Operating instructions

IO-Link input/output module

AL2350

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1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Legal and copyright information

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1.2 Symbols used

✓	Requirement
▶	Instruction
▷	Reaction, result
bold	Designation of keys, buttons or indications
	Cross-reference without link
	Cross-reference with link
	Important note Non-compliance may result in malfunction or interference
	Information Supplementary note

1.3 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:

WARNING

Warning of serious personal injury

▷ If the warning is not observed, fatal and serious injuries are possible.

CAUTION

Warning of minor to moderate personal injury

▷ If the warning is not observed, minor to moderate injuries are possible.

ATTENTION

Warning of damage to property

▷ If the warning is not observed, damage to property is possible.

2 Safety instructions

- The unit described is a subcomponent for integration into a system.
  - The system architect is responsible for the safety of the system.
  - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.

2.1 Cybersecurity

Installation

The device is suitable for operation in a secure environment according to IEC 62443-1-1.

The device was designed for operation behind a firewall.

▶ Carry out a risk assessment of the system according to IEC 62443-1-1.

▶ Take measures to ensure physical security.

Operation

▶ Observe the security functions described in the product documentation and the recommendations for their use.

Maintenance

▶ Regularly check whether software updates are available for the device.

▶ Back up system configuration and system data in accordance with your company's change management processes.

Decommissioning

▶ Ensure that no sensitive information can fall into unauthorised hands.

▶ Always reset the system settings to the factory settings before decommissioning the device.

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3 Transport, handling and storage

- Store the device in its original packaging.
- When the device is to be stored again, use the original packaging.
- Otherwise, provide unused connections with either a mating connector or a protective cap and pack the device in suitable packaging.
- Observe the permissible ambient conditions for the device during storage (→ Technical data).

4 Intended use

The device has 4 ports that can be used as follows:

- Analogue input
  - 4...20 mA
  - 0...10 V
- Analogue output
  - 4...20 mA
  - 0...10 V

The device must not be used in the food and beverage industry (use of cleaning agents under high pressure and at high temperatures).

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5 Function

5.1 IO-Link

IO-Link is a communication system for connecting intelligent sensors and actuators to automation systems. IO-Link is standardised in the IEC 61131-9 standard.

General information on IO-Link at io-link.ifm

Input Output Device Description (IODD) with all parameters, process data and detailed descriptions of the device at documentation.ifm.com

IO-Link offers the following advantages:

- Interference-free transmission of all data and process values
- Parameter setting in the running process or presetting outside the application
- Parameters for identifying the connected devices in the system
- Additional parameters and diagnostic functions
- Automatic backup and restore of parameter sets in case of device replacement (data storage)
- Logging of parameter sets, process values and events
- Device description file (IODD - Input Output Device Description) for easy project planning
- Standardised electrical connection
- Remote maintenance

5.1.1 IO-Link connection

The current required by the devices depends on the current load of the sensor supplies.

The IO-Link port must be connected according to the IO-Link specification.

Maximum cable length:

▷ With IO-Link communication: 20 m on the master side

5.1.2 Response when the IO-Link communication is interrupted

The parameter **Output state COM lost** (index 15000) is used to set how the outputs are to respond when the IO-Link communication is interrupted. For every output it can be defined separately if it:

- 0: **OFF** should be switched off (the analogue output is set to the minimum value (0 V or 4 mA))
- 1: **ON** should be switched on (the analogue output is set to the maximum value (10 V or 20 mA))
- 2: **KEEP LAST** is to keep the last state

This function requires a previously active communication. If communication has not been active up to this point, all outputs are set to **OFF**, and the parameter **Output state COM lost** (index 15000) is not applied.

5.2 Voltage supply

5.2.1 Supply voltage US

The supply voltage US supplies the device and the IO-Link interface.
It must be in a range of 18...30 V DC.

US also supplies the outputs and the sensors. There is a common monitoring of the current / switching-off in case of excessive current. Switching off US also switches off the power supply for the outputs and for the sensors and interrupts the IO-Link communication. The device has no additional port to supply the outputs and sensors.

