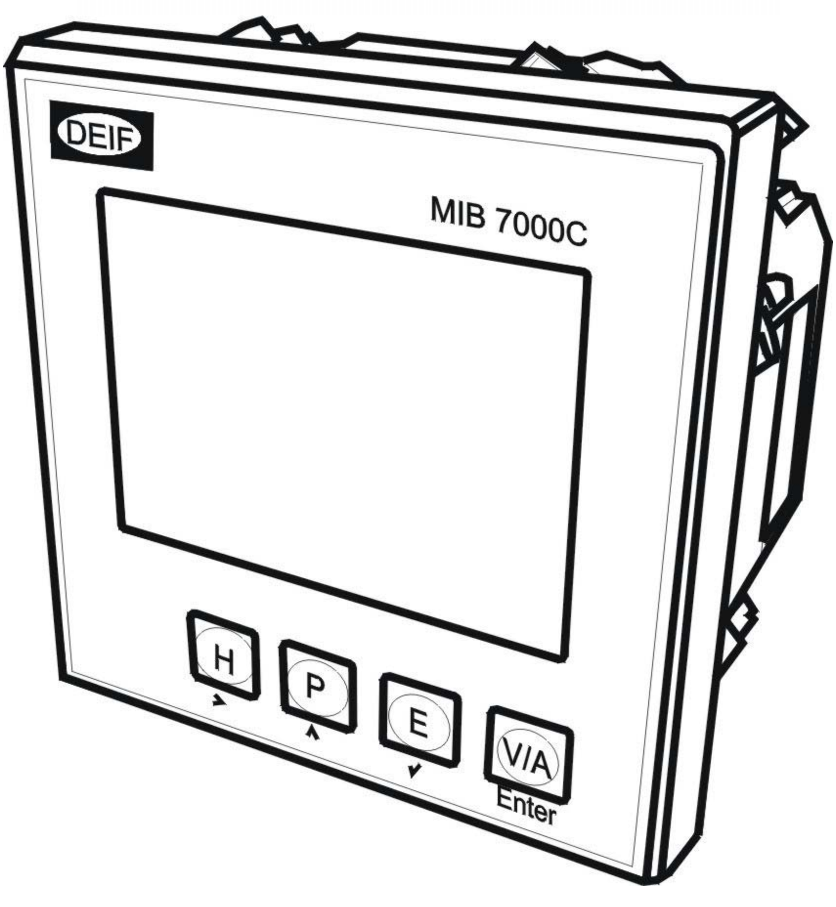
Modbus Communication Manual

-power in control

Multi-instrument MIB 7000C

4189320024C



- Measurement and functions of the MIB
- Modbus protocol
- Modbus addresses

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1. Warnings and legal information

This chapter includes important information about general legal issues relevant in the handling of DEIF products. Furthermore, some overall safety precautions will be introduced and recommended. Finally, the highlighted notes and warnings, which will be used throughout the document, are presented.

Legal information and responsibility

DEIF takes no responsibility for installation or operation of the engine set. If there is any doubt about how to install or operate the engine controlled by the unit, the company responsible for the installation or the operation of the set must be contacted.

The units are not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

Safety issues

Installing the unit implies work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

CE-marking

The MIB is CE-marked according to the EMC-directive for industrial environments, which normally covers the most common use of the product.

Definitions

Throughout this document a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

Notes

The notes provide general information which will be helpful for the reader to bear in mind.

Warnings

The warnings indicate a potentially dangerous situation which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

2. Measurement and functions of the MIB

Measuring principle

The multi-instrument MIB is based on a modern digital signal processing platform, where all current and voltage input signals are digitally sampled and all values are calculated from these sampled signals. This ensures a very accurate measuring system, which can also measure total harmonic distortion of both voltage and current.

Voltage (U)

The MIB calculates the true RMS value of the three phase-neutral voltages (V1, V2, V3) and the three phase-phase voltages (V12, V23, V31) by the following formula:

$$U_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} u_n^2}{N}}$$

N = Number of sampled values/period
u_n = Sampled value
The MIB uses N = 64

All voltages can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the voltage values:

$$U = Rx \times \frac{PT1}{PT2} / 10$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data

Current (I)

The MIB calculates the true RMS value of the three phase currents by the following formula:

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^{N} i_n^2}{N}}$$

N = Number of sampled values/period
i_n = Sampled value
The MIB uses N = 64

The average current and the neutral current are calculated from these three phase currents.

