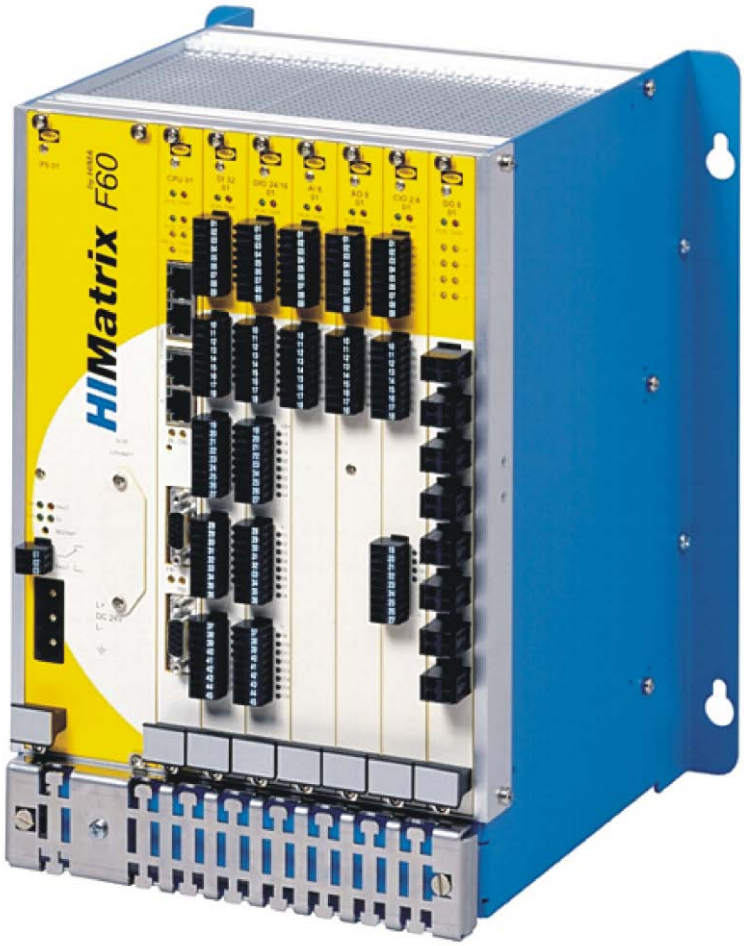
HIMatrix

Safety-Related Controller

CPU 03 Manual



HIMA Paul Hildebrandt GmbH

Industrial Automation

Rev. 2.00

HI 800 479 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`.

Contact

HIMA contact details:

HIMA Paul Hildebrandt GmbH

P.O. Box 1261

68777 Brühl, Germany

Phone: +49 6202 709-0

Fax: +49 6202 709-107

E-mail: info@hima.com

Revision index	Revisions	Type of change	
		technical	editorial
1.00	First edition of the manual	X	X
2.00	Revised: Figure 2 and Table 5 Added: CPU 034, SIL 4 certified according to EN 50126, EN 50128 and EN 50129	X	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 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 number
HIMatrix System Manual Modular System F60	Hardware description of the HIMatrix modular system	HI 800 191 E
HIMatrix Safety Manual	Safety functions of the HIMatrix system	HI 800 023 E
HIMatrix Safety Manual for Railway Applications	Safety functions of the HIMatrix system using the HIMatrix in railway applications	HI 800 437 E
SILworX Communication Manual	Description of the communication protocols, ComUserTask and their configuration in SILworX	HI 801 101 E
SILworX Online Help	Instructions on how to use SILworX	-
SILworX First Steps	Introduction to SILworX using the HIMax system as an example	HI 801 103 E

Table 1: Additional Relevant Documents

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

1.2 Target Audience

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

1.3 Formatting Conventions

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

Bold	To highlight important parts. Names of buttons, menu functions and tabs that can be clicked and used in the programming tool.
Italics	For parameters and system variables
`Courier`	Literal user inputs
RUN	Operating state are designated by capitals
Chapter 1.2.3	Cross references are hyperlinks even though 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.

This 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 [1]
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

[1] The values specified in the technical data apply and are decisive for devices with extended environmental requirements.

