



## PNOZ p1vp

**PILZ**  
THE SPIRIT OF SAFETY

- ▶ Safety relays

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SD means Secure Digital

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## Introduction

### Validity of documentation

This documentation is valid for the product PNOZ p1vp. It is valid until new documentation is published.

This operating manual explains the function and operation, describes the installation and provides guidelines on how to connect the product.

### Using the documentation

This document is intended for instruction. Only install and commission the product if you have read and understood this document. The document should be retained for future reference.

### Definition of symbols

Information that is particularly important is identified as follows:



#### **DANGER!**

This warning must be heeded! It warns of a hazardous situation that poses an immediate threat of serious injury and death and indicates preventive measures that can be taken.



#### **WARNING!**

This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.



#### **CAUTION!**

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



#### **NOTICE**

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.

**INFORMATION**

This gives advice on applications and provides information on special features.


**Safety****Intended use**

The safety relay PNOZ p1vp is a base unit of the safety system PNOZpower. It provides a safety-related interruption of a safety circuit.

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

- ▶ E-STOP pushbuttons
- ▶ Safety gates

The following is deemed improper use in particular

- ▶ Any component, technical or electrical modification to the product,
- ▶ Use of the product outside the areas described in this manual,
- ▶ Use of the product outside the technical details (see [Technical details](#)  17]).

**NOTICE****EMC-compliant electrical installation**

The product is designed for use in an industrial environment. The product may cause interference if installed in other environments. If installed in other environments, measures should be taken to comply with the applicable standards and directives for the respective installation site with regard to interference.

**Safety regulations****Safety assessment**

Before using a device, a safety assessment in accordance with the Machinery Directive is required.

The product as an individual component fulfils the functional safety requirements in accordance with EN ISO 13849 and EN 62061. However, this does not guarantee the functional safety of the overall plant/machine. To achieve the relevant safety level of the overall plant/machine's required safety functions, each safety function needs to be considered separately.

**Use of qualified personnel**

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by persons who are competent to do so.

A competent person is a qualified and knowledgeable person who, because of their training, experience and current professional activity, has the specialist knowledge required. To be able to inspect, assess and operate devices, systems and machines, the person has to be informed of the state of the art and the applicable national, European and international laws, directives and standards.

It is the company's responsibility only to employ personnel who

- ▶ Are familiar with the basic regulations concerning health and safety / accident prevention,
- ▶ Have read and understood the information provided in the section entitled Safety
- ▶ Have a good knowledge of the generic and specialist standards applicable to the specific application.

**Warranty and liability**

All claims to warranty and liability will be rendered invalid if

- ▶ The product was used contrary to the purpose for which it is intended,
- ▶ Damage can be attributed to not having followed the guidelines in the manual,
- ▶ Operating personnel are not suitably qualified,
- ▶ Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

**Disposal**

- ▶ In safety-related applications, please comply with the mission time  $T_M$  in the safety-related characteristic data.
- ▶ When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

