Manual

HIMax®

X-DO 12 01

Relay Module

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 801 022 D, Rev. 10.00 (1907)	German original document
HI 801 023 E, Rev. 10.00.00 (1920)	English translation of the German original document

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 HIMax 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.
HIMax system manual	Hardware description of the HIMax system	HI 801 001 E
HIMax safety manual	Safety functions of the HIMax system	HI 801 003 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. For registered HIMA customers, the product documentation is available at 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 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.

1.3.1 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 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.

1.3.2 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.

1.4 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 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.

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

HIMax components are designed for assembling safety-related controller systems.

When using the components in the HIMax 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 HIMax 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 HIMax 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 an overall system. 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 X-DO 12 01 relay module is intended for use in the programmable electronic system (PES) HIMax.

The module is equipped with 12 potential-free relay outputs with forcibly guided contacts. The relay outputs are suitable for connecting to ohmic and inductive loads.

The module is interference-free, in particular with respect to EMC, electrical safety, communication to the X-SB and X-CPU modules, and the user program.

The module can be inserted into any of the base plate slots except for the slots reserved for system bus modules.. Refer to the system manual (HI 801 001 E) for further details.

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).

3.1 Safety Function

The module performs its safety function using two safety relays that are connected in series and continuously monitored by the safety-related processor system. The contact outputs can be used for safety switch-off functions.

The safety function is performed in accordance with SIL 3.

3.1.1 Response in the Event of a Fault

If the safety-related processor system detects a module fault, the module adopts the safe state and all the outputs are de-energized in accordance with the 'de-energize to trip principle'. If a channel fault occurs, only the affected channel is switched off.

If the system buses fail, the outputs are de-energized.

The module activates the *Error* LED on the front plate.

3.2 Scope of Delivery

To operate, the module must be installed on a matching connector board. If a field termination assembly (FTA) is used, a system cable is required to connect the connector board to the FTA. Connector boards, system cables and FTAs are not included within the scope of delivery.

The connector boards are described in Chapter 3.7, the system cables are described in Chapter 3.8. The FTAs are described in separate manuals.

3.3 X-DO 12 01 Certification

Refer to the HIMax safety manual (HI 801 003 E) for more information on the standards used to test and certify the module and the HIMax system.

The certificates and the EU type test certificate are available on the HIMA website.

3.4 Type Label

The type label specifies the following important details:

- Product name
- Mark of conformity
- Bar code (2D or 1D code)
- Part number (Part-No.)
- Hardware revision index (HW-Rev.)
- Operating system revision index (OS-Rev.)
- Supply voltage (Power)
- Ex specifications (if applicable)
- Production year (Prod-Year:)

Figure 1: Sample Type Label

3.5 Structure

The module is equipped with 12 relay outputs. Each relay output is switched via two relays connected in series. After every cycle, the module reads the status of the forcibly guided contacts and compares its status with the output variables.

The relays have forcibly guided contacts (EN 50205) and can be used for safety switch-off functions. Forcibly guided contacts are mechanically connected to one another in such a way that make and break contacts cannot be closed simultaneously.

All 12 relay outputs are electrically safely separated from one another. Each relay output with its own contact circuit is safely separated from the voltage supply of the module. For protective separation, the air and creepage distances are designed for overvoltage category II up to 300 V in accordance with IEC 61131-2.

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

At least two monitored relays must be used to shut down the entire fuel supply safely. HIMA recommends performing the wiring such as specified in Chapter 4.4.3.

⚠ WARNING

Electrical shock, damage to the module!

The module is not designed for connecting three-phase current!

Only one phase can be connected to the X-DO 12 01 module. Connecting three-phase current is not permitted!

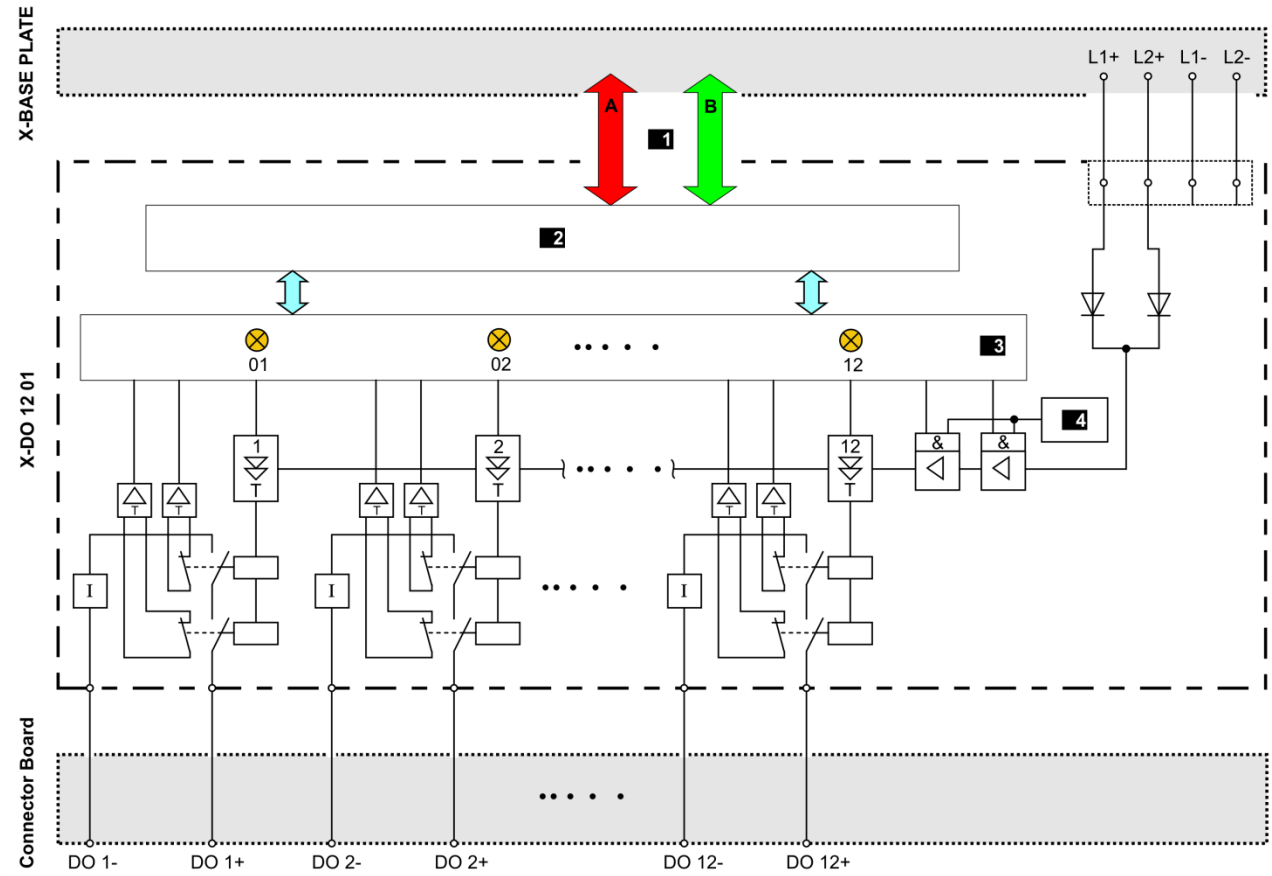
The 1oo2 processor system within the I/O module controls and monitors the I/O level. The data and states of the I/O module are provided to the processor modules via the redundant system bus. The system bus has a redundant structure for reasons of availability. Redundancy is only ensured if both system bus modules are inserted in the base plates and configured in SILworX.

LEDs on the indicator panel displaying the status of the relay outputs, see Chapter 3.5.2.

The module measures current on each channel (see Chapter 3.6.1) and issues a warning if the number of switching operations per channel exceeds 250,000.

