



HIMax[®]

Digital Input Module
Manual

SAFETY
NONSTOP



X-DI 64 01

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For further information, refer to the CD-ROM and our website <http://www.hima.de> and <http://www.hima.com>.

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1 Introduction

The present 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 is organized in the following main chapters:

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

Additionally, the following documents must be taken into account:

Name	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 Communication manual	Description of communication and protocols	HI 801 101 E
SILworX Online Help (OLH)	Instructions on how to use SIL-worX	-
First Steps	Introduction to SILworX	HI 801 103 E

Table 1: Additional Relevant Manuals

The latest manuals can be downloaded from the HIMA website at www.hima.com. The revision index on the footer can be used to compare the current version of existing manuals with the Internet edition.

1.2 Target Audience

This document addresses system planners, configuration engineers, programmers of automation devices and personnel authorized to implement, operate and maintain the devices and systems. Specialized knowledge of safety-related automation systems is required.

1.3 Formatting Conventions

To ensure improved readability and comprehensibility, the following fonts are used in this document:

Bold:	To highlight important parts Names of buttons, menu functions and tabs that can be clicked and used in SILworX.
<i>Italics:</i>	System parameter and variables
Courier	Literal user inputs
RUN	Operating state are designated by capitals
Chapter 1.2.3	Cross references are hyperlinks even though they are not particularly marked. When the cursor hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position.

Safety notes and operating tips are particularly marked.

1.3.1 Safety Notes

The safety notes are represented as described below. These notes must absolutely be observed to reduce the risk to a minimum. The content is structured as follows:

- Signal word: danger, warning, caution, notice
- Type and source of danger
- Consequences arising from the danger
- Danger prevention

SIGNAL WORD



Type and source of danger!
Consequences arising from the danger
Danger prevention

The signal words have the following meanings:

- Danger indicates hazardous situation which, if not avoided, will result in death or serious injury.
- Warning indicates hazardous situation which, if not avoided, could result in death or serious injury.
- Caution indicates hazardous situation which, if not avoided, could result in minor or modest injury.
- Notice indicates a hazardous situation which, if not avoided, could result in property damage.

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 corresponding to the additional information is located here.

Useful tips and tricks appear as follows:

TIP

The tip text is located here.

2 Safety

All safety information, notes and instructions specified in this manual must be strictly observed. The product may only be used if all guidelines and safety instructions are adhered to.

This product is operated in accordance with SELV or PELV. No imminent danger results from the module itself. The use in Ex-Zone is 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

Requirement type	Range of values
Protection class	Protection class III in accordance with IEC/EN 61131-2
Ambient temperature	0...+60 °C
Storage temperature	-40...+85 °C
Pollution	Pollution degree II in accordance with IEC/EN 61131-2
Altitude	< 2000 m
Housing	Standard: IP20
Supply voltage	24 VDC

Table 2: Environmental Requirements

Exposing the HIMax system to environmental conditions other than those specified in this manual can cause the HIMax system to malfunction.

2.1.2 ESD Protective Measures

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

NOTE



Device damage due to electrostatic discharge!

- When performing the work, make sure that the working area is free of static and wear an ESD wrist strap.
- If not used, ensure that the device is protected from electrostatic discharge, e.g., by storing it in its packaging.

2.2 Residual Risk

No imminent danger results from a HIMax module itself.

Residual risk may result from:

- Faults in the engineering
- Faults in the user program
- Faults in the wiring

2.3 Safety Precautions

Observe all local safety requirements and use the protective equipment required on site.

2.4 Emergency Information

A HIMax controller is a part of the safety equipment of a system. If the controller fails, the system adopts the safe state.

In case of emergency, no action that may prevent the HIMax systems 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 can be inserted in any of the base plate slots with the exception of the slots reserved for system bus modules. For more information, refer to the System Manual (HI 801 001 E).

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 has been certified by the TÜV for safety-related applications up to SIL 3 (IEC 61508, IEC 61511 and IEC 62061), Cat. 4 (EN 954-1) and PL e (EN ISO 13849-1).

Refer to the HIMax Safety Manual (HI 801 003 E) for more information on the standards used to test and certify the modules and the HIMax system.

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 Reaction 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

The module must be installed on a suitable connector board to be able to operate. If a 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 3.6, the system cables are described in Chapter 3.7. The FTAs are described in own manuals.

3.3 Type Label

The type label specifies the following important details:

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

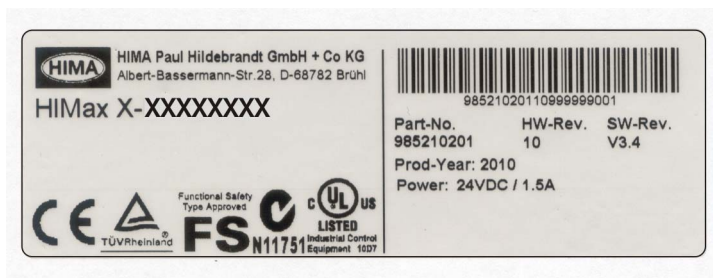


Figure 1: Sample Type Label

3.4 Structure

The module has 64 safety-related digital inputs (24 V) for digital signals, contact makers and proximity switches (two-wire). For safely detecting a high level on the digital input, the voltage and current thresholds must be exceeded (see Table 8).

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

The safety-related 1oo2 processor system for the I/O module controls and monitors the I/O level. The data and states of the I/O module are made available 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 3.4.2.

3.4.1 Block Diagram

The following block diagram illustrates the structure of the module.

