ARAMIS

Algade

RAdon Monitoring Instrument

Software

User's manual

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Contents

1. GETTING STARTED

Aramis is a software designed to be used with the Radon Monitoring Instrument (ref P-563-107) developed by ALGADE.

Aramis controls, reads, displays and converts the data recorded by the radon monitor.

Aramis is configured in our workshop to adapt it to the instrument it has to manage.

Aramis is delivered on USB flash drive with an installation manual

This software works with :

- **Windows XP**
- **Windows Vista**
- **Windows 7**

1.1. Software installation procedure

💣 *WARNING : In order to proceed to **Aramis** software installation, administrator privileges are required. Please contact your system administrator if needed.*
*Furthermore, when using **Aramis** software, write privileges will be required in the installation directory.*

Plug the **Aramis** USB flash drive and execute the *Setup_Aramis_VXX.exe* installation program.
Follow the instructions on the screen to choose the installation language and the installation directory. Please choose a directory where final user has write privileges.

The installation program will install the files on your hard disk. When the installation is complete, a shortcut to *Aramis.exe* is available in the Windows Start Menu.

1.2. USB drivers installation

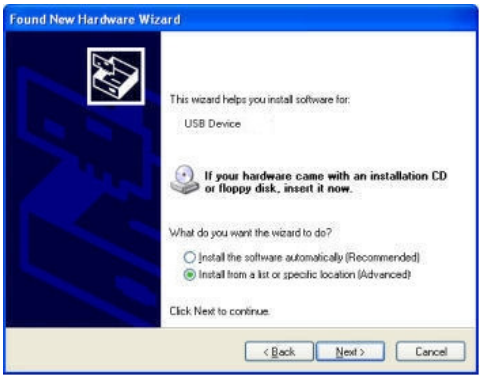
💣 *WARNING : In order to proceed to USB drivers installation, administrator privileges are required. Please contact your system administrator if needed.*

USB drivers will be requested by Windows on the first time the Radon Monitoring Instrument is connected to a USB port of your PC. Please note that the installation procedure must be repeated if the Radon Monitoring Instrument is connected to a different USB port.

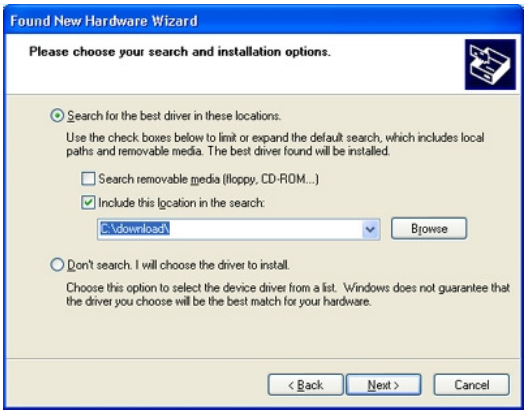
1.2.1. Windows XP Drivers Setup

a. Upon connection with the instrument, the found new hardware window will come up. Select « No, not this time » and click on « Next ».

b. Select « Install from a list or specific location » and click on « Next ».



c. Tick the option « Include this location in the search » and click on « Browse » to select the directory where **Aramis** has been installed. Validate by clicking on « Next ».

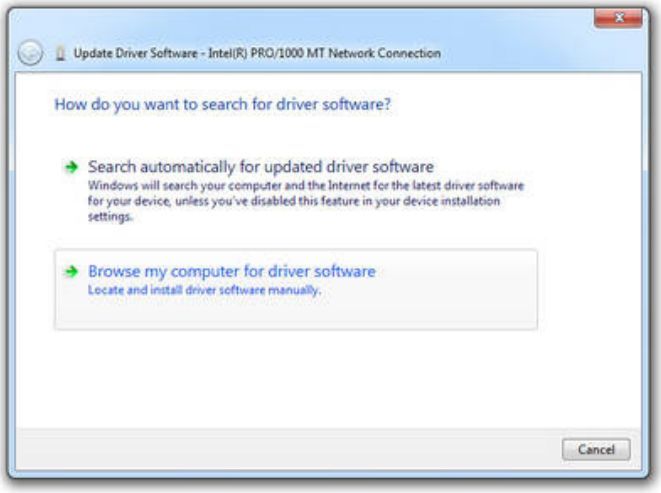


d. The installation might have to be repeated a second time.

