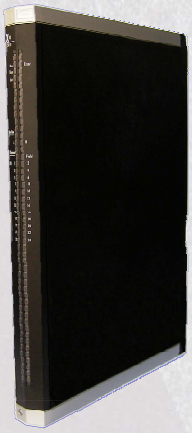

# HIMax®

## Counter Module Manual

SAFETY NONSTOP

HIMA

# X-CI 24 01

8

## Contact

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| Revision index | Revisions | Type of Change | |
|---|---|---|---|
| | | technical | editorial |
| 3.00 | New edition for SILworX V3 | X | X |
| 4.00 | Added: Chapter 4.3 and 4.4<br>New edition for SILworX V4 | 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 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 SILworX | - |
| 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<br>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 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-CI 24 01 counter module is intended for use in the programmable electronic system (PES) HIMax.

The counter 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 counter module is used to count the pulses, to measure the frequency and the rotational speed and, if defined, to recognize the rotation direction. Two channels are required to use the recognition of rotation direction function, see Chapter 4.6.4.

Proximity switches in accordance with EN 60947-5-6 (NAMUR) or control circuit devices of type 3 in accordance with EN 61131-2 can be connected to the counter module. Proximity switches and control circuit devices may not be operated simultaneously.

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 counter module samples the switching operations of the connected sensors with safety-related accuracy (1 % if the frequency is measured, ± 1 pulse if the pulse is measured) .

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 counter module enters the safe state. The rotation speed is set to 0. The user program retains its last valid process value for the counter readings.

The module activates the *Error* LED on the front plate.

## 3.2 Scope of Delivery

The counter 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, sensor selection plug, system cables and FTAs are not included within the module's scope of delivery.

The various connector boards are described in Chapter 3.6, the system cables in Chapter 3.7. The FTAs are described in separated 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:)

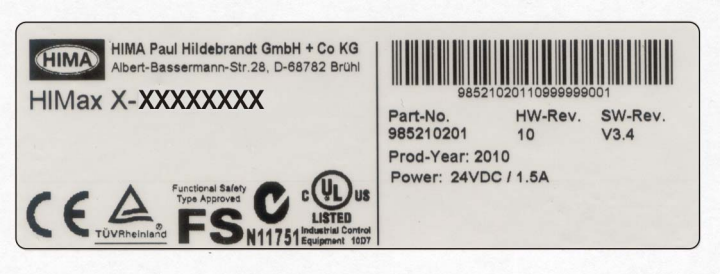



Figure 1: Sample Type Label

## 3.4 Structure

The counter module has 24 inputs that can measure frequencies in the range of 0...20 kHz for control circuit devices and in the range of 0...10 kHz for proximity switches. A short-circuit-proof transmitter supply monitoring overvoltage and undervoltage, is assigned to each input.

The 24 inputs of the counter module can either be configured for proximity switches or for control circuit devices. Which configuration should be used is defined by plugging in the sensor selection plug to the rear side of the connector board in use, see Chapter 4.2.1.

The counter module maintains a deviation tab for each channel, see Chapter 4.4.

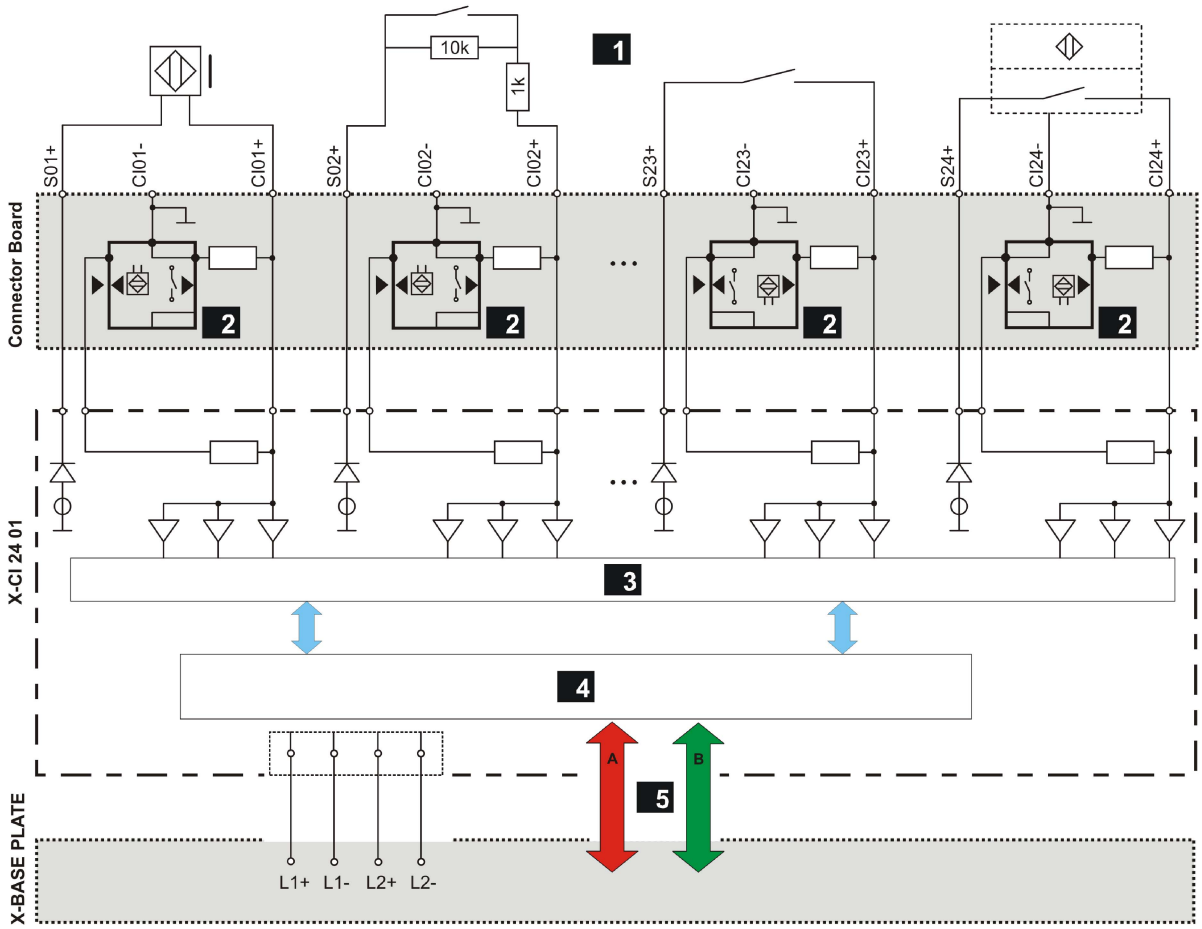
If proximity switches are used, the switching thresholds for open-circuits (OC) and short-circuits (SC) are preset in accordance with EN 60947-5-6 (NAMUR). Short-circuit (SC) and open-circuit (OC) monitoring is only allowed if the *Proximity Switch* setting is used.

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 counter outputs, see Chapter 3.4.2.

### 3.4.1 Block Diagram

The following block diagram illustrates the structure of the counter module.




1 Field Zone: Proximity Switches, Control Circuit Devices
2 Sensor Selection Plug
3 Counter
4 Safety-Related Processor System
5 System Busses

Figure 2: Block Diagram

**Sensor Selection Plug**

The sensor selection plug is drawn multiple times in the block diagram (2). This is only done to better represent the individual wirings!

### 3.4.2 Indicators

The following figure shows the LED indicators for the counter module.

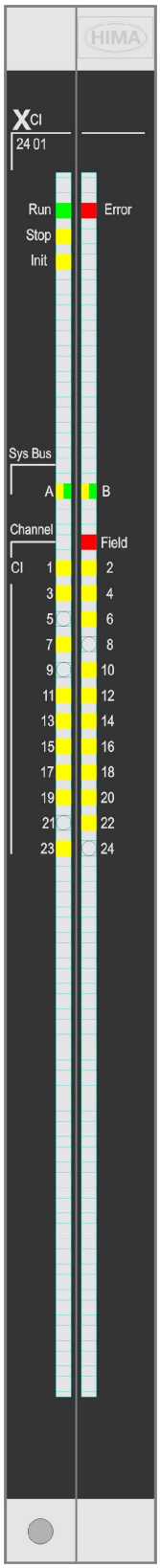



Figure 3: Indicators

The LEDs indicate the operating state of the counter module.

The LEDs on the counter module are divided into three groups:

- Module status indicators (Run, Error, Stop, Init)
- System bus indicators (A, B)
- I/O indicators (CI 1...24, 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:<br>STOP/OS_DOWNLOAD or<br>OPERATE (only with processor modules) |
| | | Off | Module not in RUN,<br>observe the other status LEDs |
| Error | Red | On/Blinking1 | Internal module faults detected by self-tests, e.g., hardware, software or voltage supply.<br>Fault while loading the operating system |
| | | Off | Normal operation |
| Stop | Yellow | On | Module state:<br>STOP / VALID CONFIGURATION |
| | | Blinking1 | Module state:<br>STOP / INVALID CONFIGURATION or<br>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.<br>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.<br>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...24 | Yellow | On | Frequency < 20 Hz at high level<br>Frequency > 20 Hz: No distinction between high and low level is made for the LED. |
| | | Blinking2 | Channel fault |
| | | Off | Frequency < 20 Hz at low level<br>Channel not configured. |
| Field | Red | Blinking2 | Field fault on at least one channel or supply (open-circuit, short-circuit, over-current, etc.) |
| | | Off | No field fault displayed! |

Table 6: I/O Indicators

**Consequences on the Channel LED during two-phase operation and fault in one of the channels of a channel pair!**

0 Hz (default value) is displayed for the *Rot. Speed (scaled) [REAL]* process value. The *Channel* LED for the faulty channel adopts the Blinking2 status and the faulty-free channel reports the input signal state. With frequencies of > 20 Hz, the *Channel* LED cannot be refreshed whenever the state changes.

## 3.5 Product Data

| General | |
|---|---|
| Supply voltage | 24 VDC, -15 %...+20 %, $r_P \leq 5$ %, SELV, PELV |
| Current input | 0.7 A at 24 VDC without load |
| Current input for 24 V per channel and high level | Proximity switch: typ. 1 mA, max. 10 mA<br>Control Circuit Device of Type 3:<br>typ. 5.5 mA, max. 30 mA |
| 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

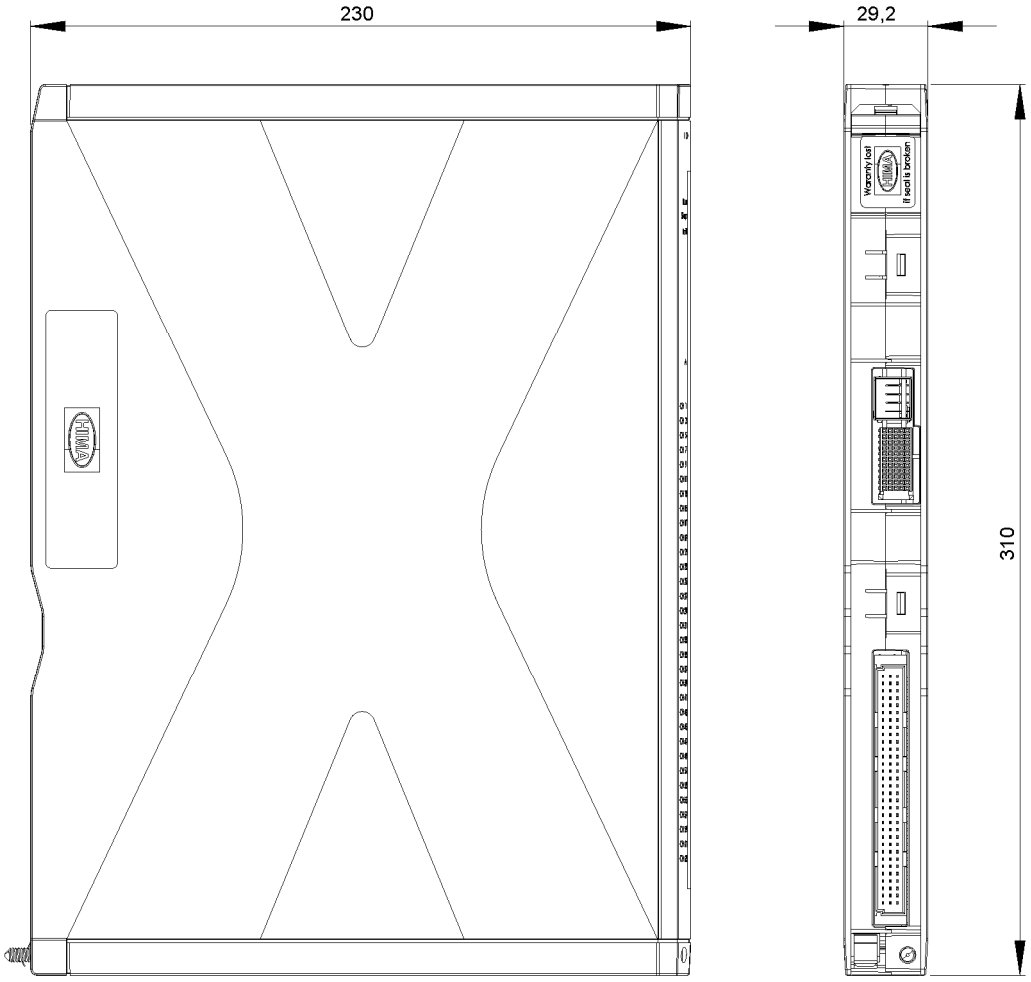



Figure 4: Views

| Counter module inputs | |
|---|---|
| Number of inputs (number of channels) | 24 with common ground CI-<br>(electrically isolated from the system bus). |
| Number of channel pairs<br>(Recognition of rotation direction) | 12,<br>Channel pair 1 = CI01 and CI02<br>Channel pair 2 = CI03 and CI04<br>...<br>Channel pair 12 = CI23 and CI24 |
| Sensors<br>(Selection performed using the sensor selection plug) | Proximity switches in accordance with EN 60947-5-6 (NAMUR), wired contacts or Control circuit devices of type 3 in accordance with EN 61131-2, power supplies. |
| Count frequency | 0...10 kHz for proximity switches<br><br>0...20 kHz for control circuit devices of type 3<br>0...10 kHz for control circuit devices of type 3 and evaluation type 2 phases / 4 edges |
| Resolution | 0.1 Hz |
| Counter resolution | 32-bit |
| Pulse width in one-phase operation | min. 16.66 µs at 20 kHz<br>min. 33.33 µs at 10 kHz |
| Minimum edge distance between two phases during two-phase operation | 6 µs |
| Accuracy of pulse count | ± 1 pulse |
| Accuracy of frequency and rotational speed measurement | |
| - 1 phase, 1 edge<br>- 1 phase, 2 edges<br>- 2 phases, 1 edge<br>- 2 phases, 2 edges<br>- 2 phases, 4 edges, $f_{max}$ = 10 kHz | ±1 Hz<br>±15 Hz, with symmetric input signal<br>±1 Hz<br>±15 Hz, with symmetric input signals<br>±20 Hz, with symmetric input signals |
| Safety-related accuracy for frequency and rotational speed measurement | ±1 % of final value |
| Proximity switch in accordance with EN 60947-5 [1)] | |
| max. line resistance | 50 Ω |
| Switch-on threshold L → H | 1.8 mA |
| Switch-off threshold H → L | 1.4 mA |
| Open-circuit | < 0.2 mA |
| Short-circuit | > 6.5 mA |
| Control circuit devices in accordance with EN 61131-2 | |
| Wire length | 1000 m |
| Switch-on threshold Low → High | > 10 V |
| Switch-off threshold High → Low | < 8 V |
| [1)] The values of the proximity switch must be consistent with the defined values. | |