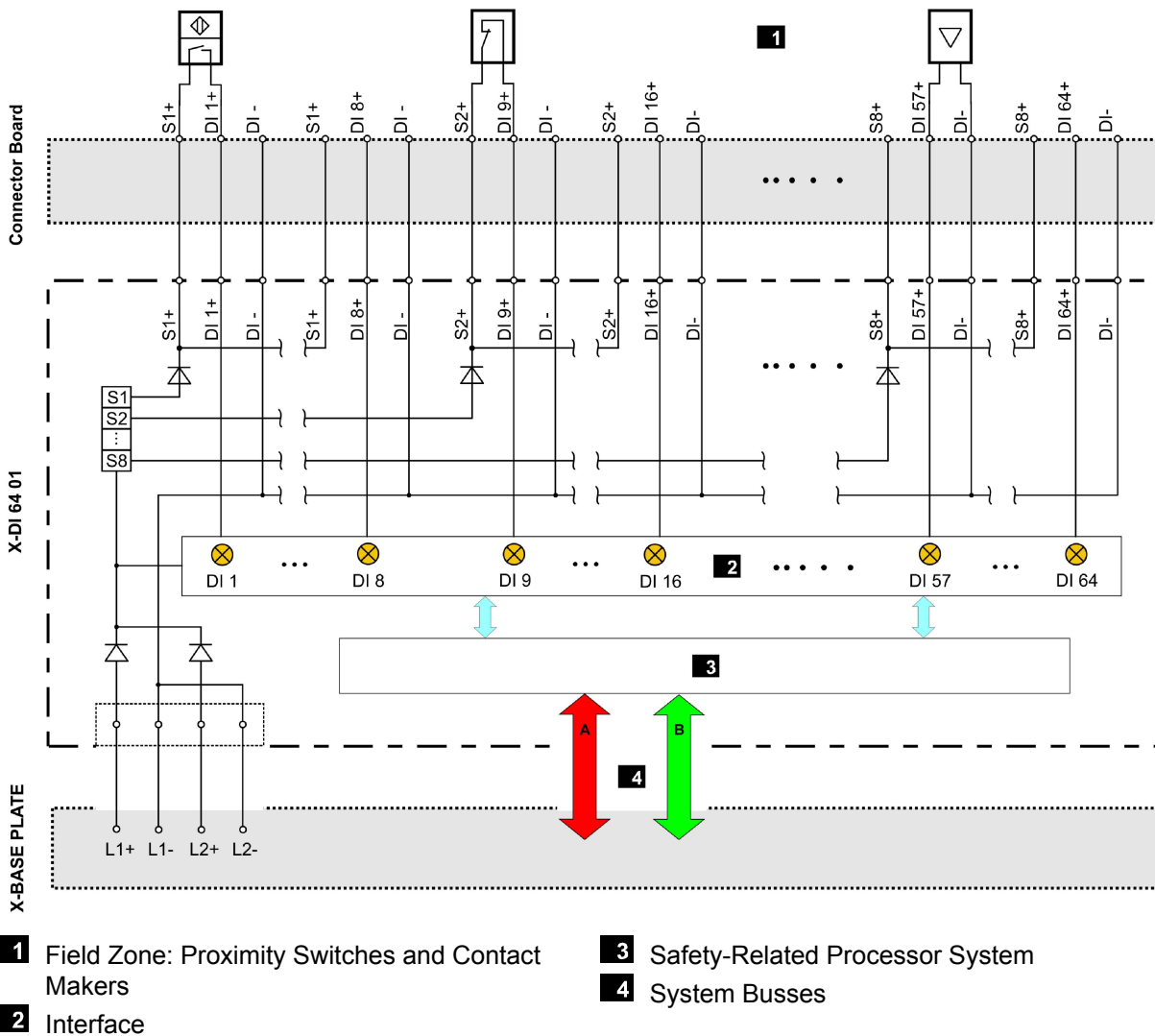


Figure 2: Block Diagram

3.4.2 Indicators

The following figure shows the LED indicators for the module.

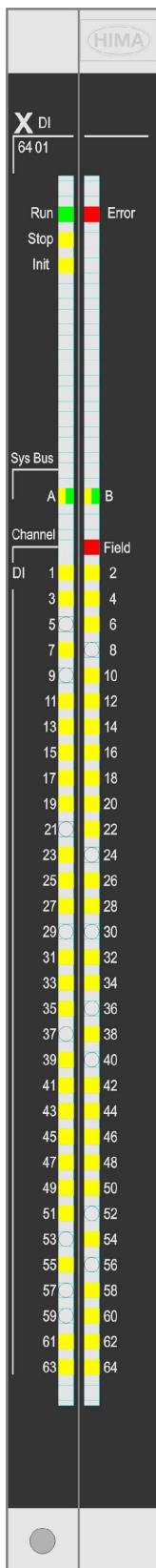


Figure 3: Indicators

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 (DO 1...64, Field)

When the supply voltage is switched on, a LED test is performed and all LEDs briefly flash simultaneously.

Definition of Blinking Frequencies

The following table defines the blinking frequencies of the LEDs:

Name	Blinking Frequencies
Blinking1	Long (approx. 600 ms) on, long (approx. 600 ms) off
Blinking2	Short (approx. 200 ms) on, short (approx. 200 ms) off, short (approx. 200 ms) on, long (approx. 600 ms) off
Blinking-x	Ethernet communication: Flashing in sync with data transfer

Table 3: Blinking Frequencies of LEDs

3.4.3 Module Status Indicators

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

LED	Color	Status	Description
Run	Green	On	Module in RUN, normal operation
		Blinking1	Module state: STOP/OS_DOWNLOAD or OPERATE (only with processor modules)
		Off	Module not in RUN, observe the other status LEDs
Error	Red	On/Blinking1	Internal module faults detected by self-tests, e.g., hardware, software or voltage supply. Fault while loading the operating system
		Off	Normal operation
Stop	Yellow	On	Module state: STOP / VALID CONFIGURATION
		Blinking1	Module state: STOP / INVALID CONFIGURATION or STOP / OS_DOWNLOAD
		Off	Module not in STOP, observe the other status LEDs
Init	Yellow	On	Module state: INIT, observe the other status LEDs
		Blinking1	Module state: LOCKED, observe to the other status LEDs
		Off	Module state: neither INIT nor LOCKED, observe the other status LEDs

Table 4: Module Status Indicators

3.4.4 System Bus Indicators

The system bus 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 5: System Bus Indicators

3.4.5 I/O Indicators

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

LED	Color	Status	Description
Channel 1...64	Yellow	On	The related channel is active (energized).
		Blinking2	Channel fault
		Off	The related channel is inactive (de-energized).
Field	Red	Blinking2	Field fault on at least one channel or supply (e.g., overcurrent, etc.)
		Off	No field fault displayed!

Table 6: I/O Indicators LEDs

3.5 Product Data

General	
Supply voltage	24 VDC, -15 %...+20 %, $r_p \leq 5 \%$, SELV, PELV
Current input	min. 400 mA max. 1.5 A
Current input per channel	max. 4 mA
Operating temperature	0 °C...+60 °C
Storage temperature	-40 °C...+85 °C
Humidity	max. 95 % relative humidity, non-condensing
Type of protection	IP20
Dimensions (H x W x D) in mm	310 x 29.2 x 230
Weight	approx. 1.1 kg

Table 7: Product Data

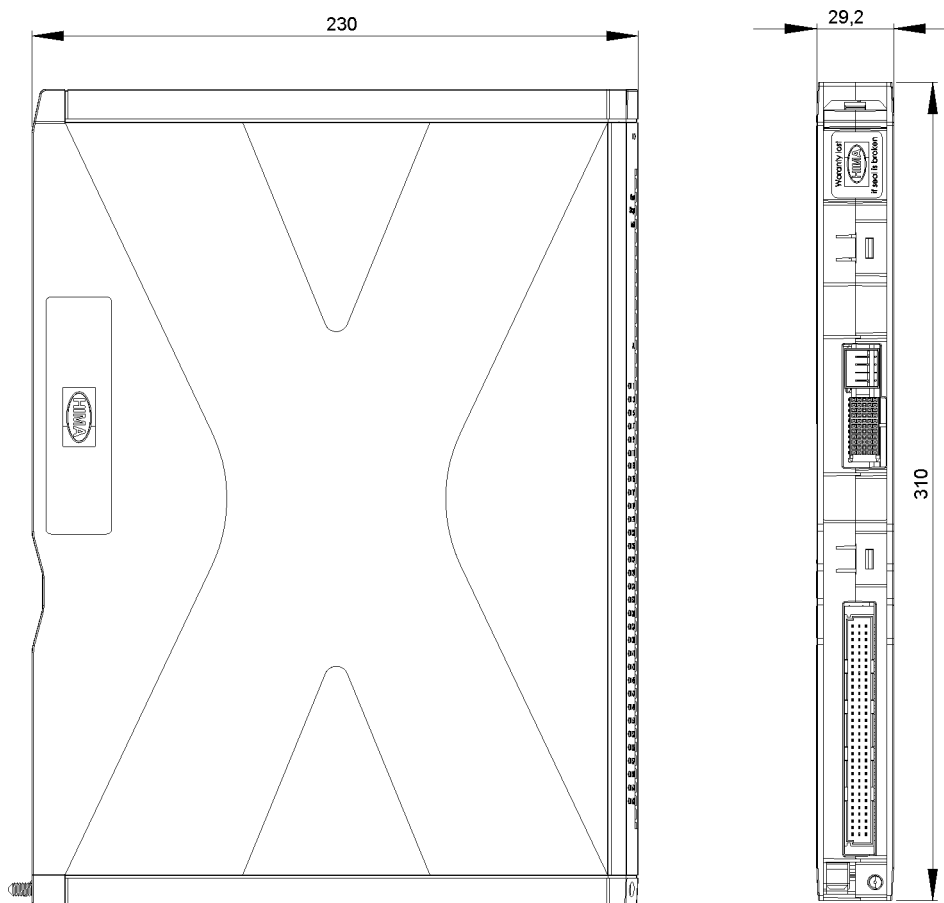


Figure 4: Views

Digital inputs	
Number of inputs (number of channels)	64 unipolar with reference pole DI- / L-, Non-galvanically isolated from one another
Type of input	Current sinking logic, 24 V, 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 \pm 0.8 V (2.1 mA \pm 0.3 mA)
Refresh of measured values (in the user program)	Cycle time of the user program

