# HIMatrix M45

## Safety-Related Controller

## M-DO 2 01 Manual


HIMA Paul Hildebrandt GmbH

Industrial Automation

Rev. 1.02

HI 800 663 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 | Revised: Chapter 6.2.2 | X | X |
| 1.02 | Revised: Chapter 6.1 | | X |
| | | | |

# Table of Contents

# 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<br>Safety Manual | Safety functions of the HIMatrix system | HI 800 653 E |
| HIMatrix M45<br>System Manual | Hardware description of the HIMatrix M45 | HI 800 651 E |
| SILworX<br>Communication Manual | Description of communication and protocols | HI 801 101 E |
| SILworX Online Help (OLH) | Instructions on how to use SILworX | - |
| SILworX<br>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.<br>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 states 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 notices and operating tips are particularly marked.

### 1.3.1 Safety Notices

The safety notices are represented as described below.
These notices 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.

**NOTICE**

**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, notices 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 II 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.

**NOTICE**

**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 **M-DO 2 01** relay module is intended for use in the HIMatrix M45 system.

Up to 62 I/O modules can be used in a HIMatrix M45 system, if the structuring conditions as of the system manual (HI 800 651 E) are met.

The module is equipped with 2 potential-free relay outputs with forcibly guided contacts. The relay outputs are suitable for connecting ohmic and inductive loads.

The module has been certified by the TÜV for safety-related applications up to SIL 3 (IEC 61508, IEC 61511, IEC 62061 and EN 50156) as well as PL e (EN ISO 13849-1). Further safety standards, application standards and test standards are specified in the certificates available on the HIMA website.

## 3.1 Safety Function

The safety function meets the integrity requirements described in the corresponding test standards.

The module is designed in accordance with the de-energize-to-trip principle. If a module fault or a channel fault occurs, both relay outputs are set to the de-energized state. In both cases, the *Err* LED is blinking.

All instructions on how to use the module specified in the safety manual must be observed.

## 3.2 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 label specifies 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:

- Safety-Related Relay Outputs
- Block Diagram
- LED Indicators

The module is equipped with a safety-related 1oo2D processor system and performs the following functions:

- Safe shutdown of the relay outputs
- Control and monitoring of the I/O level

The process data and states of the module are provided to the processor module (M-CPU) via the system bus.

### 3.4.1 Safety-Related Relay Outputs

The module is equipped with two relay outputs. Each relay output is switched by two relays in series, one relay of these is a safety relay and switched both relay outputs, see Figure 3. The safe shutdown capability is tested.

The relay outputs are cyclically monitored by the processor system. If the states do not correspond to the default values, a module fault has occurred and both relay outputs are set to the de-energized state.

Both relay outputs are electrically safely separated from one another and from the power supply. For safe separation, the air and creeping distances are designed in accordance with IEC 61131-2 for overvoltage class II up to 300 V.

#### 3.4.1.1 Burner Control Applications

For burner control applications, the switching current must be limited to 60 % of the maximum allowed value using a external fuse in accordance with EN 298 and EN 50156 (VDE 0116).

At least two monitored relays must be used to shut down the entire fuel supply safely.

The relays in use comply with the the contact lifetime required for burner control applications:

- Mechanical ≥ $3 \times 10^6$ switching operations
- electrical ≥ 250 000 switching operations

### 3.4.1.2 General Safety Applications

The instructions specified in Figure 2 and in Table 8 must be observed for general safety applications:

- The maximum permissible number of switching operations.
- The maximum permissible switching currents, voltage and power.

