Manual

HIMax®

X-DO 12 51

Relay Module

Contact

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Document designation	Description
HI 801 184 D, Rev. 11.00 (1941)	German original document
HI 801 185 E, Rev. 11.00.00 (1948)	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
HIMax maintenance manual	Description of significant operational and maintenance actions.	HI 801 171 E
Communication manual	Description of safeethernet communication and of the available protocols.	HI 801 101 E
Automation security manual	Description of automation security aspects related to the HIMA systems.	HI 801 373 E
SILworX first steps manual	Introduction to SILworX	HI 801 103 E
SILworX online help (OLH)	Instructions on how to use SILworX	---

Table 1: Additional Applicable Manuals

The current manuals can be obtained upon request by sending an e-mail to: documentation@hima.com. Registered customers can download the product documentation from the HIMA Extranet.

1.2 Target Audience

This document is aimed at the planners, design engineers, programmers and the persons authorized to start up, operate and maintain the automation systems. 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.

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 requirements 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.

3 Product Description

The X-DO 12 51 is a NonSIL relay module intended for use in the programmable electronic system (PES) HIMax.

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

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 can be operated with safety-related modules and other NonSIL modules within one base plate. Safety-related and NonSIL modules may not be wired redundantly.

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.

Module and connector boards are mechanically coded, see Chapter 3.6.1. Coding prevents installation of unsuitable I/O modules.

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

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

3.1 Safety Function

The module does not perform any safety-related functions.

The parameters and status for this module must not be used for safety functions.

3.1.1 Response in the Event of a Fault

If a module fault occurs, all outputs are 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 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

3.4 Structure

The module is equipped with 12 relay outputs; each of these outputs can be energized by a relay.

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

⚠ WARNING

Electrical shock, damage to the module!

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

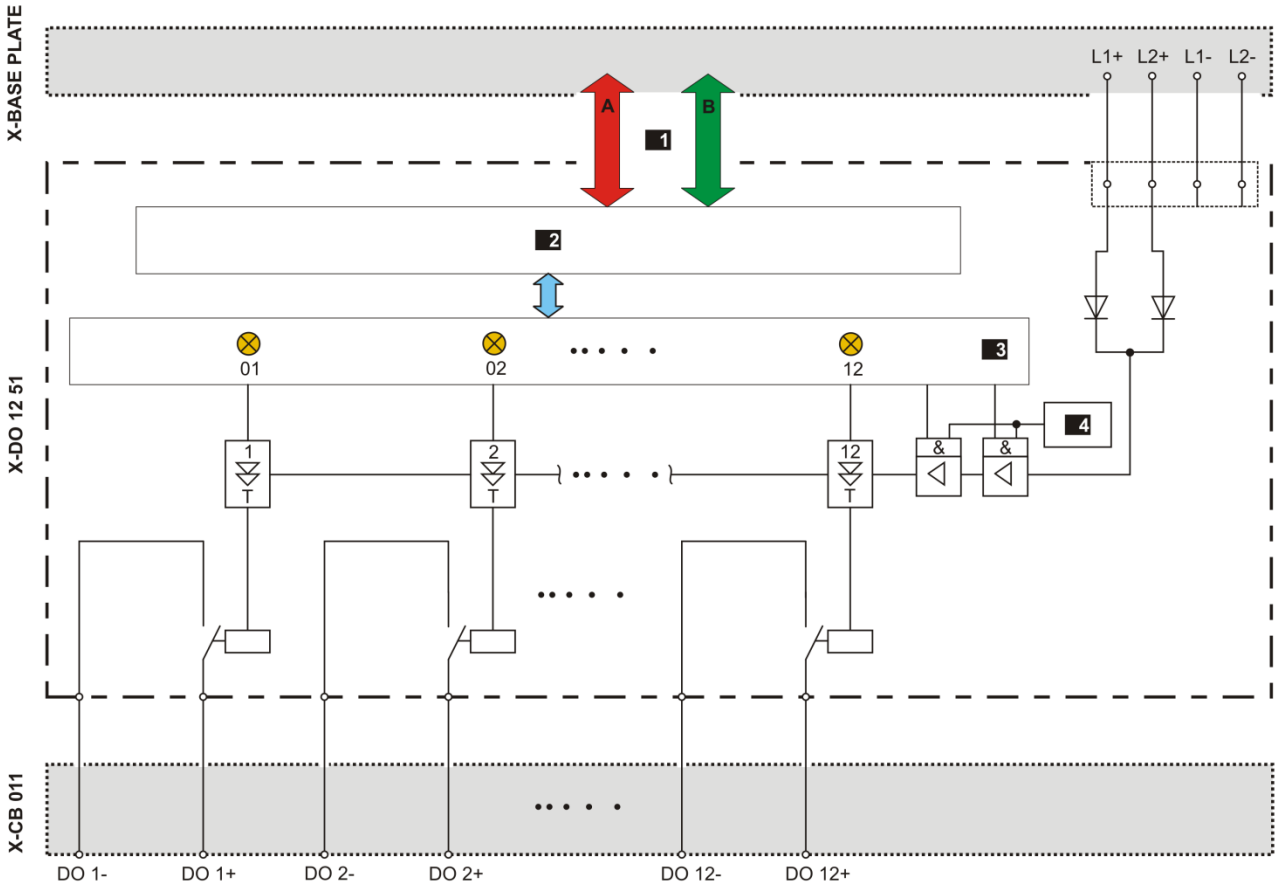
Only one phase can be connected to the X-DO 12 51 module. Connecting three-phase current is not permitted!

The 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 3.4.2.

