

Original operating instructions
Safe AS-i module

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AC505S

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1 Preliminary note

The instructions are part of the unit. They are intended for authorised persons according to the EMC, Low Voltage and Machinery Directive and safety regulations.

The instructions contain information about the correct handling of the product. Read the instructions before use to familiarise yourself with operating conditions, installation and operation.

Adhere to the safety instructions.

1.1 Explanation of symbols

- ▶ Request for action
- LED on
- LED off
- ☒ LED flashes
- ☀ LED flashes quickly

 Important note

WARNING

Warning of dangers which may lead to death or serious irreversible injuries.

2 Safety instructions

- Follow the operating instructions.
- In case of non-observance of notes or standards, specially when tampering with and/or modifying the unit, any liability and warranty is excluded.
- The unit must be installed, connected and put into operation by a qualified electrician trained in safety technology.
- The applicable technical standards for the corresponding application must be complied with.
- For installation the requirements according to EN 60204 must be observed.
- In case of malfunction of the unit please contact the manufacturer. Tampering with the unit is not allowed.
- Disconnect the unit externally before handling it. Also disconnect any independently supplied relay load circuits.
- After installation of the system perform a complete function check.
- Only use the unit under the specified operating conditions (→ chapter 12 Technical data). In case of special operating conditions please contact the manufacturer.
- In case of any questions please contact the safety authorities in your own country.

WARNING

In case of improper handling of the product, the safety and physical integrity of persons and machinery cannot be guaranteed.

Death or serious irreversible injuries may result.

- ▶ Note all remarks on installation and handling given in these instructions.
- ▶ The unit must only be used under the specified operating conditions and in accordance with use as prescribed.

2.1 Safety-related requirements regarding the application

It must be ensured that the safety requirements of the respective application correspond to the requirements stated in these instructions.

Observe the following requirements:

- ▶ Adhere to EN 14119 for interlocking devices associated with guards.
- ▶ Adhere to the specified operating conditions (→ chapter 12 Technical data). Use of the unit in the vicinity of chemical and biological media as well as ionising radiation is not permitted.
- ▶ In case of faults within the unit which result in the defined safe state: take measures to maintain the safe state when the complete control system continues to be operated.
- ▶ Replace damaged units.

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3 Items supplied

1 safe AS-i module AC505S,
1 original instructions AC505S.

If one of the above-mentioned components is missing or damaged, please contact one of the ifm branch offices.

4 Functions and features

The safe AS-i module detects safety-related switching states of 1- or 2-channel mechanical or electronic switching contacts, e.g. e-stops, position switches, door contacts, etc. For this purpose, a code table is transferred via the AS-i system with 8 x 4 bits which is evaluated by the AS-i safety monitor (e.g. AC001S, AC004S, AC032S, AC041S).

The safety function of the unit is achieved by the normally closed operation (input disconnected = safe state).

The unit can be used in applications up to Performance Level e, category 4 to EN ISO 13849-1 and SIL_{CL} 3 to EN 62061.

i Depending on the safety components used the complete safety system can also be classified for a lower Performance Level PL or Safety Integrity Level SIL_{CL}!

5 Function and electrical connection

Please also refer to all information in the description of the configuration software (e.g. E7040S) and the operating instructions of the safety monitor. The above documents provide all required instructions concerning installation, configuration, operation and maintenance of the AS-i Safety at Work system.

Information on the parameterizable safety functions of the safe AS-i module can be found in the chapter "Monitoring devices" of the configuration software manual.

i The products described here are designed to be components of a safety-oriented machine or control system. A complete safety-related system normally includes sensors, evaluation units, signalling components and concepts for safe switch-off. It is the responsibility of each manufacturer of a machine or installation to ensure a correct functioning of the whole system. The manufacturer of the safe AS-i module, his subsidiaries and affiliates are not in a position to evaluate all of the characteristics of a given machine or product not designed by him.

The manufacturer accepts no liability for any recommendation that may be implied or stated herein.

The warranty contained in the contract of sale is the sole warranty. Any statements contained herein do not create new warranties or modify existing ones.

The complete description of the configuration software, the operating instructions of the AS-i safety monitor and the operating instructions of the safe AS-i module must be taken into account!

i Maintenance requirement

A minimum of one testing per year is compulsory by a demand on the safety function.

All connected individual switches must be checked.

6 Installation

- ▶ Carefully place the yellow flat cable (e.g. E74000) in the lower part.

To maintain the indicated protection rating IP 67:

- ▶ Close the unused sockets using a bridging plug (E7005S)*, tightening torque 0.6...0.8 Nm.
- ▶ Tighten all connected M12 connectors and protective caps, tightening torque 0.6...0.8 Nm.
- ▶ Close the addressing interface using the supplied protective cap, tightening torque 0.6...0.8 Nm.
- ▶ Use the flat cable seal (E70413)* if the module is at the end of the cable line.

