EN

MV210-101

Analog Input Module

8 AI

User guide

MV210-101_2022_05_34798-1.15_EN

CE

Contents

1. Introduction 3

1.1 Terms and abbreviations 3

1.2 Symbols and key words 3

1.3 Intended use 3

1.4 Limitation of liability 4

1.5 Safety 4

2. Overview 5

2.1 Basic features 5

2.2 Design and indication 5

3. Specifications 7

3.1 Specification tables 7

3.2 Operating conditions 9

4. Configuration and operation 10

4.1 Connection with akYtecToolPro 10

4.1.1 Connection over USB 10

4.1.2 Connection over Ethernet 10

4.2 Real-time clock 11

4.3 Battery 12

4.4 Ethernet 12

4.4.1 Network parameters setting using service button 13

4.5 Modbus Slave 13

4.6 Device status 13

4.7 Data logging 14

4.8 Analog inputs 14

4.8.1 Input sampling 15

4.8.2 Signal scaling 15

4.8.3 Signal filtering 16

4.8.4 Sensor curve correction 16

4.8.5 Measured input values 16

4.8.6 Sensor diagnostic 17

4.8.7 Reference junction compensation 17

4.9 NTP protocol 18

4.10 MQTT protocol 18

4.10.1 Basics 18

4.10.2 Implementation 18

4.11 SNMP protocol 20

4.11.1 Basics 20

4.11.2 Implementation 20
4.12 Password 20
5. Installation 21
5.1 Mounting 21
5.2 Wiring 21
5.2.1 General information 22
5.2.2 Analog inputs 22
5.2.3 Ethernet 25
6. Factory settings restoration 26
7. Maintenance 27
8. Transportation and storage 28
9. Scope of delivery 29
Appendix A. Dimensions 30
Appendix B. Galvanic isolation 31
Appendix C. Battery replacement 32
Appendix D. Modbus application 33

1. Introduction

1.1 Terms and abbreviations

akYtecToolPro – configuration software

ADC – analog-digital converter

DAC – digital-analog converter

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 (*https://modbus.org/*)

NTP – Network Time Protocol

MQTT – Message Queuing Telemetry Transport, publish-subscribe network protocol to transport messages between devices

SNMP – Simple Network Management Protocol, an Internet Standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior

PWM – pulse-width modulation

RTC – real-time clock

RTD – resistance temperature detectors

TC – thermocouple

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

The device has been designed and built solely for the intended use described here, and may only be used accordingly. The technical specifications contained in this document must be observed.

The device may be operated only in properly installed condition.

Improper use

Any other use is considered improper. Especially to note:

- The device may not be used for medical appliances applied to maintain human life or health, its control or other effect on them.
- The device may not be used in explosive environment.
- The device may not be used in atmosphere in which there are chemically active substances.

1.4 Limitation of liability

Our company does not bear any responsibility with respect to breakdowns or damages caused by using the product in a manner other than described in the Manual or in violation of the current regulations and technical standards.

1.5 Safety

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.

WARNING
The device terminals may be under a dangerous voltage. De-energize the device before working on it.
Switch on the power supply only after completing all works on the device.

NOTICE
Supply voltage may not exceed 48 V. Higher voltage can damage the device.
If the supply voltage is lower than 10 V DC, the device cannot operate properly but will not be damaged.

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

2. Overview

MV210-101 is an extension module with 8 analog inputs.

The module operates as a slave in Ethernet network with Modbus TCP protocol.

The device is intended for use in industrial automation for creation of decentralized control systems.

The module can be configured with the configuration software akYtecToolPro (free) over USB or Ethernet interface (Sect. 4). The software can be downloaded from our homepage *akYtec.de*.

2.1 Basic features

- 8 analog inputs (Sect. 4.8)
- RTD, TC, active linear sensors (U, I), passive linear sensors (R), switch contacts supported (Tab. 3.2)
- Device and input status indicators (Sect. 2.2)
- Dual Ethernet (Sect. 4.4, 5.2.3)
- Slave in Modbus network over Ethernet (Sect. 4.5)
- USB configuration interface (Sect. 4.1.1)
- Real-time clock (Sect. 4.2)
- Device diagnostic (Sect. 4.6)
- Data logging and archiving (Sect. 4.7)
- Error indication (Table 2.1)
- DIN rail or wall mounting (Sect. 5.1)

2.2 Design and indication

The device is designed in a plastic case for DIN rail or wall mounting (Sect. 5.1).

Plug-in terminal blocks enable quick and easy replacement of the device.

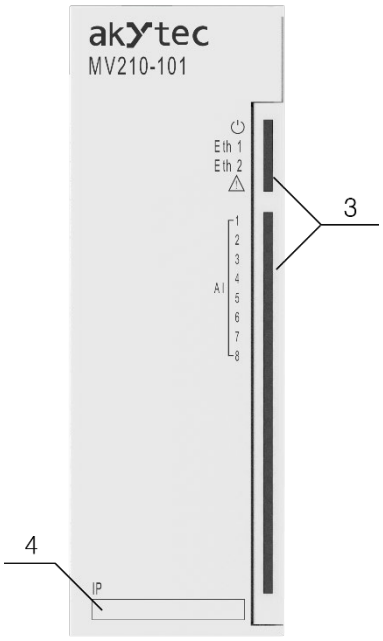

Fig. 2.1. Front view (closed cover)

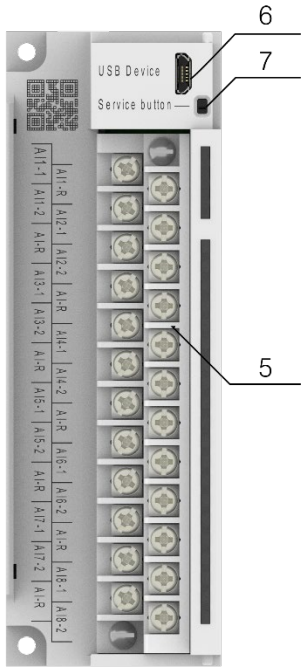

Fig. 2.2. Front view (open cover)

On the device top:

1. Power supply terminals
2. 2 Ethernet connectors (Sect. 4.4, 5.2.4)

On the front cover:

3. LED indicators (Tab. 2.1)
4. Recess for a sticker with IP address

Under the front cover:

5. AI plug-in terminal block (Sect. 5.2)
6. microUSB programming connector (Sect. 4.1.1)
7. Service button

The service button can be used for the following functions:

- IP address assignment (Sect. 4.4.1)
- Factory settings restoration (Sect. 6)
- Firmware update (Sect. 7)

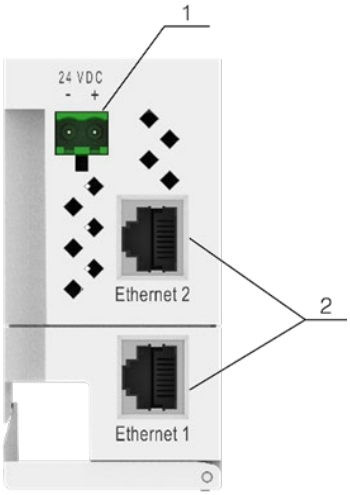

Fig. 2.3. Top view

Table 2.1. LEDs

LED	Color	State	Description
⏻	green	Off	Power off
		On	Power on
Eth 1	green	Off	Not connected
		Flashing	Data transfer over Ethernet 1 interface
Eth 2	green	Off	Not connected
		Flashing	Data transfer over Ethernet 2 interface
⚠	red	Off	No errors
		On	Program / configuration error
		Flashing (0.2 s / 2 s period)	Low battery (Sect. 4.3, App. C)
		Flashing (0.1 s / 0.5 s period)	No requests from master
		Flashing (0.9 s / 1 s period)	Hardware peripherals error (Flash, RTC, Ethernet Switch)
Input LEDs (8)	green	Off	Input is off
		On	Input signal selected
		Flashing	Measurement in progress
	orange	On	Uncritical input error
	red	On	Critical input error

8 DIP switches on the right side of the case are used to switch on the integrated 51 Ω shunt resistors in the selected input.

