HIMatrix M45

Safety-Related Controller

Manual M-LS 4 01

HIMA Paul Hildebrandt GmbH

Industrial Automation

Rev. 1.01

HI 800 669 E

All of the instructions and technical specifications in this manual have been written with great care and effective quality assurance measures have been implemented to ensure their validity. For questions, please contact HIMA directly. HIMA appreciates any suggestion on which information should be included in the manual.

Equipment subject to change without notice. HIMA also reserves the right to modify the written material without prior notice.

For further information, refer to the HIMA DVD and our website at `http://www.hima.de` and `http://www.hima.com`.

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Revision index	Revisions	Type of change	
		technical	editorial
1.00	First edition of the HIMatrix M45 manual		
1.01	Editorial revisions		X

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1 Introduction

This manual describes the technical characteristics of the module and its use. It provides information on how to install, start up and configure the module in SILworX.

1.1 Structure and Use of this Manual

The content of this manual is part of the hardware description of the HIMatrix M45 programmable electronic system.

This manual is organized in the following main chapters:

- Introduction
- Safety
- Product Description
- Start-up
- Operation
- Maintenance
- Decommissioning
- Transport
- Disposal

Additionally, the following documents must be taken into account:

Name	Content	Document no.
HIMatrix M45 Safety Manual	Safety functions of the HIMatrix system	HI 800 653 E
HIMatrix M45 System Manual	Hardware description of the HIMatrix M45	HI 800 651 E
SILworX Communication Manual	Description of communication and protocols	HI 801 101 E
SILworX Online Help (OLH)	Instructions on how to use SILworX	-
SILworX First Steps Manual	Introduction to SILworX	HI 801 103 E

Table 1: Additional Relevant Documents

The latest manuals can be downloaded from the HIMA website at www.hima.com. The revision index on the footer can be used to compare the current version of existing manuals with the Internet edition.

1.2 Target Audience

This document addresses system planners, configuration engineers, programmers of automation devices and personnel authorized to implement, operate and maintain the modules and systems. Specialized knowledge of safety-related automation systems is required.

1.3 Formatting Conventions

To ensure improved readability and comprehensibility, the following fonts are used in this document:

Bold	To highlight important parts. Names of buttons, menu functions and tabs that can be clicked and used in the programming tool.
Italics	For parameters and system variables.
`Courier`	Literal user inputs.
RUN	Operating state are designated by capitals.
Chapter 1.2.3	Cross-references are hyperlinks even if they are not particularly marked. When the cursor hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position.

Safety notes and operating tips are particularly marked.

1.3.1 Safety Notes

The safety notes are represented as described below.
These notes must absolutely be observed to reduce the risk to a minimum. The content is structured as follows:

- Signal word: warning, caution, notice
- Type and source of risk
- Consequences arising from non-observance
- Risk prevention

⚠ SIGNAL WORD

Type and source of risk!
Consequences arising from non-observance
Risk prevention

The signal words have the following meanings:

- Warning indicates hazardous situation which, if not avoided, could result in death or serious injury.
- Caution indicates hazardous situation which, if not avoided, could result in minor or modest injury.
- Notice indicates a hazardous situation which, if not avoided, could result in property damage.

NOTE

Type and source of damage!
Damage prevention

1.3.2 Operating Tips

Additional information is structured as presented in the following example:

i The text corresponding to the additional information is located here.

Useful tips and tricks appear as follows:

TIP The tip text is located here.

2 Safety

All safety information, notes and instructions specified in this document must be strictly observed. The product may only be used if all guidelines and safety instructions are adhered to.

The product is operated with SELV or PELV. No imminent risk results from the product itself. The use in Ex-Zone is permitted if additional measures are taken.

2.1 Intended Use

HIMatrix components are designed for assembling safety-related controller systems.

When using the components in the HIMatrix system, comply with the following general requirements.

2.1.1 Environmental Requirements

Requirement type	Range of values
Protection class	Protection class III in accordance with IEC/EN 61131-2
Ambient temperature	0...+60 °C
Storage temperature	-40...+85 °C
Pollution	Pollution degree II in accordance with IEC/EN 61131-2
Altitude	< 2000 m
Housing	Standard: IP20
Supply voltage	24 VDC

Table 2: Environmental Requirements

Exposing the HIMatrix system to environmental conditions other than those specified in this manual can cause the HIMatrix system to malfunction.

2.1.2 ESD Protective Measures

Only personnel with knowledge of ESD protective measures may modify or extend the system or replace devices.

NOTE

Device damage due to electrostatic discharge!

- **When performing the work, make sure that the workspace is free of static, and wear an ESD wrist strap.**
- **If not used, ensure that the device is protected from electrostatic discharge, e.g., by storing it in its packaging.**

2.2 Residual Risk

No imminent risk results from a HIMatrix M45 system itself.

Residual risk may result from:

- Faults related to engineering
- Faults related to the user program
- Faults related to the wiring

2.3 Safety Precautions

Observe all local safety requirements and use the protective equipment required on site.

2.4 Emergency Information

A HIMatrix M45 system is a part of the safety equipment of a plant. If a device or a module fails, the system enters the safe state.

In case of emergency, no action that may prevent the HIMatrix M45 systems from operating safely is permitted.

3 Product Description

The DI extension module **M-LS 4 01** is intended for use in the HIMatrix M45 system.

Additionally, the module is provided with 8 L- ports and 4 supplies for the I/O level.

The module can be used in a HIMatrix M45 system, if the structuring conditions as of the system manual (HI 800 651 E) are met.

3.1 Safety Function

The module does not perform any safety-related functions.

3.2 Equipment, Scope of Delivery

To be able to operate, the module must be installed on a suitable socket. The socket is not included within the scope of delivery of the module.

The socket is described in Chapter 3.6.

