Interface EMMOD201

Camille Bauer reserves the right to change the contents of this document at any time without notice.

CAMILLE BAUER

Contents

MOD-TRONIC INSTRUMENTS LIMITED
48 Haggert Ave N
Brampton, ON L6X 1Y3
Tel: 905 457-6322
Fax: 905 457-4716
Toll Free: 800 794-5883

1. Introduction

The devices of the A200 series of multi-functional power meters may be equipped with the optional extension module EMMOD201. This way three different operating modes may be realized:

- Standalone: The module is used for configuring the device only. There is no permanent connection to a master (PC) or it is not fixed all the time.
- Bus service: Up to 32 devices may be interconnected via RS485 interface. Measured data are requested permanently via a MODBUS master.
- Complete device control via bus: Beside the interrogation of measurands the synchronization of the mean power values, tariff switching and digital output driving (on-site alarming) may be performed via bus interface. The MODBUS master is fully responsible for a permanent control of the devices and acquires measurands periodically.

The following functions can be performed using the extension module:

- Interrogation of device features
- Modification of device features
- Acquisition of present measurnands
- Acquisition of intergrated mean-power values
- Interrogation / setting / resetting of meter contents
- Resetting minimum / maximum values
- Acquisition of mean-power values stored in the logger
- Synchronization, tariff switching or direct output driving of digital outputs via bus interface

This document descripes all these functions. The operating mode of the extension module is switchable and may be used for both RS232 interface or RS485 interface. For communication protocols according to the MODBUS specification are used. All information necessary to realize a independent software solution is provided. This way all benefits of the devices can be used.

However, normally you will work with an existing hardware and /or software platform. Therefore we will give a help to various users which chapters of this document are of help for him.

Hardware installer

2. Connecting devices

MODBUS®tool user

3. Interface realization
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Engineer who wants to realize an independent measurand acquisition

3. Interface realization
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MODBUS® - Modbus ist eine eingetragene Handelsmarke von Schneider Automation Inc.