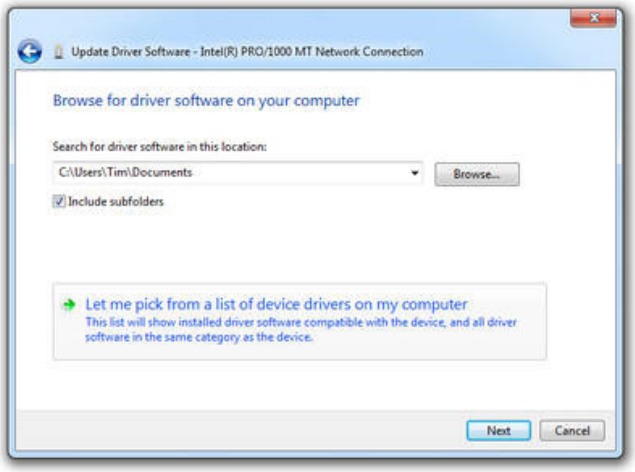
1.2.2. Windows 7 Drivers Setup

If Windows is not configured to search for drivers automatically on the internet, the installation must be carried out manually from the device manager (Access from Windows Control Panel)

Find the device from the list of devices (a yellow exclamation mark indicates the devices not yet installed), right click > « Update the driver ». Windows will display the following screen:



Select « Browse my computer for driver software ».



Use « Browse » to find the directory **Aramis** was installed and tick « Include subfolders ». Click on « Next » to finish the setup procedure.

2. USING THE SOFTWARE

After start up, the main screen appears. The following functions are accessible on the menu bar :

File	Probe	Display	Volumic Activity	Parameters	Maintenance	?
>> Default Directory	>> Read All Data					
Language	Initialization					
Open	Configuration					
Close	Test					
Save As	Stop					
Export						
Print						
Screenshot						
Exit						

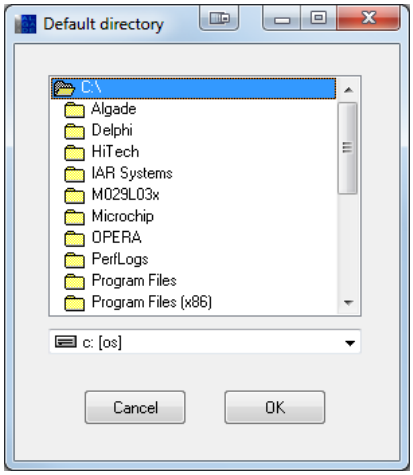
Nota : the Aramis software uses the following regional options :

- dot " ." as decimal separator
- date format dd/MM/aaaa separator" / "
- time format HH:mm separator " : "

Each time the **Aramis** software is started, these options are checked and modified if not adequate.
These options can be changed manually by accessing the *Regional and language Options* panel on the Windows *Control Panel*.

2.1. File Menu

2.1.1. Default Directory



This panel defines the directory where the data files will be stored.

2.1.1. Language

Select the desired language for the Aramis software (French or English).

2.1.2. Open

A *mra* file previously stored with the **File >> Save As** command can be loaded. Once it is loaded, the corresponding parameters can be displayed or the file can be converted into an Excel file. Measurements can also be displayed as graphs on the main window (see sections 2.3 and 3 for more information about displaying and using graphs).

2.1.3. Save As

This command saves data previously read from the Radon Monitoring Instrument or loaded from an existing file. An *mra* suffix is automatically added to the selected file name. This file contains all the parameters of the Radon Monitoring Instrument (including alarm levels and measurement period) and all the raw data recorded by the instrument.

2.1.4. Export

This command exports data previously read from the Radon Monitoring Instrument or loaded from an existing file, into an *.xls* file. This file can be opened with Excel and contains all the parameters of the Radon Monitoring Instrument (including alarm levels and measurement period) and the calculated measurements.

File format :

The first area contains the parameters of the Radon Monitoring Instrument :

HEADER

#Probe	100
Probe type	40
Probe Configuration	23755
etc…	…

The second area contains the measurements :

MEASUREMENTS

#Meas	Date/Hour	Radon (Pulses/h)	Radon (Bq/m3)	Temperature (°C)	Humidity (%)	Pluviometer	Pressure	Battery (V)	Sensor Supply (V)	Etc…
0	13/04/2007 17:45	20	43	26.6	38.4	0	9	13.3	4.8	
1	13/04/2007 18:00	56	126	26.7	40.1	0	9	13.2	4.8	
2	13/04/2007 18:15	52	118	26.8	40.6	0	9	13.2	4.8	
3	13/04/2007 18:30	60	136	26.8	40.9	0	9	13.2	4.8	

The following data are available :

