



# Modbus Interface Description



## Thermal Energy Meter (TEM)

Edition 2024-05 / V4.2.0

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# Modbus general notes

## General information

Date	25.04.2024
Product Name	22PE..-1U.. e.g. 22PEM-1UC
Product Model Number	22PF-x1(X)Ux2(x3(x4))-(SG) X1: 1, 5 x2: C, D, E, F, G, H, H x3: H, N, K x4: H, T
Protocol	Modbus RTU over RS-485, Modbus TCP over Ethernet

## Modbus RTU

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)
Address	1...247 (Default: 1)
Number of Nodes	Max. 32 (without repeater)
Terminating Resistor	120 Ω

## Modbus TCP

Terminating Resistor	Open (Default: 1)
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## Parametrisation

Tool	Beimo Assistant or through the integrated web server
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## 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 for Holding Register. The commands for Discrete Inputs and Input Registers can be used as an alternative.

## Commands

Standard commands:	Optional commands:
Read Holding Registers [3]	Read Discrete Inputs [2]
Write Single Register [6]	Read Input Registers [4]
	Write Multiple Registers [16]

## Command "Read Discrete Inputs"

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 -> **104** (Register No. 105) \* **16** (Bit) = **1664**

## Interpret values in the registers

All values in the register are unsigned integer data types. Exeptions are marked with <sup>\*\*</sup>. Signed integers are represented as two's complement.

Example unsigned integer:	Example signed integer:
Read (Function 03, 1 Register) Value Register No. x = 0001 1010 1100 1000 <sub>2</sub> = 6,856 <sub>10</sub>	Read (Function 03, 1 Register) Value Register No. x = 1111 1101 1111 0010 <sub>2</sub> = -526 <sub>10</sub>
Actual value = value * scaling factor * unit = 6,856 * 0.01 * unit = <b>68.56 unit</b>	Actual value = value * scaling factor * unit = -526 * 0.01 * unit = <b>-5.26 unit</b>

## 32-bit values in two registers

Values that exceed 65,535 are stored in two consecutive registers and have to be interpreted as "little endian byte swap" / LSW (Least Significant Word) first. Note: While the regular "little endian" interpretation refers to the each byte (8 bit Word) per register, the additional "byte swap" interpretation leads to where "little endian" refers to the 16 bit Word of one register.

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. x (Value LowWord)	Register No. x + 1 (Value HighWord)
= 14,551 <sub>10</sub>	= 19 <sub>10</sub>
= 0011 1000 1101 0111 <sub>2</sub>	= 0000 0000 0001 0011 <sub>2</sub>

<b>Value LowWord</b> = 14,551 = 0011 1000 1101 0111 <sub>2</sub>	<b>Value HighWord</b> = 19 = 0000 0000 0001 0011 <sub>2</sub>
--	---

32-bit value  
 = 0000 0000 0001 0011 0011 1000 1101 0111<sub>2</sub>  
 = 1,259,735<sub>10</sub>  
 = **1,259.735 unit**

Math formula:

32-bit value = (Value HighWord \* 65,536) + Value LowWord  
 32-bit value = (19 \* 65,536) + 14,551  
 = 1,259,735  
 = **1,259.735 unit**

## Deactivated registers

If a register is not supported by a device or by a device setting, this is indicated by 65,535 (1111 1111 1111 1111<sub>2</sub>).

# 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]	R
9	8	Absolute Volumetric Flow [gpm]	R
10	9	Absolute Volumetric Flow [selected unit]	LowWord
11	10		HighWord
13	12	Sensor 1 Value [mV] [Ω] [-]	R
14	13	Sensor 1 Temperature [°C] **)	R
15	14	Sensor 1 Temperature [°F] **)	R
..	..	–	–
20	19	Temperature 1 (remote) [°C] **)	R
21	20	Temperature 1 (remote) [°F] **)	R
22	21	Temperature 2 (flow body) [°C] **)	R
23	22	Temperature 2 (flow body) [°F] **)	R
24	23	Delta Temperature [K]	R
25	24	Delta Temperature [°F]	R
26	25	Glycol Concentration [%]	R
..	..	–	–
28	27	Absolute Power Cooling [kW]	LowWord
29	28		HighWord
30	29	Absolute Power Cooling [kBTU/h]	LowWord
31	30		HighWord
32	31	Absolute Power Cooling [selected unit]	LowWord
33	32		HighWord
34	33	Absolute Power Heating [kW]	LowWord
35	34		HighWord
36	35	Absolute Power Heating [kBTU/h]	LowWord
37	36		HighWord
38	37	Absolute Power Heating [selected unit]	LowWord
39	38		HighWord
..	..	–	–

