HIMA

SMART SAFETY.

Manual

HIMatrix®F

Maintenance Manual

Contact

HIMA Paul Hildebrandt GmbH

P.O. Box 1261

68777 Brühl

Phone: +49 6202 709-0

Fax: +49 6202 709-107

E-mail: info@hima.com

Document designation	Description
HI 800 454 D, Rev. 3.01 (1927)	German original document
HI 800 455 E, Rev. 3.01.00 (1934)	English translation of the German original document

Table of Contents

1 Introduction

This document describes all relevant activities for servicing and operating safety-related HIMatrix controllers.

- Chapter 2 lists the activities in a tabular overview.
- Chapter 3 describes the proof test.
- Chapter 4 lists the manuals to be observed and other applicable documents.
- Chapter 5 includes maintenance action details.

1.1 Target Audience and Required Know-How

This manual is aimed at the planners, design engineers, programmers and maintenance personnel of automation systems. Specialized knowledge of safety-related automation systems is required.

Additional knowledge is necessary for maintenance activities on the HIMatrix system hardware and software, e.g., for reading and evaluating diagnostics.

For work on safety-related automation systems, the safety standards demand proof of the qualifications required for maintenance personnel.

Qualified HIMA service personnel can be requested to perform maintenance tasks in accordance with the manufacturer's instructions. HIMA also offers specific training seminars to qualify the maintenance personnel.

HIMA recommends the following seminars for performing maintenance tasks:

- **FS 101** Functional safety for maintenance and operation
- **PT 220** SILworX HIMatrix Maintenance

1.2 Writing Conventions

To ensure improved readability and comprehensibility, the following writing conventions 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	Parameters and system variables, references.
`Courier`	Literal user inputs.
RUN	Operating states are designated by capitals.
Chapter 1.2.3	Cross-references are hyperlinks even if they are not specially marked. In the electronic document (PDF): When the mouse pointer hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position.

Safety notices and operating tips are specially marked.

1.2.1 Safety Notices

Safety notices must be strictly observed to ensure the lowest possible risk.

The safety notices are represented as described below.

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

The signal words have the following meanings:

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

⚠ SIGNAL WORD

Type and source of risk!

Consequences arising from non-observance.

Risk prevention.

NOTICE

Type and source of damage!

Damage prevention.

1.2.2 Operating Tips

Additional information is structured as presented in the following example:

i The text giving additional information is located here.

Useful tips and tricks appear as follows:

TIP The tip text is located here.

1.3 Safety Lifecycle Services

HIMA provides support throughout all the phases of the plant's safety lifecycle, from planning and engineering through commissioning to maintenance of safety and security.

HIMA's technical support experts are available for providing information and answering questions about our products, functional safety and automation security.

To achieve the qualification required by the safety standards, HIMA offers product or customer-specific seminars at HIMA's training center or on site at the customer's premises. The current seminar program for functional safety, automation security and HIMA products can be found on HIMA's website.

Safety Lifecycle Services:	
Onsite+ / On-Site Engineering	In close cooperation with the customer, HIMA performs changes or extensions on site.
Startup+ / Preventive Maintenance	HIMA is responsible for planning and executing preventive maintenance measures. Maintenance actions are carried out in accordance with the manufacturer's specifications and are documented for the customer.
Lifecycle+ / Lifecycle Management	As part of its lifecycle management processes, HIMA analyzes the current status of all installed systems and develops specific recommendations for maintenance, upgrading and migration.
Hotline+ / 24 h Hotline	HIMA's safety engineers are available by telephone around the clock to help solve problems.
Standby+ / 24 h Call-Out Service	Faults that cannot be resolved over the phone are processed by HIMA's specialists within the time frame specified in the contract.
Logistics+/ 24 h Spare Parts Service	HIMA maintains an inventory of necessary spare parts and guarantees quick, long-term availability.

Contact details:	
Safety Lifecycle Services	https://www.hima.com/en/about-hima/contacts-worldwide/
Technical Support	https://www.hima.com/en/products-services/support/
Seminar Program	https://www.hima.com/en/products-services/seminars//

2 Operating and Maintenance Activities

The operating and maintenance activities of the individual system components are listed in the following sections.

2.1 Activities Recurring in the Short Term

The HIMatrix system must be tested by the operator at short recurring intervals in line with the Automation Security policy. The operator must specify the test details in a security risk analysis; refer to the automation security manual (HI 801 373 E).

