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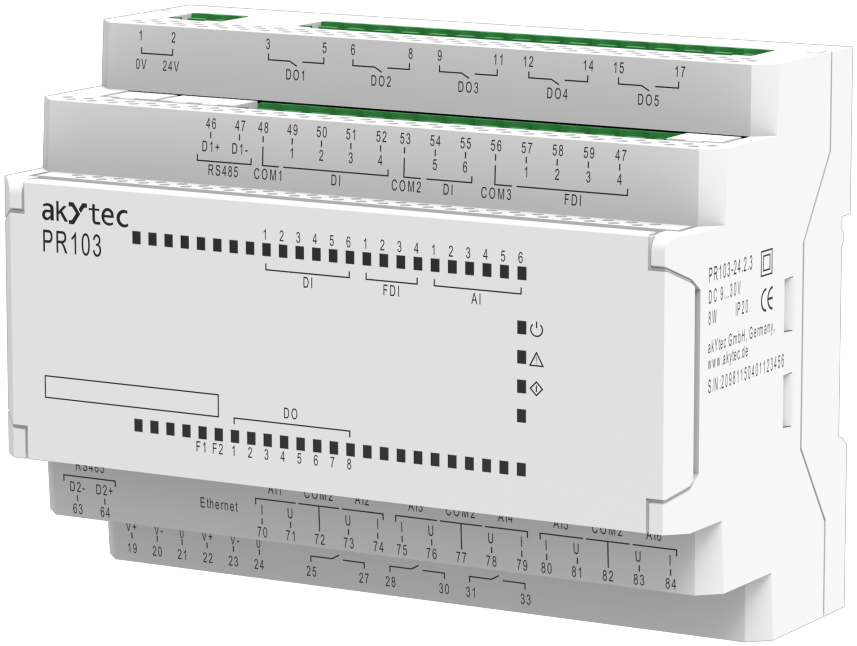

PR103.24.2.3

Programmable relay

User guide

PR103.24.2.3_3-EN-90340-1.5

Contents

1 Introduction

This manual describes the functions, configuration, operating instructions, programming and troubleshooting of the multifunctional programmable relay PR103 (hereinafter referred to as PR103, device, or relay).

1.1 Terms and abbreviations

- **ALP** – programming software akYtec ALP for programming PR series relays, based on Function Block Diagram programming language (FBD)
- **acYtecToolPro** – akYtec device configuration software
- **ADC** – analog-digital converter
- **DAC** – digital-analog converter
- **DNS (Domain Name System)** – decentralized naming system for computers, services, or other resources connected to the Internet or a private network. It translates domain names to the numerical IP addresses.
- **Modbus** – application layer messaging protocol for client/server communication between devices connected on different types of buses or networks, originally published by Modicon (now Schneider Electric), currently supported by an independent organization Modbus-IDA (***www.modbus.org***)
- **Modbus TCP** – Modbus protocol, adapted to transfer information over TCP
- **NTC** – negative temperature coefficient sensor
- **Project** – user application created in ALP software that also includes the device configuration
- **PTC** – positive temperature coefficient sensors
- **PWM** – pulse-width modulation
- **RAM** – random access memory, volatile part of the device memory
- **Retain memory** – non-volatile device memory for retain variables
- **Retain variable** – type of variable that keeps its value after device restart (power off/on cycle)
- **ROM** – read-only memory, non-volatile part of the device memory
- **RTC** – real time clock
- **RTD** – resistance temperature detectors
- **UTC (Coordinated Universal Time)** – world-wide primary time standard

1.2 Symbols and key words

WARNING
WARNING indicates a potentially dangerous situation that could result in death or serious injuries.

CAUTION
CAUTION indicates a potentially dangerous situation that could result in minor injuries.

NOTICE
NOTICE indicates a potentially dangerous situation that could result in damage to property.

NOTE
NOTE indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

1.3 Intended use

Programmable relays of PR100 series have been designed and built solely for the intended use described in this manual, and may only be used accordingly. The technical specifications contained in this manual must be observed. Only by akYtec GmbH recommended extension modules may be connected to the relay.

The relay may be operated only in properly installed condition.

Improper use

Any other use is considered improper. Especially to note:

– This device should not be used for medical devices which receive, control or otherwise affect human life or physical health.
– The device should not be used in an explosive environment.
– The device should not be used in an atmosphere with chemically active substance.

1.4 Safety requirements

WARNING

All electrical connections must be performed only by a qualified electrician.

The device terminals may be under a dangerous voltage. Cut off all power lines before working on the device.

Switch on the power supply only after completing all work on the device.

WARNING

Ensure the mains voltage matches the voltage marked on the nameplate.

Ensure the device is provided with its own power supply line and electric fuse.

Do not feed any external devices from the power contacts of the device.

NOTICE

Supply voltage may not exceed 30 V. Higher voltage can damage the device.

If the supply voltage is lower than 9 V DC, the device cannot operate properly but will not be damaged.

NOTICE

If the device is brought from a cold environment to a worm room, condensation may form inside the device. To avoid damage to the device, keep the device indoors for at least 1 hour before powering on.

2 Overview

The programmable relay PR103 is a small controller, developed for automated control systems in industry, agriculture, building technology and household applications.
User program is created as a function plan with the ALP programming software.

2.1 Basic features

- 10 passive digital inputs (including 4 fast digital inputs up to 100 kHz)
- 6 analog inputs (can be used as digital)
- 8 relay outputs
- 2 analog outputs (4-20 mA, 0-10 V)
- 2 programmable LEDs F1, F2
- Slave in Modbus network over RS485 interface (Master is in development)
- Slave in Modbus network over Ethernet interface (Master is in development)
- real-time clock
- data logging and archiving
- possibility to connect up to 2 PRM series extension modules
- configuration and programming with ALP software (free)
- configuration with akYtecToolPro software (free)
- DIN rail or wall mounting
- 3-level stepped form for installation in switchboards
- quick and easy replacement with plug-in terminal blocks

2.2 Design

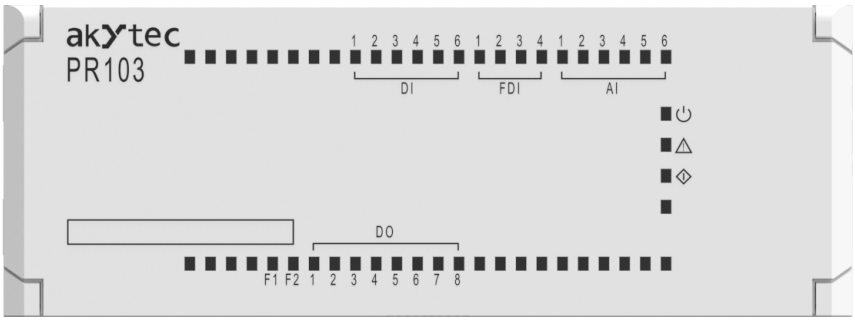

Fig. 2.1 Front cover

The LED indicators on the front cover are described in Tab. 2.1

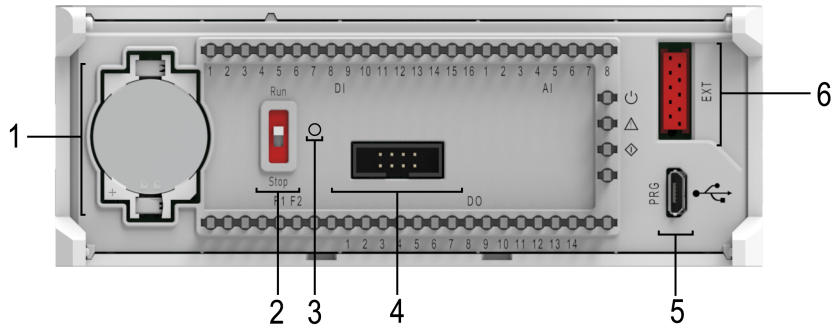

Fig. 2.2 Open front cover

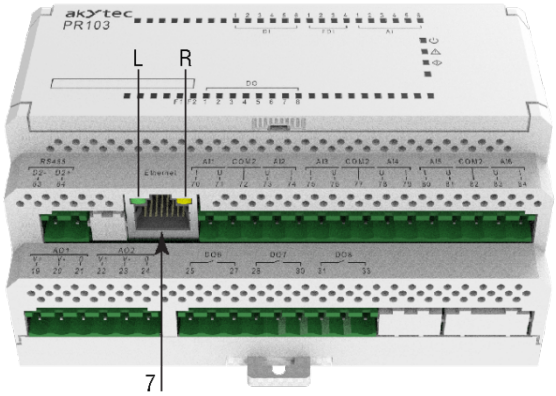

Fig. 2.3 Ethernet interface

Controls and interfaces:

1. RTC battery
2. RUN/STOP switch
3. Service button
4. Service connector
5. microUSB programming connector
6. Extension module connector
7. Ethernet connector

Table 2.1 Indicators

LED	Color	State	Description
⏻	green	ON	Power on
⚠	red	ON	– program error – retain memory error – system error
		slow flashing	Overheating
F1	green	—	Programmable
F2	green	—	
DI1...DI6	green	ON	HIGH on input
FDI1...FDI4	green		
AI1...AI6	green	ON	HIGH on input (digital mode)
DO1...DO8	green	ON	Output is on
⏀	red	ON	24 V DC power off, powered over USB, program stopped
	green	ON	24 V DC power on, program is executed
	red / green	red – ON green – fast flashing	24 V DC power on, no program on device

Service button functions:

– IP address assignment (*Sect. 4.9.1*)
– Default settings restoration (*Sect. 7*)

Table 2.2 Ethernet LED indicators

LED	Color	State	Description
R	amber	OFF	Connection with 10 Mbit/s
		ON	Connection with 100 Mbit/s
L	green	OFF	No connection activity
		ON	Connection activity

3 Specifications

3.1 Specification tables

Table 3.1 General specification

Power supply		24 (9…30) V DC
Power consumption, max.		10 W
Galvanic isolation		no
Reverse polarity protection		yes
Input	Digital	6
	Fast digital	4
	Analog	6
Output	Digital	8
	Analog	2
Network interfaces		2 × RS485
		1 × Ethernet
Protocol	RS485	Modbus RTU, Modbus ASCII
	Ethernet	Modbus TCP
Mode	RS485	Master / Slave
	Ethernet	Master / Slave
Baud rate	RS485	9.6…115.2 kbit/s
	Ethernet	10/100 Mbit/s
Galvanic isolation	RS485	1500 V
	Ethernet	510 V
Extension modules		up to 2 PRM
Real-time clock accuracy		± 3 s / day
Backup battery		CR2032
Dimensions (with terminal blocks)		123 × 108 × 58 mm
Mounting		DIN-rail (35 mm)
Weight		approx. 350 g

Table 3.2 Digital inputs

HIGH level	8.5…30 V / 2…15 mA
LOW level	-3…+5 V / 0…15 mA
Pulse length, min.	2 ms
Response time, max.	30 ms
Pulse frequency, max.	500 Hz
Galvanic isolation	510 V, in groups (DI1…DI4, DI5…DI6)

Table 3.3 Fast digital inputs

HIGH level	8.5…30 V / 2…15 mA
LOW level	-3…+5 V / 0…15 mA
Pulse length, min.	5 µs
Pulse frequency, max.	100 kHz
Galvanic isolation	510 V, in groups (FDI1…FDI4)

Table 3.4 Analog inputs

ADC resolution	12 bit
Sampling time, max.	1 ms
Galvanic isolation	no
Analog mode 1 (Linear input)	
Input signal	0-10 V, 4-20 mA
Input resistance for 0-10 V input	10 kΩ
Basic error	±0.5 %

Temperature influence		±0.5 % / 10 °C
Analog mode 2 (Temperature sensors)		
Input signal		see Tab. 3.5
Least significant bit value, max.		1 °C
Basic error	PTC thermistors	±1.5 %
	NTC thermistors	±1.0 %
Temperature influence		±0.5 % / 10 °C
Digital mode		
Nominal input voltage		24 V DC
HIGH/LOW threshold (adjustable in ALP)		2.5…10 V
LOW/HIGH threshold (adjustable in ALP)		3…10.5 V
Pulse length, min.		2 ms
Signal frequency, max.		250 Hz

Table 3.5 Sensors (analog mode 2)

Sensor	Measurement range
RTD	
Pt 500 (α = 0.00385 °C^{-1})	–200…+850 °C
500P (α = 0.00391 °C^{-1})	–200…+850 °C
Cu 500 (α = 0.00426 °C^{-1})	–50…+200 °C
500M (α = 0.00428 °C^{-1})	–180…+200 °C
Ni500 (α = 0.00617 °C^{-1})	–60…+180 °C
Cu 1000 (α = 0.00426 °C^{-1})	–50…+200 °C
1000M (α = 0.00428 °C^{-1})	–180…+200 °C
Pt 1000 (α = 0.00385 °C^{-1})	–200…+850 °C
1000P (α = 0.00391 °C^{-1})	–200…+850 °C
Ni 1000 (α = 0.00617 °C^{-1})	–60…+180 °C
Thermistors / NTC	
B57861S series, 2 kΩ, $B_{25/100}$ = 3560K	–55…+100 °C
B57861S series, 3 kΩ, $B_{25/100}$ = 3988K	–55…+145 °C
B57861S series, 5 kΩ, $B_{25/100}$ = 3988K	–35…+145 °C
B57861S series, 10 kΩ, $B_{25/100}$ = 3988K	–35…+155 °C
B57861S series, 30 kΩ, $B_{25/100}$ = 3964K	–20…+155 °C
B57861S series, 50 kΩ, $B_{25/100}$ = 3760K	–10…+155 °C
NTC 3435, 10 kΩ	–40…+105 °C
NTC 3977, 10 kΩ	–40…+125 °C
Thermistors / PTC	
KTY82-110	–55…+150 °C
KTY82-120	
KTY82-121	
KTY82-122	
KTY82-150	
KTY82-151	

Table 3.6 Digital outputs

Type		relay (NO)
Switching capacity	AC	5 A, 250 V AC (resistive load)
	DC	3 A, 30 V DC
Load current at 5 V DC, min.		10 mA
Service life, electrical	AC	200,000 switching cycles
	DC	100,000 switching cycles
Galvanic isolation		2300 V, individual

Table 3.7 Analog outputs

Output signal		4-20 mA, 0-10 V
External voltage supply		15…30 V
Basic error, max.		±0.5%
Temperature influence		±0.5% / 10°C
DAC resolution		12 bit
Load resistance	R_I (4-20 mA), max.	300 Ω
	R_U (0-10 V), min.	1 kΩ
Galvanic isolation		510 V, individual

Table 3.8 Programming

Software		ALP
Interface		USB, Ethernet, RS-485
Program execution cycle, min.		1 ms
Memory	ROM	229376 Byte
	RAM	61440 Byte
	Retain	2040 Byte
	Network variables	8192 Byte
Flash memory	Log file size, max.	2048 Byte
	Number of files, max.	300
	Logging interval, min.	10 s

3.2 Operating conditions

The device is designed for natural convection cooling.
The following environmental conditions must be observed:

– clean, dry and controlled environment, low dust level
– closed non-hazardous areas, free of corrosive or flammable gases

Table 3.9 Operating conditions

Condition	Permissible range
Ambient temperature	-40…+55 °C
Transportation and storage	
Relative humidity	up to 80 % (at +35 °C, non-condencing)
Attitude	up to 2000 m above sea level
IP code	IP20
EMC immunity	conforms to IEC 61000-6-2
EMC emission	conforms to IEC 61000-6-4

4 Configuration and programming

4.1 General information

It is recommended to configure and program the device prior to installation and wiring. Configuration and programming are carried out with ***ALP*** (Sect. 4.1.1) after creating a user project. Configuration software ***akytecToolPro*** can also be used for device configuration (Sect. 4.1.2).

