

MV110-24.8AS

Analog input module 8 channel

User guide

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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

The MV110-24.8AS analog input module is an extension module with 8 analog inputs for the following standard signals:

– 4-20 mA
– 0-20 mA
– 0-5 mA
– 0-10 V

The module has the following galvanically isolated circuits:

– Power supply
– Analog inputs
– RS485 interface

Separate inputs are not galvanically isolated.
The module has the following functions:

– Connection of peripherals with analog outputs
– Analog-digital conversion with digital signal processing
– Sensor status diagnostics
– RS485 network status diagnostics
– Error and alarm signals
– Slave device in Modbus structure

The module supports Modbus-RTU and Modbus-ASCII protocols with automatic protocol identification.
The module is to be configured using the *Mx110 Configurator* software via an RS485-USB interface adapter (not included).

2.2 Design and indication

Table 2.1 Indication

LED	LED state	Description
POWER	ON	Power on
RS485	Flashing	Data exchange via RS485 interface
FAULT	ON	Fault status

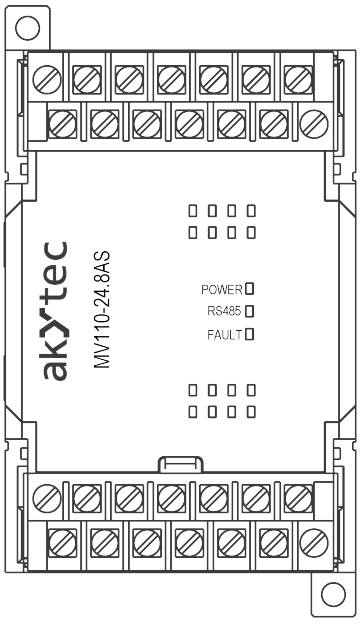


Fig. 2.1 Front view of MV110-24.8AS

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Dimensional Sketches are given in *Appendix A A.*.
Under the cover on the front panel of the module there is a 10-pole pin strip XP1 with the JP1 jumper (see *Fig. 5.1* and *Fig. 6.3*). For factory settings restoration, see *Section 6*.

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3 Specifications

3.1 Specifications

Table 3.1 General specifications

Parameter		Value
Power supply		24 (20…28) V DC
Power consumption, max.		6 W
Inputs	digital	–
	analog	8
Outputs	digital	–
	analog	–
Sampling time for each input (max.)(1)		5±2% ms
Basic error		0.25 %
Temperature influence (2)		0.12 %
Resolution	0(4)-20 mA	4 µA
	0-5 mA	1 µA
	0-10 V	2 mV
Input resistance	0(4)-20 mA	130…250 Ohm
	0-5 mA	130…500 Ohm
	0-10 V	>200 Ohm
Permissible input voltage		-40…+40 V
RS485 interface	Terminals	D+, D-
	Protocols	Modbus RTU / ASCII, akYtec
	Baud rate	2.4…115.2 kbit/s
	Data bits	7, 8
	Parity	even, odd, none
	Stop bits	1, 2
Galvanic isolation (test voltage)	Power supply/Inputs	3 kV
	Power supply/RS485	3 kV
	Inputs/RS485	0.75 kV
Dimensions		63 × 110 × 75 mm
Weight, max.		500 g
Material		plastic
IP code		IP20

(1) Since input sampling is performed sequentially, the total sampling time is equal to the sum of times of all connected inputs.
(2) % FS, per 10 °C of deviation from (20 ±5) °C within the permissible limits.

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3.2 Operating conditions

The module is designed for natural convection cooling that 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 3.2 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)
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.***

The module is controlled by the master device in Modbus network.
Modbus functions 03, 04 can be used for reading and 15, 16 can be used for writing.
The 'M110 Configurator' tool allows viewing, editing and saving of parameters. The software and its user guide can be found on the *akYtec site*.
Module should be configured first before operating in the RS485 network.
The following steps are required:

1. Install the Mx110 Configurator on the PC.
2. Connect the module to the USB port of the PC over a USB/RS485 adapter (not included).
3. Connect the power supply to the 24V/0V terminals of the module.
4. Turn on the power supply.
5. Run 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.
Otherwise, the network parameters of the configurator must be adapted.
Parameters of the module can be read, edited and saved with the 'Mx110 Configurator' software.
The full list of parameters is shown in the Table below.

