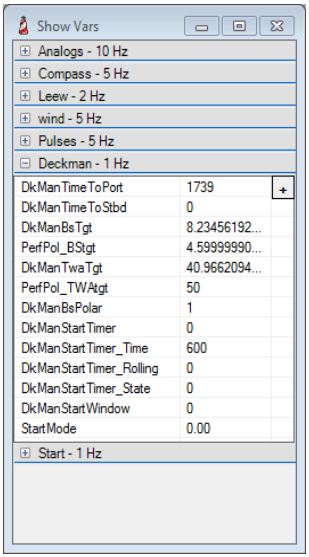
This function allows to reduce the number of variables to deal with in FaroManager, creating a list of the most used variables.



To add new variables to the list of favorites, select the variables of interest on the left list (you can type the first letters of the variables' name, in order to find them quickly). Once selected, click the  button to add them to the right list. Click OK to save the list and close the window.

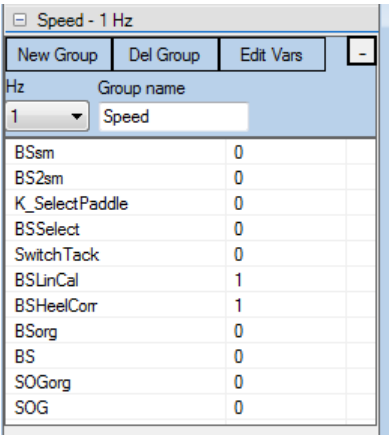
2.2 Show Variables

This function gives the opportunity to display the value of the variables. The variables are divided in groups and every group can display the values at different refresh rate (from 0.1Hz to 10Hz). To expand the content of a group, click on the bar with the name of the group.



2.2.1 Change the attributes of a group

To change the attributes of a group, expand the group and press the + button on the top right corner.



From here, you can:

- Create a new group.
- Delete the group.
- Add variables to the group.
- Change the group's name.
- Change the refresh frequency.

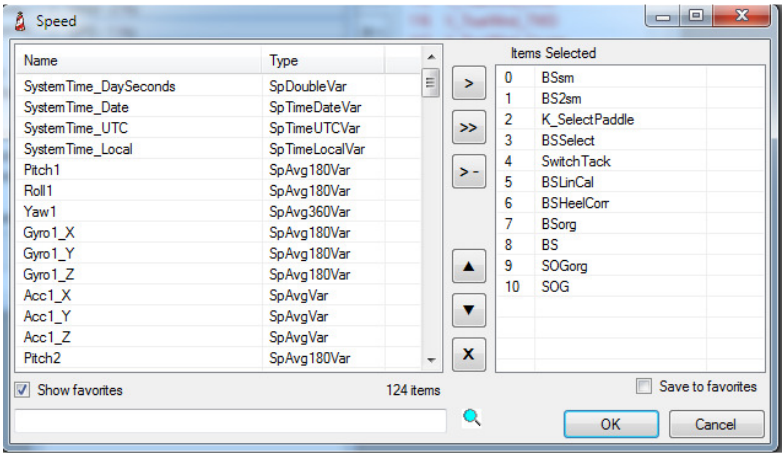
Press the  button to hide the editing features.

2.2.2 Create a new group of variables

After clicking on **New Group,** the new group is created at the bottom of the group list. There are chances you might need to collapse all the expanded group in order to see the newly created group.

2.2.3 Add variables to a group

To add/modify variables to a group, click on **Edit Vars.** By default, the form will open showing only the variables on the list of favorites. To see all the variables, un-tick the box **Show Favorites**. Select and add the variables from the left list to the right list pressing the  button. if you tick the box **Save to Favorites**, all the variables on the right list will be added to the list of favorites. Press **OK** to close the form and to add the listed variables to the group.

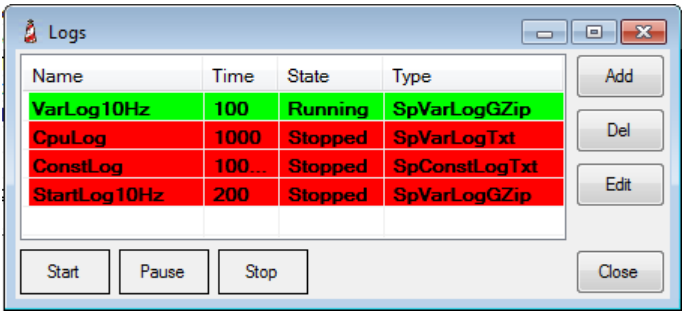

Speed
Name
Type
SystemTime_DaySeconds
SpDoubleVar
SystemTime_Date
SpTimeDateVar
SystemTime_UTC
SpTimeUTCVar
SystemTime_Local
SpTimeLocalVar
Pitch1
SpAvg180Var
Roll1
SpAvg180Var
Yaw1
SpAvg360Var
Gyro1_X
SpAvg180Var
Gyro1_Y
SpAvg180Var
Gyro1_Z
SpAvg180Var
Acc1_X
SpAvgVar
Acc1_Y
SpAvgVar
Acc1_Z
SpAvgVar
Pitch2
SpAvg180Var
Items Selected
0 BSsm
1 BS2sm
2 K_SelectPaddle
3 BSSelect
4 SwitchTack
5 BSLinCal
6 BSHeelCorr
7 BSorg
8 BS
9 SOGorg
10 SOG
>
>>
> -
Show favorites
124 items
Save to favorites
OK
Cancel

2.3 Logs

In FaRo it is possible to run different logging process, at different rates. The files are created inside the FaRo processor (by default in c:\Data\Faro\Data) and they need to be peridiocally removed to avoid risking that the disk run out of space.

> Filling the disk could bring to unpleasant effects, like losing data or corrupting files. Please, check periodically the disk usage on the bottom right of the main window.

The form managing the log process gives an overview of the current logging activities**.**



For every log process defined it will show:

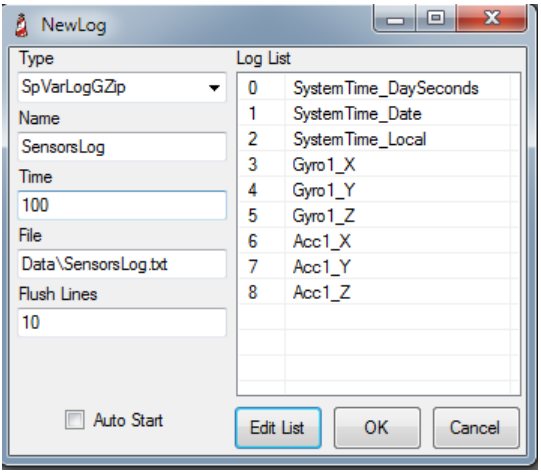
- The **File name.**
- **Acquisition Frequency** (in ms, so 100ms means 10Hz).
- **State** of the acquisition, (stopped, paused or running).
- **Type** of log.

You can Start/Stop/Pause a log by selecting the process on the list and pressing the required function.

Every Start-Stop sequence creates a new file with name ProcessName_YYYYMMDD_hhmmss_mmm (date and time when the file has been created), whereas the sequence Start-Pause doesn't create a new file, until the logging is stopped.

2.3.1 Creating a new Log Process

To define a new log process, click on **Add.**



1 Define the type of log:

- **SpVarLogTxt:** Normal file format, tab separated.
- **SpVarLogGZip:** Compressed file format.
- **SpConstLogTxt:** Log producing a line of data only when a change in the data is detected. This is useful to log variables of type Constant

It is strongly recommended to use the compressed file format for better performance and disk management. However, if the file has not been closed properly, it may get corrupted and some of the uncompressing utility might have problems opening it. In that case we suggest using the **7zip** application.

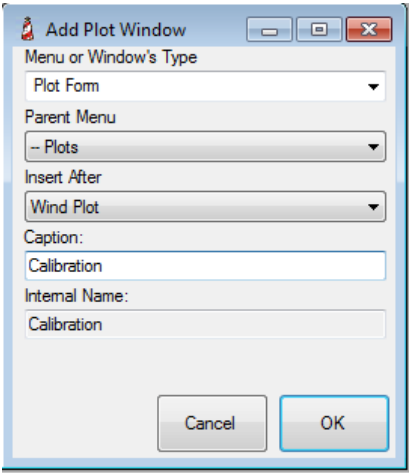
2. Give the log a name.
3. Fill the frequency wanted to log the acquired information at (in ms).
4. Add the name wanted for the file to have in the **Data** folder.
5. Add the number of **Flush Lines** (number of lines that will be written at the same time within the file)
   Add all the variables required for the log by clicking on **Edit List.**

By selecting **AutoStart,** the log will automatically start when Faro starts.

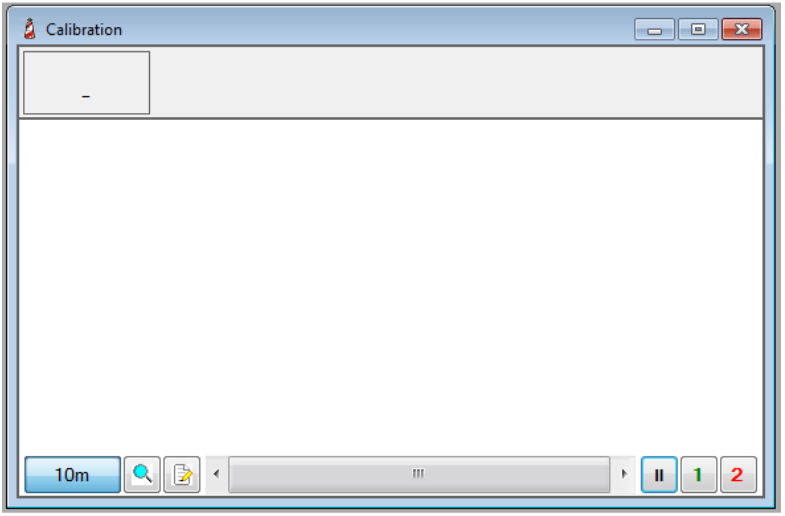
To delete or modify a process, select the log and push **Del** or **Edit**

2.4 Creating and displaying a plot window

After selecting the menu **Plots->Add Plot Window**, the following form will appear



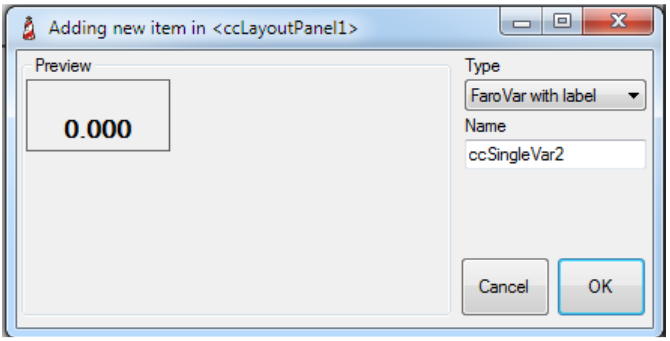
This is the window for managing custom created forms (please refer to the dedicated chapter for more info). A plot window is a pre-defined custom form, containing a LayoutPanel (used to host variables to display) and a TimePlot chart. Just fill the name of the window to create and press OK. This will create a new window and the relative sub-menu under the **Plots** voice



The complete description on how to configure the new window is in the section Custom Controls. A brief guide follows.

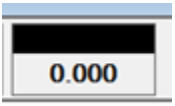
2.4.1 Adding variables in the Layout Panel

1. **Right click** in the Layout Panel and click **Add Var.**

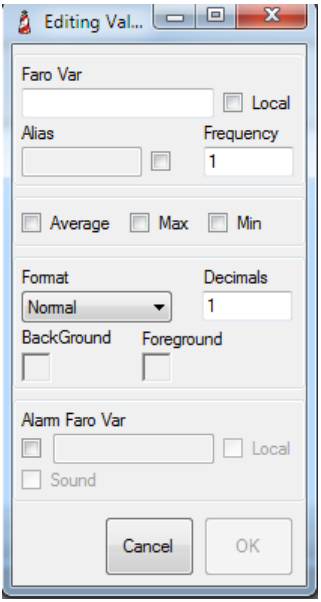


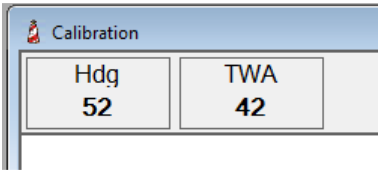
2. Enter a Name (you can leave the default one) and click **OK**. A new rectangular region will appear in the Panel.

3. With the mouse roll over the upper half side of the new rectangular region, which will turn black, then click.



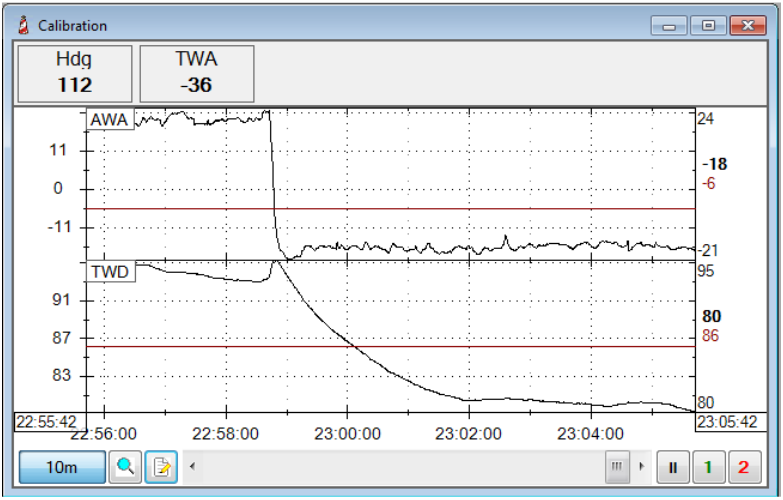
4. The **Edit** form will appear:
   - Select the variable to display, by clicking on the text box **Faro Var**
   - Thick the **Alias** check box if you want to display a different name for the variable and write the new name in the text box
   - Enter the refresh **Frequency**
   - Select the **Format** and the number of **Decimal** places
   - Select the colors for **Background** and **Foreground** (Font)
   - Click **OK**



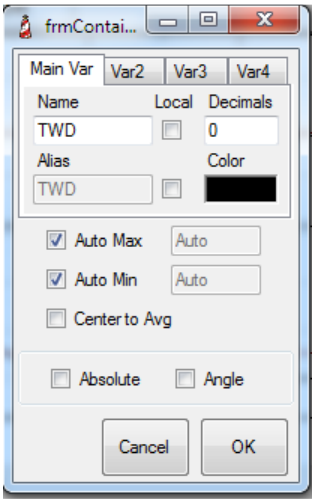


2.4.2 Adding variables to the Time Plot chart

1. **Right click** in the Chart Panel (or click the edit icon ) and click **Variables.**
2. Select the variable(s) to plot and click ok



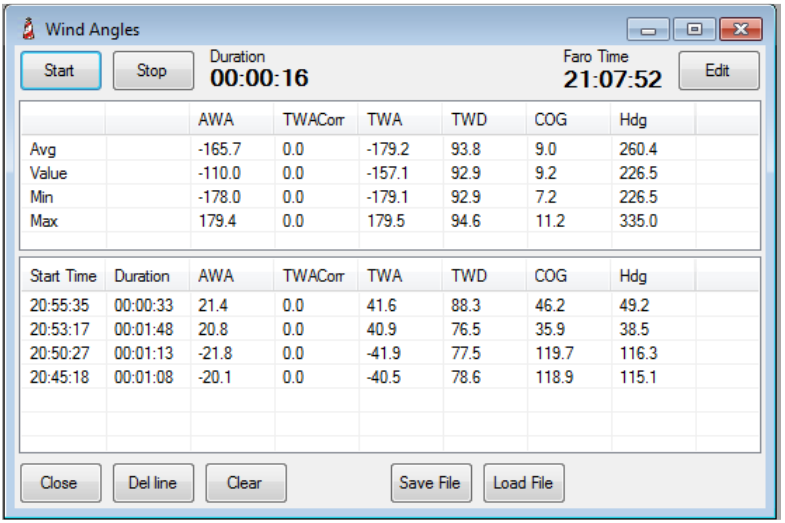
3. Click on the variable's name on the top left corner of the chart
4. Modify the properties of the plot



2.5 Calculate Averages

This function calculates and displays the average values (with min and max) of a set of variables. In the default configurations there are two predefined set, **Wind Angles** and **Speed and Compass**. The user can modify or add new sets.

Selecting, for instance, **Variables>Calc Averages->Wind Angles**, the following form will appear



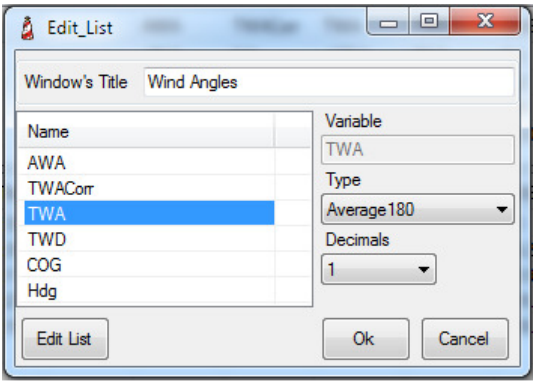
The upper side of the form is where the current values are displayed (line **Value**). When the **Start** button is pressed, a new calculation is started: the **Duration** text resets to zero and starts counting, the **Avg** line is updating the calculation of the average values, while the lines **Min** and **Max** keep track of the peaks registered during the calculation.

When the **Stop** button is pressed the calculation stops and a new line is inserted on top of the results list (on the bottom side of the form). To remove a result from the list, select a line and press the **Del line** button. The **Clear** button deletes all the results.

The list of results can be saved to a file, pressing the **Save File** button. A previous saved list of results can be loaded pressing the **Load File** button.

2.5.1 Edit the list of variables

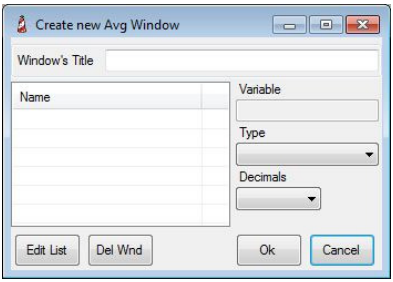
To change the list and the format of the variables used, press the Edit button.



- Press **Edit List** to display the form for choosing the variables
- Select the **Type** of average:
  - A normal average.
  - An average between -180 and 180 degrees.
  - A 360 degrees angle average.
- Select the number of **Decimal** places to display
- Press **OK** to confirm and close the form

2.5.2 Create a new Average Window

To create a new average window, on the main window, click on **Variables>Calc Averages>Create new Avg Window.**



1. First, fill the window's title box with the name of the average window.
2. Click on **Edit List** to add variables. A new form appears with all the variables available within Faro. Select the ones required and add them.
3. For each of the selected variables, define 2 parameters. First the type of average to calculate. There are three options:
    a. A normal average.
    b. An average between -180 and 180 degrees.
    c. A 360 degrees angle average.

    Also remember to choose the number of decimals places.
4. Once everything is set, press **OK**, and the window is created. It will be added automatically to the menu **CalcAvg** for easy access.

2.5.3 Delete an Average Window

To delete an average window, refer to the **Windows Manager** session in this manual.

Calibrations 3

3.1 General concepts

Calibration has a strong scientific background, but everyone has a personal approach to calibration procedures. With this philosophy in mind, although FaRo and FaroManager come with a pre-defined calibration workspace, the user is given all the tools to define and organize his own calibration procedures.

It is recommended to have at least a basic knowledge of the FaRo's MathDesigner, before changing the default calibration workspace.

The variables that might affect the calibration of sensors can be of three different types:

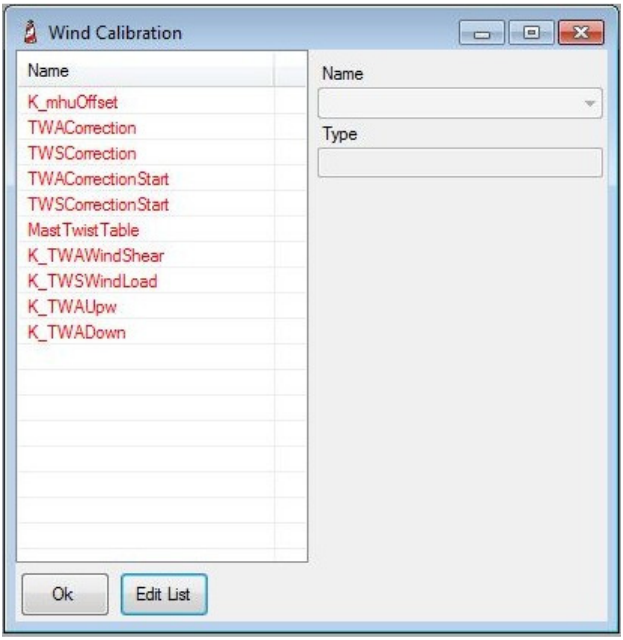
1. **Constant** - like the offset for the compass' alignment with the boat's centerline
2. **Function** - like the conversion from the output voltage of a sensor to the linear displacement of an actuator
3. **Table** - like the correction tables for the wind calibration. The tables in FaRo are arrays of constants and they are organized in:
   - one dimension
   - two dimensions, in Cartesian coordinates
   - two dimensions, in Polar coordinates
   - two dimensions, in WTP style

In FaroManager's default workspace, the calibration variables have been organized in four different groups:

- **Wind Calibration**
- **Boat Speed Calibration**
- **Compass Calibration**
- **Analog Sensors Calibration**

Compass Swing + BS Cal, included in the Calibration menu, is a calibrating procedure which takes advantage of the relations between GPS, Compass and Speedometer to achieve a reliable calibration for Compass and Boat Speed.

All the Calibration groups use the same Form Template and they can be edited and modified in the same way. To add or delete a calibration group, use the **Windows Manager** function described later in this manual.

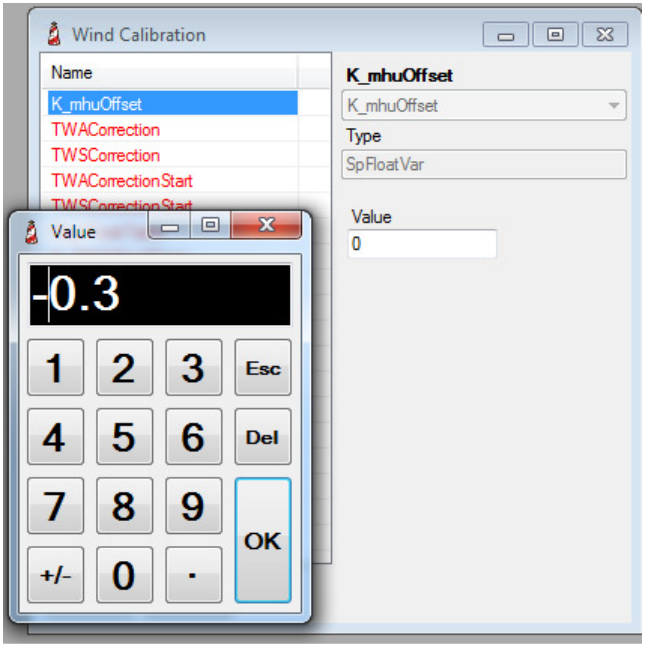


On the left side of the form, there is the list of the variables pertaining to the group. Selecting one variables at time, allows to visualize the variable's type and its value(s) on the right side of the form.

If nothing appears in the description fields when selecting a variable on the list, it means that the selected variable doesn't exist in FaRo. This could happen when a FaroManager's profile has been configured for another FaRo processor.

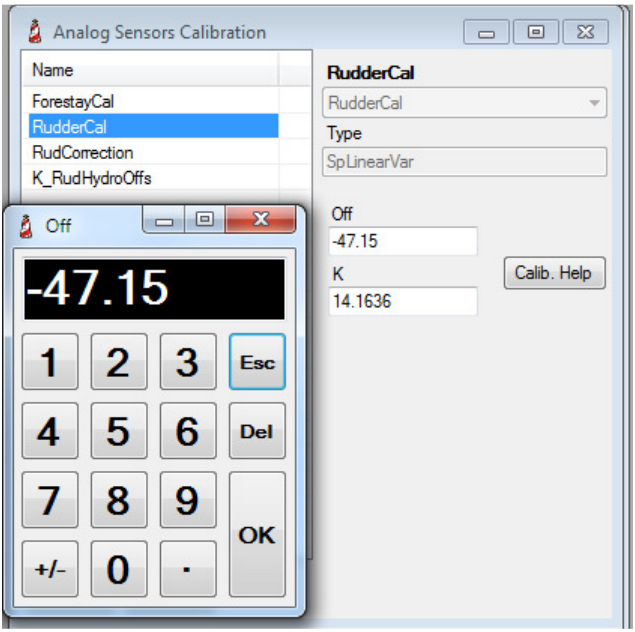
3.1.1 Constants calibration

If the variable is a **Constant** (Boolean, Integer, Unsigned Integer, Float or Double), you can see and modify the value.



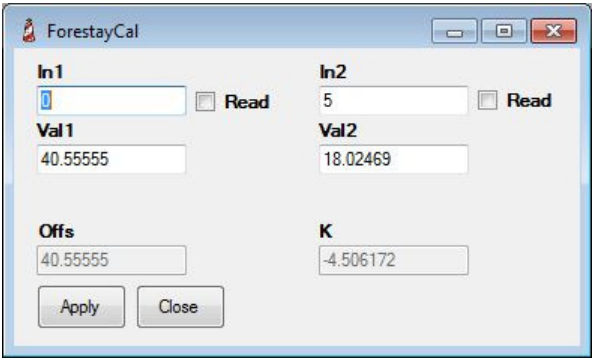
3.1.2 Linear functions calibration

If the variable is the result of a function, you can see and modify the parameters of the function. In case of a linear function, the parameters are the slope (K) and the offset (Off) of the linear relation between the input and the output.



In most cases, once the instrument has been properly calibrated, only the offset needs to be adjusted, because the slope usually represents the sensor's characteristics (like the relation between the output voltage of a string pot and its extension).

If a complete calibration is required, in FaroManager there is a Linear Calibration Procedure, that can be called pushing the button **Calib Help**.

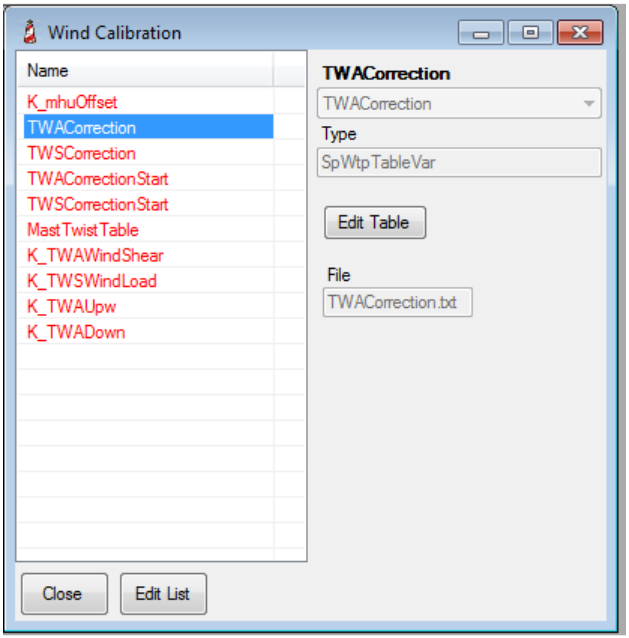


This function helps finding the Slope and the Offset of the linear calibration by entering the inputs and the expected outputs in two different measurement points. This can be done offline or while reading the instrument data.

If you are connected to the sensor, ticking the **Read** check box allows reading the current output values of the senor (which are the input of the linear function). When the box is un-tick, the value in the text box freezes to the last read value. Do this for two different measurement point (**In1** and **In2**) and write the corresponding values in the **Val1** and **Val2** text boxes. Slope (**K**) and **Offset** of the linear function are automatically updated every time a new value is typed. Click **Apply** to commit the new values to FaRo. The new values are automatically saved.

3.1.3 Tables calibration

After selecting a Table variable in the list, you need to press the **Edit Table** button in order to edit and change the values in the table.

