The reference in professional radon measurement

**ALPHA GUARD**

- High sensitivity and fast linear response at 2-2 000 000 Bq/m³
- Multiparameter features
- Long-term stable calibration
- Maintenance-free operation
- Complete system for all Rn measurement applications
- Direct RS232 interface to DataEXPERT
- Ethernet/LAN interface available

**NEW Accessory !!**

**ALPHA PM** - Radon Progeny Meter
For continuous measurement of radon decay product concentration
**Features**

- Battery or mains powered measurement of radon in air, soil, water, building materials
- Simultaneous monitoring of temperature, pressure, humidity and optionally radon progenies
- Optimal sensitivity: Alpha spectrometric detector with 5 cpm at 100 Bq/m³ (3 pCi/l)
- Linear response from 2 – 2,000,000 Bq/m³ (0.05 – 50 000 pCi/l)

**Basic Configuration**

- Communication via COM-port
- Reduced efforts for installation
- State-of-the-art evaluation software and database

**LAN/WAN Integration (Option)**

- Easy integration in networks for surveillance
- Access possible from any computer
- Addressing of monitor via IP-address or alias name

**Quality on highest level**

- Long time stable calibration factor (guaranteed 5 years)
- Calibration traceable to different national standards (PTB, NIST, NPL)
- Inbuilt quality assurance system for permanent validation of system operation and data
- Automatic background correction and contamination notification

- AlphaGUARD is suitable as reference device

**Application fields**

- Short- and long-term monitoring of radon concentration indoor and outdoor, water and soil gas analysis
- Radon surveillance and mitigation at workplaces (according to valid radiation protection regulations)
- Geological survey, e.g. volcano watching, earthquake surveillance
- As reference device for calibration of other active and passive radon detectors, reference standards for traceability to NIST are available

**Additional benefits:**

- Simultaneous measurement of
  - air temperature
  - air pressure
  - air humidity
  - relocation (anti-tamper proof)

**Free one week trial!**

- Communication via ISDN / GSM
- Communication via COM-port
- Reduced efforts for installation
- State-of-the-art evaluation software and database

**Application fields**

- Short- and long-term monitoring of radon concentration indoor and outdoor, water and soil gas analysis
- Radon surveillance and mitigation at workplaces (according to valid radiation protection regulations)
- Geological survey, e.g. volcano watching, earthquake surveillance
- As reference device for calibration of other active and passive radon detectors, reference standards for traceability to NIST are available
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**Introduction and Basic Equipment**

The nuclide **Radon-222** is an alpha emitter. It appears as a gaseous decay product of Radium-226. Radon-222 has a half-life period of 3.82 days. Together with its decay products (progenies) it causes more than half of the natural radiation exposition.

Since the beginning of this century radium is also used in technical applications (e.g.: as an additive in phosphorescent paint in the watch- and measuring device industry). Therefore radon emanation has to be expected also of a number of technical products.

The fact that radon essentially contributes to the radiation exposition of man has put radon into the center of attention in radiation protection. Modern measuring techniques allow to determine radon concentrations with high accuracy and justifiable expenditure. Thus there is a considerable demand for qualified radon measurements to determine the local radon concentration, and moreover to clear the interaction with different environmental parameters. Additionally a scenario for actions can be drawn up to deduct steps for mitigation which generally consists in a wise minimization of the radon exposition according to the object and specific situation.

The **AlphaGUARD Radon Monitor** complies with today’s latest and official regulatory requirements. Its stat-of-the-art features will be described subsequently.

**Basic Equipment**

**AlphaGUARD** is a portable, battery- or net-operated radon monitor with high storage capacity. In addition to the radon concentration in air **AlphaGUARD** also measures and records simultaneously ambient temperature, relative humidity and atmospheric pressure with integrated sensors. Furthermore tampering is recorded (acceleration sensor) and up to two external analog signals can be processed.

By combining the monitoring of radon with these associated environmental parameters it is possible to draw valid conclusions regarding the temporal and spatial distribution of the radon gas. This is of significant benefit in radon mitigation.

**AlphaGUARD** incorporates a pulse-counting ionization chamber (alpha spectroscopy). Through optimal geometry of the chamber and intelligent signal evaluation this radon monitor is suitable for the continuous monitoring of radon concentrations between $2 \to 2\,000\,000 \text{ Bq/m}^3$. **AlphaGUARD** offers high detection efficiency, a wide measurement range, fast response and permanent, maintenance-free operation with long-term stable calibration. No pump is required when operating in diffusion mode (e.g. long-term monitoring) and the instrument is insensitive to both, high humidity and vibrations.

**AlphaGUARD** is both suited for short- or long-term examination inside (e.g. in buildings) as well as outdoor. It can also be used for permanent surveillance of radon levels in industrial plants or exhaust air ducts. As a radon-sensitive control unit (threshold value) it is useful in air-conditioning equipment.

Since 1992 **AlphaGUARD** has gained high acceptance among radon specialists. Meanwhile **more than 800 units** are in use worldwide and have proved its outstanding features. **AlphaGUARD** monitors render service for multiple applications. Among the multitude of users more than twenty renowned calibration laboratories prefer this instrument as a reliable reference machine for their highly sophisticated routine calibration works.

