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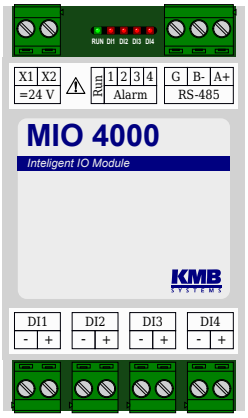
User manual

Inteligent IO module

MIO 4000

Document revision	Release date	Valid for versions			
		Hardware	Bootloader	Firmware	Software ENVIS
1.4	8.10.2020	2.0	4.0	3.0	1.8



You can find the current revision of this document on the manufacturer's website at http://www.kmb.cz/.

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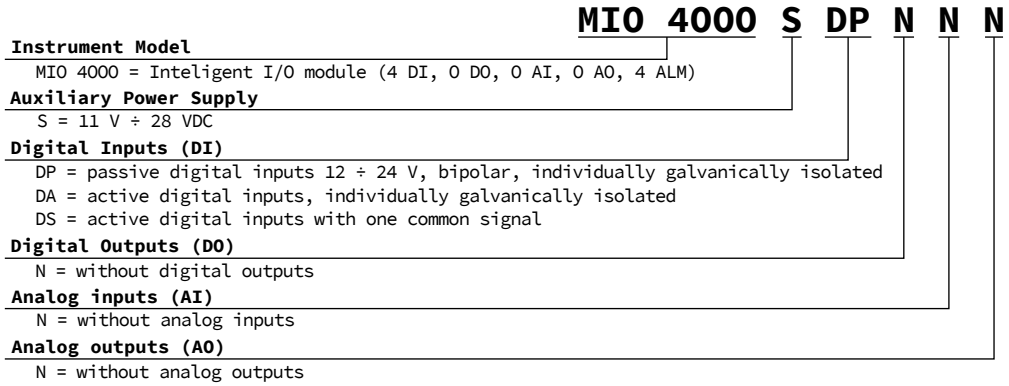


Figure 1: Ordering codes and schemas.

1 Basic description

MIO 4000 is an digital input module with robust galvanic isolation. It is designed for installation on a DIN rail or mounting panel and does not have a local display. This concept is suitable for a wide range of applications in power engineering and smart networks, in building automation and individual production processes, for remote infrastructure supervision and also for automatic load management in conjunction with KMB systems modular measuring instruments. The device is not equipped with local controls and therefore cannot easily interfere with the functions it performs — in simple terms, it should not attract the special attention of lay people in easily accessible places. To protect the settings, the device can be locked with a pin. The inputs can be easily set as pulse counters or hour meters.

The device is equipped with four digital inputs, the status of which is indicated by default by four programmable alarm LEDs. It uses the RS-485 communication line to connect to the superior system.

1.1 Characteristic features

Connection

- *DP variant:* four passive bipolar digital inputs 12 ÷ 24 V individually galvanically isolated
- *DA variant:* four active digital inputs individually galvanically isolated
- *DS variant:* four active digital inputs with common „+“ terminals galvanicaly isolated from communication and power supply
- DC supply voltage 11 ÷ 28 V_{DC}

Data transmission and evaluation

- ENVIS 1.8 or higher is available for free download
- system service ENVIS.Online for downloading and processing of archived measurement data
- data transfer, module setup and firmware update is done over RS-485 communication interface

1.2 Types and options

The MIO 4000 is available in various configurations according to the customer's specifications[1]. On figure 1 marking schema of all available options is drawn.

[1]The most up-to-date list of configurations can be obtained on request from the manufacturer.

2 Operating the measuring instrument

2.1 Safety requirements for use of the MIO 4000

When working with the device, all necessary precautions must be taken to protect persons and property against injury and electric shock.