Table 4.1 Configuration parameters

Name	Parameter	Valid value	Meaning	Default settings
Common parameters				
dev	Device	Up to 8 symbols		MV110-24.8AS
ver	Firmware version	Up to 8 symbols		manufacturer
n.Err	Last error code	0…255 (at power on – 0)		–
exit	Exit code	0	software reset	–
		6	hardware reset	
		7	power on	
		8	watchdog timer	
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	
PrtY	Parity*	0	none	none
		1	even	

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Name	Parameter	Valid value	Meaning	Default settings
		2	odd	
Sbit	Stop bits*	0	1	1
		1	2	
Addr	Device address	1…247		16
Rs.dL	Response delay, ms	0…45		2
Input Parameters				
ComF	Input filter for all channels	0	off	off
		1	50 Hz, first-order	
		2	50 Hz, second-order	
		3	50 Hz, fourth-order	
		4	200 Hz, first-order	
in-t	Sensor type	0	off	off
		1	4-20 mA	
		2	0-20 mA	
		3	0-5 mA	
		4	0-10 V	
in.Fd	Filter time constant, ms	10…10000		10
Ain.L	Lower limit	FLOAT32		0
Ain.H	Upper limit	FLOAT32		20000
dP	Decimal point	0…3		0
Peak	Rate of change limit	1…200 s^{-1}		200
OutF	Output filter	0	off	0
		1	Exponential filter	
		2	Moving average filter, L=2	
		…	…	
		16	Moving average filter, L=16	

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 Signal processing

Inputs are sampled cyclically. The measured values are converted into digital values, analyzed and processed in accordance with the set parameters. The results are saved in data registers (*Table 4.3*).

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4.2 Sampling

An input is included into the sampling list if the signal type is selected. If parameter **in-t** is set to OFF, the input is excluded from the list.

4.3 Signal change rate limitation

Signal change rate limitation allows reducing impulse noise efficiently. This limitation can be adjusted using **Peak** parameter so that the noise suppression does not affect a measuring signal. The parameter can be changed within the range from −1 to 200 s^{-1} in increments of 1 s^{-1}. Unit 1 s^{-1} corresponds to 1/200 of the measurement range.
For example, for 4-20 mA signal:
1 s^{-1} corresponds to 1*16/200 = 0.08 mA — maximum noise suppression;
200 s^{-1} correspond to 200*16/200 = 16 mA — noise suppression is off.
If the maximum signal change rate does not exceed 50 mA/s, then

$$\frac{50\ \frac{mA}{s}}{16\ mA} = 3.125\ \frac{Measuring\ range}{s}$$

In this case, **Peak** = 4 guarantees the best noise suppression and the minimum measuring signal impact at the same time.
The **Peak** factory setting is 200.

4.4 Digital Filter

The digital filter consists of two stages.

– At the first stage, a common filter affecting all 8 channels is used. The filter type must be set in **ComF** parameter. The filter provides noise suppression with frequencies the values of which are a multiply of 50 Hz. The filter factory setting is “off”.
– At the second stage, a channel filter is used and must be adjusted in **OutF** parameter.

If **OutF** = 1, the exponential filter is on. The filter time constant must be set in ms in parameter **in.Fd**. The higher the value, the higher the noise resistance and the slower the input response.

4.5 Linear signal

To scale the linear signal (current or voltage), the measurement limits must be set. Parameters **Ain. L** ‘Lower limit’ and **Ain.H** ‘Upper limit’ are set in the specified units.
If **Ain.L**<**Ain.H**, then

$$Measured\ value = Ain.L + \frac{(Ain.H - Ain.L)\cdot(S_i - S_{min})}{S_{max} - S_{min}}$$

If **Ain.L**>**Ain.H**, then

$$Measured\ value = Ain.L - \frac{(Ain.L - Ain.H)\cdot(S_i - S_{min})}{S_{max} - S_{min}}$$

where
S_{max} – is the upper signal limit (for example, 20 for 4-20 mA signal)
S_{min} – is the lower signal limit (for example, 4 for 4-20 mA signal)
S_I – is the actual signal value

4.6 Error diagnostics

When sampling the inputs, the module monitors the status of connected sensors, the process of communication and measurements. The detected errors are transmitted with the response as an error code (see *Table 4.2*).
If there is a measurement error, the last correctly saved value is transmitted.