The basic configuration consists of an **AlphaGUARD Radon Monitor** and the **DataEXPERT** database software package. As a basic cost-effective entry into the **AlphaGUARD** range of equipment the model P30 is offered.

Optionally **DataGATE** is available for connecting the **AlphaGUARD** to LAN
DataEXPERT allows configuration of AlphaGUARD via RS-232 as well as downloading, administrating, evaluating and output of data by PC:

- Holds all data measured by the AlphaGUARD (Rn, Rn-error, air temperature, air pressure and air humidity, system status etc.) in a powerful database
- Data of several parameters can be displayed and zoomed at the user's discretion
- Online function for real-time transfer of measured data
- If required DataEXPERT converts data automatically into ASCII-format; thus measuring values can directly be transferred into commercial spread-sheet programs (for example MS-EXCEL)

OPTION - DataGATE serves for configuration of the AlphaGUARD and read out stored data via LAN:

- Contains embedded webserver
- For communication with AlphaGUARD any webbrowser (MS-Internet-Explorer or Netscape) is sufficient
- Also allows integrating the monitor directly into local networks or connecting it via remote data transmission to any location (using public networks - cable and wireless)

AlphaGUARD – a versatile monitoring system

For covering all sorts of radon measuring tasks the AlphaGUARD PQ2000 PRO fits best. By hard- and software the PRO model is capable for operating in two alternative modes:

- diffusion mode with a 10 - resp. 60 min. measuring cycle
- flow mode in a 1 min. resp. 10 min. measuring cycle.

The PRO model's processor has twice the capacity of the standard processor providing extended functions, expanded memory and additional analogue and digital inputs.

This extra features allow the PRO model to form the core of a powerful and extendable system suitable to cover all upcoming radon measuring tasks.
**AlphaGUARD**

**Calibration and Quality Assurance**

**Factory Calibration**

Saphymo (formerly Genitron Instruments) has spent high efforts in accuracy and stability of the AlphaGUARD calibration.

Once the AlphaGUARD instrument is suited with correct calibration factors it keeps its stability over many years (guaranteed 5 years). Based on the in-built quality assurance system the user can have full confidence in the calibration of his unit as long as there is no indication of malfunction. However it is good laboratory practice to verify calibration parameters at least once a year tracing them back to recognized standards (NIST).

---

**High Accuracy**

**Secondary standard:**

NIST SRM-4968

# CP-48

**In-house reference units:**

PTB certified 1998

**Operational transfer standard units:**

EF 1650 for low level (at present)

EF 0501 (at present)

Periodical cross calibration of in-house reference units traceable to NIST (every 12 months)

Factory calibration

New series production and individual re-calibration

Regular participation at intercomparisons worldwide (Genitron Instruments and customers)

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*Factory Calibration at GI Facilities*
Traceability to National Standards

High accuracy of radon measurements with AlphaGUARD monitors is guaranteed by multiple reference of their calibration to accepted radon standards.

Registration-Test for US RMP-Program of the EPA

The US - Environmental Protection Agency (EPA) tested 5 radon monitors of the AlphaGUARD PQ2000 type in respect of accuracy and reproducibility of the recorded radon data.

The Radon Monitoring Proficiency (RMP) - Qualification-Test is passed, when data of the individual instruments do not differ more than ± 25% from target value. The AlphaGUARD Radon Monitor units showed an average deviation of only ± 2 rel-% and therefore extraordinary accuracy was certified.
ICE’94 - International Calibration Experiment 1994

Five AlphaGUARD monitors cross-checked in 15 different calibration chambers around the globe.

In former years international exercises for 222-Rn generally have been performed by dispatching transfer standards (glass bulbs filled with radon gas). With the AlphaGUARD a reliable “reference shuttle” to compare the radon gas concentrations inside the walk-in calibration chambers became available.

Suited with a first-class calibration traceable to NIST (USA), NPL (GB) and PTB (GER) a set of five AlphaGUARD monitors was sent out for a worldwide round trip in 1994. First EPA/ORIA (Las Vegas, NV) tested the instruments in an intensive evaluation, going far beyond normal RMP-qualification. Thereafter the monitors were calibrated by other established public and private US labs and then continued their travel through known radon chambers in Australia, Asia and Europe (see flowchart). At the end of the round trip in mid 1995 the devices were re-calibrated by EPA/ORIA in Las Vegas, NV.

Procedure of the International Calibration Experiment 1994 (ICE’94)
For each exposure, the calibration laboratory *prepared a target value* and reported the corresponding reference quintet readings to the manufacturer. The results are displayed in following chart.

All in all the results were remarkable. Not only the US Federal Agencies (as shown in the upper graph) were found within a 3 % deviation range. Also the readings of most other participating labs spread over the globe are arranged within this margin. Following diagram shows a classification of the variation of readings relative to the reported target values.
Quality Assurance System

Switching on the AlphaGUARD also its internal quality assurance system is activated. I.e. the microprocessor automatically performs in an always repeating scheme a series of control routines checking the hardware quality level as well as the plausibility of surveyed data. Reporting of these results is done the way that the values are filed simultaneously with the measured radon values and environmental parameters in the memory of the instrument.

