RS485 MODBUS Module 8AI

Expansion Module – 8 analog inputs

Version 1.4 — 15/04/2013   **User Manual**

Thank you for choosing our product.

This manual will help you with proper support and proper operation of the device.

The information contained in this manual have been prepared with utmost care by our professionals and serve as a description of the product without incurring any liability for the purposes of commercial law.

This information does not release you from the obligation of own judgement and verification.

We reserve the right to change product specifications without notice.

Please read the instructions carefully and follow the recommendations contained therein.

WARNING!

Failure to follow instructions can result in equipment damage or impede the use of the hardware or software.

1. Safety rules

- Before first use, refer to this manual

- Before first use, make sure that all cables are connected properly

- Please ensure proper working conditions, according to the device specifications (eg: supply voltage, temperature, maximum power consumption)

- Before making any modifications to wiring connections, turn off the power supply

2. Module Features

2.1. Purpose and description of the module

8AI module allows measurement of voltages and currents. Values are read via RS485 (Modbus), so we can easily integrate the module with popular PLCs, HMI or PC equipped with the appropriate adapter.

The device has a set of 8 analog input measurements. In addition, the module is equipped with 2 configurable digital outputs.

This module is connected to the RS485 bus with twisted-pair wire. Communication is via MODBUS RTU or MODBUS ASCII. The use of 32-bit ARM core processor provides fast processing and quick communication. The baud rate is configurable from 2400 to 115200.

The module is designed for mounting on a DIN rail in accordance with DIN EN 5002.

The module is equipped with a set of LEDs used to indicate the status of inputs and outputs useful for diagnostic purposes and helping to find errors.

Module configuration is done via USB by using a dedicated computer program. You can also change the parameters using the MODBUS protocol.

2.2. Technical Specifications

Power Supply	Voltage	12-24 V DC ± 20%
	Maximum Current	120 mA @ 12V / 100 mA @ 24V
Inputs	No of inputs	8
	Voltage input	0V to 10V (resolution 1.5mV)
	Voltage input	-10V to 10V (resolution 1.5mV)
	Voltage input	0V to 1V(resolution 0.1875mV)
	Voltage input	-1V to 1V(resolution 0.1875V)
	Current input	4mA to 20mA (resolution 3.75µA)
	Current input	0mA to 20mA (resolution 3.75µA)
	Current input	-20mA to 20mA (resolution 3.75µA)
	Measurement resolution	14 bits
	ADC processing time	16ms / channel
Digital outputs	Maximum current and voltage	500mA / 55V
Temperature	Work	-20 °C - +65°C
	Storage	-40 °C - +85°C
Connectors	Power Supply	2 pin
	Communication	3 pin
	Inputs & Outputs	2 x 10 pin
	Quick connector	IDC10
	Configuration	Mini USB
Size	Height	120 mm
	Length	101 mm
	Width	22,5 mm
Interface	RS485	Up to 128 devices

2.3. *Dimensions of the product*

Look and dimensions of the module are shown below. The module is mounted directly to the rail in the DIN industry standard. Power connectors, communication and IOs are at the bottom and top of the module. USB connector configuration and indicators located on the front of the module.
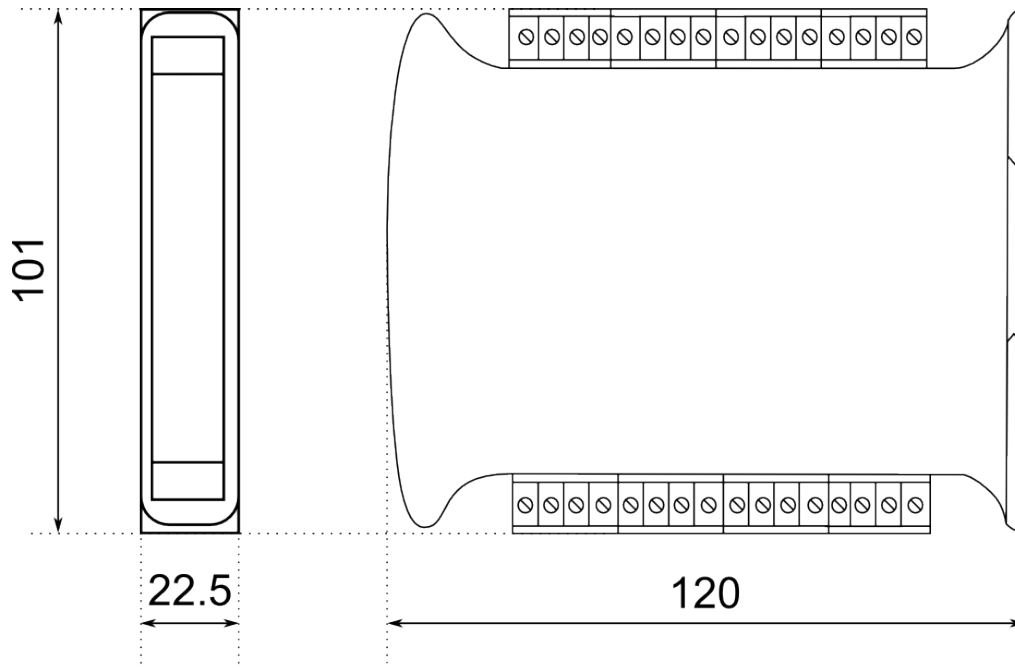
3. Communication configuration

