



PSEN cs2.1p


PSEN sensor technology

PILZ
THE SPIRIT OF SAFETY

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 SD means Secure Digital

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Introduction

Validity of documentation

This documentation is valid for the product PSEN cs2.1p. 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.

Using the documentation

This document is intended for instruction. Only install and commission the product if you have read and understood this document. The document 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**Intended use**

Safety function of safety switch:

- ▶ 2 safety outputs, each of which supply a high signal when the actuator is in the safety switch's response range and when there is a high signal at the safety inputs.

The safety switch meets the requirements in accordance with:


- ▶ EN 60947-5-3 with the actuator PSEN cs2.1 : PDDDB
- ▶ EN 62061: SIL CL 3
- ▶ EN ISO 13849-1: PL eCat. 4
- ▶ EN ISO 14119: Coding level High, Type4

The safety switch may only be used with the corresponding actuator PSEN cs2.1.

The safety level PL e (Cat. 4)/SIL CL 3 is only achieved if

- ▶ the safety outputs use 2-channel processing.

The following is deemed improper use in particular:

- ▶ Any component, technical or electrical modification to the product
- ▶ Use of the product outside the areas described in this manual
- ▶ Use of the product outside the technical details (see [Technical details](#) [ 18]).

**NOTICE**

EMC-compliant electrical installation

The product is designed for use in an industrial environment. The product may cause interference if installed in other environments. If installed in other environments, measures should be taken to comply with the applicable standards and directives for the respective installation site with regard to interference.

Safety regulations**Safety assessment**

Before using a unit it is necessary to perform a safety assessment in accordance with the Machinery Directive.

Functional safety is guaranteed for the product as a single component. However, this does not guarantee the functional safety of the overall plant/machine. In order to achieve the required safety level for the overall plant/machine, define the safety requirements for the plant/machine and then define how these must be implemented from a technical and organisational standpoint.

Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by competent persons.

A competent person is someone who, because of their training, experience and current professional activity, has the specialist knowledge required to test, assess and operate the work equipment, devices, systems, plant and machinery in accordance with the general standards and guidelines for safety technology.

It is the company's responsibility only to employ personnel who:

- ▶ Are familiar with the basic regulations concerning health and safety / accident prevention
- ▶ Have read and understood the information provided in this description under "Safety"
- ▶ And have a good knowledge of the generic and specialist standards applicable to the specific application.

Warranty and liability

All claims to warranty and liability will be rendered invalid if

- ▶ The product was used contrary to the purpose for which it is intended
- ▶ Damage can be attributed to not having followed the guidelines in the manual
- ▶ Operating personnel are not suitably qualified
- ▶ Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

Disposal

- ▶ In safety-related applications, please comply with the mission time T_M in the safety-related characteristic data.
- ▶ When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).


For your safety



WARNING!

Loss of safety function due to manipulation of the interlocking device

Manipulation of the interlocking device may lead to serious injury and death.

- You should prevent any possibility of the interlocking device being manipulated through the use of a spare actuator.
- Keep the spare actuator in a safe place and protect it from unauthorised access.
- If spare actuators are used, these must be installed as described in [Installation](#) [ 15].

- ▶ Do not remove the connector's protective cap until you are just about to connect the unit. This will prevent potential contamination.

Unit features

- ▶ Transponder technology for presence detection (safety function)
- ▶ Pilz coding type: fully coded
- ▶ Dual-channel operation
- ▶ 2 safety inputs for series connection of multiple safety switches
- ▶ 2 safety outputs
- ▶ 1 signal output
- ▶ LED display for:
 - State of the actuator
 - State of the inputs
 - Supply voltage/fault
- ▶ 4 directions of actuation

Function description

The safety outputs may have a high or low signal, depending on the position of the actuator and the signal status of the inputs.

In a safe condition there is a low signal at the safety outputs.

Electrical states of the inputs and outputs (when switch is ready for operation: Power / Fault LED is green):

Actuator in the re- sponse range	Safety input S11	Safety input S21	Safety out- put 12	Safety out- put 22	Signal out- put Y32
Yes	High	High	High	High	High
Yes	Low	Low	Low	Low	High
No	X	X	Low	Low	Low

Actuator in the response range	Safety input S11	Safety input S21	Safety output 12	Safety output 22	Signal output Y32
Yes	High	Low	High	Low	High
Yes	Low	High	Low	High	High

