Manual

HIMax®

X-DI 32 05

Digital Input Module for Proximity Switches and Wired Mechanical Contacts with SOE

Contact

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HI 801 052 D, Rev. 10.00 (1907)	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 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 in conjunction with 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. 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.

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

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.

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-DI 32 05 digital input module is intended for use in the programmable electronic system (PES) HIMax.

The module is used to evaluate up to 32 safety proximity switches (e.g., P+F), proximity switches in accordance with EN 60947-5-6 (NAMUR) or wired contacts.

The module is suitable for sequence of events recording (SOE). Events are recorded within a module cycle of 2 ms, refer to Chapter 4.3 for details.

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

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 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 evaluates the input signals of proximity switches and mechanical contacts and monitors the proximity switch and mechanical contact circuit for open-circuits and short-circuits.

The safety function is performed in accordance with SIL 3.

3.1.1 Response in the Event of a Fault

If a fault occurs, the module adopts the safe state and the assigned input variables transmit the initial value (default value = 0) to the user program.

The initial values must be set to 0 to ensure that the input variables transmit the value 0 to the user program if a fault occurs. If the raw value is evaluated instead of the process value, users must program the monitoring function and the value in the event of faults from within the user program.

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-DI 32 05 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.

3.3.1 Restrictions

Shielded field cables must be used for the module. Ensure that the field cables are provided with continuous shielding.

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 has 32 inputs, each input is measured and functionally tested using two internal measuring devices.

4 short-circuit-proof supplies feed 8 supply outputs each. One supply output is assigned to each input.

The 32 inputs can be used to evaluate the values measured for the proximity switches, safety proximity switches or wired contacts.

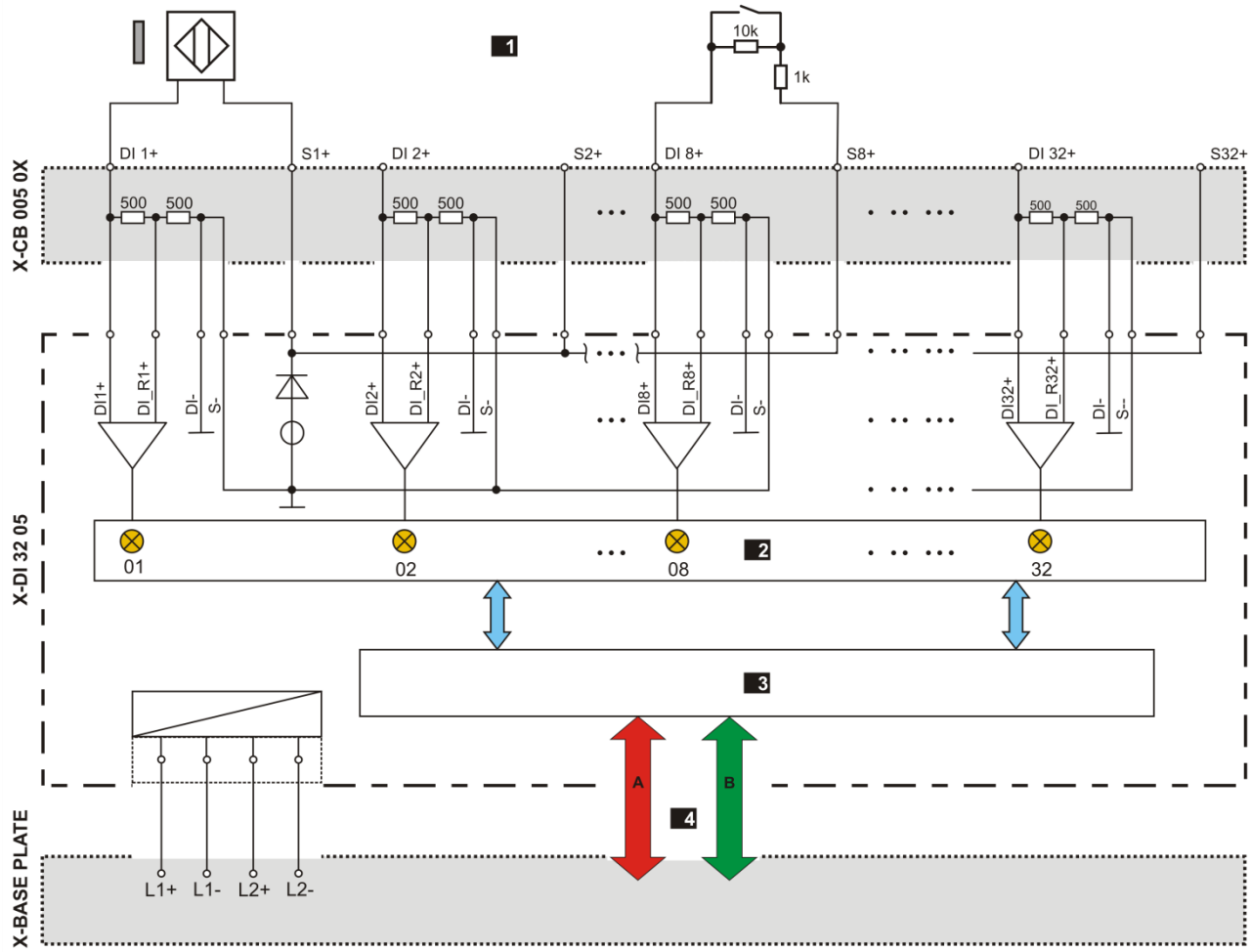
The switching thresholds for generating digital signals can be set in SILworX.

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.

The module is equipped with LEDs to indicate the status of the digital inputs, see Chapter 3.5.2.

3.5.1 Block diagram

The following block diagram illustrates the structure of the module.



1 Field level: Proximity switches and mechanical contacts
2 Interface
3 Safety-related processor system
4 System buses

Figure 2: Block Diagram

3.5.2 Indicators

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

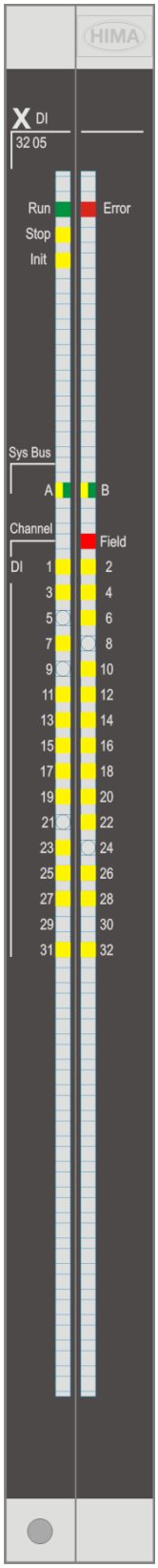


Figure 3: Front View

The LEDs indicate the operating state of the 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 (DI 1...32, 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
DI 1…DI 32	Yellow	On	High level present
		Blinking2	Channel fault
		Off	Low level present
Field	Red	Blinking2	Field fault on at least one channel, e.g., open-circuit, short-circuit, overcurrent.
		Off	No faults at the field level

Table 5: I/O Indicators

3.6 Product Data

General	
Supply voltage	24 VDC, -15…+20 %, r_p ≤ 5 % SELV, PELV
Current consumption	450 mA at 24 VDC (without channels and proximity switch supplies) Max. 1 A (if the max. output current is applied to the supplies)
Module cycle time	2 ms
Protection class	Protection class III in accordance with IEC/EN 61131-2
Operating temperature	0…+60 °C
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) in mm	310 x 29.2 x 230
Weight	Approx. 1.1 kg

