HIMax®

Digital Input Module
110 VDC or 48/120 VAC
Manual

SAFETY
NONSTOP

HIMA

X-DI 16 01

8

Contact

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Revision index	Revisions	Type of Change	
		technical	editorial
4.00	New edition for SILworX V4	X	X
5.00	Added: Chapter 3.5.2 Technical Data for 110 VDC	X	X

Table of Contents

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 the 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
- Repairs
- 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 systems	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 SILworX	-
First Steps	Introduction to SILworX	HI 801 103 E

Table 1: Additional Valid 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.
Italics:	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.
- Warning 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 document must be strictly observed. The product may only be used if all guidelines and safety instructions are adhered to.

This module is operated internally over the backplane bus with SELV or PELV.

The connector boards of this module has an additional terminal for an external power supply.

⚠ DANGER

Do not touch live parts!

If the connecting voltage to the connector board exceed SELV, use the cover hood X-CB COVER 01 or the X-FRONT COVER.

Observe all safety regulations!

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 16 01 digital input module is intended for use in the programmable electronic system (PES) HIMax.

The module can be inserted into 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 16 digital input signals. The digital inputs are current sinking logic for 110 VDC or 48/120 VAC signals in accordance with IEC 61131 (based on type 1).

The module has been certified by the TÜV for safety-related applications up to SIL 3 (IEC 61508, IEC 61511 and IEC 62061) as well as Cat. 4 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 module 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 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 in Chapter 3.7, and the FTA in chapter 3.8

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 Assembly

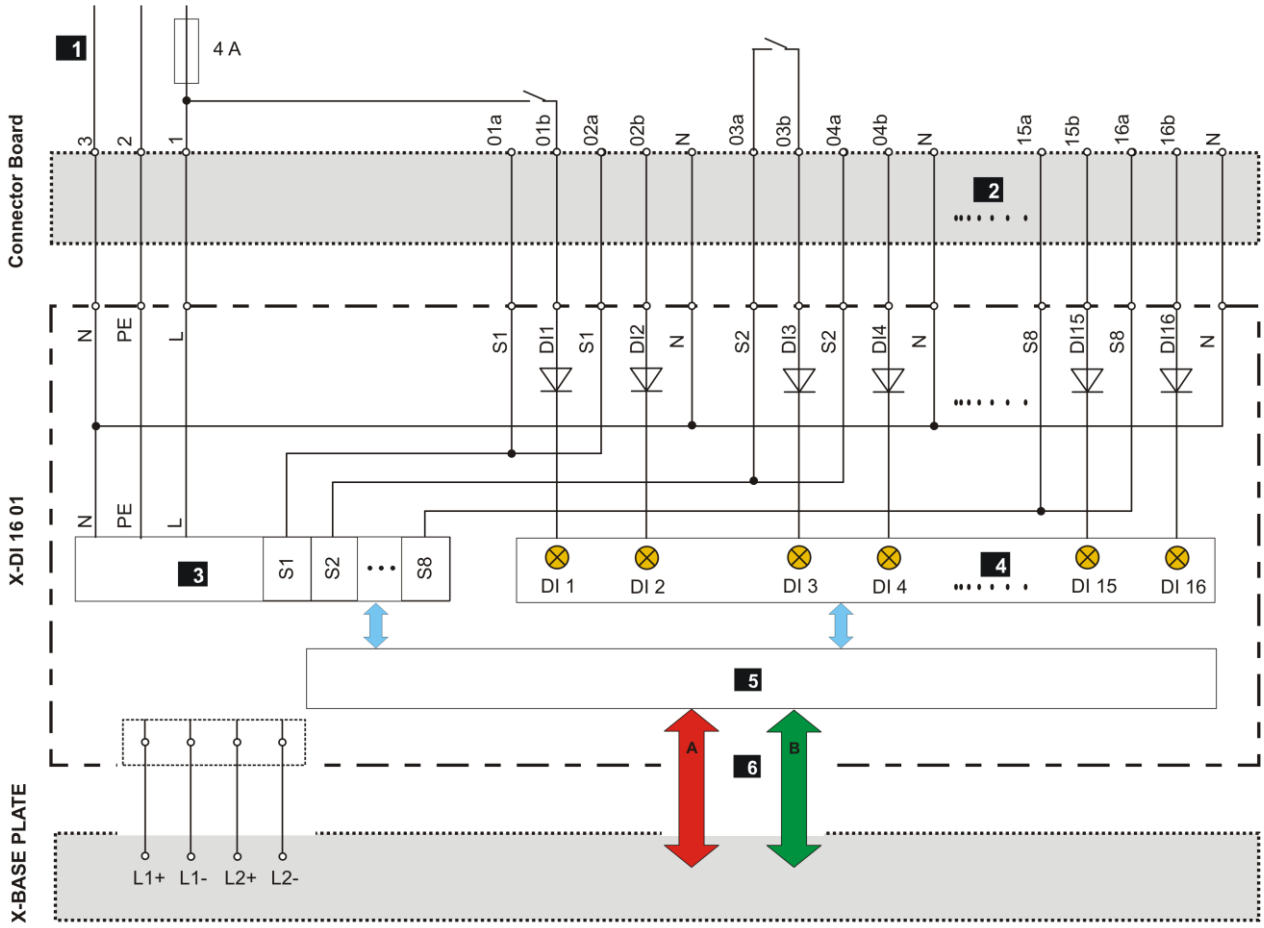
The input module has 16 safety-related digital inputs. The digital inputs may detect 110 VDC or 48/120 VAC signals from contact makers. For safely detecting a high level on the digital input, the voltage and current thresholds must be exceeded, see Table 8.

The 8 short-circuit-proof supplies feed 2 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.

3.4.1 Block Diagram

The following block diagram illustrates the structure of the module.



1 Terminal External Supply Voltage
2 Field Zone: Contact Makers
3 Supplies S1 to S8
4 Interface
5 Safety-Related Processor System
6 System Busses

Figure 2: Block Diagram

3.4.2 Indicators

The following figure shows the LED indicators for the module.

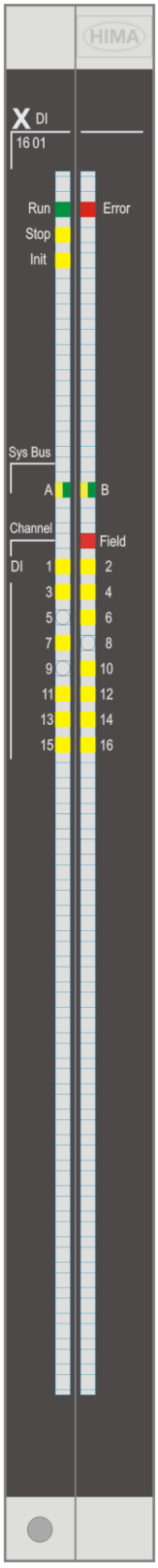


Figure 3: Indicators

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 (DI 1...16, 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…16	Yellow	On	The related channel is active (energized).
		Blinking2	The related channel is faulty.
		Off	The related channel is inactive (de-energized).
Field	Red	Blinking2	Undervoltage at least one supply, caused by field-side short circuit or supply failure.
		Off	Supply is faultless.