- **#Meas :** Up to 65536 measurements can be stored in the Radon Monitoring Instrument memory
- **Date/Hour :** In European format : *dd/mm/yyyy hh:mm*
- **Radon (Pulses/h)**
- **Radon (Bq.m^{-3})**
- **Temperature (°C)** : This is the temperature inside the Radon Monitoring Instrument internal case. This value is used for humidity and radon compensation.
- **Humidity (%)** : This is the humidity inside the Radon Monitoring Instrument internal case. This value is used for radon compensation.
- **Pluviometer** : NA
- **Pressure** : Used only for instruments equipped with a pressure sensor
- **Battery (V)** : The battery voltage should be around 13 Volts (±2 Volts) for normal operation.
- **Sensor Supply (V)** : The sensor supply should be between 4.5 and 5 Volts during normal operation.
- **Low Battery** : Set to 1 if there is a battery default when the measurement is taken.
- **Alarm 1** : Set to 1 if the volumic activity is between the alarm threshold #1 and the alarm threshold #2
- **Alarm 2** : Set to 1 if the volumic activity is greater than the alarm threshold #2
- **Alarm 3** : NA
- **Heating** : Indicates if the temperature regulation has been activated (used to keep the internal temperature of the Radon Monitoring Instrument case above a minimum temperature)
- **Pump** : Set to 1 if the pump is sampling ambient air (normal operation).
- **USB Connection** : When set to 1, this flag indicates a USB connection has been made with *Aramis* since the previous measurement.
- **Power Supply** : Set to 1 in normal operation. If a power supply failure occurs, the Radon Monitoring Instrument runs on its internal battery and this flag is set to 0.

2.1.5. Print

The graphs on the main window can be printed via this menu. Any comment can be entered as a title for the graphs. Then, the printer configuration is possible using the standard Windows panel.

2.1.6. Screenshot

A bitmap file of the current graphs on the main window can be saved via this command.

2.1.7. File > Exit

This command terminates the **Aramis** software. If some data have been read but not saved, a confirmation box allows the user to choose whereas he wants to ignore the current data or save them into a *mra* file.

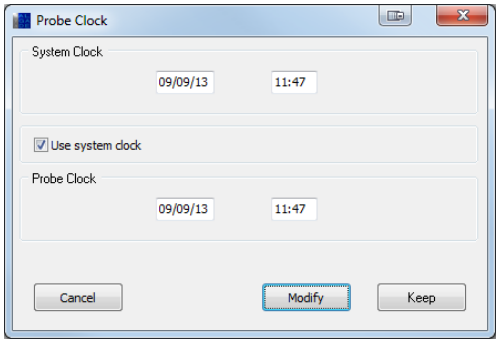
2.2. Probe Menu

2.2.1. Read All Data

All the measurements that have been recorded by the Radon Monitoring Instrument since the latest initialization, along with its parameters can be read with this command.
Then, data can be displayed (See sections 2.3 and 3 for more information about displaying and using graphs), saved as a *mra* file or converted into a *xls* file.

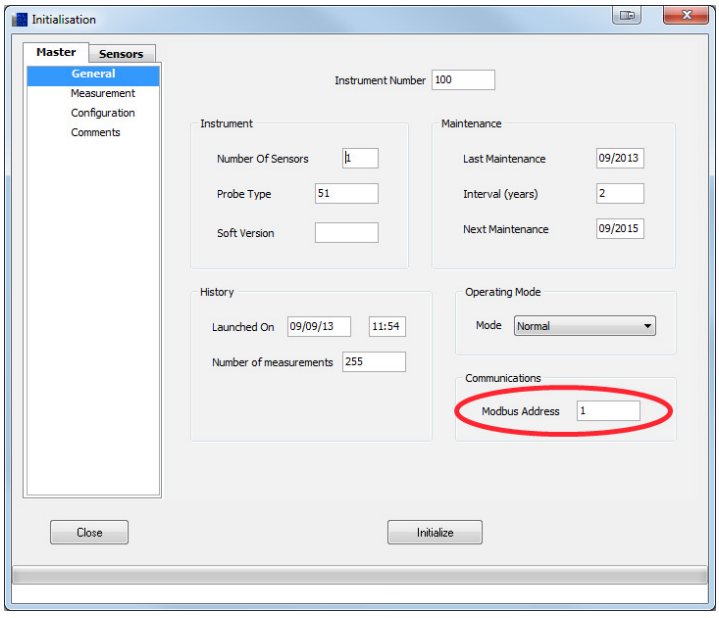
2.2.2. Initialization

This command launches a complete initialization cycle. The Radon Monitoring Instrument does not take measurements while it has not been initialized with this command.
First, the Radon Monitoring Instrument clock can be checked and modified if necessary.



Check the "Use System Clock" box to set the clock according to the PC internal clock.
Click on the *Modify* button to set the clock or on the *Keep* button to let the clock unchanged.
Then, the initialization panel appears. It shows all the current parameters of the Radon Monitoring Instrument and allows the user to modify the following ones :

a) On the *Master>General* tab :

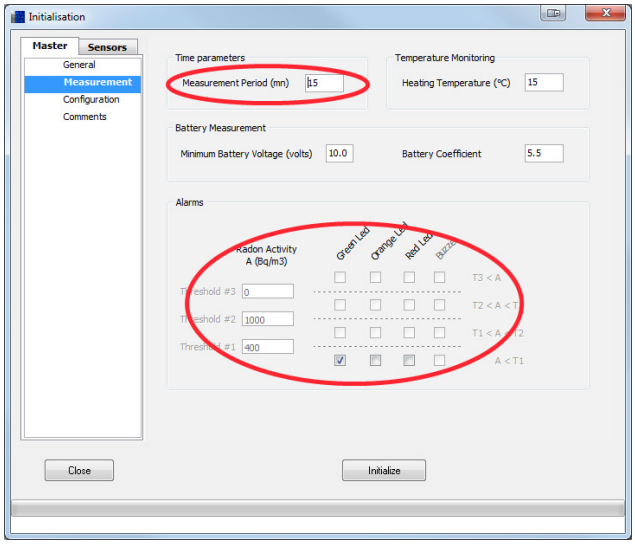


- **Modbus Address** : This is the slave address of the instrument when used with the Modbus option.

