

PSEN cs4.1a/b/p/M12

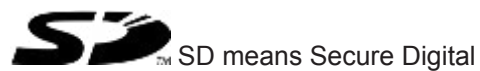
PSEN sensor technology

pilz

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Introduction

Validity of documentation

This documentation is valid for the product PSEN cs4.1a/b/p/M12. It is valid until new documentation is published.

This operating manual explains the function and operation, describes the installation and provides guidelines on how to connect the product.

Retaining the documentation

This documentation is intended for instruction and should be retained for future reference.

Definition of symbols

Information that is particularly important is identified as follows:



DANGER!

This warning must be heeded! It warns of a hazardous situation that poses an immediate threat of serious injury and death and indicates preventive measures that can be taken.



WARNING!

This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.



CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



NOTICE

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.



INFORMATION

This gives advice on applications and provides information on special features.

Safety switch PSEN cs4.1

The safety switch meets the requirements in accordance with:

- ▶ EN 60204-1 and IEC 60204-1
- ▶ EN 60947-5-3 with the actuator PSEN cs4.1
- ▶ EN 62061: SIL CL 3
- ▶ EN ISO 13849-1: PL e and Cat. 4

The safety switch may only be used with the corresponding actuator PSEN cs4.1.

The safety outputs must use 2-channel processing.

For your safety

- ▶ Only install and commission the unit if you have read and understood these operating instructions and are familiar with the applicable regulations for health and safety at work and accident prevention.
Ensure VDE and local regulations are met, especially those relating to safety.
- ▶ Any guarantee is rendered invalid if the housing is opened or unauthorised modifications are carried out.
- ▶ Do not remove the protective cap until you are just about to connect the unit.

Unit features

- ▶ Transponder technology
- ▶ Coding: fully coded
- ▶ Dual-channel operation
- ▶ 2 safety inputs for series connection of multiple safety switches
- ▶ 2 safety outputs
- ▶ 1 signal output
- ▶ LED for:
 - State of the actuator
 - State of the inputs
 - Supply voltage/fault
- ▶ 1 direction of actuation
- ▶ Connection types:
 - PSEN cs4.1a: Cable, 5 m
 - PSEN cs4.1b: Cable, 10 m
 - PSEN cs4.1p: 8 pin M8 connector
 - PSEN cs4.1 M12/8-0.15m: Connector 8 pin M12

Function description

There is a high signal or a low signal at the safety outputs, depending on the position of the actuator and the state of the inputs. The signal output Y32 signals the position of the actuator.

State of the inputs and outputs:

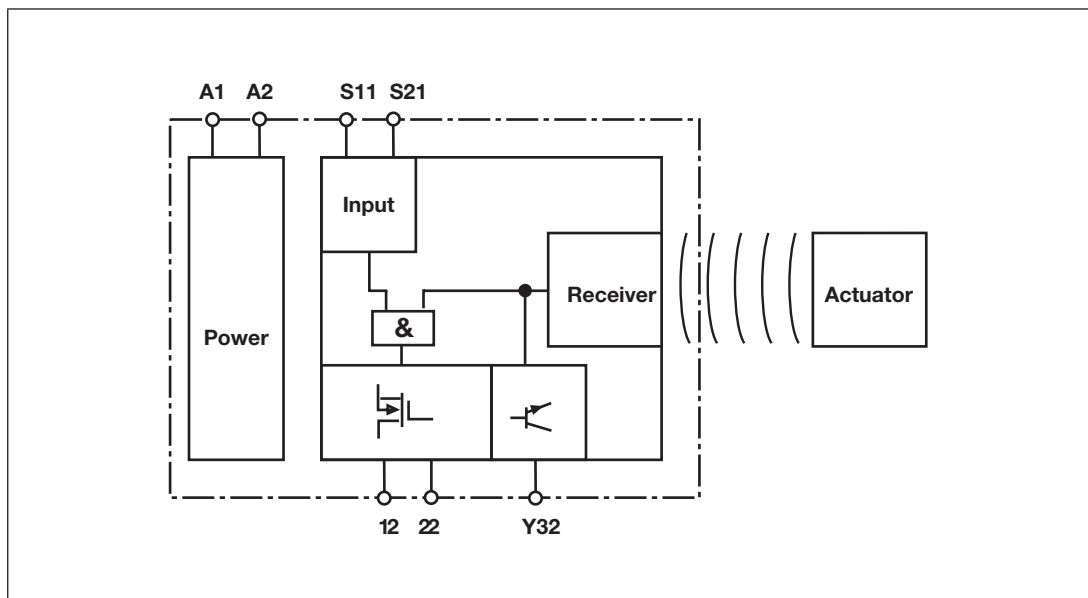
Actuator in the response range	Input S11	Input S21	Safety output 12	Safety output 22	Signal output Y32
Yes	High	Low	High	Low	High
Yes	Low	High	Low	High	High
Yes	High	High	High	High	High
Yes	Low	Low	Low	Low	High
No	x	x	Low	Low	Low

x: High or low signal

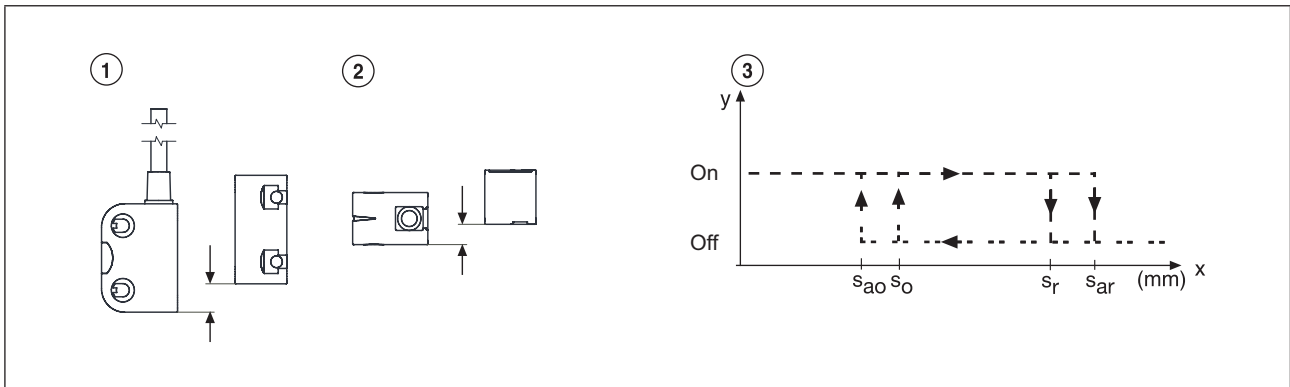
The outputs cannot be switched back on until there is a low signal at both inputs simultaneously.

Safety inputs S11 and S21 are monitored for feasibility. A high signal can be present at the inputs at offset times; the low signal must be present at both inputs simultaneously (partial operation lock).

