

HIMatrix

Safety-Related Controller

M-CPU 01 Manual



HIMA Paul Hildebrandt GmbH
Industrial Automation

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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.
<i>Italics</i>	For parameters and system variables
<code>Courier</code>	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 **M-CPU 01** processor module is the central component of the HIMatrix M45 controller.

The HIMatrix M45 module is always located at the leftmost position on the DIN rail.

The M-CPU 01 module is used to store the operating system and the user program. The module executes all central functions, including communication with the PADT and other systems. The module monitors the supply voltage and the operating temperature.

The configuration is performed using SILworX, see Chapter 4.3.

The module is suitable for sequence of events recording (SOE), see Chapter 3.4.6. The module supports multitasking and reload. For more details, refer to the system manual (HI 800 651 E).

i

A licence is required to use the events recording, the multitasking and the reload features.

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 CPU monitors the sequence and the proper logical execution of the operating system and one or more user programs. The following functions are monitored with respect to time:

- Hardware and software self-tests of the processor system
- RUN cycle of the processor system (including the user program)
- I/O tests and processing of I/O signals

3.1.1 Reaction in the Event of a Fault

If the self-tests detect errors, the user program and process data processing is stopped.

For further information on the fault reaction of the processor module, refer to Chapter 6.1.

Module faults are signaled by the *Err* LED located on the front plate, see Chapter 3.4.3.

3.2 Scope of Delivery

To be able to operate, the module must be installed on a suitable M-SO CPU 01 socket. The socket is not included within the scope of delivery of the module.

The socket is described in Chapter 3.6.

3.2.1 IP Address and System ID (SRS)

A transparent label for specifying the IP address and the system ID (SRS, System.Rack.Slot) after a change, is delivered with the device.

The label must be affixed such that the ventilation slots in the housing are not obstructed.

Refer to the *SILworX First Steps* manual for more information on how to modify the IP address and the system ID.

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

This chapter describes the module's layout and function, and communication via safe**ethernet**.

