Up to PL e of EN ISO 13849-1
PNOZ s5



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

Approvals

	PNOZ s5
cULus LISTED	◆
TÜV SÜD	◆
CCC	◆

Unit features

- Positive-guided relay outputs:
  - 2 safety contacts (N/O), instantaneous
  - 2 safety contacts (N/O), delay-on de-energisation
- 1 semiconductor output
- Connection options for:
  - E-STOP pushbutton
  - Safety gate limit switch
  - Reset button
  - Light barriers
  - PSEN
- A connector can be used to connect 1 PNOZsigma contact expander module
- Delay-on de-energisation selectable
- Operating modes and delay times can be selected via rotary switches
- LED indicator for:
  - Supply voltage
  - Input status, channel 1
  - Input status, channel 2
  - Switch status channel 1/2
  - Reset circuit
  - Error
- 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

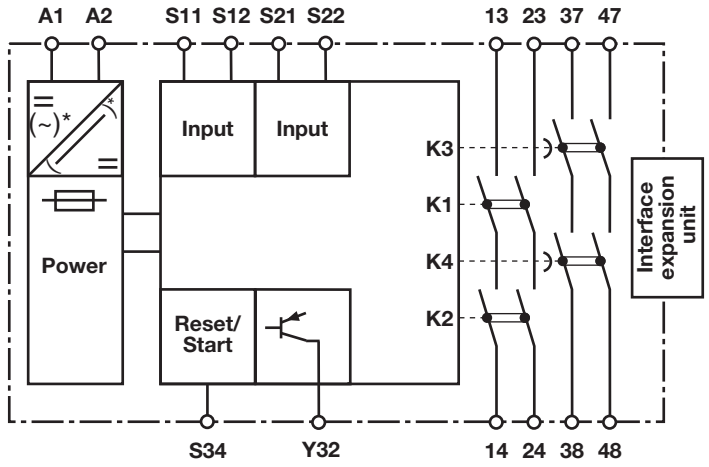
- E-STOP pushbuttons
- Safety gates
- Light beam devices

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.
- The unit has an electronic fuse.

Block diagram



*only with U_B = 48 – 240 V AC/DC

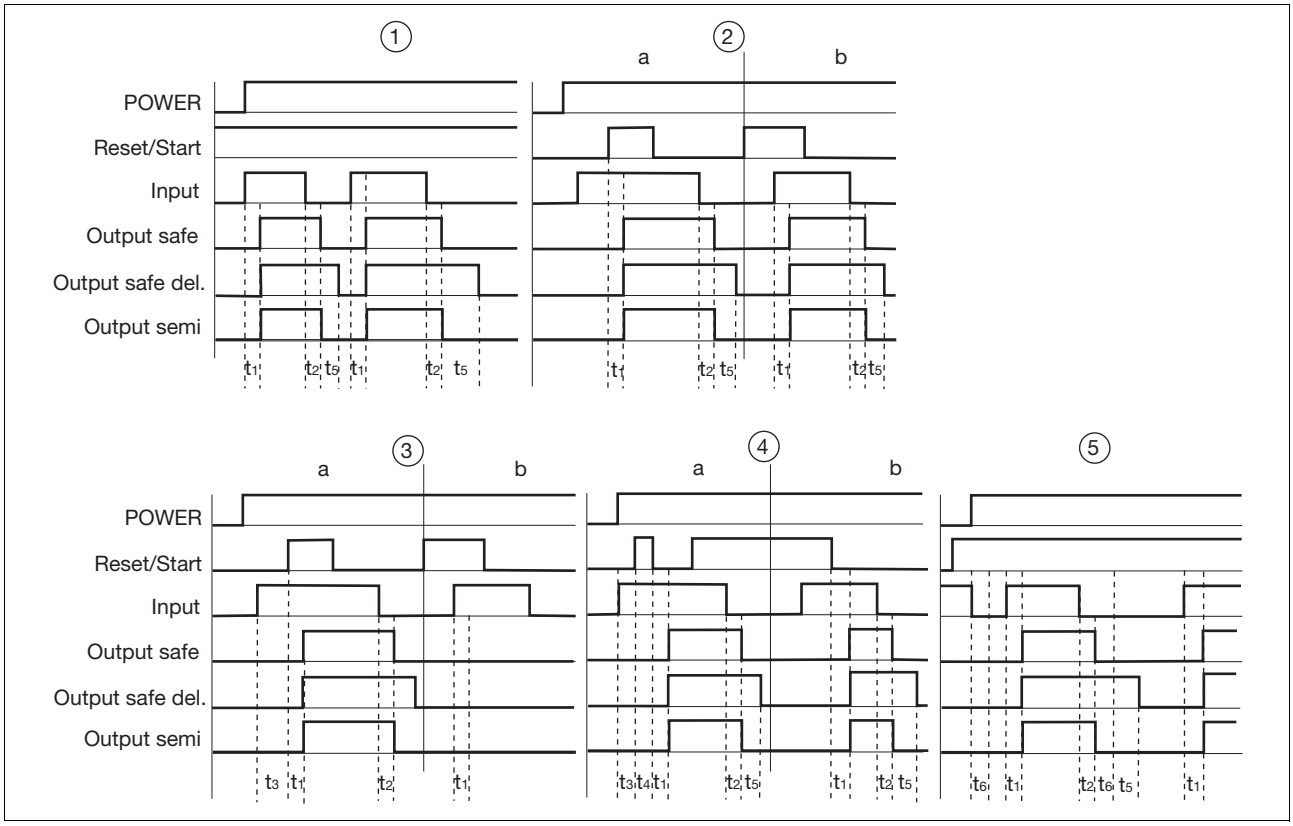
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Function description