2. Connecting devices

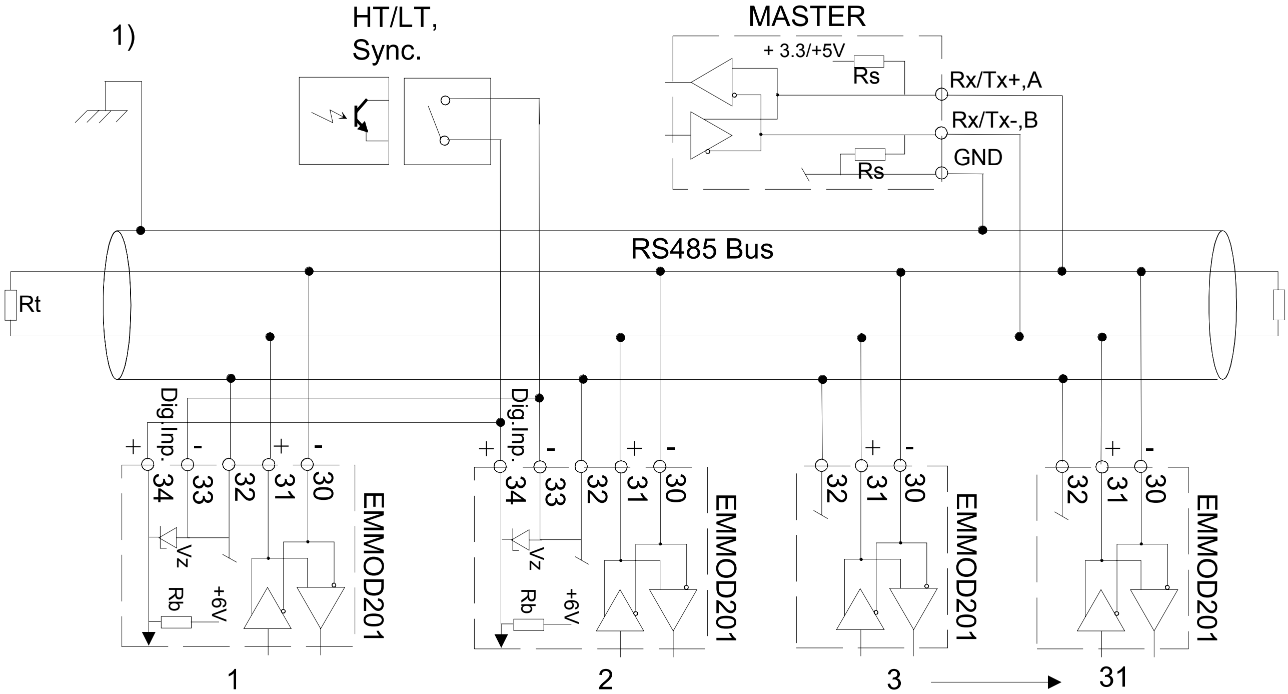
RS485: MODBUS interface

The switch on the extension module has to be in position *RS485.* One should use twisted signal wires cables and pay attention to the polarity. GND can be connected with a wire or the cable screen. Screened cables must be used in an environment with interference.

If long wires (> 10m) are used, termination resistors of each 120 Ohm are necessary on both bus ends. Additionally supply resistors of 500...1000 Ohm to signal GND and +5V are required. Normally these supply resistors are part of the bus master interface.

Attention: Simple interface converters have no built-in supply resistors. Devices with supply resistors are e.g. W&T 13601 (PC card) or W&T 86201 (converter) of Wiesemann & Theis GmbH.

Beware of long stubs, a simple line network is ideal. Up to 32 devices (including the master) may be interconnected.



All devices must use the same bus settings (baudrate, parity control) but a unique device address. These settings may be performed locally at the device or via RS232 interface.

1) One ground connection only. This is possibly already made at the master (PC).

Rt	Termination resitors 120 Ohm
Rs	Bus supply resistors 500...1000 Ohm
Rb	Contact input supply resistors 4.5kOhm
Vz	6.2V zener diode for protection

RS232: Programming interface

The switch on the extension module has to be in position *RS232*. Using a PC, the software *A200plus* and an *interface adapter cable RS232* (order no. 152 603) the configuration settings can be clearly and easily made. All the bus functions are available. However, interconnetion of more than one device is impossible.

3. Interface realization

3.1 Interface configuration

The extension module provides a switchable serial interface: RS232 or RS485. The following transmission modes can be used:

* **RS232**: 9600Bd, 1 start bit, 8 data bits, even parity, 1 stop bit
* **RS485**: Baudrate 1200, 2400, 4800, 9600 or 19200 Bd (configurable)

  char. format: 1 start, 8 data, even parity, 1 stop bit
  1 start, 8 data, odd parity, 1 stop bit
  1 start, 8 data, no parity, 2 stop bit
  1 start, 8 data, no parity, 1 stop bit (often used but not in accordance with MODBUS specification)

The settings of the transmission parameters and the device address for the RS485 interface may be performed via the front panel of the device or by software using the RS232 interface.

3.2 Transmission principle

The transmission is fully master (PC) controlled. No connected device is allowed to send a telegram without prior request by the master. The master as well monitors possibly occuring timeouts (no response from the addressed device). Telegrams are transmitted using the MODBUS RTU (Remote Terminal Unit) mode.

3.3 General message form

device address	**function**	**data**	**CRC-check**
8 bits	8 bits	n * 8 bits	16 bits

The MODBUS® specification defines a silent-interval (Pause) of at least 3.5 chars between two telegrams to transmit. Within a message two chars may be separated for not more than 1.5 chars. A typical data transmission looks like:

Pause | **Telegram 1** → ***Pause*** | **Telegram 2** → ***Pause*** | **Telegram 3** **etc.**

address: The device which is addressed (Master→Slave communication) or the responding device (Slave→Master communication). For RS485 allowed addresses are 1..247, for RS232 the fixed address 255 must be used. Address 0 is used for broadcast messages.

function: Defines the purpose of data transmission. The following standard function are supported:

Code	MODBUS® function	Used for ...
03_H	READ HOLDING REGISTERS	- Acquisition of measurands, meter contents, mean-values, logger data - Configuration data upload
08_H	DIAGNOSTIC	- By means of the subfunction 0 the connection to the device may be tested.
10_H	PRESET MULTIPLE REGISTERS	- Configuration - Setting /resetting meters - Resetting minimum/maximum values

data: Contains the data to transmit. This field is divided into register, number of registers to transmit and, if necessary, read data or information to store. Data is normally transmitted as 16 bit registers but there are also 32 bit numbers (double registers) and double bytes used (see chapter 3.5).

CRC check: The cyclic redundancy check calculation is performed on the message content to detect transmission errors.