Table 4.2 Error Codes

Error	Comment	Code
Measurement correct	Transmission in progress	0x0000

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Measured value error	Measured value incorrect	0xF000
Measurement not ready	Just upon restart	0xF006
Sensor switched off	**in-t** parameter set to **OFF**	0xF007
Measured value too high	Exceeded the measuring range of the selected sensor type	0xF00A
Measured value too low	Below measuring range of the selected sensor type	0xF00B
Wire break	Live zero linear signal	0xF00D
Calibration error	Calibration incorrect	0xF00F

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-wire line in the half-duplex mode. The modules support Modbus RTU and Modbus ASCII protocols. The network consists of a Master device and can contain up to 32 Slave devices. The maximum length is 1200 m. The number of Slave devices and the network length can be increased using an RS485 interface repeater.
Separate devices (slave devices) are connected 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 the open bus ends (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, a computer with SCADA software or a control panel.

4.8 Modbus registers

Modbus-RTU and Modbus-ASCII protocols are supported.
Modbus functions 03 and 04 are available for the following parameters:

– Measured value
– Time mark
– Error code (see *Table 4.2*)

The measured value is available in the following formats:

– Integer (16 bits)
– Integer with a time mark (16 bits + 16 bits)
– Floating-point with a time mark (32 bits + 16 bits)

The integer is calculated by multiplication of the measured value by 10^{dP}. Parameter **dP** is used for a decimal point and can be set within the range of 0…3.
When a floating-point number value is transmitted, the most significant byte of 32-bit data is stored in the first register (big-endian).
The time mark is cyclic time within the range from 0 to 655.36 seconds with the increment of 0.01 second saved as a 2-byte integer. It determines the exact time of measurement within the cycle. When the module is powered on, the cycle starts from 0 and returns to the initial state in 655.36 seconds.

Table 4.3 Modbus registers

Param-eter	Description	Data type	Input number	Register (Hex)	Access
exit	Cause of reset	INT16		0x88	r
n.Err	Last network error	BYTE		0x90	r
bPS	Baud rate	INT16		0x30	r/w

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Parameter	Description	Data type	Input number	Register (Hex)	Access
PrtY	Parity	INT16		0x38	r/w
Sbit	Stop bits	INT16		0x40	r/w
Addr	Device address	INT16		0x48	r/w
Rs.dL	Response delay	INT16		0x50	r/w
ComF	Common filters	INT16		0x28	r/w
in-t	Sensor type	INT16	1	0x00	r/w
			…	…	…
			8	0x07	r/w
in.Fd	Filter time constant	INT16	1	0x18	r/w
			…	…	…
			8	0x1F	r/w
Ain.L	Measuring range / lower limit	FLOAT32	1	0x58, 0x59	r/w
			…	…	…
			8	0x66, 0x67	r/w
Ain.H	Measuring range / upper limit	FLOAT32	1	0x68, 0x69	r/w
			…	…	…
			8	0x76, 0x77	r/w
dP	Decimal point	INT16	1	0x20	r/w
			…	…	…
			8	0x27	r/w
Peak	Change rate limit	INT16	1	0x08	r/w
			…	…	…
			8	0x0F	r/w
OutF	Channel filter	INT16	1	0x10	r/w
			…	…	…
			8	0x17	r/w
ird	Measured value (INT)	INT16	1	0x100	r/w
			…	…	…
			8	0x107	r/w
irdt	Measured value (INT) with a time mark	INT16 +INT16	1	0x108, 0x109	r/w
			…	…	…
			8	0x116, 0x117	r/w
srd	Error code	INT16	1	0x118	r/w
			…	…	…
			8	0x11F	r/w
read	Measured value (FLOAT) with a time mark	FLOAT32 +INT16	1	0x120…0x122	r/w
			…	…	…
			8	0x135…0x137	r/w

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5 Installation

5.1 Mounting

The device is designed to be installed on a DIN rail or using two screws on a mounting panel in an electric cabinet.
The operating conditions from *Sect. 3.2* must be considered when choosing the installation site.
Dimensional drawings are given in *Appendix A A.*. Only the vertical positioning of the device is allowed.
The device is 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.

Connect power supply to the 24V / 0V terminals.
The maximum conductor cross-section for power supply is 1.5 mm².

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-.
Connection to the RS485 interface is carried out via a twisted pair cable.

5.2.1 Inputs

The following must be observed:

– All the AIx terminals are internally connected.
– The total resistance of sensor output with connection lines must not exceed 100 Ohm.
– When connecting, one must ensure that the permissible input voltage (see *Table 3.1*) is not exceeded. If the voltage is within the permissible limits the input current will be limited to 35 mA automatically.