3.4.1 Block Diagram

The following block diagram illustrates the structure of the module:



1 System buses
2 Processor system
3 Interface
4 Watchdog

Figure 2: Block Diagram

3.4.2 Indicators

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

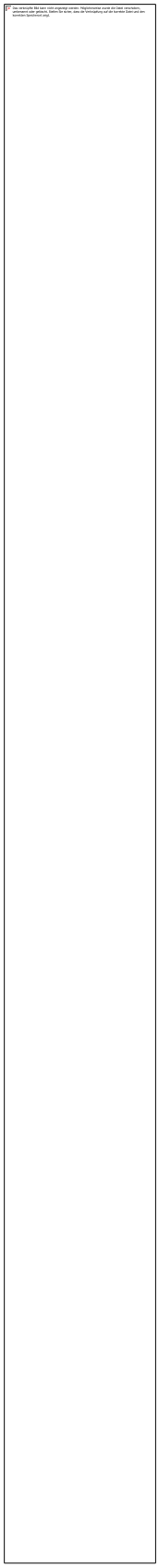


Figure 3: Indicators

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

3.4.3 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

3.4.4 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

3.4.5 I/O Indicators

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

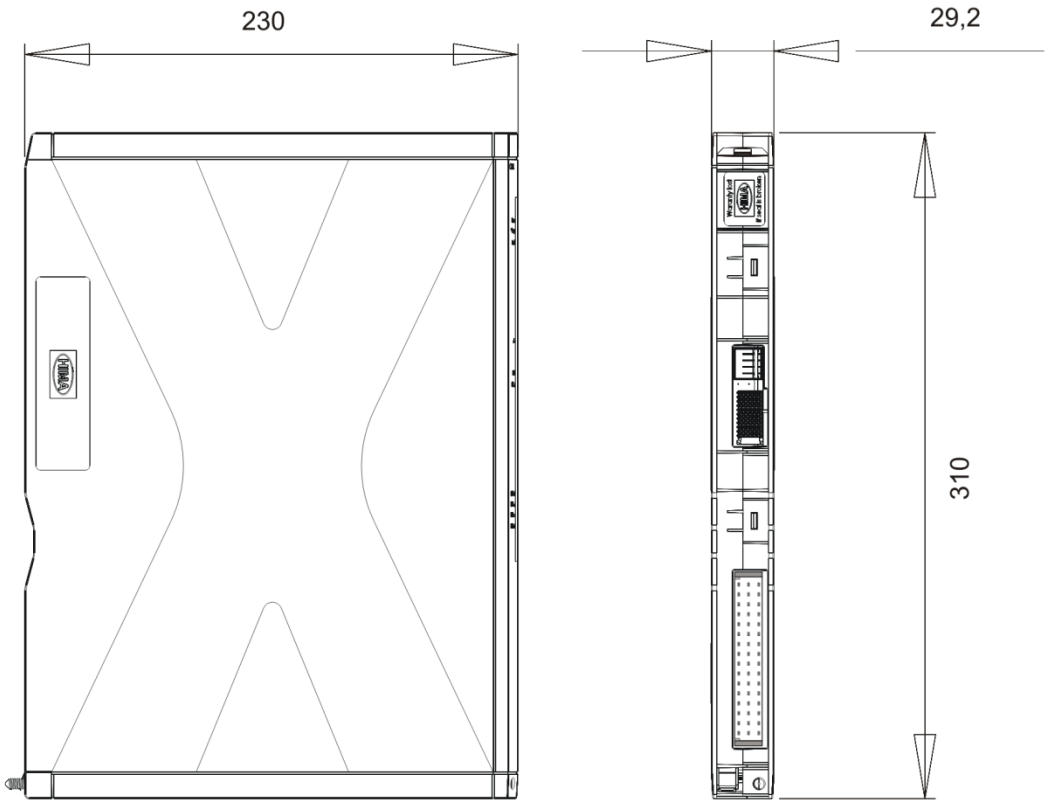
LED	Color	Status	Description
DO 1…12	Yellow	On	The corresponding channel is active (energized)
		Blinking2	Channel fault
		Off	The corresponding channel is not active (de-energized)
Field	Red	Blinking2	Without function!
		Off	

Table 5: I/O Indicators

3.5 Product Data

General information	
Supply voltage	24 VDC, -15…+20 %, $r_p \leq 5$ % SELV, PELV
Current consumption of the module, all relay de-energized	0.2 A (24 VDC)
Current consumption of the module, all relay energized	0.26 A (24 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…+70 °C
Humidity	Max. 95 % relative humidity, non-condensing
Pollution	Pollution degree II in accordance with IEC/EN 60664-1
Installation height	< 2000 m
Degree of protection	IP20
Dimensions (H x W x D)	310 x 29.2 x 230 mm
Weight	Approx. 0.75 kg

Table 6: Product Data



1 Depth: 230 mm
2 Width: 29.2 mm
3 Height: 310 mm

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	Max. 4 A
Switching frequency	Max. 20 Hz
Contact material	AgNi 0.15, hard gold plated
Lifetime ▪ mechanical ▪ electrical	 ≥ 30 x 10^6 switching operations ≥ 5 x 10^5 at 2 A switching current ≥ 3 x 10^5 at 4 A switching current

Table 7: Specifications for the Relay Outputs

Fuse protection of contact circuits is strongly recommended. The following table specifies the maximum switching capacity allowed for the relay outputs in accordance with the corresponding switching voltage.

Switching capacity DC (induction-free)	≤ 30 VDC	Max. 120 W
	≤ 70 VDC	Max. 56 W
	≤ 100 VDC	Max. 50 W
	≤ 250 VDC	Max. 60 W
Switching capacity DC (inductive load tau = L/R = 20 ms)	≤ 30 VDC	Max. 15 VA
	≤ 70 VDC	Max. 14 VA
	≤ 100 VDC	Max. 14 VA
Switching capacity AC (induction-free)	≤ 250 VAC	Max. 100 VA

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 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 51	Mono connector board with screw terminals.
X-CB 011 53	Mono connector board with cable plug.