All currents can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the current values:

$$I = Rx \times \frac{CT1}{5} / 1000$$

Rx = Register value
$CT1$ = Current transformer data

Power (P)

The three-phase power and system total power are calculated and displayed in the MIB.

All power values can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the power values:

$$P = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

Reactive power (Q)

The three-phase reactive power and system total reactive power are calculated and displayed in the MIB.

All reactive power values can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the reactive power values:

$$Q = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

Apparent power (S)

The three-phase apparent power and system total apparent power are calculated and displayed in the MIB.

All apparent power values can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the apparent power values:

$$S = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

Frequency (F)

The frequency of phase 1 (voltage input) is measured as system frequency.

The frequency can be viewed on the display. It can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the frequency value:

$$F = \frac{Rx}{100}$$

Rx = Register value

Energy (Ep)

The energy is time integral of power. The unit is kWh. As power has direction, positive means consumption and negative means generation:

- Import (Ep_imp): Consumption of energy
- Export (Ep_exp): Generation of energy

The energy counters can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the energy value:

$$Ep = \frac{Rx}{10}$$ [kWh] Rx = Register value

Reactive energy (Eq)

The reactive energy is time integral of reactive power. The unit is kVArh. As reactive power has direction, positive means inductive and negative means capacitive.

- Import (Ep_imp): Inductive reactive energy
- Export (Ep_exp): Capacitive reactive energy

The reactive energy counters can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the energy value:

$$Eq = \frac{Rx}{10}$$ [kVArh] Rx = Register value

Apparent energy (Es)

- S (Es): Apparent energy

$$Es = \frac{Rx}{10}$$ [kVAh] Rx = Register value

Maximum demand

The MIB can provide demand values of power, reactive power and apparent power. The MIB uses the sliding window statistics method. The width of the sliding window time can be set between one and 30 minutes. The window slides one minute each time. The average demand will always be calculated every minute. If the sliding window time is three minutes, it means that the MIB uses the last three minutes for calculation of the average demand.

The demand values can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formulas to calculate the power values:

$$Dmd\_P = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

$$Dmd\_Q = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

$$Dmd\_S = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

$$Max\_Dmd\_of\_I1 = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

$$Max\_Dmd\_of\_I2 = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

$$Max\_Dmd\_of\_I3 = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{5}$$

Rx = Register value
$PT1$ and $PT2$ = Voltage transformer data
$CT1$ = Current transformer data

THD (total harmonic distortion)

The MIB calculates the THD for the three-phase current, for the average current, for the three phase-neutral voltages and for the average phase-neutral voltage. (If the voltage input is 2LL, the MIB will calculate the THD for the three phase-phase voltages). The THD is expressed as a percentage of harmonics due to the fundamental frequency. The MIB uses a true RMS measurement technique, which provides accurate measurement with harmonics present up to the 15th harmonic.

The THD values can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the THD values:

$$THD = \frac{Rx}{1000x100\%}$$

Rx = Register value

Three-phase unbalance factor

The MIB can measure the three-phase voltage unbalance factor and three-phase current unbalance factor. The unbalance factor is expressed in percentage.

$$Voltage\ unbalance\ factor = \frac{Max\ difference\ value\ of\ the\ three\ voltages}{Average\ value\ of\ the\ three\ voltages}$$

$$Current\ unbalance\ factor = \frac{Max\ difference\ value\ of\ the\ three\ currents}{Average\ value\ of\ the\ three\ currents}$$

The unbalance factors can be viewed on the display. They can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formulas to calculate the unbalance factors:

$$I\_unbl = (\frac{Rx}{1000})x100\%$$ Rx = Register value

$$U\_unbl = (\frac{Rx}{1000})x100\%$$ Rx = Register value

Max./min. statistics

The MIB stores the maximum and minimum value of the following values: The three phase-neutral voltages, the three phase-phase voltages, the three phase currents, the power, the reactive power, the apparent power, the power factor, the frequency, the system total power demand, the system total reactive power demand and the system total apparent power demand.