Table 8: Specifications for the Counter Inputs

| Supply | |
|---|---|
| Number of supplies | 24 |
| Output voltage<br>(depending on the sensors) | 8.2 VDC ± 10 %, proximity switch<br>24 VDC -15 %...+20 %, control circuit device of type 3 |
| Max. output current for each supply | 25 mA |
| Nominal short-circuit current, per channel<br>(sensor short-circuit) | 8.2 mA at 8.2 V, proximity switch<br>5.45 mA at 24 V, control circuit devices of type 3 |
| Supply monitoring | The counter module monitors the supplies for overvoltage and undervoltage.<br>If the *Supply used* parameter is activated, a supply error results in a channel fault (*Channel OK* = FALSE) |
| Assignment of the supply outputs | |
| For supplying, the voltage output assigned to the input must be used. | |
| S01+…S24+ | CI1+...CI24+ |

Table 9: Product Data for Supplies

## 3.6 Connector Boards

A connector board connects the counter 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 sensor selection plug is located on the rear side of the connector boards and is used to select the type of sensor for the module (proximity switch or control circuit device of type 3). The sensor selection plug are included within the scope of delivery of the connector boards.

The following connector boards are available for the counter module:

| Connector board | Description |
|---|---|
| X-CB 013 01 | Connector board with screw terminals |
| X-CB 013 02 | Redundant connector board with screw terminals |
| X-CB 013 03 | Connector board with cable plug |
| X-CB 013 04 | Redundant connector board with cable plug |
| Sensor selection plug | |
| X-SS CB 01 | Sensor selection plug (Standard) |
| X-SS CB 02 | Sensor selection plug of type 5 |

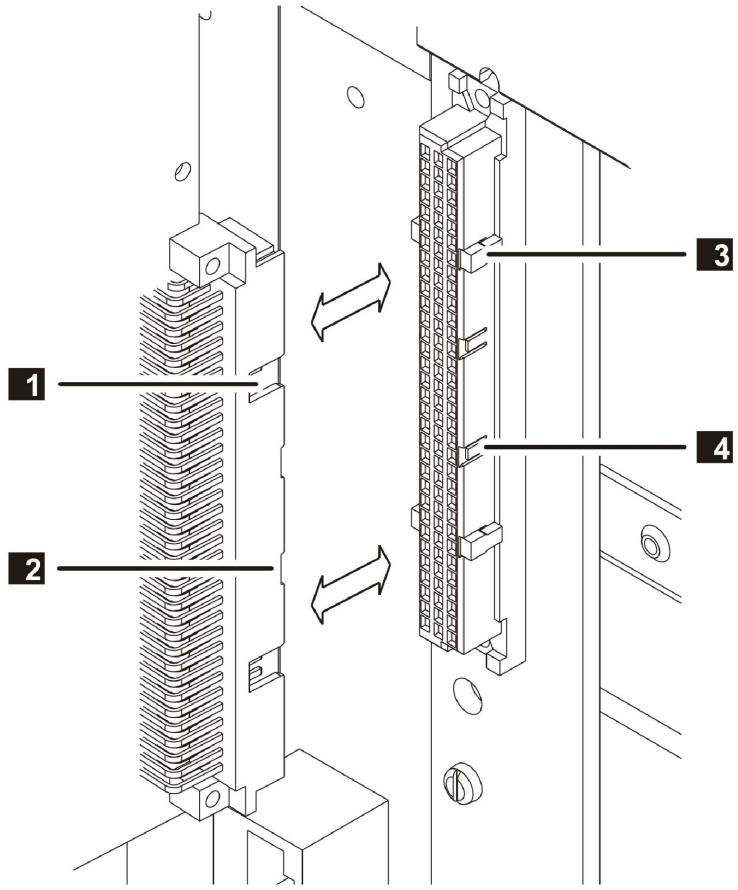
Table 10: Available Connector Boards

### 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 improper I/O modules. Coding avoids installation of improper I/O modules, thus preventing negative effects on redundant modules and field zone. A part from that, improper 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 Prepared Male Connector Recess
3 Coding Wedge
4 Guideway for Coding Wedge

Figure 5: Coding Example

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

### 3.6.2 Coding of X-CB 013 Connector Boards

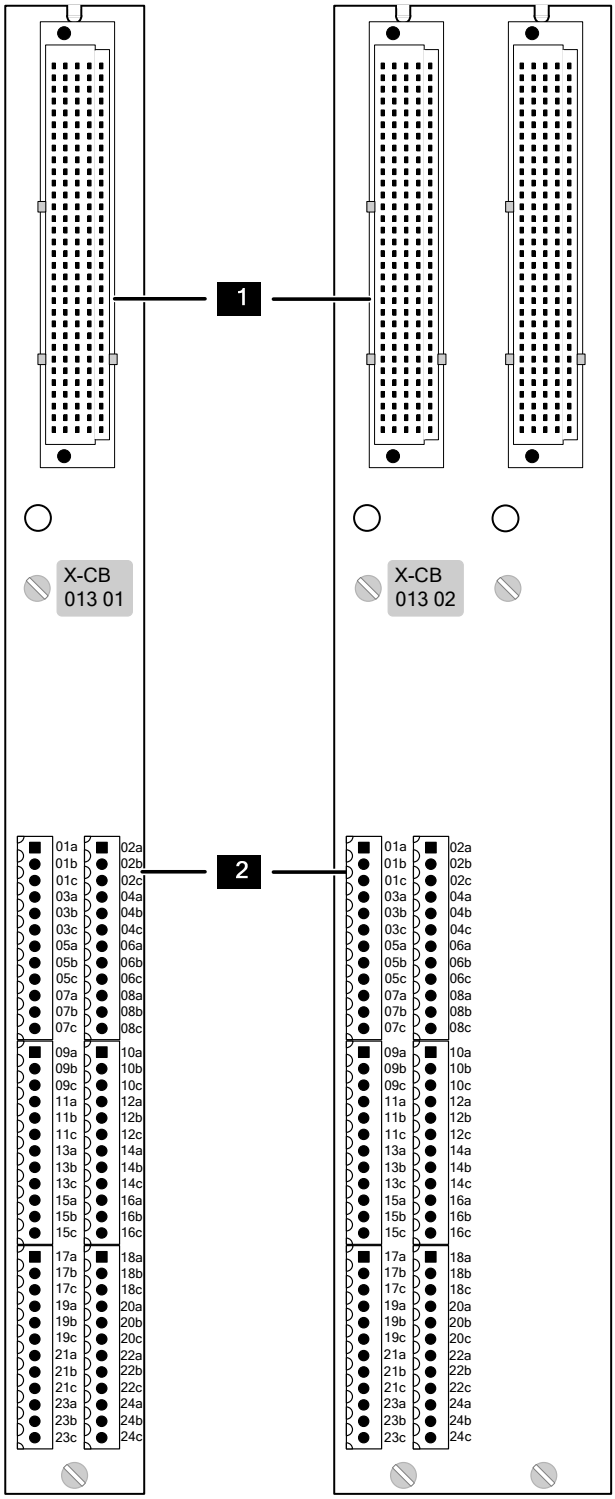
| a7 | a13 | a20 | a26 | c7 | c13 | c20 | c26 |
|---|---|---|---|---|---|---|---|
| | X | | X | | | | X |

Table 11: Position of Coding Wedges

### 3.6.3 Connector Boards with Screw Terminals

**Mono** **Redundant**

X-CB 013 01 X-CB 013 02




**1** I/O Module Plug

**2** Connection to the Field Zone (Screw Terminal Connector Block)

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 | 01a | S01+ | 1 | 02a | S02+ |
| 2 | 01b | CI1+ | 2 | 02b | CI2+ |
| 3 | 01c | CI1- | 3 | 02c | CI2- |
| 4 | 03a | S03+ | 4 | 04a | S04+ |
| 5 | 03b | CI3+ | 5 | 04b | CI4+ |
| 6 | 03c | CI3- | 6 | 04c | CI4- |
| 7 | 05a | S05+ | 7 | 06a | S06+ |
| 8 | 05b | CI5+ | 8 | 06b | CI6+ |
| 9 | 05c | CI5- | 9 | 06c | CI6- |
| 10 | 07a | S07+ | 10 | 08a | S08+ |
| 11 | 07b | CI7+ | 11 | 08b | CI8+ |
| 12 | 07c | CI7- | 12 | 08c | CI8- |
| Pin no. | Designation | Signal | Pin no. | Designation | Signal |
| 1 | 09a | S09+ | 1 | 10a | S10+ |
| 2 | 09b | CI9+ | 2 | 10b | CI10+ |
| 3 | 09c | CI9- | 3 | 10c | CI10- |
| 4 | 11a | S11+ | 4 | 12a | S12+ |
| 5 | 11b | CI11+ | 5 | 12b | CI12+ |
| 6 | 11c | CI11- | 6 | 12c | CI12- |
| 7 | 13a | S13+ | 7 | 14a | S14+ |
| 8 | 13b | CI13+ | 8 | 14b | CI14+ |
| 9 | 13c | CI13- | 9 | 14c | CI14- |
| 10 | 15a | S15+ | 10 | 16a | S16+ |
| 11 | 15b | CI15+ | 11 | 16b | CI16+ |
| 12 | 15c | CI15- | 12 | 16c | CI16- |
| Pin no. | Designation | Signal | Pin no. | Designation | Signal |
| 1 | 17a | S17+ | 1 | 18a | S18+ |
| 2 | 17b | CI17+ | 2 | 18b | CI18+ |
| 3 | 17c | CI17- | 3 | 18c | CI18- |
| 4 | 19a | S19+ | 4 | 20a | S20+ |
| 5 | 19b | CI19+ | 5 | 20b | CI20+ |
| 6 | 19c | CI19- | 6 | 20c | AI20- |
| 7 | 21a | S21+ | 7 | 22a | S22+ |
| 8 | 21b | CI21+ | 8 | 22b | CI22+ |
| 9 | 21c | CI21- | 9 | 22c | CI22- |
| 10 | 23a | S23+ | 10 | 24a | S24+ |
| 11 | 23b | CI23+ | 11 | 24b | CI24+ |
| 12 | 23c | CI23- | 12 | 24c | CI24- |

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:

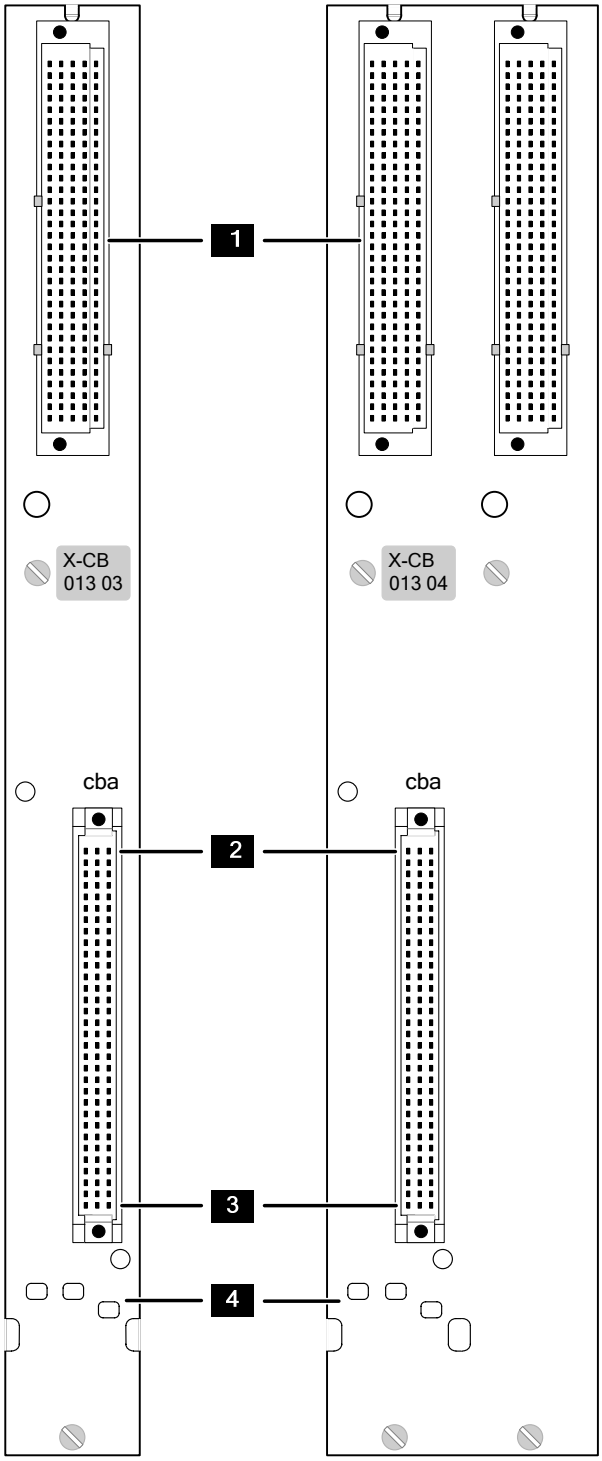
| Connection to the field zone | |
|---|---|
| Cable plugs | 6 pieces, with 12 poles |
| Wire cross-section | 0.2…1.5 $mm^2$ (single-wire)<br>0.2…1.5 $mm^2$ (finely stranded)<br>0.2…1.5 $mm^2$ (with wire end ferrule) |
| Stripping length | 6 mm |
| Screwdriver | Slotted 0.4 x 2.5 mm |
| Tightening torque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

Table 13: Cable Plug Properties

### 3.6.5 Connector Boards with Cable Plug

**Mono** **Redundant**

X-CB 013 03 X-CB 013 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.

