Manual

RTM 1688-2

Radon- and Thoron-Measurement equipment

Version 01/2024

<u>Referenced documents:</u>
Software manual Radon Vision
Software manual ROOMS 1.2.0

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Content

Applications

The universal radon and thoron monitor RTM 1688-2 can be used for the following applications in geology, mineralogy, physics, chemistry, mining and construction:

- to determine the radon and thoron concentration in the air
- to determine the radon content in water samples and running water
- soil air measurements in construction projects and geophysical research
- localization of radon entry paths (sniffing) in buildings
- Emanation measurements
- Exhalation measurements
- As autonomous measuring station for monitoring buildings or systems

The above list of possible applications can also be expanded; the user can also use the RTM 1688-2 to solve other measurement tasks. You can find more detailed information on possible areas of application in the section "Application Notes". If necessary, please also contact the manufacturer's specialists for further information and advice on a possible solution to your specific measurement task.

Short Description

Please insert the supplied fuse at the backside of the instrument before using the instrument!

The RTM 1688-2 is an absolutely universal radon / thoron monitor with which the entire range of radon measurements can be covered. Its high sensitivity, combined with the measurement method of **alpha spectroscopy**, allow the fastest possible measurements even with low radon concentrations. The thoron concentration is determined at the same time.

Radon entry paths can be discovered by the **"sniffing mode"**. Soil gas sampling as well as radon in water measurements are simple because of the built in pump.

The operation of the radon/thoron monitor is realised by only one button.

A serial printer may be connected to the interface of the RTM 1688-2 to present a protocol directly on site. The radon/thoron monitor can be directly connected to a modem for remote data transmission. The **Radon Vision software** (included in delivery) handles the remote connection as simply as a direct cable link.

The measurement chamber is not sensitive against humidity variations; a drying tube, commonly used in such instrument types, is not required.

Special attention was paid for the issue of quality assurance. Each stored data record contains a complete alpha spectrum which shows the error-free operation of the instrument for each single integration interval. Any number of measurement series may be created by starting/stopping the data acquisition. The data stored within the instrument can be read by PC even if a measurement is in progress.

The **small chamber volume** of only 250 ml must be pointed out. The measurement of probes taken from small and limited volumes is possible due to this property.

The radon/thoron monitor RTM 1688-2 can be powered either by a mains power adapter or by the internal battery which gives an autonomous operation time up to 14 days.

The instrument is equipped with sensors for temperature, humidity and barometric pressure. An integrated tilt detector will give a signal if the radon/thoron monitor has been removed from its original position during the measurement.

The instrument comes with a **calibration certificate issued by our DAkkS-accredited Radon calibration laboratory**. The calibration process fulfils the requirements of the DIN ISO EN 17025:2018.

Important Hint

The determination of the activity concentration of Radon is always a radiometric measurement, meaning a counting experiment. This causes a number of specific circumstances which have to take in consideration by the one who is carrying out this task. Only the knowledge of those particularities allows the correct set-up of a test and avoids misinterpretations of the achieved results.

Please read carefully the next chapters “Theory of Operation” and “Statistical Error” to become familiar with this kind of radiometric measurements.

Theory of Operation

The Radon (Rn-222) gas concentration will be measured by the short living daughter products, generated by the Radon decay inside a measurement chamber. Directly after the decay, the remaining Po-218-nuclei become charged positively for a short period, because some shell electrons are scattered away by the emitted alpha particle. Those ions are collected by the electrical field forces on the surface of a semiconductor detector. The number of collected Po-218 ions is proportional to the Radon gas concentration inside the chamber. Po-218 itself decays with a half-life time of only 3.05 Minutes and about 50% (particles emitted towards the detector surface) of all decays will be registered by the detector. The equilibrium between the Radon decay rate and Po-218 detector activity is given after about 5 half-life times, say 15 Minutes. This time span defines the minimum achievable response time to a Radon concentration step.

