ALPHAGUARD

USER MANUAL

ALPHAGUARD

Types D50, D2000, DF2000

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Contents

1 INTRODUCTION

The ***AlphaGUARD*** is the center piece of a professional portable measuring system for the continuous determination of the radon and radon progeny concentration in air, as well as selected climatic parameters. Depending on the model and respective configuration, AlphaGUARD allows the user to differentiate measurements of radon and thoron and to record simultaneously the radon progeny concentration, as well as the gamma dose rate. The results of the measurement operation which is controlled by real time clock are stored in a ring-memory (first-in, first-out), to ensure that with continuous measuring operation the last 60 000 data sets are always available and downloadableon a PC via USB, RS-232 or Bluetooth interface.

The AlphaGUARD can be operated independently as well as with mains power supply. The inbuilt rechargeable battery ensures an independent operation for up to 10 days.

The AlphaGUARD uses the proven principle of the pulse ionization chamber (alpha spectroscopy). AlphaGUARD impresses by its high detection efficiency for radon, fast response to concentration gradients as well as maintenance-free long-term operation. Also in extreme air humidity AlphaGUARD delivers reliable measuring values and is insensitive to both vibrations and shock.

The radon progeny measuring head ***AlphaPM is*** a professional sensor front end for recording of the airborne radon progeny concentration. The handy sensor unit is applicable for long-term measurements (building examinations) screening measurements or also in personal dosimetry.

For routine graphical work up, evaluation, archiving and presentation of the measured data ***DataVIEW PRO*** is offered as a comfortable, user-friendly WINDOWS-compatible (7, 8, 10) PC software.

The ***AlphaGUARD Monitoring System*** can be completed by further external sensors for the continuous registration of ambient parameters, for example differential pressure and temperature.

The ***integrated pump*** allows radon and thoron measurements in flow mode. The flow-regulated pump can be adjusted from flow rates of 0,05 l/min to 2 l/min.

Thanks of the internal pump, the ***AquaKIT*** and the ***Soil Gas Probe,*** suitable accessories for professional measurement of radon in water samples and soil gas can be easily operated in combination with the AlphaGUARD Monitor.

With the **REM1** (Radon Exchange Module) an all-in-one solution for time-resolved radon in water monitoring with the AlphaGUARD DF2000 is available.

For measuring the radon emanation from materials (e.g. building material, rock samples…) as well as for calibrating AlphaGUARD monitors and other radon measuring instruments or detectors, gas proof emanation and calibration containers and suitable accessories for calibration works (reference standards, charcoal filter) are available.

A wide range of accessories for remote and stationary monitoring allows customized solutions for online alarm monitoring in remote areas and the realization of ruggedized monitoring stations.

2 SAFETY INSTRUCTIONS

AlphaGUARD complies with the relevant EN/IEC norms with regard to safety requirements and electromagnetic compatibility (declaration of conformity on request).

Standard versions of the *AlphaGUARD* do not dispose of explosion protection and hence cannot be operated in hazardous areas without special precautions. We will gladly advise you regarding suitable provisions.

Use the *AlphaGUARD* only within the specified operation range (see chapter 12). Running the monitor outside the operation range can lead to erroneous measuring results up to damaging the device.

Whenever the *AlphaGUARD* has to be operated under dusty/dirty conditions the monitor should be protected by the Tyvek bag which is included in delivery (see chapter 10.1).

The *AlphaGUARD* is operated by a lead gel battery.

3 RANGE OF PRODUCTS

AlphaGUARD is manufactured in different versions (→ models/types). The available models are optimized for specified measurement applications and are therefore different in configuration in view of hard and firmware.

Though all models are based on the same detector, according to the spectrum of provided applications they feature mechanical adaptations and use optimized evaluating algorithms for the respective operation modes.

The following *AlphaGUARD* models are available:

Model / Type	General characteristics
D50	Diffusion operation only Measuring range: 50 kBq/m³ (1 350 pCi/l) Possible connection of additional sensors Upgradable to D2000 or DF2000
D2000	Diffusion operation only Measuring range: 2 MBq/m³ (54 000 pCi/l) Possible connection of additional sensors Upgradable to DF2000
DF2000	Diffusion and flow operation (also in closed circuit) Simultaneous discrimination of radon and thoron Integrated pump: 0,05 … 2 l/min, flow regulated Measuring range: 2 MBq/m³ (54 000 pCi/l) Possible connection of additional sensors

A detailed comparison of all functions and characteristics of the available models can be found in the appendix.

It is possible to upgrade the D50 and D2000 versions to higher versions. Following upgrades are possible:

- D50 → D2000
- D50 → DF2000
- D2000 → DF2000

4 RADON DETECTOR

In standard operating mode the measuring gas gets by diffusion through a large-surface glass fiber filter into the ionization chamber. That is to say through the glass fiber filter only the gaseous Radon-222 may pass, while the radon progeny products are prevented to enter the ionization chamber. At the same time the filter protects the interior of the chamber from contamination by dusty particles.

Alternatively, to the above mentioned diffusion mode with the *AlphaGUARD* type *DF2000* an active, i.e. pump-supported gas flushing of the ionization chamber can be enforced. Here, the entrance of the gas is effected via gas inlet of the *AlphaGUARD*.

4.1 Ionization Chamber

The cylindric ionization chamber of the *AlphaGUARD* has an active volume of 0,56 l. Its metallic interior has a potential of +750 V when the instrument is turned on. Along the longitudinal axis the stiff centre electrode is located which lies on a potential of 0 V. The center electrode is connected with the signal input of the highly sensitive preamplifier unit. The worked up measuring signals of the preamplifier unit are transmitted to an electronic network for further digital processing.

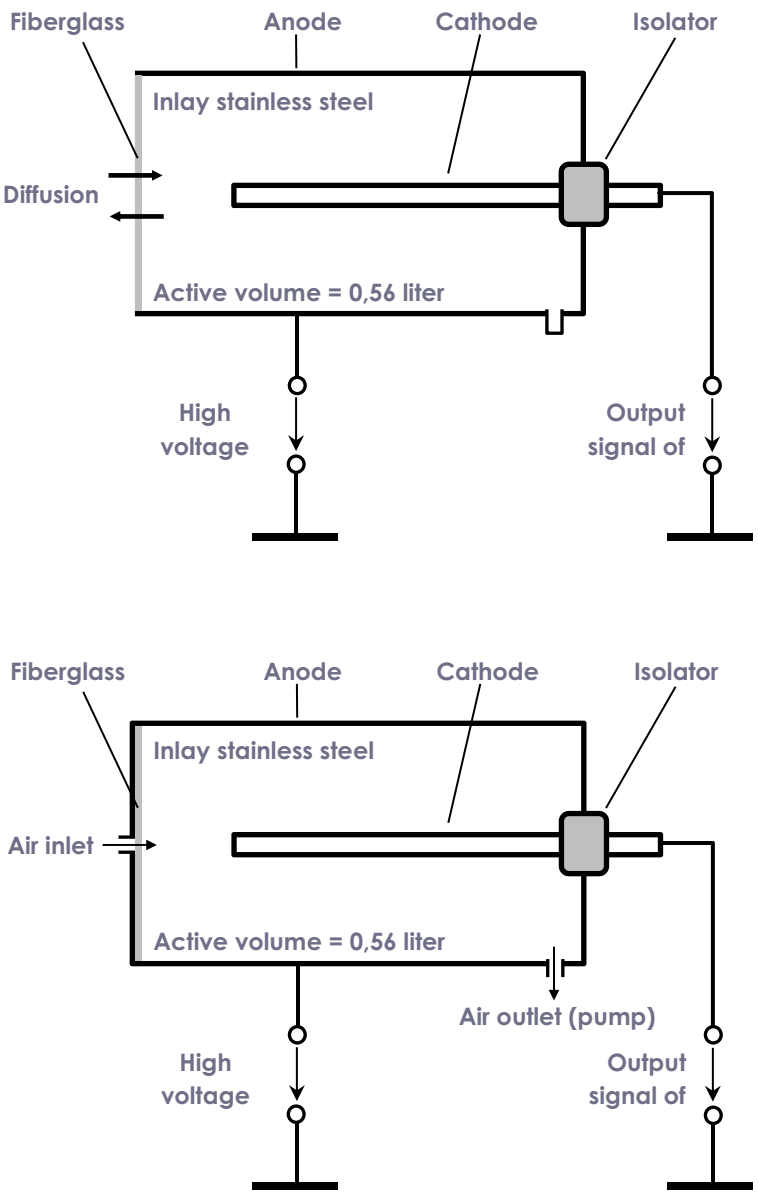


Figure 1: *AlphaGUARD* ionization chamber, above in diffusion mode, below in flow mode (schematic)

4.2 Digital Signal Processing (DSP)

For digital signal processing (Digital Signal Processing - DSP) there are three independent signal processing channels. To each channel belongs a specific analog-digital converter. This network concept allows analyzing the entering preamplifier signals simultaneously according to three different feature complexes.

Channel 1 is the spectrometric channel of the *AlphaGUARD*. Here, there is not only a signal characterization according to the pulse depth, but also a classification according to the pulse form. The result of this pulse analysis is a three-dimensional spectra. Along the X-axis there is a classification of the pulse depth, e.g. of the adjacent alpha energy. By the Y-coordinate the number of pulses per unit of time is described. The Z-coordinate stands for the classes of pulse forms.

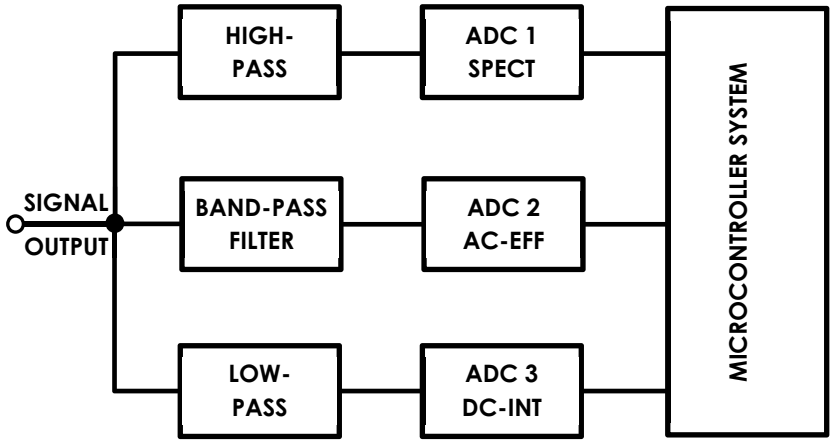


Figure 2: Block diagram of digital signal processing

Because of this complex pulse characterization, a highly effective differentiation between real alpha events and different interference effects is possible (for example: microphonic phenomena).

Signal processing via channel 2 is only effected with higher radon concentrations. The dimensioning of the used band pass filter grants that the amplitude of the

signal noise level is with high pulse densities directly proportional to the square root of the total ionization stream.

By determined use of this relation the current measurement in the picoampere range can be done with extremely high precision. Simultaneously by this a regularly appearing source of errors is eliminated, the drift of the preamplifier offset, which results of the temperature sensitive FET-structure of the preamplifier.

Channel 3 stands for a "classic" direct current measurement. Its use is bound to the appearance of extremely high radon concentrations. Moreover, it is a guarantee for a high fold back tightness of the measuring system.

On the basis of these three signal characteristics six different analyzing algorithms are processed. Finally, via an optimized density procedure the real radon concentration is determined of them. By this any of the displayed radon values of *AlphaGUARD* is the final result of ca. 50.000.000 arithmetic operations.

5 INSTRUMENT HOUSING

All measuring technical and electronic components of the *AlphaGUARD* are housed in a sturdy aluminum body. The dimensions are:

- Housing:	Length: 282 mm
	Width: 340 mm
	Height: 123 mm
- Housing, including handle:	Length: 329 mm
	Width: 355 mm
	Height: 123 mm

All functional and HMI elements are located on the front side of the *AlphaGUARD*. The sturdy handle is mounted on the left side panel.

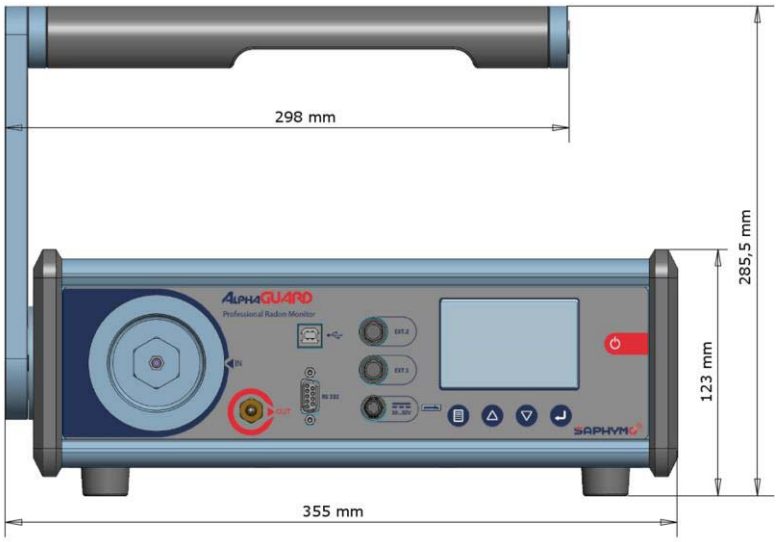


Figure 3: *AlphaGUARD* - front side

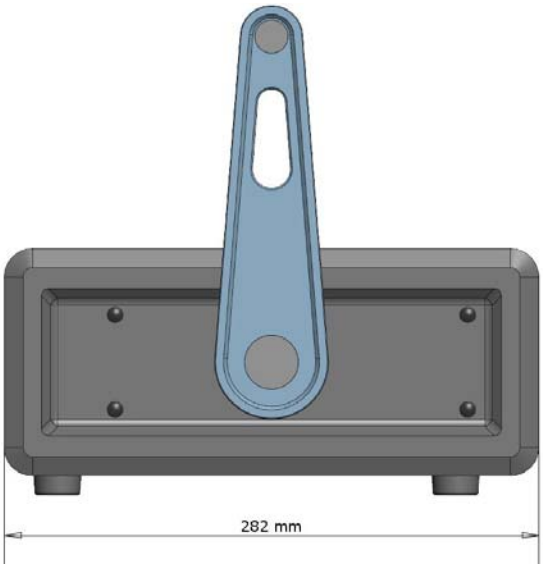


Figure 4: *AlphaGUARD* – handle side

The ergonomically designed instrument handle may be rotated through 360° and in this way orientated in six independent positions.

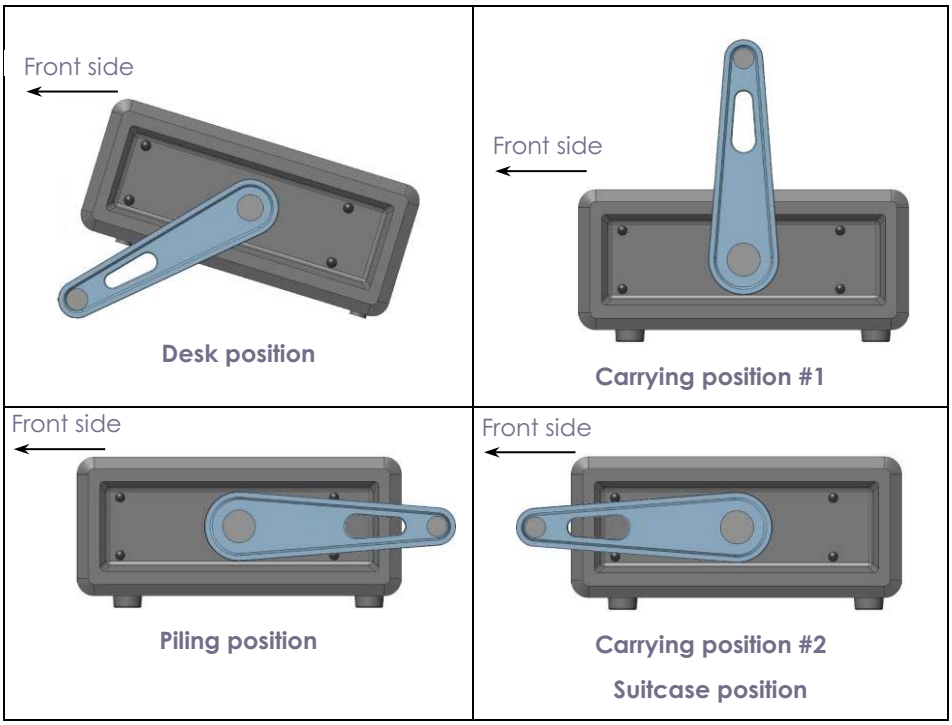


Figure 5: Standard variations of the handle position of *AlphaGUARD*

6 FUNCTIONAL ELEMENTS

The *AlphaGUARD* has the following functional elements:

- Multifunctional display with user keys
- Electrical connections
- Air inlet and outlet

Figure 6: Front panel of the *AlphaGUARD*

6.1 Multifunctional Display with user keys

The AlphaGUARD is equipped with an illuminated graphic display (resolution: 160 x 104 pixels) and 5 user keys.

On / Off switch

Turning AlphaGUARD on and off and switching the display illumination on and off.

Menu button

Enter / leave the menu / submenu.

Scroll up / Scroll down

Scrolling through the menu / Scrolling through charts in scroll mode / Adjusting parameters.

Enter

Enter submenus, confirm selection / adjustment.

The *AlphaGUARD* turns on by pushing the **On / Off switch**. After turning on the AlphaGUARD the start screen with Bertin logo and clock is displayed for 5 sec. The first values of the temperature, the air humidity and the air pressure are shown after further 2 sec. In five acquisition windows all important information on the current measurement are available. Via pushing the **Scroll up** or **Scroll down** button:

Acquisition 1/5: Current measurement values of the radon concentration in Bq/m³ (or pCi/l), temperature in °C (or °F), relative air humidity in %rH, air pressure in mbar or hpa (or inHg) and gamma ambient dose rate in nSv/h (DF2000). When operating in Radon/Thoron discrimination mode the thoron value is shown on page one (DF2000). The radon and the thoron values are followed by the appropriate statistical error bars.

Acquisition 2/5: Current measurement values of the external sensors (2 x TTL signals & 2 x analogue signals). When operating in Radon/Thoron discrimination mode, the gamma ambient dose rate is shown on page 2 (DF2000).

Acquisition 3/5: Chart of two parameters. The parameters can be freely chosen.

Acquisition 4/5: Mean value of the radon concentration and the gamma ambient dose rate over 1 d, 24 h and since start of the measurement. The mean values of the thoron concentration is shown on page 4, too, when operating in Radon/Thoron discrimination mode (DF2000)

Acquisition 5/5: Information on adjusted measurement mode, measurement cycle, index number of the current measurement with quantity of measurement points and start as well as end time and information on the interval mode

The measurement values of the radon and thoron concentration and the values of the gamma ambient dose rate are updated according to the preset measuring cycle. An exception is the 60-minute measuring cycle. With this cycle the measurement display is updated every 10 minutes, while – controlled by the internal clock – every hour a set of measurement values is stored. Such 1 hour value is calculated for each measuring parameter by averaging the results of its latest six 10 minutes cycles.

The values for temperature, air humidity, air pressure and from the external sensors are updated on the display every 2 sec.

The menu and the display of the current measuring values can be suppressed by entering a settable keycode. There are two levels of locking the device:

Lock menu: The last displayed acquisition screen is visible, no access to menu or the other acquisition screens.

Lock menu and display: The device is completely locked, no access on menu or acquisition screens. No acquisition screen is visible.

The AlphaGUARD can be switched off by pushing the **On / Off switch** for min. 3 sec.

Note

If the radon concentration in the measurement chamber exceeds 1000 Bq/m³ when switching it off, the AlphaGUARD shows a warning message and flushes the measurement chamber by running the pump in 0,5 l/min flow rate for 3 minutes. Ensure that all tubes are disconnected during the flushing.

Flow charts showing the complete menu structures can be found in the appendix.

6.2 Electrical Connection Block

AlphaGUARD has five different electrical connections, located in the middle of the front panel.

Figure 7: *AlphaGUARD* – electrical connections

USB connector

USB port for PC connection. The connector cable delivered with the *"DataVIEW PRO"* or the *"DataEXPERT"* software package has to be plugged into this interface, if communication between *AlphaGUARD* and the user's PC is required.

RS232 interface

The RS232 interface is implemented via a 9-pin SUB-D connector. This connection can be used e.g. for special applications like read out via a connected modem.

Bluetooth

The AlphaGUARD is equipped with a Bluetooth interface.

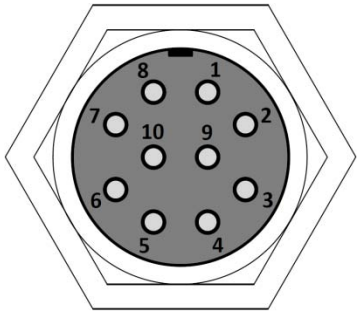
Interface for external sensors 1

For the connection of external accessories like:

- Meteorological sensor units, e.g. Multisensor
- Radon progeny measuring head AlphaPM
- External measuring unit with TTL-output
- Valve Selector Switch

Pin assignment:

Pin 1	Counter 1 in
Pin 2	GND
Pin 3	AGND
Pin 4	VBAT
Pin 5	Analog input 1
Pin 6	Analog input 2
Pin 7	VEXT Enable
Pin 8	Sync
Pin 9	Reserved 1
Pin 10	Reserved 3

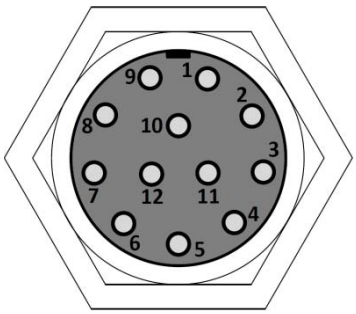


Interface for external sensors 2

For the connection of external sensors with digital output (counting signals), I²C or analogue output (with voltage of 0 - 2,5 V)

Pin assignment:

Pin 1	AN_OUT
Pin 2	VCC
Pin 3	V1
Pin 4	VEXT Enable
Pin 5	GNDA
Pin 6	Analog input 2
Pin 7	Analog input 1
Pin 8	SDA
Pin 9	SCL
Pin 10	Counter 1 in
Pin 11	Counter 2 in
Pin 12	GND



Depending on the user's choice, different external sensor units may be used. It is required that the electrical signal from the analogue sensors ranges from 0 - 2,5 V. The signal from these sensors is tapped in a 2-sec interval and digitalized with a resolution of 12 bit. In the storage of the *AlphaGUARD* the mean value over 1, 10 resp. 60 minutes is filed.