- The device must be operated by a person with the required qualifications for such operation and this person must be familiar with the principles of working with the device described in this description!
- If the module is connected to parts that are under dangerous voltage, all necessary precautions should be taken to protect users and equipment from electric shock.
- The operator performing installation or maintenance of the equipment must be equipped with personal protective equipment and other safety equipment at work.
- If the device is used in a manner not specified by the manufacturer, the protection provided by the analyzer may be reduced.
- If the device or its accessories appear to be damaged or not working properly, do not use it and send it for repair.

2.1.1 The meaning of the symbols used on the device

Table 1: Symbols

Symbol	Description
	Warning
	Direct current
	CE mark declaring conformity with European regulations and regulations
	The device must not be disposed of with household waste
	Equipment with double or reinforced insulation

2.2 Installing the device in a switchboard

The MIO 4000 is designed for mounting on a DIN rail. In the figure 2, the dimensions of the device are drawn. The hole positions for the wall mounting are dimensioned by a dashed line, which is screwed with two screws. The maximum cable cross-section for the device terminals is 2.5 mm^2.

Natural air circulation should be allowed inside the switchgear at the installation site and its immediate surroundings. Do not install other equipment that could be a significant source of heat near to the instrument.

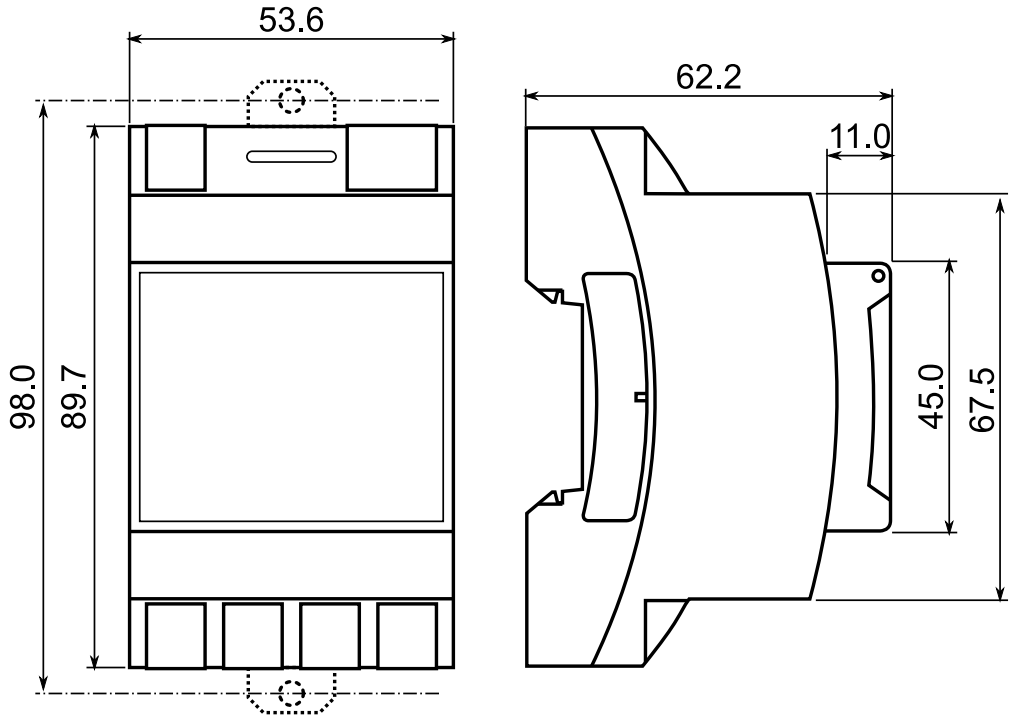


Figure 2: Dimensions of MIO 4000.

2.2.1 Auxiliary voltage

The device only has a low voltage power supply (option S) input. Caution should be taken when selecting a suitable power supply.

The instrument supply voltage must be connected to the terminals X1 and X2 via suitable fuses with apropriate characteristics for the respective environment. The disconnector must be located on the left side of the device within reach of the operator. The circuit breaker must be marked as a disconnect switch. A 0.5A circuit breaker is a suitable circuit breaker, but its location and function must be clearly identified (using the '0' and 'I' symbols according to EN 61010-1). The power supply galvanically separates the power terminals of the device from other internal circuits.

