Manual

HIMax®

X-DI 64 01

Digital Input Module

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HI 801 092 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 64 01 digital input module is intended for use in the programmable electronic system (PES) HIMax.

The module is used to evaluate up to 64 digital input signals. The digital inputs are current sinking logic for 24 VDC signals in accordance with type 3 specified in the IEC 61131-2.

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), Cat. 4 and PL e (EN ISO 13849-1). Cat.4 and PL e (EN ISO 13849-1) and SIL 4 (EN 50126, EN 50128 and EN 50129).

3.1 Safety Function

The module evaluates the digital input signals and provides them to the user program.

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.

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 64 01 Certification

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

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

3.4 Type Label

The type label specifies the following important details:

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

Figure 1: Sample Type Label

3.5 Structure

The module has 64 safety-related digital inputs (24 V) for digital signals from electromechanical switching devices (contact makers) and proximity switches (2-wire). For safely detecting a high level on the digital input, the voltage and current thresholds must be exceeded (see Table 7).

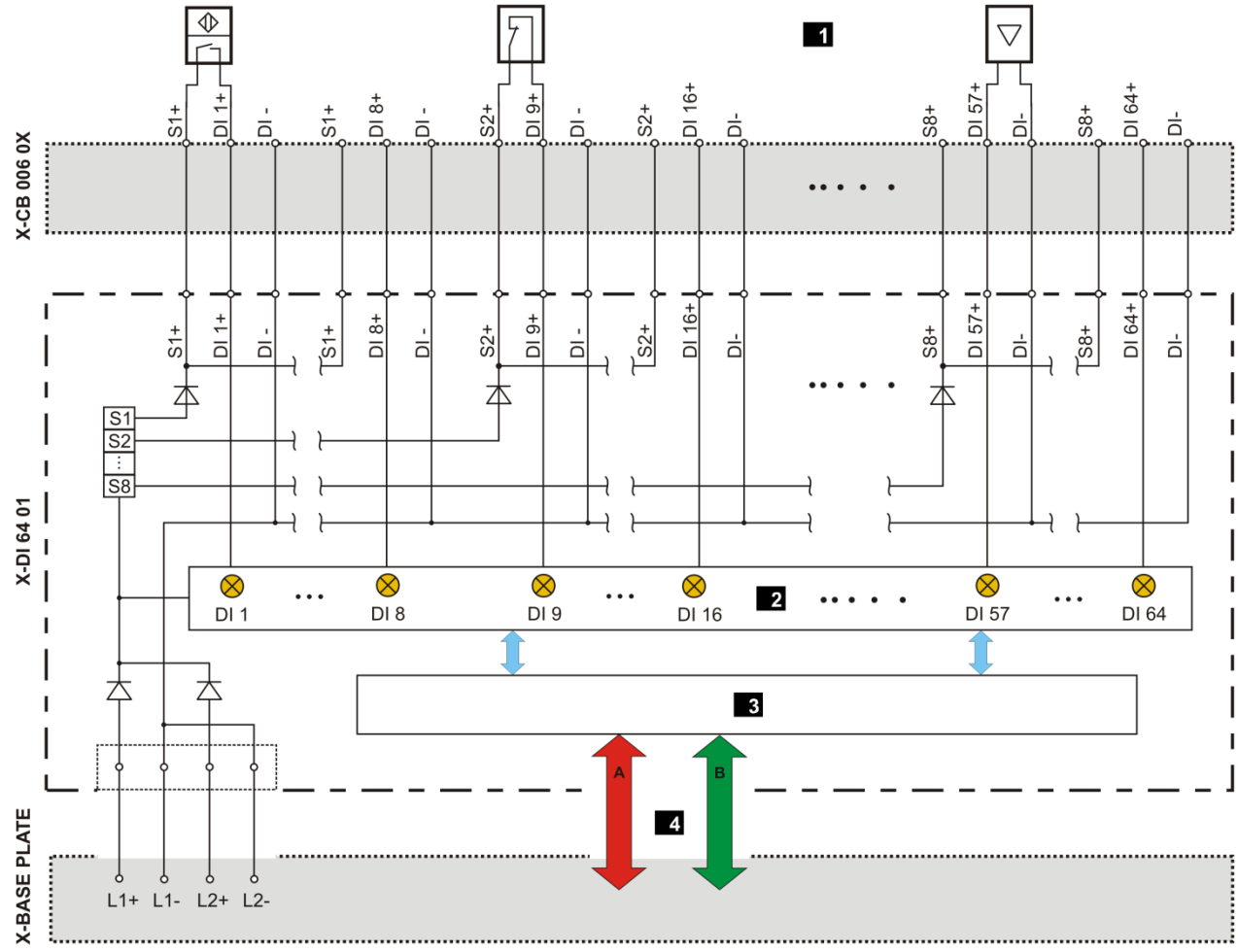
The eight short-circuit-proof supplies feed eight supply outputs each (S1+ to S8+). One supply output is assigned to each digital input.

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 switching devices
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:

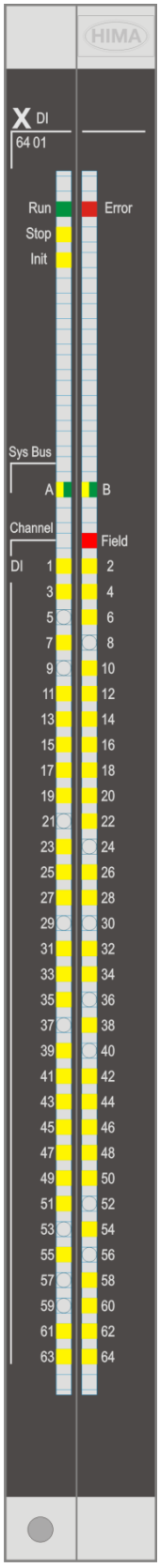


Figure 3: Front View

The LEDs indicate the operating state of the module. 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 (DI 1…64, 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*.

