



EN Operating instructions. pages 1 to 8
Original

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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 machine 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 "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 Schmersal catalogues or in the online catalogue on the Internet: www.schmersal.net.

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 improper use or manipulation of the safety switch-gear, 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

These mounting instructions apply to the following types:

CSS 15-30-2P+D-M-L

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 Comprehensive quality insurance to 2006/42/EC

Schmersal is a certified company to appendix X of the Machinery Directive. As a result, Schmersal is entitled to autonomously conduct the conformity assessment procedure for the products listed in Appendix IV of the MD without involving a notified body. The prototype test certificates are available upon request or can be downloaded from the Internet at www.schmersal.com.

2.4 Purpose

This non-contact, electronic safety sensor is designed for application in safety circuits and is used for monitoring the position of movable safety guards. In this application, the safety sensor monitors the closed position of hinged, sliding or removable safety guards by means of the coded electronic CST 30-1 or CST 34-S-3 actuator.



The safety switchgears are classified according to ISO 14119 as type 4 interlocking devices.

Mode of operation of the safety outputs

The opening of a safety guard or the removal of the actuator out of the active zone of the safety sensor, will immediately disable the safety outputs of the safety sensor (also refer to "Switching distance").

Series-wiring

Max. 16 sensors can be wired in series. A 200 m long sensor chain can be set up. Wiring examples for series-wiring, refer to appendix



The user must evaluate and design the safety chain in accordance with the relevant standards and the required safety level.
If multiple safety sensors are involved in the same safety function, the PFH values of the individual components must be added.



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

2.5 Technical data

Standards:	IEC 60947-5-3, ISO 13849-1, IEC 61508
Enclosure:	Brass, nickel-plated
Operating principle:	inductive
Actuator:	CST 30-1, CST 34-S-3
Coding level according to ISO 14119:	low
Switching distances to IEC 60947-5-3:	
Rated operating distance S_n :	CST 30-1: 15 mm, CST 34-S-3: 12 mm
Assured switching distance S_{ao} :	CST 30-1: 12 mm (s_{ao} min: 1 mm), CST 34-S-3: 10 mm
Assured switch-off distance S_{ar} :	CST 30-1: 19 mm, CST 34-S-3: 16 mm
Hysteresis:	max: 2.0 mm
Repeat accuracy R:	< 1 mm
Maximum switching frequency:	3 Hz
Series-wiring:	max. 16 components
Cable length	max. 200 m (cable length and cable section alter the voltage drop depending on the output current)
Connecting cable:	PVC / LIYY / 7 x 0,25 mm ² / UL-Style Y-UL 2464 / AWG 24 / 2 m

Ambient conditions:

Ambient temperature T_u :	
- max. output current \leq 500 mA /output	-25 °C ... +55 °C
- output current \leq 200 mA /output	-25 °C ... +65 °C
- output current \leq 100 mA /output	-25 °C ... +70 °C
Storage and transport temperature:	-25 °C ... +85 °C
Resistance to vibration:	10...55 Hz, Amplitude 1 mm
Resistance to shock:	30 g / 11 ms
Protection class:	IP65 / IP67

Electrical data:

Rated operating voltage U_e :	24 VDC --15% / +10% (stabilised PELV to IEC 60204-1)
Rated operating current I_e :	1.1 A
Required rated short-circuit current:	100 A
Fuse rating:	
- External fuse:	1.0 A at output current \leq 200 mA, 1.6 A at output current $>$ 200 mA
Rated insulation voltage U_i :	32 V
Rated impulse withstand voltage U_{imp} :	800 V
No-load current I_0 :	0,05 A
Response time:	\leq 30 ms
Duration of risk:	\leq 30 ms
Protection class:	II
Overvoltage category:	III
Degree of pollution:	3
Time to readiness:	\leq 2 s

Safety inputs X1/X2:

Rated operating voltage U_{e1} :	24 VDC -15% / +10% PELV (to IEC 60204-1)		
Rated operating current I_{e1} :	1 A		
Accepted test pulse duration on input signal:	≤ 1.0 ms		
- With test pulse interval of:	≥ 100 ms		
Classification:	ZVEI CB24I		

Sink:	C1	Source:	C1	C2	C3
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Safety outputs Y1/Y2:

NO function, p-type, short-circuit proof	
Voltage drop:	0.5 V
Rated operating voltage U_{e1} :	min. $U_e - 0.5$ V
Leakage current I_l :	≤ 0.5 mA
Rated operating current I_{e1} :	max. 0.5 A depending on the ambient temperature

Utilisation category:	DC-12 U_e/I_e 24 VDC / 0.5 A
	DC-13 U_e/I_e 24 VDC / 0.5 A

Test pulse duration:	≤ 2.0 ms
Test pulse interval:	2,000 ms
Classification:	ZVEI CB24I

Source:	C0	Sink:	
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Diagnostic output:

Diagnostic output:	short-circuit proof, p-type
Rated operating voltage U_{e2} :	max. 4 V below U_e
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 / 0.05 A

2.6 Safety classification

Standards:	ISO 13849-1, IEC 61508
PL:	e
Control Category:	4
PFH:	2.5×10^{-9} / h
SIL:	suitable for SIL 3 applications
Mission time:	20 years

3. Mounting

3.1 General mounting instructions



During fitting of the actuator and the sensor, the requirements of ISO 14119, especially paragraph 7 must be observed!