3.3 Type Label

The type plate contains the following details:

- Product name
- Mark of conformity
- Bar code (2D code)
- Part number (Part-No.)
- Hardware revision index (HW-Rev.)
- Operating system revision index (OS-Rev.)
- Operating data (Power:)
- Production year (Prod-Year:)

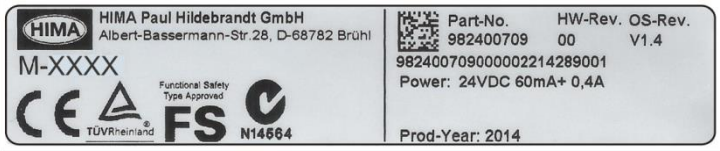


Figure 1: Sample Type Label

3.4 Structure

The chapter contains the following sections:

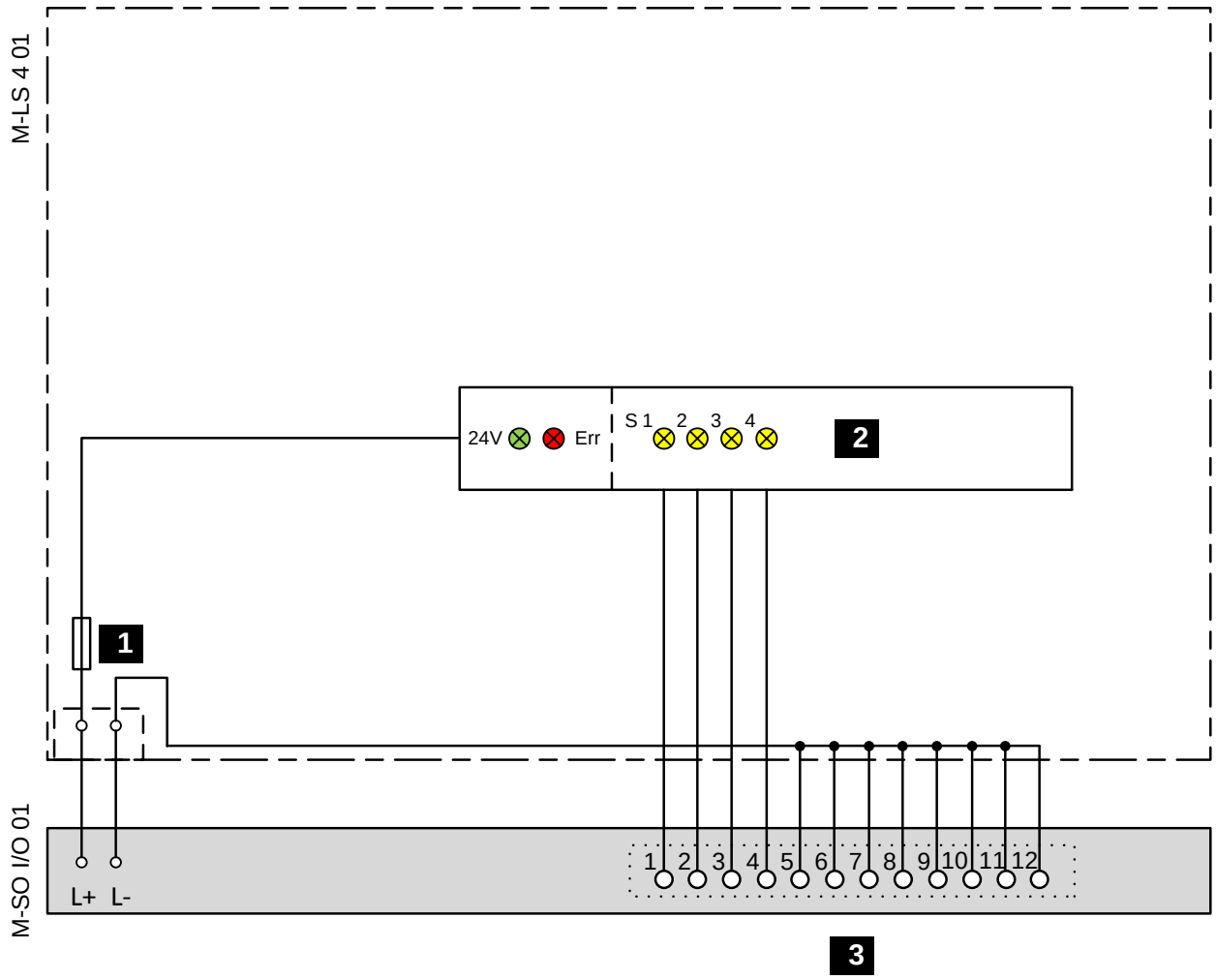
- Block Diagram
- LED Indicators

The module is equipped with four supplies for sensors, that can provide a current of up to 200 mA, e.g., proximity switches and mechanical contacts. Additionally, the module is provided with eight L- ports. These are necessary, when the L- ports of the I/O module are not sufficient for certain connection variants, see Chapter 4.4.

The system bus provides the supply voltage for the module. An internal fuse protects the module against overload. No communication occurs with the M45 system.

3.4.1 Block Diagram

The following block diagram illustrates the structure of the module.



1 Internal Fuse
2 Interface
3 Field Terminals

Figure 2: Block Diagram

3.4.2 Front View

The following figure shows the front view of the module:

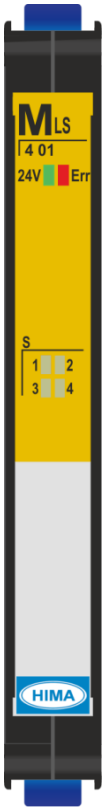


Figure 3: Front View

3.4.3 LED Indicators

When the supply voltage is switched on, an LED test is performed and all LEDs are briefly lit.

Definition of Blinking Frequencies

The following table defines the blinking frequencies of the LEDs:

Name	Blinking frequencies
Blinking1	Long (approx. 600 ms) on, long (approx. 600 ms) off
Blinking2	Short (approx. 200 ms) on, short (approx. 200 ms) off, short (approx. 200 ms) on, long (approx. 600 ms) off
Blinking-x	Ethernet communication: Blinking synchronously with data transfer

Table 3: Blinking Frequencies of LEDs

3.4.3.1 Module Status Indicators

The LEDs signal the following states:

LED	Color	Status	Description
24 V	Green	On	Supply voltage is present.
		Off	Supply voltage is not present.
Err	Red	On	Minimum one output is overloaded. The internal fuse has blown, if the *24V* LED is off during the *Err* LED is on.
		Off	Module in normal operation, if the *24V* is on during the *Err* LED is off.

Table 4: Module Status Indicators

The LED indicates the operating state of the supplies.

