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HIMax®

Analog input module
Manual

SAFETY
NONSTOP

HIMA

X-AI 32 01

3 Product Description

The X-AI 32 01 analog input module is intended for use in the programmable electronic system (PES) HIMax.

The module is 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 32 analog input signals.

The module is TÜV-certified for safety-related applications up to SIL 3 (IEC 61508, IEC 61511 and IEC 62061), 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 measures the current of the connected devices with safety-related accuracy, providing the transmitter supply with a guaranteed minimum voltage.

The safety function is performed in accordance with SIL 3.

3.1.1 Reaction in the Event of a Fault

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

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

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

3.2 Scope of Delivery

The module must be installed on a suitable connector board to be able to operate. If a Field Termination Assembly (FTA) is used, a system cable is required to connect the connector board to the FTA. Connector boards, system cables and FTAs are not included within the scope of delivery.

The connector boards are described in Chapter 3.6, the system cables are described in Chapter 3.7. The FTAs are described in own manuals.

3.3 Type Label

The type label specifies the following important details:

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

Figure 1: Sample Type Label

3.4 Assembly

The module has 32 analog current inputs (0/4...20 mA), each input is measured and functionally tested using two internal measuring facilities. A short-circuit-proof transmitter supply is assigned to each input.

The 32 analog inputs can be used to evaluate the values measured for the transmitters and safety transmitters. Two-wire or three-wire transmitters with a maximum supply current of 30 mA can be connected to the module.

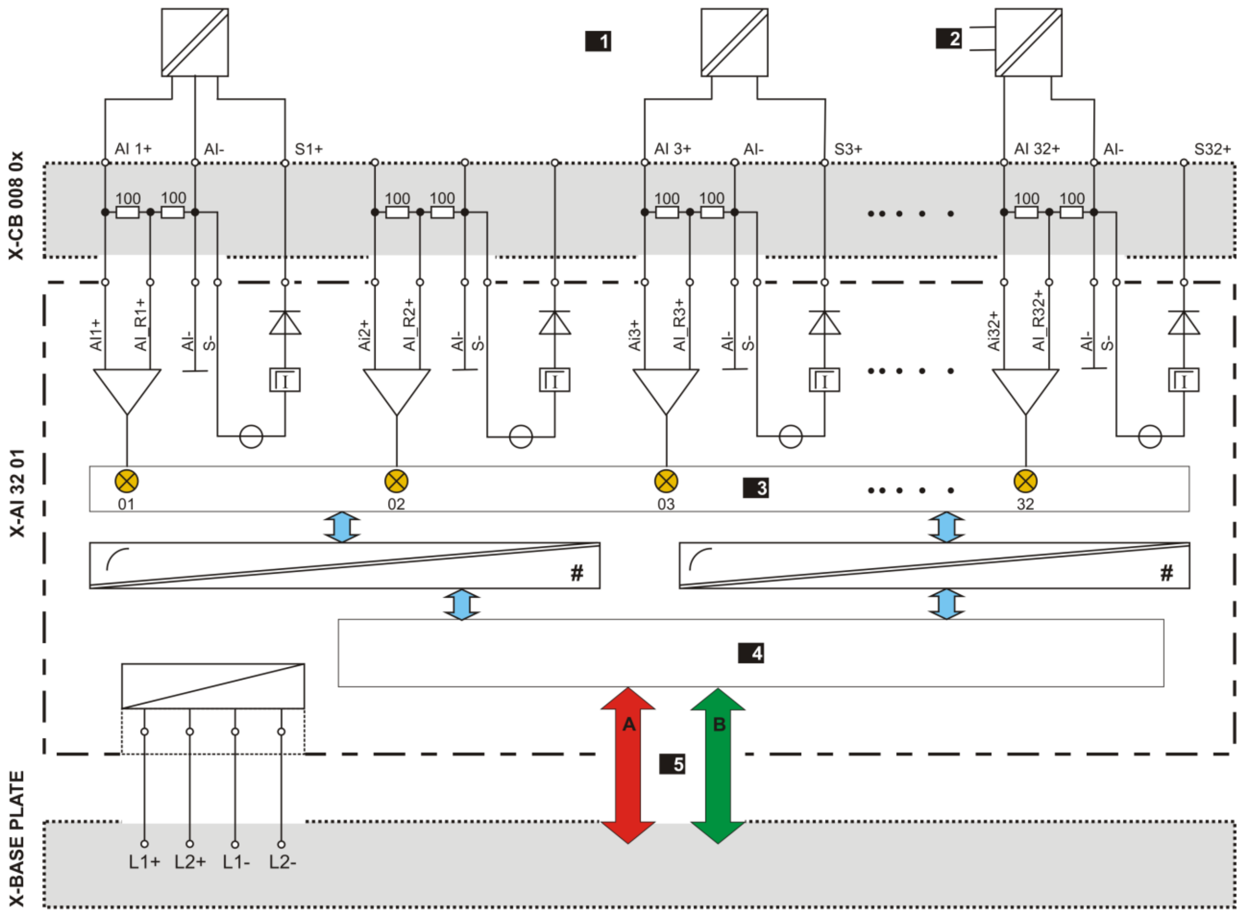
The functional units are galvanically separated to ensure that the input signals are interference-free.

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 analog inputs, see Chapter 3.4.2.

3.4.1 Block Diagram

The following block diagram illustrates the structure of the module.



1 Field Side: Transmitter
2 External Transmitter Supply
3 Interface
4 Safety-Related Processor System
5 System Busses

Figure 2: Block Diagram

3.4.2 Indicators

The following figure shows the LED indicators for the module.

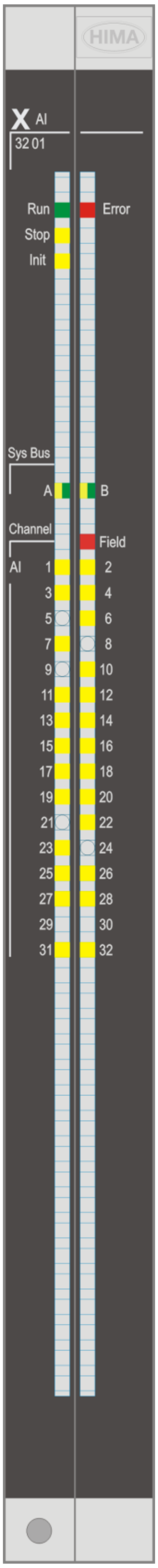


Figure 3: Indicators

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 (AI 1...32, Field)

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

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: Blinking synchronously 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 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

LED	Color	Status	Description
Channel 1...32	Yellow	On	The input current is > 4 mA or greater than the HIGH switching point (dig) configured in SILworX.
		Blinking2	Channel fault (module field or hardware fault). Input current > 20 mA
		Off	The input current is < 4 mA or less than the LOW switching point (dig) configured in SILworX.
Field	Red	Blinking2	Field fault on at least one channel or supply (open-circuit, short-circuit, over-current, etc.) Depending on the configured current thresholds.
		Off	No field fault displayed!

Table 6: I/O Indicators

3.5 Product Data

General	
Supply voltage	24 VDC, -15 %...+20 %, $r_P \leq 5$ %, SELV, PELV
Current input	min. 500 mA (without channels/transmitter supplies) max. 1.5 A (if the transmitter supplies are short-circuited)
Current input per channel	min. 0 mA (without transmitter supply) min. 30 mA (with transmitter supply)
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. 1.4 kg

