

## Up to PL e of EN ISO 13849-1 PNOZ X2.9P



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

### Approvals

PNOZ X2.9P	
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### 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:
  - Supply voltage
  - Switch status channel 1/2
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)
- ▶ See order reference for unit types

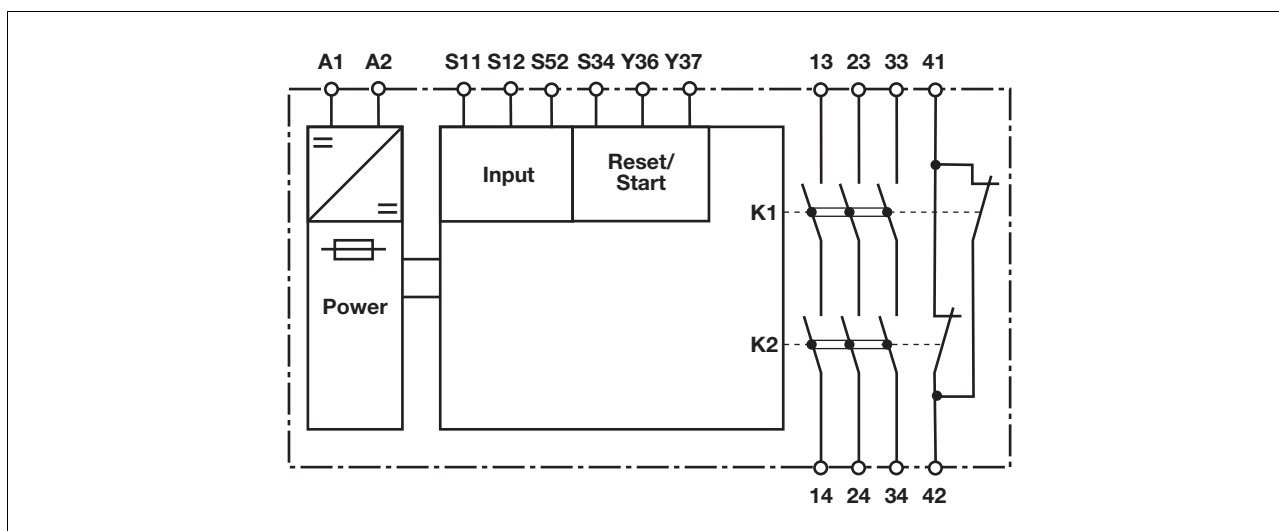
### Safety features

- 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.
  - ▶ No galvanic isolation between supply voltage and input circuit

