Solutions For Automation & Robotics

SFAR-S-8AO

User Manual

Expansion Module – 8 Analog Outputs

Modbus

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Table of contents

Thank you for choosing our product.

This manual will help you with proper handling and operating of the device.

The information included 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 discharge you from the liability of your own judgment and verification.

We reserve the right to change product specifications without notice.

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

WARNING!

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

1. Safety rules

1. Refer to this manual before the first use.
2. Make sure that all cables are connected properly before the first use
3. Please ensure proper working conditions, according to the device specifications (e.g., supply voltage, temperature, maximum power consumption)
4. Turn the power supply off before making any modifications to wiring connections.

2. Module features

2.1. Purpose and description of the module

The 8AI2DO 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 to indicate the status of inputs and outputs which is 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

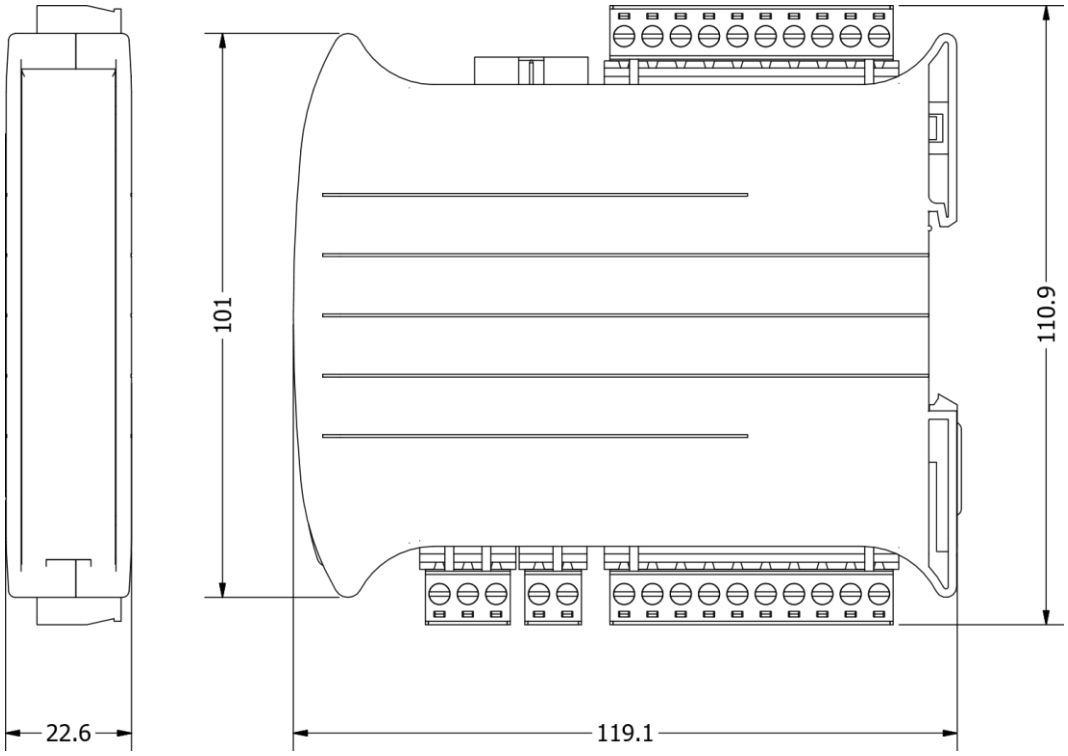
Power Supply	Voltage	10-38 V DC; 10-28 V AC
	Power consumption[1]	1.25 W @ 24 V DC
		1.5 VA @ 24 V AC
Isolation	Isolation between power supply and I/O	1000 V DC
Outputs	No of outputs	8
	Voltage output	0 V do 10 V (resolution 1.5 mV)
		Max. load current 0-10 V 5 mA
		Accuracy ± 2%
	Current output	0 mA - 20 mA (resolution 5 µA)
		4 mA - 20 mA (value in ‰ – 1000 steps) (resolution 16 µA)
		Max. resistance 500 ohm
		Accuracy ± 1%
	Output resolution	12 bits
	DAC processing time	16ms/channel
Temperature	Work	-20°C - +65°C
	Storage	-40°C - +85°C
Connectors	Power Supply	2 pins
	Communication	3 pins
	Outputs	2 x 10 pins
	Quick connector	IDC10
	Configuration	Mini USB
Size	Height	119.1 mm
	Length	101 mm
	Width	22.6 mm
Interface	RS485	Up to 128 devices

Table 1 - Technical specifications

[1] Power consumption with active Modbus transmission, all outputs on

2.3. Dimensions of the product

The appearance 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.