5.2.2 Behaviour in case of undervoltage

If the supply voltage (US) falls below 16 V, all outputs switch off.

5.2.3 Limit values, protection against excessive current

	AL2250
Total current consumption at maximum load	< 700 mA
Sensor supply (pin 1)	400 mA
Overcurrent protection (pin 1)	> 510 mA ± 15 %
Current limitation per analogue output (pin 4, 4…20 mA operation)	23 mA
Current limitation per analogue output (pin 4, 0…10 V operation, supplying current and drawing current)	± 30 mA ± 25 %

The sensor supply at pin 1 is limited to 400 mA for all ports combined. If this value is exceeded, the device activates an electronic protection function when the current exceeds > 510 mA ± 15 %. The power supply will be briefly switched off and will automatically be switched back on as soon as the current is within the permissible range again.

The device's maximum total current consumption is less than 700 mA when all analogue outputs are delivering their maximum output current and a load is connected to the sensor supply at the same time.

Overloads of the sensor supply have no influence on the function of the analogue inputs and outputs. The analogue outputs (pin 4) are technically limited to 23 mA per pin in 4...20 mA operation. In 0...10 V operation, the current limitation is ±30 mA ±25 % per pin (supplying current and drawing current). Values outside the specified range may result in functional deviations or diagnostic messages.

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5.3 Inputs / outputs

The device has 4 ports (X1...X4).

Each port has a configurable analogue input (pin 2) and a configurable analogue output (pin 4).

The analogue function of the pins is determined by the respective pin mode.

Analogue functions of ports X1…X4

Pin	Mode	Description	Measuring / output range	Notes / Connection
2	00	Pin deactivated	-	No function
	02	4...20 mA analogue input	Nominal range: 4...20 mA Permissible range: 3.8...23 mA	• Support for 2-wire and 3-wire sensors with 4...20 mA output. • For 2-wire sensors: Connection of the sensor to AI and L+. • For 3-wire sensors: Connection of the sensor to L+, L- and AI. • 2-wire sensors with a minimum load of >275Ω are not supported. • The specified accuracy is not guaranteed for values outside the nominal range.
	04	0...10 V analogue input	Nominal range: 0…10 V Permissible range: 0…11 V	• Support for 3-wire sensors with 0...10 V output. • Connection of the sensor to L+, L- and AI. • The specified accuracy is not guaranteed for values outside the nominal range.
4	00	Pin deactivated	-	No function
	02	4...20 mA analogue output	Nominal range: 4...20 mA Available range: 0...23 mA	• Output of the analogue signal via AO and L–. • L+ connection optional. Due to the common current limitation on all L+ pins, this connection must not be used to supply actuators.
	04	0...10 V analogue output	Nominal range: 0…10 V Available range: 0…11 V	• Output of the analogue signal via AO and L–. • L+ connection optional. Due to the common current limitation on all L+ pins, this connection must not be used to supply actuators.

Analogue inputs

The device has 4 analogue inputs (PNP). Each analogue input can be configured as a 4...20 mA or 0...10 V input via IO-Link parameter setting.

Display of the analogue input (AI) in **PDIn**

Voltage:

If U ≤ 11.0 V, the corresponding AI is displayed in **PDIn** with the measured voltage value U.

If U > 11.1 V, the corresponding AI in **PDIn** is replaced by the value 32760 (OL).