- position ***1*** – current input signals
- position ***0*** – other input signals

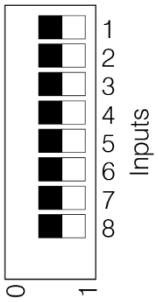

Fig. 2.4. DIP switches

3. Specifications

3.1 Specification tables

Table 3.1 General specification

Electrical		
Power supply		24 (10…48) V DC
Power consumption, max.		4 W at 24 V DC
Polarity protection		yes
Appliance class		II
Interfaces		
Data transfer		Double Ethernet 10/100 Mbps
	Protocols	Modbus TCP MQTT SNMP NTP
Configuration interfaces		USB 2.0 (micro-USB) Ethernet 10/100 Mbps
Analog inputs		
Number		8
Input signal		see Tab. 3.2
ADC resolution		16 bit
Sampling time per input, max. (1)	RTD	0.9 s
	TC	0.6 s
	Linear signals	0.6 s
Basic error	RTD	0.25 % FS
	TC	0.5 % FS
	Linear signals	0.25 % FS
Additional error due to electromagnetic interference, max.		0.25 % FS
Temperature influence		20 % of basic error / 10°C
Integrated shunt resistor		51 Ω
Flash memory (log file storage)		
File size, max.		2 kB
Number of files, max.		1000
Logging interval, min.		10 s
Real-time clock		
Accuracy		±3 s/day at 25°C ±10 s/day at -40°C
Backup battery		CR2032
Mechanical		
Dimensions		42 x 124 x 83 mm
Weight		approx. 260 g

(1) *The full sampling time is the sum of sampling times of all inputs.*

Table 3.2 Sensors / Input signals

Input signal	Temperature coefficient α, 1/°C	Measurement range	Basic error, %	Value of the least significant bit	Standard
RTD					
Pt50	0.00385	-200…+850 °C	0.25	0.1 °C	IEC 60751:2009
Pt100	0.00385	-200…+850 °C	0.25	0.1 °C	IEC 60751:2009

Specifications

Input signal	Temperature coefficient α, 1/°C	Measurement range	Basic error, %	Value of the least significant bit	Standard
Pt500	0.00385	-200…+850 °C	0.25	0.1 °C	IEC 60751:2009
Pt1000	0.00385	-200…+850 °C	0.25	0.1 °C	IEC 60751:2009
50P	0.00391	-200…+850 °C	0.25	0.1 °C	GOST 6651-2009
100P	0.00391	-200…+850 °C	0.25	0.1 °C	GOST 6651-2009
500P	0.00391	-200…+850 °C	0.25	0.1 °C	GOST 6651-2009
1000P	0.00391	-200…+850 °C	0.25	0.1 °C	GOST 6651-2009
Cu50	0.00426	-50…+200 °C	0.25	0.1 °C	GOST 6651-2009
Cu53	0.00426	-50…+200 °C	0.25	0.1 °C	GOST 6651-2009
Cu100	0.00426	-50…+200 °C	0.25	0.1 °C	GOST 6651-2009
Cu500	0.00426	-50…+200 °C	0.25	0.1 °C	GOST 6651-2009
Cu1000	0.00426	-50…+200 °C	0.25	0.1 °C	GOST 6651-2009
50M	0.00428	-180…+200 °C	0.25	0.1 °C	GOST 6651-2009
100M	0.00428	-180…+200 °C	0.25	0.1 °C	GOST 6651-2009
500M	0.00428	-180…+200 °C	0.25	0.1 °C	GOST 6651-2009
1000M	0.00428	-180…+200 °C	0.25	0.1 °C	GOST 6651-2009
Ni100	0.00617	-60…+180 °C	0.25	0.1 °C	GOST 6651-2009
Ni500	0.00617	-60…+180 °C	0.25	0.1 °C	GOST 6651-2009
Ni1000	0.00617	-60…+180 °C	0.25	0.1 °C	GOST 6651-2009
TC					
J	-	-200…+1200 °C	0.5	0.1 °C	IEC 60584-1:2013
N	-	-200…+1300 °C	0.5	0.1 °C	IEC 60584-1:2013
K	-	-200…+1360 °C	0.5	0.1 °C	IEC 60584-1:2013
S	-	-50…+1750 °C	0.5	0.1 °C	IEC 60584-1:2013
R	-	-50…+1750 °C	0.5	0.1 °C	IEC 60584-1:2013
T	-	-250…+400 °C	0.5	0.1 °C	IEC 60584-1:2013
B	-	-200…+1800 °C	0.5	0.1 °C	IEC 60584-1:2013
L (DIN)	-	-200…+900 °C	± 0,75 %	1 °C	DIN 43710
A-1	-	0…+2500 °C	0.5	0.1 °C	IEC 60584-1:2013
A-2	-	0…+2500 °C	0.5	0.1 °C	GOST 8.585-2013
A-3	-	0…+2500 °C	0.5	0.1 °C	GOST 8.585-2013
L (GOST)	-	-200…+800 °C	0.5	0.1 °C	GOST 8.585-2013
Linear signals					
0-5 mA	-	0...100 %	0.25	0.1 %	-
0-20 mA	-	0...100 %	0.25	0.1 %	IEC 60381-1:1985
4-20 mA	-	0...100 %	0.25	0.1 %	IEC 60381-1:1985
-50…+50 mV	-	0...100 %	0.25	0.1 %	-
-1…+1 V	-	0...100 %	0.25	0.1 %	-
0-2000 Ω	-	0...100 %	0.25	1 Ω	-
0-5000 Ω	-	0...100 %	0.25	1 Ω	-
Digital signals					
Switch contact	-	-	-	-	-

3.2 Operating conditions

The module is designed for natural convection cooling. It should be considered when choosing the installation site.

The following environment conditions must be observed:

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

Table 3.3 Operating conditions

Condition	Permissible range
Ambient temperature	-40…+55°C
Transportation and storage	-40…+55°C
Relative humidity	up to 95 % (at +35°C, non-condensing)
Altitude	up to 2000 m ASL
IP code	IP20
Vibration / shock resistance	conforms to IEC 61131-2
EMC emission / immunity	conforms to IEC 61131-2

4. Configuration and operation

The device parameters can be set with akYtecToolPro or by command from a network Master.

The complete parameter list is presented in Appendix D. You can also read it out from the device using the toolbar item ***Parameter list*** in akYtecToolPro.

The modules of Mx210 series have the following parameter groups:

- Real-time clock (Sect. 4.2)
- Battery (Sect. 4.3)
- Network (Sect. 4.4)
- Modbus slave (Sect. 4.5)
- Device status (Sect. 4.6)
- Data logging (Sect. 4.7)
- I/O groups depending on model (Sect. 4.8)

4.1 Connection with akYtecToolPro

The connection with akYtecToolPro running on the PC can be established over the interfaces USB (Sect. 4.1.1) or Ethernet (Sect. 4.1.2).

For configuration over Ethernet, 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.

4.1.1 Connection over USB

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

NOTICE
When the device is powered over USB, the inputs, outputs and the Ethernet 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 digital inputs and USB interface. Equipment connected to these circuits must have the same ground potential or be galvanically isolated to avoid damage to the device.

To configure the module over USB:

1. Connect the microUSB programming connector of the device (Fig. 2.2. Pos. 6) to PC over a USB-to-microUSB connection cable (not included).
2. Start akYtecToolPro.
3. In a new project, click the toolbar item ***Add devices***.
4. In an opened dialog, select the interface ***STMicroelectronics Virtual COM Port.***
5. Select the protocol ***akYtec Autodetection Protocol.***
6. Select ***Find device.***
7. Enter the device address (factory setting: 1) and click ***Search.***
8. If the correct device is found, select it and click the button ***Add devices*** to add the device to the project.
9. If the device is password protected, enter the correct password.

If you forgot the password, restore the factory settings (Sect. 6).

4.1.2 Connection over Ethernet

To configure the module over Ethernet:

1. Connect the Ethernet connector of the device to PC over the Ethernet connection cable (not included).

2. Connect the power cable to the removable 2-terminal block and plug it into the device.
3. Power on the device.
4. Start akYtecToolPro.
5. Click the toolbar item ***Add devices***.
6. In the opened dialog select the interface ***Ethernet.***
7. Select ***Find device.***
8. Enter the IP address (Factory setting: 192.168.1.99) and click ***Search.***
9. If the correct device is found, select it and click the button ***Add devices*** to add the device to the project.
10. If the device is password protected, enter the correct password.

If you forgot the password, restore the factory settings (Sect. 6).

4.2 Real-time clock

The module has a real-time clock (RTC) with a back-up battery (Sect. 4.3). The RTC time is counted as UTC in seconds, starting from 01/01/2000, 00:00.

To set the time, click the toolbar icon ***Real-time clock*** (Fig. 4.1).

Use the button ***Synchronize with PC*** to synchronize the RTC with the PC clock.

Select your time zone from the drop-down list below. You can also set the time zone in the range -720...+840 min. with a 60 min. step in the parameter group ***Real-time clock***.

Use the button ***Save*** to save the parameters in the device memory.

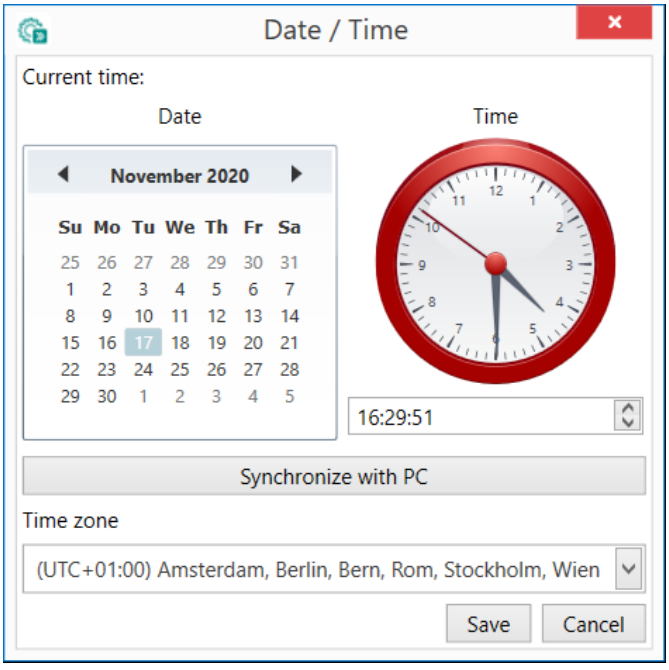

Fig. 4.1. Real-time clock parameters

The RTC is used for calculation of measuring timestamps (Sect. 4.8.5) and of ***Time (ms)*** parameter.