- 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 in the input circuit and, with a monitored reset, in the reset circuit too,
  - 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.
- Monitored reset with falling edge: Unit is active once
  - the input circuit is closed and then the reset circuit is closed and opened again.
  - the reset circuit is closed and then opened again once the input circuit is closed.
- Monitored reset with rising edge: 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).
- Reset with start-up test: The unit checks whether safety gates that are closed are opened and then closed again when supply voltage is applied.
- Ability to increase the number of contacts available on the
  - instantaneous safety contacts by using connectors to link to a PNOZsigma contact expansion module
  - delayed/instantaneous safety contacts by connecting contact expansion modules or external contactors

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Timing diagram



Key

- Power: Supply voltage
- Reset/Start: Reset circuit S12-S34
- Input: Input circuits S11-S12, S21-S22
- Output safe: Safety contacts 13-14, 23-24
- Out semi: Semiconductor outputY32
- ①: Automatic reset
- ②: Manual reset
- ③: Monitored reset with rising edge
- ④: Monitored reset with falling edge
- ⑤: Reset with start-up test
- 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
- t_4: Waiting period reset circuit was closed
- t_5: Delay time
- t_6: Minimum time safety gates open

Wiring

Please note:

- Information given in the “Technical details” must be followed.
- Outputs 13-14, 23-24 are instantaneous safety contacts, outputs 37-38, 47-48 are delay-on de-energisation safety contacts.
- To prevent contact welding, a fuse should be connected before the output contacts (see technical details).
- Calculation of the max. cable runs I_{max} in the input circuit:

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

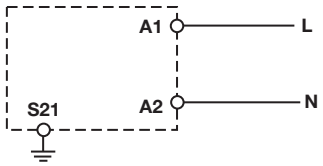
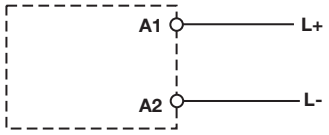
R_{lmax} = max. overall cable resistance (see technical details)
R_l / km = cable resistance/km

- Use copper wire that can withstand 60/75 °C.
- Sufficient fuse protection must be provided on all output contacts with capacitive and inductive loads.
- With U_B 48 – 240 VAC/DC: Connect S21 to the protective earth system