The software can be downloaded from our homepage *www.akYtec.de*.

The connection with the software running on PC can be established over the interfaces USB (Fig. 2.2, Pos. 5), Ethernet (Fig. 2.3, Pos. 7) or RS485 (Modbus).

For configuration over Ethernet or RS485, the device must be powered on. When being configured over USB, the device is powered by USB and the main power supply is not required

NOTICE

When the device is powered over USB, the inputs, outputs and the remaining interfaces are disabled. If you need full control over the device, you have to connect the main power, but you must observe the following:

There is no galvanic isolation between analog inputs, USB interface and power terminals.

Equipment connected to these circuits must have the same ground potential or be galvanically isolated to avoid damage to the device.

To connect the device to PC over USB:

– connect the miniUSB programming connector of the device (Fig. 2.2, Pos. 5) to PC over a USB-to-microUSB connection cable (not included)

NOTICE

The device must be powered off before being connecting to PC over USB.

To connect the device to PC over Ethernet:

– connect the Ethernet connector of the device to PC over the Ethernet connection cable (not included)
– connect the power supply to the removable 2-terminal block and plug it into the device
– power on the device

To connect the device to PC over RS485:

– connect the RS485 connector of the device to serial port of PC over a two-wire cable with DE9 connector at one end (not included)
– connect the power supply to the removable 2-terminal block and plug it into the device
– power on the device

4.1.1 Working with ALP

Configuration and programming with ***ALP***:

1. Make sure the indicator ⚠ shows no error (Tab. 2.1).
2. Start ALP and ensure the device is detected correctly.
3. Open the configuration window using the menu item ***Device > Configuration*** or the toolbar icon  .
4. Configure the device.
5. Create a user program.

The completed project can be transferred to the device memory using the menu item ***Device > Transfer application to device***.

See ALP Help for detailed information about configuration.

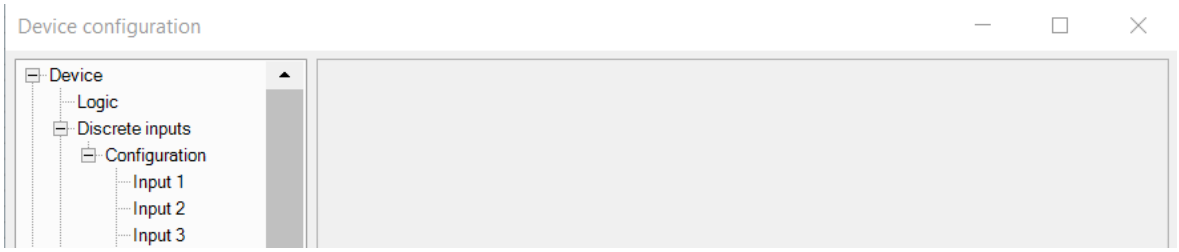

Fig. 4.1 You can select a variable to store the value of each parameter in it

4.1.2 Working with akYtecToolPro

Configuration with ***akYtecToolPro*** is performed "in real time". The configuration parameters can be read from the device, viewed, modified and saved to it.

1. Start ***akYtecToolPro***.
2. Click menu item ***Add device***
3. Select interface in drop-down list ***Interface***:
   – Ethernet – for connection via Ethernet
   – STMicroelectronics Virtual COM Port – for connection via USB or RS-485

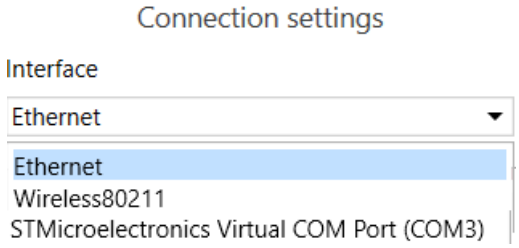

Fig. 4.2 Interface selection

Further steps for finding device depend on the selected interface.

1. To find device in Ethernet network:
   – Select radio button ***Find device***
   – Specify device IP address (default – 192.168.1.99)
   – Click ***Find***. The found device will be displayed in the right field
   – Select the device and press ***OK***
   – If the device is password protected (*Sect. 4.12*), enter the correct password
2. To find device connected over USB or RS485:
   – Select ***akYtec Auto Detection Protocol*** in drop-down list ***Protocol***.

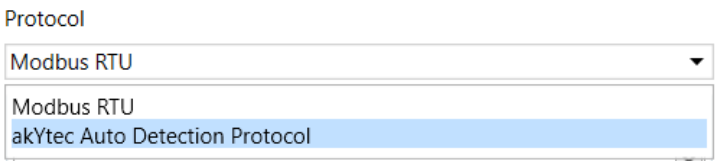

Fig. 4.3 Protocol selection

   – For USB, select ***Connection setup*** – ***Auto***
   – For RS485, select ***Connection setup*** – ***Manually*** and specify the connection parameters:
      – Baud rate – **9600** kbit/s
      – Data bits – **8**
      – Parity – **none**

- Stop bits – **1**.

– Select ratio button ***Find device***.
– Specify device address (default — **16**).
– Click the button ***Find***. The found device will be displayed in the right field.
– If the device is password protected (*Sect. 4.12*), enter correct password

4.2 Digital inputs

To configure digital inputs, open the node ***Inputs > Digital*** in the configuration dialog.

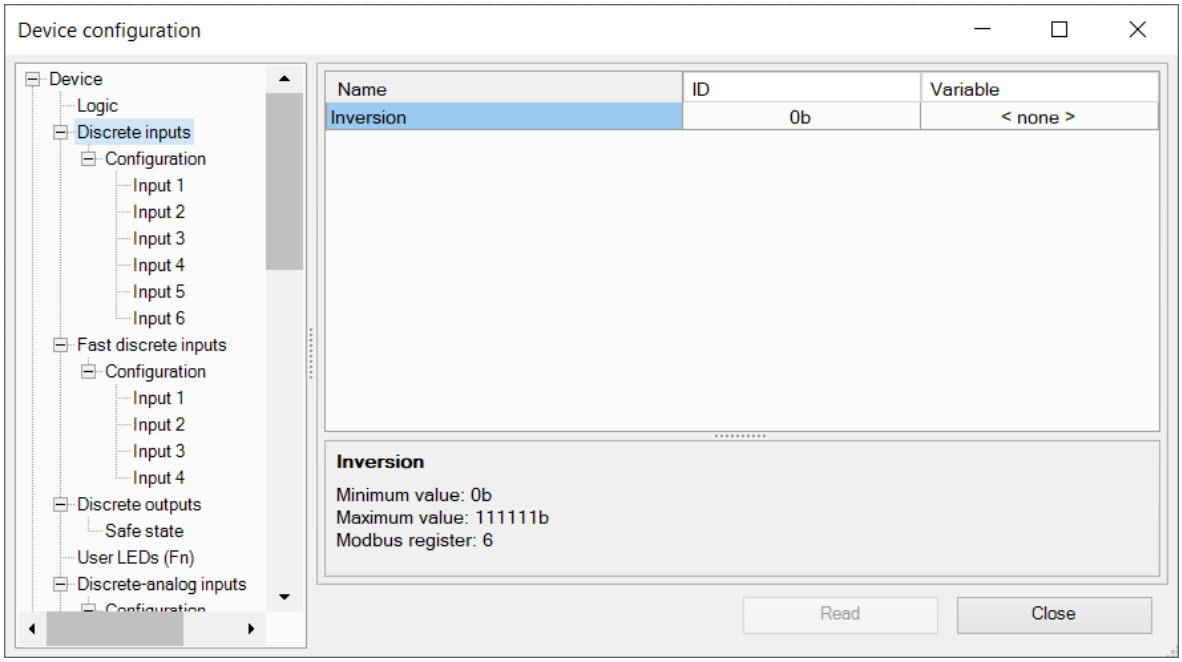

Fig. 4.4 DI group parameters

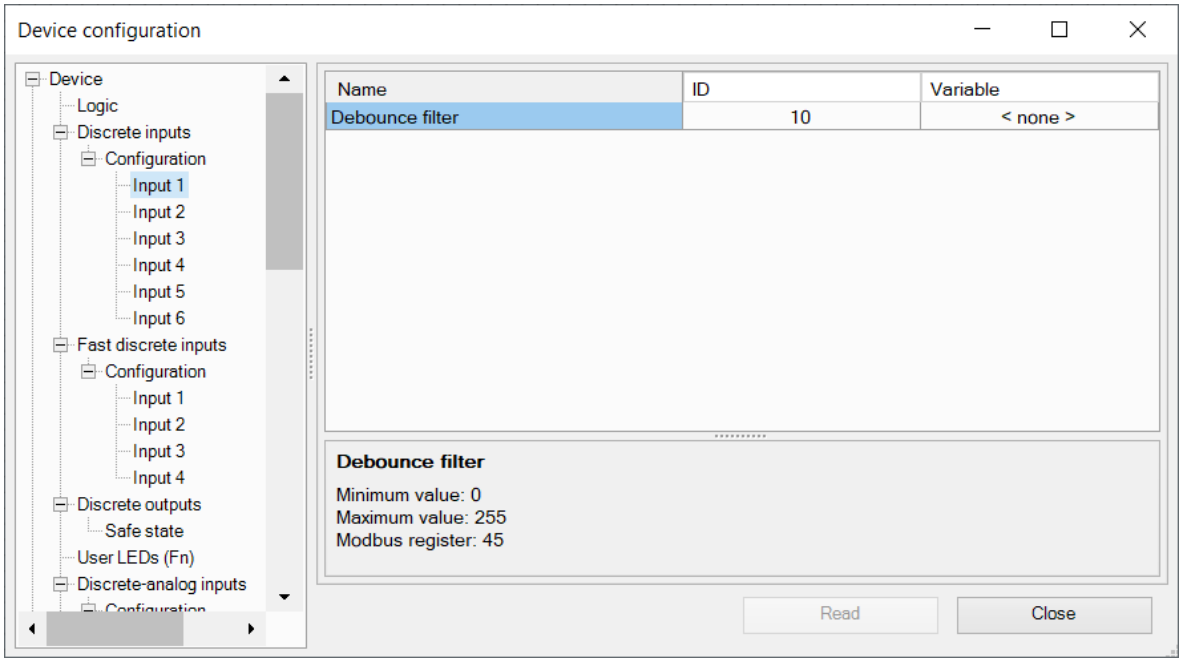

Fig. 4.5 DI individual parameters

Group parameters (Fig. 4.4):

– ***Input bitmask*** – states of individual inputs, 6 bits, read-only
– ***Input inversion*** – signal inversion bitmask, 6 bits, individual inputs can be inverted

Example:
When specifying 101101 in binary, the signal will be inverted at 1st, 3rd, 4th and 6th inputs.

Individual parameters (Fig. 4.5):
– ***Debouncing filter*** – time constant for contact bounce suppression filter. It can be set in the range of 0…255 ms. The setting 0 disables the filter.

NOTE
It is not recommended to use the contact bounce suppression for input signals with a frequency above 40 Hz and a duty cycle of 50 % or less. A useful signal can be missed.

4.3 Fast digital inputs

To configure fast digital inputs, open the node ***Inputs > Fast digital*** in the configuration dialog.