Picture 1 - Dimensions of the product

3. Configurating of the communication

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 represent the problem of data communication networks. These problems include reflections and signal attenuation.

To eliminate the presence of reflections at 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 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 be set via RS485 or USB.

Addr	SW5	SW4	SW3	SW2	SW1
0	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	ON	ON
4	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	ON	OFF	ON
6	OFF	OFF	ON	ON	OFF
7	OFF	OFF	ON	ON	ON
8	OFF	ON	OFF	OFF	OFF
9	OFF	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON	OFF
11	OFF	ON	OFF	ON	ON
12	OFF	ON	ON	OFF	OFF
13	OFF	ON	ON	OFF	ON
14	OFF	ON	ON	ON	OFF
15	OFF	ON	ON	ON	ON

Addr	SW5	SW4	SW3	SW2	SW1
16	ON	OFF	OFF	OFF	OFF
17	ON	OFF	OFF	OFF	ON
18	ON	OFF	OFF	ON	OFF
19	ON	OFF	OFF	ON	ON
20	ON	OFF	ON	OFF	OFF
21	ON	OFF	ON	OFF	ON
22	ON	OFF	ON	ON	OFF
23	ON	OFF	ON	ON	ON
24	ON	ON	OFF	OFF	OFF
25	ON	ON	OFF	OFF	ON
26	ON	ON	OFF	ON	OFF
27	ON	ON	OFF	ON	ON
28	ON	ON	ON	OFF	OFF
29	ON	ON	ON	OFF	ON
30	ON	ON	ON	ON	OFF
31	ON	ON	ON	ON	ON

Table 2 – Setting Module Address in RS485 Modbus Network

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

Table 3 - Types of variables

3.5. Communication settings

The data stored in the module's memory is given in the 16-bit registers. The access to registers happens 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

Table 4 - Default settings

3.5.2. Restore the default configuration

To restore the default configuration:

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

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

3.5.3. Configuration registers

Modbus Address	Dec	Hex	Name	Values
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

Table 5 - Configuration registers

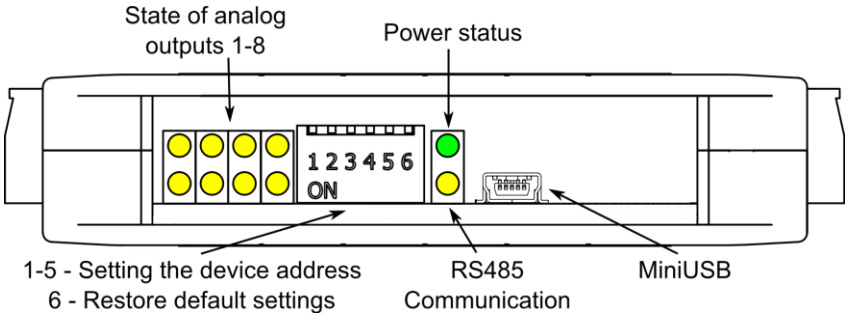
3.5.4. Watchdog information

This 16-bits register specifies the time in milliseconds to watchdog reset. If module does not receive any valid message within that time, all Digital and Analog Outputs will be set to the default state.

This feature is useful if there is an interruption in data transmission and for security reasons. Output states must be set to the appropriate state in order to reassure the safety of persons or property.

The default value is 0 milliseconds which means the watchdog function is disabled.

