EN




# MU210-403

## Digital output module

## User guide

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# 1 Introduction

## 1.1 Terms and abbreviations

**akYtecToolPro** – configuration software
**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*)
**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
**UTC** – Coordinated Universal Time, worldwide 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 applications.
– 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.***

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**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.***

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# 2 Overview

MU210-403 is an extension module with 24 relay outputs.
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 *www.akYtec.de*.

## 2.1 Basic features

- 24 relay outputs with pulse-width modulation option
- Device and output status indicators
- Dual Ethernet
- Slave in Modbus network over Ethernet
- USB configuration interface
- Real-time clock
- Data logging and archiving
- DIN rail or wall mounting

## 2.2 Design and indicators

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.

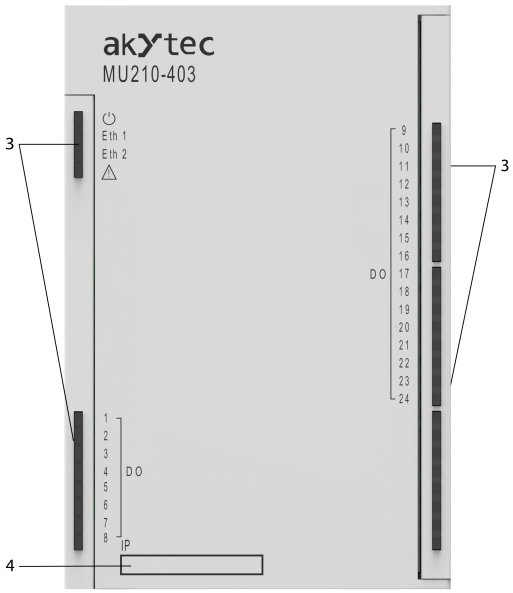



*Fig. 2.1 Front view (closed cover)*

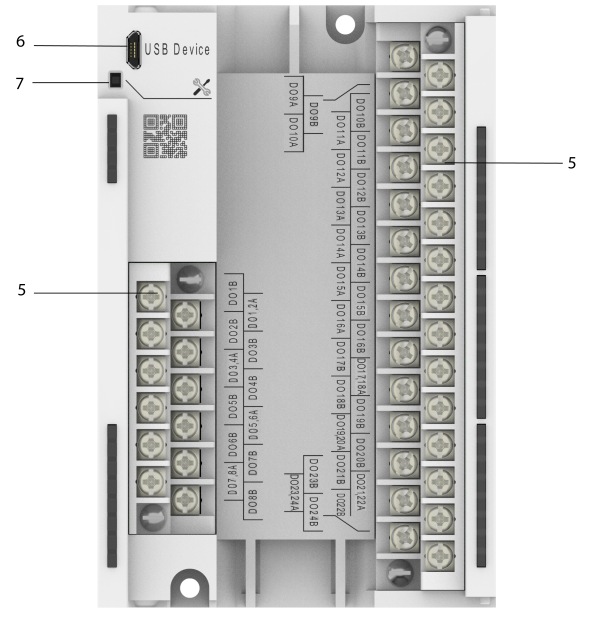



*Fig. 2.2 Front view (open cover)*

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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. Removable I/O terminal block (Sect. 5.2)
6. microUSB programming connector (Sect. 4.4.1)
7. Service button

The service button can be used for the following functions:

– IP address assignment (Sect. 4.1.1)
– Factory settings restoration (Sect. 6)

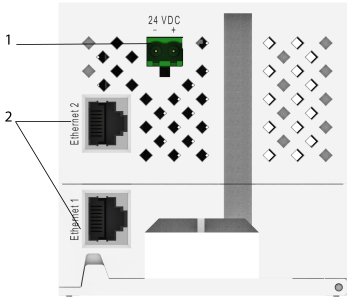



*Fig. 2.3 Top view*

*Table 2.1 LEDs*

| LED | Color | LED 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 (0.1 s / 2 s ) | Low battery (Sect. 4.3, App. C) |
| | | Flashing (0.1 s / 0.5 s) | No requests from master. Safe state activated |
| | | Flashing (0.9 s / 1 s) | Hardware peripherals error (Flash, RTC, Ethernet Switch) |
| Output LEDs (24) | green | Off | Output relay off |
| | | On | Output relay on |

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# 3 Технические характеристики