3.5.1 Block Diagram

The following block diagram illustrates the structure of the module:



1 System buses
2 Safety-related processor system
3 Interface
4 Watchdog

Figure 2: Module's Block Diagram

3.5.2 Indicators

The following figure shows the front view of the module with the LEDs:

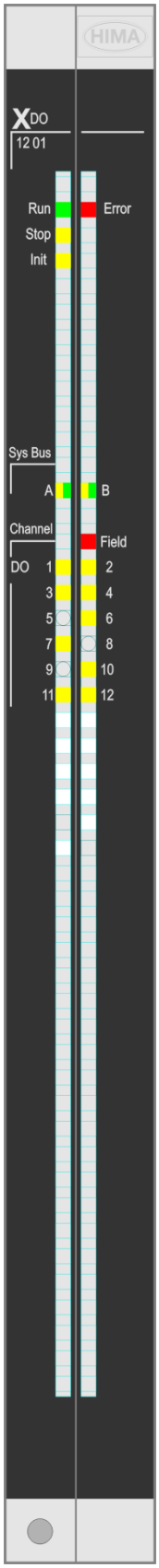


Figure 3: Indicators

The LEDs indicate the operating state of the relay module.

The LEDs on the module are divided into three groups:

- Module status indicators (Run, Error, Stop, Init)
- System bus indicators (A, B)
- I/O indicators (DO 1…12, Field)

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.

3.5.3 Module Status Indicators

These LEDs are located on the upper part of the front plate.

LED	Color	Status	Description
RUN	Green	On	Module in the RUN state, normal operation.
		Blinking1	Module state STOP / LOADING OS
		Off	Module not in the RUN state, observe the other status LEDs.
ERROR	Red	On	System warning, for example: ▪ No license for additional functions (e.g., communication protocols), test mode. ▪ Temperature warning
		Blinking1	System error, for example: ▪ Internal module faults detected by self-tests, e.g., hardware or voltage supply faults. ▪ Fault while loading the operating system.
		Off	No faults detected
STOP	Yellow	On	Module state STOP / VALID CONFIGURATION
		Blinking1	The module is in one of the following states: ▪ STOP / INVALID CONFIGURATION ▪ STOP / LOADING OS
		Off	Module not in the STOP state, observe the other status LEDs.
Init	Yellow	On	Module state: INIT
		Blinking1	The module is in one of the following states: ▪ LOCKED ▪ STOP / LOADING OS
		Off	Module is in none of the states described, observe the other status LEDs.

Table 3: Module Status Indicators

3.5.4 System Bus Indicators

The system bus indicator LEDs are labeled *Sys Bus.*

LED	Color	Status	Description
A	Green	On	Physical and logical connection to the system bus module in slot 1.
		Blinking1	No physical connection to the system bus module in slot 1.
	Yellow	Blinking1	The physical connection to the system bus module in slot 1 has been established. No connection to a (redundant) processor module running in system operation.
B	Green	On	Physical and logical connection to the system bus module in slot 2.
		Blinking1	No physical connection to the system bus module in slot 2.
	Yellow	Blinking1	The physical connection to the system bus module in slot 2 has been established. No connection to a (redundant) processor module running in system operation.
A+B	Off	Off	Neither physical nor logical connection to the system bus modules in slot 1 and slot 2.

Table 4: System Bus Indicators

3.5.5 I/O Indicators

The LEDs of the I/O indicators are labeled *Channel*.

LED	Color	Status	Description
DO 1… DO 12	Yellow	On	The corresponding channel is active (energized)
		Blinking2	Channel fault
		Off	The corresponding channel is not active (de-energized)
Field	Red	Blinking2	Without function!
		Off	

Table 5: I/O Indicators

3.6 Product Data

General	
Supply voltage	24 VDC, -15…+20 %, $r_p \leq 5$ % SELV, PELV
Current consumption	Max. 0.5 A
Current consumption of the module, all relay de-energized	0.36 A (24.0 VDC)
Current consumption of the module, all relay energized	0.48 A (24.0 VDC)
Galvanic separation of the channels	Yes
Module cycle time	2 ms
Protection class	Protection class II in accordance with IEC/EN 61131-2
Ambient temperature	0…+60 °C
Transport and storage temperature	-40…+85 °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
Dimensions (H x W x D)	310 x 29.2 x 230 mm
Weight	Approx. 1.6 kg

Table 6: Product Data

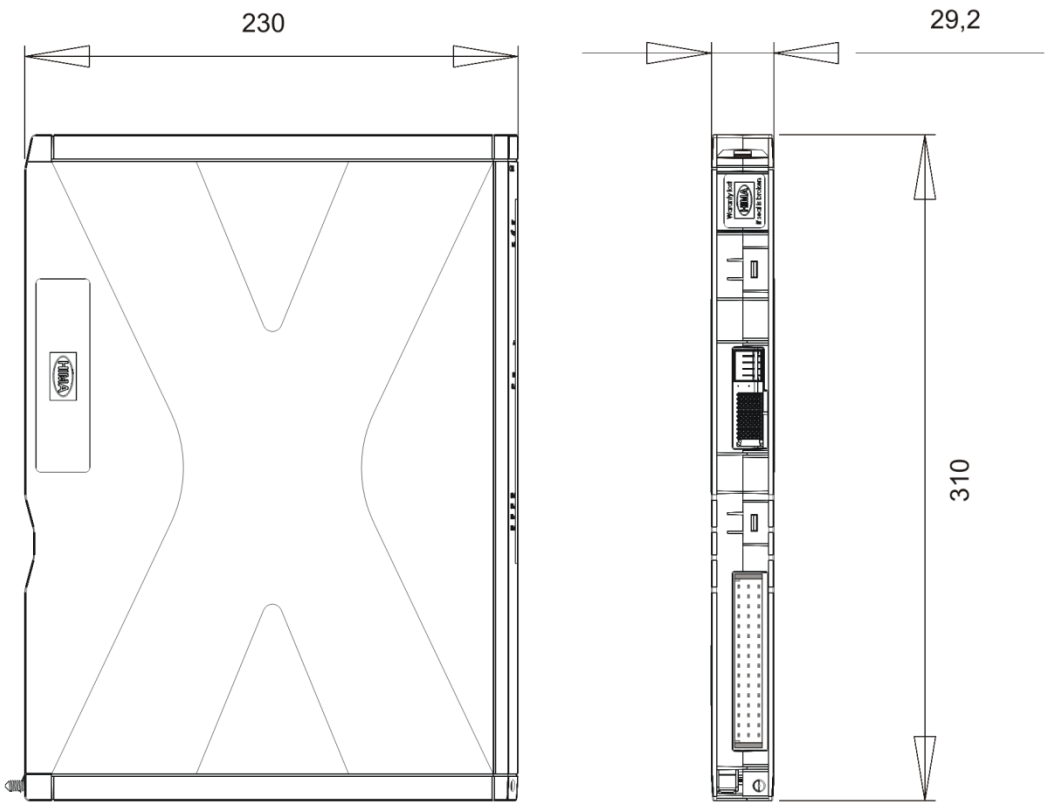


Figure 4: Views

Relay outputs	
Number of outputs (channels)	12, potential-free
Total switching current (all channels)	Max. 30 A
Switching voltage	5…250 V
Switching current per channel	5 mA…4 A
Switching frequency	Max. 4 Hz
Switching time (make contact closed)	10 ms
Reset time (break contact closed, without wiring)	3 ms
Make contact bounce time	2 ms
Contact material	AgCuNi + 0.2…0.4 µm Au
Lifetime ▪ mechanical ▪ electrical	 ≥ 10 x 10^6 switching operations ≥ 2.5 x 10^5 switching operations with ohmic full load