Table 8: Specifications for Digital Inputs

Supply	
Number of sources	8 with 8 outputs each
Output voltage for supply	Supply voltage - 2.5 V
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 <i>Supply X OK</i> 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 the supply outputs	
For supplying, the supply output assigned to the input must be used!	
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 9: Product Data for Supply

3.6 Connector Boards

A connector board connects the module to the field zone. Module and connector board form together 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	Connector board with screw terminals
X-CB 006 02	Redundant connector board with screw terminals
X-CB 006 03	Connector board with cable plug
X-CB 006 04	Redundant connector board with cable plug

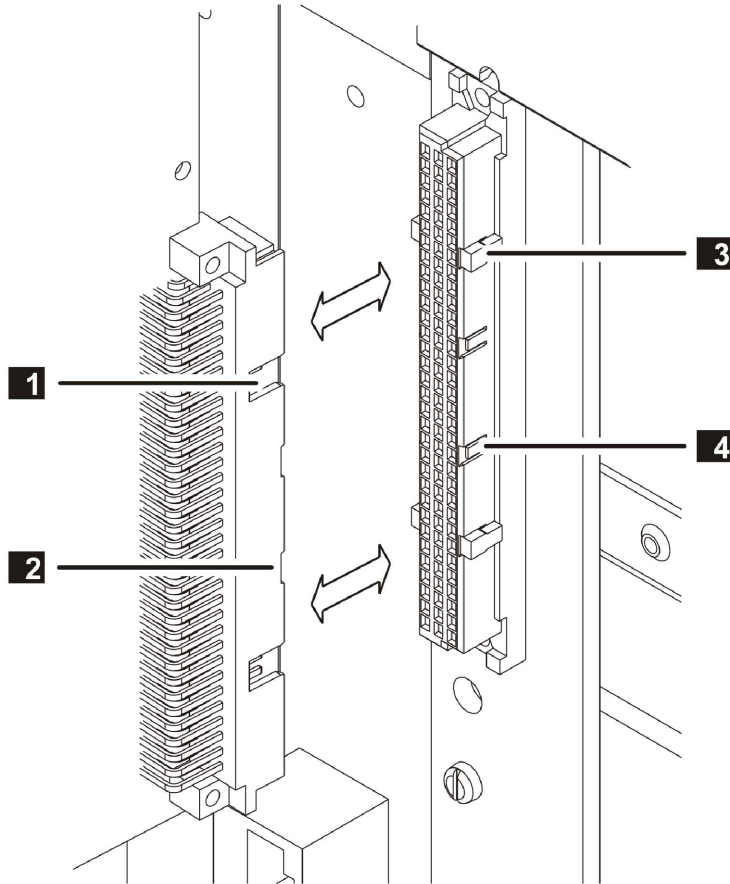
Table 10: Available Connector Boards

3.6.1 Mechanical Coding of Connector Boards

I/O modules and connector boards are mechanically coded starting from hardware revision AS10 to prevent them from being equipped with invalid I/O modules. Coding avoids incorrect installation of invalid I/O modules thus preventing negative effects on redundant modules and field zone. A part from that, invalid equipment has no effect on the HIMax system since only I/O modules that are correctly configured in SILworX enter the RUN state.

I/O modules and the corresponding connector boards have a mechanical coding in 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** Possible 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.

3.6.2 Coding of X-CB 006 Connector Boards

a7	a13	a20	a26	e7	e13	e20	e26
	X			X	X		

Table 11: Position of Coding Wedges

3.6.3 Connector Boards with Screw Terminals

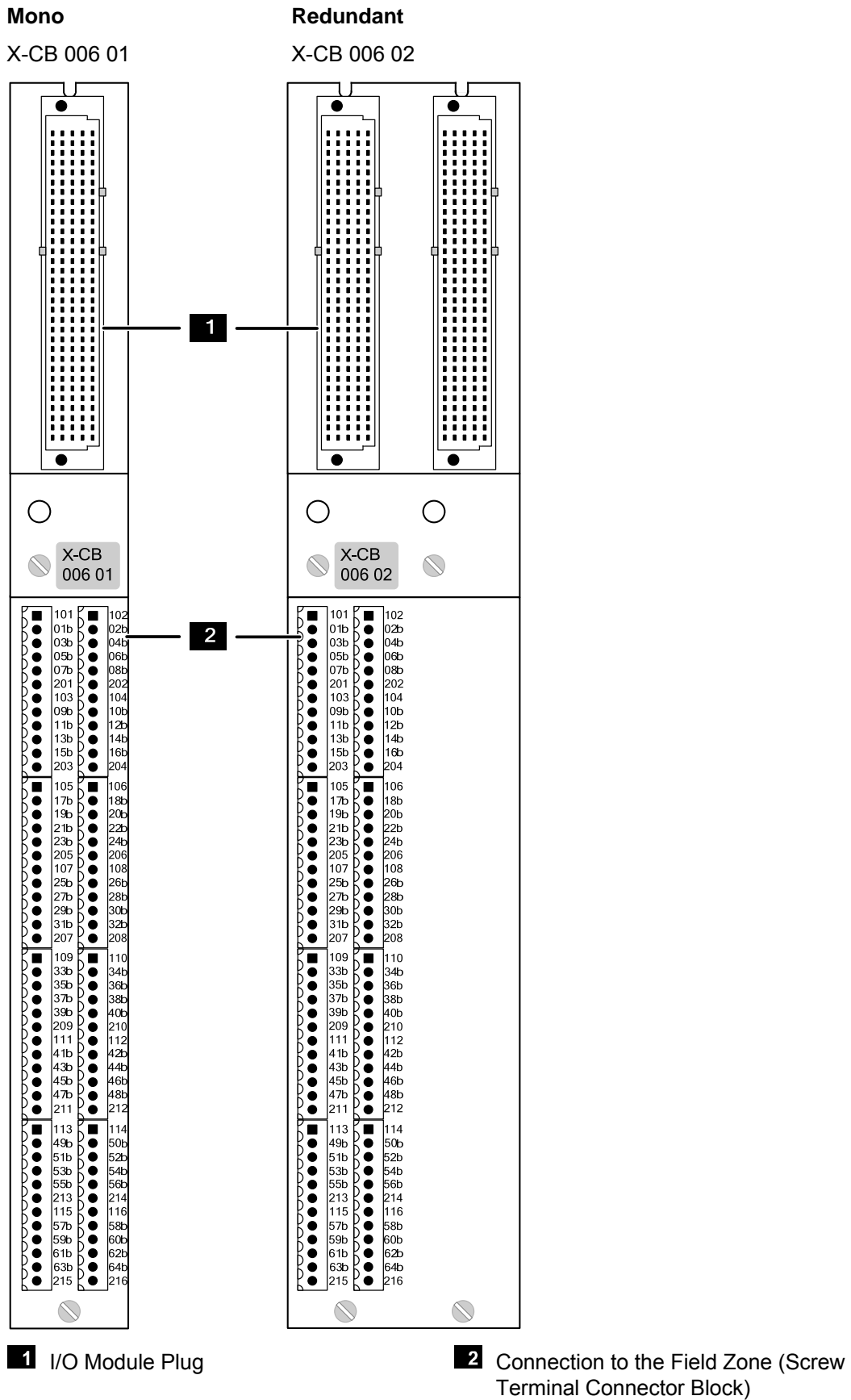


Figure 6: Connector Boards with Screw Terminals

3.6.4 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 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 zone.

