

Non-contact safety switch PSR-CT

Original operating instructions

PHOENIX CONTACT
INSPIRING INNOVATIONS

Original operating instructions

Non-contact safety switch PSR-CT

UM EN PSR-CT, Revision 01 2019-01-25

This user manual is valid for:

Designation	As of version	Order No.
PSR-CT-F-SEN-1-8	V1.1.0	2702976
PSR-CT-C-SEN-1-8	V1.1.0	2702972
PSR-CT-M-SEN-1-8	V1.1.0	2702975
PSR-CT-C-ACT	V1.0.0	2702973

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1 For your safety

Read this user manual carefully and keep it for future reference.

1.1 Identification of warning notes



This symbol indicates hazards that could lead to personal injury.

There are three signal words indicating the severity of a potential injury.

DANGER
Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING
Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION
Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.



This symbol together with the **NOTE** signal word warns the reader of actions that might cause property damage or a malfunction.



Here you will find additional information or detailed sources of information.

1.2 Qualification of users

The use of products described in this user manual is oriented exclusively to:

– Qualified personnel who plan and design safety equipment for machines and systems and are familiar with regulations governing occupational safety and accident prevention.
– Qualified personnel who install and operate safety equipment in machines and systems.

Qualified personnel

Qualified personnel are people who, because of their education, experience, and instruction and their knowledge of relevant standards, regulations, accident prevention, and service conditions, have been authorized by those responsible for the safety of the system to carry out any required operations and who are able to recognize and avoid any possible dangers.

Requirements

Knowledge of the following topics is required:

– Handling safety components
– Valid EMC regulations
– Valid regulations governing occupational safety and accident prevention

1.3 Field of application of the product

PSR-CT safety switches are suitable for use in applications for contact-free detection of secure positions of doors, flaps, or moving parts of a machine, for example.

1.3.1 Intended use

Safety function

As locking devices without guard locking device, PSR-CT safety switches perform the following safety functions:

- Monitoring the position of movable guards
- Secure position monitoring on machines

Combined with a movable guard and the machine control system, the safety switch prevents a dangerous machine function from being executed as long as the guard is open. A stop command is triggered when the guard is opened during hazardous machine operation.

For intended use, comply with the requirements for installation and operation, in particular according to the following standards:

- EN ISO 13849-1, Safety-related parts of control systems
- EN ISO 14119, Interlocking devices associated with guards
- EN 60204-1, Electrical equipment of machines

Fulfilled requirements and safety integrity

Depending on the conditions of use, the safety switch meets the following requirements and safety integrity features:

- Design 4 according to EN ISO 14119
- Requirements according to EN 60947-5-3
- Suitable up to category 4, PL e (EN ISO 13849-1), SIL 3 (IEC 61508)

Technical data and environmental conditions

Only use the device according to the defined technical data and environmental conditions.

See Section “Technical data” on page 57.

Approved components

Only use approved components and combinations for PSR-CT safety switches.

See Section “PSR-CT components” on page 13.

1.3.2 Foreseeable misuse



WARNING: Serious risks due to inappropriate use
Inappropriate or unintended use, as well as manipulation of the safety switch, can lead to serious danger for the user or damage to the machine or system.
- Please refer to the detailed information in standard EN ISO 14119.

– The safety switch may **not** be used as a stop.
– Do **not** connect any other signals to the safety inputs of a PSR-CT safety switch. Only the following signals are permitted:
  – Connection to 24 V DC for a single switch or the first switch in a series connection with PSR-CT safety switches
  – Connection through the safety outputs of a PSR-CT safety switch in a series connection with PSR-CT safety switches

1.3.3 Product changes

Modifications to hardware and firmware of the device are not permitted.

Incorrect operation or modifications to the device can endanger your safety or damage the device. Do not repair the device yourself. If the device is defective, please contact Phoenix Contact.

1.4 Safety notes

WARNING: Serious risks due to inappropriate use

Depending on the application, inappropriate use of the safety switch may pose serious risks for the user.

- Observe the safety notes in this section.
- Observe the warning instructions provided elsewhere in this document.

1.4.1 General safety notes

Documentation

Observe all information in this user manual and the accompanying documents.
See Section “Documentation” on page 12.

Safety of personnel and equipment

The safety of personnel and equipment can only be assured if the safety switch is used correctly.
See Section “Intended use” on page 7.

Startup, mounting, and modifications

Startup, mounting, modifications, and upgrades may only be carried out by qualified personnel.

Installation conditions and tamper protection

Safety components may not be bridged, turned away, removed or rendered ineffective in another manner.

- Observe the measures for reducing the bypassing possibilities of locking devices according to EN ISO 14119, Section 7.

The switching procedure may only be triggered by actuators designed specifically for this purpose.

- Make sure that no bypassing by replacement actuators takes place.
- For this, restrict the access to actuators.

Safety switches and actuators may not be used as a stop.

- Observe EN ISO 14119, Sections 5.2 and 5.3 for attaching safety switches and actuators.

Defective devices

The devices might be damaged following an error. Correct operation can no longer be ensured.

- In the event of an error, replace the device.

Do not open the housing

Only the manufacturer or their authorized representative may perform the following activities. Otherwise the warranty is invalidated.

– Repairs to the device
– Opening the housing

Decommissioning and disposal

- Dispose of the device in accordance with environmental regulations.
- Make sure that the device can never be reused.

1.4.2 Electrical safety



WARNING: Loss of safety function/hazardous shock currents
Incorrect installation can result in the loss of the safety function as well as hazardous shock currents. Depending on the application, there may be serious risks for the user.
- Observe the notes on electrical safety.
- Observe the warning instructions provided elsewhere in this document.
- Plan the devices used and their installation in the system according to the specific requirements.
- Recheck plants and systems retrofitted with the safety switch.

Electrical connection

Electrical connection may only be carried out by qualified personnel.

PELV power supply

All electrical connections have to be insulated from the mains using suitable measures.
- Observe the requirements according to EN 60204-1, Section 6.4.
- Use safety transformers according to IEC 61558-2-6 with limitation of the output voltage in the event of an error.
- Another option is to use an equivalent insulation measure according to PELV requirements.
- Use the same power source for all devices that are electrically connected to the safety switch.

Ground contact

- Use the same ground contact for all devices that are electrically connected to the safety switch.

Fuse protection for power supply

- Protect the power supply with a suitable external fuse.
See Section “Fuse protection for the power supply” on page 34.

Protective circuit in the case of inductive loads

All electrical outputs require an adequate protective circuit in the case of inductive loads.
- Protect the outputs with a freewheeling diode.
- Implement the protective circuit in parallel to the load.
- Do **not** use RC suppressors.

Sources of interference from power devices

Power devices may represent a major source of interference.
- Remove the input and output circuits for signal processing locally from these sources of interference.
- Ensure the cable installation of the safety circuits is as far away as possible from the lines of the power circuits.

EMC interference

For avoiding EMC interference:
- Ensure that the physical ambient and operating conditions at the installation location meet the requirements of EN 60204-1, Section 4.4.2.
- Observe possible fields of interference for devices like frequency converters or induction heating systems. Observe the manufacturer's information.

ESD information



NOTE: Electrostatic discharge
Electrostatic discharge can damage or destroy the components. When handling the device, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and IEC 61340-5-1.

1.4.3 Safety of machines or systems

Draw up and implement a safety concept

The machine or system manufacturer and the operator are responsible for the safety of the machine or system and the application in which the machine or system is used. In order to use the device described in this document, you must have drawn up an appropriate safety concept for your machine or system. This includes risk assessment according to the directives and standards mentioned in Section “Directives and standards” on page 11.

Risk assessment, validation and function test

- Before using the device, perform risk assessment for the machine or system.
- Validate your entire safety system.
- Carry out a new validation every time you make a safety-related modification.
- Perform a function test on a regular basis.

Achievable safety integrity

Functional safety is guaranteed for the device as a single component. However, this does not guarantee functional safety for the entire machine or system. In order to achieve the desired safety level for the entire machine or system, define the safety requirements for the machine or system, as well as how to implement them, from both a technological and organizational perspective.

1.4.4 Safety when starting applications

Start conditions

Take the following into consideration when determining the start conditions for your machine or system:

– The machine or system may only be started if it can be ensured that nobody is present in the danger zone.
– If required: meet the requirements of EN ISO 13849-1 with regard to the manual reset function.
  Pressing a reset button must not cause automatic startup of a dangerous machine function.
– Meet the requirements of EN ISO 12100 with regard to closing safety equipment:
  Closing of safety equipment must not cause automatic startup of a dangerous machine function. A separate start command must be used. For exceptions, see EN ISO 12100 or the relevant C standards.

1.5 Directives and standards

The directives and standards complied with by the PSR-CT safety switches can be found in the certificate issued by the approval body and in the EC declaration of conformity.

These documents are available on the Internet.
See phoenixcontact.net/products.



For separate notes on FCC / IC conformity, refer to the Appendix “FCC / IC conformity” on page 66.

1.6 Documentation

Latest documentation

Always use the latest documentation. Changes or additions to documentation can be found on the Internet.
See phoenixcontact.net/products.

Also observe the documentation of any additional devices used together with the safety switches.

1.7 Safety hotline

Should you have any technical questions, please contact our 24-hour hotline.

Phone: +49 5281 9462777
E-mail: safety-service@phoenixcontact.com

2 Product description and method of operation

2.1 Product features

The PSR-CT safety switches offer the following features:

- Tamper protection via RFID transponder technology
- OSSD safety outputs for safe switching-off
- Safety inputs for series connection according to EN ISO 14119
- Start/reset input for autostart or manual monitored start
- Signal output/diagnostic output
- LED indicators
- 4 actuation positions, 3 travel directions
- 3 coding types

2.2 PSR-CT components

The PSR-CT safety switch is made up of the following components:

- **Sensor** with different coding type
  for mounting on the fixed part of the safety equipment
  designation: PSR-CT-...-SEN-1-8
- Coded **actuator**
  for mounting on moving part of the safety equipment
  designation: PSR-CT-C-ACT

2.2.1 Approved combinations

The sensor and actuator combinations with checkmarks are approved combinations.

Table 2-1 Approved PSR-CT combinations

	Actuator
Sensor	PSR-CT-C-ACT
PSR-CT-F-SEN-1-8	✓
PSR-CT-C-SEN-1-8	✓
PSR-CT-M-SEN-1-8	✓

2.2.2 Mounting accessories

The following accessories are provided with the actuator of the safety switch:

– **Safety screws** for mounting to the safety equipment
– **Caps** for the mounting slots to protect against dirt accumulation

2.2.3 Optional accessories

The following accessories are available for easy connection:

– **Y distributor** for the wiring of
  – Series connection
  – Manual startup behavior
  – Integrated diagnostics via signal contact
– **Dummy plug** for each sensor circuit

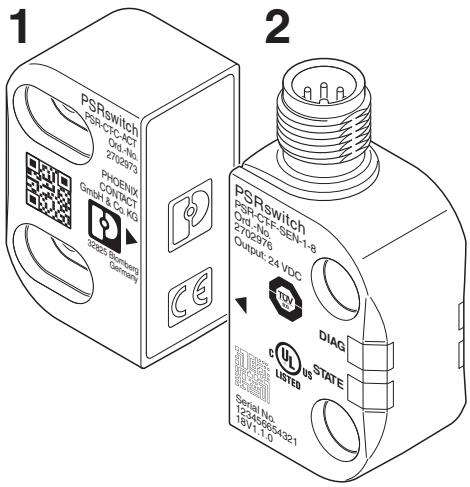
See Section “Ordering data” on page 63.