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 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 system is a part of the safety equipment of a site. If a device or a module fails, the system enters the safe state.

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

3 Product Description

The **CPU 03** module is the central component of the HIMatrix F60 controller.

The module can only be inserted in the slot located on the right, next to the power supply module of the HIMatrix F60 subrack. It is used to store the operating system and the user program, and executes all central functions, including communication with the PADT and other systems. It monitors the operating voltage and operating temperature.

The controller is available in various model variants, see Table 3.

The configuration is performed using SILworX, see Chapter 4.4.

The module is suitable for sequence of events recording (SOE), see Chapter 4.3. The module supports multitasking and reload. For more details, refer to the system manual for the modular F60 system (HI 800 191 E).

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

The module is TÜV-certified for safety-related applications up to SIL 3 (IEC 61508, IEC 61511 and IEC 62061), Cat. 4 and PL e (EN ISO 13849-1) and SIL 4 (EN 50126, EN 50128 and EN 50129).
Further safety standards, application standards and test standards are specified in the certificates available on the HIMA website.

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

3.1 Safety Function

The CPU monitors the sequence and the proper, logical execution of the operating system and user program. The following functions are time monitored:

- CPU hardware and software self-tests
- CPU RUN cycle (including the user program)
- I/O tests and processing of I/O signals

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

3.2 Equipment, Scope of Delivery

The following table specifies the available module variants:

Designation	Description
CPU 03 SILworX	Central module, Operating temperature: 0...+60 °C, for SILworX programming tool
CPU 034 SILworX	Central module, Operating temperature: -25...+70 °C (temperature class T1), Vibration and shock tested according to EN 50125-3 and EN 50155, class 1B according to IEC 61373, for SILworX programming tool

Table 3: Available Variants

3.2.1 IP Address and System ID (SRS)

A transparent label is delivered with the device to allow one to note the IP addresses of the CPU and the COM and the system ID (SRS for system rack slot) after a change.

Default value for IP address of the CPU: 192.168.0.99

Default value for IP address of the COM: 192.168.0.100

Default value for SRS: 60 000.0.0

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
- Bar code (1D or 2D code)
- Part no.
- Production year
- Hardware revision index (HW Rev.)
- Firmware revision index (FW Rev.)
- Operating voltage
- Mark of conformity

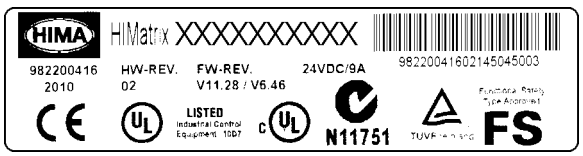
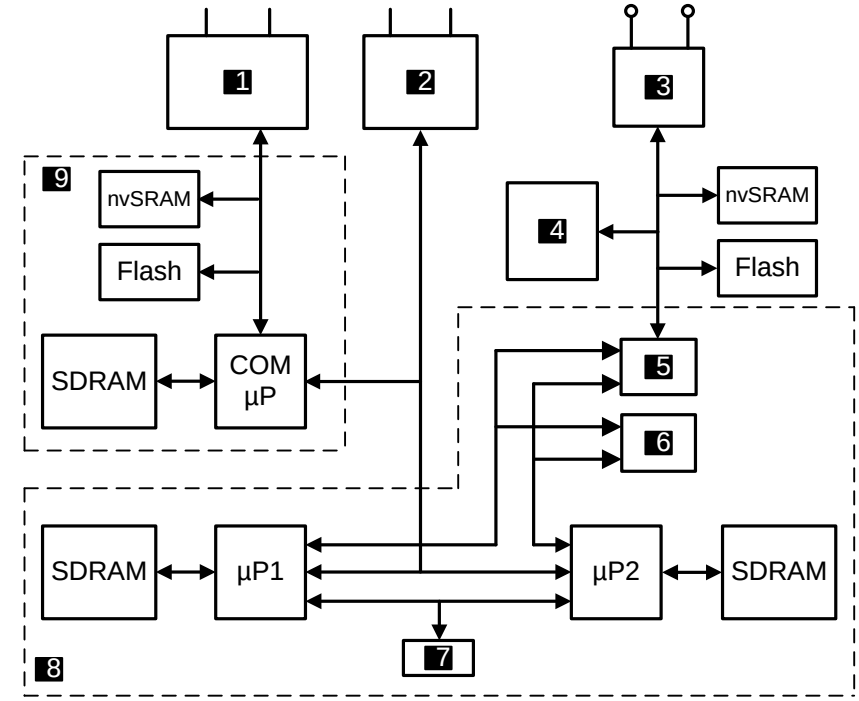


