HIMA

SMART SAFETY.

Manual

HIQuad®X

F-IOP 01

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HI 803 218 D, Rev. 1.00 (1825)	German original document
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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 the Document

The content of this manual is part of the hardware description of the HIQuad X programmable electronic system.

This manual contains the following main chapters:

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

Additionally, the following documents must be taken into account:

Document	Content	Document no.
HIQuad X system manual	Hardware description of the HIQuad X system	HI 803 211 E
HIQuad X safety manual	Safety functions of the HIQuad X system	HI 803 209 E
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 Applicable Manuals

The current manuals can be obtained upon request by sending an e-mail to: documentation@hima.com. The documentation is available for registered HIMA customers in the download area https://www.hima.com/en/downloads/.

1.2 Target Audience

This document is aimed at the planners, design engineers and programmers of automation systems as well as the persons authorized to start up, operate and maintain the devices and systems concerned. Specialized knowledge of safety-related automation systems is required.

1.3 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 particularly marked. When the cursor hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position.

Safety notices and operating tips are particularly marked.

1.3.1 Safety Notices

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 situations 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.

⚠ SIGNAL WORD

Type and source of risk!

Consequences arising from non-observance.

Risk prevention.

NOTICE

Type and source of damage!

Damage prevention.

1.3.2 Operating Tips

Additional information is structured as presented in the following example:

i	The text giving 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. Use in the Ex zone is only permitted if additional measures are taken.

2.1 Intended Use

HIQuad X components are designed for assembling safety-related controller systems.

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

2.1.1 Environmental Requirements

All the environmental conditions specified in this manual must be observed when operating the HIQuad X system. The environmental requirements are listed in the product data.

2.1.2 ESD Protective Measures

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

NOTICE

Damage to the HIQuad X system 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 components are protected from electrostatic discharge, e.g., by storing them in their packaging.**

2.2 Residual Risk

No imminent risk results from a HIMA system itself.

Residual risk may result from:

- Faults related to engineering.
- Faults in 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 HIMA system is a part of the safety equipment of a plant. If the controller fails, the system enters the safe state.

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

3 Product Description

The F-IOP 01 I/O processing module is intended for use in the programmable electronic system (PES) HIQuad X.

Tasks of I/O processing modules include:

- Communicating with the processor modules in the base rack via both system buses.
- Providing the connection to the processor modules and other I/O processing modules.
- Administrating the I/O bus of the rack where the module is located.
- Providing the input values of the I/O modules within the rack.
- Setting the output values of the I/O modules within the rack.
- Providing the watchdog signal for the output modules.
- Testing the I/O modules within the rack.
- Indicating the system, fault and communication states of the I/O processing module and of the I/O modules within the rack.

I/O processing modules within the HIQuad X system communicate with the processor modules in the base rack via the two safety-related system buses. Additionally, the I/O processing module manages the I/O bus of the rack in which it is located. The I/O bus is used to exchange process data between I/O modules and the I/O processing module within one rack.

The module can only be used in slot 13 of the H41X base rack (F-BASE RACK 02, K 1422) and in slot 17 of the extension rack (F-BASE RACK 11, K 1406).

The I/O processing modules cannot be wired redundantly. If redundancy is required, it must be implemented using a redundant extension rack. For an overview of the different HIQuad X system concepts, refer to the system manual (HI 803 211 E).

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 Cat. 4 and PL e (EN ISO 13849-1).

Refer to the HIMA website and the HIQuad X safety manual (HI 803 209 E) for more information on the standards used to test and certify the module and the HIQuad X system.

3.1 Safety Function

The safety function of the module includes the following points:

- Secure transmission of the input values to the processor modules.
- Secure transmission of the output values to the output modules.
- Safe shutdown of the rack if a fault occurs.

The safety function is performed in accordance with SIL 3.

3.1.1 Response in the Event of a Fault

If a failure occurs on a system bus, the bus connection is ensured via the redundant system bus, provided that both system buses have been previously configured.

For mono operation, the redundant system bus is not available.

If a disturbance affects the I/O bus, no process data are transmitted. The I/O level is no longer available to the system.

If a module fault occurs in the I/O processing module, the I/O level is switched off and is no longer available to the system.

If the fault occurs in the associated I/O module, the I/O processing module responds shutting down the affected I/O module or rack:

- Shutting down the faulty modules:
  - If the output modules fail, the outputs are de-energized.
  - If the input modules fail, the failsafe default value is transmitted to the user program.
- Shutting down the rack: All the output modules in the affected rack enter the safe, de-energized state. The failsafe default values are transmitted for the input modules.

The module reports faults through the LEDs on the front plate.

3.2 Scope of Delivery

The module includes 3 dummy plugs. For details on how to use the dummy plugs, refer to Chapter 4.2.1.