### Unit features

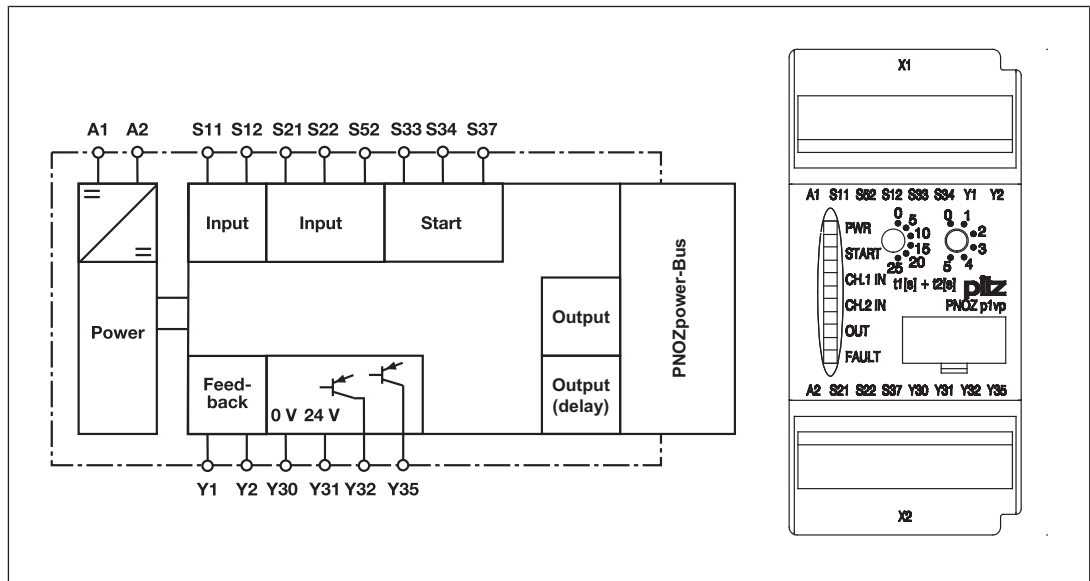
- ▶ Connection options for:
  - E-STOP pushbutton
  - Safety gate limit switch
  - Start button
- ▶ instantaneous and delay-on de-energisation control of the expansion modules via the PNOZpower bus
- ▶ 2 semiconductor outputs
- ▶ Delay time can be set via rotary switches
- ▶ LED indicator for:
  - Supply voltage
  - Input status, channel 1
  - Input status, channel 2
  - Switch status of the output
  - Start circuit
  - Error
- ▶ Semiconductor outputs signal:
  - Supply voltage/fault
  - Switch status
- ▶ Max. 8 expansion modules can be connected via jumpers:
  - max. 4 expansion modules that are controlled instantaneously,
  - max. 4 expansion modules that are controlled with a delay time
- ▶ Plug-in connection terminals
- ▶ See order reference for unit types

### Safety features

The safety 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.

## Block diagram/terminal configuration



## Function Description

The base unit PNOZ p1vp controls the expansion modules of the modular safety system via the PNOZpower bus and it is used in conjunction with the expansion modules for the safety-related interruption of a safety circuit.

When operating voltage is supplied the "PWR" LED will light. The unit is ready for operation when the feedback loop Y1-Y2 and the start circuit S33-S34 are closed. The "START" LED is lit.

- ▶ Input circuit is closed (e.g. E-STOP pushbutton not operated):
  - The LEDs "CH.1 IN" and "CH.2 IN" are lit.
  - There is a high signal at the expansion module output for instantaneous control of the expansion modules connected to the PNOZpower bus. The unit is active.
  - The "OUT" status display will illuminate.
  - The "START" LED goes out.
  - A high signal is present at the semiconductor output switch state Y32.
- ▶ Input circuit is opened (e.g. E-STOP pushbutton operated):
  - The LEDs "CH.1 IN" and "CH.2 IN" go out.
  - At the expansion module control output connected to the PNOZpower bus there is a low signal.
  - The "OUT" status display will go out.
  - A low signal is present at the semiconductor output switch state Y32.
  - Once the set delay time has elapsed there is a low signal at the output for delayed control of the expansion modules on the PNOZpower bus.

Semiconductor output supply voltage/fault Y35

- ▶ A high signal is present at semiconductor output Y35 if the supply voltage is present and the internal fuse has not blown. If there is a fault on the PNOZ p1vp or on an expansion module, there is low signal at Y35.