Table 9: Available Connector Boards

Accessories	Description
X-CB COVER 01	Cover hood.

Table 10: Connector Board Accessories

⚠ DANGER

Danger of electric shock!

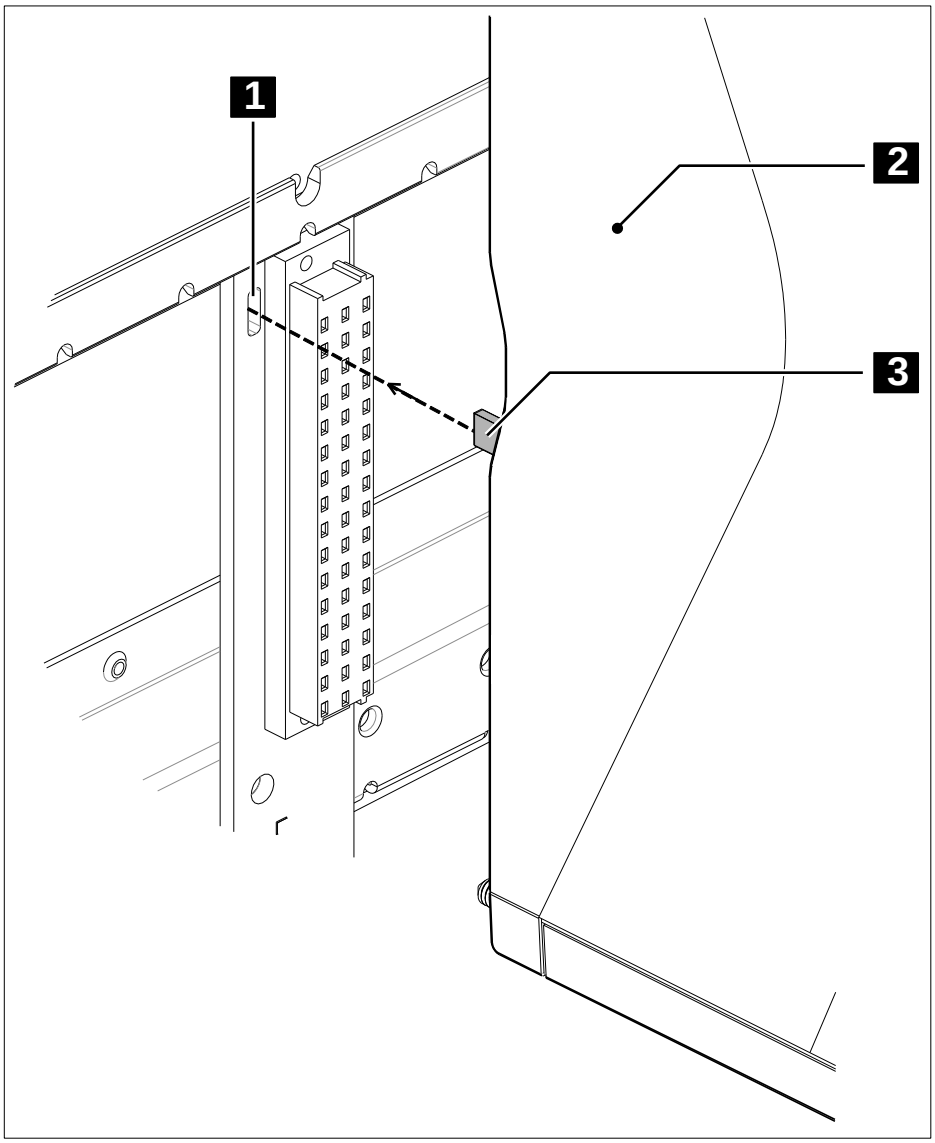
For connector boards with screw terminals: If the voltages exceed SELV, use the X-CB COVER 01 cover hoods or the X-FRONT COVER.

Observe all safety regulations!

3.6.1 Mechanical Coding of X-CB 011 5x Connector Boards

Module and connector boards are mechanically coded to prevent them from being equipped with improper I/O modules. The module is provided with a coding pin matching the coding notch of the X-CB 011 5x connector boards, see Figure 5.

Coded I/O modules can only be plugged in to the corresponding connector boards. Coding avoids installation of improper I/O modules thus preventing negative effects on redundant modules and the field level. Apart from that, improper equipment has no effect on the HIMax system since only I/O modules properly configured in SILworX can enter the RUN state.



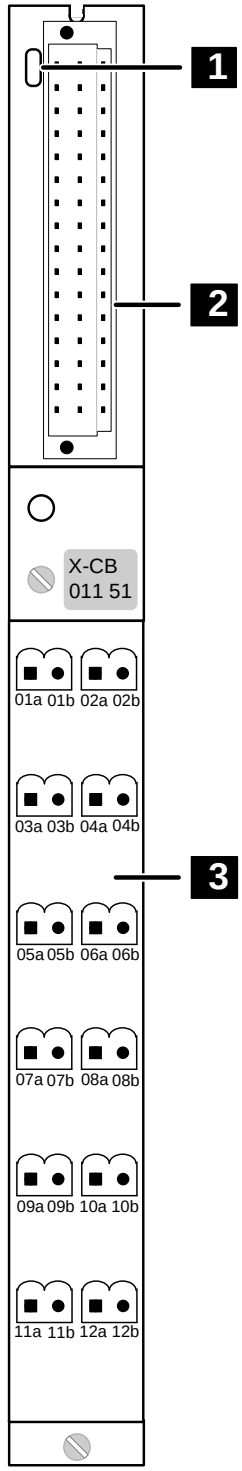
1 Connector board with coding notch
2 X-DO 12 51 relay module
3 Coding pin

