



PNOZ s4.1

Safety relays

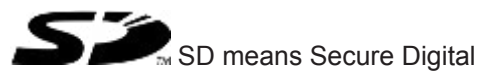


pilz

This document is the original document.

All rights to this documentation are reserved by Pilz GmbH & Co. KG. Copies may be made for internal purposes. Suggestions and comments for improving this documentation will be gratefully received.

Pilz®, PIT®, PMI®, PNOZ®, Primo®, PSEN®, PSS®, PVIS®, SafetyBUS p®, SafetyEYE®, SafetyNET p®, the spirit of safety® are registered and protected trademarks of Pilz GmbH & Co. KG in some countries.



Safety relay PNOZ s4.1

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

It is suitable for use in furnaces in accordance with EN 50156-1.

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

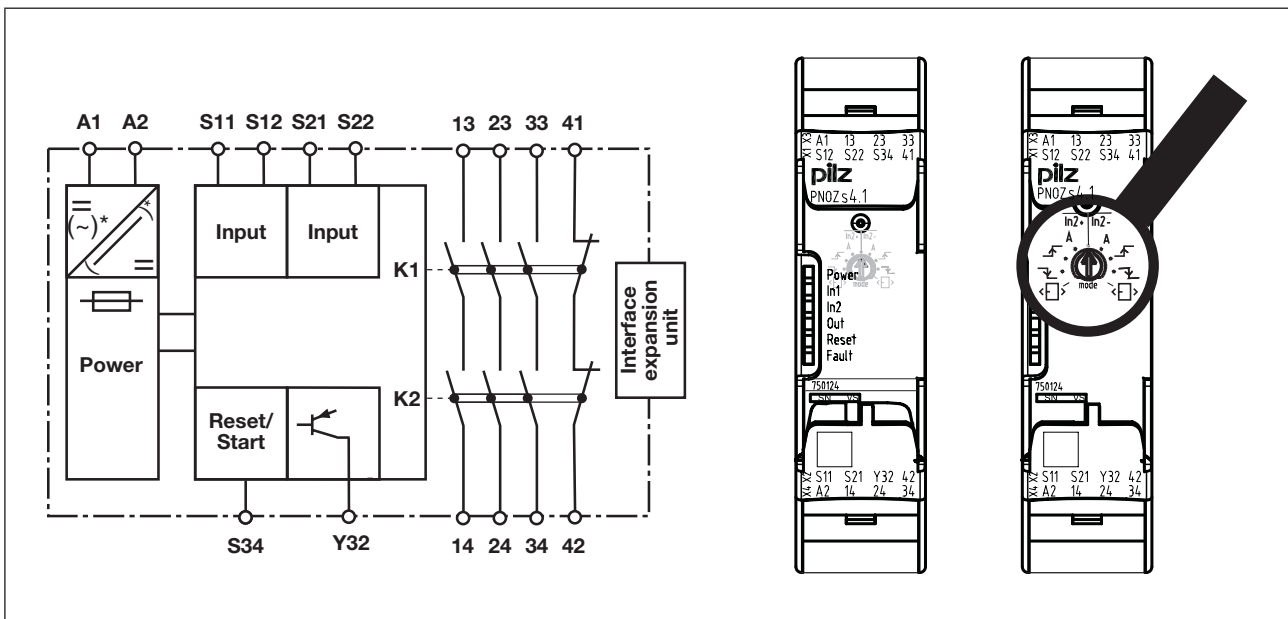
- ▶ Positive-guided relay outputs:
 - 3 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ 1 semiconductor output
- ▶ Connection options for:
 - E-STOP pushbuttons
 - Safety gate limit switches
 - Reset buttons
 - Light beam devices
 - PSEN
 - Safety valves for furnaces
- ▶ 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






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

*only when $U_B = 48 - 240 \text{ V AC/DC}$

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:

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

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

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 UB = 24 VDC)		

▶ 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	



Information

If a base unit and a contact expansion module from the PNOZsigma range are connected via the connector, no additional wiring is necessary.

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)

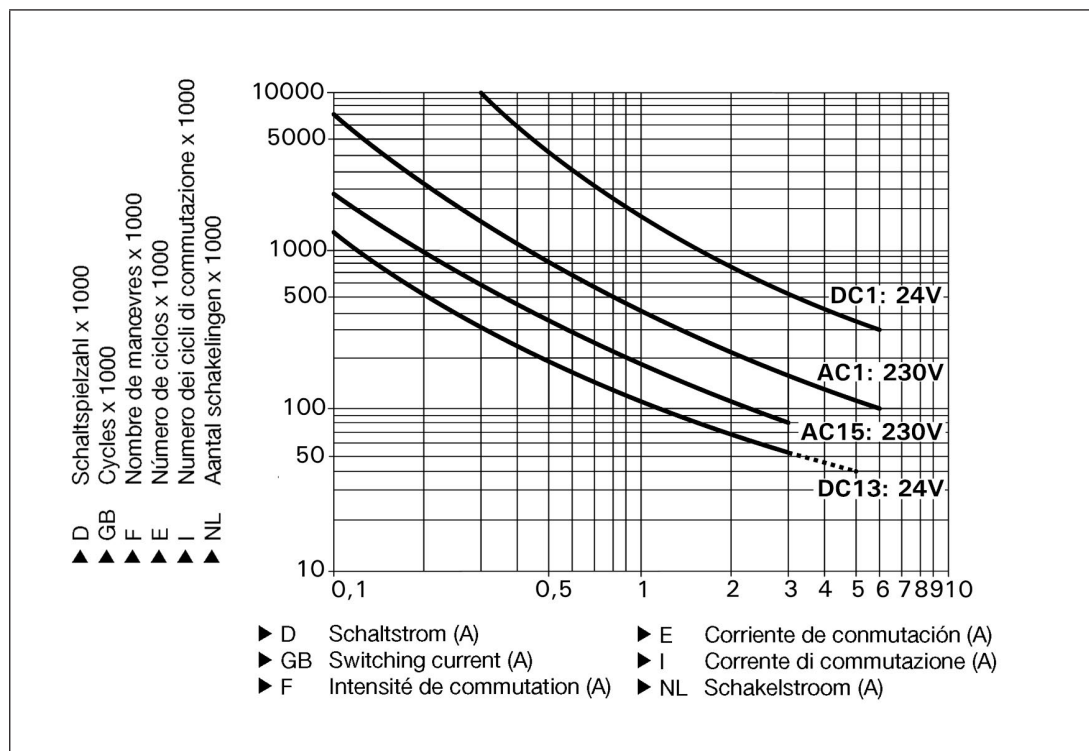
- ▶ Remedy: Switch off the supply voltage and set the required operating mode on operating mode selector switch "mode".