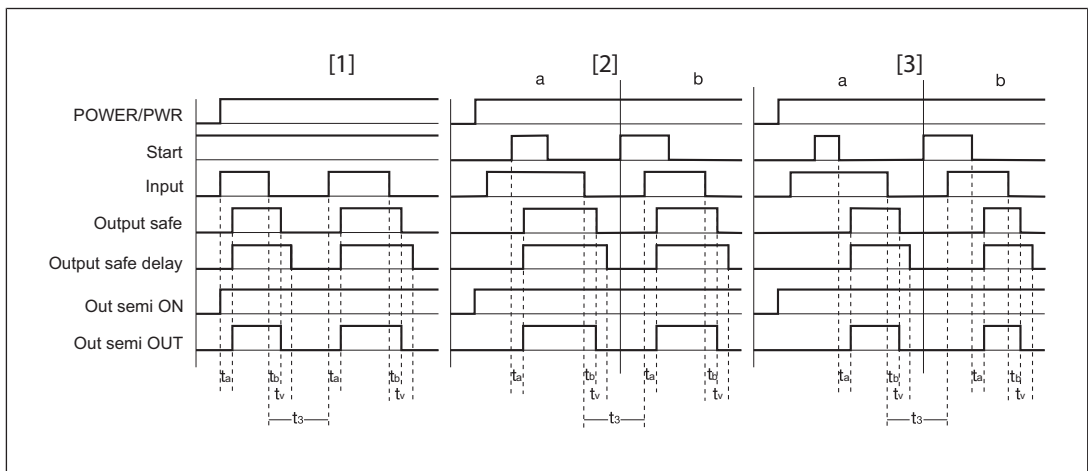
**NOTICE**

When controlling an expansion module via the den PNOZpower bus the switch-on delay/delay-on de-energisation of the controlling device (e.g base unit, control module, ...) and the expansion module are added together.

**Operating modes**

- ▶ Single-channel operation: No redundancy in the input circuit, earth faults in the start and input circuit are detected.
- ▶ Dual-channel operation with detection of shorts across contacts: Redundant input circuit, PNOZ p1vp detects
  - earth faults in the start and input circuit,
  - short circuits in the input circuit,
  - shorts across contacts in the input circuit.
- ▶ Automatic start: Unit is active once the input circuit has been closed.
- ▶ Manual start: Unit is active once the input circuit and the start circuit are closed.
- ▶ Monitored start: Unit is active once
  - the input circuit is closed and then the start circuit is closed and opened again.
  - the start circuit is closed and then opened again once the input circuit is closed.

**Timing diagram**



**Legend**

- ▶ POWER/PWR: Supply voltage
- ▶ Start: Start circuit
- ▶ Input: Input circuit
- ▶ Output safe: Output to PNOZpower bus instantaneous
- ▶ Output safe delay: Output to PNOZpower bus delayed
- ▶ Out semi ON: Semiconductor output supply voltage/fault
- ▶ Out semi OUT: Semiconductor output switch state

- ▶ [1]: Automatic start
- ▶ [2]: Manual start
- ▶ [3]: Monitored start
- ▶ a: Input circuit closes before start circuit
- ▶ b: Start circuit closes before input circuit
- ▶  $t_a$ : Switch-on delay
- ▶  $t_b$ : Delay-on de-energisation
- ▶  $t_3$ : Recovery time
- ▶  $t_v$ : Delay time

**NOTICE**

The delay-on de-energisation safety contacts open, even when a component fails, at the latest after the set delay time + 20 ms + 15% of the set value and the maximum delay-on de-energisation of the expansion module.

**Installation**

- ▶ The unit should be installed in a control cabinet with a protection type of at least IP54.
- ▶ Use the notches on the rear of the unit to attach it to a DIN rail.
- ▶ Fit the unit to a horizontal DIN rail. If other mounting positions are used, the switching capability values stated in the technical details cannot be maintained.
- ▶ There are 2 sockets on the rear of the PNOZ p1vp.  
The base unit/control module and the expansion modules are connected using the jumpers supplied.

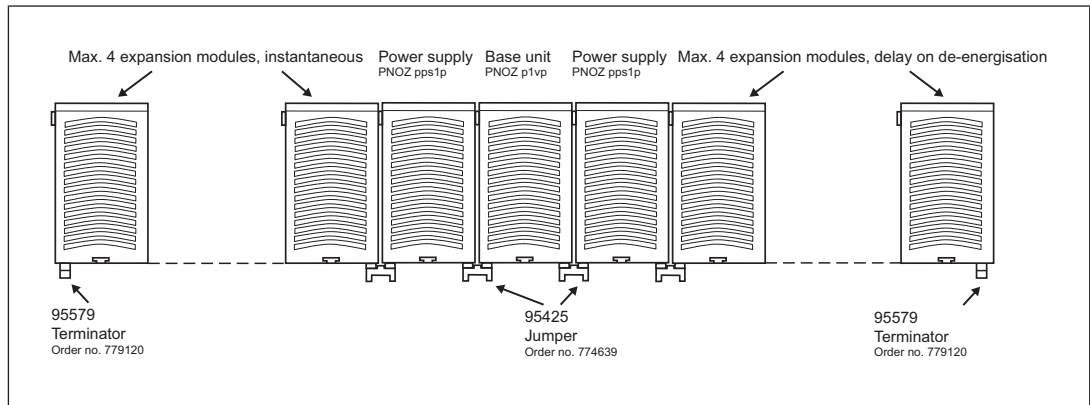
**NOTICE**

Always connect a terminator to the first and last device.