## 3.1 Specifications

*Table 3.1 General specifications*

| | | |
|---|---|---|
| **Electrical** | | |
| Power supply | | 24 (10 ... 48) V DC |
| Power consumption | | 9 W at 24 V DC<br>11 W at 48 V DC |
| Polarity protection | | Yes |
| Appliance class | | II |
| **Interfaces** | | |
| Data transfer | | Double Ethernet 10/100 Mbps |
| Protocols | | Modbus TCP<br>MQTT<br>SNMP<br>NTP |
| Configuration interface | | USB 2.0 (MicroUSB)<br>Ethernet 10/100 Mbps |
| **Digital outputs** | | |
| Outputs number | | 24 |
| Output type | | Relay, NO |
| Control | | On-Off or PWM |
| Switching capacity | AC | 5 A, 250 VAC, resistive load |
| | DC | 3 A, 30 VDC |
| Switching current, min. | | 10 mA at 5 VDC |
| Switching time | | 15 ms |
| PWM frequency, max. | | 1 Hz with 0.05 duty cycle |
| PWM pulse length, min. | | 50 ms |
| Optional functions | | Safe state |
| Service life, electrical | 3 A, 30 VDC | 35,000 switching cycles |
| | 5 A, 250 VAC | 50,000 switching cycles |
| Service life, mechanical | | 5,000,000 switching cycles |
| **Flash-memory (log file storage)** | | |
| File size, max. | | 2 kB |
| Number of log files, ,max. | | 1000 |
| Logging interval, min. | | 10 s |
| **Real time clock** | | |
| Accuracy | | ±3 s/day at +25 °C<br>±10 s/day at -40 °C |
| Backup battery | | CR2032 |
| **Mechanical** | | |
| Dimensions | | 82 × 124 × 83 mm |
| Weight | | approx. 260 g |

## 3.2 Operating conditions

The module is designed for natural convection cooling. It should 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

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*Table 3.2 Operating conditions*

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

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# 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, 4.9)

## 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.



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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.

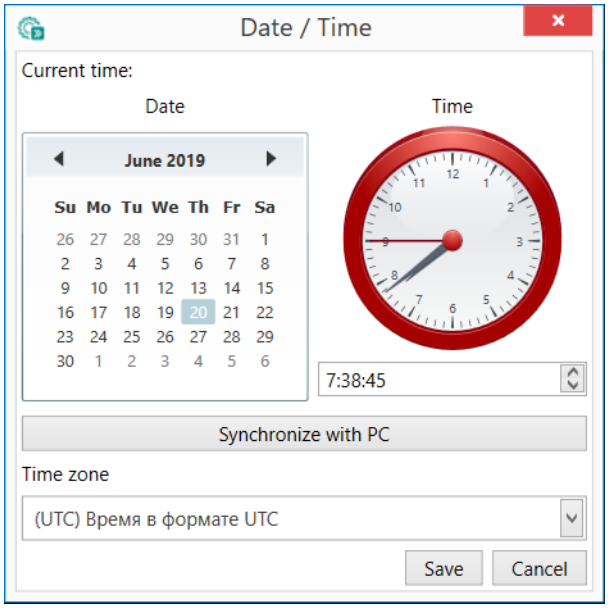



*Fig. 4.1 Real-time clock parameters*

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.

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### 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.
The battery status is updated 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.

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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, you can find it in akYtec Tool Pro by connecting the module to your computer using USB.

### 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*** | Output safe state activation delay after communication interruption (Sect. 4.9.1) | 0…60 s | 30 | RW |

### 4.6 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 4.3 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<br>0 – value incorrect, further processing not recommended |
| New line | binary | 2 Bytes | 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*.



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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 4.4 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 |

### 4.7 Digital outputs

To configure the digital outputs, open the ***Digital outputs*** group in the parameter tree.