The statistics values can be viewed on the display. The values can be read remotely via the RS485 communication and the utility software MIBLink.

The MIB stores these statistics data in a nonvolatile RAM. The statistics data can be reset from the front panel and from the RS485 communication.

If you collect the data from the instrument via the Modbus, please use the different formulas to calculate the real measuring values.

Running hour counter

The MIB also has a running hour counter. It will simply show the number of hours the instrument has been connected to the aux. supply.

The running hour counter can be viewed on the display. It can also be read remotely via the RS485 communication and the utility software MIBLink.

If you collect the data from the instrument via the Modbus, please use the following formula to calculate the running hour value:

$$RH = \frac{Rx}{10}\ [h]$$ Rx = Register value

3. Modbus protocol

Introduction of the Modbus protocol

The Modbus RTU protocol is used for communication in the MIB. The data format and error check method is defined in the Modbus protocol. The half duplex query and response mode is adopted in the Modbus protocol. There is only one master device in the communication net. The others are slave devices, waiting for the query of the master.

Transmission mode

The mode of transmission defines the data structure within a frame and the rules used to transmit data. The mode is defined in the following which is compatible with Modbus RTU mode:

Coding system	8-bit binary
Start bit	1
Data bits	8
Parity	No parity
Stop bit	1
Error checking	CRC check

Framing

Address	Function	Data	Check
8-bits	8-bits	N x 8-bits	16-bits

Table 3.1 Data frame format

Address field

The address field of a message frame contains eight bits. Valid slave device addresses are in the range of 0~247 decimals. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function field

The function code field of a message frame contains eight bits. Valid codes are in the range of 1~255 decimals. When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform.

Code	Meaning	Action
01	Read relay output status	Obtain current status of relay output
02	Read digital input (DI) status	Obtain current status of digital input
03	Read data	Obtain current binary value in one or more registers
05	Control relay output	Force relay to a state of ON or OFF
16	Preset multiple-registers	Place specific binary values into a series of consecutive multiple-registers

Table 3.2 Function code

Data field

The data field is constructed using sets of two hexadecimal digits in the range of 00 to FF hexadecimal. The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled and the count of actual data bytes in the field. For example, if the master requests a slave to read a group of holding registers (function code 03), the data field specifies the starting register and how many registers that are to be read. If the master writes to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field and the data to be written into the registers.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken. The data field can be nonexistent (of zero length) in certain kinds of messages.

Error check field

Messages include an error checking field that is based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC field is two bytes, containing a 16 bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message.

The receiving device recalculates a CRC during receipt of the message and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error occurs. The CRC is started by first preloading a 16-bit register to all 1s. Then a process begins of applying successive 8-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits and the parity bit do not apply to the CRC. During generation of the CRC, each 8-bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register current value, and the process is repeated for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value. When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

Format of communication

Explanation of frame:

Addr.	**Funct.**	**Data start reg hi**	**Data start reg lo**	**Data # of regs hi**	**Data # of regs lo**	**CRC16 hi**	**CRC16 lo**
06H	03H	00H	00H	00H	21H	84H	65H

Table 3.3 Explanation of frame

The meaning of the abbreviations in the headline of table 3.3 is described below:

Addr.: Address of slave device
Funct.: Function code
Data start reg hi: Start register address high byte
Data start reg lo: Start register address low byte
Data # of regs hi: Number of register high byte
Data # of regs lo: Number of register low byte

CRC16 hi: CRC high byte
CRC16 lo: CRC low byte

Read data (function code 03)

Query

This function allows the master to obtain the measurement results of the MIB. Table 3.4 is an example to read the 3 measured data (F, V1 and V2) from slave device number 17, the data address of F is 0130H, V1 is 0131H and V2 is 0132H.

Addr.	Funct.	Data start addr. hi	Data start addr. lo	Data # of regs hi	Data # of regs lo	CRC16 regs hi	CRC16 regs lo
11H	03H	01H	30H	00H	03H	06H	A8H

Table 3.4 Read F, V1, V2 query message

Response

The MIB response includes the MIB address, function code, quantity of data byte, data and error checking. An example of a response to read F, V1 and V2 (F = 1388H (50.00Hz), V1 = 03E7H (99.9V), V2 = 03E9H (100.1V) is shown in table 3.5.

