



## ▶ PNOZ c2

# PILZ

THE SPIRIT OF SAFETY

Operating Manual-22212-EN-08

- Safety relays



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Where unavoidable, for reasons of readability, the masculine form has been selected when formulating this document. We do assure you that all persons are regarded without discrimination and on an equal basis.

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SD means Secure Digital

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## Introduction

### Validity of documentation

This documentation is valid for the product PNOZ c2. 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**


The safety relay meets the requirements of EN 60947-5-1 and EN 60204-1 and may be used in applications with dual-channel positive-switching OSSDs such as

- ▶ periodically tested light guard type 2 in accordance with EN 61496-1
- ▶ Light guard type 4 EN 61496-1
- ▶ safe sensors with semiconductor outputs

The safety relay provides a safety-related interruption of a safety circuit.

**Improper use**

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 operating manual,
- ▶ Use of the product outside the technical details (see chapter entitled [Technical Details](#) [ 16]).

**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 device, a safety assessment in accordance with the Machinery Directive is required.

The product as an individual component fulfils the functional safety requirements in accordance with EN ISO 13849 and EN IEC 62061. However, this does not guarantee the functional safety of the overall plant/machine. To achieve the relevant safety level of the overall plant/machine's required safety functions, each safety function needs to be considered separately.

**Use of qualified personnel**

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by persons who are competent to do so.

A competent person is a qualified and knowledgeable person who, because of their training, experience and current professional activity, has the specialist knowledge required. To be able to inspect, assess and operate devices, systems and machines, the person has to be informed of the state of the art and the applicable national, European and international laws, directives and standards.

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 the section entitled Safety
- ▶ 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**

The unit meets all the necessary conditions for safe operation. However, please note the following:

- ▶ Note for overvoltage category III: If voltages higher than low voltage (>50 VAC or >120 VDC) are present on the unit, connected control elements and sensors must have a rated insulation voltage of at least 250 V.

### Unit features

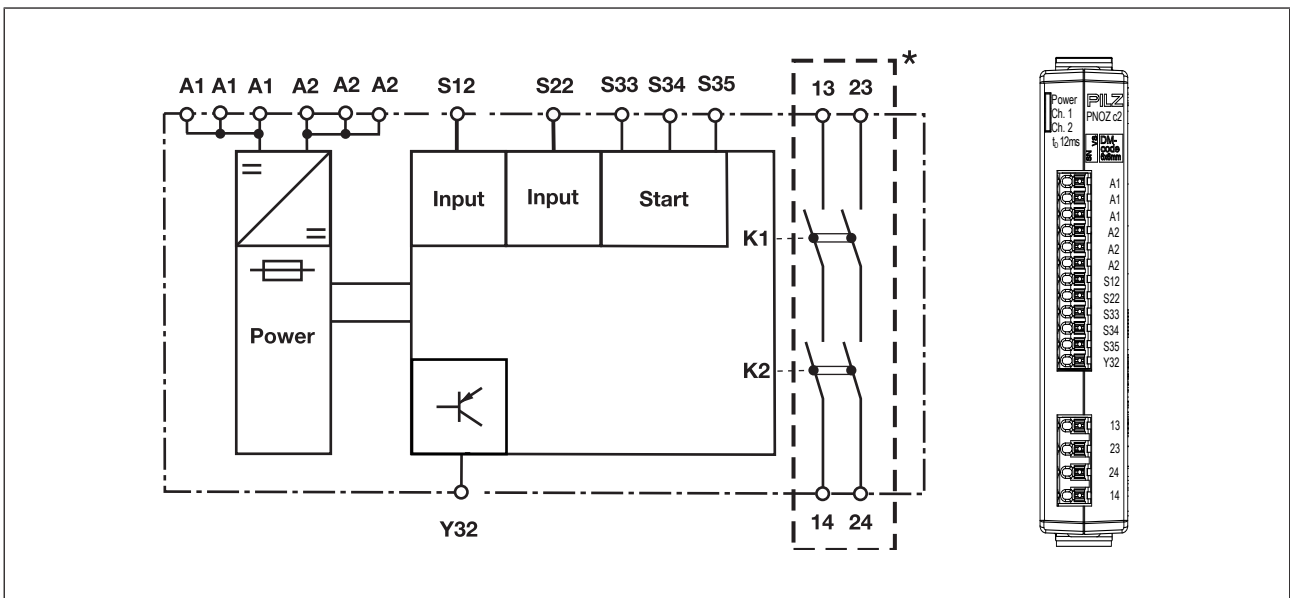
- ▶ Positive-guided relay outputs:
  - 2 safety contacts (N/O), instantaneous
- ▶ 1 semiconductor output (auxiliary output)
- ▶ Connection options for:
  - Type 2 or Type 4 light guards
  - safe sensors with semiconductor outputs (OSSD)
  - Start button
- ▶ LED display for:
  - Supply voltage
  - Switch status channel 1
  - Switch status channel 2

### Safety features

The safety relay meets the following safety requirements:

- ▶ The circuit is redundant with built-in self-monitoring.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ The correct opening and closing of the safety function relays is tested automatically in each on-off cycle.