The **functional safety** range from Phoenix Contact will provide you with suitable evaluation devices for use with PSR-CT safety switches.

See phoenixcontact.net/products.

2.3 Design

Product image



1 PSR-CT-C-ACT actuator
2 PSR-CT-...-SEN-1-8 sensor

Figure 2-1 PSR-CT safety switch

LED status indicators

The sensor has two LED indicators.

DIAG	Red LED
STATE	Green LED

The LED indicators show general states and error messages of the safety switch.

See Section “LED status indicators and switching states” on page 43.

Positioning arrows

Two arrows are printed on the sensor, one arrow on each side.
One arrow is printed on the actuator, on one side only.

The arrows indicate the permissible actuation positions and correct alignment of the sensor and actuator with one another.

See Section “Actuation positions and travel directions” on page 23 and Section “Mounting” on page 26.

Mounting slots

In the housing, the sensor and actuator each has two mounting slots each for mounting to the safety equipment. The 3-step mounting slots of the actuator can be used to set the required distance to the sensor. The actuator is mounted using the provided safety screws.

See Section “Mounting” on page 26.

M12 connection

The sensor is connected via an 8-pos. M12 connector.

See Section “Electrical connection” on page 32.

Year of manufacture and version

The year of manufacture and the current version number are located on the housing under the serial number in the format YY VX.X.X.

2.4 Inputs and outputs

The sensor of the safety switch provides the following inputs and outputs via the 8-pos. M12 connector:

– 24 V supply connection
– 2 safety inputs
– Start/reset input
– 2 safety outputs (OSSD)
– 1 signal output/diagnostic output

2.4.1 24 V supply connection

Designation: UB, 0 V

Power supply of sensor

The UB and 0 V connections are used to supply the sensor with adequate voltage. When doing so, observe the requirements on the power supply.

See Section “Electrical safety” on page 10.

See Section “Technical data for the sensors” on page 57.

Protect the power supply with a suitable external fuse.

See Section “Fuse protection for the power supply” on page 34.

Power supply of actuator

The actuator is inductively supplied with power via the sensor as soon as the actuator has reached the switch-on distance.

2.4.2 Safety inputs

Designation: FI1A, FI1B

Safety inputs FI1A and FI1B are used for safe series connection of several safety switches.

Safe series connection

Connect the safety inputs of the first switch in a series connection to 24 V DC. Connect the safety inputs of all other switches in the series connection to the safety outputs of the previous safety switch.

Single switch

When using a single safety switch, connect the safety inputs to 24 V DC.

2.4.3 Start/reset input

Designation: START

Local start/reset circuit

The safety switch provides two possible startup behaviors:

– **Autostart**
  The sensor is switched on automatically as soon as a valid actuator is detected in the response area.
– **Manual, monitored start**
  The sensor is switched on under the following conditions:
  – If there is a valid actuator in the response area
  And:
  – After a local reset button has been pressed and released again

Implement the desired startup behavior of the safety switch via the corresponding wiring of the START input.



Also observe the information and assistance notes in the following sections:
– **Section “Safety when starting applications” on page 11**
– Section “Application examples” on page 46

Autostart

For the automatic startup behavior, the sensor expects a clock signal from safety output FO1A at the START input.

- For this, bridge the START input with the FO1A safety output.

Manual, monitored start

If the sensor does **not** detect a clock signal from the FO1A/FO1B safety outputs at the START input, the sensor is in manual, monitored, start behavior.

The sensor expects a signal change at the START input as the start command.

- Connect a reset button with 24 V DC to the START input.

Start pulse

Manual, monitored start takes place with a falling edge of a 24 V signal (release of the reset button). The start signal is subject to time monitoring: The 24 V signal must be applied at the START input for **at least 100 ms** and **2 s, maximum**.

Central reset for switch chain



The safety function can be centrally reset in the event that several switches are connected in series. For this, execute the reset function at the evaluating switching device, and operate the individual switches with automatic startup behavior.

2.4.4 Safety outputs

Designation: FO1A, FO1B

The OSSD outputs FO1A and FO1B are used for safely switching off the output circuit.

The actuator moves away from the sensor when the safety equipment is opened. The actuator approaches the sensor when the safety equipment is closed.

Switching on

When the actuator has reached the switch-on distance, power is supplied via the sensor, and data transmission starts.

If the sensor detects a permissible coding, the safety outputs are switched on depending on the selected startup behavior.

Safe switching off

If the actuator leaves the response area of the sensor, the safety outputs are switched in a safety-related manner.

See Section “Switching states of the outputs” on page 19.



Observe the corresponding **switching distances** according to the actuation position and travel direction.

See Section “Mounting” on page 26 and Section “Technical data for the actuator” on page 60.

Test pulses

The safety outputs generate test pulses:

– When switched on
– When switched off during device start

Downstream devices must tolerate these test pulses.

See “Times” in Section “Technical data” on page 57.

See Section “Interface types according to ZVEI classification” on page 62.

2.4.5 Signal output/diagnostic output

Designation: DGN

Non-safety-related

The signal output is switched on as soon as the actuator has left the response area of the sensor. The information is non-safety-related. The information is used for evaluating the position of safety equipment, for example.

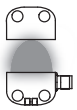
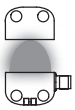
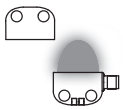
See Section “Switching states of the outputs” on page 19.

2.4.6 Switching states of the outputs

Switching states

The outputs have the following switching states when safety equipment is open or closed. The switch-on state depends on the selected startup behavior.

Table 2-2 Switching states

Output	Safety equipment closed		Safety equipment open
	– Actuator within response area – Permissible coding – Start command present/auto-start	– Actuator within response area – Permissible coding – Start command not present	– Actuator outside response area
			
FO1A **FO1B**	On	Off	Off
DGN	Off	On	On

Overview of the switching states in combination with the LED indicators for general states and error messages:

See Section “LED status indicators and switching states” on page 43.

2.5 Connector pin assignment

The sensor connector has the following pin assignment. Use the position of the connector's coding tap as a guide.

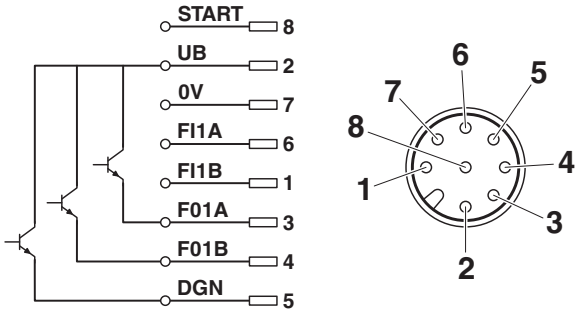


Figure 2-2 View of the connector and pin assignment

Pin assignment

Table 2-3 Pin assignment of the sensor connector

Pin	Designation	Description
1	FI1B	Enable input for channel 2
2	UB	24 V DC power supply
3	FO1A	Safety output for channel 1
4	FO1B	Safety output for channel 2
5	DGN	Signal output/diagnostic output
6	FI1A	Enable input for channel 1
7	0 V	0 V DC ground
8	START	Start/reset input

2.6 Coding types

The sensors are available in various coding types. When combined with the coded actuator, this results in a corresponding encoding level for the safety switch according to EN ISO 14119.

Fixed, unique assignment

Fixcode:

For the sensor to detect the actuator, the actuator must first be assigned to the sensor by means of a learning process.

See Section “Startup” on page 38.

The learning process can be carried out once. The sensor and actuator are then permanently assigned to each other by their coding.

Safety switches with fixcode evaluation achieve a **high** encoding level.

Fixed, multiple assignment

Unicode:

For the sensor to detect the actuator, the actuator must first be assigned to the sensor by means of a learning process.

See Section “Startup” on page 38.

Teaching-in of a new actuator can be repeated any number of times. The sensor only detects the last taught-in actuator.

Safety switches with unicode evaluation achieve a **high** encoding level.

No fixed assignment

Multicode:

The sensor detects every actuator of the permssible type. No specific actuator code can be assigned.

It is not necessary to teach in an actuator.

Safety switches with multicode evaluation achieve a **low** encoding level.

Overview of sensor coding types

You can use the product designation to determine the coding type of the sensor, which is the letter after PSR-CT-...

Table 2-4 Sensor coding types

Sensor	Coding type
PSR-CT-**F**-SEN-1-8	Fixcode
PSR-CT-**C**-SEN-1-8	Unicode
PSR-CT-**M**-SEN-1-8	Multicode

2.7 Active sensor areas and response area

RFID transponder technology

The safety switch operates with RFID transponder technology. The sensor has three active sensor surfaces:

– Front (black surface)
– Both surfaces on the side (with printing)

Transponder field

The sensor generates a transponder field with a main lobe and side lobes. The main lobe represents the defined response area of the sensor for safe switching.

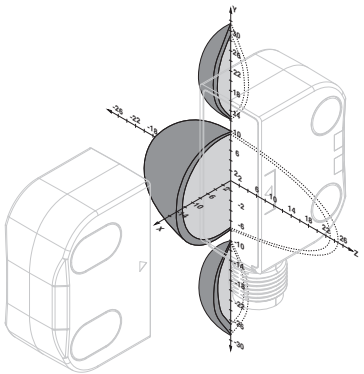


Figure 2-3 Transponder field of the sensor

The side lobes of the transponder field may influence the response behavior of the sensor depending on the actuation position and travel direction.

- In order to avoid influence of the side lobes, observe the specified **minimum distances** between sensor and actuator.
- Please observe the information in Section “Mounting” on page 26 and Section “Technical data and ordering data” on page 57.

2.8 Actuation positions and travel directions

4 actuation positions

The sensor and actuator operate in four permissible actuation positions.

The actuation position describes the orientation of the sensor and actuator towards one another, when both components are mounted to the safety equipment, and the safety equipment is closed.

Observe the **orientation of the arrow** on the sensor and actuator in order to ensure the following:

– Permissible actuation position according to the illustration (A, B, C, D)

– Alignment of the sensor and actuator without center offset

Center offset

There is a center offset when the tips of the arrows on the printing of the sensor and actuator are **not** on one line in the closed state.

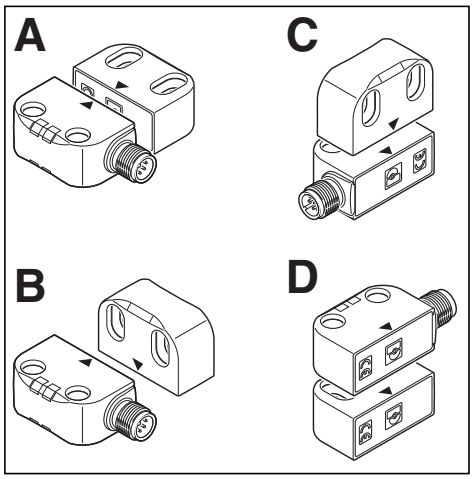


Figure 2-4 Actuation positions

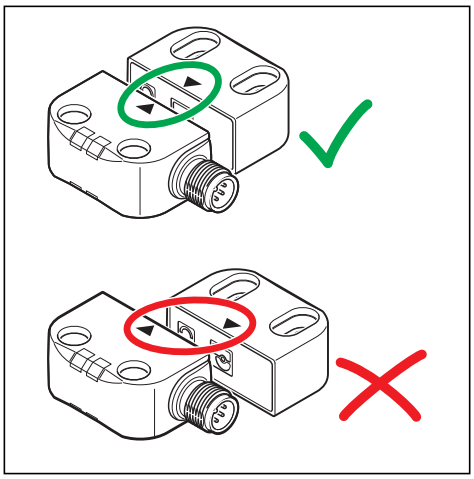


Figure 2-5 Center offset when safety equipment is closed

3 travel directions

There are three possible travel directions in each actuation position, in which the actuator can approach the sensor.

