



PNOZ s4

Safety relays

pilz

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SD means Secure Digital

PNOZ s4 safety relay

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

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

and as a safety component for lifts in accordance with Annex IV of the directive 95/16/EC and EN 81-1.

For your safety

- ▶ Only install and commission the unit if you have read and understood these operating instructions and are familiar with the applicable regulations for health and safety at work and accident prevention.
Ensure VDE and local regulations are met, especially those relating to safety.
- ▶ Any guarantee is rendered invalid if the housing is opened or unauthorised modifications are carried out.

Unit features

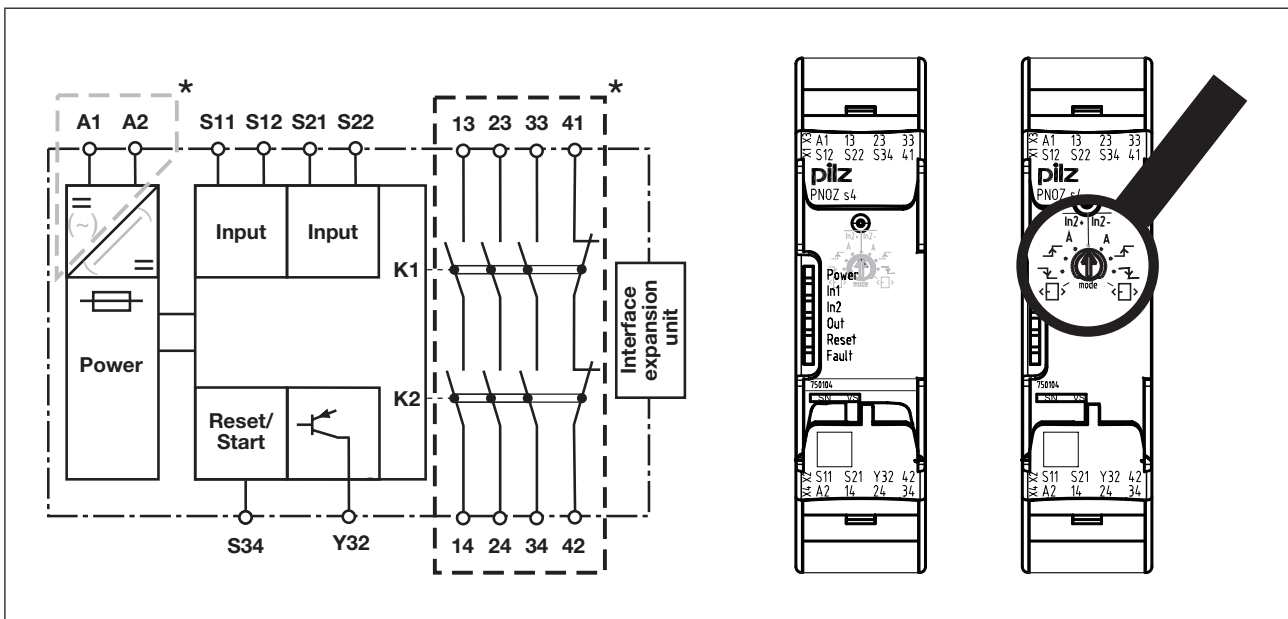
- ▶ Positive-guided relay outputs:
 - 3 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ 1 semiconductor output
- ▶ Connection options for:
 - E-STOP pushbutton
 - Safety gate limit switch
 - Start button
 - Light beam device
 - PSEN
- ▶ A connector can be used to connect 1 PNOZsigma contact expansion module
- ▶ Operating modes can be set via rotary switch
- ▶ LED indicator for:
 - Supply voltage
 - Input status, channel 1
 - Input status, channel 2
 - Switch status of the safety contacts
 - Start circuit
 - Errors
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

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/terminal configuration



Rotary cam arrangement monitoring Front view with cover, right: Front view without cover

Grey highlighted area: Applies only with $U_B = 48 - 240 \text{ V AC/DC}$

*Insulation between the non-marked area and the relay contacts: Basic insulation (overvoltage category III), safe separation (overvoltage category II)

