3. Description of the MultiSystMetrolog modules

The *MSM* software consists in two modules :

- the basic module MSM –32 bits- for Windows NT 4.0,

- the adaptation module (to the customer's project).

3.1. The basic module : MSM –32 bits- for Windows NT 4.0

It is composed of two parts :

- A visualization and command function, allowing :

  - to display the measurement data,
  - to display the alarms control screen,
  - to manage actuators manually or automatically,
 - to display the instruments control screen (visualization of the racks state).

  This part of the software is described in section 4 of the present documentation.

- A dynamic link library (DLL)

The dynamic link library was developed so as to allow a low level management of the Rack 8μp acquisition system. Its functions are the following :
  - management of the communication protocole RS485/RS232,
  - installation management by configuration files,
  - multi-racks management with priority loop (maximum 60 racks),
  - system settings configuration and backup,
  - acquisition of the sensors data,
  - data linearization, management and storage,
  - permanent consulting of the installation.

Communication with the different racks includes a priority messages management : as an example, the deconnection of a rack has the priority on data acquisitions.
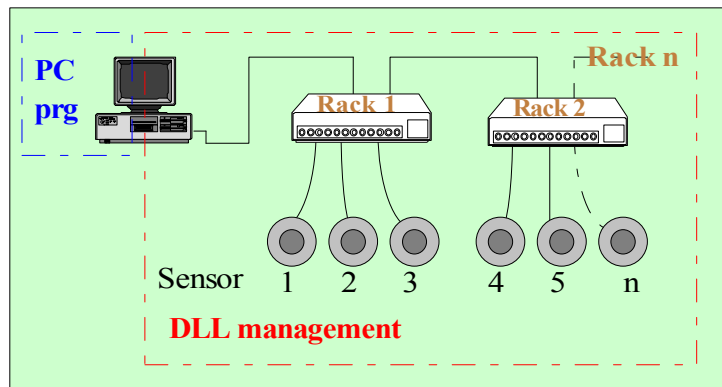
The DLL gives access to additional functions that allows the user to activate or unactivate a given rack under interrogation. The following drawing shows the DLL operation with calling functions and the positioning of these calling functions : initialization, supervision, data acquisition. The library can interrogate one or several racks. At present, the maximum interrogation rate is 10 racks per second.
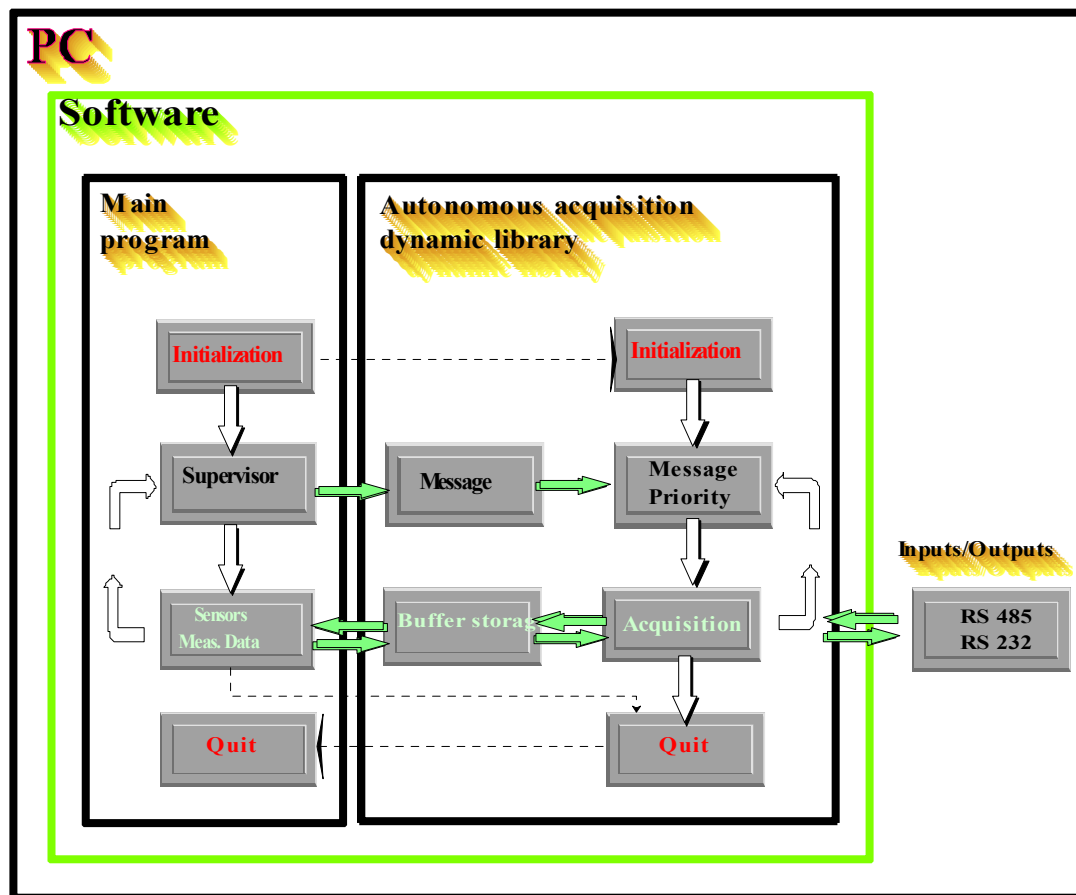
3.2. The adapation module

