Firmware version 2

- IOMOD 8DI4RO User Manual

IOMOD 8DI4RO User Manual

1. Introduction

IOMod 8DI4RO is a stand-alone digital input and relay output controller. Designed to achieve a high technological look and compact fit on DIN rail (EN 60715), IOMod 8DI4RO is used for industrial applications where digital signaling is used and robust communication is essential. It is an ideal solution for such applications as data acquisition, observation, control, process monitoring, testing, and remote measurement.

1.1 Features

- 8 digital inputs;
- 4 relay outputs;
- Configurable active input signal polarity or input inversion;
- Pulsed or latched mode for individual outputs;
- Possible output feedback measurement with inputs;
- Galvanically isolated inputs and outputs for enhanced safety and reliability;
- Firmware upgrade over USB, RS485
- Configurable using the IOMOD Utility app for user-friendly setup
- RS485 interface with a switchable terminating resistor
- Communication over Modbus RTU, IEC 60870-5-101 and IEC 60870-5-103 protocols;
- Compact case with a removable transparent front panel;
- DIN rail mounting for seamless integration into industrial systems;

1.2 Block diagram

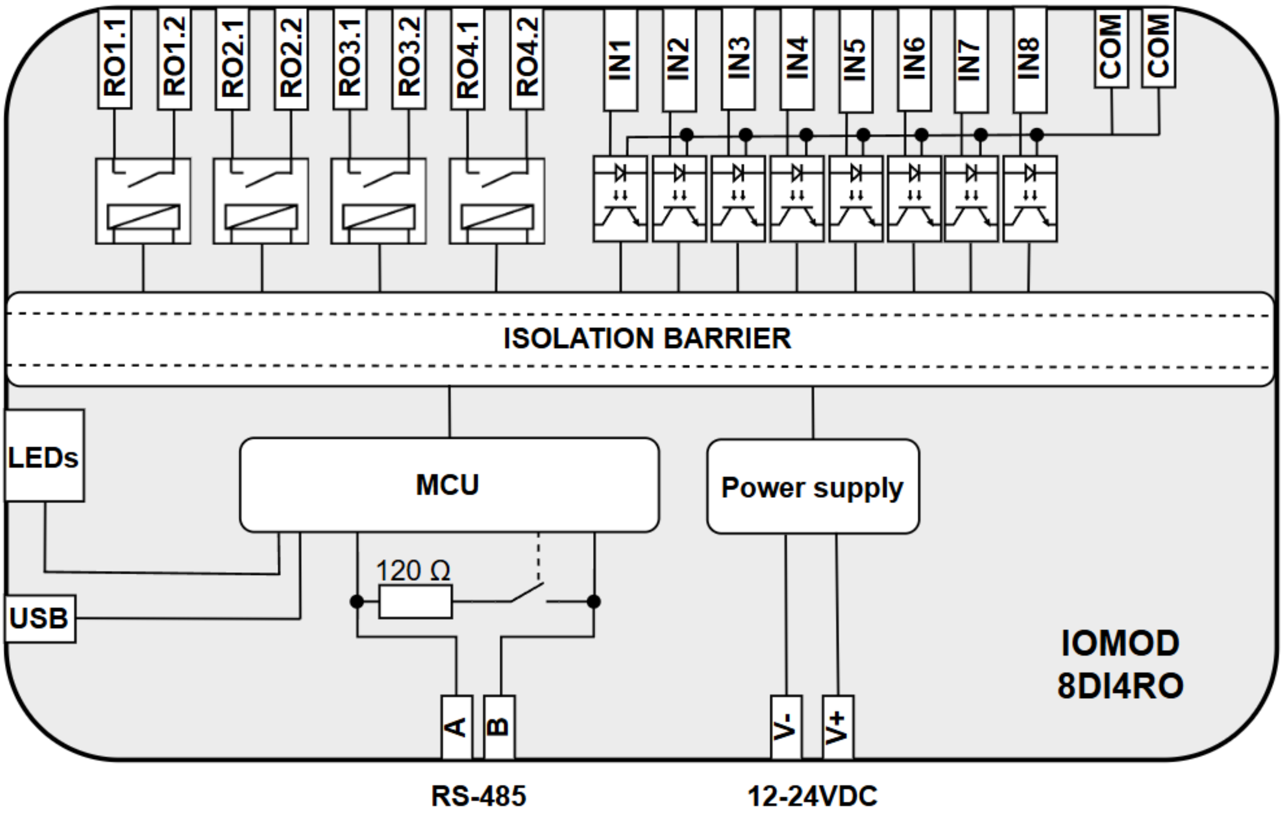


Fig. 1.2.1. IOMOD 8DI4RO internal structure and block diagram

2. Hardware data

2.1 Mechanical drawings

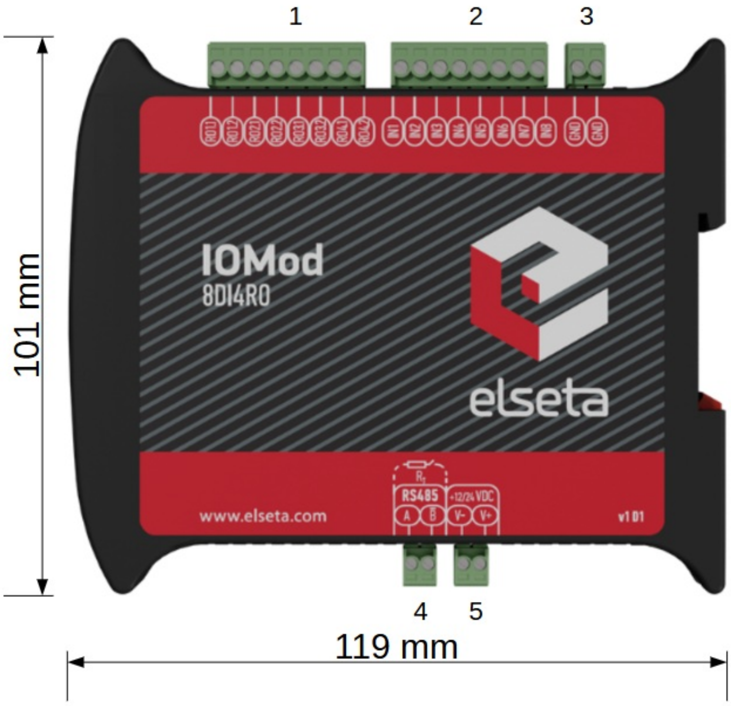


Fig. 2.1.1. IOMod 8DI4RO side view with dimensions and terminals description. 1 - four relay outputs; 2 - eight digital inputs; 3 - ground input; 4 - RS485 interface; 5 - power supply input

