

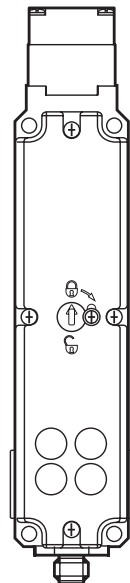


Original operating instructions
Safety switch with guard locking

AC903S
AC904S

UK

7390915/03 01/2017



Contents

1	Preliminary note.....	4
1.1	Explanation of symbols	4
2	Safety instructions	4
3	Items supplied.....	5
4	Functions and features	5
5	Structure and operating principle.....	6
5.1	Actuator version	7
5.2	Version AC903S (guard locking by spring force)	7
5.3	Version AC904S (guard locking by solenoid force)	7
5.4	Mechanical release.....	9
6	Installation.....	9
6.1	Installation instructions	9
6.1.1	Changing the actuating direction	10
6.2	Protection against environmental influences	10
7	Electrical connection.....	11
7.1	Wiring.....	11
8	Set-up	11
8.1	Setting of the AS-Interface address	11
8.2	Configuration in the AS-Interface safety monitor	11
8.2.1	Monitor with extended functions	12
9	Operation	13
9.1	LED indicators / AS-Interface status messages	13
10	Function check and troubleshooting.....	14
10.1	Mechanical function check	14
10.2	Electrical function check	14
10.3	Troubleshooting	14
11	Scale drawing	16
12	Technical data	17
13	Terms and abbreviations.....	18
14	Data bit table.....	19

15 Standards and approvals.....22
15.1 Directives and standards22
15.2 Approvals.....22

1 Preliminary note

Technical data, approvals, accessories and further information at www.ifm.com.

1.1 Explanation of symbols

► Instructions

> Reaction, result

→ Cross-reference



Important note

Non-compliance may result in malfunction or interference.



Information

Supplementary note.



WARNING

Warning of serious personal injury.

Death or serious irreversible injuries may result.

2 Safety instructions

- Follow the operating instructions.
- Improper use may result in malfunctions of the unit. This can lead to personal injury and/or damage to property during operation of the machine. For this reason note all remarks on installation and handling given in this document. Also adhere to the safety instructions for the operation of the whole installation.
- In case of non-observance of notes or standards, especially 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 60204-1 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 (→ 12 Technical data). In case of special operating conditions please contact the manufacturer.
- Use only as described below (→ 4).
- Safety switches fulfil a personal protection function. Incorrect installation or tampering can lead to serious injury.
- Safety components must not be bypassed (bridging of contacts), turned away, removed or otherwise rendered ineffective.
- On this point, take particular note of the measures to reduce the possibilities of bypassing in EN ISO 14119: 2013.
- The switching operation must only be triggered by actuators specially provided for this purpose which are permanently connected to the safety guard.
- A complete safety-related system normally consists of several signalling devices, sensors, evaluation units and concepts for a safe shut-down. The manufacturer of a machine or installation is responsible for a correct and safe overall function.
- All safety instructions and specifications in the operating instructions of the AS-Interface safety monitor must be adhered to.

3 Items supplied

- 1 AS-Interface safety switch type AC90xS
- 1 operating instructions safety switch with guard locking, ident no. 7390915.

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

4 Functions and features

AS-Interface safety switches type AC903S/AC904S operate as slaves on the safety bus AS-Interface Safety at Work and function as electromagnetic interlock devices with guard locking. The actuator has a low coding level.

In combination with a guard and the machine control system this safety component prevents the safety guard from being opened while there is potential of

exposure to a mechanical hazard.

For the control system this means the following:

- Switch-on commands which cause hazardous situations must become active only when the safety guard is in a protective position and the guard locking in locked position.
- The locked position of the guard locking must be released only when the hazardous situation is no longer present.

Before safety switches are used, a risk assessment must be performed on the machine, e.g. according to

- EN ISO 13849, Safety of machinery - Safety-related parts of control systems
- EN 12100-1, Safety of machinery - General principles for design - Risk assessment and risk reduction

Correct use includes compliance with the relevant requirements for installation and operation, in particular

- IEC 62061, Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
- EN ISO 13849, Safety of machinery - Safety-related parts of control systems
- EN 14119, Interlocking devices associated with guards
- EN 60204-1, Electrical equipment of machines



The user is responsible for a safe integration of the device into a safe overall system.