*to be ordered separately

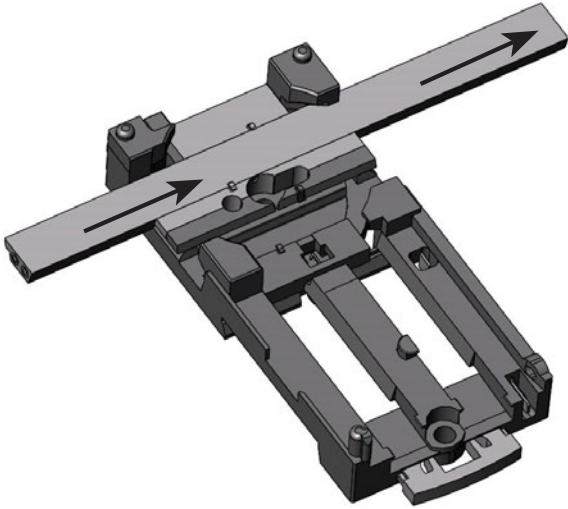
WARNING

Non-observance of the installation instructions (e.g. non-observance of the tightening torque) can lead to a loss of the protection rating and consequently to the loss of the safety function.

Death or serious irreversible injuries may result.

- ▶ Note all remarks on installation and handling given in these instructions.
- ▶ The unit must only be used under the specified operating conditions and in accordance with use as prescribed.

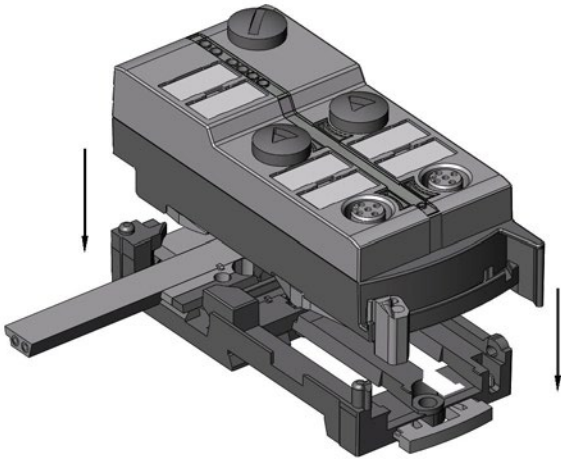
1



Alignment of the flat cable on delivery

Carefully place the yellow AS-i flat cable into the profile slot.

2

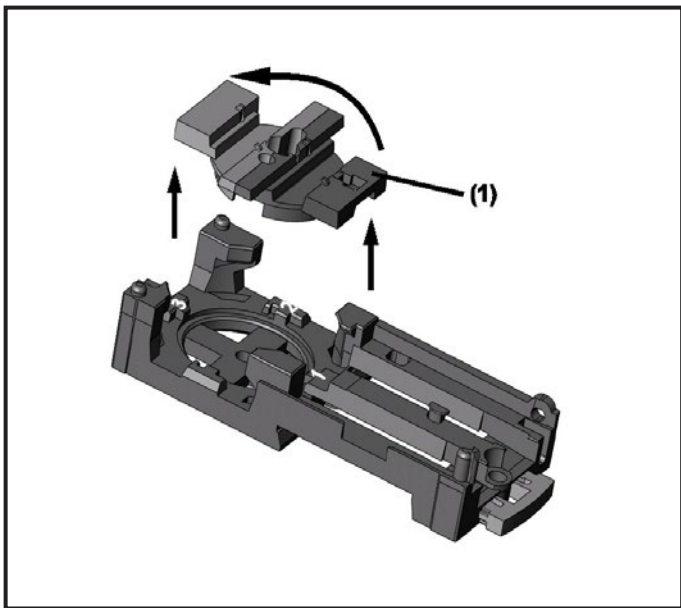


Mount the upper part.

