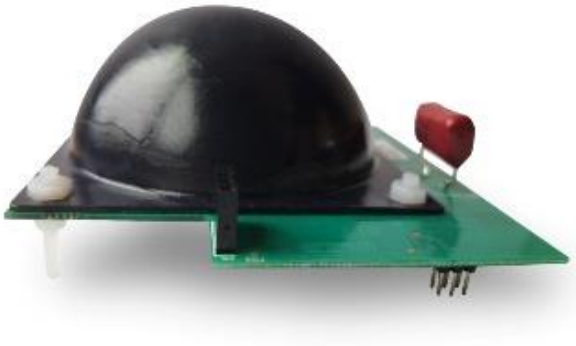
RS-Sensor | Manual

RS Sensor

December 2020



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Inhaltsverzeichnis

1 Introduction

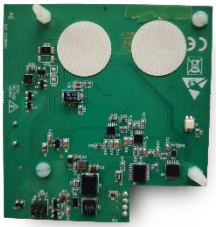
The RS Sensor provides advanced technology which is easy to use. It is ideal for portable, fixed and digital applications.

The RS Sensor delivers complete sets of information for instantaneous and average radon concentrations.

2 Equipment

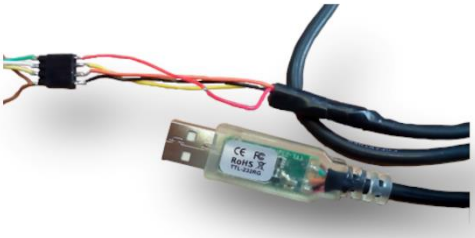
An overview of the equipment for installing and connecting the RS Sensor:

1. Personal Computer with serial terminal program (e.g. Hyperterminal, Putty, Hercules, etc.)
2. Radon Sensor



3. AC/DC Power Supply unit V out = 5V 2A

4. Cable USB to Serial 3.3V 250mA (e.g. Digikey 768-1071-ND)

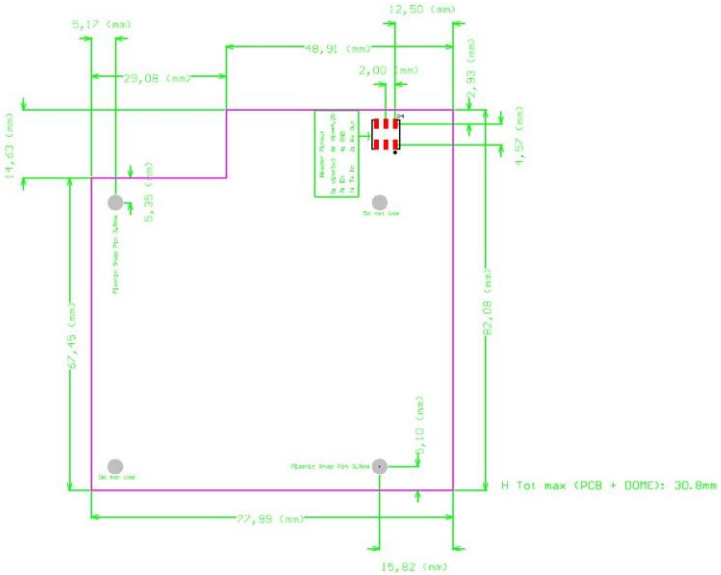


3 Specification

Radon Detector	Silicon detector with internal amplification
Measurement Units	Bq/m³
Measurement Range	0 – 65,000 Bq/m3
Lower Limit of Detection	30 Bq/m3
Sensor Warm-up time	60 minutes
Data interval	10 minutes measurement update data out every 60 minutes
Repeatability	15 % (measured at 0.037 Bq/m³)
Resolution	28 Bq/m3
Accuracy	6% (48h at 150 Bq/m³) ±13% (min. error ± 0,037 Bq/m³)
Cable Requirements	Cable USB to Serial 3.3V 250mA (e.g. Digikey 768-1071-ND)
Operation Voltage	3,3 V
Charger	5,0 V
Humidity range	RH < 90%
Operating temperature	25°C ± 15°C

4 Dimensions

The RS Sensor measures 8.0 x 8.0 x 3.1 cm.



