SAPHYMO GmbH

AlphaE

Hand-Held Device for Radon Concentration & Personal Radon Exposure

User Manual

07/2016

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Contents

1 Foreword

Congratulations for purchasing ***AlphaE***. *AlphaE* is a light-weight and handheld device for monitoring the personal radon exposure and dose as well as for short-/long-term radon surveillance indoors, outdoors or in caves and mines. *AlphaE* combines a number of extraordinary characteristics such as:

- Up to 6 months autonomous operation on rechargeable battery
- Huge storage capacity (> 8500 data sets)
- Free selectable measurement/storage cycle (1 min … 12 h)
- Sophisticated smoothing algorithm allows stable results also below 100 Bq/m³ at comparatively short response times to gradients
- Calculation and recording of the dose based on a user adjustable equilibrium factor
- Simultaneous recording and storing of auxiliary parameters (air temperature, humidity and pressure as well as tampering)
- Two alarm levels for the Radon-222 concentration as well as one threshold for the dose can be predefined
- Whenever required mean Radon-222 results, dose, temperature as well as the settings can be brought to the display.

Typical application fields are:

- Short-/long-term monitoring of radon in buildings, caves, mines, soil gas …
- Measurement of personal exposure and dosimetry for workers in health centers, mines, waterworks …
- Radon measurements for designing mitigation activities

2 Introduction / General Issues

Radon is a noble gas and is permanently generated in soil and rocks by radioactive decay of radium, a natural radio nuclide. Building materials containing Uranium minerals release radon as well. Radon is colorless, odorless and tasteless and occurs everywhere in the world.

The relatively long half-life of Radon-222 ($t_{1/2}$: 3,8 d) is essential to occurrence and spreading of this isotope: The radon gas which escapes from the soil reaches the atmosphere and moves into the interior of buildings through holes, gaps and cracks in the stonework. The ratio of the radon concentration to be found in indoor air to the concentration in soil air typically amounts to 1 to 5 ‰ (BFS).

Radon – mainly absorbed by inhalation – accounts for about 50 % of the radiation hazard human beings are exposed to. As high Radon exposure increases the risk of lung cancer this radio nuclide is of high concern in radiation protection.

Measurements provide clarity! According to this principle measurements of the radon exposure form the fundamental requirements for assessing the risk human beings are subjected to, for adopting appropriate safety measures as well as for planning and implementing mitigation actions for the population and workers.

Generally, assessments of human radon exposure and dose are derived from averaged measurements of the radon concentration at the spots where the people habitually stay like homes and work places, ignoring the actual use of the premises. As peoples' living behaviour and residing habits affect the prevailing level of radon and its decay products on a high degree the above mentioned approach implies significant uncertainties in determining the real personal radon exposure and received dose. Accurate exposure and dose estimation can be obtained by using active measurement devices which provide real-time data and are permanently worn by the persons under surveillance.

For this purpose ***AlphaE***, based on a silicon diode diffusion chamber, a light-weight personal exposimeter, has been developed by a cooperation of the Munich Helmholtz Centre and Saphymo GmbH, Germany. AlphaE is available in two versions:

AlphaE (SI): Displays and stores the values in SI units (Bq, Sv and °C)

AlphaE (US): Displays and stores the values in US units (Ci, rem and °F)

Combining all suitable features *AlphaE* represents an appropriate tool for recording the personal exposure to radon and the accumulated dose as well as for stationary short- and long-term monitoring of indoor radon concentration. The detector provides a wide measurement range up to 10 MBq/m³ and is sufficiently sensitive for reliable measurements also below 100 Bq/m³.

This manual describes all basic functions of the *AlphaE* necessary for complying with above mentioned measuring requirements. It contains general advice for safe handling as well as recommendations for reasonable use. The goal is to quickly put the user in a position to conduct high-quality measurements and screenings.

In principle *AlphaE* is a user-friendly instrument. Its few functions can be mastered easily, quickly making the instruction manual superfluous.

For any questions that are not answered by this manual, please contact Saphymo GmbH directly. We will do our best to solve the problem quickly.

3 Scope of delivery

Basic configuration

The basic delivery scope includes:

- *AlphaE* handheld radon exposimeter device
- USB Mains charger/adapter
- USB cable (USB to Mini USB)
- DataVIEW communication and evaluation software (on CD)

Options

Available accessories (see chapter 8, page 27):

- Wall support
- Belt pouch
- Suitcase for 1 x AlphaE and accessories
- Suitcase for 5 x AlphaE and accessories
- Dust protection bag

4 Instructions for Safety

AlphaE is a user-friendly and easy to handle instrument and complies with relevant EN/IEC norms with regard to safety requirements and electromagnetic compatibility (declaration of conformity on request). Nevertheless, for the user's particular safety and for assuring undisturbed functioning of the device, please strictly obey following instructions:

- Do not expose the device to rain or excess moisture of any kind.
- Do not allow liquid to enter the openings of the case (namely: diffusion orifice and USB socket).
- Do not operate the device in corrosive environment.
- Avoid excess exposure to dust - use the belt pouch or dust protection bag (Tyvek).
- Do not cover the diffusion inlet of the device during measurement.
- The battery charger works with 100 - 240 V power supply. Pay attention to the danger of high voltage! Only use the original or technically compatible charging devices.
- Detector and electronics are highly sensitive components and respond under certain circumstances also to electromagnetic fields. Hence wireless (DECT) and cellular phones should be kept on a distance of at least 20 cm to the *AlphaE*.

In case of failure do not open the device nor try to repair it !

5 Instructions for first Start-Up

With completely charged battery the *AlphaE* allows autonomous operation of up to 6 months.

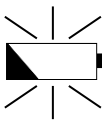
Note: Before starting up the device for the first time the battery should be charged for minimum 6 hours.

Charging of the *AlphaE* can be performed

- either directly by mains, connecting the device to the charging adapter using attached USB cable

or

- indirectly via PC by connecting the device to a running computer using attached USB cable.



During charging the display shows a flashing battery symbol.

Note: We recommend recharging the device every 3 months in order to prevent power failure during operation.

6 Technical Description of AlphaE

6.1 Principle of Detection and Operation [1]

AlphaE is an active measurement device for detecting and recording the radon concentration, exposure and dose. Based on the diffusion principle with silicon detector the radon gas diffuses through the entry holes of the case into the inner of the diffusion chamber. As the holes are entirely covered by a Gore-Tex membrane only the radon gas can enter the chamber while the decay products, also called radon daughters (Polonium, Lead, Bismuth), are retained by the filter.

Hence, the measurement performs independently from fluctuating external parameters like aerosol concentration and air humidity. This is worthwhile to mention, as these factors have a big impact on the measurement of radon progenies but no influence on the radon gas.