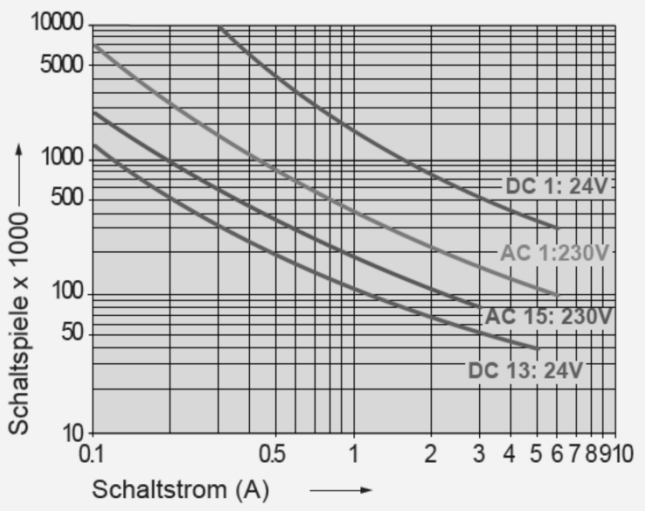
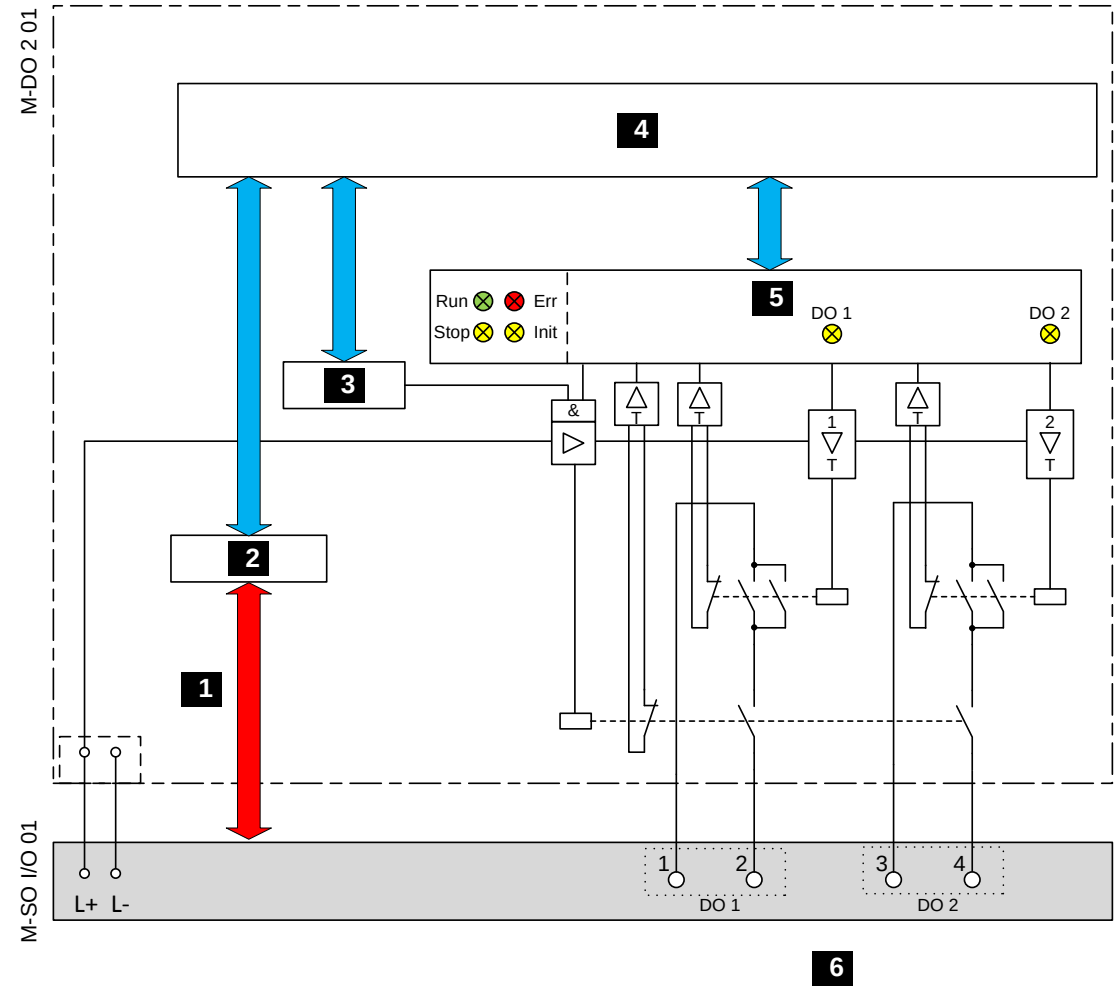



Figure 2: Contact Lifetime

### 3.4.2 Block Diagram

The following block diagram illustrates the structure of the module.




1 System Bus
2 Switch
3 Watchdog
4 Safety-Related Processor System
5 Interface
6 Field Zone

Figure 3: Block Diagram

### 3.4.3 Front View

The following figure shows the front view of the module:

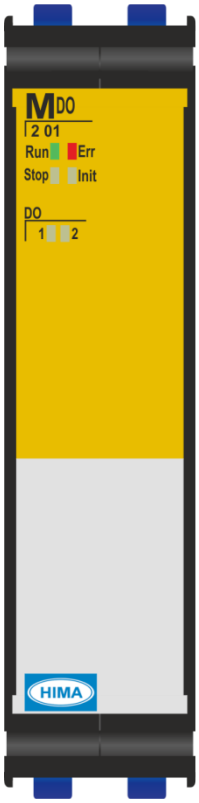



Figure 4: Front View

### 3.4.4 LED Indicators

The LEDs indicate the operating state of the module. The LEDs are classified as follows:

- Module status indicators
- I/O 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

#### 3.4.4.1 Module Status Indicators

The LEDs signal the following states:

| LED | Color | Status | Description |
|---|---|---|---|
| Run | Green | On | Module in RUN, normal operation |
| | | Blinking1 | Module state<br>STOP/OS_DOWNLOAD or<br>OPERATE (only with processor modules) |
| | | Off | Module not in RUN,<br>observe the other status LEDs. |
| Err | Red | On | Warning, e.g.:<br>No license for additional functions<br>(e.g., communication protocols), test mode. |
| | | Blinking1 | Fault, e.g.:<br>▪ Internal module fault detected by self-tests, e.g., hardware or voltage supply.<br>▪ Error while loading the operating system. |
| | | Blinking2 | Field fault, but no internal fault |
| | | Off | Normal operation |
| Stop | Yellow | On | Module state<br>STOP / VALID CONFIGURATION |
| | | Blinking1 | Module state<br>STOP / INVALID CONFIGURATION or<br>STOP / LOADING OS |
| | | Off | Module not in STOP,<br>observe the other status LEDs. |
| Init | Yellow | On | Module state: INIT |
| | | Blinking1 | Module state<br>LOCKED or<br>STOP / LOADING OS |
| | | Off | Module state: neither INIT nor LOCKED,<br>observe the other status LEDs. |

Table 4: Module Status Indicators

### 3.4.4.2 I/O Indicators

Die LEDs of the I/O indicators are labeled *DO*.

| LED | Color | Status | Description |
|---|---|---|---|
| DO 1, DO 2 | Yellow | On | The corresponding channel is active (energized) |
| | | Blinking2 | The related channel is faulty. |
| | | Off | The corresponding channel is not active (de-energized) |