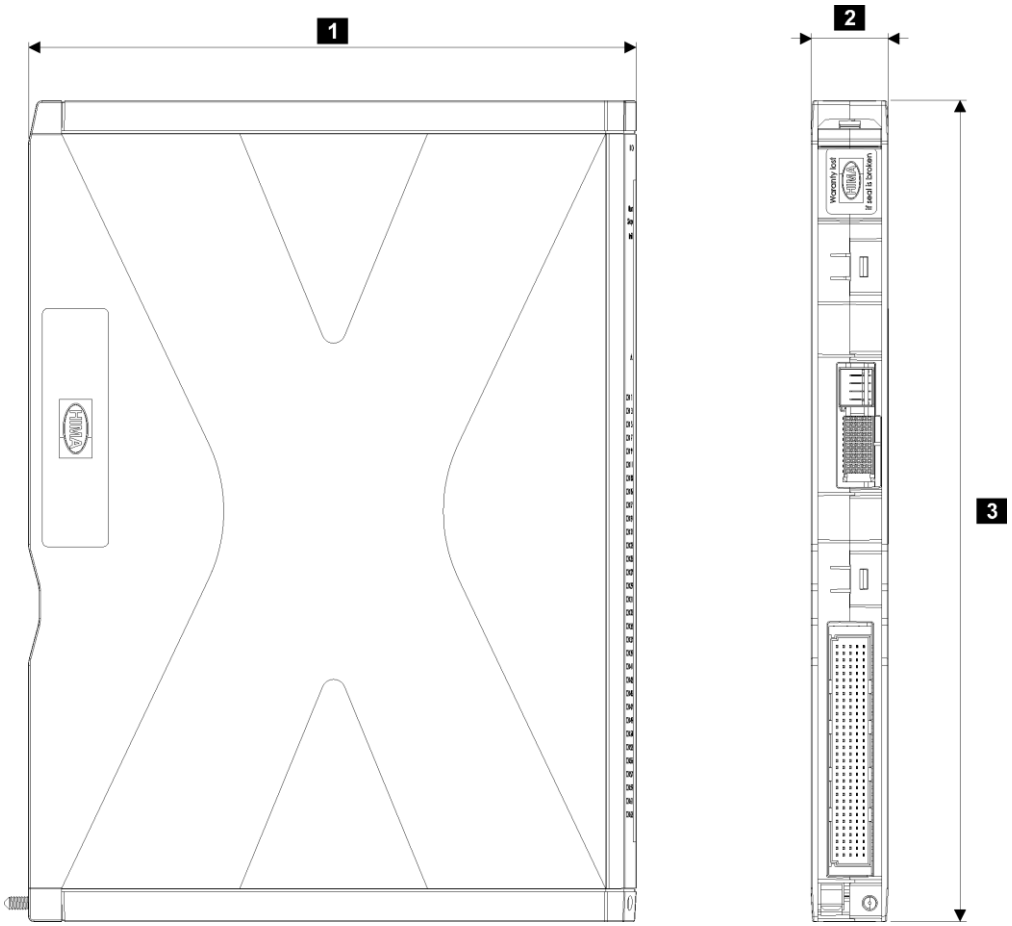
LED	Color	Status	Description
DI 1…DI 64	Yellow	On	High level present
		Blinking2	Channel fault
		Off	Low level present
Field	Red	Blinking2	Undervoltage in at least one supply, caused by short-circuit or supply failure at field level.
		Off	The supply is faultless.

Table 5: I/O Indicators

3.6 Product Data

General	
Supply voltage	24 VDC, -15…+20 %, $r_p \leq 5$ % SELV, PELV
Current consumption	400 mA at 24 VDC (without channels and supplies) Max. 1.5 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
Transport and storage temperature	-40…+85 °C
Humidity	Max. 95 % relative humidity, non-condensing
Pollution	Pollution degree II in accordance with IEC/EN 60664-1
Altitude	< 2000 m
Degree of protection	IP20
Dimensions (H x W x D) in mm	310 x 29.2 x 230
Weight	Approx. 1.1 kg

Table 6: Product Data



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

Figure 4: Views

Digital inputs	
Number of inputs (number of channels)	64 unipolar with reference pole DI- / L-. Not galvanically separated from one another.
Type of input	Current sinking logic, 24 VDC, type 3 in accordance with IEC 61131-2.
Rated input voltage	0…24 V
Input voltage operating range	-3…30 V, current limiting: 2.3…2.9 mA depending on the temperature).
Switching point	Typ. 9.4 V ± 0.8 V (2.1 mA ± 0.3 mA).

Table 7: Specifications for Digital Inputs

Supply	
Number of supplies	8 with 8 outputs each
Output voltage for supply	Supply voltage - 2.5 VDC
Output current for supply	100 mA for each group Short-circuit-proof
Undervoltage detection	The module monitors the supplies for undervoltage (< 17 VDC). If a fault occurs, the corresponding *Supply X OK* status is set to FALSE
Short-circuit of one supply	Undervoltage detection active. The output current is pulsed < 250 mA while the supply is short-circuited.
Assignment of Supply Outputs	
The supply output assigned to each input must be used for power supply!	
Supply S1+	DI1+…DI8+
Supply S2+	DI9+…DI16+
Supply S3+	DI17+…DI24+
Supply S4+	DI25+…DI32+
Supply S5+	DI33+…DI40+
Supply S6+	DI41+…DI48+
Supply S7+	DI49+…DI56+
Supply S8+	DI57+…DI64+

Table 8: Supply Specifications

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 006 01	Mono connector board with screw terminals.
X-CB 006 02	Redundant connector board with screw terminals
X-CB 006 03	Mono connector board with cable plug.
X-CB 006 04	Redundant connector board with cable plug

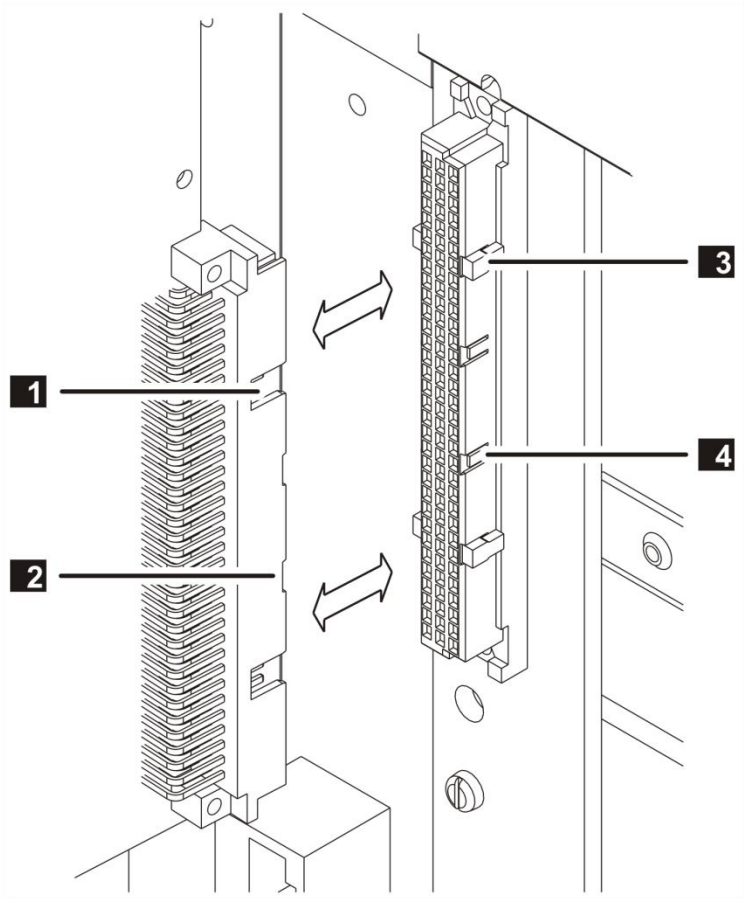
Table 9: Available Connector Boards

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.