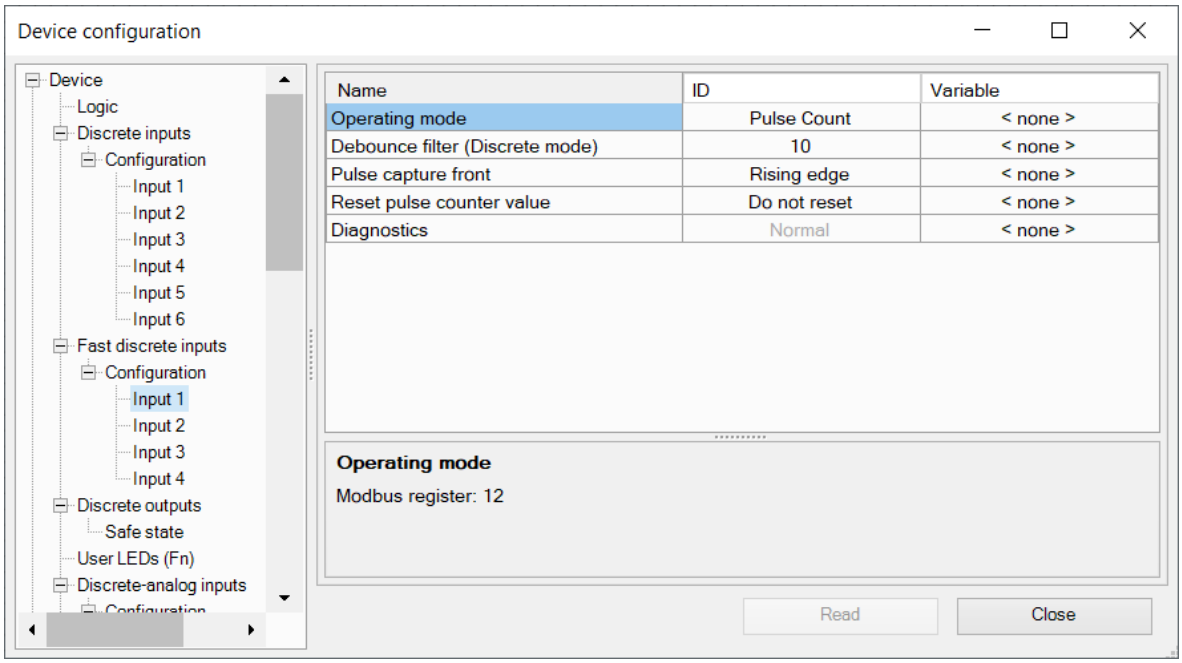

Fig. 4.6 FDI individual parameters

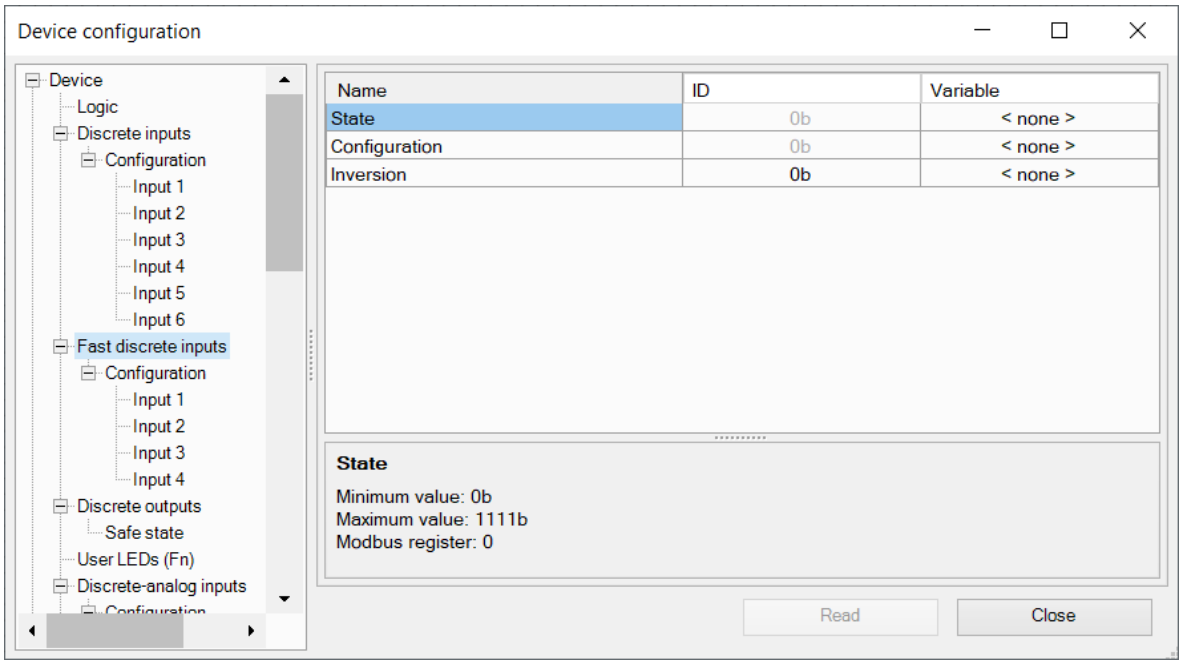

Fig. 4.7 FDI group parameters

Table 4.1 FDI parameters

Parameter	Value	Description
Mode	Digital input	HIGH / LOW level detection
	Pulse period	Pulse period measuring
	Pulse counter*	Pulse counting
	Frequency	Frequency measuring
	Encoder	Encoder signal processing
Debouncing filter**	0…255 ms	Active in the mode "Digital input" only
Pulse edge	Rising	Counter is triggered by the rising edge
	Falling	Counter is triggered by the falling edge
Counter reset***	On	Counter forced reset to 0 within 10 ms
	Off	No forced reset

NOTE

* The input counters are non-volatile, they retain their values after restarting the device. The counters of inputs with optional modes are reset after restart.

** It is not recommended to use the contact bounce suppression for input signals with a frequency above 40 Hz and a duty cycle of 50% or less. A useful signal can be missed.

*** The counter is automatically reset to 0 at overflow.

Two-channel encoders (without Z channel) can be connected to the fast digital inputs with the maximum signal frequency of 100 kHz.

The total number of pulses is stored in a 32-bit register, taking into account the direction of rotation after a zero crossing. When the direction of rotation changes (for example, from positive to negative), pulses are counted with the opposite sign (in this case, subtracted).

4.4 Analog inputs

To configure analog inputs, open the node ***Inputs > Analog*** in the configuration dialog and select the operation mode, analog or digital (Fig. 4.8).

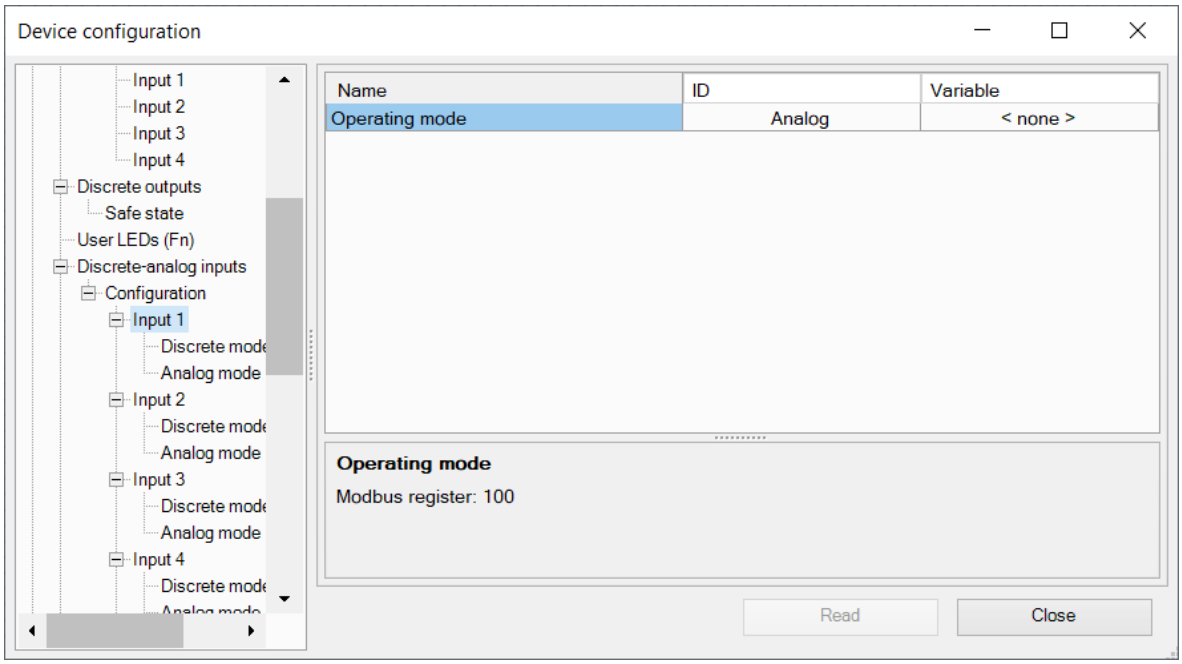

Fig. 4.8 Analog input mode

For quick access select an input in the circuit program and use ***Property Box*** to set the parameters. The parameter ***Input mode*** has to be set first.

NOTICE

Ensure that the input signal is connected to the correct input terminals and that the input configuration corresponds to the signal. Non-observance can cause damage to the device.

4.4.1 Analog mode

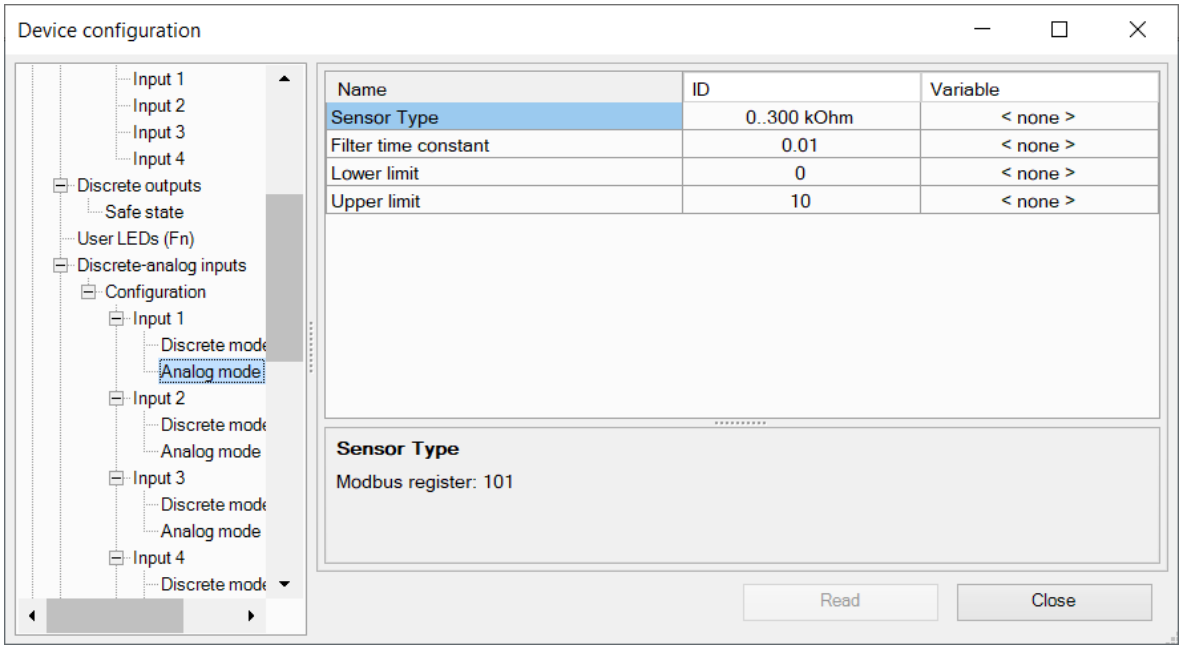

Fig. 4.9 Analog input, analog mode parameters

Configurable parameters:

– ***Input mode*** – select ***Analog***
– ***Input signal*** – linear signals (Tab. 3.4) or temperature sensors (Tab. 3.5), drop-down list

– ***Analog filter*** – valid range 0…65 s, the setting 0 disables the filter
– ***Lower measuring limit*** – minimum level of the input signal
– ***Upper measuring limit*** – maximum level of the input signal.

The lower and upper measuring limits are used to scale the input signal.

The analog filter stabilizes the input reading. The filter parameter is a time constant representing the time interval in which the signal reaches 0.63 of the measured value. It can be set for each input separately.

The greater the time constant, the higher the damping of the interference signal and the slower the reaction to changes of the input signal.

4.4.2 Digital mode

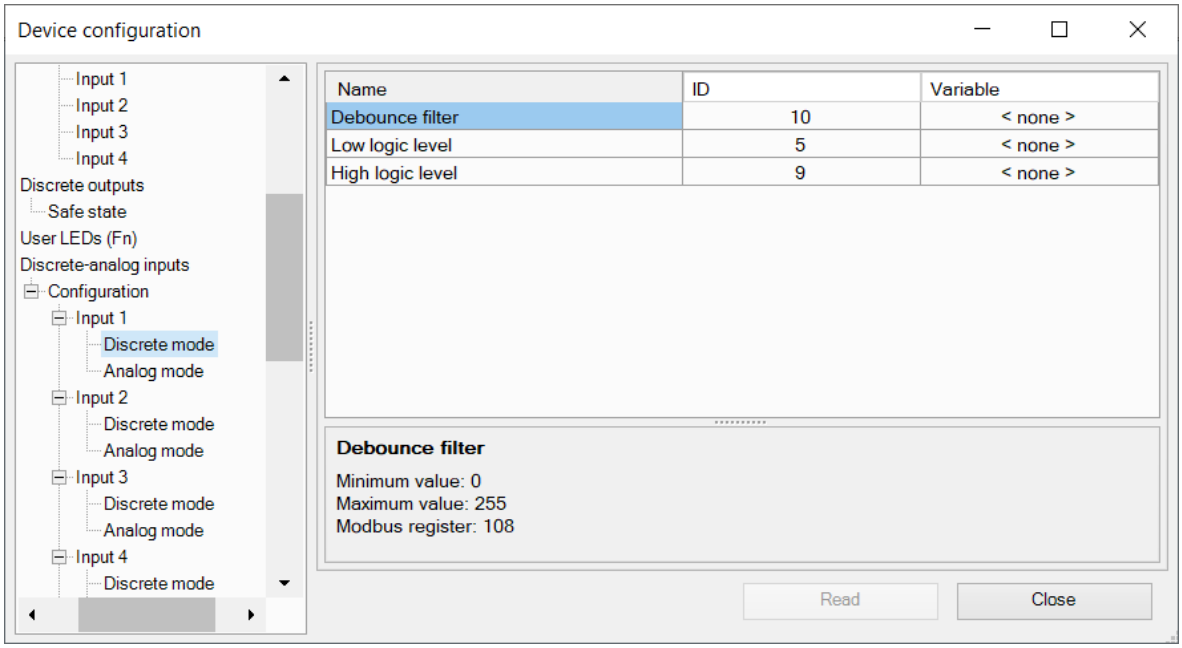

Fig. 4.10 Analog input, digital mode parameters

Configurable parameters:

– ***Input mode*** – select ***Digital***
– ***Debouncing filter*** – time constant for contact bounce suppression filter. It can be set in the range of 0…255 ms. The setting 0 disables the filter.

