# E-STOP relay, safety gate monitor

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## Up to Category 4, EN 954-1
PNOZ 16S

Safety relay for monitoring emergency stop pushbuttons, safety gates, safety mats and safe edges

### Approvals

| | PNOZ 16S |
|---|:---:|
| c(UL)us LISTED | ◆ |
| BG-PRÜFZERT | ◆ |
| CCC | ◆ |

### Block diagram

### Unit features

▸ Positive-guided relay outputs:
  – 2 safety contacts (N/O), instantaneous
▸ 2 semiconductor outputs
▸ Connection options for:
  – E-STOP pushbutton
  – Safety gate limit switch
  – Reset button
  – Safe edges
  – Safety mats
▸ LED indicator for:
  – Switch status channel 1/2
  – Supply voltage
  – Detection of shorts across contacts on safety mat "EXT. FAULT"
▸ Semiconductor outputs signal:
  – Switch status channel 1/2
  – Supply voltage is presentDetection of shorts across contacts on safety mat "EXT. FAULT"

### 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 mats
▸ Safe edges

The safety relay is not suitable for non-contact barriers because

▸ a dynamic start is not possible
▸ the unit can be started during the delay-on de-energisation time.

### 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 tranformer is short circuit-proof. An electronic fuse is used on a DC supply.
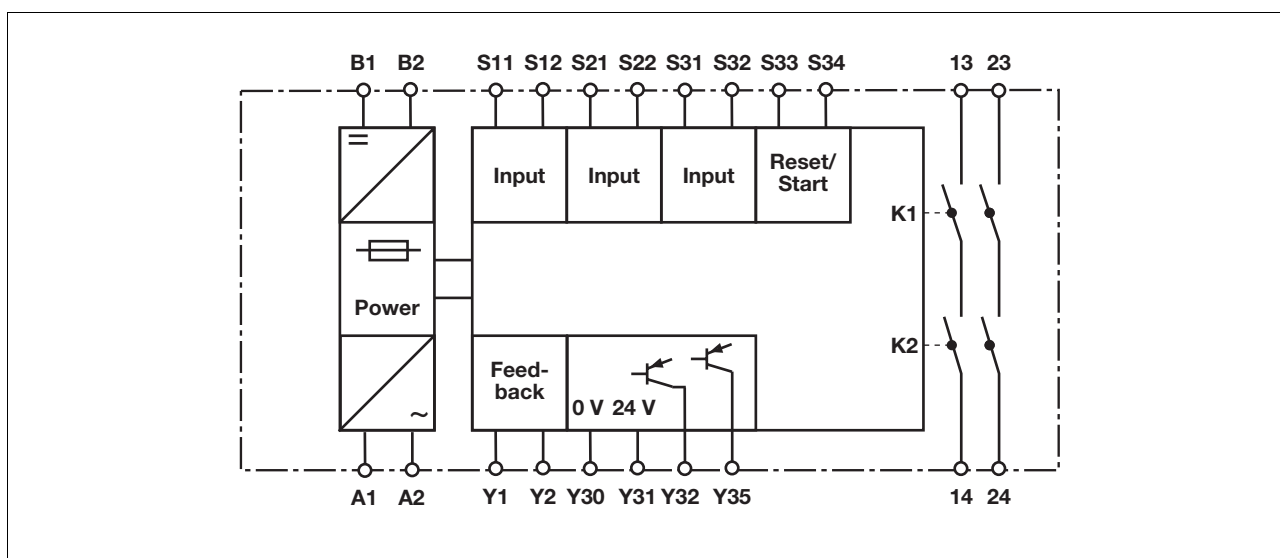
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### Function description

▶ Single-channel operation: no redundancy in the input circuit, earth faults in the reset circuit are detected.
▶ Dual-channel operation with detection of shorts across contacts: redundant input circuit, detects
  – earth faults in the reset and input circuit,
  – short circuits and shorts between contacts in the input circuit.
▶ When the safety mat is actuated, a short is formed between the inputs and internal fault detection is energised.  The safety contacts open and the LED EXT.FAULT is lit. If the safety mat is cleared and supply voltage is maintained, the unit is ready for operation again once the recovery time has elapsed.
▶ 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 contacts by connecting contact expansion modules or external contactors/relays.