Table 7: Product Data

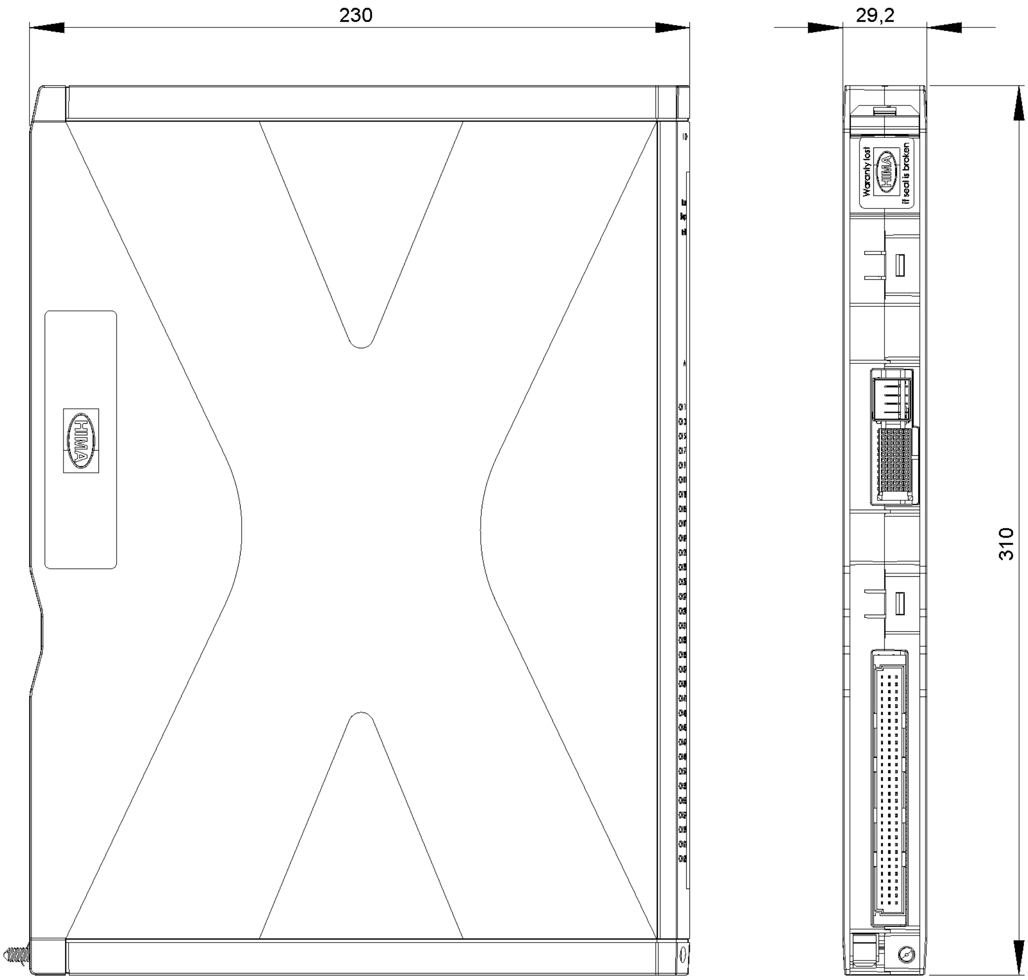


Figure 4: Views

Analog inputs	
Number of inputs (number of channels)	32 with common ground AI- (galvanic separation from the system bus and the 24 VDC supply voltage).
Nominal range	0/4...20 mA
Operating range	0...22.5 mA
Digital resolution	12-bit
Shunt for current measurement	200 Ω
Maximum permitted current via shunt	50 mA
Withstand voltage of the input	≤ 10 VDC
Interference voltage suppression	> 60 dB (common mode 50/60 Hz)
Measured value renewal (in the user program)	Cycle time of the user program
Sampling time	2 ms
Metrological accuracy	
Metrological accuracy on the entire temperature range (-10 °C...70 °C)	± 0.15 % of final value
Settling time to 99 % of the process value when the input signal changes	15 ms

Table 8: Specifications for the Analog Inputs

Transmitter supply	
Number of transmitter supplies	32
Output voltage for transmitter supply	26.5 VDC +0/-15 %
Output current of transmitter supply	max. 30 mA
Monitoring of transmitter supply	Undervoltage: 22.5 VDC Overvoltage: 30 VDC
Max. number of transmitter supplies that may be simultaneously short-circuited.	12 If more than 12 supplies are closed for longer than 3 seconds, the entire transmitter supply is switched off. If the overload disappears within 30 seconds, the transmitter supply is switched on again.
Maximum connectable load (transmitter + line)	≤ 750 Ω at 22.5 mA

Table 9: Product Data for the Transmitter 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 008 01	Connector board with screw terminals
X-CB 008 02	Redundant connector board with screw terminals
X-CB 008 03	Connector board with cable plug
X-CB 008 04	Redundant connector board with cable plug
X-CB 008 05	Redundant connector board with cable plug, redundant field termination assembly

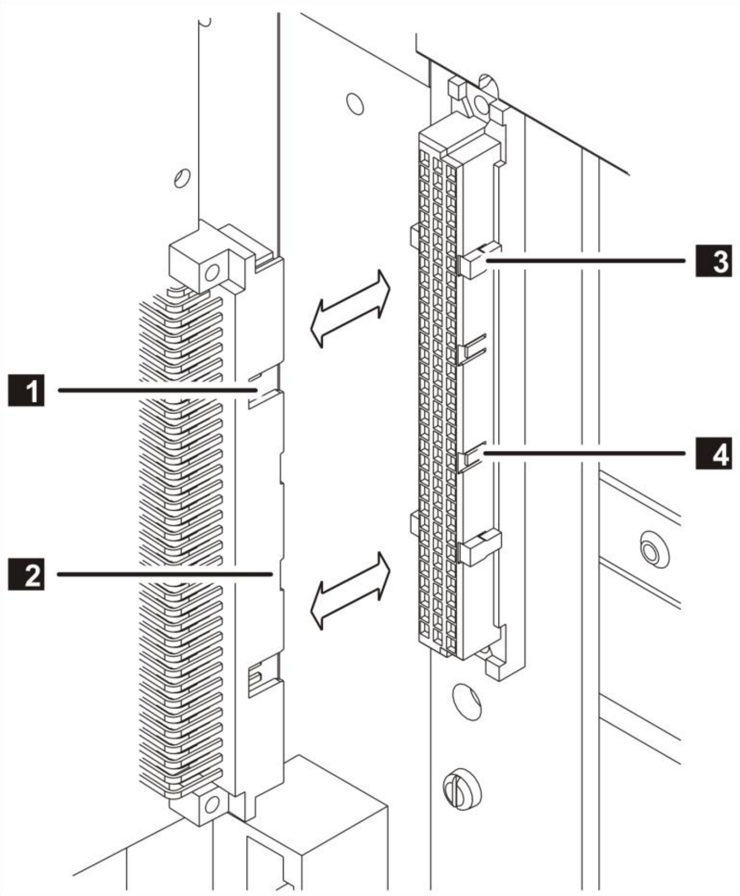
Table 10: Available Connector Boards

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 incorrect 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	3 Coding Wedge
2 Prepared Male Connector Recess	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 008 Connector Boards