Actuation position and travel direction **influence the switching distances**. Please observe the information in Section “Mounting” on page 26 and Section “Technical data and ordering data” on page 57.

2.9 Limit range monitoring

The moving part of a safety equipment product can settle with time. The actuator is attached to the moving part of the safety equipment product, and therefore moves out of the response area of the sensor. The sensor detects this and indicates that the actuator is within the limit range with a flashing DIAG LED. In this way, the safety equipment can be readjusted in time.

See Section “LED status indicators and switching states” on page 43.

2.10 Series connection

PSR-CT safety switches are suitable for operation in a series connection according to EN ISO 14119. If a safety equipment product is opened, or an error occurs at a safety switch, the entire system is switched off.

Connect a **maximum of 30** safety switches in series.

Observe the corresponding **minimum distances** between the safety switches and the **maximum cable length** of a switch chain.

See Section “Mounting” on page 26 and Section “Maximum cable lengths” on page 35.

Observe the rise of the **risk time** for a switch chain.

See Appendix “Explanation of the typical system times” on page 65.

2.11 Error safety

The sensor provides the following internal error safety features:

– Protection against polarity reversal of the supply voltage
– Short-circuit protection and short-circuit monitoring at the safety outputs
– Short-circuit protection at the signal outputs
– Cross-circuit monitoring between the safety outputs

The sensor detects errors that have occurred with the next demand to switch on the safety outputs at the latest.

Behavior in the event of an error

Safe state in the event of an error

The safety outputs are switched off in the event of an error in the sensor.

The DIAG LED lights up red. In addition, a flashing code of the green STATE LED indicates the type of error.

See Section “LED status indicators and switching states” on page 43.

Recovery in the event of an error

1. Remove the cause.
2. Open and close the safety equipment.

If the error is still indicated:

3. Restart the safety switch:
   a) Disconnect the operating voltage.
   b) Connect the operating voltage again.

If the error cannot be reset, please contact Phoenix Contact.



Perform a function test after every error.

See Section “Function test” on page 40.

2.12 Safe state

If the safety equipment is open, the safety outputs are switched off beginning at the assured release distance S_{ar}.

The device is in the safe state when the safety outputs are switched off.

The safe state is also entered in the following cases:

– Error
– Learning process

3 Mounting

Tip: for safety switches with fixcode or unicode evaluation, perform teaching **before** mounting.

3.1 Positioning and distances

Observe the **orientation of the arrows** on the sensor and actuator in order to ensure the following:

– Permissible actuation position according to illustration (A, B, C, D)

– Alignment of the sensor and actuator without center offset

See Section “Actuation positions and travel directions” on page 23.

The side lobes of the transponder field may influence the response behavior of the sensor depending on the actuation position and travel direction.

- In order to avoid influence of the side lobes, observe the specified **minimum distances** between sensor and actuator.

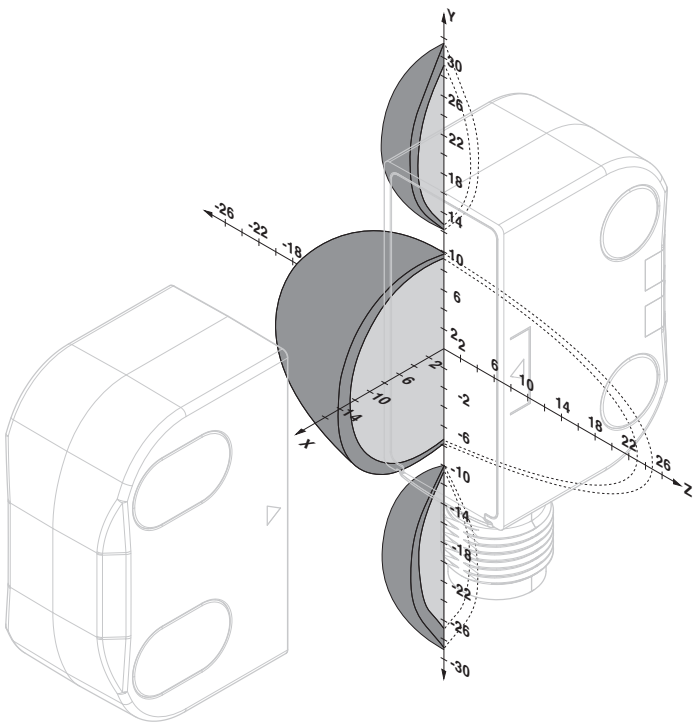


Figure 3-1 Transponder field of the sensor

The values of the switching distances apply under the following conditions:

– Center offset of m = 0 with regard to arrow alignment
– Measured on plastic mounting surface
– Without influence from surroundings and mounting surface

Table 3-1 Minimum distances and switching distances

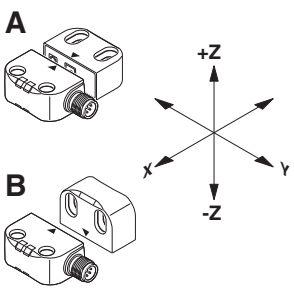
Actuation position	Travel direction	Minimum distance in X direction	Switching distances with regard to respective travel direction	
	X direction	-	Typical switch-on distance	13 mm, typical
			Assured operation distance S_{ao}	Position A: 10 mm Position B: 9 mm
			Switching hysteresis	1 mm, minimum 2 mm, typical
			Assured release distance S_{ar}	20 mm, maximum
			Repeat accuracy	≤10%
	Y direction	7 mm Minimum distance between the sensor and actuator in the X direction	Typical switch-on distance	±9 mm, typical
			Assured operation distance S_{ao} At 7 mm distance between the sensor and actuator in the X direction	Position A: ±6 mm Position B: ±5 mm
			Switching hysteresis	1 mm, minimum 2 mm, typical
			Assured release distance S_{ar}	±11 mm, maximum
			Repeat accuracy	≤10%
	Z direction	-	Typical switch-on distance	±12 mm, typical
			Assured operation distance S_{ao} At 6 mm distance between the sensor and actuator in the X direction	Position A: ±7 mm Position B: ±15 mm
			Switching hysteresis	1 mm, minimum 2 mm, typical
			Assured release distance S_{ar}	+Z direction: 23 mm, maximum -Z direction: 32 mm, maximum
			Repeat accuracy	≤10%

Table 3-1 Minimum distances and switching distances

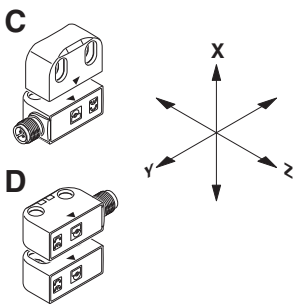
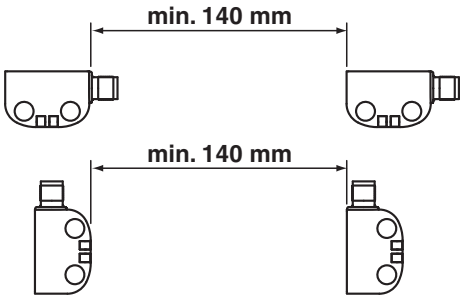
Actuation position	Travel direction	Minimum distance in X direction	Switching distances with regard to respective travel direction	
	X direction	-	Typical switch-on distance	7 mm, typical
			Assured operation distance S_{ao}	Position C: 3 mm Position D: 2 mm
			Switching hysteresis	1 mm, minimum 2 mm, typical
			Assured release distance S_{ar}	17 mm, maximum
			Repeat accuracy	≤10%
	Y direction	-	Typical switch-on distance At 4 mm distance between the sensor and actuator in the X direction	±6 mm, typical
			Assured operation distance S_{ao} 1) At 2 mm distance between the sensor and actuator in the X direction 2) At 1 mm distance between the sensor and actuator in the X direction	Position C: ±4 mm 1) Position D: ±3 mm 2)
			Switching hysteresis	1 mm, minimum 2 mm, typical
			Assured release distance S_{ar}	±15 mm, maximum
			Repeat accuracy	≤10%
	Z direction	-	Typical switch-on distance At 4 mm distance between the sensor and actuator in the X direction	±9 mm, typical
			Assured operation distance S_{ao} 1) At 2 mm distance between the sensor and actuator in the X direction 2) At 1 mm distance between the sensor and actuator in the X direction	Position C: 5 mm 1) Position D: 4 mm 2)
			Switching hysteresis	1 mm, minimum 2 mm, typical
			Assured release distance S_{ar}	±29 mm, maximum
			Repeat accuracy	≤10%

Table 3-2 Distance between sensors

Distance between sensors	
	In order to prevent mutual interference, keep a minimum distance of 140 mm between two sensors. The minimum distance applies in the following cases: – Individual wiring of safety switches – Series connection of safety switches

3.2 Mounting instructions

Qualified personnel

Mounting and removal may only be performed by qualified personnel.



WARNING: Risk due to unexpected machine startup

Unexpected machine startup during mounting may result in death or serious injury.

- Make sure that the dangerous machine function is switched off and remains switched off.
- Before working on the device, disconnect the power.



Observe the information in the section on safety regulations and installation notes.

Installation conditions



WARNING: Loss of safety function due to changed device properties depending on the surroundings and mounting surface

Electrically or magnetically conductive materials within the surroundings of the safety switch may influence the device properties. The switching distances change depending on the mounting surface material.

- Keep away from metallic surfaces in order not to affect the switching distances.
- Check the switching distances and the assured release distance S_{ar} after mounting.

Adhere to the following conditions and requirements when mounting the safety switch:

- Observe the installation measures according to EN ISO 14119.
- Mount the safety switches in such a way that the following conditions are met:
  - The minimum distance between sensor and actuator is kept (if required).
  - There is a form-fit connection between the actuator and the safety equipment.
- Ensure that all hazards are excluded if safety equipment is open until the assured release distance S_{ar} is reached.
- Ensure that the sensor and actuator cannot be easily removed or manipulated.
- Use an attachment for the actuator that cannot be removed.
- Ensure that the safety switch is not used as a stop.
- Mount the safety switch so that it can easily be accessed for checking and maintenance purposes.
- Install the connecting cable so that it is protected in areas where high-pressure cleaners are used.

Mounting surface

Prepare the mounting surface on the safety equipment appropriately.
The mounting surface requires drill holes for M4 screws.

See dimensional drawings in Section “Technical data” on page 57.

3.3 Mounting

Proceed as follows to mount the safety switch to the safety equipment:

Mounting the sensor

Tip: in order to enable later exchange, use common screws when mounting the sensor.