Recommended type of conductor	H07V-U (CY)
Recommended minimum conductor cross-section:	0,75 mm^2
Maximum conductor cross section:	2,5 mm^2

2.2.2 Digital inputs

The MIO 4000 instrument has four digital inputs, which can be active ("DA" and "DS") or passive ("DP") depending on the ordered variant.

Passive variant DP The inputs are bipolar — the polarity does not matter — and are designed to monitor signals with a voltage up to 30 V. The inputs are passive — it is always necessary to connect an external voltage source into the circuit. It is usually possible to use the supply voltage. The active level is detected when the connected voltage is greater than the voltage for the value "logic 1" according to the technical specifications, see 3.3 with any polarity between the "+" or "-" terminals.

The digital inputs inside the device are galvanically separated from the power supply, communication terminals and from the terminals of the other inputs. It is possible to connect the "+" or "-" terminals of the individual inputs to a common potential and it is also possible to switch each input with a different voltage. Thanks to the insulation distances and the components used, it is also possible to detect the switched voltage floating with the mains voltage. With a suitable software setting (hold) it is even possible to detect alternating voltage up to 30 V.

Active variant DA Each digital input is equipped with its own galvanically isolated internal voltage source. The active level is detected when the "+" and "-" terminals are bridged with smaller than the defined impedance for "logic 1" according to the technical specifications, see 3.3. The impedance in this case can be a metal contact (button, relay, reed contact, ...) or a semiconductor (open collector/drain of the transistor, optocoupler gate, ...). In the case of a unipolar semiconductor switching element, it is necessary to take into account the polarity of the internal voltage source, where the current flows from the "+" terminal to the "-" terminal when the circuit is closed.

Recommended type of conductor	H07V-U (CY)
Recommended minimum conductor cross-section:	0,2 mm^2
Maximum conductor cross section:	2,5 mm^2

2.2.3 RS-485 serial interface

It is usually used as an interface for remote reading of current values and instrument settings. The RS-485 serial line uses the A +, B-, and G-signal terminals on the terminals described by RS-485 (fig. 4). The ends of the communication line must be terminated with the specified resistance.

For common use (cable length up to 100 m, communication speed up to 9600 Bd), the choice of cable type is not critical. It is possible to use virtually any shielded cable with two pairs of conductors and to connect the shield at one point to the PE conductor. If the cable length is over 100 m, or when the communication speed is higher (about 20 kbit/s), it is advisable to use a shielded communication cable with twisted pairs (so-called "twisted pair"), which has a defined wave impedance (usually about 100 Ω). Signals A and B are connected by one pair, signal G by the other pair.

The RS-485 interface requires impedance termination of the end nodes using terminating resistors, especially at higher communication speeds and distances. Terminating resistors are only installed at the end points of the line (eg one at the PC and the other at the most remote device). They are connected between terminals A and B. A typical value of the terminating resistor is 120 Ω.

Recommended type of conductor	shielded twisted pair 2×2×0,2 mm^2, e.g. Belden 9842
Recommended minimum conductor cross-section:	0,2 mm^2
Maximum conductor cross section:	2,5 mm^2

2.3 Description of LED indicators

Function of the red LED alarm diods *A1*, *A2, A3, A4* can be configured in the IO section of instrument configuration see 2.4.2. The green *Run* LED is used to indicate the correct program run:

2 s on, 2 s off is the normal state of the device when it is switched on.

0.2 s on, 0.2 s off indicates a special status lasting 10 s after switching on the device. During this interval, the device listens on the RS-485 interface in addition to its set address at address 250, see chapter 2.4. Fast flashing can be used to visually check the device restart when the power supply is disconnected/reconnected, when saving a setting change that requires a device restart, or to perform a firmware upgrade.

During the firmware upgrade, the green *Run* LED flashes and the alarm LEDs are lit continuously. The states are as follows:

Slow blinking means that the device has restarted and is in the bootloader.