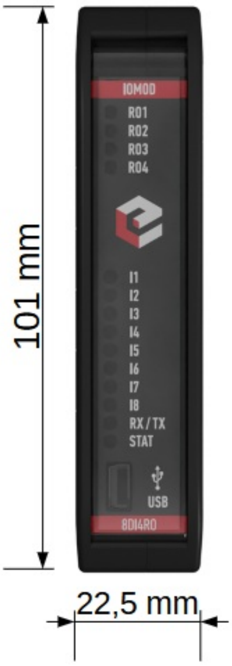


Fig. 2.1.2. IOMod 8DI4RO front view

2.2 Terminal connections

IOMod 8DI4RO has 22 terminals, which are depicted below:

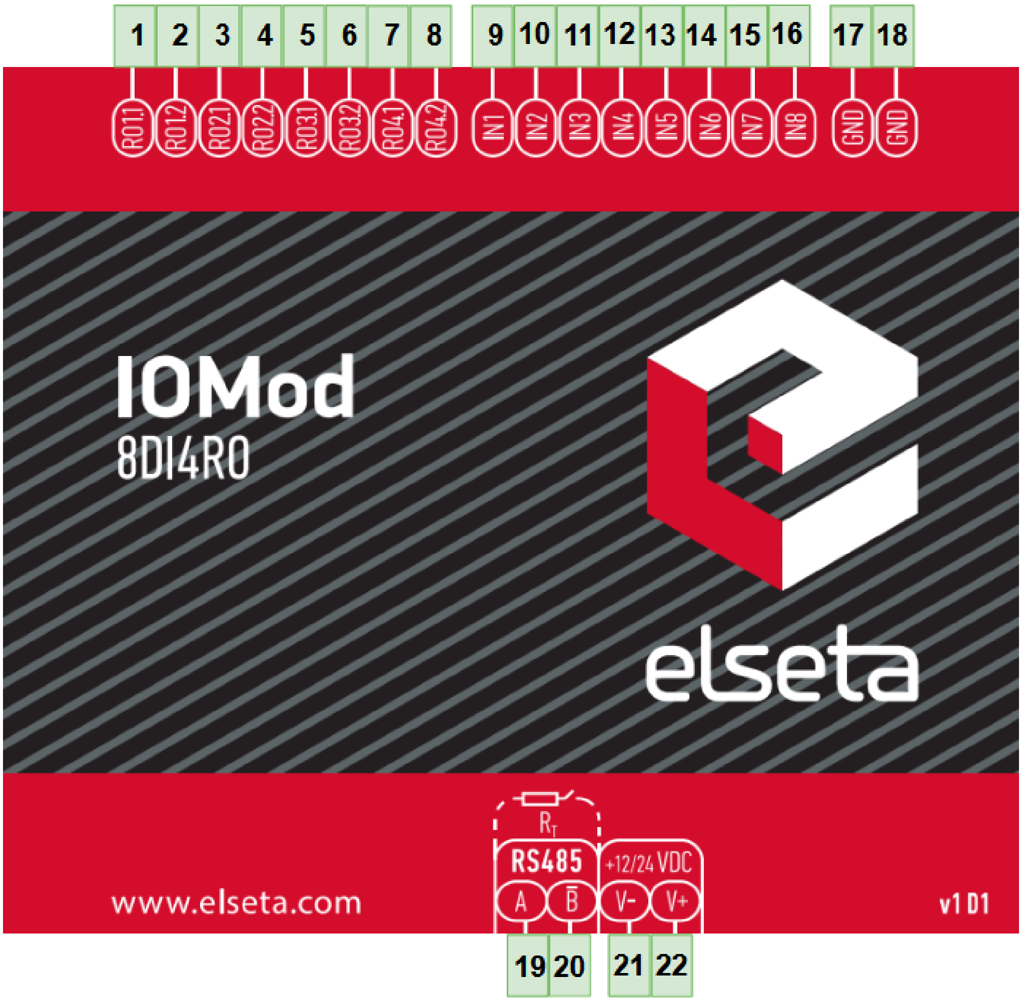


Fig. 2.2.1. IOMod 8DI4RO terminal diagram

The description of each terminal can be found in the table below:

Table 2.2.1. Terminal Specifications

Terminal number	Terminal name	Description
1	RO1.1	Relay 1 contacts (NO)
2	RO1.2	
3	RO2.1	Relay 2 contacts (NO)
4	RO2.2	
5	RO3.1	Realy 3 contacts (NO)
6	RO3.2	
7	RO4.1	Realy 4 contacts (NO)
8	RO4.2	
9	IN1	
10	IN2	

11	IN3	Digital inputs
12	IN4	
13	IN5	
14	IN6	
15	IN7	
16	IN8	
17	COM	Digital input common
18	COM	
19	A	RS485 input
20	B̄	
21	V-	Power source input
22	V+	

2.3 Status indication

IOMod 8DI4RO has fourteen LEDs (Fig 2.3.1), which indicate the statuses of the 8 digital inputs, 4 relay outputs, communication, and power.

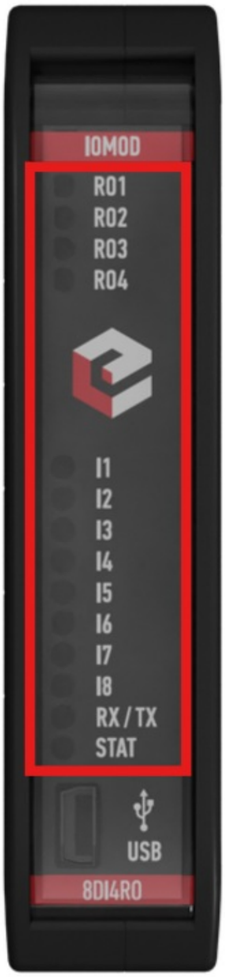


Fig. 2.3.1. IOMod 8DI4RO LEDs physical location

Table 2.3.1. Description of LEDs.

Name	LED color	Description
RO1-RO4	□ (orange)	Indicates digital relay output activation
IN1-IN8	□ (orange)	Indicates digital input activation
RX/TX	□ (green)	A blinking green light indicates active communication via the RS485 interface.
STAT	□ (green)	The power source is connected to the power supply input.
	□ (blue)	IOMod 8DI4RO is connected to an external device via a USB mini cable.

3. Technical information

Table 4.1. Technical specifications.