5 Warnings

The sensor must not be exposed to intense direct light! That may negatively affect the measurement.

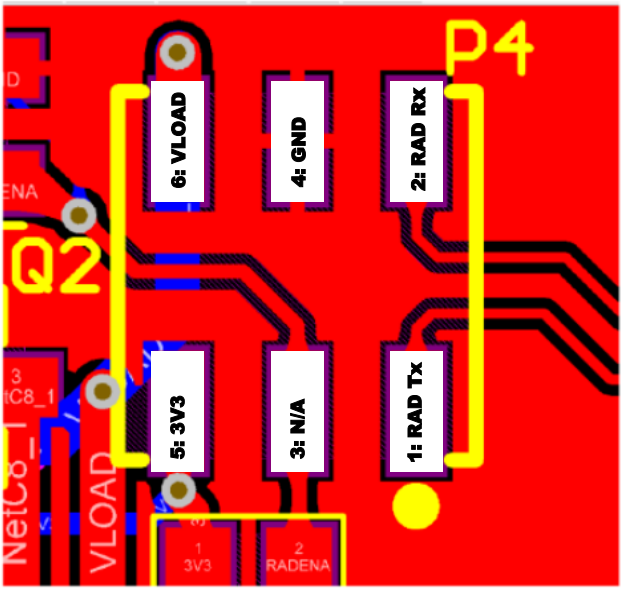
During the measurement period, the sensor temperature must be kept in the range of 0 – 40 °C.

The sensor internally generates High Voltage (approx. 300V). Although High voltage areas are isolated and protected, the contact area between measuring chamber and the main board surface can be exposed to High Voltage. Hold the sensor carefully!

6 Power Requirements

The sensor internally generates High Voltage (approx. 300V). Although High voltage areas are isolated and protected, the contact area between measuring chamber and the main board surface can be exposed to High Voltage. Hold the sensor carefully!

7 Pin Connections



Pin 1: RAD Tx

Pin 2: RAD Rx

Pin 3: not to be connected

Pin 4: GND

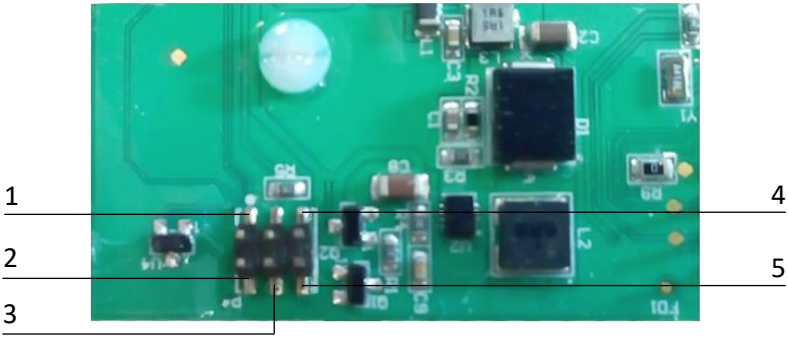
Pin 5: 3V3 (3.3V supply voltage)

Pin 6: Vload: 5.0V supply voltage
(typical 5.0V, min 3.5V, max 5.5V)

8 Interfacing

8.1 Custom Cabling

The Radon sensor requires a power supply ranging from 3.5V to 5.5V on VLOAD pin and a 3.3V to supply logic and serial interface. The next graphic shows the pin assignment of the interface connector. The unused pin is the logic enable pin. The device is enabled by default, so it is not necessary to drive it.

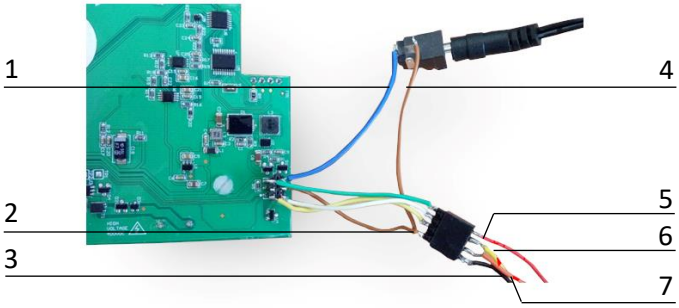


1. Tx from UART
2. To Rx UART
3. GND
4. 3,3 V
5. VLOAD

The custom cabling connects the USB/TTL cable, power supply unit and Radon sensor:

- From USB cable, connect GND (black), 3.3V (red), TX (orange), RX (yellow).
- From power supply unit, connect 5V (blue) and GND (brown).
- Don’t forget to connect GND signals from USB cable and power supply unit.
- To maintain integrity of Radon sensor’s male connector, we recommend a female connector 2x3 pin, 2mm pitch.