Permanent on for a few seconds indicates flash memory erasing.

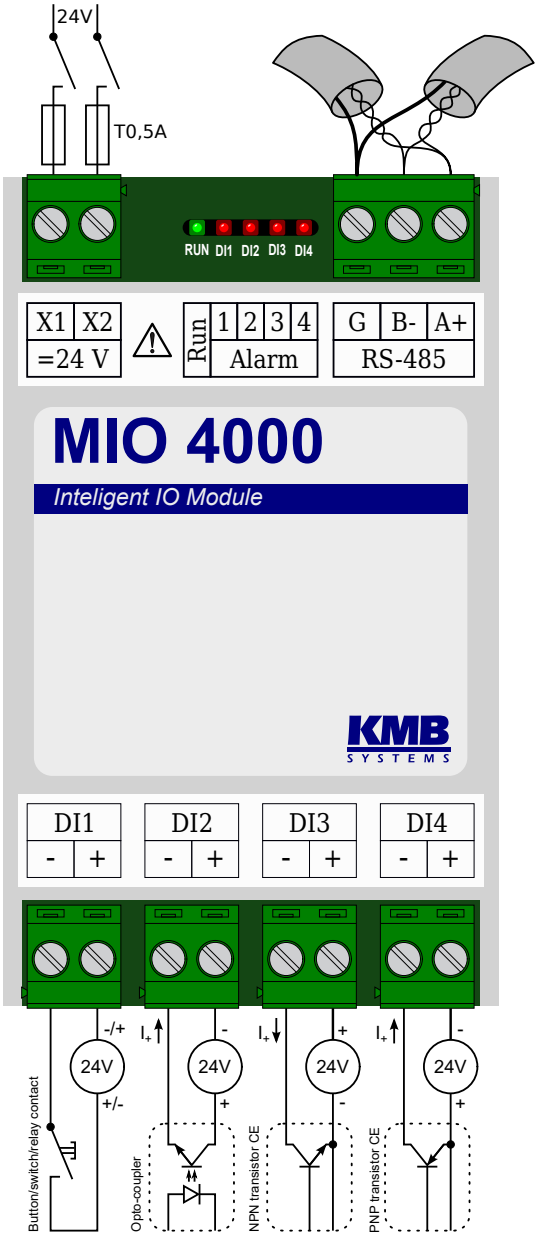
Fast_blinking lasts while sending new firmware via RS-485.

2.4 Detailed instrument settings on the PC

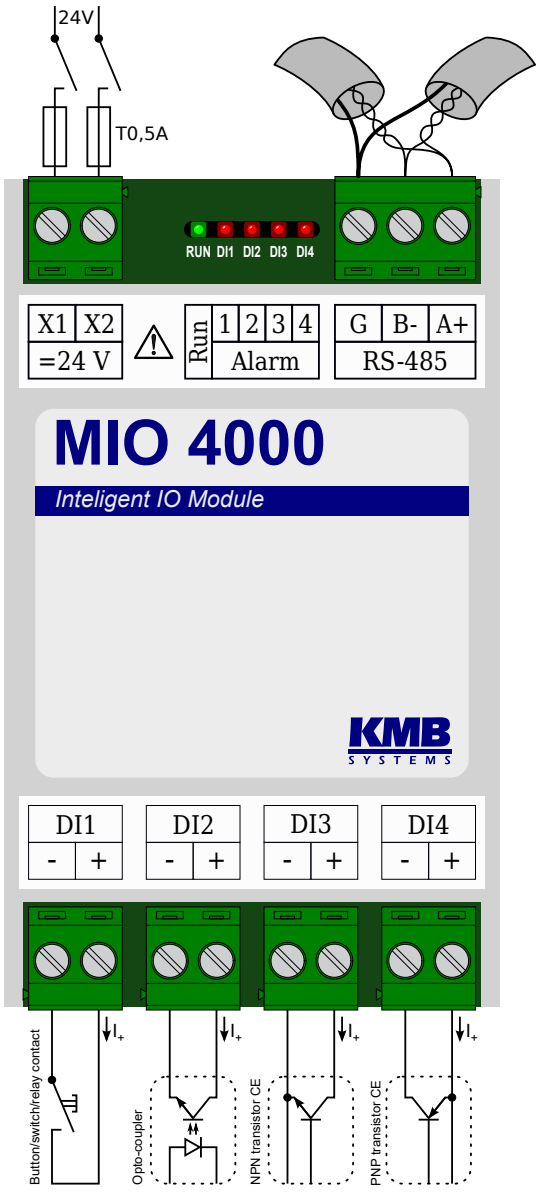
It is advisable to set the MIO 4000 instrument before starting the measurement. The settings can be made from the computer in the ENVIS[2].