Now, the decay chain is continued by the both beta emitters Pb-214 and Bi-214 followed by another alpha emitter, the Po-214. That means, each Po-218 decay causes one more detectable decay by the Po-214 which is delayed about 3 hours because of the superposed half-life times of those nuclides. The emission energies of Po-218 and Po-214 are different and therefore it is possible to separate both nuclides from each other by alpha spectroscopy. The RTM1688-2 offers two calculation modes for the Radon concentration, one (Slow) includes both, Po-218 and Po-214 decays and the other one includes Po-218 only (Fast). The advantage of the “Fast” mode is the quick response to concentration changes while the “Slow” mode gives the sensitivity twice as high compared with the fast mode. The higher sensitivity reduces the statistical error of a measurement which depends on the number of counted decay events only. The user should select the calculation mode carefully with respect to the application specific requirements (see next chapter).

In case of Thoron (Rn-220), the direct daughter product Po-216 (which also underlies the ionisation process) is used to calculate the Thoron activity concentration. The half-life of Po-216 is less than 1s and therefore the equilibrium state between gas concentration and collected activity on the detector is present immediately. The half-life of the Po-216 decay products Pb-212 (beta) and Pb-212/Bi-212 (alpha) are too long to use them for Thoron measurement. The single nuclides of the Thoron decay chain will be also separated by alpha spectroscopy.

Operating of the Instrument

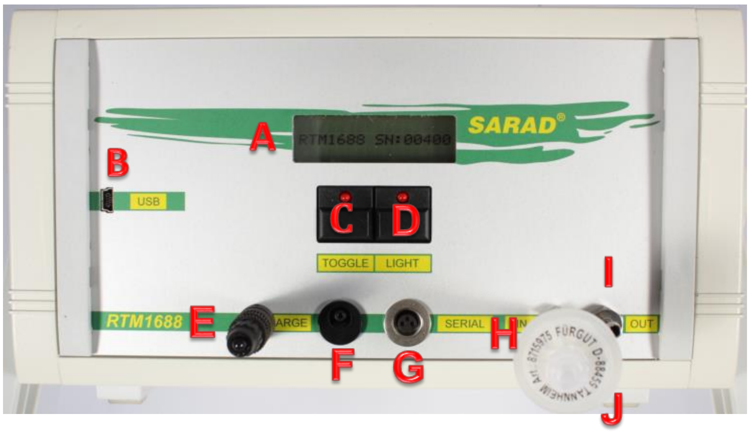

Fig. 1: operation elements and connections

A	Display	**F**	External power supply
B	USB interface	**G**	RS 232 interface
C	Operation button (Toggle)	**H**	Air inlet
D	Light	**I**	Air outlet
E	Connection water inlet protection	**J**	Dust filter

Power supply

Please insert the fuse at the backside of the instrument before using the instrument. The instrument has no power switch because the power consumption of the electronic circuits is less than the self-discharge of the battery. After inserting the fuse the instrument enters the stand by status, the display will show “RTM 1688 SN:XXXXX”. It is necessary to set the real time clock of the instrument in that case (see manual “Radon Vision”)

To maximise the capacitance and battery life time, the battery should be charged from time to time (each 3 month) even if the instrument is not in use. Otherwise the battery may become discharged deeply which can cause malfunction of the internal microprocessor. Remove the fuse if battery maintenance is not guaranteed over long periods.

The instrument is powered either by the internal 12V/3.2Ah lead gel battery or by the AC/DC wall adapter included in delivery. The battery allows an autonomous operation for more than 24 hours. The battery will be recharged as long as the AC/DC adapter is connected, the red LED on the “LIGHT” button turns on, after a while the LED ” TOGGLE” is lighting, but **it takes about 8 hours for full charging in case of a totally discharged battery.**

If the battery voltage drops below 11.8V, the display will show the phrase “LOW BATTERY!” after finishing each integration interval. The measurement is still continued for several hours. The pressing of the “TOGGLE” button leads back to the standard display output. If the battery voltage decreases down to 11.2V the running sample will be stopped and the instrument enters in the stand by status.