### 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

### Block diagram

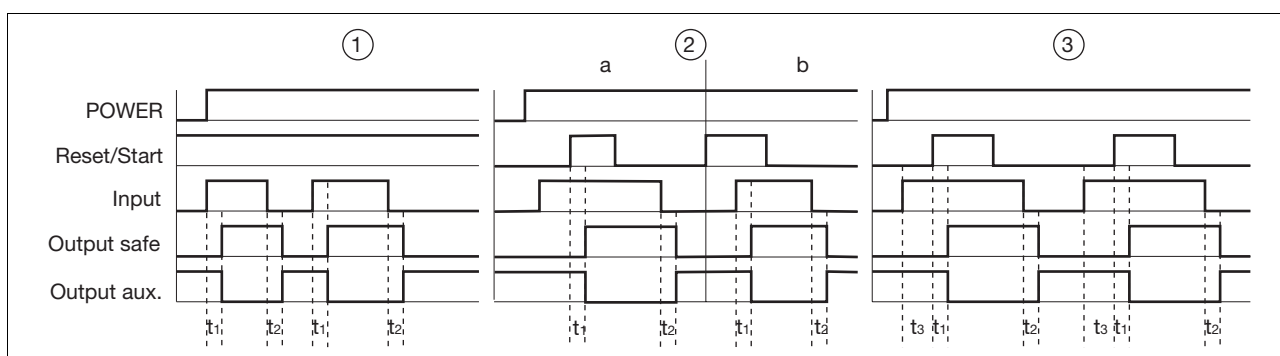


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### Function description

- ▶ Single-channel operation: no redundancy in the input circuit, earth faults in the reset 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.
- ▶ 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.
- ▶ Monitored reset: Unit is active once the input circuit is closed and once the reset circuit is closed after the waiting period has elapsed (see technical details).
- ▶ 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, Y36-Y37
- ▶ Input: Input circuits S11, S12, S52
- ▶ Output safe: Safety outputs 13-14, 23-24, 33-34
- ▶ Output aux: Auxiliary contacts 41-42
- ▶ ①: Automatic reset
- ▶ ②: Manual reset
- ▶ ③: Monitored 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
- ▶  $t_3$ : Waiting period

### 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	AC	DC

► Input circuit

Input circuit	Single-channel	Dual-channel
E-STOP <b>without</b> detection of shorts across contacts		
E-STOP <b>with</b> detection of shorts across contacts		
Safety gate <b>without</b> detection of shorts across contacts		
Safety gate <b>with</b> detection of shorts across contacts		
Light beam device <b>with</b> detection of shorts across contacts via ESPE		

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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		
Monitored reset		

### ▶ Feedback circuit

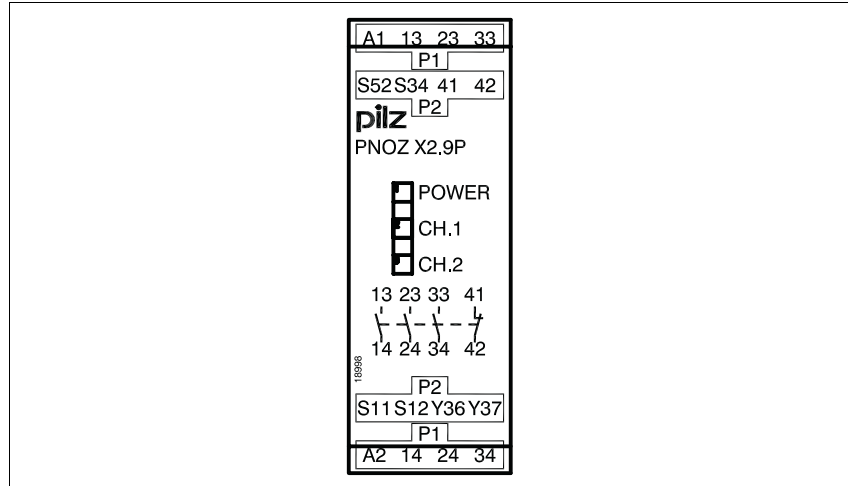
Feedback circuit	Automatic reset	Manual reset
Contacts from external contactors		

### ▶ Key

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

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### Terminal configuration

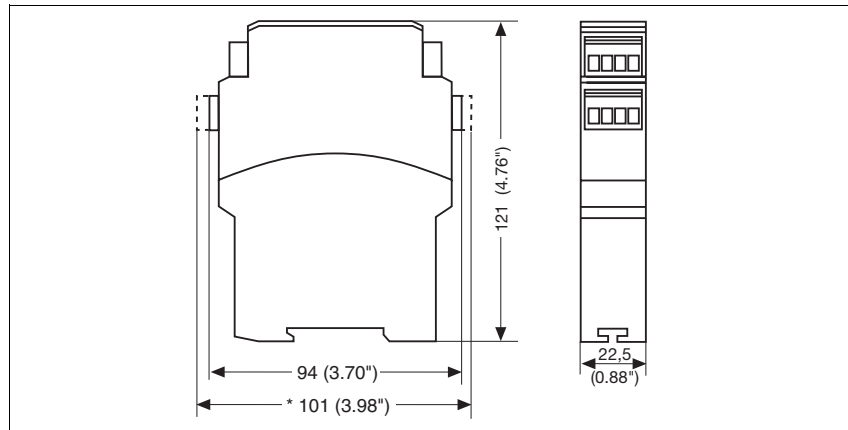


### Installation

- ▶ 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 in mm (")