NOTE
It is not recommended to use the contact bounce suppression for input signals with a frequency above 40 Hz and a duty cycle of 50% or less. A useful signal can be missed.

– ***LOW*** – switching threshold from ***HIGH*** to ***LOW***, can be adjusted in ALP in the range 2.5…10 V and should be lower than ***HIGH*** level by at least 0.5 V
– ***HIGH*** – switching threshold from ***LOW*** to ***HIGH***, can be adjusted in ALP in the range 3.0…10.5 V and should be higher than ***LOW*** level by at least 0.5 V

The input operates as a comparator with parameters ***LOW*** and ***HIGH*** which determine the hysteresis.

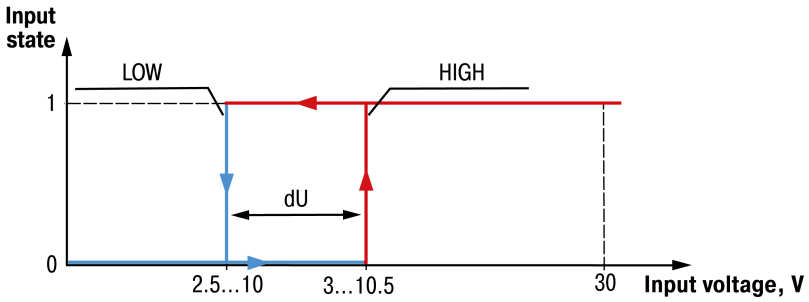

Fig. 4.11 Analog input, digital mode diagram

The input state will not change if the input voltage is within the dU interval. To avoid the ambiguity of determining the input state, the parameter ***HIGH*** must be set higher than the parameter ***LOW*** by at least 0.5 V.

4.5 Digital outputs

To configure digital outputs, open the node ***Outputs > Digital*** in the configuration dialog (Fig. 4.12).

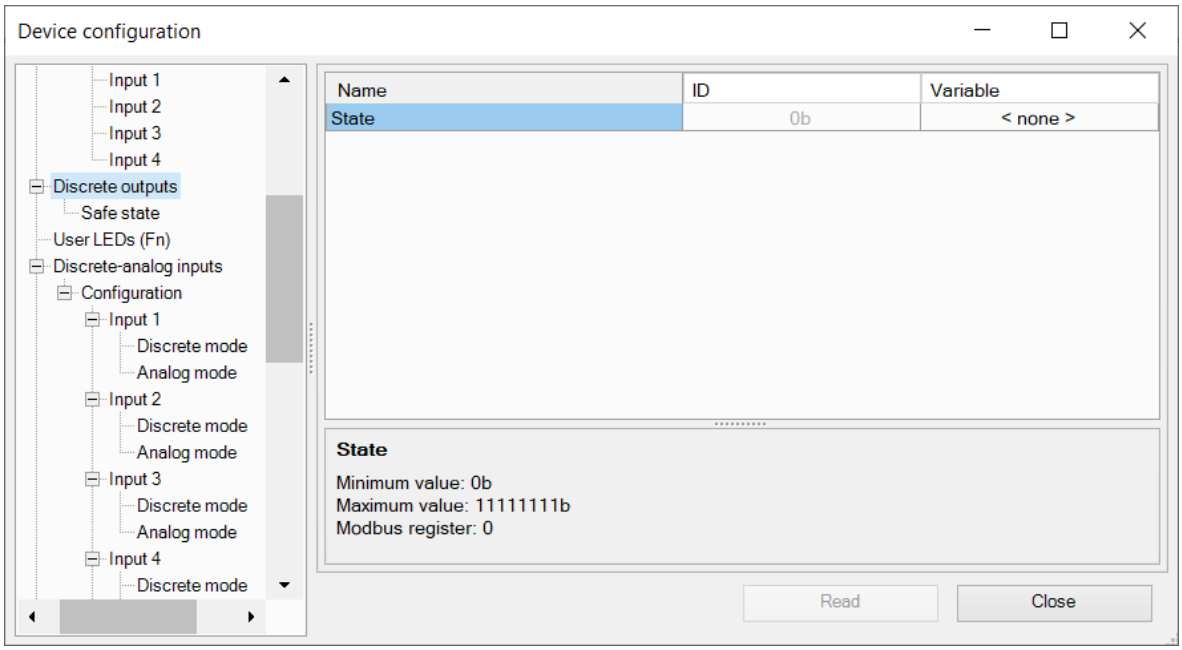

Fig. 4.12 Digital outputs parameters

Digital output parameters:

– ***Output bitmask*** – states of individual outputs, 8 bits, read-only
– ***New output bitmask*** – states of individual outputs, 8 bits. The parameter is available until the first project is transferred to the device. Hereafter the outputs will be controlled by the program.

Example:
When specifying 10100001 in binary, the 1, 3 and 8th outputs will be on.

A similar parameter is available for the outputs of the digital I/O extension module, if connected.

4.6 Analog outputs

To configure analog outputs, open the node ***Outputs > Analog*** in the configuration dialog (Fig. 4.13).

To control an output, a value of type REAL32 within the range 0…1 has to be assigned to it in the program.

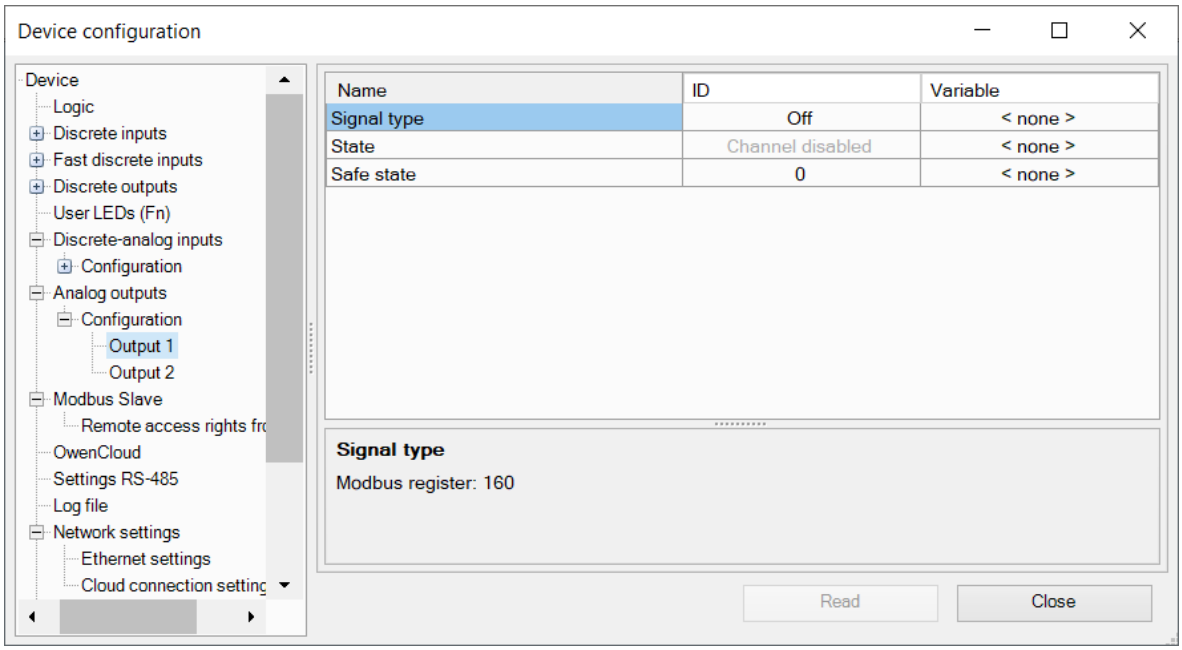

Fig. 4.13 Analog outputs parameters

Analog output parameters:

– ***Output signal*** – Off, 4-20 mA or 0-10 V
– ***Diagnostic*** – output status, read-only

Example:
When the value of 0.5 is applied to the output 4-20 mA, the output current will be 12 mA.

Example:
When the value of 0.5 is applied to the output 0-10 V, the output voltage will be 5 V.

4.7 LED indicators

PR103 has two programmable LED indicators: F1, F2 (Fig. 2.1.).

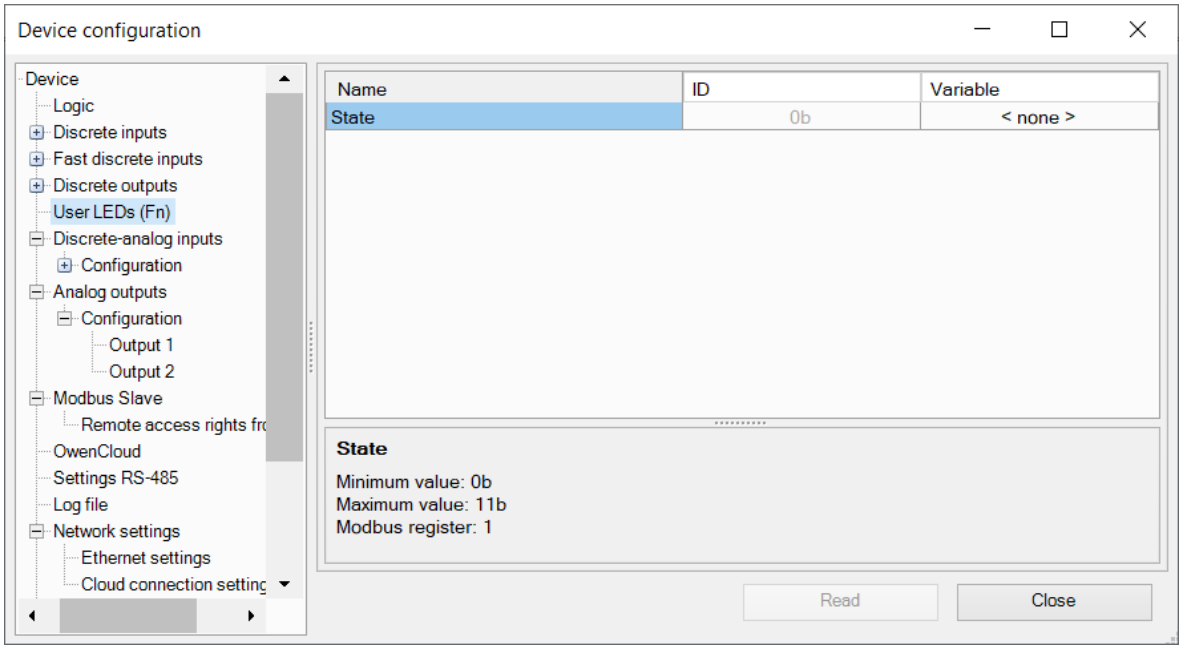

Fig. 4.14 Programmable LED parameters

LED parameters (Fig 4.14):

– ***LED bitmask*** – 0 / 1 (Off / On), 2 bits, read-only
– ***New LED bitmask*** – 0 / 1 (Off / On), 2 bits. The parameter is available until the first project is transferred to the device. Hereafter the LED indicators will be controlled by the program.

4.8 Data logging

To configure the logging, open the node ***Logging*** in the configuration dialog (Fig. 4.15).

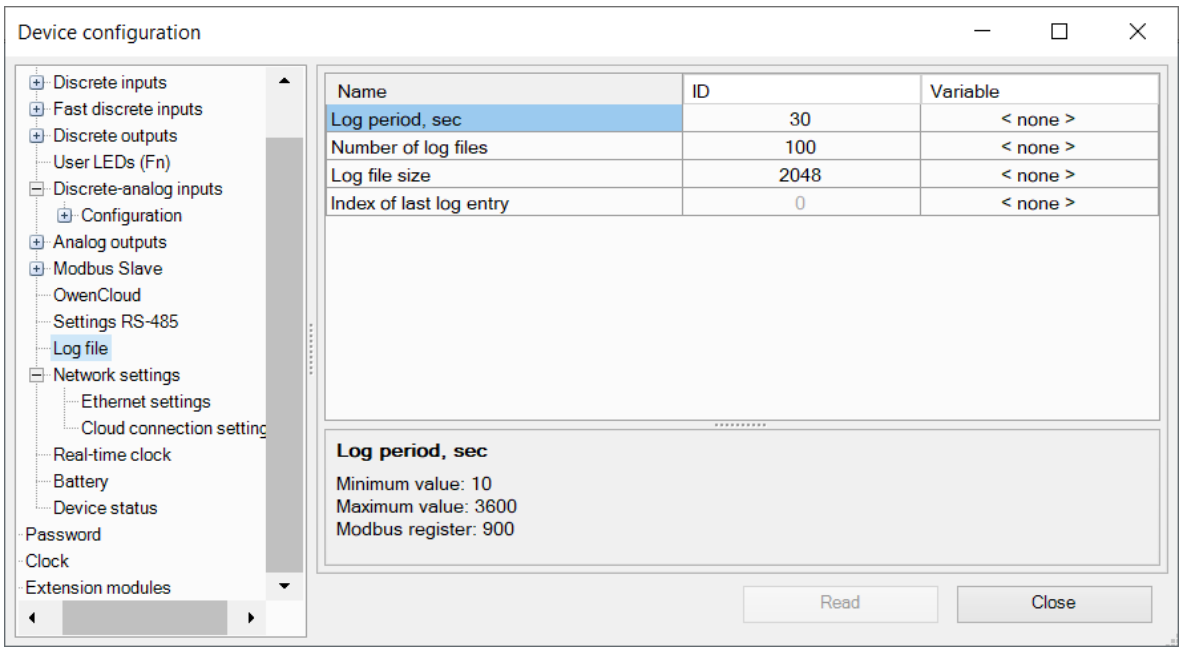

Fig. 4.15 Logging parameters in ALP

Table 4.2 Logging parameters

Parameter	Description	Valid range	Default value
Logging interval	Time interval with which the values of the variables selected for registration will be recorded	10…3600 s	30
Number of files	Maximum number of files the archive consists of	10…300	100
File size	Log file size in Bytes	200…2048	2048
Last log file ID	ID of the last written file (read-only)	0…65535	—

4.9 Network

The device operates:

– under the TCP/IP or Modbus TCP protocol (Slave / Master) over the Ethernet interface (Sect. 4.9.1.)
– under the Modbus RTU protocol (Slave / Master) over the RS485 interface (Sect. 4.9.2.)

