10. Modbus Register Map

This chapter provides a complete description of the Modbus register (protocol version 6.0) for the PEM555 series to facilitate access to information. In general, the registers are implemented as Modbus Read Only Registers (RO = read only). with the exception of the DO control registers, which are implemented as Write Only Registers (WO = write only).
The PEM555 supports the 4-digit addressing scheme and the following Modbus functions.

1. Holding register for reading values
   (Read Holding Register; function code 0x03)
2. Register for DO status setup
   (Force Single Coil; function code 0x05)
3. Register for device programming
   (Preset Multiple Registers; function code 0x10)
4. General read reference
   (Read General Reference; function code 0x14)

For a complete Modbus protocol specification, visit http://www.modbus.org.

Explanatory comments relating to the read reference (function code 0x14)
The Modbus function code "0x14" is used to access data from the

- data recorder (DR log)
- energy log
- Waveform recorder (WFR log)

Data packet structure (function code 0x14)

Read reference request packet (master to PEM)		Read reference response packet (PEM to master)	
Slave address	1 byte	Slave address	1 byte
Function code (0x14)	1 byte	Function code (0x14)	1 byte
Byte count	1 byte	Byte count	1 byte
Sub-Req X, reference type (0x06)	1 byte	Sub-Res X, byte count	1 byte
Sub-Req X, File number	2 bytes	Sub-Res X, Reference type (0x06)	1 byte
Sub-Req X, Start address	2 bytes	Sub-Res X, Register data	NxN_0 bytes
Sub-Req X, Register count	2 bytes	Sub-Res X+1…	
Sub-Req X+1…			
Error check	2 bytes	Error check	2 bytes

Table 10.1: Data packet structure (function code 0x14)

10.1 Basic measurements

Register	Property	Description	Format	Scale/unit
0000	RO	U_{L1} 1)	Float	V
0002	RO	U_{L2} 1)	Float	V
0004	RO	U_{L3} 1)	Float	V
0006	RO	Ø U_{LN}	Float	V
0008	RO	U_{L1L2}	Float	V
0010	RO	U_{L2L3}	Float	V
0012	RO	U_{L3L1}	Float	V
0014	RO	Ø U_{LL}	Float	V
0016	RO	I_1	Float	A
0018	RO	I_2	Float	A
0020	RO	I_3	Float	A
0022	RO	Ø I	Float	A
0024	RO	P_{L1} 1)	Float	W
0026	RO	P_{L2} 1)	Float	W
0028	RO	P_{L3} 1)	Float	W
0030	RO	P_{ges}	Float	W
0032	RO	Q_{L1} 1)	Float	var
0034	RO	Q_{L2} 1)	Float	var
0036	RO	Q_{L3} 1)	Float	var
0038	RO	Q_{ges}	Float	var
0040	RO	S_{L1} 1)	Float	VA
0042	RO	S_{L2} 1)	Float	VA
0044	RO	S_{L3} 1)	Float	VA
0046	RO	S_{ges}	Float	VA
0048	RO	λ_{L1} 1)	Float	

Register	Property	Description	Format	Scale/unit
0050	RO	λ_{L2} [1]	Float	
0052	RO	λ_{L3} [1]	Float	
0054	RO	λ_{ges}	Float	
0056	RO	*f*	Float	Hz
0058	RO	I_4 (measured)	Float	A
0060	RO	I_0 (= I_4 calculated)	Float	A
0062…0069	Reserved			
0070	RO	Unbalance *U*	UINT16	x 1,000[2]
0071	RO	Unbalance *I*	UINT16	x 1,000
0072…0075	Reserved			
0076	RO	Phase angle U_{L1}	UINT16	x 100, °
0077	RO	Phase angle U_{L2}	UINT16	x 100, °
0078	RO	Phase angle U_{L3}	UINT16	x 100, °
0079	RO	Phase angle I_1	UINT16	x 100, °
0080	RO	Phase angle I_2	UINT16	x 100, °
0081	RO	Phase angle I_3	UINT16	x 100, °
0082…0084	Reserved			
0085	RO	Status digital inputs [3]	UINT16	
0086	RO	Status digital outputs [4]	UINT16	
0087	RO	Alarm [5]	UINT32	
0089	RO	SOE Pointer [6]	UINT32	
0091	Reserved			
0093	RO	WFR1 Log Pointer7]	UINT32	
0095	RO	WFR2 Log Pointer7]	UINT32	
0097	RO	Energy Log Pointer 8]	UINT32	
0099	RO	DR1 Pointer [9]	UINT32	
0101	RO	DR2 Pointer [9]	UINT32	
0103	RO	DR3 Pointer [9]	UINT32	

Register	Property	Description	Format	Scale/unit
0105	RO	DR4 Pointer [9)]	UINT32	
0107	RO	DR5 Pointer [9)]	UINT32	
…				
0129	RO	DR16 Pointer [9)]	UINT32	
0131	RO	Total memory r[10)]	UINT32	
0133	RO	Available memory [10)]	UINT32	

Table 10.2: Basic measurements

Notes on table 10.2:

1) Only in the case of **wye connection** (WYE).

2) "x 1,000" means that the value returned by the register is 1000 times the measured value (the measured value can be determined by dividing the value of the register 1000).

3) Status register 0085:
Represents the **status of the six digital inputs**
B0 B5 for DI1 DI6 (1 = active/closed; 0 = inactive/opened)

4) Status register 0086:
Represents the **status of the three digital outputs**
B0 for DO1 (1 = active/closed; 0 = inactive/opened)
B1 for DO2 (1 = active/closed; 0 = inactive/opened)
B2 for DO3 (1 = active/closed; 0 = inactive/opened)

5) The **alarm register 0087** indicates the various alarm statuses (1 = active, 0 = inactive). Details of the alarm register are shown in the following table:

Bit No.	Alarm by event
B0	Setpoint 1
B1	Setpoint 2
B2	Setpoint 3
B3	Setpoint 4
B4	Setpoint 5
B5	Setpoint 6
B6	Setpoint 7
B7	Setpoint 8
B8	Setpoint 9
B9…B31	Reserved

Table 10.3: Bit sequence alarm register (0087)

6) The SOE pointer points to the last entry added. The event log can store up to 64 events. It works like a ring buffer according to the FIFO principle: The 65th value overwrites the first value, the 66th the second one and so on. The event log can be reset in the setup parameter menu (see page 44).

7) The PEM555 utilises two waveform recorders (**WFR**). Each WFR has its own pointer that indicates the most recently added entry in each case. The two WFR together can store up to 6 events. It works like a ring buffer according to the FIFO principle: the 7th entry overwrites the first value, the 8th the second one and so on. The WFR log can be reset via the communications interface.

8) The range of the **Energy Log Pointer** can be between 0 and 0xFFFFFFFF. As soon as the maximum value is reached, it starts again with 0. The Energy Log can always be reset via the communications interface.

9) The PEM555 provides 16 data recorders (DR1…DR16). Each DR has its own pointer that points to the last entry in each case. Each DR can be reset via the communications interface.

10) The total memory size of the PEM555 is 2 MB (2048 kB).
Used memory = 2048 kB - Available memory.

10.2 Energy measurement

Register	Property	Description	Format	Unit
0200	RW	Active energy import	UINT32	kWh
0202	RW	Active energy export	UINT32	kWh
0204	RO	Active energy net amount	INT32	kWh
0206	RO	Total active energy	UINT32	kWh
0208	RW	Reactive energy import	UINT32	kvarh
0210	RW	Reactive energy export	UINT32	kvarh
0212	RO	Reactive energy net amount	INT32	kvarh
0214	RO	Total reactive energy	UINT32	kvarh
0216	RW	Apparent energy	UINT32	kVAh
0218	RO	Reactive energy import, fractional value	Float	Ws
0220	RO	Active energy export, fractional value	Float	Ws
0222	RO	Active energy net value	Float	Ws
0224	RO	Total active energy value	Float	Ws
0226	RO	Reactive energy import value	Float	vars
0228	RO	Reactive energy export value	Float	vars
0230	RO	Reactive energy net value	Float	vars
0232	RO	Total amount of reactive energy	Float	vars
0234	RO	Apparent energy, fractional value	Float	VAs

Table 10.4: Energy measurements

Note:
After reaching the maximum value of 999.999.999 kWh/kvarh/kVAh, the measurement starts again with 0.