*Table 4.5 Output parameters*

| Parameter | Description | Range | Default value | Access |
|---|---|---|---|---|
| **Single** | | | | |
| ***Control*** | Output control mode | ***On-Off*** / ***PWM*** | ***On-Off*** | RW |
| ***PWM period*** | Period in PWM mode | 1000…6000 ms | 100 | RW |
| ***PWM duty cycle*** | Duty cycle in PWM mode | 0…1000 ‰ | 50 | RW |
| ***Safe state*** | Output state after communication loss (Sect. 4.9.1) | 0…1000 ‰ | 0 | RW |
| **Group** | | | | |
| ***Output bitmask*** | Output state bitmask | 0…16777215 | — | R |
| ***New outputs bistmask*** | New output state bitmask | 0…16777215 | 0 | RW |

There are two modes of output control:
– On-off
– Pulse-width modulation (PWM)
The PWM control is determined by the parameters ***PWM period*** and ***PWM duty cycle***.
Output group parameters are bitmasks. The least significant bit of the mask corresponds to the input DO1.
To change the output state, set the corresponding bit in the bitmask of the parameter ***New output bitmask***.

#### 4.7.1 Output safe state

Safe state is the PWM duty cycle in ‰, applied to the PWM output if the network data exchange is interrupted i.e. there is no request from the master within the time specified in the parameter ***Safe state timeout*** (***Modbus Slave*** group, Sect. 4.5).
Safe state can be specified in the parameter ***Safe state*** for each output.
Safe state is inactive if the parameter ***Safe state timeout*** is set to 0.
Safe state has no effect in On-off mode.
In the safe state condition the following applies:
– The LED ⚠ lights red until a new master request is received.
– The output remains in the safe state until a command from the master for state change is received.

If the module is powered on with the ***Safe state*** > 0, the outputs are set to the last saved states (before powering off), until new values of the PWM duty cycles are received from the master.
If the module is powered on with the ***Safe state*** = 0, the outputs are off until new values of the PWM duty cycles are received from the master.

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### 4.8 NTP protocol

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

*Table 4.6 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*.

### 4.9 MQTT protocol

#### 4.9.1 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****)*.

#### 4.9.2 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.***

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*Table 4.7 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) | — | — | 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 broken | 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<br>***QoS1*** - at least once<br>***QoS2*** - exactly once | ***QoS0*** / ***QoS1*** / ***QoS2*** | ***QoS0*** | RW |
| ***Keep Alive*** | Keep Alive interval in seconds | 0…600 | 0 | RW |
| ***Status*** | Broker connection status | — | — | R |

*Table 4.8 Topics*

| Parameter | Topic | Node | Function | Format |
|---|---|---|---|---|
| ***New output bitmask*** | MASK | DO | SET | UINT |
| ***Output bitmask*** | STATE | DO | GET | UINT |

***Example:***
*Device* – device name specified in akYtecToolPro

1. Read the digital inputs bitmask

   *MX210/Device/GET/DI/MASK*

   Obtained value: 15 (HIGH on inputs 1-4)
2. Write the digital outputs bitmask

   *MX210/Device/SET/DO/MASK*

   Recorded value: 15 (outputs 1-4 set)
3. Single-level wildcard usage

   *MX210/Device/GET/+/COUNTER*

   Obtained value: counter values of all digital inputs. The topic is equivalent to the group of topics:

   *MX210/Device/GET/DI1/COUNTER*

   *MX210/Device/GET/DI2/COUNTER*

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*MX210/Device/GET/…/COUNTER*

*MX210/Device/GET/DIn/COUNTER*

4. Multi-level wildcard usage

   *MX210/Device/GET/#*

   Obtained value: all module parameters available for reading. The topic is equivalent to a group of topics:

   *MX210/Device/GET/DI/MASK*

   *MX210/Device/GET/DI1/COUNTER*

   *MX210/Device/GET/DI2/COUNTER*

   *MX210/Device/GET/…/COUNTER*

   *MX210/Device/GET/DIn/COUNTER*

For more information see document: *NTP_MQTT_SNMP_protocols*.

### 4.10 SNMP protocol

#### 4.10.1 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.

#### 4.10.2 Implementation

The module supports SNMP protocol (SNMPv1 and SNMPv2c versions) and can be used as an 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 4.9 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*.

### 4.11 Password

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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).

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# 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.

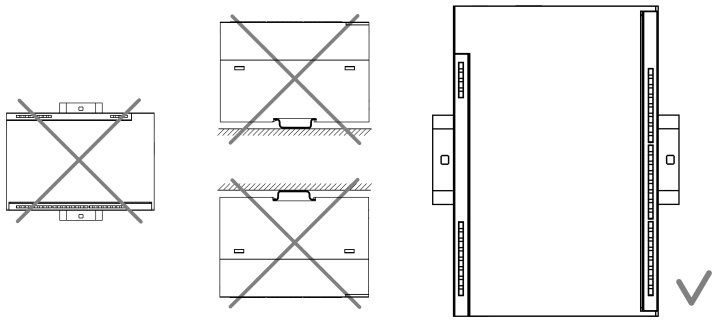


*Fig. 5.1 DIN rail mounting*

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.