Function 03 (Hex): Reading data

Request
Master->Slave

Address	Function	Data				CRC-check
		Start address		Number of registers		
addr	03_H	high byte	low byte	high byte	low byte	crc16

Answer
Slave->Master

Address	Function	Data		CRC-check
		Number of data bytes	Information	
addr	03_H	n (8 bts)	n/2 registers	crc16

Example(Hex): >>>> 11 03 00 6B 00 03 crc (Request for registers 108-110 of device 17)
<<<< 11 03 06 **02 2B 00 00 00 64** crc

Note: The register address 108 is addressed as register 107 in accordance with the MODBUS specification

Function 08 (Hex), Sub-function 00: Diagnostic (Connection test)

Request
Master->Slave

Address	Function	Data				CRC-check
		Sub-function		Data		
addr	08_H	0	0	High-Byte	Low-Byte	crc16

Answer
Slave->Master

Address	Function	Data				CRC-check
		Sub-function		Information		
addr	08_H	0	0	High-Byte	Low-Byte	crc16

Example (Hex): >>>> 11 08 00 00 AA 55 crc (The telegram is sent back 1:1)
<<<< 11 08 00 00 AA 55 crc

Function 10 (Hex): Storing data in the device

Request
Master->Slave

Address	Function	Data						CRC-check
		Start address		# registers		# bytes	Information	
addr	10_H	High	Low	High	Low	n	n bytes	crc16

Answer
Slave->Master

Address	Function	Data				CRC-check
		Start address		# registers		
addr	10_H	High	Low	High	Low	crc16

Example (Hex): >>>> 11 10 00 01 00 02 04 **00 0A 01 02** crc (Setting register 2 and 3 of device 17)
<<<< 11 10 00 01 00 02 crc

Note: The register address 2 is addressed as register 1 in accordance with the MODBUS specification

Function 10_H supports Broadcast. Using address 0 all devices may be accessed at the same time to perform the same action. This kind of telegrams will never be answered by any slave. Typical application: Reset of minimum / maximum values or setting the display brightness of all devices.

3.4 Error handling

If a transmission error occurs, i.e. if the CRC calculated by the recipient doesn't match the received one, no answer will be sent to the master. This way a timeout will be provoked. The same happens if a non-existing or switched-off device will be addressed.

If the recipient of a message detects another error, it sends back a corresponding error message to the master.

Device answer:

Address	Code	Data	Check sum	
			LByte	HByte
11_H	Code+80_H	***Error code***	CRC16	

The function code received will be sent back. However, the most significant bit (MSB) of the function code will be set. The error code indicates an operating or a programming error. The following error codes are supported:

Error code	Meaning
01_H	The used function code is not supported
02_H	The register address used is not allowed. The register address may be invalid or write-protected.
03_H	Data values used are out of range, i.e. invalid number of registers.
04_H	Internal device error

3.5 Cyclic redundancy check calculation (crc16*)* *(Example in 'C)'*

The calculation is performed on all message characters, except the check bytes itself. The low-order byte (Crc_LByte) is appended to the message first, followed by the high-order byte (Crc_HByte). The receiver of the message calculates the check bytes again and compares them with the received ones.

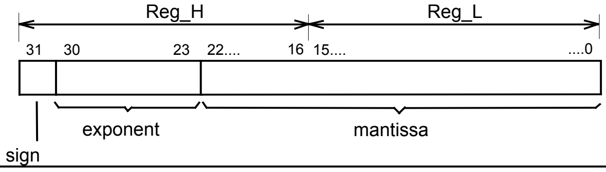
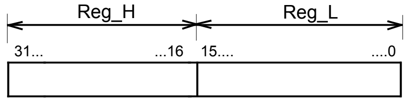
```
void main()
{
   unsigned char data[NUMDATA+2];                  // Message buffer
   unsigned char Crc_HByte,LByte;                  //
   unsigned int Crc;
   ....
   Crc=0xFFFF;
   for (i=0; i<NUMDATA; i++) {
     Crc = CRC16 (Crc, data[i] );
   }
   Crc_LByte = (Crc & 0x00FF);                     // Low byte calculation
   Crc_HByte = (Crc & 0xFF00) / 256;               // High byte calculation
}
// CRC16 calculation
// ----------------
unsigned int CRC16(unsigned int crc, unsigned int data)
{
  const unsigned int Poly16=0xA001;
  unsigned int LSB, i;

  crc = ((crc^data) | 0xFF00) & (crc | 0x00FF);
  for (i=0; i<8; i++) {
    LSB=(crc & 0x0001);
    crc=crc/2;
    if (LSB)
      crc=crc^Poly16;
  }
  return(crc);
}
```

3.6 Special data types

The standard MODBUS® protocol uses 16 bit registers for data transmission. To adapt the transducers data structure and to improve accuracy the following data types are used as well:

- ***32 bit numbers***: 32 bit unsigned integers and 32 bit float numbers are transmitted as two consecutive 16 bit registers. The format of the float number corresponds to the format normally used in PCs.