Table 6: I/O LEDs

3.5 Product Data

General	
Supply voltage	24 VDC, -15...+20 %, $r_P \leq 5$ %, SELV, PELV
Current input	0.5 A
Operating temperature	0...+60 °C
Storage temperature	-40...+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. 1.2 kg

Table 7: Product Data

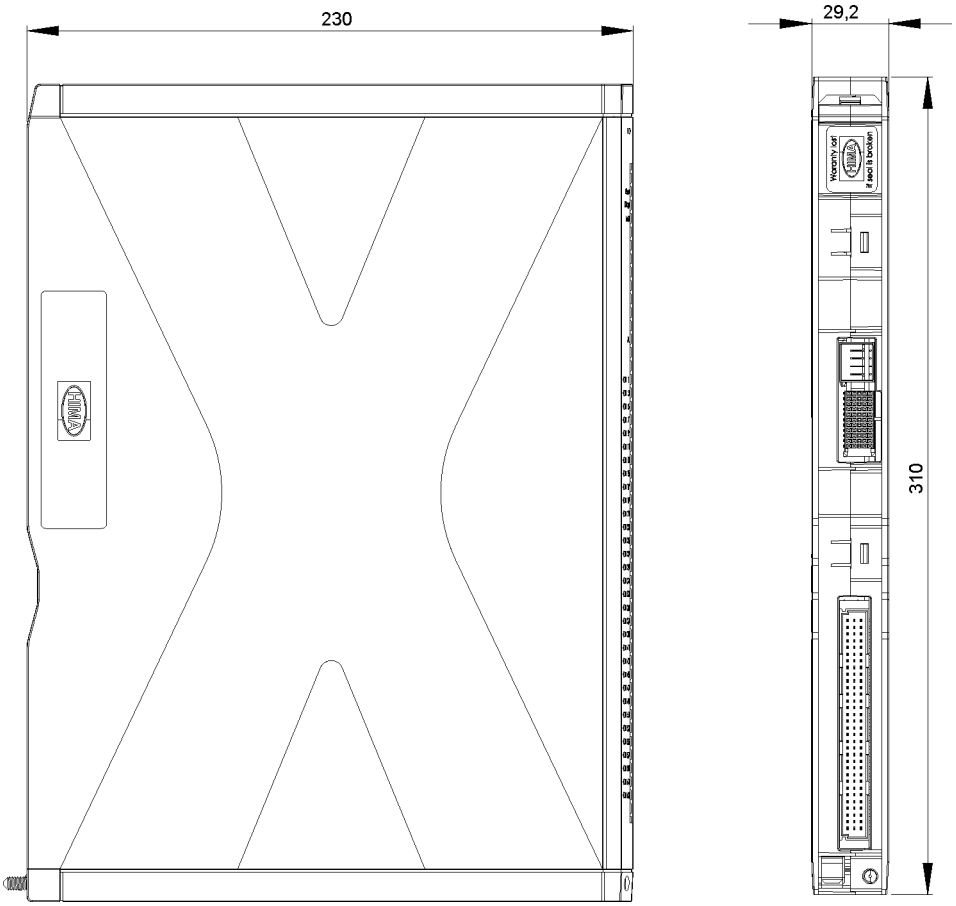


Figure 4: Views

3.5.1 Specifications of 48/120 VAC Variant

Digital inputs	
Number of inputs (number of channels)	16, unipolar with ground N, Non-galvanically isolated from one another i Ground N needs not to contact earth. If the modules are redundantly wired, both redundant channels must be connected in phase to the same voltage.
Type of input	Current sinking logic, 48/ 120 VAC[1)], based on type 1 in accordance with IEC 61131-2
Frequency	50/60 Hz sine, -6...+4 % (47...63 Hz)
Rated input voltage	0...48 VAC[1)] (nominal range 48 VAC) 0...120 VAC[1)] (nominal range 120 VAC)
Input voltage operating range	0...130 VAC[1)] (Input current limited to approx. 5 mA)
Switching point	U_S: 31.6 V (-2.5...+4 V), (2.1 mA ± 0.3 mA) U_{eff}: 22.4 V (-2...+3 V), (1.05 mA ± 0.15 mA)
Delay time of module	0 → 1 max. 25 ms 1 → 0 max. 50 ms
[1)] -15…+20 %, w_s ≤ 5 %	

Table 8: Specifications for Digital Inputs

Supply	
External supply voltage Terminal L, N	48 VAC or 120 VAC, 50/ 60 Hz, max. 130 VAC -15…+20 %, w_s ≤ 5 %
Standby current	20 mA
Maximum current input	100 mA
Number of supplies	8 with 2 outputs each
Output voltage for supply	External supply voltage -3 VAC
Output current for supply	50 mA for each group, short-circuit-proof Short cercuit detection between 60...240 mA
Low voltage detection	The module monitors the supplies for low voltage (< 25 VAC). If a fault occurs, the corresponding *Supply X OK* status is set to FALSE.
Short-circuit of one supply	Low voltage detection active The output current is pulsed < 250 mA while the supply is short-circuited.
Assignment of the supply outputs	
A supply Sn is assigned to each digital input.	
Supply S1	DI1, DI2
Supply S2	DI3, DI4
Supply S3	DI5, DI6
Supply S4	DI7, DI8
Supply S5	DI9, DI10
Supply S6	DI11, DI12
Supply S7	DI13, DI14
Supply S8	DI15, DI16

Table 9: Product Data for Supply

3.5.2 Specifications of 110 VDC Variant

Digital inputs	
Number of inputs (number of channels)	16, non-galvanically isolated from one another
Type of input	Current sinking logic, 110 VDC[1)], based on type 1 in accordance with IEC 1-61131-2
Rated input voltage	0...110 VDC[1)] (nominal range 110 VDC)
Input voltage operating range	0...115 VDC[1)] (Input current limited to approx. 5 mA)
Switching point	U_S: 31.6 V (-2.5...+4 V), (2.1 mA ± 0.3 mA)
Delay time of module	0 → 1 max. 25 ms 1 → 0 max. 50 ms
[1)] -15…+5 %, w_s ≤ 5 %	

Table 10: Specifications for Digital Inputs

Supply	
External supply voltage Terminal L, N	110 VDC, 50 mA… 2.5 A -15…+5 %, w_s ≤ 5 %
Standby current	20 mA
Maximum current input	100 mA
Number of sources	8 with 2 outputs each
Output voltage for supply	External supply voltage -3 VDC
Output current for supply	50 mA for each group, short-circuit-proof Short cercuit detection between 60...240 mA
Undervoltage detection	The module monitors the supplies for undervoltage (< 25 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 the supply outputs	
A supply Sn is assigned to each digital input.	
Supply S1	DI1, DI2
Supply S2	DI3, DI4
Supply S3	DI5, DI6
Supply S4	DI7, DI8
Supply S5	DI9, DI10
Supply S6	DI11, DI12
Supply S7	DI13, DI14
Supply S8	DI15, DI16

Table 11: 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 007 01	Connector board with spring terminals
X-CB 007 02	Redundant connector board with spring terminals
X-CB 007 03	Connector board for system cable set
X-CB 007 04	Redundant connector board for system cable set

Table 12: Available Connector Boards

Connector Boards with Spring Terminals

The connector boards X-CB 007 01 and X-CB 007 02 are delivered with the appropriate spring terminals.