- ▶ Only use terminators, jumpers and terminals of the modular safety system PNOZpower.
- ▶ Layout:
  - The base module and the expansion modules can be installed in any position on the PNOZpower modular safety system.
  - Expansion modules installed to the left of the base unit are controlled instantaneously, expansion modules installed to the right of the base unit are controlled with a time delay.
  - When using the power supply PNOZ pps1p: Install a power supply to the left of the base unit for instantaneously controlled expansion modules and a power supply to the right of the base unit for expansion modules controlled with a delay time.

► Maximum hardware:

- 1 base unit
- 4 expansion modules that are controlled instantaneously
- 4 expansion modules that are controlled with a delay time
- 2 power supplies (one device each for delayed and instantaneous expansion modules)



**WARNING!**

**Risk of electrocution!**

When voltage is applied, contact with live components could result in serious or even fatal injury from an electric shock.

The plug-in connection terminals should only be connected and disconnected when the voltage is switched off.

## Wiring

Please note:

- ▶ Information given in the "[Technical details \[17\]](#)" must be followed.
- ▶ Delivery condition: Link between Y1-Y2 (feedback loop)
- ▶ Semiconductor outputs should **not** be used for safety circuits!
- ▶ Calculation of the max. cable length  $l_{\max}$  in the input circuit:

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

$R_{l_{\max}}$  = max. overall cable resistance (see [Technical details \[17\]](#))

$R_l / \text{km}$  = cable resistance/km

- ▶ Use copper wiring with a temperature stability of 60/75 °C.
- ▶ To prevent EMC interferences (particularly common-mode interferences) the measures described in EN 60204-1 must be executed. This includes the separate routing of cables of the control circuits (input, start and feedback loop) from other cables for energy transmission or the shielding of cables, for example.
- ▶ When connecting magnetically operated, reed proximity switches, ensure that the max. peak inrush current (on the input circuit) does not overload the proximity switch.
- ▶ Use the power supply PNOZ pps1p or an external power supply that complies with the regulations for extra low voltages with safe electrical separation (SELV, PELV).

### Important for detection of shorts across contacts:

As this function for detecting shorts across contacts is not failsafe, it is tested by Pilz during the final control check. If there is a danger of exceeding the cable length, we recommend the following test after the installation of the device:

1. Unit active (the LEDs "PWR", "CH.1 IN", "CH.2 IN" and "OUT" are lit).
2. Short circuit the test terminals S12, S22 for detecting shorts across the inputs.
3. The unit's fuse must be triggered (only the "FAULT" LED is lit). Cable lengths in the scale of the maximum length can delay the fuse triggering for up to 2 minutes.
4. Reset the fuse: Remove the short circuit and switch off the supply voltage for approx. 1 minute.

## Preparing for operation

### Set delay time

The delay time results for the addition of the times set by the two rotary switches.

Examples:

- ▶ Unit type with a delay time of 30 s:
  - Required delay time: 7 s
  - Setting: left rotary switch: 5, right rotary switch: 2
- ▶ Unit type with a delay time of 300 s:
  - Required delay time: 240 s
  - Setting: left rotary switch: 200, right rotary switch: 40

Supply voltage	AC	DC



### NOTICE

When the PNOZ pps1p power supply unit is used, the unit draws power via the PNOZpower bus. Do not connect an external supply voltage to A1 and A2!