Typical external additional sensors are besides the *Differential Pressure Sensor (DSP-5000)* and the *Multisensor Unit* for recording differential pressure, temperature or flow rates, for example:

- Anemometer for recording wind/weather speeds
- Micro manometer for determining differential pressure (inside-/outside pressure)
- Thermo hydrometer for measuring ground temperature / -dampness
- Rain gauge for recording periods of precipitation

Note

When using the sockets for external sensors a correct allocation of the connectors always has to be granted. False seizure or false voltage at the connector pins of the sockets can cause damage on the AlphaGUARD or the connected electronic unit.

Moreover, the Ext.1 socket (pin 8) provides a control signal for synchronizing connected devices with the measuring cycle of the *AlphaGUARD*. This control signal is triggered each time after finishing a measuring cycle for 1 ms to "High" (+3,3 V). During the remaining time of an ongoing measuring cycle the control signal is "Low" (±0 V).

Mains power support and alarm output

For the connection of the mains power supply with 10 … 32 VDC.

When exceeding the free settable alarm threshold, an alarm output signal is given via the socket of the mains power supply. With a small Alarm Outbreak Box (optional accessory) the two alarm signals can be extracted:

Alarm high signal (switch to supply voltage, open emitter):

- No Alarm: switch opened (high-impedance)
- Alarm: switch closed (connected to power supply), max. 100 mA

Alarm low signal (switch to ground, open collector):

- No Alarm: switch opened (high-impedance)
- Alarm: switch closed (connected to ground), max 100 mA

With the Switch Box (part of the Alarm Outbreak Box), the alarm output signal can directly be used to switch on an external 220 V device (e.g. ventilation system).

Note

Always use mains power adapter delivered by Bertin GmbH.

6.3 Air inlet and outlet

On the left side of the front plate the air inlet and the air outlet are located.

Figure 8: Air inlet with adapter for diffusion mode (left picture) and for flow mode (just for AlphaGUARD DF2000, right picture)

6.3.1 Diffusion mode

In diffusion mode the diffusion adapter is mounted which is equipped with a grid. The diffusion adapter allows an optimal air exchange and covers the filter which is located in front of the measurement chamber. The air outlet is not used in this mode.

6.3.2 Flow mode

In flow mode, the flow through adapter has to be mounted. The flow through adapter consists of an aluminium screw cap equipped with a tube nozzle for quick coupling system (diameter: 2,7 mm) which allows the connection of plastic tubes with inner diameters of 5/32" resp. 4 mm. The air outlet is provided with a tube nozzle too, e.g. to set up a closed cycle.

To mount the flow-through adapter the following steps have to be effected at the *AlphaGUARD DF2000*:

- Remove the diffusion adapter from the air inlet (can be unscrewed by hand)
- Screw in the flow-through adapter (screw cap with tube nozzle)

Note

- The filter paper must not be touched. High risk of damage!
- Make sure that the O-ring within the screw cap is correctly positioned.
- Tighten the screw cap carefully by hand using the hexagon spanner.

With the flow-through adapter (screw cap) the *AlphaGUARD DF2000* can be operated in flow mode (open and in closed cycle).

Converting *AlphaGUARD DF2000* again for diffusion mode requires the above steps in reverse order. It is sufficient to screw the diffusion adapter slightly by hand as it has no sealing function.

To avoid contamination of the plain paper filter at the chamber entrance, an external radon progeny filter (accessory) has to be connected to the tube in front of the air inlet.

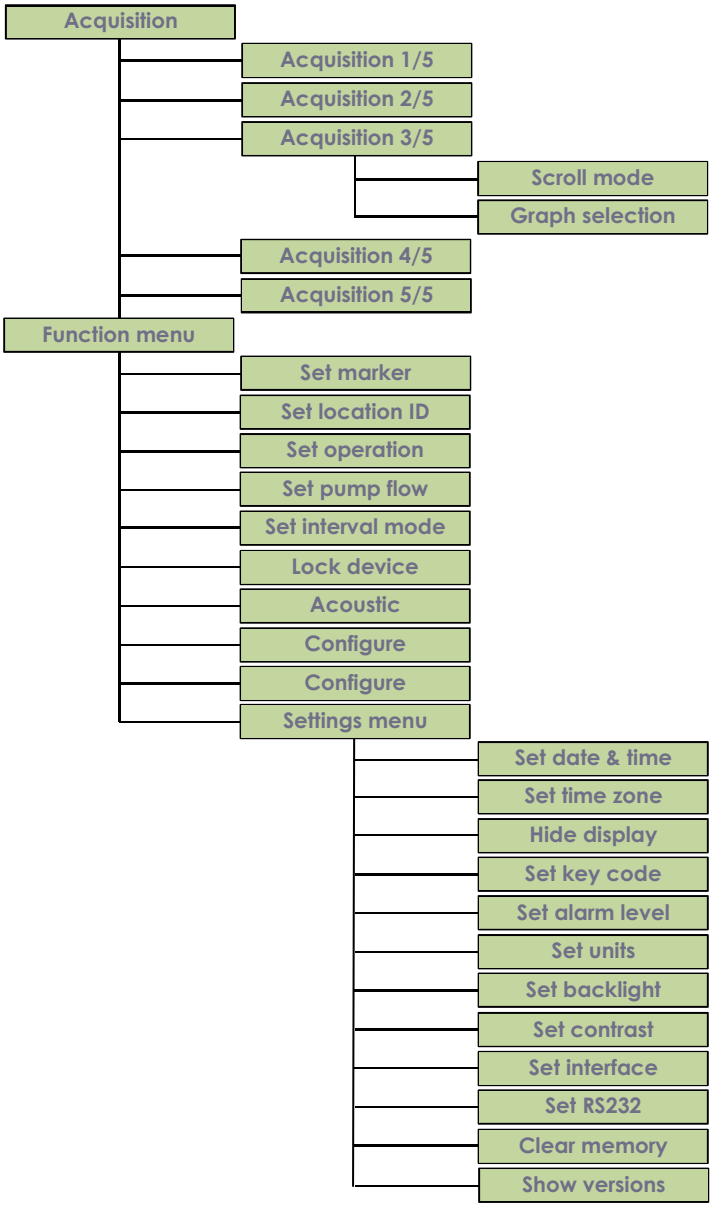
Figure 9: Using external radon progeny filter in front of the air inlet (flow mode)

Important note

Operate the active adapter only with connecting in series the external radon progeny filter (enclosed accessory); otherwise there is acute danger of contamination of the plain paper filter at the chamber entrance.

7 ALPHAGUARD MENU

The following flowchart gives an overview of the complete menu structure:



7.1 Acquisition

By means of five acquisition windows all important information on the configuration as well as current measurement is available. Via pushing the **Scroll up** or **Scroll down** button .

7.1.1 Acquisition 1/5

Displays the current measurement values of the radon concentration in Bq/m³ (or pCi/l), the temperature in °C (or °F), the relative air humidity in %rH, the air pressure in mbar or hpa (or inHg) and the gamma ambient dose rate in nSv/h (if equipped with dose rate module). When operating in Radon/Thoron discrimination mode, the thoron value appears on Acquisition 1/5 instead of the gamma ambient dose rate (DF2000). The radon and the thoron values are followed by the appropriate statistical error bars.

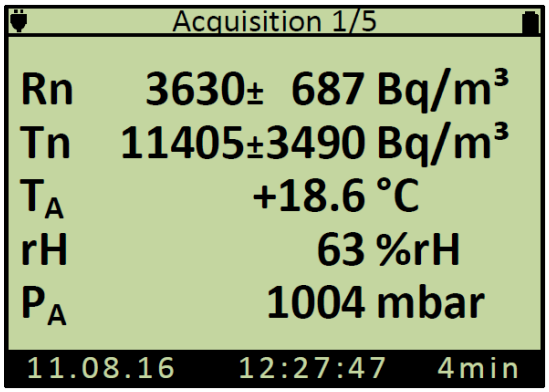


Figure 10: Acquisition window 1/5

In order to record and display gamma dose rate measurement values it is required to equip the *AlphaGUARD* with an additional module consisting of a Geiger-Müller tube and associated electronics. The dose rate (gamma) as ambient dose equivalent rate H*10 is displayed in the unit nSv/h. The measuring range of the additional gamma dose rate detector is 20 nSv/h - 10 mSv/h.

Note

The display value for the gamma dose rate is updated along with each new measuring cycle.

7.1.2 Acquisition 2/5

Display of the current measurement values of the external sensors (2 x TTL signals & 2 x analogue signals). When operating in Radon/Thoron discrimination mode, the gamma ambient dose rate is shown on page 2 also (DF2000).

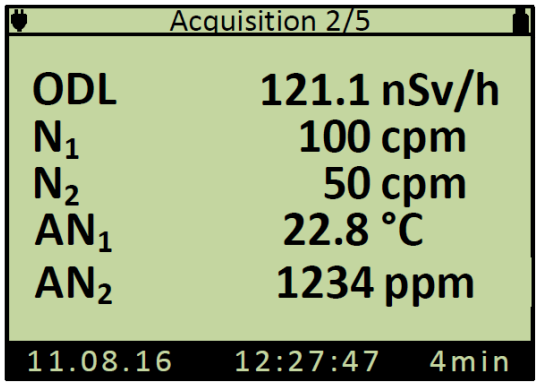


Figure 11: Acquisition window 2/5

N_1 / N_2

The *AlphaGUARD* is equipped with a counter module that allows processing of externally produced count rates (e.g. TTL signals transmitted by the radon progeny monitor AlphaPM). The count rate (counts) is displayed in the unit "counts per minute" (cpm). The maximal count rate of the counter module is 10 kHz resp. 600.000 cpm.

Note

The display values for the count rate are updated along with each new measuring cycle.

AN_1 / AN_2

The current measuring values of two additional external sensors can be displayed. The appearing results depend on the selected configuration of the analog inputs (see 7.2.8).

The displayed values are based on a cyclic interrogation of the analog inputs in a 2-second cycle.

7.1.3 Acquisition 3/5

This window allows the simultaneous chart of two data values. The last 143 measurement values of each parameter can be displayed simultaneously. The time base depends on the chosen measuring cycle: With a measuring cycle of 1 min, the values of the last 143 min, with a measuring cycle of 10 min, the last 24 hours and with a measuring cycle of 60 min, the last 6 days can be displayed.

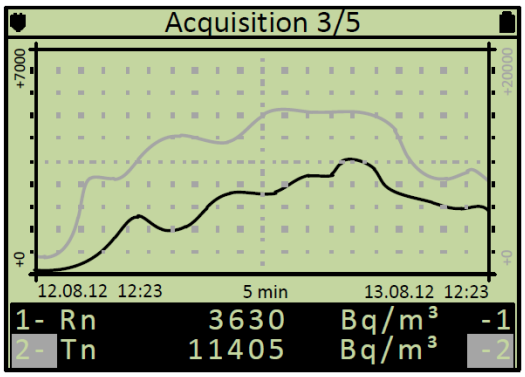


Figure 12: Acquisition window 3/5

Whenever the data series exceeds the limit of 143 values, which can be displayed in one window, the scroll mode can be activated by pushing shortly the Enter button. The Scroll up and Scroll down buttons can be used to navigate through the complete time period of the measurement experiment. The scroll mode can be left by pushing the Enter button again.

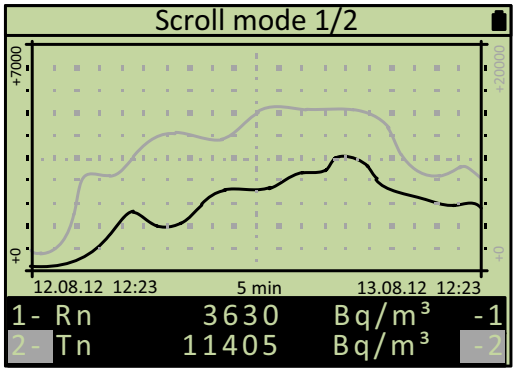


Figure 13: Scroll mode

The parameters can be freely chosen by pushing the **Enter** button for 2 sec. The parameters can be selected by pressing the **Scroll up** and **Scroll down** button and confirming by pushing the Enter button for 2 sec.

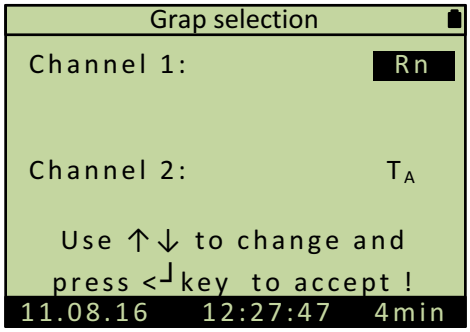


Figure 14: Select parameters for the chart

7.1.1 Acquisition 4/5

This window displays the mean values of the radon concentration and the gamma ambient dose rate over 1 h, 24 h and since start (Rn ON) of the measurement. The mean values of the thoron concentration is shown on Acquisition 4/5, too, when operating in Radon/Thoron discrimination mode (DF2000)

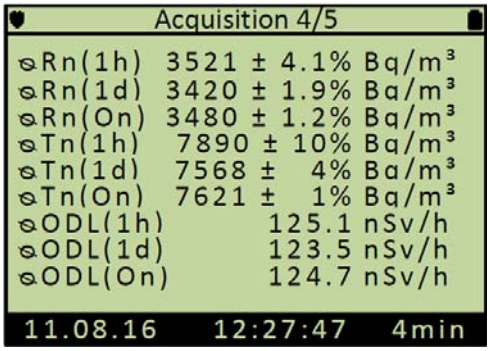


Figure 15: Acquisition window 4/5

Note

The mean values are only available after the respective time period is completed.

7.1.2 Acquisition 5/5

This window allows to display information on the selected measurement mode and measurement cycle, the index number of the current measurement series with quantity of measurement points, its start and end time as well as information on the interval mode.

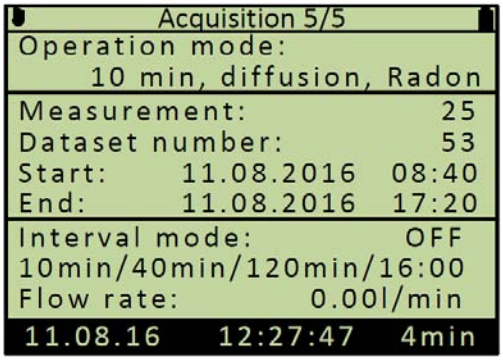


Figure 16: Acquisition window 5/5

7.2 Function menu

The function menu can be called up by pushing the **menu button** . Several functions and settings are available in the function menu. Use the **Scroll up** or **Scroll down** button to navigate and push the **Enter** button to enter a sub item.

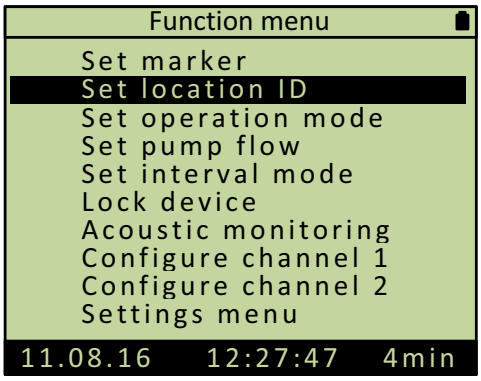


Figure 17: Function menu

7.2.1 Set marker

This function allows time markers to be placed within the current data series. Set time markers are represented in the *"DataVIEW PRO"* or *"DataEXPERT"* software by a straight line entry in the status area of the data window.

Note

Only one-time marker can be set per each storage cycle, e.g. according to the selected cycle length 1 x per 1 min, 1 x per 10 min or 1 x per 60 min

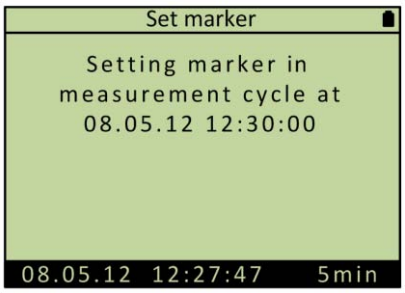


Figure 18: Setting the marker

7.2.2 *Set location ID*

To associate different measurement locations a location ID between 0 and 31 can be selected. The location ID is included in the read out data series. It can be selected by using the **Scroll up** or **Scroll down** button and pushing the **Enter** button for 2 sec.

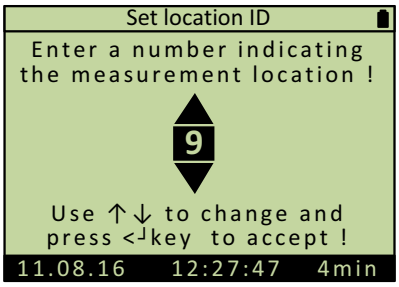


Figure 19: Setting the location ID

7.2.3 *Set operation mode*

This submenu allows the selection of the operation mode and the period of the measuring cycle.

The diffusion mode with measuring cycles of 10 minutes and 60 minutes is available with all types of *AlphaGUARD*.

The flow mode with measuring cycles of 1 minute and 10 minutes, as well as the Radon/Thoron discrimination mode with a cycle time of 10 minutes, are available with the *AlphaGUARD DF2000*.

Use the **Scroll up** or **Scroll down** button to navigate and push the **Enter** button for 2 sec. to choose an operation mode.

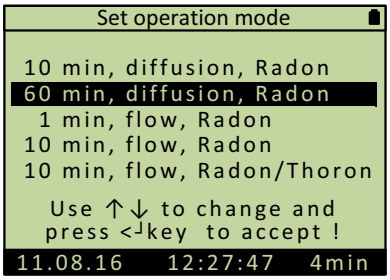


Figure 20: Setting the operation mode

If the flow mode operation is chosen, the running pump is indicated by a pump symbol in the upper right corner:

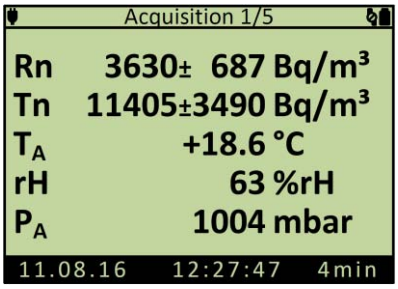


Figure 21: Acquisition window with pump symbol

Note

- The contents of the display are updated along with each new measuring cycle resp. every 10 min with the 60 min cycle.
- A change of the measuring mode or measuring cycle automatically leads to the creation of a new data series.

7.2.4 Set pump flow

The integrated pump allows radon and thoron measurements in flow mode. The flow-regulated pump can be adjusted from flow rates of 0,05 l/min to 0,5, 1 and 2 l/min by using the **Scroll down** and **Scroll up** buttons. The adjustment is acknowledged by pushing the **Enter** button for 2 sec.

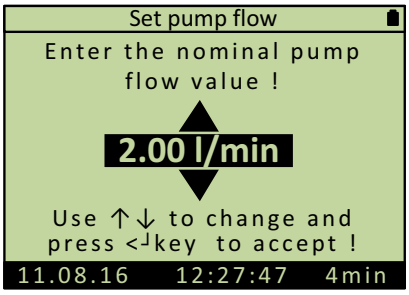


Figure 22: Setting the pump flow

Note

Flow rates of 0,05 – 0,45 /min are realized by periodical pump operation: the pump is switched on and off for particular periods in order to obtain a reduced flow rate over time. During periodical pump operation, the base flow is 0,5 l/min.

7.2.5 Set interval mode

When operating the *AlphaGUARD* in the interval mode, the measurement takes place just in defined time period for a defined sample time, e.g. every 60 minutes for 30 minutes. With this mode an extended battery life time can be achieved for flow operation.

The interval mode can be activated by choosing "ON" pressing the **Scroll up** or **Scroll down** button and pushing the **Enter** button for 2 sec for acknowledgement.

The interval mode can be configured by the following parameters:

Pre-sample time:	Activated pump to flush the measurement chamber before sampling is started During the Pre-Sample time no measurement is performed
Sample time:	Activated pump and running measurement
Time period:	The time period includes the complete time interval (from the start of the sampling time to the start of the next sampling time)
Start time:	Start time of the first sample time

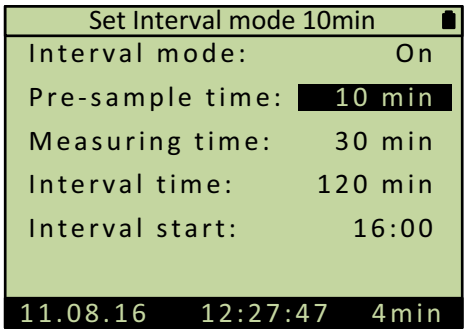


Figure 23: Settings for interval mode

Note

- The interval time has to be longer than the pre-sample time + the measuring time.
- Within the sample time the measurement values are stored according to the selected operation mode. In the meantime, no measurement values are stored and the read-out data series shows gaps for these periods.

The chart in Acquisition 3/5 is modified when operating the *AlphaGUARD* in interval mode. The interval is adapted to the chosen measuring time. Every time period is marked with a dotted line.

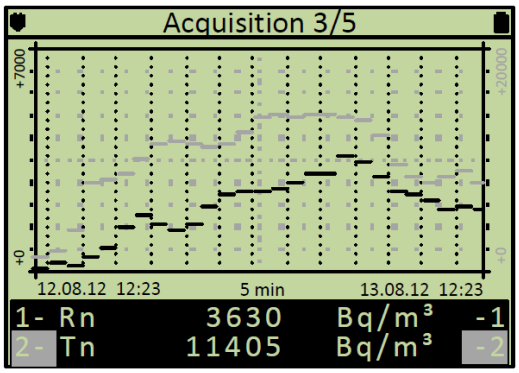


Figure 24: Acquisition screen 3/5 with activated interval mode

7.2.6 Lock device

The *AlphaGUARD* can be locked and thereby protected against manipulation. To lock the device the key code has to be entered by using the **Scroll up** or the **Scroll down** button. The next digit can be selected by pushing the **Enter** button shortly and the selection has to be acknowledged by pushing the **Enter** button for 2 sec. The activated lock is confirmed by following screen which appears for 8 seconds.

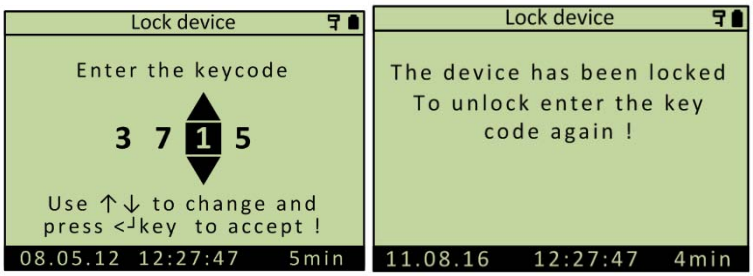


Figure 25: Entering the key code for locking the device and confirmation screen

If "Hide display content" is deactivated (See 7.2.9, "Hide display content"), the last displayed acquisition screen is still visible. During the device lock the lock is marked by the key in the top right corner of the display.

