iSMACONTROLLI

SfAR-1M-4DI-M

User Manual

Expansion Module - 4 Digital Inputs

Modbus

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1 Introduction

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 judgement 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.

1.1 Revision History

Rev.	Date	Description
3.1	25 May 2022	Rebranded

Table 1. Revision history

2 Safety Rules

- Improper wiring of the product can damage it and lead to other hazards. Make sure that the product has been correctly wired before turning the power on.
- Before wiring or removing/mounting the product, make sure to turn the power off. Failure to do so might cause an electric shock.
- Do not touch electrically charged parts such as power terminals. Doing so might cause an electric shock.
- Do not disassemble the product. Doing so might cause an electric shock or faulty operation.
- Use the product only within the operating ranges recommended in the specification (temperature, humidity, voltage, shock, mounting direction, atmosphere, etc.). Failure to do so might cause a fire or faulty operation.
- Firmly tighten the wires to the terminal. Failure to do so might cause a fire.
- Avoid installing the product in close proximity to high-power electrical devices and cables, inductive loads, and switching devices. Proximity of such objects may cause an uncontrolled interference, resulting in an instable operation of the product.
- Proper arrangement of the power and signal cabling affects the operation of the entire control system. Avoid laying the power and signal wiring in parallel cable trays. It can cause interferences in monitored and control signals.
- It is recommended to power controllers/modules with AC/DC power suppliers. They provide better and more stable insulation for devices compared to AC/AC transformer systems, which transmit disturbances and transient phenomena like surges and bursts to devices. They also isolate products from inductive phenomena from other transformers and loads.
- Power supply systems for the product should be protected by external devices limiting overvoltage and effects of lightning discharges.
- Avoid powering the product and its controlled/monitored devices, especially high power and inductive loads, from a single power source. Powering devices from a single power source causes a risk of introducing disturbances from the loads to the control devices.
- If an AC/AC transformer is used to supply control devices, it is strongly recommended to use a maximum 100 VA Class 2 transformer to avoid unwanted inductive effects, which are dangerous for devices.
- Long monitoring and control lines may cause loops in connection with the shared power supply, causing disturbances in the operation of devices, including external communication. It is recommended to use galvanic separators.
- To protect signal and communication lines against external electromagnetic interferences, use properly grounded shielded cables and ferrite beads.
- Switching the digital output relays of large (exceeding specification) inductive loads can cause interference pulses to the electronics installed inside the product. Therefore, it is recommended to use external relays/contactors, etc. to switch such loads. The use of controllers with triac outputs also limits similar overvoltage phenomena.
- Many cases of disturbances and overvoltage in control systems are generated by switched, inductive loads supplied by alternating mains voltage (AC 120/230 V). If they do not have appropriate built-in noise reduction circuits, it is recommended to use external circuits such as snubbers, varistors, or protection diodes to limit these effects.

3 Module Features

3.1 Purpose and Description of the Module

The SfAR-1M-4DI-M module is an innovative device that provides a simple and cost-effective extension of the number of lines of input in popular PLCs.

The module has 4 digital inputs with configurable timer/counter option, which allows to connect two encoders. All inputs are isolated from the logic with optocouplers. Each channel can be individually configured in one of several modes.

The module has a fast non-volatile FRAM memory that stores values of the counters and the counters captured. This means that even after a power failure, these values are stored and can further be used, when the power returns
The module is connected to the RS485 bus with a 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. It also allows for changing the parameters using the Modbus protocol.

3.2 Technical Specification

Power Supply	Voltage	10-38 V DC; 10-28 V AC
	Power consumption (with active Modbus transmission and high state on all inputs)	1 W at 24 V DC
		2 VA at 24 V AC
Digital Inputs	No. of inputs	4
	Voltage range	0-36 V
	Low state "0"	0-3 V
	High state "1"	6-36 V
	Input impedance	4 kΩ
	Isolation	1500 Vrms
	Input type	PNP or NPN

Counters	No.	4
	Resolution	32 bits
	Frequency	1 kHz (max.)
	Impulse width	500 µs (min.)
Temperature	Work	-20°C to +65°C
	Storage	-40°C to +85°C
Connectors	Power supply	3 pin
	Communication	3 pin
	Inputs	2 x 3 pin
	Configuration	mini USB
Size	Height	90 mm
	Length	56.4 mm
	Width	17.5 mm
Interface	RS485	Up to 128 devices

Table 2. Technical specification

3.3 Dimensions

The appearance and dimensions of the module are shown below. The module is mounted directly to the rail in the DIN industry standard.