Block diagram



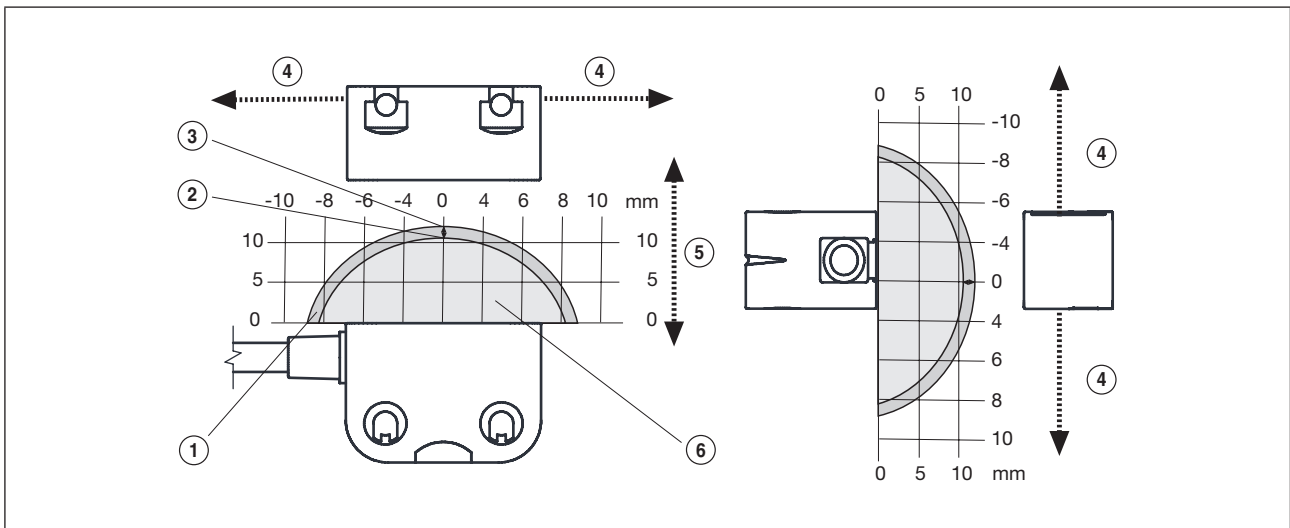
Operating distances



Legend:

- ▶ ①: Lateral offset
- ▶ ②: Vertical offset
- ▶ ③: Switch states (y-axis) dependent on operating distances (x-axis)
- ▶ S_{ao} : Assured operating distance: 8,0 mm
- ▶ S_o : Typical operating distance: 11,0 mm
- ▶ S_r : Typical release distance: 14,0 mm
- ▶ S_{ar} : Assured release distance: 20,0 mm

Lateral and vertical offset



Legend:

- ▶ ①: Hysteresis
- ▶ ②: Typical operating distance S_o
- ▶ ③: Typical release distance S_r
- ▶ ④: Offset in mm
- ▶ ⑤: Switching distance in mm
- ▶ ⑥: Response range

Wiring

Please note:

- ▶ Information given in the "Technical details" must be followed.
- ▶ Calculation of the max. cable length l_{max} in the input circuit:

$$l_{max} = \frac{R_{lmax}}{R_l / km}$$

R_{lmax} = Max. overall cable resistance (see [Technical details](#) [20])

R_l / km = cable resistance/km

Pin assignment, connector and cable

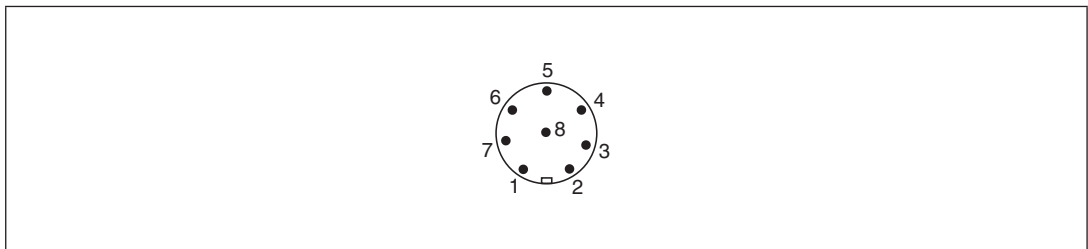


Fig.: 8 pin M8/M12 connector

PIN	Pin designation	Function	Wire colour
1	S21	Input, channel 2	White
2	A1	+24 VUB	Brown
3	12	Output, channel 1	Green
4	22	Output, channel 2	Yellow
5	Y32	Signal output	Grey
6	S11	Input, channel 1	Pink
7	A2	0 V UB	Blue
8	-	Do not connect	Red

The wire colour also applies for the cable available from Pilz as an accessory.

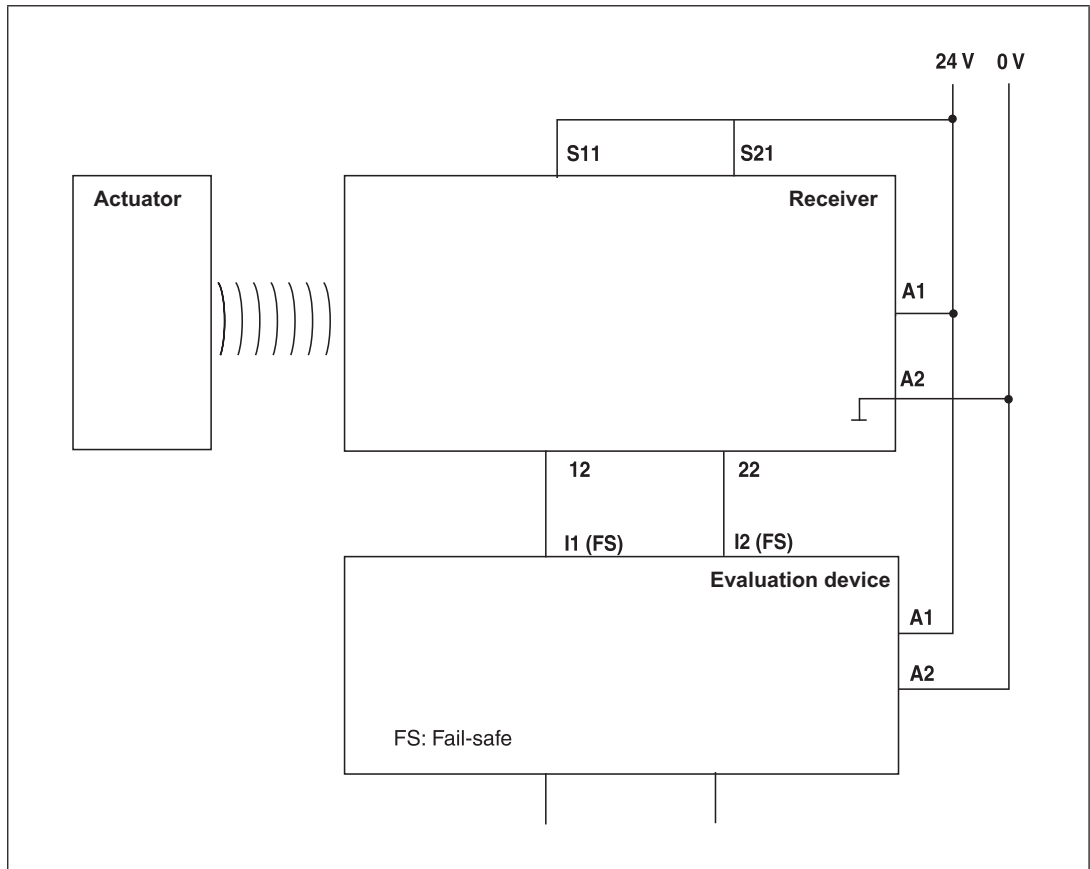
Connection to evaluation devices

Please note:

- ▶ The power supply must meet the regulations for extra low voltages with safe separation (SELV, PELV).
- ▶ The inputs and outputs of the safety switch must have a safe separation to voltages over 60 V AC.

CAUTION!
The safety outputs must use 2-channel processing.

Single connection



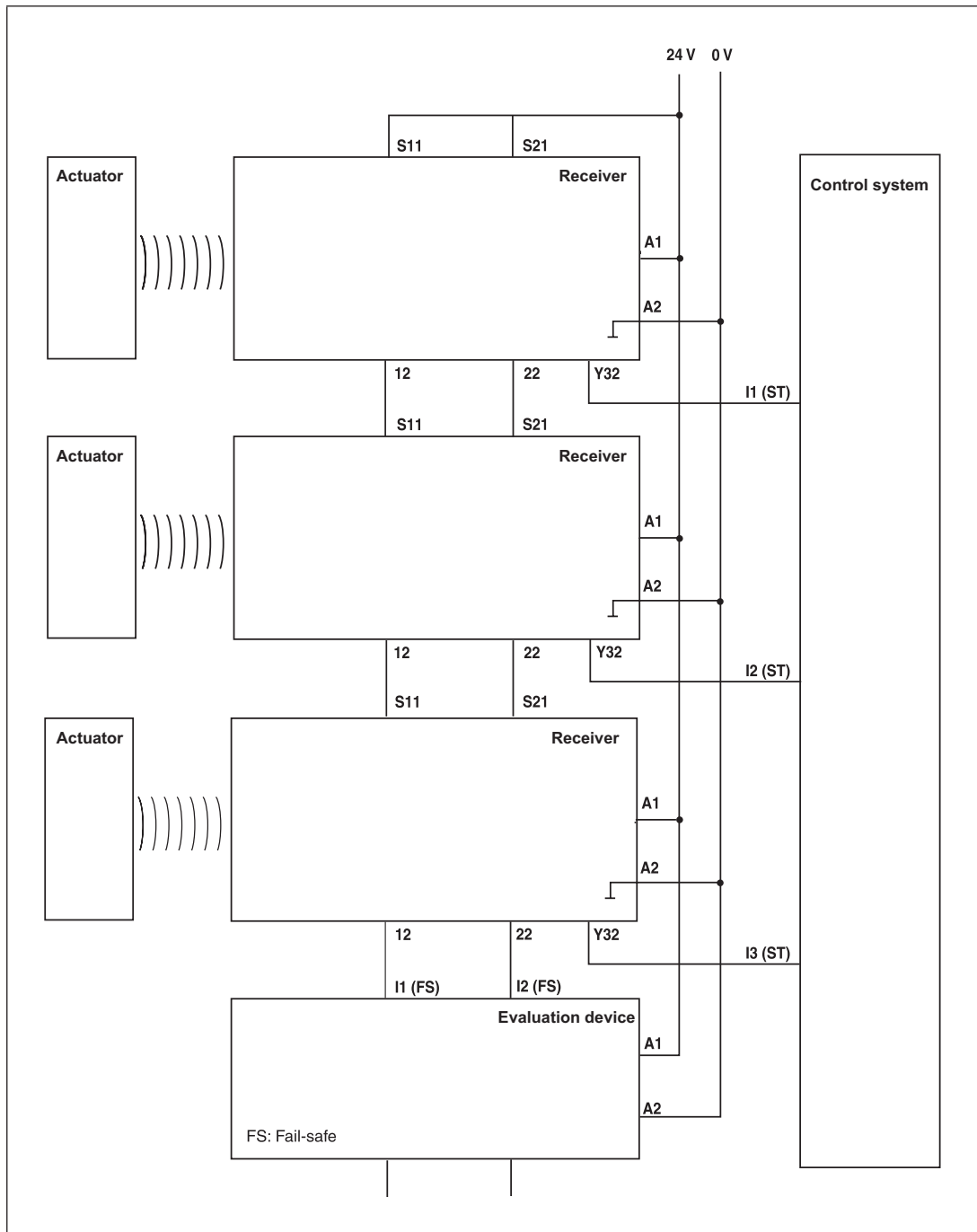
Series connection



CAUTION!

Extension of delay-on de-energisation

When several units are connected in series, the delay-on de-energisation time increases in direct proportion to the number of interconnected safety switches.



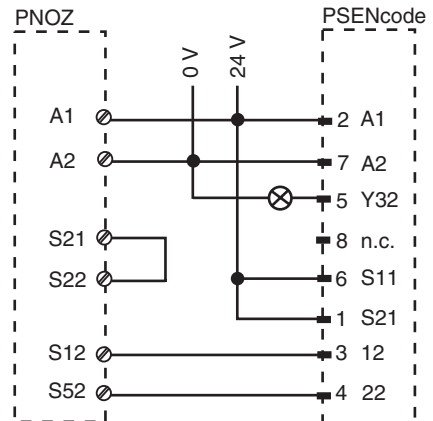
Connection to PNOZ X, PNOZpower, PNOZsigma, PNOZelog



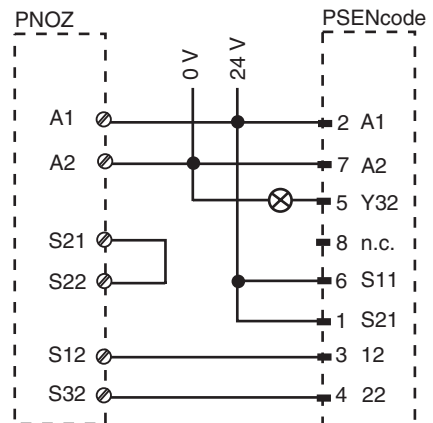
INFORMATION

Only use safety relays with a 24 VDC supply voltage. Safety relays with universal power supply or in AC unit versions have internal potential isolation and are not suitable as evaluation devices.