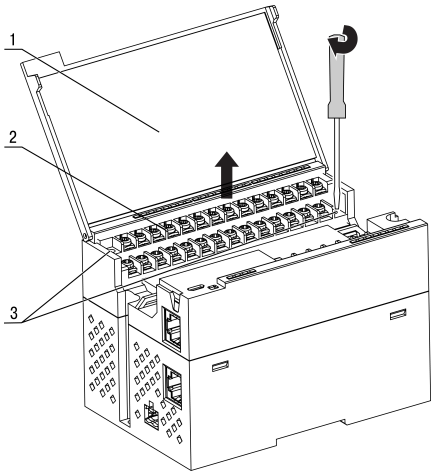



*Fig. 5.2 Remove terminal block*

## 5.2 Wiring

**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.***

**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.***

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### 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.
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.

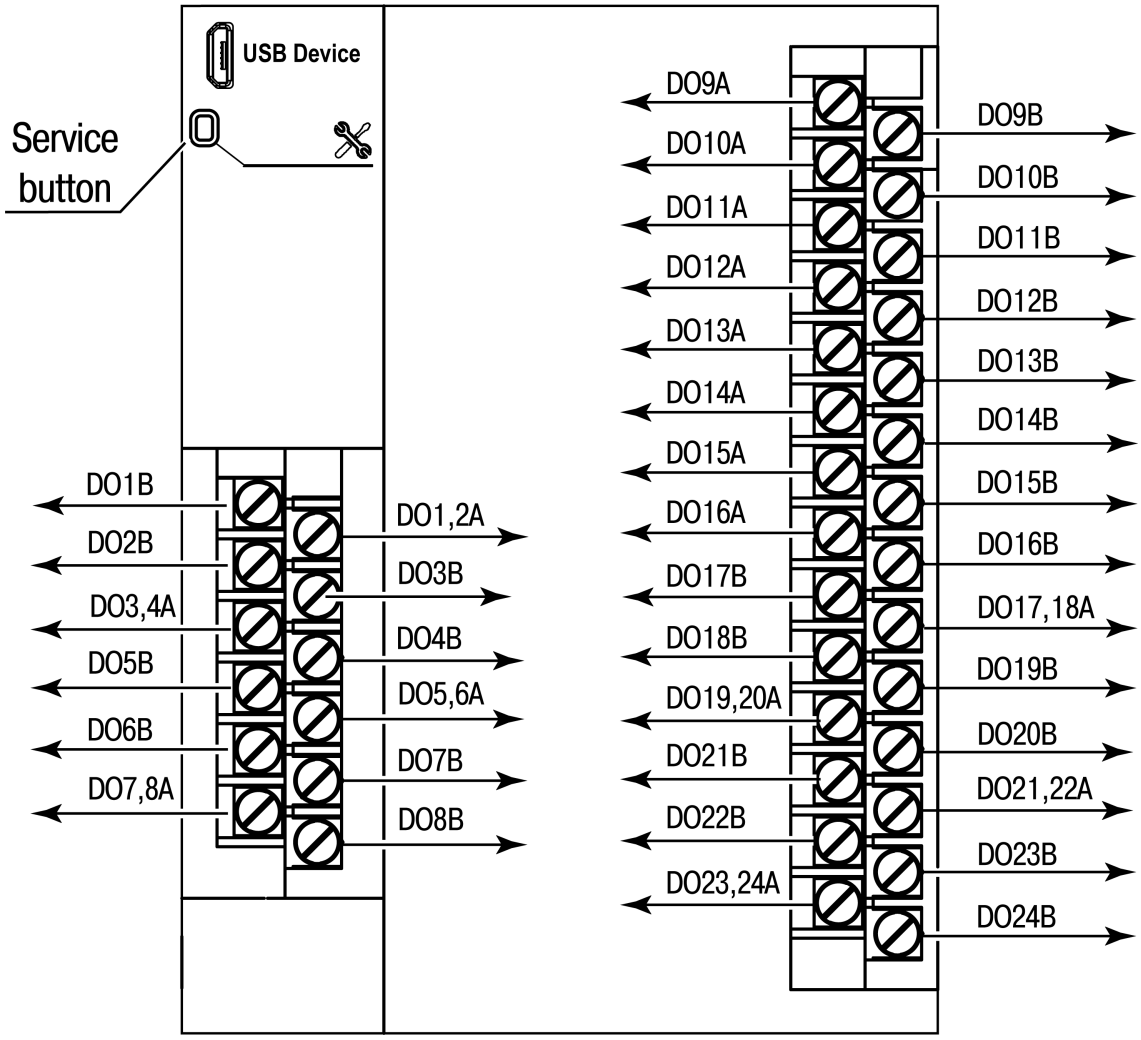



*Fig. 5.3 Front view (open cover)*

*Table 5.1 Terminal assignments*

| Marking | | Description |
|---|---|---|
| Relay, NO | DO1A…DO24A | Connection to NO contact |
| | DO1B…DO24B | |