Figure 5: Coding of X-DO 12 51 and X-CB 011

3.6.2 Connector board with screw terminals

Mono

X-CB 011 51



1 Coding Notch

2 I/O module plug

3 Connection to the field level (screw terminals)

Figure 6: Connector Board with Screw Terminals

3.6.3 Terminal Assignment for Connector Board 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 11: Terminal Assignment for Connector Board 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:

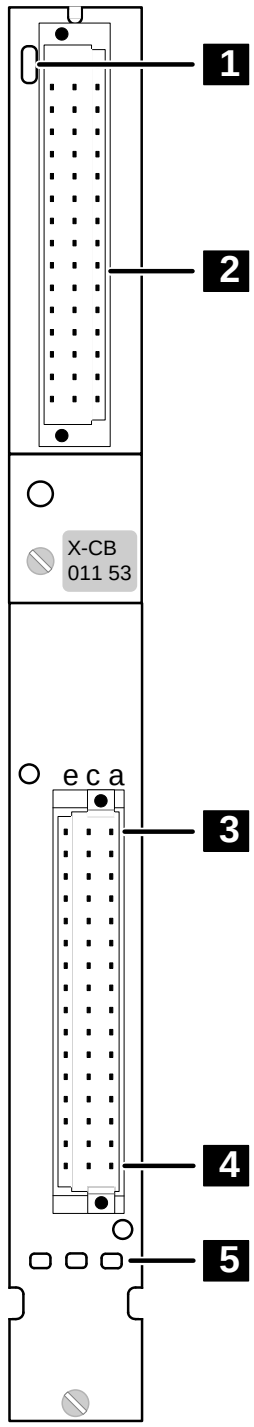
Connection to the field level	
Cable plugs	12 pieces, with 2 poles
Wire cross-section	0.2…2.5 mm^2 (single-wire) 0.2…1.5 mm^2 (finely stranded) 0.2…1.5 mm^2 (with wire end ferrule)
Stripping length	13 mm
Screwdriver	Slotted 0.6 x 3.5 mm
Tightening torque	0.4…0.5 Nm

Table 12: Cable Plug Characteristics

3.6.4 Connector board with cable plug

Mono

X-CB 011 53



1 Coding Notch
2 I/O module plug
3 Connection to the field level (cable plug in row 2)
4 Connection to the field level (cable plug in row 32)
5 Coding of cable plugs

Figure 7: Connector Board with Cable Plug

3.6.5 Pin Assignment for Connector Board with Cable Plug

HIMA provides ready-made system cables for use with this connector board, see Chapter 3.7. The cable plug and the connector board are coded.

Connector pin assignment!

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

Pin assignment						
Row	e		c		a	
	Signal	Wire number	Signal	Wire number	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!						

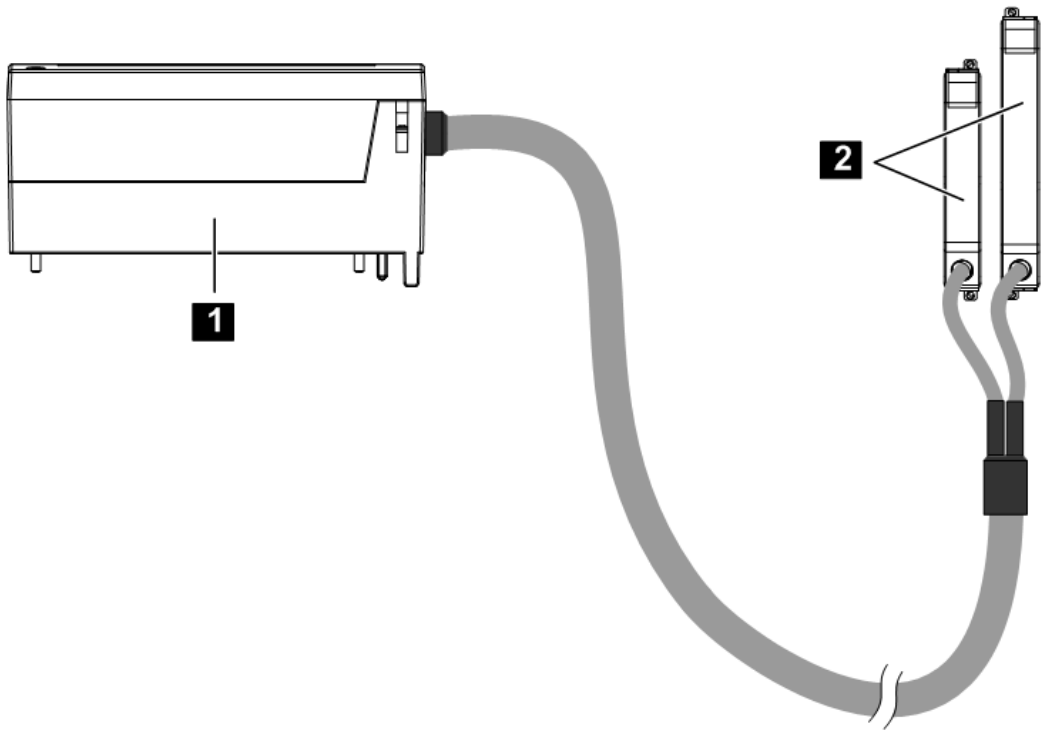
Table 13: Pin Assignment for the System Cable Plug

3.7 System Cable X-CA 012

System cable X-CA 012 is used to connect the X-CB 011 53 connector board to the X-FTA 005 02L field termination assembly.

General information	
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 13.

Table 14: Cable Data



1 Cable plug on connector board

2 Cable plug on FTA

Figure 8: X-CA 12 01 n

The system cable is available in the following standard lengths:

System cables	Description	Length	Weight
X-CA 012 01 8	Cable plugs on both sides.	8 m	3.7 kg
X-CA 012 01 15		15 m	10.4 kg
X-CA 012 01 30		30 m	20.6 kg

Table 15: Available System Cables

3.7.1 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 7.