3.4.1 Block Diagram

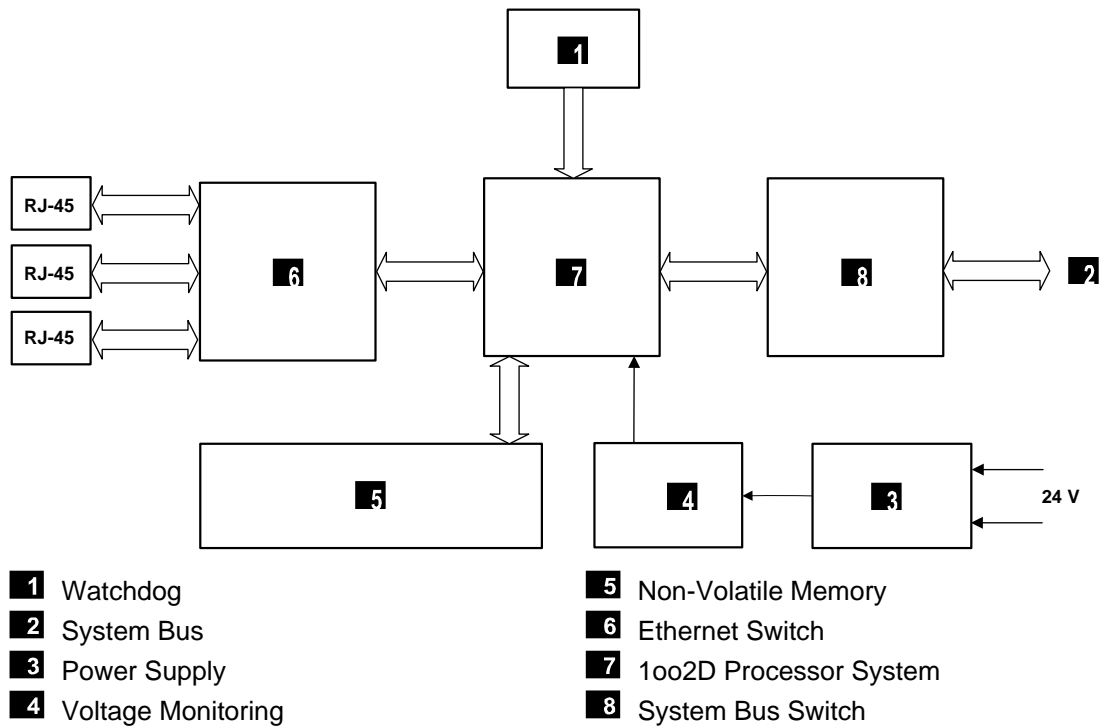


Figure 2: Block Diagram

3.4.2 Front View

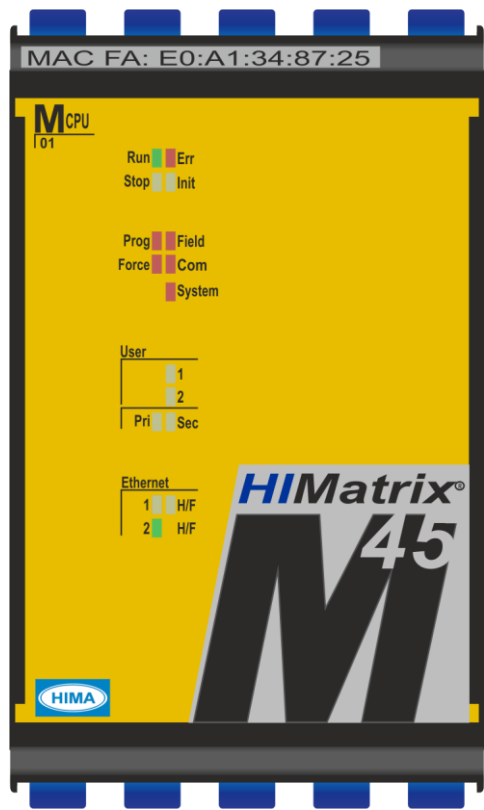


Figure 3: Front View M-CPU 01

3.4.3 LED Indicators

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

- System LEDs
- Program LEDs
- User and system bus LEDs
- Communication LEDs

When the supply voltage is switched on, a 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
Run	Green	On	<ul style="list-style-type: none"> ▪ Module in RUN, normal operation ▪ Emergency loader active
		Blinking1	<ul style="list-style-type: none"> ▪ A new operating system is being loaded. ▪ Module in the OPERATE state, no user program started
		Off	Module is in none of the states described.
Err	Red	On	Warning, e.g.: <ul style="list-style-type: none"> ▪ No license for additional functions (communication protocols, reload), test mode ▪ Temperature warning
		Blinking1	Fault, e.g.: <ul style="list-style-type: none"> ▪ Internal module fault detected by self-tests, e.g., hardware or voltage supply. The processor system can only be restarted with a command from the PADT (reboot). ▪ System configuration fault. ▪ Error while loading the operating system. ▪ Emergency loader active.
		Off	No faults detected.
Stop	Yellow	On	<ul style="list-style-type: none"> ▪ Module in the STOP / VALID CONFIGURATION state. ▪ Emergency loader active
		Blinking1	<ul style="list-style-type: none"> ▪ Module in the STOP / INVALID CONFIGURATION state. ▪ A new operating system is being loaded.
		Off	Module is in none of the states described.
Init	Yellow	On	<ul style="list-style-type: none"> ▪ Module is in the INIT state. ▪ Emergency loader active.
		Blinking1	<ul style="list-style-type: none"> ▪ A new operating system is being loaded.
		Off	Module is in none of the states described.

Table 4: Module Status Indicators

3.4.3.2 Program LEDs

The LEDs signal the following states:

LED	Color	Status	Description
Prog	Yellow	On	<ul style="list-style-type: none"> The controller is being loaded with a new configuration. Emergency loader active A new operating system is being loaded. Change to watchdog time, safety time or SRS. Check for duplicate IP address. A PADT write command is being processed.
		Blinking1	<ul style="list-style-type: none"> Reload is running A duplicate IP address was detected. ¹⁾ PROFINET has received an identify request. ¹⁾
		Off	None of the described events occurred.
Force	Yellow	On	Forcing prepared: The force switch is set for a variable, the force main switch is still deactivated. The module is in the RUN or STOP state.
		Blinking1	<ul style="list-style-type: none"> Forcing is active: At least one local or global variable has adopted the corresponding force value. A duplicate IP address was detected. ¹⁾ PROFINET has received an identify request. ¹⁾
		Off	None of the described events occurred.
Field	Red	On	<ul style="list-style-type: none"> A field warning occurred. Operating system emergency loader active.
		Blinking1	A field fault occurred.
		Off	None of the described events occurred.
COM	Red	On	<ul style="list-style-type: none"> Warning related to external process data communication. Operating system emergency loader active.
		Blinking1	Fault in the external process data communication.
		Off	None of the described events occurred.
System	Red	On	<ul style="list-style-type: none"> A system warning occurred. Operating system emergency loader active.
		Blinking1	A system error occurred.
		Off	None of the described events occurred.

¹⁾ If all the LEDs PROG and FORCE are blinking simultaneously.

Table 5: Program LEDs

3.4.3.3 User and System Bus LEDs

The LEDs are labeled *User*. The LEDs signal the following states:

LED	Color	Status	Description
User 1, User 2	Yellow	On	These LEDs can be switched by the user program. The meaning of these LEDs is user-specific.
		Blinking1	
		Off	
Pri	Yellow	On	System bus connection established, no data transfer.
		Blinking-x	Data transfer through system bus.
		Off	System bus connection not established.
Sec	Yellow	On / Off	For future applications. <i>On</i> only during LED test, otherwise <i>Off</i> .

Table 6: User and System Bus LEDs

The meaning of the user LEDs must be defined and described for the operator during the engineering phase. Placing user-specific labels on the front plate LEDs helps the operator.

3.4.3.4 Ethernet Indicators

The Ethernet LEDs are labeled *Ethernet*. The LEDs signal the following states:

LED	Color	Status	Description
1, 2	Green	On	Communication partner connected No communication detected on interface
		Blinking1	IP address conflict detected All Ethernet LEDs are blinking
		Blinking-x	Communication detected on interface
		Off	No communication partner connected
H/F	Yellow	On	Full duplex operation on Ethernet line
		Blinking1	IP address conflict detected. All Ethernet LEDs are blinking.
		Blinking-x	Collisions detected on Ethernet line
		Off	Half duplex operation on Ethernet line

Table 7: Ethernet Indicators

3.4.4 Operating System

The operating system loaded into the processor module contains all basic functions of the HIMatrix M45 programmable electronic system (PES), for example:

- Reading the inputs and writing to the outputs
- Processing the user program
- Performing all test routines for hardware and software
- Cycle time monitoring (watchdog)
- Communication with other systems

For a description of the operating system functions and the variables used to configure the systems and all modules, refer to the HIMatrix M45 system manual (HI 800 651 E).

3.4.5 User Program

The user program is created using the SILworX programming tool. It is then translated into a machine code using the code generator and transferred to the flash EPROM of the processor module.

3.4.6 Alarms&Events

The processor module records alarms and other events in its non-volatile memory. Up to 4000 events can be configured. The event buffer includes 1000 events.

For further details on alarms and events, their creation and recording, refer to the system manual (HI 800 651 E).

3.4.7 Communication

Communication with external systems occurs via the Ethernet interfaces of the M-CPU 01 module.



When configuring safety-related communication, observe the instructions specified in the SILworX communication manual (HI 801 101 E).

3.4.7.1 Connections for Ethernet Communication

Ethernet interfaces	
Ports	3
Transfer standard	10BASE-T/100BASE-Tx, half and full duplex
Auto negotiation	Yes
Auto crossover	Yes
Connection Socket	RJ-45
IP Address	Freely configurable ¹⁾
Subnet Mask	Freely configurable ¹⁾
Supported protocols	<ul style="list-style-type: none"> ▪ safeethernet ▪ Programming and debugging tool (PADT), SNTP
¹⁾ The general rules for assigning IP address and subnet masks must be adhered to.	

Table 8: Connections for Fieldbus Communication

The three RJ-45 connectors are located on the front plate of the module. The status is indicated by LEDs, see Chapter 3.4.3.4.

The connection parameters are read based on the MAC address (media access control address) defined during manufacturing.