Table 6: Product Data

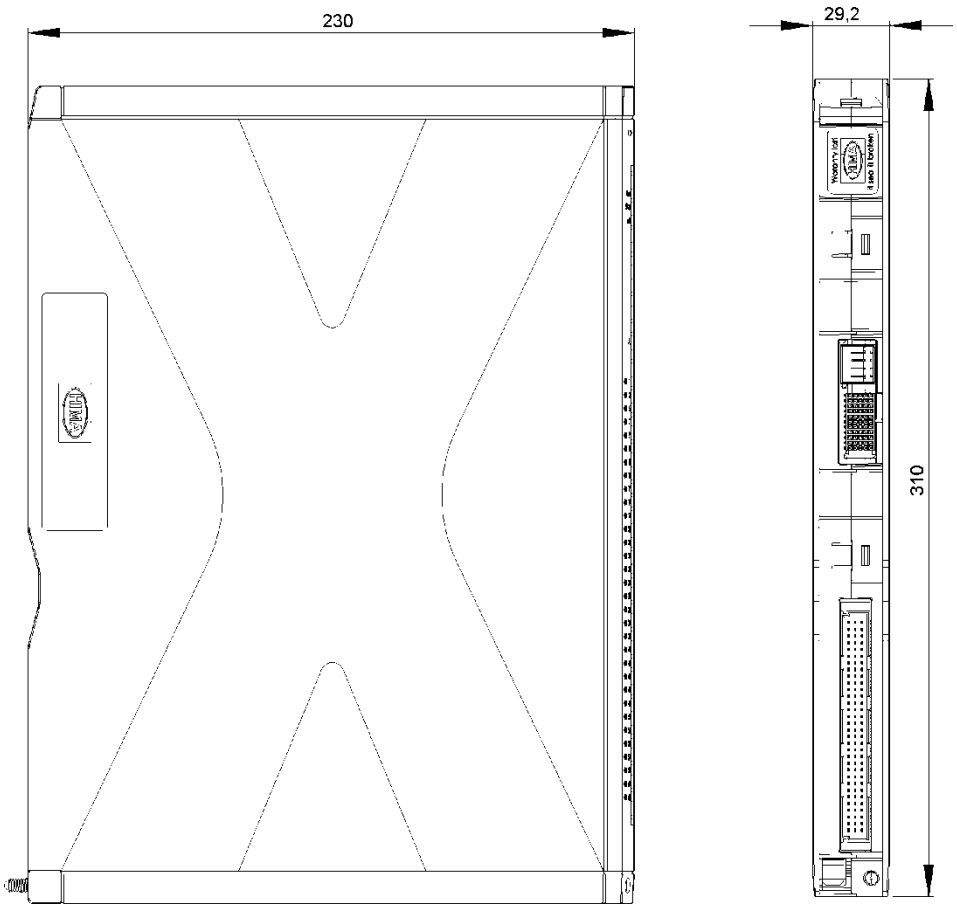


Figure 4: Views

Digital inputs	
Number of inputs (number of channels)	32 unipolar with reference pole DI- Not galvanically separated from one another
Type of input	Digital signal inputs for safety proximity switches (e.g., P+F), proximity switches in accordance with EN 60947-5-6 (NAMUR) or wired contacts.
Rated input current	0…9.25 mA Switching thresholds freely configurable in SILworX
Operating range: input current	0…9.3 mA
Resolution	12-bit
LSB value (LSB = Least Significant Bit)	0.1 µA
Shunt for current measurement	1000 Ω, on the connector board
Cable length	The wire length depends on the wire resistance ≤ 50 Ω, in accordance with EN 60947-5-6
Sequence of events recording cycle	2 ms
Measured value refresh (in the user program)	Cycle time of the user program
Metrological errors from the full scale	
Accuracy: intrinsic errors	< ±0.5 % incl. shunt
Accuracy: operating errors	< ±1 % at 0…60 °C, incl. shunt

Table 7: Specifications for Digital Inputs

Standard values for the digital inputs	
Proximity switch in accordance with EN 60947–5	Verify the values of the proximity switches actually in use.
Switch-on threshold Low -> High	1.8 mA
Switch-off threshold High -> Low	1.4 mA
Open-circuit	≤ 0.2 mA
Short-circuit	≥ 6.55 mA
Safety proximity switches in accordance with EN 60947-5-6	Verify the values of the proximity switches actually in use.
Switch-on threshold Low -> High	1.8 mA
Switch-off threshold High -> Low	1.4 mA
Open-circuit	≤ 0.2 mA
Short-circuit	≥ 4.825 mA
Mechanical contact with resistor combination (1 kΩ / 10 kΩ)	Verify the values actually used for the resistor combination.
Switch-on threshold Low -> High	1.8 mA
Switch-off threshold High -> Low	1.4 mA
Open-circuit	≤ 0.2 mA
Short-circuit	≥ 6.55 mA

Table 8: Standard Values for Digital Inputs

Proximity switch supply	
Number of proximity switch supplies	4 with 8 outputs each
Proximity switch supply output voltage	8.2 VDC, ±6 %
Proximity switch supply monitoring	The module monitors the proximity switch supplies for overvoltage, undervoltage and overcurrent. If a fault occurs, the corresponding *Supply X OK* status is set to FALSE
Short-circuit of a proximity switch supply	> 200 mA (0 V per module) The module switches off the affected proximity switch supply and sets the corresponding *Supply X OK* status to FALSE.
Maximum overload duration of the short-circuit (S+ -> DI+)	60 s
Assignment of supply outputs	
The voltage output assigned to each input must be used for power supply.	
S1+…S8+	DI1+…DI8+
S9+…S16+	DI2+…DI16+
S17+…S24+	DI17+…DI24+
S25+…S32+	DI15+…DI32+

Table 9: Product Data of the Proximity Switch Supply

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 005 01	Mono connector board with screw terminals.
X-CB 005 02	Redundant connector board with screw terminals
X-CB 005 03	Mono connector board with cable plug.
X-CB 005 04	Redundant connector board with cable plug
X-CB 005 05	Mono connector board with cable plug, redundant FTA

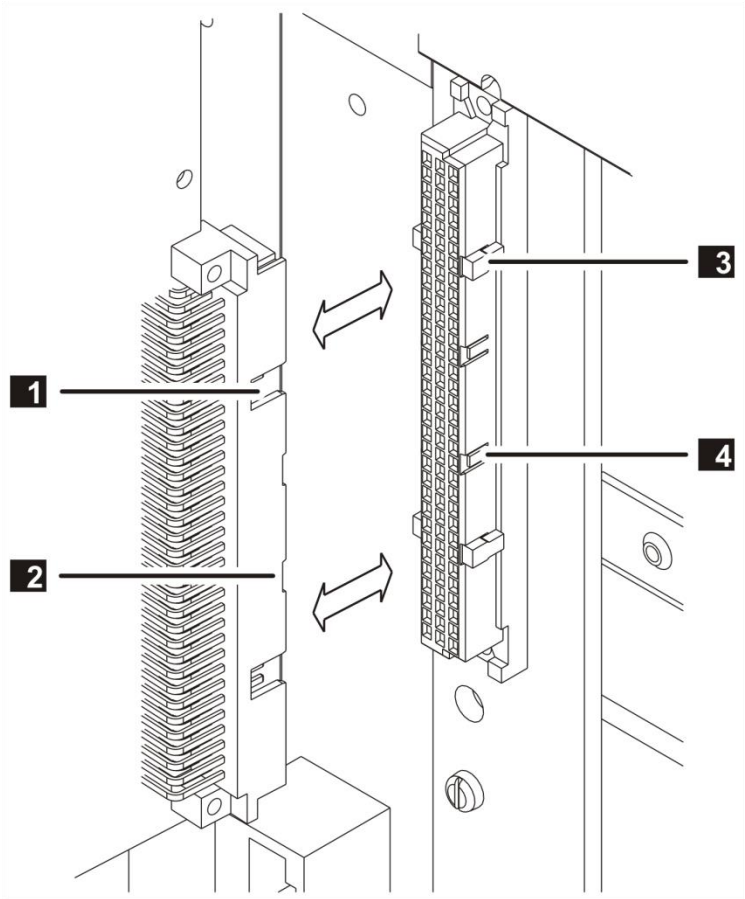
Table 10: Available Connector Boards

3.7.1 Mechanical Coding of Connector Boards

I/O modules and connector boards are mechanically coded starting from hardware revision index (HW-Rev.) 10. 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.

I/O modules and the corresponding connector boards have a mechanical coding in the form of wedges. The coding wedges in the female connector of the connector board match with the male connector recesses of the I/O module plug, see Figure 5.

Coded I/O modules can only be plugged in to the corresponding connector boards.



1 Male connector recess
2 Prepared male connector recess
3 Coding wedge
4 Guideway for coding wedge

Figure 5: Coding Example

Coded I/O modules can be plugged in to uncoded connector boards. Uncoded I/O modules cannot be plugged in to coded connector boards.