The instruments and actuators have the same location order on the Customer's installation and on the visualization synoptic. The actuators state can thus be directly seen and the measurement data of each sensor can be interrogated by positioning the mouse on the icone of the desired sensor.

4. Description of the software windows and functions

Four main windows or modules allows to access different functions of the software. They will be successively described in the present documentation. They are :
- the *Demo* window*,*
- the *Alarm* window*,*
- the *Control screen* window,
- the *Group screen* window.

4.1. *Demo* window

This main window allows to get to other windows or to quit the running application. The software name and version are given at the top left.

Clicking on the right button of the mouse bouton, once in the window, makes a « *popup* » menu appear. It allows to reduce the window, to quit the main program and to select the other windows (*Control screen* or *Group screen*).

4.2. *Alarm* window

This window warns the user that a dysfunction of the system has been detected.
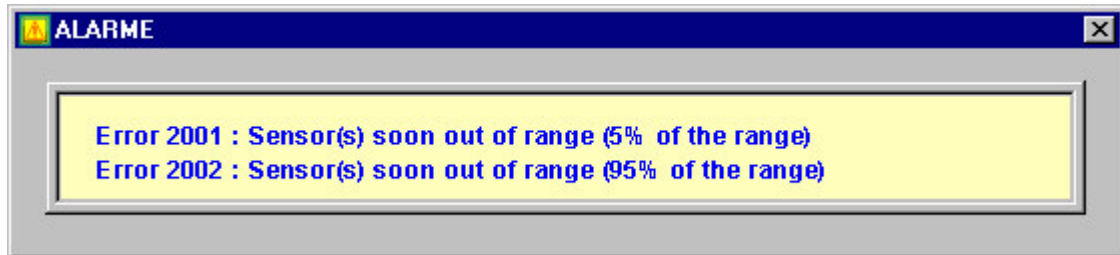
This window displays the number of the last detected error(s) and the corresponding error message(s). Error messages are removed when dysfunctions have been solved.

For screen update and dialogs management reasons, the update period of the *alarm* window is equal to 5 s * RIA racks number in the network.

Example :
         If two RIA racks are in the network, the dialog update will appear every

$$2 * 5 = 10 \text{ seconds.}$$

Error numbers are associated to the following messages :
-          error 2001 : sensor soon out of range (5% of the range)
-          error 2002 : sensor soon out of range (95 % of the range)
-          error 2010 : no rack
-          error 2011 : problem on the system (communication)
-          error 2016 : rack released (sensor short-circuited or in contact with the target
-          error 2018 : error during data saving (Division / Zero)
-          error 3001 : ABNORMAL levels on VR1 system
-          error 3002 : ABNORMAL levels on VR2 system
-          error 3003 : FAULTY STATE of level sensors of VR1 system
-          error 3004 : FAULTY STATE of level sensors of VR2 system
-          error 4001 : Depression/Leak in the hydraulic web
-          error 4002 : Overpressure in the hydraulic web

4.3. *Control screen* **window**

This window displays the operation state of the instruments and their measurement data by means of a dynamic window.

