EN

MV110-8AS

Analog input module
8 channel

User guide

MV110-8AS_2016.12_0226_EN

CE

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Contents

1 Description

1.1 Function

The MV110-8AS 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 performs the following functions:

- Connection of peripherals with analog outputs
- Conversion of analog signals to digital values
- Sensor-based status diagnostics
- Diagnostics of RS485 network status
- Generation of appropriate error signals or alarm signals
- Slave device in Modbus protocol structure

The module supports Modbus RTU, Modbus ASCII protocols with automatic protocol identification.

The module is to be configured using ‘M110 Configurator’ software (included on CD) via RS485-USB interface adapter (not included).

1.2 RS485 network

The I/O modules of Mx110 series use common standard RS485 for data exchange. The RS485 serial interface is based on two-wire technology and half-duplex mode. Protocols Modbus RTU, Modbus ASCII and akYtec are supported. 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 with using a 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 connections and spur lines are not allowed.

Line reflections always occur at the open bus ends (the first and the last node). The higher the chosen data transmission rate, the stronger they are. A terminating resistor is needed to minimize reflections. Experience proves that the most efficient practice is to use terminating resistors of 150 ohm.

The module can be used as slave devices only. Master device can be PLC, PC 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 via RS485 interface

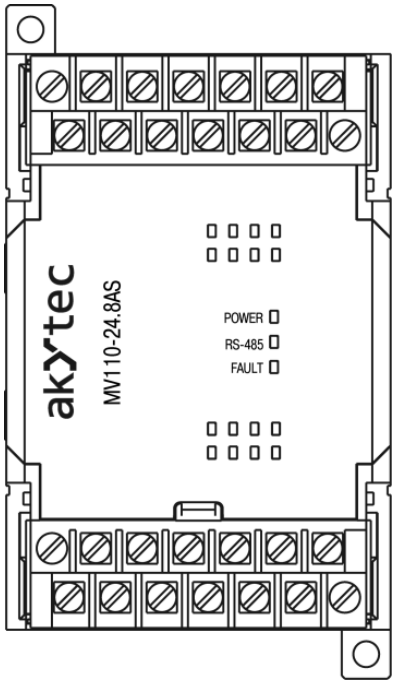

Fig. 1.1 Front View

Dimensional Sketches are given in Appendix A.

Under the cover on the front panel of the module there is a 10-pole pin strip XP1 with the jumper JP1 (see Figure 4.1, 7.3) for factory settings restoration (see 7).

2 Specifications

Table 2.1 General Specifications

Power supply		24 (21…35) V DC
Power consumption, max		6 W
Inputs	digital	–
	analog	8
Outputs	digital	-
	analog	–
Sampling time for each input [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 control	even, odd, none
	Stop bits	1, 2
Dimensions		63 x 110 x 75 mm
Weight		approx. 240 g
Material		plastic

[1] *Because the sampling of inputs is performed sequentially, the total sampling time is equal to the sum of the times of all connected inputs*.

[2] *% FS, per 10 °C of deviation from (20 ±5) °C within the permissible limits.*

2.1 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 2.2 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)
IP code	IP20
Altitude	up to 2000 m above sea level

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.

4 Installation

⚠ WARNING

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

- The device is intended to be mounted in a cabinet on DIN-rail or on the wall.
- Install the module in a clean, dry and controlled environment. Further requirements are described in paragraph 2.1.
- The module is designed for convective self-cooling. This should be taken into account when selecting 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!

► NOTICE

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

- Terminal connections are shown in Fig. 4.1, terminal assignments are given in Table 4.1.
- The inputs should be wired in accordance with Fig. 4.2 – 4.7.
- Connect the supply voltage to the terminals 24V and 0V.
- The maximum wire cross-section for power supply is1.5 mm²

► NOTICE

EMC-safety
Signal cables should be routed separately or screened from the supply cables
Only shielded cable may be used for data transmission and signal lines.
Shield in the control cabinet for best electromagnetic immunity recommended

- Connect RS485 line to terminals D+ and D-.
- Use twisted pair cable for RS485 connection. The length of the line should not exceed 1200 m.

