Up to PL e of EN ISO 13849-1
PNOZ X2.8P

Safety relay for monitoring E-STOP pushbuttons, safety gates and light beam devices

Approvals

	PNOZ X2.8P
c UL us LISTED	◆
TÜV SÜD	◆
CCC	◆

Unit features

- Positive-guided relay outputs:
  - 3 safety contacts (N/O), instantaneous
  - 1 auxiliary contact (N/C), instantaneous
- Connection options for:
  - E-STOP pushbutton
  - Safety gate limit switch
  - Reset button
  - Light barriers
- LED indicator for:
  - Switch status channel 1/2
  - Supply voltage
- Plug-in connection terminals (either spring-loaded terminal or screw terminal)
- See order reference for unit types

Unit description

The safety relay meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1 and may be used in applications with

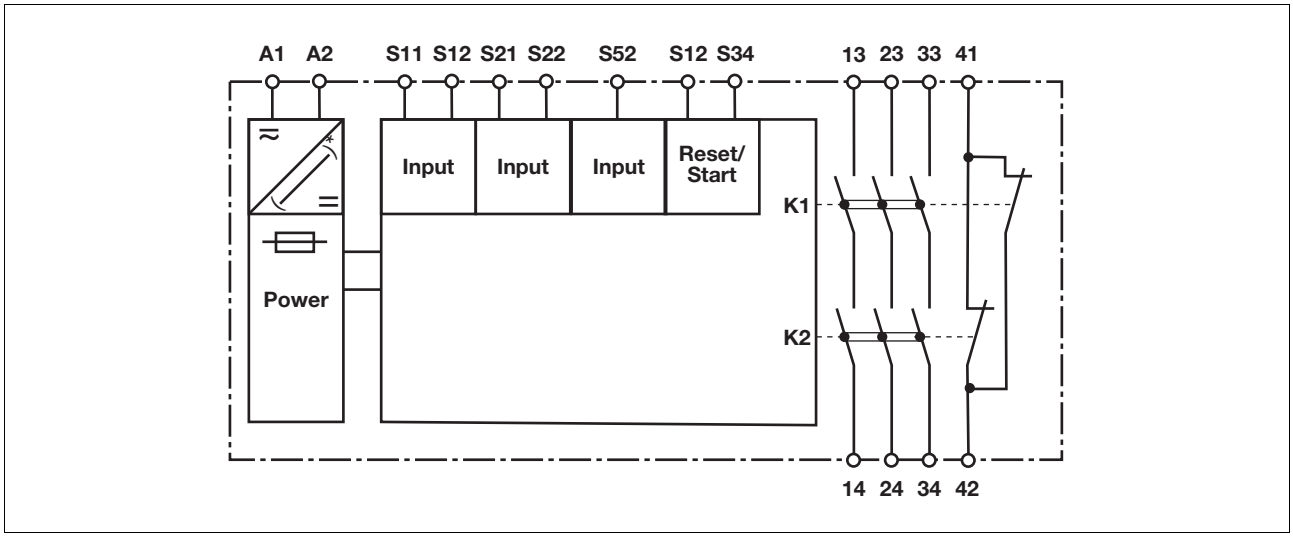
- E-STOP pushbuttons
- Safety gates
- Light beam devices

Safety features

The 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



*only applicable for U_B 24 - 240 VAC/DC

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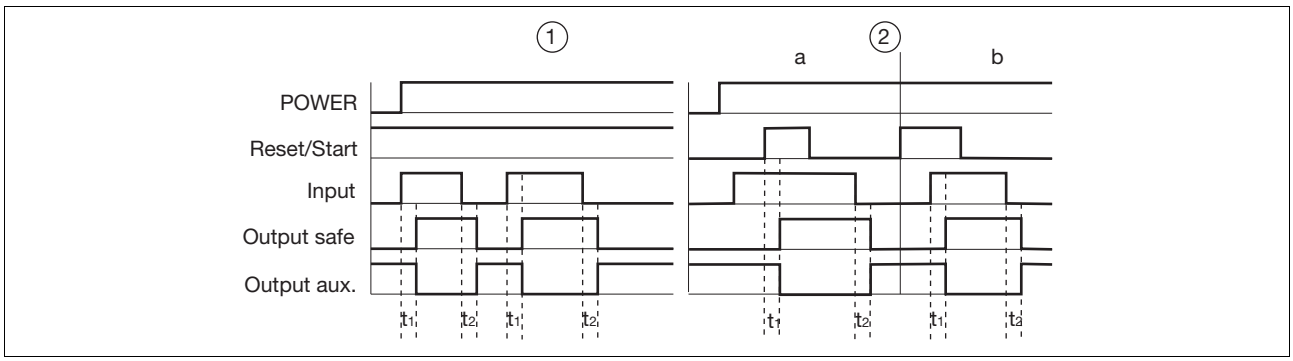
Function description

