

PNOZ s7.1

PILZ
THE SPIRIT OF SAFETY

Safety relays

Operating Manual-21865-EN-10

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SD means Secure Digital

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Introduction

Validity of documentation

This documentation is valid for the product PNOZ s7.1. 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 contact expansion module PNOZ s7.1 meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. It is used to increase the number of safety contacts available on a base unit. Base units are all safety relays with feedback loop.

The max. achievable safety level depends on the base unit. The expansion module may not exceed this. The safety-related characteristic values stated under Safety-related characteristic data [📖 19] can only be achieved if the base unit also exhibits these values.

The following is deemed improper use in particular

- Any component, technical or electrical modification to the product,
- Use of the product outside the areas described in this manual,
- Use of the product outside the technical details (see Technical details [📖 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 it is necessary to perform a safety assessment in accordance with the Machinery Directive.

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

Use of qualified personnel

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

A competent person is 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

- Relay outputs:
  - 3 safety contacts (N/O), instantaneous
- Supply voltage for expansion modules
- LED for:
  - Supply voltage at B1 and B2
  - Input status, channel 1
  - Input status, channel 2
  - Switch status of the safety contacts
  - Fault
- Plug-in connection terminals (either spring-loaded terminal or screw terminal)
- See order reference for unit types

Safety features

The unit meets the following safety requirements:

- The contact expander module expands an existing circuit. As the output relays are monitored via the base unit's feedback loop, the safety functions on the existing circuit are transferred to the contact expander module.
- The safety function remains effective in the case of a component failure.
- Earth fault in the feedback loop:
  Detected, depending on the base unit that is used.
- Earth fault in the input circuit:
  The output relays de-energise and the safety contacts open.

Block diagram/terminal configuration

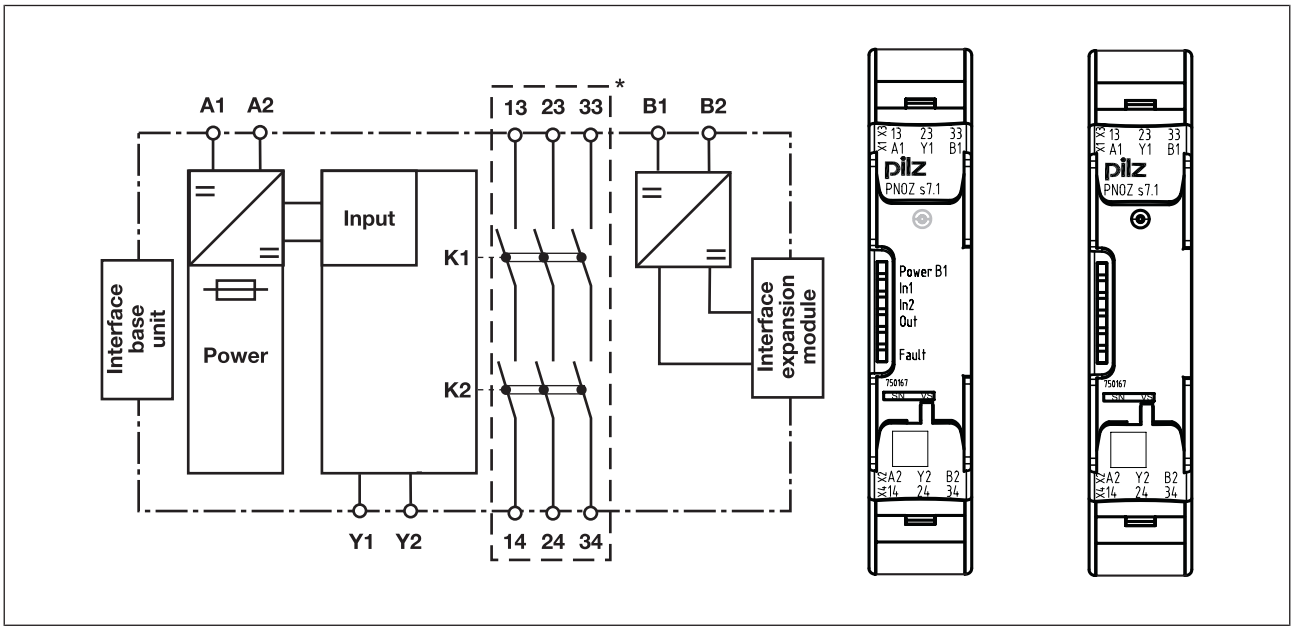


Fig.: Centre: Front view with cover, right: Front view without cover

*Safe separation from non-marked area in accordance with EN 60947-1, 6 kV, basic insulation between all safety contacts.

