LUMEL

# 4-CHANNEL MODULE OF ANALOG INPUTS

# SM2




USER'S MANUAL

CE

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# 1. APPLICATION

the SM2 4-channel module of analog inputs is destined to convert standard signals, resistance or temperature signals into numerical data accessible through the RS-485 or RS-232 port by means of the MODBUS protocol.

The measurement is carried out independently on four, galvanically insulated between them channels. RS-485 and RS-232 output ports are galvanically insulated from input signals and the supply. The module programming is possible by means of the RS-485 or RS-232 port. In the set of SM2 module there is a connecting cable, to connect with the PC computer (RS-232).

The SM2 module realises following functions:

- mathematical operations on channels and between measuring channels,
- conversion of measured or calculated quantities basing on the individual linear characteristic,
- storage of maximal and minimal values for each channel,
- programmable digital filter for measurement, independently for each channel,
- handling of RS-485 and RS-232 interfaces in MODBUS protocol, in RTU mode,
- change of the OC type output state basing on set alarm values.

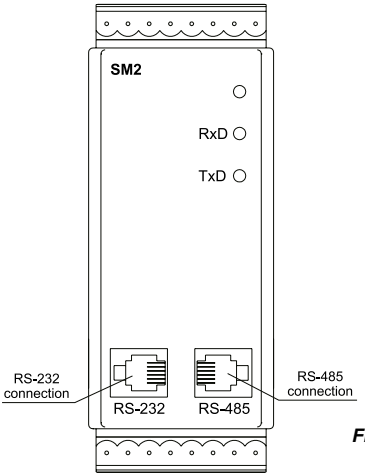



***Fig. 1. View of the SM2 module***

## 2. SET OF THE SM2 MODULE

The set consists of:

- SM2 module .....1 pc.
- plug with screw terminals .....4 pcs
- hole plug of the RS-485 and RS-232 sockets .....2 pc

***When unpacking the module, please check whether the type and execution code on the data plate correspond to the order.***

## 3. BASIC REQUIREMENTS, SAFETY INFORMATION

Symbols located in this service manual mean:



WARNING!

Warning of potential, hazardous situations. Especially important. One must acquaint with this before connecting the module. The non-observance of notices marked by these symbols can occasion severe injuries of the personnel and the damage of the module.



CAUTION!

Designates a general useful note. If you observe it, handling of the module is made easier. One must take note of this, when the module is working inconsistently to the expectations. Possible consequences if disregarded!

In the security scope the module meets the requirements of the EN 61010-1 standard.

**Remarks concerning the operator safety:** 

***1. General***

- The SM2 module is destined to be installed in measuring systems.
- Non-authorized removal of the required housing, inappropriate use, incorrect installation or operation create the risk of injury to personnel or damage to equipment. For more detailed information please study the user's manual.

- All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel and national regulations for the prevention of accidents must be observed.
- According to this basic safety information, qualified, skilled personnel are persons who are familiar with the installation, assembly, commissioning, and operation of the product and who have qualifications necessary for their occupation.

## ***2. Transport, storage***

Please observe the notes on transport, storage and appropriate handling.
Observe the climatic conditions given in Technical Data.

## ***3. Installation***

- The module must be installed according to the regulation and instructions given in this user's manual.
- Ensure proper handling and avoid mechanical stress.
- Do not bend any components and do not change any insulation distances.
- Do not touch any electronic components and contacts.
- Modules may contain electrostatically sensitive components, which can easily be damaged by inappropriate handling.
- **Do not damage or destroy any electrical components since this might endanger your health!**

## ***4. Electrical connection***

- Before switching the module on, one must check the correctness of connection to the network.
- In case of the protection terminal connection with a separate lead one must remember to connect it before the connection of the module to the mains.
- When working on live modules, the applicable national regulations for the prevention of accidents must be observed.
- The electrical installation must be carried out according to the appropriate regulations (cable cross-sections, fuses, PE connection). Additional information can be obtained from the user's manual.
- Apply a two-wire cable for the connection to the network acc. to the EN 61010-1 standard.
- Do not connect the module to the network through an autotransformer.
- In the building installation, a cut-out or a circuit-breaker should exist, situated near the device and easy accessible to the operator. It should be marked as the element switching the device out.

- The documentation contains information about installation in compliance with EMC (shielding, grounding, filters and cables). These notes must be observed for all CE-marked products.
- The manufacturer of the measuring system or installed devices is responsible for the compliance with the required limit values demanded by the EMC legislation.

***5. Operation***

- Measuring systems including SM1 modules must be equipped with protection devices according to the corresponding standard and regulations for prevention of accidents.
- After the instrument has been disconnected from the supply voltage, live components and power connections must not be touched immediately because capacitors can be charged.
- The housing must be closed during operation.
- The RS-232 socket serves only to connect the device (Fig.5) working with the MODBUS protocol. When the module is not used place the hole plug in the RS-232 socket of the module.

***6. Maintenance and servicing.***

Please observe the manufacturer's documentation.

Read all product-specific safety and application notes in this user's manual.

- Before taking the module out, one must turn the supply off.
- The removal of the module housing during the warranty contract period may cause its cancellation.

## 4. INSTALLATION

### 4.1 Way of fixing

The SM2 module is fixed on a 35 mm rail in accordance with EN 60715. The module housing is made of a self-extinguishing plastic. Overall dimensions of the housing: 45 × 120 × 100 mm. One must connect to the module, external wires with cross-section up to 2.5 $mm^2$

Overall dimensions and the fixing way are presented on the fig. 2.

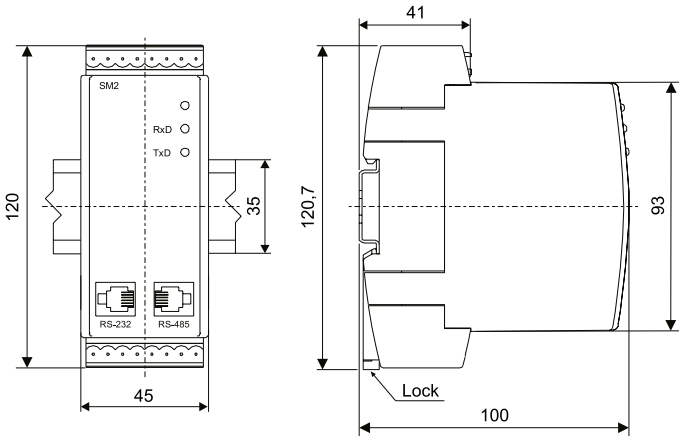



*Fig.2. Overall dimensions and way of fixing the module*

## 4.2. External connection diagrams

Make the connection of input signals, supply and interface acc. to the fig. 3, 4 and 5



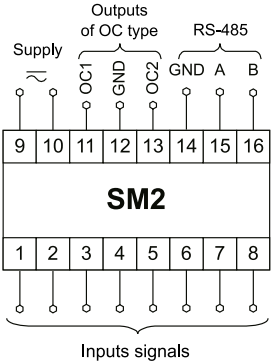



***Fig. 3***
***Connection way of external signals. The connection diagram is also placed on the module housing***

The polarization is optional when supplying by d.c. voltage.

