PNOZ s3

Safety relays

Operating Manual-21395-EN-10

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SD means Secure Digital

PNOZ s3 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

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

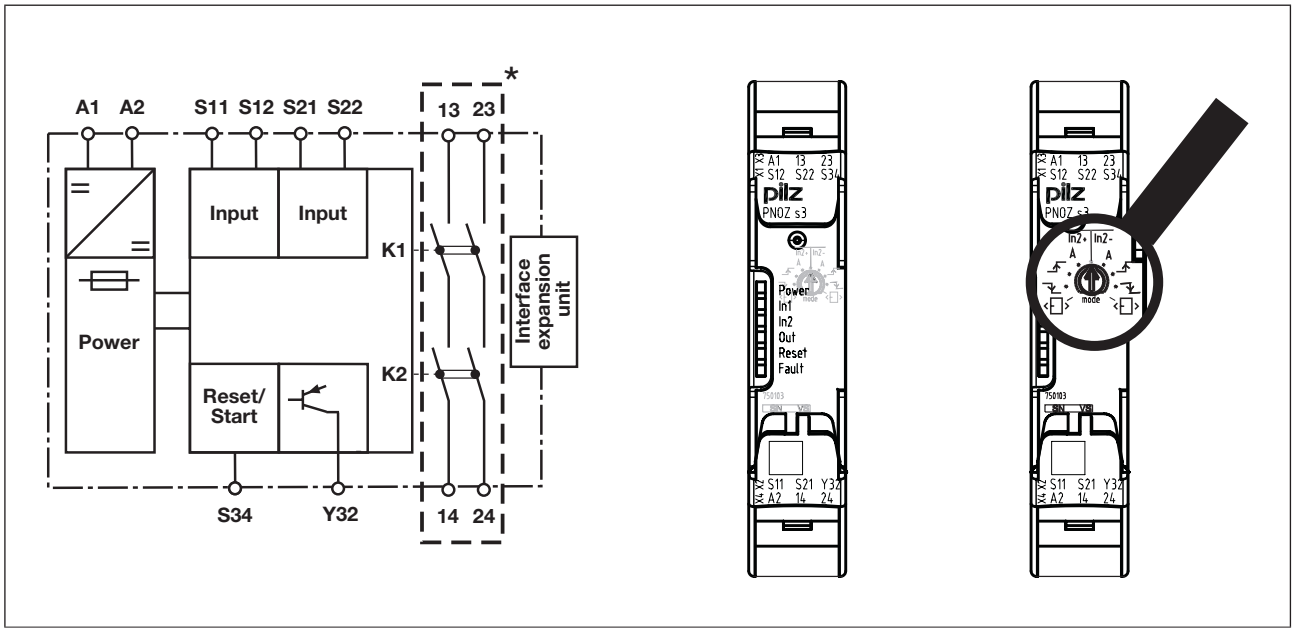
- Positive-guided relay outputs:
  - 2 safety contacts (N/O), instantaneous
- 1 semiconductor output
- Connection options for:
  - E-STOP pushbutton
  - Safety gate limit switch
  - Start button
  - Light beam device
  - PSEN
- A connector can be used to connect 1 PNOZsigma contact expansion module
- Operating modes can be set via rotary switch
- LED indicator for:
  - Supply voltage
  - Input status, channel 1
  - Input status, channel 2
  - Switch status channel 1/2
  - Start circuit
  - Error
- 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

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

Function description

- 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.
- 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.
- The outputs 13-14, 23-24 are safety contacts.
- 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 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.
- 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.

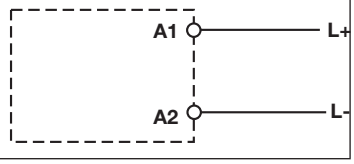
Set operating modes

- 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.