The alpha radiation emitted during the decay of Radon-222 is recorded by the silicon detector. However, along with the decay of Radon-222 also its progenies develop in the interior of the chamber and separate out at its walls. The alpha radiation caused by the Radon progenies when decaying is proportional to the Radon-222 concentration inside the chamber. Its radiation contribution accounts for the major part of the signal and is considered accordingly by the evaluating algorithm and calibration factor.

Voltage pulses generated by the silicon detector are subsequently amplified, counted, converted to the required units and stored by the mirco controller in accordance to the predefined measurement cycle.

In addition to the discrete measurement values derived from the accumulated counts in the course of respective measurement cycle as

described before, a floating (sliding) mean is calculated permanently, stored and always shown on the display of the device. This mode suppresses the statistical fluctuations and allows the *AlphaE* even at low radon concentration levels to always provide on its display a reliable value which is adjusted for statistical outliers.

It should be mentioned at this point that there is a principle goal conflict between the requirement of providing stable and reliable measurement values also at low radon concentrations and the demand of a fast and appropriate response on possible radon gradients. We have implemented the most suitable smoothing characteristics in order to optimally meet both requirements. However, the user is able to adjust the smoothing factor according to his specific needs (→ communication software).

Besides the Radon concentration the accumulated dose is calculated on basis of factors for the equilibrium concentration (EEC) and dose conversion. Both factors are preset and can be adjusted by the user according to his condidions and requirements. (→ communication software) The dose data is continuesly accumulated and stored. The recent value can be called up on the display whenever required.

Inbuilt sensors for measuring air temperature, humidity and pressure as well as for recording shock and relocation events (→ tampering) provide auxiliary data. These values are also stored along with the radiological data and serve for thorough analysis especially of the dynamics of Radon.

Two alarm thresholds can be defined for the radon concentration as well as one limit value for the accumulated dose.

6.2 Case

All the electronic components of the *AlphaE* radon exposimeter are housed in an impact resistant aluminum case. The case consists of a rectangular hollow section that is sealed with aluminum molds at the front and back. The outer dimensions of the *AlphaE* are:

6.2.1 Dimensions and Weight

Width :	68 mm	Weight :	165 g
Height :	108 mm		
Depth :	30 mm		

6.3 Functional and Control Elements

AlphaE provides the following functional and control elements:

- Mini USB (upper front side)
- ON/OFF button
- Mode button
- Multifunctional display (6 digits LCD + 5 digit alphanumeric)
- Beeper
- Air entrance window Diffusion orifice (arrangement of drill holes covered by a membrane)

6.3.1 Mini-USB port

AlphaE provides an interface based on standard USB which is designed as Mini-USB socket. The port serves for data exchange between *AlphaE* and a PC (download of measurement data and parameterization of the device) as well as for charging the inbuilt battery. The device can be charged by a PC alternatively by using a mains charger which is suited with a Mini-USB plug (5 VDC).

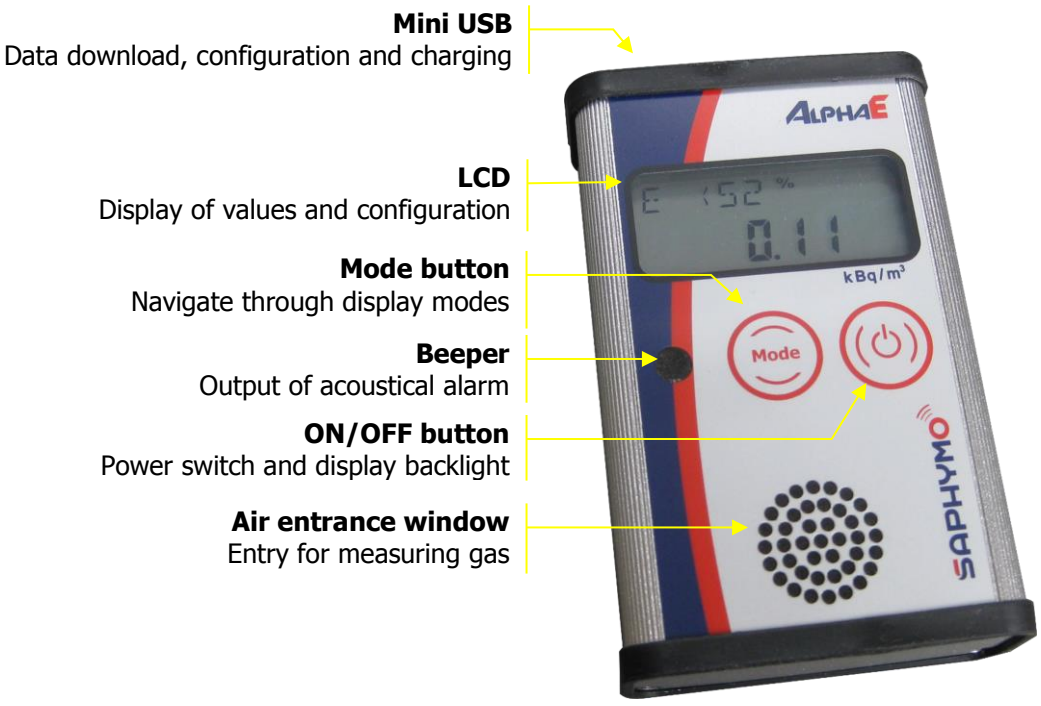


Figure 1: AlphaE – Functional and control elements

6.3.2 ON/OFF Button

ON/OFF button serves for switching the *AlphaE* on/off and for activating the display backlight (see chapter 6.4.1., 6.4.3 and 6.4.4)

6.3.3 Mode Button

For navigating through the menu items indicated on the display, for retrieving recent measurement results, status information and for performing following settings (see display states on Table 1 and chapter 6.4.2):

- Quitting acoustic alarm
- Enable/disable acoustic alarm

Note: During the first 5 seconds after switching on the device the measurement operation is initialized and a series of self-tests are performed. During this time the Mode button is disabled until the countdown for starting the measurement is indicated by displaying "WAIT …. 00x".

