



## Thermal Energy Meter (TEM)

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**Modbus General Notes**

<b>General information</b>	Date	15.01.2022						
	Product Name	22PE...-1U.. e.g. 22PEM-1UC						
	Protocol	Modbus RTU over RS-485, Modbus TCP over Ethernet						
<b>Modbus RTU</b>	Transmission formats	1-8-N-2, 1-8-N-1, 1-8-E-1, 1-8-O-1 (default: 1-8-N-2)						
	Baud rates	9'600, 19'200, 38'400, 76'800, 115'200 Bd (default: 38'400 Bd)						
	Address	1...247 (default: 1)						
	Number of nodes	Max. 32 (without repeater)						
	Terminating resistor	120 Ω						
<b>Modbus TCP</b>	Port	open (default: 1)						
<b>Parameterisation</b>	Tool	Assistant App or through the integrated web server						
<b>Register implementation</b>	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 for Holding Register. The commands for Discrete Inputs and Input Registers can be used as an alternative.							
<b>Commands</b>	Standard commands: Read Holding Registers [3] Write Single Register [6]  Optional commands: Read Discrete Inputs [2] Read Input Registers [4] Write Multiple Registers [16]							
<b>Command „Read Discrete Inputs“</b>	The command reads one or more bits and can alternatively be used for Register No. 105 (Malfunction and Service information).							
Example	The start address to be used is 1664 → <b>104</b> (Register Address) * <b>16</b> (Bit) = <b>1664</b>							
<b>Interpret values in the registers</b>	All values in the register are unsigned integer datatypes. <b>Exceptions are Register No.20/22. Signed integers are represented as two`s complement.</b>							
Example unsigned integer	Read (Function 03, 1 Register) Value Register No. 7 = 0001'1010'1100'1000 <sub>2</sub> = 6'856 <sub>10</sub> Actual Value = Value * Scaling factor * Unit = 6'856 * 0.01 * % = <b>68.56 %</b>							
Example signed integer	Read (Function 03, 1 Register) Value Register No. 20 = 1111'1101'1111'0010 <sub>2</sub> = -526 <sub>10</sub> Actual Value = Value * Scaling factor * Unit = -526 * 0.01 * °C = <b>-5.26 °C</b>							
<b>32-bit values in two registers</b>	Values that exceed 65'535 are stored in two consecutive Registers and have to be interpreted as „little endian“ / LSW (Least Significant Word) first Both registers have to be written at once with function „Write Multiple Registers [16]“. It cannot be written together with other registers.							
Example	Register No. 10 (AbsFlow LowWord) = 14'551 = 0011'1000'1101'0111 <sub>2</sub> Register No. 11 (AbsFlow HighWord) = 19 = 0000'0000'0001'0011 <sub>2</sub>							
	<table border="1"> <thead> <tr> <th>AbsFlow HighWord</th> <th>AbsFlow LowWord</th> </tr> </thead> <tbody> <tr> <td>19</td> <td>14'551</td> </tr> <tr> <td>0000'0000'0001'0011<sub>2</sub></td> <td>0011'1000'1101'0111<sub>2</sub></td> </tr> </tbody> </table>		AbsFlow HighWord	AbsFlow LowWord	19	14'551	0000'0000'0001'0011 <sub>2</sub>	0011'1000'1101'0111 <sub>2</sub>
AbsFlow HighWord	AbsFlow LowWord							
19	14'551							
0000'0000'0001'0011 <sub>2</sub>	0011'1000'1101'0111 <sub>2</sub>							
	AbsFlow = 0000'0000'0001'0011'0011'1000'1101'0111 <sub>2</sub> = 1'259'735 = <b>1259.735 l/h</b>							
	Math formula: AbsFlow = ( AbsFlow HighWord * 65'536 ) + AbsFlow LowWord AbsFlow = ( 19 * 65'536 ) + 14'551 = 1'259'735 = <b>1259.735 l/h</b>							
<b>Deactivated registers</b>	If a register is not supported by a device or by a device setting it is indicated with 65'535 (1111'1111'1111'1111 <sub>2</sub> ).							