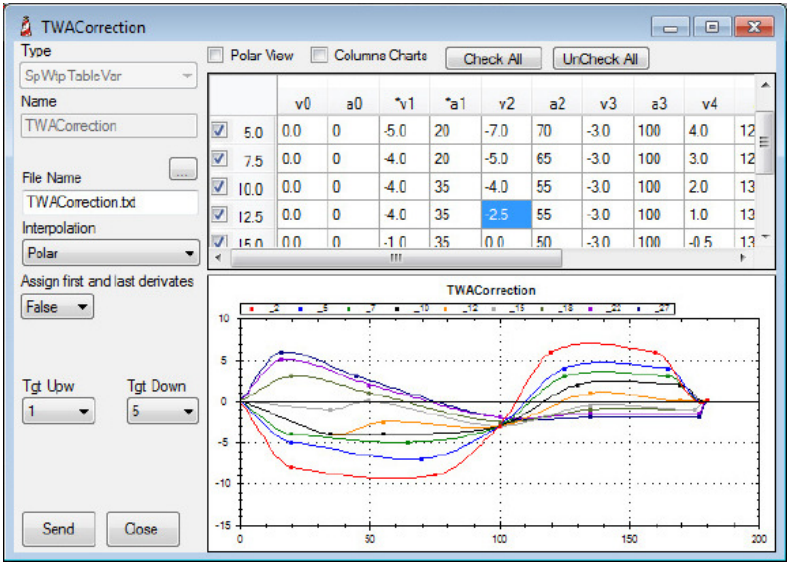


Tables in FaRo are managed as external files (.txt), containing values separated by tab or spaces.
Hereafter, we give a brief description of how to modify a WTP-style calibration table using FaroManager. For a more exhaustive explanation, refer to Appendix A.

The table form is divided into three sectors:

- on the left the general properties of the table, including the external file name
- on the top right the grid containing the values

- on the bottom right the graphical representation of the values, including the visualization of the selected interpolation



To change a value in the table, click on the selected cell and enter the new number using the numeric pad. The corresponding value is automatically modified in the graph below. For a better visualization, you can show and hide the relevant curves by ticking on and off the check boxes on the left side of the grid.

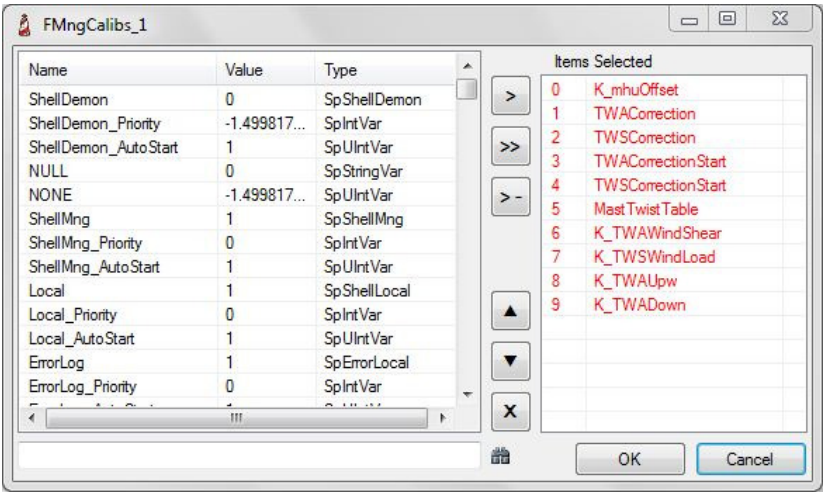
You can also change the graphical representation by ticking the check boxes on the top of the grid:

- **Polar View** plots the points in polar coordinates
- **Column data** plots the points by columns

The changes are committed and saved into FaRo when the **Send** button is pressed.

3.1.4 Modifying the list of calibration variables

To add or remove calibration variables on the list, press the **Edit List** button: the standard Select Variables form will pop up.



Add variables on the list by selecting them on the left list and clicking the > button.
Remove variables from the list by selecting them on the right list and clicking the X button.
You can change the order of the variables in the list by selecting them on the right list and clicking the ▲ and ▼ buttons.

> To find the variable on the list, type the first letters and the automatic filter will reduce the number of variables to a few matching the text.

Once the list has been modified, push the **OK** button to save the changes and to close the form.

3.2 Wind Calibration

In this group there are all the variables that, in the default profile, are related to the wind calibration.

Variable	Description
K_mhuOffset	Angle offset of the wind sensor.
TWACorrection	Upwash correction table for TWA.
TWSCorrection	Upwash correction table for TWS.
TWACorrectionStart	Upwash correction table for TWA used during the prestart procedure.
TWSCorrectionStart	Upwash correction table for TWS used during the prestart procedure.
MastTwistTable	Correction table for the mast twist. The mast twist correction is applied on the apparent wind angle, before the gyros' compensation. Positive values are required to compensate the rotation.
K_TWAWindShear	Angle correction for the wind shear
K_TWSWindLoad	Wind Load coefficient
K_TWAUpw	TWA below which the boat is sailing upwind
K_TWADown	TWA over which the boat is sailing downwind

3.3 Boat Speed Calibration

In this group there are all the variables that, in the default profile, are related to the boat speed calibration.

Variable	Description
K_PadLog	Paddle Wheel calibration constant.
K_Pad2Log	Paddle Wheel calibration constant for a second paddle wheel
BSLinCal	1D table correcting possible non linearity of the paddle wheel with speed (due to the hull shape). The input is the Bsp
BSHeelCorr	1D table correcting possible non linearity of the paddle wheel with heeling (due to the hull shape). The input is a damped value of heel.
LeewK0	1D table in function of the TWS that outputs the constant K used in the leeway calculation

3.4 Compass Calibration

The number of compass available in the market has recently growing very quickly. In general, they are complete IMU, providing 3 orientation angles, 3 rate gyros and 3 axis accelerometers. Although this enhances the chances to install a reliable compass even for low budgets, it introduces few drawbacks:

- Every compass needs a different driver. Even compass of the same brand might need a new driver for a new release (this the case, for instance, of the 3DM series compass). Please check with the technical assistance for FaRo's compatibility before committing to a new compass.
- Different compass might use different sign conventions. FaRo uses a right-handed reference system, with the x axis aligned with the boat's centerline and pointing forward, y axis on the deck plane and pointing on the right, z axis perpendicular to the deck plane and pointing downward. In this reference, the pitch angle is positive when the bow goes up and the roll angle is positive when the mast head tilts on the right. Moreover, trim angle is positive for bow up (same as pitch), heel angle is positive for mast head tilting on the left (opposite of roll). If a compass outputs pitch and roll with different signs, adjustments need to be made in the MathDesigner (this has to be done at the installation)
- The north reference can be geographic (for fibre optics or dual-antenna gps systems compass) or magnetic (traditional magnetometers). FaRo uses the magnetic north as reference and a parameter identifies the compass output as magnetic or geographic.

The calibration variables for the standard FaRo's configuration take in account a main and a spare compass.

Variable	Description
K_DeclMagn	Local magnetic variation.
K_Heading1Offs	Mechanical offset of the main compass.
K_Pitch1Offs	Pitch offset of the main compass
K_Roll1Offs	Roll offset of the main compass
Heading1Curve	1D table compensating the residual on-board magnetic interferences
K_SelectMagnOffs1	Constant that defines if the compass is magnetic or not. Put 0 for geographic, 1 for magnetic
K_Heading2Offs	Mechanical offset of the spare compass.
K_Pitch2Offs	Pitch offset of the spare compass.
K_Roll2Offs	Roll offset of the spare compass.
Heading2Curve	1D table compensating the residual on-board magnetic interferences
K_ SelectMagnOffs2	Constant that defines if the compass is magnetic or not. Put 0 for geographic, 1 for magnetic

3.5 Analog Sensors Calibration

The variables in this group can be very different from boat to boat. In this group there are the variables for calibrating the sensors that are not related to the solution of the wind triangle (rudder, trim-tab, deflectors, dagger-boards, load-pins..). Here are listed the variables for a TP52 boat with a basic installation.

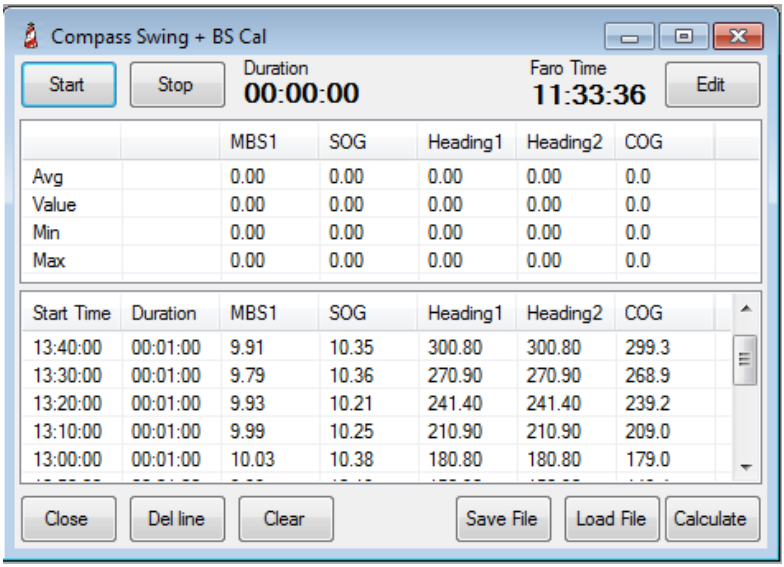
Variable	Description
ForestayCal	Forestay's load pin linear calibration.
RudderCal	Rudder linear calibration.
RudCorrection	1D table correcting possible non linearity in the rudder angles.
K_RudHydroOffs	Offset correction for the rudder to be used in case the geometrical offset (determined with the linear calibration) doesn't provide symmetric angles while sailing
RakemmCal	Linear rake calibration in millimeters.
RakeDeg	Linear rake calibration, converting the extension of the rake ram in degrees

3.6 Compass Swing + Bs Cal

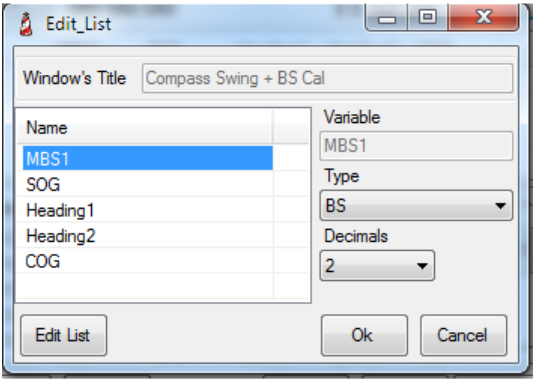
This function is a calibrating procedure which takes advantage of the relations between GPS, Compass and Speedometer to achieve a reliable calibration for Compass and Boat Speed.

The concept is to motor the boat upright at constant speed in different directions, for segments of at least 60 seconds. This allows to estimate the current effect on boat speed and heading, although it is always advisable to do the procedure in an area where the current is negligible. For better results, it is also suggested to sail at not consecutive intervals of 30 or 45 degrees.

The default profile takes in account the calibration of one paddle wheel and two compass



To change the list of variables involved in the calibration, pres the **Edit** button



Click on **Edit List** to modify the list of variables. After the list has been completed, verify that all the variables are assigned to the correct type. This is very important to make sure the calibration procedure succeeds. The types are;

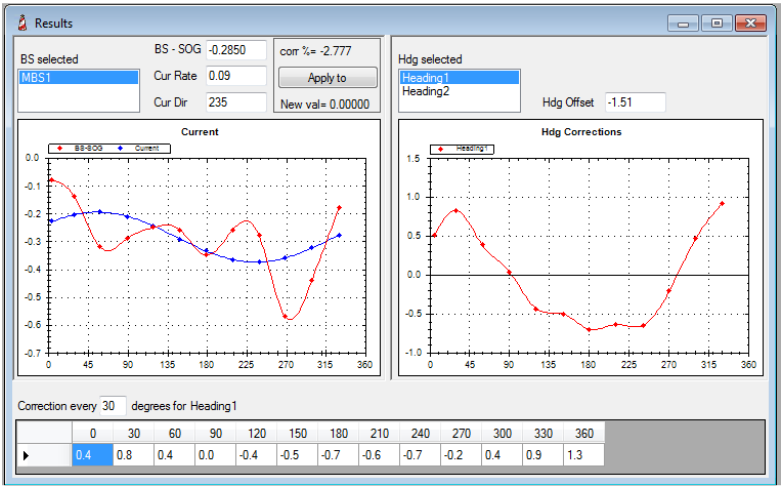
- **BS** - for sensors measuring boat speed relative to the water (paddle wheel)
- **SOG** - for sensors measuring speed relative to the ground (GPS)
- **Heading** - for sensors measuring the direction relative to the water (compass)
- **COG** - for sensors measuring the direction relative to the ground (GPS)

It is important that there is at least one variable for each type in the list. Click **OK** to save and close.

3.6.1 Collecting Data

- Make sure your local magnetic variation is correctly set-up.
- Start motoring in a chosen direction and, when the speed has reached a stable value (as close as possible to a usual sailing speed), press the **Start** button.
- Proceed in a straight line for 60-90 seconds at constant speed, then press the **Stop** button.
- A new line will appear in the lower list on the calibration form, with the calculated average values of the run.
- Repeat the same operation for different directions, every 30 or 45 degrees, but try to avoid to increment the angle progressively. The intent is to cover the smaller area as possible, to reduce the effect of unstable currents

Once the runs are terminated, you can save the results in a file for post-analysis. Press **Calculate** to visualize the calibration results.



The form is divided in three areas.

The left side is related to the boat speed sensors calibration, the right side displays the correction graph for the compass, the bottom side gives the numerical correction suggested for the compass at different fixed angles.

3.6.2 Boat Speed calibration results

- On the **BS selected** list there are all the boat speed sensors (just one in our example). Select one sensor to visualize the results.
- In the **Graph** there are the measured differences between BS and SOG in the different runs (**red line**)
- The **blue line** is the best sinusoidal approximation of the measured points. This represents the best approximation of a current with a constant rate and direction
- The **BS-SOG** text box is the Y-offset of the blue sinusoidal line, which represents the calculated difference between the SOG and the boat speed compensated with the current
- **Cur Rate** and **Cur Dir** are the calculated values of the measured current
- You can manually modify the values of BS-SOG and current. The blue line in the graph will change accordingly (as well as the correction graph for the compass)
- You might find that some of the points "disrupt" a smooth calculation. In that case you can close the form and delete from the results list the point(s) that causes the anomalies (save the results in a file before, so you can always recall the deleted lines). Open the Calculation form again and verify if the overall results seem better
- The **corr%** label is the suggested percentage value to apply to the calibration constant of the selected paddle wheel
- If you want to visualize the new value, click on **Apply to** and select the relative calibration constant fro the list of the

FaRo variables. The **New val** label will show the suggested value to apply to the constant.

- The value is not automatically applied. To change the constant values, open the Boat Speed calibration window and manually apply the change.

3.6.3 Compass calibration results

- On the **Hdg selected** list there are all the compass used for calibration. Select one compass to visualize the results.
- In the **Graph** the corrections to apply for the selected compass are plotted at different angles
- The Hdg Offset text box shows the correction to apply to the current offset
- The table below calculates the correction values at selected intervals. You can change the interval clicking on the text box just above the table

All the new correction values are calculated as a difference from the current calibration. So, if the current heading offset is +1.5 and the calibration outputs -0.5, the new value to apply will be +1.0

Settings

4

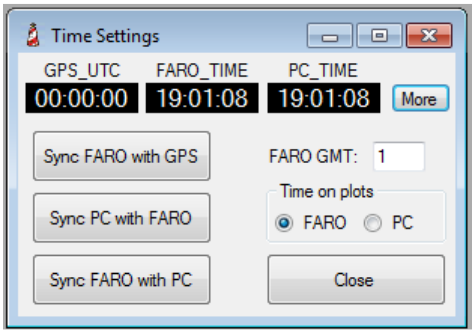
Settings in FaroManager are organized with the same philosophy of calibrations: a default configuration is prepared covering all the basic needs, but the user can modify the workspace changing groups and variables at any time.

In the settings workspace, the user can:

- Manage the time synchronization in FaRo
- Modify the filters of the variables to display
- Modify the values describing the boat (boat length, mast height...)
- Manage the polar tables
- Toggle between source instruments
- Configure FaRo for the Navigation software in use
- Activate or deactivate special functions
- Manage the variables to send to the display
- Configure a NMEA2000 network

4.1 Time Settings

With this function it is possible to manage the time in FaRo and in the computer where FaroManager runs.



- **GPS_UTC** is the UTC time as read from the GPS connected to FaRo.
- **FARO_TIME** is the System Time in FaRo
- **PC_TIME** is the System Time of the computer connected to FaRo
- **FARO GMT** is the local difference in hours from the Coordinated Universal Time
- Pushing **Sync FARO with GPS**, FaRo synchronizes with the GPS time
- Pushing **Sync PC with FARO,** the local PC, connected to FaRo, synchronizes with FaRo's time
- Pushing **Sync FARO with PC**, FaRo synchronizes with the connected PC.
- Time on Plots allows to chose which source time to use in the plot charts. You might decide to use the local time (PC) when the network connection is unstable.

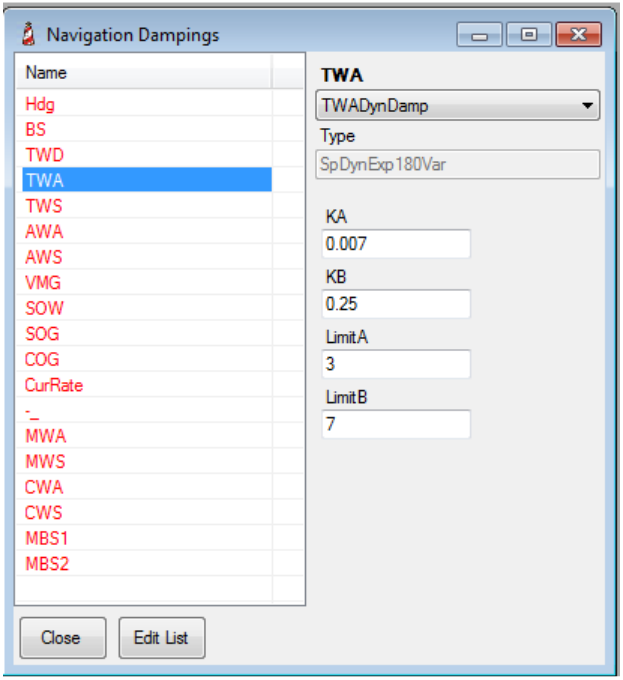
4.2 Modifying filters in FaRo

FaRo implements different types of filters, but here we will discuss only the two most used low pass filters:

- **Average Filter** is calculated as average of the last n measurements.
- **Exponential Filer** is calculated as weighted balance of the last measurement with the previous calculated value. The weighting factor, called "smoothing constant", is a number between 0 and 1: the smaller the number, the higher the effect of the filter. The smoothing constant is also the inverse of the "time constant", that is the time necessary for the filtered signal to reach 63% of the target value

The filters' parameters can be **fixed** numbers or they can change based on some defined conditions (**Dynamic** filters). Dynamic filters are commonly used when we want numbers to behave differently from straight line to maneuvers, in which case the yaw rate is the variable determining the sailing mode. If the yaw rate is below an assigned limit (usually around 3-5 deg/sec), filters' parameters are set to some values; if the yaw rate is above a second limit (6-8 deg/sec)), filter's parameters are set to different values; if the yaw rate is between the two limits, a linear interpolation is performed to calculate the parameters to assign to the filter.

In FaroManager, **Dampings** forms have the same functionalities of the **Calibration** forms. On the left side of the form, there is the list of the filters. Selecting one variable at time, it allows to visualize the filter's type and its parameter(s) on the right side of the form.



Some variables, when highlighted, show a combo box, containing more than one filter: for those variables, FaRo calculates more than one filter and the user can select which one to use.

To add or delete variables on the list, press the **Edit List** button. The type of variables to add on the list are:

- **SpAvgVar**
- **SpAvg180Var** (for -180 + 180 angles)
- **SpAvg360Var** (for 0 360 angles)
- **SpAvgVectorVar** (for variables of type vector)
- **SpExpVar**
- **SpExp180Var** (for -180 + 180 angles)
- **SpExp360Var** (for 0 360 angles)
- **SpExpVectorVar** (for variables of type vector)

- **SpDynAvgVar** (dynamic avg filter)
- **SpDynAvg180Var** (for -180 + 180 angles)
- **SpDynAvg360Var** (for 0 360 angles)
- **SpDynAvgVectorVar** (for variables of type vector)
- **SpDynExpVar** (dynamic exponential filter)
- **SpDynExp180Var** (for -180 + 180 angles)
- **SpDynExp360Var** (for 0 360 angles)
- **SpDynExpVectorVar** (for variables of type vector)
- **SpSelectVar** - Not all the Select variables are related to filters. You need to look for the SelectVar that has filter variables on their list. The filters accounted in a select var don't need to be added to the List

4.2.1 Modifying an average filter

An average filter has only one parameter to set up: the number of samples to use for calculating the average (**width**). When choosing the appropriate width for a filter, the base frequency of the hosting calculation process has to be taken in account. The default frequency for calculations in FaRo is 10 Hz (100 ms), so usually the width needs to be 10 times bigger than the required damping in seconds (eg: to achieve a damping of 5 seconds, the width value needs to be 50).

4.2.2 Modifying an exponential filter

An exponential filter has only one parameter to set up: the smoothing factor **K**.

- The smoothing factor needs to be **between 0 and 1**, the smaller the number the higher the filtering effect.
- Bigger values are automatically reduced to 1 and the filter doesn't have any effect.

- Negative values are automatically set to 0 and the output is a constant value

Like for the width of the average filter, the smoothing factor's real efficacy depends on the frequency of the host calculation process. So, using the default 10 Hz for the calculation as example, a smoothing factor of 0.02 is equivalent to 0.2 on a 1Hz process, which is a time constant of 5 seconds (to reach 63% of the theoretical value).

4.2.3 Modifying a dynamic filter

A dynamic filter is defined by four parameters

1. **KA:** parameter to use when the yaw rate is less than or equal to the value specified in **LimitA**.
2. **KB:** parameter to use when the yaw rate is greater than or equal to the value specified in **LimitB.**
3. **LimitA:** Lower limit of the yaw rate (in degree per seconds), under which the boat is considered sailing in straight line
4. **LimitB:** Upper limit of the yaw rate, over which the boat is considered maneuvering.

Anytime the yaw rate is between limitA and limitB, the parameter in use is a linear interpolation between KA and KB.

4.3 Navigation Dampings

In **Navigation Damping** are collected all the filters for the navigation variables. In the default configuration they are

Variable	Description
Hdg	Heading.
BS	Boat Speed.
TWD	True Wind Direction.
TWA	True Wind Angle.
TWS	True Wind Speed.
AWA	Apparent Wind Angle.
AWS	Apparent Wind Speed.
VMG	Velocity Made Good.
SOG	Speed Over Ground.
COG	Magnetic Course Over Ground.
CurRate	Current vector
MWA	Measured Apparent Wind Angle after offset correction and twist correction.
MWS	Measured Apparent Wind Speed

CWA	MWA after gyro correction.
CWS	MWS after gyro correction.
MBS1	Boat speed as pure first paddle wheel conversion (before corrections)
MBS2	Boat speed as pure second paddle wheel conversion (before corrections)

4.4 Instruments Dampings

In **Instruments Damping** are collected all the filters for the variables not related to navigation. In the default configuration they are

Variable	Description
Heel	Heel
Pitch	Pitch
Rudder	Rudder
Forestay	Forestay load.

4.5 Boat Settings

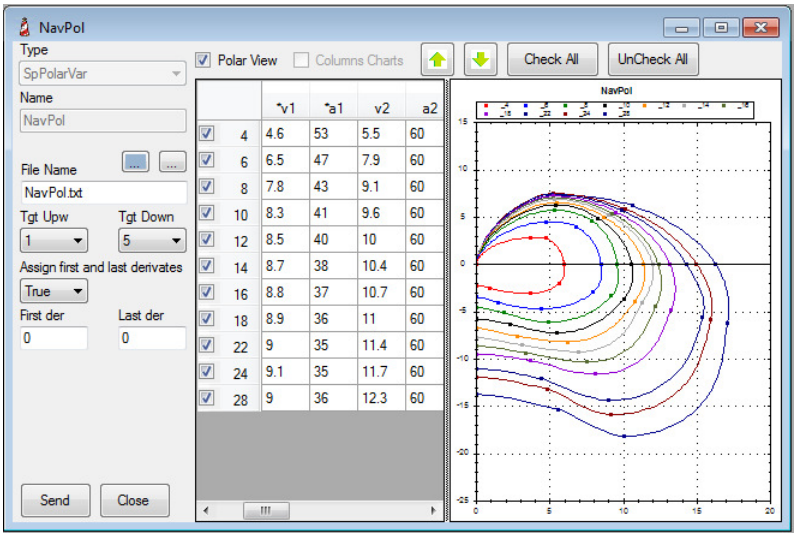
Boat settings collects the constant variables defining the boat's dimensions. In the default configuration, they are:

Variable	Description
K_BoatLength	Boat length in meters (from the GPS antenna to the bow)
K_MastHeight	Mast height in meters (from the water line)
K_distXmhu	Distance x between the position of the mhu and the supposed rotation point of the boat. In a keel-rudder configuration, usually it is slightly behind the keel, so the value is negative

4.6 Polars and Targets

In **Polars and Targets** the user can modify existing or load new polar tables. They are:

Variable	Description
NavPol	Navigation polar of the boat.
PerfPol	Performance polar of the boat.
StartPol	Prestart polar of the boat. This table is automatically loaded when FaRo enters in pre-start more (refer to toggle options)



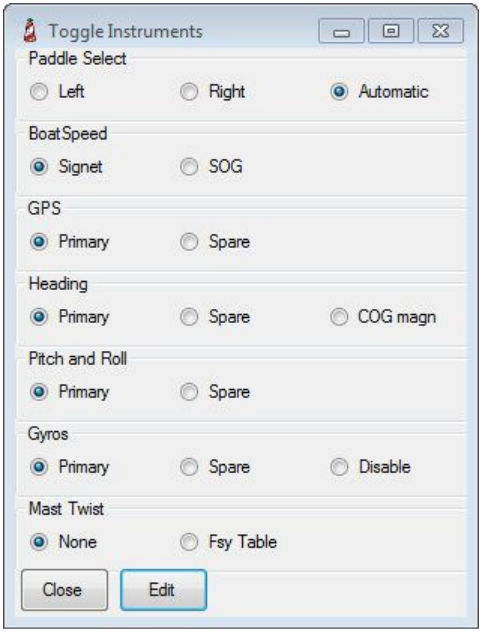
Polar tables are in "WTP style", with the columns organized in couples of boat speed and true wind angle. The target columns are marked with a ***** and they can be chosen with the combo boxes on the left side of the window. There is no limit on the number of columns and rows.

To load a table stored on the FaRo processor, click on the  button. To load a table from the local PC (and subsequently copying it into the FaRo processor) click on the  button.

The window opens with the graph in polar view. It is also possible to plot the table by rows (un-ticking the **Polar View** check box) or by columns (ticking the **Column Charts** check box). The changes are committed and save in FaRo only after pressing the button **Send.**

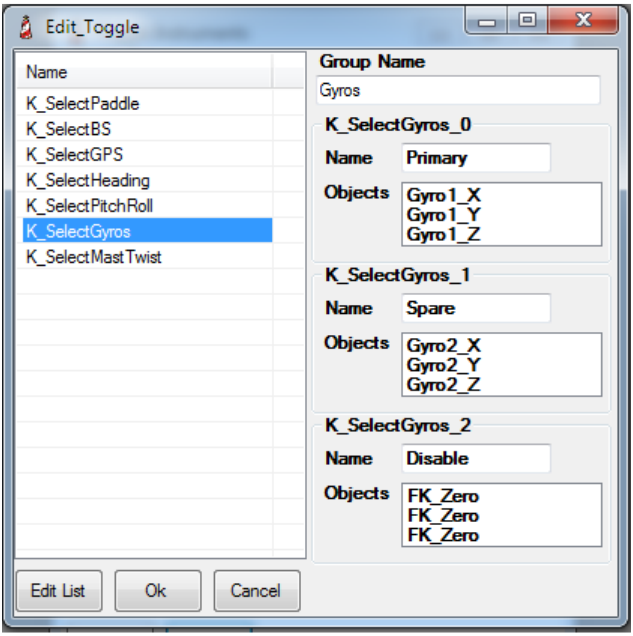
4.7 Toggle Instruments

Toggle instruments allows the user to switch between sensors. Even in this case it is possible to completely modify the window's content, although the options listed in this window are strictly related to the sensors installed. It is therefore advisable that only persons with a deep knowledge of the boat's configuration would perform such a task.