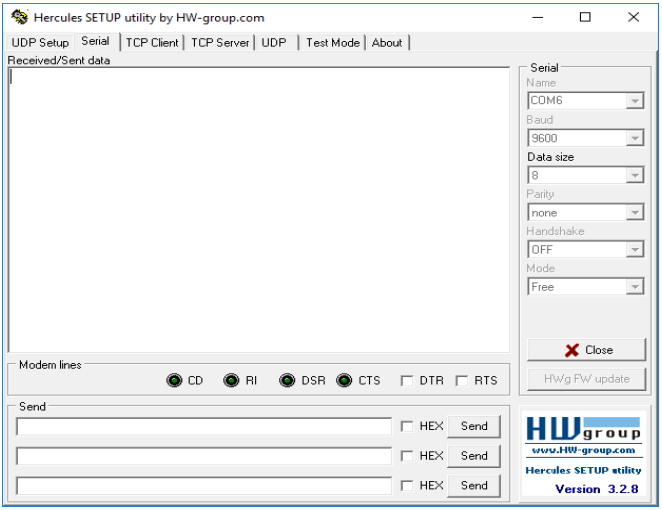
The next graphic shows a complete custom cabling:



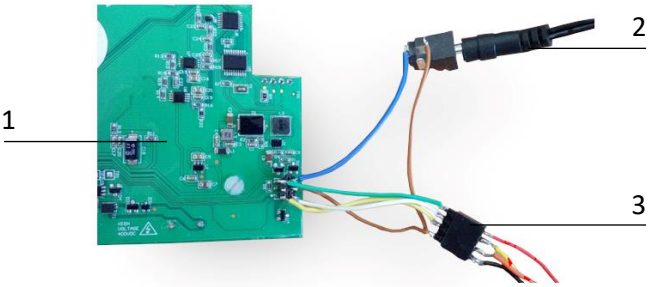
1. 5V
2. GND NODE
3. GND
4. GND
5. 3,3 V
6. RX
7. TX

8.2 Testing procedure

- Connect the USB/TTL serial cable to your PC.
- It will create a virtual COM port - note the number.
- Run the Serial Terminal software.
- Select the USB cable COM port number (see above) and set parameters to:
  9600bps, 8 bits, NO parity, 1 Stop bit, no SW/HW protocol.
- If possible, enable an option to show the local typed characters (sent from PC to the module).
- If possible, enable an option to show the received data in hexadecimal format.
- Enable (Open) the COM port



- Plug the power supply unit to the main supply (i.e. 230Vac).
- Connect the custom cable to the power supply unit and USB cable.
- Connect the custom cable to the Radon sensor.



1. Radon module
2. Power Supply Unit
3. USB Serial cable

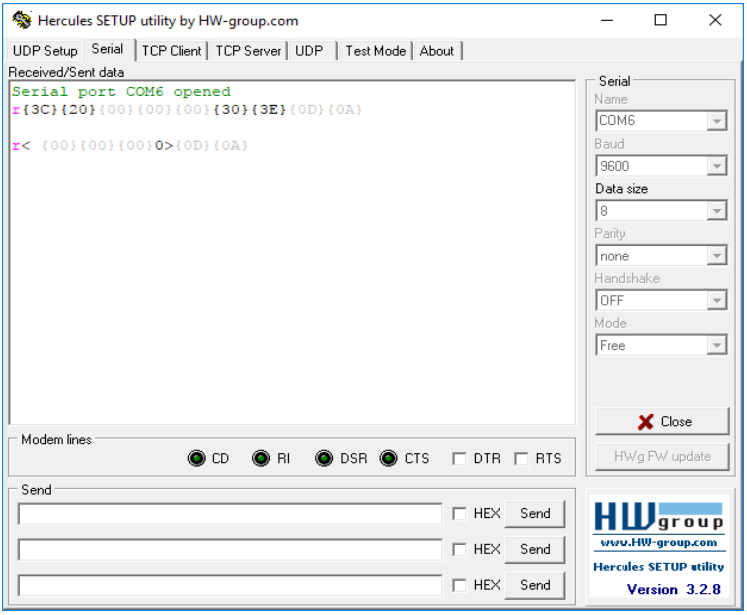
- The Radon sensor will start to measure radon gas concentration.