\* with spring-loaded terminals



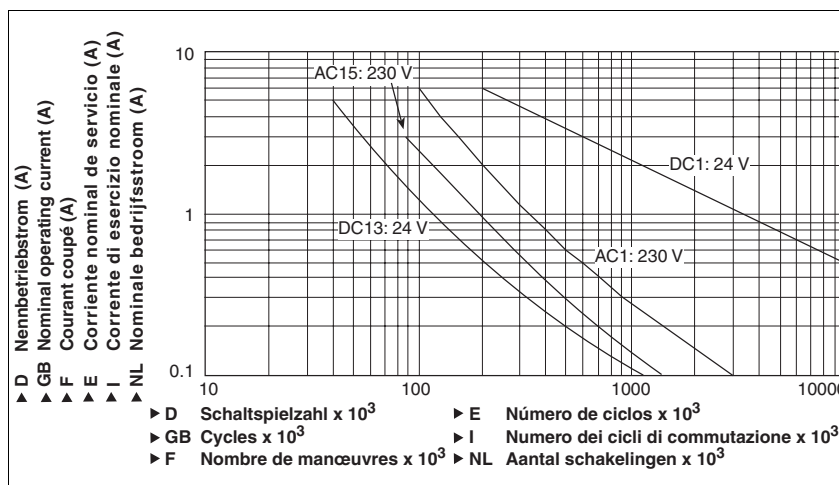
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### Notice

This data sheet is only intended for use during configuration. For installation and operation, please refer to the operating instructions supplied with the unit.

### 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.



### Example

- ▶ Inductive load: 0.2 A
  - ▶ Utilisation category: AC15
  - ▶ Contact service life: 700 000 cycles
- Provided the application requires fewer than 700 000 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. We recommend you use semiconductor outputs to switch 24 VDC loads.

### Technical details

#### Electrical data

Supply voltage	
Supply voltage $U_B$ DC	<b>24 V</b>
Voltage tolerance	<b>-15 %/+10 %</b>
Power consumption at $U_B$ DC	<b>2.0 W</b>
Residual ripple DC	<b>160 %</b>
Voltage and current at	
Input circuit DC: <b>24.0 V</b>	<b>30.0 mA</b>
Reset circuit DC: <b>24.0 V</b>	<b>60.0 mA</b>
Feedback loop DC: <b>24.0 V</b>	<b>60.0 mA</b>
Number of output contacts	
Safety contacts (S) instantaneous:	<b>3</b>
Auxiliary contacts (N/C):	<b>1</b>