► Validate the whole system, e.g. to EN ISO 13849-2.

If the simplified procedure to EN ISO 13849-1:2016 (section 6.3) is used for validation, the performance level (PL) may be reduced in the event of several units being connected in series. If a data sheet is supplied with the product, the specifications of the data sheet apply in case of deviations from the operating instructions.

5 Structure and operating principle

AS-Interface safety switches, type AC903S/AC904S feature a slave interface to the safety bus AS-Interface Safety at Work. They enable locking of movable safety guards.

There is a rotatable camshaft in the head of the switch that is blocked/released via the locking bolt. When the actuator is inserted/removed or when the guard locking is activated/released the locking bolt is moved. The switching contacts are activated.

When the camshaft is blocked (guard locking active) the actuator cannot be drawn out of the switch head. For reasons of design, the guard locking can only be activated if the protective equipment is closed (protected against incorrect locking).

Position monitoring of the safety guard and monitoring of interlocking are performed via two separate contact elements (door monitoring contact SK and solenoid monitoring contact ÜK).

When the safety guard is closed and the guard locking is active, each AS-i safety switch transmits a switch-specific unique safety code sequence comprising 8x4 bits via the AS-Interface bus. This code sequence is evaluated by an AS-Interface safety monitor. The positively driven contact SK for door monitoring is represented by the AS-Interface input bits D0 and D1. The solenoid monitoring contact ÜK is represented by the AS-Interface input bits D2 and D3.

- Configure the safety switch in the AS-Interface safety monitor accordingly (refer to the operating instructions of the AS-Interface safety monitor and the data bit table).

5.1 Actuator version

Actuator S for the AS-i safety switches AC903S/AC904S without insertion funnel.

5.2 Version AC903S (guard locking by spring force)

The locking bolt is held in locked position by spring force and is electromagnetically released. The spring-interlocked guard locking operates normally closed. In the event of interruption of the solenoid power supply the safety guard cannot be opened immediately.

For process protection the interlocking solenoid can be switched by software via the AS-Interface output bit D0.

5.3 Version AC904S (guard locking by solenoid force)



Use only in special cases after a strict assessment of the risk of accident.

In the event of interruption of the solenoid power supply the safety guard can be opened immediately!

The locking bolt is electromagnetically held in locked position and released by spring force. The guard locking operates normally open.

- ▶ For process protection switch the interlocking solenoid by software via the AS-Interface output bit D0.
- ▶ Close the safety guard and activate the guard locking.
- ▶ Insert the actuator into the safety switch.
 - > The locking bolt is released.
 - > The door monitoring contact closes.
 - AC903S: The locking bolt passes into the locked position by spring force.
 - AC904S: The locking bolt passes into the locked position by applying the operating voltage of the solenoid.
 - > The safety contacts close.
 - > The whole safety code sequence (8 x 4 bits) is transmitted via the AS-Interface input bits D0 to D3.
- ▶ Deactivate the guard locking and open the safety guard.

AC903S

- ▶ Apply the operating voltage of the solenoid and release the guard locking via the AS-Interface output bit D0.
 - > The guard locking is deactivated, the solenoid monitoring contact ÜK opens. The value pair 0, 0 is transmitted in every bus cycle via the AS-Interface input bits D2 and D3.
- ▶ Remove the actuator.
 - > The door monitoring contact SK is positively opened and the guard locking is blocked in this position (protection against unintentional closing). The values 0, 0, 0, 0 are continuously transmitted via the AS-Interface input bits D0 to D3.

AC904S

- ▶ Switch off the operating voltage of the solenoid and release the guard locking via the AS-Interface output bit D0.
- > The guard locking is deactivated, the solenoid monitoring contact ÜK opens. The value pair 0, 0 is transmitted in every bus cycle via the AS-Interface input bits D2 and D3.
- ▶ Remove the actuator.
- > The door monitoring contact SK is positively opened and the guard locking is blocked in this position (protection against unintentional closing). The values 0, 0, 0, 0 are continuously transmitted via the AS-Interface input bits D0 to D3.

UK

5.4 Mechanical release

In the event of malfunction the guard locking can be released with the mechanical release irrespective of the state of the solenoid (→ 6.1.1).

- ▶ Remove the locking screw.
- ▶ Using a screwdriver, turn the mechanical release by approx. 180° in direction of the arrow.
- ▶ The locking screw must be returned to its original position and sealed after use (for example with sealing lacquer).
- ▶ Carry out a function check after releasing the guard locking. For further information please refer to the standard EN ISO 14119:2013, section 5.7.5.1.