The cable plugs feature the following properties:

Connection to the field zone	
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 13: Cable Plug Properties

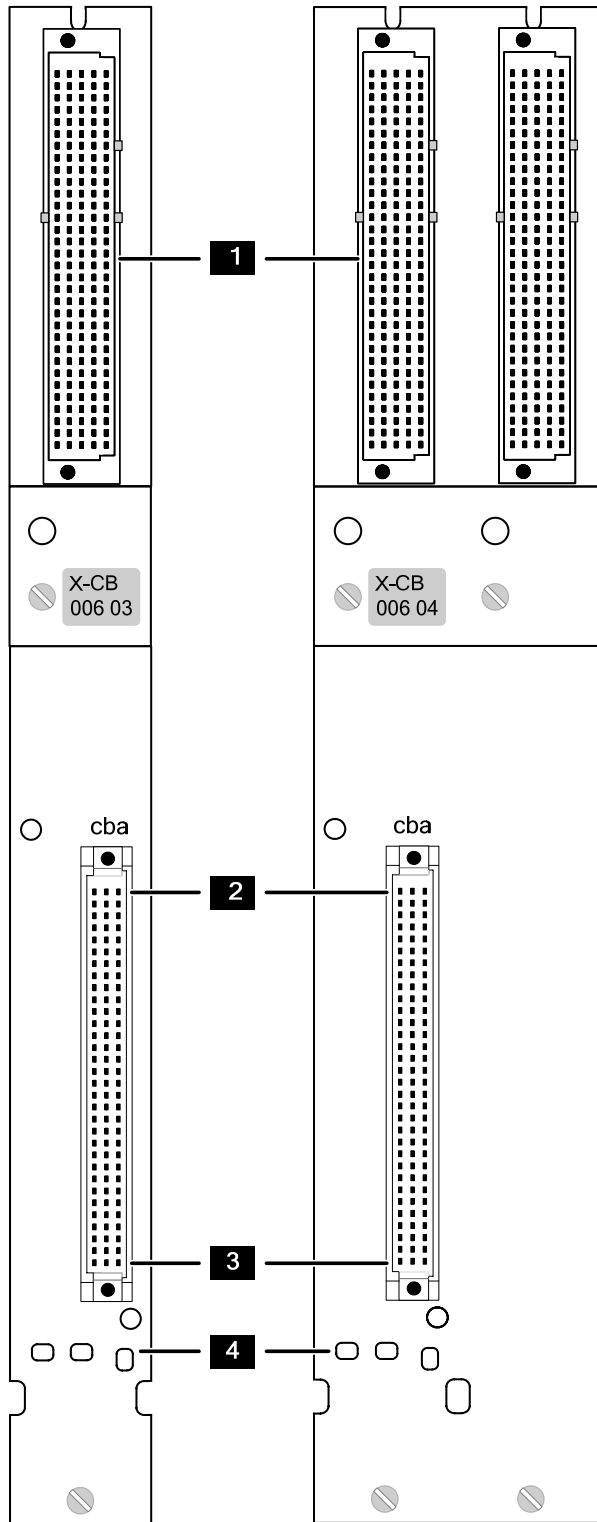
3.6.5 Connector Boards with Cable Plug

Mono

X-CB 006 03

Redundant

X-CB 006 04



1 I/O Module Plug

2 Connection to the Field Zone (Cable Plug in Row 1)

3 Connection to the Field Zone (Cable Plug in Row 32)

4 Coding for Cable Plugs

Figure 7: Connector Boards with Cable Plug

3.6.6 Pin Assignment for Connector Boards with Cable Plug

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

i**Connector pin assignment!**

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

Lead marking based on DIN 47100:

Row	c		b		a	
	Signal	Color	Signal	Color	Signal	Color
1	DI64+	YE-BU ¹⁾	DI32+	YE-BU	Reserved	YE ²⁾
2	DI63+	GN-BU ¹⁾	DI31+	GN-BU	Reserved	GN ²⁾
3	DI62+	YE-PK ¹⁾	DI30+	YE-PK	Reserved	BN ²⁾
4	DI61+	PK-GN ¹⁾	DI29+	PK-GN	Reserved	WH ²⁾
5	DI60+	YE-GY ¹⁾	DI28+	YE-GY		
6	DI59+	GY-GN ¹⁾	DI27+	GY-GN		
7	DI58+	BN-BK ¹⁾	DI26+	BN-BK		
8	DI57+	WH-BK ¹⁾	DI25+	WH-BK		
9	DI56+	BN-RD ¹⁾	DI24+	BN-RD		
10	DI55+	WH-RD ¹⁾	DI23+	WH-RD		
11	DI54+	BN-BU ¹⁾	DI22+	BN-BU		
12	DI53+	WH-BU ¹⁾	DI21+	WH-BU		
13	DI52+	PK-BN ¹⁾	DI20+	PK-BN		
14	DI51+	WH-PK ¹⁾	DI19+	WH-PK		
15	DI50+	GY-BN ¹⁾	DI18+	GY-BN		
16	DI49+	WH-GY ¹⁾	DI17+	WH-GY		
17	DI48+	YE-BN ¹⁾	DI16+	YE-BN	DI-	RD-BK
18	DI47+	WH-YE ¹⁾	DI15+	WH-YE	DI-	BU-BK
19	DI46+	BN-GN ¹⁾	DI14+	BN-GN	DI-	PK-BK
20	DI45+	WH-GN ¹⁾	DI13+	WH-GN	DI-	GY-BK
21	DI44+	RD-BU ¹⁾	DI12+	RD-BU	DI-	PK-RD
22	DI43+	GY-PK ¹⁾	DI11+	GY-PK	DI-	GY-RD
23	DI42+	VT ¹⁾	DI10+	VT	DI-	PK-BU
24	DI41+	BK ¹⁾	DI9+	BK	DI-	GY-BU
25	DI40+	RD ¹⁾	DI8+	RD	S8+	YE-BK ¹⁾
26	DI39+	BU ¹⁾	DI7+	BU	S7+	GN-BK ¹⁾
27	DI38+	PK ¹⁾	DI6+	PK	S6+	YE-RD ¹⁾
28	DI37+	GY ¹⁾	DI5+	GY	S5+	GN-RD ¹⁾
29	DI36+	YE ¹⁾	DI4+	YE	S4+	YE-BK
30	DI35+	GN ¹⁾	DI3+	GN	S3+	GN-BK
31	DI34+	BN ¹⁾	DI2+	BN	S2+	YE-RD
32	DI33+	WH ¹⁾	DI1+	WH	S1+	GN-RD

¹⁾ Additional orange ring if one lead marking color is repeated.

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

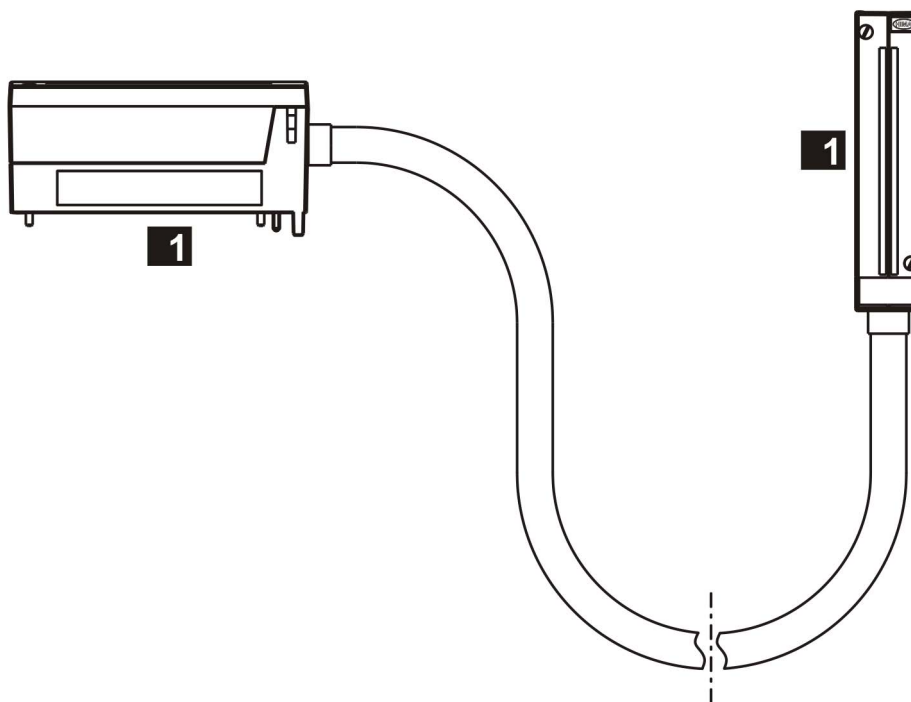
Table 14: Pin Assignment for the System Cable Plug

3.7 System Cable

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

General	
Cable	LIYY 80 x 0.25 mm ² + 2 x 2 x 0.25 mm ²
Wire	Finely stranded
Average outer diameter (d)	approx. 15.3 mm
Minimum bending radius	5 x d 10 x d
Fixed laying	
Flexible application	
Combustion behavior	Flame resistant and self-extinguishing in accordance with IEC 60332-1-2, -2-2
Length	8...30 m
Color coding	Based on DIN 47100, see Table 14.