4.1.1 Inputs

The following must be observed:

- All 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 2.1) is not exceeded. If the voltage is within the permissible limits the input current will be limited to 35 mA automatically.

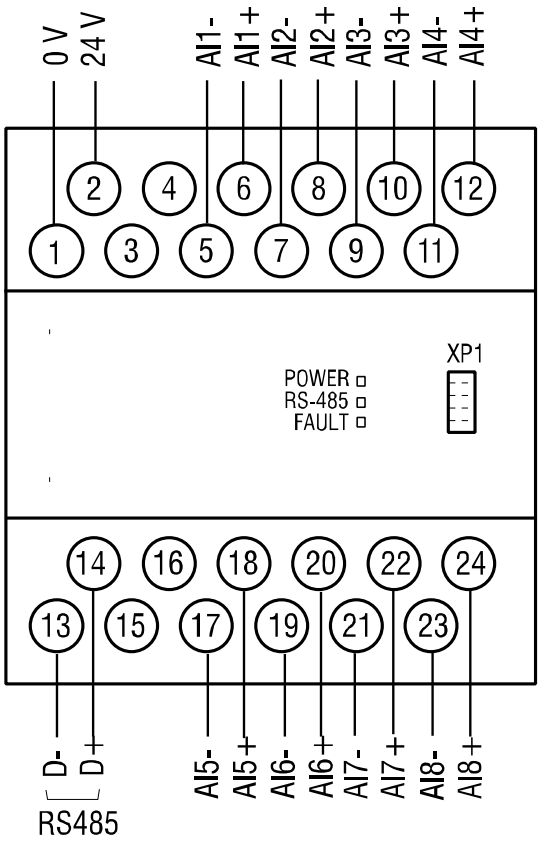

Fig. 4.1 Electrical connections

Table 4.1 Terminal assignments

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

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

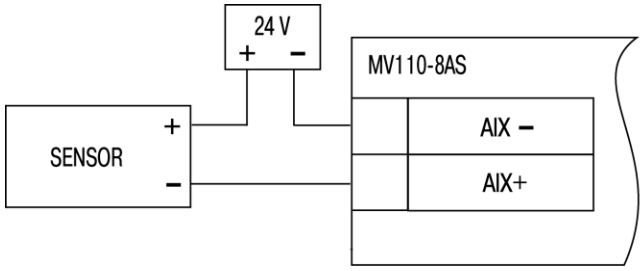

Fig. 4.2 Connection of 2-wire sensors

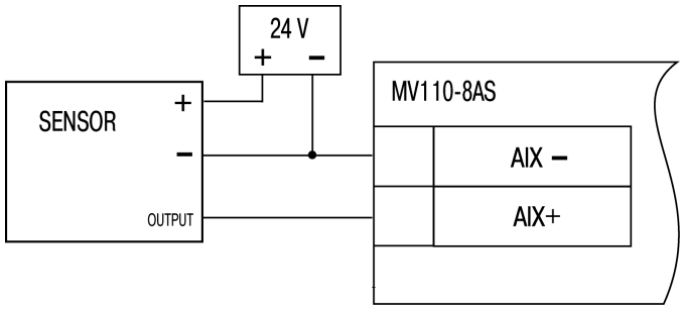

Fig. 4.3 Connection of 3-wire sensors

4.1.2 Different input signals

Each input can be configured for any type of signal individually. The signal type (sensor type) must be selected for **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.

5 Configuration

► NOTICE

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

The configuration tool ‘M110 Configurator’ allows viewing, editing and saving of parameters. The complete list of parameters is shown in Table 5.1.

The software and the manual are included on the CD.

The module must be configured in order to use it in RS485 network. Proceed as follows:

- install the configuration software ‘M110 Configurator’ on the PC
- connect the module to the USB interface of the PC over USB/RS485 adapter (not included)
- connect a power source 24V DC to the module terminals 24V/0V
- switch the power on
- run the M110 Configurator

If the factory settings of the module have not been changed, then connection with the module is established automatically. The module is automatically identified, the module configuration parameters are readout and a window with an appropriate configuration mask opens.