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

Modbus Register Overview

Operation

No.	Address	Register	Access
..	...	-	-
4	3	Device Type	R
7	6	Relative volumetric flow [%]	R
8	7	Absolute volumetric flow [l/s] 0...45 l/s (0...45'000)	R
9	8	Absolute volumetric flow [gpm] 0...713 gpm (0...7'130)	R
10	9	Absolute volumetric flow [selected units]	LowWord
11	10		HighWord
13	12	Sensor value 1 [mV] [Ω] [-]	R
14	13	Sensor 1 as analog value [°C]	R
15	14	Sensor 1 as analog value [°F]	R
...	...	-	-
20	19	Temperature 1 (external) [°C]	R
21	20	Temperature 1 (external) [°F]	R
22	21	Temperature 2 (integrated) [°C]	R
23	22	Temperature 2 (integrated) [°F]	R
24	23	Delta temperature [K]	R
25	24	Delta temperature [°F]	R
26	25	Glycol concentration [%]	R
...	...	-	-
28	27	Absolute cooling power [kW]	LowWord
29	28		HighWord
30	29	Absolute cooling power [kBTU/h]	LowWord
31	30		HighWord
32	31	Absolute cooling power [selected units]	LowWord
33	32		HighWord
34	33	Absolute heating power [kW]	LowWord
35	34		HighWord
36	35	Absolute heating power [kBTU/h]	LowWord
37	36		HighWord
38	37	Absolute heating power [selected units]	LowWord
39	38		HighWord
...	...	-	-
60	59	Total Volume [m3]	LowWord
61	60		HighWord
62	61	Total Volume [gal]	LowWord
63	62		HighWord
64	63	Total Volume [selected units]	LowWord
65	64		HighWord
66	65	Cooling Energy [kWh]	LowWord
67	66		HighWord
68	67	Cooling Energy [kBTU]	LowWord
69	68		HighWord
70	69	Cooling Energy [selected units]	LowWord
71	70		HighWord
72	71	Heating Energy [kWh]	LowWord
73	72		HighWord
74	73	Heating Energy [kBTU]	LowWord
75	74		HighWord
76	75	Heating Energy [selected units]	LowWord
77	76		HighWord

Modbus Register Overview

Service

No.	Address	Register	Access
100	99	Bus Termination	R
101	100	Series Number 1 <sup>st</sup> part	R
102	101	Series Number 2 <sup>nd</sup> part	R
103	102	Series Number 4 <sup>th</sup> part	R
104	103	Firmware Version	R
105	104	Malfunction and Service Information	R
...	...	-	-
110	109	Communication Watch dog	R / W
111	110	Nominal volumetric flow [l/s]	R
112	111	Nominal volumetric flow [gpm]	R
113	112	Vnom	LowWord
114	113		HighWord
...	...	-	-
121	120	Sensor 1 input type	R / W
122	121	Sensor 1 passive sensor Type	R / W
...	...	-	-
148	147	Unit Selection Flow	R / W
149	148	Unit Selection Power	R / W
150	149	Unit Selection Total Flow	R / W
151	150	Unit Selection Energy	R / W
...	...	-	-
201	200	Meter_Serial_No First Part	LowWord
202	201		HighWord
203	202	Meter_Serial_No_Second Part	LowWord
204	203		HighWord
205	204	Select Meter Registers	R / W