4 Start-Up

This chapter describes how to install, configure and connect the module. For further details, refer to the HIMax system manual (HI 801 001 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 3.6.
- 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.

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.

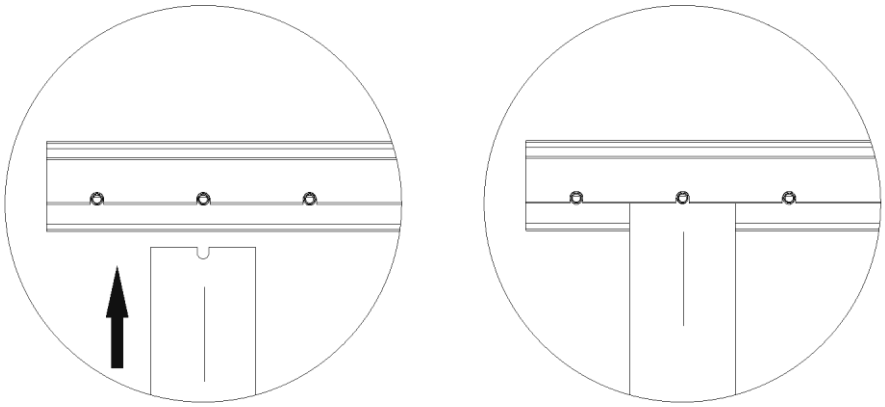


Figure 9: Example of how to Insert the Mono Connector Board

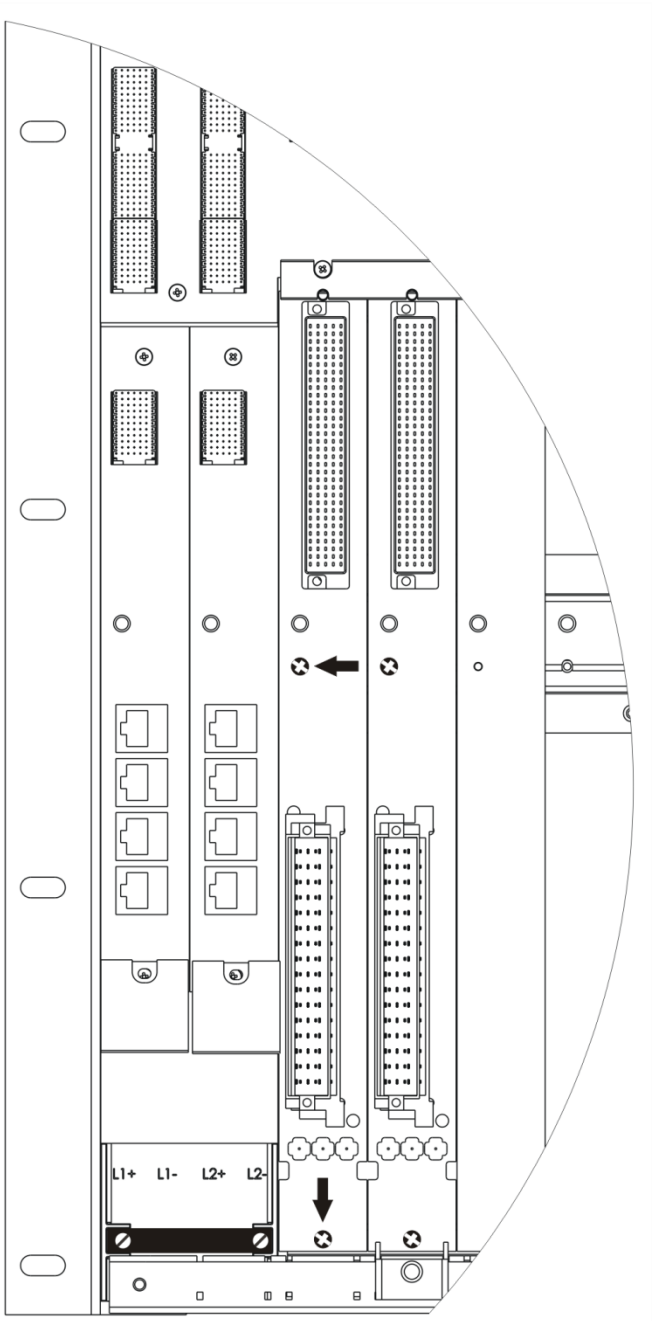


Figure 10: Example of how to Secure the Mono Connector Board with Captive Screws

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:

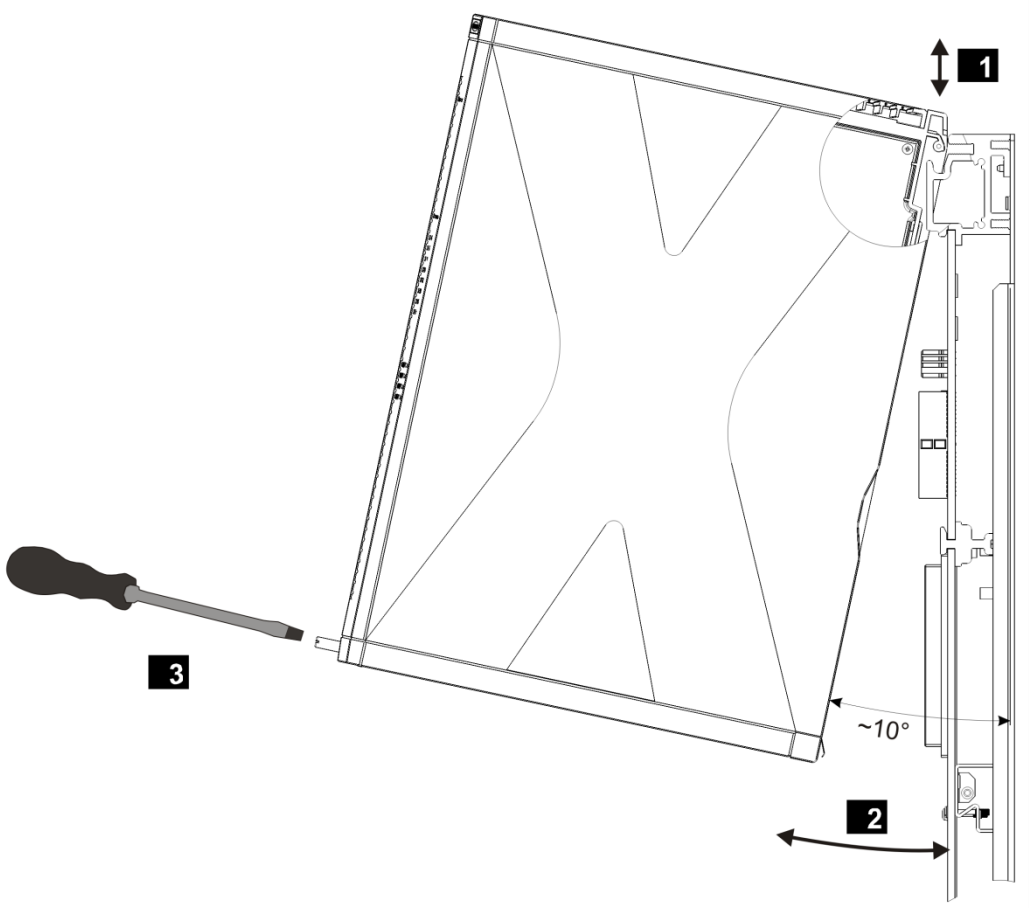
- Screwdriver, slotted 0.8 x 4.0 mm.
- Screwdriver, slotted 1.2 x 8.0 mm.

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 11: 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:

<table>
<tr><th>System parameter</th><th>Data type</th><th>R/W</th><th>Description</th></tr>
<tr><td>Name</td><td>---</td><td>W</td><td>Module name.</td></tr>
<tr><td>Spare Module</td><td>---</td><td>W</td><td>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!</td></tr>
<tr><td>Noise Blanking</td><td>---</td><td>W</td><td>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.</td></tr>
<tr><th>System parameter</th><th>Data type</th><th>R/W</th><th>Description</th></tr>
<tr><td colspan="4">The following statuses and parameters can be assigned global variables and used in the user program.</td></tr>
<tr><td>Module OK</td><td>BOOL</td><td>R</td><td>TRUE:
• 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!</td></tr>
<tr><td>Module Status</td><td>DWORD</td><td>R</td><td>Status of the module.
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x00000001</td><td>Module fault.[1)]</td></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>Voltage on L1+ is defective.</td></tr>
<tr><td>0x00000020</td><td>Voltage on L2+ is defective.</td></tr>
<tr><td>0x00000040</td><td>Internal voltage is defective.</td></tr>
<tr><td>0x80000000</td><td>No connection to the module. [1)]</td></tr>
<tr><td colspan="2">[1)] These faults affect the Module OK status and need not be separately evaluated in the user program.</td></tr>
</table></td></tr>
<tr><td>Timestamp [µs]</td><td>DWORD</td><td>R</td><td>Microsecond fraction of the timestamp.
Time: Testing of the relay outputs completed.</td></tr>
<tr><td>Timestamp [s]</td><td>DWORD</td><td>R</td><td>Second fraction of the timestamp.
Time: Testing of the relay outputs completed.</td></tr>
</table>

Table 16: The **Module** Tab in the Hardware Editor

4.3.2 The **I/O Submodule DO 12_51** Tab

The **I/O Submodule DO12_51** tab contains the following system parameters:

System parameter	Data type	R/W	Description
Name	---	W	Tab name
System parameter	Data type	R/W	Description
The following statuses and parameters can be assigned global variables and used in the user program.			
Diagnostic Request	DINT	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	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	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	R	TRUE: Background test is faulty. FALSE: Background test is not faulty.
Restart on Error	BOOL	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	R	TRUE: No submodule fault, no channel faults. FALSE: Submodule fault, channel faults (external faults included).
Submodule Status	DWORD	R	Bit-coded submodule status. For coding details, see Chapter 4.3.4.

Table 17: The **I/O Submodule DO 12_51** Tab in the Hardware Editor

4.3.3 The **I/O Submodule DO 12_51: Channels** Tab

The **I/O Submodule DO12_51: Channels** tab contains the following system parameters for each digital input.
Global variables can be assigned to the system parameters with **->** and used in the user program. The value without **->** must be directly entered.

System parameter	Data type	R/W	Description
Channel no.	---	R	Channel number, preset and cannot be changed.
Channel Value [BOOL] ->	BOOL	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	R	TRUE: Fault-free channel. The channel value is valid. FALSE: Faulty channel. The channel is de-energized.
Redund.	---	W	TRUE: Redundancy group created. FALSE: Module in mono operation. The redundancy group can only be created and deleted using the corresponding context menu.

Table 18: The **I/O Submodule DO12_51: 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).

Table 19: 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 rowspan="3">Not used!</td></tr>
<tr><td>202</td></tr>
<tr><td>203</td></tr>
<tr><td>300</td><td>Comparator 24 V undervoltage (BOOL).</td></tr>
<tr><td>1001…1012</td><td>Status of channels 1…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 I/O bus.</td></tr>
</table>
</td></tr>
</table>

Table 20: 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.

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-).
- Use fuses suitable for current limiting.
  - 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.