### Timing diagram
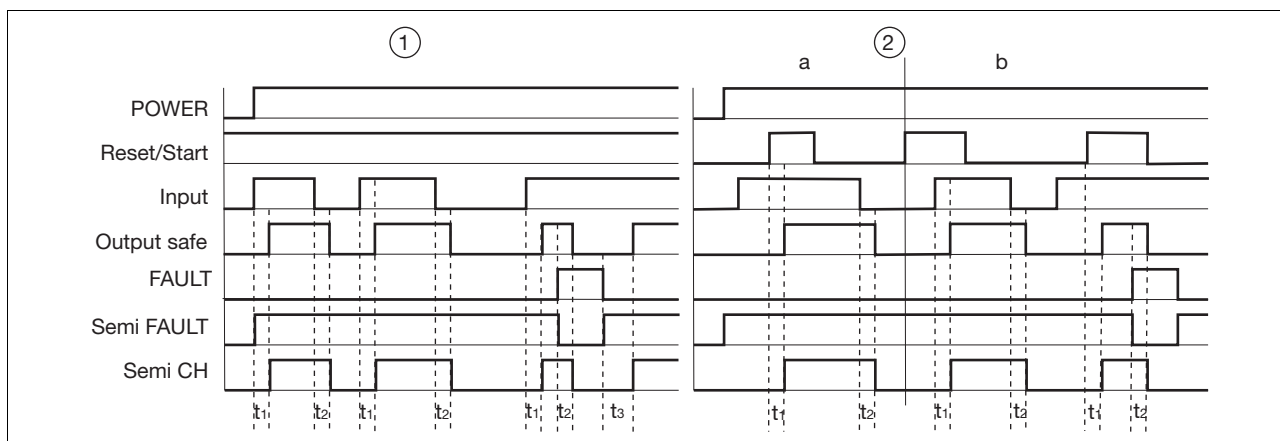


### Key
▶ Power: Supply voltage
▶ Reset/start: Reset circuit S33-S34
▶ Input: Input circuits S11-S12, S21-S22, S31-S32
▶ Output safe: Safety contacts 13-14, 23-24
▶ Out semi FAULT: Semiconductor output supply voltage Y35
▶ Out semi CH: Semiconductor output switch status Y32
▶ FAULT: Short between contacts in the input circuit due to actuation of safety mat
▶ ①: Automatic reset
▶ ②: Manual reset
▶ a: Input circuit closes before reset circuit
▶ b: Reset circuit closes before input circuit
▶ $t_1$: Switch-on delay
▶ $t_2$: Delay-on de-energisation
▶ $t_3$: Recovery time after short across contacts

### 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:

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

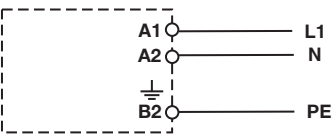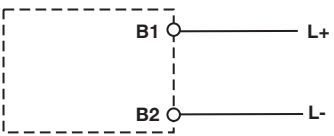$R_{lmax}$ = max. overall cable resistance (see technical details)

$R_l$ /km = cable resistance/km
▶ Use copper wire that can withstand 60/75 °C.
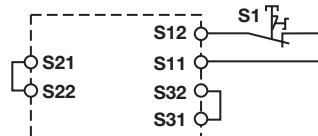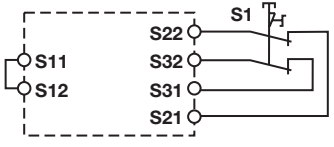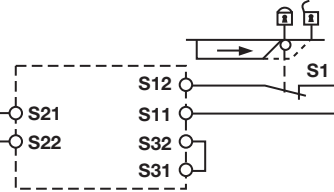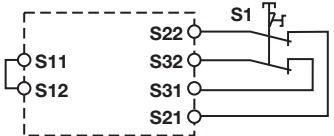▶ Sufficient fuse protection must be provided on all output contacts with capacitive and inductive loads.
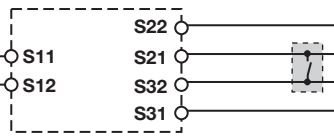
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**Preparing for operation**