**Modbus Register Description**

No.	Address	Description Comment	Range Enumeration	Unit	Scaling	Access
4	3	Actuator type	0: Device not connected 1: Air/Water 2: VAV / EPIV 3: Fire 4: Energy Valve / Energy Meter 5: 6-way EPIV	-	1	R
7	6	Relative volumetric flow [%] relates to Vnom	0...15'000	%	0.01	R
8	7	Absolute volumetric flow [l/s]	0...1.5*Vnom	l/s	0.01	R
9	8	Absolute volumetric flow [gpm]	0...16'000	gpm	0.1	R
10	9	Absolute volumetric flow [selected units]	0...360'000'000	UnitSel	0.001	R
11	10	Unit can be selected in Register No. 148				
13	12	Sensor value 1 [mV] [Ω] [-]	Resistance and Voltage 0...65'535	mV Ω (NTC10K) 0 / 1	1 1 10 1	R
14	13	Sensor 1 as analog value [°C]	-2'000...12'000	°C	0.01	R
15	14	Sensor 1 as analog value [°F]	-400...24'800	°F	0.01	R
20	19	Temperature 1 (external) [°C]	-2'000...12'0000	°C	0.01	R
21	20	Temperature 1 (external) [°F]	-400...24'800	°F	0.01	R
22	21	Temperature 2 (integrated) [°C]	-2'000...12'0000	°C	0.01	R
23	22	Temperature 2 (integrated) [°F]	-400...24'800	°F	0.01	R
24	23	DeltaT_K	0...14'000	K	0.01	R
25	24	DeltaT_F	0...25'200	°F	0.001	R
26	25	Glycol concentration	0...10'000	%	0.01	R
28	27	Absolute Power cooling [kW]	0...21'500'000	kW	0.001	R
29	28					
30	29	Absolute Power cooling [kBTU/h]	0...74'150'000	kBTU/h	0.001	R
31	30					
32	31	Absolute Power Heating [selected units]	0...741'500'000	UnitSel	0.1	R
33	32	Unit can be selected in Register No. 149				
34	33	Absolute Power Heating [kW]	0...21'500'000	kW	0.001	R
35	34					
36	35	Absolute Power Heating [kBTU/h]	0...74'150'000	kBTU/h	0.001	R
37	36					
38	37	Absolute Power Heating [selected units]	0...741'500'000	UnitSel	0.1	R
39	38	Unit can be selected in Register No. 149				
60	59	Total Volume [m3]	0...2'147'483'600	m3	0.01	R
61	60					
62	61	Total Volume [gal]	0...2'147'483'647	gal	1	R
63	62					
64	63	Total Volume [selected units]	0...2'147'483'647	UnitSel	1	R
65	64	Unit can be selected in Register No. 150				
66	65	Cooling Energy [kWh]	0...2'147'483'647	kWh	1	R
67	66					
68	67	Cooling Energy [kBTU]	0...2'147'483'647	kBTU	1	R
69	68					
70	69	Cooling Energy [selected units]	0...2'147'483'647	UnitSel	1	R
71	70	Unit can be selected in Register No. 151				
72	71	Heating Energy [kWh]	0...2'147'483'647	kWh	1	R
73	72					
74	73	Heating Energy [kBTU]	0...2'147'483'647	kBTU	1	R
75	74					
76	75	Heating Energy [selected units]	0...2'147'483'647	UnitSel	1	R
77	76	Unit can be selected in Register No. 151				