When a system includes actuators commands (taps, pumps etc ….), parts 2 and 3 are active.
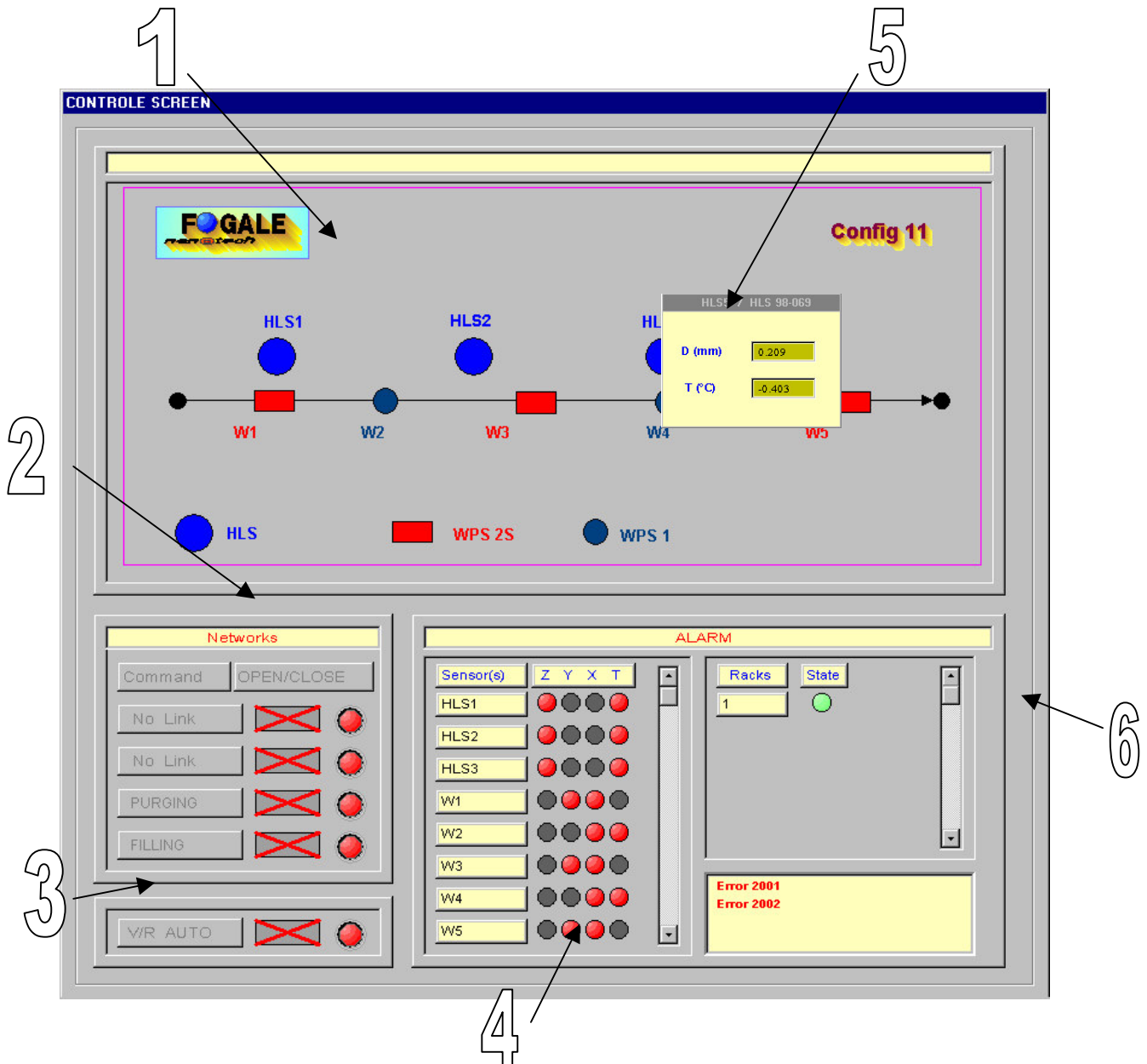
Clicking on the right button of the mouse in the window gives access to the *popup* menu that allows to get to the other windows of the application and to reduce the *Control screen* window.

1 Installation synoptic

The installation synoptic is peculiar to each project (see Appendix 2 : Example of synoptic) ; it is designed by FOGALE Nanotech according to the information given by the customer about his installation.
It allows to visualize :
- the sensors developed by FOGALE Nanotech : HLS, WPS1, WPS2, TMS, DOMS, or other sensors. The measurement data of a sensor appear when the mouse is pointed at it while the *Shift* button is pressed.
- *Specific to the HLS system* : the various parts which make the hydraulic network with, for example, electro-taps and filling/purging tanks.
- *Specific to the HLS system* : state variations of the hydraulic network parts.

Specific to the HLS system
The taps state (symbol ⋈) is directly displayed on the circuit synoptic, as follows :
→ the red color means closed tap.
→ the orange color means tap in transition state (between open state and close state).
→ the red color means open tap.
→ the grey color means no tap state control.

The state of the filling/purging device, (symbol ▯) is directly displayed on the circuit synoptic, as follows:
→ the blue color means tank full.
→ the green color means tank normally filled up.
→ the yellow color means tank empty.
→ the red color means normal state of the filling/purging device or abnormal state of the purging tank.

- As far the pump is concerned (symbol ◯)
→ the red color means pump stopped.
→ the green color means pump in operation.