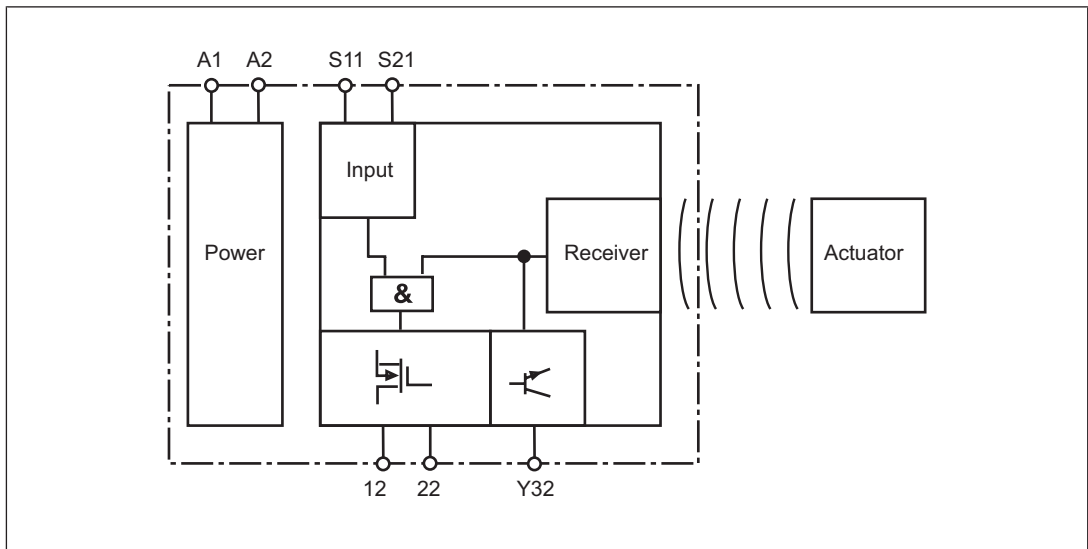
x: High or low signal

Feasibility monitoring for safety inputs S11 and S21

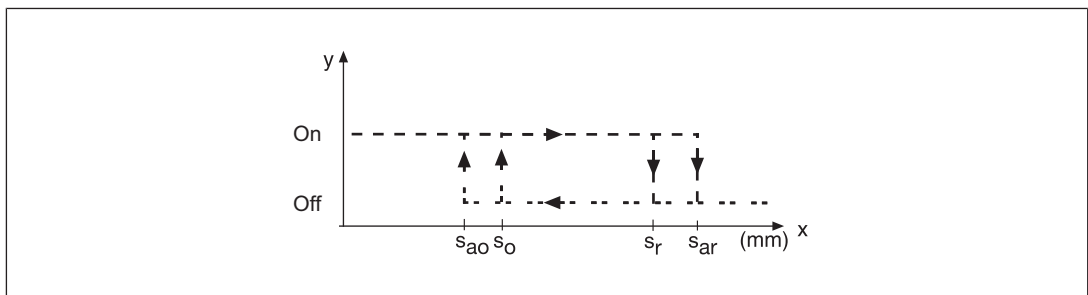
- ▶ If one safety input switches from high to low, while the other safety input remains high, an unequal status is displayed: **Input LED flashes yellow**
- ▶ If this safety input switches back from low to high, while the other safety input remains high, a feasibility error is displayed and a partial operation lock is triggered: **Input LED flashes yellow**

A switch to a high signal will only lead to normal switch operation if both inputs had a low signal. From this moment on, the switch to high may occur (partial operation lock see [Error display \[16\]](#)).