Table 15: Cable Data



1 Identical Cable Plugs

Figure 8: System Cable X-CA 003 01 n

The system cable is available in the following standard variants:

System Cable	Description	Length
X-CA 003 01 8	Coded cable plugs on both sides	8 m
X-CA 003 01 15		15 m
X-CA 003 01 30		30 m

Table 16: Available System Cables

3.7.1 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 more information, refer to the Safety Manual (HI 801 003 E).

i

The safety-related application (SIL 3 in accordance with IEC 61508) of the inputs and the proximity switches connected must comply with the safety requirements. For more information, refer to the HIMA Safety Manual.

4.1 Mounting

Observe the following points when mounting the module:

- Only operate the module with the appropriate fan components. For more information, see the System Manual (HI 801 001 E).
- Only operate the module with the suitable connector board. For more information, see Chapter 3.6.
- The module and its connected components must be mounted to provide protection of at least IP20 in accordance with EN 60529: 1991 + A1: 2000.

NOTE



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 zone.
 - Take the appropriate earthing measures when connecting the plugs and terminals to the field zone.
 - An unshielded cable may be used for connecting proximity switches and switching contacts to the digital inputs.
 - When using stranded wires, 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 9.
- HIMA recommends using the supply of the module.

If an external supply or measurement unit fails, the affected digital input on the module can be overloaded and damaged. If an external supply is required for the given application, check the switching threshold following a non-transient overload that exceeds the limit values of the module.
- The inputs can be interconnected redundantly using the corresponding connector boards, see Chapters 3.6 and 4.4.

4.1.1 Wiring Inputs Not in Use

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

4.2 Mounting and Removing the Module

When replacing an existing module or mounting a new one, follow the instructions given in this chapter.

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

4.2.1 Mounting a Connector Board

Tools and utilities

- Screwdriver, 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 figure). Fit the groove into the guiding rail pin.
2. Place the connector board on the cable shield rail.
3. Secure the two captive screws to the base plate. First screw in the lower than the upper screw.

To remove the connector board

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

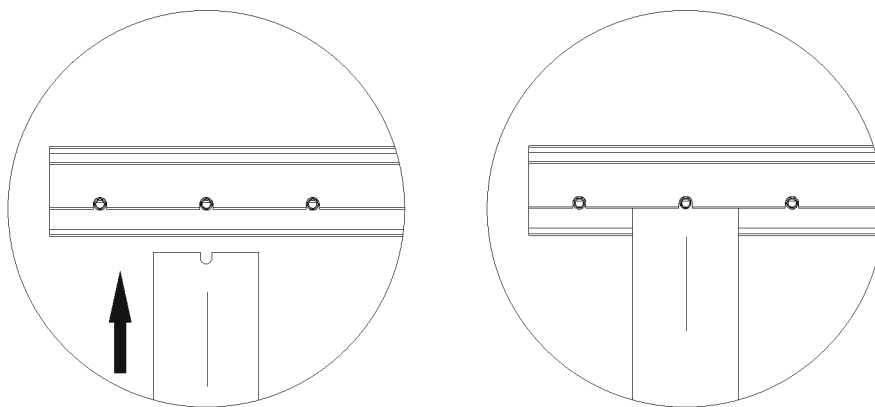


Figure 9: Inserting the Connector Board

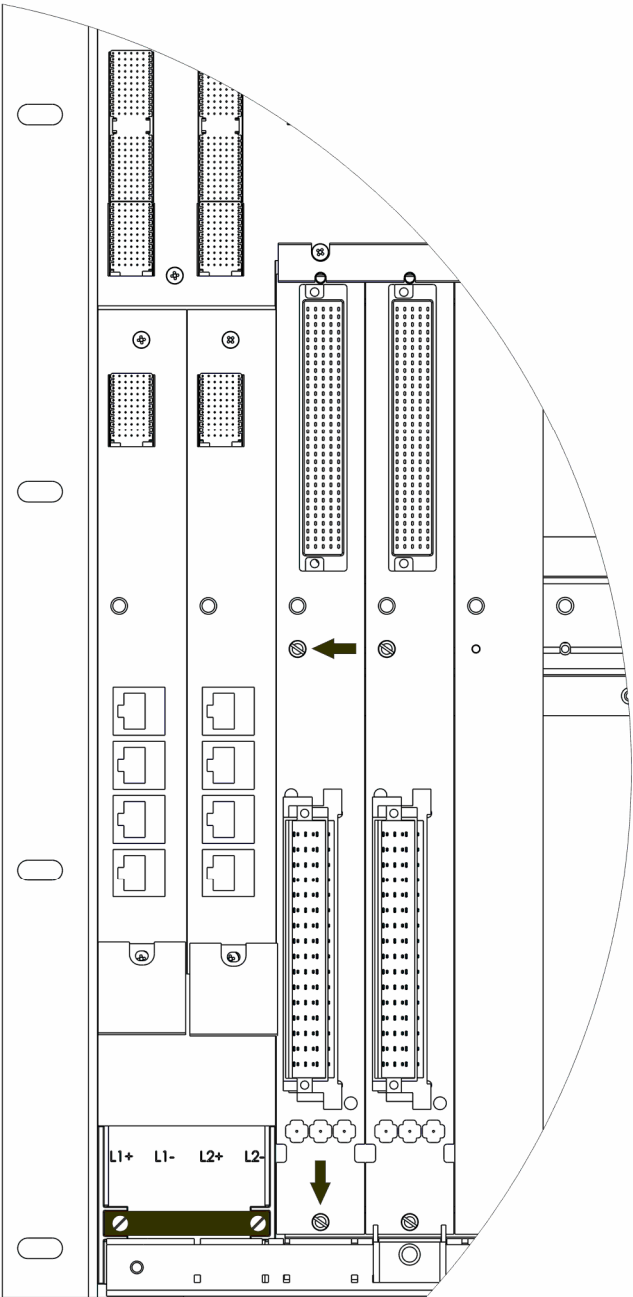


Figure 10: Securing the Connector Board with Captive Screws

4.2.2 Mounting and Removing the 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 observe this can damage the controller.

Always take care when inserting the module in the base plate.