Connector Boards with no Spring Terminals

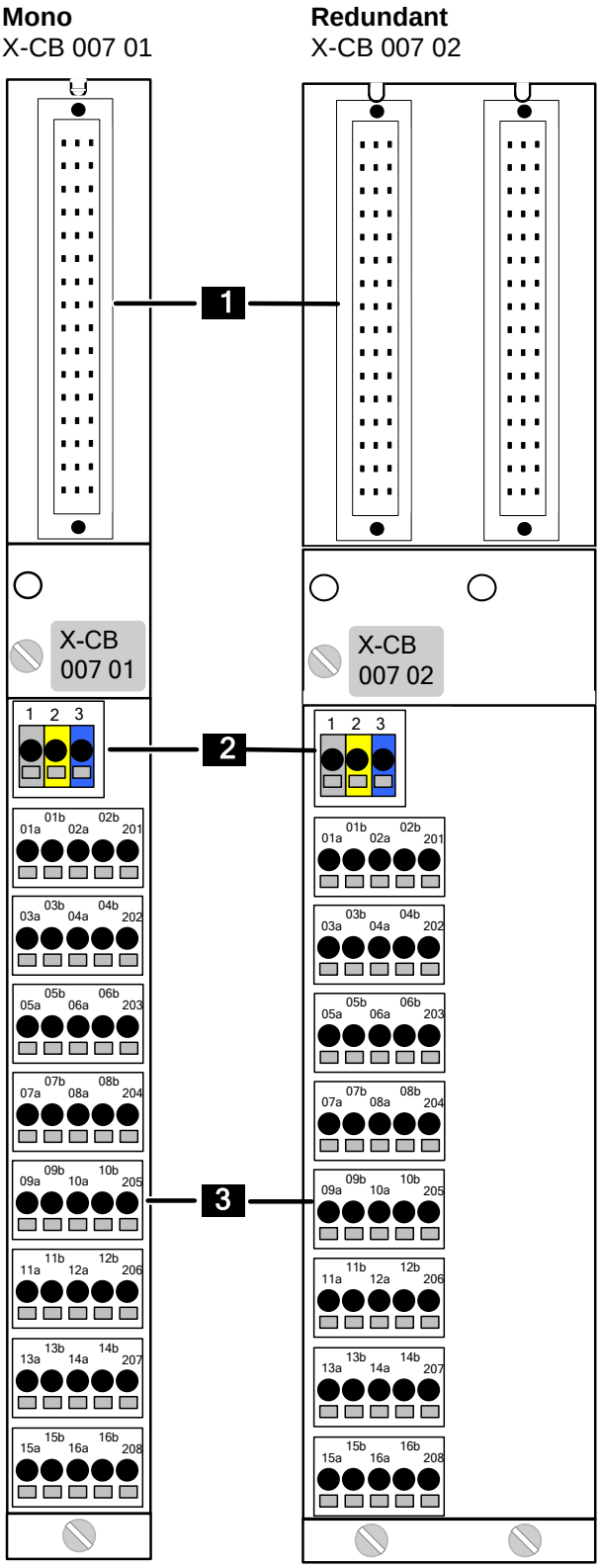
The connector boards X-CB 007 03 and X-CB 007 04 are required if system cable set X-CA 004 01 or X-CA 004 02 should be used. Refer to Chapter 3.7 for more information.

Spring terminals to connect to external power supply are delivered with all connector boards.

3.6.1 Mechanical Coding of Connector Boards

The female connector of the X-CB 007 01/02 connector boards and the I/O module plug of the module are shifted opposite to any other HIMax modules. This prevents faulty module assembly.

3.6.2 Pin Assignment for Connector Boards with Cable Plugs



1 I/O Module Plug

2 Connection to the External Power Supply

3 Connection to Field Zone (with Spring Terminals)

Figure 5: Connector Boards with Cable Plugs

3.6.3 Pin Assignment for Connector Boards with Cable Plug

Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	1	L	L+
2	2	PE	PE
3	3	N	L-
Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	01a	S1	S1
2	01b	DI1	DI1
3	02a	S1	S1
4	02b	DI2	DI2
5	201	N	L-
Pin no.	Designation	Signal (VAC)	Signal (VDC)
DI11	03a	S2	S2
2	03b	DI3	DI3
3	04a	S2	S2
4	04b	DI4	DI4
5	202	N	L-
Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	05a	S3	S3
2	05b	DI5	DI5
3	06a	S3	S3
4	06b	DI6	DI6
5	203	N	L-
Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	07a	S4	S4
2	07b	DI7	DI7
3	08a	S4	S4
4	08b	DI8	DI8
5	204	N	L-
Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	09a	S5	S5
2	09b	DI9	DI9
3	10a	S5	S5
4	10b	DI10	DI10
5	205	N	L-
Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	11a	S6	S6
2	11b	DI11	DI11
3	12a	S6	S6
4	12b	DI12	DI12
5	206	N	L-
Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	13a	S7	S7
2	13b	DI13	DI13
3	14a	S7	S7
4	14b	DI14	DI14
5	207	N	L-

Pin no.	Designation	Signal (VAC)	Signal (VDC)
1	15a	S8	S8
2	15b	DI15	DI15
3	16a	S8	S8
4	16b	DI16	DI16
5	208	N	L-