6 Installation

Do not use safety switches and actuators as an end stop and only mount in assembled condition.

- ▶ At ambient temperatures higher than 40 °C protect the switch against contact with inflammable material or personnel.

6.1 Installation instructions

- ▶ Mount the safety switch so that
 - access to the switch is difficult for operators when the safety guard is open and the operation of the mechanical release is still possible.
 - address programming, inspection and replacement by authorised personnel is possible.
- ▶ Insert the actuator in the actuating head.

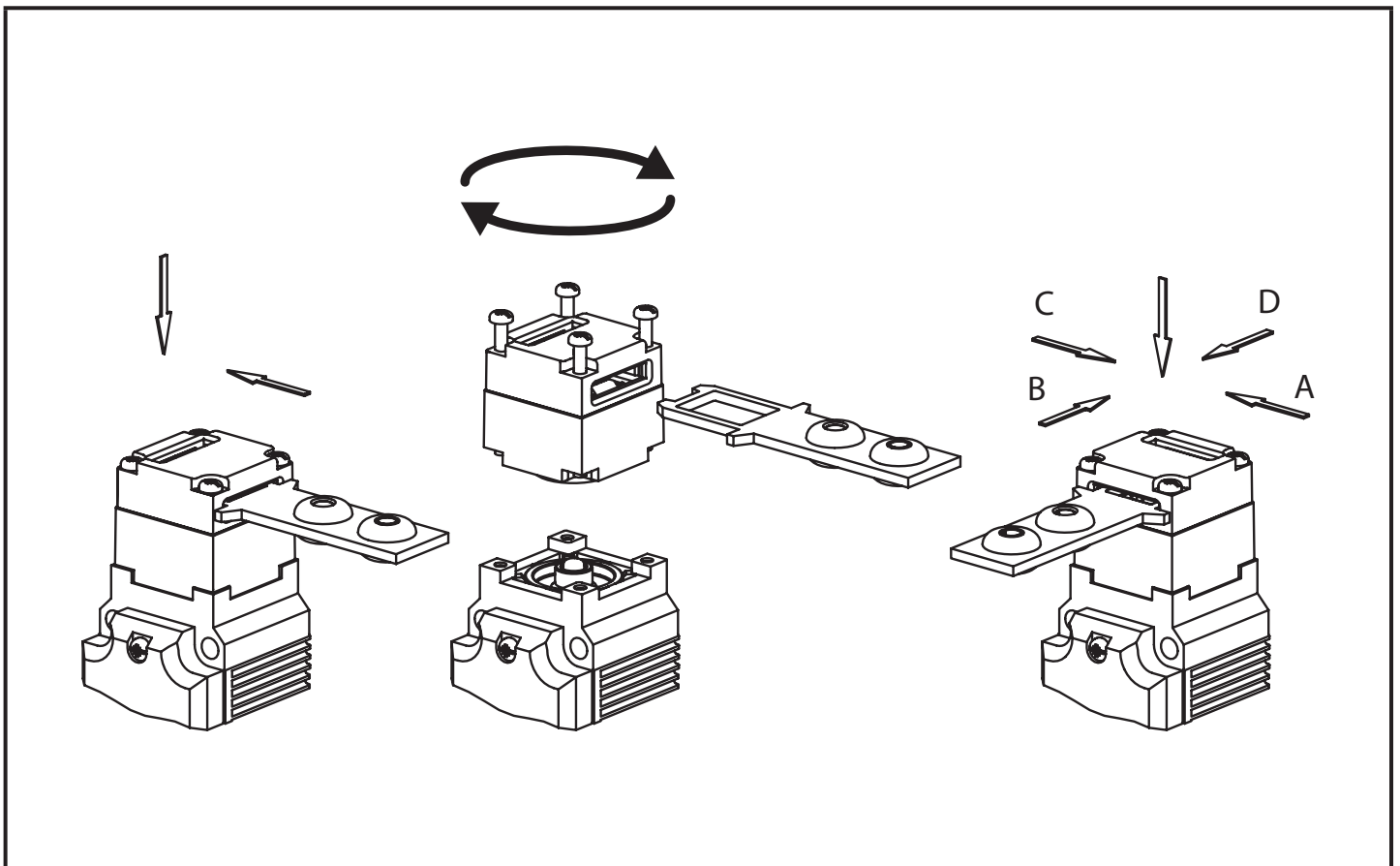
- ▶ Mount the safety switch positively.
- ▶ Permanently connect the actuator to the safety guard so that it cannot be detached (e.g. using the enclosed non-removable screws), alternatively rivet or weld.
- ▶ Fit an additional end stop for the movable part of the safety guard.



