Modbus interface SINEAX AM1000 / AM2000 / AM3000

Content

The basics of the **MODBUS®** communication are summarized in the document **"Modbus Basics. PDF"** (see documentation CD or on our website https://www.camillebauer.com)

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1 Modbus communication

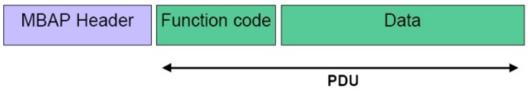
Addressing

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

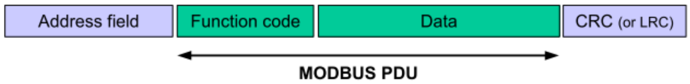
Example: Measurement U1N on register address 102

- Address declaration in value table (see chapter 4.1): (4x)102
- Real address: 102 (offset 1)
- Address used in telegram transmission: 101 (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 bit information: Function 0x01, Read Coil Status

Bits are represented within a byte in a conventional way, MSB (Bit 7) on the most left and LSB (Bit 0) most right (0101’1010 = 0x5A = 90).

Example: Reading coils 100 up to 111 of device 17

Byte	Request		Answer	
1	Slave address	0x11 resp. 0xFF	Slave address	0x11 resp. 0xFF
2	Function code	0x01	Function code	0x01
3	Start address	0x00	Byte count	0x02
4	99 = Coil 100	0x63	Byte 1	**0x53**
5	Number of registers:	0x00	Byte 2	**0x03**
6	100…111 => 12	0x0C	Checksum	crc_l
7	Checksum	crc_l	CRC16	crc_h
8	CRC16	crc_h		

for Modbus/RTU only

The start address of the request plus the bit position in the answer bytes corresponds to the coil address. Started bytes are filled with zeros.

	Hex	Binary	Coil 8	Coil 7	Coil 6	Coil 5	Coil 4	Coil 3	Coil 2	Coil 1
Byte 1	0x53	01010011b	OFF	ON	OFF	ON	OFF	OFF	ON	ON

	Hex	Binary	-	-	-	-	Coil 12	Coil 11	Coil 10	Coil 9
Byte 2	0x03	00000011b	-	-	-	-	OFF	OFF	ON	ON

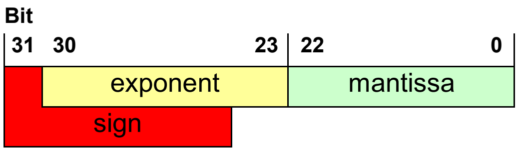
Reading float numbers (REAL): Function 0x03, Read Holding Register

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.

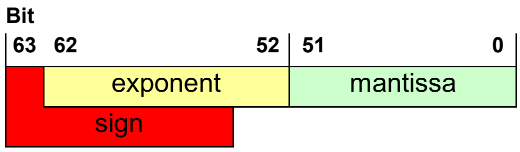
The IEEE 754 standard as the most often used standard for the representation of floating numbers is applied. 32 and 64 Bit numbers are used:

- 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

<table>
<tr><td colspan="16">0x436A</td><td colspan="16">0xE873</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>+</td><td colspan="8">Exponent: 134-127=7</td><td colspan="23">Mantissa=1.11010101110100001110011b=1,8352187871932983d</td></tr>
</table>

- **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

To reduce the number of commands the device image has been mapped using „Holding register“ if possible. Quantities normally addressed as a single bit information are implemented as „Coil“ or „Discrete input“.

2.2 Used addresses

4x addresses	# Reg.	Description	Access
100 – 193	94	Instantaneous values general	R
850 – 869	20	Instantaneous values of imbalance analysis acc. Fortescue	R
900 – 947	48	Instantaneous values of extended power analysis	R
1000 – 1081	82	Timestamps of minimum/maximum of instantaneous values	R
1100 – 1181	82	Minimum/maximum of instantaneous values	R
1850 – 1865	16	Maximum values of imbalance analysis acc. Fortescue	R
1870 – 1909	40	Timestamps of maximum values of extended power analysis	R
1920 – 1959	40	Maximum values of extended power analysis	R
2000 – 2099	100	Power mean-values: Trend, last value, minimum / maximum value	R
2150 – 2293	144	User-defined mean-values: Trend, last value, minimum / maximum	R
2300 – 2323	24	Bimetal current: Present value, timestamp and slave-pointer	R
2400 – 2415	16	Instantaneous values of fault current modules	R
2420 – 2435	16	Instantaneous values of temperature modules	R
2600 – 2631	32	Reading meter contents of standard quantities (REAL64)	R
2640 – 2735	96	Reading meter contents of user-defined quantities (REAL64)	R
2740 – 2741	2	Reading device operating hour counter	R
2742 – 2747	6	Reading free operating hour counters 1…3	R
2750 – 2781	32	Setting meter contents of standard quantities	W
2790 – 2885	48	Setting meter contents of user-defined quantities	W
2900 – 2931	32	Setting analog outputs (remote control)	W
2940 – 3067	128	Reading meter contents of digital inputs (REAL64)	R
3080 – 3143	64	Reading meter contents of digital inputs (REAL32)	R
3160 – 3287	128	Setting meter contents of digital inputs	W
3340 – 3343	4	Last recorded event: Timestamp and event type	R
4100 – 4115	16	Reading meter contents of standard quantities (REAL32)	R
4120 – 4167	48	Reading meter contents of user-defined quantities (REAL32)	R
4200 – 4229	30	Instantaneous values THD/TDD (from FW version 1.0x.875)	R
4230 – 6209	1980	Instantaneous values of harmonics (from FW version 1.0x.875)	R
6250 – 6271	22	Timestamps min/max values harmonic analysis (from FW version 1.0x.875)	R
6300 – 6321	22	Maximum values THD /TDD (from FW version 1.0x.875)	R
6326 – 8125	1800	Maximum values harmonics (from FW version 1.0x.875)	R

0x addresses	# Coils	Description	Access
1 – 5	5	Reset of min/max values group 1…5	W
20	1	Reset of summary alarm	W
30 – 32	3	Reset of operating hour counters 1…3	W
50 – 59	10	Remote I/O	W
100 – 111	12	State of limit values 1-12	R
140 – 147	8	State of monitoring functions 1…8	R
170 – 171	2	State of summary alarm	R
180	1	Digital input 0.1: State / energy meter tariff	R
200 – 215	16	States of the optional digital inputs	R
220 – 243	24	State alarm / pre-warning / breakage of fault current channels	R
250 – 289	40	State alarm / short circuit / breakage of temperature channels	R

Access: R = readable, W = writable

2.3 Used Syntax

Address 4x / 0x	Start address of described data block (Register, Coil or Input Status)
Time	4x register address of a timestamp, typically of a minimum / maximum value
Value	4x register address of a measured value, typically for minimum / maximum values
Reset	Coil 0x register address to reset a corresponding measured quantity
Name	Unique name of a variable or structure
Type	**Data type of variable** UINT32: 32-bit integer without sign REAL32 (32-bit float) REAL64 (64-bit float) CHAR[..]:String with/without termination (NULL) TIME: seconds since 1970/1/1 (UINT32) COIL: Bit information
Default	Value when delivering, after a hardware reset or if quantity is not available
Description	Description of the quantity
14 2L 3G 3P 3U 3A 4U 4O	Availability of the measured quantities, depending on the connected system **14** = single phase system or 4-wire balanced load **2L** = two phase system (split phase) **3G** = 3-wire balanced load **3P** = 3-wire balanced load, phase shift (2U,1I) **3U** = 3-wire unbalanced load **3A** = 3-wire balanced load, Aron connection **4U** = 4-wire unbalanced load **4O** = 4-wire unbalanced load, Open-Y connection

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	A*PLUS*	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

The value for Data2 is reserved for future extensions.