Tools and utilities

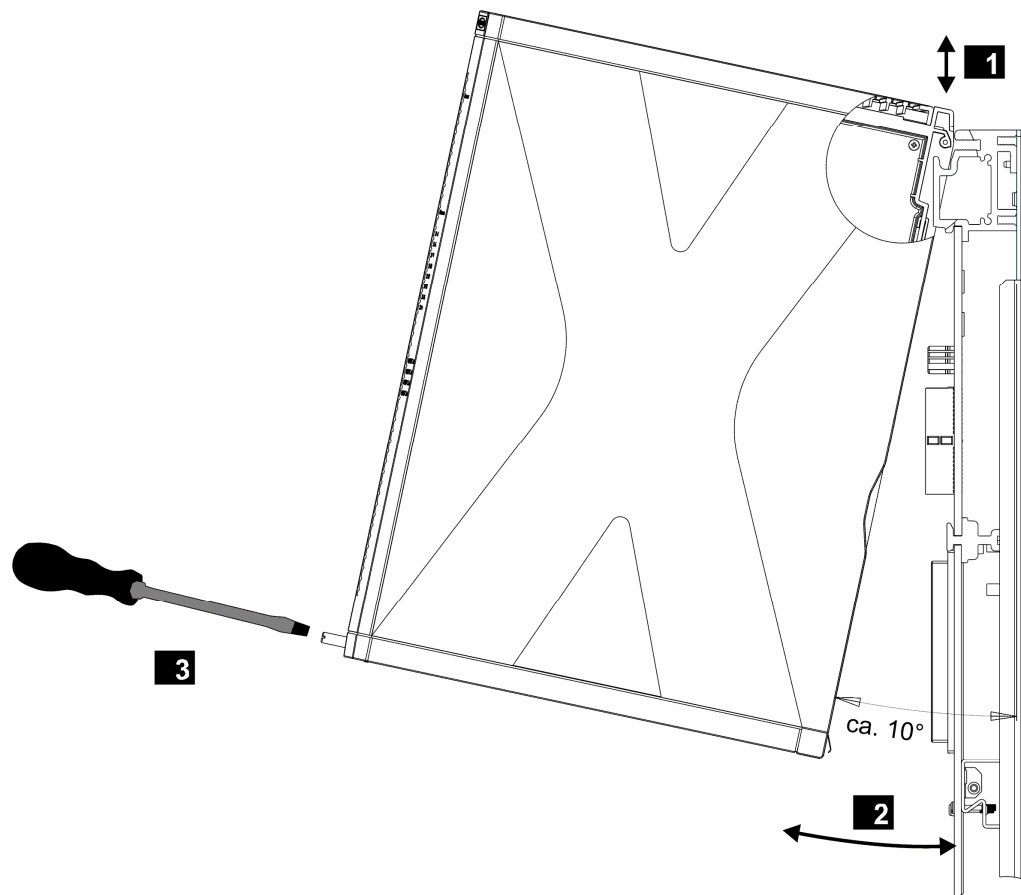
- Screwdriver, slotted 0.8 x 4.0 mm
- Screwdriver, slotted 1.2 x 8.0 mm

Installation

1. Open the cover plate on the fan rack:
 - Move the locks to the *open* position.
 - Lift the cover plate and insert 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.

Removal

1. Open the cover plate on the fan rack:
 - Move the locks to the *open* position.
 - Lift the cover plate and insert into the fan rack
2. Release the screw **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

3 Securing and Releasing a Module

2 Swiveling a Module in and out

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 more information on the statuses and parameters, refer to the tables starting with Chapter 4.3.1.
- The channel supply is monitored. If the *Supply used* parameter is activated, a supply error results in a channel fault (*Channel OK* = FALSE). If the channel supply is not used, the *Supply used* parameter must be deactivated. This ensures that a supply error does not lead to a channel fault (-> *Channel OK* = TRUE). To diagnose the supply in use, evaluate the *Supply X OK* status in the user program. Refer to Table 18 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 statuses from within the user program, assign the module statuses global variables. Perform this step in the module's detail view of the Hardware Editor.

The following tables present the statuses and parameters for the module in the same order given in the SILworX Hardware Editor.

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

4.3.1 Tab: Module

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

Name	R/W	Description																			
Enter these statuses and parameters directly in the Hardware Editor.																					
Name	W	Module name																			
Spare Module	W	Activated: The module missing in the redundancy group is not considered as a fault. Deactivated: The module missing in the redundancy group is considered as a fault. Default setting: Deactivated It is only displayed in the redundancy group tab!																			
Noise Blanking	W	Noise blanking performed by processor module allowed (activated/deactivated). Default setting: Activated The processor modules defers the reaction to detected transient faults until the safety time has expired. The user program retains its last valid process value.																			
Name	Data Type	R/W	Description																		
The following statuses and parameters can be assigned global variables and used in the user program.																					
Module OK	BOOL	R	TRUE: Mono operation: No module faults. Redundant operation: At least one of the redundant modules is faultless (OR logic). FALSE: Module fault Channel fault (no external faults) The module is not plugged in. Observe the <i>Module Status</i> parameter!																		
Module Status	DWORD	R	Status of the module <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Coding</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0x00000001</td> <td>Module fault ¹⁾</td> </tr> <tr> <td>0x00000002</td> <td>Temperature threshold 1 exceeded</td> </tr> <tr> <td>0x00000004</td> <td>Temperature threshold 2 exceeded</td> </tr> <tr> <td>0x00000008</td> <td>Incorrect temperature value</td> </tr> <tr> <td>0x00000010</td> <td>Voltage L1+ is defective</td> </tr> <tr> <td>0x00000020</td> <td>Voltage L2+ is defective</td> </tr> <tr> <td>0x00000040</td> <td>Internal voltage is defective</td> </tr> <tr> <td>0x80000000</td> <td>No connection to the module ¹⁾</td> </tr> </tbody> </table> <p>¹⁾ These faults affect the <i>Module OK</i> status and need not be separately evaluated in the user program.</p>	Coding	Description	0x00000001	Module fault ¹⁾	0x00000002	Temperature threshold 1 exceeded	0x00000004	Temperature threshold 2 exceeded	0x00000008	Incorrect temperature value	0x00000010	Voltage L1+ is defective	0x00000020	Voltage L2+ is defective	0x00000040	Internal voltage is defective	0x80000000	No connection to the module ¹⁾
Coding	Description																				
0x00000001	Module fault ¹⁾																				
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0x00000020	Voltage L2+ is defective																				
0x00000040	Internal voltage is defective																				
0x80000000	No connection to the module ¹⁾																				
Timestamp [µs]	DWORD	R	Microsecond fraction of the timestamp. Point in time at which the digital inputs were measured.																		
Timestamp [s]	DWORD	R	Second fraction of the timestamp. Point in time at which the digital inputs were measured.																		

Table 17: Module Tab in the Hardware Editor

4.3.2 Tab: I/O Submodule DI64_01

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

Name		R/W	Description
This parameter cannot be changed.			
Name		W	Module name
Name	Data Type	R/W	Description
The following statuses and parameters can be assigned global variables and used in the user program.			
Background Test Error	BOOL	R	TRUE: Background test is faulty FALSE: Background test is free of faults
Diagnostic Request	DINT	W	To request a diagnostic value, the appropriate ID must be sent to the module using the parameter <i>Diagnostic Request</i> (see Chapter 4.3.5 for coding details).
Diagnostic Response	DINT	R	As soon as <i>Diagnostic Response</i> returns the ID of <i>Diagnostic Request</i> (see 4.3.5 for coding details), <i>Diagnostic Status</i> contains the diagnostic value requested.
Diagnostic Status	DWORD	R	Requested diagnostic value in accordance with <i>Diagnostic Response</i> . The IDs of <i>Diagnostic Request</i> and <i>Diagnostic Response</i> can be evaluated in the user program. <i>Diagnostic Status</i> only contains the requested diagnostic value when both <i>Diagnostic Request</i> and <i>Diagnostic Response</i> have the same ID.
Restart on Error	BOOL	W	Using the parameter <i>Restart on Error</i> , each I/O module that has switched off permanently due to faults can be forced to re-adopt the RUN state. To do this, set the <i>Restart on Error</i> parameter FALSE to TRUE. The I/O module performs a complete self-test and only enters the RUN state if no faults are detected. Default setting: FALSE
Submodule OK	BOOL	R	TRUE: No submodule fault No channel faults FALSE: Submodule fault Channel fault (external faults included)
Submodule Status	DWORD	R	Bit-coded submodule status (see 4.3.4 for coding details)
Supply 1 OK	BOOL	R	The supplies are monitored for undervoltage TRUE: The supply is faultless. FALSE: The supply is faulty.
Supply 2 OK	BOOL	R	Such as <i>Supply 1 OK</i>
Supply 3 OK	BOOL	R	Such as <i>Supply 1 OK</i>
Supply 4 OK	BOOL	R	Such as <i>Supply 1 OK</i>
Supply 5 OK	BOOL	R	Such as <i>Supply 1 OK</i>
Supply 6 OK	BOOL	R	Such as <i>Supply 1 OK</i>
Supply 7 OK	BOOL	R	Such as <i>Supply 1 OK</i>
Supply 8 OK	BOOL	R	Such as <i>Supply 1 OK</i>

Table 18: Tab I/O Submodule DI64_01 in the Hardware Editor

4.3.3 Tab: I/O Submodule DI64_01: Channels

The **I/O Submodule DI64_01: Channels** tab contains the following parameters and statuses for each digital input.