Input Filter

The instrument is equipped with a high efficient multi-stage filter to prevent penetration of daughter products into the measurement chamber. This filter will be protected against contamination by an additional syringe filter fitted to the air inlet. Do not use the instrument without that filter and replace it if required (becomes dark if loaded with dust). Take care for the correct flow direction. Some filters can block the air flow completely when used in wrong flow direction.

Water ingress protection (optional)

Please never measure radon in soil gases or in water samples without the stainless-steel container connected to the water inlet protection! This prevents that water could enter into the high-voltage chamber of the device. **The penetration of water into the device can lead to its failure and, as a result, to very expensive repairs!**

SARAD GmbH offers to its customers a special stainless-steel container with floating contact to prevent the penetration of water into the device when measuring radon in soil gases and in water samples. For this purpose, a special stainless-steel container (see photo) is connected to the air suction line of the radon measuring device between the soil air probe or water sample and the measuring device and also connected with a plug. If water penetrates the stainless-steel container, the pump and the air intake are automatically switched off, to prevent the penetration of water into the high-voltage chamber and which results in a failure of the device. To continue the measurement, pour out the water that has entered in the stainless-steel container. The plug should be disconnected from the device and the stainless-steel container should be removed for emptying.

In order to ensure the correct functioning of the water ingress protection system, the stainless-steel container must be strictly in vertical position during the measurement!

If the device is used to measure radon in air, the supplied loose plug must be inserted instead of connecting the special stainless-steel container. Otherwise the built-in pump would no longer suck air.

fig 2: water ingress protection

Carrying out a measurement

Press the push button to start a new measurement series. The pump starts and the display will show the remaining time to complete the first integration interval.

```
RTM1688 SN:00001
Wait 120 Minutes
 for first data!
```

The actual status and set-up information (see below) may be displayed by pressing the button again.

If the first interval has been completed, five different display pages are available. The several pages can be toggled by repeated pressing the push button. Depending on the selected system of units, the concentration values are given either in 'Bq/m³' or 'pCi/L' (mbar/inHg, °C/°F)

The first page shows the actual Radon concentration (calculated for the last sampling interval) with the statistical error for a 1 Sigma confidence interval. If "Fast" mode was selected, a starlet is appended to the word "Radon" in the first row. Right beside, the time stamp is given when the integration interval of the calculated concentration was finished

The bottom row contains at the left hand side the total number of integration intervals since the last start of a measurement series. At the right hand side the pre-set integration interval and the remaining time period of the actual sample is displayed.

```
RADON*     12:20
     85Bq/m³±10%
#34   117/120Min
```

Page two gives the same information for Thoron (Rn-220)

```
Thoron     12:20
    124Bq/m³±16%
#34   117/120Min
```

The readings of the additional sensors are shown at the third page. These values represent averages which are derived from all "one Minute shots" of the entire integration interval.

```
Ambient   12:20
21.5°C  987mbar
46%rH     12.3V
```

The next page shows the average values of the Radon and Thoron concentration from the start of the actual measurement series. The total sampling time is given in the first row.

```
Average  68.0Hrs
Rn:     314Bq/m³
Tn:     141Bq/m³
```


The last page contains the status information, beginning with the date and time of the start of the measurement series followed by the actual alert settings in the second line. The lower line shows the selected pump and sniffing mode.

```
>>17.04.06 16:32
ALM:     250Bq/m³
CONT.    SNIFF216
```

To finish a measurement series keep the push button down and wait for at least four beeps from the buzzer. If the button is released, the sample will be stopped. If the button has been locked by software, the button has to be unlocked before.