2 *Command* window

This window allows to monitor the installation actuators, particularly for the control of the hydraulic network taps of the HLS system. The opening / closing is possible by means of a switch. The indicator light located at the switch right confirms the open state (green) or close state (red).

3 *VR Manuel* funcion (of the *command window*)

This function allows the manual control of the filling/purging device during a filling or purging period predetermined by the user in the *PARAM.INI* configuration file. In the case of several filling/purging devices, choose in the *groupe VISU* window the network in which the concerned filling/purging device is installed. Click on the filling or purging icon according to the desired function.

This function allows to carry out filling and purging tests so as to control the sensors good operation.

4 States window

Color indicator lights show the measurement situation within the instrumentation measuring range. The four indicator lights types (X, Y, Z and T) correspond to the four possible measurement types a positioning sensor can carry out. For each sensor an indicator light has a peculiar meaning :
-   for the HLS sensors : Z (displacement) and T (temperature)
-   for WPS1 sensors : X (displacement) and T (temperature)
-   for WPS2 sensors : X (radial displacement) and Z (vertical displacement).

The following graph shows the alarm colors as a function of the sensors measuring range.
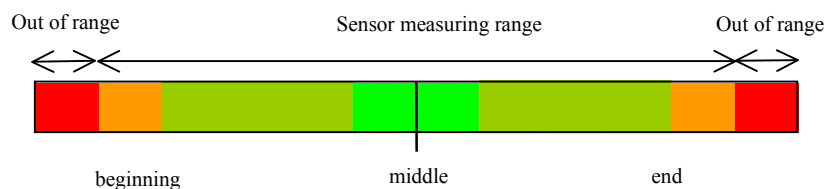
Each rack includes an indicator light that warns if the rack is in operation or if it is inhibited (State).
- green : normal operation,
- red : no rack (no communication or rack absent).

5 Dynamic display window

In order to see the measurement data of an instrument by using the installation synoptic, point the mouse pointer on the concerned instrument and press the *SHIFT* button. The dynamic display window showing the measurement data appears. It is removed when the *SHIFT* button is released.

4.4. *Groupe Visu* window

This window displays the measurement data of the sensors and the associated statistical calculations. It gives also access to the measurement data saving, to options concerning the acquisition and the racks operation.
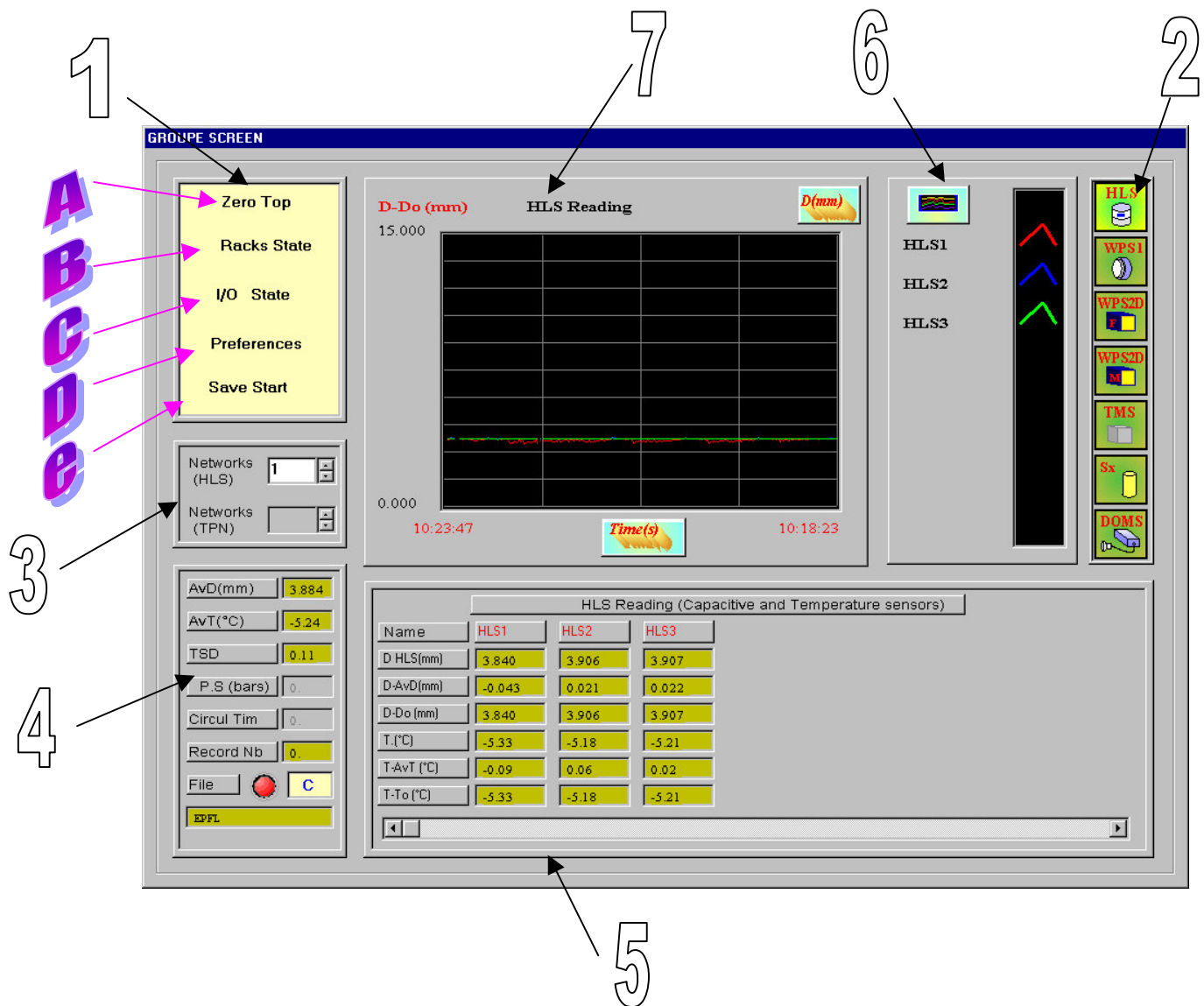
4.4.1. Functions table

