



MU110-8R(K)

Digital output module
8 channel

User guide

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Description

1 Description

1.1 Functions

Digital output module MU110-8R(K) is an extension module with 8 digital outputs.

The module provides following actions:

- connection of actuators with digital outputs
- output control using Modbus network
- pulse width modulation (see 6.3)
- network diagnostic
- fault and alarm signals
- Slave in a Modbus protocol structure.

The module uses Modbus-RTU and Modbus-ASCII protocols with automatic protocol identification.

The module can be configured with the 'M110 Configurator' software (on CD included) using a RS485-USB interface adapter (not included).

1.2 RS485 network

I/O modules of series Mx110 use the common standard RS485 for data exchange.

Serial interface RS485 enables communication via two-wired line in half-duplex mode. Modules support Modbus RTU and Modbus ASCII protocols. The network consists of a Master device and can contain up to 32 Slave devices. Maximum length is 1200 m. The number of Slave devices and network length can be increased using RS485 interface repeater.

Devices are connected to a network according to linear (bus) topology. It means that the line goes from the first device to the second one, from the second one to the third one, etc. Star connection and spur lines are not allowed.

Line reflections always occur at each of the 2 ends of the bus (the first and the last node). The higher the data transmission rate, the stronger they are. A terminating resistor is needed to minimize reflections. Line termination may be a 150 ohms value (0.5 W) resistor.

All modules can be used as Slave devices only. Master device can be PLC, computer with SCADA software or control panel.

1.3 Design

- | | |
|-------------------|---|
| – Enclosure | plastic, grey, for DIN-rail or wall mounting |
| – Terminal blocks | 2 plug-in terminal blocks with 24 screw terminals |
| – LED POWER | power supply indicator |
| – LED RS-485 | flashes at data exchange over serial port |
| – LED FAULT | lit when data exchange via serial port is interrupted |
| – 8 LEDs OUTPUTS | lit at logical 1 on the relevant output |

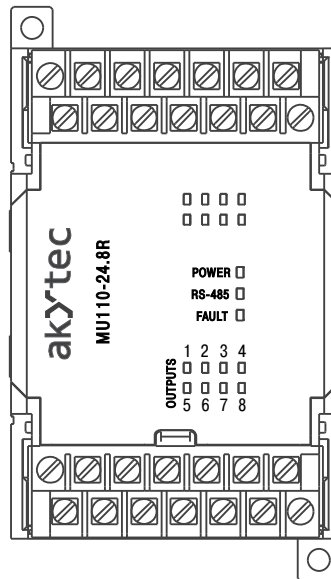


Fig. 1.1 Front view MU110-8R

Dimensional drawings are given in App. A.

Exterior of the device's front panel is shown on Fig. 1.1. There are three jumpers under a module front cover (see Fig. 4.1):

- X1 – DRAM write-protection (see 4.1.1)
- X2 – restore factory settings (see 7)
- X3 – service function

All jumpers are in OFF position by default.

Specifications

2 Specifications

2.1 Ordering information

Module MU110-8R(K) can be ordered in 2 modifications depending on the output type.

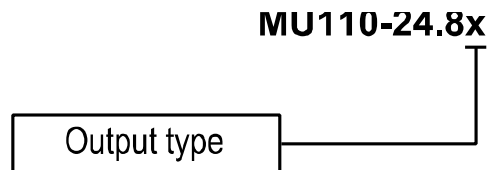


Fig. 1.2 Ordering code

Output type:

- R - relay outputs
- K - NPN transistor outputs

2.2 Technical data

Table 2.1 General data

Power supply		24 (20...28) V DC
Power consumption, max.		6 W
Inputs	Digital	–
	Analog	–
Outputs	Digital	8
	Analog	–
RS485 interface	Connection	D+, D-
	Protocols	Modbus RTU/ASCII
	Baud rate	2.4...115.2 kbit/s
	Data bits	7, 8
	Parity	odd, even, none
	Stop bits	1, 2
Dimensions		63 x 110 x 75 mm
Weight		approx. 300 g
Material		plastic