Function description

- ▶ $\overline{\text{In2}}$ Single-channel operation: no redundancy in the input circuit, earth faults in the start circuit and input circuit are detected.
- ▶ Dual-channel operation without detection of shorts across contacts: redundant input circuit, detects
 - earth faults in the start and input circuit,
 - short circuits in the input circuit and, with a monitored start, in the start circuit too.
- ▶ $\overline{\text{In2}}$ Dual-channel operation with detection of shorts across contacts: redundant input circuit, detects
 - earth faults in the start and input circuit,
 - short circuits in the input circuit and, with a monitored start, in the start circuit too,
 - shorts between contacts in the input circuit.

- ▶ **A** Automatic start: Unit is active once the input circuit has been closed.
- ▶ Manual start: Unit is active once the input circuit is closed and then the start circuit is closed.
- ▶  Monitored start with falling edge: Unit is active once
 - the input circuit is closed and then the start circuit is closed and opened again.
 - the start circuit is closed and then opened again once the input circuit is closed.
- ▶  Monitored start with rising edge: Unit is active once the input circuit is closed and once the start circuit is closed after the waiting period has elapsed (see technical details).
- ▶  Start with start-up test: The unit checks whether safety gates that are closed are opened and then closed again when supply voltage is applied.
- ▶ Increase in the number of available instantaneous safety contacts by connecting contact expander modules or external contactors/relays;
A connector can be used to connect 1 PNOZsigma contact expander module.

Installation

Install base unit without contact expansion module:

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

Connect base unit and PNOZsigma contact expansion module:

- ▶ Remove the plug terminator at the side of the base unit and at the contact expansion module.
- ▶ Connect the base unit and the contact expansion 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 bracket or end angle).
- ▶ Push the device upwards or downwards before lifting it from the DIN rail.

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).
- ▶ Auxiliary contact 41-42 and 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).

- ▶ Calculation of the max. cable length $l_{\max}$ in the input circuit:

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

$R_{l\max}$ = 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
- ▶ When connecting magnetically operated, reed proximity switches, ensure that the max. peak inrush current (on the input circuit) does not overload the proximity switch.

Preparing for operation

Operating modes

The operating mode is set via the rotary switch on the unit. You can do this by opening the cover on the front of the unit.



CAUTION!

Do not adjust the rotary switch during operation, otherwise an error message will appear, the safety contacts will open and the unit will not be ready for operation until the supply voltage has been switched off and then on again.

Set operating modes

- ▶ Switch off supply voltage.
- ▶ Select operating mode via the operating mode selector switch "mode".
- ▶ If the operating mode selector switch "mode" is in its start position (vertical position), an error message will appear.

Operating mode selector switch "mode"	Automatic/manual start	Monitored start rising edge	Monitored start falling edge	Automatic start with start-up test
Without detection of shorts across contacts				
With detection of shorts across contacts				

Connection

► 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 $U_B = 24\text{ VDC}$)		

**CAUTION!**

When used as a safety component in accordance with EN 81-1:

- The switch that is used must be designed as a safety switch in accordance with 14.1.2.2 of EN 81-1, so that a failure to open when energised is excluded.
- The supply lines to the safety switch must be laid in accordance with 13.5 of EN 81-1 so that short circuits that would bridge the contacts in the switch can be excluded.

► Reset circuit/feedback loop

Reset circuit/feedback loop	Reset circuit	Feedback loop
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	

Legend

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

Operation

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

LEDs indicate the status and errors during operation:



LED on



LED flashes



Information

Status indicators and error indicators may occur independently. In the case of an error display, the "Fault" LED will light or flash (exception: "Supply voltage too low"). An LED that is also flashing indicates the potential cause of the error. An LED that is lit and is static indicates a normal operating status. Several status indicators and error indicators may occur simultaneously.

Status indicators



Power

Supply voltage is present.



In1

Input circuit at S12 is closed.



In2

Input circuit at S22 is closed.