System		
Dimension	101 x 119 x 22.5 mm	
Case	IP20, blend PC/ABS self-extinguishing, black	
Working environment	Indoors	
Operating temperature	From -40°C to +85°C	
Recommended operating conditions	5-95% RH (non-condensing)	
Configuration	USB, RS485	
Firmware upgrade	USB, RS485	
Electrical specifications		
Inputs	Nominal input voltage range	12-48VDC
	Isolation	8 X 3kV$_{(rms)}$
	Maximum input voltage	60VDC
Outputs	Isolation	4 X 3kV$_{(rms)}$
	Rated resistive load	5 A (at 250 VAC or 30 VDC)
	Rated inductive (L/R=7ms) load	2 A (at 250 VAC or 30 VDC)
	Maximum switching voltage	277 VAC 125 VDC
	Maximum switching current	5 A
Power		
Power Supply	12-24 VDC / 9-33 VDC (full range)	
Current consumption	70 mA	

4. Mounting and installation

4.1 Connection Diagrams

In this chapter, the various options for connecting the device are discussed.

4.2 Digital inputs

The typical application of IOMod 8DI4RO inputs is shown in Fig. 4.2.1. When the default input configuration is applied, the user will see inputs connected to +12-24V as “high” or state “1” and the input status LED will glow.

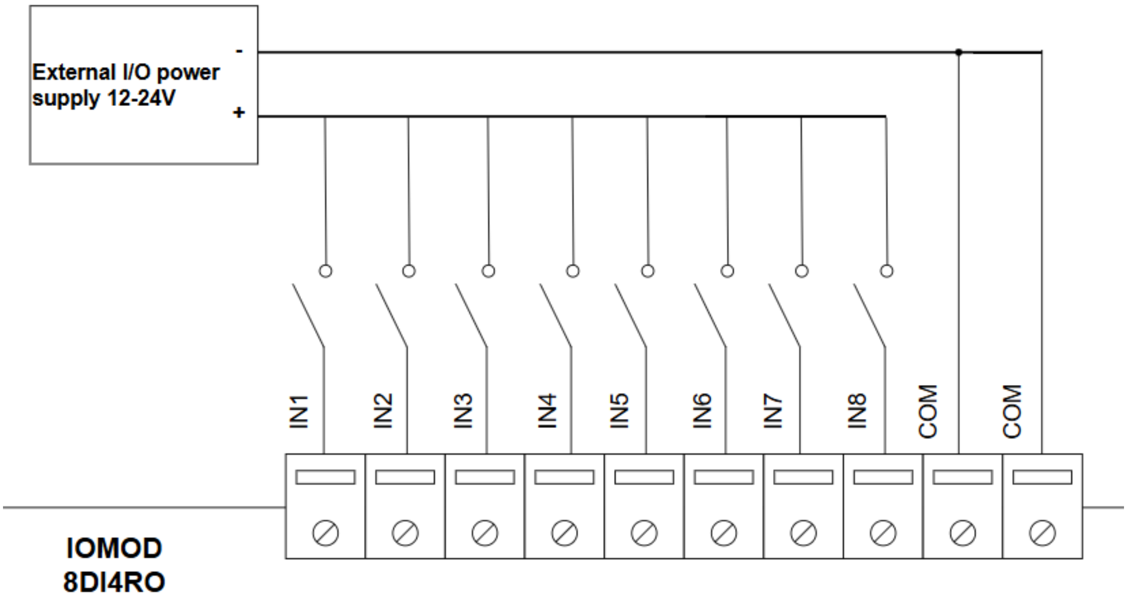


Fig. 4.2.1. IOMod 8DI4RO digital inputs

Users also can configure to enable software input inversion. With this configuration, the user will see inputs connected to 0V (see Fig. 3.) as “high” or state “1”, input status LED will NOT glow.

4.3 Digital relay outputs

IOMod 8DI4RO has 4 relay outputs. Internal clamp diodes are connected to each output, making IOMOD 8DI4RO ideal for driving inductive loads like relays. Maximum 5A per output is allowed. For higher loads outputs can be connected in parallel. Make sure your power supply can provide enough power. The typical application of outputs is shown in Fig. 4.3.1

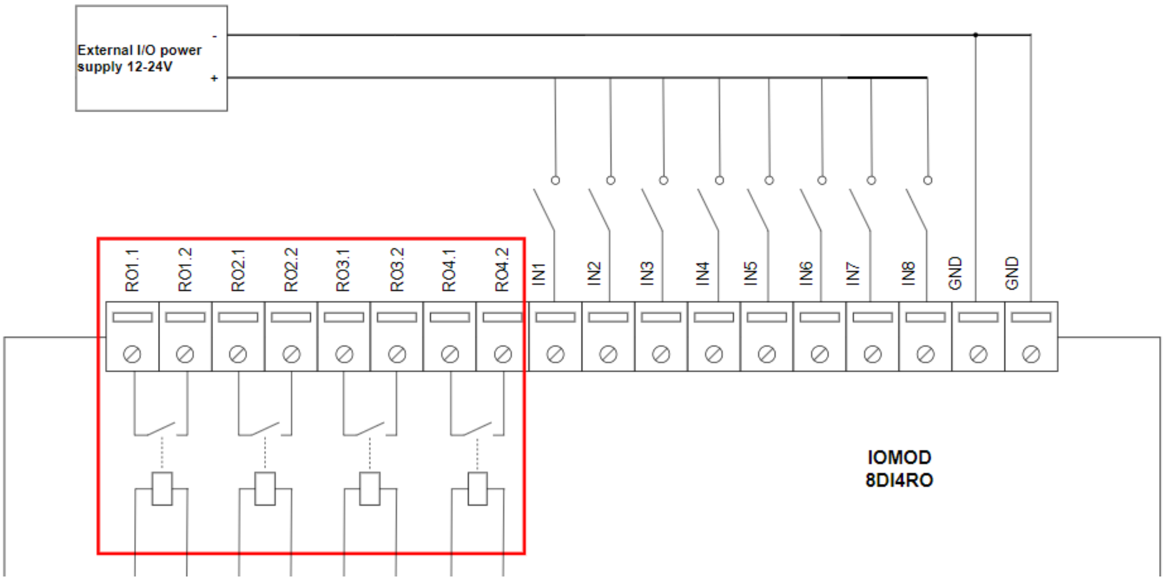
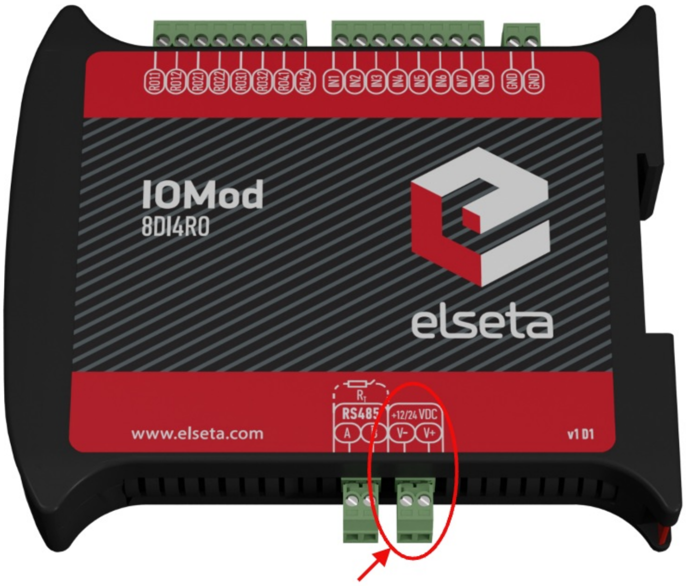


Fig. 4.3.1. IOMod 8DI4RO digital relay outputs

4.4 Power supply

IOMod 8DI4RO needs to be powered by a 9–33 V power source. IOMod 8DI4RO power supply inputs are located next to RS485 interface inputs (Fig 4.4.1).