Figure 1: Sample Type Label

3.4 Assembly

This chapter describes the layout and function of the plug-in module, and its communication via safe**ethernet**.

3.4.1 Block Diagram



1 Fieldbus Interfaces
2 Ethernet Interfaces
3 I/O-Bus Module
4 V_{cc} and Temperature Monitoring
5 Comparator
6 Watchdog
7 Real Time Clock
8 Safety-Related Processor System (CPU)
9 Communication System

Figure 2: Block Diagram

3.4.2 Front View

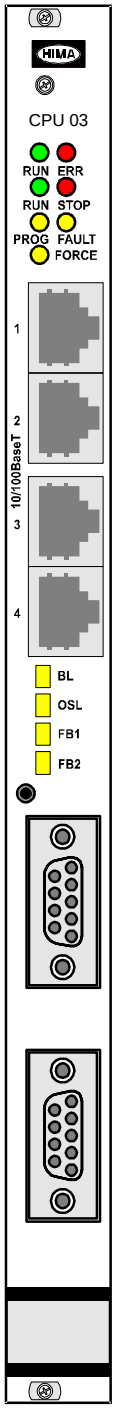


Figure 3: Front View CPU 03

3.4.3 LED Indicators

The light-emitting diodes (LEDs) indicate the operating state of the device. The LEDs are classified as follows:

- § System LEDs
- § Program LEDs
- § Communication LEDs
- § Fieldbus 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
Blinking-x	Ethernet communication: Blinking synchronously with data transfer

Table 4: Blinking Frequencies of LEDs

3.4.3.1 System Light Emitting Diodes

While the controller is being booted, all LEDs are lit simultaneously.

LED	Color	Status	Description
RUN	Green	On	Controller in STOP or RUN, normal operation
		Blinking1	A new operating system is being loaded.
		Off	The controller is not in the RUN state.
ERR	Red	On	Missing license for additional functions (communication protocols, reload), test mode.
		Blinking1	§ The controller is in the ERROR STOP state. Internal system faults 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 § Fault while loading the operating system.
		Off	No faults detected.

Table 5: System Light Emitting Diodes

3.4.3.2 Program Light Emitting Diodes

While the controller is being booted, all LEDs are lit simultaneously.

LED	Color	Status	Description
RUN	Green	On	The controller is in the RUN state. The user program is in the RUN or FREEZE state.
		Blinking1	§ The controller is in the OPERATE state. § A new operating system is being loaded.
		Off	Controller is in none of the states described.
STOP	Red	On	Controller in the STOP / VALID CONFIGURATION state
		Blinking1	§ Controller in the STOP / INVALID CONFIGURATION state § A new operating system is being loaded.
		Off	Controller is in none of the states described.
PROG	Yellow	On	§ The controller is being loaded with a new configuration. § A new operating system is being loaded. § WDT or safety time change § Check for duplicate IP address § SRS change
		Blinking1	§ Reload is being performed § 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 controller is in the RUN or STOP state.
		Blinking1	§ 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.
FAULT	Yellow	Blinking1	§ The new operating system is corrupted (after OS download). § Fault while loading a new operating system § The loaded configuration is not valid. § One or multiple I/O faults occurred. § A duplicate IP address was detected. [1)] § PROFINET has received an identify request. [1)]
		Off	None of the described faults occurred.
OSL	Yellow	Blinking1	§ Operating system emergency loader active. § A duplicate IP address was detected. [1)] § PROFINET has received an identify request. [1)]
		Off	None of the described events occurred.
BL	Yellow	Blinking1	§ OS and OSL binary defective or INIT_FAIL hardware fault. § Fault in the external process data communication § A duplicate IP address was detected. [1)] § PROFINET has received an identify request. [1)]
		Off	None of the described events occurred.
[1)] If all the LEDs PROG, FORCE, FAULT, OSL and BL are blinking simultaneously.			