Current:

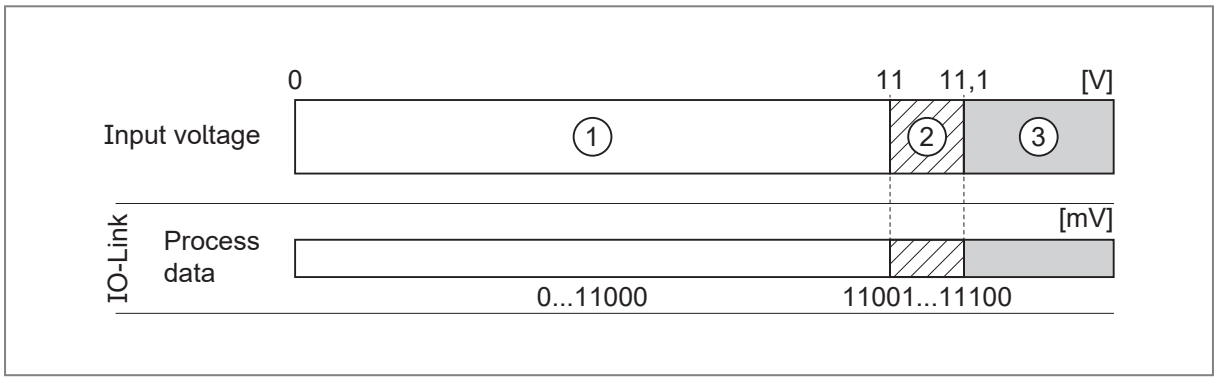
If 3.8 mA ≤ I ≤ 23.0 mA, the corresponding AI is displayed in **PDIn** with the measured current value I.

If I < 3.6 mA, the corresponding AI in **PDIn** is replaced by the value -32760 (UL).

If I > 23.1 mA, the corresponding AI in **PDIn** is replaced by the value 32760 (OL)

U is the measured voltage value.

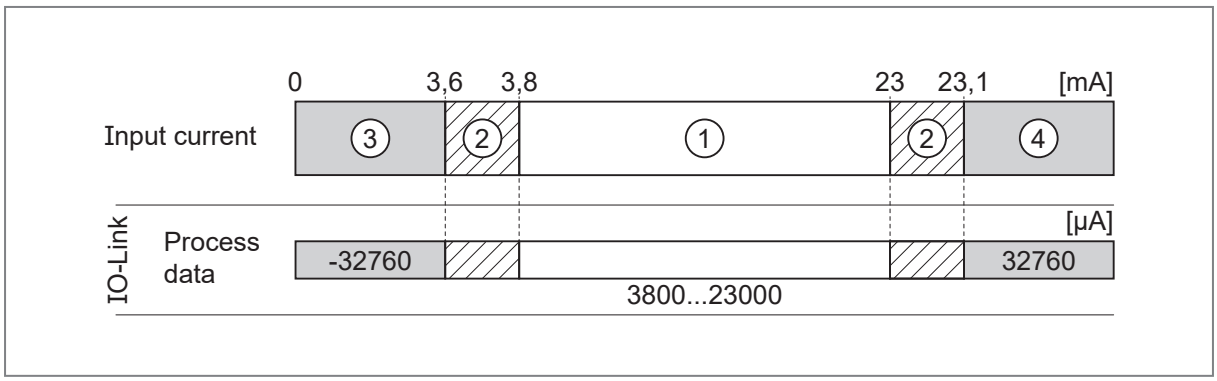
I is the measured current value



1: If U ≤ 11.0 V, the analogue value in **PDIn** is displayed as **U**.

2: Hysteresis (11…11.1 V)

3: If U > 11.1 V, the analogue value in **PDIn** is replaced by 32760 (OL).



1: If 3.8 mA ≤ I ≤ 23.0 mA, the value I is displayed in the analogue value in **PDIn**.

2: Hysteresis (23...23.1 mA or 3.6...3.8 mA)

3: If I < 3.6 mA, the value -32760 (UL) is displayed in the analogue value in **PDIn**.

4: If I > 23.1 mA, the value 32760 (OL) is displayed in the analogue value in **PDIn**.

Analogue outputs

The device has 4 analogue outputs (pin 4). Each analogue output can be configured as 4...20 mA or 0...10 V output via IO-Link parameter setting.