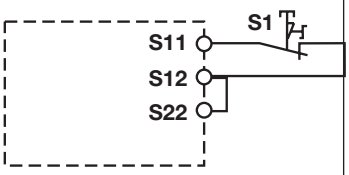
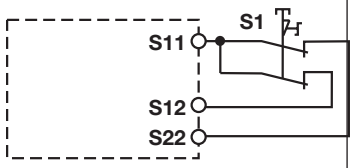
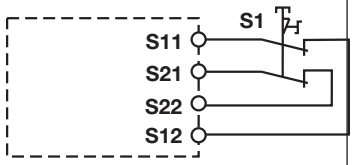
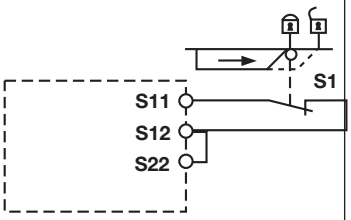
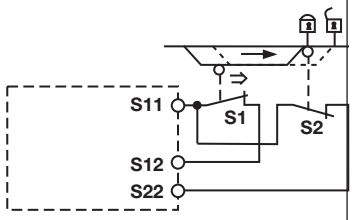
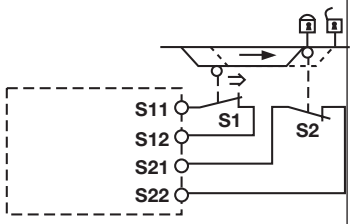
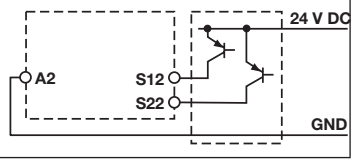
Operating mode selector switch "mode"	Automatic/manual start	Monitored start rising edge	Monitored start falling edge	Automatic start with start-up test
Without detection of shorts across contacts				
With detection of shorts across contacts				

Connection

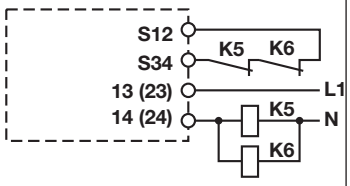
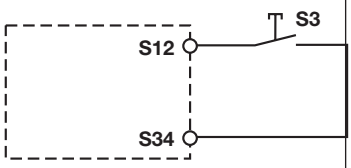
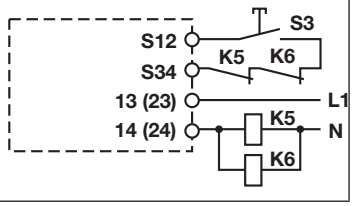
- Supply voltage

Supply voltage	AC	DC
		

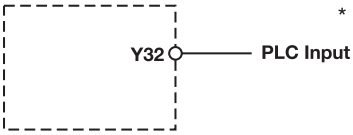
- Input circuit

Input circuit	Single-channel	Dual-channel
Emergency stop **without** detection of shorts across contacts		
Emergency 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		

- Start circuit/feedback loop

Start circuit/feedback loop	Start circuit	Feedback loop
Automatic start		
Manual/monitored start		

- Semiconductor output



*Connect together the 0V connections on all the external power supplies

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)