Block diagram



Operating distances

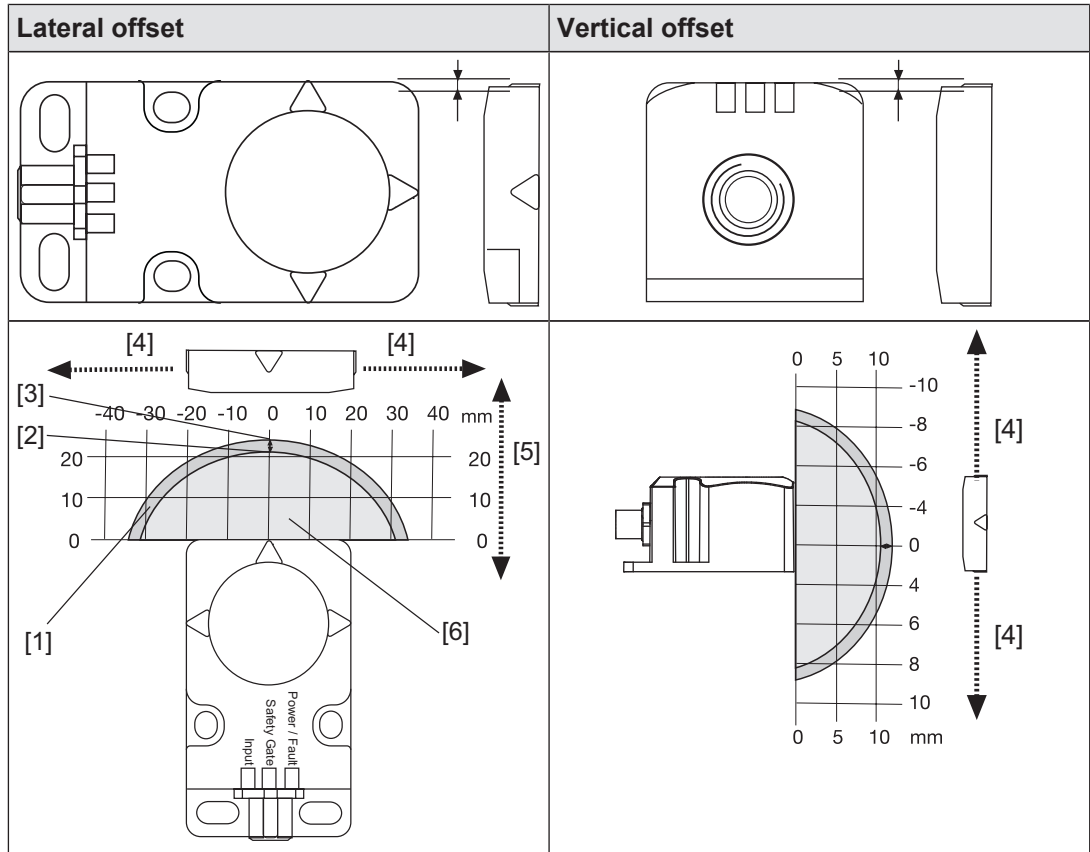


Legend:

- ▶ S_{ao} : Assured operating distance: 15 mm

- ▶ S_o : Typical operating distance: 21 mm
- ▶ S_r : Typical release distance: 32 mm
- ▶ S_{ar} : Assured release distance: 40 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]: Operating distance in mm
- ▶ [6]: Response range

Wiring

Please note:

- ▶ Information given in the [Technical details \[18\]](#) must be followed.
- ▶ The max. cable length l_{max} in the input circuit is calculated from
 - the max. cable capacitance at the safety outputs (see [Technical data \[18\]](#)).
 - the minimum permitted supply voltage at the sensor (19.2 V).
- ▶ The power supply must meet the regulations for extra low voltages with protective separation (SELV, PELV).

- ▶ The inputs and outputs of the safety switch must have a protective separation to voltages over 60 VDC.



INFORMATION

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



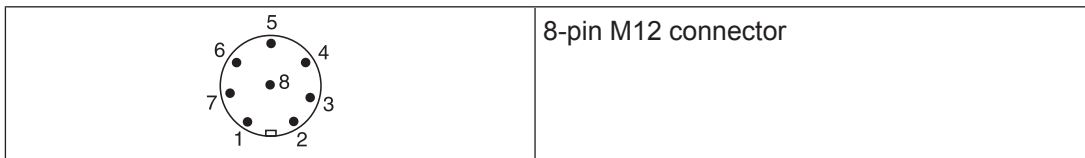
CAUTION!

Do not connect the signal output to 0 V!

If the signal output Y32 is connected to 0 V, the safety switch may be damaged as a result. Connect the signal output Y32 to a consumer, e.g. to the input on a control system, or leave the signal output unconnected.

- ▶ The supply voltage to the safety switch must be protected with a 2 A to 4 A quick-acting fuse.
- ▶ Ensure the EMC requirements of IEC 60204-1 are met.
- ▶ When connecting in series, make sure you comply with the wiring technology requirements (DIN EN 60204-1) and manipulation protection requirements (EN ISO 14119).

Pin assignment, connector and cable



PIN	Pin designation	Function	Wire colour
1	S21	Input, channel 2	white
2	A1	+24 VUB	brown
3	12	Output, channel1	Green
4	22	Output, channel2	yellow
5	Y32	Signal output	grey
6	S11	Input, channel 1	Pink
7	A2	0 V UB	blue
8	-	Do not connect	red

