

# RS485 MODBUS Module 8AO

Expansion Module – 8 analog outputs

Version 1.3 — 12/02/2013

User Manual



**SFAA**  
Solutions For Automation & Robotics

Manufactured for

**ESPAR**

CE

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 judgment 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

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- 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

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### 2.1. Purpose and description of the module

The 8AO module has a set of 8 analog outputs that could work as a current output (0-20mA or 4-20mA) or as a voltage output (0-10V). Setting the output current or voltage value is done via RS485 (Modbus protocol), so you can easily integrate the module with popular PLCs, HMI or PC equipped with the appropriate adapter.

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.

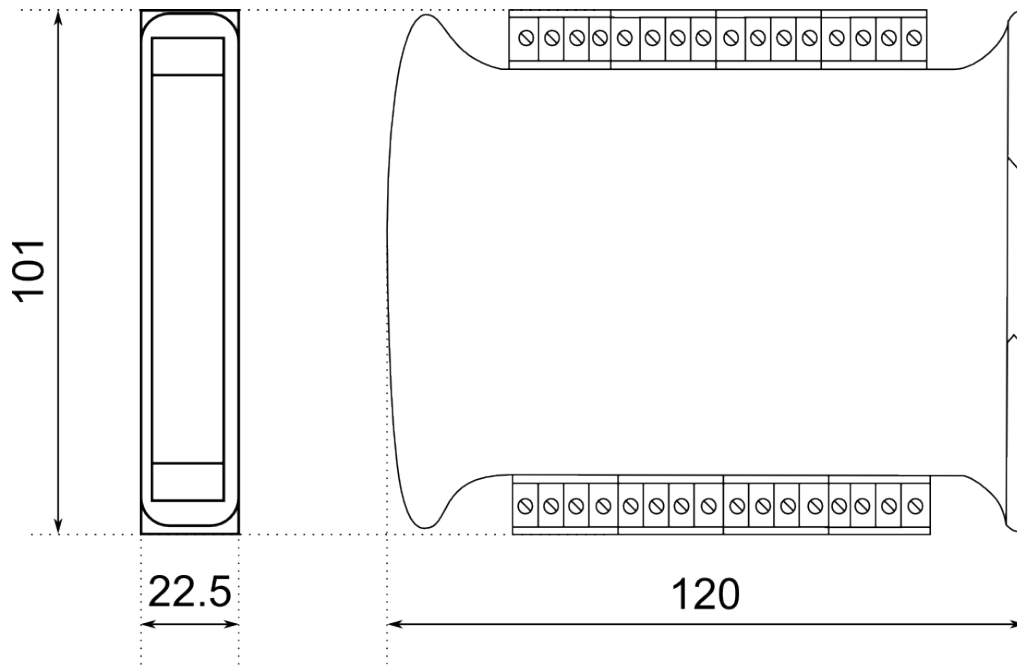
Module configuration is done via USB by using a dedicated computer program. You can also change the parameters using the MODBUS protocol.

## 2.2. Technical Specifications

<b>Power Supply</b>	Voltage	12-24 V DC $\pm$ 20%
	Maximum Current	120 mA @ 12V / 100 mA @ 24V
<b>Outputs</b>	No of outputs	8
	Voltage output	0V do 10V (resolution 1.5mV)
	Current output	0mA do 20mA (resolution 5 $\mu$ A)
	Current output	4mA do 20mA (value in ‰ – 1000 steps) (resolution 16 $\mu$ A)
	Measurement resolution	12 bits
	ADC processing time	16ms / channel
<b>Temperature</b>	Work	-20 °C - +65°C
	Storage	-40 °C - +85°C
<b>Connectors</b>	Power Supply	2 pins
	Communication	3 pins
	Outputs	2 x 10 pins
	Quick connector	IDC10
	Configuration	Mini USB
<b>Size</b>	Height	120 mm
	Length	101 mm
	Width	22,5 mm
<b>Interface</b>	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  $\Omega$ .