Various functionalities are available :

Zero Top window

The *Zero Top* window allows to trace the measurements stability with respect to a reference time. Clicking on *Zero Top* allows to memorize all sensors values and to substract them to the dynamic value (see line D-Do of table 4 in *Group screen)*.
This function applies to all sensors of the selected network (see table 3).

There are four possibilities :

Zero Top :   to memorize the instant sensor values in D_0
End :   to quit the *Zero Top* screen and valid the top
Cancel Zero Top: to cancel last choice
Offset = 0   to initialize the reference values to zero

ZERO TOP

| Zero Top Date | 01/03/1999 | Zero Top Time | 10:24:33 |

Name	HLS1	HLS2	HLS3	W1	W2	W3	W4	W5
Z distance (mm)	3.865	3.879	3.871	-0.799	0.000	-0.797	0.000	-0.789
X distance (mm)	0.000	0.000	0.000	-0.803	-4.410	-0.796	4.141	-0.787
Y distance (mm)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
T (°C)	-5.218	-5.210	-5.231	0.000	-5.234	0.000	-5.217	0.000
Z (mrad)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
X (mrad)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Y (mrad)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
XA(mrad)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YB(mrad)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Zero Top   End   Offset = 0   Cancel Zero Top

NB : The *Zero Top* is only used for the measurements visualization. The values saved on file are always absolute measurement values.

Racks state window

Clicking on *Rack state* makes the rack physical representation appear. Each rack has in standard 16 channels, i.e. 2 channels per connected sensor (channels A and B). The rack restart button is located on the left of the front panel.

When the installation consists of several racks, the scrolling allows to see the state of the different racks.

The two following displays are possible. They depend on the type of rack :

- display for a RIA 8μp rack without option :
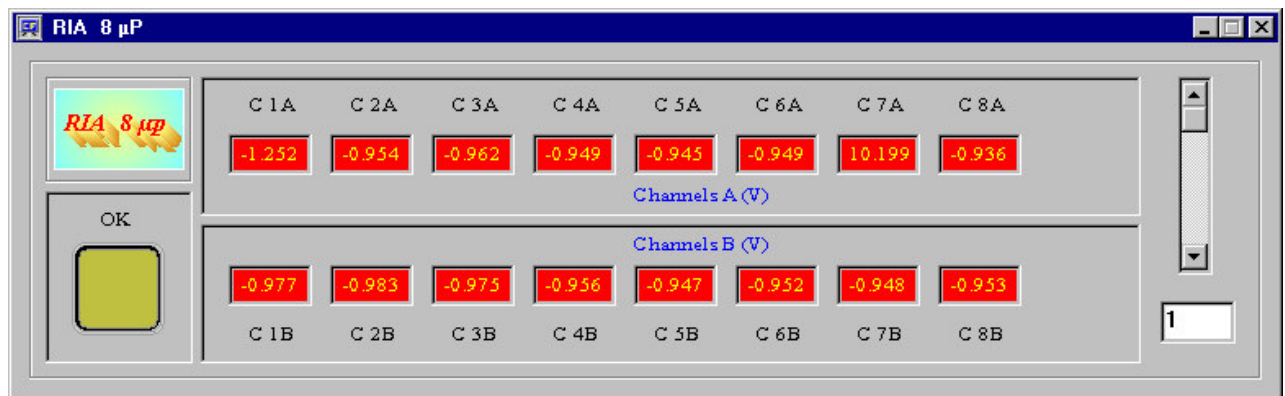
Specific to the HL S system :

The RIA 8 μP rack is equipped with a breaker insuring the protection of the HLS sensors electrode in case a vessel is flooded. When voltages are inferior to −10 V, the protection system gets active and the rack cuts the sensors supply. The voltages display background is then yellow.