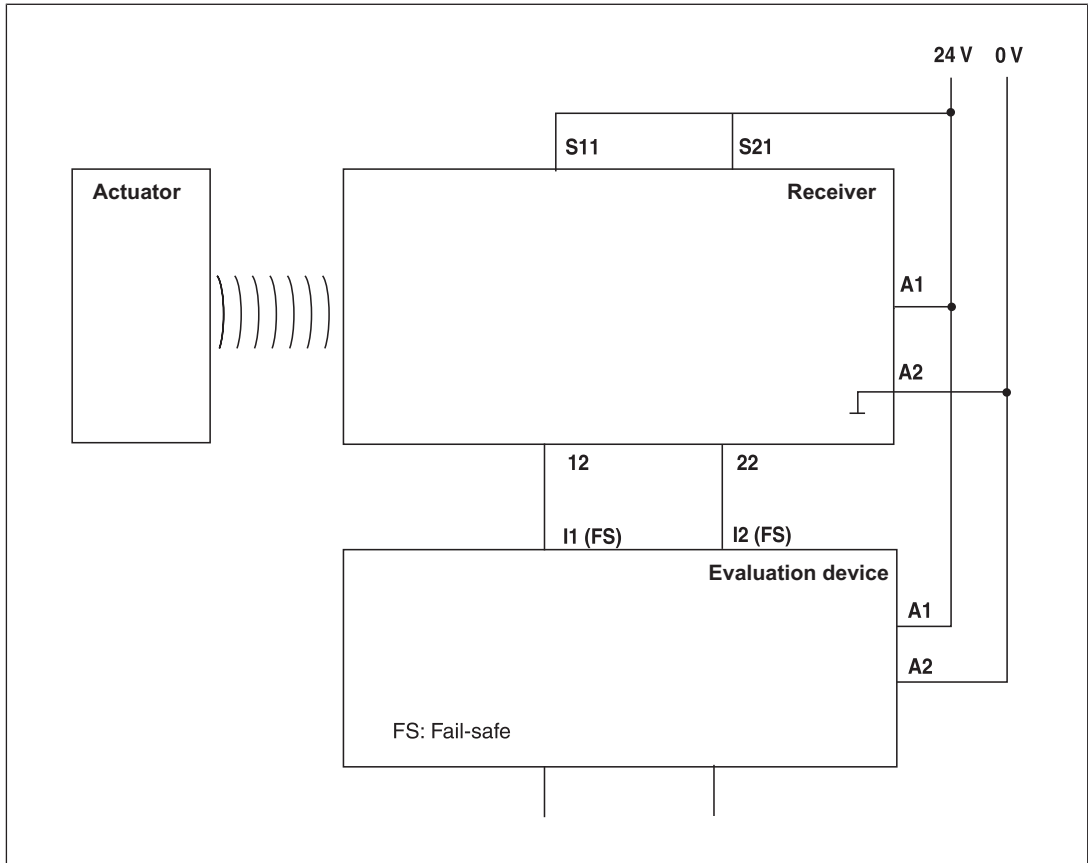
The wire colour also applies for the cable available from Pilz as an accessory.

Connection to evaluation devices

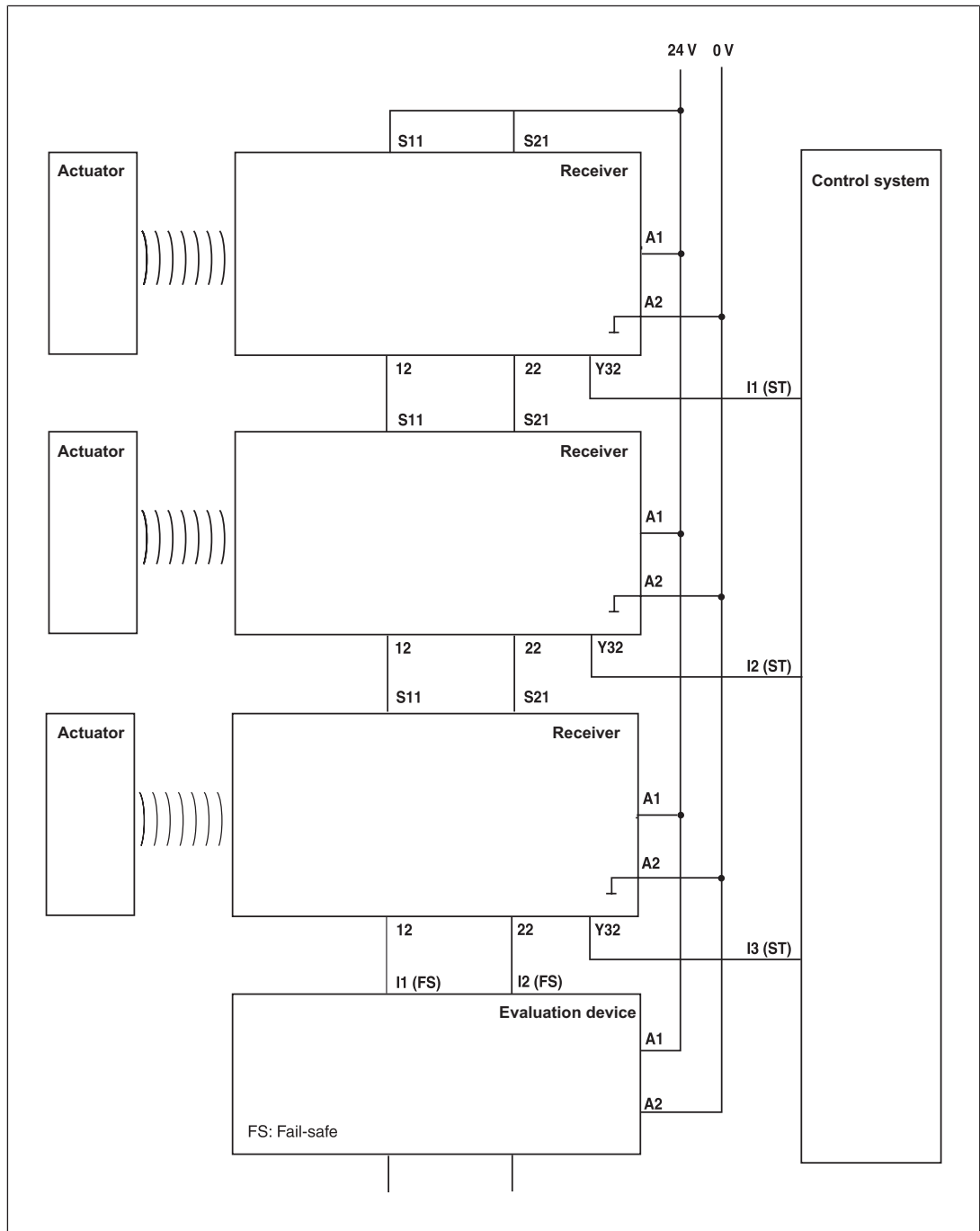
Make sure that the selected evaluation device has the following properties:

- ▶ Dual-channel with feasibility monitoring
- ▶ OSSD signals are evaluated

Connection diagram, single connection



Connection diagram, series connection





CAUTION!

Extension of delay-on de-energisation

When several (n) devices are connected in series, the delay-on de-energisation time adds with the number of interconnected safety switches.

- The may. delay-on de-energisation is composed of
- max. delay-on de-energisation actuator
 - + (n-1) x max. delay-on de-energisation of the inputs
 - + delay-on de-energisation of the evaluation device

Suitable Pilz evaluation devices are, for example:

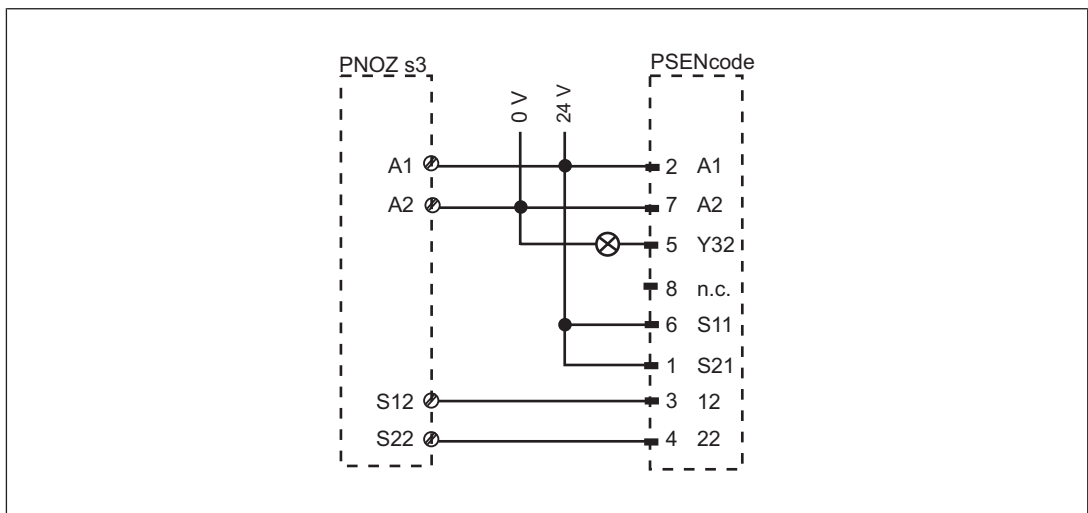
- ▶ PNOZelog for safety gate monitoring
- ▶ PNOZpower for safety gate monitoring
- ▶ PNOZsigma for safety gate monitoring
- ▶ PNOZ X for safety gate monitoring
- ▶ PNOZmulti for safety gate monitoring
Configure the switch in the PNOZmulti Configurator with switch type 3.
- ▶ PSS for safety gate monitoring with standard function block SB064, SB066 or FS_Safety Gate
- ▶ PSSuniversal PLC for safety gate monitoring with function block FS_SafetyGate

The correct connection to the respective evaluation device is described in the instructions for the evaluation device. Make sure that the connection is made in accordance with the specifications in the instructions for the selected evaluation device.

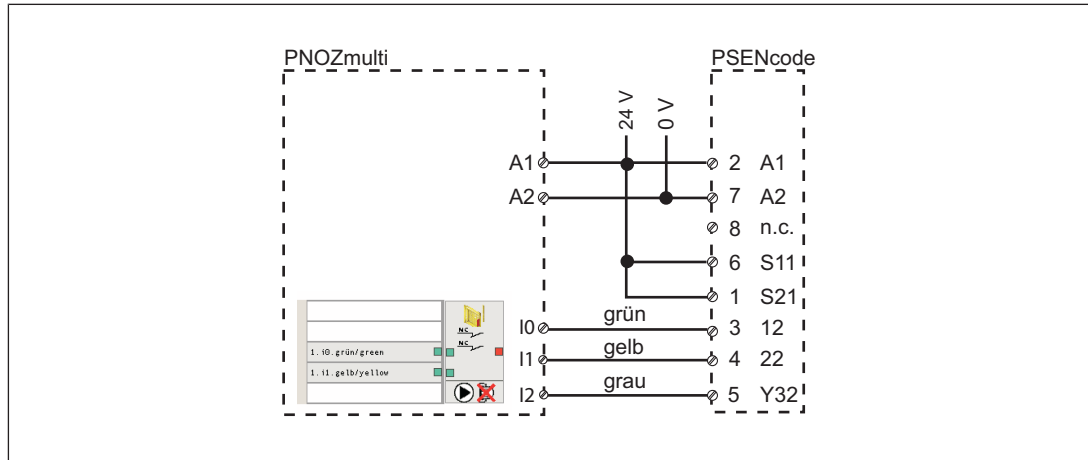
The connections to two evaluation devices are shown on the following pages, by way of example:

- ▶ PNOZ s3 and
- ▶ PNOZmulti

PNOZ s3



PNOZmulti



Legend:

I0	Input OSSD
I1	Input OSSD
I2	Signal input

Teaching in the actuator

Teaching in the actuator for the first time:

The first actuator PSEN cs2.1 detected by the safety switch is automatically taught in as soon as it is brought into the response range.

To teach in a new actuator:

- ▶ A maximum of 8 learning procedures are possible.
1. 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.
 2. 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.
 3. 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.



NOTICE

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

Installation



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.

- ▶ The safety switch and actuator should be installed opposite each other in parallel.
- ▶ Safety switches and actuators should be permanently secured using M5 safety screws with a flat head (e.g. M5 cheese-head or pan head screws).
- ▶ Protect the actuator from contamination.
- ▶ Torque setting: Please note the information provided under [Technical details \[18\]](#).
- ▶ The distance between two safety switches must be maintained (see [Technical details \[18\]](#)).
- ▶ Make sure that the safety switch and actuator cannot be used as an end stop.

Procedure:

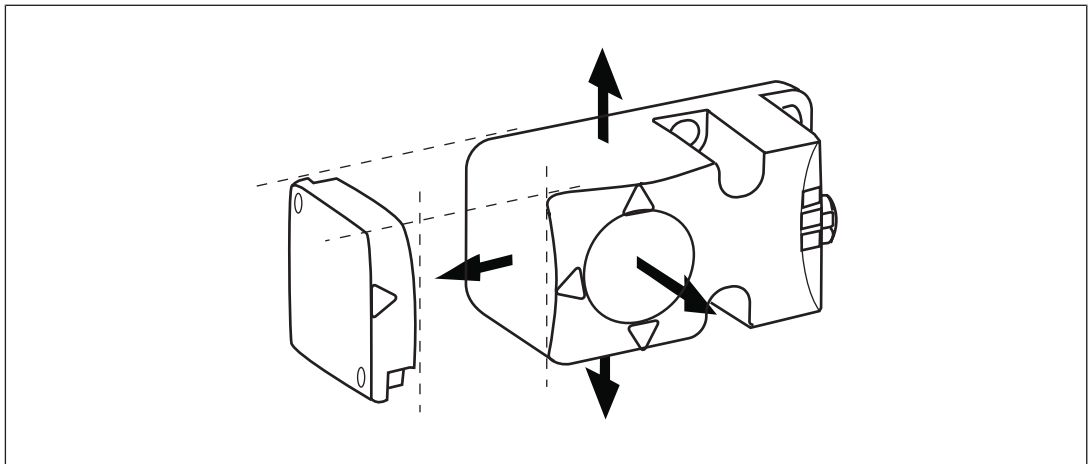





Fig.: Sensing faces on the sensor

1. Drill holes (for M5 screws) in the mounting surface to secure the actuator and sensor (see [Dimensions in mm \[18\]](#)).
2. Use a screw to fix the sensor to the mounting surface.
Make sure that the sensor marking that is be used for operation can be operated using the actuator from the right side.
3. Do not fully tighten the second screw on the safety switch.
4. Use a screw to fix the actuator to the mounting surface.
Make sure that the actuator with the printed side points towards the marking on the sensor.
5. Do not fully tighten the second screw on the actuator.
6. Align the safety switch and tighten the screws.
7. Align the actuator and tighten the screws.

Adjustment

- ▶ The stated operating distances (see [Technical details](#) [ 18]) 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 and Lateral and vertical offset](#) [ 9]).

Operation



NOTICE

The safety function should be checked after initial commissioning and each time the plant/machine is changed. The safety functions may only be checked by qualified personnel.

Status indicators:

- ▶ "Power / Fault" LED illuminates 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" or "Input" LED (see [Error display through flashing codes](#)).
Remedy: Rectify fault and interrupt power supply.

Please note the different times for

- ▶ The switch-on delay after UB is applied
- ▶ The recovery time of the sensor and evaluation device.