▶ Supply voltage
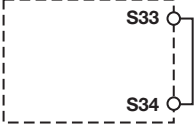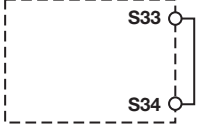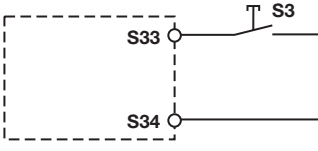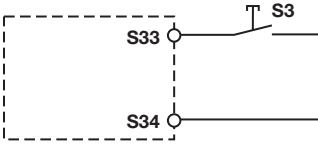
| Supply voltage | AC | DC |
|---|---|---|
| | A1 — L1<br>A2 — N<br>⏚<br>B2 — PE | B1 — L+<br><br>B2 — L- |
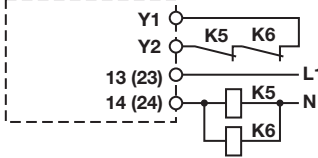
▶ Input circuit

| Input circuit | Single-channel | Dual-channel |
|---|---|---|
| E-STOP **without** detection of shorts across contacts | S21<br>S22<br>S12 — S1<br>S11<br>S32<br>S31 | |
| E-STOP **with** detection of shorts across contacts | | S11<br>S12<br>S22 — S1<br>S32<br>S31<br>S21 |
| Safety gate **without** detection of shorts across contacts | S21<br>S22<br>S12 — S1<br>S11<br>S32<br>S31 | |
| Safety gate **with** detection of shorts across contacts | | S11<br>S12<br>S22<br>S21 — S1 — S2<br>S32<br>S31 |
| Safety mat, safe edge **with** detection of shorts across contacts | | S11<br>S12<br>S22<br>S21<br>S32<br>S31 |

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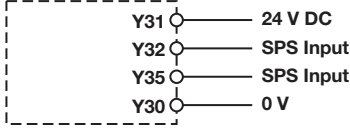
▶ Reset circuit

| Reset circuit | E-STOP wiring (single-channel) Safety gate (single-channel) | E-STOP wiring (dual-channel) Safety gate (dual-channel) |
|---|---|---|
| Automatic reset | S33<br>S34 | S33<br>S34 |
| Manual reset | S3<br>S33<br>S34 | S3<br>S33<br>S34 |

▶ Feedback loop

| Feedback loop | |
|---|---|
| Contacts from external contactors | Y1<br>Y2 — K5 K6<br>13 (23) — L1<br>14 (24) — K5 N<br>K6 |

▶ Semiconductor output

| |
|---|
| Y31 — 24 V DC<br>Y32 — SPS Input<br>Y35 — SPS Input<br>Y30 — 0 V |

▶ Key

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

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**Terminal configuration**
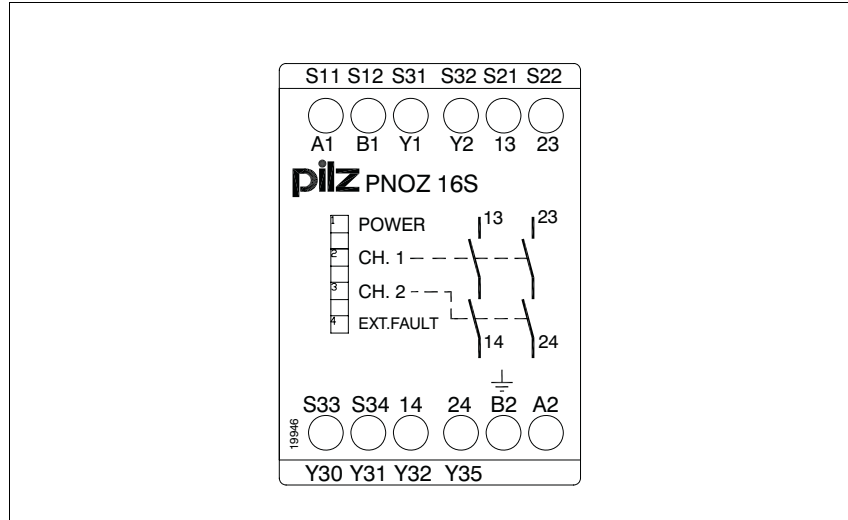


**Installation**

▸ 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).