3.3 Type Label

The type label specifies the following important details:

- Product name
- Mark of conformity
- Part no.
- Serial number
- Hardware revision index (HW-Rev.)
- Operating system revision index (OS-Rev.)
- Ex specifications (if applicable)
- Production year (Prod-Year:)

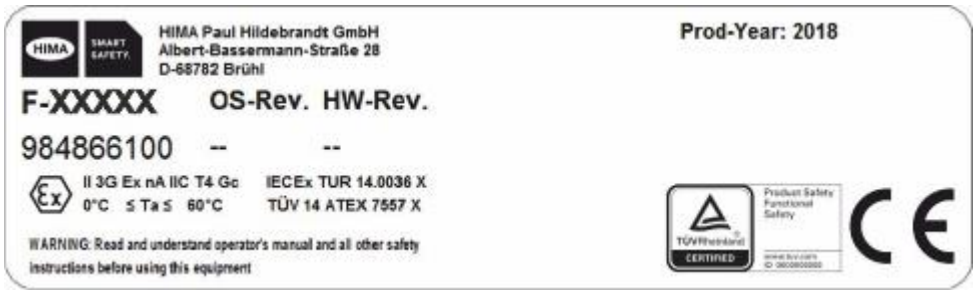


Figure 1: Sample Type Label

3.4 Structure

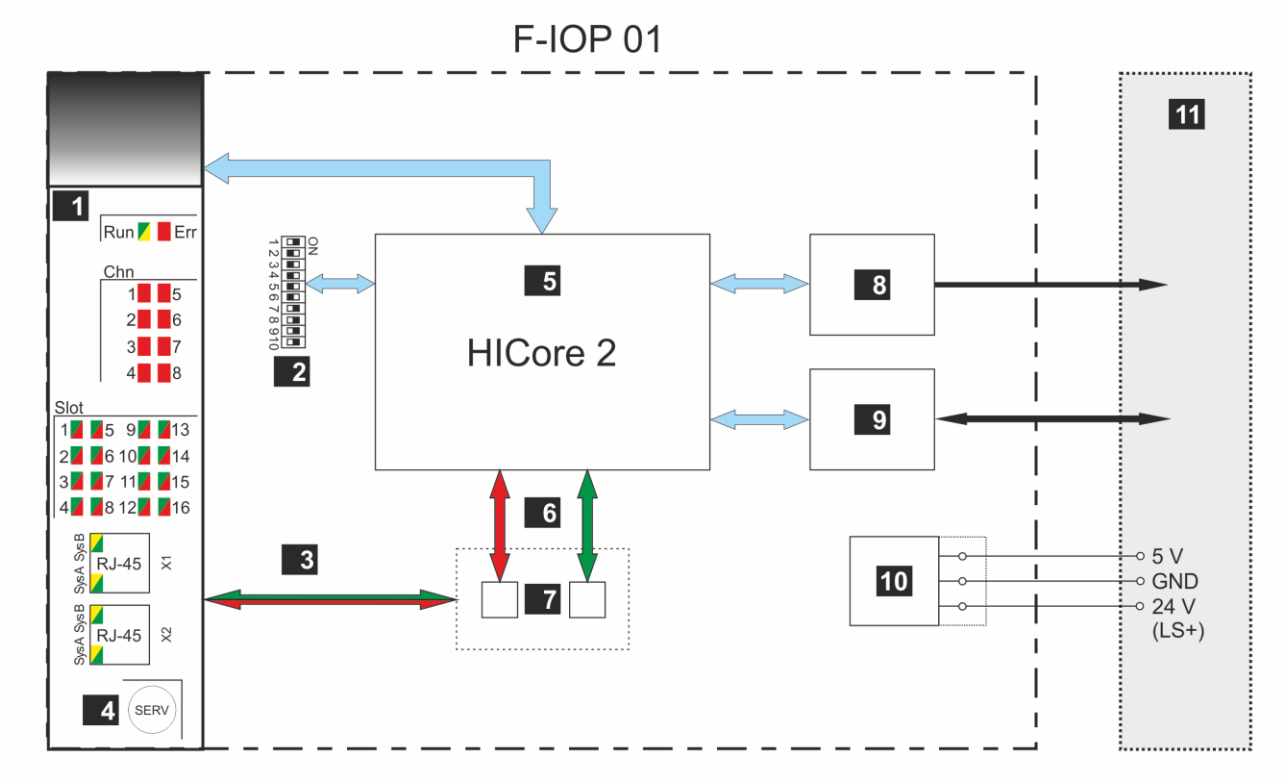
The I/O processing module is a plug-in module that is inserted into a rack and supplied with electric power.

Essential functional units of the module are:

- Safety-related processor system.
- Ethernet switches.
- System bus interfaces, see Chapter 3.4.3.
- Service push-button, see Chapter 3.4.3.
- DIP switch for rack ID, see Chapter 3.4.2.
- Indicators, see Chapter 3.4.2.

3.4.1 Block Diagram

The following block diagram illustrates the structure of the module.



1 Front plate
2 DIP switch for rack ID
3 System bus A and/or system bus B
4 SERV push-button
5 Safety-related processor system
6 System bus A and system bus B
7 Switches of system bus A and system bus B
8 Watchdog
9 I/O bus connection
10 Power supply
11 Rack

Figure 2: Block Diagram

3.4.2 Indicators

The following figure shows the front view of the module with the LEDs and both Ethernet connection sockets.