Function description

with PNOZsigma base unit:

- Dual-channel operation via PNOZsigma connector

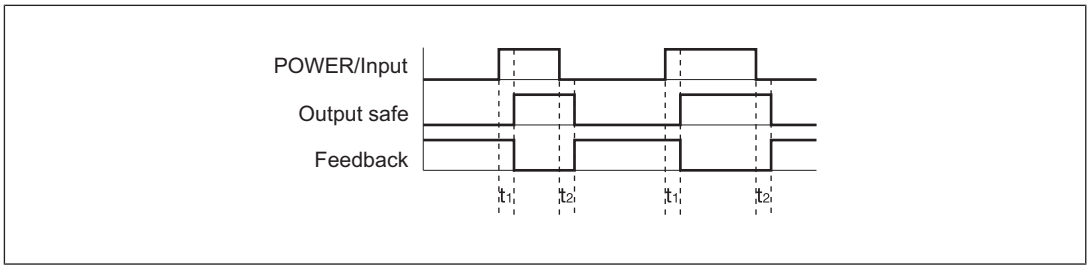
without PNOZsigma base unit:

- Single-channel operation: one input circuit affects the output relays
- Connection for base unit

with PNOZsigma s7.2 expansion modules:

- Dual-channel operation and supply voltage via PNOZsigma connector

Timing diagram



Legend

- POWER/Input: Supply voltage/Input
- Output safe: Safety contacts
- Feedback: Feedback loop
- t_1: Switch-on delay
- t_2: Delay-on de-energisation

Installation

Install contact expansion module without base unit:

- Ensure that the plug terminator is inserted at the side of the unit.

Connect base unit and contact expansion module PNOZ s7.1:

- Remove the plug terminator at the side of the base unit and at the left of the contact expansion module
- Connect the base unit and the contact expansion module using the connector supplied, before mounting the units to the DIN rail.

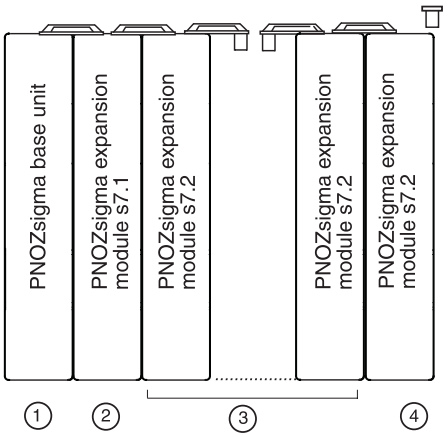
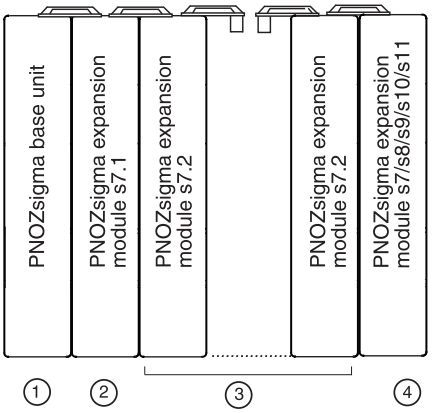
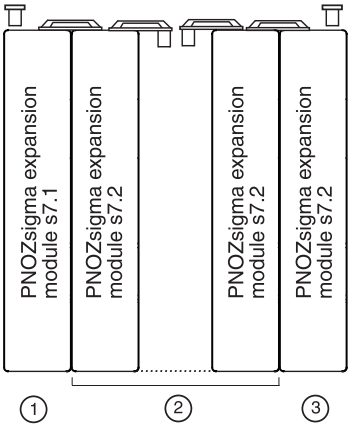
Connect contact expansion module PNOZ s7.1 to PNOZsigma contact expansion modules