10.3 Pulse counter

The value stored in the registers **0350…0360** is 1000 times the actual value, i. e. the measured value can be determined by dividing the register value by 1000.

Register	Property	Description	Format
0350	RW	Pulse counter DI1	UINT32
0352	RW	Pulse counter DI2	UINT32
0354	RW	Pulse counter DI3	UINT32
0356	RW	Pulse counter DI4	UINT32
0358	RW	Pulse counter DI5	UINT32
0360	RW	Pulse counter DI6	UINT32

Table 10.5: Pulse counter

10.4 Fundamental measurement (PQ log)

Register	Property	Description	Format	Unit
0450	RO	$\lambda_{L1\ (f0)}$ [1)]	Float	
0452	RO	$\lambda_{L2\ (f0)}$ [1)]	Float	
0454	RO	$\lambda_{L3\ (f0)}$ [1)]	Float	
0456	RO	$\lambda_{ges\ (f0)}$	Float	
0458	RO	k-factor I_1	UINT16	x 10
0459	RO	k-factor I_2	UINT16	x 10
0460	RO	k-factor I_3	UINT16	x 10
0461	RO	THD_{UL1}	UINT16	x 10,000
0462	RO	THD_{UL2}	UINT16	x 10,000
0463	RO	THD_{UL3}	UINT16	x 10,000
0464	RO	THD_{I1}	UINT16	x 10,000
0465	RO	THD_{I2}	UINT16	x 10,000
0466	RO	THD_{I3}	UINT16	x 10,000

Register	Property	Description	Format	Unit
0467	RO	THD_{I4} 2)or reserved	UINT16	x 10,000
0468	RO	$TOHD_{UL1}$	UINT16	x 10,000
0469	RO	$TOHD_{UL2}$	UINT16	x 10,000
0470	RO	$TOHD_{UL3}$	UINT16	x 10,000
0471	RO	$TOHD_{I1}$	UINT16	x 10,000
0472	RO	$TOHD_{I2}$	UINT16	x 10,000
0473	RO	$TOHD_{I3}$	UINT16	x 10,000
0474	RO	$TOHD_{I4}$ 2)or reserved	UINT16	x 10,000
0475	RO	$TEHD_{UL1}$	UINT16	x 10,000
0476	RO	$TEHD_{UL2}$	UINT16	x 10,000
0477	RO	$TEHD_{UL3}$	UINT16	x 10,000
0478	RO	$TEHD_{I1}$	UINT16	x 10,000
0479	RO	$TEHD_{I2}$	UINT16	x 10,000
0480	RO	$TEHD_{I3}$	UINT16	x 10,000
0481	RO	$TEHD_{I4}$ 2)or reserved	UINT16	x 10,000
0482	RO	U_{L1} 2^{nd}. harmonic	UINT16	x 10,000
0483	RO	U_{L2} 2^{nd} harmonic	UINT16	x 10,000
0484	RO	U_{L3} 2^{nd} harmonic	UINT16	x 10,000
0485	RO	I_1 2^{nd} harmonic	UINT16	x 10,000
0486	RO	I_2 2^{nd} harmonic	UINT16	x 10,000
0487	RO	I_3 2^{nd} harmonic	UINT16	x 10,000
0488	RO	I_4 2^{nd} harmonic 2) or reserved	UINT16	x 10,000
…	RO	…	UINT16	x 10,000

Register	Property	Description	Format	Unit
0685	RO	U_{L1} 31st harmonic	UINT16	x 10,000
0686	RO	U_{L2} 31st harmonic	UINT16	x 10,000
0687	RO	U_{L3} 31st harmonic	UINT16	x 10,000
0688	RO	I_1 31st harmonic	UINT16	x 10,000
0689	RO	I_2 31st harmonic	UINT16	x 10,000
0690	RO	I_3 31st harmonic	UINT16	x 10,000
0691	RO	I_4 31st harmonic 2) or reserved	UINT16	x 10,000

Table 10.6: Harmonic measurements

Notes on table 10.6:

1) Only in the case of wye connection (WYE). Related to fundamental f_0.

2) only if the device is equipped with the I_4 input, otherwise it is reserved.

10.5 Demand

10.5.1 Present demand

Register	Property	Description	Format	Unit
1000	RO	Demand U_{L1}	INT32	x 100, V
1002	RO	Demand U_{L2}	INT32	x 100, V
1004	RO	Demand U_{L3}	INT32	x 100, V
1006	RO	Ø Demand U_{LN}	INT32	x 100, V
1008	RO	Demand U_{L1L2}	INT32	x 100, V
1010	RO	Demand U_{L2L3}	INT32	x 100, V
1012	RO	Demand U_{L3L1}	INT32	x 100, V
1014	RO	Ø Demand U_{LL}	INT32	x 100, V
1016	RO	Demand I_1	INT32	x 1,000 A
1018	RO	Demand I_2	INT32	x 1,000 A
1020	RO	Demand I_3	INT32	x 1,000 A
1022	RO	Ø Demand I	INT32	x 1,000 A
1024	RO	Demand I_4 [1)] or reserved	INT32	x 1,000 A
1026	RO	Demand P_{L1}	INT32	W
1028	RO	Demand P_{L2}	INT32	W
1030	RO	Demand P_{L3}	INT32	W
1032	RO	Demand P_{ges}	INT32	W
1034	RO	Demand Q_{L1}	INT32	var
1036	RO	Demand Q_{L2}	INT32	var
1038	RO	Demand Q_{L3}	INT32	var
1040	RO	Demand Q_{ges}	INT32	var
1042	RO	Demand S_{L1}	INT32	VA
1044	RO	Demand S_{L2}	INT32	VA
1046	RO	Demand S_{L3}	INT32	VA
1048	RO	Demand S_{ges}	INT32	VA

Register	Property	Description	Format	Unit
1050	RO	Demand λ_1	INT32	x 1,000
1052	RO	Demand λ_2	INT32	x 1,000
1054	RO	Demand λ_3	INT32	x 1,000
1056	RO	Demand λ_{ges}	INT32	x 1,000
1058	RO	Demand *f*	INT32	x 100, Hz
1060	RO	Demand unbalance *U*	INT32	x 1,000
1062	RO	Demand unbalance *I*	INT32	x 1,000
1064	RO	Demand THD_{UL1}	INT32	x 10,000
1066	RO	Demand THD_{UL2}	INT32	x 10,000
1068	RO	Demand THD_{UL3}	INT32	x 10,000
1070	RO	Demand THD_{I1}	INT32	x 10,000
1072	RO	Demand THD_{I2}	INT32	x 10,000
1074	RO	Demand THD_{I3}	INT32	x 10,000

Table 10.7: Register: Present demands

1) Only if the device is equipped with the I_4 input, otherwise it is reserved

10.5.2 Maximum values per demand period

Register	Property	Description	Format	Unit
1400	RO	$U_{L1\ max}$	INT32	x 100, V
1402	RO	$U_{L2\ max}$	INT32	x 100, V
1404	RO	$U_{L3\ max}$	INT32	x 100, V
1406	RO	Ø $U_{LN\ max}$	INT32	x 100, V
1408	RO	$U_{L1L2\ max}$	INT32	x 100, V
1410	RO	$U_{L2L3\ max}$	INT32	x 100, V
1412	RO	$U_{L3L1\ max}$	INT32	x 100, V
1414	RO	Ø $U_{LL\ max}$	INT32	x 100, V
1416	RO	$I_{1\ max}$	INT32	x 1,000 A