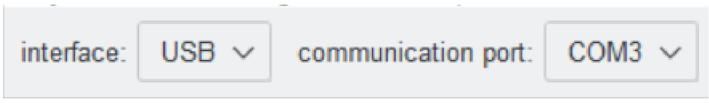


Power supply inputs

Fig. 4.4.1. Power supply inputs physical location

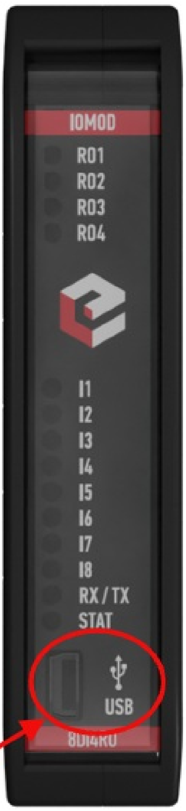
4.5 USB connection

The IOMod 8DI4RO device features a USB-mini connection port, which primarily facilitates a physical connection between the IOMod and a PC. By selecting the USB interface and the appropriate communication port in the IOMod Utility (Fig. 4.6.1), users can establish a connection to control the device's parameters. Additionally, this connection can serve as a power source for the module.



interface: USB communication port: COM3

Fig. 4.6.1. IOMod Utility interface and communication port parameters



USB-mini connection port

Fig. 4.6.2. IOMod 8DI4RO USB connection port physical location

5. Parametrization

In this section, the IOMod 8DI4RO settings configuration is described. IOMod 8DI4RO configuration is performed via IOMod Utility (the manual can be accessed here). All IOMod-related settings can be found in the "Iomod settings" tab (Fig. 5.1).

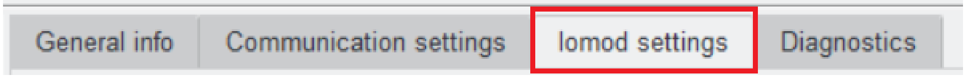
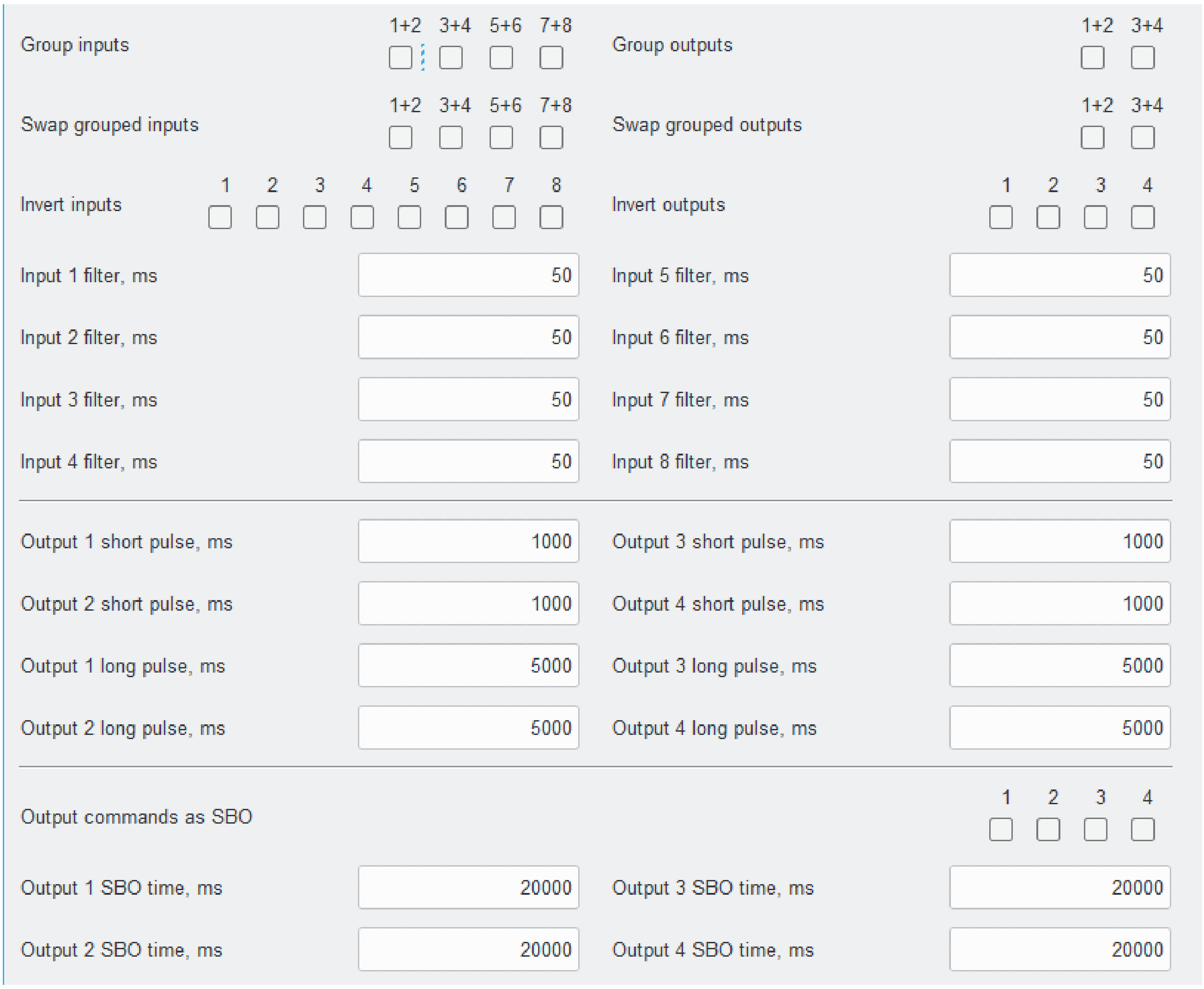


Fig. 5.1. IOMod settings tab

5.1 Iomod Settings

To configure IOMod 8DI4RO general settings open the "Iomod settings" tab in IOMod Utility (Fig. 5.1.1).