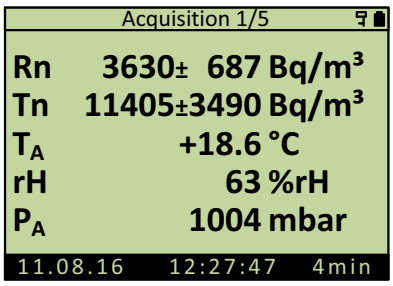


Figure 26: Locking screen without "hide display content"

If "Hide display content" is activated (See 7.2.9, "Hide display content"), the following screen is visible instead of the last displayed acquisition screen.

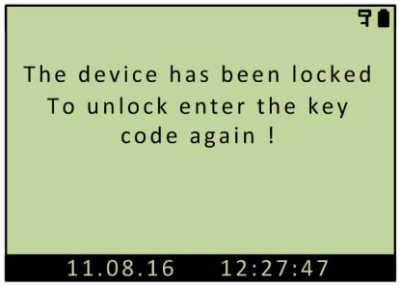


Figure 27: Locking screen with "hide display content"

The AlphaGUARD can be unlocked by pushing any key and entering the key code.

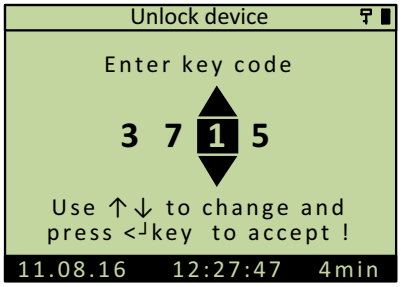


Figure 28: Unlock the device by entering the key code

The key code can be changed in the settings menu (see 7.2.9, "Set key code").

7.2.7 *Acoustic monitoring*

This function acknowledges each alpha event recorded by *AlphaGUARD* with an acoustic signal in the form of a beep.

The audio output is enabled by selecting "ON".

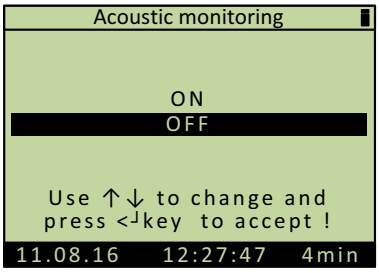


Figure 29: Switch beeper on or off

Note

With concentrations up to 3 kBq/m³ the beep sequence is proportional to the measured radon concentration. Above 3 kBq/m³ the acoustic signal is generally suppressed.

7.2.8 *Configure channel 1 / Configure channel 2*

According to user's choice different external sensor units may be used. It is required that the external sensor provides a linear output signal from 0 - 2,5 V. The specifications of the analog external signals (see 7.1.2) can be configured by this menu. Following adjustments have to be done:

1. Enter the number of digits behind the decimal point. In total up to 4 digits are available; up to 3 digits can be assigned to decimal places.

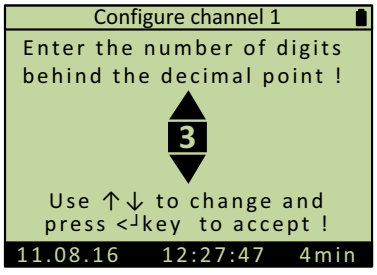


Figure 30: Configure channel 1 or 2 - enter number of digits for decimal places

2. Enter the sensor's measurement value corresponding to 0,0 V.

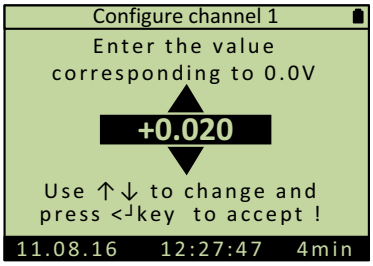


Figure 31: Configure channel 1 or 2 - enter value corresponding to 0 V

3. Enter the sensor's measurement value corresponding to 2,5 V.

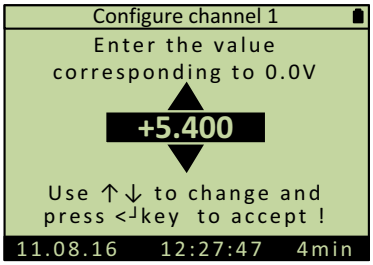


Figure 32: Configure channel 1 or 2 - enter value corresponding to 2,5 V

4. Enter the measurement unit of the sensor. Any unit can be implemented, 6 characters are available for the selection.

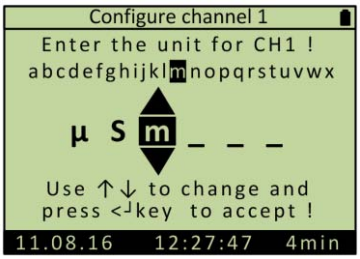


Figure 33: Configure channel 1 or 2 - enter the unit

Note

Just the units used for MultiSensor (l/min, °C, Pa) are transferred during data read out by DataVIEW or DataEXPERT. All other units are converted to a percentage presentation (0 % … 100 %) when being read out by DataVIEW or DataEXPERT.

7.2.9 Settings menu

The Settings menu, in two parts, provides the system settings of the AlphaGUARD. Use the **Scroll up** or **Scroll down** button to navigate and push the **Enter** button to enter the selected sub item.

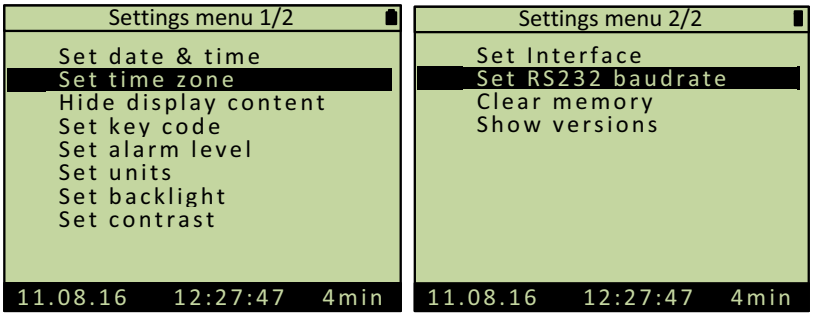


Figure 34: Settings menu (2 pages)

7.2.9.1 Set date & time

Date and time can be adjusted by this menu item. The date has the format DD.MM.YYYY, the time HH:MM:SS. The entries can be changed by using the **Scroll up** or the **Scroll down** button. The selection is acknowledged by pushing the **Enter** button for 2 sec.

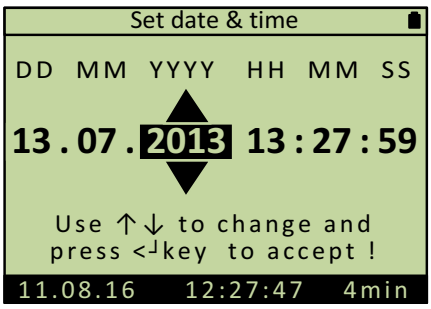


Figure 35: Setting date and time

7.2.9.2 Set time zone

Select the time zone with or without daylight saving time (DST) via using the **Scroll up** or **Scroll down** button and acknowledge by pushing the **Enter** button for 2 sec.

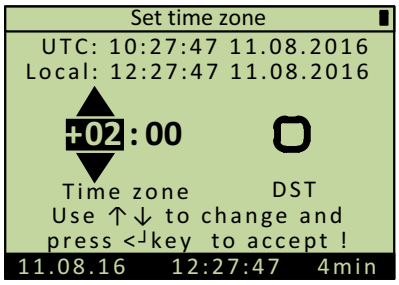


Figure 36: Setting the time zone

7.2.9.3 Hide display content

When this selection is activated ("ON"), the display content is hidden during "lock device" is activated (see 7.2.6).

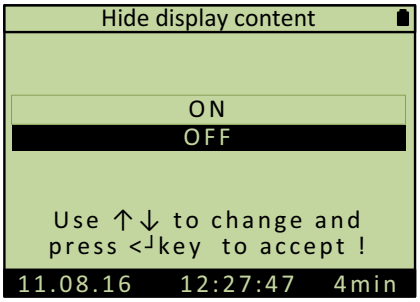


Figure 37: Selection, whether the display content should be hidden or not during "lock device" state

7.2.9.4 Set key code

The key code can be changed by using the **Scroll up** or the **Scroll down** button. To go to the next digit push the **Enter** button briefly. The selection has to be acknowledged by pushing the **Enter** button for 2 sec.

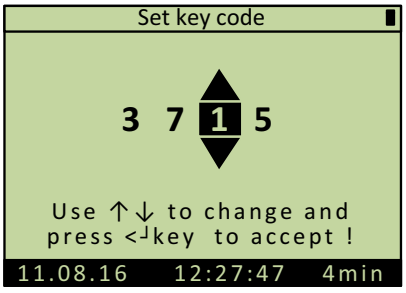


Figure 38: Setting the key code for locking the *AlphaGUARD*

Note

The key code can be changed at any time by via the communication module of DataVIEW or DataEXPERT.

7.2.9.5 Set alarm level

The alarm threshold can be changed by using the **Scroll up** or the **Scroll down** button. The selection is acknowledged by pushing the **Enter** button for 2 sec.

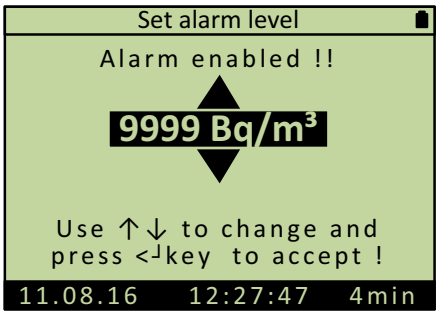


Figure 39: Setting the alarm threshold

Whenever the radon measurement value exceeds the alarm threshold, an exclamation mark appears in the top right corner of the display and an alarm signal is made available to the alarm output - which can be externally used (see 6.2, "Mains power support and alarm output").

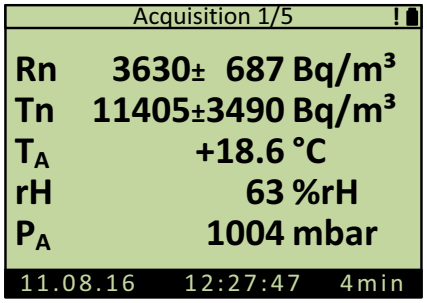


Figure 40: Alarm indication by exclamation mark (!) on the top right corner

Note

The alarm is disabled when reducing the alarm threshold to values < 2 Bq/m³.

7.2.9.6 Set units

The units of the radon concentration, the temperature and the pressure can be changed by using the **Scroll up** or the **Scroll down** button. The next field can be selected by pushing the **Enter** button shortly. The selection has to be acknowledged by pushing the **Enter** button for 2 sec.

The following units are selectable:

- Radon concentration: Bq/m³, Ci/l
- Temperature: °C, °F
- Pressure: mBar, hPa, inHg

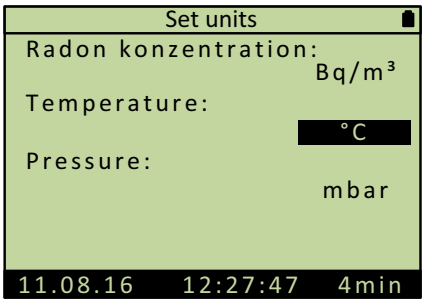


Figure 41: Changing the units for radon concentration, temperature and pressure

7.2.9.7 Set backlight

The backlight mode can be changed by using the **Scroll up** or the **Scroll down** button. The selection has to be acknowledged by pushing the **Enter** button. Selecting "**Backlight auto**", the back light is switched off after 30 sec. of inactivity. The back light is switched on again with any keystroke. Selecting "**Backlight on**" or "**Backlight off**", the backlight is switched on or off permanently. With these backlight modes the backlight can be always switched on or off by briefly pushing the **On/Off Switch**.

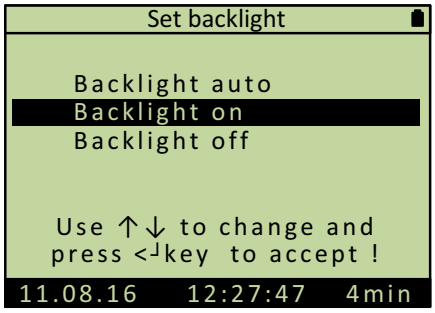


Figure 42: Adjusting the backlight

7.2.9.8 Set contrast

The contrast of the display can be changed by using the **Scroll up** or the **Scroll down** button. The selection has to be acknowledged by pushing the **Enter** button.

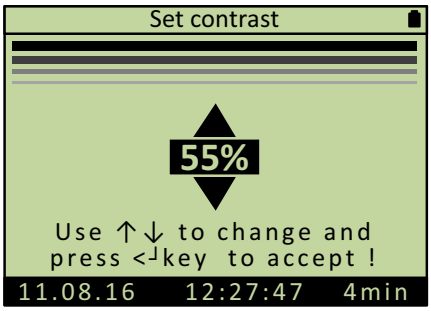


Figure 43: changing the display contrast

7.2.9.9 Set interface

The *AlphaGUARD* provides three interfaces: USB, RS232 and Bluetooth (for the setup of the Bluetooth connection with a computer, see point 14.2). Just one interface can be used at the same time and has to be selected before usage. The other two interfaces are deactivated to reduce battery consumption. The interface can be selected by using the **Scroll up** or the **Scroll down** button. The selection has to be acknowledged by pushing the **Enter** button.

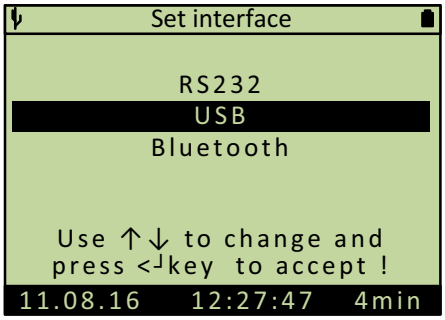


Figure 44: Selection window for the interface

The current selection of the interface can be checked in the top left of the display:

 Bluetooth

 Bluetooth connection established

 USB

 RS232

7.2.9.10 Set RS232 baud rate

The settable baud rate determines the data transmission speed between *AlphaGUARD* and connected PC. In a noisy environment or when using a very long connection cable, it can be necessary to reduce the preset baud rate until down to 300 Bd in order to ensure error-free data transfers. Depending on the interface hardware used by the PC it may also be possible to work with the maximal baud rate of 115 200 Bd in order to reduce data transfer time. The

"communication module" of the *DataVIEW* or *DataEXPERT* software recognizes the set baud rate of the *AlphaGUARD* automatically.

The transfer of a several days lasting measuring series out of the value storage of the *AlphaGUARD* into the working memory of a PC lasts with 115 200 Bd some seconds, max. a few minutes depending on amount, operation mode, etc. With appreciably lower baud rates this process can take several minutes more. The set baud rate can be changed by selecting the required rate and pressing the Enter-key for acknowledgement.

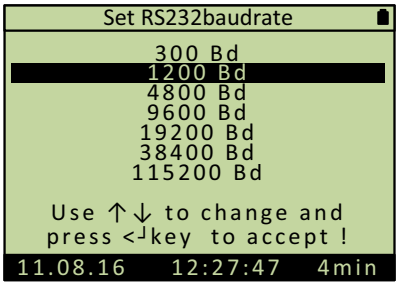


Figure 45: Selecting the baud rate for the RS232 interface

Note

Setting of the baud rate can also be carried out using the DataVIEW or DataEXPERT communication module via PC.

Important

In order to avoid disturbances with the AlphaGUARD monitor, if possible please use the delivered RS-232/USB cable. Longer cables can cause disturbances due to EMI interferences and thus malfunctions of the instrument. For on-line operation over longer distances with RS-232 cable the AlphaGUARD interface must be galvanically separated from the cable connection.

Note

Only use interface modules with an own power supply.

7.2.9.11 *Clear memory*

The data storage of the *AlphaGUARD* can be deleted by using the **Scroll up** or the **Scroll down** button to select "YES". The selection has to be acknowledged by pushing the **Enter** button.

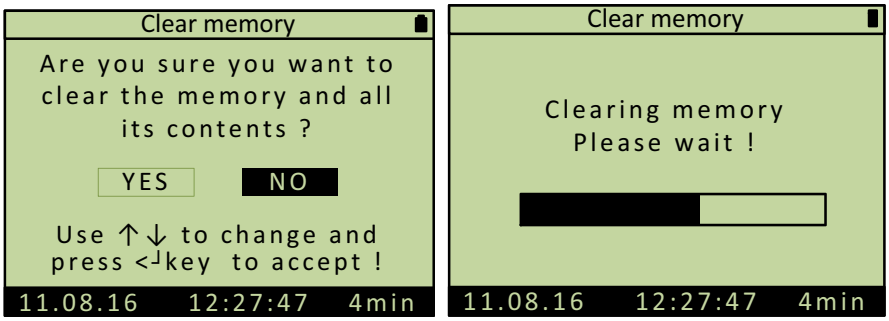


Figure 46: Acknowledgement for clearing the memory

Note

All stored data series will be deleted after clearing the memory.

7.2.9.12 Show versions

This window gives an overview of the version numbers of the hardware and software as well as information on the radon background of the measurement chamber:

- AlphaGUARD DF2000 — version of AlphaGUARD
- HW: REV 1.0 — hardware revision AlphaGUARD
- BT: 1.0.14 — firmware revision Bluetooth module
- FW:AG0.013 v. Jul 04 2016 — firmware revision AlphaGUARD
- SN: AG000012 — serial number AlphaGUARD
- CD:6FFFh — internal use
- FW:PM0.001 v. Jun 14 2016 — firmware revision pump module
- SN: PM000005 — serial number pump module

Compensation of background for PB-210 contamination of measurement chamber:

- U: +0 User offset: This parameter characterizes a positive or negative offset, which can be allotted by the user to the AlphaGUARD for fine tuning the automatic background correction. This term for fine tuning can be determined by a measuring sequence in radon-free atmosphere.
- T: +0 Total offset: This parameter is the sum of the automatically calculated background (intrinsic effect) of the detector due to the complete exposure history of the AlphaGUARD and the above mentioned fine tuning term (User offset).

An accumulated exposure of 1 MBqh/m³, as result from the contamination of the ionization chamber by long-living radon progeny products (Pb-210), produces an internal rise of the background of 0,5 ... 0,9 Bq/m³. This can be observed with subsequent low-level measurements in the form of increased statistical error of the individual measuring values. If the scatter reaches a degree which cannot be tolerated by the user any more, the manufacturer can provide revitalization measures. The necessity and scope of revitalization procedure is always determined by the total exposure of the radon monitor on the one hand and the required precision in the low-level range on the other hand.

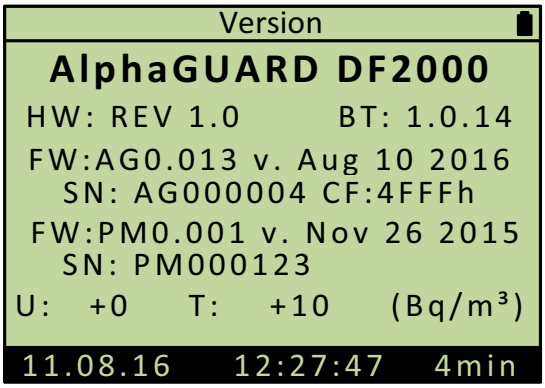


Figure 47: Overview of the version numbers as well as information on the background of the measurement chamber

Note

- The self-triggering update of the internally calculated correction term and thus also of the total sum which is considered for the automatic background correction is always effected twice a year i.e. to the deadline January 1 and July 1.
- During a measuring series in process the automatic background correction is suppressed. In such cases, it is only effected after a re-initialization and starting a new measuring series.

8 QUALITY ASSURANCE SYSTEM

Switching on the *AlphaGUARD* also activates its internal quality assurance system. E.g. the microprocessor automatically performs a series of control routines and plausibility checks in an always repeating mode. Reporting of QA results is done the way that the values are filed simultaneously with the measured radon values and environmental parameters in the storage of the instrument.

When reading out the measurement series the report of the quality assurance system is also handed over to the PC. Via "*DataVIEW*" or "*DataEXPERT*" this protocol can be analyzed. This enables the user to analyze the status of his *AlphaGUARD* during the last measuring cycle in a time resolved way. A difference between conspicuous measuring values and physically caused artifacts can definitely be drawn when the radon monitor had to be operated under extreme circumstances (e.g. at potentially existing danger of condensation).

The quality assurance protocol is divided in two parts:

- **SYSQAG** hardware condition
- **DATAQA** data quality

Two protocol parts exist independently of each other in the value storage of the *AlphaGUARD*. The two following tables characterize the quality parameters:

8.1 SYSQAG - hardware condition

Short definition	Description of quality parameter	Recommendation
DCOFF	Offset of preamplifier outside of target range	Contact your local Bertin distributor in case of increased incidence
LOW_HV	Radon detector high voltage outside of target range	Contact your local Bertin distributor in case of increased incidence
ACCUfail	Battery error detected	Battery has to be changed
DETCO	Total exposition of detector (kBqh/m³) reached a critical value, e.g. Po-210 contamination cannot be compensated by the correction routines sufficiently	Contact your local Bertin distributor
ALARM	Alarm status	-
WDerr	System-Reset, initiated by self-control routine of *AlphaGUARD*	-
MEMerr	Error found in *AlphaGUARD* storage administration	Contact your local Bertin distributor
NORES	Detector signal can mathematically not clearly be analyzed - no plausible radon data - malfunction of detector	Contact your local Bertin distributor in case of increased incidence
LOW_POW	Low battery voltage	Connect *AlphaGUARD* to mains power

EXT_POW	*AlphaGUARD* runs on external power supply	-
CHARGER	Charging the battery of *AlphaGUARD* in process	-
PUMP_ERR	Flow of pump module outside of valid control range	Check tubes connected to the *AlphaGUARD* (ensure that there is no interruption of the flow e.g. by sharply bended tubes). If the problem persists, contact your local Bertin distributor
IV_MODE	Interval mode activated	-
ODL_HVerr	High voltage of Geiger-Müller detector outside of target range	Contact your local Bertin distributor

8.2 DATAQA - data quality

Short definition	Description of quality parameter	Recommendation
LOLIM	Measuring value was outside lower measuring range (< 2 Bq/m³) or Rn-error was higher than respective Rn-value (AlphaGUARD display shows the radon value preset with "<"	-
UPLIM	Measuring value exceeded the upper measuring range (> 2 MBq/m³) (> 50 KBq/m³ for D50)	-
PREA	Automatic determination of the present base line of the preamplifier offset has been effected (typical for each hundredth measuring cycle, if Rn-concentration: 100 - 10 000 Bq/m³, temperature: 10 - 30°C, air humidity: < 80 % rH and other parameters of the DATAQA inconspicuous)	-
QASPE	Alpha spectra shows irregular form	Contact your local Bertin distributor in case of increased incidence
QANOI	Inadmissible noise level diagnosed in the alpha spectra	Contact your local Bertin distributor in case of increased incidence
DEWPT	Ambient conditions were in the dew point range, e.g. potential danger of condensation for the measuring electronics	-

QAFIT	Inadmissible differences between results of corresponding analyzing algorithms diagnosed	Contact your local Bertin distributor in case of increased incidence
QABAS	Inadmissible drift phenomena diagnosed in the preamplifier unit	Contact your local Bertin distributor in case of increased incidence
MARKER	Marker flag	-
Operation mode	Used operation mode (e.g. 10 min diffusion)	-
An modif	Spare	-
Flow modif	Flow of the pump is changed	-
DR himax	Ambient dose rate outside upper measuring range	-
Pump off	Pump is manually switched off or disabled by DPS5000 pressure sensor	-

Note

- The appearance of quality statements in a measuring series does not necessarily mean that the marked measuring values are incorrect. For these values it was only diagnosed, that they were produced under critical conditions hard or software wise.
- Measuring values which are accompanied by statements of the quality assurance system and are not "LOLIM" or "UPLIM" statements resp. the periodically returning statement "PREA" should always be checked critically concerning their plausibility.

