



Safety relays PNOZsigma

pilz

Configuration guide, safety relays PNOZsigma

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Selection guide

1.1

Selection guide

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Selection guide

Safety relays PNOZsigma





1.1

Type	Application					Safety-related characteristic data				
						PL in acc. with EN ISO 13849-1	SIL in acc. with EN 62061	for application up to category (in acc. with EN 954-1)		
								2	3	4
PNOZ s1	◆	◆				c	2	◆		
PNOZ s2	◆	◆				d	3	◆		
PNOZ s3	◆	◆	◆			e	3	◆	◆	◆
PNOZ s4	◆	◆	◆			e	3	◆	◆	◆
PNOZ s4.1	◆	◆	◆			e	3	◆	◆	◆
PNOZ s5	◆	◆	◆			e	3	◆	◆	◆
PNOZ s6				◆		e	3	EN 574, Type IIIC		
PNOZ s6.1				◆		e	3	EN 574, Type IIIA		
PNOZ s7	Contact expansion modules					e	3	As base unit		
PNOZ s7.1	Contact expansion modules					e	3	As base unit		
PNOZ s7.2	Contact expansion modules					e	3	As base unit		
PNOZ s8	Contact expansion modules					c	2	As base unit (max. category 3)		
PNOZ s9	Contact expansion modules							◆		
PNOZ s10	Contact expansion modules					e	3	As base unit		
PNOZ s11	Contact expansion modules					e	3	As base unit		

◆ Can be installed in this category

Selection guide

Safety relays PNOZsigma

Type	Output contacts				Universal power supply	Housing width in mm	Page
	safe		not safe				
							
PNOZ s1	2			1		12,5	1.2-2
PNOZ s2	3		1	1		17,5	1.2-10
PNOZ s3	2			1		17,5	1.2-18
PNOZ s4	3		1	1	◆	22,5	1.2-26
PNOZ s4.1	3		1	1	◆	22,5	1.2-35
PNOZ s5	2	2		1	◆	22,5	1.2-44
PNOZ s6	3		1	1	◆	22,5	1.2-54
PNOZ s6.1	3		1	1	◆	22,5	1.2-62
PNOZ s7	4		1			17,5	1.2-76
PNOZ s7.1	3					17,5	1.2-83
PNOZ s7.2	4		1			17,5	1.2-93
PNOZ s8	2			1		12,5	1.2-70
PNOZ s9	3	◆	1			17,5	1.2-116
PNOZ s10	4		1			45	1.2-102
PNOZ s11	8		1			45	1.2-109

◆ Can be installed in this category

Safety relays PNOZsigma

Safety relays PNOZsigma

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Up to PL e of EN ISO 13849-1	PNOZ s3 1.2-18
	PNOZ s4 1.2-26
	PNOZ s4.1 1.2-35
	PNOZ s5 1.2-44
Two-hand relays	
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Contact expander modules	
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Up to PL c of EN ISO 13849-1 PNOZ s1

1.2



Safety relay for monitoring E-STOP pushbuttons and safety gates.

Approvals

PNOZ s1	
	◆
	◆
	◆

Unit features

- ▶ Relay outputs:
 - 2 safety contacts (N/O), instantaneous
- ▶ 1 semiconductor output
- ▶ Connection options for:
 - E-STOP pushbutton
 - Safety gate limit switch
 - Reset button
- ▶ A connector can be used to connect 1 PNOZsigma contact expander module
- ▶ LED indicator for:
 - Supply voltage
 - Input status, channel 1
 - Input status, channel 2
 - Switch status, safety contacts
 - Reset circuit
 - Error
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

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

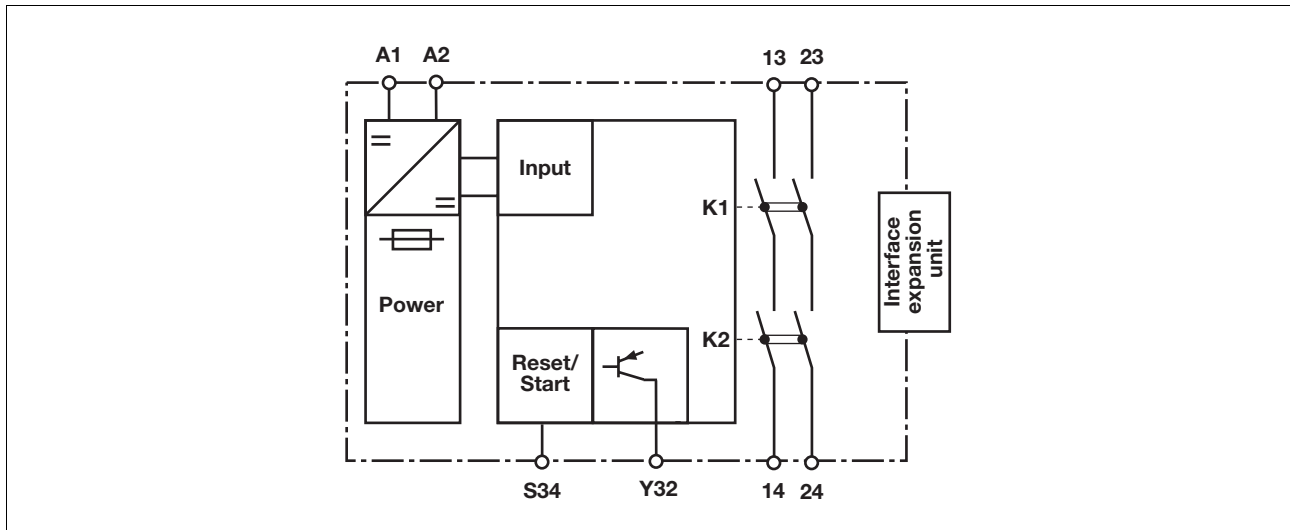
- ▶ E-STOP pushbuttons
- ▶ Safety gates

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

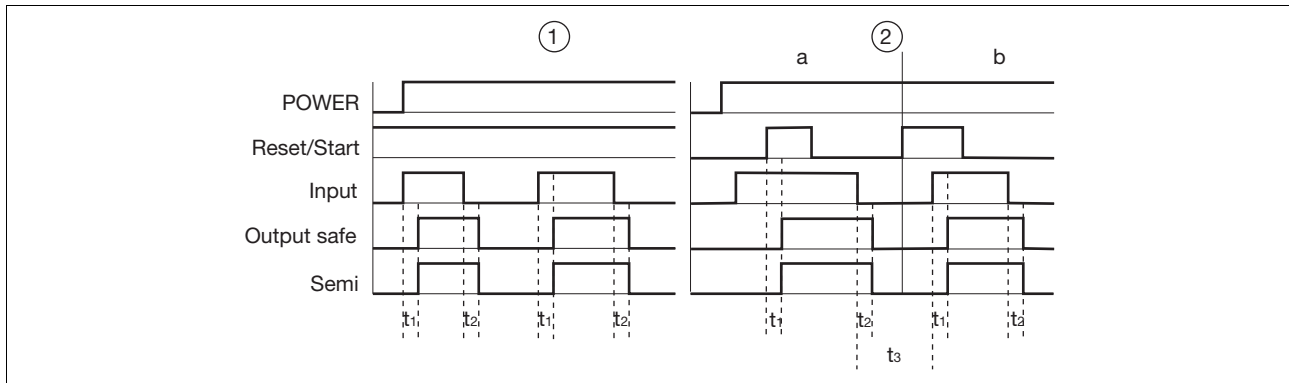


Up to PL c of EN ISO 13849-1 PNOZ s1

Function description

- ▶ Single-channel operation: no redundancy in the input circuit, earth faults in the reset and input circuit are detected.
- ▶ 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.
- ▶ 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.

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Reset/Start: Reset circuit S34
- ▶ Input: Input circuits A1-A2
- ▶ Output safe: Safety contacts 13-14, 23-24
- ▶ Semi: Semiconductor output Y32
- ▶ ①: Automatic reset
- ▶ ②: Manual reset
- ▶ a: Input circuit closes before reset circuit
- ▶ b: Reset circuit closes before input circuit
- ▶ t₁: Switch-on delay
- ▶ t₂: Delay-on de-energisation
- ▶ t₃: Recovery time

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs 13-14, 23-24 are 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.

Up to PL c of EN ISO 13849-1 PNOZ s1

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		
Safety gate without detection of shorts across contacts		

▶ Reset circuit

Reset circuit	Reset circuit	Feedback loop
Automatic reset		
Manual reset		




▶ Semiconductor output

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

Up to PL c of EN ISO 13849-1 PNOZ s1

► Key

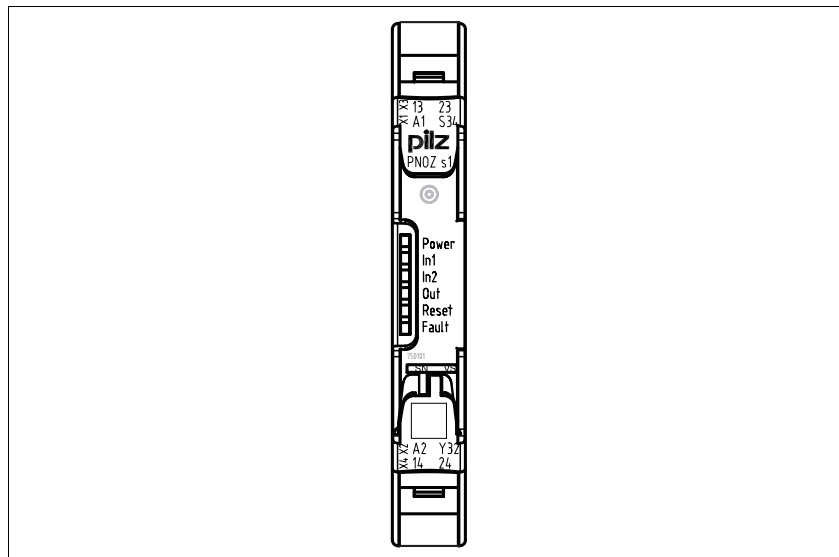
S1	E-STOP pushbutton
S3	Reset button
	Switch operated
	Gate open
	Gate closed

INFORMATION

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

Up to PL c of EN ISO 13849-1 PNOZ s1

Terminal configuration



Installation

Install base unit without contact expander module:

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

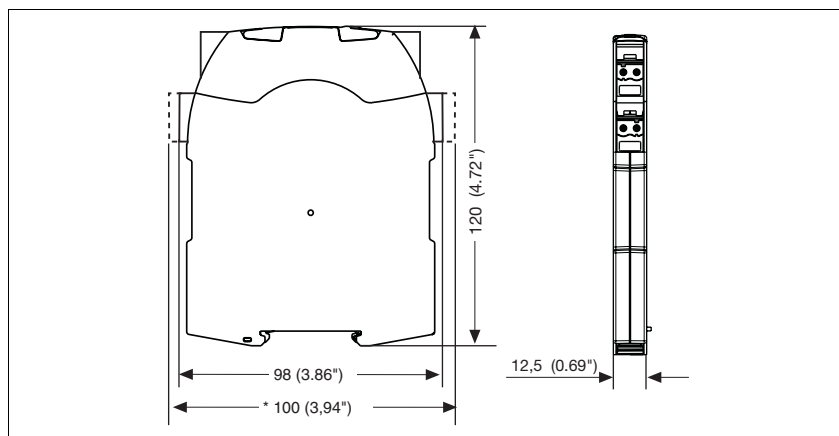
Connect base unit and PNOZsigma contact expander module:

- ▶ 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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions



Up to PL c of EN ISO 13849-1 PNOZ s1

NOTICE

This data sheet is only intended for use during configuration. For installation and operation, please refer to the op-

erating instructions supplied with the unit.

1.2

Technical details	
Electrical data	
Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-15 %/+10 %
Power consumption at U_B DC	2.0 W
Residual ripple DC	20 %
Voltage and current at	
Input circuit DC: 24.0 V	60.0 mA
Reset circuit DC: 24.0 V	20.0 mA
Feedback loop DC: 24.0 V	20.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	2
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.02 A, I_{max}: 3.0 A$ $P_{max}: 720 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.02 A, I_{max}: 3.0 A$ $P_{max}: 72 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 1.5 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 1.5 A$
Contact material	AgSnO2
External contact fuse protection ($I_k = 1 kA$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	4 A
Blow-out fuse, slow	
Safety contacts:	2 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	2 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
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	c
Category of output contacts in accordance with EN 954-1, EN ISO 13849-1	
Safety contacts (S) instantaneous:	2
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.00E-07 1/h
Mission time/Proof test interval in years	20

Up to PL c of EN ISO 13849-1 PNOZ s1

1.2

Times	
Switch-on delay	
with automatic reset typ.	100 ms
with automatic reset max.	150 ms
with automatic reset after power on typ.	100 ms
with automatic reset after power on max.	150 ms
with manual reset typ.	50 ms
with manual reset max.	60 ms
Delay-on de-energisation	
with E-STOP typ.	30 ms
with E-STOP max.	40 ms
with power failure typ.	30 ms
with power failure max.	40 ms
Recovery time at max. switching frequency 1/s after E-STOP	100 ms
after power failure	100 ms
Supply interruption before de-energisation	10 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	4.0 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	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750101
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750101
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750101
Torque setting with screw terminals	0.50 Nm Order no.: 750101
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 2.50 mm ² , 24 - 12 AWG Order no.: 751101
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751101
Stripping length	9 mm Order no.: 751101
Dimensions	
Height	100.0 mm Order no.: 751101 98.0 mm Order no.: 750101
Width	12.5 mm
Depth	120.0 mm
Weight	105 g

The standards current on **2006-04** apply.

Up to PL c of EN ISO 13849-1 PNOZ s1

Conventional thermal current

I_{th} (A) at U_B DC	
1 contact	3.00 A
2 contacts	3.00 A

Order reference

Type	Features	Terminals	Order no.
PNOZ s1	24 VDC	With screw terminal	750 101
PNOZ s1 C	24 VDC	With spring-loaded terminal	751 101

Up to PL d of EN ISO 13849-1 PNOZ s2

1.2



Safety relay for monitoring E-STOP pushbuttons and safety gates.

Approvals

PNOZ s2	
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 3 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ Safe separation of safety contacts from all other circuits
- ▶ 1 semiconductor output
- ▶ Connection options for:
 - E-STOP pushbutton
 - Safety gate limit switch
 - Reset button
- ▶ A connector can be used to connect 1 PNOZsigma contact expander module
- ▶ Operating modes can be set via rotary switch
- ▶ LED indicator for:
 - ▶ Supply voltage
 - ▶ Input status, channel 1
 - ▶ Input status, channel 2
 - ▶ Switch status, safety contacts
 - ▶ 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

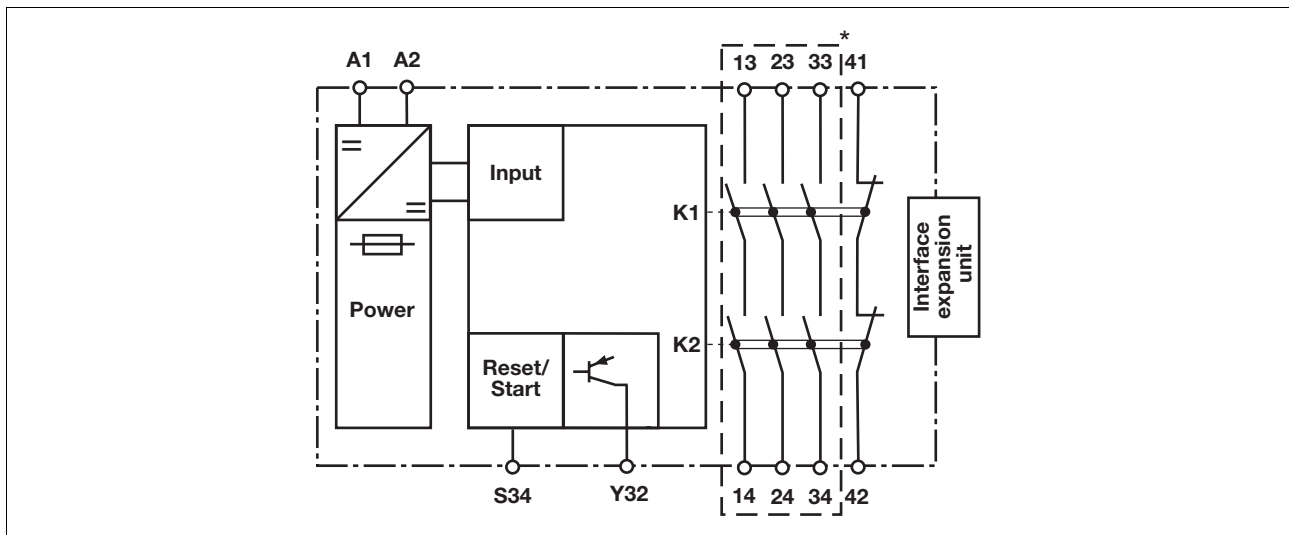
- ▶ E-STOP pushbuttons
- ▶ Safety gates

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



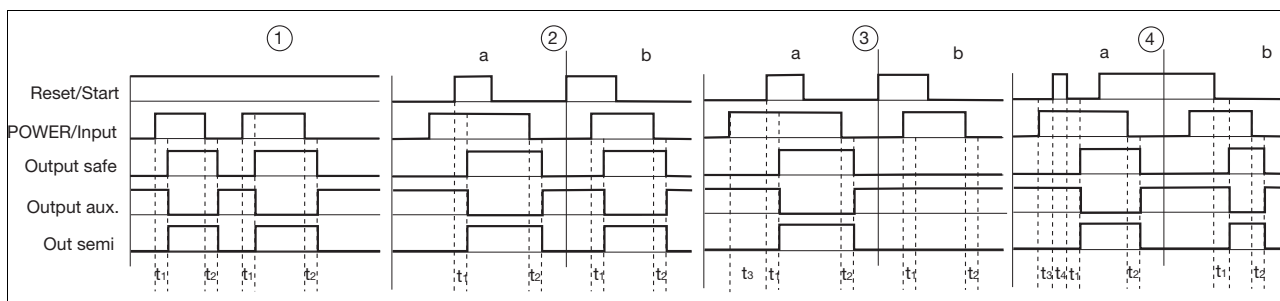
* Safe separation in accordance with EN 60947-1, 6 kV

Up to PL d of EN ISO 13849-1 PNOZ s2

Function description

- ▶ Single-channel operation: no redundancy in the input circuit, earth faults in the reset and input circuit are detected.
- ▶ 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).
- ▶ 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.

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Reset/Start: Reset circuit S34
- ▶ Input: Input circuits A1-A2
- ▶ Output safe: Safety contacts 13-14, 23-24, 33-34
- ▶ Output aux.: Auxiliary contacts 41-42
- ▶ Out semi: Semiconductor output Y32
- ▶ ①: Automatic reset
- ▶ ②: Manual reset
- ▶ ③: Monitored reset with rising edge
- ▶ ④: Monitored reset with falling edge
- ▶ a: Input circuit closes before reset circuit
- ▶ b: Reset circuit closes before input circuit
- ▶ t₁: Switch-on delay
- ▶ t₂: Delay-on de-energisation
- ▶ t₃: Waiting period
- ▶ t₄: Waiting period reset circuit was closed

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 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.

Up to PL d of EN ISO 13849-1 PNOZ s2

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		
Safety gate without detection of shorts across contacts		

► Reset circuit/feedback loop

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



► Semiconductor output

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

Up to PL d of EN ISO 13849-1 PNOZ s2

► Key

S1	E-STOP pushbutton
S3	Reset button
	Gate open
	Gate closed

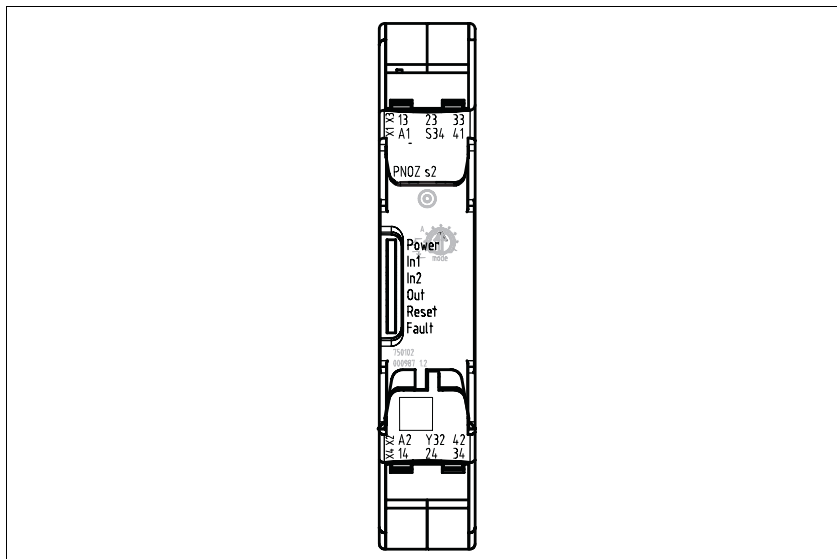
INFORMATION

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

Up to PL d of EN ISO 13849-1 PNOZ s2

1.2

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:

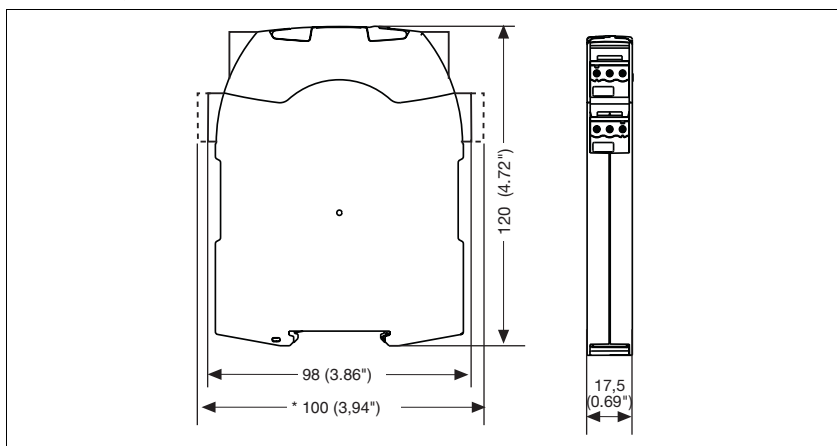
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module.
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

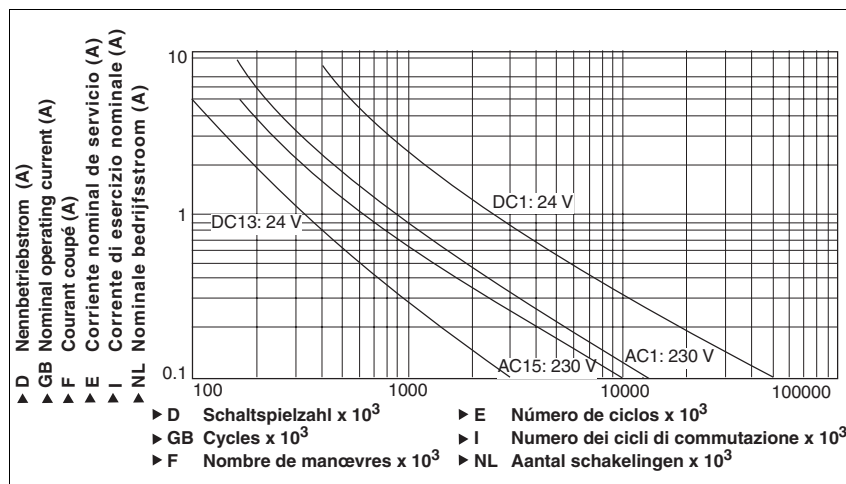


Up to PL d of EN ISO 13849-1 PNOZ s2

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



Technical details

Electrical data

Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-15 %/+10 %
Power consumption at U_B DC	2.0 W
Residual ripple DC	20 %
Voltage and current at	
Input circuit DC: 24.0 V	75.0 mA
Reset circuit DC: 24.0 V	7.0 mA
Feedback loop DC: 24.0 V	7.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	3
Auxiliary contacts (N/C):	1
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Auxiliary contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Auxiliary contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
Auxiliary contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
Contact material	AgCuNi + 0.2 µm Au

Up to PL d of EN ISO 13849-1 PNOZ s2

1.2

Electrical data	
External contact fuse protection ($I_k = 1 \text{ kA}$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	10 A
Auxiliary contacts:	10 A
Blow-out fuse, slow	
Safety contacts:	6 A
Auxiliary contacts:	6 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	6 A
Auxiliary contacts:	6 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
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	d
Category of output contacts in accordance with EN 954-1 , EN ISO 13849-1	
Safety contacts (S) instantaneous:	2
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.50E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset typ.	75 ms
with automatic reset max.	250 ms
with automatic reset after power on typ.	75 ms
with automatic reset after power on max.	250 ms
with manual reset typ.	75 ms
with manual reset max.	250 ms
on monitored reset with rising edge typ.	75 ms
on monitored reset with rising edge max.	250 ms
on monitored reset with falling edge typ.	55 ms
on monitored reset with falling edge max.	70 ms
Delay-on de-energisation	
with E-STOP typ.	50 ms
with E-STOP max.	70 ms
with power failure typ.	50 ms
with power failure max.	70 ms
Recovery time at max. switching frequency 1/s	
after E-STOP	100 ms
after power failure	100 ms
Waiting period with a monitored reset	
with rising edge	100 ms
with falling edge	110 ms
Min. start pulse duration with a monitored reset	
with rising edge	100 ms
with falling edge	100 ms
Supply interruption before de-energisation	10 ms

Up to PL d of EN ISO 13849-1 PNOZ s2

Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	6.0 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	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750102
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750102
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750102
Torque setting with screw terminals	0.50 Nm Order no.: 750102
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 2.50 mm ² , 24 - 12 AWG Order no.: 751102
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751102
Stripping length	9 mm Order no.: 751102
Dimensions	
Height	102.0 mm Order no.: 751102 96.0 mm Order no.: 750102
Width	17.5 mm
Depth	120.0 mm
Weight	170 g

The standards current on 2006-04 apply.

Conventional thermal current	
I_{th} (A) at U_B DC	
1 contact	8.00 A
2 contacts	6.00 A
3 contacts	5.00 A

Order reference			
Type	Features	Terminals	Order no.
PNOZ s2	24 VDC	With screw terminal	750 102
PNOZ s2 C	24 VDC	With spring-loaded terminal	751 102

Up to PL e of EN ISO 13849-1 PNOZ s3

1.2



Safety relay for monitoring E-STOP pushbuttons, safety gates and light barriers.

Approvals

PNOZ s3	
	◆
	◆
	◆

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
 - Reset button
 - Light barriers
 - PSEN
- ▶ A connector can be used to connect 1 PNOZsigma contact expander 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
 - Reset circuit
 - Error
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

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

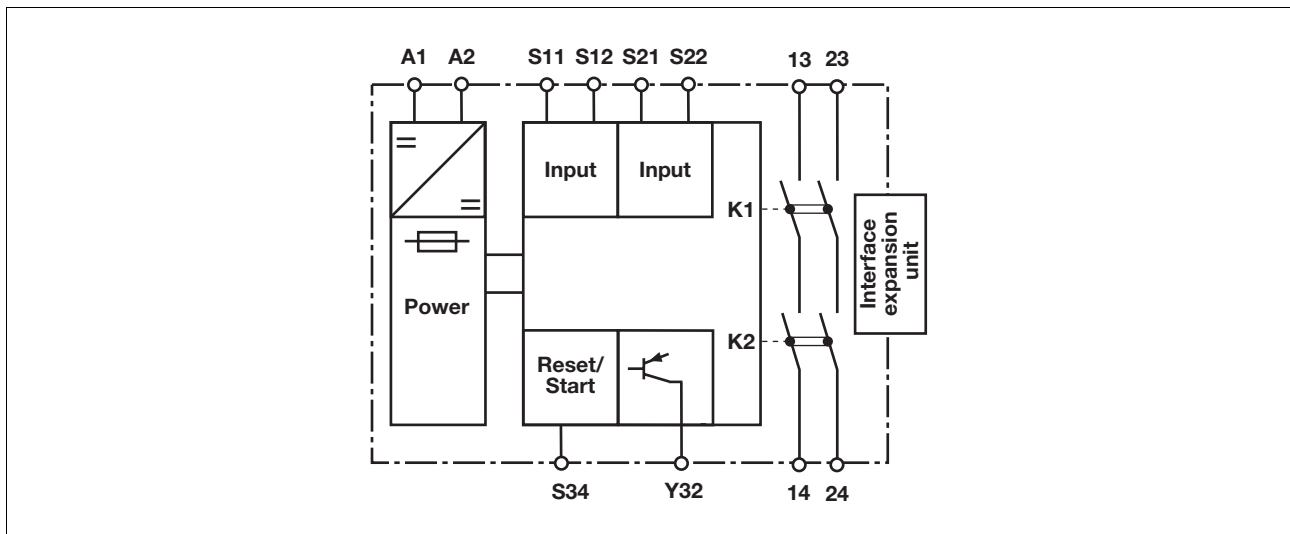
- ▶ E-STOP pushbuttons
- ▶ Safety gates
- ▶ Light barriers

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



Up to PL e of EN ISO 13849-1 PNOZ s3

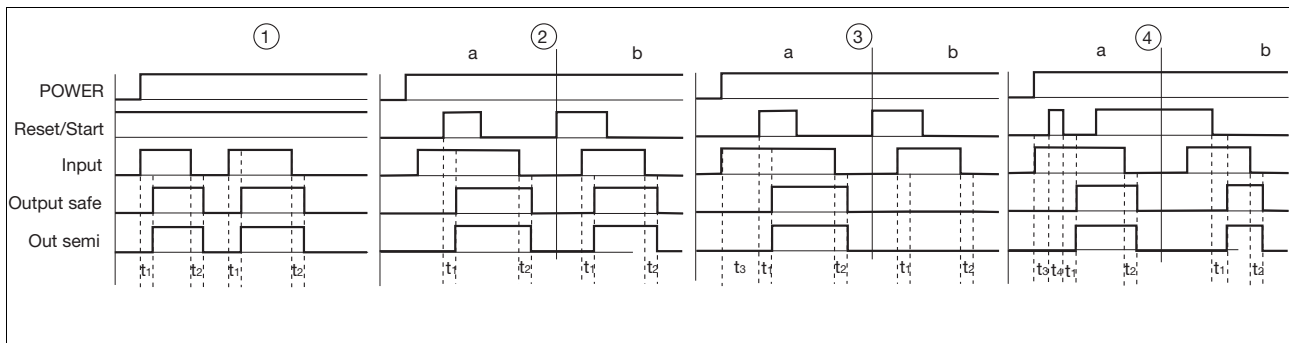
Function description

- ▶ Single-channel operation: no redundancy in the input circuit, earth faults in the reset circuit 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

- short circuits in the input circuit and, with a monitored reset, in the reset circuit too,
- shorts between contacts in the input circuit.
- ▶ Automatic reset: 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 in-

- put 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.
- ▶ 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.

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 output Y32
- ▶ ①: Automatic reset
- ▶ ②: Manual reset
- ▶ ③: Monitored reset with rising edge
- ▶ ④: Monitored reset with falling edge
- ▶ a: Input circuit closes before reset circuit
- ▶ b: Reset circuit closes before input circuit
- ▶ t₁: Switch-on delay
- ▶ t₂: Delay-on de-energisation
- ▶ t₃: Waiting period
- ▶ t₄: Waiting period reset circuit was closed

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs 13-14, 23-24 are 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.