3

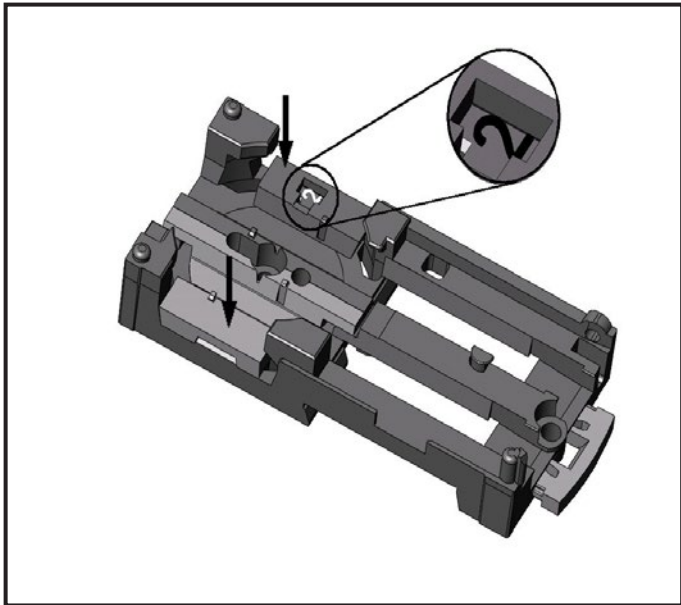


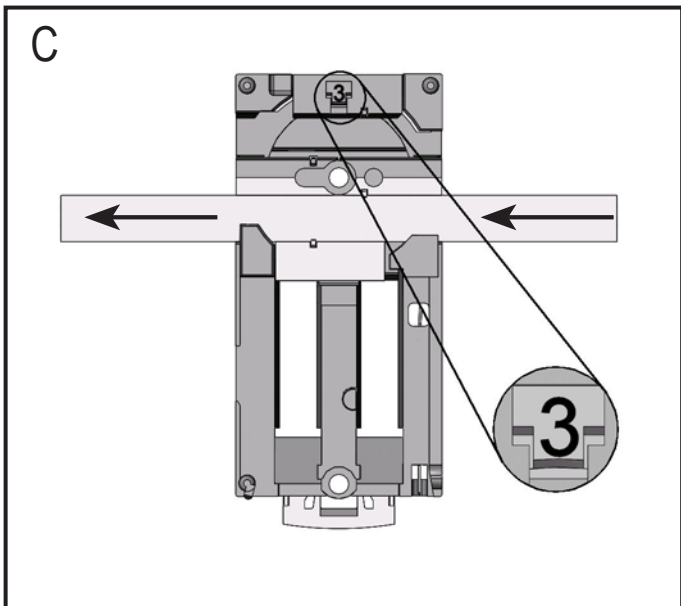
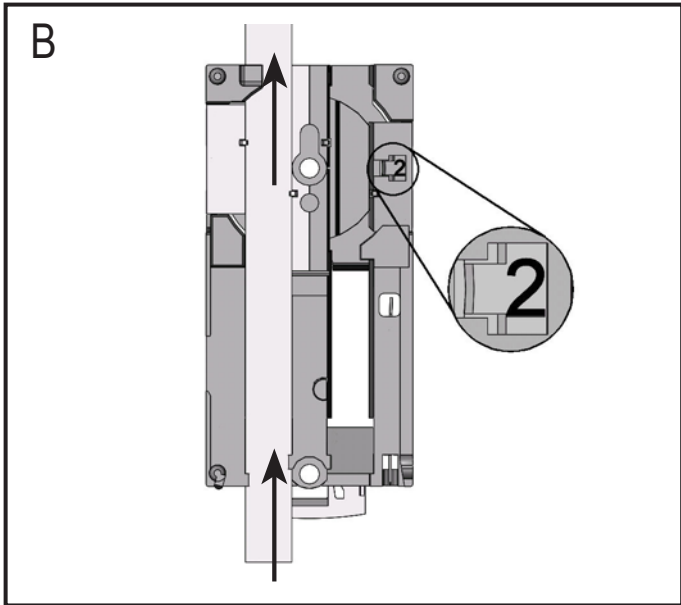
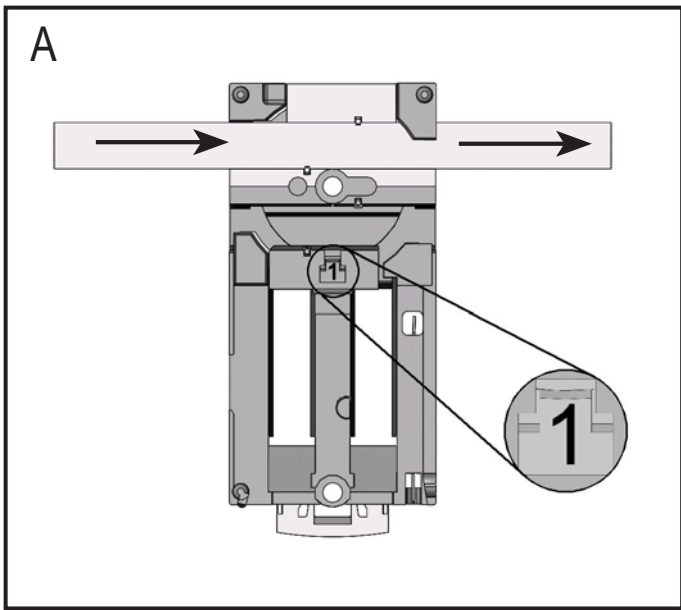
Lock the unit.



With the supplied lower part the flat cable can be aligned in three directions.

For the requested direction place the flat cable guide (1) accordingly.

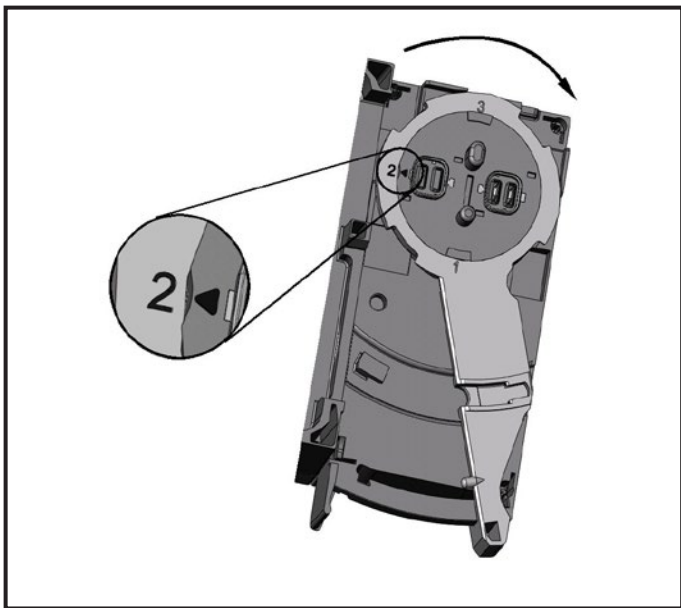




Settings at the lower part

Select the position 1, 2 or 3 depending on the required flat cable alignment (→).