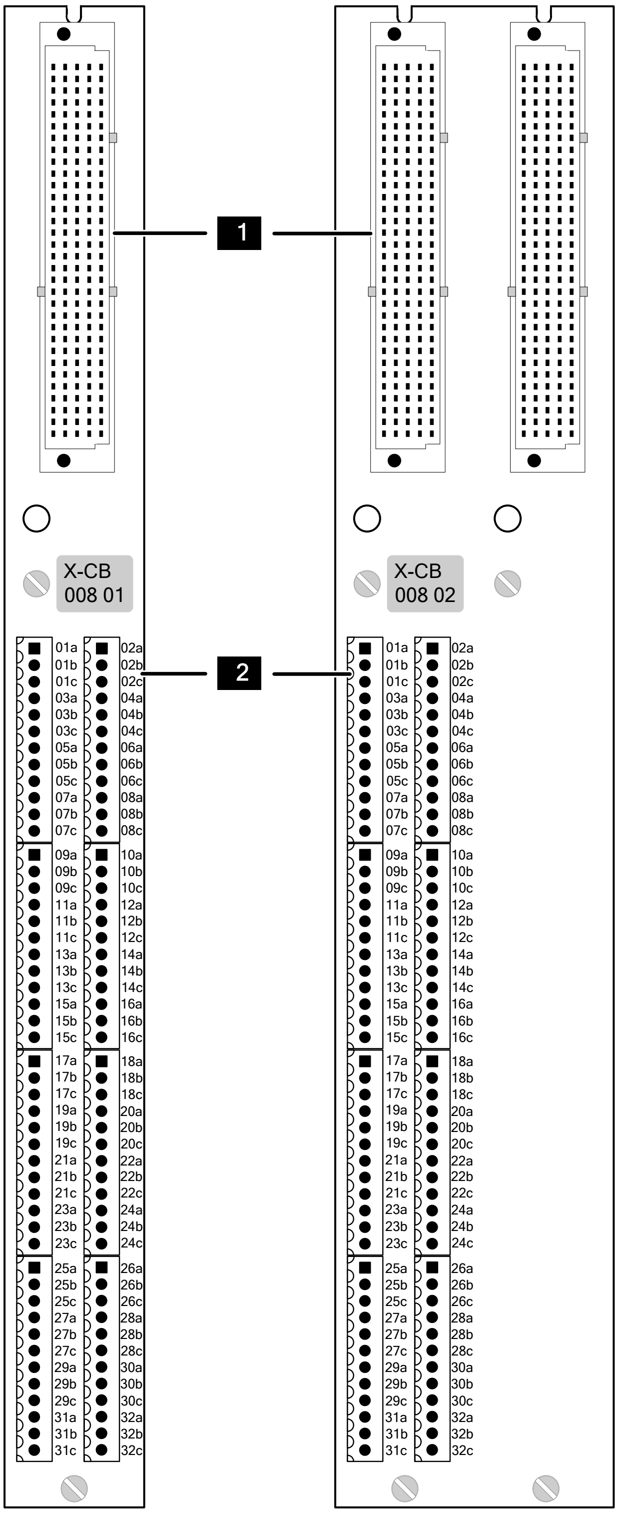
a7	a13	a20	a26	c7	c13	c20	c26
		X		X		X	

Table 11: Position of Coding Wedges

3.6.3 Pin Assignment for Connector Boards with Screw Terminals

Mono — X-CB 008 01

Redundant — X-CB 008 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	S1+	1	02a	S2+
2	01b	AI1+	2	02b	AI2+
3	01c	AI1-	3	02c	AI2-
4	03a	S3+	4	04a	S4+
5	03b	AI3+	5	04b	AI4+
6	03c	AI3-	6	04c	AI4-
7	05a	S5+	7	06a	S6+
8	05b	AI5+	8	06b	AI6+
9	05c	AI5-	9	06c	AI6-
10	07a	S7+	10	08a	S8+
11	07b	AI7+	11	08b	AI8+
12	07c	AI7-	12	08c	AI8-
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	09a	S9+	1	10a	S10+
2	09b	AI9+	2	10b	AI10+
3	09c	AI9-	3	10c	AI10-
4	11a	S11+	4	12a	S12+
5	11b	AI11+	5	12b	AI12+
6	11c	AI11-	6	12c	AI12-
7	13a	S13+	7	14a	S14+
8	13b	AI13+	8	14b	AI14+
9	13c	AI13-	9	14c	AI14-
10	15a	S15+	10	16a	S16+
11	15b	AI15+	11	16b	AI16+
12	15c	AI15-	12	16c	AI16-
Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	17a	S17+	1	18a	S18+
2	17b	AI17+	2	18b	AI18+
3	17c	AI17-	3	18c	AI18-
4	19a	S19+	4	20a	S20+
5	19b	AI19+	5	20b	AI20+
6	19c	AI19-	6	20c	AI20-
7	21a	S21+	7	22a	S22+
8	21b	AI21+	8	22b	AI22+
9	21c	AI21-	9	22c	AI22-
10	23a	S23+	10	24a	S24+
11	23b	AI23+	11	24b	AI24+
12	23c	AI23-	12	24c	AI24-

Pin no.	Designation	Signal	Pin no.	Designation	Signal
1	25a	S25+	1	26a	S26+
2	25b	AI25+	2	26b	AI26+
3	25c	AI25-	3	26c	AI26-
4	27a	S27+	4	28a	S28+
5	27b	AI27+	5	28b	AI28+
6	27c	AI27-	6	28c	AI28-
7	29a	S29+	7	30a	S30+
8	29b	AI29+	8	30b	AI30+
9	29c	AI29-	9	30c	AI30-
10	31a	S31+	10	32a	S32+
11	31b	AI31+	11	32b	AI32+
12	31c	AI31-	12	32c	AI32-

Table 12: Terminal Assignment for Connector Boards with Screw Terminals

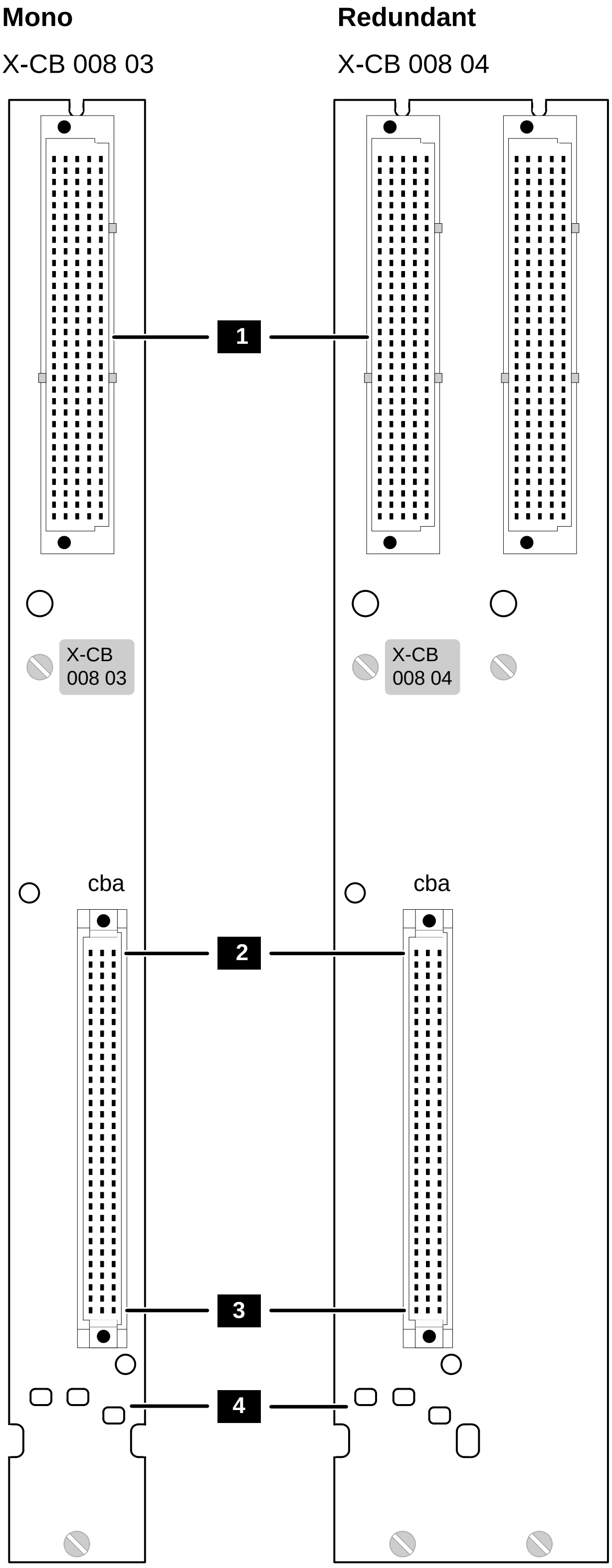
Cable plugs attached to the connector board pin headers are used to connect to the field zone.

The cable plugs feature the following properties:

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

Table 13: Cable Plug Properties

3.6.5 Pin Assignment for Connector Boards with Cable Plug



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 Cable Plug Coding

Figure 7: Connector Boards with Cable Plug

3.6.6 Pin Assignment for Connector Boards with Cable Plug

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

i **Connector pin assignment!**

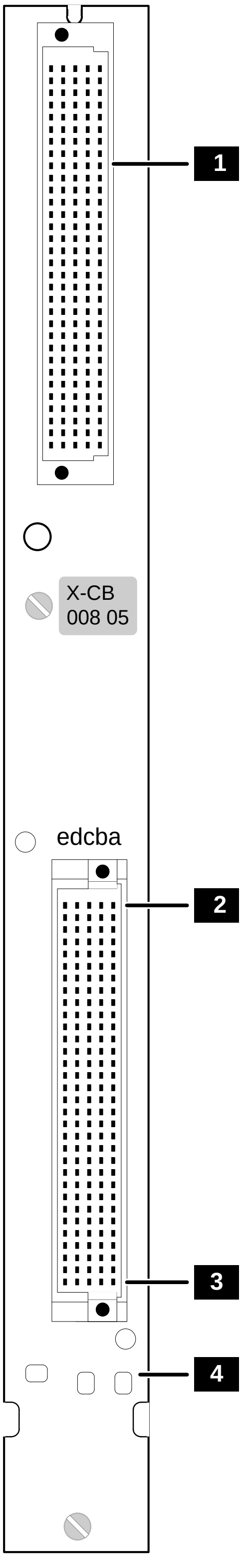
The following table describes the connector pin assignment of the system cable plug.

Lead marking based on DIN 47100:

Row	c		b		a	
	Signal	Color	Signal	Color	Signal	Color
1	S32+	PKBN[1)]	AI32+	WHPK[1)]	Reserved	YEBU[1)]
2	S31+	GYBN[1)]	AI31+	WHGY[1)]	Reserved	GNBU[1)]
3	S30+	YEBN[1)]	AI30+	WHYE[1)]	Reserved	YEPK[1)]
4	S29+	BNGN[1)]	AI29+	WHGN[1)]	Reserved	PKGN[1)]
5	S28+	RDBU[1)]	AI28+	GYPK[1)]		
6	S27+	VT[1)]	AI27+	BK[1)]		
7	S26+	RD[1)]	AI26+	BU[1)]		
8	S25+	PK[1)]	AI25+	GY[1)]		
9	S24+	YE[1)]	AI24+	GN[1)]		
10	S23+	BN[1)]	AI23+	WH[1)]		
11	S22+	RDBK	AI22+	BUBK		
12	S21+	PKBK	AI21+	GYBK		
13	S20+	PKRD	AI20+	GYRD		
14	S19+	PKBU	AI19+	GYBU		
15	S18+	YEBK	AI18+	GNBK		
16	S17+	YERD	AI17+	GNRD		
17	S16+	YEBU	AI16+	GNBU		
18	S15+	YEPK	AI15+	PKGN		
19	S14+	YEGY	AI14+	GYGN		
20	S13+	BNBK	AI13+	WHBK		
21	S12+	BNRD	AI12+	WHRD		
22	S11+	BNBU	AI11+	WHBU		
23	S10+	PKBN	AI10+	WHPK		
24	S9+	GYBN	AI9+	WHGY		
25	S8+	YEBN	AI8+	WHYE	AI-	YEGY[1)]
26	S7+	BNGN	AI7+	WHGN	AI-	GYGN[1)]
27	S6+	RDBU	AI6+	GYPK	AI-	BNBK[1)]
28	S5+	VT	AI5+	BK	AI-	WHBK[1)]
29	S4+	RD	AI4+	BU	AI-	BNRD[1)]
30	S3+	PK	AI3+	GY	AI-	WHRD [1)]
31	S2+	YE	AI2+	GN	AI-	BNBU[1])
32	S1+	BN	AI1+	WH	AI-	WHBU[1)]
[1)] Additional orange ring if one lead marking color is repeated.						