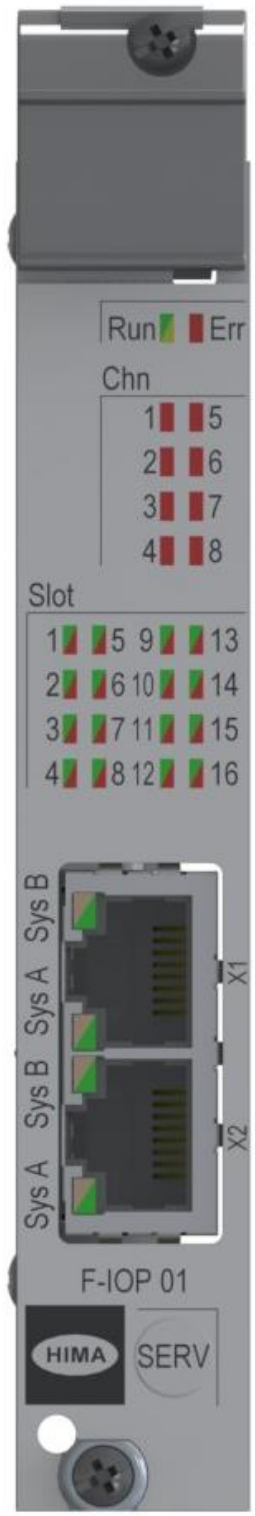


Figure 3: Front View

Additionally, the SERV push-button is located on the front plate.

The LEDs indicate the operating state of the module. All LEDs should be considered together. The LEDs on the module are divided into the following groups:

- System status indicators (Run, Err)
- Channel indicators (Chn 1…8)
- Slot indicators (Slot 1…16)
- System bus indicators (Sys A, Sys B)

After connecting the supply voltage, an LED test is performed and all the LEDs are lit for at least 2 s. The color of two-color LEDs changes once during the test.

Definition of blinking frequencies

The following table defines the blinking frequencies:

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

Table 2: Blinking Frequencies of the LEDs

Some LEDs can report warnings (On) and faults or errors (Blinking1), see the following tables. The indication of errors or faults has priority over the indication of warnings. Warnings cannot be reported if errors or faults are being signaled.

3.4.2.1 System Status Indicators

The LEDs of the system status indicators are located above the channel indicators.

LED	Color	Status	Description
RUN	Green	On	Module in the RUN state, normal operation.
	Yellow	On	The module is in one of the following states: ▪ Module state: STOP / VALID CONFIGURATION. ▪ The emergency loader is active.
		Blinking1	The module is in one of the following states: ▪ STOP / INVALID CONFIGURATION. ▪ STOP / LOADING OS. ▪ INIT / OutOfGroup. ▪ LOCKED.
Err	Red	On	System warning, for example: ▪ Temperature warning.
		Blinking1	System error, for example: ▪ Internal module faults detected by self-tests, e.g., hardware or voltage supply faults. ▪ System configuration error. ▪ I/O module fault (the I/O watchdog is open). ▪ Error while loading the operating system. ▪ The emergency loader is active.
		Off	No faults detected.

Table 3: System Status Indicators

3.4.2.2 Channel Indicators

The channel indicator LEDs are labeled *Chn*.

LED	Color	Status	Description
1…8	Red	On	Internal channel fault (system fault).
		Blinking1	External channel fault (field fault).
		Blinking2	The service mode is active (all the channel indicator LEDs are blinking). Take the slot indicator LEDs into account.
		Off	The module is in one of the following states: ▪ No faults detected on this channel. ▪ Transition to service mode or exit from service mode. Take the slot indicator LEDs into account. ▪ A warning is present for at least one I/O module. The warning for the affected I/O modules is signaled via the slot indicators.

Table 4: Channel Indicators

3.4.2.3 Slot Indicators

The slot indicator LEDs are labeled *Slot*.

LED	Color	Status	Description
1…16	Green	On	The I/O module in this slot returns no errors or warnings.
		Blinking1	The user was requested to activate or deactivate the service mode for the rack. The I/O module in this slot returns no errors or warnings.
		Blinking2	The service mode is active: The I/O module in this slot returns no errors or warnings. All the channel indicator LEDs return Blinking2.
	Red	On	The module is in one of the following states: ▪ The I/O module in this slot returns errors or warnings. Take the channel indicator LEDs into account. ▪ SERV push-button pressed: When the SERV button is pressed, all the slot indicators are lit red and the channel indicators are off. This indication is effective for a maximum of 2 s if the SERV push-button is permanently pressed.
		Blinking1	The module is in one of the following states: ▪ The channel indicators display information on external or internal faults and warnings concerning the I/O module in this slot. ▪ Transition to service mode or exit from service mode. The I/O module in this slot returns an error or a warning.
		Blinking2	The service mode is active: The I/O module in this slot returns an error or a warning. All the channel indicator LEDs return Blinking2.
	Off	Off	The module is in one of the following states: ▪ No I/O module is configured for the slot. ▪ The module is in the STOP state.

Table 5: Slot Indicators

3.4.2.4 System Bus Indicators

The system bus indicator LEDs are labeled *Sys A* and *Sys B*. Each of the two Ethernet connection sockets X1 and X2 includes the system bus indicators for both system buses, see Figure 3.