Table 5: I/O Indicators

## 3.5 Product Data

| General | |
|---|---|
| Supply voltage | 24 VDC, -15...+20 %, $r_p$ ≤ 5 %,<br>PELV, SELV |
| Max. supply voltage | 30 VDC |
| Current input | max. 100 mA<br>max. 2 W |
| Current input of the module, all relay de-energized | 54 mA (24 VDC) |
| Current input of the module, all relay energized | 80 mA (24 VDC) |
| Max. reaction time of the module [1)] | 110 ms |
| Electrical isolation of the channels | Yes |
| Ambient temperature | 0…+60 °C |
| Storage temperature | -40…+85 °C |
| Humidity | max. 95 % relative humidity, non-condensing |
| Type of protection | IP20 |
| Dimensions without socket<br>(H x W x D) in mm | 105 x 25 x 72 |
| Dimensions with socket up to DIN rail<br>(H x W x D) in mm | 165 x 25.2 x 90 |
| Weight<br>Module<br>Socket | <br>approx. 140 g<br>approx. 80 g |
| [1)] In case of an internal fault | |

Table 6: Product Data

| Relay Outputs | |
|---|---|
| Relay types per channel | 2 relays with forcibly guided contacts |
| Number of channels | 2 potential-free normally open contacts |
| Switching voltage | 5…250 V |
| Switching current per channel | 5 mA…4 A |
| Switching frequency | max. 4 Hz |
| Response time<br>(normally-open contact closed) | Typ. 10 ms |
| Drop-out time, normally-closed contact closed | Typ. 3 ms |
| Contact material | AgCuNi + 0.2…0.4 µm Au |
| Contact lifetime<br>- Mechanical<br>- Electrical | <br>> 10 x $10^6$ switching operations<br>See Figure 2 |

Table 7: Specifications for the Relay Outputs

| Relay Output Switching Capacity (general safety applications) | | |
|---|---|---|
| Switching capacity DC induction-free [1)] | ≤ 30 VDC | max. 120 W |
| | ≤ 70 VDC | max. 100 W |
| | ≤ 100 VDC | max. 70 W |
| | ≤ 250 VDC | max. 60 W |
| Switching capacity DC (Inductive load tau = L/R = 40 ms) | ≤ 30 VDC | max. 45 VA |
| | ≤ 70 VDC | max. 38 VA |
| | ≤ 100 VDC | max. 38 VA |
| | ≤ 250 VDC | max. 30 VA |
| Switching capacity AC induction-free [1)] | ≤ 250 VAC | max. 800 VA |
| Switching capacity AC cos φ > 0.5 | ≤ 250 VAC | max. 800 VA |
| [1)] Circuit induction-free<br>- Free-wheeling diode<br>- Use suitable protective circuit, e.g., RC elements, Zener diodes or varistors | | |

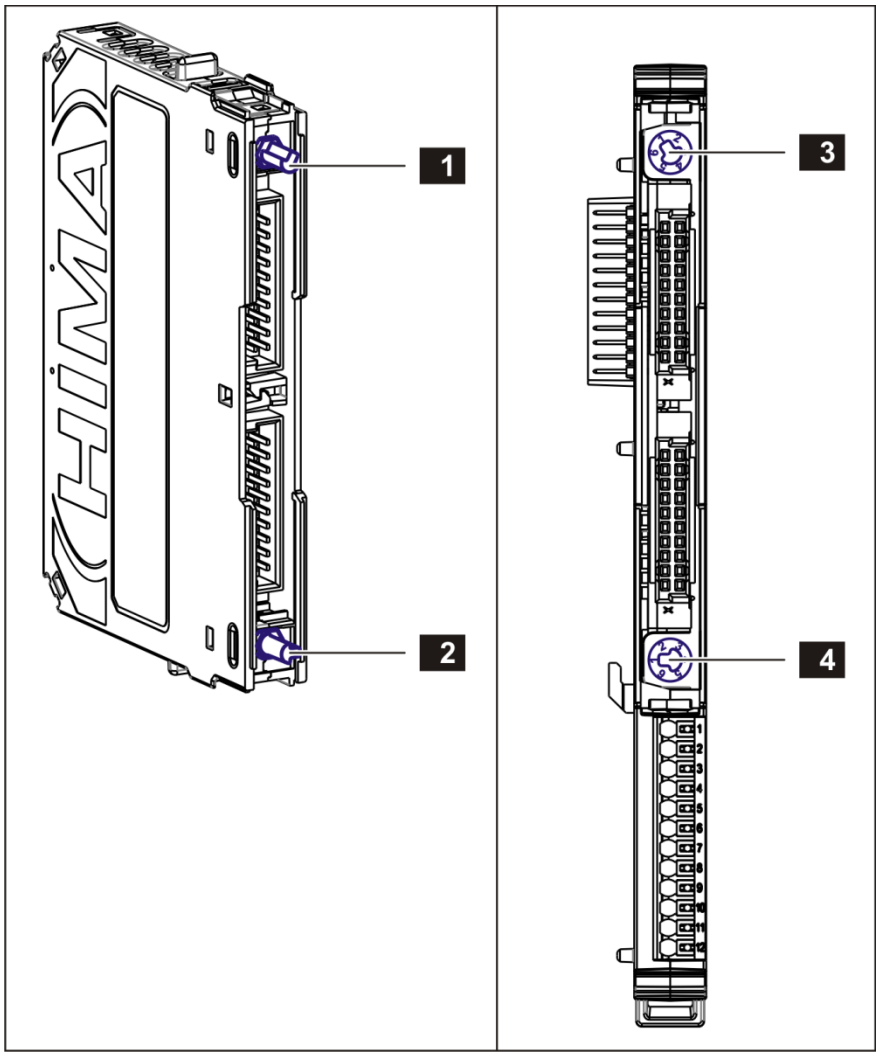
Table 8: Relays Output Switching Capacity

## 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 sockets cable plugs, see Figure 6.

### 3.6.1 Mechanical Coding

Module and socket are mechanically coded, see Figure 5. 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 5: Example of Module and Socket Coding