Time (ms) is a cyclic time in milliseconds that starts with turning on and stops with turning off of the device. It is reset to zero at the end of cycle (4294967295 ms). The parameter is used for device diagnostic purposes.

To set the RTC time over Modbus network, proceed as follows:

1. Write the new time in the parameter ***New time.***
2. Set the parameter ***Apply new time*** = 1 and hold the value for at least 1 second.
3. Set the parameter ***Apply new time*** = 0 and hold the value for at least 1 second.

The time value cannot be changed more than once per second.

4.3 Battery

The RTC is powered by the supply voltage. When the device is powered off, RTC is powered by a replaceable battery of type CR2032.

A fully charged battery can power the RTC for 5 years. At the temperatures near the permissible limits (Tab. 3.2), the battery life time is reduced.

The parameter ***Voltage*** in the group ***Battery*** shows the battery voltage in mV.

This parameter is queried each time after powering on and then every 12 hours.

The battery should be replaced if at least one of the following events has occurred:

- LED indicator ⚠ lights up for 0.2 s with a period of 2 s, which means that $U_B \leq 2$ V and the battery has to be replaced as soon as possible, but the RTC can still work for about 2 weeks without power supply.
- The battery was last time replaced 6 years ago.

For battery replacement, see App. C.

NOTE
If the battery voltage is less than 1.6 V, the configuration parameters are written to the battery-backed RAM and then transferred to the flash memory. The recording interval depends on the load of the module processor (at least 2 minutes).
Since the number of erase cycles of the flash memory is limited, it is not recommended to record the configuration parameters cyclically when the battery is low.

4.4 Ethernet

To configure the Ethernet interface, open the node ***Network > Ethernet*** in the parameter tree.

Table 4.1. Ethernet parameters

Parameter	Description	Default value	Access
IP address	IPv4 Internet Protocol address	192.168.1.99	R
Subnet mask	IP address recognition area in the subnet	255.255.255.0	R
Gateway	IP address of the gateway	192.168.1.1	R
DNS server 1	Primary DNS server	77.88.8.8	RW
DNS server 2	Secondary DNS server	8.88.8.8	RW
New IP address	Enter new value	–	RW
New subnet mask	Enter new value	–	RW
New gateway	Enter new value	–	RW
DHCP	***On*** / ***Off*** / ***Service button***	***Service button***	RW

The Ethernet parameters can be set using:

- only main toolbar
- service button on the device (recommended if you need to configure several devices at once) (Sect. 4.4.1.)

To change Ethernet parameters using the main toolbar:

1. Enter new values for the parameters ***New IP address***, ***New subnet mask*** and ***New gateway***
2. Set the parameter ***DHCP*** to ***Off***
3. Click the toolbar item ***Write parameters***
4. Click the toolbar item ***Restart device***
5. 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.

If a dynamic IP address is required (e.g. to use a cloud service), set ***DHCP*** to ***On***.

4.4.1 Network parameters setting using service button

If you need to assign IP addresses for several modules, it is more comfortable to use service buttons on devices (Fig. 2.2. Pos. 7), previously having all the modules connected to the PC over Ethernet.

To change the Ethernet parameters using service buttons:

1. Connect all modules in series to the PC over Dual Ethernet ports (Fig. 2.3. Pos. 2)
2. Power on the modules
3. Start akYtecToolPro
4. Set the parameter ***DHCP*** to ***Service button*** on all modules
5. Click the toolbar item ***IP addresses*** IP
6. Set the IP address for the first module from the group
7. Press the service buttons on the modules sequentially, checking the result in the dialog box, where will be indicated on which module the button was pressed. The specified static IP address and other network parameters, if any have been changed, are assigned to this module. The address is automatically incremented by 1 for each subsequent device.

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

If you forgot the IP address of the device, restore the factory settings (Sect. 6.).

4.5 Modbus Slave

The module can operate in Modbus TCP network as a slave, using the port 502 and the standard address 1. The address can be changed in the group ***Modbus Slave*** (Tab. 4.2).

The device can handle maximum 4 Modbus TCP connections.

For details on Modbus working see Appendix D.

For Modbus protocol specifications see *Modbus specifications*.

Table 4.2. Modbus Slave parameters

Parameter	Description	Range	Default value	Access
Slave address	Device address in a Modbus network	1...254	1	RW
Safe state timeout (1)	Output safe state activation delay after communication interruption	0…60 s	30	RW

(1) *The parameter has no application in the device.*

4.6 Device status

The parameters of the device status are in the group ***Device status*** in the parameter tree.

Table 4.3. Device status parameters

Parameter	Description	Range	Default value	Access
Update period	Status update time interval	1…60 s	5	RW
Status	32-bit status code	0…4294967295	–	R

4.7 Data logging

An archive is saved as a set of encrypted log files. A log file consists of a set of records separated by line break characters (0x0A0D). Each record corresponds to one parameter and consists of fields separated by semicolon. The format of the record is described in Tab. 4.4.

Table 4.4. Record format

Field	Type	Size	Comment
Time	binary	4 Byte	In seconds, beginning from 01/01/2000, 00:00 (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
New line	binary	2 Byte	0x0A0D

Log files are stored in a built-in flash memory, formatted as a file system with encryption. For flash memory specifications see section “Flash memory” in Table 3.1.

If an archive overflows, the new entry will overwrite the oldest one in the archive.

The archiving parameters are described in Tab. 4.5.

To view all logged parameters, use the toolbar item ***Device information*** in akYtecToolPro.

The archive can be read with via Modbus TCP using function 20 (Tab. D.3). This function allows reading one or several records from one or several files in one request. For details on function usage see *Modbus specifications*.

The file number in the Modbus request should be calculated as file ID + 4096. File indexing starts with zero. The parameter ***Last log file ID*** contains the ID of the archive file to which the data was last written.

The time zone is not contained in the file but can be read from the parameter ***Time zone*** (Tab. D.1).

Table 4.5. Archiving parameters

Parameter	Description	Range	Default value	Access
Logging interval	Time interval with which the values of the selected parameters will be recorded	10…3600 s	30	RW
Number of files	Maximum number of archive files	10…300	100	RW
File size	Log file size in Bytes	200…2048	2048	RW
Last log file ID	ID of the last written file	0…65535	–	R

4.8 Analog inputs

To configure the analog inputs, open the ***Analog inputs*** group in the parameter tree.

Table 4.6. AI parameters

Parameter	Description	Range	Default value	Access
Group				
CJC	Reference junction compensation option for thermocouples (Sect. 4.8.7)	***On*** / ***Off***	***On***	RW
Maximum sampling rate	***On*** – Sampling time is automatically adjusted to the minimum possible for the selected input signal (Sect. 4.8.1)	***On*** / ***Off***	***On***	RW

Parameter	Description	Range	Default value	Access
Reference junction 1	Temperature of reference junction sensor 1	-	-	R
Reference junction 2	Temperature of reference junction sensor 2	-	-	R
Reference junction 3	Temperature of reference junction sensor 3	-	-	R
Single				
Input signal	Input signal selection (Sect. 4.8.1) ***Off*** – input excluded from sampling	List	***Switch contact***	RW
Curve offset	Offset correction of sensor characteristic curve (Sect. 4.8.4)	-10000…10000	0	RW
Curve slope	Slope correction of sensor characteristic curve (Sect. 4.8.4)	-1…10		RW
Upper measuring limit	Maximum level of the input signal (Sect. 4.8.2)	-10000…10000	1	RW
Lower measuring limit	Minimum level of the input signal (Sect. 4.8.2)	-10000…10000	0	RW
Sampling time	Input sampling interval (Sect. 4.8.1)	600…10000 ms	3000	RW
Filter bandwidth	Input filter bandwidth in units of measurement (Sect. 4.8.3)	0…100	10	RW
Decimal point offset	***AIn INT*** = ***AIn REAL*** * 10^{DP} (Sect. 4.8.5)	0…7	0	RW
Filter time constant	Filter time constant (Sect. 4.8.3) 0 – filter disabled	0…65535 s	3	RW
AIn REAL	Measured value of input AIn as REAL32 (Sect. 4.8.5)	REAL32	-	R
AIn timestamp	Timestamp of input AIn as INT16 (Sect. 4.8.5)	0…65535 s/100	-	R
AIn INT	Measured value of input AIn as INT16 (Sect. 4.8.5)	-32768…32767	-	R

4.8.1 Input sampling

As long as the ***Input signal*** parameter is set to ***Off***, the input is excluded from the sampling list. If one of the signals is selected, the input will be included in the sampling list.

The parameter ***Sampling time*** can be set for each input separately in the range 0.6...10 seconds. If the input cannot be sampled with the specified interval (that is, if the parameter is set to 0.6 seconds for each of 8 inputs, the total sampling interval will be ca. 4.8 s), the sampling interval will be increased to the shortest possible one.

If the option ***Maximum sampling rate*** is activated (***On***), the sampling time is automatically adjusted to the minimum possible for the selected input signal and the parameter ***Sampling time*** is ignored.

4.8.2 Signal scaling

If a linear input signal is selected, it can be scaled using the parameters ***Lower measuring limit*** and ***Upper measuring limit*** according to the limits of the connected sensor. Thus, it can be converted to the units of measurement.

Example 1:
When using a sensor with an output signal of 4-20 mA, which controls the pressure in the range of 0...25 atm., set the ***Lower measuring limit*** to 00.00, and in the ***Upper measuring limit*** to 25.00. Then, the processing and display of readings will be carried out in atmospheres.