LED	Color	Status	Description
Sys A, Sys B	Green	On	Logical and physical connection to the redundancy group.
		Blinking1	Transient disturbances on the system bus.
	Yellow	On	The registration of the rack ID in the matching group was successful and a logical connection has been established.
		Blinking1	There is only a physical connection to a system bus subscriber, but no registration in the matching group yet.
		Blinking2	There is a physical connection to a system bus subscriber, but it is improperly configured.
	Off	Off	There is no connection to another system bus subscribers device.

Table 6: System Bus Indicators

3.4.3 System Bus Interfaces

The I/O processing module communicates with the processor modules via the system buses.

The system bus interfaces connect the I/O processing module to the processor modules in the base rack or to other I/O processing modules. Patch cables complying with Ethernet standard (at least Cat. 5e in accordance with IEEE 802.3) must be used to connect the system buses. The maximum length of the patch cable between two system bus subscribers is 50 m.

The I/O processing module is equipped with 2 RJ-45 sockets. Each socket is used to route both system bus connections (A and B).

The RJ-45 interfaces may only be used for the system bus connections. No active elements, e.g., switches, (z. B Switches) may be connected to the system bus.

System bus Interfaces	
Number	2
Transfer Rate	100 Mbit/s, full duplex
Connection socket	RJ-45
Labeling	▪ X1: Sys A, Sys B. ▪ X2: Sys A, Sys B.

Table 7: Specifications for the System Bus Interfaces

During mono operation, only one system bus is available.

During redundancy operation, both system buses are available. **Both** system buses between the I/O processing modules operates in parallel via **one** patch cable. To increase availability, the two system buses can be routed to separate patch cables using a standard Ethernet Y adapter. Only one system bus connection (A or B) is routed between a processor module and an I/O processing module via each patch cable.

Pin assignment of system bus interfaces X1 and X2:

Pin	Signal	Description
1	RXP	System bus A, RX+ (receive+)
2	RXN	System bus A, RX- (receive-)
3	TXP	System bus A, TX+ (send+)
4	RXP	System bus B, RX+ (receive+)
5	RXN	System bus B, RX- (receive-)
6	TXN	System bus A, TX- (send-)
7	TXP	System bus B, TX+ (send+)
8	TXN	System bus B, TX- (send-)

Table 8: Pin Assignment X1 and X2

3.4.4 Service Mode

The service mode allows the user to replace I/O modules during operation. The service mode must be activated to replace I/O modules. When the service mode is active, I/O module faults requiring that the I/O level is shut down, are suppressed. The system issues a warning for the affected rack. This warning is signaled via the rack connection indicators.

i If the service mode is active, the second shutdown option (via the I/O watchdog) is blocked! This option cannot be used to put the output modules in the safe state.

The service mode must be activated or deactivated separately for each rack. The service mode is either activated or deactivated using the service push-button (SERV) on the front side of the I/O processing module or via a PADT command.

The service mode stops automatically 24 h after activation, unless it was manually deactivated beforehand. If the service mode is deactivated, all the I/O modules in the safe state are restarted. If the I/O modules report an error after the restart, the I/O processing module uses the I/O watchdog (second shutdown option) to place the rack in the safe state.

If the user triggers the deactivation, the service mode remains active until the replaced I/O modules have been initialized and none of them requires that the rack is shut down, or until it is automatically deactivated after 24 h.

3.4.4.1 The SERV Push-Button

The SERV push-button is located on the front plate below the system bus connectors and next to the HIMA logo, see Figure 3. The function of the SERV push-button can be deactivated via a system parameter, see Table 13. Afterwards, the service mode can only be activated or deactivated through a PADT command.

To activate or deactivate the service mode, the SERV push-button must be pressed for at least 2 s and no longer than 7 s.

Activating the Service Mode

Observe the following points when activating the service mode:

- If the SERV push-button is pressed, the I/O processing module lights the LEDs for no longer than 2 s to indicate that the push-button has been used. All *Slot* LEDs are lit red to signalize On and all *Chn* LEDs are off.
- If the SERV push-button is pressed for longer than 2 s, the I/O processing module lights the LEDs to indicate the transition phase until the service mode is activated. All *Slot* LEDs are lit green to signalize Blinking1 for I/O modules with no fault or warning, are lit red to signalize Blinking1 for I/O modules with faults or warning and all *Chn* LEDs are off.
- If the SERV push-button is pressed for longer than 7 s, the I/O processing module stops indicating the transition phase. The service mode does not change (not activated).

Deactivating the Service Mode

Observe the following points when deactivating the service mode:

- If the SERV push-button is pressed, the I/O processing module lights the LEDs for no longer than 2 s to indicate that the push-button has been used. All *Slot* LEDs are lit red to signalize On and all *Chn* LEDs are off.
- If the SERV push-button is pressed for longer than 2 s, the I/O processing module lights the LEDs to indicate the transition phase until the service mode is deactivated. All *Slot* LEDs are lit green to signalize Blinking1 for I/O modules with no fault or warning, are lit red to signalize Blinking1 for I/O modules with faults or warning and all *Chn* LEDs are off.

  All I/O modules that need user intervention are initialized. The service mode remains active as long as at least one I/O module is being initialized or an I/O module reports a fault. After 24 h, the system deactivates the service mode.