1. Screw the sensor to the fixed part of the safety equipment.
2. Close the mounting slots using the caps.

Mounting the actuator

Use the safety screws provided.
Observe the permissible tightening torque for the screws.
See Section “Technical data” on page 57.
The safety screws can only be used once.
After tightening, the screws cannot be removed again.

1. At first, only loosely attach the actuator to the moving part of the safety equipment.
2. Adjust the actuator:
   – According to the arrow alignment between the sensor and actuator
   – According to the required distances between the sensor and actuator
3. Tighten the actuator.
4. Close the mounting slots using the caps.

4 Electrical connection

You have the following options when connecting the safety switch:

– Stand-alone operation
– Series connection

For the simple connection, different **Y distributors** and a **dummy plug** are available.

See Section “Ordering data” on page 63.

When using a single safety switch or a switch chain, please refer to Section “Application examples” on page 46.

4.1 Connection notes

Qualified personnel

Electrical connection may only be performed by qualified personnel.

WARNING: Risk due to unexpected machine startup or electric shock

Unexpected machine startup or electric shock may result in death or serious injury.

- Make sure that the machine is disconnected from the power and remains disconnected from the power.
- Make sure that the dangerous machine function is switched off and remains switched off.

WARNING: Loss of safety function due to incorrect connection

In order to guarantee the safety function, observe the following points when connecting the safety switch:

- Always evaluate both safety outputs.
- Do not use the signal outputs as safety outputs.

CAUTION: Damage to equipment or malfunction due to incorrect connection

Observe the following points when connecting the safety switch:

The safety outputs generate their own test pulses when switched on and switched off.

- Do not use a controller with clocking, or switch off the clocking of the controller.
- Make sure that a downstream controller can tolerate the test pulses of the safety switch.
- Please note: the test pulses of the safety switch can lead to temporary switching operations, depending on the inertia of the downstream device (relay, controller, etc.).

When switched on, the safety outputs provide a +24 V level.

- Use downstream evaluation devices with pulse-switching inputs.

Observe the information in the section on safety regulations and installation notes.

4.1.1 Notes on using Y distributors and dummy plugs

Observe the following notes when connecting with Y distributors and the corresponding dummy plugs:

– Do not stick Y distributors directly on the connection of the safety switch.
– Use suitable connecting cables to connect the Y distributor and the safety switch.
– In order to prevent manipulation, install the Y distributors or cables out of reach of people.

4.1.2 UL notes

Adhere to the following conditions for use according to cULus requirements[1]:

– Use of a power supply with “for use in class 2 circuits” feature
– Alternatively: electrically isolated power supply unit with a maximum off-load voltage of 30 V DC and a maximum limited current of 8 A
– Use of a connecting cable that is listed under UL category code CYJV2 or CYJV

[1] The devices have been checked according to the requirements of UL508 and CSA/ C22.2 no. 14 (protection against electric shock and fire). Only for use according to NFPA 79 (Industrial Machinery).

4.2 Fuse protection for the power supply

Protect the power supply externally.

Design the external fuse depending on the number of switches and the required power for the outputs. Also observe the connecting cable used.

Observe the following rules:

Maximum current consumption of a single switch

$\mathbf{I_{max}}$	= I_{UB} + $I_{FO1A+FO1B}$
$\mathbf{I_{UB}}$	= Current consumption of the switch (see technical data)
$\mathbf{I_{FO1A+FO1B}}$	= Switching current of safety outputs (2 x maxiumum switching current, see technical data)

Maximum current consumption of a switch chain

$\Sigma\mathbf{I_{max}}$	= n x I_{UB} + $I_{FO1A+FO1B}$
n	= Number of connected switches

If you protect the safety switch and evaluation device with a common fuse, also observe the requirements of the evaluation device when designing the fuse.

4.3 Requirements on connecting cables

CAUTION: Damage to equipment or malfunction due to inappropriate connecting cables

Observe the requirements on the connecting cables in the following table.

Table 4-1 Requirements on connecting cables

Parameter	Value
Conductor cross-section, minimum	0.34 mm²
R, maximum	80 Ω/km
C, maximum	120 nF/km
L, maximum	0.65 mH/km
Recommended cable type	LIYY 8 x 0.34 mm²

Note that too high cable capacities at very low load currents may falsify the test pulses of the safety outputs.

If you are planning a cable design that differs (cross section, material, etc.), please contact Phoenix Contact:

4.4 Maximum cable lengths

Switch chains up to the maximum cable length as per Table 4-2 are permitted while observing the voltage drop due to the cable resistance. Also observe the maximum permissible cable lengths between two safety switches.

Table 4-2 Maximum cable length

Number of switches in the chain	Supply voltage at the first switch	Maximum cable length l_{max}
≤20	24 V DC	200 m
≤30	24 V DC	130 m
Maximum cable length between two safety switches l_n:		100 m

Note that a high voltage drop at large load currents leads to low input voltages at the sensor and evaluation unit.

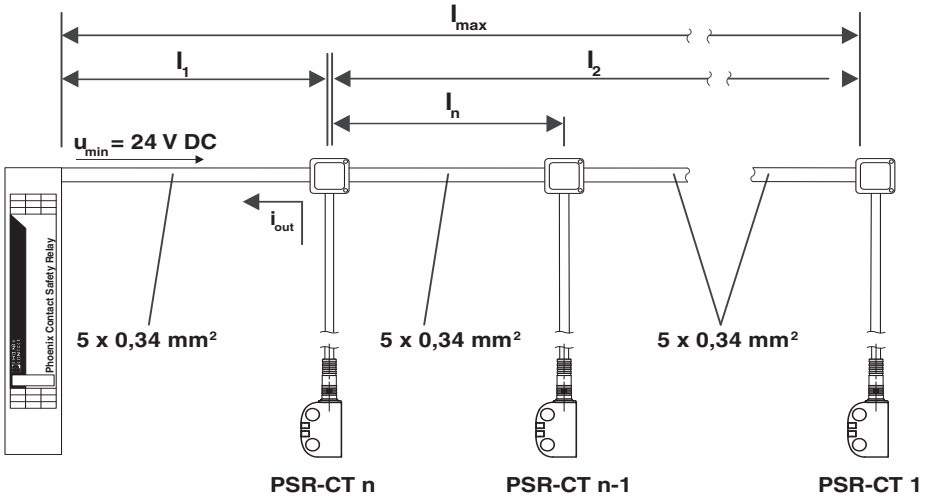


Figure 4-1 Maximum cable length with n PSR-CT safety switches

Key:

PSR-CT 1	**First** switch in the switch chain
PSR-CT n	**Last** switch in the switch chain

4.4.1 Checking the planned design

Check the planned design using Table 4-3 “Example table for cable lengths”. Proceed as described in the example.

See “Example: determining the cable length” on page 37.

The information on the cable lengths applies under the following conditions:

– The requirements on the connecting cables according to Table 4-1 are adhered to.

Table 4-3 Example table for cable lengths

n Maximum number of switches	**i_{out} [mA]** Possible output current per channel FO1A/FO1B	**l1 [m]** Maximum cable length from the last switch to the controller
		0.34 mm² cable
5	10	100
	25	100
	50	80
	100	50
6	10	100
	25	90
	50	70
	100	50
10	10	70
	25	60
	50	50
	100	35

Note that connecting a reset button will influence the cable length design.

If you are connecting more than ten switches in series, please contact Phoenix Contact:

Example: determining the cable length

– Six switches in series are to be used.
– The cable length from the safety relay in the control cabinet to the last switch (PSR-CT 6) is 40 m.
– The cable length between each individual switch is 20 m.
– The safety relay consumes 75 mA at each of the two safe inputs.

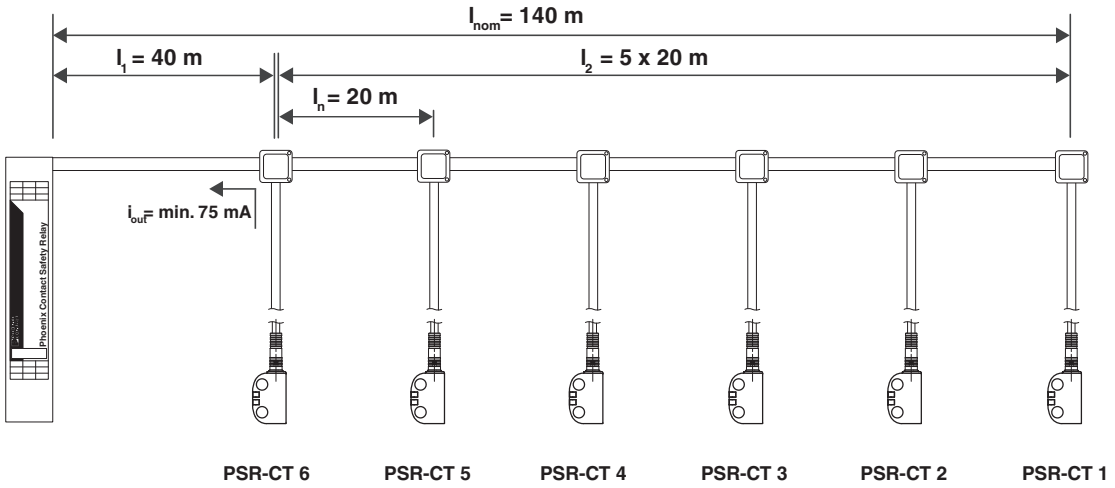


Figure 4-2 Switch chain with six PSR-CT safety switches

Determine the relevant values using the example table:

1. In **column n**, select the corresponding section.
   – In this example, six switches.
2. In the selected section, search **column i_{out}** for a current ≥75 mA.
   – In this example: 100 mA.
3. In the same line, read the maximum cable length from the last switch (PSR-CT 6) to the controller from **column l_1**.
   – In this example: 50 m.

Result:

– With a length of 40 m, the desired cable length l_1 is lower than the permissible value in Table 4-3.
– The total length of the switch chain l_{target} is 140 m and therefore lower than the maximum value according to Table 4-2 (l_{max} = 200 m for ≤20 switches).

The planned application in this format is operational.

5 Startup

5.1 Startup information

Qualified personnel

Startup may only be carried out by qualified personnel.

Tips:

- For safety switches with fixcode or unicode evaluation, perform teaching **before** mounting.
- Mark sensors and actuators that belong together.
- Switch chain: perform teaching-in for each safety switch **before** connecting in series.

5.2 Safety switches with multicode sensors

Safety switches with multicode sensors are in normal mode after the operating voltage has been applied and the self-test has been carried out successfully.

It is not necessary to teach in an actuator.

5.3 Safety switches with unicode or fixcode sensors

In order for the safety switch to form an operational function unit, use a learning process to assign the actuator to the unicode or fixcode sensor.

Safe state

The safety outputs are switched off during the learning process. The safety switch is in the safe state.

Requirements

The learning process can only be carried out if the safety switch is operating without errors.

– The red DIAG LED is **not** on.

Ready to learn

In the case of safety switches that have not been taught in, the ready-to learn period is **unlimited**.
When teaching in again, the ready-to-learn period is **3 min, approximately**.

Learning duration

A successful learning process takes **30 s, approximately**.

Information on fixcode sensors

– The learning process can be carried out once.
– It is not possible to teach in any additional actuators.

