



**EN** Operating instructions. . . . .pages 1 to 8  
Translation of the original operating instructions

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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, 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](http://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 switchgear, personal hazards or damages to machinery or plant components cannot be excluded when safety switchgear is used. 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:

CSS 11-①-②-M-ST		
No.	Option	Description
①	30NO	Stainless steel enclosure
	300	Thermoplastic enclosure
②	D	With diagnostic output
	SD	With serial diagnostic function
<b>Actuator</b>		
CST 30S-1		M30-Stainless steel threaded pipe

### 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 EC prototype test certificates are available upon request or can be downloaded from the Internet at [www.schmersal.com](http://www.schmersal.com).

### 2.4 Destination and use

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 position of hinged, sliding or removable safety guards by means of the coded electronic actuator.



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



The safety sensor CSS 300 is suitable for concealed installation behind stainless steel.

The diagnostic output of the safety sensor alternatively can be used as a conventional output or as a "serial output" with input and output channel. The serial connections of the individual sensors are wired in series together with other devices and connected to a Field Bus Gateway.

### Mode of operation of the safety outputs

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 (also refer to Switching distance of the safety sensor).

Any error that does not immediately affect the functioning of the safety sensor (e.g. too high the ambient temperature, interference potential at a safety output, cross-wire short) will lead to a delayed shut-down. The safety outputs are disabled after 30 minutes if the error 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 enable and allow a restart.

### Series-wiring

Max. 31 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
Housing:	
- CSS 30S:	stainless steel, 1.4404 to EN 10088
- CSS 300:	thermoplastic enclosure
Operating principle:	inductive
Coding level according to ISO 14119:	low
<b>Switching distances to IEC 60947-5-3:</b>	
Rated operating distance $S_n$ :	11 mm
Assured switching distance $s_{so}$ :	8 mm
Assured switch-off distance $s_{gr}$ :	15 mm
Hysteresis:	< 2 mm
Repeat accuracy:	< 1 mm
Switching frequency f:	3 Hz
Connection:	M12 connector, 8 pole
Series-wiring:	max. 31 devices
Fuse (Circuit breaker):	external, 2 A
Cable length:	max. 200 m
<b>Ambient conditions:</b>	
Ambient temperature $T_u$ :	
- CSS 30S:	-25 °C ... +65 °C
- CSS 300:	-25 °C ... +60 °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:	
- CSS 30S:	IP69K, to DIN 40050-9; IP65, IP67 to IEC 60529
- CSS 300:	IP65, IP67 to IEC 60529
EMC rating:	according to EN 61000-6-2
Electromagnetic interference:	according to EN 61000-6-4
<b>Electrical data:</b>	
Rated operating voltage $U_e$ :	24 VDC -15% / +10% (stabilised PELV to IEC 60204-1)
Rated operating current $I_e$ :	0.6 A
No-load current $I_o$ :	max. 0.1 A; in average: 50 mA
Protection class:	II
Overvoltage category:	III
Degree of pollution:	3

Rated impulse withstand voltage $U_{imp}$ :	0.8 kV
Rated insulation voltage $U_i$ :	32 V
Response time:	< 60 ms
Duration of risk:	< 60 ms
<b>Safety outputs Y1/Y2:</b>	NO function, dual-channel, p-type, short-circuit proof
Rated operating voltage $U_{e1}$ :	24 VDC (-15% / +10%)
Voltage drop:	$U_e < 1$ V
Leakage current $I_l$ :	< 0.5 mA
Related operating current $I_{e1}$ :	max. 0.25 A
Minimum operating current $I_m$ :	0.5 mA
Utilisation category:	DC-12, DC-13
Required rated short-circuit current:	100 A
<b>Diagnostic output:</b>	short-circuit proof, p-type
Rated operating voltage $U_{e2}$ :	24 VDC (-15% / +10%)
Voltage drop:	$U_e < 5$ V
Related operating current $I_{e2}$ :	max. 0.05 A
Utilisation category:	DC-12, DC-13
<b>Serial diagnostic</b>	
Operating current:	150 mA, short-circuit proof
Wiring capacitance for serial diagnostics:	max. 50 nF

### 2.6 Safety classification

Standards:	ISO 13849-1, IEC 61508
PL:	e
Control Category:	4
PFH:	$3.6 \times 10^{-9}$ / h
PFD:	$3.95 \times 10^{-5}$
SIL:	suitable for SIL 3 applications
Service life:	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 sensor enclosure must not be used as an end stop. The component can be mounted in any position. The active surface 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 safety sensor and the corresponding actuator can be fixed using the supplied M30 nuts (A/F 36). The max. tightening torque is 30 Nm (CSS 30S) or 400 Ncm (CSS 300).