LED	Color	Status	Description
S 1…4	Yellow	On	Supply On
		Off	Supply Off

Table 5: LED Supply

3.5 Product Data

General	
Supply voltage	24 VDC, -15...+20 %, r_p ≤ 5 %, PELV, SELV
Max. supply voltage	30 VDC
Current input	10 mA at 24 VDC
Ambient temperature	0…+60 °C
Storage temperature	-40…+85 °C
Humidity	Max. 95 % relative humidity, non-condensing
Type of protection	IP20
Dimensions without socket (H x W x D) in mm	105 x 12.5 x 72
Dimensions with socket up to DIN rail (H x W x D) in mm	165 x 12.7 x 90
Weight Module Socket	 approx. 60 g approx. 55 g

Table 6: Product Data

Supplies	
Number of sources	4, non-galvanically separated, common ground L-
Output voltage	L+ minus 2 V
Output current	Max. 200 mA

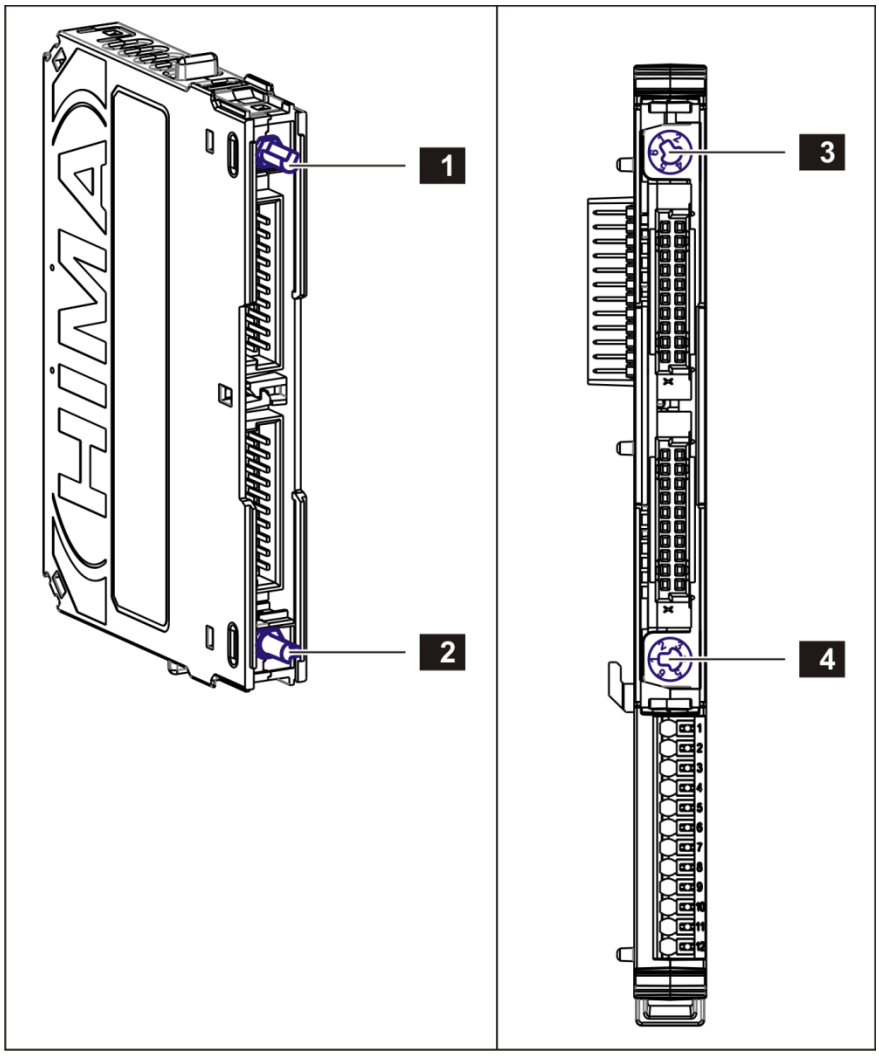
Table 7: Product Data for Supplies

3.6 Socket

Socket and module form together a functional unit. The module is connected to the system bus, the power supply and the field zone via a socket. The field lines are connected to the socket's tension clamp terminals, see Figure 5.

3.6.1 Mechanical Coding

Module and socket are mechanically coded, see Figure 4. The position of the coding pins determines the module's coding and is defined by the manufacturer. Two coding sockets accept the coding pins and must be configured in the selected module, see Chapter 3.6.2. Coding prevents the socket from improper assembling.



1 Upper Coding Pin
2 Lower Coding Pin
3 Upper Coding Socket
4 Lower Coding Socket

Figure 4: Example of Module and Socket Coding

3.6.2 Coding the M-LS 4 01 Module and Socket

To attach the module, the coding of the M-SO I/O 01 socket must be set as follows:

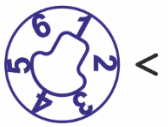
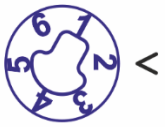
Order	Module coding (rear view)	Position	Coding socket
Upper		2	
Lower		2	

Table 8: Module and Socket Coding

3.6.2.1 Configuring the Socket Coding

Tools and utilities:

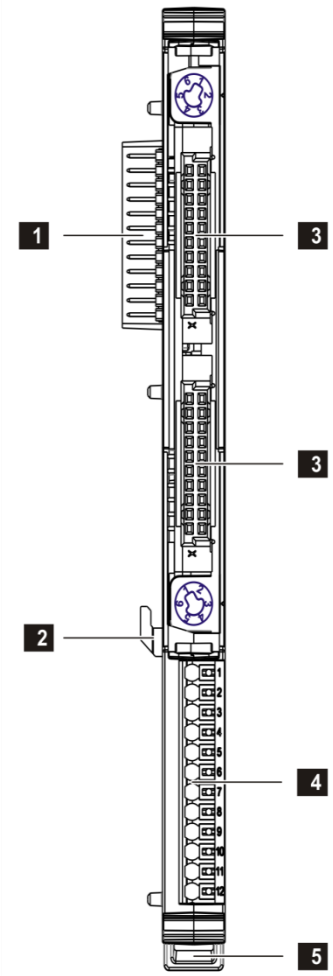
- Screwdriver, slotted 0.8 x 4.0 mm

Configuring the upper and lower coding socket

1. Insert the screwdriver into the opening of the upper coding socket.
2. Turn the screwdriver until the required coding is set.
3. Repeat these steps for the lower coding socket.
4. Insert the module into the socket to check the coding.
5. Remove the module

3.6.3 Socket M-SO I/O 01

Universal socket for being equipped with different modules, see system manual HI 800 651 E.



