Modbus Interface Description

Air quality sensors
22DTH-..5.., 22DTM-..5, 22UTH-..50X

Modbus

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Content

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Modbus general notes

General information

Sensor Types	22DTH-15.., 22DTM-15, 22UTH-150X
	22DTH-55M, 22UTH-550X
Protocol	Modbus RTU / RS-485

Modbus RTU

Transmission Formats	1-8-N-2, 1-8-E-1, 1-8-O-1
	(Default: 1-8-N-2)
	E = Even, O = Odd, N = None
	Bitstructure: Start – Data – Parity – Stop
Baud Rates	9'600, 19'200, 38'400, 57'600 Bd
	(Default: 9'600)
Address	1...31
	0 = Broadcast
Number of Nodes	Max. 32 (without repeater)
Terminating Resistor	120 Ω (can be switched on by a DIP Switch description see page 3)

Parametrisation

Tool	Via Dip switches or via Belimo Duct Sensor Assistant App (setting of baud rate, parity and Modbus Address)

Register implementation

All data is arranged in a table and addressed by 1..n (Register No.) or 0..n-1 (Address). No distinction is made between data types (Discrete Inputs, Coils, Input Registers and Holding Registers). As a consequence, all data can be accessed with the two commands below.

Supported commands

Standard commands:
Read Holding Registers [3]
Write Single Register [6]
Write Multiple Registers [16]

Interpret values in the registers

All values in the register are shown as unsigned (marked T = **u**), signed (marked T = **s**), or float integers (marked T = **f**).
Signed integers are represented as two's complement.

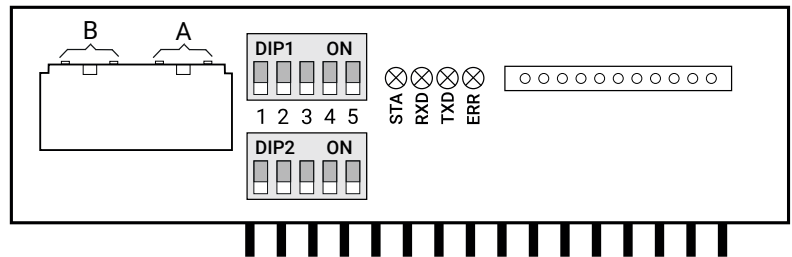| Example unsigned integer:	Example signed integer:
Read (Function 03, 1 Register) Value Register No. x $= 0000\ 0001\ 0010\ 1110_2$ $= 302_{10}$	Read (Function 03, 1 Register) Value Register No. x $= 1111\ 1111\ 0010\ 0001_2$ $= -223_{10}$
Actual value = value * scaling factor * unit = 302 * 0.01 * unit = **30.2 unit**	Actual value = value * scaling factor * unit = −223 * 0.01 * unit = **−22.3 unit**

⚠ All writeable registers >100 are persistent and are **not** supposed to be written on a regular basis.

Operating elements for addressing and parametrisation

RS 485 module

In addition to the basic board, each Modbus sensor is equipped with a RS-485 module.
The Modbus communication lines A (D+) and B (D-) are connected to the module. Furthermore, on the two DIP switches, the Modbus address of the sensor can be selected and the communication parameters can be set.

Functions of DIP switch 1 and DIP switch 2

DIP switch **DIP 1** (5-way) is used to set the Modbus address binary coded in a range of 1–31 (address 0 is reserved for broadcast and can't be set).

DIP switch **DIP 2** (5-way) is used to parameterise termination (120 Ω), baud rate and parity.

All DIP switches are factory set to the OFF position.

1 2 3 4 5
DIP1   **ON**

1–5 Address

2^0 (1)	2^1 (2)	2^2 (4)	2^3 (8)	2^4 (16)	
1	**2**	**3**	**4**	**5**	**Address**
OFF	OFF	OFF	OFF	OFF	**0**
ON	OFF	OFF	OFF	OFF	**1**
OFF	**ON**	OFF	OFF	OFF	**2**
ON	**ON**	OFF	OFF	OFF	**3**
OFF	OFF	**ON**	OFF	OFF	**4**
ON	OFF	**ON**	OFF	OFF	**5**
OFF	**ON**	**ON**	OFF	OFF	**6**
*	*	*	*	*	*
ON	**ON**	**ON**	**ON**	**ON**	**31**