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### 5.2.2 Relay outputs wiring

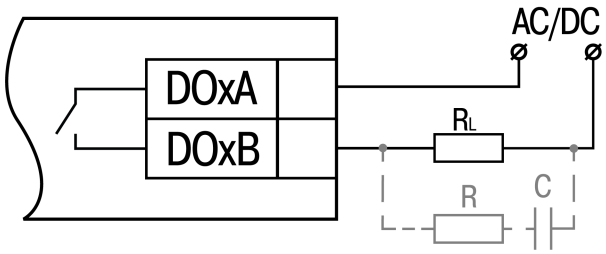



*Fig. 5.4 Relay output wiring*

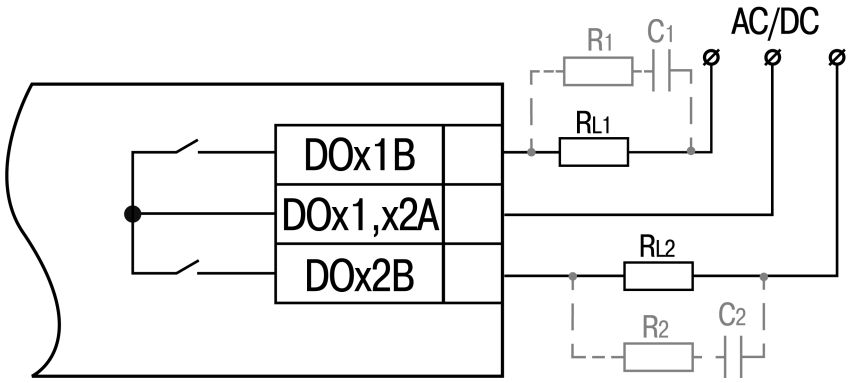



*Fig. 5.5 Relay output wiring (common contact)*

**NOTICE**
***When connecting inductive load, it is recommended to install an RC circuit in parallel with the load. It will suppress arcing and noise at switching.***

### 5.2.3 Ethernet

The Ethernet connection can be established in a star or daisy chain topology (Fig. *5.6*, *5.7*).
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.

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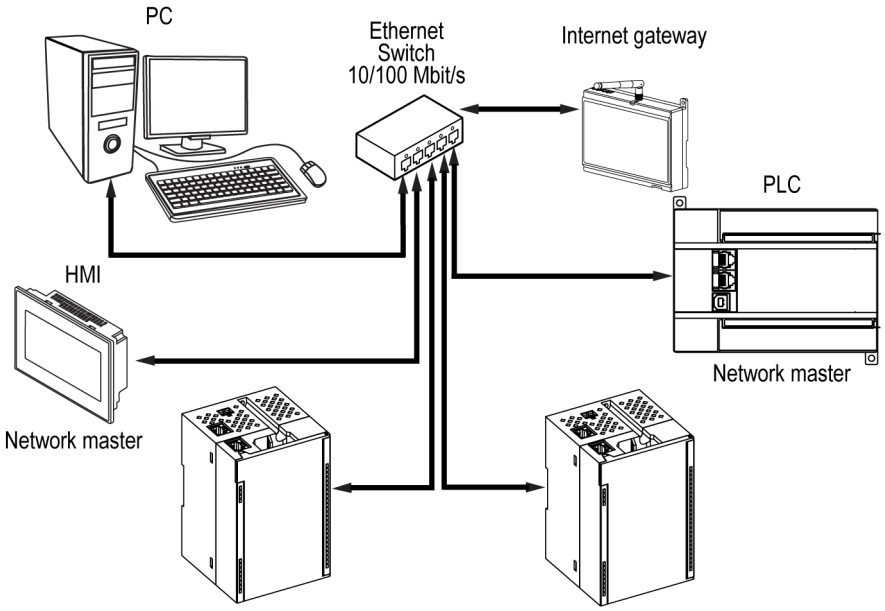