Table 2.2 Outputs data

Property	MU110-8R	MU110-8K
Output	relay (NO)	NPN transistor
Permissible load	4 A, 250 V AC, cosφ > 0.4 or 30 V DC	400 mA, 60 V DC

Specifications

2.3 Environmental conditions

The module is designed for natural convection cooling. It should be taken into account 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 2.3 Environmental conditions

Condition	Permissible range
Ambient temperature	-20...+55°C
Transportation and storage	-25...+55°C
Relative humidity	up to 80% (at +25°C, non-condensing)
IP code	IP20
Altitude	up to 2000 m above sea level

Safety

3 Safety

Explanation of the symbols and keywords used:

 **DANGER**

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

 **WARNING**

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 **CAUTION**

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

 **NOTICE**

NOTICE indicates a potentially harmful situation which, if not avoided, may result in damage of the product itself or of adjacent objects.

3.1 Intended use

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

The device may be operated only in properly installed condition.

Improper use

Any other use is considered improper. Especially to note:

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

Installation

4 Installation



WARNING

Improper installation

Improper installation can cause serious or minor injuries or device damage. Installation must be performed only by fully qualified personnel

- The module is intended to be mounted in a cabinet on DIN-rail or on the wall. For the dimension drawings see Appendix A.
- Install the device in a cabinet with clean, dry and controlled environment. For further details see 2.3.
- The module is designed for natural convection cooling. It should be taken into account when choosing the installation site.

4.1 Wiring



DANGER

Dangerous voltage

Electric shock could kill or seriously injure.

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

Ensure that the mains voltage matches the voltage marked on the nameplate!

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



CAUTION

Switch on the power supply only after the wiring of the device has been completely performed.

- The electrical connections are shown in Fig. 4.1 and the terminal assignments in Table 4.1.
- Wiring options for both types of outputs are shown on Fig. 4.2–4.3.
- Connect the power supply to the terminals 24V /0V.
- The maximum conductor cross-section for power supply is 1.5 mm².



NOTICE

Signal cables should be routed separately or screened from the supply cables.



NOTICE

Only a shielded cable may be used for signal lines.

- Connect the RS485 lines to terminals D+ and D-.
- Twisted pair cable should be used for the connection to RS485 interface. Maximal cable length is 1200 m.

4.1.1 Hardware write protection

Data stored in permanent memory can be lost because of strong electromagnetic interference.

Jumper X1 (Hardware write-protection) can help to avoid data loss.

The following steps are required:

- Turn the power supply off;
- Open the front cover of the module (see Fig. 4.1)
- Set up jumper X1.

Notice following:

- to change the configuration parameters, the jumper X1 must be removed again.

4.1.2 Outputs

- Module MU110-8R has 8 relay outputs, and MU110-8K has 8 NPN transistor outputs.

Installation

- Outputs can be controlled via RS485 network.
- Each output can be operated in pulse width modulation mode (PWM).
- Output technical data are shown in Tab. 2.2.

► NOTICE

Make sure that voltage and current on the outputs do not exceed maximum values even briefly.

If voltage rises, especially when inductive load (relay, coil etc.) is connected, keep the voltage peaks limited by protective measures.