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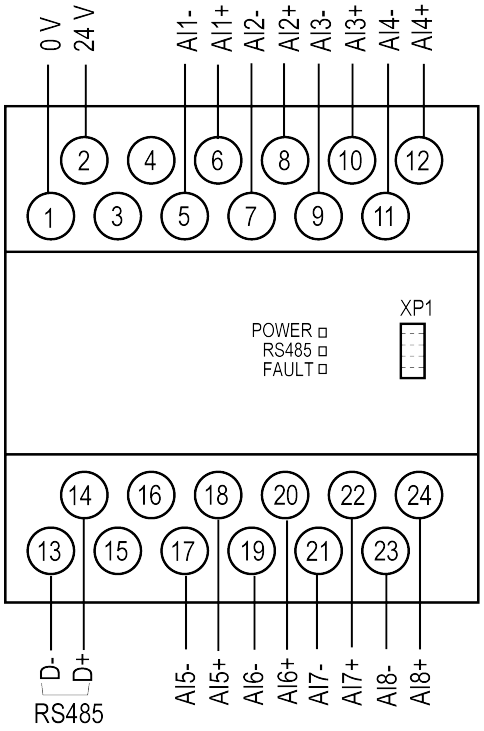


Fig. 5.1 Electrical connections

Table 5.1 Terminal assignment of MV110–24.8AS

No.	Description	No.	Description
1	Power supply (0 V)	13	RS485 (D-)
2	Power supply (24 V)	14	RS485 (D+)
3	free	15	free
4	free	16	free
5	common negative (AI1-)	17	common negative (AI5-)
6	AI1+	18	AI5+
7	common negative (AI2-)	19	common negative (AI6-)
8	AI2+	20	AI6+
9	common negative (AI3-)	21	common negative (AI7-)
10	AI3+	22	AI7+
11	common negative (AI4-)	23	common negative (AI8-)
12	AI4+	24	AI8+

When connecting current and voltage signals take into account an external additional voltage source.

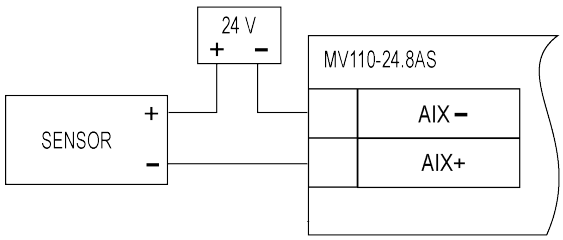


Fig. 5.2 Connection of 2-wire sensors

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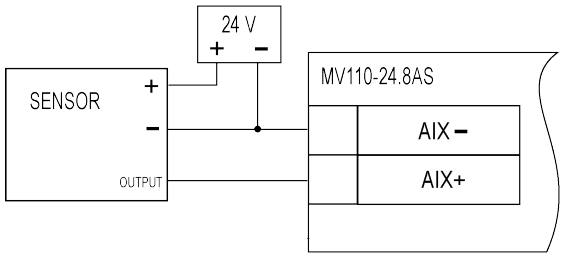


Fig. 5.3 Connection of 3-wire sensors

5.2.2 Different input signals

Each input can be configured for any type of signal individually. The signal type (sensor type) must be selected for the **in-t** parameter. A full list of configuration parameters is presented in Appendix B. If a sensor has a positive output you can use a common additional voltage source. In case of a negative output, a separate additional voltage source should be provided for each sensor.

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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. Proceed as follows:

1. Turn off the power supply.
2. Remove the front cover of the module.
3. Insert jumper JP1 (see *Figure 6.3*) onto pins 9-10 (bottom row). Now the module is operated with default network parameters, the user settings are saved.
4. Turn on the power supply.

> **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 software.
6. In window ‘Connection to device’ enter the values from *Table 6.1* or click ‘Use factory settings’.

