

MODBUS RTU “over serial line” protocol for SARAD instruments

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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.

Protocol

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

Smart Radon Sensor

Function code 0x03 (read holding register)

Valid register addresses are:

Register Address	Register content	Number of registers	Format
0x0000	Radon concentration [Bq/m ³]	2	Float
0x0002	Statistical error of Radon concentration [%]	2	Float
0x0004	Average Radon concentration since last start [Bq/m ³]	2	Float
0x0006	Statistical error of average concentration [%]	2	Float
0x0008	Temperature [°C]	2	Float
0x000A	Relative humidity [%]	2	Float
0x000C	Standard: not available Option P: barometric pressure [hPa] Option CO2: CO2 concentration [ppm]	2	Float

IEEE 754 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 toggle switch at the instrument (selection of Baudrate [9600/19200] by INIT software)

Sample frame

Request to send the relative humidity from instrument address 1:

Address	Function	Register H-Byte	Register L-Byte	Number H-Byte	Number H-Byte	CRC L-Byte	CRC H-Byte
0x01	0x03	0x00	0x0A	0x00	0x02	0x08	0x24

Response (rel. humidity = 39.9002 %):

Address	Function	Number of data bytes	Data byte 1	Data byte 2	Data byte 3	Data byte 4	CRC L-Byte	CRC H-Byte
0x01	0x03	0x04	0x99	0xCE	0x42	1F	F7	38

RTM1688-2

Function code 0x03 (read holding register)

Valid register addresses are:

Register Address	Register content	Number of registers	Format
0x0000	Radon concentration [Bq/m ³]	2	Float
0x0002	Statistical error of Radon concentration [%]	2	Float
0x0004	Average Radon concentration since last start [Bq/m ³]	2	Float
0x0006	Battery voltage [V]	2	Float
0x0008	Temperature [°C]	2	Float
0x000A	Relative humidity [%]	2	Float
0x000C	barometric pressure [hPa]	2	Float
0x000E	Thoron concentration [Bq/m ³]	2	Float
0x0010	Statistical error of Thoron concentration [%]	2	Float
0x0012	Average Thoron concentration since last start [Bq/m ³]	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

DACM based instruments

Preliminary information (not yet implemented)

Function code 0x03 (read holding register)

DACM based instruments can generate various data dependent on instrument type and configuration. Due to this universal approach, the access to the desired reading is realized by three indexes:

1. Component index

This index selects the physical component which is creating the result. This could be for example an analogous input AINn or a spectrometer module SPECn. The indexes for the component are stated in the appendix of the user manual for each instrument.

2. Result index

Some physical components can generate more than one result. For example, a spectrometer unit in Radon calculation mode calculates Radon and Thoron concentration. The order of results (and therefore for indexes) is determined by the component itself.

3. Result type index

This index allows the user to select between recent readings (updated once per second), the value calculated from the data of the last completed sampling interval (as defined by the used sampling cycle) and the minimum and maximum reading within this interval. The order is:

Index	Meaning
0	Recent reading, e.g. actual temperature or count rate
1	Result of the last completed interval, e.g. Radon concentration or temperature average
2	Minimum: for radiological values this item represents the lower level of the statistical error band, for other readings the lowest single reading within the interval
3	Maximum: for radiological values this item represents the upper level of the statistical error band, for other readings the lowest single reading within the interval

These three indexes are used to create the MODBUS register for accessing the desired measurement result (all indexes starting at zero):

Register H-Byte	Register L-Byte	
	Bits 4...7	Bits 0...3
Component index	Result Index	Result type index

Examples

To read the actual temperature of the last interval from a RTM2200 where the internal temperature sensor is assigned to the component index 10, the (hexadecimal) register address is 0x0A00. Bits 4...7 are zero because this component offers just one result.

To read the activity of the Thoron concentration of the last interval from the same RTM, the register address is 0x1921 where the H byte represents the index of the spectrometer module SPEC1 (25 = 19hex). The L byte contains the result index 2 (third result of the spectrometer in Radon calculation mode) in the high nibble and the result type index 1 for the interval value in the low nibble.

All results are transferred as four-byte IEEE 754 float values which are transferred as two two-byte registers. That means only one value can be transmitted per frame. Other values and not stated register addresses will cause an exception response.