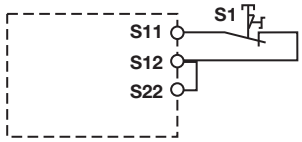
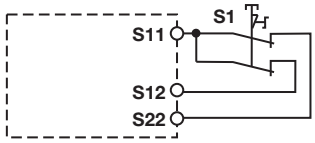
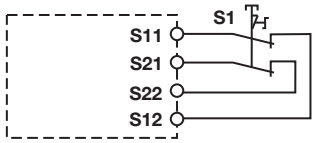
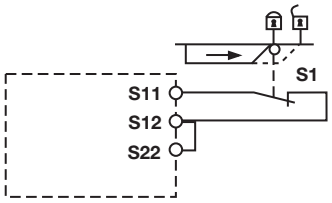
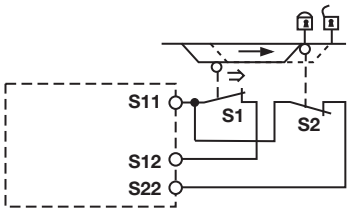
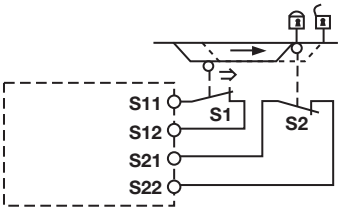
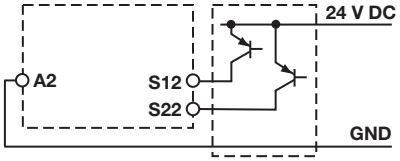
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Preparing for operation

- Supply voltage

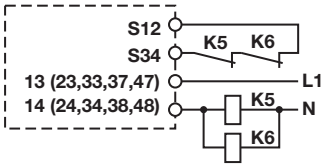
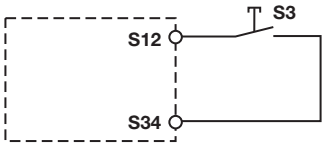
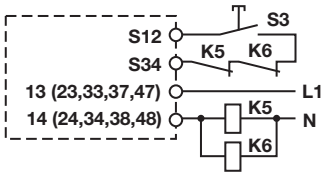
Supply voltage	AC	DC
		

- Input circuit

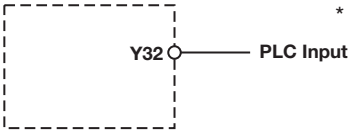
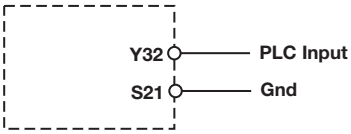
Input circuit	Single-channel	Dual-channel
E-STOP **without** detection of shorts across contacts		
E-STOP **with** detection of shorts across contacts		
Safety gate **without** detection of shorts across contacts		
Safety gate **with** detection of shorts across contacts		
Light beam device or safety switch **with** detection of shorts across contacts via ESPE (only when U_B = 24 VDC)		

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- Reset circuit/feedback loop

Reset circuit/feedback loop	Reset circuit	Feedback circuit
Automatic reset		
Manual/monitored reset		