9 MEASURING OPERATION

Depending on the particular model the *AlphaGUARD* disposes of different measurement modes which are optimized for their respective measuring applications in terms of the hardware configuration as well as of the applied evaluation algorithms (firmware).

9.1 Diffusion mode (D50, D2000, DF2000)

Measuring in diffusion mode is designated for ordinary radon monitoring outdoors or in buildings. As both energy consumption and mechanical wear of the measuring system are minimal with the diffusion mode this type of operation is best suited for long-term surveillance. In order to compensate the time lag of such measurements at occurring radon fluctuations (gradients), caused by the delay of the measuring gas when entering the chamber by diffusing through the filter, special algorithms for forecasting the true radon concentration in the ambient air are applied (→ fast design-optimized passive diffusion). Following preparatory configuration measures are necessary for measuring in diffusion mode:

- Check if the diffusion adapter is mounted. If not, unscrew the flow through adapter by using the hexagon key and screw the diffusion adapter by hand (see Figure 50 in reverse order).
- Start the *AlphaGUARD* by pushing the ON/OFF button.
- Check if set operation mode is OK (10 or 60 min, diffusion, Radon). If necessary, change the required operation mode via menu (see 7.2.3) or by means of a PC connected to the *AlphaGUARD* using *DataVIEW* or *DataEXPERT* software (see *DataVIEW* or *DataEXPERT* manual).
- If mains operation is required (when battery is discharged and/or for long term operation) simply connect the mains adapter.

Note

When operating the AlphaGUARD DF2000 in diffusion mode, make sure that the diffusion adapter is mounted in order.

- to allow unhindered diffusion of the measuring gas through the entrance window into the chamber,
- to avoid damages of the plain filter as well as disturbances by electromagnetic interferences.

Figure 48: Air inlet with mounted diffusion adapter

As soon as the respective measuring cycle is finalized the recent data are shown on the display. For the description of the acquisition windows see 7.1.

The measurement data stored by the *AlphaGUARD* can be downloaded at any time, i.e. during or after the measurement, on a PC when connected to the monitor via USB or RS232 cable or via Bluetooth (see *DataVIEW* or *DataEXPERT* manual).

9.2 Flow mode (DF2000)

Flow measurements can be performed either in the form of an open or a closed gas circuit. Following preparatory measures of configuration are necessary:

- Check if flow through adapter is mounted. If not, unscrew the diffusion adapter by hand and screw the flow through adapter by using the hexagon key (see Figure 50).
- Start the AlphaGUARD by pushing the ON/OFF button
- Check if set operation mode is OK (1 or 10 min, flow, Radon). If necessary, change the required operation mode via menu (see 7.2.3) or by means of a PC connected to the AlphaGUARD using DataVEIW or DataEXPERT software (see DataVIEW or DataEXPERT manual).
- If mains operation is required (when battery is discharged and/or for long term operation) simply connect the mains adapter.
- If the pump flow gets out of control (indicated by an acoustic signal), ensure that there is no interruption of the flow e.g. by sharp bended tubes etc.

Important note

Operate the active adapter only with connecting in series the external radon progeny filter (enclosed accessory); otherwise there is acute danger of contamination of the plain paper filter at the chamber entrance.

Note

The flow through adapter must be mounted. Even with flow measurements in open circuit, the screw cap should be installed in order to avoid distortion of the measurement values caused by back diffusion - which might occur especially in cases very low flow rates are applied.

Figure 49: Air inlet with mounted flow through adapter for connecting tubes

For mounting and dismounting the diffusion adapter it is sufficient to screw it by hand. It is not necessary to screw down the diffusion adapter strongly as it has no sealing function.

For mounting and dismounting the flow through adapter the hexagon key has to be used. The flow through adapter has sealing functions and has to be carefully hand-tightened to avoid leakages.

The following pictures show the process of exchanging the adapters:

Figure 50: Exchanging the diffusion and the flow through adapters

The status of the pump operation is indicated by a pump symbol in the upper right of the screen. Following states are possible:

Flow mode activated, pump flow within operational limits

Flow mode activated, flow of the pump disturbed (e.g. by sharp bended tubes) or hardware problem with pump module

Flow mode activated, pump manually stopped (see chapter 10.7 Soil gas probe)

9.3 Radon/Thoron discrimination mode (only DF2000)

The measuring and evaluation procedure - for continuously differentiating radon from thoron in the ambient air - makes use of the significant difference in the half-lives of these nuclides (radon: 3,8 days, thoron: 55 sec.). This measuring mode requires splitting the applied quasi-continuous 10min measuring cycle into three subsequent phases. For speedy filling the measuring chamber during the first phase the internal pump of *AlphaGUARD* is used.

The main challenge of the setup with this mode is to get as much thoron as possible into the chamber during the pump operation period (first 3 minutes of each 10 min measuring cycle). It is important to avoid that appreciable fraction of this noble gas decays on its way into the measuring chamber due to the short half-life of thoron (55 seconds).

This is obtained by flushing the air into the chamber on the most direct way and by using the highest available pump rate (2 l/min).

Following preparatory configuration measures are necessary:

- Check if flow through adapter is mounted. If not, unscrew the diffusion adapter by hand and screw the flow through adapter by using the hexagon key (see Figure 50).
- Start the *AlphaGUARD* by pushing the ON/OFF button
- Check if set operation mode is OK (10 min, flow, Radon/Thoron). If necessary, change the required operation mode via menu (see 7.2.3) or by means of a PC connected to the *AlphaGUARD* using *DataVEIW* or *DataEXPERT* software (see *DataVIEW* or *DataEXPERT* manual).
- If mains operation is required (when battery is discharged and/or for long term operation) simply connect the mains adapter.

The status of the pump operation is indicated by a pump symbol in the upper right of the screen. Following states are possible:

Flow mode activated, pump flow within operational limits

Flow mode activated, flow of the pump disturbed (e.g. by sharp bended tubes) or hardware problem with pump module

Note

- With the continuous radon/thoron operation mode, the AlphaGUARD generates useful results in 10 min cycle up to a mix ratio between thoron and radon of 1:5 and vice versa (5:1). With bigger differences in ratio, the uncertainties of individual results on the part of the gas with the lower concentration becomes too large in order to deliver qualified data for the respective parameter.
- Operating the AlphaGUARD in radon/thoron mode the build-up of the thoron progeny Po212 is determined and the results of radon and thoron are corrected accordingly. After switching from the RnTn mode to the conventional radon modes (diffusion or flow) the correction of Po212 is lost. For subsequent measurements, this may lead to overestimating the radon concentration due to remaining Po212 activity in the chamber. Hence, after measuring high thoron concentrations, it is recommended to allow residual activity to decline and resume radon measurements only a couple of days later.
- In case the flow rate is set to a different value, the flow rate will be changed to 1 l/min resp. 2 l/min according to the selected Radon/Thoron discrimination mode. After deactivating the Radon/Thoron discrimination mode, the originally selected flow rate will be set back.

Important note

- It has to be ensured that the thread between chamber entry window and diffusion / flow adapter is always lubricated. For lubricating the thread ordinary lubricants can be used like silicon oil or Vaseline.

10 EXTERNAL ACCESSORIES

At this place the external accessories of the *AlphaGUARD* can only be described as far as the correct connection to the *AlphaGUARD* is concerned. Details relating to the parameters of the performance of these components are available in the corresponding technical description.

10.1 Tyvek® dust protection bag

When using *AlphaGUARD* in dusty environments (e.g. mines), it is recommendable to protect the *AlphaGUARD* against dust with a Tyvek® bag. The Tyvek® dust protection bag consists of paper fleece like functional textile made from high density polyethylene fibres. The diffusion activity of the radon into the detector is only marginally delayed by the bag's tissue.

10.2 External battery

To extend the battery life time of AlphaGUARD an external battery unit can be connected to the mains power connector. Please check with us for individual solutions and proposals.

10.3 Radon progeny front end *AlphaPM*

The radon progeny measuring front end of the type *AlphPM* is a professional radon progeny meter for the time-resolved recording of air-borne radon progeny concentration. An integrated pumping element continually sucks the air through a filter, collecting radon progeny products which are attached to aerosol particles. Based on a 10 min, cycle, the alpha activity of the accumulated progeny products is measured by an alpha sensitive microchip opposite to the filter platelet, evaluated and transferred as a sequence of TTL-signals to its signal output (Interface for external sensors 1) where it is tapped by the *AlphaGUARD*.

To the range of delivery of the *AlphaPM* belongs a shielded special cable. This cable is provided with a plug for the Interface for external sensors 1 and serves for transmitting the signals between *AlphaPM* and *AlphaGUARD*.

Figure 51: *AlphaPM* connected as front-end to *AlphaGUARD* for simultaneous monitoring of radon and its decay products

Note

- Only the original cable may be used
- The power supply of the AlphPM is assured via its built-in rechargeable battery and/or the mains-/ charging unit
- The sampling time of the AlphaPM has to be set to "cont_h" for continuous recording of the radon progeny concentration.

After connecting the communication cable between *AlphaGUARD* and the *AlphaPM* the progeny meter is synchronized and controlled by the *AlphaGUARD* (incl. switched ON/OFF).

Note

- The quantity "counts" on the AlphaGUARD's display shows a count rate which is proportional to the real result of the recent equivalent progeny product concentration
- The AlphaGUARD solely files count rates in its data storage
- In order to represent the concentration of radon progenies, correctly by its respective units, using DataVIEW or DataEXPERT software, the conversion factor for the progenies measurement channel needs to be set to 44.4. (see also operating manual "DataVIEW" or "DataEXPERT")

Reference

For details regarding the simultaneous measurement of radon decay products please see the AlphaPM Instruction Manual.

10.4 AquaKIT

In combination with *AlphaGUARD DF2000* the *AquaKIT* allows determining the radon concentration in water samples directly and precisely. The glass vessels of the *AquaKIT* measuring equipment grant a hermetically sealed enclosure of the radon, expelled from the water samples as well as a fast change of samples - which prevents incorrect measurements as a consequence of leakages.

With the *AquaKIT* set-up, the *AlphaGUARD DF2000* user can determine radon directly and radium indirectly in water samples. In a closed gas cycle radon is expelled from the water sample by the internal pump of *AlphaGUARD*. With the *AlphaGUARD DF2000*, whose ionization chamber is also part of the gas cycle, the radon concentration in the system is determined and stored in its memory (1- resp. 10- min. cycle) in form of a concentration time series.

Figure 52: Water sample measurement with *AquaKIT*

Reference

For details regarding the simultaneous measurement of radon decay products please see the AquaKIT Instruction Manual.

10.5 REM1

The REM1 (Radon Exchange Module) is an all-in-one solution for time-resolved radon monitoring in water with the AlphaGUARD DF2000. The setup is equipped with an embedded pump for water sampling. The portable suitcase includes all necessary accesories, for a well-suited set up, for laboratory as well as field measurements.

Figure 53: Complete setup with REM1 and AlphaGUARD DF2000

Figure 54: Interior view of REM1 with water pump, tubing and the REM module itself

10.6 Multisensor Unit D/T

The *Multisensor Unit* is an external sensor module with precise differential pressure- and temperature sensor particularly developed for *AlphaGUARD* (e.g. for radon measurement applications in buildings).

A shielded cable belongs to the delivery of both types. The cable is provided with a plug for the Interface for external sensors 1. This cable serves for the electrical connection between *AlphaGUARD* and the *Multisensor Unit*. This assures the transmission of the analog signals of the sensors as well as their voltage supply by the battery of the *AlphaGUARD*.

The *Multisensor Unit* is also equipped with an electrical socket by which the *Multisensor Unit* and *AlphaGUARD* can be supplied by an external voltage source (*AlphaGUARD*-mains/charging adapter). Alternatively, the unit as well as the *AlphaGUARD* (if connected) can be powered by a booster battery which has to be attached using the MINI-DIN-8S plug.

Figure 55: Multisensor Unit

Note

Only use the original cable.

After establishing the electrical connection between an *AlphaGUARD* and the *Multisensor Unit* and start of operation, the correct function of the sensors and the signal transmission can be checked directly.

For this purpose the 1-, 10, resp. 60-min. measuring cycle (flow or diffusion) have to be chosen at the *AlphaGUARD* and the analog input 1 and 2 have to be adapted to the used *Multisensor Unit* (see 7.2.8). Now the correctness of the appearing measuring values can be displayed in the screen of Acquisition 2/5 (see 7.1.2).

Reference

For details regarding the simultaneous measurement of radon decay products please see the Mutlisensor Unit Instruction Manual.

10.7 Soil gas probe

The *soil gas probe* has been reliably applied for many years in conventional soil gas analysis. It is suited for manual as well as for machine-driven propulsion (adaptor for striking tools of the types Cobra, Bosch, Wacker and Makita). The exchangeable drilling tip, the insertable capillary probe and the aqua-stop filter ensure easy and safe sampling.

The *AlphaGUARD* as measuring and recording device provides optimized features for soil gas measurement, e.g. short recovery time (typically: 5 min), even after measuring extremely high radon concentrations.

A sampling method, developed in cooperation with GGD Leipzig is provided. This approach is based on the experience with several thousand measurements. The expenditure of time for one measurement point is approx. 15 min.

The soil gas probe can optionally be completed by an inflatable bag (packer) for airtight measurements when using existing drill holes (ø 35–42 mm). Moreover, an extension set up to 10 m as well as lifting tools or hydraulic extraction devices for safely pulling out the rod are available on request.

Figure 56: Soil gas probe with accessories

The full procedure for soil gas measurement is provided with the soil gas probe. As described during this procedure it is required to switch off the pump of the *AlphaGUARD* manually:

1. By pressing the 'OK' key for 5 seconds in the numeric measurement windows (Acquisition 1/5 and 2/5), the pump can be switched off in the 1min and 10min Radon flow mode (manual stop). An acoustic signal is issued and the 'pump off' flag in the DataQA is set.
2. The manual stop is indicated by an unfilled pump symbol in the upper right corner of the display.
3. In the measurement status window (Acquisition 5/5) the flow rate shows 'Manual off'.
4. The manual stop is not possible in the diffusion modes or in thoron mode.
5. The manual stop is not possible while the interval mode is active.
6. The manual stop of the pump can be terminated by the following actions:
    a. Pressing the OK key for 5 seconds in the numeric measurement windows (Acquisition 1/5 and 2/5)
    b. Exiting the 'set pump flow' menu with the OK key
    c. A change of the operation mode
    d. A change in the analog channel 1 or 2 menu
    e. A change in the interval mode
    f. A change in the date/time menu
    g. After the execution of a memory clearing
    h. Turning off and on the device

Note

- During the recovery time the AlphaGUARD should be flushed with radon-poor fresh air.
- A fine-mesh filter cartridge (radon progeny filter) has to be connected between Soil gas probe and AlphaGUARD. If there is a danger of seeping water during the sampling of soil gas then additionally an aqua-stop filter has to be connected between Soil gas probe and AlphaGUARD.

Reference

For details regarding the simultaneous measurement of radon decay products please see the Soil gas probe Instruction Manual.

10.8 Differential Pressure Sensor DPS-5000

The DPS-5000 differential pressure sensor is an external sensor module optimized for the combined use with a radon monitor of the type *AlphaGUARD DF2000*. The measuring system *DPS-5000 – AlphaGUARD DF2000* allows simultaneous recording of differential pressure drawing therewith correlations to the radon concentration values and meteorological parameters measured by *AlphaGUARD*.
The registered differential pressures can be professionally analyzed by the *DataVIEW* or *DataEXPERT* software along with all the other parameters registered by the *AlphaGUARD*.

The *DPS-5000* sensor unit is especially suited for soil gas measurements and estimating the soil permeability. The device is directly connected to the gas inlet of the measurement chamber of *AlphaGUARD* type DF. The *DPS-5000* records simultaneously the pressure level within the gas circuit and forwards the signal to the *AlphaGUARD* for converting and storing. Moreover, it protects the internal gas pump from elevated negative pressure levels by a particular shut-off feature.

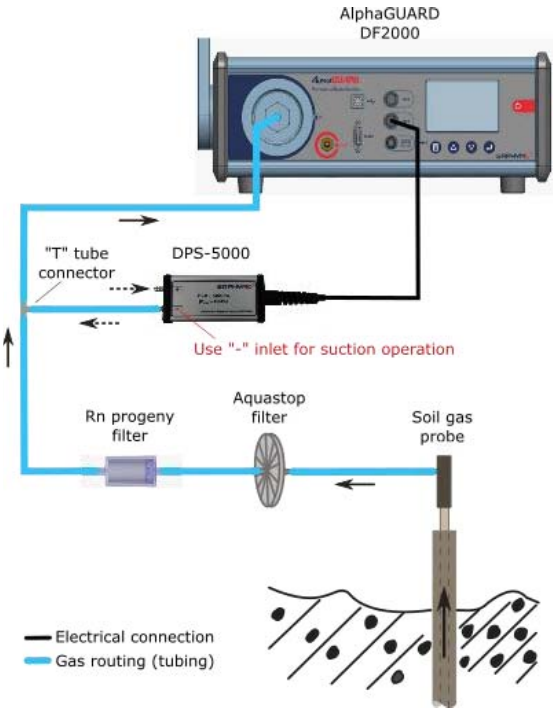


Figure 57: Setup of *DPS-5000* with *AlphaGUARD DF2000* for soil gas measurements

Reference

For details regarding the operation of the DSP-5000 in combination with the AlphaGUARD DF2000 please see the DSP-5000 Manual.

10.9 Equipment for calibration measurements

A wide range of calibration equipment can be provided: Gas-tight calibration containers in different sizes, active coal filters, radon calibration source, etc., suitable for different applications from small re-calibration systems to large calibration facilities e.g. for calibration labs. Please check with us for standard and individual solutions.

Figure 58: 50 L calibration container

Figure 59: 1 L active coal filter for low level tests (left) and radon calibration source, traceable to the Czech Metrology institute (right)

10.10 Remote and stationary monitoring

For remote access of the *AlphaGUARD* as well as for the integration of one or more *AlphaGUARD* units into real time online networks, suitable solutions for specific requirements are available. These solutions are based on publicly available IT services and approved transmission components. Specifically developed software modules ensure a reliable interaction of the *AlphaGUARD* units with the applied IT interfaces.

Data transmission can be adapted according to the requirements of the application (e.g. outdoor cabinets for outdoor use, automatic ventilation or heating for extreme weather conditions, specified data transmission solutions, etc.). Depending on the application, the following equipment is needed:

- AlphaGUARD
- COM Server (accessory for LAN integration) or DACC (LAN integration for real time monitoring, mobile phone network connection (4G) optional)
- Outdoor cabinet (if needed)
- DataVIEW PRO Software (intuitive software for comfortable data read out and parametrization), or
- DataEXPERT 10 software (Fig. 4). This software eases system management by showing all technical and radiological events of the connected probes in real time. The users have access to the system's overview, and all the instruments' parameters can be adjusted using its remote setup functions.

There is two types of data connection:

1. Manual read-out and parametrization by using LAN or internet connection, with a COM Server and DataVIEW PRO software.
2. Real time online monitoring by using LAN, internet connection or 4G mobile phone network, with a DACC (Data Acquisition & Configuration Computer) and DataEXPERT 10 software.

10.10.1 Manual remote read-out and remote parametrization

This solution ensures the access to the *AlphaGUARD* for configuration purposes and manual data downloads. The simple online mode of *DataVIEW PRO* can be used as well (Attention: there is no alarm functions available in the simple online mode). The *DataVIEW PRO* software must permanently be running and the online routine has to be started manually for each *AlphaGUARD* unit part of the network.

The communication with the AlphaGUARD is realized with a COM server connected to the AlphaGUARD. The COM server is accessable via LAN and/or Internet by using a virtual COM interface.

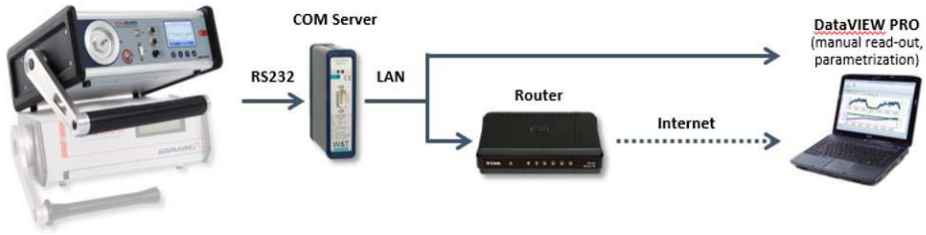


Figure 60: Setup for manual remote read-out and parametrization

10.10.2 Real-time online monitoring

This solution provides full online functionalities with real time data acquisition, alarm function, visualization, analyzing and reporting by using the software *DataEXPERT 10*. The software should permanently be running on a PC or a server. In case of an interrupted connection, the missing data are automatically retrieved subsequently. For this solution the AlphaGUARD is connected via RS232 to the Data Acquisition and Configuration Computer (DACC). The DACC can be equipped with integrated 3G / 4G modem for wireless remote monitoring. Alternatively, the DACC can be connected to the Web by using a DSL Router.

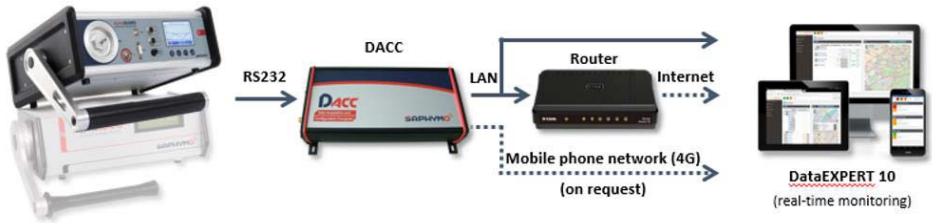


Figure 61: Setup for real time remote online monitoring

10.10.3 Stationary monitoring

For the continuous control of radon concentration at measurement points in remote areas, remote radon monitoring stations can be provided. Such monitoring stations can be used for radiation protection purposes or applications using radon as a tracer (e.g. in high seismological risk level areas, the radon in soil gas can be used as an indicator for seismic activities).