- Single-channel operation: no redundancy in the input circuit, earth faults in the reset and input circuit are detected.
- Dual-channel operation without detection of shorts across contacts: redundant input circuit, detects
  - earth faults in the reset and input circuit,
  - short circuits in the input circuit and, with a monitored reset, in the reset circuit too.
- Dual-channel operation with detection of shorts across contacts: redundant input circuit, detects
  - earth faults in the reset and input circuit,
  - short circuits and shorts between contacts in the input circuit.
- Automatic start: Unit is active once the input circuit has been closed.
- Manual reset: Unit is active once the input circuit is closed and then the reset circuit is closed.
- Increase in the number of available instantaneous safety contacts by connecting contact expansion modules or external contactors.

Timing diagram



Key

- Power: Supply voltage
- Reset/start: Reset circuit S12-S34
- Input: Input circuits S11-S12, S21-S22, S52
- Output safe: Safety contacts 13-14, 23-24, 33-34,
- Output aux: Auxiliary contacts 41-42
- ①: Automatic reset
- ②: Manual reset
- a: Input circuit closes before reset circuit
- b: Reset circuit closes before input circuit
- t_1: Switch-on delay
- t_2: Delay-on de-energisation

Wiring

Please note:

- Information given in the “Technical details” must be followed.
- Outputs 13-14, 23-24, 33-34, are safety contacts, output 41-42 is an auxiliary contact (e.g. for display).
- To prevent contact welding, a fuse should be connected before the output contacts (see technical details).
- Calculation of the max. cable runs l_{max} in the input circuit:

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

  R_{lmax} = max. overall cable resistance (see technical details)
  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.

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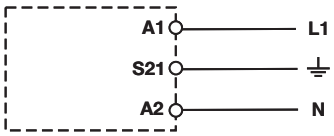
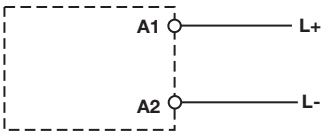
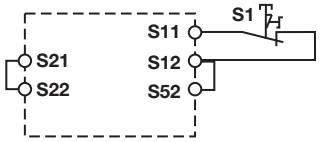
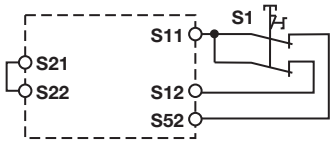
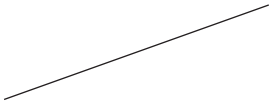
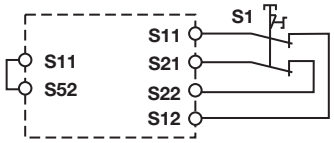
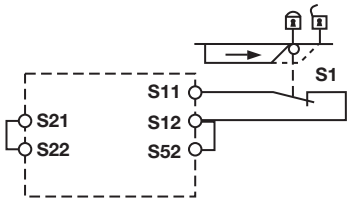
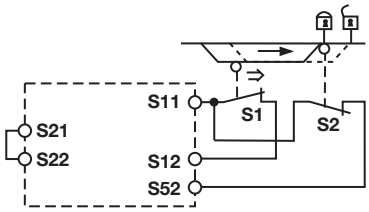
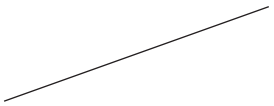
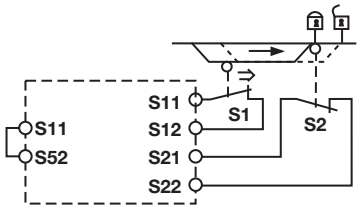
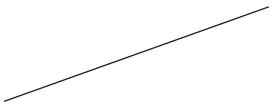
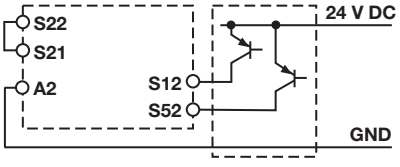
Preparing for operation