**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 | | PK-BN [1)] | | WH-PK [1)] | Reserved | YE-BU [1)] |
| 2 | | GY-BN [1)] | | WH-GY [1)] | Reserved | GN-BU [1)] |
| 3 | | YE-BN [1)] | | WH-YE [1)] | Reserved | YE-PK [1)] |
| 4 | | BN-GN [1)] | | WH-GN [1)] | Reserved | PK-GN [1)] |
| 5 | | RD-BU [1)] | | GY-PK [1)] | | |
| 6 | | VT [1)] | | BK [1)] | | |
| 7 | | RD [1)] | | BU [1)] | | |
| 8 | | PK [1)] | | GY [1)] | | |
| 9 | S24+ | YE [1)] | CI24+ | GN [1)] | CI- | |
| 10 | S23+ | BN [1)] | CI23+ | WH [1)] | CI- | |
| 11 | S22+ | RD-BK | CI22+ | BU-BK | CI- | |
| 12 | S21+ | PK-BK | CI21+ | GY-BK | CI- | |
| 13 | S20+ | PK-RD | CI20+ | GY-RD | CI- | |
| 14 | S19+ | PK-BU | CI19+ | GY-BU | CI- | |
| 15 | S18+ | YE-BK | CI18+ | GN-BK | CI- | |
| 16 | S17+ | YE-RD | CI17+ | GN-RD | CI- | |
| 17 | S16+ | YE-BU | CI16+ | GN-BU | CI- | |
| 18 | S15+ | YE-PK | CI15+ | PK-GN | CI- | |
| 19 | S14+ | YE-GY | CI14+ | GY-GN | CI- | |
| 20 | S13+ | BN-BK | CI13+ | WH-BK | CI- | |
| 21 | S12+ | BN-RD | CI12+ | WH-RD | CI- | |
| 22 | S11+ | BN-BU | CI11+ | WH-BU | CI- | |
| 23 | S10+ | PK-BN | CI10+ | WH-PK | CI- | |
| 24 | S09+ | GY-BN | CI9+ | WH-GY | CI- | |
| 25 | S08+ | YE-BN | CI8+ | WH-YE | CI- | YE-GY [1)] |
| 26 | S07+ | BN-GN | CI7+ | WH-GN | CI- | GY-GN [1)] |
| 27 | S06+ | RD-BU | CI6+ | GY-PK | CI- | BN-BK [1)] |
| 28 | S05+ | VT | CI5+ | BK | CI- | WH-BK [1)] |
| 29 | S04+ | RD | CI4+ | BU | CI- | BN-RD [1)] |
| 30 | S03+ | PK | CI3+ | GY | CI- | WH-RD [1)] |
| 31 | S02+ | YE | CI2+ | GN | CI- | BN-BU [1)] |
| 32 | S01+ | BN | CI1+ | WH | CI- | WH-BU [1)] |

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

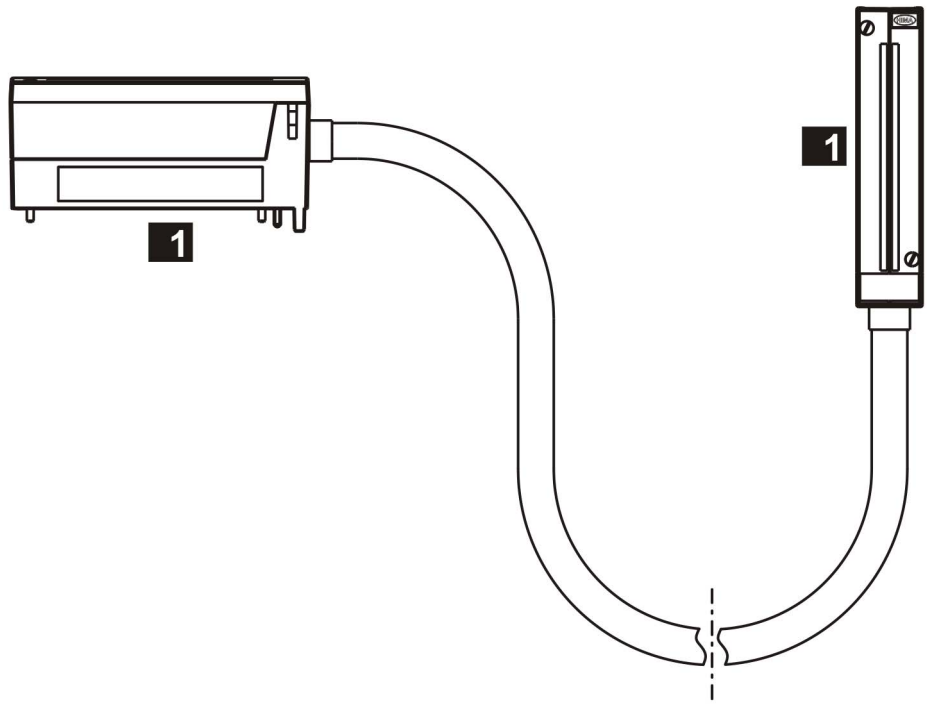
Table 14: Pin Assignment for the System Cable Plug

## 3.7 System Cable

The X-CA 005 system cable is used to wire the X-CB 013 03/04 connector board with the field zone via field termination assemblies.

| General | |
|---|---|
| Cable | LIYCY-TP 38 x 2 x 0.25 mm² |
| Wire | Finely stranded |
| Average outer diameter (d) | approx. 16.8 mm |
| Minimum bending radius<br>Fixed laying<br>Flexible application | <br>5 x d<br>10 x d |
| 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 005 01 n

The system cable is available in the following standard variants:

| System cable | Description | Length |
|---|---|---|
| X-CA 005 01 8 | Coded cable plugs on both sides | 8 m |
| X-CA 005 01 15 | | 15 m |
| X-CA 005 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 sensors 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).
- Only operate the module with the suitable connector board. For more information, see Chapter 3.6.
- Prior to mounting the module, the connector boards must be equipped with a sensor selection plug, see Chapter 4.2.1.
- The module and its connected components must be mounted to provide protection of at least IP 20 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.
  - If shielded cables are used, connect the shielding on the module side to the cable shield rail (use SK 0 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 supply assigned to the corresponding input (e.g., S1+ with CI1+).
- For proximity switches, only the counter module supply may be used. **External supplies are not permitted for proximity switches!**
- HIMA recommends using the counter module supply for control circuit devices and wired contacts. Failure of an external supply or measurement unit can lead to overload and damage of the affected input on the counter module.
- The inputs may be wired redundantly using the corresponding connector boards. For more information, see Chapters 3.6 and 4.6.

### 4.1.1 Wiring Inputs Not in Use

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

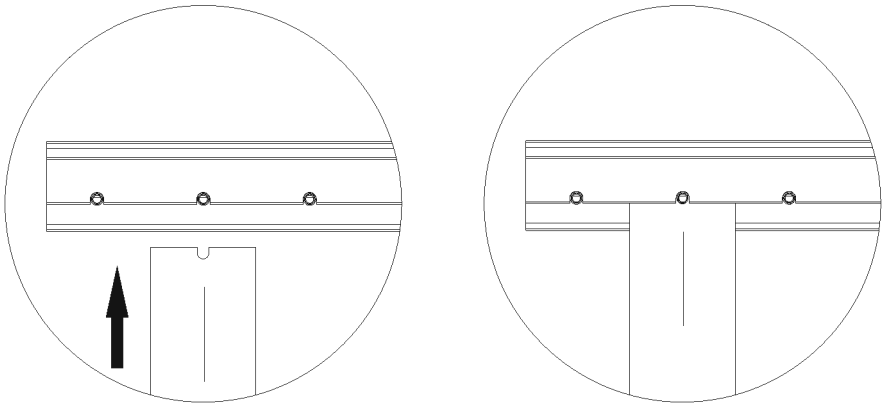


Figure 9: Inserting the Connector Board

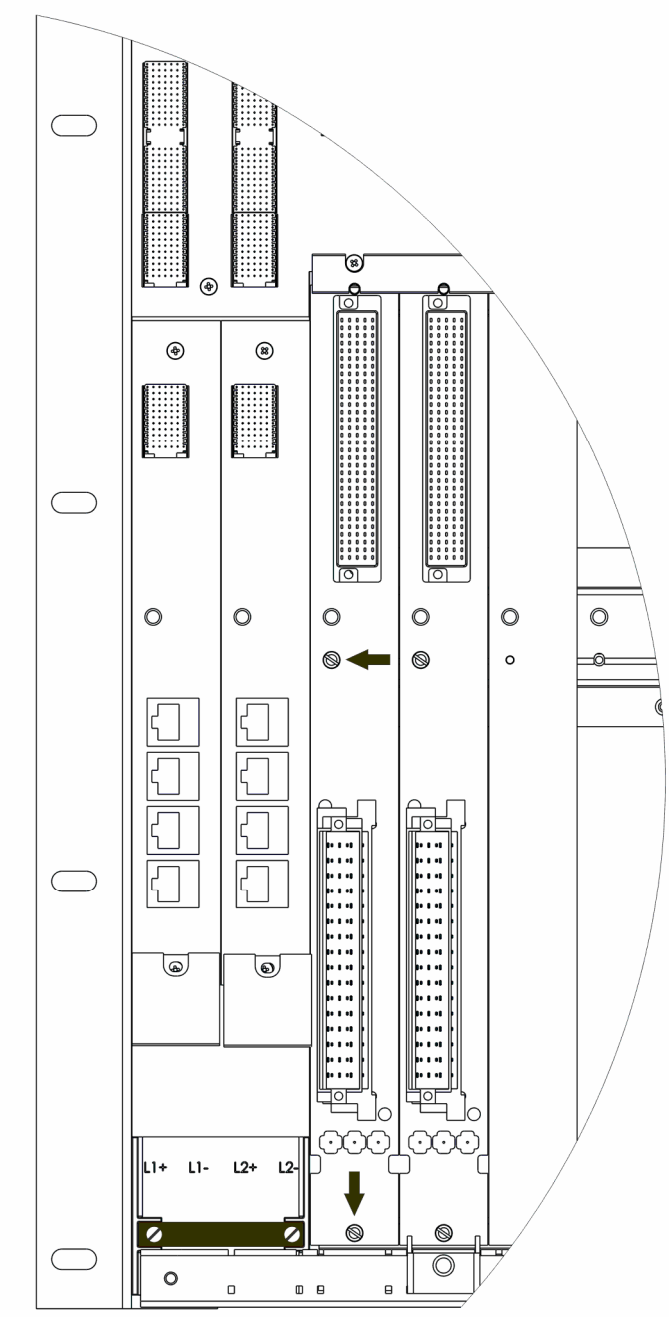



Figure 10: Securing the Connector Board with Captive Screws

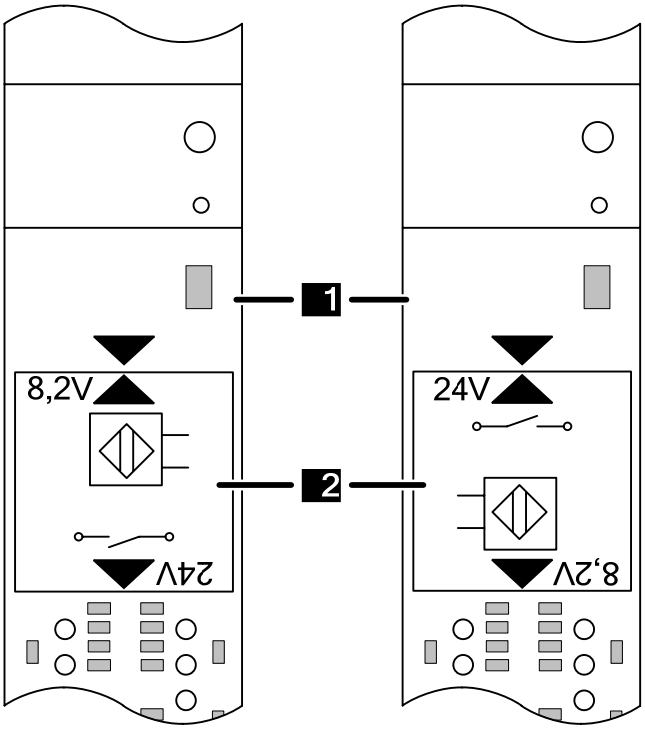
### 4.2.2 Using the Sensor Selection Plug to Define the Sensors

A sensor selection plug plugged in to the rear side of the X-CB 013 connector board is used to either select the configuration with proximity switch in accordance with EN 60947-5-6 or with control circuit devices of type 3 in accordance with EN 61131-2, see Figure 11.