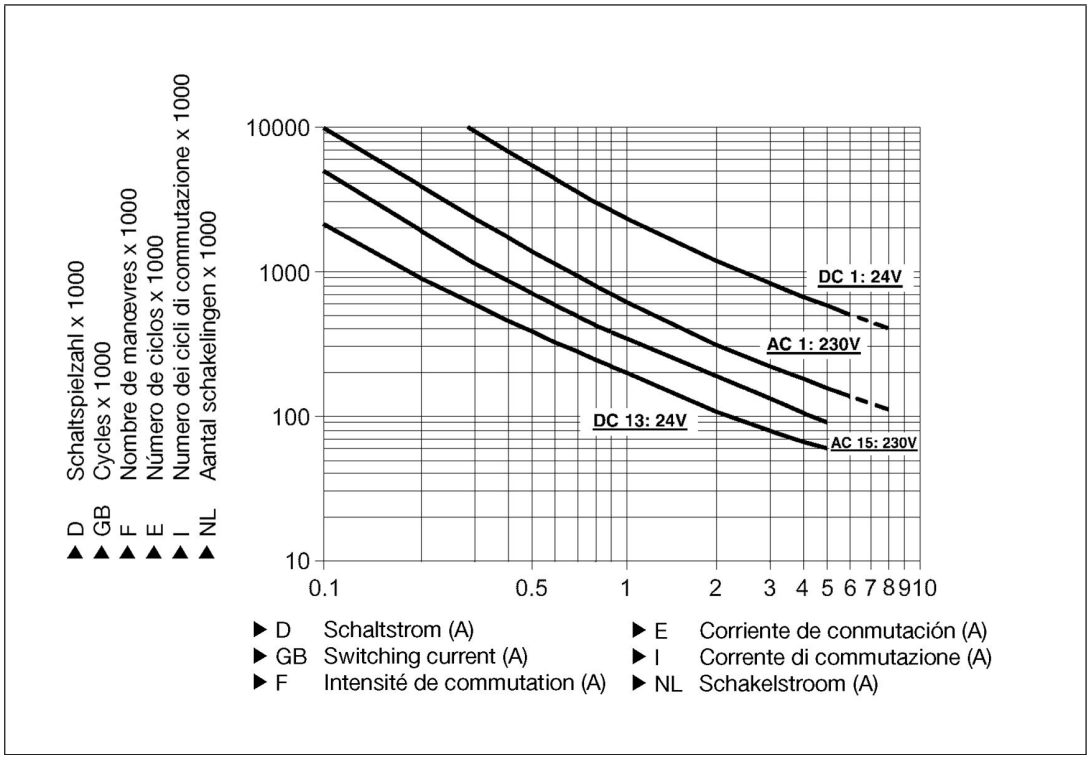
- Remedy: Switch off the supply voltage and set the required operating mode on operating mode selector switch "mode".

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: 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.

Technical Details

General	750103	751103
Approvals	**CCC, CE, GOST, KOSHA, TÜV, cULus Listed**	**CCC, CE, GOST, KOSHA, TÜV, cULus Listed**
Electrical data	**750103**	**751103**
Supply voltage		
Voltage	**24 V**	**24 V**
Type	**DC**	**DC**
Voltage tolerance	**-15 %/+10 %**	**-15 %/+10 %**
Output of external power supply (DC)	**2,5 W**	**2,5 W**
Residual ripple DC	**20 %**	**20 %**
Continuous duty	**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**
Feedback loop	**0,20 A**	**0,20 A**
Max. overall cable resistance Rl-max		
Single-channel at UB DC	**30 Ohm**	**30 Ohm**
Dual-channel without detection of shorts across contacts at UB DC	**60 Ohm**	**60 Ohm**
Dual-channel with detection of shorts across contacts at UB DC	**30 Ohm**	**30 Ohm**
Min. input resistance at power-on	**110 Ohm**	**110 Ohm**
Voltage at		
Input circuit DC	**24,0 V**	**24,0 V**
Reset circuit DC	**24,0 V**	**24,0 V**
Feedback loop DC	**24,0 V**	**24,0 V**
Current at		
Input circuit DC	**50,0 mA**	**50,0 mA**
Reset circuit DC	**50,0 mA**	**50,0 mA**
Feedback loop	**50,0 mA**	**50,0 mA**
Number of output contacts		
Instantaneous safety contacts (N/O)	**2**	**2**
Inputs	**750103**	**751103**
Number	**2**	**2**
Semiconductor outputs	**750103**	**751103**
Number	**1**	**1**
Voltage	**24,0 V**	**24,0 V**
Current	**20 mA**	**20 mA**