1 System Bus with Power Supply
2 Latch (Connection to the Left Socket)
3 I/O Plug
4 Field Terminals (Tension Clamp Terminals)
5 Latch (Securing to DIN Rail)

Figure 5: M-SO I/O 01 Socket

The latches are used to secure the socket (2, 5) to the DIN rail and simultaneously to ensure connection to the socket on the left hand-side. Socket and module are connected to the processor module and the power supply via the system bus. The I/O plugs provide the connection between module and socket. The sensors are connected to the field terminals, see Chapter 3.6.3.1 and Chapter 4.4.

3.6.3.1 Terminal Assignment for the Field Terminals

Terminal	Signal	Function
1	S1	Supply 1
2	S2	Supply 2
3	S3	Supply 3
4	S4	Supply 4
5	L-	Ground
6	L-	Ground
7	L-	Ground
8	L-	Ground
9	L-	Ground
10	L-	Ground
11	L-	Ground
12	L-	Ground

Table 9: Terminal Assignment for Field Terminals

3.6.3.2 Field Terminal Properties

The field terminals are implemented as tension clamp terminals with the following properties:

Connection to the field zone	
Tension clamp terminal	12-pole
Wire cross-section	0.2…1.5 mm^2 (single-wire) 0.2…1.5 mm^2 (finely stranded) 0.2…1.5 mm^2 (with wire end ferrule) 0.2…0.75 mm^2 (with wire end ferrule with collar)
Stripping length	8 mm
Screwdriver	Slotted, 0.6 x 3.5

Table 10: Tension Clamp Terminal Properties

4 Start-up

This chapter describes how to install, configure and connect the module. For more information, refer to HIMatrix M45 system manual (HI 801 651 E).

4.1 Mounting

The module is plugged in to the corresponding socket, which is mounted on a 35 mm DIN rail.

Observe the following points when mounting the module and the socket:

Sockets or modules may only be removed or replaced in the de-energized state.

4.2 Mounting Module and Socket

This chapter describes how to mount and remove the modules and sockets. When replacing modules, the sockets remain on the DIN rail. This saves additional wiring effort since all field lines are connected to the socket.

4.2.1 Mounting and Removing the Sockets

Tools and utilities:

- Screwdriver, slotted 1.0 x 5.5 mm

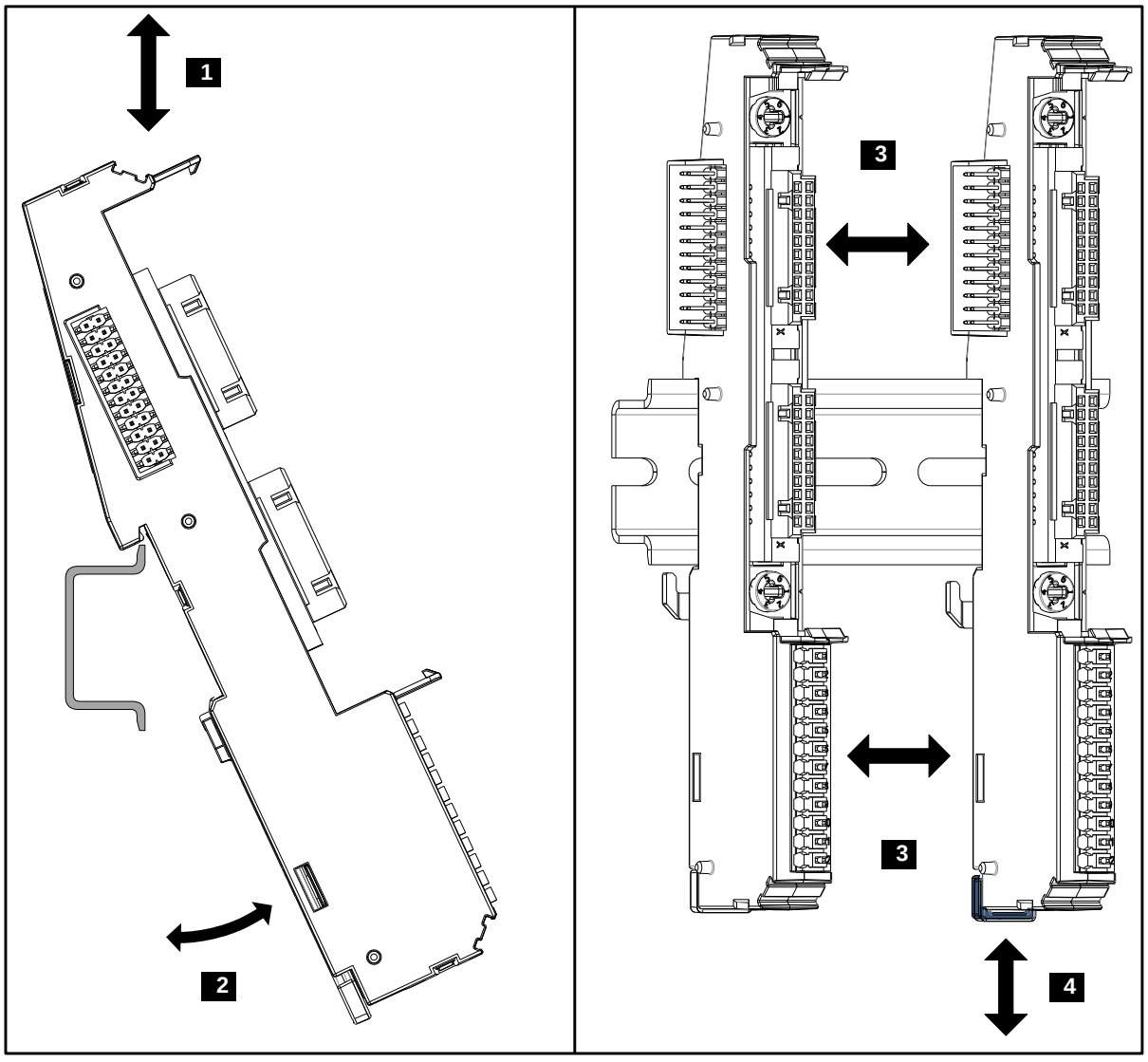
To insert the socket

1. Set the socket onto the DIN rail 1.
2. Swivel the socket in 2.
3. Move the socket on the DIN rail and connect it to another socket 3.
4. Press the socket's latch upwards 4.
   ☑ The latch is used to attach the socket to the DIN rail, and is secured to the socket located on its left-hand side.
5. The socket mounting is completed, the field lines can be connected.