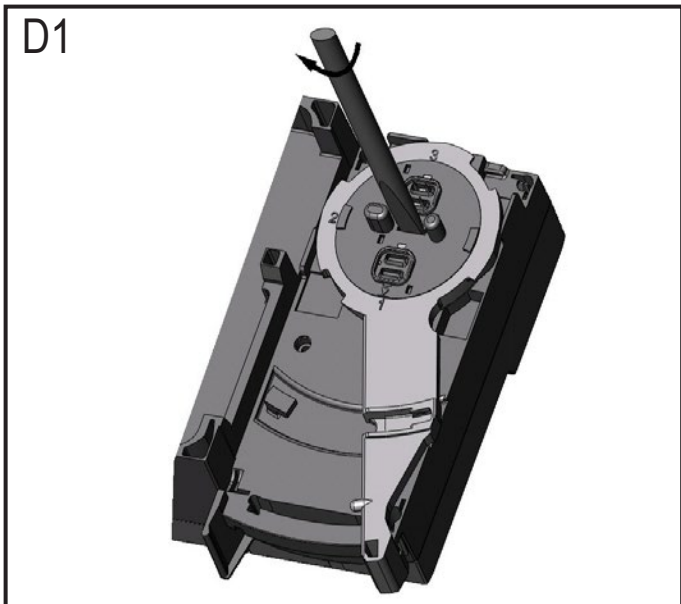
A = factory setting



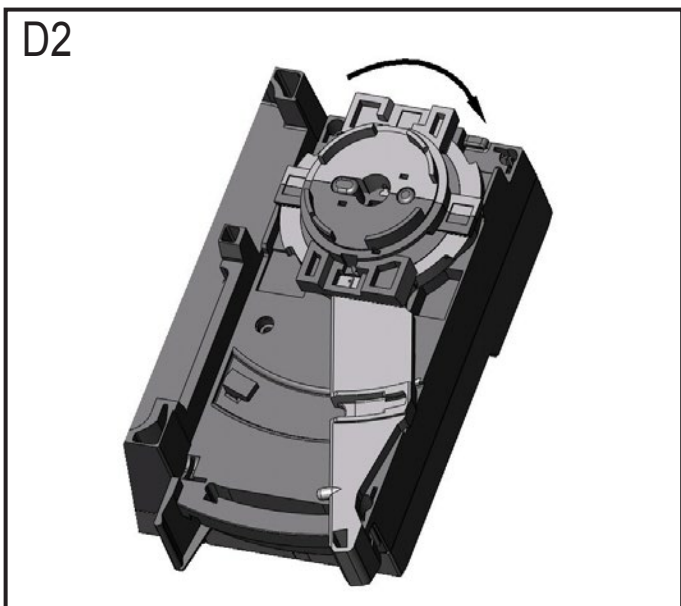
Settings at the upper part

Then set the selected position at the upper part. To do so, turn the triangle to the corresponding number (fig. D1 and D2).

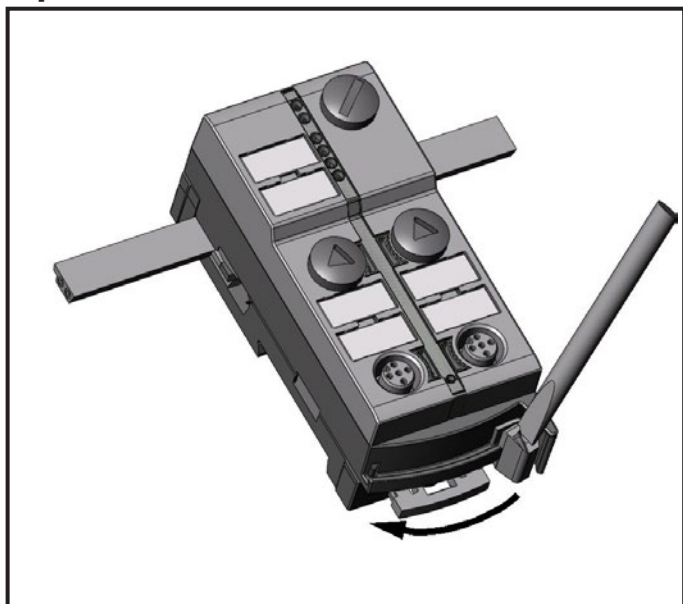
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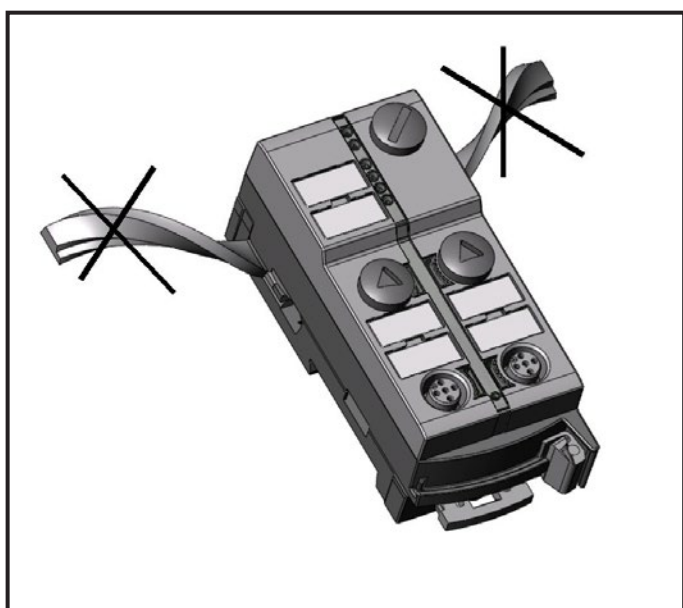
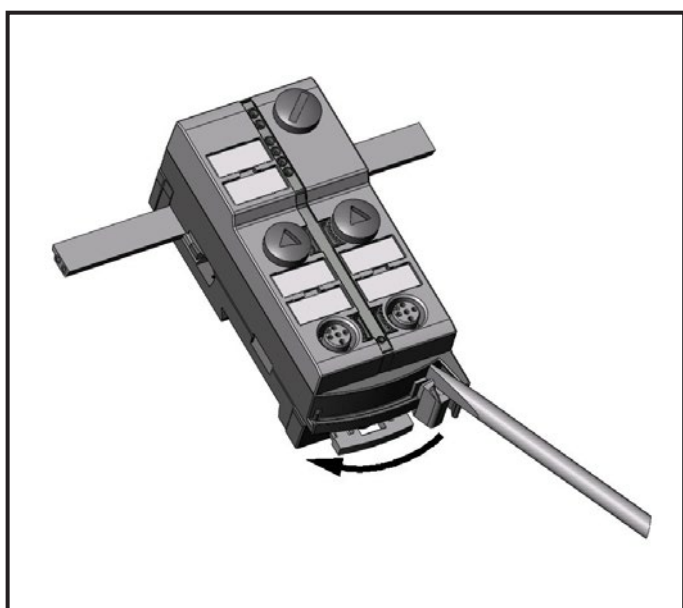
Use a tool, e.g. a screwdriver (figure D1) or the yellow / black flat cable guide (figure D2).