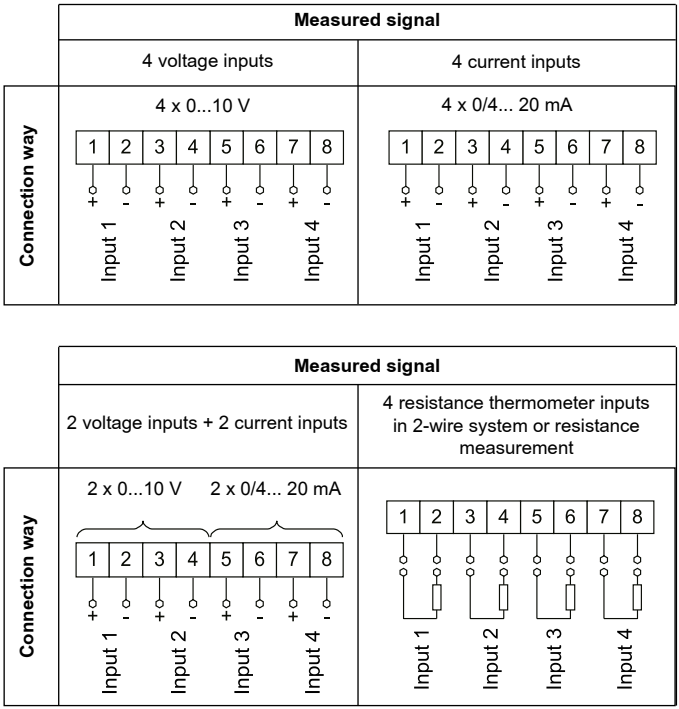



***Fig. 4 connection way of input signals***

Taking in consideration electromagnetic interference one must use shielded wires to connect input signals and output signals. The supply must be connected by a two-wire cable, with the appropriate wire diameter ensuring its protection by means of a safety fuse.

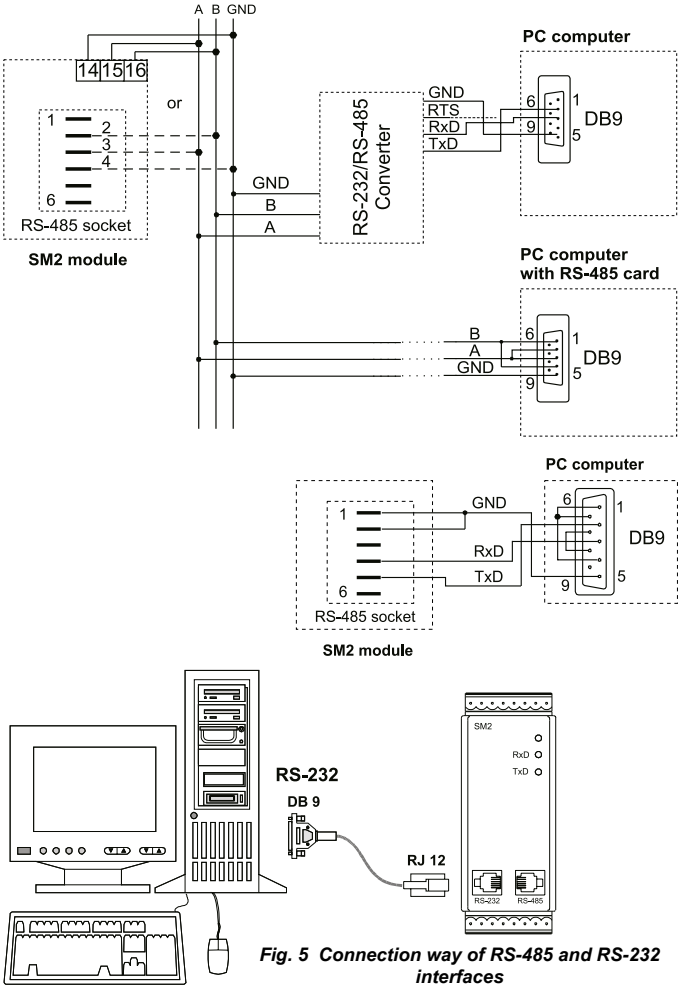



*Fig. 5 Connection way of RS-485 and RS-232 interfaces*

# 5. HANDLING

After connecting external signals and switching the supply on, the SM2 module is ready to work.

The lighted green diode signals the module work. The green diode (RxD) signals the module polling, however the yellow diode (TxD) signals the module response. Diodes should ignite in cycles during the data transmission, both through the RS-232 and the RS-485 interface. One can program all module parameters by means of RS-232 or RS-485.

The RS-232 port has constant transmission parameters in accordance with technical data, what enables the connection with the module even when programmed parameters of the RS-485 digital output are unknown (address, mode, rate). The RS-485 standard allows to the direct connection to 32 devices on a single serial link up to 1200 m. To connect a greater number of devices, it is necessary to use additional intermediate-separating systems.

The way of the interface connection is given in the user's manual (fig.5). To obtain the correct transmission, it is necessary to connect **A** and **B** lines in parallel with their counterparts in other devices. The connection must be carried out with a screened wire. The screen must be connect to the protective terminal in a single point. The **GND** line serves to the additional protection of the interface line at long connections. One must connect it to the protective terminal (it is not necessary for the correct interface work). To obtain the connection with the PC computer through the RS-485 port, an RS-232/RS-485 converter (e.g. PD51) or an RS-485 interface card is indispensable. The marking of transmission lines for the card in the PC computer depends on the card manufacturer. To obtain the connection through the RS-232 port, the wire added to the module is sufficient. The connection way of both ports (RS-232 and RS-485) is shown on the fig. 5.

The module can be connected to the device of master type only through one interface port. In case of a simultaneous connection of both ports, the module will work through the RS-232 interface.

## 5.1. Description of MODBUS protocol implementation

The transmission protocol describes ways of the information exchange between devices through serial links.

The MODBUS protocol has been implemented in the module in accordance with the PI-MBUS-300 Rev G specification of the Modicon company.

Set of parameters of the module serial link in the MODBUS protocol:

- Module address - 1... 247
- Baud rate - 2400, 4800, 9600, 19200, 38400, 57600, 115200 bit/s
- Working modes - RTU

- Information unit - RTU: 8N2, 8E1, 8O1, 8N1
- Maximal response time - 100 ms.
- Maximal number of read/written register with one command - 30

The parameter configuration of the serial link is described in the further part of the user's manual. It consists on establishing the baud rate (**Rate parameter**), device address (**Adr parameter**) and the information unit type (Mode parameter).

In case of the module connection with the computer through the RS-232 wire, the module set automatically following transmission parameters:

**Baud rate:** 9600 bps,

**Working mode:** RTU 8N1,

**Address:** 1.

***Notice:*** Each module connected to the communication network must:

- have a unique address, different from addresses of other devices connected to the network,
- identical baud rate and information unit type,
- the message sent with the address „0" is identified as the data transmission mode (transmission to many devices)

Only one module can be connected to the master's RS-232.

## 5.2. Description of the MODBUS protocol function

Opis funkcji

| ***Code*** | ***Signification*** |
|---|---|
| 03 (03 h) | Readout of n-register |
| 06 (06 h) | Write of a single register |
| 16 (10 h) | Write of n-registers |
| 17 (11 h) | Slave device identification |

Following functions of the MODBUS protocol have been implemented in the SM2 module

**Readout of n-registers (code 03h)**

The function is not accessible in the broadcast mode.

***Example:*** Readout of 2 registers beginning by the register with the 1DBDh

| Device address | Function | Register address | | Number of registers | | Checksum CRC |
|---|---|---|---|---|---|---|
| | | Hi | Lo | Hi | Lo | |
| 01 | 03 | 1D | BD | 00 | 02 | 52 43 |

address (7613)

| Device address | Function | Number of bytes | Value from the register 1DBD (7613) | | | | Value from the register 1DBE (7614) | | | | Check-sum CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 03 | 08 | 3F | 80 | 00 | 00 | 40 | 00 | 00 | 00 | 42 8B |

Demand:

Answer:

**Write of values in the register (code 06h)**

The function is accessible in the broadcast mode.

| Device address | Function | Register address | | Value for the register 1DBD (7613) | | | | Checksum CRC |
|---|---|---|---|---|---|---|---|---|
| | | Hi | Lo | | | | | |
| 01 | 06 | 1D | BD | 3F | 80 | 00 | 00 | 85 AD |

Answer:

| Device address | Function | Register address | | Value from the register 1DBD (7613) | | | | Checksum CRC |
|---|---|---|---|---|---|---|---|---|
| | | Hi | Lo | | | | | |
| 01 | 06 | 1D | BD | 3F | 80 | 00 | 00 | 85 AD |

**Write in n-registers (code 10h)**

The function is accessible in broadcast mode.