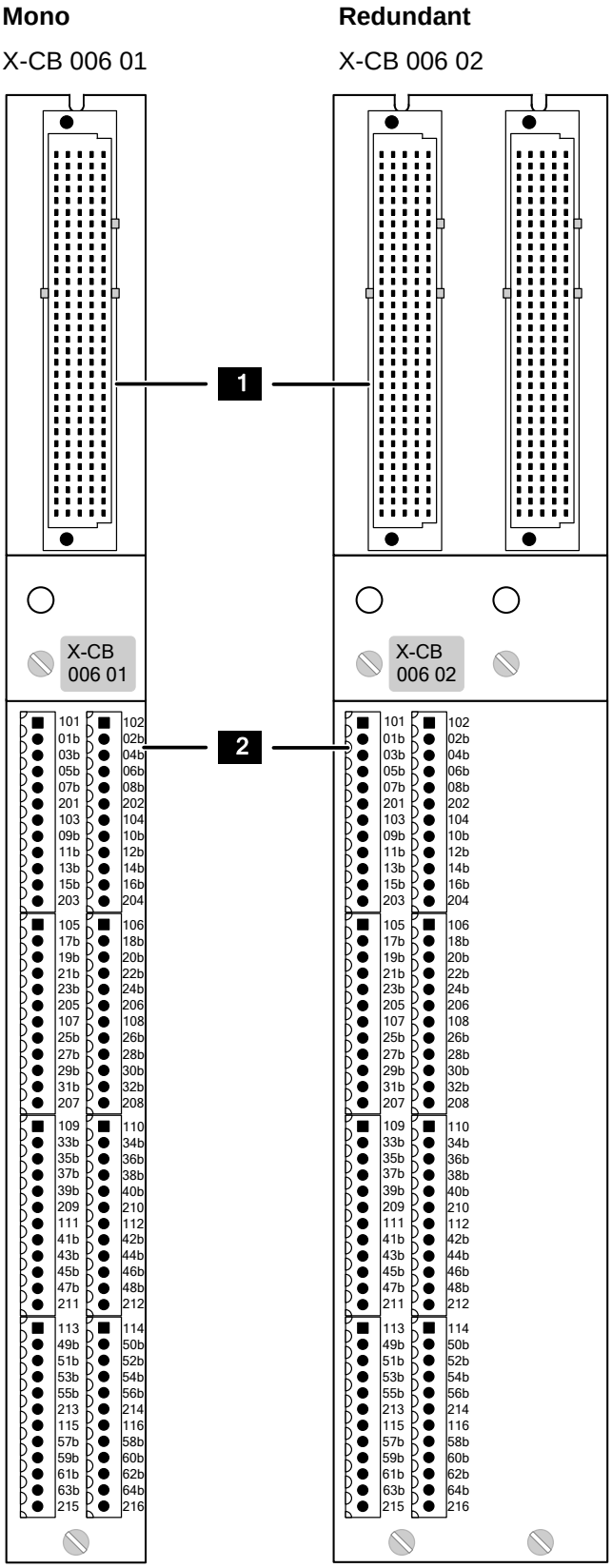
3.7.2 Coding of X-CB 006 0X Connector Boards

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 10: 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	101	S1+	1	102	S1+
2	01b	DI1+	2	02b	DI2+
3	03b	DI3+	3	04b	DI4+
4	05b	DI5+	4	06b	DI6+
5	07b	DI7+	5	08b	DI8+
6	201	DI-	6	202	DI-
7	103	S2+	7	104	S2+
8	09b	DI9+	8	10b	DI10+
9	11b	DI11+	9	12b	DI12+
10	13b	DI13+	10	14b	DI14+
11	15b	DI15+	11	16b	DI16+
12	203	DI-	12	204	DI-
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	105	S3+	1	106	S3+
2	17b	DI17+	2	18b	DI18+
3	19b	DI19+	3	20b	DI20+
4	21b	DI21+	4	22b	DI22+
5	23b	DI23+	5	24b	DI24+
6	205	DI-	6	206	DI-
7	107	S4+	7	108	S4+
8	25b	DI25+	8	26b	DI26+
9	27b	DI27+	9	28b	DI28+
10	29b	DI29+	10	30b	DI30+
11	31b	DI31+	11	32b	DI32+
12	207	DI-	12	208	DI-
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	109	S5+	1	110	S5+
2	33b	DI33+	2	34b	DI34+
3	35b	DI35+	3	36b	DI36+
4	37b	DI37+	4	38b	DI38+
5	39b	DI39+	5	40b	DI40+
6	209	DI-	6	210	DI-
7	111	S6+	7	112	S6+
8	41b	DI41+	8	42b	DI42+
9	43b	DI43+	9	44b	DI44+
10	45b	DI45+	10	46b	DI46+
11	47b	DI47+	11	48b	DI48+
12	211	DI-	12	212	DI-

Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	113	S7+	1	114	S7+
2	49b	DI49+	2	50b	DI50+
3	51b	DI51+	3	52b	DI52+
4	53b	DI53+	4	54b	DI54+
5	55b	DI55+	5	56b	DI56+
6	213	DI-	6	214	DI-
7	115	S8+	7	116	S8+
8	57b	DI57+	8	58b	DI58+
9	59b	DI59+	9	60b	DI60+
10	61b	DI61+	10	62b	DI62+
11	63b	DI63+	11	64b	DI64+
12	215	DI-	12	216	DI-

Table 11: 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:

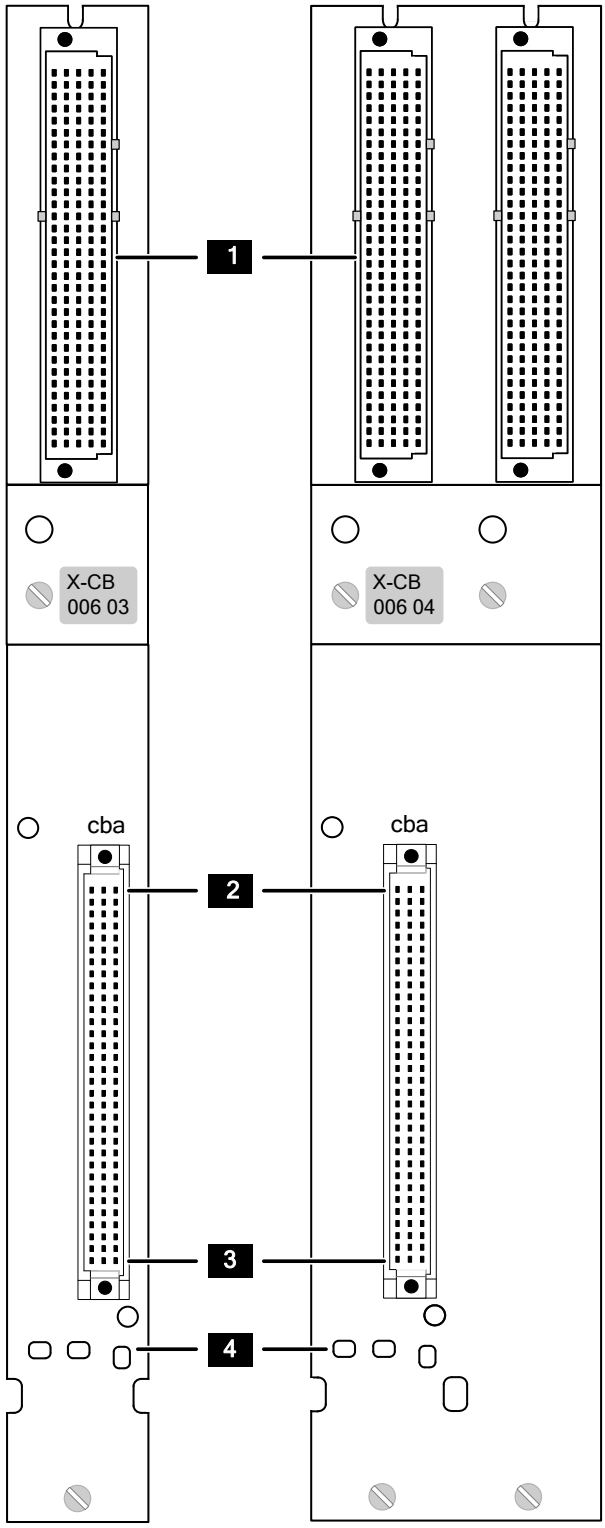
Connection to the field level	
Cable plugs	8 pieces, with 12 poles
Wire cross-section	0.2…1.5 mm^2 (single-wire) 0.2…1.5 mm^2 (finely stranded) 0.2…1.5 mm^2 (with wire end ferrule)
Stripping length	6 mm
Screwdriver	Slotted 0.4 x 2.5 mm
Tightening torque	0.2…0.25 Nm

Table 12: Cable Plug Characteristics

3.7.5 Connector Boards with Cable Plug

Mono X-CB 006 03

Redundant X-CB 006 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	DI64+	YEBU [1]	DI32+	YEBU	Internal use [3]	YE [2]
2	DI63+	GNBU [1]	DI31+	GNBU		GN [2]
3	DI62+	YEPK [1]	DI30+	YEPK		BN [2]
4	DI61+	PKGN [1]	DI29+	PKGN		WH [2]
5	DI60+	YEGY [1]	DI28+	YEGY		
6	DI59+	GYGN [1]	DI27+	GYGN		
7	DI58+	BNBK [1]	DI26+	BNBK		
8	DI57+	WHBK [1]	DI25+	WHBK		
9	DI56+	BNRD [1]	DI24+	BNRD		
10	DI55+	WHRD [1]	DI23+	WHRD		
11	DI54+	BNBU [1]	DI22+	BNBU		
12	DI53+	WHBU [1]	DI21+	WHBU		
13	DI52+	PKBN [1]	DI20+	PKBN		
14	DI51+	WHPK [1]	DI19+	WHPK		
15	DI50+	GYBN [1]	DI18+	GYBN		
16	DI49+	WHGY [1]	DI17+	WHGY		
17	DI48+	YEBN [1]	DI16+	YEBN	DI-	RDBK
18	DI47+	WHYE [1]	DI15+	WHYE	DI-	BUBK
19	DI46+	BNGN [1]	DI14+	BNGN	DI-	PKBK
20	DI45+	WHGN [1]	DI13+	WHGN	DI-	GYBK
21	DI44+	RDBU [1]	DI12+	RDBU	DI-	PKRD
22	DI43+	GYPK [1]	DI11+	GYPK	DI-	GYRD
23	DI42+	VT [1]	DI10+	VT	DI-	PKBU
24	DI41+	BK [1]	DI9+	BK	DI-	GYBU
25	DI40+	RD [1]	DI8+	RD	S8+	YEBK [1]
26	DI39+	BU [1]	DI7+	BU	S7+	GNBK [1]
27	DI38+	PK [1]	DI6+	PK	S6+	YERD [1]
28	DI37+	GY [1]	DI5+	GY	S5+	GNRD [1]
29	DI36+	YE [1]	DI4+	YE	S4+	YEBK
30	DI35+	GN [1]	DI3+	GN	S3+	GNBK
31	DI34+	BN [1]	DI2+	BN	S2+	YERD
32	DI33+	WH [1]	DI1+	WH	S1+	GNRD

[1] For repeated wire color coding: Additional orange ring.

[2] For the second repeated wire color coding: Additional violet ring.

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

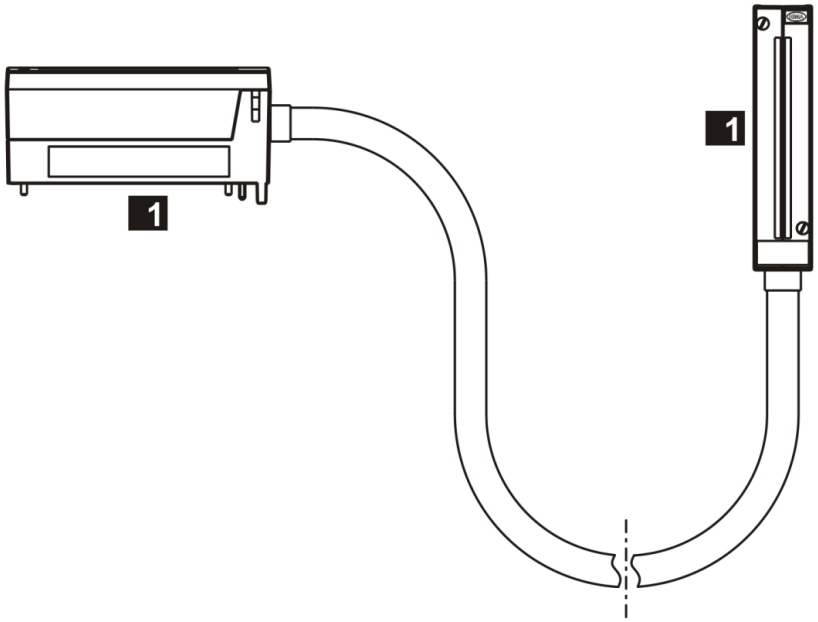
Table 13: Pin Assignment for the System Cable Plug

3.8 System Cable X-CA 003

System cable X-CA 003 is used to connect the X-CB 006 03/04 connector board to the field termination assembly.

General	
Cable	LIYY 80 x 0.25 mm² + 2 x 2 x 0.25 mm²
Wire	Finely stranded
Average outer diameter (d)	Approx. 15.3 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 13.