### Block diagram/terminal configuration



\* Insulation from non-marked area: Safe separation (overvoltage category III),  
 Insulation between relay contacts: basic insulation (overvoltage category III), safe separation (overvoltage category II)



### Function description

When the supply voltage is supplied, the "POWER" LED illuminates. The unit is ready for operation when the start circuit is closed or a start contact in the start circuit is opened and then closed again.

- ▶ High signal at the input circuit (e.g. light guard not interrupted): The safety contacts are closed and the auxiliary contact is enabled.
- ▶ Low signal at the input circuit (e.g. light guard interrupted): The safety contacts are open and the auxiliary contact is disabled.
- ▶ Dual-channel operation without detection of shorts across contacts: Redundant input circuit, detects earth faults in the start and input circuit .
- ▶ Automatic start: Unit is active as soon as a high signal is present at the input circuit.
- ▶ Monitored start: Unit is active when there is a high signal at the input circuit is closed and then the start circuit is closed.
- ▶ Increase in the number of available contacts by connecting contact expansion modules or external contactors/relays.

### Installation

- ▶ The unit should be installed in a control cabinet with a protection type of at least IP54.
- ▶ Use the notch on the rear of the unit to attach it to a DIN rail (35 mm).
- ▶ When installed vertically: Secure the unit by using a fixing element (e.g. retaining bracket or end angle).

## Wiring

Please note:

- ▶ Information given in the "[Technical details \[16\]](#)" must be followed.
- ▶ Outputs 13-14 and 23-24 are safety contacts, the semiconductor output Y32 is an auxiliary output (e.g. for display).
- ▶ Semiconductor output Y32 should **not** be used for safety circuits!
- ▶ To prevent contact welding, a fuse should be connected before the output contacts (see [Technical details \[16\]](#)).
- ▶ Use copper wiring with a temperature stability of 60/75 °C.
- ▶ To prevent EMC interferences (particularly common-mode interferences) the measures described in EN 60204-1 must be executed. This includes the separate routing of cables of the control circuits (input, start and feedback loop) from other cables for energy transmission or the shielding of cables, for example.
- ▶ Do **not** connect capacitive load.
- ▶ Do not switch low currents using contacts that have been used previously with high currents.
- ▶ The power supply must comply with the regulations for extra low voltages with protective electrical separation (SELV, PELV) in accordance with VDE 0100, Part 410.



### INFORMATION

The voltage at the inputs S12, S22 has to be at least 24 V DC less the lower tolerance value of the supply voltage (s. technical details). When the voltage is too low, increase the supply voltage until at least the lower tolerance value is reached at the inputs.

**Connect cable with crimp connector**

- ▶ Strip the cable [1] and apply a crimp connector.
- ▶ Insert the stripped cable with the crimp connector applied into the terminal point [2] [3] as far as it will go.

**NOTICE**

Do not use a tool to connect the cable.