Open the unit

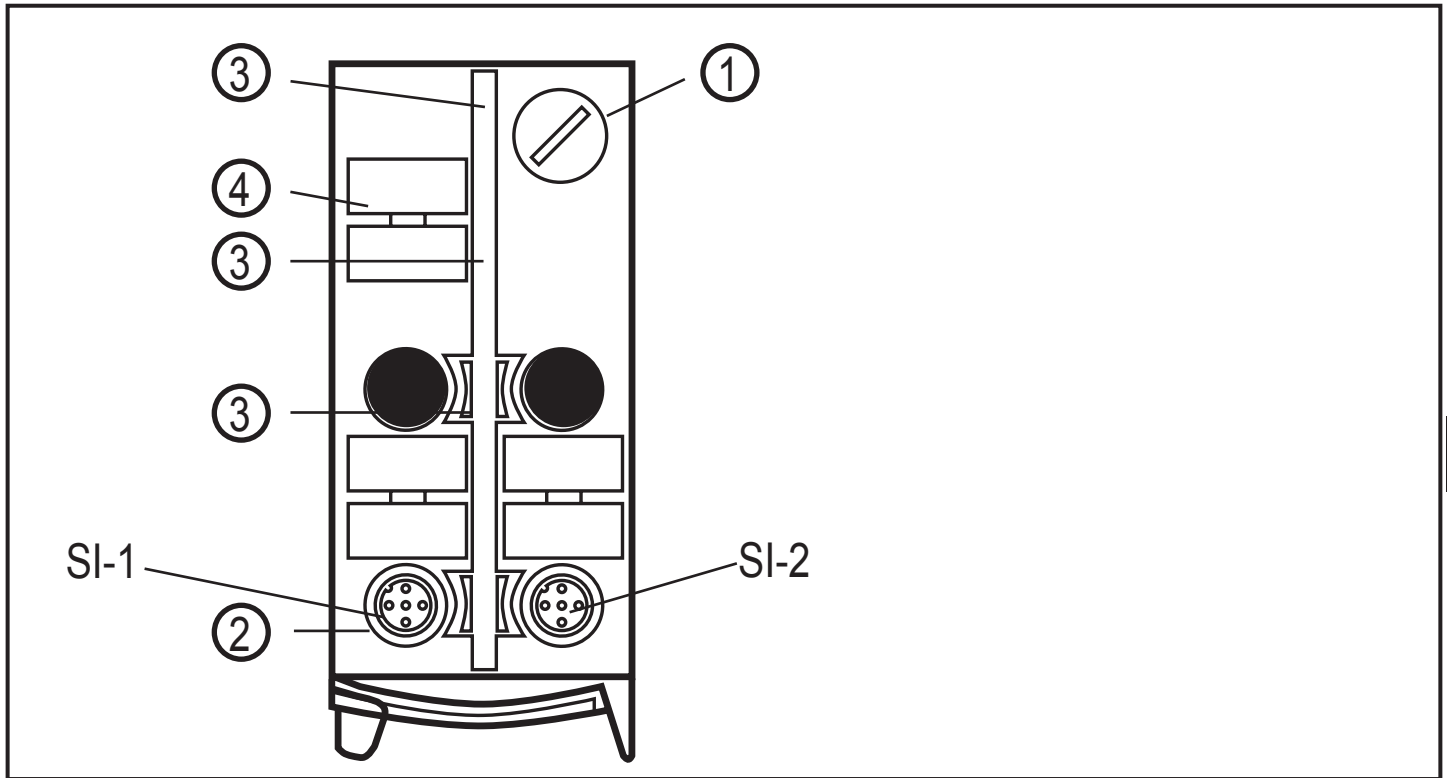


Open the unit using a tool as shown (e.g. screwdriver).