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<b>Electrical data</b>	
Utilisation category in accordance with <b>EN 60947-4-1</b>	
Safety contacts: AC1 at <b>240 V</b>	$I_{\min}$ : <b>0.01 A</b> , $I_{\max}$ : <b>6.0 A</b> $P_{\max}$ : <b>1500 VA</b>
Safety contacts: DC1 at <b>24 V</b>	$I_{\min}$ : <b>0.01 A</b> , $I_{\max}$ : <b>6.0 A</b> $P_{\max}$ : <b>150 W</b>
Auxiliary contacts: AC1 at <b>240 V</b>	$I_{\min}$ : <b>0.01 A</b> , $I_{\max}$ : <b>6.0 A</b> $P_{\max}$ : <b>1500 VA</b>
Auxiliary contacts: DC1 at <b>24 V</b>	$I_{\min}$ : <b>0.01 A</b> , $I_{\max}$ : <b>6.0 A</b> $P_{\max}$ : <b>150 W</b>
Utilisation category in accordance with <b>EN 60947-5-1</b>	
Safety contacts: AC15 at <b>230 V</b>	$I_{\max}$ : <b>3.0 A</b>
Safety contacts: DC13 at <b>24 V</b> (6 cycles/min)	$I_{\max}$ : <b>4.0 A</b>
Auxiliary contacts: AC15 at <b>230 V</b>	$I_{\max}$ : <b>3.0 A</b>
Auxiliary contacts: DC13 at <b>24 V</b> (6 cycles/min)	$I_{\max}$ : <b>4.0 A</b>
Contact material	<b>AgSnO<sub>2</sub> + 0.2 µm Au</b>
External contact fuse protection ( $I_K = 1$ kA) to <b>EN 60947-5-1</b>	
Blow-out fuse, quick	
Safety contacts:	<b>6 A</b>
Auxiliary contacts:	<b>6 A</b>
Blow-out fuse, slow	
Safety contacts:	<b>4 A</b>
Auxiliary contacts:	<b>4 A</b>
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	<b>4 A</b>
Auxiliary contacts:	<b>4 A</b>
Max. overall cable resistance $R_{l\max}$	
input circuits, reset circuits	
single-channel at $U_B$ DC	<b>50 Ohm</b>
dual-channel without detect. of shorts across contacts at $U_B$ DC	<b>80 Ohm</b>
Min. input resistance when switching on	
	<b>205 Ohm</b>
<b>Safety-related characteristic data</b>	
PL in accordance with <b>EN ISO 13849-1: 2006</b>	<b>PL e (Cat. 4)</b>
Category in accordance with <b>EN 954-1</b>	<b>Cat. 4</b>
SIL CL in accordance with <b>EN IEC 62061</b>	<b>SIL CL 3</b>
PFH in accordance with <b>EN IEC 62061</b>	<b>2.31E-09</b>
SIL in accordance with <b>IEC 61511</b>	<b>SIL 3</b>
PFD in accordance with <b>IEC 61511</b>	<b>2.03E-06</b>
$t_M$ in years	<b>20</b>
<b>Times</b>	
Switch-on delay	
with automatic reset typ.	<b>200 ms</b>
with automatic reset max.	<b>400 ms</b>
with automatic reset after power on typ.	<b>200 ms</b>
with automatic reset after power on max.	<b>400 ms</b>
with manual reset typ.	<b>100 ms</b>
with manual reset max.	<b>400 ms</b>
on monitored reset with rising edge typ.	<b>30 ms</b>
on monitored reset with rising edge max.	<b>50 ms</b>
Delay-on de-energisation	
with E-STOP typ.	<b>10 ms</b>
with E-STOP max.	<b>20 ms</b>
with power failure typ.	<b>70 ms</b>
with power failure max.	<b>120 ms</b>
Recovery time at max. switching frequency 1/s	
after E-STOP	<b>50 ms</b>
after power failure	<b>150 ms</b>

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Times	
Waiting period with a monitored reset with rising edge	200 ms
Min. start pulse duration with a monitored reset with rising edge	30 ms
Simultaneity, channel 1 and 2	∞
Supply interruption before de-energisation	20 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2
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
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 mm <sup>2</sup> , 24 - 12 AWG No. 777300
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm <sup>2</sup> , 24 - 16 AWG No. 777300
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm <sup>2</sup> , 24 - 16 AWG No. 777300
Torque setting with screw terminals	0.50 Nm No. 777300
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 1.50 mm <sup>2</sup> , 24 - 16 AWG No. 787300
Spring-loaded terminals: Terminal points per connection	2 No. 787300
Stripping length	8 mm No. 787300
Dimensions	
Height	101.0 mm No. 787300 94.0 mm No. 777300
Width	22.5 mm
Depth	121.0 mm
Weight	175 g No. 787300 180 g No. 777300

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.

The standards current on 2009-11 apply.



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### Conventional thermal current

$I_{th}$  (A) at  $U_B$  DC

1 contact	<b>6.00 A</b>
2 contacts	<b>6.00 A</b>
3 contacts	<b>4.50 A</b>

### Order reference

Type	Features	Terminals	Order no.
PNOZ X2.9P C	24 VDC	Spring-loaded terminals	787 300
PNOZ X2.9P	24 VDC	Screw terminals	777 300