Table 14: Pin Assignment for the System Cable Plug

3.6.7 Connector Board Redundancy using Two Base Plates



- **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 8: Connector Board with Cable Plug, Variant X-CB 008 05

3.6.8 Pin Assignment for X-CB 008 05

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

i **Connector pin assignment!**

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

Lead marking based on DIN 47100.

Row	e		d		c		b		a	
	Signal	Color	Signal	Color	Signal	Color	Signal	Color	Signal	Color
1	S32+	RD[2)]	AI_R32+	PKBN[1)]	AI32+	WHBK[1)]			reserv.	YEGY[2)]
2	S31+	BU[2)]	AI_R31+	GYBN[1)]	AI31+	WHGY[1)]			reserv.	GYGN[2)]
3	S30+	PK[2)]	AI_R30+	YEBN[1)]	AI30+	WHYE[1)]			reserv.	BNBK[2)]
4	S29+	GY[2)]	AI_R29+	BNGN[1)]	AI29+	WHGN[1)]			reserv.	WHBK[2)]
5	S28+	YE[2)]	AI_R28+	RDBU[1)]	AI28+	GYPK[1)]				
6	S27+	GN[2)]	AI_R27+	VT[1)]	AI27+	BK[1)]				
7	S26+	BN[2)]	AI_R26+	RD[1)]	AI26+	BU[1)]				
8	S25+	WH[2)]	AI_R25+	PK[1)]	AI25+	GY[1)]				
9	S24+	RDBK[1)]	AI_R24+	YE[1)]	AI24+	GN[1)]				
10	S23+	BUBK[1)]	AI_R23+	BN[1)]	AI23+	WH[1)]				
11	S22+	PKBK[1)]	AI_R22+	RDBK	AI22+	BUBK				
12	S21+	GYBK[1)]	AI_R21+	PKBK	AI21+	GYBK				
13	S20+	PKRD[1)]	AI_R20+	PKRD	AI20+	GYRD				
14	S19+	GYRD[1)]	AI_R19+	PKBU	AI19+	GYBU				
15	S18+	PKBU[1)]	AI_R18+	YEBK	AI18+	GNBK				
16	S17+	GYBU[1)]	AI_R17+	YERD	AI17+	GNRD				
17	S16+	YEBK[1)]	AI_R16+	YEBU	AI16+	GNBU	S-	BNRD[2)]		
18	S15+	GNBK[1)]	AI_R15+	YEPK	AI15+	PKGN	S-	WHRD[2)]		
19	S14+	YERD[1)]	AI_R14+	YEGY	AI14+	GYGN	S-	BNBU[2)]		
20	S13+	GNRD[1)]	AI_R13+	BNBK	AI13+	WHBK	S-	WHBU[2)]		
21	S12+	YEBU[1)]	AI_R12+	BNRD	AI12+	WHRD	S-	PKBN[2)]		
22	S11+	GNBU[1)]	AI_R11+	BNBU	AI11+	WHBU	S-	WHPK[2)]		
23	S10+	YEPK[1)]	AI_R10+	PKBN	AI10+	WHPK	S-	GYBN[2)]		
24	S9+	PKGN[1)]	AI_R9+	GYBN	AI9+	WHGY	S-	WHGY[2)]		
25	S8+	YEGY[1)]	AI_R8+	YEBN	AI8+	WHYE	AI-	YEBN[2)]		
26	S7+	GYGN[1)]	AI_R7+	BNGN	AI7+	WHGN	AI-	WHYE[2)]		
27	S6+	BNBK[1)]	AI_R6+	RDBU	AI6+	GYPK	AI-	BNGN[2)]		
28	S5+	WHBK[1)]	AI_R5+	VT	AI5+	BK	AI-	WHGN[2)]		
29	S4+	BNRD[1)]	AI_R4+	RD	AI4+	BU	AI-	RDBU[2)]		
30	S3+	WHRD[1)]	AI_R3+	PK	AI3+	GY	AI-	GYPK[2)]		
31	S2+	BNBU[1)]	AI_R2+	YE	AI2+	GN	AI-	YT[2)]		
32	S1+	WHBU[1)]	AI_R1+	BN	AI1+	WH	AI-	BK[2)]		

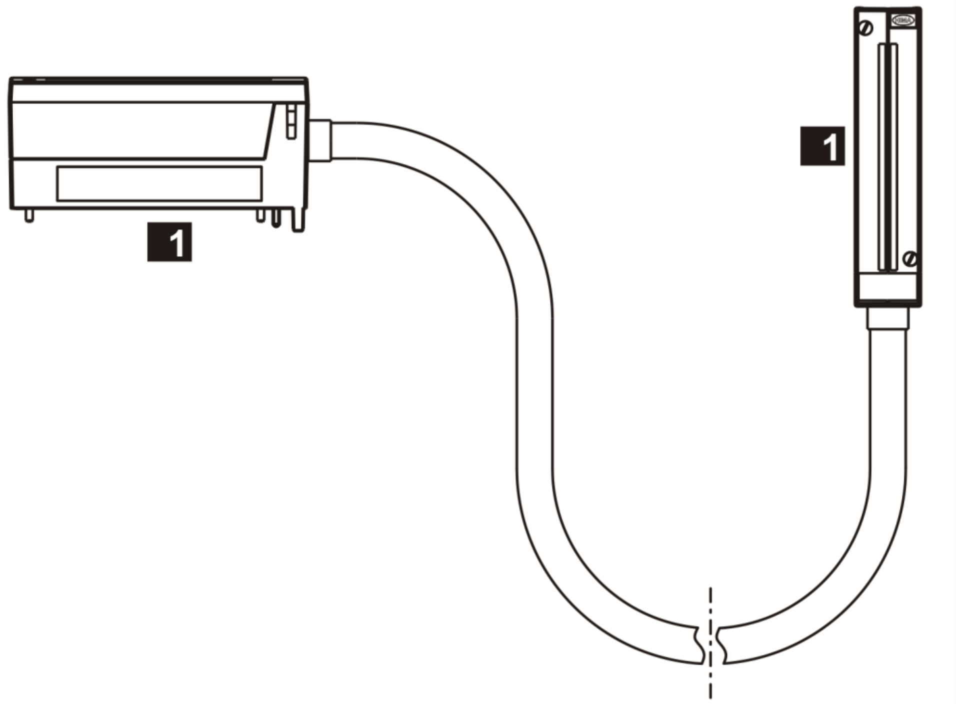
[1)] Additional orange ring if one lead marking color is repeated for the first time.

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

Table 15: Pin Assignment for the System Cable Plug

3.7 System cable

The system cables are used to wire the connector boards with the field zone via field termination assemblies or inline terminals.



1 Identical Cable Plugs

Figure 9: System Cable

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

3.7.1 System Cable X-CA 005

The X-CA 005 system cable is used to connect the X-CB 008 03/04 connector boards to the field zone via field termination assemblies or inline terminals.

General	
Cable	LIYCY-TP 38 x 2 x 0.25 mm²
Wire	Finely stranded
Average outer diameter (d)	approx. 16.8 mm max. 20 mm for all types of system cables
Minimum bending radius Fixed installation Flexible application	 5 x d 10 x d
Combustion behavior	Flame resistant and self-extinguishing in accordance with IEC 60332-1-2, -2-2
Length	5…30 m
Color coding	Based on DIN 47100, see Table 14.

Table 16: Cable Data X-CA 005

The system cable is available in the following standard length:

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 17: Available System Cables X-CA 005

3.7.2 System Cable X-CA 009

The X-CA 009 system cable is used to connect the X-CB 008 05 connector board to the field zone via field termination assemblies.

General	
Cable	LIYCY-TP 58 x 2 x 0.14 mm²
Wire	Finely stranded
Average outer diameter (d)	approx. 18.3 mm max. 20 mm for all types of system cables
Minimum bending radius Fixed installation Flexible application	 5 x d 10 x d
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 15.

Table 18: Cable Data X-CA 009

The system cable is available in the following standard length:

System cable	Description	Length
X-CA 009 01 8	Coded cable plugs on both sides	8 m
X-CA 009 01 15		15 m
X-CA 009 01 30		30 m

Table 19: Available System Cables X-CA 009

3.7.3 Cable Plug Coding

The cable plugs are equipped with three coding pins. Cable plugs only match connector boards and FTAs with the corresponding recesses, see Figure 7 and Figure 8.

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 sensors connected must comply with the safety requirements. For 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.
- The module and its connected components must be mounted to provide protection of at least IP20 in accordance with EN 60529: 1991 + A1: 2000.

NOTE

Damage due to incorrect wiring!

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

Observe the following points.