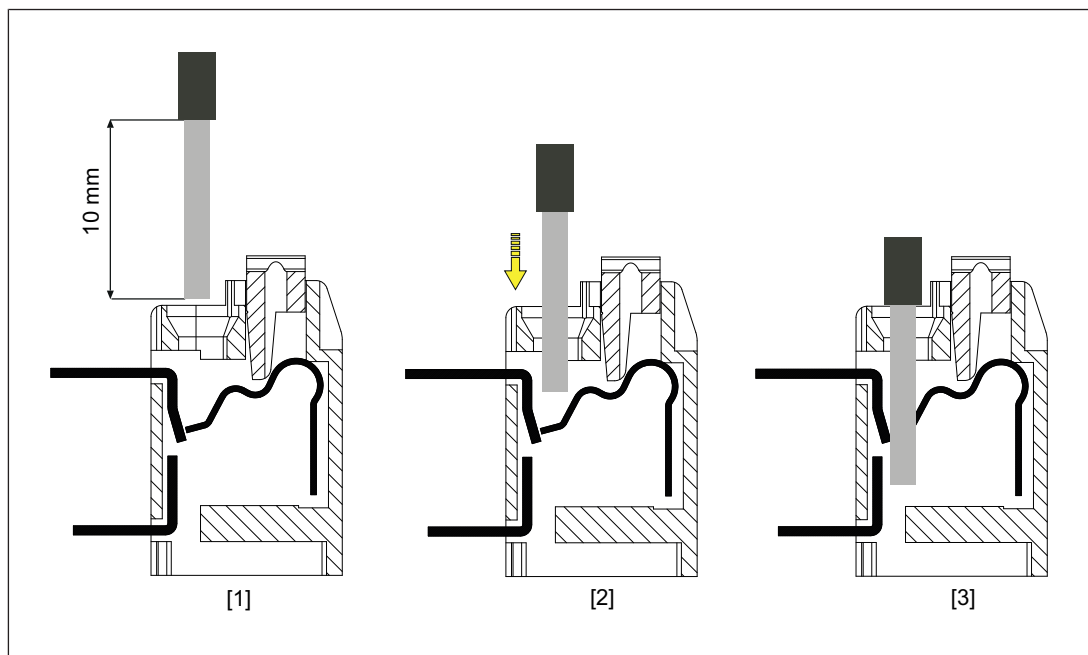


Fig.: Connect cable with crimp connector

**Connect cable without crimp connector**

- ▶ Strip the cable [1].
- ▶ Using the screwdriver, press the actuator button [2] and insert the stripped cable into the terminal point [2] [3] as far as it will go.

We recommend you use a screw driver with a 0.4 x 2.5 mm (DIN 5264) blade!

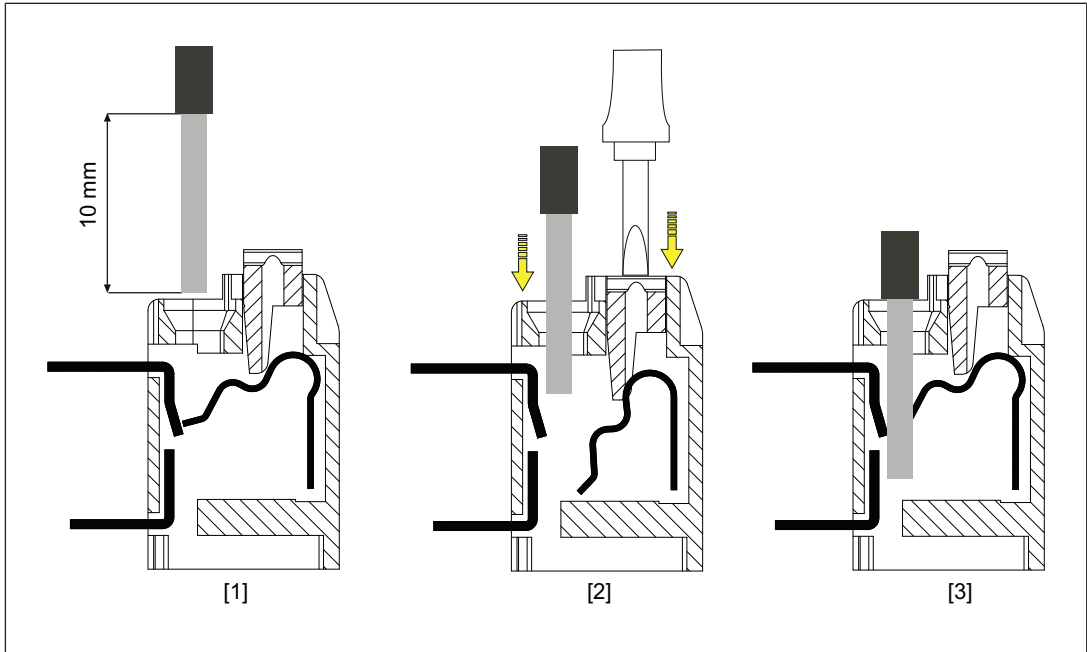


Fig.: Connect cable without crimp connector

**Disconnect cable**

We recommend you use a screw driver with a 0.4 x 2.5 mm (DIN 5264) blade!

- ▶ Using the screwdriver, press the actuator button and pull the cable out of the terminal point [4].