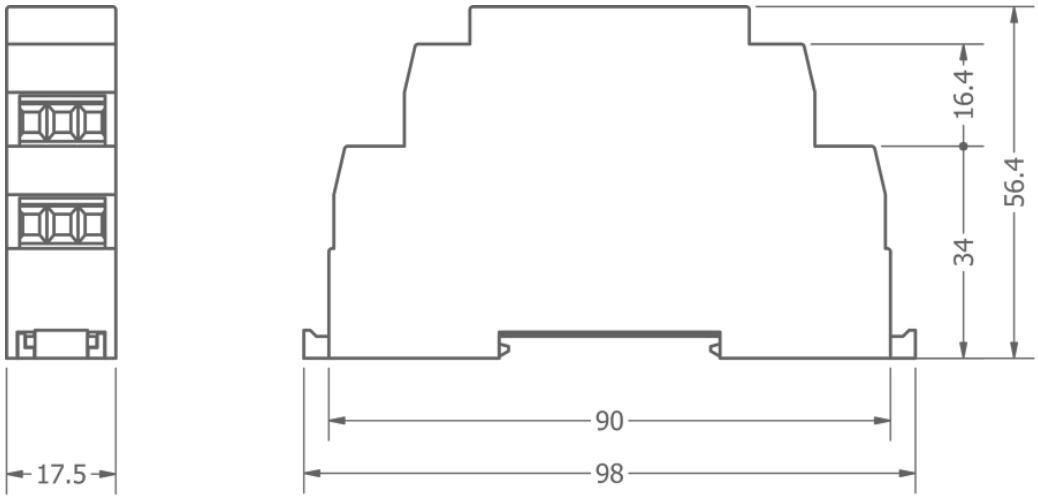

Figure 1. Dimensions

4 Communication

4.1 Grounding and Shielding

In most cases, I/O modules will be installed in an enclosure along with the other devices, which generate electromagnetic radiation. Relays, contactors, transformers, motor invertors, etc., are examples of such devices. Radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the module. Whether or not the SfAR modules are immune to such effects, the interferences must be suppressed at their source if possible to ensure the proper functioning of the entire system. Appropriate grounding, shielding and other protective steps should be taken at the installation stage to prevent these effects. It is recommended to at least follow the rules below:

- line power cables must be routed with spatial separation from signal and data transmission cables;
- analog and digital signal cables should also be separated;
- it is recommended to use shielded cables for analog signals, cable shields should not be interrupted by intermediate terminals;
- the shielding should be earthed directly after the cable enters the cabinet.

It is recommended to install interference suppressors when switching inductive loads (e.g., coils of contactors, relays, solenoid valves). RC snubbers or varistors are suitable for AC voltage and freewheeling diodes for DC voltage loads. The suppressing elements must be connected as close to the coil as possible.

4.2 Network Termination

Transmission line effects often present problems for data communication networks. These problems include reflections and signal attenuation. To eliminate the presence of reflections of signal from the end of the cable, the cable must be terminated at both ends with a resistor across the line adequate to its characteristic impedance. Both ends must be terminated since the propagation is bidirectional. In case of an RS485 twisted pair cable, this termination is typically 120 Ω.

4.3 Types of Modbus Functions

There are 4 types of Modbus functions supported by the SfAR modules.

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

Type	Beginning Address	Variable	Access	Modbus Command
4	40001	Output Registers	Registered Read/write	4, 6, 16

Table 3. Types of Modbus functions supported by the module

4.4 Communication Settings

The data stored in the module's memory is given in the 16-bit registers. The access to registers is via Modbus RTU or Modbus ASCII.

4.4.1 Default Settings

Parameter Name	Value
Address	1
Baud rate	19200
Parity	No
Data bits	8
Stop bits	1
Reply delay [ms]	0
Modbus type	RTU

Table 4. Default settings

4.5 Configuration Registers

Modbus Address	Decimal Address	Hex Address	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 0 4 – always 1
40004	3	0x03	Stop Bits	1 – one stop bit 2 – two stop bits

Modbus Address	Decimal Address	Hex Address	Name	Values
40004	3	0x03	Data Bits	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