4.8.3 Signal filtering

To protect against electromagnetic interference, the module is equipped with a digital low-pass filter. Digital filtering is carried out in two stages.

1. At the first stage, the pronounced "dips" and "overshoots" are filtered out from the useful signal. The difference between the last two measurements is compared with the ***Filter bandwidth*** parameter. If the difference exceeds the bandwidth, the measurement is repeated with the doubled bandwidth. If the new measuring confirms the correctness of the previous one, its result will be taken as a new stable state to which the bandwidth reduced back to the set value will be applied. If not, the result will be discarded. This algorithm protects the input from the single-pulse interferences often generated by industrial plants.

   The ***Filter bandwidth*** parameter is specified in measurement units for each input. Decreasing the bandwidth improves the interference immunity of the input, but leads to a slower reaction to rapid changes of the input signal. Therefore, when the interference level is low or when working with rapidly changing processes, it is recommended to increase the filter bandwidth or disable the filter stage by setting the parameter to 0.

   When working in conditions of strong interferences, it is recommended to decrease the bandwidth to eliminate their influence on the operation of the module.

2. At the second stage of filtering, the signal is smoothed (damped) in order to eliminate electromagnetic noise components. The main parameter of the damping filter is the ***Filter time constant***.

   Filtering takes place according to the formula:

$$S = S_n * T + S_{n-1} * (1 - T)$$

   where

   S – stored signal value
   S_n – signal value measured at the last sampling
   S_{n-1} – signal value measured at the previous sampling
   T – damping factor

$$T = 1/(\frac{K}{10} + 1)$$

   K – ***Filter time constant***

The ***Filter time constant*** is set in seconds for each input. The increasing of the filter constant improves the noise immunity of the input, but at the same time increases its inertia i.e. slows down the reaction to rapid changes in the input signal.

The second filter stage can be disabled by setting the parameter to 0.

4.8.4 Sensor curve correction

The characteristic curve of the sensor can be corrected with two parameters ***Curve offset*** and ***Curve slope***.

The ***Curve offset*** can be applied in the following cases:

- to compensate the lead wires resistance in a two-wire RTD connection
- to compensate the R_0 drift of a thermocouple

The ***Curve slope*** can be used, to compensate the errors of the sensors themselves or inaccuracy of the shunt resistor. The ***Curve slope*** is set in dimensionless units in the range 1…10.

4.8.5 Measured input values

Measurement results of the input signals are presented in two formats (Tab. 4.6):

AIn REAL – 4-byte floating point value
AIn INT – 2-byte integer value

where

***AIn INT* = *AIn REAL* * 10 ^{DP}**
DP – ***Decimal point offset*** specified in the range 0…7.

NOTE
Setting the "Decimal point offset" to 6 or 7 can cause that the "AIn INT" value goes beyond the range -32768…32767 (or 0…65535 for unsigned presentation) and cannot be saved in INT16 format. This should be taken into account when setting the "Decimal point offset" value.

AIn timestamp is a cyclic time with the 0.01 second step, stored in two bytes. The time counting starts with the first measuring and is reset to zero every 65536 steps, i.e. 655.36 seconds. It marks the time of the measurement in the channel. Using the timestamp, you do not have to take the Ethernet transmission delay into account (e.g. when calculating the derivation time in the PID control).

The measured values are stored in their respective memory registers (Tab. D.1) and can be read with Modbus functions 3 (0x03) or 4 (0x04).

4.8.6 Sensor diagnostic

The module monitors the operation of the transmitters connected to its inputs. If a malfunction is detected, the module transmits an error message over Ethernet. Common error cases:

- All transmitter types – the measured values are beyond the permissible range
- RTD or TC sensor break
- RTD short circuit
- Cold junction temperature is beyond the range -40...+90 °C

Some transmitter errors cannot be detected:

- Current and voltage sensor breaks. The measuring channel shows a zero value or the error "Measured value too low".
- Due to the implemented diagnostic of a thermocouple short circuit, resistance signals below 25 Ω are considered invalid. Therefore, the resistance sensor 0...2 kΩ cannot measure signals in the range 0…25 Ω (0…1.26% of the measuring range).

In case of an input error, the error code is written to the most significant byte of the corresponding ***AIn REAL*** register instead of the measured value and to the ***AIn status*** register.

Table 4.7. Input diagnostic errors

Error code	Description	Input indicator
0xF0	Incorrect value	orange
0xF6	Data not ready. Wait for the results of the first measurement after powering on.	orange
0xF7	Input disabled (Off)	off
0xF8	Cold junction temperature too high	orange
0xF9	Cold junction temperature too low	orange
0xFA	Measured value too high	orange
0xFB	Measured value too low	orange
0xFC	Sensor short circuit	red
0xFD	Sensor break	red
0xFE	No connection with ADC	red
0xFF	Incorrect calibration coefficient	orange

4.8.7 Reference junction compensation

The input circuit provides an optional correction of the measured values for thermocouples using the reference (cold) junction temperature compensation (CJC). The cold junction temperature is measured by three

integrated sensors. The option is active by default. It can be deactivated by setting the ***CJC*** parameter to ***Off***.

4.9 NTP protocol

The module supports the synchronization of the RTC with an NTP server v4. Open the ***NTP*** group to configure NTP parameters.

Table 4.8. NTP parameters

Parameter	Description	Range	Default value	Access
Enable	Enable NTP connection	***On*** / ***Off***	***Off***	RW
NTP server pool	IP or URL of NTP pool. If the server is located in an external network, check the correct values for the parameters ***Gateway*** and ***DNS*** (***Network*** group)	-	pool.ntp.org	RW
NTP server 1	IP or URL of the primary NTP server	-	192.168.1.1	RW
NTP server 2	IP or URL of the secondary NTP server		192.168.1.2	RW
Synchronization period	Time synchronization period in seconds. Ensure the set value is not less than the minimum value for the selected NTP server.	5…65535 s	5	RW
Status	Server connection status	-	-	R

All specified NTP servers (including servers from the pool) have the same polling priority.

For more information see document: NTP_MQTT_SNMP_protocols.

4.10 MQTT protocol

4.10.1 Basics

The MQTT protocol defines two types of network entities: a message ***broker*** and a number of clients. Broker is a server that receives all messages from the clients and then routes the messages to the appropriate destination clients. Client can be ***publisher*** or / and ***subscriber***.

Published messages are organized in a hierarchy of ***topics***. When a publisher has a new data to distribute, it sends a message with the data under the particular topic to the connected broker. The broker distributes the message to any clients that have subscribed to that topic.

A topic is a UTF-8 encoded character string that the broker uses to filter messages for each connected client. The topic consists of one or more topic ***levels***. Each topic level is separated by a forward slash (topic level separator).

When a client subscribes to a topic, it can subscribe to the exact topic of a published message or it can use wildcards to subscribe to multiple topics simultaneously. There are two kinds of wildcard symbols: ***single-level*** (+) and ***multi-level*** (#) (see Example 2).

4.10.2 Implementation

The module supports the MQTT protocol (v3.1.1) and can be used as client. It can publish information about the status of its inputs and outputs and can be subscribed to topics which control its outputs.

To configure the MQTT parameters, open the ***MQTT*** group in the parameter tree.

NOTE
When using the MQTT protocol, it is recommended to set the parameter "Safe state timeout" ("Modbus Slave" group) to 0, since writing is usually event-driven and not cyclic in this case.

Table 4.9. MQTT parameters

Parameter	Description	Range	Default value	Access
Presence detection. Enable	If ***On***, the module publishes the message "Online" to the topic specified in the parameter ***Topic name*** after switching on. If no messages are received from the module, the broker publishes an “Offline” message in this topic.	***On*** / ***Off***	***Off***	RW
Presence detection. Topic name	Topic name used for presence detection.	-	***MQTT-status***	RW
Connect to broker	Set to ***On*** to establish connection	***On*** / ***Off***	***Off***	RW
User name	Used for device authentication on the broker side. Authentication is not used if the values are not specified.	-	-	RW
Password		-	-	RW
Device name	Device name used in the topic name (see Example 2)	-	-	RW
Broker address	Broker IP or URL. If the broker is located in an external network, check the correct values for the parameters ***Gateway*** and ***DNS*** (***Network*** group)	-	-	RW
Port	Port for broker	0…65535	1883	RW
Store last message	If ***On***, other clients subscribed to the module's topics will receive the latest messages from these topics.	***On*** / ***Off***	***Off***	RW
Publishing interval	Publishing interval in seconds	5…600	10	RW
Quality of service	***QoS0*** - at most once ***QoS1*** - at least once ***QoS2*** - exactly once	***QoS0*** / ***QoS1*** / ***QoS2***	***QoS0***	RW
Keep Alive interval	Keep Alive interval in seconds	0…600	0	RW
Status	Broker connection status	-	-	R

Table 4.10. Topics

Parameter	Topic	Node	Function	Format
AIn REAL	VALUE	AI1…AI8	GET	REAL

Example 2:

Device – device name specified in akYtecToolPro

1. Read the input AI1 measured value
   MX210/Device/GET/AI1/VALUE
   Obtained value: measured value on input 1
2. Single-level wildcard usage
   MX210/Device/GET/+/VALUE
   Obtained value: measured values of all analog inputs. The topic is equivalent to the group of topics:

   MX210/Device/GET/AI1/VALUE
   MX210/Device/GET/AI2/VALUE
   MX210/Device/GET/…/VALUE
   MX210/Device/GET/AI8/VALUE
3. Multi-level wildcard usage
   MX210/Deviceme/GET/#
   Obtained value: measured values of all analog inputs. The topic is equivalent to the group of topics:

   MX210/Device/GET/AI1/VALUE
   MX210/Device/GET/AI2/VALUE
   MX210/Device/GET/…/VALUE
   MX210/Device/GET/AI8/VALUE

For more information see document: NTP_MQTT_SNMP_protocols.

