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EN Operating instructions

pages 11 to 20

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1. About this document

1.1 Function

This operating instructions manual provides all the information you need for the mounting, set-up and commissioning to ensure the safe operation and disassembly of the safety switchgear. The operating instructions must be available in a legible condition and a complete version in the vicinity of the device.

1.2 Target group: authorised qualified personnel

All operations described in this operating instructions manual must be carried out by trained specialist personnel, authorised by the plant operator only.

Please make sure that you have read and understood these operating instructions and that you know all applicable legislations regarding occupational safety and accident prevention prior to installation and putting the component into operation.

The machine builder must carefully select the harmonised standards to be complied with as well as other technical specifications for the selection, mounting and integration of the components.

1.3 Explanation of the symbols used



Information, hint, note:

This symbol is used for identifying useful additional information.



Caution: Failure to comply with this warning notice could lead to failures or malfunctions.

Warning: Failure to comply with this warning notice could lead to physical injury and/or damage to the machine.

1.4 Appropriate use

The products described in these operating instructions are developed to execute safety-related functions as part of an entire plant or machine. It is the responsibility of the manufacturer of a machine or plant to ensure the correct functionality of the entire machinery or plant.

The safety switchgear must be exclusively used in accordance with the versions listed below or for the applications authorised by the manufacturer. Detailed information regarding the range of applications can be found in the chapter "2. Product description".

1.5 General safety instructions

The user must observe the safety instructions in this operating instructions manual, labelled with the caution or warning symbol above, the country-specific installation standards as well as all prevailing safety regulations and accident prevention rules.



Further technical information can be found in the SSP catalogues or in the online catalogue on the Internet:
www.safety-products.de.

The information contained in this operating instructions manual is provided without liability and is subject to technical modifications.

There are no residual risks, provided that the safety instructions as well as the instructions regarding mounting, commissioning, operation and maintenance are observed.

1.6 Warning about misuse



In case of inadequate or improper use or manipulations of the safety switchgear, personal hazards or damages to machinery or plant components cannot be excluded. The relevant requirements of the standard ISO 14119 must be observed.

1.7 Exclusion of liability

We shall accept no liability for damages and malfunctions resulting from defective mounting or failure to comply with this operating instructions manual. The manufacturer shall accept no liability for damages resulting from the use of unauthorised spare parts or accessories.

For safety reasons, invasive work on the device as well as arbitrary repairs, conversions and modifications to the device are strictly forbidden; the manufacturer shall accept no liability for damages resulting from such invasive work, arbitrary repairs, conversions and/or modifications to the device.

2. Product description

2.1 Ordering code

This operating instructions manual applies to the following types:

SAFIX ① ②

No.	Option	Description
①	I	Standard coding
	W	Individual coding
	T	Individual coding, re-teaching enabled
②	1	Transmitter (actuator)
	3	With diagnostic output
	4	Standard actuator

2.2 Special versions

For special versions, which are not listed in the order code below 2.1, these specifications apply accordingly, provided that they correspond to the standard version.

2.3 Destination and use

This non-contact, electronic safety switch is designed for application in safety circuits and is used for monitoring the position of movable safety guards. In this application, the safety switch monitors the position of hinged, sliding or removable safety guards by means of the coded electronic actuator.

The safety function consists of safely switching off the safety outputs when the safety guard is opened and maintaining the safe switched off condition of the safety outputs for as long as the safety guard is open.

Series-wiring

Series-wiring can be set up. The response and risk times are not altered by wiring in series. The number of components is only limited by the external cable protection according to the technical data and the line loss.

Protection is not required when pilot wires are laid. The cables however must be separated from the supply and energy cables. The max. fuse rate for a sensor chain depends on the section of the connecting cable of the sensor.



The entire concept of the control system, in which the safety component is integrated, must be validated to the relevant standards.