- Semiconductor output

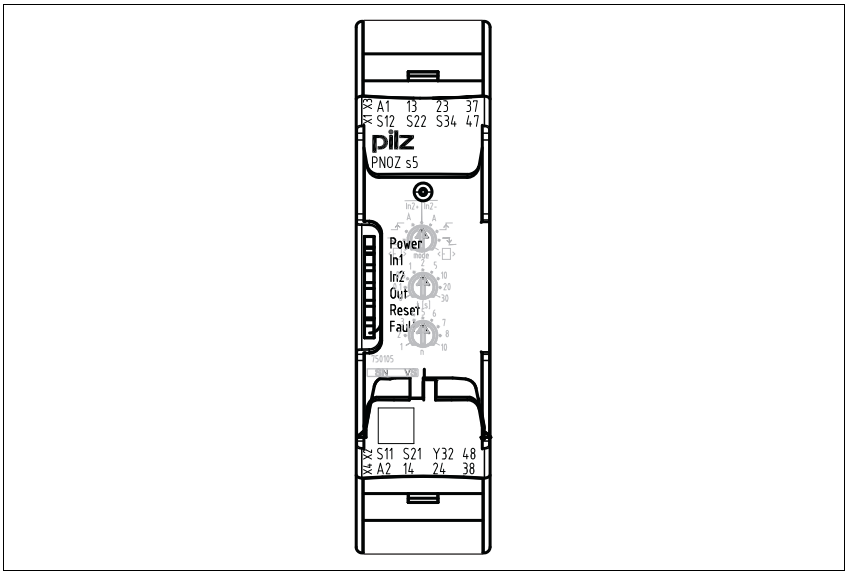
U_B 24 VDC	U_B 48 – 240 VAC/DC
 *Connect together the 0V connections on all the external power supplies	

- Key

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

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Terminal configuration



Installation

Install base unit without contact expander module:

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

Connect base unit and PNOZsigma contact expander module:

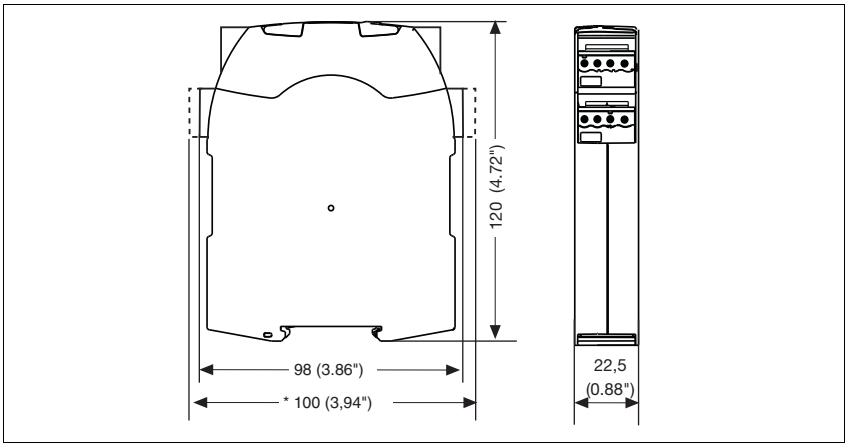
- Remove the plug terminator at the side of the base unit and at the contact expander module.
- Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

Installation in control cabinet

- 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 brakket or end angle).
- Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals



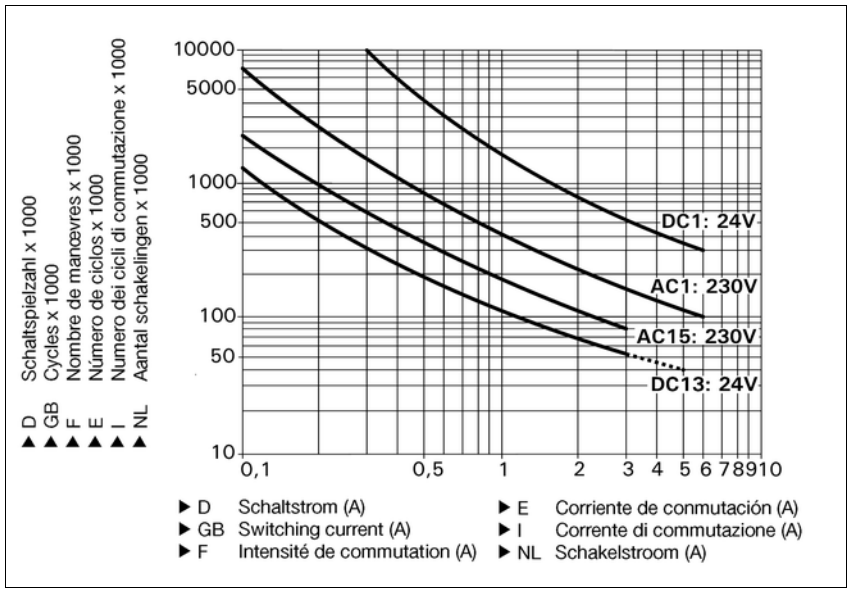
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Notice

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.