At the moment the device operates only as a Slave. Master mode is in development.

Network parameters can be set with ***ALP*** (Sect. 4.1.1.) or ***akYtecToolPro*** (Sect. 4.1.2.).

NOTE

If the network parameters are set with akYtecToolPro, the device must be restarted in order to apply the new network parameters.

If you want to check the new parameters or continue configuring the device, you must add it again to the project with the new network parameters.

Otherwise the connection to the device cannot be established.

4.9.1 Ethernet – TCP/IP

To configure the Ethernet interface, open the node ***Network > Ethernet*** in the configuration dialog (Fig. 4.16).

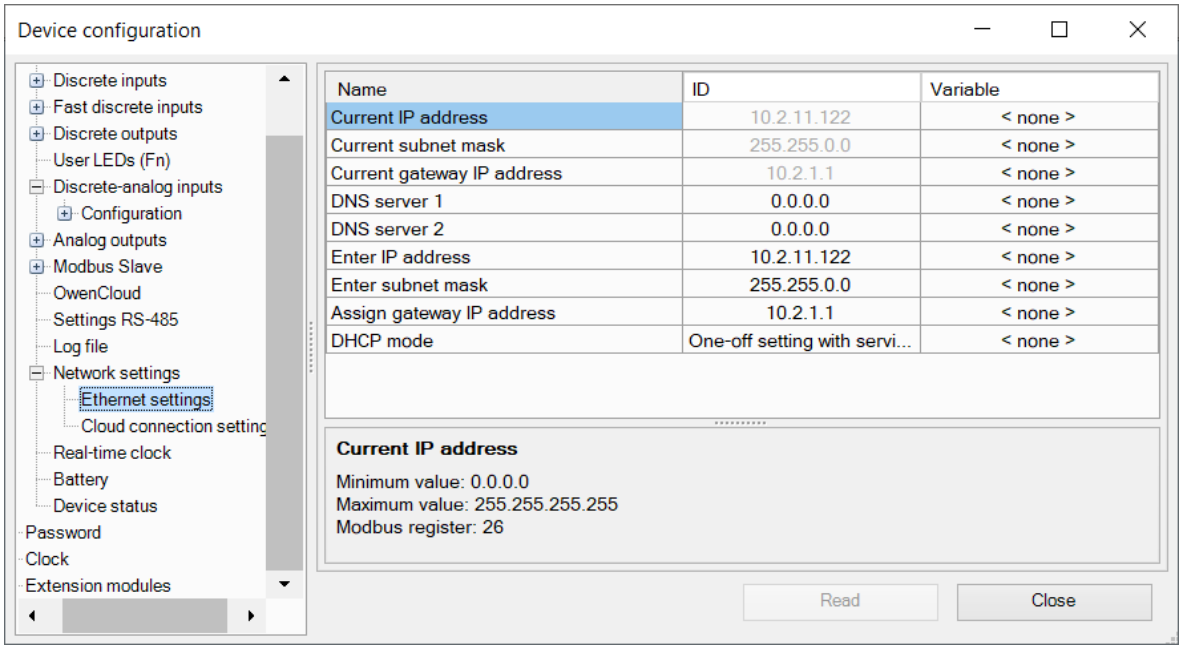

Fig. 4.16 Ethernet parameters in ALP

Table 4.3 Ethernet parameters

Parameter	Description	Default value
IP address	IPv4 Internet Protocol address (read-only)	192.168.1.99
Subnet mask	IP address recognition area in the subnet (read-only)	255.255.0.0
Gateway	IP address of the gateway (read-only)	192.168.1.1
DNS server 1	Used to translate the host name to the numerical IP addresses	77.8.8.8
DNS server 2	Used to translate the host name to the numerical IP addresses	8.8.8.8
New IP address	Enter new value	—
New subnet mask	Enter new value	—
New gateway	Enter new value	—
DHCP	On / Off / Service button	Service button

In ***ALP***, proceed as follows:
– set the parameters ***New IP address***, ***New subnet mask***, ***New gateway***
– save the project
– transfer the project to the device

In ***akYtecToolPro***, proceed as follows:
– set the parameters ***New IP address***, ***New subnet mask***, ***New gateway***
– set the parameter ***DHCP*** to ***Off***
– click the menu item ***Write parameters***
– click the menu item ***Restart device***
– add the device to the project again

Setting the Ethernet parameters using service button:
– Connect the device to the PC with Ethernet cable

– Power on the device
– Start ***akYtecToolPro***
– Set the parameter ***DHCP*** to ***Service button***
– Click the menu item ***IP addresses*** IP
– Follow the instructions in the opened dialog

Only Ethernet parameters will be applied, other parameters will not be affected.

4.9.2 RS485 – Modbus RTU

To configure the RS485 interface, open the node ***RS485*** in the configuration dialog (Fig. 4.17).

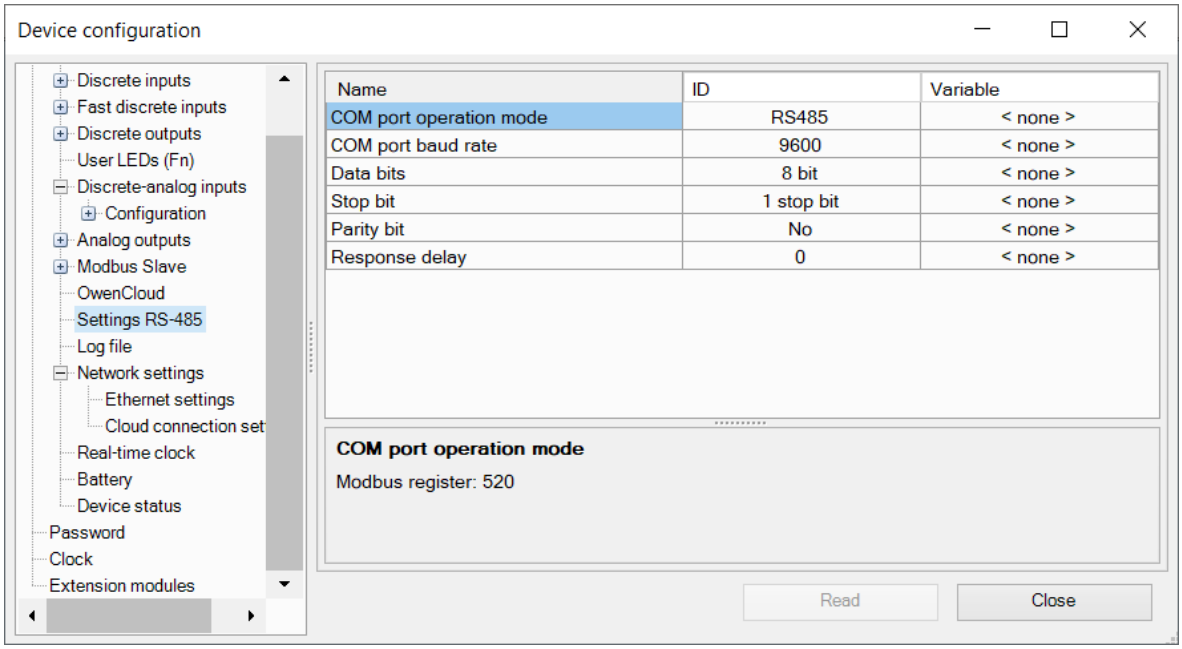

Fig. 4.17 RS485 parameters in ALP

Table 4.4 RS485 parameters

Parameter	Valid range	Default value
Mode	Slave / Master	Slave
Baud rate	0.3…921.6 kbit/s	9.6
Data bits	8	8
Stop bits	1 / 2	1
Parity	none / even / odd	none
Response delay	0…20 ms	0

4.9.3 Modbus Slave

To use the device as a Slave, set the parameter ***Mode*** in the node RS485 to ***Slave***.
To configure Modbus Slave, open the node ***Modbus Slave*** in the configuration dialog (Fig. 4.18).
The parameters in this node are relevant both for RS485 and Ethernet interfaces.

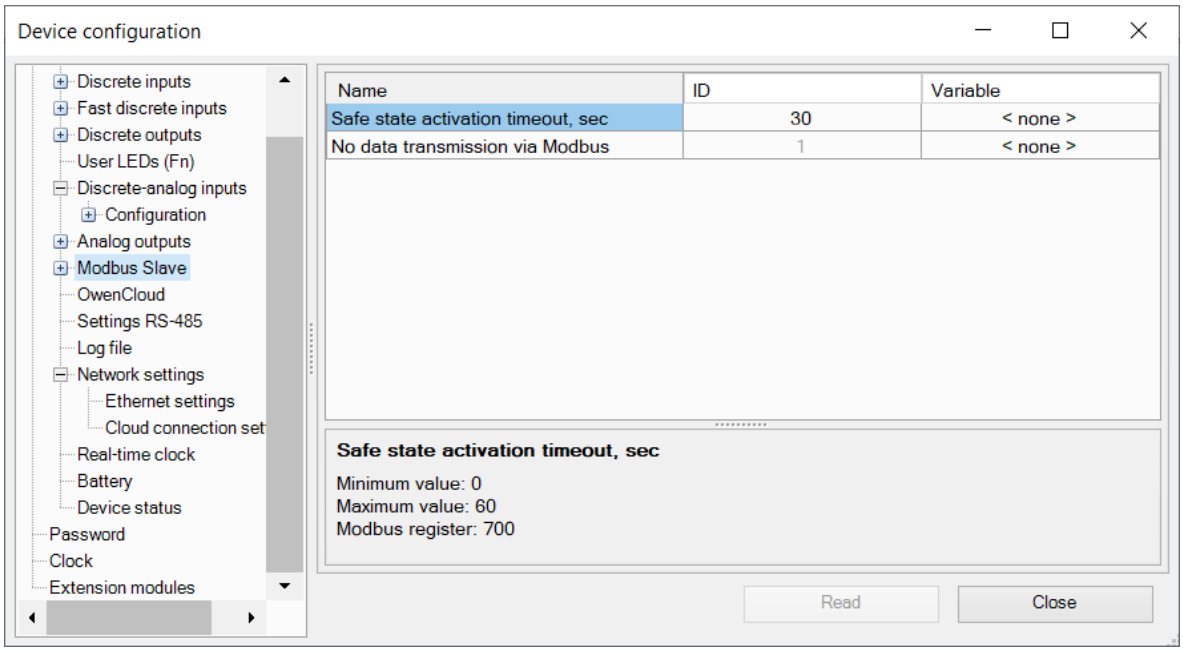

Fig. 4.18 Modbus Slave parameters in ALP

Table 4.5 Modbus Slave parameters

Parameter	Description	Valid range	Default value
Safe state activation delay	Activation delay of the safe state of the outputs after communication interruption	0…60 s	30
Data exchange interruption	1 – no data exchange via Modbus (read-only)	0 / 1	—

For the protocol Modbus TCP, the port 502 and the default address 1 are used.
The device as a Slave can handle maximum 4 Modbus TCP connections.

4.10 Real-time clock, battery

The RTC time is counted as UTC in seconds, starting from 0:00 01.01.2000. It is used as a timestamp by logging.
To configure RTC, open the node ***Clock*** in the configuration dialog (*Fig. 4.19*).

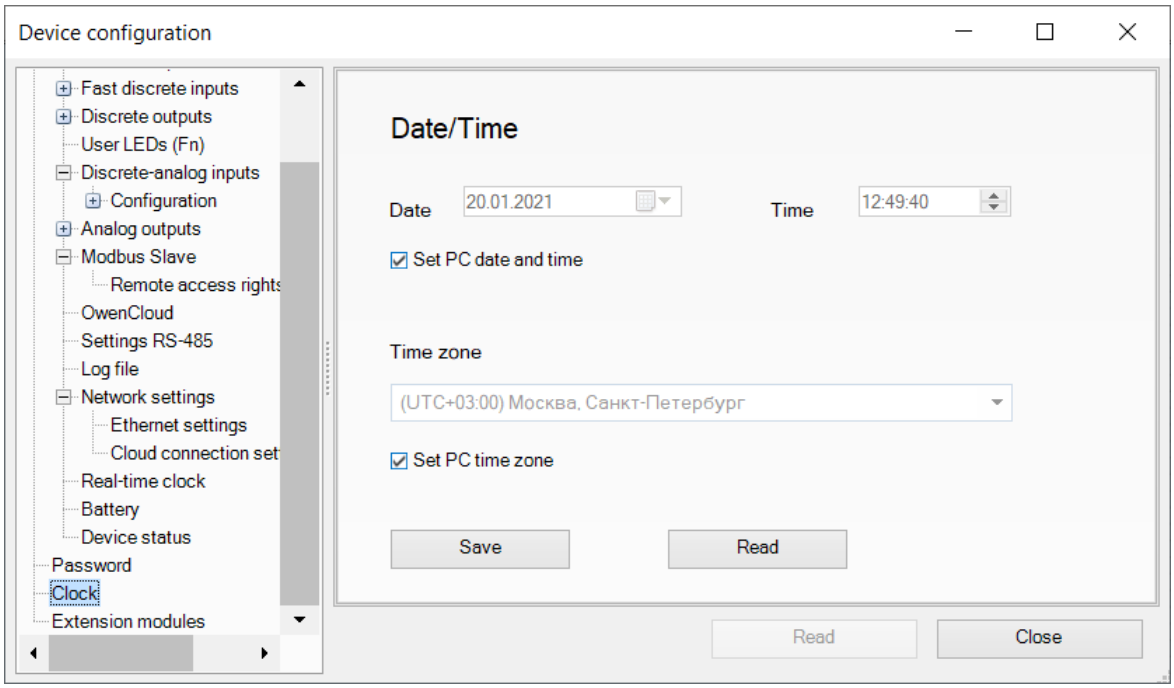

Fig. 4.19 Real-time clock parameters

Date, time and time zone can be set manually or by selecting the option ***Syncronize with PC***.
To read the time from RTC, use ***Read*** button.
To set the RTC time, use ***Save*** button.
To check the battery, open the node ***Battery*** in the configuration dialog (Fig. 4.20).