2.4 Technical data

Standards:	IEC 60947-5-3, IEC 61508, ISO 13849-1
Enclosure:	Thermoplastic hotmelt, macromelt 6208S
Operating principle:	RFID
Actuator:	SAFIX T3
Series-wiring:	Unlimited number of components, please observe external cable protection, Connector plug M8, 8-pole, A-coded
Connection:	Connector plug M8, 8-pole, A-coded
Switching distances to IEC 60947-5-3:	
Typical switching distance:	12 mm;
- in case of lateral actuation:	9 mm
assured switching distance s_{a0} :	10 mm;
- in case of lateral actuation:	6 mm
assured switch-off distance s_{ar} :	18 mm;
- in case of lateral actuation:	15 mm
Hysteresis:	< 2.0 mm
Repeat accuracy R:	< 0.5 mm
Ambient conditions:	
Ambient temperature T_U :	-25 °C ... +65 °C
Storage and transport temperature:	-25 °C ... +85 °C
Protection class:	IP65 / IP67 to IEC 60529
Resistance to vibration:	10 ... 55 Hz, Amplitude 1 mm
Resistance to shock:	30 g / 11 ms
Switching frequency f:	1 Hz
Drop-out time:	
- Actuator	≤ 100 ms
Duration of risk:	≤ 200 ms
Time to readiness:	≤ 5 s
Electrical data:	
Rated operating voltage U_e :	24 VDC -15% / +10% (PELV to IEC 60204-1)
Rated operating current I_e :	0.6 A
Minimum operating current I_m :	0,5 mA
Required rated short-circuit current:	100 A
Rated insulation voltage U_i :	32 V
Rated impulse withstand voltage U_{imp} :	800 V
No-load current I_0 :	35 mA
Overvoltage category:	III
Degree of pollution:	3
Safety inputs X1/X2:	
Rated operating voltage U_{e1} :	24 VDC -15% / +10% (PELV unit)
Power consumption per input:	5 mA
safety outputs Y1/Y2:	
p-type, short-circuit proof	
Operating current I_{e1} :	max. 0,25 A
Utilisation category:	DC-12 U_e/I_e 24 VDC / 0.25 A DC-13 U_e/I_e 24 VDC / 0.05 A
Voltage drop:	$U_e < 1 V$
Diagnostic output:	
short-circuit proof, p-type	
Operating current I_{e2} :	max. 0,05 A
Utilisation category:	DC-12 U_e/I_e 24 VDC / 0.05 A DC-13 U_e/I_e 24 VDC / 0.25 A
Voltage drop:	$U_e < 2 V$
Operating current:	150 mA
Wiring capacitance:	max. 50 nF
Device fuse rating:	≤ 2 A when used to UL 508

2.5 Safety classification

Standards:	EN ISO 13849-1, IEC 61508, IEC 62061
PL:	e
Control Category:	4
PFH value:	$6.8 \times 10^{-10} / h$
PFD:	1.2×10^{-4}
SIL:	suitable for SIL 3 applications
Service life:	20 years

2.6 Foreseeable defeat according to ISO 14119

SAFIX S:	low coding level
SAFIX I:	high coding level
SAFIX W:	high coding level

3. Mounting

3.1 General mounting instructions



During fitting, the requirements of ISO 14119 must be observed.

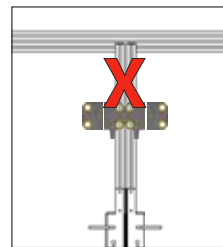
The mounting holes provide for a variable mounting by means of M4 screws (max. tightening torque 0.8 Nm). The component can be mounted in any position. The labelled surfaces of the safety switch and the actuator have to be opposite. The safety switch must only be used within the assured switching distances $\leq s_{a0}$ and $\geq s_{ar}$.



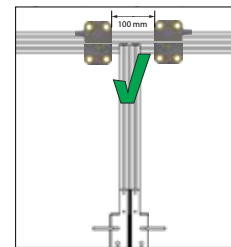
Safety switch and actuator must be permanently fitted to the safety guards and protected against displacement by suitable measures (tamperproof screws, gluing, drilling of the screw heads).