When reading the measurement series the report of the quality assurance system is also handed over to the PC. Via the multiparameter software DataEXPERT this protocol can be analyzed. This enables the user to characterize the time resolved status of his AlphaGUARD during the passed measuring cycle. A difference between conspicuous measuring values and physically caused artifacts can definitely be drawn when the radon monitor has to be operated under extreme circumstances (e.g. at condensed humidity).

Evaluation of radon, environmental parameters and QA information with DataEXPERT software.

Upper chart: Overlay presentation of radon, air temperature and humidity (instrument’s fast reaction to changing gradients apparent)

Lower chart: QA protocol

Note the period of high humidity (99 %rH) accompanied by “dew point” warning flags in the QA chart.
Intercomparisons

Since 1992, AlphaGUARD monitors have participated in plenty of intercomparison experiments. The results of two experiments are shown below.

**Stable Calibration**

Intercomparison at Environmental Protection Agency of Thuringia, Germany, 09/97 (measurements at different levels)

Intercomparison at GSF, Neuherberg, 04/1998 (low level measurements)
**Extension to a versatile Radon Monitoring System**

**Extension 1:**

**Decay Products**

**Simultaneous Monitoring of Radon and Radon Progeny Products**

For the simultaneous recording of the radon concentration (Rn-222), the radon progeny concentration (Po-218/Po-214) and the equilibrium factor we have developed an efficient and cost-effective measuring system consisting of:

**AlphaGUARD PQ2000 PRO**, our top model for covering all radon monitoring applications. Equipped with:

- Overdrive-processor – special microprocessor with possibility for the configuration of the counter signal and external counter signals
- Counter module – built in hardware auxiliary facility providing a digital signal input for external counter signal (expansion set for the continuous measurement of radon progeny). The Counter module cumulates all incoming pulses continuously forwarding them according to AlphaGUARD’s measuring cycle to the storage.

**AlphaPM**, the new Radon-Progeny-Meter, is used as an external radon progeny measuring head.

- Alphasensitive microchip
- Quasi-continuous operation (sampling in 10 min intervals)
- Flow controlled pumping unit adjustable according to required sensitivity (0-2 l/min), consisting of long-lived swinging lever pump
- Typical sensitivity: 130 pulses/h at 1 Bq/m³ EEC (0.03 MeV/cm³) and a pump rate of 2 l/min
- Lower detection limit: 2 Bq/m³ EEC (0.06 MeV/cm³) at 10 min and 2 l/min in flow
- Battery and mains operation (mains independent operation > 24 h at 2 l/min flow rate)

**DataEXPERT** additionally allows administrating, evaluating and output of data acquired by WL-meter:

- Administration of the calibration factors of applied radon progeny measuring frontends (WL-meters)
- Identification of the potential alpha energy concentration in the units mWL, MeV/L and J/m³
- Calculation of the equilibrium equivalent Rn-222 concentration (EEC) in Bq/m³
- Determination of respective equilibrium factors (EF) as quotient of measured EEC and Rn-concentration
Setup of AlphaGUARD & AlphaPM for continuous measurement

Example for simultaneous Rn-222 & Po-218/214-measurement incl. automatic determination of the equilibrium factor with DataEXPERT

**Upper chart:** Overlay of radon (Rn222) and the equilibrium equivalent Radon concentration (EEC) as well as complete value table

**Lower chart left:** Equilibrium factor (EF) which is the ratio between EEC and Rn222

**Lower chart right:** Potential Alpha energy concentration in Working Level (WL)
Monitoring of Radon in soil gas

For screening measurement (sampling) as well as for the continuous monitoring of the radon concentration in soil gas we offer a cost-effective, all-over applicable measuring system. Following components are required:

**AlphaGUARD PQ2000 PRO** as measuring- and recording device providing also special features for soil gas measurement:

- Flow-through adapter set and additionally implemented algorithms which are optimized for flow operation allow to switch over from the standard diffusion mode to flow through and cycle operation
- Short recovery time, even after measuring extremely high radon concentrations (typically: 5 min)
- 1/10 min measuring cycle settable
- Besides mains powered operation 10 days of autonomous operation. This period can be extended to over 30 days by using available booster battery (OPTION)

Samples are taken with an easy-to-use **soil gas measuring probe**, reliably applied since years in conventional soil gas analysis.

- Probe Ø 22 mm, length 1 m
- Suited for manual and mechanical propulsion (adapter for striking tools of the types Cobra, Bosch, Wacker and Makita)
- Exchangeable drilling tip
- Aqua-stop filter

Can optionally be completed by

- Inflatable bag for airtight measurements in existing drill holes of Ø 35–42 mm (for example after pile driving soundings)
- Extension sets up to 10 m over all length
- Mechanical or hydraulic drawing device for the salvage of tubes above depths of 2 m

**AlphaPUMP**, lightweight and easy-to-use sampling pump, transports the soil gas from the tube tip into the measuring chamber of the **AlphaGUARD**.

- Leaktight pump mechanism
- Electronically adjustable pump rate (0.03–1 L/min)
- Internal aqua-stop filter prevents damage from water break-in
- Battery and mains operation

**OPTION** - The **MultiSensor Unit** (version D/D) optimized for the needs of soil gas monitoring is equipped with a pressure and a flow sensor. This allows to draw conclusions of the permeability of this place. The specific ground can be described with the radiological size “disposable radon”. When connected to the AlphaGUARD the MultiSensor forwards generated data to the AlphaGUARD to be stored.