Up to PL e of EN ISO 13849-1 PNOZ s3

Preparing for operation

► Supply voltage

Supply voltage	AC	DC
	/	

► Input circuit

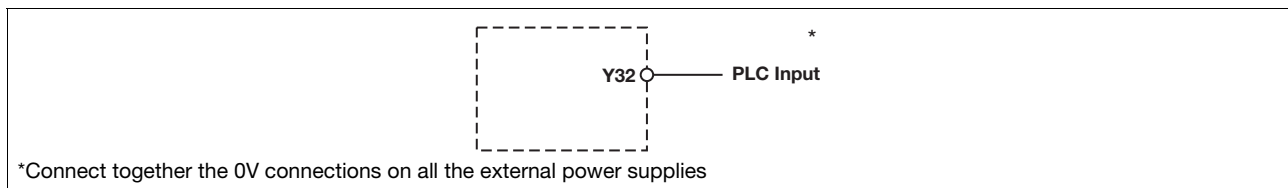
Input circuit	Single-channel	Dual-channel
E-STOP without detection of shorts across contacts		
E-STOP with detection of shorts across contacts	/	
Safety gate without detection of shorts across contacts		
Safety gate with detection of shorts across contacts	/	
Light barrier or safety switch with detection of shorts across contacts via ESPE	/	

Up to PL e of EN ISO 13849-1 PNOZ s3

▶ Reset circuit/feedback loop

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

▶ Semiconductor output



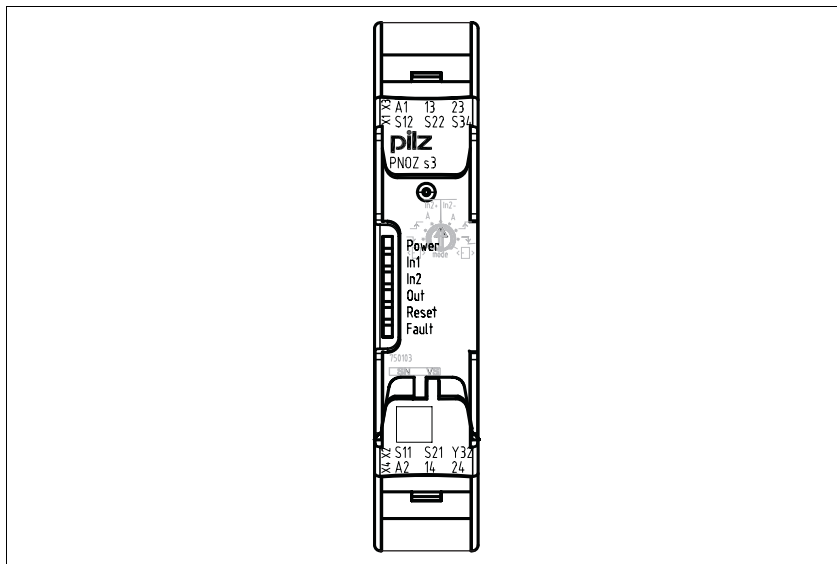
▶ Key

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

Up to PL e of EN ISO 13849-1 PNOZ s3

1.2

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:

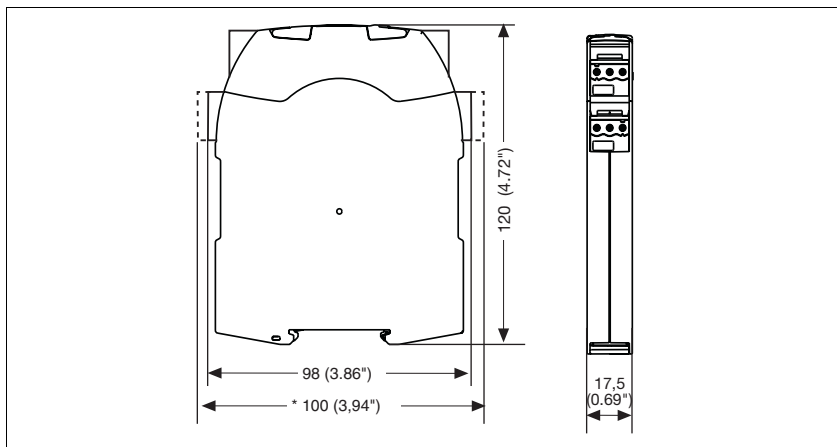
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module.
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

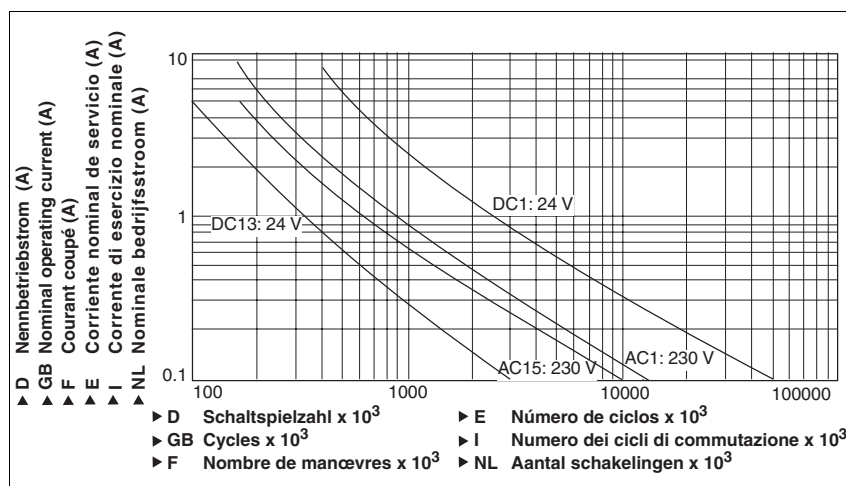


Up to PL e of EN ISO 13849-1 PNOZ s3

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



Technical details

Electrical data

Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-15 %/+10 %
Power consumption at U_B DC	2.5 W
Residual ripple DC	20 %
Voltage and current at	
Input circuit DC: 24.0 V	50.0 mA
Reset circuit DC: 24.0 V	50.0 mA
Feedback loop DC: 24.0 V	50.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	2
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
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:	10 A
Blow-out fuse, slow	
Safety contacts:	6 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	6 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
dual-channel without detect. of shorts across contacts at U_B DC	60 Ohm
dual-channel with detect. of shorts across contacts at U_B DC	30 Ohm

Up to PL e of EN ISO 13849-1 PNOZ s3

1.2

Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Category of output contacts in accordance with EN 954-1, EN ISO 13849-1	
Safety contacts (S) instantaneous:	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset typ.	170 ms
with automatic reset max.	300 ms
with automatic reset after power on typ.	350 ms
with automatic reset after power on max.	600 ms
with manual reset typ.	40 ms
on monitored reset with rising edge typ.	35 ms
on monitored reset with rising edge max.	50 ms
on monitored reset with falling edge typ.	55 ms
on monitored reset with falling edge max.	70 ms
Delay-on de-energisation	
with E-STOP typ.	10 ms
with E-STOP max.	20 ms
with power failure typ.	40 ms
with power failure max.	60 ms
Recovery time at max. switching frequency 1/s	
after E-STOP	50 ms
after power failure	100 ms
Waiting period with a monitored reset	
with rising edge	120 ms
with falling edge	250 ms
Min. start pulse duration with a monitored reset	
with rising edge	30 ms
with falling edge	100 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 - 55 Hz
Amplitude	0.35 mm
Climatic suitability	EN 60068-2-78
Airgap creepage in accordance with EN 60947-1	
Pollution degree	2
Rated insulation voltage	250 V
Rated impulse withstand voltage	4.0 kV
Ambient temperature	-10 - 55 °C
Storage temperature	-40 - 85 °C
Protection type	
Mounting (e.g. cabinet)	IP54
Housing	IP40
Terminals	IP20

Up to PL e of EN ISO 13849-1 PNOZ s3

Mechanical data

Housing material	
Housing	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750103
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750103
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750103
Torque setting with screw terminals	0.50 Nm Order no.: 750103
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 2.50 mm ² , 24 - 12 AWG Order no.: 751103
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751103
Stripping length	9 mm Order no.: 751103
Dimensions	
Height	102.0 mm Order no.: 751103 96.0 mm Order no.: 750103
Width	17.5 mm
Depth	120.0 mm
Weight	140 g

The standards current on **2006-04** apply.

Conventional thermal current

I_{th} (A) at U_B DC	
1 contact	8.00 A
2 contacts	6.00 A

Order reference

Type	Features	Terminals	Order no.
PNOZ s3	24 VDC	With screw terminals	750 103
PNOZ s3 C	24 VDC	With spring-loaded terminals	751 103

Up to PL e of EN ISO 13849-1 PNOZ s4

1.2



Safety relay for monitoring E-STOP pushbuttons, safety gates and light barriers.

Approvals

PNOZ s4	
	◆
	◆
	◆

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
 - Reset button
 - Light barriers
 - PSEN
- ▶ A connector can be used to connect 1 PNOZsigma contact expander module
- ▶ Operating modes can be set via rotary switch
- ▶ LED indicator for:
 - Supply voltage
 - Input status, channel 1
 - Input status, channel 2
 - Switch status, safety contacts
 - Reset circuit
 - Error
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

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

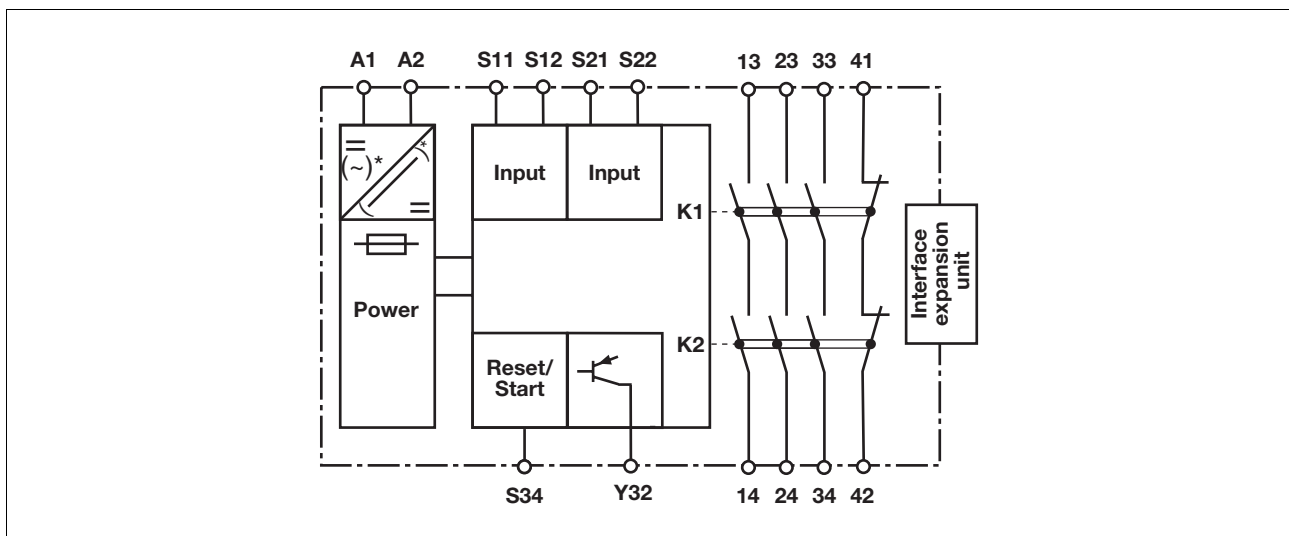
- ▶ E-STOP pushbuttons
- ▶ Safety gates
- ▶ Light barriers

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



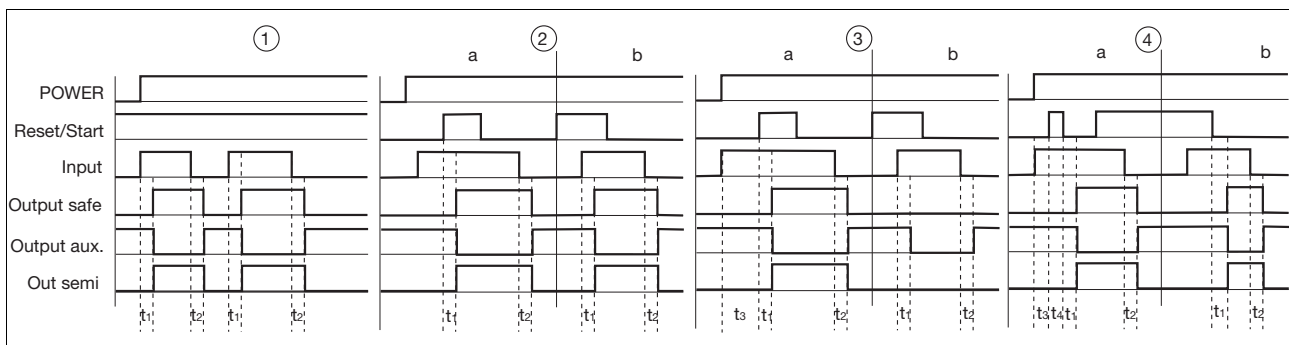
* only when $U_B = 48 - 240 \text{ VAC/DC}$

Up to PL e of EN ISO 13849-1 PNOZ s4

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.
- ▶ 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.
- ▶ 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.

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Reset/start: Reset circuit S34 S34
- ▶ Input: Input circuits S11-S12, S21-S22
- ▶ Output safe: Safety contacts 13-14, 23-24, 33-34
- ▶ Output aux.: Auxiliary contacts 41-42
- ▶ Out semi: Semiconductor output Y32
- ▶ ①: Automatic reset
- ▶ ②: Manual reset
- ▶ ③: Monitored reset with rising edge
- ▶ ④: Monitored reset with falling edge
- ▶ a: Input circuit closes before reset circuit
- ▶ b: Reset circuit closes before input circuit
- ▶ t₁: Switch-on delay
- ▶ t₂: Delay-on de-energisation
- ▶ t₃: Waiting period
- ▶ t₄: Waiting period reset circuit was closed

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 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.

Up to PL e of EN ISO 13849-1 PNOZ s4

Preparing for operation

► Supply voltage

Supply voltage	AC	DC

► Input circuit

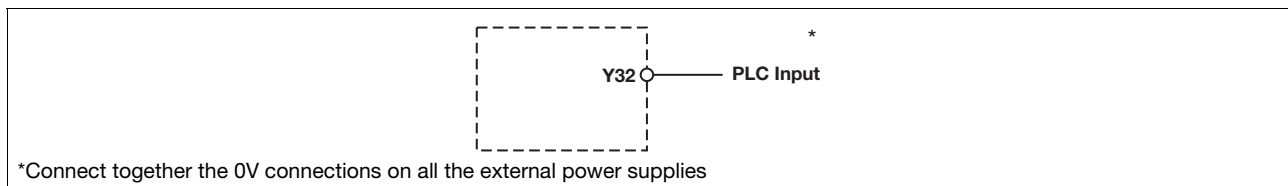
Input circuit	Single-channel	Dual-channel
E-STOP without detection of shorts across contacts		
E-STOP with detection of shorts across contacts		
Safety gate without detection of shorts across contacts		
Safety gate with detection of shorts across contacts		
Light beam device or safety switch with detection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

Up to PL e of EN ISO 13849-1 PNOZ s4

▶ Reset circuit/feedback loop

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

▶ Semiconductor output



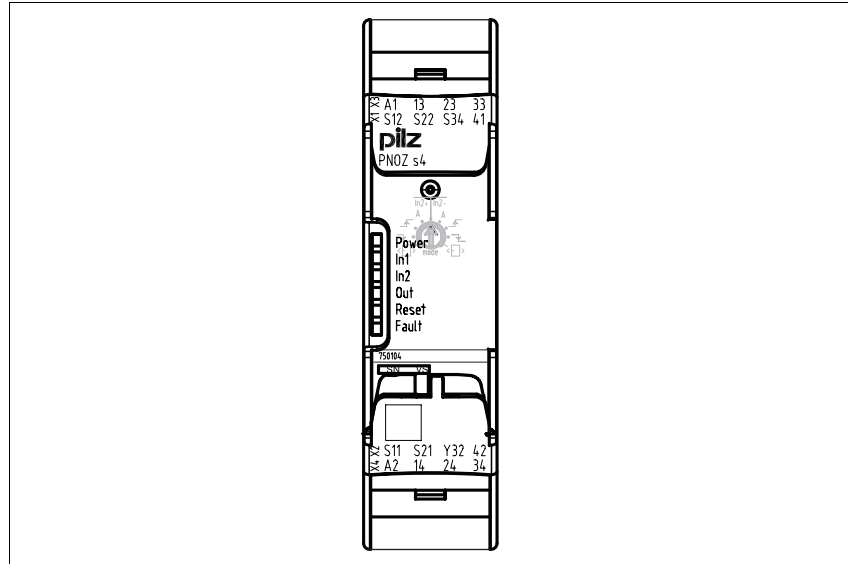
▶ Key

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

Up to PL e of EN ISO 13849-1 PNOZ s4

1.2

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:

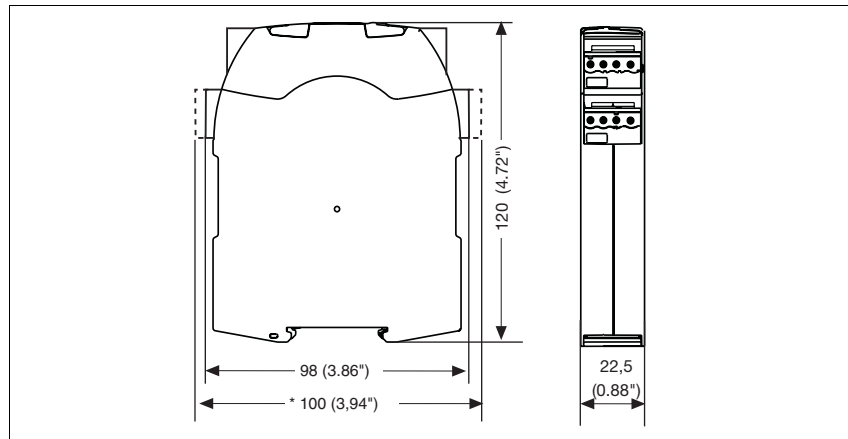
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module.
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals



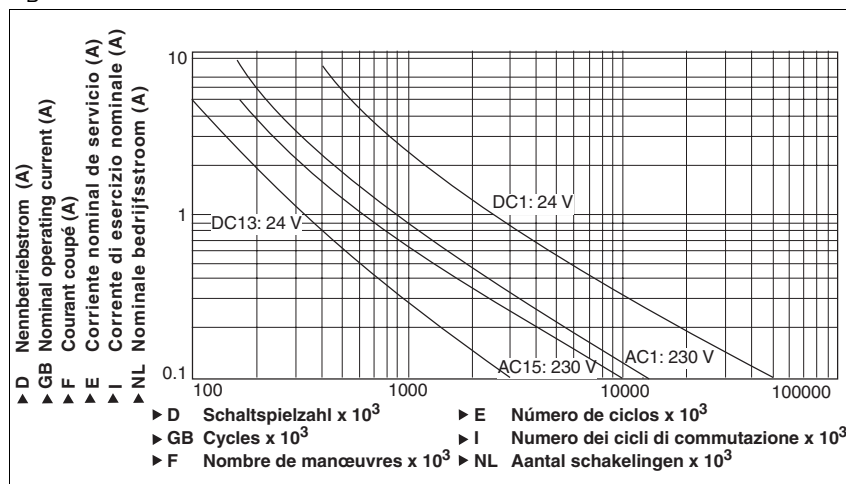
Up to PL e of EN ISO 13849-1 PNOZ s4

Notice

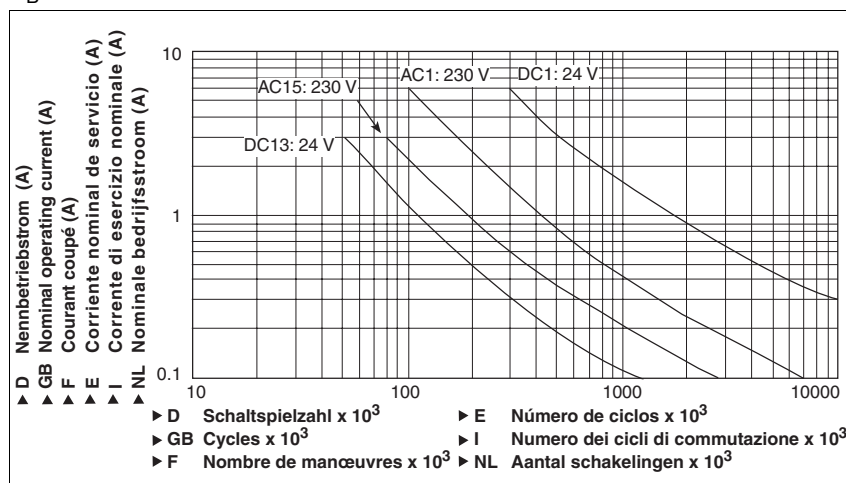
This data sheet is only intended for use during configuration. For installation and operation, please refer to the operating instructions supplied with the unit.

Service life graph

U_B 24 VDC



U_B 48-240 VAC/DC



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	5.0 VA Order no.: 750134, 751134
Power consumption at U_B DC	2.5 W
Frequency range AC	50 - 60 Hz
Residual ripple DC	20 %, 160 %
Voltage and current at	
Input circuit DC: 24.0 V	50.0 mA
Reset circuit DC: 24.0 V	50.0 mA
Feedback loop DC: 24.0 V	50.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	3
Auxiliary contacts (N/C):	1

Up to PL e of EN ISO 13849-1 PNOZ s4

Electrical data

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** Order no.: 750134, 751134
8.0 A Order no.: 750104, 751104

P_{max} : **1500 VA** Order no.: 750134, 751134
2000 VA Order no.: 750104, 751104

Safety contacts: DC1 at **24 V**

I_{min} : **0.01 A**, I_{max} : **6.0 A** Order no.: 750134, 751134
8.0 A Order no.: 750104, 751104

P_{max} : **150 W** Order no.: 750134, 751134
200 W Order no.: 750104, 751104

Auxiliary contacts: AC1 at **240 V**

I_{min} : **0.01 A**, I_{max} : **6.0 A** Order no.: 750134, 751134
8.0 A Order no.: 750104, 751104

P_{max} : **1500 VA** Order no.: 750134, 751134
2000 VA Order no.: 750104, 751104

Auxiliary contacts: DC1 at **24 V**

I_{min} : **0.01 A**, I_{max} : **6.0 A** Order no.: 750134, 751134
8.0 A Order no.: 750104, 751104

P_{max} : **150 W** Order no.: 750134, 751134
200 W Order no.: 750104, 751104

Utilisation category in accordance with **EN 60947-5-1**

Safety contacts: AC15 at **230 V**

I_{max} : **3.0 A** Order no.: 750134, 751134
6.0 A Order no.: 750104, 751104

Safety contacts: DC13 at **24 V** (6 cycles/min)

I_{max} : **4.0 A** Order no.: 750134, 751134
5.0 A Order no.: 750104, 751104

Auxiliary contacts: AC15 at **230 V**

I_{max} : **3.0 A** Order no.: 750134, 751134
6.0 A Order no.: 750104, 751104

Auxiliary contacts: DC13 at **24 V** (6 cycles/min)

I_{max} : **4.0 A** Order no.: 750134, 751134
5.0 A Order no.: 750104, 751104

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:

10 A Order no.: 750104, 751104
6 A Order no.: 750134, 751134

Auxiliary contacts:

10 A Order no.: 750104, 751104
6 A Order no.: 750134, 751134

Blow-out fuse, slow

Safety contacts:

4 A Order no.: 750134, 751134
6 A Order no.: 750104, 751104

Auxiliary contacts:

4 A Order no.: 750134, 751134
6 A Order no.: 750104, 751104

Circuit breaker 24 VAC/DC, characteristic B/C

Safety contacts:

4 A Order no.: 750134, 751134
6 A Order no.: 750104, 751104

Auxiliary contacts:

4 A Order no.: 750134, 751134
6 A Order no.: 750104, 751104

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 Order no.: 750134, 751134

dual-channel without detect. of shorts across contacts at U_B DC

30 Ohm Order no.: 750134, 751134

60 Ohm Order no.: 750104, 751104

dual-channel without detect. of shorts across contacts at U_B AC

30 Ohm Order no.: 750134, 751134

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 Order no.: 750134, 751134

Safety-related characteristic data

Performance level (PL) in accordance with **EN ISO 13849-1**

Safety contacts, instantaneous

e

Category of output contacts in accordance with **EN 954-1, EN ISO 13849-1**

Safety contacts (S) instantaneous:

4

Up to PL e of EN ISO 13849-1 PNOZ s4

Safety-related characteristic data	
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset typ.	170 ms
with automatic reset max.	300 ms
with automatic reset after power on typ.	350 ms
with automatic reset after power on max.	600 ms
with manual reset typ.	40 ms
on monitored reset with rising edge typ.	35 ms
on monitored reset with rising edge max.	50 ms
on monitored reset with falling edge typ.	55 ms
on monitored reset with falling edge max.	70 ms
Delay-on de-energisation	
with E-STOP typ.	10 ms
with E-STOP max.	20 ms
with power failure typ.	40 ms
with power failure max.	60 ms
Recovery time at max. switching frequency 1/s after E-STOP	
after power failure	50 ms
after power failure	100 ms
Waiting period with a monitored reset	
with rising edge	120 ms
with falling edge	150 ms Order no.: 750134, 751134
with falling edge	250 ms Order no.: 750104, 751104
Min. start pulse duration with a monitored reset	
with rising edge	30 ms
with falling edge	100 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 - 55 Hz
Amplitude	0.35 mm
Climatic suitability	EN 60068-2-78
Airgap creepage in accordance with EN 60947-1	
Pollution degree	2
Rated insulation voltage	250 V
Rated impulse withstand voltage	4.0 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	PC
Front	PC

Up to PL e of EN ISO 13849-1 PNOZ s4

Mechanical data

Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm² , 24 - 12 AWG Order no.: 750104, 750134
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm² , 24 - 16 AWG Order no.: 750104, 750134
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm² , 24 - 16 AWG Order no.: 750104, 750134
Torque setting with screw terminals	0.50 Nm Order no.: 750104, 750134
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751104, 751134
Stripping length	9 mm Order no.: 751104, 751134
Dimensions	
Height	102.0 mm Order no.: 751104, 751134 96.0 mm Order no.: 750104, 750134
Width	22.5 mm
Depth	120.0 mm
Weight	190 g Order no.: 750104, 751104 210 g Order no.: 750134, 751134

The standards current on **2006-04** apply.

Conventional thermal current

Number of contacts	I_{th} (A) at U_B DC	I_{th} (A) at U_B AC
1	6.00 A Order no.: 750134, 751134	6.00 A Order no.: 750134, 751134
	8.00 A Order no.: 750104, 751104	
2	6.00 A	6.00 A Order no.: 750134, 751134
3	4.50 A Order no.: 750134, 751134	4.50 A Order no.: 750134, 751134
	5.00 A Order no.: 750104, 751104	

Order reference

Type	Features	Terminals	Order no.
PNOZ s4	24 VDC	With screw terminals	750 104
PNOZ s4 C	24 VDC	With spring-loaded terminals	751 104
PNOZ s4	48 – 240 VAC/DC	With screw terminals	750 134
PNOZ s4 C	48 – 240 VAC/DC	With spring-loaded terminals	751 134

Up to PL e of EN ISO 13849-1 PNOZ s4.1



Safety relay for use in furnaces and for monitoring E-STOP pushbuttons, safety gates and light barriers.

Approvals

PNOZ s4.1	
	◆
	◆
	◆

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
 - Reset button
 - Light barriers
 - PSEN
 - Safety valves for furnaces
 - ▶ A connector can be used to connect 1 PNOZsigma contact expander module
- Operating modes can be set via rotary switch
- ▶ LED indicator for:
 - Supply voltage
 - Input status, channel 1
 - Input status, channel 2
 - Switch status, safety contacts
 - Reset circuit
 - Error
 - ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

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 barriers

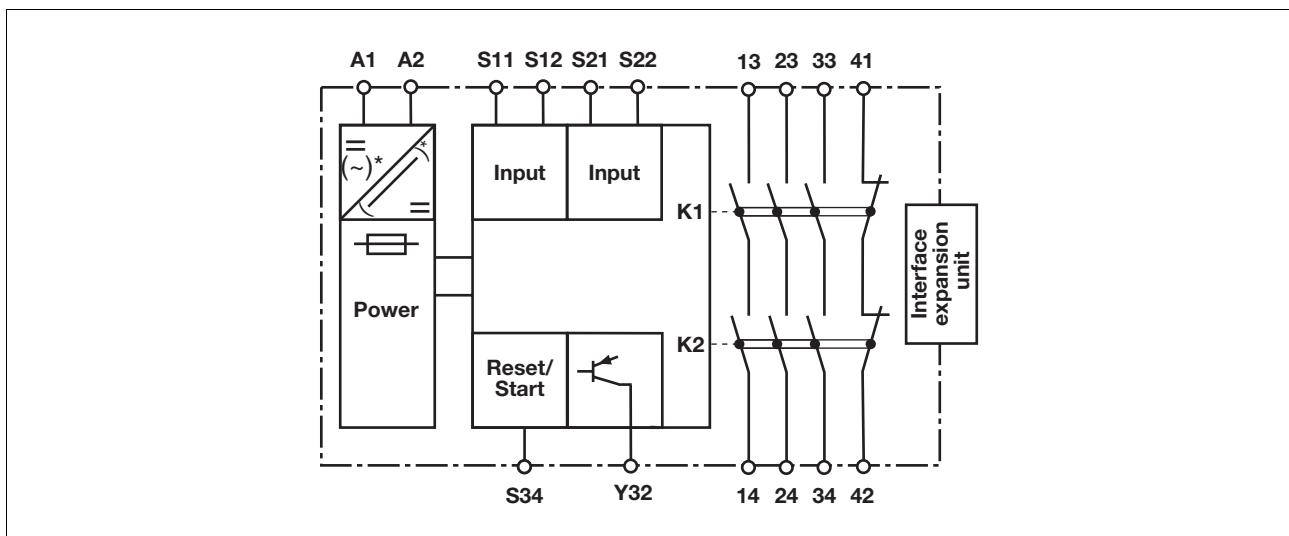
It is designed for use in furnaces in accordance with EN 50156-1.

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

Up to PL e of EN ISO 13849-1 PNOZ s4.1

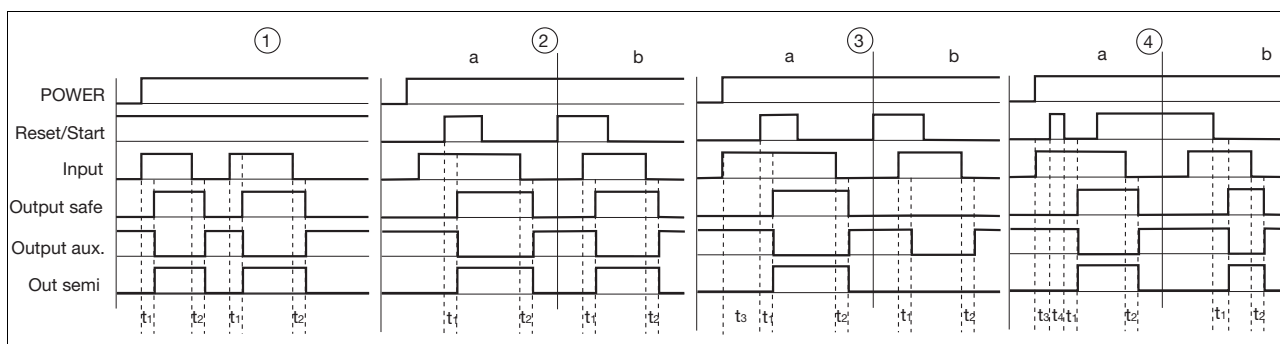
Function description

- ▶ 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

- 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 in-

- put 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.
- ▶ 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.

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Reset/start: Reset circuit S34 S34
- ▶ Input: Input circuits S11-S12, S21-S22
- ▶ Output safe: Safety contacts 13-14, 23-24, 33-34
- ▶ Output aux.: Auxiliary contacts 41-42
- ▶ Out semi: Semiconductor output Y32
- ▶ ①: Automatic reset
- ▶ ②: Manual reset
- ▶ ③: Monitored reset with rising edge
- ▶ ④: Monitored reset with falling edge
- ▶ a: Input circuit closes before reset circuit
- ▶ b: Reset circuit closes before input circuit
- ▶ t₁: Switch-on delay
- ▶ t₂: Delay-on de-energisation
- ▶ t₃: Waiting period
- ▶ t₄: Waiting period reset circuit was closed

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 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.