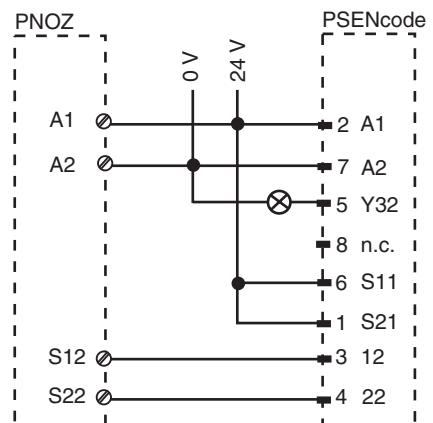
PNOZ X2.7P
 PNOZ X2.8P
 PNOZ X4
 PNOZ X8P
 PNOZ X9P



PNOZ X3P
 PNOZ X3.10P
 PNOZ XV3P
 PNOZ X3.1P

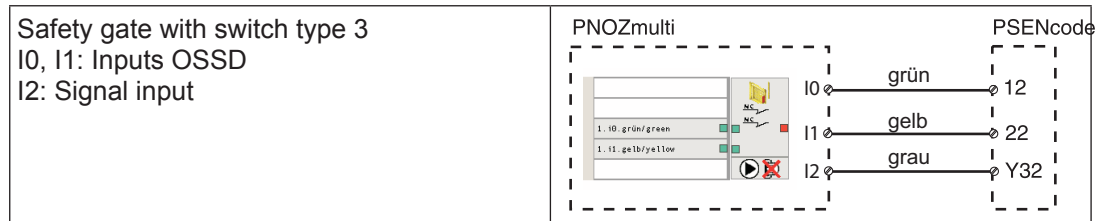


PNOZ s3
 PNOZ s4
 PNOZ s4.1
 PNOZ s5
 PNOZ X5

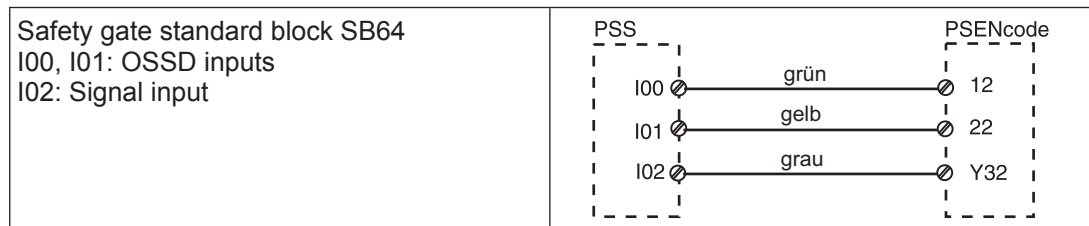


<p>PNOZ X2.9P</p>	
<p>PNOZ X10.1 PNOZ X10.11P</p>	
<p>PNOZ e1.1p PNOZ e1vp PNOZ e6.1p PNOZ e6vp</p>	
<p>PNOZ e5.11p PNOZ e5.13p</p>	

Connection to PNOZmulti



Connection to PSS



Teaching in the actuator

Teaching in the actuator for the first time:

The first actuator detected by the safety switch (PSEN cs4.1) is automatically taught in as soon as it is brought into the response range.

To teach in a new actuator:

- ▶ The actuator that is to be taught in must be brought into the safety switch's response range as the only transponder. As soon as the actuator is detected, the "Safety Gate" LED will flash yellow.
- ▶ After 20 s has elapsed, the "Safety Gate" LED turns to quick yellow flashes. Trigger a system reset in the next 120 s by interrupting the power supply.
- ▶ When the supply voltage is switched back on, the learning procedure is complete and the number of permitted additional learning procedures is reduced by 1.
- ▶ A maximum of 8 learning procedures are possible.




NOTICE

- The actuator must not be removed during the learning procedure.
- This actuator cannot be retaught on the same safety switch.

Installation

- ▶ The safety switch and actuator should be installed opposite each other in parallel.



CAUTION!


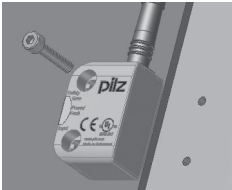

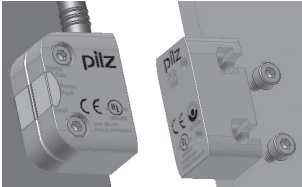
The unit's properties may be affected if installed in an environment containing electrically or magnetically conductive material. Please check the operating distances and the assured release distance.

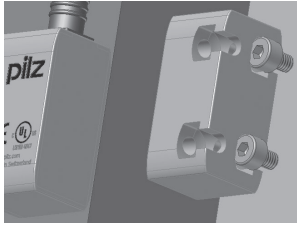
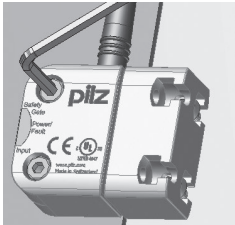
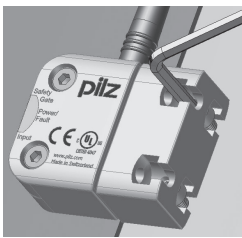
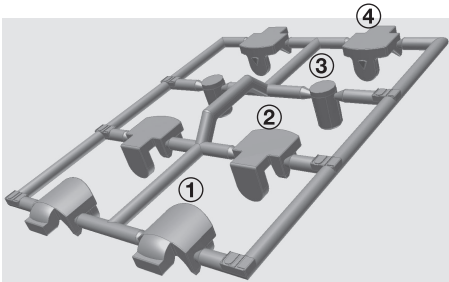
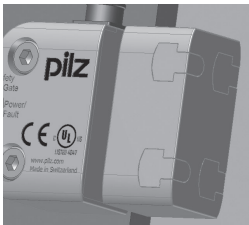

- ▶ Safety switches and actuators should only be secured using M4 screws with a flat head (e.g. M4 cheese-head or pan head screws).
- ▶ The actuator should be protected from unauthorised removal and from contamination. Close the mounting holes using the seals provided.
- ▶ Torque setting: Max. 0.8 Nm.
- ▶ The distance between two safety switches must be maintained (see [Technical Details](#) [20]).


Safety switches and actuators

- ▶ Should not be exposed to heavy shock or vibration and
- ▶ Should not be used as a limit stop.