The safety sensor and the corresponding actuator can be fixed using the supplied M30 nuts (A/F 36). The max. tightening torque of the supplied screws is 30 Nm. Alternatively, the H 30 fixing clamp (accessory) can be used for the fixation of the safety sensor. The CST- 30-1 actuator can be screwed into a prepared tapped hole M30.

A concealed mounting is possible, however this reduces the switching distance. The reduction will be lower, when the sensor and the actuator protrudes a few mm.

The component can be mounted in any position. The only condition is that, the active surface of the safety sensor and the actuator are opposite. The marking of the safety sensor simultaneously identifies the active face. The sensor enclosure must not be used as an end stop. The safety sensor must only be used within the assured switching distances $\leq s_{a0}$ and $\geq s_{ar}$.



The actuator and/or clamp must be permanently fitted to the guard system and protected against displacement by suitable measures (tamperproof screws, gluing, drilling of the screw heads, pinning).

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 the center lines of two sensors: 100 mm

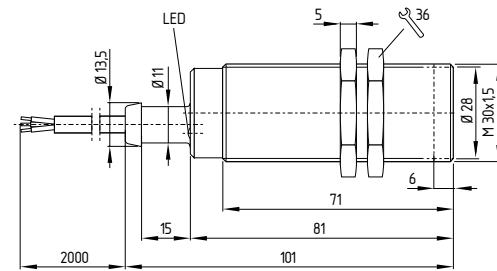


When used at ambient temperatures < -10 °C, the connecting cables must be hardwired.

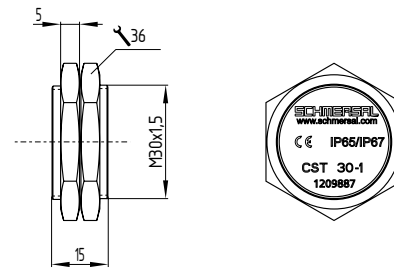
3.2 Dimensions

All measurements in mm.

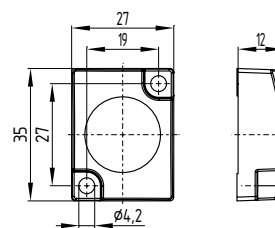
Safety sensor



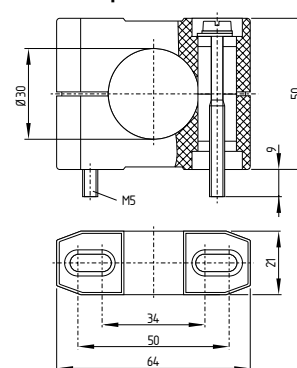
CST 30-1 actuator



Actuator CST 34-S-3



H 30 clamp



3.3 Adjustment

The LED in the end cap of the safety sensor can be used as adjustment tool.

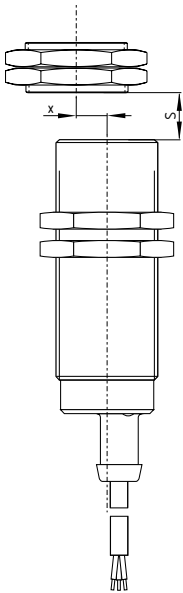
The yellow flashing LED of a sensor signals that an adjustment of the switching distance is required. Reduce the distance between the sensor and the actuator, until the of the LED in the end cap of the safety sensor is continuously lit yellow.

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

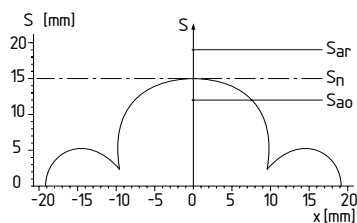
3.4 Switch distance

The graphs show the switch-on and switch-off points of the sensor due to the approach of the actuator CST 30-1. The maximum misalignment of the actuator with regard to the sensor centre is: refer to on the switching diagram.

A concealed mounting is possible, however this reduces the switching distance. The reduction will be lower, when the sensor and the actuator protrudes a few mm.