Furthermore the MultiSensor prevents the AlphaPUMP from overloading by switching it off remotely when certain threshold of vacuum is exceeded.

**DataEXPERT** additionally allows administering, evaluating and output of data provided by external analogue sensors like the MultiSensor D/D does.
Basic setup for soil gas measurements: Measuring cycle 1 min – short recovery time

OPTION: Soil Gas Measurement using the MultiSensor Unit D/D

Set-Up scheme for measuring differential pressure and flow along with radon in soil gas
Radon Exhalation Measurements

For monitoring the radon exhalation from soil or construction surfaces (concrete, walls etc.) the Radon-Box - a square plastic case - is available. The AlphaGUARD Monitor can be operated

- outside in flow mode being tubed in series with the AlphaPUMP and the box
- or
- suspended inside the box in diffusion mode

![Diagram of AlphaGUARD operating outside the Radon-Box in flow mode with AlphaPUMP.](image1)

![Diagram of AlphaGUARD hanging within the Radon-Box and operating in diffusion mode.](image2)
**AquaKIT**

**Reliable method for the determination of radon in water**

*AquaKIT* is a set of accessories – mostly glass components - for measuring directly radon gas of liquid samples. Within a closed system the radon solved in the liquid is gassed out whereas the equilibrium concentration generated in the air is determined by *AlphaGUARD*. The *AlphaPUMP* which copes with best gas proofness is required for the degasification process.

**Outstanding features:**

- Fast and reliable direct measurement in closed gas cycle
- Easy to handle procedure – compact and field tested (battery operation)
- Measurement uncertainties caused by sampling can be minimized
- Long-term stable and easy to verify calibration coefficient (CF)

\[
CF_{AquaKIT} = \frac{CF_{\text{AlphaGUARD/air}} \times Volume_{\text{complete system}}}{Volume_{\text{water sample}}}
\]

- For all water qualities, also waste water with high salt- and suspended particles
- Sample systems free of leakage guarantee good reproducability
- Error caused by leakage and retarding negligible

Regarding the required accuracy of measurement/ lower detection limit and available time alternative methods can be applied:

**A) Rapid determination of Rn-222 in water**

Typ. operation range: 5 Bq/l to 20 000 Bq/l (direct measurement)

Time of execution: < 15 min/sample (sampling, degassing, measuring, analyzing)

Statistical error: at 5 Bq/l ≤ 10% (1-sigma error)

**B) Precise determination of Rn-222 in water**

Larger sampling volume (up to 500 ml) and longer measuring times (30 – 300 min) decrease the statistical error band and enlarge the lower limit of detection down to 0.1 Bq/l.

This method is also suitable for the determination of Ra-226 in water via previous Rn-222 build up.
Evaluation of radon concentration in water applying DataEXPERT software.

**Upper chart:** Measurement series of five successive water samples (instrument's fast reaction to changing gradients apparent)

**Lower chart:** Measurement of two parts out of a water sample incl. synthetic decay curve
Emanation- and Calibration Set

Emanation Container (50 L Model)

An essential requirement for the radiological evaluation of a radon source is the determination of its emanation rate. This can be realized with justifiable technical effort by integrating the radon source (sample) together with a continuous working radon monitor into an airtight container. For such a container there are high requirements in terms of tightness in order to exclude an uncontrolled exchange of gas between the measuring volume and the environment. If this condition is assumed then the emanation rate can be determined by the temporal rise in the radon concentration resp. via the resulting activity equilibrium of the sample.

For this purpose we offer a handy 50 L Emanation and Calibration Container, a gas tight vessel made of stainless steel which serves for retaining the monitor and the sample as well. Power supply as well as interfaces are led via gas tight ducts to the interior. By this unlimited measuring operations and online data transfer to the PC are possible without disturbing the measurement. A couple of inspection glasses allow watching the arrangement in the container’s interior.

Two taps allow gas exchange and cycle operation, e.g. operating the AlphaGUARD outside and tube it in series with the container.

The impermeability of the container is tested and certified.

*) Containers with volumes of 100, 200 and 300 liters also available

>>> NEW <<<

OPTION - LabPUMP is best suited for long time continuous gas pumping. Consisting of a long-lived electronically powered swinging lever pumping element the device is not subject to mechanical wearout.

This mains powered device is leak-tight, disposes of an adjustable flow rate between 0 and 4 l/min and thus can meet all professional laboratory requirements.
To grant the comparability and reproducibility of performed radon measurements in the long run requires to connect the applied devices regularly to a suitable activity standard, e.g. to expose the measuring system to a known radon concentration.

Such calibration can be done by the user himself. For this purpose the Emanation & Calibration Container serves as impermeable "mini" chamber with defined volume where the AlphaGUARD has to be locked in.

Furthermore a reference is required to trace the AlphaGUARD’s calibration back to approved standards. For this purpose we provide the NIST standard reference material (SRM 4968). SRM 4968 is a radon source consisting of a polyethylene-capsulated radium-226 solution that emanates a known (certified) quantity of radon-222 gas.