Table 7: Specifications for the Relay Outputs

		Standard applications	Standard applications	Burner applications in accordance with VDE 0116, EN 50156
Switching operations		< 100 000	< 250 000	< 250 000
Switching capacity DC (induction-free)	≤ 30 VDC	Max. 4.00 A	Max. 4.00 A	Fuse 3.15 A
	≤ 50 VDC	Max. 2.10 A	Max. 2.10 A	Fuse 1.25 A
	≤ 70 VDC	Max. 1.25 A	Max. 1.25 A	Fuse 0.63 A
	≤ 127 VDC	Max. 0.50 A	Max. 0.50 A	Fuse: 0.315 A
	≤ 250 VDC	Max. 0.28 A	Max. 0.25 A	Fuse 0.125 A
Switching capacity DC (ind. load tau = L/R = 40 ms)	≤ 30 VDC	Max. 0.80 A	Max. 0.50 A	Fuse: 0.315 A
	≤ 50 VDC	Max. 0.70 A	max. 0.40 A	Fuse 0.25 A
	≤ 70 VDC	Max. 0.32 A	Max. 0.20 A	Fuse 0.125 A
	≤ 127 VDC	Max. 0.19 A	Max. 0.12 A	Fuse 0.063 A
	≤ 250 VDC	Max. 0.10 A	Max. 0.06 A	Not specified
Switching capacity AC (induction-free)	≤ 125 VAC	Max. 4.00 A	Max. 3.00 A	Fuse 1.25 A
	≤ 250 VAC	Max. 4.00 A	Max. 1.50 A	Fuse 0.63 A
Switching capacity AC cos φ > 0.5	≤ 125 VAC	Max. 3.00 A	Max. 1.20 A	Fuse 0.63 A
	≤ 250 VAC	Max. 1.50 A	Max. 0.60 A	Fuse: 0.315 A

Table 8: Currents and Fuses

The table contains fuse values for burner applications and permissible maximum values for standard applications.

Fuse protection is mandatory for burner application contact circuits and HIMA strongly recommends employing fuse protection in standard applications.

3.6.1 Current Measurement

The module measures the current of each channel in intervals of 140 ms.

If two channels are interconnected in parallel, the current is divided across both channel. Only the current actually flowing through each channels is measured.

Current measurement	
Measurement interval	140 ms
Dead time after switching	100 ms
Nominal current	0…4 A
Digital value per mA	10 000
Resolution	10-bit
Intrinsic error DC	+/-5 % of full scale
Operating error DC	+/-7 % of full scale
Form factor	1.2 for sine waves
Intrinsic error AC	+/-7 % of full scale
Operating error AC	+/-9 % of full scale

Table 9: Current Measurement per Channel

3.7 Connector Boards

A connector board connects the module to the field level. Module and connector board together form a functional unit. Insert the connector board into the appropriate slot prior to mounting the module.

The following connector boards are available for the module:

Connector board	Description
X-CB 011 01	Connector board with screw terminals
X-CB 011 02	Redundant connector board with screw terminals
X-CB 011 03	Connector board with cable plug
X-CB 011 04	Redundant connector board with cable plug

Table 10: Available Connector Boards

Accessories	Description
X-CB COVER 01	Cover hood

Table 11: Connector Board Accessories

⚠ DANGER

Danger of electric shock!

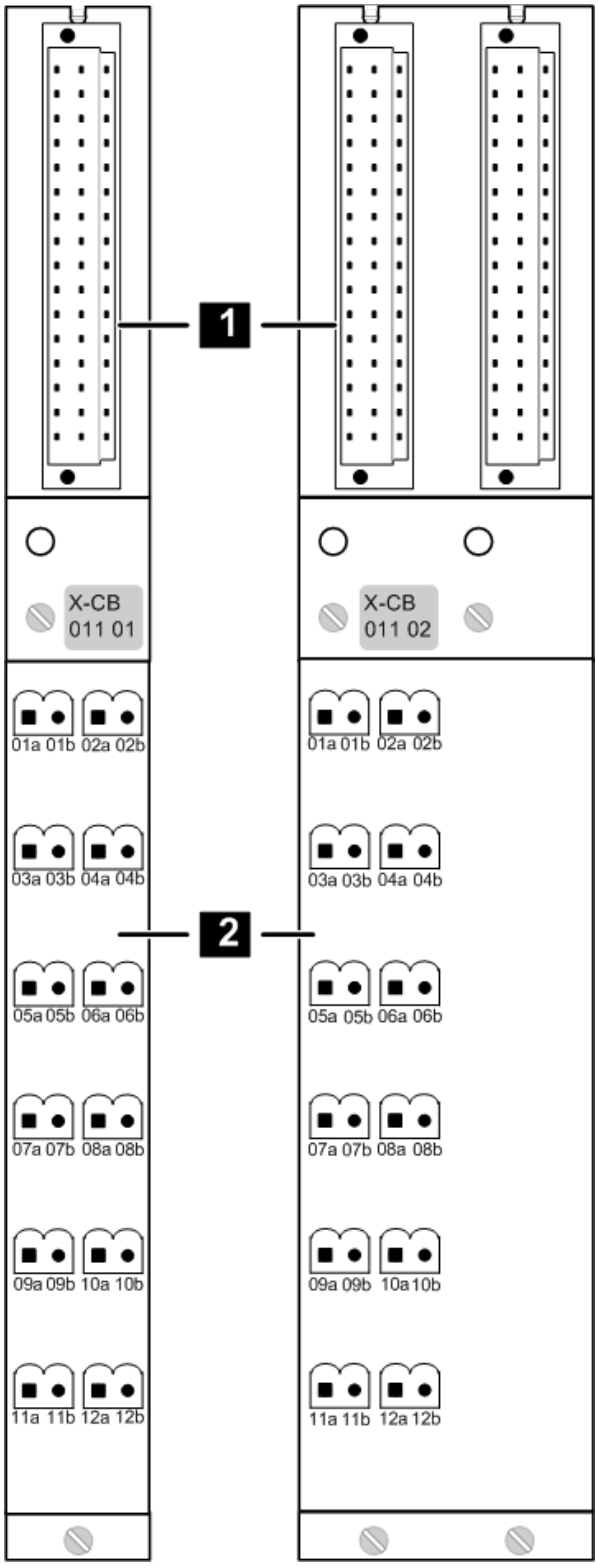
For connector boards with screw terminals: If the voltages exceed SELV, use the X-CB COVER 01 cover hoods or the X-FRONT COVER.

Observe all safety regulations!

3.7.1 Connector Boards with Screw Terminals

Mono **Redundant**

X-CB 011 01 X-CB 011 02



1 I/O module plug

2 Connection to the field level (screw terminals)

Figure 5: Connector Boards with Screw Terminals

3.7.2 Terminal Assignment for Connector Boards with Screw Terminals

Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	01a	DO1-	1	02a	DO2-
2	01b	DO1+	2	02b	DO2+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	03a	DO3-	1	04a	DO4-
2	03b	DO3+	2	04b	DO4+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	05a	DO5-	1	06a	DO6-
2	05b	DO5+	2	06b	DO6+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	07a	DO7-	1	08a	DO8-
2	07b	DO7+	2	08b	DO8+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	09a	DO9-	1	10a	DO10-
2	09b	DO9+	2	10b	DO10+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	11a	DO11-	1	12a	DO12-
2	11b	DO11+	2	12b	DO12+

Table 12: Terminal Assignment for Connector Boards with Screw Terminals

Cable plugs attached to the connector board pin headers are used to connect to the field level.

