Modbus-TCP and Modbus-RTU protocol documentation for panel meters, power quality analyzers and power factor controllers

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PA 144, SML 133,

SMC 118, SMC 133, SMC 144, SMY 133, SMY 134, SMP 133, SMZ 133,

SMC 235, SMC 233, ARTIQ 235, ARTIQ 233, BC 235, BCPM 233, EMU 3, SMZ 244,

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1.1	28.6.2019	>3.0.21	Corrections of 0x4E00-0x4EFA block
1.2	1.12.2019	3.0.28+ / 3.3.2+	Voltage Event archive over modbus

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1 Communication Options

Each device is equipped with RS-485 or USB local port and various other remote communication ports. The USB port can be used for data acquisition, configuration and status checks using the proprietary protocol supported by the ENVIS software suite. With the remote serial communication Modbus RTU or TCP is supported respectively to provide easy and open access to all actual measured values.

With serial lines the protocol is recognised automatically between proprietary KMB messages and the standard ModBus RTU. For this option the device address, baud rate and parity bit must be specified (see user manual for details). A gap between bytes corresponding to maximum 1.5 characters (bytes) is allowed while receiving a command or transmitting a reply.

With Ethernet option different application access different ports on its designated addresses. Modbus TCP, KMB protocol and web server is supported by default. Modbus master (MM) and Ethernet-to-serial Gateway (ES) can be optionaly activated. For Modbus TCP the listening port can be configured together with other TCP/IP settings (default port: 502). The instrument sends back a reply within 200 ms time frame after receiving each command. At least three parallel connections from different masters can be processed simultaneously by each device. Between each master and the instrument the communication must follow the single request-reply schema. Master should wait for each reply before submitting a new request.

2 Description of Modbus Implementation

2.1 Supported Standard Functions

- 3 (0x03) read holding registers
- 4 (0x04) read input registers
- 16 (0x10) write multiple registers

2.2 Supported Custom Functions

Some instruments with enabled UP fw. module also support a set of custom Modbus functions to enable remote access to the several archives (see ch. 3.5).

- 100 (0x64) read archived average value
- 101 (0x65) read archived minimum value
- 102 (0x66) read archived maximum value

2.3 Modbus Quantity Encoding

Access to data structure components is provided using read/write from/to relevant registers as shown in the chart in the following subsections. Modbus protocol is based on variable mappings into 16 bit registers. Single-byte quantities are stored in such a register in the format of 0x00nn where nn is a single-byte parameter. For multi-byte quantities the byte ordering is a big endian. 32-bit and 64-bit integers and floats are ordered in consequent 16-bit registers from MSB to LSB serially. Floats are encoded using the IEEE 754 float number format. You can see example below, encoded number in example is 0.1875.

bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
meaning	sign	exponent (8 bits)								fraction (23 bits)																						
example	0	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Double precision number format has 64 bits and is coded same as float with exponent 11 bits and 52 bit fraction.

Date and time is stored in 64-bit or 32-bit KMBTime format. Its value means number of miliseconds (64b) or seconds (32b) since 1.1.2000 00:00 UTC. ANSI C, C++ and .NET C# functions (sample code) can be provided upon request.

Each logical block of values is stored within the array of registers starting at the base address (organised as chapters and sections in this document).

2.4 Addressing

The "broadcast" mode is not supported. Instead, with Modbus Master module, the address 0 in its configuration represents data from the master itself. Standard Modbus addressing applies for all three phase single feeder analysers.

Instruments with multiple feeders and some multi-channel single phase instruments do limit the allowable base address range for an instrument between 1 - 20. The rest of Modbus address ranges 21-240 is reserved to mirror the register map for quantities from feeders (channels) 2 to 12. Correct Modbus address for channel X is determined by this formula: $ModbusAddressX = (X - 1) \times 20 + ModbusAddressBase$.

2.5 Example

Modpoll is a free open source tool for Windows, Linux and Solaris available free of charge for download. We promote this 3rd-party tool for reference testing of our Modbus implementation. The following examples can be used as a starting point for developing of a custom support implementation and for debugging other issues.

2.5.1 Modbus TCP Examples

Code to display device number with:

```
modpoll -m tcp -a 1 -r 528 -t 3:int -i -c 1 -1 -0 -p 502 IP
```

Default value for port number (parameter *-p*) is 502 and isn't necessary to explicitly specify it. Default value for slave address (*-a*) is 1. Shorter version with same meaning:

```
modpoll -r 528 -t 3:int -i -c 1 -1 -0 IP
```

Command *-1* means only one iteration, *-0* selects Modbus PDU addressing mode[1] and *-c 1* is number of retrieved values. Used data type is specified with parameter *-t*: *-t 3* = 16 bit integer, *-t 3:hex* = 16 bit hexadecimal value, *-t 3:int* = 32 bit integer, *-t 3:float* = 32-bit float. Similar output with number 4. Parameter *-r* is base address.

2.5.2 Modbus RTU Examples

RTU variant is similar:

```
modpoll -m rtu -b 19200 -d 8 -s 1 -p none -a 1 -r 528 -t 3:int -c 1 -i -1 -0 COM
```

Default values data bits *-d* is *8*, stop bits *-s* is *1*, parity *-p* is *even*, but default values for KMB devices is *none*, therefore it is usually necessary to set it. Default baud rate *-b* is 19200. Usual command is simple:

[1] Software Modpoll uses Modbus data model as default addressing mode, where register addresses in each block always starts from 1. Without *-0* parameter it would be necessary to increse every address by one.

```
modpoll -m rtu -p none -r 528 -c 1 -t 3:int -i -1 -0 COM
```

Full help is available with command:

```
modpoll --help
```

2.5.3 Other examples

Read all Voltage values - example of float values (full output):

```
$ modpoll -r 4352 -c 4 -t 3:float -f -1 -0 10.0.0.60
modpoll 3.4 - FieldTalk(tm) Modbus(R) Master Simulator
Copyright (c) 2002-2013 proconX Pty Ltd
Visit http://www.modbusdriver.com for Modbus libraries and tools.

Protocol configuration: MODBUS/TCP
Slave configuration...: address = 1, start reference = 4352 (PDU), count = 4
Communication.........: 10.0.0.60, port 502, t/o 1.00 s, poll rate 1000 ms
Data type.............: 32-bit float, input register table
Word swapping.........: Slave configured as big-endian float machine

-- Polling slave...
[4352]: 236.074005
[4354]: 236.056198
[4356]: 236.089401
[4358]: 236.033752
```

Read Device number and software, hardware and bootloader versions - example of integer values (shortened output):

```
$ modpoll -r 528 -c 4 -t 3 -f -1 -0 147.230.72.5
...
-- Polling slave...
[528]: 0          => SN = 7
[529]: 7
[530]: 3          => FW = 3.0.10.4478
[531]: 0
[532]: 10
[533]: 4478
[534]: 2          => HW = 2.0.0.0
[535]: 0
[536]: 0
[537]: 0
[538]: 4          => BL = 4.0.0.0
[539]: 0
[540]: 0
[541]: 0
```

2.6 Modbus RTU encapsulated over Ethernet

Since the fw. 3.0 the conversion between RTU and TCP will automatically hapen on the Modbus Ethernet port. So if a Modbus TCP request arrives over Ethernet it is treated as Modbus TCP. If a correct Modbus RTU packet data arrives on the Modbus port over Ethernet, the answer is also encoded as Modbus RTU.

2.7 Modbus TCP and Modbus RTU over ES module

Ethernet-to-serial (ES) module converts communication between Ethernet and serial interface. It can often be intended to read out Modbus RTU data from slaves connected on the local serial line. Instrument configuration offers two distinct options:

```
Without RTU <-> TCP conversion:
RTU - request 01 04 12 00 00 02 74 B3
TCP - request 00 00 00 00 00 06 01 04 12 00 00 02

With RTU <-> TCP conversion:
RTU - request 01 04 12 00 00 02 74 B3
TCP - request 01 04 12 00 00 02 74 B3
```

RTU request remains same as received no matter if the RTU<->TCP conversion is turned on or off. TCP request is converted to RTU if the RTU<->TCP conversion is turned on. The reply is also translated accordingly.

3 Modbus Register Map

Mapped register block	Base address		Type
	DEC	HEX	
Autentification	0	0x0000	holding register
Real-time Clock (RTC)	256	0x0100	input/holding
Identification	512	0x0200	input register
Archive Control Block	768	0x0300	input/holding
Counter Control Block	1536	0x0600	input/holding
Configurable Settings	1792	0x0700	holding register
Read-only Settings	2048	0x0800	input register
Actual Data	4096	0x1000	input register
Electricity Meter	8192	0x2000	input register
Aggregated Values	16384	0x4000	input register
Residual Current Monitoring	19712	0x4D00	input register
Max. Demand	19968	0x4E00	input register
Power Quality Indices	20480	0x5000	input register
Ripple Control Signals	21248	0x5300	input register
Modbus Master	24576	0x6000	input register
Actual data - DC and AC/DC	25088	0x6200	input register
Inputs & Outputs	36864	0x9000	input register
Actual Data - PFC	40960	0xA000	input register

3.1 0x0000 Authentication

If the instrument authentication feature is enabled, Modbus client may be required to write the username and PIN into a special modbus registers to unlock the communication. By default, this function is disabled. How to enable and control the authentication options please see the KMB_AppNote_0004, available online or through our support channels. Authentication features in instruments are generally available since the fw 3.0.

Table 1: Example login credentials.

	Example	Encoding	Hexadecimal
PIN	123456789	Unsigned 32 bit	0x075BCD15
Username	Albert	ASCII string	0x41 0x6C 0x62 0x65 0x72 0x75 0x00

Table 2: Example credentials assigned to modbus registers.

	PIN		Username						
	MSB	LSB	Char. 1, 2	3, 4	5, 6	7, 8	9, 10	11, 12	13, '\0'
Address	0x0	0x01	0x02	0x03	0x04	0x05	0x06	0x07	0x08
Data	0x075B	0xCD15	0x416C	0x6265	0x7275	0x0000	Don't care		

If the *GUEST* user does not have *Modbus Read* and/or *Modbus Write* permission, the procedure below is required.

1. Write a *username* and *PIN* of the user with *Modbus Read* or *Modbus Write* persmission to the register range 0 through 8 as illustrated in table 1 and 2. The *PIN* is encoded as unsigned 32-bit number into two registers. The *username* is encoded as ASCII characters ending with 0 (NULL) with two letters per register. It is expected that both the pin and username are in the big-endian format. The *username*, *PIN* or both together have to be sent in a single Modbus message.
2. Continue as usual.
3. Write 0x00000000 to the *PIN* registers — immediately disables any potential illegal communication. This happens automatically one hour after the pin is entered.

All modbus login registers are write-only.

3.2 0x0100 Device Real-time Clock Control (RTC)

In fw. 3.0.11+ this new information and control block is implemented. Time can be read, set or adjusted with the following registers and with propper authentication.

The adjustment only works within 26 hours of time difference between instrument time end the adjusted one. Requests to adjust time with any bigger difference are ignored. Succesfull adjustment should be checked by reading and comparing the register again.

Mapped data	Base address		Size/type	Encoding
	DEC	HEX		
get/set time Unix	256	0x0100	64b	Unix Time (ms)
get/set time KMB GMT	260	0x0104	64b	KMBTime (GMT)
get/set time KMB local	264	0x0108	64b	KMBTime (local)
get/adjust time Unix	272	0x0110	64b	Unix Time (ms)
get/adjust time KMB GMT	276	0x0114	64b	KMBTime (GMT)
get/adjust time KMB local	280	0x0118	64b	KMBTime (local)
Time set last	288	0x0120	64b	KMBTime GMT
Time adjusted last	292	0x0124	64b	KMBTime GMT
Time zone	296	0x0128	16b	0..24, 12 = GMT
Summer time	297	0x0129	16b	1 .. Enabled
Time sync. 1	298	0x012A	16b	0 - none, 1 - PPS, 2 - PPM, 3 - NMEA, 4 - NTP, 5 - Freq
Time sync. 2	299	0x012B	16b	0x0F - DI, 0x80 - PPS/PPM, 0x40 - 1/0
NTP server	300	0x012C	32b	a.b.c.d

3.3 0x0150 Aggregation

Mapped data	Base address		Size/type	Encoding
	DEC	HEX		
U, I AVG method	336	0x0150	16b	0:fixed, 1:floating, 2:termal function
U, I evaluation interval	337	0x0151	16b	0: in interval, 1: clear by user
U, I AVG period	338	0x0152	32b	200 ms step
U, I Min/Max reset	340	0x0154	32b	see 'Reset methods' bellow...
P,Q AVG method	342	0x0156	16b	0:fixed, 1:floating, 2:termal function
P, Q evaluation interval	343	0x0157	16b	0: in interval, 1: clear by user
P,Q AVG period	344	0x0158	32b	200 ms step
P,Q Min/Max reset	346	0x015A	32b	see 'Reset methods' bellow...
Demand AVG method	348	0x015C	16b	0:fixed, 1:floating, 2:termal function
Demand evaluation interval	349	0x015D	16b	0: day,1: week,2: month,3: quarter,4: year
Demand AVG period	350	0x015E	32b	second
Demand limit (3p)	352	0x0160	32b, floeat	W
I_{rcm} AVG period	354	0x0162	32b	200 ms step
I_{rcm} Min/Max reset	356	0x0164	32b	see 'Reset methods' bellow...