<table>
<tr><th>Type</th><th>32 bit float</th><th>32 bit unsigned integer</th></tr>
<tr><td>Format</td><td>
</td><td>
</td></tr>
<tr><td>Calculation</td><td>$\text{Value} = (-1)^{\text{sign}} * 2^{(\text{exponent}-126)} * \frac{\text{mantissa} + 2^{23}}{2^{24}}$</td><td></td></tr>
</table>

Transmission order:

Reg_L		*Reg_H*	
HByte	LByte	HByte	LByte

4. Measurand acquisition

The power monitoring devices acquisite the measurands of an electrical system. These measurands and derived quantities may be interrogated via the extension module EMMOD201. These information can be divided as follows:

1. Present measurands
2. Minimum / maximum values
3. Meter contents
4. Mean-power values (integrated for a synchronization interval)
5. Progression of mean-power values (Logger)

4.1 Present measurands

Register address	Measurand	single-phase / 3 or 4-wire balanced load systems	3-wire unbalanced load system	4-wire unbalanced load system
100	U	☻	-	-
102	U1N	-	-	☻
104	U2N	-	-	☻
106	U3N	-	-	☻
108	U12	-	☻	☻
110	U23	-	☻	☻
112	U31	-	☻	☻
114	I	☻	-	-
116	I1	-	☻	☻
118	I2	-	☻	☻
120	I3	-	☻	☻
122	Iavg	☻	-	-
124	I1_avg	-	☻	☻
126	I2_avg	-	☻	☻
128	I3_avg	-	☻	☻
130	IN	-	-	☻
132	P1	-	-	☻
134	P2	-	-	☻
136	P3	-	-	☻
138	P	☻	☻	☻
140	Q1	-	-	☻
142	Q2	-	-	☻
144	Q3	-	-	☻
146	Q	☻	☻	☻
148	S1	-	-	☻
150	S2	-	-	☻
152	S3	-	-	☻
154	S	☻	☻	☻
156	F	☻	☻	☻
158	PF1	-	-	☻
160	PF2	-	-	☻
162	PF3	-	-	☻
164	PF	☻	☻	☻

☻ = Valid measurand - = not used (0.00)

All present values are 32-bit float numbers (2 registers for each value). If primary transformers are used they refer to the primary value of the appropriate measurand.

4.2 Minimum- / Maximum values

Register address	Measurand	single-phase / 3 or 4-wire balanced load systems	3-wire unbalanced load system	4-wire unbalanced load system
200	U_max	☻	-	-
202	U1N_max	-	-	☻
204	U2N_max	-	-	☻
206	U3N_max	-	-	☻
208	U12_max	-	☻	☻
210	U23_max	-	☻	☻
212	U31_max	-	☻	☻
214	I1_max	☻	-	-
216	I1_max	-	☻	☻
218	I2_max	-	☻	☻
220	I3_max	-	☻	☻
222	I_avg_max	☻	-	-
224	I1_avg_max	-	☻	☻
226	I2_avg_max	-	☻	☻
228	I3_avg_max	-	☻	☻
230	IN_max	-	-	☻
232	P1_max	-	-	☻
234	P2_max	-	-	☻
236	P3_max	-	-	☻
238	P_max	☻	☻	☻
240	Q1_max	-	-	☻
242	Q2_max	-	-	☻
244	Q3_max	-	-	☻
246	Q_max	☻	☻	☻
248	S1_max	-	-	☻
250	S2_max	-	-	☻
252	S3_max	-	-	☻
254	S_max	☻	☻	☻
256	U_min	☻	-	-
258	U1N_min	-	-	☻
260	U2N_min	-	-	☻
262	U3N_min	-	-	☻
264	U12_min	-	☻	☻
266	U23_min	-	☻	☻
268	U31_min	-	☻	☻
270	PFmin_ind	☻	☻	☻
272	PFmin_cap	☻	☻	☻

☻ = Valid measurand - = not used (0.00)

All values are 32-bit float numbers (2 registers for each value). If primary transformers are used they refer to the primary value of the appropriate measurand.