\*\*) signed integer

## Operation

No.	Address	Register	Access
60	59	Volume [m <sup>3</sup> ]	LowWord
61	60		HighWord
62	61	Volume [gal]	LowWord
63	62		HighWord
64	63	Volume [selected unit]	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 unit]	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 unit]	LowWord
77	76		HighWord

Definition Access: R = Read, W = Write

# Modbus register overview

## Service

No.	Address	Register	Access
100	99	Bus Termination	R
101	100	Series Number 1 <sup>st</sup> part	
102	101	Series Number 2 <sup>nd</sup> part	R
103	102	Series Number 4 <sup>th</sup> part	
104	103	Firmware Version	-
105	104	Malfunction and Service Information	R
..	..	-	-
111	110	Nominal Volumetric Flow (qp) [l/s]	R
112	111	Nominal Volumetric Flow (qp) [gpm]	R
113	112	Nominal Volumetric Flow (qp) [selected unit]	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 Volume	R / W
151	150	Unit Selection Energy	R / W
160	159	Absolute Nominal Power [kW]	LowWord
161	160		HighWord
162	161	Absolute Nominal Power [kBTU/h]	LowWord
163	162		HighWord
164	163	Absolute Nominal Power [selected unit]	LowWord
165	164		HighWord
201	200	Energy Meter Serial Number First Digits	LowWord
202	201		HighWord
203	202	Energy Meter Serial Number Last Digits	LowWord
204	203		HighWord
205	204	Select Meter Registers	R / W

Definition Access: R = Read, W = Write



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

# Modbus register description

No.	Address	Description Comment	Range, enumeration	Unit	Scaling	Access
4	3	<b>Device type</b>	0: Device not connected 1: Air/Water 2: VAV / EPIV 3: Fire 4: <b>Energy Valve / Energy Meter</b> 5: 6-way EPIV	–	1	R
7	6	<b>Relative volumetric flow in % of qp</b> (Nominal volumetric flow) Related to nominal volumetric flow (qp) (Register No 111, 112, 113/114)	0...15'000	%	0.01	R
8	7	<b>Absolute volumetric flow</b>	0...1.5*qp	l/s	0.01	R
9	8	<b>Absolute volumetric flow</b>	0...16'000	gpm	0.1	R
10	9	<b>Absolute volumetric flow in selected unit</b> → Unit can be selected by Register No. 148	0...100	m <sup>3</sup> /s	0.001	R
11	10		0...360'000 0...100'000 0...6'000'000 0...360'000'000	m <sup>3</sup> /h l/s l/min l/h		
13	12	<b>Sensor 1 value</b> The conversion of passive sensors can be selected by Register No. 122  Scaling depends on the sensor type PT1000 / Ni1000 → 1 NTC10K → 10	0...65'535	mV Ω –	1 1 / 10 0 / 1	R
14	13	<b>Sensor 1 temperature</b>	-400...24'800	°C	0.01	R
15	14	<b>Sensor 1 temperature</b>	-400...24'800	°F	0.01	R
..	..	–	–	–	–	–
20	19	<b>Temperature 1 (remote)</b>	-2'000...12'0000	°C	0.01	R
21	20	<b>Temperature 1 (remote)</b>	-400...24'800	°F	0.01	R
22	21	<b>Temperature 2 (flow body)</b>	-2'000...12'0000	°C	0.01	R
23	22	<b>Temperature 2 (flow body)</b>	-400...24'800	°F	0.01	R
24	23	<b>Delta temperature</b>	0...14'000	K	0.01	R
25	24	<b>Delta temperature</b>	0...25'200	°F	0.001	R
26	25	<b>Glycol concentration</b>	0...10'000	%	0.01	R
..	..	–	–	–	–	–
28	27	<b>Absolute power cooling</b>	0...21'500'000	kW	0.001	R
29	28					
30	29	<b>Absolute power cooling</b>	0...74'150'000	kBTU/h	0.001	R
31	30					
32	30	<b>Absolute power heating in selected unit</b> → Unit can be selected by Register No. 149	0...741'500'000	UnitSel	0.1	R
33	32					
34	33	<b>Absolute power heating</b>	0...21'500'000	kW	0.001	R
35	34					



