



Sensor Modbus-Register

- **22DTH-..5..**
Duct sensor humidity / temperature
- **22UTH-..50X**
Outdoor sensor humidity / temperature
- **22DTM-..5**
Duct sensor CO2 / humidity / temperature
- **22ADP-..5..**
Differential pressure sensor

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1. Modbus General Notes

General information	Protocol:	Modbus RTU / RS-485
	Number of nodes:	Max. 32 (without repeater)
	Address	1...31 0 = Broadcast
	Transmission Formats:	1-8-N-2, 1-8-E-1, 1-8-O-1 <i>Default: 1-8-N-2</i>
		<i>E = Even, O = Odd, N = None</i> <i>Bit structure: Start – Data – Parity – Stop</i>
	Baud rate:	9'600, 19'200, 38'400, 57'600 Bd <i>Default: 9'600</i>
	Terminating resistor:	120 Ω (can be switched on by a DIP Switch description see page 3)
Parameterization:	Via DIP switches (setting of baud rate and parity description on page 3)	

Register implementation All data are arranged in a table and addressed by 1...n (register) 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 commands below.

Standard commands
 Read Holding Registers [03]
 Write Single Register [06]
 Write Multiple Registers [16]

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

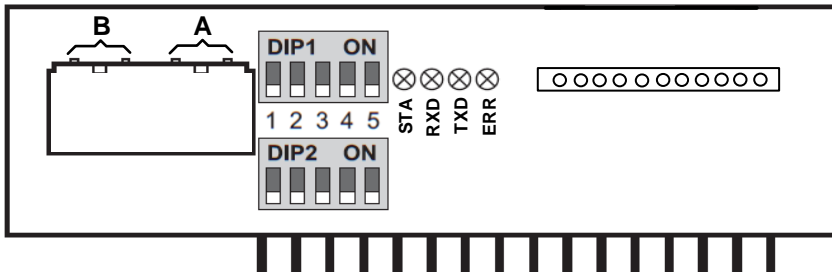
Example unsigned integer Read (Function 03, 1 Register) Value Register No. 1 = 0000'0001'0010'1110₂ = 302₁₀
 Actual Value = Value * Scaling factor * Unit = 302 * 0.1 * °C = **30.2 °C**

Example signed integer Read (Function 03, 1 Register) Value Register No. 1 = 1111'1111'0010'0001₂ = -223₁₀
 Actual Value = Value * Scaling factor * Unit = -223 * 0.1 * °C = **-22.3 °C**

2. Operating elements for addressing and parametrization

2.1 RS 485 module

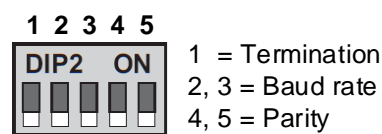
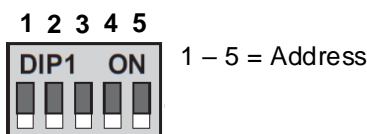
In addition to the basic board, each Modbus sensor is equipped with a RS485 module. The Modbus communication lines A (D+) and B (D-) are connected to the module. Furthermore, on the two DIP switches, the Modbus address of the sensor can be selected and the communication parameters can be set.



2.2 Functions of DIP switch 1 and DIP switch 2

DIP switch **DIP1** (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 **DIP2** (5-way) is used to parametrize termination ($120\ \Omega$), baud rate and parity.



2^0 (1)	2^1 (2)	2^2 (4)	2^3 (8)	2^4 (16)	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	Function
OFF					Termination OFF
ON					Termination ON
	OFF	OFF			Baud rate 9600
	ON	OFF			Baud rate 19200
	OFF	ON			Baud rate 38400
	ON	ON			Baud rate 57600
			OFF	OFF	Parity none
			ON	OFF	Parity even
			OFF	ON	Parity odd
			ON	ON	Parity not used

2.3 LED functions

The four LEDs on the RS485 module show the actual operating status of the RS485 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 RS485 module.


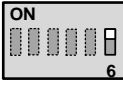
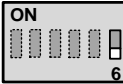

TXD LED is turned ON if bus telegrams are sent by the RS485 module.

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

3. Modbus-Register description

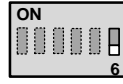
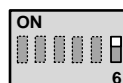
3.1 Register measured variable

Registers No. 1 - 10 define the measured variable.
Sensor type detection in register 502.

