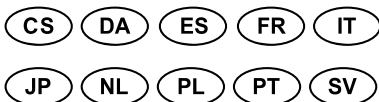




EN Operating instructions pages 1 to 5
Original



Detailed user information at products.schmersal.com.

1. About this document

This document provides all the information you need for the mounting, set-up and commissioning to ensure the safe operation and disassembly of the switchgear. The operating instructions enclosed with the device must always be kept in a legible condition and accessible.

All operations described in the 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 user must observe the safety instructions in this operating instructions manual, the country specific installation standards as well as all prevailing safety regulations and accident prevention rules.

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

Products in Schmersal's range are not intended to be used by private end consumers.

2. Product description

2.1 Purpose

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.

2.2 Warning about misuse



In case of improper use or manipulation of the safety switchgear, personal hazards or damages to machinery or plant components cannot be excluded. There are no residual risks, provided that the safety instructions as well as the instructions regarding mounting, commissioning, operation and maintenance are observed.

2.3 Exclusion of liability

We shall accept no liability for damages and malfunctions resulting from defective mounting or failure to comply with the 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.

2.4 Technical Data

General data

Standards EN ISO 13849-1,
EN IEC 60947-5-3,
EN IEC 61508

Coding level according to EN ISO 14119 I1 variant: High
I2 variant: High
Standard coded variant: Low

Working principle RFID

Frequency band RFID 125 kHz

Transmitter output RFID, maximum -6 dB/m

Time to readiness, maximum 2,000 ms

Duration of risk, maximum 200 ms

Reaction time, switching off safety outputs via actuator, maximum 100 ms

Reaction time, switching off safety outputs via safety inputs, maximum 0.5 ms

Degree of protection IP65, IP67, IP69

Safety classification

Standards EN ISO 13849-1,
EN IEC 61508

Performance Level, up to e

Category 4

PFH value 2.70×10^{-10} /h

PFD value 2.10×10^{-5}

Safety Integrity Level (SIL), suitable for applications in 3

Mission time 20 Year(s)

Mechanical data

Latching force, approx. 18 N

Type of the fixing screws 2 x M4 cylinder head screw
with washers to
DIN 125A/form A

Tightening torque of the fixing screws 2.2 ... 2.5 Nm

Mechanical data - Switching distances according EN IEC 60947-5-3

Switch distance, typical 12 mm

Assured switching distance "ON" S_{ao} 10 mm

Assured switching distance "OFF" S_{ar} 20 mm

Mechanical data - Connection technique

Connection type Cable (Y-UL 2517), 8-pole,
Connector M12, 8-pole,
Connector M12, 5-pole,
A-coded

Note (series-wiring) Unlimited number of devices,
observe external line
fusing, max. 31 devices in
case of serial diagnostic SD

Note (length of the sensor chain) Cable length and cross-section
change the voltage drop
depending on the output
current

Electrical data

Rated operating voltage 24 VDC -15 % / +10 %

Note (Power supply, general) stabilised PELV power
supply

Operating current, minimum 0.5 mA

No-load supply current I_0 , maximum 35 mA

Required rated short-circuit current 100 A

Electrical fuse rating, maximum 2 A

Switching frequency, maximum	1 Hz
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Electrical data - Safety digital inputs

Designation, Safety inputs	X1 and X2
Current consumption of the safety inputs	5 mA
Test pulse duration, maximum	1 ms
Test pulse interval, minimum	100 ms

Electrical data - Safety digital outputs

Designation, Safety outputs	Y1 and Y2
Voltage drop U_{di} , maximum	1 V
Leakage current I_r , maximum	0.5 mA
Utilisation category DC-12	24 VDC / 0.25 A
Utilisation category DC-13	24 VDC / 0.25 A
Test pulse duration, maximum	0.3 ms
Test pulse interval, typical	1000 ms

Electrical data - Diagnostic outputs

Designation, Diagnostic outputs	OUT
Design of control elements	p-type
Utilisation category DC-12	24 VDC / 0.05 A
Utilisation category DC-13	24 VDC / 0.05 A
Voltage drop U_{di} , maximum	2 V

Electrical data - Serial diagnostic SD

Operating current	150 mA
Wiring capacitance	50 nF

3. Mounting

3.1 General mounting instructions



Please observe the relevant requirements of the standards ISO 12100, ISO 14119 and ISO 14120.