- Plugs and terminals connected to the field zone.
  - Take the appropriate earthing measures when connecting the plugs and terminals to the field zone.
  - Use shielded cables with twisted pairs.
  - Connect one twisted pair of the shielded cable to each of the measurement 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 transmitter supply is used, use the one assigned to the input, e.g., S1+ with AI1+.
- HIMA recommends using the transmitter supply of the module.
  Failure of an external supply or measurement unit can lead to overload and damage of the affected measurement input on the module.
  If an external supply is used for the given application, check the zero and final values following a non-transient overload!
- The inputs may be wired redundantly using the corresponding connector boards, see Chapter 3.6.

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 zone.

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.

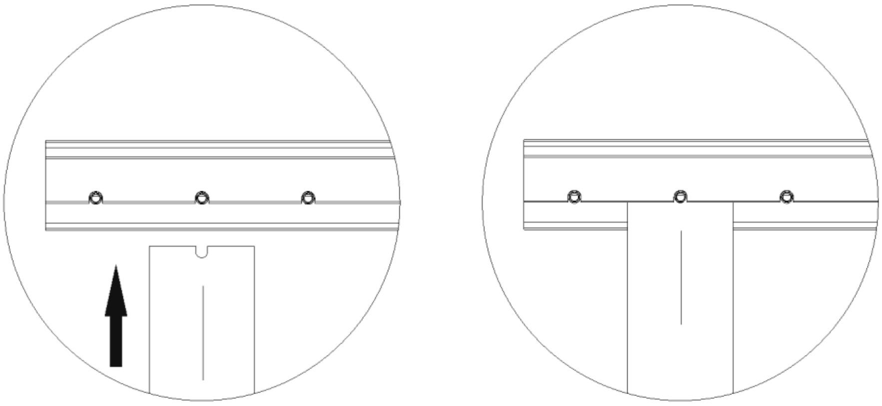


Figure 10: Example of how to Insert the Mono Connector Board

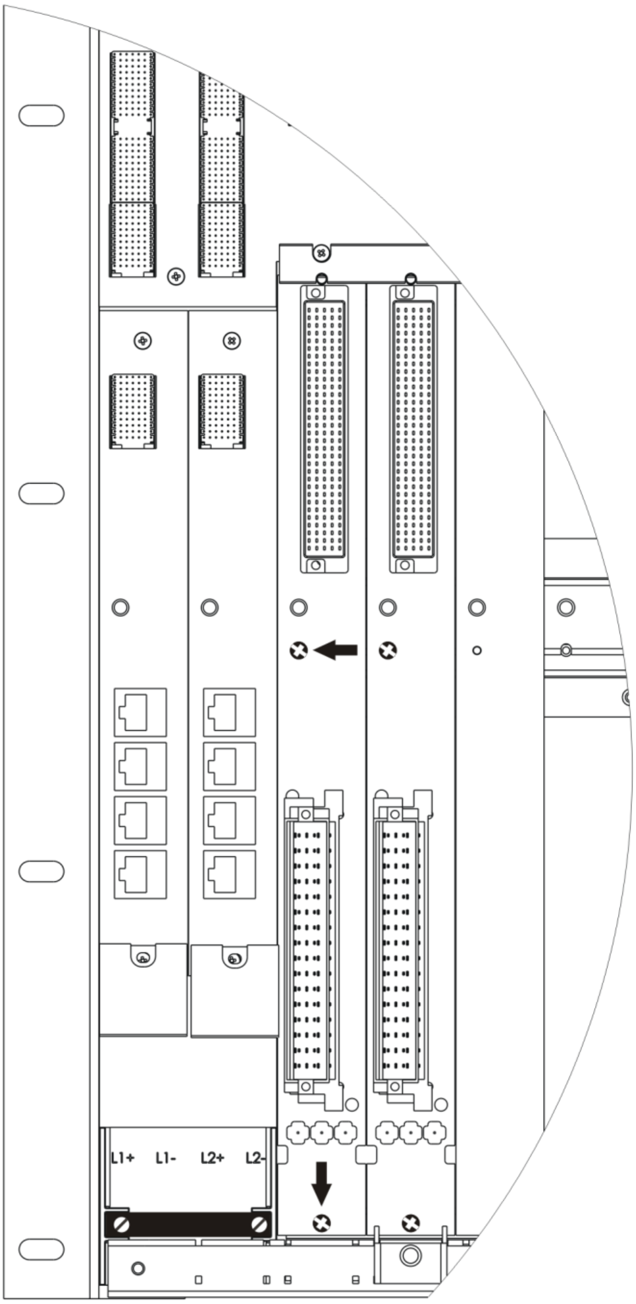


Figure 11: Example of how to Secure the Mono Connector Board with Captive Screws

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.

NOTE

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

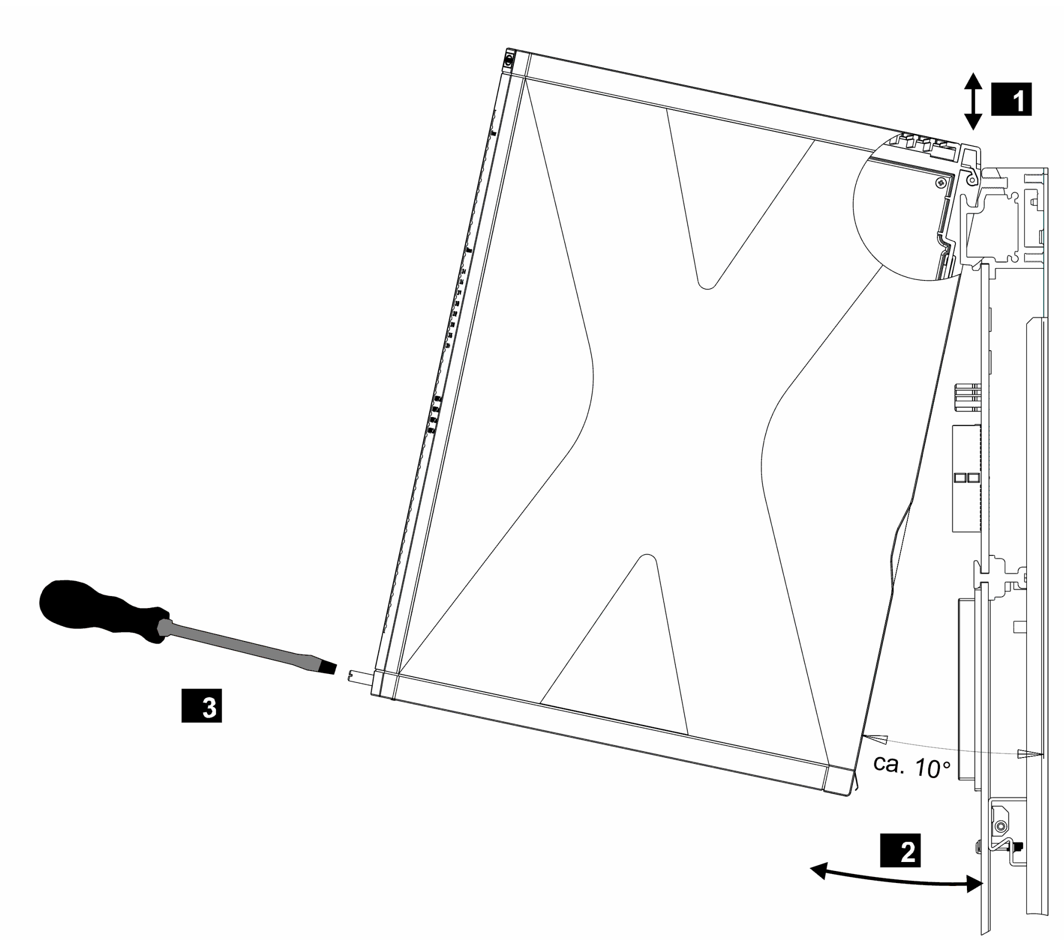
- Screwdriver, slotted 0.8 x 4.0 mm
- Screwdriver, slotted 1.2 x 8.0 mm

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 4.3.1.
- If the 0 value is within the valid measuring range, the user program must evaluate the -> *Channel OK* status in addition to the -> *raw value.* This and other diagnostic statuses (such as short-circuits and open-circuits) allow the user to diagnose the external wiring and configure fault reactions in the user program.
- For monitoring short-circuit and open-circuit, two thresholds are detected by the module. The switching thresholds are configurable through the configuration of the module in SILworX. By default, the limits are set to the OC/SC values specified in NAMUR, Recommendation NE 43.
- If the transmitter supply of the module is used (i.e., *Supply ON* parameter), the *Sup. used* parameter must also be activated for the corresponding channel. To diagnose the transmitter supply in use, the status -> *Supply OK* can be evaluated within the user program. For more information on these system parameters, see Table 21 and Table 22.
- 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 transmitter supply is monitored.

If a fault occurs in the transmitter supply, the module reports a channel fault and sets the process value to the initial value of the connected global variables.