Proximity switches in accordance with EN 60947-5-6 are operated with a supply voltage of 8.2 V. For this reason, select the appropriate input signal type in the SILworX Hardware Editor.

Control circuit devices of type 3 in accordance with EN 61131-2 are operated with a supply voltage of 24 V. Select the type of input signals accordingly.

For **Proximity Switches** For **Control Circuit Devices**




**1** Rear Side of X-CB 013 Connector Board

**2** Sensor selection plug

Figure 11: Plugging-In the Sensor Selection Plug

The configuration with proximity switches or control circuit devices is defined as follows:

- Plug in the sensor selection plug to the connector board such that the arrowheads point at each other, see Figure 11.

i The sensor selection plug must be plugged in prior to mounting the connector board.
The sensor selection plug may only be plugged and unplugged if the connector board is removed!

Additionally, the type of the input signals must be defined in the SILworX Hardware Editor, see Chapter 4.5.2.

i If the input signal type set in SILworX does not correspond to the definition on the connector board rear side, the module is not able to complete the initialization.

### 4.2.3 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

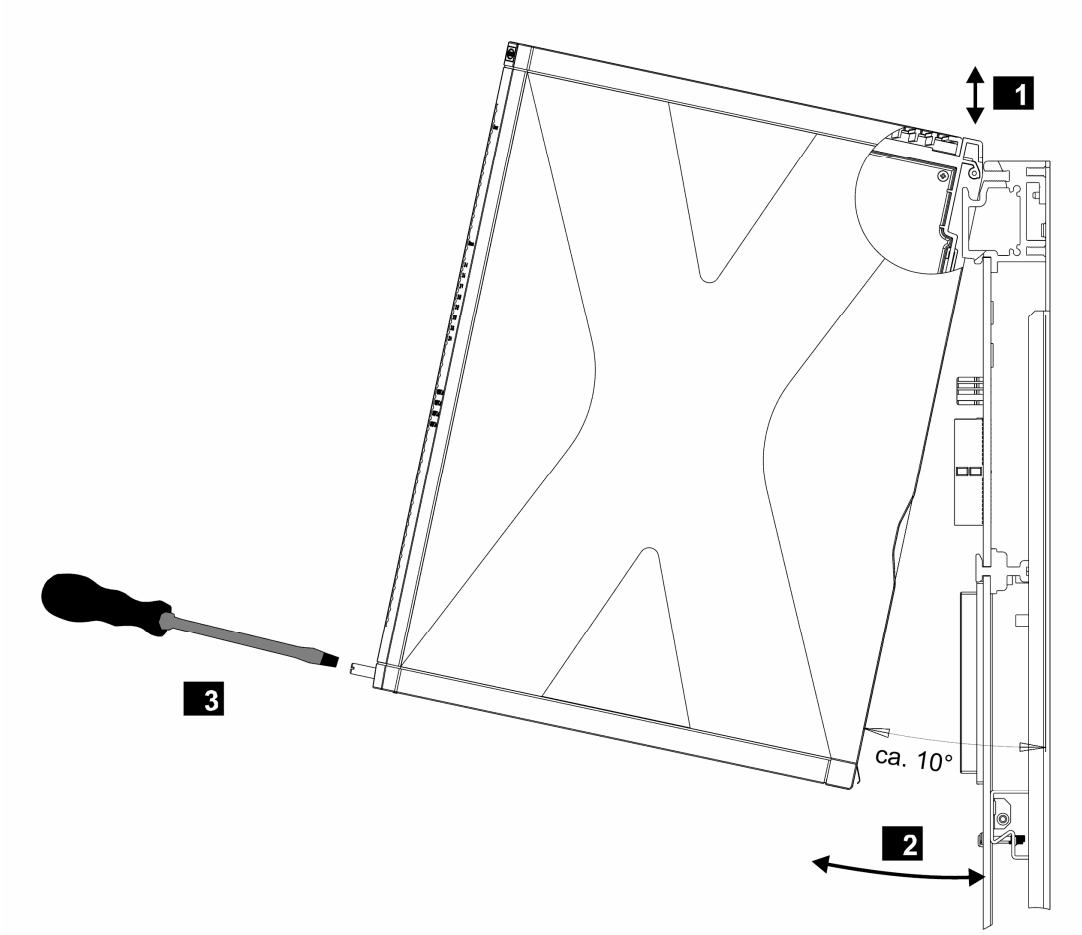
- Screwdriver, slotted 0.8 x 4.0 mm
- Screwdriver, slotted 1.2 x 8.0 mm

**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.



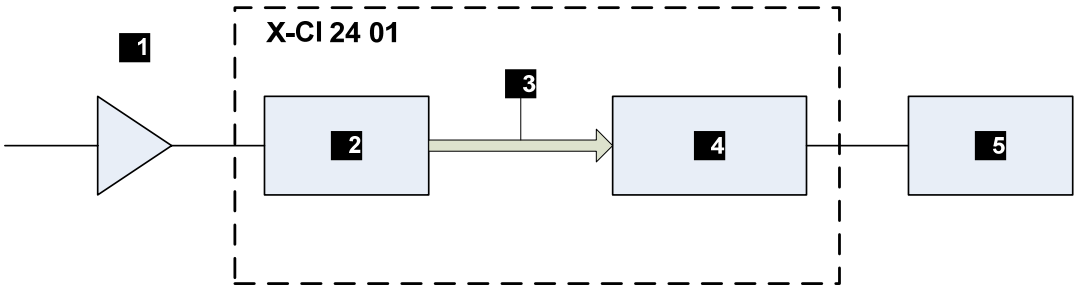

1 Inserting and Removing a Module
2 Swiveling a Module in and out
3 Securing and Releasing a Module

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 Counter Module Sampling

The following chapter describes how the input signal is sampled.




1 Input Signal
2 Counter
3 Processing Cycle
4 Safety-Related Processor System
5 X-CPU 01

Figure 13: Input Signal Evaluation

The input signal is sampled by the counter 2 in accordance with SIL 3 and is provided to the processor system of the counter module. The counter 2 increments each pulse in the -> *Counter reading revolving [UDINT]* parameter.

This parameter is used to determine the following values:

- -> Counter Reading [UDINT]
- -> Rotation Speed in mHz [DINT]

The processor module (5) reads the -> *Counter reading revolving [UDINT]* parameter. The last valid value is subtracted from the read value and the difference is output to the -> *Counter reading [UDINT]* parameter. The parameter is limited to a maximum value of $2^{32}$-1. If the maximum value is exceeded, the counting process restarts at 0 and the excess counter pulses are added. The -> *Overflow* status is activated!

The processor system (4) calculates the rotation speed for the duration of one process cycle (3) and outputs the result to the -> *Rotation Speed [mHz] [DINT]* parameter.

If the frequency changes, a valid rotation speed value is only output upon completion of an entire processing cycle.

If the frequency changes from a high rotation speed value to a very low value, the rotation speed can only be determined with the next impulse. Until the next pulse starts, the rotation speed has no measured value and is determined using the following formula:

$$f = \frac{1}{(n * 2\,\text{ms})}$$

n = Number of measuring cycles without pulse

### 4.3.1 Type of Evaluation Count Pulses

The evaluation type for inputs is selected from a drop-down menu located in the **I/O Submodule CI24_01: Channels** tab (Table 19):

- 1 Phase, 1 Edge, no Rotation Direction
- 1 Phase, 2 Edges, no Rotation Direction
- 2 Phases, 1 Edge
- 2 Phases, 2 Edges
- 2 Phases, 4 Edges
- 2 Phases, 1 Edge, Static Rotation Direction

The evaluation type is always set for a channel pair (channel 1 and 2, channel 3 and 4 through channel 23 and 24). The evaluation types are also represented in Figure 14.

#### 4.3.1.1. 1 Phase, 1 Edge, no Rotation Direction

This evaluation type is used to count the rising edges of the input signal. This evaluation type does not allow recognition of the rotation direction.

#### 4.3.1.2. 1 Phase, 2 Edges, no Rotation Direction

This evaluation type is used to count the rising and falling edges of the input signal. To do this, a symmetric input signal is required (pulse duty factor 1:1). With this evaluation type, one has the advantage to determine the process value two times faster than with the evaluation type 1 phase, 1 edge, no rotation direction. This evaluation type does not allow recognition of the rotation direction.

#### 4.3.1.3. 2 Phases, 1 Edge

This evaluation type allows recognition of the rotation direction. To this end, a channel pair (e.g., CI1+ and CI2+) with input signals phase-delayed by ±90 ° is required. The odd input is used to count the rising edge and the even input is used to determine the rotation direction via the phase-delayed input signal.

#### 4.3.1.4. 2 Phases, 2 Edges

This evaluation type allows to recognize the rotation direction. To this end, a channel pair (e.g., CI1+ and CI2+) with its input signals phase-delayed by ±90 ° is required. A symmetric input signal (pulse duty factor 1:1) is required for the input signals. The odd input is used to count the rising and falling edges, and the even input is used to determine the rotation direction via the phase-delayed input signal. This evaluation type has the advantage of being able to determine the process value two times faster than with the evaluation type 2 phases, 1 edge.

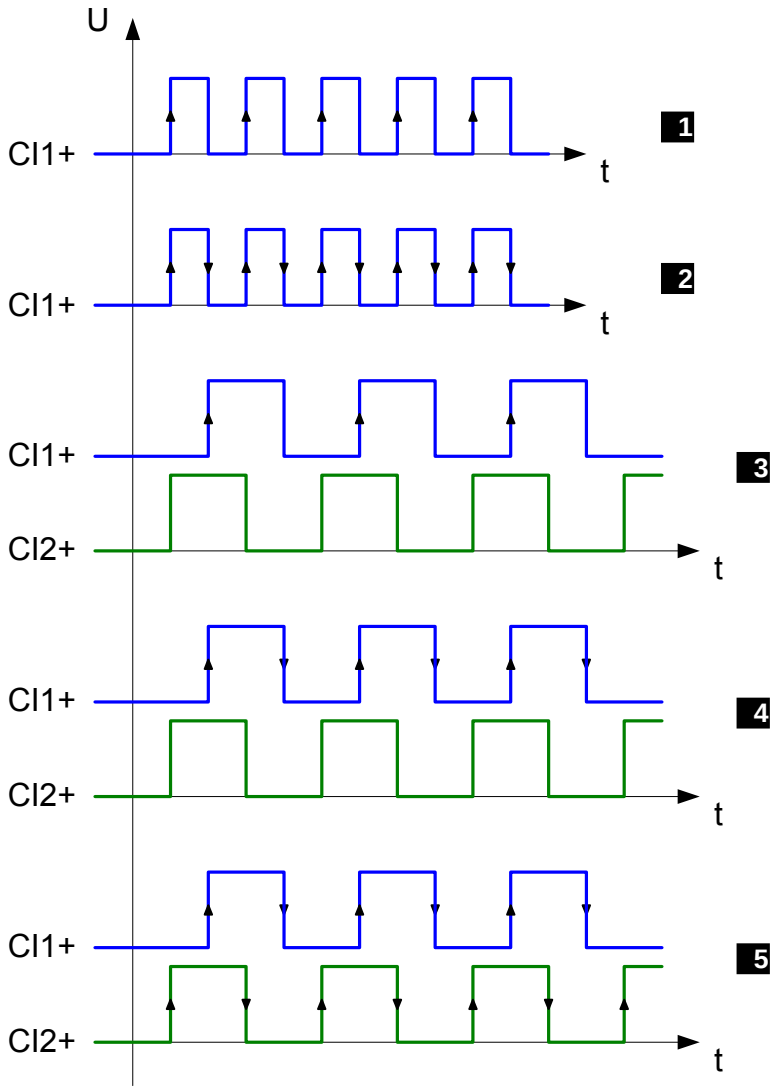
#### 4.3.1.5. 2 Phases, 4 Edges

This evaluation type allows recognition of the rotation direction up to a frequency of 10 kHz. To this end, a channel pair (e.g., CI1+ and CI2+) with input signals phase-delayed by ±90 ° is required. A symmetric input signal (pulse duty factor 1:1) is required for the input signals. Both inputs are used to count the rising and falling edges, and the even input is additionally used to determine the rotation direction via the phase-delayed input signal. With this evaluation type, one has the advantage to determine the process value four times faster than with the evaluation type 2 phases, 1 edge.

### 4.3.1.6. 2 Phases, 1 Edge, Static Rotation Direction

With this evaluation type, the sensor provides a static rotation direction signal which changes the level whenever the rotation direction changes. A channel pair (e.g., CI1+ and CI2+) is required for this evaluation type. The odd input is used to count the rising edge and the even input is used to output the static rotation direction.

The -> *Leading [BOOL] (rotation direction)* system parameter can be used to evaluate the current rotation direction in the user program.




1 1 Phase, 1 Edge, no Rotation Direction
2 1 Phase, 2 Edges, no Rotation Direction
3 2 Phases, 1 Edge
4 2 Phases, 2 Edges
5 2 Phases, 4 Edges

Figure 14: Evaluation Type, Recognition of Rotation Direction with CI1+ and CI2+ Channel Pair

## 4.4 Deviation Tab

Each input channel has an internal parallel structure that evaluate each input pulse in accordance with SIL 3. Deviating evaluations of a pulse are reported in the *-> Current I/O Dev. [UDINT]* deviation tab. The processor module cyclically adds this value to a process value in the *-> Current CPU Dev. [UDINT]*).