Take care in laying the AS-i flat cable, the flat cable should be laid straight for about 15 cm.

7 Operating and display elements



1: addressing interface

2: 2 M12 sockets

3: LEDs

4: labels

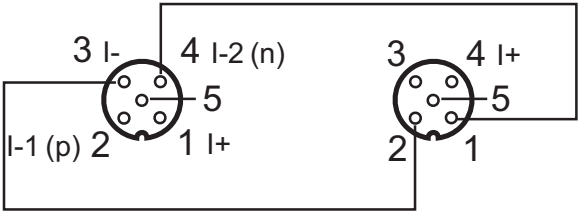
8 Electrical connection

► Disconnect power. Also disconnect any independently supplied relay load circuits.

i Do **not** connect inputs and outputs to an external potential.

Use switching contacts with

- a current rating of ≥ 1 A.
- a minimum load current < 7 mA.
- electrically isolated contact elements.
- contacts which open when there is a demand on the safety function.
- with a safety function by positive opening to IEC / EN 60947-5-1 annex K.

	M12 sockets	Socket SI-1/2 / pin	Socket SI-2 / pin
		supply I+	1
	input I-1(p)	2	-
	supply I-	3	2
	input I-2(n)	4	1
	not used	5	3,5

8.1 Mechanical contacts

The connected switching contacts must be configured as normally closed in accordance with IEC / EN 60947-5-1 annex K. The connection of two positively driven or two dependent switching contacts must be made to the socket SI-1/2.

- ▶ Connect the first switching contact SI-1(p) to pin 1 and pin 2.
- ▶ Connect the second switching contact SI-2(n) to pin 3 and pin 4.

The connection of two independent switching contacts is made to the socket SI-1/2 (pin 1 and pin 2) and to the socket SI-2 (pin 1 and pin 2). It is not allowed to connect switching contact SI-2(n) to the sockets SI-1/2 and SI-2 at the same time.

8.2 Electronic contacts

The safe input SI-1 (PNP) corresponds to the digital input of type 2 of EN 61131-2. The unit supports the connection of safe electronic sensors in **3-wire operation**. The duration of the switch-off test pulses of electronic sensors must not be longer than 1 ms.

i If only one single-channel switch is to be connected to the module, it is to be connected to the input SI-1(p). The second input SI-2(n) must be bridged.

- ▶ Use the bridging plug E7005S* for input SI-2 (*to be ordered separately).
- ▶ Tighten the bridging plug with a tightening torque of 0.6 ... 0.8 Nm.

This is the only way to ensure the maximum protection of IP 67.

i Do not connect any of the pins to an external potential since they are electrically connected to the AS-i cable.

Attention: The wiring influences the achievable Performance Level PL or the Safety Integrity Level SIL_{CL}.

The requirements Performance Level d to EN ISO 13849-1 / SIL_{CL} 2 (EN 62061) are met. Performance Level e to EN ISO 13849-1 / SIL_{CL} 3 (EN 62061) can be achieved by wiring the contacts to be monitored to the module so that cross faults between the wires can be excluded (incl. switch elements). This can for example be achieved if the contacts to be monitored are protected against external damage.

9 Addressing

The module can be addressed via the addressing unit AC1154.