a) On the M*aster>Measurement* tab :

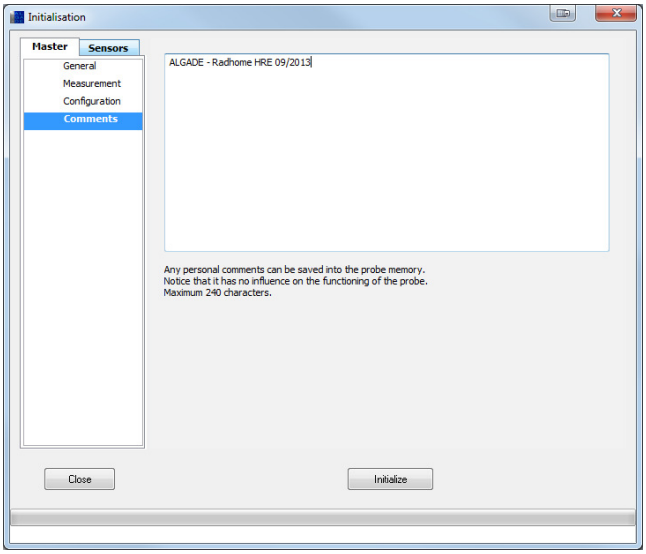
- **Measurement period** : This is the Integration Time (P) (Range from 1 to 240 minutes).

- **Alarm configuration** : If volumic activity reaches predefined thresholds, the visual and audible alarms of the Radon Monitoring Instrument can be activated (Two thresholds are available). For example, on the following screen capture :

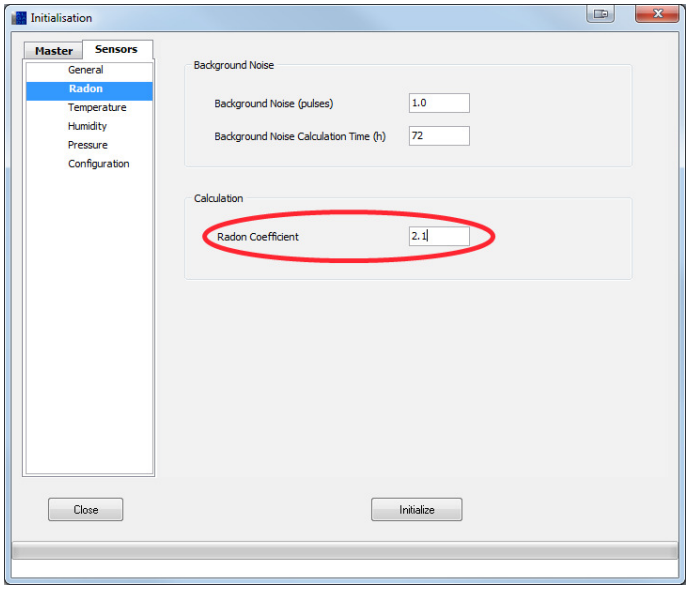


  - Threshold #1 is set to 1000 Bq.m^{-3} and threshold #2 is set to 10000 Bq.m^{-3}.
  - When volumic activity is below 1000 Bq.m^{-3}, the green led is activated.
  - When volumic activity is between 1000 and 10000 Bq.m^{-3}, the orange led is activated.
  - When volumic activity is above 10000 Bq.m^{-3}, the red led and the buzzer are activated.

b) On the *Master>Comments* tab, 240 characters are available for user comments :



c) On the *Sensor>Radon* tab, the radon coefficient can be adjusted by the user (not available for all instruments)



Nota : Other parameters are used for factory configuration of the Radon Monitoring Instrument.

Finally, click the Initialize button to start the initialization procedure :

- The previous measurements are erased from the memory of the Radon Monitoring Instrument
- The current parameters are erased
- The new parameters are written into the Radon Monitoring Instrument memory
- The acquisition is started.

Warning : All data in the Radon Monitoring Instrument memory will be lost during the initialization procedure. Please, be sure you have read and saved all the previous data before starting this procedure.

The acquisition will take place at each whole minute. Moreover, to make it easier to interpret the measurements, rules have been adopted for the following periods :

- 5 minutes : Start-up at T=0 modulo 5
- 10 minutes : Start-up at T= 0 modulo 10
- 15 minutes : Start-up at T= 0 modulo 15
- 30 minutes : Start-up at T= 0 modulo 30
- 60, 120, 180 and 240 minutes : Start-up at T= 0 modulo 60.