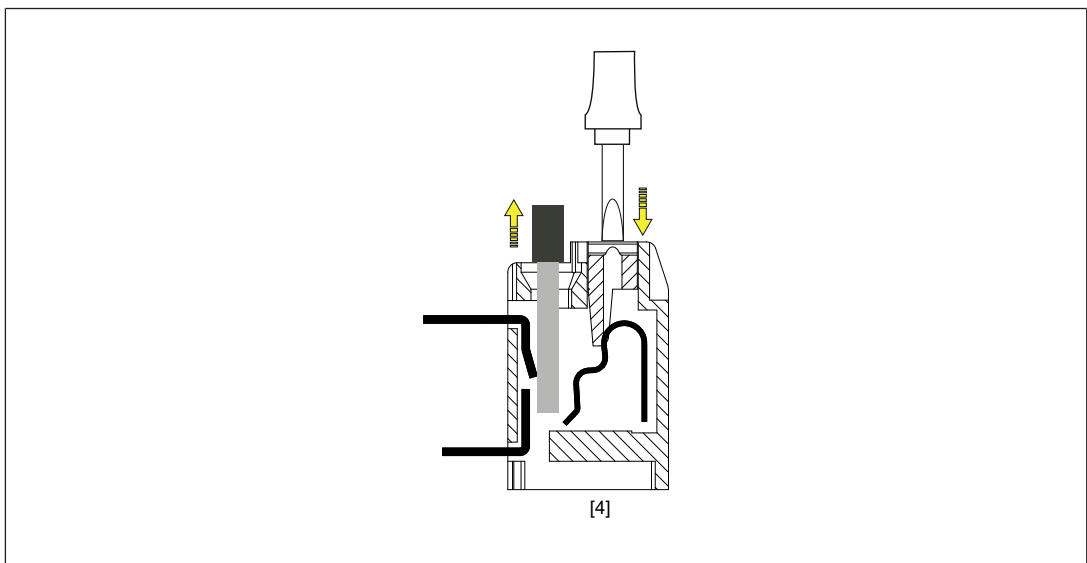


Fig.: Disconnect cable

### Preparing for operation

| Supply voltage   | AC             | DC           |
|--|----------------|--------------|
|  |                |              |
| Input circuit  | Single-channel | Dual-channel |
| Light grid of safe sensor with detection of shorts across contacts and short-circuit-proof OSSDs |                |              |



#### NOTICE

It must **not** be possible to switch off the supply voltage for the PNOZ c2 separately from the supply voltage for the safe sensor or the light guard.

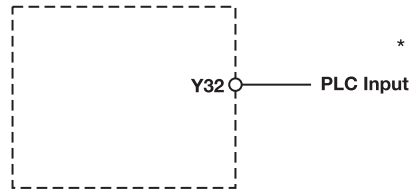
\* When operated with a light guard: Use the free connections A1 and A2 to connect the supply voltage for the transmitter.

| Start circuit/feedback loop | Start circuit | Feedback loop |
|-----------------------------|---------------|---------------|
| automatic start             |               |               |
| Monitored start             |               |               |

**NOTICE****In the event of an automatic start:**

The unit starts up automatically when the safeguard is reset, e.g. when the E-STOP pushbutton is released. Use external circuit measures to prevent an unexpected restart.

### Semiconductor output



\*Connect together the 0V connections on all the external power supplies

## Operation

When the relay outputs are switched on, the mechanical contact on the relay cannot be tested automatically. Depending on the operational environment, measures to detect the non-opening of switching elements may be required under some circumstances.

When the product is used in accordance with the European Machinery Directive, a check must be carried out to ensure that the safety contacts on the relay outputs open correctly. Open the safety contacts (switch off output) and start the device again, so that the internal diagnostics can check that the safety contacts open correctly

- ▶ for SIL 3/PL e at least 1x per month
- ▶ for SIL 2/PL d at least 1x per year

**NOTICE**

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

The unit is ready for operation when the Power LED is permanently lit.

LEDs indicate the status and errors during operation:

### Status indicators

**POWER**

Supply voltage is present.

**CH.1**

Safety contacts of channel 1 are closed.