Otherwise, the network parameters of the configurator must be adapted.

Table 5.1 Configuration parameters

Name	Parameter	Permissible values	Significance	Default value
Common parameters				
dev	Device	up to 8 characters		MV110-8AS
ver	Firmware version	up to 8 characters		Manufacturer
n.Err	Last error code	0…255 (at power 0n – 0)		–
exit	Exit code	0	software reset	–
		6	hardware reset	
		7	power on	
		8	watchdog timer	
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	
		8	115.2	
PrtY	Parity *	0	none	none
		1	even	
		2	odd	
Sbit	Stop bits *	0	1	1
		1	2	
Addr	Device address	1…247		16

Name	Parameter	Permissible values	Significance	Default value
Rs.dL	Response delay, ms	0…45		2
Inputs				
ComF	Input filter for all chanels	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	4-20 mA
		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	

***** *Invalid network parameter combinations:*

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

6 Operation

The module is controlled by the master device in Modbus network.
Following Modbus function s are available: 03, 04 for reading and 15, 16 for writing.

6.1 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 6.1).

6.1.1 Sampling

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

6.1.2 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

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

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.

6.1.3 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 **in.fd** parameter in ms. The higher the value, the higher the noise resistance and the slower the input response.

6.1.4 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 physical.

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

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

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

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

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

6.2 Modbus communication

Modbus-RTU and Modbus-ASCII protocols are supported.

Modbus functions 03 and 04 for the following parameters are available:

- Measured value
- Time mark
- Error code (see 6.2.1)

The measured value is in two formats available:

- 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}. The parameter **dP** is used for a decimal point and can be set within the range 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 6.1 Modbus registers

Parame-ter	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	RW
PrtY	Parity	INT16		0x38	RW
Sbit	Stop bits	INT16		0x40	RW
Addr	Device address	INT16		0x48	RW
Rs.dL	Response delay	INT16		0x50	RW
ComF	Common filters	INT16		0x28	RW
in-t	Sensor type	INT16	1	0x00	RW
			…	…	…
			8	0x07	RW
in.Fd	Filter time constant	INT16	1	0x18	RW
			…	…	…
			8	0x1F	RW
Ain.L	Measuring range / lower limit	FLOAT32	1	0x58, 0x59	RW
			…	…	…
			8	0x66, 0x67	RW
Ain.H	Measuring range / upper limit	FLOAT32	1	0x68, 0x69	RW
			…	…	…

Parame-ter	Description	Data type	Input number	Register hex	Access
			8	0x76, 0x77	RW
dP	Decimal point	INT16	1	0x20	RW
			…	…	…
			8	0x27	RW
Peak	Change rate limit	INT16	1	0x08	RW
			…	…	…
			8	0x0F	RW
OutF	Channel filter	INT16	1	0x10	RW
			…	…	…
			8	0x17	RW
ird	Measured value (INT)	INT16	1	0x100	RW
			…	…	…
			8	0x107	RW
irdt	Measured value (INT) with a time mark	INT16 +INT16	1	0x108, 0x109	RW
			…	…	…
			8	0x116, 0x117	RW
srd	Error code	INT16	1	0x118	RW
			…	…	…
			8	0x11F	RW
read	Measured value (FLOAT) with a time mark	FLOAT32 +INT16	1	0x120…0x 122	RW
			…	…	…
			8	0x135…0x 137	RW

6.3 Error diagnosis

When polling inputs, the module controls the status of the connected sensors, the correctness of communication and the measurement. The detected errors are transmitted with the response as an error code (see Table 6.2).

If there is a measurement error, the last correctly saved value is transmitted.