Adjustment of the sampling interval

The adjustment can be carried out as long the sampling is stopped. The “TOGGLE” button must be hold down for at least 6 seconds (beeper). On the display appears:

```
INTERVAL: 1min
```

Now, the interval can be toggled by the button between 1, 5, 10, 15, 30, 60 and 120 minutes. To accept the new setting, the button must be pressed again for at least 6 seconds.

Operation Modes

Pump

There are two different pump modes available, either continuous or interval pumping, selectable by software. In continuous mode the pump is running during the whole measurement period while the pump will switch off after the first five Minutes of each new integration interval in case of interval mode. If the selected integration interval is less than five Minutes the pump will run continuously too.

Alarm

If the measured Radon concentration exceeds the programmable alarm limit, the buzzer will sound shortly each second. The alert has to be acknowledged by pressing the push button. The alert check is performed after completion of each integration interval. If the alert is enabled, “ALARM ON” will appear in the lower line of the status page.

Fast/Slow Mode

“Fast” and “Slow” mode will determine the kind of calculation of the Radon concentration. Please refer to the chapters “Theory of Operation” and “Statistical Error”.

Sniffing

“Sniffing” means the search for radon entry paths, which are usually recognizable by locally increased concentrations. Thoron can often be used as an indicator, since it is still available in higher concentrations at such points (if any) and immediately decomposes in the measuring chamber. In order to receive information as quickly as possible, the acoustic signal generator can be set to "sniffing" mode. Each registered decay is indicated by a short signal.

Depending on the setup setting, either only the decays of the thoron decay product Po-216 or additionally those of the radon decay product Po-218 are signaled.

However, due to the relatively long half-life of about three minutes, the Po-218 is only suitable for "sniffing" to a limited extent.

The procedure for the "sniffing" measurement would be as follows:

You should configure the device using the supplied software (Radonvision).

The interval can be set anywhere between 1 and 255 minutes via the software (only fixed values can be selected on the device). An interval of 5 min can be selected for radon and 1 min for thoron. The configuration of the alarm can be determined. The pump mode should be set to continuous. The measurement should be made for radon in the "fast" (FAST) mode (display shows radon*).

The charging status of the battery should be checked (if possible >12V).

It should be noted that the pump only runs when the water ingress protection is plugged in (or just the plug).

A sealing compound should be applied around the hose at the measuring point to prevent the surrounding air from being sucked in.

The measurement can be started by pressing the toggle button.

If the measured values are below the limit to be detected, BDL (Below Detection Limit) appears on the display.

Data Handling

Data Storage

All data are stored in a non-volatile memory using a circular architecture. That means, the last 2047 data records (data of last 2047 integration intervals) remain in the memory. Older data will be overwritten if the memory exceeds the limit. Because the complete measurement data are transferred during download to the PC, the memory should cleared after successful data transmission and storage on hard disk. This will save time during the next transmission and avoids redundant data storage.

Each data record is stored after completion of the integration interval and contains the full information of this single integration interval:

- time stamp
- integration time
- alpha spectrum
- readings of additional sensors

All sequential records with a time distance to the last record equal to the integration interval are interpreted later as one measurement series. The measurement may be interrupted as often as desired to finish the old and start a new measurement series. There is no limit for the number of series. Single point measurements are also possible.

Printing a protocol

The RTM 1688-2 enables the direct printout of acquired data on the portable protocol printer. Only the last acquired measurement series can be printed. Connect the printer to the RTM 1688-2 by the adapter cable (9-pin SUB-D male to 3-pin round connector) included in the delivery. To switch on the printer press the right button at the panel. The LED is constant, green. Note: after about 30 seconds, the printer switches in the sleep mode if no print job is carried out. To start a protocol print, the instrument has to set in stand-by mode - stop the measurement in case of a running sample. Start the printing out by pressing the “TOGGLE” button for at least 5 Seconds (wait for four beeps). During printing out the display will show the phrase “...print protocol”. If a new series was started unintended, the measurement may be stopped again before completing the first interval. The print data remain valid as long.