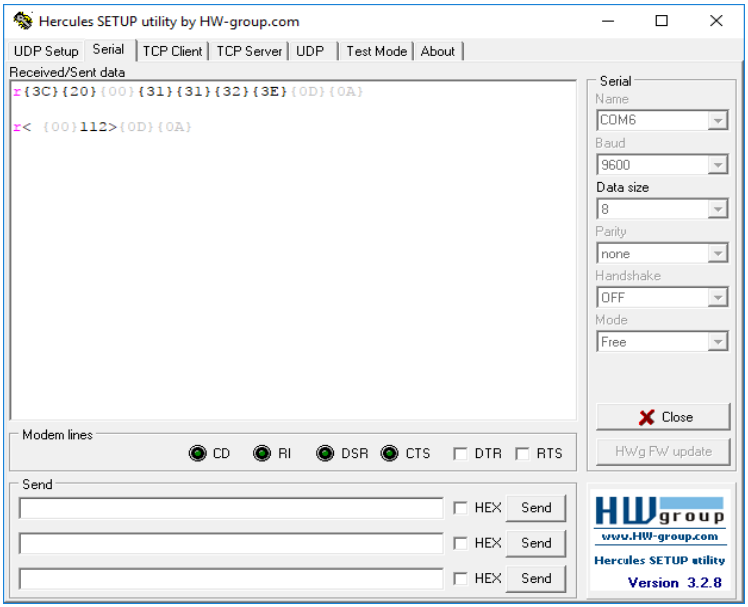
DO NOT touch Radon sensor when power supply is applied. You can risk an electric shock due to the 400VDC generated by the sensor itself to supply the black dome.

- The Radon sensor sends automatically a packet with the Radon concentration every hour.

- If the sensor receives an ‘R’ or ‘r’ character, it will answer with the last Radon concentration measurement.

The next graphics shows a read command sent to the radon sensor (red coloured ‘r’ character) and the answer packet (displayed in full hexadecimal format and Hex/ascii format):





Please note:

The format of the data packet is not a standard ASCII string because there is a blank (0x20) and some 0x00 characters.

The next string shows a concentration of 112 Bq/m^3:

Interfacing software must send the ‘r’ command and wait for the answer, managing some retries,

because the module sometimes can be busy, and the command is lost.

Once the answer is received, the radon value starts from the first ASCII number value (from ‘0’ to

‘9’, 0x30…0x39) to the one before the ‘>’ (0x3E) character.

CALIBRATION & CORRECTION FACTOR

Each data set received from the Radon sensor needs to have a correction factor applied. This depends on the type of internal photodiode.

To know the “Type”, send the command “t” (key) through serial as below.

The response should be “(a)<cr><lf>”. Then apply the following corrections factors. There are three thresholds to calculate the right correction factor for each Radon value read ‘R’ from the sensor:

Type	R < 625 bq/m3	625 < R < 2100 bq/m3	R > 2100 bq/m3
a	0,76	0,68	0,72
b	0,88	0,75	0,82
c	0,76	0,72	0,75

For “d" type, please use a conversion factor of 0,72. The scale factor for “d” is 0,72 for the entire range.

The Radon concentration value is calculated by: C=R*T

C= Radon concentration

R= Value read from the sensor

T= Correction Factor

9 Communication: electronic

The two communication related pins (as indicated on the board) are: Tx and Rx.