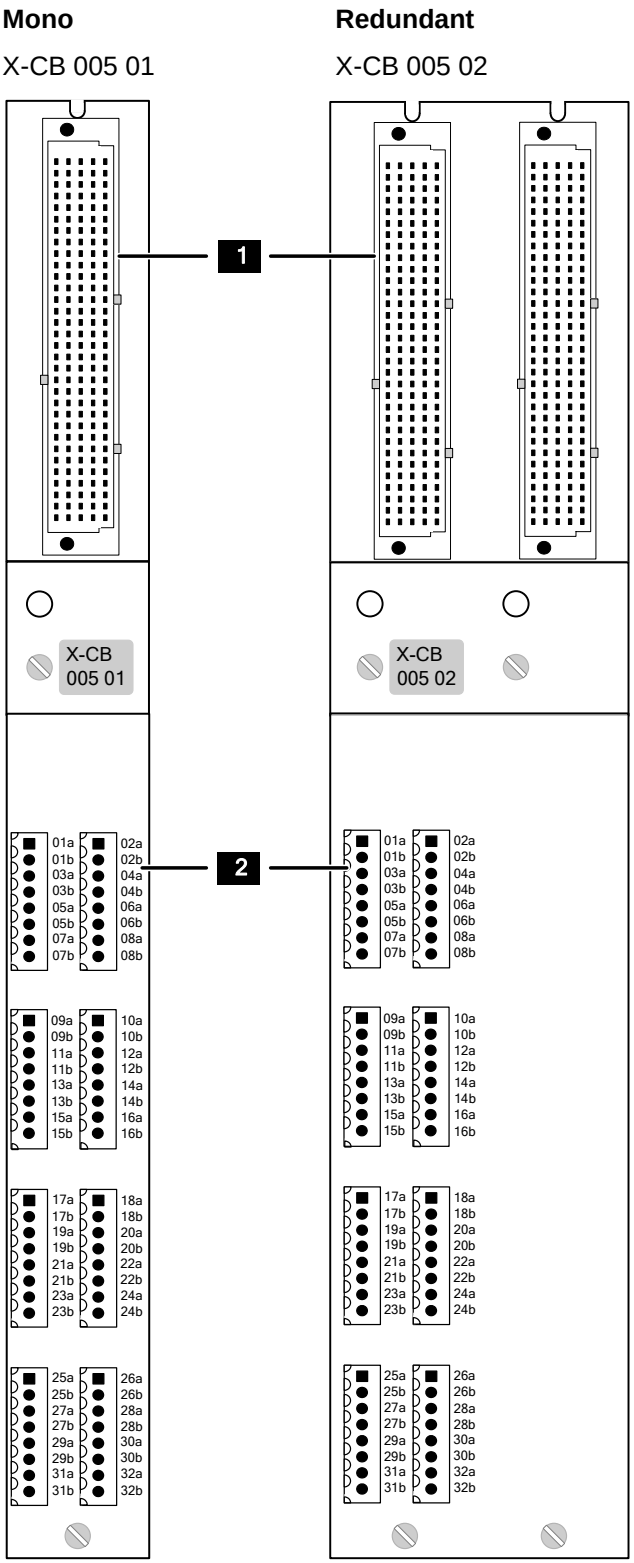
3.7.2 Coding of X-CB 005 0X Connector Boards

The following table specifies the position of the coding wedges on the I/O module plug:

a7	a13	a20	a26	e7	e13	e20	e26
		X			X		X

Table 11: Position of Coding Wedges

3.7.3 Connector Boards with Screw Terminals



1 I/O module plug

2 Connection to the field level (screw terminals)

Figure 6: Connector Boards with Screw Terminals

3.7.4 Terminal Assignment for Connector Boards with Screw Terminals

Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	01a	S1+	1	02a	S2+
2	01b	DI1+	2	02b	DI2+
3	03a	S3+	3	04a	S4+
4	03b	DI3+	4	04b	DI4+
5	05a	S5+	5	06a	S6+
6	05b	DI5+	6	06b	DI6+
7	07a	S7+	7	08a	S8+
8	07b	DI7+	8	08b	DI8+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	09a	S9+	1	10a	S10+
2	09b	DI9+	2	10b	DI10+
3	11a	S11+	3	12a	S12+
4	11b	DI11+	4	12b	DI12+
5	13a	S13+	5	14a	S14+
6	13b	DI13+	6	14b	DI14+
7	15a	S15+	7	16a	S16+
8	15b	DI15+	8	16b	DI16+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	17a	S17+	1	18a	S18+
2	17b	DI17+	2	18b	DI18+
3	19a	S19+	3	20a	S20+
4	19b	DI19+	4	20b	DI20+
5	21a	S21+	5	22a	S22+
6	21b	DI21+	6	22b	DI22+
7	23a	S23+	7	24a	S24+
8	23b	DI23+	8	24b	DI24+
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	25a	S25+	1	26a	S26+
2	25b	DI25+	2	26b	DI26+
3	27a	S27+	3	28a	S28+
4	27b	DI27+	4	28b	DI28+
5	29a	S29+	5	30a	S30+
6	29b	DI29+	6	30b	DI30+
7	31a	S31+	7	32a	S32+
8	31b	DI31+	8	32b	DI32+

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:

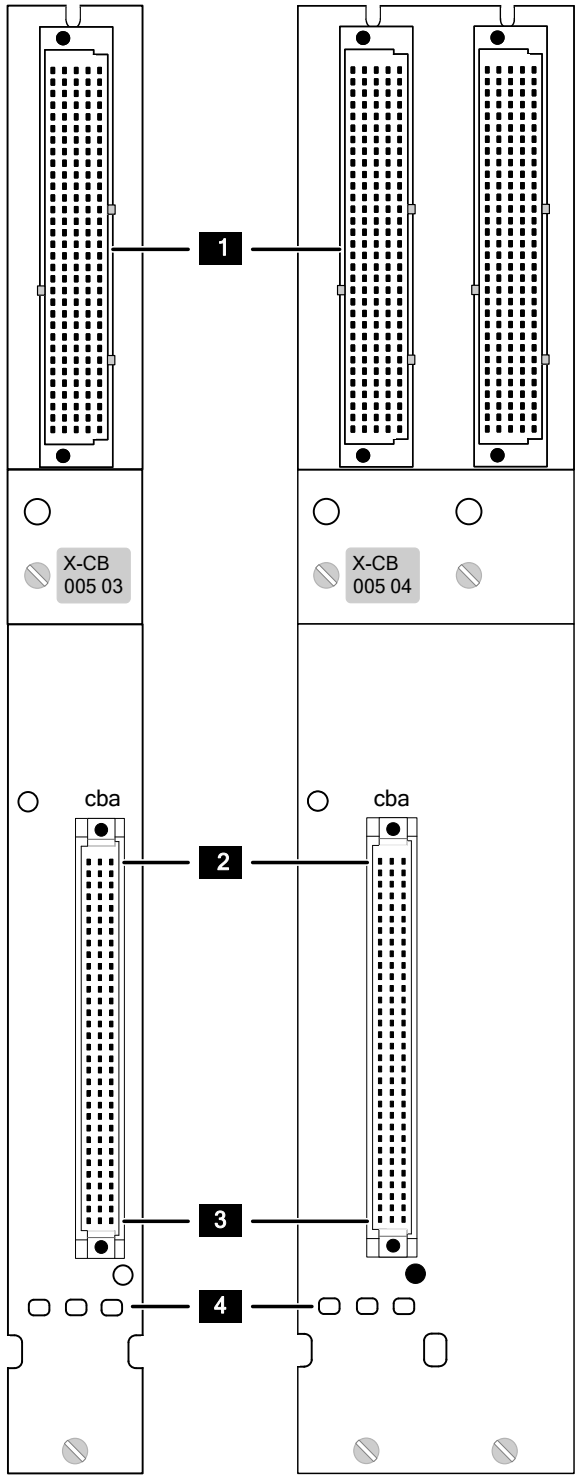
Connection to the field level	
Cable plugs	8 pieces, with 8 poles
Wire cross-section	0.2…1.5 mm^2 (single-wire) 0.2…1.5 mm^2 (finely stranded) 0.2…1.5 mm^2 (with wire end ferrule)
Stripping length	6 mm
Screwdriver	Slotted 0.4 x 2.5 mm
Tightening torque	0.2…0.25 Nm

Table 13: Cable Plug Characteristics

3.7.5 Connector Boards with Cable Plug

Mono X-CB 005 03

Redundant X-CB 005 04



1 I/O module plug

2 Connection to the field level (cable plug in row 1)

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

4 Coding of cable plugs

Figure 7: Connector Boards with Cable Plug

3.7.6 Pin Assignment for Connector Boards with Cable Plug

HIMA provides ready-made system cables for use with these connector boards, see Chapter 3.8. The cable plug and the connector boards are coded.