Information on unicode sensors

- The learning process can be repeated as often as required.
- The sensor only detects the last actuator taught in.
- If a new actuator (B) is taught in, the sensor blocks the code of the last actuator (A). This actuator (A) **cannot** be used during the next learning process.
- The sensor releases the blocked code again after a third actuator (C) has been taught in. Actuator (A) can be used again. Actuator (B) is now blocked.
- If the actuator to be learned is located in the response area of the sensor for **less than 30 s**, the sensor will not accept it. The actuator learned last remains valid.

5.3.1 Teaching in actuators



Observe the LED status indicators on the sensor.

See Section “LED status indicators and switching states” on page 43.

Proceed as follows to teach in an actuator:

Starting situation: the actuator is not within the response area / the safety equipment is open.

1. Apply the operating voltage to the safety switch.

The green STATE LED flashes quickly, 5 Hz.
The sensor is performing a self-test for 5 s, approximately.

The green STATE LED flashes cyclically: 2 x green, off long.
The sensor is ready to learn:
3 min when teaching in again, unlimited for switches that have not been taught in before.

2. Move the actuator towards the sensor.

Observe the assured operation distance S_{ao}.

The green STATE LED flashes cyclically: off short, green long.
The learning process has started.

3. Keep the actuator within the response are of the sensor for 30 s, approximately.

The red DIAG LED and the green STATE LED flash alternately: red short, green long.
The learning process has been completed successfully.



If the learning process has not been successful, the LEDs flash in the reverse order: red long, green short. A blocked actuator could be involved in the case of unicode sensors.

4. Restart the safety switch:

a) Disconnect the operating voltage.
b) Apply the operating voltage again.

The safety switch is in normal mode after the self-test has been carried out successfully.

6 Function test

Qualified personnel

The function test may only be carried out by qualified personnel.

WARNING: Careless installation and function test may result in fatal injuries
Observe the following points during installation and the function test:
- Make sure that there are no persons in the danger zone.
- Observe the applicable regulations for accident prevention.

Perform a complete check of the safety function in the following cases:
– After installation
– After any modification
– After any error
– During initial startup of the machine or system

During the function test, check whether the machine and the safety switch behavior is according to expectations.

If the machine or the safety switch behavior is **not** according to expectations, the function test is **not** successful.

WARNING: Loss of safety function due to malfunction
If the function test of the safety switch is not successful, the device no longer operates properly.
- Replace the device.

6.1 Performing the function test

Observe the LED status indicators on the sensor.
See Section “LED status indicators and switching states” on page 43.
The red DIAG LED should remain switched off during the entire function test.

Proceed as follows to check the safety function of each safety switch on all safety equipment.

Starting situation: the actuator is not within the response area / the safety equipment is open.

1. Switch on the operating voltage on the safety switch.

Expected machine behavior:

– The machine must **not** start up automatically.

Expected behavior of the safety switch:

– The green STATE LED flashes quickly, 5 Hz.
The sensor is performing a self-test for 5 s, approximately.
– In the case of **multicode and fixcode sensors**:
The green STATE LED flashes cyclically: green short, off long.
The sensor indicates normal mode with open safety equipment.
– In the case of **unicode sensors**:
The green STATE LED flashes cyclically: 2 x green, off long.
The sensor is ready to learn.

2. Close all safety equipment.

Expected machine behavior:

– The machine must **not** start up automatically.

Expected behavior of the safety switch:

– For **automatic** startup behavior:
The green STATE LED is permanently on.
The sensor indicates normal mode with closed safety equipment.
– For **manual, monitored** start behavior:
The green STATE LED flashes slowly, 1 Hz.
The sensor is waiting for a start command via the reset button.

3. Enter a start command for the machine via your controller.

a) If provided: press the reset button. Release it again.

Expected machine behavior:

– The machine starts up.

Expected behavior of the safety switch:

The green STATE LED is permanently on.
The sensor indicates normal mode with closed safety equipment.

4. Open the first safety equipment.

Expected machine behavior:

– The machine **must be** switched off.
– It must **not** be possible to start the machine as long as the safety equipment is open.

Expected behavior of the safety switch:

– The green STATE LED flashes cyclically: green short, off long.
The sensor indicates normal mode with open safety equipment.

5. Repeat steps 1 to 4 individually for each safety equipment.

7 Service and maintenance

The device requires no maintenance during the permissible duration of use.

Repairs may not be carried out. In the event of an error, please contact Phoenix Contact.

Perform the following checks regularly:

- Visual inspection
- Function test
- Distance measurement
- Check the devices and connections for the following, among other things:
  - Secure mounting
  - Contamination

Perform the following, if required:

- Cleaning
- Adjustment



Observe the relevant manufacturer specifications for carrying out maintenance on connected I/O devices.

8 LED status indicators and switching states

The following section describes the LED indicators for general states and error messages, as well as the respective switching states of the safety outputs and the signal output.

In the event of an error or fault that is not listed, please contact Phoenix Contact.

Table 8-1 LED status indicators and switching states

Operating state			Switching state		LED indicators	
			FO1A FO1B	DGN		
1	**Self-test** runs 5 s, approximately		Off	Off	DIAG STATE	DIAG LED is off. STATE LED regularly flashes green (5 Hz, quick flashing).
2	**Normal mode**	No supply voltage	Off	Off	DIAG STATE	DIAG LED is off. STATE LED is off.
3		Limit range monitoring: actuator leaves response area	On	Off	DIAG STATE	DIAG LED flashes cyclically: 2 x red, off long. STATE LED lights up green.
4		Safety equipment closed	On	Off	DIAG STATE	DIAG LED is off. STATE LED lights up green.
5		Waiting for start command	Off	On	DIAG STATE	DIAG LED is off. STATE LED regularly flashes green (1 Hz, slow flashing).
6		Safety equipment open	Off	On	DIAG STATE	DIAG LED is off. STATE LED flashes cyclically: green short, off long.
7	**Error**	Wiring error: FO1B is present instead of FO1A at the START input	Off	Off	DIAG STATE	DIAG LED is off. STATE LED regularly flashes green (1 Hz, slow flashing).
8		System error, internal error	Off	Off	DIAG STATE	DIAG LED lights up red. STATE LED is off.
9		External error, OSSD cross-circuit	Off	Off	DIAG STATE	DIAG LED lights up red. STATE LED flashes cyclically: 2 x off, green long.
10		Incorrect/disabled actuator	Off	On	DIAG STATE	DIAG LED lights up red. STATE LED lights up green.
11		Error at START input – Manual start (stuck-at-high)	Off	On	DIAG STATE	DIAG LED lights up red. STATE LED regularly flashes green (1 Hz, slow flashing).

Table 8-1 LED status indicators and switching states

Operating state			Switching state		LED indicators	
			FO1A FO1B	DGN		
12	Learning process	Learning process not successful	Off	On	DIAG STATE	DIAG and STATE LEDs flash alternately: red long, green short.
13		Learning process successful	Off	On	DIAG STATE	DIAG and STATE LEDs flash alternately: red short, green long.
14		Learning process running	Off	On	DIAG STATE	DIAG LED is off. STATE LED flashes cyclically: off short, green long.
15		Ready to learn	Off	On	DIAG STATE	DIAG LED is off. STATE LED flashes cyclically: 2 x green, off long.

Key:

The LED symbols have the following meaning in the respective LED color.



The LED is off.



The LED is permanently on.



The LED flashes regularly (1 Hz, slow flashing).



The LED flashes regularly (5 Hz, quick flashing).



The LED executes a repeating flashing cycle.
During this, the LED flashes briefly and then pauses for a longer period.



The LED executes a repeating flashing cycle.
During this, the LED flashes for a longer period and then pauses briefly.



The LED executes a repeating flashing cycle.
During this, the LED flashes 2 x briefly and then pauses for a longer period.



The LED executes a repeating flashing cycle.
During this, the LED goes off 2 x briefly and then lights up for a longer period.

8.1 Recovery in the event of an error

1. Remove the cause.
2. Open and close the safety equipment.

If the error is still indicated:

3. Restart the safety switch:
   a) Disconnect the operating voltage.
   b) Apply the operating voltage again.

If the error cannot be reset, please contact Phoenix Contact.

Perform a function test after every error.

See Section “Function test” on page 40.

9 Application examples

9.1 Application information

Each of the presented application examples shows only one section that is relevant for the wiring of the PSR-CT safety switch.

The user carries out the complete integration in the overall system and the safety classification of the overall safety function.

WARNING: Loss of safety function due to incorrect connection

In order to guarantee the safety function, observe the following points when connecting the safety switch:

- Always evaluate both safety outputs.
- Do not use the signal outputs as the safety outputs.

Information on switch chains

– Connect a **maximum of 30** PSR-CT safety switches in series.
– The safety outputs are permanently assigned to the respective safety inputs of the subsequent switch: FO1A to FI1A and FO1B to FI1B. If the connections are mixed up, the switch changes to the error state.
– If a reset function is executed on the switching device to be evaluated, you can reset the safety function centrally. Operate the individual switches with autostart behavior.

Information regarding operation on safe controllers

For operating PSR-CT safety switches on safe controllers, observe the following notes and requirements:

– Use a common power supply for the controller and the connected safety switch.
– Do **not** use a clocked power supply for the safety switch.
– Tap the supply voltage directly from the power supply unit.
– When connecting the supply voltage to a terminal of a safe controller, this output must supply sufficient power.
– Always connect safety inputs FI1A and FI1B directly to a power supply unit or to safety outputs FO1A and FO1B of another safety switch.
– Do **not** use clocked signals at safety inputs FI1A and FI1B.
– You can connect safety outputs FO1A and FO1B of a safety switch to the safe inputs of a controller.
  Requirements:
  – The input of the controller must be suitable for clocked safety signals (OSSD).
  – The controller must tolerate test pulses on the input signals (can usually be parameterized).
  – See Section “Interface types according to ZVEI classification” on page 62.

9.2 PSR-CT safety switches with safety relay

9.2.1 Series connection with central reset on the switching device

Application description

Switch chain

The application example shows three PSR-CT safety switches connected in series for monitoring safety equipment. The switch chain is connected to a safety relay. The safety relay evaluates the signals of the switch chain and switches connected actuators.

Central manual, monitored start

The safety relay is equipped with a reset button for manual, monitored start.

The safety switches are wired for operation with autostart.

If at least one safety equipment item is opened and closed again, the safety function is reset centrally via the reset button on the switching device.

Notes



WARNING: Loss of functional safety
Make sure that all safety switches and the safety relay have the same ground potential.



WARNING: Risk due to unexpected machine startup
Cross-circuit between A2 (0 V) and the cable of the reset button for connecting S34 of the safety relay can result in automatic machine startup.

- Avoid cross-circuit between A2 (0 V) and the cable from the reset button to S34 by means of design measures, e.g., protected cable installation.
- See fault exclusion according to EN ISO 13849-2.



Also observe the documentation for all other devices used together with the safety switch.

Phoenix Contact components used

– 3 x PSR-CT safety switch
– Safety relay: PSR-MC40-3NO-1DO-24DC-..