The polyethylene capsule has to be stored in the Emanation Bulb, a glass vessel which allows undisturbed radon accumulation within a 100 % humidity atmosphere. Then the accumulated radon gas is transferred to the container via the gas valves using the gas tight AlphaPUMP. Finally the measured radon concentration is related to the activity released by the standard material and the deviation can be calculated.
AlphaGUARD – An accepted reference device

AlphaGUARD disposes of an accurate and long-time stable calibration. This fact is acknowledged in circles of experts without doubt. Furthermore the calibration can be checked by the user himself using the Calibration Set with the NIST Standard Reference Material.

What else is required to make an instrument a reference than a long-term stable calibration all time traceable to an acknowledged standard?

It is recognized that the AlphaGUARD with its sophisticated QA system suits all requirements of a reference machine. Thus a lot of users apply the AlphaGUARD and the Calibration Set in order to calibrate other active and passive radon detectors.

For specific calibration requirements containers of different sizes and further components like radon sources and active coal filter for zero level measurements can be supplied.

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**Radon calibration equipment**

Traceability to national standards

NIST NPL PTB

Reference radon monitor

Charcoal container for zero adjustment

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AlphaGUARD as reference device for calibrating other radon measurement devices
## References

**AlphaGUARD used at calibration facilities**

<table>
<thead>
<tr>
<th>Country</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Austria</td>
<td>BEV (Bundesamt für Eich- und Vermessungswesen) / Wien</td>
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<tr>
<td>Australia</td>
<td>ARPANSA (Australian Radiation Protection &amp; Nuclear Safety Agency) / Yallambie</td>
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<td>Czech Republic</td>
<td>State Metrological Centre / Kamenna</td>
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<td>Czech Republic</td>
<td>Institute of Public Health / Prague</td>
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<td>Czech Republic</td>
<td>National Radiation Protection Institute (SURO) / Prague</td>
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<td>Denmark</td>
<td>Ris* National Lab. / Roskilde</td>
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<td>France</td>
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<td>Finland</td>
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<td>Mexico</td>
<td>Comisión Nacional de Seguridad Nuclear / Mexico City</td>
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<td>Russia</td>
<td>Mendeleyev Institute of Metrology / St. Petersburg</td>
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<td>Slovenia</td>
<td>Jozef Stefan Institute, University / Ljubljana</td>
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<td>South Korea</td>
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<td>Sweden</td>
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<td>USA</td>
<td>USBM / Denver</td>
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</tbody>
</table>
Excerpt of Users

Worldwide more than 800 units in operation

- Bundesamt für Strahlenschutz, Außenstelle Berlin, Abt. ST 1, Berlin, Germany, Dr. Volkmar Schmidt
- Bundesamt für Gesundheit, Fach- und Informationsstelle Radon, Bern, Switzerland, Dr. Georges Pliller; 32 units in operation
- WISMUT GmbH Chemnitz, Technisches Ressort, Abt. Engineering, Chemnitz, Germany, Mr. Manfred Knittel; more than 90 units in operation
- IAEA International Atomic Energy Agency, Radiation Safety, Vienna, Austria, Dr. Peter Stegnar
- IPSN Institut de Protection et de Sureté Nucléaire, Gif-sur-Yvette, France, Madame M.C. Robé; 27 units in operation
- NRPB National Radiation Protection Board, Chilton Didcot, Great Britain, Dr. John Miles, phone: 0044-1235-831 600
- SSI Swedish Radiation Protection Institute, Stockholm, Sweden, Dr. Rolf Falk
- Kernforschungszentrum Karlsruhe, Hauptabt. Sicherheit HS, Karlsruhe, Germany, Dr. M. Urban
- GSF Research Center, Institut für Strahlenschutz, Oberschleißheim, Germany, Ms. Martina Müsch
- D.I. Mendeleyev Institute of Metrology, Main State Center of Measurement Assurance, St.-Petersburg, Russia, Dr. Vladimir Fominykh; in Russia and Ukraine more than 70 units in operation
- St.-Petersburg Research Institute of Radiation Hygiene, Laboratory of Environmental Dosimetry, St.-Petersburg, Russia, Dr. Eduard Krisiuk
- Ministry of Health, Moscow, Russia, Dr. Polakov
- VNIIFTRI, All Russian Research Institute for Physical, Technical and Radiometrical Measurements, Gos Standard RI, Moscow, Russia, Dr. Bregadze
- Ministry of Sanitary Epidemiological Survey Ros.RIAZ Russian Information and Analyzing Center, Moscow, Russia, Dr. Perminova
- Finnish Center for Radiation and Nuclear Safety, Helsinki, Finland, Mr. Hannu Anvela
- ENEA Frascati, Rome, Dr. Vasselli, via RadTech, Italy; in Italy more than 77 units in operation
- Japan Chemical Analysis Center, via Seiko EG & G, Chiba-shi, Japan, Mr. Akira Hara; via Seiko more than 50 units in operation in Japan
- British Geological Survey, Keyworth, Nottingham, Great Britain, Dr. Philip Roberts, Dr. Keith Ball,
- Building Research Establishment, Garston, Watford, Great Britain, Mr. Mike Wooliscroft
- DCPS Devon & Cornwall Prospecting Society, Paignton, Devon, Great Britain, Mr. David Buttenwer, Ms. Gillian Pearce
- Defence Radiological Protection Service (DRPS), Institute of Naval Medicine, Alverstoke, Gosport, Great Britain, Mr. Tony Rowell/Mr. Simon Warth
- Institute of Nuclear Science, National Tsing Hua University, Hsinchu, Taiwan, Prof. Dr. Chien Chung
- Australian Radiation Lab (ARL), Yallambie, Victoria, Australia, Dr. Stephan B. Solomon
- Geologische Bundesanstalt, Inst.f. Meteorologie/ Geophys., Vienna, Austria, Mr. Gernot Oberlicher
- Österreichisches Forschungszentrum Seibersdorf, Seibersdorf, Austria, Dr. Hannes Stadtmann
- U.S. Environmental Protection Agency, Montgomery, AL, USA, Dr. Ed Sensintaffer/Mr. Sam Poppel
- U.S. Environmental Protection Agency, Las Vegas NV, USA, Dr. Dick Hopper/Mr. Emilio Braganza
- U.S. Department of Energy, Environmental Measurements, New York, NY, Dr. Earl Knutson/Dr. Andy George
- BECHTEL SAIC Company LLC, Las Vegas, USA, 14 units in operation Mr. Pete Roesner, Kevin Shenk, Bill Carl
- University of Florida, Department of Nuclear Engineering, Gainesville, FL, USA, Dr. Hintenlang
- Comisión Nacional de Seguridad Nuclear, Mexico City, Mexico, Mrs. Teresa Quintanilla, Raul Ortez Magana
- Analyte Associates, Inc. Mapleton, IL, USA, Dr. Richard L. Hoffman
- SAROK Office of Supply Republic of Korea, Public Health Environment Institute of Pusan, Pusan, South Korea, via SCADA Eng, Mr. Yoon
- MPA - Staatliches Materialprüfungsamt Nordrhein-Westf., Abt. 5 / Dez.52 Strahlenschutz, Dortmund, Germany, Dr. Axel Rox
- Landesanstalt für Umweltschutz Baden-Württemberg, Abt. 3, Karlsruhe, Germany, Mr. Thomas Griesser
- Universität Bern, Physikalisches Institut, Bern, Switzerland, Dr. B. Lehmann
References Calibration Chambers