3.1. *Grounding and shielding*

In most cases, IO modules will be installed in an enclosure along with other devices which generate electromagnetic radiation. Examples of these devices are relays and contactors, transformers, motor controllers etc. This electromagnetic radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the module causing negative effects on the system. Appropriate grounding, shielding and other protective steps should be taken at the installation stage to prevent these effects. These protective steps include control cabinet grounding, module grounding, cable shield grounding, protective elements for electromagnetic switching devices, correct wiring as well as consideration of cable types and their cross sections.

3.2. *Network Termination*

Transmission line effects often present a problem on data communication networks. These problems include reflections and signal attenuation.

To eliminate the presence of reflections from the end of the cable, the cable must be terminated at both ends with a resistor across the line equal to its characteristic impedance. Both ends must be terminated since the direction of propagation is bi-directional. In the case of an RS485 twisted pair cable this termination is typically 120 Ω.

3.3. *Setting Module Address in RS485 Modbus Network*

The following table shows how to set switch to determine the address of the module. The module address is set with the switches in the range of 0 to 31. Addresses From 32 to 255 can by set via RS485 or USB.

Addr	SW5	SW4	SW3	SW2	SW1	Addr	SW5	SW4	SW3	SW2	SW1	Addr	SW5	SW4	SW3	SW2	SW1
0	OFF	OFF	OFF	OFF	OFF	11	OFF	ON	OFF	ON	ON	22	ON	OFF	ON	ON	OFF
1	OFF	OFF	OFF	OFF	ON	12	OFF	ON	ON	OFF	OFF	23	ON	OFF	ON	ON	ON
2	OFF	OFF	OFF	ON	OFF	13	OFF	ON	ON	OFF	ON	24	ON	ON	OFF	OFF	OFF
3	OFF	OFF	OFF	ON	ON	14	OFF	ON	ON	ON	OFF	25	ON	ON	OFF	OFF	ON
4	OFF	OFF	ON	OFF	OFF	15	OFF	ON	ON	ON	ON	26	ON	ON	OFF	ON	OFF
5	OFF	OFF	ON	OFF	ON	16	ON	OFF	OFF	OFF	OFF	27	ON	ON	OFF	ON	ON
6	OFF	OFF	ON	ON	OFF	17	ON	OFF	OFF	OFF	ON	28	ON	ON	ON	OFF	OFF
7	OFF	OFF	ON	ON	ON	18	ON	OFF	OFF	ON	OFF	29	ON	ON	ON	OFF	ON
8	OFF	ON	OFF	OFF	OFF	19	ON	OFF	OFF	ON	ON	30	ON	ON	ON	ON	OFF
9	OFF	ON	OFF	OFF	ON	20	ON	OFF	ON	OFF	OFF	31	ON	ON	ON	ON	ON
10	OFF	ON	OFF	ON	OFF	21	ON	OFF	ON	OFF	ON						

3.4. *Types of Modbus Registers*

There are 4 types of variables available in the module

Type	Beginning address	Variable	Access	Modbus Command
1	00001	Digital Outputs	Bit Read & Write	1, 5, 15
2	10001	Digital Inputs	Bit Read	2
3	30001	Input Registers	Registered Read	3
4	40001	Output Registers	Registered Read & Write	4, 6, 16

3.5. *Communication settings*

The data stored in the modules memory are in 16-bit registers. Access to registers is via MODBUS RTU or MODBUS ASCII.