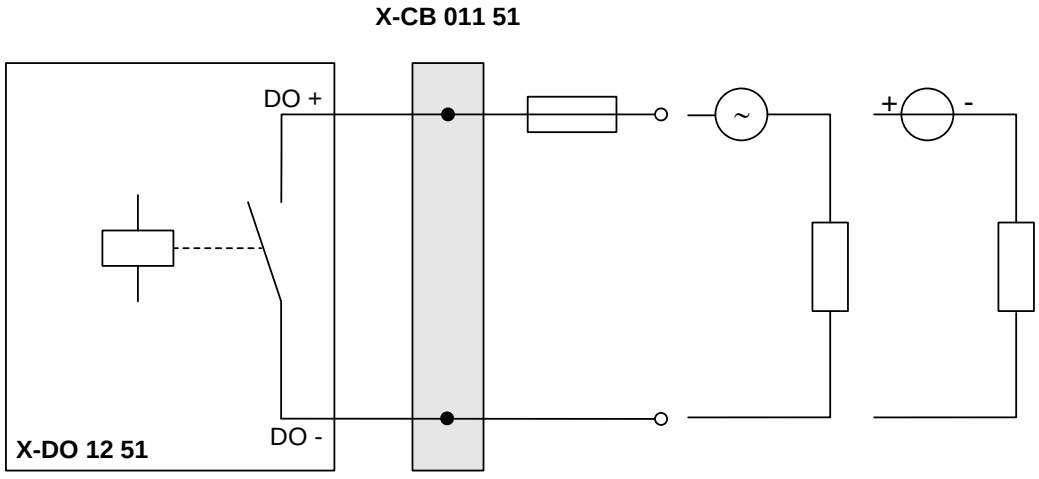
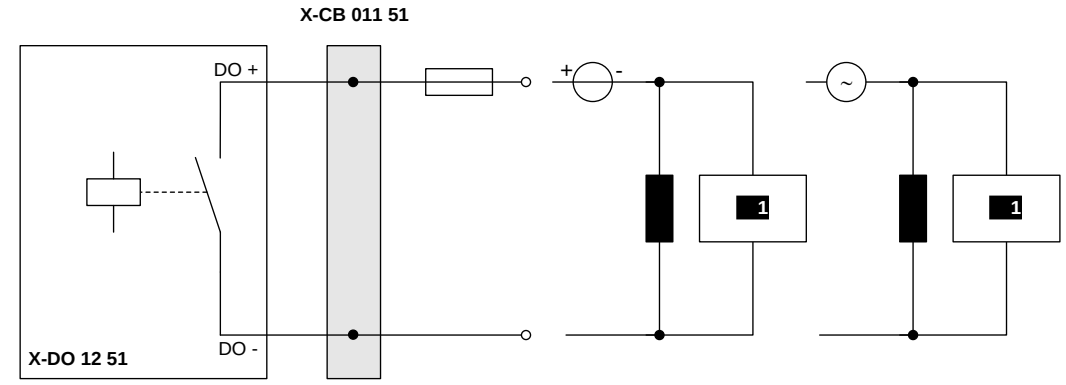


Figure 12: Wiring an Actuator to DC or AC Voltage

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 13: Actuator Wired to Inductive Load

4.4.3 Wiring an Actuator to Redundant Modules

An actuator can be wired to redundant relay modules using two mono connector boards X-CB 011 51 as specified in Figure 14.

NOTICE

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

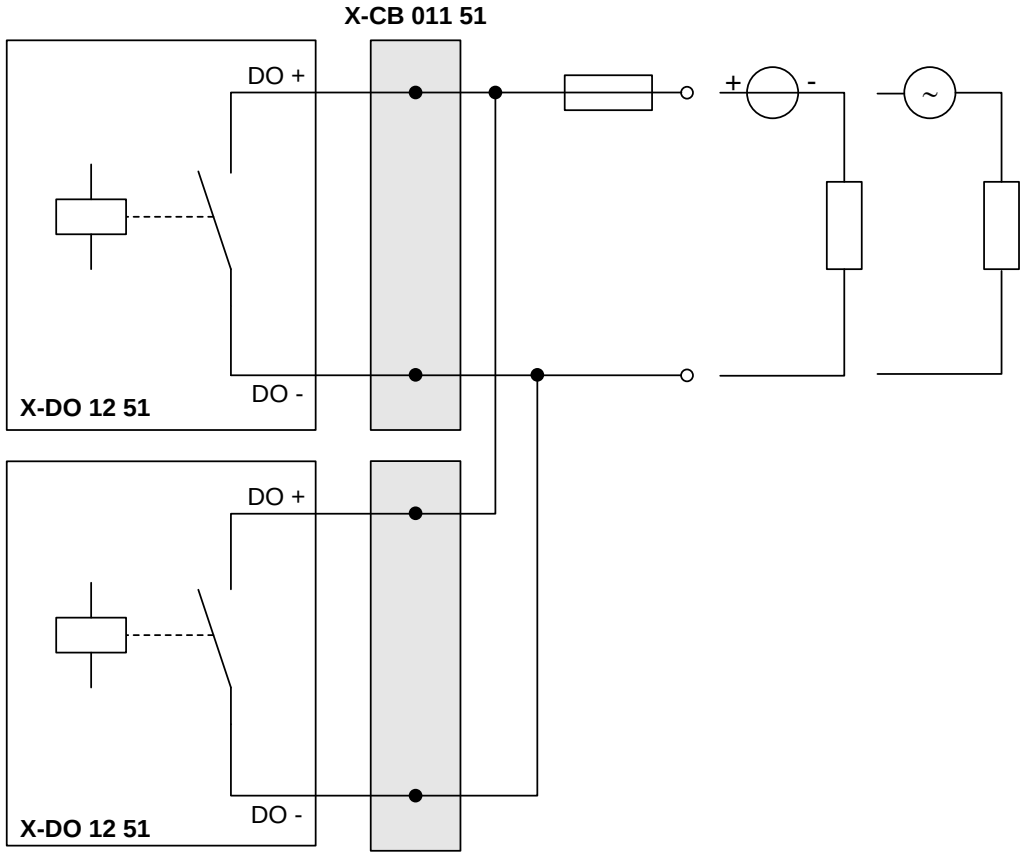
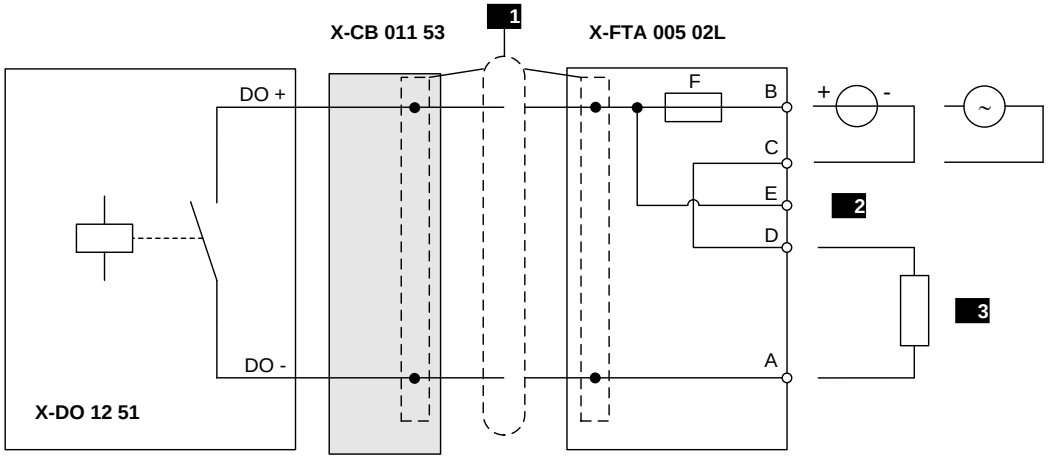


