

Description of serial communication RS485 - MODBUS for radon probe RPP-R

Setting device address „ADDRESS“

Address of slave device is possible to set in range 1-247 by switches "ADDRESS". After changing of address is always necessary to make a restart of device. LSB (least significant bit) of address is switch with label „1“. Logical level „0“ is represented by switch in down position.

Setting of parameters of communication „RATE“

Communication parameters is possible to set by switches „RATE“ according chart below. After changing of switches is always necessary to make a restart of device.

RATE 4 3 2 1	speed (kbaud)	parity	stop-bit
0 0 0 0	19,2	EVEN	1
0 0 0 1	9,6	EVEN	1
0 0 1 0	2,4	EVEN	1
0 0 1 1	1,2	EVEN	1
0 1 0 0	19,2	ODD	1
0 1 0 1	9,6	ODD	1
0 1 1 0	2,4	ODD	1
0 1 1 1	1,2	ODD	1
1 0 0 0	19,2	NONE	2
1 0 0 1	9,6	NONE	2
1 0 1 0	2,4	NONE	2
1 0 1 1	1,2	NONE	2
1 1 0 0			
1 1 0 1	Don't use		
1 1 1 0			
1 1 1 1			

Registers map

Every register has 2 bytes of binary data (WORD). Maximum number of registers for reading at once is 60 registers (120 bytes). **Blue highlight** registers are most interesting for quick SW implementation of device.

(L)... means Lower 2 bytes in 4 bytes value;

(H)... means Higher 2 bytes in 4 bytes value;

(INT)... means INTEGER data type of binary value;

(UINT)... means UNSIGNED INTEGER data type of binary value

Registers of current values (command 0x03) – only reading

Add ress of reg	Value	Description
1	concentrationTime	Actual running time in interval 240s (4 min.) in seconds. New value of Rn concentration is available every 4 min! (UINT)
2	concentration (L)	Actual value of Rn concentration in Bq/m3. Values is moving average per last 1 hour. New value of Rn concentration is available every 4 min! (UINT)
3	concentration (H)	
4	temperature	Actual temperature in °C (INT) in chamber. Coding signed char - range from -128 to +127 °C dec hex °C 0 0x00 0 1 0x01 +1 . 127 0x7F +127 128 0x80 -128 129 0x81 -127 . 254 0xFE -2 255 0xFF -1
5	humidity	Actual humidity in % (UINT) in chamber.
6	reserve	
7	reserve	
8	sum1(L)	Actual number of Alpha particles with energy power below level d1 (for service use) (UINT)
9	sum1(H)	
10	sum2(L)	Actual number of Alpha particles with energy power between level d1 and level d2 (for service use) (UINT)
11	sum2(H)	
12	sum3(L)	Actual number of Alpha particles with energy power between level d2 and level d3 (for service use) (UINT)
13	sum3(H)	
14	sum4(L)	Actual number of Alpha particles with energy power above d3 (for service use) (UINT)
15	sum4(H)	
16	impulsesHV	Actual number of voltage impulses for create high voltage – status of high voltage generator (for service use) (UINT)
17	concentrationDay(L)	Actual value of long-term Rn concentration in Bq/m3. Values is moving average per last 1 day. (UINT)
18	concentrationDay(H)	
19	recordTime	Actual running time in setting interval of record saving in seconds. Records are saved into radon probe memory. (UINT)
20	recordCount	Actual number of saved records. max 4096 (UINT)
21	spectrumTime	Actual running time in setting interval of energy spectrum saving in seconds. Energy spectrum are saved into radon probe memory. (UINT)
22	spectrumCount	Actual number of record just measured energy spectrum (UINT)
23	impulsesTotal(L)	Actual total number of Alpha particles for life (for service use) (UINT)
24	impulsesTotal(H)	

Setting registers – reading and writing (commands 0x03 and 0x10)

Red highlight registers are very important for correct measurement of probe. It is recommended not to change this registers.