4.11 SNMP protocol

4.11.1 Basics

The protocol is based on the Client / Server architecture, where clients are called ***managers*** and servers are called ***agents***.

Managers can read (GET) and write (SET) agent parameters. Agents can send messages (***traps***) to managers about changes in any parameter.

Each agent parameter has a unique identifier (OID - object identifier), which is a sequence of numbers separated by periods.

4.11.2 Implementation

The module supports SNMP protocol (SNMPv1 and SNMPv2c versions) and can be used as agent with GET and SET requests.

All module parameters are available via SNMP protocol. The list of parameters is given in App. D.

NOTE
When using the SNMP protocol without GET requests, it is recommended to set the parameter "Safe state timeout" ("Modbus Slave" group) to 0, since writing is usually event-driven and not cyclic in this case.

Table 4.11. SNMP parameters

Parameter	Description	Range	Default value	Access
Enable	Enable SNMP connection	***On*** / ***Off***	***Off***	RW
Read community	Password for read access	-	***public***	RW
Write community	Password for write access	-	***private***	RW
Trap IP address	IP address to which the trap will be sent in case of changing the mask of the digital inputs (modules with digital inputs only)	-	10.2.4.78	RW
Trap port	Port number to which the trap will be sent	0…65535	162	RW
SNMP version	Protocol version	***SNMPv1*** / ***SNMPv2***	***SNMPv1***	RW

For more information see document: NTP_MQTT_SNMP_protocols.

4.12 Password

You can use password to protect the configuration parameters of the device from an unauthorized access.

To set the password, use the toolbar item ***Password*** *** or the same item in the device context menu. There is no password by default.

If you forgot the password, restore the factory settings (Sect. 6).

5. Installation

The safety requirements from the section 1.5 must be observed.

5.1 Mounting

The device is designed to be installed on DIN rail or using two screws on a mounting panel in an electric cabinet.

The operating conditions from the Sect. 3.2 must be considered when choosing the installation site.

Dimensional drawings are given in Appendix A. Only the vertical positioning of the device is allowed.

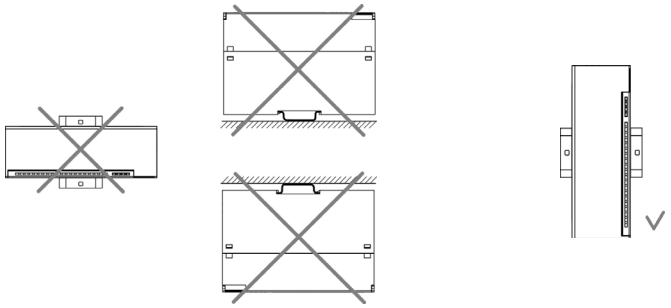

Fig. 5.1 DIN rail mounting

Device replacement (Fig. 5.2):

- switch off the power supply of the module and all connected devices
- open the front cover 1
- loosen the two screws 3
- remove the terminal block 2

Now you can replace the device.

Reverse this procedure after replacing the device.

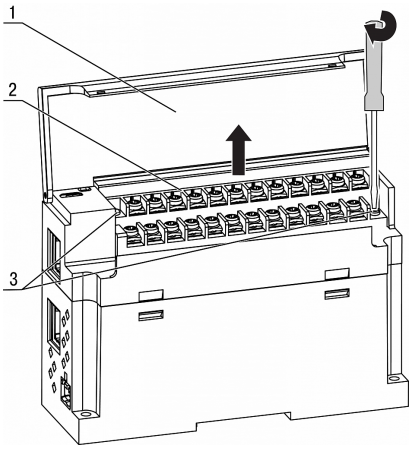

Fig. 5.2 Device replacement

5.2 Wiring

WARNING

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

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.

NOTE

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.***

5.2.1 General information

Power supply terminals and Ethernet interfaces are placed on the top of the device (Fig. 2.3. Pos.1). Mating plug for the power supply is included.

Terminal assignments are given in Fig. 5.3 and Tab. 5.1.

Electrical connections for inputs and outputs are given in Fig. 5.4…5.10.

Maximum conductor cross-section is 1.0 mm².

Plug-in terminal block for power supply and removable terminal block for I/O connections enable quick and easy replacement of the device (see Fig. 5.2).

When wiring is completed, the wires should be placed in a special recess under the cover so that adjacent devices can be placed on the DIN rail close to each other.

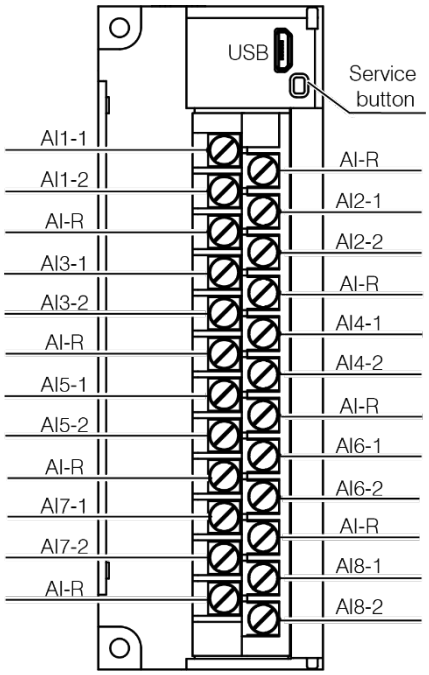

Fig. 5.3 Front view (open cover)

Table 5.1 Terminal assignments

Marking	Description
AI1-1…AI8-1	Input terminals 1 (-)
AI1-2…AI8-2	Input terminals 2 (+)
AI-R	Common terminals R (internally connected)

5.2.2 Analog inputs

Table 5.2 Sensor line requirements

Sensor type	Line length m	Line resistance, max. Ω	Line design
RTD	100	15	Three-wire cable, wires of equal length and cross-section
TC	20	100	Thermocouple (compensating) cable
Current signal	100	100	Two-wire cable
Voltage signal	100	50	Two-wire cable
Resistance signal	10	5	Two-wire cable

5.2.2.1 RTD

For supported sensors see Tab. 3.2.

The RTD sensor should be connected to an input using a three-wire line in order to reduce the influence of the resistance of the lead wires on the measurement results.

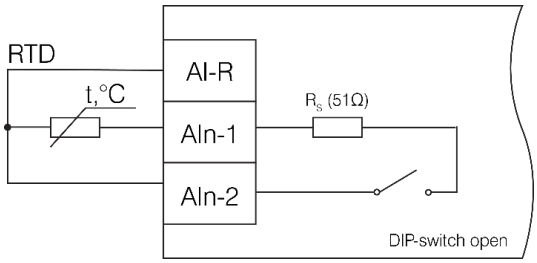

Fig. 5.4 RTD wiring

5.2.2.2 TC

For supported sensors see Tab. 3.2.

NOTICE

Only thermocouples with insulated (ungrounded) measuring („hot“) junction can be used, because the negative terminals AIn-1 of all inputs have the same electric potential.

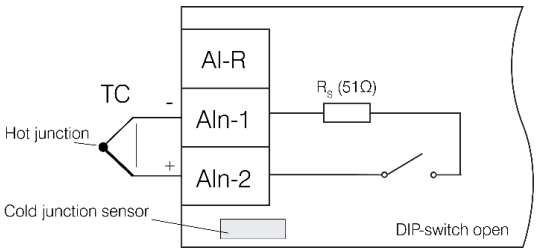

Fig. 5.5 TC wiring

To connect a remote thermocouple to the input, use thermocouple (compensating) cable.

About using of cold junction compensation (CJC) see Sect. 4.8.7.

5.2.2.3 Current or voltage active linear signals

For supported signals see Tab. 3.2.

Active sensors use external DC voltage source.

NOTICE

The negative terminals of all inputs AIn have the same electric potential.

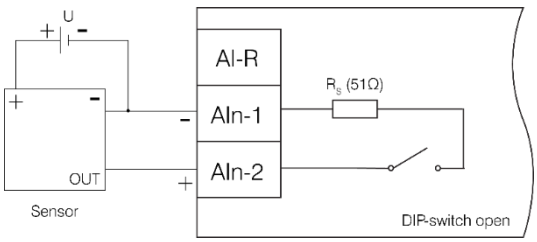

Fig. 5.6 Voltage sensor wiring (3-wire)

Before connecting a current sensor to the selected input, turn the DIP switch of this input to “1” position (Fig. 2.4).

Turn the DIP switch in “0” position when using a non-current sensor. Otherwise the measured values will be calculated incorrectly.