4.3 Meter contents

Register address	No tariff switching	Tariff switching activated
300	$P_{incoming}$	$P_{incoming}$ HT
302	-	$P_{incoming}$ LT
304	$P_{outgoing}$	$P_{outgoing}$ HT
306	-	$P_{outgoing}$ LT
308	$Q_{inductive}$	$Q_{inductive}$ HT
310	-	$Q_{inductive}$ LT
312	$Q_{capacitive}$	$Q_{capacitive}$ HT
314	-	$Q_{capacitive}$LT

All meter contents are unsigned 32-bit integer numbers (2 registers for each value). These values refer to the significant numbers, which will be displayed on the display unit itself.

Unit factor

Register address	No tariff switching	Tariff switching activated
320	Unit factor **x**	

The unit factor is a unsigned 16-bit integer number. It is used to scale the meter contents to the appropriate physical unit and to define the number of post decimal positions. It contains as well the conversion for possibly conneted primary transformers.

$$\text{Physical meter content} = \text{Meter content} * 10^{x} \text{ [Wh or varh]}$$

Example: $P_{incoming}$ = 12056; x=4

Meter content=12056 x 10^{4} Wh =12056 x 10^{6} x10^{-2} Wh =**120.56 MWh**

4.4 Mean-power values

Register address	Measurand	Time reference
350	P_int_0	t
352	P_int_1	t – 1 Interval
354	P_int_2	t – 2 Interval
356	P_int_3	t – 3 Interval
358	P_int_4	t – 4 Interval
360	Q_int_0	t
362	Q_int_1	t – 1 Interval
364	Q_int_2	t – 2 Interval
366	Q_int_3	t – 3 Interval
368	Q_int_4	t – 4 Interval
370	S_int_0	t
372	S_int_1	t – 1 Interval
374	S_int_2	t – 2 Interval
376	S_int_3	t – 3 Interval
378	S_int_4	t – 4 Interval

All mean-power values are 32-bit float numbers (2 registers for each value). If primary transformers are used they refer to the primary value of the appropriate measurand.

4.5 Mean-power values progression (Logger)

The logger stores the progression of the mean-power values for a longer time period. The maximum storage time depends on the selected synchronization interval and the number of measurands to store.

The following **settings** (see 7. Configuration) may be performed for the logger:

- Measurands to log: None (logger OFF), Pint, Qint, Pint+Qint

- Logger mode: one-time or endless

The logger provides the following **information**:

- Status information:

  ● Number of logged measurands (total of all Pint and Qint values)

  ● Up to 10 power fail informations: Register address of the interrupted measuring interval. In cases of power failure, the possibility to synchronize logged data to the PC clock when reading them, will be lost.

Register	Meaning	Values
950	Logger status	Bit 0..7 Number of power failures since last logger reset Bit 8 Logger buffer is full Bit 9 Logger-mode 0: one-time (recording stops if buffer is full) 1: endless (oldest values will be deleted if buffer is full) Bit 10 If set: Q interval will be logged Bit 11 If set: P interval will be logged Bit 12..15 not used
951	Number of logged measurands	- 0 if no power failure information is registred - Register address of interrupted interval if power failure occured
952	Register address power failure 1	
953	Register address power failure 2	
954	Register address power failure 3	
955	Register address power failure 4	
956	Register address power failure 5	
957	Register address power failure 6	
958	Register address power failure 7	
959	Register address power failure 8	
960	Register address power failure 9	
961	Register address power failure 10	

- Measurands: Pint and / or Qint. Maximum number of values 16'000. All values are 32-bit float numbers (2 registers for each value), scaled on primary values. If present, Pint will be stored before Qint. An attempt to read values not yet stored will be answered by a 03H error message.

  For endless logger with full buffer only: On each reading of logger data a timeout of 10s will be started. During this time the assignment of the measurands and the register addresses will not be modified. New values will be stored separately and filled in if the timeout expires. This way it can be assured, that a complete reading of the logger can be performed, before a register offset may take place.

  A modbus telegram allows to read a maximum of 255 data bytes. Therefore the reading of larger data segments must be divided. If both measurands are logged you may read 60 data elements (120 registers) at the same time. If only one measurand is logged the limit is 62 data elements (124 registers).

Register	Meaning	Assignment
1'000...32'998	Logger values	The data will be stored in ascending order. Therefore register 1000 will always contain the oldest recorded value.