### 3.6.2 Coding the M-DO 2 01 Module and Socket

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

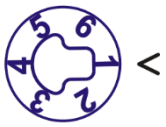
| Order | Module coding (rear view) | Position | Coding socket |
|---|---|---|---|
| Upper |  | 1 |  |
| Lower |  | 6 |  |

Table 9: Module and Socket Coding

#### 3.6.2.1 Configuring the Socket Coding

Tools and utilities:

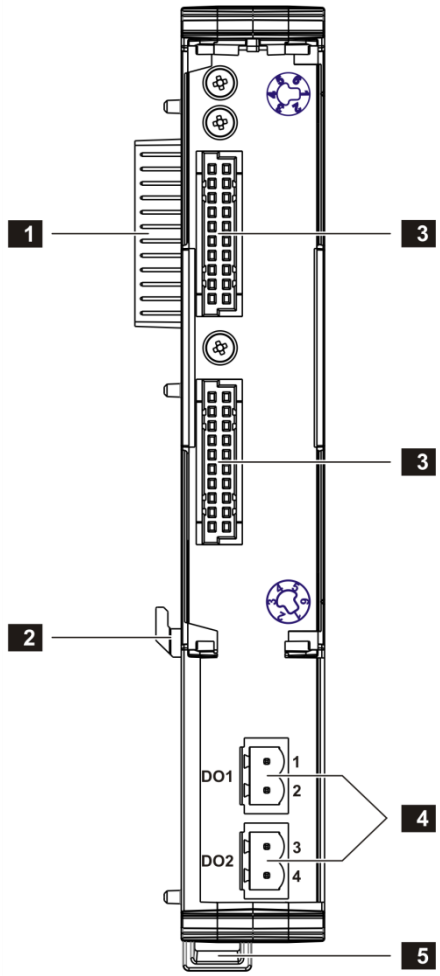
- Screwdriver, slotted 0.8 x 4.0 mm

**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 REL 01

Socket for being equipped with relay modules M-DO 2 01, see system manual (HI 800 651 E).




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

Figure 6: M-SO REL 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 actuators are connected to the field terminals, see Chapter 3.6.3.1 and Chapter 4.4.

#### 3.6.3.1 Terminal Assignment for the Cable Plugs

| Terminal | Signal | Function |
|---|---|---|
| 1 | DO1 | Relay output 1 |
| 2 | DO1 | Relay output 1 |
| 3 | DO2 | Relay output 2 |
| 4 | DO2 | Relay output 2 |

Table 10: Terminal Assignment for Cable Plugs

#### 3.6.3.2 Cable Plug Properties

The cable plugs feature the following properties:

| Connection to the Field Zone | |
|---|---|
| Cable plugs | 2 pieces, with 2 poles |
| Wire cross-section | 0.2…1.5 $mm^2$ (single-wire)<br>0.2…1.5 $mm^2$ (finely stranded)<br>0.2…1.5 $mm^2$ (with wire end ferrule)<br>0.2…1.5 $mm^2$ (with wire end ferrule with collar) |
| Stripping length | 13 mm |
| Screwdriver | Slotted, 0.6 x 3.5 |
| Tightening torque | 0.4…0.5 Nm |

Table 11: Cable Plug 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 800 651 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.

### 4.1.1 Wiring Outputs not in Use

Outputs that are not being used may stay open and need not be terminated. To prevent short-circuits and sparks in the field zone, never connect a wire to a socket if it is open on the field side.