To avoid any interference inherent to this kind of system and any reduction of the switching distances, please observe the following guidelines:

- The presence of metal chips in the vicinity of the sensor is liable to modify the switching distance.
- Keep away from metal chips.
- Minimum distance between two sensors: 100 mm



Wrong



Right

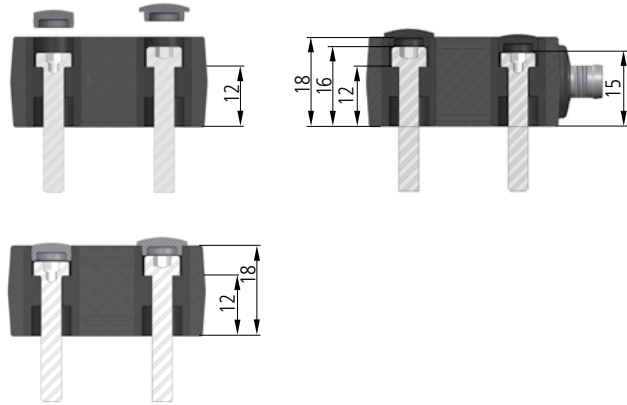
Accessories (to be ordered separately)

Kit tamper-proof screws

- SAFIX Z S20: 4 x M4x20 incl. washers, ordering code **SP-K-71-000-00**
- SAFIX Z S25: 4 x M4x25 incl. washers, ordering code **SP-K-71-000-01**

Sealing kit SAFIX Z D

- Ordering code **SP-K-71-000-02**
- Plugs: 4 flat pieces for flush finish and 4 with border for high screw heads
- To seal the mounting holes:
Flush one-way plugs for flat screw heads, also suitable as tampering protection for the screw fixings



Mounting set SAFIX Z M

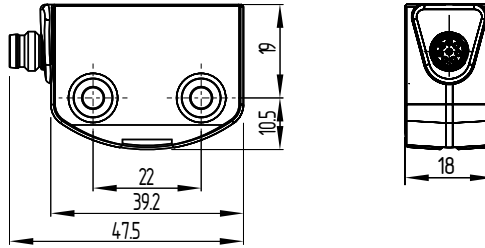
- Ordering code **SP-K-71-000-03**
- Alternative use of the mounting plates or ferrules
- Mounting plates: 2 pieces for mounting on non-linear stable basis, e.g. on groove rails/profiles
- Ferrules: 4 pieces for insertion to secure the screw fixings to the mounting surface for applications with regular high temperature variations



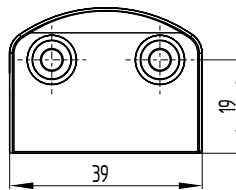
3.2 Dimensions

All measurements in mm.

Safety switch SAFIX __



Actuator: SAFIX T3



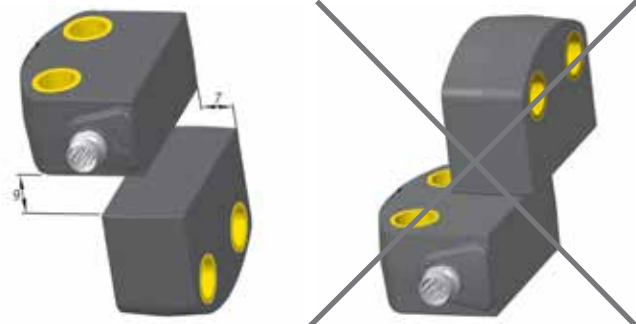
Alternative suitable actuators with different design: refer to www.safety-products.de.

3.3 Actuating directions

Actuation from front



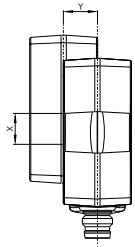
Actuation from side



Lateral actuation only from the shown sensor side.

3.4 Switching distance

The side allows for a maximum height misalignment (X) of sensor and actuator of ± 8 mm (e.g. mounting tolerance or due to guard door sagging). The axial misalignment (y) is max. ± 18 mm.



3.5 Adjustment

The continuous signal of the yellow LED signals the actuator detection.



Recommended Adjustment

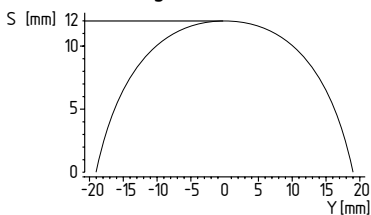
Align the safety switch and actuator at a distance of $0.5 \times s_{a0}$.

The correct functionality of both safety channels must be checked by means of the connected safety-monitoring module.