*Fig. 5.6 Star topology*

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).

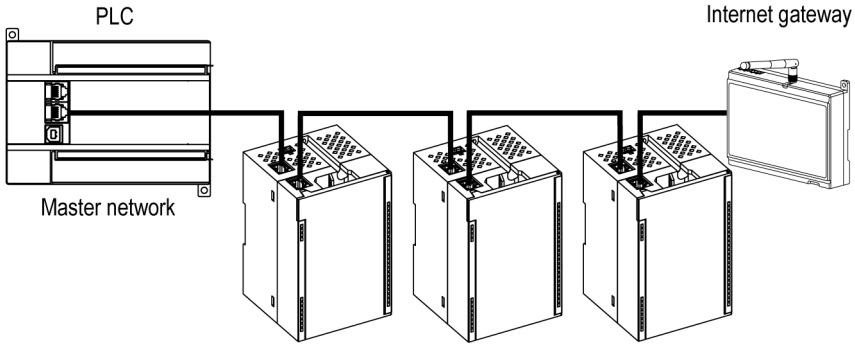



*Fig. 5.7 Chain topology*

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# 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:

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

The device will operate with the default parameters.

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# 7 Maintenance

**WARNING**
***Cut off all power before maintenance.***

The maintenance includes:

– cleaning of the housing 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.***

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# 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.***

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# 9 Scope of delivery

| | |
|---|---|
| – MU210–403 | 1 |
| – Ethernet connection cable | 1 |
| – 2-pole plug-in terminal block | 1 |
| – Rubber plug | 1 |
| – Short guide | 1 |