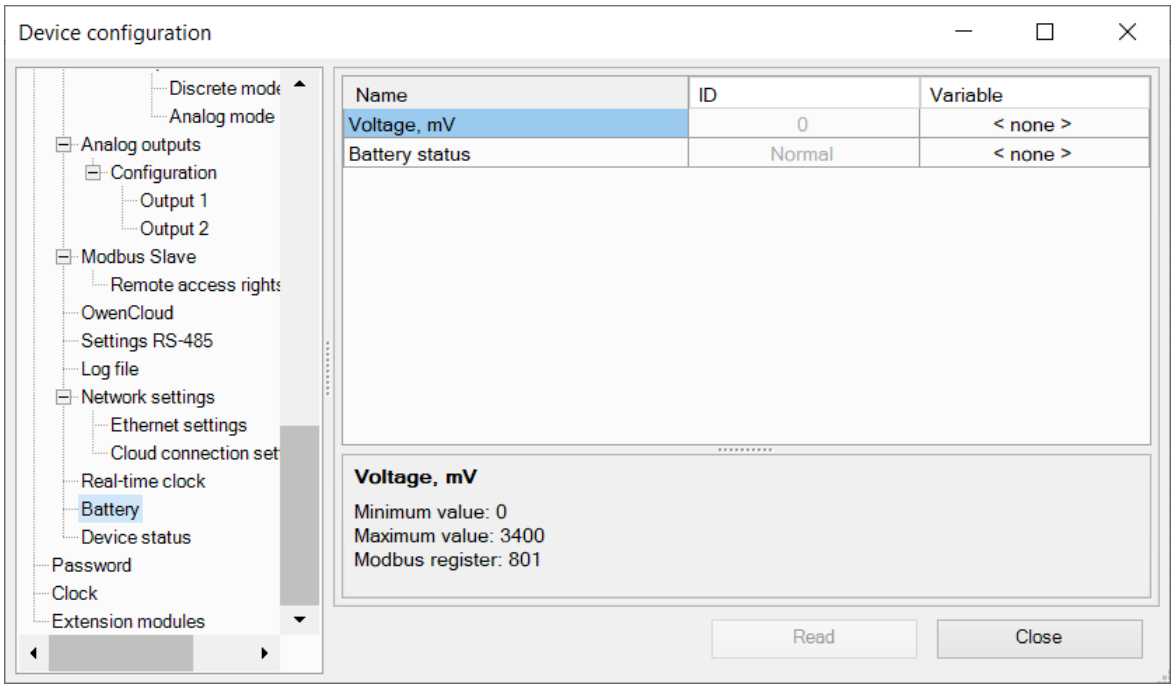

Fig. 4.20 Battery parameters

The RTC is powered from the main voltage when the device is powered on. Otherwise, the RTC is powered by the battery.

A fully charged battery can supply RTC continuously for 5 years. At the temperatures near the limits of the operating range (Tab. 3.6), the RTC operating time is reduced. The battery level can be checked in ***ALP*** or ***akYtecToolPro***.

For battery replacement see Sect. 10.

4.11 Device status

The parameters of the device status are under the node ***Device status*** in the configuration dialog available (Fig. 4.21).

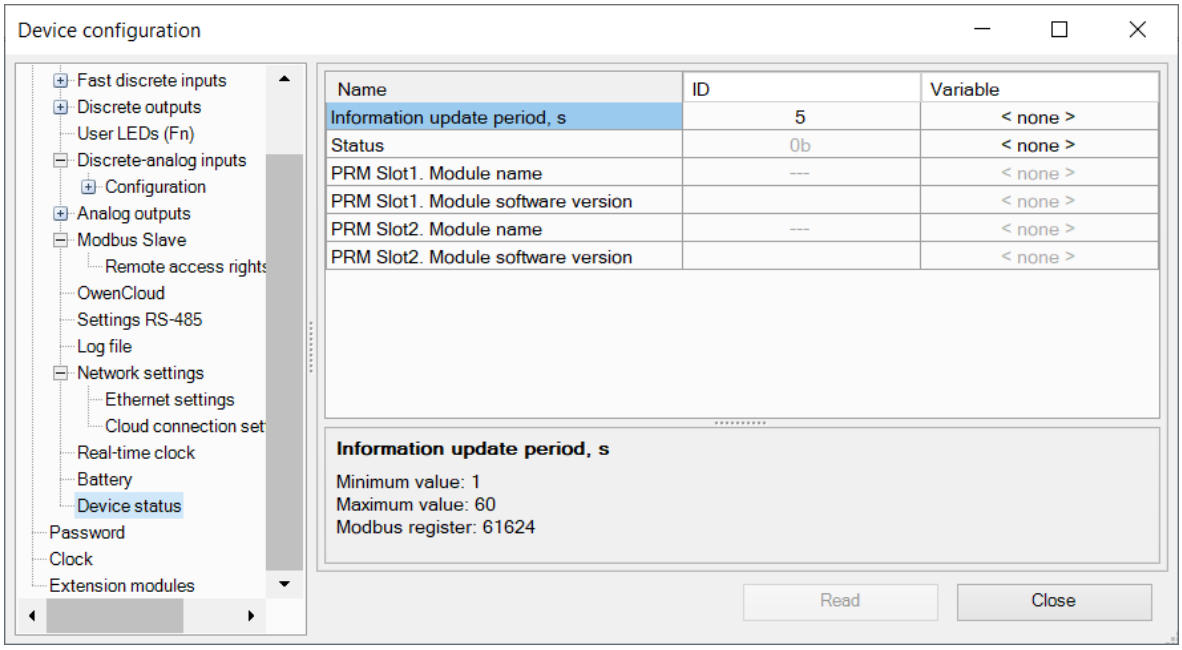

Fig. 4.21 Device status parameters

Table 4.6 Device status parameters

Parameter	Description	Valid range	Default value
Update period	Time interval for status update	1 …60 s	5
Status mask	Device status binary code	0…4294967295	—
PRM slot 1. Device	Extension module name if connected	—	not connected
PRM slot 1. FW version	Extension module firmware version if connected	—	—
PRM slot 2. Device	Extension module name if connected	—	not connected
PRM slot 2. FW version	Extension module firmware version if connected	—	—

4.12 Password

You can protect your configuration parameters and user program with a password. There is no password by default.

To set a password, open the node ***Password*** in the configuration dialog.

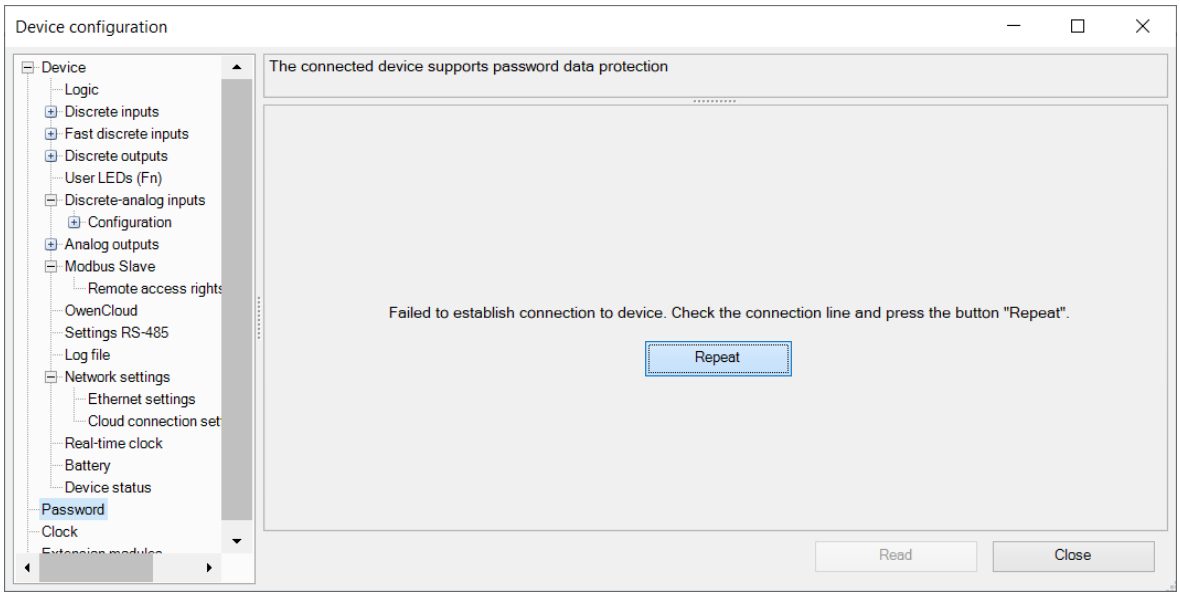

Fig. 4.22 Password setting

If you forgot the password, restore the default settings (*Sect. 7*).

4.13 User program parameters

The parameters of a user program can be seen only in ***akYtecToolPro***.

If the user program is saved in the device and the device is added to the akYtecToolPro project, the program parameters and variables will be displayed in the parameter tree in the node ***User program***.

The following parameters are available:

– Cycle time (ms)
– Program status
– Inputs
– Outputs
– Network variables

NOTE
After transferring a new user program to the device, the device must be re-added to the akYtecToolPro project. Otherwise, the connection between the device and akYtecToolPro cannot be established.

5 Installation

The relay is designed for DIN rail mounting. The operating conditions from the Sect. 3.2 should be taken into account when choosing the installation site. For dimension drawing see App. A.

Relay is equipped with plug-in terminal blocks which enable quick replacement of the device without disconnecting the existing wiring (*Fig. 5.1*).

To replace the device:

1. Power off all connected lines including power supply.
2. Remove the terminal blocks.
3. Replace the device.
4. Connect the terminal blocks with existing wiring to the device.

Reverse this procedure after replacing the device.

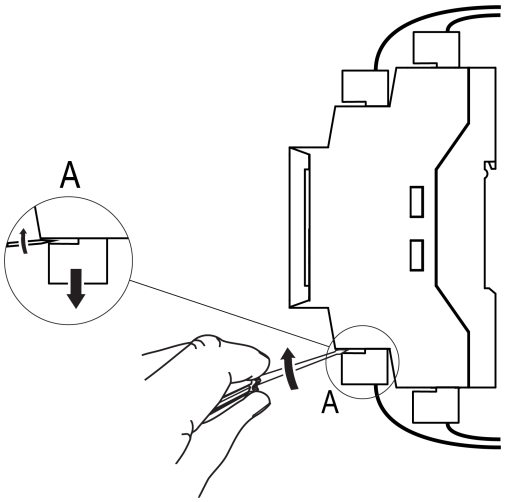

Fig. 5.1 Quick replacement

5.1 Wiring

The safety requirements from the section 1.4 must be observed.

WARNING

The device must be powered off before connecting to peripheral equipment or PC. Switch on the power supply only after the wiring of the device has been completed.

CAUTION

The program will be executed immediately after it has been transferred to the relay.

For safety reasons it is recommended to transfer the program before wiring the relay.

Otherwise, ensure that all external devices are disconnected from the relay outputs before transferring the program.

NOTICE

Ensure that the input signal is connected to the correct input terminals and that the input configuration corresponds to the signal. Non-observance can cause the device damage.

NOTICE

To ensure compliance with the EMC requirements:

- ***Signal cables should be routed separately or screened from the supply cables.***
- ***Shielded cable should be used for the signal lines.***

5.1.1 Terminal block layout

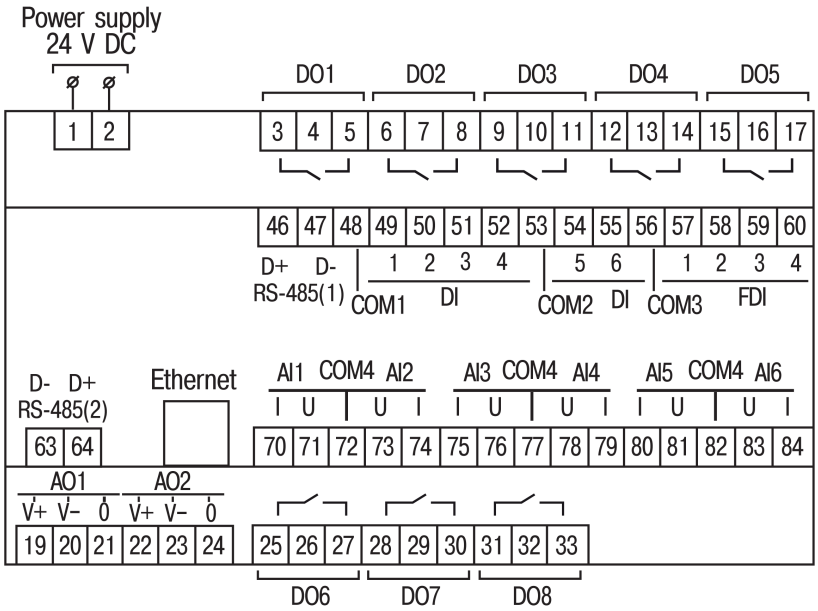

Fig. 5.2 Terminal block layout

Table 5.1 Terminal assignment

No.	Mark-ing	Description	No.	Mark-ing	Description
1	0 V	Power supply	Ethernet		Ethernet interface
2	24 V	Power supply			
3	DO1	DO1 digital output	70	I	AI1 current input
4	—	Not connected	71	U	AI1 voltage input
5	DO1	DO1 digital output	72	COM4	AI1...AI6 common contact
6	DO2	DO2 digital output	73	U	AI2 voltage input
7	—	Not connected	74	I	AI2 current input
8	DO2	DO2 digital output	75	I	AI3 current input
9	DO3	DO3 digital output	76	U	AI3 voltage input
10	—	Not connected	77	COM4	AI1...AI6 common contact
11	DO3	DO3 digital output	78	U	AI4 voltage input
12	DO4	DO4 digital output	79	I	AI4 current input
13	—	Not connected	80	I	AI5 current input
14	DO4	DO4 digital output	81	U	AI5 voltage input
15	DO5	DO5 digital output	82	COM4	AI1...AI6 common contact
16	—	Not connected	83	U	AI6 voltage input
17	DO5	DO5 digital output	84	I	AI6 current input
46	D+	RS485 interface 1	19	V+	AO1 +24 VDC
47	D-	RS485 interface 1	20	V-	AO1 -24 VDC
48	COM1	DI1…DI4 common contact	21	0	AO1 analog output
49	DI1	DI1 digital input	22	V+	AO2 +24 VDC
50	DI2	DI2 digital input	23	V-	AO2 -24 VDC
51	DI3	DI3 digital input	24	0	AO2 analog output
52	DI4	DI4 digital input	25	DO6	DO6 digital output
53	COM2	DI5…DI6 common contact	24	—	Not connected
54	DI5	DI5 digital input	27	DO6	DO6 digital output
55	DI6	DI6 digital input	28	DO7	DO7 digital output
56	COM3	FDI1…FDI4 common contact	29	—	Not connected
57	FDI1	FDI1 digital input	30	DO7	DO7 digital output