***Example:*** Write of two registers beginning from the register with 1DBDh (7613) address

Demand:

| Device address | Function | Register address | | Number of registers | | Number of bytes | Value for the register 1DBD (7613) | | | | Value for the register 1DBE (7614) | | | | Checksum CRC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hi | Lo | Hi | Lo | | | | | | | | | | |
| 01 | 10 | 1D | BD | 00 | 02 | 08 | 3F | 80 | 00 | 00 | 40 | 00 | 00 | 00 | 03 09 |

Answer:

| Device address | Function | Register address | | Number of registers | | Checksum CRC |
|---|---|---|---|---|---|---|
| | | Hi | Lo | Hi | Lo | |
| 01 | 03 | 1D | BD | 00 | 02 | 52 43 |

**Report identifying the device (code 11h)**

Demand:

| Device address | Function | Checksum (CRC) |
|---|---|---|
| 01 | 11 | C0 2C |

Answer:

| Device address | Function | Number of bytes | Device identifier | Device version | Check-sum |
|---|---|---|---|---|---|
| X | 11 | 08 | 89 | „SM2 c0XXX fY.YY -vSTANDARD” | |

**Device address** - depends on the set value

**Function** - function number: 0x11

**Number of bytes** - 0x08

**Device identifier** - 0x89

**Device state** - 0xFF

**Field depended of the device** - XXXXXX

**Output of OC type** - 0x01 - 2 outputs of OC type, 01 X X X X X

Type of input - Field depended on the module execution code:
- 0x00 - four 0...10 V voltage inputs, X 00 X X X X
- 0x01 - four 0/4...20 mA current inputs, X 01 X X X X
- 0x02 - two 0...10 V voltage inputs, two 0/4...20 mA current inputs, X 02 X X X X
- 0x03 - four Pt100 inputs or four resistance inputs up to 400 Ω, X 03 X X X X

Number of the software version - software version implemented in the module
X X_ _ _ _4 - byte variable of float

**Checksum**
- 2 bytes in case of work in RTU mode
- 1 byte in case of work in ASCII mode

***Example:***

Work in **RTU** mode, e.g. **Mode = RTU 8N2** (value 0x02 in case of readout/write through the interface

The device address is set on **Adr=0x01**

For the SM2 module the answer frame has the following shape:

| Device address | Function | Number of bytes | Device identifier | Device state | Field depending on the device type | Check-sum |
|---|---|---|---|---|---|---|
| 01 | 11 | 08 | 89 | FF | 01 01 3F 80 00 00 | C3 60 |

***Example:*** Write the register with 1DBDh (7613) address

Demand:
It is the SM2 module:
- with two OC type outputs
- with four 0/4...20 mA current inputs
- software version: 1.00

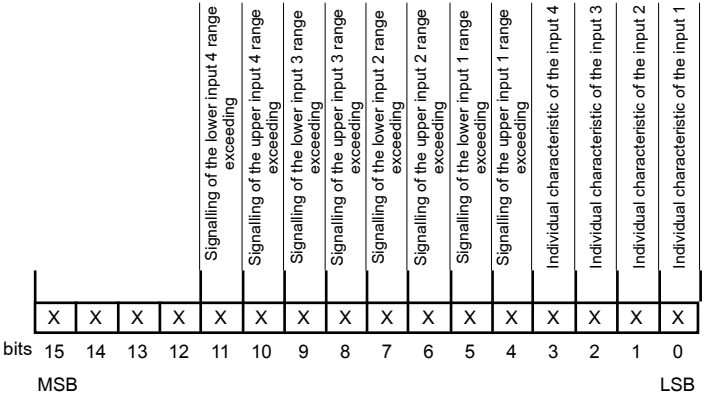
## 5.3. Register map

| ***Address range*** | ***Value type*** | ***Description*** |
|---|---|---|
| 7000-7200 | float (32 bit) | The value is placed in two successive 16-bit registers. Registers contain the same data as 32-bit registers from the area 7500. The register is for readout only |
| 7200-7400 | float (32 bit) | The value is placed in two successive 16-bit registers. Registers contain the same data as 32-bit registers from the area 7600. Registers can be read out and written. |
| 7500-7600 | float (32 bit) | The value is placed in the 32-bit register. The register is for readout only. |
| 7600-7700 | float (32 bit) | The value is placed in the 32-bit register. Registers can be read out and written. |

## 5.4. Registers only for readout

| The value is located in two successive 16-bite registers. These registers include the same data as 32-bite registers from the area 7500. | The value is placed into 32-bite registers. | Name | Write (w)/Readout (r) | Unit | Quantity name |
|---|---|---|---|---|---|
| 7000 | 7500 | **Identifier** | r | - | Constant identifying the device |
| | | | | | **Value** / |
| | | | | | 0x89 - - h / SM2 identifier |
| | | | | | 0x - - 00h / Four 0...10 V voltage inputs |
| | | | | | 0x - - 01h / Four 0/4...20 mA currents |
| | | | | | 0x - - 02h / Two 0...10 V voltage input<br>Two 0/4...20 mA current input |
| | | | | | 0x - - 03h / Four Pt100 inpus or<br>Four resistance inputs up to 400 Ω |
| 7002 | 7501 | **Status 1** | r | - | Status 1 is the register describing the present module state |
| 7004 | 7502 | **Status 2** | r | - | Status 2 is the register describing the present module state |
| 7006 | 7503 | **W1** | r | - | Measured value on the input 1 |
| 7008 | 7504 | **W2** | r | - | Measured value on the input 2 |
| 7010 | 7505 | **W3** | r | - | Measured value on the input 3 |
| 7012 | 7506 | **W4** | r | - | Measured value on the input 4 |
| 7014 | 7507 | **WF** | r | - | Calculated value basing on the function |
| 7016 | 7508 | **Min 1** | r | - | Minimum of the measured value on the input 1 |
| 7018 | 7509 | **Max 1** | r | - | Maximum of the measured value on the input 1 |
| 7020 | 7510 | **Min 2** | r | - | Minimum of the measured value on the input 2 |
| 7022 | 7511 | **Max 2** | r | - | Maximum of the measured value on the input 2 |
| 7024 | 7512 | **Min 3** | r | - | Minimum of the measured value on the input 3 |
| 7026 | 7513 | **Max 3** | r | - | Maximum of the measured value on the input 3 |
| 7028 | 7514 | **Min 4** | r | - | Minimum of the measured value on the input 4 |
| 7030 | 7515 | **Max 4** | r | - | Maximum of the measured value on the input 4 |
| 7032 | 7516 | **WF Min** | r | - | Minimum of the calculated value |
| 7034 | 7517 | **WF Max** | r | - | Maximum of the calculated value |

## Description of the Status1 register




***Bit-15...12 Empty***
Bit value is always equal 0

***Bit-11 Signalling of the lower range exceeding of input 4***
0 - normal work
1 - range exceeding

***Bit-10 Signalling of the upper range exceeding of input 4***
0 - normal work
1 - range exceeding

***Bit-9 Signalling of the lower range exceeding of input 3***
0 - normal work
1 - range exceeding

***Bit-8 Signalling of the upper range exceeding of input 3***
0 - normal work
1 - range exceeding

***Bit-7 Signalling of the lower range exceeding of input 2***
0 - normal work
1 - range exceeding

***Bit-6 Signalling of the upper range exceeding of input 2***
0 - normal work
1 - range exceeding

***Bit-5 Signalling of the lower range exceeding of input 1***
0 - normal work
1 - range exceeding

***Bit-4 Signalling of the upper range exceeding of input 1***
0 - normal work
1 - range exceeding

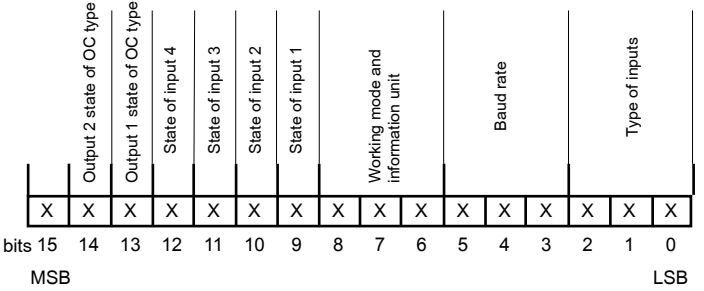
***Bit-3 Individual characteristic of the input 4***
0 - individual characteristic switched on
1 - individual characteristic switched off