Ensure the safety sensor and actuator is mounted on a flat surface. The component can be mounted in any position. The universal mounting holes provide for a variable mounting by means of M4 screws. Mounting: a screw length of 25 mm is sufficient for sensor mounting and for side mounting of the actuators. 30 mm long screws are recommended when the actuator is mounted upright and/or when the sealing discs are used. (Tightening torque 2,2...2,5 Nm). The labelled surfaces of the safety sensor and the actuator have to be opposite. The safety sensor must only be used within the assured switching distances $\leq s_{ao}$ and $\geq s_{ar}$.



The 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 100 mm between two safety sensors as well as other systems with same frequency (125 kHz)

3.2 Adjustment

The continuous signal of the yellow LED signals the actuator detection; the flashing of the yellow LED signals that the safety sensor is actuated in the hysteresis area.



Recommended Adjustment

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

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

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 required electrical cable fuse protection must be integrated in the installation.

4.2 Wiring configuration

Function safety switchgear		Pin configuration of the connector	
	with convention- al diagnostic output	with serial diag- nostic function	
A1	U_s		1
X1	Safety input 1		2
A2	GND		3
Y1	Safety output 1		4
OUT	Diagnostic output	SD-output	5
X2	Safety input 2		6
Y2	Safety output 2		7
IN	without function	SD-input	8

5. Actuator coding

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

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

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

For ordering suffix -I1, the executed allocation of safety switchgear and actuator is irreversible.

For ordering suffix -I2, 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. In case of power failure during the lapse of time, the 10-minutes tampering protection time will restart.

6. Working principle and diagnostic function

6.1 Mode of operation of the safety outputs

The safety outputs can be integrated into 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.

6.2 Diagnostic-LEDs

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



The following LED indicators are the same for safety sensors with conventional diagnostic output as for those with a serial diagnostic function.

The green LED indicates that the safety sensor is ready for operation. The supply voltage is on and all safety inputs are present. Flashing (1Hz) of the green LED signals that a voltage is missing on one or both of the safety inputs (X1 and/or X2). The yellow LED always signals the presence of an actuator within range. If the actuator is operating in the limit area of the sensor switching distance, it will be indicated by flashing. 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.

LED indication (red)		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		Wrong or defective actuator
Continuous red		Internal fault, with yellow flashing teaching procedure

6.3 Operating principle of the electronic diagnostic output

A diagnostic output additionally indicates the switching condition of the safety switchgear. These signals can be used in a downstream control.

The short-circuit proof diagnostic output OUT can be used for central visualisation or control tasks, e.g. in a PLC.

The diagnostic output is not a safety-related output.

Error

Errors which no longer guarantee the function of the safety switchgear (internal errors) cause the safety outputs to be disabled within the duration of risk. After fault rectification, the error message is reset by opening and re-closing the corresponding safety guard.

Error warning

A fault that does not immediately endanger the safety function of the safety switchgear (e.g. too high ambient temperature, safety output at external potential, cross-circuit) leads to delayed shutdown. This signal combination, diagnostic output disabled and safety channels still enabled, can be used to stop the production process in a controlled manner.

An error warning is deleted when the cause of error is eliminated. If the fault warning remains on for 30 minutes, the safety outputs are also switched off (red LED flashes).

Table 1: Examples of the diagnostic function of the safety-sensor with conventional diagnostic output

Sensor function		LED's green	red	yellow	Diagnostic-output	Safety outputs Y1, Y2	Comments
I.	Supply voltage	On	Off	Off	0 V	0 V	Voltage on, no evaluation of the voltage quality
II.	actuated	Off	Off	On	24 V	24 V	The yellow LED always signals the presence of an actuator within range.
III.	Actuated, actuator in limit area	Off	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	Off	0 V	24 V	After 30 minutes if the error is not rectified
V.	Error	Off	Flashes	Off	0 V	0 V	Refer to table with flash codes
VI.	Teach actuator	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 input circuit X1 and/or X2	Flashes (1Hz)	Off	Off	0 V	0 V	Example: door open; a door in the safety circuit upstream is also open.
IX.	Error in input circuit X1 and/or X2	Flashes (1Hz)	Off	On	24 V	0 V	Example: door closed, a door in the safety circuit upstream is open.

6.4 Safety-sensors with serial diagnostic function

Safety sensors with serial diagnostic cable have a serial input and output instead of the conventional diagnostic output. If RSS / CSS safety

sensors are wired in series, the safety channels as well as the inputs and outputs of the diagnostic channels are wired in series.