- Supply voltage

Supply voltage	24 – 240 VAC/DC	24 VAC/DC
		

- Input circuit

Input circuit	Single-channel	Dual-channel
E-STOP **without** detection of shorts across contacts		
E-STOP **with** detection of shorts across contacts		
Safety gate **without** detection of shorts across contacts		
Safety gate **with** detection of shorts across contacts		
Light beam device **with** detection of shorts across contacts (not on units with a universal power supply)		

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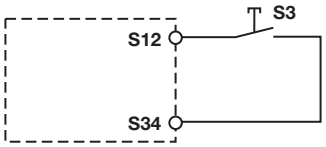
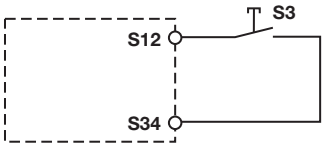
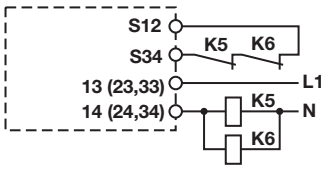
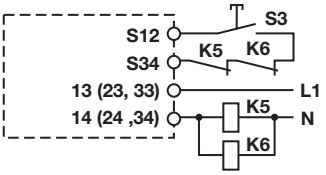
▸ Reset circuit

Reset circuit	E-STOP wiring (single-channel) Safety gate (single-channel)	E-STOP wiring (dual-channel) Safety gate (dual-channel)
Automatic reset		
Manual reset		

▸ Feedback circuit

Feedback circuit	Automatic reset	Manual reset
Contacts from external contactors		

▸ Key

S1/S2	E-STOP/safety gate switch
S3	Reset button
	Switch operated
	Gate open
	Gate closed

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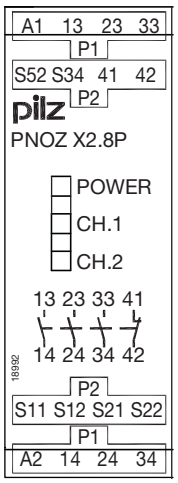
Terminal configuration

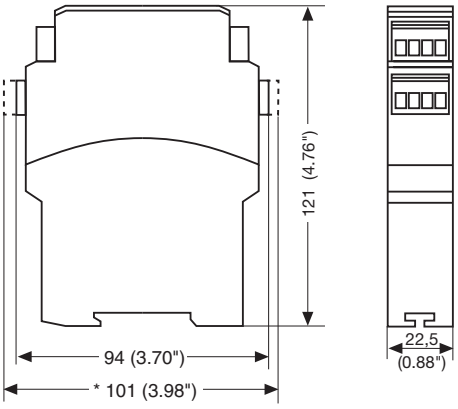


Installation

- 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.
- Ensure the unit is mounted securely on a vertical DIN rail (35 mm) by using a fixing element (e.g. retaining bracket or an end angle).

Dimensions

* with spring-loaded terminals



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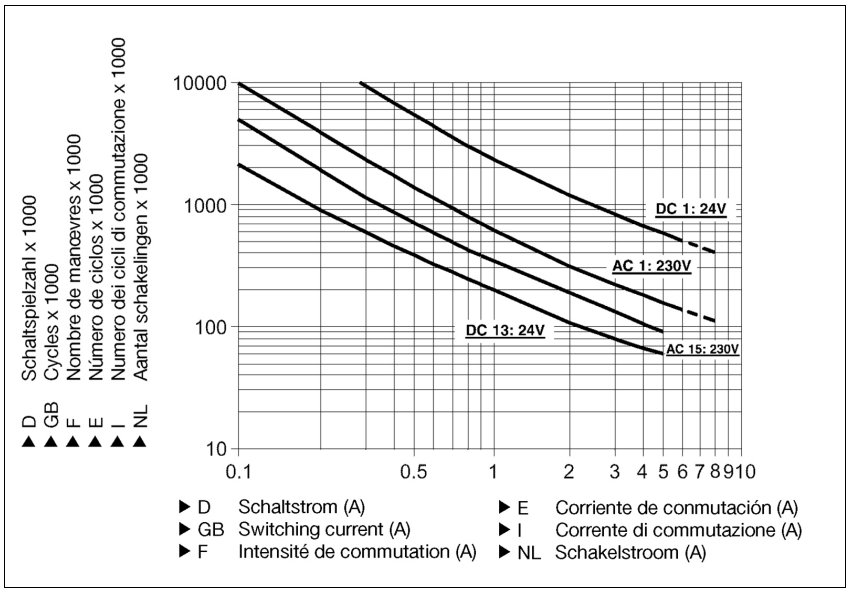
Notice