***Bit-2 Individual characteristic of the input 3***
0 - individual characteristic switched on
1 - individual characteristic switched off

***Bit-1 Individual characteristic of the input 2***
0 - individual characteristic switched on
1 - individual characteristic switched off

***Bit-0 Individual characteristic of the input 1***
0 - individual characteristic switched on
1 - individual characteristic switched off

## Description of the Status 2 register




***Bit-15 Empty***
Bit value is always equal 0

***Bit-14 Output 2 state of OC type***
0 - OC switched off
1 - OC switched on

***Bit-13 Output 1 state of OC type***
0 - OC switched off
1 - OC switched on

***Bit-12 State of measuring input 4***
0 - input switched off (lack of measurement)
1 - input switched on

***Bit-11 State of measuring input 3***
0 - input switched off (lack of measurement)
1 - input switched on

***Bit-10 State of measuring input 2***
0 - input switched off (lack of measurement)
1 - input switched on

***Bit-9 State of measuring input 1***
0 - input switched off (lack of measurement)
1 - input switched on

***Bit-8...6 Working mode and information unit***
100 - 8N2 - RTU
101 - 8E1 - RTU
110 - 8O1 - RTU
111 - 8N1 - RTU

***Bit-5...3 Baud rate***
000 - 2400 bit/s
001 - 4800 bit/s
010 - 9600 bit/s
011 - 19200 bit/s
100 - 38400 bit/s
101 - 57600 bit/s
110 - 115200 bit/s

***Bit-2...0 Type of inputs***
000 - 4 x 0...10 V
001 - 4 x 0/4...20 mA
010 - 2 x 0...10 V, 2 x 0/4...20 mA
011 - 4 x Pt100 resistance thermometer inputs or
4 x resistance inputs up to 400 Ω

## 5.5. Registers for readout and write

Table 1

| The value is placed in two successive 16-bytes registers. These registers include the same data as 32-bit registers from the area 7600. | The value is placed in 32-bit registers. | Symbol | Write (w)/Readout (r) | Range | Description | |
|---|---|---|---|---|---|---|
| 7200 | 7600 | **Identifier** | r | - | Device identifier | |
| | | | | | **Value** | |
| | | | | | 0x89 - - h | SM2 Identifier |
| | | | | | 0x - - 00h | Four 0...10 V voltage inputs |
| | | | | | 0x - - 01h | Four 0/4...20 mA current inputs |
| | | | | | 0x - - 02h | Two 0...10 V voltage input<br>Two 0/4...20 mA current input |
| | | | | | 0x - - 03h | Four Pt100 inputs or<br>Four resistance inputs up to 400 Ω |
| 7202 | 7601 | **Rate** | W/r | 0... 6 | Baud rate of the RS-485 interface (bit/s) | |
| | | | | | **Value** | |
| | | | | | 0 | 2400 |
| | | | | | 1 | 4800 |
| | | | | | 2 | 9600 |
| | | | | | 3 | 19 200 |
| | | | | | 4 | 38400 |
| | | | | | 5 | 57600 |
| | | | | | 6 | 115200 |
| 7204 | 7602 | **Mode** | W/r | 0... 7 | Kind of transmission through the RS-485 interface | |
| | | | | | **Value** | |
| | | | | | 4 | RTU 8N2 |
| | | | | | 5 | RTU 8E1 |
| | | | | | 6 | RTU 8O1 |
| | | | | | 7 | RTU 8N1 |

| | | | | | |
|---|---|---|---|---|---|
| 7206 | 7603 | **Adr** | W/r | 0... 247 | Device address |
| 7208 | 7604 | **Apply** | W/r | 0... 1 | Acceptation of module transmission parameter changes |
| | | | | | **Value** |
| | | | | | 0 Lack of reaction |
| | | | | | 1 Acceptation of changes |
| 7210 | 7605 | **Input 1** | W/r | 0... 1 | Switching ON/OFF of the measuring input 1 |
| | | | | | **Value** |
| | | | | | 0 Measuring input switched off |
| | | | | | 1 Measuring input switched on |
| | | | | | In case of the input off the value 0 is returned |
| 7212 | 7606 | **W1 type** | W/r | 0... 1 | Input 1 type |
| | | | | | **Range** |
| | | | | | 0 — 0...10 V for SM2-00XXX execution<br>0...10 V for SM2-02XXX execution<br>0/4...20 mA for SM2-01XXX execution |
| | | | | | 0... 1 — 0 - Pt100<br>1 - Resistance < 400 Ω |
| | | | | | **Notice!**<br>The range change of this parameter depends on the execution code |
| 7214 | 7607 | **Cnt W1** | W/r | 0... 30 | Filter time constant of the input 1 |
| | | | | | **Value** |
| | | | | | 0 Filter is switched off |
| | | | | | 0.1...100.0 Time constant in seconds |
| 7216 | 7608 | **Ind W1** | W/r | 0... 1 | Individual characteristic of the input 1 |
| | | | | | **Value** |
| | | | | | 0 off |
| | | | | | 1 on |

<table>
<tr><td>7218</td><td>7609</td><td>X1 W1</td><td>W/r</td><td>-99999...99999</td><td>Parameters of the individual characteristic of input 1</td></tr>
<tr><td>7220</td><td>7610</td><td>Y1 W1</td><td>W/r</td><td>-99999...99999</td><td rowspan="4">On the base of given co-ordinates of two points by the user the module determines (from the system of equations) coefficients a and b of the individual characteristic.<br>$\begin{cases} Y1W1 = a \cdot X1W1 + b \\ Y2W1 = a \cdot X2W1 + b \end{cases}$<br>where:<br>X1 W1 and X2 W1 - measured value<br>Y1 W1 and Y2 W1 - Expected value on the digital output.<br>The graphical presentation of the individual characteristic is presented on the fig. 6.<br>At output signal recalculations, at first the module recalculates the value on the base of the individual characteristic and then, this result is transmitted to the arithmetic function,</td></tr>
<tr><td>7222</td><td>7611</td><td>X2 W1</td><td>W/r</td><td>-99999...99999</td></tr>
<tr><td>7224</td><td>7612</td><td>Y2 W1</td><td>W/r</td><td>-99999...99999</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>7226</td><td>7613</td><td>Input 2</td><td>W/r</td><td>0... 1</td><td>Switching ON/OFF of the measuring input 2</td></tr>
<tr><td colspan="5"></td><td><table><tr><td>Value</td><td></td></tr><tr><td>0</td><td>Measuring input switched off</td></tr><tr><td>1</td><td>Measuring input switched on</td></tr></table>In case of the input off the value 0 is returned</td></tr>
<tr><td>7228</td><td>7614</td><td>Typ W2</td><td>W/r</td><td>0... 1</td><td>Input 2 type</td></tr>
<tr><td colspan="5"></td><td>Range of changes as for the W1 type</td></tr>
<tr><td>7230</td><td>7615</td><td>Cnt W2</td><td>W/r</td><td>0... 6500</td><td>Measurement averaging time of the input 2</td></tr>
<tr><td colspan="5"></td><td>Range of changes as for the Cnt W1 type</td></tr>
<tr><td>7232</td><td>7616</td><td>Ind W2</td><td>W/r</td><td>0... 1</td><td>Individual characteristic of the input 2</td></tr>
<tr><td colspan="5"></td><td><table><tr><td>Value</td><td></td></tr><tr><td>0</td><td>off</td></tr><tr><td>1</td><td>on</td></tr></table></td></tr>
<tr><td>7234</td><td>7617</td><td>X1 W2</td><td>W/r</td><td>-99999...99999</td><td>Parameters of the individual characteristic of input 2</td></tr>
<tr><td>7236</td><td>7618</td><td>Y1 W2</td><td>W/r</td><td>-99999...99999</td><td rowspan="3">The range changes as for: X1 W1, Y1 W1, X2 W1, Y2 W1</td></tr>
<tr><td>7238</td><td>7619</td><td>X2 W2</td><td>W/r</td><td>-99999...99999</td></tr>
<tr><td>7240</td><td>7620</td><td>Y2 W2</td><td>W/r</td><td>-99999...99999</td></tr>
<tr><td colspan="6"></td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| 7242 | 7621 | **Input 3** | W/r | 0... 1 | Switching ON/OFF of the measuring input 3 |
| | | | | | **Value** \| |
| | | | | | 0 \| Measuring input switched off |
| | | | | | 1 \| Measuring input switched on |
| | | | | | In case of the input off the value 0 is returned |
| 7244 | 7622 | **W3 type** | W/r | 0... 1 | Input 3 type |
| | | | | | **Range** \| |
| | | | | | 0 \| 0...10 V for SM2-00XXX execution; 0/4...20 mA for SM2-01XXX execution, for SM2-02XXX execution |
| | | | | | 0... 1 \| 0 - Pt100; 1 - Resistance < 400 Ω |
| | | | | | **Notice!** The range change of this parameter depends on the execution code |
| 7246 | 7623 | **Cnt W3** | W/r | 0... 100 | Filter time constant of the input 3 |
| | | | | | Range of changes as for the **Cnt W1** type |
| 7248 | 7624 | **Ind W3** | W/r | 0... 1 | Individual characteristic of the input 3 |
| | | | | | **Value** \| |
| | | | | | 0 \| off |
| | | | | | 1 \| on |
| 7250 | 7625 | **X1 W3** | W/r | -99999...99999 | Parameters of the individual characteristic of input 3 |
| 7252 | 7626 | **Y1 W3** | W/r | -99999...99999 | The range changes as for: **X1 W1**, **Y1 W1**, **X2 W1**, **Y2 W1** |
| 7254 | 7627 | **X2 W3** | W/r | -99999...99999 | |
| 7256 | 7628 | **Y2 W3** | W/r | -99999...99999 | |
| 7258 | 7629 | **Input 4** | W/r | 0... 1 | Switching ON/OFF of the measuring input 4 |
| | | | | | **Value** \| |
| | | | | | 0 \| Measuring input switched off |
| | | | | | 1 \| Measuring input switched on |
| | | | | | In case of the input off the value 0 is returned |