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# Appendix A. Dimensions

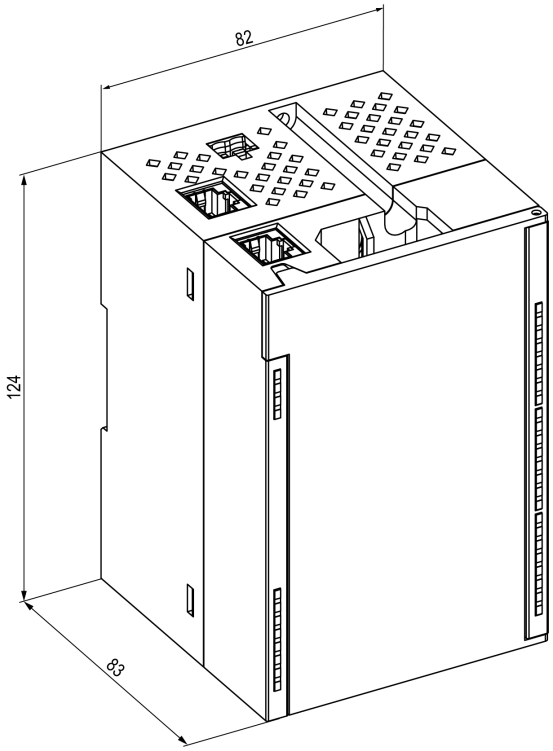



*Fig. A.1*

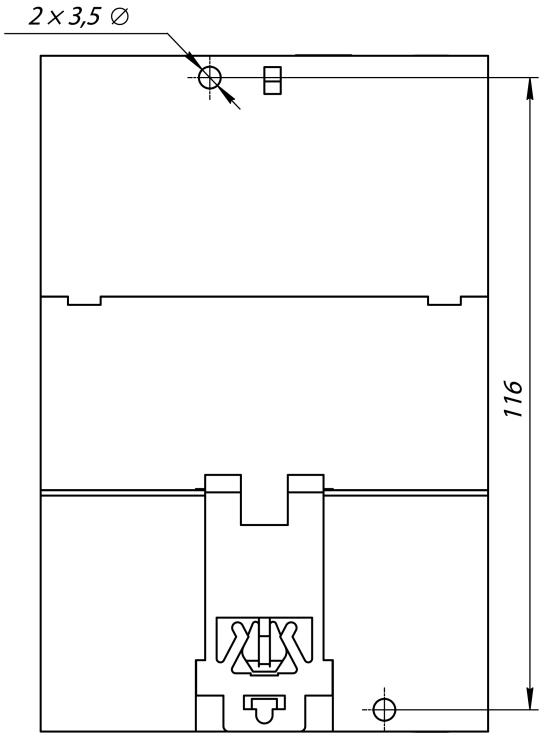



*Fig. A.2*

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## Appendix B. Galvanic isolation

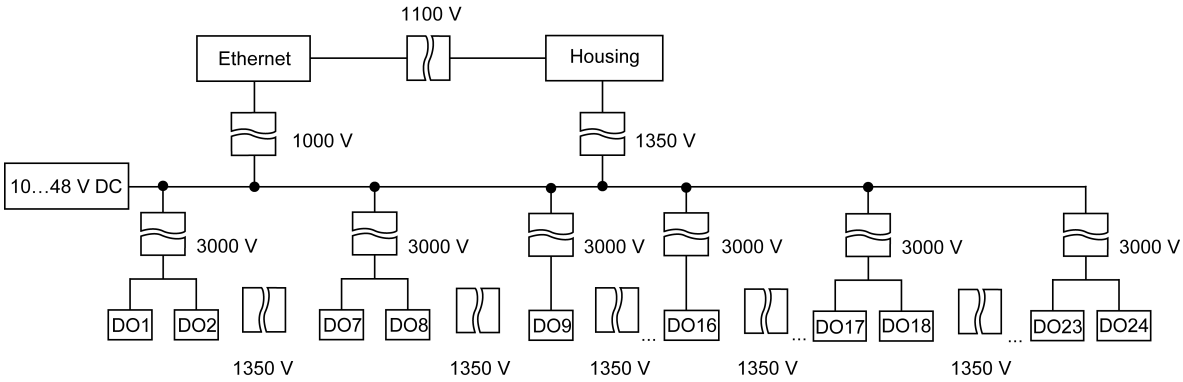



*Fig. B.1 Galvanic isolation*

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## Appendix C. Battery replacement

To replace the battery, proceed as follows:

1. Power off the module and all connected devices
2. Remove the terminal blocks without disconnecting the connected wires (Fig. 5.2)
3. Remove the module from the DIN rail
4. Remove the front part the enclosure by opening the four side latches one-by-one using a flat screwdriver (Fig. C.1)
5. Replace the battery.