6.3.4 LC Display

The display consists of a 6-digit 7-segment block for displaying the measurement results as well as 5-digit sector for alphanumeric display. Following menu items can be called up by repeatedly pressing the Mode button in the order as shown on Table 1 (see also 6.4.2):

Menu Item	***Display / description***
RADON	*Standard mode, display of radon floating mean value and related statistical error in %*
AQUIT	*Quitting alarm*
INFO	*Display sequence of* *(1) set measurement cycle in sec* *(2) alarm status (on/off) and alarm level 1 in kBq/m³ (pCi/l)*)*
24H	*Display of mean value during previous calendar day (if no data available, "----.--" is displayed)*
RMEAN	*Display of Radon mean value since switched on*
DOSE	*Display of dose in mSv (rem) *)*
BAT	*Display of battery voltage and remaining capacity in %*
TEMP	*Display of air temperature*
HUM	*Display of air humidity*
PRESS	*Display of air pressur*
DATE	*Display of date/time*
TEST	*Self-test*
AL ON	*Enable acoustic alarm*
AL OFF	*Disable acoustic alarm*

**) Relevant for US versions*

Table 1: Menu of LC display

6.3.5 Beeper

With enabled alarm function the beeper gives acoustical alert in case one or both of the defined alarm thresholds (radon concentration or/and dose) are exceeded. The acoustical signals for alarm level 1 and 2 are different with regard to their beeping frequency:

Alarm level 1 : 2 beep/sec

Alarm level 2 : 5 beep/sec

Note: If alerting is required make sure that the alarm function is enabled ⇨ "AL ON".

6.3.6 Air Entrance Window

The diffusion entry consists of 41 circularly arranged drilling holes (∅ 2mm) and is equipped with a membrane of type GORE GAW112 for retaining the radon progenies. The total surface of the entry window amounts to 1,3 cm^3.

6.4 Operation of *AlphaE*

6.4.1 Starting the Measurement

By pressing the ON/OFF button for 1 sec. the device is switched on. Following states are passed through (see Figure 2):

1. Self-test of the display (1 sec)
2. Initialization of measurement: Display passes following states:
    1. Firmware version and battery voltage for 5 sec
    2. Alarm status (ON/OFF) and threshold of alarm level 1 (5 sec)
    3. Count down waiting period (15 sec)

3. Measuring status: Display shows Radon concentration (floating mean) with associated error in kBq/m³

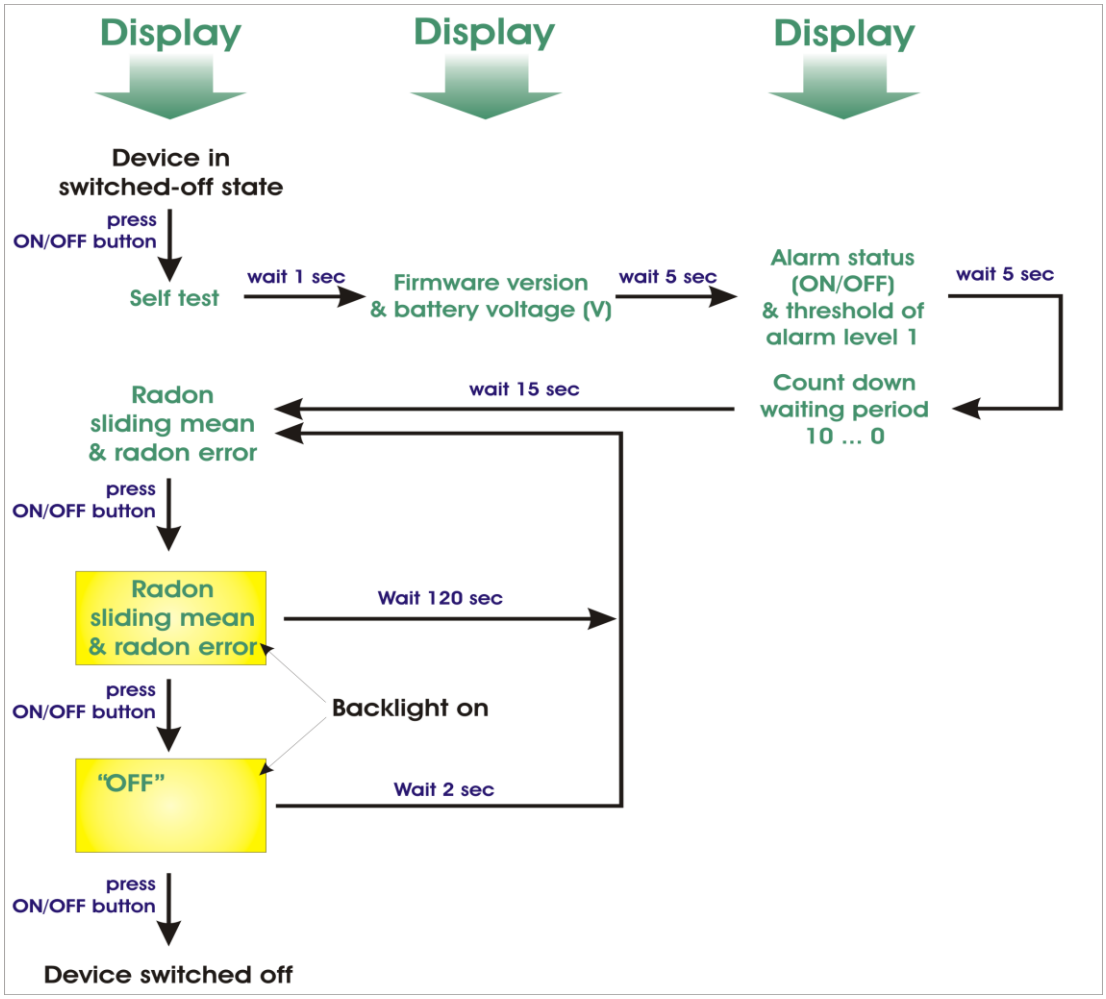


Figure 2: ON/OFF button – Sequence of functions

6.4.2 Displaying Available Parameters and Changing Settings

The menu of the *AlphaE* is a closed loop. Pressing the Mode button repeatedly the menu items can be called up and displayed successively (see Figure 3).

Note: The value of selected parameter is displayed for 5 sec. Thereafter the display automatically switches back to the default view (Radon concentration).

Pausing on a setting item for minimum 5 sec leads to activating of respective setting. Thereafter the display automatically switches back to the default view (Radon concentration).

Parameters and settings can only be displayed/changed as long as the keys are not disabled by the communication software (with disabled keyboard the display shows "LOCK" along with the Radon concentration)

RADON

RADON

After the initialization procedure is finished the display shows the floating mean of the radon concentration in kBq/m³ (pCi/l) with associated error in %. According to the internal evaluation intervall the display is updated every 10 sec (not to be confused with the measurement/ storage interval).

At the start of the measurement operation an error > 99% is assigned. With increasing measurement time the error decreases gradually.

Thanks to the suitable floating mean algorithm which is applied always a stable and reliable radon concentration is displayed whereby statistical fluctuations are widely suppressed.

QUIT

QUIT

Wait 5 sec leads to supressing (quitting) the accoustical alert which might be set on the radon concentration (alarm level 1 and 2). The alarm is reactivated whenever the radon concentration decreases and then exceeds the alarm treshold again. This menu item can be disabled by software.

Note: Alert due to exceeding the dose threshold cannot be quitted by the keys; only by software.