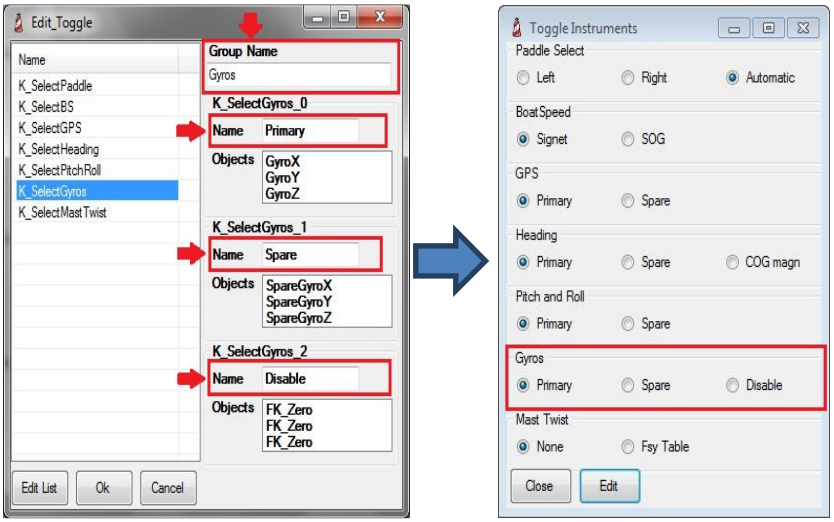
To modify the window's content, push the **Edit** button.
The variables on the list are all **K_Select** constants, which are the inputs of **SpSelectVar** type variables. Depending on the value of the K_Select constant, the Select function outputs one of the variables that are contained in its list.

One K_Select constant can be the input of more than one Select function.



Selecting one of the K_Select constants listed on the left, the right side of the window shows which variables are listed in the Select function(s). It is possible to modify the title of the function (Group Name) and the name of each group of variables.

To Add/Remove any of K_Select constants, click on the button **Edit List** and choose the K_Select variables that are related to switching instrument.



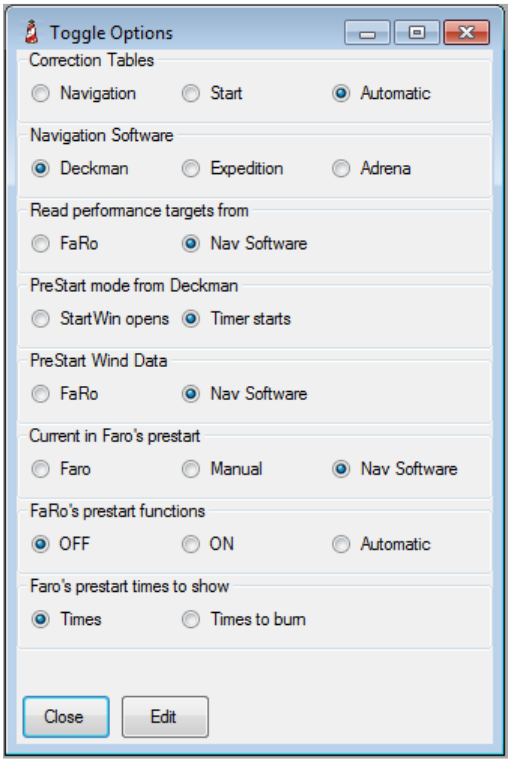
In the default configuration, the toggle instruments contains:

Toggle	Description
Paddle Select	In case of multiple paddle wheels, the choice can be a manual switch or an automatic switch related to the sailing tack
BoatSpeed	If the paddlewheel has problems, it allows the use of SOG in the wind triangle calculation.
GPS	Toggle between main and spare GPS
Heading	Toggle between main and spare compass

Pitch and Roll	Toggle between the main and spare pitch and roll.
Gyros	Select which gyro sensor to use for the wind calculation. Selecting **NONE** switches off the gyro correction.
Mast Twist	Allows the use of a calculation table for the mast twist

4.8 Toggle Options

Toggle Options is a collection of options given to the user in order to personalize some of the functions in FaRo. As in Toggle Instruments, there is the possibility to modify the workspace. The nature of the functions involved, though, makes the personalization task quite difficult to achieve without a deep knowledge of the mathematics relations in FaRo and of the exchange protocols with the navigation software.



4.8.1 Correction Tables

As seen in the Wind Calibration paragraph, FaRo has two sets of correction tables for TWA and TWS, one for the pre-start and one for racing. Here it is possible to select which set of tables to use for the wind calculation. When the **Automatic** option is selected, FaRo loads automatically the pre-start tables when the systems enters in pre-start mode.

4.8.2 Navigation Software

The three more used navigation software, **Deckman**, **Expedition** and **Adrena**, have three different ways to exchange information with FaRo. When connecting a navigation software with FaRo, remember to select here which software is in use.

4.8.3 Read performance targets from

Navigation software and FaRo manage their own polar tables. The resulting targets are used for calculating important racing information, like time to start line or time to the lay lines. Here you can chose the source of the targets.

4.8.4 PreStart mode from Deckman

When connected with Expedition or Adrena, FaRo enters in pre-start mode when the Timer for the countdown is activated. When connected with Deckman, there is also the option of entering the pre-start mode when the Start window in Deckman is opened.

4.8.5 Faro's preStart functions

FaRo contains a set of advanced functions used for calculating possible trajectories during the pre-start. From these functions, few options for distances (and times) to different points of the starting line are shown to the user. Because the functions are quite hungry of CPU, it is better to activate them only when necessary. From here you can turn them on, off or let FaRo to start them automatically when it enters in pre-start mode

4.8.6 PreStart Wind Data

This function is used only by the pre-start functions in FaRo.
Reading a correct wind during a lively pre-start sequence sometimes might result quite problematic. Navigation software usually have the option to manually "tweak" the wind when necessary. Selecting the option **Nav Software**, it gives FaRo's pre-start functions the opportunity to benefit of the manual wind manipulation operated from the navigation software

4.8.7 Current in FaRo's pre-start

This function is used only by the pre-start functions in FaRo.
Navigation software might have different options for reading or calculating the current. Although FaRo is using its own calculations for evaluating the current, the user can have alternative sources (grib files, tides data..) for the current.

4.8.8 FaRo's pre-start times to show

This function is used only by the pre-start functions in FaRo.

Pre-start functions in FaRo might output an amount of numbers quite difficult to keep under control. For this reason, only one variable is used to show the time to reach a target and the time to burn for the same target. With this option it is possible to toggle from one to the other.

4.9 Configuring displays

FaRo can communicate with the following displays:

- B&G displays based on FastNet protocol (H2000 and H3000 series)
- Garmin GNX 120 and GNX 130 displays
- Any Nmea2000 compatible display (eg: B&G H5000 and Triton)

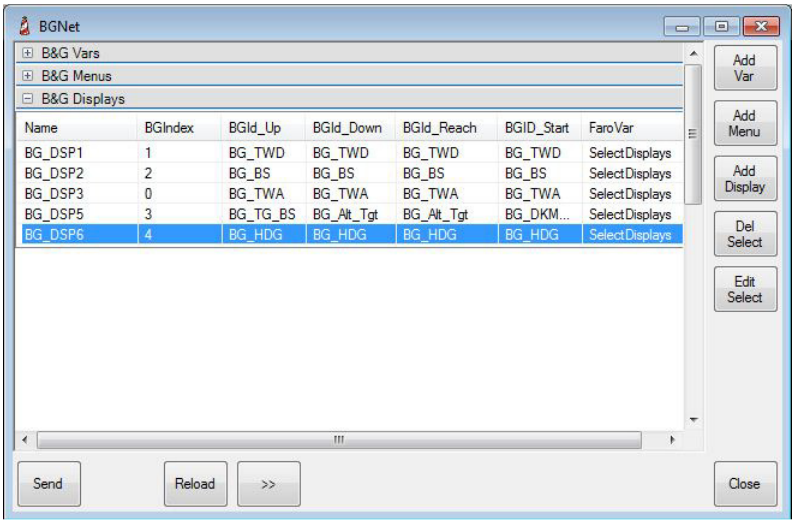
Some general remarks about display network in FaRo.

- There is no limit to the number of networks Faro can manage simultaneously.
- Different type of network can coexist in the same FaRo system.
- The Nmea2000 protocol accepts only standard PGN sentences: only variables included in the PGN sentences can be sent to a Nmea2000 standard display.
- Garmin GNX 120 and GNX 130 displays are based on Nmea2000, but they can also handle up to 20 custom defined variables.
- FaRo uses a third party adapter (Actisense NGT-1) in order to communicate with Garmin and Nmea2000 displays. Please, refer to the NGT-1 user manual to configure the adapter for the required PGN sentences.

FaRo handles the different type of network display with separate functions.

4.10 B&G FastNet displays

If a B&G FastNet network is installed on board, you can configure the displays from the menu **Settings->BGNet**. Another option is to look for the device **BGNet** in the list of **Serial Devices** (see later in the **Advanced** section).



The configuration window is divided in three main sections:

- **B&G Vars:** where the variables to send to the displays are created and modified
- **B&G Menus:** where the displays' menus are managed. A variable needs to belong to a menu (or more) in order to be seen on the displays
- **B&G Displays:** where the variables to display on the HVision 20/20 (or other sizes) displays are managed.

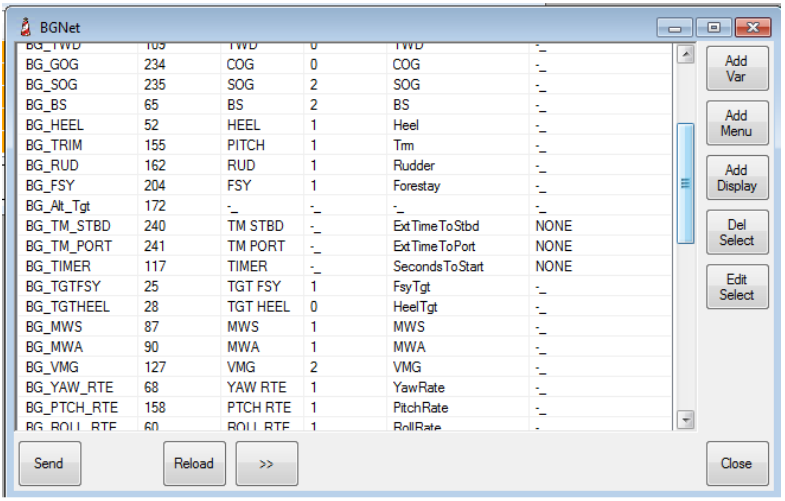
The bottom bar hosts few commands for the network:

- Press the button **Send** to save and commit the changes to the network. Changes are not visible on the displays until the Send button is not pressed.
- Press the button **Reload** to load on FaroManager the current configuration of the B&G network. This is useful if you want to undo the changes that haven't been committed yet.
- The button **>>** allows showing three more functions for controlling the network:

- **Start**, to start sending the variables to the network
- **Stop**, to stop sending the variables to the network
- **Reset**, to re-initiate the B&G network

4.10.1 Managing B&G Variables

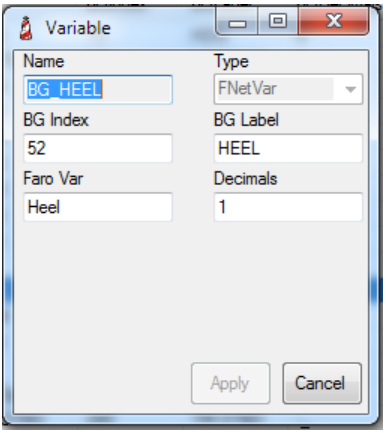
Click on the bar **B&G Vars** to show the defined variables.



- To edit a variable, select a line on the list and press the **Edit Select** button (or double click on the variable)
- To delete a variable, select a line on the list and press **the Del Select** button
- To add a variable, press the **Add Var** button

There are 4 different types of BGVars:

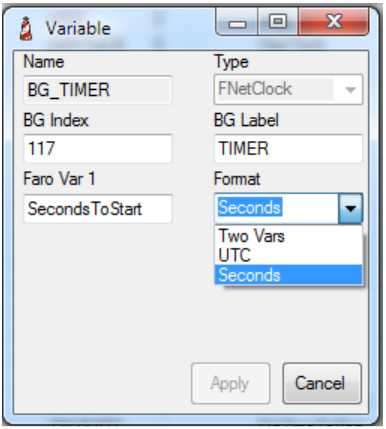
FNetVar is the standard variable for the displays and it is defined by the following parameter:



- **Name**: name of the B&G variable, preferably with the prefix BG_
- **BG Index**: the index identifying the variable on the network
- **BG Label**: the name used on the display for the variable
- **Faro Var**: the variable to send to the display
- **Decimals**: the number of decimal digits

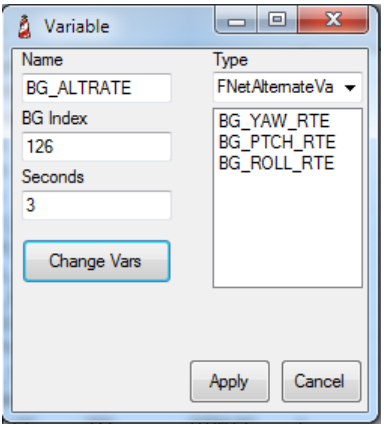
Every variable inside the net has a specific pre-defined BG index. In **Appendix B** there is the complete list of the indices as defined by B&G. It is recommended to use the assigned indices for existing variables and to use the free indices for new custom variables.

FNetClock is the special format for the time variables and it is defined by the following parameter:



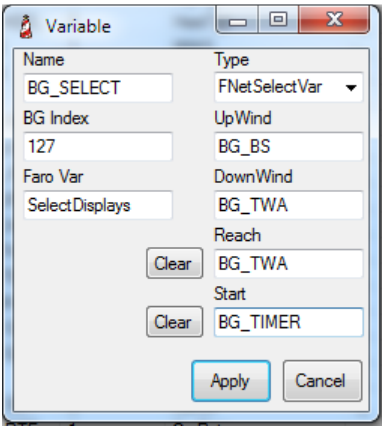
- **Name**: name of the B&G variable, preferably with the prefix BG_
- **BG Index**: the index identifying the variable on the network
- **BG Label**: the name used on the display for the variable
- **Faro Var**: the variable to send to the display
- **Format**: the format of the FaRo's variable. In the displays, the time is shown as "hh:mm" or "mm:ss". The variable can be sent as **Seconds** or as **UTC** (hhmm or mmss). A third option is sending two different variables (**Two Vars**): the first one will be shown before the colon, the second after the colon (it will be displayed as "var1:var2" - Be aware that var1 and var2 will be represented as two digits integers)

FNetAlternate shows a sequence of variables, alternating at a defined period, and it is defined by the following parameter:



- **Name**: name of the B&G variable, preferably with the prefix BG_
- **BG Index**: the index identifying the variable on the network
- **Seconds**: the number of seconds each variable is displayed
- **List**: the sequence of BGVars displayed. To edit the list, press the **Change Var** button

FNetSelect is a special variable that displays different variables based on a select function. It is mostly used to automatically select variables based on the sailing mode, but it can be used as a more generic function (for instance: changing the variable displayed just pushing a pre-defined button). FNetSelect is defined by the following parameter:

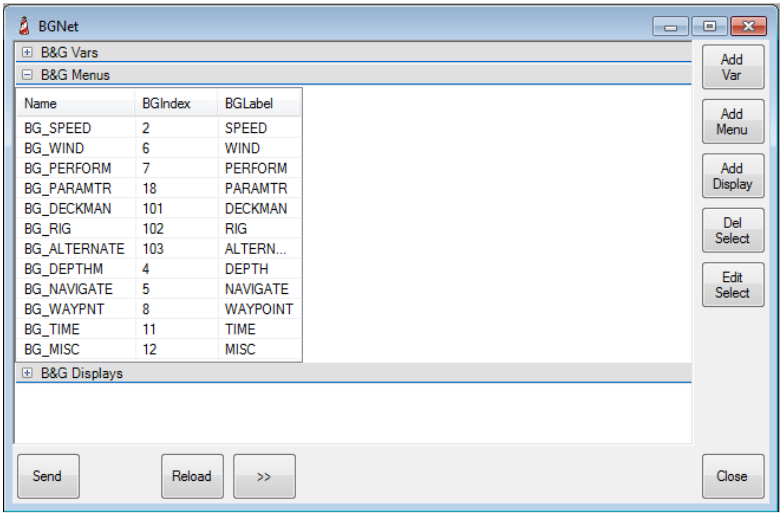


- **Name**: name of the B&G variable, preferably with the prefix BG_
- **BG Index**: the index identifying the variable on the network
- **Faro Var**: the FaRo variable that selects the variable to display. It has to be an integer between 0 and 3. In FaRo's default configuration, the variable **SelectDisplays** determines the sailing modes:
  - 0 -> Upwind
  - 1 -> Reaching
  - 2 -> Downwind
  - 3 -> Pre-start
- **UpWind**: the BGVar to display when sailing upwind (or when FaroVar is 0)
- **DownWind**: the BGVar to display when sailing downwind (or when FaroVar is 1)

- **Reach**: the BGVar to display when reaching (or when FaroVar is 2)
- **Start**: the BGVar to display when in pre-start mode (or when FaroVar is 3)

4.10.2 Managing B&G Menus

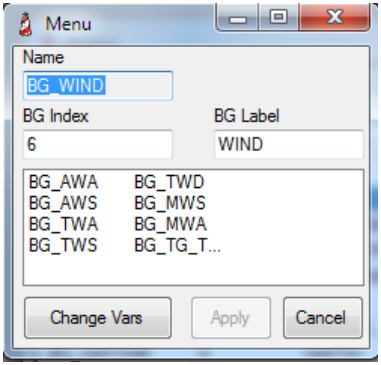
B&G displays show numbers only if they belong to one or more menu. From FaroManager it is possible to add or modify menus for the B&G displays.
Click on the bar **B&G Menus** to show the defined menus.



- To edit a menu, select a line on the list and press the **Edit Select** button (or double click on the menu)
- To delete a menu, select a line on the list and press **the Del Select** button
- To add a menu, press the **Add Menu** button

A menu is defined by the following parameters

- **Name**: name of the B&G menu, preferably with the prefix BG_
- **BG Index**: the index identifying the menu on the network.
- **BG Label**: the name used on the display for the menu
- **List**: the list of BGVars belonging to the menu. To edit the list, press the **Change Vars** button

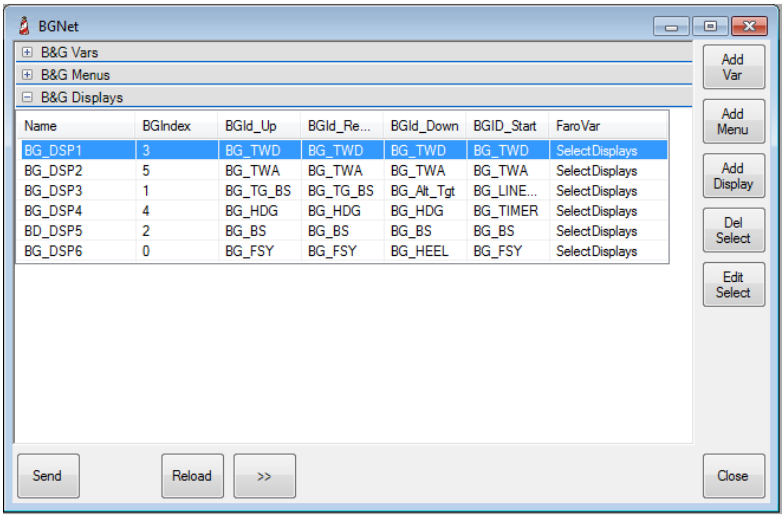


4.10.3 Managing B&G HVision Displays

HVision displays are usually configured remotely from a FFD or GFD display on the same network. FaRo and FaroManager manage the HV displays with the graphic interface utility, allowing an easier and more intuitive configuration.

The FaRo's configuration tools for the HV displays overwrites the remote operations from a FFD or GFD on the network.

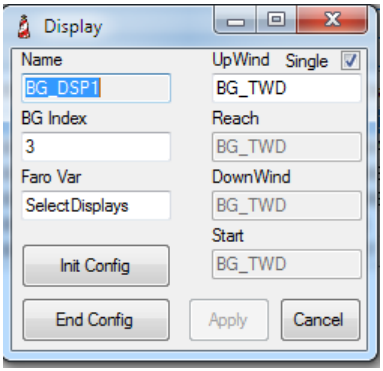
Click on the bar **B&G Displays** to show the defined HV displays. The number of variables on the list should match the number of HV displays wired in the network.



- To edit a display, select a line on the list and press the **Edit Select** button (or double click on the menu)
- To delete a display, select a line on the list and press **the Del Select** button
- To add a display, press the **Add Display** button

Configuring an HV display is very similar to configuring a FNetSelect Variable. An HV display is defined by the following parameters:

- **Name**: name of the B&G display, preferably with the prefix BG_
- **BG Index**: the index identifying the HV display on the network



The HV displays configure themselves automatically when a change in the network is detected or when a reset is done. To know which **BG Index** is the display you desire to configure, introduce a value inside the **BG Index** field and click on **Init Config** button. The corresponding display with that particular index will start blinking. In case it's the one you wanted, click on **End Config** and the display will stop blinking. Otherwise, introduce a new **BG Index** and repeat the procedure.

- **Faro Var**: the FaRo variable that selects the variable to display. It has to be an integer between 0 and 3. In FaRo's default configuration, the variable **SelectDisplays** determines the sailing modes:
  - 0 -> Upwind
  - 1 -> Reaching
  - 2 -> Downwind
  - 3 -> Pre-start
- **UpWind**: the BGVar to display when sailing upwind (or when FaroVar is 0). If the **Single** check box is ticked, this is the variable displayed in every sailing mode.

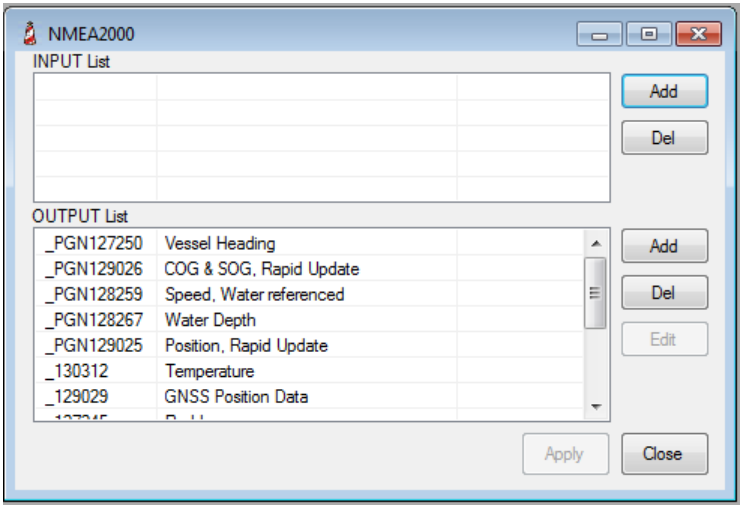
- **DownWind**: the BGVar to display when sailing downwind (or when FaroVar is 1)
- **Reach**: the BGVar to display when reaching (or when FaroVar is 2)
- **Start**: the BGVar to display when in pre-start mode (or when FaroVar is 3)

4.11 NMEA2000 network

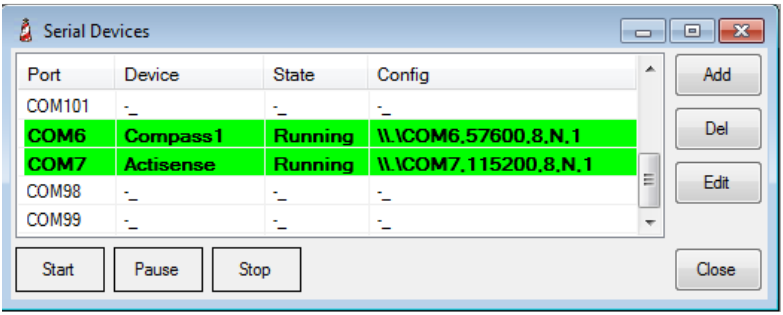
FaRo is NMEA2000 compatible using third parties hardware. Although FaRo can communicate with different NMEA2000 adapters, at the time of writing this manual only the Actisense NGT-1 has been fully certified for a two way communication between FaRo and a NMEA2000 network. The following notes are referred solely to the use of the Actisense NGT-1 (either USB or serial versions).

The NGT-1 adapter needs to be programmed with the Actisense's proprietary software **NMEAReader** . Every PGN sentence sent from a sensor and every PGN sentence to be sent to a display or instrument needs to be activated inside the NGT-1 with NMEAReader.

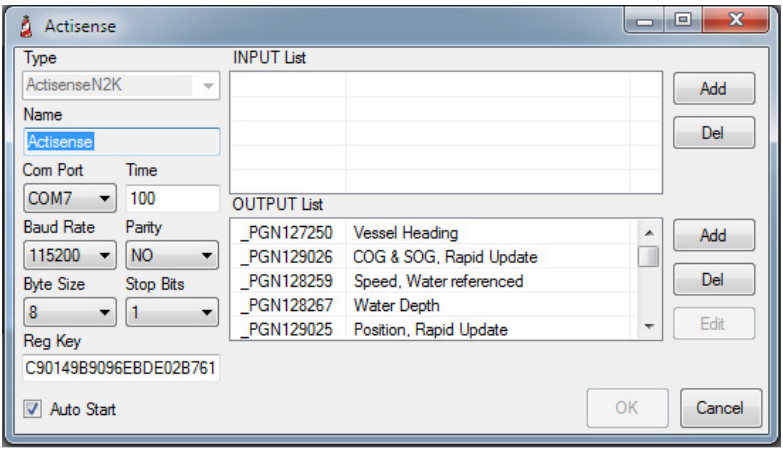
To configure a NME2000 network, click on the menu **Settings->NMEA200**



If you don't see this menu, you can open a similar windows from **Advanced->Serial Devices** and look for the **ActsenseN2K** type device (in some version called **Actisense**, in others **NMEA2000**).



Select it and click the **Edit** button.
From here, you can also change the general serial settings of the communication (they need to match the NGT-1 communication settings). The **Time** parameter represents the frequency at which FaRo and the NGT-1 exchange information. As already pointed out, being 1ms the base time-stamp in FaRo, the **Time** parameter is the gap in milliseconds between cycles (Time=100 means a 10Hz exchanging frequency).



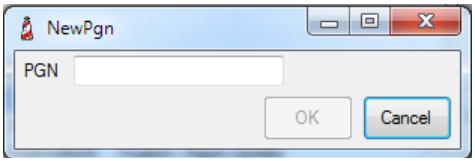
In the NMEA2000 network, the variables are exchanged through pre-defined PGN sentences.

- **Input List** contains all the sentences that FaRo reads from NMEA2000 instruments
- **Output List** contains all the sentences that FaRo sends to NMEA2000 instruments. Those instruments can be displays or any device able to read NMEA2000 PGN sentences (like chart plotters).