Table 14: Cable Data



1 Identical cable plugs

Figure 8: System Cable X-CA 003 01 n

The system cable is available in the following standard lengths:

System cables	Description	Length	Weight
X-CA 003 01 8	Coded cable plugs on both sides.	8 m	3.75 kg
X-CA 003 01 15		15 m	7 kg
X-CA 003 01 30		30 m	14 kg

Table 15: Available System Cables

3.8.1 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.

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 the proximity switches and switching devices 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 4.4.

4.1.1 Wiring Unused Inputs

Inputs 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.

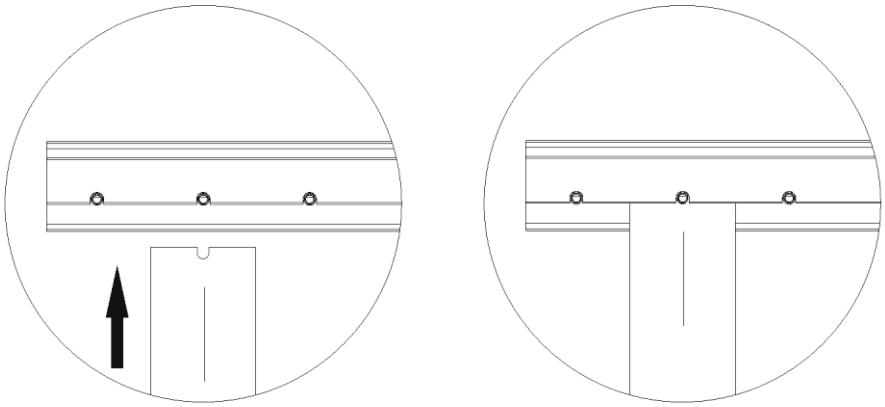


Figure 9: Example of how to Insert the Mono Connector Board

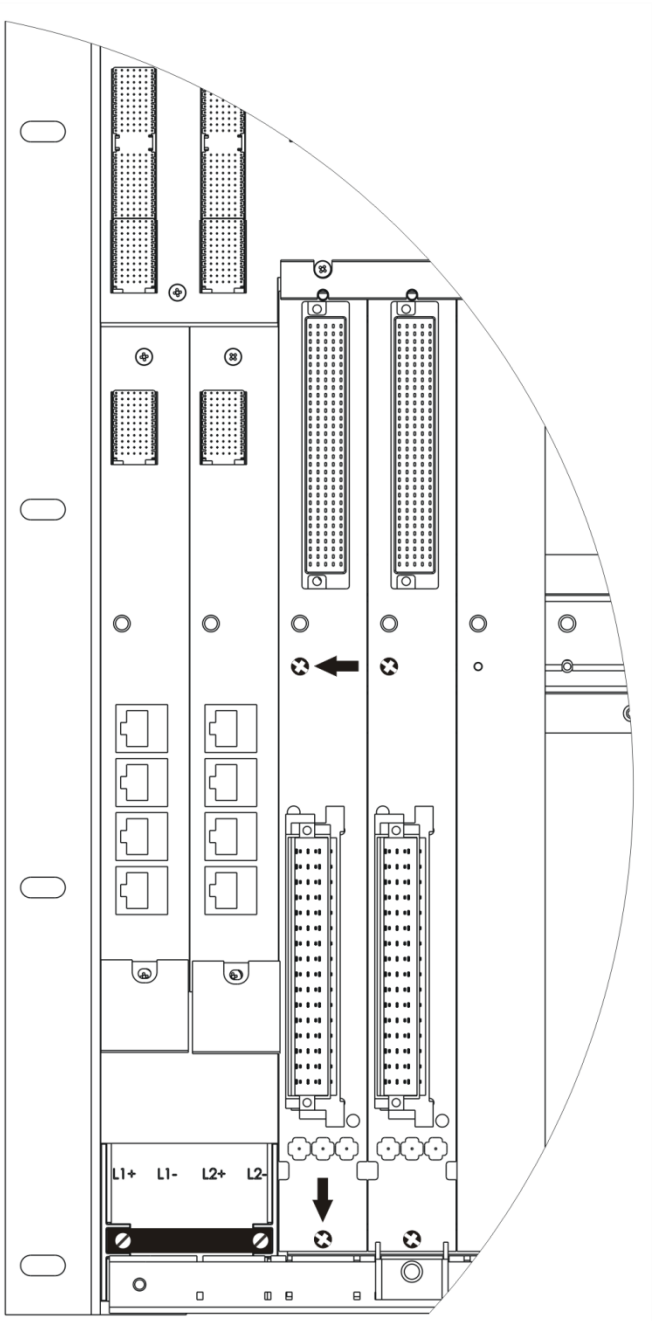


Figure 10: Example of how to Secure the Mono Connector Board with Captive Screws

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:

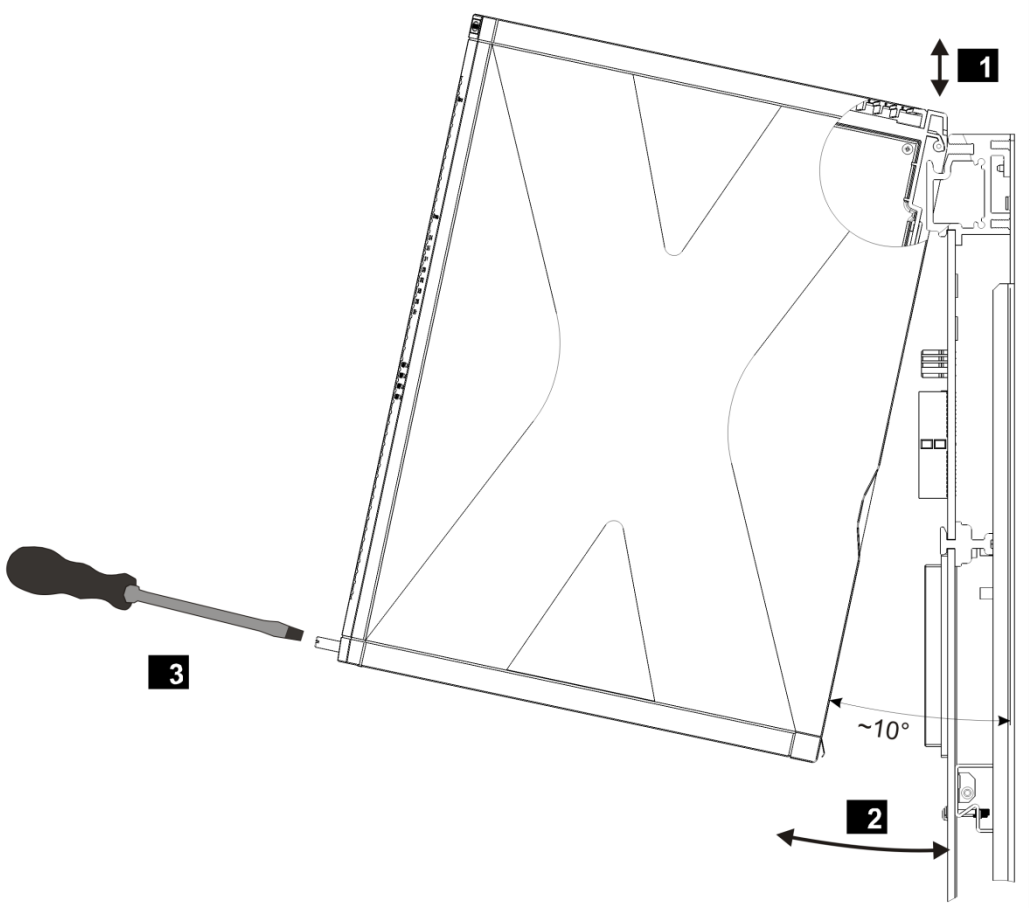
- Screwdriver, slotted 0.8 x 4.0 mm.
- Screwdriver, slotted 1.2 x 8.0 mm.

