

MU110–24.16R(K)

Digital output module

User guide

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MU110–24.16R(K)_3-EN-143217-1.2
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1 Introduction

1.1 Abbreviations

MX110_configurator – 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*)

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.

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 28 V. Higher voltage can damage the device.
If the supply voltage is lower than 20 V DC, the device cannot operate properly but will not be damaged.

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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

2.1 Basic features

Digital output module MU110-24.16R(K) is an extension module with 16 digital outputs.
The module has the following functions:

– Connection of actuators with digital outputs
– Output control using Modbus network
– Pulse width modulation (see *Section 4.3*)
– Network diagnostics
– 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 *Mx110 Configurator software* using an RS485-USB interface adapter (not included).

2.2 Design and indication

Table 2.1 Indication

LED	LED state	Description
OUTPUTS 1...16	ON	Output is on
RS485	Flashing	Data exchange via serial port
POWER	ON	Power is on
FAULT	ON	Data exchange via serial port is interrupted

Dimensional drawings are given in *Appendix A.*
Exterior of the device's front panel is shown in *Fig. 2.1*.

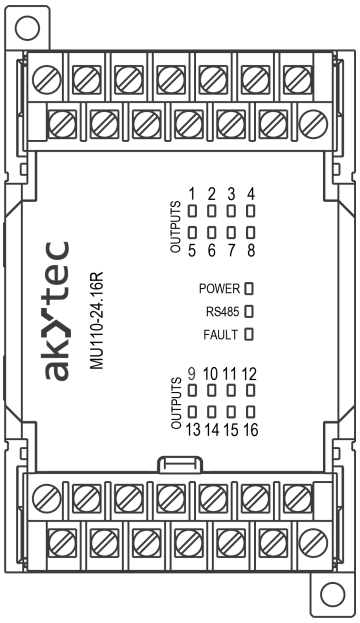


Fig. 2.1 Front view

There are three DIP switches under a module front cover:

– S1 - restore factory settings (see *Section 4.2*)
– S2 – service function
– S3 – DRAM write-protection (see *Section 4.9*)

All DIP switches are in the OFF position by default.

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3 Specifications

3.1 Specifications

Table 3.1 Specifications

Parameter		Value
Power supply		24 (20…28) VDC
Power consumption, max.		12 W
Outputs	Digital	16
RS485 interface	Connection	D+, D-
	Protocols	Modbus RTU / ASCII
	Baud rate	2.4…115.2 kbps
	Data bits	7, 8
	Parity	even, odd, none
	Stop bits	1, 2
Dimensions		63 × 110 × 75 mm
Weight		approx. 500 g
Material		plastic
IP Code		IP20

Table 3.2 Technical data of outputs

Parameter	MU110-24.16R	MU110-24.16K
Output	relay (NO)	NPN transistor
Permissible load	3 A, 250 VAC, cos φ > 0.4 or 30 VDC	400 mA, 60 VDC
Galvanic isolation	in groups of 4	in groups of 4

3.2 Environmental conditions

The module is designed for natural convection cooling which 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 3.3 Operating 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)
Altitude	up to 2000 m above sea level

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4 Configuration and operation

NOTE
Before switching on, make sure that the device was stored at the specified ambient temperature (-20 ... +55 °C) for at least 60 minutes.

Parameters of the module can be read, edited and saved with the Mx110 Configurator software. The full list of parameters is shown in *Table 4.1*.
The software and its user guide can be found on the *akYtec* site.
Module has to be configured first before operating in the RS485 network.
The following steps are required:

1. Install the Mx110 Configurator on the PC.
2. The module should be connected to the 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.
3. Connect the power supply to 24V/0V terminals of the module.
4. Turn on the power supply.
5. Start the Mx110 Configurator.

If the factory settings of the module have not been changed, the connection to the module is automatically established, the module is automatically recognized, its configuration parameters are read out and an appropriate configuration mask opens.
If it does not happen, parameters of the configurator have to be changed.