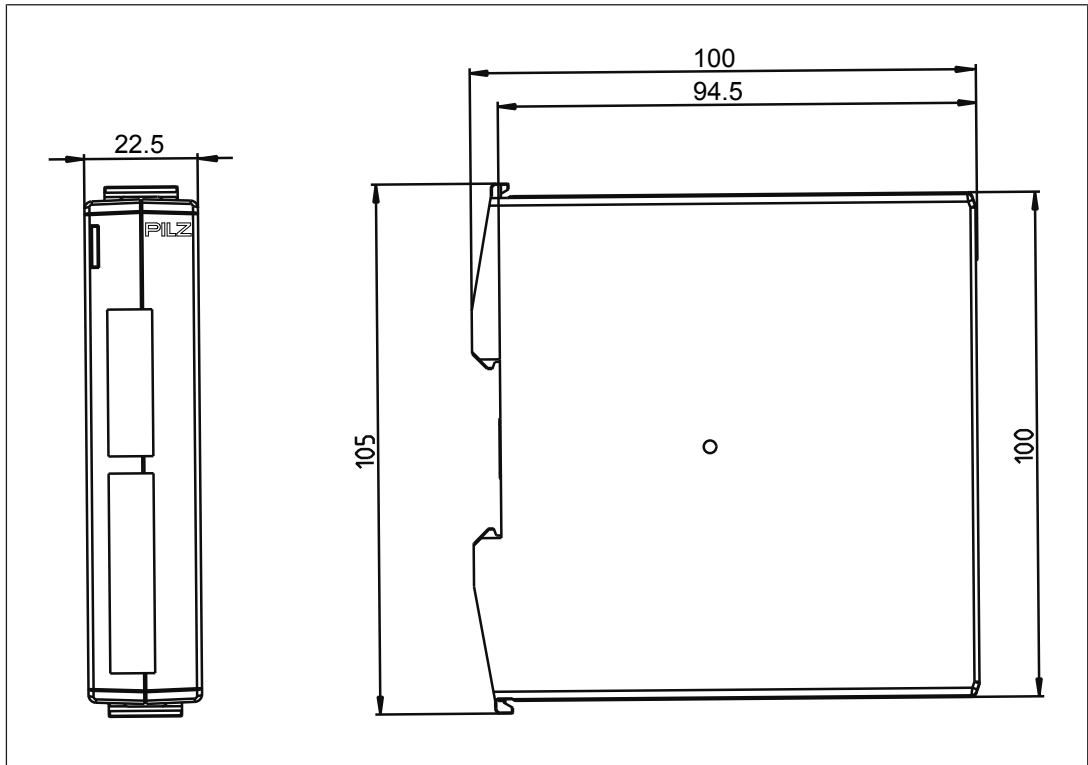
**CH.2**

Safety contacts of channel 2 are closed.

### Faults - malfunctions

- ▶ Contact malfunctions: If the contacts have welded, reactivation will not be possible after the input circuit has opened.

### Dimensions in mm



## Technical details

### General

Certifications **CCC, CE, EAC, TÜV, UKCA, cULus Listed**

### Electrical data

#### Supply voltage

|                                      |                    |
|--------------------------------------|--------------------|
| Voltage                              | <b>24 V</b>        |
| Kind                                 | <b>DC</b>          |
| Voltage tolerance                    | <b>-20 %/+20 %</b> |
| Output of external power supply (DC) | <b>3 W</b>         |
| Residual ripple DC                   | <b>20 %</b>        |

Duty cycle **100 %**

#### Max. inrush current impulse

|                    |             |
|--------------------|-------------|
| Current pulse, A1  | <b>2 A</b>  |
| Pulse duration, A1 | <b>4 ms</b> |

### Inputs

Quantity **2**

#### Voltage at

|                  |             |
|------------------|-------------|
| Input circuit DC | <b>24 V</b> |
| Start circuit DC | <b>24 V</b> |
| Feedback loop DC | <b>24 V</b> |

#### Current at

|                  |              |
|------------------|--------------|
| Input circuit DC | <b>30 mA</b> |
| Start circuit DC | <b>40 mA</b> |
| Feedback loop DC | <b>40 mA</b> |

#### Max. inrush current impulse

|                               |               |
|-------------------------------|---------------|
| Current pulse, input circuit  | <b>0,2 A</b>  |
| Pulse duration, input circuit | <b>70 ms</b>  |
| Current pulse, feedback loop  | <b>0,15 A</b> |
| Pulse duration, feedback loop | <b>1 ms</b>   |
| Current pulse, start circuit  | <b>0,15 A</b> |
| Pulse duration, start circuit | <b>1 ms</b>   |

### Semiconductor outputs

|  |               |
|--|---------------|
| Quantity   | <b>1</b>      |
| Voltage  | <b>24 V</b>   |
| Current  | <b>20 mA</b>  |
| Residual current at "0" signal                     | <b>0,1 mA</b> |
| Max. internal voltage drop                         | <b>5 V</b>    |
| Conditional rated short circuit current            | <b>100 A</b>  |
| Lowest operating current                           | <b>0 mA</b>   |
| Utilisation category in accordance with EN 60947-1 | <b>DC-12</b>  |

### Relay outputs

#### Number of output contacts

|                                      |          |
|--------------------------------------|----------|
| Safety contacts (N/O), instantaneous | <b>2</b> |
|--------------------------------------|----------|