To remove the socket

Prior to removing the socket, the module must be removed and the field lines must be released from the terminals.

1. Use a screwdriver to push the blue latch downwards 4.
2. Remove the sockets from the adjacent sockets 3.
3. Swivel the socket out 2.
4. Lift the socket and remove it 1.



1 Setting and Lifting the Socket
2 Swiveling the Socket In and Out
3 Connecting and Disconnecting Sockets
4 Closing and Opening the Latch

Figure 6: Example of Socket Mounting

4.2.2 Inserting and Removing the Module

This chapter describes how to mount and remove a module in the M45 system.

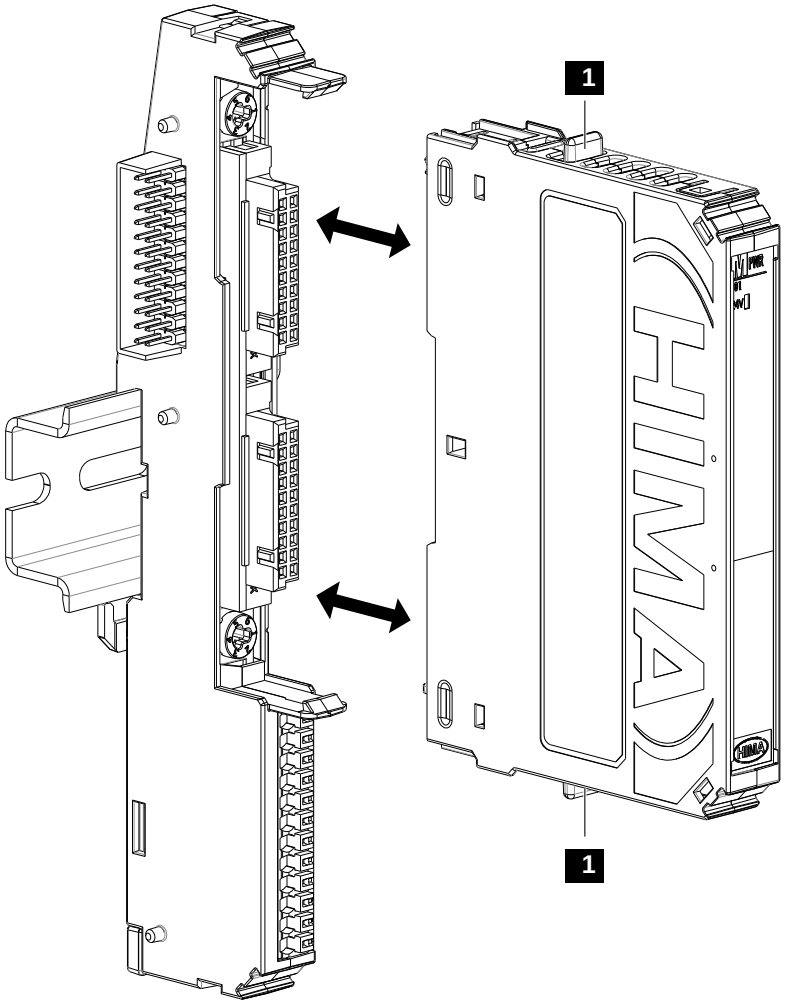
Coding prevents the module from improper assembling.

To insert the module

1. Plug the module in to the socket, until the locking mechanism is engaged.

To remove the module

1. Press the latch **1** backwards as far as it can go. The locking mechanism is released.
2. Remove the module from the socket.



1 Latch for Releasing the Module

Figure 7: Example of Mounting and Removing the Module

4.3 Configuration with SILworX

The module need not be configured.