Table 4.1 Configuration parameters

Name	Parameter	Valid value	Meaning	Default settings
Common parameters				
dev	Device	Up to 8 symbols		MU110-24.16R
ver	Firmware version	Up to 8 symbols		manufacturer
Network parameters				
bPS	Baud rate, kbps	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	
		8	115.2	
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	

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Name	Parameter	Valid value	Meaning	Default settings
Addr	Device address	1…247		16
t.out	Time-out, s	0…600		0
Rs.dL	Response delay, ms	0…45		2
Output parameters				
THPD	PWM period, s	1…900	1…900	1
O.ALr	Safe output status, %	0…100	0…100	0

NOTE
* Invalid network parameter combinations:
– *prty=0; sbit=0; len=0*
– *prty=1; sbit=1; len=1*
– *prty=2; sbit=1; len=1*

4.1 Operation modes

In the operation mode the module is controlled by a network Master in the Modbus network. It can be performed in different ways:
– Individual control in digital mode (see *Section 4.3*)
– Individual control in PWM mode (see *Section 4.4*)
– Group control (see *Section 4.5*).

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

4.2 Functional test

To test the module for proper functioning the following steps are required:
– Connect the module to a USB-port of the PC using a USB/RS485 adapter.
– Start the Mx110 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 MU110-24.16R modification can be optionally measured with an ohmmeter.
  – Max resistance on closed outputs = 1 Ω
  – Min resistance on open outputs = 2 MΩ
– If there are any deficiencies in functioning, contact the akYtec service staff.

4.3 Individual ON/OFF control

Using Modbus function 15 (0x0F) ‘Write Multiple Coils’ certain outputs can be controlled.
The command includes:
– Start address (0x0000…0x000F)
– Number of bits (0x0001…0x0010)
– Number of bytes, n (0x01…0x02)
– Data (bitmask, n bytes).

Addressing of individual cells is shown in *Table 4.4*.

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4.4 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 *Table 4.2*. Modbus function 16 is to be used to transfer the duty cycle value to the module.

Table 4.2 Pulse width modulation

Duty cycle		Output status
in configuration	in 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 a Modbus command can differ. For example, the duty cycle must be set to 1 for switching on the DO1 output 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:

NOTE
Permanent memory
As the permanent memory is not unlimited rewritable (approx. 10^6 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, the PWM duty cycle.

– The minimum PWM period is 50 µs and cannot be changed.

4.5 Group control

Group control is performed using Modbus function 16.
Thus, the output status bitmask (see *Table 4.3*) 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.

4.6 Fault condition

If the data exchange via the serial port is interrupted (i. e. there is no command from the master within the time specified by the **t.out** parameter) all outputs are set to a safe status. The ‘Fault Condition’ is a combination of all safe PWM duty cycle values, set in ther **O.ALr** parameter (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 the **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 *Section 4.4* should be taken into account.

4.7 RS485 network

The I/O modules of series Mx110 use the common standard RS485 standard for data exchange. The RS485 serial interface enables communication via a two-wired line in the half-duplex mode. The modules support Modbus RTU and Modbus ASCII protocols. The network consists of a Master

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device and can contain up to 32 Slave devices. The maximum length is 1,200 m. The number of Slave devices and the network length can be increased using an 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 Ω value (0.5 W) resistor.
All modules can be used as Slave devices only. Master device can be a PLC, computer with SCADA software or control panel.

4.8 Modbus registers

All variables and parameters in *Table 4.3* are of the UINT16 type.
Variables in *Table 4.4* are of the BOOL type.
R – read access.
W – write access

Table 4.3 Modbus registers

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 DO16	-	0…1	0…1000	RW	000F	0015
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**) DO16	-	0…100	0…1000	RW	001F	0031
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**) DO16	s	1…900	1…900	RW	002F	0047
Time-out (**t.out**)	s	0…600	0…600	RW	0030	0048
Output status bitmask	-	-	0…65535	RW	0032	0050

Table 4.4 Output status binary addresses for Modbus function 15

Output	Access	Address	
		hex	dec
1	W	0000	0000

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2	W	0001	0001
…	W	…	…
16	W	000F	0015

4.9 Hardware write protection

Data stored in permanent memory can be lost because of strong electromagnetic interference.
DIP-switch S3 (Hardware write-protection) can help to avoid data loss.
The following steps are required:

1. Turn off the power supply.
2. Open the front cover of the module (see *Fig. 5.1*).
3. Set switch S3 to ON.

NOTE
Switch S3 must be turned off again before changing the module parameters.

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5 Installation

5.1 Mounting

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

The device is designed to be mounted in a cabinet on DIN rail or on the wall.
Install the module in a cabinet with clean, dry and controlled environment. The environmental conditions from *Section 3.2* must be considered when choosing the installation site.
Dimensional drawings are given in *Appendix A.*
The device has been designed for natural convection cooling. Make sure that the cabinet provides sufficient clearance for natural convection.