Register	Property	Description	Format	Unit
1418	RO	$I_{2\ max}$	INT32	x 1,000 A
1420	RO	$I_{3\ max}$	INT32	x 1,000 A
1422	RO	Ø I_{max}	INT32	x 1,000 A
1424	RO	$I_{4\ max}$ [1)] or reserved	INT32	x 1,000 A
1426	RO	$P_{L1\ max}$	INT32	W
1428	RO	$P_{L2\ max}$	INT32	W
1430	RO	$P_{L3\ max}$	INT32	W
1432	RO	$P_{ges\ max}$	INT32	W
1434	RO	$Q_{L1\ max}$	INT32	var
1436	RO	$Q_{L2\ max}$	INT32	var
1438	RO	$Q_{L3\ max}$	INT32	var
1440	RO	$Q_{ges\ max}$	INT32	var
1442	RO	$S_{L1\ max}$	INT32	VA
1444	RO	$S_{L2\ max}$	INT32	VA
1446	RO	$S_{L3\ max}$	INT32	VA
1448	RO	$S_{ges\ max}$	INT32	VA
1450	RO	$\lambda_{1\ max}$	INT32	x 1,000
1452	RO	$\lambda_{2\ max}$	INT32	x 1,000
1454	RO	$\lambda_{3\ max}$	INT32	x 1,000
1456	RO	$\lambda_{ges\ max}$	INT32	x 1,000
1458	RO	f_{max}	INT32	x 100, Hz
1460	RO	max. unbalance *U*	INT32	x 1,000
1462	RO	max. unbalance *I*	INT32	x 1,000
1464	RO	$THD_{UL1\ max}$	INT32	x 10,000
1466	RO	$THD_{UL2\ max}$	INT32	x 10,000
1468	RO	$THD_{UL3\ max}$	INT32	x 10,000

Register	Property	Description	Format	Unit
1470	RO	$THD_{I1\ max}$	INT32	x 10,000
1472	RO	$THD_{I2\ max}$	INT32	x 10,000
1474	RO	$THD_{I3\ max}$	INT32	x 10,000

Table 10.8: Maximum values per demand period

1) **Register 1424** is valid only if the device is equipped with the I_4 input, otherwise it is reserved.

10.5.3 Minimum values per demand period

Register	Property	Description	Format	Unit
1600	RO	$U_{L1\ min}$	INT32	x 100, V
1602	RO	$U_{L2\ min}$	INT32	x 100, V
1604	RO	$U_{L3\ min}$	INT32	x 100, V
1606	RO	Ø $U_{LN\ min}$	INT32	x 100, V
1608	RO	$U_{L1L2\ min}$	INT32	x 100, V
1610	RO	$U_{L2L3\ min}$	INT32	x 100, V
1612	RO	$U_{L3L1\ min}$	INT32	x 100, V
1614	RO	Ø $U_{LL\ min}$	INT32	x 100, V
1616	RO	$I_{1\ min}$	INT32	x 1,000 A
1618	RO	$I_{2\ min}$	INT32	x 1,000 A
1620	RO	$I_{3\ min}$	INT32	x 1,000 A
1622	RO	Ø I_{min}	INT32	x 1,000 A
1624	RO	$I_{4\ min}$ [1] or reserved	INT32	x 1,000 A
1626	RO	$P_{L1\ min}$	INT32	W
1628	RO	$P_{L2\ min}$	INT32	W
1630	RO	$P_{L3\ min}$	INT32	W
1632	RO	$P_{ges\ min}$	INT32	W

Register	Property	Description	Format	Unit
1634	RO	$Q_{L1\ min}$	INT32	var
1636	RO	$Q_{L2\ min}$	INT32	var
1638	RO	$Q_{L3\ min}$	INT32	var
1640	RO	$Q_{ges\ min}$	INT32	var
1642	RO	$S_{L1\ min}$	INT32	VA
1644	RO	$S_{L2\ min}$	INT32	VA
1646	RO	$S_{L3\ min}$	INT32	VA
1648	RO	$S_{ges\ min}$	INT32	VA
1650	RO	$\lambda_{1\ min}$	INT32	x 1,000
1652	RO	$\lambda_{2\ min}$	INT32	x 1,000
1654	RO	$\lambda_{3\ min}$	INT32	x 1,000
1656	RO	$\lambda_{ges\ min}$	INT32	x 1,000
1658	RO	f_{min}	INT32	x 100, Hz
1660	RO	min. unbalance *U*	INT32	x 1,000
1662	RO	min. unbalance *I*	INT32	x 1,000
1664	RO	$THD_{UL1\ min}$	INT32	x 10,000
1666	RO	$THD_{UL2\ min}$	INT32	x 10,000
1668	RO	$THD_{UL3\ min}$	INT32	x 10,000
1670	RO	$THD_{I1\ min}$	INT32	x 10,000
1672	RO	$THD_{I2\ min}$	INT32	x 10,000
1674	RO	$THD_{I3\ min}$	INT32	x 10,000

Table 10.9: Minimum values per demand period

1) **Register 1624** is valid only if the device is equipped with the I_4 input, otherwise it is reserved.

10.5.4 Peak demand of this month

The value of the peak demand register is 1000 times the actual value. To obtain a value in kW, kVA or kvar, the value of the register has to be divided by 1,000.

Register	Property	Description	Format	Unit
1800…1805	RO	Peak demand P_{ges} of this month	see table 10.12	W
1806…1811	RO	Peak demand Q_{ges} of this month		var
1812…1817	RO	Peak demand S_{ges} of this month		VA
1818…1823	RO	Peak demand I_1 of this month		x 1,000 A
1824…1829	RO	Peak demand I_2 of this month		x 1,000 A
1830…1835	RO	Peak demand I_3 of this month		x 1,000 A

Table 10.10: Peak demand of this month

10.5.5 Peak demand last month

The value of the peak demand register is 1.000 times the actual value. To obtain a value in kW, kVA or kvar, the value of the register has to be divided by 1,000.

Register	Property	Description	Format	Unit
1850…1855	RO	Peak demand P_{ges} *of* last month	see table 10.12	W
1856…1861	RO	Peak demand Q_{ges} of last month		var
1862…1867	RO	Peak demand S_{ges} of last month		VA
1868…1873	RO	Peak demand I_1 of last month		x 1,000 A
1874…1879	RO	Peak demand I_2 of last month		x 1,000 A
1880…1885	RO	Peak demand I_3 of last month		x 1,000 A

Table1011: Peak demand of last month

10.5.6 Peak demand data structure

Offset	Property	Description	Format	Note
+ 0	RO	Peak demand value	INT32	
+ 2	RO	HiWord: year	UINT16	1…99 (year-2000)
	RO	LoWord: month		1…12
+ 3	RO	HiWord: day	UINT16	1…28/29/30/31
	RO	LoWord: hour		0…23
+ 4	RO	HiWord: minute	UINT16	0…59
	RO	LoWord: Second		0…59
+ 5	RO	Milliseconds	UINT16	1…999

Table 10.12: Peak demand data structure

10.6 Max/Min log

10.6.1 Maximum values of this month

Register	Property	Description	Format	Factor/unit
2000…2005	RO	$U_{L1\ max}$	see table 10.17	x 100, V
2006…2011	RO	$U_{L2\ max}$		x 100, V
2012…2017	RO	$U_{L3\ max}$		x 100, V
2018…2023	RO	Ø $U_{LN\ max}$		x 100, V
2024…2029	RO	$U_{L1L2\ max}$		x 100, V
2030…2035	RO	$U_{L2L3\ max}$		x 100, V
2036…2041	RO	$U_{L3L1\ max}$		x 100, V
2042…2047	RO	Ø $U_{LL\ max}$		x 100, V
2048…2053	RO	$I_{1\ max}$		x 1,000 A
2054…2059	RO	$I_{2\ max}$		x 1,000 A
2060…2065	RO	$I_{3\ max}$		x 1,000 A
2066…2071	RO	Ø I_{max}		x 1,000 A

Register	Property	Description	Format	Factor/unit
2072…2077	RO	$I_{4\ max}$ [1] or reserved	see table 10.17	x 1,000 A
2078…2083	RO	$P_{ges\ max}$		W
2084…2089	RO	$Q_{ges\ max}$		var
2090…2095	RO	$S_{ges\ max}$		VA
2096…2101	RO	$\lambda_{ges\ max}$		x 1,000
2102…2107	RO	f_{max}		x 100, Hz
2108…2113	RO	$THD_{UL1\ max}$		x 10,000
2114…2119	RO	$THD_{UL2\ max}$		x 10,000
2120…2125	RO	$THD_{UL3\ max}$		x 10,000
2126…2131	RO	$THD_{I1\ max}$		x 10,000
2132…2137	RO	$THD_{I2\ max}$		x 10,000
2138…2143	RO	$THD_{I3\ max}$		x 10,000
2144…2149	RO	k-factor I_1		x 10
2150…2155	RO	k-factor I_2		x 10
2156…2161	RO	k-factor I_3		x 10
2162…2167	RO	max. unbalance *U*		x 1,000
2168…2173	RO	max. unbalance *I*		x 1,000