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 DC	**24 V**
Supply voltage U_B AC/DC	**48 - 240 V**
Voltage tolerance	**-15 %/+10 %**
Power consumption at U_B AC	**8.0 VA** No. 750135, 751135
Power consumption at U_B DC	**4.0 W**
Frequency range AC	**50 - 60 Hz**
Residual ripple DC	**160 %** No. 750135, 751135 **20 %** No. 750105, 751105, 751185
Voltage and current at	
Input circuit DC: **24.0 V**	**40.0 mA**
Reset circuit DC: **24.0 V**	**40.0 mA**
Feedback loop DC: **24.0 V**	**40.0 mA**

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Electrical data	
Number of output contacts	
Safety contacts (S) instantaneous:	**2**
Safety contacts (N/O), delayed:	**2**
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**
Safety contacts, delayed: AC1 at **240 V**	I_{min}: **0.01 A** , I_{max}: **6.0 A** P_{max}: **1500 VA**
Safety contacts, delayed: 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**
Safety contacts: DC13 at **24 V** (6 cycles/min)	I_{max}: **4.0 A**
Safety contacts, delayed: AC15 at **230 V**	I_{max}: **3.0 A**
Safety contacts, delayed: DC13 at **24 V** (6 cycles/min)	I_{max}: **4.0 A**
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:	**6 A**
Safety contacts, delayed:	**6 A**
Blow-out fuse, slow	
Safety contacts:	**4 A**
Safety contacts, delayed:	**4 A**
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	**4 A**
Safety contacts, delayed:	**4 A**
Semiconductor outputs (short circuit proof)	**24.0 V** DC, **20 mA**
Max. overall cable resistance R_{lmax} input circuits, reset circuits	
single-channel at U_B DC	**30 Ohm**
single-channel at U_B AC	**30 Ohm** No. 750135, 751135
dual-channel without detect. of shorts across contacts at U_B DC	**30 Ohm**
dual-channel without detect. of shorts across contacts at U_B AC	**30 Ohm** No. 750135, 751135
dual-channel with detect. of shorts across contacts at U_B DC	**30 Ohm**
dual-channel with detect. of shorts across contacts at U_B AC	**30 Ohm** No. 750135, 751135
Min. input resistance when switching on	**110 Ohm**
Safety-related characteristic data	
PL in accordance with **EN ISO 13849-1: 2006**	
Safety contacts, instantaneous	**PL e** (**Cat. 4**)
Safety contacts, delayed	**PL e** (**Cat. 4**)
Category in accordance with **EN 954-1**	
Safety contacts, instantaneous	**Cat. 4**
Safety contacts, delayed	**Cat. 4**
SIL CL in accordance with **EN IEC 62061**	
Safety contacts, instantaneous	**SIL CL 3**
Safety contacts, delayed	**SIL CL 3**
PFH in accordance with **EN IEC 62061**	
Safety contacts, instantaneous	**2.31E-09**
Safety contacts, delayed	**2.34E-09**
SIL in accordance with **IEC 61511**	
Safety contacts, instantaneous	**SIL 3**
Safety contacts, delayed	**SIL 3**