Control the liquid level in each vessel and clean the wet sensors. Once the problem has been solved, the rack can be restarted by using the adequate button.

-    display for a 8µp rack with I/O option
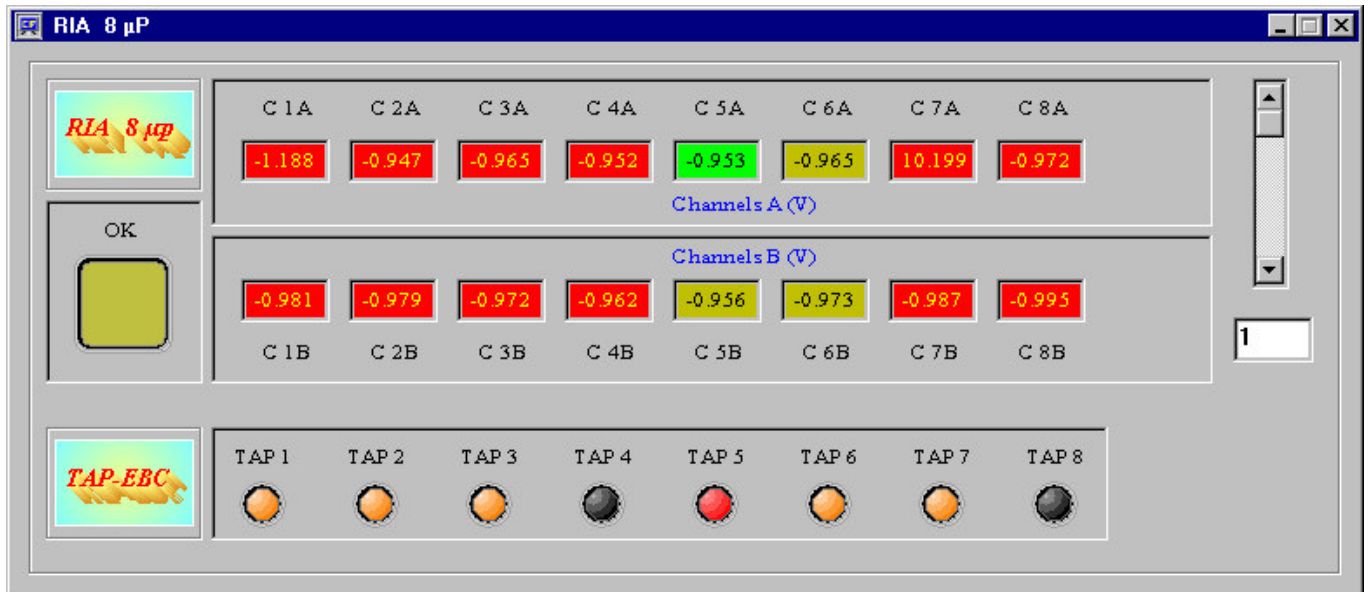
The indicator lights TAP1 to TAP8 show the state of the eight actuators connected to the TAP EBC rack, particularly taps in the case of a HLS system. State colors are described in section 4.2.

I/O state window

The I/O (TAP EBC) window allows a manual control of the actuators present in the installation, particularly taps in the case of a HLS system.
The TAP EBC rack can be accessed by the user.
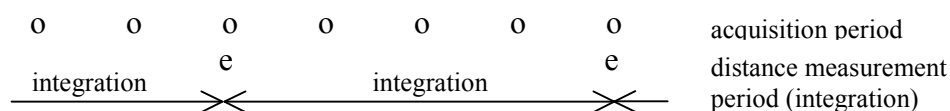The TAP EBC window allows a manual control of the taps for maintenance.

Settings

This dialog allows to display and modify the various pre-selected acquisition and saving settings.

The following drawing shows the different measurement and acquisition periods.

Acquisition period : It defines the time interval between the acquisition of two measurements.

Distance measurement period (integration) : It defines the time interval between two savings. The saved value is the mean of the values acquired during the acquisition period.