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 actuator has a slot in the active front surface. In confined spaces, this slot can be used to fix the actuator by means of a screwdriver.



Safety sensor 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).

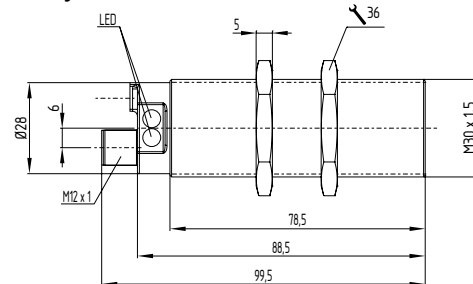
To avoid any interference inherent to this kind of system and any reduction of the switching distances, please observe the following guidelines:

- Minimum distance between two sensors:  
CSS 30S: 50 mm  
CSS 300: 100 mm
- The presence of metal chips in the vicinity of the sensor is liable to modify the switching distance
- Keep away from metal chips

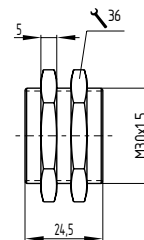
### 3.2 Dimensions

All measurements in mm.

#### Safety sensor size



#### Dimensions Actuator



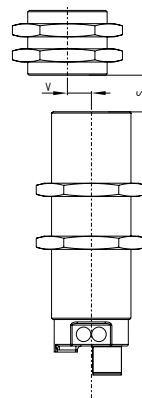
### 3.3 Adjustment

The LED of the safety sensor can be used as an 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 LED of the safety sensor is continuously lit yellow.

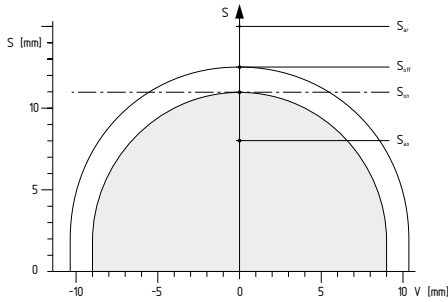
The correct functionality of both safety channels must be checked by means of the connected safety-monitoring module.

### 3.4 Switching distance

The graphs show the switch-on and switch-off points of the sensor due to the approach of the actuator. The maximum misalignment of the actuator with regard to the sensor centre is 9 mm. A concealed mounting of the sensor and the actuator will reduce the switching distance. (see "Mounting" part)



Typical response range of the sensor



- Key**
- S Switching distance
  - X Axial misalignment
  - $S_{on}$  Switch-on distance
  - $S_{off}$  Switch-off distance
  - $S_h$  Hysteresis range  $S_h = S_{off} - S_{on}$
  - $S_{ao}$  Assured switch-on distance to IEC 60947-5-3
  - $S_{ar}$  Assured switch-off distance to IEC 60947-5-3

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.

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

The sensors cyclically switch off the safety output to test them. The switch-off times of 250  $\mu$ s – 1500  $\mu$ s must be tolerated by the safety-monitoring module. The switch-off time of 250 $\mu$ s of the safety sensor is additionally extended depending on the cable length and the capacity of the cable used. Typically a switch off time of 500  $\mu$ s with 100 m of connection cable is reached. A cross-wire short detection is therefore not required as part of the evaluation.



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](http://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 blanking 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

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.



When wiring SD devices, please observe the voltage drop on the cables and the current carrying capacity of the individual components.

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 safety sensor is wired, open and close the safety guard to check whether the enabling signal is given.

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 LED's

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

The green LED indicates that the safety sensor is ready for operation. The supply voltage is on. The yellow LED always signals the presence of an actuator within range. If the actuator is operating near the limit of the hysteresis range of the safety sensor, the LED is 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. Either red or green illuminates in a two colour LED. If an error is detected, the red LED will be activated.