1. Turn the power on. Its presence will be indicated by the flashing green RUN LED.

[2]Daq application. ENVIS.Daq is also part of the ENVIS installation package. A detailed description can be found in the ENVIS user manual.



(a) MIO 4000 S DP N N N



(b) MIO 4000 S DA N N N

Figure 3: Connection example of the device MIO 4000.

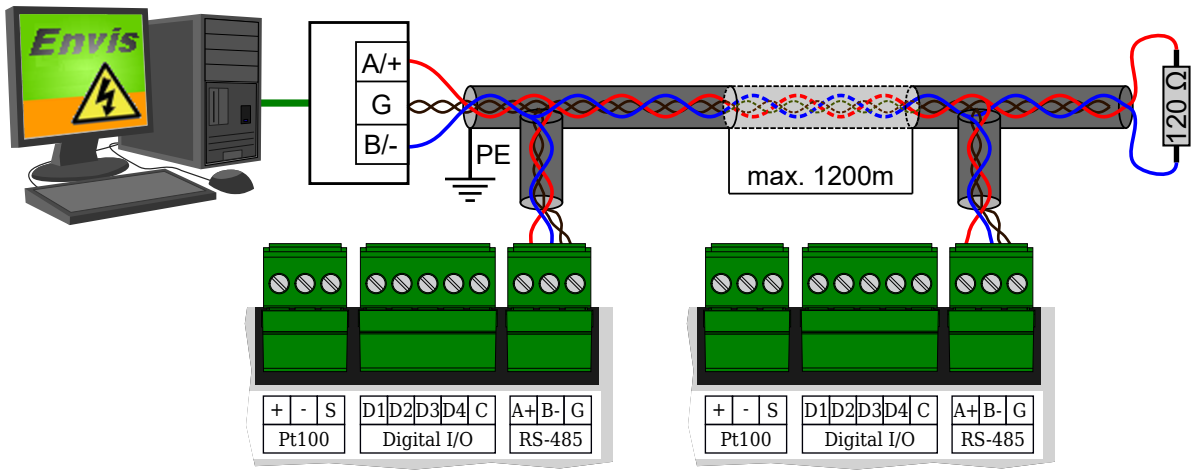


Figure 4: Connection of RS-485 communication lines to MIO 4000 devices MIO 4000.

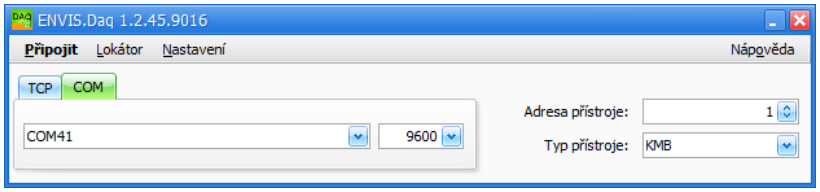


Figure 5: Main window of ENVIS.Daq application after its launch — select the type of communication used, set its parameters and press Connect in menu to continue.