- If the SERV push-button is pressed for longer than 7 s, the I/O processing module stops indicating the transition phase. The service mode does not change (activated).

3.4.4.2 Sequence for Replacing Modules

To replace a module in service mode

1. Press the SERV push-button or use the PADT command **Start Service Mode** to activate the service mode. When doing so, consider that the SERV push-button could have been deactivated via the *Deactivate service mode push-button* system parameter.
2. See the LEDs on the I/O processing module to check if the service mode is active.
3. Replace the module.
4. Press the SERV push-button or use the PADT command **Quit Service Mode** to deactivate the service mode. When doing so, consider that the SERV push-button could have been deactivated via the *Deactivate service mode push-button* system parameter.
5. The replaced modules are automatically initialized. If a fault that would could the I/O level to shut down occurs during initialization, the I/O processing module remains in service mode. In such a case, the faulty modules can once again be replaced (step 3 et seqq.) or a new attempt can be made (step 4) to quit the service mode.
6. The service mode stops when all the I/O modules have been completely initialized without errors.

3.4.5 DIP Switches

The I/O processing module is equipped with a 10-pole DIP switch. The rack ID of the rack where the I/O processing module is inserted is set on the DIP switch. The following figure shows the DIP switch with the switch position at delivery.

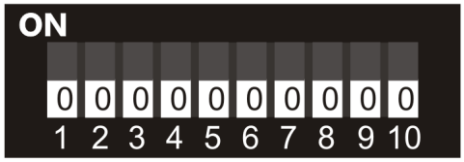


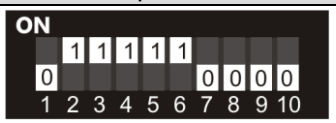
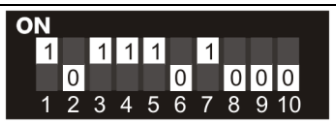
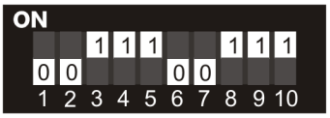
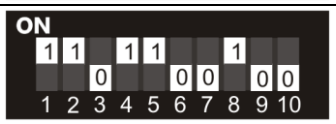
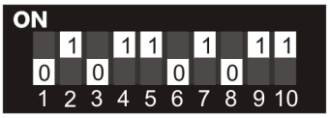
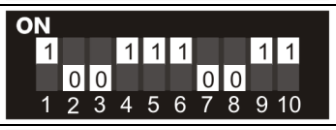
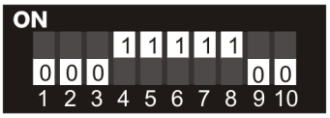
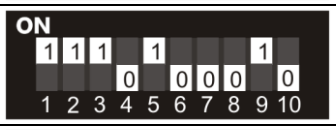
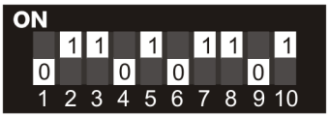
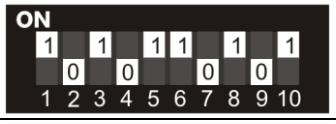
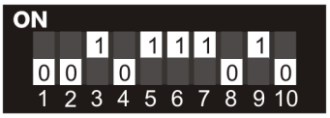
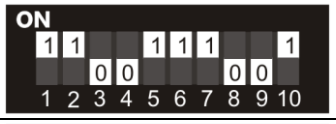
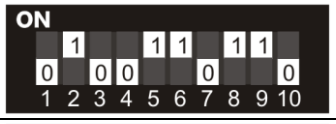
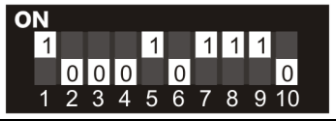
Figure 4: 10-Pole DIP Switch

A unique rack ID that matches the configuration in SILworX must be allocated to each rack. The system checks if the set rack ID matches the configuration in SILworX. If this is not true, the module enters the STOP/INVALID CONFIGURATION state.

The DIP switch can only be set if the I/O processing module has been removed.

3.4.5.1 H51X Rack ID

The following table shows the permitted positions for the DIP switch on H51X:

Rack ID	DIP switch position
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	

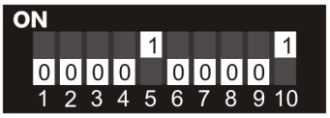
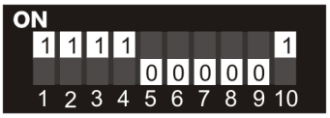
Rack ID	DIP switch position
15	
16	

Table 9: Rack ID Settings in H51X

Observe the following points when assigning the rack ID:

- No I/O processing module is inserted in the base rack of H51X. The base rack has rack ID 0. The rack ID in SILworX is preset and cannot be modified.
- The rack ID assignment for the extension racks must match the configuration in SILworX.