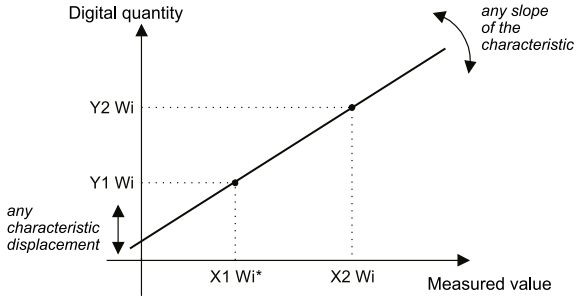
| | | | | | |
|---|---|---|---|---|---|
| 7260 | 7630 | **W4 type** | W/r | 0... 1 | Input 4 type |
| | | | | | Range of changes as for **W1 type** |
| 7262 | 7631 | **Cnt W4** | W/r | 0... 6500 | Czas uśredniania pomiaru wejścia 4 |
| | | | | | Zakres zmian jak dla **Cnt W1** |
| 7264 | 7632 | **Ind W4** | W/r | 0... 1 | Individual characteristic of the input 4 |
| | | | | | **Value** / |
| | | | | | 0 / off |
| | | | | | 1 / on |
| 7266 | 7633 | **X1 W4** | W/r | -99999...99999 | Parameters of the individual characteristic of input 4 |
| 7268 | 7634 | **Y1 W4** | W/r | -99999...99999 | The range changes as for: **X1 W1**, **Y1 W1**, **X2 W1**, **Y2 W1** |
| 7270 | 7635 | **X2 W4** | W/r | -99999...99999 | |
| 7272 | 7636 | **Y2 W4** | W/r | -99999...99999 | |
| 7274 | 7637 | **A** | W/r | 0... 12 | Parameters of the mathematical function |
| 7276 | 7638 | **B** | W/r | 0... 12 | **Value** / |
| 7278 | 7639 | **C** | W/r | 0... 12 | 0 / Parameter switched off |
| 7280 | 7640 | **D** | W/r | 0... 12 | 1 / Result 1 (input 1) (W1) |
| | | | | | 2 / Result 2 (input 2) (W2) |
| | | | | | 3 / Result 3 (input 3) (W3) |
| | | | | | 4 / Result 4 (input 4) (W4) |
| | | | | | 5 / Root of the result 1 $\sqrt{W1}$ |
| | | | | | 6 / Root of the result 2 $\sqrt{W2}$ |
| | | | | | 7 / Root of the result 3 $\sqrt{W3}$ |
| | | | | | 8 / Root of the result 4 $\sqrt{W4}$ |
| | | | | | 9 / Result 1 squared ($W1^2$) |
| | | | | | 10 / Result 2 squared ($W2^2$) |
| | | | | | 11 / Result 3 squared ($W3^2$) |
| | | | | | 12 / Result 4 squared ($W4^2$) |
| | | | | | Parameters of the mathematical function serves to recalculate the measured input quantity into th output quantity (WF) basing on the function: **WF=A<Operator1>B<Operator2>C<Operator3>D** When recalculating the input signal.the module recalculates at first the value basing on the individual characteristic and then, this result is transmitted to the arythmetical function. Examples of using mathematical functions are presented in the section „Examples of module programming". |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7282 | 7641 | **Operator1** | W/r | 0... 3 | Operators of the mathematical function | |
| 7284 | 7642 | **Operator2** | W/r | 0... 3 | **Value** | |
| 7286 | 7643 | **Operator3** | W/r | 0... 3 | 0 | Addition „+” |
| | | | | | 1 | Subtraction „-” |
| | | | | | 2 | Multiplication „*” |
| | | | | | 3 | Division „/” |
| | | | | | The calculation of the output value is carried out basing on the assumpted operator weight i.e.: At first multiplication and division operations are realised and after addition and subtraction operations. „*” and „/” operators and „+” and „-” operators have the same importance weight. Examples of using mathematical functions are presented in the section „Examples of module programming”. | |
| 7288 | 7644 | **WF Operator** | W/r | 0... 3 | Mathematical operations on the result of **WF** function | |
| | | | | | **Value** | |
| | | | | | 0 | Operator switched off |
| | | | | | 1 | Extraction of roots $\sqrt{WF}$ |
| | | | | | 2 | Squaring $WF^2$ |
| | | | | | 3 | Inverse 1/WF |
| | | | | | The module at first calculates the function programmed by the user and then, its result can be submitted to further operations described in this point. In the case of the WF operator switching on the final result is situated in the WF register, however the result from before this operation is not accessible. | |
| 7290 | 7645 | **OC1** | W/r | 0... 4 | Input quantity, on which the output 1 of OC type has to operate. | |
| | | | | | **Value** | |
| | | | | | 0 | Input 1 (W1) |
| | | | | | 1 | Input 2 (W2) |
| | | | | | 2 | Input 3 (W3) |
| | | | | | 3 | Input 4 (W4) |
| | | | | | 4 | Result of the function (WF) |
| | | | | | Recalculated results, basing on the individual user's characteristic (if it is switched on) and basing on programmed mathematical function (if the value 4 has been selected and the function is switched on) are transmitted to the output. In case of choosing the value 4 and switching the mathematical function off, the value 0 is transmitted to the output. | |