Out

Safety contacts are closed and semiconductor output Y32 carries a high signal.



Reset

24 V DC is present at S34.

Error indicators

All LEDs off

Diagnostics: Short across contacts/earth fault; unit switched off

- ▶ Remedy: Rectify short across contacts/earth fault, switch off supply voltage for 1 min.



Fault

Diagnostics: Plug terminator not connected

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

**Fault**

Diagnostics: Internal error, unit defective

- ▶ Remedy: Switch supply voltage off and then on again, change unit if necessary.

**Power**

Diagnostics: Supply voltage too low

- ▶ Remedy: Check the supply voltage.

**In1, In2 alternately****Fault**

Diagnostics: Short detected between S12 and S22

- ▶ Remedy: Rectify short across contacts, switch supply voltage off and then on again.

**In1****Fault**

Diagnostics: Power-up blocked due to short-term interruption at S12; input circuits not operated simultaneously

- ▶ Remedy: Open both input circuits, S12 and S22, simultaneously and then close again.

**In2****Fault**

Diagnostics: Power-up blocked due to short-term interruption at S22; input circuits not operated simultaneously

- ▶ Remedy: Open both input circuits, S12 and S22, simultaneously and then close again.

**Reset****Fault**

Diagnostics: Position of rotary switch is not permitted or rotary switch was adjusted during operation.

- ▶ Remedy: Switch supply voltage off and then on again.



Power, In1, In2, Out, Reset, Fault

Diagnostics: The operating mode selector switch "mode" is in its start position (vertical position)

- ▶ Remedy: Switch off the supply voltage and set the required operating mode on operating mode selector switch "mode".