Table 10.13: Max log of this month

[1] **Register 2072…2077** are valid only if the device is equipped with the I_4 input, otherwise it is reserved

10.6.2 Min log of this month

Register	Property	Description	Format	Factor/unit
2300…2305	RO	$U_{L1\ min}$		x 100, V
2306…2311	RO	$U_{L2\ min}$		x 100, V
2312…2317	RO	$U_{L3\ min}$		x 100, V
2318…2323	RO	Ø $U_{LN\ min}$		x 100, V
2324…2329	RO	$U_{L1L2\ min}$		x 100, V
2330…2335	RO	$U_{L2L3\ min}$		x 100, V
2336…2341	RO	$U_{L3L1\ min}$		x 100, V
2342…2347	RO	Ø $U_{LL\ min}$		x 100, V
2348…2353	RO	$I_{1\ min}$		x 1,000 A
2354…2359	RO	$I_{2\ min}$		x 1,000 A
2360…2365	RO	$I_{3\ min}$		x 1,000 A
2366…2371	RO	Ø I_{min}		x 1,000 A
2372…2377	RO	$I_{4\ min}$ [1] or reserved	see table 10.17	x 1,000 A
2378…2383	RO	$P_{ges\ min}$		W
2384…2389	RO	$Q_{ges\ min}$		var
2390…2395	RO	$S_{ges\ min}$		VA
2396…2401	RO	$\lambda_{ges\ min}$		x 1,000
2402…2407	RO	f_{min}		x 100, Hz
2408…2413	RO	$THD_{UL1\ min}$		x 10,000
2414…2419	RO	$THD_{UL2\ min}$		x 10,000
2420…2425	RO	$THD_{UL3\ min}$		x 10,000
2426…2431	RO	$THD_{I1\ min}$		x 10,000
2432…2437	RO	$THD_{I2\ min}$		x 10,000
2438…2443	RO	$THD_{I3\ min}$		x 10,000
2444…2449	RO	k-factor I_1		x 10

Register	Property	Description	Format	Factor/unit
2450…2455	RO	k-factor I_2	see table 10.17	x 10
2456…2461	RO	k-factor I_3		x 10
2462…2467	RO	min. unbalance *U*		x 1,000
2468…2473	RO	min. unbalance *I*		x 1,000

Table 10.14: Min log of this month

1) **Register 2372…2377** are valid only if the device is equipped with the I_4 input, otherwise it is reserved.

10.6.3 Max log of last month

Register	Property	Description	Format	Factor/unit
2600…2605	RO	$U_{L1\ max}$	see table 10.17	x 100, V
2606…2611	RO	$U_{L2\ max}$		x 100, V
2612…2617	RO	$U_{L3\ max}$		x 100, V
2618…2623	RO	Ø $U_{LN\ max}$		x 100, V
2624…2629	RO	$U_{L1L2\ max}$		x 100, V
2630…2635	RO	$U_{L2L3\ max}$		x 100, V
2636…2641	RO	$U_{L3L1\ max}$		x 100, V
2642…2647	RO	Ø $U_{LL\ max}$		x 100, V
2648…2653	RO	$I_{1\ max}$		x 1,000 A
2654…2659	RO	$I_{2\ max}$		x 1,000 A
2660…2665	RO	$I_{3\ max}$		x 1,000 A
2666…2671	RO	Ø I_{max}		x 1,000 A
2672…2677	RO	$I_{4\ max}$ [1] or reserved		x 1,000 A
2678…2683	RO	$P_{ges\ max}$		W
2684…2689	RO	$Q_{ges\ max}$		var

2690…2695	RO	$S_{ges\ max}$	see table 10.17	VA
2696…2701	RO	$\lambda_{ges\ max}$		x 1,000
2702…2707	RO	f_{max}		x 100, Hz
2708…2713	RO	$THD_{UL1\ max}$		x 10,000
2714…2719	RO	$THD_{UL2\ max}$		x 10,000
2720…2725	RO	$THD_{UL3\ max}$		x 10,000
2726…2731	RO	$THD_{I1\ max}$		x 10,000
2732…2737	RO	$THD_{I2\ max}$		x 10,000
2738…2743	RO	$THD_{I3\ max}$		x 10,000
2744…2749	RO	k-factor I_1		x 10
2750…2755	RO	k-factor I_2		x 10
2756…2761	RO	k-factor I_3		x 10
2762…2767	RO	max. voltage unbalance		x 1,000
2768…2773	RO	max. current unbalance		x 1,000

Table 10.15: Max log of last month

1) **Register 2672…2677** are valid only if the device is equipped with the I_4 input, otherwise it is reserved

10.6.4 Min log last month

Register	Property	Description	Format	Factor/unit
2900…2905	RO	$U_{L1\ min}$	see table 10.17	x 100, V
2906…2911	RO	$U_{L2\ min}$		x 100, V
2912…2917	RO	$U_{L3\ min}$		x 100, V
2918…2923	RO	Ø $U_{LN\ min}$		x 100, V
2924…2929	RO	$U_{L1L2\ min}$		x 100, V
2930…2935	RO	$U_{L2L3\ min}$		x 100, V
2936…2941	RO	$U_{L3L1\ min}$		x 100, V
2942…2947	RO	Ø $U_{LL\ min}$		x 100, V

Register	Property	Description	Format	Factor/unit
2948…2953	RO	$I_{1\ min}$	see table 10.17	x 1,000 A
2954…2959	RO	$I_{2\ min}$		x 1,000 A
2960…2965	RO	$I_{3\ min}$		x 1,000 A
2966…2971	RO	Ø I_{min}		x 1,000 A
2972…2977	RO	$I_{4\ min}$ [1] or reserved		x 1,000 A
2978…2983	RO	$P_{ges\ min}$		W
2984…2989	RO	$Q_{ges\ min}$		var
2990…2995	RO	$S_{ges\ min}$		VA
2996…3001	RO	$\lambda_{ges\ min}$		x 1,000
3002…3007	RO	f_{min}		x 100, Hz
3008…3013	RO	$THD_{UL1\ min}$		x 10,000
3014…3019	RO	$THD_{UL2\ min}$		x 10,000
3020…3025	RO	$THD_{UL3\ min}$		x 10,000
3026…3031	RO	$THD_{I1\ min}$		x 10,000
3032…3037	RO	$THD_{I2\ min}$		x 10,000
3038…3043	RO	$THD_{I3\ min}$		x 10,000
3044…3049	RO	k-factor I_1		x 10
3050…3055	RO	k-factor I_2		x 10
3056…3061	RO	k-factor I_3		x 10
3062…3067	RO	min. unbalance *U*		x 1,000
3068…3073	RO	min. unbalance *I*		x 1,000

Table 10.16: Minimum log of last month

1) **Register 2972…2977** are valid only if the device is equipped with the I_4 input, otherwise it is reserved.