The first measurement will be registered P minutes after starting time

Just after the initialization, the *pause* symbol ⏸ appears on the screen of the Radon Monitoring Instrument : This indicates the instrument is currently waiting for a whole minute, according to the rules above.

When the acquisition actually starts, the *record* symbol ● appears on the screen. This indicates the instrument is currently taking measurements.

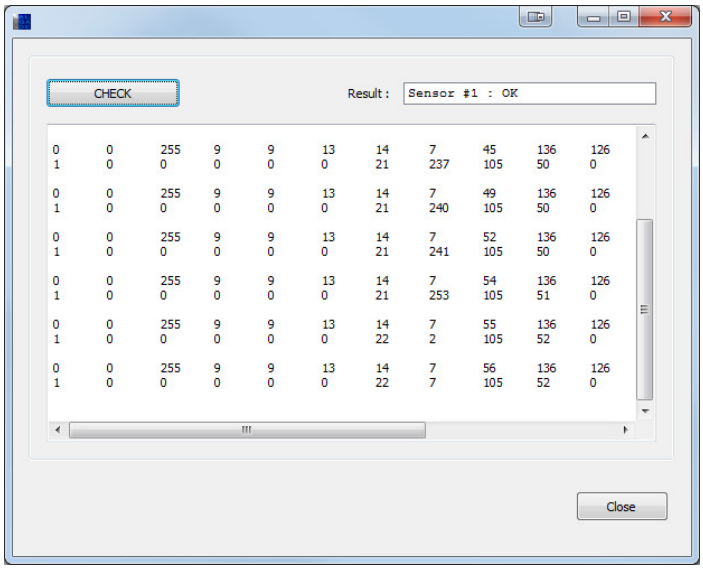
Example : If started at 2:07 pm with a 15 mn period, the Radon Monitoring Instrument will stay idle ⏸ until 2:15 pm, then the acquisition will start ● at 2:15 pm and the first measurement will be available at 2:30 pm.

2.2.3. Configuration

Reserved for maintenance purpose. User does not have access to this command.

2.2.4. Test

Some instruments are equipped with a remote radon probe. In this case, it can be useful to check the communication between the remote probe and the instrument.
To check the communication, click the CHECK button. The test results is displayed in the top field, while the communication log is displayed in the memo box :

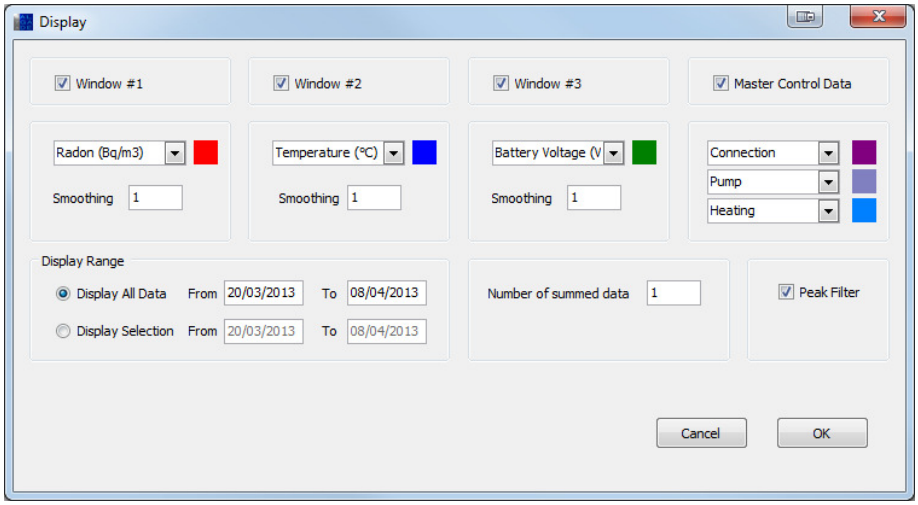


2.2.5. Stop

The Radon Monitoring Instrument is stopped and goes into sleep mode. The stop symbol ■ appears on the screen of the instrument. No more measurements are taken. An initialization procedure will be necessary to start again the acquisition.

2.3. Display Menu

This command opens the **Display** panel :



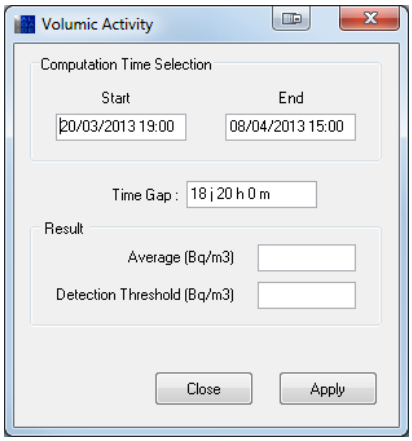
This panel also opens automatically after a *mra* file has been opened with the **File >> Open** command or after having read the Radon Monitoring Instrument with the **Probe >> Read All Data** command.

