



EN Operating instructions.pages 1 to 8
Original

Content

1 About this document

1.1 Function 1

1.2 Target group: authorised qualified personnel. 1

1.3 Explanation of the symbols used 1

1.4 Appropriate use 1

1.5 General safety instructions 1

1.6 Warning about misuse 1

1.7 Exclusion of liability 2

2 Product description

2.1 Ordering code 2

2.2 Special versions. 2

2.3 Determination and use for functional safety. 2

2.4 Determination and use for explosion protection. 2

2.5 Technical data 2

2.6 Safety classification 3

3 Mounting

3.1 General mounting instructions 3

3.2 Dimensions 3

3.3 Adjustment. 4

3.4 Switching distance 4

4 Electrical connection

4.1 General information for electrical connection. 4

4.2 Connection example 4

4.3 Series wiring 4

4.4 Wiring example 5

4.5 Note on the total length of a safety sensor chain. 5

5 Set-up and maintenance

5.1 Functional testing. 6

5.2 Maintenance 6

6 Diagnostic functions

6.1 Operating principle of the diagnostic LED's 6

6.2 Operating principle of the electronic diagnostic output 6

7 Disassembly and disposal

7.1 Disassembly. 6

7.2 Disposal 6

8 EU Declaration of conformity

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 Schmersal range of products is not intended for private consumers.

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: products.schmersal.com.

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.

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:

EX-CSS①-180-②-③-④-3GD-⑤

No.	Option	Description
①	B	Typical switching distance 8 mm
②	2P+D	2 short-circuit proof PNP safety outputs and diagnostic output
③	M	Multifunction connection
④	L	Cable
⑤		Cable length 2 m
	...M	Cable length in m

2.2 Special versions

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

2.3 Determination and use for functional safety

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 180-1 or CST 180-2 actuators.



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

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 safety sensor, will immediately disable the safety outputs (also refer to Switching distance of the safety sensor).

Series wiring

Max. 16 sensors can be wired in series. A 200 m long sensor chain can be set up.



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.

2.4 Determination and use for explosion protection

The components can be used in explosion-endangered areas of Zone 2 and 22 equipment category 3 GD. The installation and maintenance requirements to the standard series 60079 must be met.

Conditions for safe operation

Due to their specific impact energy, the components must be fitted with a protection against mechanical stresses. The specific ambient temperature range must be observed. The user must provide for a protection against the permanent influence of UV rays.

2.5 Technical data

Marking in accordance with the ATEX Directive: Ⓜ II 3G
Ⓜ II 3D

Marking in accordance with standards: Ex eC IIC T6 Gc X
Ex tc IIIC T70°C Dc X

Applied standards: EN 60947-5-3, EN ISO 13849-1, EN 61508,
EN IEC 60079-0, EN 60079-7, EN 60079-31

Enclosure: glass-fibre reinforced thermoplastic

Max. impact energy: 4 J

Actuator: CST 180-1, CST 180-2

Operating principle: inductive

Coding level according to EN ISO 14119: low

Response time: < 30 ms

Duration of risk: ≤ 30 ms

Time to readiness: ≤ 2 s

Switching distances EN 60947-5-3:

Typical switching distance S_n : 8 mm

Assured switching distance s_{so} : 7 mm

Assured switch-off distance s_{ar} : 10 mm

Hysteresis: ≤ 0.7 mm

Repeat accuracy: ≤ 0.2 mm

Connection: Cable, 2 m

Cable section: 7 × 0.25 mm²

Series-wiring: max. 16 components

Cable length: max. 200 m (cable length and
cable section alter the voltage drop
depending on the output current)

Ambient conditions:

Ambient temperature: -20 °C ... +40 °C

Storage and transport temperature: -25 °C ... +85 °C

Relative humidity: max. 93 %,
non condensing, non icing

Degree of protection: IP65/IP67 to EN 60529,
IP65/IP67 to the standard series 60079

Installation altitude above sea level: max. 2,000 m

Protection class: II

Resistance to vibration: 10...55 Hz, Amplitude 1 mm

Resistance to shock: 30 g / 11 ms

Insulation values to EN 60664-1:

- Rated insulation voltage U_i : 32 VDC

- Rated impulse withstand voltage U_{imp} : 0.8 kV

- Over-voltage category: III

- Degree of pollution: 3

EMC rating: according to EN 61000-6-2

Electromagnetic interference: according to EN 61000-6-4

Switching frequency: ≤ 3 Hz

Electrical data:

Rated operating voltage U_e : 24 VDC -15% / +10%
PELV (to EN 60204-1)

Rated operating current I_g : 1 A

Required rated short-circuit current: 100 A

No-load current I_o : 0.05 A

Leakage current I_l : ≤ 0.5 mA

Safety inputs X1/X2:

Rated operating voltage U_e : 24 VDC -15% / +10%
(PELV to EN 60204-1)

Rated operating current I_g : 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:	p-type, short-circuit proof
Utilisation category:	DC-12 U_e/I_e 24 VDC / 0.5 A DC-13 U_e/I_e 24 VDC / 0.5 A
Rated operating current I_{e1} :	max. 0.5 A depending on the ambient temperature
Voltage drop:	0.5 V
Leakage current I_r :	< 0.5 mA
Test pulse duration:	≤ 2.0 ms
Test pulse interval:	2,000 ms
Classification:	ZVEI CB24I
Source:	C2
Sink:	

Diagnostic output:	short-circuit proof, p-type
Utilisation category:	DC-12 U_e/I_e 24 VDC / 0.05 A DC-13 U_e/I_e 24 VDC / 0.05 A
Rated operating voltage U_{e2} :	max. 4 V below U_e
Rated operating current I_{e2} :	max. 0.05 A
External fuse rating:	fuse: 1.0 A at output current ≤ 200 mA 1.6 A at output current > 200 mA

2.6 Safety classification

Standards:	EN ISO 13849-1, EN 61508
PL:	e
Category:	4
PFH value:	$3.57 \times 10^{-9} / h$
SIL:	suitable for SIL 3 applications
Mission time:	20 years

3. Mounting

3.1 General mounting instructions



Fitting is only authorised in a de-energised condition



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



Due to their specific impact energy, the components must be fitted with a protection against mechanical stresses.

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 sensor enclosure must not be used as an end stop. The safety sensor must only be used within the assured switching distances s_{ao} and s_{ar} .

The safety sensor and the corresponding actuator can be fixed using the supplied M18 nuts (A/F 24). The max. tightening torque of the supplied screws is 500 Ncm. Alternatively, the H18 fixing clamp (accessory) can be used for the fixation of the safety sensor.

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

The CST 180-1 actuator has two fixing holes displaced by 90°. The max. tightening torque of the supplied screws is 100 Ncm.

The CST 180-2 actuator is screwed into a prepared tapped hole M 18 × 1. Use the slot to the front.



Actuator and clamp must be permanently fitted to the safety guards 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 two sensors: 100 mm

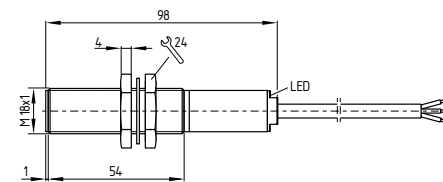


Please observe the relevant requirements of the standards EN ISO 12100, EN ISO 14119 and EN ISO 14120.

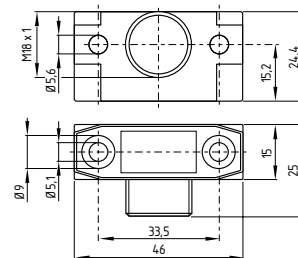
3.2 Dimensions

All measurements in mm.

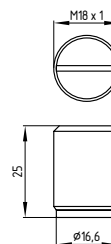
Safety sensor



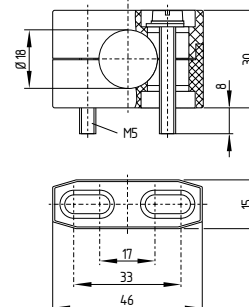
CST 180-1 actuator



CST 180-2 actuator



H 18 clamp



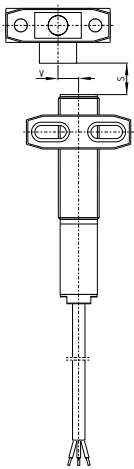
3.3 Adjustment

The LED in the end cap of the safety sensor can be used as adjustment tool. The yellow flashing LED of a sensor signals if an adjustment of the switching distance is required. Reduce the distance between the sensor and the actuator, until the LED in the end cap of the safety sensor is continuously lit yellow. In this position, a reliable switching position of the sensor is obtained. (also refer to "Operating Principle of the Diagnostic Outputs").