4. Indicators



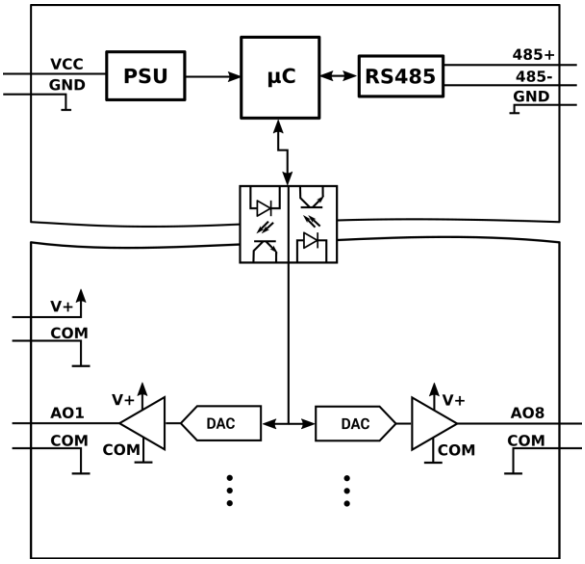
Picture 2 - Indicators

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.

Table 6 - Descriptions of indicators

5. Module connection

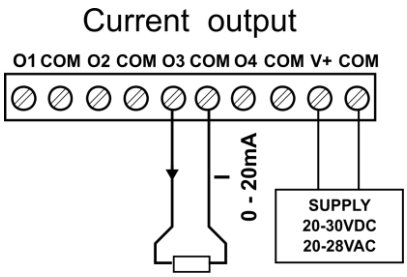
5.1. Block diagram



Picture 3 – Block diagram

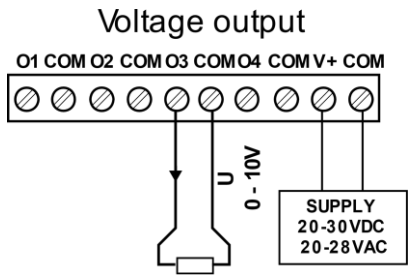
5.2. Connection of analog output

5.2.1. Connection of current output



Picture 4 – Connection of current output

5.2.2. Connection of voltage output

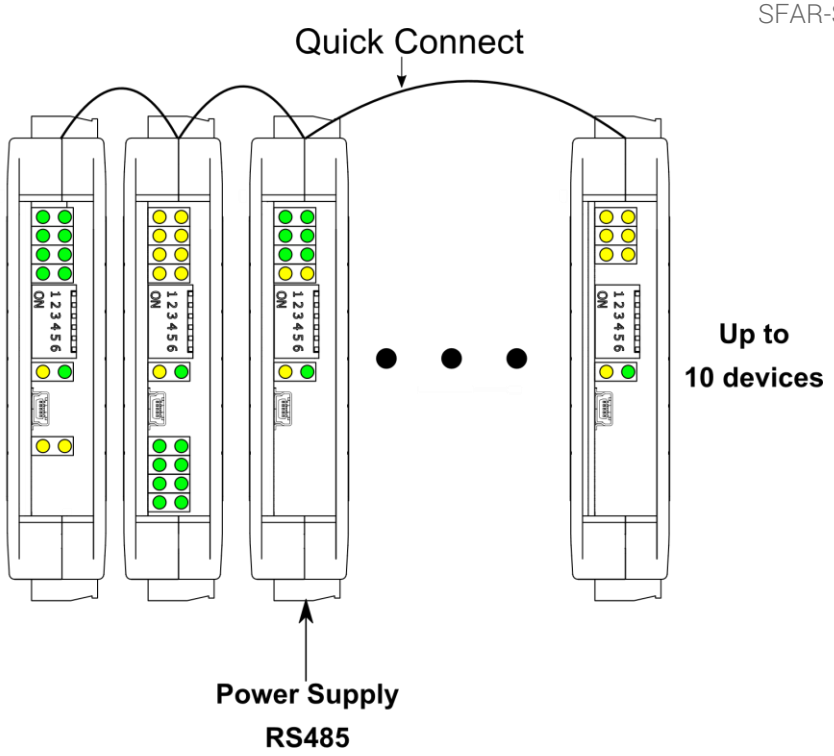


Picture 5– Connection of voltage output

5.3. Quick Connect

Quick Connect is an unique feature of modules that allows you to quickly connect group of devices with a flat ribbon cable. Thanks to this solution, it is enough to connect power and RS485 communication to one of the devices in the group and the others will be powered and communicated with ribbon cable.