<table>
<tr><td>7292</td><td>7646</td><td>OC1 type</td><td>W/r</td><td>0... 4</td><td colspan="2">Output 1 type of OC type</td></tr>
<tr><td colspan="5" rowspan="7"></td><td>Value</td><td></td></tr>
<tr><td>0</td><td>Normal</td></tr>
<tr><td>1</td><td>Schwitched on</td></tr>
<tr><td>2</td><td>Schwitched off</td></tr>
<tr><td>3</td><td>Manually schwitched on</td></tr>
<tr><td>4</td><td>Manually schwitched off</td></tr>
<tr><td colspan="2">The graphical imaging of the OC type output operation is presented on the fig. 7.</td></tr>
<tr><td>7294</td><td>7647</td><td>Prl OC1</td><td>W/r</td><td>-99999...99999</td><td colspan="2">Lower threshold of output 1 OC type operation</td></tr>
<tr><td>7296</td><td>7648</td><td>Prh OC1</td><td>W/r</td><td>-99999...99999</td><td colspan="2">Upper threshold of output 1 OC type operation</td></tr>
<tr><td>7298</td><td>7649</td><td>Dly OC1</td><td>W/r</td><td>0... 6500</td><td colspan="2">The operation delay of the output 1 of OC type in seconds.<br>The OC output will be steered up if the alarm active state will be longer than the programmed value.</td></tr>
<tr><td>7300</td><td>7650</td><td>OC2</td><td>W/r</td><td>0... 4</td><td colspan="2">The input quantity on which the output 2 of OC type is to operate.</td></tr>
<tr><td colspan="5" rowspan="7"></td><td>Value</td><td></td></tr>
<tr><td>0</td><td>Result 1 (W1)</td></tr>
<tr><td>1</td><td>Result 2 (W2)</td></tr>
<tr><td>2</td><td>Result 3 (W3)</td></tr>
<tr><td>3</td><td>Result 4 (W4)</td></tr>
<tr><td>4</td><td>Result of (WF) function</td></tr>
<tr><td colspan="2">Recalculated results, basing on the individual user's characteristic (if it is switched on) and basing on programmed mathematical function (if the value 4 has been selected and the function is switched on) are transmitted to the output. In case of choosing the value 4 and switching the mathematical function off, the value 0 is transmitted to the output.</td></tr>
<tr><td>7302</td><td>7651</td><td>OC2 type</td><td>W/r</td><td>0... 4</td><td colspan="2">Output 2 type of OC type</td></tr>
<tr><td colspan="5" rowspan="7"></td><td>Value</td><td></td></tr>
<tr><td>0</td><td>Normal</td></tr>
<tr><td>1</td><td>Schwitched on</td></tr>
<tr><td>2</td><td>Schwitched off</td></tr>
<tr><td>3</td><td>Manually schwitched on</td></tr>
<tr><td>4</td><td>Manually schwitched off</td></tr>
<tr><td colspan="2">The graphical imaging of the OC type output operation is presented on the fig. 7.</td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| 7304 | 7652 | **Prl OC2** | W/r | -99999...99999 | Lower threshold of output 2 OC type operation |
| 7306 | 7653 | **Prh OC2** | W/r | -99999...99999 | Upper threshold of output 2 OC type operation |
| 7308 | 7654 | **Dly OC2** | W/r | 0... 6500 | The operation delay of the output 2 of OC type in seconds.<br>The OC output will be steered up if the alarm active state will be longer than the programmed value. |
| 7310 | 7655 | **Del min 1** | W/r | 0... 1 | Erasing of the input 1 minimal value |
| 7312 | 7656 | **Del max 1** | W/r | 0... 1 | Erasing of the input 1 maximal value |
| 7314 | 7657 | **Del min 2** | W/r | 0... 1 | Erasing of the input 2 minimal value |
| 7316 | 7658 | **Del max 2** | W/r | 0... 1 | Erasing of the input 2 maximal value |
| 7318 | 7659 | **Del min 3** | W/r | 0... 1 | Erasing of the input 3 minimal value |
| 7320 | 7660 | **Del max 3** | W/r | 0... 1 | Erasing of the input 2 maximal value |
| 7322 | 7661 | **Del min 4** | W/r | 0... 1 | Erasing of the input 4 minimal value |
| 7324 | 7662 | **Del max 4** | W/r | 0... 1 | Erasing of the input 2 maximal value |
| 7326 | 7663 | **Del min WF** | W/r | 0... 1 | Erasing of the function result minimal value |
| 7328 | 7664 | **Del max WF** | W/r | 0... 1 | Erasing of the function result maximal value |
| 7330 | 7665 | **Del min max** | W/r | 0... 1 | Erasing of minimal and maximal value |
| | | | | | **Range**<br>0 lack of operation<br>1 erasing<br>**Caution!**<br>After carrying out the erasing operation the value of this register is zero. |
| 7332 | 7666 | **Comp W1** | W/r | 0... 40 | Resistance value of wires connecting the sensor with the module input 1<br>The register is used only in the execution for the resistance or temperature measurement |
| 7334 | 7667 | **Comp W2** | W/r | 0... 40 | Resistance value of wires connecting the sensor with the module input 2<br>The register is used only in the execution for the resistance or temperature measurement |

| | | | | | |
|---|---|---|---|---|---|
| 7336 | 7668 | **Comp W3** | W/r | 0... 40 | Resistance value of wires connecting the sensor with the module input 1<br>The register is used only in the execution for the resistance or temperature measurement |
| 7338 | 7669 | **Comp W4** | W/r | 0... 40 | Resistance value of wires connecting the sensor with the module input 1<br>The register is used only in the execution for the resistance or temperature measurement |
| 7340 | 7670 | **Standard** | W/r | 0... 1 | Restoration of manufacturer's parameters |
| | | | | | **Value** \| |
| | | | | | 0 \| lack of operation |
| | | | | | 1 \| Write of manufacturer' s parameters |
| | | | | | Introduction of the value 1 will cause the write of manufacturer's parameters into the module acc. to the table. 2 |




* *i = 1... 4*

X1 Wi value in the module input of systems => Y1 W1 digital value
X2 Wi value in the module input of systems => Y2 W1 digital value
Other points of the characteristic are calculated

***Fig. 6. Individual user's characteristic***

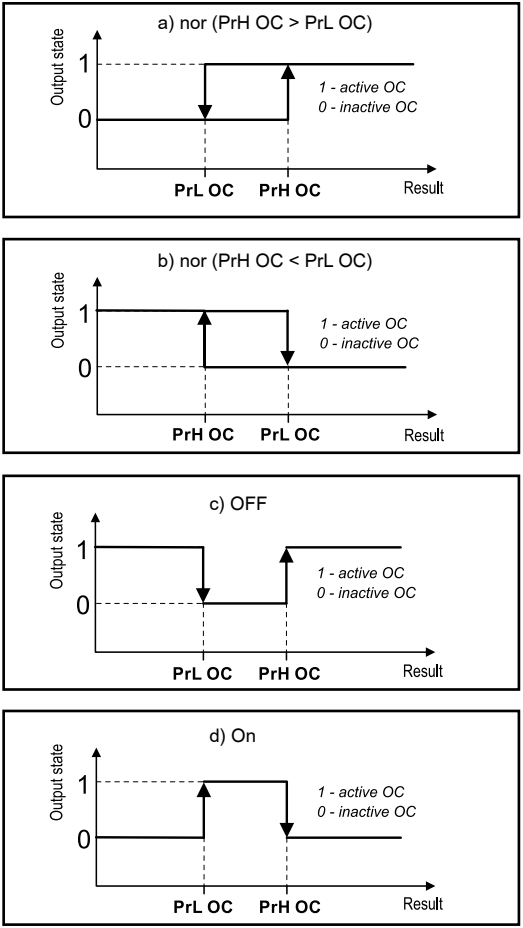



***Fig. 7. Types of OC1 and OC2 output***

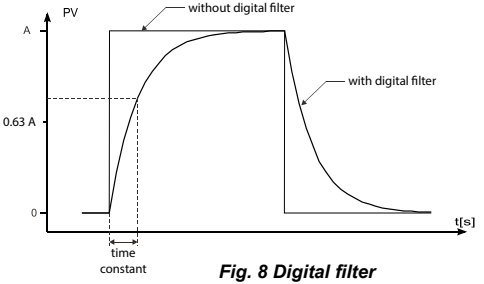



***Fig. 8 Digital filter***

In the case where the measurement is unstable, you can enable the digital filter with a programmable time constant. You need to set the minimum filter time constant at which the measurement is stable. A high time constant can cause delays in reading the rapid changes in the measurement.