2.2 Activities Recurring on an Annual Basis

The chapter specifies the maintenance activities recurring on an annual basis.

2.2.1 Mechanical Test (Visual Inspection)

The table specifies the maintenance activities for the mechanics:

Activity	Who	Reference
Check whether the compact systems are securely fastened to the DIN rail (DIN).	Operating company, assembler, maintenance personnel	D1
Check the module screws for firm connection, tighten if necessary (HIMatrix F60).	Operating company, assembler, maintenance personnel	D2
Check the data cables for firm connection, including to the communication interfaces.	Operating company, assembler, maintenance personnel	D1, D2
Check the fans for proper function (HIMatrix F60).	Operating company, assembler, maintenance personnel	D2

Table 1: Annual Activities for the Mechanics

2.2.2 Power Supply Test

The table specifies the maintenance activities for the power supply:

Activity	Who	Reference
Check the 230 VAC/24 VDC power supply for compliance with tolerances, 24 VDC, -15…+20 %, $r_p \leq 5$ %.	Operating company, assembler, maintenance personnel	D1, D2
Check the 24 VDC distribution. Check any existing decoupling diodes for proper function.	Operating company, assembler, maintenance personnel	D1, D2
Check the redundant supply for proper function.	Operating company, assembler, maintenance personnel	D1, D2

Table 2: Annual Activities for the Power Supply

2.3 Activities Recurring in the Long Term

The chapter specifies maintenance activities recurring in the long term.

2.3.1 Hardware

The table specifies the activities for the hardware:

Activity	Who	Reference
At an operating temperature of > 40 °C: Replace the fans every **3** years (HIMatrix F60).	Operating company, assembler, maintenance personnel	D2
At an operating temperature of ≤ 40 °C: Replace the fans every **5** years (HIMatrix F60).	Operating company, assembler, maintenance personnel	D2
In the case of a safety-related application in accordance with SIL 3, check the compact system with relay (e.g., F2 DO 16 02) for proper functioning every **3** years.		D3, D6
In the case of a safety-related application in accordance with SIL 3, check the F 60 DO 8 01 relay module for proper function every **3** years.		D2, D6

Table 3: Activities for the Hardware Recurring in the Long Term

2.3.2 Proof Test

The table specifies the activities for the proof test:

Activity	Who	Reference
The proof test interval must be in accordance with the interval required by the application-specific safety integrity level (SIL). The complete safety functions within the HIMA safety-related system must be checked during the proof test.	Operating company, assembler, maintenance personnel	N2, D3 Chapter 3.1

Table 4: Proof Test

2.4 Activities as Required

The chapter specifies activities to be carried out as required.

2.4.1 Hardware

The table specifies the activities for the hardware:

Activity	Who	Reference
Replace the compact system.	Operating company, assembler, maintenance personnel	D1, D7
Replace the modules (HIMatrix F60).	Operating company, assembler, maintenance personnel	D2, D8 Chapter 5.2.2

Table 5: Activities for the Hardware to be Carried out as Required

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

NOTICE

Damage due to electrostatic discharge!

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

Use a grounding strap and connect it to the ESD connection point on the control cabinet before touching the module to preclude any potential residual charge during module replacement. This also applies when inserting the plugs of cables and data lines.

If the control cabinet is not provided with an ESD connection point, get in contact with a grounded part of the control cabinet before touching the module.

Avoid any direct contact with electronic module components and their PCBs. Only touch the modules by their handles.

2.4.2 Software

The table specifies the activities for the software:

Activity	Who	Reference
Load the user program.	Operating company, assembler, maintenance personnel	D1
Load new operating systems.	Operating company, assembler, maintenance personnel	D1, Chapter 5.3
Change the system parameters.	Operating company, assembler, maintenance personnel	D1, D2, D3, D6, D7, D8

Table 6: Activities for the Software to be Carried out as Required

3 Proof Test (in Accordance with IEC 61508)

HIMA safety systems must be subject to a proof test in regular intervals. The proof test interval for HIMA controllers must be in accordance with the interval required by the application-specific safety integrity level (SIL). The proof test must comply with the applicable safety standards.

Refer to the functional safety data manual (HI 800 579 E) for the safety-related characteristic values of HIMA's HIMatrix system.