Global variables can be assigned to the statuses and parameters with -> and used in the user program. The value without -> must be directly entered.

Name	Data Type	R/W	Description
Channel no.	---	R	Channel number, defined by default
-> Channel Value [BOOL]	BOOL	R	Boolean value of the digital input LOW or HIGH.
-> Channel OK	BOOL	R	TRUE: Faultless channel The channel value is valid. FALSE: Faulty channel The input value is set to FALSE
Ton [µs]	UDINT	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} . Important: The maximum reaction time T_R (worst case) for this channel is extended by the delay time, since a level change is not detected until the delay time has expired. Range of values: 0 ... ($2^{32} - 1$) Default setting: 0
Toff [µs]	UDINT	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} . Important: The maximum reaction time T_R (worst case) for this channel is extended by the delay time, since a level change is not detected until the delay time has expired. Range of values: 0...($2^{32}-1$) Default setting: 0
Test Suppression [µs]	UDINT	W	The digital 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 is extended. Range of values 0...500 µs Default setting: 0 (deactivated for this channel)
Sup. used	BOOL	W	Activated: The supply is used. Deactivated: The supply is not used. Default setting: Activated
Redund.	BOOL	W	Requirement: A redundant module must exist. Activated: Activate the channel redundancy for this channel Deactivated: Deactivate the channel redundancy for this channel Default setting: Deactivated

Name	Data Type	R/W	Description
Redundancy value	BYTE	W	Setting for determining the redundancy value. <ul style="list-style-type: none"> ▪ And ▪ Or Default setting: Or It is only displayed in the redundancy group tab!

Table 19: Tab I/O Submodule D64_01: Channels in the Hardware Editor

4.3.4 Submodule Status [DWORD]

Coding of the variable **Submodule Status**.

Coding	Description
0x00000001	Hardware unit fault (submodule).
0x00000002	Reset of an I/O bus
0x00000004	Faults detected while configuring the hardware
0x00000008	Fault detected while verifying the coefficients
0x00000010	First temperature threshold exceeded (warning temperature)
0x00000020	Second temperature threshold exceeded (limit temperature)
0x00000040	Overcurrent, module shutdown
0x00000080	Reset on the chip select monitoring
0x00800000	Module fault reference voltage A
0x01000000	Fault reference voltage A (overvoltage)
0x02000000	Fault reference voltage B (undervoltage)
0x04000000	Module fault reference voltage B
0x08000000	Fault auxiliary voltage
0x10000000	Fault reference voltage A (undervoltage)
0x20000000	Fault reference voltage B (overvoltage)
0x40000000	Fault chip select monitoring A
0x80000000	Fault chip select monitoring B

Table 20: Submodule Status [DWORD]

4.3.5 Diagnostic Status [DWORD]
Coding of the variable **Diagnostic State**.

ID	Description																
0	Diagnostic values (100...2008) 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																	
203																	
300	Comparator 24 V undervoltage (BOOL)																
1001...1064	Status of the channels 1..64 <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Coding</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0x0001</td> <td>Hardware unit fault (submodule) occurred</td> </tr> <tr> <td>0x0002</td> <td>Channel fault due to internal fault</td> </tr> <tr> <td>0x0004</td> <td>Overcurrent, channel shutdown</td> </tr> <tr> <td>0x1000</td> <td>Connection fault I/O bus A</td> </tr> <tr> <td>0x2000</td> <td>Connection fault I/O bus A</td> </tr> <tr> <td>0x4000</td> <td>Channel fault while testing the digital input circuit A</td> </tr> <tr> <td>0x8000</td> <td>Channel fault while testing the digital input circuit B</td> </tr> </tbody> </table>	Coding	Description	0x0001	Hardware unit fault (submodule) occurred	0x0002	Channel fault due to internal fault	0x0004	Overcurrent, channel shutdown	0x1000	Connection fault I/O bus A	0x2000	Connection fault I/O bus A	0x4000	Channel fault while testing the digital input circuit A	0x8000	Channel fault while testing the digital input circuit B
Coding	Description																
0x0001	Hardware unit fault (submodule) occurred																
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0x0004	Overcurrent, channel shutdown																
0x1000	Connection fault I/O bus A																
0x2000	Connection fault I/O bus A																
0x4000	Channel fault while testing the digital input circuit A																
0x8000	Channel fault while testing the digital input circuit B																
2001...2008	Fault status of the power sources 1...8 (supplies) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Coding</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0x0001</td> <td>Module fault</td> </tr> <tr> <td>0x8000</td> <td>Undervoltage of the supplies</td> </tr> </tbody> </table>	Coding	Description	0x0001	Module fault	0x8000	Undervoltage of the supplies										
Coding	Description																
0x0001	Module fault																
0x8000	Undervoltage of the supplies																

Table 21: Diagnostic Information [DWORD]

4.4 Connection Variants

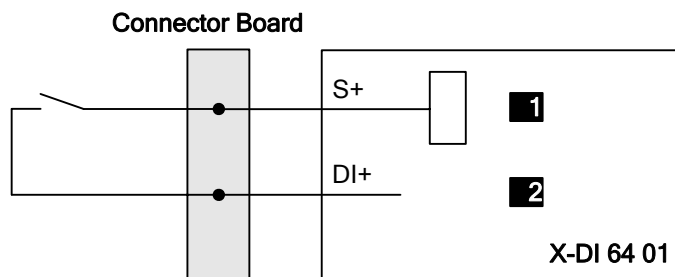
This chapter describes the correct wiring of the module in safety-related applications. The connection variants specified here are permitted.

4.4.1 Input Wiring

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

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

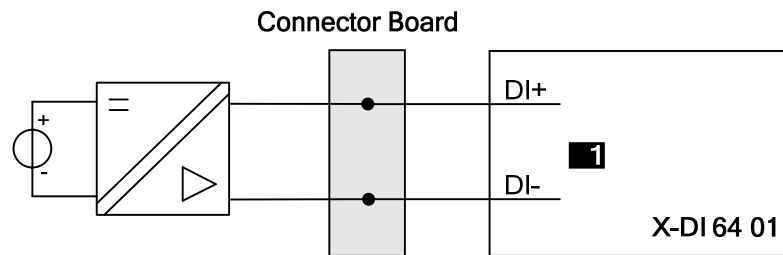
Connector boards X-CB 006 01 (with screw terminals) or X-CB 006 03 (with cable plug) can be used to perform the wiring such as described in Figure 12, Figure 13 and Figure 14.



1 Transmitter Supply

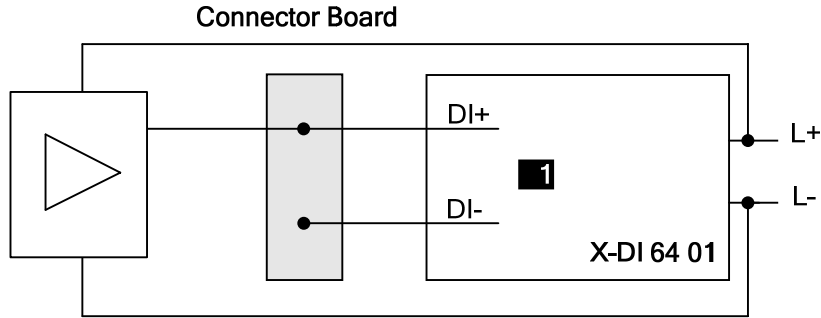
2 Digital Input

Figure 12: Wiring with Contact Maker or Two-Wire Proximity Switch



1 Digital Input

Figure 13: Wiring of a Digital Signal Source with Electrically Isolated Supply



1 Digital Input

Figure 14: Wiring of a Digital Signal Source with Non-Electrically Isolated Supply

NOTE



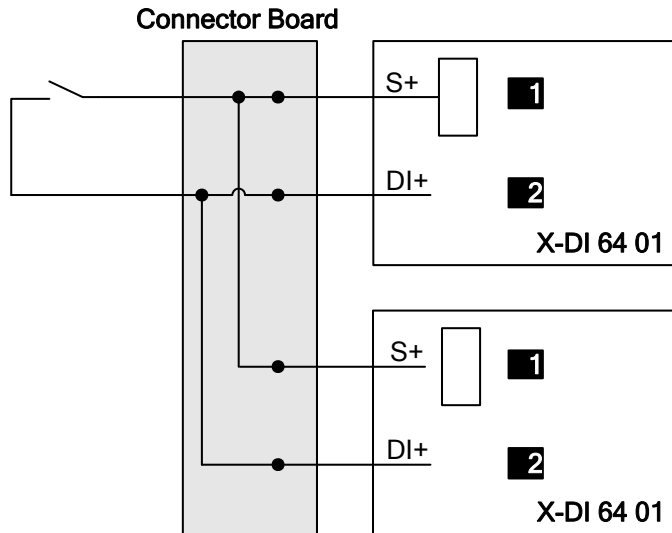
Overcurrent due to incorrect wiring!