**Caution!**

- In the execution for the measurement of resistance or temperature (Pt100) only the two-wire method is accessible. The resistance of the wire connecting the sensor with the module must be introduced from the master device (e.g. PC). For this purpose we propose:
- switch the module into the resistance measurement mode,
- short-circuit the ends of wires which the sensor is fixed to,
- read out the numeric value which represents the resistance of both wires,
- introduce the read out value into the Comp WX (X = 1... 2) register of the appropriate input.

  Each input has a separate compensation register. The described procedure must be carried out for switched on measuring inputs. The resistance can be also measured by any meter (class < 0.1%) and introduced into registers.

- In case on user's individual characteristic switched on, the measured result is linearly transformed in accordance with introduced **X** and **Y** parameters. Then, the calculated value is found in the result register.

- In case of mathematical operations switching on, the result in the **WF** register is calculated in accordance with the equation introduced to the module. Sequence of calculations: result recalculation basing on the user's individual characteristic (if it is switched on), calculation of the introduced function, carrying out the operation on the function result.

- The module supervises currently the value of the introduced parameter . In case when the introduced value is beyond the range of changes given in the table 1, the module does not make the parameter write.

**Manufacturer' parameters of the SM2 module** Table 2

| *Symbol* | *Manufacturer's value* |
|---|---|
| Input 1,2,3,4 | 1 (switched on) |
| Cnt W1, Cnt W2, Cnt W3, Cnt W4 | 1 (1 s) |
| Ind W1, Ind W2, Ind W3, Ind W4 | 0 (switched off) |
| X1 W1, X1 W2, X1 W3, X1 W4 | 0 |
| Y1 W1, Y1 W2, Y1 W3, Y1 W4 | 0 |
| X2 W1, X2 W2, X2 W3, X2 W4 | 0 |
| Y2 W1, Y2 W2, Y2 W3, Y2 W4 | 0 |
| A,B,C,D | 0 (switched off) |
| Operator 1,2,3 | 0 („+") |
| Operator WF | 0 (switched off) |
| Rate | 2 (9600) |
| Mode | 4 (RTU 8N2) |
| Address | 1 |
| OC1 | 0 (input 1) |
| Typ OC1 | 4 (switched off manually) |
| Prl OC1 | 0 |
| Prh OC1 | 0 |
| Dly OC1 | 0 (lack of delay) |
| OC2 | 0 (Input 1) |
| Typ OC2 | 4 (switched off manually) |
| Prl OC2 | 0 |
| Prh OC2 | 0 |
| Dly OC2 | 0 (lack of delay) |
| Comp W1, Comp W2, Comp W3, Comp W4 | 0 |

# 6. TECHNICAL DATA

**INPUTS:**

**Depending on the execution code for individual channels:**

| | | |
|---|---|---|
| - voltage measurement | 0...10 V | input resistance > 1 MΩ |
| - current measurement | 0...20 mA | input resistance < 10 Ω |
| - resistance measurement | 0... 400 Ω | |
| - Pt100 | (- 200... + 850)°C | |

Current flowing through the Pt 100 sensor: < 250 μA

Resistance of leads connecting the resistance thermometer with the module: max 20 Ω /wire

Pt100 characteristic acc. to EN 60751+A2

**Error detection in measuring circuit:**

| | |
|---|---|
| voltage measurement | below -0.5 V and above 10.5 V |
| current measurement | below -1 mA and above 21 mA |
| Pomiar rezystancji | below 420 Ω |
| Pt100 | measuring range exceeding |

**OUTPUTS:**

– **open collector (OC)**

voltageless of OC type with npn transistor (maximal load 25 mA)

range of added voltages: 5... 24 V d.c.

– **digital**

a) RS-485 interface

| | |
|---|---|
| transmission protocol | MODBUS |
| RTU | 8N2, 8E1, 8O1, 8N1 |
| baud rate | 2400...115200 bauds |
| address | 1... 247 |

b) RS-232 interface

| | |
|---|---|
| transmission protocol | MODBUS |
| RTU | 8N1 |
| baud rate | 9600 bauds |
| address | 1 |

maximal response time to the query frame: 100 ms[1)].

**Basic error** 0.1% of measuring range

**Additional error from ambient temperature changes** ± (0.1% of range/10K)

**Measurement time of a single input:** 100 ms...400 ms

**Rated operation conditions:**

| | |
|---|---|
| - supply voltage depending on the execution code | 85... 253 V a.c./d.c.<br>20... 50 V a.c./d.c. |
| - supply voltage frequency | 40... 440 Hz |
| - ambient temperature | -10...23...55°C |
| - storage temperature | -25...+85°C |
| - relative humidity | < 95% (condensation inadmissible) |
| - preheating time | 10 min |

**Sustained overload:**

| | |
|---|---|
| - resistance thermometers | 1% |
| - measurement of voltage, current and resistance | 10% |

**Short-duration overload (3 s):**

| | |
|---|---|
| - voltage input | 10 Un |
| - current input | 10 In |

**Ensured protection grade acc. to EN 60529:**

| | |
|---|---|
| - through the housing | IP 40 |
| - electrical connections | IP 20 |

| | |
|---|---|
| **Dimensions** | 45 × 120 × 100 mm |
| **Weight** | < 0.3 kg |
| **Fixing** | on a 35 mm rail |
| **Power consumption** | < 4 VA |
| Resistance against decays | acc. to EN 50082-2 |

**Electromagnetic compatibility:**

| | |
|---|---|
| - immunity | acc. to EN 50082-2 |
| - emission | acc. to EN 50081-2 |
| - additional error from electromagnetic hazard | < 0.2% |

**Safety requirements acc. to EN 61010-1 standard:**

| | |
|---|---|
| - installation category | III |
| - pollution grade | 2 |
| - phase-to-earth working voltage: | |
| - supply | 300 V |
| - input | 50 V |
| - output | 50 V |



[1)] response time for readout

# 7. BEFORE A FAILURE WILL BE DECLARED

In case of incorrect symptoms please to acquaint with the table below.

| SYMPTOMS | PROCEDURE | REMARKS |
|---|---|---|
| 1. The module diode is not illuminated. | Check the connection of the network cable | |
| 2. The module does not communicate with the device master via the RS-232 port. Lack of transmission signalling on RxD and TxD diodes. | Check if the wire is connected to the appropriate module socket. Check if the device master is set on 9600 baud rate, 8N1 mode and address 1. | (RS-232 has constant transmission parameters) |
| 3. The module does not communicate with the device master via the RS-485 port. Lack of transmission signalling on RxD and TxD diodes. | Check if the wire is connected to the appropriate module terminal. Check if the device master is set on the same transmission parameters as the module (baud rate, mode, address). In case of necessity to change transmission parameters when we cannot communicate through RS-485 one can use the RS-232 port which has constant transmission parameters (in case of further problems, see the section 2). After changing e RS-485 parameters into the required one, one can switch over on RS-485 port. | |
| 4. The module returns the value 0 on the given input. | Check if the input which the value 0 is returned on, is not switched out and if the averaging time is > 0.1 s. Check if the user's individual characteristic with zero parameters is not switched on. | |
| 5. The result in WF register (function result) is inconsistent with our expectations, | Check the correctness of the introduced formula. Check if the operation sequence is correct. The operator weight is essential - at first, multiplication and division are carried out and next, addition and subtraction. Perhaps it is sufficient to reorder results in the formula. See programming examples in the section 8 | |
| 6. In result registers the IE20 value is min or max | Check the correctness of the input signal connection. The IE20 value is set when the measured signal is beyond the measuring range. The recorded IE20 value in max and min registers remains till the time of its erasing by the user. | |
| 7. The value of the measured resistance or temperature is overstated. | Check if correct values of the wires' resistance have been introduced to Comp W1, Comp W2, Comp W3 and Comp W4 registers. In case of necessity, one must introduce this value. See the user's manual under the description of the Status 2. | Concerns only the module for resistance measurement or for co-operation with a Pt100 sensor. |

# 8. EXAMPLES OF SM2 MODULE PROGRAMMING

**Example 1: Switching appropriate measuring inputs and digital filter on**

Module operation with two inputs ( e.g. 1 and 3). The first input has the filter with time constant of 100 ms (0.1s) and the third input with a 100 s constant time.