The cable plugs feature the following characteristics:

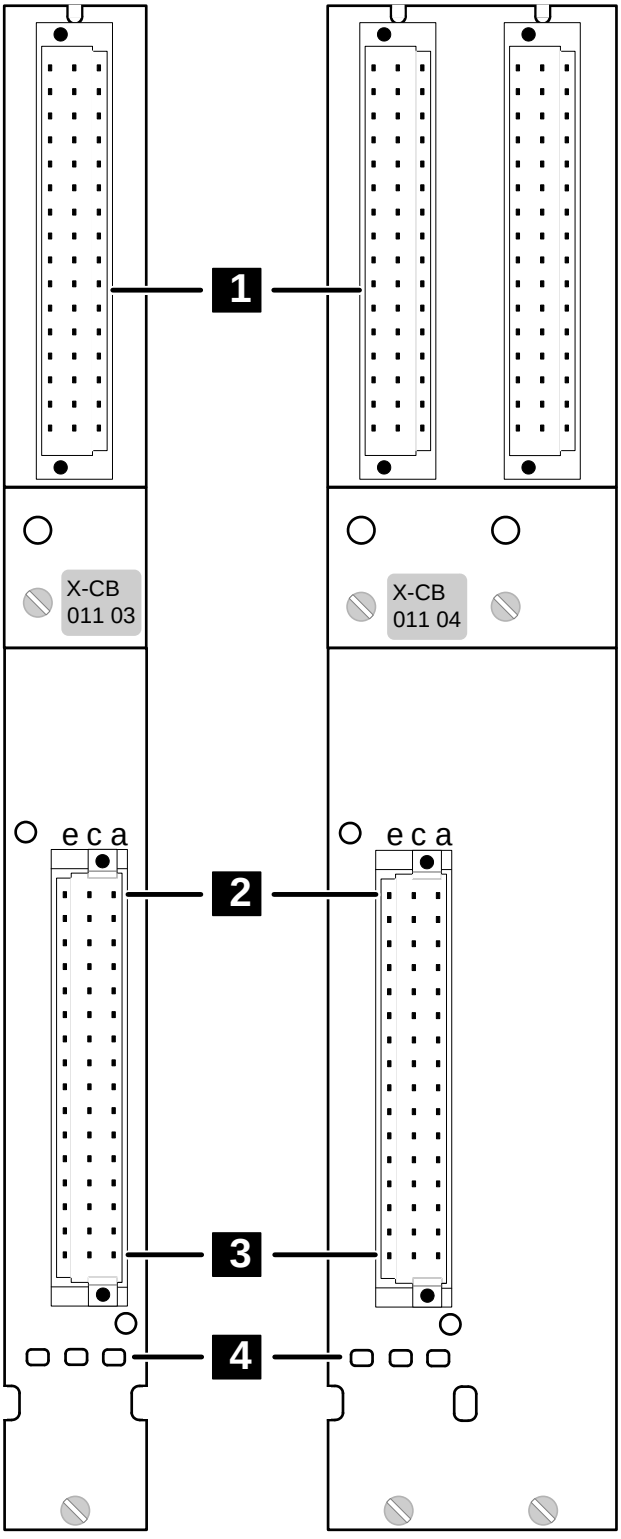
Connection to the field level	
Cable plugs	12 pieces, with 2 poles
Wire cross-section	0.2…2.5 mm^2 (single-wire) 0.2…1.5 mm^2 (finely stranded) 0.2…1.5 mm^2 (with wire end ferrule)
Stripping length	13 mm
Screwdriver	Slotted 0.6 x 3.5 mm
Tightening torque	0.4…0.5 Nm

Table 13: Cable Plug Characteristics

3.7.3 Connector Boards with Cable Plug

Mono X-CB 011 03

Redundant X-CB 011 04



1 I/O module plug

2 Connection to the field level (cable plug in row 2)

3 Connection to the field level (cable plug in row 32)

4 Coding of cable plugs

Figure 6: Connector Boards with Cable Plug

3.7.4 Pin Assignment for Connector Boards with Cable Plug

HIMA provides ready-made system cables for use with these connector boards, see Chapter 3.8.

Connector pin assignment!

The following table describes the connector pin assignment of the system cable plug.

Pin assignment						
Row	e		c		a	
	Signal	Wire color coding	Signal	Wire color coding	Signal	Color
2	DO1+	1	DO1-	2	Internal use 1)	YE
4	DO2+	3	DO2-	4		GN
6	DO3+	5	DO3-	6		BN
8	DO4+	7	DO4-	8		WH
10	not used		not used			
12	DO5+	9	DO5-	10		
14	DO6+	11	DO6-	12		
16	not used		not used			
18	DO7+	13	DO7-	14		
20	DO8+	15	DO8-	16		
22	not used		not used			
24	DO9+	17	DO9-	18		
26	DO10+	19	DO10-	20		
28	not used		not used			
30	DO11+	21	DO11-	22		
32	DO12+	23	DO12-	24		
1) The wires must be isolated individually! No other use is permitted!						

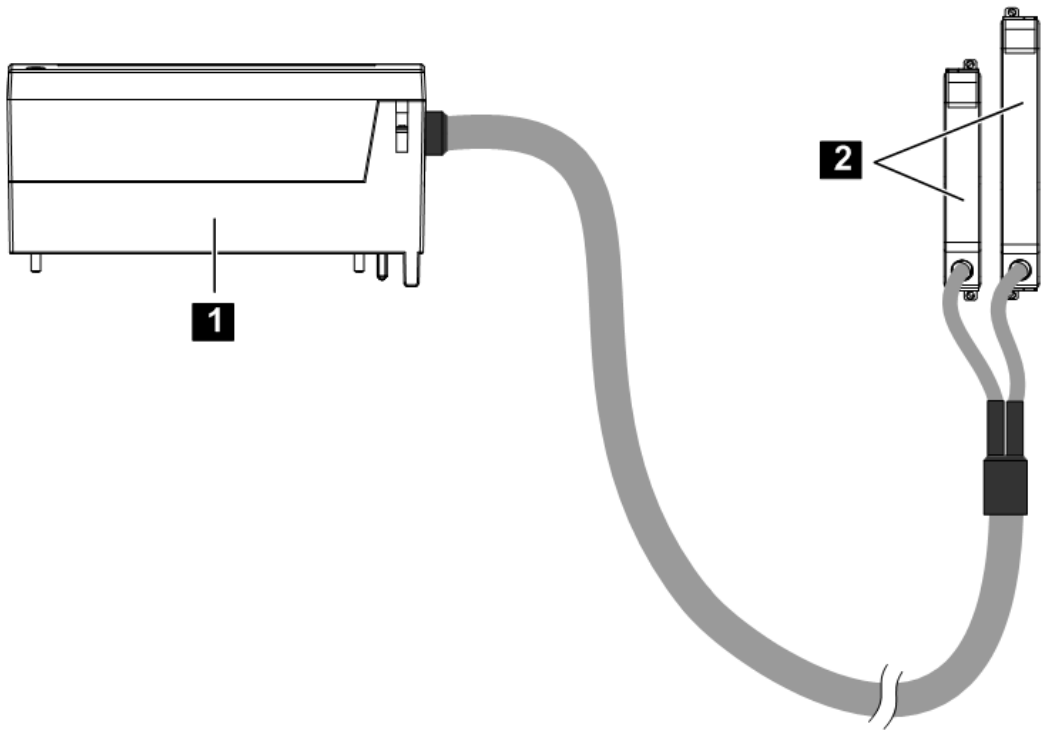
Table 14: Pin Assignment for the System Cable Plug

3.8 System Cable X-CA 012

System cable X-CA 012 is used to connect the X-CB 002 03/04 connector board to field termination assemblies.

General	
Cable	LIYY 24 x 1.5 mm² + 2 x 2 x 0.14 mm²
Wire	Finely stranded
Average outer diameter (d)	Max. 20 mm for all system cable types
Minimum bending radius Fixed installation Flexible application	 5 x d 10 x d
Burning behavior	Flame retardant and self-extinguishing in accordance with IEC 60332-1-2, IEC 60332-2-2
Length	8…30 m
Number coding Color coding	1…24 Color coding based on DIN 47100, see Table 14.

Table 15: Cable Data



1 Cable plug on connector board 2 Cable plug on FTA

Figure 7: X-CA 12 01 n

The system cable is available in the following standard lengths:

System cables	Description	Length
X-CA 012 01 8	Cable plugs on both sides.	8 m
X-CA 012 01 15		15 m
X-CA 012 01 30		30 m

Table 16: Available System Cables

3.8.1 Cable Plug Coding

The cable plug for connection with the connector board is equipped with three coding pins. Therefore, this cable plug only matches connector boards with the corresponding coding, see Figure 6.