5 Indicators

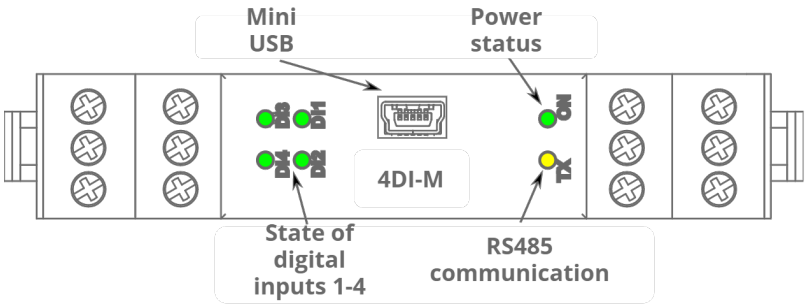

Figure 2. Indicators

Indicator	Description
ON	The LED indicates that the module is correctly powered
TX	The LED lights up when the unit received the correct packet and sends the answer
DI1, 2, 3, 4	The LED indicates that on the input is high state

Table 6. Description of indicators

6 Connections

6.1 Block Diagram

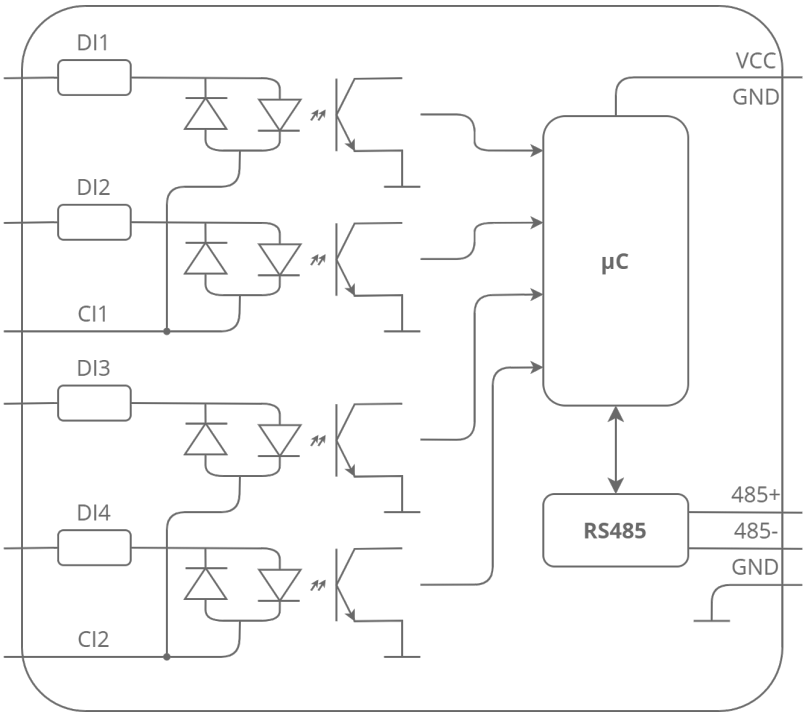

Figure 3. Block diagram

6.2 Power Supply Connection

6.2.1 DC Power Connection

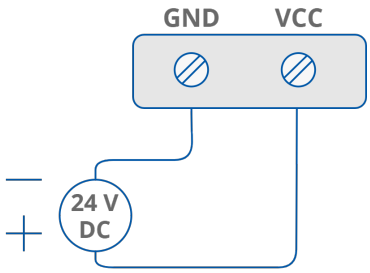

Figure 4. DC power connection

6.2.2 AC Power Connection

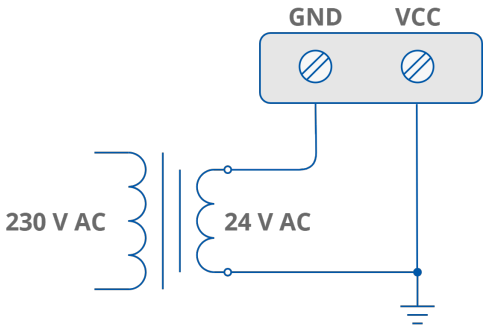

Figure 5. AC power connection

6.3 Communication Bus Connection

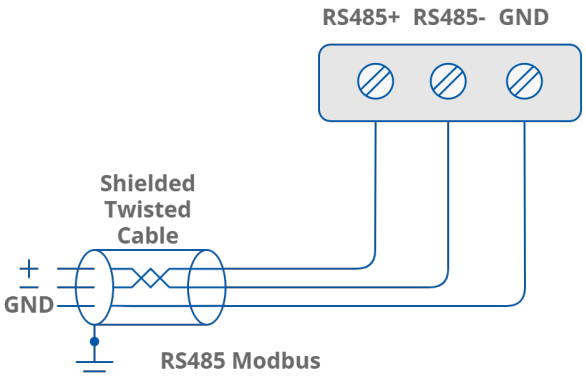

Figure 6. Communication bus connection

6.4 Connection of Digital Inputs

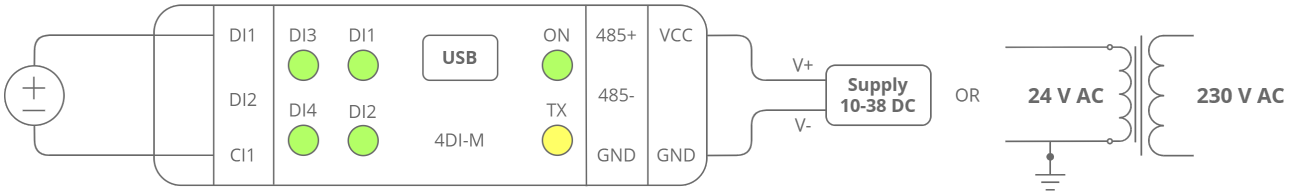

Figure 7. Connection of digital inputs

7 Module Registers

7.1 Registered Access

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description
30001	0	0x00	Version/Type	Read	Version and type of the device
30002	1	0x01	Address	Read	Module address
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
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 LSR (Least Significant Register)	Read/write	No. of received packets
40034	33	0x21	Received Packets MSR (Most Significant Register)	Read/write	
40035	34	0x22	Incorrect Packets LSR	Read/write	No. of received packets with error
40036	35	0x23	Incorrect Packets MSR	Read/write	
40037	36	0x24	Sent Packets LSR	Read/write	No. of sent packets
40038	37	0x25	Sent Packets MSR	Read/write	
30051	50	0x32	Inputs	Read	Inputs state
40053	52	0x34	Counter 1 LSR	Read/write	32-bit counter 1
40054	53	0x35	Counter 1 MSR	Read/write	
40055	54	0x36	Counter 2 LSR	Read/write	32-bit counter 2
40056	55	0x37	Counter 2 MSR	Read/write	
40057	56	0x38	Counter 3 LSR	Read/write	32-bit counter 3
40058	57	0x39	Counter 3 MSR	Read/write	

Modbus Address	Decimal Address	Hex Address	Register Name	Access	Description
40059	58	0x3A	Counter 4 LSR	Read/write	32-bit counter 4