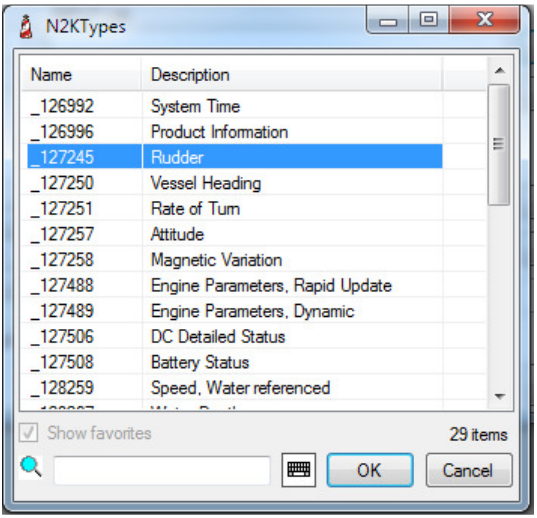
NMEA2000 devices can select the "source" instrument for the PGN sentences. In case of a duplicate PGN sentence running on the network, it is important to configure the device for decoding the PGN from the required instrument. For NMEA2000 displays, be sure to select the NGT-1 adapter as the source device.

- To edit a PGN sentence, select a line on one of the lists and press the **Edit** button (or double click the element on the list)
- To delete a PGN sentence, select a line on one of the lists and press the **Del** button
- To add a PGN sentence, press the **Add** button

When adding a new PGN sentence (as input or output), a window requiring the PGN code pops up.

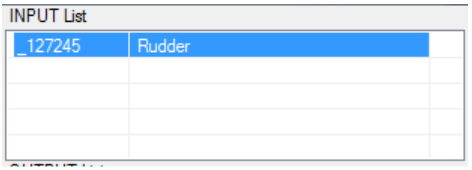


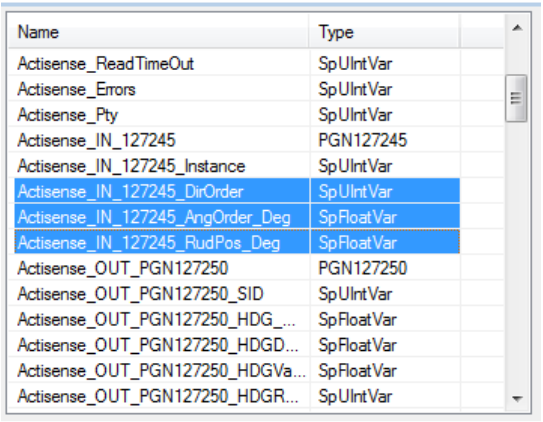
Click on the **PGN** text box to show the list of available PGN sentences in FaRo



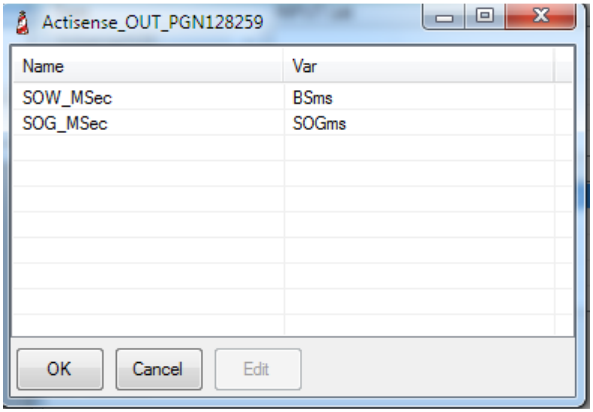
Select the required PGN sentence and clcik OK.

In case of a PGN sentence of the **Input List**, there is nothing more to do. The New device is added to the list and new variables, containing the values of the connected instrument, are created in FaRo.





In case of a PGN sentence of the **Output List**, the new sentence is added to the list. In order to map the variables of the sentence to the required FaRo's variables, select the PGN on the list and click Edit.



Every variable belonging to the sentence, on the left, needs to be associated with a Faro's variable. Select a variable of the list and press **Edit**. Choose the variable from the list and click **OK**.

There are few aspects to consider when mapping variables with NMEA2000 instruments:

- NMEA2000 variables are defined in specific units, so be careful to convert the FaRo's variable in the required unit, if necessary (for instance: speed in m/sec)
- Some NMEA2000 displays and instruments have the ability to solve the wind triangulation, depending on how the PGN 130306 (Wind Data) is configured. Unfortunately, the calculated variables overwrite the equivalent variables sent by FaRo. To exploit wind calculation and variable filters from FaRo, the best solution is to define two Wind Data PGN 130306, as follow:

1) WSpd_MSec=" AWSms " (apparent wind speed m/sec)
   WDir_Deg="AWA360" (apparent wind angle 0 -360)
   WRef="FK_Two"

2) WSpd_MSec=" TWSms " (true wind speed m/sec)
   WDir_Deg="TWA360" (true wind angle 0 -360)
   WRef="FK_Four"

- With this configuration, the TWD is overwritten by the NMEA2000 display's own calculation. If you prefer sending TWD end TWS to the displays, send only one PGN 130306 as follow:

  WSpd_MSec=" TWSms " (true wind speed m/sec)
  WDir_Deg="TWD"
  WRef="FK_Four"

4.12 Garmin GNX displays

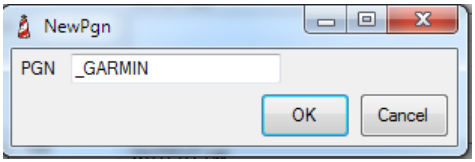
The Garmin GNX displays are fully NMEA2000 compliant, but they are able to send up to 20 variables and labels not listed in the NMEA2000 standard.

The configuration of the Garmin displays follows the same procedure of a standard NMEA2000 display. The custom variables can be sent using the **PGN 126720**, which is referred in FaroManager as **_GARMIN** sentence.

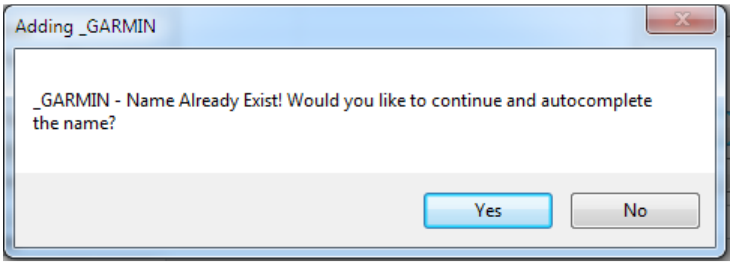
The **PGN 126720** sentence needs to be activated in the NGT-1 adapter using the software **NMEAReader**

4.12.1 Adding a custom Garmin PGN

To configure the Garmin GNX displays, click on the menu **Advanced->Serial Devices** and look for the **ActsenseN2K** type device. Follow the same procedure for configuring a standard NMEA2000 PGN. When selecting a PGN for the Output List, look for the **_GARMIN** type.



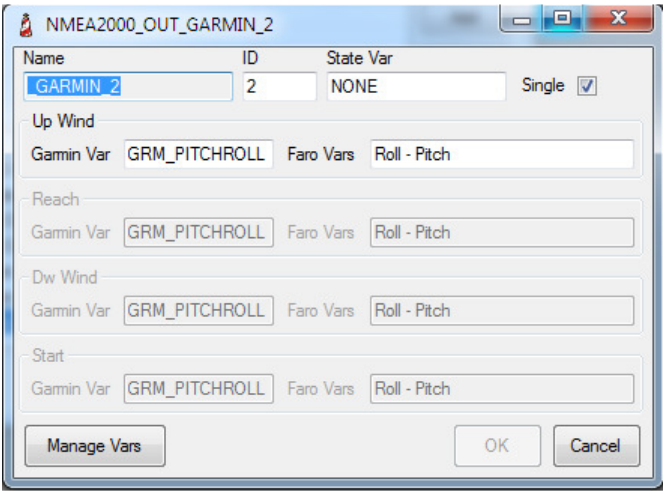
You need to add a PGN _GARMIN sentence for every custom variable to send. From the second sentence, a warning message asks to automatically complete the name of the sentence.



Click **Yes** and the new PGN is added to the list.

4.12.2 Configuring a custom Garmin PGN

Select a _GARMIN PGN on the Output list and click **Edit**



A Garmin PGN sentence can be configured in a similar way of a B&G HVision display and it is defined by the following parameters:

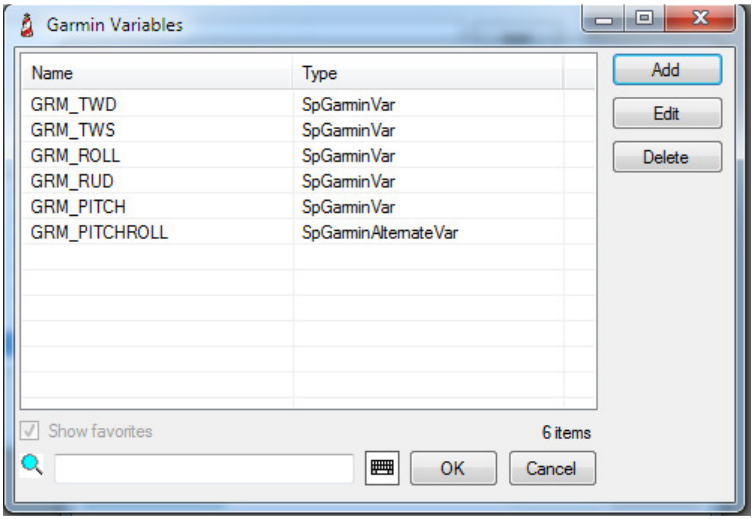
- **Name**: name of the GARMIN PGN.

- **ID**: the index identifying the GARMIN PGN on the network. It has to be unique and it can be between 0 and 19
- **State Var**: the FaRo variable that selects the variable to display. It has to be an integer between 0 and 3. In FaRo's default configuration, the variable **SelectDisplays** determines the sailing modes:
  - 0 -> Upwind
  - 1 -> Reaching
  - 2 -> Downwind
  - 3 -> Pre-start
- **UpWind**: the GARMIN variable to display when sailing upwind (or when StateVar is 0). To select the Garmin variable, click on the text box and choose from the list. If the **Single** check box is ticked, this is the variable displayed in every sailing mode.
- **DownWind**: the GARMIN variable to display when sailing downwind (or when StateVar is 1)
- **Reach**: the GARMIN variable to display when reaching (or when StateVar is 2)
- **Start**: the GARMIN variable to display when in pre-start mode (or when StateVar is 3)
- **Faro Vars**: the FaRo's variable(s) associated to the Garmin variable. These fields are auto-filled after the selection of the Garmin variable

To add or to change a Garmin variable, click on the **Garmin Var** text box. After selecting the new variable, click **OK** on the **Garmin Variables** window to commit the change

4.12.3 Configuring a Garmin variable

There are two ways to configure a Garmin variable:
- Click on one of the **Garmin Var** text box
- Press the **Manage Vars** button

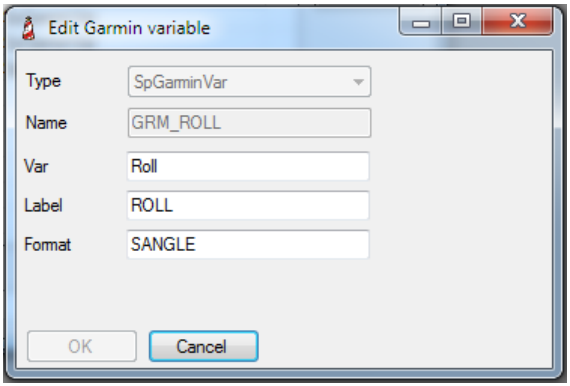


- To add a variable, press the **Add** button
- To edit a variable, select a line on the list and press the **Edit** button
- To delete a variable, select a line on the list and press the **Del** button

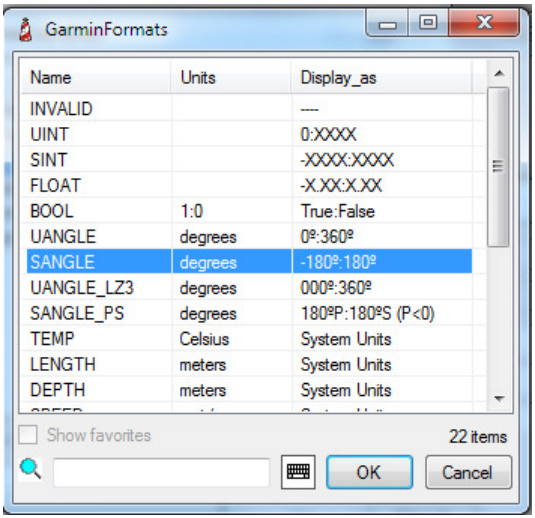
There are 2 different types of Garmin variables:

SpGarminVar is the standard variable for the displays and it is defined by the following parameter:

- **Name**: name of the Garmin Variable, preferably with the prefix GRM_
- **Var**: the FaRo variable to send to the display
- **Label**: the name used on the display for the variable
- **Format**: the format to use for the displayed variable.

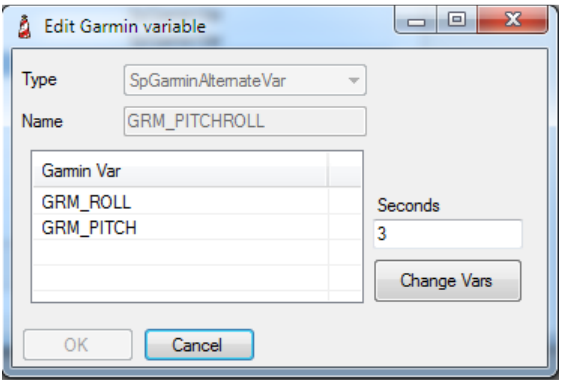


Clicking on the **Format** text box, the list of available formats is displayed.



If you select the **INVALID** format, the variable is not going to be displayed

SpGarminalternateVar shows a sequence of variables, alternating at a defined period, and it is defined by the following parameter:



- **Name**: name of the Garmin variable, preferably with the prefix GRM_
- **Seconds**: the number of seconds each variable is displayed
- **List**: the sequence of Garmin Variables displayed. To edit the list, press the **Change Vars** button

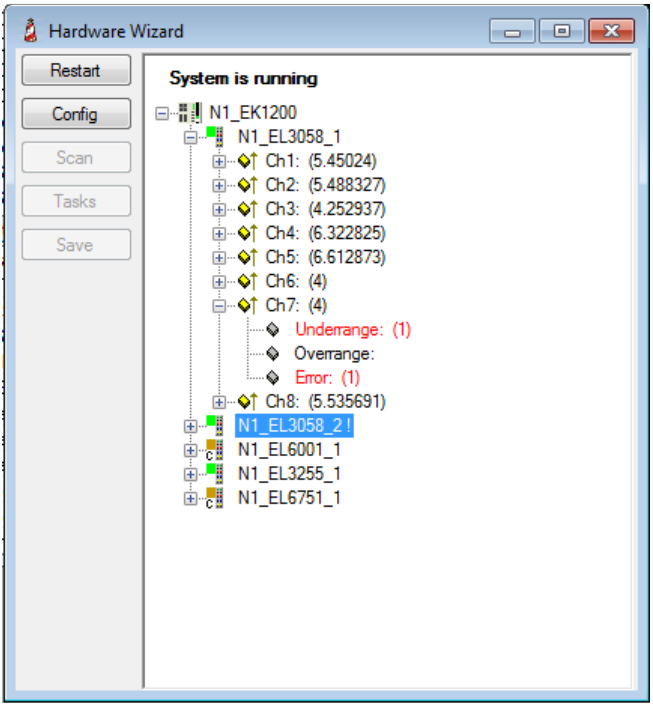
Advanced 5

5.1 Command Shell

The **Command Shell** is a powerful tool allowing the low-level control of the FaRo software. The use of the command line is only for expert users and its explanation goes beyond the purpose of this manual. Please, refer to your technical assistance for further explanation or contact support@faroadv.com.

5.2 Hardware Wizard

The **Hardware Wizard** is the user friendly tool which allows to monitor and configure the hardware in FaRo.



On top of the window, a diagnostic message shows the current system's status:

- If the **System is running**, the hardware is ready to exchange information with the sensors
- If the **System is in config mode**, the hardware is in "stand-by", waiting to be activated
- If the **System is stopped**, there isn't any hardware activity

FaRo is reading signals from the instruments only when the **System is running**. If the system is not running and you are not configuring the system, press the **Restart** button. If the problem persist, call the technical assistance.

The modular system is represented in a tree-view style schematic form.

- When clicking on one of the main nodes, the list of modules belonging to the node are displayed.
- When clicking on a module, the I/O channels of the module are displayed

In case of instrumentation's anomalies, from the hardware wizard page it is quick and intuitive to understand where the cause of the problem can be.

Depending on the type of module, some diagnostic values are displayed and updated every second. They are:

- The name of the module, as seen in FaRo
- The current status of the module
- The name of the I/O channels, as is seen in FaRo
- The current values of the I/O channels
- The error status of the channels. If in error, they are displayed in red
- The anomalies in the I/O channels (signals out of range). If anomalies are detected, they are shown in red.

From the Hardware Wizard it is also possible to reconfigure the system after hardware changes.

5.2.1 Reconfiguring FaRo's hardware

Anytime there is a hardware change (adding or removing modules, swapping modules), FaRo needs to be instructed about the occurred changes.

In order to apply the changes, the system needs to be in Config mode.

Please, follow these instructions only if you have full knowledge of the system's configuration. In case of doubts, contact the technical assistance.

1. Click the **Config** button and wait for the message "**System is in config mode**".
2. Click the **Scan** button. The system will start checking the whole hardware. If you are close to the FaRo box, you'll see green lights flashing at irregular intervals on every FaRo component. The message on the window becomes "**please wait**"
3. Depending on the number of modules, the scan operation could last from few seconds to few minutes. The scan is terminated when the message turns back to "**System is in config mode**".
4. If everything is fine, the new hardware configuration is shown in the tree view. Verify that the drawn configuration corresponds to the current installed hardware.

Not all the modules are displayed in the tree view. The modules FRB&G, FRPWR, FRSGN and FRPLS (and all the modules that don't have the diagnostic functions, like the power distributors) are not visible on the Hardware Wizard window.

5. Click the **Save** button to activate and save the new configuration. After few seconds, the system is back in "**Running mode**" and FaRo is communicating with the instruments again.

Before applying the new configuration, it is possible to verify the created I/O tasks and variables, clicking the **Task** button.

5.2.2 Understanding Faro's Tasks

Faro's protocol, EtherCAT, operates at machine level. This means that the exchange of information between modules and processor happens in a layer below the Operating System, assuring a true real time operation. To optimize the transmission, EtherCAT groups the signals in independent tasks. Every task sends a package of information within an assigned frequency and it is strictly related to the hardware configuration; a task stops working if its internal mapping does not match the current hardware. Therefore, a hardware change requires a reconfiguration of the tasks.

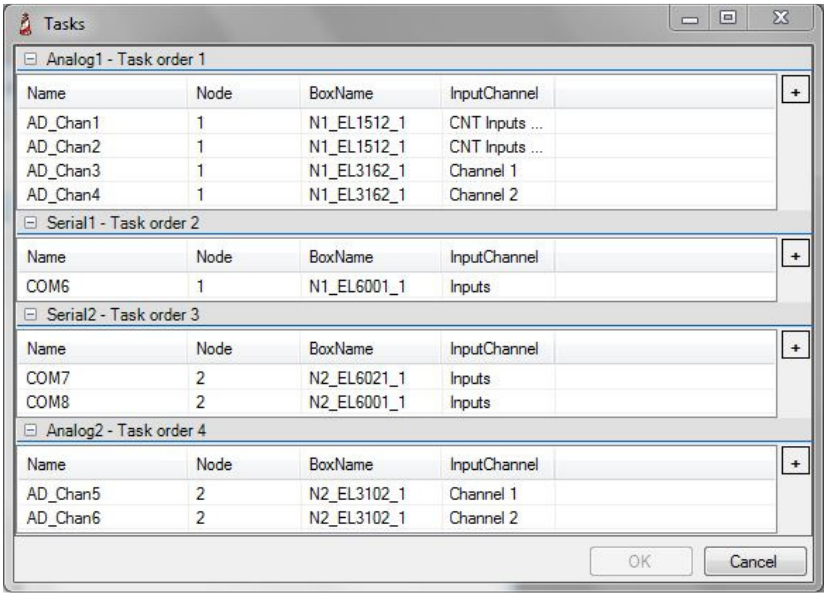
 For every task, Faro automatically creates a mirror task *(a Windows XP process),* which ultimately links the inputs to Faro software.

Faro's processor can run up to 4 independent EtherCAT tasks. When Faro Manager scans the system for hardware changes, Faro automatically defines the tasks of the new configuration.

The logic Faro uses to assign the Task is the following:

1. The first task is reserved to counters modules, running at 1 KHz and with the highest priority.
2. All the other tasks have a base frequency of 200 Hz.
3. If only one node is configured, one task is assigned to all serial modules and one task to all the analog modules.
4. If there are 2 or 3 nodes, all the modules of every node are grouped in a task (with the exception of the counters, being an independent task)
5. If there are more than 3 nodes, the first 2 nodes are independent tasks; the third and the remaining nodes are grouped in a unique task.

To verify, or change the default tasks settings, click the **Tasks** button.



All the tasks are listed with their corresponding channels. The name of the channels represents the Input (or output) variable to link to the FaRo's variables.

To verify and change a task property, click on the **+** button on the right.

From the displayed panel is possible to change the following task's properties:

- **Frequency:** assigns the task's frequency (in Hz)
- **Task priority:** assigns the Windows priority to the Faro process associated with the task. Priority 0 is the default. Priority 15 (the highest available) is assigned to the fast process in charge of counting the pulses.
- **Tasks order:** tells EtherCAT in which order to execute the task.
- **Task name:** change the task's name.

From the properties' panel, it is also possible do the following:

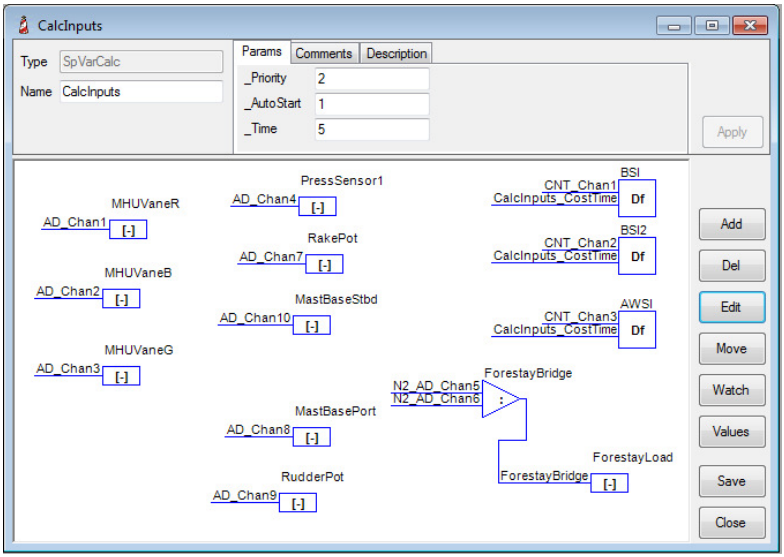
- **New Task:** add a new task. It is impossible to create more than 4 tasks.
- **Del Task:** delete a task. A task can be deleted only if it is empty. It is necessary to move the task's variables to another task, before the task can be deleted.
- Move variables from one task to another with a simple drag and drop operation

 It is impossible to add or remove variables, because they represent the inputs detected with the Hardware Wizard

5.2.3 Mapping I/O variables to FaRo's variables

When scanning the hardware, FaRo automatically creates the variables that represents the inputs and the outputs. These variables are displayed in the Task window, together with the corresponding hardware channels.

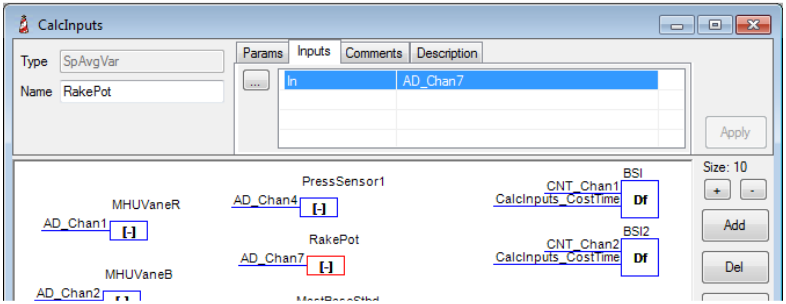
The I/O variables are mapped to the FaRo's variable in **CalcInputs**, the process in the MathDesigner dedicated to the I/O functions.



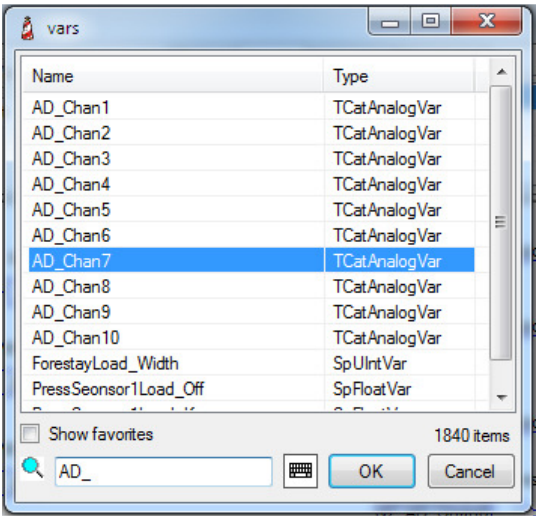
CalcInputs is a high priority (level 2) and high speed (200 Hz) process, where the analog signals are filtered at 10 Hz and the pulse signals are converted to frequencies.
When a new hardware is configured, you need to verify the mapping between I/Os and FaRo's variables .

In case you need changing the mapping:

1. In the **CalcInputs** window, click the **FaRo's variable** that needs to be remapped.
2. Click the **Inputs** Tab
3. Select the line representing the input variable



4. Click the ... button



5. Search and select the corresponding I/O variable (as learned in the Task window)
6. Click **OK**

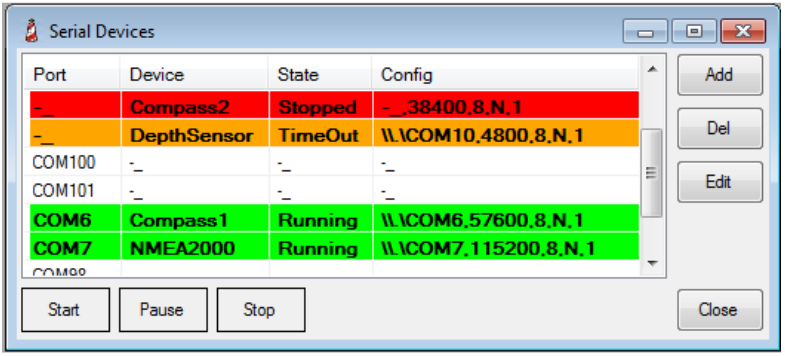
7. Click the **Apply** button, to commit the change
8. Click the **Save** button to permanently store the change

5.3 Serial Devices

With the **Serial Devices** tool it is possible to set-up and monitor the communication between FaRo and serial devices. Serial devices are:

- Any sensor streaming data through a RS232/RS422/RS482 bus (compass, gps, bar-code readers, RFID readers..)
- Any Pc or computer device able to exchange data through a serial port
- A FastNet B&G network
- An Actisense NGT-1 adapter for NME2000 network

The list of the available serial ports is shown with the list of the serial devices defined. A serial port can be empty (no device is attached) and a device might not have a port assigned (the device is not connected to FaRo). You can start, pause or stop the communication with a device after selecting the device and pressing the **Start**, **Pause** or **Stop** buttons.



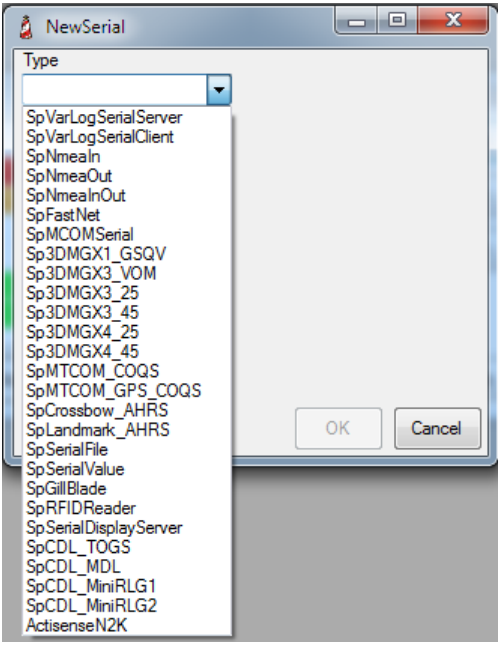
- The device is shown in green (State = Running) if there is a working communication
- The device is shown in orange (State = TimeOut) if there are communication problems, if the communication has been paused or if the device is not present

- The device is shown in red (State = Stopped) if the communication has stopped

> When you stop a device FaRo closes the com port. This can be useful if you want to monitor the incoming stream with an external terminal software.