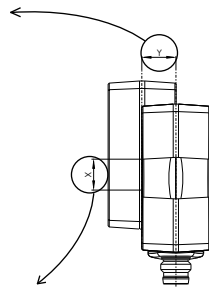
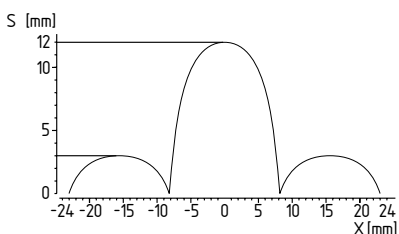
Actuating curves

The actuating curves represent the typical switching distance of the safety switch during the approach of the actuator subject to the actuating direction

Transverse misalignment



Height misalignment



Preferred actuation directions: from front or from side
In case of a lateral actuation, the switching distances are reduced by approx. 3 mm.

4. Electrical connection

4.1 General information for electrical connection



The electrical connection may only be carried out by authorised personnel in a de-energised condition.

The safety outputs can be integrated in the safety circuit of the control system. For applications of PL e / control category 4 to ISO 13849-1, the safety outputs of the safety switch or of the sensor chain must be wired to a safety monitoring-module of the same control category.

Requirements for the connected safety-monitoring module

- Dual-channel safety input, suitable for p-type sensors with NO function



Possible monitoring modules by SSP:

SP-S-00-003-01 Leansafe S
SP-S-00-003-02 Leansafe T
SP-R-11-000-00 Mosaic M1
www.safety-products.de

If the safety switch is wired to relays or to non-safety relevant control components, a new risk analysis must be carried out.

The sensors cyclically switch off the safety output to test them. The safety-monitoring module therefore does not need to be equipped with a cross-wire short detection. The switch-off times must be tolerated by the safety-monitoring module. The switch-off time of the safety switch is additionally extended depending on the cable length and the capacity of the cable used. Typically, a switch-off time of 250 μ s is reached with a 30-m connecting cable.



Configuration of the safety-monitoring module

If the safety switch is connected to electronic safety-monitoring modules, we recommend that you set a discrepancy time of 100 ms. The safety inputs of the safety-monitoring module must be able blanking a test impulse of approx. 1 ms.

5. Operating principles and coding

5.1 Mode of operation of the safety outputs

The safety outputs can be integrated in the safety circuit of the control system. The opening of a safety guard, i.e. the actuator is removed out of the active zone of the sensor, will immediately disable the safety outputs of the sensor (switching distances refer to technical data).

Any error that does not immediately affect the functionality of the safety switch (e.g. too high the ambient temperature, interference potential at a safety output, cross-wire short) will lead to a warning message, the disabling of the diagnostic output and the delayed shut-down of the safety outputs. The safety outputs are disabled if the error warning is active for 30 minutes.

The signal "combination, diagnostic output disabled" and "safety channels still enabled", can be used to stop the production process in a controlled manner.

After fault rectification, the error message is reset by opening and re-closing the corresponding safety guard. The safety outputs enable and allow a restart.

5.2 Coding

Safety switches with standard coding are ready to use upon delivery.

Individually coded safety switches and actuators will require the following "teach-in" procedure:

1. Switch the safety switch's voltage supply off and back on.
2. Introduce the actuator in the detection range. The teach-in procedure is signalled at the safety switch, red LED on, yellow LED flashes (1 Hz).
3. After 10 seconds, brief cyclic flashes (3 Hz) request the switch-off of the operating voltage of the safety switch. (If the voltage is not switched off within 5 minutes, the safety switch cancels the "teach-in" procedure and signals a false actuator by 5 red flashes).
4. After the operating voltage is switched back on, the actuator must be detected once more in order to activate the taught actuator code. In this way, the activated code is definitively saved!

For ordering suffix I, the thus executed allocation of safety switch and actuator is irreversible.

For ordering suffix W, the "teach-in" procedure for a new actuator can be repeated an unlimited number of times. When a new actuator is taught, the code, which was applicable until that moment, becomes invalid. Subsequent to that, an enabling inhibit will be active for ten minutes, thus providing for an increased protection against tampering. The green LED will flash until the expiration of the time of the enabling inhibit and the detection of the new actuator.