3.5.1. Default settings

You can restore the default configuration by the switch SW6 (see 3.5.2 - Restore the default configuration)

Baud rate	19200
Parity	No
Data bits	8
Stop bits	1
Reply Delay [ms]	0
Modbus Type	RTU

3.5.2. Restore the default configuration

To restore the default configuration:

- turn off the power

- turn on the switch SW6

- turn on the power

- when power and communication LED flash turn off the switch SW6

Caution! After restoring the default configuration all values stored in the registers will be cleared as well.

3.5.3. Configuration registers

Modbus	Dec	Hex	Name	Values
Address				
40003	2	0x02	Baud rate	0 – 2400 1 – 4800 2 – 9600 3 – 19200 4 – 38400 5 – 57600 6 – 115200 other – value * 10
40005	4	0x04	Parity	0 – none 1 – odd 2 – even 3 – always 1 4 – always 0
40004	3	0x03	Stop Bits LSB	1 – one stop bit 2 – two stop bits
40004	3	0x03	Data Bits MSB	7 – 7 data bits 8 – 8 data bits
40006	5	0x05	Response delay	Time in ms
40007	6	0x06	Modbus Mode	0 – RTU 1 – ASCII

4. Indicators
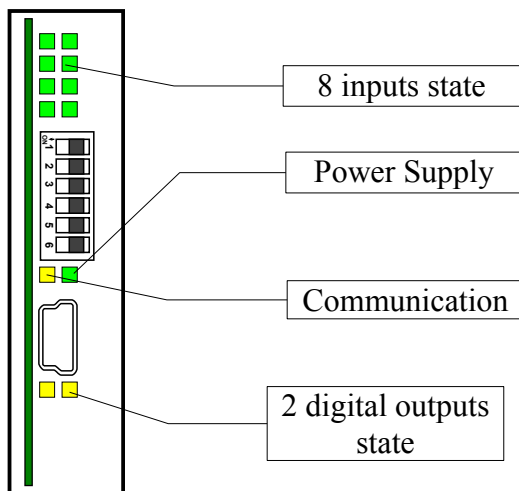
| Indicator	Description
Power supply	LED indicates that the module is correctly powered.
Communication	The LED lights up when the unit received the correct packet and sends the answer.
Inputs state	LED indicates that the signal to input is connected.
Outputs state	LED indicates that the output is on.