4.4 Connection Variants

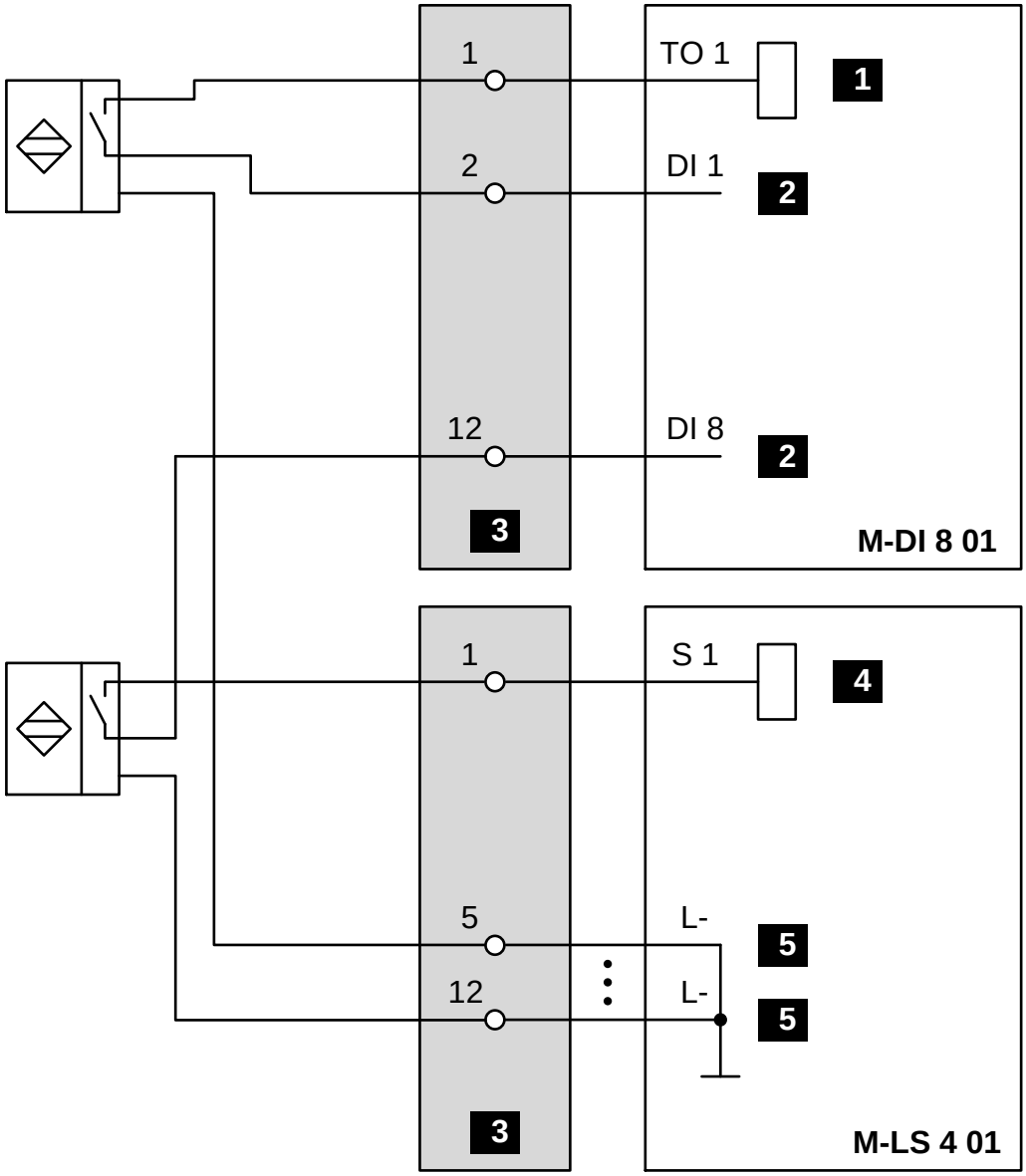
This chapter describes the correct wiring of the module in safety-related applications. The connection variants specified here are permitted.

Observe the following points when using the module:

- The modules supplies must not be connected in parallel.

4.4.1 Connecting 3-Wire Proximity Switches to M-DI 8 01 and M-LS 4 01

For connecting 3-wire proximity switches, the modules M-DI 8 01 and M-LS 4 01 must be connected to one another. To this end, the DI extension module is equipped with four supplies and eight L- ports.

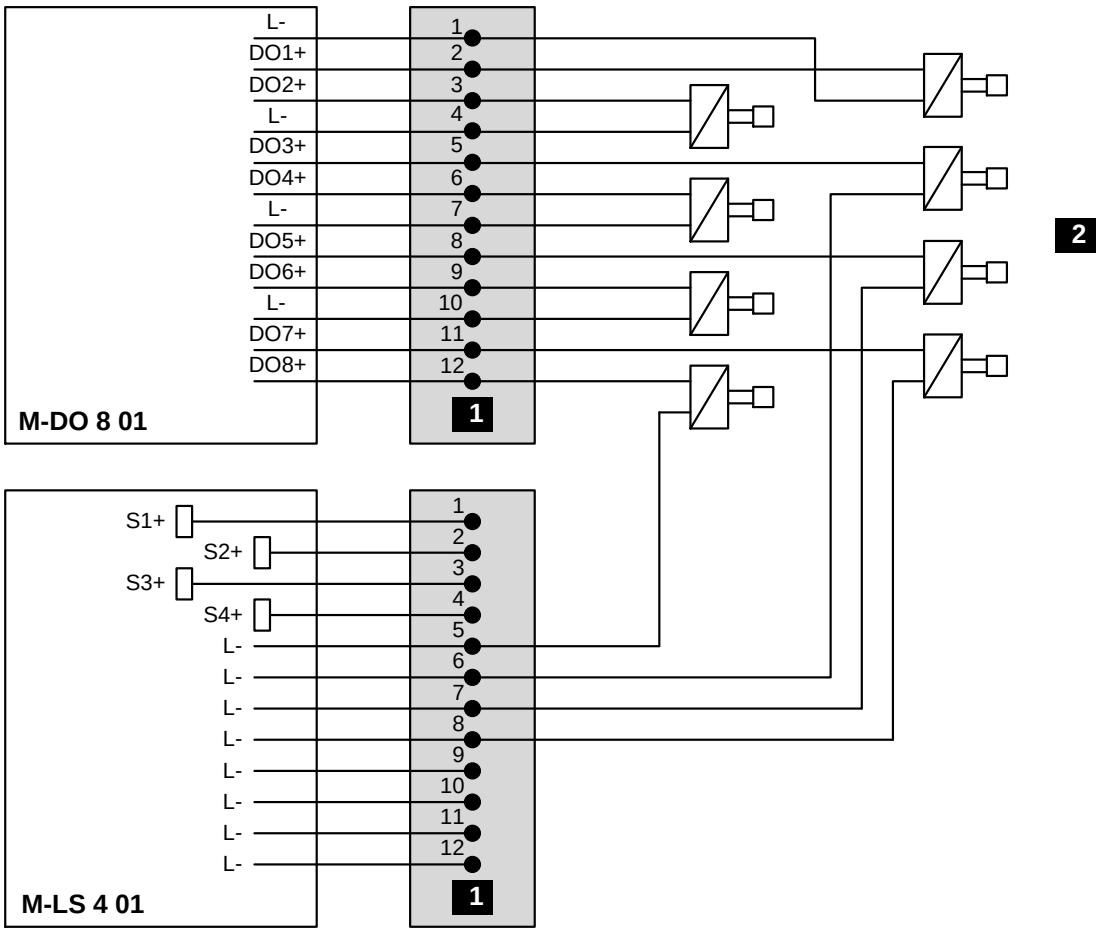


1 Pulsed Output M-DI 8 01
2 Digital Input M-DI 8 01
3 Socket M-SO I/O 01
4 Supply M-LS 4 01
5 Common Ground

Figure 8: Connecting 3-Wire Proximity Switches to M-DI 8 01 and M-LS 4 01

4.4.2 Connecting Actuators to M-DO 8 01 and M-LS 4 01

The M-DO 8 01 module is only equipped with 4 L- ports for 4 actuators. Therefore, when connecting more than 4 actuators, the M-LS 4 01 DI extension module must be used.