1 2 3 4 5
DIP2   **ON**

1 = Termination
2, 3 = Baud rate
4,5 = Parity

1	**2**	**3**	**4**	**5**	**Function**
OFF					Termination **OFF**
ON					Termination **ON**
	OFF	OFF			Baud rate 9'600
	ON	OFF			Baud rate 19'200
	OFF	**ON**			Baud rate 38'400
	ON	**ON**			Baud rate 57'600
			OFF	OFF	Parity **none** – **2** Stopbits
			ON	OFF	Parity **even** – **1** Stopbit
			OFF	**ON**	Parity **odd** – **1** Stopbit
			ON	**ON**	Parity **none** – **1** Stopbit

LED functions

The four LEDs on the RS-485 module show the actual operating status of the RS-485 module.

STA   During normal operation the LED is flashing.
LED is turned ON during sensor initialization after Power ON of the device.

RXD   LED is turned ON if bus telegrams are received by the RS-485 module.

TXD   LED is turned ON if bus telegrams are sent by the RS-485 module.

ERR   LED is turned ON in case of a faulty bus configuration or in case of internal errors.

Modbus register descriptions

Register measured variable

Registers No. 1–54 define the measured variable.
Sensor type detection in Register No. 502.

No.	Address	Register measured variable	Unit		T	Access
1	0	**Temperature** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	SI Imperial	°C °F	s	R
2	1	**Relative humidity** [scaling factor: 0.1]	%		s	R
3	2	**Absolute humidity** [scaling factor: 0.01] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	SI Imperial	g/m^3 gr/ft^3	s	R
4	3	**Enthalpy** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	SI Imperial	kJ/kg BTU/lb	s	R
5	4	**Dew point** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	SI Imperial	°C °F	s	R
6	5	**CO_2** [scaling factor: 1.0]	ppm		s	R
7	6	**VOC** [scaling factor: 0.1]	%		s	R
8	7	**CO_2 VOC Mix** [scaling factor: 0.1]	%		s	R
9	8	–	–		–	–

Description Access: R = Read, W = Write

Register offset and correction values

Registers No. 101–106 define the offset and correction values of the sensor.

No.	Address	Register offset and correction values	Unit		T	Access
101	100	**Offset temperature** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	SI Imperial	°C °F	s	R / W
102	101	**Offset relative humidity** [scaling factor: 1.0]	%		s	R / W
103	102	**Offset CO_2** [scaling factor: 1.0]	ppm		s	R / W
104	103	**Offset VOC** [scaling factor: 1.0]	%		s	R / W

Description Access: R = Read, W = Write

Register upper and lower limit of the sensor scale

Registers No. 201–224 define the upper/lower limit for the sensor output and is used to scale the two DC 0...10 V analog outputs.

No.	Address	Register upper and lower limit of the sensor scale	Values	Unit		T	Access
201	200	**Lower limit temperature** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	-50...+250°C	SI	°C	s	R / W
			-30...+480°F	Imperial	°F		
202	201	**Upper limit temperature** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401	-50...+250°C	SI	°C	s	R / W
			-30...+480°F	Imperial	°F		
203	202	**Lower limit relative humidity** [scaling factor: 1.0]	0...100 % RH	%		s	R / W
204	203	**Upper limit relative humidity** [scaling factor: 1.0]	0...100 % RH	%		s	R / W
205	204	**Lower limit absolute humidity** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	0...80 g/m^3	SI	g/m^3	s	R / W
			0...35 gr/ft	Imperial	gr/ft		
206	205	**Upper limit absolute humidity** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401 (1 = SI, 2 = Imperial)	0...80 g/m^3	SI	g/m^3	s	R / W
			0...35 gr/ft	Imperial	gr/ft		
207	206	**Lower limit enthalpy** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401	0...85 KJ/kg	SI	kJ/kg	s	R / W
			0...40 BTU/lb	Imperial	BTU/lb		
208	207	**Upper limit enthalpy** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401	0...85 KJ/kg	SI	kJ/kg	s	R / W
			0...40 BTU/lb	Imperial	BTU/lb		
209	208	**Lower limit enthalpy** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401	-20...+80°C	SI	°C	s	R / W
			0...+200°F	Imperial	°F		
210	209	**Upper limit enthalpy** [scaling factor: 0.1] Selection of SI or Imperial units via Register No. 401	-20...+80°C	SI	°C	s	R / W
			0...+200°F	Imperial	°F		
211	210	**Lower limit CO$_2$** [scaling factor: 0.1]	0...5000 ppm	ppm		s	R / W
212	211	**Upper limit CO$_2$** [scaling factor: 0.1]	0...5000 ppm	ppm		s	R / W
213	212	**Lower limit VOC** [scaling factor: 0.1]	0...100 %	%		s	R / W
214	213	**Upper limit VOC** [scaling factor: 0.1]	0...100 %	%		s	R / W
215	214	**Lower limit CO$_2$ / VOC mix** [scaling factor: 0.1]	0...100 %	%		s	R / W
216	215	**Upper limit CO$_2$ / VOC mix** [scaling factor: 0.1]	0...100 %	%		s	R / W