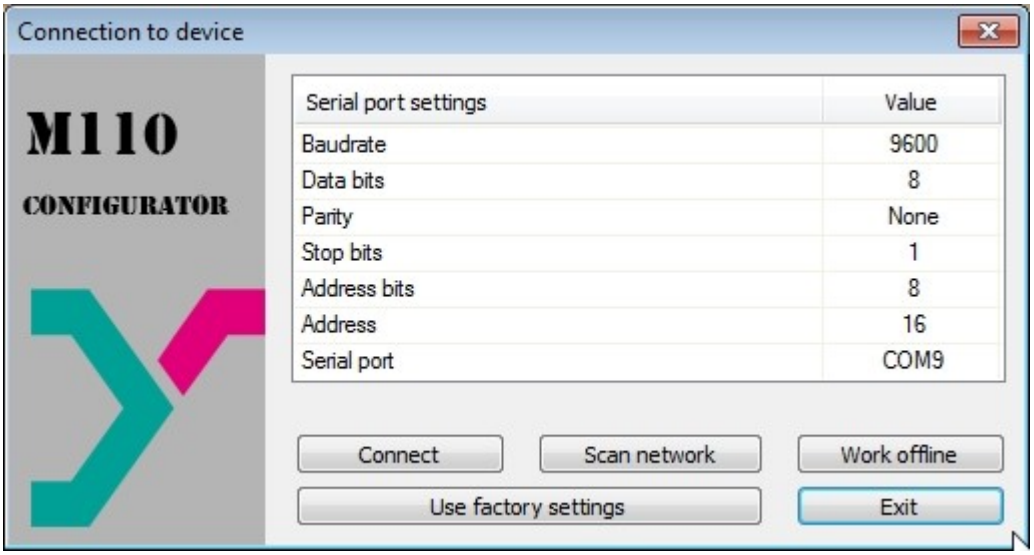


Fig. 6.1 Mx110 Configurator start window

7. Click ‘Connect’ to establish connection with factory settings.
8. The main window of the Configurator opens. Now the saved network parameters of the module can be read.
9. Open folder ‘Network parameters’ and note the values of the network parameters.

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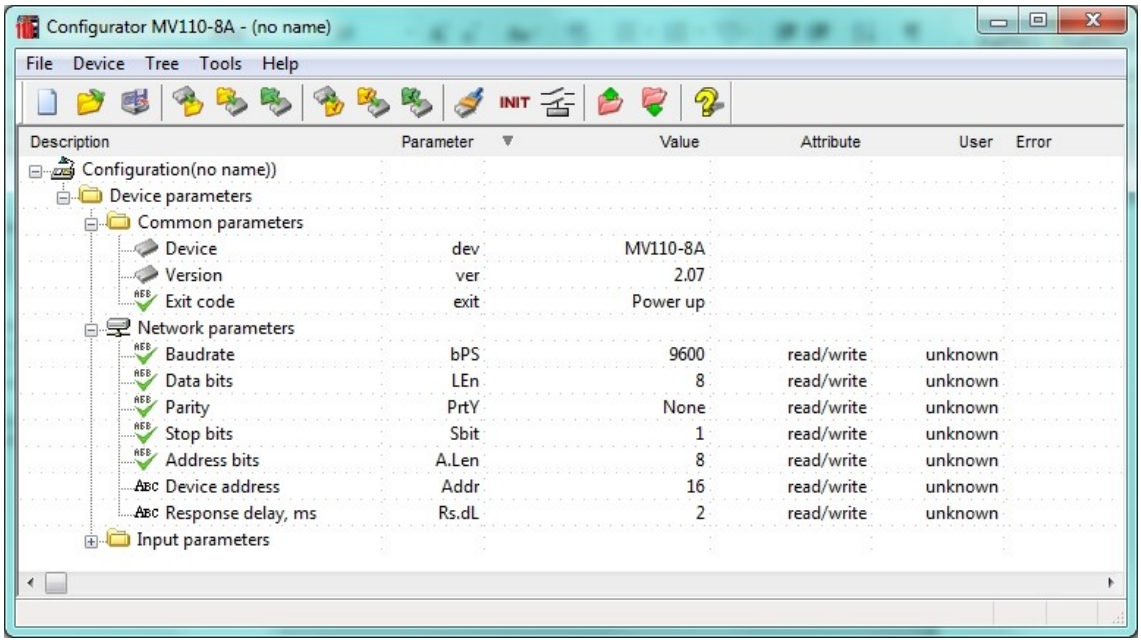