5.2 Wiring

WARNING
Electric shock could kill or seriously injure

WARNING
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 an electric fuse!

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

The electrical connections are shown in *Fig. 5.1* and the terminal assignments in *Table 5.1*.
Wiring options for both types of outputs are shown in *Fig. 5.2* and *Fig. 5.3*.
Connect power supply to the 24V / 0V terminals.
The maximum conductor cross-section for power supply is 1.5 mm^2.

NOTE
EMC safety
Signal cables should be routed separately or screened from the supply cables.
Only a shielded cable may be used for signal lines.

Connect the RS485 cable to terminals D+ and D-.
The twisted pair cable should be used for the connection to the RS485 interface. The maximal cable length is 1200 m.

5.3 Outputs

- The MU110-24.16R module has 16 relay outputs, and MU110-24.16K has 16 NPN transistor outputs.
- Outputs can be controlled via the RS485 network.
- Each output can be operated in the pulse width modulation mode (PWM).
- Output technical data are shown in *Table. 3.2*

NOTE
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.

- 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 5.1*).
- Outputs are 4-group isolated (1...4, 5...8, 9...12, 13...16). If connecting an inductive load, use only a common terminal (COMx) of the same group (see *Table 5.1*).
- In the MU110-24.16K module COMx are group negative terminals.

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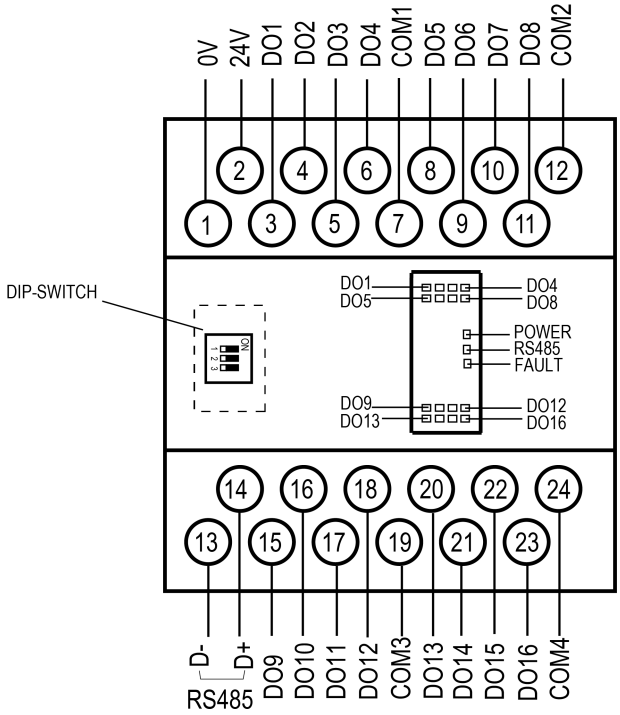


Fig. 5.1 Electrical connections

Table 5.1 Terminal assignments

No	Name	Description	No	Name	Description
1	0V	Power supply	13	D-	RS485 D-
2	24V		14	D+	RS485 D+
3	DO1	NO	15	DO9	NO
4	DO2	NO	16	DO10	NO
5	DO3	NO	17	DO11	NO
6	DO4	NO	18	DO12	NO
7	COM1	DO1…DO4	19	COM3	DO9…DO12
8	DO5	NO	20	DO13	NO
9	DO6	NO	21	DO14	NO
10	DO7	NO	22	DO15	NO
11	DO8	NO	23	DO16	NO
12	COM2	DO5…DO8	24	COM4	DO13…DO16