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.
- The channel supply is monitored. If the *Sup. Used* parameter is activated, a supply fault results in a channel fault (-> *Channel OK* = FALSE). If the channel supply is not used, the *Sup. Used* parameter must be deactivated. In doing so, a supply error does not result in a channel fault (-> *Channel OK* = TRUE). To diagnose the supply in use, evaluate the *Supply X OK* parameter in the user program. Refer to Table 17 for more details about the *Supply X OK* status.
- If a redundancy group is created, its configuration is defined in the tabs. The tabs specific to the redundancy group differ from those of the individual modules, see the following tables.

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

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

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

4.3.1 The **Module** Tab

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

System 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 on one channel (no external faults). The module is not plugged in. Observe the *Module Status* parameter!
Module Status	DWORD	Y	R	Status of the module
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 when the digital inputs were measured.

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.

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

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

4.3.2 The **I/O Submodule DI 64_01** Tab

The **I/O Submodule DI64_01** tab contains the following system parameters:

System parameter	Data type	S [1]	R/W	Description
This parameter cannot be changed.				
Name	---	---	W	Module name.
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 4.3.5).
Diagnostic Response	DINT	N	R	As soon as *Diagnostic Response* returns the ID of *Diagnostic Request* (for coding details, see Chapter 4.3.5), *Diagnostic Status* contains the diagnostic value requested.
Diagnostic Status	DWORD	N	R	Requested diagnostic value in accordance with *Diagnostic Response*. The IDs of *Diagnostic Request* and *Diagnostic Response* can be evaluated in the user program. *Diagnostic Status* only contains the requested diagnostic value when both *Diagnostic Request* and *Diagnostic Response* have the same ID.
Background Test Error	BOOL	N	R	TRUE: Background test is faulty. FALSE: Background test is free of faults.
Restart on Error	BOOL	Y	W	The *Restart on Error* parameter can be used to cause any I/O module that is shut down permanently due to errors or faults to once again enter the RUN state. To do so, set the *Restart on Error* parameter from FALSE to TRUE. The I/O module performs a complete self-test and only enters the RUN state if no faults are detected. Default setting: FALSE
Supply 1 OK	BOOL	N	R	The supplies are monitored for undervoltage. TRUE: The supply is not faulty. FALSE: The 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.*
Supply 5 OK	BOOL	N	R	Such as *Supply 1 OK.*
Supply 6 OK	BOOL	N	R	Such as *Supply 1 OK.*
Supply 7 OK	BOOL	N	R	Such as *Supply 1 OK.*
Supply 8 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 4.3.4.
[1] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 17: The **I/O Submodule DI 64_01** Tab in the Hardware Editor

4.3.3 The **I/O Submodule DI64_01: Channels** Tab

The **I/O Submodule DI64_01: 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	S [1)]	R/W	Description
Channel no.	---	---	R	Channel number, preset and cannot be changed.
-> Channel Value [BOOL]	BOOL	Y	R	Boolean value of the digital input LOW or HIGH.
-> Channel OK [BOOL]	BOOL	Y	R	TRUE: Fault-free channel. The channel value is valid. FALSE: Faulty channel. The input value is set to FALSE.
T on [µs]	UDINT	J	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^{31} - 1) Granularity: 1000 µs, e.g., 0, 1000, 2000, … Default setting: 0
T off [µs]	UDINT	J	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}. For blanking surge pulses in accordance with EN 61000-4-5, a time off delay of 2000 µs must be configured. 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. Range of values: 0…(2^{31} - 1) Granularity: 1000 µs, e.g., 0, 1000, 2000, … Default setting: 0
Test Suppression [µs]	UDINT	J	W	The digital input module can filter out external test impulses (set from HIGH to LOW for a short time) that last for the duration of $t_{Pulse} < t_{Suppression}$. The suppression time $t_{Suppression}$ can be configured by the user. The highest suppression time configured for a channel applies to all channels on the module if the suppression time set for the channels is greater than 0. Note that the duration of the I/O cycle and thus that of the CPU cycle are extended. Range of values: 0…500 µs Default setting: 0 (deactivated for this channel)

System parameter	Data type	S [1)]	R/W	Description
Sup. Used	BOOL	N	W	Activated: The supply is used. Deactivated: The supply is not in use. Default setting: Activated
Redund.	BOOL	Y	W	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. ▪ And ▪ Or Default setting: OR **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 18: The **I/O Submodule DI64_01: Channels** Tab in the Hardware Editor

4.3.4 Description of *Submodule Status [DWORD]*

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

Coding	Description
0x00000001	Fault in hardware unit (submodule).
0x00000002	Reset of an I/O bus.
0x00000004	Fault detected while initializing the hardware.
0x00000008	Fault detected while checking the coefficients.
0x00800000	Module fault connected with reference voltage A.
0x01000000	Fault connected with reference voltage A (overvoltage).
0x02000000	Fault connected with reference voltage B (undervoltage).
0x04000000	Module fault connected with reference voltage B.
0x08000000	Fault connected with auxiliary voltage.
0x10000000	Fault connected with reference voltage A (low voltage).
0x20000000	Fault connected with reference voltage B (overvoltage).
0x40000000	Fault connected with chip select monitoring A.
0x80000000	Fault connected with chip select monitoring B.

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:

ID	Description
0	Diagnostic values are indicated consecutively.
100	Bit-coded temperature status. 0 = normal. Bit0 = 1: Temperature threshold 1 has been exceeded. Bit1 = 1: Temperature threshold 2 has been exceeded. Bit2 = 1: Fault in temperature measurement.
101	Measured temperature (10 000 digits/ °C).
200	Bit-coded voltage status. 0 = normal. Bit0 = 1: L1+ (24 V) is faulty. Bit1 = 1: L2+ (24 V) is faulty.
201	Not used!
202	Actual value of the internal 3V3 operating voltage.
203	Actual value of the internal core voltage.
204…207	Not used!
300	Comparator 24 V undervoltage (BOOL).
1001…1064	Status of the channels 1…64

Coding	Description
0x0001	Fault occurred in hardware unit (submodule)
0x0002	Channel fault due to internal fault.
0x1000	Faulty connection to I/O bus A.
0x2000	Faulty connection to I/O bus B.
0x4000	Channel fault while testing digital input circuit A.
0x8000	Channel fault while testing digital input circuit B.