Table 6: Program Light Emitting Diodes

3.4.3.3 Communication LEDs

All RJ-45 connectors are provided with a small green and a yellow LEDs. The LEDs signal the following states:

LED	Status	Description
Green	On	Full duplex operation
	Blinking1	IP address conflict, all communication LEDs are blinking
	Blinking-x	Collision
	Off	Half duplex operation, no collision
Yellow	On	Connection available
	Blinking1	IP address conflict, all communication LEDs are blinking
	Blinking-x	Interface activity
	Off	No connection available

Table 7: Ethernet Indicators

3.4.3.4 Fieldbus LEDs

LEDs FB1…2 are used to display the state of communication occurring via the serial interfaces. The function of the LED depends on the used protocol.

Refer to the SILworX communication manual (HI 801 101 E) for more details on the function of the LEDs.

3.4.4 Operating System

The operating system loaded into the CPU contains all basic functions of the HIMatrix 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 system manual for the modular F60 system.

3.4.5 User Program

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

3.4.6 Communication

The Ethernet interfaces and fieldbus interfaces of the CPU 03 module are used to communicate with external systems.

The controller communicates with remote I/Os via safe**ethernet**. Characteristics and configuration of safe**ethernet** are described in the SILworX communication manual (HI 801 101 E).

i When configuring safety-related communication, observe the instructions specified in the SILworX communication manual.

3.4.6.1 Connections for Ethernet Communication

Property	Description
Ports	4 x RJ-45
Transfer standard	10BASE-T/100BASE-Tx, half and full duplex
Auto negotiation	Yes
Auto crossover	Yes
IP address	Freely configurable[1)]
Subnet mask	Freely configurable[1)]
Supported protocols	§ Safety-related: safe**ethernet,** PROFIsafe § Standard protocols: Programming and debugging tool (PADT), OPC, Modbus TCP, TCP SR, SNTP, ComUserTask, PROFINET
[1)] The general rules for assigning IP address and subnet masks must be adhered to.	

Table 8: Connections for Fieldbus Communication

The 4 RJ-45 connectors with integrated LEDs are located on the front plate of the module. Refer to Chapter 3.4.3.3 for a description of the LEDs' function.

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

The CPU and COM have their own MAC addresses. The MAC addresses of the module are specified on the label on the rear side of the printed circuit board. The first MAC address applies for the CPU module on the CPU 03, the second for the COM module. The COM MAC address corresponds to the CPU MAC address, except for the last byte which is increased by 1.

Example:

CPU MAC address: 00.E0.A1.00.06.C0

COM MAC address: 00.E0.A1.00.06.C1

3.4.6.2 Network Ports Used for Ethernet Communication

UDP ports	Use
123	SNTP (time synchronization between PES and remote I/O, PES and external devices)
502	Modbus salve (can be modified by the user)
6010	safe**ethernet** and OPC
6005 / 6012	If TCS_DIRECT was not selected in the HH network
8000	Programming and operation with SILworX
8004	Configuration of the remote I/O using the PES (SILworX)
34 964	PROFINET endpoint mapper (required for establishing the connection)
49 152	PROFINET RPC server
49 153	PROFINET RPC client

Table 9: Network Ports (UDP Ports) in Use

TCP ports	Use
502	Modbus salve (can be modified by the user)
xxx	TCP SR assigned by the user

Table 10: Network Ports (TCP Ports) in Use

i The ComUserTask can use any port if it is not already used by another protocol.

3.4.6.3 Connections for Fieldbus Communication

The 2 9-pole D-sub connectors can be accessed through the front plate of the module.

The fieldbus interfaces FB1 and FB2 can be equipped with fieldbus submodules. The fieldbus submodules are optional and must be mounted by the manufacturer. The available fieldbus submodules are described in the SILworX communication manual (HI 801 101 E).

The fieldbus interfaces are not operational without fieldbus submodule.