The MAC address of the module is specified on the label on the front plate.

Example of label: MAC: 00.E0.A1.00.0E.04

3.4.7.2 Network Ports Used for Ethernet Communication

UDP ports	Use
8000	Programming and operation with the programming tool
8004	Configuration of the remote I/O using the PES (SILworX)
6010	safeethernet and OPC
123	SNTP (time synchronization between PES and remote I/O, PES and external devices)

Table 9: Network Ports (UDP Ports) in Use

3.4.8 Monitoring the Operating Voltage

The M-CPU 01 processor module monitors the 24 VDC operating voltage of the HIMatrix M45; reactions occur in accordance with the listed levels:

Voltage level	Reaction of the CPU
18...28.8 V	No reaction
< 18.0 V	Alarm state (the internal variables are written to)
< 13.0 V	Shutdown

Table 10: Operating Voltage Monitoring

The alarm can be evaluated with a PADT loaded with a programming tool, using the *Power Supply State* system parameter.

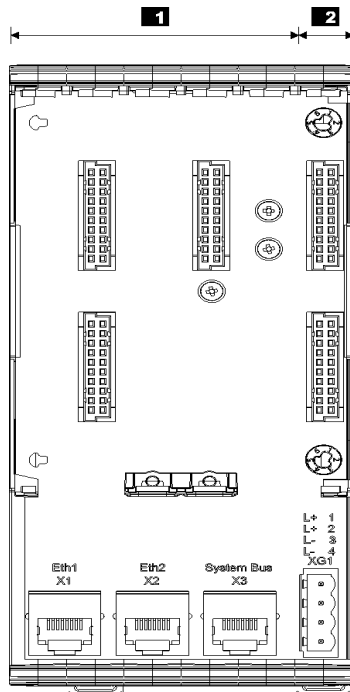
3.5 Product Data

General	
Supply voltage	24 VDC, -15...+20 %, $r_p \leq 5$ %, from a power supply unit with safe insulation in accordance with IEC 61131-2
Maximum supply voltage	30 V
Operating data	3.3 VDC / 1.5 A 5 VDC / 0.1 A
Microprocessor	PowerPC
Total program and data memory for all user programs	5 MB less 64 kB for CRCs
Data memory for retain variables	32 kB
Number of user programs	1...32
Number of event definitions	0...4000
Size of the non-volatile event buffer.	1000 Events
Ethernet interfaces	3 x RJ-45, 10BASE-T/100BASE-Tx with integrated switch
Buffer for date/time	Gold capacitor
Ambient temperature	0...+60 °C
Storage temperature	-40...+85 °C
Humidity	Max. 95 % relative humidity, non-condensing
Type of protection	IP20
Space requirement	
Module housing (H x X D) in mm	105 x 62.5 x 68
Socket (H x W) in mm	165 x 65
Module housing + socket	D 90 mm to DIN rail, 96 mm total
Weight	
Module	approx. 215 g
Socket	approx. 180 g

Table 11: Product Data

3.6 Socket M-SO CPU 01

The M-SO CPU 01 socket is equipped with slots for the M-CPU 01 processor module and the M-PWR 01 power module, see Figure 4. The power module supplies the processor module as well as the modules connected on the right-hand side, see the corresponding manual (HI 800 659 E).



1 Processor Module Slot

2 Power Module Slot

Figure 4: The M-SO CPU 01 Socket

3.7 Certified HIMatrix M-CPU 01

M-CPU 01	
TÜV, CE	EMC, machinery and low voltage directives IEC 61508 1-7:2010 up to SIL 3 IEC 61511 1-3:2004 EN ISO 13849-1:2008 + AC:2009 up to Cat. 4 and PL e EN 62061:2005 + AC:2010 + A1:2013 EN 50156-1:2004 up to SIL 3 EN 12067-2:2004 EN 298:2012 EN 61131-2:2007 EN 61326-3-1:2008 EN 54-2:1997 + AC:1999 + A1:2006 NFPA 85:2011 NFPA 86:2011 NFPA 72:2013
PROFIBUS Nutzerorganisation (PNO)	Test Specification for PROFIBUS DP Slave, V3.0 November 2005

Table 12: Certificates

Further safety and application standards are specified on the certificate. The TÜV certificate and the EC type test certificate are available on the HIMA website at www.hima.com.