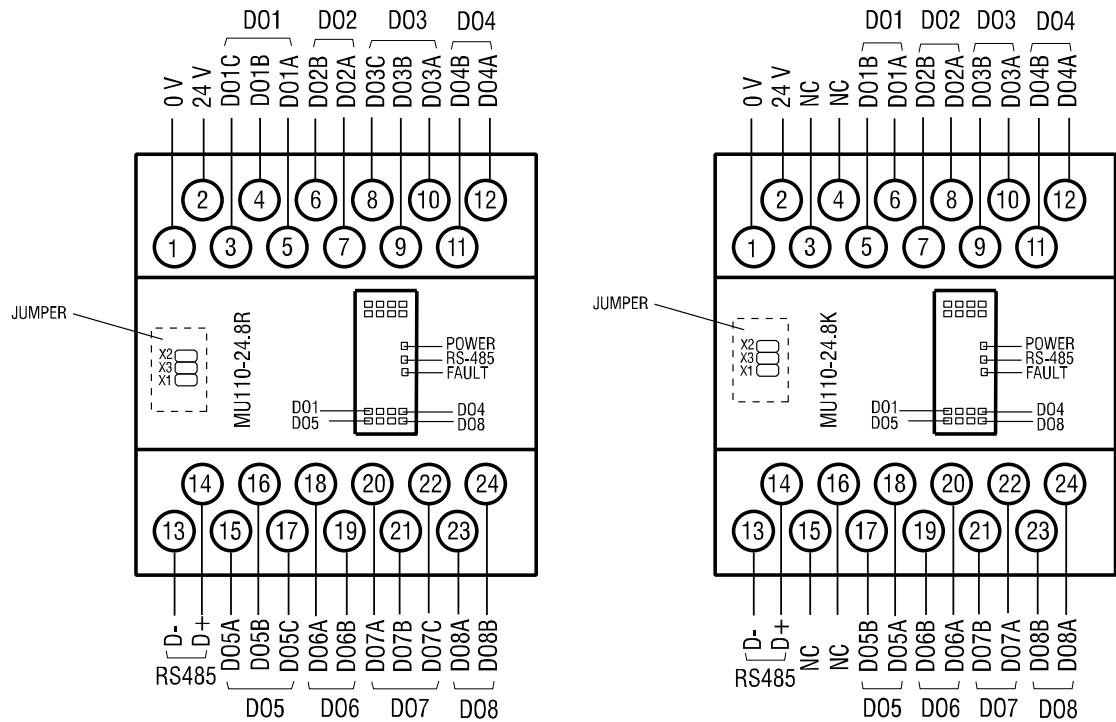


Fig. 4.1 Electrical connections MU110-8R and -8K

Table 4.1 Terminal assignments MU110-8R

No	Indication	Description	No	Indication	Description
1	0V	Power supply	13	D-	RS485 D-
2	24V		14	D+	RS485 D+
3	DO1C	DO1 NO	15	DO5A	DO5 NO
4	DO1B	DO1 CO	16	DO5B	DO5 CO
5	DO1A	DO1 NC	17	DO5C	DO5 NC
6	DO2B	DO2 NO	18	DO6A	DO6 NO
7	DO2A		19	DO6B	
8	DO3C	DO3 NO	20	DO7A	DO7 NO
9	DO3B	DO3 CO	21	DO7B	DO7 CO
10	DO3A	DO3 NC	22	DO7C	DO7 NC
11	DO4B	DO4 NO	23	DO8A	DO8 NO
12	DO4A		24	DO8B	

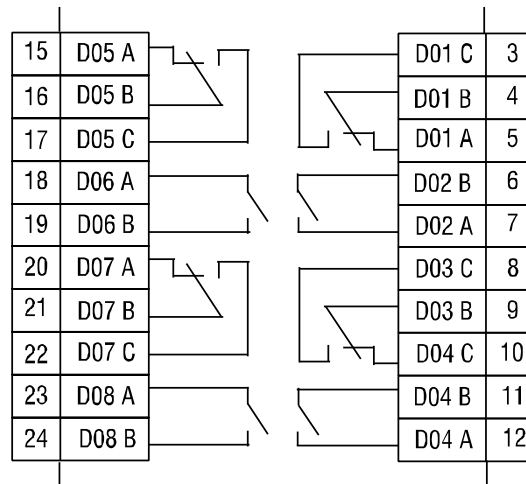


Fig. 4.2 MU110-8R outputs

Table 4.2 Terminal assignments MU110-8K

No	Indication	Description	No	Indication	Description
1	0V	Power supply	13	D-	RS485 D-
2	24V		14	D+	RS485 D+
3	not connected	NC	15	not connected	NC
4	not connected	NC	16	not connected	NC
5	DO1B	DO1 NO	17	DO5B	DO5 NO
6	DO1A		18	DO5A	
7	DO2B	DO2 NO	19	DO6B	DO6 NO
8	DO2A		20	DO6A	
9	DO3B	DO3 NO	21	DO7B	DO7 NO
10	DO3A		22	DO7A	
11	DO4B	DO4 NO	23	DO8B	DO8 NO
12	DO4A		24	DO8A	

If there is inductive load on an NPN output, it is recommended to connect VD diode (100 V, 1 A) to protect the transistor (see Fig. 4.3).