10.6.5 Max/Min log data structure

Offset	Property	Description	Format	Note
+ 0	RO	Max resp. Min value	INT32	
+ 2	RO	HiWord: Year	UINT16	1…99 (year-2000)
	RO	LoWord: month		1…12
+ 3	RO	HiWord: day	UINT16	1…28/29/30/31
	RO	LoWord: hour		0…23
+ 4	RO	HiWord: Minute	UINT16	0…59
	RO	LoWord: Second		0…59
+ 5	RO	Millisecond	UINT16	0…999

Table 10.17: Max/Min log data structure

10.7 Setup parameters

Register	Property	Description	Format	Range/unit
6000	RW	Transformation ratio, voltage transformer	UINT16	1*…10,000
6001	RW	Transformation ratio, measuring current transformer	UINT16	1*…6.000 (current input 5 A) 1*…30.000 (current input 1 A)
6002	RW	Transformation ratio, measuring current transformer I_4	UINT16	1*…10,000
6003	RW	Wiring mode	UINT16	0 = WYE* 1 = DELTA 2 = DEMO
6004	RW	U_{nom}	UINT16	100*…700 V (U_{LL})
6005	RW	f_{nom}	UINT16	0 = 50 Hz*; 1 = 60 Hz
6006	RW	Protocol interface 1 (RS-485)	UINT16	0* = Modbus 1 = EGATE
6007	RW	Device address interface 1 (RS-485)	UINT16	1…247 (100*)
6008	RW	Baud rate interface 1 (RS-485)	UINT16	0 = 1,200; 1 = 2,400 2 = 4,800; 3 = 9,600* 4 = 19,200; 5 = 38,400
6009	RW	Parity interface 1 (RS-485)	UINT16	0 = 8N2; 1 = 8O1 2 = 8E1* ; 3 = 8N1 4 = 8O2 ; 5 = 8E2
6010	RW	IP address	UINT32	192.168.0.100* Contents of register for factory setting: 0xC0A80064
6012	RW	Subnet mask	UINT32	288.255.255.0* Contents of register for factory setting: 0xFFFFFF00

Register	Property	Description	Format	Range/unit
6014	RW	Gateway address	UINT32	192.168.0.1* Contents of register for factory setting: 0x0A80001
6016	RW	Power factor λ rule	UINT16	0* = IEC; 1 = IEEE 2 = -IEEE
6017	RW	Calculation method *S*	UINT16	0* = vector 2 = scalar
6018	RW	Demand period	UINT16	1…60 minutes (15*)
6019	RW	Number of measurement periods (sliding windows)	UINT16	1*…15
6020	RW	Function DI1	UINT16	0 = digital input 1 = pulse counter 2 = SYNC DI 3 = PPS
6021	RW	Function DI2	UINT16	
6022	RW	Function DI3	UINT16	
6023	RW	Function DI4	UINT16	
6024	RW	Function DI5	UINT16	
6025	RW	Function DI6	UINT16	
6026	RW	Debounce time DI1	UINT16	1…1,000 ms (20*)
6027	RW	Debounce time DI2	UINT16	
6028	RW	Debounce time DI3	UINT16	
6029	RW	Debounce time DI4	UINT16	
6030	RW	Debounce time DI5	UINT16	
6031	RW	Debounce time DI6	UINT16	
6032	RW	Resolution of setting DI1	UINT32	1*…1,000,000
6034	RW	Resolution of setting DI2	UINT32	
6036	RW	Resolution of setting DI3	UINT32	
6038	RW	Resolution of setting DI4	UINT32	
6040	RW	Resolution of setting DI5	UINT32	
6042	RW	Resolution of setting DI6	UINT32	

Register	Property	Description	Format	Range/unit
6044	RW	Function DO1	UINT16	0*= digital output
6045	RW	Function DO2	UINT16	
6046	RW	Function DO3	UINT16	
6047…6050		Reserved		
6052	RW	Polarity measuring current transformer L1	UINT16	0* = normal 1 = reversed
6053	RW	Polarity measuring current transformer L2	UINT16	0* = normal 1 = reversed
6054	RW	Polarity measuring current transformer L3	UINT16	0* = normal 1 = reversed
6055	RW	Calculation method harmonic distortion***	UINT16	0 = Fundamental 1*= RMS
6056	RW	Enable energy pulse	UINT16	0*= disable 1 = enable
6057	RW	Pulse constant	UINT16	0* = 1,000 imp/kxh 1 = 3,200 imp/kxh 2 = 5,000 imp/kxh 3 = 6,400 imp/kxh 4 = 12,800 imp/kxh
6058		Reserved		
6059	RW	Enable transient events	UINT16	0*= disable 1 = enable
6060	RW	Limit for transient events [1)]	UINT16	5…100 (x 0.01 U_{nom}) (50*)
6061	RW	Backlight timeout	UINT16	0 = Display is always switched on 1…60 min (3*)

Table 10.18: Setup parameters

Notes table 10.18:

Register 6000 and 6001

Current input 5 A: Transformation ratio current x transformation ratio voltage < 1,000,000
Current input 1 A: Transformation ratio current x transformation ratio voltage < 5,000,000

[1)] **Register 6060** A transient event only triggers WFR1

10.8 Clear/reset register

Register	Property	Description	Format	Unit
6400	WO	Manual trigger WFR1	UINT16	Writing 0xFF00 to the register triggers the respective waveform recorder
6401	WO	Manual trigger WFR2	UINT16	
6402	WO	Clear DR1	UINT16	Writing 0xFF00 to the register clears the respective DR
6403	WO	Clear DR2	UINT16	
…				
6416	WO	Clear DR15	UINT16	
6417	WO	Clear DR16	UINT16	
6418	WO	Clear WFR1	UINT16	Writing 0xFF00 to the register clears the respective log
6419	WO	Clear WFR2	UINT16	
6420	WO	Clear energy log	UINT16	
6421	Reserved			
6422	WO	Clear event log	UINT16	
6423	WO	Clear energy register	UINT16	
6424	WO	Clear Max/Min log of this month	UINT16	
6425	WO	Clear peak demand log of this month	UINT16	
6426	WO	Clear counter DI1	UINT16	Writing 0xFF00 to the register clears the respective counter
6427	WO	Clear counter DI2	UINT16	
…				
6430	WO	Clear counter DI5	UINT16	
6431	WO	Clear counter DI6	UINT16	
6432…6436	Reserved			
6437	WO	Clear all logs (registers 6400…6431)	UINT16	Writing 0xFF00 to the register clears all logs mentioned above

Table 10.19: Clear/reset register

10.9 Register Setpoints

Register	Property	Description	Format
6600…6609	RW	Setpoint 1	Register structure, refer to table 10.21
6610…6619	RW	Setpoint 2	
6620…6629	RW	Setpoint 3	
6630…6639	RW	Setpoint 4	
6640…6649	RW	Setpoint 5	
6650…6659	RW	Setpoint 6	
6660…6669	RW	Setpoint 7	
6670…6679	RW	Setpoint 8	
6680…6689	RW	Setpoint 9	

Table 10.20: Register Setpoints

Register structure setpoint

Offset	Property	Description	Format	Unit
0	RW	Type	UINT16	0 = disabled 1 = over setpoint 2 = under setpoint
+1	RW	Measured quantity[1)]	UINT16	1*…26
+2	RW	Active limit	INT32	5000*
+4	RW	Inactive limit	INT32	1,000*
+6	RW	Active delay	UINT16	0…9,999 s (1*)
+7	RW	Inactive delay	UINT16	0…9,999 s (1*)
+8	RW	Trigger 1 [2)]	UINT16	0…21 (1*)
+9	RW	Trigger 2 [2)]	UINT16	0…21 (2*)

Table 10.21: Register structure setpoint

Notes table 10.21:

[1)] Measured quantity: "Measured quantity" specifies the value to be monitored.
The following measured quantities can be set:

Key	Measured quantity	Scale/unit
1	U_{LN}	x 100, V
2	U_{LL}	x 100, V
3	*I*	x 1,000, A
4	*I4*	x 1,000, A
5	*F*	x 100, Hz
6	P_{ges}	kW
7	S_{ges}	kvar
8	λ	x 1,000
9	DI1	**Over setpoint**: active limit is DI close (DI = 1), inactive limit DI open (DI = 0) **Under setpoint**: active limit is DI open (DI = 0), inactive limit is DI close (DI = 1)
10	DI2	
11	DI3	
12	DI4	
13	DI5	
14	DI6	
15	Reserved	
16	Demand P_{ges}	kW
17	Demand Q_{ges}	kvar
18	Demand λ	x 1,000
19	THD_U	x 10,000
20	$TOHD_U$	x 10,000
21	$TEHD_U$	x 10,000
22	THD_I	x 10,000
23	$TOHD_I$	x 10,000
24	$TEHD_I$	x 10,000
25	Unbalance *U*	x 1,000
26	Unbalance *I*	x 1,000

Table 10.22: Setpoint parameter "Measured quantity"