Addr.	Funct.	Byte count	Data 1 hi	Data 1 lo	Data 2 hi	Data 2 lo	Data 3 hi	Data 3 lo	CRC16 hi	CRC16 lo
11H	03H	06H	13H	88H	03H	E7H	03H	E9H	7FH	04H

Table 3.5 Read F, V1 and V2 message

Preset/reset multi-register (function code 16)

Query

Function 16 allows the user to modify the contents of a multi-register. Any register that exists within the MIB can have its contents changed by this message.

The example below is a request to a MIB number 17 to preset Ep_imp (17807783.3kWh), while its Hex value 0A9D4089H. Ep_imp data address is 0156H and 0157H.

Address	11H
Function	10H
Data start register high	01H
Data start register low	56H
Data register high	00H
Data register low	02H
Byte count	04H
Value high	0AH
Value low	9DH
Value high	40H
Value low	89H
CRC high	4DH
CRC low	B9H

Table 3.6 Preset kWh query message

Response

The normal response to a preset multi-register request includes the MIB address, function code, data start register, the number of registers and error checking.

Address	11H
Function code	10H
Data start address high	01H
Data start address low	56H
Data register high	00H
Data register low	02H
CRC high	A2H
CRC low	B4H

Table 3.7 Preset multi-registers response message

4. Modbus addresses

Modbus

BIT	binary bit	
word	unsign integer of 16 bit	Unsigned integer (16 bit)
Integer	sign integer of 16 bit	Signed integer (16 bit)
dword	unsign integer of 32 bit	Unsigned integer (32 bit)

Parameter settings

Addr.	Parameter	Range	Object Type	Function code	Relation between register value Rx and real value
0100H	Access Code	0~9999	Unsigned integer (16 bit)	03 Read data / 16 Presetting	AC=Rx
0101H	Communication Address	0~247	Unsigned integer (16 bit)	03 Read data / 16 Presetting	CA=Rx
0102H	Baud Rate	1200~38400	Unsigned integer (16 bit)	03 Read data / 16 Presetting	BR=Rx
0103H	Voltage Input Wiring Type	0: 3LN, 1: 2LN, 2: 2LL, 3: 3LL	Unsigned integer (16 bit)	03 Read data / 16 Presetting	VIWT=Rx
0104H	Current Input Wiring Type	0: 3CT 1: 1CT 2: 2CT	Unsigned integer (16 bit)	03 Read data / 16 Presetting	CIWT=Rx
0105H 0106H	PT1 (high) PT1 (low)	50~1000000	Unsigned integer (32 bit)	03 Read data / 16 Presetting	PT1=Rx
0107H	PT2	50~400	Unsigned integer (16 bit)	03 Read data / 16 Presetting	PT2=Rx
0108H	CT1	5	Unsigned integer (16 bit)	03 Read data / 16 Presetting	CT1=Rx
0109H	CT2	0: Pulse 1: Alarm	Unsigned integer (16 bit)	03 Read data / 16 Presetting	CT2=Rx
010AH	Definition of reactive power	0: Sinusoidal 1: Non-sin	Unsigned integer (16 bit)	03 Read data / 16 Presetting	De_Rea=Rx
010BH	Backlight time	0~120	Unsigned integer (16 bit)	03 Read data / 16 Presetting	Back_light=Rx
010CH	Time of Dmd slide window	1~30	Unsigned integer (16 bit)	03 Read data / 16 Presetting	Dmd_slide=Rx
010DH	Clear Max	0aH: Clear	Unsigned integer (16 bit)	03 Read data / 16 Presetting	
010EH	Clear energy enable	0: Disable 1: Enable	Unsigned integer (16 bit)	03 Read data / 16 Presetting	
010FH	Clear energy	0: Do not clear 0aH: Clear	Unsigned integer (16 bit)	03 Read data / 16 Presetting	
0110H	Clear run time	0aH: Clear	Unsigned integer (16 bit)	03 Read data / 16 Presetting	