Input circuit	Single-channel	Dual-channel
E-STOP <b>without</b> detection of shorts across contacts		
E-STOP <b>with</b> detection of shorts across contacts		
Safety gate <b>without</b> detection of shorts across contacts		

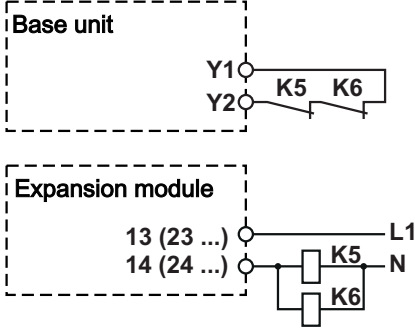
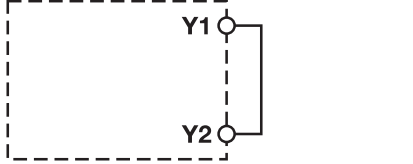
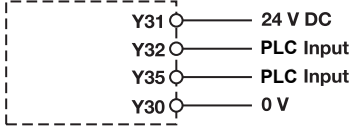
Input circuit	Single-channel	Dual-channel
Safety gate <b>with</b> detection of shorts across contacts		
Light beam device <b>with</b> detection of shorts across contacts via ESPE		
Start circuit	E-STOP/safety gate wiring (single-channel and dual-channel without detection of shorts across contacts)	E-STOP/safety gate wiring (dual-channel with detection of shorts across contacts)
Automatic start		
Manual start		
Monitored start		






**NOTICE**

**In the event of an automatic start or manual start with bridged start contact (fault):**

The unit starts up automatically when the safeguard is reset, e.g. when the E-STOP pushbutton is released. Use external circuit measures to prevent an unexpected restart.

Feedback loop	with feedback loop monitoring	without feedback loop monitoring
Link or contacts from external contactors		
Semiconductor output		
Y31, Y30: External supply voltage		

### Legend

- ▶ S1: E-STOP pushbuttons
- ▶ S3: Start button
- ▶ : Switch operated
- ▶ : Gate open
- ▶ : Gate closed

### Operation



#### NOTICE

The safety function should be checked after initial commissioning and each time the plant/machine is changed. The safety functions may only be checked by qualified personnel.

### Status indicators

LEDs indicate the status and errors during operation:



LED on



#### PWR

Supply voltage is present.



#### START

Start circuit is closed.



#### CH.1 IN

Channel 1 input circuit is closed.



#### CH.2 IN

Channel 2 input circuit is closed.



#### OUT

The output on the PNOZpower bus and the semiconductor output Y32 have a high signal.



#### FAULT

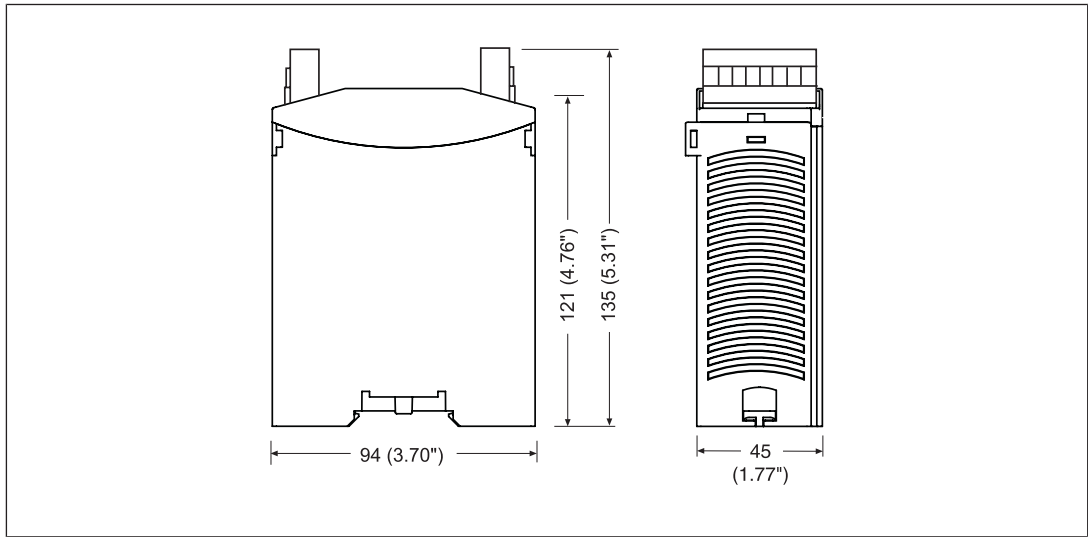
Earth fault or short across contacts has occurred.

