Modbus interface option PME central unit

Content

GMC INSTRUMENTS

Camille Bauer Metrawatt AG
Aargauerstrasse 7
CH-5610 Wohlen / Switzerland

Phone: +41 56 618 21 11
Telefax: +41 56 618 35 35

E-Mail: info@cbmag.com
https://www.camillebauer.com

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1 Modbus communication

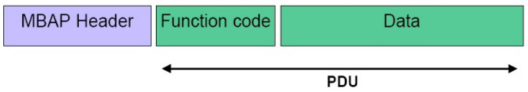
Addressing

Modbus groups different data types as references. For addressing data, one has to know that Modbus starts the register numeration at 1, but the addressing at 0.

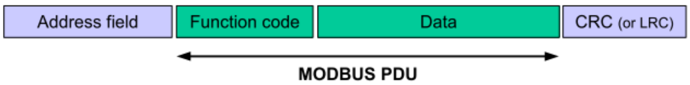
Example: Measurement P on register address 10000

- ➢ Address declaration in value table (see chapter 4.1): (4x)10000
- ➢ Real address: 10000 (offset 1)
- ➢ Address used in telegram transmission: 9999 (offset 0)

Telegrams



Modbus/TCP



Modbus/RTU

- The information to transmit is the same for both Modbus/TCP and Modbus/RTU, displayed in green above.
- For Modbus/TCP device addressing is done by means of the IP address. The slave address (address field) of the Modbus/RTU telegram is therefore no longer required, but I still present in the MBAP header and set to 0xFF.
  The network installation of the devices is done directly at the device or via web browser (see device handbook). As soon as all devices have a unique network address they may be accessed by means of a Modbus master client.
- The CRC check sum of the Modbus/RTU communication is dropped, because the security of the transmission is assured on TCP communication level.

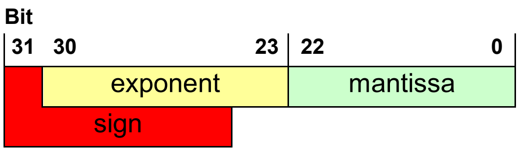
Reading float numbers (REAL): Function 0x03, Read Holding Register

There is no representation for floating point numbers in the Modbus specification. But as a matter of principle any desired data structure can be casted to a sequence of 16Bit registers.

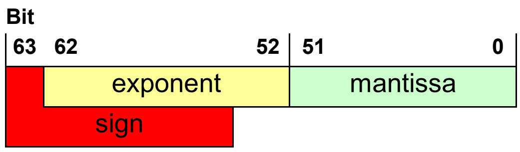
The IEEE 754 standard as the most often used standard for the representation of floating numbers is applied. 32- and 64-bit numbers are used:

- The first register contains the bits 0 – 15
- The second register contains the bits 16 – 31
- The third register contains the bits 32 – 47
- The fourth register contains the bits 48 – 63

32-Bit Float (REAL32)



64-Bit Float (REAL64)



Example: Reading voltage U1N on register address 102 of device 17 (32-bit float)

Byte	Request		Answer	
1	Slave address	0x11 resp. 0xFF	Slave address	0x11 resp. 0xFF
2	Function code	0x03	Function code	0x03
3	Start address (102-1)	0x00	Byte Count	0x04
4		0x65	Byte 1	**0xE8**
5	Number of registers: 2	0x00	Byte 2	**0x73**
6		0x02	Byte 3	**0x43**
7	Checksum CRC16	crc_l	Byte 4	**0x6A**
8		crc_h	Checksum CRC16	crc_l
9				crc_h

for Modbus/RTU only

0x436A																**0xE873**															
0	1	0	0	0	0	1	1	0	1	1	0	1	0	1	0	1	1	1	0	1	0	0	0	0	1	1	1	0	0	1	1
+	Exponent: 134-127=**7**								Mantissa=1.11010101110100001110011b=**1,8352187871932983d**																						

➢ **U1N** = +2^7 * 1,8352187871932983 **= 234,908V**

2 Mapping

2.1 Address space

The address space may be divided in 4 address spaces in accordance with the 4 data types.