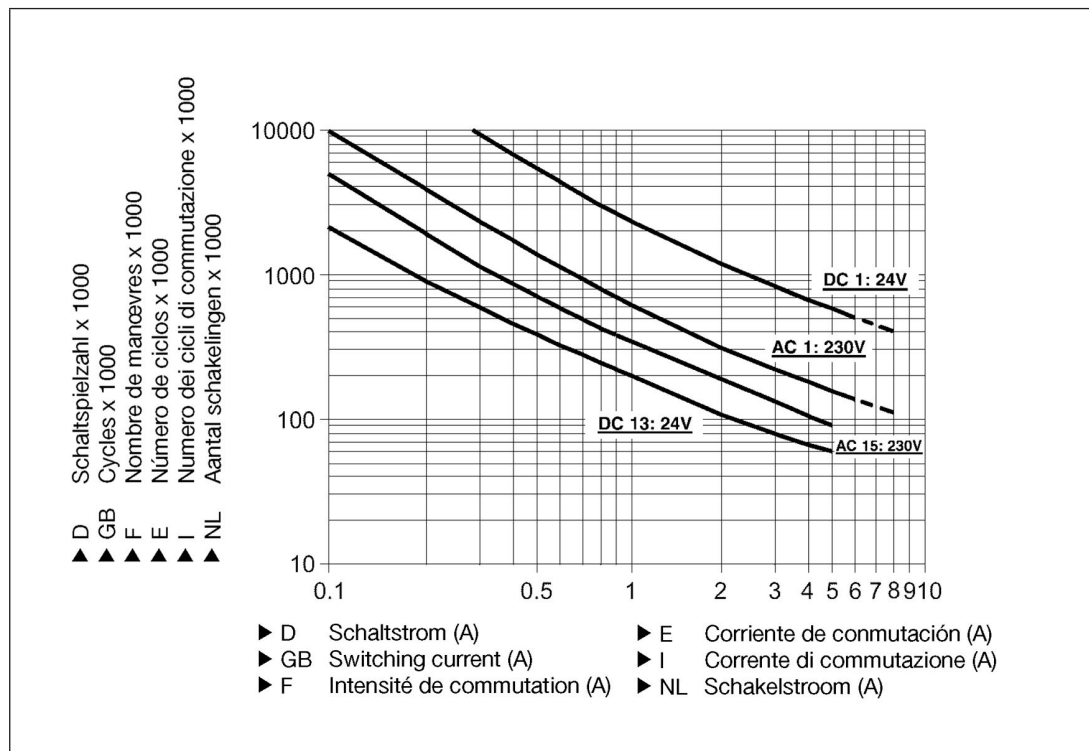
Faults - malfunctions

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

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 VDC



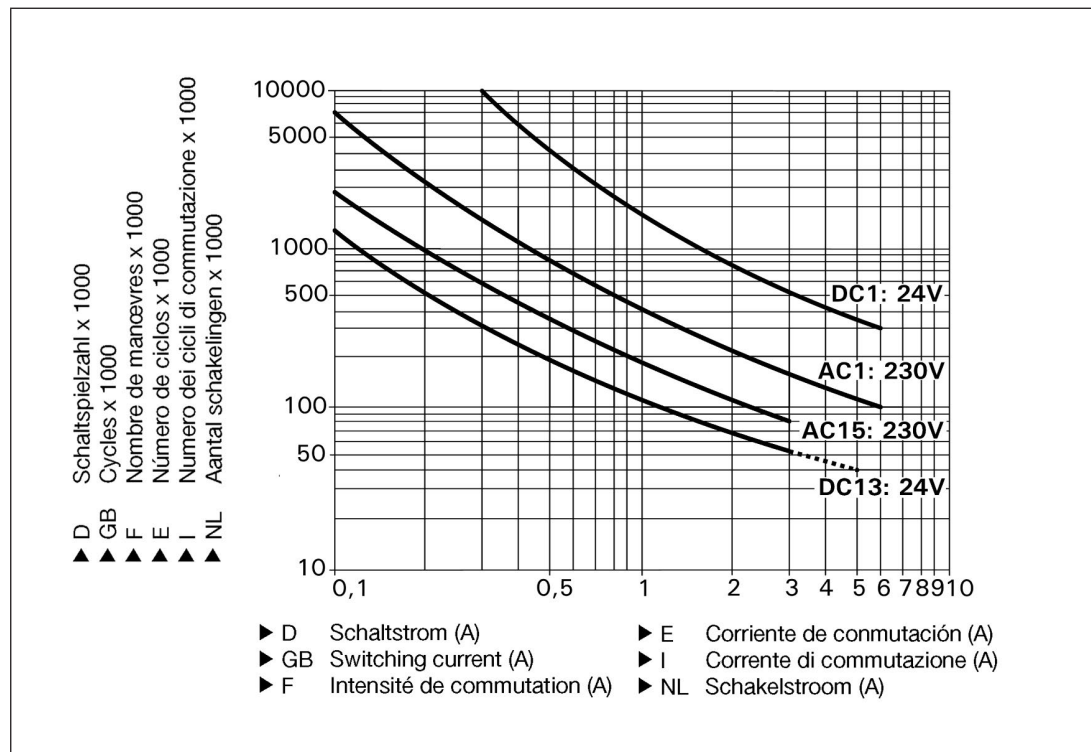
Example

- ▶ 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.