Typical response range of the safety sensor



Key	
S	Switch distance
X	Axial offset
S _n	Rated operating distance
S _{ao}	Assured switching distance
S _{ar}	Assured switch-off distance

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 power supply for the safety sensors must provide protection against permanent over-voltage. Under fault conditions, the voltage must not exceed 60 V. supply units according to IEC 60204-1 is recommended.

The safety outputs can be integrated into 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 sensor or sensor of the 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
- Digital inputs to EN 61131-2, Table "Standard operating ranges for digital inputs (current sinking)"

The safety-monitoring module must tolerate internal functional tests of the sensors with cyclic switch-off of the sensor outputs for max. 1 ms. The safety-monitoring module must not be equipped with a cross-wire detection function. Short-circuit recognition by the evaluation is not necessary.



Information for the selection of suitable safety-monitoring modules can be found in the Schmersal catalogues or in the online catalogue on the Internet: www.schmersal.net.



If the safety sensor is connected to electronic safety-monitoring modules, we recommend that you set a discrepancy time of min. 100 ms. The safety inputs of the safety-monitoring module must be able to blank a test impulse of approx. 1 ms. The safety-monitoring module does not need to have a cross-wire short monitoring function, if necessary, the cross-wire short monitoring function must be disabled.

4.2 Series-wiring

A 200 m long sensor chain can be set up. Please note that voltage losses could occur (due to cable length, cable section, voltage drop/ sensor)! For longer cable lengths, the section of the connecting cables must be taken as large as possible.

Wiring examples for series-wiring, refer to appendix.

4.3 Note on the total length of a safety sensor chain

The voltage drop of a long sensor chain must be taken into account when planning the wiring.

Typical resistance of the different sensor connecting cables (20°C):

- 0,50 mm²: ca. 36 Ω / km
- 0,34 mm²: ca. 52 Ω / km
- 0,25 mm²: ca. 71 Ω / km

The resistance of the safety outputs / sensor used is load-dependent:

- 300 mΩ at 1 A current load, i.e. max. load of the safety outputs is 2 x 500 mA
- 30 mΩ at 100 mA current load, i.e. 2x 50 mA load when a safety-monitoring module is connected.
- Power consumption of a safety sensor approx. 30 mA
- Diagnostic output of a safety sensor max. 50 mA

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.

5. Set-up and maintenance

5.1 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)

After the sensor is wired, please check whether:

1. the enabling signal is given when the safety guard is closed and
2. the machine is switched off when the safety guard is opened.

5.2 Maintenance

In the case of correct installation and adequate use, the safety sensor 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 sensor, the actuator and the cable
2. Remove possible metal chips



Measures must be taken to protect against manipulation or against the bypassing of safety device, for example, using an extra actuator.

Damaged or defective components must be replaced.

6. Diagnostic functions

6.1 Operating principle of the 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 green LED indicates that the safety sensor is ready for operation. The sensor is not actuated. When the safety sensor is actuated by the actuator, the indication LED switches from green to yellow. The safety outputs of the safety sensor are enabled. If the actuator is near the limit of the sensor's switching distance, the yellow LED will flash. The safety outputs remain enabled. The sensor can be readjusted before the safety outputs are disabled, thus stopping the machine. An active fault is indicated by the red flashing LED and causes the diagnostic output to be disabled. Errors in the coding of the actuator, at the outputs of the sensor or in the sensor are signalled by the red LED. After a short analysis of the active fault, signalled by the red permanent signal, the defined error is indicated by flash pulses. The safety outputs are disabled in a delayed manner, when the fault is active for 1 minute.

Flash codes red diagnostic LED

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 error

6.2 Operating principle of the electronic diagnostic output

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

The electronic diagnostic output signals faults before the safety outputs are disabled, thus enabling a controlled shutdown.

The diagnostic output is not a safety-relevant output!

The closed condition of the safety guard, i.e. the sensor is actuated, is indicated through a positive signal. If the sensor is operating near the limit of its switching distance, e.g. due to the sagging of the safety guard, the sensor will emit a 2 Hz cyclic signal before the safety outputs are disabled. An active fault will disable the diagnostic output after a short analysis.

Table: diagnostic information

Sensor status	LED	Diagnostic output	Safety outputs
Not actuated	green	0 V	0 V
Actuated	yellow	24 V	24 V
Actuated in limit area	flashes yellow	2 Hz pulsed	24 V
Fault: 1- 5 pulses	flashes red	10 s delayed 24 V → 0 V	1 min delayed 24 V → 0 V
Error	red	10 s delayed 24 V → 0 V	undelayed 24 V → 0 V

Error

Faults which no longer guarantee the functioning of the safety sensor (internal fault,) will also disable the safety outputs immediately. Any error that does not immediately affect the safe functioning of the safety sensor (e.g. the ambient temperature too high, interference potential at a safety output, cross-wire short) will lead to a delayed shut-down. In this situation, the diagnostic output will be switched off after approx. 10 seconds. The safety outputs are disabled after max. 1 minute 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.