4 Measurements

4.1 General instantaneous values

Address 4x	Name	14	2L	3G	3P	3U	3A	4U	4O	Type	Description
100	U	●	●	-	●	-	-	-	-	REAL32	System voltage [V]
102	U1N	-	●	-	-	-	-	●	●		Voltage phase L1 to N [V]
104	U2N	-	●	-	-	-	-	●	●		Voltage phase L2 to N [V]
106	U3N	-	-	-	-	-	-	●	●		Voltage phase L3 to N [V]
108	U12	-	-	●	-	●	●	●	●		Voltage phase L1 to L2 [V]
110	U23	-	-	●	-	●	●	●	●		Voltage phase L2 to L3 [V]
112	U31	-	-	●	-	●	●	●	●		Voltage phase L3 to L1 [V]
114	UNE	●[1]	●[1]	-	-	-	-	●	●		Zero displacement voltage in 4-wire systems [V]
116	I	●	-	●	●	-	-	-	-	REAL32	System current [A]
118	I1	-	●	-	-	●	●	●	●		Current in phase L1 [A]
120	I2	-	●	-	-	●	●	●	●		Current in phase L2 [A]
122	I3	-	-	-	-	●	●	●	●		Current in phase L3 [A]
124	I4 / IN	-	●	-	-	-	-	●	●		Neutral current [A]
126	P	●	●	●	●	●	●	●	●	REAL32	Active power system [W]
128	P1	-	●	-	-	-	-	●	●		Active power phase 1 (L1 – N) [W]
130	P2	-	●	-	-	-	-	●	●		Active power phase 2 (L2 – N) [W]
132	P3	-	-	-	-	-	-	●	●		Active power phase 3 (L3 – N) [W]
134	Q	●	●	●	●	●	●	●	●	REAL32	Reactive power system [var]
136	Q1	-	●	-	-	-	-	●	●		Reactive power phase 1 (L1 – N) [var]
138	Q2	-	●	-	-	-	-	●	●		Reactive power phase 2 (L2 – N) [var]
140	Q3	-	-	-	-	-	-	●	●		Reactive power phase 3 (L3 – N) [var]
142	S	●	●	●	●	●	●	●	●	REAL32	Apparent power system [VA]
144	S1	-	●	-	-	-	-	●	●		Apparent power phase 1 (L1 – N) [VA]
146	S2	-	●	-	-	-	-	●	●		Apparent power phase 2 (L2 – N) [VA]
148	S3	-	-	-	-	-	-	●	●		Apparent power phase 3 (L3 – N) [VA]
150	F	●	●	●	●	●	●	●	●	REAL32	System frequency [Hz]
152	PF	●	●	●	●	●	●	●	●	REAL32	PF = P / S, Power factor system
154	PF1	-	●	-	-	-	-	●	●		Power factor phase 1 (L1 – N)
156	PF2	-	●	-	-	-	-	●	●		Power factor phase 2 (L2 – N)
158	PF3	-	-	-	-	-	-	●	●		Power factor phase 3 (L3 – N)
160	QF	●	●	●	●	●	●	●	●	REAL32	QF = Q / S, Reactive power factor system
162	QF1	-	●	-	-	-	-	●	●		Reactive power factor phase 1 (L1 – N)
164	QF2	-	●	-	-	-	-	●	●		Reactive power factor phase 2 (L2 – N)
166	QF3	-	-	-	-	-	-	●	●		Reactive power factor phase 3 (L3 – N)
168	LF	●	●	●	●	●	●	●	●	REAL32	sign(Q)·(1 – abs(PF)), Load factor system
170	LF1	-	●	-	-	-	-	●	●		Load factor phase 1 (L1 – N)
172	LF2	-	●	-	-	-	-	●	●		Load factor phase 2 (L2 – N)
174	LF3	-	-	-	-	-	-	●	●		Load factor phase 3 (L3 – N)
176	U_MEAN	-	●	●	-	●	●	●	-	REAL32	Average value of voltages (U1x+U2x+U3x)/3 [V]
178	I_MEAN	-	●	-	-	●	-	●	●		Average value of currents (I1+I2+I3)/3 [A]
180	UF12	-	-	●	-	●	●	●	●	REAL32	Phase angle voltage U1-U2 [°]
182	UF23	-	-	●	-	●	●	●	●		Phase angle voltage U2-U3 [°]
184	UF31	-	-	●	-	●	●	●	●		Phase angle voltage U3-U1 [°]
186	DEV_UMAX	-	●	●	-	●	●	●	●	REAL32	Max. deviation from the average value of voltages [V]
188	DEV_IMAX	-	●	-	-	●	●	●	●	REAL32	Max. deviation from the average value of currents [A]
190	IMS	●	●	●	●	●	●	●	●	REAL32	Average value of currents with sign of P [A]
192	IPE [1]	-	●	-	-	●	-	●	●	REAL32	Earth current [A]

[1] Available for AM3000 only

4.2 System analysis

4.2.1 Instantaneous values of harmonic analysis (from version 1.0x.875)

Address 4x	Name	14	2L	3G	3P	3U	3A	4U	4O	Type	Description
4200	THD_U1N	●	●	-	-	-	-	●	●		Total Harmonic Distortion Voltage U1N [%]
4202	THD_U2N	-	●	-	-	-	-	●	●	REAL32	Total Harmonic Distortion Voltage U2N [%]
4204	THD_U3N	-	-	-	-	-	-	●	●		Total Harmonic Distortion Voltage U3N [%]
4206	THD_U12	-	-	●	●	●	●	-	-		Total Harmonic Distortion Voltage U12 [%]
4208	THD_U23	-	-	●	●	●	●	-	-	REAL32	Total Harmonic Distortion Voltage U23 [%]
4210	THD_U31	-	-	●	●	●	●	-	-		Total Harmonic Distortion Voltage U31 [%]
4214	TDD_I1	●	●	●	●	●	●	●	●		Total Demand Distortion current I1 [%]
4216	TDD_I2	-	●	-	-	●	●	●	●	REAL32	Total Demand Distortion current I2 [%]
4218	TDD_I3	-	-	-	-	●	●	●	●		Total Demand Distortion current I3 [%]
4222	THD_I1	●	●	●	●	●	●	●	●		Total Harmonic Distortion current I1 [%]
4224	THD_I2	-	●	-	-	●	●	●	●	REAL32	Total Harmonic Distortion current I2 [%]
4226	THD_I3	-	-	-	-	●	●	●	●		Total Harmonic Distortion current I3 [%]