Reset methods:

0xFFFFFFFF: manual,

<60: seconds,

<60*60: minutes,

<86400: hours,

=86400: every day,

=86400*7: every week,

=86400*30: every month,

=86400*365: every year

3.4 0x0200 Device Identification

Change notification: in the fw 3.0.8 and following the firmware, hardware and bootloader version register address and value encoding was changed to reflect the 3.0 versioning.

Mapped data	Base address		Size/type	Encoding
	DEC	HEX		
Run Time	512	0x0200	64b	KMBTime
GMT Time	516	0x0204	64b	KMBTime
PROPS_TYPE	520	0x0208	16b	
DEVICE_TYPE	521	0x0209	16b	
SUBDEVICE TYPE 1	522	0x020A	16b	
SUBDEVICE TYPE 2	523	0x020B	16b	
SUBDEVICE TYPE 3	524	0x020C	16b	
SUBDEVICE TYPE 4	525	0x020D	16b	
SUBDEVICE TYPE 5	526	0x020E	16b	
SUBDEVICE TYPE 6	527	0x020F	16b	
DEVICE_NUMBER	528	0x0210	32b	
Firmware version	530	0x0212	64b	a.b.c.d
Hardware version	534	0x0216	64b	a.b.0.0
Bootloader version	538	0x021A	64b	a.b.0.0
Active firmware modules	542	0x021E	32b	

PROPS_TYPES and DEVICE_TYPES bellow is a list of the most common device types. Other options may exist and are not listed. In such case please contact our support for further information. Props type defines a group of similar instruments (family), device type specifies the exact instrument and sub device type 1 to 6 may specify detailed option information.

Props type 0x2001 IO modules family

- **device type: 0x101x** MIO 4410
- **device type: 0x102x** MIO 4000

Props type 0x0030 Standard panel PQ analyser family (line 1xx)

- **device type: 0x81xx** SML 133
- **device type: 0x82xx** SMY 133
- **device type: 0x83xx** SMZ 133
- **device type: 0x84xx** SMP 133
- **device type: 0x85xx** SMY 134

Props type 0x0040 Novar power factor controllers

Props type 0x0050: Standard din rail PQ and power analyser family (line 1xx)

- **device type: 0x3xxx** SMC 144
- **device type: 0x4xxx** PA 144
- **device type: 0x5xxx** SMC 133
- **device type: 0x81xx** SMC 118
- **device type: 0x84xx** SMC 112
- **device type: 0x87xx** SMC 114

Props type 0x0100 The high-end PQ analyser family (line 2xx)

- **device type: 0x20xx** ARTIQ 235
- **device type: 0x30xx** SMC 235
- **device type: 0x40xx** BC 235
- **device type: 0x50xx** SMC 233
- **device type: 0x60xx** SMZ 244
- **device type: 0x70xx** ARTIQ 233

Version information

FW, HW and BOOTLOADER version:

- **a** is a generation number,
- **b** is incremented with every major update,
- **c** is incremented with every public release
- **d** is internal revision number.

Active firmware modules:

- **0x01** RCS module
- **0x02** GO module
- **0x04** MM module
- **0x08** ES module
- **0x20** PQ-A or PQ-S module
- **0x80** reserved (true in fw. v. 3.0)
- **0x200** UP module

3.5 0x0300 Archive Control Block

Change notification: Basic functionality is available since fw 3.0.8 and is a subject to further modifications.

Functions to read out historical values from archive files in the instrument are described in the following section. The functionality is available in instruments with internal archive and with the UP module enabled in firmware. Availability of the specific archived data is controlled via the following register control blocks for each archive type:

Archive Type	Implemented	Base address	
		DEC	HEX
Main	YES	768	0x0300
S-profile	x	784	0x0310
M-profile	x	800	0x0320
Log	x	816	0x0330
PQ Main	x	832	0x0340
Voltage Events	YES	848	0x0350
Electricity Meter	YES	864	0x0360
reserved	x		
reserved	x		
reserved	x		
reserved	x		
General Oscillograms	x	928	0x03A0
reserved	x		
Modbus	x	960	0x03C0
Histogram	x	976	0x03D0
V-Dip	x	992	0x03E0
Event Log	x	1008	0x03F0
Trends	x	1024	0x0400

For each archive the control registers are as follows. Modbus function 4 is supported to read the value, and Modbus function 16 to write the value. The following table show an example for main archive registers.

Archive Type	Base address		Size	Type	Function 16	
Main archive	DEC	HEX			Value	Action
Record time	768	0x0300	u64	KMB time	0x1 0x2 0x3-0xFF(..)FE 0xFF(..)FF	go to the next record go to the previous record go to nearest record after ... go to the newest record with auto-scroll
First time	772	0x0304	u64	KMB time	N/A	
Last time	776	0x0308	u64	KMB time	N/A	
Nr. of records	780	0x030C	u32		0xFF(..)FF	clear archive
Record interval	782	0x030E	u32	ms	N/A	

Reading out archive values is performed with a custom Modbus function 100 over the same set of registers as for actual data (Modbus fn. 4). If a value for an inspected quantity is not available in archive or it is not defined at all, the (float or double) not-a-number value is returned in the respective register.

Supported values are implemented on respective register blocks starting at

- 0x1000, 0x1100, 0x1200 and 0x1300 for main archive,
- 0x2000, 0x2400, 0x2800 and 0x2B00 for electricity meter archive,
- 0x5500 for voltage event archive. In case there are multiple events stored with same timestamp, first of them is listed why accesing it's time stamp. Write 0x01 or 0x02 to 0x0350 to list other.

3.6 0x0600 Reset of values

Reset of time dependent values such as AVG, Min/Max, Energy meter, RCM, Voltage events table. Use function 4 to read time and function 16 to erease the values.

Mapped data	Base address		Size/type	Function 16
	DEC	HEX		
Last Energy meter clear time	1536	0x0600	u32, KMB time	write anything to reset
Last AVG, min/max U, I clear time	1538	0x0602	u32, KMB time	write anything to reset
Last AVG, min/max P, Q clear time	1540	0x0604	u32, KMB time	write anything to reset
Last Demad clear time	1542	0x0606	u32, KMB time	write anything to reset
Last RCM clear time	1544	0x0608	u32, KMB time	write anything to reset
Last voltage event table clear time	1546	0x060A	u32, KMB time	write anything to reset

3.7 0x0700 Configurable Settings

The configurable settings as provided in the following table can be modified by the Modbus function 16 - Write Multiple Registers. When device receives a message with such function, all related registers are stored. If necessary the soft erase action is performed prior to sending an answer to the request. The need for this action is implied by the change to certain registers - see column „Soft Erase". The change is then also written to the device log for further reference.

Mapped data	Base address		Size/type	Soft Erase
	DEC	HEX		
Connection Type	1792	0x0700	16b	Yes
Connection Mode	1793	0x0701	32b	Yes
Nominal Frequency	1795	0x0703	32b, float	Yes
Nominal voltage U_{nom}	1797	0x0705	32b, float	Yes
Nominal power P_{nom} (3P)	1799	0x0707	32b, float	Yes
Primary VT	1801	0x0709	16b	Yes
Secondary VT	1802	0x070A	16b	Yes
Multiplier VT	1803	0x070B	32b, float	Yes
Primary VTN	1805	0x070D	16b	Yes
Secondary VTN	1806	0x070E	16b	Yes
Multiplier VTN	1807	0x070F	32b, float	Yes
Primary CT	1809	0x0711	16b	Yes
Secondary CT	1810	0x0712	16b	Yes
Multiplier CT	1811	0x0713	32b, float	Yes
Primary CTN	1813	0x0715	16b	Yes
Secondary CTN	1814	0x0716	16b	Yes
Multiplier CTN	1815	0x0717	32b, float	Yes
Nominal current I_{nom}	1817	0x0719	32b, float	Yes

3.8 0x0800 Read-only Settings

If device doesn't have certain interface, appropriate addresses will be inaccessible.

3.8.1 0x0800 COM1

- COM Modbus Master indicates which port is used for Modbus Master module if is used. Indexed from zero, COM1 = 0, COM2 = 1.
- Device address: configurable address of the slave unit. 0 and 249..255 are reserved addresses.
- Baud rate: speed of communication in bauds per second.
- Parity: 0 = none, 1 = even, 2 = odd.
- Data bit + parity: 0 = 8 data bits + no parity, 1 = 8 data bits + 1 parity bit (odd or even).
- Stop bit: 0 = one stop bit, 1 = two stop bits.

Mapped data	Base address		Size/type
	DEC	HEX	
COM Modbus Master	2048	0x0800	16b
Device Address	2049	0x0801	16b
Baud Rate	2050	0x0802	32b, uint
Parity	2052	0x0804	16b
Data Bits + parity	2053	0x0805	16b
Stop Bit	2054	0x0806	16b

3.8.2 0x0820 COM2

Mapped data	Base address		Size/type
	DEC	HEX	
Device Address	2080	0x0820	16b
Baud Rate	2081	0x0821	32b
Parity	2083	0x0823	16b
Data Bits + parity	2084	0x0824	16b
Stop Bit	2085	0x0825	16b

3.8.3 0x0840 ETH1

- DHCP: 0 = disabled, 1 = enabled.

Mapped data	Base address		Size/type
	DEC	HEX	
DHCP	2112	0x0840	16b
IP Address	2113	0x0841	32b
Netmask	2115	0x0843	32b
Gateway	2117	0x0845	32b
KMB Port	2119	0x0847	16b
Modbus Port	2120	0x0848	16b
Webserver Port	2121	0x0849	16b
MAC	2122	0x084A	64b

3.9 0x1000 Actual Data

3.9.1 0x1000 Shared Actual Data

Config Change counter counts number of configuration changes and thus can be used to detect any change in instrument configuration.

Error code - 32 bits indicating actual status of the instrument operation - value 0 of a given bit indicates correct operation, value 1 indicates a possible problem.

- **0x01** RAM error
- **0x02** instrument configuration error
- **0x04** instrument callibration error
- **0x08** remote communication module error (WiFi/ZigBee)
- **0x10** clock error (RTC)
- **0x80** instrument archive error
- **0x100** flash memory error
- **0x200** display error

Phase order detects an actual phase order

- **0** - Unknown
- **1** - correct 1-2-3 order
- **-1** - inverted 1-3-2 order

Sample overflow/underflow flags are set if one or more voltage or current channels measures signal which is out of the channels linearity range. In such case precision is influenced and the measured quantity must be used with extra consideration.

- **0x01, 0x02, 0x04, 0x08** - sampled voltage value in channel 1,2..4 out of range
- **0x10, 0x20, 0x40, 0x80, 0x100, 0x200, 0x400, 0x800** - sampled current value in channel 1,2..4 out of range

Flags - marks if and which actual data measuremnt is influenced by voltage or other events

- **0x01, 0x02, 0x04, 0x08** - voltage, current and powers in channel 1,2..4
- **0x10, 0x20, 0x40, 0x80** - short time flicker in channel 1,2..4
- **0x100, 0x200, 0x400, 0x800** - long time flicker in channel 1,2..4
- **0x1000** - frequency
- **0x2000** - automatic current probe range switchover

Mapped data	Base address		Size/type
	DEC	HEX	
Config Change counter	4096	0x1000	16b
Error code	4097	0x1001	32b
Phase order	4099	0x1003	16b
Actual frequency (f)	4100	0x1004	32b, float
10-second frequency (f10s)	4102	0x1006	32b, float
Sample overflow/underflow flags (per channel)	4104	0x1008	16b
Flags	4105	0x1009	32b

3.9.2 0x1100 Actual Voltage Readings

$THDU_{1-N}$= harmonic distortion, $TIDU_{1-N}$= interharmonic distortion, CF_{U1-N}= Crest factor

Mapped data	Base address		Size/type
	DEC	HEX	
U_{LN1}	4352	0x1100	32b, float
U_{LN2}	4354	0x1102	32b, float
U_{LN3}	4356	0x1104	32b, float
U_N	4358	0x1106	32b, float
U_{LL1}	4360	0x1108	32b, float
U_{LL2}	4362	0x110A	32b, float
U_{LL3}	4364	0x110C	32b, float
$THDU_1$	4366	0x110E	32b, float
$THDU_2$	4368	0x1110	32b, float
$THDU_3$	4370	0x1112	32b, float
$THDU_N$	4372	0x1114	32b, float
$TIDU_1$	4374	0x1116	32b, float
$TIDU_2$	4376	0x1118	32b, float
$TIDU_3$	4378	0x111A	32b, float
$TIDU_N$	4380	0x111C	32b, float
CF_{U1}	4382	0x111E	32b, float
CF_{U2}	4384	0x1120	32b, float
CF_{U3}	4386	0x1122	32b, float
CF_{UN}	4388	0x1124	32b, float
Ufh_1	4390	0x1126	32b, float
Ufh_2	4392	0x1128	32b, float
Ufh_3	4394	0x112A	32b, float
Ufh_N	4396	0x112C	32b, float
φu_1	4398	0x112E	32b, float
φu_2	4400	0x1130	32b, float
φu_3	4402	0x1132	32b, float
φu_N	4404	0x1134	32b, float
u_2	4406	0x1136	32b, float
positive sequence U_1	4408	0x1138	32b, float
negative sequence U_2	4410	0x113A	32b, float
zero sequence U_0	4412	0x113C	32b, float
TDD_{U1}	4414	0x113E	32b, float
TDD_{U2}	4416	0x1140	32b, float
TDD_{U3}	4418	0x1142	32b, float
TDD_{U4}	4420	0x1144	32b, float