Deviations can be due to:

- Interfering pulses with valid signal level
- Signals with invalid signal level

Observe the following points when using the deviation tabs:

- In the **I/O Submodule CI24_01: Channels** (SILworX) tab, the *Max. I/O Dev. [UDINT] ->* parameter (maximum deviation allowed for the parallel structure) can be set using a global variable.
  **Default value = 0**: When the first deviation occurs, the channel is reported as faulty (*Channel OK* = FALSE).
- In the **I/O Submodule CI24_01: Channels** (SILworX) tab, the *Max. CPU Dev. [UDINT] -> >* parameter (maximum deviation allowed for the parallel process value) can be set using a global variable.
  **Default value = 0**: When the first deviation occurs, the channel is reported as faulty (*Channel OK* = FALSE).
- If the maximum permissible number of deviations is exceeded, the corresponding channel is reported as faulty (*Channel OK* = FALSE).
- In the **I/O Submodule CI24_01: Channels** tab (SILworX), the *-> Current I/O Dev. [UDINT]* parameter (current deviation of the parallel structure) can be read using a global variable.
- In the **I/O Submodule CI24_01: Channels** tab (SILworX), the *-> Current CPU Dev. [UDINT]* parameter (process value) can be read using a global variable.
- The value in the *-> Current CPU Dev. [UDINT]*) tab is a process value and is stored in the processor module (CPU module). Replacing the counter module does not affect the value contained in the deviation tab since the new module adopts the last valid process value.
- If redundant counter modules are used, the process value is the greatest individual value of the two redundant modules.
- The number of detected deviations *-> Current I/O Dev. [UDINT]* and *-> Current CPU Dev. [UDINT],* can only be reset by resetting a channel (*Reset [BOOL] ->*).

## 4.5 Configuring the Counter 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 4.5.1.
- Short-circuit (SC) and open-circuit (OC) monitoring is only allowed in SILworX if the *Type of Input Signals* system parameter is set to *Proximity Switch*. The monitoring function is defined for each channel using the -> *OC* and -> *SC* system parameters. The detection of a short-circuit or open-circuit triggers the fault reaction of the affected channel.
- The counter module supply is monitored. If the *Supply used* parameter is activated, a supply error results in a channel fault (*Channel OK* = FALSE). If the supply is not used for a channel, the *Supply used* parameter must be deactivated. This ensures that a supply error does not lead to a channel fault (-> *Channel OK* = TRUE).
- If the evaluation type with 2 phases is used, the -> *Level* parameter must be assigned a global variable in both channels of a channel pair. Only then are both channels configured as channels.
- If one of the parameters *Input Signal Type* or Counting Pulses Evaluation Type are changed, or both simultaneously, the counter module must be restarted. To do this, remove the module and reinsert it in the base plate. If the parameter *Type of Input Signals* is changed, the sensor selection plug need not be unplugged and plugged in to the connector board, see Chapter 4.2.2.
- 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.

The supply is monitored.

If the *Supply used* parameter is activated for a given channel, a supply error leads to a fault in that channel. If a supply is short-circuited from S+ to L-, it is switched off and the *Diagnostic Status* parameter reports undervoltage. In both cases, the counter module reports a channel fault, the counter module is frozen and the frequency (rotation speed) is set to zero.

To evaluate the statuses from within the user program, system parameters are assigned global variables. Perform this step in the Hardware Editor using the module's detail view.

The following tables present the statuses and parameters for the counter 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.

### 4.5.1 Tab: Module

The **Module** tab contains the statuses and parameters for the counter 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.<br>Deactivated: The module missing in the redundancy group is considered as a fault.<br>Default setting: Deactivated<br>**It is only displayed in the redundancy group tab!** |
| Noise Blanking | | W | Noise blanking performed by processor module allowed (activated/deactivated).<br>Default setting: Deactivated, for SILworX V4 and beyond.<br>Default setting: Activated, for SILworX V3 and versions prior to 3.<br>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.<br>The *Activated* settings may result in losing counter pulses! |
| **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:<br>Mono operation: No module faults.<br>Redundant operation: At least one of the redundant modules is faultless (OR logic).<br><br>FALSE:<br>Module fault<br>Channel fault (no external faults)<br>The module is not plugged in.<br><br>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 [µsec] | DWORD | R | Microsecond fraction of the timestamp.<br>Time point of the sampling performed by the processor system of the I/O module. |
| Timestamp [s] | DWORD | R | Second fraction of the timestamp.<br>Time point of the sampling performed by the processor system of the I/O module. |

Table 17: Module Tab in the Hardware Editor

### 4.5.2 Tab: I/O Submodule CI24_01

The **I/O Submodule CI24_01** tab contains the following statuses and parameters:

| Name | | R/W | Description |
|---|---|---|---|
| Enter these statuses and parameters directly in the Hardware Editor. | | | |
| Name | | R | Module name |
| Type of Input Signals | | W | Selection of the sensors connected on the input:<br>- Type 3 (control circuit devices)<br>- Proximity switch<br>Default setting: Type 3 (control circuit devices) |
| 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 4.5.5 for coding details). |
| Diagnostic Response | DINT | R | As soon as *Diagnostic Response* returns the ID of *Diagnostic Request* (see 4.5.5 for coding details), *Diagnostic Status* contains the diagnostic value requested. |
| Diagnostic Status | DWORD | R | Requested diagnostic value in accordance with *Diagnostic Response.*<br>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<br>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.<br>The I/O module performs a complete self-test and only enters the RUN state if no faults are detected.<br>Default setting: FALSE |
| Supply 1 OK | BOOL | R | Function is not currently supported. |
| Supply 2 OK | BOOL | R | Function is not currently supported. |
| Submodule OK | BOOL | R | TRUE: No submodule fault, no channel faults.<br>FALSE: Submodule fault.<br>Channel fault (external faults included) |
| Submodule Status | DWORD | R | Bit-coded submodule status (For coding details, see Chapter 4.5.4) |

Table 18: Tab: I/O Submodule CI24_01 in the Hardware Editor

### 4.5.3 Tab: I/O Submodule CI24_01: Channels

The **I/O Submodule CI24_01: Channels** tab contains the following system parameters for each counter input. Refer to Chapter 4.5.3.1 for details on how the system parameters behave if a redundant input connection is used.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 |
| -> Counter Reading [UDINT] | UDINT | R | Channel counter reading: 0...$2^{32}$-1, value calculated by the X-CPU based on -> *Counter reading revolving [UDINT]*.<br>**Behavior upon overflow:**<br>The value is added up to a maximum value ($2^{32}$-1). If the maximum value is exceeded, the -> *Overflow [BOOL]* status is set to TRUE, the counting process restarts at 0 and the excess counter pulses are added.<br>The -> *Overflow [BOOL]* status is reset to FALSE with the next cycle.<br>The -> *Overflow [BOOL]* status must be evaluated in the user program. |
| Counter | LREAL | W | Counter scaling factor<br>Default setting: 1.0 |
| -> Count.Read. (scaled) [REAL] | REAL | R | Counter reading (scaled) = counter scaling factor * counter reading<br>**Behavior upon overflow:**<br>With overflow, the value is based on the last counter reading, see -> *Counter reading [UDINT]* |
| -> Rotation speed [mHz] [DINT] | DINT | R | Unhandled value measured for the channel<br>0...20 000 000 mHz, (rotation speed 1000 = 1 Hz) |
| Rot. Speed | LREAL | W | Rotation speed scaling factor<br>Default setting: 0.001 |
| -> Rot. Speed (scaled) [REAL] | REAL | R | Rotation speed (scaled) = rotation speed scaling factor * rotation speed in mHz |
| -> Channel OK | BOOL | R | TRUE: Faultless channel<br>The process value is valid.<br>FALSE: Faulty channel<br>Rotation speed (frequency) is set to 0 and the counter is frozen.<br>Reset with system parameters<br>*Reset [BOOL] ->* |
| -> OC | | R | TRUE: Open-circuit<br>FALSE: No open-circuit<br>It only applies for proximity switches |
| -> SC | BOOL | R | TRUE: Short-circuit<br>FALSE: No short-circuit<br>It only applies for proximity switches |
| Sup. used | BOOL | W | Activated: Supply errors affect the -> *Channel OK* parameter.<br>Deactivated: Supply errors do not affect the -> *Channel OK* parameter.<br>Default setting: Activated |

| Name | Data type | R/W | Description |
|---|---|---|---|
| Counting Pulse Evaluation Type | BYTE | W | - 1 phase, 1 edge, no rotation direction<br>- 1 phase, 2 edges, no rotation direction<br>- 2 phases, 1 edge<br>- 2 phases, 2 edges<br>- 2 phases, 4 edges<br>- 2 phases, 1 edge, static rotation direction<br>Default setting: 1 phase, 1 edge, no rotation direction, see Chapter 4.3.1 |
| -> Overflow | BOOL | R | TRUE: Counter overflow<br>FALSE: No counter overflow |
| Max. CPU Dev. [UDINT] -> | UDINT | W | Maximum deviation allowed for the process value |
| -> Current CPU Dev. [UDINT] | UDINT | R | Currently detected process value deviation, it is added to the value of the *-> Current I/O Dev. [UDINT]* parameter. |
| Max. I/O Dev. [UDINT] - > | UDINT | W | Maximum deviation allowed for the parallel structure. |
| -> Current I/O Dev. [UDINT] | UDINT | R | Deviation currently detected for the parallel structure. |
| -> Level [BOOL] | BOOL | R | TRUE: The related channel is active (energized).<br>FALSE: The related channel is active (de-energized).<br>During two-phase operation, this parameter must be assigned a global variable in the two channels of a channel pair.<br>**It must not be used for safety-related applications.** |
| -> Leading [BOOL] (rotation direction) | BOOL | R | TRUE: Leading signal<br>FALSE: Lagging signal |
| Reset [BOOL] -> | BOOL | W | **If the maximum permissible number of deviations has been exceeded, the *Reset [BOOL]* parameter must be set to TRUE to allow *Channel OK* to be reset to TRUE!**<br>TRUE: Counter reading (process value) and deviation tab reset to 0<br>FALSE: Counter reading (process value) and deviation tab not reset |
| Restart [BOOL] -> | BOOL | W | TRUE: Prevents a restart after channel or module fault<br>FALSE: Allow restarts even after a channel or module fault |
| -> Count.Read. (revolv.) [UDINT] | UDINT | R | It adds the values gathered by the counter up to a maximum value of ($2^{32}$-1). A revolving reset of the counter reading is not allowed. Noise blanking has no influence on this value.<br>**Behavior upon overflow:**<br>If the maximum value is exceeded, the *Counter reading revolving* restarts at 0 and adds the excess counter pulses.<br>**It must not be used for safety-related applications.** |

| Name | Data Type | R/W | Description |
|---|---|---|---|
| Redund. | BOOL | R<br><br>W | TRUE: Channel redundancy<br>FALSE: No channel redundancy<br>The channel redundancy can only be set and reset using the corresponding context menu. |
| Redundancy value | BYTE | W | Insert the value that should be adopted!<br>- Min<br>- Max<br>- Average<br>Default setting: Max<br>**It is only displayed in the redundancy group tab!** |

Table 19: Tab: I/O Submodule CI24_01:Channels in the Hardware Editor

#### 4.5.3.1. System Parameters with Redundant Input Wiring

The chapter describes the process values of the system parameters for counter modules that use redundant input wiring.

| System parameter | Process values if redundant counter modules are used |
|---|---|
| -> Counter Reading [UDINT] | The process value is the greatest individual value (maximum value) of the two redundant modules.<br>If one of the two redundant counter modules is replaced, the module inserted last adopts the process value lastly stored in the processor module (X-CPU). |
| -> Count.Read. (scaled) [REAL] | It is derived from the -> *Counter Reading [UDINT]* parameter. |
| -> Rotation speed [mHz] [DINT] | The process value is the highest (max.) or lowest (min.) individual value of the two redundant modules, or the arithmetic mean (average) of the two individual values. Which value should be determined is set in the *Redundancy Value* parameter, see Chapter 4.5.3. |
| -> Rot. Speed (scaled) [REAL] | It is derived from the -> *Rotation Speed [mHZ] [DINT]* parameter. |
| -> Channel OK | TRUE: Faultless redundant channel<br>The input value is valid<br>FALSE: Faulty redundant channel<br>Rotation speed (frequency) is set to 0 and the counter is frozen. |
| -> OC | AND gate of redundant value |
| -> SC | AND gate of redundant value |
| -> Overflow | TRUE: Counter overflow at redundant process value *-> Counter Reading [UDINT]*<br>FALSE: No counter overflow at redundant process value *-> Counter Reading [UDINT]* |
| -> Current CPU Deviation [UDINT] | The process value is the greatest individual value (maximum value) of the two redundant modules.<br>If one of the two redundant counter modules is replaced, the module inserted last adopts the process value lastly stored in the processor module (X-CPU). |
| -> Level [BOOL] | OR gate of redundant value |
| -> Leading [BOOL] (rotation direction) | AND gate of redundant value. If a different rotation direction is detected, the status provides the last valid value. |

Table 20: System Parameter Behavior with Redundancy

### 4.5.4 Submodule Status [DWORD]

Coding of the **Submodule Status**

| Coding | Description |
|---|---|
| 0x00000001 | Fault in hardware unit (submodule). |
| 0x00000002 | Reset of an E/A bus |
| 0x00000004 | Faults detected while configuring the hardware |
| 0x00000008 | Fault detected while verifying the coefficients |
| 0x20000000 | Open-circuit detection defective |
| 0x40000000 | Short-circuit detection defective |
| 0x80000000 | Module or sensor selection plug is not properly plugged in. |

Table 21: Submodule Status [DWORD]

### 4.5.5 Diagnostic Status [DWORD]

Coding of **Diagnostic Status**

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>0</td><td>Diagnostic values (100...1024) are indicated consecutively.</td></tr>
<tr><td>100</td><td>Bit-coded temperature status<br>0 = normal<br>Bit0 = 1 : Temperature threshold 1 has been exceeded<br>Bit1 = 1 : Temperature threshold 2 has been exceeded<br>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<br>0 = normal<br>Bit0 = 1 : L1+ (24 V) is faulty<br>Bit1 = 1 : L2+ (24 V) is faulty</td></tr>
<tr><td>201</td><td rowspan="3">Not used!</td></tr>
<tr><td>202</td></tr>
<tr><td>203</td></tr>
<tr><td>300</td><td>Comparator 24 V low voltage (BOOL)</td></tr>
<tr><td>1001…1024</td><td>Status of the channels 1...24
<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>0x0010</td><td>Short-circuit detected</td></tr>
<tr><td>0x0020</td><td>Open-circuit detected</td></tr>
<tr><td>0x0040</td><td>Channel fault, fault in the even channel of a channel pair</td></tr>
<tr><td>0x0080</td><td>Internal assessment provides unequal counter pulses (deviation tab)</td></tr>
<tr><td>0x0100</td><td>Channel fault, defective supply status</td></tr>
<tr><td>0x0200</td><td>Maximum permissible deviation exceeded</td></tr>
<tr><td>0x0400</td><td>Low or overvoltage (supply)</td></tr>
<tr><td>0x0800</td><td>No value exists for the rotation direction</td></tr>
<tr><td>0x1000</td><td>The process values cannot be created</td></tr>
<tr><td>0x2000</td><td>Defective channel configuration</td></tr>
<tr><td>0x4000</td><td>Channel not configured</td></tr>
<tr><td>0x8000</td><td>Short-circuit or open-circuit detected</td></tr>
</table></td></tr>
</table>

Table 22: Diagnostic Information [DWORD]

## 4.6 Connection Variants

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

The inputs are wired via connector boards equipped with the corresponding sensor selection plug. Specific connector boards are available for redundantly wiring the modules, see Chapter 3.6.