U_B 48-240 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

General	750104	750134	751104	751134
Approvals	CCC, CE, GOST, KOSHA, TÜV, cULus Listed	CCC, CE, GOST, KOSHA, TÜV, cULus Listed	CCC, CE, GOST, KOSHA, TÜV, cULus Listed	CCC, CE, GOST, KOSHA, TÜV, cULus Listed
Electrical data	750104	750134	751104	751134
Supply voltage				
Voltage	24 V	48 - 240 V	24 V	48 - 240 V
Type	DC	AC/DC	DC	AC/DC
Voltage tolerance	-15 %/+10 %	-15 %/+10 %	-15 %/+10 %	-15 %/+10 %
Output of external power supply (AC)	–	5,0 VA	–	5,0 VA
Output of external power supply (DC)	2,5 W	2,5 W	2,5 W	2,5 W
Frequency range AC	–	50 - 60 Hz	–	50 - 60 Hz
Residual ripple DC	20 %	160 %	20 %	160 %
Continuous duty	100 %	100 %	100 %	100 %
Max. inrush current impulse				
A1	0,50 A	–	0,50 A	–
Pulse duration	5,0000 ms	–	5,0000 ms	–
Reset circuit	0,20 A	0,20 A	0,20 A	0,20 A
Feedback loop	0,20 A	0,20 A	0,20 A	0,20 A
Max. overall cable resistance R _{lmax}				
Single-channel at UB DC	30 Ohm	30 Ohm	30 Ohm	30 Ohm
Single-channel at UB AC	–	30 Ohm	–	30 Ohm
Dual-channel without detection of shorts across contacts at UB DC	60 Ohm	30 Ohm	60 Ohm	30 Ohm
Dual-channel without detection of shorts across contacts at UB AC	–	30 Ohm	–	30 Ohm
Dual-channel with detection of shorts across contacts at UB DC	30 Ohm	30 Ohm	30 Ohm	30 Ohm

Electrical data	750104	750134	751104	751134
Dual-channel with – detection of shorts across contacts at UB AC		30 Ohm	–	30 Ohm
Min. input resistance at power-on	110 Ohm	110 Ohm	110 Ohm	110 Ohm
Voltage at				
Input circuit DC	24,0 V	24,0 V	24,0 V	24,0 V
Reset circuit DC	24,0 V	24,0 V	24,0 V	24,0 V
Feedback loop DC	24,0 V	24,0 V	24,0 V	24,0 V
Current at				
Input circuit DC	50,0 mA	50,0 mA	50,0 mA	50,0 mA
Reset circuit DC	50,0 mA	50,0 mA	50,0 mA	50,0 mA
Feedback loop	50,0 mA	50,0 mA	50,0 mA	50,0 mA
Number of output contacts				
Instantaneous safety contacts (N/O)	3	3	3	3
Auxiliary contacts (N/C)	1	1	1	1
Inputs	750104	750134	751104	751134
Number	2	2	2	2
Semiconductor outputs	750104	750134	751104	751134
Number	1	1	1	1
Voltage	24,0 V	24,0 V	24,0 V	24,0 V
Current	20 mA	20 mA	20 mA	20 mA
Relay outputs	750104	750134	751104	751134
Max. short circuit current I _K	1 kA	1 kA	1 kA	1 kA
Utilisation category				
In accordance with the standard	EN 60947-4-1	EN 60947-4-1	EN 60947-4-1	EN 60947-4-1
Auxiliary contacts, AC1 at	240 V	240 V	240 V	240 V
Min. current	0,01 A	0,01 A	0,01 A	0,01 A
Max. current	6,0 A	6,0 A	6,0 A	6,0 A
Max. power	1500 VA	1500 VA	1500 VA	1500 VA
Auxiliary contacts, DC1 at	24 V	24 V	24 V	24 V
Min. current	0,01 A	0,01 A	0,01 A	0,01 A
Max. current	6,0 A	6,0 A	6,0 A	6,0 A
Max. power	150 W	150 W	150 W	150 W
Safety contacts, AC1 at	240 V	240 V	240 V	240 V
Max. current	6,0 A	6,0 A	6,0 A	6,0 A