The 10-minutes protection time will subsequently restart in case of a power failure during the lapse of time.

6. Diagnostic functions








6.1 Operating principle of the diagnostic LED's



The safety switch indicates the operating condition and faults by means of three-colour LED's located in the lateral surfaces of the sensor.

The green LED indicates that the safety switch is ready for operation. The supply voltage is on and all safety inputs are present. If the green LED is flashing, it signalizes an error within one or two safety inputs (X1 and/or X2).

The flashing can be used to prematurely detect variations in the clearance between the sensor and the actuator (e.g. sagging of a safety guard). The sensor must be adjusted before the distance to the actuator increases and before the safety outputs are disabled, thus stopping the machine. If an error is detected, the red LED will be activated.

Diagnostic LED's

LED indication (rot)		Error cause
1 flash pulse		Error output Y1
2 flash pulses		Error output Y2
3 flash pulses		Cross-wire Y1/Y2
4 flash pulses		Ambient temperature too high
5 flash pulses		incorrect or defective actuator
Continuous red		Internal fault
Continuous red with yellow flashing		Teaching procedure

LED-Anzeige (grün)		Fehlerursache
1 flash pulse		Error in the input circle X1 or X2. For instance, a door in a safety circuit before is open.
2 flash pulses		10 minutes pause after reteaching

6.2 Operating principle of the electronic diagnostic output

A diagnostic output additionally indicates the operating condition (refer to table 1). These signals can be used in a downstream control.

The short-circuit proof diagnostic output OUT can be used for central visualisation or control functions, e.g. in a PLC. It indicates the switching condition as shown in the table 1.

Error

Errors, which no longer guarantee the function of the safety switch (internal errors) cause the safety outputs to be disabled within the risk time. Any error that does not immediately affect the safe functionality of the safety switch (e.g. the ambient temperature too high, interference potential at a safety output, cross-wire short) will lead to a delayed shut-down (refer to table 2).

After the rectification of the error, the error message is reset by opening the corresponding safety guard.

Error warning

The diagnostic output can also be used to detect clearance variations between the sensor and the actuator in the same way as the yellow LED. An active fault is visualised by the red LED and causes the diagnostic output to be disabled. The safety outputs are disabled after max. 30 minutes if the fault is not rectified. This signal combination, diagnostic output disabled and safety channels still enabled, can be used to stop the production process in a controlled manner.

Table 1: Examples of the diagnostic function of the safety-sensor

Sensor function		LED's			Diagnostic output	Safety outputs Y1, Y2	Note
		Green	Red	Yellow			
I.	Supply voltage	On	Off	Off	0 V	0 V	Voltage on, no evaluation of the voltage quality
II.	Actuated	On	Off	On	24 V	24 V	The yellow LED always signals the presence of an actuator within range
III.	Actuated in limit area	On	Off	Flashes (1Hz)	24 V pulsed	24 V	The sensor must be adjusted before the distance to the actuator increases and before the safety outputs are disabled, thus stopping the machine
IV.	Error warning, sensor actuated	Off	Flashes	On	0 V	24 V	After 30 minutes if the error is not rectified
V.	Error	Off	Flashes	On	0 V	0 V	Refer to table with flash codes
VI.	Teach target	Off	On	Flashes	0 V	0 V	Sensor in teaching mode
VII.	Protection time	Flashes	Off	Off	0 V	0 V	10 minutes pause after re-teaching
VIII.	Error in the input circuit X1, X2	Flashes	Off	Off	0 V	0 V	Input circuit X1 or X2 does not exist

See table " Diagnostic LED's " section 6.1

7. Set-up and maintenance

7.1 Functional testing

The safety function of the safety components must be tested. The following conditions must be previously checked and met:

1. Fitting of the sensor and the actuator.
2. Fitting and integrity of the power cable.
3. The system is free of dirt and soiling (in particular metal chips).

7.2 Maintenance

In the case of correct installation and adequate use, the safety switch features maintenance-free functionality.

A regular visual inspection and functional test, including the following steps, is recommended:

1. Check the fitting and integrity of the safety switch, the actuator and the cable.
2. Remove possible metal chips.

Damaged or defective components must be replaced.