3.4.5.2 H41X Rack ID

The following table shows the permitted positions for the DIP switch on H41X:

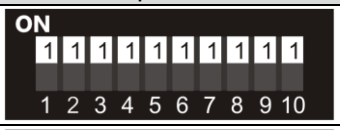
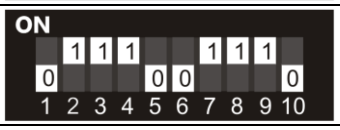
Rack ID	DIP switch position
1	
2	

Table 10: Rack ID Settings in H41X

Observe the following points when assigning the rack ID:

- The base rack of H41X has rack ID 1. The rack ID in SILworX is preset and cannot be modified.
- The extension rack of H41X has rack ID 2. The rack ID in SILworX is preset and cannot be modified.
- The rack ID assignment for the racks must match the configuration in SILworX.

3.4.6 Monitoring the Supply Voltage

The power supplies (F-PWR 01) monitor the values of the 24 V supply voltage (L1+/L1-, L2+/L2-) and 5 V supply voltage of the HIQuad X system, refer to the F-PWR 01 manual (HI 803 225 E) for details. The voltage values and the monitoring results are provided to the processor module F-CPU 01 via the infobus.

System variables can be used to evaluate the state of the supply voltage in the user program. For details on the system variables, refer to the system manual (HI 803 211 E).

The I/O processing module monitors its 5 V supply voltage and tests it for undervoltage and overvoltage.

Additionally, the I/O processing module monitors and tests its internal voltages. Faults in the internal voltages cause the module to reboot. The communication with the processor module is interrupted.

Status and voltage values are entered in the diagnostics, see Table 14.

3.4.7 Monitoring the Watchdog Supply Voltage LS+

The I/O processing module monitors the 24 V supply voltage (LS+) of the watchdog signal for undervoltage. Undervoltage is reported as a warning via the *Module Status* system parameter, see Table 13.

If the application requirements include uninterrupted function for short interruptions of > 2 ms, observe the following points:

- If the I/O processing module is located in an F-BASE-RACK 11 extension rack (K 1406), the watchdog supply voltage (LS+) must be provided from the F-PWR 02 buffer module. The F-PWR 02 buffer module bridges voltage dropouts of up to 10 ms. If the application requires uninterrupted function for 10 ms, the user must implement suitable measures to buffer the watchdog supply voltage LS+.
- If the I/O processing module is located in an H41X base rack (F-BASE RACK 02, K 1422), the user must implement suitable measures to buffer the watchdog supply voltage LS+..
- The F-BASE-RACK 11 extension rack (K 1406) and the H41X base rack (F-BASE RACK 02, K 1422) include connectors for the watchdog supply voltage (LS+). Only power supply units of type SELV or PELV may be used to supply the watchdog.

3.4.8 Temperature Monitoring

Sensors continuously measure the temperature of the modules.

The temperature state of a module indicates whether the temperature thresholds have been exceeded with respect to the following ambient temperature ranges:

Temperature thresh-old	Temperature state	*Temperature State [X]* [BYTE]
≤ 40 °C	Normal	0x00
> 40 °C	Warning: Threshold 1 exceeded.	0x01
> 60 °C	Error: Threshold 2 exceeded.	0x03

Table 11: Temperature State

If the temperature exceeds a specific threshold or falls below it, the temperature state changes.

Table 11 applies when the HIQuad X system with the system fan is running in normal operation. Depending on the module slot in the rack and its power dissipation, the system variable *Temperature State [X]* may be activated below the specified temperature thresholds. The system variables can be evaluated in the user program. For details on the system variables, refer to the system manual (HI 803 211 E).

In case of abnormal operation, e.g., without fans, the temperature state can indicate that the temperature thresholds have been exceeded even at a lower ambient temperature.

Status and measured temperature are recorded in the diagnostics, see .Table 14

The user must implement suitable measures to ensure that the ambient temperature limits specified for the system are met.

3.5 Product Data

General	
Current consumption	< 700 mA at 5 VDC < 500 mA at 24 VDC (watchdog)
Microprocessor	HIMA HICore 2
Protection class	Protection class III in accordance with IEC/EN 61131-2.
Ambient temperature	0...+60 °C
Transport and storage temperature	-40...+70 °C
Humidity	Max. 95 % relative humidity, non-condensing
Pollution	Pollution degree II in accordance with IEC/EN 60664-1
Altitude	< 2000 m
Degree of protection	IP20
Space requirement	4 HP
Weight	Approx. 150 g

Table 12: Product Data

4 Start-Up

This chapter describes how to install and configure the module.

The module is started up by inserting it into a permissible base rack slot, see Chapter 4.1.1.

Inserting and removing the module under voltage is possible, but may result in the following undesirable effects:

- Malfunction of the I/O processing module.
- Increased wear on the backplane bus plugs and sockets.
- Malfunction of the I/O modules inserted in the affected rack.
- Increased power consumption of the rack due to malfunction of the I/O modules.

4.1 Mounting

Observe the following points when mounting the module:

- The module is intended for use within a HIQuad X system. For more information on how to structure the system, refer to the HIQuad X system manual (HI 803 211 E).
- Only operate the processor module in the permissible slot, see Chapter 4.1.1.
- Modifications or extensions to the system wiring must be performed by personnel with knowledge of ESD protective measures.

NOTICE

Electrostatic discharge!

Failure to comply with these instructions can destroy the module.

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

- Effects due to EMC influences:

  Exposing the module to environmental influences other than those specified in the manual may lead to malfunctions or even the destruction of the module.