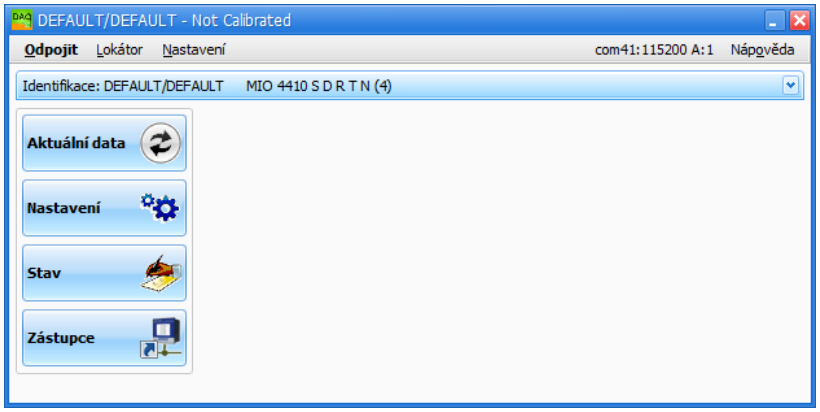


Figure 6: ENVIS.Daq application window with connected instrument.

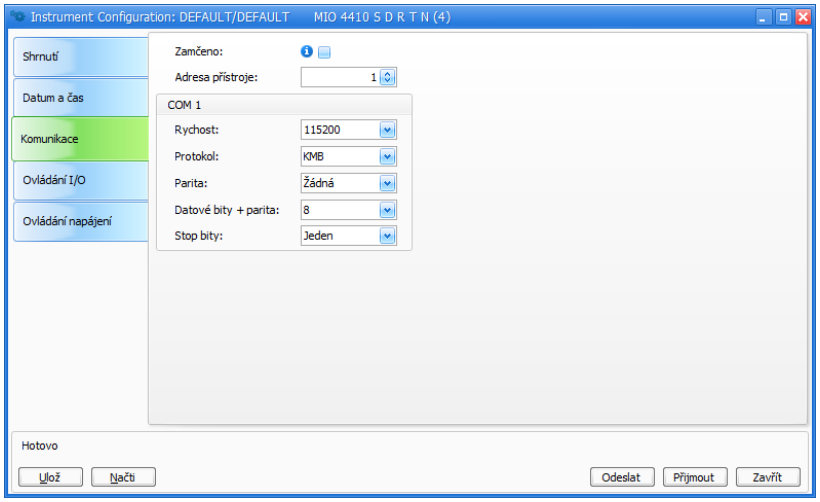


Figure 7: ENVIS.Daq — setting of communication line parameters.

2. Connect MIO 4000 to a computer via RS-485. The device is now ready for configuration.
3. Run the ENVIS.Daq application and select the COM tab (Fig. 5).
4. Fill in the communication link parameters
   (a) Select the appropriate serial port from the list and select the communication speed set in the device — the default speed is *115200* bps. In addition to the set speed, the device always listens at a service speed of *9600* bps.
   (b) Fill in the device address according to the settings — the default address is *1*. For 10 seconds after turning on the power, the device listens in addition to its set address on service address *250*. Each received message at the service address extends its validity for the next 60 seconds.
   (c) Select Device Type *KMB*.
5. Press *Connect* on menu or *ENTER*. The application attempts to connect to the specified device. If the connection is successful, it loads the settings stored in the device and displays a summary window (fig. 6).
6. Press the *Configs* button in the left column of the menu. A new window with device settings tabs appears.

The *Instrument Configuration* contains individual tabs with device parameters divided by meaning. User can change any parameters in individual tabs. Changes to settings are made only in the application and uploaded to the device by pressing the *Send* button. The *Receive* button can be used to retrieve the current valid settings from the device at any time. Bookmarks that have been changed locally and have not yet been written to the device are marked with a warning symbol. The *Save* and *Load* buttons are used to archive the current settings to or from a file.

In particular, the *Communication* and *IO Management* tabs are essential for proper operation.

2.4.1 Communication (fig. 7)

The device is always equipped with a RS-485 communication interface for parameterization.

- *Device Address* — Assign a unique address to each device on one serial line.

COM

- *Port speed* — baud-rate of a communication line. The default adjustable value is 115200 Bd. Fixed service speed is 9600 Bd.
- *Protocol* — select default settings for KMB or M-Bus.
- *Parity* — even, odd or none.