4 Start-Up

To start up the controller, it must be mounted, connected and configured in the programming tool.

4.1 Mounting

The module is mounted on a 35 mm DIN rail using the corresponding M-SO CPU 01 socket.

When installing the HIMatrix M45 system, its socket must be the first to be mounted and must be located at the leftmost position on the DIN rail. The remaining sockets must be mounted on the right-hand side.

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.

WARNING

The module may only be plugged out and in again 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 communication 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

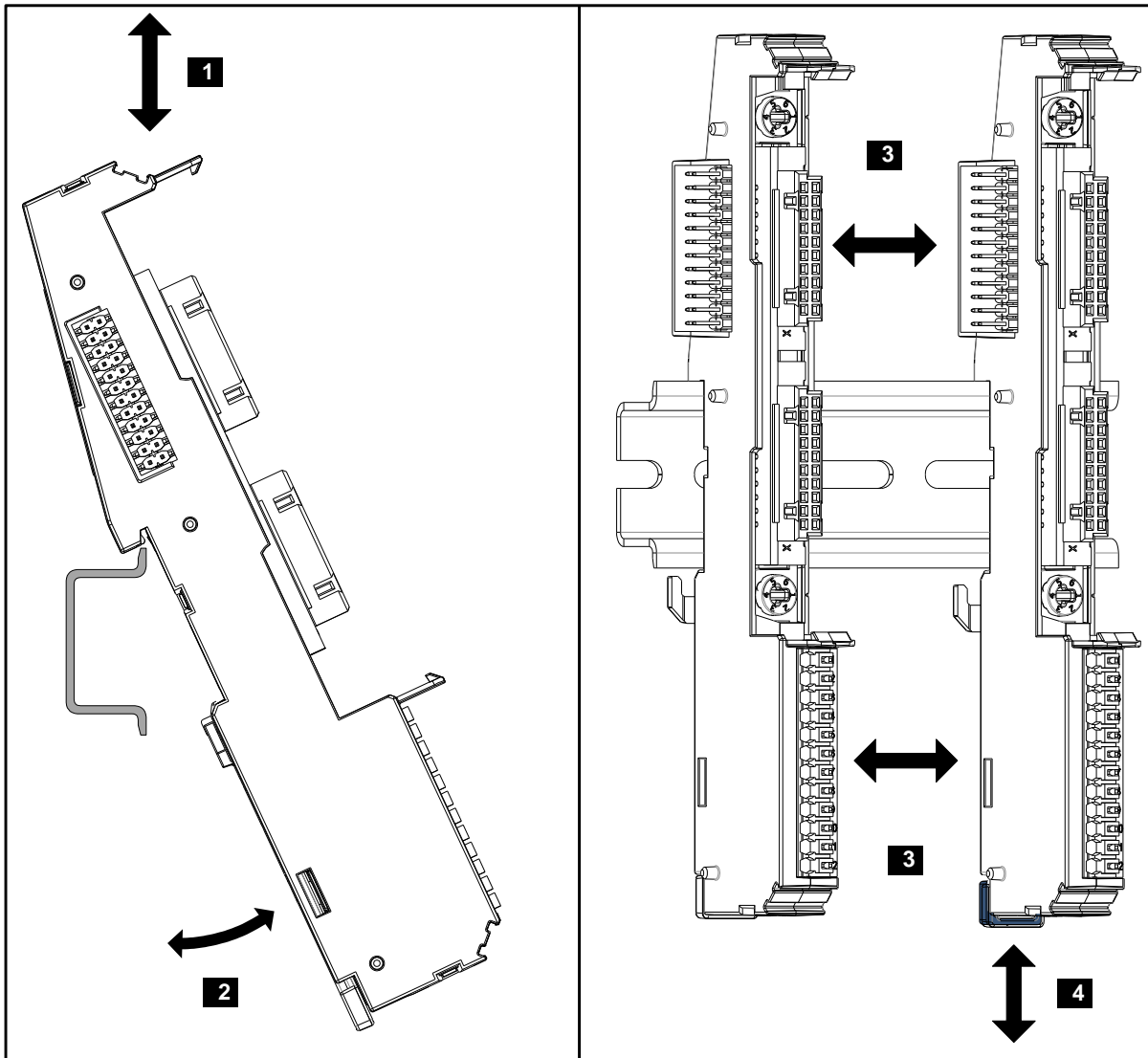
To insert the socket

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 5: Example of Socket Mounting