The calculation of the saved standard deviation of each sensor is based on this period.

Continuous measurement :
→ click on *Yes* for continuous measurements
→ click on *no* for measurements during a given period (see measurement time).

Measurement time (for non continuous measurement) : It is the saving duration that one wants to program when the option non continuous measurement is chosen. The saving is completed when the measurement time has gone by.

Main cut :
Automatic restart of the software in case of power cut.

Restart MSM :
→ click on *yes* so that *NT* automatically start the *Administrator* and launch *MSM* after a main cut.
→ click on *no* to avoid that *NT* start the *Administrator* and *MSM* by itself.

Start MSM with the last used settings :
Save parameters entered by the user.
→ click on *yes* so as to save all the software settings and use them as default settings when *MSM* is next runned.
→ click on *no* to avoid the software settings backup. When *MSM* is next runned, it will use the default parameters (manufacturer's settings) .

Start saving / Stop saving

Clicking on this function launches or stops the measurement data saving. If the saving is running, the indicator light located over the small box showing the file name is green, otherwise it is red.

4.4.2. Sensors table

The icons, located in the sensors table, allow to choose the type of measurement one wants to display in table 5 and graph 7 :

HLS	Icon of the HLS system
WPS1	Icon of the WPS1 system
WPS2D F	Icon of the WPS2 system : fixed sensor, moving wire
WPS2D F	Icon of the WPS2 system : moving sensor, fixed wire
TMS	Icon of the TMS system
Sx	Icon of the INCLINOMETER system
DOMS	Icon of the DOMS system

4.4.3. Network table

The sensors making up the installation can be grouped in networks according to their type, their location... Such a grouping allows to display readings, Zero Top, savings per network... The composition of each network is made up by Fogale when the adaptation module (to the customer's project) has been ordered.

Specific to HLS : Networks are particularly used when a hydraulic circuit is composed of several hydraulic networks, for example, in the case of two hydraulic networks 1 and 2, separated by taps managed by the software.

4.4.4. Curve icon

This icon gives access to a dialog box in which the number of curves associated with given sensors (maximum 8) are selected..

Click in the squares to unactivate the selectioned curves
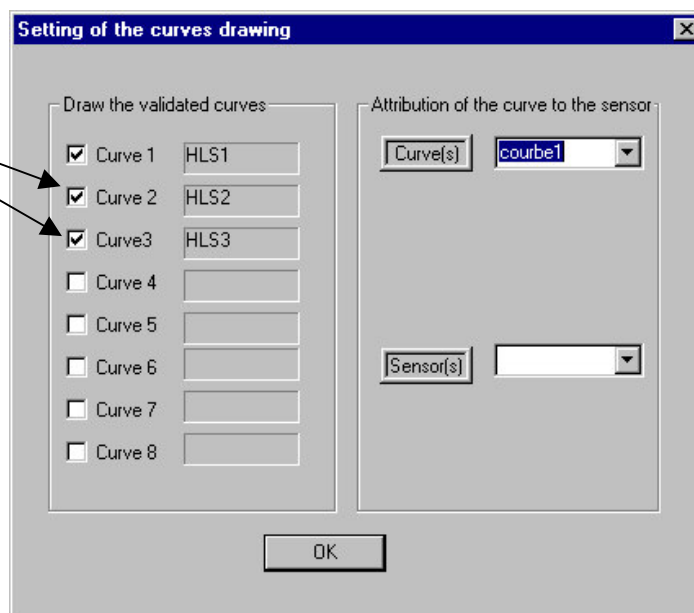
In standard, the first eight sensors are automatically associated with the eight first curves.
The *Setting of the curves drawing* dialog allows to associate a specific curve to a given sensor.
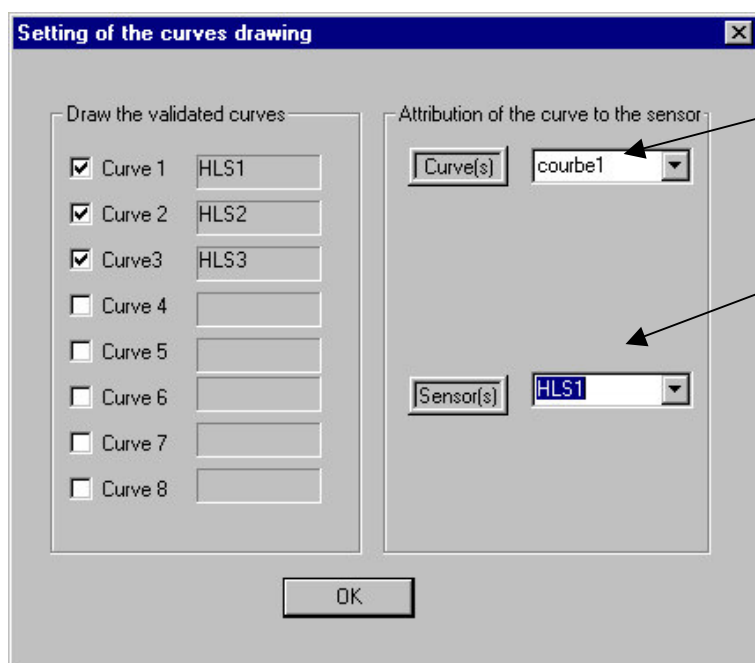
Choose the curve number