Group inputs	1+2 ☐ 3+4 ☐ 5+6 ☐ 7+8 ☐	Group outputs	1+2 ☐ 3+4 ☐
Swap grouped inputs	1+2 ☐ 3+4 ☐ 5+6 ☐ 7+8 ☐	Swap grouped outputs	1+2 ☐ 3+4 ☐
Invert inputs	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐	Invert outputs	1 ☐ 2 ☐ 3 ☐ 4 ☐
Input 1 filter, ms	50	Input 5 filter, ms	50
Input 2 filter, ms	50	Input 6 filter, ms	50
Input 3 filter, ms	50	Input 7 filter, ms	50
Input 4 filter, ms	50	Input 8 filter, ms	50
Output 1 short pulse, ms	1000	Output 3 short pulse, ms	1000
Output 2 short pulse, ms	1000	Output 4 short pulse, ms	1000
Output 1 long pulse, ms	5000	Output 3 long pulse, ms	5000
Output 2 long pulse, ms	5000	Output 4 long pulse, ms	5000
Output commands as SBO			1 ☐ 2 ☐ 3 ☐ 4 ☐
Output 1 SBO time, ms	20000	Output 3 SBO time, ms	20000
Output 2 SBO time, ms	20000	Output 4 SBO time, ms	20000

Fig. 5.1.1 IOMod Utility with IOMod 8DI4RO Iomod settings window opened

IOMod Utility is a tool created to configure IOMods with firmware version 2. This tool allows users to connect, configure, and diagnose IOMods such as 8DI8DO, 8DI4RO, 16DI, 8AI, 4RTD, 4CS4VS, METER, and FPI. The Utility's interface allows users to connect to IOMod via USB port, RS485, and ser2net. More information about this tool and its installation can be found on the documentation page IOMod Utility.

To configure IOMod 8DI4RO using IOMod Utility, first connect to a device or create a template as explained in the IOMod Utility documentation. Parameters for IOMod 8DI4RO can be configured on the *Iomod settings* tab. IOMod with default settings is configured as an Modbus slave device. Default IOMod parameters can be seen in the picture above.

Sometimes, two inputs or outputs need to be combined into double point input (DPI) or double command output (DCO). Inputs and outputs can be grouped in pairs of two, where only adjacent pins can be paired, and the first pin in the pair must have an odd number. Once grouped, the second pin in the pair is no longer used, and any requests for it will result in an error. For example, RO1.1-2 and RO2.1-2 can be grouped, but after grouping, RO2.1-2 is disabled. RO2.1-2 and RO3.1-2 cannot be grouped, but RO3.1-2 and RO4.1-2 can be grouped, disabling RO4.1-2.

If desired, input/output groups can be swapped. *Grouped Input/Output Swapping* allows you to exchange the positions of the grouped pins. After swapping, the even-numbered pin can become the first pin in the pair, and the odd-numbered pin follows. For instance, if RO1.1-2 and RO2.1-2 are grouped, you can swap their positions so that RO2.1-2 becomes the first in the pair. Parameters *Group inputs/Group outputs* and *Swap grouped inputs/Swap grouped outputs* are only available for protocols IEC101 and IEC103.

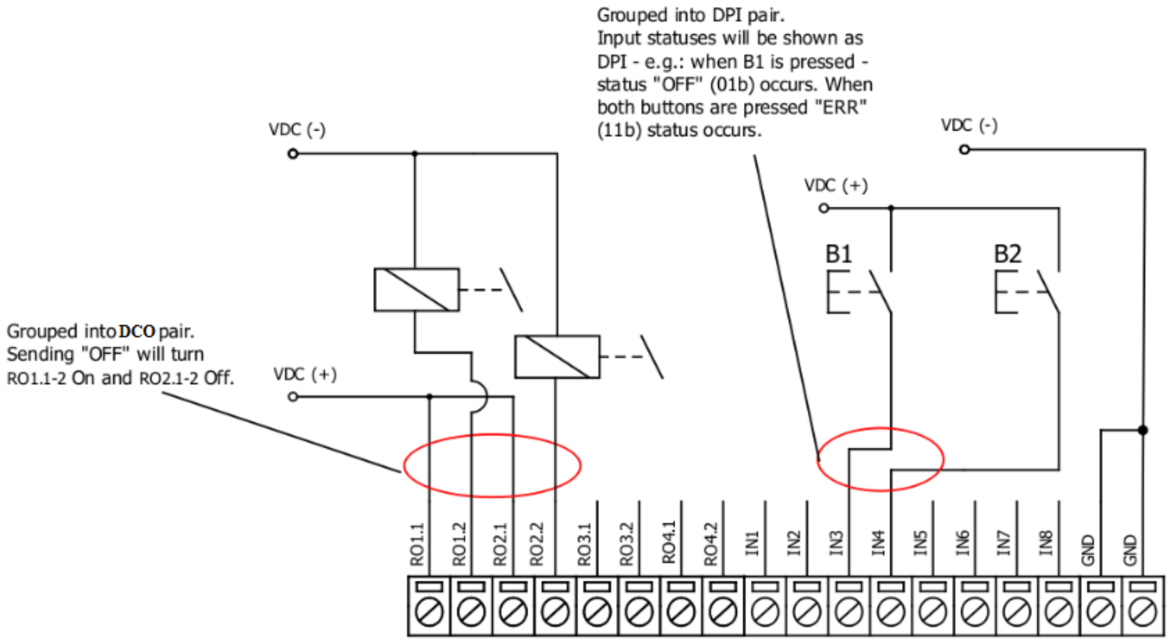

Grouped into DPI pair.
Input statuses will be shown as DPI - e.g.: when B1 is pressed - status "OFF" (01b) occurs. When both buttons are pressed "ERR" (11b) status occurs.
VDC (-)
VDC (-)
VDC (+)
B1
B2
Grouped into DCO pair.
Sending "OFF" will turn RO1.1-2 On and RO2.1-2 Off.
VDC (+)
RO1.1
RO1.2
RO2.1
RO2.2
RO3.1
RO3.2
RO4.1
RO4.2
IN1
IN2
IN3
IN4
IN5
IN6
IN7
IN8
GND
GND

Fig. 5.1.2. Input/Output grouping example

Input/Output grouping and swapping is only available with IEC 60870-5-101 and IEC 60870-5-103 protocols.

Invert inputs and *Invert outputs* parameters revert the state of the input/output. If the user wants the output status to display as 'ON' when the output signal is in a low state, the outputs can be logically inverted. Unlike 8DI8DO, IOMOD 8DI4RO does not have pull-up resistors. If the user desires to turn the input status on, when that input signal is low, the user then inverts inputs logically. All input indication LEDs stay the same (are not inverted).