Up to PL e of EN ISO 13849-1 PNOZ s4.1

Preparing for operation

► Supply voltage

Supply voltage	AC	DC

► Input circuit

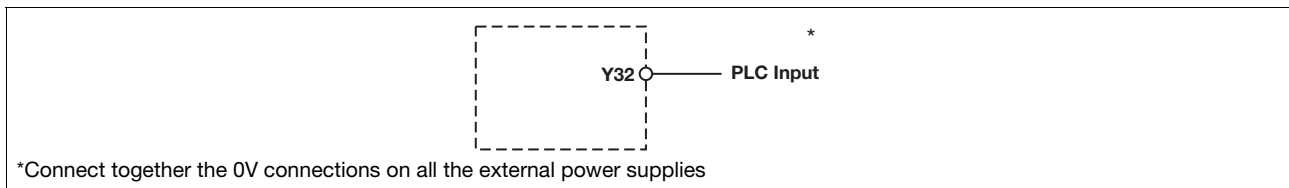
Input circuit	Single-channel	Dual-channel
E-STOP without detection of shorts across contacts		
E-STOP with detection of shorts across contacts		
Safety gate without detection of shorts across contacts		
Safety gate with detection of shorts across contacts		
Light beam device or safety switch with detection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

Up to PL e of EN ISO 13849-1 PNOZ s4.1

▶ Reset circuit/feedback loop

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

▶ Semiconductor output



▶ Key

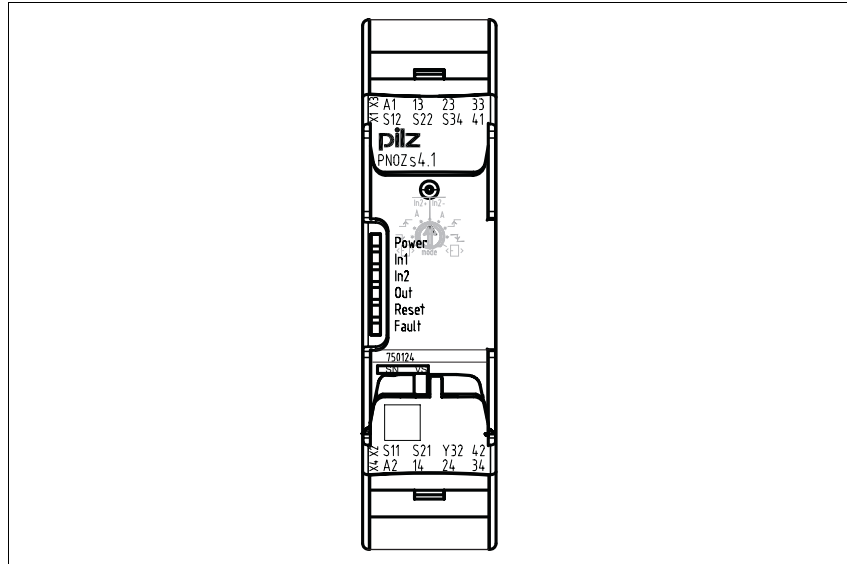
S1/S2	E-STOP/safety gate switch
S3	Reset button
	Switch operated
	Gate open
	Gate closed

INFORMATION

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

Up to PL e of EN ISO 13849-1 PNOZ s4.1

Terminal configuration



1.2

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:

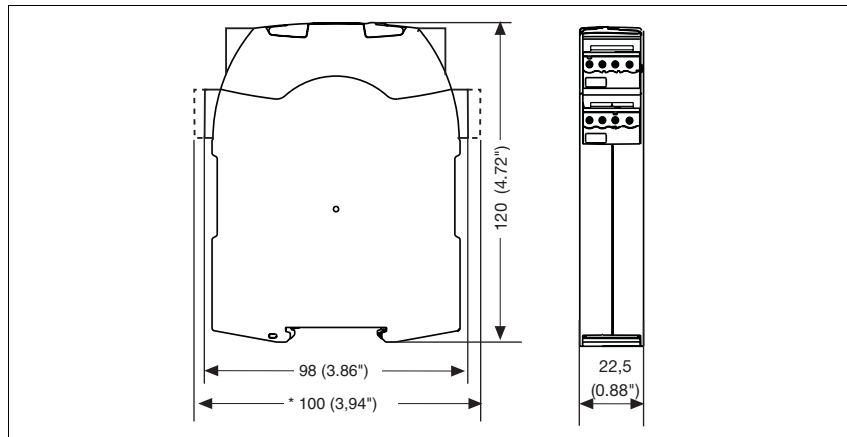
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module.
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

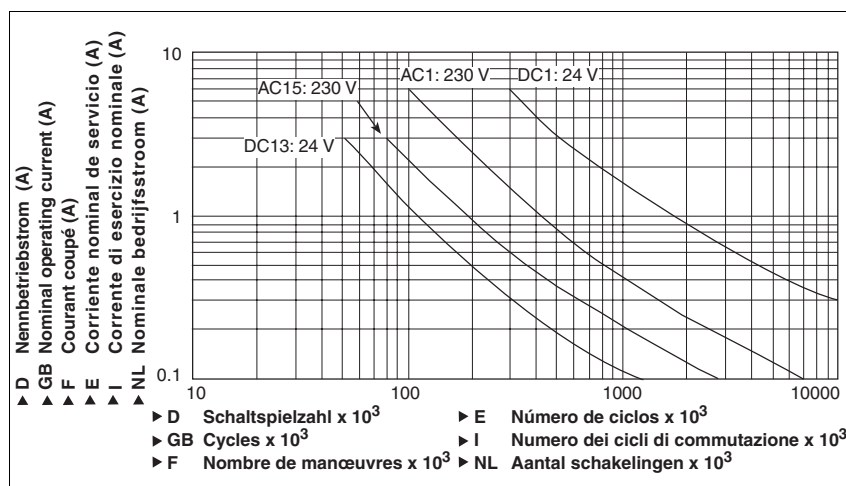


Up to PL e of EN ISO 13849-1 PNOZ s4.1

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



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	5.0 VA Order no.: 750154, 751154
Power consumption at U _B DC	2.5 W
Frequency range AC	50 - 60 Hz
Residual ripple DC	20 %, 160 %
Voltage and current at	
Input circuit DC: 24.0 V	50.0 mA
Reset circuit DC: 24.0 V	50.0 mA
Feedback loop DC: 24.0 V	50.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	3
Auxiliary contacts (N/C):	1
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	I _{min} : 0.01 A , I _{max} : 1.5 A P _{max} : 375 VA
Safety contacts: DC1 at 24 V	I _{min} : 0.01 A , I _{max} : 6.0 A P _{max} : 150 W
Auxiliary contacts: AC1 at 240 V	I _{min} : 0.01 A , I _{max} : 1.5 A P _{max} : 375 VA
Auxiliary contacts: 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} : 0.6 A
Safety contacts: DC13 at 24 V (6 cycles/min)	I _{max} : 0.4 A
Auxiliary contacts: AC15 at 230 V	I _{max} : 0.6 A
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	I _{max} : 0.4 A
Contact material	AgCuNi + 0.2 µm Au

Up to PL e of EN ISO 13849-1 PNOZ s4.1

Electrical data	
External contact fuse protection ($I_K = 1 \text{ kA}$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	6 A
Auxiliary contacts:	6 A
Blow-out fuse, slow	
Safety contacts:	4 A
Auxiliary contacts:	4 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	4 A
Auxiliary contacts:	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 Order no.: 750154, 751154
dual-channel without detect. of shorts across contacts at U_B DC	60 Ohm
dual-channel without detect. of shorts across contacts at U_B AC	60 Ohm Order no.: 750154, 751154
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 Order no.: 750154, 751154
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Category of output contacts in accordance with EN 954-1, EN ISO 13849-1	
Safety contacts (S) instantaneous:	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset typ.	170 ms
with automatic reset max.	300 ms
with automatic reset after power on typ.	350 ms
with automatic reset after power on max.	600 ms
with manual reset typ.	40 ms
with manual reset max.	300 ms
on monitored reset with rising edge typ.	35 ms
on monitored reset with rising edge max.	50 ms
on monitored reset with falling edge typ.	55 ms
on monitored reset with falling edge max.	70 ms
Delay-on de-energisation	
with E-STOP typ.	10 ms
with E-STOP max.	20 ms
with power failure typ.	40 ms Order no.: 750124, 751124
	75 ms Order no.: 750154, 751154
with power failure max.	110 ms Order no.: 750154, 751154
	60 ms Order no.: 750124, 751124
Recovery time at max. switching frequency 1/s	
after E-STOP	50 ms
after power failure	100 ms
Waiting period with a monitored reset	
with rising edge	120 ms
with falling edge	150 ms Order no.: 750154, 751154
	250 ms Order no.: 750124, 751124

Up to PL e of EN ISO 13849-1 PNOZ s4.1

1.2

Times	
Min. start pulse duration with a monitored reset	
with rising edge	30 ms
with falling edge	100 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 - 150 Hz
Amplitude	0.35 mm
Climatic suitability	EN 60068-2-78
Airgap creepage in accordance with EN 60947-1	
Pollution degree	2
Rated insulation voltage	250 V
Rated impulse withstand voltage	4.0 kV
Ambient temperature	-10 - 60 °C
Storage temperature	-40 - 85 °C
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 Order no.: 750124, 750154
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm², 24 - 16 AWG Order no.: 750124, 750154
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm², 24 - 16 AWG Order no.: 750124, 750154
Torque setting with screw terminals	0.50 Nm Order no.: 750124, 750154
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 2.50 mm², 24 - 12 AWG Order no.: 751124, 751154
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751124, 751154
Stripping length	9 mm Order no.: 751124, 751154
Dimensions	
Height	102.0 mm Order no.: 751124, 751154 96.0 mm Order no.: 750124, 750154
Width	22.5 mm
Depth	120.0 mm
Weight	190 g Order no.: 750124, 751124 210 g Order no.: 750154, 751154

The standards current on **2008-04** apply.

Conventional thermal current		
Number of contacts	I_{th} (A) at U_B DC	I_{th} (A) at U_B AC
1	6.00 A	6.00 A Order no.: 750154, 751154
2	6.00 A	6.00 A Order no.: 750154, 751154
3	4.50 A	4.50 A Order no.: 750154, 751154

Up to PL e of EN ISO 13849-1 PNOZ s4.1

Order reference

Type	Features	Terminals	Order no.
PNOZ s4.1	24 VDC	With spring-loaded terminals	751 124
PNOZ s4.1	24 VDC	With screw terminals	750 124
PNOZ s4.1	48 - 240 VAC/DC	With spring-loaded terminals	751 154
PNOZ s4.1	48 - 240 VAC/DC	With screw terminals	750 154

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

1.2



Safety relay for monitoring E-STOP pushbuttons, safety gates and light barriers.

Approvals

	PNOZ s5
	◆
	◆
	◆

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

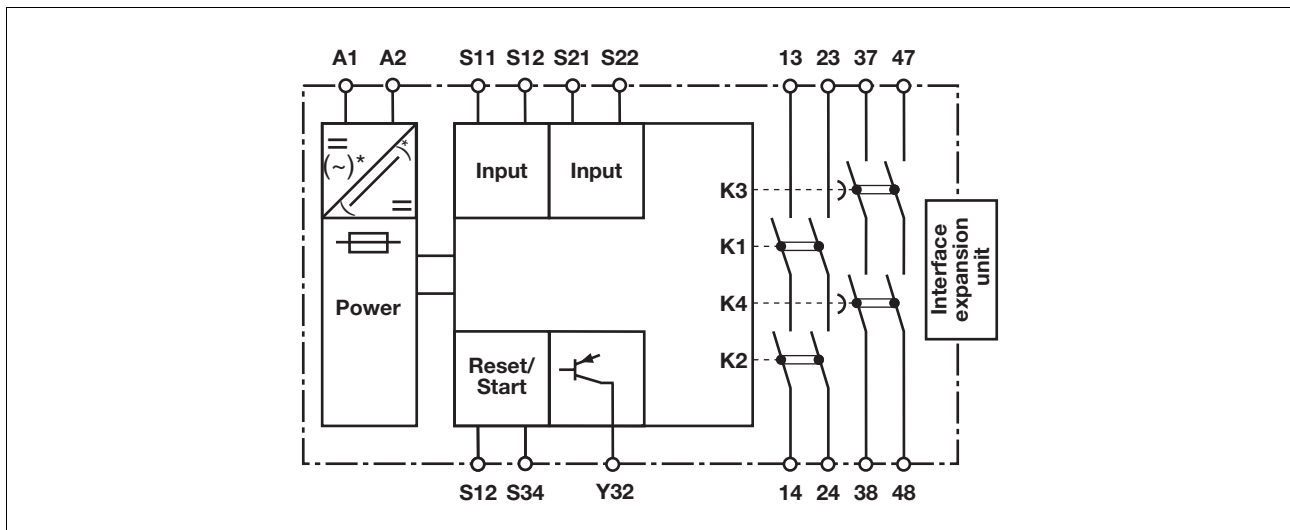
The safety relay meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1 and may be used in applications with

- ▶ E-STOP pushbuttons
- ▶ Safety gates
- ▶ Light barriers

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



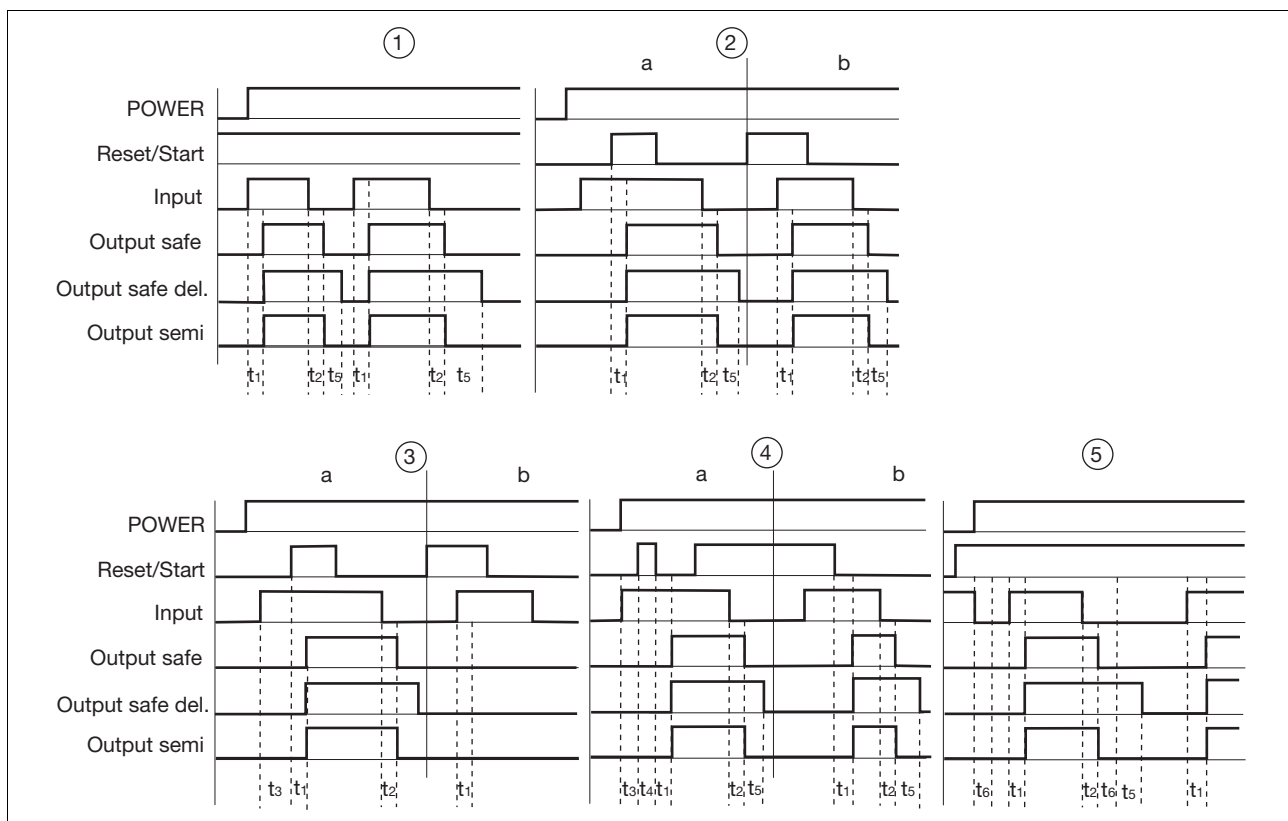
* only when $U_B = 48 - 240 \text{ VAC/DC}$

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

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

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 output Y32
- ▶ ①: Automatic reset
- ▶ ②: Manual reset
- ▶ ③: Monitored reset with rising edge
- ▶ ④: Monitored reset with falling edge
- ▶ ⑤: Reset with start-up test

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

- ▶ a: Input circuit closes before reset circuit
- ▶ b: Reset circuit closes before input circuit
- ▶ t₁: Switch-on delay
- ▶ t₂: Delay-on de-energisation
- ▶ t₃: Waiting period
- ▶ t₄: Waiting period reset circuit was closed
- ▶ t₅: Delay time
- ▶ t₆: 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:

$$I_{\max} = \frac{R_{I_{\max}}}{R_1 / \text{km}}$$

R_{I_{max}} = max. overall cable resistance (see technical details)

R₁ / 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

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

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 $U_B = 24\text{ VDC}$)		

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

▶ Reset circuit/feedback loop

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

▶ Semiconductor output

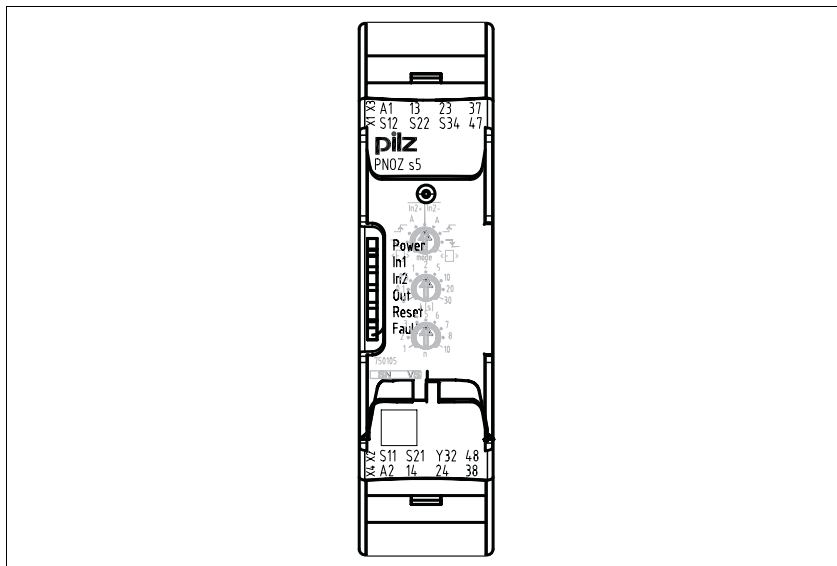
U_B 24 VDC	U_B 48 – 240 VAC/DC
*Connect together the 0V connections on all the external power supplies	

▶ Key

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

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

Terminal configuration



1.2

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:

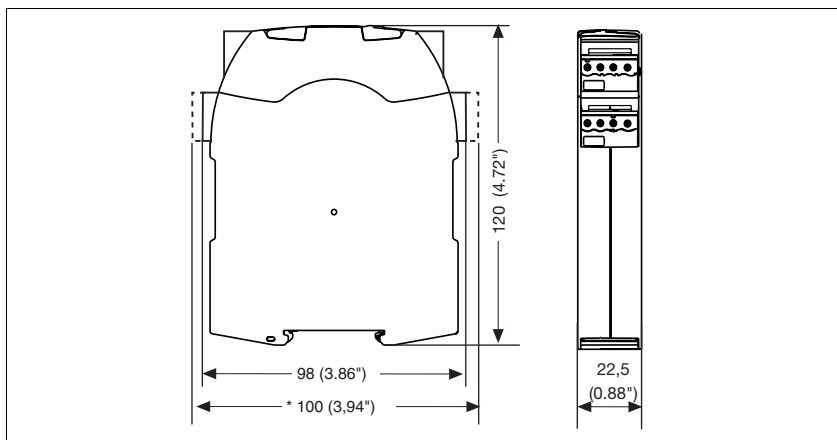
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module.
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

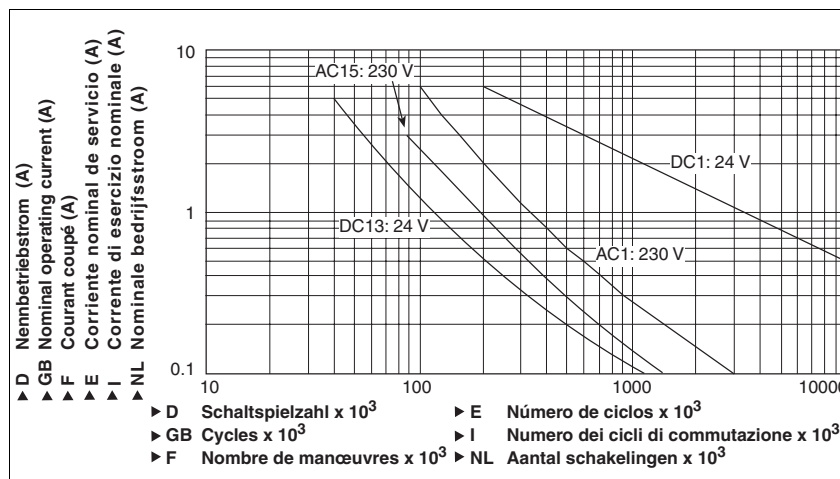


Up to PL e of EN ISO 13849-1 PNOZ s5

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



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 Order no.: 750135, 751135
Power consumption at U _B DC	4.0 W
Frequency range AC	50 - 60 Hz
Residual ripple DC	20 %, 160 %
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
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

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

Electrical data	
External contact fuse protection ($I_k = 1 \text{ kA}$) 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 Order 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 Order 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 Order no.: 750135, 751135
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Safety contacts, delayed <30 s	e
Safety contacts, delayed ≥ 30 s	e
Category of output contacts in accordance with EN 954-1 , EN ISO 13849-1	
Safety contacts (S) instantaneous:	4
Delay time <30 s	4
Delay time ≥ 30 s	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Safety contacts, delayed <30 s	3
Safety contacts, delayed ≥ 30 s	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Safety contacts, delayed <30 s	2.34E-09 1/h
Safety contacts, delayed ≥ 30 s	2.34E-09 1/h
Mission time/Proof test interval in years	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

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

1.2

Times	
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 %/+1 %, -20 ms/+20 ms
Repetition accuracy in the case of a fault	-15 %/+15 %, -20 ms/+20 ms
Time accuracy	-1 %/+1 %, -20 ms/+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 - 55 Hz
Amplitude	0.35 mm
Climatic suitability	EN 60068-2-78
Airgap creepage in accordance with EN 60947-1	
Pollution degree	2
Rated insulation voltage	250 V
Rated impulse withstand voltage	4.0 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	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750105, 750135
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750105, 750135
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750105, 750135
Torque setting with screw terminals	0.50 Nm Order no.: 750105, 750135
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 2.50 mm ² , 24 - 12 AWG Order no.: 751105, 751135, 751185
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751105, 751135, 751185
Stripping length	9 mm Order no.: 751105, 751135, 751185
Dimensions	
Height	102.0 mm Order no.: 751105, 751135, 751185 96.0 mm Order no.: 750105, 750135
Width	22.5 mm
Depth	120.0 mm
Weight	235 g Order no.: 750105, 751105, 751185 280 g Order no.: 750135, 751135

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

The standards current on **2006-04** apply.

Conventional thermal current	
I_{th} (A) at U_B DC	
1 contact	6.00 A
2 contacts	6.00 A
3 contacts	6.00 A
4 contacts	6.00 A

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

Up to PL e of EN ISO 13849-1 PNOZ s6

1.2



Two-hand control unit for press controllers and safety circuits

Approvals

PNOZ s6	
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 3 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ 1 semiconductor output
- ▶ Connection options for:
 - 2 operator elements (buttons)
- ▶ A connector can be used to connect 1 PNOZsigma contact expander module
- ▶ LED indicator for:
 - Supply voltage
 - Input status, channel 1
 - Input status, channel 2
 - Switch status, safety contacts
 - Feedback loop
 - Errors
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

Unit description

The two-hand control relay meets the requirements of EN 574 Type IIIC. It forces the operator to keep his hands

outside the danger zone area during the hazardous movement. The unit is suitable for use on controllers for metalworking presses as a component for simultaneous switching.

It can be used in applications with

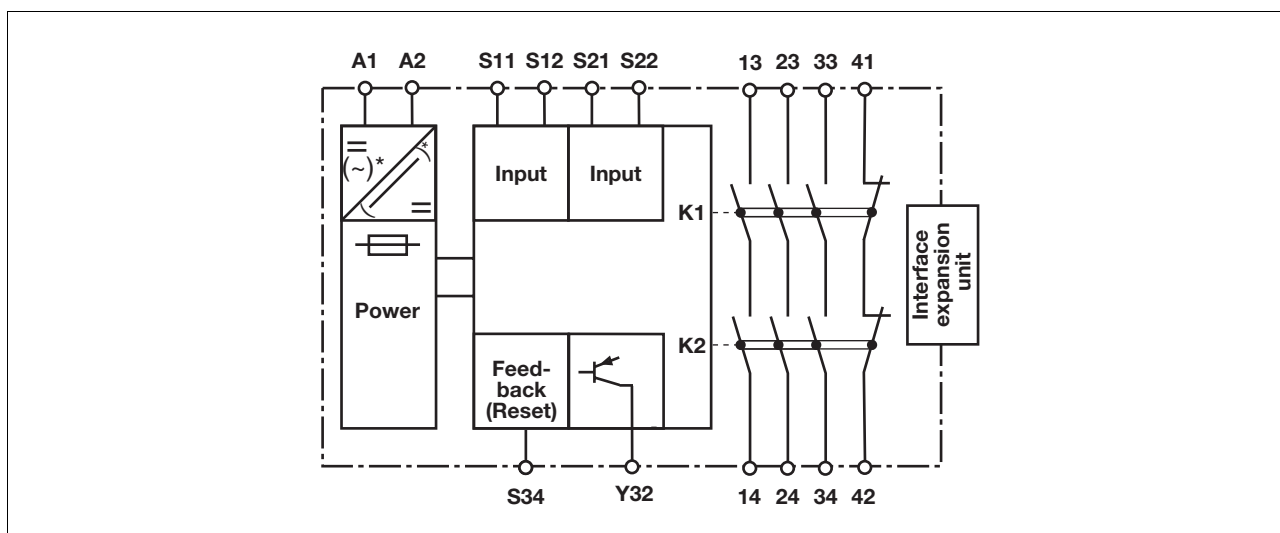
- ▶ Mechanical presses (EN 692)
- ▶ Hydraulic presses (EN 693)
- ▶ Safety circuits in accordance with EN 60204-1

Safety features

The two-hand control 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 circuit prevents a further press stroke in the case of:
 - Relay failure
 - Contact welding
 - Coil defect on a relay
 - Open circuit
 - Short circuit
- ▶ The unit has an electronic fuse.

Block diagram



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

Up to PL e of EN ISO 13849-1 PNOZ s6

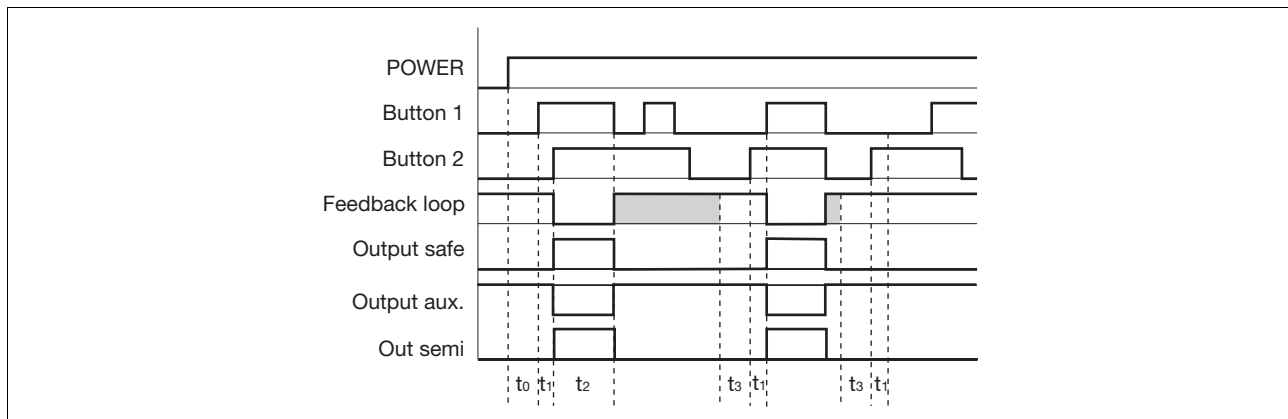
Function description

- ▶ The two-hand control relay must be activated by simultaneously press-

ing two buttons within **0.5 s**. If one or both of the buttons are released, the unit interrupts the control command for the hazardous movement.

- ▶ Reactivation: The output relays will not re-energise until both operator elements have been released and then re-operated simultaneously.

Timing diagram



Key

- ▶ POWER: Supply voltage
- ▶ Button 1/Button 2: Input circuits S11-S12, S21- S22
- ▶ Feedback loop: Feedback loop S34
- ▶ Output safe: Safety outputs 13-14, 23-24, 33-34
- ▶ Output aux: Auxiliary contacts 41-42
- ▶ Out semi: Semiconductor output switch status Y32
- ▶ t_0 : Recovery time after power on
- ▶ t_1 : Simultaneity, channel 1 and 2
- ▶ t_2 : Operating cycle ended through button 1 or 2
- ▶ t_3 : S34-S12 must be closed before the button is operated (recovery time)
- ▶ Shaded area: Status irrelevant

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 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.

Up to PL e of EN ISO 13849-1 PNOZ s6

Preparing for operation

▶ Supply voltage

Supply voltage	AC	DC

▶ Input circuit

Input circuit	Single-channel	Dual-channel
Two-hand button with detection of shorts across contacts		

▶ Feedback loop

	Feedback loop
Contacts from external contactors	

▶ Semiconductor output

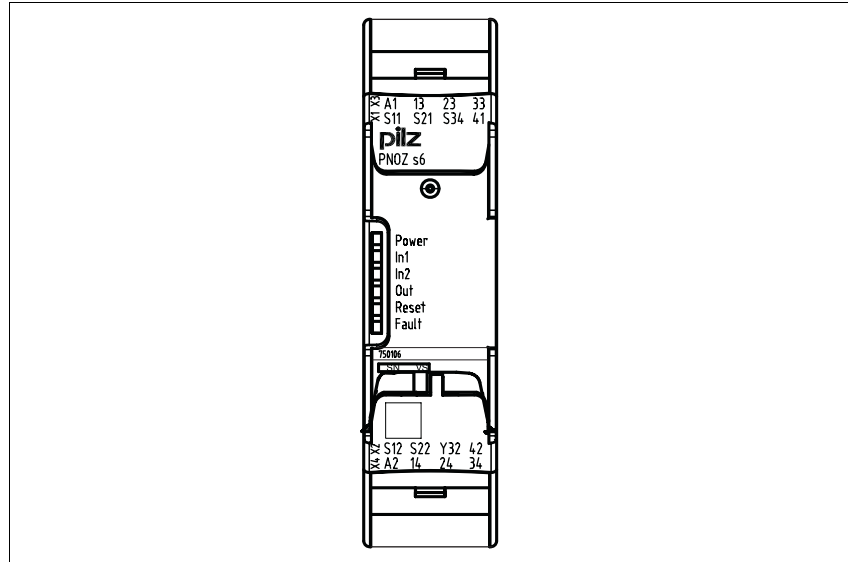
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▶ Key

S1/S2	Two-hand button
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Up to PL e of EN ISO 13849-1 PNOZ s6

Terminal configuration



1.2

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

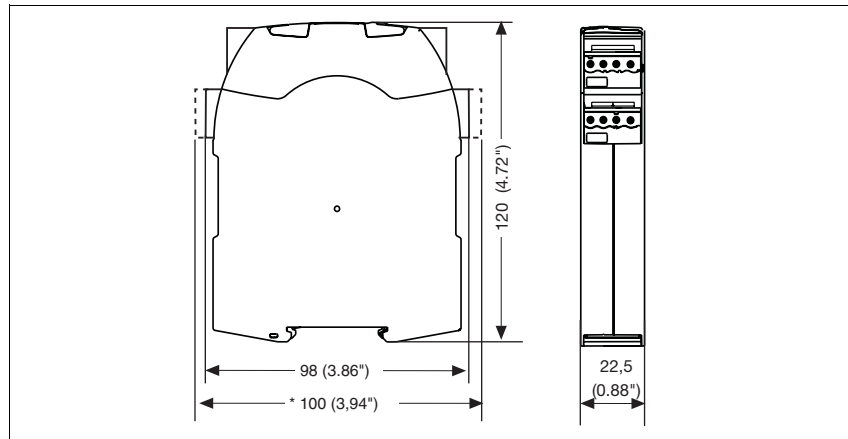
CAUTION!

The distance of the button connected to the two-hand relay from the nearest danger zone must be large enough that if one of the buttons is released, the dangerous movement is interrupted before the operator can reach into the danger zone (see EN 999 "The po-

sitioning of protective equipment in respect of approach speeds of parts of the human body").