2001…2008	Fault status of the power sources 1…8 (supplies).

Coding	Description
0x0001	Module fault.
0x8000	Undervoltage of supplies.

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

4.4 Connection Variants

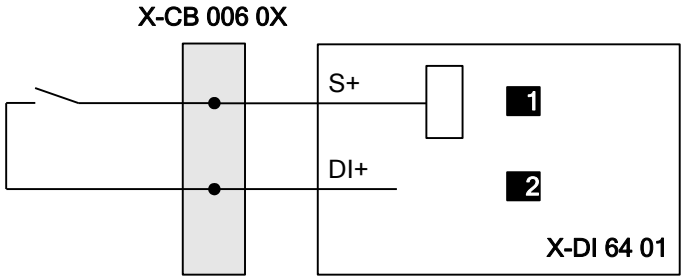
This chapter describes the proper wiring of the module in safety-related applications. The following connection variants are permitted.

4.4.1 Input Wiring Variants

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

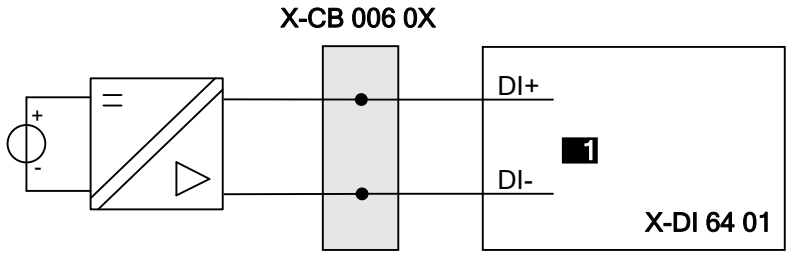
The supply is decoupled using diodes. This ensures that the supplies of two modules can supply one proximity switch if the modules are redundant to one another.

Connector boards X-CB 006 01 (with screw terminals) or X-CB 006 03 (with cable plug) can be used to perform the wiring such as described in Figure 12, Figure 13 and Figure 14.



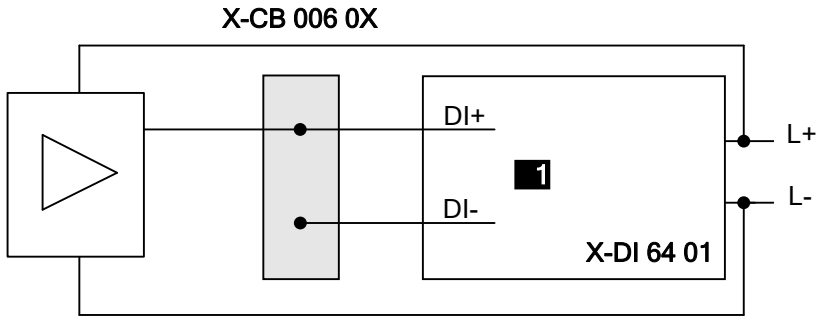
1 Transmitter supply 2 Digital input

Figure 12: Wiring with Mechanical Contact or 2-Wire Proximity Switch



1 Digital input

Figure 13: Wiring of a Digital Signal Source with Galvanically Separated Supply



1 Digital input

Figure 14: Wiring of a Digital Signal Source with Non-Galvanically Separated Supply

NOTICE

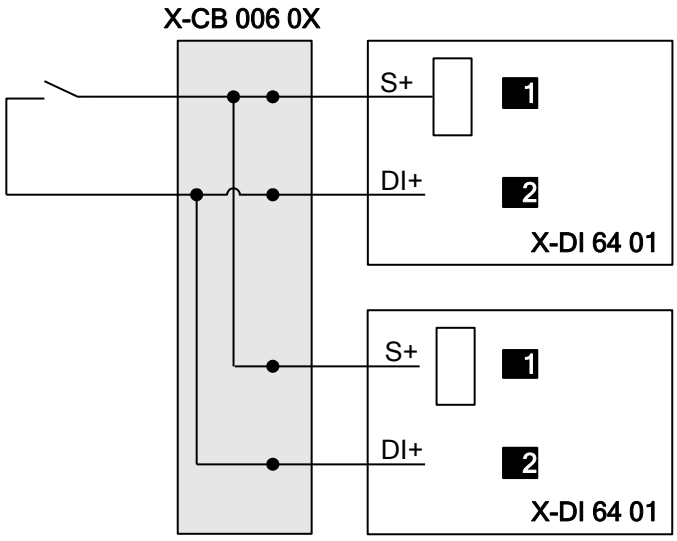
Overcurrent due to incorrect wiring!

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

Do not connect the ground of a digital signal source with a non-galvanically separated supply to the DI- of the module.

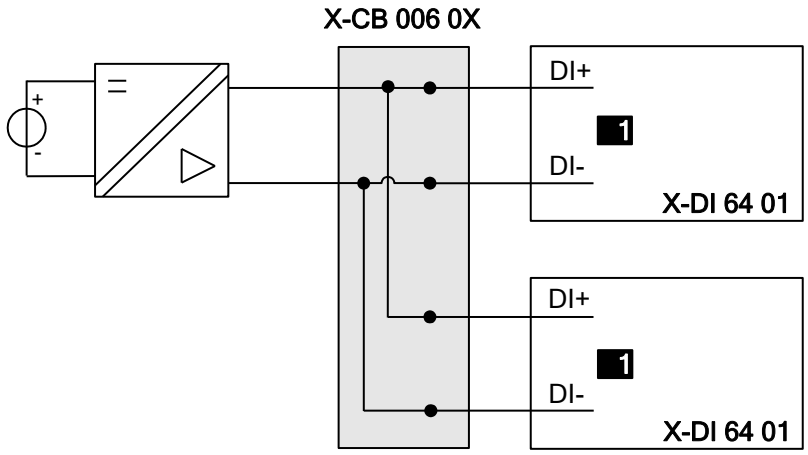
When redundantly wired as specified in Figure 15 and Figure 16, the modules are inserted in the base plate next to each other and on a common connector board.

Connector boards X-CB 006 02 (with screw terminals) or X-CB 006 04 (with cable plug) can be used.