Max. short circuit current I<sub>K</sub> **1 kA**



## Relay outputs

|   |                                      |
|---|--------------------------------------|
| Utilisation category  |                                      |
| in accordance with the standard                               | <b>EN 60947-4-1</b>                  |
| Utilisation category of safety contacts                       |                                      |
| AC1 at  | <b>240 V</b>                         |
| Min. current  | <b>0,01 A</b>                        |
| Max. current  | <b>3 A</b>                           |
| Max. power  | <b>750 VA</b>                        |
| DC1 at  | <b>24 V</b>                          |
| Min. current  | <b>0,01 A</b>                        |
| Max. current  | <b>4 A</b>                           |
| Max. power  | <b>100 W</b>                         |
| Utilisation category  |                                      |
| in accordance with the standard                               | <b>EN 60947-5-1</b>                  |
| Utilisation category of safety contacts                       |                                      |
| AC15 at   | <b>230 V</b>                         |
| Max. current  | <b>1,5 A</b>                         |
| DC13 (6 cycles/min) at  | <b>24 V</b>                          |
| Max. current  | <b>1,5 A</b>                         |
| Utilisation category in accordance with UL                    |                                      |
| Voltage   | <b>240 V AC G.U. (same polarity)</b> |
| with current  | <b>3 A</b>                           |
| Voltage   | <b>24 V DC G. U.</b>                 |
| with current  | <b>4 A</b>                           |
| Pilot Duty  | <b>B300, R300</b>                    |
| External contact fuse protection, safety contacts             |                                      |
| in accordance with the standard                               | <b>EN 60947-5-1</b>                  |
| Max. melting integral   | <b>66 A<sup>2</sup>s</b>             |
| Blow-out fuse, quick  | <b>4 A</b>                           |
| Blow-out fuse, slow   | <b>3,15 A</b>                        |
| Blow-out fuse, gG   | <b>4 A</b>                           |
| Circuit breaker 24V AC/DC, characteristic B/C                 | <b>3 A</b>                           |
| Conventional thermal current                                  | <b>4 A</b>                           |
| Contact material  | <b>AgCuNi + 0,2 µm Au</b>            |
| <b>Times</b>  |                                      |
| Switch-on delay   |                                      |
| with automatic start typ.                                     | <b>200 ms</b>                        |
| with automatic start max.                                     | <b>550 ms</b>                        |
| with monitored start with rising edge typ.                    | <b>20 ms</b>                         |
| with monitored start with rising edge max.                    | <b>50 ms</b>                         |
| Delay-on de-energisation                                      |                                      |
| with E-STOP typ.  | <b>5 ms</b>                          |
| with E-STOP max.  | <b>12 ms</b>                         |
| Recovery time at max. switching frequency 1/s<br>after E-STOP | <b>300 ms</b>                        |


| <b>Times</b>  |   |
|---|---|
| Waiting period with a monitored start<br>with rising edge                                       | <b>300 ms</b>   |
| Min. start pulse duration with a monitored start<br>with rising edge                            | <b>30 ms</b>  |
| Supply interruption before de-energisation  | <b>20 ms</b>  |
| Simultaneity, channel 1 and 2 max.  | $\infty$  |
| <b>Environmental data</b>   |   |
| Climatic suitability  | <b>EN 60068-2-78</b>  |
| Ambient temperature<br>Temperature range  | <b>-10 - 55 °C</b>  |
| Storage temperature<br>Temperature range  | <b>-40 - 85 °C</b>  |
| Climatic suitability<br>Humidity  | <b>93 % r. h. at 40 °C</b>                                    |
| Condensation during operation   | <b>Not permitted</b>  |
| EMC   | <b>EN 60947-5-1, EN 61000-6-2, EN 61000-6-4, EN 61326-3-1</b> |
| Vibration<br>in accordance with the standard  | <b>EN 60068-2-6</b>   |
| Frequency   | <b>10 - 55 Hz</b>   |
| Amplitude   | <b>0,35 mm</b>  |
| Airgap creepage<br>in accordance with the standard  | <b>EN 60947-1</b>   |
| Overvoltage category  | <b>III</b>  |
| Pollution degree  | <b>2</b>  |
| Rated insulation voltage  | <b>250 V</b>  |
| Rated impulse withstand voltage   | <b>6 kV</b>   |
| Protection type<br>Housing  | <b>IP40</b>   |
| Terminals   | <b>IP20</b>   |
| Mounting area (e.g. control cabinet)  | <b>IP54</b>   |
| <b>Mechanical data</b>  |   |
| Mounting position   | <b>Any</b>  |
| Mechanical life   | <b>10,000,000 cycles</b>                                      |
| Material<br>Bottom  | <b>PC</b>   |
| Top   | <b>PC</b>   |
| Connection type   | <b>Spring-loaded terminal</b>                                 |
| Mounting type   | <b>Fixed</b>  |
| Conductor cross section with spring-loaded terminals<br>1 core flexible without crimp connector | <b>0,25 - 1,5 mm<sup>2</sup>, 24 - 16 AWG</b>                 |
| 1 core flexible with crimp connector  | <b>0,25 - 0,75 mm<sup>2</sup>, 24 - 20 AWG</b>                |
| Spring-loaded terminals: Terminal points per connection   | <b>1</b>  |
| Stripping length with spring-loaded terminals   | <b>10 mm</b>  |

**Mechanical data**

|            |         |
|------------|---------|
| Dimensions |         |
| Height     | 105 mm  |
| Width      | 22,5 mm |
| Depth      | 100 mm  |
| Weight     | 160 g   |

Where standards are undated, the 2022-09 latest editions shall apply.