4 Start-Up

This chapter describes how to install, configure and connect the module. For further details, refer to the HIMax system manual (HI 800 001 E).

i The safety-related application (SIL 3 in accordance with IEC 61508) of the outputs and the connected actuators must comply with the safety requirements. For further details, refer to the HIMax safety manual (HI 801 003 E).

4.1 Mounting

Observe the following points when mounting the module:

- Only operate the module with the appropriate fan components. For further details, see the system manual (HI 801 001 E).
- Only operate the module with the suitable connector board. For further details, see Chapter 3.7.
- The module, including its connected components, must be installed to ensure compliance with the requirements for degree of protection IP20 or higher in accordance with EN 60529:1991 + A1:2000.
- The outputs may be wired redundantly using the corresponding connector boards. For further details, see Chapter 3.7 and Chapter 4.3.1.

4.1.1 Wiring Unused Outputs

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

4.2 Mounting and Removing the Module

This chapter describes how to replace an existing module or mount a new one.

When removing the module, the connector board remains in the HIMax base plate. This saves additional wiring effort at the clamp terminals since all field terminals are connected via the connector board of the module.

4.2.1 Mounting a Connector Board

Tools and utilities:

- Screwdriver, cross PH 1 or slotted 0.8 x 4.0 mm.
- Matching connector board.

To install the connector board

1. Insert the connector board into the guiding rail with the groove facing upwards (see following drawing). Fit the groove into the guiding rail pin.
2. Place the connector board on the cable shield rail.
3. Secure the captive screws to the base plate. First screw in the lower screws than the upper ones.

To remove the connector board

1. Release the captive screws from the base plate.
2. Carefully lift the lower section of the connector board from the cable shield rail.
3. Remove the connector board from the guiding rail.

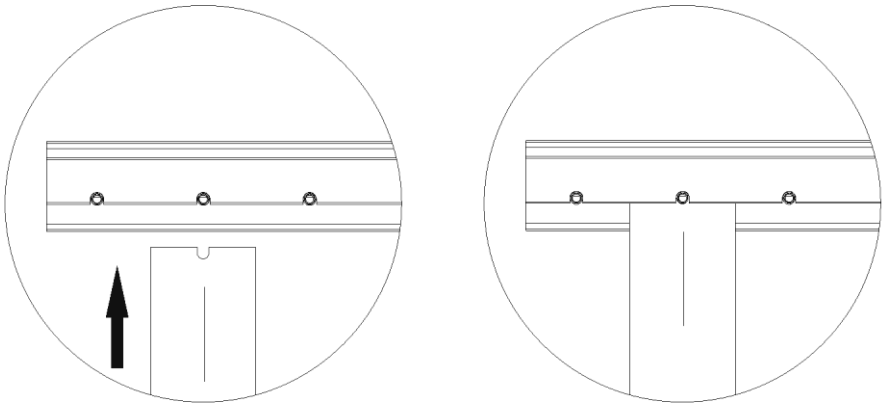


Figure 8: Example of how to Insert the Mono Connector Board

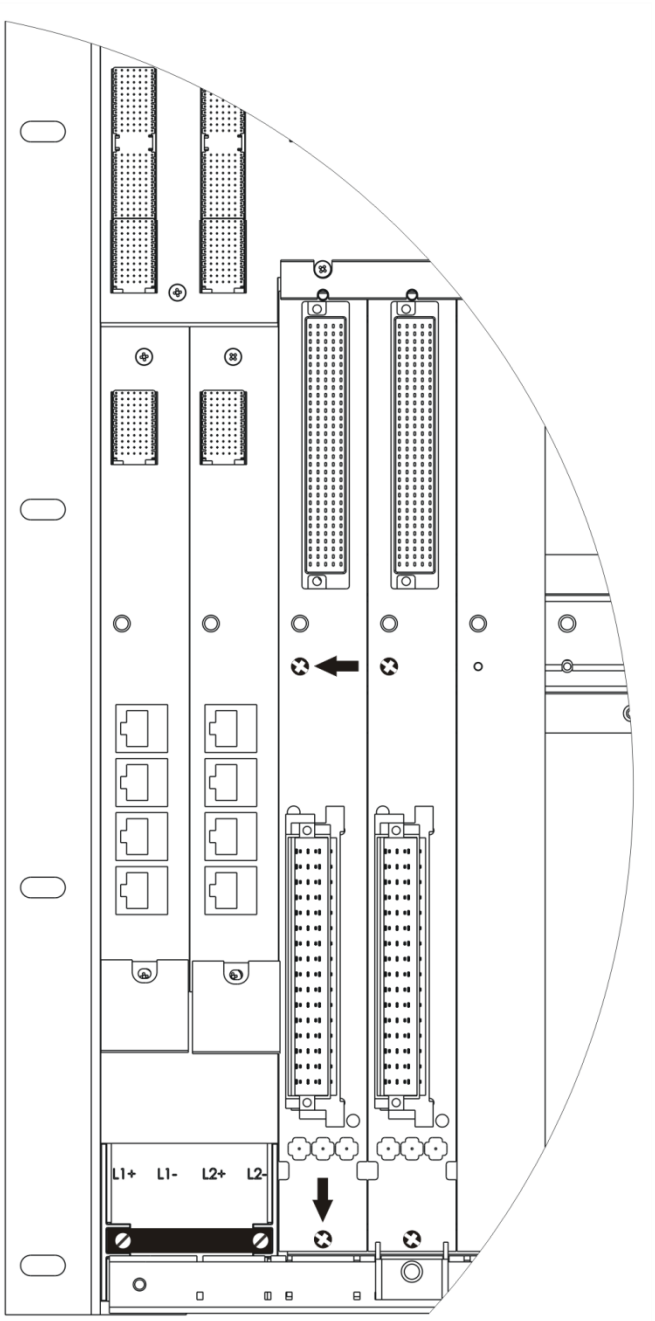


Figure 9: Example of how to Secure the Mono Connector Board with Captive Screws

i These instructions also apply for redundant connector boards. The number of used slots varies in accordance with the connector board type. The number of captive screws depends on the connector board type.

4.2.2 Mounting and Removing a Module

This chapter describes how to mount and remove the HIMax module. A module can be mounted and removed while the HIMax system is operating.

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 and utilities:

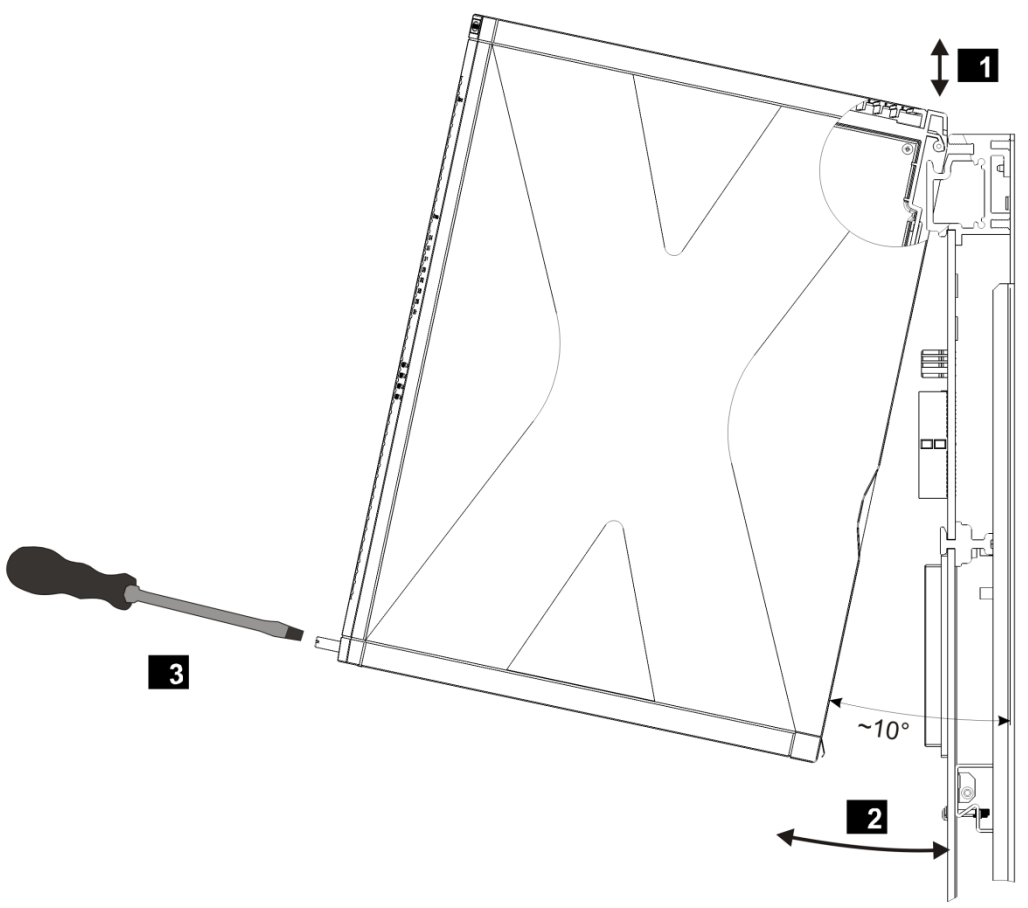
- Screwdriver, slotted 0.8 x 4.0 mm.
- Screwdriver, slotted 1.2 x 8.0 mm.