5.3.1 Adding or editing a Serial Device

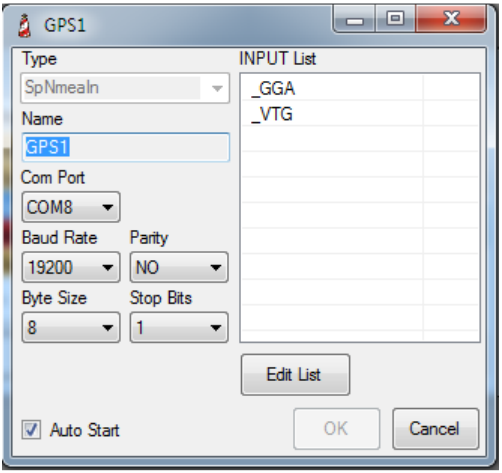
Press the **Add** button to add a new device
Select a device and press the **Edit** button to edit an existing device.



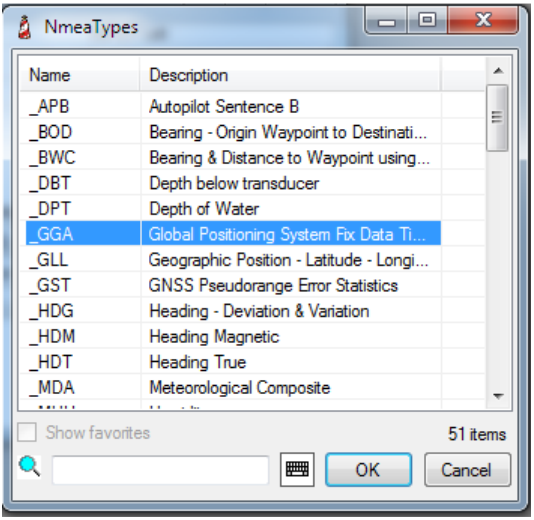
The **Type** combo box contains the list of supported devices. FaRo supports several serial protocols and the list of compatible devices is growing periodically. Please, check with your technical support for the updated list.

- Select the protocol from the **Type** list. Depending on the selected protocol, the right side of the window shows different fields.
- Select the **Com Port**
- Select the appropriate communication parameters (**Baud Rate**, **Parity**, **Byte Size**, **Stop Bits**)
- Thick the **Auto Start** check box if you want to initiate the communication when the processor starts.

A widely used serial protocol is the **NMEA 0183**. The following notes explain how to configure a NMEA 0183 instrument.

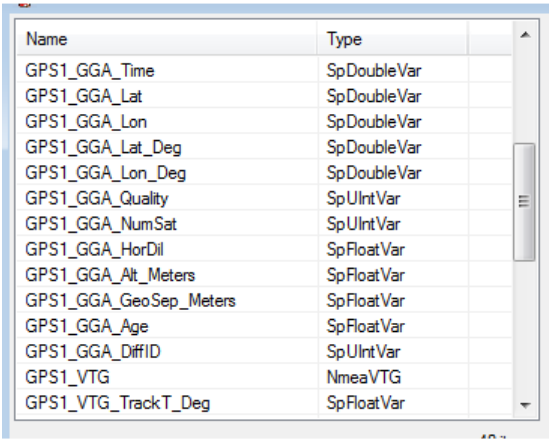


- Press the Edit List button to show the list of supported NMEA 0182 sentences

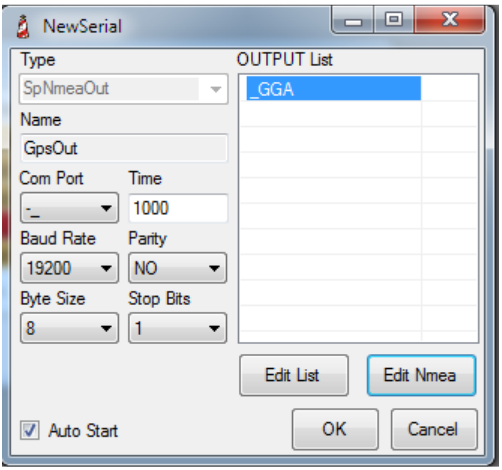


- Select the sentences that are configured in the connected sensor.
- Press the OK button to save and close.

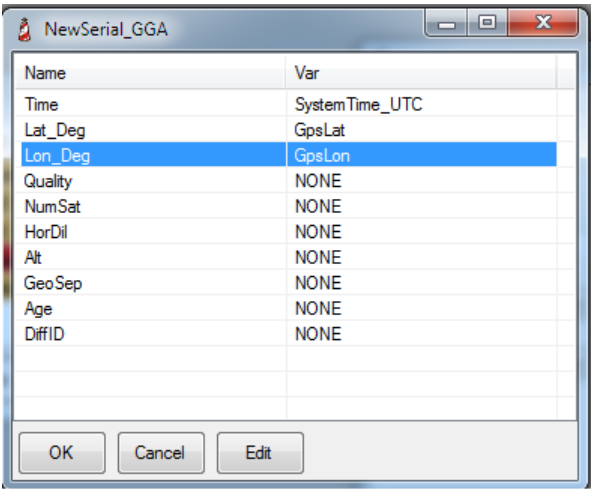
The variables associated with the selected sentences are automatically created in FaRo



FaRo can also output NMA 0183 sentences to other devices.
In this case, the **Time** (in mseconds) at which FaRo outputs every sentence needs to be specified.



Press **Edit Nmea** button to map the FaRo variables for each NMEA sentence selected.

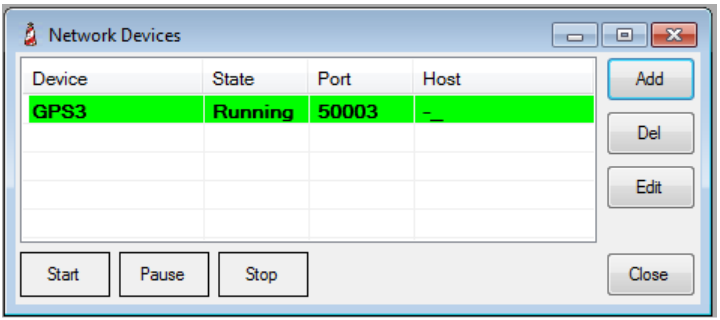


5.4 Network Devices

With the **Network Devices** tool it is possible to set-up and monitor the communication between FaRo and network devices. Network protocols have becoming more popular during the last few years and they are progressively replacing the serial protocols. Managing network devices in FaRo is very similar to managing serial devices. Network devices are:

- Any sensor streaming data using UDP or TCP protocols over Ethernet bus (compass, gps, fibre optics interrogators...)
- Any Pc or computer device able to exchange data through a network port
- An ADF Web adapter for NME2000 network

You can start, pause or stop the communication with a device after selecting the device and pressing the **Start**, **Pause** or **Stop** buttons.

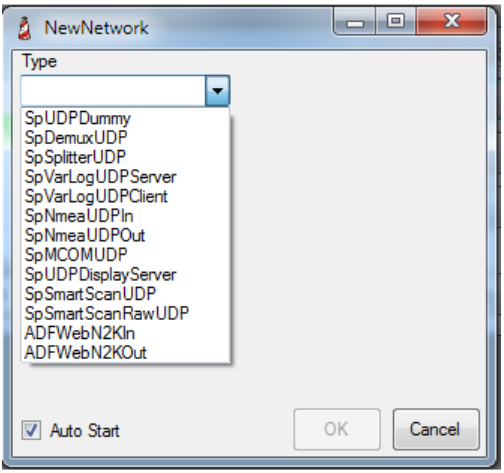


- The device is shown in green (State = Running) if there is a working communication
- The device is shown in orange (State = TimeOut) if there are communication problems, if the communication has been paused or if the device is not present

- The device is shown in red (State = Stopped) if the communication has stopped

5.4.1 Adding or editing a Network Device

Press the **Add** button to add a new device
Select a device and press the **Edit** button to edit an existing device.



The **Type** combo box contains the list of supported devices. FaRo supports several network protocols and the list of compatible devices is growing periodically. Please, check with your technical support for the updated list.

- Select the protocol from the **Type** list. Depending on the selected protocol, the right side of the window shows different fields.
- Enter the **UDP Port** (it has to match the UDP port of the communicating device and it cannot be shared with other devices or services)

- Thick the **Auto Start** check box if you want to initiate the communication when the processor starts.

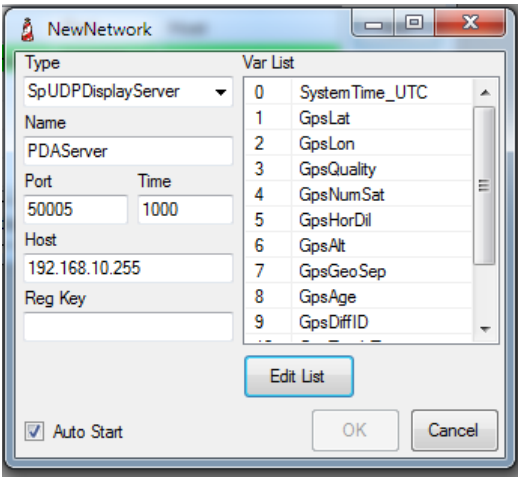
A widely used network protocol is the **NMEA 0183**. Adding or editing a NMEA UDP device is very similar to adding or editing a NMEA serial device. Please, refer to the Serial Devices session for more details.

5.4.2 Configuring FaRo for PDA Remote Display

Faro Remote Display is a software designed for Windows and Windows Mobile devices.
Easy-to-configure and easy-to-use, FaRo Remote Display is the perfect tool for sailors and designers in need of real time data:

- On board crew (helmsman, tactician, strategist, trimmer, bowman and guests), through a short range wifi network or Bluetooth connection
- On chase coach and supporters, through a long range wifi network
- On shore technical support, via a long range telemetry

The communication between FaRo and the Remote Display device is managed with the **SpUDPDisplayServe** protocol.



- Enter the **UDP port** (it has to match the port to open on the remote device)
- Enter the interval **Time** (in milliseconds) at which the variables are sent
- Enter the IP number (**Host**) of the device running the Remote Display software. If the devices are more than one, the last number of the IP address has to be 255.
- Press the **Edit List** button to select the FaRo variables to send to the devices.
- Press **OK** to save and close

The UDPDisplayServer protocol is released as paid license. Contact your technical assistance to obtain a Registration Key.

5.5 Math Designer

Math Designer is the powerful graphical tool that gives the Faro user the full control of the mathematic relations in Faro. In a few seconds, and just with few mouse clicks, it is possible to create a new set of variables, add relations and filters and visualize the results. Changes are applied immediately in Faro and there is no need to restart to verify the new variables' values.

5.5.1 How Math Designer works

Math Designer is divided into **processes**. Every process in FaRo runs as independent task, at the assigned frequency, and contains definitions of variables and relations. There are no limits on the number of process and on the number of variables each process can host. Apart from few exceptions, the structure of the math is totally free, allowing the user to organize variables and relations at will. Organizing processes and variables is often a mere exercise of keeping the structure tidy and understandable. To help improving the intelligibility of the math, user's comments can be added to every object, process or variable, defined inside Math Designer.

There are three type of process:

- **Time**
- **Calculation**
- **Simulation**

From the Math Designer main window it is possible to add new **Calculation** process only.

A **Time** process is already defined as unique reference to the FaRo's CPU time.

Two **Simulation** process are pre-defined to help the user to do simulations and replays. Even if Math Designer provides the tools for changing the properties of the Simulation process, a dedicated section in FaroManager gives the user a better interface to define and play with the simulator.

Check section **5.6 Simulation** for further information.

Variables are managed inside process. With Math Designer is possible to add, delete and modify variables. A variable can also be moved between processes.

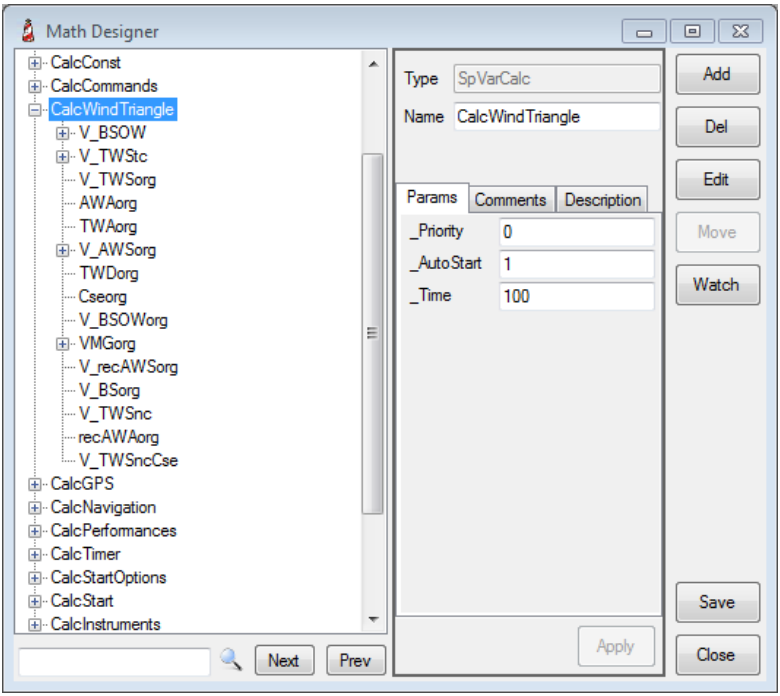
These variables can contain other variables, but this is done only to keep an ordered structure: there is no difference if variable A contains variable B or vice-versa.

Many types of variables are defined. They are divided into categories, only for sake of simplicity.

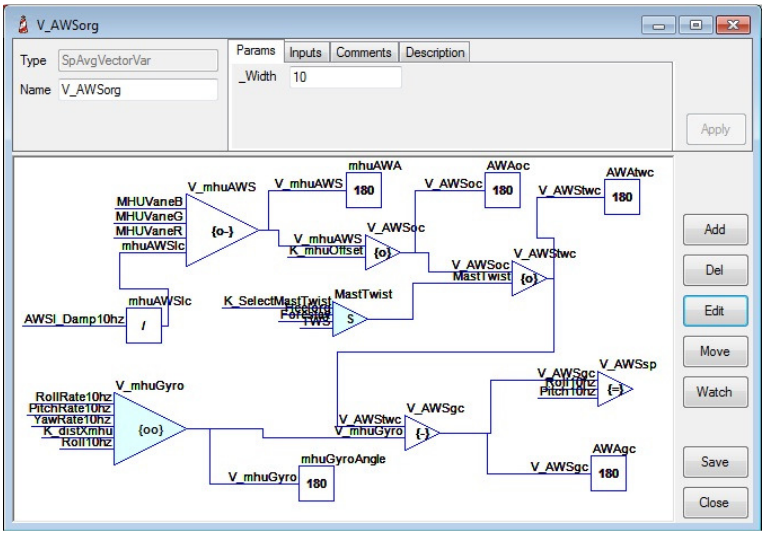
5.5.2 Displaying processes and variables

Math Designer uses essentially two different windows' style and almost all the actions are available from both windows.

The main window displays the tree of all the objects (processes and variables) defined inside the math.



Selecting an object of the tree and clicking **Edit** (or double-clicking the object) opens the **object window**. The **object window** graphically displays the variables contained in the selected object and the relations between them.



From both windows it is possible to display properties, to add, to delete and to modify processes and variables. Moreover, both windows allow moving a variable from a process to another and watching the dependencies created by a variable.

5.5.3 Main window

The main window is divided in 3 vertical frames.

On the left, the **Tree** frame displays all the existing processes and variables. All the processes are defined at root level.

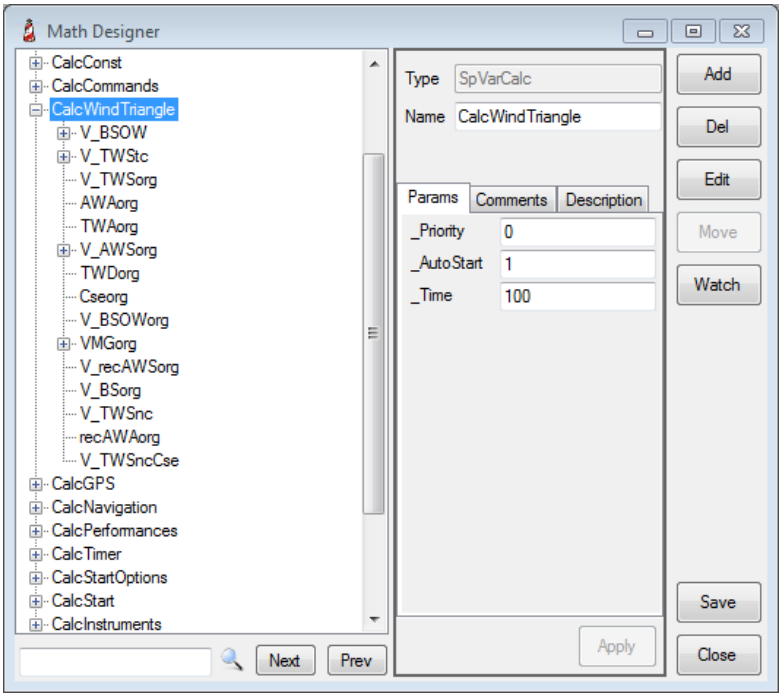
Clicking the ⊞button expands the tree of the selected process. The expanded tree shows the variables contained into the process.
Variables containing other variables can be expanded in the same way, allowing a complete view of the objects defined in the math.

> A free search utility at the bottom of the Tree frame allows the direct search of any object defined in the math.

On the center of the main window, the **Properties** frame displays and allows modifying the properties of the selected object.Every object has different properties and the layout of the frame complies with the properties of the selected object.

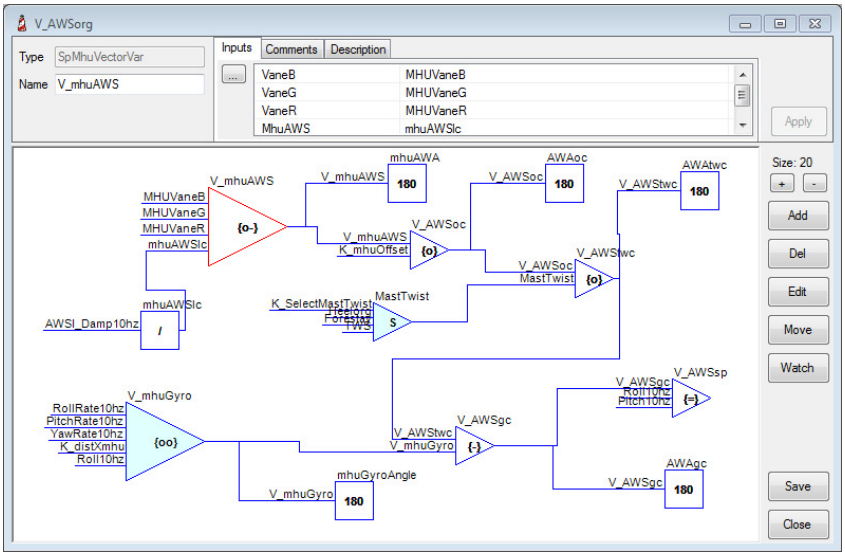
> To commit the changes to FaRo it is always necessary to push the **Apply** button before moving the focus away from the Properties frame.

On the right side of the main window, the **Action** frame allows adding, modifying, deleting and moving the objects inside the math.
Moreover, from the Action frame it is possible to permanently save the math inside FaRo.


Math Designer
CalcConst
CalcCommands
CalcWindTriangle
V_BSOW
V_TWStc
V_TWSorg
AWAorg
TWAorg
V_AWSorg
TWDorg
Cseorg
V_BSOWorg
VMGorg
V_recAWSorg
V_BSorg
V_TWSnc
recAWAorg
V_TWSncCse
CalcGPS
CalcNavigation
CalcPerformances
CalcTimer
CalcStartOptions
CalcStart
CalcInstruments
Next
Prev
Type
SpVarCalc
Name
CalcWindTriangle
Params
Comments
Description
_Priority
0
_AutoStart
1
_Time
100
Apply
Add
Del
Edit
Move
Watch
Save
Close

5.5.4 Object window

In the object window, the **Graphic display** occupies the bigger portion of the window.



Inside the Graphic display, every object represents a variable. The connection lines show the relations between variables: a line exiting from the right side of the object represents an output, while a line entering from the left side represents an input. If an input is not defined on the same window, the input is showed with a short line and the name.

Variables containing other variables are represented by objects filled with solid blue. Also it is possible to drag an object around the Graphic display; the connections lines will change consequently.

Clicking the  buttons allows to resize the selected object. To save the object on the new position and with the new size, it is necessary to press the **Save** button.

Double-clicking an object is equivalent to select the object and press the button **Edit**: a new object window will open with the properties of the selected object.

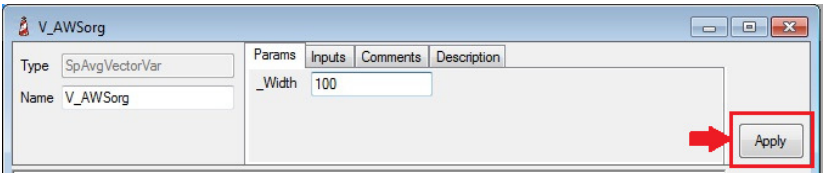
On the top side of the object window, the **Properties** frame displays and allows modifying the properties of the selected object.
To commit the changes to FaRo it is always necessary to push the Apply button before moving the focus away from the Properties frame.

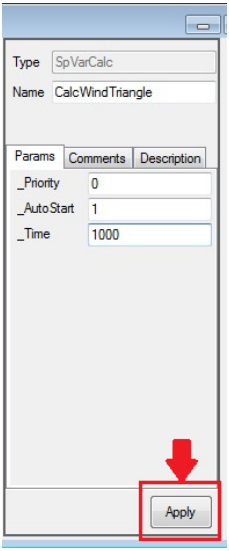
Every object has different properties and the aspect of the frame complies with the properties of the selected object.

On the right side of the object window, the **Action** frame allows adding, modifying, deleting and moving the objects inside the math.
Moreover, from the Action frame it is possible to permanently save the changes of the modified object and the positions of the contained objects.

5.5.5 Applying and saving

For a better use of Math Designer it is important to understand the difference between the actions **Apply** and **Save**.





Whenever an object is created or modified, the change is not committed to FaRo until the button **Apply** is not pressed. New objects and changes are lost if the button **Apply** is not pressed before moving the focus away from the **Properties** frame. Once the button Apply has been pressed, the changes are committed and FaRo elaborates immediately the changes.

Every change committed to FaRo is kept in memory until FaRo's restarts. To permanently store the changes, it's necessary to push the button **Save**.

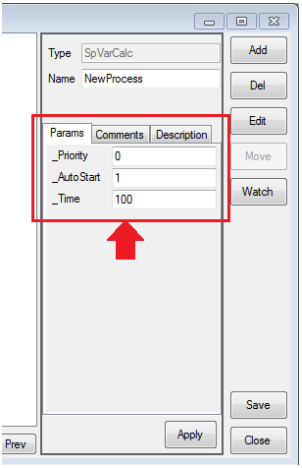
If the button Save is pressed from the object window, the object itself, all the objects contained in the window and their positions are saved.

If the button **Save** is pressed from the main window, all the math is saved (but not the positions of the objects).

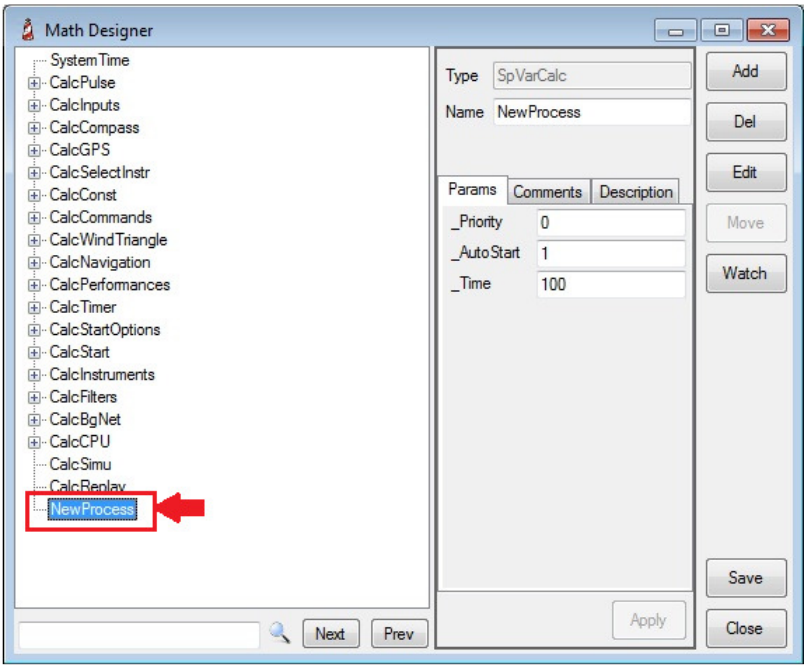
5.5.6 Adding a Process

Processes are managed from the main Math Designer window.To add a new process, from the Main window click the button **Add** and fill the **Name** box with the name of the process.

> The name cannot start with numbers and cannot contain spaces



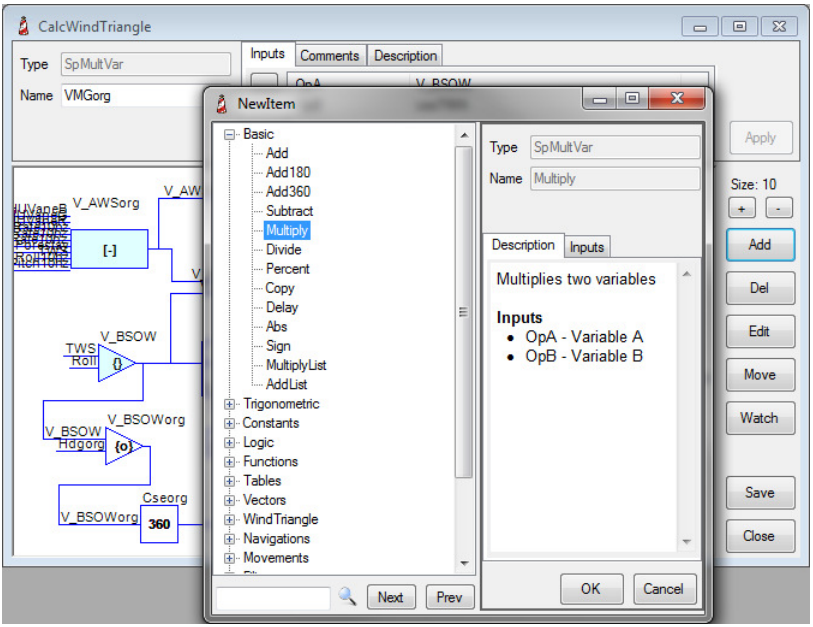
Assign the parameters **_Priority**, **_AutoStart** and **_Time**, then click **Apply**. The new process is added at the bottom of the tree on the left side.