4.2.2 Mounting and Removing the Processor Module

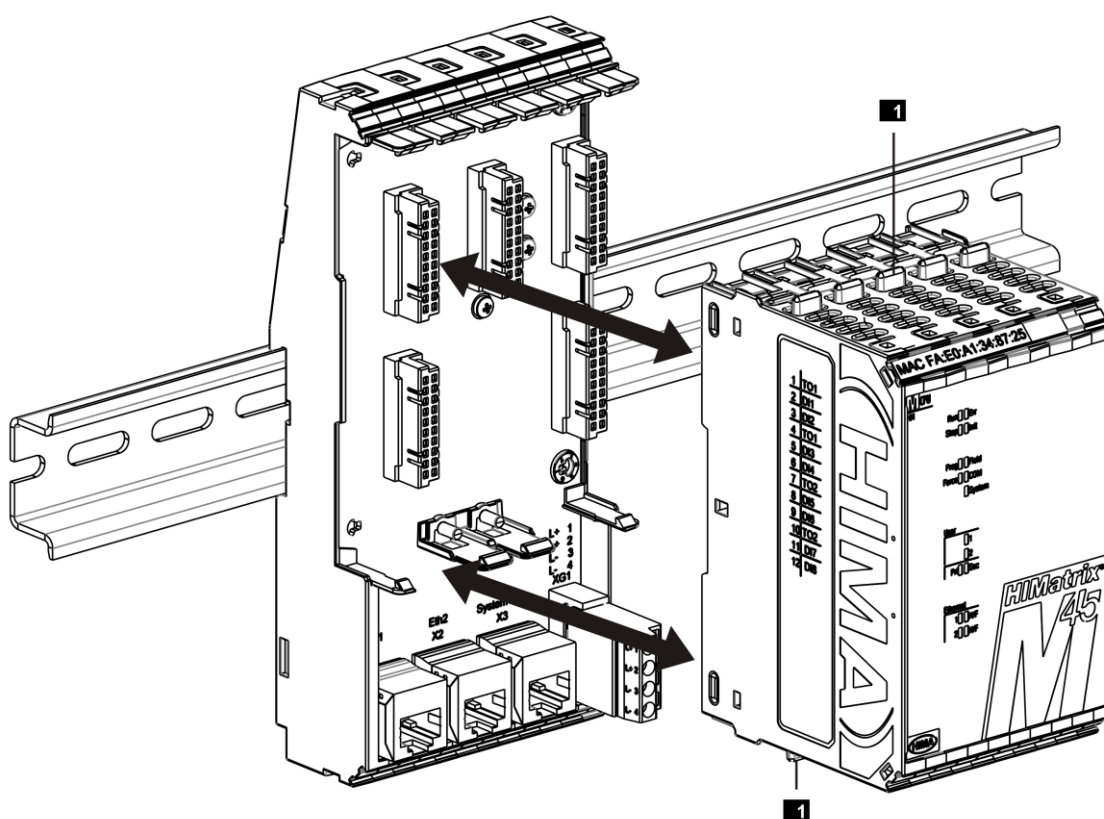
This chapter describes how to mount and remove the processor module in the M45 system.

To insert the module

1. Plug the module in to the socket without jamming it, until the locking mechanism is engaged. The module is mounted.

To remove the module

1. Press all 10 latches on both sides backwards as far as they can go. 5 latches are located at the top and 5 at the bottom of the module.
 - ☒ The locking mechanism is opened.
 2. Loosen and remove the module from the socket.
- The module is removed.



1 Latch for Releasing the Module

Figure 6: Mounting a Module onto the Socket

4.3 Configuration

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

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 parameters for the processor module (M-CPU 01) in the same order as given in the SILworX Hardware Editor.