INFO

INFO

Information on following settings is displayed for 5 sec each:

1. Preset measurement cycle in sec
2. Alarm status (ON/OFF) as well as alarm level 1

24H

24H

The radon mean concentration in kBq/m³ (pCi/l) from the previous calendar day is displayed provided that the device has not been switched off/on or re-initialized in the mean while. As long as the current measurement does not dispose of data from previous day at all, "----.--" is displayed.

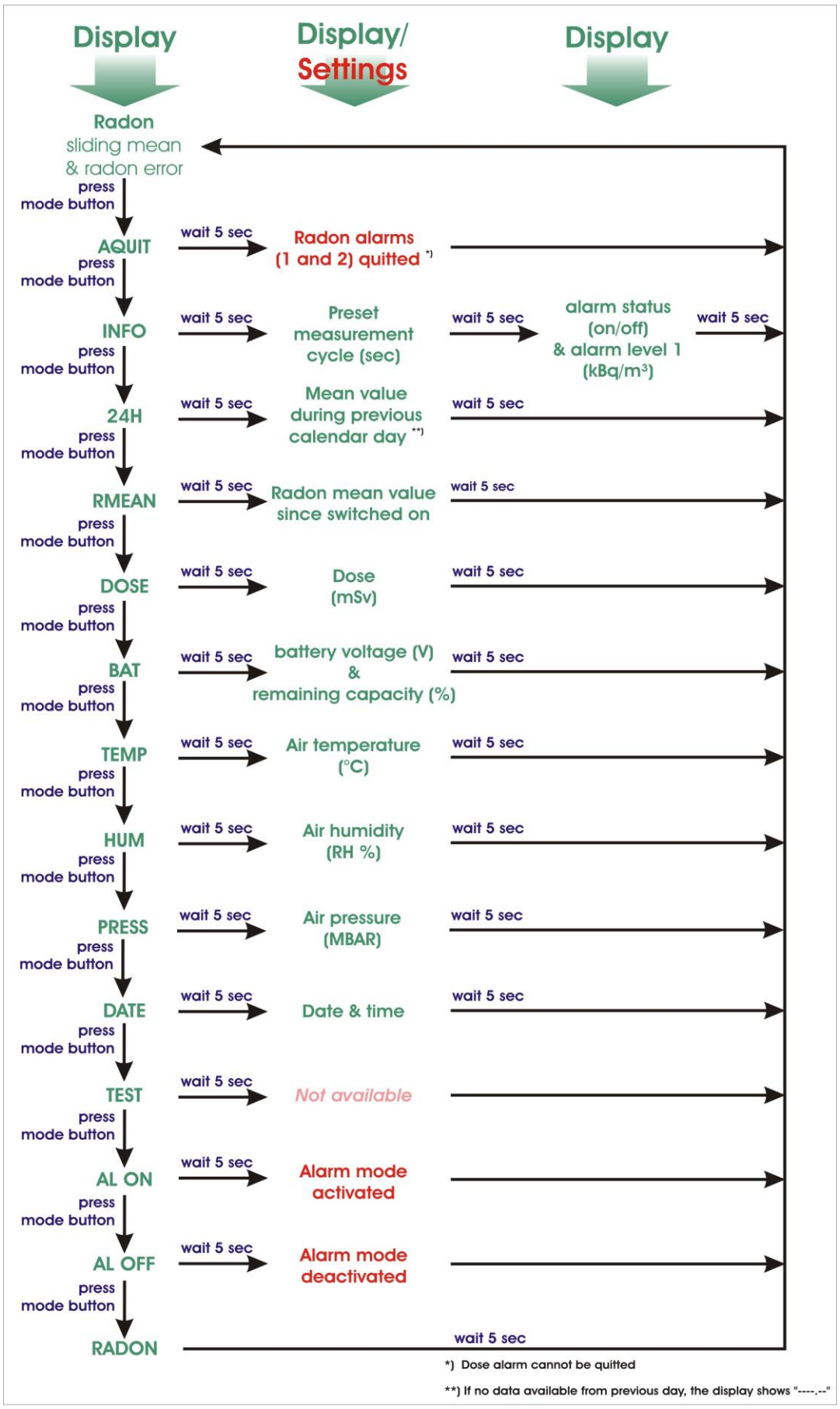


Figure 3: Display menu – Sequence of displayed menu items

RMEAN

RMEAN

The radon mean concentration in kBq/m³ (pCi/l) since the instrument has been swiched on or re-initialized by software is displayed as well as the time (in h) which has elapsed since then.

DOSE

DOSE

The accumulated dose in mSv (rem) is displayed. The dose calculation is performed simultaneously during operation. Thereby following factors are preset:

$$EF \rightarrow 0{,}4$$

1 Bq/m³ EEC $\rightarrow$ 7,8 nSv (according ICRP 65, 1993)
(1 pCi/l EEC $\rightarrow$ 0,021 µrem)

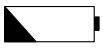
Both, the equilibrium factor (EF) for obtaining the Equilibrium-Equivalent Concentration of radon (EEC) as well as the dose conversion coefficient can be adjusted by the user using the communication software (see chapter 7.2.3, page 19).

Re- or presetting of the dose as well as quitting or disabling of the dose alarm also require using the communication software module (see chapter 7.2.3 and 7.2.4, page 19 et sqq).

BAT

BAT

The battery state is displayed. Charge condition (in %) as well as the battery voltage (in V) are indicated.



Moreover, with low battery conditions the battery symbol is permanently displayed. Charging of battery is indicated by flashing battery symbol.

TEMP

TEMP

The current air temperature (in °C) is displayed. This parameter is recorded by an internal sensor and simultaneously evaluated and stored as well.

HUM

HUM

The current air humidity (in %RH) is displayed. This parameter is recorded by an internal sensor and simultaneously evaluated and stored as well.

PRESS

PRESS

The current air pressure (in MBAR) is displayed. This parameter is recorded by an internal sensor and simultaneously evaluated and stored as well.

DATE

DATE

The current time (formate: hh:mm) and date (formate: ddmmyy) are displayed.

TEST

TEST

Only for manufacturer's use.

AL ON

AL ON

Waiting 5 sec leads to enabling the alarm function.

All alarm functions (alarm level 1, alarm level 2 and dose alarm) are set active. This menu item can be disabled by software.

AL OFF

Waiting 5 sec leads to disabling the alarm function. **AL OFF**

All alarm functions (alarm level 1, alarm level 2 and dose alarm) are set inactive. This menu item can be disabled by software.

RADON

Leads to the default view of the display (closed menu loop). **RADON**

6.4.3 Backlight of Display

For activating the display's backlight the ON/OFF button has to be pressed once. The display remains illuminated for 2 min (see Figure 2).

6.4.4 Switching the device off

The *AlphaE* is switched off by pressing the ON/OFF button three times consecutively (see Figure 2).