Dimensions

*with spring-loaded terminals



Up to PL e of EN ISO 13849-1 PNOZ s6

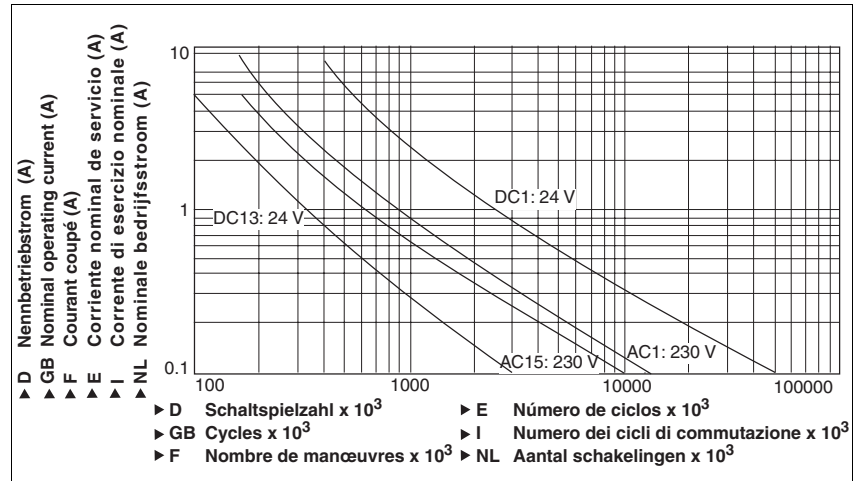
NOTICE

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

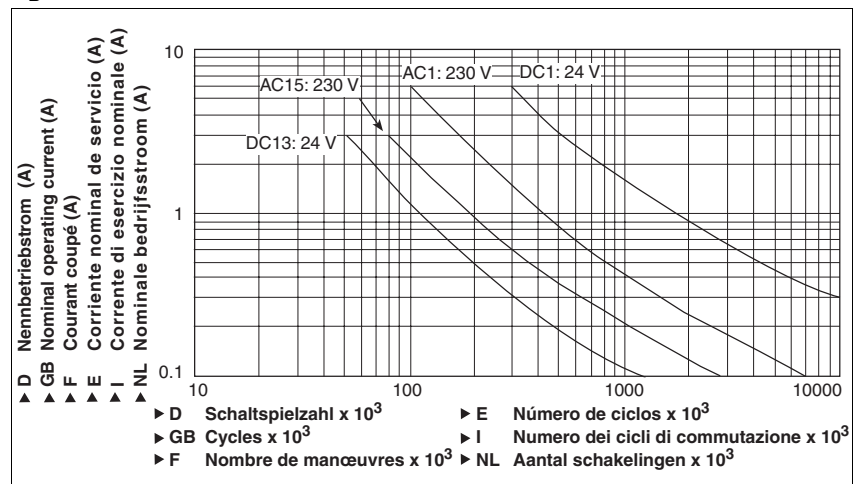
1.2

Service life graph

U_B 24 VDC



U_B 48-240 VAC/DC



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	7.0 VA Order no.: 750136, 751136
Power consumption at U_B DC	3.5 W
Frequency range AC	50 - 60 Hz
Residual ripple DC	20 %
Voltage and current at	
Input circuit DC: 24.0 V	
N/O contact	20 mA
N/C contact	10 mA
Feedback loop DC: 24.0 V	15.0 mA

Up to PL e of EN ISO 13849-1 PNOZ s6

Electrical data	
Number of output contacts	
Safety contacts (S) instantaneous:	3
Auxiliary contacts (N/C):	1
Type in accordance with EN 574	III C
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 Order no.: 750136, 751136 8.0 A Order no.: 750106, 751106 P_{max} : 1500 VA Order no.: 750136, 751136 2000 VA Order no.: 750106, 751106
Safety contacts: DC1 at 24 V	I_{min} : 0.01 A , I_{max} : 6.0 A Order no.: 750136, 751136 8.0 A Order no.: 750106, 751106 P_{max} : 150 W Order no.: 750136, 751136 200 W Order no.: 750106, 751106
Auxiliary contacts: AC1 at 240 V	I_{min} : 0.01 A , I_{max} : 6.0 A Order no.: 750136, 751136 8.0 A Order no.: 750106, 751106 P_{max} : 1500 VA Order no.: 750136, 751136 2000 VA Order no.: 750106, 751106
Auxiliary contacts: DC1 at 24 V	I_{min} : 0.01 A , I_{max} : 6.0 A Order no.: 750136, 751136 8.0 A Order no.: 750106, 751106 P_{max} : 150 W Order no.: 750136, 751136 200 W Order no.: 750106, 751106
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	I_{max} : 3.0 A Order no.: 750136, 751136 6.0 A Order no.: 750106, 751106
Safety contacts: DC13 at 24 V (6 cycles/min)	I_{max} : 4.0 A Order no.: 750136, 751136 5.0 A Order no.: 750106, 751106
Auxiliary contacts: AC15 at 230 V	I_{max} : 3.0 A Order no.: 750136, 751136 6.0 A Order no.: 750106, 751106
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	I_{max} : 4.0 A Order no.: 750136, 751136 5.0 A Order no.: 750106, 751106
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:	10 A Order no.: 750106, 751106 6 A Order no.: 750136, 751136
Auxiliary contacts:	10 A Order no.: 750106, 751106 6 A Order no.: 750136, 751136
Blow-out fuse, slow	
Safety contacts:	4 A Order no.: 750136, 751136 6 A Order no.: 750106, 751106
Auxiliary contacts:	4 A Order no.: 750136, 751136 6 A Order no.: 750106, 751106
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	4 A Order no.: 750136, 751136 6 A Order no.: 750106, 751106
Auxiliary contacts:	4 A Order no.: 750136, 751136 6 A Order no.: 750106, 751106
Semiconductor outputs (short circuit proof)	24.0 V DC, 20 mA
Max. overall cable resistance R_{lmax} per input circuit	30 Ohm
Safety-related characteristic data	
Performance Level (PL)* of EN ISO 13849-1	
Safety contacts, instantaneous	e
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.44E-09 1/h
Mission time/Proof test interval in years	20

Up to PL e of EN ISO 13849-1

PNOZ s6

Times

Delay-on de-energisation (reaction time in accordance with EN 574)

N/O contact **30 ms**

N/C contact **40 ms**

Recovery time **250 ms**

Simultaneity, channel 1 and 2 **0.5 s**

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 - 55 Hz**

Amplitude **0.35 mm**

Climatic suitability **EN 60068-2-78**

Airgap creepage in accordance with **EN 60947-1**

Pollution degree **2**

Rated insulation voltage **250 V**

Rated impulse withstand voltage **4.0 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 **PC**

Front **PC**

Cross section of external conductors with screw terminals

1 core flexible **0.25 - 2.50 mm², 24 - 12 AWG** Order no.: 750106, 750136

2 core, same cross section, flexible:

with crimp connectors, without insulating sleeve **0.25 - 1.00 mm², 24 - 16 AWG** Order no.: 750106, 750136

without crimp connectors or with TWIN crimp connectors **0.20 - 1.50 mm², 24 - 16 AWG** Order no.: 750106, 750136

Torque setting with screw terminals **0.50 Nm** Order no.: 750106, 750136

Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors **0.20 - 2.50 mm², 24 - 12 AWG** Order no.: 751106, 751136

Spring-loaded terminals: Terminal points per connection **2** Order no.: 751106, 751136

Stripping length **9 mm** Order no.: 751106, 751136

Dimensions

Height **100.0 mm** Order no.: 751106, 751136

98.0 mm Order no.: 750106, 750136

Width **22.5 mm**

Depth **120.0 mm**

Weight **190 g** Order no.: 750106, 751106

210 g Order no.: 750136, 751136

*not within BG's scope of inspection

The standards current on **2006-07** apply.

Up to PL e of EN ISO 13849-1 PNOZ s6

Conventional thermal current

Number of contacts	I_{th} (A) at U_B DC	I_{th} (A) at U_B AC
1	6.00 A Order no.: 750136, 751136 8.00 A Order no.: 750106, 751106	6.00 A Order no.: 750136, 751136
2	6.00 A Order no.: 750136, 751136 8.00 A Order no.: 750106, 751106	6.00 A Order no.: 750136, 751136
3	4.50 A Order no.: 750136, 751136 6.00 A Order no.: 750106, 751106	4.50 A Order no.: 750136, 751136

Order reference

Type	Features	Terminals	Order no.
PNOZ s6	24 VDC	With screw terminals	750 106
PNOZ s6 C	24 VDC	With spring-loaded terminals	751 106
PNOZ s6	48 – 240 VAC/DC	With screw terminals	750 136
PNOZ s6 C	48 – 240 VAC/DC	With spring-loaded terminals	751 136

Up to PL e of EN ISO 13849-1 PNOZ s6.1

1.2



Two-hand control device for safety circuits

Approvals

PNOZ s6.1	
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 3 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ 1 semiconductor output
- ▶ Connection options for:
 - 2 operator elements (buttons)
- ▶ A connector can be used to connect 1 PNOZsigma contact expander module
- ▶ LED indicator for:
 - Supply voltage
 - Input status, channel 1
 - Input status, channel 2
 - Switch status, safety contacts
 - Feedback loop
 - Fault
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)
- ▶ See order reference for unit types

Unit description

The two-hand control relay meets the requirements of EN 574 Type IIIA. It

forces the operator to keep his hands outside the danger zone area during the hazardous movement. It is designed for use in two-hand circuits.

CAUTION!

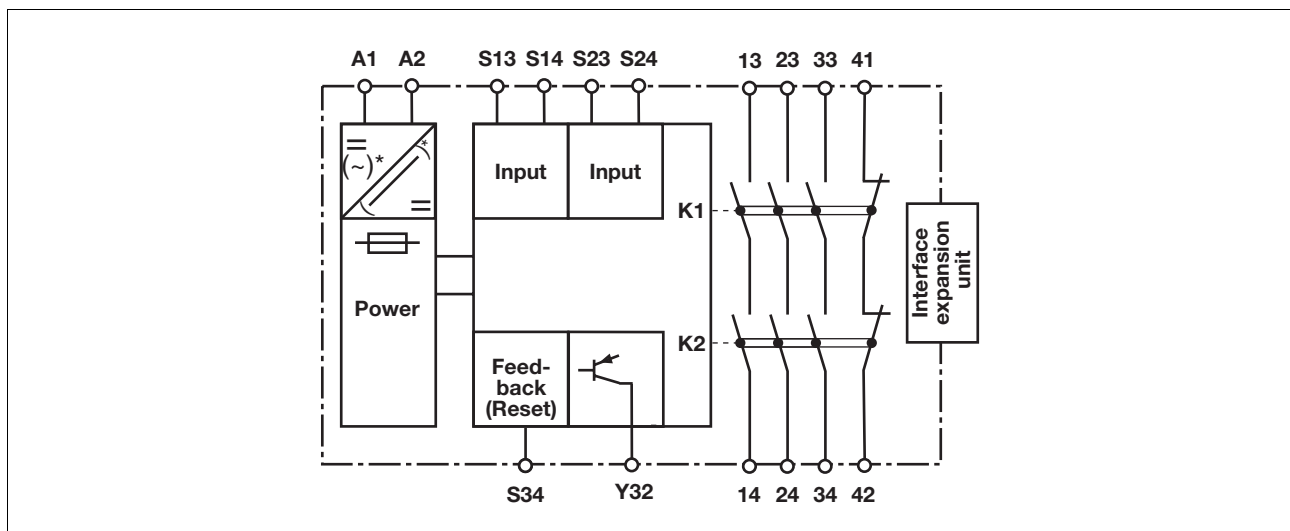
The two-hand control relay may **not** be used on **press controllers**. It is only suitable for use where the risk analysis has established a low level of risk (e.g. EN 954-1 Cat. 1).

Safety features

The two-hand control relay meets the following safety requirements:

- ▶ The two-hand control relay prevents the plant from being enabled in the following cases:
 - Power supply failure
 - Component failure
 - Short circuit on an input circuit
 - Coil defect
 - Open circuit
 - Earth fault
- ▶ In each on-off cycle, the output relays on the safety device are tested to ensure they open and close correctly

Block diagram



*only with UB = 48 – 240 VAC/DC

Up to PL e of EN ISO 13849-1 PNOZ s6.1

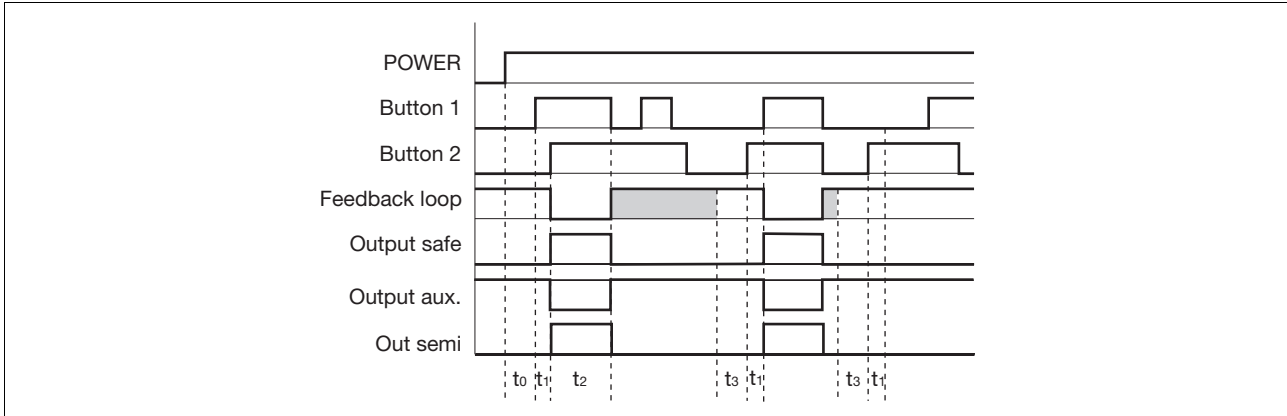
Function description

- ▶ The two-hand control relay must be activated by simultaneously press-

ing two buttons within **0.5 s**. If one or both of the buttons are released, the unit interrupts the control command for the hazardous movement.

- ▶ Reactivation: The output relays will not re-energise until both operator elements have been released and then re-operated simultaneously.

Timing diagram



Key

- ▶ POWER: Supply voltage
- ▶ Button 1/Button 2: Input circuits S13-S14, S23-S24
- ▶ Feedback loop: Feedback loop S34
- ▶ Output safe: Safety outputs 13-14, 23-24, 33-34
- ▶ Output aux: Auxiliary contacts 41-42
- ▶ Out semi: Semiconductor output switch status Y32
- ▶ t_0 : Recovery time after power on
- ▶ t_1 : Simultaneity, channel 1 and 2
- ▶ t_2 : Operating cycle ended through button 1 or 2
- ▶ t_3 : S34-S12 must be closed before the button is operated (recovery time)
- ▶ Shaded area: Status irrelevant

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 I_{\max} in the input circuit:

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

$R_{I_{\max}}$ = 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.

Two-hand relays

Up to PL e of EN ISO 13849-1 PNOZ s6.1

Preparing for operation

▶ Supply voltage

Supply voltage	AC	DC

▶ Input circuit

Input circuit	Single-channel	Dual-channel
Two-hand button with detection of shorts across contacts		

▶ Feedback loop

	Feedback loop
Contacts from external contactors	

▶ Semiconductor output

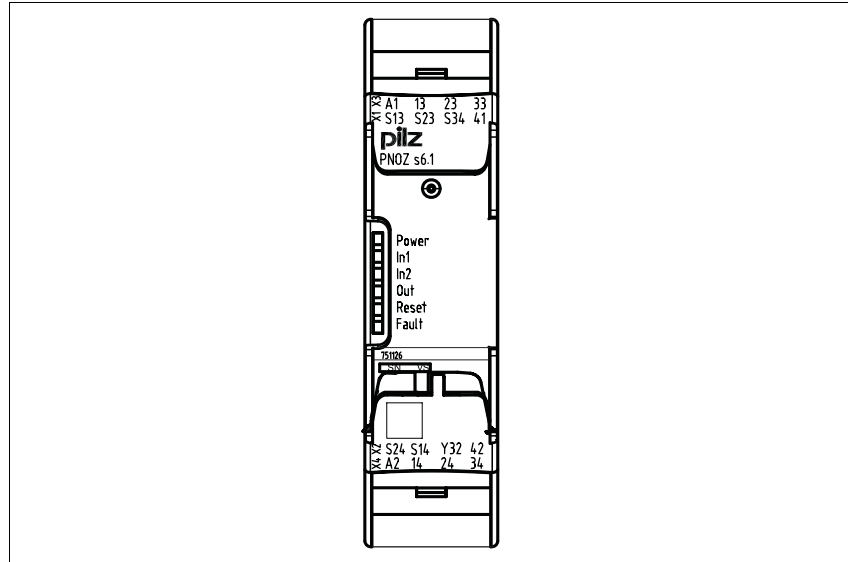
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▶ Key

S1/S2	Two-hand button
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Up to PL e of EN ISO 13849-1 PNOZ s6.1

Terminal configuration



1.2

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:

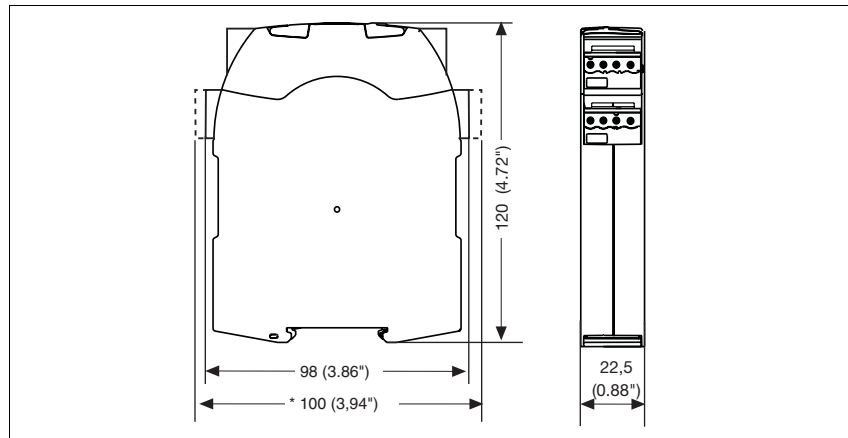
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module.
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals



Up to PL e of EN ISO 13849-1 PNOZ s6.1

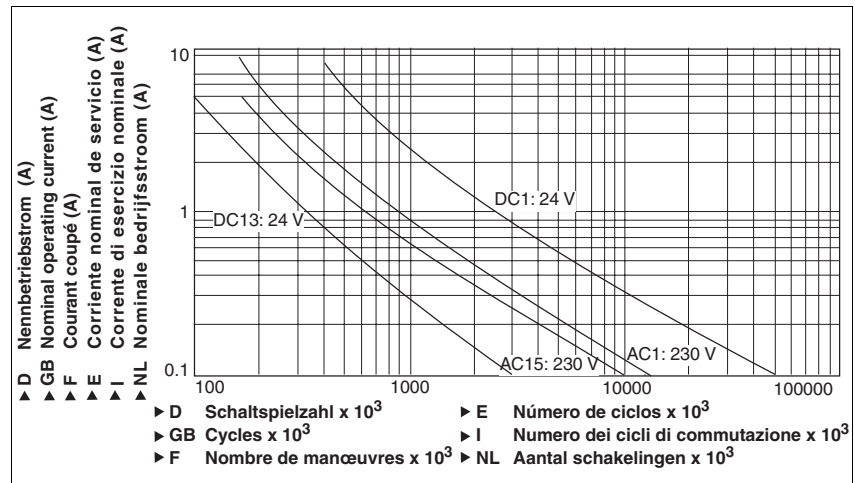
NOTICE

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

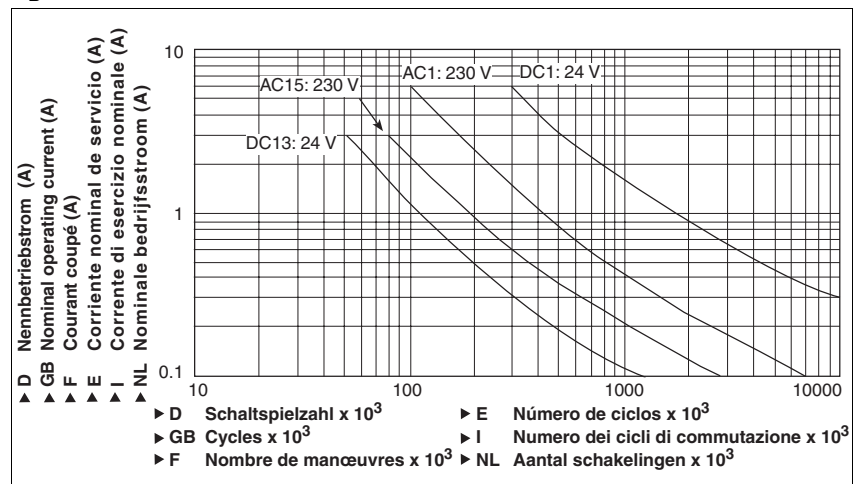
1.2

Service life graph

U_B 24 VDC



U_B 48-240 VAC/DC



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	7.0 VA Order no.: 750156, 751156
Power consumption at U_B DC	3.5 W
Frequency range AC	50 - 60 Hz
Residual ripple DC	20 %
Voltage and current at	
Input circuit DC: 24.0 V	
N/O contact	20 mA
Feedback loop DC: 24.0 V	15.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	3
Auxiliary contacts (N/C):	1

Up to PL e of EN ISO 13849-1 PNOZ s6.1

Electrical data	
Type in accordance with EN 574	III A
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 Order no.: 750156, 751156 8.0 A Order no.: 750126, 751126 P_{max} : 1500 VA Order no.: 750156, 751156 2000 VA Order no.: 750126, 751126
Safety contacts: DC1 at 24 V	I_{min} : 0.01 A , I_{max} : 6.0 A Order no.: 750156, 751156 8.0 A Order no.: 750126, 751126 P_{max} : 150 W Order no.: 750156, 751156 200 W Order no.: 750126, 751126
Auxiliary contacts: AC1 at 240 V	I_{min} : 0.01 A , I_{max} : 6.0 A Order no.: 750156, 751156 8.0 A Order no.: 750126, 751126 P_{max} : 1500 VA Order no.: 750156, 751156 2000 VA Order no.: 750126, 751126
Auxiliary contacts: DC1 at 24 V	I_{min} : 0.01 A , I_{max} : 6.0 A Order no.: 750156, 751156 8.0 A Order no.: 750126, 751126 P_{max} : 150 W Order no.: 750156, 751156 200 W Order no.: 750126, 751126
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	I_{max} : 3.0 A Order no.: 750156, 751156 6.0 A Order no.: 750126, 751126
Safety contacts: DC13 at 24 V (6 cycles/min)	I_{max} : 4.0 A Order no.: 750156, 751156 5.0 A Order no.: 750126, 751126
Auxiliary contacts: AC15 at 230 V	I_{max} : 3.0 A Order no.: 750156, 751156 6.0 A Order no.: 750126, 751126
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	I_{max} : 4.0 A Order no.: 750156, 751156 5.0 A Order no.: 750126, 751126
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:	10 A Order no.: 750126, 751126 6 A Order no.: 750156, 751156
Auxiliary contacts:	10 A Order no.: 750126, 751126 6 A Order no.: 750156, 751156
Blow-out fuse, slow	
Safety contacts:	4 A Order no.: 750156, 751156 6 A Order no.: 750126, 751126
Auxiliary contacts:	4 A Order no.: 750156, 751156 6 A Order no.: 750126, 751126
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	4 A Order no.: 750156, 751156 6 A Order no.: 750126, 751126
Auxiliary contacts:	4 A Order no.: 750156, 751156 6 A Order no.: 750126, 751126
Semiconductor outputs (short circuit proof)	24.0 V DC, 20 mA
Max. overall cable resistance R_{lmax} per input circuit	30 Ohm
Safety-related characteristic data	
Performance Level (PL)* of EN ISO 13849-1	
Safety contacts, instantaneous	e
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.44E-09 1/h
Mission time/Proof test interval in years	20

Up to PL e of EN ISO 13849-1 PNOZ s6.1

Times	
Delay-on de-energisation (reaction time in accordance with EN 574)	
N/O contact	40 ms
N/C contact	50 ms
Recovery time	250 ms
Simultaneity, channel 1 and 2	0.5 s
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 - 55 Hz
Amplitude	0.35 mm
Climatic suitability	EN 60068-2-78
Airgap creepage in accordance with EN 60947-1	
Pollution degree	2
Rated insulation voltage	250 V
Rated impulse withstand voltage	4.0 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	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750126, 750156
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750126, 750156
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750126, 750156
Torque setting with screw terminals	0.50 Nm Order no.: 750126, 750156
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751126, 751156
Stripping length	9 mm Order no.: 751126, 751156
Dimensions	
Height	
	100.0 mm Order no.: 751126, 751156
	98.0 mm Order no.: 750126, 750156
Width	
	22.5 mm
Depth	
	120.0 mm
Weight	
	190 g Order no.: 750126, 751126
	210 g Order no.: 750156, 751156

*not within BG's scope of inspection

The standards current on 2006-07 apply.

Up to PL e of EN ISO 13849-1 PNOZ s6.1

Conventional thermal current

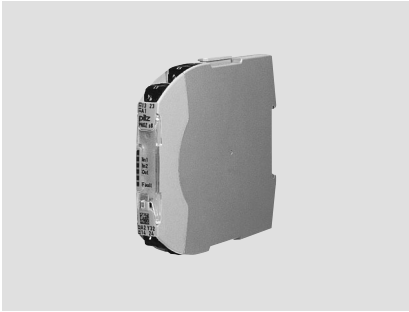
Number of contacts	I_{th} (A) at U_B DC	I_{th} (A) at U_B AC
1	6.00 A Order no.: 750156, 751156 8.00 A Order no.: 750126, 751126	6.00 A Order no.: 750156, 751156
2	6.00 A Order no.: 750156, 751156 8.00 A Order no.: 750126, 751126	6.00 A Order no.: 750156, 751156
3	4.50 A Order no.: 750156, 751156 6.00 A Order no.: 750126, 751126	4.50 A Order no.: 750156, 751156

Order reference

Type	Features	Terminals	Order no.
PNOZ s6.1	24 VDC	With screw terminals	750 126
PNOZ s6.1 C	24 VDC	With spring-loaded terminals	751 126
PNOZ s6.1	48 – 240 VAC/DC	With screw terminals	750 156
PNOZ s6.1 C	48 – 240 VAC/DC	With spring-loaded terminals	751 156

Up to PL c of EN ISO 13849-1 PNOZ s8

1.2



Contact expansion module for increasing the number of available contacts

Approvals

PNOZ s8	
	◆
	◆
	◆

Unit features

- ▶ Relay outputs:
 - 2 safety contacts (N/O), instantaneous
- ▶ 1 semiconductor output
- ▶ LED indicator for:
 - Input status, channel 1
 - Input status, channel 2
 - Switch status of the safety contacts
 - Errors
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

Unit description

The unit meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. The contact expansion module is used to increase the number of instantaneous safety contacts available on a base unit. Base units are all safety relays with feedback loop monitoring.

The category that can be achieved in accordance with EN 954-1 and EN ISO 13849-1 depends on the cate-

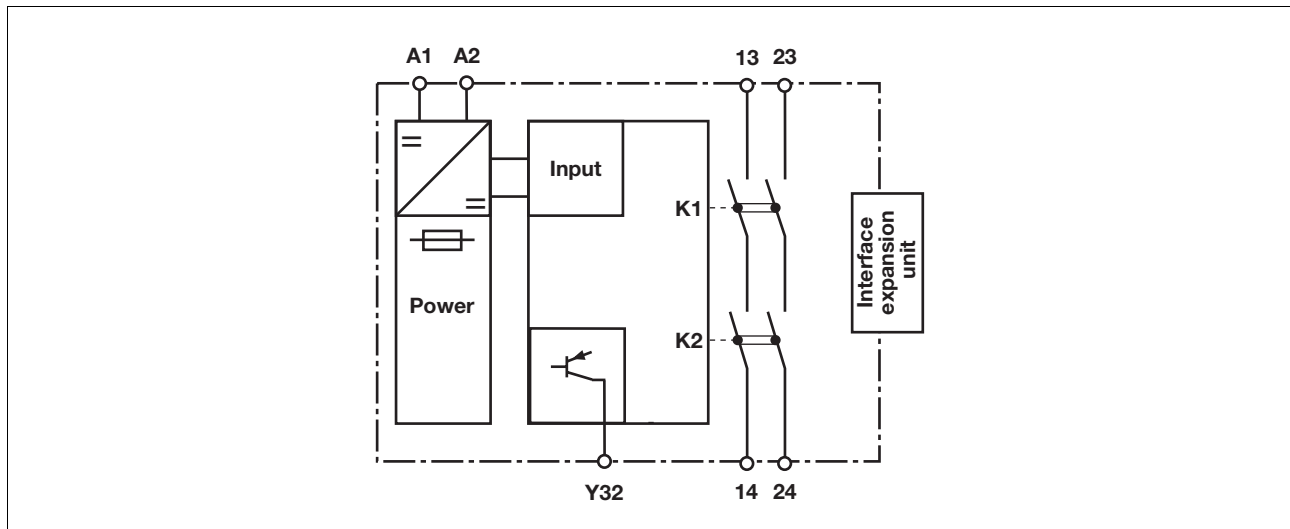
gory of the base unit. The contact expansion module may not exceed this.

Safety features

The unit meets the following safety requirements:

- ▶ The unit monitors its own output contacts.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ Earth fault in the feedback loop: Detected, depending on the base unit that is used.
- ▶ Earth fault in the input circuit: The output relays de-energise and the safety contacts open.

Block diagram



Up to PL c of EN ISO 13849-1 PNOZ s8

Function description

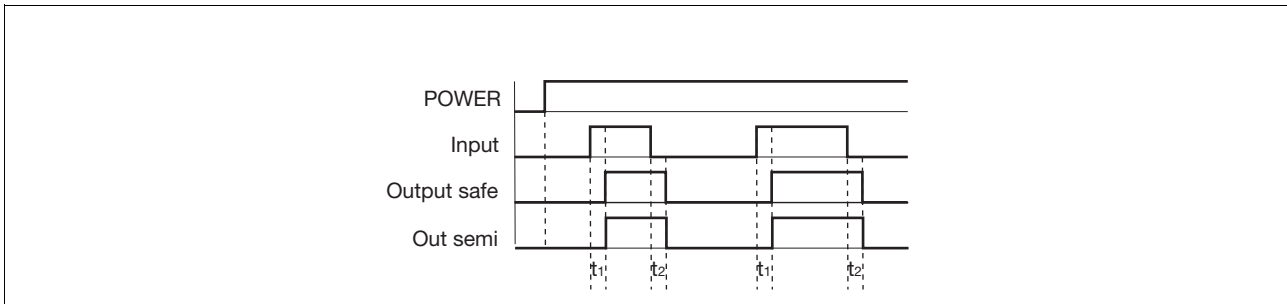
with PNOZsigma base unit:

- ▶ Dual-channel operation via PNOZsigma connector

without PNOZsigma base unit:

- ▶ Single-channel operation: one input circuit affects the output relays

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuits A1
- ▶ Output safe: Safety contacts 13-14, 23-24
- ▶ Out semi: Semiconductor output Y32
- ▶ t_1 : Switch-on delay
- ▶ t_2 : Delay-on de-energisation

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs 13-14, 23-24 are safety contacts.
- ▶ 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.

Up to PL c of EN ISO 13849-1 PNOZ s8

Preparing for operation

▶ Supply voltage

Supply voltage	AC	DC

▶ Input circuit

Input circuit	Single-channel	Dual-channel
Base unit: PNOZ X safety relay		
Base unit: PNOZelog safety relay Driven via semiconductor outputs (24 VDC)		

▶ Feedback loop

with PNOZsigma base unit:
The feedback loop is connected and evaluated via the connector.

without PNOZsigma base unit:
Feedback loop does not need to be monitored because the contact ex-

pansion block monitors its own output contacts.

▶ Semiconductor output

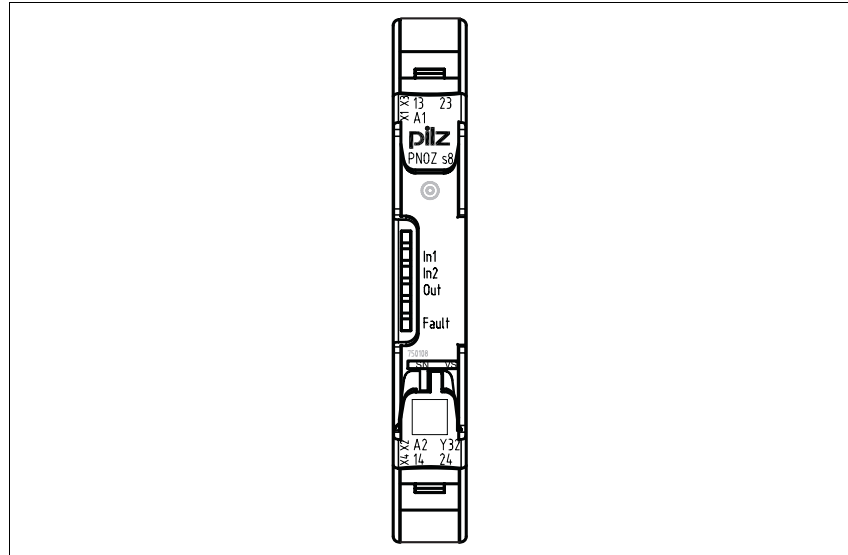
<p>*Connect together the 0V connections on all the external power supplies</p>

INFORMATION

If a base unit and a contact expander module from the PNOZsigma range are connected via the connector, no additional wiring is necessary. Do not connect A1 to the contact expander module!

Up to PL c of EN ISO 13849-1 PNOZ s8

Terminal configuration



1.2

Installation

Install contact expander module without base unit:

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

Connect base unit and PNOZsigma contact expander module:

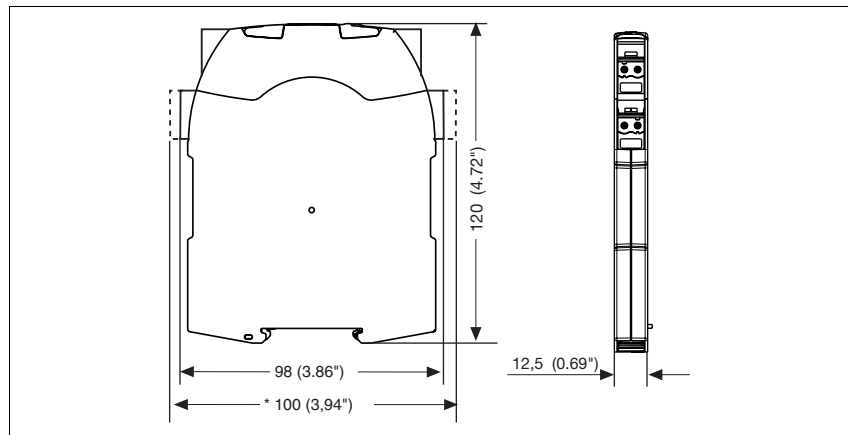
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals



Up to PL c of EN ISO 13849-1 PNOZ s8

NOTICE

This data sheet is only intended for use during configuration. For installation and operation, please refer to the op-

erating instructions supplied with the unit.

Technical details

Electrical data

Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-20 %/+20 %
Power consumption at U_B DC	2.0 W
Residual ripple DC	20 %
Voltage and current at	
Input circuit DC: 24.0 V	65.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	2
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.02 A, I_{max}: 3.0 A$ $P_{max}: 720 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.02 A, I_{max}: 3.0 A$ $P_{max}: 72 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 1.5 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 1.5 A$
Contact material	AgSnO2
External contact fuse protection ($I_k = 1 kA$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	4 A
Blow-out fuse, slow	
Safety contacts:	2 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	2 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
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	c
Category of output contacts in accordance with EN 954-1, EN ISO 13849-1	
Safety contacts (S) instantaneous:	3
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.00E-07 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset after power on typ.	100 ms
with automatic reset after power on max.	150 ms
Delay-on de-energisation	
with E-STOP typ.	30 ms
with E-STOP max.	40 ms
with power failure typ.	30 ms
with power failure max.	40 ms

Up to PL c of EN ISO 13849-1 PNOZ s8

Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	4.0 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	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750108
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750108
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750108
Torque setting with screw terminals	0.50 Nm Order no.: 750108
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 2.50 mm ² , 24 - 12 AWG Order no.: 751108
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751108
Stripping length	9 mm Order no.: 751108
Dimensions	
Height	102.0 mm Order no.: 751108 98.0 mm Order no.: 750108
Width	12.5 mm
Depth	120.0 mm
Weight	105 g

The standards current on 2006-04 apply.