Table 13: Pin Assignment for Connector Boards with Cable Plugs

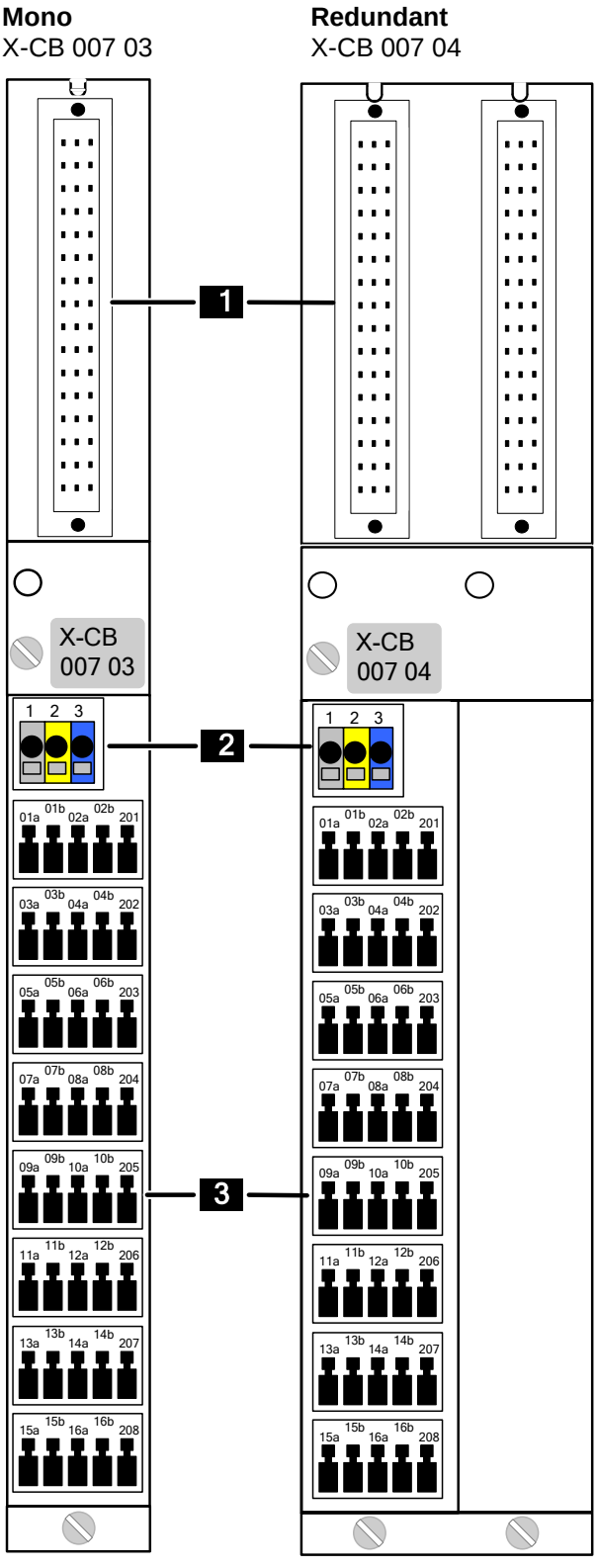
Cable plugs attached to the connector board pin headers are used to connect to the field zone and to external power supplies.

The cable plugs feature the following properties:

Connection to the field zone	
Cable Plugs	8 pieces, with 5 poles, spring terminals
Wire cross-section	0.14…4 mm^2 (single-wire) 0.14…1.5 mm^2 (finely stranded) 0.14…1.5 mm^2 (with wire end ferrule)
Stripping length	10 mm
External power supply	
Cable plugs	with 3 poles
Wire cross-section	0.14…4 mm^2 (single-wire) 0.14…2.5 mm^2 (finely stranded) 0.214…2.5 mm^2 (with wire end ferrule)
Stripping length	10 mm

Table 14: Cable Plug Properties

3.6.4 Pin Assignment for Connector Boards without Cable Plugs



1 I/O Module Plug

2 Connection to External Power Supply

3 Connection to Field Zone (without Cable Plugs)

Figure 6: Connector Boards without Cable Plugs

3.6.5 Pin Assignment for Connector Boards without Cable Plugs

For these connector boards, HIMA provides the pre-assembled system-cable set X-CA 004 01. Refer to Table 15 for more information.

Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	01a	S1	S1	1
2	01b	DI1	DI1	2
3	02a	S1	S1	3
4	02b	DI2	DI2	4
5	201	N	L-	5
Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	03a	S2	S2	1
2	03b	DI3	DI3	2
3	04a	S2	S2	3
4	04b	DI4	DI4	4
5	202	N	L-	5
Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	05a	S3	S3	1
2	05b	DI5	DI5	2
3	06a	S3	S3	3
4	06b	DI6	DI6	4
5	203	N	L-	5
Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	07a	S4	S4	1
2	07b	DI7	DI7	2
3	08a	S4	S4	3
4	08b	DI8	DI8	4
5	204	N	L-	5
Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	09a	S5	S5	1
2	09b	DI9	DI9	2
3	10a	S5	S5	3
4	10b	DI10	DI10	4
5	205	N	L-	5
Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	11a	S6	S6	1
2	11b	DI11	DI11	2
3	12a	S6	S6	3
4	12b	DI12	DI12	4
5	206	N	L-	5
Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	13a	S7	S7	1
2	13b	DI13	DI13	2
3	14a	S7	S7	3
4	14b	DI14	DI14	4
5	207	N	L-	5

Pin no.	Designation	Signal (VAC)	Signal (VDC)	Lead marking
1	15a	S8	S8	1
2	15b	DI15	DI15	2
3	16a	S8	S8	3
4	16b	DI16	DI16	4
5	208	N	L-	5

Table 15: Pin Assignment for Connector Boards without Cable Plugs

i The three-pole cable plug for the external power supply is enclosed. Table 14 specifies the cable plug properties.

3.7 System Cable

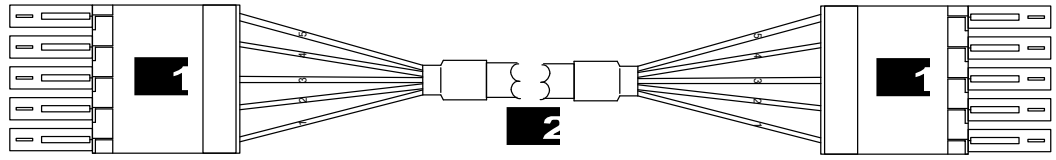
The system cables are used to wire the connector boards with the field zone via the field termination assembly or inline terminals. The following type of cable is used for the system cables:

General	
Cable	LIYY 5 x 0.5 mm^2
Wire	Finely stranded
Average outer diameter (d)	approx. 6.3 mm
Minimum bending radius Fixed laying Flexible application	 4 x d 7.5 x d
Combustion behavior	Flame resistant and self-extinguishing in accordance with IEC 60332-1-2, -2-2
Length	5…30 m
Number coding	See Table 15 for details on the pin assignment.

Table 16: Cable Data

System Cable Set X-CA 004 01

The X-CA 004 01 system cable set is delivered with 8 cables which are required for connector boards X-CB 007 03 and X-CB 007 04. The cables are used to connect the connector boards to the field zone via the X-FTA 004 field termination assembly. Cable plugs with spring terminals are already mounted on the pre-assembled cables.