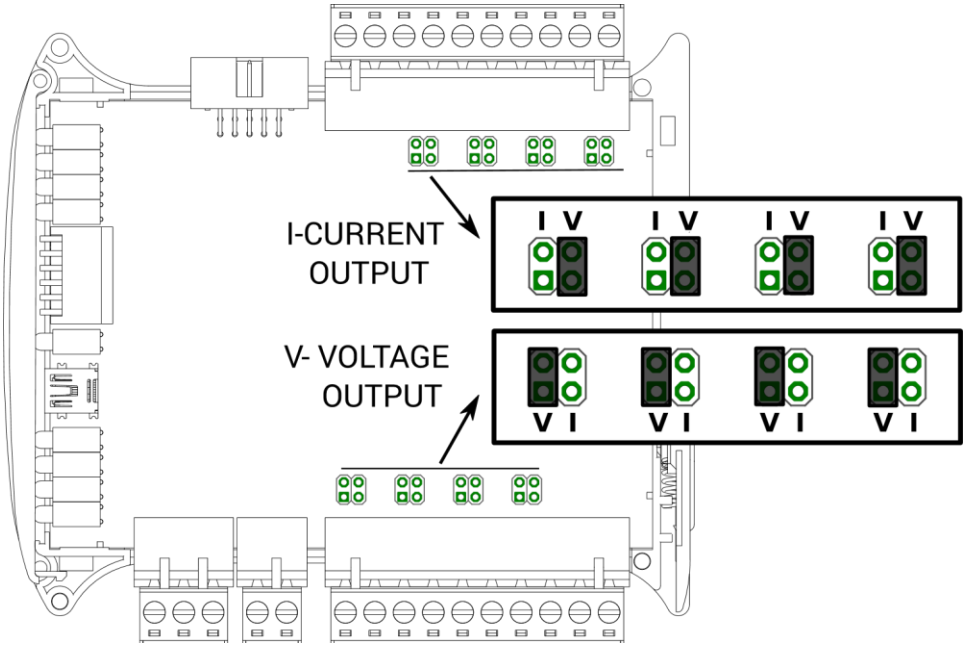
The Quick Connect is sufficient to connect up to 10 devices next to each other. What is important that the various types of modules in the SFAR-S family can be connected with the ribbon cable



Picture 6– Connection of quick connect

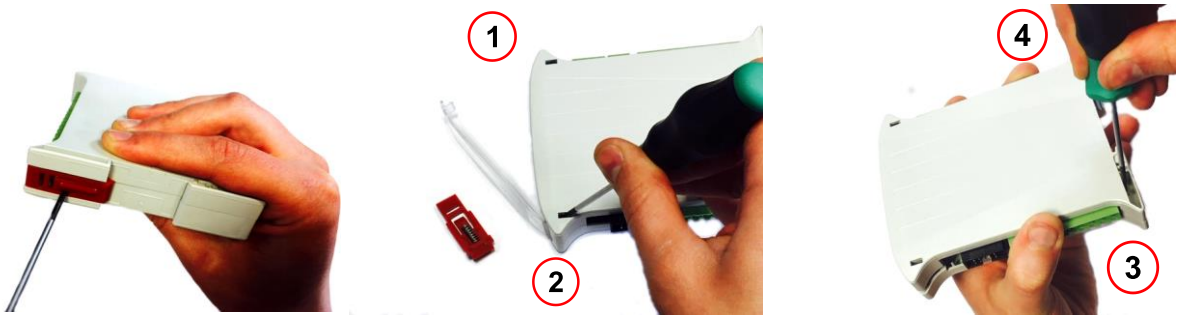
6. Setting output mode

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 the following picture.



Picture 7– Jumper setting

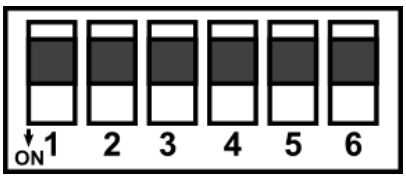
7. Opening the case



Picture 8– Opening the case

1.Remove the catch by pressing it and moving it towards the center of the case. Mind the spring located under the catch.
2.Seperate parts of the case by gently tilting catches located as shown in the picture using thin tool.