- Bundesamt für Strahlenschutz, Außenstelle Berlin, Abt. ST 1, Berlin, Germany, Dr. Volkmar Schmidt
- PTB Physikalisch Technische Bundesanstalt, Braunschweig, Germany, Dr. Arnold
- GSF-Research Center, Institut für Strahlenschutz, Oberschleißheim, Germany, Ms. Martina Müsch
- Bayerisches Landesamt für Umweltschutz, München, Germany, Ms. Simone Körner/Mr. Trautmannsheimer
- Comisión Nacional de Seguridad Nuclear, Mexico City, Mexico, Mrs. Teresa Quintanilla, Raul Ortez Magana
- KFDA Korea Food & Drug Administration, Radiation Protection Division, Seoul, South Korea, Mr. Hyeog-Ju Kim
- KINS Korea Institute of Nuclear Safety, Taejon, Korea
- KFUPM King Fahd University of Petroleum & Minerals, Dharhan, Saudi Arabia, Prof. Dr. Mohammed Ibrahim Al-Jarallah
- Ministry of Sanitary Epidemiological Survey Ros.RIAZ Russian Information and Analyzing Center, Moscow, Russia, Ms. Podunova
- Medical Center under due Administration of the President of the Russian Federation, RMP "MEDTEKHNIKA", Moscow, Russia
- Institute for Biology, Syktyvkar, Republic Komi, Russia, Mr. Anatoly Taskaev
- Center of Sanitary Epidemiology, Bamaul, Russia, Mr. Alexandr Marchenko
- Regional Centre Gossanepidnadzor, Krasnojarsk, Russia, Mr. Sergey Kurkatov
- Center of Sanitary Epidemiology, Belgorod, Russia, Mr. Valery Ewdokimov
- Center of Sanitary Epidemiology, Rostov, Russia, Ms. Tamara Kontratenko
- Regional Centre Gossanepidnadzor, Ivanovo, Russia, Ms. Gubernatorova
- Regional Centre Gossanepidnadzor, Juzhno-Sachalinsk, Russia, Mr. Juri Stiplin
- Regional Centre Gossanepidnadzor, Taganrog, Russia, Dr. Jegorova
- Regional Centre Gossanepidnadzor, Kemerovo, Russia, Mr. Vladimir Senkov
- Sokolovskaja AG, Kiselevsk, Russia, Mr. Tkatsch
- AOOT Chemical Concentrate Plan, Novosibirsk, Russia, Mr. Alexandr Ustjugov
- Technical University, Graz, Austria, Dr. Kindl
- VKEA, Verein für Kernverfahrenstechnik, Rossendorf, Germany, Dr. Hüttig
- Universität der Bundeswehr, Neubiberg, Germany, Prof. Zeman
- Fachhochschule München, München, Germany, Prof. Schwankner
- PI Center for Eco-toxicological Researches of Montenegro, Podgorica, Montenegro, Mrs. Ana Misurovic
- DBE Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH, Peine, Germany, Mr. O. Görke
- Shanghai Municipal Centre for Disease Prevention and Control, Shanghai, China
- Guang Dong Institute of Occupational Health, Guang Dong, China

and others
Application examples under extreme conditions

A harsh field test for AlphaGUARD at 99 rel% humidity performed by the British Devon & Cornwall Prospecting Society.