[2] Trigger

The trigger specifies what action the setpoint will take when it becomes active

Key	Action	Key	Action
0	—		
1	DO1	12	DR9
2	DO2	13	DR10
3	DO3	14	DR11
4	DR1	15	DR12
5	DR2	16	DR13
6	DR3	17	DR14
7	DR4	18	DR15
8	DR5	19	DR16
9	DR6	20	WFR1
10	DR7	21	WFR2
11	DR8		

Table 10.23: Setpoint trigger

10.10 Data recorder (DR)

10.10.1 Data recorder register

Register	Property	Description	Format
7000…7022	RW	Data recorder 1 (DR1)	Format see table 10.24
7023…7045	RW	Data recorder 2 (DR2)	
7046…7068	RW	Data recorder 3 (DR3)	
7069…7091	RW	Data recorder 4 (DR4)	
7092…7114	RW	Data recorder 5 (DR5)	
7115…7137	RW	Data recorder 6 (DR6)	
7138…7160	RW	Data recorder 7 (DR7)	

Register	Property	Description	Format
7161…7138	RW	Data recorder 8 (DR8)	Format see table 10.24
7134…7206	RW	Data recorder 9 (DR9)	
7107…7229	RW	Data recorder 10 (DR10)	
7230…7252	RW	Data recorder 11 (DR11)	
7253…7275	RW	Data recorder 12 (DR12)	
7276…7298	RW	Data recorder 13 (DR13)	
7299…7321	RW	Data recorder 14 (DR14)	
7322…7344	RW	Data recorder 15 (DR15)	
7345…7367	RW	Data recorder 16 (DR16)	
7368	RO	DR1 record size (bytes)	UINT16
7369	RO	DR2 record size (bytes)	UINT16
7370	RO	DR3 record size (bytes)	UINT16
7371	RO	DR4 record size (bytes)	UINT16
7372	RO	DR5 record size (bytes)	UINT16
7373	RO	DR6 record size (bytes)	UINT16
7374	RO	DR7 record size (bytes)	UINT16
7375	RO	DR8 record size (bytes)	UINT16
7376	RO	DR9 record size (bytes)	UINT16
7377	RO	DR10 record size (bytes)	UINT16
7378	RO	DR11 record size (bytes)	UINT16
7379	RO	DR12 record size (bytes)	UINT16
7380	RO	DR13 record size (bytes)	UINT16
7381	RO	DR14 record size (bytes)	UINT16
7382	RO	DR15 record size (bytes)	UINT16
7383	RO	DR16 record size (bytes)	UINT16

10.10.2Structure data recorder registers

Offset	Property	Description	Format	Range/options
+ 0	RW	Trigger mode [1)]	UINT16	0* = disabled 1 = triggered by timer 2 = triggered by setpoint
+ 1	RW	Recording mode	UINT16	0*= stop-when-full 1 = FIFO (First-In-First-Out)
+ 2	RW	Number of records	UINT16	0…65,535 (5,760*)
+ 3	RW	Recording interval	UINT32	1…3,456,000 s (900*)
+ 5	RW	Recording delay [2)]	UINT16	0*…43,200 s
+ 6	RW	Number of measured quantities [3)]	UINT16	0…16*
+ 7	RW	Measured quantity 1	UINT16	0*…322
+ 8	RW	Measured quantity 2	UINT16	0*…322
+ 9	RW	Measured quantity 3	UINT16	0*…322
+ 10	RW	Measured quantity 4	UINT16	0*…322
+ 11	RW	Measured quantity 5	UINT16	0*…322
+ 12	RW	Measured quantity 6	UINT16	0*…322
+ 13	RW	Measured quantity 7	UINT16	0*…322
+ 14	RW	Measured quantity 8	UINT16	0*…322
+ 15	RW	Measured quantity 9	UINT16	0*…322
+ 16	RW	Measured quantity 10	UINT16	0*…322
+ 17	RW	Measured quantity 11	UINT16	0*…322
+ 18	RW	Measured quantity 12	UINT16	0*…322
+ 19	RW	Measured quantity 13	UINT16	0*…322
+ 20	RW	Measured quantity 14	UINT16	0*…322
+ 21	RW	Measured quantity 15	UINT16	0*…322
+ 22	RW	Measured quantity 16	UINT16	0*…322

Table 10.24: Data recorder register structure

Notes: table 10.24

*The data recorder is only operational when the **offset entries +1, +2, +3 and +6 are all non-zero**!*

1) Data recorders can be triggered by a **timer** (the internal clock) **or** a **setpoint**. In trigger mode 2 when the setpoint goes active, the recorder starts to record, and when the setpoint becomes inactive, the data recorder stops.

2) Recording delay: In Trigger mode 1, a fixed time can be set in seconds to delay the start of the measurement (triggered by timer). .Example: "300" means that the recording will be delayed by 5 minutes after being triggered by timer. In order to obtain evaluable results, the time set for recording delay should be less than that of the recording interval.

   For Trigger mode 2, a recording delay cannot be set.

3) For data recorders the measured quantities 0…322 listed in table 8.3 can be used.

*Modifying an offset parameter will **clear the DR log** and reset the pointer to 0.*

10.11 Waveform recorder (WFR)

The PEM555 utilises two independent waveform recorders (WFR1 and WFR2) which together can store 6 entries.
Each waveform recorder can simultaneously record 3-phase voltage and current signals at a maximum resolution of 128 samples per cycle.

Register	Property		Description	Format
7600	RW	WFR 1	Number of records	0*…6
7601	RW		Number of samples per cycle[1)]	0 = 16 1 = 32 2 = 64 3*= 128
7602	RW		Number of cycles per record[2)]	40/20/10/5*
7603	RW		Number of cycles before the event occurred	0*…5

Register	Property		Description	Format
7604	RW	WFR2	Number of records[1)]	0*…6
7605	RW		Number of samples [2)]	0 = 16 1 = 32 2 = 64 3*= 128
7606	RW		Number of cycles per record[2)]	40/20/10/5*
7607	RW		Number of cycles before the event occurred	0*…5

Table 10.25: Register waveform recorder

table 10.25Notes:

1) The waveform recorders' overall capacity is 6, i.e. the total number of records in WFR1 and WFR2 must be ≤ 6. If the entry "Number of records = 0" is selected, both waveform recorders will be disabled.

2) The following WFR formats (number of samples per cycle x number of cycles) can be selected:16 x 40, 32 x 20, 64 x 10, 128 x 5.

*Modifying any of the registers **7600…7607** will clear the WFR log and reset the pointer to 0.*

Waveform recorder data structure (WFR log)
The waveform recorder data are secondary side values.

For **voltage values** the **factor of 10**
and for **current values** the **factor 1000** is to be taken into account.

The voltage and current values of the primary side are calculated as follows:
$U_{primary} = U_{secondary}$ x voltage transformer transformation ratio/10
$I_{primary} = I_{secondary}$ x CT transformation ratio/1,000

Offset	Property	Description	Format	Range/options
+ 0	RO	Trigger mode	UINT16	0*= disabled 1 = manual 2 = setpoint 3 = transient event
+ 1	RO	HiWord: year	UINT16	0…99 (year - 2000)
	RO	LoWord: month		1…12
+ 2	RO	HiWord: day	UINT16	1…31
	RO	LoWord: hour		1…23
+ 3	RO	HiWord: minute	UINT16	0…59
	RO	LoWord: second		0…59
+ 4	RO	millisecond	UINT16	0…999
+ 5…N+4	RO	U_{L1} of sample N#	UINT16	x 10, V
N+5…2N+4	RO	U_{L2} of sample N#	UINT16	x 10, V
2N+5…3N+4	RO	U_{L3} of sample N#	UINT16	x 10, V
3N+5…4N+4	RO	I_1 of sample N#	UINT16	x 1,000, A
4N+5…5N+4	RO	I_2 of sample N#	UINT16	x 1,000, A
5N+5…6N+4	RO	I_3 of sample N#	UINT16	x 1,000, A

Table 10.26: Waveform recorder data structure

N# = number of sample (1…N)

10.12 Energy log

Register	Property	Description		Format	Range/options	
7700	RW	Recording mode		UINT16	0*= disabled 1 = stop-when-full 2 = FIFO	
7701	RW	Number of records[1)]		UINT16	0…65,535 (5,760*)	
7702	RW	Recording interval		UINT16	0 = 5 min 1 = 10 min 2*= 15 min 3 = 30 min 4 = 60 min	
7703	RW	Start-up time[2)]	HiWord: year	UINT16	0…99 (year - 2000)	
			LoWord: month		1…12	
7704	RW		HiWord: day	UINT16	1…31	
			LoWord: hour		1…23	
7705	RW		HiWord: minute	UINT16	0…59	
			LoWord: second		0…59	
7706	RW	Number of measured quantities (N)		UINT16	0…5*	
7707	RW	Measured quantity 1		UINT16	0 = active energy import 1 = active energy export 2 = reactive energy import 3 = reactive energy export 4 = apparent energy	0*
7708	RW	Measured quantity 2		UINT16		1*
7709	RW	Measured quantity 3		UINT16		2*
7710	RW	Measured quantity 4		UINT16		3*
7711	RW	Measured quantity 5		UINT16		4*
7712	RO	Data record size		UINT16	Unit: bytes	

Table 10.27: Energy log registers

Notes on table 10.27:

1) If the entry "Number of records = 0" is selected, the energy log will be disabled.