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Safety-related characteristic data	
PFD in accordance with **IEC 61511**	
Safety contacts, instantaneous	**2.03E-06**
Safety contacts, delayed	**2.75E-05**
T_M [year] in accordance with **EN ISO 13849-1: 2006**	**20**
Times	
Switch-on delay	
with automatic reset typ.	**180 ms**
with automatic reset max.	**400 ms**
with automatic reset after power on typ.	**1,430 ms**
with automatic reset after power on max.	**2,000 ms**
with manual reset typ.	**45 ms**
with manual reset max.	**85 ms**
on monitored reset with rising edge typ.	**45 ms**
on monitored reset with rising edge max.	**130 ms**
on monitored reset with falling edge typ.	**60 ms**
on monitored reset with falling edge max.	**150 ms**
Delay-on de-energisation	
with E-STOP typ.	**15 ms**
with E-STOP max.	**20 ms**
with power failure typ.	**75 ms**
with power failure max.	**110 ms**
Recovery time at max. switching frequency 1/s	
after E-STOP	**150 ms +tv**
after power failure	**200 ms**
Delay time t_V: selectable	**0,00 s**; **0,10 s**; **0,20 s**; **0,30 s**; **0,40 s**; **0,50 s**; **0,60 s**; **0,70 s**; **0,80 s**; **1,00 s**; **1,50 s**; **2,00 s**; **2,50 s**; **3,00 s**; **3,50 s**; **4,00 s**; **5,00 s**; **6,00 s**; **7,00 s**; **8,00 s**; **10,00 s**; **12,00 s**; **14,00 s**; **15,00 s**; **16,00 s**; **20,00 s**; **25,00 s**; **30,00 s**; **35,00 s**; **40,00 s**; **50,00 s**; **60,00 s**; **70,00 s**; **80,00 s**; **90,00 s**; **100,00 s**; **120,00 s**; **140,00 s**; **150,00 s**; **160,00 s**; **180,00 s**; **200,00 s**; **210,00 s**; **240,00 s**; **300,00 s**
Repetition accuracy	**+/-1 % + +/-20 ms**
Repetition accuracy in the case of a fault	**+/-15 % + +/-20 ms**
Time accuracy	**+/-1 % + +/-20 ms**
Waiting period with a monitored reset	
with rising edge	**150 ms**
with falling edge	**240 ms**
Min. start pulse duration with a monitored reset	
with rising edge	**30 ms**
with falling edge	**70 ms**
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	**10.0 - 55.0 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**

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Environmental data	
Protection type	
Mounting (e.g. cabinet)	**IP54**
Housing	**IP40**
Terminals	**IP20**
Mechanical data	
Housing material	
Housing	**PC**
Front	**PC**
Cross section of external conductors with screw terminals	
1 core flexible	**0.25 - 2.50 mm² , 24 - 12 AWG** No. 750105, 750135
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	**0.25 - 1.00 mm² , 24 - 16 AWG** No. 750105, 750135
without crimp connectors or with TWIN crimp connectors	**0.20 - 1.50 mm² , 24 - 16 AWG** No. 750105, 750135
Torque setting with screw terminals	**0.50 Nm** No. 750105, 750135
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	**0.20 - 2.50 mm² , 24 - 12 AWG** No. 751105, 751135, 751185
Spring-loaded terminals: Terminal points per connection	**2** No. 751105, 751135, 751185
Stripping length	**9 mm** No. 751105, 751135, 751185
Dimensions	
Height	**100.0 mm** No. 751105, 751135, 751185 **98.0 mm** No. 750105, 750135
Width	**22.5 mm**
Depth	**120.0 mm**
Weight	**235 g** No. 750105, 751105, 751185 **260 g** No. 750135, 751135

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 **2009-12** 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** No. 750135, 751135
2	**6.00 A**	**6.00 A** No. 750135, 751135
3	**6.00 A**	**6.00 A** No. 750135, 751135
4	**6.00 A**	**6.00 A** No. 750135, 751135

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Order reference

Type	Features		Terminals	Order no.
PNOZ s5		24 VDC	With screw terminals	750 105
PNOZ s5 C		24 VDC	With spring-loaded terminals	751 105
PNOZ s5 C (coated version)		24 VDC	With spring-loaded terminals	751 185
PNOZ s5	48 – 240 VAC	48 – 240 VDC	With screw terminals	750 135
PNOZ s5 C	48 – 240 VAC	48 – 240 VDC	With spring-loaded terminals	751 135