3.9.3 0x1200 Actual Current Readings

Mapped data	Base address		Size/type
	DEC	HEX	
I_1	4608	0x1200	32b, float
I_2	4610	0x1202	32b, float
I_3	4612	0x1204	32b, float
I_N or I_4	4614	0x1206	32b, float
$I_{Nc} = \sum_{samples}(I_1, I_2, I_3)$	4616	0x1208	32b, float
$I_{PEc} = \sum_{samples}(I_1, I_2, I_3, I_N)$	4618	0x120A	32b, float
$THD\,I_1$	4620	0x120C	32b, float
$THD\,I_2$	4622	0x120E	32b, float
$THD\,I_3$	4624	0x1210	32b, float
$THD\,I_N$	4626	0x1212	32b, float
$TID\,I_1$	4628	0x1214	32b, float
$TID\,I_2$	4630	0x1216	32b, float
$TID\,I_3$	4632	0x1218	32b, float
$TID\,I_N$	4634	0x121A	32b, float
CF_{I1}	4636	0x121C	32b, float
CF_{I2}	4638	0x121E	32b, float
CF_{I3}	4640	0x1220	32b, float
CF_{IN}	4642	0x1222	32b, float
Ifh_1	4644	0x1224	32b, float
Ifh_2	4646	0x1226	32b, float
Ifh_3	4648	0x1228	32b, float
Ifh_N	4650	0x122A	32b, float
φi_1	4652	0x122C	32b, float
φi_2	4654	0x122E	32b, float
φi_3	4656	0x1230	32b, float
φi_N	4658	0x1232	32b, float
i_2	4660	0x1234	32b, float
positive sequence I_1	4662	0x1236	32b, float
negative sequence I_2	4664	0x1238	32b, float
zero sequence I_0	4666	0x123A	32b, float
3I	4668	0x123C	32b, float
TDD_{I1}	4670	0x123E	32b, float
TDD_{I2}	4672	0x1240	32b, float
TDD_{I3}	4674	0x1242	32b, float
TDD_{I4}	4676	0x1244	32b, float

3.9.4 0x1300 Actual Power Readings

0x1300 Power factor and cos(φ)

Mapped data	Base address		Size/type
	DEC	HEX	
$3PF$	4864	0x1300	32b, float
$3cos(\varphi)$	4866	0x1302	32b, float
PF_1	4868	0x1304	32b, float

Mapped data	Base address		Size/type
	DEC	HEX	
PF_2	4870	0x1306	32b, float
PF_3	4872	0x1308	32b, float
PF_N	4874	0x130A	32b, float
$cos(\varphi)_1$	4876	0x130C	32b, float
$cos(\varphi)_2$	4878	0x130E	32b, float
$cos(\varphi)_3$	4880	0x1310	32b, float
$cos(\varphi)_N$	4882	0x1312	32b, float

0x1314 Active, reactive, apparent and distortion power

Mapped data	Base address		Size/type
	DEC	HEX	
$3P$	4884	0x1314	32b, float
$3Q$	4886	0x1316	32b, float
$3S$	4888	0x1318	32b, float
$3P_{fh}$	4890	0x131A	32b, float
$3Q_{fh}$	4892	0x131C	32b, float
$3D$	4894	0x131E	32b, float
P_1	4896	0x1320	32b, float
P_2	4898	0x1322	32b, float
P_3	4900	0x1324	32b, float
P_N	4902	0x1326	32b, float
Q_1	4904	0x1328	32b, float
Q_2	4906	0x132A	32b, float
Q_3	4908	0x132C	32b, float
Q_N	4910	0x132E	32b, float
S_1	4912	0x1330	32b, float
S_2	4914	0x1332	32b, float
S_3	4916	0x1334	32b, float
S_N	4918	0x1336	32b, float
P_{fh1}	4920	0x1338	32b, float
P_{fh2}	4922	0x133A	32b, float
P_{fh3}	4924	0x133C	32b, float
P_{fhN}	4926	0x133E	32b, float
Q_{fh1}	4928	0x1340	32b, float
Q_{fh2}	4930	0x1342	32b, float
Q_{fh3}	4932	0x1344	32b, float
Q_{fhN}	4934	0x1346	32b, float
D_1	4936	0x1348	32b, float
D_2	4938	0x134A	32b, float
D_3	4940	0x134C	32b, float
D_N	4942	0x134E	32b, float

0x1350 Active power import/export This block has been added in fw 3.0.11 and is only available in SMC 133, 144, 233, 235, ARTIQ 233, 235 a SMY 134 at the moment. Instrument provides different data acording to used modbus function:

Function 3 provides AVG (average) values according to the instrument setup.

Function 4 provides actual (200ms/10 period) values.

Function 100 is custom modbus function that provides AVG value from main archive.

Function 101 is custom modbus function that provides MIN value from main archive.

Function 102 is custom modbus function that provides MAX value from main archive.

Mapped data	Base address		Size/type
	DEC	HEX	
$3P+$	4944	0x1350	32b, float
3P-	4946	0x1352	32b, float
$P1+$	4948	0x1354	32b, float
P2+	4950	0x1356	32b, float
P3+	4952	0x1358	32b, float
P4+	4954	0x135A	32b, float
P1-	4956	0x135C	32b, float
P2-	4958	0x135E	32b, float
P3-	4960	0x1360	32b, float
P4-	4962	0x1362	32b, float

0x1364 Active power in four-quadrants This block has been added in fw 3.0.11 and is only available in SMC 133, 144, 233, 235, ARTIQ 233, 235 a SMY 134 at the moment. Instrument provides different data acording to used modbus function. For details refer to chapter 3.9.4.

Mapped data	Base address		Size/type
	DEC	HEX	
3Pi	4964	0x1364	32b, float
3Pii	4966	0x1366	32b, float
3Piii	4968	0x1368	32b, float
3Piv	4970	0x136A	32b, float
P1i	4972	0x136C	32b, float
P2i	4974	0x136E	32b, float
P3i	4976	0x1370	32b, float
P4i	4978	0x1372	32b, float
P1ii	4980	0x1374	32b, float
P2ii	4982	0x1376	32b, float
P3ii	4984	0x1378	32b, float

Mapped data	Base address		Size/type
	DEC	HEX	
P4ii	4986	0x137A	32b, float
P1iii	4988	0x137C	32b, float
P2iii	4990	0x137E	32b, float
P3iii	4992	0x1380	32b, float
P4iii	4994	0x1382	32b, float
P1iv	4996	0x1384	32b, float
P2iv	4998	0x1386	32b, float
P3iv	5000	0x1388	32b, float
P4iv	5002	0x138A	32b, float

0x1390 Reactive power import/export and inductive/capacitive This block has been added in fw 3.0.11 and is only available in SMC 133, 144, 233, 235, ARTIQ 233, 235 a SMY 134 at the moment. Instrument provides different data acording to used modbus function. For details refer to chapter 3.9.4.

Mapped data	Base address		Size/type
	DEC	HEX	
3QL	5008	0x1390	32b, float
3QC	5010	0x1392	32b, float
3Q+	5012	0x1394	32b, float
3Q-	5014	0x1396	32b, float
Q1L	5016	0x1398	32b, float
Q2L	5018	0x139A	32b, float
Q3L	5020	0x139C	32b, float
Q4L	5022	0x139E	32b, float
Q1C	5024	0x13A0	32b, float
Q2C	5026	0x13A2	32b, float
Q3C	5028	0x13A4	32b, float
Q4C	5030	0x13A6	32b, float
Q1+	5032	0x13A8	32b, float
Q2+	5034	0x13AA	32b, float
Q3+	5036	0x13AC	32b, float
Q4+	5038	0x13AE	32b, float
Q1-	5040	0x13B0	32b, float
Q2-	5042	0x13B2	32b, float
Q3-	5044	0x13B4	32b, float
Q4-	5046	0x13B6	32b, float

0x13B8 Reactive power in four-quadrants This block has been added in fw 3.0.11 and is only available in SMC 133, 144, 233, 235, ARTIQ 233, 235 a SMY 134 at the moment. Instrument provides different data acording to used modbus function. For details refer to chapter 3.9.4.

Mapped data	Base address		Size/type
	DEC	HEX	
3Qi	5048	0x13B8	32b, float
3Qii	5050	0x13BA	32b, float
3Qiii	5052	0x13BC	32b, float
3Qiv	5054	0x13BE	32b, float
Q1i	5056	0x13C0	32b, float
Q2i	5058	0x13C2	32b, float
Q3i	5060	0x13C4	32b, float
Q4i	5062	0x13C6	32b, float
Q1ii	5064	0x13C8	32b, float
Q2ii	5066	0x13CA	32b, float
Q3ii	5068	0x13CC	32b, float
Q4ii	5070	0x13CE	32b, float
Q1iii	5072	0x13D0	32b, float
Q2iii	5074	0x13D2	32b, float
Q3iii	5076	0x13D4	32b, float
Q4iii	5078	0x13D6	32b, float
Q1iv	5080	0x13D8	32b, float
Q2iv	5082	0x13DA	32b, float
Q3iv	5084	0x13DC	32b, float
Q4iv	5086	0x13DE	32b, float

3.9.5 0x1400 Voltage and Current Harmonics (magnitudes, angles)

Mapped data	Base address		Size/type
	DEC	HEX	
$U_{1h1...h50}$	5120...5218	0x1400...0x1462	32b, float
$U_{2h1...h50}$	5220...5318	0x1464...0x14C6	32b, float
$U_{3h1...h50}$	5320...5418	0x14C8...0x152A	32b, float
$U_{Nh1...h50}$	5420...5518	0x152C...0x158E	32b, float
$\varphi U_{1h1...h50}$	5520...5618	0x1590...0x15F2	32b, float
$\varphi U_{2h1 \cdots h50}$	5620...5718	0x15F4...0×1656	32b, float
$\varphi U_{3h1...h50}$	5720...5818	0x16BC...0x171E	32b, float
$\varphi U_{Nh1...h50}$	5820..5918	0x1720...0x1782	32b, float
$I_{1h1...h50}$	5920...6018	0x1784...0x17E6	32b, float
$I_{2h1...h50}$	6020...6118	0x17E8...0x184A	32b, float
$I_{3h1...h50}$	6120...6218	0x184C...0x18AE	32b, float
$I_{Nh1...h50}$	6220...6318	0x18B0...0x1912	32b, float
$\Delta\varphi I_{1h1...h50}$	6320...6418	0x1978...0x19DA	32b, float
$\Delta\varphi I_{2h1...h50}$	6420...6518	0x19DC...0x1A3E	32b, float
$\Delta\varphi I_{3h1...h50}$	6520...6618	0x1A40...0x1AA2	32b, float
$\Delta\varphi I_{Nh1...h50}$	6620...6718	0x1AA4...0x1B00	32b, float

3.9.6 0x1B00 Interharmonics (with active PQ module)

Mapped data	Base address		Size/type
	DEC	HEX	
$U_{1ih1...ih50}$	6812...6910	0x1B00...0x1B62	32b, float
$U_{2ih1...ih50}$	6912...7010	0x1B64...0x1BC6	32b, float
$U_{3ih1...ih50}$	7012...7110	0x1BC8...0x1C2A	32b, float
$U_{Nih1...ih50}$	7112...7210	0x1C2C...0x1C8E	32b, float
$I_{1ih1...ih50}$	7212...7310	0x1C90...0x1CF2	32b, float
$I_{2ih1...ih50}$	7312...7410	0x1CF4...0x1D56	32b, float
$I_{3ih1...ih50}$	7412...7510	0x1D58...0x1DBA	32b, float
$I_{Nih1...ih50}$	7512...7610	0x1DBC...0x1E1E	32b, float

3.10 0x2000 Electricity Meter Readings

3.10.1 0x2000 Two-quadrant (2Q, import/export, inductive/capacitive) threee phase active and reactive energy

These summary energies are most often required in all three phase systems.

Energy	Direction/Character	Mapped data	Base address		Size, type
			DEC	HEX	
3-phase active	imported	3EP+	8192	0x2000	64b, double
	exported	3EP-	8196	0x2004	64b, double
3-phase reactive	inductive	3EQL	8200	0x2008	64b, double
	capacitive	3EQC	8204	0x200C	64b, double

3.10.2 0x2010 Two-quadrant (2Q, import/export) single phase active energy

For detailed overview of energy flow we provide also registers for each phase.