Table 6.2 Error Codes

Error	Comment	Code
Measurement correct	Transmission in progress	0x0000
Measured value error	Measured value incorrect	0xF000
Measurement not ready	Just upon restart	0xF006
Sensor switched off	**in-t** parameter set to **OFF**	0xF007
Measurement value too high	Exceeded the measuring range of the selected sensor type	0xF00A
Measurement value too low	Below measuring range of the selected sensor type	0xF00B
Wire break	Live zero linear signal	0xF00D
Calibration error	Calibration incorrect	0xF00F

7 Factory settings restoration

If communication between the PC and the module cannot be established and the network parameters of the module are unknown, the factory settings of the network parameters must be restored. Proceed as follows:

- power off the module
- remove the left cover from the front panel of the module
- turn the DIP switch S1 in ON position
- install jumper JP1 (see Figure 7.3) onto pins 9-10 (bottom row), now the module is operated with default network parameters, the user settings are saved
- switch the power on

⚠ WARNING

Dangerous voltage
Electric shock could kill or seriously injure.
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!

- start the ‘M110 Configurator’ software
- in the ‘Connection to device’ window set the parameters to default (see Table 7.1) or click the ‘Use factory settings’ button (see Fig. 7.1)

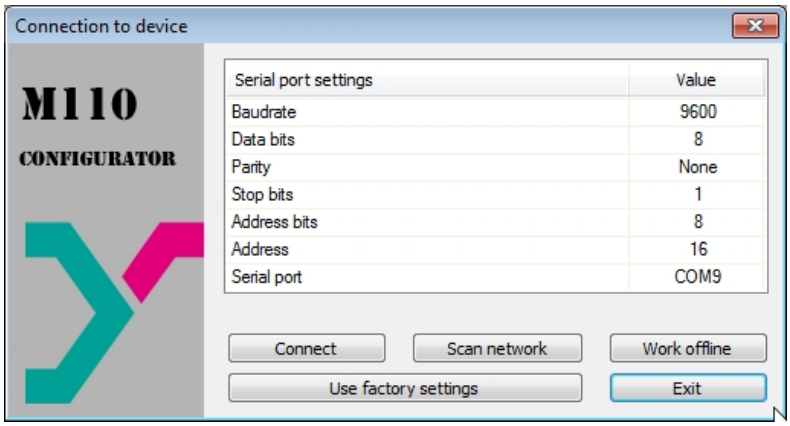

Fig. 7.1 Start window of configuration software

- press ‘Connect’ button. Connection is established with the default network parameters.
- the main window of the configurator opens. Now the saved network parameters of the module can be read out (see Fig. 7.2)

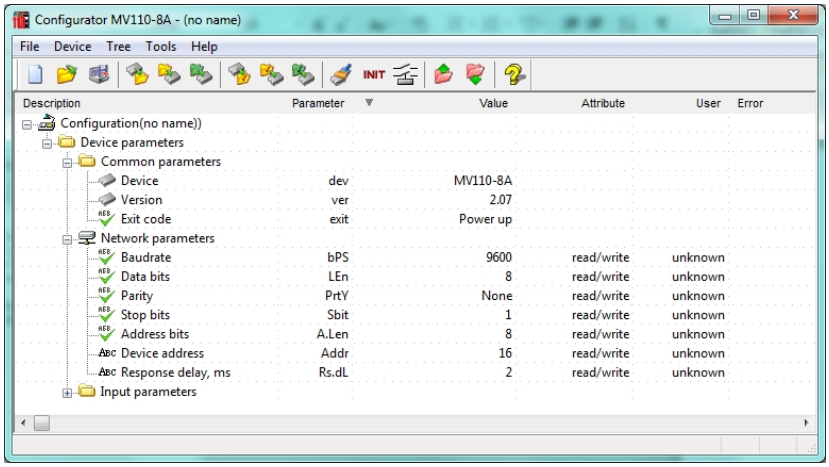

Fig. 7.2 Main window of M110 Configurator

- open the ‘Network parameters’ folder in the configuration tree, read and note down the values of the network parameters
- close the Configurator
- switch the power off
- remove jumper JP1 and install it onto pin 10 (do not strap!)
- close the cover
- switch the power on
- restart the Configurator
- enter the written network parameters
- press ‘Connect’ button

The module is ready for operation.