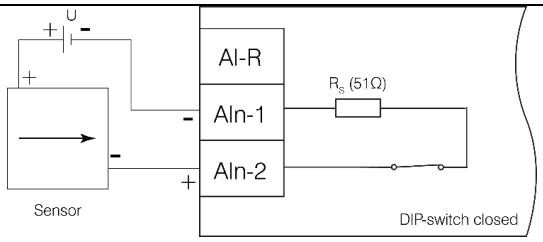

Fig. 5.7 Current sensor wiring (2-wire)

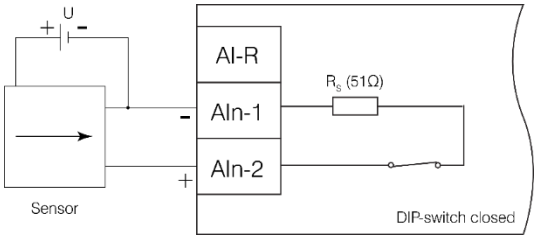

Fig. 5.8 Current sensor wiring (3-wire)

5.2.2.4 Linear resistance signals

For supported signals see Tab. 3.2.

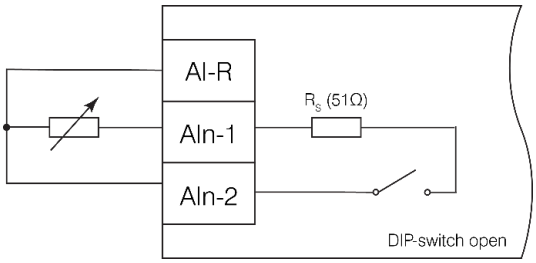

Fig. 5.9 Resistance sensor wiring (3-wire)

5.2.2.5 Switch contact

Two discrete "dry contact" signals can be connected to each analog input (switches, buttons, relay contacts, etc.).

Any resistors in the range 200…3000 Ω can be used as shunt resistors. Both resistors on the input must have the same nominal value.

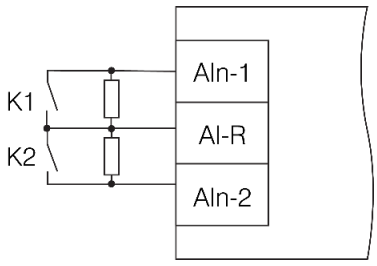

Fig. 5.10 Switch contact wiring

The status of the input connected with two switch contacts is represented as an integer in the range 0…3 (Tab. 5.3).

Table 5.3 Digital input status

Status	K1	K2
0	open	open
1	open	closed
2	closed	open
3	closed	closed

5.2.3 Ethernet

Ethernet connections can be established in a star or daisy chain topology (Fig. 5.11, 5.12).

It is recommended to seal the unused connector with a rubber plug (included).

Star topology:

- The maximum length of the network lines between modules is 100 m.
- Both Ethernet connectors can be used.

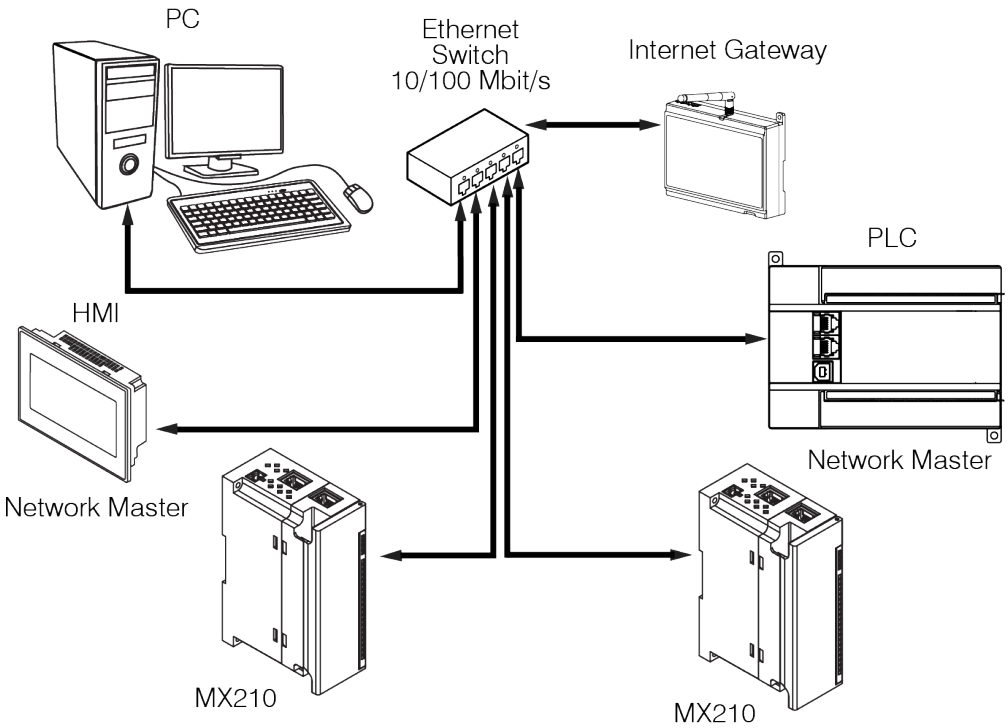

Fig. 5.11 Star topology

Chain topology:

- maximum section length is 100 m
- realized with two Ethernet connectors
- If the module fails (device error or power supply loss), the data is transferred directly from connector 1 to connector 2 (auto-bypass).

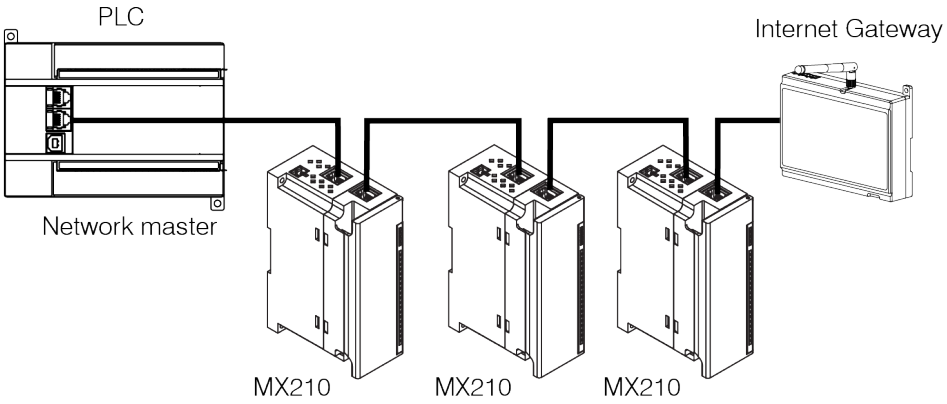

Fig. 5.12 Chain topology

6. Factory settings restoration

NOTE
After restoring the factory settings all parameters but Ethernet will be reset to default values and the password deleted. The Ethernet parameters will not be affected.

To restore the factory settings:

- Power on the device
- Open the front cover
- Using a thin tool, press and hold the service button (Fig. 2.2. Pos. 7) for at least 12 seconds
- Close the cover

The device will operate with the default parameters.

7. Maintenance

WARNING
Cut off all power before maintenance.

The maintenance includes:

- cleaning the case and terminal blocks from dust, dirt and debris
- checking the device fastening
- checking the wiring (connecting wires, terminal connections, absence of mechanical damages).

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

8. 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.

The environmental conditions from the Sect. 3.2 must be considered during transportation and storage.

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.

9. Scope of delivery

– MV210-101	1
– Ethernet connection cable	1
– 2-pole plug-in terminal block	1
– Rubber plug	1
– Short guide	1

Appendix A. Dimensions

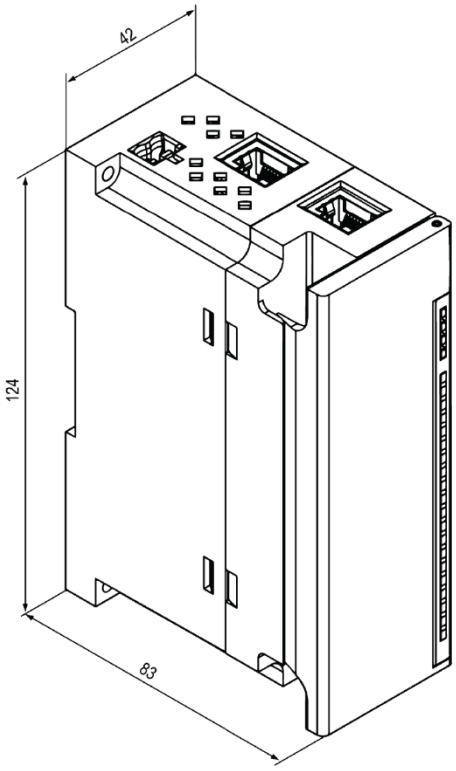

Fig. A.1 External dimensions

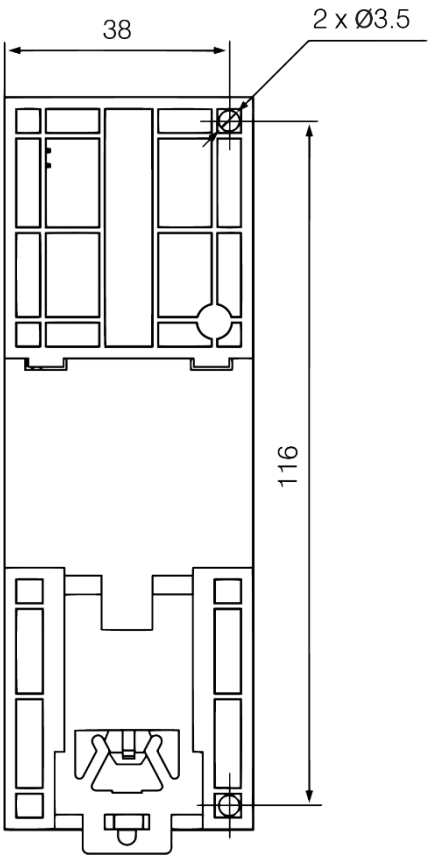

Fig. A.2 Wall mounting dimensions

Appendix B. Galvanic isolation

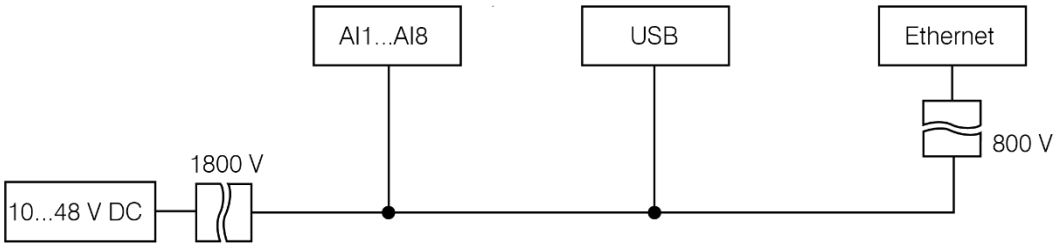

Fig. B.1 Galvanic isolation

The test voltages shown in Fig. B.1 correspond to the tests carried out under normal operating conditions with 1 minute exposure time.