Space	Access	Function code	
Coil / 0x	readable / writable	0x01 0x05 0x0F	Read Coil Status Force Single Coil Force Multiple Coils
Discrete input / 1x	read only	0x02	Read Input Status [1)]
Input register / 3x	read only	0x04	Read Input Register [1)]
Holding register / 4x	readable / writable	0x03 0x06 0x10	Read Holding Register Force Single Register [1)] Preset Multiple Register

1) not implemented

2.2 Used addresses

4x addresses	# Reg.	Description	Access
9990	2	Control register for resetting energy meters	W
9992	2	Control register for deleting the energy meter data logger	W
9994	2	Control register for deleting the mean-values data logger	W
		Data for 1st PME measurement system	
10000 – 10071	72	- Instantaneous values	R
10080 – 10151	72	- Mean-values	R
10152 – 10223	72	- Minimum RMS values within the averaging interval	R
10224 – 10295	72	- Maximum RMS values within the averaging interval	R
10300 – 10315	16	- Energy meters	R
10330 – 10345	16	- Sensor information	R

Access: R = readable, W = writable

Data of the further PME measurement systems can be accessed with an offset of +350 each. Thus, for example, the instantaneous value block of the 5th PME measuring system begins at address 11400.

2.3 Used syntax

Address 4x	Start address of described data block (Register)
Name	Unique name of a variable or structure
Type	**Data type of variable** REAL32 (32-bit float) REAL64 (64-bit float) INT32 (32-bit integer)
Description	Description of the quantity
2LN | **3L** | **4L** | **4LN**	Availability of the measured quantities, depending on the monitored grid load **2LN** = 3-wire load in a split phase system, with neutral current measurement **3L** = 3-phase load, unbalanced load **4L** = 4-wire load, unbalanced load, without neutral current measurement **4LN** = 4-wire load, unbalanced load, with neutral current measurement

3 Device information

3.1 Device identification

The type of the connected device may be identified using the function ***Report Slave ID*** (0x11).

Device address	Function	CRC	
ADDR	0x11	Low-Byte	High-Byte

Device answer:

Device address	Function	#Bytes	Device ID	Data1	Data2	CRC	
ADDR	0x11	3	<sid>			Low-Byte	High-Byte

0x01	0x00	VR660	Temperature controller
0x02	0x00	A200R	Display unit temperature controller
0x03	0x01	CAM	Measurement unit power quantities
0x04	0xFF	APLUS	Multifunctional display unit
0x05	0x00	V604s	Universal transmitter
0x05	0x01	VB604s	Universal transmitter
0x05	0x02	VC604s	Universal transmitter
0x05	0x03	VQ604s	Universal transmitter
0x07	0x00	VS30	Temperature transmitter
0x08	0x00	DM5S	Multi-transducer DM5S
0x08	0x01	DM5F	Multi-transducer DM5F
0x0A	0xFF	HW730	Angular transmitter
0x0B	0xFF	AM1000	Multifunctional display unit
0x0C	0xFF	AM2000	Multifunctional display unit
0x0D	0xFF	AM3000	Multifunctional display unit
0x0E	0xFF	PQ3000	Power quality display unit
0x0F	0xFF	PQ5000	Power quality measurement unit
0x10	0xFF	DM5000	Measurement unit power quantities
0x11	0xFF	CU3000	Multif. display unit with CODESYS
0x12	0xFF	CU5000	Multif. measurement unit with CODESYS
0x13	0xFF	PQ1000	Power quality display unit
0x1F	0xFF	PQ5000-MOBILE	Mobile power system analysis unit
0x25	0xFF	PQ5000R	Power quality measurement unit
0x26	0xFF	PQ1000	Power quality measurement unit
0x29	0xFF	PQ5000CL	Power quality measurement unit

The value for Data2 is reserved for future extensions.

4 Measurements

All access information given in this chapter are related to the first user-defined PME measurement system.

The data of the further PME measurement systems can be accessed with an **offset of +350** each. Thus, for example, active power for the 2nd PME measuring system is available via address 10350.

4.1 Instantaneous values of PME measurement systems

The below table contains the available instantaneous values of the first PME measurement system.