### Faults – Interference

- ▶ Earth fault or short across contacts  
The supply voltage fails and the safety contacts open via an electronic fuse. Once the cause of the respective fault has been removed and the supply voltage is switched off for approx. 1 minute, the unit is ready for operation again.
- ▶ LED "PWR" does not light: Short circuit or no supply voltage.
- ▶ Error at an PNOZ p1vp expansion module: Semiconductor output Y35 has a Low signal.



**Dimensions in mm**



**Technical details**

General	773950	773951
Certifications	CE, EAC (Eurasian), TÜV, cULus Listed	CE, EAC (Eurasian), TÜV, cULus Listed
Electrical data	773950	773951
Supply voltage		
Voltage	24 V	24 V
Kind	DC	DC
Voltage tolerance	-15 %/+10 %	-15 %/+10 %
Power consumption	4 W	4 W
Residual ripple DC	160 %	160 %
Duty cycle	100 %	100 %
Inputs	773950	773951
Number	2	2
Voltage at		
Input circuit DC	24 V	24 V
Start circuit DC	24 V	24 V
Feedback loop DC	24 V	24 V
Current at		
Input circuit DC	40 mA	40 mA
Start circuit DC	340 mA	340 mA
Feedback loop DC	40 mA	40 mA
Min. input resistance at power-on	70 Ohm	70 Ohm


<b>Inputs</b>	<b>773950</b>	<b>773951</b>
Max. overall cable resistance Rl-max		
Single-channel at UB DC	<b>60 Ohm</b>	<b>60 Ohm</b>
Dual-channel without detection of shorts across contacts at UB DC	<b>120 Ohm</b>	<b>120 Ohm</b>
Dual-channel with detection of shorts across contacts at UB DC	<b>30 Ohm</b>	<b>30 Ohm</b>
<b>Semiconductor outputs</b>	<b>773950</b>	<b>773951</b>
Number	<b>2</b>	<b>2</b>
Voltage	<b>24 V</b>	<b>24 V</b>
Current	<b>20 mA</b>	<b>20 mA</b>
External supply voltage	<b>24 V</b>	<b>24 V</b>
Voltage tolerance	<b>-15 %/+10 %</b>	<b>-15 %/+10 %</b>
Residual current at "0" signal	<b>0,1 mA</b>	<b>0,1 mA</b>
Max. internal voltage drop	<b>5,5 V</b>	<b>5,5 V</b>
Conditional rated short circuit current	<b>100 A</b>	<b>100 A</b>
Lowest operating current	<b>0 mA</b>	<b>0 mA</b>
Utilisation category in accordance with EN 60947-1	<b>DC-12</b>	<b>DC-12</b>
<b>Times</b>	<b>773950</b>	<b>773951</b>
Switch-on delay		
With automatic start max.	<b>250 ms</b>	<b>250 ms</b>
With automatic start after power on max.	<b>270 ms</b>	<b>270 ms</b>
With manual start max.	<b>250 ms</b>	<b>250 ms</b>
With monitored start with rising edge max.	<b>210 ms</b>	<b>210 ms</b>
Delay-on de-energisation		
With E-STOP max.	<b>30 ms</b>	<b>30 ms</b>
With power failure max.	<b>70 ms</b>	<b>70 ms</b>
Recovery time at max. switching frequency 1/s		
After E-STOP	<b>1 s</b>	<b>1 s</b>
After power failure	<b>1 s</b>	<b>1 s</b>
Selectable delay times	<b>0,3 ... 5 s, 10 ... 15 s, 15 ... 20 s, 20 ... 25 s, 25 ... 30 s, 5 ... 10 s</b>	<b>1,5 ... 50 s, 100 ... 150 s, 150 ... 200 s, 200 ... 250 s, 250 ... 300 s, 50 ... 100 s</b>
Time accuracy based on range end value	<b>+/-15 % +20 ms</b>	<b>+/-15 % +20 ms</b>
Supply interruption before de-energisation	<b>20 ms</b>	<b>20 ms</b>
Simultaneity, channel 1 and 2 max.	<b>210 ms</b>	<b>210 ms</b>
<b>Environmental data</b>	<b>773950</b>	<b>773951</b>
Climatic suitability	<b>EN 60068-2-78</b>	<b>EN 60068-2-78</b>