Fig. 6.2 Mx110 Configurator main window

10. Close Mx110 Configurator.
11. Remove jumper JP1 and install it onto pin 10 (do not strap!).
12. Close the front cover.
13. Turn on the power supply again.
14. Start the Configurator.
15. Enter the noted network parameters.
16. 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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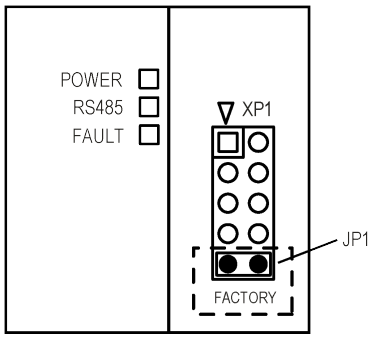


Fig. 6.3 Jumper JP1

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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

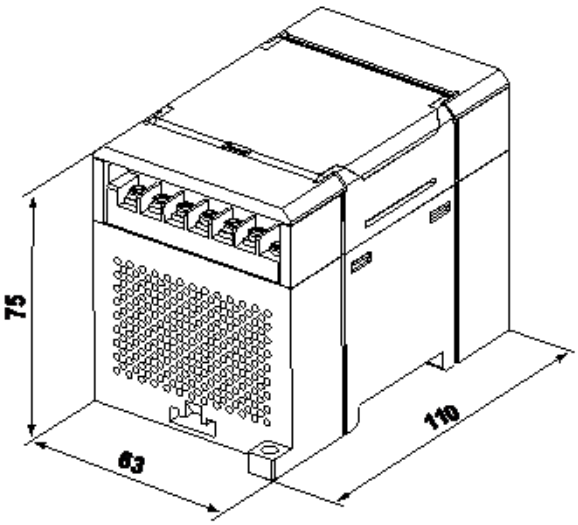


Fig. A.1 External dimensions

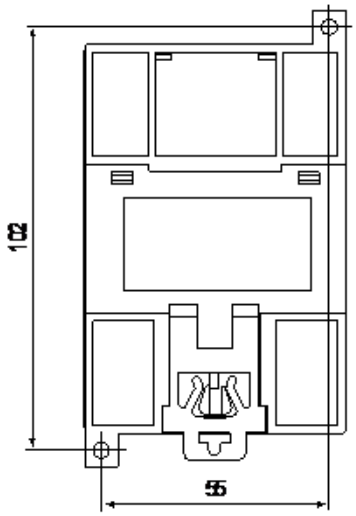


Fig. A.2 Wall mounting dimensions

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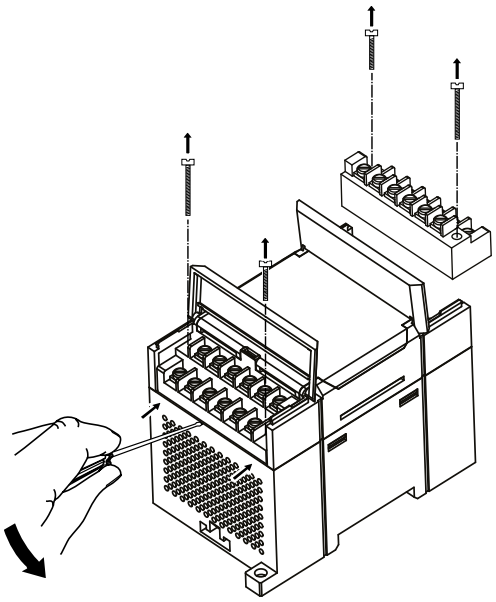


Fig. A.3 Replacement of terminal blocks

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Appendix B. Galvanic Isolation

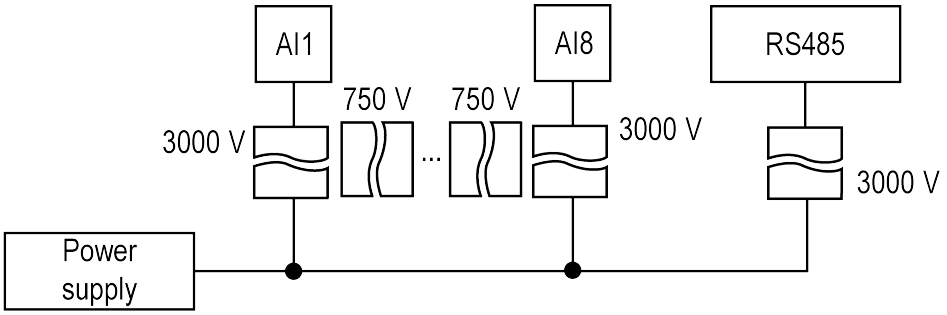


Fig. B.1 Galvanic isolation of MV110–24.8AS

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