To insert the modules

1. Open the cover plate on the fan rack:
   ☑ Move the locks to the *open* position.
   ☑ Lift the cover plate and insert it into the fan rack.
2. Insert the top of the module into the hook-in rail, see 1.
3. Swivel the lower edge of the module towards the base plate and apply light pressure to snap it into place, see 2.
4. Tighten the screws, see 3.
5. Pull the cover plate out of the fan rack and close it.
6. Lock the cover plate.

To remove the modules

1. Open the cover plate on the fan rack:
   ☑ Move the locks to the *open* position.
   ☑ Lift the cover plate and insert it into the fan rack.
2. Release the screw, see 3.
3. Swivel the lower edge of the module away from the base plate. Lift and apply light pressure to remove the module from the hook-in rail, see 2 and 1.
4. Pull the cover plate out of the fan rack and close it.
5. Lock the cover plate.



1 Inserting and removing a module
2 Swiveling the module in and out
3 Securing and releasing a module

Figure 10: Mounting and Removing a Module

i If the HIMax system is operating, do not open the cover plate of the fan rack for more than a few minutes (< 10 min) since this affects the forced cooling.

4.3 Configuring the Module in SILworX

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

Observe the following points when configuring the module:

- To diagnose the module and channels, both the statuses and the measured value can be evaluated within the user program. For further details on the system parameters, refer to the following tables.
- If a redundancy group is created, its configuration is defined in the tabs. The tabs specific to the redundancy group differ from those of the individual modules, see the following tables.

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 system parameters for the module:

System parameters	Data type	S [1]	R/W	Description
Name	---	---	W	Module name
Spare Module	BOOL	Y	W	Activated: It is not considered a fault if a module of the redundancy group is missing in the base plate. Deactivated: It is considered a fault if a module of the redundancy group is missing in the base plate Default setting: Deactivated **It is only displayed in the redundancy group tab!**
Noise Blanking	BOOL	Y	W	Allow noise blanking performed by the process module (activated/deactivated). Default setting: Activated. The processor module delays its response to transient interference until the safety time. The user program retains its last valid process value. Refer to the system manual (HI 801 001 E) for further details on noise blanking.
System parameters	Data type	S [1]	R/W	Description
The following statuses and parameters can be assigned global variables and used in the user program.				
Module OK	BOOL	Y	R	TRUE: Faultless. Mono operation: No module faults. Redundancy operation: At least one of the redundant modules has no module fault (OR logic). FALSE: Module fault Channel fault on one channel (no external faults). The module is not plugged in. Observe the *Module Status* parameter!
Module Status	DWORD	Y	R	Status of the module Coding / Description: 0x00000001 Module fault. [2] 0x00000002 Temperature threshold 1 exceeded. 0x00000004 Temperature threshold 2 exceeded. 0x00000008 Incorrect temperature value. 0x00000010 Voltage on L1+ is defective. 0x00000020 Voltage on L2+ is defective. 0x00000040 Internal voltage is defective. 0x80000000 No connection to the module. [2] [2] These faults affect the *Module OK* status and need not be separately evaluated in the user program.
Timestamp [µs]	DWORD	N	R	Microsecond fraction of the timestamp. Time: Testing of the relay outputs completed
Timestamp [s]	DWORD	N	R	Second fraction of the timestamp. Time: Testing of the relay outputs completed
[1] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 17: The **Module** Tab in the Hardware Editor

4.3.2 The **I/O Submodule DO 12_01** Tab

The **I/O Submodule DO12_01** tab contains the following system parameters:

System parameters	Data type	S [1]	R/W	Description
Name	---	---	W	Module name
Output Noise Blanking	BOOL	Y	W	Allow output noise blanking by the output module (Activated/Deactivated). Default setting: Deactivated (**recommended!**) If the channel's default and read-back values are not consistent, the channel switch-off is suppressed. Refer to the system manual (HI 801 001 E) for further details on output noise blanking.
Test Current Measurement	BOOL	Y	W	Functional check of the current measurement (Activated/Deactivated) Default setting: Deactivated
System parameters	Data type	S [1]	R/W	Description
The following statuses and parameters can be assigned global variables and used in the user program.				
Diagnostic Request	DINT	N	W	To request a diagnostic value, the appropriate ID must be sent to the module using the parameter *Diagnostic Request* (for coding details, see Chapter 4.3.5).
Diagnostic Response	DINT	N	R	As soon as *Diagnostic Response* returns the ID of *Diagnostic Request* (for coding details, see Chapter 4.3.5), *Diagnostic Status* contains the diagnostic value requested.
Diagnostic Status	DWORD	N	R	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.
Background Test Error	BOOL	N	R	TRUE: Background test is faulty. FALSE: Background test is free of faults.
Restart on Error	BOOL	Y	W	The *Restart on Error* parameter can be used to cause any I/O module that is shut down permanently due to errors or faults to once again enter the RUN state. To do so, set the *Restart on Error* parameter from FALSE to TRUE. The I/O module performs a complete self-test and only enters the RUN state if no faults are detected. Default setting: FALSE
Submodule OK	BOOL	Y	R	TRUE: No submodule fault, no channel faults. FALSE: Submodule fault, channel faults (external faults included).
Submodule Status	DWORD	Y	R	Bit-coded submodule status. (For coding details, see Chapter 4.3.4).
[1] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 18: The **I/O Submodule DO 12_01** Tab in the Hardware Editor

4.3.3 The **I/O Submodule DO 12_01: Channels** Tab

The **I/O Submodule DO12_01: Channels** tab contains the following system parameters for each relay output.
Global variables can be assigned to the system parameters with **->** and used in the user program. The value without **->** must be directly entered.

System parameters	Data type	S [1)]	R/W	Description
Channel no.	---	---	R	Channel number, preset and cannot be changed.
Channel Value [BOOL] ->	BOOL	Y	R	Binary value in accordance with the switching levels LOW (dig) and HIGH (dig). TRUE: Channel energized FALSE: Channel de-energized
-> Channel OK [BOOL]	BOOL	Y	R	TRUE: Fault-free channel. The channel value is valid. FALSE: Faulty channel. The channel is de-energized.
-> Channel Current [DINT]	DINT	Y	R	Measured channel current (10 000 digit/mA) Range of values 0…50 000 000
Redund.	BOOL	Y	W	Requirement: The redundant module must exist. Activated: The channel redundancy for this channel is active. Deactivated: The channel redundancy for this channel is not active. Default setting: Deactivated
1) The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 19: The **I/O Submodule DO12_01: Channels** Tab in the Hardware Editor

4.3.4 Description of **Submodule Status [DWORD]**

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

Coding	Description
0x00000001	Fault in hardware unit (submodule)
0x00000002	Reset of an E/A bus
0x00000004	Fault detected while initializing the hardware.
0x00000008	Fault detected while checking the coefficients.
0x00000080	Reset of CS monitoring (Chip Select monitoring)
0x20000000	Warning about inaccurate current measurement
0x40000000	Error while reading back the relay voltage
0x80000000	Error when reading back the safety switch status.