The communication protocol is 3.3V TTL Serial Asynchronous. It follows these specifications:

Nominal voltage	**3,3 V**
Absolute maximum voltage	**3,6 V**
Speed rate	**9600 bps**
Data bits	**8**
Stop bits	**1**
Parity	**None**
Flow control	**None**

Do not apply signal above 3,3 V to the communication lines (TX and Rx). This may lead to microcontroller failure and severe sensor malfunction.

10 Communication: dialogue

The sensor provides radon concentration level every hour. Thus, the first valid data is available 1 hour after powering up.

Radon concentration data may be affected by severe variations, according to the high variability that radon has in short-term periods. Thus, in order to obtain a more accurate representation of the data, it is recommended to use a **mean value**.

The Mean will represent the actual Radon presence in a much better way than the instantaneous value. For a short-term analysis, it is recommended to use a 3 hour mean. For a long-term analysis, it is suggested to calculate a 12 hour mean.

The sensor sends out the instantaneous Radon level via asynchronous communication (UART) each hour. Moreover, it is possible to communicate simple tasks to the sensor:

- Polling systems can interrogate the sensor simply by sending the ‘r’ character (ASCII: 114d, 72h). Sensor will answer back with the last calculated value.
- The sent data can have 2 different formats: ‘char’ and ‘numeric’. For system start up, always set it to ‘char’. That can be changed by sending the ‘c’ (ASCII: 99d, 63h) or the ‘n’ (ASCII: 110d, 6Eh) character respectively for ‘char’ and ‘numeric’ format. No ACK or positive feedback is sent back.

- It is possible to perform a hard reset of the system via software. That will Kill each process and will restart the system from the beginning. It is achievable by sending the 'k' (ASCII: 107d, 6Bh) character. Still, no ACK or positive feedback is sent back.

11 Communication: format

The only data sent out by the system (when requested or every hour) is the Radon concentration level expressed in **Becquerel/m³** with a maximum of 65,000 Bq/m³. The format of the sent value is the following:

< conc >

The 'less-than sign' (ASCII: 60d, 3Ch) is followed by the concentration value, followed by the 'greater-than sign' (ASCII: 62d, 3Eh). Lastly, the Carriage Return (ASCII: CR, 13d, 0Dh) and New Line Feed (ASCII: LF, 10d, 0Ah) are sent. Concentration is expressed:

- with ASCII characters if 'char' format is activated (suitable for monitor visualisation).
- with an unsigned Word value (16 bit) sent split in two unsigned Bytes (8bit). First the Most Significant Byte (MSB) is sent, then the Least Significant Byte (LSB).

It may occur that the data sent out by the device will show an asterisk ‘ * ’ at the end of it.

The asterisk indicates NOT-VALID data! Some of the most common causes might be power supply problems or sensor exposed to direct light.

Examples:

Case	Data out
280 Bq/m³, ‘*char*’ format	< 280> (CR, LF)
280 Bq/m³, ‘*numeric*’ format	3Ch 01h 18h 3Eh (CR, LF)
280 Bq/m³, *‘char’* format, NOT VALID data	< 280>* (CR, LF)

Here is a sample extract of communication with the radon sensor:

```
char cmd, len, I, err;
uint16 RadonValue;
char *buf[20];

cmd = 'r';                                  // Send Read command (1 char)
UART3sendMsg(&cmd,1);                       // UART3 is our communication port
WaitMsec(1000);                             // Wait answer for 1 second (the device
len = UART3ReadReceivedData(buf);           // Read answer in 'buf'

if (len == 0)
{
..no answer from device..                   // Exit with a timeout error code
}

if (buf[0] == '<')                          // Check packet header
{
   for (i = 1; i < len; i++)                // Parse received data
  {
     if (buf[i] == '>')
    {
        buf[i] = 0x00;                      // Convert end packet char in a 0x00 (so we
                                            can manage data as string)
        if (buf[i+1] == '*')
        {
            err =                           // Set Invalid data
RADON_SAMPLE_ERR;
            break;
        }
    }
  }                                         // Be Careful: the serial protocol fills
  for (i=2; i<len; i++) if (buf[i] != 0x00) unused characters with some 0x00 before
break;                                      the radon data, so you must search the first
                                            non 0x00 data before apply data conversion

  Radon Value = atoi(&buf[i]);              // Convert data string in binary value
}                                           [Bq/m^3]
else
   err = RADON_PACKET_ERR;                  // Set packet error
```

12 How to connect into a system

In order to connect the sensor via serial to another system such as a PC or microcontroller, attention is needed as to the communication port voltage level. The communication protocol is 3.3V TTL Serial Asynchronous.