To evaluate the statuses from within the user program, the 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 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:

<table>
<tr><th colspan="2">Name</th><th>R/W</th><th>Description</th></tr>
<tr><td colspan="4">Enter these statuses and parameters directly in the Hardware Editor.</td></tr>
<tr><td colspan="2">Name</td><td>W</td><td>Module name</td></tr>
<tr><td colspan="2">Spare Module</td><td>W</td><td>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!</td></tr>
<tr><td colspan="2">Noise Blanking</td><td>W</td><td>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.</td></tr>
<tr><th>Name</th><th>Data type</th><th>R/W</th><th>Description</th></tr>
<tr><td colspan="4">The following statuses and parameters can be assigned global variables and used in the user program.</td></tr>
<tr><td>Module OK</td><td>BOOL</td><td>R</td><td>TRUE:
Mono operation: No module faults.
Redundant operation: At least one of the redundant modules is faultless (OR logic).

FALSE:
Module fault
Channel fault (no external faults)
The module is not plugged in.

Observe the Module Status parameter!</td></tr>
<tr><td>Module Status</td><td>DWORD</td><td>R</td><td>Status of the module
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x00000001</td><td>Module fault 1)</td></tr>
<tr><td>0x00000002</td><td>Temperature threshold 1 exceeded</td></tr>
<tr><td>0x00000004</td><td>Temperature threshold 2 exceeded</td></tr>
<tr><td>0x00000008</td><td>Incorrect temperature value</td></tr>
<tr><td>0x00000010</td><td>Voltage on L1+ is defective</td></tr>
<tr><td>0x00000020</td><td>Voltage on L2+ is defective</td></tr>
<tr><td>x000000040</td><td>Internal voltage is defective</td></tr>
<tr><td>0x80000000</td><td>No connection to the module 1)</td></tr>
<tr><td colspan="2">1) These faults affect the Module OK status and need not be separately evaluated in the user program.</td></tr>
</table></td></tr>
<tr><td>Timestamp [µs]</td><td>DWORD</td><td>R</td><td>Microsecond fraction of the timestamp.
Point in time at which the analog inputs were measured.</td></tr>
<tr><td>Timestamp [s]</td><td>DWORD</td><td>R</td><td>Second fraction of the timestamp.
Point in time at which the analog inputs were measured.</td></tr>
</table>

Table 20: Module Tab in the Hardware Editor

4.3.2 Tab I/O Submodule AI32_01

The **I/O Submodule AI32 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
Supply ON		W	Use the transmitter supplies of the module. Activated: Transmitter supplies for channels 1...32 activated. Deactivated: Transmitter supplies for channels 1...32 deactivated. Default setting: Activated
Show Signal Overflow		W	The *Field* LED displays a potential signal overflow. Activated: Show signal overflow activated. Deactivated: Show signal overflow deactivated Default setting: Activated
Show Supply Overcurrent		W	Show supply overcurrent with *Field* LED. Activated: Show supply overcurrent activated. Deactivated: Show supply overcurrent deactivated. Default setting: Activated
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 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
Submodule OK	BOOL	R	TRUE: No submodule fault. No channel faults. FALSE: Submodule fault. Channel fault (external faults included)
Submodule Status	DWORD	R	Bit-coded submodule status (For coding details, see Chapter 4.3.4)

Table 21: Tab: I/O Submodule AI32_01 in the Hardware Editor

4.3.3 Tab I/O Submodule AI32_01: Channels

The **I/O Submodule AI32_01:Channels** tab contains the following parameters and statuses for each analog 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, preset and not changeable
-> Process Value [REAL]	REAL	R	Process value determined using the intermediate data points 4 mA and 20 mA.
4 mA	REAL	W	Intermediate data point used to calculate the process value on the lowest scale final value (4 mA) of the channel. Default setting: 4.0
20 mA	REAL	W	Intermediate data point used to calculate the process value on the highest scale final value (20 mA) of the channel. Default setting: 20.0
-> Raw Value [DINT]	DINT	R	Unprocessed measured value of the channel: 0...200 000 (0...20 mA). If the raw value is evaluated instead of the process value, the user must program the monitoring function and the value in the event of faults from within the user program.
-> Channel OK	BOOL	R	TRUE: Faultless channel The input value is valid FALSE: Faulty channel The input value is set to 0.
Sup. used	BOOL	W	Activated: If a fault occurs in the transmitter supply, the module reports a channel fault and sets the input value to 0. Deactivated: If a fault occurs in the transmitter supply, the module reports no channel fault and the input value is not defined. Default setting: Activated
-> Sup. OK	BOOL	R	TRUE: No faults in the transmitter supply. FALSE: The transmitter supply is faulty.
OC Limit	DINT	W	Threshold in mA for detecting an open-circuit If the analog measured value falls under *OC Limit*, the module detects an open-circuit and switches off the *Channel* LED for this channel. Default setting: 36 000 (3.6 mA)
-> OC	BOOL	R	TRUE: One open-circuit present FALSE: No open-circuit present Defined through *OC Limit*
SC Limit	DINT	W	Threshold in mA for detecting a short-circuit If the measured analog value exceeds *SC Limit*, the module detects a short-circuit and sets the *Channel* LED for this channel to Blinking2. Default setting: 213 000 (21,.3 mA)
-> SC	BOOL	R	TRUE: One short-circuit present FALSE: No short-circuit present Defined through *SC Limit*
SP LOW	DINT	W	Upper limit of LOW level *SP LOW* (switching point LOW) is the limit value: if this limit is exceeded, the module detects a LOW and switches the *Channel* LED off. Restriction: *SP LOW* ≤ *SP HIGH* Default setting: 39 500 (3,95 mA)

Name	Data type	R/W	Description
SP HIGH	DINT	W	Lower limit of high level *SP HIGH* (switching point HIGH) is the limit value: if this limit is exceeded, the module detects a HIGH and switches the *Channel* LED on. Restriction: *SP LOW* ≤ *SP HIGH* Default setting: 40 500 (4,05 mA)
-> Channel Value [BOOL]	[BOOL]	R	Boolean channel value in accordance with the limits *SP LOW* and *SP HIGH*.
T on [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 signal change is not detected until the delay time has expired. Range of values: 0…(2^{32} - 1) Default setting: 0
T off [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 signal change is not detected until the delay time has expired. Range of values: 0…(2^{32} - 1) Default setting: 0
-> State LL	BOOL	R	TRUE: Value associated with the LL event state FALSE: Value out of the range associated with the LL event state
-> State L	BOOL	R	TRUE: Value associated with the L event state FALSE: Value out of the range associated with the L event state
-> State N	BOOL	R	TRUE: Value associated with the N (normal) event state FALSE: Value out of the range associated with the N (normal) event state
-> State H	BOOL	R	TRUE: Value associated with the H event state FALSE: Value out of the range associated with the H event state
-> State HH	BOOL	R	TRUE: Value associated with the HH event state FALSE: Value out of the range associated with the HH event state
redund.	BOOL	W	Requirement: The redundant module must be configured. Activated: Activate the channel redundancy for this channel Deactivated: Deactivate the channel redundancy for this channel Default setting: Deactivated
Redundancy value	BYTE	W	Setting for determining the redundancy value. ▪ Min ▪ Max ▪ Average Default setting: Max **It is only displayed in the redundancy group tab!**

Table 22: Tab I/O Submodule CI32_01:Channels in the Hardware Editor

4.3.4 Submodule Status [DWORD]

Coding of the **Submodule Status**

Coding	Description
0x00000001	Fault in hardware unit (submodule).
0x00000002	Reset of an E/A bus
0x00000004	Fault detected while configuring the hardware
0x00000008	Fault detected while verifying the coefficients
0x10000000	Fault during AD conversion (conversion end)
0x20000000	Faulty operating voltages
0x40000000	Fault during AD conversion (conversion begin)
0x80000000	Test function transmitter monitoring overvoltage

Table 23: Submodule Status [DWORD]

4.3.5 Diagnostic Status [DWORD]

Coding of **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</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 undervoltage (BOOL)</td></tr>
<tr><td>1001...1032</td><td>Status of the channels 1...32
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x0001</td><td>Hardware unit fault (submodule) occurred.</td></tr>
<tr><td>0x0002</td><td>Reset of an E/A bus</td></tr>
<tr><td>0x0400</td><td>SC / OC limits exceeded or
channel/module fault</td></tr>
<tr><td>0x0800</td><td>Measured values invalid (potential failure in the measurement system)</td></tr>
<tr><td>0x1000</td><td>Measured values out of the safety-related accuracy</td></tr>
<tr><td>0x2000</td><td>Underflow/overflow of the measured value</td></tr>
<tr><td>0x4000</td><td>Channel not configured</td></tr>
<tr><td>0x8000</td><td>Independent measurements of both measurement system malfunctioning</td></tr>
</table></td></tr>
<tr><td>2001...2032</td><td>Fault status of the power sources 1...32
<table>
<tr><th>Coding</th><th>Description</th></tr>
<tr><td>0x1000</td><td>Undervoltage of transmitter monitoring</td></tr>
<tr><td>0x2000</td><td>Undervoltage of > 12 transmitter supplies</td></tr>
<tr><td>0x4000</td><td>Undervoltage of transmitter supply.</td></tr>
<tr><td>0x8000</td><td>Overvoltage of transmitter supply.</td></tr>
</table></td></tr>
</table>

Table 24: Diagnostic Status [DWORD]

4.4 Connection Variants

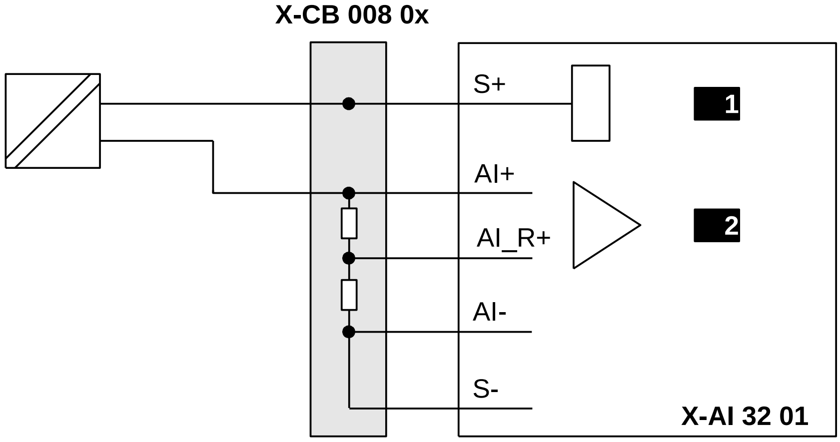
This chapter describes the correct wiring of the module in safety-related applications. The connection variants specified here are permitted.