Application drawing

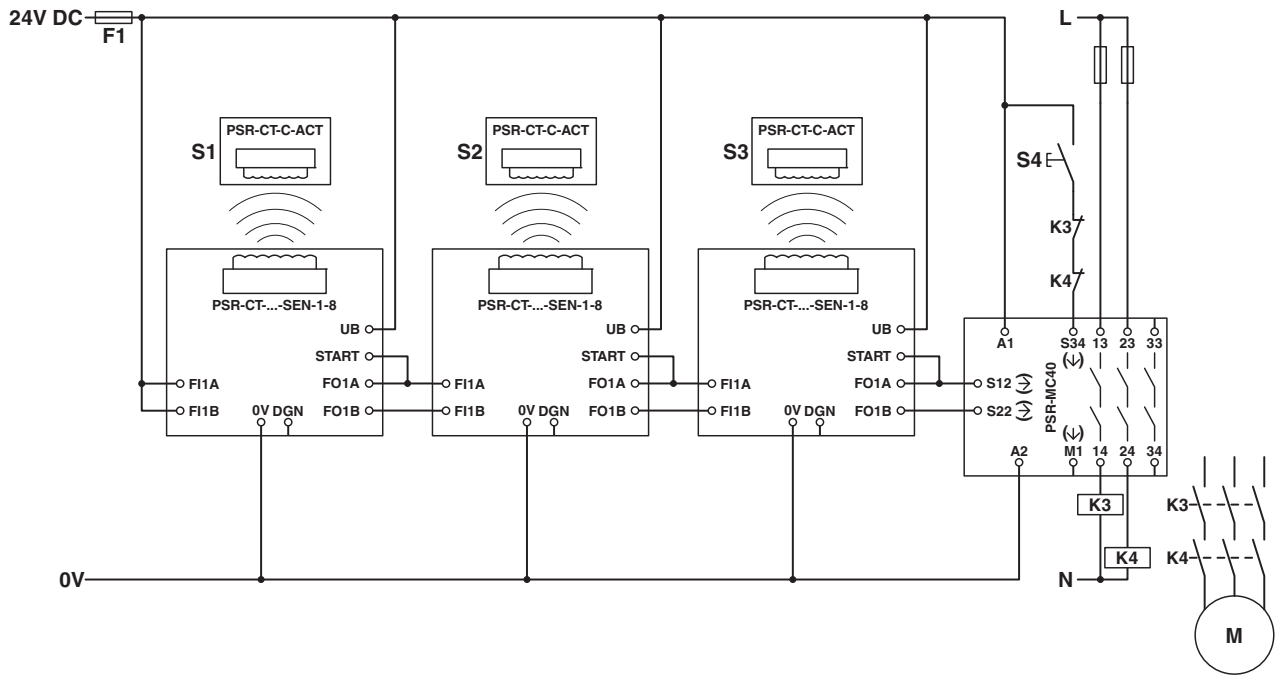


Figure 9-1 Series connection with central reset on the switching device

Key:

S1, S2, S3	Safety switches
S4	Central reset button on the switching device
FO1A, FO1B	Safety outputs
START	Start/reset input
UB	24 V DC power supply
DGN	Signal output
FI1A, FI1B	Safety inputs
A1/A2	Power supply of the safety relay
S34	Start input of the safety relay
S12, S22	Sensor circuit inputs of the safety relay
13/14, 23/24	Enabling current paths of the safety relay
K3, K4	Positively driven contactors
F1	Fuse protection for the power supply

9.2.2 Series connection with central reset for all safety switches

Application description

Switch chain

The application example shows three PSR-CT safety switches connected in series for monitoring safety equipment. The switch chain is connected to a safety relay. The safety relay evaluates the signals of the switch chain and switches connected actuators.

Central manual, monitored start

The safety relay is wired for operation with autostart.

All safety switches are equipped with a reset button for manual, monitored start.

If at least one safety equipment item is opened and closed again, the safety function is reset centrally via the reset button of the safety switches.

Notes



WARNING: Loss of functional safety

Make sure that all safety switches and the safety relay have the same ground potential.



WARNING: Risk due to unexpected machine startup

Cross-circuit between output FOA1 and the cable of the reset button can result in automatic machine startup.

- Avoid cross-circuit between FOA1 and the cable from the reset button by means of design measures, e.g., protected cable installation.
- See fault exclusion according to EN ISO 13849-2.



Also observe the documentation for all other devices used together with the safety switch.

Phoenix Contact components used

– 3 x PSR-CT safety switch
– Safety relay: PSR-MC40-3NO-1DO-24DC-..

Application drawing

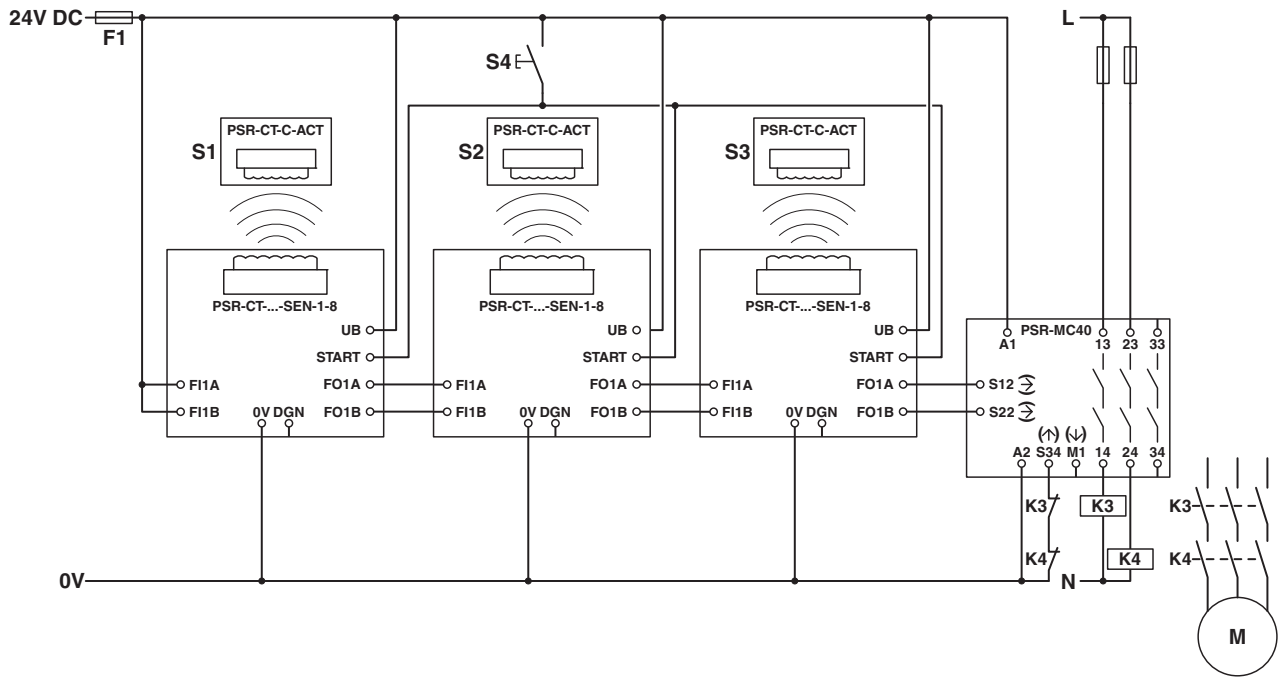


Figure 9-2 Series connection with central reset for all safety switches

Key:

S1, S2, S3	Safety switches
S4	Central reset button on the first safety switch
FO1A, FO1B	Safety outputs
START	Start/reset input
UB	24 V DC power supply
DGN	Signal output
FI1A, FI1B	Safety inputs
A1/A2	Power supply of the safety relay
S34	Start input of the safety relay
S12, S22	Sensor circuit inputs of the safety relay
13/14, 23/24	Enabling current paths of the safety relay
K3, K4	Positively driven contactors
F1	Fuse protection for the power supply

9.2.3 Series connection with local reset on all safety switches

Application description

Switch chain

The application example shows three PSR-CT safety switches connected in series for monitoring safety equipment. The switch chain is connected to a safety relay. The safety relay evaluates the signals of the switch chain and switches connected actuators.

Local manual, monitored start

The safety relay is wired for operation with autostart.

Each safety switch is equipped with a local reset button for manual, monitored start.

If at least one safety equipment item is opened and closed again, the safety function expects a reset command locally at the affected switch and at all subsequent switches in the chain.

Notes

WARNING: Loss of functional safety
Make sure that all safety switches and the safety relay have the same ground potential.

WARNING: Risk due to unexpected machine startup
Cross-circuit between output FOA1 and the cable of the reset button can result in automatic machine startup.

- Avoid cross-circuit between FOA1 and the cable from the reset button by means of design measures, e.g., protected cable installation.
- See fault exclusion according to EN ISO 13849-2.

Also observe the documentation for all other devices used together with the safety switch.

Phoenix Contact components used

– 3 x PSR-CT safety switch
– Safety relay: PSR-MC40-3NO-1DO-24DC-..

Application drawing

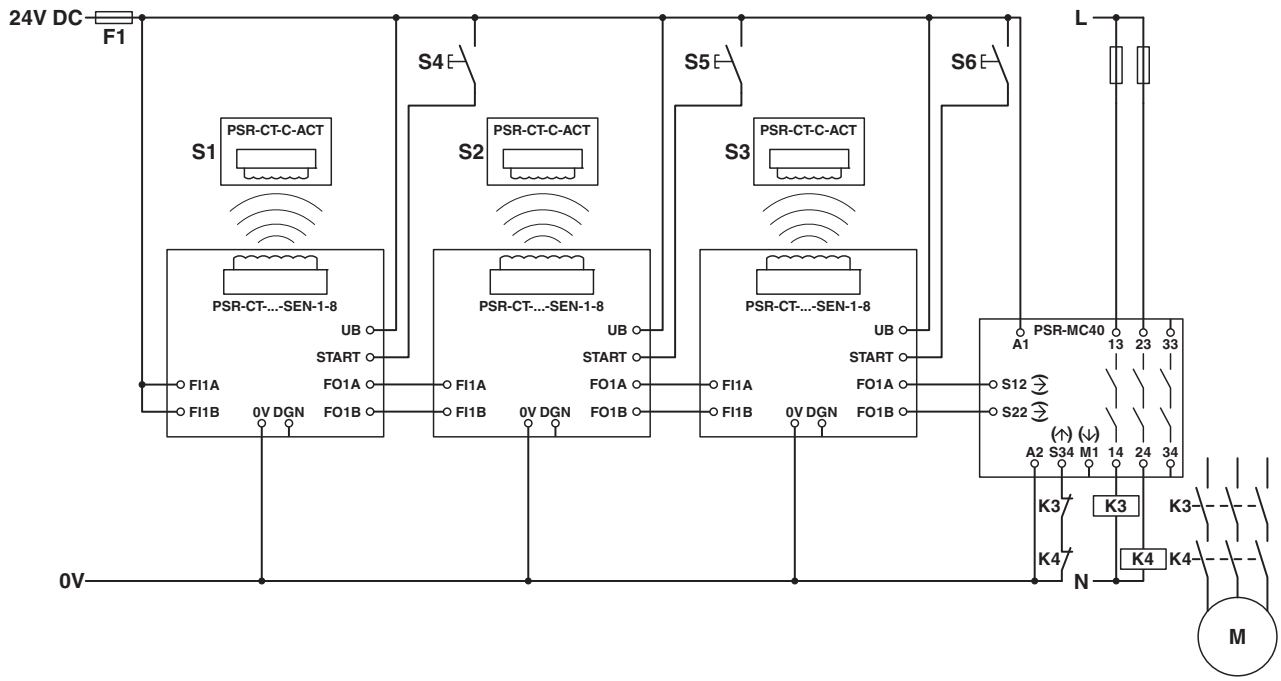


Figure 9-3 Series connection with local reset on all safety switches

Key:

S1, S2, S3	Safety switches
S4, S5, S6	Local reset button on the safety switches
FO1A, FO1B	Safety outputs
START	Start/reset input
UB	24 V DC power supply
DGN	Signal output
FI1A, FI1B	Safety inputs
A1/A2	Power supply of the safety relay
S34	Start input of the safety relay
S12, S22	Sensor circuit inputs of the safety relay
13/14, 23/24	Enabling current paths of the safety relay
K3, K4	Positively driven contactors
F1	Fuse protection for the power supply

9.2.4 Series connection with mixed startup behavior

Application description

Switch chain

The application example shows three PSR-CT safety switches connected in series for monitoring safety equipment. The switch chain is connected to a safety relay. The safety relay evaluates the signals of the switch chain and switches connected actuators.