Error display through flashing codes

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

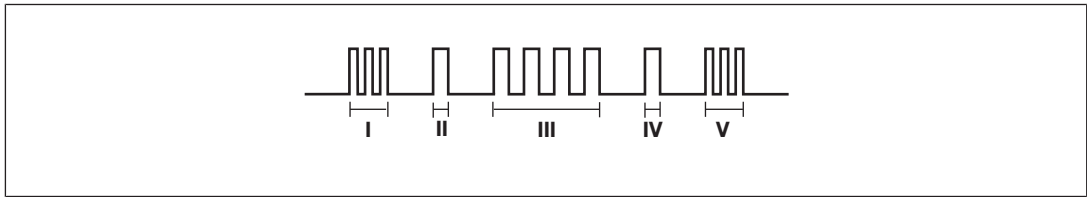
Each error code is indicated by three short flashes of the "Input" or "Safety Gate" LED. After a longer pause, the LED will then flash at one second intervals. The number of LED flashes corresponds to a digit in the error code. The error code can consist of up to 3 digits. The digits are separated by 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 "Safety Gate" or "Input" LED



Meaning of flash frequency:

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

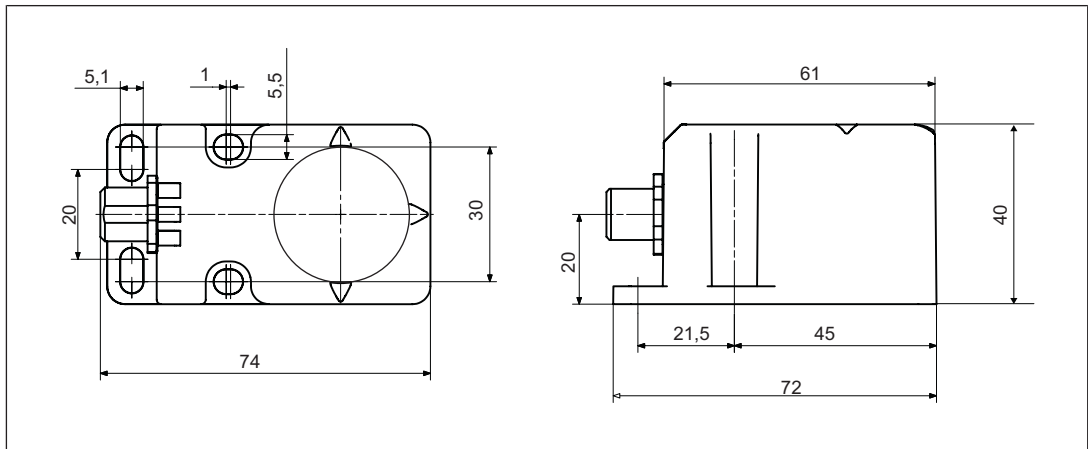
Table of error codes

Error code Decimal	Number of flashes	Description	Remedy
1.4.1	3x short – 1x long – 4x long – 1x long – 3x short	Wiring error	Rectify wiring error
1.12	3x short – 1x long – 12x long – 3x short	Wiring error	Rectify wiring error
1.13	3x short – 1x long – 12x long – 3x short	Wiring error	Rectify wiring error
14	3x short – 14x long – 3x short	Wiring error	Rectify wiring error
15	3x short – 15x long – 3x short	Wiring error	Rectify wiring error

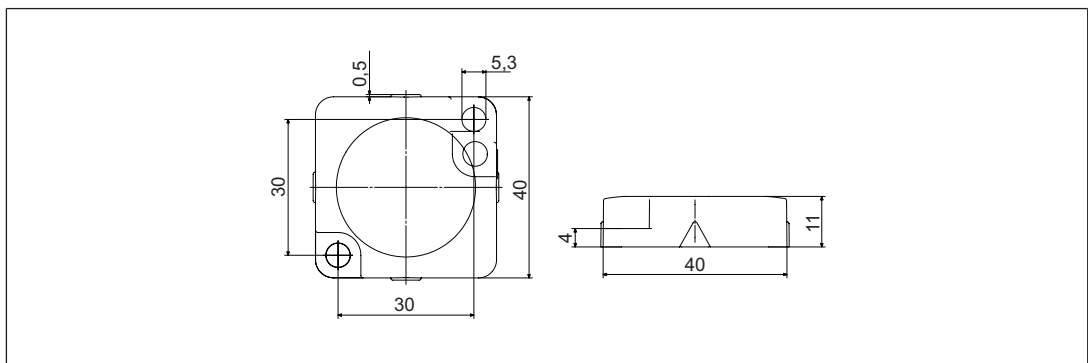
Other flashing codes signal an internal error. Remedy: Change device.