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Display of the analogue output (AO) via **PDOut**

Voltage:

Voltage range adjustable via **PDOut**: 0…11 V

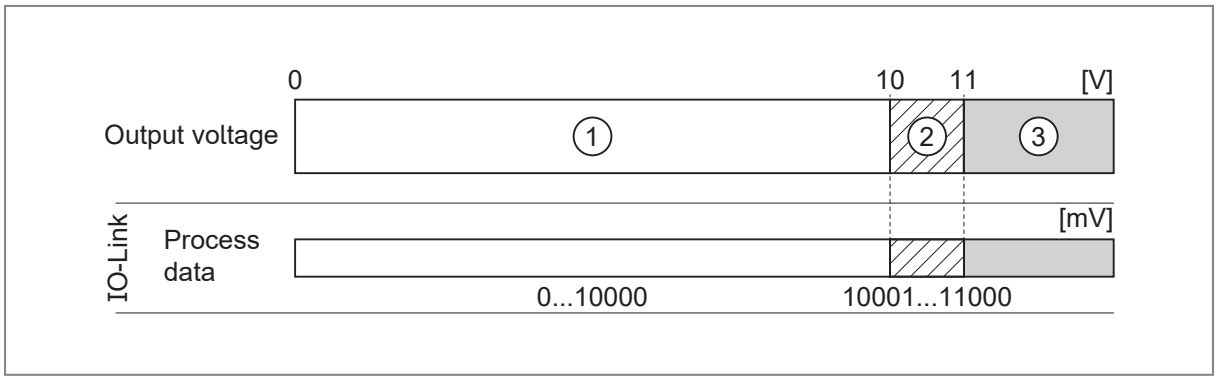
Specified accuracy range: 0…10 V

Current:

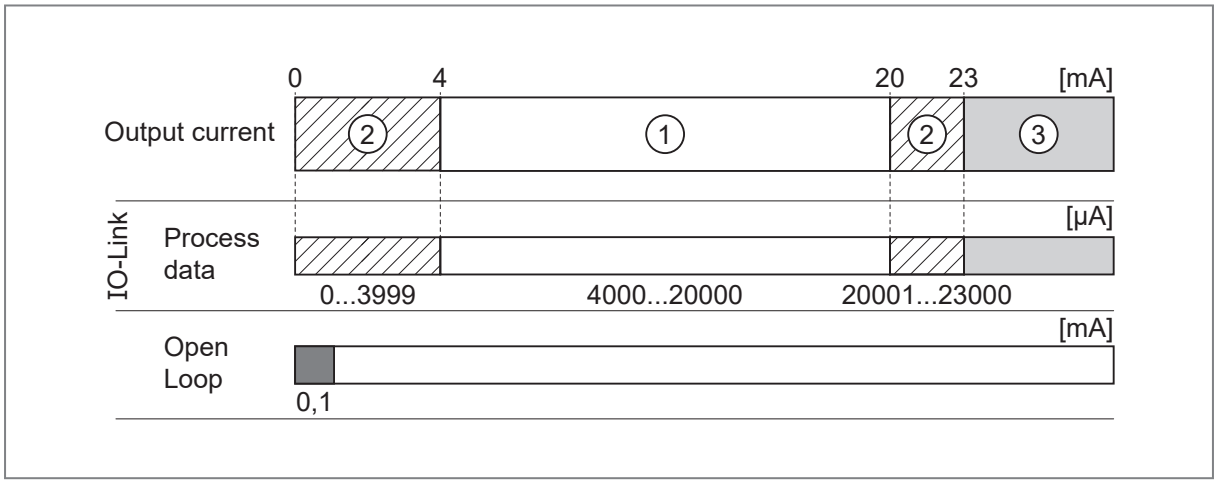
Current range adjustable via **PDOut**: 0...23 mA

Specified accuracy range: 4...20 mA

It is possible to set values outside the defined accuracy ranges. However, no guarantee of accuracy is given for these values. They can, for example, be used for signalling a system fault (e.g. 11 V or 23 mA).