Note: Switching the device off as well as re-initialization leads to:

1. Resetting the floating mean calculation
2. Reset of recording the mean value
3. Reset of the previous day mean value (if applicable).

7 Communication Software Module

The Communication Software Module allows the user to read out and display the status information of *AlphaE*, performing all settings which might be changed by the user as well as downloading the stored measurement values, display, print them out and even export the data to CSV or XML format (*.upf2).

7.1 Installation of Communication Software Modules

Prior to setting up the communication between *AlphaE* and PC the communication software which is delivered on a CD has to be installed (i.e. copied) on a hard drive of the user's PC. Please find the necessary instructions in the document called *"AlphaE software installation 2013-07.pdf"* which can also be found on the installation CD.

7.2 Working with the Communication Software

7.2.1 Establishing the Connection between *AlphaE* and PC

For setting up the communication following steps have to be performed:

1. Connect USB cable between PC and *AlphaE*
2. Start communication software by clicking on ***wCCM_MT.exe*** to be found in subdirectory …\MiniTRACE\xApp_CCM) – the main screen mask appears (see Figure 4)

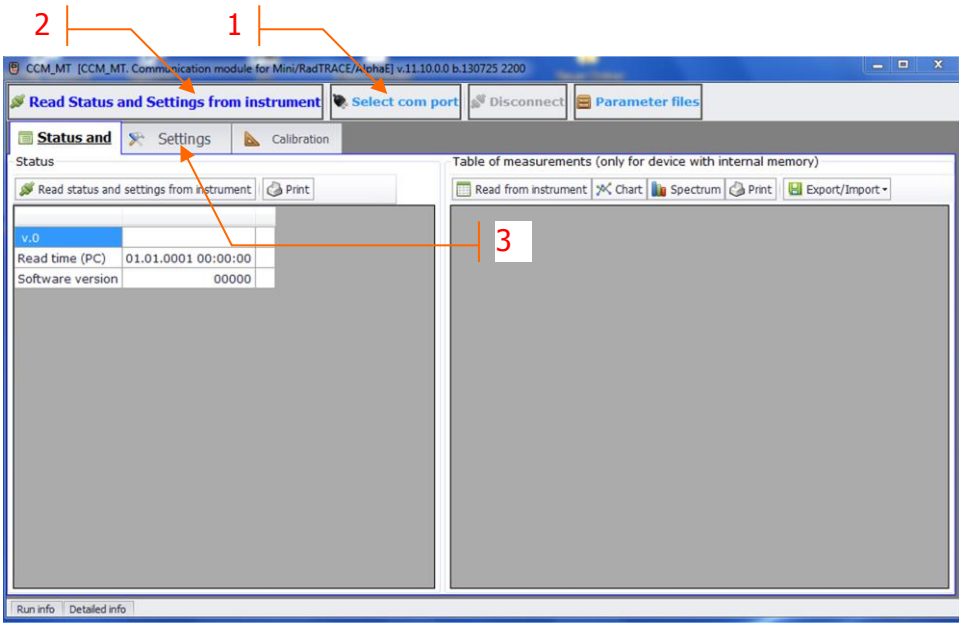


Figure 4: Main screen mask after starting the application

3. Click the button "Select COM port" (see 1, Figure 4), select correct COM port and baud rate 9600bd (the correct COM port is

generally the highest figure, could be also checked in Windows device manager)

7.2.2 Reading out the Status

After heaving pressed the button "Read status and settings from instrument" (see 2, Figure 4) the screen mask displays the current status of the *AlphaE (sample data):*

AlphaE v.0	*AE000023* Serial number of read out AlphaE device
Read time (instrument)	*07.08.2013 14:08:48* Precise date (DD.MM.YYYY) and time (hh:mm:ss) the status was read out
Software version	*A0030* Firmware version of AlphaE
Dose	*26,75* [µSv / rem] Accumulated dose value
Battery voltage	*4.096,00* [mV] Current battery state
Last saved measurement:	
Measurement time	*07.08.2013 14:07:56* Date and time last data set was stored
Measurement period	*600* [sec] Preset storing cycle of measurement data
Radon	*214,00* [Bq/m³ / pCi/l] Discrete radon concentration of last saved measurement cycle
Radon floating mean	*33,00* [Bq/m³ / pCi/l] Floating mean radon concentration of last saved measurement cycle
Radon floating mean error	*22,25* [Bq/m³ / pCi/l]] Error of the floating mean radon concentration of last saved measurement cycle
QA AlphaE:	
- Noise	*1* *(0=no interference)* Interfering signals detected (microphonic/electromagnetic interference) of last saved measurement cycle
- OVR	*1* *(0=no overrun)* Overrun of measurement range of last saved measurement cycle
- DEAD	*1* *(0=detector OK)* Detector failure detected for last saved measurement cycle

- LoBat	*1* *(0=OK)* Critical charge state of battery for last saved measurement cycle
- Alarm Radon	*1* *(0=not triggered)* Radon alarm triggered for last saved measurement cycle
- Alarm Dose	*1* *(0= not triggered)* Dose alarm triggered for last saved measurement cycle
- Switch On	*1* *(0=no restart)* Device has been switched on or reinitialized at the start of last measurement cycle
- Relocation	*1* *(0=no tampering)* Acceleration identified for last saved measurement cycle (→ tampering)
Temperature	*26,5* [° C] Air temperature record of last saved measurement cycle
Humidity	*41* *[rel.-%]* Air humidity record of last saved measurement cycle
Pressure	*1014,14* *[mbar]* Air pressure record of last saved measurement cycle
Dose ambient	*26,69* [µSv] Accumulated dose value until last saved measurement cycle
Equilibrium factor	*0,4* Preset Equilibrium factor value

Table 2: Status of AlphaE (contents of screen mask)

7.2.3 Changing User parameters

Clicking the button "Settings" (see 3, Figure 4) the dialog "User Parameters" is displayed (see 3, Figure 5).