The **Display** panel manages the representation of the values recorded by the Radon Monitoring Instrument. The representation will be divided into 1 to 4 windows. All the windows displayed simultaneously are temporally interdependent both for modifications of time scale and for curser moves.

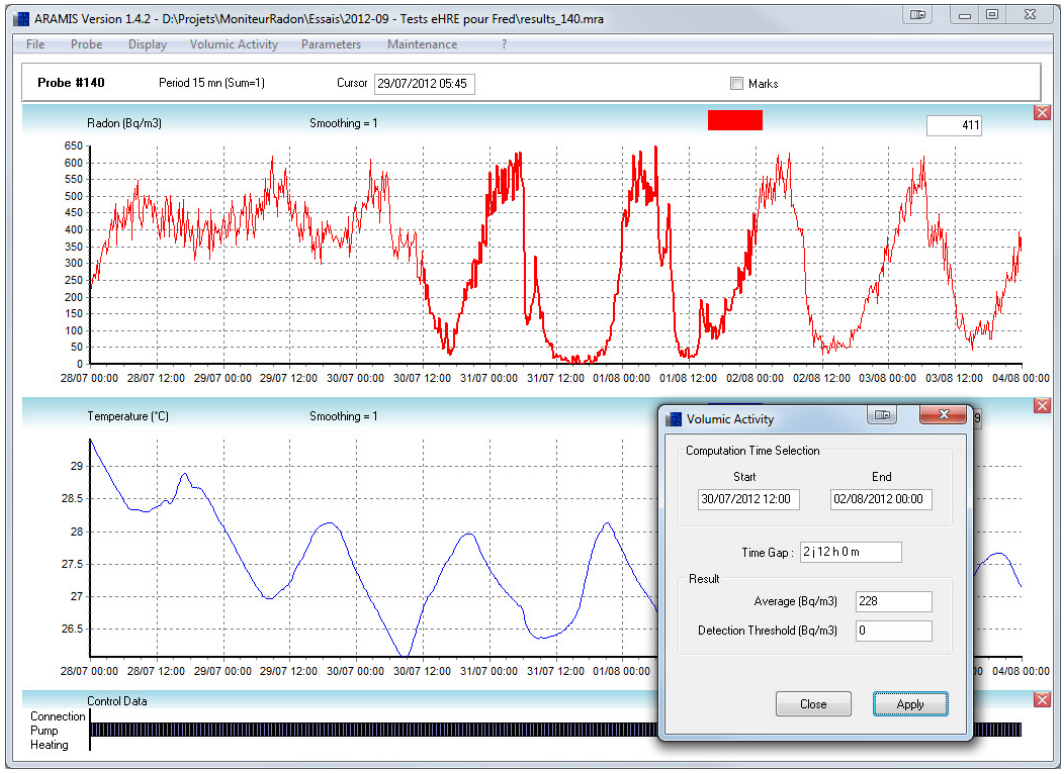
- The ***Window #X*** checkbox defines whether each window will appear on the main window or not. For each window, a data type to be displayed must be selected in the corresponding ***list box***.
- The ***smoothing*** coefficient associated with each curve is set in the "*smoothing*" box. A coefficient of 1 corresponds to the raw curve. Smoothing is carried out by a sliding average on the number of measurement points displayed in this area (from 1 to 10).
- The color of each curve can be modified by clicking on the ***color fields***.
- The ***Display Range*** selects the time interval to be displayed.
- The ***Number of summed data*** parameter (from 1 to 20) can generate a display and file outputs at multiples of the integration time. For example, a display on a step of 1 hour can be obtained from an acquisition made on an integration step of 15 minutes by entering 4 as *"Number of summed data"*.
- ***Peak Filter*** function : When the Radon Monitoring Instrument is used in electrically harsh environments (for example, electromagnetic interferences, GSM or radio communications being made very close to the Instrument, etc…), its radon detector may show abnormal peaks which does not correspond to radon signals. The *"Peak Filter"* function is used to filter these parasites when displaying a radon graph.

2.4. Volumic Activity Menu

A Radon graph must be displayed (in $Bq.m^{-3}$ units) in order to access this function. When selected, this command opens the **"Volumic Activity"** window.