Conventional thermal current	
I_{th} (A) at U_B DC	
1 contact	3.00 A
2 contacts	3.00 A

Order reference			
Type	Features	Terminals	Order no.
PNOZ s8	24 VDC	With screw terminal	750 108
PNOZ s8 C	24 VDC	With spring-loaded terminal	751 108

Up to PL e of EN ISO 13849-1 PNOZ s7

1.2



Contact expansion module for increasing the number of available contacts

Approvals

PNOZ s7	
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 4 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ Safe separation of safety contacts 13-14, 23-24, 33-34 from all other circuits
- ▶ LED indicator for:
 - Input status, channel 1
 - Input status, channel 2
 - Switch status of the safety contacts
 - Errors
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

Unit description

The unit meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. The contact expansion module is used to increase the number of instantaneous safety contacts available on a base unit. Base units are all safety relays with feedback loop monitoring.

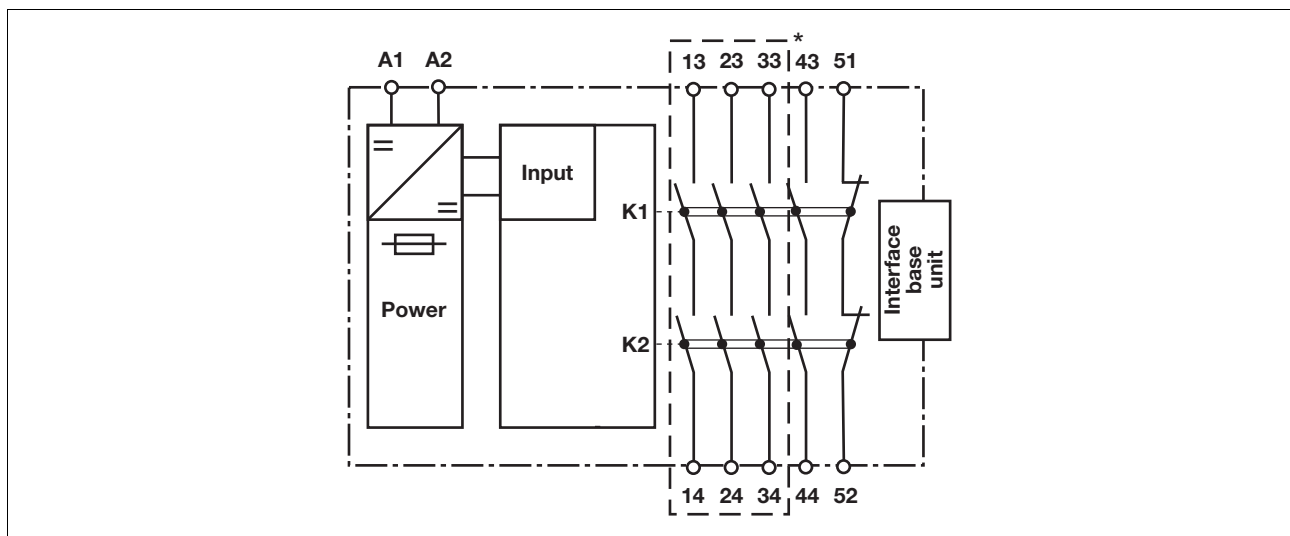
The category that can be achieved in accordance with EN 954-1 and EN ISO 13849-1 depends on the category of the base unit. The contact expansion module may not exceed this.

Safety features

The unit meets the following safety requirements:

- ▶ The contact expansion module expands an existing circuit. As the output relays are monitored via the base unit's feedback loop, the safety functions on the existing circuit are transferred to the contact expansion module.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ Earth fault in the feedback loop: Detected, depending on the base unit that is used.
- ▶ Earth fault in the input circuit: The output relays de-energise and the safety contacts open.

Block diagram



* Safe separation in accordance with EN 60947-1, 6 kV

Up to PL e of EN ISO 13849-1 PNOZ s7

Function description

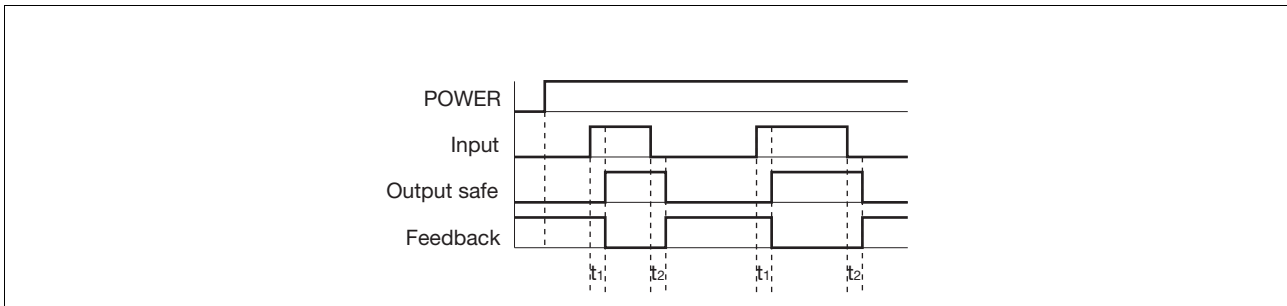
with PNOZsigma base unit:

- ▶ Dual-channel operation via PNOZsigma connector

without PNOZsigma base unit:

- ▶ Single-channel operation: one input circuit affects the output relays

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuits A1
- ▶ Output safe: Safety contacts 13-14, 23-24, 33-34, 43-44
- ▶ Feedback: Feedback loop 51-52
- ▶ t_1 : Switch-on delay
- ▶ t_2 : Delay-on de-energisation

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs 13-14, 23-24, 33-34, 43-44 are safety contacts, output 51-52 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.

Up to PL e of EN ISO 13849-1 PNOZ s7

Preparing for operation

▶ Supply voltage

Supply voltage	AC	DC

▶ Input circuit

Input circuit	Single-channel	Dual-channel
Base unit: PNOZ X safety relay		
Base unit: PNOZelog safety relay Driven via semiconductor outputs (24 VDC)		

▶ Feedback loop

Feedback loop	Base unit: Safety relay PNOZ X	Base unit: PNOZelog safety relay
Y1, Y2 and Input are inputs on the base unit; they evaluate the feedback loop		

▶ Connection to PNOZsigma base unit

	Base unit: PNOZsigma safety relay
The feedback loop is connected and evaluated via the connector	

INFORMATION

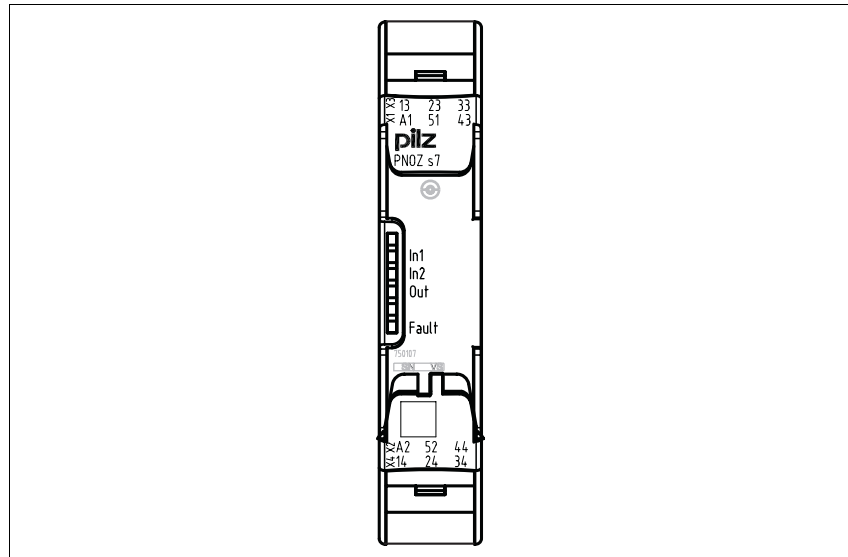
If a base unit and a contact expander module from the PNOZsigma range

are connected via the connector, no additional wiring is necessary.

Do not connect A1 to the contact expander module!

Up to PL e of EN ISO 13849-1 PNOZ s7

Terminal configuration



1.2

Installation

Install contact expander module without base unit:

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

Connect base unit and PNOZsigma contact expander module:

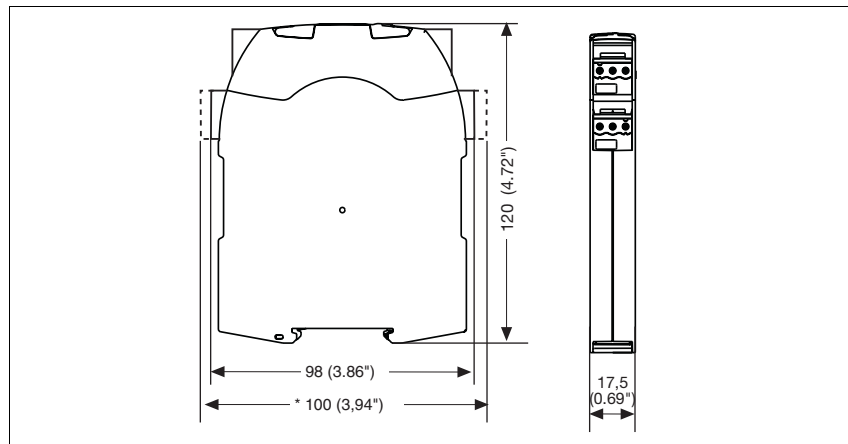
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

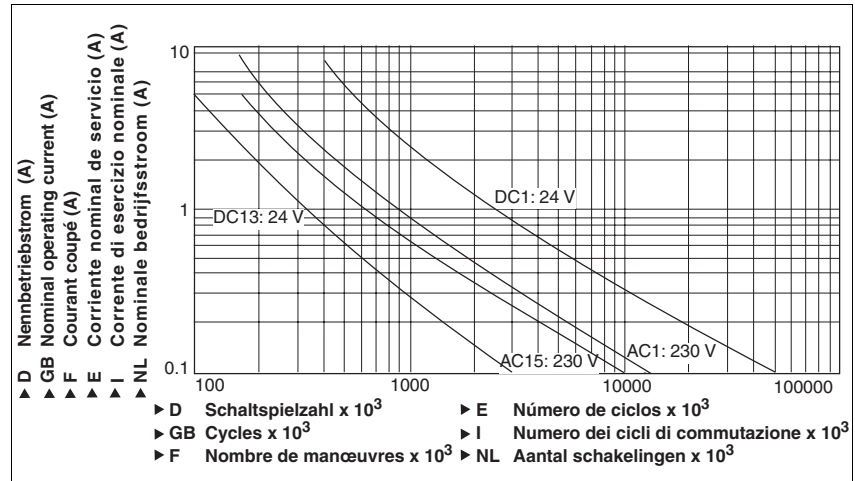


Up to PL e of EN ISO 13849-1 PNOZ s7

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



Technical details

Electrical data

Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-20 %/+20 %
Power consumption at U_B DC	2.0 W
Residual ripple DC	20 %
Voltage and current at Input circuit DC: 24.0 V	70.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	4
Auxiliary contacts (N/C):	1
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	I_{min} : 0.01 A , I_{max} : 8.0 A P_{max} : 2000 VA
Safety contacts: DC1 at 24 V	I_{min} : 0.01 A , I_{max} : 8.0 A P_{max} : 200 W
Auxiliary contacts: AC1 at 240 V	I_{min} : 0.01 A , I_{max} : 2.0 A P_{max} : 500 VA
Auxiliary contacts: DC1 at 24 V	I_{min} : 0.01 A , I_{max} : 2.0 A P_{max} : 50 W
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	I_{max} : 6.0 A
Safety contacts: DC13 at 24 V (6 cycles/min)	I_{max} : 5.0 A
Auxiliary contacts: AC15 at 230 V	I_{max} : 2.0 A
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	I_{max} : 2.0 A
Contact material	AgCuNi + 0.2 µm Au

Up to PL e of EN ISO 13849-1 PNOZ s7

Electrical data	
External contact fuse protection ($I_k = 1 \text{ kA}$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	10 A
Auxiliary contacts:	4 A
Blow-out fuse, slow	
Safety contacts:	6 A
Auxiliary contacts:	2 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	6 A
Auxiliary contacts:	2 A
Max. overall cable resistance R_{lmax} input circuits, reset circuits single-channel at U_B DC	
	30 Ohm
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Category of output contacts in accordance with EN 954-1 , EN ISO 13849-1	
Safety contacts (S) instantaneous:	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset after power on typ.	30 ms
with automatic reset after power on max.	50 ms
Delay-on de-energisation	
with E-STOP typ.	18 ms
with E-STOP max.	30 ms
with power failure typ.	18 ms
with power failure max.	30 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	6.0 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	PC
Front	PC

Up to PL e of EN ISO 13849-1 PNOZ s7

Mechanical data

Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm² , 24 - 12 AWG Order no.: 750107
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm² , 24 - 16 AWG Order no.: 750107
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm² , 24 - 16 AWG Order no.: 750107
Torque setting with screw terminals	0.50 Nm Order no.: 750107
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	
	0.20 - 2.50 mm² , 24 - 12 AWG Order no.: 751107
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751107
Stripping length	9 mm Order no.: 751107
Dimensions	
Height	102.0 mm Order no.: 751107 98.0 mm Order no.: 750107
Width	17.5 mm
Depth	120.0 mm
Weight	170 g

The standards current on **2006-04** apply.

Conventional thermal current

I_{th} (A) at U_B DC

1 contact	8.00 A
2 contacts	5.50 A
3 contacts	4.50 A
4 contacts	4.00 A

Order reference

Type	Features	Terminals	Order no.
PNOZ s7	24 VDC	With screw terminal	750 107
PNOZ s7 C	24 VDC	With spring-loaded terminal	751 107

Up to PL e of EN ISO 13849-1 PNOZ s7.1



Contact expansion module for increasing the number of available contacts

Approvals

	PNOZ s7.1
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 3 safety contacts (N/O), instantaneous
- ▶ Safe separation of safety contacts 13-14, 23-24, 33-34 from all other circuits
- ▶ Supply voltage for expansion modules
- ▶ LED for:
 - Supply voltage at B1 and B2
 - Input status, channel 1
 - Input status, channel 2
 - Switch status of the safety contacts
 - Fault
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

Unit description

The unit meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. The contact expansion module is used to increase the number of instantaneous safety contacts available on a base unit. Base units are all safety relays with feedback loop monitoring.

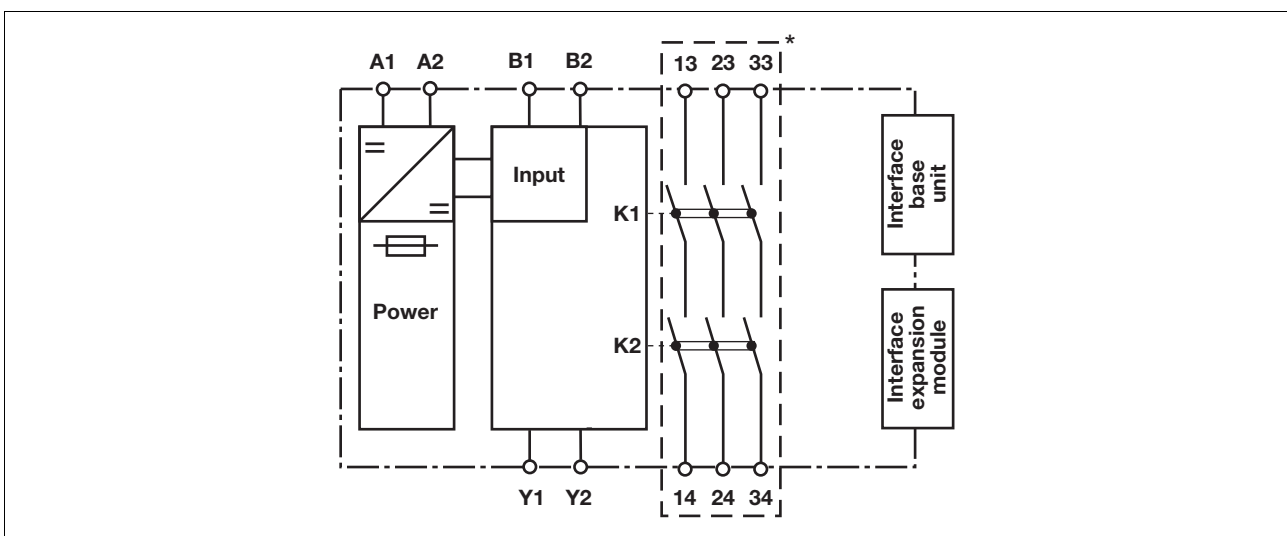
The category that can be achieved in accordance with EN 954-1 and EN ISO 13849-1 depends on the category of the base unit. The contact expansion module may not exceed this.

Safety features

The unit meets the following safety requirements:

- ▶ The contact expansion module expands an existing circuit. As the output relays are monitored via the base unit's feedback loop, the safety functions on the existing circuit are transferred to the contact expansion module.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ Earth fault in the feedback loop: Detected, depending on the base unit that is used.
- ▶ Earth fault in the input circuit: The output relays de-energise and the safety contacts open.

Block diagram



* Safe separation in accordance with EN 60947-1, 6 kV

Up to PL e of EN ISO 13849-1 PNOZ s7.1

Function description

with PNOZsigma base unit:
 ▶ Dual-channel operation via PNOZsigma connector

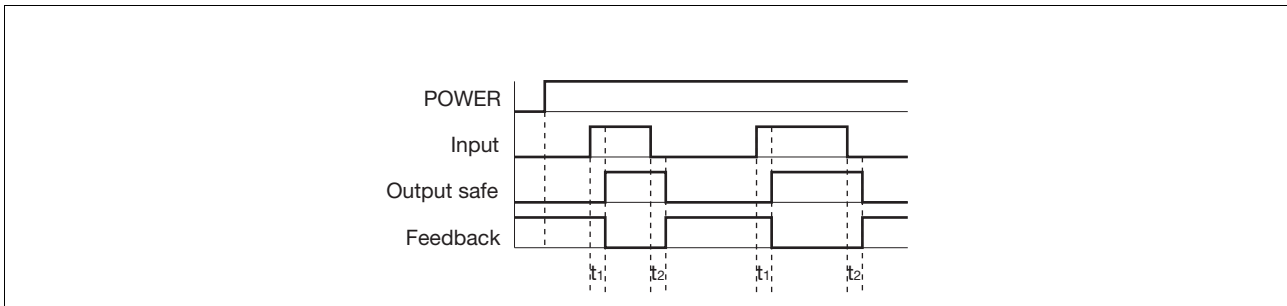
without PNOZsigma base unit:

▶ Single-channel operation: one input circuit affects the output relays

with PNOZsigma s7.2 expander units:

▶ Dual-channel operation and supply voltage via PNOZsigma connector

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuits
- ▶ Output safe: Safety contacts
- ▶ Feedback: Feedback loop 51-52
- ▶ t_1 : Switch-on delay
- ▶ t_2 : Delay-on de-energisation

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs are safety contacts.
- ▶ 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.

Up to PL e of EN ISO 13849-1 PNOZ s7.1

Preparing for operation

► Supply voltage

Supply voltage	AC	DC
Base unit: Safety relay PNOZsigma		
Base unit: Safety relay PNOZ X		
Supply voltage for expansion modules PNOZsigma		

► Input circuit

Input circuit	Single-channel	Dual-channel
Base unit: Safety relay PNOZsigma		
Base unit: Safety relay PNOZ X		
Base unit: Safety relay PNOZelog Driven via semicon- ductor outputs (24 VDC)		

Up to PL e of EN ISO 13849-1 PNOZ s7.1

▶ Reset circuit/feedback loop

Reset circuit/feedback loop	Base unit: Safety relay PNOZ X	Base unit: Safety relay PNOZelog
Y1, Y2 and Input are inputs on the base unit; they evaluate the feedback loop		

▶ Connection to PNOZsigma base unit

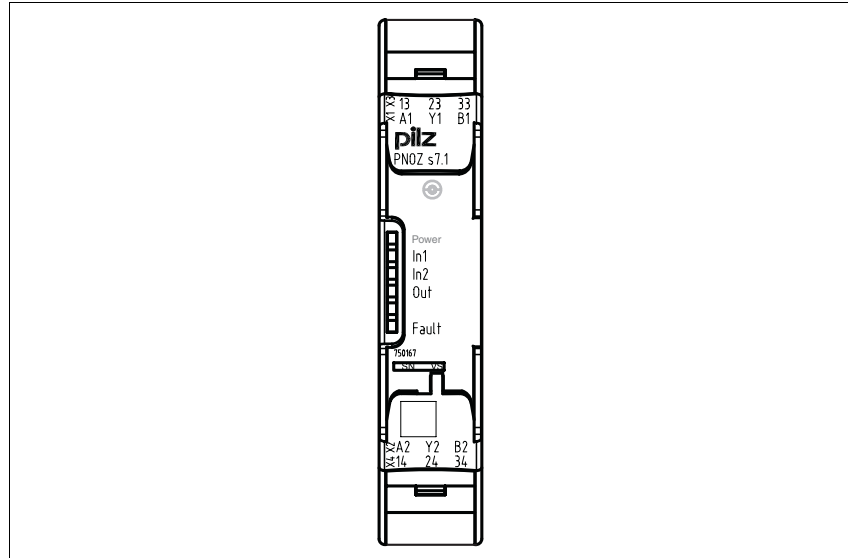
	Base unit: Safety relay PNOZsigma
The feedback loop is connected and evaluated via the connector.	

INFORMATION

If a base unit and a contact expansion module from the PNOZsigma range are linked via the connector, no additional wiring is necessary.
Do not connect A1 und Y1/Y2 to the expansion module!

Up to PL e of EN ISO 13849-1 PNOZ s7.1

Terminal configuration



1.2

Installation

Install contact expansion module without base unit:

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

Connect base unit and contact expansion module PNOZ s7.1:

- ▶ Remove the plug terminator at the side of the base unit and at the left of the contact expansion module

- ▶ Connect the base unit and the contact expansion module using the connector supplied, before mounting the units to the DIN rail.

Connect contact expansion module PNOZ s7.1 to PNOZsigma contact expansion modules

- ▶ Connect the contact expansion modules using the connector supplied.

Control cabinet 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).
Push the unit upwards or downwards before lifting it from the DIN rail.

Expansion options	Please note the max. power consumption of the contact expansion modules (see Technical data PNOZ s7.1).
<p>①: Base unit</p> <p>②: Contact expansion module PNOZ s7.1</p> <p>③: Contact expansion module PNOZ s7.2</p> <p>④: Contact expansion module PNOZ s7.2 with terminator</p>	

Up to PL e of EN ISO 13849-1 PNOZ s7.1

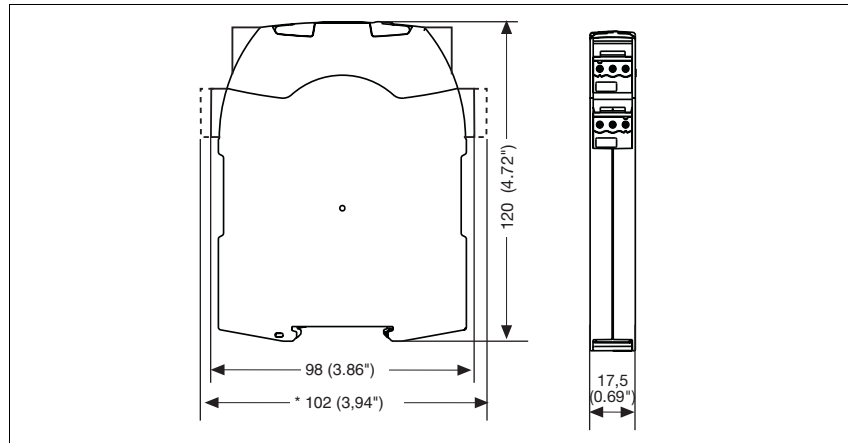
1.2

<p>①: Base unit</p> <p>②: Contact expansion module PNOZ s7.1</p> <p>③: Contact expansion module PNOZ s7.2</p> <p>④: Contact expansion module PNOZ s7, s8, s9, s10, s11 as terminator</p>	<p>The diagram shows a vertical stack of four modules. From left to right: 1. PNOZsigma base unit (labeled ①), 2. PNOZsigma expansion module s7.1 (labeled ②), 3. PNOZsigma expansion module s7.2 (labeled ③), and 4. PNOZsigma expansion module s7/s8/s9/s10/s11 (labeled ④). A bracket groups modules 2, 3, and 4.</p>
<p>①: Contact expansion module PNOZ s7.1 with terminator</p> <p>②: Contact expansion module PNOZ s7.2</p> <p>③: Contact expansion module PNOZ s7.2 with terminator</p>	<p>The diagram shows a vertical stack of three modules. From left to right: 1. PNOZsigma expansion module s7.1 with terminator (labeled ①), 2. PNOZsigma expansion module s7.2 (labeled ②), and 3. PNOZsigma expansion module s7.2 with terminator (labeled ③). A bracket groups modules 1, 2, and 3.</p>
<p>①: Contact expansion module PNOZ s7.1 with terminator</p> <p>②: Contact expansion module PNOZ s7.2</p> <p>③: Contact expansion module PNOZ s7, s8, s9, s10, s11 as terminator</p>	<p>The diagram shows a vertical stack of three modules. From left to right: 1. PNOZsigma expansion module s7.1 with terminator (labeled ①), 2. PNOZsigma expansion module s7.2 (labeled ②), and 3. PNOZsigma expansion module s7/s8/s9/s10/s11 (labeled ③). A bracket groups modules 1, 2, and 3.</p>
<p>①: Base unit</p> <p>②: Contact expansion module PNOZ s7.1</p> <p>③: Contact expansion module PNOZ s7.2</p> <p>④: Contact expansion module PNOZ s7.1</p> <p>⑤: Contact expansion module PNOZ s7.2</p> <p>⑥: Contact expansion module PNOZ s7.2 with terminator</p>	<p>The diagram shows a vertical stack of seven modules. From left to right: 1. PNOZsigma base unit (labeled ①), 2. PNOZsigma expansion module s7.1 (labeled ②), 3. PNOZsigma expansion module s7.2 (labeled ③), 4. PNOZsigma expansion module s7.1 (labeled ④), 5. PNOZsigma expansion module s7.2 (labeled ⑤), 6. PNOZsigma expansion module s7.2 (labeled ⑥), and 7. PNOZsigma expansion module s7.2 with terminator (labeled ⑦). Brackets group modules 2-3, 4-5, and 6-7.</p>

Up to PL e of EN ISO 13849-1 PNOZ s7.1

Dimensions

*with spring-loaded terminals

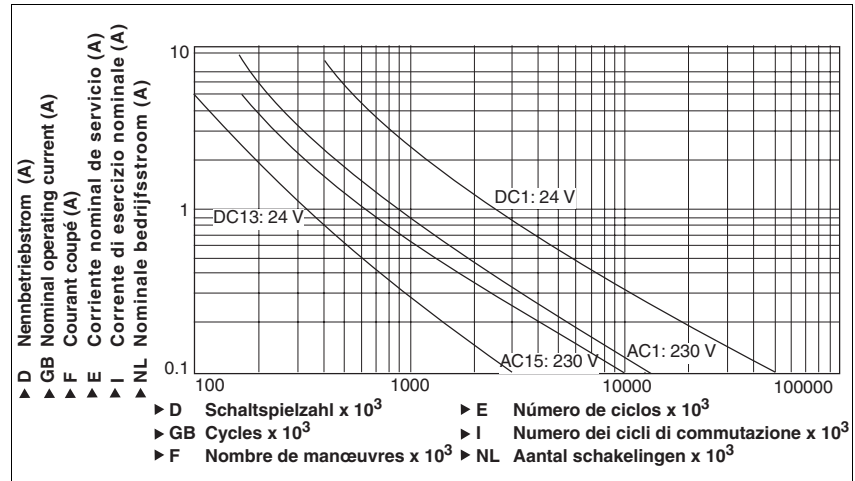


Up to PL e of EN ISO 13849-1 PNOZ s7.1

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



Technical details

Electrical data

Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-20 %/+20 %
Power consumption at U_B DC	2.0 W
Max. output of all expansion modules	20 W
Residual ripple DC	20 %
Voltage and current at Input circuit DC: 24.0 V	70.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	3
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
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:	10 A
Blow-out fuse, slow	
Safety contacts:	6 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	6 A
Max. overall cable resistance R_{lmax} input circuits, reset circuits single-channel at U_B DC	30 Ohm
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Category of output contacts in accordance with EN 954-1, EN ISO 13849-1	
Safety contacts (S) instantaneous:	4

Up to PL e of EN ISO 13849-1 PNOZ s7.1

Safety-related characteristic data	
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset after power on typ.	30 ms
with automatic reset after power on max.	50 ms
Delay-on de-energisation	
with E-STOP typ.	18 ms
with E-STOP max.	30 ms
with power failure typ.	18 ms
with power failure max.	30 ms
Supply interruption before de-energisation	5 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	6.0 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	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750167
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750167
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750167
Torque setting with screw terminals	0.50 Nm Order no.: 750167
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	
	0.20 - 2.50 mm ² , 24 - 12 AWG Order no.: 751167
Spring-loaded terminals: Terminal points per connection	
	2 Order no.: 751167
Stripping length	
	9 mm Order no.: 751167
Dimensions	
Height	
	102.0 mm Order no.: 751167
	98.0 mm Order no.: 750167
Width	
	17.5 mm
Depth	
	120.0 mm
Weight	
	170 g

The standards current on **2007-10** apply.

Up to PL e of EN ISO 13849-1 PNOZ s7.1

Conventional thermal current

I_{th} (A) at U_B DC

1 contact	8.00 A
2 contacts	5.50 A
3 contacts	4.50 A

Order reference

Type	Features	Terminals	Order no.
PNOZs 7.1 C	24 VDC	With spring-loaded terminals	751 167
PNOZs 7.1	24 VDC	With screw terminals	750 167

Up to PL e of EN ISO 13849-1 PNOZ s7.2



Contact expansion module for increasing the number of available contacts

Approvals

	PNOZ s7.2
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 4 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ Safe separation of safety contacts 13-14, 23-24, 33-34, 43-44 from all other circuits
- ▶ Connection options for expansion modules
- ▶ LED for:
 - Input status, channel 1
 - Input status, channel 2
 - Switch status of the safety contacts
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

Unit description

The unit meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. The contact expander module is used to increase the number of instantaneous safety contacts available on a base unit. The category that can be achieved in accordance with EN 954-1 and EN ISO 13849-1 de-

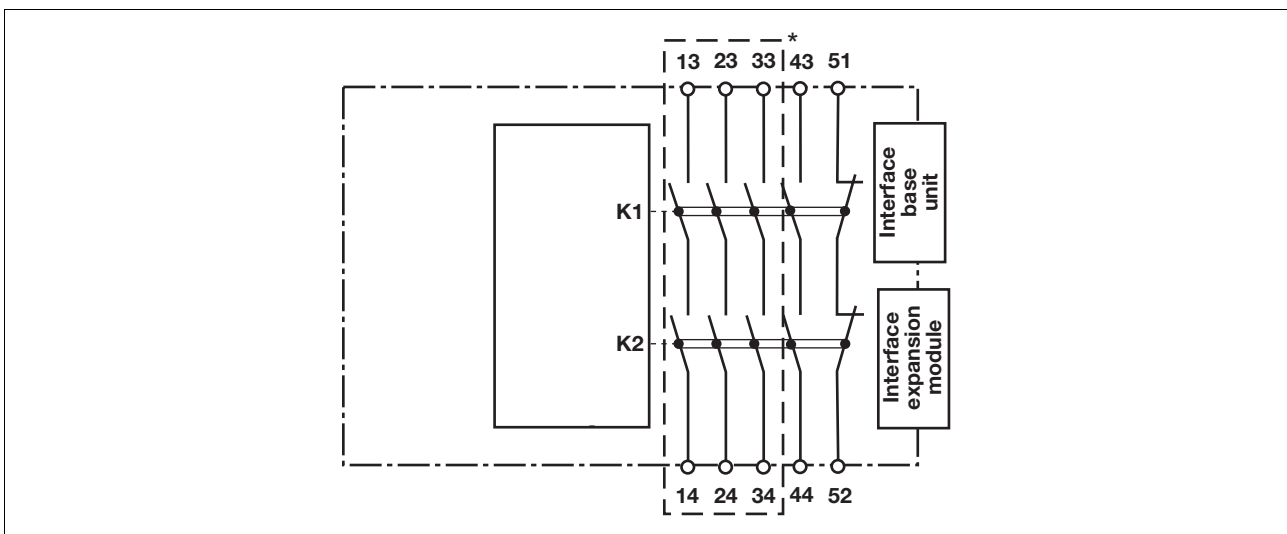
pends on the category of the base unit. The contact expander module may not exceed this.

Safety features

The unit meets the following safety requirements:

- ▶ The contact expansion module expands an existing circuit. As the output relays are monitored via the base unit's feedback loop, the safety functions on the existing circuit are transferred to the contact expansion module.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ Earth fault in the feedback loop: Detected, depending on the base unit that is used.
- ▶ Earth fault in the input circuit: The output relays de-energise and the safety contacts open.