Address of reg	Value	Description
25	reserve	
26	reserve	
27	reserve	
28	discrimination1(d1)	The whole energy spectrum is divided into three adjustable discriminatory layers divides the whole area into four parts. Value of layer 1. It is determined individually during probe calibration. (UINT)
29	discrimination2(d2)	The whole energy spectrum is divided into three adjustable discriminatory layers divides the whole area into four parts. Value of layer 2. It is determined individually during probe calibration. (UINT)
30	discrimination3(d3)	The whole energy spectrum is divided into three adjustable discriminatory layers divides the whole area into four parts. Value of layer 3. It is determined individually during probe calibration. (UINT)
31	calibrationA	The constant value for the calculation of the concentration of radon from RnA. It is determined individually during probe calibration. (UINT)
32	calibrationAC	The constant value for the calculation of the concentration of radon from RnA + RnC. It is determined individually during probe calibration. (UINT)
33	limit	Limit of radon concentration for generate alarm at some kind of systems (UINT)
34	gain	Value of movement of the energy spectrum to left or right. It is determined individually during probe calibration. (UINT)
35	offset	Offset value for correct setup of analog path. It is determined individually during probe calibration. (UINT)
36	RecordInterval	Regular time interval for saving record of data (concentration) in minutes (default is 60 (1 hour)) (UINT)
37	SpectrumInterval	Regular time interval for saving energy spectra in minutes (default is 720 (12 hours)) (UINT)
38	algorithm	Type of concentration calculation. 0 – calculation from RnA; 1..255 – calculation from RnA + RnC (UINT)
39	realTime(L)	Actual number of seconds since start of year 2000. (UINT)
40	realTime(H)	
41-50	customerText	Customer text string 20x ASCII
51-59	reserve	

Identification (command 0x03) – only reading

Address of reg	Value	Description
60-64	device	Type of device 10x ASCII
65-69	versionSW	SW version 10x ASCII
70-74	serialNumber	Serial number 10x ASCII

Register command formats

Reading from registers

command 0x03 - Read Holding Registers - example

```
dev.address  command      addr 1. reg of read      num of reading reg      Crc
0x02        0x03          0x0004                   0x0001                   
```

answer:

```
dev.address  command      num of bytes  byte1  byte2      Crc
'0x02        0x03          0x0002       0x00  0x18                   
```

Writing to registers

command 0x10 - Write Multiple Registers - example

```
dev.address  command  addr 1. reg of write  num of writing reg  num of bytes  byte1  byte2  Crc
0x02        0x10    0x0033                0x0001             0x02         0x00  0xC8   
```

answer:

```
dev.address  command  addr 1. reg of write  num of writing reg  Crc
'0x02        0x10    0x0033                0x0001             
```

Reading of records and spectra from probe internal memory

command 0x14 - Read File Record

```
dev.address  command  num of head bytes  ref  type of file  num of record  num of words  Crc
0x02        0x14    0x07               0x06 0x000t       0xn      0x00NN
                                     t=1-RECORDS 1-4096     N=14 (28 bytes)=0x000E
                                     t=2-SPECTRA 1-511      N=51(102 bytes)=0x0033
```

answer:

```
dev.address  command  num of head bytes  num of data bytes  ref  data bytes(N*2)
0x02        0x14    0x02               0x1C(66)          0x06  DATA-RECORDS (SPECTRA)
```

DATA - RECORDS

Byte	Value	Description
1	Date and Time (H)	Date and time of record. Time when the data record was saved into internal memory Actual number of seconds since start of year 2000. (UINT)
2	Date and Time	
3	Date and Time	
4	Date and Time (L)	
5	Rn concentration (H)	Rn concentration in Bq/m3. Average value per RecordInterval (default per 1h). (UINT)
6	Rn concentration	
7	Rn concentration	
8	Rn concentration (L)	
9	Temperature	Temperature in °C (INT) in chamber. Average value per RecordInterval (default per 1h).