Input filters define the time after which the input state is considered changed. The input filter is a simple glitch filter with time input. This filter time corresponds to the stable time that input must achieve before sending a status change. For example, if the input state is OFF and the input filter value is 50 ms, the state changes to ON and stays ON for more than 50 ms, then it will be represented as ON, but if the input state was ON for less than 50 ms it will not change and will stay as OFF. This parameter helps to filter values causing less unneeded data.

Users can configure outputs to be pulse controlled – it means that output will be turned on for the configured amount of time. When this time runs out, output is turned off. This is useful when pulse toggle relays are used. The output pulse is independent of the output grouping option and can be used on both grouped and ungrouped outputs. When output is grouped, the device will allow only one command completion at a time – when output is already turned ON, other “turn ON” requests will be responded to with NACK. If the user desires latching outputs to be used, the output pulse time is set to 0.

The IEC 60870-5-101 protocol has settings for long and short pulse commands. Unlike the Modbus RTU protocol, the IEC 60870-5-101 protocol offers options for short and long pulses. A short pulse is typically sent with qualifier 1 (QU/QL = 1), while a long pulse is usually sent with qualifier 2 (QU/QL = 2). The IEC 60870-5-103 and Modbus protocols only have pulse parameters without the ability to configure short or long pulses. The default pulse time for Modbus and IEC103 is the same as the short pulse in IEC 60870-5-101 (1000 ms).

Select Before Operate (SBO) ensures that an output action (such as turning a relay on or off) is carried out only after the output has been explicitly selected. This helps prevent accidental or unauthorized operations, ensuring that the operator's intent is confirmed before acting. For example, the user wants to turn on RO1. First, they issue a select command to RO1. After the selection is acknowledged, the user sends an operation command to turn on RO1. If the command is successful, the IOMod changes the state of the relay, and the output is turned on. If there’s an issue, a **negative acknowledgement (NACK)** will be sent, and no change will occur. There is also an output SBO time option that ensures that a relay operation is not immediately executed but is instead delayed to allow for confirmation or review before the operation is carried out.

The Iomod settings' available values and ranges can be seen in the table below (Table 5.1.1).

Table 5.1.1 IOMOD 8DI4RO parameter ranges and default values

Parameter	Range	Default value
Input [ ] filter, ms	1–65535	50

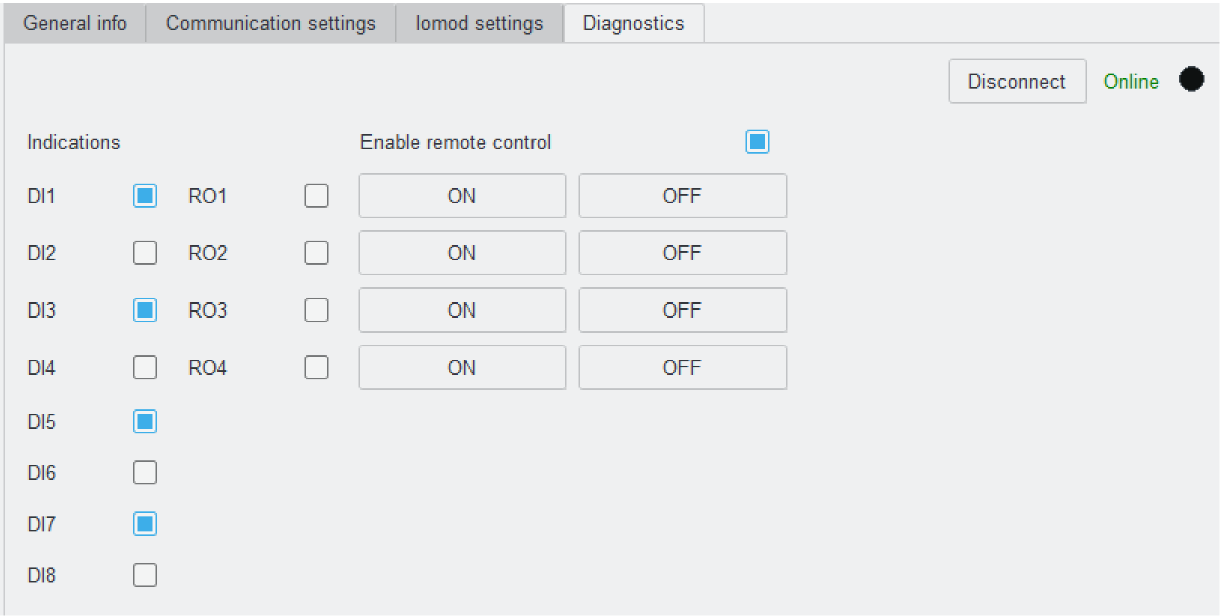
Output [ ] short pulse, ms*	1–65535	1000
Output [ ] long pulse, ms*	1–65535	5000
Output [ ] SBO time, ms*	1–65535	20000

** The parameters are defined only for the IEC 60870-5-101 communication protocol.*

5.2 Diagnostics

The Utility diagnostics windows allow users to connect to IOMod directly and observe the values in real-time. The 8DI4RO diagnostics window shows input and output states and also allows activation of the outputs. If an input or output is on, the Diagnostics window indicates it with a blue square next to it (unless the input/output is grouped, swapped or inverted, then they would behave in a configured way).

To turn on real-time monitoring of both Diagnostics sections, the "Connect" button to the left of the "Offline" word designation needs to be pressed. After pressing the "Connect" button the word designation of Diagnostics mode changes to "Online", the black circle starts blinking and the button name changes to "Disconnect" (Fig. 5.2.1). When a fault is detected the checkboxes are going to be checked.



Enable remote control ☑

DI1 ☑ RO1 ☐
DI2 ☐ RO2 ☐
DI3 ☑ RO3 ☐
DI4 ☐ RO4 ☐
DI5 ☑
DI6 ☐
DI7 ☑
DI8 ☐

Fig. 5.2.1. IOMOD utility Diagnostics tab in online mode

6. Communication protocols

IOMod 8DI4RO uses Modbus (RTU), IEC 60870-103 or IEC 60870-101 protocols over Ser2Net or RS485 connection, which can be used for cable lengths up to 1500 meters and connect up to 30 devices on one line. Default Modbus, IEC 60870-103 and IEC 60870-101 settings are: 19200 bauds/s baudrate, 8E1, Slave (Link) address - 1.

6.1 Modbus RTU Operational information

Modbus RTU is a serial communication protocol widely used in industrial automation for reliable data exchange between a master device and slave devices, such as I/O modules, sensors, and controllers. It operates over RS-485 or RS-232 interfaces, using a simple request-response model to read and write data.