4.4.1 Input Wiring

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

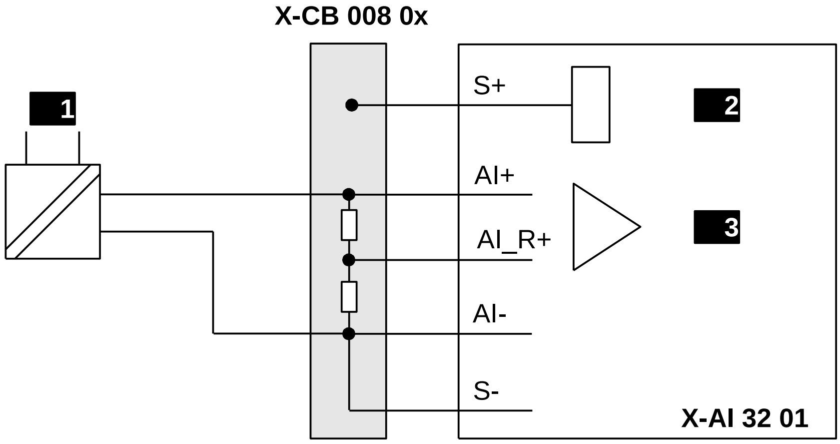
The transmitter supplies are decoupled using diodes. This ensures that the transmitter supplies of two modules can supply one transmitter if the modules are redundant to one another.

Connector boards X-CB 008 01 (with screw terminals) or X-CB 008 03 (with cable plug) can be used to perform the wiring such as described in Figure 13 and Figure 14.



1 Transmitter Supply **2** Analog Input

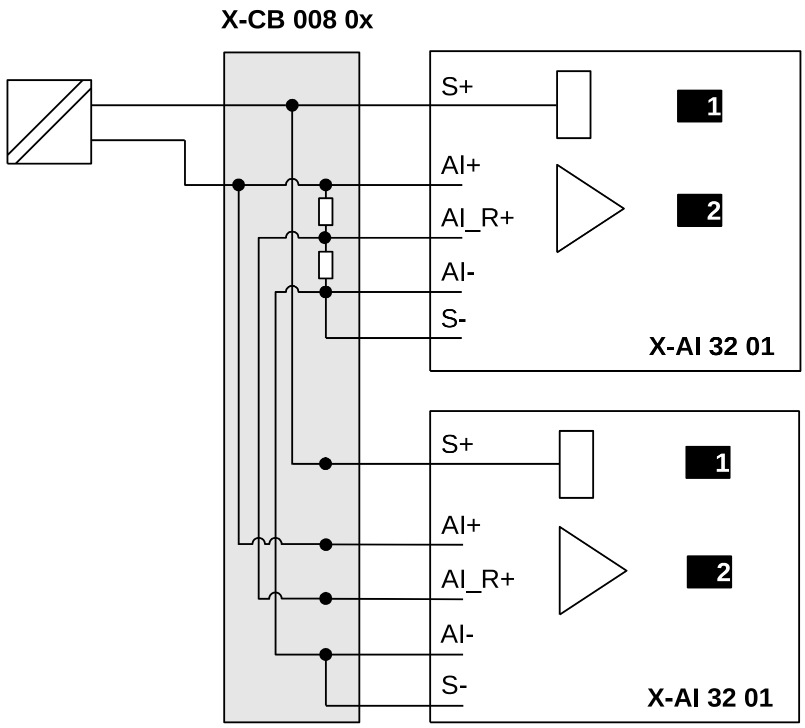
Figure 13: Single-Channel Connection of a Passive Two-Wire Transmitter



1 External Transmitter Supply **3** Analog Input
2 Transmitter Supply

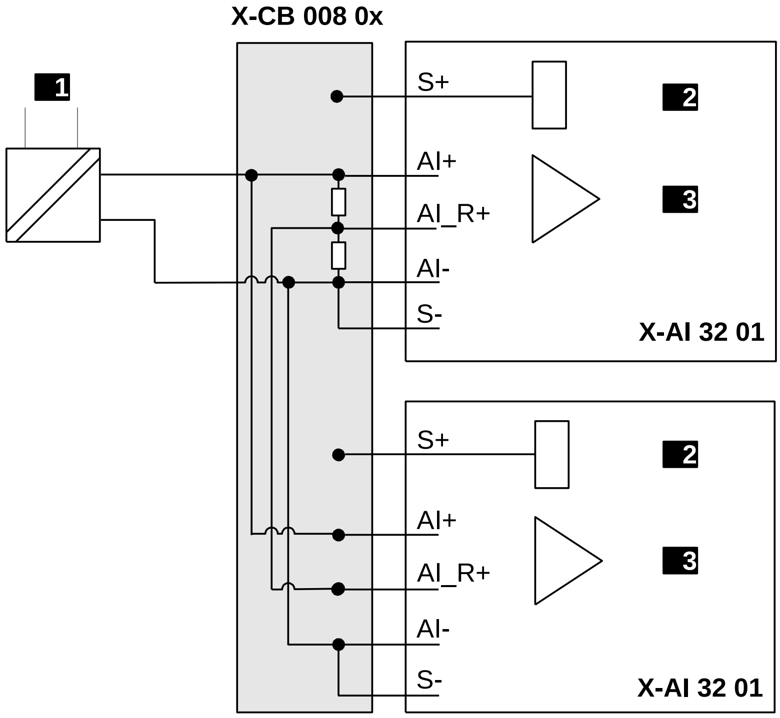
Figure 14: Single-Channel Connection of an Active Two-Wire Transmitter

When redundantly wired as specified in Figure 15 and Figure 16, the modules are inserted in the base plate next to each other and on a common connector board. Connector boards X-CB 008 02 (with screw terminals) or X-CB 008 04 (with cable plug) can be used.



1 Transmitter Supply **2** Analog Input

Figure 15: Redundant Connection of a Passive Two-Wire Transmitter

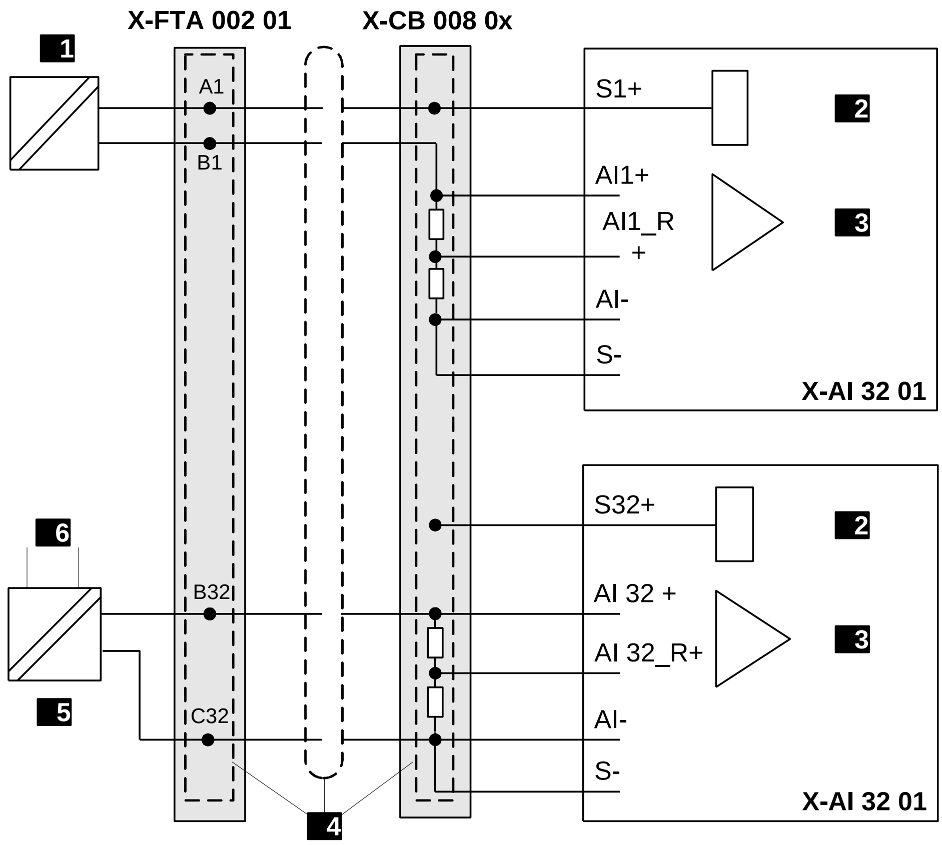


1 External Transmitter Supply
2 Transmitter Supply
3 Analog Input

Figure 16: Redundant Connection of an Active Two-Wire Transmitter

4.4.2 Wiring Transmitters via Field Termination Assembly

Passive and active two-wire transmitters are connected via the X-FTA 002 01 as described in Figure Figure 17:. For further information, refer to the X-FTA 002 01 Manual (HI 801 117 E).