40060	59	0x3B	Counter 4 MSR	Read/write	
40061	60	0x3C	CCounter 1 LSR	Read/write	32-bit value of captured counter 1
40062	61	0x3D	CCounter 1 MSR	Read/write	
40063	62	0x3E	CCounter 2 LSR	Read/write	32-bit value of captured counter 2
40064	63	0x3F	CCounter 2 MSR	Read/write	
40065	64	0x40	CCounter 3 LSR	Read/write	32-bit value of captured counter 3
40066	65	0x41	CCounter 3 MSR	Read/write	
40067	66	0x42	CCounter 4 LSR	Read/write	32-bit value of captured counter 4
40068	67	0x43	CCounter 4 MSR	Read/write	
40069	68	0x44	Counter Config 1	Read/write	Counter configuration +1 – time measurement (if 0 counting impulses) +2 – autocatch counter every 1 sec +4 – catch value when input low +8 – reset counter after catch +16 – reset counter if input low +32 – encoder
40070	69	0x45	Counter Config 2	Read/write	
40071	70	0x46	Counter Config 3	Read/write	
40072	71	0x47	Counter Config 4	Read/write	
40073	72	0x48	Catch	Read/write	Catch counter
40074	73	0x49	Status	Read/write	Captured counter

Table 7. Registered access

7.2 Bit Access

Modbus Address	Dec Address	Hex Address	Register Name	Access	Description
10801	800	0x320	Input 1	Read	Input 1 state
10802	801	0x321	Input 2	Read	Input 2 state
10803	802	0x322	Input 3	Read	Input 3 state

Modbus Address	Dec Address	Hex Address	Register Name	Access	Description
10804	803	0x323	Input 4	Read	Input 4 state
1153	1152	0x480	Capture 1	Read/write	Capture counter 1
1154	1153	0x481	Capture 2	Read/write	Capture counter 2
1155	1154	0x482	Capture 3	Read/write	Capture counter 3
1156	1155	0x483	Capture 4	Read/write	Capture counter 4
1169	1168	0x490	Captured 1	Read/write	Captured value of counter 1
1170	1169	0x491	Captured 2	Read/write	Captured value of counter 2
1171	1170	0x492	Captured 3	Read/write	Captured value of counter 3
1172	1171	0x493	Captured 4	Read/write	Captured value of counter 4

Table 8. Bit access

8 Configuration Software

The SfAR Configurator is 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 is a convenient way to test the system as well as to observe real-time changes in the registers.