Energy	Direction	Mapped data	Base address		Size, type
			DEC	HEX	
active	imported	EP1+	8208	0x2010	64b, double
		EP2+	8212	0x2014	64b, double
		EP3+	8216	0x2018	64b, double
		EP4+	8220	0x201C	64b, double
active	exported	EP1-	8224	0x2020	64b, double
		EP2-	8228	0x2024	64b, double
		EP3-	8232	0x2028	64b, double
		EP4-	8236	0x202C	64b, double

3.10.3 0x2010 Two-quadrant (2Q, inductive/capacitive) single phase reactive energy

Energy	Character	Mapped data	Base address		Size, type
			DEC	HEX	
reactive	inductive	EQL1	8240	0x2030	64b, double
		EQL2	8244	0x2034	64b, double
		EQL3	8248	0x2038	64b, double
		EQL4	8252	0x203C	64b, double
reactive	capacitive	EQC1	8256	0x2040	64b, double
		EQC2	8260	0x2044	64b, double
		EQC3	8264	0x2048	64b, double
		EQC4	8268	0x204C	64b, double

3.10.4 0x2400 Four-quadrant (4Q) three phase reactive energy

Energy	Direction & Character	Mapped data	Base address		Size, type
			DEC	HEX	
3-phase reactive	imported inductive	3EQL+	9216	0x2400	64b, double
	exported inductive	3EQL-	9220	0x2404	64b, double
	imported capacitive	3EQC+	9224	0x2408	64b, double
	exported capacitive	3EQC-	9228	0x240C	64b, double

3.10.5 0x2410 Four-quadrant (4Q) single phase reactive energy

For detailed overview of reactive energy flow we provide also registers for each phase separated by the direction of flow of active power in each phase.

Energy	Direction & Character	Mapped data	Base address		Size, type
			DEC	HEX	
reactive	imported inductive	EQL1+	9232	0x2410	64b, double
		EQL2+	9236	0x2414	64b, double
		EQL3+	9240	0x2418	64b, double
		EQL4+	9244	0x241C	64b, double
reactive	exported inductive	EQL1-	9248	0x2420	64b, double
		EQL2-	9252	0x2424	64b, double
		EQL3-	9256	0x2428	64b, double
		EQL4-	9260	0x242C	64b, double
reactive	imported capacitive	EQC1+	9264	0x2430	64b, double
		EQC2+	9268	0x2434	64b, double
		EQC3+	9272	0x2438	64b, double
		EQC4+	9276	0x243C	64b, double
reactive	exported capacitive	EQC1-	9280	0x2440	64b, double
		EQC2-	9284	0x2444	64b, double
		EQC3-	9288	0x2448	64b, double
		EQC4-	9292	0x244C	64b, double

3.10.6 0x2800 Two-quadrant (2Q, import/export) three phase active energy per tariff

Tarif (TOU) represents an interval of time during day with a special energy rate. Number of such registers is given by configuration. Number of tarifs can be configured between 1 and 6 (T1,T2,...T6) in the instrument configuration. In polyphase instruments these tariff summary registers only count energy consumption in phase 1, 2 and 3.

Energy	Direction	Mapped data	Base address		Size, type
			DEC	HEX	
active	import	T1.3EP+	10240	0x2800	64b, double
		T2.3EP+	10244	0x2804	64b, double
		T3.3EP+	10248	0x2808	64b, double
		T4.3EP+	10252	0x280C	64b, double
		T5.3EP+	10256	0x2810	64b, double
		T6.3EP+	10260	0x2814	64b, double
active	export	T1.3EP-	10264	0x2818	64b, double
		T2.3EP-	10268	0x281C	64b, double
		T3.3EP-	10272	0x2820	64b, double
		T4.3EP-	10276	0x2824	64b, double
		T5.3EP-	10280	0x2828	64b, double
		T6.3EP-	10284	0x282C	64b, double

3.10.7 0x2830 Two-quadrant (2Q, inductive/capacitive) three phase reactive energy per tariff

Energy	Character	Mapped data	Base address		Size, type
			DEC	HEX	
reactive	inductive	T1.3EQL	10288	0x2830	64b, double
		T2.3EQL	10292	0x2834	64b, double
		T3.3EQL	10296	0x2838	64b, double
		T4.3EQL	10300	0x283C	64b, double
		T5.3EQL	10304	0x2840	64b, double
		T6.3EQL	10308	0x2844	64b, double
reactive	capacitive	T1.3EQC	10312	0x2848	64b, double
		T2.3EQC	10316	0x284C	64b, double
		T3.3EQC	10320	0x2850	64b, double
		T4.3EQC	10324	0x2854	64b, double
		T5.3EQC	10328	0x2858	64b, double
		T6.3EQC	10332	0x285C	64b, double

3.10.8 0x2B00 Four-quadrant (4Q) three phase reactive energy per tariff

In polyphase instruments these tariff summary registers only count energy consumption in phase 1, 2 and 3.

Energy	Direction & Character	Mapped data	Base address		Size, type
			DEC	HEX	
reactive	inductive import	T1.3EQL+	11008	0x2B00	64b, double
		T2.3EQL+	11012	0x2B04	64b, double
		T3.3EQL+	11016	0x2B08	64b, double
		T4.3EQL+	11020	0x2B0C	64b, double
		T5.3EQL+	11024	0x2B10	64b, double

Energy	Direction & Character	Mapped data	Base address		Size, type
			DEC	HEX	
		T6.3EQL+	11028	0x2B14	64b, double
reactive	inductive export	T1.3EQL-	11032	0x2B18	64b, double
		T2.3EQL-	11036	0x2B1C	64b, double
		T3.3EQL-	11040	0x2B20	64b, double
		T4.3EQL-	11044	0x2B24	64b, double
		T5.3EQL-	11048	0x2B28	64b, double
		T6.3EQL-	11052	0x2B2C	64b, double
reactive	capacitive import	T1.3EQC+	11056	0x2B30	64b, double
		T2.3EQC+	11060	0x2B34	64b, double
		T3.3EQC+	11064	0x2B38	64b, double
		T4.3EQC+	11068	0x2B3C	64b, double
		T5.3EQC+	11072	0x2B40	64b, double
		T6.3EQC+	11076	0x2B44	64b, double
reactive	capacitive export	T1.3EQC-	11080	0x2B48	64b, double
		T2.3EQC-	11084	0x2B4C	64b, double
		T3.3EQC-	11088	0x2B50	64b, double
		T4.3EQC-	11092	0x2B54	64b, double
		T5.3EQC-	11096	0x2B58	64b, double
		T6.3EQC-	11100	0x2B5C	64b, double

3.11 0x4000 Aggregated Values

This block contains several register blocks, which holds minimum, maximum, average and actual values for most often required quantities. Sections 3.11.1, 3.11.2, 3.11.3 and 3.11.4 are only available in some instruments.

3.11.1 0x4200-0x42FF time stamps of maximal values block

This block offers time of occurences (time stamps for maximum average values since reset (ch. 3.11.3).

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
time of max. U1	16952	4238	32b, KMBTime	s
time of max. U2	16954	423A	32b, KMBTime	s
time of max. U3	16956	423C	32b, KMBTime	s
time of max. U12	16958	423E	32b, KMBTime	s
time of max. U23	16960	4240	32b, KMBTime	s
time of max. U31	16962	4242	32b, KMBTime	s
time of max. I1	16964	4244	32b, KMBTime	s
time of max. I2	16966	4246	32b, KMBTime	s
time of max. I3	16968	4248	32b, KMBTime	s
time of max. IN	16970	424A	32b, KMBTime	s
time of max. P1	16972	424C	32b, KMBTime	s
time of max. P2	16974	424E	32b, KMBTime	s
time of max. P3	16976	4250	32b, KMBTime	s
time of max. 3P	16978	4252	32b, KMBTime	s
time of max. S1	16980	4254	32b, KMBTime	s

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
time of max. S2	16982	4256	32b, KMBTime	s
time of max. S3	16984	4258	32b, KMBTime	s
time of max. 3S	16986	425A	32b, KMBTime	s
time of max. Q1	16988	425C	32b, KMBTime	s
time of max. Q2	16990	425E	32b, KMBTime	s
time of max. Q3	16992	4260	32b, KMBTime	s
time of max. 3Q	16994	4262	32b, KMBTime	s
time of max. CosPhi1	16996	4264	32b, KMBTime	s
time of max. CosPhi2	16998	4266	32b, KMBTime	s
time of max. CosPhi3	17000	4268	32b, KMBTime	s
time of max. frequency (f)	17002	426A	32b, KMBTime	s
RESERVED				
time of max. THD U1	17062	42A6	32b, KMBTime	s
time of max. THD U2	17064	42A8	32b, KMBTime	s
time of max. THD U3	17066	42AA	32b, KMBTime	s
time of max. THD I1	17068	42AC	32b, KMBTime	s
time of max. THD I2	17070	42AE	32b, KMBTime	s
time of max. THD I3	17072	42B0	32b, KMBTime	s

3.11.2 0x4400-0x44FF time stamps of minimal values block

This block offers time of occurences (time stamps for minimum average values since reset (ch. 3.11.4).

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
time of min. U1	17464	4438	32b, KMBTime	s
time of min. U2	17466	443A	32b, KMBTime	s
time of min. U3	17468	443C	32b, KMBTime	s
time of min. U12	17470	443E	32b, KMBTime	s
time of min. U23	17472	4440	32b, KMBTime	s
time of min. U31	17474	4442	32b, KMBTime	s
time of min. I1	17476	4444	32b, KMBTime	s
time of min. I2	17478	4446	32b, KMBTime	s
time of min. I3	17480	4448	32b, KMBTime	s
time of min. IN	17482	444A	32b, KMBTime	s
time of min. P1	17484	444C	32b, KMBTime	s
time of min. P2	17486	444E	32b, KMBTime	s
time of min. P3	17488	4450	32b, KMBTime	s
time of min. 3P	17490	4452	32b, KMBTime	s
time of min. S1	17492	4454	32b, KMBTime	s
time of min. S2	17494	4456	32b, KMBTime	s
time of min. S3	17496	4458	32b, KMBTime	s
time of min. 3S	17498	445A	32b, KMBTime	s
time of min. Q1	17500	445C	32b, KMBTime	s
time of min. Q2	17502	445E	32b, KMBTime	s
time of min. Q3	17504	4460	32b, KMBTime	s

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
time of min. 3Q	17506	4462	32b, KMBTime	s
time of min. CosPhi1	17508	4464	32b, KMBTime	s
time of min. CosPhi2	17510	4466	32b, KMBTime	s
time of min. CosPhi3	17512	4468	32b, KMBTime	s
time of min. frequency (f)	17514	446A	32b, KMBTime	s
RESERVED				
time of min. THD U1	17574	44A6	32b, KMBTime	s
time of min. THD U2	17576	44A8	32b, KMBTime	s
time of min. THD U3	17578	44AA	32b, KMBTime	s
time of min. THD I1	17580	44AC	32b, KMBTime	s
time of min. THD I2	17582	44AE	32b, KMBTime	s
time of min. THD I3	17584	44B0	32b, KMBTime	s

3.11.3 0x4600-0x46FF Maximum since reset data

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
U1	17976	4638	32-bit, float	V
U2	17978	463A	32-bit, float	V
U3	17980	463C	32-bit, float	V
U12	17982	463E	32-bit, float	V
U23	17984	4640	32-bit, float	V
U31	17986	4642	32-bit, float	V
I1	17988	4644	32-bit, float	A
I2	17990	4646	32-bit, float	A
I3	17992	4648	32-bit, float	A
IN=I1+I2+I3	17994	464A	32-bit, float	A
P1	17996	464C	32-bit, float	W
P2	17998	464E	32-bit, float	W
P3	18000	4650	32-bit, float	W
3P	18002	4652	32-bit, float	W
S1	18004	4654	32-bit, float	VA
S2	18006	4656	32-bit, float	VA
S3	18008	4658	32-bit, float	VA
3S	18010	465A	32-bit, float	VA
Q1	18012	465C	32-bit, float	var
Q2	18014	465E	32-bit, float	var
Q3	18016	4660	32-bit, float	var
3Q	18018	4662	32-bit, float	var
CosPhi1	18020	4664	32-bit, float	-
CosPhi2	18022	4666	32-bit, float	-
CosPhi3	18024	4668	32-bit, float	-
frequency (f)	18026	466A	32-bit, float	Hz
RESERVED				
THD U1	18086	46A6	32-bit, float	percent

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
THD U2	18088	46A8	32-bit, float	percent
THD U3	18090	46AA	32-bit, float	percent
THD I1	18092	46AC	32-bit, float	percent
THD I2	18094	46AE	32-bit, float	percent
THD I3	18096	46B0	32-bit, float	percent

3.11.4 0x4800-0x48FF Minimum since reset data

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
U1	18488	4838	32-bit, float	V
U2	18490	483A	32-bit, float	V
U3	18492	483C	32-bit, float	V
U12	18494	483E	32-bit, float	V
U23	18496	4840	32-bit, float	V
U31	18498	4842	32-bit, float	V
I1	18500	4844	32-bit, float	A
I2	18502	4846	32-bit, float	A
I3	18504	4848	32-bit, float	A
IN=I1+I2+I3	18506	484A	32-bit, float	A
P1	18508	484C	32-bit, float	W
P2	18510	484E	32-bit, float	W
P3	18512	4850	32-bit, float	W
3P	18514	4852	32-bit, float	W
S1	18516	4854	32-bit, float	VA
S2	18518	4856	32-bit, float	VA
S3	18520	4858	32-bit, float	VA
3S	18522	485A	32-bit, float	VA
Q1	18524	485C	32-bit, float	var
Q2	18526	485E	32-bit, float	var
Q3	18528	4860	32-bit, float	var
3Q	18530	4862	32-bit, float	var
CosPhi1	18532	4864	32-bit, float	-
CosPhi2	18534	4866	32-bit, float	-
CosPhi3	18536	4868	32-bit, float	-
frequency (f)	18538	486A	32-bit, float	Hz
RESERVED				
THD U1	18598	48A6	32-bit, float	percent
THD U2	18600	48A8	32-bit, float	percent
THD U3	18602	48AA	32-bit, float	percent
THD I1	18604	48AC	32-bit, float	percent
THD I2	18606	48AE	32-bit, float	percent
THD I3	18608	48B0	32-bit, float	percent

3.11.5 0x4A00-0x4AFF Actual/average data (19000 DEC)

This block of data provides simple acquisition method for the most commonly used actual and average values in one simple block-read request.