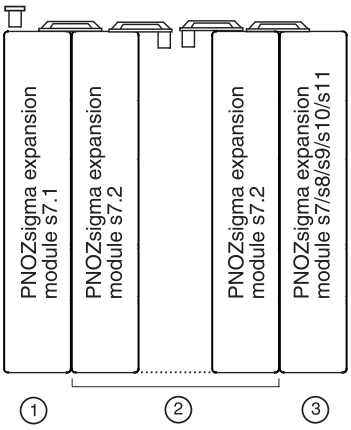
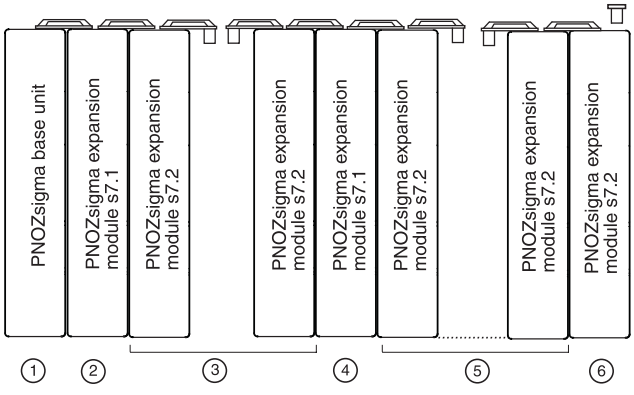
- Connect the contact expansion modules using the connector supplied.

Control cabinet installation

- The safety relay 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).

Push the unit upwards or downwards before lifting it from the DIN rail.

Expansion options	Please note the max. power consumption of the contact expansion modules (see technical data PNOZ s7.1).
①: Base unit ②: Contact expansion module PNOZ s7.1 ③: Contact expansion module PNOZ s7.2 ④: Contact expansion module PNOZ s7.2 with terminator	
①: Base unit ②: Contact expansion module PNOZ s7.1 ③: Contact expansion module PNOZ s7.2 ④: Expansion module PNOZ s7, s8, s9, s10, s11 as a terminator	
①: Contact expansion module PNOZ s7.1 with terminator ②: Contact expansion module PNOZ s7.2 ③: Contact expansion module PNOZ s7.2 with terminator	

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①: Base unit ②: Contact expansion module PNOZ s7.1 ③: Contact expansion module PNOZ s7.2 ④: Contact expansion module PNOZ s7.1 ⑤: Contact expansion module PNOZ s7.2 ⑥: Contact expansion module PNOZ s7.2 with terminator	

Wiring

Please note:

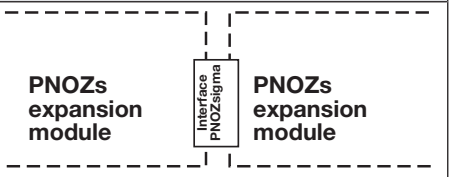
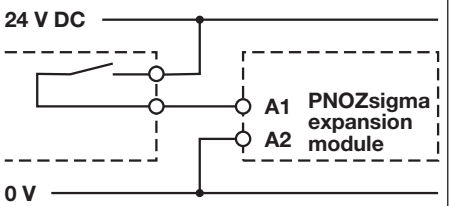
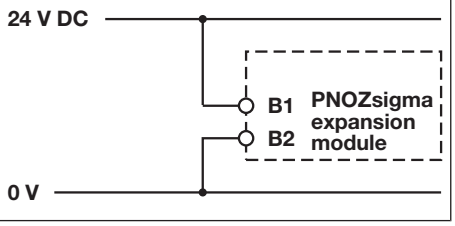
- Information given in the "Technical details [📖 16]" must be followed.
- The output contacts 13-14, 23-24, 33-34 are safety contacts.
- To prevent contact welding, a fuse should be connected before the output contacts (see Technical details [📖 16]).
- Calculation of the max. cable length l_{max} in the input circuit:

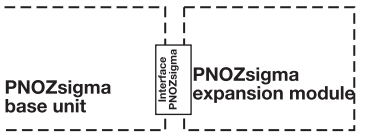
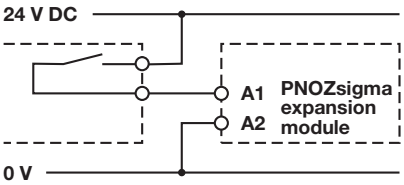
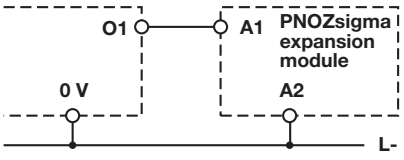
$$l_{max} = \frac{R_{lmax}}{R_l / km}$$

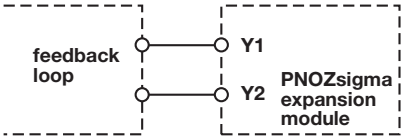
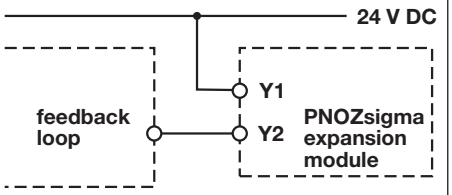
R_{lmax} = max. overall cable resistance (see Technical details [📖 16])
R_l / km = cable resistance/km

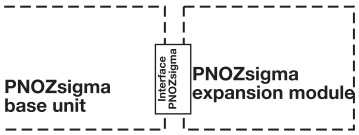
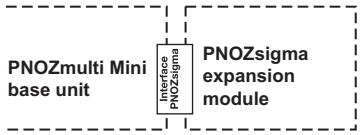
- Use copper wire that can withstand 60/75 °C.
- Sufficient fuse protection must be provided on all output contacts with capacitive and inductive loads.
- Ensure the wiring and EMC requirements of EN 60204-1 are met.
- The power supply must comply with the regulations for extra low voltages with protective electrical separation (SELV, PELV) in accordance with VDE 0100, Part 410.

Preparing for operation

Supply voltage	AC	DC
Base unit: Safety relay PNOZsigma		
Base unit: Safety relay PNOZ X		
Supply voltage for expansion modules PNOZsigma		

Input circuit	Single-channel	Dual-channel
Base unit: Safety relay PNOZsigma		
Base unit: Safety relay PNOZ X		
Base unit: Safety relay PNOZelog driven via semiconductor outputs (24 VDC)		

Start circuit/feedback loop	Base unit: Safety relay PNOZ X	Base unit: Safety relay PNOZelog
The inputs that evaluate the feedback loop will depend on the base unit and application		

Connection to PNOZsigma base unit/PNOZmulti Mini base unit	Base unit: Safety relay PNOZ-sigma	Base unit: Small control system PNOZmulti Mini
The feedback loop is connected and evaluated via the connector		

INFORMATION

If a base unit and a contact expansion module are linked via the connector, no additional wiring is necessary.
Do not connect A1 und Y1/Y2 to the expansion module!

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

NOTICE

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

LEDs indicate the status and errors during operation:

☼ LED on

Status indicators

☼ **POWER B1**
Supply voltage applied for the expansion modules.

☼ **IN1**
Channel 1 actuated.

☼ **IN2**
Channel 2 actuated.

☼ **IN1, IN2, OUT**
Safety contacts are closed.