Volcano watching in Sicily: AlphaGUARD forms the core of a radon in soil gas monitoring system for permanent operation at a remote location in the open air.

AlphaGUARD’s measurement incl. wind speed data are transferred to the headquarter via cellular phone network (GSM modem).

"Innovative" deployment of AlphaGUARD in a uranium mine in northern Saskatchewan, CDN, performed by Adam Hutter, Radon specialist at DOE/ EML New York, N.Y.

Radwaste storage in a salt mine: An AlphaGUARD system (plus anemometer) records the total radon activity released through the main exhaust shaft. The system here is protected by a TYVEK bag to prevent the intrusion of corrosive salt-dust.
Integrated solutions

Measurement Instruments

External instruments and sensors
Serial
Analog

Data Communication Modules

Infrared
0...10 m

Cable: RS232
0...10 m

Radio: Smart LINK
1...5 km

Cable: RS485
0...500 m

Radio: Sky LINK
5...100 km

Cable: Ethernet
0...500 m

Radio: Satellite worldwide

Cable: ISDN/GSM worldwide

Data Management and Visualization

DataEXPERT

Online

Alarm

MapVIEW

Report
DATAEXPERT

The integrated solution for online monitoring networks

- Unlimited number of background maps
- Eventlist for system and probe status
- Alarm management

- Quality assurance:
  - Automatic daily system check
  - Online quality check of incoming data

- Chart visualization of:
  - Measured and related quality data
  - Comfortable zoom and mathematical options

- Visualization of:
  - Passing alarm level 1 (yellow)
  - Passing alarm level 2 (red)

**SkyREPORT**

**GammaTRACER, GENITRON**

Day: 05-October-2002

<table>
<thead>
<tr>
<th>Location</th>
<th>Minimum dose rate (nSv/h)</th>
<th>Maximum dose rate (nSv/h)</th>
<th>Time of maximum</th>
<th>Mean dose rate (nSv/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1555</td>
<td>35</td>
<td>129</td>
<td>05/10/2002 00:15</td>
<td>85</td>
</tr>
<tr>
<td>1556</td>
<td>80</td>
<td>88</td>
<td>05/10/2002 11:00</td>
<td>84</td>
</tr>
<tr>
<td>1561</td>
<td>78</td>
<td>88</td>
<td>05/10/2002 07:00</td>
<td>83</td>
</tr>
<tr>
<td>1553</td>
<td>78</td>
<td>90</td>
<td>05/10/2002 04:00</td>
<td>84</td>
</tr>
<tr>
<td>1594</td>
<td>80</td>
<td>89</td>
<td>05/10/2002 06:00</td>
<td>82</td>
</tr>
<tr>
<td>1555</td>
<td>75</td>
<td>89</td>
<td>05/10/2002 06:00</td>
<td>82</td>
</tr>
</tbody>
</table>
## Technical data