2) When the current time meets or exceeds the start-up time, the energy log starts to record.

Modifying any of the registers 7701…7711 will clear the WFR log and reset the pointer to 0.

Energy log data structure

Offset	Property	Description	Format	Range/options
+0	RO	Measured quantity 1	INT32	-
+2	RO	Measured quantity 2	INT32	-
…	RO	…	INT32	-
+2N	RO	Measured quantity N (N = 0…5)	INT32	-
+2N+1	RO	HiWord: year	UINT16	0…99 (year - 2000)
		LoWord: month		1…12
+2N+2	RO	HiWord: day	UINT16	1…31
		LoWord: hour		1…23
+2N+3	RO	HiWord: minute	UINT16	0…59
		LoWord: second		0…59
+2N+4	RO	millisecond	UINT16	0…999

Table 10.28: Energy log data structure

10.13 Event log (SOE log)

Each event entry occupies 8 registers, as shown in the following table. The internal data structure of the event log is listed in table 10.30.

10.13.1 Event log register

Register	Property	Description	Format
10000…10007	RO	Event 1	Format see table 10.30
10008…10015	RO	Event 2	
10016…10023	RO	Event 3	
10024…10031	RO	Event 4	
10032…10039	RO	Event 5	
10040…10047	RO	Event 6	
10048…10055	RO	Event 7	
10056…10063	RO	Event 8	
10064…10071	RO	Event 9	
10072…10079	RO	Event 10	
10080…10087	RO	Event 11	
…			
10504…10511	RO	Event 64	

Table 10.29: Event log (SOE log)

10.13.2 Event log data structure

The following table describes the internal data structure of the 8 registers, which belong to each entry in the event log (SOE log).

Offset	Property	Description	Format
+ 0	RO	Reserved	UINT16
+ 1	RO	HiWord: Event classification LoWord: Sub classification (see table 10.13.3 ff.)	UINT16
+ 2	RO	HiWord: year-2000 LoWord: month (1…12)	UINT16
+ 3	RO	HiWord: day (0…31) LoWord: hour (1…23)	UINT16

Offset	Property	Description	Format
+ 4	RO	HiWord: minute (0…59) LoWord: second (0…59)	UINT16
+ 5	RO	millisecond (0…999)	UINT16
+ 6	RO	Event value	INT32

Table 10.30: Event data structure

10.13.3 Event classification (SOE log)

Event classification	Event sub classification	Event value Unit Option	Description
1	1	1/0	DI1 closed/opened
	2	1/0	DI2 closed/opened
	3	1/0	DI3 closed/opened
	4	1/0	DI4 closed/opened
	5	1/0	DI5 closed/opened
	6	1/0	DI6 closed/opened
2	1	1/0	DO 1 closed/opened by communications interface
	2	1/0	DO2 closed/opened by communications interface
	3	1/0	DO3 closed/opened by communications interface
	4	1/0	DO1 closed/opened by setpoint
	5	1/0	DO2 closed/opened by setpoint
	6	1/0	DO3 closed/opened by setpoint

Event classification	Event sub classification	Event value Unit Option	Description
3	1	Trigger value x 100	>-Setpoint U_{LN} exceeded
	2	Trigger value x 100	>-Setpoint U_{LL} exceeded
	3	Trigger value x 1,000	>-Setpoint *I* exceeded
	4	Trigger value x 1,000	>-Setpoint I_4 exceeded
	5	Trigger value x 100	>-Setpoint *f* exceeded
	6	Trigger value	>-Setpoint P_{ges} exceeded
	7	Trigger value	>-Setpoint Q_{ges} exceeded
	8	Trigger value x 1,000	>-Setpoint λ_{ges} exceeded
	9	1	Setpoint DI1 close active
	10	1	Setpoint DI2 close active
	11	1	Setpoint DI3 close active
	12	1	Setpoint DI4 close active
	13	1	Setpoint DI5 close active
	14	1	Setpoint DI6 close active
	15	Reserved	
	16	Trigger value	>-Setpoint demand P_{ges} exceeded
	17	Trigger value	>-Setpoint demand Q_{ges} exceeded
	18	Trigger value x 1,000	>-Setpoint demand λ_{ges} exceeded
	19	Trigger value x 100	>-Setpoint THD_U exceeded
	20	Trigger value x 100	>-Setpoint $TOHD_U$ exceeded
	21	Trigger value x 100	>-Setpoint $TEHD_U$ exceeded

Event classification	Event sub classification	Event value Unit Option	Description
3	22	Trigger value x 100	>-Setpoint THD_I exceeded
	23	Trigger value x 100	>-Setpoint $TOHD_I$ exceeded
	24	Trigger value x 100	>-Setpoint $TEHD_I$ exceeded
	25	Trigger value x 10	>-Setpoint unbalance *U* exceeded
	26	Trigger value x 10	>-Setpoint unbalance *I* exceeded
		Reserved	
	46	Return value x 100	>-Setpoint U_{LN} return
	47	Return value x 100	>-Setpoint U_{LL} return
	48	Return value x 1,000	>-Setpoint *I* return
	49	Return value x 1,000	>-Setpoint I_4 return
	50	Return value x 100	>-Setpoint *f* return
	51	Return value	>-Setpoint P_{ges} return
	52	Return value	>-Setpoint Q_{ges} return
	53	Return value x 1,000	>-Setpoint λ_{ges} return
	54	0	Setpoint DI1 close return
	55	0	Setpoint DI2 close return
	56	0	Setpoint DI3 close return
	57	0	Setpoint DI4 close return
	58	0	Setpoint DI5 close return
	59	0	Setpoint DI6 close return

Event classification	Event sub classification	Event value Unit Option	Description
3	60	Reserved	
	61	Return value	>- Setpoint demand P_{ges} return
	62	Return value	>-Setpoint demand Q_{ges} return
	63	Return value x 1,000	>-Setpoint demand λ_{ges} return
	64	Reserved	
	65		
	66		
	67	Return value x 100	>-Setpoint THD_U return
	68	Return value x 100	>-Setpoint $TOHD_U$ return
	69	Return value x 100	>-Setpoint $TEHD_U$ return
	70	Return value x 100	>-Setpoint THD_I return
	71	Return value x 100	>-Setpoint $TOHD_I$ return
		Reserved	
	90	Trigger value x 100	Under <-Setpoint U_{LN}
	91	Trigger value x 100	Under <-Setpoint U_{LL}
	92	Trigger value x 1,000	Under <-Setpoint I
	93	Trigger value x 1,000	<-Under I_4 setpoint
	94	Trigger value x 100	Under <-Setpoint f