The proper functionality must always be checked by means of the connected safety-monitoring module.

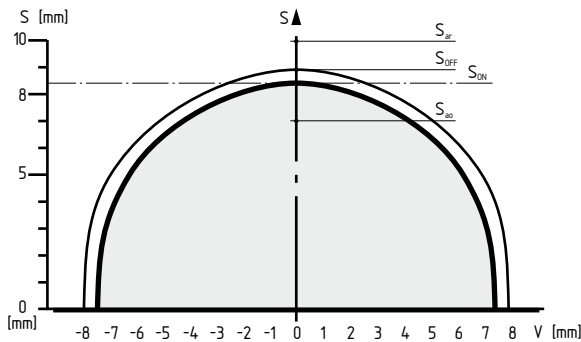
3.4 Switching distance

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 7 mm. A concealed mounting of the sensor and the actuator will reduce the switching distance.



Key
S = switching distance
V = axial misalignment

Typical response range of the sensor



S_{ON} Switching point
 S_{OFF} Switch-off point
 S_H Hysteresis range $s_H = S_{OFF} - S_{ON}$
 S_{a0} 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 overvoltage. Under fault conditions, the voltage must not exceed 60 V. The use of PELV supply units according to EN 60204-1 is recommended. The required electrical cable and device fuse protection must be integrated in the installation.

The safety outputs can be integrated into the safety circuit of the control system. For applications of PL e / category 4 to EN 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 category.

Requirements for the connected safety-monitoring module:

- Dual-channel safety input, suitable for p-type safety sensors with NC function.



Safety controller configuration

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 does not need to have a cross-wire short monitoring function, if necessary, the cross-wire short monitoring function must be disabled.



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

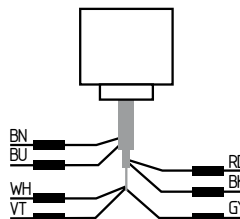
If the safety component is wired to relays or to non-safety relevant control components, a new risk analysis must be carried out.

4.2 Connection example

Sensor with safety inputs and safety outputs in one pre-wired cable:

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

Colour	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



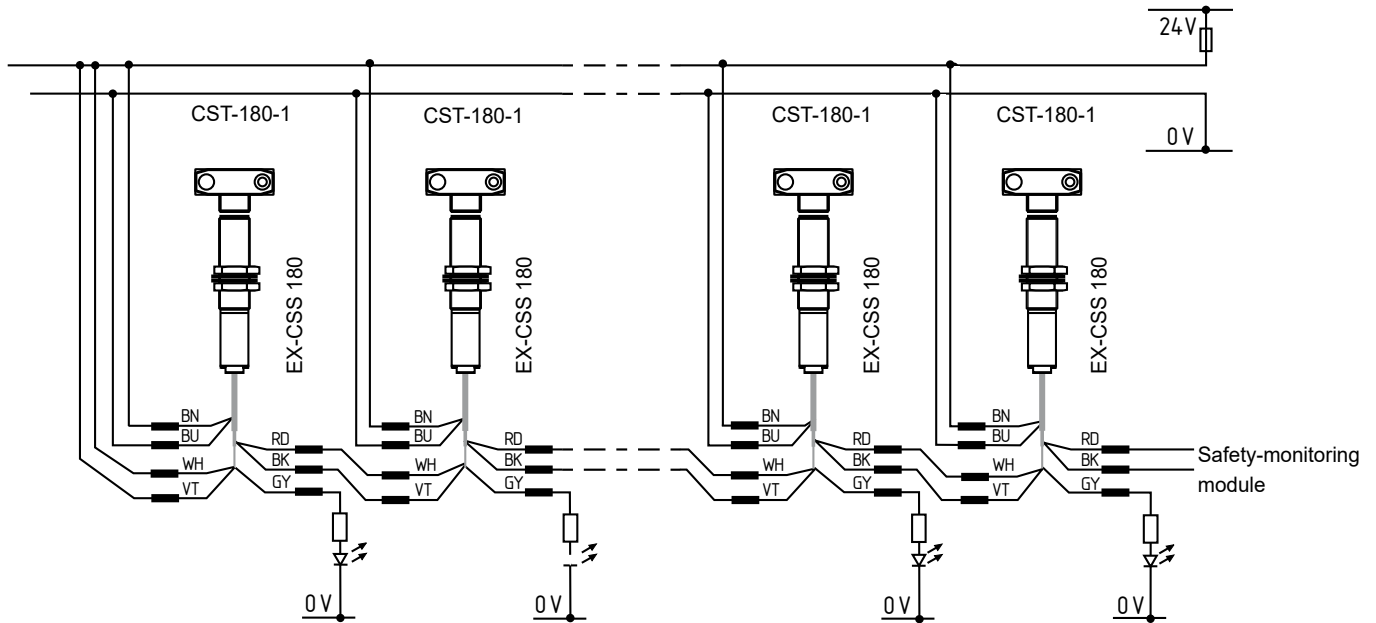
4.3 Series wiring

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.

4.4 Wiring example

Series-wiring of 4 safety sensors EX-CSS 8-180-2P+D+M-L-3GD with common connecting cable for the inputs and outputs

The series-wiring of multiple sensors is realised by wiring in the control cabinet or in on-site junction boxes. A sensor of this type can also be used as individual component or as first sensor of a chain. In these both cases, the positive operating voltage is supplied in both safety inputs.



4.5 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

An approx. 200 m long sensor chain with 6 sensors, 0.5 mm² cable section and at 20 °C, features approx. 2 V voltage drop when the total current load of the safety outputs is 100 mA. If junction boxes are used for longer cable lengths, the conductor sections between the junction boxes should be designed so that the connected load causes a low as possible voltage drop on the connection cables.

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.



For very long sensor chains, it can be useful supplying the voltage at the beginning of the chain. In that case, the supply of the safety sensors and that of the safety channels can be protected individually e.g. by 1 A gG each.

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. The installation is executed according to the instructions
2. The connection is executed correctly
3. The safety component is not damaged
4. The system is free of dirt and soiling (in particular metal chips)
5. Check cable entry and connections in a de-energised condition

5.2 Maintenance

In the case of correct installation and adequate use, the safety-monitoring module 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



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.

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 lateral surfaces of the sensor.

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

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 CST 180 actuator, the indication 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 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. 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 enabled in a delayed manner, when the fault is active for 1 minute.

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.

Error

Faults which no longer guarantee the functioning of the safety sensor (internal error)s cause the safety outputs to be disabled within the risk time. 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


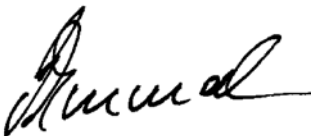
7.1 Disassembly

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. EU Declaration of conformity

EU Declaration of conformity		
Original	K.A. Schmersal GmbH & Co. KG Möddinghofe 30 42279 Wuppertal Germany Internet: www.schmersal.com	
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:	EX-CSS 180	
Type:	See ordering code	
Marking:	Ⓢ II 3G Ex eC IIC T6 Gc X Ⓢ II 3D Ex tc IIIC T70°C Dc X	
Description of the component:	Non-contact safety sensor	
Relevant Directives:	Machinery Directive 2006/42/EC EMC-Directive 2014/30/EU Explosion Protection Directive (ATEX) 2014/34/EU RoHS-Directive 2011/65/EU	
Applied standards:	EN 60947-5-3:2013 EN IEC 60079-0:2018 + AC:2020 EN 60079-7:2015 EN 60079-31:2014 EN ISO 13849-5-1:2023 EN 61508 parts 1-7:2010	
Notified body for Type Examination in accordance with the Machinery Directive 2006/42/EC and for the approval of the full quality assurance system, referred to in Appendix IV, 2014/34/EU:	TÜV Rheinland Industrie Service GmbH Am Grauen Stein 51105 Köln ID n°: 0035	
EC-Type Examination Certificate in accordance with the Machinery Directive 2006/42/EC:	01/205/5874.00/21	
Person authorised for the compilation of the technical documentation:	Oliver Wacker Möddinghofe 30 42279 Wuppertal	
Conformity with the Explosion Protection Directive 2014/34/EU (ATEX) is declared by the manufacturer without involving a test center.		
Place and date of issue:	Wuppertal, October 31, 2025	
EX-CSS180-E-EN		
	Authorised signature Philip Schmersal Managing Director	



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



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