The logged data may be deleted at all time:

Register	Meaning	Values
970	Reset	Bit 0 set: All logged data will be deleted Bit 1 set: Interval timer will be restarted (for internal synchronization only)

5. Status interrogation / remote control

The bus interface allows to request informations about presettings or device states. Another possibility is to control functions like tariff switching, digital output driving or synchronization via bus.

All these functions are provided by reading or setting register 400. When using the remote control facility more than one task may be transmitted woth one command. Subsequent commands don't have to consider the previous state of register 400.

5.1 Status interrogation

Register	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
400											O2	O1			HL		

HL: Present active tariff situation (0=high tariff, 1=low tariff)
O1: Present state of digital output 1 (0=OFF, 1=ON)
O2: Present state of digital output 2 (0=OFF, 1=ON)

The states of the digital outputs is tracked only, if the outputs are configured for alarm limit monitoring.

5.2 Remote control of digital outputs

Register	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
400			E2	E1				O2	O1								

The state of the digital outputs may be set via bus interface. This way e.g. the following functions may be performed:

- Test ob subsequent equipment during installation
- On-site alarming via digital outputs, independent of the device function

To perform these tasks it must be assured, that digital outputs are configured for bus control. Therefore it may be necessary to temporary deactivate the configured function of the digital outputs, by setting the most significant bit of the parameter `Diga_Konfig[0]` resp. `Diga_Konfig[1]` (see chapter 7).

Output 1 O1: Set state of digital output 1 (0=no, 1=yes)
E1: Desired state of digital output 1 (0=OFF, 1=ON)
Output 2 O2: Set state of digital output 2 (0=no, 1=yes)
E2: Desired state of digital output 2 (0=OFF, 1=ON)

5.3 Setting tariff situation

Register	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
400						EN	HL										

HL: Desired tariff situation (0=high tariff, 1=low tariff)
EN: Set state of tariff situation (0=no, 1=yes)

5.4 Synchronization via bus interface

Register	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
400														SY			

The synchronization for the calculation of the mean-power values may be performed via bus interface as well. To do so, the digital input may not be configured for synchronization. Additionally bits 0..5 of the configuration byte `EnergyControl` must be set to 0 to deactivate internal synchronization.

To transmit a synchronization pulse you have to set bit 'SY' of register 400. For logical reasons this command should be sent as a broadcast message (to all devices). To make this a senseful application the presence of a master is required all the time.

5.5 Firmware versions and device type

Register address	Measurand	Example
402	Firmware version basic device	214 = Version 02.14
403	Firmware version extension module	102 = Version 01.02
404	Hardware range limit current input	100=1A, 500=5A
405	Hardware range limit voltage input	100=100V, 500=500V

Register address	Measurand	Example
410..412	Device type (string)	"A210\0"

6. Resetting measurands

The power monitoring device contains information considering the progression of measurands in time. Especially these are minimum / maximum values and meters. All these values may be resetted independently or all at the same time.

6.1 Resetting Rücksetzen von Minimal- / Maximalwerten

The existing values may be influenced in groups. To reset one of these groups the appropriate bit in the register must be set. Using broadcast messages (address 0) the reset may be performed for all devices connected to the bus and all selected measurand groups at the same time.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Register address	Measurands	Bit
430	Ux_max	0
	Ix_max	1
	Ix_avg_max	2
	Px_max	3
	Qx_max	4
	Sx_max	5
	Ux_min	6
	PF_min	7

The bit set will be automatically reset by the device itself as soon as the function completes.

Note: If broadcast messages are used (all devices) you will receive no acknowledgment.

6.2 Setting / resetting meters

Meters can be set to zero independently or all at the same time. They may be set to any desired content as well. This way you can take over existing meter contents for newly installed devices.

Resetting
To reset meters for each value to reset the appropriate bit in the register must be set.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Register address	Bit	No tariff switching	Tariff switching activated
420	0	$P_{incoming}$	$P_{incoming}$ HT
	1	-	$P_{incoming}$ LT
	2	$P_{outgoing}$	$P_{outgoing}$ HT
	3	-	$P_{outgoing}$ LT
	4	$Q_{inductive}$	$Q_{inductive}$ HT
	5	-	$Q_{inductive}$ LT
	6	$Q_{capacitive}$	$Q_{capacitive}$ HT
	7	-	$Q_{capacitive}$LT

Setting

The same registers will be used as for meter readings.