Fault indicators

FAULT

Diagnostics: Plug terminator not connected

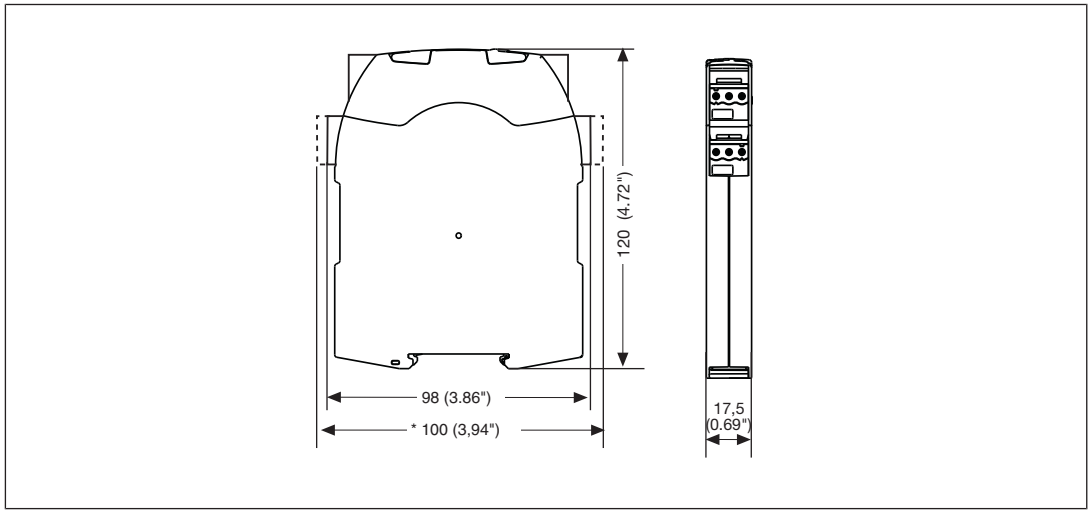
- Remedy: Insert plug terminator, switch supply voltage off and then on again.

Faults - malfunctions

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

Dimensions in mm

*with spring-loaded terminals



Technical details

General	750167	751167
Approvals	**CCC, CE, EAC (Eurasian), TÜV, cULus Listed**	**CCC, CE, EAC (Eurasian), TÜV, cULus Listed**
Electrical data	**750167**	**751167**
Supply voltage		
Voltage	**24 V**	**24 V**
Kind	**DC**	**DC**
Voltage tolerance	**-20 %/+20 %**	**-20 %/+20 %**
Output of external power supply (DC)	**2 W**	**2 W**
Residual ripple DC	**20 %**	**20 %**
Duty cycle	**100 %**	**100 %**
Max. power of all expansion modules	**20 W**	**20 W**
Inputs	**750167**	**751167**
Number	**1**	**1**
Voltage at		
Input circuit DC	**24 V**	**24 V**
Current at		
Input circuit DC	**70 mA**	**70 mA**
Max. inrush current impulse		
Current pulse, input circuit	**2 A**	**2 A**
Pulse duration, input circuit	**0,1 ms**	**0,1 ms**
Max. overall cable resistance Rl-max		
Single-channel at UB DC	**30 Ohm**	**30 Ohm**
Relay outputs	**750167**	**751167**
Number of output contacts		
Safety contacts (N/O), instantaneous	**3**	**3**
Max. short circuit current IK	**1 kA**	**1 kA**
Utilisation category		
In accordance with the standard	**EN 60947-4-1**	**EN 60947-4-1**
Utilisation category of safety contacts		
AC1 at	**240 V**	**240 V**
Min. current	**0,01 A**	**0,01 A**
Max. current	**6 A**	**6 A**
Max. power	**1500 VA**	**1500 VA**
DC1 at	**24 V**	**24 V**
Min. current	**0,01 A**	**0,01 A**
Max. current	**6 A**	**6 A**
Max. power	**150 W**	**150 W**