Observe EN ISO 14119:2013, sections 5.2 and 5.3, on mounting of a safety switch and an actuator.

Observe EN ISO 14119:2013, section 7, on measures to reduce the possibilities of bypassing.

6.1.1 Changing the actuating direction



- ▶ Remove the screws from the actuating head.
- ▶ Set the required direction.
- ▶ Tighten the screws with 0.6 Nm.
- ▶ Close the unused actuating slots with the supplied slot covers.

6.2 Protection against environmental influences

A lasting and correct safety function requires that the actuating head must be protected against the penetration of foreign bodies such as swarf, sand, blasting shot etc.

- ▶ Cover the actuating slot, the actuator and the type label during paint work.

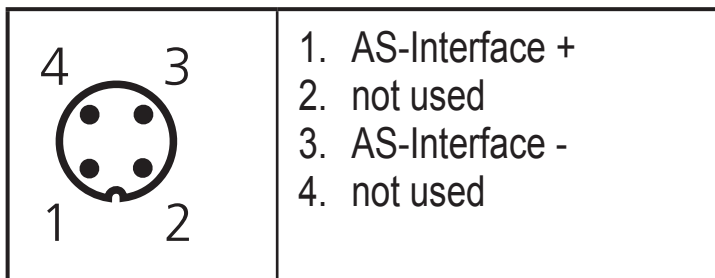
7 Electrical connection

- ▶ For use and operation as per the UL requirements use an isolating transformer or a power supply with secondary overcurrent protection (3 A).

UK

7.1 Wiring

The safety switch is connected to the bus system with an M12 connector and a 4-pole cable. Additionally, via a passive AS-Interface splitter with a yellow AS-Interface cable.



Observe the total current consumption from AS-i (→ chapter 12)

8 Set-up

8.1 Setting of the AS-Interface address

The address can be set before or after installation.

- ▶ Set the AS-Interface address of the safety switch using an AS-Interface programming device. Addresses 1 to 31 are valid.
- ▶ Connect the programming device to the M12 connector of the safety switch using a programming cable.

Address 0 is the default setting on delivery. During operation the AS-Interface LED red Fault is lit and the AS-Interface LED green Power flashes.

8.2 Configuration in the AS-Interface safety monitor

Refer to the operating instructions of the AS-Interface safety monitor and the data bit table.

Configure the safety switch in the AS-Interface safety monitor with the set AS-Interface address, for example, as follows:

Dual-channel dependent

- synchronisation time = infinite (∞)

In this operating mode, the safety guard must be opened each time prior to restarting in order to perform the start-up test.

Dual-channel independent

The guard locking is opened or closed via the output D0. When the guard locking is open, the safety circuit shuts down. It is not necessary to open the door. Safety is provided again when the guard locking is closed.

The dual-channel feature and the door contact are not tested in this configuration. Take additional measures for testing outside the monitor.

8.2.1 Monitor with extended functions

For the monitor with extended functions the following configuration is possible:

- dual-channel conditionally dependent
- independent: In-1

The guard locking is opened or closed via the output D0. When the guard locking is open, the safety circuit shuts down. It is not necessary to open the door. Safety is provided again when the guard locking is closed.

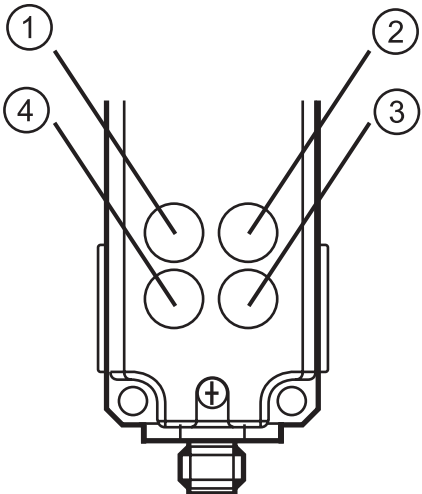
The switch is monitored for malfunction, the door contact (SK) must not switch before the guard locking contact (ÜK).