- Modbus function 03 Read Holding Registers **returns average values** for normal quantities.
- Modbus function 04 Read Input Registers **returns actual 200ms values** for normal quantities.
- For energy registers booth functions offer the total kWh/kVarh counts.

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
U1	19000	4A38	32-bit, float	V
U2	19002	4A3A	32-bit, float	V
U3	19004	4A3C	32-bit, float	V
U12	19006	4A3E	32-bit, float	V
U23	19008	4A40	32-bit, float	V
U31	19010	4A42	32-bit, float	V
I1	19012	4A44	32-bit, float	A
I2	19014	4A46	32-bit, float	A
I3	19016	4A48	32-bit, float	A
INc	19018	4A4A	32-bit, float	A
P1	19020	4A4C	32-bit, float	W
P2	19022	4A4E	32-bit, float	W
P3	19024	4A50	32-bit, float	W
3P	19026	4A52	32-bit, float	W
S1	19028	4A54	32-bit, float	VA
S2	19030	4A56	32-bit, float	VA
S3	19032	4A58	32-bit, float	VA
3S	19034	4A5A	32-bit, float	VA
Q1	19036	4A5C	32-bit, float	var
Q2	19038	4A5E	32-bit, float	var
Q3	19040	4A60	32-bit, float	var
3Q	19042	4A62	32-bit, float	var
CosPhi1	19044	4A64	32-bit, float	-
CosPhi2	19046	4A66	32-bit, float	-
CosPhi3	19048	4A68	32-bit, float	-
frequency (f)	19050	4A6A	32-bit, float	Hz
phase order	19052	4A6C	32-bit, float	-
EP1 total	19054	4A6E	32-bit, float	Wh
EP2 total	19056	4A70	32-bit, float	Wh
EP3 total	19058	4A72	32-bit, float	Wh
3EP total	19060	4A74	32-bit, float	Wh
EP1 consumed	19062	4A76	32-bit, float	Wh
EP2 consumed	19064	4A78	32-bit, float	Wh
EP3 consumed	19066	4A7A	32-bit, float	Wh
3EP consumed	19068	4A7C	32-bit, float	Wh
EP1 delivered	19070	4A7E	32-bit, float	Wh

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
EP2 delivered	19072	4A80	32-bit, float	Wh
EP3 delivered	19074	4A82	32-bit, float	Wh
3EP delivered	19076	4A84	32-bit, float	Wh
ES1	19078	4A86	32-bit, float	VAh
ES2	19080	4A88	32-bit, float	VAh
ES3	19082	4A8A	32-bit, float	VAh
3ES	19084	4A8C	32-bit, float	VAh
EQ1	19086	4A8E	32-bit, float	varh
EQ2	19088	4A90	32-bit, float	varh
EQ3	19090	4A92	32-bit, float	varh
3EQ	19092	4A94	32-bit, float	varh
EQL1	19094	4A96	32-bit, float	varh
EQL2	19096	4A98	32-bit, float	varh
EQL3	19098	4A9A	32-bit, float	varh
3EQL	19100	4A9C	32-bit, float	varh
EQC1	19102	4A9E	32-bit, float	varh
EQC2	19104	4AA0	32-bit, float	varh
EQC3	19106	4AA2	32-bit, float	varh
3EQC	19108	4AA4	32-bit, float	varh
THD U1	19110	4AA6	32-bit, float	percent
THD U2	19112	4AA8	32-bit, float	percent
THD U3	19114	4AAA	32-bit, float	percent
THD I1	19116	4AAC	32-bit, float	percent
THD I2	19118	4AAE	32-bit, float	percent
THD I3	19120	4AB0	32-bit, float	percent

3.12 0x4D00 Residual Current Monitor (RCM)

This block of data is present in instruments with one or more RCM inputs. It contains several register blocks, which holds minimum, maximum, average and actual values for the RCM values. Meaning of the data differs according to the modbus function used:

Function 3 registers offer aggregated average values (avg, min of avg, max of avg).

Function 4 registers offer aggregated actual values (act, min of act, max of act).

Mapped Data	Base address		Size, type	Unit
	DEC	HEX		
RCM min, avg, max reset timestamp	19726	0x4D0E	32b, KMBTime	s
time of the last $I\Delta 1$ maximum	19728	0x4D10	32b, KMBTime	s
time of the last $I\Delta 2$ maximum	19730	0x4D12	32b, KMBTime	s
time of the last $I\Delta 3$ maximum	19732	0x4D14	32b, KMBTime	s
time of the last $I\Delta 4$ maximum	19734	0x4D16	32b, KMBTime	s
time of the last $I\Delta 5$ maximum	19736	0x4D18	32b, KMBTime	s
time of the last $I\Delta 6$ maximum	19738	0x4D1A	32b, KMBTime	s
time of the last $I\Delta 7$ maximum	19740	0x4D1C	32b, KMBTime	s
time of the last $I\Delta 8$ maximum	19742	0x4D1E	32b, KMBTime	s

Mapped Data	Base address		Size, type	Unit
	DEC	HEX		
time of the last $I\Delta1$ minimum	19744	0x4D20	32b, KMBTime	s
time of the last $I\Delta2$ minimum	19746	0x4D22	32b, KMBTime	s
time of the last $I\Delta3$ minimum	19748	0x4D24	32b, KMBTime	s
time of the last $I\Delta4$ minimum	19750	0x4D26	32b, KMBTime	s
time of the last $I\Delta5$ minimum	19752	0x4D28	32b, KMBTime	s
time of the last $I\Delta6$ minimum	19754	0x4D2A	32b, KMBTime	s
time of the last $I\Delta7$ minimum	19756	0x4D2C	32b, KMBTime	s
time of the last $I\Delta8$ minimum	19758	0x4D2E	32b, KMBTime	s

Mapped Data	Base address		Size, type	Unit
	DEC	HEX		
last $I\Delta1$ maximum	19760	0x4D30	32b, float	A
last $I\Delta2$ maximum	19762	0x4D32	32b, float	A
last $I\Delta3$ maximum	19764	0x4D34	32b, float	A
last $I\Delta4$ maximum	19766	0x4D36	32b, float	A
last $I\Delta5$ maximum	19768	0x4D38	32b, float	A
last $I\Delta6$ maximum	19770	0x4D3A	32b, float	A
last $I\Delta7$ maximum	19770	0x4D3C	32b, float	A
last $I\Delta8$ maximum	19772	0x4D3E	32b, float	A

Mapped Data	Base address		Size, type	Unit
	DEC	HEX		
last $I\Delta1$ minimum	19776	0x4D40	32b, float	A
last $I\Delta2$ minimum	19778	0x4D42	32b, float	A
last $I\Delta3$ minimum	19780	0x4D44	32b, float	A
last $I\Delta4$ minimum	19782	0x4D46	32b, float	A
last $I\Delta5$ minimum	19784	0x4D48	32b, float	A
last $I\Delta6$ minimum	19786	0x4D4A	32b, float	A
last $I\Delta7$ minimum	19788	0x4D4C	32b, float	A
last $I\Delta8$ minimum	19790	0x4D4E	32b, float	A

Mapped Data	Base address		Size, type	Unit
	DEC	HEX		
$I\Delta1$	19792	0x4D50	32b, float	A
$I\Delta2$	19794	0x4D52	32b, float	A
$I\Delta3$	19796	0x4D54	32b, float	A
$I\Delta4$	19798	0x4D56	32b, float	A
$I\Delta5$	19800	0x4D58	32b, float	A
$I\Delta6$	19802	0x4D5A	32b, float	A
$I\Delta7$	19804	0x4D5C	32b, float	A
$I\Delta8$	19806	0x4D5E	32b, float	A

3.13 0x4E00 Demand and Maximum Demand Values

Demand in an evaluation period, and maximum demand over interval or since reset are provided in the following registers. It used to be reffered also as PAvgMax, PAvgMax(E), monitoring of quarter-hour maximum or EMAX in other literature. Behavior of this function is related to the actual instrument configuration - namely the parameters in 'Maximum demand' panel in 'Aggregation' tab of the instrument configuration.

3.13.1 0x4E00 Last, actual and estimated demand values

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
last avg reset date/time	19968	4E00	32b, KMBTime	s
last average demand 3LD	19970	4E02	32b, float	W
last average demand LD1	19972	4E04	32b, float	W
last average demand LD2	19974	4E06	32b, float	W
last average demand LD3	19976	4E08	32b, float	W
last average demand LD4	19978	4E0A	32b, float	W
interval since last avg started	19980	4E0C	32b, KMBTime	s
actual average demand 3AD	19982	4E0E	32b, float	W
actual average demand AD1	19984	4E10	32b, float	W
actual average demand AD2	19986	4E12	32b, float	W
actual average demand AD3	19988	4E14	32b, float	W
actual average demand AD4	19990	4E16	32b, float	W
next avg reset date/time	19992	4E18	32b, KMBTime	s
next average demand 3ED	19994	4E1A	32b, float	W
next average demand ED1	19996	4E1C	32b, float	W
next average demand ED2	19998	4E1E	32b, float	W
next average demand ED3	20000	4E20	32b, float	W
next average demand ED4	20002	4E22	32b, float	W

3.13.2 0x4E30 Maximum recorded demand values since manual reset

*/ *Emphasized quantities* are planned to be implemented in a future release. In firmware version 3.0 only the values with address filled are available and all the rest is a reserved register. It is possible to be read out with block read and its value is NaN.

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
max **3MD demand** date/time	20016	4E30	32b, KMBTime	s
maximum **demand 3MD**	20018	4E32	32b, float	W
*related demand AD*1	20020	4E34		NaN
*related demand AD*2	20022	4E36		NaN
*related demand AD*3	20024	4E38		NaN
*related demand AD*4	20026	4E3A		NaN
max **MD1 demand** date/time	20028	4E3C	32b, KMBTime	s
related demand 3AD	20030	4E3E		NaN
maximum **demand MD1**	20032	4E40	32b, float	W
*related demand AD*2	20034	4E42		NaN

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
related demand AD3	20036	4E44		NaN
related demand AD4	20038	4E46		NaN
max **MD2 demand** date/time	20040	4E48	32b, KMBTime	s
related demand 3AD	20042	4E4A		NaN
related demand AD1	20044	4E4C		NaN
maximum **demand MD2**	20046	4E4E	32b, float	W
related demand AD3	20048	4E50		NaN
related demand AD4	20050	4E52		NaN
max **MD3 demand** date/time	20052	4E54	32b, KMBTime	s
related demand 3AD	20054	4E56		NaN
related demand AD1	20056	4E58		NaN
related demand AD2	20058	4E5A		NaN
maximum **demand MD3**	20060	4E5C	32b, float	W
related demand AD4	20062	4E5E		NaN
max **MD4 demand** date/time	20064	4E60	32b, KMBTime	s
related demand 3AD	20066	4E62		NaN
related demand AD1	20068	4E64		NaN
related demand AD2	20070	4E66		NaN
related demand AD3	20072	4E68		NaN
maximum **demand MD4**	20074	4E6A	32b, float	W

3.13.3 0x4E70 Maximum demand values in the last observed interval

*/ *Emphasized quantities* are planned to be implemented in a future release. In firmware version 3.0 only the following values with type and encoding are available and all the rest is a reserved register. It is possible to be read out with block read and its value is NaN. Evaluation interval is a part of configuration and can be selected as day, week , month, quartal or year.

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
last max **3MD demand** date/time	20080	4E70	32b, KMBTime	s
last maximum **demand 3MD**	20082	4E72	32b, float	W
last *related demand AD1*	20084	4E74		NaN
last *related demand AD2*	20086	4E76		NaN
last *related demand AD3*	20088	4E78		NaN
last *related demand AD4*	20090	4E7A		NaN
last max **MD1 demand** date/time	20092	4E7C	32b, KMBTime	s
last *related demand 3AD*	20094	4E7E		NaN
last maximum **demand MD1**	20096	4E80	32b, float	W
last *related demand AD2*	20098	4E82		NaN
last *related demand AD3*	20100	4E84		NaN
last *related demand AD4*	20102	4E86		NaN
last max **MD2 demand** date/time	20104	4E88	32b, KMBTime	s
last *related demand 3AD*	20106	4E8A		NaN
last *related demand AD1*	20108	4E8C		NaN
last maximum **demand MD2**	20110	4E8E	32b, float	W

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
last *related demand AD*3	20112	4E90		NaN
last *related demand AD*4	20114	4E92		NaN
last max **MD3 demand** date/time	20116	4E94	32b, KMBTime	s
last *related demand 3AD*	20118	4E96		NaN
last *related demand AD*1	20120	4E98		NaN
last *related demand AD*2	20122	4E9A		NaN
last maximum **demand MD3**	20124	4E9C	32b, float	W
last *related demand AD*4	20126	4E9E		NaN
last max **MD4 demand** date/time	20128	4EA0	32b, KMBTime	s
last *related demand 3AD*	20130	4EA2		NaN
last *related demand AD*1	20132	4EA4		NaN
last *related demand AD*2	20134	4EA6		NaN
last *related demand AD*3	20136	4EA8		NaN
last maximum **demand MD4**	20138	4EAA	32b, float	W

3.13.4 0x4EC0 Maximum demand values in the currently observed interval

*/ *Emphasized quantities* are planned to be implemented in a future release. In firmware version 3.0 only the following values with type and encoding are available and all the rest is a reserved register. It is possible to be read out with block read and its value is NaN. Evaluation interval is a part of configuration and can be selected as day, week , month, quartal or year.