No.	Address	Description Comment	Range, enumeration	Unit	Scaling	Access
36	35	<b>Absolute power heating</b>	0...74'150'000	kBTU/h	0.001	R
37	36					
38	37	<b>Absolute power heating in selected unit</b> → Unit can be selected by Register No. 149	0...74'150'000	UnitSel	0.1	R
39	38					
..	..	-	-	-	-	-
60	59	<b>Volume</b> Accumulated volume	0...2'147'483'600	m <sup>3</sup>	0.01	R
61	60					
62	61	<b>Volume</b> Accumulated volume	0...2'147'483'647	gal	1	R
63	62					
64	63	<b>Volume in selected unit</b> → Unit can be selected by Register No. 150	0...42'000'000	m <sup>3</sup> l gal cf	1	R
65	64		0...11'095'226'199 0...1'483'216'002.3			
66	65	<b>Cooling energy</b>	0...2'147'483'647	kWh	1	R
67	66					
68	67	<b>Cooling energy</b>	0...2'147'483'647	kBTU	1	R
69	68					
70	69	<b>Cooling Energy in selected unit</b> → Unit can be selected by Register No. 151	0...2'147'483'647	-	1	R
71	70					
72	71	<b>Heating energy</b>	0...2'147'483'647	kWh	1	R
73	72					
74	73	<b>Heating energy</b>	0...2'147'483'647	kBTU	1	R
75	74					
76	75	<b>Heating energy in selected unit</b> → Unit can be selected by Register No. 151	0...2'147'483'647	-	1	R
77	76					
..	..	-	-	-	-	-
100	99	<b>Bus termination</b> Indicates if bus termination (120 Ω) is enabled. Bus termination can be set by configuration tools.	0: Disabled 1: Enabled Default: 0	-	-	R
101	100	<b>Series number 1<sup>st</sup> part</b> 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 1 <sup>st</sup> part: 00839 2 <sup>nd</sup> part: 31324 4 <sup>th</sup> part: 008	-	-	-	R
102	101	<b>Series number 2<sup>nd</sup> part</b>	-	-	-	R
103	102	<b>Series number 4<sup>th</sup> part</b>	-	-	-	R