This data sheet is only intended for use during configuration. Please refer to the operating manual for installation and operation.

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.

U_B 24 V AC/DC



Example

- Inductive load: 0,2 A
- Utilisation category: AC15
- Contact service life: 2,000,000 cycles

Provided the application requires fewer than 2,000,000 cycles, the PFH value (see technical details) 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 contactors, use freewheel diodes for spark suppression.

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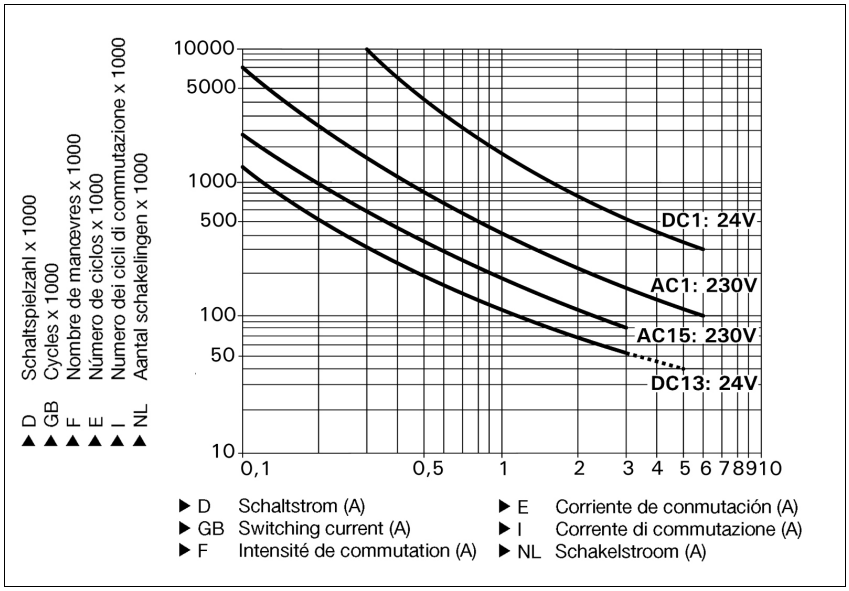
U_B 24 - 240 VAC/DC



Example
- Inductive load: 0,2 A
- Utilisation category: AC15
- Contact service life: 1,000,000 cycles

Provided the application requires fewer than 1,000,000 cycles, the PFH value (see technical details) 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 contactors, use freewheel diodes for spark suppression.

Technical details

Electrical data	
Supply voltage	
Supply voltage U_B AC/DC	**24 - 240 V**, **24 V**
Voltage tolerance	**-15 %/+10 %**
Power consumption at U_B AC	**4.5 VA** No. 777302, 787302 **5.5 VA** No. 777301, 787301
Power consumption at U_B DC	**2.0 W** No. 777302, 787302 **2.5 W** No. 777301, 787301
Frequency range AC	**50 - 60 Hz**
Residual ripple DC	**160 %**
Voltage and current at	
Input circuit DC: **24.0 V**	**25.0 mA** No. 777302, 787302 **30.0 mA** No. 777301, 787301
Reset circuit DC: **24.0 V**	**40.0 mA** No. 777301, 787301 **50.0 mA** No. 777302, 787302
Feedback loop DC: **24.0 V**	**40.0 mA** No. 777301, 787301 **50.0 mA** No. 777302, 787302
Number of output contacts	
Safety contacts (S) instantaneous:	**3**
Auxiliary contacts (N/C):	**1**