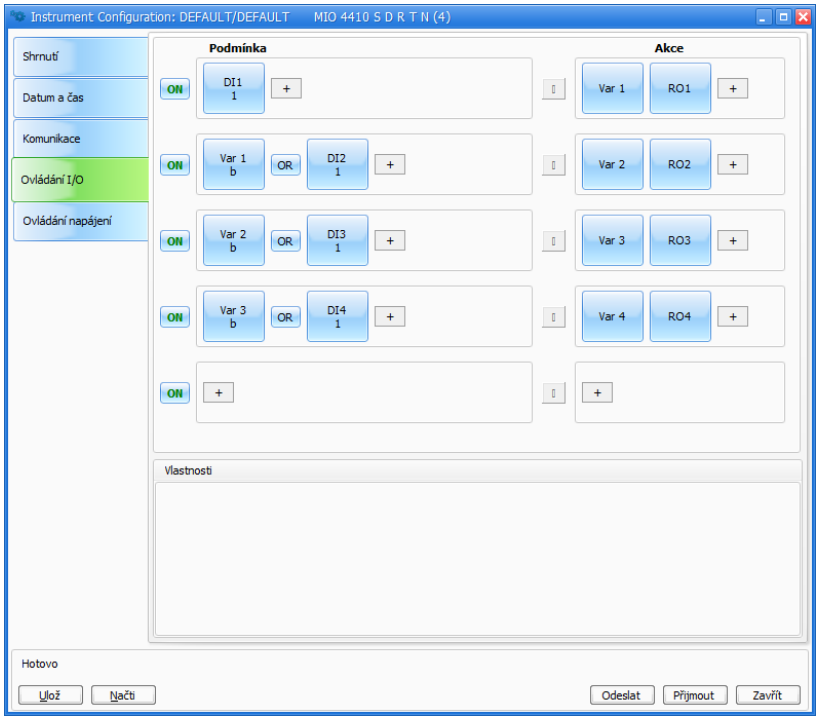


Figure 8: ENVIS.Daq - configuration of programmable inputs and outputs behavior.

- *Data bits + parity* — specifies the number of data bits including parity bits. For 8 bit + parity, select 9. For 8 bit without parity, select 8.
- *Stop Bits* — specifies the number of synchronization bits transmitted by the interface after each character sent.

2.4.2 I/O Management (fig. 8)

MIO 4000 is equipped with four inputs and four alarm LEDs. A function can be set (programmed) in the device that controls any alarm output according to a combination of input status or auxiliary status variables. It is possible to create both combinational and simple sequential logic functions. The status of inputs, internal variables, alarms or counters can be read via Modbus or monitored using the ENVIS.Daq software.

3 Technical parameters

3.1 Basic parameters

Auxiliary Voltage	
	model „S“
rated auxiliary voltage range	10 ÷ 26 VDC
AC auxiliary voltage range	N/A
DC auxiliary voltage range	9 ÷ 29 VDC
power supply	2 W
overvoltage category	IV (50 V)
pollution degree	2
maximum operating altitude	2000 m
connection	isolated, polarity free

spec-AUX-en

Other Specifications	
operational temperature	- 25 to 60°C
storage temperature	- 40 to 80°C
operational and storage humidity	< 95 % - non-condensable environment
EMC – immunity	EN 61000-4-2 ed. 3: level 3 (6/8 kV) EN 61000-4-3 ed. 3: level 3 (10 V/m, 80 – 3000 MHz) EN 61000-4-4 ed. 3: level 4 (4/2 kV) EN 61000-4-5 ed. 3: level 4 (4/2 kV) EN 61000-4-6 ed. 4: úroveň 3 (10 V, 0.15 – 80 MHz)
EMC – emissions	EN 55011 ed. 4, class A
communication ports	RS-485 (2400 ÷ 921600 Bd)
communication protocols	KMB, Modbus RTU
status indication	1 × green LED, 4 × red LED
ingress protection front panel whole instrument	 IP 40 IP 20
protection class	II
service life	> 15 years
dimensions front panel whole instrument	 54 x 45 mm 54 x 90 x 61 mm
weight	max. 0.15 kg

spec-Other-en

3.2 Measured quantities

Measured Quantities – Temperature	
Temperature (internal sensor, measured value affected by the instrument power dissipation)	
measuring range	- 40 ÷ 80°C
measuring uncertainty	± 2 °C