Up to 31 safety switchgear devices can be connected in series with serial diagnostics. For the evaluation of the serial diagnostics line either the PROFIBUS-Gateway SD-I-DP-V0-2 or the Universal-Gateway SD-I-U-... are used. This SD-Gateway is integrated as a slave in an existing field bus system. In this way, the diagnostic signals can be evaluated by means of a PLC. The necessary software for the integration of the SD-Gateway is available for download at products.schmersal.com.

The response data and the diagnostic data are automatically and permanently written in the assigned input byte of the PLC for each safety sensor in the series-wired chain.

The request data for each safety sensor are transmitted to the device through an output byte of the PLC.

In the event of a communication error between the SD-Gateway and the safety sensor, the switching condition of the safety output of the safety sensor is maintained.

Bit 0: safety outputs enabled
 Bit 1: safety sensor actuated, actuator identified
 Bit 4: both safety inputs live
 Bit 5: safety sensor actuated in hysteresis area
 Bit 6: error warning, switch-off delay activated
 Bit 7: error, safety outputs switched off

Error

Errors which no longer guarantee the function of the safety switchgear (internal errors) cause the safety outputs to be disabled within the duration of risk. The fault is reset, when the cause is eliminated and bit 7 of the request byte changes from 1 to 0 or the safety guard is opened. Faults at the safety outputs are only deleted upon the next release, as the fault rectification cannot be detected sooner.

Diagnostic error (warning)

If an error (warning) is signalled in the response byte, detailed fault information can be read out.

Table 2: Function of the visual diagnostic LEDs, the serial status signals and the safety outputs by means of an example

System condition	LED's			Safety outputs Y1, Y2	Status signals serial diagnostic byte Bit n°							
	green	red	yellow		7	6	5	4	3	2	1	0
Non-actuated, inputs X1 and X2 enabled	On	Off	Off	0 V	0	0	0	1	0	0	0	0
Actuated, safety outputs enabled	Off	Off	On	24 V	0	0	0	1	0	0	1	1
Actuated in limit area	Off	Off	Flashes (1Hz)	24 V	0	0	1	1	0	0	1	1
Actuated, warning	Off	On/flashes	Off	24 V	0	1	0	1	0	0	1	1
Actuated, fault	Off	On/flashes	Off	0 V	1	1	0	1	0	0	1	0

The shown bit order of the diagnostic byte is an example. A different combination of the operational conditions will lead to a change of the bit order.

Table 3: Tabular overview of status signals, warnings or error messages(The described condition is reached, when Bit = 1)

Communication directions: Request byte: from the PLC to the local safety sensor
 Response byte: from the local safety sensor to the PLC
 Warning/error byte: from the local safety sensor to the PLC

Bit n°	Request byte	Response byte	Diagnostic	
			Error warning	Error messages
Bit 0:	---	Safety output activated	Error output Y1	Error output Y1
Bit 1:	---	Actuator detected	Error output Y2	Error output Y2
Bit 2:	---	---	Cross-wire Y1/Y2	Cross-wire Y1/Y2
Bit 3:	---	---	Temperature too high	Temperature too high
Bit 4:	---	Input condition X1 and X2	---	Incorrect or defective actuator
Bit 5:	---	Actuated in limit area	Internal device error	Internal device error
Bit 6:	---	Error warning	Communication error between the field bus Gateway and the safety switchgear	---
Bit 7:	Error reset	Error (enabling path switched off)	---	---

7. Set-up and maintenance

The safety function of the safety components must be tested. In the case of correct installation and adequate use, the safety switchgear features maintenance-free functionality. A regular visual inspection and functional test, including the following steps, is recommended:

1. Check fixation of the safety switch and the actuator.
2. Fitting and integrity of the cable connections.
3. The system is free of dirt and soiling (in particular metal chips).



Adequate measures must be taken to ensure protection against tampering either to prevent tampering of the safety guard, for instance by means of replacement actuators.



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. Declaration of conformity

We declare under our sole responsibility that the products mentioned comply with all relevant provisions of the directives and regulations listed below and conform to the following standards.

Einschlägige Richtlinien:

2006/42/EG	SI 2008/1597	EN 60947-5-3:2013
2014/53/EU	SI 2017/1206	EN 300 330 V2.1.1:2017
2011/65/EU	SI 2012/3032	ISO 14119:2013
		EN ISO 13849-1:2015
		IEC 61508 Teile 1-7:2010



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The currently valid declaration of conformity can be downloaded from the internet at products.schmersal.com.

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