5. Module Connection
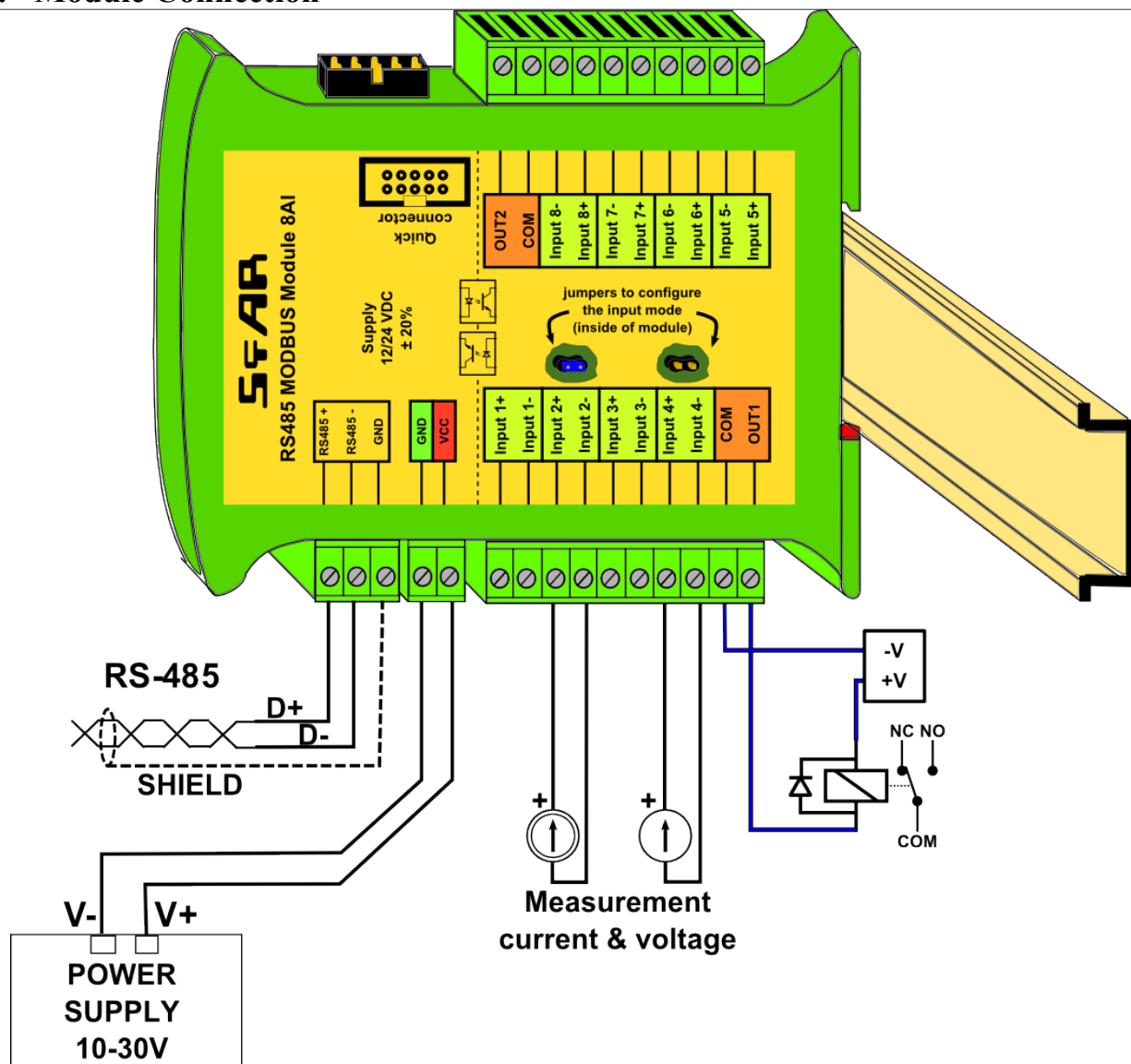
6. Selecting the input mode

Each input can be used to measure the voltage (the default) or current. To change the operating mode in addition to configuration changes by using the program, also set the jumpers inside the module as shown below

Jumper		Description
off	□ □	Voltage measurement
shorted	■ ■	Current measurement

7. Switches
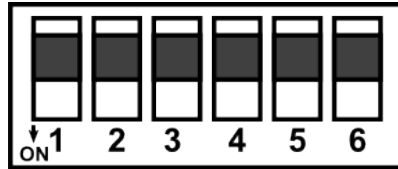
Switch	Function	Description
1	Module address +1	
2	Module address +2	
3	Module address +4	Setting module address from 0 to 31
4	Module address +8	
5	Module address +16	
6	Restoring default settings	Restoring default settings (see 3.5.1 - Default settings and 3.5.2 - Restore the default configuration).