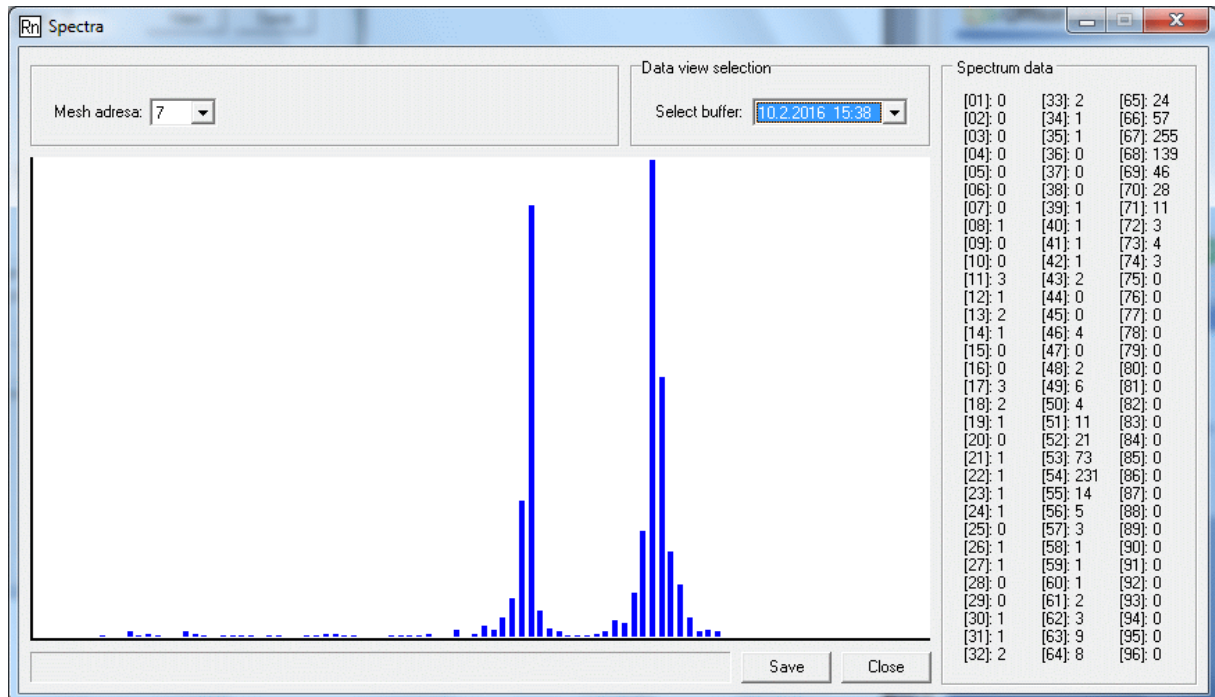
		Coding signed char - range from -128 to +127 °C dec hex °C 0 0x00 0 1 0x01 +1 . 127 0x7F +127 128 0x80 -128 129 0x81 -127 . 254 0xFE -2 255 0xFF -1
10	Humidity	Humidity in % (UINT) in chamber. Average value per RecordInterval (default per 1h).
11	Sum1(H)	Number of Alpha particles with energy power below level d1 (for service use) (UINT). Sum of impulses per RecordInterval (default per 1h)
12	Sum1	
13	Sum1	
14	Sum1 (L)	
15	Sum2(H)	Number of Alpha particles with energy power between level d1 and level d2 (for service use) (UINT). Sum of impulses per RecordInterval (default per 1h) sum2=(RaA(²¹⁸ Po-218))
16	Sum2	
17	Sum2	
18	Sum2 (L)	
19	Sum3(H)	Number of Alpha particles with energy power between level d2 and level d3 (for service use). Sum of impulses per RecordInterval (default per 1h) (UINT). sum3=(RaC(²¹⁴ Po))
20	Sum3	
21	Sum3	
22	Sum3 (L)	
23	Sum4(H)	Number of Alpha particles with energy power above d3 (for service use) (UINT). Sum of impulses per RecordInterval (default per 1h).
24	Sum4	
25	Sum4	
26	Sum4 (L)	
27	impulsesHV	Number of voltage impulses for create high voltage – status of high voltage generator (for service use)
28	algorithm	Type of setting concentration calculation. 0 – calculation from RnA; 1..255 – calculation from RnA + RnC

DATA - SPECTRA

Byte	Value	Description
1	Date and Time (H)	Date and time of record Actual number of seconds since start of year 2000. (UINT)
2	Date and Time	
3	Date and Time	
4	Date and Time (L)	
5	MeasureTime (H)	Real time of spectrum measurement (UINT) in seconds. If the number of impulses in some energy levels crosses 255 the record of the spectrum is stopped earlier before reaching the end of the measurement interval (SpectrumInterval).
6	MeasureTime (L)	
7 to 102	spectrumData	96 values (UINT) (bytes) of number of alpha impulses. Every value shows number of Alpha impulses in 96 diferent energy channels. (for radon expert use only) Detail description of energy spectrum and graphical example of spectrum data is on figure below.

The energy spectrum shows the number of impulses generated due to radon decay. Every detected impulse has definite energy which is measured and evaluated into 96 discrete energy levels (channels). One discrete level presents energy interval 0,1 MeV and the whole energy graph is approximately ranging 0 - 10 MeV. If the number of impulses in some energy levels crosses 255 the record of the spectrum is stopped earlier before reaching the end of the measurement.

The expected energy peak for Po-218 is in 60-61 channel as 6,00MeV. The expected energy peak for Po-214 is in 77-78 channel as 7,69MeV.



Clearing of records and spectra from probe internal memory and zeroing current values (moving average of concentration)

command 0x10 - Write Multiple Registers

dev.add	command	addr	1. reg of write	num of writing reg	num of bytes	byte1	byte2
0x02	0x10	0x0064		0x0001	0x02	0x56	0x00 Crc