Monitoring stations can be adapted to the planned application according to the individual needs. Please check with us for standard and individual solutions.

Figure 62: Example of remote monitoring station

10.11 Alarm Outbreak Box

The AlphaGUARD provides an adjustable alarm threshold for the radon concentration. To extract alarm signals when the alarm threshold is exceeded, the Alarm Outbreak Box can be connected to the power supply connector of the AlphaGUARD (the power supply can be connected to the Alarm Outbreak Box). The Alarm Outbreak Box provides the following information:

Alarm high signal (switch to supply voltage, open emitter):

- No Alarm: switch opened (high impedance)
- Alarm: switch closed (connected to power supply), max. 100 mA

Alarm low signal (switch to ground, open collector):

- No Alarm: switch opened (high impedance)
- Alarm: switch closed (connected to ground), max 100 mA

With the Switch Box (part of the Alarm Outbreak Box), the alarm output signal can directly be used to switch on an external 230 V device (e.g. ventilation system). In addition, also a connecting cable with open end is included, e.g. for implementing the AlphaGUARD in an existing electronic alarm monitoring system.

Figure 63: Alarm Outbreak Box with Switch Box

10.12 Valve Selector

The *Valve Selector Unit* is a microprocessor-controlled device and serves as supplementary module to the *AlphaGUARD* for timer regulated switching between up to five gas entrances. This enables the *AlphaGUARD* Radon Monitor for quasi-simultaneously monitoring the radon concentration of up to five different environments by performing successive measurement steps in an always repeating manner.

The adjustable measurement regime can be passed through one by one in a repeating sequence or can be interrupted by a flushing cycle between each switching state.

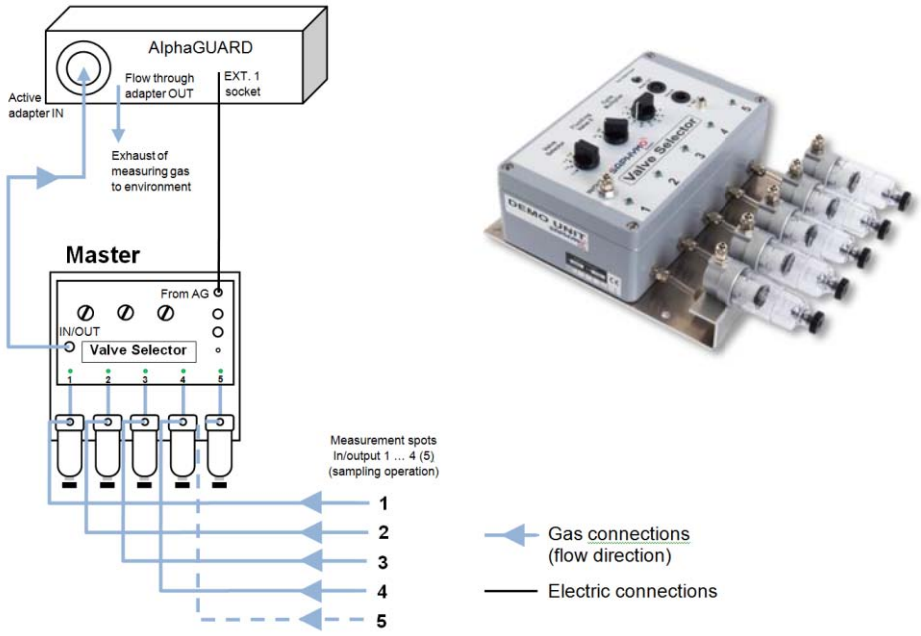


Figure 64: Multi-spot measurement using the Valve Selector Switch Box

Reference

For details regarding the operation of the Valve Selector please see the Valve Selector Manual.

11 PARTICULAR INFORMATION FOR USE

- AlphaGUARD disposes of an internal real time clock. When there are simultaneous measurements with several instruments the clocks have to be synchronized in advance.

Note

Only when the system clocks run parallel a correct correlation of measuring values is possible.

- Each time when switching on AlphaGUARD a new measurement series is generated automatically, and after receiving the first value established in the working memory. Here, all following measuring values are filed as far as the user has not enforced a further measuring series by memory reset, change of the system clock, change of the operation mode or switching the monitor off and on.

- The working memory of the AlphaGUARD has a capacity of up to 60 000 data points. If the memory is full, then automatically the eldest data point is overwritten respectively (ring storage). This means that with permanent operation of the AlphaGUARD, data of the last 60 000 measuring cycles are always available in the memory.

- The numbers of experiments are placed by the AlphaGUARD autonomously in ascending order. Up to a maximum of 512 measuring series can be administrated in the memory of AlphaGUARD. This means that initiating further measuring series leads to overwriting of the eldest measuring series.

Note

In order to avoid loss of data the memory should regularly be read out under consideration of the selected measuring cycle.

- Operating the AlphaGUARD for longer times mains-independently (> 10 days), the instrument switches off automatically. In this case the remaining capacity of the internal rechargeable battery has fallen below a certain limit to operate correctly. This security switch off secures the battery against a total discharging and prevents the complete system from malfunction.

- The automatic background correction can lead to negative radon values especially when measuring with short cycles (1 or 10 min) close to the lower detection limit.

- The automatic background correction of the AlphaGUARD can only be executed at the beginning of a measuring series. Therefore with measurements lasting longer than six months the set-up of a new measuring series should be manually enforced, i.e. immediately after every half year, January 01 and July 01 (for example by ON/OFF or setting the system clock with DataVIEW or DataEXPERT).

Note

During a measuring series in process the automatic background correction is suppressed.

12 TECHNICAL DATA

12.1 Basic functions *AlphaGUARD D50*

Type of radon detector	Ionization chamber, HV ≈ 750 VDC
Mode of operation	3D-alpha spectroscopy and current mode
Total detector volume	0,62 liter (38 cubic inches)
Active detector volume	0,56 liter (34 cubic inches)
Type of Radon progeny filter (detector entry window)	Fine dust filter (retention coefficient >99,9 %)
Detector filling mechanism	Design-optimized for fast passive diffusion
Transient response function (time delay)	Signal > 30 % after 10 min Signal > 70 % after 20 min Signal > 90 % after 30 min
Detector signal acquisition	Fast digital signal sampling network, using three separate ADC channels
Spectral signal extraction	DSP (Digital Signal Processing), on-line-cross correlation algorithms
Detector efficiency	1 CPM at 20 Bq/m³ (or at 0,55 pCi/l)
Background signal due to internal detector contamination	< 1 Bq/m³ (0.03 pCi/l)
Measurement range Radon (Rn-222)	2 Bq/m³ … 50 000 Bq/m³ (<0.05 pCi/l … 1 350 pCi/l)
Resolution on LCD display	1 Bq/m³ (0.01 pCi/l)
Fold back protection	**> 10.000.000 Bq/m³ (> 300 000 pCi/l) verified**
System linearity error	< 3% within total range
Instrument calibration error (Rn-222)	± 3 % (plus uncertainty of the primary standard)
Measurement modes and cycles	10 min, 60 min (Diffusion)
Data capacity (non-volatile)	Up to 60 000 measurement points ~ 400 days at 10 min measuring cycle ~ 2 500 days at 60 min measuring cycle

Operation from internal battery	> 10 days
Weight (incl. Internal battery)	6,2 kg (13,7 lbs)
Dimensions without handle (L x W x H) **Dimensions with handle (L x W x H)**	282 mm x 340 mm x 123 mm 329 mm x 355 mm x 123 mm
System operating range - **Temperature** - **Atmospheric pressure** - **Humidity**	 -10 °C … +50 °C (+14 … +122 °F) 700 mbar … 1100 mbar 0 % rH … 95 % rH (non-condensing)
Power consumption external power supply	100 – 240 V (400 mA) 50 – 60 Hz

12.2 Basic functions *AlphaGUARD D2000*

Type of radon detector	Ionization chamber, HV ≈ 750 VDC
Mode of operation	3D-alpha spectroscopy a n d current mode
Total detector volume	0,62 liter (38 cubic inches)
Active detector volume	0,56 liter (34 cubic inches)
Type of Radon progeny filter (detector entry window)	Fine dust filter (retention coefficient >99,9 %)
Detector filling mechanism	Design-optimized for fast passive diffusion
Transient response function (time delay)	Signal > 30 % after 10 min Signal > 70 % after 20 min Signal > 90 % after 30 min
Detector signal acquisition	Fast digital signal sampling network, using three separate ADC channels
Spectral signal extraction	DSP (Digital Signal Processing), on-line-cross correlation algorithms
Detector efficiency	1 CPM at 20 Bq/m³ (or at 0,55 pCi/l)

Background signal due to internal detector contamination	< 1 Bq/m³ (0.03 pCi/l)
Measurement range Radon (Rn-222)	2 Bq/m³ … 2 000 000 Bq/m³ (<0.05 pCi/l … 54 000 pCi/l)
Resolution on LCD display	1 Bq/m³ (0.01 pCi/l)
Fold back protection	> 10.000.000 Bq/m³ (> 300 000 pCi/l) verified
System linearity error	< 3% within total range
Instrument calibration error (Rn-222)	± 3 % (plus uncertainty of the primary standard)
Measurement modes and cycles	10 min, 60 min (Diffusion)
Data capacity (non-volatile)	Up to 60 000 measurement points ~ 400 days at 10 min measuring cycle ~ 2 500 days at 60 min measuring cycle
Resolution of graphic display	160 x 104 pixels
Operation from internal battery	> 10 days
Weight (incl. Internal battery)	6,2 kg (13,7 lbs)
Dimensions without handle (L x W x H) **Dimensions with handle (L x W x H)**	282 mm x 340 mm x 123 mm 329 mm x 355 mm x 123 mm
System operating range - **Temperature** - **Atmospheric pressure** - **Humidity**	 -10 °C … +50 °C (+14 … +122 °F) 700 mbar … 1100 mbar 0 % rH … 95 % rH (non-condensing)
Power consumption external power supply	100 – 240 V (400 mA) 50 – 60 Hz

12.3 Basic functions *AlphaGUARD DF2000*

Type of radon detector	Ionization chamber, HV ≈ 750 VDC
Mode of operation	3D-alpha spectroscopy a n d current mode
Total detector volume	0,62 liter (38 cubic inches)
Active detector volume	0,56 liter (34 cubic inches)
Type of Radon progeny filter (detector entry window)	Fine dust filter (retention coefficient >99,9 %)
Detector filling mechanism	Design-optimized for fast passive diffusion
Transient response function (time delay)	Signal > 30 % after 10 min Signal > 70 % after 20 min Signal > 90 % after 30 min
Detector signal acquisition	Fast digital signal sampling network, using three separate ADC channels
Spectral signal extraction	DSP (Digital Signal Processing), on-line-cross correlation algorithms
Detector efficiency in Radon measurement mode	1 CPM at 20 Bq/m³ (0,55 pCi/l)
Detector efficiency in Rn/Tn discrimination mode - **for radon** - **for thoron at 1l/min flow rate** - **for thoron at 2l/min flow rate**	1 CPM at 60 Bq/m³ (1,6 pCi/l) 1 CPM at 200 Bq/m³ (5,5 pCi/l) 1 CPM at 140 Bq/m³ (3,8 pCi/l)
Background due to internal detector contamination	< 1 Bq/m³ (0.03 pCi/l)
Measurement range Radon (Rn-222)	2 Bq/m³ … 2 000 000 Bq/m³ (0.05 pCi/l … 54 000 pCi/l)
Measurement range Thoron (Rn-220)	2 Bq/m³ … 2 000 000 Bq/m³ (0.05 pCi/l … 54 000 pCi/l)
Resolution on display	1 Bq/m³ (0.01 pCi/l)
Fold back protection	> 10.000.000 Bq/m³ (> 300 000 pCi/l) verified
System linearity error	< 3% within total range
Instrument calibration error (Rn-222)	± 3 % (plus uncertainty of the primary standard)

Measurement modes and cycles	10 min, 60 min (Diffusion) 1 min, 10 min (Flow) 10 min (Rn/Tn mode) Interval mode (applicable for flow mode)
Flow range of pump	Flow-regulated: 0,05 - 0,5 l/min, 1 l/min, 2 l/min
Data capacity (non-volatile)	Up to 60 000 measurement points ~ 40 days at 1 min measuring cycle ~ 400 days at 10 min measuring cycle ~ 2 500 days at 60 min measuring cycle
Resolution of graphic display	160 x 104 pixels
Battery life time (diffusion mode) **Battery life time (flow mode)**	> 10 days > 10 h
Dimensions without handle (L x W x H) **Dimensions with handle (L x W x H)**	282 mm x 340 mm x 123 mm 329 mm x 355 mm x 123 mm
Weight (incl. Internal battery)	7 kg (15,4 lbs)
System operating range - **Temperature** - **Atmospheric pressure** - **Humidity**	 -10 °C … +50 °C (+14 … +122 °F) 700 mbar … 1100 mbar 0 % rH … 95 % rH (non-condensing)
Power consumption external power supply	100 – 240 V (400 mA) 50 – 60 Hz

12.4 Multiparameter Features *AlphaGUARD D50, D2000, DF2000*

Atmospheric air pressure - **Type of sensor** - **Measurement range** - **Resolution displayed on Screen** - **Resolution under DataVIEW or DataEXPERT** - **Initial calibration uncertainty**	Piezo-resistive semiconductor sensor 700 mbar ... 1100 mbar 0,1 mbar 0,1 mbar +/- 3 mbar
Ambient temperature (sensor in ionization chamber) - **Type of sensor** - **Measurement range** - **Resolution displayed on Screen** - **Resolution under DataVIEW or DataEXPERT** - **Initial calibration uncertainty**	Band gab semiconductor sensor - 20 °C ... + 70 °C (- 4 ... + 158 °F) 0,1 °C (0,1 °F) 0,1 °C (0,1 °F) +/- 1,5 °C (+/-2,5 °F)
Relative air humidity (sensor in ionization chamber) - **Type of sensor** - **Measurement range** - **Resolution displayed on Screen** - **Resolution under DataVIEW or DataEXPERT** - **Initial calibration uncertainty**	Capacitive semiconductor sensor 0 % rH ... 99 % rH 0,1 % rH 0,1 % Rh +/- 3 % rH
External sensor channel 1 & 2 - **Measurement range** - **Resolution under DataVIEW or DataEXPERT** - **Signal sampling rate** - **Total signal error** - **Input impedance** - **Input connector type**	0 VDC ... 2,5 VDC 0,00061 VDC 30 per minute +/- 0,01 VDC plus +/- 3 % 10 kOhm HIROSE HR10A-10R-10PB

Relocation sensor - **Type of sensor** - **Events detected** - **Notation for DataEXPERT**	3-axis, capacitive semiconductor sensor Gentle acceleration (low-freq. only) Number of events per cycle (max. 254)
Mains power monitor - **Operating principle** - **Events detected** - **Notation for *DataEXPERT***	Monitors ext. 10 … 32 VDC supply from mains adapter Loss or restart of mains supply, charging Irrevocable flag set for loss or restart and charging
External counter signal channel 1 & 2 - **Operating principle** - **Events detected** - **Measuring range** - **Notation for *DataEXPERT***	Pulse counter Counts per minute (cpm) 0 ... 10 kHz Series of statistical values of pulse rate
Gamma dose rate channel (option) - **Type of sensor** - **Measuring range** - **Initial calibration uncertainty** - **Resolution displayed on Screen**	Geiger-Müller tube 20 nSv/h … 10 mSv/h +/- 20 rel.-% 1 nSv/h

13 RANGE OF DELIVERY

Following table shows the standard range of delivery depending on type of the different *AlphaGUARD* radon monitor:

	D50 / D2000	DF2000
1) AlphaGUARD	✓	✓
2) Transport case	✓	✓
3) Mains-/charging adapter	✓	✓
4) USB cable	✓	✓
5) Dust protection bag (Tyvek)	✓	✓
6) Diffusion adapter	✓	✓
7) Flow through adapter	✗	✓
8) Hexagon key for flow through adapter	✗	✓
9) Air tube (ca. 2 m)	✗	✓
10) Radon progeny filter	✗	✓
11) Quick coupling (2 x)	✗	✓
12) DataVIEW PRO	✓ Needs to be ordered separately	✓ Needs to be ordered separately
13) User manual & Certificate of calibration	✓	✓

Figure 65: Range of delivery

14 APPENDIX

14.1 *AlphaGUARD* models – characteristics and application areas

	D50	D2000	DF2000
Measuring range	2 to 50 000 Bq/m³	2 to 2 000 000 Bq/m³	2 to 2 000 000 Bq/m³
Storage capacity	60 000	60 000	60 000
2 x ext. analog input	✓	✓	✓
2 x ext. counter input	✓	✓	✓
Diffusion mode	✓	✓	✓
Flow mode (internal pump)	✗	✗	✓
Measuring cycles (Diffusion)	10 min 60 min	10 min 60 min	10 min 60 min
Measuring cycles (Flow)	✗	✗	1 min 10 min 10 min (Rn/Tn mode) Interval mode
Radon in air	✓ Diffusion	✓ Diffusion	✓ Diffusion and Flow
Radon/Thoron discrimination	✗	✗	✓
Radon in soil gas*	✗	✗	✓ With Soil Gas probe
Radon in water samples*	✗	✗	✓ With AquaKIT
Radon progenies*	✓ With AlphaPM	✓ With AlphaPM	✓ With AlphaPM
Dose rate*	✓ With dose rate module	✓ With dose rate module	✓ With dose rate module
Multisensor Unit*	✓	✓	✓
Calibration measurements*	✓ Inside container by diff.	✓ Inside container by diff.	✓ In. / out. container by diffusion/flow
Emanation measurements*	✓ Inside container by diff.	✓ Inside container by diff.	✓ In. / out. container by diffusion/flow
Exhalation measurements*	✓ Inside Radon box by diffusion	✓ Inside Radon box by diffusion	✓ Inside / outside Radon box by diffusion/flow

*Optional / external accessories required

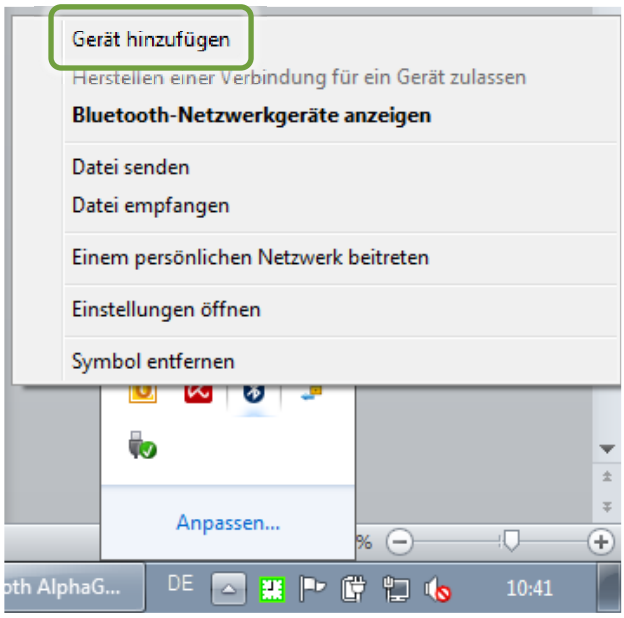
14.2 *Setup of Bluetooth connection*

The Bluetooth interface of the AlphaGUARD can be used to establish a wireless Bluetooth connection to computers with Windows 7 or 10 and DataVIEW PRO installation as an alternative to the cabled connection. For this, a virtual COM interface needs to be adjusted via the following procedure (depending on Windows version):

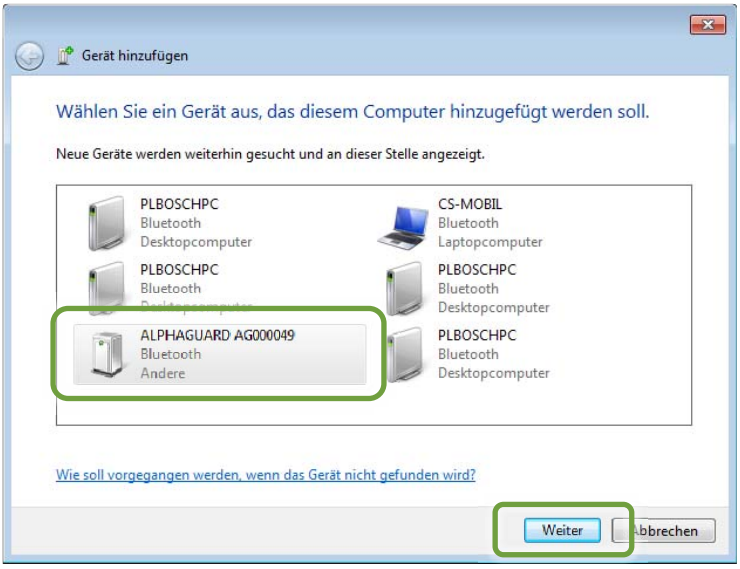
14.2.1 Bluetooth communication with Windows 7

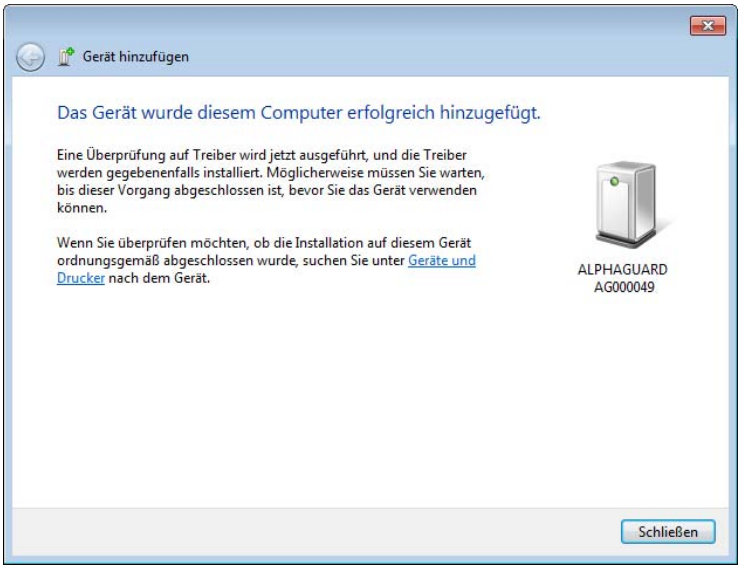
1. Activate the Bluetooth connection at the AlphaGUARD (see also point 7.2.9.9):
    a. Push the menu button
    b. Navigate to "Settings menu" and push the enter button
    c. Navigate to "Set interface" and push the enter button
    d. Choose "BLUETOOTH" and push the enter button
    e. Navigate back by pushing the menu button