<table>
<thead>
<tr>
<th>Basic Functions</th>
<th>P30</th>
<th>P2000</th>
<th>PQ2000</th>
<th>PQ2000 PRO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of radon detector</td>
<td>ionization chamber</td>
<td>HV = 750 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation principle</td>
<td>3D alpha spectroscopy and current mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detector volume total / active</td>
<td>0.62 liter / 0.56 liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating modes</td>
<td>optimized diffusion</td>
<td>optimized diffusion</td>
<td>optimized diffusion flow (active filling)</td>
<td>optimized diffusion flow (closed cycle)</td>
</tr>
<tr>
<td>Type of Rn-progeny filter</td>
<td>glass fiber (retention factor &gt; 99,9 %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transient response function (time delay in diffusion mode)</td>
<td>signal &gt; 30% after 10 min / signal &gt; 70% after 20 min / signal &gt; 90% after 30 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detector signal acquisition</td>
<td>fast digital signal sampling network, using three separate ADC-channels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spectral signal extraction</td>
<td>DSP, on-line cross-correlation algorithms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity of detector</td>
<td>1 CPM at 20 Bq/m³ (1 CPM at 0,55 pCi/l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background signal due to internal detector contamination</td>
<td>&lt; 1 Bq/m³ (&lt; 0,03 pCi/l) – new condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range of radon concentrations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- lower limit</td>
<td>&lt; 2 Bq/m³ (&lt; 0,05 pCi/l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- upper limit</td>
<td>30,000 Bq/m³ (800 pCi/l)</td>
<td>2,000,000 Bq/m³ (54,000 pCi/l)</td>
<td>2,000,000 Bq/m³ (54,000 pCi/l)</td>
<td>2,000,000 Bq/m³ (54,000 pCi/l)</td>
</tr>
<tr>
<td>Resolution on LCD display</td>
<td>1 Bq/m³ (0,01 pCi/l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foldback protection</td>
<td>&gt; 10,000,000 Bq/m³ (300,000 pCi/l) verified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System linearity error</td>
<td>&lt; 3% within total range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument calibration error</td>
<td>±3% (plus uncertainty of primary standard)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement cycle time (user-selectable)</td>
<td>Diffusion mode 10 min or 60 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data capacity (non-volatile)</td>
<td>≈ 20 days at 10 min</td>
<td>≈ 30 days at 60 min</td>
<td>≈ 3 days at 1 min</td>
<td>≈ 30 days at 1 min 180 days at 60 min</td>
</tr>
<tr>
<td>Operation from internal battery</td>
<td>10 days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (incl. Pb-accumulator)</td>
<td>4,5 kg (10 lbs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System operating range:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- temperature</td>
<td>-10 ... +50°C (+14 ... +122°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- atmospheric pressure</td>
<td>700 ...... 1,100 mbar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- humidity (non-condensing)</td>
<td>0 ...... 99% rH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atmospheric air pressure</td>
<td>laser-trimmed silicon bridge-transducer</td>
<td>800 ... 1,050 mbar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- type of sensor</td>
<td>1 mbar</td>
<td>0,1 mbar</td>
<td>3 mbar</td>
<td></td>
</tr>
<tr>
<td>- measurement range</td>
<td>0 ... +60°C (0 ... +140°F)</td>
<td>1°C (1°F)</td>
<td>0,2°C (0,3°F)</td>
<td>1,5°C (± 2,5°F)</td>
</tr>
<tr>
<td>- resolution displayed on LCD</td>
<td>0,1 mbar</td>
<td>3 mbar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- temperature coefficient</td>
<td>typ. 0,1 mbar/°C (100 ppm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>precision monolithic integrated circuit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- type of sensor</td>
<td>1°C (1°F)</td>
<td>0,2°C (0,3°F)</td>
<td>1,5°C (± 2,5°F)</td>
<td></td>
</tr>
<tr>
<td>- measurement range</td>
<td>0 ... +15°C (0 ... +60°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- resolution displayed on LCD</td>
<td>1°C (1°F)</td>
<td>0,2°C (0,3°F)</td>
<td>1,5°C (± 2,5°F)</td>
<td></td>
</tr>
<tr>
<td>- temperature coefficient</td>
<td>0,1 mbar/°C</td>
<td>0,1 mbar/°C</td>
<td>0,1 mbar/°C</td>
<td>0,1 mbar/°C</td>
</tr>
<tr>
<td>Relative air humidity</td>
<td>hydrophilic polymer film on hybrid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- type of sensor</td>
<td>0 ... 99% rH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- measurement range</td>
<td>1% rH</td>
<td>0,2% rH</td>
<td>3% rH</td>
<td></td>
</tr>
<tr>
<td>- resolution displayed on LCD</td>
<td>0 ... 99% rH</td>
<td>1% rH</td>
<td>0,2% rH</td>
<td>3% rH</td>
</tr>
<tr>
<td>- resolution under DataEXPERT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- initial calibration uncertainty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External sensor channel</td>
<td>Mini-DIN 8S (delivered with instrument)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- measurement range</td>
<td>0 ... 2,5 VDC</td>
<td>0,01 VDC</td>
<td>12 per minute</td>
<td>10 kOhm</td>
</tr>
<tr>
<td>- resolution under DataEXPERT</td>
<td>± 0,02 VDC and ± 3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- signal sampling rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- total signal error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- input impedance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- input connector type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relocation sensor</td>
<td>piezo ceramic with seismic mass</td>
<td>gentle acceleration (low-frequency only) number of events per cycle (max. 15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
... the range of sophisticated products available from Saphymo

### Measurement of Radioactivity

**Dosimetry**

- **Saphydose**: Electronic dosimeters for gamma and neutron
- **AMIRA**: Environmental monitor for photon and neutron dose rate
- **MiniTRACE gamma**: Gamma dose rate meter

**Radon measurement**

- **AlphaGUARD**: Professional radon monitoring system
- **E-PERM**: Integrating passive dosimeter (electret technology based)

**Environmental monitoring**

- **GammaTRACER**: Autonomous probe for gamma-dose rate (up to 10 years autonomy, opt. 100 km wireless transmission)
- **BAB**: High reliability aerosol measurement

**Contamination monitoring**

- **CORAPI**: Radiological control gates for pedestrians
- **RCVL**: Radiological scrap control, vehicle monitoring systems
- **DG5**: Portable high sensitivity gamma monitor (plastic scintillation detector)
- **MiniTRACE beta**: Handheld contamination meter for beta and gamma

### Transport Telematics

- **ULYS**: Battery powered GPS/GSM beacons for the localisation of containers, wagons or locomotives (up to 5 years autonomy)

### Wireless Sensor Networks

- **SkyLINK**: Battery powered wide area data transmission (100 km range, up to 10 years autonomy)
- **ShortLINK**: Battery powered short-range data transmission (5 km range, up to 10 years autonomy)
- **GSM/GPRS**: Integrated triband GSM/GPRS Modem. Battery lifetime up to 3 years or external power supply

... competence from sensor to database!