Status signals (not relevant to safety)

The status of the AS-Interface input bits D0 and D1 for door monitoring and the AS-Interface input bits D2 and D3 for solenoid monitoring can also be requested via the controller (PLC) (see operating instructions AS-Interface safety monitor).

9 Operation

9.1 LED indicators / AS-Interface status messages

	Status LED 3 Fault and LED 4 Power	Device status
	green is lit	normal operation
	red and green are lit	No data exchange between master and slave. Possible causes: - master in the STOP mode - slave not in LAS - slave with wrong IO ID - reset active at slave
	red is lit green is flashing	No data exchange between master and slave. Cause: - slave address = 0
	red and green flashing	device error in the slave
	red is flashing green is lit	

- 1: LED green
- 2: LED red
- 3: LED red Fault
- 4: LED green Power

Two additional function LEDs 1 + 2 can be connected via the AS-Interface bus, e.g. to indicate the door status. The red LED 2 is connected via the bit D1 as output to the AS-Interface bus, the green LED 1 via the bit D2.

UK

10 Function check and troubleshooting

WARNING

Errors during installation and function check can lead to fatal injury.

- ▶ Before the function check ensure that there are no persons in the hazardous area.
- ▶ Adhere to the applicable accident prevention regulations.
- ▶ After installation and each error carry out a complete check of the safety function.

10.1 Mechanical function check

The actuator must slide easily into the actuating head.

- ▶ Close the safety guard several times to check the function.

10.2 Electrical function check

- ▶ 1. Switch the operating voltage on.
- ▶ 2. Close all safety guards.
- ▶ In case of guard locking by means of solenoid force activate the guard locking.

The machine must not start automatically. It must not be possible to open the safety guard.

- ▶ 3. Activate operation in the controller

It must not be possible to deactivate the guard locking as long as the operation is active.

- ▶ 4. Switch off the operation in the controller and deactivate the guard locking.

The safety guard must remain locked until there is no longer a risk of injury. It must not be possible to start the machine as long as the guard locking is deactivated.

- ▶ Repeat steps 2 - 4 for every safety guard individually.

10.3 Troubleshooting

- ▶ In case of damage or wear replace the complete switch and actuator assembly.

Replacement of individual parts or assemblies, especially of the actuating head, is not permitted!



The production year is indicated in the bottom right corner of the type label.



Maintenance is not necessary.

To ensure a trouble-free long-term operation regular inspections are necessary.