8. Disassembly and disposal

8.1 Disassembly

The safety switchgear must be disassembled in a de-energised condition only.

8.2 Disposal

The safety switchgear must be disposed of in an appropriate manner in accordance with the national prescriptions and legislations.

9. Anhang

The application examples shown are suggestions. They however do not release the user from carefully checking whether the switchgear and its set-up are suitable for the individual application.

9.1 Wiring examples

Wiring example 1:

Wiring of SAFIX with diagnostic output

Input X1 and X2 will be connected with 24 V DC.

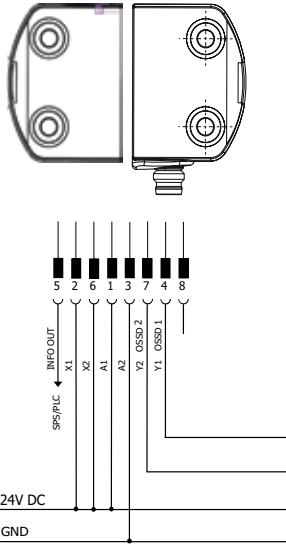
Output Y1 and Y2 are wired to the safety-monitoring module.

The diagnostic output can be connected for instance with a PLC.

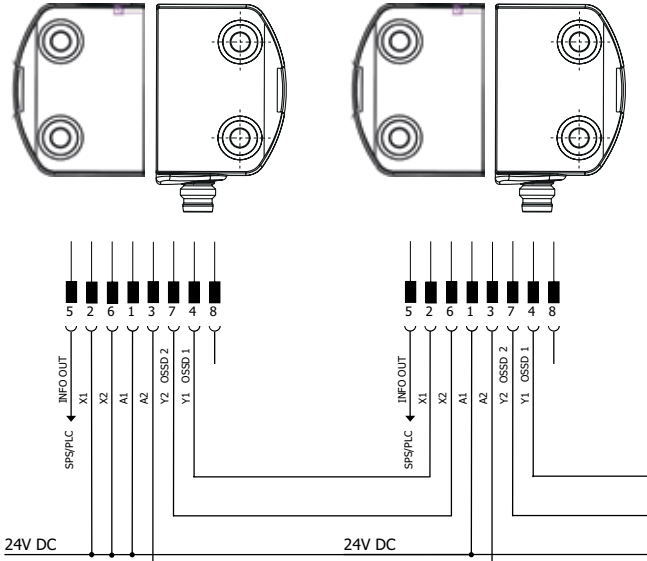
Wiring example 2:

Series-wiring of SAFIX with diagnostic output

The voltage is supplied to both safety inputs of the last safety switch of the chain (considered from the safety-monitoring module). The safety outputs of the first safety switch are wired to the safety-monitoring module. The diagnostic output can be connected for instance to a PLC.



Y1 and Y2 = Safety outputs → dual-channel safety monitoring module



9.2 Wiring configuration and connector accessories

Function safety switchgear		Pin configuration of the connector	Possible colour codes of other customary connectors
with diagnostic output			to EN 60947-5-2: 2007
A1	U _e	1	BN
X1	Safety input 1	2	WH
A2	GND	3	BU
Y1	Safety output 1	4	BK
OUT	Diagnostic output	5	GY
X2	Safety input 2	6	PK
Y2	Safety output 2	7	VT
IN	without function	8	OR

Colour code legend

Code	Colour	Code	Colour	Code	Colour	Code	Colour
BK	Black	GN	green	PK	pink	WH	white
BN	brown	GY	grey	RD	red	YE	yellow
BU	blue	OR	orange	VT	violet		

Connectin cables with coupling (female) IP67, M8, 8-pole - 8 x 0,25 mm², straight

Cable length	Part number
5 m	SP-X-33-000-00
10 m	SP-X-33-000-01
20 m	SP-X-33-000-02

Connectin cables with coupling (female) IP67, M8, 8-pole - 8 x 0,25 mm², angled

Cable length	Part number
5 m	SP-X-33-000-03
10 m	SP-X-33-000-04
20 m	SP-X-33-000-05

Connection adapter M8 coupling M12 connector, IP 67, 8-pole - 8 x 0,25 mm²

Cable length	Part number
2 m	SP-X-33-000-06