Basic analogue measurements

Addr.	Parameter	Range	Object Type	Function code	Relation between register value Rx and real value
0130H	Frequency F	0~65535	Unsigned integer (16 bit)	03 Read data	F=Rx/100 [Hz]
0131H	Phase Voltage V1	0~65535	Unsigned integer (16 bit)	03 Read data	V1=Rx*(PT1/PT2)/10 [V]
0132H	Phase Voltage V2	0~65535	Unsigned integer (16 bit)	03 Read data	V2=Rx*(PT1/PT2)/10 [V]
0133H	Phase Voltage V3	0~65535	Unsigned integer (16 bit)	03 Read data	V3=Rx*(PT1/PT2)/10 [V]
0134H	Line Voltage V12	0~65535	Unsigned integer (16 bit)	03 Read data	V12=Rx*(PT1/PT2)/10 [V]
0135H	Line Voltage V23	0~65535	Unsigned integer (16 bit)	03 Read data	V23=Rx*(PT1/PT2)/10 [V]
0136H	Line Voltage V31	0~65535	Unsigned integer (16 bit)	03 Read data	V31=Rx*(PT1/PT2)/10 [V]
0137H	Current I1	0~65535	Unsigned integer (16 bit)	03 Read data	I1=Rx*(CT1/5)/1000 [A]
0138H	Current I2	0~65535	Unsigned integer (16 bit)	03 Read data	I2=Rx*(CT1/5)/1000 [A]
0139H	Current I3	0~65535	Unsigned integer (16 bit)	03 Read data	I3=Rx*(CT1/5)/1000 [A]
013AH	Neutral Line Current In	0~65535	Unsigned integer (16 bit)	03 Read data	In=Rx*(CT1/5)/1000 [A]
013BH	Phase Power P1	-32768~32767	Signed integer (16 bit)	03 Read data	P1=Rx*(PT1/PT2)*(CT1/5) [W]
013CH	Phase Power P2	-32768~32767	Signed integer (16 bit)	03 Read data	P2=Rx*(PT1/PT2)*(CT1/5) [W]
014DH	Phase Power P3	-32768~32767	Signed integer (16 bit)	03 Read data	P3=Rx*(PT1/PT2)*(CT1/5) [W]
013EH	System Power Pcon	-32768~32767	Signed integer (16 bit)	03 Read data	Psum=Rx*(PT1/PT2)*(CT1/5) [W]
013FH	Phase Reactive Power Q1	-32768~32767	Signed integer (16 bit)	03 Read data	Q1=Rx*(PT1/PT2)*(CT1/5) [VAr]
0140H	Phase Reactive Power Q2	-32768~32767	Signed integer (16 bit)	03 Read data	Q2=Rx*(PT1/PT2)*(CT1/5) [VAr]
0141H	Phase Reactive Power Q3	-32768~32767	Signed integer (16 bit)	03 Read data	Q3=Rx*(PT1/PT2)*(CT1/5) [VAr]
0142H	System Reactive Power Qcon	-32768~32767	Signed integer (16 bit)	03 Read data	Qsum=Rx*(PT1/PT2)*(CT1/5) [VAr]
0143H	System Apparent Power Scon	0~65535	Unsigned integer (16 bit)	03 Read data	Ssum=Rx*(PT1/PT2)*(CT1/5) [VA]
0144H	Phase Power Factor PF1	-1000~1000	Signed integer (16 bit)	03 Read data	PF1=Rx/1000 [ ]
0145H	Phase Power Factor PF2	-1000~1000	Signed integer (16 bit)	03 Read data	PF2=Rx/1000 [ ]
0146H	Phase Power Factor PF3	-1000~1000	Signed integer (16 bit)	03 Read data	PF3=Rx/1000 [ ]
0147H	System Power Factor PFcon	-1000~1000	Signed integer (16 bit)	03 Read data	PF=Rx/1000 [ ]
0148H	Voltage Unbalance Factor U_unbl	0~1000	Unsigned integer (16 bit)	03 Read data	U_unbl=(Rx/1000) x 100%
0149H	Current Unbalance Factor I_unbl	0~1000	Unsigned integer (16 bit)	03 Read data	I_unbl=(Rx/1000) x 100%
014AH	Load Type RT (L/C/R)	76/67/82	Unsigned integer (16 bit)	03 Read data	ASCII of L,C,R Low 8bit of register
0150H	Power Demand Dmd_P	-32768~32767	Signed integer (16 bit)	03 Read data	Dmd_P=Rx*(PT1/PT2)*(CT1/5) [W]
0151H	Reactive power Demand Dmd_Q	-32768~32767	Signed integer (16 bit)	03 Read data	Dmd_Q=Rx*(PT1/PT2)*(CT1/5) [VAr]
0152H	Phase 1 current demand I1_Dmd	0~65535	Signed integer (16 bit)	03 Read data	I1=Rx*(CT1/5)/1000 [A]