2. Click on the Bluetooth symbol in the windows system area and then click on "Add a Bluetooth Device":



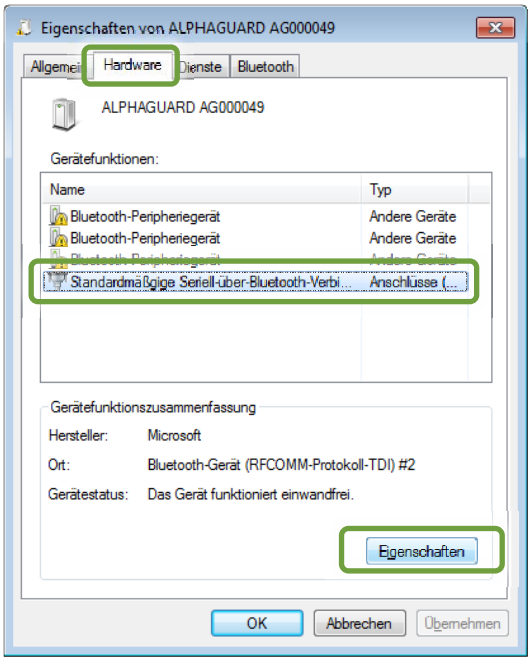
3. Click on "ALPHAGUARD AGXXXXXX" and then "OK" (ignore error message "… was not correctly installed"):

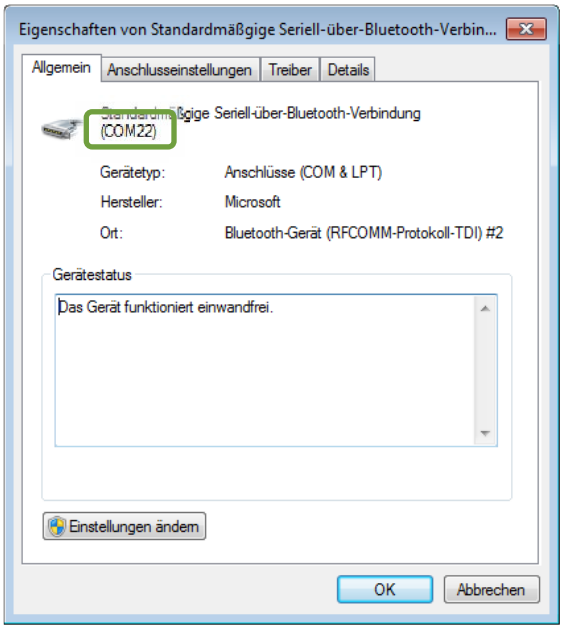




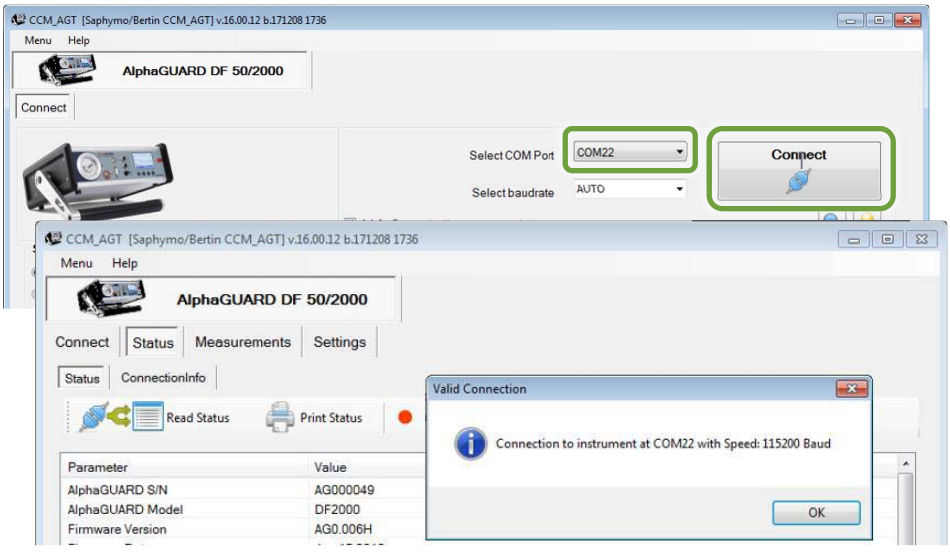
4. Open "Devices and printers" in the system settings, Right-hand click "ALPHAGUARD AGXXXXXX" and then on "Properties" (ignore the warning symbol):

5. Click on "Hardware", then on "Standard serial via Bluetooth connection", then on "Properties" and check the no. of the COM interface (in that case: "COM22):





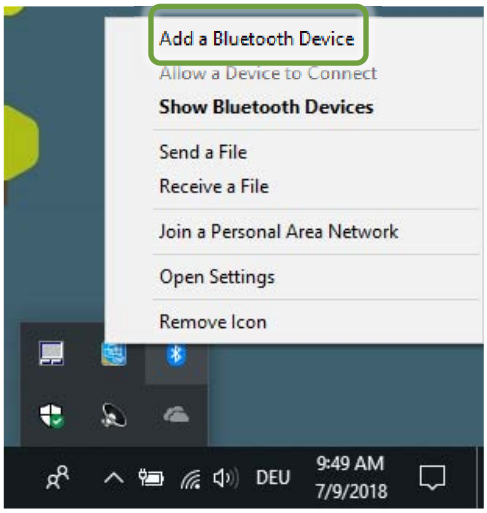
6. Open DataVIEW PRO and choose the COM interface identified under point 5 (in that case: "COM22") for the data connection. The connection will work like a cabled connection after clicking on "Connect":



14.2.2 Bluetooth communication with Windows 10

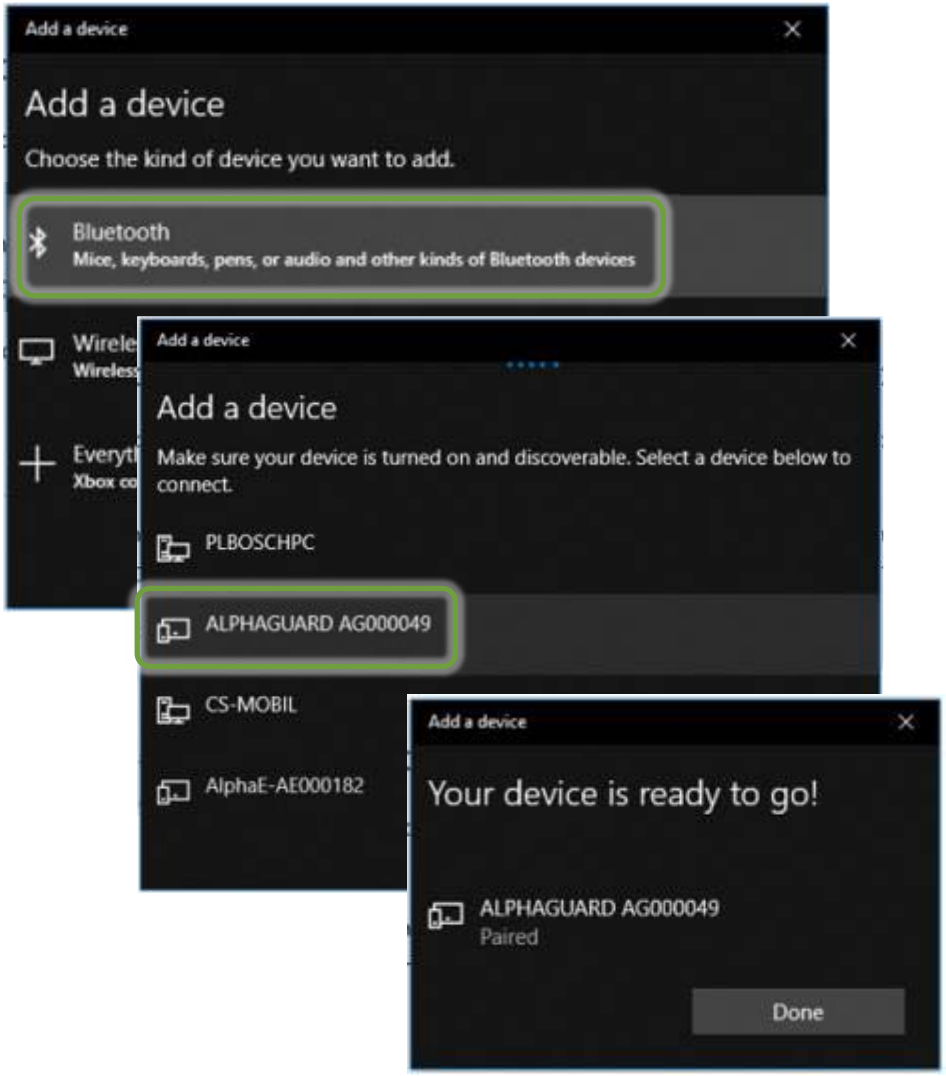
1. Activate the Bluetooth connection of the AlphaGUARD (see also point 7.2.9.9):
    a. Push the menu button
    b. Navigate to "Settings menu" and push the enter button
    c. Navigate to "Set interface" and push the enter button
    d. Choose "BLUETOOTH" and push the enter button
    e. Navigate back by pushing the menu button

2. Click on the Bluetooth symbol in the windows system area and then click on "Add a Bluetooth Device":

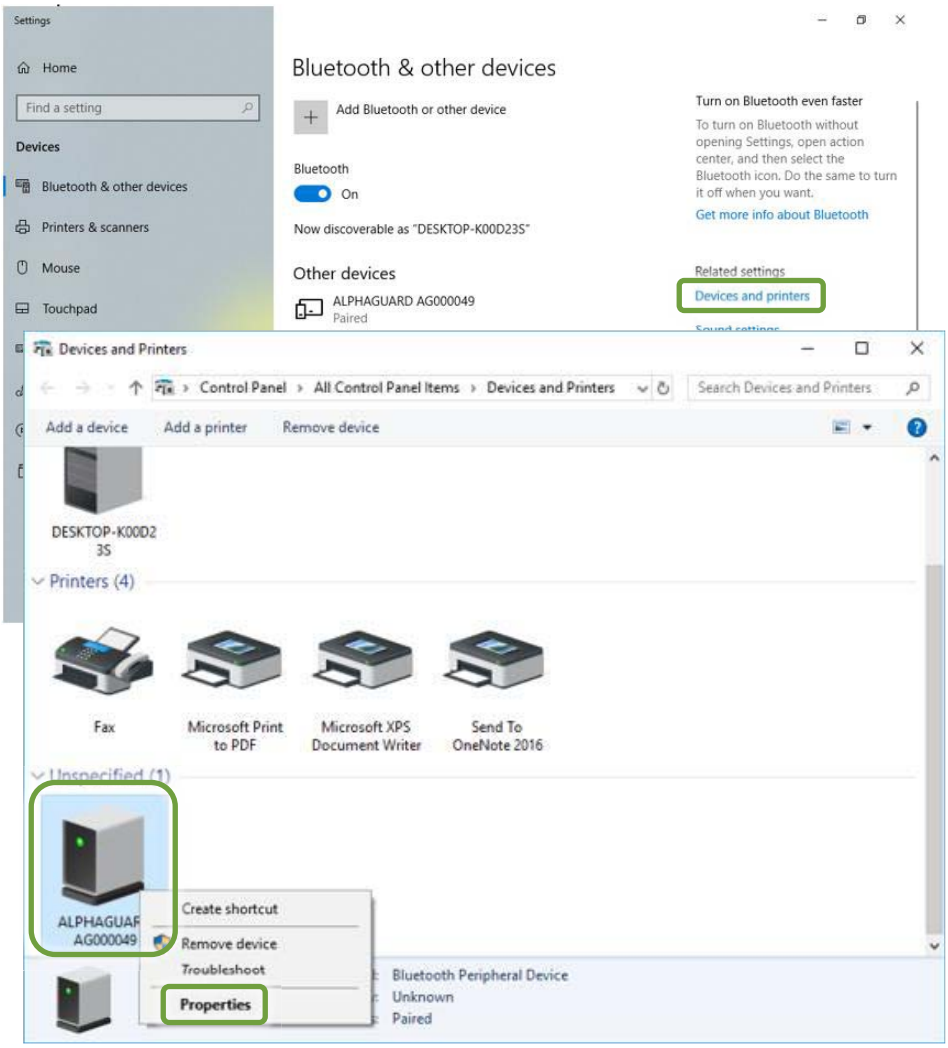


3. Click on "Add Bluetooth or other device":

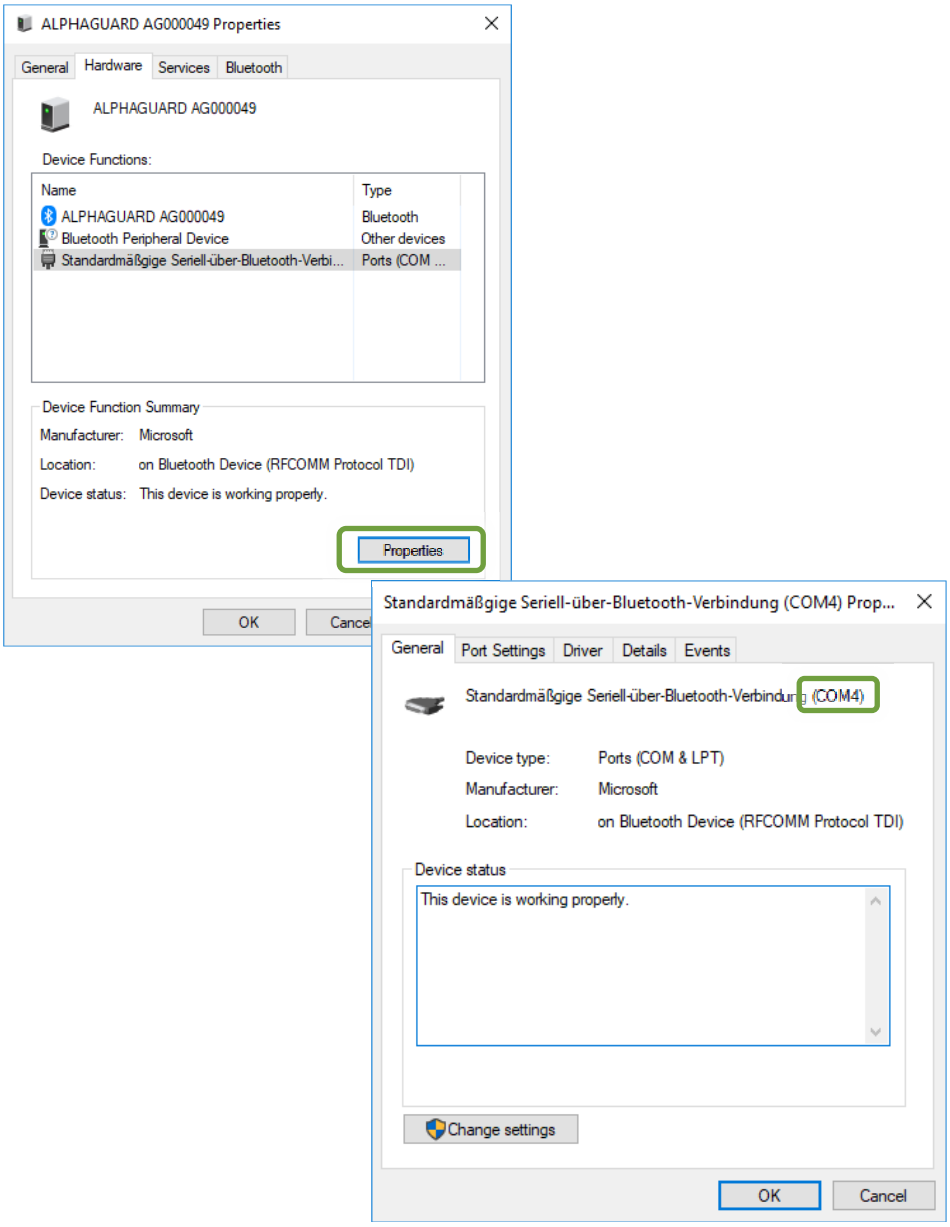
4. Click on "Bluetooth" and then on "ALPHAGUARD AGXXXXXX" to pair the computer to the AlphaGUARD:



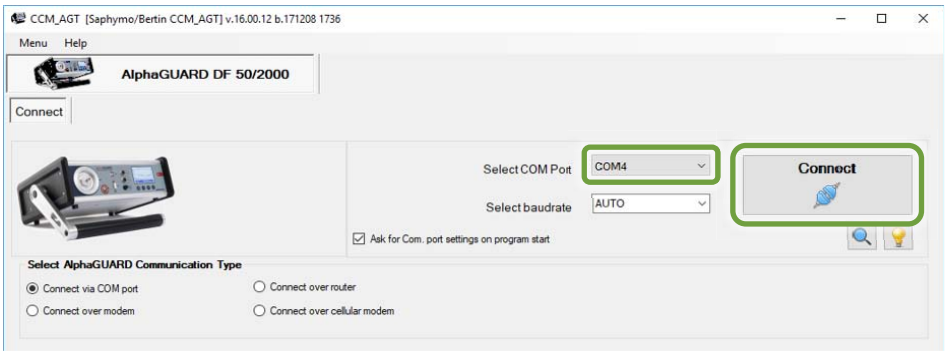
5. Click on "Devices and printers", then on "AlphaGUARD AGXXXXXX", then on "Properties":

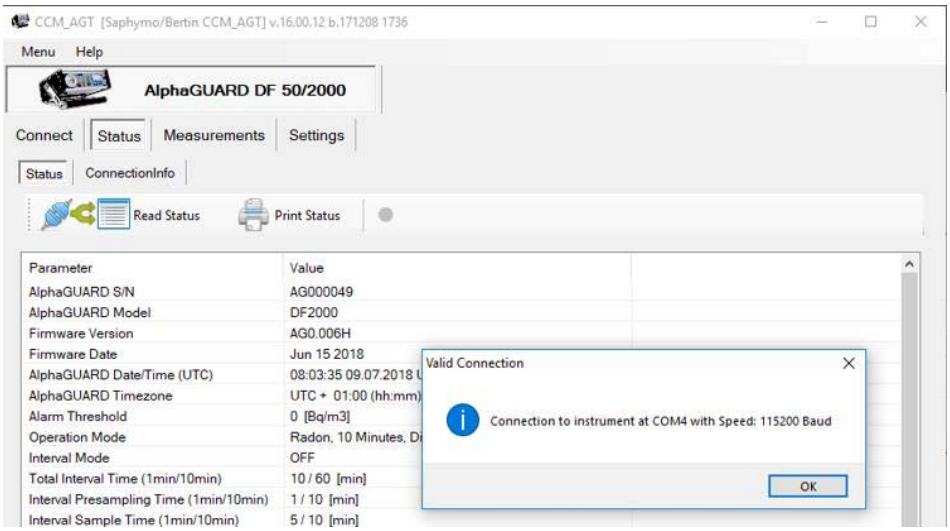


6. Click on "Properties" and check the no. of the COM interface (in that case "COM4"):



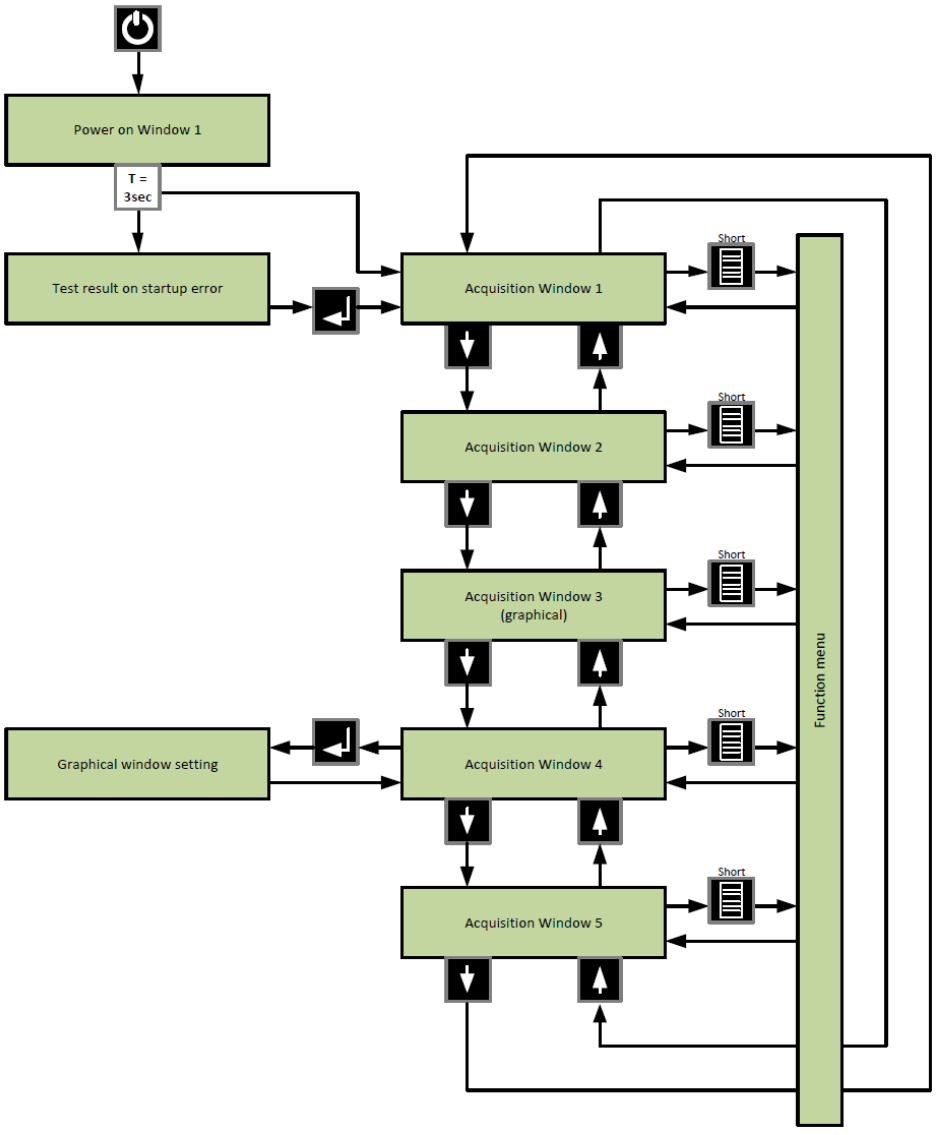
7. Open DataVIEW PRO and choose the COM interface identified under point 6 (in that case: "COM4") for the data connection. The connection will work like a cabled connection after clicking on "Connect":