<b>Environmental data</b>	<b>773950</b>	<b>773951</b>
Ambient temperature		
Temperature range	<b>-10 - 55 °C</b>	<b>-10 - 55 °C</b>
Storage temperature		
Temperature range	<b>-40 - 85 °C</b>	<b>-40 - 85 °C</b>
Climatic suitability		
Humidity	<b>93 % r. h. at 40 °C</b>	<b>93 % r. h. at 40 °C</b>
Condensation during operation	<b>Not permitted</b>	<b>Not permitted</b>
EMC	<b>EN 60947-5-1, EN 61000-6-2, EN 61326-3-1</b>	<b>EN 60947-5-1, EN 61000-6-2, EN 61326-3-1</b>
Vibration		
In accordance with the standard	<b>EN 60068-2-6</b>	<b>EN 60068-2-6</b>
Frequency	<b>10 - 55 Hz</b>	<b>10 - 55 Hz</b>
Amplitude	<b>0,35 mm</b>	<b>0,35 mm</b>
Airgap creepage		
In accordance with the standard	<b>EN 60947-1</b>	<b>EN 60947-1</b>
Overvoltage category	<b>III</b>	<b>III</b>
Pollution degree	<b>2</b>	<b>2</b>
Rated insulation voltage	<b>30 V</b>	<b>30 V</b>
Rated impulse withstand voltage	<b>0,8 kV</b>	<b>0,8 kV</b>
Protection type		
Housing	<b>IP30</b>	<b>IP30</b>
Terminals	<b>IP20</b>	<b>IP20</b>
Mounting area (e.g. control cabinet)	<b>IP54</b>	<b>IP54</b>
<b>Mechanical data</b>	<b>773950</b>	<b>773951</b>
Mounting position	<b>horizontally on mounting rail</b>	<b>horizontally on mounting rail</b>
Material		
Bottom	<b>PPO UL 94 V0</b>	<b>PPO UL 94 V0</b>
Top	<b>ABS UL 94 V0</b>	<b>ABS UL 94 V0</b>
Connection type	<b>Screw terminal</b>	<b>Screw terminal</b>
Mounting type	<b>plug-in</b>	<b>plug-in</b>
Conductor cross section with screw terminals		
1 core flexible	<b>0,2 - 2,5 mm<sup>2</sup>, 24 - 12 AWG</b>	<b>0,2 - 2,5 mm<sup>2</sup>, 24 - 12 AWG</b>
2 core with the same cross section, flexible with crimp connectors, no plastic sleeve	<b>0,25 - 1 mm<sup>2</sup>, 24 - 16 AWG</b>	<b>0,25 - 1 mm<sup>2</sup>, 24 - 16 AWG</b>
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	<b>0,5 - 1,5 mm<sup>2</sup>, 24 - 16 AWG</b>	<b>0,5 - 1,5 mm<sup>2</sup>, 24 - 16 AWG</b>
Torque setting with screw terminals	<b>0,6 Nm</b>	<b>0,6 Nm</b>
Stripping length with screw terminals	<b>8 mm</b>	<b>8 mm</b>

Mechanical data	773950	773951
Dimensions		
Height	94 mm	94 mm
Width	45 mm	45 mm
Depth	135 mm	135 mm
Weight	355 g	355 g

Where standards are undated, the 2020-07 latest editions shall apply.

**Safety characteristic data**




**NOTICE**  
 You must comply with the safety characteristic data in order to achieve the required safety level for your plant/machine.

Operating mode	EN ISO 13849-1: 2015 PL	EN ISO 13849-1: 2015 Category	EN 62061 SIL CL	EN 62061 PFH <sub>D</sub> [1/h]	EN ISO 13849-1: 2015 T <sub>M</sub> [year]
Safety contacts, instantaneous	PL e	Cat. 4	SIL CL 3	2,31E-09	20
Safety contacts, delayed <30 s	PL d	Cat. 3	SIL CL 2	2,64E-09	20
Safety contacts, delayed ≥30 s	PL c	Cat. 1	SIL CL 1	2,87E-09	20

Explanatory notes for the safety-related characteristic data:

- ▶ The SIL CL value in accordance with EN 62061 corresponds to the SIL value in accordance with EN 61508.
- ▶ T<sub>M</sub> is the maximum mission time in accordance with EN ISO 13849-1. The value also applies as the retest interval in accordance with EN 61508-6 and IEC 61511 and as the proof test interval and mission time in accordance with EN 62061.