**Safety characteristic data**



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


| Operating mode | EN ISO 13849-1: 2015 | EN ISO 13849-1: 2015 | EN IEC 62061 SIL CL/ maximum SIL | EN IEC 62061 PFH <sub>D</sub> [1/h] | EN/IEC 61511 SIL | EN/IEC 61511 PFD | EN ISO 13849-1: 2015 T <sub>M</sub> [year] |
|----------------|----------------------|----------------------|----------------------------------|-------------------------------------|------------------|------------------|--|
|                | PL e                 | Cat. 4               | SIL 3                            | 2,31E-09                            | SIL 3            | 2,03E-06         | 20   |

Safety contacts, instantaneous

Explanatory notes for the safety-related characteristic data:

- ▶ Safety characteristic data in accordance with EN IEC 62061 and EN/IEC 61511 was calculated based on EN/IEC 61508.
- ▶ T<sub>M</sub> is the maximum mission time in accordance with EN ISO 13849-1. The value also applies as the retest interval in accordance with EN/IEC 61508-6 and EN/IEC 61511 and as the proof test interval and mission time in accordance with EN IEC 62061.

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



### CAUTION!

It is essential to consider the relay's service life graphs. The relay outputs' safety-related characteristic data is only valid if the values in the service life graphs are met.

The PFH value depends on the switch frequency and the load of the relay output. If the service life graphs are not accessible, the stated PFH value can be used irrespective of the switch frequency and the load, as the PFH value already considers the relay's B10d value as well as the failure rates of the other components.

The safety relay meets the requirements of EN 60947-5-1 and EN 60204-1 and may be used in applications with dual-channel positive-switching OSSDs such as

- ▶ periodically tested light guard type 2 in accordance with EN 61496-1
- ▶ Light guard type 4 EN 61496-1
- ▶ safe sensors with semiconductor outputs

### Service life graph

The service life graphs indicate the number of cycles from which failures due to wear must be expected. The wear is mainly caused by the electrical load; the mechanical load is negligible.