Connector pin assignment!

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

The wire color coding complies with IEC 60304. The color abbreviations used are in accordance with IEC 60757.

Row	c		b		a	
	Signal	Color	Signal	Color	Signal	Color
1	S32+	PKBN [1]	DI32+	WHPK [1]	Internal use [2]	BNRD [1]
2	S31+	GYBN [1]	DI31+	WHGY [1]		WHRD [1]
3	S30+	YEBN [1]	DI30+	WHYE [1]		BNBU [1]
4	S29+	BNGN [1]	DI29+	WHGN [1]		WHBU [1]
5	S28+	RDBU [1]	DI28+	GYPK [1]		
6	S27+	VT [1]	DI27+	BK [1]		
7	S26+	RD [1]	DI26+	BU [1]		
8	S25+	PK [1]	DI25+	GY [1]		
9	S24+	YE [1]	DI24+	GN [1]		
10	S23+	BN [1]	DI23+	WH [1]		
11	S22+	RDBK	DI22+	BUBK		
12	S21+	PKBK	DI21+	GYBK		
13	S20+	PKRD	DI20+	GYRD		
14	S19+	PKBU	DI19+	GYBU		
15	S18+	YEBK	DI18+	GNBK		
16	S17+	YERD	DI17+	GNRD		
17	S16+	YEBU	DI16+	GNBU		
18	S15+	YEPK	DI15+	PKGN		
19	S14+	YEGY	DI14+	GYGN		
20	S13+	BNBK	DI13+	WHBK		
21	S12+	BNRD	DI12+	WHRD		
22	S11+	BNBU	DI11+	WHBU		
23	S10+	PKBN	DI10+	WHPK		
24	S9+	GYBN	DI9+	WHGY		
25	S8+	YEBN	DI8+	WHYE		
26	S7+	BNGN	DI7+	WHGN		
27	S6+	RDBU	DI6+	GYPK		
28	S5+	VT	DI5+	BK		
29	S4+	RD	DI4+	BU		
30	S3+	PK	DI3+	GY		
31	S2+	YE	DI2+	GN		
32	S1+	BN	DI1+	WH		

[1] Additional orange ring if one wire color is repeated.

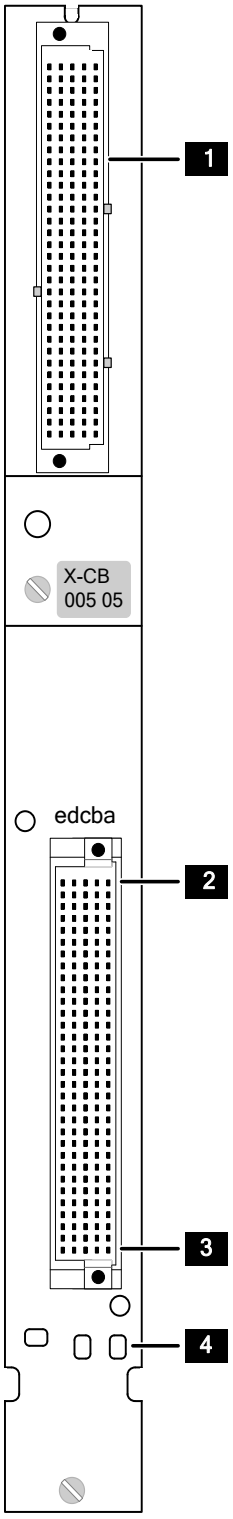
[2] The wires must be isolated individually! No other use is permitted!

Table 14: Pin Assignment for the System Cable Plug

3.7.7 Mono Connector Board Redundancy using 2 Base Plates

Mono

X-CB 005 05



1 I/O module plug

2 Connection to the field level (cable plug in row 1)

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

4 Coding of cable plugs

Figure 8: X-CB 005 05 Mono Connector Board with Cable Plug

3.7.8 Pin Assignment for X-CB 005 05

HIMA provides ready-made system cables for use with this connector board, see Chapter 3.8. The cable plug and the connector boards are coded.

Connector pin assignment!

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

The wire color coding complies with IEC 60304. The color abbreviations used are in accordance with IEC 60757.

Row	e		d		c		b		a	
	Signal	Color	Signal	Color	Signal	Color	Signal	Color	Signal	Color
1	S32+	RD 2)	DI_R32+	PKBN 1)	DI32+	WHPK 1)				BNRD 2)
2	S31+	BU 2)	DI_R31+	GYBN 1)	DI31+	WHGY 1)			Internal use 3)	WHRD 2)
3	S30+	PK 2)	DI_R30+	YEBN 1)	DI30+	WHYE 1)				BNBU 2)
4	S29+	GY 2)	DI_R29+	BNGN 1)	DI29+	WHGN 1)				WHBU 2)
5	S28+	YE 2)	DI_R28+	RDBU 1)	DI28+	GYPK 1)				
6	S27+	GN 2)	DI_R27+	VT 1)	DI27+	BK 1)				
7	S26+	BN 2)	DI_R26+	RD 1)	DI26+	BU 1)				
8	S25+	WH 2)	DI_R25+	PK 1)	DI25+	GY 1)				
9	S24+	RDBK 1)	DI_R24+	YE 1)	DI24+	GN 1)				
10	S23+	BUBK 1)	DI_R23+	BN 1)	DI23+	WH 1)				
11	S22+	PKBK 1)	DI_R22+	RDBK	DI22+	BUBK				
12	S21+	GYBK 1)	DI_R21+	PKBK	DI21+	GYBK				
13	S20+	PKRD 1)	DI_R20+	PKRD	DI20+	GYRD				
14	S19+	GYRD 1)	DI_R19+	PKBU	DI19+	GYBU				
15	S18+	PKBU 1)	DI_R18+	YEBK	DI18+	GNBK				
16	S17+	GYBU 1)	DI_R17+	YERD	DI17+	GNRD				
17	S16+	YEBK 1)	DI_R16+	YEBU	DI16+	GNBU	S-	BNRD 2)		
18	S15+	GNBK 1)	DI_R15+	YEPK	DI15+	PKGN	S-	WHRD 2)		
19	S14+	YERD 1)	DI_R14+	YEGY	DI14+	GYGN	S-	BNBU 2)		
20	S13+	GNRD 1)	DI_R13+	BNBK	DI13+	WHBK	S-	WHBU 2)		
21	S12+	YEBU 1)	DI_R12+	BNRD	DI12+	WHRD	S-	PKBN 2)		
22	S11+	GNBU 1)	DI_R11+	BNBU	DI11+	WHBU	S-	WHPK 2)		
23	S10+	YEPK 1)	DI_R10+	PKBN	DI10+	WHPK	S-	GYBN 2)		
24	S9+	PKGN 1)	DI_R9+	GYBN	DI9+	WHGY	S-	WHGY 2)		
25	S8+	YEGY 1)	DI_R8+	YEBN	DI8+	WHYE	DI-	YEBN 2)		
26	S7+	GYGN 1)	DI_R7+	BNGN	DI7+	WHGN	DI-	WHYE 2)		
27	S6+	BNBK 1)	DI_R6+	RDBU	DI6+	GYPK	DI-	BNGN 2)		
28	S5+	WHBK 1)	DI_R5+	VT	DI5+	BK	DI-	WHGN 2)		
29	S4+	BNRD 1)	DI_R4+	RD	DI4+	BU	DI-	RDBU 2)		
30	S3+	WHRD 1)	DI_R3+	PK	DI3+	GY	DI-	GYPK 2)		
31	S2+	BNBU 1)	DI_R2+	YE	DI2+	GN	DI-	VT 2)		
32	S1+	WHBU 1)	DI_R1+	BN	DI1	WH	DI-	BK 2)		

1) Additional orange ring if one wire color is repeated for the first time.