Mixed startup behavior

The safety relay is wired for operation with autostart.

The first safety switch is equipped with a reset button for manual, monitored start. The other safety switches are wired for operation with autostart.

If the first safety equipment item is opened and closed again, the safety function expects a local reset command for the first safety switch. All the other safety switches start automatically after the relevant safety equipment was closed again.

Notes



WARNING: Loss of functional safety
Make sure that all safety switches and the safety relay have the same ground potential.



WARNING: Risk due to unexpected machine startup
Cross-circuit between output FOA1 and the cable of the reset button can result in automatic machine startup.

- Avoid cross-circuit between FOA1 and the cable from the reset button by means of design measures, e.g., protected cable installation.
- See fault exclusion according to EN ISO 13849-2.



Also observe the documentation for all other devices used together with the safety switch.

Phoenix Contact components used

– 3 x PSR-CT safety switch
– Safety relay: PSR-MC40-3NO-1DO-24DC-..

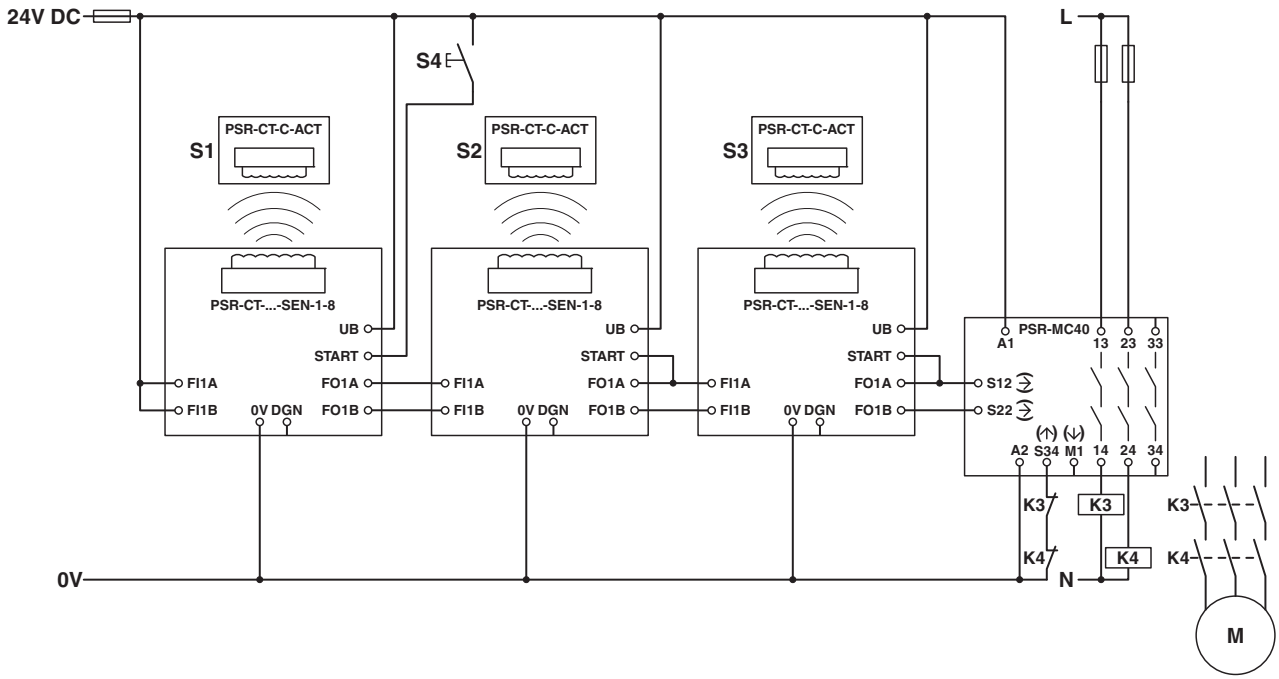


Figure 9-4 Series connection with mixed startup behavior

Key:

S1, S2, S3	Safety switches
S4	Central reset button on the first safety switch
FO1A, FO1B	Safety outputs
START	Start/reset input
UB	24 V DC power supply
DGN	Signal output
FI1A, FI1B	Safety inputs
A1/A2	Power supply of the safety relay
S34	Start input of the safety relay
S12, S22	Sensor circuit inputs of the safety relay
13/14, 23/24	Enabling current paths of the safety relay
K3, K4	Positively driven contactors
F1	Fuse protection for the power supply

9.3 PSR-CT safety switch connected to a safe controller

Application description

Switch chain

The application example shows three PSR-CT safety switches connected in series for monitoring safety equipment. The switch chain is connected to a safe controller.

Central manual, monitored start

The safe controller is equipped with a reset button for manual, monitored start.

The safety switches are wired for operation with autostart.

If at least one safety equipment item is opened and closed again, the safety function is reset centrally via the reset button on the safe controller.

Notes



WARNING: Loss of functional safety
Make sure that all safety switches and the safe controller have the same ground potential.



Also observe the documentation for all other devices used together with the safety switch.

Phoenix Contact components used

– 3 x PSR-CT safety switch

Application drawing

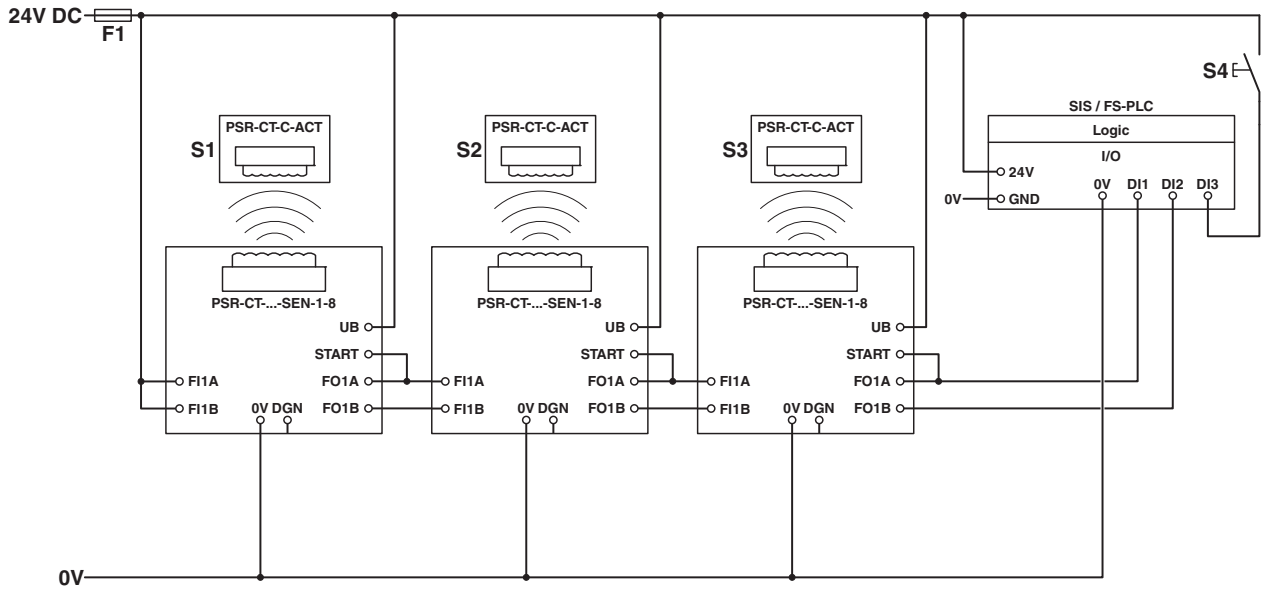


Figure 9-5 PSR-CT safety switch connected to a safe controller

Key:

S1, S2, S3	Safety switches
S4	Central reset button at the safe controller
FO1A, FO1B	Safety outputs
START	Start/reset input
UB	24 V DC power supply
DGN	Signal output
FI1A, FI1B	Safety inputs
SIS / FS-PLC	Safety Instrumented System / failsafe controller
DI1 ... DI3	Digital inputs
F1	Fuse protection for the power supply

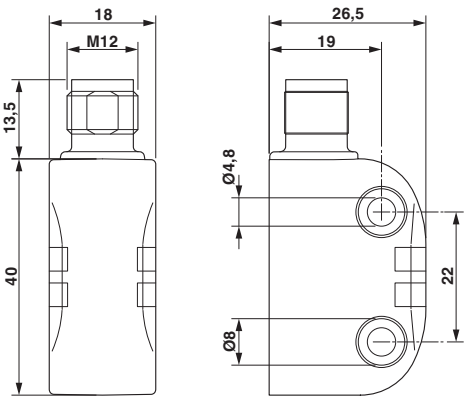
10 Technical data and ordering data

10.1 Technical data

10.1.1 System properties of safety switches

System properties of safety switches		
Technology	RFID transponder technology	
Actuation positions	4 (A, B, C, D)	
Travel directions	3 (x, y, z direction)	
Coding type Depending on the sensor used	PSR-CT-F-SEN-1-8 PSR-CT-C-SEN-1-8 PSR-CT-M-SEN-1-8	Fixcode Unicode Multicode
Encoding level according to EN ISO 14119 Depending on the sensor used	PSR-CT-F-SEN-1-8 PSR-CT-C-SEN-1-8 PSR-CT-M-SEN-1-8	High High Low
Design according to EN ISO 14119	4	

10.1.2 Technical data for the sensors

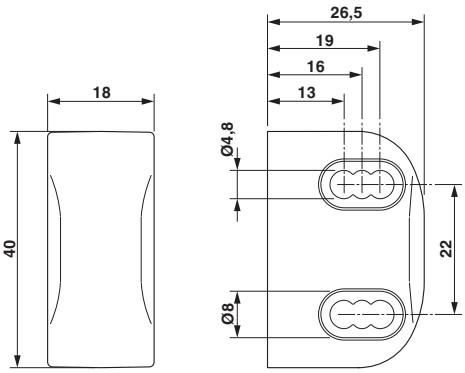
Dimensions/weight	
Dimensions (W/H/D)	26.5 x 40 x 18
Net weight (SAP)	80 g
Dimensional drawing	

Ambient conditions	
Ambient temperature (operation)	-25 °C ... 55 °C
Ambient temperature (storage/transport)	-40 °C ... 70 °C
Vibration (operation)	According to EN 60947-5-2
EMC conformity	According to EN 60947-5-3