No.	Mark-ing	Description	No.	Mark-ing	Description
58	FDI2	FDI2 digital input	31	DO8	DO8 digital output
59	FDI3	FDI3 digital input	32	—	Not connected
60	FDI4	FDI4 digital input	33	DO8	DO8 digital output
63	D-	RS485 interface 2	—	—	—
64	D+	RS485 interface 2	—	—	—

5.1.2 Digital inputs

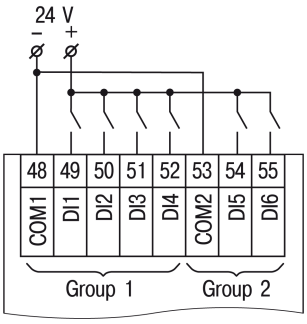

Fig. 5.3 DI – switch contacts wiring

5.1.3 Fast digital inputs

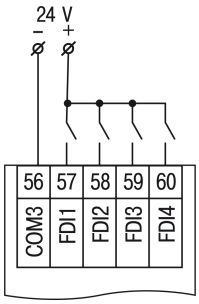

Fig. 5.4 FDI – switch contacts wiring

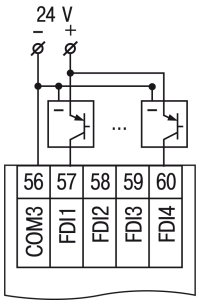

Fig. 5.5 FDI – PNP sensors wiring

5.1.4 Analog inputs

NOTICE

Before connecting analog sensors, ensure the input signal selected in configuration corresponds to the connected one. Wrong signal can cause the device damage.

The COM4 terminals are internally connected.

Table 5.2 Sensor cable requirements

Signal	Cable length, max. (m)	Total resistance, max. (Ω)
4-20 mA	100	5
0-10 V	100	100
2-wire RTD, thermistors, other resistive signals	100	—

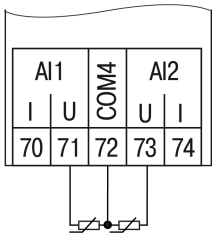

Fig. 5.6 RTD sensors wiring

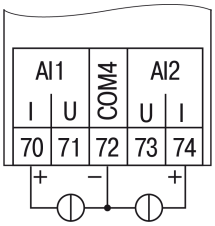

Fig. 5.7 Current sensors wiring

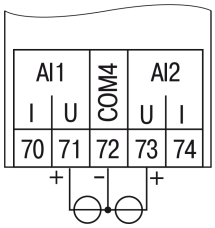

Fig. 5.8 Voltage sensors wiring

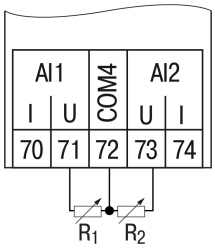

Fig. 5.9 Resistance sensors wiring

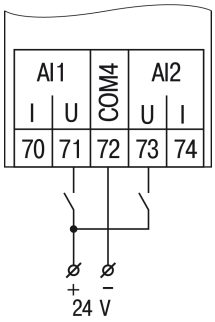

Fig. 5.10 Switch contacts wiring (digital mode)

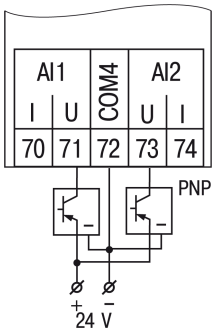

Fig. 5.11 PNP sensors wiring (digital mode)

5.1.5 Digital outputs

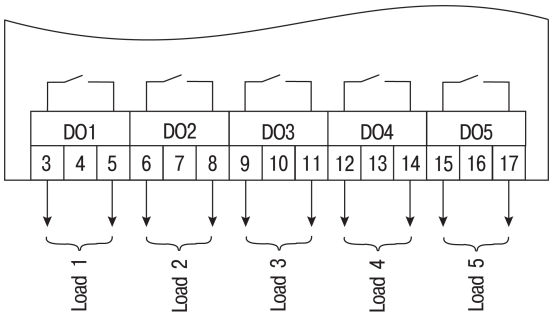

Fig. 5.12 Relay outputs

5.1.6 Analog outputs

Analog outputs require external voltage supply.

CAUTION
The external supply voltage may not exceed 30 V. Higher voltage can damage the device.

The analog outputs have individual galvanic isolation.

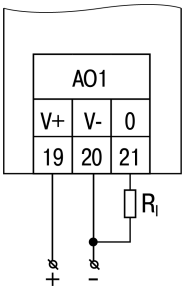

Fig. 5.13 4-20 mA output

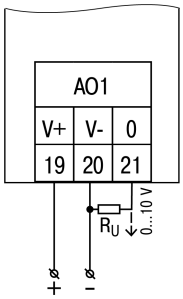

Fig. 5.14 0-10 V output

Load resistance for 4-20 mA output signal must not exceed 300 Ω.

Load resistance for 0-10 V output signal must not be lower than 1 kΩ.

5.2 Extension modules

NOTICE
The device must be powered off before connecting extension modules.

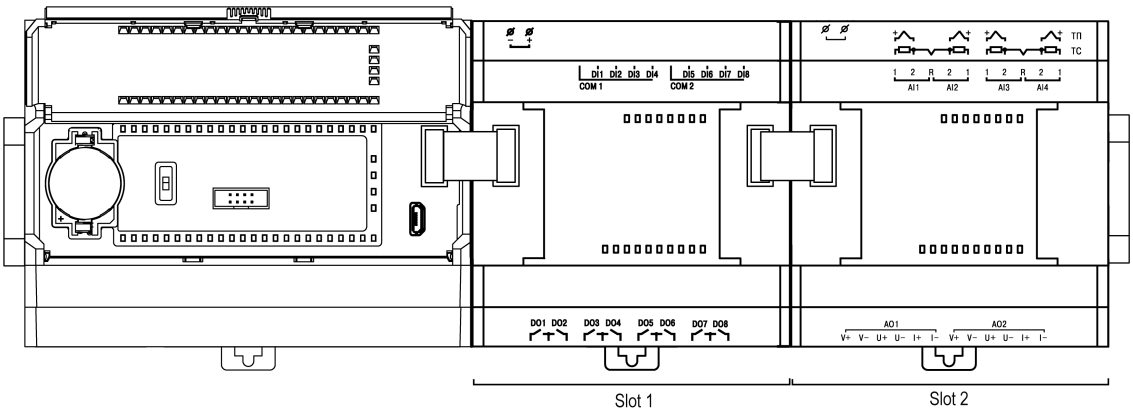

Fig. 5.15 Extension modules connection

Maximum two PRM modules can be connected to PR103 in series.

Mount the modules on the DIN rail to the right of the PR103 and connect them using the supplied 4.5 cm flat cable.

PRM has two EXT connectors located under the right and left front covers. The connector under the left cover is used to connect the 1st PRM to the PR103.

When connected, the flat cable should be placed in a special recess under the cover to enable the PRM to be pushed close to the PR103 (Fig. 5.16).

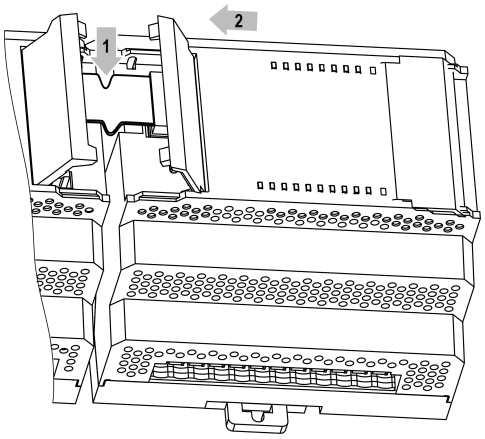

Fig. 5.16

Each module has an independent power supply. It is possible to combine the basic device and modules with different supply voltages.

5.3 RS485 connection

Fig. 5.17 RS485 connection

Line reflections can occur at the open bus ends (the first and the last node). The higher the chosen data transmission rate, the stronger they are. A terminating resistor (R_T) can minimize reflections. Experience proves that the most efficient practice is to use terminating resistors of 120…150 Ω.

5.4 Ethernet connection

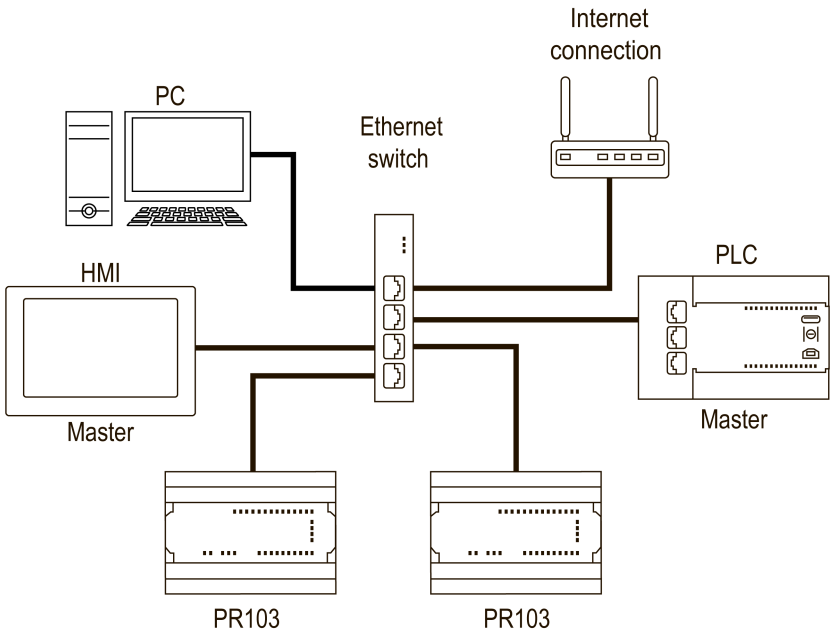

Fig. 5.18 Star topology

6 Operation

6.1 Operation diagram

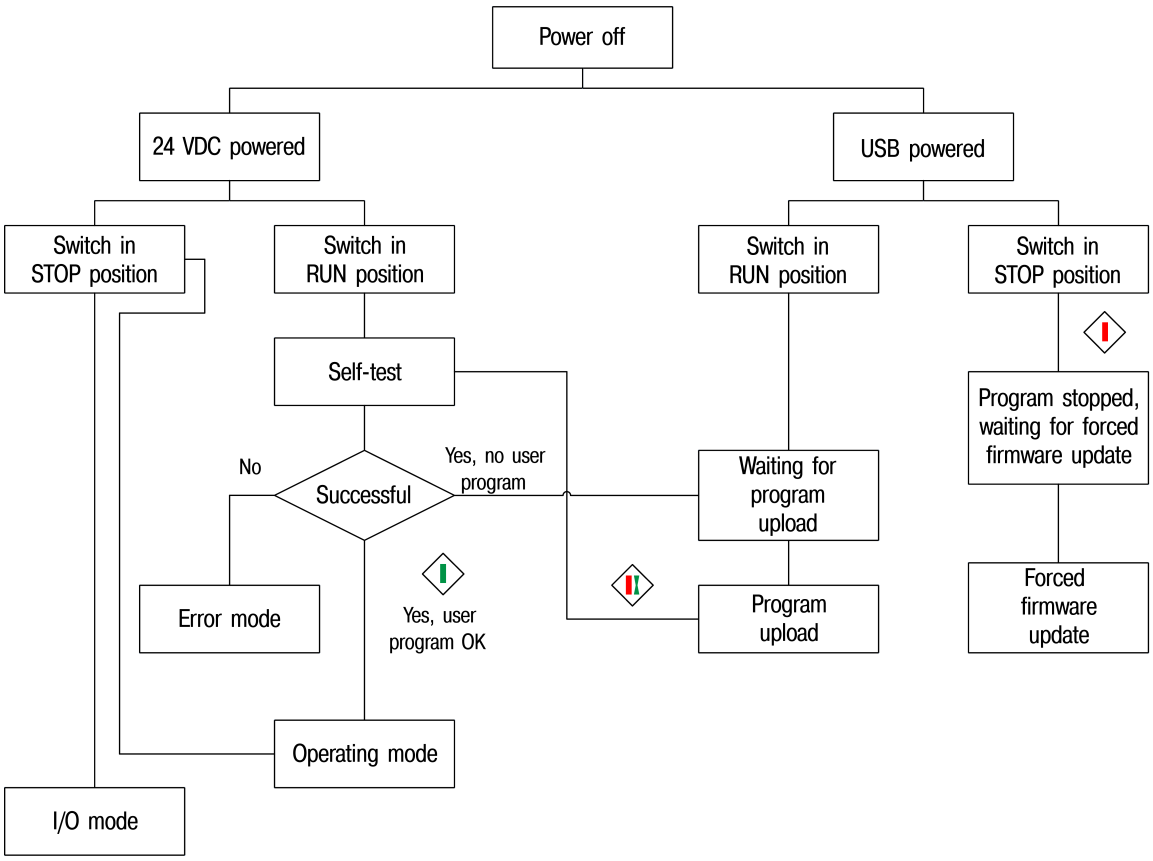

Fig. 6.1 Operation diagram

NOTE
When the device is powered over USB, the inputs, outputs and the remaining interfaces are disabled.