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.



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	750124	750154	751124	751154
Approvals	CCC, CE, GOST, TÜV, cULus Listed	CCC, CE, GOST, TÜV, cULus Listed	CCC, CE, GOST, TÜV, cULus Listed	CCC, CE, GOST, TÜV, cULus Listed
Electrical data	750124	750154	751124	751154
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				
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	60 Ohm	60 Ohm	60 Ohm
Dual-channel without detection of shorts across contacts at UB AC	–	60 Ohm	–	60 Ohm
Dual-channel with detection of shorts across contacts at UB DC	30 Ohm	30 Ohm	30 Ohm	30 Ohm
Dual-channel with detection of shorts across contacts at UB AC	–	30 Ohm	–	30 Ohm

Electrical data	750124	750154	751124	751154
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				
Number	2	2	2	2
Semiconductor outputs				
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				
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	1,5 A	1,5 A	1,5 A	1,5 A
Max. power	375 VA	375 VA	375 VA	375 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	1,5 A	1,5 A	1,5 A	1,5 A
Min. current	0,01 A	0,01 A	0,01 A	0,01 A
Max. power	375 VA	375 VA	375 VA	375 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

Relay outputs	750124	750154	751124	751154
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	0,6 A	0,6 A	0,6 A	0,6 A
Auxiliary contacts, DC13 (6 cycles/min) at	24 V	24 V	24 V	24 V
Max. current	0,4 A	0,4 A	0,4 A	0,4 A
Safety contacts, AC15 at	230 V	230 V	230 V	230 V
Max. current	0,6 A	0,6 A	0,6 A	0,6 A
Safety contacts, DC13 (6 cycles/min) at	24 V	24 V	24 V	24 V
Max. current	0,4 A	0,4 A	0,4 A	0,4 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	6 A	6 A	6 A	6 A
Blow-out fuse, slow	4 A	4 A	4 A	4 A
Circuit breaker, 24V AC/DC, characteristic B/C	4 A	4 A	4 A	4 A
Contact fuse protection, external auxiliary contacts				
Blow-out fuse, quick	6 A	6 A	6 A	6 A
Blow-out fuse, slow	4 A	4 A	4 A	4 A
Circuit breaker, 24 V AC/DC, characteristic B/C	4 A	4 A	4 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	750124	750154	751124	751154
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	4,50 A	4,50 A	4,50 A	4,50 A
Times	750124	750154	751124	751154
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 manual reset max.	300 ms	300 ms	300 ms	300 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	750124	750154	751124	751154
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	50 ms	50 ms	50 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				
Climatic suitability	EN 60068-2-78	EN 60068-2-78	EN 60068-2-78	EN 60068-2-78
Ambient temperature				
Temperature range	-10 - 60 °C	-10 - 60 °C	-10 - 60 °C	-10 - 60 °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 - 150,0 Hz	10,0 - 150,0 Hz	10,0 - 150,0 Hz	10,0 - 150,0 Hz
Max. amplitude	0,35 mm	0,35 mm	0,35 mm	0,35 mm

Environmental data	750124	750154	751124	751154
Airgap creepage				
In accordance with the standard	EN 60947-1	EN 60947-1	EN 60947-1	EN 60947-1
Overvoltage category	III	III	III	III
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	750124	750154	751124	751154
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	750124	750154	751124	751154
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	EN ISO 13849-1: 2006	EN IEC 62061	EN IEC 62061	IEC 61511	IEC 61511	EN ISO 13849-1: 2006
	PL	Category	SIL CL	PFH _D [1/h]	SIL	PFD	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 s4.1		24 VDC		Screw terminals	750 124
PNOZ s4.1 C		24 VDC		Spring-loaded terminals	751 124
PNOZ s4.1	48 - 240 VAC/DC			Screw terminals	750 154
PNOZ s4.1 C	48 - 240 VAC/DC			Spring-loaded terminals	751 154

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



► ...
In many countries we are represented by our subsidiaries and sales partners.

Please refer to our homepage for further details or contact our headquarters.

► Technical support

+49 711 3409-444
support@pilz.com

pilz