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Electrical data	
Utilisation category in accordance with **EN 60947-4-1**	
Safety contacts: AC1 at **240 V**	I_{min}: **0.01 A** , I_{max}: **6.0 A** P_{max}: **1500 VA**
Safety contacts: DC1 at **24 V**	I_{min}: **0.01 A** , I_{max}: **6.0 A** P_{max}: **150 W**
Auxiliary contacts: AC1 at **240 V**	I_{min}: **0.01 A** , I_{max}: **6.0 A** P_{max}: **1500 VA**
Auxiliary contacts: DC1 at **24 V**	I_{min}: **0.01 A** , I_{max}: **6.0 A** P_{max}: **150 W**
Utilisation category in accordance with **EN 60947-5-1**	
Safety contacts: AC15 at **230 V**	I_{max}: **3.0 A** No. 777302, 787302 **5.0 A** No. 777301, 787301
Safety contacts: DC13 at **24 V** (6 cycles/min)	I_{max}: **4.0 A** No. 777302, 787302 **5.0 A** No. 777301, 787301
Auxiliary contacts: AC15 at **230 V**	I_{max}: **3.0 A** No. 777302, 787302 **5.0 A** No. 777301, 787301
Auxiliary contacts: DC13 at **24 V** (6 cycles/min)	I_{max}: **4.0 A** No. 777302, 787302 **5.0 A** No. 777301, 787301
Contact material	**AgCuNi + 0.2 µm Au**
External contact fuse protection (I_K = 1 kA) to **EN 60947-5-1**	
Blow-out fuse, quick	
Safety contacts:	**10 A** No. 777301, 787301 **6 A** No. 777302, 787302
Auxiliary contacts:	**10 A** No. 777301, 787301 **6 A** No. 777302, 787302
Blow-out fuse, slow	
Safety contacts:	**4 A** No. 777302, 787302 **6 A** No. 777301, 787301
Auxiliary contacts:	**4 A** No. 777302, 787302 **6 A** No. 777301, 787301
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	**4 A** No. 777302, 787302 **6 A** No. 777301, 787301
Auxiliary contacts:	**4 A** No. 777302, 787302 **6 A** No. 777301, 787301
Max. overall cable resistance R_{lmax} input circuits, reset circuits	
single-channel at U_B DC	**30 Ohm** No. 777301, 787301 **45 Ohm** No. 777302, 787302
single-channel at U_B AC	**100 Ohm** No. 777301, 787301 **45 Ohm** No. 777302, 787302
dual-channel without detect. of shorts across contacts at U_B DC	**50 Ohm** No. 777301, 787301 **80 Ohm** No. 777302, 787302
dual-channel without detect. of shorts across contacts at U_B AC	**100 Ohm** No. 777301, 787301 **80 Ohm** No. 777302, 787302
dual-channel with detect. of shorts across contacts at U_B DC	**15 Ohm**
dual-channel with detect. of shorts across contacts at U_B AC	**15 Ohm**
Min. input resistance when switching on	**209 Ohm** No. 777302, 787302 **88 Ohm** No. 777301, 787301
Safety-related characteristic data	
PL in accordance with **EN ISO 13849-1: 2006**	**PL e** (**Cat. 4**)
Category in accordance with **EN 954-1**	**Cat. 4**
SIL CL in accordance with **EN IEC 62061**	**SIL CL 3**
PFH in accordance with **EN IEC 62061**	**2.31E-09**
SIL in accordance with **IEC 61511**	**SIL 3**
PFD in accordance with **IEC 61511**	**2.03E-06**
T_M [year] in accordance with **EN ISO 13849-1: 2006**	**20**