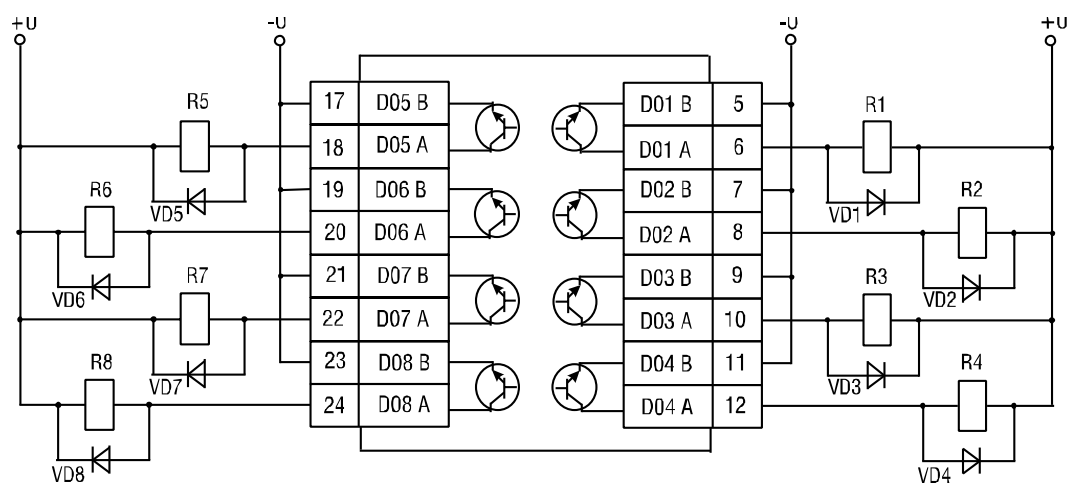


Fig. 4.3 MU110-8K outputs

Configuration

5 Configuration

► NOTICE

Before starting

Before switching on, make sure that the device was stored at the specified ambient temperature (-20 ... +55 °C) for at least 30 minutes.

Parameters of the module can be read, edited and saved with 'M110 Configurator' software. The full list of parameters is shown in the Table 5.1.

The software and its user guide can be found on the CD included.

Module has to be configured first before operating in RS485 network.

The following steps are required:

- Install M110 Configurator on the PC.
- The module should be connected to USB port of the PC over a USB/RS485 adapter (not included). Connect the D+/D- terminals of the module with the D+/D- contacts of the adapter.
- Connect the power supply to 24V/0V terminals of the module.
- Turn on the power supply.
- Run the M110 Configurator.

If the factory settings of the module have not been changed, the connection to the module is automatically established, the module automatically recognized, its configuration parameters read out and an appropriate configuration mask open.

If it does not happen, parameters of the configurator have to be changed.

Table 5.1 Configuration parameters

Name	Parameter	Valid value	Meaning	Default settings
Basic parameters				
dev	Device	Up to 8 symbols		MU110-8
ver	Firmware version	Up to 8 symbols		manufacturer
Network parameters				
bPS	Baud rate, kbit/s	0	2.4	9.6
		1	4.8	
		2	9.6	
		3	14.4	
		4	19.2	
		5	28.8	
		6	38.4	
		7	57.6	
LEn	Data bits *	0	7	8
		1	8	
PrtY	Parity *	0	none	none
		1	even	
		2	odd	
Sbit	Stop bits *	0	1	1
		1	2	
A.Len	Address bits	0	8	8
		1	11	
Addr	Device address	1...247		16
t.out	Time-out, s	0...600		0
Rs.dL	Response delay, ms	0...45		2

Configuration

Name	Parameter	Valid value	Meaning	Default settings
Output parameters				
THPD	PWM period, s	1...900	1...900	1
O.ALr	Safe output status, %	0...100	0...100	0

* Invalid network parameter combinations:

- *prty=0; sbit=0; len=0*
- *prty=1; sbit=1; len=1*
- *prty=2; sbit=1; len=1*

Operation

6 Operation

In the operation mode the module is controlled by a network Master in Modbus network. It can be performed in different ways:

- Individual control in PWM mode (see 6.3)
- Group control (see 6.4)

Modbus functions 03, 04 for reading and 15, 16 for writing can be used.