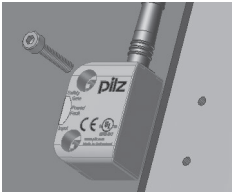
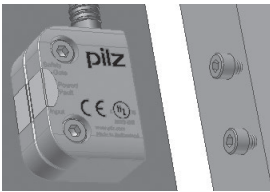
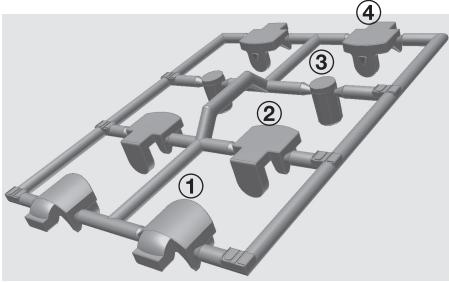
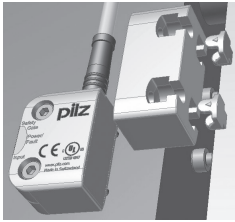
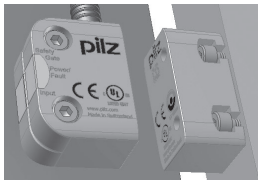
Parallel assembly


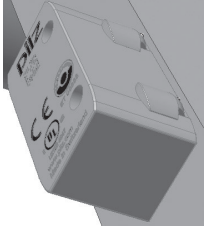
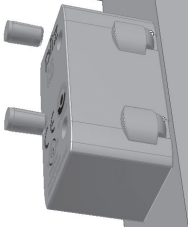
	<p>Drill holes in the mounting surface (see Dimensions [19]) and cut threads in the holes for M4 screws.</p>
	<p>Use a screw to fix the safety switch in place.</p>
	<ol style="list-style-type: none"> 1. Do not fully tighten the 2nd screw on the safety switch. 2. Attach the screws for the actuator, leaving a distance of 3 ... 6 mm between the screw head and plate.
	<p>Slide the actuator on to the mounting surface. The inscribed area on the actuator (sensing face) should face the safety switch.</p>

	<p>Slide the actuator on to the screws.</p>
	<p>Align the safety switch and tighten the screws.</p>
	<p>Align the actuator and tighten the screws.</p>
	<p>For the next steps you will need the seals as illustrated.</p>
	<p>Use the seals to close the screws' mounting holes on the actuator</p> <ul style="list-style-type: none"> ▶ (4): Without UL approval ▶ (1): For UL approval
	<p>Use the seals (2) to close the unused mounting holes on the actuator.</p>




	<p>Use the seals (3) to close the mounting holes on the sensing face of the safety switch.</p>
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Orthogonal assembly

	<p>Drill holes in the mounting surface (see Dimensions [19]) and cut threads in the holes for M4 screws.</p>
	<p>Use a screw to fix the safety switch in place.</p>
	<ol style="list-style-type: none"> 1. Do not fully tighten the 2nd screw on the safety switch. 2. Attach the screws for the actuator, leaving a distance of 3 ... 6 mm between the screw head and plate.
	<p>For the next steps you will need the seals as illustrated.</p>
	<p>Use the seals (2) to close the unused mounting holes on the actuator.</p>
	<p>Slide the actuator on to the screws.</p>

	Align the actuator and tighten the screws.
	Use the seals to close the screws' mounting holes on the actuator <ul style="list-style-type: none"> ▶ (4): Without UL approval ▶ (1): For UL approval
	Use the seals (3) to close the mounting holes on the sensing face of the safety switch.

Adjustment

- ▶ The stated operating distances (see [Technical details](#) [ 20]) only apply when the safety switch and actuator are installed facing each other in parallel. Operating distances may deviate if other arrangements are used.
- ▶ Note the maximum permitted lateral and vertical offset (see [Operating distances](#) [ 7] and [Lateral and vertical offset](#) [ 7]).

Operation

Check the function of the safety switch before commissioning.

Status indicators:

- ▶ "POWER/Fault" LED lights up green: The unit is ready for operation
- ▶ "Safety Gate" LED lights up yellow: Actuator is within the response range
- ▶ "Input" LED lights up yellow: There is a high signal at both inputs.

Error display through periodic flashing:

- ▶ "Input" LED lights up yellow: the signal switches from high to low at one input, while a high signal remains on the other input (partial operation).
Remedy: Open both channels of the input circuit.
- ▶ "POWER/Fault" LED lights up red: Error message
Flashing codes for fault diagnostics are output to the "Safety Gate" and "Input" LEDs (see Error display through flashing codes).
Remedy: Rectify fault and interrupt power supply.

Please note the different switch-on delay after U_B is applied and after the recovery time of the sensor and evaluation device.

Error display through flashing codes

The "Safetygate" and "Input" LEDs send flash signals; an error code can be established from the number and sequence. The "Power/Fault" LED illuminates red.

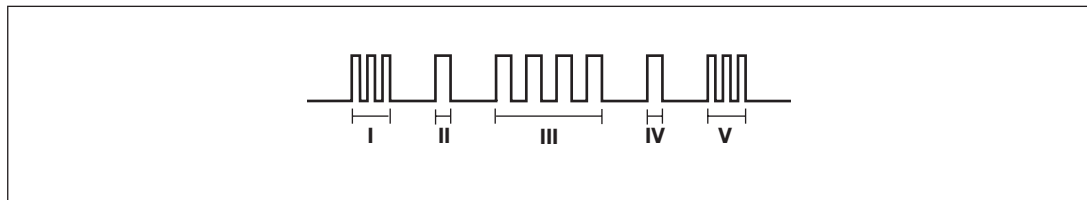
Each error code is indicated by three short flashes of the "Input" or "Safetygate" LED. After a longer pause, the LED will then flash at one second intervals. The number of LED flashes corresponds to a digit in the error code. The error code can consist of up to 4 digits. The digits are separated by a longer period without flashing. The entire sequence is constantly repeated.

Number of flashes	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Decimal error code	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 0

Example:

Error code 1,4,1:

Flash frequency of the "Safetygate" or "Input" LED



Meaning of flash frequency:

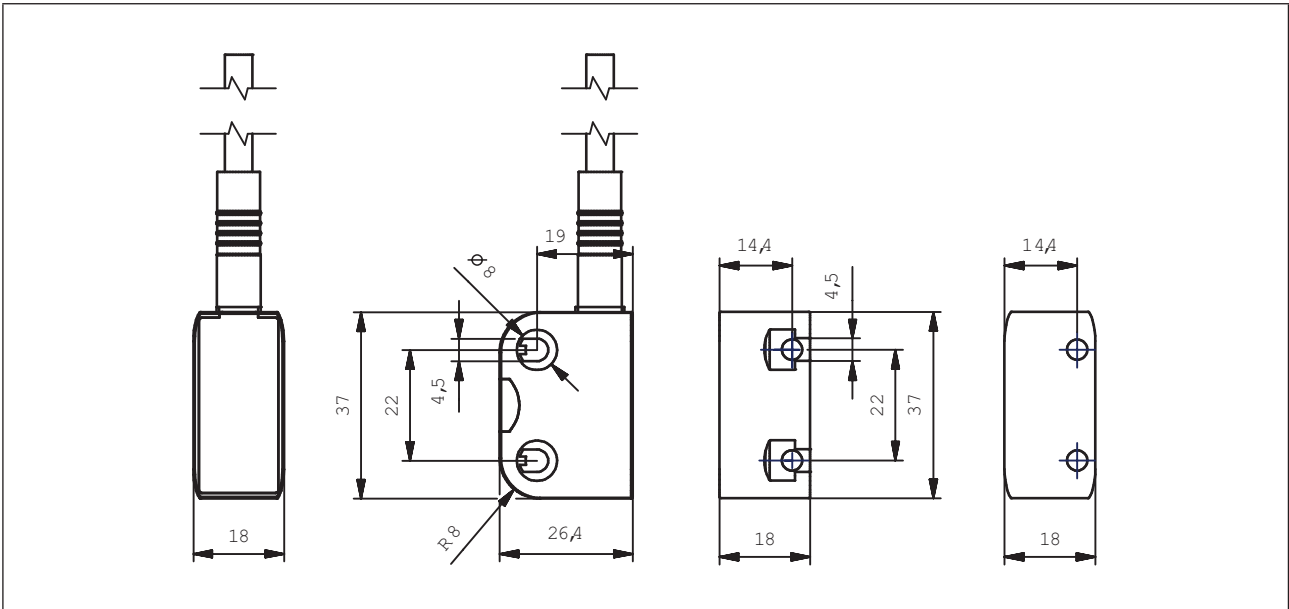
	Flash frequency	Meaning
I	3 times, short	Code for error message
II	Once for one second	Code for 1st digit
III	4 times, for one second each	Code for 2nd digit
IV	Once for one second	Code for 3rd digit
V	3 times, short	Code for error message repeated