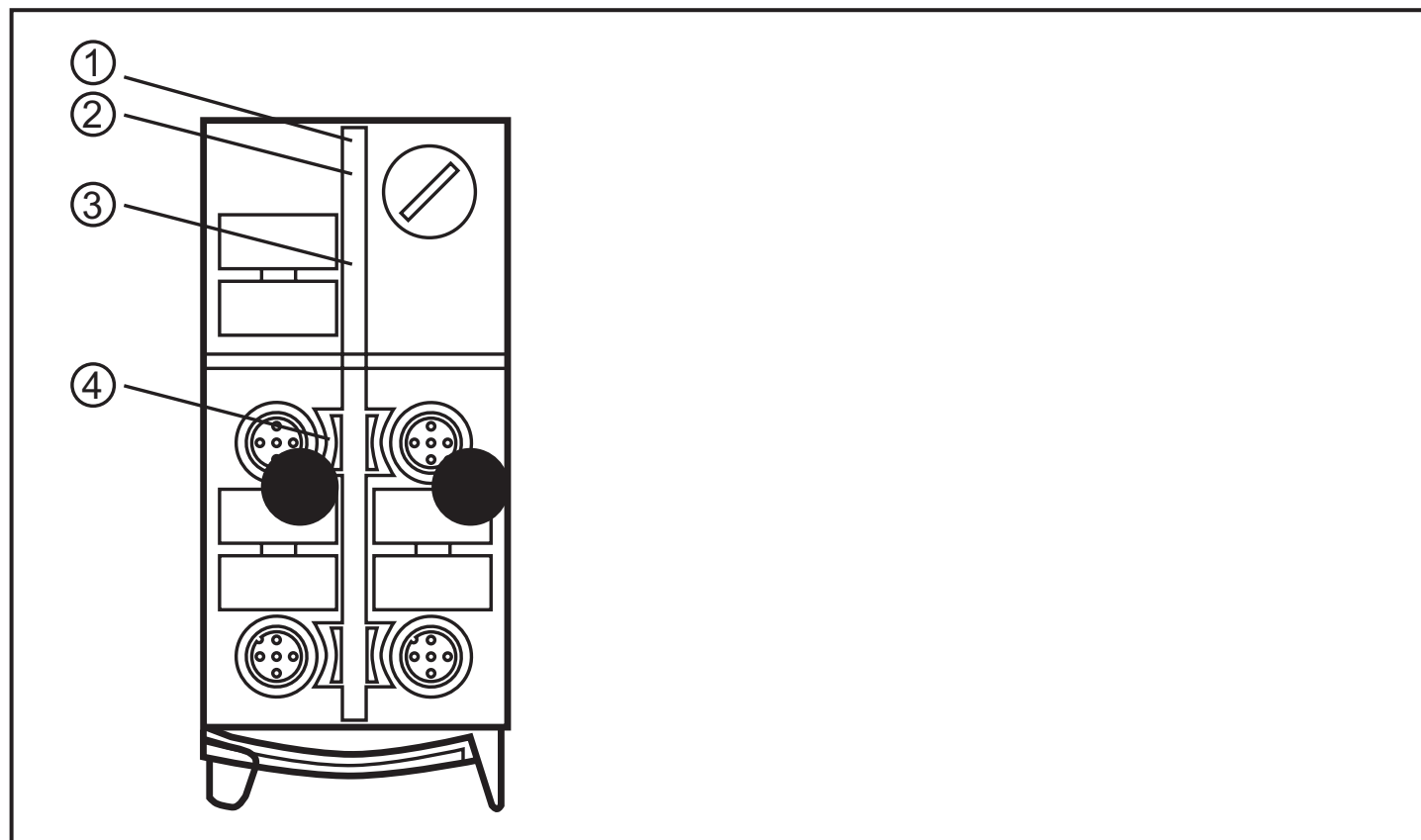
► Assign a free address between 1 and 31, on delivery the address is 0.

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When mounted and wired the module can be addressed with the addressing cable (E70213) via the integrated addressing interface.

10 Operation

Avoid build-up of dirt and dust on the upper and lower parts so that the locking mechanism is not affected.



- 1: LED green PWR
- 2: LED red FAULT
- 3: LED red O1, O2 alarm LEDs
- 4: LEDs yellow, inputs

LED Description	LED state / colour	Operating status
FAULT	⊗ red	periphery fault, e.g. overload or short circuit of the sensor supply
	● red	AS-i communication error, slave does not participate in the "normal" exchange of data, e.g. slave address 0
PWR	○ green ● green	no voltage voltage supply ok
Alarm O1, O2	● red	alarm output logic state of the alarm LED outputs O1 and O2
Input	○ yellow ● yellow	safety contact opened safety contact closed

i LED indications are no safe information.

Overload and short circuit of the input supply are signalled to the AS-i master (version 2.1) via the "periphery fault" flag in the status register.

10.1 Data bits

Data bit	D3	D2	D1	D0
Input	SI-2	SI-2	SI-1	SI-1
Output	-	-	LED alarm O-2	LED alarm O-1

The output bits D0 and D1 have effect on the red alarm LEDs on the front panel (O-1, O-2) and can be used for signalling directly on the module.

Activated input channel	Bit sequence D3-D0
SI-1	XX00
SI-2	00XX
SI-1 and SI-2	0000
none	XXXX

Activated alarm output	Bit sequence D3-D0
O-1	XXX1
O-2	XX1X

X = random

The code words 0000, XX00 and 00XX cause the AS-i safety monitor to bring the installation into the safe state.

For more details on the effect of the data bits on the transmission sequence refer to the configuration software manual (see the chapter "Monitoring devices").

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10.2 Parameter

This module allows to read the current module parameters and informs which of the 2 connected switching contacts was opened during the demand on the safety function.

i However, this parameter information is not part of the safe AS-i transmission, the parameter information is thus to be treated as non-safe and must in no case be linked with any safety functions nor evaluated!