Address 4x	Name	2LN	3L	4L	4LN	Type	Description
10000	P	●	●	●	●	REAL32	Active power system [W]
10002	Q	●	●	●	●	REAL32	Reactive power system [var]
10004	S	●	●	●	●	REAL32	Apparent power system [VA]
10006	Q(H1)	●	●	●	●	REAL32	Fundamental reactive power system [var]
10008	PF	●	●	●	●	REAL32	P / S, Power factor system
10010	CPHI	●	●	●	●	REAL32	P_{H1} / S_{H1}, active power factor of fundamental, system
10012	I1	●	●	●	●	REAL32	Current in phase L1 [A]
10014	I2	●	●	●	●		Current in phase L2 [A]
10016	I3	-	●	●	●		Current in phase L3 [A]
10018	IN	●	-	-	●		Neutral current [A]
10020	THD1	●	●	●	●	REAL32	Total Harmonic Distortion I1 [%]
10022	THD2	●	●	●	●		Total Harmonic Distortion I2 [%]
10024	THD3	-	●	●	●		Total Harmonic Distortion I3 [%]
10026	THDN	●	-	-	●		Total Harmonic Distortion IN [%]
10028	TDD1	●	●	●	●	REAL32	Total Demand Distortion I1 [%]
10030	TDD2	●	●	●	●		Total Demand Distortion I2 [%]
10032	TDD3	-	●	●	●		Total Demand Distortion I3 [%]
10034	TDDN	●	-	-	●		Total Demand Distortion IN [%]
10036	P1	●	-	●	●	REAL32	Active power phase 1 (L1 – N) [W]
10038	P2	●	-	●	●		Active power phase 2 (L2 – N) [W]
10040	P3	-	-	●	●		Active power phase 3 (L3 – N) [W]
10042	Q1	●	-	●	●	REAL32	Reactive power phase 1 (L1 – N) [var]
10044	Q2	●	-	●	●		Reactive power phase 2 (L2 – N) [var]
10046	Q3	-	-	●	●		Reactive power phase 3 (L3 – N) [var]
10048	S1	●	-	●	●	REAL32	Apparent power system [VA]
10050	S2	●	-	●	●		Apparent power phase 1 (L1 – N) [VA]
10052	S3	-	-	●	●		Apparent power phase 2 (L2 – N) [VA]
10054	Q1(H1)	●	-	●	●	REAL32	Fundamental reactive power, phase 1 (L1 – N) [var]
10056	Q2(H1)	●	-	●	●		Fundamental reactive power, phase 2 (L2 – N) [var]
10058	Q3(H1)	-	-	●	●		Fundamental reactive power, phase 3 (L3 – N) [var]
10060	PF1	●	-	●	●	REAL32	P1 / S1, active power factor L1
10062	PF2	●	-	●	●		P2 / S2, active power factor L2
10064	PF3	-	-	●	●		P3 / S3, active power factor L3
10066	CPHI1	●	-	●	●	REAL32	$P1_{H1}$ / $S1_{H1}$, active power factor of fundamental L1
10068	CPHI2	●	-	●	●		$P2_{H1}$ / $S2_{H1}$, active power factor of fundamental L2
10070	CPHI3	-	-	●	●		$P3_{H1}$ / $S3_{H1}$, active power factor of fundamental L3

The measurements are related to the current or power demand of the monitored feeder. The term system therefore describes the total of all values, which can be determined by means of a PME measurement system.

4.2 Mean-values of PME measurement systems

The below table contains the available

- Mean-values of the last averaging interval
- Minimum values (RMS) within the last averaging interval
- Maximum values (RMS) within the last averaging interval

for the first PME measurement system.

Address 4x			Base	2LN	3L	4L	4LN	Type	Description of base quantity
average	min	max							
10080	10152	10224	P	●	●	●	●	REAL32	Active power system [W]
10082	10154	10226	Q	●	●	●	●	REAL32	Reactive power system [var]
10084	10156	10228	S	●	●	●	●	REAL32	Apparent power system [VA]
10086	10158	10230	Q(H1)	●	●	●	●	REAL32	Fundamental reactive power system [var]
10088	10160	10232	PF	●	●	●	●	REAL32	P / S, Power factor system
10090	10162	10234	CPHI	●	●	●	●	REAL32	P_{H1} / S_{H1}, active power factor of fundamental, system
10092	10164	10236	I1	●	●	●	●		Current in phase L1 [A]
10094	10166	10238	I2	●	●	●	●	REAL32	Current in phase L2 [A]
10096	10168	10240	I3	-	●	●	●		Current in phase L3 [A]
10098	10170	10242	IN	●	-	-	●		Neutral current [A]
10100	10172	10244	THD1	●	●	●	●		Total Harmonic Distortion I1 [%]
10102	10174	10246	THD2	●	●	●	●	REAL32	Total Harmonic Distortion I2 [%]
10104	10176	10248	THD3	-	●	●	●		Total Harmonic Distortion I3 [%]
10106	10178	10250	THDN	●	-	-	●		Total Harmonic Distortion IN [%]
10108	10180	10252	TDD1	●	●	●	●		Total Demand Distortion I1 [%]
10110	10182	10254	TDD2	●	●	●	●	REAL32	Total Demand Distortion I2 [%]
10112	10184	10256	TDD3	-	●	●	●		Total Demand Distortion I3 [%]
10114	10186	10258	TDDN	●	-	-	●		Total Demand Distortion IN [%]
10116	10188	10260	P1	●	-	●	●		Active power phase 1 (L1 – N) [W]
10118	10190	10262	P2	●	-	●	●	REAL32	Active power phase 2 (L2 – N) [W]
10120	10192	10264	P3	-	-	●	●		Active power phase 3 (L3 – N) [W]
10122	10194	10266	Q1	●	-	●	●		Reactive power phase 1 (L1 – N) [var]
10124	10196	10268	Q2	●	-	●	●	REAL32	Reactive power phase 2 (L2 – N) [var]
10126	10298	10270	Q3	-	-	●	●		Reactive power phase 3 (L3 – N) [var]
10128	10200	10272	S1	●	-	●	●		Apparent power system [VA]
10130	10202	10274	S2	●	-	●	●	REAL32	Apparent power phase 1 (L1 – N) [VA]
10132	10204	10276	S3	-	-	●	●		Apparent power phase 2 (L2 – N) [VA]
10134	10206	10278	Q1(H1)	●	-	●	●		Fundamental reactive power, phase 1 (L1 – N) [var]
10136	10208	10280	Q2(H1)	●	-	●	●	REAL32	Fundamental reactive power, phase 2 (L2 – N) [var]
10138	10210	10282	Q3(H1)	-	-	●	●		Fundamental reactive power, phase 3 (L3 – N) [var]
10140	10212	10284	PF1	●	-	●	●		P1 / S1, active power factor L1
10142	10214	10286	PF2	●	-	●	●	REAL32	P2 / S2, active power factor L2
10144	10216	10288	PF3	-	-	●	●		P3 / S3, active power factor L3
10146	10218	10290	CPHI1	●	-	●	●		$P1_{H1}$ / $S1_{H1}$, active power factor of fundamental L1
10148	10220	10292	CPHI2	●	-	●	●	REAL32	$P2_{H1}$ / $S2_{H1}$, active power factor of fundamental L2
10150	10222	10294	CPHI3	-	-	●	●		$P3_{H1}$ / $S3_{H1}$, active power factor of fundamental L3