Description Access: R = Read, W = Write

Register channel selection for sensor output and LCD-display

Registers No. 301–310 define the channel selection for the measured variable. This can be used to assign the two analog outputs to the corresponding measured value (channel # 1 = AOU1, channel # 2 = AOU2). In addition, 4 fields of the LCD-display (optional) can be assigned to measured values by using the corresponding channel #.

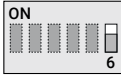| No.	Address	Channel selection for sensor output		T	Access	Notes
301	300	**Channel temperature**	**Default value channel #**	u	R / W	
		Sensor 22DTH-..5..	**2 (AOU2)**			
		Sensor 22UTH-..50X	**2 (AOU2)**			
		Sensor 22DTM-..5	**2 (AOU2)**			
302	301	**Channel relative humidity**	**Default value channel #**	u	R / W	
		Sensor 22DTH-..5..	**1 (AOU1)**			
		Sensor 22DTH-..5..	**1 (AOU1)**			
		Sensor 22DTM-..5	**3**			
303	302	**Channel absolute humidity**	**Default value channel #**	u	R / W	**Channel Selection #** **Valid values 1, 2, 3 or 4** The channels with channel #1 and #2 are output, both via Modbus Registers No. 1–10 and via the analog outputs AOU1 and AOU2.
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
304	303	**Channel enthalpy**	**Default value channel #**	u	R / W	**4 fields of the LCD-display** (optional) can be assigned to measured values by using the corresponding channel #.
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			Unused channels are set to zero.
		Sensor 22DTM-..5	0			
305	304	**Channel dew point**	**Default value channel #**	u	R / W	
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
306	305	**Channel CO_2**	**Default value channel #**	u	R / W	
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	**1 (AOU1)**			
307	306	**Channel VOC**	**Default value channel #**	u	R / W	
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
308	307	**Channel CO_2 VOC Mix**	**Default value channel #**	u	R / W	
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			

Assignment:
LCD fields to channel #

22DTM-..Sensor

Description Access: R = Read, W = Write

Subject to technical modifications

Register sensor units of measurement and constants

Registers No. 401–492 the required unitary system (SI or Imperial) can be selected and further sensor parameters can be chosen.

No.	Address	Register sensor units of measurement and constants	Unit			T	Access
401	400	**Selection of the unitary system** (SI or Imperial) **Note:** For sensors with differential pressure / volumetric flow (22ADP), this value is only readable and is set via the 6th dip switch (ON = Imperial / OFF = SI)	SI	°C	value = 1	u	R / W
			Imperial	°F	value = 2		
..	..	–	–			–	–
414	413	**Percentage value of the CO_2 value in the CO_2 VOC Mix Signal**	0...100 % Example: 25% means: CO_2 VOC Mix = 25% CO_2 and 75% VOC			u	R / W

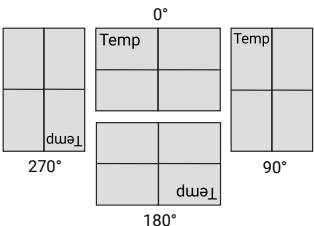Description Access: R = Read, W = Write

Register general device information

Registers No. 501–513 define general device information.