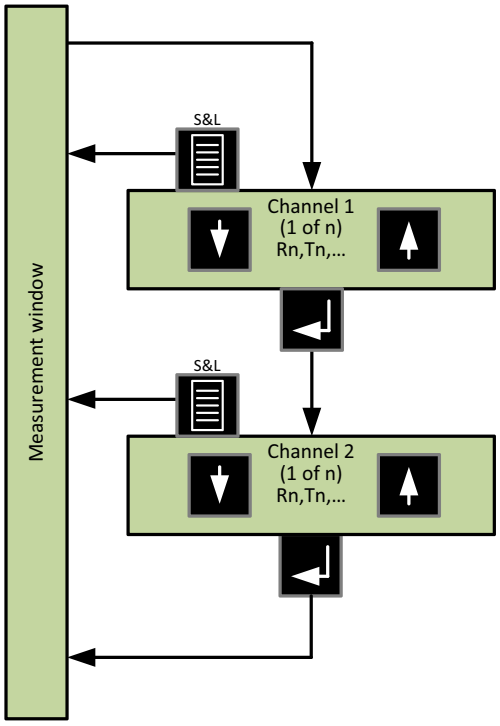


14.3 *Flow diagrams of the AlphaGUARD menu*

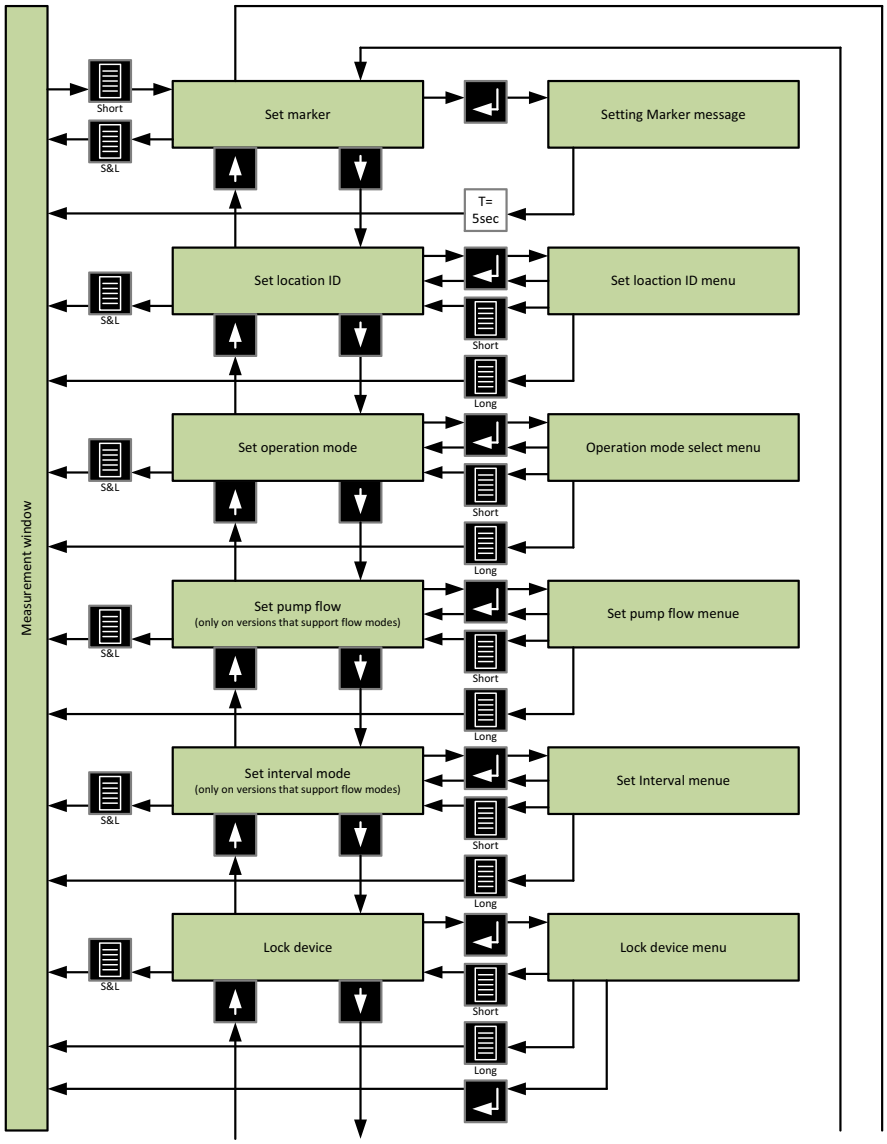
14.3.1 Acquisition windows



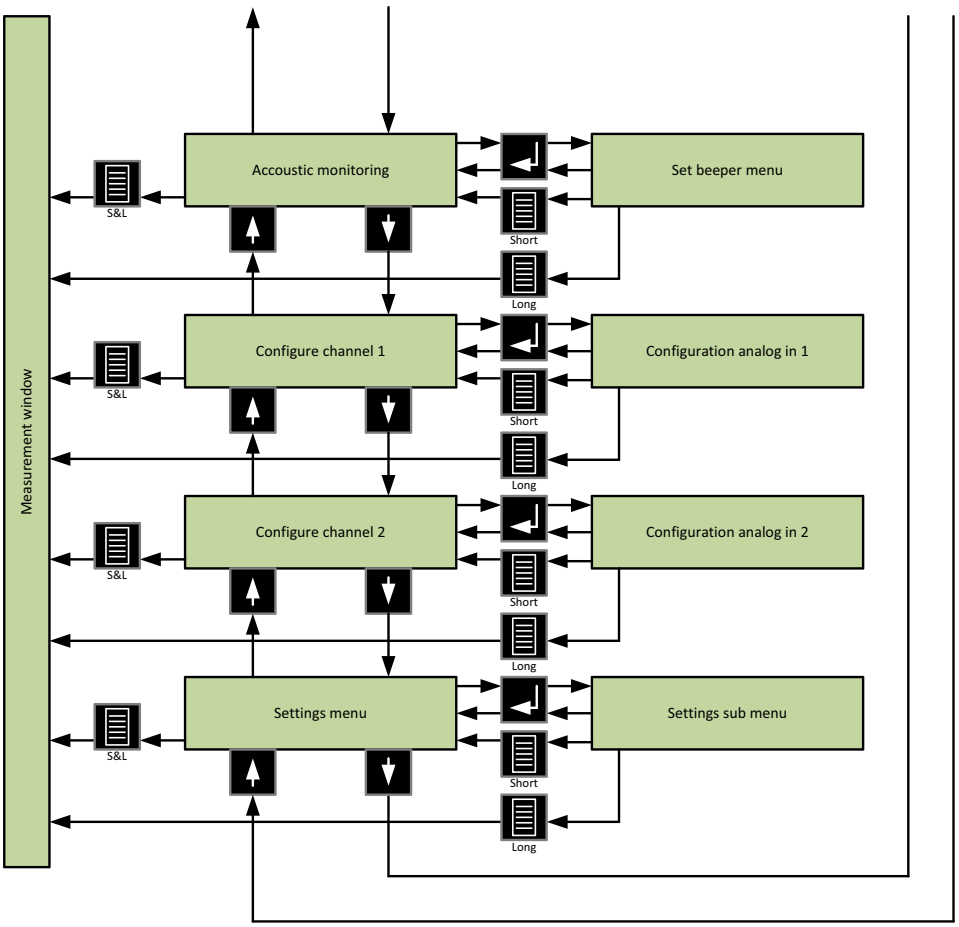
Graph selection (Acquisition 3)



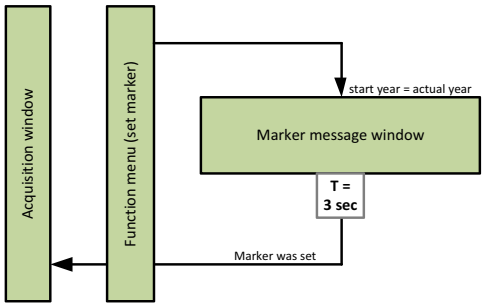
14.3.2 Function menu



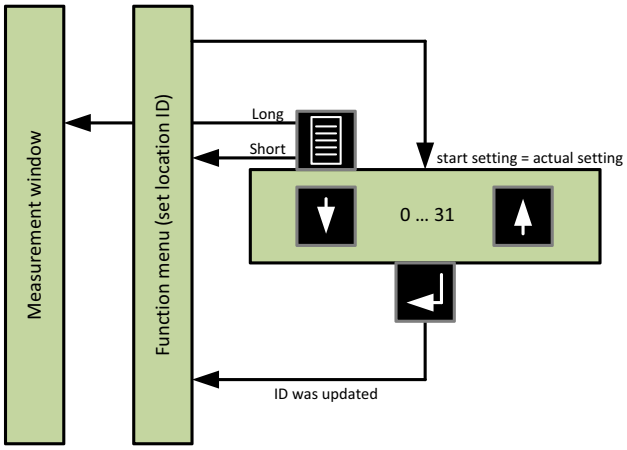
... Continuation on next page


Measurement window
Accoustic monitoring
Set beeper menu
Configure channel 1
Configuration analog in 1
Configure channel 2
Configuration analog in 2
Settings menu
Settings sub menu
S&L
Short
Long

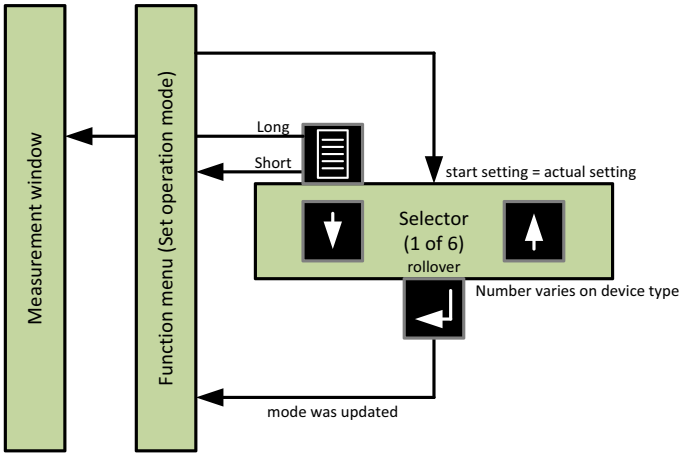
Set marker


Acquisition window
Function menu (set marker)
start year = actual year
Marker message window
T =
3 sec
Marker was set

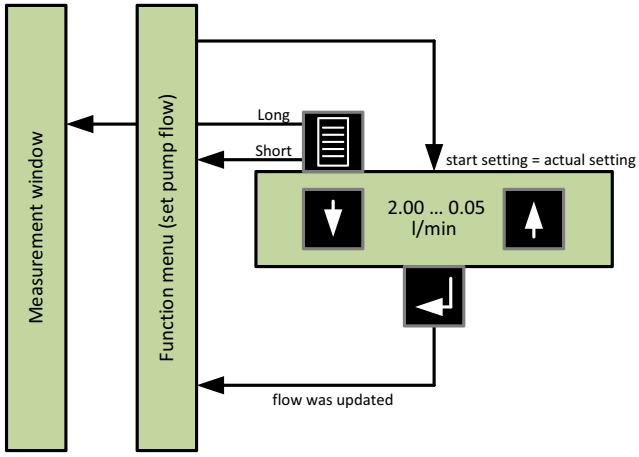
Set location ID



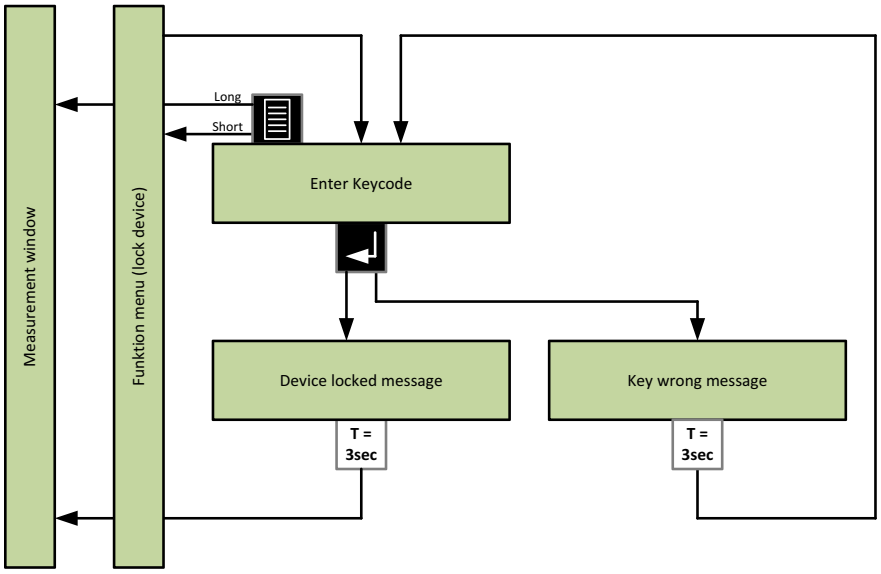
Set operation mode

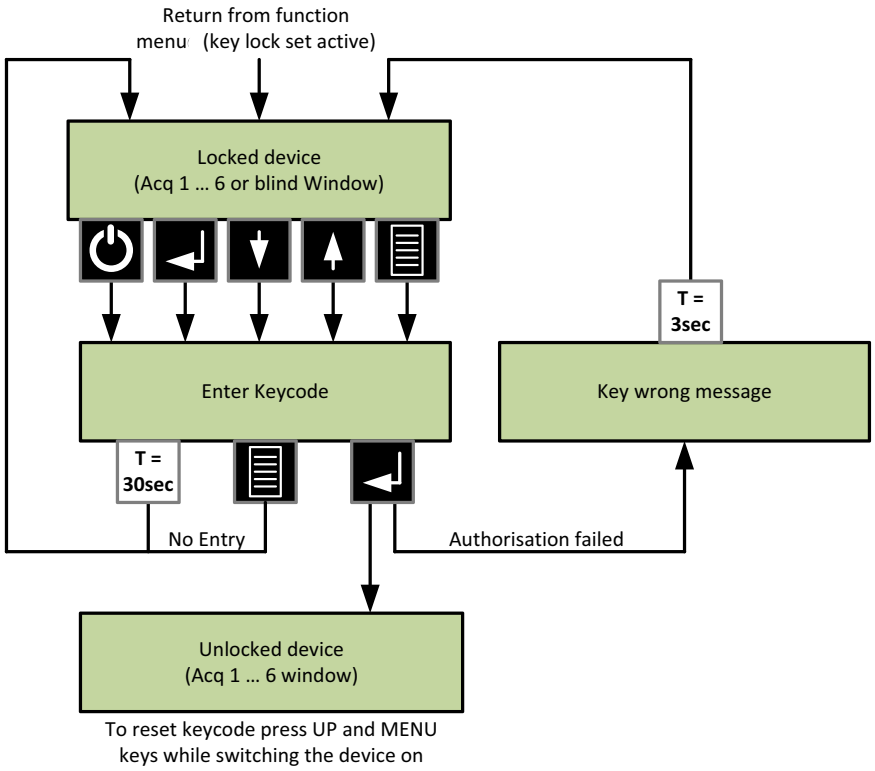


Set pump flow

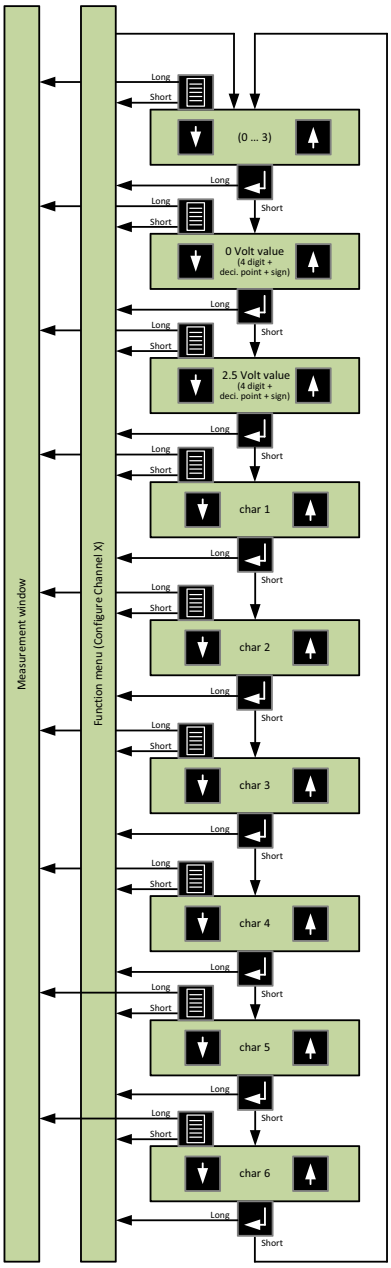


Lock device

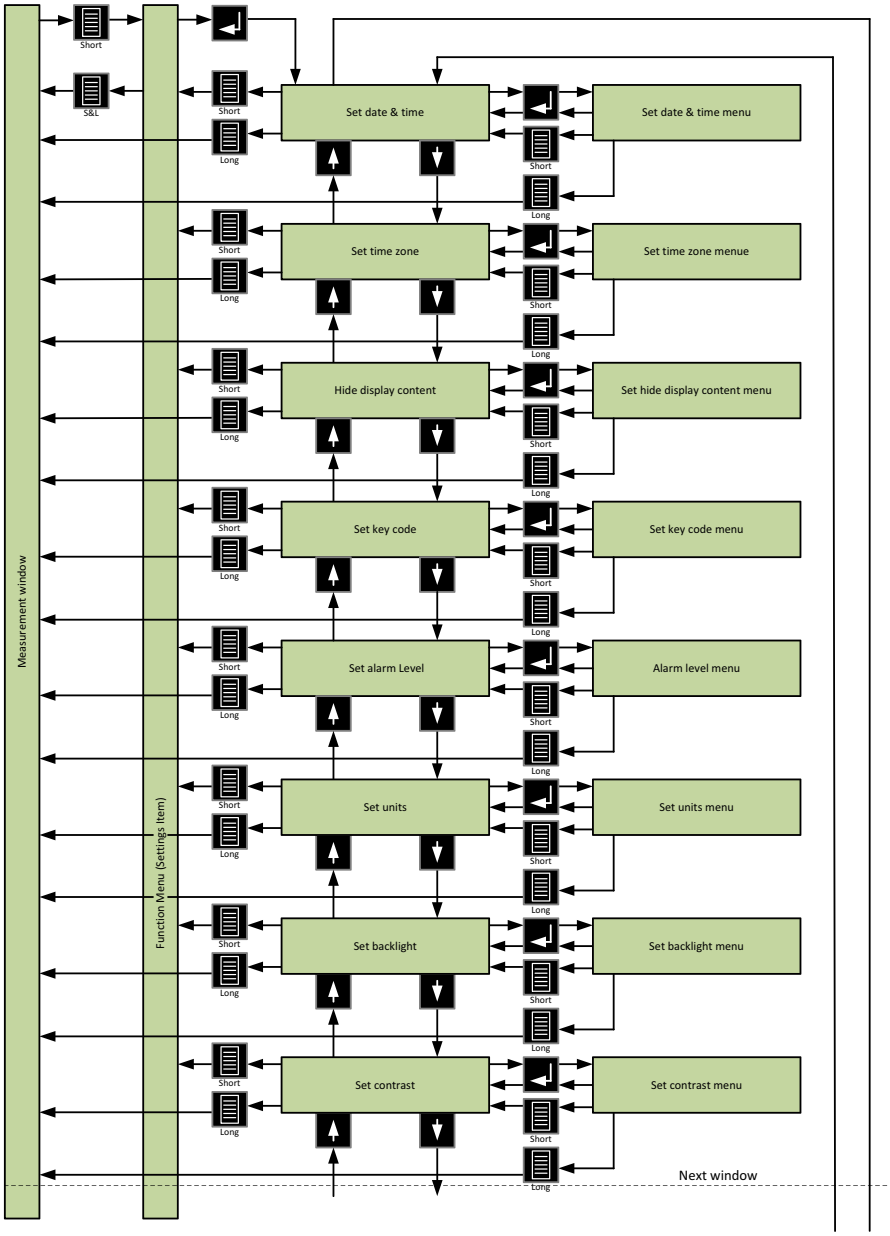



Return from function
menu (key lock set active)
Locked device
(Acq 1 ... 6 or blind Window)
Enter Keycode
T =
30sec
No Entry
T =
3sec
Key wrong message
Authorisation failed
Unlocked device
(Acq 1 ... 6 window)
To reset keycode press UP and MENU
keys while switching the device on

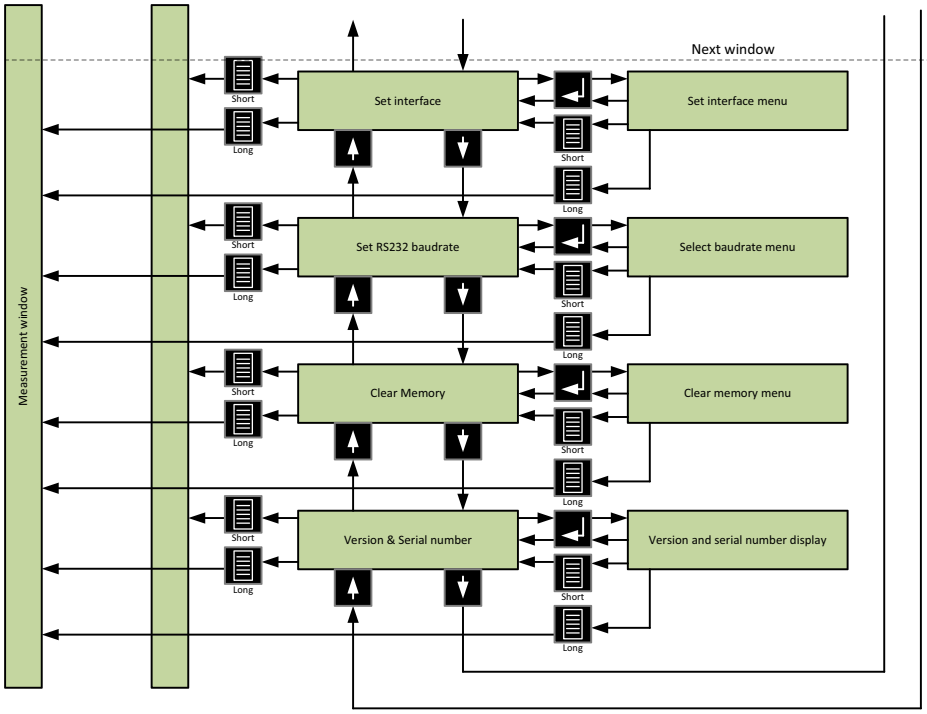
Configure Channel 1 (2)