Register address	No tariff switching	Tariff switching activated
300	$P_{incoming}$	$P_{incoming}$ HT
302	-	$P_{incoming}$ LT
304	$P_{outgoing}$	$P_{outgoing}$ HT
306	-	$P_{outgoing}$ LT
308	$Q_{inductive}$	$Q_{inductive}$ HT
310	-	$Q_{inductive}$ LT
312	$Q_{capacitive}$	$Q_{capacitive}$ HT
314	-	$Q_{capacitive}$LT

Unit factor (read only)

Register address	No tariff switching	Tariff switching activated
320	Unit factor **x**	

All meter contents are unsigned 32-bit integer numbers (2 registers for each value). These values refer to the significant numbers, which will be displayed on the display unit itself.

The unit factor is a unsigned 16-bit integer number. It is used to scale the meter contents to the appropriate physical unit and to define the number of post decimal positions (see chapter 4.3). This factor is valid for all meter contents of a device and can't be modified.

7. Configuration

The power monitoring device may be adjusted to changed conditions on-site by modifying its parameter. The configuration may be performed on register base or block oriented.

Register	Variable	Format	Range	Description
500	Pulsrate[0]	int	0...5000	Rate of pulse output 1 (Pulses / xWvarh)
501	Pulsrate[1]	int	0...5000	Rate of pulse output 2 (Pulses / xWvarh)
502	UPrimAnz	int	100...999	[1] Primary voltage ext. voltage transformer
503	USekAnz	int	100...999	[2] Secondary voltage ext. voltage transformer
504	IPrimAnz	int	100...999	[3] Primary current ext. current transformer
505	ISekAnz	int	100...999	[4] Secondary current ext. current transformer
506	UPrimPot USekPot	char char	0...+3 0	[1] Decimal power for primary voltage of the external voltage transformer [2] Decimal power for secondary voltage of the external voltage transformer
507	IPrimPot ISekPot	char char	-2...+3 -2	[3] Decimal power for primary current of the external current transformer [4] Decimal power for secondary current of the external current transformer
508	COM_Address COM_Konfig	BYTE BYTE	1...247 see table	[5] Device address Baudrate, Parity
509..532	COM_Info[0..47]	char	ASCII	Device description text
533 534 535 536	Diga_GW_close[0] Diga_GW_close[1] Diga_GW_open[0] Diga_GW_open[1]	int int int int	-12000...12000 -12000...12000 -12000...12000 -12000...12000	Alarm limit ON digital output 1 Alarm limit ON digital output 2 Alarm limit OFF digital output 1 Alarm limit OFF digital output 2
537	Anz_Hell System	BYTE BYTE	0...12 see table	Display brightness System
538	Bild_Nr Diga_Konfig[0]	char BYTE	see table see table	No. of diplayed measurands combination configuration digital output 1
539	Diga_Konfig[1] Energy_Control	BYTE BYTE	see table see table	configuration digital output 2 Synchronization + tariff switching
540	Logger_Modus	WORD	see table	Logger: Operating mode, Measurands to log

[1] Range: 100...999 * $10^{UPrimPot}$ V_{LL} rsp. 100V...999kV

[2] Range: 100...999 * $10^{UPrimPot}$ V_{LL} rsp. 100V...999V

[3] Range: 100...999 * $10^{IPrimPot}$ A rsp. 1.00A..999kA

[4] Range: 100...999 * $10^{ISekPot}$ A rsp. 1.00A..9,99A

[5] Configuration via RS232 interface only

BYTE System

Measuring	**System**	**Coding**
single-line	Single-line system 3-wire system, balanced load 4-wire system, balanced load	0x00 0x01 0x02
multi-line	3-wire system, asymmetrical (Aron) 4-wire system, asymmetrical	0x03 0x04

BYTE Energy_Control

Bit	**Function**	**Value**
5...0	Synchronization interval	0: Remote control via bus interface 1...60: 1...60 min (internal)
7...6	Digital input function	00: OFF 01: tariff switching 10: Mean-power values synchronization

BYTE Diga_Konfig[2]