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-related output!**

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 causes the diagnostic output to be disabled. The safety outputs are disabled after max. 30 minutes if the fault is not rectified. The 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 with conventional diagnostic output**

System condition	Duo LED		LED	Diagnostic output	Safety outputs Y1, Y2	Note
	green	red	yellow			
Supply voltage on, not actuated	On	Off	Off	0 V	0 V	Voltage on, no evaluation of the voltage quality
Actuated	On	Off	On	24 V	24 V	The yellow LED always signals the presence of an actuator within range
Actuated in limit area	On	Off	Flashes	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
Actuator, error warning	Off	Flashes	On	0 V	24 V	The safety outputs are disabled after 30 minutes if the error is not rectified.
Actuated, fault	Off	Flashes	On	0 V	0 V	Refer to table with flash codes
Actuated, internal fault	Off	On	On	0 V	0 V	---

**6.3 Safety-sensors with serial diagnostic function**

Safety sensors with serial diagnostic cable have a serial input and output cable instead of the conventional diagnostic output. If safety sensors are wired in series, the safety channels as well as the inputs and outputs of the diagnostic channels are wired in series.

Max. 31 sensors can be wired in series. 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 serial diagnostic interface 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 documentation for the integration of the SD-Gateway is available for download at [www.schmersal.com](http://www.schmersal.com).



**Accessories SD interface**

For ease of wiring and series-wiring of SD devices, considerable accessories are available. Detailed information is available on the Internet, [www.schmersal.net](http://www.schmersal.net).

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 field bus Gateway and the safety sensor, the switching condition of the safety output of the safety sensor is maintained.

**Error**

A fault has occurred, which causes the safety outputs to be disabled. 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 has occurred, which causes the safety outputs to be disabled after 30 minutes. The safety outputs initially remain enabled. This enables the shutdown of the process in a controlled manner. An error warning is deleted when the cause of error is eliminated.

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

System condition	Duo-LED		LED	Safety outputs Y1, Y2	Response byte Bit-Nr.								
	green	red	yellow		7	6	5	4	3	2	1	0	
Supply voltage on, not actuated	On	Off	Off	0 V	0	0	0	0	0	0	0	0	0
Actuated, safety outputs enabled	On	Off	On	24 V	0	0	0	1	0	0	1	1	
Actuated in limit area	On	Off	Flashes	24 V	0	0	1	1	0	0	1	1	
Actuator, error warning	Off	Flashes	On	24 V	0	1	0	1	0	0	1	1	
Actuated, fault	Off	Flashes	On	0 V	1	0	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: I/O data and diagnostic data

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	Diagnostic error
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 switch	---
Bit 7:	Error reset	Error (enabling path switched off)	---	---

The described condition is reached, when Bit = 1

## 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.

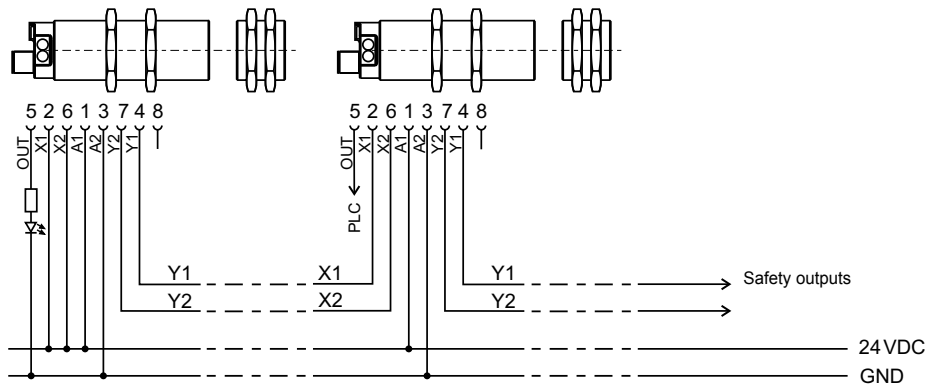
## 8. Appendix

### 8.1 Wiring examples

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.