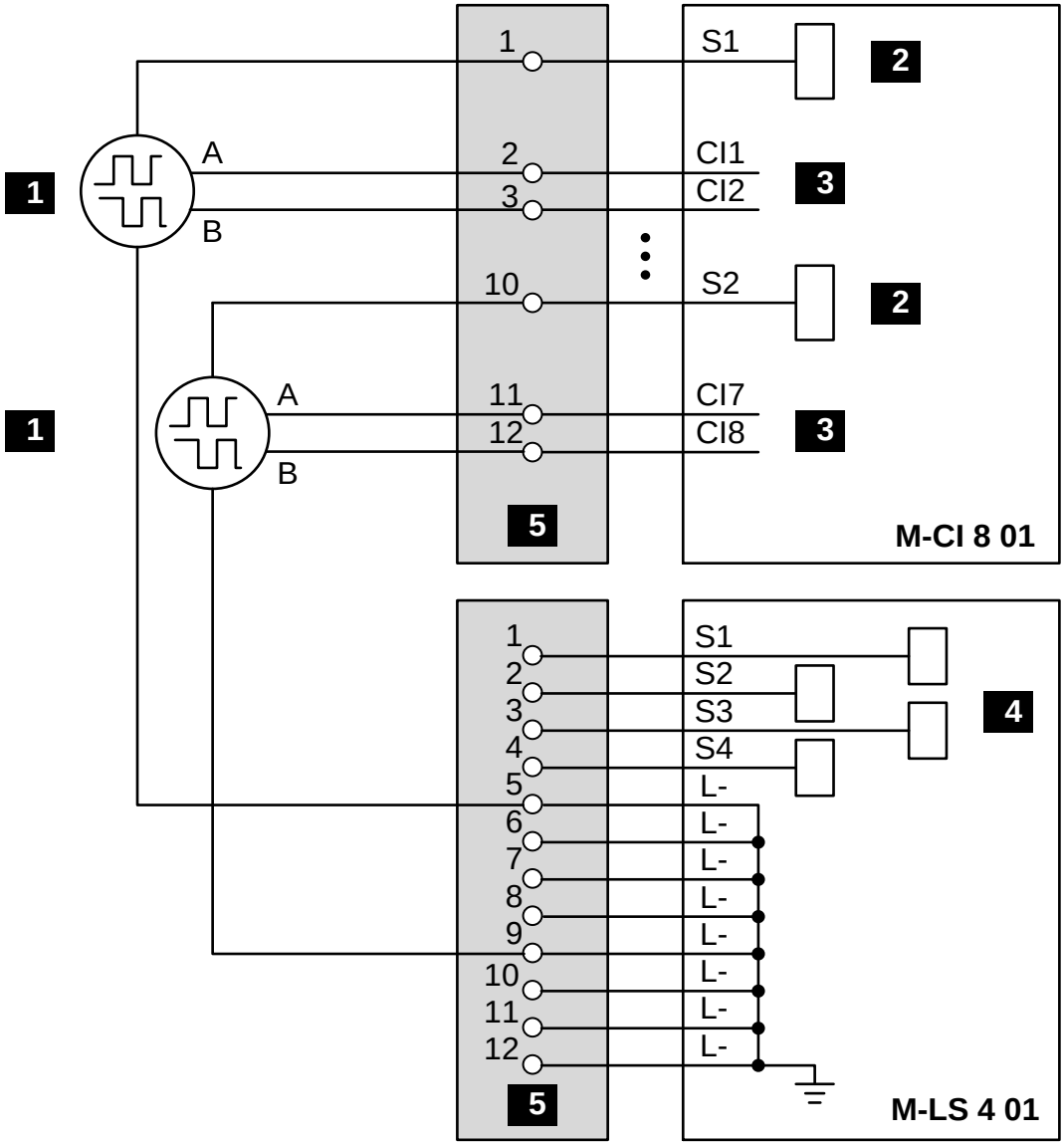


1 Socket M-SO I/O 01 **9** Actuators

Figure 9: Connecting Actuators to M-LS 4 01 and M-DO 8 01

4.4.3 Connecting Incremental Encoder to M-CI 8 01 and M-LS 4 01

For connecting incremental encoders to the modules M-CI 8 01 and M-LS 4 01, observe the instructions provided in the M-CI 8 01 manual. Use M-LS 4 01 DI extension module to ground the incremental decoders, see Figure 10.