3.3 Inputs

Digital Inputs	
Digital Inputs (signal, 4 pcs)	
Variant DP	
type	Opticaly isolated, bipolar (polarity free)
maximum voltage	30 V_{DC}
voltage for “logical 1“	> 15 V_{DC}
voltage for “logical 0“	< 10 V_{DC}
input current	1.8 mA @ 15V / 3.5 mA @ 24V
dynamic par. (pulse counter): - pulse/gap duration - maximum frequency	 >= 0.5 / 0.5 ms 1 kHz
state change detection delay	<= 20 ms
Galvanicaly isolated between - inputs to each other - inputs and internal circuits	 Functional 150V CAT IV/300V CAT III Reinforced 150V CAT IV/300V CAT III
Variant DA	
type	Opt. isolated, active with internal volt. sources (current returns to “-”)
internal voltage source	24 VDC
impedance for “logical 1“	< 2 kΩ (2.5 mA)
impedance for “logical 0“	> 20 kΩ (1 mA)
current through switching element	2.8 mA @ 0 W
dynamic par. (pulse counter): - pulse/gap duration - maximum frequency	 >= 0.5 / 0.5 ms 1 kHz
state change detection delay	<= 20 ms
Galvanicaly isolated between - inputs to each other - inputs and internal circuits	 Functional 150V CAT IV/300V CAT III Reinforced 150V CAT IV/300V CAT III
Variant DS	
type	Opt. isolated, active with internal volt. source (current returns to “-”)
internal voltage source	24 VDC
impedance for “logical 1“	< 2 kΩ (2.5 mA)
impedance for “logical 0“	> 20 kΩ (1 mA)
current through switching element	2.8 mA @ 0 W
dynamic par. (pulse counter): - pulse/gap duration - maximum frequency	 >= 0.5 / 0.5 ms 1 kHz
state change detection delay	<= 20 ms
Galvanicaly isolated between - inputs to each other - inputs and internal circuits	 Galvanicaly interconnected “+” terminals of all inputs Reinforced 150V CAT IV/300V CAT III

4 Maintenance, service and warranty

Maintenance The module MIO 4000 does not require any special maintenance. For reliable operation, it is only necessary to adhere to the specified operating conditions and not to expose it to rough handling and exposure to water or various chemicals that could cause damage.

Service

In case of product failure, a warranty must be claimed with the manufacturer at:

K M B systems, s.r.o.
Tř. dr. M. Horákové 559
460 05 Liberec 7
Czech republic
Tel.: +420 485 130 314
E-mail: kmb@kmb.cz
Web: www.kmb.cz

The product must be properly packed to avoid shipping damage. A description of the fault must be provided with the product.

If warranty repair is claimed, the warranty card must also be sent. If an out-of-warranty repair is required, an order for this repair must be attached.

Warranty card: The module is warranted for a period of 24 months from the date of purchase, but no longer than 30 months from the manufacturer's delivery date. Defects that arise within these time limits demonstrably due to defective design, faulty construction or unsuitable material will be repaired free of charge by the manufacturer or authorized service organization.

The warranty also expires during the warranty period if the user performs unauthorized modifications or changes on the module, if the module connects to incorrectly selected values, if the module has been violated by unauthorized falls or improper handling, or if it has been operated in contrary to the specified technical parameters.

Product type:	MIO 4000	Serial number:	.....
Delivery date:	.....	Checkout control:	.....
		Manufacturer's stamp:	.....
Date of sale:	.....	Seller's stamp:	.....