No.	Adr	Register measured variable	unit	T	R/W		
1	0	Temperature [scaling factor: 0.1] Selection of SI or Imperial units via register 401 (1 = SI, 2 = Imperial)	SI	°C	s	R	
			Imperial	°F			
2	1	Relative humidity [scaling factor: 0.1]	%rH	s	R		
3	2	Absolute humidity [scaling factor: 0.01] Selection of SI or Imperial units via register 401 (1 = SI, 2 = Imperial)	SI	g/m ³	s	R	
			Imperial	gr/ft ³			
4	3	Enthalpy [scaling factor: 0.1] Selection of SI or Imperial units via register 401 (1 = SI, 2 = Imperial)	SI	kJ/kg	s	R	
			Imperial	BTU/lb			
5	4	Dew point [scaling factor: 0.1] Selection of SI or Imperial units via register 401 (1 = SI, 2 = Imperial)	SI	°C	s	R	
			Imperial	°F			
6	5	CO2 [scaling factor: 1.0]	ppm	s	R		
7	6	VOC [scaling factor: 0.1]	%	s	R		
8	7	CO2 VOC Mix [scaling factor: 0.1]	%	s	R		
9	8	Differential pressure Selection Pa via 6 th DIP switch (OFF) of sensor main board 22ADP. Value in Pa [scaling factor: 1.0] Value of register 401 is 1 (SI)	 Pa (m ³ /h)	SI	Pa	s	R
			 Inch WC (cfm)	Imperial	inchWC		
10	9	Volumetric flow Selection (m³/h) via 6 th DIP switch (OFF) of sensor main board 22ADP. Value of register 401 is 1 (SI) If register 405 is set to 0 or 1 register shows a value in m ³ /h [scaling factor: 100.0] If register 405 is set to 2 register shows a value in m ³ /s [scaling factor: 0.01] Selection (cfm) via 6 th DIP switch (ON) of sensor main board (22ADP). Value in cfm [scaling factor: 10.0] Value of register 401 is 2 (Imperial)	 Pa (m ³ /h)	SI	m ³ /h m ³ /s	s	R
			 Inch WC (cfm)	Imperial	cfm		

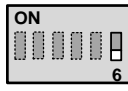
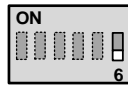
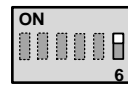
3.2 Register offset and correction values

Registers 101 - 105 define the offset and correction values of the sensor.

No.	Adr	Register offset and correction values	unit	T	R/W		
101	100	Offset temperature [scaling factor: 0.1] Selection of SI or Imperial units via register No. 401 (1 = SI, 2 = Imperial)	SI	°C	s	R/W	
			Imperial	°F			
102	101	Offset relative humidity [scaling factor: 1.0]	%rH	s	R/W		
103	102	Offset CO2 [scaling factor: 1.0]	ppm	s	R/W		
104	103	Offset VOC [scaling factor: 1.0]	%	s	R/W		
105	104	Offset differential pressure Selection of Pa via 6 th DIP switch (OFF) of sensor main board 22ADP. Value in Pa [scaling factor: 1.0] Value of register 401 is 1 (SI) Selection InchWC via 6 th DIP switch (ON) of sensor main board 22ADP. Value in InchWC [scaling factor: 0.001] Value of register 401 is 2 (Imperial)	 Pa (m ³ /h)	SI	Pa	s	R/W
			 Inch WC (cfm)	Imperial	inchWC		

3.3 Register upper and lower limit of the sensor scale

Registers. 201 - 220 define the upper/lower limit for the sensor output and is used to scale the two 0 – 10 Vdc analog outputs.