3.4.7 Reset Key

The device is equipped with a reset key. The key is only required if the user name or password for administrator access is not known. If only the set device IP address does not match the PADT (PC), the connection can be established with a `Route add` entry on the PC.

i Only the model variants without protective lacquer are equipped with a reset key.

The key can be accessed through a small round hole located on the front plate. The key is engaged using a suitable pin made of insulating material to avoid short-circuits within the device.

The reset is only effective if the device is rebooted (switched off and on) while the key is simultaneously engaged for at least 20 s. Engaging the key during operation has no effect.

⚠ CAUTION

Fieldbus communication may be disturbed!

Prior to switching on the device with the reset key engaged, all device fieldbus connectors must be unplugged to ensure that the fieldbus communication among other stations is not disturbed.

The fieldbus plugs may only be plugged in again when the device is in the RUN or STOP state.

Properties and behavior of the device after a reboot with engaged reset key:

- Connection parameters (IP address and system ID) are set to the default values.
- All accounts are deactivated except for the default account administrator with empty password.
- Loading a user program or operating system with default connection parameters is inhibited! The loading procedure is only allowed after the connection parameters and the account have been configured on the device and the device has been rebooted.

After a new reboot without the reset key engaged, the connection parameters (IP address and system ID) and accounts become effective.

- Those configured by the user.
- Those valid prior to rebooting with the reset key engaged, if no changes were performed.

3.4.8 Monitoring the Operating Voltage

The CPU 03 central module monitors the 24 VDC operating voltage of the HIMatrix F60; 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 11: 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	
Total program and data memory for all user programs	5 MB less 64 kBytes for CRCs
Response time	[3] 6 ms
Ethernet interfaces	4 x RJ-45, 10BASE-T/100BASE-Tx (at 100 Mbit/s) with integrated switch
Fieldbus interfaces	2 x 9-pole D-sub FB1 and FB2 with fieldbus submodule pluggable
Operating voltage	24 VDC, -15 %...+20 %, r_P £ 15 %, provided by a power supply unit with safe isolation, in accordance with IEC 61131-2 requirements.
Operating data	3.3 VDC / 1.5 A 5 VDC / 0.1 A
Buffer for date/time	Gold capacitor
Ambient temperature	0...+60 °C
Storage temperature	-40...+85 °C
Space requirement	6 RU, 4 HP
Weight	280 g

Table 12: Product Data

3.5.1 Product Data F60 CPU 034

The F60 CPU 034 model variant is intended for use in railway applications. The electronic components are coated with a protective lacquer.

F60 CPU 034	
Operating temperature	-25…+70 °C

Table 13: Product Data F60 CPU 034

The controller F60 CPU 034 meets the conditions for vibrations and shock test according to EN 61373, category 1, class B.

3.6 Certified HIMatrix F60 CPU 03

HIMatrix F60 CPU 03	
CE	EMC
TÜV	IEC 61508 1-7:2010 up to SIL 3 IEC 61511:2004 EN ISO 13849-1:2008 IEC 62061:2005 EN 50156-1:2004 EN 298:2003 EN 230:2005
PROFIBUS Nutzerorganisation (PNO)	Test Specification for PROFIBUS DP Slave, Version 3.0 November 2005
TÜV CENELEC	Railway applications EN 50126: 1999 up to SIL 4 EN 50128: 2001 up to SIL 4 EN 50129: 2003 up to SIL 4

Table 14: Certificates

Further safety standards and application standards are specified in the certificate. The 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 Installation and Mounting

The module is mounted in the subrack of the modular HIMatrix F60 system.

4.1.1 Mounting and Removing the Modules

To mount and remove the modules, the connection cable clamp terminals must be unplugged.

Additionally, personnel must be protected from electrostatic discharge. For details, refer to Chapter 2.1.2.

Mounting the Modules

To mount a module into the subrack

1. Insert the module as far as it can go – without jamming it – into the two guiding rails which are located on the housing's upper and lower part.
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 upper and lower extremity of the front plate.

The module is mounted.

Removing the Modules

To remove a module from the subrack

1. Remove the plugs from the module front plate.
2. Release the locking screws located on the upper and lower extremity 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.