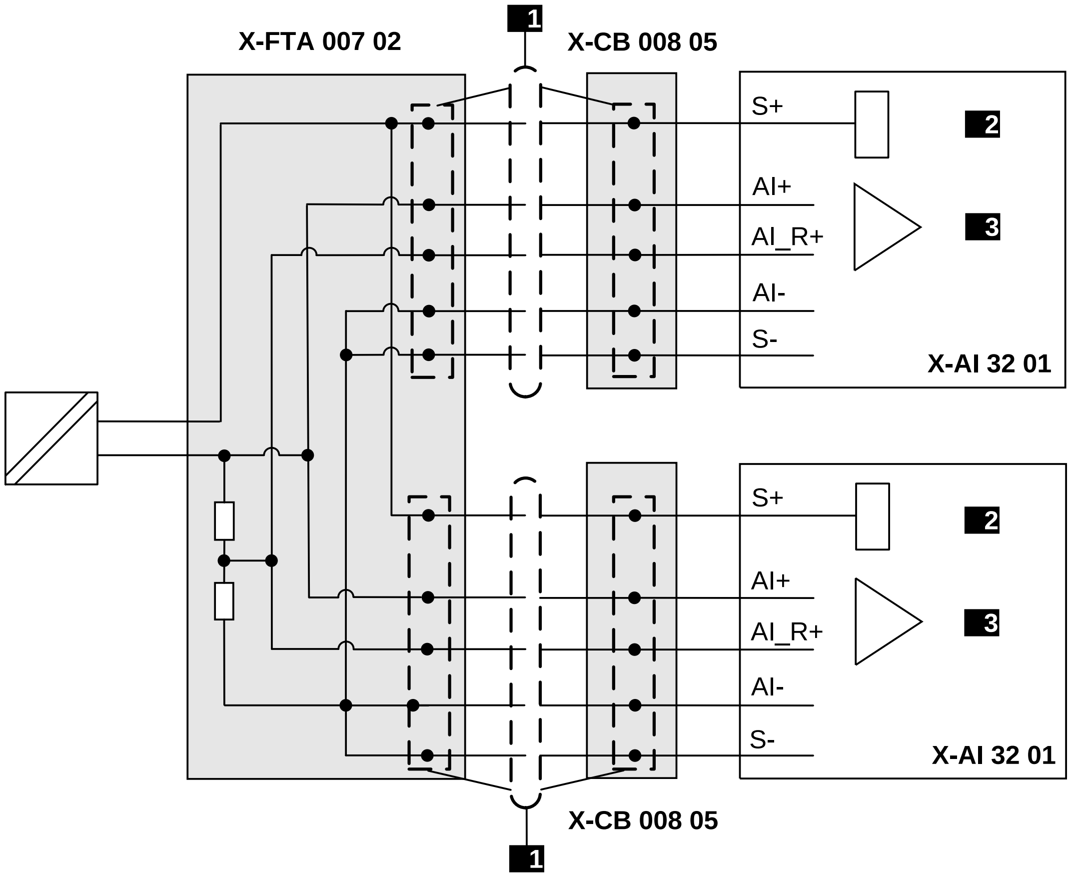


1 Passive Two-Wire Transmitter
2 Transmitter Supply
3 Analog Input
4 System Cable with Cable Plug
5 Active Two-Wire Transmitter
6 External Transmitter Supply

Figure 17: Connection via Field Termination Assembly

4.4.3 Redundant Connection via Two Base Plates

The figure shows the connection of one transmitter if the redundant modules inserted in different base plates or are not located in the base plate adjacently. The instrument shunts are placed on the field termination assembly.



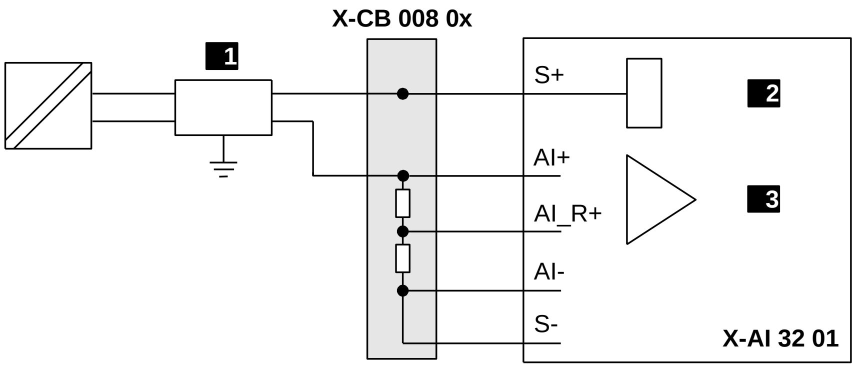
1 System Cable X-CA 009 01 n **3** Analog Input

2 Transmitter Supply

Figure 18: Redundant Connection via Two Base Plates

4.4.4 Ex-Protection with Zener Barriers

Zener barriers can be used for EX-protection, e.g., barriers of MTL, Type 7787+ or Pepperl+Fuchs, Type Z787.

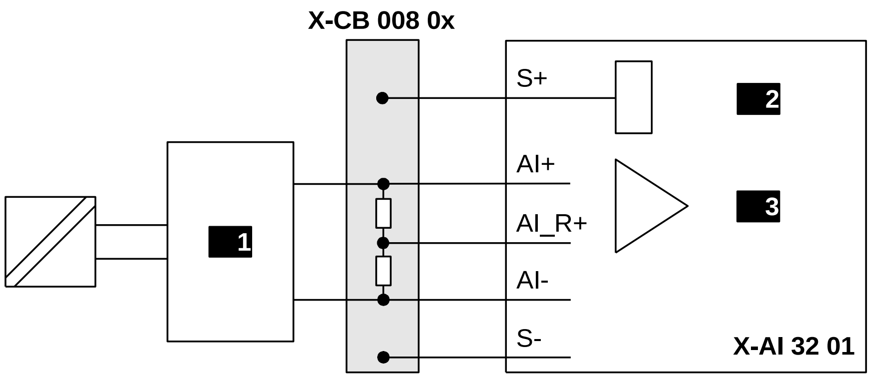


1 Barriers
2 Transmitter Supply
3 Analog Input

Figure 19: Single-Channel Transmitter Connection with Barrier

4.4.5 EX-Protection with Repeater Power Supply

Analog power supply isolators such as the H 6200A from HIMA can be implemented for EX-protection. The module's transmitter supply is not used when a power supply isolator is wired.



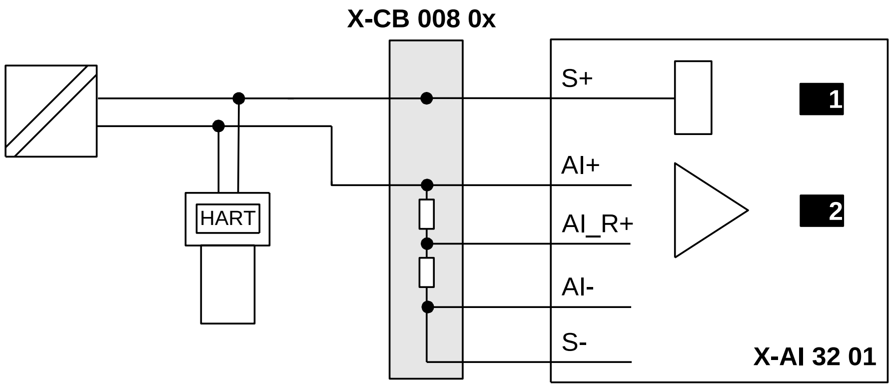
1 Analog Repeater Power Supply
2 Transmitter Supply
3 Analog Input

Figure 20: Single-Channel Wiring of One Analog Power Supply Isolator

4.4.6 Characteristics of HART Communication

To ensure HART communication, a HART handheld can be connected in parallel to the transmitter. The current fluctuation caused by the HART communications is removed using filters on the analog input so that the residual error of the analog measurement is 1%.

i Higher residual error with HART communication. Remove the HART terminal directly after the diagnosis!



1 Transmitter Supply
2 Analog Input

Figure 21: HART Handheld in Parallel to the Transmitter and Input Module