Block diagram



*Safe separation in accordance with EN 60947-1, 6 kV

Up to PL e of EN ISO 13849-1 PNOZ s7.2

Function description

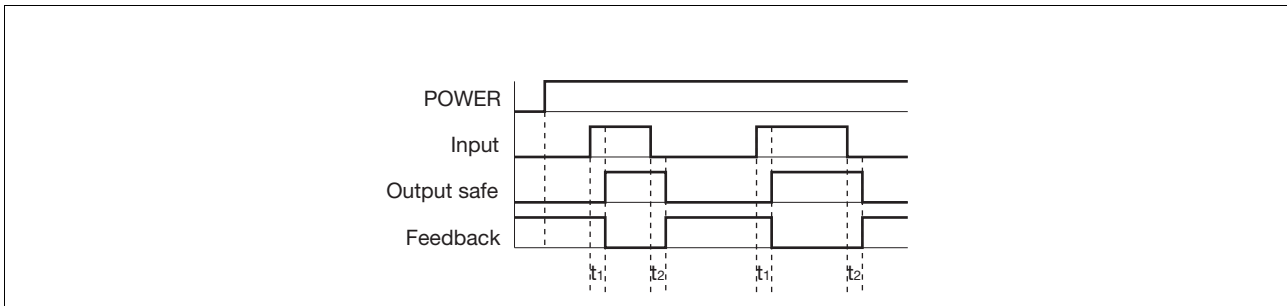
with PNOZsigma s7.1:

- ▶ Dual-channel operation and supply voltage via PNOZsigma connector

with PNOZsigma expander modules:

- ▶ Dual-channel operation and supply voltage via PNOZsigma connector

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuits
- ▶ Output safe: Safety contacts
- ▶ Feedback: Feedback loop 51-52
- ▶ t_1 : Switch-on delay
- ▶ t_2 : Delay-on de-energisation

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs are safety contacts, output is an auxiliary contact (e.g. for display).
- ▶ To prevent contact welding, a fuse should be connected before the output contacts (see technical details).
- ▶ Use copper wire that can withstand 60/75 °C.
- ▶ Sufficient fuse protection must be provided on all output contacts with capacitive and inductive loads.

Up to PL e of EN ISO 13849-1 PNOZ s7.2

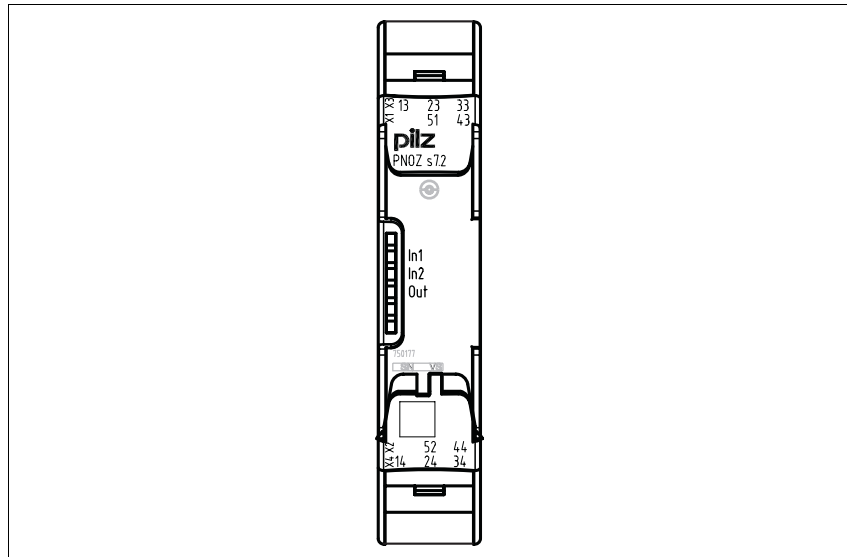
Preparing for operation

- ▶ Supply voltage/input circuit/feed-back loop

Supply voltage/input circuit/feed-back loop	AC	DC
Contact expansion module PNOZ s7.2		

Up to PL e of EN ISO 13849-1 PNOZ s7.2

Terminal configuration



1.2

Installation

Connect contact expansion module PNOZ s7.2 to PNOZsigma contact expansion modules

- ▶ Connect the contact expansion modules using the connector supplied.

Control cabinet 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 us-

ing a fixing element (e.g. retaining bracket or an end angle). Push the unit upwards or downwards before lifting it from the DIN rail.

Expansion options	Please note the max. power consumption of the contact expansion modules (see Technical data PNOZ s7.1).
<p>①: Base unit</p> <p>②: Contact expansion module PNOZ s7.1</p> <p>③: Contact expansion module PNOZ s7.2</p> <p>④: Contact expansion module PNOZ s7.2 with terminator</p>	

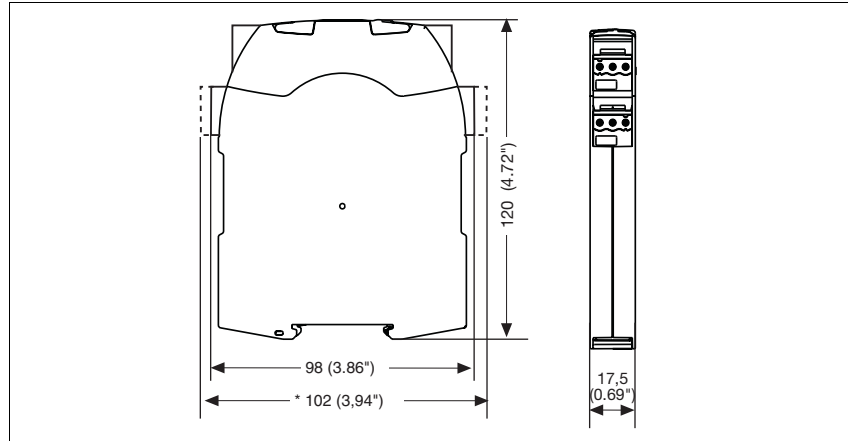
Up to PL e of EN ISO 13849-1 PNOZ s7.2

<p>①: Base unit</p> <p>②: Contact expansion module PNOZ s7.1</p> <p>③: Contact expansion module PNOZ s7.2</p> <p>④: Contact expansion module PNOZ s7, s8, s9, s10, s11 as terminator</p>	
<p>①: Contact expansion module PNOZ s7.1 with terminator</p> <p>②: Contact expansion module PNOZ s7.2</p> <p>③: Contact expansion module PNOZ s7.2 with terminator</p>	
<p>①: Contact expansion module PNOZ s7.1 with terminator</p> <p>②: Contact expansion module PNOZ s7.2</p> <p>③: Contact expansion module PNOZ s7, s8, s9, s10, s11 as terminator</p>	
<p>①: Base unit</p> <p>②: Contact expansion module PNOZ s7.1</p> <p>③: Contact expansion module PNOZ s7.2</p> <p>④: Contact expansion module PNOZ s7.1</p> <p>⑤: Contact expansion module PNOZ s7.2</p> <p>⑥: Contact expansion module PNOZ s7.2 with terminator</p>	

Up to PL e of EN ISO 13849-1 PNOZ s7.2

Dimensions

*with spring-loaded terminals

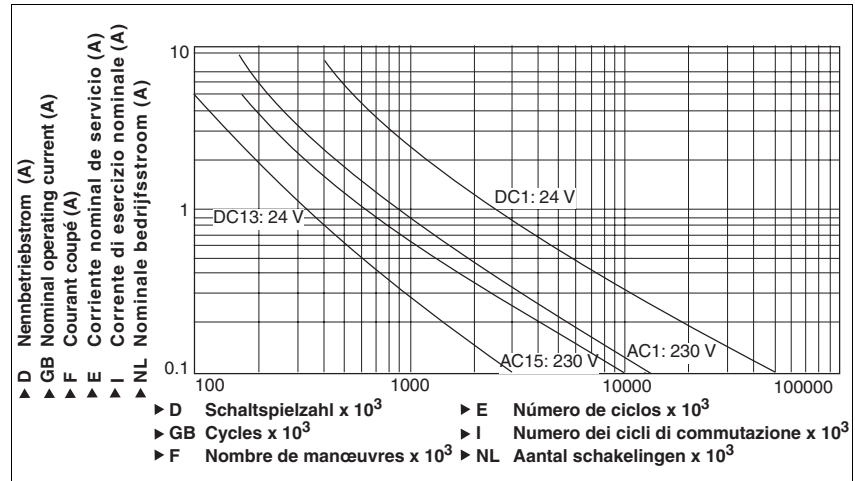


Up to PL e of EN ISO 13849-1 PNOZ s7.2

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



Technical details

Electrical data

Power consumption at U_B DC	2.0 W
Number of output contacts	
Safety contacts (S) instantaneous:	4
Auxiliary contacts (N/C):	1
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Auxiliary contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 2.0 A$ $P_{max}: 500 VA$
Auxiliary contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 2.0 A$ $P_{max}: 50 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
Auxiliary contacts: AC15 at 230 V	$I_{max}: 2.0 A$
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 2.0 A$
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:	10 A
Auxiliary contacts:	4 A
Blow-out fuse, slow	
Safety contacts:	6 A
Auxiliary contacts:	2 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	6 A
Auxiliary contacts:	2 A
Max. overall cable resistance R_{lmax} input circuits, reset circuits single-channel at U_B DC	30 Ohm

Up to PL e of EN ISO 13849-1 PNOZ s7.2

1.2

Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Category of output contacts in accordance with EN 954-1 , EN ISO 13849-1	
Safety contacts (S) instantaneous:	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset after power on typ.	30 ms
with automatic reset after power on max.	50 ms
Delay-on de-energisation	
with E-STOP typ.	18 ms
with E-STOP max.	30 ms
with power failure typ.	18 ms
with power failure max.	30 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	6.0 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	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750177
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750177
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750177
Torque setting with screw terminals	0.50 Nm Order no.: 750177
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751177
Stripping length	9 mm Order no.: 751177
Dimensions	
Height	
Height	102.0 mm Order no.: 751177
	98.0 mm Order no.: 750177
Width	17.5 mm
Depth	120.0 mm
Weight	170 g

Up to PL e of EN ISO 13849-1 PNOZ s7.2

The standards current on **2007-07** apply.

Conventional thermal current	
I_{th} (A) at U_B DC	
1 contact	8.00 A
2 contacts	5.50 A
3 contacts	4.50 A
4 contacts	4.00 A

Order reference			
Type	Features	Terminals	Order no.
PNOZs 7.2 C	24 VDC	With spring-loaded terminals	751 177
PNOZs 7.2	24 VDC	With screw terminals	750 177

Up to PL e of EN ISO 13849-1 PNOZ s10

1.2



Contact expansion module for increasing the number of available contacts

Approvals

	PNOZ s10
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 4 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ Safe separation of safety contacts from all other circuits
- ▶ LED indicator for:
 - Input status, channel 1
 - Input status, channel 2
 - Switch status, safety contacts
 - Error
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

Unit description

The unit meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. The contact expansion module is used to increase the number of instantaneous safety contacts available on a base unit. Base units are all safety relays with feedback loop monitoring. The category that can be achieved in accordance with EN 954-1 and

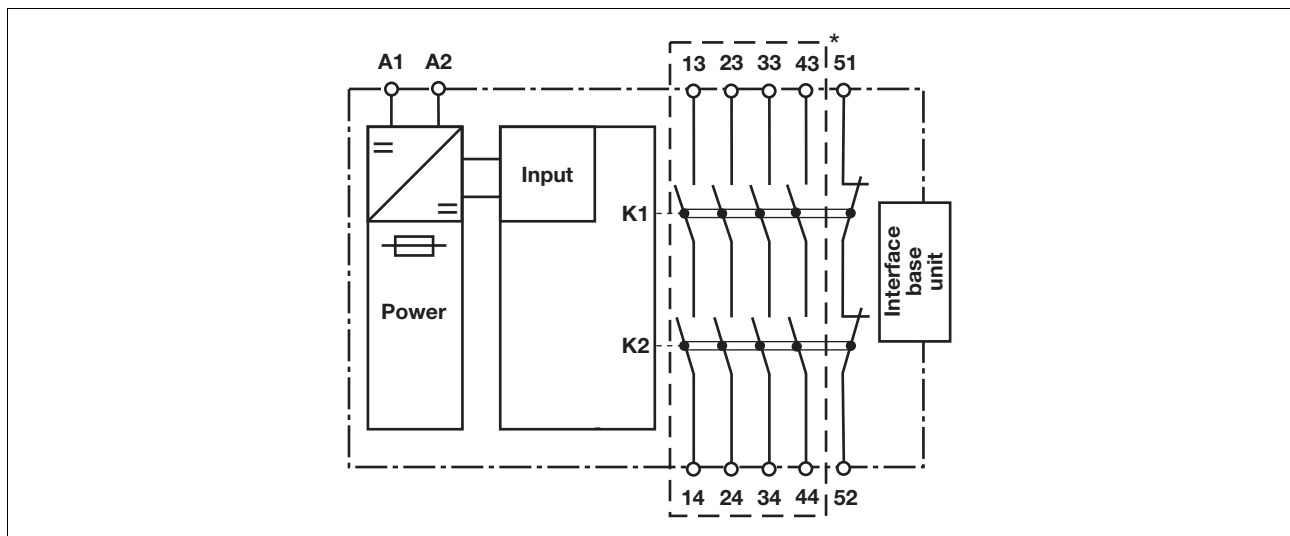
EN ISO 13849-1 depends on the category of the base unit. The contact expansion module may not exceed this.

Safety features

The unit meets the following safety requirements:

- ▶ The contact expansion module expands an existing circuit. As the output relays are monitored via the base unit's feedback loop, the safety functions on the existing circuit are transferred to the contact expansion module.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ Earth fault in the feedback loop: Detected, depending on the base unit that is used.
- ▶ Earth fault in the input circuit: The output relays de-energise and the safety contacts open.

Block diagram



* Safe separation in accordance with EN 60947-1, 6 kV

Up to PL e of EN ISO 13849-1 PNOZ s10

Function description

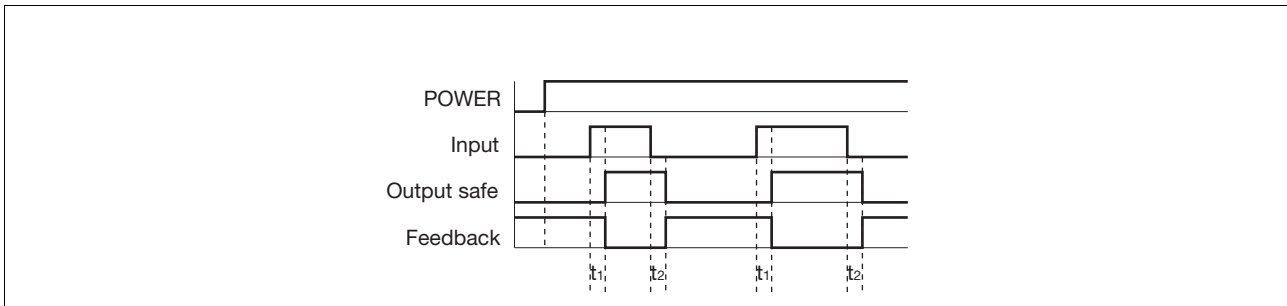
with PNOZsigma base unit:

- ▶ Dual-channel operation via PNOZsigma connector

without PNOZsigma base unit:

- ▶ Single-channel operation: one input circuit affects the output relays

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuits A1
- ▶ Output safe: Safety contacts 13-14, 23-24, 33-34, 43-44
- ▶ Feedback: Feedback loop 51-52
- ▶ t_1 : Switch-on delay
- ▶ t_2 : Delay-on de-energisation

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs 13-14, 23-24, 33-34, 43-44 are safety contacts, output 51-52 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.

Up to PL e of EN ISO 13849-1 PNOZ s10

Preparing for operation

▶ Supply voltage

Supply voltage	AC	DC

▶ Input circuit

Input circuit	Single-channel	Dual-channel
Base unit: PNOZ X safety relay		
Base unit: PNOZelog safety relay Driven via semiconductor outputs (24 VDC)		

▶ Feedback loop

Feedback loop	Base unit: Safety relay PNOZ X	Base unit: PNOZelog safety relay
Y1, Y2 and Input are inputs on the base unit; they evaluate the feedback loop		

▶ Connection to PNOZsigma base unit

	Base unit: PNOZsigma safety relay
The feedback loop is connected and evaluated via the connector	

INFORMATION

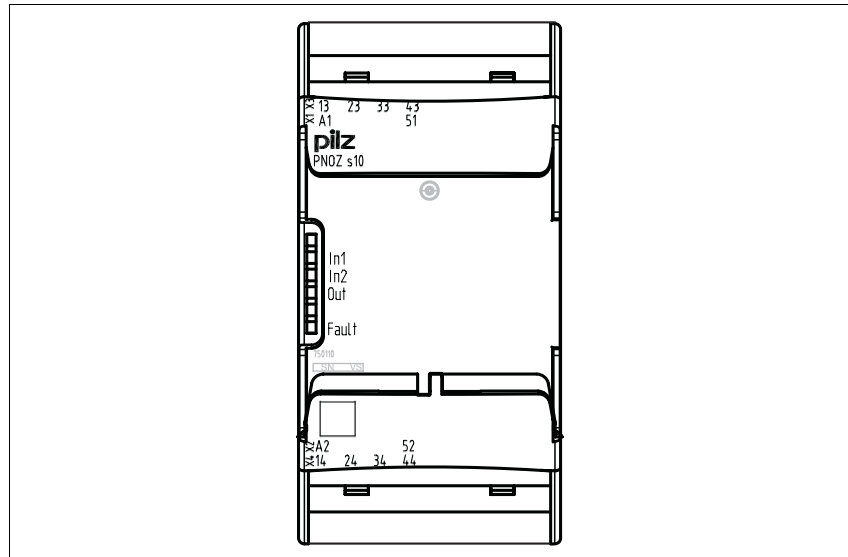
If a base unit and a contact expander module from the PNOZsigma range

are connected via the connector, no additional wiring is necessary.

Do not connect A1 to the contact expander module!

Up to PL e of EN ISO 13849-1 PNOZ s10

Terminal configuration



Installation

Install contact expander module without base unit:

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

Connect base unit and PNOZsigma contact expander module:

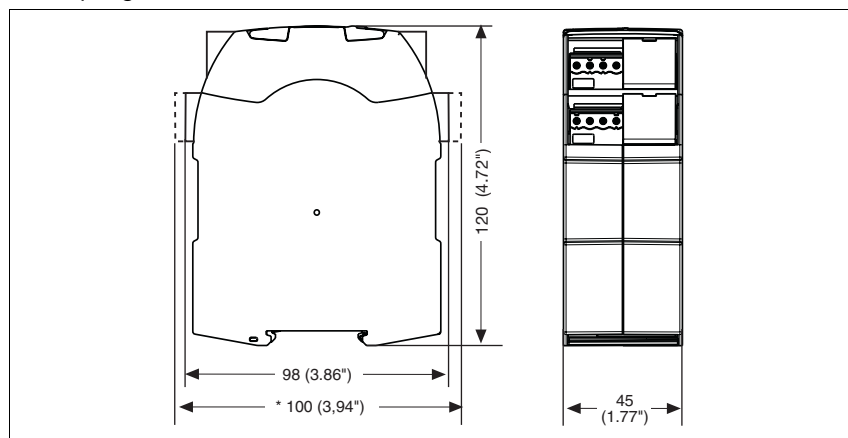
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

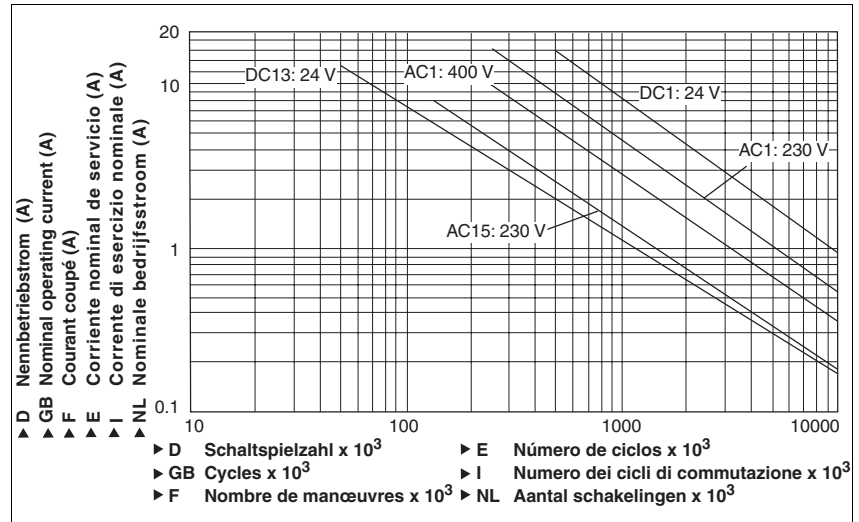


Up to PL e of EN ISO 13849-1 PNOZ s10

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



Technical details

Electrical data

Supply voltage	
Supply voltage U _B DC	24 V
Voltage tolerance	-20 %/+20 %
Power consumption at U _B DC	3.0 W
Residual ripple DC	20 %
Voltage and current at Input circuit DC: 24.0 V	95.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	4
Auxiliary contacts (N/C):	1
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	I _{min} : 0.01 A , I _{max} : 12.0 A P _{max} : 3000 VA
Safety contacts: DC1 at 24 V	I _{min} : 0.01 A , I _{max} : 12.0 A P _{max} : 300 W
Auxiliary contacts: AC1 at 240 V	I _{min} : 0.01 A , I _{max} : 2.0 A P _{max} : 500 VA
Auxiliary contacts: DC1 at 24 V	I _{min} : 0.01 A , I _{max} : 2.0 A P _{max} : 50 W
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	I _{max} : 6.0 A
Safety contacts: DC13 at 24 V (6 cycles/min)	I _{max} : 7.5 A
Auxiliary contacts: AC15 at 230 V	I _{max} : 2.0 A
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	I _{max} : 2.0 A
Contact material	AgSnO2 + 0.2 µm Au

Up to PL e of EN ISO 13849-1 PNOZ s10

Electrical data	
External contact fuse protection ($I_k = 1 \text{ kA}$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	16 A
Auxiliary contacts:	4 A
Blow-out fuse, slow	
Safety contacts:	10 A
Auxiliary contacts:	2 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	10 A
Auxiliary contacts:	2 A
Max. overall cable resistance R_{lmax} input circuits, reset circuits single-channel at U_B DC	
	30 Ohm
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Category of output contacts in accordance with EN 954-1 , EN ISO 13849-1	
Safety contacts (S) instantaneous:	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset after power on typ.	30 ms
with automatic reset after power on max.	50 ms
Delay-on de-energisation	
with E-STOP typ.	20 ms
with E-STOP max.	30 ms
with power failure typ.	20 ms
with power failure max.	30 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	6.0 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	PC
Front	PC

Up to PL e of EN ISO 13849-1 PNOZ s10

Mechanical data

Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm² , 24 - 12 AWG Order no.: 750110
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm² , 24 - 16 AWG Order no.: 750110
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm² , 24 - 16 AWG Order no.: 750110
Torque setting with screw terminals	0.50 Nm Order no.: 750110
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751110
Stripping length	9 mm Order no.: 751110
Dimensions	
Height	98.0 mm
Width	45.0 mm
Depth	120.0 mm
Weight	300 g

The standards current on **2006-04** apply.

Conventional thermal current

I_{th} (A) at U_B DC

1 contact	12.00 A
2 contacts	11.00 A
3 contacts	9.00 A
4 contacts	8.00 A

Order reference

Type	Features	Terminals	Order no.
PNOZ s10	24 VDC	With screw terminal	750 110
PNOZ s10 C	24 VDC	With spring-loaded terminal	751 110

Up to PL e of EN ISO 13849-1 PNOZ s11



Contact expansion module for increasing the number of available contacts

Approvals

PNOZ s11	
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs:
 - 8 safety contacts (N/O), instantaneous
 - 1 auxiliary contact (N/C), instantaneous
- ▶ Safe separation of safety contacts from all other circuits
- ▶ LED indicator for:
 - Input status, channel 1
 - Input status, channel 2
 - Switch status, safety contacts
 - Error
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

Unit description

The unit meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. The contact expansion module is used to increase the number of instantaneous safety contacts available on a base unit. Base units are all safety relays with feedback loop monitoring. The category that can be achieved in accordance with EN 954-1 and EN ISO 13849-1 depends on the cate-

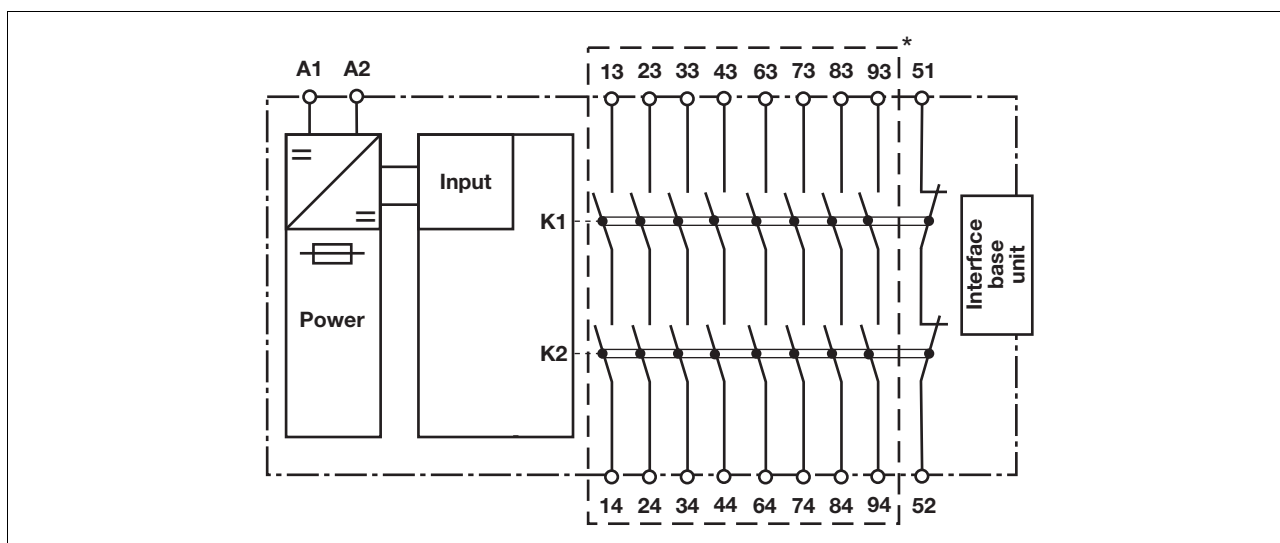
gory of the base unit. The contact expansion module may not exceed this.

Safety features

The unit meets the following safety requirements:

- ▶ The contact expansion module expands an existing circuit. As the output relays are monitored via the base unit's feedback loop, the safety functions on the existing circuit are transferred to the contact expansion module.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ Earth fault in the feedback loop: Detected, depending on the base unit that is used.
- ▶ Earth fault in the input circuit: The output relays de-energise and the safety contacts open.

Block diagram



*Safe separation in accordance with EN 60947-1, 6 kV

Up to PL e of EN ISO 13849-1 PNOZ s11

Function description

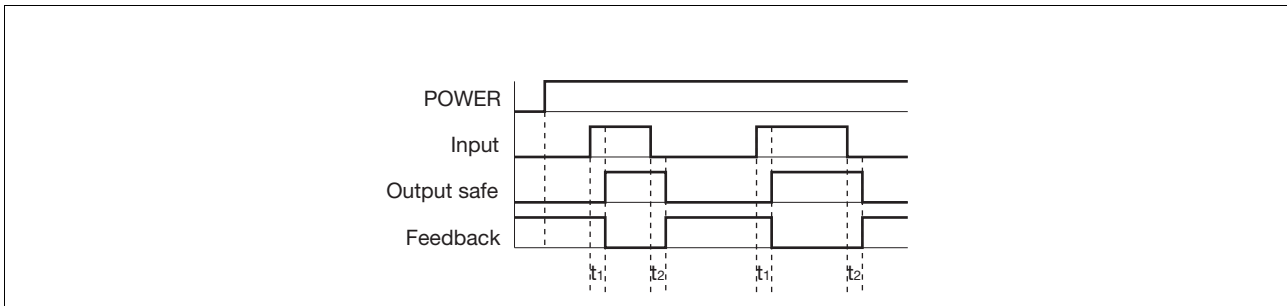
with PNOZsigma base unit:

- ▶ Dual-channel operation via PNOZsigma connector

without PNOZsigma base unit:

- ▶ Single-channel operation: one input circuit affects the output relays

Timing diagram



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuits A1
- ▶ Output safe: Safety contacts 13-14, 23-24, 33-34, 43-44, 63-64, 73-74, 83-84, 93-94
- ▶ Feedback: Feedback loop 51-52
- ▶ t_1 : Switch-on delay
- ▶ t_2 : Delay-on de-energisation

Wiring

Please note:

- ▶ Information given in the "Technical details" must be followed.
- ▶ Outputs 13-14, 23-24, 33-34, 43-44, 63-64, 73-74, 83-84, 93-94 are safety contacts, output 51-52 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.

Up to PL e of EN ISO 13849-1 PNOZ s11

Preparing for operation

Supply voltage

Supply voltage	AC	DC

Input circuit

Input circuit	Single-channel	Dual-channel
Base unit: PNOZ X safety relay		
Base unit: PNOZelog safety relay Driven via semiconductor outputs (24 VDC)		

Feedback loop

Feedback loop	Base unit: Safety relay PNOZ X	Base unit: PNOZelog safety relay
Y1, Y2 and Input are inputs on the base unit; they evaluate the feedback loop		

Connection to PNOZsigma base unit

	Base unit: PNOZsigma safety relay
The feedback loop is connected and evaluated via the connector	

INFORMATION

If a base unit and a contact expander module from the PNOZsigma range

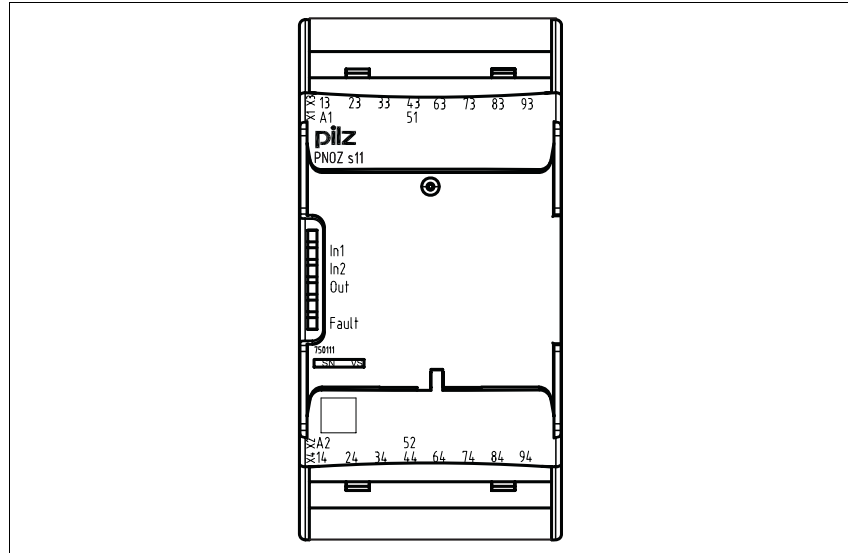
are connected via the connector, no additional wiring is necessary.

Do not connect A1 to the contact expander module!