No.	Adr	Register upper and lower limit of the sensor scale	unit	T	R/W	
201	200	Lower limit temperature [scaling factor: 1.0] Selection of SI or Imperial units via register 401 (1 = SI, 2 = Imperial)	SI	°C	s	R/W
			Imperial	°F		
202	201	Upper limit temperature [scaling factor: 1.0] Selection of SI or Imperial units via register 401	SI	°C	s	R/W
			Imperial	°F		
203	202	Lower limit relative humidity [scaling factor: 1.0]	%rH		s	R/W
204	203	Upper limit relative humidity [scaling factor: 1.0]	%rH		s	R/W
205	204	Lower limit absolute humidity [scaling factor: 1.0] Selection of SI or Imperial units via register 401 (1 = SI, 2 = Imperial)	SI	g/m ³	s	R/W
			Imperial	gr/ft ³		
206	205	Upper limit absolute humidity [scaling factor: 1.0] Selection of SI or Imperial units via register 401 (1 = SI, 2 = Imperial)	SI	g/m ³	s	R/W
			Imperial	gr/ft ³		
207	206	Lower limit enthalpy [scaling factor: 1.0] Selection of SI or Imperial units via register 401	SI	kJ/kg	s	R/W
			Imperial	BTU/lb		
208	207	Upper limit enthalpy [scaling factor: 1.0] Selection of SI or Imperial units via register 401	SI	kJ/kg	s	R/W
			Imperial	BTU/lb		
209	208	Lower limit dew point [scaling factor: 1.0] Selection of SI or Imperial units via register 401	SI	°C	s	R/W
			Imperial	°F		
210	209	Upper limit dew point [scaling factor: 1.0] Selection of SI or Imperial units via register 401	SI	°C	s	R/W
			Imperial	°F		
211	210	Lower limit CO2 [scaling factor: 1.0]	ppm		s	R/W
212	211	Upper limit CO2 [scaling factor: 1.0]	ppm		s	R/W
213	212	Lower limit VOC [scaling factor: 1.0]	%		s	R/W
214	213	Upper limit VOC [scaling factor: 1.0]	%		s	R/W
215	214	Lower limit CO2 / VOC mix [scaling factor: 1.0]	%		s	R/W
216	215	Upper limit CO2 / VOC mix [scaling factor: 1.0]	%		s	R/W
217	216	reserve				
218	217	reserve				
219	218	Lower limit volumetric flow Selection (m³/h) via 6 th DIP switch (OFF) of sensor main board 22ADP. Value of register 401 is 1 (SI) 	SI	m ³ /h m ³ /s	u	R/W
			Imperial	cfm		
220	219	Upper limit volumetric flow Selection (m³/h) via 6 th DIP switch (OFF) of sensor main board 22ADP. Value of register 401 is 1 (SI) 	SI	m ³ /h m ³ /s	u	R/W
			Imperial	cfm		
		Selection (cfm) via 6 th DIP switch (ON) of sensor main board 22ADP. Value of register 401 is 2 (Imperial) Value in cfm [scaling factor: 10.0] 				

3.4 Register channel selection for sensor output and LCD display

Registers 301 - 312 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.	Adr	Channel selection for sensor output	T	R/W	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)			
		Sensor 22ADP-..5	0			
302	301	Channel relative humidity	Default value channel #		u	R/W
		Sensor 22DTH-..5..	1 (AOU1)			
		Sensor 22UTH-..50X	1 (AOU1)			
		Sensor 22DTM-..5	3			
		Sensor 22ADP-..5	0			
303	302	Channel absolute humidity	Default value channel #		u	R/W
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
		Sensor 22ADP-..5	0			
304	303	Channel enthalpy	Default value channel #		u	R/W
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
		Sensor 22ADP-..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			
		Sensor 22ADP-..5	0			
306	305	Channel CO2	Default value channel #		u	R/W
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	1 (AOU1)			
		Sensor 22ADP-..5	0			
307	306	Channel VOC	Default value channel #		u	R/W
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
		Sensor 22ADP-..5	0			
308	307	Channel CO2 VOC Mix	Default value channel #		u	R/W
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
		Sensor 22ADP-..5	0			
309	308	Channel differential pressure	Default value channel #		u	R/W
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
		Sensor 22ADP-..5	1 (AOU1)			
310	309	Channel volumetric flow	Default value channel #		u	R/W
		Sensor 22DTH-..5..	0			
		Sensor 22UTH-..50X	0			
		Sensor 22DTM-..5	0			
		Sensor 22ADP-..5	2 (AOU2)			

Channel Selection #
Valid values 1, 2, 3 or 4
The channels with channel #1 and #2 are output both via Modbus registers 1 - 10 and via the analog outputs AOU1 and AOU2.

4 fields of the LCD display (optional) can be assigned to measured values by using the corresponding channel #.

Unused channels are set to zero.

Assignment LCD fields to channel #

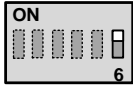
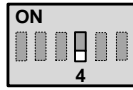
field 1 (channel 1)	field 2 (channel 2)	field 3 (channel 3)	field 4 (channel 4)

example →

22DTM-..Sensors			
CO2	ppm	rH	%
	1278		63
Temp	°C		
	23.7		

3.5 Register sensor units of measurement and constants

Registers 401 - 409 the required unitary system (SI or Imperial) can be selected and further sensor parameters can be chosen.