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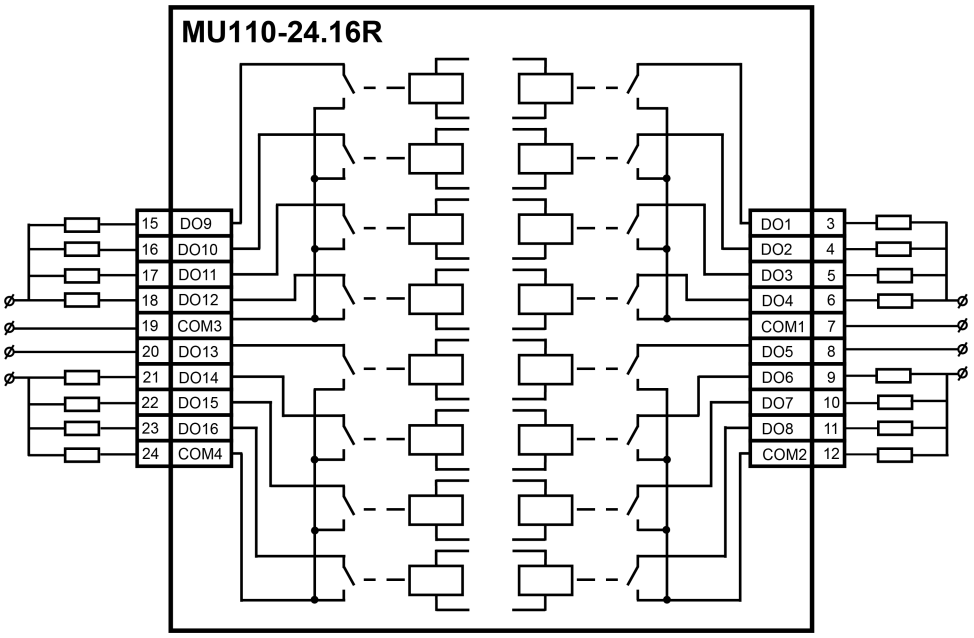


Fig. 5.2 MU110-24.16R outputs

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. 5.3*).

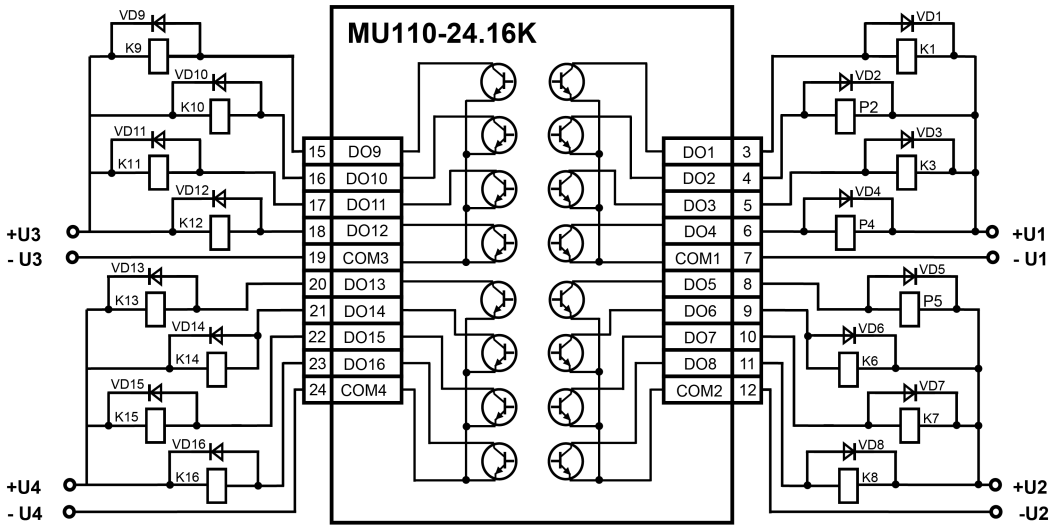


Fig. 5.3 MU110-24.16K outputs

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6 Factory settings restoration

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:

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

> **WARNING**
> 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!

5. Start the Mx110 Configurator.
6. In the window ‘Connection to device’ enter the values from *Table 6.1* or click the key ‘Use factory settings’ (see *Fig. 6.1*).