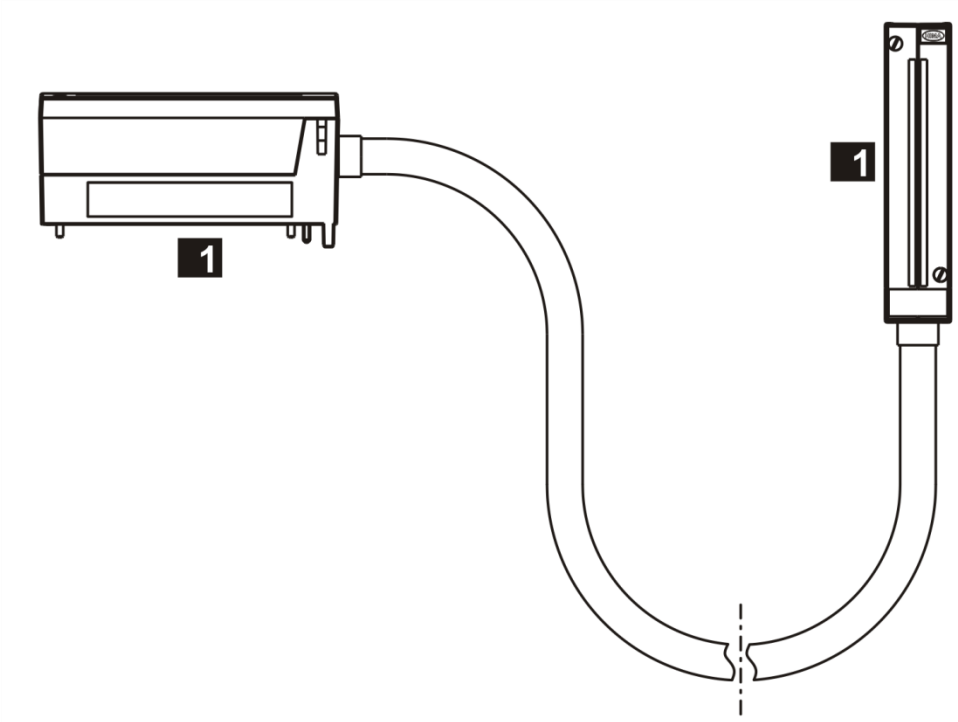
2) Additional violet ring if one wire color is repeated for the second time.

3) The wires must be isolated individually! No other use is permitted!

Table 15: Pin Assignment for the System Cable Plug

3.8 System Cables

The system cables connect the connector boards to the field termination assembly.



1 Identical cable plugs

Figure 9: System Cable X-CA 002 01 n

Depending on the type of connector board, two different types of system cables are available.

3.8.1 System Cable X-CA 002

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

General	
Cable	LIYY-TP 34 x 2 x 0.25 mm²
Wire	Finely stranded
Average outer diameter (d)	Approx. 15.2 mm Max. 20 mm for all types of system cables
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
Color coding	Based on DIN 47100, see Table 14.

Table 16: Cable Data X-CA 002

The system cable is available in the following standard lengths:

System cables	Description	Length	Weight
X-CA 002 01 8	Coded cable plugs on both sides.	8 m	3.5 kg
X-CA 002 01 15		15 m	6.5 kg
X-CA 002 01 30		30 m	13 kg

Table 17: Available System Cables X-CA 002

3.8.2 System Cable X-CA 009

System cable X-CA 009 is used to connect the X-CB 005 05 connector board to the field termination assembly.

General	
Cable	LIYCY-TP 58 x 2 x 0.14 mm²
Wire	Finely stranded
Average outer diameter (d)	Approx. 18.3 mm Max. 20 mm for all types of system cables
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
Color coding	Based on DIN 47100, see Table 15.

Table 18: Cable Data X-CA 009

The system cable is available in the following standard lengths:

System cables	Description	Length	Weight
X-CA 009 01 8	Coded cable plugs on both sides.	8 m	4.25 kg
X-CA 009 01 15		15 m	8 kg
X-CA 009 01 30		30 m	16 kg

Table 19: Available System Cables X-CA 009

3.8.3 Cable Plug Coding

The cable plugs are equipped with three coding pins. Therefore, cable plugs only match connector boards and FTAs encoded accordingly, see Figure 7 und Figure 8.

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 inputs and the connected proximity switches must comply with the safety requirements. For further details, refer to the 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.

NOTICE

Damage due to incorrect wiring!

Failure to comply with these instructions can damage the electronic components.

Observe the following points.

- Plugs and terminals connected to the field level.
  - Take the appropriate grounding measures when connecting the plugs and terminals to the field level.
  - An unshielded cable may be used for connecting proximity switches and switching contacts to the digital inputs.
  - If finely stranded wires are used, HIMA recommends fastening ferrules to the wire ends. The terminals must be suitable for fastening the cross-sections of the cables in use.
- If the supply is used, utilize the supply output used for the assigned input, see Table 8.

  HIMA recommends using the supply of the module.
  If an external current source is malfunctioning, the affected digital module input can be overloaded and damaged. If an external current source is used, the switching thresholds must be checked after a non-transient overload occurred at the digital inputs.
- The inputs can be interconnected redundantly using the corresponding connector boards, see Chapters 3.7 and 4.3.

4.1.1 Wiring Unused Inputs

Inputs that are not being used may stay open and need not be terminated. However, to prevent short-circuits, 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.

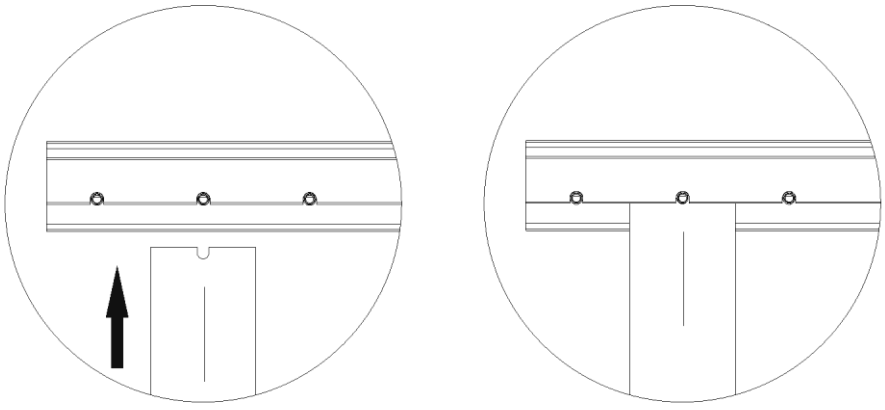


Figure 10: Example of how to Insert the Mono Connector Board

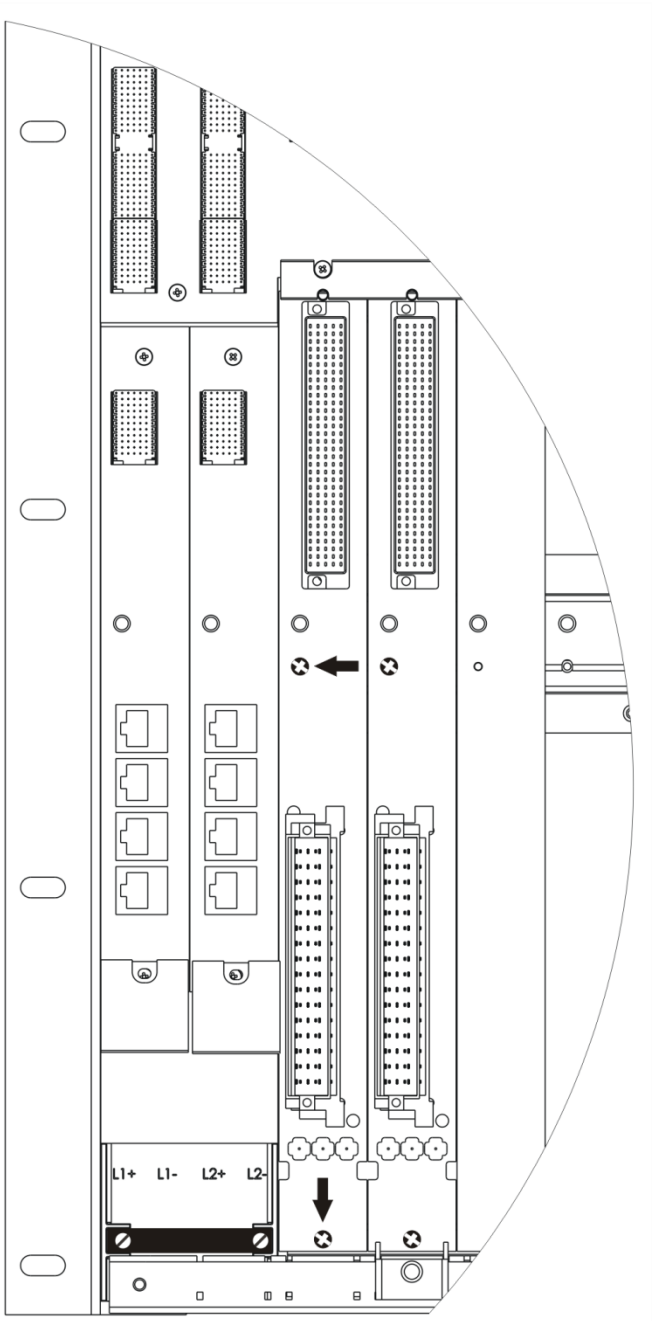


Figure 11: Example of how to Secure the Mono Connector Board with Captive Screws

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:

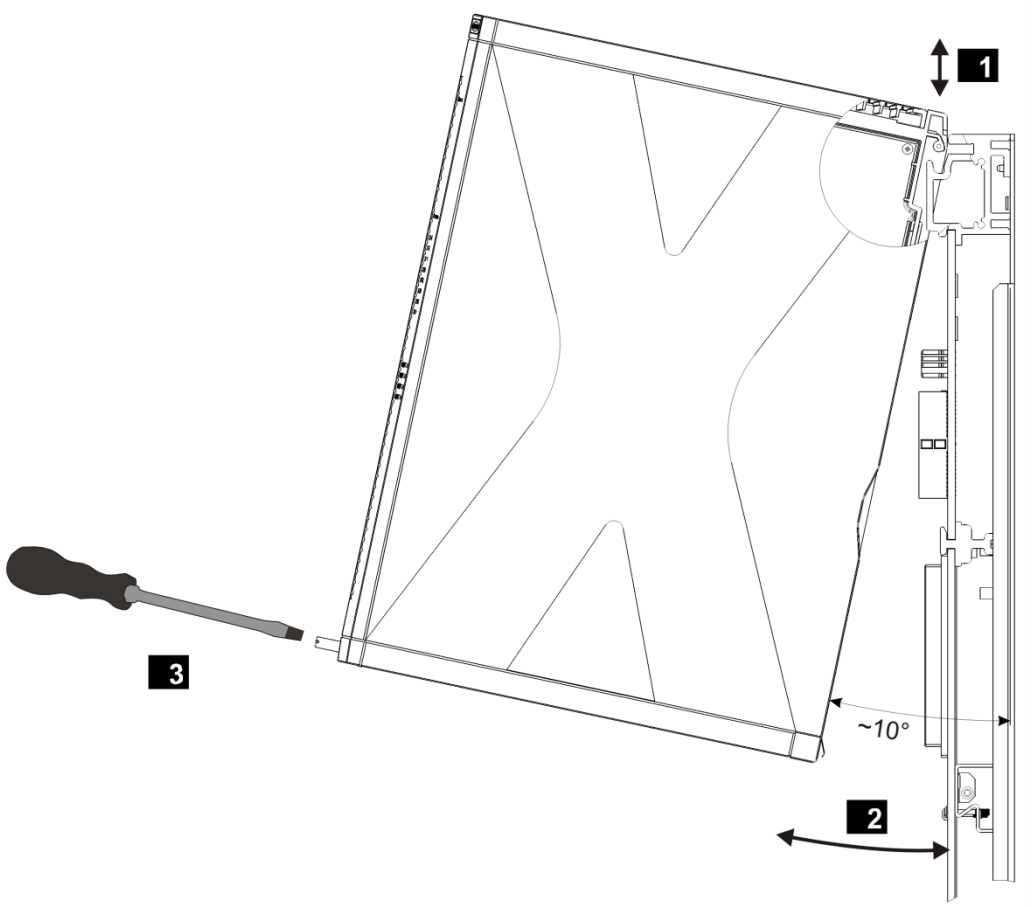
- Screwdriver, slotted 0.8 x 4.0 mm.
- Screwdriver, slotted 1.2 x 8.0 mm.

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 12: 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 Sequence of Events Recording (SOE)

Exactly one event (I/O event) can be configured for each channel. The configuration is performed using the programming tool SILworX, see the online help and the communication manual (HI 801 101 E).

During each cycle (2 ms), the I/O module reads the values measured for the digital inputs and records the events that are stored in the volatile I/O event buffer.

An event is composed of:

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

Table 20: Event Description

The processor module reads the events from the I/O event buffer cyclically and stores them in its non-volatile memory. Events stored in the I/O event buffer can be overwritten with new events read by the processor module.

If the I/O event buffer is full, the I/O module creates an overflow system event entry in the non-volatile memory of the processor module. Thereafter, events are no longer recorded until existing events have been read and space is once again available in the buffer.

4.3.1 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.
- When scaling the input value -> *Raw Value [DINT],* users must make sure that the scaling result is within the range of values for the REAL data type. Representation of the scaling result must be possible with a REAL variable.
- For short-circuit and open-circuit monitoring, two thresholds are safely detected by the module. The switching thresholds can be set in SILworX in the module configuration.
- If the proximity switch supply of the module is used, activate the parameter *Supply X ON* parameter. To diagnose the proximity switch supply in use, the *Supply X OK* status can be evaluated in the user program. Refer to Table 22 for more details about the *Supply X OK* status.
- If the modules are redundantly connected, the proximity switch supply group must be activated using the parameter *Supply X ON*.
  To diagnose the redundant proximity switch supplies, the *Supply X OK* statuses of the two used proximity switch supplies must be evaluated in the user program using an OR function block.
  A time-off delay (e.g., a TOF functional block) of at least one CPU cycle must be used at the output of the OR function block. This avoids temporary interruption of diagnostic monitoring (e.g., while replacing a redundant module). Note that this measure causes the evaluation for this status to be delayed accordingly.
- 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.

4.3.2 The **Module** Tab

The **Module** tab contains the following system parameters for the module:

System parameter	Data type	S [1]	R/W	Description
Name	---	---	W	Module name.
Spare Module	BOOL	N	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	N	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 parameter	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: 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 (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. Point in time when the digital inputs were measured.
Timestamp [s]	DWORD	N	R	Second fraction of the timestamp. Point in time at which the measurement was performed.
[1] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 21: The **Module** Tab in the Hardware Editor

4.3.3 The **I/O Submodule DI 32_05** Tab

The **I/O Submodule DI32_02** tab contains the following system parameters:

System parameters	Data type	S [1)]	R/W	Description
Enter these statuses and parameters directly in the Hardware Editor.				
Name	---	---	R	Module name.
Show Signal Overflow	BOOL	N	W	Show signal overflow with *Field* LED (Activated/Deactivated). Default setting: Activated
Show Supply Overcurrent	BOOL		W	Show supply overcurrent with *Field* LED (Activated/Deactivated). Default setting: Activated
Supply 1 ON	BOOL		W	Use module's proximity switch supplies for Channel 1 to Channel 8 (Activated/Deactivated). Default setting: Activated
Supply 2 ON	BOOL		W	Use module's proximity switch supplies for Channel 9 to Channel 16 (Activated/Deactivated). Default setting: Activated
Supply 3 ON	BOOL		W	Use module's proximity switch supplies for Channel 17 to Channel 24 (Activated/Deactivated). Default setting: Activated
Supply 4 ON	BOOL		W	Use module's proximity switch supplies for Channel 25 to Channel 32 (Activated/Deactivated). Default setting: Activated
System parameter	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 4.3.6).
Diagnostic Response	DINT	N	R	As soon as *Diagnostic Response* returns the ID of *Diagnostic Request* (for coding details, see Chapter 4.3.6), *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 not faulty.
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

System parameters	Data type	S [1)]	R/W	Description
Supply 1 OK	BOOL	N	R	The proximity switch supplies are monitored for overvoltage, undervoltage and overcurrent. TRUE: The proximity switch supply is not faulty. FALSE: The proximity switch supply is faulty.
Supply 2 OK	BOOL	N	R	Such as *Supply 1 OK*.
Supply 3 OK	BOOL	N	R	Such as *Supply 1 OK*.
Supply 4 OK	BOOL	N	R	Such as *Supply 1 OK*.
Submodule OK	BOOL	Y	R	TRUE: No submodule fault, no channel faults. FALSE: Submodule fault, channel faults (external faults included).
Submodule Status	DWORD	N	R	Bit-coded submodule status. For coding details, see Chapter 4.3.5.
[1)] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 22: The **I/O Submodule DI 32_05** Tab in the Hardware Editor

The proximity switch supplies of the module are short-circuit-proof. The module switches off the corresponding proximity switch supply if the total current is exceeded (> 200 mA). If the overload disappears within 30 s, the proximity switch supply is switched on again. If the overload is still present after 30 s, the module attempts to restart the proximity switch supply in intervals of 60 s.

Short transient interferences (< 5 ms) do not cause the proximity switch supply to switch off.