NOTICE

Damage to the controller or system malfunction possible!

Only expose the modules to permissible environmental influences, see Chapter 3.5.

4.1.1 Permitted Slots

The following points must be observed when assigning the slots to the I/O processing module, including the Hardware Editor:

- In the base rack of H41X (F-BASE-RACK 02, K 1422), the I/O processing module may only be inserted in slot 13.
- No I/O processing module may be used in the base rack of H51X (F-BASE-RACK 01, K 1421).
- In the F-BASE RACK 11 (K 1406) of the extension rack, the I/O processing module may only be inserted in slot 17.

4.2 Mounting and Removing the Module

This chapter describes how to mount and remove a module.

The following points must be adhered to when mounting and removing modules:

- Only use the module in the designated slot.
- When replacing modules, observe the instructions specified in the system manual (HI 803 211 E) and safety manual (HI 803 209 E).

i HIMA cannot be made liable for consequential loss caused by improperly removing and reinserting the modules.

NOTICE

Damage to bus and power sockets due to module jamming!

Failure to comply with these instructions can damage the controller.

Always insert the module in the base plate carefully.

Tools:

- Screwdriver, cross PH1.

Installation:

1. Ensure the rack ID settings on the DIP switch comply with the application and if not, adjust them accordingly.
2. Pull back as far as possible the fastening screws on the module's front plate.
3. Carefully insert the module into the guiding rail of the intended slot and push it in the rack as far as it can go.
4. With your thumbs, press the module on the extractor handle carefully, but quickly inwards as far as it can go.
5. Tighten the fastening screws of the module (max. 0.35 Nm).
6. Insert the patch cable.

► The module is mounted.

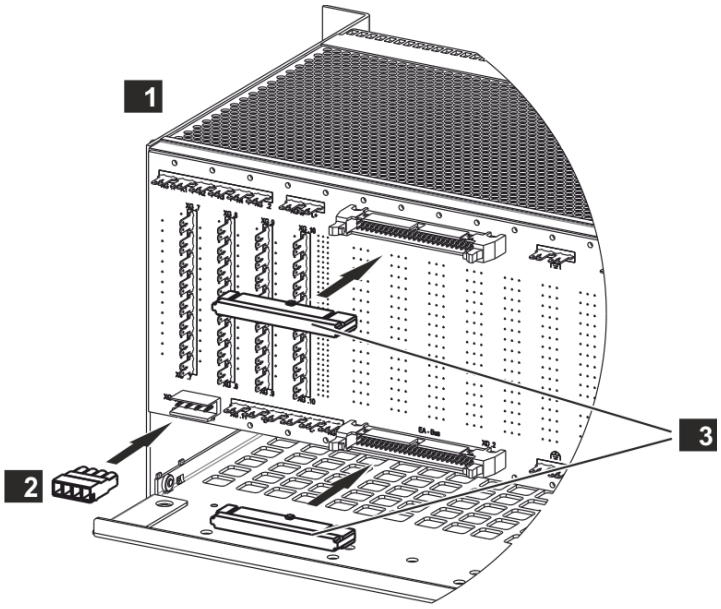
Removal:

1. Remove the patch cable.
2. Completely release the fastening screws from the module.
3. Completely push the extractor handle upwards to rapidly separate the module from the backplane. This avoids faulty signals.
4. Remove the module from the rack holding it by the extractor handle.

► The module is removed.

4.2.1 Mounting the Dummy Plugs

The module includes 3 dummy plugs. The dummy plugs on the rear of the F-BASE RACK 11 extension rack (K 1406) are used to mechanically lock the watchdog signal connector (XG.5) and the two I/O bus connectors (XD.1 and XD.2).



1 F-BASE-RACK 11 (K 1406)
2 Dummy plugs for watchdog connection
3 Dummy plugs for I/O bus connections

Figure 5: Mounting the Dummy Plugs

4.3 Configuring the Module in SILworX

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

When creating an extension rack in the Hardware Editor, the module is already inserted in slot 17.

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

The following tables present the system parameters for the module in the same order as in the SILworX Hardware Editor.

TIP A scientific calculator such as the Windows® calculator with the corresponding view can be used to convert hexadecimal values to bit strings.