Relay outputs	750103	751103
Max. short circuit current IK	**1 kA**	**1 kA**
Utilisation category		
In accordance with the standard	**EN 60947-4-1**	**EN 60947-4-1**
Safety contacts, AC1 at	**240 V**	**240 V**
Max. current	**6,0 A**	**6,0 A**
Min. current	**0,01 A**	**0,01 A**
Max. power	**1500 VA**	**1500 VA**
Safety contacts, DC1 at	**24 V**	**24 V**
Max. current	**6,0 A**	**6,0 A**
Min. current	**0,01 A**	**0,01 A**
Max. power	**150 W**	**150 W**
Utilisation category		
In accordance with the standard	**EN 60947-5-1**	**EN 60947-5-1**
Safety contacts, AC15 at	**230 V**	**230 V**
Max. current	**5,0 A**	**5,0 A**
Safety contacts, DC13 (6 cycles/min) at	**24 V**	**24 V**
Max. current	**5,0 A**	**5,0 A**
Contact fuse protection, external safety contacts		
In accordance with the standard	**EN 60947-5-1**	**EN 60947-5-1**
Blow-out fuse, quick	**10 A**	**10 A**
Blow-out fuse, slow	**6 A**	**6 A**
Circuit breaker, 24V AC/DC, characteristic B/C	**6 A**	**6 A**
Conventional thermal current	**6,0 A**	**6,0 A**
Contact material	**AgCuNi + 0,2 µm Au**	**AgCuNi + 0,2 µm Au**
Times	**750103**	**751103**
Switch-on delay		
With automatic reset typ.	**170 ms**	**170 ms**
With automatic reset max.	**300 ms**	**300 ms**
With automatic reset after power on typ.	**350 ms**	**350 ms**
With automatic reset after power on max.	**600 ms**	**600 ms**
With manual reset typ.	**40 ms**	**40 ms**
With monitored reset with rising edge typ.	**35 ms**	**35 ms**
With monitored reset with rising edge max.	**50 ms**	**50 ms**
With monitored reset with falling edge typ.	**55 ms**	**55 ms**
With monitored reset with falling edge max.	**70 ms**	**70 ms**

Times	750103	751103
Delay-on de-energisation		
With E-STOP typ.	**10 ms**	**10 ms**
With E-STOP max.	**20 ms**	**20 ms**
With power failure typ.	**40 ms**	**40 ms**
With power failure max.	**60 ms**	**60 ms**
Recovery time at max. switching frequency 1/s		
After E-STOP	**100 ms**	**100 ms**
After power failure	**100 ms**	**100 ms**
Waiting period with a monitored reset		
With rising edge	**120 ms**	**120 ms**
With falling edge	**250 ms**	**250 ms**
Min. start pulse duration with a monitored reset		
With rising edge	**30 ms**	**30 ms**
With falling edge	**100 ms**	**100 ms**
Supply interruption before de-energisation	**20 ms**	**20 ms**
Simultaneity, channel 1 and 2	∞	∞
Environmental data	**750103**	**751103**
Climatic suitability	**EN 60068-2-78**	**EN 60068-2-78**
Ambient temperature		
Temperature range	**-10 - 55 °C**	**-10 - 55 °C**
Storage temperature		
Temperature range	**-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**
Vibration		
In accordance with the standard	**EN 60068-2-6**	**EN 60068-2-6**
Frequency	**10,0 - 55,0 Hz**	**10,0 - 55,0 Hz**
Max. amplitude	**0,35 mm**	**0,35 mm**
Airgap creepage		
In accordance with the standard	**EN 60947-1**	**EN 60947-1**
Overvoltage category	**III / II**	**III / II**
Pollution degree	**2**	**2**
Rated insulation voltage	**250 V**	**250 V**
Rated impulse withstand voltage	**4,00 kV**	**4,00 kV**
Protection type		
Mounting (e.g. cabinet)	**IP54**	**IP54**
Housing	**IP40**	**IP40**
Terminals	**IP20**	**IP20**

Mechanical data	750103	751103
Mounting position	**Any**	**Any**
Mechanical life	**10,000,000 cycles**	**10,000,000 cycles**
Material		
Bottom	**PC**	**PC**
Front	**PC**	**PC**
Top	**PC**	**PC**
Cross section of external conductors with screw terminals		
1 core flexible	**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**	–
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	**0,20 - 1,50 mm², 24 - 16 AWG**	–
Torque setting with screw terminals	**0,50 Nm**	–
Connection type	**Screw terminal**	**Spring-loaded terminal**
Mounting type	**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**
Spring-loaded terminals: Terminal points per connection	–	**2**
Stripping length	–	**9 mm**
Dimensions		
Height	**98,0 mm**	**100,0 mm**
Width	**17,5 mm**	**17,5 mm**
Depth	**120,0 mm**	**120,0 mm**
Weight	**140 g**	**140 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 s3		24 V DC		Screw terminals	750 103
PNOZ s3 C		24 V DC		Spring-loaded terminals	751 103

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.
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