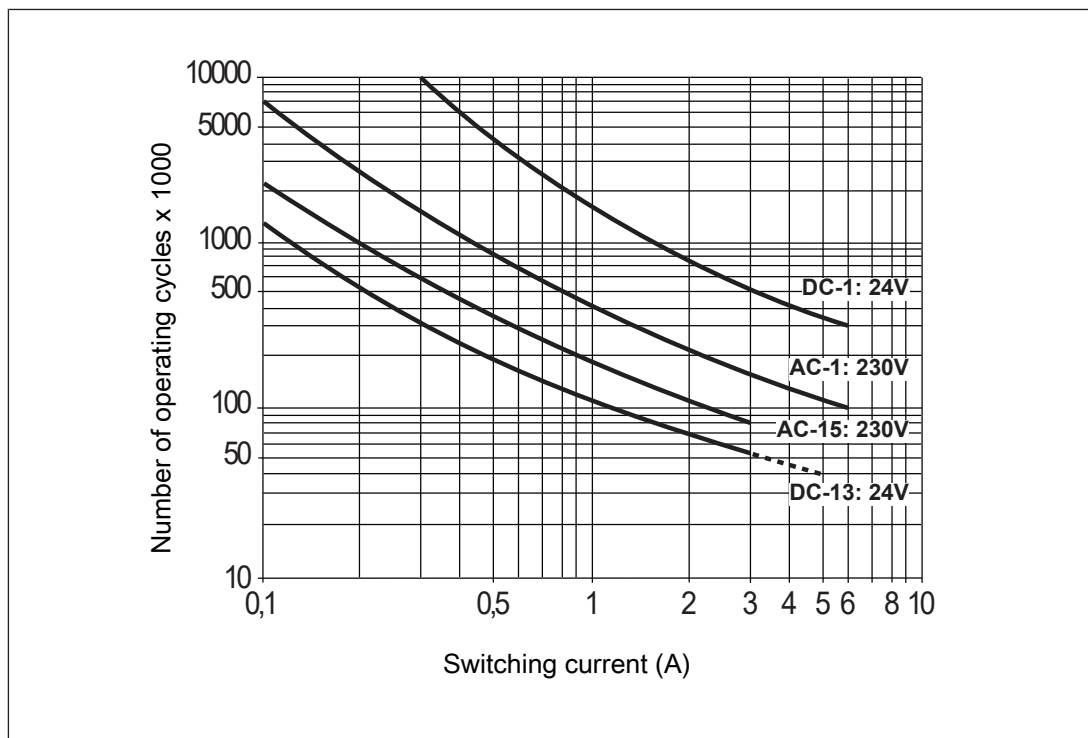


Fig.: Service life graphs at 24 V DC and 230 V AC

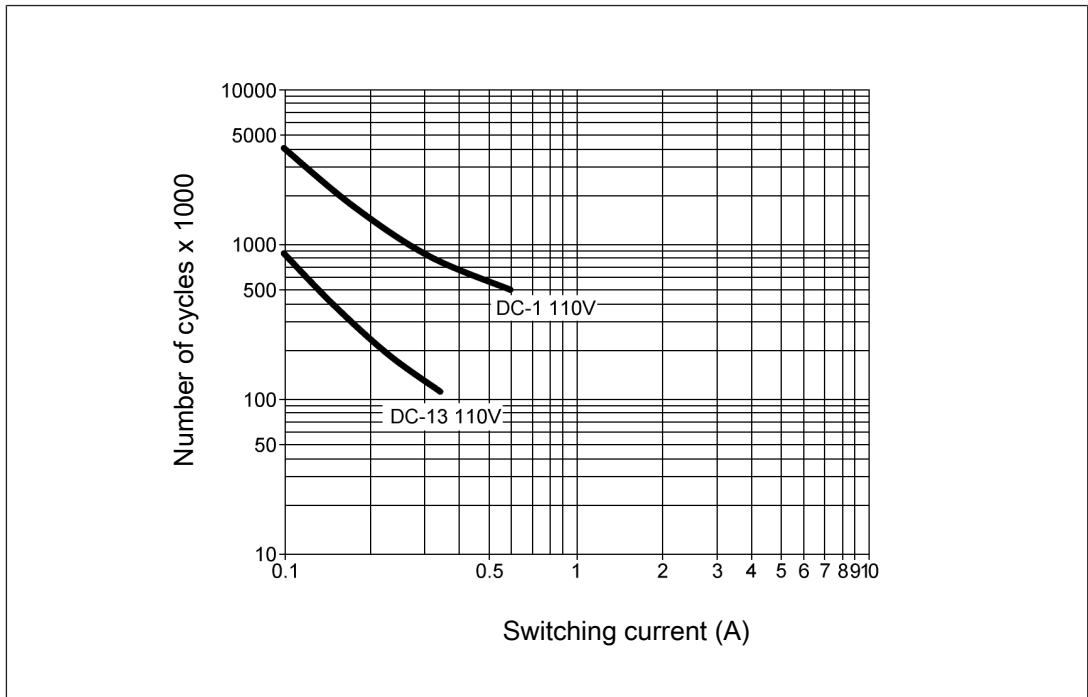


Fig.: Service life graphs at 110 V DC

**Example**

- ▶ Inductive load: 0.2 A,
- ▶ Utilisation category: AC15
- ▶ Contact service life: 1 000 000 cycles

Provided the application to be implemented requires fewer than 1 000 000 cycles, the PFH value (see [Technical details \[16\]](#)) can be used in the calculation.

To increase the service life, sufficient spark suppression must be provided on all output contacts. With DC contactors, use flywheel diodes for spark suppression.

### Permitted operating height in accordance with EN 60664-1

The values stated in the technical details apply to the use of the device in operating heights up to max. 2000 m above sea level. When used in greater heights, constraints have to be taken into account:

- ▶ Permitted maximum operating height 5000 m
- ▶ Reduction of rated insulation voltage and rated impulse withstand voltage for applications with safe separation:

| Maximum operation height | Rated insulation voltage | Overvoltage category | Max. rated impulse withstand voltage |
|--------------------------|--------------------------|----------------------|--------------------------------------|
| 3000 m                   | 150 V                    | II                   | 2.5 kV                               |
|                          | 100 V                    | III                  | 2.5 kV                               |
| 4000 m                   | 150 V                    | II                   | 2.5 kV                               |
|                          | 100 V                    | III                  | 2.5 kV                               |
| 5000 m                   | 150 V                    | II                   | 2.5 kV                               |
|                          | 100 V                    | III                  | 2.5 kV                               |

- ▶ Reduction of rated insulation voltage and rated impulse withstand voltage for applications with basic insulation:

| Maximum operation height | Rated insulation voltage | Overvoltage category | Max. rated impulse withstand voltage |
|--------------------------|--------------------------|----------------------|--------------------------------------|
| 3000 m                   | 250 V                    | II                   | 2.5 kV                               |
|                          | 150 V                    | III                  | 2.5 kV                               |
| 4000 m                   | 250 V                    | II                   | 2.5 kV                               |
|                          | 150 V                    | III                  | 2.5 kV                               |
| 5000 m                   | 250 V                    | II                   | 2.5 kV                               |
|                          | 150 V                    | III                  | 2.5 kV                               |

- ▶ From an operating height of 2000 m the max. permitted ambient temperature is reduced by 0.5 °C/100 m

| Operating height | Permitted ambient temperature |
|------------------|-------------------------------|
| 3000 m           | 50 °C                         |
| 4000 m           | 45 °C                         |
| 5000 m           | 40 °C                         |

**Order reference**

| Product type | Features | Terminals                    | Order no. |
|--------------|----------|------------------------------|-----------|
| PNOZ c2      | 24 V DC  | With spring-loaded terminals | 710002    |

**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](http://www.pilz.com/downloads).

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**UKCA-Declaration of Conformity**

This product(s) complies with following UK legislation: Supply of Machinery (Safety) Regulation 2008.

The complete UKCA Declaration of Conformity is available on the Internet at [www.pilz.com/downloads](http://www.pilz.com/downloads).

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