Once the program has been transferred to the device memory, the device restarts.
Operation of the device is cycle oriented:

1. operational readiness test
2. input process image update
3. program execution for one cycle
4. output process image update
5. back to 1.

6.2 Error mode

In the error mode, the program is stopped until the error cause is eliminated.

Table 6.1 Error indication

Indication	Cause	Remedy
⚠ ON	Program checksum error	Update the firmware
	Retain memory error	
	System error	Transfer the user program to the device once more. If it does not help, contact technical support
⚠ flashing	Overheating	Ensure the operation temperature according to Tab. 3.6

6.3 I/O mode

In I/O mode:

– user program is stopped

– relay operates as I/O extension module

To use the relay as I/O module, the RS485 interface must be previously configured in ALP as a slave. In I/O mode it is possible to read inputs and to control outputs, but there is no access to network variables. If any PRM modules are connected to the device, polling them over RS485 is impossible.

The I/O mode can be used for

– firmware update

– user program rewriting if it causes an incorrect operation of the device (Tab. 6.1, System error)

To activate the I/O mode, turn the RUN/STOP switch (Fig. 2.2, Pos. 2) to ***STOP*** position.

To switch to normal operation, turn the RUN/STOP switch to ***RUN*** position.

6.4 Data logging

An archive is saved as a set of encrypted log files. The logging parameters can be set in ***ALP*** or ***akYtecToolPro*** (Sect. 4.8).

When the archive overflows, the data will be overwritten, starting with the oldest record in the oldest file.

The log file consists of a set of records separated by Newline (0x0D0A). Each record corresponds to one parameter and consists of fields separated by semicolon (Tab. 6.2).

Table 6.2 Record format

Field	Type	Size	Description
Timestamp	binary	4 Byte	In seconds, beginning from 00:00 01.01.2000 (UTC+0)
Separator	string	1 Byte	Semicolon (;)
UID (parameter ID)	string	8 Byte	String of HEX characters with leading zeros
Separator	string	1 Byte	Semicolon (;)
Parameter value	string	parameter depending	String of HEX characters with leading zeros
Separator	string	1 Byte	Semicolon (;)
Parameter status	binary	1 Byte	1 – value correct 0 – value incorrect, further processing not recommended
Newline	binary	2 Byte	\n\r (0x0A0D)

Besides the parameters, the following data is stored in the log file:

– Battery status

– Device status - service information for the technical support (Sect. 4.11.)

The archive can be read with ***ALP*** or ***akYtecToolPro***.

It can be read also via Modbus using the read function 20 (0x14) Read File Record. For details see *Modbus specifications*.

The time zone is not contained in the file but can be read from the parameter ***Time zone***.

6.5 Extension modules

PRM extension modules are used to increase the number of I/O points. For installation see Sect. 5.2. The operation of a module is determined by user program in basic device. Previously the module must be added to the project configuration. See PRM user guide and ALP HELP for further information.

After the first connection to the basic device, the ERROR LED on the module blinks, since there is no data exchange between the module and the basic device. Only when the module is added to the basic device configuration and the project is transferred to the device, the ERROR LED on the module goes out. If that doesn't happen, update the module firmware.

7 Factory settings restoration

NOTICE
After restoring the factory settings:
– user program is deleted
– all parameters except Ethernet are reset to factory values
– password is deleted

To restore the factory settings:

1. Power on the PR103.
2. Open the front cover.
3. Using a thin tool, press and hold the service button (Fig. 2.2. Pos. 3) for at least 12 seconds.
4. Release the button. The LED ⚠ blinks once.
5. Close the cover.
6. Power off the device.

The next time the power is on, the device will operate with the factory settings.

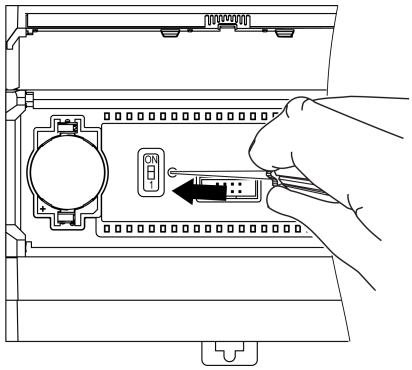

Fig. 7.1 Default settings restoration

8 Firmware update

The firmware update is carried out with ***akYtecToolPro*** or ***ALP***, over USB or Ethernet. The update over Ethernet is recommended, because the integrity of the firmware file and checksum will be verified.

8.1 Firmware update with akYtecToolPro

Proceed as follows:

1. Download an archive file with the firmware from *www.akytec.de*.
2. Unpack the archive.
3. Connect the PR103 over the programming connector (Fig. 2.2, Pos. 5) or Ethernet connector (Fig. 2.3, Pos. 7) to PC with the running ***akYtecToolPro***.
4. Power on the device.
5. Select the device in the project and use the item ***Firmware update*** in the main menu or in the device context menu.
6. In the opened dialog, select the firmware update ***From file*** and click ***Continue***.
7. Select the correct firmware file with the extension ***.fw*** and follow the instructions.
8. Once the firmware upload is completed, restart the device.

8.2 Firmware update with ALP

During project transfer, you will be asked to update the firmware if a newer version is available.

The firmware update can be also carried out manually using the menu item Device > Firmware update.

See ALP HELP for details.

If the firmware update was unsuccessful (power outage, communication errors etc.), it can be forced. The forced firmware update can be made if the device is not detected in ALP, but the device connection is correctly displayed in the Windows Device Manager.

To force the firmware update:

1. Connect the PR103 over the programming connector (Fig. 2.2, Pos. 5) or Ethernet connector (Fig. 2.3, Pos. 7) to PC with the running ***ALP***.
2. Power on the device.
3. If Ethernet is connected, power on the device.
4. Turn the RUN/STOP switch to ***STOP*** position. The LED ⏀ lights red. The firmware and user program are blocked.
5. Check in the Windows Device Manager which COM port the device is using, open the dialog ***Port settings*** using the menu and enter this COM port.
6. Select menu item ***Device > Firmware update***. The currently connected device will be proposed. You can confirm or select another one. During firmware update, the LED ⏀ flashes green and a progress bar is displayed in ALP.
7. After the firmware update is successfully completed (message in ALP, LED ⏀ lights red), turn the RUN/STOP switch to ***RUN*** position to start the normal device operation.

If problems were not resolved after a forced firmware update, contact technical support.

9 Maintenance

WARNING
Cut off all power before maintenance.

The maintenance includes:

– cleaning of the housing and terminal blocks from dust, dirt and derbis
– checking the device fastening
– checking the wiring (connecting leads, fastenings, mechanical damage)

NOTICE
The device should be cleaned with a damp cloth only. No abrasives or solvent-containing cleaners may be used.

10 Battery replacement

NOTE
The supply voltage may remain on when replacing the battery. This will prevent the real-time clock reset.

To replace the RTC battery:

1. Open the front cover.
2. Use a screwdriver to pick up the battery on the right side and, holding it, pull it out of the device.
3. Insert a new battery observing polarity.
4. Close the cover.

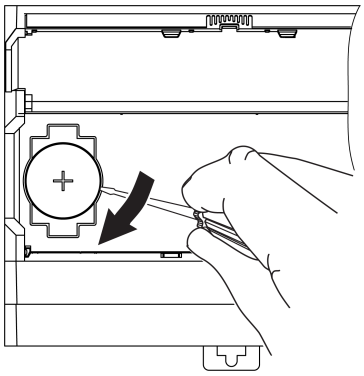

Fig. 10.1 Battery replacement

11 Transportation and storage

Pack the device in such a way as to protect it reliably against impact for storage and transportation. The original packaging provides optimum protection.

If the device is not taken immediately after delivery into operation, it must be carefully stored at a protected location. The device should not be stored in an atmosphere with chemically active substances.

Permitted storage temperature: -40 … +55 °C

NOTICE

The device may have been damaged during transportation.

Check the device for transport damage and completeness!

Report the transport damage immediately to the shipper and akYtec GmbH!

12 Scope of delivery

PR103	1
Short guide	1
Terminal blocks (set)	1

Appendix A Dimensions

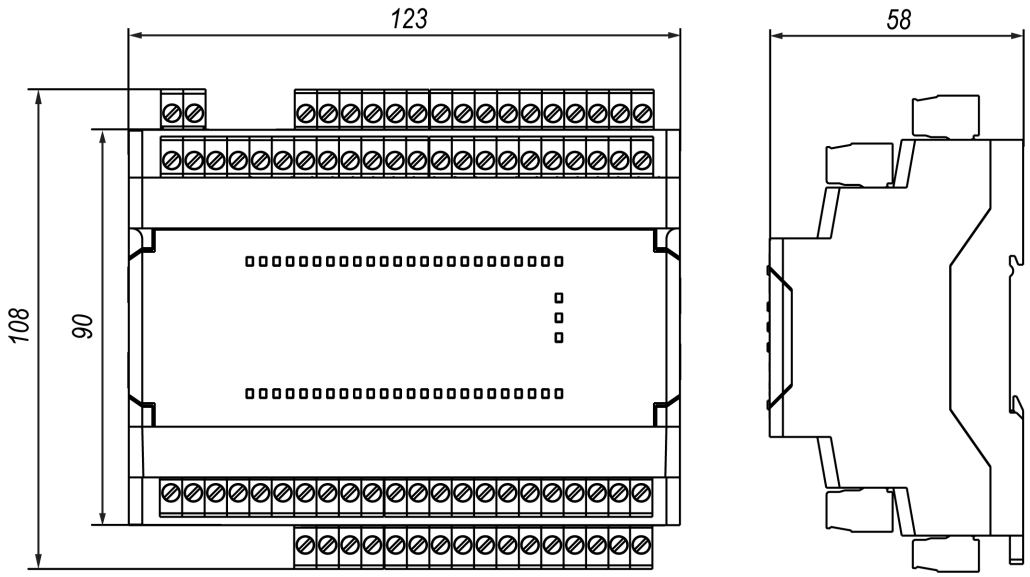

Fig. A.1 Dimensions

Appendix B Galvanic isolation

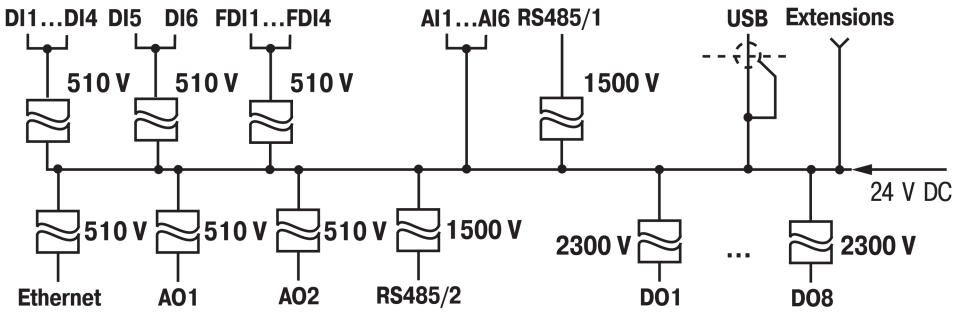

Fig. B.2 Galvanic isolation

Appendix C Modbus working

The list of device parameters with register numbers can be viewed in ***akYtecToolPro*** using the menu item ***Parameter list***. Data storage order:

– byte order − most significant byte first
– register order − least significant register first

Table C.1 Supported Modbus functions

Code	Function	Description
03 (0x03)	Read Holding Registers	Read the contents of a contiguous block of holding registers
04 (0x04)	Read Input Registers	Read from 1 to 125 contiguous input registers
06 (0x06)	Write Single Register	Write a single holding register
16 (0x10)	Write Multiple registers	Write a block of contiguous registers (1 to 123 registers)
20 (0x14)	Read File Record	Read record file as a set of records
21 (0x15)	Write File Record	Write record file as a set of records

The bit mask parameters can be read by functions 0x03 and 0x01. In case of using the function 0x01, you should multiply the register number by 16 and add the bit number.

Table C.2 Basic data formats

Format	Size (Byte)	Description
REAL32	4	Unsigned integer
UINT32	4	Unsigned integer
UINT16	2	Unsigned integer
UINT8	1	Unsigned integer
INT16	2	Signed integer
DATETIME	4	UTC in seconds, starting from 0:00 01.01.2000
String 128	8	16 symbol string
String 64	4	8 symbol string
String 48	3	6 symbol string
Enum 1...Enum 37	1	Describes the position of the selected parameter in the list (e.g. signal type)

Table C.3 Basic registers

Parameter	Register	Size (Byte)	Type	Comments
Device name	0xF000	32	String	Win-1251
Firmware version	0xF010	32	String	Win-1251
Series	0xF020	32	String	Win-1251
Subseries	0xF030	32	String	Win-1251
Hardware version	0xF040	16	String	Win-1251
Additional information	0xF048	16	String	Win-1251
Time and date	0xF080	4	UINT	UTC in seconds, starting from 0:00 01.01.2000
Time zone	0xF082	2	INT	Counted in minutes
S/N	0xF084	32	String	Win-1251, 17 symbols used

Table C.4 Modbus error codes

Code	Name	Description
01	Illegal Function	Function code received in the query is not recognized or allowed by slave
02	Illegal Data Address	Data address of some or all the required entities are not allowed or do not exist in slave
03	Illegal Data Value	Value is not accepted by slave
04	Slave Device Failure	Unrecoverable error occurred while slave was attempting to perform requested action. The device is in error mode.
05	Acknowledge	Slave has accepted the request and is processing it, but it takes time. This response is returned to prevent a timeout error from occurring in the master.
06	Slave Device Busy	Slave is engaged in processing a long-duration command. Master should retry later.
08	Memory Parity Error	Specialized use in conjunction with function codes 20 and 21. Slave detected a parity error in memory. Master can retry the request, but service may be required on the slave device.