6.1 Functional test

To test the module for proper functioning the following steps are required:

- Connect the module to USB-port of the PC using a USB/RS485 adapter.
- Run M110 Configurator on the PC.
- If the connection has not been established automatically, the network parameters of the configurator have to be changed.
- Choose menu item ‘Device -> I/O status...’. A new window “Output status” will open.
- For each output the PWM duty cycle (pulse to period ratio) between 0 and 1 can be set, so that output is switched on/off or a continuous pulse train is generated.
- Output resistance for MU110-8R modification can be optionally measured with an ohmmeter.
- Max resistance on closed outputs - 1 ohm.
- Min resistance on open outputs - 2 Mohm.
- If there are any deficiencies in functioning, contact technical support of akYtec GmbH.

6.2 Individual control in PWM mode

Average voltage can be changed using pulse width modulation (PWM). Pulses with the specified period (parameter **THPD**) and the duty cycle (pulse to period ratio) are generated on the output.

Possible output statuses depending on duty cycle are shown in the Table 6.1. Modbus function 16 is to be used to transfer the duty cycle value to the module.

Table 6.1 Pulse width modulation

Duty cycle		Output status
Configuration	Modbus command	
0	0	0
1	1000	1
between 0 and 1	between 0 and 1000	between 0 and 1

- The configurator uses not the Modbus protocol but its own internal communication protocol. Therefore, range of value in configuration and in Modbus command can differ. For example, the duty cycle must be set to 1 for switching on the output DO1 during the functioning test. In a Modbus command the duty cycle must be written as 0001 in register 0000.
- The PWM period (**THPD**) is usually set during the configuration. The period can also be changed by a Modbus command, and the following should be noted:

Permanent memory

As the permanent memory is not unlimited rewritable (approx. 10⁶ times), it is not advisable to change the parameters ‘THPD’ (PWM period) and ‘O.ALr’ (Safe output status) by Modbus commands as often as, for instance, PWM duty cycle.

- The minimum PWM period is 50 msec and cannot be changed.



Operation

6.3 Group control

Group control is performed using Modbus function 16. Thus the output status bitmask (see Tab. 6.2) has to be written into the register 50 (0x0032). This way all outputs can be controlled simultaneously. Bit 0 corresponds to the output 1.

With the transfer of the mask the generation of the pulse is stopped and the outputs are set in accordance with the mask.

6.4 Fault Condition

If the data exchange on the serial port is interrupted (i. e. there is no command from the master within the time specified by the parameter **t.out**) all outputs are set to a safe status. The 'Fault Condition' is a combination of all safe PWM duty cycle values, set in parameter **O.ALr** (Safe output status) for each output.

In this condition the following applies:

- LED FAULT flashes.
- A request from the master device terminates the Fault Condition.
- Outputs remain in the safe status until a command from the master changes the output status.
- If **t.out** parameter is set to 0, 'Fault Condition' is not defined.

Parameters **t.out** and **O.ALr** can be set during configuration or operation as well. The note 'Permanent memory' in sec. 6.3 should be taken into account.

6.5 Memory addressing

All variables and parameters in the Table 6.2 are of the type UINT16.

Variables in the Table 6.3 are of the type BOOL.

R – read access

W – write access

Table 6.2 Modbus register

Parameter	Unit	Value		Access	Address	
		Configu-ration	Modbus command		hex	dec
Duty cycle DO1	-	0...1	0...1000	RW	0000	0000
Duty cycle DO2	-	0...1	0...1000	RW	0001	0001
Duty cycle DO...	-	0...1	0...1000	RW
Duty cycle DO8	-	0...1	0...1000	RW	0007	0007
Safe output status (O.ALr) DO1	-	0...100	0...1000	RW	0010	0016
Safe output status (O.ALr) DO2	-	0...100	0...1000	RW	0011	0017
Safe output status (O.ALr) DO...	-	0...100	0...1000	RW
Safe output status (O.ALr) DO8	-	0...100	0...1000	RW	0017	0023
PWM period (THPD) DO1	s	1...900	1...900	RW	0020	0032
PWM period (THPD) DO2	s	1...900	1...900	RW	0021	0033
PWM period (THPD) DO...	s	1...900	1...900	RW
PWM period (THPD) DO8	s	1...900	1...900	RW	0027	0039
Time-out (t.out)	s	0...600	0...600	RW	0030	0048
Output status bitmask	-	-	0...65535	RW	0032	0050