Switching off a proximity switch supply affects all inputs of this group (Table 9), i.e., the digital values of these inputs are reset to their initial values. If line monitoring (OC) was configured, the module also reports an open-circuit in all 8 inputs.

The configured proximity switch supplies are switched on in the STOP-VALID status of the HIMax controller.

The proximity switch supply outputs of the module cannot be forced and may only be configured in the Hardware Editor.

The voltage limits of the proximity switch supply outputs are safely monitored by the module. In case of overvoltage, undervoltage or overcurrent, the corresponding status *Supply X OK* is set to FALSE.

For supplying a channel, the voltage output assigned to the input must be used (e.g., S1+ with DI1+).

4.3.4 The **I/O Submodule DI32_05: Channels** Tab

The **I/O Submodule DI32_05: 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 parameters	Data type	S [1)]	R/W	Description
Channel no.	---	---	R	Channel number, preset and cannot be changed.
SP LOW	DINT	Y	W	Upper limit of LOW level. *SP LOW* (switching point LOW) is the limit value: if this limit is exceeded, the module detects LOW and switches off the *Channel* LED. Restriction: *SP LOW ≤ SP HIGH* Default setting: 14 000 (1.4 mA)
SP HIGH	DINT	Y	W	Lower limit for the high level. *SP HIGH* (switching point HIGH) is the limit value: if this limit is exceeded, the module detects a HIGH and switches on the *Channel* LED. Restriction: *SP LOW ≤ SP HIGH* Default setting: 18 000 (1.8 mA)
-> Channel Value [BOOL]	BOOL	Y	R	Boolean channel process value in accordance with the limits *SP LOW* and *SP HIGH*.
-> Channel OK [BOOL]	BOOL	Y	R	TRUE: Fault-free channel. The input value is valid. FALSE: Faulty channel. The input value is set to 0.
OC Limit	DINT	Y	W	Threshold in mA for detecting an open-circuit. If the analog measured value falls under *OC Limit*, the module detects an open-circuit and switches off the *Channel* LED for this channel. Default setting: 2000 (0.2 mA)
-> OC [BOOL]	BOOL	Y	R	TRUE: Open-circuit present. FALSE: No open-circuit present. Defined through *OC Limit.*

System parameters	Data type	S [1]	R/W	Description
SC Limit	DINT	Y	W	Threshold in mA for detecting a short-circuit. If the measured analog value exceeds *SC Limit*, the module detects a short-circuit and sets the *Channel* LED for this channel to Blinking2. Default setting: 65 500 (6.55 mA)
-> SC [BOOL]	BOOL	Y	R	TRUE: Short-circuit present. FALSE: No short-circuit present. Defined through *SC Limit.*
T on [µs]	UDINT	Y	W	Time on delay The module only indicates a level change from LOW to HIGH if the high level is present for longer than the configured time t_{on}. The time on delay cannot be extended by more than the cycle time of the module. This also results in a delayed evaluation of the -> *Channel Value [BOOL]* parameter. For blanking surge pulses in accordance with EN 61000-4-5, a time-on delay of 2000 µs must be configured. Range of values: 0…(2^{32} - 1) Granularity: 1000 µs, e.g., 0, 1000, 2000, … Default setting: 0
T off [µs]	UDINT	Y	W	Time off delay The module only indicates a level change from HIGH to LOW if the low level is present for longer than the configured time t_{off}. The time off delay cannot be extended by more than the cycle time of the module. This also results in a delayed evaluation of the -> *Channel Value [BOOL]* parameter. For blanking surge pulses in accordance with EN 61000-4-5, a time off delay of 2000 µs must be configured. Range of values: 0…(2^{32} - 1) Granularity: 1000 µs, e.g., 0, 1000, 2000, … Default setting: 0
-> Raw Value [DINT]	DINT	N	R	Unhandled analog value measured for the channel Range of values: 0…93 000 (0…9.3 mA)
Redund.	BOOL	Y	R	Requirement: The redundant module must exist. Activated: The channel redundancy for this channel is active. Deactivated: Deactivate the channel redundancy for this channel. Default setting: Deactivated
Redundancy Value	BYTE	Y	W	Setting for determining the redundancy value. ▪ Min ▪ Max ▪ Average Default setting: Max **It is only displayed in the redundancy group tab!**

[1] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).

Table 23: The **I/O Submodule DI32_05: Channels** Tab in the Hardware Editor

4.3.5 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 I/O bus.
0x00000004	Faults detected while configuring the hardware unit.
0x00000008	Fault detected while checking the coefficients.
0x20000000	Operating voltages faulty.
0x40000000	Fault during A/D conversion (conversion begin).
0x10000000	Fault during AD conversion (conversion end).

Table 24: Coding of *Submodule Status [DWORD]*

4.3.6 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>Not used!</td></tr>
<tr><td>202</td><td>Actual value of the internal core 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…1032</td><td>Status of the channels 1…32
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Fault in hardware unit (submodule).</td></tr>
<tr><td>0x0002</td><td>Channel fault due to internal fault.</td></tr>
<tr><td>0x0400</td><td>SC / OC limits violated or
Channel or module fault.</td></tr>
<tr><td>0x0800</td><td>Measured values invalid (potential measurement system fault).</td></tr>
<tr><td>0x1000</td><td>The measured values are out of the measurement accuracy range.</td></tr>
<tr><td>0x2000</td><td>Underflow or overflow of the measured value.</td></tr>
<tr><td>0x4000</td><td>Channel not configured.</td></tr>
<tr><td>0x8000</td><td>Independent measurements of both measurement systems malfunctioning.</td></tr>
</table></td></tr>
<tr><td>2001…2004</td><td>Fault status of the power sources 1…4 (e.g., proximity switch supplies)
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x2000</td><td>Overload of the proximity switch supply.</td></tr>
<tr><td>0x4000</td><td>Undervoltage of the proximity switch supply</td></tr>
<tr><td>0x8000</td><td>Overvoltage of the proximity switch supply.</td></tr>
</table></td></tr>
</table>

Table 25: Coding for *Diagnostic Status [DWORD]*

4.4 Connection Variants

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

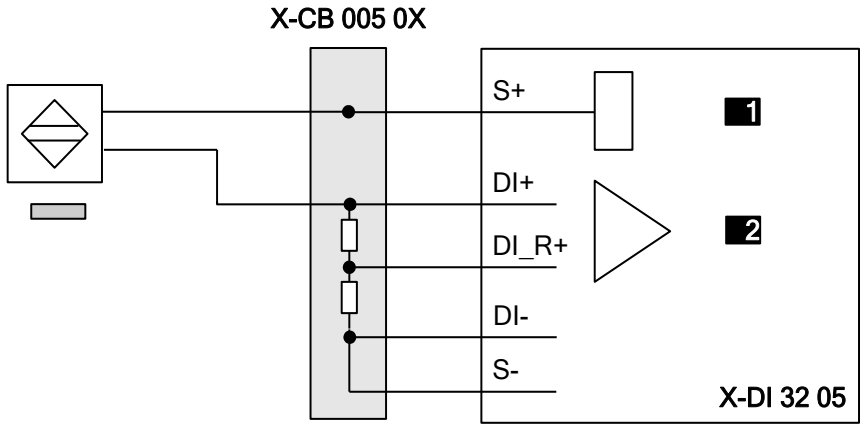
i The mechanical contacts must be connected to a resistor combination, e.g., 1 kΩ and 10 kΩ, to detect open-circuits and short-circuits, see also Chapter 3.5.1 and Chapter 3.6.

4.4.1 Wiring with Proximity Switch or Wired Mechanical Contact

The inputs are wired via connector boards. Special connector boards are available for redundantly wiring the modules.

The proximity switch supplies are decoupled using diodes. This ensures that the proximity switch supplies of two modules can supply one proximity switch if the modules are redundant to one another.