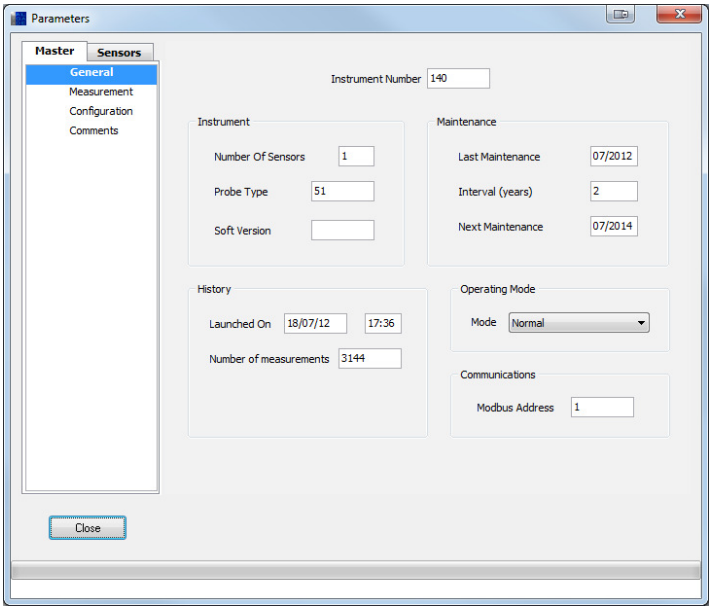
A time gap can be selected for this calculation (by default the whole curve is selected). The **Apply** button calculates the volumic activity value during this time gap and displays in bold the selected portion of the graph.



The calculated detection threshold indicates the value above which the instrument gives a correct result at statistical level.

2.5. Parameters Menu

This command is accessible after having loaded a previous *mra* file with the **File >> Open** command or after having read the Radon Monitoring Instrument with the **Probe >> Read All Data** command. The current parameters are displayed.

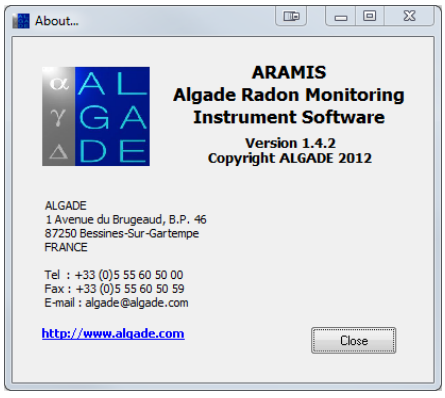


Nota : the parameter panel is the same than the one displayed during the initialization procedure excepted that no parameter can be modified.

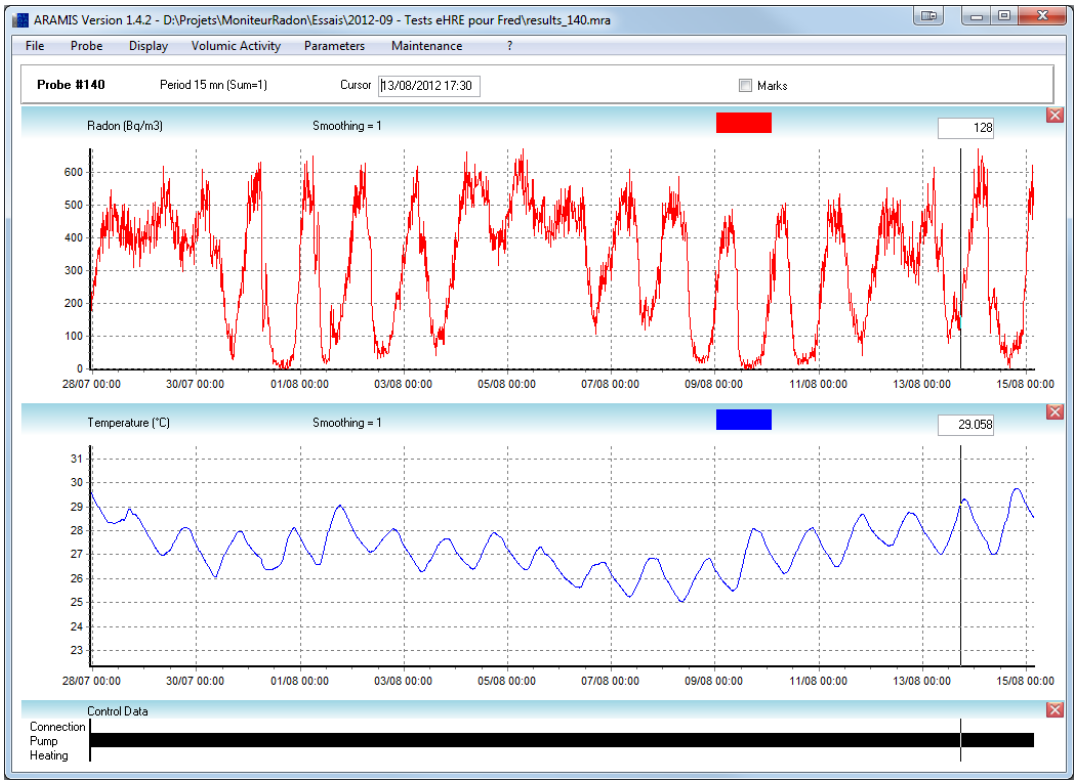
2.6. Maintenance Menu

Access to the maintenance functions is restricted by a password. This function allows to modify the internal parameters of the Radon Monitoring Instrument.