► THD_U: Harmonic content related to the fundamental of the RMS value of the voltage

► TDD_I: Harmonic content related to the **rated value** of the current

► THD_I: Harmonic content related to the fundamental of the RMS value of the current

Address 4x	Name	14	2L	3G	3P	3U	3A	4U	4O	Type	Description
4234	H2_U1N	●	●	-	-	-	-	●	●	REAL32	Voltage U1N: Content 2^{nd} harmonic [%]
	.....										.....
4408	H89_U1N										Voltage U1N: Content 89^{th} harmonic [%]
4414	H2_U2N	-	●	-	-	-	-	●	●	REAL32	Voltage U2N: Content 2^{nd} harmonic [%]
	.....										.....
4588	H89_U2N										Voltage U2N: Content 89^{th} harmonic [%]
4594	H2_U3N	-	-	-	-	-	-	●	●	REAL32	Voltage U3N: Content 2^{nd} harmonic [%]
	.....										.....
4768	H89_U3N										Voltage U3N: Content 89^{th} harmonic [%]
4774	H2_U12	-	-	●	●	●	●	-	-	REAL32	Voltage U12: Content 2^{nd} harmonic [%]
	.....										.....
4948	H89_U12										Voltage U12: Content 89^{th} harmonic [%]
4954	H2_U23	-	-	●	●	●	●	-	-	REAL32	Voltage U23: Content 2^{nd} harmonic [%]
	.....										.....
5128	H89_U23										Voltage U23: Content 89^{th} harmonic [%]
5134	H2_U31	-	-	●	●	●	●	-	-	REAL32	Voltage U31: Content 2^{nd} harmonic [%]
	.....										.....
5308	H89_U31										Voltage U31: Content 89^{th} harmonic [%]
5494	H2_I1	●	●	●	●	●	●	●	●	REAL32	Current I1: Content 2^{nd} harmonic [%]
	.....										.....
5668	H89_I1										Current I1: Content 89^{th} harmonic [%]
5674	H2_I2	-	●	-	-	●	●	●	●	REAL32	Current I2: Content 2^{nd} harmonic [%]
	.....										.....
5848	H89_I2										Current I2: Content 89^{th} harmonic [%]
5854	H2_I3	-	-	-	-	●	●	●	●	REAL32	Current I3: Content 2^{nd} harmonic [%]
	.....										.....
6028	H89_I3										Current I3: Content 89^{th} harmonic [%]

► Hi_Uxy: Harmonic content of the voltage related to the fundamental 100 %

► Hi_Ix: Harmonic content of the current related to the **rated** current

► At rated frequency 60Hz harmonics are available up to the 75^{th} only, the other values are 0.0

4.2.2 Instantaneous values of imbalance analysis acc. Fortescue

Address 4x	Name	14	2L	3G	3P	3U	3A	4U	4O	Type	Description
850	UR1	-	-	●	-	●	●	●	-	REAL32	Voltage [V]: Positive sequence
852	UR2	-	-	●	-	●	●	●	-		Voltage [V]: Negative sequence
854	U0	-	-	-	-	-	-	●	-		Voltage [V]: Zero sequence
856	IR1	-	-	-	-	●	-	●	●	REAL32	Current [A]: Positive sequence
858	IR2	-	-	-	-	●	-	●	●		Current [A]: Negative sequence
860	I0	-	-	-	-	-	-	●	●		Current [A]: Zero sequence
862	UNB_UR2_UR1	-	-	●	-	●	●	●	-	REAL32	Imbalance factor voltage: UR2/UR1 [%]
864	UNB_IR2_IR1	-	-	-	-	●	-	●	●		Imbalance factor current: IR2/IR1 [%]
866	UNB_U0_UR1	-	-	-	-	-	-	●	-	REAL32	Imbalance factor voltage: U0/UR1 [%]
868	UNB_I0_IR1	-	-	-	-	-	-	●	●		Imbalance factor current: I0/IR1 [%]

4.2.3 Instantaneous values of extended power analysis

Address 4x	Name	14	2L	3G	3G	3U	3A	4U	4O	Type	Description
900	P_H1	●	●	●	●	●	●	●	●	REAL32	Fundamental active power, system [W]
902	P1_H1	-	●	-	-	-	-	●	●		Fundamental active power, L1 [W]
904	P2_H1	-	●	-	-	-	-	●	●		Fundamental active power, L2 [W]
906	P3_H1	-	-	-	-	-	-	●	●		Fundamental active power, L3 [W]
908	Q_H1	●	●	●	●	●	●	●	●	REAL32	Reactive power of fundamental, system [var]
910	Q1_H1	-	●	-	-	-	-	●	●		Reactive power of fundamental, phase L1 [var]
912	Q2_H1	-	●	-	-	-	-	●	●		Reactive power of fundamental, phase L2 [var]
914	Q3_H1	-	-	-	-	-	-	●	●		Reactive power of fundamental, phase L3 [var]
916	S_H1	●	●	●	●	●	●	●	●	REAL32	Fundamental apparent power, system [VA]
918	S1_H1	-	●	-	-	-	-	●	●		Fundamental apparent power, L1 [VA]
920	S2_H1	-	●	-	-	-	-	●	●		Fundamental apparent power, L2 [VA]
922	S3_H1	-	-	-	-	-	-	●	●		Fundamental apparent power, L3 [VA]
924	D	●	●	●	●	●	●	●	●	REAL32	Distortion reactive power, system [var]
926	D1	-	●	-	-	-	-	●	●		Distortion reactive power, phase L1 [var]
928	D2	-	●	-	-	-	-	●	●		Distortion reactive power, phase L2 [var]
930	D3	-	-	-	-	-	-	●	●		Distortion reactive power, phase L3 [var]
932	CPHI	●	●	●	●	●	●	●	●	REAL32	cos(φ) of fundamental, system
934	CPHI1	-	●	-	-	-	-	●	●		cos(φ) of fundamental, phase L1
936	CPHI2	-	●	-	-	-	-	●	●		cos(φ) of fundamental, phase L2
938	CPHI3	-	-	-	-	-	-	●	●		cos(φ) of fundamental, phase L3
940	TPHI	●	●	●	●	●	●	●	●	REAL32	tan(φ) of fundamental, system
942	TPHI1	-	●	-	-	-	-	●	●		tan(φ) of fundamental, phase L1
944	TPHI2	-	●	-	-	-	-	●	●		tan(φ) of fundamental, phase L2
946	TPHI3	-	-	-	-	-	-	●	●		tan(φ) of fundamental, phase L3

4.2.4 Instantaneous values of optional fault current modules

➢ The registers described below are available for devices with equipped fault current modules only.