## 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

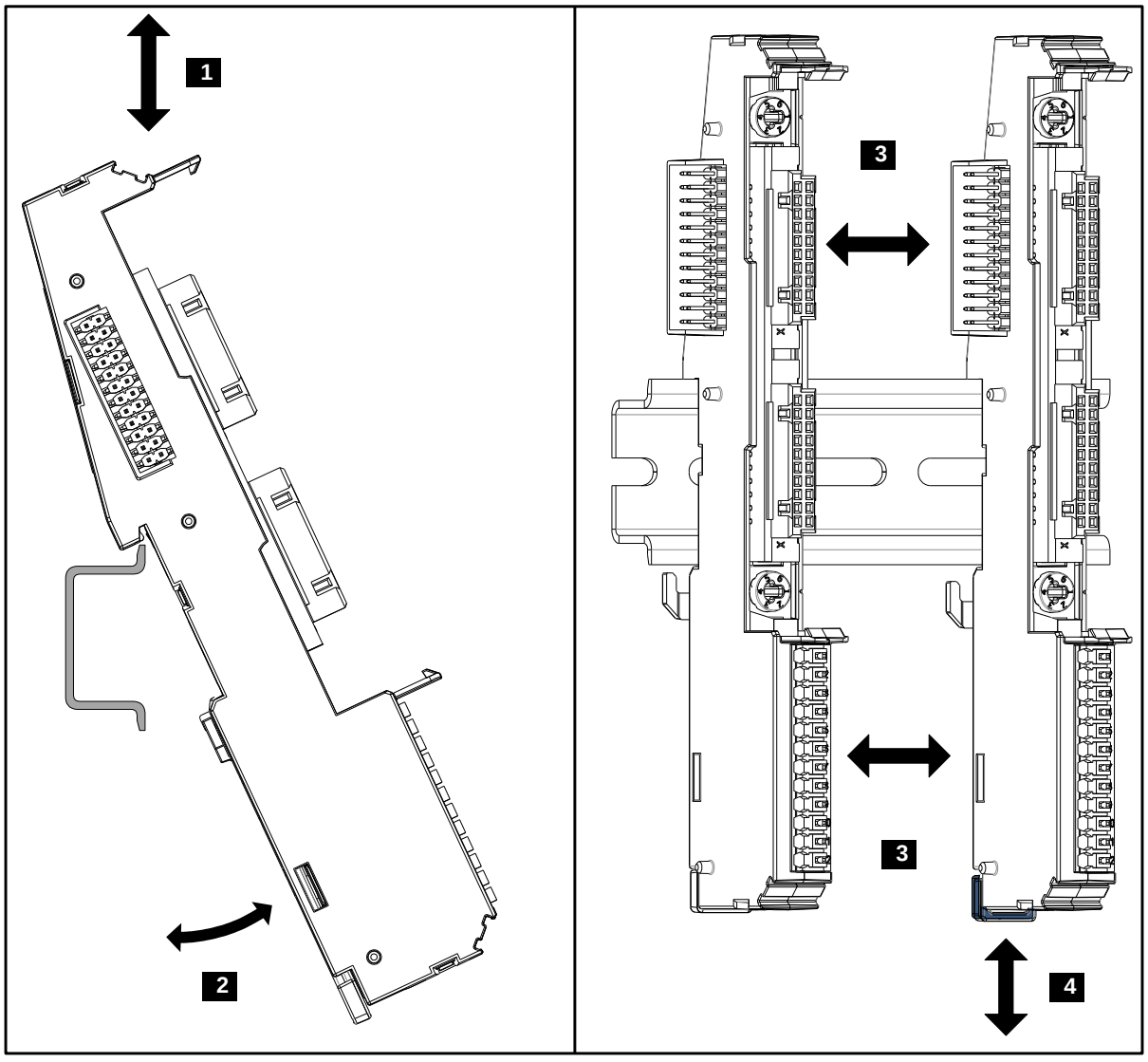
**To insert the socket**

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 7: 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.

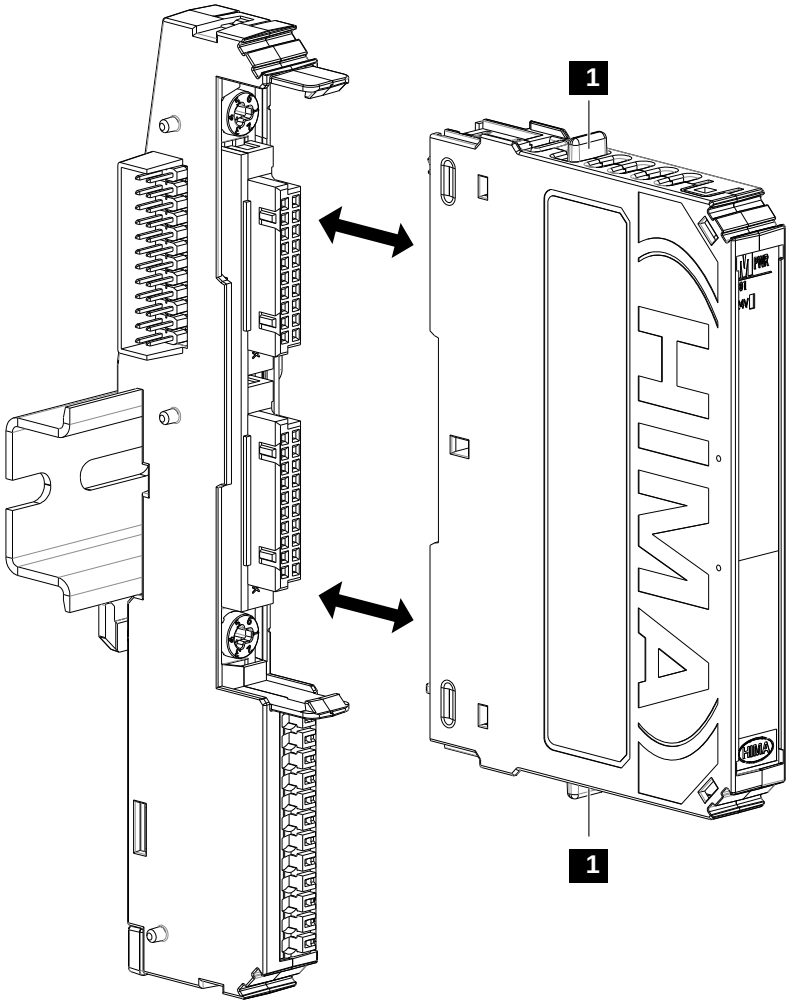
Coding prevents the module from improper assembling.

**To insert the module**

1. Plug the module onto 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 8: Example of Mounting and Removing the Module

## 4.3 Configuration with SILworX

The module is configured in the Hardware Editor of the SILworX programming tool.

Observe the following points when configuring the module:

To evaluate the system parameters from within the user program, they must be connected to global variables. Perform this step in the Hardware Editor using the module's detail view.

The following tables present the statuses and parameters for the module in the same order given in the SILworX Hardware Editor.

### 4.3.1 Tab Module

The **Module** tab contains the following system parameters:

| Name | | R/W | Description |
|---|---|---|---|
| Enter these statuses and parameters directly in the Hardware Editor. | | | |
| Name | | W | Module name |
| Name | Data type | R/W | Description |
| The following statuses and parameters can be assigned global variables and used in the user program. | | | |
| Data valid | BOOL | R | TRUE: Current values are processed.<br>FALSE: Initial values are processed. |
| Module OK | BOOL | R | TRUE: No faults detected<br>FALSE: Faults detected on at least one channel or module. |
| Power Supply State | BYTE | R | Bit-coded state of the power supply units<br>0 = normal<br>Bit0 = 1: Supply voltage (24 V) faulty |
| Temperature State | BYTE | R | Bit-coded temperature state of the module<br>0 = normal<br>Bit0 = 1: Temperature threshold 1 has been exceeded<br>Bit1 = 1: Temperature threshold 2 has been exceeded<br>Bit2 = 1: Fault in temperature measurement<br>For further details, refer to chapter *Monitoring the Temperature State* integrated in the system manual. |