Table of error codes

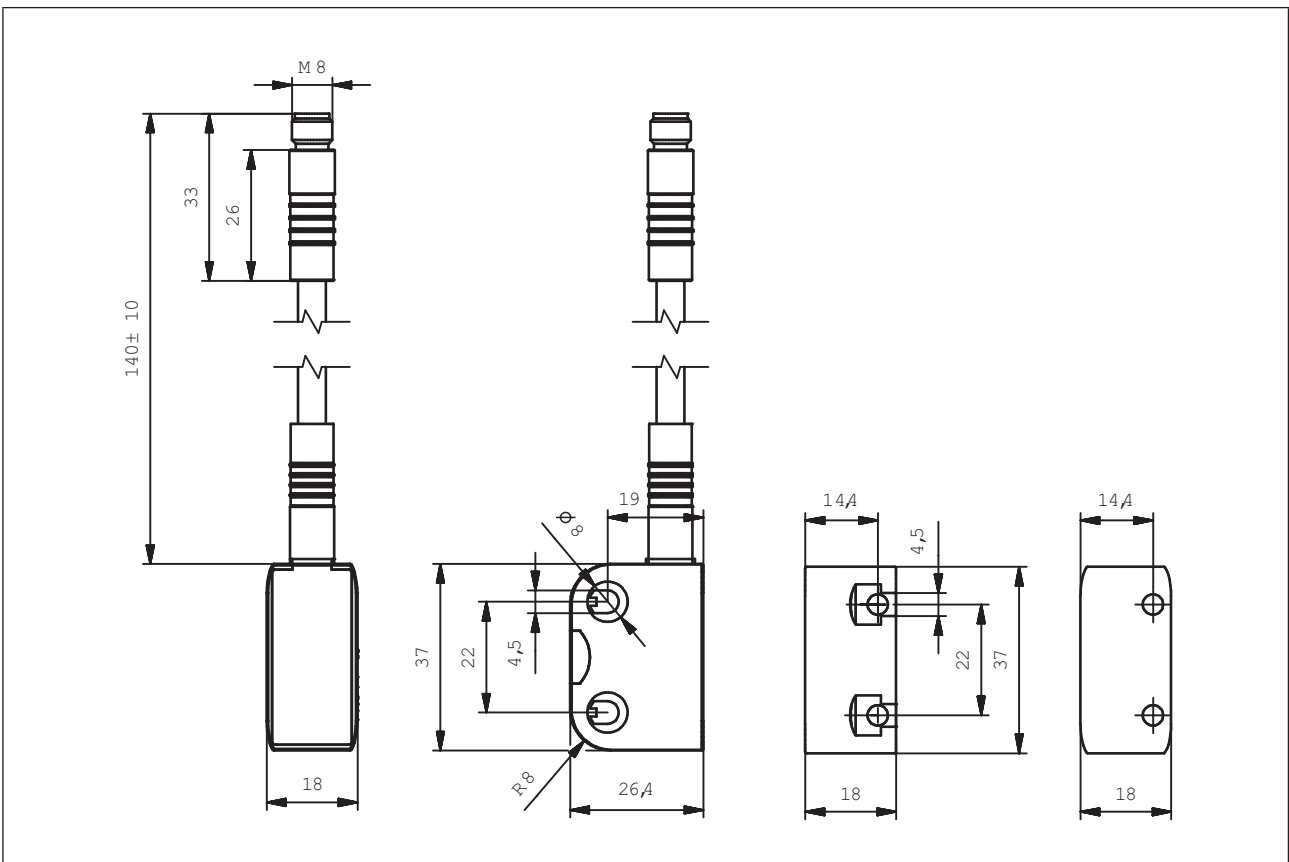
Error code decimal	Number of flashes	Description	Remedy
1,4,1	3x short – 1x long – 4x long – 1x long – 3x short	At least one of the two safety outputs 12 and 22 have voltage applied during system run-up	Check the wiring of safety outputs 12 and 22, rectify the wiring error
1,12	3x short – 1x long – 12x long – 3x short	During operation, short circuit between safety output 12 and 0 VDC	Rectify wiring error at safety output 12
1,13	3x short – 1x long – 13x long – 3x short	During operation, short circuit between safety output 22 and 0 VDC	Rectify wiring error at safety output 22
14	3x short – 14x long – 3x short	During operation, short circuit between safety output 12 and 24 VDC	Rectify wiring error at safety output 12
15	3x short – 15x long – 3x short	During operation, short circuit between safety output 22 and 24 VDC	Rectify wiring error at safety output 22