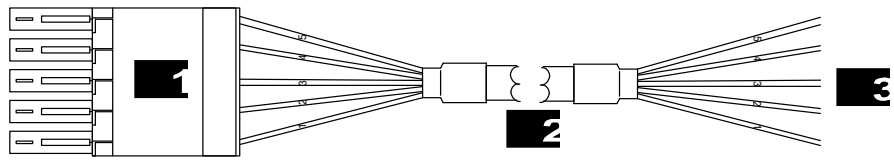
1 Cable Plugs

2 Cable LIYY 5 x 0.5 mm^2

Figure 7: Cable from the System Cable Set X-CA 004 01

System Cable X-CA 004 02

The X-CA 004 01 system cable set is delivered with 8 cables which are required for connector boards X-CB 007 03 and X-CB 007 04. The cables are used to connect the connector boards to the field zone. Cable plugs with spring terminals are already mounted on the pre-assembled cables. The ends of the cables are opened on the field side and can be connected to the appropriate terminal. For more information about the mounting refer to Chapter 4.1.



1 Cable Plugs

2 Cable LIYY 5 x 0.5 mm^2

3 Connection to Field Zone (Cable with Open Ends)

Figure 8: Cable from the X-CA 004 02 System Cable Set

For labeling the cable plugs zack strips are included within the scope of delivery of the connector boards and FTA. The zack stripes must be inserted by the user into the cable plugs.

The following 4 system cables sets are available for the module:

Designation	Description
X-CA 004 01 8	8 x system cable 5 x 0.5 mm^2, 8 m
X-CA 004 01 15	8 x system cable 5 x 0.5 mm^2, 15 m
X-CA 004 01 30	8 x system cable 5 x 0.5 mm^2, 30 m
X-CA 004 02 5	8 x system cable 5 x 0.5 mm^2, 5 m

Table 17: Available System Cable Sets

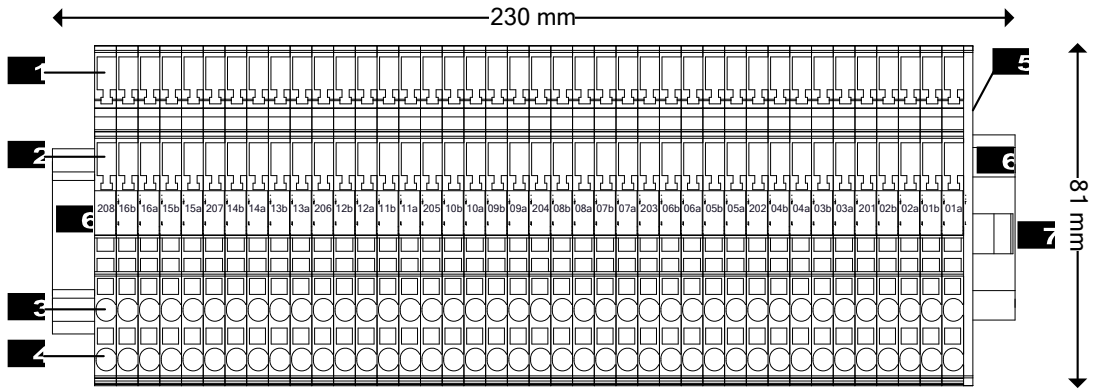
3.8 Field Termination Assembly

The X-FTA 004 connects each contact maker from the field zone to the connector board of the module. It is delivered as a kit and is composed of terminals mounted on a DIN rail within the control or marshalling cabinet.

The X-FTA 004 is suitable for operating the module redundantly or as a single module. The use of the X-FTA 004 to set the redundancy allows I/O modules that are not located in the base plate adjacently to be connected redundantly.

Assembly

The X-FTA 004 consists of the delivered terminal combination such as specified in Figure 9:



1 Terminal Socket
2 Redundant Terminal Socket
3 Connection to the Field Zone
4 Redundant Connection to the Field Zone
5 Cover for Terminal
6 End Bracket
7 Tag Holder for End Bracket

Figure 9: X-FTA 004 Field Termination Assembly

Dimensions

Height: 81 mm

Width: 230 mm

Depth: 36.5 mm (with no spring terminals)

Parts List Terminal Combination

Two labels kits are delivered to designate the terminal combinations, the first is labeled from the left to the right and the second from the right to the left. After mounting the terminal combination, use the label kit that ensures better readability.

Number	Designation
40	Spring-cage modular terminal block
1	Cover for Terminal
2	End bracket
1	Tag holder for end bracket, height adjustable
1	Protective film for tag holder
2	Labels kits zack strip left/right and right/left for FTA and system cable

Table 18: Parts List Terminal Combination

Specifications for Spring-Cage Modular Terminal Block

To facilitate the redundancy setting, the terminals on each spring-cage modular terminal block (**1**, **2**, **3** and **4**) have already been electrically connected with one another.

Spring-cage modular terminal block	
Terminal cross-section	0.08...2.5 mm² flexible
Dimensions (H x W x D)	81 x 5.2 x 36.5 mm (with no spring terminals)
Type of connection	Spring-cage connection
Stripping length	10 mm
Plug gauge	A3
Mounting	on 35 mm DIN rail
Mounting position	Horizontal or vertical

Table 19: Specifications for Spring-Cage Modular Terminal Block

4 Start-up

This chapter describes how to install, configure and connect the module. For more information, refer to HIMax System Manual (HI 801 001 E).

i The safety-related application (SIL 3 in accordance with IEC 61508) of the inputs and the contact makers connected must comply with the safety requirements. Fore more information, refer to the HIMax 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).
- Operation is only permitted with the suitable connector board, see Chapter 3.6.

⚠ DANGER

Danger of electric shock!

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

Observe all safety regulations!

- 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

Overcurrent due to incorrect wiring!

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

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

Only one phase can be connected to the module.

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 the contact makers to the digital inputs.
  - On the module side, the shielding must be connected to the cable shield rail (use SK 20 shield connection terminal block or similar).
  - 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 voltage 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 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, 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 figure). Fit the groove into the guiding rail pin.
2. Place the connector board on the cable shield rail.
3. Secure the captive screws to the base plate. First screw in the lower screws than the upper ones.