Per channel the following information is available:

- Present value of the measured fault currents
- State of the alarm limit monitoring
- State of the pre-warning limit monitoring
- State of breakage monitoring

Address 4x	Name	Type	Description
2400	RC_1_1	REAL32	Measured current, channel 1.1
2402	RC_1_2	REAL32	Measured current, channel 1.2
2404	RC_2_1	REAL32	Measured current, channel 2.1
2406	RC_2_2	REAL32	Measured current, channel 2.2
2408	RC_3_1	REAL32	Measured current, channel 3.1
2410	RC_3_2	REAL32	Measured current, channel 3.2
2412	RC_4_1	REAL32	Measured current, channel 4.1
2414	RC_4_2	REAL32	Measured current, channel 4.2

Address 0x Alarm	Address 0x Pre-warning	Address 0x Breakage	Type	Description
220	221	222	COIL	Monitoring state, channel 1.1 (0=inactive, 1=active)
223	224	225	COIL	Monitoring state, channel 1.2 (0=inactive, 1=active)
226	227	228	COIL	Monitoring state, channel 2.1 (0=inactive, 1=active)
229	230	231	COIL	Monitoring state, channel 2.2 (0=inactive, 1=active)
232	233	234	COIL	Monitoring state, channel 3.1 (0=inactive, 1=active)
235	236	237	COIL	Monitoring state, channel 3.2 (0=inactive, 1=active)
238	239	240	COIL	Monitoring state, channel 4.1 (0=inactive, 1=active)
241	242	243	COIL	Monitoring state, channel 4.2 (0=inactive, 1=active)

4.2.5 Instantaneous values of optional temperature modules

➢ The registers described below are available for devices with equipped temperature modules only.

In addition, the information available per channel depends on the sensor type selected.

Information	Pt100	PTC
Temperature	●	-
State of alarm 1	●	-
State of alarm 2	●	-
State of PTC alarm	-	●
State short-circuit monitoring	●	●
State breakage monitoring	●	-

Address 4x	Name	Type	Description
2420	TEMP_1_1	REAL32	Temperature channel 1.1 [1)]
2422	TEMP_1_2	REAL32	Temperature channel 1.2 [1)]
2424	TEMP_2_1	REAL32	Temperature channel 2.1 [1)]
2426	TEMP_2_2	REAL32	Temperature channel 2.2 [1)]
2428	TEMP_3_1	REAL32	Temperature channel 3.1 [1)]
2430	TEMP_3_2	REAL32	Temperature channel 3.2 [1)]
2432	TEMP_4_1	REAL32	Temperature channel 4.1 [1)]
2434	TEMP_4_2	REAL32	Temperature channel 4.2 [1)]

[1)] *temperature values available for Pt100 measurement only*

Address 0x Pt100 Alarm1	Address 0x Pt100 Alarm2	Address 0x PTC Alarm	Address 0x Short Circuit	Address 0x Sensor/line breakage	Type	Description
250	251	252	253	254	COIL	State, channel 1.1 (0=inactive, 1=active)
255	256	257	258	259	COIL	State, channel 1.2 (0=inactive, 1=active)
260	261	262	262	264	COIL	State, channel 2.1 (0=inactive, 1=active)
265	266	267	268	269	COIL	State, channel 2.2 (0=inactive, 1=active)
270	271	272	273	274	COIL	State, channel 3.1 (0=inactive, 1=active)
275	276	277	278	279	COIL	State, channel 3.2 (0=inactive, 1=active)
280	281	282	283	284	COIL	State, channel 4.1 (0=inactive, 1=active)
285	286	287	288	289	COIL	State, channel 4.2 (0=inactive, 1=active)

4.3 Last recorded event

This information is available for device versions with disturbance recorder only.

Time [TIME]	Value [REAL32]	Name	Description
3340	3342	LAST_EVENT	Last recorded event with timestamp **Value** 0: undefined trigger 1: Voltage swell 2: Voltage dip 3: Voltage interruption 4: Rapid voltage change (RVC) 5: Over-current 7: Mains signalling voltage 8: Current swell 9: Current dip 10: Snapshot by user If **time** is "0" no event was recorded since device start. ⚠ The registers for time and event type cannot be read with one request, two telegrams are required.

4.4 Minimum / maximum values of system quantities

Time [TIME]	Value [REAL32]	Name	14	2L	3G	3P	3U	3A	4U	4O	Description
1000	1100	U_MAX	●	●	-	●	-	-	-	-	Maximum value of U [V]
1002	1102	U1N_MAX	-	●	-	-	-	-	●	●	Maximum value of U1N [V]
1004	1104	U2N_MAX	-	●	-	-	-	-	●	●	Maximum value of U2N [V]
1006	1106	U3N_MAX	-	-	-	-	-	-	●	●	Maximum value of U3N [V]
1008	1108	U12_MAX	-	-	●	-	●	●	●	●	Maximum value of U12 [V]
1010	1110	U23_MAX	-	-	●	-	●	●	●	●	Maximum value of U23 [V]
1012	1112	U31_MAX	-	-	●	-	●	●	●	●	Maximum value of U31 [V]
1014	1114	UNE_MAX	●[1)]	●[1)]	-	-	-	-	●	●	Maximum value of UNE [V]
1016	1116	I_MAX	●	-	●	●	-	-	-	-	Maximum value of I [A]
1018	1118	I1_MAX	-	●	-	-	●	●	●	●	Maximum value of I1 [A]
1020	1120	I2_MAX	-	-	-	-	●	●	●	●	Maximum value of I2 [A]
1022	1122	I3_MAX	-	-	-	-	●	●	●	●	Maximum value of I3 [A]
1024	1124	IN_MAX	-	●	-	-	-	-	●	●	Maximum value of IN [A]
1026	1126	P_MAX	●	●	●	●	●	●	●	●	Maximum value of P [W]
1028	1128	P1_MAX	-	●	-	-	-	-	●	●	Maximum value of P1 [W]
1030	1130	P2_MAX	-	●	-	-	-	-	●	●	Maximum value of P2 [W]
1032	1132	P3_MAX	-	-	-	-	-	-	●	●	Maximum value of P3 [W]
1034	1134	Q_MAX	●	●	●	●	●	●	●	●	Maximum value of Q [var]
1036	1136	Q1_MAX	-	●	-	-	-	-	●	●	Maximum value of Q1 [var]
1038	1138	Q2_MAX	-	●	-	-	-	-	●	●	Maximum value of Q2 [var]
1040	1140	Q3_MAX	-	-	-	-	-	-	●	●	Maximum value of Q3 [var]
1042	1142	S_MAX	●	●	●	●	●	●	●	●	Maximum value of S [VA]
1044	1144	S1_MAX	-	●	-	-	-	-	●	●	Maximum value of S1 [VA]
1046	1146	S2_MAX	-	●	-	-	-	-	●	●	Maximum value of S2 [VA]
1048	1148	S3_MAX	-	-	-	-	-	-	●	●	Maximum value of S3 [VA]
1050	1150	F_MAX	●	●	●	●	●	●	●	●	Maximum value of F [Hz]
1052	1152	DEV_UMAX_MAX	-	-	●	-	●	●	●	●	Maximum value of DEV_UMAX [V]
1054	1154	DEV_IMAX_MAX	-	-	-	-	●	●	●	●	Maximum value of DEV_IMAX [A]
1056	1156	U_MIN	●	●	-	●	-	-	-	-	Minimum value of U [V]
1058	1158	U1N_MIN	-	●	-	-	-	-	●	●	Minimum value of U1N [V]
1060	1160	U2N_MIN	-	●	-	-	-	-	●	●	Minimum value of U2N [V]
1062	1162	U3N_MIN	-	-	-	-	-	-	●	●	Minimum value of U3N [V]
1064	1164	U12_MIN	-	-	●	-	●	●	●	●	Minimum value of U12 [V]
1066	1166	U23_MIN	-	-	●	-	●	●	●	●	Minimum value of U23 [V]
1068	1168	U31_MIN	-	-	●	-	●	●	●	●	Minimum value of U31 [V]
1070	1170	PF_MIN_QI	●	●	●	●	●	●	●	●	min. power factor quadrant I
1072	1172	PF_MIN_QIV	●	●	●	●	●	●	●	●	min. power factor quadrant IV
1074	1174	PF_MIN_QIII	●	●	●	●	●	●	●	●	min. power factor quadrant III
1076	1176	PF_MIN_QII	●	●	●	●	●	●	●	●	min. power factor quadrant II
1078	1178	F_MIN	●	●	●	●	●	●	●	●	Minimum value of F [Hz]
1080	1180	IPE_MAX [1)]	-	●	-	-	●	-	●	●	Maximum value of IPE [A]