Figure 14: Redundant Wiring of an Actuator to Redundant Relay Modules

4.4.4 Wiring Actuators via Field Termination Assembly

Actuators are connected via the X-FTA 005 02L as described in Figure 15. 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

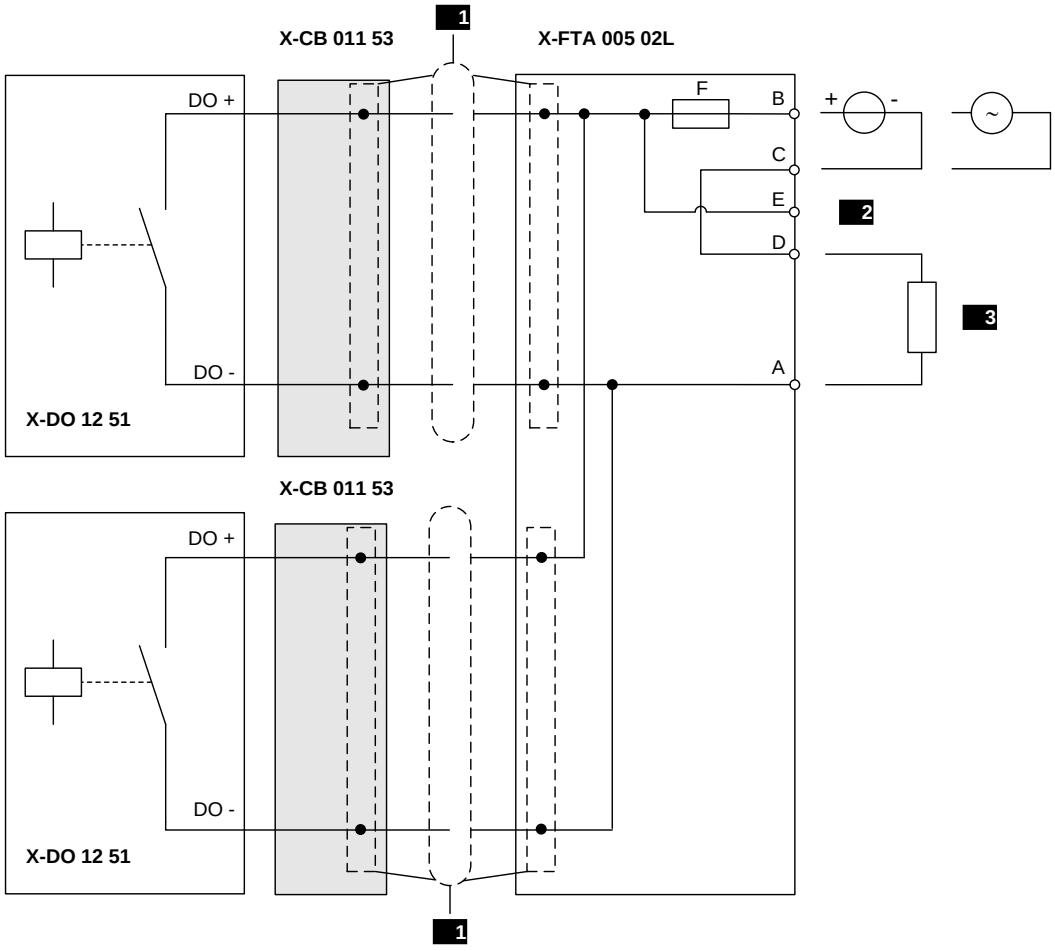
Figure 15: Wiring via Field Termination Assembly

4.4.5 Redundantly Wiring Actuators via Field Termination Assembly

Actuators are redundantly wired via the field termination assembly X-FTA 005 02L as specified in Figure 16. For further information, refer to the X-FTA 005 02L manual (HI 801 125 E).

NOTICE

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



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

Figure 16: Redundantly 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 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 3.4.2.

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

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 a faultless module of the same type or with an approved replacement model.

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

6.1 Maintenance Measures

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 3.3.

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

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