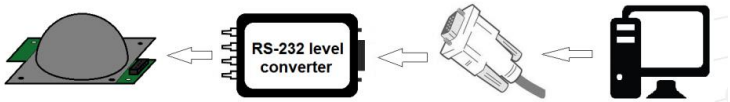
Communication **MUST** follows these specs:

Nominal voltage	3,3 V
Absolute maximum voltage	3,6 V
Speed rate	9600 bps
Data bits	8
Stop bits	1
Parity	None
Flow control	None

Do not apply signal above 3.3 V to the communication lines (TX and Rx). This may lead to microcontroller failure and severe sensor malfunction.

In order to connect the sensor to a PC or microcontroller, the following scheme is recommended. Any serial enabled communication software may be utilised (Hyper Terminal – Putty or others):

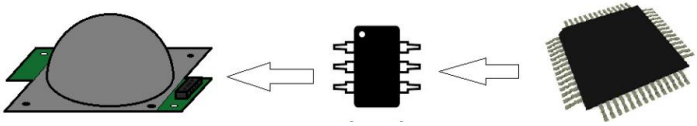
Sensor to PC Connection Scheme



Radon Sensor RS-232 cable PC

In order to connect the sensor to a microcontroller or CPU that implements UART, the following scheme is recommended:

Sensor to Microcontroller Connection Scheme



Radon sensor Level converter Microcontroller with UART

According to chapter 6, a system will be able to communicate with the sensor module by receiving concentration value (expressed as shown in chapter 7) and sending out allowed commands (as explained in chapter 6).

Example of concentration request

A PC will send the character **'r'** in order to request the current Radon concentration value.

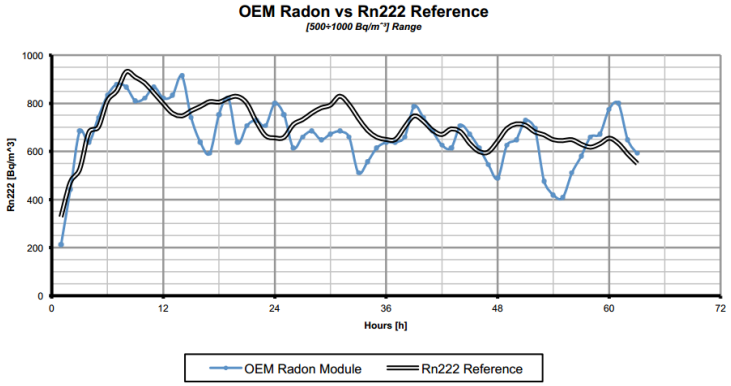
A microcontroller will be programmed to send out the word '72h' or the number 114 (decimal value) that corresponds to the ASCII character 'r'.

The system will then send back the current Radon concentration value according to the current selected format (see chapter 7).

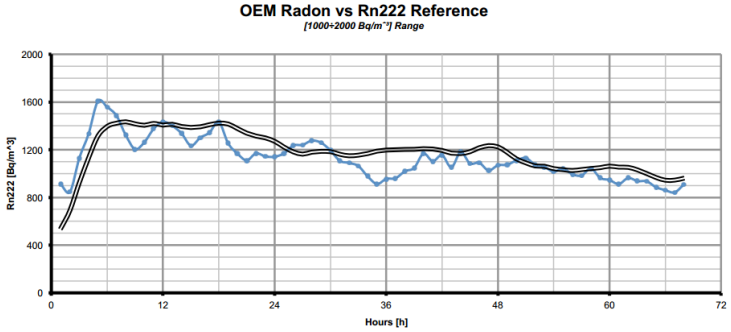
The sensor provides a valid Radon concentration level every hour. Thus, the first valid data that will be sent out is available 1 hour after powering up. Therefore, a 'concentration request' executed within 60 minutes from power-up will give back a zero (see chapter 7 to know how it will be shown).