8. Modules Registers

8.1. Registered access

Modbus	Dec	Hex	Register Name	Access	Description
30001	0	0x00	Version/Type	Read	Version and Type of the device
30002	1	0x01	Switches	Read	Switches state
40003	2	0x02	Baud rate	Read & Write	RS485 baud rate
40004	3	0x03	Stop Bits & Data Bits	Read & Write	No of Stop bits & Data Bits (see 3.5.3)
40005	4	0x04	Parity	Read & Write	Parity bit
40006	5	0x05	Response Delay	Read & Write	Response delay in ms
40007	6	0x06	Modbus Mode	Read & Write	Modbus Mode (ASCII or RTU)
40033	32	0x20	Received packets MSB	Read & Write	No of received packets
40034	33	0x21	Received packets LSB	Read & Write	
40035	34	0x22	Incorrect packets MSB	Read & Write	No of received packets with error
40036	35	0x23	Incorrect packets LSB	Read & Write	
40037	36	0x24	Sent packets MSB	Read & Write	No of sent packets
40038	37	0x25	Sent packets LSB	Read & Write	
30051	50	0x32	Inputs	Read	Connected inputs Bit in high state → signal is connected
40052	51	0x33	Outputs	Read & Write	Alarms state bit 8 and 9 alarm outputs
30053	52	0x34	Analog 1	Read	Value of analog input in mV for voltage inputs in µA for current inputs
30054	53	0x35	Analog 2	Read	
30055	54	0x36	Analog 3	Read	
30056	55	0x37	Analog 4	Read	
30057	56	0x38	Analog 5	Read	
30058	57	0x39	Analog 6	Read	
30059	58	0x3A	Analog 7	Read	
30060	59	0x3B	Analog 8	Read	
30061	60	0x3C	Value of 1. alarm input	Read	Current values of voltage / current for alarm inputs
30062	61	0x3D	Value of 2. alarm input	Read	
40063	62	0x3E	MAX alarm level 1	Read & Write	If the analog signal exceeds this value the corresponding alarm flag is set
40064	63	0x3F	MAX alarm level 2	Read & Write	
40065	64	0x40	MAX alarm level 3	Read & Write	
40066	65	0x41	MAX alarm level 4	Read & Write	
40067	66	0x42	MAX alarm level 5	Read & Write	
40068	67	0x43	MAX alarm level 6	Read & Write	
40069	68	0x44	MAX alarm level 7	Read & Write	
40070	69	0x45	MAX alarm level 8	Read & Write	
40071	70	0x46	MIN alarm level 1	Read & Write	If the analog signal is below this value corresponding alarm flag is set
40072	71	0x47	MIN alarm level 2	Read & Write	
40073	72	0x48	MIN alarm level 3	Read & Write	

| Modbus	Dec	Hex	Register Name	Access	Description
40074	73	0x49	MIN alarm level 4	Read & Write	
40075	74	0x4A	MIN alarm level 5	Read & Write	
40076	75	0x4B	MIN alarm level 6	Read & Write	
40077	76	0x4C	MIN alarm level 7	Read & Write	
40078	77	0x4D	MIN alarm level 8	Read & Write	
40079	78	0x4E	Alarm settings 1	Read & Write	Alarm settings 0 – alarm due to the current analog signal value 1 – Remember the value of the alarm, until reset by the master via Modbus
40080	79	0x4F	Alarm settings 2	Read & Write	
40081	80	0x50	Alarm settings 3	Read & Write	
40082	81	0x51	Alarm settings 4	Read & Write	
40083	82	0x52	Alarm settings 5	Read & Write	
40084	83	0x53	Alarm settings 6	Read & Write	
40085	84	0x54	Alarm settings 7	Read & Write	
40086	85	0x55	Alarm settings 8	Read & Write	
40087	86	0x56	Input 1 settings	Read & Write	Analog input mode: 0 – input disabled 1 – voltage 0V to 10V 2 – voltage -10V to 10V 3 – voltage 0V to 1V 4 – voltage -1V to 1V 5 – current 4mA to 20mA 6 – current 0mA to 20mA 7 – current -20mA to 20mA
40088	87	0x57	Input 2 settings	Read & Write	
40089	88	0x58	Input 3 settings	Read & Write	
40090	89	0x59	Input 4 settings	Read & Write	
40091	90	0x5A	Input 5 settings	Read & Write	
40092	91	0x5B	Input 6 settings	Read & Write	
40093	92	0x5C	Input 7 settings	Read & Write	
40094	93	0x5D	Input 8 settings	Read & Write	To change the input mode you must to set jumper inside of module (see 5 – Module Connection and 6 - Selecting the input mode)
40095	94	0x5E	Output 1 settings	Read & Write	Alarm output settings 0 – output is set by PLC +1 – value from input 1 +2 – value from input 2 +4 – value from input 3 +8 – value from input 4 +16 – value from input 5 +32 – value from input 6 +64 – value from input 7 +128 – value from input 8
40096	95	0x5F	Output 2 settings	Read & Write	+256 – Output is set if value is greater than Alarm Value (register 40097 or 40098) („cooling") +512 – Output is set if value is less than Alarm Value (register 40097 or 40098) („heating") +1024 – The lowest value from selected inputs +2048 – The greatest value from selected inputs (if not select either of the two above options than is used average value of selected inputs)
40097	96	0x60	Alarm Value 1	Read & Write	Alarm value for outputs
40098	97	0x61	Alarm Value 2	Read & Write	
40099	98	0x62	Alarm hysteresis 1	Read & Write	The hysteresis value for alarm outputs
40100	99	0x63	Alarm hysteresis 2	Read & Write	