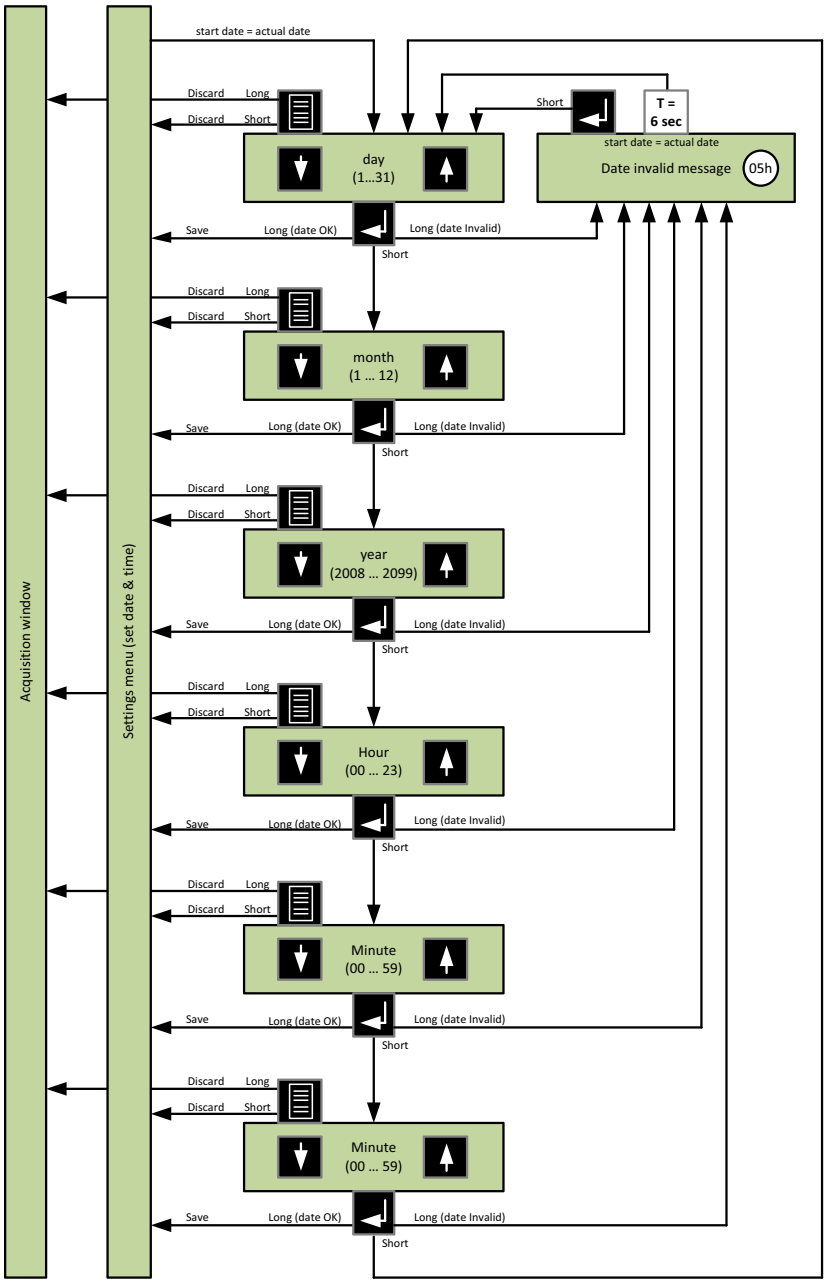
14.3.3 Settings menu



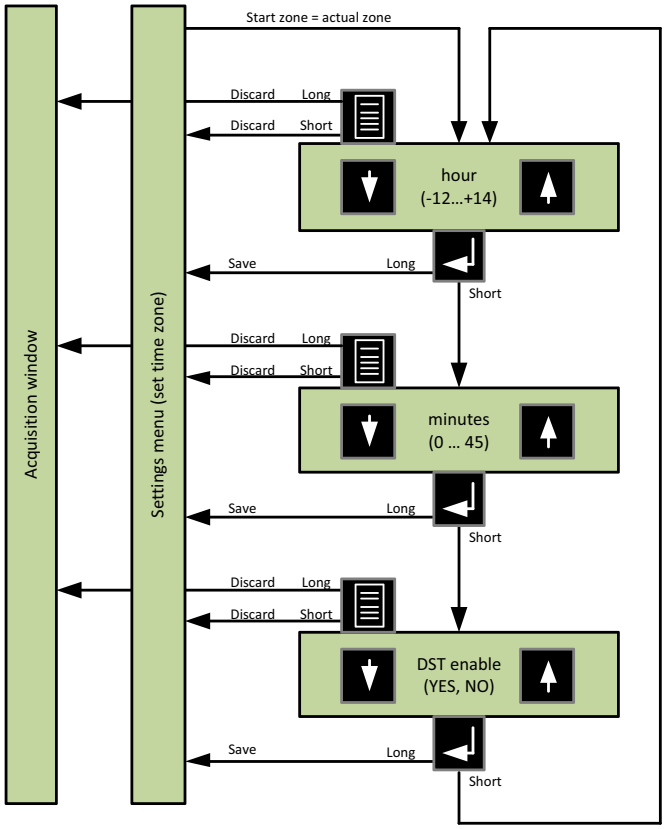
... Continuation on next page


Measurement window
Next window
Short
Long
Set interface
Set interface menu
Set RS232 baudrate
Select baudrate menu
Clear Memory
Clear memory menu
Version & Serial number
Version and serial number display

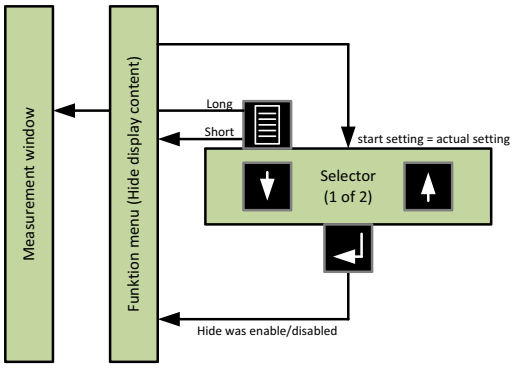
Set date & time



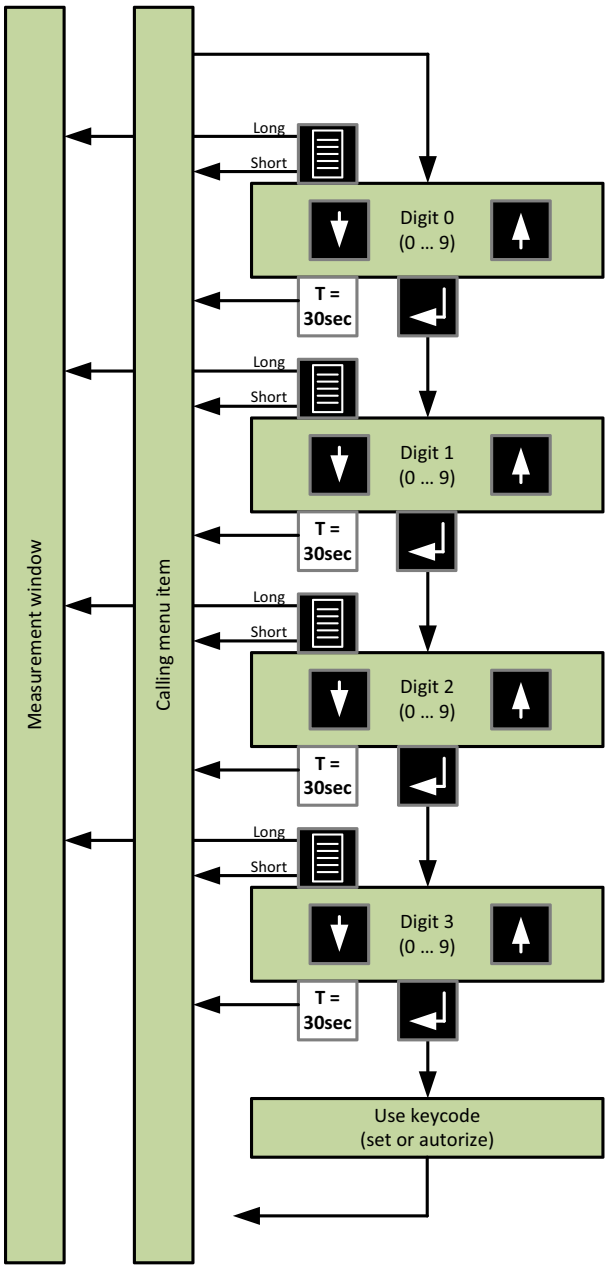
Set time zone



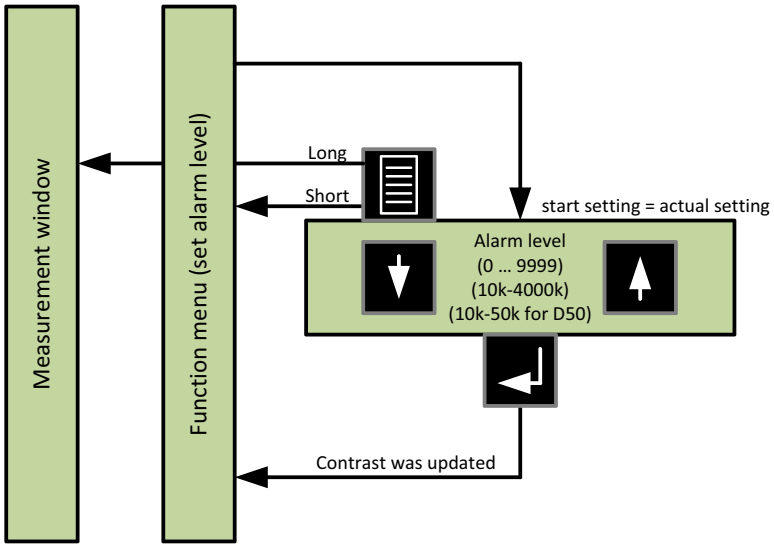
Hide display content



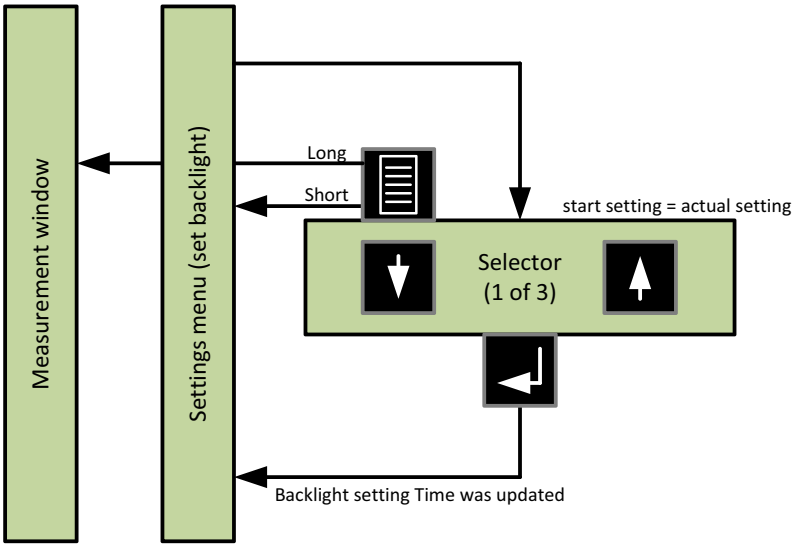
Set keycode


Measurement window
Calling menu item
Long
Short
Digit 0
(0 ... 9)
T =
30sec
Long
Short
Digit 1
(0 ... 9)
T =
30sec
Long
Short
Digit 2
(0 ... 9)
T =
30sec
Long
Short
Digit 3
(0 ... 9)
T =
30sec
Use keycode
(set or autorize)

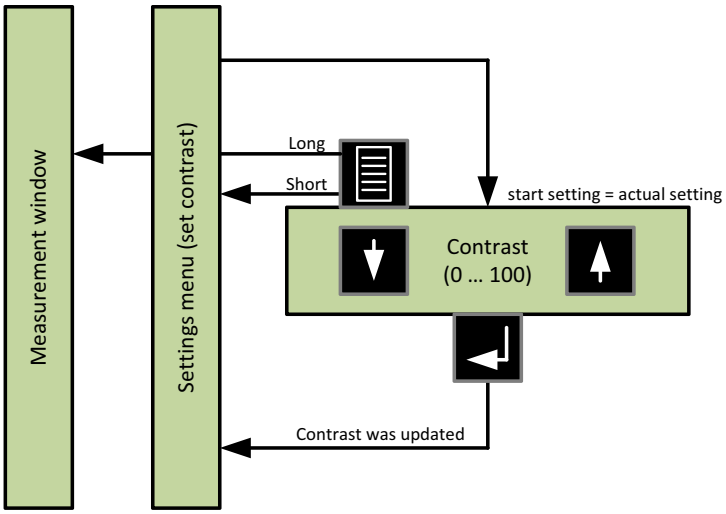
Set alarm level



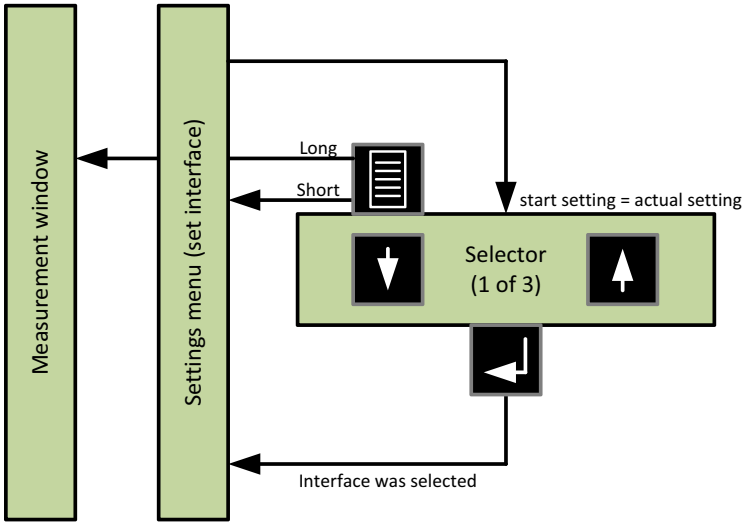
Set backlight



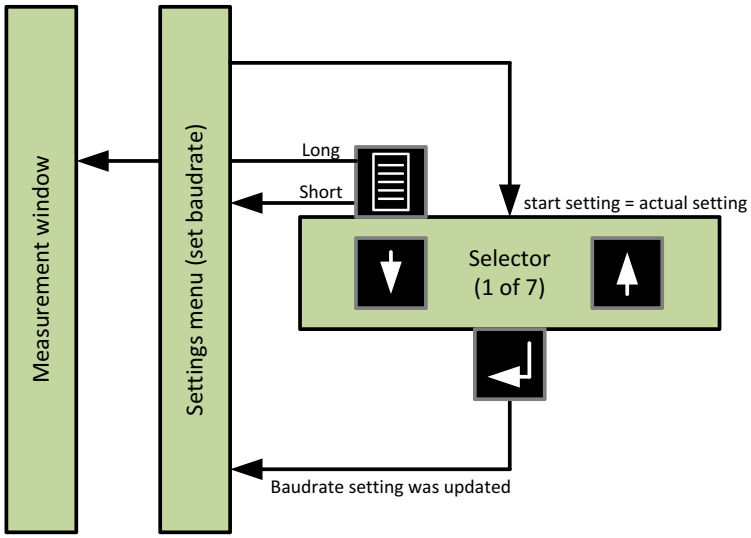
Set contrast



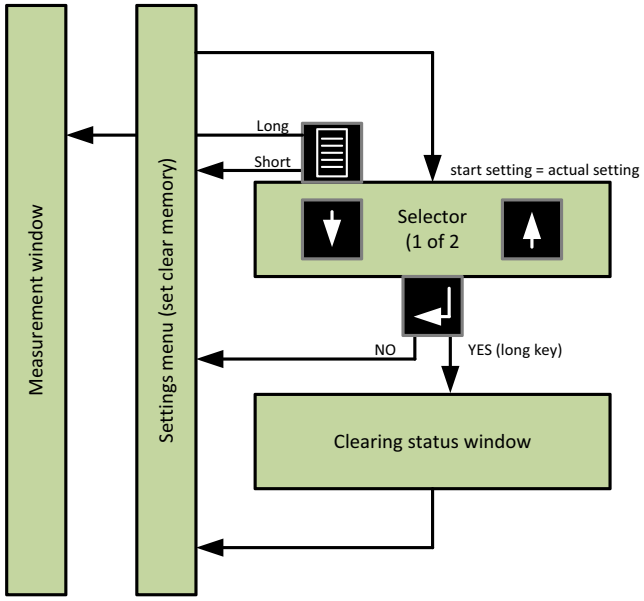
Set interface



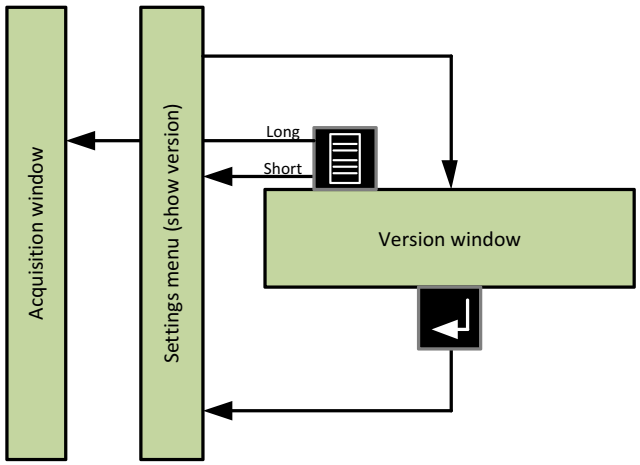
Set baud rate



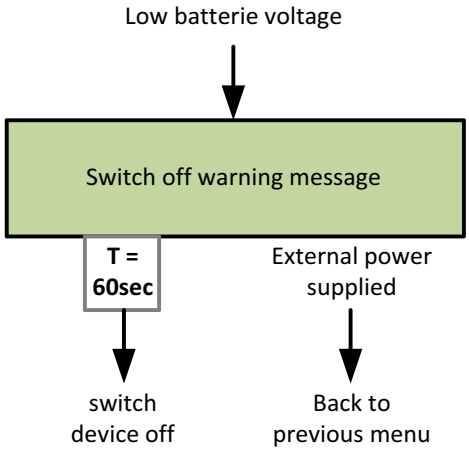
Clear memory



Show version



14.3.4 Low Battery voltage



15 TROUBLESHOOTING

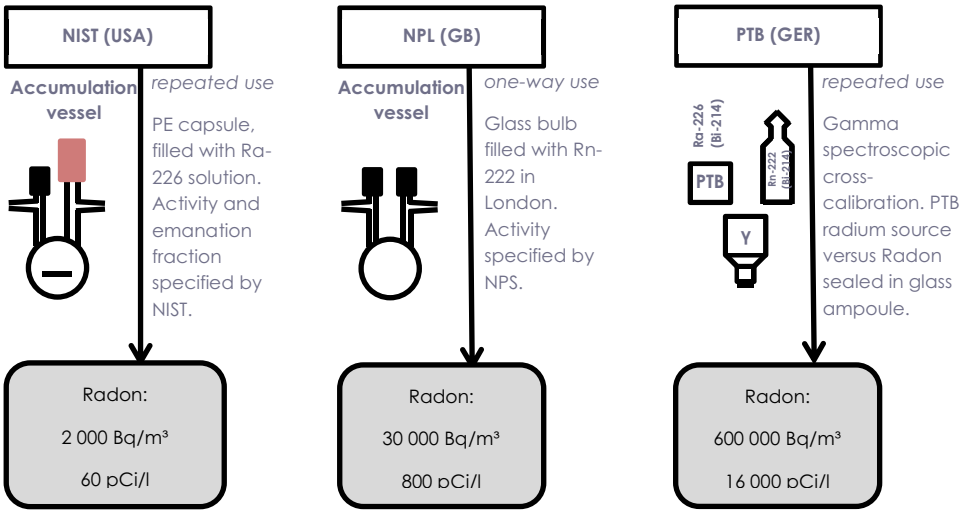
When starting the *AlphaGUARD*, several routines for system check are carried out. If an error is detected, the associated error code is displayed according to following table:

Severe Error, device no longer operational		
0x00000001	Fail to initialize system oscillator (not used at the moment)	Internal Hardware Error ! , contact your local Bertin dealer, press <enter> to turn off device
0x00000002	Clock hardware not available	Internal Hardware Error ! , contact your local Bertin dealer, press <enter> to turn off device
0x00000004	EEPROM chip not writeable (ID Read returned only 0x00 or 0xFF)	Internal Hardware Error ! , contact your local Bertin dealer, press <enter> to turn off device
0x00000008	FLASH chip not readable (ID Read returned only 0x00 or 0xFF)	Internal Hardware Error ! , contact your local Bertin dealer, press <enter> to turn off device
0x00000010	ADC converter init failed	Internal Hardware Error ! , contact your local Bertin dealer, press <enter> to turn off device
Severe Error, device still operational		
0x00000100	Invalid parameter values found, firmware defaults loaded	System parameters corrupted, default values from firmware loaded, contact your local Bertin dealer, press enter to continue
0x00000200	Invalid parameter values found, backup defaults loaded	System parameters corrupted, default backup values loaded, contact your local Bertin dealer, press enter to continue
0x00000400	No valid parameter Backup available	No valid system backup available, contact your local Bertin dealer, press enter to continue
0x00000800	Tamper sensor init failed	Disabled tamper measurement
0x00001000	pressure sensor init failed	Disabled pressure measurement

0x00002000	Humidity sensor init failed	Humidity/Temperature sensor defective, please contact your local Bertin dealer, press enter to continue
0x00004000	Clock battery low	
0x00010000	Internal pump module failed to initialize	Pump module defective, please contact your local Bertin dealer, press enter to continue
0x00020000	Failed to initialize GM board	Dose rate module not found or defective, please contact your local Bertin dealer, press enter to continue
0x00040000	Failed to initialize bluetooth module	
Volatile Errors, device still operational		
0x01000000	Battery voltage is below operation level	Battery low, connect charger to operate the device, device will switch off in 9 seconds
0x02000000	Clock needs to be set	System clock needs to be set, press <enter> to continue
0x04000000	File system not present	Filesystem corrupted, erase memory to repair filesystem, press <enter> to continue
0x08000000	Database consistency test failed	Recommendation to read out device and erase memory
0x10000000	High voltage generation failed	

16 CALIBRATION SCHEME OF ALPHAGUARD

The AlphaGUARD is traceable to national activity standards. The following Figure gives an overview of the traceability:



Frankfurt Radon chamber:
Radon to be blown out inside the calibration chamber (remote controlled)

Frankfurt Radon chamber:
Radon to be blown out inside the calibration chamber (remote controlled)

Frankfurt Radon chamber:
Radon to be released by breaking the glass ampoule inside the chamber
(remote controlled)

The correctness of the radon concentration values measured with ***AlphaGUARD*** monitors are assured through a multiple reference of the instrument calibration to recognized calibration standards.

ALPHAGUARD

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