0153H	Phase 2 current demand I2_Dmd	0~65535	Signed integer (16 bit)	03 Read data	I2=Rx*(CT1/5)/1000 [A]
0154H	Phase 3 current demand I3_Dmd	0~65535	Signed integer (16 bit)	03 Read data	I3=Rx*(CT1/5)/1000 [A]

Energy measurements

Addr.	Parameter	Range	Object Type	Function code	Relation between register value Rx and real value
0156H 0157H	Import Energy Ep_imp	0~99999999.9	Unsigned integer (32 bit)	03 Read data 16 Presetting	Ep=Rx/10 [kWh]
0158H 0159H	Export Energy Ep_exp	0~99999999.9	Unsigned integer (32 bit)	03 Read data 16 Presetting	Ep=Rx/10 [kWh]
015AH 015BH	Import Reactive Energy Eq_imp	0~99999999.9	Unsigned integer (32 bit)	03 Read data 16 Presetting	Eq=Rx/10 [kVArh]
015CH 015DH	Export Reactive Energy Eq_exp	0~99999999.9	Unsigned integer (32 bit)	03 Read data 16 Presetting	Eq=Rx/10 [kVArh]
015EH 015FH	Apparent Energy Es	0~99999999.9	Unsigned integer (32 bit)	03 Read data 16 Presetting	Ep=Rx/10 [kVArh]

Max./min. statistics value

Addr.	Parameter	Range	Object Type	Function code	Relation between register value Rx and real value
0460H	Max of V1 V1_max	0~65535	Unsigned integer (16 bit)	03 Read data	V1_max=Rx*(PT1/PT2)/10 [V]
0461H	Max of V2 V2_max	0~65535	Unsigned integer (16 bit)	03 Read data	V2_max=Rx*(PT1/PT2)/10 [V]
0462H	Max of V3 V3_max	0~65535	Unsigned integer (16 bit)	03 Read data	V3_max=Rx*(PT1/PT2)/10 [V]
0463H	Max of V12 V12_max	0~65535	Unsigned integer (16 bit)	03 Read data	V12_max=Rx*(PT1/PT2)/10 [V]
0464H	Max of V23 V23_max	0~65535	Unsigned integer (16 bit)	03 Read data	V23_max=Rx*(PT1/PT2)/10 [V]
0465H	Max of V31 V31_max	0~65535	Unsigned integer (16 bit)	03 Read data	V31_max=Rx*(PT1/PT2)/10 [V]
0466H	I1_max	0~65535	Unsigned integer (16 bit)	03 Read data	I1_max=Rx*(CT1/5)/1000 [A]
0467H	I2_max	0~65535	Unsigned integer (16 bit)	03 Read data	I2_max=Rx*(CT1/5)/1000 [A]
0468H	I3_max	0~65535	Unsigned integer (16 bit)	03 Read data	I3_max=Rx*(CT1/5)/1000 [A]
0469H	Max power Dmd P_max	-32768~32767	Signed integer (16 bit)	03 Read data	P_max=Rx*(PT1/PT2)*(CT1/5) [W]
046AH	Max Q power Dmd Q_max	-32768~32767	Signed integer (16 bit)	03 Read data	Q_max=Rx*(PT1/PT2)*(CT1/5) [VAr]
046BH	Max current Dmd I1	0~65535	Unsigned integer (16 bit)	03 Read data	Dmd I1_max=Rx*(CT1/5)/1000 [A]
046CH	Max current Dmd I2	0~65535	Unsigned integer (16 bit)	03 Read data	Dmd I2_max=Rx*(CT1/5)/1000 [A]
046DH	Max current Dmd I3	0~65535	Unsigned integer (16 bit)	03 Read data	Dmd I3_max=Rx*(CT1/5)/1000 [A]
0470H	V1_min	0~65535	Unsigned integer (16 bit)	03 Read data	V1_min=Rx*(PT1/PT2)/10 [V]
0471H	V2_min	0~65535	Unsigned integer (16 bit)	03 Read data	V2_min=Rx*(PT1/PT2)/10 [V]
0472H	V3_min	0~65535	Unsigned integer (16 bit)	03 Read data	V3_min=Rx*(PT1/PT2)/10 [V]
0473H	V12_min	0~65535	Unsigned integer (16 bit)	03 Read data	V12_min=Rx*(PT1/PT2)/10 [V]