Table 20: Coding of *Submodule Status [DWORD]*

4.3.5 Description of **Diagnostic Status [DWORD]**

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

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>0</td><td>Diagnostic values are indicated consecutively.</td></tr>
<tr><td>100</td><td>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</td></tr>
<tr><td>101</td><td>Measured temperature (10 000 digits/ °C).</td></tr>
<tr><td>200</td><td>Bit-coded voltage status.
0 = normal
Bit0 = 1 : L1+ (24 V) is faulty
Bit1 = 1 : L2+ (24 V) is faulty</td></tr>
<tr><td>201</td><td>Maximum value of the 24 V voltage supply (L1+ and L2+)</td></tr>
<tr><td>202</td><td>Actual value of the internal 3V3 operating voltage</td></tr>
<tr><td>203</td><td>Actual value of the internal core voltage</td></tr>
<tr><td>204…207</td><td>Not used!</td></tr>
<tr><td>300</td><td>Comparator 24 V undervoltage (BOOL)</td></tr>
<tr><td>1001…1012</td><td>12
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Fault in hardware unit</td></tr>
<tr><td>0x0002</td><td>Reset of an E/A bus</td></tr>
<tr><td>0x0008</td><td>Hardware fault.
Read-back value = 0 with setpoint = 1</td></tr>
<tr><td>0x0040</td><td>Fault (unspecific)
Read-back value = 1 with setpoint = 0</td></tr>
<tr><td>0x0080</td><td>Field errors
Read-back value = 0 with setpoint = 1</td></tr>
<tr><td>0x0400</td><td>The output cannot be energized:
Signals change too fast for relay contacts.</td></tr>
<tr><td>0x0800</td><td>Fault, test of relay auxiliary contacts.</td></tr>
<tr><td>0x1000</td><td>Fault when reading back the status of relay 1.</td></tr>
<tr><td>0x2000</td><td>Fault when reading back the status of relay 2.</td></tr>
<tr><td>0x4000</td><td>Limit of switching operations exceeded.</td></tr>
<tr><td>0x8000</td><td>The output cannot be energized:
- Read back error
- Contact cleaning</td></tr>
</table></td></tr>
<tr><td>3001…3012</td><td>Description of Diag_Value
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x4000</td><td>Functionally test the current measurement.</td></tr>
<tr><td>0x8000</td><td>Read the current value.</td></tr>
</table></td></tr>
<tr><td>5001…5012</td><td>Diagnostic information for each channel concerning the number of switching operations.</td></tr>
</table>

Table 21: Coding of *Diagnostic Status [DWORD]*

4.4 Connection Variants

This chapter describes the proper wiring of the relay module in safety-related applications. The following connection variants are permitted.

The outputs are wired via connector boards. Special connector boards are available for redundantly wiring the modules, see Chapter 3.7.

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

- With DC applications, pay attention to the polarity of the terminals (DO1+/DO1-). This ensures that the current measurement accuracy defined in the specification is achieved.
- Use fuses suitable for current limiting, see Table 8.
  - Melting integral ≤ 100 A²s
  - The switching capacity of the fuse must be adjusted to the network to be connected.

Use a protective circuit when connecting inductors. The protective circuit can include RC elements, free-wheeling diodes, Z-diodes, bi-directional Z-diodes or varistors.

⚠ CAUTION

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

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

4.4.1 Wiring Actuators to Ohmic Load

The following figure shows the wiring of actuators to ohmic load.

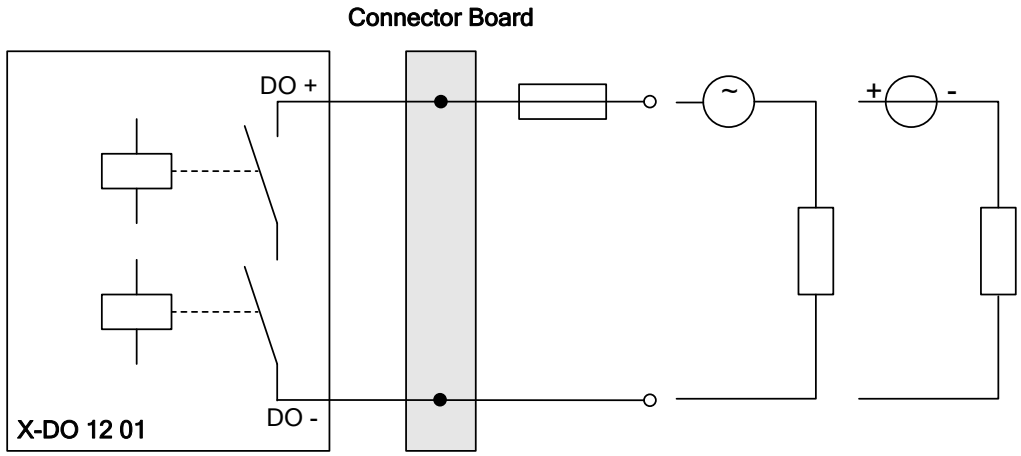
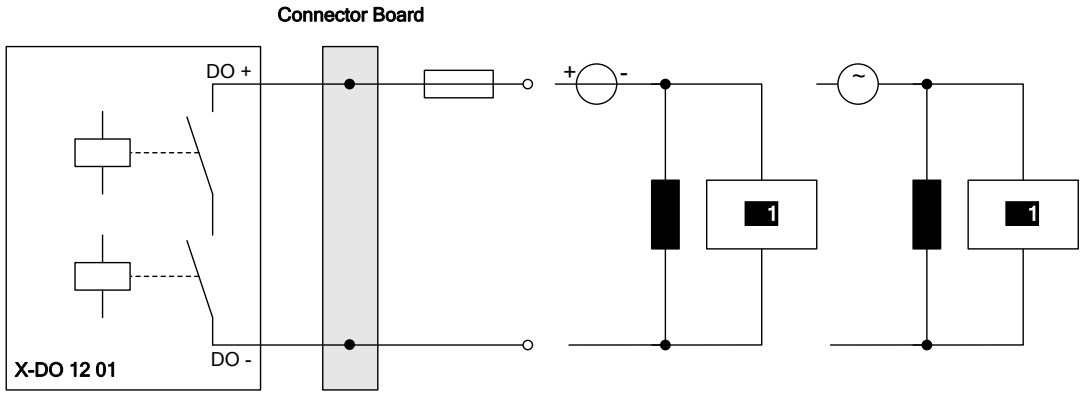


Figure 11: Wiring an Actuator to DC or AC Voltage

4.4.2 Wiring Actuators to Inductive Load

When wiring to inductive load, a free-wheel circuit must be used in parallel to the load.



1 Free-wheeling circuit

Figure 12: Actuator Wired to Inductive Load

4.4.3 Wiring an Actuator to Redundant Modules

Use a redundant X-CB 011 02 (Figure 13) connector board to connect an actuator to redundant relay modules or use two connector boards of type X-CB 011 01, if the redundant modules are not plugged in to the base plate adjacently.

NOTICE

When connecting an actuator to redundant relay modules, the actuator must be connected to the same channel number of the two modules.