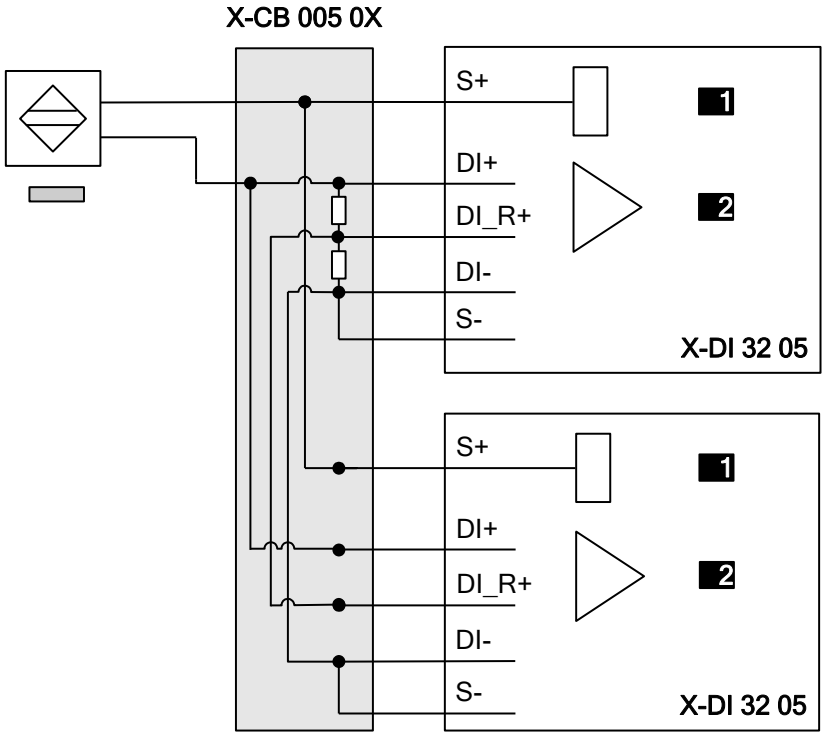
Connector boards X-CB 005 01 (with screw terminals) or X-CB 005 03 (with cable plug) can be used to perform the wiring in accordance with Figure 13.



1 Proximity switch supply 2 Processing of analog measured value

Figure 13: 1-Channel Proximity Switch or Wired Mechanical Contact

When redundantly wired as specified in Figure 14, the modules are inserted in the base plate next to each other and on a common connector board. Connector boards X-CB 005 02 (with screw terminals) or X-CB 005 04 (with cable plug) can be used.



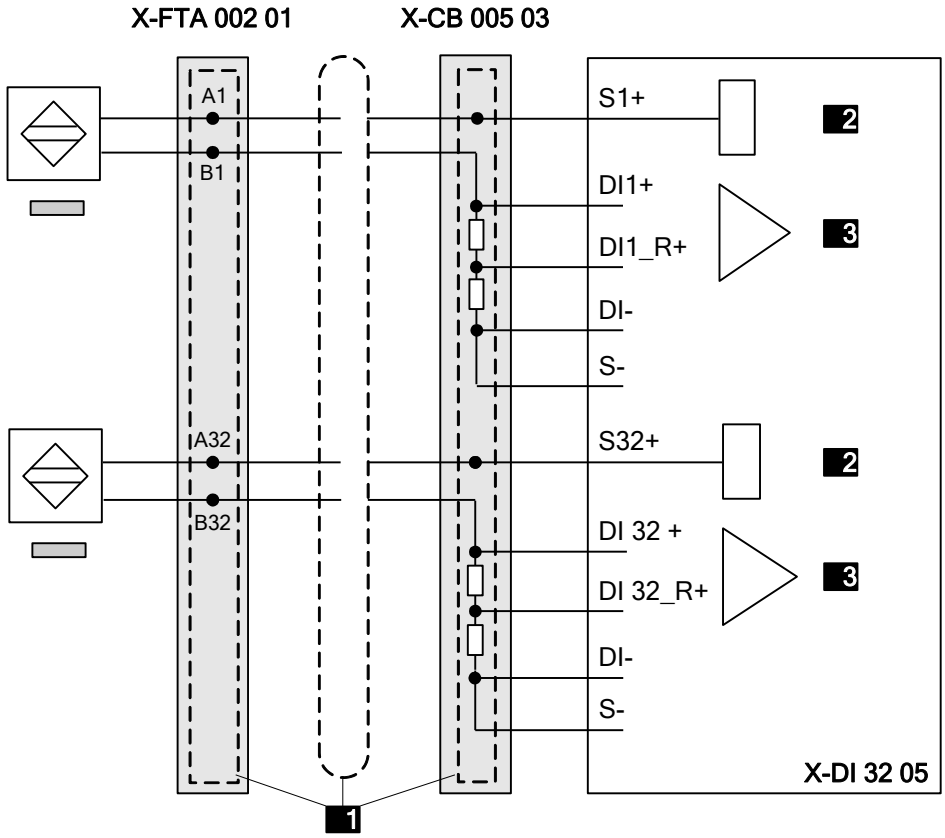
1 Proximity switch supply

2 Processing of analog measured value

Figure 14: Redundant Proximity Switch or Wired Mechanical Contact

4.4.2 Wiring Transmitters via Field Termination Assembly

Proximity switches are connected via the X-FTA 002 01 as described in Figure 15. For further information, refer to the X-FTA 002 01 manual (HI 801 117 E).



1 System cable X-CA 002 01 n

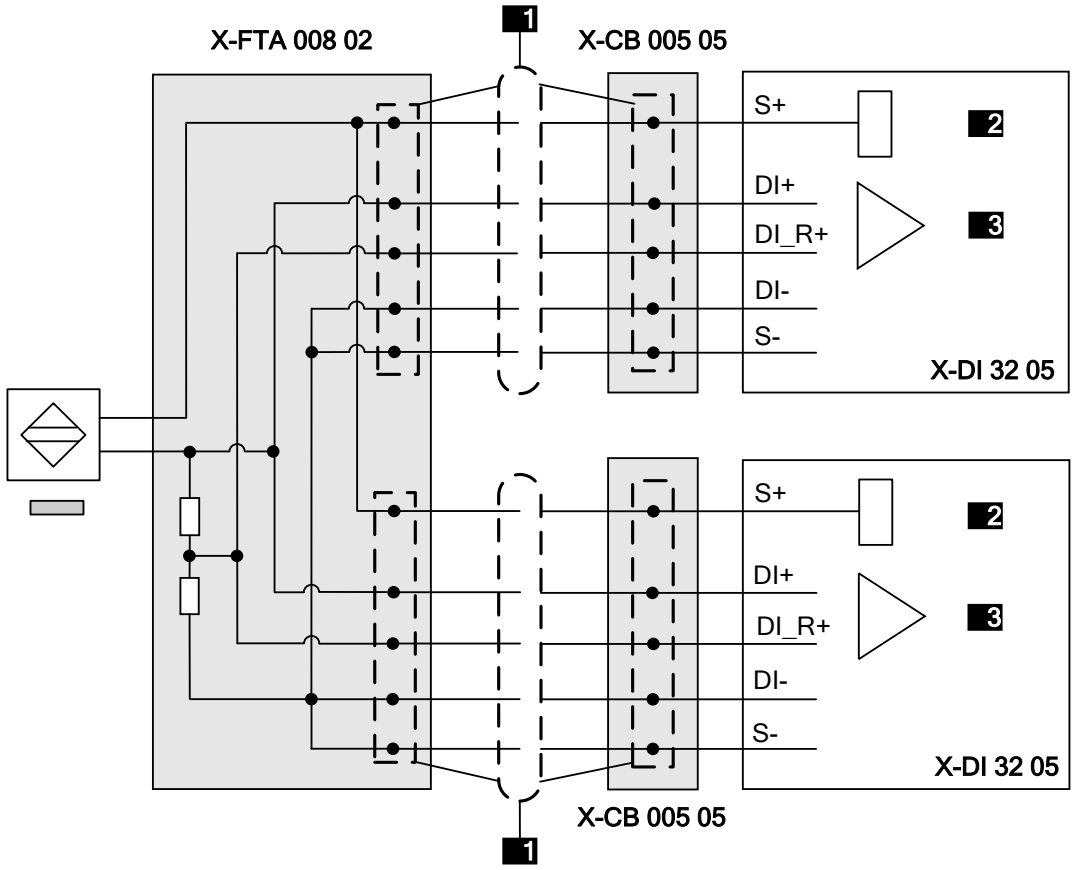
2 Proximity switch supply

3 Processing of analog measured value

Figure 15: Connection via Field Termination Assembly

4.4.3 Redundant Connection via Two Base Plates

The figure shows the connection of one proximity switch or wired contact if the redundant modules are inserted in different base plates or not located adjacently in the rack. The shunts are placed on the field termination assembly.



1 System cable X-CA 009 01 n

2 Proximity switch supply

3 Processing of analog measured value

Figure 16: Redundant Connection via Two Base Plates

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 digital inputs. 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 out using SILworX. Chapter 4.3.5 and Chapter 4.3.6 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

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