Table 12: System Parameters of the Relay Outputs, Module Tab

### 4.3.2 Tab M-DO 2 01_1: Channels

The **M-DO 2 01_01: Channels** tab contains the following system parameters for each relay output.
Global variables can be assigned to the statuses and parameters with **->** and used in the user program. The value without **->** must be directly entered.

| Name | Data type | R/W | Description |
|---|---|---|---|
| Channel no. | --- | R | Channel number, preset and not changeable |
| Channel Value [BOOL] -> | BOOL | W | Output value of the relay output:<br>TRUE: Channel energized<br>FALSE: Channel de-energized |
| -> Channel OK | BOOL | R | TRUE: Faultless channel.<br>The channel value is valid.<br>FALSE: Faulty channel.<br>Channel de-energized<br>For channel 1 or 2, the parameter is either TRUE or FALSE. |
| -> Trigger Failure [BOOL] | BOOL | R | Prior to close, the relay contact must be safely open.<br>TRUE: Relay contact not yet safely open, to fulfil the requirement close.<br>FALSE: Relay contact safely open, to fulfil the requirement close. |

Table 13: Tab M-DO 2 01_01: Channels in the Hardware-Editor

## 4.4 Connection Variants

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

The following points must be taken into account when connecting the actuators to the relay outputs:

- At both relay outputs, actuators must be supplied with the same power source, e.g., 24/48/230 VDC/VAC
- Use fuses suitable for current limiting.
  - Melting integral ≤ 100 A²s
  - The breaking capacity of the fuses must be adjusted to the network to be switched.
- For operation in zone C according to IEC 61131-2, install the filter H 7013 or similar to enhance immunity to interference (surges).

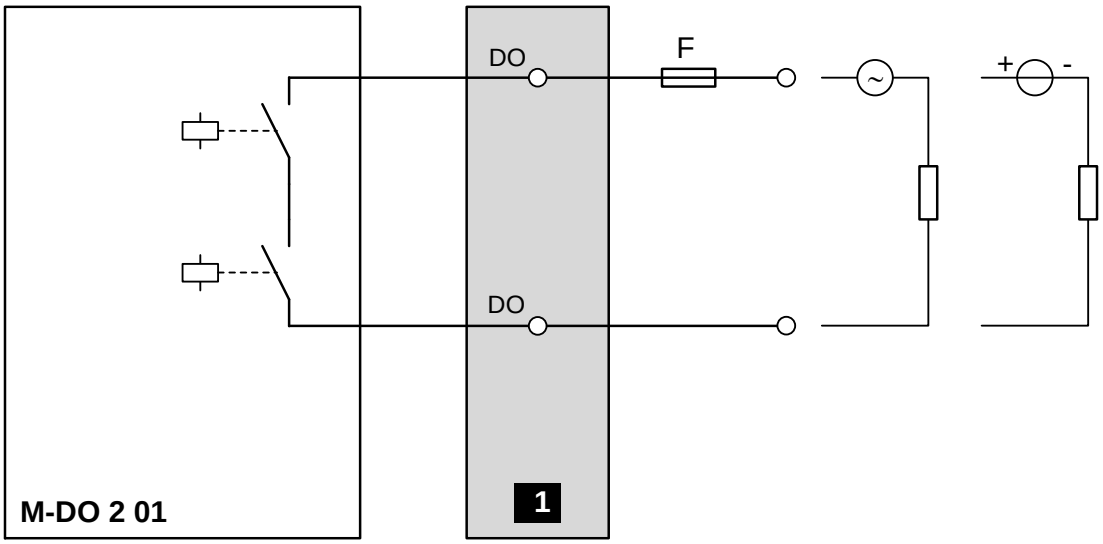
**⚠ CAUTION**

**System damage due to improper dimensioning of fuse in contact circuit!**

**To ensure that the fuse is dimensioned properly, observe Table 7 and Table 8 specified in the Product Data.**

### 4.4.1 Connecting Actuators

Electromechanical control circuit devices are connected as follows:

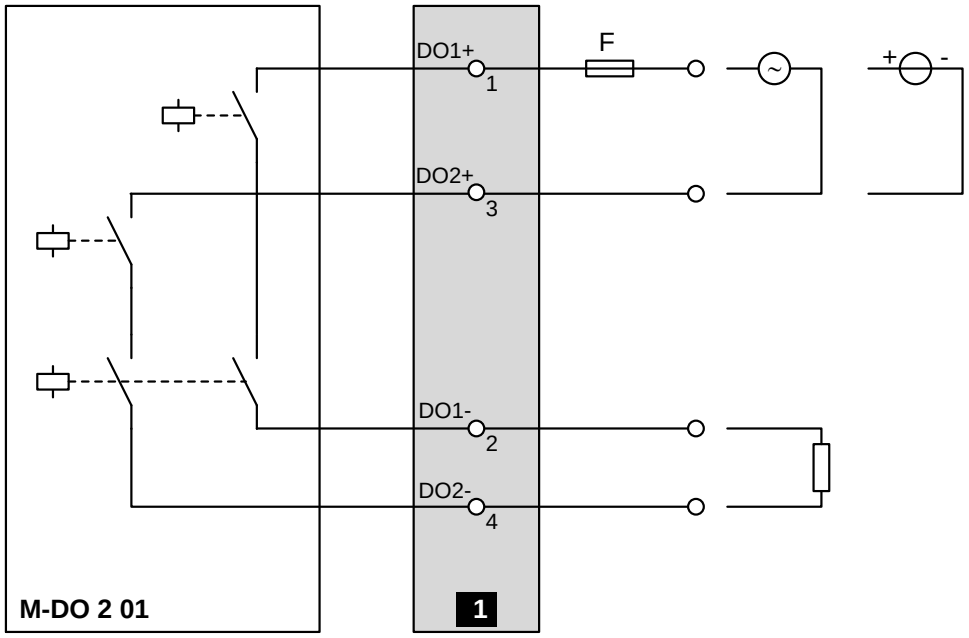



1 Socket M-SO REL 01

Figure 9: Wiring an Actuator with DC or AC Voltage

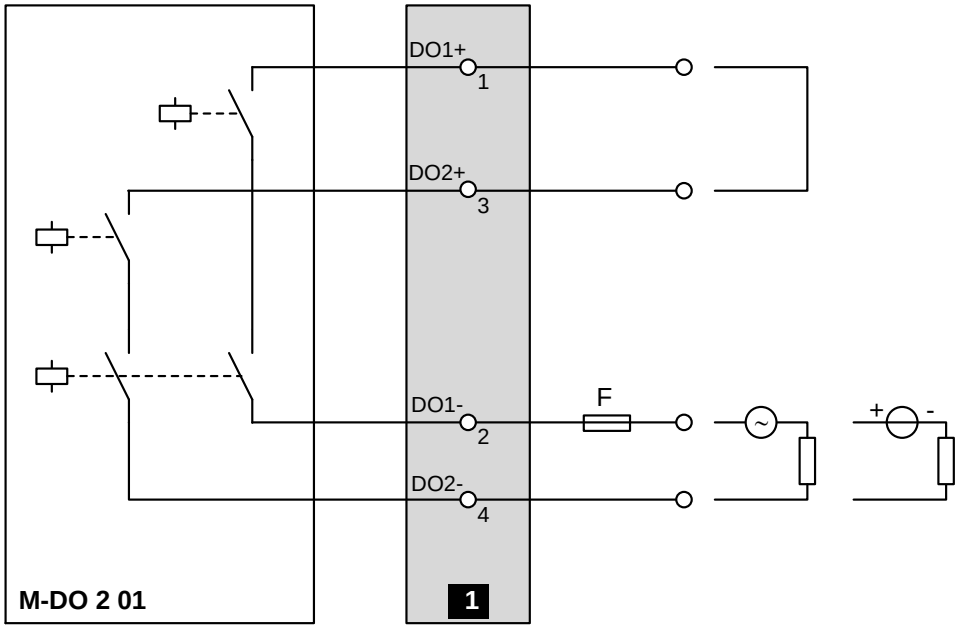
## 4.4.2 Applications for Fast and Safe Shutdown

The following applications allow for fast and safe shutdown (drop-out time of the relay), and take internal module faults into account, see Figure 10, Figure 11 and Figure 12. To this end, both channels must be switched on and off simultaneously.




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

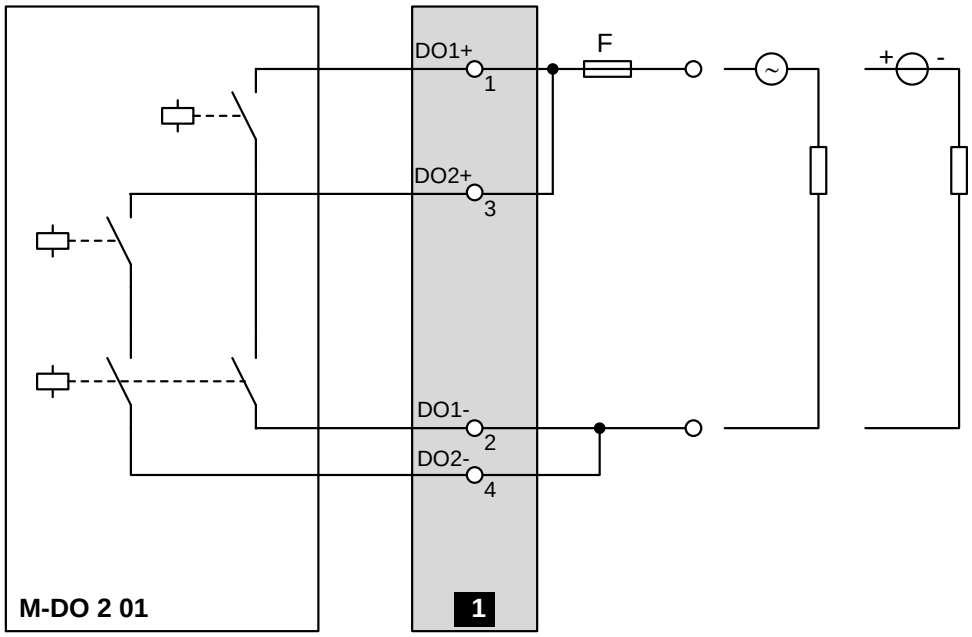
Figure 10: Increased Safety Trough 2-Pole Connection of an Actuator




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

Figure 11: Increased Safety Through Serial Connection of an Actuator

Additionally, the following application increases the availability of the actuator.