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Times	
Switch-on delay	
with automatic reset typ.	**250 ms** No. 777301, 787301 **340 ms** No. 777302, 787302
with automatic reset max.	**400 ms** No. 777302, 787302 **450 ms** No. 777301, 787301
with automatic reset after power on typ.	**250 ms** No. 777301, 787301 **600 ms** No. 777302, 787302
with automatic reset after power on max.	**450 ms** No. 777301, 787301 **800 ms** No. 777302, 787302
with manual reset typ.	**125 ms** No. 777301, 787301 **180 ms** No. 777302, 787302
with manual reset max.	**400 ms** No. 777302, 787302 **450 ms** No. 777301, 787301
Delay-on de-energisation	
with E-STOP typ.	**10 ms** No. 777302, 787302 **15 ms** No. 777301, 787301
with E-STOP max.	**20 ms** No. 777302, 787302 **30 ms** No. 777301, 787301
with power failure typ.	**60 ms** No. 777301, 787301
with power failure max.	**100 ms** No. 777301, 787301
with power failure typ. U_B AC/DC: **24 V** No. 777302, 787302	**180 ms** No. 777302, 787302
with power failure max. U_B AC/DC: **24 V** No. 777302, 787302	**230 ms** No. 777302, 787302
with power failure typ. U_B AC : **240 V**	**1,100 ms** No. 777302, 787302
with power failure max. U_B AC : **240 V**	**1500 ms** No. 777302, 787302
Recovery time at max. switching frequency 1/s	
after E-STOP	**50 ms**
after power failure	**200 ms** No. 777301, 787301 **250 ms** No. 777302, 787302
after power failure on universal power supply	**1500 ms** No. 777302, 787302
Simultaneity, channel 1 and 2	∞
Supply interruption before de-energisation	**20 ms**
Environmental data	
EMC	**EN 60947-5-1**, **EN 61000-6-2**, **EN 61000-6-4**
Vibration to **EN 60068-2-6**	
Frequency	**10 - 55 Hz**
Amplitude	**0.35 mm**
Climatic suitability	**EN 60068-2-78**
Airgap creepage in accordance with **EN 60947-1**	
Pollution degree	**2**
Overvoltage category	**III / II**
Rated insulation voltage	**250 V**
Rated impulse withstand voltage	**4.00 kV**
Ambient temperature	**-10 - 55 °C** No. 777302, 787302 **-35 - 55 °C** No. 777301, 787301
Storage temperature	**-40 - 85 °C**
Protection type	
Mounting (e.g. cabinet)	**IP54**
Housing	**IP40**
Terminals	**IP20**
Mechanical data	
Housing material	
Housing	**PPO UL 94 V0**
Front	**ABS UL 94 V0**
Cross section of external conductors with screw terminals	
1 core flexible	**0.25 - 2.50 mm² , 24 - 12 AWG** No. 777301, 777302
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	**0.25 - 1.00 mm² , 24 - 16 AWG** No. 777301, 777302
without crimp connectors or with TWIN crimp connectors	**0.20 - 1.50 mm² , 24 - 16 AWG** No. 777301, 777302

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Mechanical data	
Torque setting with screw terminals	**0.50 Nm** No. 777301, 777302
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	**0.20 - 1.50 mm² , 24 - 16 AWG** No. 787301, 787302
Spring-loaded terminals: Terminal points per connection	**2** No. 787301, 787302
Stripping length	**8 mm** No. 787301, 787302
Dimensions	
Height	**101.0 mm** No. 787301, 787302 **94.0 mm** No. 777301, 777302
Width	**22.5 mm**
Depth	**121.0 mm**
Weight	**190 g** No. 777301, 787301 **210 g** No. 777302, 787302

No. stands for order number.

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.

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.

The standards current on **2010-07** apply.

Conventional thermal current while loading several contacts

Number of contacts	I_{th} per contact at U_B DC	I_{th} at U_B AC
1	**6.00 A**	**6.00 A**
2	**6.00 A**	**4.00 A** No. 777301, 787301 **6.00 A** No. 777302, 787302
3	**4.50 A** No. 777302, 787302 **5.00 A** No. 777301, 787301	**3.50 A** No. 777301, 787301 **4.50 A** No. 777302, 787302

Order reference

Type	Features		Terminals	Order no.
PNOZ X2.8P C	24 VAC	24 VDC	Spring-loaded terminals	787 301
PNOZ X2.8P	24 VAC	24 VDC	Screw terminals	777 301
PNOZ X2.8P C	24 - 240 VAC	24 - 240 VDC	Spring-loaded terminals	787 302
PNOZ X2.8P	24 - 240 VAC	24 - 240 VDC	Screw terminals	777 302