The protocol header contains the serial number of the instrument, the start and the end of a measurement series, the Radon and Thoron average concentrations and the time period used for averaging (between start and end of the test). The header is followed by the records of the measurement series containing time stamp, Radon and Thoron concentration and environmental sensor readings.

```
RTM1688 SN:XXXXX

Begin        06/12/23 12:34
End          06/12/24 17:34
Average             12.2Hrs
Radon          1234567Bq/m³
Thoron         1234567Bq/m³

04/27/06              15:32
Radon      1234567Bq/m³±12%
Thoron     1234567Bq/m³±12%
25.5°C     56%rH    1002mbar

... more records
```

The printer is supplied by an internal rechargeable battery which can re-charged using a mains power adapter. It takes about 15 hours to complete the charging process (full charged) depending on manufacturer. During charging the LED lights orange and blinks short green. A discharged battery is indicated by a short red blinking LED. The LED blinks also red in case other problems.

To insert a new paper spool, the paper compartment can be opened by sliding the Lid Release Button forward until the lid springs open. Unwind a small amount of paper from the roll and insert the paper roll into the printer. Close the lid down, and the paper is loaded. For more detailed information please look at the printer's operation manual. Please follow always the Manufacturers' instructons!

Data transfer

The acquired measurement data can be downloaded to a PC using the USB or serial interface. The easiest way to get data downloaded is to use USB interface on the front panel of the monitor and USB cable supplied. Another possibility is to connect the PC interface cable (9-pin SUB-D female to 3-pin round male) to both, instrument and PC COM port. If the PC is not equipped with a standard COM port a USB to serial converter can be used. For further information read the software manual.

Version RTM1688-2 MODBUS

The MODBUS protocol offers a communication option in addition to the SARAD standard protocol. The protocol type can – depending on the type of instrument – be selected either by jumper, switch or menu. The MODBUS protocol implements only a part of the interface functionality and has been implemented primarily for the cyclic reading of current measuring results. The adjustment of the configuration parameters as well as the download of time distributions stored in the instrument is not possible.

Standards

- MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b3
- MODBUS over serial line specification and implementation guide V1.02
- www.modbus.org

With respect to the standard following communication parameter are defined:

Baud rate: 9600bps or 19200bps (configurable)

Data format: 1 start bit, 8 data bits, 1 parity bit, 1 stop bit (total 11 bit)

Parity: even

Address range: 1…255 (configurable)

Bus timing

	9600 bps	19200 bps
Min. period between two frames (t3.5)	4.025ms	2.01ms
Max. period between two bytes within a frame (t1.5)	1.75ms	0.862ms
Response time	< 1s	< 1s

Error management

Incomplete frames or frames with invalid check sums will be ignored and result in a client time out. Invalid or not supported function codes, register addresses and data length settings are responded by the related exception codes:

- Invalid function: Code 0x01
- Invalid address: Code 0x02
- Invalid number of registers: Code 0x03

Hardware

- Instruments with native RS-485 interface (full bus functionality)
- Instruments with RS-232 interface with RS-232/RS-485 converter (full bus functionality)
- Instruments with RS-232 interface or internal USB/UART converter (point to point connection without bus functionality – for example host which handles transmission over virtual (COM port)
- Instrument specific implementation of the bus functions

Implemented MODBUS functions

Function code 0x03 (read holding register)

Valid register addresses are:

Register Address	Register content	Number of registers	Format
0x0000	Radon concentration [Bq/m³]	2	Float
0x0002	Statistical error of Radon concentration [%]	2	Float
0x0004	Average Radon concentration since last start [Bq/m³]	2	Float
0x0006	Battery voltage [V]	2	Float
0x0008	Temperature [°C]	2	Float
0x000A	Relative humidity [%]	2	Float
0x000C	barometric pressure [mbar]	2	Float
0x000E	Thoron concentration [Bq/m³]	2	Float
0x0010	Statistical error of Thoron concentration [%]	2	Float
0x0012	Average Thoron concentration since last start [Bq/m³]	2	Float

IEEE 745 float values (4 Byte) are transmitted as two sequential 16 bit registers. The number of registers to be read must be two. That means, only one value can be transmitted per frame. Other values and not stated register addresses will cause an exception response.