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
this max **3MD demand** date/time	20160	4EC0	32b, KMBTime	s
this maximum **demand 3MD**	20162	4EC2	32b, float	W
this *related demand AD*1	20164	4EC4		NaN
this *related demand AD*2	20166	4EC6		NaN
this *related demand AD*3	20168	4EC8		NaN
this *related demand AD*4	20170	4ECA		NaN
this max **MD1 demand** date/time	20172	4ECC	32b, KMBTime	s
this *related demand 3AD*	20174	4ECE		NaN
this maximum **demand MD1**	20176	4ED0	32b, float	W
this *related demand AD*2	20178	4ED2		NaN
this *related demand AD*3	20180	4ED4		NaN
this *related demand AD*4	20182	4ED6		NaN
this max **MD2 demand** date/time	20184	4ED8	32b, KMBTime	s
this *related demand 3AD*	20186	4EDA		NaN
this *related demand AD*1	20188	4EDC		NaN
this maximum **demand MD2**	20190	4EDE	32b, float	W
this *related demand AD*3	20192	4EE0		NaN
this *related demand AD*4	20194	4EE2		NaN
this max **MD3 demand** date/time	20196	4EE4	32b, KMBTime	s
this *related demand 3AD*	20198	4EE6		NaN
this *related demand AD*1	20200	4EE8		NaN
this *related demand AD*2	20202	4EEA		NaN

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
this maximum **demand MD3**	20204	4EEC	32b, float	W
this *related demand* $AD4$	20206	4EEE		NaN
this max **MD4 demand** date/time	20208	4EF0	32b, KMBTime	s
this *related demand 3AD*	20210	4EF2		NaN
this *related demand* $AD1$	20212	4EF4		NaN
this *related demand* $AD2$	20214	4EF6		NaN
this *related demand* $AD3$	20216	4EF8		NaN
this maximum **demand MD4**	20218	4EFA	32b, float	W

3.14 0x5000 Power Quality Values (opt. PQ modules)

These registers provide valid readings only with PQ firmware module enabled.

Mapped data	Base address		Size, type	Description
	DEC	HEX		
time of last PQ eval.	20480	0x5000	64b, KMBTime	actual reading
last PQ evaluation	20484	0x5004	32b	0x1 100%, 0x2 95%
time of last failed 100%	20486	0x5006	64b, KMBTime	ms since 1.1.2000
last failed 100% crit.	20490	0x500A	32b	binary encoded indices
time of last failed 95%	20492	0x500C	64b, KMBTime	ms since 1.1.2000
last failed 95% crit.	20496	0x500E	32b	binary encoded indices
act. record in PQ buffer	20498	0x5012	32b	index to the buffer below
buffer for PQ intervals	20500..20625	0x5014..0x5091	32b	array**:** 63×32b

Encoding of evaluation indices (last PQ evaluation, last failed 100% and 95%): 0 — all correct, 0x0001 — freqency, 0x0002 — U_1, 0x0004 — U_2, 0x0008 — U_3 , 0x0020 — THD_{U1}, 0x0040 — THD_{U2}, 0x0080 — THD_{U3}, 0x0200 — UNB_U, 0x0400 — P_{ST1}, 0x0800 — P_{ST2}, 0x1000 P_{ST3}, 0x2000 —U_{HARM1}, 0x4000 — U_{HARM2}, 0x8000 — U_{HARM3}.

Encoding of interval evaluation buffer: bitwise true/false value for the last 32x63 PQ evaluation intervals. Updated in the round manner. Typically for a 10-minute interval which is by default set in the instruments this buffer is sufficient for last two weeks of data. This can be modified in the instrument configuration.

3.14.1 0x5100 Actual Flicker Severity Index Values (PQ module)

These registers provide valid readings only with PQ firmware module enabled.

P_{st1-4} are Short Term Flicker values - 10 minutes (configurable).

P_{lt1-4} ale Long Term Flicker values - fixed 2 hours average of P_{st1-4} (configurable).

$P_{inst1-4}$ Instant Flicker value.

Mapped data	Base address		Size, type
	DEC	HEX	
P_{st1}	20736	0x5100, 0x5101	32b, float
P_{st2}	20738	0x5102, 0x5103	32b, float
P_{st3}	20740	0x5104, 0x5105	32b, float
P_{st4}	20742	0x5106, 0x5107	32b, float

Mapped data	Base address		Size, type
	DEC	HEX	
P_{lt1}	20744	0x5108, 0x5109	32b, float
P_{lt2}	20746	0x510A, 0x510B	32b, float
P_{lt3}	20748	0x510C, 0x510D	32b, float
P_{lt4}	20750	0x510E, 0x510F	32b, float
P_{inst1}	20752	0x5110, 0x5111	32b, float
P_{inst2}	20754	0x5112, 0x5113	32b, float
P_{inst3}	20756	0x5114, 0x5115	32b, float
P_{inst4}	20758	0x5116, 0x5117	32b, float

3.14.2 0x5200 Last PQ interval values (PQ module)

These registers provide valid readings only with PQ firmware module enabled.

Values in this table are computed in 10 minute intervals[2].

f_{avg} is an average frequency during the PQ interval.

f_{mostly}, f_{always}, f_{below}, f_{above} are counters. Every 10 s value is taken and appropriate counter or counters are incremented.

U_{1-4} and THD_{1-4} are average values for 10 minute interval.

$U_{harm1-4}$ are encoded harmonic values. There is 1 bit for each harmonic. 0 = OK, 1 = this harmonic is out of defined range.

P_{ST1-4} are flicker values.

UNB_U is average value of Voltage unbalance in %.

RCS_{Count} is a total number of 3 s RCS measurements in the last PQ interval

RCS_{L1-3} are counts of measurements per channel out of toleration.

Mapped data	Base address		Size, type
	DEC	HEX	
f_{avg}	20992	0x5200	32b, float
f_{mostly}	20994	0x5202	16b
f_{always}	20995	0x5203	16b
f_{below}	20996	0x5204	16b
f_{above}	20997	0x5205	16b
U_1	20998	0x5206	32b, float
U_2	21000	0x5208	32b, float
U_3	21002	0x520A	32b, float
U_4	21004	0x520C	32b, float
THD_{U1}	21006	0x520E	32b, float
THD_{U2}	21008	0x5210	32b, float
THD_{U3}	21010	0x5212	32b, float
THD_{U4}	21012	0x5214	32b, float
U_{harm1}	21014	0x5216	64b
U_{harm2}	21018	0x521A	64b
U_{harm3}	21022	0x521E	64b
U_{harm4}	21026	0x5222	64b
P_{ST1}	21030	0x5226	32b, float

[2] Duratioin of the basic power quality evaluatioin interval can be changed by a user in the instrument configuration.

Mapped data	Base address		Size, type
	DEC	HEX	
P_{ST2}	21032	0x5228	32b, float
P_{ST3}	21034	0x522A	32b, float
P_{ST4}	21036	0x522C	32b, float
UNB_U	21038	0x522E	32b, float
RCS_{count}	21040	0x522F	16 bit, uint
RCS_{L1}	21041	0x5230	16 bit, uint
RCS_{L2}	21042	0x5231	16 bit, uint
RCS_{L3}	21043	0x5232	16 bit, uint

3.14.3 0x5400 Voltage Events - Table - Swells (PQ module)

Mapped data	Base address		Size, type	Description	
	DEC	HEX		Overvoltage [%]	Duration [ms]
$S1$	21504	0x5400	32b, int	$u \geq 120$	$10 \leq t \leq 200$
$T1$	21506	0x5402	32b, int	$120 > u > 110$	
$S2$	21508	0x5404	32b, int	$u \geq 120$	$500 < t \leq 5000$
$T2$	21510	0x5406	32b, int	$120 > u > 110$	
$S3$	21512	0x5408	32b, int	$u \geq 120$	$5000 < t \leq 60000$
$T3$	21514	0x540A	32b, int	$120 > u > 110$	

3.14.4 0x540C Voltage Events - Table - Dips (PQ module)

Mapped data	Base address		Size, type	Description	
	DEC	HEX		Residual voltage [%]	Duration [ms]
$A1$	21516	0x540C	32b, int	$90 > u \geq 80$	$10 \leq t \leq 200$
$B1$	21518	0x540E	32b, int	$80 > u \geq 70$	
$C1$	21520	0x5410	32b, int	$70 > u \geq 40$	
$D1$	21522	0x5412	32b, int	$40 > u \geq 5$	
$X1$	21524	0x5414	32b, int	$5 > u$	
$A2$	21526	0x5416	32b, int	$90 > u \geq 80$	$200 < t \leq 500$
$B2$	21528	0x5418	32b, int	$80 > u \geq 70$	
$C2$	21530	0x541A	32b, int	$70 > u \geq 40$	
$D2$	21532	0x541C	32b, int	$40 > u \geq 5$	
$X2$	21534	0x541E	32b, int	$5 > u$	
$A3$	21536	0x5420	32b, int	$90 > u \geq 80$	$500 < t \leq 1000$
$B3$	21538	0x5422	32b, int	$80 > u \geq 70$	
$C3$	21540	0x5424	32b, int	$70 > u \geq 40$	
$D3$	21542	0x5426	32b, int	$40 > u \geq 5$	
$X3$	21544	0x5428	32b, int	$5 > u$	
$A4$	21546	0x542A	32b, int	$90 > u \geq 80$	$1000 < t \leq 5000$
$B4$	21548	0x542C	32b, int	$80 > u \geq 70$	
$C4$	21550	0x542E	32b, int	$70 > u \geq 40$	
$D4$	21552	0x5430	32b, int	$40 > u \geq 5$	

Mapped data	Base address DEC	Base address HEX	Size, type	Description: Residual voltage [%]	Description: Duration [ms]
$X4$	21554	0x5432	32b, int	$5 > u$	
$A5$	21556	0x5434	32b, int	$90 > u \geq 80$	$5000 < t \leq 60000$
$B5$	21558	0x5436	32b, int	$80 > u \geq 70$	
$C5$	21560	0x5438	32b, int	$70 > u \geq 40$	
$D5$	21562	0x543A	32b, int	$40 > u \geq 5$	
$X5$	21564	0x543C	32b, int	$5 > u$	
Last Erase Time	21566	0x543E	32b, int	Last erase time in s from 1.1.2000	

3.14.5 0x5500 Voltage Events - Last Event (PQ module)

Mapped data	Base address DEC	Base address HEX	Size, type	Description
Phase	21760	0x5500	16b, int	see note bellow*
Event Type	21761	0x5501	16b, int	1 = Swell, 2 = Dip, 3 = Interruption, 4 = Power Failure
Event Time	21762	0x5502	64b, int	Time of the event in ms from 1.1.2000
Duration	21766	0x5506	32b, int	Duration of event in ms
Value	21768	0x5508	32b, float	Maximal/Minimal measured voltage

* 3×1p measurement: 0 = L1, 1 = L2, 2 = L3, 3 = L4
3p measurement: 0x80|0x01 = L1, 0x80|0x02 = L2, 0x80|0x04 = L3

3.15 0x5300 Ripple Control Signal (opt. RCS module)

These registers provide valid readings of ripple control signal levels only with RCS firmware module enabled.

$RCS\,L1-3_{Time}$ is a time and date of the last received RCS telegram in KMBTime - seconds since 1.1.2000.

$RCS\,L1-3_{\{AVG|MIN|MAX\}}$ are minimum, maximum and average values of signal in V for all true bits (value = 1) in the last received telegram.