No.	Address	Description Comment	Range, enumeration	Unit	Scaling	Access
104	103	<b>Firmware version</b> Firmware version of communication module Example: 402, Version 4.02 For details see Firmware history	–	–	–	R
105	104	<b>Malfunction and service information</b> Value is bit-coded. More than one bit can be set to 1. Not all bits mentioned in the enumeration are used for this product range.  3: Reverse flow: Reverse flow is detected. 6: Flow actual exceeds flow nominal : Actual flow exceeds qp (designed nominal volumetric flow). 7: Flow measurement error: Air in the system, error occurred during flow measurement. 8: Remote temperature error: No connection to external temperature sensor. 9: Flowbody temperature error: Error with embedded temperature sensor. 10: Communication to sensor interrupted: Internal communication to flow sensor interrupted. 11: Freeze warning: Measured temperature & glycol concentration indicate that grease ice can build up. 12: Glycol detected: Glycol was detected in a MID application. 14: Device end of life reached (MID only): The sensor module must be replaced.	Bitmask =  0: – 1: – 2: – 3: Reverse flow 4: – 5: – 6: Actual flow exceeds nominal flow 7: Flow measurement error 8: Remote temperature error 9: Flow body temperature error 10: Communication to sensor interrupted 11: Freeze warning 12: Glycol detected 13: – 14: Device end of life reached 15: –	–	–	R
..	..	–	–	–	–	–
111	110	<b>Nominal volumetric flow (qp)</b>	0...10'000	l/s	0.01	R
112	111	<b>Nominal volumetric flow (qp)</b>	0...15'850	gpm	0.1	R
113	112	<b>Nominal volumetric flow (qp) in selected unit</b> ► Unit can be selected by Register No. 148	0...100 0...360'000 0...100'000 0...6'000'000 0...360'000'000	m <sup>3</sup> /s m <sup>3</sup> /h l/s l/min l/h	0.001	R
114	113		0...1'585'030 0...211'887.997	gpm cfm		
..	..	–	–	–	–	–
121	120	<b>Sensor 1 type</b> Additional sensor input	0: None 1: Active 2: – 3: Passive 4: Switch Default: 0	–	–	R / W
122	121	<b>Sensor 1 passive sensor type</b>	0: Resistance Measurement 1: PT1000 2: Ni1000 3: – 4: – 5: – 6: – 7: NTC10k2 8: NTC10k3 Default: 0	–	–	R / W
..	..	–	–	–	–	–
148	147	<b>Unit selection flow</b>	0: m <sup>3</sup> /s 1: m <sup>3</sup> /h 2: l/s 3: l/min 4: l/h 5: gpm 6: cfm Default: 4	–	–	R / W

No.	Address	Description Comment	Range, enumeration	Unit	Scaling	Access	
149	148	<b>Unit selection power</b>	0: W 1: kW 2: MW 3: BTU/h	4: kBTU/h 5: ton Default: 1	-	-	R / W
150	149	<b>Unit selection volume</b>	0: m <sup>3</sup> 1: Litre 2: Gallon	3: cf Default: 0	-	-	R / W
151	150	<b>Unit selection energy</b>	0: J 1: kJ 2: MJ 3: GJ 4: Wh 5: kWh	6: MWh 7: BTU 8: kBTU 9: ton Default: 5	-	-	R / W
..	..	-	-	-	-	-	-
160	159	<b>Absolute nominal power</b>	0...21'500'000	kW	0.001	R	
161	160						
162	161	<b>Absolute nominal power</b>	0...73'361'045	kBTU/h	0.001	R	
163	162						
164	163	<b>Absolute nominal power in selcted unit</b> → Unit can be selected by Register No. 149	0...215'000'000 0...215'000 0...215 0...733'610'451.1	W kW MW BTU/h	0.1	R	
165	164		0...733'610.5 0...61'134.2	kBTU/h ton			
..	..	-	-	-	-	-	-
201	200	<b>Energy Meter serial number first digits</b>	-	-	1	R	
202	201	ProductionOrderNumber					
203	202	<b>Energy Meter serial number last digits</b>	-	-	1	R	
204	203	ProductionSequenceNumber					

No.	Address	Description Comment	Range, enumeration	Unit	Scaling	Access
205	204	<p><b>Select meter register</b></p> <p>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).</p> <p>Avoid toggling between the two registers as this will affect data logging.</p> <p>Following registers depend on the selected meter register:</p> <p>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</p>	<p>0: Certified meter register 1: Lifetime meter register Default: 0</p>	-	-	R / W

Definition Access: R = Read, W = Write

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

# All inclusive.

Belimo as a global market leader develops innovative solutions for the controlling of heating, ventilation and air-conditioning systems. Damper actuators, control valves, sensors and meters represent our core business.

Always focusing on customer value, we deliver more than only products. We offer you the complete product range for the regulation and control of HVAC systems from a single source. At the same time, we rely on tested Swiss quality with a five-year warranty. Our worldwide representatives in over 80 countries guarantee short delivery times and comprehensive support through the entire product life. Belimo does indeed include everything.

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