4.2 Numbering of Slots

Slots 1 and 2 on the F60 subrack are reserved for the PS 01 power supply module and CPU module, respectively. Any type of I/O modules can be plugged in to slots 3...8.

The module slots in SILworX are numbered as follows:

Module	Slot on the rack	Slot in SILworX
PS 01	1	-
CPU/COM	2	0/1
I/O	3	2
I/O	4	3
I/O	5	4
I/O	6	5
I/O	7	6
I/O	8	7

Table 15: Module Slots

i
- The PS 01 power supply module is not configured.
- CPU and COM are both on the F60 CPU 03 module. In the programming tool SILworX, however, they are represented as separated items.

4.3 Sequence of Events Recording (SOE)

The global variables of the controller can be monitored using sequence of events recording. Global variables to be monitored are configured using SILworX, see the online help and the SILworX communication manual (HI 801 101 E). Up to 4000 events can be configured.

An event is composed of:

Entry data	Description
Event ID	The event ID is assigned by the PADT.
Timestamp	Date (e.g., 21/11/2008) Time (e.g., 9:31:57.531)
Event state	Alarm/Normal (Boolean event) LL, L, N, H, HH (scalar event)
Event quality	Quality good/ Quality bad, see www.opcfoundation.org

Table 16: Event Description

Events are recorded within the cycle of the user program. The processor system uses global variables to create the events and stores them in its non-volatile event buffer.

The event buffer includes 1000 events. If the event buffer is full, an overflow system event entry is created. Thereafter, events are no longer recorded until existing events have been read and space is once again available in the event buffer.

4.4 Configuration with SILworX

The SILworX Hardware Editor represents the modular HIMatrix F60 system as a subrack with the following modules:

§ one processor module (CPU)
§ one communication module (COM)

Double-click the module to open the Detail View with the corresponding tabs.

i Refer to the safety manual for the HIMatrix system for more details on how to configure the processor module for safety-related operation.

Processor module system parameters such as *Fan State*, *Power Supply State*, *Temperature State* can be evaluated in the user program by assigning them to variables in the SILworX detail view for the HIMatrix F60, refer to the system manual for the modular F60 system for more details.

4.4.1 Processor Module

The following tables present the parameters for the processor module (CPU) in the same order as given in the Hardware Editor. The tabs **Module** and **Routings** tabs for the processor module and the communication module are identical.

4.4.1.1 Tab **Module**

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

Parameter	Description
Name	Module name
Activate Max. µP Budget for HH Protocol	§ Activated: Use CPU load limit from the *Max. µP Budget for HH Protocol [%]* field. § Deactivated: Do not use the CPU Load limit for safe**ethernet**. Default setting: Deactivated
Max. µP Budget for HH Protocol [%]	Maximum CPU load of module that can be used for processing the safe**ethernet** protocols. i The maximum load must be distributed among all the implemented protocols that use this communication module.
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 the system login. Default setting: Deactivated
Default Gateway	IP address of the default gateway. Default value: 0.0.0.0

Parameter	Description
ARP Aging Time [s]	A processor or COM module stores the MAC addresses of the communication partners in a MAC/IP address assignment table (ARP cache). If in a period of 1x....2x *ARP Aging Time ...* § ... messages of the communication are received, the MAC address remains stored in the ARP cache. § ... no messages of the communication partner are received, the MAC address is erased from the ARP cache. The typical value for the *ARP Aging Time* in a local network ranges from 5...300 s. The user cannot read the contents of the ARP cache. Range of values: 1...3600 s Default value: 60 s If routers or gateways are used, the user must adjust (increase) the *ARP Aging Time* due to the additional time required for two-way transmission. If the *ARP Aging Time* is too low, the processor or the COM module deletes the MAC address of the communication partner from the ARP cache and the communication is either delayed or breaks down entirely. For an efficient performance, the *ARP aging time* value must be less than the receive timeout set for the protocols in use.
MAC Learning	MAC Learning and *ARP Aging Time* are used to set how quick the Ethernet switch should learn the MAC address. The following settings are possible: § 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 one *ARP Aging Time* and a maximum of two *ARP Aging Time* 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 *Tolerant* setting must be used if the availability of communication is more important than the authorized access to the controller. Default setting: Conservative
IP Forwarding	Allow a processor module to operate as router and to forward data packets to other network nodes. Default setting: Deactivated