Relay outputs	750167	751167
Utilisation category		
In accordance with the standard	**EN 60947-5-1**	**EN 60947-5-1**
Utilisation category of safety contacts		
AC15 at	**230 V**	**230 V**
Max. current	**5 A**	**5 A**
DC13 (6 cycles/min) at	**24 V**	**24 V**
Max. current	**5 A**	**5 A**
Utilisation category in accordance with UL		
Voltage	**240 V AC G.U. (same polarity)**	**240 V AC G.U. (same polarity)**
With current	**6 A**	**6 A**
Voltage	**24 V DC G. U.**	**24 V DC G. U.**
With current	**6 A**	**6 A**
External contact fuse protection, safety contacts		
In accordance with the standard	**EN 60947-5-1**	**EN 60947-5-1**
Max. melting integral	**260 A²s**	**260 A²s**
Blow-out fuse, quick	**10 A**	**10 A**
Blow-out fuse, slow	**6 A**	**6 A**
Blow-out fuse, gG	**10 A**	**10 A**
Circuit breaker 24V AC/DC, characteristic B/C	**6 A**	**6 A**
Contact material	**AgCuNi + 0,2 µm Au**	**AgCuNi + 0,2 µm Au**
Conventional thermal current while loading several contacts	**750167**	**751167**
Ith per contact at UB DC; AC1: 240 V, DC1: 24 V		
Conv. therm. current with 1 contact	**6 A**	**6 A**
Conv. therm. current with 2 contacts	**5,5 A**	**5,5 A**
Conv. therm. current with 3 contacts	**4,5 A**	**4,5 A**
Times	**750167**	**751167**
Switch-on delay		
With automatic start after power on typ.	**30 ms**	**30 ms**
With automatic start after power on max.	**50 ms**	**50 ms**
Delay-on de-energisation		
With E-STOP typ.	**18 ms**	**18 ms**
With E-STOP max.	**30 ms**	**30 ms**
With power failure typ.	**18 ms**	**18 ms**
With power failure max.	**30 ms**	**30 ms**
Supply interruption before de-energisation	**5 ms**	**5 ms**

Environmental data	750167	751167
Climatic suitability	**EN 60068-2-78**	**EN 60068-2-78**
Ambient temperature		
Temperature range	**-10 - 55 °C**	**-10 - 55 °C**
Storage temperature		
Temperature range	**-40 - 85 °C**	**-40 - 85 °C**
Climatic suitability		
Humidity	**93 % r. h. at 40 °C**	**93 % r. h. at 40 °C**
Condensation during operation	**Not permitted**	**Not permitted**
EMC	**EN 60947-5-1, EN 61000-6-2, EN 61000-6-4, EN 61326-3-1**	**EN 60947-5-1, EN 61000-6-2, EN 61000-6-4, EN 61326-3-1**
Vibration		
In accordance with the standard	**EN 60068-2-6**	**EN 60068-2-6**
Frequency	**10 - 55 Hz**	**10 - 55 Hz**
Amplitude	**0,35 mm**	**0,35 mm**
Airgap creepage		
In accordance with the standard	**EN 60947-1**	**EN 60947-1**
Overvoltage category	**III**	**III**
Pollution degree	**2**	**2**
Rated insulation voltage	**250 V**	**250 V**
Rated impulse withstand voltage	**6 kV**	**6 kV**
Protection type		
Housing	**IP40**	**IP40**
Terminals	**IP20**	**IP20**
Mounting area (e.g. control cabinet)	**IP54**	**IP54**
Mechanical data	**750167**	**751167**
Mounting position	**Any**	**Any**
Mechanical life	**10,000,000 cycles**	**10,000,000 cycles**
Material		
Bottom	**PC**	**PC**
Front	**PC**	**PC**
Top	**PC**	**PC**
Connection type	**Screw terminal**	**Spring-loaded terminal**
Mounting type	**plug-in**	**plug-in**
Conductor cross section with screw terminals		
1 core flexible	**0,25 - 2,5 mm², 24 - 12 AWG**	–
2 core with the same cross section, flexible with crimp connectors, no plastic sleeve	**0,25 - 1 mm², 24 - 16 AWG**	–
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	**0,2 - 1,5 mm², 24 - 16 AWG**	–
Torque setting with screw terminals	**0,5 Nm**	–

Mechanical data	750167	751167
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	–	**0,2 - 2,5 mm², 24 - 12 AWG**
Spring-loaded terminals: Terminal points per connection	–	**2**
Stripping length with spring-loaded terminals	–	**9 mm**
Dimensions		
Height	**98 mm**	**100 mm**
Width	**17,5 mm**	**17,5 mm**
Depth	**120 mm**	**120 mm**
Weight	**170 g**	**170 g**

Where standards are undated, the 2017-01 latest editions shall apply.