Bus Settings:

- Address by INIT software
- Transfer protocol by push button menu at instrument

Statistical Error (for non-mathematicians)

The radioactive decay is a statistical process. That means, even if the Radon concentration is constant over the time, the number of decays N counted within several intervals of the same period will be different. N will vary around the mean value of all considered intervals. Considering an infinite number of intervals would lead to an average which one indicates the "true" result of N. For a single interval, the value of N will be either below or above the "true" value. This observed deviation is covered by the term "Statistical Error".

Therefore, each serious measurement contains beside the calculated Radon value the error band for a stated confidence interval. The commonly used confidence intervals are 1, 2 or 3 Sigma (σ) which refer to a likelihood of 68.3%, 95.45% and 99.73%.

For example, the correct interpretation of a measured Radon concentration of 780 Bq/m³ with a statistical 1σerror of ±15% is:

The real "true" Radon concentration lies with a likelihood of 68.3% within the range from 663 Bq/m³ (780 Bq/m³ - 15%) to 897 Bq/m³ (780 Bq/m³ + 15%).

Error Prediction

The relative statistical error E for a chosen confidence interval of k-Sigma can be predicted from the number of detected counts N by the equation:

$E[\%] = 100\% * k * \sqrt{(N)} / N$

The simple consequence is: The higher the number of counts the higher is the accuracy of the measurement. From the opposite point of view one could ask: How many counts I have to detect to achieve a predefined uncertainty?

Two items will affect the number of counted decays: The sensitivity of the instrument at the one hand side and the time period used for counting process (integration interval) on the other hand.

While the sensitivity is an instrument specific constant, the integration interval may be expanded to the maximum acceptable value for the desired time resolution of a measurement series.

The relationship between the measured Radon concentration C_{Rn} and the number of counts N within an integration interval T is:

$C_{Rn} = N / (T * S)$

whereby S represents the Sensitivity of the instrument, given in the unit [cts/(min*kBq/m³)]. The sensitivity using the slow mode is double as high as in the fast mode (see chapter "Theory of Operation") and whenever the required response time is more than 2 hours the slow mode should be selected.

For the following examples a fast mode sensitivity of 4 cts/(min*kBq/m³) shall assumed while the slow mode sensitivity shall be 8 cts/(min*kBq/m³).

The first question could be: Which integration interval T has to set to get a statistical uncertainty less than 10% at a confidence level of 1σif the expected Radon concentration is 200 Bq/m³?

A 1σerror of 10% requires 100 counts (100%* 1 * $\sqrt{}$(100) / 100 = 10%). Using the fast mode, the integration interval can be calculated by

$T(fast) = N / (C_{Rn} * S) = 100\ cts / (0.2\ kBq/m^3 * 4\ cts/(min*kBq/m^3) = 125\ min.$

Because the required interval is longer than 2 hours, the slow mode is the better choice, leading to the following result:

$T(slow) = N / (C_{Rn} * S) = 100\ cts / (0.2\ kBq/m^3 * 8\ cts/(min*kBq/m^3) = 62.5\ min.$

That looks pretty but makes no sense because of the longer response time. So we will set the interval to 120 Minutes and ask for the statistical error in this case:

$N(slow) = C_{Rn} * T * S = 0.2\ kBq/m^3 * 120\ min * 8\ cts/(min*Bq/m^3) = 192\ cts$ $E(1\sigma) = 100\ \% * 1 * \sqrt{}(N) / N = 100\ \% * 1 * \sqrt{}(192) / 192 = 7.22\ \%$

Now one could say 68.3% is not sure enough, I want to choose 2��confidence interval to get a more trustable result:

$E(2\sigma) = 100\,\% * 2 * \sqrt{(N)} / N = 100\,\% * 2 * \sqrt{(192)} / 192 = 14.44\,\%$

For interpretation look at begin of this chapter.