The measurements are related to the current or power demand of the monitored feeder. The term system therefore describes the total of all values, which can be determined by means of a PME measurement system.

4.3 Energy meters of PME measurement systems

The below table contains the available meters of the first PME measurement system.

Address 4x	Name	2LN	3L	4L	4LN	Type	Description
10300	P_I_IV	●	●	●	●	REAL64	Active energy QI+IV [Wh]
10304	P_II_III	●	●	●	●	REAL64	Active energy QII+III [Wh]
10308	Q_I_II	●	●	●	●	REAL64	Reactive energy QI+II [varh]
10312	Q_III_IV	●	●	●	●	REAL64	Reactive energy QIII+IV [varh]

4.4 Sensor information of PME measurement systems

The below table contains the sensor information of the first PME measurement system.

Address 4x	Name	2LN	3L	4L	4LN	Type	Description
10330	TEMP_SENS1	●	●	●	●	REAL32	Temperature in sensor 1 [°C]
10332	CAP_SENS1	●	●	●	●	REAL32	Battery capacity sensor 1 [%]
10334	TEMP_SENS2	●	●	●	●	REAL32	Temperature in sensor 2 [°C]
10336	CAP_SENS2	●	●	●	●	REAL32	Battery capacity sensor 2 [%]
10338	TEMP_SENS3	●	●	●	●	REAL32	Temperature in sensor 3 [°C]
10340	CAP_SENS3	●	●	●	●	REAL32	Battery capacity sensor 3 [%]
10342	TEMP_SENS4	-	-	-	●	REAL32	Temperature in sensor 4 [°C]
10344	CAP_SENS4	-	-	-	●	REAL32	Battery capacity sensor 4 [%]

5 Resetting energy meters

The meters of the PME measurement systems can be reset to 0 selectively or collectively, by setting the register METER_RESET to a value. After executing the reset, the register is automatically reset.

Address 4x	Name	Type	Value
9990	METER_RESET	INT32	-1 Reset the meter contents of all PME measurement systems 1 Reset the meter contents of PME measurement system 1 2 Reset the meter contents of PME measurement system 2 ….. 100 Reset the meter contents of PME measurement system 100

6 Deleting data recordings

Recordings of the meter and mean-value loggers of the PME measurement systems can be deleted selectively or collectively, by setting the associated register to a value. After executing the deletion, the register is automatically reset.

Address 4x	Name	Type	Value
9992	LOG_MTR_RESET	INT32	-1 Delete the meter logger of all PME measurement systems 1 Delete the meter logger of PME measurement system 1 2 Delete the meter logger of PME measurement system 2 ….. 100 Delete the meter logger of PME measurement system 100

Address 4x	Name	Type	Value
9994	LOG_AVG_RESET	INT32	-1 Delete mean-value logger of all PME measurement systems 1 Delete mean-value logger of PME measurement system 1 2 Delete mean-value logger of PME measurement system 2 ….. 100 Delete mean-value logger of PME measurement system 100