**Modbus Register Description**

No.	Address	Description Comment	Range Enumeration	Unit	Scaling	Access
100	99	Bus Termination Indicates if bus termination (120 Ω) is enabled. Bus termination can be set with configuration tools.	0: disabled 1: enabled Default: 0	-	-	R
101	100	Series Number 1st part Each device has an unambiguous series number, which is either impressed on or glued to the housing. The series number consists of 4 segments, although only parts 1, 2 and 4 are displayed on Modbus. Example: 00839-31324-064-008 1st part: 00839 2nd part: 31324 4th part: 008	-	-	-	R
102	101	Series Number 2nd part	-	-	-	R
103	102	Series Number 4th part	-	-	-	R
104	103	Firmware Version Firmware version of communication module Example: 302, Version 3.02 for details see Firmware history	-	-	-	R
105	104	Malfunction and Service Information No communication to actuator: Communication with actuator not possible. Gear disengagement: Gear disengaged button is pressed. Actuator cannot move: Mechanical overload due to blocked valve, etc. (only available for EV..R+KBAC) Reverse flow: Reverse flow is detected. Flow setpoint not reached: Setpoint cannot be reached within 15 min during flow control. Actual flow exceeds nominal flow: Actual flow exceeds the designed nominal flow. Flow measurement error: Air in the system, error occurred during flow measurement. External temperature sensor not OK: No connection to the external temperature sensor Integrated temperature sensor not OK: Error with embedded temperature sensor. Communication to sensor interrupted: Internal communication to flow sensor interrupted. Freeze warning: Measured temperature & glycol concentration indicate that grease ice can build up. Glycol detected: Glycol was detected in a MID application. Power setpoint not reached: Setpoint cannot be reached within 15 min during power control.	Bitmask = 0: not used 1: not used 2: not used 3: Reverse flow 4: not used 5: not used 6: Actual flow exceeds nominal flow 7: Flow measurement error 8: External temperature error 9: Integrated temperature error 10: Communication to sensor interrupted 11: not used 12: Glycol detected 13: not used	-	-	R
110	109	Communication Watchdog Time until Bus Fail will be detected. If Bus Watchdog = 0 then deactivated. If Bus Fail setpoint (Register 110) different from 0 then Timeout for Bus Watchdog is by default 120s (parameterizable). Not functional --> reserved for future	0...3'600 Default: 0 (120)	s	1	R / W
111	110	Nominal volumetric flow [l/s] (Vnom)	0...10'000	l/s	0.001	R
112	111	Nominal volumetric flow [gpm] (Vnom)	0...16'000	gpm		R
113	112	Nominal volumetric flow (qp) [selected units] (Vnom)	0...360'000'000	UnitSel	0.001	R
114	113	Unit can be selected in Register No. 148				
121	120	Sensor 1 Type Additional sensor input Only selectable if SpSource (Register 119) is set to bus.	0: None 1: Active 2: - 3: Passive 4: Switch Default: 0	-		R / W

## Modbus Register Description

No.	Address	Description Comment	Range Enumeration	Unit	Scaling	Access
122	121	Sensor 1 passive sensor Type	0: Resistance Measurement 1: PT1000 2: Ni1000 3: - 4: - 5: - 6: - 7: NTC10k2 8: NTC10k3 Default: 0	-	-	R / W
148	147	Unit Selection Flow	0: m3/s 1: m3/h 2: l/s 3: l/min 4: l/h 5: gpm 6: cfm Default: 4	-	-	R / W
149	148	Unit Selection Power	0: W 1: kW 2: MW 3: BTU/h 4: kBTU/h 5: ton Default: 1	-	-	R / W
150	149	Unit Selection Volume	0: m3 1: Litre 2: Gallon 3: cf Default: 0	-	-	R / W
151	150	Unit Selection Energy	0: J 1: kJ 2: MJ 3: GJ 4: Wh 5: kWh 6: MWh 7: BTU 8: kBTU 9: ton Default: 5	-	-	R / W
201	200	Sensor Serial Number First Part	-	-	1	R
202	201	ProductionOrderNumber	-	-	1	R
203	202	Sensor Serial Number Second Part	-	-	1	R
204	203	ProductionSequenceNumber	-	-	1	R
205	204	Select Meter Register Value 0 only available for models with MID certification: EV..R2+MID. For non MID certified models value 1 is defined as default. Select between certified meter register and lifetime register. The certified meter register will be reset when the sensor module is replaced. The lifetime register is compensated for glycol (if applicable). Avoid toggling between the two registers as this will affect data logging. Following registers depend on the selected meter register: Register No. 60/61 Register No. 62/63 Register No. 64/65 Register No. 66/67 Register No. 68/69 Register No. 70/71 Register No. 72/73 Register No. 74/75 Register No. 76/77	0: Certified meter register 1: Lifetime meter register Default: 0	-	-	R / W

## Note:

According to the present configuration settings of the Energy Valve (e.g. DN size) the HVAC application may perform a size limitation within the indicated Modbus value range. Each Energy Valve may have different HVAC value size limitations.