The sensor module has been exposed to different Radon concentration. The test has been performed in a 220l Radon chamber with calibrated commercial instruments as Radon reference.

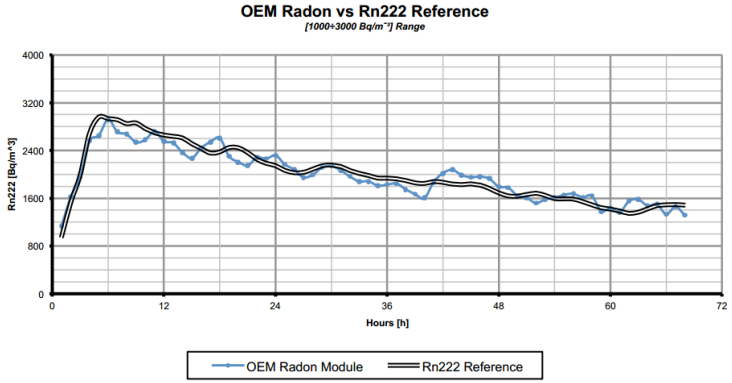
Example of Radon sensor operation.
Rn222 Concentration = [500÷1000 Bq/m^3]



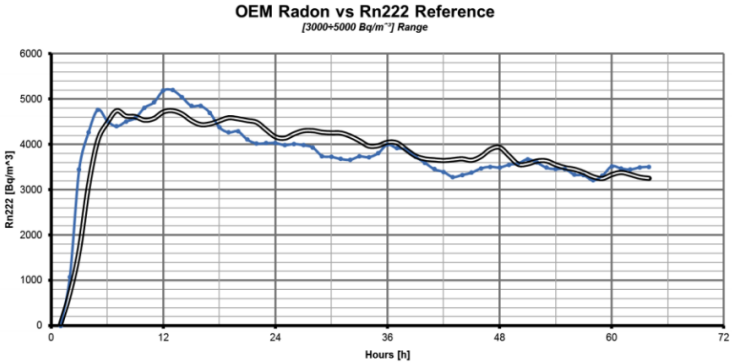
Example of Radon sensor operation.
Rn222 Concentration = [1000÷2000 Bq/m^3]



Example of Radon sensor operation.
Rn222 Concentration = [1000÷3000 Bq/m^3]



Example of Radon sensor operation.
Rn222 Concentration = [3000÷5000 Bq/m^3]



13 One Year Limited Warranty

This limited warranty applies to RS Sensor, purchased from RadonTec GmbH or authorized vendors.

This covers defects in material or workmanship under normal use for a period of one year after receipt of the product. Contamination due to dirt or improper use is not covered by the warranty.

During this period, the product will be repaired or replaced the product at no charge.

**Exclusions:*

This warranty does not cover damages caused by abuse, neglect, or misuse. This includes damage from drops, impacts, or penetrations. It will also be rendered void if the product has been repaired or altered by anyone other EIC Inc.

To obtain this warranty service, please contact us at:

info@radontec.de

By the nature of the technology used, any sensor can potentially fail to meet specification without warning. The manufacturer makes every effort to ensure reliability of all sensors but where life safety is a performance requirement of the product and, where practical, the manufacturer recommends that all gas sensors and instruments using sensors are checked for response to gas before use. The data contained in this document is believed to

be accurate and reliable. The data given is for guidance only. The manufacturer accepts no liability for any consequential losses, injury or damage resulting from the use of this datasheet or the information contained in it. Customers should test the sensors under their own conditions to ensure that the sensors are suitable for their own requirements and in accordance with the plans and circumstances of the specific project and any standards/regulations pertaining to the country in which the sensors will be utilised. Performance characteristics on this data sheet outline the performance of newly supplied sensors. Output signal can drift below the lower limit over time. This datasheet is not intended to form the basis of a contract and in the interest of product improvement, the manufacturer reserves the right to alter design features and specifications without notice. 11/20

14 Contact and Support

14.1 Troubleshooting/FAQ

You will find answers to the most frequently asked questions on our website:

https://www.radontec.de

14.2 Contact Us

Should you have any further questions or require further help and technical support, please do not hesitate to contact us.

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