Operation

Table 6.3 Output status binary addresses for Modbus function 15

Output	Access	Address	
		hex	dec
1	W	0000	0000
2	W	0001	0001
...	W
8	W	0007	0007

Restore factory settings

7 Restore factory settings

If the communication between the module and PC cannot be established and network parameters of the module are unknown, the default network settings should be restored.

The following steps are required:

- Turn off the power supply
- Remove a left front cover of the module
- Turn on DIP-switch S1. Module will operate with the default network parameters, the user settings remain stored.
- Turn on the power supply again



Dangerous voltage

The voltage on some components of the circuit board can be dangerous! Direct contact with the circuit board or penetration of a foreign body in the enclosure must be avoided!

- Run M110 Configurator
- In the window 'Connection to device' enter the values from the Table 7.1 or click the key 'Use factory settings' (see Fig. 7.1);

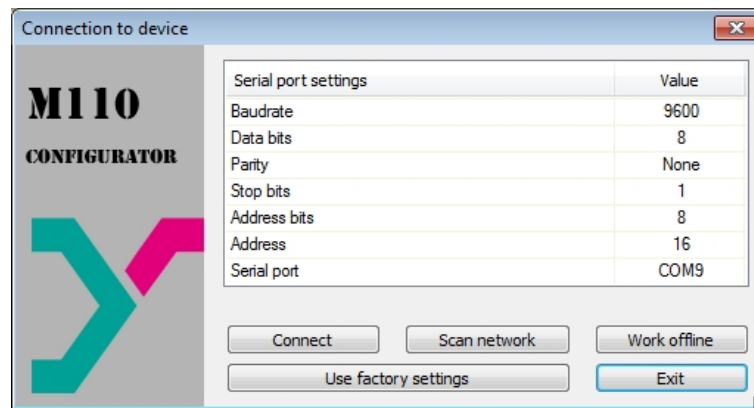


Fig. 7.1 M110 Configurator start window

- Click 'Connect' to establish the connection with factory settings.
- The main window of the Configurator opens. Saved user parameters of the module can be read now (see Fig. 7.2).
- Open folder 'Network parameters' and note the user network parameters.

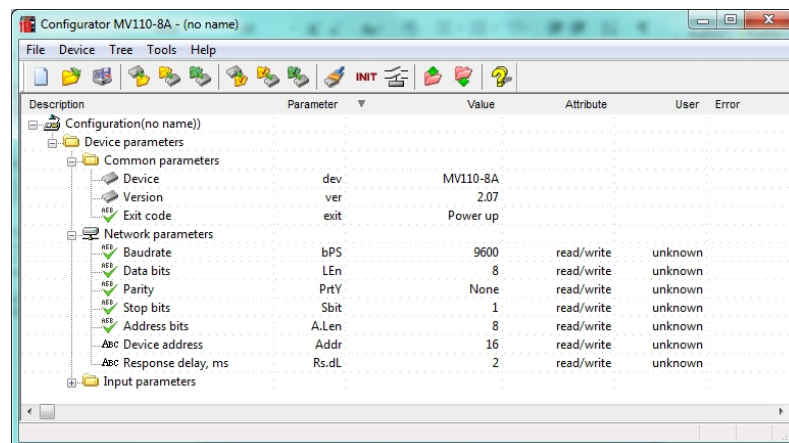


Fig. 7.2 M110 Configurator main window

- Close M110 Configurator

Restore factory settings

- Turn off the power supply
- Turn off DIP-switch S1
- Close the front cover
- Turn on the power supply again
- Start M110 Configurator
- Enter the noted network parameters
- Click 'Connect'.