Appendix C. Battery replacement

To replace the battery, proceed as follows:

- power off the module and all connected devices
- remove the terminal blocks without disconnecting the connected wires (Fig. 5.2)
- remove the module from the DIN rail
- remove the front part of the case by opening the four side latches one-by-one using a flat screwdriver (Fig. C.1)
- replace the battery.

The replacement should not take longer than one minute. Otherwise, the real-time clock has to be adjusted anew.

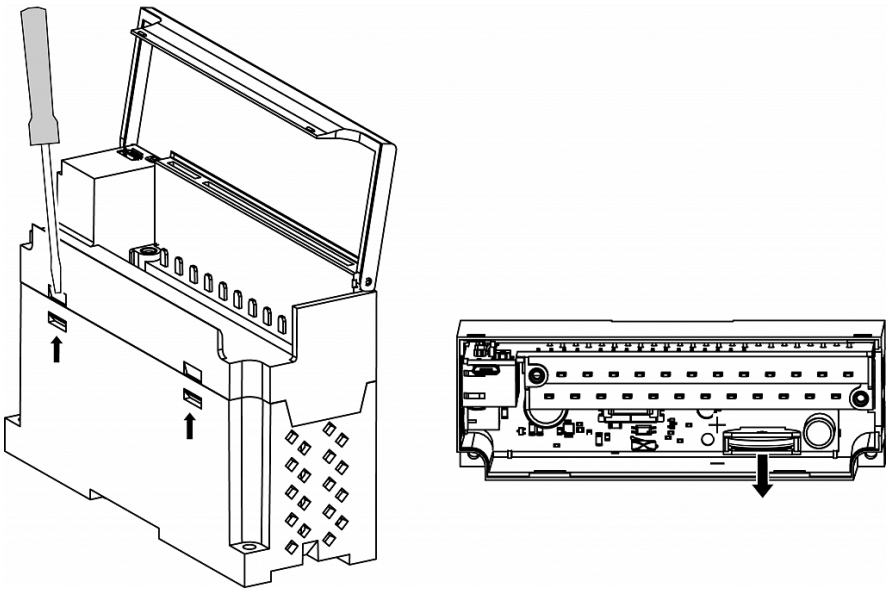

Fig. C.1 Battery replacement

Appendix D. Modbus application

Table D.1 – device parameters with register addresses

Table D.2 – used data types

Table D.3 – used Modbus functions

Table D.4 – possible data exchange errors

Table D.5 – function-specific errors

If an error occurs when receiving a request, the module sends a response to the Master with an error code.

If the request does not comply with the Modbus specification, it will be ignored.

Table D.1. Modbus registers

Parameter	Value	Unit	Access	Address		Data type
				hex	dec	
Device information						
Device name (dev)	-	-	R	0xF000	61440	String32
Firmware version (ver)	-	-	R	0xF010	61456	String32
Platform name	-	-	R	0xF020	61472	String32
Platform version	-	-	R	0xF030	61488	String32
Hardware version	-	-	R	0xF040	61504	String16
Additional text information	-	-	R	0xF048	61512	String16
S/N	-	-	R	0xF084	61572	String32
MAC address	-	-	R	0xF100	61696	UINT48
Real-time clock						
Time	-	s	R	0xF080	61568	DATETIME
Time zone	-	min	RW	0xF082	61570	TIMEZONE
Time (ms)	0…4294967295	ms	R	0xF07B	61563	UINT32
New time	-	s	RW	0xF07D	61565	DATETIME
Apply new time	0 - off / 1 - on	-	RW	0xF07F	61567	UINT16
Network / Ethernet						
IP address	-	-	R	0x001A	26	UINT32
Subnet mask	-	-	R	0x001C	28	UINT32
Gateway	-	-	R	0x001E	30	UINT32
DNS server 1	-	-	RW	0x000C	12	UINT32
DNS server 2	-	-	RW	0x000E	14	UINT32
New IP address	-	-	RW	0x0014	20	UINT32
New subnet mask	-	-	RW	0x0016	22	UINT32
New gateway	-	-	RW	0x0018	24	UINT32
DHCP	0 - off 1 - on 2 - service button	-	RW	0x0020	32	UINT16
Battery						
Voltage	0…3300	mV	R	0x0321	801	UINT16
Modbus Slave						
Safe state timeout	0…60	s	RW	0x2BC	700	UINT8
Device status						
Status	-		R	0xF0B4	61620	UINT32

Data logging						
Logging interval	10…3600	s	RW	0x0384	900	UINT16
Analog inputs / Group						
CJC	0 - off / 1 - on	-	RW	0x1000	4096	UINT16
Maximum sampling rate	0 - off / 1 - on	-	RW	0x1001	4097	UINT16
Reference junction 1	-	-	R	0x1FC8	4040	REAL32
Reference junction 2	-	-	R	0x1FCA	4042	REAL32
Reference junction 3	-	-	R	0x1FCC	4044	REAL32
Analog inputs / Single						
AI1 Input signal	See Tab. 3.2	-	RW	0x1004	4100	UINT32
AI1 Filter bandwidth	0…100	-	RW	0x1006	4102	UINT16
AI1 Decimal point offset	0…7	-	RW	0x1007	4103	UINT16
AI1 Curve offset	-10000…10000	-	RW	0x1008	4104	REAL32
AI1 Curve slope	-1…10	-	RW	0x100A	4106	REAL32
AI1 Upper measuring limit	-10000…10000	-	RW	0x100C	4108	REAL32
AI1 Lower measuring limit	-10000…10000	-	RW	0x100E	4110	REAL32
AI1 Filter time constant	0…65535	s	RW	0x1010	4112	UINT16
AI1 Sampling time	600…10000	ms	RW	0x1011	4113	UINT16
AI2 Input signal	See Tab. 3.2	-	RW	0x1014	4116	UINT32
AI2 Filter bandwidth	0…100	-	RW	0x1016	4118	UINT16
AI2 Decimal point offset	0…7	-	RW	0x1017	4119	UINT16
AI2 Curve offset	-10000…10000	-	RW	0x1018	4120	REAL32
AI2 Curve slope	-1…10	-	RW	0x101A	4122	REAL32
AI2 Upper measuring limit	-10000…10000	-	RW	0x101C	4124	REAL32
AI2 Lower measuring limit	-10000…10000	-	RW	0x101E	4126	REAL32
AI2 Filter time constant	0…65535	s	RW	0x1020	4128	UINT16
AI2 Sampling time	600…10000	ms	RW	0x1021	4129	UINT16
AI3 Input signal	See Tab. 3.2	-	RW	0x1024	4132	UINT32
AI3 Filter bandwidth	0…100	-	RW	0x1026	4134	UINT16
AI3 Decimal point offset	0…7	-	RW	0x1027	4135	UINT16
AI3 Curve offset	-10000…10000	-	RW	0x1028	4136	REAL32
AI3 Curve slope	-1…10	-	RW	0x102A	4138	REAL32
AI3 Upper measuring limit	-10000…10000	-	RW	0x102C	4140	REAL32
AI3 Lower measuring limit	-10000…10000	-	RW	0x102E	4142	REAL32
AI3 Filter time constant	0…65535	s	RW	0x1030	4144	UINT16
AI3 Sampling time	600…10000	ms	RW	0x1031	4145	UINT16
AI4 Input signal	See Tab. 3.2	-	RW	0x1034	4148	UINT32
AI4 Filter bandwidth	0…100	-	RW	0x1036	4150	UINT16
AI4 Decimal point offset	0…7	-	RW	0x1037	4151	UINT16
AI4 Curve offset	-10000…10000	-	RW	0x1038	4152	REAL32
AI4 Curve slope	-1…10	-	RW	0x103A	4154	REAL32
AI4 Upper measuring limit	-10000…10000	-	RW	0x103C	4156	REAL32
AI4 Lower measuring limit	-10000…10000	-	RW	0x103E	4158	REAL32
AI4 Filter time constant	0…65535	s	RW	0x1040	4160	UINT16
AI4 Sampling time	600…10000	ms	RW	0x1041	4161	UINT16
AI5 Input signal	See Tab. 3.2	-	RW	0x1044	4164	UINT32
AI5 Filter bandwidth	0…100	-	RW	0x1046	4166	UINT16
AI5 Decimal point offset	0…7	-	RW	0x1047	4167	UINT16