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

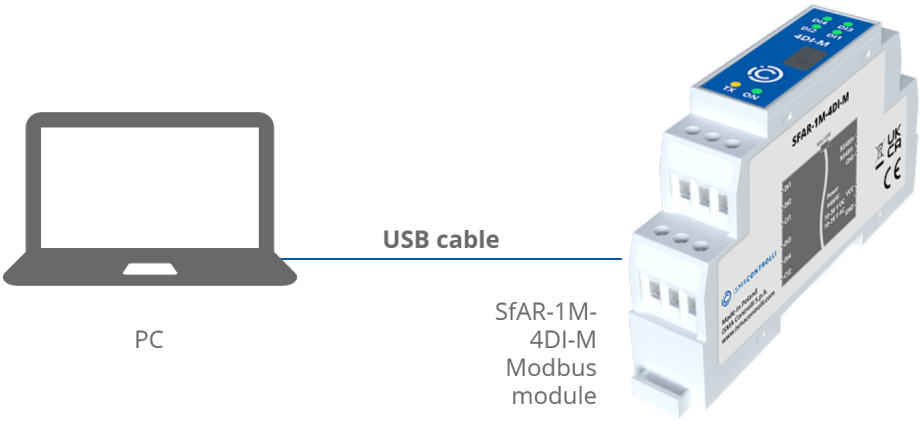

Figure 8. PC connection

The SfAR Configurator is a universal software, where it is possible to configure all available modules.

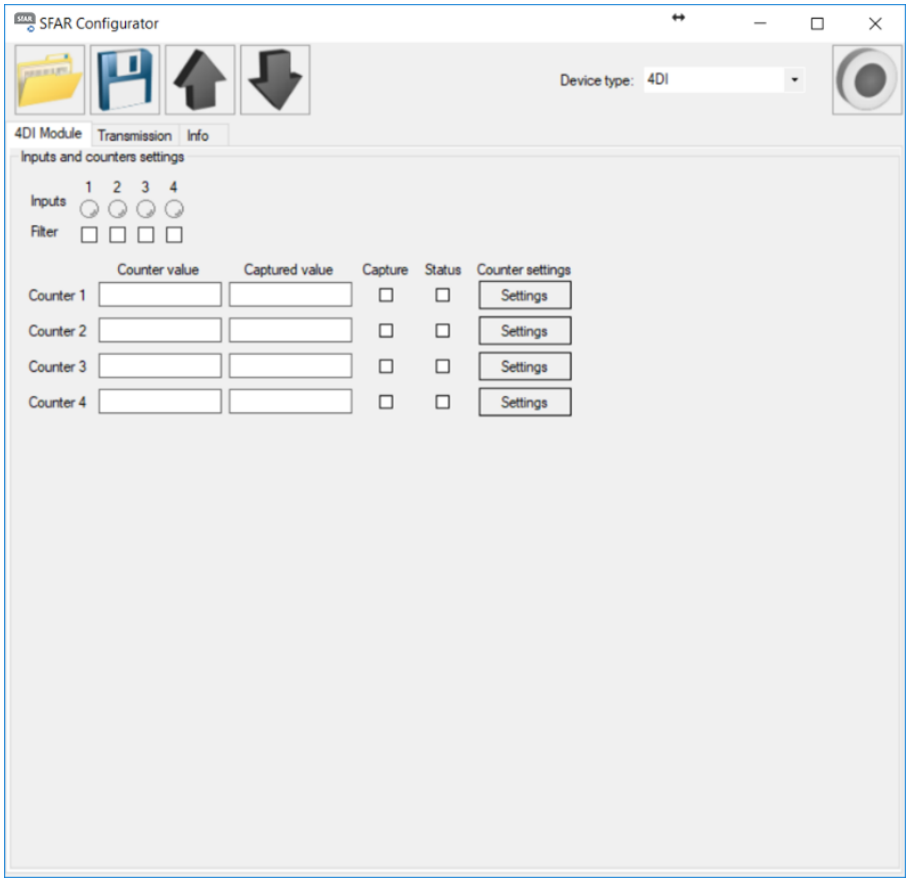

Figure 9. The SfAR Configurator