**Dimensions**

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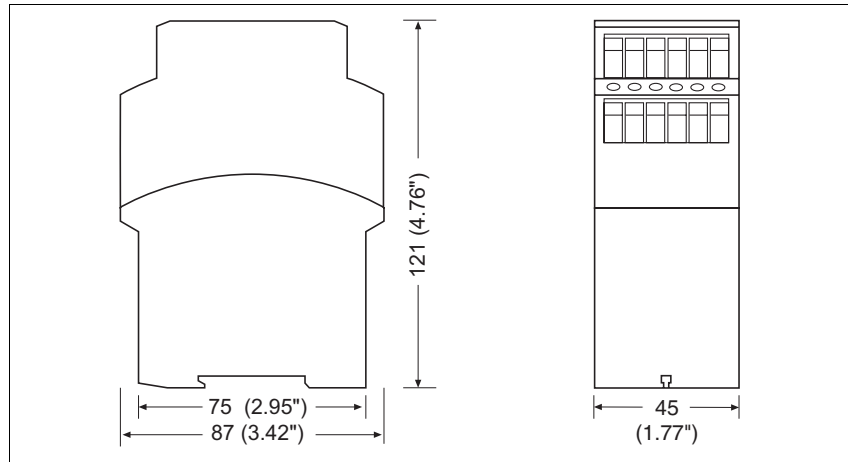
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### Notice

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



| | | |
|---|---|---|
| ▶ D | Schaltspielzahl x 10³ | ▶ E | Número de ciclos x 10³ |
| ▶ GB | Cycles x 10³ | ▶ I | Numero dei cicli di commutazione x 10³ |
| ▶ F | Nombre de manœuvres x 10³ | ▶ NL | Aantal schakelingen x 10³ |
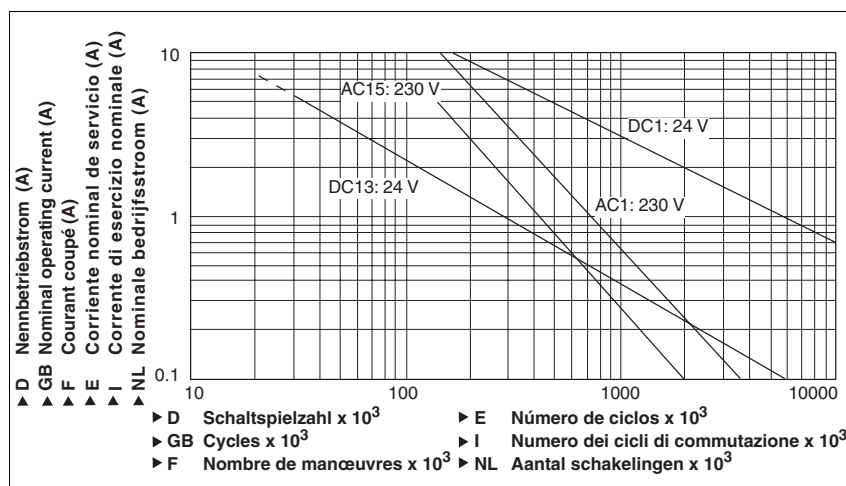
## Technical details