The supplies are decoupled via diodes; this ensures that the supplies of two redundant modules can supply one proximity switch or a control switch device of type 3.

**NOTE**

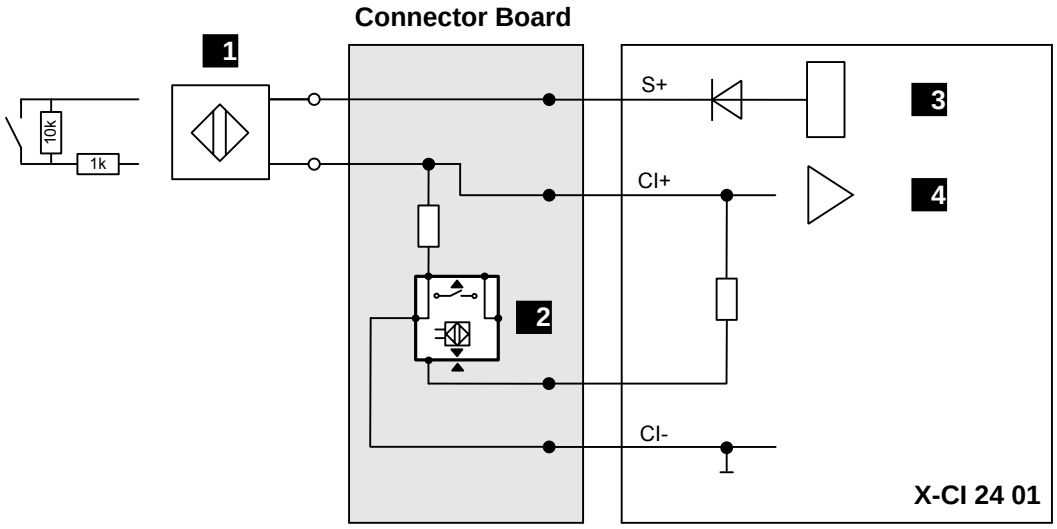
**If the sensor selection plug is used, observe the following notes:**

- **Ensure that the mounting positions of the sensor selection plug and connected sensors are consistent!**
- **If the proximity switches are redundantly connected, ensure that the connector boards are equipped differently, with X-SS CB 01 or X-SS CB 02, see Figure 23.**

**If these points are neglected, malfunctions may result.**

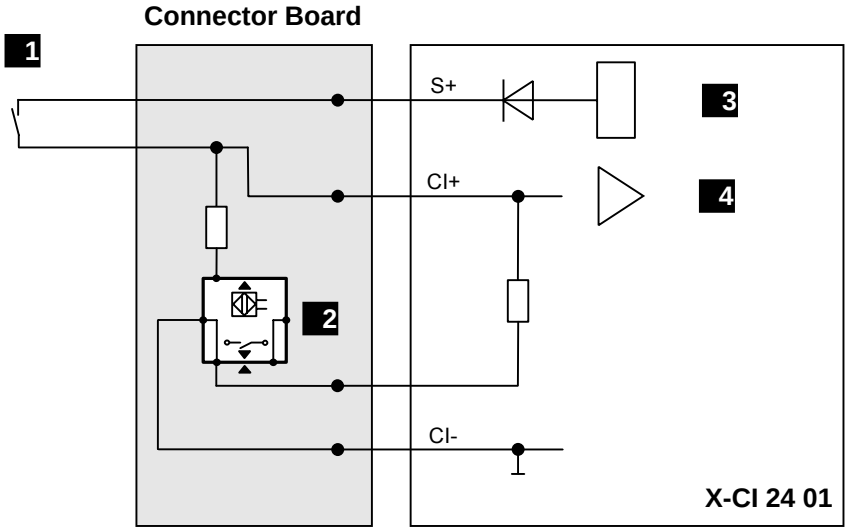
### 4.6.1 Single-Channel Input Wiring

In the wiring variants presented in Figure 15 through Figure 19, the counter modules use the mono connector boards X-CB 013 01 (with screw terminals) or X-CB 013 03 (with cable plug).



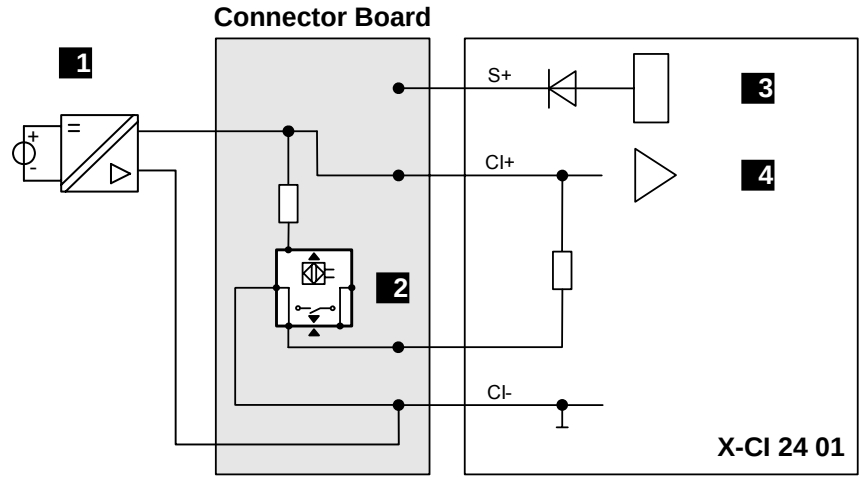

1 Proximity Switch or Wired Mechanical Contact
2 X-SS CB 01 Sensor Selection Plug
3 Supply
4 Counter Input

Figure 15: Single-Channel Wiring of a Proximity Switch




1 Control Circuit Device of Type 3
2 X-SS CB 01 Sensor Selection Plug
3 Supply
4 Counter Input

Figure 16: Single-Channel Wiring of a Control Circuit Device of Type 3




1 Digital Signal Source
2 X-SS CB 01 Sensor Selection Plug
3 Supply
4 Counter Input

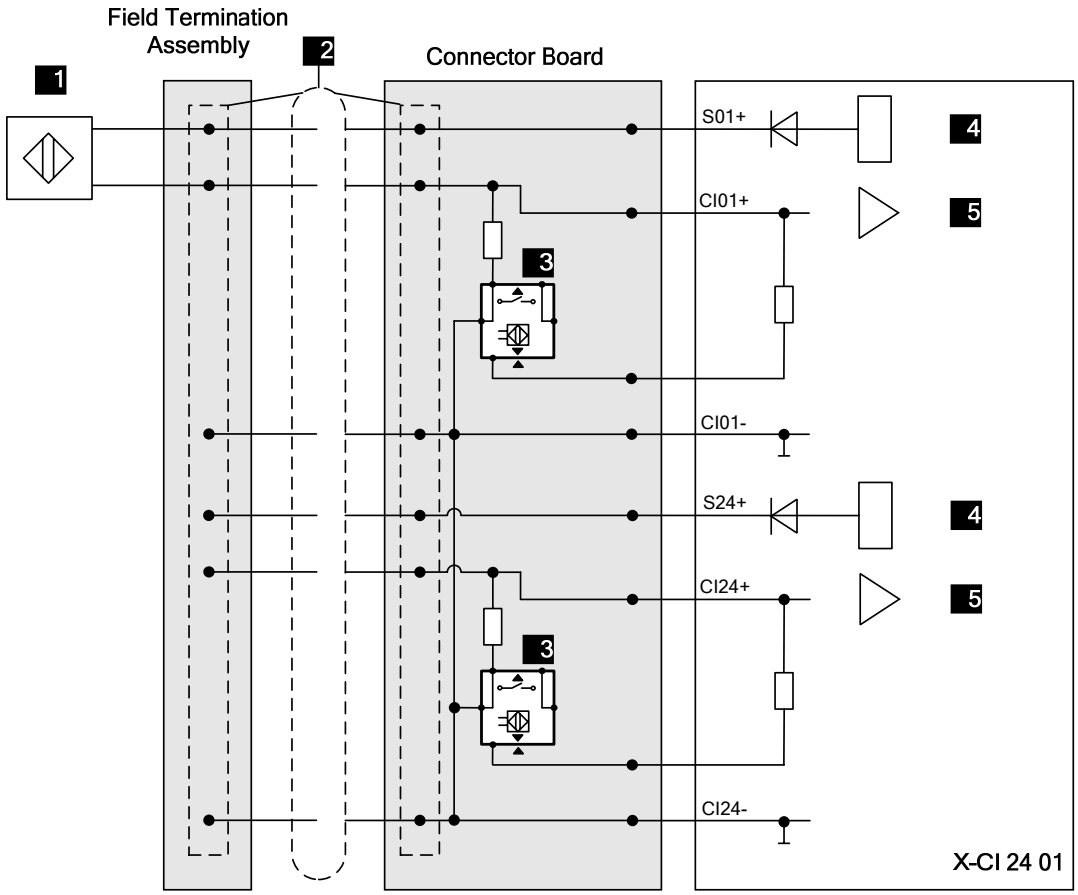
Figure 17: Wiring of a Digital Signal Source with Electrically Isolated Supply

## 4.6.2 Single-Channel Input Connection via X-FTA 002

The X-FTA 002 field termination assembly is used to connect the sensors, whereas the X-CA 005 system cable is used to connect the X-CB 013 03 mono connector board with cable plug.

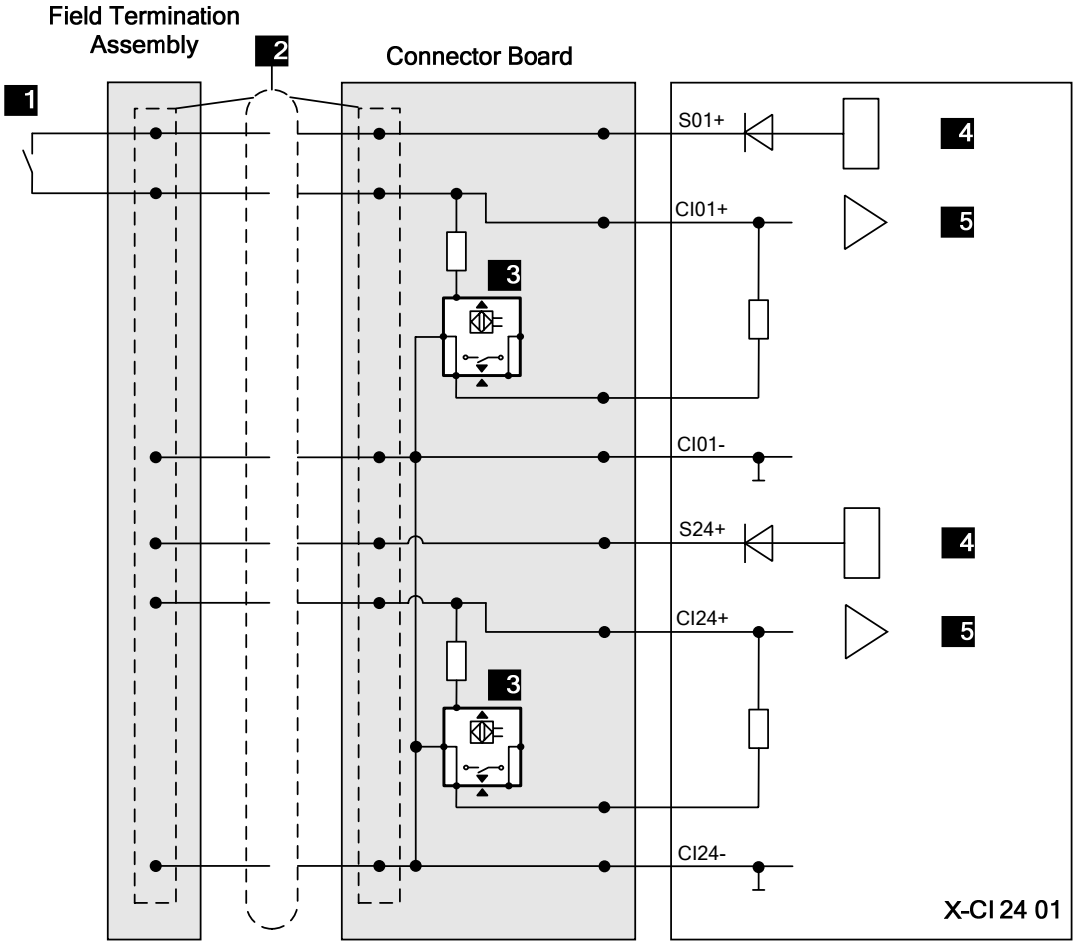
**Sensor Selection Plug**

The sensor selection plug (3) in Figure 18 and Figure 19 is drawn two times. This is only done to better represent the wiring!