3.1 Proof Testing

The proof test is performed by powering off and on again the controller. When the controller is restarted, all electronic components (e.g., memory and processors) are initialized and all diagnostic tests are performed simultaneously.

To perform the proof test

1. Power off the controller (Power OFF).
2. Power on the controller (Power ON).
   ☑ Restart completed.
3. After the restart, read out the following diagnostic information and check for error entries:
   - LEDs on the modules.
   - Warning and error counter in the Control Panel.
   - Diagnostic files of the processor modules.

Proof test as a part of the functional test (loop test)

Proof testing can be dispensed with if the complete safety functions between field level and controller are tested with sufficient testing depth within the specified intervals. The test of the complete safety functions includes all field devices connected to the controller, such as sensors and actuators.

The input and output modules of the safety controller can be tested independently of one another. The safety controller's application logic test is completed through a CRC check with the version comparator.

When testing analog signals in HIMatrix modules, a sufficient testing depth is achieved by:

- Running through the nominal range, e.g., 0/4…20 mA, and simultaneously checking the switching thresholds.
- Underrunning the open-circuit limit, e.g., ≤ 3.6 mA.
- Overrunning the short-circuit limit, e.g., ≥ 21.0 mA.

When testing binary signals in HIMatrix modules, a sufficient testing depth is achieved by:

- Checking the switching thresholds for high and low levels.
- Checking for open-circuits, if possible.
- Checking for short-circuits, if possible.

When testing counter signals in HIMatrix modules, a sufficient testing depth is achieved by:

- Checking the switching thresholds for high and low levels.
- Checking the signal nominal range at 1 %, 10 %, 50 % and 100 %.
- Checking for open-circuits (line breaks), if possible.
- Checking for short-circuits, if possible.

The frequency values, in particular the error bits and value changes, must be checked and documented for 30 s each.

While testing the complete safety functions, the controller's response must be monitored using the SILworX programming tool. Significant channel information such as error states, channel values, open-circuits or short-circuits, must be monitored and documented.

If errors occur, they must be promptly removed (< MTTR for high demand mode) and the corresponding tests must be repeated.

3.2 Proof Test for Systems with Relay Outputs

For remote I/Os and modules with relay outputs, the proof test must be performed in intervals of 3 years.

Remote I/Os and modules with relay outputs are designed with with forcibly guided contacts, the relay contacts are tested during each switching operation. In this way, defects that arise are detected immediately.

The proof test for relay outputs consists in triggering a switching operation, e.g., by forcing the relay output variables. Applications in which the relays are frequently activated during normal operation (more than once per day) do not require a proof test for the relay outputs.

4 Other Applicable Documents

The following table specifies other applicable documents.

Reference	Standard/Document ID	Description
N1	IEC 61511-1, Section 12	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements
N2	IEC 61508-4, Section 3.8.5	Proof Test
D1	HI 800 141 E	HIMatrix system manual for compact systems
D2	HI 800 191 E	HIMatrix system manual for modular systems
D3	HI 800 023 E	HIMatrix safety manual
D4	HI 800 578 E	HIMatrix functional safety data manual
D5	HI 801 373 E	Automation security manual
D6	---	SILworX online help
Reference	Standard/Document ID	Description
D7	**HIMatrix manuals for compact systems**	
	HI 800 153 E	F1 DI 16 01 manual
	HI 800 155 E	F2 DO 4 01 manual
	HI 800 157 E	F2 DO 8 01 manual
	HI 800 159 E	F2 DO 16 01 manual
	HI 800 139 E	F2 DO 16 02 manual
	HI 800 161 E	F3 AIO 8/4 01 manual
	HI 800 179 E	F3 DIO 8/8 01 manual
	HI 800 177 E	F3 DIO 16/8 01 manual
	HI 800 345 E	F3 DIO 20/8 02 manual
	HI 800 473 E	F30 03 manual
	HI 800 477 E	F35 03 manual
Reference	Standard/Document ID	Description
D8	**HIMatrix manuals for modular systems**	
	HI 800 195 E	F60 AI 8 01 module manual
	HI 800 197 E	F60 AO 8 01 module manual
	HI 800 199 E	F60 CIO 2/4 01 module manual
	HI 800 479 E	F60 CPU 03 module manual
	HI 800 201 E	F60 DI 24 01 module manual
	HI 800 203 E	F60 DI 32 01 module manual
	HI 800 205 E	F60 DIO 24/16 01 module manual
	HI 800 207 E	F60 DO 8 01 module manual
	HI 800 183 E	F60 GEH 01 module manual
	HI 800 209 E	F60 MI 24 01 module manual
	HI 800 211 E	F60 PS 01 module manual

Table 7: Other Applicable Documentation

Derived variants: Variants derived from some compact systems (the corresponding manuals are specified in Table 7) were developed for special application fields. These derived variants require the same maintenance actions valid for the basic variants.