8.2. Bit access

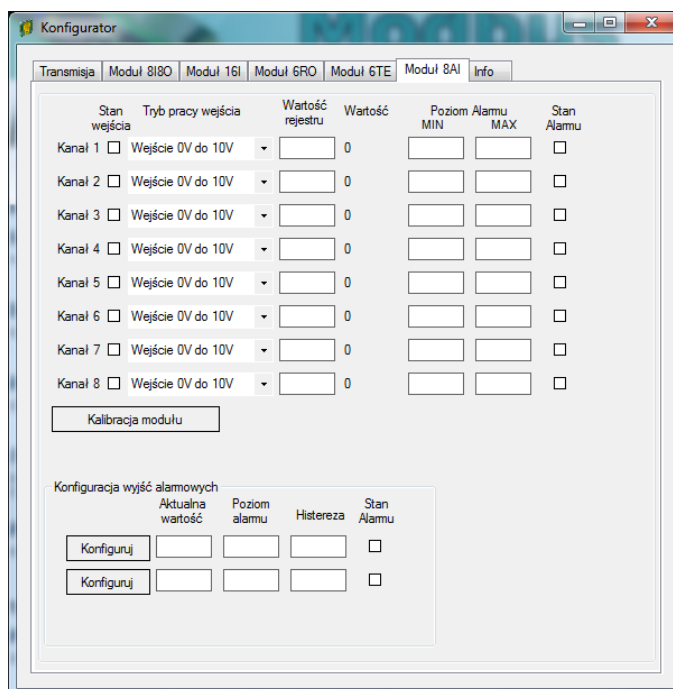| Modbus Address	Dec Address	Hex Address	Register name	Access	Description
801	800	0x320	Input 1	Read	Set when the input is connected
802	801	0x321	Input 2	Read	Set when the input is connected
803	802	0x322	Input 3	Read	Set when the input is connected
804	803	0x323	Input 4	Read	Set when the input is connected
805	804	0x324	Input 5	Read	Set when the input is connected
806	805	0x325	Input 6	Read	Set when the input is connected
807	806	0x326	Input 7	Read	Set when the input is connected
808	807	0x327	Input 8	Read	Set when the input is connected
817	816	0x330	Alarm 1	Read	Alarm state 1
818	817	0x331	Alarm 2	Read	Alarm state 2
819	818	0x332	Alarm 3	Read	Alarm state 3
820	819	0x333	Alarm 4	Read	Alarm state 4
821	820	0x334	Alarm 5	Read	Alarm state 5
822	821	0x335	Alarm 6	Read	Alarm state 6
823	822	0x336	Alarm 7	Read	Alarm state 7
824	823	0x337	Alarm 8	Read	Alarm state 8
825	824	0x338	Digital output 1	Read & Write	State of digital output 1
826	825	0x339	Digital output 1	Read & Write	State of digital output 2

9. Configuration software

Modbus Configurator is software that is designed to set the module registers responsible for communication over Modbus network as well as to read and write the current value of other registers of the module. This program can be a convenient way to test the system as well as to observe real-time changes in the registers.

Communication with the module is done via the USB cable. The module does not require any drivers.

USB Cable

PC

Modbus Module
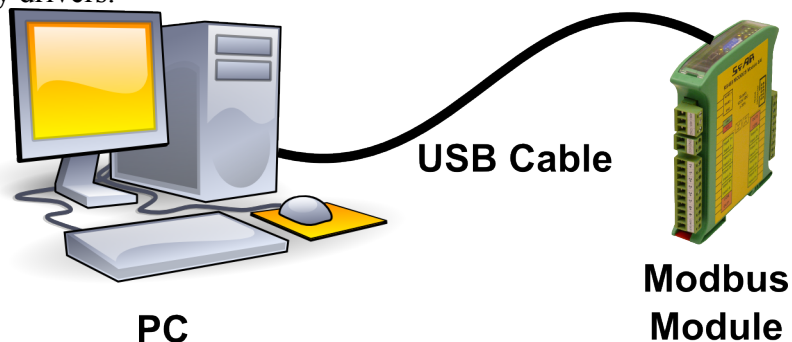
Configurator is a universal program, whereby it is possible to configure all available modules.

Table of Content

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Input No	Voltage input (default)	Current input
1		
2		
3		
4		
5		
6		
7		
8		