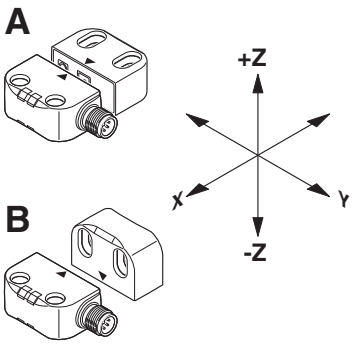
Mounting	
Mounting position	Any
Mounting type	Not flush
Minimum distance	140 mm (between two safety switches) 7 mm (between sensor and actuator when traveling in y direction)
Assembly instruction	Observe EN ISO 14119 Maximum tightening torque for mounting: 0.8 Nm
Connection data	
Connection technology	M12 connectors
Number of positions	8
General data	
Housing material	PBT
Color	Yellow
Status indicator	2 LEDs
Degree of protection	IP65/IP67/IP69/IP69K IP67 (with SAC cabling)
Protection class	III
Pollution degree	3
Rated insulation voltage	300 V, maximum
Rated surge voltage	1.5 kV, maximum
Conditional short-circuit current	100 A, typical
Switching frequency	1 Hz, maximum
Supply	
Supply voltage U_B	24 V DC ±15% (PELV, controlled, residual ripple <5%)
Current consumption I_{UB}	40 mA, maximum
Protection	0.25 A, minimum (to be performed externally) 8 A, maximum (to be performed externally)
Safety outputs	
Designation	FO1A, FO1B
Output description	Semiconductor outputs, sourcing
Number of outputs	2
Short-circuit proof	Yes
Output voltage	U_B - 1.5 V, minimum (HIGH FO1A, FO1B)) U_B, maximum (HIGH FO1A, FO1B)) 0 V DC, minimum (LOW FO1A/FO1B) 1 V DC, maximum (LOW FO1A/FO1B)
Switching current	1 mA, minimum (per safety output) 150 mA, maximum (per safety output)

Safety outputs	
Utilization category according to IEC 60947-5-2	150 mA (24 V (DC13))
Note on protective circuit	**NOTE:** Protect the outputs under inductive loads with a free-wheeling diode.
Residual current	≤0.25 mA
Signal outputs	
Designation	DGN
Output description	Sourcing
Number of outputs	1
Short-circuit proof	Yes
Output voltage	U_B - 1.5 V, minimum (HIGH) U_B, maximum (HIGH) 0 V DC, minimum (LOW) 1 V DC, maximum (LOW)
Current I_{DGN}	1 mA, minimum 50 mA, maximum
Times	
Switch-on delay	5 s, typical (after switching on U_B)
Risk time according to EN 60947-5-3	125 ms, maximum (stand-alone device)
Delay time	10 ms, typical (risk time delay per device)
Switch-on time	400 ms, maximum (of the safety outputs)
Discrepancy time	10 ms, maximum (between the safety outputs)
Test pulses	300 µs, typical (test pulse duration) 100 ms, approximately (test pulse interval)

10.1.3 Technical data for the actuator

Dimensions/weight	
Dimensions (W/H/D)	26.5 x 40 x 18
Net weight (SAP)	30 g
Dimensional drawing	
Ambient conditions	
Ambient temperature (operation)	-25 °C ... 55 °C
Ambient temperature (storage/transport)	-40 °C ... 70 °C
Mounting	
Mounting position	Active surface opposite of the sensor
Mounting type	Not flush
Minimum distance	140 mm (between two safety switches) 7 mm (between sensor and actuator when traveling in y direction)
Assembly instruction	Observe EN ISO 14119 Maximum tightening torque for mounting: 0.8 Nm
General data	
Housing material	PBT
Color	Yellow
Degree of protection	IP65/IP67/IP69/IP69K
Power supply	Inductively, via the sensor

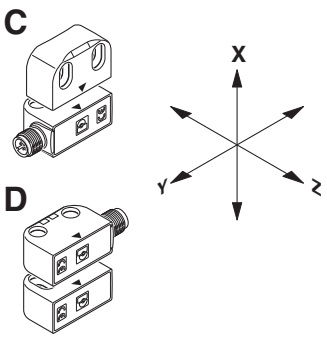
Switching distances: actuation position A, B when traveling in X direction



Switch-on distance, typical	13 mm, typical
Assured operation distance S_{ao}	10 mm (position A) 9 mm (position B)
Switching hysteresis	1 mm, minimum 2 mm, typical
Assured release distance S_{ar}	20 mm, maximum
Repeat accuracy	≤10%

Additional values Table 3-1 “Minimum distances and switching distances” in Section “Positioning and distances” on page 26.

Switching distances: actuation position C, D when traveling in X direction



Switch-on distance, typical	7 mm, typical
Assured operation distance S_{ao}	Position C: 3 mm Position D: 2 mm
Switching hysteresis	1 mm, minimum 2 mm, typical
Assured release distance S_{ar}	17 mm, maximum
Repeat accuracy	≤10%

Additional values Table 3-1 “Minimum distances and switching distances” in Section “Positioning and distances” on page 26.

10.1.4 Safety-related characteristics

Safety characteristics according to EN ISO 13849-1:2015	
Category	4
Performance level	e
Duration of use	240 months
Safety-related characteristics for IEC 61508	
SIL	3
PFH_D	6×10^{-10} 1/h

10.1.5 Interface types according to ZVEI classification

Safety outputs FO1A, FO1B

Source/ drain	Interface type	Additional measure	Source/ drain	Suitable interface type	Suitable interface type
Source	C2	M	Drain	C1	C2
Additional measure M	– Outputs are not types according to IEC 61131-2				

10.1.6 Approvals

See phoenixcontact.com for the latest approvals.

10.2 Ordering data

Products

Description	Type	Order No.	Pcs./Pkt.
Sensor for contact-free safety switch – **Fixcode** coding type – **High** encoding level	PSR-CT-F-SEN-1-8	2702976	1
Sensor for contact-free safety switch – **Unicode** coding type – **High** encoding level	PSR-CT-C-SEN-1-8	2702972	1
Sensor for contact-free safety switch – **Multicode** coding type – **Low** encoding level	PSR-CT-M-SEN-1-8	2702975	1
Actuator for contact-free safety switch – Coded – Compatible with all sensor coding types	PSR-CT-C-ACT	2702973	1

Accessories

Description	Type	Order No.	Pcs./Pkt.
Dummy plugs for each PSR-CT safety switch sensor circuit	SAC-5P-M12MS BK BR 1-2-4	1054366	1
Type 1 Y distributor for **series connection** of PSR-CT safety switches	SAC-8PY-M/2XF BK 1-PSR	1054338	1
Type 2 Y distributor for **manual startup behavior** of PSR-CT safety switches	SAC-8PY-M/2XF BK 2-PSR	1054339	1
Type 3 Y distributor for **integrated diagnostics** via the signal contact in the case of PSR-CT safety switches	SAC-8PY-M/2XF BK 3-PSR	1054341	1

A Technical appendix

A 1 Explanation of switching distances

For detailed values of the switching distances, please refer to Table 3-1 “Minimum distances and switching distances” in Section “Positioning and distances” on page 26.

Assured operation distance S_{ao} according to EN 60947-5-3

(Description adapted)

Distance from the active surface of the sensor, within which the presence of the actuator is properly detected, while considering all specified ambient conditions and tolerances.

Assured release distance S_{ar} according to EN 60947-5-3

(Description adapted)

Distance from the active surface of the sensor, outside of which the absence of the actuator is properly detected, while considering all specified ambient conditions and tolerances.

Typical switch-on distance S_{typ}

Typical distance for switching on safety outputs.

Switching hysteresis

Defined distance range in which the sensor detects the actuator, but does not initiate a switching operation of the safety outputs. In this way, the switching hysteresis prevents unintended switching of the safety outputs in the case of vibrations.

Repeat accuracy

The switching operation at a certain switching distance is repeated with this accuracy in the case of the same switching distance.

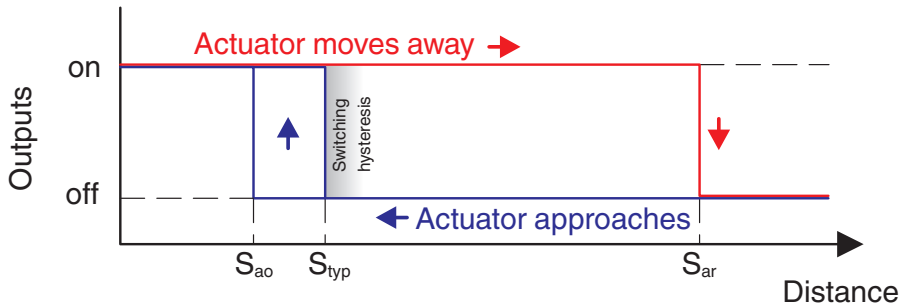


Figure A-1 Schematic view of the switching distances

A 2 Explanation of the typical system times

The values for the typical system times can be found in the technical data.
See “Times” in Section “Technical data” on page 57.

Switch-on delay

The sensor performs a self-test when the operating voltage is switched on. Only after this time is the safety switch ready for operation.

Switch-on time of the safety outputs

The maximum switch-on time of the safety outputs applies starts when the actuator is in the response area and ends when the safety outputs are switched on.

Synchronous activation monitoring of the safety inputs

If the safety inputs have a different switching state over a certain time, the safety outputs are switched off. The safety switch changes to the error state.

Risk time according to EN 60947-5-3

(Description adapted)

If the actuator leaves the response area of the sensor, the safety outputs are switched off when the risk time has elapsed at the latest.

If several safety switches are operated in a series connection, the risk time of the entire switch chain increases with every additional device.

Use the following formula to calculate the risk time for a switch chain:

$\mathbf{t_r}$ = $t_{r,e} + (n \times t_l)$
$\mathbf{t_r}$ = Total risk time
$\mathbf{t_{r,e}}$ = Risk time of an individual device (see technical data)
$\mathbf{t_l}$ = Risk time delay for each device (see technical data)
n = Number of additional devices (total number - 1)

Discrepancy time

The safety outputs are switched at a slight offset. The safety outputs have the same state as soon as the discrepancy time has elapsed at the latest.

Test pulses on the safety outputs

The safety outputs generate test pulses:
– When switched on
– When switched off during device startup

Downstream devices have to tolerate these test pulses.

A 3 FCC / IC conformity

FCC

FCC ID: YG3-PSR1

This device complies with Part 15 of the FCC rules.
Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: Interference

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.

IC

IC certificate: 4720B-PSR1

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s licence-exempt RSS(s).
Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L’émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d’Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence.
L’exploitation est autorisée aux deux conditions suivantes :

(1) L’appareil ne doit pas produire de brouillage;

(2) L’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.

B Revision history

Revision	Date	Contents	Page
00	2018-06-13	First publication	
01	2019-01-25	Revision of the sensors increased Reference to Appendix A 3 “FCC / IC conformity” in Section 1.5, “Directives and standards” added Picture frame for Figure 2-4 and Figure 2-5 inserted Risk time according to EN 60947-5-3 and delay time of the risk time changed Publication year for EN ISO 13849-1: 2015 inserted Appendix A 3 “FCC / IC conformity” inserted	2 11 23 59 62 66

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