#### 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 be 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

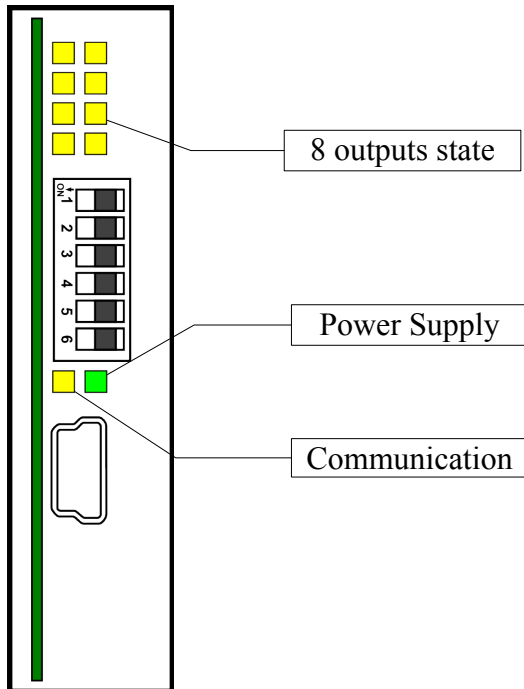
**Caution!** After restoring the default configuration all values stored in the registers will be cleared as well.