8. Switches



Picture 8- 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).

Table 7 - Description of switches

9. Modules Registers

9.1. 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 ≠ 0
40053	52	0x34	Analog output 1	Read & Write	Value of Analog Output: in mV for voltage output (max 10240) in µA for current output 0 – 20 mA (max 20480) in ‰ for current output 4-20 mA (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)utput 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:
40070	69	0x45	Output 2 setting	Read & Write	

Modbus	Dec	Hex	Register Name	Access	Description
40071	70	0x46	Output 3 setting	Read & Write	0 – output disabled 1 – voltage output 2 – current output 0-20 mA 3 – current output 4-20 mA Caution! For the change to take effect, you must also set the jumper inside the module.
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	

Table 8 - Registered access

9.2. Bit access

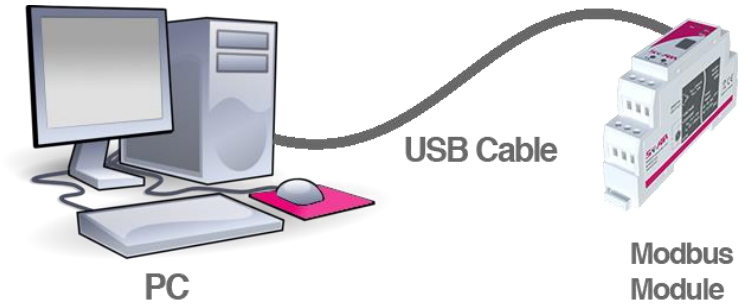
Modbus Address	Dec Address	Hex Address	Register name	Access	Description
801	800	0x320	Output 1	Read	If voltage or current is greater than 0 then according bit is set.
802	801	0x321	Output 2	Read	
803	802	0x322	Output 3	Read	
804	803	0x323	Output 4	Read	
805	804	0x324	Output 5	Read	
806	805	0x325	Output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

Table 9 - Bit access

10. Configuration software

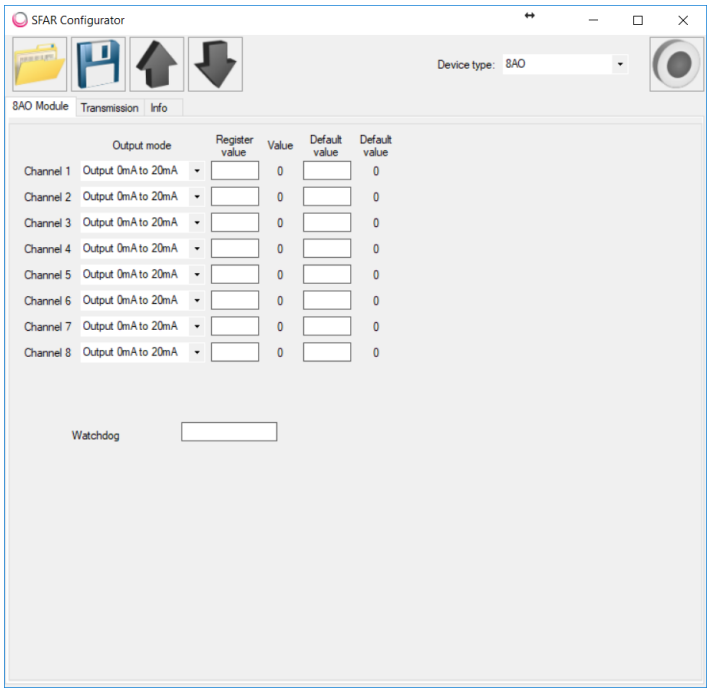
Modbus Configurator the type of software which is designed to set the communication module registers over Modbus network as well as to read and write the current value of other registers of the module. It's a convenient way to test the system as well as to observe real-time changes in the registers.

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



Picture 9 - Connection process

Configurator is an universal software, whereby it is possible to configure all available modules.



Picture 10 - Configurator