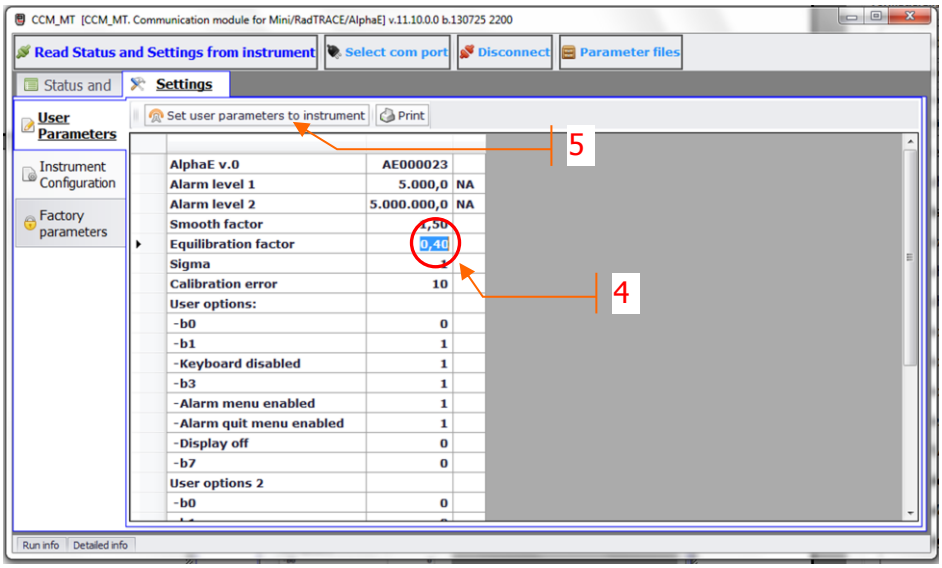


Figure 5: Main screen mask – User parameters

With the aid of this mask the user can check and change a number of parameters *(sample data)*.

AlphaE v.0	*AE000023* Serial number of read out AlphaE device
Alarm level 1	*5.000,0* Bq/m³ Preset Radon alarm threshold 1
Alarm level 2	*5.000.000,0* Bq/m³ Preset Radon alarm threshold 2
Smooth factor	*1,50* Smoothing constant used for determination of the floating mean radon concentration. The higher the value the lower the fluctuation of Radon values but the slower the response on gradients and vice versa
Equilibrium factor	*0,40* Preset equilibrium factor (used for converting Radon 222 to Radon EEC) Decimal values between 0 … 1 can be selected
Sigma	*1* Presetting of confidence interval (σ) of respective floating mean radon concentration 1 = 68% 2 = 95% 3 = 99%

Calibration error	*10* [%] Calibration uncertainty
User options:	
- b0	*0* - not used
- b1	*0* - not used
- Keyboard disabled	*0* For disabling the keys of the *AlphaE* (ON/OFF and MODE) set this parameter to "1" (→ „LOCK" is displayed)
- b3	*0* - not used
- Alarm menu enabled	*1* Alarm can be enabled by using the MODE key of the *AlphaE* (0= function locked)
- Alarm quit menu enabled	*1* Alarm can be quitted by using the MODE key of the *AlphaE* (0= quitting disabled)
- Display off	*0* To lock the display set this parameter to "1" (no radon values displayed)
- b7	*0* - not used
User options 2	
- b0	*0* - not used
- b1	*0* - not used
- Enable alarm	*1* Alarm function to be enabled (0= alarm function disabled)
- b3	*0* - not used
- b4	*0* - not used
- b5	*0* - not used
- b6	*0* - not used
- b7	*0* - not used
Alarm level dose	*0,00* *[µSv / rem]* Threshold for dose to be preset
Measurement cycle	*600* *[sec]* Measurement/storing cycle to be preset
Measurement cycle Alarm	*600* *[sec]* Alarm measurement/storing cycle to be preset (e.g. shorter measurement cycle in case the alarm threshold is exceeded)
Dose conversion factor	*0,0078* Dose conversion coefficient. The preset value complies with ICRP 65, 1993
Background	*0,00* Detector background [Bq/m³] can be adjusted by the user in case of elevated contamination by long-living radon progenies (Po-210). Requires measure-ment test in radon poor atmosphere.

Table 3: User Parameters (contents of screen mask)

By double click on respective cell or pressing the F2 key the setting can be changed, i.e. enabled (1), disabled (0) or modified by entering the desired value (see 4, **Fehler! Verweisquelle konnte nicht gefunden werden.**). Pressing the button "Set user parameters to instrument" (see 5, **Fehler! Verweisquelle konnte nicht gefunden werden.**) the modified parameter set is transferred to the *AlphaE*.

Note: This intervention causes re-initialization of the *AlphaE*.

7.2.4 Instrument Configuration

Clicking the button "Instrument Configuration" (see 6, Figure 6) the dialog for basic settings is displayed.

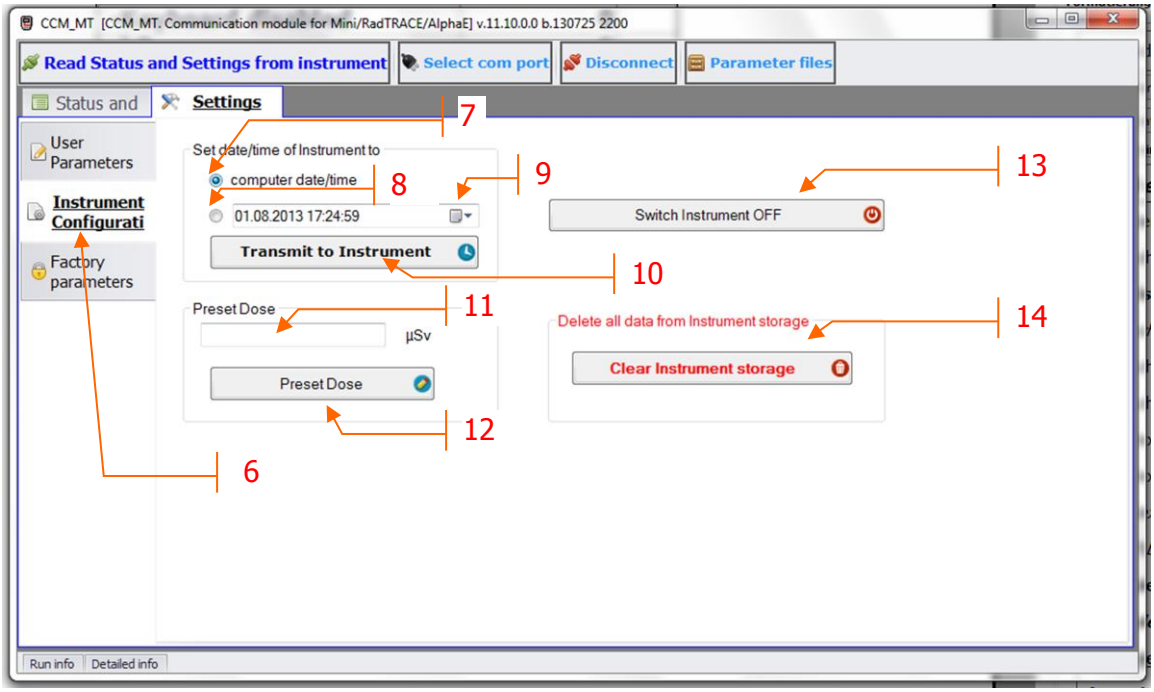


Figure 6: Main screen mask – Instrument configuration

This mask allows the user performing following configuration:

1. Setting date and time
   - Date and time can be synchronized with the PC clock by checking the radio button "computer date/time" (see 7, Figure 6).
   - Date/time can be edited after clicking the radio button beneath (see 8, Figure 6). Alternatively, the date can also be selected from calendar by using the pull down menu (see 9, Figure 6). For transmitting the new date/time settings press the button "Transmit to instrument" (see 10, Figure 6).