Choose the associated sensor

4.4.5. Sensors graph

The graph of this window allows to trace in time the measurement data of the instruments corresponding to the icon selected in the sensors table and to modify the readings and time scales.
The distance or temperature readings on the graph can be chosen by clicking on the D/T (°C) icon.
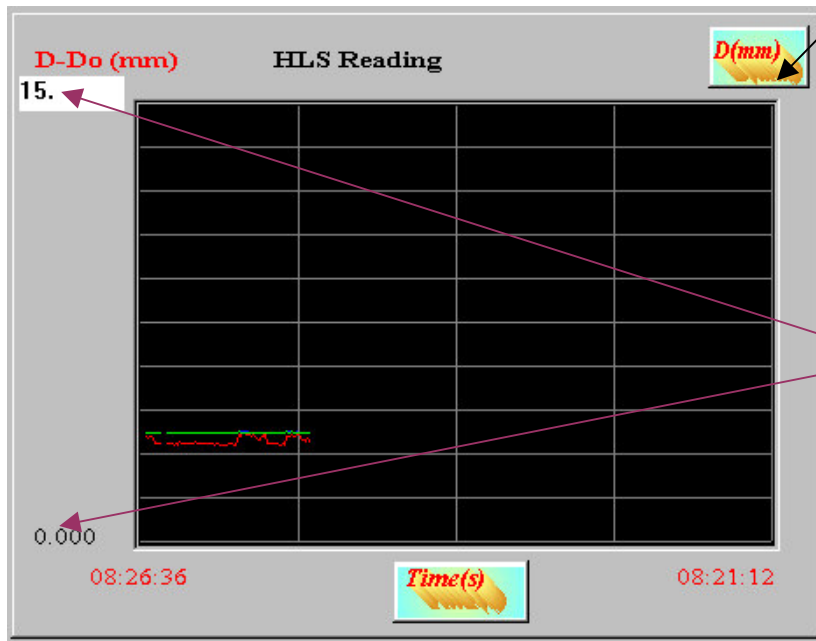
By clicking on this icon, you can choose to display distance readings D or temperature readings T(°C)

To modify the amplitudes scale, click directly on the upper and down limits and replace the value
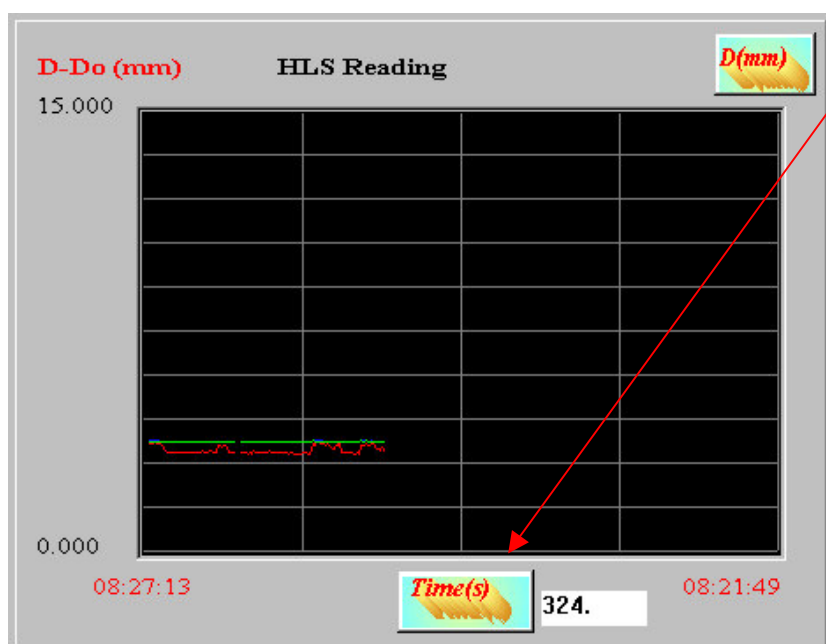
Click on the icon Temps to set the scale