4.3.1 Tab **Module**

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

Parameter	Description
Name	Module name
Activate Max. μ P Budget for HH Protocol	<ul style="list-style-type: none"> Activated: Use CPU load limit from the <i>Max. μP Budget for HH Protocol [%]</i> field. Deactivated: Do not use the CPU load limit for IP data transfer. Default setting: Deactivated
Max. μ P Budget for HH Protocol [%]	Maximum module's CPU load that can be used for processing the IP data transfer. <div> <i>i</i> The maximum load must be distributed among all the implemented protocols that use this processor module. </div>
IP Address	IP address of the Ethernet interface. Default value: 192.168.0.99
Subnet Mask	32-bit address mask to split up the IP address in network and host address. Default value: 255.255.252.0
Standard Interface	Activated: The interface is used as standard interface for system login. Default setting: Deactivated
Default Gateway	IP address of the default gateway. Default value: 0.0.0.0
ARP Aging Time [s]	<p>A processor module stores the MAC addresses of the communication partners in a MAC/IP address assignment table (ARP cache).</p> <p>The MAC address remains stored in the ARP cache, if messages from the communication partner are received in a period of 1x...2x <i>ARP Aging Time</i>.</p> <p>The MAC address is erased from the ARP cache, if no messages from the communication partner are received in a period of 1x...2x <i>ARP Aging Time</i>.</p> <p>The typical value for the <i>ARP Aging Time</i> in a local network ranges from 5...300 s.</p> <p>The user cannot read the contents of the ARP cache.</p> <p>Range of values: 1...3600 s Default value: 60 s</p> <p>Note: If routers or gateways are used, the <i>ARP Aging Time</i> must be adjusted (increased) due to the additional time required for two-way transmission.</p> <p>If the <i>ARP Aging Time</i> is too low, the MAC address of the communication partner is erased from the ARP cache and communication is delayed or interrupted. For an efficient performance, the <i>ARP aging time</i> value must be less than the receive timeout set for the protocols in use.</p>

Parameter	Description
MAC Learning	<p><i>MAC Learning</i> and <i>ARP Aging Time</i> are used to set how quick the Ethernet switch should learn the MAC address.</p> <p>The following settings are possible:</p> <ul style="list-style-type: none"> Conservative (recommended): If the ARP cache already contains MAC addresses of communication partners, these are locked and cannot be replaced by other MAC addresses for at least 1 <i>ARP Aging Time</i> and a maximum of 2 <i>ARP Aging Time</i> periods. This ensures that data packets cannot be intentionally or unintentionally forwarded to external network subscribers (ARP spoofing). Tolerant: When a message is received, the IP address contained in the message is compared to the data in the ARP cache and the MAC address stored in the ARP cache is immediately overwritten with the MAC address from the message. The <i>Tolerant</i> setting must be used if the availability of communication is more important than the authorized access to the controller. <p>Default setting: Conservative</p>
IP Forwarding	<p>Allow a processor module to operate as router and to forward data packets to other network nodes.</p> <p>Default setting: Deactivated</p>
ICMP Mode	<p>The Internet Control Message Protocol (ICMP) allows the higher protocol layers to detect error states on the network layer and optimize the transmission of data packets.</p> <p>Message types of Internet Control Message Protocol (ICMP) supported by the processor module:</p> <ul style="list-style-type: none"> No ICMP Responses All the ICMP commands are deactivated. This ensures a high degree of safety against potential sabotage that might occur over the network. Echo Response If Echo Response is activated, the node responds to a ping command. It is thus possible to determine if a node can be reached. Safety is still high. Host Unreachable Not important for the user. Only used for testing at the manufacturer's facility. All Implemented ICMP Responses All ICMP commands are activated. This allows a more detailed diagnosis of network malfunctions. <p>Default setting: Echo Response</p>

Table 13: Configuration Parameters, Module Tab

4.3.2 Tab **Routings**

The **Routings** tab contains the routing table. This table is empty if the module is new. A maximum of 8 routing entries are possible.