Value	Function	Measurand	single line	3-wire balanced	4-wire balanced	3-wire asymmetr.	4-wire asymmetr.
0	Alarm limit	Current	I	I	I	I	I
1	Alarm limit	Average current	I.avg	I.avg	I.avg	I.avg	I.avg
2	Alarm limit	Phase-to-phase voltage	-	-	-	U.LL	U.LL
3	Alarm limit	Phase-neutral voltage	U	U	U	-	U.LN
4	Alarm limit	Active power	P	P	P	P	P
5	Alarm limit	Reactive power	Q	Q	Q	Q	Q
6	Alarm limit	Apparent power	S	S	S	S	S
7	Alarm limit	Power factor	PF	PF	PF	PF	PF
8	Alarm limit	Active power interval	P.int	P.int	P.int	P.int	P.int
9	Alarm limit	Reactive power interval	Q.int	Q.int	Q.int	Q.int	Q.int
10	Alarm limit	Apparent power interval	S.int	S.int	S.int	S.int	S.int
11	Alarm limit	Neutral current	-	-	-	-	in
12	Alarm limit	Frequency	F	F	F	F	F
13..63		Reserved					

To determine the alarm limit output the measurands of each phase will be OR-combined. Therefore, if e.g. an alarm-limit (high alarm)is configured for current, it will be "ON" if one of the phase currents exceeds the given limit.

Value	Function	Measurand	Pulses per...
64	Pulse output	Active energy, incoming, high tariff	Pulses /Wh
65	Pulse output	Active energy, incoming, high tariff	Pulses /kWh
66	Pulse output	Active energy, incoming, high tariff	Pulses /MWh
67	Pulse output	Active energy, incoming, high tariff	Pulses /GWh
68	Pulse output	Active energy, incoming, low tariff	Pulses /Wh
69	Pulse output	Active energy, incoming, low tariff	Pulses /kWh
70	Pulse output	Active energy, incoming, low tariff	Pulses /MWh
71	Pulse output	Active energy, incoming, low tariff	Pulses /GWh
72	Pulse output	Active energy, outgoing, high tariff	Pulses /Wh
73	Pulse output	Active energy, outgoing, high tariff	Pulses /kWh
74	Pulse output	Active energy, outgoing, high tariff	Pulses /MWh
75	Pulse output	Active energy, outgoing, high tariff	Pulses /GWh
76	Pulse output	Active energy, outgoing, low tariff	Pulses /Wh
77	Pulse output	Active energy, outgoing, low tariff	Pulses /kWh
78	Pulse output	Active energy, outgoing, low tariff	Pulses /MWh
79	Pulse output	Active energy, outgoing, low tariff	Pulses /GWh
80	Pulse output	Reactive energy, inductive, high tariff	Pulses /varh
81	Pulse output	Reactive energy, inductive, high tariff	Pulses /kvarh
82	Pulse output	Reactive energy, inductive, high tariff	Pulses /Mvarh
83	Pulse output	Reactive energy, inductive, high tariff	Pulses /Gvarh
84	Pulse output	Reactive energy, inductive, low tariff	Pulses /varh
85	Pulse output	Reactive energy, inductive, low tariff	Pulses /kvarh
86	Pulse output	Reactive energy, inductive, low tariff	Pulses /Mvarh
87	Pulse output	Reactive energy, inductive, low tariff	Pulses /Gvarh
88	Pulse output	Reactive energy, capacitive, high tariff	Pulses /varh
89	Pulse output	Reactive energy, capacitive, high tariff	Pulses /kvarh
90	Pulse output	Reactive energy, capacitive, high tariff	Pulses /Mvarh
91	Pulse output	Reactive energy, capacitive, high tariff	Pulses /Gvarh
92	Pulse output	Reactive energy, capacitive, low tariff	Pulses /varh
93	Pulse output	Reactive energy, capacitive, low tariff	Pulses /kvarh
94	Pulse output	Reactive energy, capacitive, low tariff	Pulses /Mvarh
95	Pulse output	Reactive energy, capacitive, low tariff	Pulses /Gvarh
96..127	Reserved		
>127	No function or remote control via bus interface		

If the digital input isn't configured for tariff-switching, only high tariff meters will be served. Exception: Low tariff is commanded via bus interface.

BYTE COM_Konfig

Bite	**Function**	**Coding**
2...0	Baudrate	000: 1200 Bd 001: 2400 Bd 010: 4800 Bd 011: 9600 Bd 100: 19200 Bd
4...3	Parity	00: NO (2 stop bits) 01: EVEN 10: ODD 11: SPACE (1 stop bit)
6...5	Protocol	00: Modbus
7	Reserved	

BYTE Logger_Modus

Bit	**Function**
8...0	not used
9	Logger mode 0: one-time (recording stops if buffer is full) 1: endless (oldest value will be deleted if buffer is full)
10	If set: Q interval will be logged
11	If set: P interval will be logged
15...12	not used