Safety characteristic data

NOTICE

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

Operating Mode	EN ISO 13849-1: 2015 PL	EN ISO 13849-1: 2015 Category	EN 62061 SIL CL	EN 62061 PFH_D [1/h]	IEC 61511 SIL	IEC 61511 PFD	EN ISO 13849-1: 2015 T_M [year]
Safety contacts, instantaneous	**PL e**	**Cat. 4**	**SIL CL 3**	**2,31E-09**	**SIL 3**	**2,03E-06**	**20**

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

INFORMATION

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

Supplementary data

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 switching frequency and the load on the relay output.
If the service life graphs are not accessible, the stated PFH value can be used irrespective of the switching 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.

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.

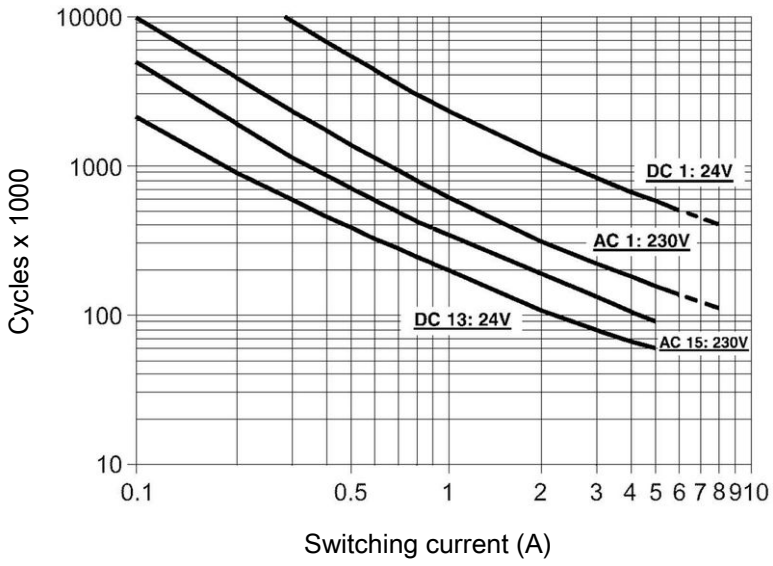


Fig.: Service life graphs at 24 V DC and 230 V AC

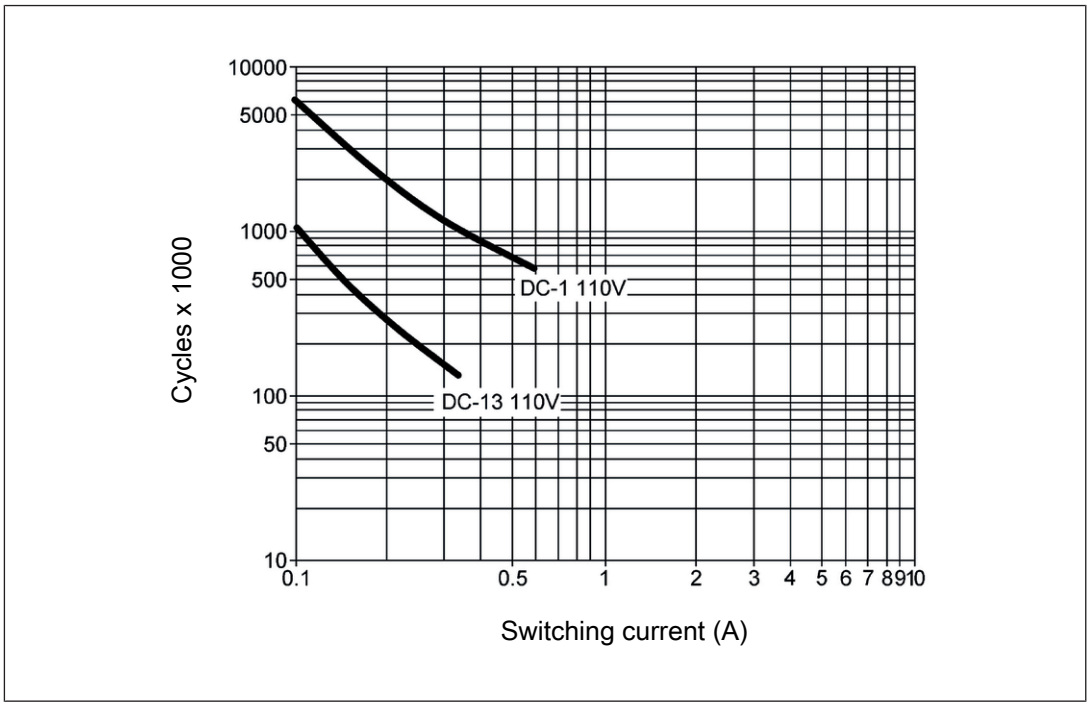


Fig.: Service life graphs at 110 V DC

Example

- Inductive load: 0.2 A
- Utilisation category: AC15
- Contact service life: 2 000 000 cycles