2. Pre- or re-setting of the dose. Enter any value; for re-setting enter "0" (see 11, Figure 6). Press the button "Preset Dose" to transmit the setting to the device (see 12, Figure 6).
3. Switch off the *AlphaE* device by clicking on the button "Switch instrument OFF" (see 13, Figure 6).
4. Reset the storage of the *AlphaE*. By clicking on the button "Clear Instrument storage" all stored data is deleted.

Note: Deleting the storage (Memory Reset) does NOT cause reset of dose.

Completing any of above mentioned interventions causes re-initialization of the *AlphaE*.

7.2.5 Downloading Measurement Data

Given the mask view of the "Status and Settings" the button "Read from instrument" is available (see 15, Figure 7). Clicking this button opens the dialog for data download.

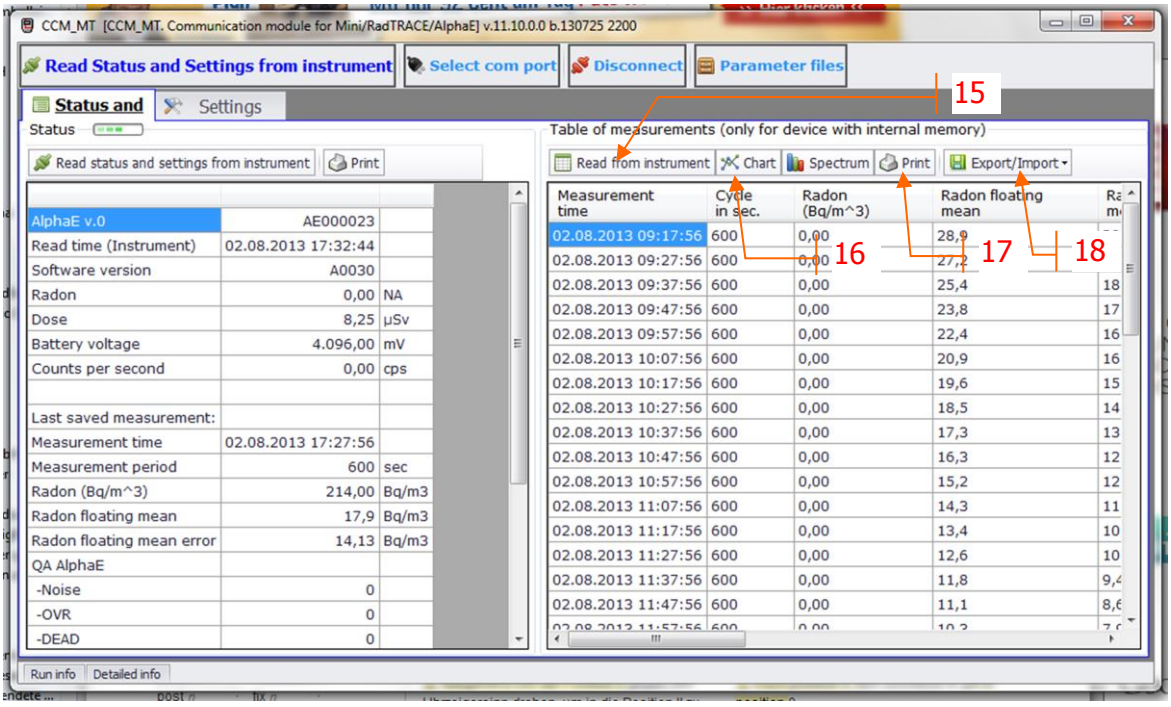


Figure 7: Main screen mask – Read from instrument

This menu allows reading out a defined number of data sets or all of them by activating the check box (see 19 resp. 20, Figure 8).

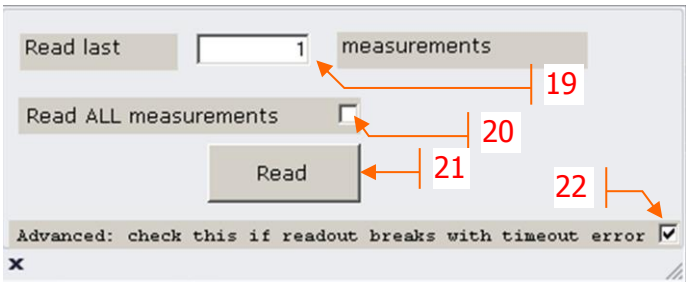


Figure 8: Dialog – data download

Note: In case the data transmission process is aborted accompanied by a timeout message please change the given setting by checking respectively unchecking the box at the lower right of the window (see 22, Figure 8).

After the download is finished the data is displayed as table on the right part of the screen mask. Each line consists of one data set which is in turn determined by one measurement interval. In columns arranged following parameters are listed:

Measurement time	Time stamp the data set was calculated and stored
Cycle in sec	Time interval in which the values have been accumulated.
Radon (Bq/m³ / pCi/l)	«Raw» Radon concentration value
Radon floating mean (Bq/m³ / pCi/l)	Floating mean Radon concentration (determined on basis of smoothing algorithms)
Radon floating mean error (Bq/m³ / pCi/l)	Error associated to respective floating mean Radon concentration
QA AlphaE	QA bits (for diagnostic purposes)
Temperature (°C / °F)	Temperature
Dose ambient (µSv / rem)	Accumulated Dose (since re-/preset)
Equilibrium factor	Preset Equilibrium factor (applied for dose conversion)
Voltage (mV)	Current battery voltage
Accumulated time	Ratio of 10 sec intervals which have been suppressed during last saved measuring cycle due to noise events

Table 4: Measurement Data (contents of screen mask)

7.2.6 Generating a chart

Clicking the button "Chart" a graphical view is generated and previewed (see 16, Figure 7).

