SCHMERSAL

EN Operating instructions ..... pages 1 to 6
Original

CS DA ES FR IT
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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.

The Schmersal range of products is not intended for private consumers.

2. Product description

2.1 Purpose and use

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-version: high I2-version: high Standard coding version: 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 x 10^{-10} /h
PFD value	2.10 x 10^{-5}
Safety Integrity Level (SIL), suitable for application in	3
Mission time	20 years
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 for the fixing screws	2.2 ... 2.5 Nm
Mechanical data - switch distances according to EN IEC 60947-5-3	
Switching distance, typically	12 mm
Assured switching distance "ON" S_{ao}	10 mm
Assured switching distance "OFF" S_{ao}	20 mm
Mechanical data - Termination	
Termination	plug connector M12, 8-pin, plug connector M12, 5-pin, A-coded
Notice (Series-wiring)	Unlimited number of components, please observe external cable protection, max. 31 components in case of serial diagnostics SD
Notice (Length of the sensor chain)	Cable length and cable section alter the voltage drop depending on the output current
Electrical data	
Rated operating voltage	24 VDC −15 % / +10 %
Note (Power supply, general)	stabilised PELV
Operating current, minimum	0,5 mA
Open circuit 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_d, minimum	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_d, minimum	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 ≤ s_{ao} and ≥ 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 x 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.

With the F0/F1 option, the sensor performs the tasks of a safety-monitoring module. At both safety outputs, two auxiliary contactors[1)] or Relays[1)] ([1)] each with positive-action contacts in accordance with EN 60947-5-1 or EN 50205) can be connected, whose safety-related function is checked by the sensor by means of a feedback circuit (External Device Monitoring). The feedback circuit includes the series-wiring of the NC contacts of the auxiliary contactors or relays. For the F0 version, an “enabling switch” (without safety function) can be integrated into the feedback circuit. For the F1 version, a so-called “reset button” is required, which is monitored for a trailing edge. This function corresponds to the “manual reset function” to EN ISO 13849-1.

The Q option monitors simultaneous shutdown of the sensor inputs. Series-wired sensors enable integration of EMERGENCY STOP switching elements for applications to PL e. The EMERGENCY STOP contacts are supplied by the cross-circuit monitored output signals of an upstream electronic safety switchgear device. At the end of the chain, a sensor with Q option for connecting an acknowledgement function monitors the chain for synchronous shutdown of both channels. In the event of erroneous shutdown, the error must be rectified. The safety outputs can be reactivated only once the error has been acknowledged.

4.2 Connection example

Function safety switchgear			Pin configuration of the connector	
	With conventional diagnostic output	with serial diagnostic function		
A1	U_e		1	1
X1	Safety input 1		2	
A2	GND		3	3
Y1	Safety output 1		4	4
OUT	Diagnostic output	SD-output	5	5
X2	Safety input 2		6	
Y2	Safety output 2		7	2
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		Incorrect or defective actuator
6 flash pulses		Discrepancy time error at X1/X2
Continuous red (yellow LED flashing)		Actuator teaching (if actuator within range)
Continuous red (possibly with yellow flashing LED)		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			Diagnostic output	Safety outputs	Comments
		green	red	yellow		Y1, Y2	
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.	Internal error or in the event of simultaneous flashing, teach-in process	On	Off	Flashes (1Hz)	24 V	0 V	The sensor awaits a signal on the feedback circuit: F0: Closure of the feedback circuit F1: Falling edge on the feedback circuit
V.	Actuated in limit area and feedback circuit open	On	Off	Flashes alternating (1Hz / 5Hz)	24 V pulsed	0 V	LED indication combines the sensor functions III. and IV.
VI.	Error warning, sensor actuated	Off	Flashes	Off	0 V	24 V	After 30 minutes if the error is not rectified
VII.	Error	Off	Flashes / On	Off / Flashes	0 V	0 V	Refer to table with flash codes
VIII.	Teach actuator	Off	On	Flashes	0 V	0 V	Sensor in teaching mode
IX.	Protection time	Flashes	Off	Off	24 V	0 V	10 minutes pause after re-teaching
X.	No input signal at 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.
XI.	No input signal at 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 3: feedback circuit open or reset button not actuated
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.

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).

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

Detailed information about the use of the serial diagnostics can be found in the operating instructions of the PROFIBUS-Gateway SD-I-DP-V0-2 and the Universal-Gateway SD-I-U-….

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	Status signals serial diagnostic byte Bit n°							
	green	red	yellow	Y1, Y2	7	6	5	4	3	2	1	0
Non-actauted, inputs X1 and X2 enabled	On	Off	Off	0 V	0	0	0	1	0	0	0	0
Actuated, feedback circuit open / not actuated	On	Off	Flashes (5Hz)	0 V	0	0	0	1	1	0	1	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 acknowledgement, Discrepancy time exceeded	Error warning	Communication error between the field bus Gateway and the safety switchgear	Error, discrepancy time exceeded at X1/X2
Bit 7:	Error reset	Error (enabling path switched off)	---	---

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. 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).

Functional test after assembly and connection of the RSS 36…-F0/-F1 All safety guards must be closed prior to the start of the functional test. The feedback circuit must be opened. [1]			
No.	**Action to test the operation**	**Reaction RSS 36 F0 version**	**Reaction RSS 36 F1 version**
1	Switch on the operating voltage	The yellow LED flashes at 5 Hz and the relays are disabled.	The yellow LED flashes at 5 Hz and the relays are disabled.
2	Close the feedback circuit: actuate the connected button [2]	The yellow LED is on and both connected relays are enabled	No change compared to 1
3	Only version F1: reset button actuation	No change compared to 2	The yellow LED is on and both connected relays are enabled

[1] If no button is used, the feedback circuit must be opened by loosening the cable. To that effect, the voltage must be switched off.
[2] If no button is used, the feedback circuit must be closed by reconnecting the cable. To that effect, the voltage must be switched off.

With the F1 function, the button monitored on the falling edge must be actuated.
A non-monitored button integrated into the feedback circuit with function F0 is effective on closing.

An emergency-stop switching element integrated into series wiring can be monitored by the Q function in the last sensor of the chain. This monitors the simultaneous shutdown of its safety inputs and closes the safety outputs in the event of deviations greater than 500 ms. A malfunction in the chain detected in this way must be rectified immediately. Release is only then possible after the error has been acknowledged. The error will remain saved even in the event of a power interruption. Error acknowledgement must be effected via the negative edge of an acknowledge button connected to pin 8 or via the serial diagnosis line.

In addition, when emergency-stop switching elements are integrated, a reset button must be provided, as no automatic restart of the machine is permissible when an emergency-stop command is revoked.

As per the test interval referenced in the Maintenance chapter, the emergency-stop switching elements monitored in this way meet the requirements to PL e.

7.2 Functional testing

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 the fixing and integrity of the safety switchgear, the actuator and the cable.
2. Remove possible 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.

EMERGENCY STOP switching elements integrated into a series circuit with Q monitoring must have their function checked manually on a regular basis. An annual inspection is sufficient for a typical Cat. 3/PL d application. A monthly inspection is required for a typical Cat. 4/PL e application.

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.

Relevant Directives:

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 13849-1:2023
		IEC 61508 parts 1-7:2010

	Notified body for Type Examination:	Type Examination Certificate
CE	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln ID n°: 0035	01/205/5115.03/24
UKCA	TÜV Rheinland UK 1011 Stratford Road Solihull, B90 4BN ID n°: 2571	01/205U/5115.01/25

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

10. Contact

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