1: Analogue value in the standard range: 0…10 V 2: Analogue value in the range: 10…11 V
3: Last valid analogue value



1: Analogue value in the standard range: 4...20 mA 2: Analogue value in the range: 0...4 mA, 20...23 mA
3: Last valid analogue value

Detection of an interrupted circuit if > 0.1 mA / IO-Link event: **0x8CA5**

5.3.1 Analogue input filters

Each analogue input has an internal filter that averages the measured value over an adjustable time span.

The filter time is set via the IO-Link parameter **Timespan average calculation** (index 15104) and can be adjusted in 10 ms steps within the range of 10 ms to 1000 ms.

The filter calculates the arithmetic mean value of all the measured values recorded within the set time span. The filtered value is then made available in the process data channel. The filter reduces measurement noise and stabilises the input values in applications with fluctuating signals or signals prone to interference.

The set filter time has a direct effect on the update rate of the process data value.

5.4 iSC functionality

The iSC functionality can be used in the following pin modes and on the following pins:

- Pin mode 2; pin 2 of all ports (analogue input 4...20 mA)
- Pin mode 4; pin 2 of all ports (analogue input 0...10 V)

The functionality is identical to that of the Smart Sensor Profile (SSP).
The only difference is in the parameters used.

5.4.1 Function diagrams

The device provides digital switching signals via switching channels (iSC = ifm Signal Channel).

The device has 8 digital switching channels, iSC1.1 to iSC4.2, which can be used to output the process value.

Explanation of the numbering of the switching channels iSCx.y:
x = port number; y = switching channel

The switching signal channels can only be evaluated via the IO-Link interface.

The parameters for each switching signal channel can be set individually.

During parameter setting, the switch points, mode and logic of the switching signal channels are set.

Mode

You can choose between the following modes:

- **Deactivated**
- **Single Point Mode**
- **Two Point Mode**
- **Window Mode**

The switching channel changes to the active state depending on the process data value (PDV).

The active state is above the switch point in **Single Point Mode** and **Two Point Mode** and within the window section in **Window Mode**.

Logic

By setting the logic **High active** or **Low active**, you can specify which value the switching signal channel has in the active state:

- **High active**: The switching signal channel is “high” in the active state (= ON = normally open = 1)
- **Low active**: The switching signal channel is “low” in the active state (= OFF = normally closed = 0)

The following figures show the status of the switching signal channels depending on the mode, logic and process data value (PDV).

Deactivated

If the **Deactivated** mode is set for a switching signal channel, the switching signal channel will permanently have the following value regardless of the process value:

- For logic **High active**: permanently “low”.
- For logic **Low active**: permanently “high”.

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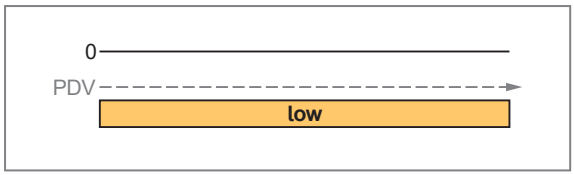

Fig. 1: **Deactivated** / **High active**

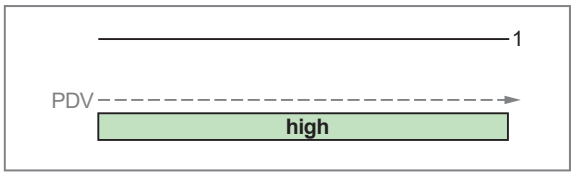

Fig. 2: **Deactivated** / **Low active**

Single point mode

Only one switch point **SP1** is manually set.

The reset point **SP1**-**H** results from the switch point and the set hysteresis.