► Resetting of min/max values in groups, see Resetting of min/max values

► A timestamp "1.1.1970" indicates that the associated measurement is invalid.

[1)] For AM3000 only

4.5 Minimum / maximum values of system analysis

4.5.1 Maximum values of harmonic analysis (from version 1.0x.875)

Time [TIME]	Value [REAL32]	Name	14	2L	3G	3P	3U	3A	4U	4O	Description
6250	6300	THD_U1N_MAX	●	●	-	-	-	-	●	●	max. THD value voltage U1N [%]
6252	6302	THD_U2N_MAX	-	●	-	-	-	-	●	●	max. THD value voltage U2N [%]
6254	6304	THD_U3N_MAX	-	-	-	-	-	-	●	●	max. THD value voltage U3N [%]
6256	6306	THD_U12_MAX	-	-	●	●	●	●	-	-	max. THD value voltage U12 [%]
6258	6308	THD_U23_MAX	-	-	●	●	●	●	-	-	max. THD value voltage U23 [%]
6260	6310	THD_U31_MAX	-	-	●	●	●	●	-	-	max. THD value voltage U31 [%]
6264	6314	TDD_I1_MAX	●	●	●	●	●	●	●	●	max. TDD value current I1 [%]
6266	6316	TDD_I2_MAX	-	●	-	-	●	●	●	●	max. TDD value current I2 [%]
6268	6318	TDD_I3_MAX	-	-	-	-	●	●	●	●	max. TDD value current I3 [%]

Time [TIME]	Value [REAL32]	Name	14	2L	3G	3P	3U	3A	4U	4O	Description
6250	6326 ….. 6500	H2_U1N_MAX ….. H89_U1N_MAX	●	●	-	-	-	-	●	●	Voltage U1N: Max. content 2nd harmonic [%] ….. Voltage U1N: Max. content 89th harmonic [%]
6252	6506 ….. 6680	H2_U2N_MAX ….. H89_U2N_MAX	-	●	-	-	-	-	●	●	Voltage U2N: Max. content 2nd harmonic [%] ….. Voltage U2N: Max. content 89th harmonic [%]
6254	6686 ….. 6860	H2_U3N_MAX ….. H89_U3N_MAX	-	-	-	-	-	-	●	●	Voltage U3N: Max. content 2nd harmonic [%] ….. Voltage U3N: Max. content 89th harmonic [%]
6256	6866 ….. 7040	H2_U12_MAX ….. H89_U12_MAX	-	-	●	●	●	●	-	-	Voltage U12: Max. content 2nd harmonic [%] ….. Voltage U12: Max. content 89th harmonic [%]
6258	7046 ….. 7220	H2_U23_MAX ….. H89_U23_MAX	-	-	●	●	●	●	-	-	Voltage U23: Max. content 2nd harmonic [%] ….. Voltage U23: Max. content 89th harmonic [%]
6260	7226 ….. 7400	H2_U31_MAX ….. H89_U31_MAX	-	-	●	●	●	●	-	-	Voltage U31: Max. content 2nd harmonic [%] ….. Voltage U31: Max. content 89th harmonic [%]
6264	7590 ….. 7764	H2_I1X_MAX ….. H89_I1X_MAX	●	●	●	●	●	●	●	●	Current I1: Max. content 2nd harmonic [%] ….. Current I1: Max. content 89th harmonic [%]
6266	7770 ….. 7944	H2_I2X_MAX ….. H89_I2X_MAX	-	●	-	-	●	●	●	●	Current I2: Max. content 2nd harmonic [%] ….. Current I2: Max. content 89th harmonic [%]
6268	7950 ….. 8124	H2_I3X_MAX ….. H89_I3X_MAX	-	-	-	-	●	●	●	●	Current I3: Max. content 2nd harmonic [%] ….. Current I3: Max. content 89th harmonic [%]

► The maximum values of the harmonic analysis arise from monitoring the maximum values of THD resp. TDD. The maximum values of the individual harmonics are not monitored separately, but stored when a maximum value of THD or TDD is recognized. The image of the maximum harmonics therefore always corresponds to the associated THD resp. TDD.

► At rated frequency 60Hz only harmonics up to the 75th are available, the other values are 0.0

► Resetting of min/max values in groups, see Resetting of min/max values

► A timestamp "1.1.1970" indicates that the associated measurement is invalid.

The individual harmonics are implemented as 32-bit float numbers (2 registers per value).

4.5.2 Maximum values of imbalance analysis acc. Fortescue

Time [TIME]	Value [REAL32]	Name	14	2L	3G	3P	3U	3A	4U	4O	Description	
1850	1858	UNB_UR2_UR1_MAX	-	-	●	-	●	●	●	-	max. imbalance UR2/UR1	[%]
1852	1860	UNB_IR2_IR1_MAX	-	-	-	-	-	-	●	●	max. imbalance IR2/IR1	[%]
1854	1862	UNB_U0_UR1_MAX	-	-	-	-	●	-	●	-	max. imbalance U0/UR1	[%]
1856	1864	UNB_I0_IR1_MAX	-	-	-	-	-	-	●	●	max. imbalance I0/IR1	[%]

► Resetting of min/max values in groups, see Resetting of min/max values

► A timestamp "1.1.1970" indicates that the associated measurement is invalid.

The imbalance maximum values are implemented as 32-bit float numbers (2 registers per value).