To read the status of relay outputs (On or Off), Modbus function 01 is used. The IOMod 8DI4RO has 4 relay outputs, with addresses ranging from 0 to 3.

Modbus function 02 reads the status of digital inputs (On or Off). The IOMod 8DI4RO has 8 digital inputs, with addresses ranging from 0 to 7. These inputs are active-high by default.

Function 03 allows the user to read counter/timer values related to digital inputs. There are 40 Modbus registers. The values in these registers are described in the table below. Two types of values are stored: Pulse Counter and On Timer. The On Timer calculates the duration for which a respective input remains in its active state.

Function 04 allows the user to read counter/timer values related to digital inputs. There are 80 Modbus registers. The values in these registers are described in the table below. Two types of values are stored: Pulse Counter and On Timer, with the On Timer calculating the time (in seconds) for which a respective input remained in its active state. This function is deprecated and is maintained for backward compatibility with earlier versions of IOMod 16DI.

To set the state of a single relay output (On or Off), Modbus function 05 is used. The output addresses range from 0 to 3 (the first output is address 0, last output is address 3).

Function 06 sets the value of a single register. The register addresses are identical to those used in the "Read Input Registers" function.

Modbus function 15 sets the state of multiple relay outputs (On or Off) simultaneously. The output addresses range from 0 to 3 (the first output is address 0, last output is address 3).

Table 6.1.1 Modbus protocol register table

Address (Dec)	**Description**	**Comment**
Coils:		
8	input 1 value	
9	input 2 value	
10	input 3 value	
11	input 4 value	
12	input 5 value	
13	input 6 value	
14	input 7 value	
15	input 8 value	
0	output 1 value	accepts command with 5 or 15 function
1	output 2 value	
2	output 3 value	
3	output 4 value	
Registers:		
0	input 1 pulse count	accepts command with 6 or 16 function to change value
1-2	input 1 on time	
3	input 2 pulse count	
4-5	input 2 on time	
6	input 3 pulse count	
7-8	input 3 on time	
9	input 4 pulse count	
10-11	input 4 on time	
12	input 5 pulse count	
13-14	input 5 on time	
15	input 6 pulse count	
16-17	input 6 on time	

18	input 7 pulse count	
19-20	input 7 on time	
21	input 8 pulse count	
22-23	input 8 on time	

6.2 IEC 60870-5-101 Operational Information

IEC 60870-5-101 (IEC101) is a communication protocol designed for telecontrol applications in power systems, enabling communication between a master station and slave devices (e.g., Remote Terminal Units or RTUs).

The IOMod 8DI4RO uses the IEC101 protocol to transmit digital input (DI) status and control relay outputs (RO) in a standardized format. Each signal is assigned an Information Object Address (IOA) and a Type Identifier (TI). The protocol efficiently conveys binary status changes (e.g., on/off state of equipment or alarms) and control commands with associated timestamps, enabling reliable communication in automation systems.

Table 6.2.1 IEC 60870-5-101 protocol register table

IOA	Description	TI
9	input 1 SPI event	30
10	input 2 SPI event	30
11	input 3 SPI event	30
12	input 4 SPI event	30
13	input 5 SPI event	30
14	input 6 SPI event	30
15	input 7 SPI event	30
16	input 8 SPI event	30
1	output 1 SPI event	30
2	output 2 SPI event	30
3	output 3 SPI event	30
4	output 4 SPI event	30
101	output 1 SPI command	45
102	output 2 SPI command	45
103	output 3 SPI command	45
104	output 4 SPI command	45
9	input 1-2 DPI event	31
11	input 3-4 DPI event	31
13	input 5-6 DPI event	31

15	input 7-8 DPI event	31
1	output 1-2 DPI event	31
3	output 3-4 DPI event	31
101	output 1-2 DPI command	46
103	output 3-4 DPI command	46

** SPI - single-point information, DPI - double-point information*

To read single-point inputs/outputs, TI 30 is used, which provides single-point information with time tag. If double-point inputs/outputs need to be read, TI 31 is used, which provides information with time tag.

TI 45 is used to send a command to a single-point output, whereas TI 46 is used to send a command to a double-point output. The outputs are controlled by the master (controlling station)

IOmod communicates using the standard IEC-60870-5-101 protocol. The master (controlling station) initiates all actions, while the IOmod device (controlled station) only responds to these requests.

1. **Initiation**:
   The master sends the first message to request the link status (function code = 9). If the link is available, IOmod replies with the link status (function code = 11); otherwise, it does not respond.
2. **Resetting the Link**:
   After receiving the link status, the master sends a "Reset Remote Link" command (function code = 0) to restart communication. IOmod will respond with either:
   - **ACK (Acknowledgment)**: Function code = 0 (indicating success).
   - **NACK (Negative Acknowledgment)**: Function code = 1 (indicating failure).

If IOmod responds with ACK, initialization is complete, and the master can proceed with other IEC 60870-5-101 protocol messages.

Once initialization is complete, the master can request data from the IOMod device using a**general interrogation** command. This command retrieves the current status of all inputs and outputs.

By specifying the corresponding IOA, the master can turn outputs ON or OFF. If an invalid command is sent (e.g., incorrect IOA or TI), the device responds with a **negative acknowledgement (NACK)**.

Time synchronization is critical for logging events. To synchronize time, the master sends a Time Sync command C_CS_NA_1 (103) with Cause of Transmission (COT) 6. According to the IEC 60870-5-101 protocol specification, time synchronization can be performed for multiple devices using broadcast messages. To broadcast a time synchronization message, the link address must be set to 255.

If the frame is valid, the IOMod responds with command C_CS_NA_1 (103) with COT: 0x07 (positive confirmation). The response includes the device’s timestamp.

If the sync is disabled or the CASDU is incorrect, the response will be COT: 0x47 (negative confirmation) with p/n bit: 1

To start the General Interrogation (GI), the master sends the C_IC_NA_1 (100) command withe th Cause of Transmission (COT) set to 6. The command must be sent to the correct link address and CASDU (default is the link address).

- **If the command is valid**:
  The IOMod responds with the same C_IC_NA_1 (100) command, COT = 0x07 (positive confirmation), andp/n bit = 0. The device then begins to send all its data.
- **If the command is invalid**:
  The IOMod responds with the same command, but p/n bit = 1 (negative confirmation) andCOT = 0x47.
- **End of GI**:
  If the GI is successful, the IOMod will send another C_IC_NA_1 (100) command with COT = 0x10 (ActTerm), indicating that the interrogation is complete.