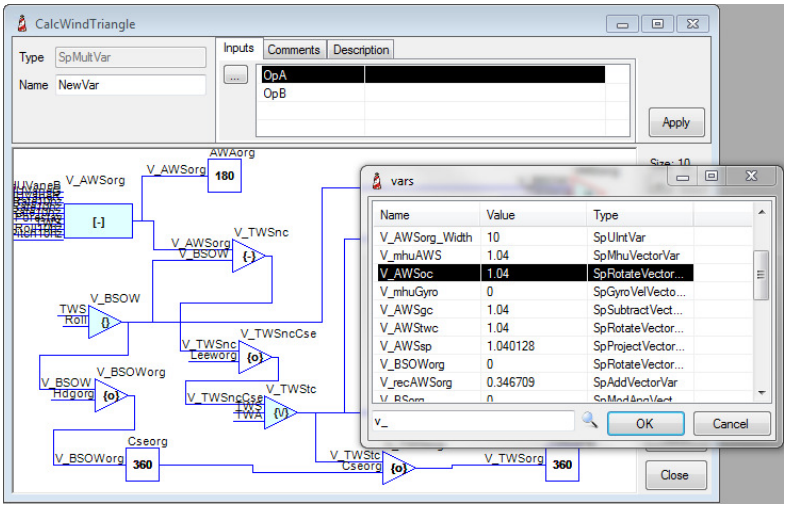
To add variables on the new created Process, double-click on the Process' name (or click **Edit**) to open the object window of the project.

5.5.7 Adding a Variable

To add a new variable on the math, click the Add button from the object window that will contain the variable.

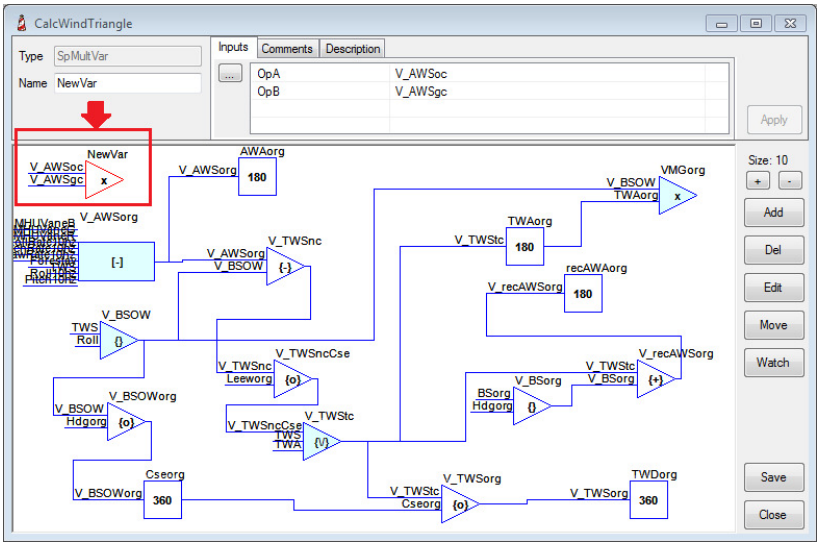


Select from the tree the type of the variable to add and press **OK**. Now fill the text box with the name of the variable. Depending on the variable's type, it might be necessary to provide more information, like inputs, parameters or lists. A comment can be added, as a remainder for the purpose of the variable.
Push **Apply** to commit the change to FaRo.



A new object, representing the variable, will appear on the top left corner of the Graphic display. Drag the new object in a convenient position and click **Save** to permanently store the new variable and its position in FaRo.

It is not necessary to fill all the fields before pushing **Apply**: the new variable can be edited at any time later.

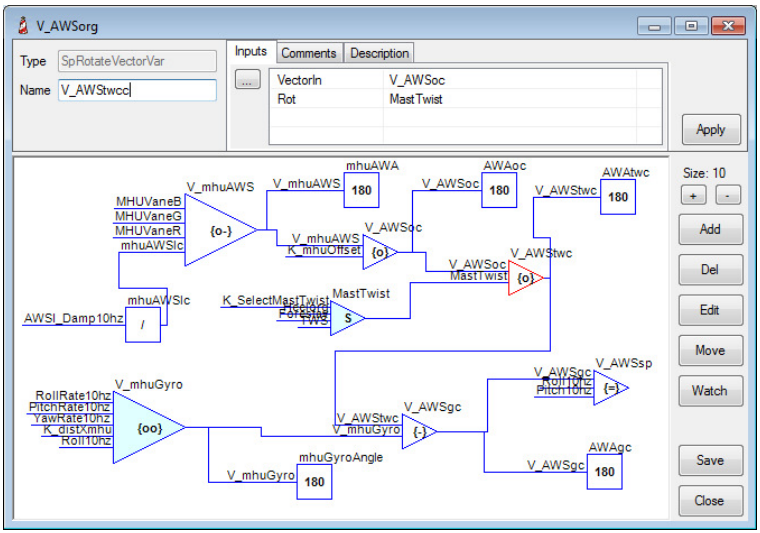

CalcWindTriangle
Type
SpMultVar
Name
NewVar
Inputs
Comments
Description
OpA
V_AWSoc
OpB
V_AWSgc
Apply
Size: 10
Add
Del
Edit
Move
Watch
Save
Close
NewVar
V_AWSoc
V_AWSgc
x
V_AWSorg
AWAorg
180
V_AWSorg
[-]
V_AWSorg
V_BSOW
V_TWSnc
{-}
V_BSOW
TWS
Roll
{}
V_TWSncCse
V_TWSnc
Leeworg
{o}
V_BSOWorg
V_BSOW
Hdgorg
{o}
V_TWStc
V_TWSncCse
TWS
TWA
{\}
Cseorg
V_BSOWorg
360
VMGorg
V_BSOW
TWAorg
x
TWAorg
V_TWStc
180
recAWAorg
V_recAWSorg
180
V_recAWSorg
V_TWStc
V_BSorg
{+}
V_BSorg
BSorg
Hdgorg
{}
V_TWSorg
V_TWStc
Cseorg
{o}
TWDorg
V_TWSorg
360

5.5.8 Editing an object

An object (Process or Variable) can be edited to change its name or any other property. The only property that cannot be changed is the type.

When changing a name, any reference to the object will change accordingly (if, for instance, a variable change name, any variable using it as input will change the name of the input).

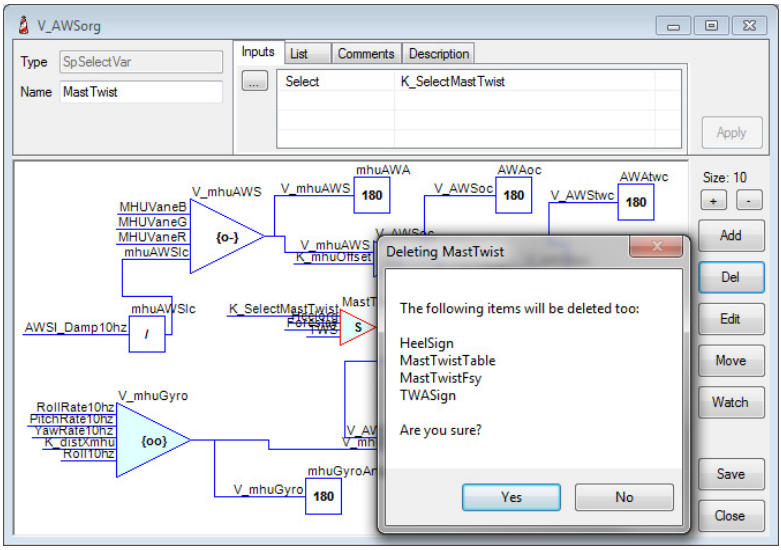
The properties of an object can be changed from the main window or from the object window. Just select the object on the tree of the main window or on the Graphic display of the object window: the Properties frame will display the properties of the selected object. After modifying the properties, click **Apply** to commit the changes to FaRo.



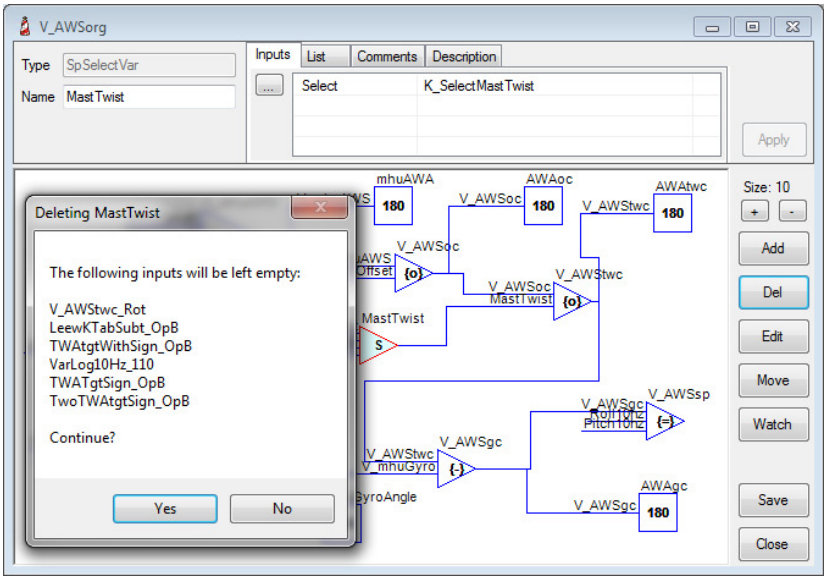
5.5.9 Deleting an object

To delete an object, select the object and click the button **Delete**, either from the main window or from the object window.

If the object contains other variables, a pop-up window warns that the contained variables are going to be deleted too.



If the object is used by other objects, a pop-up window warns that the related object would be left without reference

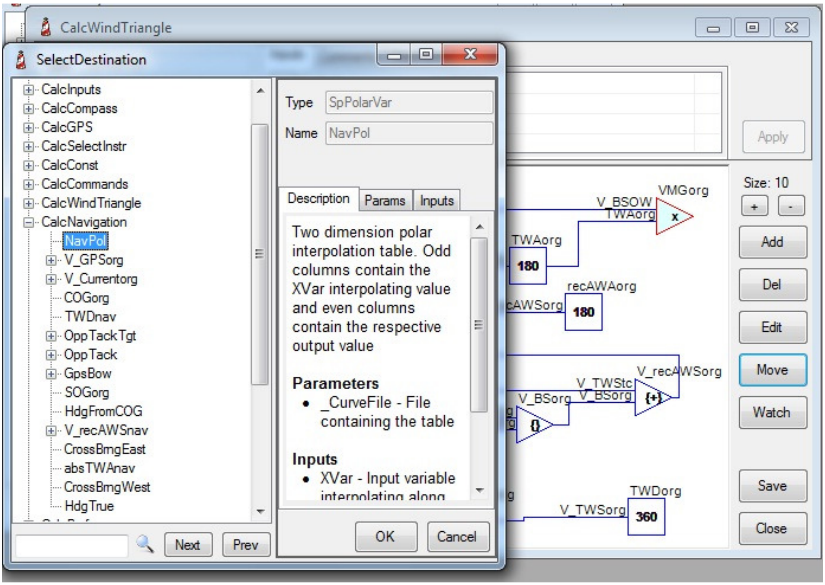


If the operation is confirmed, the object is removed from FaRo.

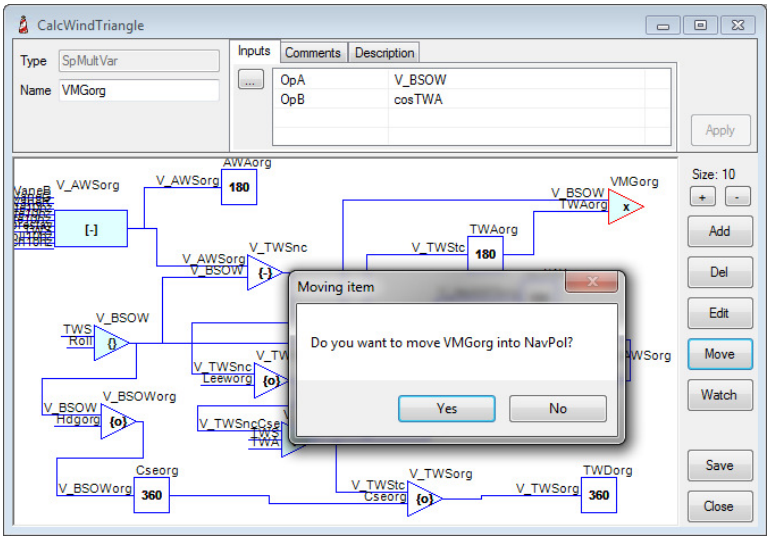
To permanently delete the object, it's necessary to click **Save.**

5.5.10 Moving a variable

A variable can be moved from one object to another. Select the variable and click the button **Move**, either from the main window or from the object window.



The tree of the math pops-up. Select the object that is going to be the new container and click **OK**.A message box will ask to confirm to move the variable into the new destination.

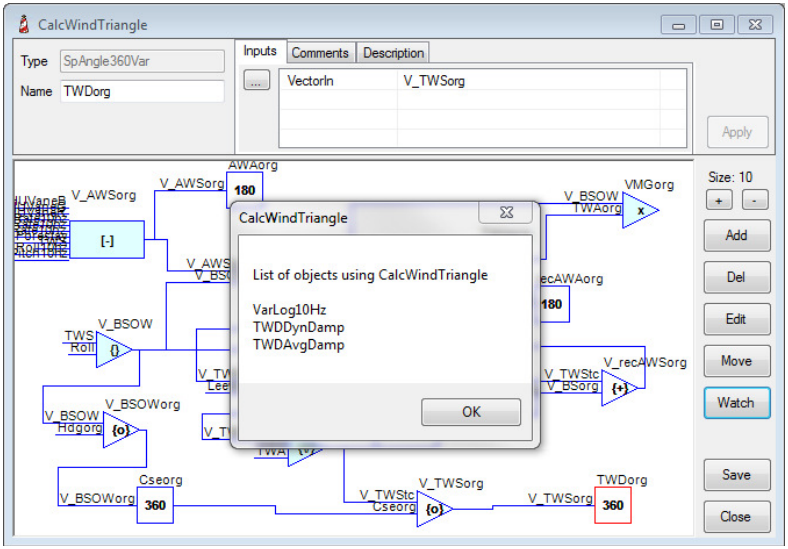


Depending on the size of the whole math and/or the connection speed, it might take few seconds before the operation completes.
Once the operation is completed, open the destination object and drag the variable in a suitable position.

To save the changes and the new position it is necessary to click the button **Save** in both objects, the original container and the new destination.

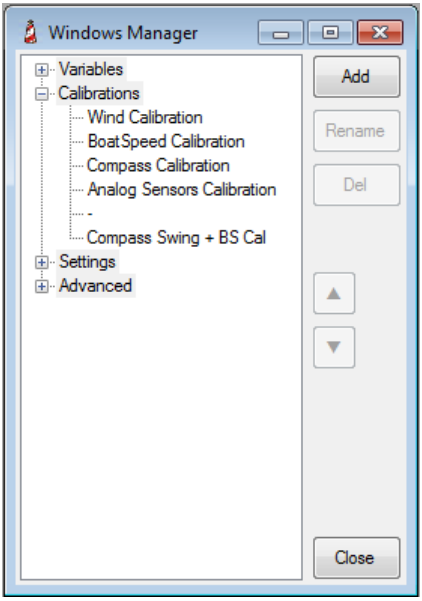
5.5.11 Watching references

It might be useful to know which objects contain a reference to a variable. A variable's reference is created anytime the variable is used as input of another variable or the variable is added to a list (for instance in a log file). To list a variable's references, select the variable and click the button **Watch**, either from the main window or from the object window.



5.6 Windows Manager

Windows Manager allows the user to personalize the FaroManager workspace. From Windows Manager it is possible to create, delete, rename and re-arrange the menus and the functions of FaroManager.

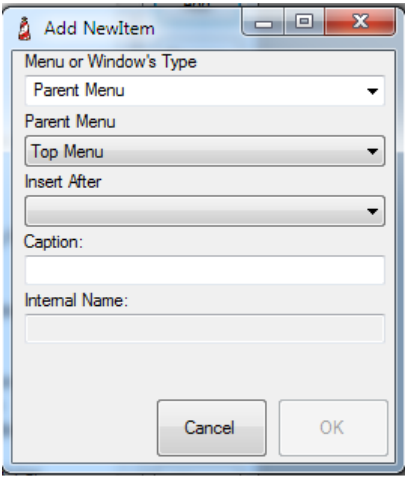


The main form shows the whole FaroManager menu structure. From here it is possible to **Rename** a menu (and the relative window) or **Delete** it. You can also move a menu **up** and **down** using the buttons ▲ and ▼.

Some of the menus cannot be deleted, because they are related to the important functions of FaroManager

5.6.1 Adding a new Menu

To create a new menu, press the **Add** button.



When creating a new menu, you need to specify:

- The **Type** of menu (see below)
- The **Parent Menu** to which the new menu has to be attached
- The position of the new menu inside the list (**Insert after**)
- The **Caption** of the new menu

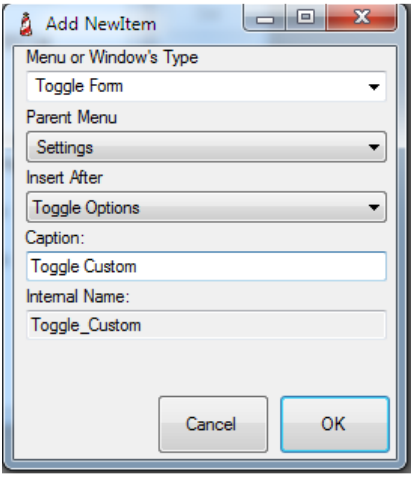
A menu can be associated to a function or it can simply be a parent for other menus. In the first case, a new window opens when the menu is clicked, in the second case a list of menu voices appears on the side of the clicked menu.

More in detail, the type of menus that can be created are:

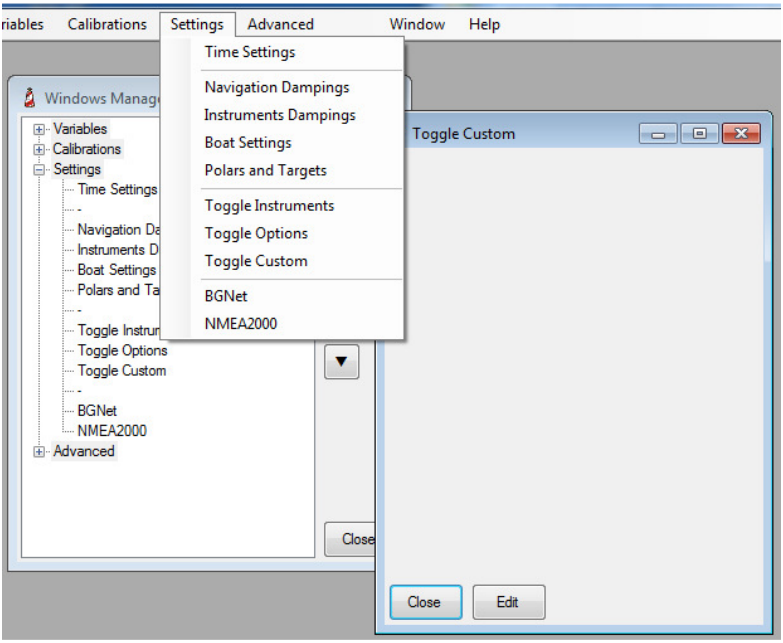
- **Parent Menu** - A menu that is supposed to host other menus

- **Menu Separator** - A simple separator to insert between voices of the menu, with the purpose of helping to keep the structure more organized
- **Averages Form** - A menu that opens a new Averages window
- **Calibration Form** - A menu that opens a new Calibration window
- **Settings Form** - A menu that opens a new Settings window
- **Toggle Form** - A menu that opens a new Toggle window
- **Plot Form** - A menu that opens a new Plot Window
- **Custom Form** - A menu that opens a new Custom window

After filling all the fields, press the **OK** button to create the new menu.



The menu will be inserted instantaneously in the requested position. If the menu is associated to a function, the new created window automatically opens, ready to be configured.

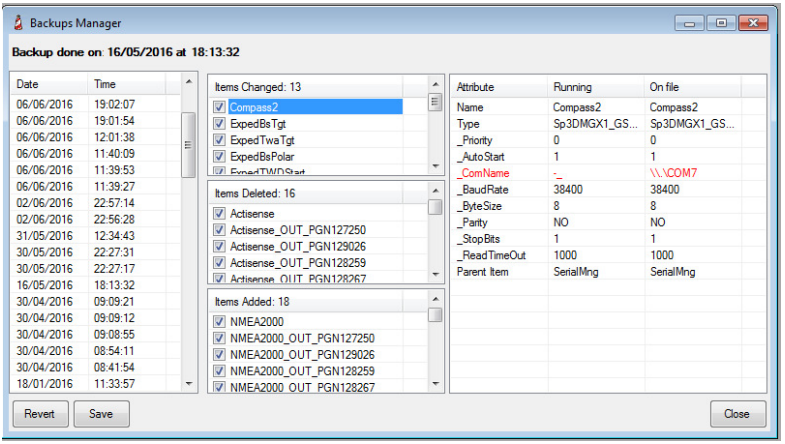

riables
Calibrations
Settings
Advanced
Window
Help
Time Settings
Navigation Dampings
Instruments Dampings
Boat Settings
Polars and Targets
Toggle Instruments
Toggle Options
Toggle Custom
BGNet
NMEA2000
Windows Manag
Variables
Calibrations
Settings
Time Settings
Navigation Da
Instruments D
Boat Settings
Polars and Ta
Toggle Instrun
Toggle Options
Toggle Custom
BGNet
NMEA2000
Advanced
Close
Toggle Custom
Close
Edit

5.7 Backups Manager

Every time a new configuration is saved, FaRo automatically creates a copy of the previous configuration. With the **Backups Manager** it is possible to review the changes and to revert (partially or totally) to a previous configuration.

> The backup manager looks for changes only in the file Faro.xml. External files, like calibration tables, are not taken into consideration by the backup manager. All the backup files are anyway available in the \Backup folder

The Backup Manager windos is divided into three vertical sections:



- On the left there is the chronology of the saved configurations.
- After selecting one saved configuration on the left, the central section of the window fills up with the elements that have changed since the selected configuration.

The changes are relative to the version currently running in the processor, they are not the changes from the previous version.

- **Items Changed** are the variables that have been found different between the two versions
- **Items Deleted** are the variables that have been deleted since the selected backup (they existed in the selected version but they don't exist anymore in the running version)
- **Items Added** are the variables that have been added since the selected backup (they exist in the running version but they didn't exist in the selected version)
- After selecting any of the elements in the central section, the right section fills up with details about the selected element. For each variable's attribute, the running value and the saved value are compared side to side. If they are different, they are highlighted in red.
- Uncheck the elements you don't want to revert to the previous configuration
- Press the **Revert** button to revert to the previous values all the elements that have been left checked.

It is recommended to make a copy of the file Faro.xml before operating a Revert, in case the function doesn't complete successfully, for a quick restore.

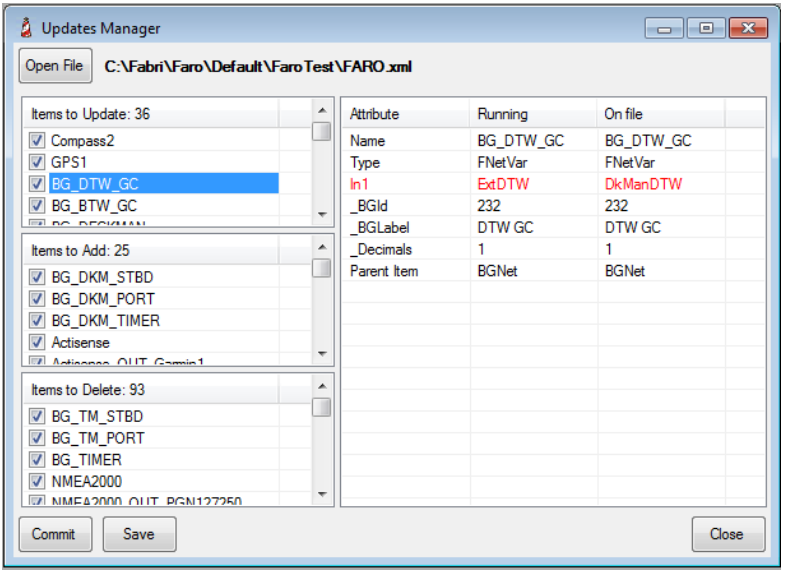
- If the revert succeeds, the checked elements on the center section should disappear
- Click **Save** to permanently save the configuration (this will create a backup copy of the previous configuration).

5.8 Updates Manager

One of the features of FaRo is the ability to play on a local computer with a running copy of the on board system. Without being connected, you can manipulate the mathematics, change calibrations and testing new sensors.

When connecting back to the system, with the **Update Manager** you can review the changes done off-line and, if needed, you can commit them to the running system.

The update manager looks for changes only in the file Faro.xml. External files, like calibration tables, are not taken into consideration by the update manager. To upload a new table into the system, you need to use the **Load** function of the **Table** object.



The Update Manager looks very similar to the Update Manager and it works on the same principles: it looks for the differences between two versions of the configuration file Faro.xml.

- Click the **Open File** button to load the file Faro.xml modified off-line
- The left section of the window fills up with the elements that have changed in the off-line version.
- **Items Changed** are the variables that have been found different between the two versions
- **Items To Add** are the variables that have been added in the off-line version.
- **Items To Delete** are the variables that have been deleted in the off-line version.
- After selecting any of the elements, the right section fills up with details about the selected element. For each variable's attribute, the running value and the off-line value are compared side to side. If they are different, they are highlighted in red.
- Uncheck the elements you don't want to revert to the previous configuration
- Press the **Commit** button to upload the selected changes from the off-line file to the running system

 It is recommended to make a copy of the file Faro.xml before operating a Revert, in case the function doesn't complete successfully, for a quick restore.

- If the upload succeeds, the checked elements on the center section should disappear
- Click **Save** to permanently save the configuration (this will create a backup copy of the previous configuration).

5.9 Simulation

The simulation package is a special process defined in the MathDesigner. It reads variables from a log file and it uses them as inputs. The input variables are then processed by the FaRo's mathematics. The purpose of the simulation process depends on which variables are selected as inputs.

In the standard configuration, FaRo has defined two simulation process:

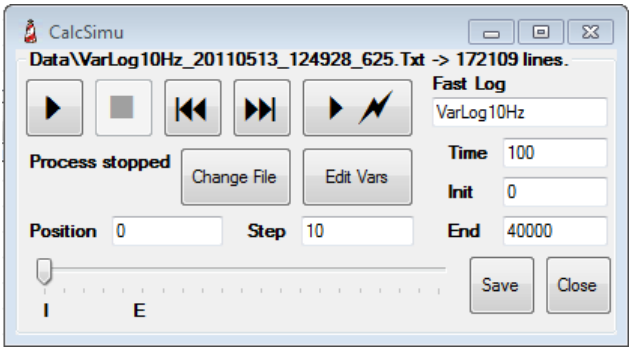
- **CalcSimu** is the process using the raw data from the sensors as inputs, in order to review calibrations, filters and relations between variables
- **CalcReplay** is the process using the navigation data as inputs, in order to replay sailing moments.

The simulation process can be run in two different ways:

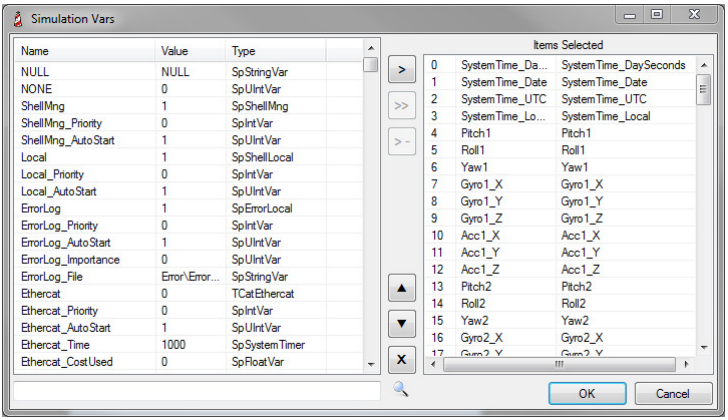
- In **Real time**: using a player form, the user can start, pause, stop, rewind, fast-forward and jump in time. This is suitable for the replay mode, because the variables are displayed as they are read. In simulation mode, only the normal play mode is meaningful, because the filter functions are time-step dependent.
- In **Fast Mode**: the process runs off-line and the user cannot interact until the calculation is terminated. The process is fast and it can last from few seconds to few minutes, depending on the time-span of the period to simulate. This is suitable for the simulation mode, because the simulated logged data can be compared with the original logged data to verify the effect of new calibrations and new filters.