One must program the parameter:

- Input 1 = 1
- Input 2 = 0
- Input 3 = 1
- Input 4 = 0
- Cnt W1 = 0.1
- Cnt W3 = 100

The module will carry out the measurement on the input 1 and 3.

In the register corresponding to first input, the result will be refreshed every 100 ms and in the register corresponding to third register, every 10 minutes.

**Example 2: Programming the user's individual characteristic**

One must program the module in such a way that it measures the water level in a tank with characteristic: 4 mA => 0 m., 20 mA => 3.6 m. in the input 1, whereas on the input 2, the temperature with characteristic: 4 mA => 0°C, 20 mA => 50 °C

One must program the parameter:

- Ind W1 = 1
- X1 W1 = 0
- Y1 W1 = 0
- X2 W1 = 3.6
- Ind W2 = 1
- X1 W2 = 4
- Y1 W2 = 0
- X2 W2 = 20
- Y2 W2 = 50

**Example 3: Programming mathematical function**

One must program the module in such a way that it measures the current on the input 1, the voltage on the input 2, and calculate the apparent power of the variable signal. The module is working with transducers of variable signal into a standard signal, e.g. P11Z transducer. The measurement of max current = 1200 A (0 =→ 4 mA; 1200 A =→ 20 mA), measurement of max voltage = 400 V ( 0 V =→ 0 V; 400 V =→ 10 V).

One must program the parameter:

- Ind W1 = 1
- X1 W1 = 4
- Y1 W1 = 0
- X2 W1 = 20
- Y2 W1 = 1200
- Ind W2 = 1
- X1 W2 = 0
- Y1 W2 = 0
- X2 W2 = 10
- Y2 W2 = 400

one must carry out the following equation: $S = U \cdot I$

- A = 1 (result from input 1)
- B = 2 (result from input 2)
- Operator 1 = 2 (multiplication).

The apparent power 0...480 000 VA will be calculated in the WF register, whereas the 0...1200 A current in the result register 1, and the 0...400 V voltage in the result register 2.

**Example 4: Programming mathematical function**

The module is working with:

On the input 1 -> a.c. current transducer on standard signal, e.g. P11Z.

Current measurement on the 5 A range (transducer characteristic -> 0 A => 4 mA, 5 A => 20 mA).

On the input 2 -> a.c. voltage transducer on standard signal, e.g. P11Z.

Voltage measurement on the 400 V range (transducer characteristic -> 0 V => 0 V

400 V => 10 V)

On the input 3 -> active on standard signal, e.g. P34P or PP84

Active power measurement on the 2000 W range (transducer characteristic 0 W => 4 mA 2000 W => 20 mA.

Its task is to transmit voltage, current and reactive power values to the system.

One must program the parameter:

- Ind W1 = 1
- X1 W1 = 4
- Y1 W1 = 0
- X2 W1 = 20
- Y2 W1 = 5
- Ind W2 = 1

- X1 W2 = 0
- Y1 W2 = 0
- X2 W2 = 10
- Y2 W2 = 400
- Ind W3 = 1
- X1 W3 = 4
- Y1 W3 = 0
- X2 W3 = 20
- Y2 W3 = 2000

One must carry out the following formula:

$$Q = \sqrt{S^2 - P^2} = \sqrt{(U \cdot I)^2 - P^2} = \sqrt{U^2 \cdot I^2 - P^2}$$

And program as follows:

- A = 10 (squared result from the output 2)
- B = 9 (squared result from the output 1)
- C = 11 (squared result from the output 3)
- Operator 1 = 2 (multiplication)
- Operator 2 = 1 (subtraction)
- Operator WF = 1 (extraction of roots from the function result)

The reactive power 0...2000 var ($Q = \sqrt{S^2 - P^2}$) will be calculated in the WF register, whereas the current 0...5 A in the result 1 register, the voltage 0...400 V in the result 2 register and the active power 0...2000 W in the result 3 register.

**Example 5 : Programming mathematical function**

The example is based on the example 4, but instead the calculation of the reactive power, one must calculate cosφ.

- We program individual characteristic parameters acc to the example 4, however the function must be programmed acc. to the formula:

$$\cos\varphi = \frac{P}{S} = \frac{P}{U \cdot I}$$

We must program:

- A = 3 (result from the input 3, power)
- B = 2 (result from the input 2, voltage)
- C = 1 (result from the input 3, current)
- Operator1 = 3 (division)
- Operator2 = 3 (division)

We have to pay attention to the weight of mathematical operations. At first, the multiplication and division are carried out, and next, the subtraction and addition.

Since the weight of multiplication and division are the same, the first operation in the formula is carried out.

For this reason, the given formula above must be written as:

$$\cos\varphi = P/U/I \text{ and not as } P/U * I.$$

In the WF register, the phase displacement angle will be calculated:

$$(\cos\varphi = \frac{P}{S} = \frac{P}{U \cdot I}),$$

However, the current 0...5 A in the result 1 register, the voltage 0...400 V in the result 2 register and the active power 0...2000 W in the result 3 register.

**Example 6 : Programming the OC type input**

One must program the module such a way that the OC1 output could react on the input 1 and the OC2 output on the input 4. The signal on the input 4 is recounted into temperature (4 mA = 0°C ; 20 mA = 100 °C ) The OC1 output is to be actice in the interval 2...4 V, and the OC2 output is to be active after exceeding 50°C and be desactivated below 20°C.

One must program the parameter:

- Ind W4 = 1
- X1 W4 = 4
- Y1 W4 = 0
- X2 W4 = 20
- Y2 W4 = 100
- OC1 = 0
- Typ OC1 = 1
- Prl OC1 = 2
- Prh OC1 = 4
- OC2 = 3
- Typ OC2 = 0
- Prl OC1 = 20
- Prh OC1 = 50

The OC1 output will operate acc. to the fig. 7a and the OC2 output acc. to the fig. 7d.

## 9. ORDERING CODES

| SM2 Module | XX | X | X |
|---|---|---|---|

**Input signal*:**

| | | |
|---|---|---|
| 4 voltage inputs | 0...10 V | **00** |
| 4 current inputs | 0/4...20 mA | **01** |
| 2 voltage input + 2 current input | 0...10V + 0/4...20 mA | **02** |
| 4 resistance or Pt100 inputs | Pt100 or resistance < 400 Ω | **03** |
| on order** | | **XX** |

**Supply:**

| | |
|---|---|
| 85... 253 V a.c./d.c. | **1** |
| 20... 50 V a.c./d.c. | **2** |
| on order ** | **X** |

**Acceptance tests:**

| | |
|---|---|
| without a quality inspection certificate | **8** |
| with a quality inspection certificate | **7** |
| acc. customer's agreement** | **X** |

* Possible version of a cheaper module with a smaller quantity of inputs. Possibility to mix input kinds (e.g. 1 voltage and 3 current inputs).

** Code numbers must be agreed with the manufacturer.

## EXAMPLE OF ORDER

When ordering, please respect successive code numbers.

Code: **SM2 01 1 0** means:

**SM2** - 2-channel module of analog inputs,
**01** - module with 4 current inputs 0/4...20 mA,
**1** - supply voltage: 85... 253 V a.c./d.c.
**8** - without a quality inspection certificate.

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SM2-09C