4.5.3 Maximum values of extended power analysis

Time [TIME]	Value [REAL32]	Name	14	2L	3G	3P	3U	3A	4U	4O	Description	
1870	1920	P_MAX_H1	●	●	●	●	●	●	●	●	Max. active power of fundamental, system	[W]
1872	1922	P1_MAX_H1	-	●	-	-	-	-	●	●	Max. active power of fundamental, phase L1	[W]
1874	1924	P2_MAX_H1	-	●	-	-	-	-	●	●	Max. active power of fundamental, phase L2	[W]
1876	1926	P3_MAX_H1	-	-	-	-	-	-	●	●	Max. active power of fundamental, phase L3	[W]
1878	1928	Q_MAX_H1	●	●	●	●	●	●	●	●	Max. reactive power fundamental, system	[var]
1880	1930	Q1_MAX_H1	-	●	-	-	-	-	●	●	Max. reactive power fundamental, phase L1	[var]
1882	1932	Q2_MAX_H1	-	●	-	-	-	-	●	●	Max. reactive power fundamental, phase L2	[var]
1884	1934	Q3_MAX_H1	-	-	-	-	-	-	●	●	Max. reactive power fundamental, phase L3	[var]
1886	1936	S_MAX_H1	●	●	●	●	●	●	●	●	Max. apparent power of fundamental, system	[VA]
1888	1938	S1_MAX_H1	-	●	-	-	-	-	●	●	Max. apparent power fundamental, phase L1	[VA]
1890	1940	S2_MAX_H1	-	●	-	-	-	-	●	●	Max. apparent power fundamental, phase L2	[VA]
1892	1942	S3_MAX_H1	-	-	-	-	-	-	●	●	Max. apparent power fundamental, phase L3	[VA]
1894	1944	D_MAX	●	●	●	●	●	●	●	●	Max. distortion reactive power, system	[var]
1896	1946	D1_MAX	-	●	-	-	-	-	●	●	Max. distortion reactive power, phase L1	[var]
1898	1948	D2_MAX	-	●	-	-	-	-	●	●	Max. distortion reactive power, phase L2	[var]
1900	1950	D3_MAX	-	-	-	-	-	-	●	●	Max. distortion reactive power, phase L3	[var]
1902	1952	CPHI_MIN_QI	●	●	●	●	●	●	●	●	min. cos(φ) quadrant I (*)	
1904	1954	CPHI _MIN_QIV	●	●	●	●	●	●	●	●	min. cos(φ) quadrant IV (*)	
1906	1956	CPHI _MIN_QIII	●	●	●	●	●	●	●	●	min. cos(φ) quadrant III (*)	
1908	1958	CPHI _MIN_QII	●	●	●	●	●	●	●	●	min. cos(φ) quadrant II (*)	

(*) min. cos(φ) of the system fundamental in all 4 quadrants

All values are implemented as 32-bit float numbers (2 registers per value).

► Resetting of min/max values in groups, see Resetting of min/max values

► A timestamp "1.1.1970" indicates that the associated measurement is invalid.

4.6 Mean values: Trend, Last values, minimum / maximum values

4.6.1 Mean values of power (standard quantities), averaging interval t1

	Trend	Mean-value	Maximum		Minimum		
Name	[REAL32]	Last ...... - 4 [REAL32]	**Time** [TIME]	**Value** [REAL32]	**Time** [TIME]	**Value** [REAL32]	**Description**
AVG_P_I_IV	2000	2010... 2018	2060	2080	2070	2090	Mean-value P, quadrant I+IV [W]
AVG_P_II_III	2002	2020... 2028	2062	2082	2072	2092	Mean-value P, quadrant II+III [W]
AVG_Q_I_II	2004	2030... 2038	2064	2084	2074	2094	Mean-value Q, quadrant I+II [var]
AVG_Q_III_IV	2006	2040... 2048	2066	2086	2076	2096	Mean-value Q, quadrant III+IV [var]
AVG_S	2008	2050... 2058	2068	2088	2078	2098	Mean-value S [VA]

- ► Resetting of min/max values in groups, see Resetting of min/max values
- ► A timestamp "1.1.1970" indicates that the associated measurement is invalid.
- ► For each of the standard quantities the mean-value for the last interval and the 4 previous values are provided.

4.6.2 User-defined mean values, averaging interval t2

	Trend	Mean-value	Maximum		Minimum		
Name	[REAL32]	Last [REAL32]	**Time** [TIME]	**Value** [REAL32]	**Time** [TIME]	**Value** [REAL32]	**Description**
AVG_1	2150	2174	2198	2246	2222	2270	Config. mean-value 1
AVG_2	2152	2176	2200	2248	2224	2272	Config. mean-value 2
AVG_3	2154	2178	2202	2250	2226	2274	Config. mean-value 3
AVG_4	2156	2180	2204	2252	2228	2276	Config. mean-value 4
AVG_5	2158	2182	2206	2254	2230	2278	Config. mean-value 5
AVG_6	2160	2184	2208	2256	2232	2280	Config. mean-value 6
AVG_7	2162	2186	2210	2258	2234	2282	Config. mean-value 7
AVG_8	2164	2188	2212	2260	2236	2284	Config. mean-value 8
AVG_9	2166	2190	2214	2262	2238	2286	Config. mean-value 9
AVG_10	2168	2192	2216	2264	2240	2288	Config. mean-value 10
AVG_11	2170	2194	2218	2266	2242	2290	Config. mean-value 11
AVG_12	2172	2196	2220	2268	2244	2292	Config. mean-value 12

- ► Resetting of min/max values in groups, see Resetting of min/max values
- ► A timestamp "1.1.1970" indicates that the associated measurement is invalid.

4.6.3 Bimetal current, averaging interval t3

	Value	Maximum										
Name	[REAL32]	**Time** [TIME]	**Value** [REAL32]	**14**	**2L**	**3G**	**3P**	**3U**	**3A**	**4U**	**4O**	**Description**
IB	2300	2308	2316	●	-	●	●	-	-	-	-	Damped current in balanced systems [A]
IB1	2302	2310	2318	-	●	-	-	●	●	●	●	Damped current in phase L1 [A]
IB2	2304	2312	2320	-	●	-	-	●	●	●	●	Damped current in phase L2 [A]
IB3	2306	2314	2322	-	-	-	-	●	●	●	●	Damped current in phase L3 [A]

- ► Resetting of min/max values in groups, see Resetting of min/max values
- ► A timestamp "1.1.1970" indicates that the associated measurement is invalid.

4.7 Resetting of min/max values

Min/max values may be reset in groups via coils.