2.7. About (?) Menu



3. USING GRAPHS FUNCTIONS

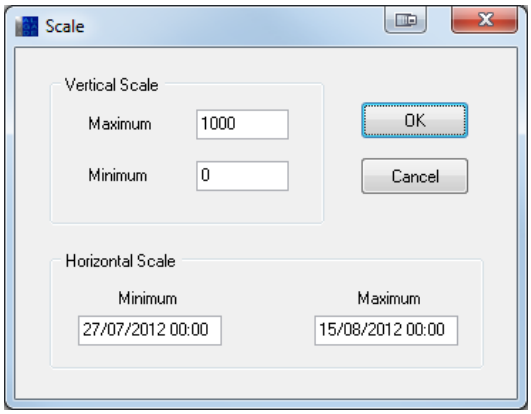


Marks checkbox : Displays the measurement dots on the curves

Zoom function : Left-click on the desired graph and draw a rectangle from the upper left to the bottom right to zoom in the desired area. Left-click on any graph and draw an inverted rectangle (from the bottom right to the upper left) to zoom out and go back to the whole curves.

Scroll function : Right-click on a graph and move in any direction to scroll along the time axis.

Scale function : A click on any axis opens the **Scale** window, which allows to manually adjust horizontal scale for all time axis and vertical scale for the corresponding Y axis.



4. EQUATIONS USED FOR DATA PROCESSING

The following equations are used for data display on the screen of the instrument and for the calculation of the values in the output files.

4.1. Temperature in °C

T_n is the numeric value measured by the embedded microcontroller.
The corresponding voltage is :

$$T_v = 2.5 * \frac{T_n}{32768 * 8}$$

T is obtained by solving the equation :

$$a * T^2 + b * T + c = 0$$

with $a = -0.00000058$ $b = 0.0039$ $c = 1 - \frac{2.5 + 2 * T_v}{2.5 - 2 * T_v}$

$$\Delta = b^2 - 4ac$$

$$T(°C) = \frac{-b + \sqrt{\Delta}}{2a}$$

4.2. Relative humidity in %

RHn is a 12 bits numeric value given by the humidity sensor.
The uncompensated relative humidity RH_l is obtained by the following equation :

$$RH_l = 0.0000028 * RH_n^{\ 2} + 0.0405 * RH_n - 4$$

Then, the temperature-compensated relative humidity is obtained by the equation :

$$RH(\%) = RH_l + (0.00008 * RH_n + 0.01) * (T - 25)$$

4.3. Humidity compensation coefficient (K)

Ions collection on the detector surface by the means of an electric field is dependant of the absolute humidity.

First, absolute humidity (AH in $g.m^{-3}$) is obtained from temperature (in °C) and relative humidity (RH in %) :

$$AH = (c_0 * T^2 + b_0 * T + a_0) * \frac{RH}{100}$$

a_0, b_0, c_0 coefficients are given by Dupré formula,
with $c_0 = 0.0227$ $b_0 = 0.1489$ $a_0 = 5.335$

Then, K is calculated with the following equation :

$$K = a_1 * AH + b_1$$

with $a_1 = -0.02679$ $b_1 = 1.276$

In general : 0.85 < K < 1.12

4.4. Radon

t is the acquisition interval in minutes (15 mn by default),
C is the radon calibration coefficient in Bq/m^3/pulse/h,
B is the instrument background noise in pulse/h,
x is the number of pulses measured during the acquisition interval.
x= (counter value at t) - (counter value at t-1)
K is the humidity compensation coefficient

The volumic activity, in Bq/m^3 is :

$$R_n = \left(x.\frac{60}{t} - B\right).C.\left(\frac{1}{K}\right)$$

Important (1) : When the calculation gives a negative result, R_n is made equal to zéro.

Important (2) : R_n corresponds to the volumic activity of radon in the air inside the measurement chamber.

The pulse counter capacity is limited to 3 bytes ($16*10^6$ pulses)
The corresponding maximal activity if t=240 mn and C=1 is : $4*10^6$ Bq.m^{-3},
which is much higher than typical values measured in the environment.

4.5. Decision threshold

The decision threshold indicates the minimum significant value of radon activity in Bq/m^3. Below this value, results are not significant, given the instrument background noise.

t_b is the measurement time of the instrument background noise, in hours,
t is the number of hours selected for the calculation of the volumic activity,
B is the background noise of the instrument in pulse/h,
C is the radon calibration coefficient in Bq/m^3/impulsion/h,

The decision threshold is :

$$Sd = 2C\left(\frac{1}{t} + \sqrt{\frac{1}{t^2} + B\left(\frac{1}{t} + \frac{1}{tb}\right)}\right)$$

4.6. Battery

V is the numeric value measured by the instrument,
k is the battery coefficient,

$$V_{bat} = V / k$$