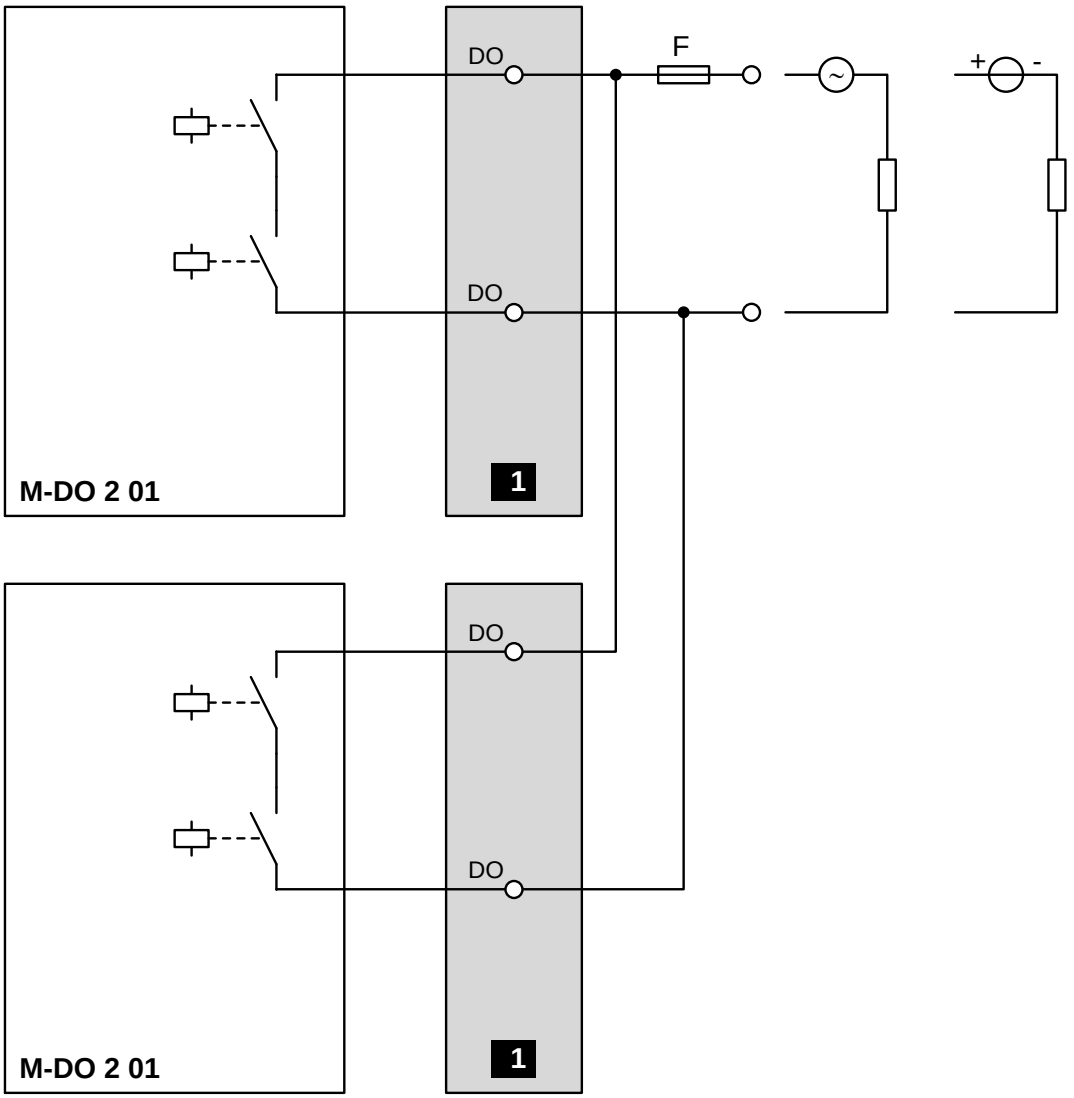



**1** Socket M-SO I/O 01

Figure 12: Increased Availability of an Actuator

### 4.4.3 Wiring one Actuator to Redundant Modules

Burner applications can be performed with an actuator at redundant modules.




**1** Socket

Figure 13: Redundant Wiring of an Actuator and Redundant Relay Modules

**NOTICE**

**Burner applications**

**To switch off the entire fuel feed of continuously operating combustion plants where regular tests cannot be performed in sufficiently short intervals, the relay function must be tested, depending on the application, using the wiring shown above, e.g., once per day.**

# 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 3.4.4.

The diagnostic history of the M45 system can also be read using SILworX.

# 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.

## 6.1 Faults

Refer to Chapter 3.1, for more information on the fault reaction of relay outputs.

If the test harness of the module detect safety-critical faults (module faults), the module is rebooted.

If the fault is still present, the module is rebooted again. This process is repeated as long as the fault is present. If no fault is detected, the module is restarted (RUN state).

If a further module fault occurs within the first minute after reboot, the module enters the STOP_INVALID state and will remain in this state. This means that the outputs switch to the de-energized, safe state. The evaluation of diagnostics provides information on the fault cause.

If the restart after a module fault must be prevented, the user program must be configured accordingly. To this end, use the system parameters *Emergency Stop 1*…*Emergency Stop 4*. If the system parameters *Emergency Stop 1*…*Emergency Stop 4* are used, the entire M45 system enters the STOP state.

## 6.2 Maintenance Measures

The following measures are required for the module:

- Load the operating system, if a new version is required
- Perform the proof test

### 6.2.1 Loading the Operating System

HIMA is continuously improving the operating system of the modules.
HIMA recommends using system downtimes to load the current version of the operating system into the module.

Refer to the release notes to check the impact of the operation system version on the system!

The operating system can be loaded into the module using SILworX. To this end, the HIMatrix M45 system must be in the STOP state. Otherwise, stop the system.

For more information, refer to the system manual (HI 800 651 E).

i The current version of the module in use is displayed in the SILworX Control Panel. The type label specifies the version when the module is delivered, see Chapter 3.3.

### 6.2.2 Proof Test

HIMatrix M45 modules must be subjected to a proof test in intervals of 10 years. For more information, refer to the safety manual (HI 800 653 E).

If used in accordance with the Machinery Directive, additional functional tests must be performed.

# 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),<br>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 error stop state. |
| WDT | Watchdog time |

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SAFETY
NONSTOP

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