Table 7.1 Network factory settings

Parameter	Name	Default
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

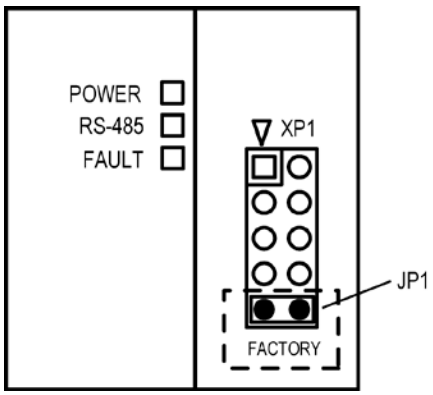

Fig. 7.3 Jumper JP1

8 Maintenance

The maintenance includes:

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

The safety information in section 3 must be observed when carrying out maintenance.

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!!

10 Scope of delivery

–	Module MV110-24.8AS	1
–	User guide	1
–	CD with software and documentation	1

Appendix A Dimensions

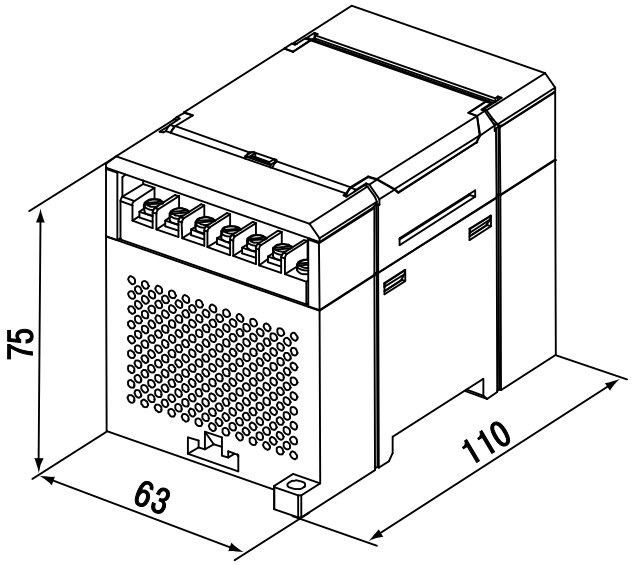

Fig. A.1 External dimensions

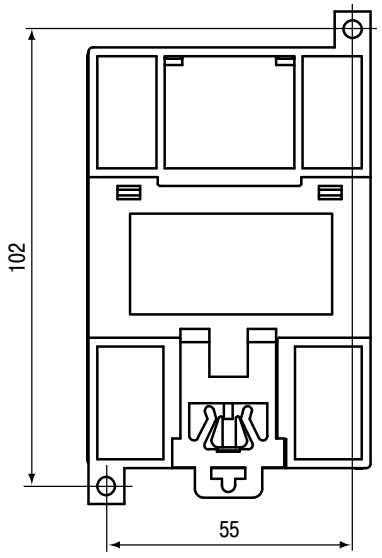

Fig. A.2 Wall mounting dimensions

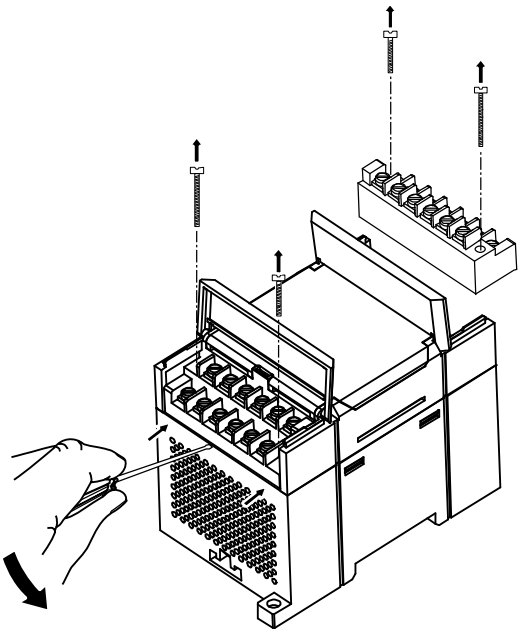

Fig. A.3 Replacement of terminal blocks