After fault rectification, the error message is reset by opening and re-closing the corresponding safety guard.

The safety outputs will switch, thus enabling the machine. For the release, the chain of sensors must be permanently actuated.



A cross-wire short at the safety outputs of a sensor chain will load the sensor from the place where the fault is located up to the end of the chain. The fault therefore can be signalled by multiple sensors. Starting from the safety-monitoring module, the cross-wire short is located before the first sensor signalling the fault.

7. Disassembly and disposal

7.1 Disassembly

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

7.2 Disposal

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

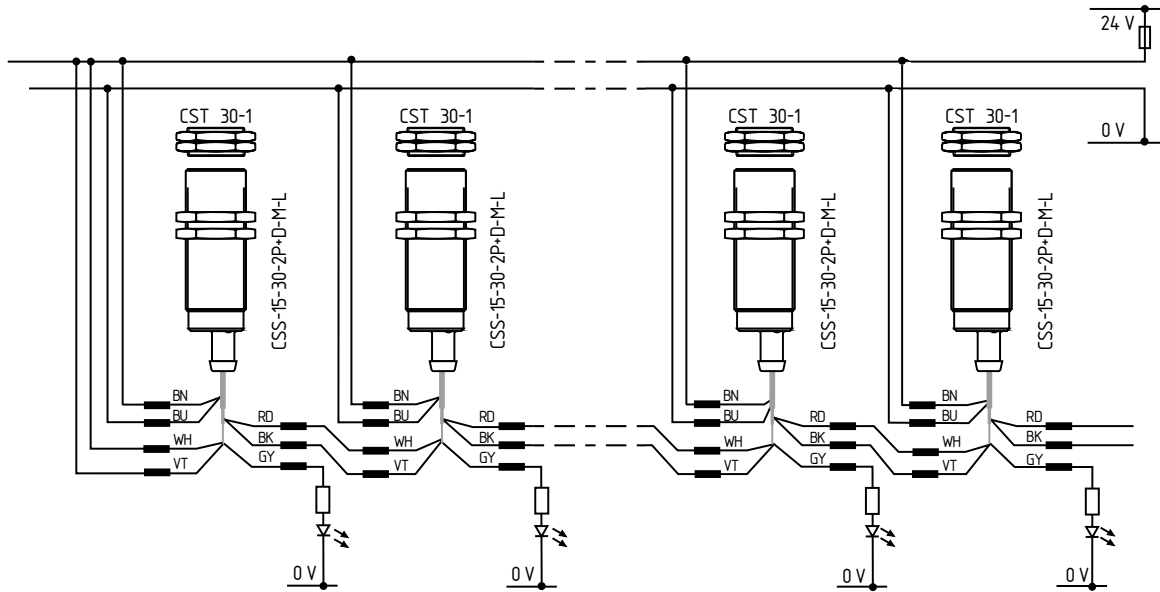
8. Appendix

8.1 Wiring example

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

Series-wiring of safety sensors with common connecting cable for the inputs and outputs

The series-wiring of multiple safety sensors is realised by wiring in the control cabinet or in on-site junction boxes.



BK and RD = safety outputs Y1 and Y2 -> safety-monitoring module

For the last safety sensor of the series-wiring, the positive operating voltage must be wired to both safety inputs.

8.2 Connection example

Lead colours	Connection example
BN (brown)	A1 Ue
BU (blue)	A2 GND
VT (violet)	X1 safety input 1
WH (white)	X2 safety input 2
BK (black)	Y1 safety output 1
RD (red)	Y2 safety output 2
GY (grey)	Diagnostic output

9. EU Declaration of conformity

EU Declaration of conformity



Original K.A. Schmersal GmbH & Co. KG
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We hereby certify that the hereafter described components both in their basic design and construction conform to the applicable European Directives.

Name of the component: CSS 15-30

Description of the component: Non-contact safety sensor

Relevant Directives: 2006/42/EC Machinery Directive
2014/30/EU EMC-Directive
2011/65/EU RoHS-Directive

Applied standards: DIN EN 60947-5-3:2014,
ISO 14119:2013,
DIN EN ISO 13849-1:2008,
DIN EN 61508:2011

Notified body for the prototype test: IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung
Prüf und Zertifizierungsstelle im DGUV Test
Alte Heerstraße 111
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Philip Schmersal
Managing Director

CSS30-E-EN



The currently valid declaration of conformity can be downloaded from the internet at www.schmersal.net.



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