Dimensions in mm

Safety switch



Actuator



Technical details


General	
Approvals	CE, EAC (Eurasian), FCC, IC, TÜV, cULus Listed
Sensor's mode of operation	Transponder
Coding level in accordance with EN ISO 14119	High
Design in accordance with EN ISO 14119	4
Classification in accordance with EN 60947-5-3	PDDB
Pilz coding type	fully coded
Electrical data	
Supply voltage	
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+20 %
Output of external power supply (DC)	2 W
Max. inrush current at UB	0,12 A
Max. switching frequency	3 Hz

Electrical data	
Max. cable capacitance at the safety outputs	
No-load, PNOZ with relay contacts	40 nF
PNOZmulti, PNOZelog, PSS	70 nF
No-load current	50 mA
Inputs	
Number	2
Voltage at inputs	24 V DC
Input current range	5 mA
Max. overall cable resistance R _{lmax}	
Single-channel at UB DC	1000 Ohm
Semiconductor outputs	
OSSD safety outputs	2
Signal outputs	1
Switching current per output	500 mA
Breaking capacity per output	12 W
Potential isolation from system voltage	No
Short circuit-proof	Yes
Residual current at outputs	10 µA
Voltage drop at OSSDs	3,5 V
Lowest operating current	0 mA
Utilisation category in accordance with EN 60947-1	DC-12
Times	
Test pulse duration, safety outputs	450 µs
Switch-on delay	
after UB is applied	1 s
Inputs typ.	13 ms
Inputs max.	20 ms
Actuator typ.	45 ms
Actuator max.	100 ms
Delay-on de-energisation	
Inputs typ.	15 ms
Inputs max.	20 ms
Actuator typ.	30 ms
Actuator max.	260 ms
Supply interruption before de-energisation	20 ms
Simultaneity, channel 1 and 2	∞
Environmental data	
Ambient temperature	
In accordance with the standard	EN 60068-2-14
Temperature range	-25 - 70 °C
Storage temperature	
In accordance with the standard	EN 60068-2-1/-2
Climatic suitability	
In accordance with the standard	EN 60068-2-78
Humidity	93 % r. h. at 40 °C

Environmental data	
EMC	EN 60947-5-3
Vibration	
In accordance with the standard	EN 60947-5-2
Frequency	10 - 55 Hz
Amplitude	1 mm
Shock stress	
In accordance with the standard	EN 60947-5-2
Acceleration	30g
Duration	11 ms
Airgap creepage	
Overvoltage category	III
Pollution degree	3
Rated insulation voltage	75 V
Rated impulse withstand voltage	1 kV
Protection type	
Housing	IP67
Mechanical data	
Actuator 1	PSEN cs2.1
Operating distances	
Assured operating distance Sao	15 mm
Typical operating distance So	21 mm
Assured release distance Sar	40 mm
Typical release distance Sr	32 mm
Repetition accuracy switching distances	10 %
Change of operating distance with temperature changes	+0,01mm/°C
Typ. Hysteresis	3 mm
Min. distance between safety switches	400 mm
Sensor flush installation in accordance with EN 60947-5-2	Yes, follow installation guidelines
Connection type	M12, 8-pin male connector
Material	
Top	PBT
Max. torque setting for fixing screws	1 Nm
Dimensions	
Height	75 mm
Width	40 mm
Depth	40 mm
Actuator dimensions	
Height	11 mm
Width	40 mm
Depth	40 mm
Weight of safety switch	130 g
Weight of actuator	20 g
Weight	150 g

Where standards are undated, the 2014-10 latest editions shall apply.


Safety characteristic data



NOTICE
 You must comply with the safety-related characteristic data in order to achieve the required safety level for your plant/machine.

Operating mode	EN ISO 13849-1: 2008 PL	EN ISO 13849-1: 2008 Category	EN 62061 SIL CL	EN 62061 PFH _D [1/h]	IEC 61511 SIL	IEC 61511 PFD	EN ISO 13849-1: 2008 T _M [year]
2-ch. OSSD	PL e	Cat. 4	SIL CL 3	4,10E-09	SIL 3	1,10E-04	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.

Supplementary data

Radio approval

USA/Canada

FC FCC ID: VT8- PSENC51
 IC: 7482A- PSENC51

FCC/IC-Requirements:
 This product complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standards. Operation is subject to the following two conditions:
 1) this product may not cause harmful interference, and
 2) this product must accept any interference received, including interference that may cause undesired operation.

Changes or modifications made to this product not expressly approved by Pilz may void the FCC authorization to operate this equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Le présent produit est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
 (1) le produit ne doit pas produire de brouillage, et
 (2) l'utilisateur de le produit doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Order reference

Product type	Features	Connection type	Order no.
PSEN cs2.1p / PSEN cs2.1	Safety gate system, fully coded	8-pin M12 connector	540 100
PSEN cs2.1p (switch)	Safety switch, fully coded	8-pin M12 connector	540 150
PSEN cs2.1	Actuator, coded		540 180

EC declaration of conformity

This product/these products meet the requirements of the directive 2006/42/EC for machinery of the European Parliament and of the Council. The complete EC Declaration of Conformity is available on the Internet at www.pilz.com/downloads.

Representative: Norbert Fröhlich, Pilz GmbH & Co. KG, Felix-Wankel-Str. 2, 73760 Ostfildern, Germany

► Support

Technical support is available from Pilz round the clock.

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Partner of the Engineering Industry Sustainability Initiative



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