Assignment of the parameter bits

Parameter bit	P0	P1	P2	P3
Switching contact socket	SI-1	SI-2	-	-

Meaning of the logic states P0 and P1

1: Contact closed

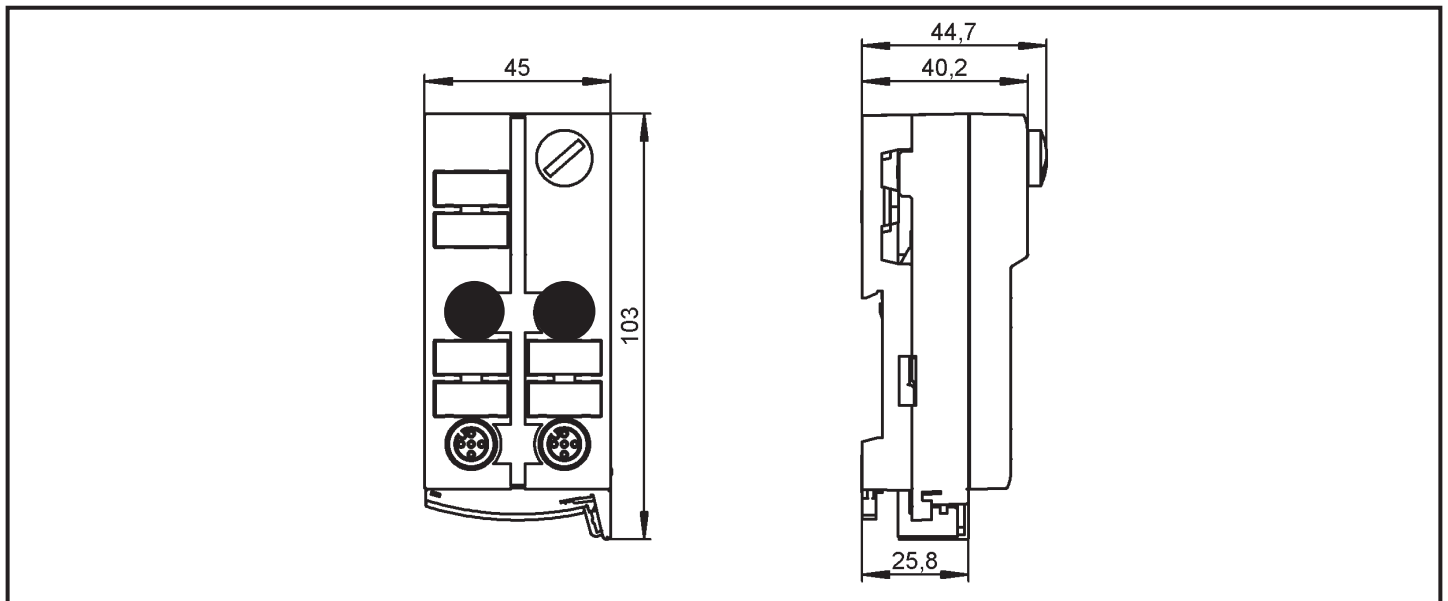
0: Contact open

10.3 Response times

The response time of the safe AS-i module for a safety demand is max. 10 ms.

For the calculation of the response time of the complete system the response times of the other components also have to be added (mechanical contacts, safety monitor and external relays or contactors possibly connected to the safety monitor output).

11 Scale drawing



12 Technical data

AC505S	
2 safe inputs / 2 non-safe LED outputs	
Operating voltage	26.5 ... 31.6 V DC
Current consumption	≤ 280 mA
Inputs	
Wiring	DC PNP, DC NPN
Voltage supply	via AS-i
Short-circuit detection	yes
Input current	typ. 12 mA
Cross fault monitoring	yes
Sensor supply	
Voltage supply	via AS-i
Voltage range	24 V DC (18...30 V DC)
Current rating	200 mA
Short-circuit proof	yes
LED outputs	
Supply via AS-i	yes
Integrated watchdog	yes
LED function display	
Operation / fault / function	green / red / yellow

Protection rating	IP 67
AS-Interface / extended addressing mode possible	version 2.11 and 3.0 / no
AS-i profile	S-7.B.0
I/O configuration / ID code	7 [Hex] / B.0 [Hex]
AS-i certificate	in preparation
Maximum number of safety modules per master	31
Ambient temperature	-25 ... +55 °C
EMC	EN 62026-2
Housing materials	PA
Housing dimensions	103 x 45 x 44.7 mm (H x W x D)
Cable length between module and mechanical/electronic contacts	≤ 10 m

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12.1 Safety classification

Characteristics	Value
Life time T	20 years
Performance Level PL	PL d / PL e*)
SIL _{cl}	SIL _{cl} 2 / SIL _{cl} 3*)
Category	cat. 3 / cat. 4*)
*) PL e, cat. 4, SIL _{cl} 3 only if the fault exclusions described in the manual are used (→ chapter 8 Electrical connection).	
PFH (PFH _D)	3.3 E-11 (1/h)

- These calculations were made on the basis of an ambient temperature of 40 °C.
- The PFH and MTTFd values of the other components, especially of the AS-i safety monitor, can be found in the corresponding documentation.

13 Troubleshooting

The LEDs of the safe AS-i module indicate faulty operating states (→ chapter 10 Operation).

14 Maintenance, repair and disposal

If used correctly no maintenance and repair measures are necessary.

Only the manufacturer is allowed to repair the unit.

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

15 Terms and abbreviations

PL	Performance Level	Capability of safety-related parts to perform a safety function under predictable conditions to fulfil the expected risk reduction.
PFH (PFH _D)	Probability of (dangerous) Failure per Hour	
SIL _{cl}	Safety Integrity Level claim limit	

16 Approvals / certificates

- EC declaration of conformity
- TÜV Rheinland
- AS-Interface approval number 97101
- UL (cULus)

The unit shall be supplied via an appropriate class 2 source such that the supply class requirements in accordance with UL 508 are met.