No.	Adr	Register sensor units of measurement and constants	unit			T	R/W
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 6 th dip switch (ON = Imperial / OFF = SI) 	SI	°C	value = 1	u	R/W
			Imperial	°F	value = 2		
402	401	reserved					
403	402	Input height above sea level [scaling factor: 1.0] Default value = 330 m (input always in m and not in ft)		m		u	R/W
404	403	Input k-factor volumetric flow according to manufacturer's specification [scaling factor: 0.1] [Default value = 1.0]		--		u	R/W
405	404	Selection of the fan manufacturer (The fan model has influence on the formula to calculate the volumetric flow) [Default value = 0]	Rosenberg Comefri Gebhart Nicotra		value = 0	u	R/W
			Ziehl-Abegg EBM-Papst		value = 1		
			Fläkt-Woods		Value = 2		
406	405	reserve					
407	406	reserve					
408	407	reserve					
409	408	Response time volumetric flow [scaling factor: 1.0] [Default value = 4.0] 		s		u	R
410	409	reserve					
411	410	reserve					

Equations of fan manufacturers

Each fan manufacturer has their own equation; k factor range and unit of measure (see tables). By selecting, a manufacturer in register 405 and corresponding plant-specific k factor in register 404, correct settings for each manufacturer will automatically be applied.

Manufacturer	Equation	Unit	k factor range	Manufacturer	Equation	Unit	k factor range
Fläkt Woods	$q = \frac{1}{k} \cdot \sqrt{\Delta P}$	m ³ /s	0.3...99	Ziehl-Abegg	$q = k \cdot \sqrt{\Delta P}$	m ³ /h	10...1500
Rosenberg	$q = k \cdot \sqrt{\frac{2 \cdot \Delta P}{\rho}}$	m ³ /h	37...800	Comefri	$q = k \cdot \sqrt{\frac{2 \cdot \Delta P}{\rho}}$	m ³ /h	10...2000
Nicotra-Gebhardt	$q = CPFN \cdot \sqrt{\frac{2 \cdot \Delta P}{\rho}}$	m ³ /h	10...1500	EBM - Papst	$q = k \cdot \sqrt{\Delta P}$	m ³ /h	10...1500
				Gebhardt	$q = k \cdot \sqrt{\frac{2 \cdot \Delta P}{\rho}}$	m ³ /h	50...4700

Note: If the units of measurement are set to Imperial register 10 output is cfm.

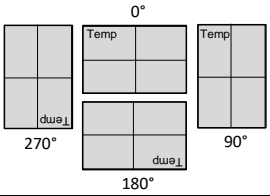


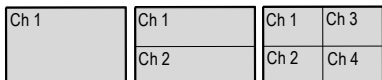
3.6 Register general device information

Registers 501 - 512 define general device information.

No.	Adr	Register general device information	unit	T	R/W	Notes	
501	500	Device detection		u	R	700 ₁₆	
502	501	Sensor detection [value 1 = Sensor value available, value 0 = Sensor not available]				example: CO2 available 0000'0000'0001'0000 example: CO2 & temperature available 0000'0000'0001'0001	
		Bit					
		0	Temperature				
		1	Relative humidity				
		2	Absolute humidity				
		3	Enthalpy				
		4	Dew point				
		5	CO2				
		6	VOC				
		7	CO2 VOC Mix				
			u		R		
503	502	Hardware version main circuit board		u	R	version# is shown as a hexadecimal number (example V 4.6 → 0406 ₁₆ → 0000'0100'0000'0110 ₂)	
504	503	Firmware version main circuit board		u	R		
505	504	Hardware version RS 485 module		u	R		
506	505	Firmware version RS 485 module		u	R		
507	506	reserve					
508	507	reserve					
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 5 th 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 calibration time after which sensor shall be checked. (After count down time has expired a new countdown value has to be set.	
513	512	Countdown for calibration [scaling factor: 1.0] [Default value = 17520]	h	u	R/W		

3.7 Register LCD display configuration

Registers 601 - 617 define display parameters of the optional LCD.

No.	Adr	Register LCD display configuration	unit	T	R/W	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 512 and 513) has expired, the symbol will be shown on the LCD display.
606	605	Enable symbol calibration on LCD [value 0 = disabled, value 1 = enabled, default = 1] 		u	R/W	
607	606	reserve				
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 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 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	
616	615	Threshold value traffic light function Range 1 → range 2		u	R/W	Setting for change threshold of LCD back lightning. The value input corresponds to Channel 1, which is set in Register 301 - 310 Example: Change from blue to green at 20° C Change from green to red at 35° C Range 1 (Register 613) set to blue = 4 ₁₀ Range 2 (Register 614) set to green = 1 ₁₀ Range 3 (Register 615) set to red = 3 ₁₀ Threshold range1→ 2 (Register 616) = 20 ₁₀ Threshold range 1→ 3 (Register 617) = 35 ₁₀
617	616	Threshold value traffic light function Range 2 → range 3		u	R/W	Exception: If 6 th DIP switch of the sensor main board (22ADP) is (ON) set to inchWC [scaling factor is 0.001] Value of register 401 is 2 (imperial) 