### Electrical data

| | |
|---|---|
| Supply voltage | |
| Supply voltage $U_B$ AC | **24 V, 42 V, 48 V, 110 V, 115 V, 120 V, 230 V, 240 V** |
| Supply voltage $U_B$ DC | **24 V** |
| Voltage tolerance | **-15 %/+10 %** |
| Power consumption at $U_B$ AC | **3.5 VA** |
| Power consumption at $U_B$ DC | **2.0 W** |
| Frequency range AC | **50 - 60 Hz** |
| Residual ripple DC | **20 %** |
| Voltage and current at | |
| Input circuit DC: **24.0 V** | **25.0 mA** |
| Reset circuit DC: **24.0 V** | **25.0 mA** |
| Feedback loop DC: **24.0 V** | **25.0 mA** |
| Number of output contacts | |
| Safety contacts (S) instantaneous: | **2** |
| Category of output contacts in accordance with **EN 954-1**, **EN ISO 13849-1** | |
| Safety contacts (S) instantaneous: | **4** |
| 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** | $I_{max}$: **5.0 A** |
| Safety contacts: DC13 at **24 V** (6 cycles/min) | $I_{max}$: **6.0 A** |
| Contact material | **AgSnO2 + 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** |

## Up to Category 4, EN 954-1
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| Electrical data | |
|---|---|
| Semiconductor outputs (short circuit proof) | **24.0 V** DC,**20 mA** |
| External supply voltage | **24.0 V** DC |
| Voltage tolerance | **-15% / +10%** |
| Safety mat resistance | **80 Ohm** |
| Max. overall cable resistance $R_{lmax}$ input circuits, reset circuits | |
| single-channel at $U_B$ DC | **40 Ohm** |
| single-channel at $U_B$ AC | **40 Ohm** |
| dual-channel with detect. of shorts across contacts at $U_B$ DC | **80 Ohm** |
| dual-channel with detect. of shorts across contacts at $U_B$ AC | **80 Ohm** |
| **Times** | |
| Switch-on delay | |
| with automatic reset typ. | **230 ms** |
| with automatic reset max. | **350 ms** |
| with automatic reset after power on typ. | **310 ms** |
| with automatic reset after power on max. | **450 ms** |
| with manual reset typ. | **230 ms** |
| with manual reset max. | **350 ms** |
| Delay-on de-energisation | |
| with E-STOP typ. | **18 ms** |
| with E-STOP max. | **30 ms** |
| with power failure typ. | **50 ms** |
| with power failure max. | **80 ms** |
| Recovery time at max. switching frequency 1/s | |
| after E-STOP | **50 ms** |
| after power failure | **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** |
| 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 | **PPO UL 94 V0** |
| Front | **ABS UL 94 V0** |
| Cross section of external conductors with screw terminals | |
| 1 core flexible | **0.20 - 4.00 mm² , 24 - 10 AWG** |
| 2 core, same cross section, flexible: | |
| with crimp connectors, without insulating sleeve | **0.20 - 2.50 mm² , 24 - 14 AWG** |
| without crimp connectors or with TWIN crimp connectors | **0.20 - 2.50 mm² , 24 - 14 AWG** |
| Torque setting with screw terminals | **0.60 Nm** |

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| Mechanical data | |
|---|---|
| Dimensions | |
| Height | **87.0 mm** |
| Width | **45.0 mm** |
| Depth | **121.0 mm** |
| Weight | **350 g** |

The standards current on **2008-06** apply.

### Conventional thermal current

| Number of contacts | $I_{th}$ (A) at $U_B$ DC | $I_{th}$ (A) at $U_B$ AC |
|---|---|---|
| 1 | **8.00 A** | **8.00 A** |
| 2 | **6.00 A** | **6.00 A** |

### Order reference

| Type | Features | | Terminals | Order no. |
|---|---|---|---|---|
| PNOZ 16S | 24 VAC/DC | | Screw terminals | 774 070 |
| PNOZ 16S | 42 VAC | 24 VDC | Screw terminals | 774 071 |
| PNOZ 16S | 48 VAC | 24 VDC | Screw terminals | 774 072 |
| PNOZ 16S | 110 VAC | 24 VDC | Screw terminals | 774 073 |
| PNOZ 16S | 115 VAC | 24 VDC | Screw terminals | 774 074 |
| PNOZ 16S | 120 VAC | 24 VDC | Screw terminals | 774 075 |
| PNOZ 16S | 230 VAC | 24 VDC | Screw terminals | 774 076 |
| PNOZ 16S | 240 VAC | 24 VDC | Screw terminals | 774 077 |