Provided the application to be implemented requires fewer than 2 000 000 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 capacitive loads, any power surges that occur must be noted. With DC contactors, use flywheel diodes for spark suppression.

Permitted operating height

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

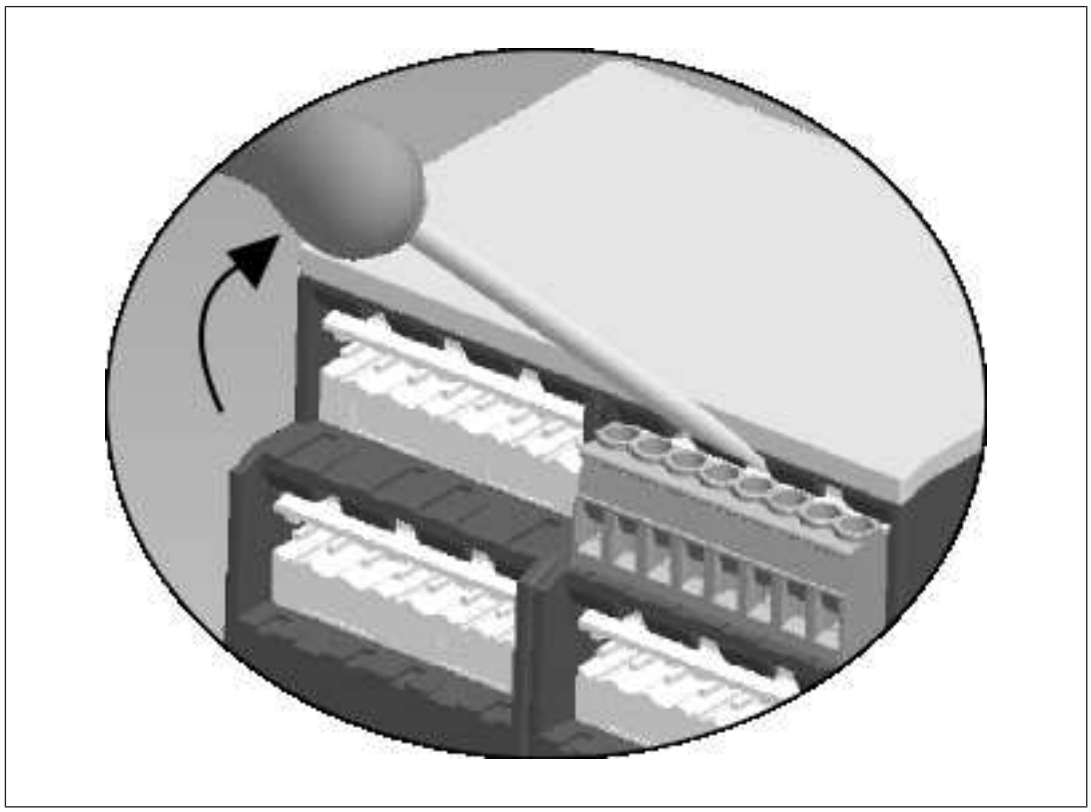
- From an operating height of 2000 m the max. permitted ambient temperature is reduced by 0.5 °C/100 m

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

Remove plug-in terminals

Procedure: Insert the screwdriver into the housing recess behind the terminal and lever the terminal out.

Do **not** remove the terminals by pulling the cables!



Order reference

Product type	Features	Connection type	Order No.
PNOZ s7.1	24 VDC	Screw terminals	750 167
PNOZ s7.1 C	24 VDC	Spring-loaded terminals	751 167

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.
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PILZ
THE SPIRIT OF SAFETY

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