The module is now ready for operation.

Table 7.1 Factory settings for network parameters

Parameter	Name	Factory setting
Baud rate	bPS	9600
Data bits	LEn	8
Parity	PrtY	None
Stop bits	Sbit	1
Address bits	A.Len	8
Address	Addr	16
Response delay, ms	Rs.dL	2

8 Maintenance

The maintenance includes:

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

The device should be cleaned with a damp cloth only. No abrasives or solvent-containing cleaners may be used. The safety information in section 3 must be observed when carrying out maintenance.

Transportation and storage

9 Transportation and storage

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

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

Permitted storage temperature: -25...+55 °C

► NOTICE

Transport damage, completeness

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!

Scope of delivery

10 Scope of delivery

- | | |
|--------------------------------------|---|
| – Module MU110-8R(K) | 1 |
| – User guide | 1 |
| – CD with software and documentation | 1 |

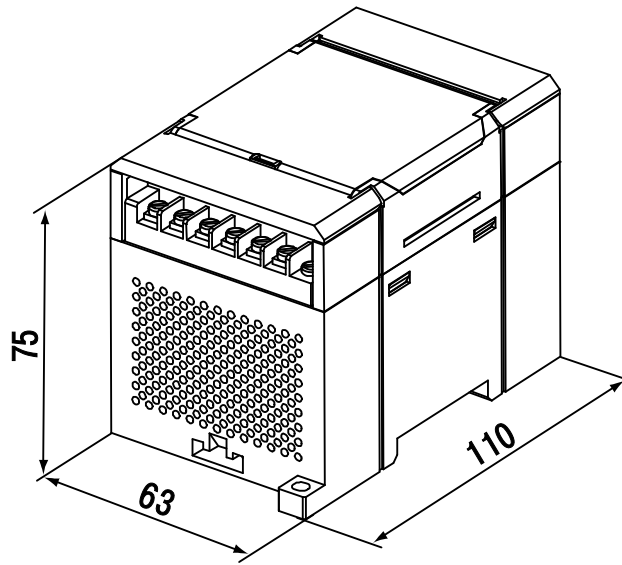


Fig. A.1 External dimensions

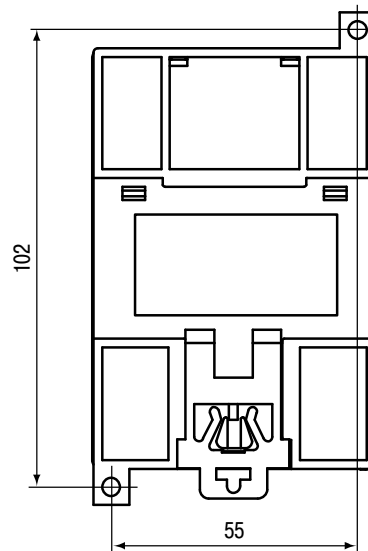


Fig. A.2 Wall mounting dimensions

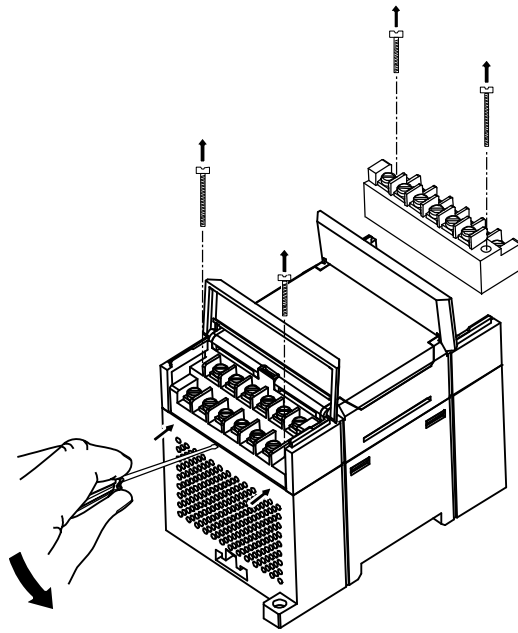


Fig. A.3 Replacement of terminal blocks