Mapped data	Base address DEC	Base address HEX	Size, type
$Urc1_{Time}$	21248	0x5300	64b
$Urc1_{AVG}$	21252	0x5304	32b, float
$Urc1_{MIN}$	21254	0x5306	32b, float
$Urc1_{MAX}$	21256	0x5308	32b, float
$Urc2_{Time}$	21258	0x530A	64b
$Urc2_{AVG}$	21262	0x530E	32b, float
$Urc2_{MIN}$	21264	0x5310	32b, float

Mapped data	Base address		Size, type
	DEC	HEX	
$Urc2_{MAX}$	21266	0x5312	32b, float
$Urc3_{Time}$	21268	0x5314	64b
$Urc3_{AVG}$	21272	0x5318	32b, float
$Urc3_{MIN}$	21274	0x531A	32b, float
$Urc3_{MAX}$	21276	0x531C	32b, float

RCS Message start-bit 1 and 2 (RMS value)

Mapped data	Base address		Size, type
	DEC	HEX	
$Urc1\,b1$	21280	0x5320	32b, float
$Urc1\,b2$	21282	0x5322	32b, float
$Urc2\,b1$	21284	0x5324	32b, float
$Urc2\,b2$	21286	0x5326	32b, float
$Urc3\,b1$	21288	0x5328	32b, float
$Urc3\,b2$	21290	0x532A	32b, float

3.16 0x6000 Modbus Master Readings (opt. MM module)

Modbus master reads configured input data from itself or from other instruments (slaves) connected to its serial line. It converts all the input data to a block of unified values (float type) starting on register 0x6000. Mapping of the data source is made in an instument configuration (ENVIS.daq). Modbus master result values are provided in actual data, on the web site and in the register map of a master instument. MM data is ordered in up to 16 sets. One set can hold up to 100 float results, all 16 sets together can handle 300 results. Each set represents only one slave address. More than one MM set can be used to process data from a given slave instrument. In the following map we use addressing of the Modbus RTU protocol to select distinct sets — modbus TCP addres 1 provides data from set 1, address 2 from set 2 etc. (X in table marks set number).

Read out is performed automaticaly by the master in a predefined period and under normal conditions it could only be interrupted with an ES gateway module connection to the same master. The incomming ES connections have priority over the MM to access the slave bus to allow any 3rd party protocol to reach the given slave as well. Such connection can be used to configure, upgrade or occasionally read out proprietary values from slave units.

Mapped data	Base address		Size, type
	DEC	HEX	
First MM value for set X	24576	0x6000	32b, float
up to 98× per set, 300 total	...	...	...
Last MM value for set X	24776	0x60C8	32b, float

3.17 0x6200 Actual Data for DC and AC/DC

Starting with firmware v. 3.0 instruments provide voltage and current average value readings over the aggregation interval - the DC component. Under special configuration option this even allows to use fixed sampling and to calculate f, U, I, P and ˜Q in time domain for signals with power frequency of 0 or 5 Hz up to 500 Hz. Lower limit is different for instrument with different current sensors. This feature allows to correctly evaluate special quantities for DC grids such as photovoltaics, UPS and baterry backups, transportation etc., or to monitor appliances supplied by a variable speed drive.

- avg ... mean value of the sampled voltage or curent signal of the respective channel, also the DC component of such.
- min, max ... extreme value of the sampled voltage or current signal of the respective channel
- instruments with more than 4 current inputs do use address multiplexing for the quantities derived from I5 and above channels.

Mapped data	Base address		Size, type
	DEC	HEX	
$Uavg_{L1}$	25088	0x6200	32b, float
$Uavg_{L2}$	25090	0x6202	32b, float
$Uavg_{L3}$	25092	0x6204	32b, float
$Uavg_{L4}$	25094	0x6206	32b, float
$Umin_{L1}$	25096	0x6208	32b, float
$Umin_{L2}$	25098	0x620A	32b, float
$Umin_{L3}$	25100	0x620C	32b, float

Mapped data	Base address		Size, type
	DEC	HEX	
$Umin_{L4}$	25102	0x621E	32b, float
$Umax_{L1}$	25104	0x6210	32b, float
$Umax_{L2}$	25106	0x6212	32b, float
$Umax_{L3}$	25108	0x6214	32b, float
$Umax_{L4}$	25110	0x6216	32b, float

Mapped data	Base address		Size, type
	DEC	HEX	
$Iavg_{L1}$	25112	0x6218	32b, float
$Iavg_{L2}$	25114	0x621A	32b, float
$Iavg_{L3}$	25116	0x621C	32b, float
$Iavg_{L4}$	25118	0x621E	32b, float
$Imin_{L1}$	25120	0x6220	32b, float
$Imin_{L2}$	25122	0x6222	32b, float
$Imin_{L3}$	25124	0x6224	32b, float
$Imin_{L4}$	25126	0x6226	32b, float
$Imax_{L1}$	25128	0x6228	32b, float
$Imax_{L2}$	25130	0x622A	32b, float
$Imax_{L3}$	25132	0x622C	32b, float
$Imax_{L4}$	25134	0x622E	32b, float

3.18 0x9000 Input and Output Values

3.18.1 0x9000 Input Values

Mapped data	Base address		Size, type
	DEC	HEX	
Digital Inputs (1-16)	36864	0x9000	16b
Digital Inputs(17-32)	36865	0x9001	16b
Frequency Counter 1 (FC1)	36866	0x9002	32b, float
Frequency Counter 2 (FC2)	36868	0x9004	32b, float
Frequency Counter 3 (FC3)	36870	0x9006	32b, float
Frequency Counter 4 (FC4)	36872	0x9008	32b, float
Frequency Counter 5 (FC5)	36874	0x900A	32b, float
Frequency Counter 6 (FC6)	36876	0x900C	32b, float
Frequency Counter 7 (FC7)	36878	0x900D	32b, float
Frequency Counter 8 (FC8)	36880	0x900F	32b, float
Pulse Counter 1 (PC1)	36882	0x9012	32b, float
Pulse Counter 2 (PC2)	36884	0x9016	32b, float
Pulse Counter 3 (PC3)	36886	0x901A	32b, float
Pulse Counter 4 (PC4)	36888	0x901E	32b, float
Pulse Counter 5 (PC5)	36890	0x9022	32b, float
Pulse Counter 6 (PC6)	36892	0x9026	32b, float
Pulse Counter 7 (PC7)	36894	0x902A	32b, float

Mapped data	Base address		Size, type
	DEC	HEX	
Pulse Counter 8 (PC8)	36896	0x902E	32b, float
Clear Time of PC1	36914	0x9032	64b, KMBtime
Clear Time of PC2	36918	0x9036	64b, KMBtime
Clear Time of PC3	36922	0x903A	64b, KMBtime
Clear Time of PC4	36926	0x903E	64b, KMBtime
Clear Time of PC5	36930	0x9042	64b, KMBtime
Clear Time of PC6	36934	0x9046	64b, KMBtime
Clear Time of PC7	36938	0x904A	64b, KMBtime
Clear Time of PC8	36942	0x904E	64b, KMBtime
Analog Input 1	36994	0x9082	32b, float
Analog Input 2	36996	0x9084	32b, float
Analog Input 3	36998	0x9086	32b, float
Analog Input 4	37000	0x9088	32b, float
Temperature 1 - Internal (Ti)	37056	0x90C0	32b, float
Temperature 2 - External (Te)	37058	0x90C2	32b, float
Temperature 3	37060	0x90C4	32b, float
Temperature 4	37062	0x90C6	32b, float

3.18.2 0x9300 Output Values

It is possible to control real as well as virtual outputs and alarms. If an output is used in configuration of the I/O management it is blocked in Modbus and can not be controlled remotely. Value of the controlled output(s) can be set to 0 or 1. Selection of outputs to be assigned is controlled by mask (high byte of the register). Controllable outputs have the corresponding mask bit set to 1. Rest of the mask bits are set to 0.

Mapped data	Base address		Size, type	Encoding
	DEC	HEX		
Digital Outputs (1-8)	37632	0x9300	16b	high byte mask, low byte status
Digital Outputs (9-16)	37633	0x9301	16b	high byte mask, low byte status
Digital Outputs (17-24)	37634	0x9302	16b	high byte mask, low byte status
Digital Outputs (25-32)	37635	0x9303	16b	high byte mask, low byte status
I/O Variables (1-8)	37636	0x9304	16b	high byte mask, low byte status
I/O Variables (9-16)	37638	0x9305	16b	high byte mask, low byte status
Analog Output 1	37696	0x9340	32b, float	
Analog Output 2	37698	0x9342	32b, float	
Analog Output 3	37700	0x9344	32b, float	
Analog Output 4	37702	0x9346	32b, float	

Example of Digital Output encoding:

Reading	MSB	16b register value														LSB
	Mask of the output								Status of the output							
Output nr.	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
Retrived value	0	1	0	0	1	1	1	1	0	0	0	0	0	0	1	0
Description	**0** = output is not available **1** = available for control								**0** = output is not active **1** = output is active							

Writing	MSB	16b register value														LSB
	Mask of the output								Status of the output							
Output nr.	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
Written value	0	0	1	0	1	1	0	1	0	0	1	0	1	0	0	1
Description	**0** = output won't change **1** = output will change								**0** = deactivate output **1** = activate output							
Result									X	X	1	X	1	0	X	1

During writing, the new value of each output is evaluated according to the equation

$$y_n = (y_a \wedge \neg m) \vee (s \wedge m) \quad ,$$

where m ... mask bit, s ... status bit, y_a ... actual output state and y_n ... new output state. So the given output changes to the 'status' value only if the corresponding bit 'mask' has value 1. Otherwise the output doesn't change.

3.18.3 0x9700 Hour Meter

Instruments with more than 4 channels (as SMC 118, SMC and ARTIQ 235 or SMZ 244) might offer more than 4 hour meters configured in the I/O configuration. In such case the HMs above 4 are available in a virtual instrument space, whose modbus address is the actual instrument address incremented by 20.

Mapped data	Base address		Size, type
	DEC	HEX	
Hour Meter HM1 Active	38656	0x9700	64b, int
Hour Meter HM1 Passive	38660	0x9704	64b, int
Hour Meter HM2 Active	38664	0x9708	64b, int
Hour Meter HM2 Passive	38668	0x970C	64b, int
Hour Meter HM3 Active	38672	0x9710	64b, int
Hour Meter HM3 Passive	38676	0x9714	64b, int
Hour Meter HM4 Active	38680	0x9718	64b, int
Hour Meter HM4 Passive	38684	0x971C	64b, int
Hour Meter HM1 counter	38688	0x9720	32b, int
Hour Meter HM2 counter	38690	0x9722	32b, int
Hour Meter HM3 counter	38692	0x9724	32b, int
Hour Meter HM4 counter	38694	0x9726	32b, int

Mapped data	Base address		Size, type
	DEC	HEX	
Clear Time of HM1	38696	0x9728	32b, KMBtime
Clear Time of HM2	38698	0x972A	32b, KMBtime
Clear Time of HM3	38700	0x972C	32b, KMBtime
Clear Time of HM4	38702	0x972E	32b, KMBtime
First time ON HM1	38704	0x9730	32b, KMBtime
First time ON HM2	38706	0x9732	32b, KMBtime
First time ON HM3	38708	0x9734	32b, KMBtime
First time ON HM4	38710	0x9736	32b, KMBtime
Last time ON HM1	38712	0x9738	32b, KMBtime
Last time ON HM2	38714	0x973A	32b, KMBtime
Last time ON HM3	38716	0x973C	32b, KMBtime
Last time ON HM4	38718	0x973E	32b, KMBtime
Last time OFF HM1	38720	0x9740	32b, KMBtime
Last time OFF HM2	38722	0x9742	32b, KMBtime
Last time OFF HM3	38724	0x9744	32b, KMBtime
Last time OFF HM4	38726	0x9746	32b, KMBtime

3.19 0xA000 PFC Actual Data & Status (NOVAR 2xxx)

Mapped data	Base address		Size, type	Unit
	DEC	HEX		
$3RC$ (3p cap. compensation reserve power)	40960	0xA000	32b, float	var
$3RL$ (3p ind. comp. reserve power)	40962	0xA002	32b, float	var
$RC1$ (cap. comp. reserve power - 1. ph)	40964	0xA004	32b, float	var
$RC2$ (cap. comp. reserve power - 2. ph)	40966	0xA006	32b, float	var
$RC3$ (cap. comp. reserve power - 3. ph)	40968	0xA008	32b, float	var
$RL1$ (ind. comp. reserve power - 1. ph)	40970	0xA00A	32b, float	var
$RL2$ (ind. comp. reserve power - 2. ph)	40972	0xA00C	32b, float	var
$RL3$ (ind. comp. reserve power - 3. ph)	40974	0xA00E	32b, float	var
$CHL1$ (capacitors harmonic load - 1. ph)	40976	0xA010	32b, float	%
$CHL2$ (capacitors harmonic load - 2. ph)	40978	0xA012	32b, float	%
$CHL3$ (capacitors harmonic load - 3. ph)	40980	0xA014	32b, float	%
reserve	40982	0xA016	32b	
$3\Delta Qfh$ (3p control deviation)	40984	0xA018	32b, float	var
$\Delta Qfh1$ (control deviation - 1. ph)	40986	0xA01A	32b, float	var
$\Delta Qfh2$ (control deviation - 2. ph)	40988	0xA01C	32b, float	var
$\Delta Qfh3$ (control deviation - 3. ph)	40990	0xA01E	32b, float	var
reserve	40992	0xA020	32b	
PFC state	40994	0xA022	32b	
Output & Input state	40996	0xA024	32b	
Alarm State	40998	0xA026	32b	
Control time - 3p	41000	0xA028	16b	s
Control time - 1. ph	41001	0xA029	16b	s
Control time - 2. ph	41002	0xA02A	16b	s
Control time - 3. ph	41003	0xA02B	16b	s
reserve	41004	0xA02C	32b	
PFC Output - Type & Condition - 1.1÷2.9	41006 - 41023	0xA02E - 0xA03F	16b	
3p Output Power - 1.1÷2.9	41024 - 41059	0xA040 - 0xA063	32b, float	var
reserve	41060	0xA065	32b	
# of switching per output - 1.1÷2.9	41062 - 41097	0xA067 - 0xA089	32b	
Switch-on time per output - 1.1÷2.9	41098 - 41133	0xA08A - 0xA0AD	32b, float	h