### 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

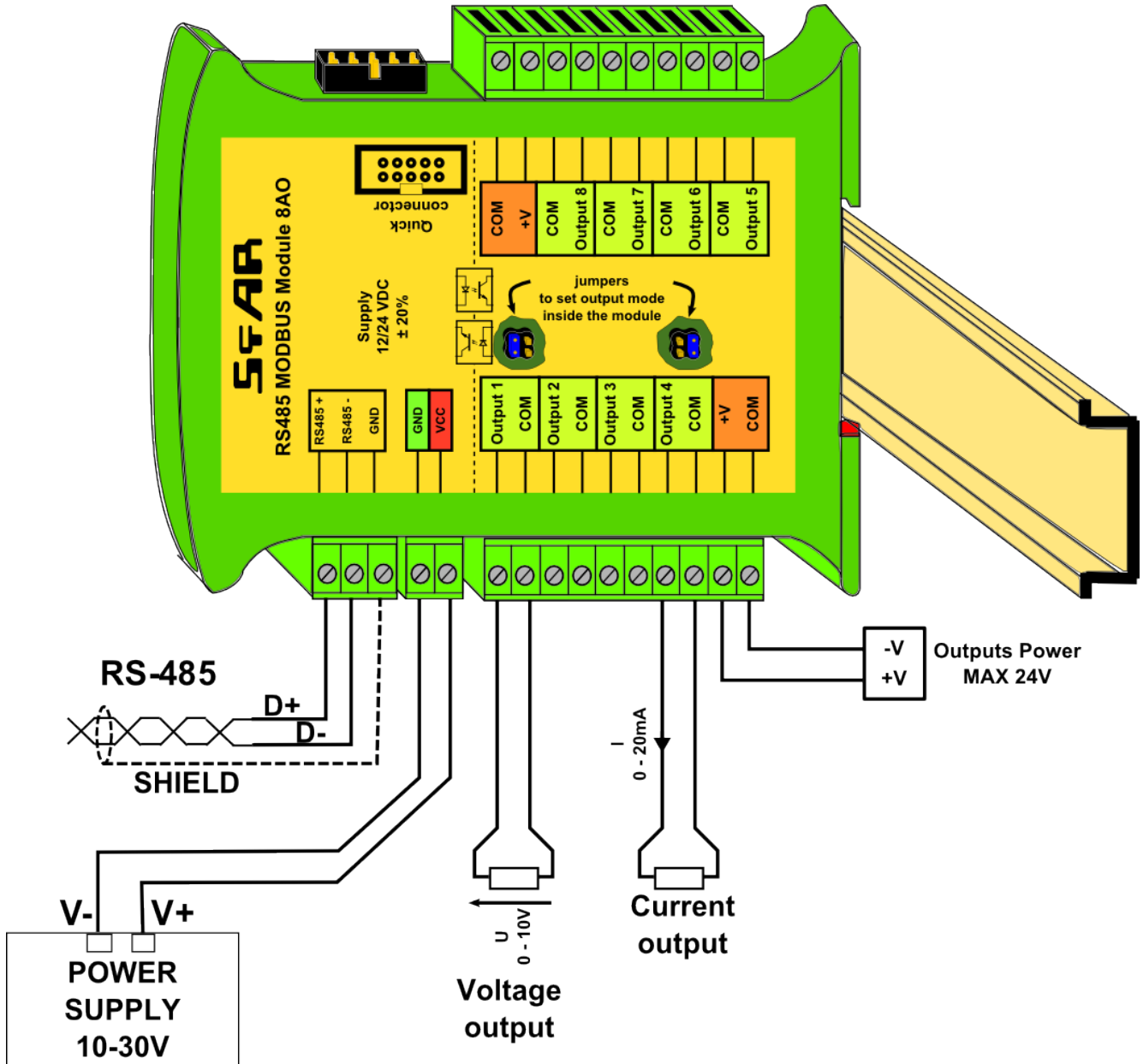


#### 4. Indicators



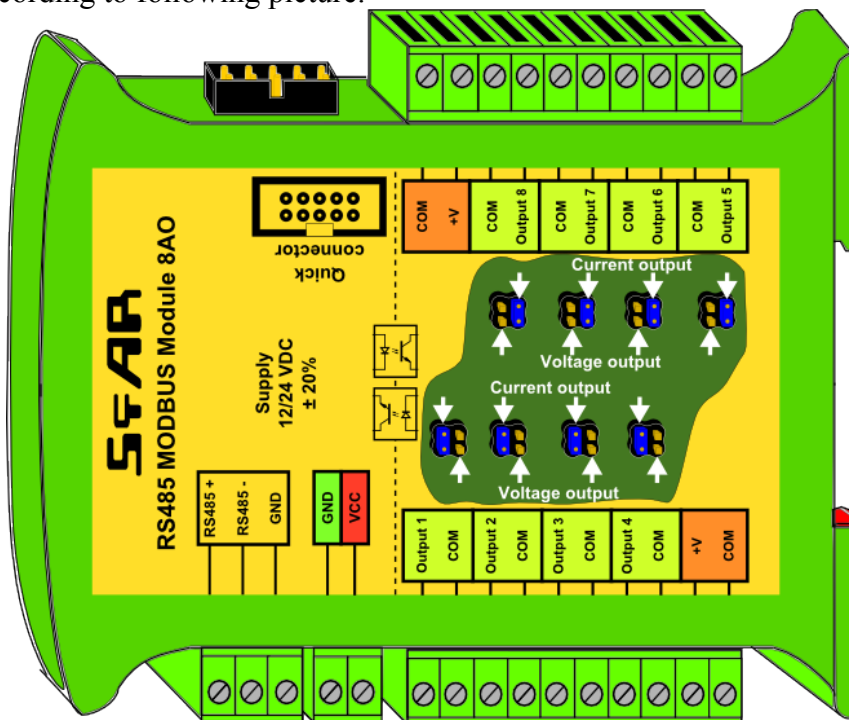
Indicator	Description
Power supply	LED indicates that the module is correctly powered.
Communication	The LED lights up when the unit received the correct packet and sends the answer.
Outputs state	LED indicates that the output is on.

5. Module Connection

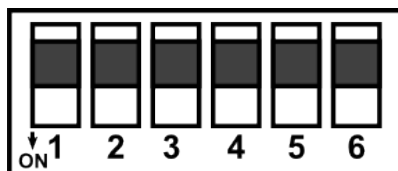


## 6. Setting output mode

To change output mode from current to voltage you should set appropriate values of registers (40069 – 40076) and change the position of jumper inside the module according to following picture.



## 7. Switches



Switch	Function	Description
1	Module address +1	Setting module address from 0 to 31
2	Module address +2	
3	Module address +4	
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)
40009	8	0x08	Watchdog	Read & Write	Watchdog
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	Outputs	Read	Bit is set if value $\neq$ 0
40053	52	0x34	Analog output 1	Read & Write	Value of analog output: in mV for voltage output (max 10240)  in $\mu$ A for current output 0 - 20mA (max 20480)  in ‰ for current output 4-20mA (max 1000)
40054	53	0x35	Analog output 2	Read & Write	
40055	54	0x36	Analog output 3	Read & Write	
40056	55	0x37	Analog output 4	Read & Write	
40057	56	0x38	Analog output 5	Read & Write	
40058	57	0x39	Analog output 6	Read & Write	
40059	58	0x3A	Analog output 7	Read & Write	
40060	59	0x3B	Analog output 8	Read & Write	
40061	60	0x3C	Default output 1 value	Read & Write	Default value of output set when power is on or when watchdog reset occurs
40062	61	0x3D	Default output 2 value	Read & Write	
40063	62	0x3E	Default output 3 value	Read & Write	
40064	63	0x3F	Default output 4 value	Read & Write	
40065	64	0x40	Default output 5 value	Read & Write	
40066	65	0x41	Default output 6 value	Read & Write	
40067	66	0x42	Default output 7 value	Read & Write	
40068	67	0x43	Default output 8 value	Read & Write	
40069	68	0x44	Output 1 setting	Read & Write	Setting of output mode:

Modbus	Dec	Hex	Register Name	Access	Description
40070	69	0x45	Output 2 setting	Read & Write	0 – output disabled 1 – voltage output <b>2 – current output 0-20mA</b> 3 – current output 4-20mA  Caution! For the change to take effect, you must also set the jumper inside the module.
40071	70	0x46	Output 3 setting	Read & Write	
40072	71	0x47	Output 4 setting	Read & Write	
40073	72	0x48	Output 5 setting	Read & Write	
40074	73	0x49	Output 6 setting	Read & Write	
40075	74	0x4A	Output 7 setting	Read & Write	
40076	75	0x4B	Output 8 setting	Read & Write	

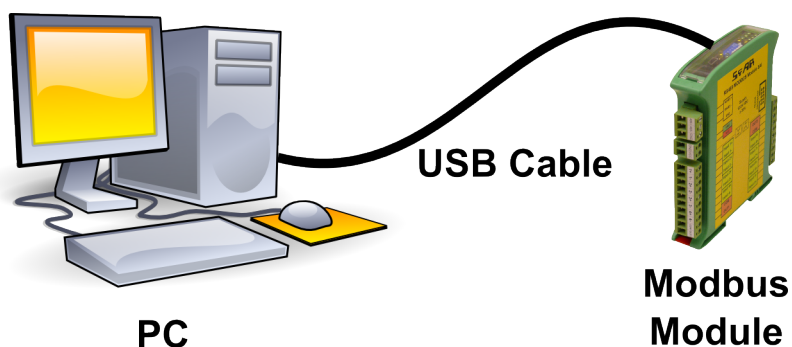
## 8.2. Bit access

Modbus Address	Dec Address	Hex Address	Register name	Access	Description
801	800	0x320	Output 1	Read	If voltage or current is greater than 0 then according bit is set.
802	801	0x321	Output 2	Read	
803	802	0x322	Output 3	Read	
804	803	0x323	Output 4	Read	
805	804	0x324	Output 5	Read	
806	805	0x325	Output 6	Read	
807	806	0x326	Output 7	Read	
808	807	0x327	Output 8	Read	

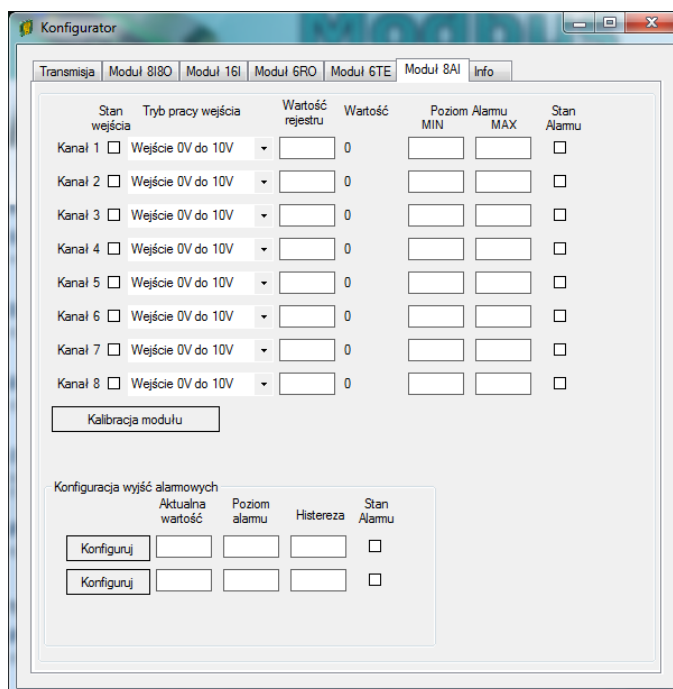
## 9. Configuration software

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.



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



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Output No	Current output (default)	Voltage output
1		
2		
3		
4		
5		
6		
7		
8		