Relay outputs	750104	750134	751104	751134
Min. current	0,01 A	0,01 A	0,01 A	0,01 A
Max. power	1500 VA	1500 VA	1500 VA	1500 VA
Safety contacts, DC1 at	24 V	24 V	24 V	24 V
Max. current	6,0 A	6,0 A	6,0 A	6,0 A
Min. current	0,01 A	0,01 A	0,01 A	0,01 A
Max. power	150 W	150 W	150 W	150 W
Utilisation category				
In accordance with the standard	EN 60947-5-1	EN 60947-5-1	EN 60947-5-1	EN 60947-5-1
Auxiliary contacts, AC15 at	230 V	230 V	230 V	230 V
Max. current	5,0 A	3,0 A	5,0 A	3,0 A
Auxiliary contacts, DC13 (6 cycles/min) at	24 V	24 V	24 V	24 V
Max. current	5,0 A	4,0 A	5,0 A	4,0 A
Safety contacts, AC15 at	230 V	230 V	230 V	230 V
Max. current	5,0 A	3,0 A	5,0 A	3,0 A
Safety contacts, DC13 (6 cycles/min) at	24 V	24 V	24 V	24 V
Max. current	5,0 A	4,0 A	5,0 A	4,0 A
Contact fuse protection, external safety contacts				
In accordance with the standard	EN 60947-5-1	EN 60947-5-1	EN 60947-5-1	EN 60947-5-1
Blow-out fuse, quick	10 A	6 A	10 A	6 A
Blow-out fuse, slow	6 A	4 A	6 A	4 A
Circuit breaker, 24V AC/DC, characteristic B/C	6 A	4 A	6 A	4 A
Contact fuse protection, external auxiliary contacts				
Blow-out fuse, quick	10 A	6 A	10 A	6 A
Blow-out fuse, slow	6 A	4 A	6 A	4 A
Circuit breaker, 24 V AC/DC, characteristic B/C	6 A	4 A	6 A	4 A
Contact material	AgCuNi + 0,2 µm Au	AgCuNi + 0,2 µm Au	AgCuNi + 0,2 µm Au	AgCuNi + 0,2 µm Au

Conventional thermal current while loading several contacts	750104	750134	751104	751134
Ith per contact at UB AC				
Conv. therm. current with 1 contact	—	6,00 A	—	6,00 A
Conv. therm. current with 2 contacts	—	6,00 A	—	6,00 A
Conv. therm. current with 3 contacts	—	4,50 A	—	4,50 A
Ith per contact at UB DC				
Conv. therm. current with 1 contact	6,00 A	6,00 A	6,00 A	6,00 A
Conv. therm. current with 2 contacts	6,00 A	6,00 A	6,00 A	6,00 A
Conv. therm. current with 3 contacts	5,00 A	4,50 A	5,00 A	4,50 A
Times	750104	750134	751104	751134
Switch-on delay				
With automatic reset typ.	170 ms	170 ms	170 ms	170 ms
With automatic reset max.	300 ms	300 ms	300 ms	300 ms
With automatic reset after power on typ.	350 ms	350 ms	350 ms	350 ms
With automatic reset after power on max.	600 ms	600 ms	600 ms	600 ms
With manual reset typ.	40 ms	40 ms	40 ms	40 ms
With monitored reset with rising edge typ.	35 ms	35 ms	35 ms	35 ms
With monitored reset with rising edge max.	50 ms	50 ms	50 ms	50 ms
With monitored reset with falling edge typ.	55 ms	55 ms	55 ms	55 ms
With monitored reset with falling edge max.	70 ms	70 ms	70 ms	70 ms

Times	750104	750134	751104	751134
Delay-on de-energisation				
With E-STOP typ.	10 ms	10 ms	10 ms	10 ms
With E-STOP max.	20 ms	20 ms	20 ms	20 ms
With power failure typ.	40 ms	40 ms	40 ms	40 ms
With power failure max.	80 ms	80 ms	80 ms	80 ms
Recovery time at max. switching frequency 1/s				
After E-STOP	100 ms	50 ms	100 ms	50 ms
After power failure	100 ms	100 ms	100 ms	100 ms
Waiting period with a monitored reset				
With rising edge	120 ms	120 ms	120 ms	120 ms
With falling edge	250 ms	150 ms	250 ms	150 ms
Min. start pulse duration with a monitored reset				
With rising edge	30 ms	30 ms	30 ms	30 ms
With falling edge	100 ms	100 ms	100 ms	100 ms
Supply interruption before de-energisation	20 ms	20 ms	20 ms	20 ms
Simultaneity, channel 1 and 2	∞	∞	∞	∞
Environmental data	750104	750134	751104	751134
Climatic suitability	EN 60068-2-78	EN 60068-2-78	EN 60068-2-78	EN 60068-2-78
Ambient temperature				
Temperature range	-10 - 55 °C	-10 - 55 °C	-10 - 55 °C	-10 - 55 °C
Storage temperature				
Temperature range	-40 - 85 °C	-40 - 85 °C	-40 - 85 °C	-40 - 85 °C
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
Vibration				
In accordance with the standard	EN 60068-2-6	EN 60068-2-6	EN 60068-2-6	EN 60068-2-6
Frequency	10,0 - 55,0 Hz	10,0 - 55,0 Hz	10,0 - 55,0 Hz	10,0 - 55,0 Hz
Max. amplitude	0,35 mm	0,35 mm	0,35 mm	0,35 mm