5 Maintenance Actions in Details

This chapter describes the individual maintenance actions for the components of the HIMatrix system and indicates which points must be observed during maintenance and replacement.

i Only qualified personnel may perform maintenance actions to supply, signal and data lines, taking all ESD protection measures into account. Personnel must be electrostatically discharged prior to any direct contact with these supply or signal lines!

5.1 Compact Systems

Defective compact systems must be replaced with systems of the same type.

When replacing compact systems, observe the instructions specified in the system manual for compact systems (HI 800 141 E) and safety manual (HI 800 023 E).

5.1.1 Replacing Compact Systems

To remove compact systems from the DIN rail

1. Remove all connector plugs from the compact system:
   - Pluggable screw terminals.
   - Ethernet plugs.
   - Fieldbus plugs, if existing.
2. Insert a flathead screwdriver into the gap between the housing and the latch, using it as a lever to move the latch downward and simultaneously lift the compact system from the rail.

► The compact system is removed from the DIN rail.

To mount the compact system on the DIN rail

1. Shift the latch on the rear side of the compact system downwards, press it against the housing frame and snap it into position.
2. Attach the guiding rail located on the rear side of the compact system to the upper edge of the DIN rail.
3. Press the compact system against the DIN rail and release the latch again to secure the compact system to the DIN rail.
4. Insert all plugs into the correct sockets:
   - Pluggable screw terminals.
   - Ethernet plugs.
   - Fieldbus plugs, if existing.

► The compact system is secured to the DIN rail.

5.2 F60 Modular Systems

Modular systems may require the following maintenance actions:

- Replace the fans.
- Replace the modules.
- Replace the base plate.

5.2.1 Replacing the Fans

HIMA recommends replacing the fans of the HIMatrix F60 regularly to prevent the fans to fail:

- At increased temperatures, > 40 °C: every 3 years.
- At normal temperatures, ≤ 40 °C: every 5 years.

The fans may be replaced while the controller is operating, the controller needs not be shut down.

NOTICE

Use in zone 2!

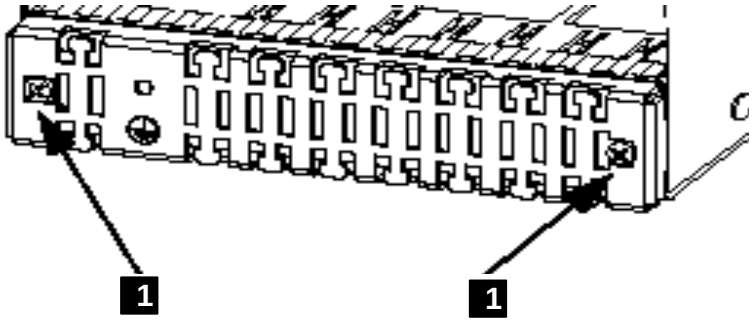
If used in hazardous areas zone 2, the fans must be replaced by HIMA. Failure to comply with this information leads to the loss of the Ex zone 2 approval (certificate)!

- **Contact HIMA technical support on time.**

Tools: Screwdriver, slotted 1.0 x 5.5 mm

To replace the fans in the base plate

1. Unscrew both fastening screws located on the left and right of the ground grid, see Figure 1.



1 Fastening Screws

Figure 1: Ground Grid with Fastening Screws

2. Position the ground grid (including the attached cables) to allow the fan mounting plate located behind it to be removed diagonally downwards.
3. Release the plugs for the fan voltage supply and remove the fan mounting plate completely.
4. Unscrew and remove the four fastening screws on each fan to allow replacement of the old fans.
5. Attach the new fans using the fastening screws; in doing so, pay attention the direction of the air flow.
6. Place the mounting plate with the new fans into position and plug in the connectors for the power supply of the fans. Afterwards, insert the mounting plate completely.
7. Place the ground grid into position and tighten the two fastening screws.