Dimensions in mm

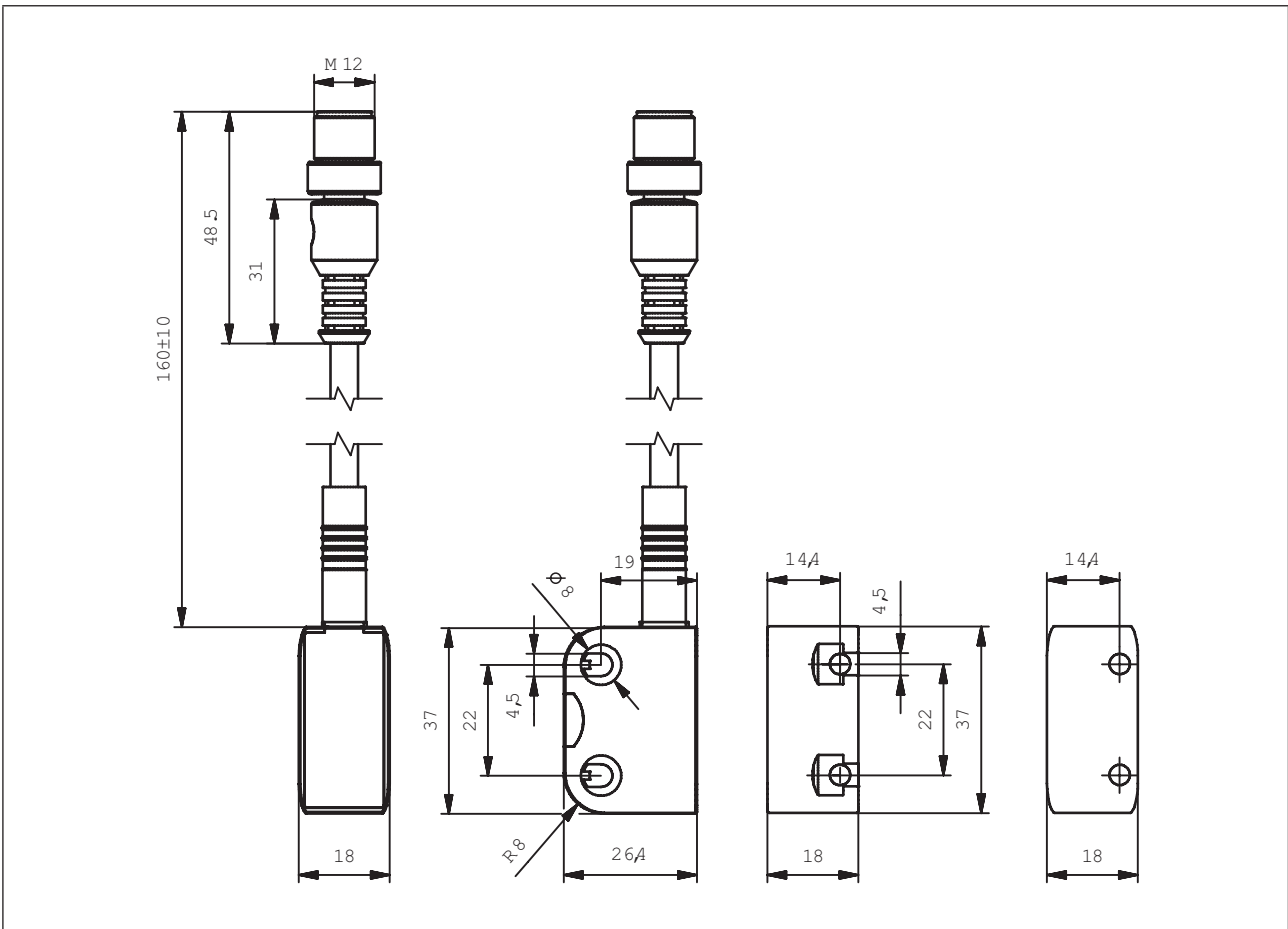
PSEN cs4.1a, PSEN cs4.1b



PSEN cs4.1p



PSEN cs4.1 M12/8-0.15m



Technical details

PSEN cs4.1a and PSEN cs4.1b

General	541111	541112
Approvals	CE, GOST, TÜV, cULus Listed	CE, GOST, TÜV, cULus Listed
Sensor's mode of operation	Transponder	Transponder
Electrical data	541111	541112
Supply voltage		
Voltage	24 V	24 V
Type	DC	DC
Voltage tolerance	-20 %/+20 %	-20 %/+20 %
Output of external power supply (DC)	1,0 W	1,0 W
Max. switching frequency	3 Hz	3 Hz
Switching current per output	100 mA	100 mA
Breaking capacity per output	2,4 W	2,4 W

Electrical data	541111	541112
Max. cable capacitance at the safety outputs		
No-load, PNOZ with relay contacts	400 nF	400 nF
PNOZmulti, PNOZelog, PSS	400 nF	400 nF
Max. inrush current impulse		
Current pulse, A1	0,58 A	0,58 A
Pulse duration, A1	1,0000 ms	1,0000 ms
Max. overall cable resistance R _I -max		
Single-channel at UB DC	1000 Ohm	1000 Ohm
Inputs	541111	541112
Number	2	2
Voltage at inputs	24 V DC	24 V DC
Input current range	5,0 mA	5,0 mA
Potential isolation between input and voltage for the internal module bus	No	No
Semiconductor outputs	541111	541112
OSSD safety outputs	2	2
Signal outputs	1	1
Potential isolation from system voltage	No	No
Short circuit-proof	Yes	Yes
Times	541111	541112
Test pulse duration, safety outputs	450 µs	450 µs
Switch-on delay		
After UB is applied	1,0 s	1,0 s
Inputs typ.	13 ms	13 ms
Inputs max.	20 ms	20 ms
Actuator typ.	45 ms	45 ms
Actuator max.	120 ms	120 ms
Delay-on de-energisation		
Inputs typ.	15 ms	15 ms
Inputs max.	20 ms	20 ms
Actuator typ.	40 ms	40 ms
Actuator max.	260 ms	260 ms
Supply interruption before de-energisation in the input circuit	10,0 ms	10,0 ms
Simultaneity, channel 1 and 2	∞	∞
Environmental data	541111	541112
Ambient temperature		
In accordance with the standard	EN 60068-2-14	EN 60068-2-14
Temperature range	-25 - 70 °C	-25 - 70 °C
Storage temperature		
In accordance with the standard	EN 60068-2-1/-2	EN 60068-2-1/-2
Temperature range	-25 - 70 °C	-25 - 70 °C

Environmental data	541111	541112
Climatic suitability		
In accordance with the standard	EN 60068-2-78	EN 60068-2-78
Humidity	93 % r. h. at 40 °C	93 % r. h. at 40 °C
EMC		
	EN 60947-5-3	EN 60947-5-3
Vibration		
In accordance with the standard	EN 60947-5-2	EN 60947-5-2
Frequency	10,0 - 55,0 Hz	10,0 - 55,0 Hz
Amplitude	1,00 mm	1,00 mm
Shock stress		
In accordance with the standard	EN 60947-5-2	EN 60947-5-2
Acceleration	30g	30g
Duration	18 ms	18 ms
Airgap creepage		
Overvoltage category	III	III
Pollution degree	3	3
Rated insulation voltage	75 V	75 V
Rated impulse withstand voltage	0,80 kV	0,80 kV
Protection type		
Housing	IP6K9K	IP6K9K
Mechanical data	541111	541112
Change of switching distance with fluctuations in temperature	+0,01mm/°C	+0,01mm/°C
Actuator 1	PSEN cs4.1	PSEN cs4.1
Typ. hysteresis	2,0 mm	2,0 mm
Operating distances		
Assured operating distance Sao	8,0 mm	8,0 mm
Typical operating distance So	11,0 mm	11,0 mm
Assured release distance Sar	20,0 mm	20,0 mm
Typical release distance Sr	14,0 mm	14,0 mm
Min. distance between safety switches	100 mm	100 mm
Connection type	5 m cable	10 m cable
Cable	LiYY 8 x 0.14 mm²	LiYY 8 x 0.14 mm²
Material		
Top	PBT	PBT
Dimensions		
Height	37,0 mm	37,0 mm
Width	26,0 mm	26,0 mm
Depth	18,0 mm	18,0 mm
Actuator dimensions		
Height	37,0 mm	37,0 mm
Width	18,0 mm	18,0 mm
Depth	18,0 mm	18,0 mm
Weight of safety switch	205 g	380 g
Weight of actuator	10 g	10 g
Weight	215 g	390 g