1 Transmitter supply 2 Digital input

Figure 15: Redundant Wiring with Switching Devices or 2-Wire Proximity Switch



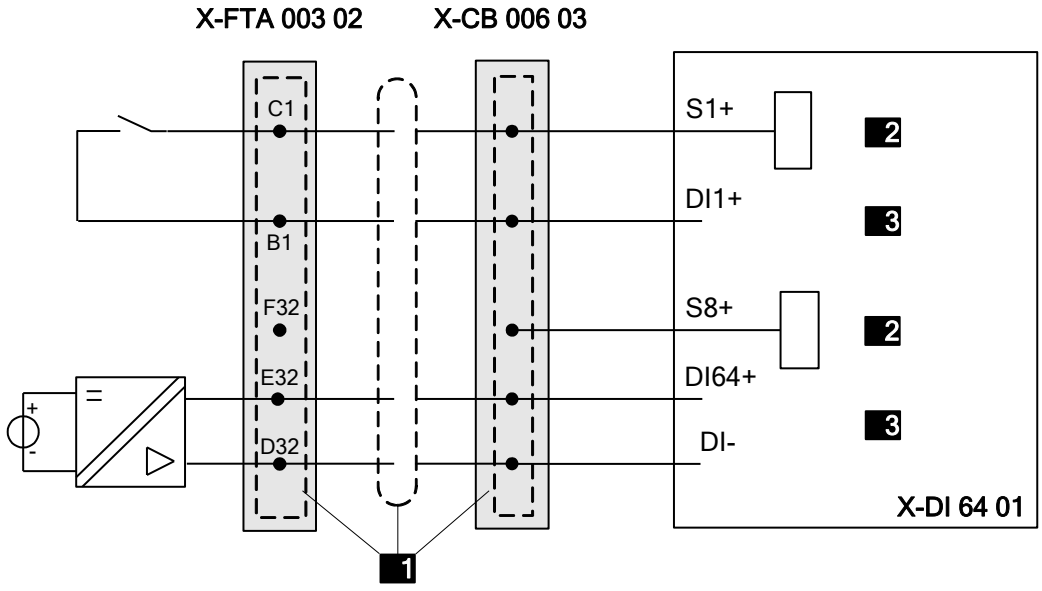
1 Digital input

Figure 16: Redundant Wiring of a Digital Signal Source with Galvanically Separated Supply

4.4.2 Connection to Transmitters via Field Termination Assembly

Contact makers and transmitters are connected via the X-FTA 003 02 as described in Figure 17. For further information, refer to the X-FTA 003 02 manual (HI 801 121 E).

The X-CB 006 03 connector board is used.

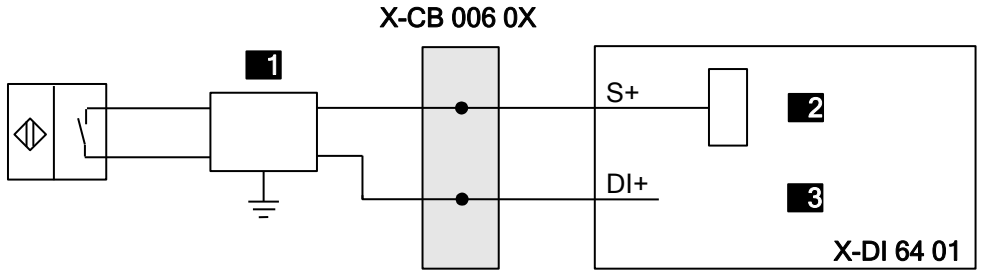


1 System cable with cable plug
2 Transmitter supply
3 Digital input

Figure 17: Connection via Field Termination Assembly

4.4.3 Ex Protection with Zener Barriers

Zener barriers can be used for Ex protection, e.g., barriers from MTL, type 7787+ or Pepperl+Fuchs, type Z787.

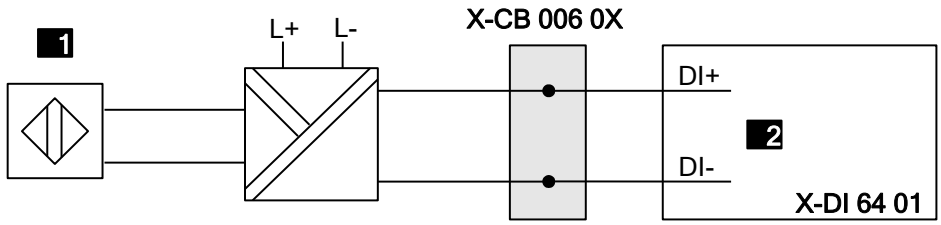


1 Barriers
2 Transmitter supply
3 Digital input

Figure 18: Single-Channel Proximity Switch Connection with Barrier

4.4.4 Ex Protection with Isolation Amplifier

Isolation amplifiers must be used for Ex protection such as the isolation amplifiers H 4011 and H 4012 from HIMA. The proximity switch supply is not used when wiring a repeater power supply.



Safety proximity switch (NAMUR)
2 Digital input

Figure 19: Single-Channel Connection to Isolation Amplifier

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 using SILworX. Chapter 4.3.4 and Chapter 4.3.5 describe the most important diagnostic statuses.

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

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

6 Maintenance

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

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

6.1 Maintenance Measures

The following maintenance measures must be implemented for the modules:

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

6.1.1 Proof Test

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

6.1.2 Loading of Enhanced Operating System Versions

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

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

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

7 Decommissioning

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

8 Transport

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

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

9 Disposal

Industrial customers are responsible for correctly disposing of decommissioned hardware. Upon request, a disposal agreement can be arranged with HIMA.

All materials must be disposed of in an ecologically sound manner.

Appendix

Glossary

Term	Description
AI	Analog input
AO	Analog output
ARP	Address resolution protocol, network protocol for assigning the network addresses to hardware addresses
COM	Communication module
CRC	Cyclic redundancy check
DI	Digital input
DO	Digital output
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
FB	Fieldbus
FBD	Function block diagrams
HW	Hardware
ICMP	Internet control message protocol, network protocol for status or error messages
IEC	International electrotechnical commission
Interference-free	Inputs are designed for interference-free operation and can be used in circuits with safety functions
MAC	Media access control address, hardware address of one network connection
PADT	Programming and debugging tool (in accordance with IEC 61131-3), PC with SILworX
PELV	Protective extra low voltage
PES	Programmable electronic system
R	Read, the variable is read out
R/W	Read/Write, column title for system variable type
Rack ID	Base plate identification (number)
r_P	Peak value of a total AC component
SB	System bus (module)
SC/OC	Short-circuit/open-circuit
SELV	Safety extra low voltage
SFF	Safe failure fraction, portion of faults that can be safely controlled
SIL	Safety integrity level (in accordance with IEC 61508)
SILworX	Programming tool
SNTP	Simple network time protocol (RFC 1769)
SRS	System.Rack.Slot, addressing of a module
SW	Software
TMO	Timeout
W	Write, the variable receives a value, e.g., from the user program
WD	Watchdog, device for monitoring the system's correct operation Signal for fault-free process
WDT	Watchdog time

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MANUAL
X-DI 64 01

HI 801 093 E

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