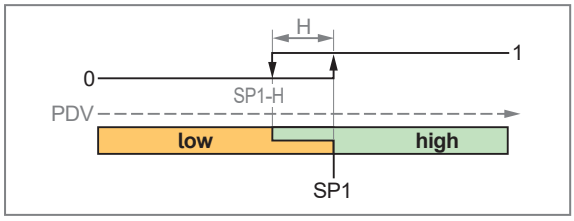

Fig. 3: **Single Point Mode** / **High active**

H: Hysteresis
SP1: Setpoint
SP1-H Reset point

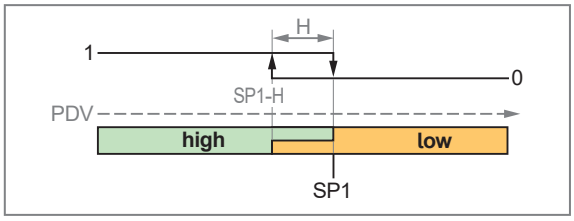

Fig. 4: **Single Point Mode** / **Low active**

H: Hysteresis
SP1: Setpoint
SP1-H Reset point

Two point mode

A switch point **SP1** and a switch point **SP2** are manually set.

SP1 must be greater than **SP2**. Thus, switch point 2 is always the reset point.

The hysteresis will be ignored in Two Point Mode.

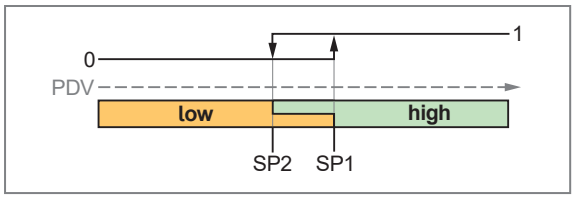

Fig. 5: **Two Point Mode** / **High active**

SP1: Switch point 1
SP2: Switch point 2

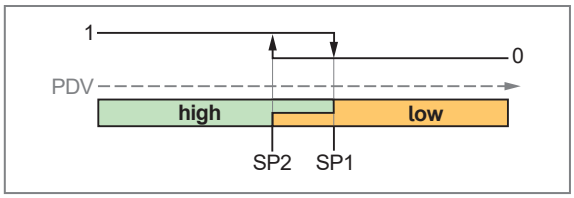

Fig. 6: **Two Point Mode** / **Low active**

SP1: Switch point 1
SP2: Switch point 2

Window mode

Two switch points **SP1** and **SP2** are manually set.

The two switch points define a window area.

SP1 must be greater than **SP2**. Thus, switch point 2 is always the reset point.

When the process data value enters the window area, the status of the switching signal channel changes when the switch points are exceeded/not reached.

When the process data value leaves the window area, the status of the switching signal channel changes when the switch point plus/minus the hysteresis is exceeded/not reached.

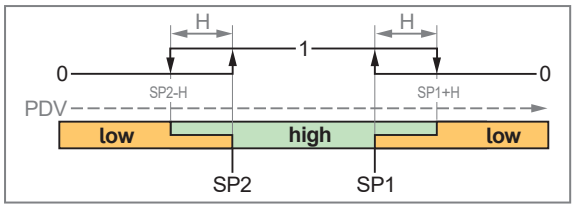

Fig. 7: **Window Mode** / **High active**

H: Hysteresis
SP1: Switch point 1
SP2: Switch point 2

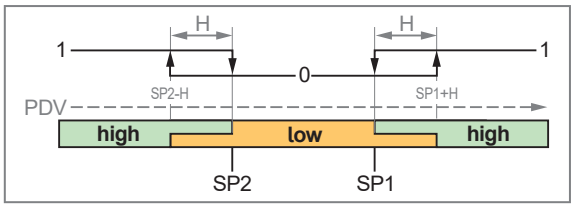

Fig. 8: **Window Mode** / **Low active**

H: Hysteresis
SP1: Switch point 1
SP2: Switch point 2

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6 Installation

- Disconnect the power of the machine before installation.

- For installation choose a flat mounting surface.

- Fasten the module onto the mounting surface using M5 mounting screws and washers. Tightening torque 1.8 Nm.

7 Electrical connection

The unit must be connected by a qualified electrician.
Observe the national and international regulations for the installation of electrical equipment.
Voltage supply according to SELV, PELV.