The first thing to do, before running a simulator or a replay, is to load the source file (usually a FaRo log from the sailing day).

From the menu Advanced, select CalcSimu or CalcReplay. Click **Change File** to select a log file

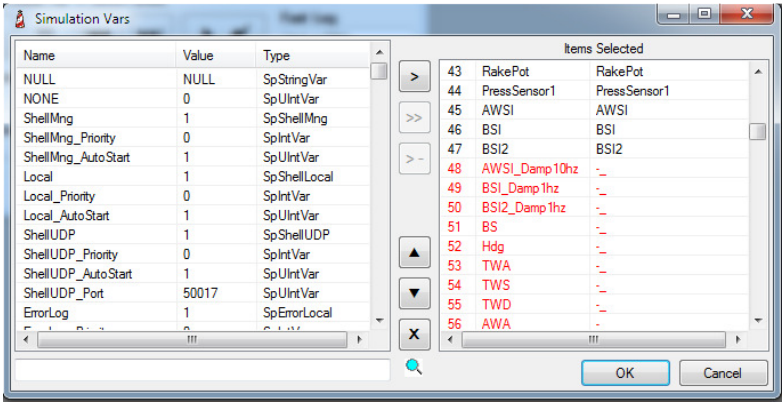


The next step is mapping the variables to use for the simulation. Click **Edit Vars** to map the variables

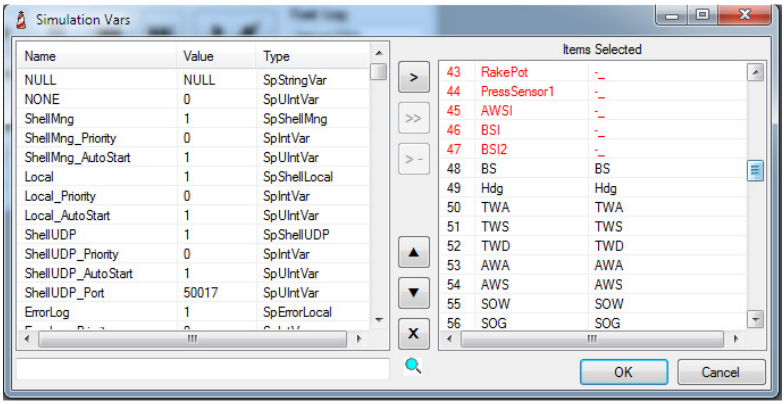


The left list contains all the FaRo variables. The right list associates the log variables with the FaRo variables: in the left column there are the log variables, in the right column you need to copy the associated variables from FaRo. This means that the FaRo variable on the right column is using as input the corresponding log variable on the left column.

Observing the mapping in CalcSimu, the mapped variables are the ones that in FaRo are strictly related to the sensors. Modifying filters and calibration will affect the values of the calculations.



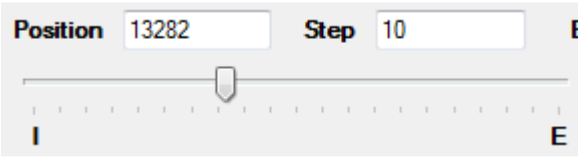
The mapped variables in CalcReplay are the variables at the end of the calculation chain. In this case, modifying filters and calibrations doesn't produce any effect.



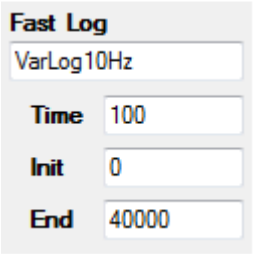
A part from the variables mapping, CalcSimu and CalcReplay have the same functions (in fact, they are two different instances of the same process).

- The player buttons activate the typical functions of a media track: **Play**, **Pause**, **Stop**, **Fast Forward**, **Rewind** .

- In the lower portion of the window, a **Slider** updates constantly the position inside the file and it can also used as input to jump quickly in different positions
- The **Position** text box shows the current position inside the file. The text box can also be used to enter a position to jump to
- The **Step** text box tells the process how many lines to read every seconds. If the file has been logged at 10Hz, playing 10 steps gives a real-time simulation/play back



- The **Fast Log** text box tells the process where logging the results of the **Fast Simulation**.
- **Time** is the time base (in milliseconds) for the Fast Simulation. it has to be the same frequency of the logged file
- **Init** is the file's starting line for the simulation
- **End** is the file's last line to simulate



- The **Fast Mode** is activated with the button 

FaRo and navigation software 6

One of the tasks of FaroManager is to act as plug-in for the more popular navigation software, allowing Deckman, Expedition and Adrena software to use FaRo as instruments system.

The communication between FaroManager and the navigation software is bidirectional:

- FaroManager send to the navigation software the boat variables to perform tactical calculations.
- The navigation software send to FaroManager the tactical numbers to be displayed and other information.

Some features (calibrations, filters...) are performed by FaRo and by the navigation software. It is important to disable them either in FaRo or in the navigation software to avoid unpredictable numbers.

The three software use three different ways to communicate with FaroManager. Therefore, every software needs a different configuration routine.

Don't forget to select the navigation software in **Toggle Options**, if it's enabled in your version of FaroManager.

6.1 Use FaRo with Deckman

The version of FaroManager for Deckman is a dll and it is called FaroForDeckman. The installation software automatically performs few operations, in order to minimize the need of manual configuration.

- It copies all the necessary files in Deckman folder and subfolders. Among them, the file **FaroForDeckman.dll** in the **Addin** subfolder.
- It installs the software **com0com**, a freeware utility used to create virtual serial ports on Windows PCs.
- It creates two pairs of serial ports in com0com. Paired virtual ports work like two serial ports interconnected. The installation software creates the following ports
  com98 paired to **com99**
  com100 paired to **com101**
- It overwrites the following lines of the file deckman.ini
  port=101,9600,N,8,1,0
  comgps=99,9600,N,8,1,0
  comgpsmode=2

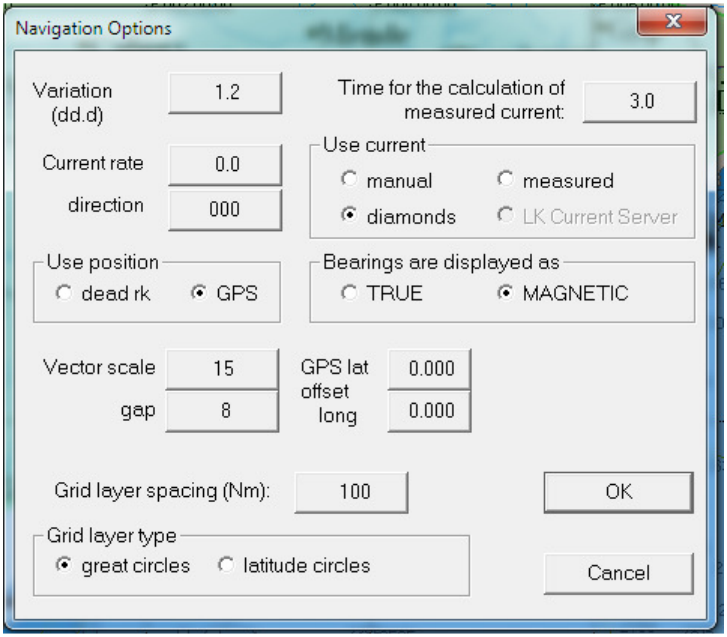

Due to the protection level of windows OS starting from Vista, the file deckman.ini might not change. Please, verify and, in case, enter the above values manually.

6.1.1 Configuring Deckman

When starting Deckman for the first time, click on **gmenu>change instruments** and select the instrument **B&G H200 – RS232**. Soon, the message box **No instruments** shows up;

Click **NO** to close the box and not to be reminded about the missing instruments.

- Deckman and FaroForDeckman communicate through the **.Net interface** developed in Deckman. Although Deckman is instructed to connect to a H2000 system through com101, there is no data activity on the serial port.
- The GPS data are transmitted to Deckman using the virtual serial port **com99**. Deckman reads them on port **com98**.
- To use the current calculated by Faro, it is necessary to set to **diamonds** the option in **Navigation Options**.

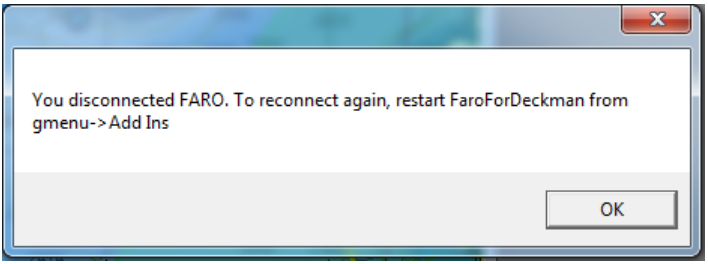


6.1.2 Starting FaRoForDeckman

To start FaroForDeckman open the Deckman software and click on **gmenu>Add Ins>FaroForDeckman**. FaroManager will open as internal window in Deckman.

If you close the FaroForDeckman window, the communication between FaRo and Deckman is interrupted.

A warning message tells if the window has been colsed.



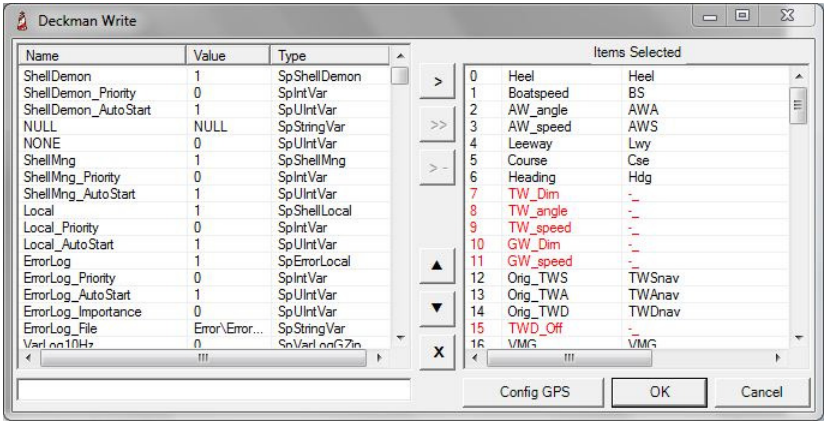
There is a dedicated menu item Deckman in the menu bar.

It contains two sub menus:

- **Deckman Write**, to configure the communication from FaRo to Deckman
- **Dckman Read**, to configure the communication from Deckman to FaRo

6.1.3 Deckman Write

Deckman Write maps the variables sent from FaRo to Deckman. Deckman's variables are defined in the file j_var06.d, located in the sub-folder Deckman\data.



The left list contains all the FaRo variables. The right list contains the j_vars06 variables (on the left) and the associated FaRo variables.

To associate a Faro variable to a Deckman variable, select the variable from the left table and click on the > button.

To find the variable on the list, type the first letters of the Faro variable desired and the automatic filter will reduce the number of variables to a few matching your text.

The selected item will be associated with the first free Deckman variable. To map the variable with the one of your choice, select the Faro variable on the right table and click on the ▼ button

(or press the **Enter** key), until the requested j_vars variable is reached.

By default, the following DFW variables are associated with Faros' variables:

- Heel
- BoatSpeed
- AW_angle
- AW_speed
- Leeway
- Course
- Heading
- Orig_TWS
- Orig_TWA
- Orig_TWD
- VMG
- SOG
- COG
- DCur_Rate
- DCur_Dir
- LCur_Rate
- LCur_Dir
- Depth

> Auxiliary variables (like rudder angle or loads) need to be defined in the j_vars06.d file before they can be mapped in Deckman Write.

It is relevant to know that:

- FaRo maps Orig_TWS, Orig_TWA and Orig_TWD because the Deckman variables TWS, TWD and TWA cannot be

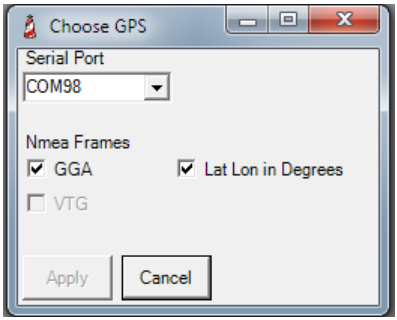
overwritten. Be aware that TWS, TWD and TWA have different values when:

- A Wind-Load factor is applied in Deckman
- A wind-shear correction is applied in Deckman
- Correction tables are used in Deckman

- TWA is different because Deckman back-calculates it from TWD and Course (the filter applied is different from FaRo)
- The current calculated by FaRo is passed to Deckman as "**diamond** current" (**DCur_Rate** and **DCur_Dir**). Deckman calculates its own current (**measured** current in the **Navigation Options**) and the user can decide which current to use for the navigation. For sake of consistency, the same current is used in the FaRo's prestart functions. For this reason, the variables **LCur_Rate** and **LCur_Dir** (which are normally not used in Deckman) are mapped to the Faro variable SelectCurrent and then sent back to FaRo as pre-start variables (see later in Deckman Read)

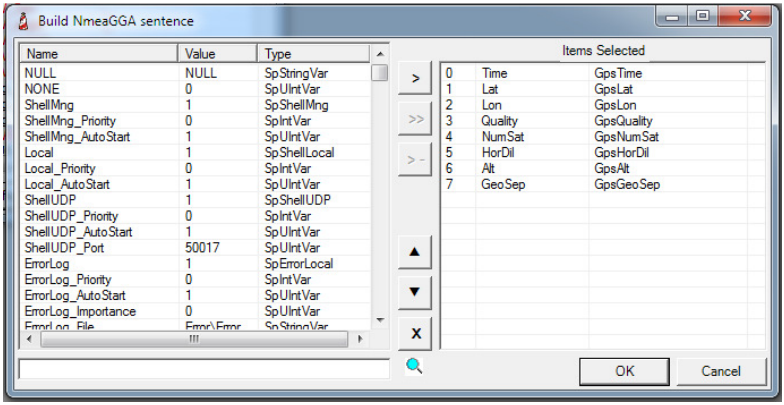
6.1.4 Configuring GPS

As already mentioned, GPS is passed to Deckman as an independent sensor through the virtual serial port. To configure the GPS, press the button **Config GPS**



The options are:

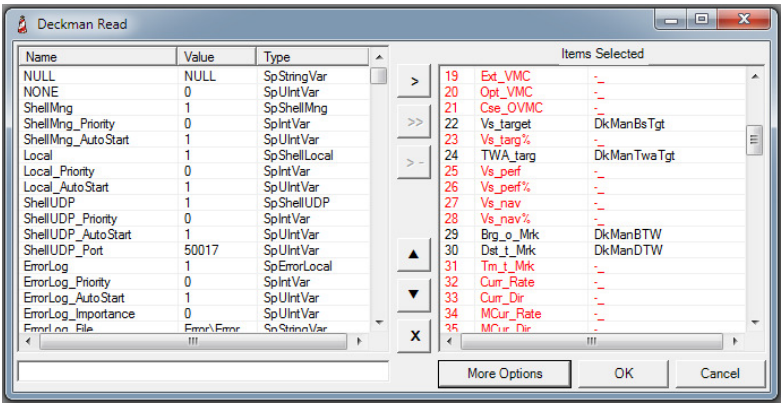
- **Serial Port**: the virtual serial port Deckman reads from (no need to change it, unless the com0com configuration as changed)
- **Nmea Frames**: the NMEA sentences FaroForDeckman sends to Deckman through the serial port. Currently only the option **GGA** is active.
- To map the variables for the GGA sentence, Un-check and check back the GGA check box.



- The way the mapping works is the same used for the j_wars variables. By default, the selected GPS values are mapped.
- **Lat Lon in Degrees**: starting from version 1.2, FaRo uses the coordinates in **Degrees and fraction of degrees**, instead of the traditional NMEA format **Degrees, minutes and fraction of minutes**. Tick the check box if your FaRo's version is 1.2 or older, otherwise un-tick the option

6.1.5 Deckman Read

Deckman Read maps the variables sent from Deckman to FaRo.

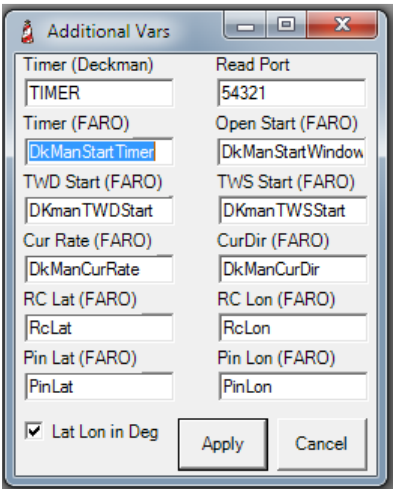


The left list contains all the FaRo variables. The right list contains the j_vars06 variables (on the left) and the associated FaRo variables.
To associate a Faro variable to a Deckman variable, select the variable from the left table and click on the [>] button.

By default, the following j_vars variables are sent from Deckman to FaRo:

- Vs_target
- TWA_targ
- Brg_o_Mrk
- Dst_t_Mrk
- TM_STRB
- TM_PORT

There are few more variables that Deckman send to FaRo through FaroManager. They are not defined in the j_vars06 file and to configure them click on **More Options**



- **Timer (Deckman)** is the timer variable in Deckman. It is defined in the j_vars06 file, although in some versions it needs to be added manually (read later about adding the pre-start variables in j_vars06). The timer variable is not sent directly to FaRo. FaRo reads the status of the TIMER variable and synchronizes the events with an internal timer.
- **Timer (FARO)** is the timer variable in FaRo that synchronizes with the Deckman Timer. This is the variable that is passed to the displays.
- **Open Start (FARO)** is a FaRo variables that changes value based on the status of the pre-start window in Deckman. This is used in case you want to set FaRo in pre-start mode when Deckman opens the start window (for more details, **TWD Start** and **TWS Start** are the wind variables used by the pre-start functions in FaRo. If during the prestart the wind values are manually modified, the same values are used in

FaRo (this is true if the option of reading the start wind from the navigation software is activated. For more details, refer to **Toggle Options**).

- **Cur Rate** and **Cur Dir** are the current variables used by the pre-start functions in FaRo. They are used in the same way of TWD start and TWS start.
- **RC Lat** and **RC Lon** are the coordinates of the Race Committee and they are used in the FaRo pre-start functions.
- **Pin Lat** and **Pin Lon** are the coordinates of the pin end of the starting line and they are used in the FaRo pre-start functions.
- If your version of Faro is 1.2 or older, you need to tick the **Lat Lon in deg**

Adding pre-start variables to Deckman j_vars06.d file

To ensure a correct use of the pre-start variables, it is necessary to define the start variables inside j_vars06.d file:

Add these variables to the [variables] section:

97	TM_PEND	TPE	0	0	3
98	DST_PEND	DPE	0	0	4
99	TM_SEND	TSE	0	0	3
100	DST_SEND	DSE	0	0	4
101	TM_LINEP	TLP	0	0	3
102	DSTLINEP	DLP	0	0	4
103	TM_LINES	TLS	0	0	3
104	DSTLINES	DLS	0	0	4
105	VERTDIST	VDL	0	0	4
106	TIMER	TMR	0	0	3
107	STR_LEFT	SLL	0	0	2

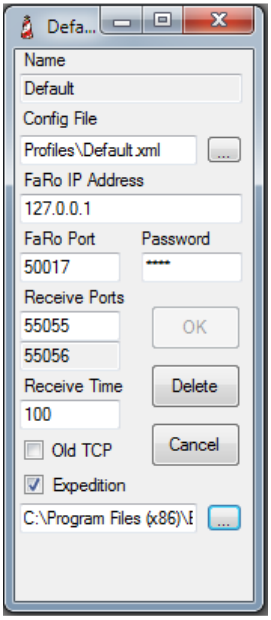
108	STR_RIGHT	SRL	0	0	2
109	LINEWIND	LWD	0	0	2
110	BIASGAIN	BSG	2	0	0
111	BIASANG	BSA	0	0	1

Add the following lines after the [variables] section:

```
[StartVariables]
VarTPE 97
VarDPE 98
VarTSE  99
VarDSE 100
VarTLP  101
VarDLP 102
VarTLS  103
VarDLS 104
VarVDL 105
VarTmr    106
VarSLL  107
VarSRL  108
VarLWD109
VarBsG 110
VarBsA    111
```

6.2 Use FaRo with Expedition

FaRo and Expedition communicate using the library EpxDLL.dll, provided by Expedition software.
Start FaroManager, click **Connect** and click **Edit** to verify the connection settings.



At the bottom of the window, tick the check box Expedition and press the ... button to look for the **EpxDLL.dll**. Usually, it is found at the path:
C:\Program Files (x86)\Expedition\Expedition\ExpDLL.dll

Click **OK** to confirm.

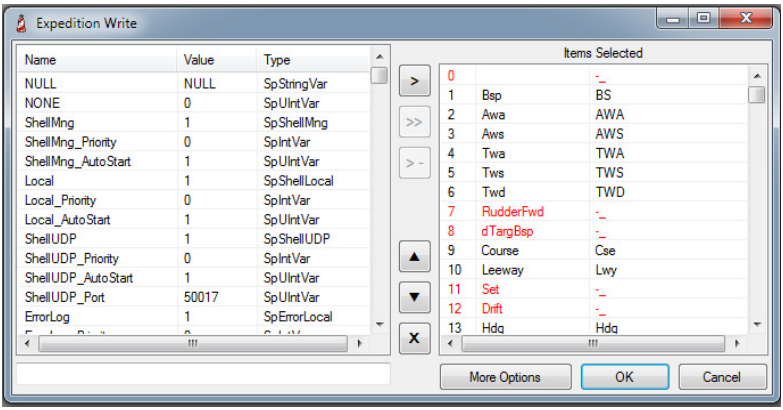
After connecting, if the dll is found, FaroManager loads the item **Expedition** on the main menu bar, containing two sub-menus:

- **Exped Write**, to configure the communication from FaRo to Expedition
- **Exped Read**, to configure the communication from Expedition to FaRo

In Expedition, the variables are hard-coded into the software. The default variables cover the needs of the more demanding navigators. If more variables are needed, there are up to 32 **User** variables free for custom purpose.

6.2.1 Exped Write

Exped Write maps the variables sent from FaRo to Deckman.



The left list contains all the FaRo variables. The right list contains the Expedition variables (on the left) and the associated FaRo variables.
To associate a Faro variable to an Expedition variable, select the variable from the left table and click on the  button.

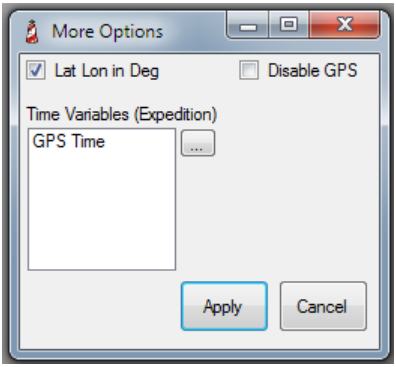

To find the variable on the list, type the first letters of the Faro variable desired and the automatic filter will reduce the number of variables to a few matching your text.

The selected item will be associated with the first free Deckman variable. To map the variable with the one of your choice, select the Faro variable on the right table and click on the  button (or press the **Enter** key), until the requested Expedition variable is reached.

By default, the following Expedition variables are associated with Faros' variables:

- Bsp
- Awa
- Aws
- Twa
- Tws
- Twd
- Course
- Leeway
- Hdg
- Depth
- Heel
- Trimorg
- Rudder
- Forestay
- VMG
- GpsQual
- HDOP
- GpsNum
- GpsAge
- Altitude
- GeoSep
- Lat
- Lon
- Cog
- Sog
- GPS Time

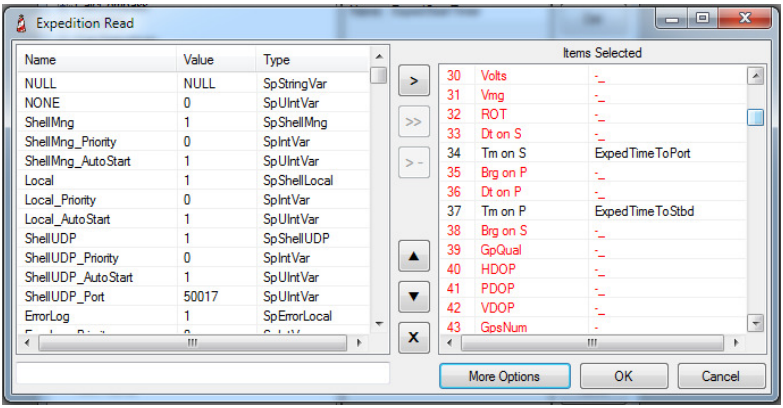
More configurations are available clicking the **More Options** button.



- **Lat Lon in Deg**: starting from version 1.2, FaRo uses the coordinates in **Degrees and fraction of degrees**, instead of the traditional NMEA format **Degrees, minutes and fraction of minutes**. Tick the check box if your FaRo's version is 1.2 or older, otherwise un-tick the option
- **Disable GPS**: this option, if enabled, tells FaRo not to send the GPS information (although the variables are mapped), in order to allow Expedition to receive the GPS from another source.
- **TimeVariables (Expedition):** this is the list of Expedition variables in Time Format. They need to be inserted in this list in order to be converted from FaRo Time Format to Expedition Time Format

6.2.2 Exped Read

Exped Read maps the variables sent from Deckman to FaRo.



The left list contains all the FaRo variables. The right list contains the Expedition variables (on the left) and the associated FaRo variables.
To associate a Faro variable to an Expedition variable, select the variable from the left table and click on the > button.

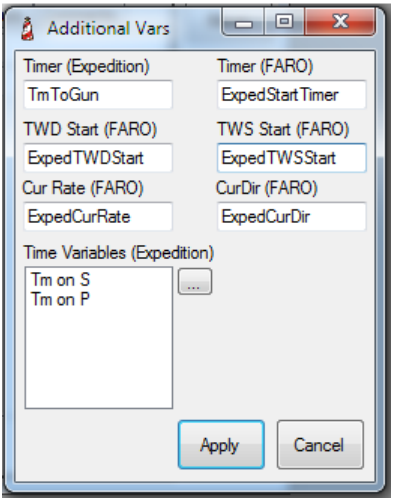
By default, the following Expedition variables are sent from Expedition to FaRo:

- Tm on S
- Tm on P
- TargTwaN
- TargBspN
- PolBsp
- MkRng
- MkBrg
- Port Lat

- Port Lon
- Stbd Lat
- Stbd Lon

The last four are the coordinates of the starting line. They are used in FaRo by the pre-start functions.

There are few more variables that Deckman send to FaRo through FaroManager. They are not defined in the j_vars06 file and to configure them click on **More Options**



- **Timer (Expedition)** is the timer variable in Expedition. The timer variable is not sent directly to FaRo. FaRo reads the status of the TIMER variable and synchronizes the events with an internal timer.
- **Timer (FARO)** is the timer variable in FaRo that synchronizes with the Expedition Timer. This is the variable that is passed to the displays.
- **TWD Start** and **TWS Start** are the wind variables used by the pre-start functions in FaRo. If during the prestart the wind

values are manually modified, the same values are used in FaRo (this is true if the option of reading the start wind from the navigation software is activated. For more details, refer to **Toggle Options**)

- **Cur Rate** and **Cur Dir** are the current variables used by the pre-start functions in FaRo. They are used in the same way of TWD start and TWS start.
- **TimeVariables (Expedition):** this is the list of Expedition variables in Time Format. They need to be inserted in this list in order to be converted from Expedition Time Format to FaRo Time Format.