PSEN cs4.1 M12 and PSEN cs4.1p

General	541109	541110
Approvals	CE, GOST, TÜV, cULus Listed	CE, GOST, TÜV, cULus Listed
Sensor's mode of operation	Transponder	Transponder
Electrical data	541109	541110
Supply voltage		
Voltage	24 V	24 V
Type	DC	DC
Voltage tolerance	-20 %/+20 %	-20 %/+20 %
Output of external power supply (DC)	1,0 W	1,0 W
Max. switching frequency	3 Hz	3 Hz
Switching current per output	100 mA	100 mA
Breaking capacity per output	2,4 W	2,4 W
Max. cable capacitance at the safety outputs		
No-load, PNOZ with relay contacts	400 nF	400 nF
PNOZmulti, PNOZelog, PSS	400 nF	400 nF
Max. inrush current impulse		
Current pulse, A1	0,58 A	0,58 A
Pulse duration, A1	1,0000 ms	1,0000 ms
Max. overall cable resistance R _{I-max}		
Single-channel at UB DC	1000 Ohm	1000 Ohm
Inputs	541109	541110
Number	2	2
Voltage at inputs	24 V DC	24 V DC
Input current range	5,0 mA	5,0 mA
Potential isolation between input and voltage for the internal module bus	No	No
Semiconductor outputs	541109	541110
OSSD safety outputs	2	2
Signal outputs	1	1
Potential isolation from system voltage	No	No
Short circuit-proof	Yes	Yes
Times	541109	541110
Test pulse duration, safety outputs	450 µs	450 µs
Switch-on delay		
After UB is applied	1,0 s	1,0 s
Inputs typ.	13 ms	13 ms
Inputs max.	20 ms	20 ms
Actuator typ.	45 ms	45 ms
Actuator max.	120 ms	120 ms

Times	541109	541110
Delay-on de-energisation		
Inputs typ.	15 ms	15 ms
Inputs max.	20 ms	20 ms
Actuator typ.	40 ms	40 ms
Actuator max.	260 ms	260 ms
Supply interruption before de-energisation in the input circuit		
	10,0 ms	10,0 ms
Simultaneity, channel 1 and 2		
	∞	∞
Environmental data	541109	541110
Ambient temperature		
In accordance with the standard	EN 60068-2-14	EN 60068-2-14
Temperature range	-25 - 70 °C	-25 - 70 °C
Storage temperature		
In accordance with the standard	EN 60068-2-1/-2	EN 60068-2-1/-2
Temperature range	-25 - 70 °C	-25 - 70 °C
Climatic suitability		
In accordance with the standard	EN 60068-2-78	EN 60068-2-78
Humidity	93 % r. h. at 40 °C	93 % r. h. at 40 °C
EMC		
	EN 60947-5-3	EN 60947-5-3
Vibration		
In accordance with the standard	EN 60947-5-2	EN 60947-5-2
Frequency	10,0 - 55,0 Hz	10,0 - 55,0 Hz
Amplitude	1,00 mm	1,00 mm
Shock stress		
In accordance with the standard	EN 60947-5-2	EN 60947-5-2
Acceleration	30g	30g
Duration	18 ms	18 ms
Airgap creepage		
Overvoltage category	III	III
Pollution degree	3	3
Rated insulation voltage		
	75 V	75 V
Rated impulse withstand voltage		
	0,80 kV	0,80 kV
Protection type		
Housing	IP67	IP67
Mechanical data	541109	541110
Change of switching distance with fluctuations in temperature		
	+,-0,01mm/°C	+,-0,01mm/°C
Actuator 1		
	PSEN cs4.1	PSEN cs4.1
Typ. hysteresis		
	2,0 mm	2,0 mm
Operating distances		
Assured operating distance Sao	8,0 mm	8,0 mm
Typical operating distance So	11,0 mm	11,0 mm
Assured release distance Sar	20,0 mm	20,0 mm
Typical release distance Sr	14,0 mm	14,0 mm
Min. distance between safety switches		
	100 mm	100 mm

Mechanical data	541109	541110
Connection type	M12, 8-pin male connector	M8, 8-pin male connector
Cable	LiYY 8 x 0.14 mm²	LiYY 8 x 0.14 mm²
Material		
Top	PBT	PBT
Dimensions		
Height	37,0 mm	37,0 mm
Width	26,0 mm	26,0 mm
Depth	18,0 mm	18,0 mm
Actuator dimensions		
Height	37,0 mm	37,0 mm
Width	18,0 mm	18,0 mm
Depth	18,0 mm	18,0 mm
Weight of safety switch	40 g	35 g
Weight of actuator	10 g	10 g
Weight	50 g	45 g

The standards current on 2009-01 apply.

Safety characteristic data

Operating mode	EN ISO 13849-1: 2008	EN ISO 13849-1: 2008	EN IEC 62061	EN IEC 62061	IEC 61511	IEC 61511	EN ISO 13849-1: 2008
	PL	Category	SIL CL	PFH_D [1/h]	SIL	PFD	T_M [year]
2-ch. OSSD	PL e	Cat. 4	SIL CL 3	2,62E-09	SIL 3	7,68E-05	20

All the units used within a safety function must be considered when calculating the safety characteristic data.



INFORMATION

A safety function's SIL/PL values are **not** identical to the SIL/PL values of the units that are used and may be different. We recommend that you use the PAScal software tool to calculate the safety function's SIL/PL values.

Order reference

Product type	Features	Connection type	Order no.
PSEN cs4.1 M12/8-0.15m/ PSEN cs4.1	Safety gate system, fully coded	8-pin M12 connector	541 109
PSEN cs4.1p/PSEN cs4.1	Safety gate system, fully coded	8-pin M8 connector	541 110
PSEN cs4.1a/PSEN cs4.1	Safety gate system, fully coded	Cable, 5 m	541 111
PSEN cs4.1b/PSEN cs4.1	Safety gate system, fully coded	Cable, 10 m	541 112
PSEN cs4.1 M12/8-0.15m (switch)	Safety switch, fully coded	8-pin M12 connector	541 159
PSEN cs4.1p (switch)	Safety switch, fully coded	8-pin M8 connector	541 160
PSEN cs4.1a (switch)	Safety switch, fully coded	Cable, 5 m	541 161
PSEN cs4.1b (switch)	Safety switch, fully coded	Cable, 10 m	541 162
PSEN cs4.1	Actuator, coded		541 180



► ...
In many countries we are represented by our subsidiaries and sales partners.

Please refer to our homepage for further details or contact our headquarters.

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