To remove the connector board

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

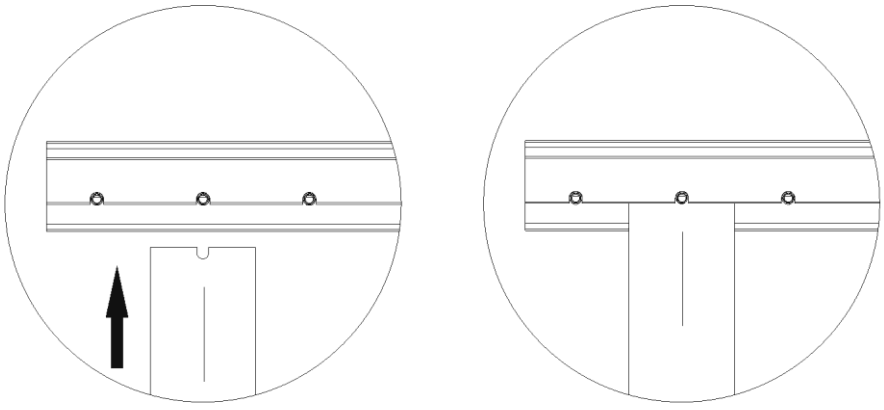


Figure 10: Example of how to Insert the Mono Connector Board

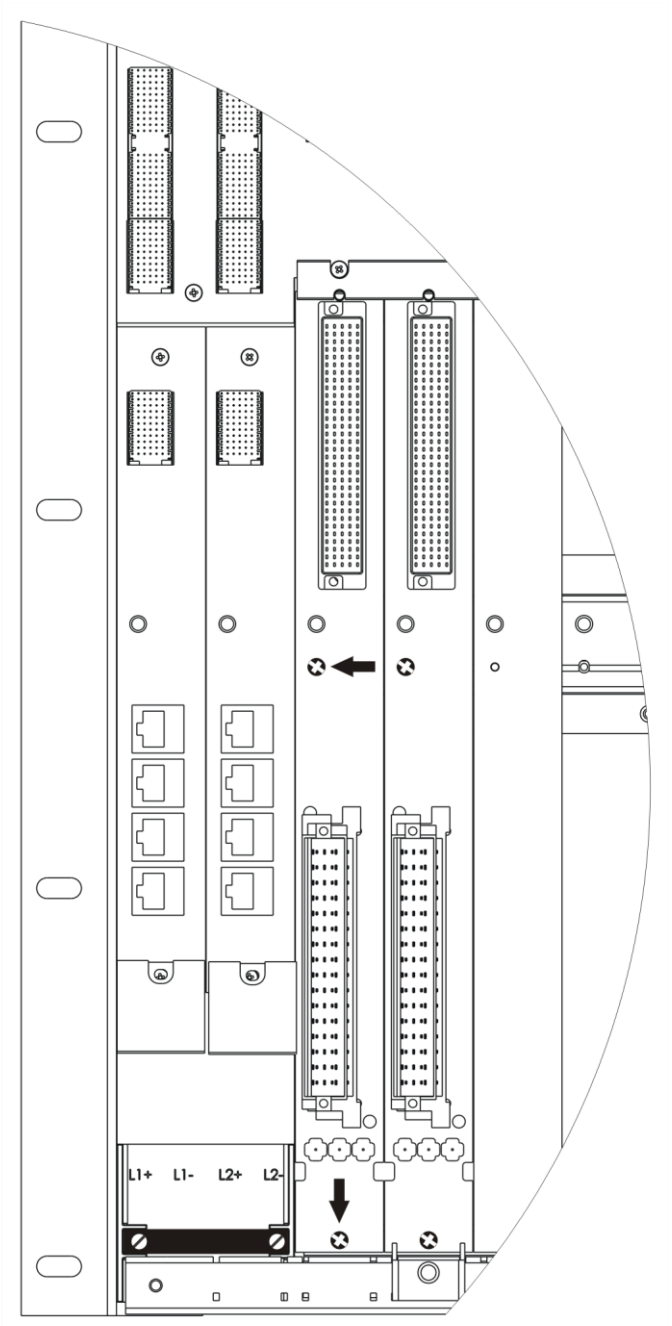


Figure 11: Example of how to Secure the Mono Connector Board with Captive Screws

i These instructions also apply for redundant connector boards. The number of slots used 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 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

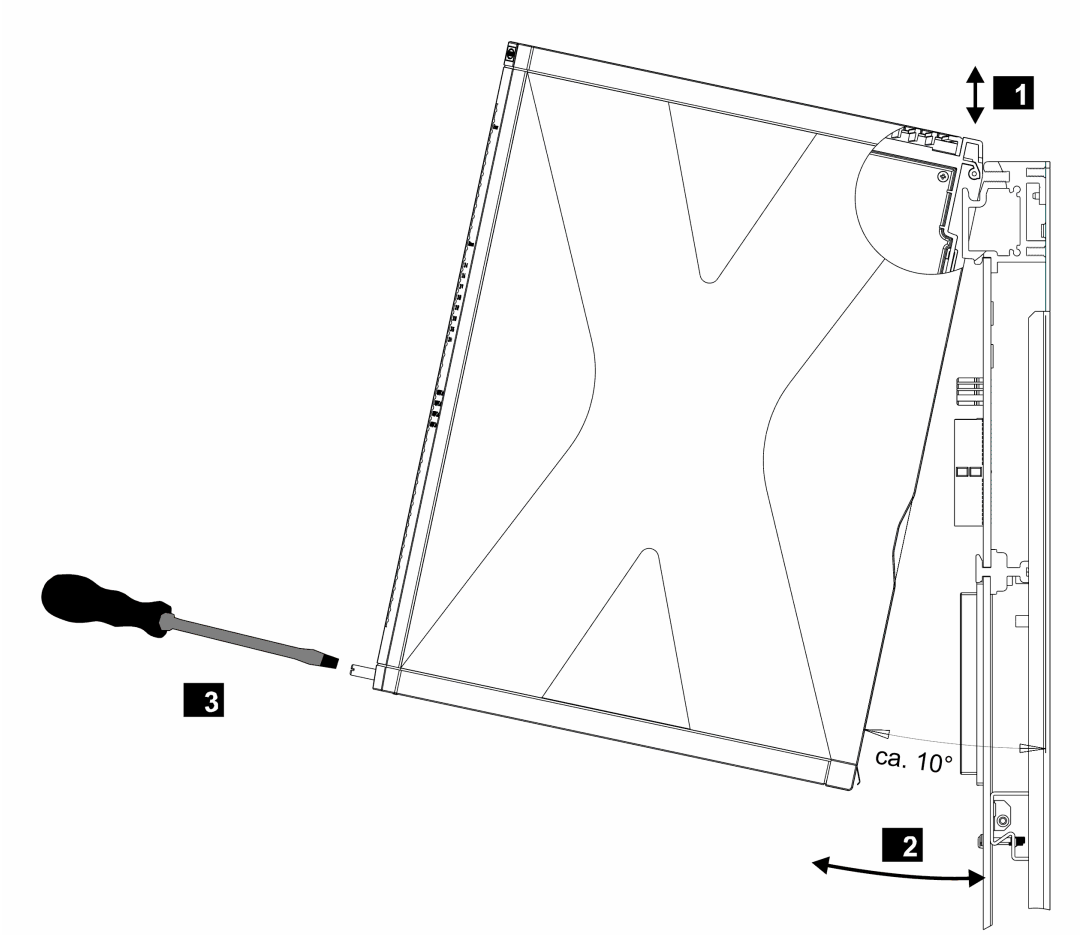
- Screwdriver, slotted 0.8 x 4.0 mm
- Screwdriver, slotted 1.2 x 8.0 mm

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
2 Swiveling a Module in and out
3 Securing and Releasing a Module

Figure 12: Mounting and Removing a Module

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

4.3 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.
- 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 21 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 statuses and 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. Refer to the System Manual (HI 801 001 E) for more details about noise blanking.
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 inserted. Observe the *Module Status* parameter!
Module Status	DWORD	R	Status of the module Coding / Description: 0x00000001 Module fault [1)] 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 [1)] [1)] These faults affect the *Module OK* status and need not be separately evaluated in the user program.
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 20: Module Tab in the Hardware Editor