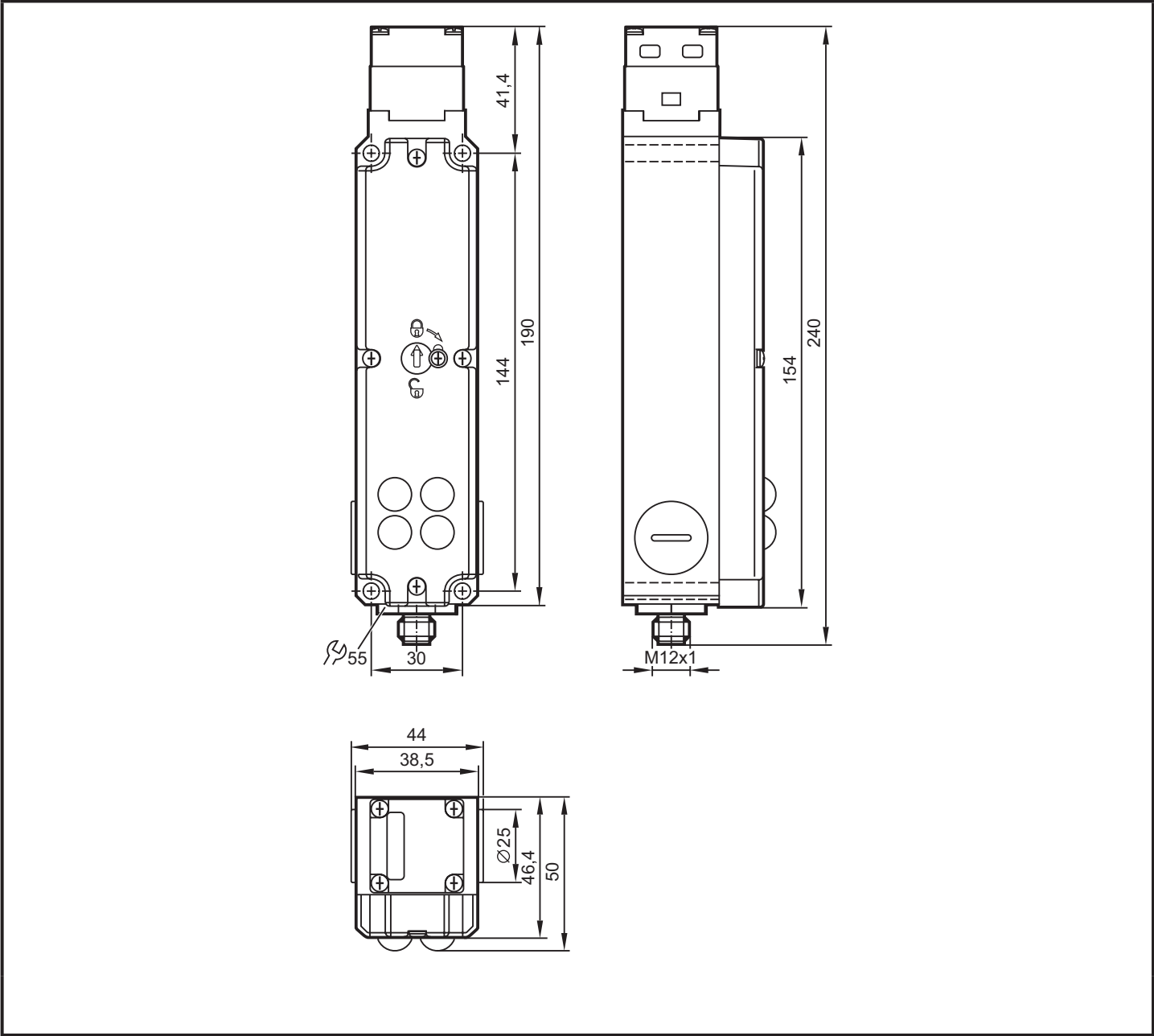
► Check the unit for the following points:

- correct switching function
- secure mounting of the components
- dirt and wear
- loose connectors

Exclusion of liability under the following circumstances:

- if the unit is not used for its intended purpose
- non-compliance with the safety regulations
- installation and electrical connection by non-authorized personnel
- failure to perform function checks

11 Scale drawing



12 Technical data

AC903S, AC904S

Safety switch with guard locking

The unit can be used in applications to PL d according to EN ISO 13849-1: 2016.

Mechanical data	
Housing material	reinforced glass-fibre thermoplastic
Degree of protection to IEC 529	IP 67, mating connector plugged in
Life	1 x 10 ⁶ operating cycles
Ambient temperature	-20...55 °C
Installation position	freely selectable
Max. approach speed	20 m/min
Actuation frequency	1200 / h
Actuation force	35 N
Extraction force	30 N (not locked)
Retention force	20 N
Locking force F _{max}	2500 N
Locking force F _{Zh} in accordance with the test principles GS-ET-19	$F_{Zh} = (F_{max} / 1.3) = 2000 \text{ N}$
Weight	approx. 0.5 kg
Switching principle SK, ÜK	positively driven, slow-action switching element
Minimum travel and overtravel	
Approach direction horizontal (h) and vertical (v)	actuator S (standard) 24.5 + 5
AS-Interface specifications	
AS-Interface operating voltage	22.5 ... 31.6 V DC
Max. total current consumption	400 mA
AS-Interface / _extended addressing mode possible	version 3.0 / no
AS-i profile	S-7.B.E
Valid AS-Interface addresses	1...31
AS-i certificate	96201
AS-Interface inputs	
Door monitoring contact SK	D0, D1