The master (controlling station) sends commands following the IEC 60870-5-103 protocol to enable or disable relay outputs. The function type of the output commands has to be 46 (Table 6.2.1). DPI signals consist of two bits of information, allowing for four possible states:

Table 6.2.2 Double-point states

Value	State
00	intermediate
01	off

10	on
11	error

6.3 IEC 60870-5-103 Operational Information

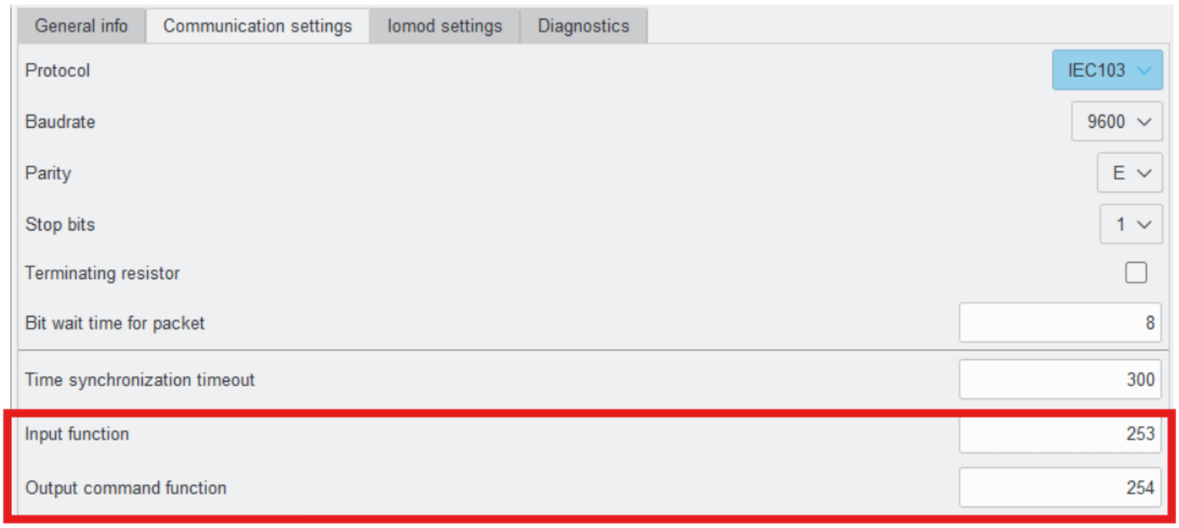
IEC 60870-5-103 is a communication protocol specifically designed for telecontrol and automation systems in the electrical power industry, particularly for substation automation. IEC 60870-5-103 is more specialized for applications related to protection, control, and monitoring in electrical substations.

Table 6.3.1 IEC 60870-5-103 protocol register table

IOA	Description	Function
1	input 1 SPI event	253
2	input 2 SPI event	253
3	input 3 SPI event	253
4	input 4 SPI event	253
5	input 5 SPI event	253
6	input 6 SPI event	253
7	input 7 SPI event	253
8	input 8 SPI event	253
1	output 1 SPI event	254
2	output 2 SPI event	254
3	output 3 SPI event	254
4	output 4 SPI event	254
1	output 1 SPI command	254
2	output 2 SPI command	254
3	output 3 SPI command	254
4	output 4 SPI command	254
1	input 1-2 DPI event	253
3	input 3-4 DPI event	253
5	input 5-6 DPI event	253
7	input 7-8 DPI event	253
1	output 1-2 DPI event	254
3	output 3-4 DPI event	254
1	output 1-2 DPI command	254
3	output 3-4 DPI command	254

** SPI - single-point information, DPI - double-point information*

Function 253 is responsible for input event detection. IOMod continuously monitors its input channels to detect changes. Function 254 is responsible for output event detection and command sending. These two functions are default in IOMod utility app (Fig. 6.3.1) but can be modified according to needs.



Protocol: IEC103
Baudrate: 9600
Parity: E
Stop bits: 1
Terminating resistor: □
Bit wait time for packet: 8
Time synchronization timeout: 300
Input function: 253
Output command function: 254

Fig. 6.3.1. IOMod utility input/output fonctions location

IOMod communicates using the standard IEC 60870-5-103 protocol. The master (controlling station) initiates all actions, while the IOMod device (controlled station) only responds to these requests.

1. **Reset Command:**
   - The master sends a "Reset CU" or "Link Reset FCB" command (function code = 7).
   - IOMod responds with an acknowledgement (ACK, function code = 0).
2. **Requesting Link Status:**
   - The master sends a "Request Status of Link" command (function code = 9).
   - IOMod replies with the link status (function code = 11).
3. **Resetting the Remote Link:**
   - The master sends a "Reset Remote Link" command (function code = 0).
   - IOMod responds with an acknowledgement (ACK, function code = 0).

Once the initialization process is complete, the master can send other IEC 60870-5-103 protocol messages. Any messages sent before completing the initialization process will be ignored by IOMod.

When initialization is complete, the master may poll the IOMOD device with both Class 1 and Class 2 requests. Class 2 is used when master polls for cyclic data. The controlled device answers with a message containing an Access Demand flag when spontaneous data exists and the master then sends a request for Class 1. IOMod would then respond with a time-tagged message.

On the first Class 1 request IOmod device always asks for the Access Demand to send an identification string. However, if there are spontaneous messages to be sent, they will be sent before the identification string.

The master (controlling station) sends commands following the IEC 60870-5-103 protocol to enable or disable relay outputs. The function type of the output commands has to be 254 (Table 6.2.1). DPI signals consist of two bits of information, allowing for four possible states:

Table 6.3.2 Double-point states

Value	State
00	intermediate
01	off
10	on
11	error

The successful command is accepted with a positive acknowledgement.

When an input status changes, the IOMod filters out glitches using a user-configurable filter time. Once the filter is passed, the device sends a **"Spontaneous"** message with the Information Number field indicating the input pin address and a default **Function Type** of 253. These messages include a 4-byte timestamp without date information, so the controlling station must handle signals properly, especially at the start of a new day.

Time synchronization is critical for logging events. To synchronize time, the master sends a Time Sync command C_CS_NA_1 (103) with Cause of Transmission (COT) 6. According to the IEC 60870-5-103 protocol specification, time synchronization can be performed for multiple devices using broadcast messages. To broadcast a time synchronization message, the link address must be set to 255.

General Interrogation (GI) starts when the master sends a variable frame with:

- **Function Code**: 3
- **Type Identification**: 7
- **Information Number**: 0
- **Cause of Transmission**: 9

The slave device acknowledges (ACK) the request. The master then retrieves IOMod data through Class 2 polling requests. IOMod responds with time-tagged messages containing DPI states of outputs (sent first) and inputs. PINs are represented by the Info Number fields in the packets. Finally, the slave sends an End of GI message:

- **Cause of Transmission:** 10
- **Type Identification:** 8