1 Field Zone: Proximity Switch
2 System Cable X-CA 005
3 X-SS CB 01 Sensor Selection Plug
4 Supply
5 Counter Input

Figure 18: Input Wiring via X-FTA 002 and Proximity Switch




1 Field Zone Control Circuit Device of Type 3
2 System Cable X-CA 005
3 X-SS CB 01 Sensor Selection Plug
4 Supply
5 Counter Input

Figure 19: Input Wiring via X-FTA 002 and Control Circuit Device of Type 3

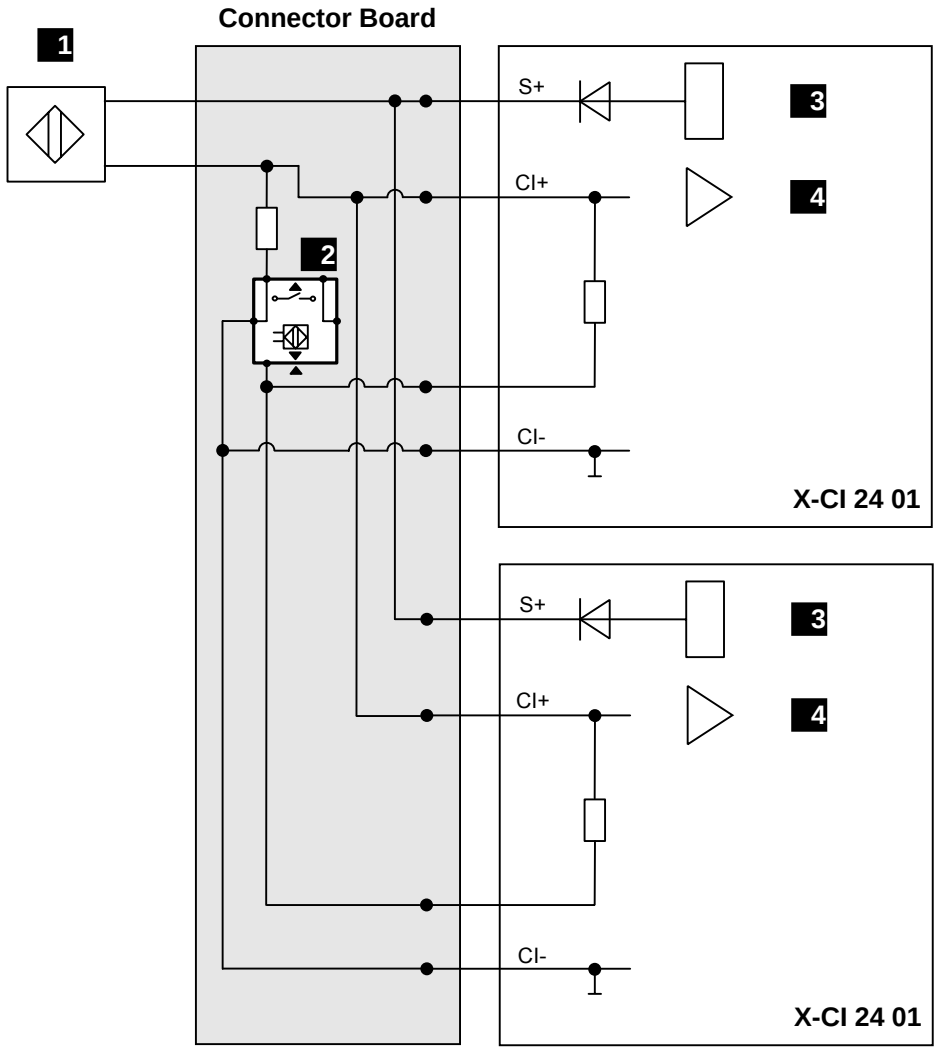
### 4.6.3 Redundant Input Wiring

The redundant input wiring is differentiated in the following variants:

- Two counter modules using a redundant connector board and are located adjacent to one another in the base plate.
- Two counter modules, that are each inserted into a mono connector board and connected to the redundant X-FTA 002 02 field termination assembly via system cables. The counter modules can also be inserted into two system base plates that are physically separated from one another.

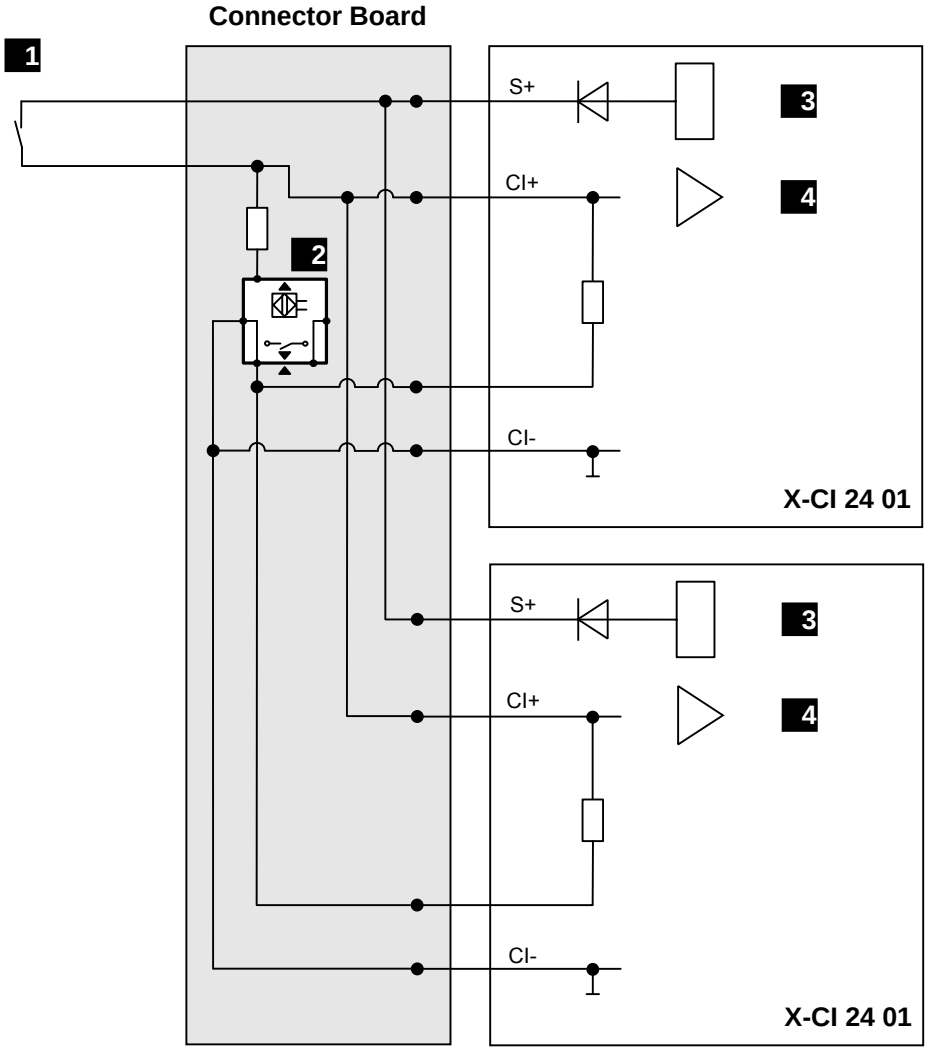
#### 4.6.3.1. Counter Modules with Redundant Connector Board

In this variant, the counter modules use a redundant connector board (X-CB 013 02 with screw terminals or X-CB 013 04 with cable plug) and are located adjacent to one another in the base plate.




1 Proximity Switch
2 X-SS CB 01 Sensor Selection Plug
3 Supply
4 Counter Input

Figure 20: Redundant Wiring of a Proximity Switch




1 Control Circuit Device of Type 3
2 X-SS CB 01 Sensor Selection Plug
3 Supply
4 Counter Input

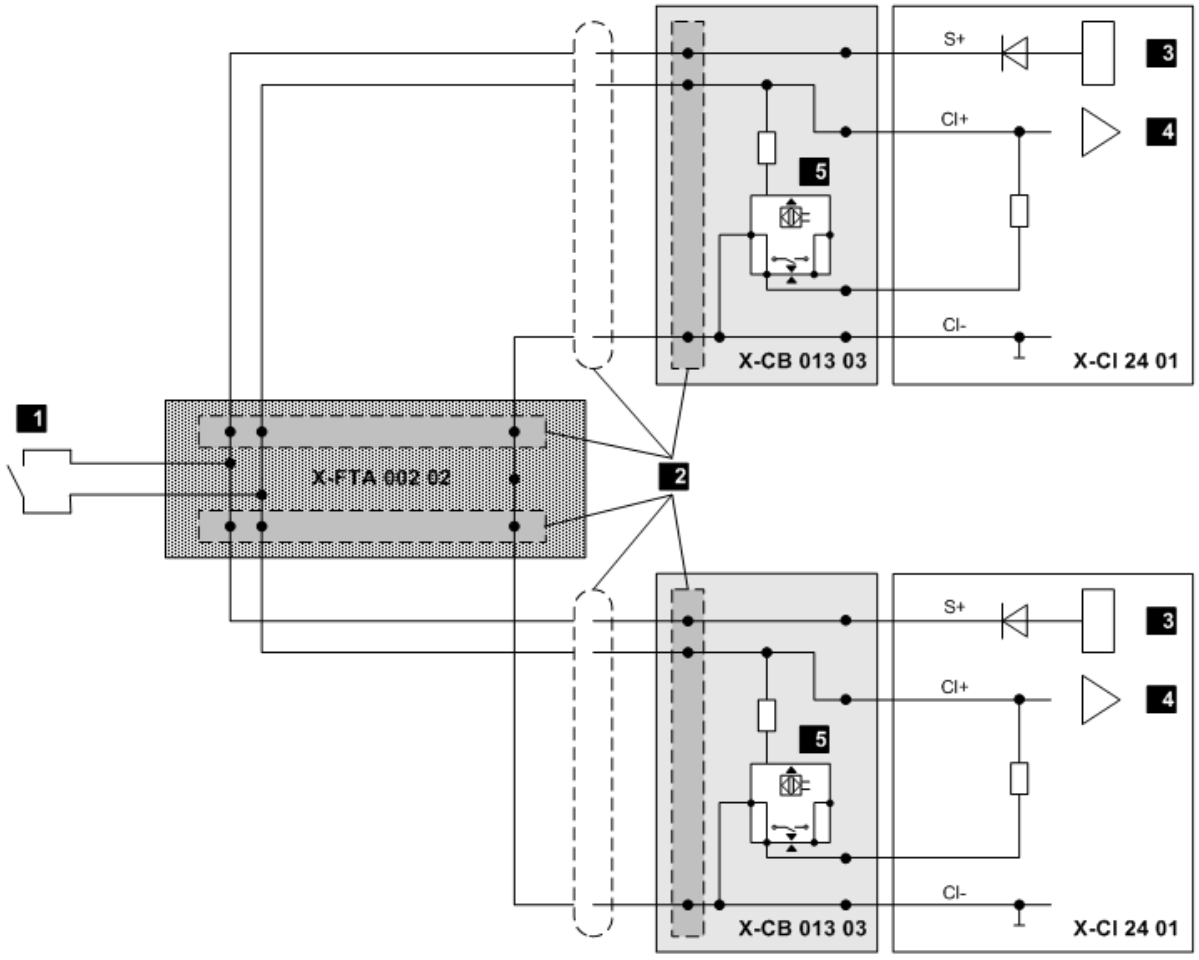
Figure 21: Redundant Wiring of a Control Circuit Device of Type 3

### 4.6.3.2. Redundant Input Wiring via X-FTA 002 02

In this variant, the counter modules use the redundant X-FTA 002 02 field termination assembly. Each of the counter modules is inserted into an X-CB 013 03 mono connector board and is connected to the field termination assembly via the X-CA 005 system cables. The counter modules can be located adjacently within the same base plate or be inserted into system base plates that are physically separated from one another.