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

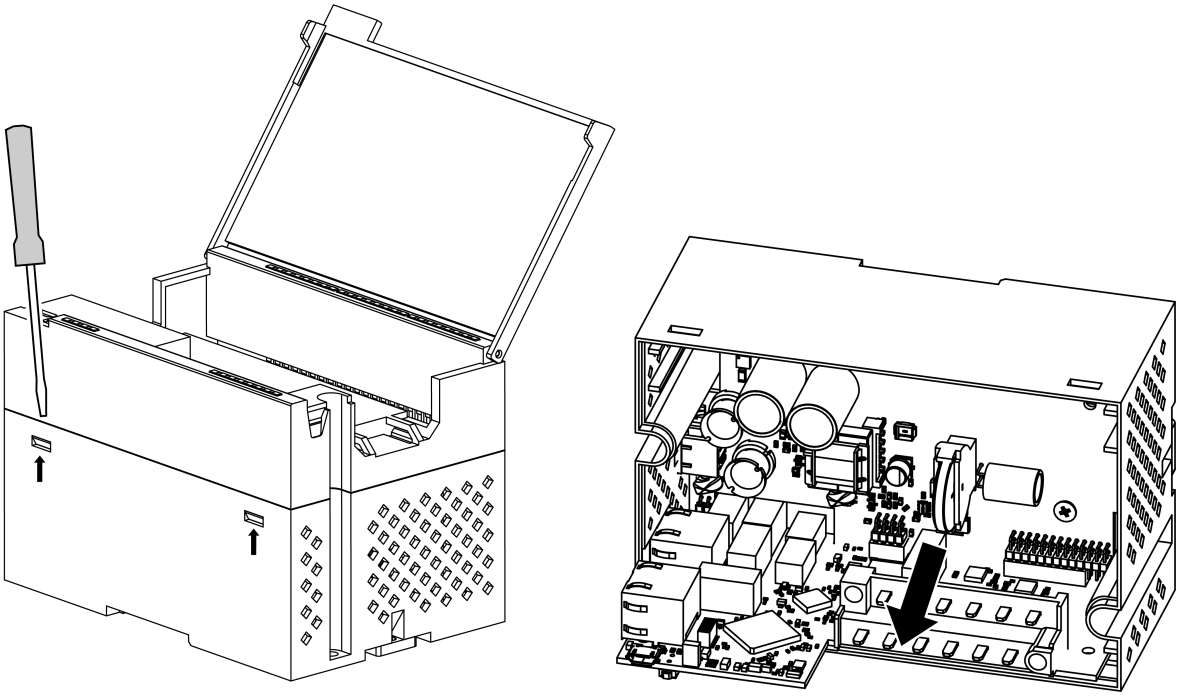


*Fig. C.1 Battery replacement*

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# 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 register*

| 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 | String32 |
| Additional text information | — | — | R | 0xF048 | 61512 | String32 |
| 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<br>1 – on<br>2 – service button | — | — | 0x0020 | 26 | UINT16 |
| **Battery** | | | | | | |
| Voltage | 0…3300 | mV | R | 0x0321 | 801 | UINT16 |
| **Modbus Slave** | | | | | | |
| Safe state timeout | 0…60 | s | RW | 0x02BC | 700 | UINT8 |
| **Data logging** | | | | | | |
| Logging interval | 10…3600 | s | RW | 0x0384 | 900 | UINT16 |

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| Parameter | Value | Unit | Access | Address | | Data type |
|---|---|---|---|---|---|---|
| | | | | hex | dec | |
| **Digital outputs / Single** | | | | | | |
| DO1 Control mode | 0 – on/off / 1 – PWM | — | RW | 0x0110 | 272 | UINT16 |
| … | … | … | … | … | … | … |
| DO24 Control mode | 0 – on/off / 1 – PWM | — | RW | 0x0127 | 295 | UINT16 |
| DO1 PWM period | 1000…60000 | — | RW | 0x0134 | 308 | UINT16 |
| … | … | … | … | … | … | … |
| DO24 PWM period | 1000…60000 | — | RW | 0x014B | 331 | UINT16 |
| DO1 PWM duty cycle | 0…1000 | ‰ | RW | 0x0154 | 340 | UINT16 |
| … | … | … | … | … | … | … |
| DO24 PWM duty cycle | 0…1000 | ‰ | RW | 0x016B | 363 | UINT16 |
| DO1 safe state | 0 – off / 1 – on | — | RW | 0x01DA | 474 | UINT16 |
| … | … | … | … | … | … | … |
| DO24 safe state | 0 – off / 1 – on | ms | RW | 0x01F1 | 497 | UINT16 |
| **Digital outputs / Group** | | | | | | |
| Output bitmask | 0…16777215 | — | R | 0x01D4 | 468 | UINT32 |
| New output bitmask | 0…16777215 | — | RW | 0x01D6 | 470 | UINT32 |
| **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 |
| NTP status | 0 – off<br>1 – on<br>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<br>1 – QoS1<br>2 – QoS2 | — | RW | 0x1705 | 5893 | UINT16 |
| Keep Alive | 0…600 | s | RW | 0x1768 | 5992 | UINT16 |
| Status | 0 – off<br>1 – on<br>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 |

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| Parameter | Value | Unit | Access | Address | | Data type |
|---|---|---|---|---|---|---|
| | | | | hex | dec | |
| SNMP version | 0 – SNMPv1<br>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 register |
| 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 file as a set of records |
| 21 (0x15) | Write File Record | Write file as a set of records |

*Table D.4 Modbus error codes*

| Code | Name | Description |
|---|---|---|
| 01 | Illegal Function | The received function code is not recognized or accepted 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 request |
| 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 not supported by this function.<br>Supported types:<br>– INT, UINT, max. 2 bytes |



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| Function code | Error code | Possible error causes |
|---|---|---|
| | | – enumerated<br>– 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 |

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