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 SARAD protocol 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: 9600 bps or 19200 bps (configurable)

Data format: 1 start bit, 8 data bits, 2 stop bit (total 11 bit)

Parity: none

Address range: 1…255 (configurable)

Bus timing

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

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/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	Standard: not available Option *P*: barometric pressure [mbar] Option *CO2*: CO2 concentration [ppm]	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 and baud rate by Setup dialog of application software *Radon Vision*
- Transfer protocol (SARAD/Modbus) by sliding switch at the instrument

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/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 Setup dialog of application software *Radon Vision*
- Transfer protocol by TOGGLE button at the instrument. The TOGGLE button must be held down until it beeps five times.

DACM-based instruments

These are currently

- RTM 2300
- RPM 2300
- EQF 3300

DACM-based instruments are highly configurable, meaning that the assignment of measurement parameters to Modbus addresses depends on the device configuration. That is why we use the *dVISION* application software to find the address assigned to the respective parameter. Figure 1 shows the DACM Components List window of *dVISION* that opens after clicking on the Components button in the *dVISION* toolbar. In the column *Modbus address* you can read the appropriate address as well in hexadecimal as in decimal form. All addresses point to two registers containing floating point values.

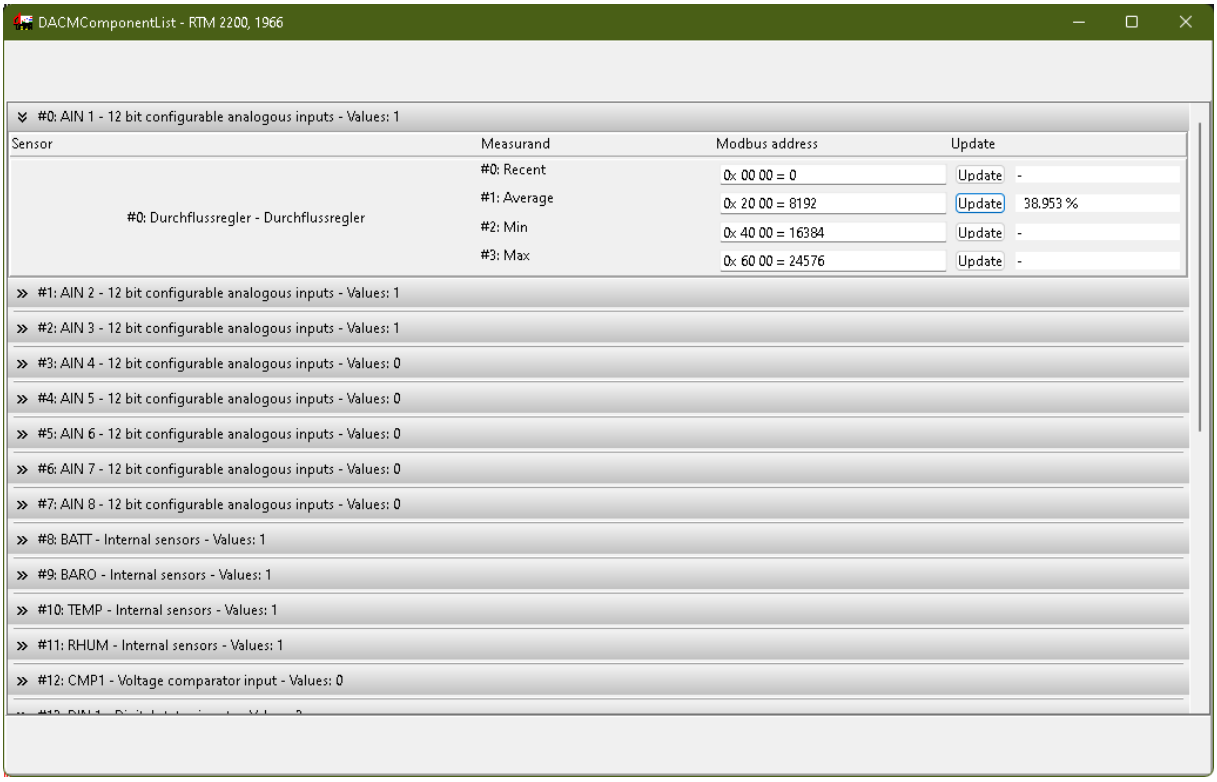

Figure 1 Usage of Components view in dVISION to find out appropriate Modbus addresses