Event classification	Event sub classification	Event value Unit Option	Description
3	95	Trigger value	Under <-Setpoint P_{ges}
	96	Trigger value	<-Under setpoint Q_{ges}
	97	Trigger value x 1,000	Under <-Setpoint λ_{ges}
	98	0	Setpoint DI1 open active
	99	0	Setpoint DI2 open active
	100	0	Setpoint DI3 open active
	101	0	Setpoint DI4 open active
	102	0	Setpoint DI5 open active
	103	0	Setpoint DI6 open active
	104	Reserved	
	105	Trigger value	Under <-Setpoint demand P_{ges}
	106	Trigger value	Under <-Setpoint demand Q_{ges}
	107	Trigger value x 1,000	Under <-Setpoint demand λ_{ges}
	108	Trigger value x 100	Under <-Setpoint THD_U
	109	Trigger value x 100	Under <-Setpoint $TOHD_U$
	110	Trigger value x 100	Under <-Setpoint $TEHD_U$
	111	Trigger value x 100	Under <-Setpoint THD_I
	112	Trigger value x 100	Under <-Setpoint $TOHD_I$
	113	Trigger value x 1,000	Under <-Setpoint $TEHD_I$
	114	Trigger value x 10	Under <-Setpoint voltage unbalance
	115	Trigger value x 10	Under <-Setpoint current unbalance

Event classification	Event sub classification	Event value Unit Option	Description
3		Reserved	
	135	Return value x 100	<-Setpoint U_{LN} return
	136	Return value x 100	<-Setpoint U_{LL} return
	137	Return value x 1,000	<-Setpoint *I* return
	138	Return value x 1,000	<-Setpoint I_4 return
	139	Reserved	
	140	Return value	<-Setpoint P_{ges} return
	141	Return value	<-Setpoint Q_{ges} return
	142	Return value x 1,000	<-Setpoint λ_{ges} return
	143	1	Setpoint DI1 open return
	144	1	Setpoint DI2 open return
	145	1	Setpoint DI3 open return
	146	1	Setpoint DI4 open return
	147	1	Setpoint DI5 open return
	148	1	Setpoint DI6 open return
	149	Reserved	
	150	Return value	<-Setpoint demand P_{ges} return
	151	Return value	<-Setpoint demand Q_{ges} return
	152	Return value x 1,000	<-Setpoint demand λ_{ges} return

Event classification	Event sub classification	Event value Unit Option	Description
3	153	Reserved	
	154		
	155		
	156	Return value x 100	<-Setpoint THD_U return
	157	Return value x 100	<-Setpoint $TOHD_U$ return
	158	Return value x 100	<-Setpoint $TEHD_U$ return
	159	Return value x 100	<-Setpoint THD_I return
	160	Return value x 100	<-Setpoint $TOHD_I$ return
	161	Return value x 100	<-Setpoint $TEHD_I$ return
	162	Return value x 10	<-Setpoint voltage unbalance return
	163	Return value x 10	<-Setpoint current unbalance return
	164	Reserved	
	165		
4	1	0	Battery voltage low
	2	0	Fault power supply CPU
	3	0	A/D fault
	4	0	NVRAM fault
	5	0	Error system parameter
	6	0	Fault parameter calibration
	7	0	Fault parameter setpoint
	8	0	Fault parameter data recorder
	9	0	Fault parameter waveform recorder
	10	0	Fault parameter energy log

Event classification	Event sub classification	Event value Unit Option	Description
5	1	0	Supply voltage on
	2	0	Supply voltage off
	3	0	Clock set via front panel
	4	0	Setup changed via device buttons
	5	0	DI counter cleared via front panel
	6	0	Event log cleared via front panel
	7	0	Reserved
	8	0	Energy values cleared via front panel
	9	0	Data recorder cleared via front panel
	10	0	Waveform recorder cleared via front panel
	11	0	Energy log cleared via front panel
	12	0	Max/Min value log of this month cleared via front panel
	13	0	Peak demand of this month cleared via front panel
	14	0	Setup changed via communications interface
	15	0	DI counter cleared via communications interface
	16	0	Event log cleared via communications interface
	17	0	Max/Min value log of last month cleared via communicationsinterface
	18	0	Energy values cleared via communications interface
	19	0	Data recorder cleared via communications interface
	20	0	Waveform recorder cleared via communications interface

Event classification	Event sub classification	Event value Unit Option	Description
5	21	0	Energy log cleared via communications interface
	22	0	Max/Min value log of this month cleared via communications interface
	23	0	Peak demand of this month cleared via communications interface
	24	0	Peak demand of last month cleared via communications interface
6	1	0	Waveform reorder triggered by communications interface (remote control)
	2	Setpoint 1…9	Waveform recorder triggered by setpoint
	3	Setpoint 1…9	Data recorder triggered by setpoint
	4	0	Waveform recorder triggered by transient event

Table 10.31: Event classification

10.14 Time setting

There are two time register formats supported by PEM555:

1. Year/month/day/hour/minute/second register 9000…9002
2. UNIX-time register 9004

When sending the time via Modbus communications, care should be taken to only write one of the two time register sets. All registers within a time register set must be written in a single transaction.
If all the registers **9000…9004** are set, both timestamp registers will be updated to reflect the new time specified in the UNIX time register set. Time specified in the first display format will be ignored.

Optionally, the register **9003** displays milliseconds. When broadcasting time, the function code has to be set to 0x10 (Preset Multiple Register). Incorrect date or time values will be rejected by the universal measuring device.

Register	Property	Description	Format	Note
9000	RW	year and month	UINT16	HiWord: year - 2000 LoWord: month (1…12)
9001	RW	day and hour	UINT16	HiWord: day (1…31) LoWord: hour (0…23)
9002	RW	minute and second	UINT16	HiWord: minute (0…59) LoWord: second (0…59)
9003	RW	millisecond	UINT16	0…999
9004	RW	UNIX time	UINT32	Time in seconds elapsed since January 01, 1970 (00:00:00 h) (946684800…4102444799)

Table 10.32: Timestamp register

10.15 DOx control

The control register of the digital outputs are implemented as Write-Only registers (WO) and can be controlled with the function code 0x05. In order to query the current DO status, the register **0086** has to be read out.

PEM555 supports the execution of commands to the outputs in two steps (**ARM before EXECUTING**): Before sending an open or close command to one of the outputs, it must be activated first. This is achieved by writing 0xFF00 to the appropriate DO register. If an "Execute" command is not received within 15 seconds, the output will be deactivated again.

Each command to be executed sent to an output not being activated before, will be ignored by the PEM555 and returned as an exception code 0x04.

Register	Property	Format	Description	Note
9100	WO	UINT16	Activate DO1 close	Writing 0xFF00
9101	WO	UINT16	Execute DO1 close	Writing 0xFF00
9102	WO	UINT16	Activate DO1 open	Writing 0xFF00

Register	Property	Format	Description	Note
9103	WO	UINT16	Execute DO1 open	Writing 0xFF00
9104	WO	UINT16	Activate DO2 close	Writing 0xFF00
9105	WO	UINT16	Execute DO2 close	Writing 0xFF00
9106	WO	UINT16	Activate DO2 open	Writing 0xFF00
9107	WO	UINT16	Execute DO2 open	Writing 0xFF00
9108	WO	UINT16	Activate DO3 close	Writing 0xFF00
9109	WO	UINT16	Execute DO3 close	Writing 0xFF00
9110	WO	UINT16	Activate DO3 open	Writing 0xFF00
9111	WO	UINT16	Execute DO3 open	Writing 0xFF00

Table 10.33: Digital output control register

10.16 Universal measuring device information

Register	Property	Description	Format	Note
9800… 9819	RO	Model*	UINT16	see table 10.35
9820	RO	Software version	UINT16	e.g.: 10000 = V1.00.00
9821	RO	Protocol version	UINT16	e.g.: 40 = V4.0
9822	RO	Software update date (year-2000)	UINT16	e.g.: 080709 = July 9, 2008
9823	RO	Date of software update: month	UINT16	
9824	RO	Date of software update: day	UINT16	
9825…9826	RO	Serial number	UINT32	
9827…9829	Reserved			
9830	RO	Input current	UINT16	1/5 (A)
9831	RO	U_S	UINT16	100/400 (V)

Table 10.34: Measuring device information

* The model of the universal measuring device is included in the registers 9800…9819. A coding example is given in the table below using the "PEM555" by way of example.

Register	Value (Hex)	ASCII
9800	0x50	P
9801	0x45	E
9802	0x4D	M
9803	0x35	5
9804	0x37	7
9805	0x35	5
9806…9819	0x20	Null

Table 10.35: ASCII coding of "PEM555"