4.3.1 The **Module** Tab

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

<table>
<tr><th>System parameters</th><th>Data type</th><th>S [1)]</th><th>R/W</th><th>Description</th></tr>
<tr><td>Diagnostic Request</td><td>DINT</td><td>N</td><td>W</td><td>To request a diagnostic value, the appropriate ID must be sent to the module using the parameter Diagnostic Request (for coding details, see Chapter 4.3.2).</td></tr>
<tr><td>Diagnostic Response</td><td>DINT</td><td>N</td><td>R</td><td>As soon as Diagnostic Response returns the ID of Diagnostic Request (for coding details, see Chapter 4.3.2), Diagnostic Status contains the diagnostic value requested.</td></tr>
<tr><td>Diagnostic Status</td><td>DWORD</td><td>N</td><td>R</td><td>Requested diagnostic value in accordance with Diagnostic Response.
The IDs of Diagnostic Request and Diagnostic Response can be evaluated in the user program. Diagnostic Status only contains the requested diagnostic value when both Diagnostic Request and Diagnostic Response have the same ID.</td></tr>
<tr><td>Module OK</td><td>BOOL</td><td>N</td><td>R</td><td>Module state:
TRUE: The I/O processing module did not detect any fault.
FALSE: Module fault, module in the STOP state or connection loss.</td></tr>
<tr><td>Module Status</td><td>DWORD</td><td>N</td><td>R</td><td>Status of the module
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x00000002</td><td>Temperature threshold 1 exceeded.</td></tr>
<tr><td>0x00000004</td><td>Temperature threshold 2 exceeded.</td></tr>
<tr><td>0x00000008</td><td>Incorrect temperature value.</td></tr>
<tr><td>0x00000010</td><td>The monitoring of the I/O watchdog supply voltage signals a warning.</td></tr>
<tr><td>0x00000040</td><td>Internal voltage is defective.</td></tr>
<tr><td>0x00000200</td><td>Error during the I/O watchdog test.</td></tr>
<tr><td>0x00000400</td><td>Error during the I/O bus test.</td></tr>
<tr><td>0x80000000</td><td>The module is in one of the following states:
▪ Module in the SyncLock status.
▪ No connection to the module.</td></tr>
</table></td></tr>
<tr><td>Restart on Error</td><td>BOOL</td><td>Y</td><td>W</td><td>Initiating the restart.
The module is restarted when TRUE changes to FALSE.</td></tr>
<tr><td>Restart on Error Required</td><td>BOOL</td><td>Y</td><td>R</td><td>The module is in a faulty state that needs a user intervention to restart the module.
TRUE: Restart by user is required.
FALSE: No user intervention required.
A restart is performed for all the I/O modules within this rack.</td></tr>
<tr><td>Service Mode Active</td><td>BOOL</td><td>Y</td><td>R</td><td>Service mode status:
TRUE: The service mode is active.
FALSE: The service mode is not active.</td></tr>
<tr><td>Service Mode Residual Time [s]</td><td>UDINT</td><td>N</td><td>R</td><td>Time in seconds indicating how long the service mode is still active before it automatically stops.</td></tr>
</table>

System parameters	Data type	S [1)]	R/W	Description
Deactivate service mode push-button	BOOL	Y	W	Triggering of the service mode using the SERV push-button can be prevented. TRUE: The SERV push-button is deactivated. The service mode can only be activated and deactivated through a PADT command. FALSE: The SERV push-button is activated.
Noise Blanking	BOOL	N	R	Status of background test noise blanking: TRUE: Background test noise blanking is active. A faulty test is repeated until it is successfully completed. FALSE: Background test noise blanking is not active.
Timestamp [µs]	UDINT	N	R	Microsecond fraction of the timestamp.
Timestamp [s]	UDINT	N	R	Second fraction of the timestamp.
[1)] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 13: The **Module** Tab in the Hardware Editor

4.3.2 Description of *Diagnostic Status*

The following table specifies the coding of the *Diagnostic Status* parameter:

ID	Description
0	Diagnostic values are indicated consecutively.
100	Bit-coded temperature status: 0 = normal. Bit0 = 1: Temperature threshold 1 has been exceeded. Bit1 = 1: Temperature threshold 2 has been exceeded. Bit2 = 1: Fault in temperature measurement.
101	Measured temperature (10 000 digits/ °C).
200	Bit-coded voltage status: 0 = normal. Bit0 = 1 : L1+ (24 V) is faulty. Bit26 = 1 : Overvoltage on 5 V supply voltage. Bit27 = 1 : Undervoltage on 5 V supply voltage.
201…205	Measurement of internal voltages.

Table 14: Coding for *Diagnostic Status*

5 Operation

The module is operated within a HIQuad X system. No specific monitoring is required.

5.1 Handling

The SERV push-button is located on the front plate of the I/O processing module. For details on how to operate the SERV push-button, refer to Chapter 3.4.4.

Additional handling of the module is not foreseen.

5.2 Diagnostics

LEDs on the front side of the module indicate the module state, see Chapter 3.4.2.

The I/O processing module includes a diagnostic memory. The diagnostic memory can be read out via a PADT connection to a processor module. The diagnostic memory can store up to 500 diagnostic messages for short-term diagnosis and 400 diagnostic messages for long-term diagnosis.

6 Maintenance

Defective modules must be replaced with a faultless module of the same type or with an approved replacement model.

Only the manufacturer is authorized to repair the module.

6.1 Maintenance Measures

6.1.1 Loading the Operating System

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

For detailed instructions on how to load the operating system, refer to the system manual (HI 803 211 E) and the online help. The module must be in the STOP state to be able to load an operating system.

i The module's operating system version can be read out via the SILworX Control Panel. The type label specifies the version when the module is delivered, see Chapter 3.3.

6.1.2 Proof Test

The proof test interval for HIQuad X modules must be in accordance with the interval required by the application-specific safety integrity level (SIL).

7 Decommissioning

To decommission the module, remove it from the base rack. For more details, refer to the Chapter *Mounting and Removing the Module*.

8 Transport

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

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

9 Disposal

Industrial customers are responsible for correctly disposing of decommissioned 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
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
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
Rack ID	Rack identification (number)
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

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