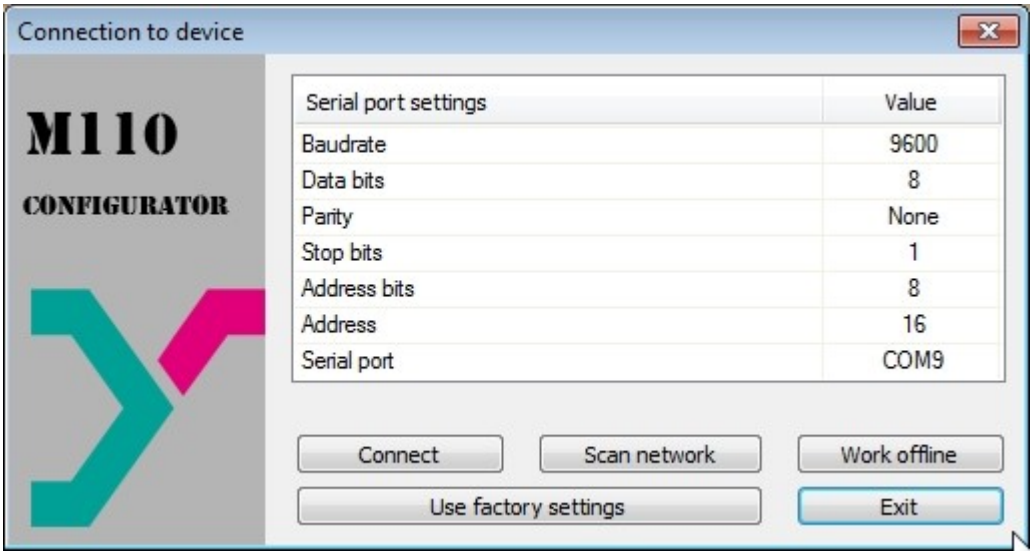


Fig. 6.1 Mx110 Configurator start window

7. Click ‘Connect’ to establish the connection with factory settings.
8. The main window of the Configurator opens. Saved user parameters of the module can be read now (see *Fig. 6.2*).
9. Open folder ‘Network parameters’ and note the user network parameters.

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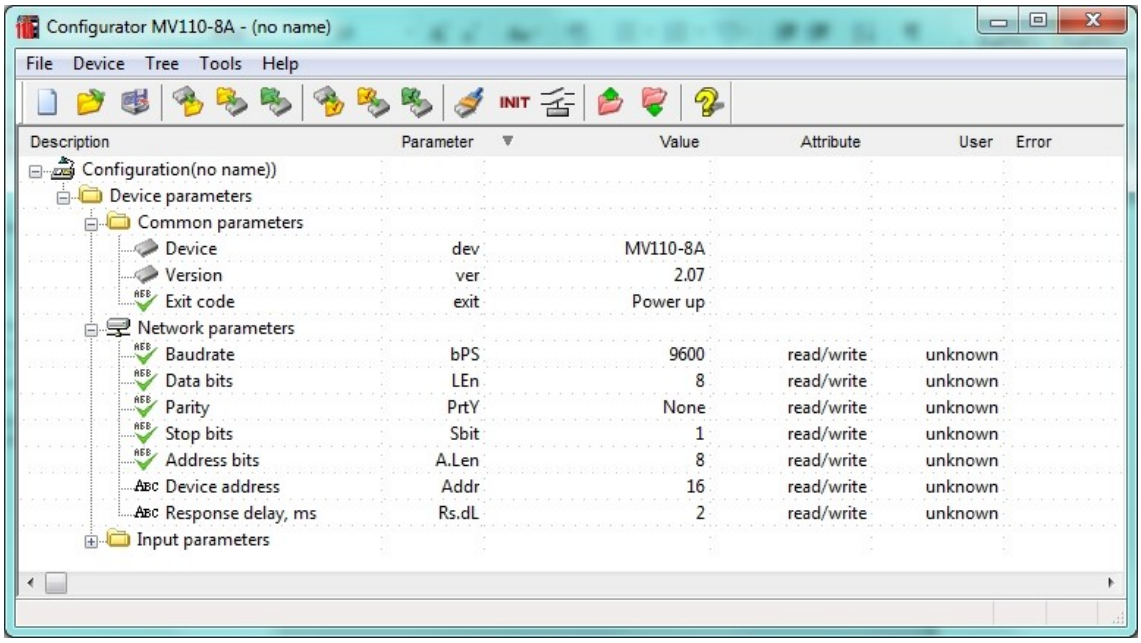


Fig. 6.2 Mx110 Configurator main window

10. Close the Mx110 Configurator.
11. Turn off the power supply.
12. Turn off DIP-switch S1.
13. Close the front cover.
14. Turn on the power supply again.
15. Start the Mx110 Configurator.
16. Enter the noted network parameters.
17. Click ‘Connect’.

The module is now ready for operation.

Table 6.1 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

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

NOTICE
The device may have been damaged during transportation.
Check the device for transport damage and completeness!
Report the transport damage immediately to the shipper and akYtec GmbH!