Up to PL e of EN ISO 13849-1 PNOZ s11

1.2

Terminal configuration



Installation

Install contact expander module without base unit:

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

Connect base unit and PNOZsigma contact expander module:

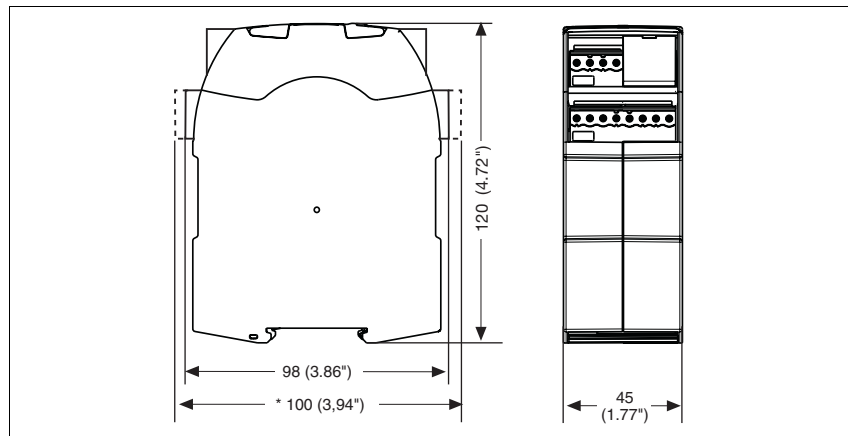
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

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.
- ▶ 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

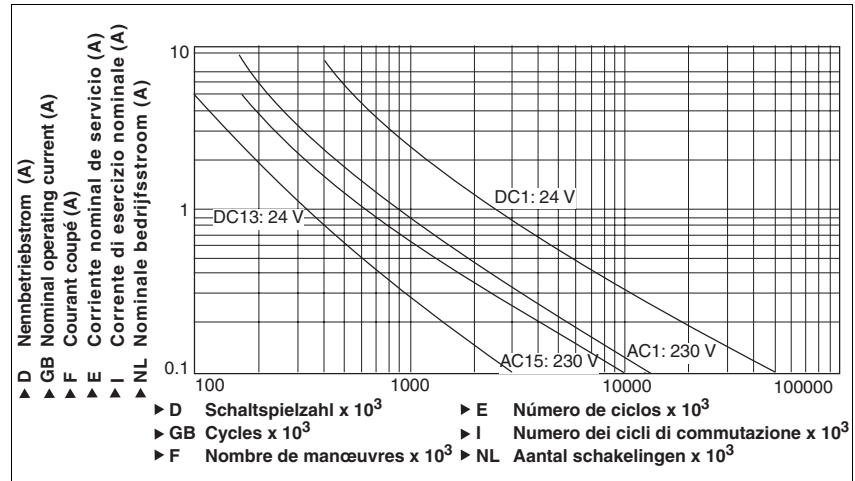


Up to PL e of EN ISO 13849-1 PNOZ s11

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



Technical details

Electrical data

Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-20 %/+20 %
Power consumption at U_B DC	3.0 W
Residual ripple DC	20 %
Voltage and current at Input circuit DC: 24.0 V	95.0 mA
Number of output contacts	
Safety contacts (S) instantaneous:	8
Auxiliary contacts (N/C):	1
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Auxiliary contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Auxiliary contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
Auxiliary contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
Contact material	AgCuNi + 0.2 μm Au

Up to PL e of EN ISO 13849-1 PNOZ s11

1.2

Electrical data	
External contact fuse protection ($I_k = 1 \text{ kA}$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	10 A
Auxiliary contacts:	10 A
Blow-out fuse, slow	
Safety contacts:	6 A
Auxiliary contacts:	6 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	6 A
Auxiliary contacts:	6 A
Max. overall cable resistance R_{lmax} input circuits, reset circuits single-channel at U_B DC	
	30 Ohm
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, instantaneous	e
Category of output contacts in accordance with EN 954-1 , EN ISO 13849-1	
Safety contacts (S) instantaneous:	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, instantaneous	3
Probability of dangerous failure per hour (PFH_D) in accordance with EN IEC 62061	
Safety contacts, instantaneous	2.31E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with automatic reset after power on typ.	30 ms
with automatic reset after power on max.	50 ms
Delay-on de-energisation	
with E-STOP typ.	18 ms
with E-STOP max.	30 ms
with power failure typ.	18 ms
with power failure max.	30 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	6.0 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	PC
Front	PC

Up to PL e of EN ISO 13849-1 PNOZ s11

Mechanical data

Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm² , 24 - 12 AWG Order no.: 750111
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm² , 24 - 16 AWG Order no.: 750111
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm² , 24 - 16 AWG Order no.: 750111
Torque setting with screw terminals	0.50 Nm Order no.: 750111
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751111
Stripping length	9 mm Order no.: 751111
Dimensions	
Height	100.0 mm Order no.: 751111 98.0 mm Order no.: 750111
Width	45.0 mm
Depth	120.0 mm
Weight	340 g

The standards current on **2006-10** apply.

Conventional thermal current

I_{th} (A) at U_B DC

1 contact	8.00 A
2 contacts	8.00 A
3 contacts	8.00 A
4 contacts	7.00 A
5 contacts	6.30 A
6 contacts	5.70 A
7 contacts	5.30 A
8 contacts	5.00 A

Order reference

Type	Features	Terminals	Order no.
PNOZ s11	24 VDC	With screw terminal	750 111
PNOZ s11 C	24 VDC	With spring-loaded terminal	751 111

Up to PL e of EN ISO 13849-1 PNOZ s9

1.2



Contact expander module for increasing the number of available contacts, Pulse-on timer relay for step-by-step control of movement sequences, Delay-on energisation timer for unlocking an interlock with delay, Shutdown of application with delay-on de-energisation, controlled stop

Approvals

	PNOZ s9
	◆
	◆
	◆

Unit features

- ▶ Positive-guided relay outputs, either instantaneous, delay-on de-energisation (also retriggerable), pulsing or delay-on energisation:
 - 3 safety contacts
 - 1 auxiliary contact
- ▶ Safe separation of safety contacts 17-18, 27-28, 37-38 from all other circuits
- ▶ Switch-on time, pulse time or delay-on de-energisation selectable
- ▶ LED for:
 - Supply voltage
 - Input status, channel 1
 - Input status, channel 2
 - Switch status channel 1/2
 - Reset circuit
 - Errors
- ▶ Plug-in connection terminals (either spring-loaded terminals or screw terminals)

Unit description

The unit meets the requirements of EN 60947-5-1, EN 60204-1 and VDE 0113-1. In conjunction with a base unit the unit is used as a

- ▶ Contact expansion module to increase the number of contacts available on a base unit. Base units are all safety relays with feedback loop monitoring.
- ▶ Pulse relay
 - In accordance with EN ISO 12100-1 and EN ISO 12100-2 (inching circuit for limited movement of hazardous machine components during installation, set up and positioning)
 - in safety circuits in accordance with VDE 0113 and EN 60204-1 (e.g. on movable guards)
- ▶ Safe timer relays
 - in accordance with EN 1088 (release with delay through timer)
 - in safety circuits in accordance with VDE 0113-1 and EN 60204-1 (e.g. on movable guards)

The category that can be achieved in accordance with EN 954-1 depends on the category of the base unit. The contact expansion module may not exceed this.

- ▶ The unit can also be used without a base unit as a pulse relay or safe timer.

The unit is designed for use with

- ▶ Safety relays from the PNOZ X, PNOZsigma, PNOZelog, PNOZmulti series
- ▶ Safety gate monitors from the PST series
- ▶ Two-hand relays from the PNOZsigma, P2HZ series

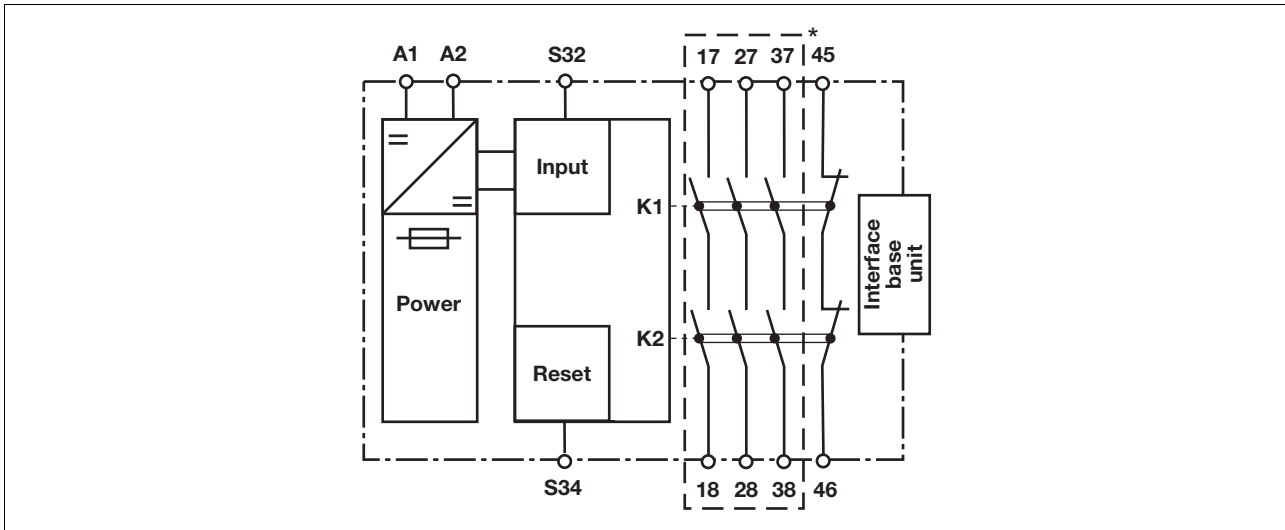
Safety features

The unit meets the following safety requirements:

- ▶ The unit monitors its own output contacts.
- ▶ The safety function remains effective in the case of a component failure.
- ▶ Earth fault in the feedback loop is detected.
- ▶ Earth fault in the input circuit: The output relays de-energise and the safety contacts open.
- ▶ The unit has an electronic fuse.

Up to PL e of EN ISO 13849-1 PNOZ s9

Block diagram



*Safe separation in accordance with EN 60947-1, 6 kV

Function description

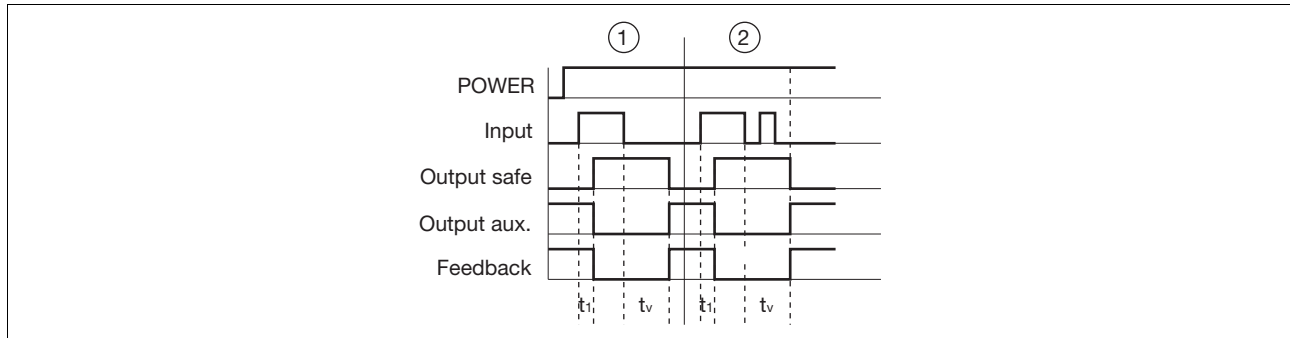
- ▶ Delay-on de-energisation, not retriggerable
If the supply voltage at the input circuit is interrupted, the safety contacts will open once the set release time has elapsed, even if the safety function is cancelled during the delay time. The unit cannot be reactivated until the delay time has elapsed.
- ▶ Delay-on de-energisation, retriggerable (only possible as a standalone application or with the PNOZsigma base unit!)
If the supply voltage at the input circuit is interrupted, the safety contacts will open once the set release time has elapsed.
If the safety function is cancelled during the delay time (e.g. safety gate closed) and the reset button is operated, the unit will remain active.
- ▶ Pulse on switching on
The safety contacts close when supply voltage is applied, the feedback loop is closed and finally the input circuit is closed. The safety contacts are reopened once the pulse time has elapsed.
If the input circuit is opened for more than 10 ms during the pulse

- time, the safety contacts will open immediately and the auxiliary contact will be closed.
- ▶ Delay-on energisation
The set delay time is started when supply voltage is applied, the feedback loop is closed and finally the input circuit is closed.
If the input circuit and feedback loop are closed once the delay time has elapsed, the safety contacts will close and the auxiliary contact will be opened.
If the input circuit is opened for more than 10 ms, the safety contacts will open immediately and the auxiliary contact will be closed.
with PNOZsigma base unit:
 - ▶ Dual-channel operation via PNOZsigma connector
 with other base units or without base unit:
 - ▶ Single-channel operation: one input circuit affects the output relays

Up to PL e of EN ISO 13849-1 PNOZ s9

Timing diagrams

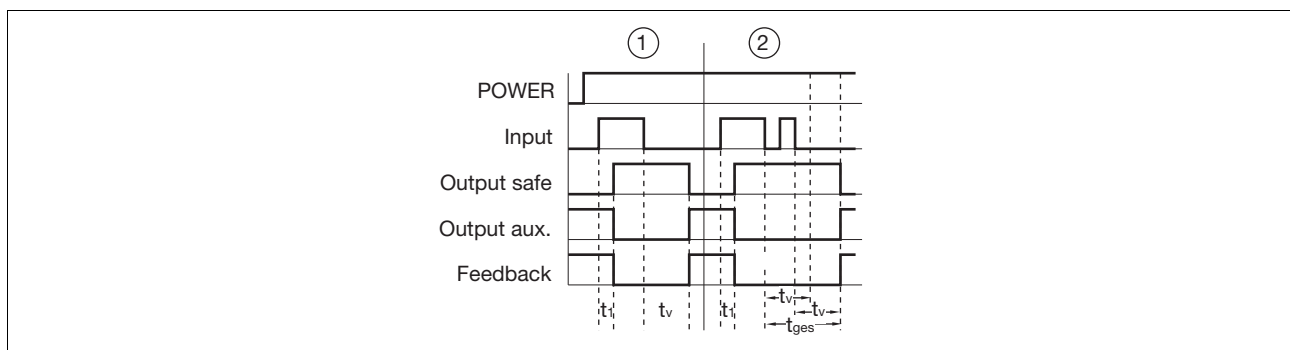
Delay-on de-energisation, not retriggerable



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuit S32
- ▶ Output safe: Safety contacts 17-18, 27-28, 37-38
- ▶ Output aux: Auxiliary contact 45-46
- ▶ Feedback: Feedback loop S34
- ▶ t_1 : Switch-on delay
- ▶ t_v : Delay time
- ▶ ①: Delay-on de-energisation with the time t_v
- ▶ ②: No retriggering in the time t_v

Delay-on de-energisation, retriggerable

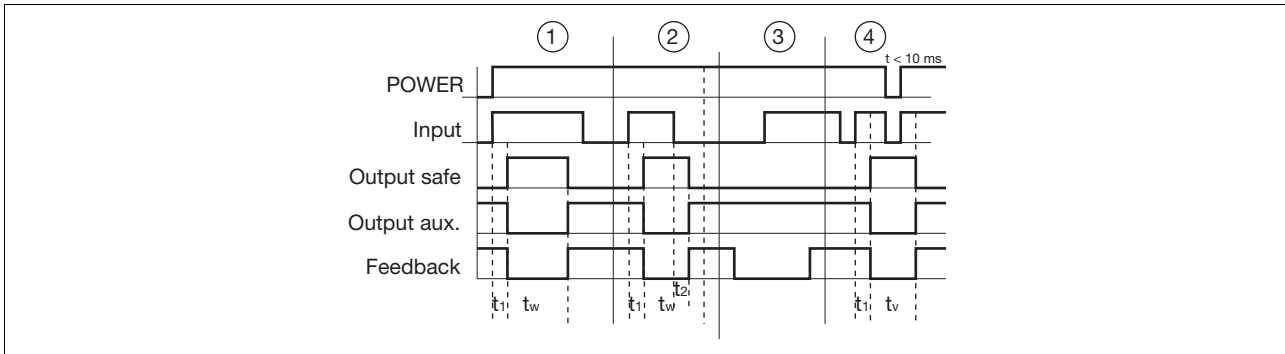


Key

- ▶ Power: Supply voltage
 - ▶ Input: Input circuit S32
 - ▶ Output safe: Safety contacts 17-18, 27-28, 37-38
 - ▶ Output aux: Auxiliary contact 45-46
 - ▶ Feedback: Feedback loop S34
 - ▶ t_1 : Switch-on delay
 - ▶ t_v : Delay-on de-energisation
 - ▶ t_{ges} : Overall delay time
 - ▶ ①: Delay-on de-energisation with the time t_v
 - ▶ ②: Retriggering in the time t_v for overall delay-on de-energisation
- t_{ges}

Up to PL e of EN ISO 13849-1 PNOZ s9

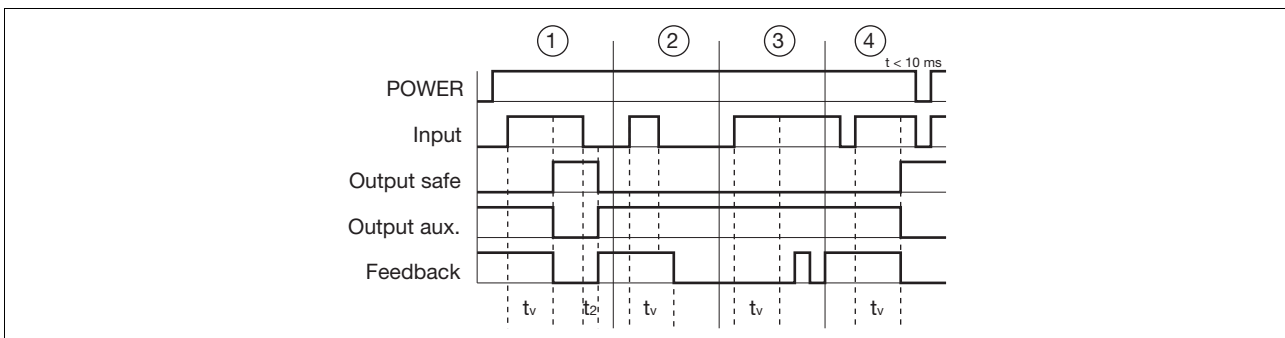
Pulse on switching on



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuit S32
- ▶ Output safe: Safety contacts 17-18, 27-28, 37-38
- ▶ Output aux.: Auxiliary contact 45-46
- ▶ Feedback: Feedback loop S34
- ▶ t_1 : Switch-on delay
- ▶ t_2 : Delay-on de-energisation
- ▶ t_w : Pulse time
- ▶ ①: Normal operating cycle
- ▶ ②: Fault: Input circuit opened too early
- ▶ ③: Fault: Feedback loop closed too late
- ▶ ④: Normal operating cycle with supply interruption < 10 ms

Delay-on energisation



Key

- ▶ Power: Supply voltage
- ▶ Input: Input circuit S32
- ▶ Output safe: Safety contacts 17-18, 27-28, 37-38
- ▶ Output aux.: Auxiliary contact 45-46
- ▶ Feedback: Feedback loop S34
- ▶ t_2 : Delay-on de-energisation
- ▶ t_v : Delay time
- ▶ ①: Normal operating cycle
- ▶ ②: Fault: Input circuit opened too early
- ▶ ③: Fault: Feedback loop closed too late after t_2 elapsed
- ▶ ④: Normal operating cycle with supply interruption < 10 ms

Wiring

Please note:

- ▶ Information given in the “Technical details” must be followed.
- ▶ Outputs 17-18, 27-28, 37-38 are safety contacts, output 45-46 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.

Up to PL e of EN ISO 13849-1 PNOZ s9

Preparing for operation

► Supply voltage

Supply voltage	AC	DC

► 1-channel input circuit/feedback loop

Input circuit	Input circuit	Feedback loop
Without base unit (standalone)		
Base unit: PNOZ X safety relay		
Base unit: PNOZelog safety relay; driven via semiconductor outputs (24 VDC)		

Y1 and Y2 are inputs on the PNOZ X; they evaluate the feedback loop.

Input is an input on the PNOZelog, which evaluates the feedback loop

* PNOZ e1p only; all other PNOZelog safety relays without delay-on de-energisation with PNOZ s9

Up to PL e of EN ISO 13849-1 PNOZ s9

▶ 2-channel input circuit

	Base unit: Safety relays PNOZ s3, PNOZ s4, PNOZ s5	Base unit: Safety relays PNOZ s1, PNOZ s2
The input circuit is connected and evaluated via the connector.		
	Base unit: Two-hand control unit PNOZ s6	Base unit: Two-hand control unit PNOZ s6.1
The input circuit is connected and evaluated via the connector.		

▶ Application

	without feedback loop	with feedback loop
without base unit		

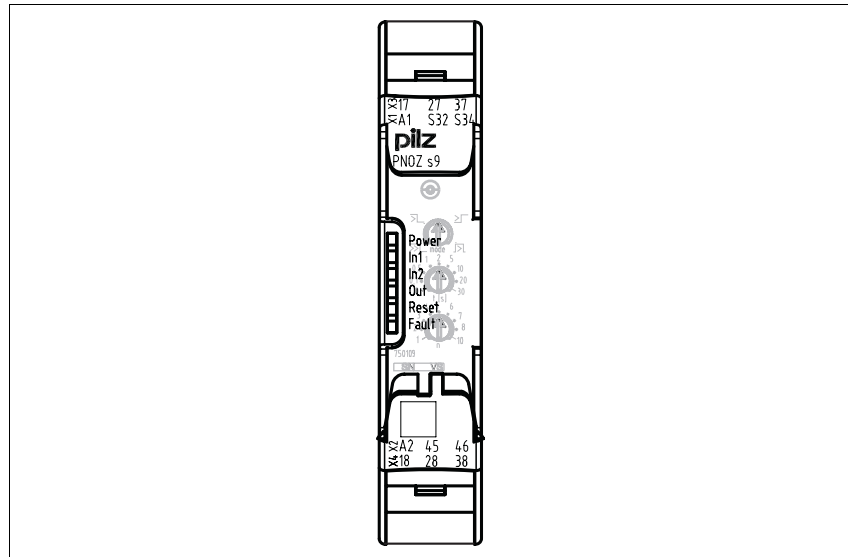
▶ Key

S3	Reset button
----	--------------

Up to PL e of EN ISO 13849-1 PNOZ s9

1.2

Terminal configuration



Installation

Install safety relay without PNOZsigma base unit:

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

Connect PNOZsigma base unit and PNOZsigma contact expansion module:

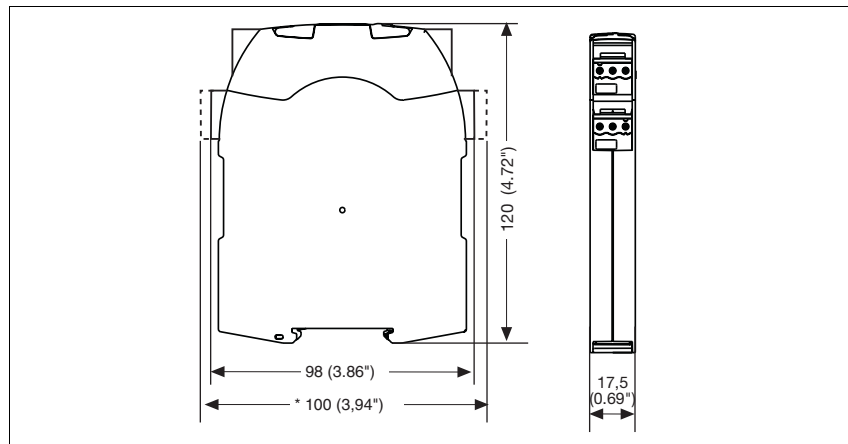
- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module
- ▶ Connect the base unit and the contact expansion module using the connector supplied, before mounting the units to the DIN rail.

Control cabinet 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).
- ▶ Push the unit upwards or downwards before lifting it from the DIN rail.

Dimensions

*with spring-loaded terminals

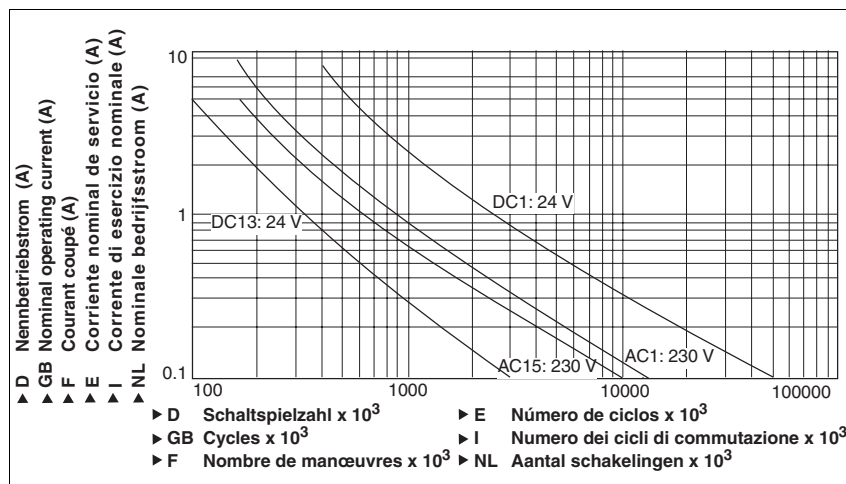


Up to PL e of EN ISO 13849-1 PNOZ s9

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



Technical details

Electrical data

Supply voltage	
Supply voltage U_B DC	24 V
Voltage tolerance	-20 %/+20 %
Power consumption at U_B DC	2.0 W
Residual ripple DC	20 %
Typ. supply current at A1	70 mA
Voltage and current at	
Input circuit DC:	15.0 mA
Feedback loop DC: 24.0 V	15.0 mA
Max. current pulse	
A1	0.70 A
Input circuit	0.10 A
Feedback loop	0.10 A
Number of output contacts	
Safety contacts (N/O), delayed:	3
Auxiliary contacts (N/C), delayed:	1
Utilisation category in accordance with EN 60947-4-1	
Safety contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Safety contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Auxiliary contacts: AC1 at 240 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 2000 VA$
Auxiliary contacts: DC1 at 24 V	$I_{min}: 0.01 A, I_{max}: 8.0 A$ $P_{max}: 200 W$
Utilisation category in accordance with EN 60947-5-1	
Safety contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Safety contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
Auxiliary contacts: AC15 at 230 V	$I_{max}: 6.0 A$
Auxiliary contacts: DC13 at 24 V (6 cycles/min)	$I_{max}: 5.0 A$
Contact material	AgCuNi + 0.2 μm Au

Up to PL e of EN ISO 13849-1 PNOZ s9

1.2

Electrical data	
External contact fuse protection ($I_K = 1 \text{ kA}$) to EN 60947-5-1	
Blow-out fuse, quick	
Safety contacts:	10 A
Auxiliary contacts:	10 A
Blow-out fuse, slow	
Safety contacts:	6 A
Auxiliary contacts:	6 A
Circuit breaker 24 VAC/DC, characteristic B/C	
Safety contacts:	6 A
Auxiliary contacts:	6 A
Max. overall cable resistance R_{lmax}	
A1/A2	20 Ohm
Input circuit	30 Ohm
Feedback loop	30 Ohm
Safety-related characteristic data	
Performance level (PL) in accordance with EN ISO 13849-1	
Safety contacts, delayed <30 s	e
Safety contacts, delayed $\geq 30 \text{ s}$	e
Category of output contacts in accordance with EN 954-1, EN ISO 13849-1	
Delay time <30 s	4
Delay time $\geq 30 \text{ s}$	4
SIL claim limit (SIL CL) in accordance with EN IEC 62061	
Safety contacts, delayed <30 s	3
Safety contacts, delayed $\geq 30 \text{ s}$	3
Probability of dangerous failure per hour (PFH _D) in accordance with EN IEC 62061	
Safety contacts, delayed <30 s	2.34E-09 1/h
Safety contacts, delayed $\geq 30 \text{ s}$	2.34E-09 1/h
Mission time/Proof test interval in years	20
Times	
Switch-on delay	
with manual reset typ.	60 ms
with manual reset max.	80 ms
Delay-on de-energisation	
with E-STOP typ.	40 ms
with E-STOP max.	50 ms
Recovery time at max. switching frequency 1/s after power failure	
	800 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 %/+1 %, -20 ms/+20 ms
Supply interruption before de-energisation	10 ms
Supply interruption before de-energisation in the input circuit	10.0 ms
Environmental data	
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
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
Rated insulation voltage	250 V
Rated impulse withstand voltage	6.0 kV

Up to PL e of EN ISO 13849-1 PNOZ s9

Environmental data	
Ambient temperature	-15 - 55 °C
Storage temperature	-40 - 85 °C
Protection type	
Mounting (e.g. cabinet)	IP54
Housing	IP40
Terminals	IP 20
Mechanical data	
Housing material	
Housing	PC
Front	PC
Cross section of external conductors with screw terminals	
1 core flexible	0.25 - 2.50 mm ² , 24 - 12 AWG Order no.: 750109
2 core, same cross section, flexible:	
with crimp connectors, without insulating sleeve	0.25 - 1.00 mm ² , 24 - 16 AWG Order no.: 750109
without crimp connectors or with TWIN crimp connectors	0.20 - 1.50 mm ² , 24 - 16 AWG Order no.: 750109
Torque setting with screw terminals	0.50 Nm Order no.: 750109
Cross section of external conductors with spring-loaded terminals: Flexible with/without crimp connectors	0.20 - 2.50 mm ² , 24 - 12 AWG Order no.: 751109
Spring-loaded terminals: Terminal points per connection	2 Order no.: 751109
Stripping length	9 mm Order no.: 751109
Dimensions	
Height	100.0 mm Order no.: 751109 96.0 mm Order no.: 750109
Width	17.5 mm
Depth	120.0 mm
Weight	175 g

The standards current on **2007-02** apply.

Conventional thermal current	
I_{th} (A) at U_B DC	
1 contact	8.00 A
2 contacts	7.00 A
3 contacts	6.00 A

Order reference			
Type	Features	Terminals	Order no.
PNOZ s9	24 VDC	With screw terminals	750 109
PNOZ s9 C	24 VDC	With spring-loaded terminals	751 109

Order reference



2.0

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Order reference	
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Safety relays PNOZsigma

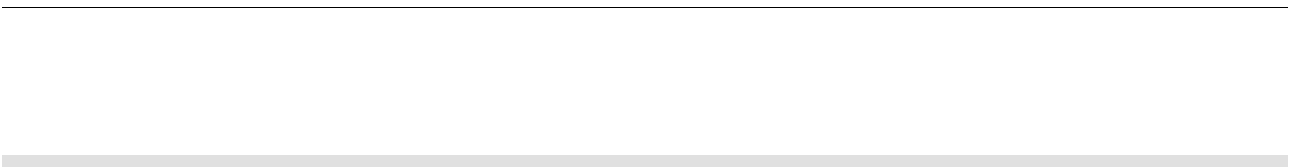
Alphabetically by type

Type	Features	Terminals	Order no.	Page
PNOZ s1	24 VDC	With screw terminal	750 101	1.2-2
PNOZ s1 C	24 VDC	With spring-loaded terminal	751 101	1.2-2
PNOZ s10	24 VDC	With screw terminal	750 110	1.2-102
PNOZ s10 C	24 VDC	With spring-loaded terminal	751 110	1.2-102
PNOZ s11	24 VDC	With screw terminal	750 111	1.2-109
PNOZ s11 C	24 VDC	With spring-loaded terminal	751 111	1.2-109
PNOZ s2	24 VDC	With screw terminal	750 102	1.2-10
PNOZ s2 C	24 VDC	With spring-loaded terminal	751 102	1.2-10
PNOZ s3	24 VDC	With screw terminals	750 103	1.2-18
PNOZ s3 C	24 VDC	With spring-loaded terminals	751 103	1.2-18
PNOZ s4	24 VDC	With screw terminals	750 104	1.2-26
PNOZ s4	48 – 240 VAC/DC	With screw terminals	750 134	1.2-26
PNOZ s4 C	24 VDC	With spring-loaded terminals	751 104	1.2-26
PNOZ s4 C	48 – 240 VAC/DC	With spring-loaded terminals	751 134	1.2-26
PNOZ s4.1	24 VDC	With spring-loaded terminals	751 124	1.2-35
PNOZ s4.1	24 VDC	With screw terminals	750 124	1.2-35
PNOZ s4.1	48 - 240 VAC/DC	With spring-loaded terminals	751 154	1.2-35
PNOZ s4.1	48 - 240 VAC/DC	With screw terminals	750 154	1.2-35
PNOZ s5	24 VDC	With screw terminals	750 105	1.2-44
PNOZ s5	48 – 240 VAC 48 – 240 VDC	With screw terminals	750 135	1.2-44
PNOZ s5 C	24 VDC	With spring-loaded terminals	751 105	1.2-44
PNOZ s5 C	48 – 240 VAC 48 – 240 VDC	With spring-loaded terminals	751 135	1.2-44
PNOZ s5 C (coated version)	24 VDC	With spring-loaded terminals	751 185	1.2-44
PNOZ s6	24 VDC	With screw terminals	750 106	1.2-54
PNOZ s6	48 – 240 VAC/DC	With screw terminals	750 136	1.2-54
PNOZ s6 C	24 VDC	With spring-loaded terminals	751 106	1.2-54
PNOZ s6 C	48 – 240 VAC/DC	With spring-loaded terminals	751 136	1.2-54
PNOZ s6.1	24 VDC	With screw terminals	750 126	1.2-62
PNOZ s6.1	48 – 240 VAC/DC	With screw terminals	750 156	1.2-62
PNOZ s6.1 C	24 VDC	With spring-loaded terminals	751 126	1.2-62
PNOZ s6.1 C	48 – 240 VAC/DC	With spring-loaded terminals	751 156	1.2-62
PNOZ s7	24 VDC	With screw terminal	750 107	1.2-76
PNOZ s7 C	24 VDC	With spring-loaded terminal	751 107	1.2-76
PNOZ s8	24 VDC	With screw terminal	750 108	1.2-70
PNOZ s8 C	24 VDC	With spring-loaded terminal	751 108	1.2-70
PNOZ s9	24 VDC	With screw terminals	750 109	1.2-116
PNOZ s9 C	24 VDC	With spring-loaded terminals	751 109	1.2-116
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PNOZs 7.1 C	24 VDC	With spring-loaded terminals	751 167	1.2-83
PNOZs 7.2	24 VDC	With screw terminals	750 177	1.2-93
PNOZs 7.2 C	24 VDC	With spring-loaded terminals	751 177	1.2-93

Safety relays PNOZsigma

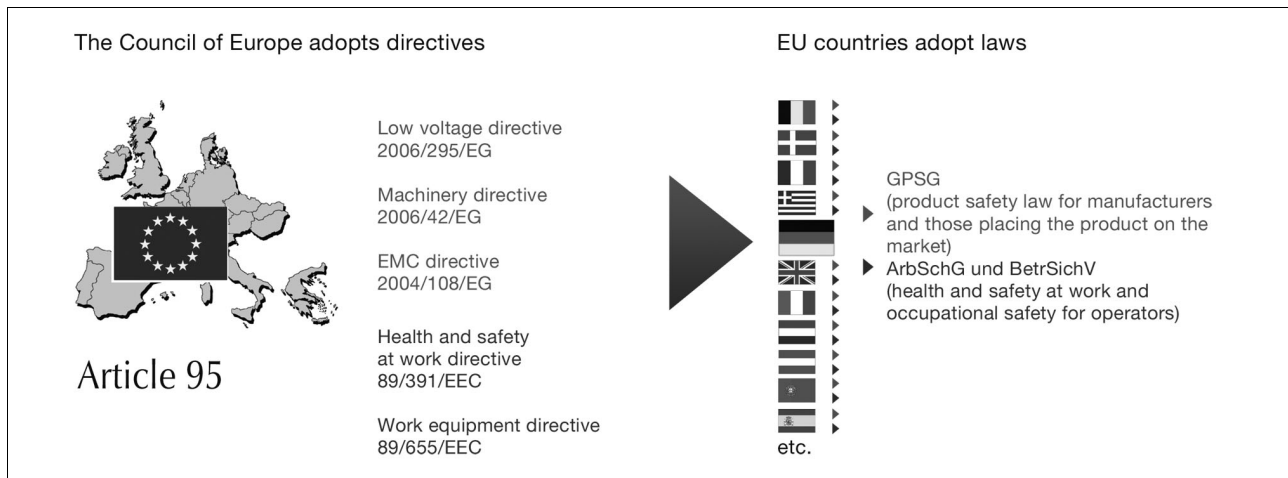
Numerically by order number

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750 104	PNOZ s4		24 VDC With screw terminals	1.2-26
750 105	PNOZ s5		24 VDC With screw terminals	1.2-44
750 106	PNOZ s6		24 VDC With screw terminals	1.2-54
750 107	PNOZ s7		24 VDC With screw terminal	1.2-76
750 108	PNOZ s8		24 VDC With screw terminal	1.2-70
750 109	PNOZ s9		24 VDC With screw terminals	1.2-116
750 110	PNOZ s10		24 VDC With screw terminal	1.2-102
750 111	PNOZ s11		24 VDC With screw terminal	1.2-109
750 124	PNOZ s4.1		24 VDC With screw terminals	1.2-35
750 126	PNOZ s6.1		24 VDC With screw terminals	1.2-62
750 134	PNOZ s4	48 – 240 VAC/DC	24 VDC With screw terminals	1.2-26
750 135	PNOZ s5	48 – 240 VAC	48 – 240 VDC With screw terminals	1.2-44
750 136	PNOZ s6	48 – 240 VAC/DC	24 VDC With screw terminals	1.2-54
750 154	PNOZ s4.1	48 - 240 VAC/DC	24 VDC With screw terminals	1.2-35
750 156	PNOZ s6.1	48 – 240 VAC/DC	24 VDC With screw terminals	1.2-62
750 167	PNOZs 7.1		24 VDC With screw terminals	1.2-83
750 177	PNOZs 7.2		24 VDC With screw terminals	1.2-93
751 101	PNOZ s1 C		24 VDC With spring-loaded terminal	1.2-2
751 102	PNOZ s2 C		24 VDC With spring-loaded terminal	1.2-10
751 103	PNOZ s3 C		24 VDC With spring-loaded terminals	1.2-18
751 104	PNOZ s4 C		24 VDC With spring-loaded terminals	1.2-26
751 105	PNOZ s5 C		24 VDC With spring-loaded terminals	1.2-44
751 106	PNOZ s6 C		24 VDC With spring-loaded terminals	1.2-54
751 107	PNOZ s7 C		24 VDC With spring-loaded terminal	1.2-76
751 108	PNOZ s8 C		24 VDC With spring-loaded terminal	1.2-70
751 109	PNOZ s9 C		24 VDC With spring-loaded terminals	1.2-116
751 110	PNOZ s10 C		24 VDC With spring-loaded terminal	1.2-102
751 111	PNOZ s11 C		24 VDC With spring-loaded terminal	1.2-109
751 124	PNOZ s4.1		24 VDC With spring-loaded terminals	1.2-35
751 126	PNOZ s6.1 C		24 VDC With spring-loaded terminals	1.2-62
751 134	PNOZ s4 C	48 – 240 VAC/DC	24 VDC With spring-loaded terminals	1.2-26
751 135	PNOZ s5 C	48 – 240 VAC	48 – 240 VDC With spring-loaded terminals	1.2-44
751 136	PNOZ s6 C	48 – 240 VAC/DC	24 VDC With spring-loaded terminals	1.2-54
751 154	PNOZ s4.1	48 - 240 VAC/DC	24 VDC With spring-loaded terminals	1.2-35
751 156	PNOZ s6.1 C	48 – 240 VAC/DC	24 VDC With spring-loaded terminals	1.2-62
751 167	PNOZs 7.1 C		24 VDC With spring-loaded terminals	1.2-83
751 177	PNOZs 7.2 C		24 VDC With spring-loaded terminals	1.2-93
751 185	PNOZ s5 C (coated ver- sion)		24 VDC With spring-loaded terminals	1.2-44



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European directives and position of the standards in Europe



3.1

Incorporation of the directives into domestic law (using Germany as an example)

European directives

The concept of a single European internal market in terms of the “New Approach” can be traced right back to the start of the 70s: The low voltage directive is the first piece of European legislation to take into account the approach towards harmonisation of a common single market.