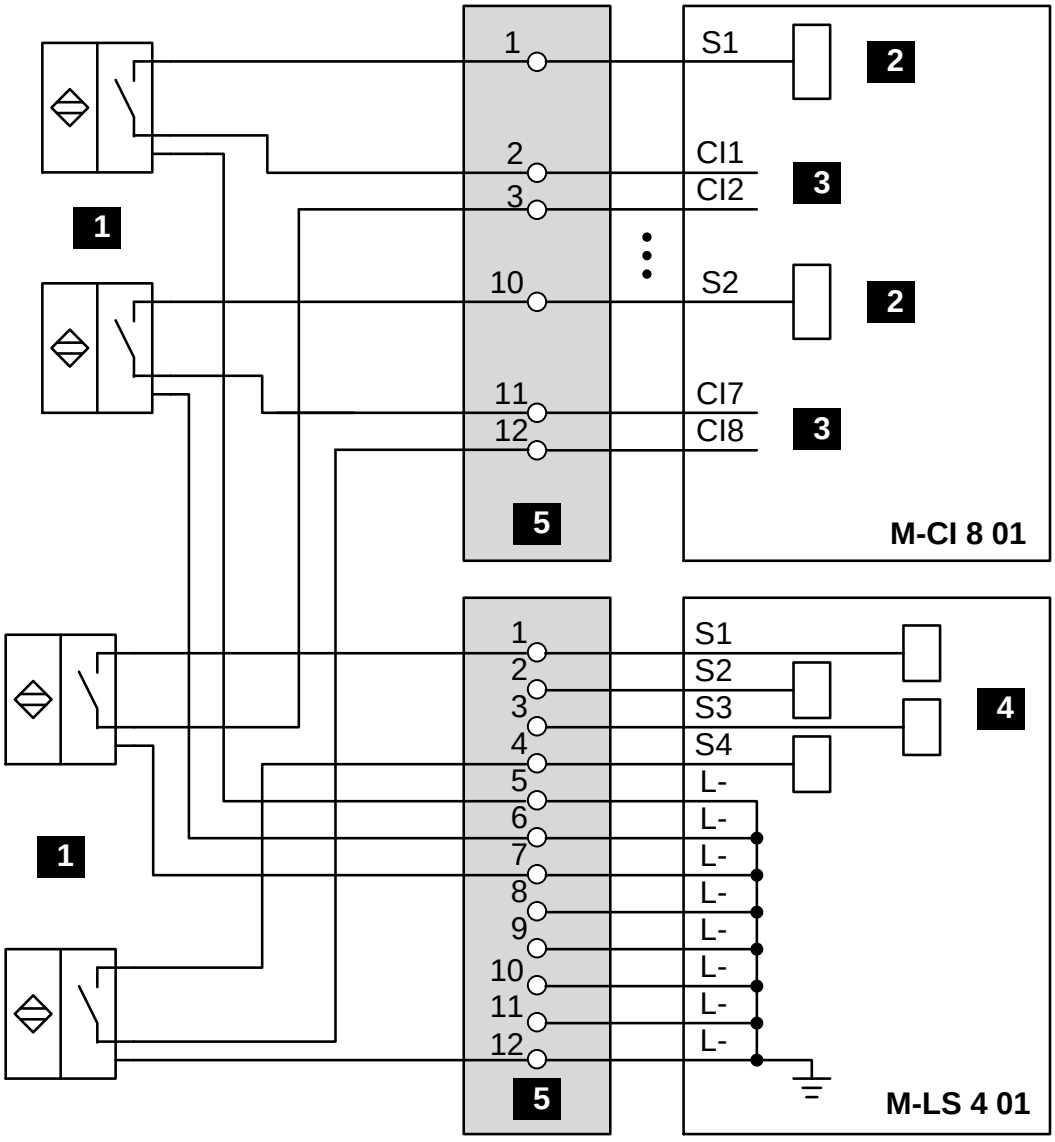


1 Incremental Encoder
2 Supplies S1, S2 of M-CI 8 01
3 Counter Inputs
4 Supplies S1…S4 of M-LS 4 01
5 Socket M-SO I/O 01

Figure 10: Connecting Incremental Encoder to M-CI 8 01 and M-LS 4 01

4.4.4 Connecting 3-Wire Proximity Switches to M-CI 8 01 and M-LS 4 01

For connecting 3-wire proximity switches to the modules M-CI 8 01 and M-LS 4 01, observe the instructions provided in the M-CI 8 01 manual. To this end, the DI extension module is equipped with four supplies and eight L- ports, see Figure 11.



1 3-Wire Proximity Switch
2 Supplies S1, S2 of M-CI 8 01
3 Counter Inputs
4 Supplies S1…S4 of M-LS 4 01
5 Socket M-SO I/O 01

Figure 11: Connecting 3-Wire Proximity Switches to M-CI 8 01 and M-LS 4 01

5 Operation

The module runs within the HIMatrix M45 system and does not require any specific monitoring.

When operating the system, ensure that the air circulation is not obstructed.

5.1 Handling

Handling of the module and the HIMatrix M45 system during operation is not required.

Do not pull or plug the modules during operation!

5.2 Diagnosis

The LEDs are used to give a overview of the operating state, see Chapter 3.4.3.

6 Maintenance

No maintenance measures are required during normal operation.

If a failure occurs, the defective module must be replaced with a module of the same type or with a replacement model approved by HIMA.

Modules may only be replaced in the de-energized state.

Only the manufacturer is authorized to repair the module.

7 Decommissioning

The decommissioning of the module is carried out after de-energization. Following steps are necessary:

1. Stop the HIMatrix M45 system.
2. Disconnect the system from the power supply.
3. Remove the module from the socket.

8 Transport

To avoid mechanical damage, HIMatrix M45 components must be transported in packaging.

Always store HIMatrix components in their original product packaging. This packaging also provides protection against electrostatic discharge.

9 Disposal

Industrial customers are responsible for correctly disposing of decommissioned HIMatrix hardware. Upon request, a disposal agreement can be arranged with HIMA.

All materials must be disposed of in an ecologically sound manner.

Appendix

Glossary

Term	Description
ARP	Address resolution protocol: Network protocol for assigning the network addresses to hardware addresses
AI	Analog input
AO	Analog output
COM	Communication module
CRC	Cyclic redundancy check
DI	Digital input
DO	Digital output
EMC	Electromagnetic compatibility
EN	European norm
ESD	Electrostatic discharge
FB	Fieldbus
FBD	Function block diagrams
FTT	Fault tolerance time
ICMP	Internet control message protocol: Network protocol for status or error messages
IEC	International electrotechnical commission
MAC Address	Media access control address: Hardware address of one network connection
PADT	Programming and debugging tool (in accordance with IEC 61131-3), PC with SILworX
PE	Protective earth
PELV	Protective extra low voltage
PES	Programmable electronic system
R	Read: The system variable or signal provides value, e.g., to the user program
Rack ID	Base plate identification (number)
Interference-free	Supposing that two input circuits are connected to the same source (e.g., a transmitter). An input circuit is termed *interference-free* if it does not distort the signals of the other input circuit.
R/W	Read/Write (column title for system variable/signal type)
SB	System bus
SELV	Safety extra low voltage
SFF	Safe failure fraction, portion of faults that can be safely controlled
SIL	Safety integrity level (in accordance with IEC 61508)
SILworX	Programming tool for HIMatrix systems
SNTP	Simple network time protocol (RFC 1769)
SRS	System.Rack.Slot addressing of a module
SW	Software
TMO	Timeout
W	Write: System variable is provided with value, e.g., from the user program
r_P	Peak value of a total AC component
Watchdog (WD)	Time monitoring for modules or programs. If the watchdog time is exceeded, the module or program enters the STOP_ERROR state.
WDT	Watchdog time

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