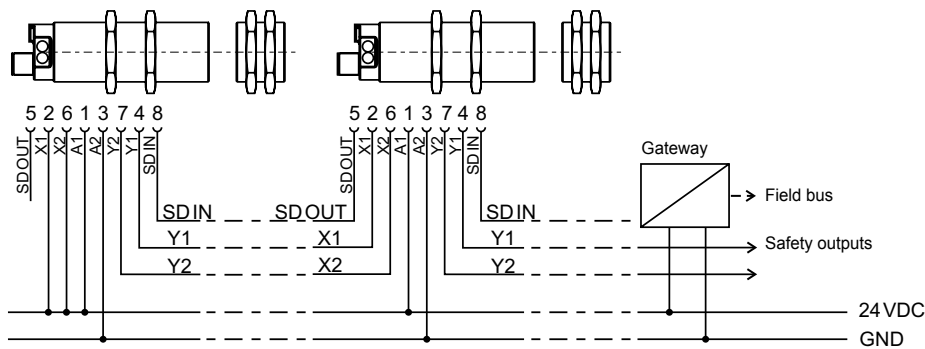
**Wiring example 1: Series-wiring of the safety sensor with diagnostic output**

The voltage is supplied at the safety inputs of the terminal sensor of the chain (considered from the safety-monitoring module). The safety outputs of the first sensor are wired to the safety-monitoring module.

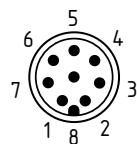
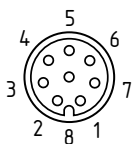


**Wiring example 2: Series-wiring of the safety sensor with serial diagnostic function**

The safety outputs of the first sensor (viewed from the monitoring position) are wired to the safety-monitoring module. The Fieldbus Gateway is connected to the serial diagnostic input of the first sensor.



**Table 4: Wiring and connectors**



**Connecting cables with coupling (female)**

**IP67, M12, 8-pole - 8 x 0.23 mm<sup>2</sup>**  
 Cable length 2.5 m                   **1209963**  
 Cable length 5 m                       **1209964**  
 Cable length 10 m                      **1209960**

**IP69K, M12, 8-pole - 8 x 0.21 mm<sup>2</sup>**  
 Cable length 5 m                       **1210560**  
 Cable length 5 m, angled           **1210561**


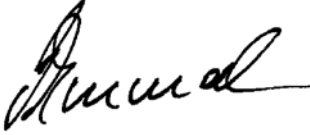
Function safety switchgear		Pin configuration of the integrated connector	Colour code of the Schmersal connector or the integrated cable	Poss. Colour codes of other conventional connectors	
with conventional diagnostic output	with serial diagnostic function			to IEC 60947-5-2: 2007	to DIN 47100
<b>A1</b>	$U_e$	1	BN	BN	WH
<b>X1</b>	Safety input 1	2	WH	WH	BN
<b>A2</b>	GND	3	BU	BU	GN
<b>Y1</b>	Safety output 1	4	BK	BK	YE
<b>OUT</b>	Diagnostic output	SD output	5	GY	GY
<b>X2</b>	Safety input 2	6	VT	PK	PK
<b>Y2</b>	Safety output 2	7	RD	VT	BU
<b>IN</b>	without function	SD input	8	PK	OR / shielded

**Colour code key**

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		

9. Declaration of conformity

9.1 EC Declaration of conformity

	
<b>EC Declaration of conformity</b>	
Translation of the original Declaration of Conformity	K.A. Schmersal GmbH & Co. KG Möddinghofe 30 42279 Wuppertal Germany www.schmersal.com
We hereby certify that the hereafter described safety components both in its basic design and construction conform to the applicable European Directives.	
<b>Name of the safety component:</b>	CSS 30S CSS 300
<b>Type:</b>	Refer to ordering code
<b>Description of the safety component:</b>	Non-contact safety sensor
<b>Harmonised EC-Directives:</b>	2006/42/EC-EC-Machinery Directive 2004/108/EC EMC-Directive
<b>Person authorised for the compilation of the technical documentation:</b>	Oliver Wacker Möddinghofe 30 42279 Wuppertal
<b>Notified body, which approved the full quality assurance system, referred to in Appendix X, 2006/42/EC:</b>	TÜV Rheinland Industrie Service GmbH Alboinstr. 56 12103 Berlin ID n°: 0035
<b>Place and date of issue:</b>	Wuppertal, February 14, 2014
CSS 30S-D-EN	
	Authorised signature <b>Philip Schmersal</b> Managing Director



The currently valid declaration of conformity can be downloaded from the internet at [www.schmersal.net](http://www.schmersal.net).



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