Address 0x	Name	Type	Group to be reset
1	MM_RES1	COIL	- Min/max of voltages, currents, frequency
2	MM_RES2	COIL	- Min/max of active, reactive, apparent power - Min/max of fundamental and distortion reactive power - Minimum values of load factors, cosφ
3	MM_RES3	COIL	- Min/Max values of power mean-values / configurable mean-values - Bimetal slave pointers
4	MM_RES4	COIL	- Maximum of THD U/I, TDD I, individual harmonics
5	MM_RES5	COIL	- Maximum values of imbalance analysis

4.8 Present state of limit values

Address 0x	Name	Type	Description	
100	LIMIT_ST1	COIL	State of limit value 1 (0=OFF, 1=ON)	read only
101	LIMIT_ST2		State of limit value 2 (0=OFF, 1=ON)	
102	LIMIT_ST3		State of limit value 3 (0=OFF, 1=ON)	
103	LIMIT_ST4		State of limit value 4 (0=OFF, 1=ON)	
104	LIMIT_ST5		State of limit value 5 (0=OFF, 1=ON)	
105	LIMIT_ST6		State of limit value 6 (0=OFF, 1=ON)	
106	LIMIT_ST7		State of limit value 7 (0=OFF, 1=ON)	
107	LIMIT_ST8		State of limit value 8 (0=OFF, 1=ON)	
108	LIMIT_ST9		State of limit value 9 (0=OFF, 1=ON)	
109	LIMIT_ST10		State of limit value 10 (0=OFF, 1=ON)	
110	LIMIT_ST11		State of limit value 11 (0=OFF, 1=ON)	
111	LIMIT_ST12		State of limit value 12 (0=OFF, 1=ON)	

4.9 Present state of monitoring functions

Address 0x	Name	Type	Description	
140	MFUN_ST1	COIL	State of monitoring function 1 (0=inactive, 1=active)	read only
141	MFUN_ST2		State of monitoring function 2 (0=inactive, 1=active)	
142	MFUN_ST3		State of monitoring function 3 (0=inactive, 1=active)	
143	MFUN_ST4		State of monitoring function 4 (0=inactive, 1=active)	
144	MFUN_ST5		State of monitoring function 5 (0=inactive, 1=active)	
145	MFUN_ST6		State of monitoring function 6 (0=inactive, 1=active)	
146	MFUN_ST7		State of monitoring function 7 (0=inactive, 1=active)	
147	MFUN_ST8		State of monitoring function 8 (0=inactive, 1=active)	

4.10 Present state of digital inputs

Address 0x	Name	Type	Description	
180	DI0_1_ST	COIL	State digital input 0.1 (0=inactive, 1=active)	read only
200	DI1_1_ST		State digital input 1.1 (0=inactive, 1=active)	
201	DI1_2_ST		State digital input 1.2 (0=inactive, 1=active)	
202	DI1_3_ST		State digital input 1.3 (0=inactive, 1=active)	
203	DI1_4_ST		State digital input 1.4 (0=inactive, 1=active)	
204	DI2_1_ST		State digital input 2.1 (0=inactive, 1=active)	
205	DI2_2_ST		State digital input 2.2 (0=inactive, 1=active)	
206	DI2_3_ST		State digital input 2.3 (0=inactive, 1=active)	
207	DI2_4_ST		State digital input 2.4 (0=inactive, 1=active)	
208	DI3_1_ST		State digital input 3.1 (0=inactive, 1=active)	
209	DI3_2_ST		State digital input 3.2 (0=inactive, 1=active)	
210	DI3_3_ST		State digital input 3.3 (0=inactive, 1=active)	
211	DI3_4_ST		State digital input 3.4 (0=inactive, 1=active)	
212	DI4_1_ST		State digital input 4.1 (0=inactive, 1=active)	
213	DI4_2_ST		State digital input 4.2 (0=inactive, 1=active)	
214	DI4_3_ST		State digital input 4.3 (0=inactive, 1=active)	
215	DI4_4_ST		State digital input 4.4 (0=inactive, 1=active)	

4.11 Summary alarm

The summary alarm represents the over-all alarm state of the device. It is the AND combination of all defined monitoring functions enabled for the summary alarm and is active if at least one function is in the alarm state. The summary alarm is used for showing the alarm state on the display and can also activate a logic output (e.g. digital output or relay).

Via interface the summary alarm may be influenced as follows:

- **Resetting** the logic output of the summary alarm: The output will be reset even if there summary alarm is active.

Address 0x	Name	Type	Description
170	SA_STATE	COIL	State of summary alarm (0=inactive, 1=active)
171	SA_RES_STATE	COIL	Logic output of summary alarm (0=inactive or reset, 1=active)
20	SA_RESET	COIL	For **Resetting** the logic output of the summary alarm

5 Energy meters

Meter contents may be read in two different formats:

- REAL64 numbers (4 registers per value): High resolution
- REAL32 numbers (2 registers per value): Reduced resolution

All meter contents are scaled in the basic unit of the appropriate base quantity

5.1 Meter contents of standard quantities

Reading [REAL64]	Reading [REAL32]	Writing [REAL64]	Name	14	2L	3G	3G	3U	3A	4U	4O	Description
2600	4100	2750	P_I_IV_HT	●	●	●	●	●	●	●	●	Active energy QI+IV, high tariff [Wh]
2604	4102	2754	P_II_III_HT	●	●	●	●	●	●	●	●	Active energy QII+III, high tariff [Wh]
2608	4104	2758	Q_I_II_HT	●	●	●	●	●	●	●	●	Reactive energy QI+II, high tariff [varh]
2612	4106	2762	Q_III_IV_HT	●	●	●	●	●	●	●	●	Reactive energy QIII+IV, high tariff [varh]
2616	4108	2766	P_I_IV_LT	●	●	●	●	●	●	●	●	Active energy QI+IV, low tariff [Wh]
2620	4110	2770	P_II_III_LT	●	●	●	●	●	●	●	●	Active energy QII+III, low tariff [Wh]
2624	4112	2774	Q_I_II_LT	●	●	●	●	●	●	●	●	Reactive energy QI+II, low tariff [varh]
2628	4114	2778	Q_III_IV_LT	●	●	●	●	●	●	●	●	Reactive energy QIII+IV, low tariff [varh]

- All values implemented as REAL64 numbers (4 registers per value).

5.2 Meter contents of user-defined quantities

Reading [REAL64]	Reading [REAL32]	Writing [REAL64]	Name	Description
2640	4120	2790	METER1_HT	User-defined meter 1, high tariff
2644	4122	2794	METER2_HT	User-defined meter 2, high tariff
2648	4124	2798	METER3_HT	User-defined meter 3, high tariff
2652	4126	2802	METER4_HT	User-defined meter 4, high tariff
2656	4128	2806	METER5_HT	User-defined meter 5, high tariff
2660	4130	2810	METER6_HT	User-defined meter 6, high tariff
2664	4132	2814	METER7_HT	User-defined meter 7, high tariff
2668	4134	2818	METER8_HT	User-defined meter 8, high tariff
2672	4136	2822	METER9_HT	User-defined meter 9, high tariff
2676	4138	2826	METER10_HT	User-defined meter 10, high tariff
2680	4140	2830	METER11_HT	User-defined meter 11, high tariff
2684	4142	2834	METER12_HT	User-defined meter 12, high tariff