Is an observed concentration change statistical significant or not?

If you have a look at the acquired time distribution you will see variations of the concentration from point to point. The question is now: Is it a real change in the Radon concentration or only a statistical fluctuation?

The test is very simple: Define a confidence level with respect to your needs and look at the statistical error bands of the two points of interest. If the error bands do not overlap each other, the change in the Radon concentration is significant otherwise it “can be or not can be”.

Example 1:

Reading 1: 1500 Bq/m³ ±10% → error band [1350 ... 1650 Bq/m³]

Reading 2: 1300 Bq/m³ ±13% → error band [1131 ... 1469 Bq/m³]

The upper limit of the error band of the reading 2 is higher than the lower limit of the error band of reading 1. Because the “true” value could be placed within 1350 Bq/m³ and 1469 Bq/m³, the variation of both readings is not statistical significant.

Example 2:

Reading 1: 1500 Bq/m³ →10% →error band [1350 ... 1650 Bq/m³]

Reading 2: 1000 Bq/m³ →15% →error band [850 ... 1150 Bq/m³]

The error bands of the readings do not overlap each other. Therefore, a statistical significant concentration change is given.

Two arbitrary points of a measurement series may be considered using this test. It is not necessary that the points are direct neighbours.

Detection Limit

The term Detection Limit defines the smallest value of the Radon concentration which delivers a non-zero reading of the instrument within a given integration interval (at least 1 decay per interval). Because of the statistical behaviour a related confidence interval has to be stated.

Why is it necessary to know the Detection Limit? If the set integration interval is short and the Radon concentration low, the expected “true” value of the number of detected decays may be around or less than 1. Because of the statistical variations, intervals without any detected decay will appear frequently. The most extreme situation would be a measurement series with a lot of “zero” intervals and only one interval with one detected decay (because a decay cannot be split).

When calculating the Radon concentration by the given formula, the concentration value for the interval with the one count is much too high while all other values show zero. Then, all intervals have to be averaged to get a usable result. This procedure is nothing else than to create an integration interval long enough to meet the Detection limit for the applied Radon concentration. To avoid zero readings, set the integration interval with respect to the lowest expected concentration level during measurement.

The mean („true“) value of the number of decays during an integration interval in case of a Radon concentration in the surrounding of the detection limit is less than 16 and therefore the statistical fluctuations have to be derived by the Poisson distribution. The stated confidence interval gives the probability that the detected number of decays within the interval is not zero.

Confidence Interval	Required Mean Value for N at the Detection Limit
63,2%	1
95%	3
99,75%	6

Example:

Determination of the detection limit of the Monitor using the „Fast-Mode“ and an integration interval of 60 Minutes. The confidence interval shall be 95% (that means in about 95 from 100 intervals a no zero reading should appear):

Required mean value (number of counts from the table): N = 3. Calculating the detection limit by the formula:

$C = N / (T * S) = 3$ cts / (60 min * 8 cts/(min*kBq/m^3)) = 0.00625 kBq/m^3 = 6.25 Bq/m^3 The detection limit in this case is 6.25 Bq/m^3.

Service

We offer a comprehensive repair, maintenance and calibration service for all our products.

Please fill out the form on our homepage (SARAD - Service) BEFORE SENDING A DEVICE and send it to us. We need the device type and serial number as well as a short description of the error that occurred or the expected service. You will then receive an initial cost estimate from us as well as information on how to proceed.

The device check and the preparation of the cost estimate for repairs after the warranty has expired are subject to a fee.

To use the calibration service, please also go to our homepage (SARAD) and fill out the appropriate form.

Disposal instructions

Batteries and accumulators must not be disposed of in the garbage, but you are legally obligated to return them to the appropriate waste collection centres. The measuring instruments must be disposed of in the electronic waste or handed to the manufacturer at the end of their service life for proper disposal. If necessary, they have to be decontaminated before.