This view consists of three vertically arranged charts, each showing the time distribution as described below:

Upper Chart - Discrete and floating mean radon values

Middle chart - Uncertainty of floating mean radon values and QA information

Lower Chart - Temperature and accumulated dose

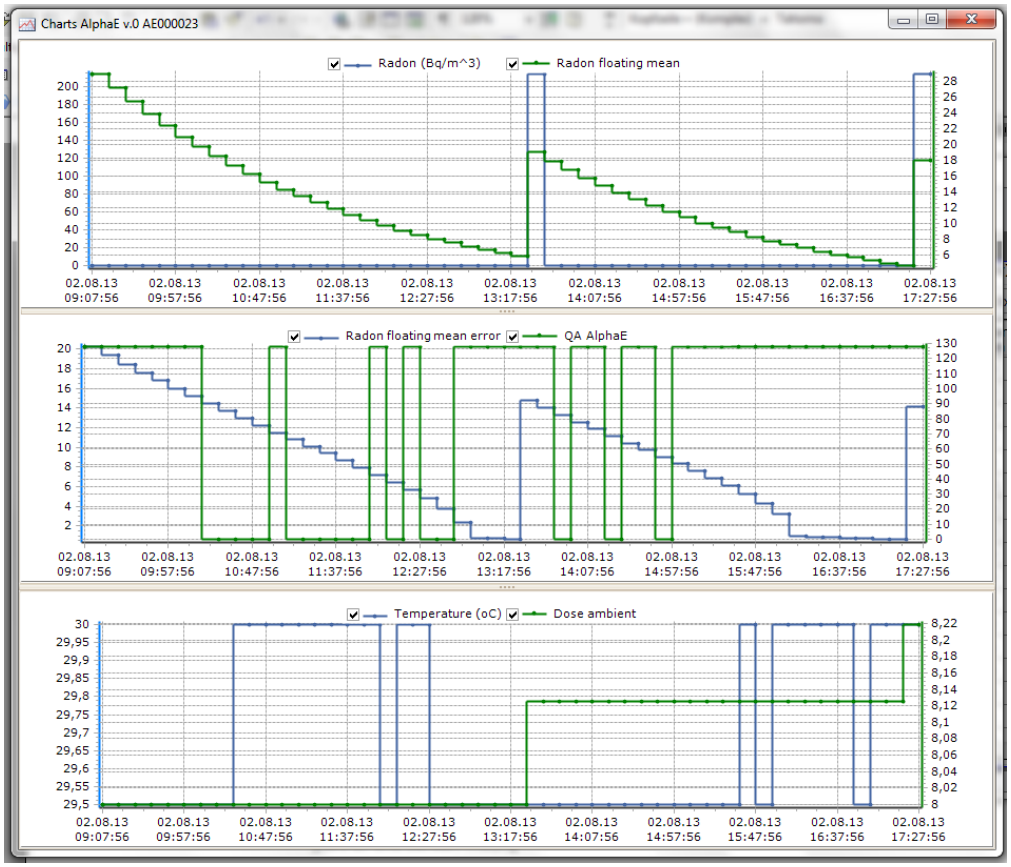


Figure 9: Graphical output of results – Three vertically arranged charts

A detailed description of the charting functions is still under construction

7.2.7 Printing out the value table

By pressing the "Print" button (see 17, Figure 7) the value table which has been previously downloaded from the storage of the *AlphaE* can be printed out. First a print preview pops up in order to check the output before printing.

7.2.8 Exporting and Importing Data

By pressing the "Export/Import" button (see 18, Figure 7) data can be stored on any drive or stored data can be loaded from a file.

Export to CSV

Stores data in a file format compatible with EXCEL. Following Parameters are listed in the exported table:

MTime	Time stamp the data set was calculated and stored
MCycleSec	Time interval in which the values have been accumulated.
IT	Type of measurement instrument (AlphaE = 40)
SN	Serial number of *AlphaE* device
Radon (Bq/m³ / pCi/l)	«Raw» Radon concentration value
Radon floating mean (Bq/m³ / pCi/l)	Floating mean Radon concentration (determined on basis of smoothing algorithms)
Radon floating mean error (Bq/m³ / pCi/l)	Error associated to respective floating mean Radon concentration
QA AlphaE	QA bits (for diagnostic purposes)
Temperature (°C / °F)	Temperature
Dose ambient (µSv / rem)	Accumulated Dose (since re-/preset)
Equilibrium factor	Preset Equilibrium factor (applied for dose conversion)
Voltage (mV)	Battery voltage
Accumulated time	Ratio of 10 sec intervals which have been suppressed during last saved measuring cycle due to noise events

Table 5: CSV Export (contents of export table)

Export to upf2 *(mainly for Saphymo use)*

Stores data in Saphymo file format. Upf2 files can be loaded again later on by the communication software.

8 Accessories

8.1 Wall support

For stationary surveillance of the radon concentration a suitable holder made of black painted aluminum sheet (thickness: 1,5 mm) is available. This appliance allows fixing the *AlphaE* safely to a wall or an object. A clamp and a padlock prevent theft and damage.

Dimensions and Weight

Width : 86 mm (with padlock: ca. 95 mm)
Height : 118 mm
Depth : 33 mm

Weight : ca. 100 g (incl. padlock)

Figure 10: AlphaE – Wall-mounted for stationary use

8.2 Belt pouch

For accurately assessing the personal radon exposure and dose of workers under surveillance it is recommended that the *AlphaE* is permanently worn by concerned persons. The available belt pouch with viewing window allows comfortable wearing as well as undisturbed operation of *AlphaE* and unhindered access to function keys and display.

Figure 11: AlphaE – Protected by the belt pouch

8.3 Dust protection bag (Tyvek)

9 Technical Data

Detection principle	Diffusion chamber with silicon diode
Measurement units:	SI [Bq/m³] or US [pCi/l] (specify with order)
Measurement range:	20 Bq/m³… 10 MBq/m³ (0,54 pCi/l … 270 000 pCi/l)*)
Detector efficiency:	3 cph at 100 Bq/m³ (2,7 pCi/l)*)
Dose range:	0 … 1 Sv (0 … 10 rem)*)
Lower limit of detection:	100 Bq/m³ (2,7 pCi/l)*) in 12 hrs (DIN 25 482)
Measuring cycle:	Adjustable from 1 min to 12 hrs
Diffusion time constant:	1 … 2 hrs (to reach 90 % of final value)
Display:	6 digit LCD + 5 digit alphanumeric
Storage capacity:	10 000 data sets
Communication and power interface:	USB
Battery capacity / operation time:	2 Ah / up to 6 months (rechargeable via USB)
Power supply:	5 VDC (via USB, incl. cable and mains adapter)
Power consumption:	1,5 mW
Additional sensors:	Temperature sensor, relocation sensor (for tamper detection)
Operational temperature range:	-20 … +50°C (-4 … 122 °F)
Dimensions (H/B/T):	108 x 68 x 30 mm
Weight:	165 g
Mains adapter:	Switching power supply Input: 100-240V~, 50-60Hz, 200mA Output: +5V, 1 A max (USB socket)

*) Relevant for US versions

10 Literature

[1] **K**arinda, Frank L.: Verbesserung und Einsatz von Echtzeit-Exposimetern zur Bestimmung individueller Radonexpositionen. Dissertation at Helmholtz Zentrum München (German Research Center for Environmental Health), 2009