4.3.2 Tab: I/O Submodule DI16_01

The **I/O Submodule DI16_01** tab contains the following statuses and parameters:

Name		R/W	Description
This parameter cannot be changed.			
Name		W	Module name
External Power Supply		W	on: use external power supply off: do not use external power supply Default setting: on
Name	Data type	R/W	Description
The following statuses and parameters can be assigned global variables and used in the user program.			
Diagnostic Request	DINT	W	To request a diagnostic value, the appropriate ID must be sent to the module using the parameter *Diagnostic Request* (see Chapter 4.3.5 for coding details).
Diagnostic Response	DINT	R	As soon as *Diagnostic Response* returns the ID of *Diagnostic Request* (see Chapter 4.3.5 for coding details), *Diagnostic Status* contains the diagnostic value requested.
Diagnostic Status	DWORD	R	Requested diagnostic value in accordance with *Diagnostic Response.* The IDs of *Diagnostic Request* and *Diagnostic Response* can be evaluated in the user program. *Diagnostic Status* only contains the requested diagnostic value when both Diagnostic Request and Diagnostic Response have the same ID.
Background Test Error	BOOL	R	TRUE: Background test is faulty FALSE: Background test is free of faults
Restart on Error	BOOL	W	Using the parameter *Restart on Error*, 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 *Restart on Error* 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
Supply 1 OK	BOOL	R	The supplies are monitored for low voltage TRUE: The supply is faultless. FALSE: The supply is faulty.
Supply 2 OK	BOOL	R	Such as *Supply 1 OK*
Supply 3 OK	BOOL	R	Such as *Supply 1 OK*
Supply 4 OK	BOOL	R	Such as *Supply 1 OK*
Supply 5 OK	BOOL	R	Such as *Supply 1 OK*
Supply 6 OK	BOOL	R	Such as *Supply 1 OK*
Supply 7 OK	BOOL	R	Such as *Supply 1 OK*
Supply 8 OK	BOOL	R	Such as *Supply 1 OK*
Submodule OK	BOOL	R	TRUE: No submodule fault No channel faults FALSE: Submodule fault Channel fault (external faults included)
Submodule Status	BOOL	R	Bit-coded submodule status (see Chapter 4.3.4 for coding details)

Table 21: Tab: I/O Submodule DI16_01 in the Hardware Editor

4.3.3 Tab: I/O Submodule DI16_01: Channels

The **I/O Submodule DI16_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^{31}-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^{31}-1) Default setting: 0
Test Suppression [µs]	UDINT	W	The 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: The redundant module must be configured. Acivated: 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. ▪ And ▪ Or Default setting: Or **It is only displayed in the redundancy group tab!**

Table 22: Tab: I/O Submodule DI16_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 E/A bus
0x00000004	Faults detected while configuring the hardware
0x00000008	Fault detected while verifying the coefficients
0x00000080	Reset of the chip select monitoring
0x04000000	Module fault reference voltage B
0x08000000	Fault auxiliary voltage
0x10000000	Fault reference voltage A
0x20000000	Fault reference voltage B
0x40000000	Fault chip select monitoring A
0x80000000	Fault chip select monitoring B

Table 23: Submodule Status [DWORD]

4.3.5 Diagnostic State [DWORD]

Coding of the variable **Diagnostic Status**.

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>0</td><td>Diagnostic values are indicated consecutively.</td></tr>
<tr><td>100</td><td>Bit-coded temperature status
0 = normal
Bit0 = 1 : Temperature threshold 1 has been exceeded
Bit1 = 1 : Temperature threshold 2 has been exceeded
Bit2 = 1 : Fault in temperature measurement</td></tr>
<tr><td>101</td><td>Measured temperature (10 000 digits/ °C)</td></tr>
<tr><td>200</td><td>Bit-coded voltage status
0 = normal
Bit0 = 1 : L1+ (24 V) is faulty
Bit1 = 1 : L2+ (24 V) is faulty</td></tr>
<tr><td>201
202
203</td><td>Do not use it!</td></tr>
<tr><td>300</td><td>Comparator 24 V low voltage (BOOL)</td></tr>
<tr><td>1001…1016</td><td>Status of the channels 1...16
<table>
<tr><th>Coding</th><th>Description</th></tr>
<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>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>
</table></td></tr>
<tr><td>2001…2008</td><td>Fault status of the power sources 1...8 (supplies)
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Module fault</td></tr>
<tr><td>0x8000</td><td>Low voltage of the supplies</td></tr>
</table></td></tr>
</table>

Table 24: Diagnostic Status [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.

NOTE

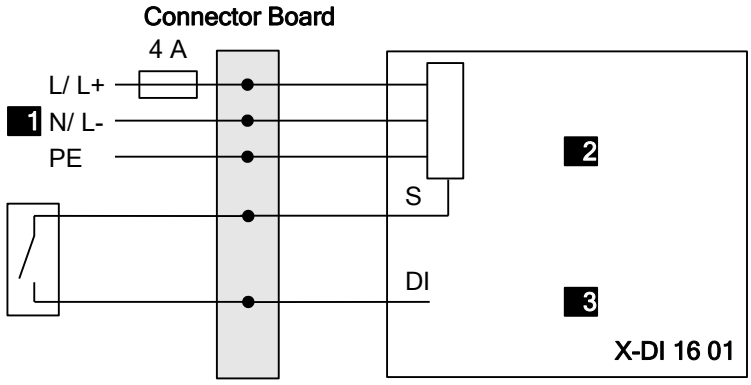
Overcurrent due to incorrect wiring!

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

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

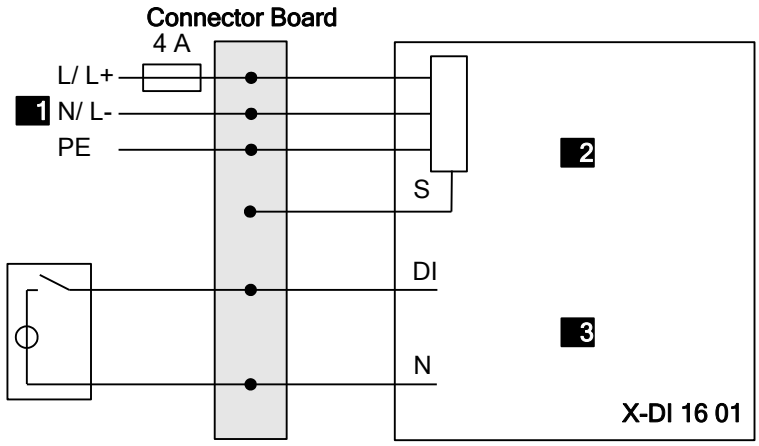
Only one phase can be connected to the module.

Connector board X-CB 007 01/03 is used for the wiring variants according to Figure 13.