0474H	V23_min	0~65535	Unsigned integer (16 bit)	03 Read data	V23_min=Rx*(PT1/PT2)/10 [V]
0475H	V31_min	0~65535	Unsigned integer (16 bit)	03 Read data	V31_min=Rx*(PT1/PT2)/10 [V]
0476H	I1_min	0~65535	Unsigned integer (16 bit)	03 Read data	I1_min=Rx*(CT1/5)/1000 [A]
0477H	I2_min	0~65535	Unsigned integer (16 bit)	03 Read data	I2_min=Rx*(CT1/5)/1000 [A]
0478H	I3_min	0~65535	Unsigned integer (16 bit)	03 Read data	I3_min=Rx*(CT1/5)/1000 [A]

Running hour meter

Addr.	Parameter	Range	Object Type	Function code	Relation between register value Rx and real value
047CH 047DH	RHh (high) RHl (low)	0~99999999.9	Unsigned integer (32 bit)	03 Read data	RH=Rx/10 [h]

Power quality measurements

Addr.	Parameter	Range	Object Type	Function code	Relation between register value Rx and real value in %
0400H	Total Harmonic Distortion of V1 or V12 THD_V1	0~10000	Unsigned integer (16 bit)	03 Read data	THD_V1=Rx/100
0401H	Total Harmonic Distortion of V2 or V23 THD_V2	0~10000	Unsigned integer (16 bit)	03 Read data	THD_V2=Rx/100
0402H	Total Harmonic Distortion of V3 or V31THD_V3	0~10000	Unsigned integer (16 bit)	03 Read data	THD_V3=Rx/100
0403H	Total Harmonic Distortion of I1 THD_I1	0~10000	Unsigned integer (16 bit)	03 Read data	THD_I1=Rx/100
0404H	Total Harmonic Distortion of I2 THD_I2	0~10000	Unsigned integer (16 bit)	03 Read data	THD_I2=Rx/100
0405H	Total Harmonic Distortion of I3 THD_I3	0~10000	Unsigned integer (16 bit)	03 Read data	THD_I3=Rx/100
0406H-0413H	Harmonic content of V1 or V12 (2^{nd} – 15^{th})	0~10000	Unsigned integer (16 bit)	03 Read data	THD_V1=Rx/100
0414H-0421H	Harmonic content of V2 or V23 (2^{nd} – 15^{th})	0~10000	Unsigned integer (16 bit)	03 Read data	THD_V2=Rx/100
0422H-042FH	Harmonic content of V3 or V31 (2^{nd} – 15^{th})	0~10000	Unsigned integer (16 bit)	03 Read data	THD_V3=Rx/100
0430H-043DH	Harmonic content of I1 (2^{nd} – 15^{th})	0~10000	Unsigned integer (16 bit)	03 Read data	THD_I1=Rx/100
043EH-044BH	Harmonic content of I2 (2^{nd} – 15^{th})	0~10000	Unsigned integer (16 bit)	03 Read data	THD_I2=Rx/100
044CH-0459H	Harmonic content of I3 (2^{nd} – 15^{th})	0~10000	Unsigned integer (16 bit)	03 Read data	THD_I3=Rx/100

DEIF A/S reserves the right to change any of the above.