Encoding of PFC state

PFC state	**40994 (0xA022)**
bits 0 ÷ 3	0 = Standby (valid for control state only)
	1 = AOR Process in progress (automatic output recognition)
	2 = PFC Control in progress (valid for control state only)
	3 = Temporary Standby (valid for control state only)
	4 = CT test
	5 = ACD Process in progress (automatic connection detection)
bit 4	'0' = manual state
	'1' = control state
bit 5	PFC - tariff actual state
bit 6	'0' = alarm is not active
	'1' = alarm is active
bit 7	'0' = export is not present (consumption)
	'1' = export is present (generation)

Encoding of Output and Input state

Output & Input state	**40996 (0xA024)**
bits 0 ÷ 8	**output 1.1 ÷ 1.9**
	'0' - disengaged
	'1' - engaged
bits 9 ÷ 17	**output 2.1 ÷ 2.9**
	'0' - disengaged
	'1' - engaged
bits 18 ÷ 31	'0' - digital input not active
	'1' - digital input active

Encoding of Alarm state

Alarm state		**40998 (0xA026)**	
'0' - alarm is not active (no indication, no actuation)			
'1' - alarm is active (indication or actuation or both)			
bit 0	U<<	bit 9	PF><
bit 1	U<	bit 10	NS>
bit 2	U>	bit 11	OE
bit 3	I<	bit 12	T1><
bit 4	I>	bit 13	T2><
bit 5	CHL>	bit 14	EXT
bit 6	THDU>	bit 15	OoC
bit 7	THDI>	bit 16	RCF
bit 8	P<		

Encoding of PFC Output - Type & Condition

PFC Output - Type & Condition	**41006 - 41023**		
	Output type		
bits 0 ÷ 5	0 = 0	7 = C123	14 = L123
	1 = C1	8 = L1	15 = Z
	2 = C2	9 = L2	16 = Alarm
	3 = C3	10 = L3	17 = Fan
	4 = C12	11 = L12	18 = Heater
	5 = C23	12 = L23	
	6 = C31	13 = L31	
bits 6 ÷ 7	’00’ (0) = control		
	’01’ (1) = fixed on		
	’10’ (2) = fixed off		
bit 8	’0’ = step is OK		
	’1’ = step is faulty		

3.20 0xA100 PFC Setup (NOVAR 2xxx, fw. 3.0.12+)

Mapped data	Base address		Size, type	Encoding
	DEC	HEX		
PFC setup	41216	0xA100	32b, uint	see table bellow
Control strategy	41218	0xA102	16b, unit	bits 5, 4 00 = 3p 10 = 3p + 1p
reserve	41219	0xA103		
Target PF (tariff 1)	41220	0xA104	32b, float	$cos\varphi/tg\varphi/\varphi$
Control time UC (tariff 1)	41222	0xA106	16b, uint	bits 14 ÷ 0 time (s) bit 15: 0 = quadratic reduction 1 = linear reduction
Control time OC (tariff 1)	41223	0xA107	16b, uint	bits 14 ÷ 0 time (s) bit 15: 0 = quadratic reduction 1 = linear reduction
Control bandwidth (tariff 1)	41224	0xA108	32b, float	$cos\varphi/tg\varphi/\varphi$
Offset power Q1 (tariff 1)	41226	0xA10A	32b, float	var
Offset power Q2 (tariff 1)	41228	0xA10C	32b, float	var
Offset power Q3 (tariff 1)	41230	0xA10E	32b, float	var
Offset power P1 (tariff 1)	41232	0xA110	32b, float	var
Offset power P2 (tariff 1)	41234	0xA112	32b, float	var
Offset power P3 (tariff 1)	41236	0xA114	32b, float	var
reserve	41238÷41239	0xA116÷0xA117		
Target PF (tariff 2)	41240	0xA118	32b, float	$cos\varphi/tg\varphi/\varphi$
Control time UC (tariff 2)	41242	0xA11A	16b, uint	bits 14 ÷ 0 time (s) bit 15: 0 = quadratic reduction 1 = linear reduction
Control time OC (tariff 2)	41243	0xA11B	16b, uint	bits 14 ÷ 0 time (s) bit 15: 0 = quadratic reduction 1 = linear reduction
Control bandwidth (tariff 2)	41244	0xA11C	32b, float	$cos\varphi/tg\varphi/\varphi$
Offset power Q1 (tariff 2)	41246	0xA11E	32b, float	var
Offset power Q2 (tariff 2)	41248	0xA120	32b, float	var
Offset power Q3 (tariff 2)	41250	0xA122	32b, float	var
Offset power P1 (tariff 2)	41252	0xA124	32b, float	var
Offset power P2 (tariff 2)	41254	0xA126	32b, float	var
Offset power P3 (tariff 2)	41256	0xA128	32b, float	var
reserve	41258	0xA12A		
Set 2	41259	0xA12B	16b, uint	0 = off 1÷17 = set 2 starts at output 1.2÷2.9
Discharge time - set 1	41260	0xA12C	16b, uint	s

Mapped data	Base address		Size, type	Encoding
	DEC	HEX		
Discharge time - set 2	41261	0xA12D	16b, uint	s
Out. 1.1 power component Q1	41262	0xA12E	32b, float	var
Out. 1.1 power component Q2	41264	0xA130	32b, float	var
Out. 1.1 power component Q3	41266	0xA132	32b, float	var
Out. 1.1 power component P1	41268	0xA134	32b, float	W
Out. 1.1 power component P2	41270	0xA136	32b, float	W
Out. 1.1 power component P3	41272	0xA138	32b, float	W
Out. 1.2 power Q1 ÷ P3	41274÷41284	0xA13A÷0xA144	32b, float	var, W
Out. 1.3 ÷ .... (32 outputs)	41286÷41644	0xA146÷0xA2AC	32b, float	var, W
Fixed outputs	41646	0xA2AE	32b, uint	n^{th} bit: 0 = output n is fixed 1 = output n is control (= not fixed)
Fixed output values	41648	0xA2B0	32b, uint	n^{th} bit: 0 = output n is fixed-on 1 = output n is fixed-on
Choke control limit PF	41650	0xA2B2	32b, float	$cos\varphi/tg\varphi/\varphi$
reserve	41652÷41653	0xA2B4		
Alarm indication setup	41654	0xA2B6	32b, uint	see table bellow
Alarm actuation setup	41656	0xA2B8	32b, uint	see table bellow
Alarm control quantity	41658	0xA2BA	32b, uint	see table bellow
Alarm limits (if makes sense, up to 24 alarms)	41660÷41683	0xA2BC÷0xA2D3	16b, int	see table bellow
reserve	41684÷41687	0xA2D4÷0xA2D7		
Output error alarm limit range tolerance in 0.1 percent	41688	0xA2D8	16b, int	
T1 and T2 deviation polarity	41689	0xA2D9	16b, int	bit 0: T1>< bit 1: T2>< 0 = „>” 1 = „<”
Delays for alarms (if makes sense, up to 24 alarms)	41690÷41713	0xA2DA÷0xA2F1	16, uint	see table bellow
Alarm affected relays (up to 24 alarms)	41714÷41721	0xA2F2÷0xA2F9	64b, uint	see table bellow
reserve	41722÷41725	0xA2FA÷0xA2FD		
Fan/heating/alarm output alternative function setup	41726	0xA2FE	16b, uint	see table bellow
The ultimate output fan/heating temperature threshold to close	41727	0xA2FF	8b, int	°C
The ultimate output fan/heating temperature threshold to open	41728	0xA300	8b, int	°C
The penultimate output fan/heating temperature threshold to close	41729	0xA301	8b, int	°C

Mapped data	Base address		Size, type	Encoding
	DEC	HEX		
The penultimate output fan/heating temperature threshold to open	41730	0xA302	8b, int	°C
The antepenultimate output fan/heating temperature threshold to close	41731	0xA303	8b, int	°C
The antepenultimate output fan/heating temperature threshold to open	41732	0xA304	8b, int	°C
reserve	41733÷41736	0xA305÷0xA308		
Tariff 2 control power	41737	0xA309	16b, int	% of Pnom, negative means ”signed” limit

Encoding of PFC setup

PFC setup	**41216 (0xA100)**
bit 0	'0' = manual state
	'1' = control state
bit 1	'0' = tariff 2 control off
	'1' = tariff 2 control on
bits 3, 2	tariff 2 control mode
	'00' = digital input
	'01' = power
	'10' = table
bit 4	reserved
bit 5	'0' = output recognizer off
	'1' = output recognizer auto
bit 6	reserved
bits 8, 7	target PF format
	'00' = $cos\varphi$
	'01' = $tg\varphi$
	'10' = φ
bit 9	'0' = offset control off
	'1'= offset control on
bits 15÷10	reserved
bits 17÷16	'00' = inteligent switching mode
bits 19÷18	choke control
	'00' = off
	'01' = mixed
	'10' = non-mixed

Encoding of alarm indication setup

Alarm indication		**41654 (0xA2B6)**	
'0' - off			
'1' - indication			
bit 0	U<<	bit 10	NS>
bit 1	U<	bit 11	OE
bit 2	U>	bit 12	T1><
bit 3	I<	bit 13	T2><
bit 4	I>	bit 14	EXT
bit 5	CHL>	bit 15	OoC
bit 6	THDU>	bit 16	RCF
bit 7	THDI>	bit 17	PF>
bit 8	P<	bit 18	PF<
bit 9	PF><		

Encoding of alarm actuation setup

Alarm actuation		**41656 (0xA2B8)**	
'0' - off			
'1' - actuation			
bit 0	U<<	bit 10	NS>
bit 1	U<	bit 11	OE
bit 2	U>	bit 12	T1><
bit 3	I<	bit 13	T2><
bit 4	I>	bit 14	EXT
bit 5	CHL>	bit 15	OoC
bit 6	THDU>	bit 16	RCF
bit 7	THDI>	bit 17	PF>
bit 8	P<	bit 18	PF<
bit 9	PF><		

Encoding of alarm control quantity

Alarm control		**41656 (0xA2B8)**	
'0' - actual value (actual internal temperature Ti for T1><, T2><)			
'1' - average value (actual external temperature Te for T1><, T2><)			
bit 0	U<<	bit 10	NS>
bit 1	U<	bit 11	OE
bit 2	U>	bit 12	T1><
bit 3	I<	bit 13	T2><
bit 4	I>	bit 14	EXT
bit 5	CHL>	bit 15	OoC
bit 6	THDU>	bit 16	RCF
bit 7	THDI>	bit 17	PF>
bit 8	P<	bit 18	PF<
bit 9	PF><		

Encoding of alarm limits

Alarm limits	**41660÷41682 (0xA2BC÷A2D2)**
Order is same as in alarm indication setup (41660 = U<< ... 41682 = PF<)	
positive values in percent of appropriate nominal value unless otherwise indicated	
P<	negative alarm limit value means „signed" limit evaluation
T1><, T2><	in °C, negative values possible
I<	in 0.1%
P<	in 0.1%
NS>	alarm limit is expressed in thousands of switching operations

Alarm delays for alarms

Alarm delay	41690÷41713 (0xA2DA÷0xA2F1)
0 = 0 s	9 = 2 min
1 = 5 s	10 = 3 min
2 = 10 s	11 = 4 min
3 = 15 s	12 = 5 min
4 = 20 s	13 = 7 min
5 = 30 s	14 = 10 min
6 = 45 s	15 = 15 min
7 = 1 min	16 = 20 min
8 = 1 min 30 s	

Alarm affected relays

Affected relay		41714÷41721 (0xA2F2÷0xA2F9)	
0 = not affected, 1 = affected			
Variable No. 1	bits 2,1,0	alarm No. 1 (U<<)	map of affected relays No. 3,2,1
	bits 5,4,3	alarm No. 2 (U<)	map of affected relays No. 3,2,1
	⋮	⋮	⋮
	bits 62,61,60	alarm No. 21	map of affected relays No. 3,2,1
Variable No. 2	bits 2,1,0	alarm No. 22	map of affected relays No. 3,2,1
	⋮	⋮	⋮
	bits 8,7,6	alarm No. 24	map of affected relays No. 3,2,1

Alternative output functions

Output		41726 (0xA2FE)
bits 2,1,0	ultimate output	bit 0 ... 0 = alternative function on, 1 = alternative function off
		bit 1 ... 0 = output open/heating, 1 = output closed/fan
		bit 2 ... 0 = alarm function, 1 = fan/heating function
bits 6,5,4	penultimate output	bit 4 ... 0 = alternative function on, 1 = alternative function off
		bit 5 ... 0 = output open/heating, 1 = output closed/fan
		bit 6 ... 0 = alarm function, 1 = fan/heating function
bits 10,9,8	antepenultimate output	bit 8 ... 0 = alternative function on, 1 = alternative function off
		bit 9 ... 0 = output open/heating, 1 = output closed/fan
		bit 10 ... 0 = alarm function, 1 = fan/heating function

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