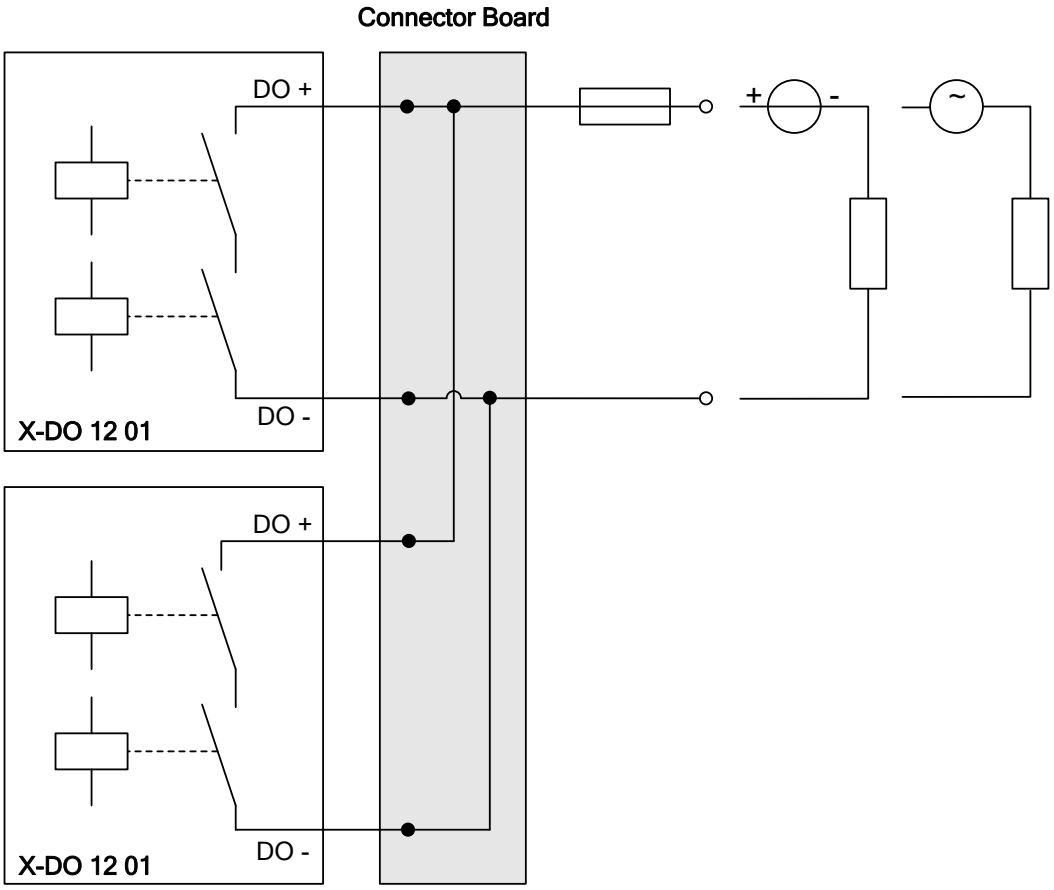


Figure 13: Redundant Wiring of an Actuator to Redundant Relay Modules

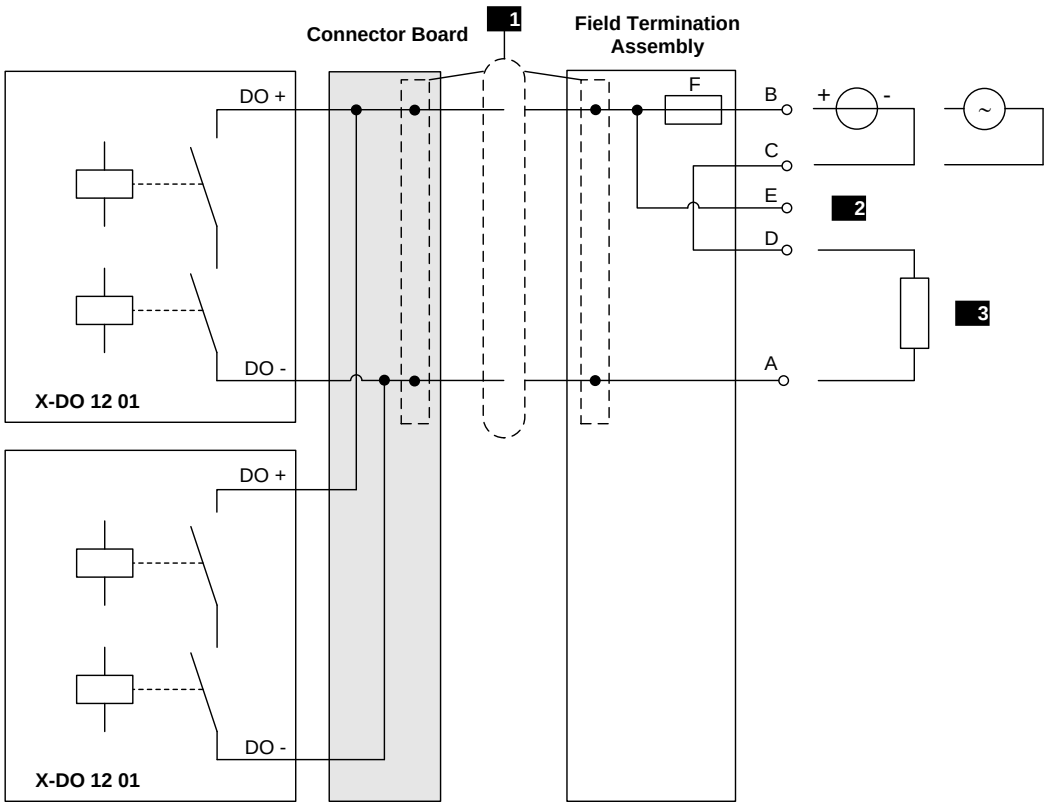
NOTICE

Burner applications

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

4.4.4 Wiring Actuators via Field Termination Assembly

Actuators are connected via the X-FTA 005 02L as described in Figure 14. For further information, refer to the X-FTA 005 02L manual (HI 801 125 E).



1 System cable X-CA 012 01
2 Monitoring
3 Load

Figure 14: Wiring via Field Termination Assembly

5 Operation

The module runs within a HIMax base plate and does not require any specific monitoring.

5.1 Handling

Direct handling of the module is not foreseen.

The module is operated from within the PADT, e.g., for forcing the relay outputs. For further details, refer to the SILworX documentation.

5.2 Diagnostics

LEDs on the front side of the module indicate the module state, see Chapter 3.5.2.

The diagnostic history of the module can also be read using SILworX. Chapter 4.3.4 and Chapter 4.3.5 describe the most important diagnostic statuses.

i If a module is plugged in to a base plate, it generates diagnostic messages during its initialization phase indicating faults such as incorrect voltage values.

These messages only indicate a module fault if they occur after the system starts operation.

6 Maintenance

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

When replacing modules, observe the instructions specified in the HIMax system manual (HI 801 001 E) and HIMax safety manual (HI 801 003 E).

6.1 Maintenance Measures

The following maintenance measures must be implemented for the modules:

- Proof testing.
- Loading of enhanced operating system versions.

6.1.1 Proof Test

The proof test interval for HIMax modules must be in accordance with the interval required by the application-specific safety integrity level (SIL). For further details, refer to the safety manual (HI 801 003 E).

6.1.2 Loading of Enhanced Operating System Versions

As part of product maintenance, HIMA is continuously improving the operating systems of the modules. HIMA recommends using system downtimes to load the current operating system versions into the modules.

i The current operating system versions of modules are displayed in the SILworX Control Panel. The type label specifies the delivered module version, see Chapter 3.4.

Before loading operating systems into the modules, check the system compatibilities and restrictions of the operating system versions. To this end, use the applicable release notes. Use SILworX to load the operating systems into the modules and ensure that these are in the STOP state.

7 Decommissioning

To decommission the module, remove it from the base plate. For more details, refer to 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	Base plate identification (number)
r_P	Peak value of a total AC component
SB	System bus (module)
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

Index

MANUAL
X-DO 12 01

HI 801 023 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 HIMax online:

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

www.hima.com