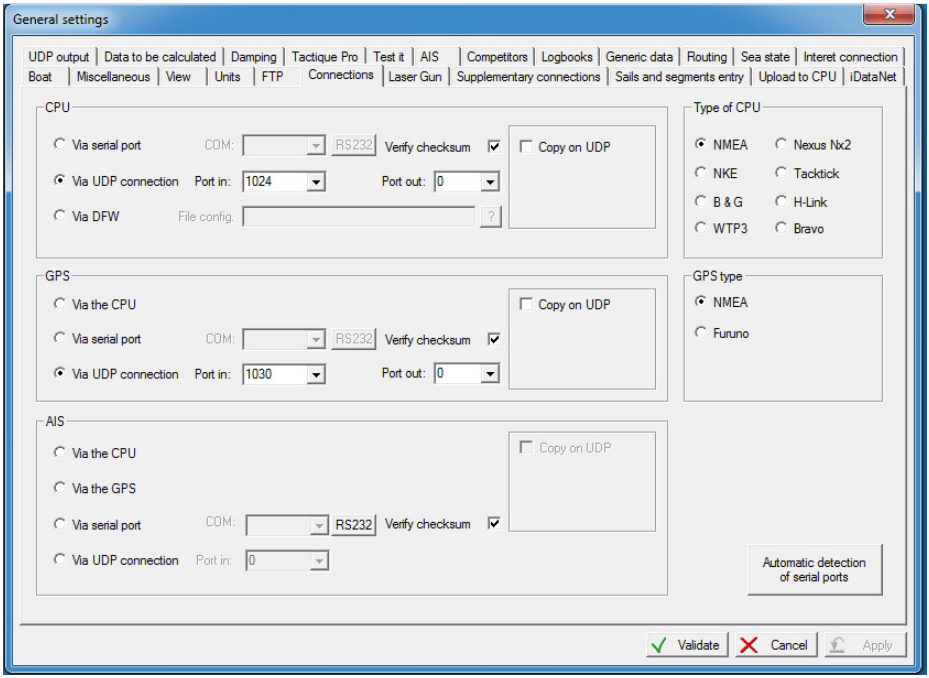
6.3 Use FaRo with Adrena

FaRo and Adrena communicate through 3 different UDP connections:

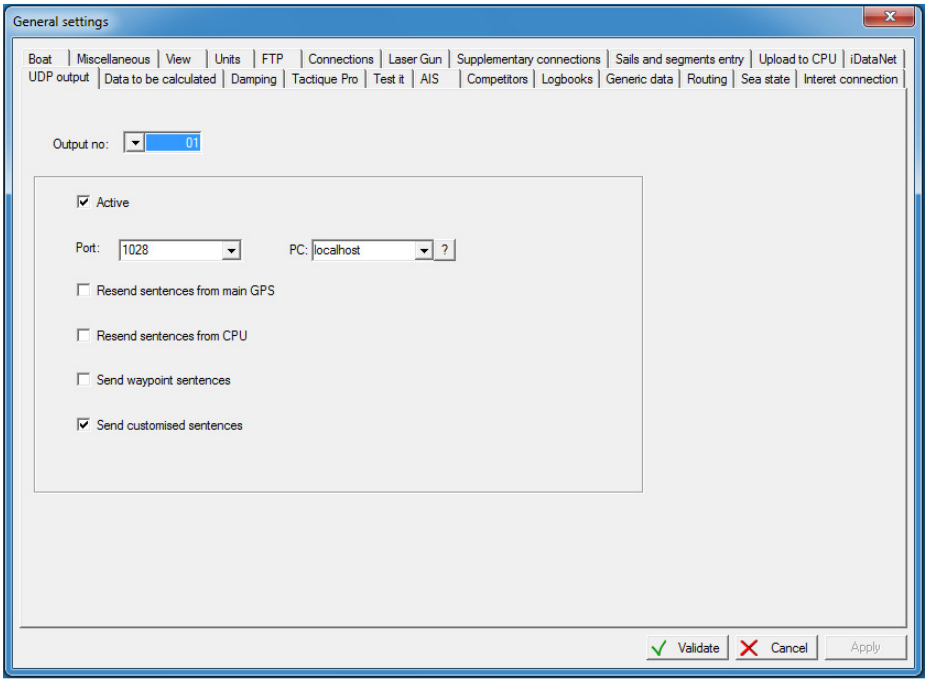
- A connection for the variables FaRo send to Adrena
- A connection dedicated to the GPS only (from FaRo to Adrena)
- A connection for the variables Adrena send to FaRo

6.3.1 Configuring connections from Adrena

In ***General Settings***, ***Connections*** Tab, select UDP connection for CPU and GPS. Choose two different UDP ports, NMEA standard communication



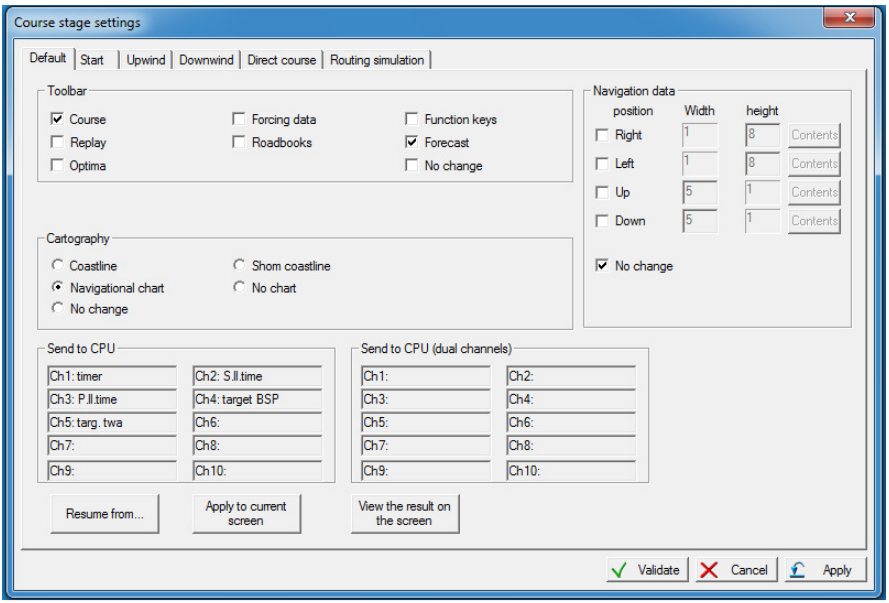
In ***General Settings***, ***UDP Out*** Tab, activate an ***Output no*** on a third Port (different from the previous ones), enter FaRo's IP number and check the ***Send customized sentences*** option



In ***Course stage settings***, choose the variables to send to FaRo. For a basic purpose (variables to show on displays) the following variables need to be sent:

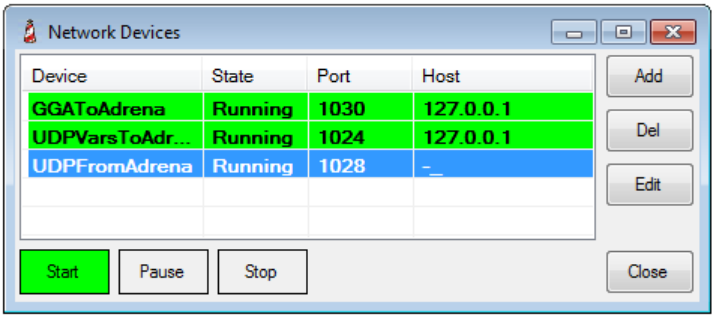
- **timer**
- **time to port lay line**
- **time to stbd lay line**
- **target BSP**
- **target twa**

You might decide to enable sending different variables for different sailing modes, but this doesn't affect the way FaRo reads the variables: FaRo manages internally the different sailing modes (pre-start, upwind, reaching, downwind)



6.3.2 Configuring connections from FaRo

You need three network devices in FaRo to communicate with Adrena. You can add or modify the required devices from FaroManager, menu ***Advanced->Network Devices*** (refer to the Network devices session for more information)

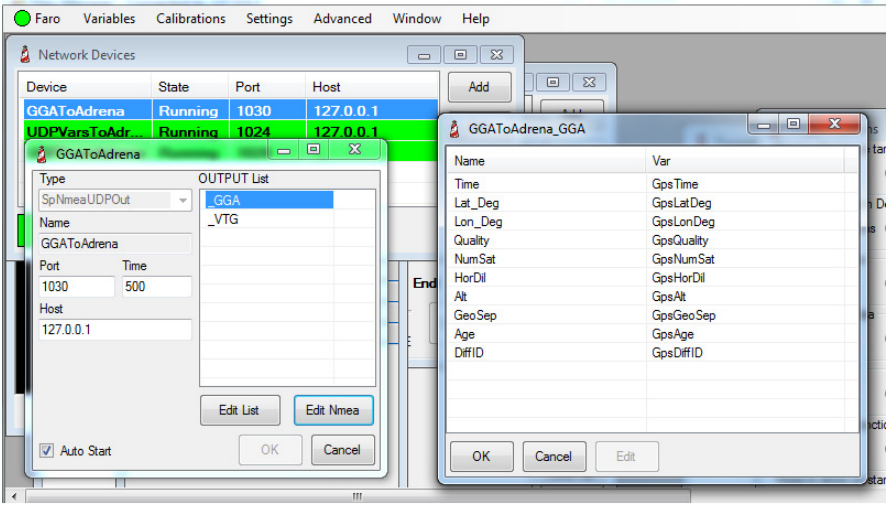


Add or configure GPS information for Adrena

Add a ***SpNmeaUDPOut*** sentence with the following parameters:

- **Port**: the same Port number defined in Adrena for **GPS** information
- **IP number**: the network address of the navigation computer
- **Time**: the rate at which you want to send the sentences ("Time" is the interval time in milliseconds between sentences: a value of 500 means 2 sentences per seconds).

Add **GGA** and **VTG** to the ***OUTPUT List*** and associate the GPS values from FaRo to the corresponding NMEA component



Add or configure navigation variables for Adrena

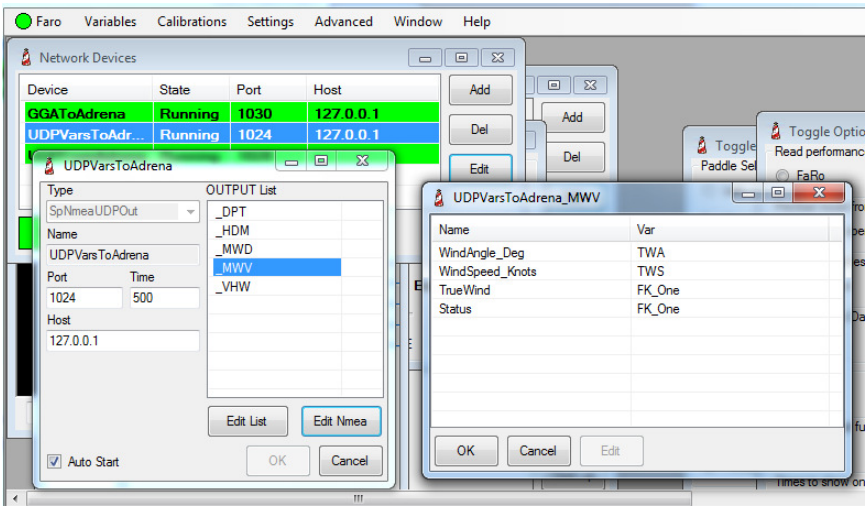
Add a ***SpNmeaUDPOut*** sentence with the following parameters:

- **Port**: the same Port number defined in Adrena for **CPU** information
- **IP number**: the network address of the navigation computer
- **Time**: the rate at which you want to send the sentences

Add at least the following sentences to the ***OUTPUT List***:

- **DPT** (Depth)
- **HDM** (Magnetic Heading)
- **MWD** (Wind direction)
- **MWV** (True Wind)
- **VHW** (Apparent Wind)

Every sentence needs to be properly configured with the corresponding FaRo variables

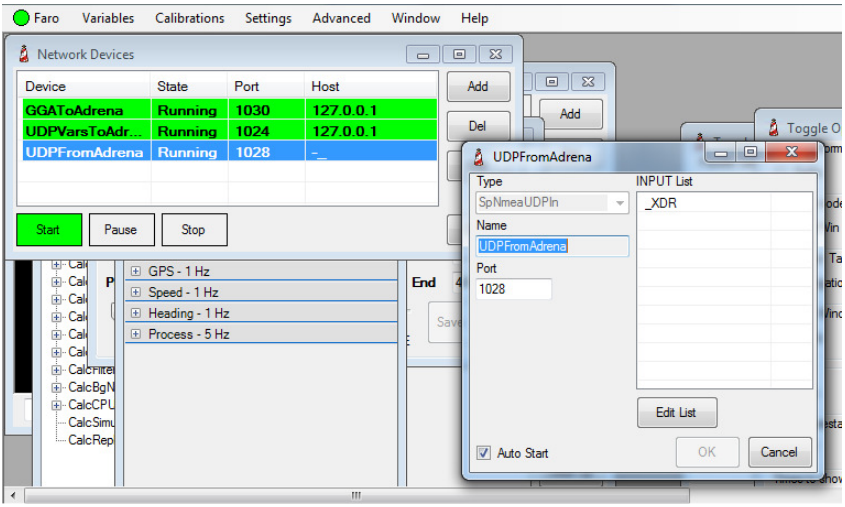


Add or configure variables sent from Adrena

Add a ***SpNmeaUDPOut*** sentence with the following parameters:

- **Port**: the same Port number defined in Adrena for **UDP OUT** information

Add the **XDR** sentence to the ***INPUT List***.



6.3.3 How FaRo reads variables from Adrena

Adrena sends one XDR sentence for each variable defined in the output list. FaRo decodes the information received and adds a variable for every XDR sentence. Few points need to be highlighted:

- FaRo creates the variables dynamically, which means that the XDR variables are not available in FaRo until Adrena doesn't start sending them. It's impossible therefore to proceed with the steps described below until FaRo doesn't receive all the XDR sentences from Adrena

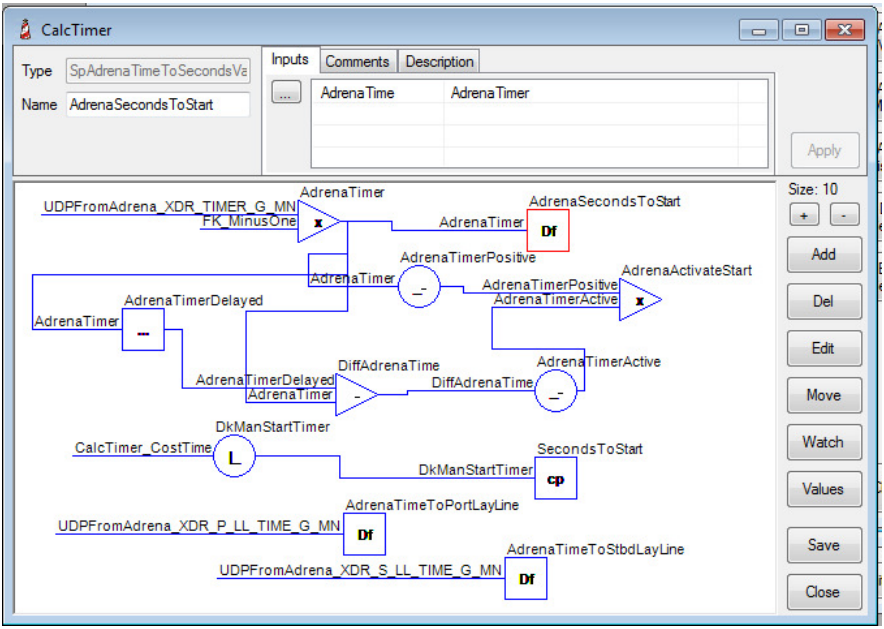
- The way FaRo creates a XDR variable's name is *VariableName_VariableType_Units*. This leads to a couple of issues: 1) if Adrena is set to a different language from a previous configuration, the name of the variable might change and 2) sometimes the same variable is sent in different units, so be sure to use the variable named after the unit you are interested to. To make an example, the times to the lay lines can be expressed in mm:ss or hh:mm, depending on the effective time necessary to reach the lay lines. At present time, FaRo might create two independent variables, if Adrena sends two different units in different moments. For inshore racing, of course, be sure to use the time in format mm:ss. Future releases will solve this issue.

- FaRo variable's name cannot contain the dot "." and special characters. When a XDR sentence from Adrena is sent with special characters, FaRo substitutes them with the underscore character "_". This feature is present in **NmeaVarsLib** starting from release **1.2.0.35**, so be sure to have the proper library installed

- Time variables are sent from Adrena in format “mm.ss” or “hh.mm”. For FaRo, times need to be treated as TotalSeconds and the conversion is done by the function **SpAdrenaTimeToSecondsVar** (included in **StdVarsLib** from version **1.2.0.23**).

Using Adrena variables in FaRo

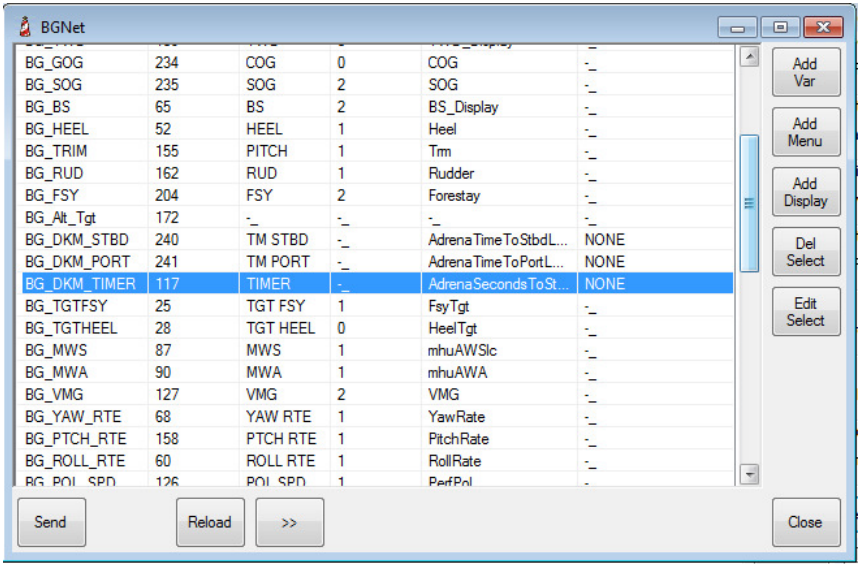
Here below is the schema of how the start timer is configured in FaRo. First of all, the sign is inverted (start timer is positive in FaRo), then it is converted in TotalSeconds (**AdrenaSecondsToStart**). This variable is then sent to the displays (see below).



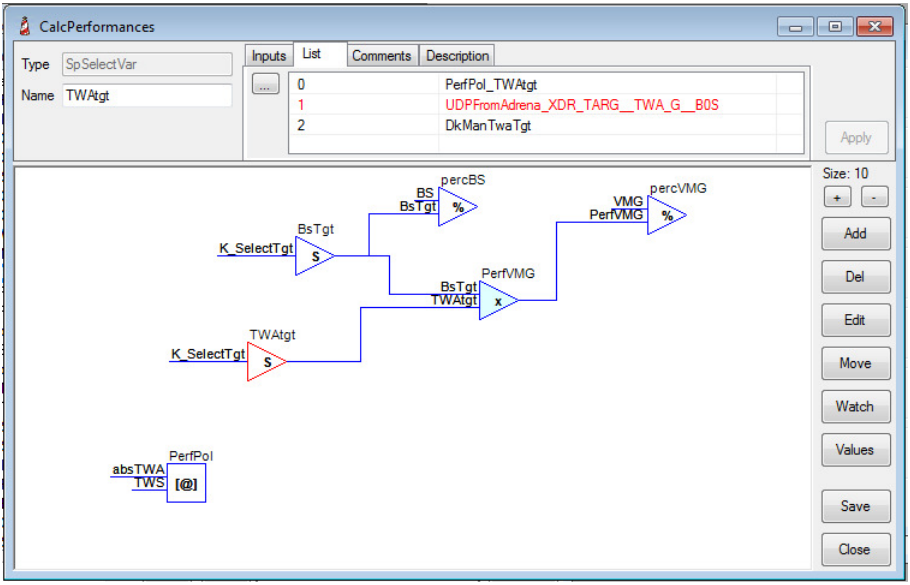
The variable **AdrenaActivateStart** is a boolean value that is TRUE when the Timer is actively counting down before the start. After the start, or when the timer is not active, the variable AdrenaActivateStart is FALSE.

> AdrenaActivateStart is the variable used by FaRo to know when the race is in pre-start mode and the displays are configured consequently.

AdrenaTimeToPortLayLine and **AdrenaTimeToStbdLayLine** are the variables sent to the displays for the times to lay lines



The targets values are also sent to the displays (if selected) and are used to calculate the percentage values of BSP and VMG



In case further variables need to be sent to FaRo, be sure to follow the guidelines (“How FaRo reads variables from Adrena”) to configure and read the values properly

Appendix A

Using Tables in Faro

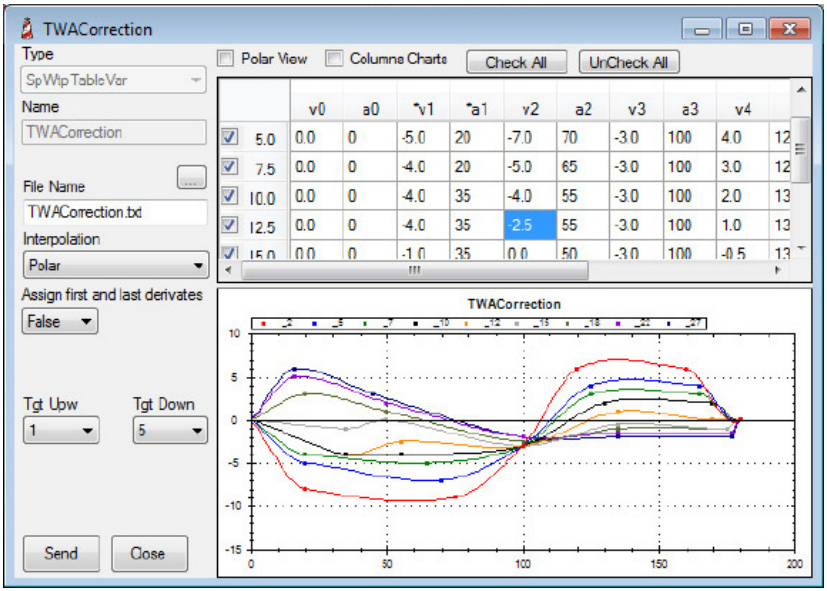
Tables in Faro are widely used and a correct understanding of their possibilities and use, is important to adjust your numbers as accurately as possible.

These are the general properties of tables inside Faro:

1. Tables are in the same format as used by WTP or DFW.
2. There are no limits on the number of rows and columns.
3. There is no restriction on the position of the target columns.
4. Three types of interpolation are possible:
   - Linear
   - Cubic Spline
   - Polar Spline
5. First derivatives can be assigned on the extreme points of the spline interpolations.
6. Outside the boundaries of the table, the extrapolated value is a constant value equal to the closer value on the table.
7. There are no hidden columns on the tables. For correction tables is therefore necessary to explicitly define de columns for TWA=0 and TWA=180.
8. Faro applies corrections in **retroactive mode,** which means that TWS and TWA calculated on the previous cycle are the table's inputs on the current cycle. Therefore, correction values are applied at the exact TWA and TWS of the table.

Editing a table window

Once the table window is open, there are several values which can be configured.



- **Interpolation type:** *Linear*, *spline* or *polar*.
- If the interpolation is spline or *polar*, it is possible to assign the first derivative at the extreme points of the table.
- If the interpolation is *polar*, it is possible to declare which column of the table represents the upwind target and which column represents the downwind target.
- Clicking on any cell of the table allows changing the value on that particular cell.

 To apply the changes in Faro is necessary to click on the **Send** button.

Some features are included to help the setting and layout of the table:

- Clicking on the **Polar View** check box allows switching the view of the graph from *normal* to *polar.*
- Clicking on the **Column Charts** check box allows switching the view of the graph from rows to columns, in order to check the interpolations in both directions.
- If you click on the check box situated on the header of every row (or on the header of every column) allows hiding/showing the correspondent function on the graph.
- Pressing the **Check All** button allows showing all the functions on the graph.
- Pressing on the **UnCheck All** button allows hiding all the functions on the graph.

Appendix B

Variables BGIndex for B&G Displays

Function Description	BGIndex	BGLabel
Air Temperature degrees ºC	**29**	
Alternative Target	**172**	**-**
Apparent Wind Angle	**81**	**AWA**
Apparent Wind Angle, Raw	**82**	
Apparent Wind Speed, knots	**77**	**AWS**
Apparent Wind Speed, m/s	**79**	
Apparent Wind Speed, Raw	**78**	
Average Speed	**100**	
Barometric Pressure	**135**	
Barometric Pressure Trend	**134**	
Battery Volts	**141**	**Bat**
Bearing to Waypoint, G.C., Mag.	**230**	**BTW GC**
Bearing to Waypoint, G.C., True	**229**	
Bearing to Waypoint, Rhumb Mag.	**228**	
Bearing to Waypoint, Rhumb True	**227**	
Bearing Wpt. to Wpt., Mag	**225**	
Bearing Wpt. to Wpt., True	**224**	
Boatspeed	**65**	**BS**
Boatspeed, Raw	**66**	
Boatspeed derived from Perf Polar	**126**	**POL SPD**
Canard Angle	**103**	

Course	**105**	
Corrected Measured Wind Angle	**168**	**CWA**
Corrected Measured Wind Speed	**169**	**CWS**
Course Over Ground, Mag.	**234**	**COG**
Course Over Ground, True	**233**	
Cross Track Error (XTE)	**238**	**XTE**
Daggerboard Position	**163**	
Dead Reckoning Course	**211**	
Dead Reckoning Distance	**129**	
Depth Meters	**193**	**DEPTH**
Depth Feet	**194**	
Depth Fathoms	**195**	
Depth Sounder Receiver Gain	**54**	
Depth Sounder Noise	**55**	
Distance to Waypoint, G.C.	**232**	**DTW GC**
Distance to Waypoint, Rhumb	**231**	
Forward rudder Angle	**40**	**FWR**
Fore/Aft Trim	**155**	
Forestay	**204**	**FSY**
Forestay Pressure	**164**	**FSY PRESS**
Heading	**73**	**HDG**
Heading, Raw	**74**	
Heading on Next Tack	**154**	**OPPTACK**
Head/Lift Trend	**39**	
Heel Angle	**52**	**HEEL**
Heel Difference	**174**	**HEEL DIFF**
Keel Angle	**201**	
Leeway	**130**	**LEEWAY**
Layline Distance	**226**	
Local Time	**220**	
Mast Rotation Angle	**156**	
Measured Wind Angle	**90**	**MWA**
Measured Wind Speed	**87**	**MWS**

Next Leg Apparent Wind Angle	**111**	
Next Leg Apparent Wind Speed	**113**	
Next Leg Target Boat Speed	**112**	
Next Waypoint Distance	**250**	
Off Course (Pilot)	**41**	
Pitch	**155**	**PITCH**
Pitch Rate	**156**	**PTCH RTE**
Rake in mm	**202**	**RAKE MM**
Reaching	**124**	**REACHING**
Reaching Performance	**51**	
Roll Rate	**60**	**ROLL RTE**
Rudder Angle	**162**	**Rud**
Sea Temperature degrees ºC	**31**	**SEA TEMP**
Sea Temperature degrees ºF	**30**	
Selected Trim	**150**	**Stm**
Speed Over Ground	**235**	**SOG**
Stored Log	**205**	
Target Boatspeed	**125**	**TG BS**
Target Forestay	**25**	**TGT FSY**
Target Heel	**28**	**TGT HEEL**
Target TWA	**83**	**TG TWA**
Tidal Set	**132**	**TIDE SET**
Tidal Drift	**131**	**TIDE RTE**
Trim tab Angle	**104**	
Timer	**117**	**DKM TIMER**
Time in seconds, since midnight	**221**	**UTC**
Time to Port	**241**	**TM PORT**
Time to Starboard	**240**	**TM STBD**
Time to Layline	**251**	
Time to Waypoint	**53**	
Trip Log	**207**	
True Wind Angle	**89**	**TWA**
True Wind Direction	**109**	**TWD**

True Wind Speed, Knots	**85**	**TWS**
True Wind Speed, m/s	**86**	
Vang	**203**	**Vng**
VMG to Waypoint (VMC)	**236**	
Velocity Made Good	**127**	**VMG**
Velotícy Made Good Target %	**50**	**VGP**
Wind Angle to the Mast	**157**	
Yaw Rate	**68**	**YAW RTE**