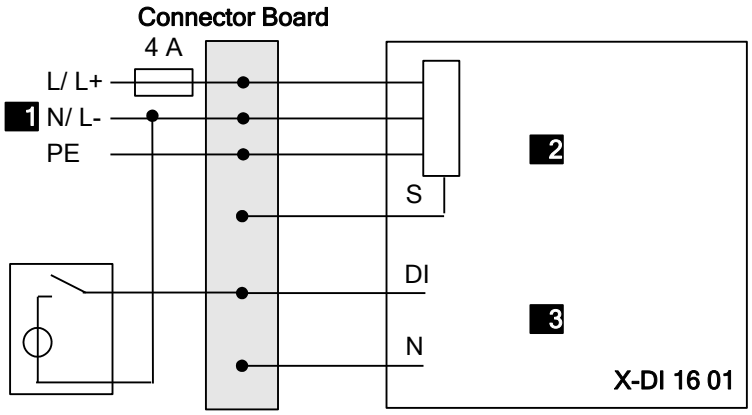
1 External Power Supply
2 Channel Supply
3 Digital Input

Figure 13: Wiring with Contact Maker



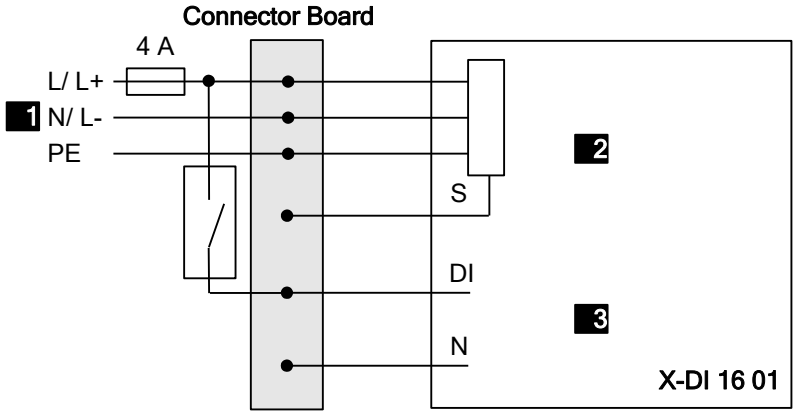
1 External Power Supply
2 Channel Supply
3 Digital Input

Figure 14: Wiring with Digital Signal



1 External Power Supply
2 Channel Supply
3 Digital Input

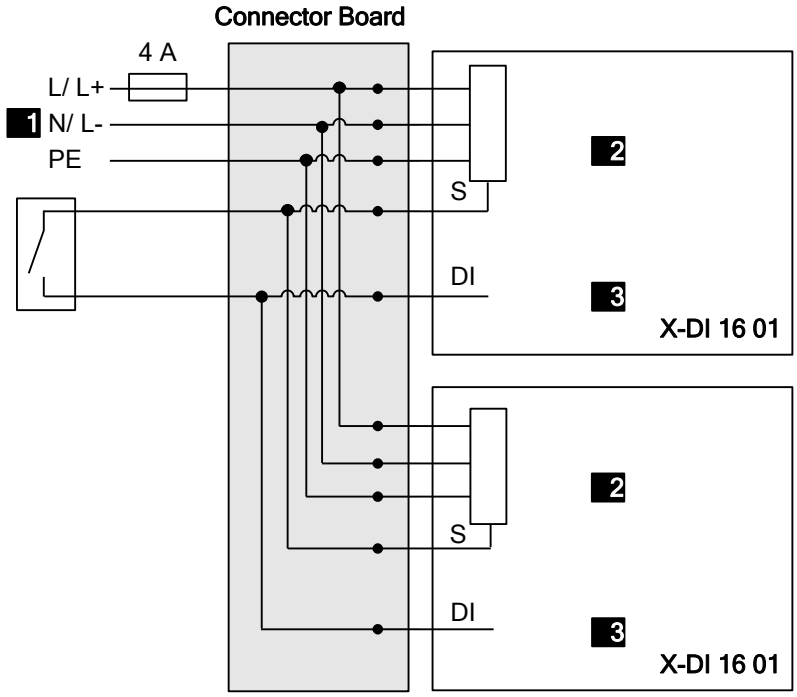
Figure 15: Wiring with Common N/L-



1 External Power Supply
2 Channel Supply
3 Digital Input

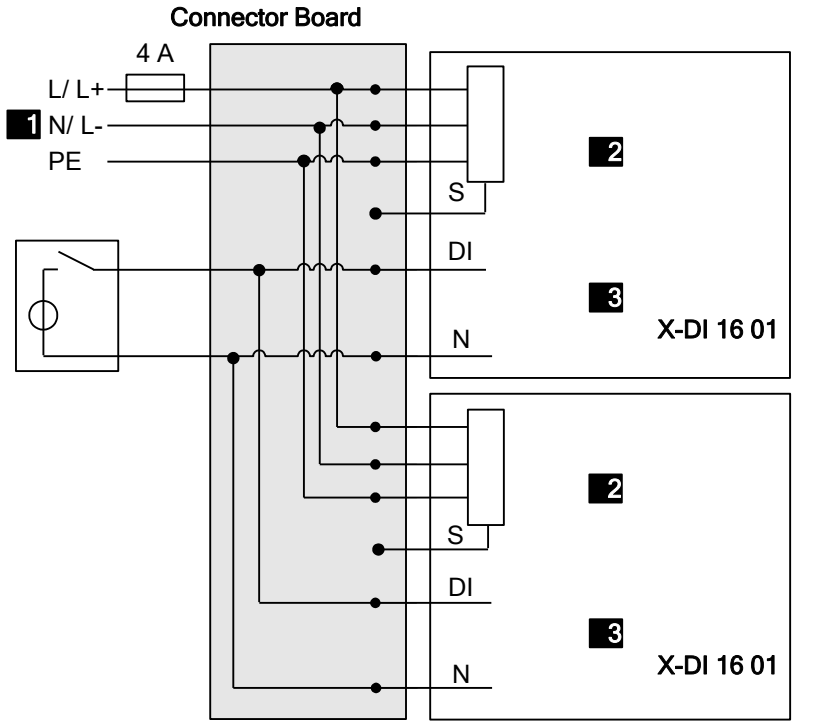
Figure 16: Wiring with Common N/L+

When redundantly wired as specified in Figure 17 and Figure 18, the input modules are inserted in the base plate next to each other and on a common X-CB 007 02/04 connector board.



1 External Power Supply
2 Channel Supply
3 Digital Input

Figure 17: Redundant Wiring with Contact Maker



1 External Power Supply
2 Channel Supply
3 Digital Input

Figure 18: Redundant Wiring with Digital Signal

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 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 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
r_P	Peak value of a total AC component
Rack ID	Base plate identification (number)
Interference-free	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
W	Write
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

Index of Figures

Index of Tables

Index

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8