AI5 Curve offset	-10000…10000	-	RW	0x1048	4168	REAL32
AI5 Curve slope	-1…10	-	RW	0x104A	4170	REAL32
AI5 Upper measuring limit	-10000…10000	-	RW	0x104C	4172	REAL32
AI5 Lower measuring limit	-10000…10000	-	RW	0x104E	4174	REAL32
AI5 Filter time constant	0…65535	s	RW	0x1050	4176	UINT16
AI5 Sampling time	600…10000	ms	RW	0x1051	4177	UINT16
AI6 Input signal	See Tab. 3.2	-	RW	0x1054	4180	UINT32
AI6 Filter bandwidth	0…100	-	RW	0x1056	4182	UINT16
AI6 Decimal point offset	0…7	-	RW	0x1057	4183	UINT16
AI6 Curve offset	-10000…10000	-	RW	0x1058	4184	REAL32
AI6 Curve slope	-1…10	-	RW	0x105A	4186	REAL32
AI6 Upper measuring limit	-10000…10000	-	RW	0x105C	4188	REAL32
AI6 Lower measuring limit	-10000…10000	-	RW	0x105E	4190	REAL32
AI6 Filter time constant	0…65535	s	RW	0x1060	4192	UINT16
AI6 Sampling time	600…10000	ms	RW	0x1061	4193	UINT16
AI7 Input signal	See Tab. 3.2	-	RW	0x1064	4196	UINT32
AI7 Filter bandwidth	0…100	-	RW	0x1066	4198	UINT16
AI7 Decimal point offset	0…7	-	RW	0x1067	4199	UINT16
AI7 Curve offset	-10000…10000	-	RW	0x1068	4200	REAL32
AI7 Curve slope	-1…10	-	RW	0x106A	4202	REAL32
AI7 Upper measuring limit	-10000…10000	-	RW	0x106C	4204	REAL32
AI7 Lower measuring limit	-10000…10000	-	RW	0x106E	4206	REAL32
AI7 Filter time constant	0…65535	s	RW	0x1070	4208	UINT16
AI7 Sampling time	600…10000	ms	RW	0x1071	4209	UINT16
AI8 Input signal	See Tab. 3.2	-	RW	0x1074	4212	UINT32
AI8 Filter bandwidth	0…100	-	RW	0x1076	4214	UINT16
AI8 Decimal point offset	0…7	-	RW	0x1077	4215	UINT16
AI8 Curve offset	-10000…10000	-	RW	0x1078	4216	REAL32
AI8 Curve slope	-1…10	-	RW	0x107A	4218	REAL32
AI8 Upper measuring limit	-10000…10000	-	RW	0x107C	4220	REAL32
AI8 Lower measuring limit	-10000…10000	-	RW	0x107E	4222	REAL32
AI8 Filter time constant	0…65535	s	RW	0x1080	4224	UINT16
AI8 Sampling time	600…10000	ms	RW	0x1081	4225	UINT16
Analog inputs / Measuring values						
AI1 REAL	-	-	R	0x0FA0	4000	REAL32
AI1 timestamp	0…65535	s/100	R	0x0FA2	4002	UINT16
AI1 INT	-	-	R	0x0FE0	4064	INT16
AI2 REAL	-	-	R	0x0FA3	4003	REAL32
AI2 timestamp	0…65535	s/100	R	0x0FA5	4005	UINT16
AI2 INT	-	-	R	0x0FE1	4065	INT16
AI3 REAL	-	-	R	0x0FA6	4006	REAL32
AI3 timestamp	0…65535	s/100	R	0x0FA8	4008	UINT16
AI3 INT	-	-	R	0x0FE2	4066	INT16
AI4 REAL	-	-	R	0x0FA9	4009	REAL32
AI4 timestamp	0…65535	s/100	R	0x0FAB	4011	UINT16
AI4 INT	-	-	R	0x0FE3	4067	INT16
AI5 REAL	-	-	R	0x0FAC	4012	REAL32
AI5 timestamp	0…65535	s/100	R	0x0FAE	4014	UINT16

AI5 INT	-	-	R	0x0FE4	4068	INT16
AI6 REAL	-	-	R	0x0FAF	4015	REAL32
AI6 timestamp	0…65535	s/100	R	0x0FB1	4017	UINT16
AI6 INT	-	-	R	0x0FE5	4069	INT16
AI7 REAL	-	-	R	0x0FB2	4018	REAL32
AI7 timestamp	0…65535	ms	R	0x0FB4	4020	UINT16
AI7 INT	-	-	R	0x0FE6	4070	INT16
AI8 REAL	-	-	R	0x0FB5	4021	REAL32
AI8 timestamp	0…65535	ms	R	0x0FB7	4023	UINT16
AI8 INT	-	-	R	0x0FE7	4071	INT16
Analog inputs / Input statuses						
AI1 status	-	-	R	0x0FE8	4072	UINT16
AI2 status	-	-	R	0x0FE9	4073	UINT16
AI3 status	-	-	R	0x0FEA	4074	UINT16
AI4 status	-	-	R	0x0FEB	4075	UINT16
AI5 status	-	-	R	0x0FEC	4076	UINT16
AI6 status	-	-	R	0x0FED	4077	UINT16
AI7 status	-	-	R	0x0FEE	4078	UINT16
AI8 status	-	-	R	0x0FEF	4079	UINT16
NTP						
Enable	0 - off / 1 - on	-	RW	0x1600	5632	UINT16
NTP server pool	-	-	RW	0x1601	5633	String32
NTP server 1	-	-	RW	0x1641	5697	UINT32
NTP server 2	-	-	RW	0x1643	5699	UINT32
Synchronization period	5…65535	s	RW	0x1645	5701	UINT16
Status	0 - off 1 - on 2 - synchronized	-	RW	0x1646	5702	UINT16
MQTT						
Connect to broker	0 - off / 1 - on	-	RW	0x1700	5888	UINT16
User name	-	-	RW	0x1728	5928	String32
Password	-	-	RW	0x1748	5960	String32
Device name	-	-	RW	0x1708	5896	String32
Broker address	-	-	RW	0x1769	5993	String32
Port	0…65535	-	RW	0x1703	5891	UINT16
Store last message	0 - off / 1 - on	-	RW	0x1707	5895	UINT16
Publishing interval	5…600	s	RW	0x1704	5892	UINT16
Quality of service	0 - QoS0 1 - QoS1 2 - QoS2	-	RW	0x1705	5893	UINT16
Keep Alive interval	0…600	s	RW	0x1768	5992	UINT16
Status	0 - off 1 - on 2 - connection error	-	R	0x1789	6025	UINT16
Enable	0 - off / 1 - on	-	RW	0x178A	6026	UINT16
SNMP						
Enable	0 - off / 1 - on	-	RW	0x1400	5120	UINT16
Read community	-	-	RW	0x1771	6001	String32
Write community	-	-	RW	0x1781	6017	String32
Trap IP address	-	-	RW	0x1401	5121	UINT32

Trap port	0…65535	-	RW	0x1403	5123	UINT16
SNMP version	0 - SNMPv1 1 - SNMPv2	-	RW	0x1404	5124	UINT16

Table D.2. Data types

Data type	Size (registers)	Size (bytes)	Description
UINT8	1	1	Unsigned integer
UINT16	1	2	Unsigned integer
UINT32	2	4	Unsigned integer
UINT48	3	6	Unsigned integer
INT16	1	2	Signed integer
String16	8	16	String of characters (Win-1251 code page)
String32	16	32	String of characters (Win-1251 code page)
DATETIME	2	4	UINT32, time in seconds, starting from 01/01/2000, 00:00
TIMEZONE	1	2	INT16, difference between UTC and local time in minutes

Table D.3. Modbus functions

Code	Name	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

Table D.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

Table D.5. Function-specific errors

Function code	Error code	Possible error causes
03	02	Number of requested registers is greater than the maximum possible (125)
		Nonexistent parameter requested
04	02	Number of requested registers is greater than the maximum possible (125)
		Request for a nonexistent parameter
06	02	An attempt to write a parameter longer than 2 bytes
		An attempt to write a read-only parameter
		An attempt to write a parameter of a type that cannot be written to by this function. Supported types: – INT, UINT, max. 2 bytes – enumerated – REAL16
		Nonexistent parameter requested
	03	Parameter value is beyond the valid limits
16	02	Nonexistent parameter requested
		An attempt to write a read-only parameter
		Number of requested registers is greater than the maximum possible (123)
	03	No termination character (\0) in string parameter
		Size of the requested data is less than the size of the first or last parameter in the request
		Parameter value is beyond the valid limits

20	01	Invalid data size (valid range 0x07 … 0xF5)
	02	Not specified reference type
		Failed to open the file for reading (may be nonexistent)
	03	Failed to move to the desired offset in the file
	04	Error while deleting file on delete request
		Too much data requested (more than 250 bytes)
		Invalid record number (greater than 0x270F)
		Invalid record length (greater than 0x7A)
21	01	Invalid data size (valid range 0x09 ... 0xFB)
	02	Not specified reference type
		Failed to open the file for writing
	04	Nonexistent file requested
		Read-only file requested
		Failed to write the required number of bytes