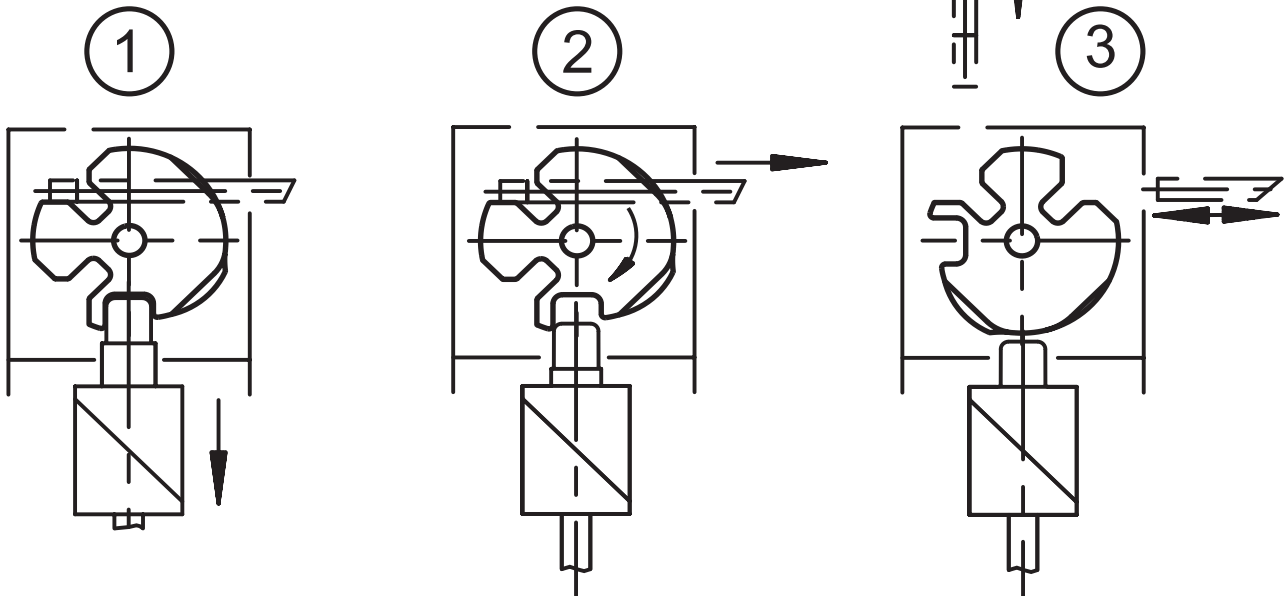
UK

Solenoid monitoring contact ÜK	D2, D3
AS-Interface outputs	
D0	interlocking solenoid, 1 = solenoid energised
D1	LED red, 1 = LED on
D2	LED green, 1 = LED on
AS-Interface LED Power	green, AS-Interface voltage applied
AS-Interface LED Fault	red, offline phase or address "0"
Reliability values to EN ISO 13849-1	
B10 _d	5 x 10 ⁶

13 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.
B10d		Number of cycles at which 10 % of the components have failed and caused danger.

14 Data bit table



- 1: Protective equipment closed and locked
- 2: Protective equipment closed but not locked
- 3: Protective equipment open

Programming	Status	D0, D1	D2, D3	Monitor diagnostics
dual-channel conditionally dependent	protective equipment closed and locked	code sequence		green
	protective equipment closed but not locked	half- sequence	00	yellow, flashing
	invalid state (protective equipment open, guard locking active)	00	half- sequence	flashing red (monitoring of the invalid state)
	protective equipment open	00	00	red
	address 0 or communication disturbed	—		grey

UK

Programming	Status	D0, D1	D2, D3	Monitor diagnostics
dual-channel independent	protective equipment closed and locked	code sequence		green
	protective equipment closed but not locked	half-sequence	00	red
	invalid state (protective equipment open, guard locking active)	00	half-sequence	red
	protective equipment open	00	00	red
	address 0 or communication disturbed	—		grey

Programming	Status	D0, D1	D2, D3	Monitor diagnostics
dual-channel dependent synchronisation time infinite ∞	protective equipment closed and locked	code sequence		Green, if the protective equipment has been open before or yellow, flashing, after start-up, if only the guard locking has been open.
	protective equipment closed but not locked	half-sequence	00	Yellow, flashing, if the protective equipment has been closed before. Red, if the protective equipment has been open before.
	invalid state (protective equipment open, guard locking active)	00	half-sequence	Yellow, flashing, if the protective equipment has been closed before. Red, if the protective equipment has been open before.
	protective equipment open	00	00	red
	address 0 or communication disturbed	—		grey

UK

15 Standards and approvals

15.1 Directives and standards

The following standards and directives have been applied:

- Machinery Directive 2006/42/EC
- EN ISO 13849-1: 2016
- EN 62026-2: 2013
- EN 60947-5-1: 2004/: 2009
- EN 60947-5-1: 2004/: 2009 - Annex K
- EN 14119: 2013

15.2 Approvals

- EU declaration of conformity
- UL (cULus)
- AS-i certificate