Reading [REAL64]	Reading [REAL32]	Writing [REAL64]	Name	Description
2688	4144	2838	METER1_NT	User-defined meter 1, low tariff
2692	4146	2842	METER2_NT	User-defined meter 2, low tariff
2696	4148	2846	METER3_NT	User-defined meter 3, low tariff
2700	4150	2850	METER4_NT	User-defined meter 4, low tariff
2704	4152	2854	METER5_NT	User-defined meter 5, low tariff
2708	4154	2858	METER6_NT	User-defined meter 6, low tariff
2712	4156	2862	METER7_NT	User-defined meter 7, low tariff
2716	4158	2866	METER8_NT	User-defined meter 8, low tariff
2720	4160	2870	METER9_NT	User-defined meter 9, low tariff
2724	4162	2874	METER10_NT	User-defined meter 10, low tariff
2728	4164	2878	METER11_NT	User-defined meter 11, low tariff
2732	4166	2882	METER12_NT	User-defined meter 12, low tariff

5.3 Meter contents of digital inputs

Reading [REAL64]	Reading [REAL32]	Writing [REAL64]	Name	Description
2940	3080	3160	M1_1_HT	Meter content 1.1, high tariff
2944	3082	3164	M1_2_HT	Meter content 1.2, high tariff
2948	3084	3168	M1_3_HT	Meter content 1.3, high tariff
2952	3086	3172	M1_4_HT	Meter content 1.4, high tariff
2956	3088	3176	M2_1_HT	Meter content 2.1, high tariff
2960	3090	3180	M2_2_HT	Meter content 2.2, high tariff
2964	3092	3184	M2_3_HT	Meter content 2.3, high tariff
2968	3094	3188	M2_4_HT	Meter content 2.4, high tariff
2972	3096	3192	M3_1_HT	Meter content 3.1, high tariff
2976	3098	3196	M3_2_HT	Meter content 3.2, high tariff
2980	3100	3200	M3_3_HT	Meter content 3.3, high tariff
2984	3102	3204	M3_4_HT	Meter content 3.4, high tariff
2988	3104	3208	M4_1_HT	Meter content 4.1, high tariff
2992	3106	3212	M4_2_HT	Meter content 4.2, high tariff
2996	3108	3216	M4_3_HT	Meter content 4.3, high tariff
3000	3110	3220	M4_4_HT	Meter content 4.4, high tariff
3004	3112	3224	M1_1_NT	Meter content 1.1, low tariff
3008	3114	3228	M1_2_NT	Meter content 1.2, low tariff
3012	3116	3232	M1_3_NT	Meter content 1.3, low tariff
3016	3118	3236	M1_4_NT	Meter content 1.4, low tariff
3020	3120	3240	M2_1_NT	Meter content 2.1, low tariff
3024	3122	3244	M2_2_NT	Meter content 2.2, low tariff
3028	3124	3248	M2_3_NT	Meter content 2.3, low tariff
3032	3126	3252	M2_4_NT	Meter content 2.4, low tariff
3036	3128	3256	M3_1_NT	Meter content 3.1, low tariff
3040	3130	3260	M3_2_NT	Meter content 3.2, low tariff
3044	3132	3264	M3_3_NT	Meter content 3.3, low tariff
3048	3134	3268	M3_4_NT	Meter content 3.4, low tariff
3052	3136	3272	M4_1_NT	Meter content 4.1, low tariff
3056	3138	3276	M4_2_NT	Meter content 4.2, low tariff
3060	3140	3280	M4_3_NT	Meter content 4.3, low tariff
3064	3142	3284	M4_4_NT	Meter content 4.4, low tariff

► Digital inputs are available for device versions with appropriate input modules only

5.4 Present tariff of meters

The device supports two tariffs, high and low tariff. The same tariff is used for both, standard meters and free selectable meters. The tariff can be defined via digital input 0.1. The present state of this digital input therefore represents the active tariff.

Reading [COIL]	Name	Description	
180	DIGIN0_1	**Tariff situation** 0: high tariff 1: low tariff	read only

6 Operating hour counters

The operating hour counters have a resolution of [s]. This allow to measure operating times up to 136 years, whereby an overflow is excluded.

The operating hour counter of the device itself starts to count as soon as the power supply is applied to the device. The meter is designed as endless counter and can't be reset.

The resettable operating hour counters 1...3 count if the associated condition is fulfilled. Possible conditions are:

- always (power supply switched on)
- never (counter inactive)
- if a measured value goes above or below a certain limit value
- fulfilled monitoring function

Reading [UINT32]	**Reset** [COIL]	**Description**	**Description**
2740	-	OPR_CNTR	Operating hour counter of the device [s]
2742	30	OPR_CNTR1	Resettable operating hour counter 1 [s]
2744	31	OPR_CNTR2	Resettable operating hour counter 2 [s]
2746	32	OPR_CNTR3	Resettable operating hour counter 3 [s]

The resettable operating hour counters are available for AM1000 and AM3000 only

7 Remote interface

All relays or digital outputs **not used** for the normal device functionality may be used for other purposes. Driving is performed via the configuration interface, e.g. by means of a Modbus master software.

Address 0x	Name	Type	Description	
50	STAT_O1	COIL	State of digital output 0.1	write only
51	STAT_O2	COIL	State of digital output 0.2	
52	STAT_O3	COIL	State of relay 1.1	
53	STAT_O4	COIL	State of relay 1.2	
54	STAT_O5	COIL	State of relay 2.1	
55	STAT_O6	COIL	State of relay 2.2	
56	STAT_O7	COIL	State of relay 3.1	
57	STAT_O8	COIL	State of relay 3.2	
58	STAT_O9	COIL	State of relay 4.1	
59	STAT_O10	COIL	State of relay 4.2	

► The relay outputs are available for device versions with appropriate relay modules only

Analog outputs

Address 4x	Name	Type	Description	
2900	AOUT1_1	REAL32	Analog output 1.1 [mA]	write only
2902	AOUT1_2	REAL32	Analog output 1.2 [mA]	
2904	AOUT1_3	REAL32	Analog output 1.3 [mA]	
2906	AOUT1_4	REAL32	Analog output 1.4 [mA]	
2908	AOUT2_1	REAL32	Analog output 2.1 [mA]	
2910	AOUT2_2	REAL32	Analog output 2.2 [mA]	
2912	AOUT2_3	REAL32	Analog output 2.3 [mA]	
2914	AOUT2_4	REAL32	Analog output 2.4 [mA]	
2916	AOUT3_1	REAL32	Analog output 3.1 [mA]	
2918	AOUT3_2	REAL32	Analog output 3.2 [mA]	
2920	AOUT3_3	REAL32	Analog output 3.3 [mA]	
2922	AOUT3_4	REAL32	Analog output 3.4 [mA]	
2924	AOUT4_1	REAL32	Analog output 4.1 [mA]	
2926	AOUT4_2	REAL32	Analog output 4.2 [mA]	
2928	AOUT4_3	REAL32	Analog output 4.3 [mA]	
2930	AOUT4_4	REAL32	Analog output 4.4 [mA]	

► Analog outputs are available for device versions with appropriate analog output modules only