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

Do not connect the ground of a digital signal source with a non-electrically isolated 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.

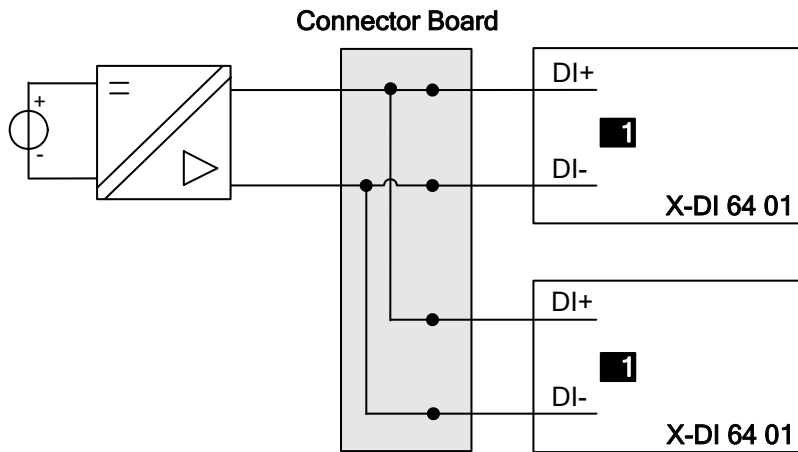
Connector boards X-CB 006 02 (with screw terminals) or X-CB 006 04 (with cable plug) can be used.



1 Transmitter Supply

2 Digital Input

Figure 15: Redundant Wiring with Contact Maker or Two-Wire Proximity Switch



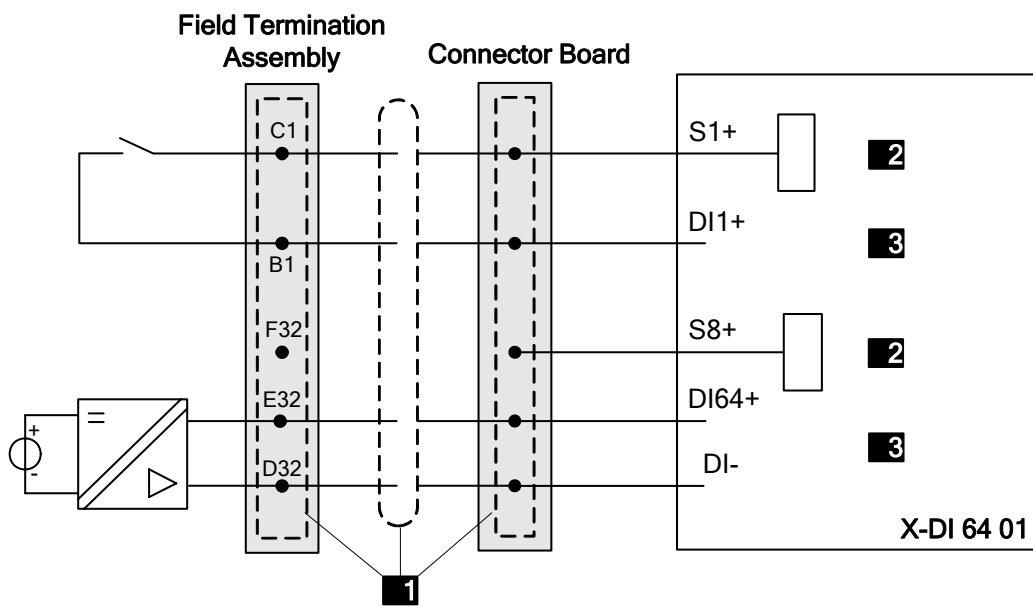
1 Digital Input

Figure 16: Redundant Wiring of a Digital Signal Source with Electrically Isolated Supply

4.4.2 Wiring 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).

X-CB 006 03 connector board is used.



1 System Cable with Cable Plug

3 Digital Input

2 Transmitter Supply

Figure 17: Connection via Field Termination Assembly

5 Operation

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

5.1 Handling

Direct handling of the module is not foreseen.

The module is operated from within the PADT, e.g., for forcing the digital inputs. For more details, refer to the SILworX documentation.

5.2 Diagnosis

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

The module diagnostic history can also be read using the programming tool 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 a faultless module of the same type or with an approved replacement model.

Only the manufacturer is authorized to repair the module.

When replacing modules, observe the instructions specified in the System Manual (HI 801 001 E) and Safety Manual (HI 801 003 E).

6.1 Maintenance Measures

6.1.1 Loading the Operating System

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

For detailed instructions on how to load the operating system, see the system manual and the online help. The module must be in STOP to be able to load an operating system.

i

The current version of the module in use is displayed in the SILworX Control Panel! The type label specifies the version when the module is delivered, see Chapter 3.3.

6.1.2 Proof Test

HIMax modules must be subjected to a proof test in intervals of 10 years. For more information, refer to the Safety Manual HI 801 003 E.

7 Decommissioning

To decommission the module, remove it from the base plate. For more information, see *Mounting and Removing the Module*.

8 Transport

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

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

9 Disposal

Industrial customers are responsible for correctly disposing of decommissioned HIMax 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
ARP	Address Resolution Protocol: Network protocol for assigning the network addresses to hardware addresses
AI	Analog Input
Connector Board	Connector board for the HIMax module
COM	Communication module
CRC	Cyclic Redundancy Check
DI	Digital Input
DO	Digital Output
EMC	Electromagnetic Compatibility
EN	European Norm
ESD	ElectroStatic Discharge
FB	Fieldbus
FBD	Function Block Diagram
FTT	Fault Tolerance Time
ICMP	Internet Control Message Protocol: Network protocol for status or error messages
IEC	International Electrotechnical Commission
MAC address	Hardware address of one network connection (Media Access Control)
PADT	Programming And Debugging Tool (in accordance with IEC 61131-3), PC with SILworX
PE	Protective Earth
PELV	Protective Extra Low Voltage
PES	Programmable Electronic System
PFD	Probability of Failure on Demand, probability of failure on demand of a safety function
PFH	Probability of Failure per Hour, probability of a dangerous failure per hour
R	Read
Rack ID	Base plate identification (number)
Non-reactive	Supposing that two input circuits are connected to the same source (e.g., a transmitter). An input circuit is termed "non-reactive" if it does not distort the signals of the other input circuit.
R/W	Read/Write
SB	System Bus (Module)
SELV	Safety Extra Low Voltage
SFF	Safe Failure Fraction, portion of safely manageable faults
SIL	Safety Integrity Level (in accordance with IEC 61508)
SILworX	Programming tool for HIMax
SNTP	Simple Network Time Protocol (RFC 1769)
SRS	System.Rack.Slot addressing of a module
SW	Software
TMO	TiMeOut
TMR	Triple Module Redundancy
W	Write
r_p	Peak value of a total AC component
Watchdog (WD)	Time monitoring for modules or programs. If the watchdog time is exceeded, the module or program enters the ERROR STOP state.
WDT	WatchDog Time

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