Parameter	Description
ICMP Mode	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. Message types of Internet Control Message Protocol (ICMP) supported by the processor module: § 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. Default setting: Echo Response

Table 17: CPU and COM Configuration Parameters, **Module** Tab

4.4.1.2 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 18: Routing Parameters of the CPU and COM

4.4.1.3 Tab **Ethernet Switch**

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

Parameter	Description
Name	Name of the port (Eth1...Eth4) 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 *Advertising* function (forwarding the speed and flow control properties) is also performed if the parameters *Speed* and *Flow Control* have fixed values. This allows other devices with ports set to *Autoneg* to recognize the HIMax 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 19: Ethernet Switch Parameters

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

For configuring the use of port-based VLAN.

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

For each port on one switch, the user can define which other ports of the switch received Ethernet frames may be sent to, refer to Figure 2.
The table in the VLAN tab contains entries through which the connection between two ports can be set as active or inactive.

	Eth1	Eth2	Eth3	Eth4	COM
Eth1					
Eth2	Active				
Eth3	Active	Active			
Eth4	Active	Active	Active		
COM	Active	Active	Active	Active	
CPU	Active	Active	Active	Active	Active

Table 20: **VLAN** Tab

4.4.1.5 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.

LLDP uses the following values depending on whether PROFINET is configured on the communication module.

PROFINET on the COM module	ChassisID	TTL (Time to Live)
Used	Device name	20 s
Not used	MAC address	120 s

Table 21: Values for LLDP

The processor and communication modules support LLDP on the Eth1, Eth2, Eth3 and Eth4 ports

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: Send/Receive

4.4.1.6 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/Egress	Incoming and outgoing data of this port are duplicated.
Dest Port	This port is used to send duplicated data.

Default setting: OFF

4.4.2 Communication Module

The communication module contains the **Module** tab and the **Routings** tab. Their content is identical to those of the processor module, see Table 17 and Table 18.

5 Operation

The module runs within a HIMatrix subrack and does not require any specific monitoring.

5.1 Handling

Handling of the controller during operation is not required.

5.2 Diagnosis

A first diagnosis results from evaluating the LEDs, see Chapter 3.4.3.

The device diagnostic history can also be read using SILworX.

6 Maintenance

No maintenance measures are required during normal operation.

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

Only the manufacturer is authorized to repair the device or 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 device and the outputs switch to the de-energized, safe state. The evaluation of diagnostics provides information on 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.

A module may only be replaced while the power is switched off.

i Modules may not be removed or inserted during operation.

The instructions specified in Chapter 4.1.1 must be observed when replacing an existing module or installing a new one.

6.2 Maintenance Measures

The following measures are required for the device:

§ Loading the operating system, if a new version is required

§ Executing the proof test

6.2.1 Loading the Operating System

HIMA is continuously improving the operating system of the devices. HIMA recommends to use system downtimes to load a current version of the operating system into the devices.

Refer to the release list to check the consequences of the new operation system version on the system!

The operating system is loaded using the programming tool.

Prior to loading the operating system, the device must be in STOP (displayed in the programming tool). Otherwise, stop the device.

For more information, refer to the programming tool documentation.

6.2.2 Proof Test

HIMatrix devices and modules must be subjected to a proof test in intervals of 10 years. For more information, refer to the safety manual (HI 800 023 E).

7 Decommissioning

Remove the supply voltage of the PS 01 supply module to decommission the module. Afterwards pull out the pluggable screw terminal connector blocks for inputs and outputs and the Ethernet cables.

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
ELOP II Factory	Programming tool for HIMatrix systems
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 or ELOP II Factory
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)
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/signal is provided with value, e.g., from the user program
r_{PP}	Peak-to-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

Index of Figures

Index of Tables

Index

HIMA Paul Hildebrandt GmbH
P.O. Box 1261
68777 Brühl, Germany
Phone: +49 6202 709-0
Fax: +49 6202 709-107
E-mail: info@hima.com Internet: www.hima.com

(1334)