Environmental data 750104		750134	751104	751134
Airgap creepage				
In accordance with the standard	EN 60947-1	EN 60947-1	EN 60947-1	EN 60947-1
Overvoltage category	III / II	III / II	III / II	III / II
Pollution degree	2	2	2	2
Rated insulation voltage	250 V	250 V	250 V	250 V
Rated impulse withstand voltage	4,00 kV	4,00 kV	4,00 kV	4,00 kV
Protection type				
Mounting (e.g. cabinet)	IP54	IP54	IP54	IP54
Housing	IP40	IP40	IP40	IP40
Terminals	IP20	IP20	IP20	IP20
Mechanical data 750104		750134	751104	751134
Mounting position	Any	Any	Any	Any
Mechanical life	10,000,000 cycles	10,000,000 cycles	10,000,000 cycles	10,000,000 cycles
Material				
Bottom	PC	PC	PC	PC
Front	PC	PC	PC	PC
Top	PC	PC	PC	PC
Cross section of external conductors with screw terminals				
1 core flexible	0,25 - 2,50 mm², 24 - 12 AWG	0,25 - 2,50 mm², 24 - 12 AWG	–	–
2 core with the same cross section, flexible with crimp connectors, no plastic sleeve	0,25 - 1,00 mm², 24 - 16 AWG	0,25 - 1,00 mm², 24 - 16 AWG	–	–
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,20 - 1,50 mm², 24 - 16 AWG	0,20 - 1,50 mm², 24 - 16 AWG	–	–
Torque setting with screw terminals	0,50 Nm	0,50 Nm	–	–
Connection type	Screw terminal	Screw terminal	Spring-loaded terminal	Spring-loaded terminal
Mounting type	plug in	plug in	plug in	plug in
Cross section of external conductors with spring-loaded terminals: flexible with/without crimp connector	–	–	0,20 - 2,50 mm², 24 - 12 AWG	0,20 - 2,50 mm², 24 - 12 AWG

Mechanical data	750104	750134	751104	751134
Spring-loaded terminals: Terminal points per connection	–	–	2	2
Stripping length	–	–	9 mm	9 mm
Dimensions				
Height	98,0 mm	98,0 mm	100,0 mm	100,0 mm
Width	22,5 mm	22,5 mm	22,5 mm	22,5 mm
Depth	120,0 mm	120,0 mm	120,0 mm	120,0 mm
Weight	190 g	210 g	190 g	210 g

The standards current on 2009-12 apply.

Safety characteristic data

Operating mode	EN ISO 13849-1: 2006 PL	EN ISO 13849-1: 2006 Category	EN IEC 62061 SIL CL	EN IEC 62061 PFH _D [1/h]	IEC 61511 SIL	IEC 61511 PFD	EN ISO 13849-1: 2006 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.



ATTENTION!

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.

Order reference

Order reference					
Product type	Features			Terminals	Order no.
PNOZ s4		24 VDC		Screw terminals	750 104
PNOZ s4 C		24 VDC		Spring-loaded terminals	751 104
PNOZ s4	48 – 240 VAC/DC			Screw terminals	750 134
PNOZ s4 C	48 – 240 VAC/DC			Spring-loaded terminals	751 134

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.

Representative: Norbert Fröhlich, Pilz GmbH & Co. KG, Felix-Wankel-Str. 2, 73760 Ostfildern, Germany



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