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9 Scope of delivery

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Appendix A. Dimensions

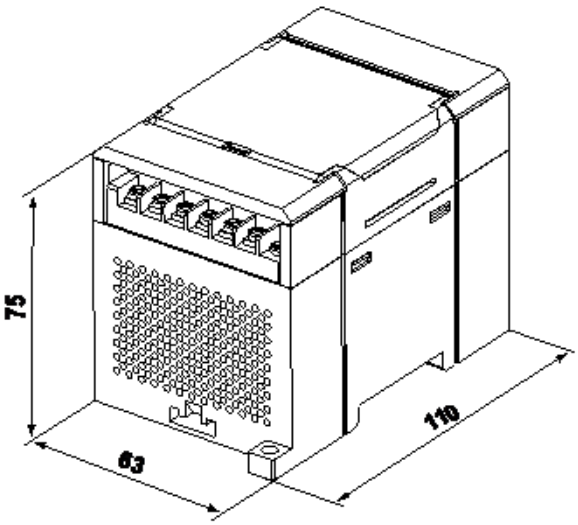


Fig. A.1 External dimensions

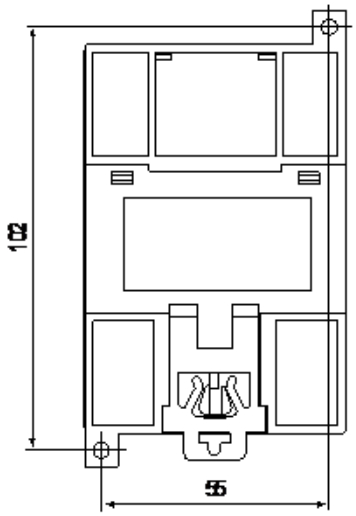


Fig. A.2 Wall mounting dimensions

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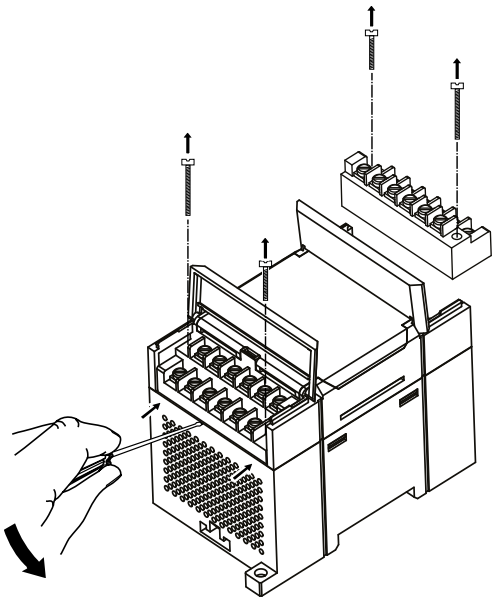


Fig. A.3 Replacement of terminal blocks

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Appendix B. Galvanic isolation

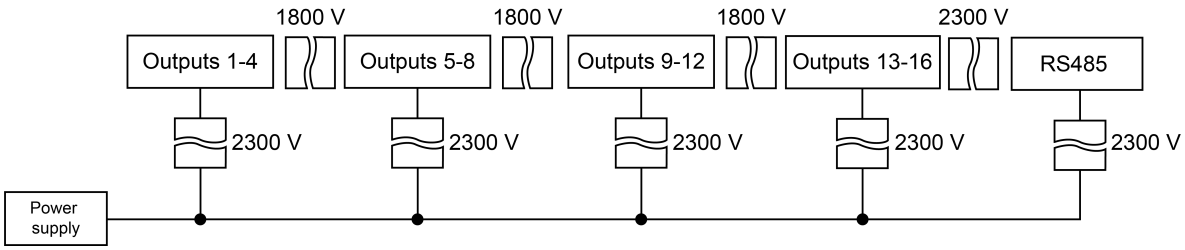


Fig. B.1 MU110–24.16R galvanic isolation

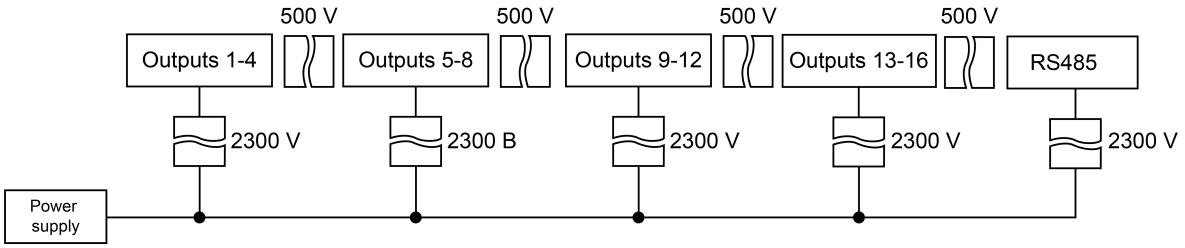


Fig. B.2 MU110–24.16K galvanic isolation

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