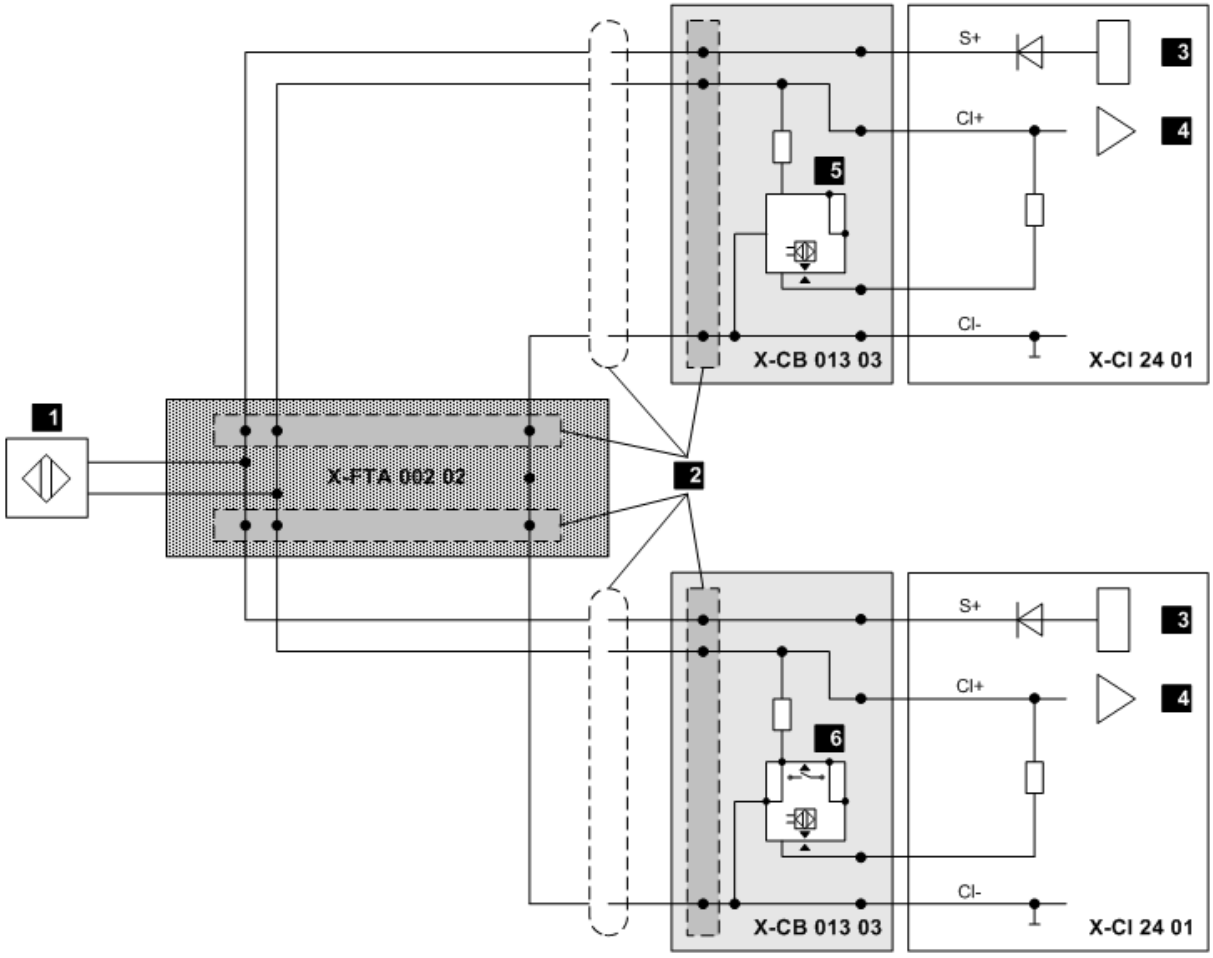
If a control circuit device of type 3 is used, the connector boards must be equipped with an X-SS CB 01 sensor selection plug, see Chapter 4.2.2.

If a proximity switch is connected, one of the connector boards must be equipped with an X-SS CB 01 sensor selection plug and the other must be fitted with an X-SS CB 02 sensor selection plug, see Figure 23.




1 Control Circuit Device of Type 3
2 System Cable X-CA 005
3 Supply
4 Counter Input
5 X-SS CB 01 Sensor Selection Plug

Figure 22: Control Circuit Device of Type 2 Redundantly Connected via X-FTA 002 02




1 Proximity Switch
2 X-CA 005 System Cable with Cable Plug
3 Supply
4 Counter Input
5 X-SS CB 02 Sensor Selection Plug
6 X-SS CB 01 Sensor Selection Plug

Figure 23: Proximity Switch Redundantly Connected via X-FTA 002 02

### 4.6.4 Measuring the Rotational Speed with Recognition of Rotation Direction

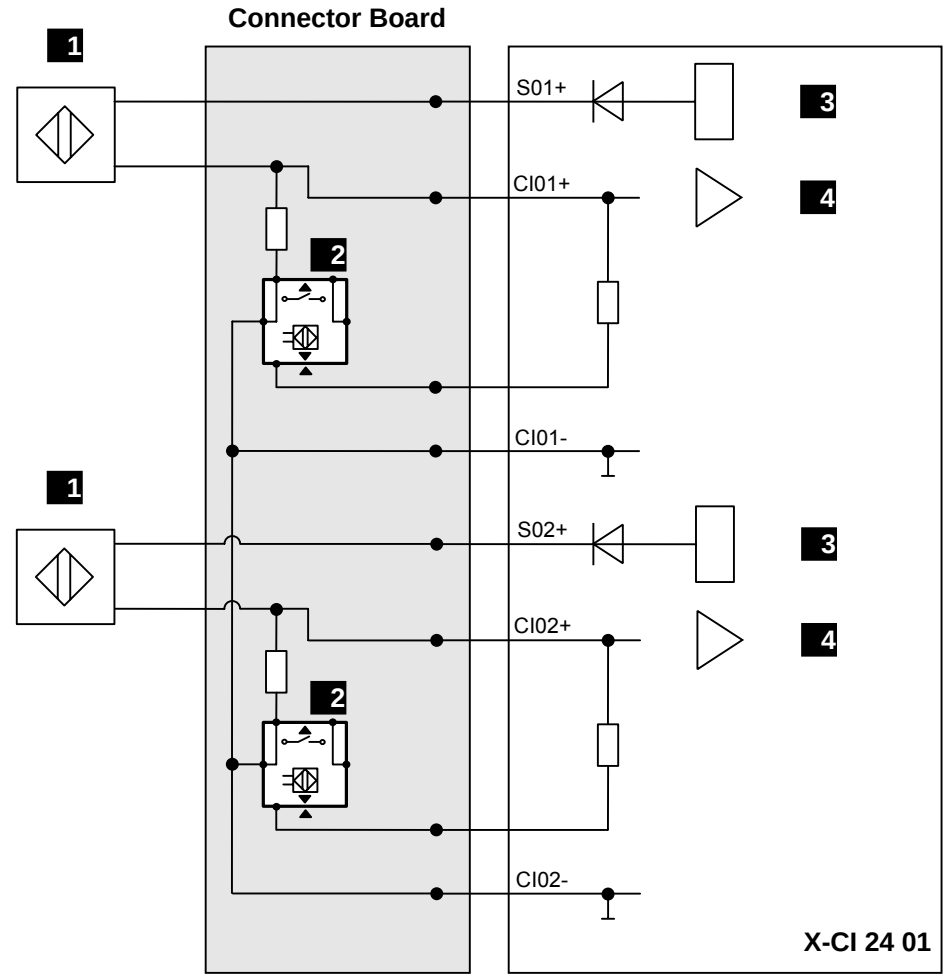
Two input signals are required for measuring the rotation speed with recognition of rotation direction. The signals are led to one channel pair (e.g. CI01 and CI02).

**NOTE**

- **This wiring is only permitted if the two input signals are led to one channel pair 1...12 of the module, see Figure 24 and Figure 25**

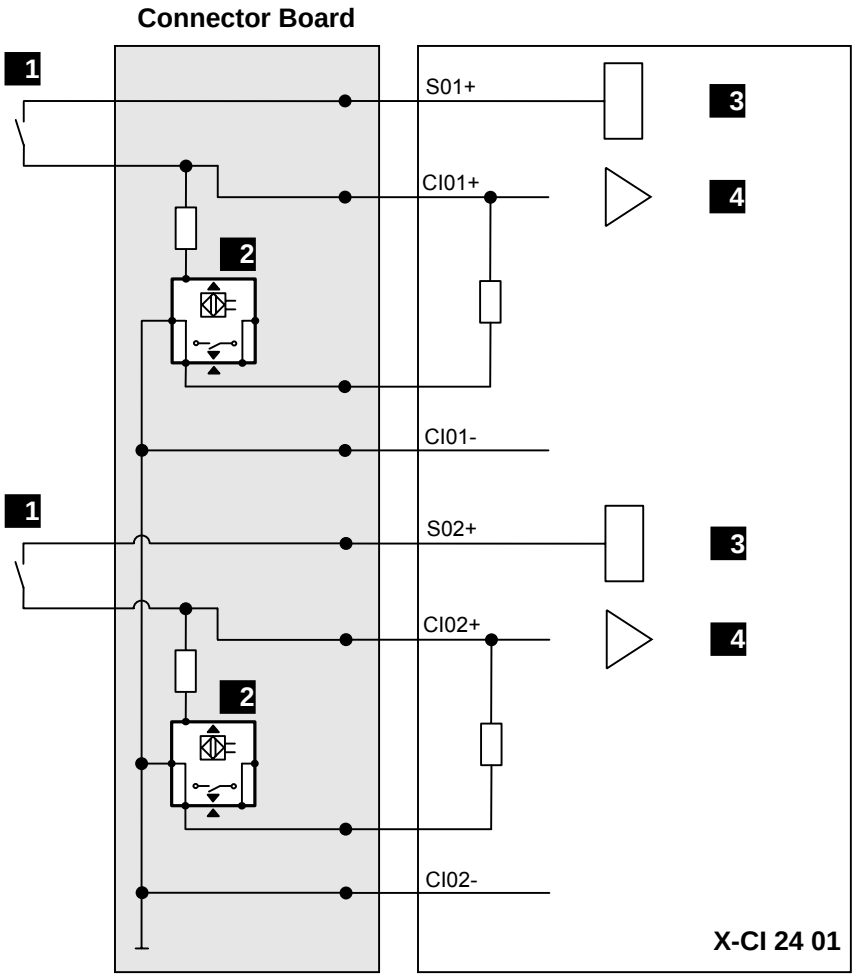
**Sensor Selection Plug**

The sensor selection plug (2) in Figure 24 and Figure 25 is drawn two times. This is only done to better represent the wiring!




1 Field Zone: Proximity Switch
2 X-SS CB 01 Sensor Selection Plug
3 Supply
4 Counter Input

Figure 24: Rotation Speed Measurement with Recognition of Rotation Direction - Proximity Switch




1 Field Zone Control Circuit Device of Type 3

2 X-SS CB 01 Sensor Selection Plug

3 Supply

4 Counter Input

Figure 25: Rotation Speed Measurement with Recognition of Rotation Direction - Control Circuit Device of Type 3

# 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 counter outputs. For more details, refer to the SILworX documentation.

If one or multiple channels are reported as faulty (*Channel OK = FALSE*), e.g., because the maximum permissible number of deviations was exceeded, the system variable can only be reset by resetting a channel (*Reset [BOOL] ->*).

## 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 counter module can also be read using SILworX.
Chapter 4.5.4 and Chapter 4.5.5 describe the most important module-specific diagnostic messages.

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

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

# 6 Maintenance

Defective modules must be replaced with a faultless module of the same type or with an approved replacement model.

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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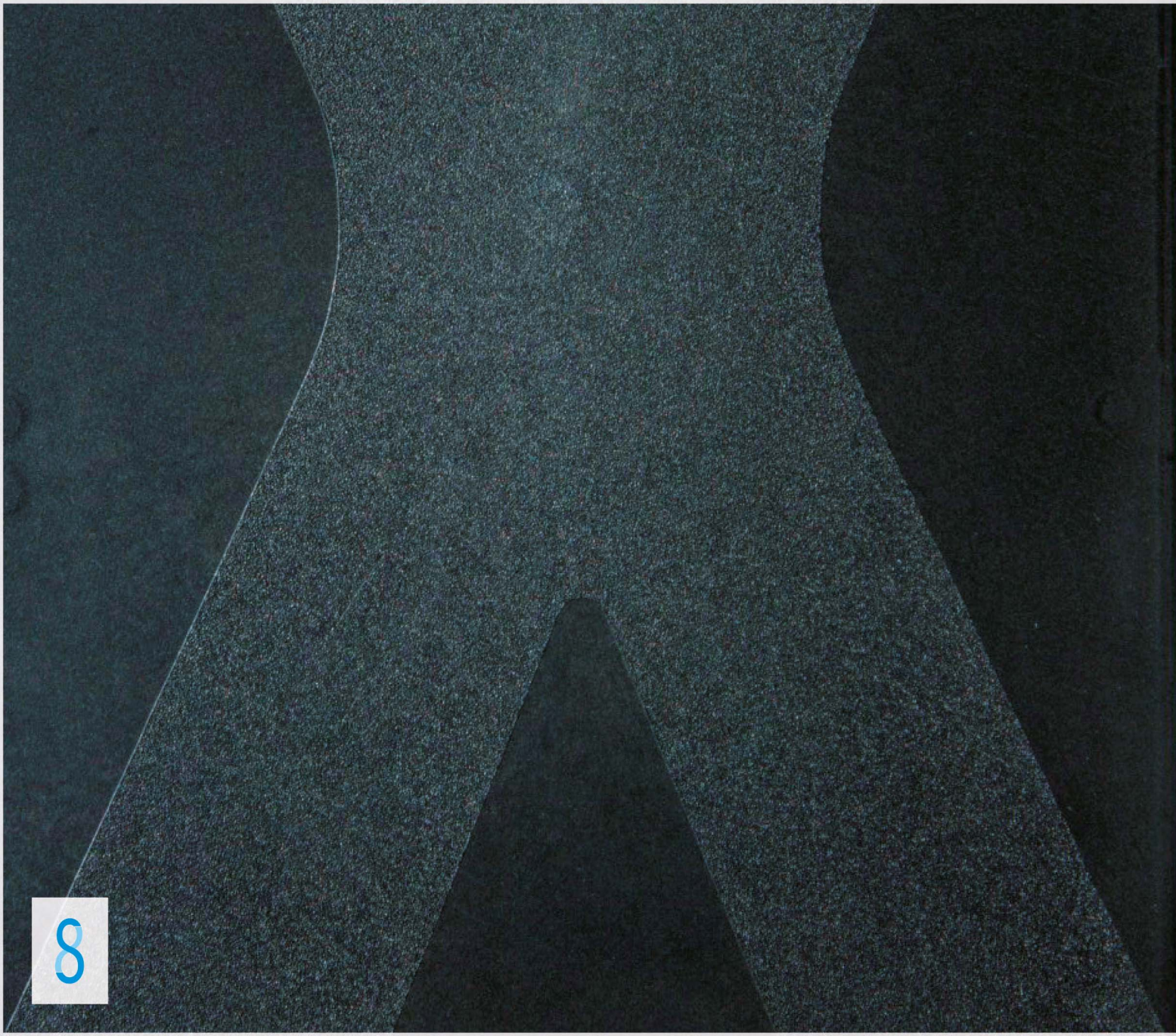
HIMA

SAFETY
NONSTOP



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