► The fans are replaced.

5.2.2 Replacing the Modules

Defective modules must be replaced with modules of the same type or with approved replacement models.

When replacing compact systems, observe the instructions specified in the system manual for modular systems (HI 800 191 E) and in the safety manual (HI 800 023 E).

NOTICE

Damage to the controller possible!

Only replace the modules if the controller is shut down!

To remove a module from the base plate

1. Remove the plugs from the module front plate.
2. Release the locking screws located on the upper and lower end of the front plate.
3. Loosen the module using the handle located on the lower part of the front plate and remove it from the guiding rails.

► The module is removed.

To mount a module in the base plate

1. Insert the module as far as it can go – without jamming it – into the two guiding rails located on the upper and lower part of the housing.
2. Apply pressure to the upper and lower extremity of the front plate until the module plugs snap into the backplane socket.
3. Secure the module with the screws located on the upper and lower end of the front plate.
4. Depending on the type of module, insert the plugs of the communication cables or field cables into the front plate.

► The module is mounted.

5.2.3 Replacing the Base Plates in the F60

Defective base plates must be replaced with new ones.

To replace the base plate in the F60

1. Switch the voltage supply off to put the controller out of operation.
2. Remove all the modules from the base plate, see Chapter 5.2.2.
3. Remove the base plate from the support, e.g., the cabinet.
4. Mount the new base plate on the support.
5. Insert all modules into the new base plate, see Chapter 5.1.1.
6. Connect the voltage supply and restart the controller.

► The base plate is replaced.

5.3 Loading Operating Systems

The processor and communication systems have different operating systems that are stored in the rewritable flash memories and can be replaced, if necessary.

NOTICE

Interruption of safety-related operation!

The controller must be in STOP to enable the programming tool to load new operating systems.

During this time period, the operator must ensure the plant safety, e.g., by taking organizational measures.

i

- The programming tool prevents controllers from loading operating systems in the RUN state and reports this accordingly.
- Interruption or incorrect termination of the loading process causes the controller to be no longer functional. It is possible, however, to reload the operating system.

The operating system for the processor system (processor operating system) must be loaded before that for the communication system (communication operating system).

Operating systems for controllers differ from those for remote I/Os.

A new operating system can only be loaded, if previously stored in a directory accessible to the programming tool.

i

The current operating system versions of modules are displayed in the SILworX Control Panel. The type label specifies the delivered module version.

To load the new operating system

1. Set the controller to the STOP state, if this has not yet been done.
2. Open the online view of the hardware and log in to the controller with administrator rights.
3. Right-click the module (processor or communication module) to be loaded
4. The context menu appears. Click **Maintenance/Service->Load Module Operating System**.
5. In the *Load Module Operating System* dialog box, select the type of firmware that should be loaded.
6. A dialog box for selecting a file appears. Select the file with the operating system that should be loaded and click **Open**.

► SILworX loads the new operating system into the controller.

Appendix

Glossary

Term	Description
AI	Analog input
AO	Analog output
ARP	Address resolution protocol, network protocol for assigning the network addresses to hardware addresses
COM	Communication module
CRC	Cyclic redundancy check
DI	Digital input
DO	Digital output
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
FB	Fieldbus
FBD	Function block diagrams
HW	Hardware
ICMP	Internet control message protocol, network protocol for status or error messages
IEC	International electrotechnical commission
Interference-free	Inputs are designed for interference-free operation and can be used in circuits with safety functions
MAC	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 variable is read out
R/W	Read/Write (column title for system variable type)
r_P	Peak value of a total AC component
SC/OC	Short-circuit/open-circuit
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
SNTP	Simple network time protocol (RFC 1769)
SRS	System.Rack.Slot, addressing of a module
SW	Software
TMO	Timeout
W	Write, the variable receives a value, e.g., from the user program
WD	Watchdog, device for monitoring the system's correct operation Signal for fault-free process
WDT	Watchdog time

Index of Figures

Index of Tables

MANUAL
Maintenance Manual

HI 800 455 E

For further information, please contact:

HIMA Paul Hildebrandt GmbH
Albert-Bassermann-Str. 28
68782 Brühl, Germany

Phone +49 6202 709-0
Fax +49 6202 709-107
E-mail info@hima.com

Learn more about HIMatrix online:

https://www.hima.com/en/products-services/himatrix/

www.hima.com