- ▶ Disconnect power.
- ▶ Connect the plugs of the sensors to the M12 sockets.
  Tightening torque max. 1 Nm.
- ▶ During installation, place the connectors vertically so that the coupling nut will not damage the thread.
- ▶ Provide all outgoing cables with a suitable strain relief. Observe the minimum bending radius of the cables (information from the cable manufacturer).
- ▶ Ensure correct fit and proper assembly of the M12 connection parts.
- ▶ Cover the unused sockets with protective caps (E12542, E73004 or E12839).
  Tightening torque 0.6...0.8 Nm.
- ▷ If these instructions are not complied with, the specified protection rating cannot be guaranteed.

Observe the maximum tightening torque of the connection cable.

Do not apply external voltage to the outputs.

7.1 Pin assignment

M12 connector, A-coded, IO-Link (XC1)

1: L+ (US)
2: not used
3: L- (US)
4: IO-Link

M12 socket, A-coded, ports (X1...X4)

1: L+ (US, max. 400 mA)
2: AI (4...20 mA / 0...10 V analogue input)
3: L- (US)
4: AO (4...20 mA / 0...10 V analogue output)
5: FE

7.2 Ground connection

The FE potential is connected to the following points of the device:

- Upper mounting lug of the housing

To ensure the protection of the device against electrical interference and to ensure the safe function of the device, the housing has to be connected to the GND of the installation using the shortest possible route.

- ▶ Ground the device via the mounting screw of the upper mounting lug.

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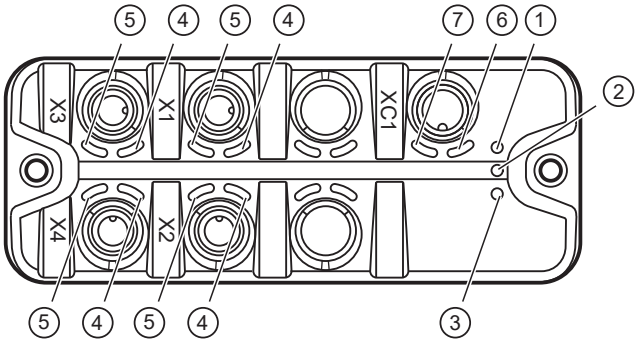
8 Operating and display elements



1: LED INT Internal error
2: LED 1 Error 1
3: LED 2 Error 2
4: LED AI Analogue input status
5: LED AO Analogue output status
6: LED US Supply voltage
7: LED IO-Link communication

8.1 LEDs

LED	Colour	Status	Designation
INT	red	On	Internal error
		Off	No internal error Device in operating mode
1	red	On	Short circuit on X1…X4 L+ (sensor supply)
		Off	No errors
2	red	On	Short circuit on X1…X4 L+ (sensor supply)
		Off	No errors
US	green	On	Voltage supply ≥ 18 V
		Off	Voltage supply < 16 V
	green	On	IO-Link communication active
		Off	IO-Link communication not active
AI	yellow	On	Input signal is within the measuring range
		On, flashing 2 Hz	Short circuit on X1…X4 L+ (sensor supply)
		On, flashing 1 Hz	Analogue input underload (UL) or overload (OL)
		Off	Analogue input is deactivated (Pin 2 mode: **OFF**)
AO	yellow	On	Output active, valid **PDOut**
		On, flashing 2 Hz	Short circuit on X1…X4 L+ (sensor supply)
		On, flashing 1 Hz	Wire break or load impedance too high (only in 4...20 mA mode)
		Off	Analogue output is deactivated (Pin 4 mode: **OFF**) or **PDOut** has not been set

9 Maintenance, repair and disposal

9.1 Maintenance

The unit is maintenance-free.

9.2 Cleaning the housing surface

- Disconnect the device from the voltage supply.
- Clean the device from dirt using a soft, chemically untreated and dry micro-fibre cloth.

9.3 Repair

- The device must only be repaired by the manufacturer. Observe the safety instructions (⇒ Safety instructions).

9.4 Disposal

- After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

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