Products that are covered by one or more of the following directives have to apply a CE mark, i.e. the product must be accompanied by a declaration of conformity. With a declaration of conformity the manufacturer confirms that his product meets all the requirements of the European directives that relate to his product. This means he can launch and sell his product within the scope of the EU without consideration of any national regulations.

Key engineering directives:

- ▶ General product safety (2001/95/EC)
- ▶ Health and safety (89/391/EEC)
- ▶ Use of work equipment (89/655/EEC)
- ▶ Lifts (95/16/EC)
- ▶ Waste electrical and electronic equipment (2002/96/EC)
- ▶ Electromagnetic compatibility (EMC) (2004/108/EC)

- ▶ Devices for use in potentially explosive areas (ATEX) (94/9/EC)
- ▶ Machinery (98/37/EC) / (2006/42/EC)
- ▶ Low voltage equipment (2006/95/EC)
- ▶ Personal protective equipment (89/686/EEC)
- ▶ Cable cars (2000/9/EC)

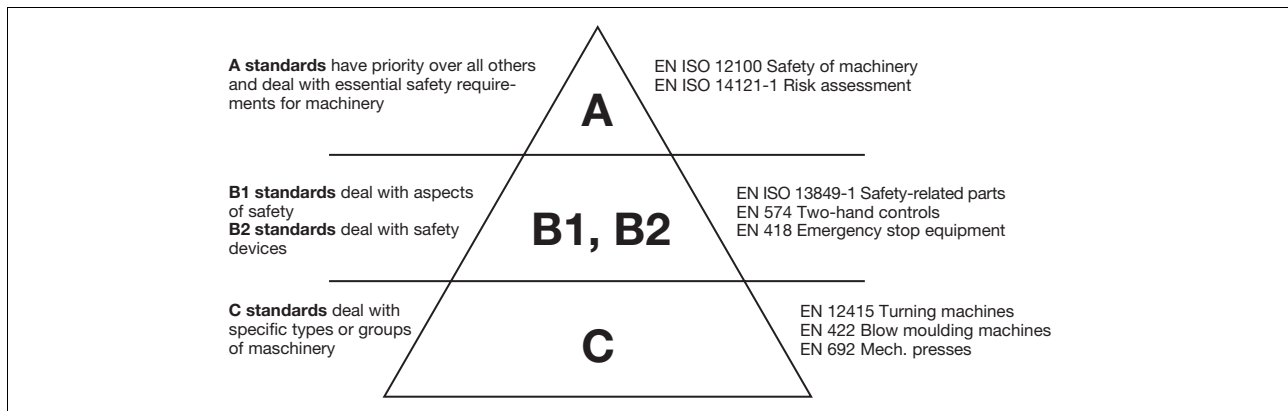
The directives are addressed to member states, who are obliged to incorporate the European directives into domestic law. In Germany this is normally achieved through the device safety law.

Position of the standards in Europe

The legal status of standards is constantly under discussion. Inside Europe, i.e. within the scope of the European directives that are subject to the CE marking obligation, a manufacturer is not bound by standards or other specifications. He simply needs to comply with the health and safety requirements of the directive(s). The associated benefits of a division between standards and legislation are obvious: It is easier for legislators to agree on the essential requirements than on technical details. Also, the directives do not regularly have to be adapted to the state of technology; member states can use their own legal system for incorporation and manu-

facturers are free to select the ways in which they implement the requirements of the directive.

European directives and position of the standards in Europe



Standards pyramid

So what are the benefits of applying the standards? With so-called harmonised standards with presumption of conformity, there is a shifting of the burden of proof, i.e. if manufacturers apply these standards, it is presumed that they will also comply with the specific requirements of the European directives. The regulatory authorities would therefore need to prove that a

manufacturer did not meet the legal requirements.

However, should a manufacturer deviate from the harmonised standards, he himself must prove how he has met the essential safety requirements. This is generally done via a hazard analysis. In practice one would endeavour to apply the harmonised standards, un-

less the products concerned are highly innovative and no harmonised standards yet exist. The standards for which this "presumption effect" applies can be researched in the Official Journal of the EU (e.g. on the Internet). Standards in Europe are subdivided into what are termed A, B, and C standards.

Risk assessment

Risk analysis

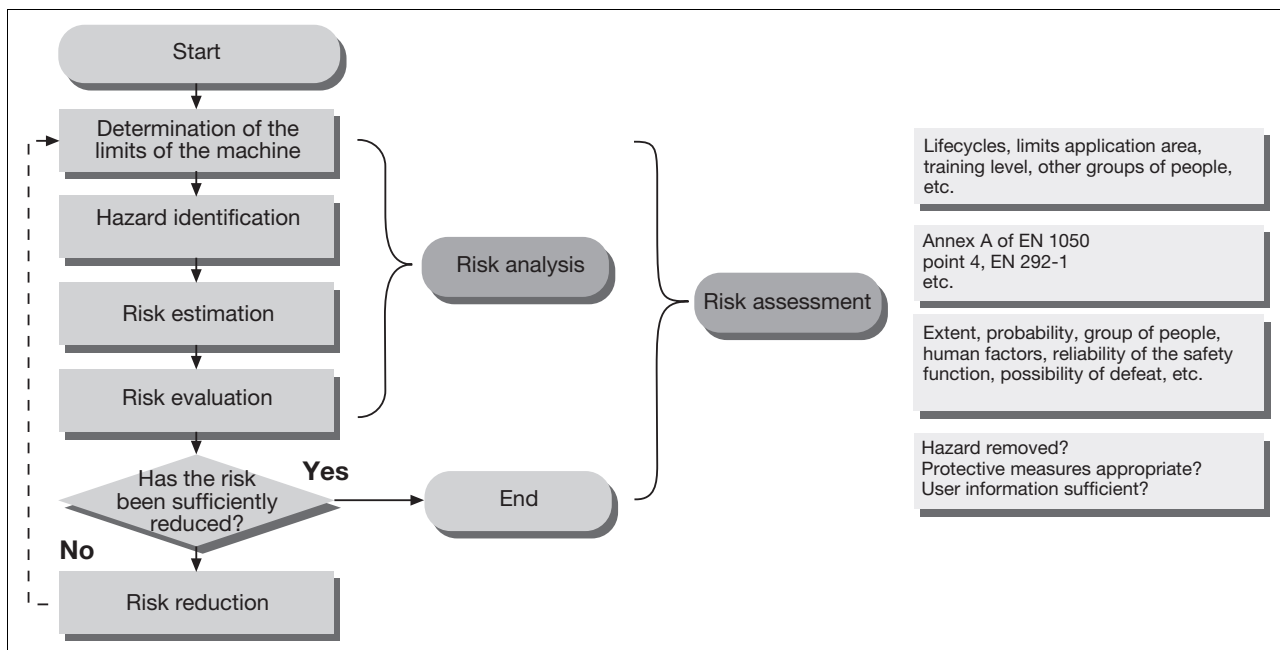
Under the terms of the machinery directive, a machine manufacturer must assess the hazards in order to identify all the hazards that apply to his machine. He must then design and construct the machine to take account of his assessment. This requirement also applies to operators who act as manufacturers under the terms of the machinery directive. For example, this

may occur with machines that are interlinked or for machinery that has been upgraded and substantially modified.

EN ISO 14121-1 contains "Principles for risk assessment" on machinery. These approaches can be called upon as part of a comprehensive analysis. EN ISO 13849-1 expands on EN ISO 14121-1 with regard to the assessment of safety-related parts of control systems.

The hazards emanating from a machine may be many and varied, so for example, it is necessary to consider not just mechanical hazards through crushing and shearing, but also thermal and electrical hazards and hazards from radiation. Risk reduction is therefore an iterative process, i.e. it is carried out before and during the planning phase and after completion of the plant or machine.

3.1



Iterative process in accordance with EN ISO 14121-1

Legal regulations outside Europe and standards for functional safety

Legal regulations outside Europe

The situation is somewhat different in the USA: people there are mainly familiar with two types of standards: ANSI (American National Standards Institute) and OSHA (Occupational Safety and Health Administration).

OSHA standards are published by the state and compliance is mandatory. ANSI standards, on the other hand, are developed by private organisations and their application is generally not absolutely essential. However, ANSI standards can still be found included as part of a contract. Beyond that ANSI standards are being taken over by OSHA. You can also still come across the NFPA (National Fire Protection Association), which developed NFPA 79 as a counterpart to EN 60204-1, for example. OSHA standards can be compared with the European directives. Unlike the European directives, OSHA standards are more involved with formulating technical specifications than abstract requirements.

The legal basis in the USA can be seen as a mix of product standards, fire codes (NFPA), electrical codes (NEC) and national laws. Local government bodies have the authority to monitor that these codes are being enforced and implemented.

Russia and the CIS states have implemented GOST-R certification for some years now, in other words, technical devices that fall within a specific product area must undergo a certain certification process. Machinery and any corresponding technical accessories undergo a type approval test through a European notified body, for example. This test is generally recognised by a Russian-based approvals body. From the point of view of safety, the same requirements apply as in Europe.

China, on the other hand, has introduced CCC certification. Similar to the position in Russia, technical products are subject to mandatory certification through a national approvals body in China. In addition, production sites are

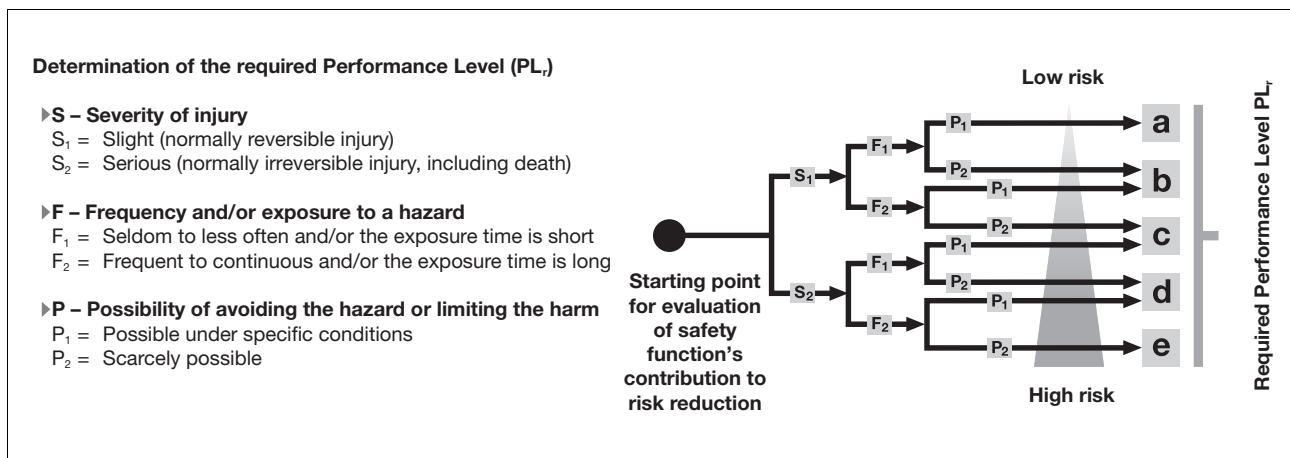
inspected. If a technical device falls with the scope of the product list, which is subdivided into 19 categories, certification is mandatory, otherwise it will be necessary to supply a type of “declaration of no objection” from a national notified body.

Japan is currently in a transition period: The plan is for Japan to adopt the European “new approach” – in other words, to keep standards and legislation separate. At the moment the international ISO and IEC standards are being directly incorporated into national legislation, which is why people are currently confronted with frequent amendments to laws and lengthy implementation periods.

Standards for functional safety

Different standards may be called upon to observe functional safety on control systems, depending on the application. In the area of machine safety, EN ISO 13849-1 is the main standard named for safety-related control systems. Irrespective of the technology, this applies for the whole chain from the sensor to the actuator. The risk graphs and corresponding risk parameters can be used to estimate the potential risk for danger zones on machinery. The category is then established without the use of risk-reducing measures.

Safety-related parts of control systems - General principles for design in accordance with EN ISO 13849-1



3.1

Safety-related parts of control systems – General principles for design in accordance with EN ISO 13849-1

As the successor standard to EN 954-1, EN ISO 13849-1 is based on the familiar categories. Equally, it examines complete safety functions, including all the components involved in their design. EN ISO 13849-1 goes beyond the qualitative approach of EN 954-1 to include a quantitative assessment of the safety functions. A performance level (PL) is used for this, building upon the categories.

Components/devices require the following safety parameters:

- ▶ Category (structural requirement)
- ▶ PL: Performance level
- ▶ MTTFd: Mean time to dangerous failure Mean Time To Dangerous Failure)
- ▶ DC: Diagnostic coverage Diagnostic Coverage)
- ▶ CCF: Common cause failure Common Cause Failure)

The standard describes how to calculate the performance level (PL) for safety-related parts of control systems, based on designated architectures. EN ISO 13849-1 refers any deviations to IEC 61508.

Risk assessment in accordance with EN ISO 13849-1

Risk assessment is an iterative process, i.e. it will need to be carried out more than once. The risk must be estimated and the performance level defined for each hazard on which the risk is to be reduced through control measures. The risk is estimated through consideration of the severity of injury (S), the frequency and duration of exposure to the hazard (F) and the possibility of avoiding or limiting the harm (P).

Parameters S, F and P are used on the risk graph to determine the required performance level (PL_r) for a safety function. The selection of parameters is no different to the procedure used in EN 954-1 (1996). However, the result is no longer a category but a PL.

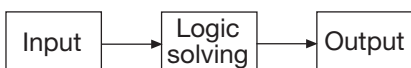
Safety-related parts of control systems - General principles for design in accordance with EN ISO 13849-1

Performance level

The performance level (PL) classifies 5 levels of probability of failure. The table shows the relationship between PL and the probability of dangerous failure per hour (PFHD).

Performance Levels (PL) in accordance with EN ISO 13849-1	Probability of a dangerous failure per hour [1/h]
a	$10^{-5} < PFH < 10^{-4}$
b	$3 \times 10^{-6} < PFH < 10^{-5}$
c	$10^{-6} < PFH < 3 \times 10^{-6}$
d	$10^{-7} < PFH < 10^{-6}$
e	$10^{-8} < PFH < 10^{-7}$

Once the required PL has been established, the PL achieved by the safety function (SRP/CL) is calculated. To do this the SRP/CL can be divided into logical blocks, such as input, logic solving and output for example.

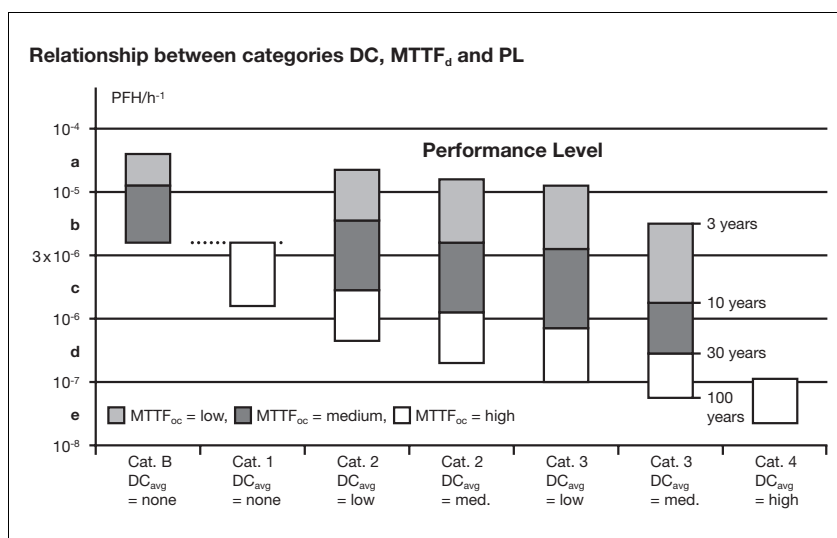


When using a designated architecture or an architecture of similar structure, the achieved PL can be calculated graphically using the bar chart. To do this the architecture of the SRP/CL is divided into categories. $MTTF_D$ and DC_{avg} are also required. From Category 2 onwards, the CCF will also need to be examined. A component's $MTTF_D$ value is usually provided by the manufacturer. The standard provides tables and check lists for calculating the other values.

It is also possible to calculate the achieved PL of an SRP/CL. The probability of dangerous failure of all the blocks that combine to form the safety function is added up:

$$PFH_{System} = PFH_{Input} + PFH_{Logic} + PFH_{Output}$$

The PL achieved by an SRP/CL must be at least as high as the PL required by the safety function. If this condition is not met, the safety function must be implemented differently.



Functional safety and legal position of EN/IEC 61508

Functional safety with EN/IEC 61508?

EN/IEC 61508 is regarded as a generic safety standard, which deals with the functional safety of electrical, electronic and programmable electronic systems, irrespective of the application.

One of the main tasks of EN/IEC 61508 is to serve as a basis for the

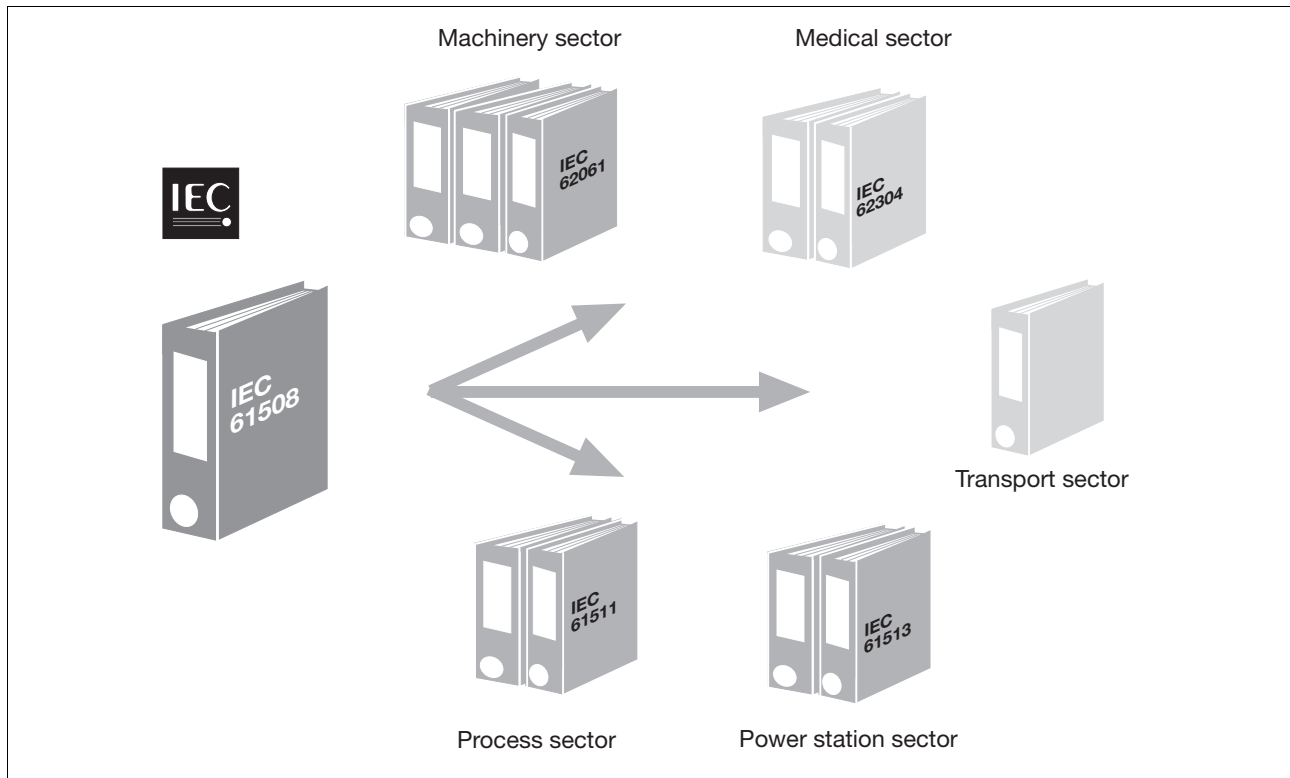
development of application-oriented standards. Standards' committees are currently busy in the areas of machine safety with EN/IEC 62061, and process safety with EN/IEC 61511.

These sector-specific standards are intended to continue the principle approaches of EN/IEC 61508 and to implement the requirements for the relevant application area in a suitably practical manner.

What is the legal status of EN/IEC 61508?

As EN/IEC 61508 is not listed in the Official Journal of the European Communities for implementation as a European directive, it lacks the so-called "presumption effect": so if the standard is used on its own, a control system designer cannot presume that the relevant requirements of the specific European directive have been met.

3.1



Sector standards from EN/IEC 61508

Functional safety in accordance with EN/IEC 62061

Risk assessment and determination of required Safety Integrity Level (SIL)												
Consequences	S	Class CI					Frequency and duration	Fr	Probability of hzd. event		Avoidance	
		3-4	5-7	8-10	11-13	14-15			Pr	Pr	P	
Death, losing an eye or arm	4	SIL 2	SIL 2	SIL 2	SIL 3	SIL 3	≤ 1 hour	5	Very high	5		
Permanent, losing fingers	3		OM	SIL 1	SIL 2	SIL 3	> 1 h – ≤ 1 day	5	Likely	4		
Reversible, medical attention	2			OM	SIL 1	SIL 2	> 1 day – ≤ 2 wks	4	Possible	3	Impossible	5
Reversible, first aid	1				OM	SIL 1	> 2 wks – ≤ 1 year	3	Rarely	2	Possible	3
							> 1 year	2	Negligible	1	Likely	1

☐ AM = Other measures recommended

Functional safety of safety-related electrical, electronic and programmable electronic control systems in accordance with EN/IEC 62061

EN/IEC 62061 represents a sector-specific standard under EN/IEC 61508. It describes the implementation of safety-related electrical control systems on machinery and

examines the overall lifecycle from the concept phase through to decommissioning. Quantitative and qualitative examinations of the safety functions form the basis.

Risk estimation is an iterative process, i.e. it will need to be carried out more than once. The risk must be assessed and the SIL defined for each hazard on which the risk is to be reduced through

control measures. The risk is estimated through consideration of the severity of injury (Se), the frequency and duration of exposure to the hazard (Fr), probability of occurrence of a hazardous event (Pr) and the possibility of avoiding or limiting the harm (Av). The required SIL is assigned using the table above, where $CI = Fr + Pr + Av$.

Functional safety in accordance with EN/IEC 62061

Safety Integrity Level (SIL) in accordance with EN IEC 62061	Probability of a dangerous failure per hour [1/h]
No special safety requirement	$10^{-5} < PFH < 10^{-4}$
1 (1 failure in 100 000 h)	$3 \times 10^{-6} < PFH < 10^{-5}$
1 (1 failure in 100 000 h)	$10^{-6} < PFH < 3 \times 10^{-6}$
2 (1 failure in 1 000 000 h)	$10^{-7} < PFH < 10^{-6}$
3 (1 failure in 10 000 000 h)	$10^{-8} < PFH < 10^{-7}$

SIL assignment

The safety integrity level (SIL) classifies three levels of probability of failure. The table shows the relationship between SIL and the probability of dangerous failure per hour (PFH_D).

The SRECS (safety-related electrical control system) is divided into subsystems. These subsystems are assigned to actual devices, known as subsystems and subsystem elements. The SIL must be defined for each subsystem.

The probability of a dangerous failure is calculated by adding the probabilities of failure of all the subsystems of the SRECS:

$$PFH_D = PFH_{D1} + \dots + PFH_{Dn}$$

The selection or design of the SRECS must always meet the following minimum requirements:

Requirements for hardware safety integrity, comprising

- ▶ Architectural constraints for hardware safety integrity
- ▶ Requirements for the probability of dangerous random hardware failures

plus requirements for systematic safety integrity, comprising

- ▶ Requirements for avoidance of failures and
- ▶ Requirements for the control of systematic failures.

The following parameters are required in assessing hardware safety integrity:

- λD: Dangerous failure rate
- T1: Proof test
- T2: Diagnostic test interval
- DC: Diagnostic coverage
- β: Common cause failure

The calculated probability of failure (PFH_D) of each SRECS must be less than the probability of failure required by the safety function. The required probability of failure, depending on the SIL, can be taken from the table. If this condition is not met, the safety function must be implemented differently.

The achieved SIL can only be as high as the lowest SILCL (SIL Claim Limit) of a subsystem involved in performing the safety function.

Safe failure fraction (SFF)	Hardware fault tolerance 0	Hardware fault tolerance 1	Hardware fault tolerance 2
< 60 %	Not allowed	SIL 1	SIL 2
60 % – < 90 %	SIL 1	SIL 2	SIL 3
90 % – < 99 %	SIL 2	SIL 3	SIL 3
99 %	SIL 3	SIL 3	SIL 3

Risk parameters and categories of EN 954-1/EN ISO 13849-1*

Risk parameters

S = Severity of injury:

- 1 = Slight (normally reversible) injury
- 2 = Serious (normally irreversible) injury including death

F = Frequency and/or exposure time to the hazard:?

- 1 = Seldom to quite often and/or the exposure time is short
- 2 = Frequent to continuous and/or the exposure time is long

P = Possibility of avoiding the hazard:

- 1 = Possible under specific conditions
- 2 = Scarcely possible

Example: Safety switch with forced-opening contacts.

Well-tried safety principles are circuits that are constructed in such a way that certain faults can be avoided by the appropriate arrangement or layout of components.

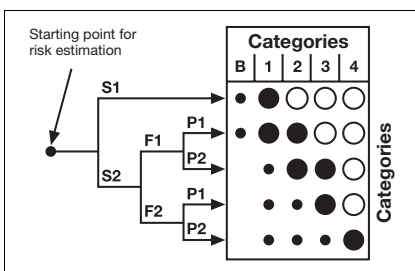
Example: avoiding a short circuit through appropriate separation, avoiding component failures that result from over-dimensioning, using the failsafe principle (on switching off).

Note: The occurrence of a fault can lead to the loss of the safety function.

In general Category 2 can be realised with electronic techniques. The system behaviour allows the occurrence of a fault to lead to the loss of the safety function between checks; the loss of the safety function is detected by the check.

Category 3

Safety-related parts of control systems shall be designed so that a single fault in any of these parts does not lead to the loss of the safety function. Whenever reasonably practicable, the single fault shall be detected at or before the next demand upon the safety function.



Risk graph from EN 954

Categories in accordance with EN 954-1

The control system requirements derived from the risk graph are specified as follows:

Category B

Basic category with no special requirements = "good industrial standard"

Category 1

Safety-related parts shall be designed and constructed using well-tried components and well-tried safety principles.

Well-tried means: the components have been widely used in the past with successful results in similar applications, or they have been manufactured using principles that demonstrate its suitability and reliability for safety-related applications.

Category 2

Safety-related parts of control systems shall be designed so that their safety function(s) are checked at suitable intervals by the machine control system. The safety function(s) must be checked: at the machine start-up and prior to the initiation of any hazardous situation; periodically during operation, if the risk assessment and the kind of operation show that it is necessary.

This check may be initiated automatically or manually. Automatically, for example, the check may be initiated by a signal generated from a control system at suitable intervals. The automatic test should be provided by preference. The decision about the type of test depends on the risk assessment and the judgement of the end user or machine builder. If no fault is detected, operation may be approved as a result of the test. If a fault is detected, an output must be generated to initiate appropriate control action. A second, independent shutdown route is required for this.

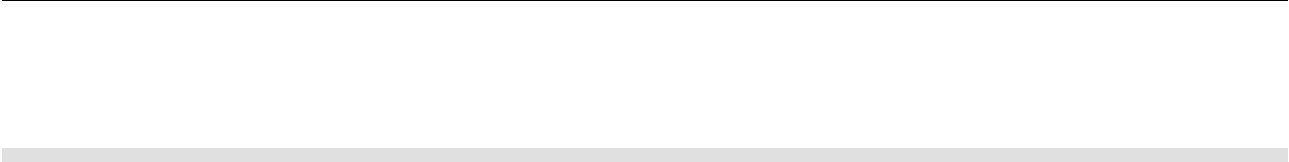
Notes: In some cases Category 2 is not applicable because the checking of the safety function cannot be applied to all components and devices. Moreover, the cost involved in implementing Category 2 correctly may be considerable, so that it may make better economic sense to implement a different category.

This does not mean that all faults will be detected. The accumulation of undetected faults can lead to an unintended output and a hazardous situation at the machine.

Category 4

Safety-related parts of control systems must be designed so that a single fault in any of these parts does not lead to a loss of the safety function; the single fault must be detected at or before the next demand upon the safety functions (e.g. immediately at switch on, at the end of a machine operating cycle). If this detection is not possible, then an accumulation of faults shall not lead to a loss of the safety function.

**Only applicable until November 2009. Replaced by EN ISO 13849-1*



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Pre-sales/after sales Professional Services



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Assessment of the hazards and risks on plant and machinery, based on norms and standards.



Safety concept

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System implementation

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