No.	Address	Register general device information	Unit	T	Access	Notes
501	500	**Device detection**	–	u	R	700_{16}
502	501	**Sensor detection** [value 1 = Sensor value available, value 0 = Sensor not available] Bit: 0: Temperature 1: Relative humidity 2: Absolute humidity 3: Enthalpy 4: Dew point 5: CO_2 6: VOC 7: CO_2 VOC Mix 8: – 9: – 10: – 11: –	–	u	R	Example: CO_2 available = 0000 0000 0010 0000 Example: CO_2 and temperature available = 0000 0000 0010 0001
503	502	**Hardware version main circuit board**	–	u	R	Version# is shown as a hexadecimal number
504	503	**Firmware version main circuit board**	–	u	R	
505	504	**Hardware version RS-485 module**	–	u	R	Example: V 4.6 ➔ 0406_{16}
506	505	**Firmware version RS-485 module**	–	u	R	➔ $0000\ 0100\ 0000\ 0110_2$
507	506	**Reserved**	–	–	–	–
508	507	**Reserved**	–	–	–	–
509	508	**Minimum output voltage** [scaling factor: 1.0] (Value is adjustable 0...9 V, default value = 0 V)	V	u	R / W	
510	509	**Maximum output voltage** [scaling factor: 1.0] (Value is 5 or 10 V according to pos. of 5th DIP switch of DIP switch on main board 22ADP OFF = 10 V, ON = 5V)	V	u	R	–
511	510	**Operating hours counter** [scaling factor: 1.0]	h	u	R	–
512	511	**Countdown for maintenance** [scaling factor: 1.0] [Default value = 17520]	h	u	R / W	Set a maintenance or visual inspection time after which sensor shall be checked. (After countdown time has expired a new countdown value has to be set.)
513	512	**Countdown for visual inspection** [scaling factor: 1.0] [Default value = 17520]				

Description Access: R = Read, W = Write

Register LCD-display configuration

Registers No. 601–617 define display parameters of the optional LCD.

No.	Address	Register LCD-display configuration	Unit	T	Access	Notes
601	600	**Enable LCD** [value 1 = enabled, value 0 = disabled]	–	u	R / W	–
602	601	**Brightness LCD** [scaling factor: 1.0] [0...100%]	%	u	R / W	–
603	602	**Rotation LCD** [value 0 = 0°, value 1 = 90°, value 2 = 180°, value 3 = 270°]	–	u	R / W	
604	603	**Enable traffic light function LCD** [value 0 = disabled, value 1 = enabled]	–	u	R / W	–
605	604	**Enable symbol maintenance on LCD** [value 0 = disabled, value 1 = enabled, default = 1]	–	u	R / W	If the countdown time (set value of Register No. 512 and 513) has expired, the symbol will be shown on the LCD-display.
606	605	**Enable symbol visual inspection on LCD** [value 0 = disabled, value 1 = enabled, default = 1]	–	u	R / W	
607	606	**Reserved**	–	–	–	–
608	607	**Enable LCD channel 1** [value 0 = disabled, value 1 = enabled]	–	u	R / W	According to selection of sensor channels of measuring values Register No. 301–310
609	608	**Enable LCD channel 2** [value 0 = disabled, value 1 = enabled]	–	u	R / W	
610	609	**Enable LCD channel 3** [value 0 = disabled, value 1 = enabled]	–	u	R / W	
611	610	**Enable LCD channel 4** [value 0 = disabled, value 1 = enabled]	–	u	R / W	
612	611	**Channel assignment for traffic light function**	–	u	R / W	Input Channel Nr. 1–4 from the settings of Register No. 301–310
613	612	**Traffic light function** Definition of color of LCD back lightning range 1	–	u	R / W	0 = Off 1 = Green 2 = Yellow 3 = Red 4 = Blue 5 = Magenta 6 = Cyan 7 = White
614	613	**Traffic light function** Definition of color of LCD back lightning range 2	–	u	R / W	
615	614	**Traffic light function** Definition of color of LCD back lightning range 3	–	u	R / W	

No.	Address	Register LCD-display configuration	Unit	T	Access	Notes
616	615	**Threshold value traffic light function** Range 1 ➟ range 2	–	s	R / W	Setting for change threshold of LCD back lightning. The value input corresponds to Channel 1, which is set in Register No. 301–310. Examples: Change from blue to green at 20°C Change from green to red at 35°C Range 1 (Register No. 613) set to blue = 410 Range 2 (Register No. 614) set to green = 110 Range 3 (Register No. 615) set to red = 310
617	616	**Threshold value traffic light function** Range 2 ➟ range 3	–	s	R / W	Threshold range1 ➟ 2 (Register No. 616) = 2010 Threshold range 1 ➟ 3 (Register No. 617) = 3510 Exception: If 6th DIP switch of the sensor main board (22ADP) is (ON) set to **InchWC** [scaling factor is 0.001] Value of Register No. 401 is 2 (imperial). ON Inch WC (cfm) 6

Description Access: R = Read, W = Write

All inclusive.

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