Technical Data

Measurement Range	
Radon/Thoron	1 Bq/m³ … 10 MBq/m³
Temperature	-20 °C … 40 °C
Humidity	0 … 100 %
Bar. Pressure	800 mbar … 1200 mbar
Response time (95%)	
Radon fast	15 Minutes
Radon slow	120 Minutes
Thoron	1 Minute
Sensitivity (fast/slow)	3 / 6.5 cts/(min*kBq/m³)
Measurement accuracy	7%/5% @1kbq/m3; 1h
Sample Interval	1 … 255 Minutes (adjustable)
Memory	2047 data records (circular structure)
Pump rate	0.3 l/min
Internal volume (chamber/air loop)	approx. 250 ml
Power supply	
Battery operation	> 160h (continuous pumping)
	> 10 days (pump in interval mode)
Recharge Time	8 Hours
AC/DC adapter	100-240V/AC, 50/60Hz, 18V/DC1A
User interface	Display 3 x 16, 2 push buttons, buzzer
Interface	USB, RS232, RS485 (optional)
Protocols	SARAD proprietary
	MODBUS RTU (9600/19200bps)
	ASCII Protocol print
Dimensions	232 mm x 182 mm x 135 mm
Environmental condition	
Temperature	5 °C … 40 °C
rel. humidity	0 … 95%, not condensing
bar. pressure	800...1100 hPa
Weight, net	3.5 kg
Tamper detection	if instrument is moved > 8 Seconds

Scope of delivery:

Article no.	Name	Quantity	Remarks
22050020	RTM 1688-2	1	
	Adapter 110-240V/AC, 50/60Hz /18VDC	1	
80020002	dust filter 40 µm	2	
	fuse	2	
	PVC tube (6,35 x 3,18)mm	1,5 m	
	USB cable	1	
	RS232 cable	1	
	Suitcase for transport	1	Could be substituted by measuring case
	Manual RTM 1688-2	1 CD*	
	Radon Vision Software, manual	1 CD*	Actual version
	Certificate of calibration acc ISO17025	1	
	Warranty certificate	1	

*also available on our Homepage https://sarad.de

Optional accessories:

No.	Article no.	Name	Quantity	Remark
1	20050025	Measurement case * incl. 1x tube 2m (6x3mm) 2x adapter 5/10mm 1x tube 1m (10x6mm)	1	
2	20050021	Transportation case for RTM 1688-2 with IP68 (Peli™)*	1	
3	10010003	Aqua Kit 500ml incl. 1x tube 1m (6x3mm) 2x adapter 5/10mm 2x tubes 15cm (10x6mm)	1set	to measure Rn in water
4	10010004	Gas transfer membrane	1 set	to measure Rn in water
5	10010007	Soil gas probes incl.2x adapter 10/13mm, 2x adapter 5/10mm, 1x tube 1,5m (6x3mm) 1x tube 1,5m (10x6mm) 1x tube 15cm (14x10mm)	1 Set	
6	10010017	Sharp tips for soil gas probes	1 set	100 pcs
7	80020005	Simple retractor for soil gas probes	2 pcs	
8	10010010	Special retractor for soil gas probes	1	
9	20040003	Monopak, borehole packer probe + pump	1 set	

10	20040004	Twinpak, borehole packer probe (up to 4,3m)	1 set	
11	10010009	Exhalation unit 430 mm x 430 mm incl. 1x tube 1,5m (6x3mm) 2x adapter 5/10mm 2x tubes 15cm (10x6mm	1	
12	22050100	Thermal printer	1	
13	90050027	Water ingress protection	1 Set	
14	80020002	Dust filter	1 Set	10 pcs
15	78800001	4G VPN-Router incl. adapter	1	
16	50011012	5l barrel	1	to measure radon emanation from bulk materials

* selectable