Parameter	Description
Name	Denomination of the routing settings.
IP Address	Target IP address of the communication partner (with direct host routing) or network address (with subnet routing). Range of values: 0.0.0.0...255.255.255.255 Default value: 0.0.0.0
Subnet Mask	Define the target address range for a routing entry. 255.255.255.255 (with direct host routing) or subnet mask of the addressed subnet. Range of values: 0.0.0.0...255.255.255.255 Default value: 255.255.255.255
Gateway	IP address of the gateway to the addressed network. Range of values: 0.0.0.0...255.255.255.255 Default value: 0.0.0.1

Table 14: Routing Parameters

4.3.3 Tab **Ethernet Switch**

The **Ethernet Switch** tab contains the following parameters:

Parameter	Description
Name	Name of the port (Eth1...Eth2) as printed on the housing; per port, only one configuration may exist.
Speed [Mbit/s]	10: Data rate 10 Mbit/s 100: Data rate 100 Mbit/s Autoneg: Automatic baud rate setting Default value: Autoneg
Flow Control	Full duplex: Simultaneous communication in both directions Half duplex: Communication in one direction Autoneg: Automatic communication control Default value: Autoneg
Autoneg also with fixed values	The <i>Advertising</i> function (forwarding the speed and flow control properties) is also performed if the parameters <i>Speed</i> and <i>Flow Control</i> have fixed values. This allows other devices with ports set to <i>Autoneg</i> to recognize the port settings. Default setting: Activated
Limit	Limit the inbound multicast and/or broadcast packets. Off: No limitation Broadcast: Limit broadcast packets (128 kbit/s) Multicast and Broadcast: Limit multicast and broadcast packets (1024 kbit/s) Default value: Broadcast

Table 15: Ethernet Switch Parameters

4.3.4 Tab **VLAN** (Port-Based VLAN)

For configuring the use of port-based VLAN.

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Should VLAN be supported, port-based VLAN should be off to enable each port to communicate with the other switch ports.

For each switch port, the user can define which other switch ports received Ethernet frames may be sent to.

The table in the VLAN tab contains entries through which the connection between two ports can be set to *active* or *inactive*.

Name	Eth1	Eth2
Eth1		
Eth2	active	
CPU	active	active

Table 16: VLAN Tab

Default setting: All connection between ports *active*

4.3.5 Tab **LLDP**

With LLDP (Link Layer Discovery Protocol), information such as MAC address, device name, port number is sent per multicast in periodic intervals via the own device and is received from the neighboring devices.

The processor module supports LLDP on ports Eth1 and Eth2.

The following parameters define how a given port should work:

Off	LLDP is disabled on this port.
Send	LLDP sends LLDP Ethernet frames, received LLDP Ethernet frames are deleted without being processed.
Receive	LLDP sends no LLDP Ethernet frames, but received LLDP Ethernet frames are processed.
Send/Receive	LLDP sends and processes received LLDP Ethernet frames.

Default setting: Off

4.3.6 Tab **Mirroring**

Mirroring is used to configure whether the module should duplicate Ethernet packets on a given port such that they can be read from a device connected to that port, e.g., for test purposes.

The following parameters define how a given port should work:

Off	This port does not participate to the mirroring process.
Egress:	Outgoing data of this port are duplicated.
Ingress:	Incoming data of this port are duplicated.
Ingress/Egress:	Incoming and outgoing data of this port are duplicated.
Dest Port:	This port is used to send duplicated data.

Default setting: Off

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. 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 with the same type or with a replacement model approved by HIMA.

Replacing of modules is only permitted in the de-energized state.

Only the manufacturer is authorized to repair the module.

6.1 Faults

If the test harnesses detect safety-critical faults, the module enters the STOP_INVALID state and will remain in this state. This means that the input signals are no longer processed by the module and the outputs switch to the de-energized, safe state. The evaluation of diagnostics provides information about the fault cause.

Module faults are signaled by the *Err* LED located on the front plate. Additionally, the status parameters can be evaluated in the user program.

NOTE



If a failure occurs, the module must be replaced to ensure the plant's safety.

The instructions specified in Chapter 4.2.2 must be observed when replacing an existing module or installing a new one.

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 to use 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 STOP. Otherwise, stop the system.

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



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).

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 components must be transported in packaging.

Always store HIMatrix components in their original product packaging. This packaging also provides protection against electrostatic discharge. Note that the product packaging alone is not suitable for transport.

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 <i>interference-free</i> 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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SAFETY
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