All the units used within a safety function must be considered when calculating the safety characteristic data.

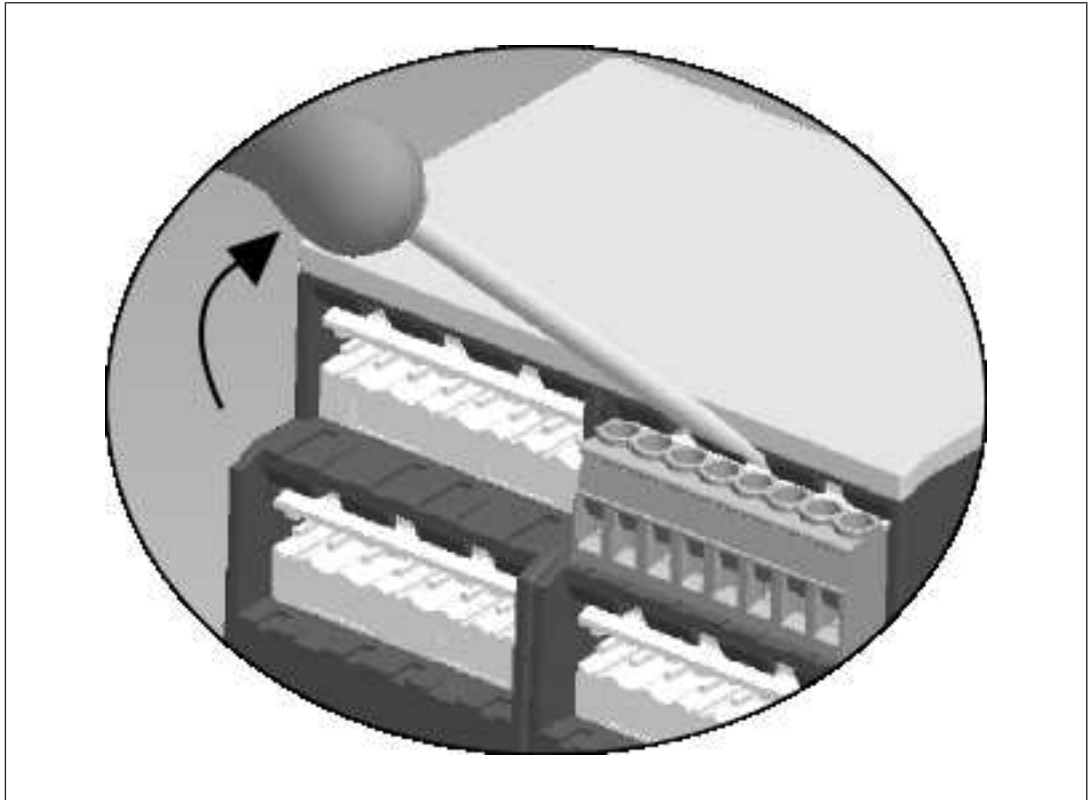


**INFORMATION**  
 A safety function's SIL/PL values are **not** identical to the SIL/PL values of the units that are used and may be different. We recommend that you use the PASCAL software tool to calculate the safety function's SIL/PL values.

## Remove plug-in terminals

Procedure: Insert the screwdriver into the housing recess behind the terminal and lever the terminal out.

Do **not** remove the terminals by pulling the cables!



### WARNING!

#### Risk of electrocution!

When voltage is applied, contact with live components could result in serious or even fatal injury from an electric shock.

The plug-in connection terminals should only be connected and disconnected when the voltage is switched off.

## Order reference

Product type	Features	Connection type	Order no.
PNOZ p1vp	24 VDC; Delay: up to 30 s selectable	Screw terminals	773950
PNOZ p1vp	24 VDC; Delay: up to 300 s selectable	Screw terminals	773951

### **EC declaration of conformity**

This product/these products meet the requirements of the directive 2006/42/EC for machinery of the European Parliament and of the Council. The complete EC Declaration of Conformity is available on the Internet at [www.pilz.com/support/downloads](http://www.pilz.com/support/downloads).

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# ► Support

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Pilz develops environmentally-friendly products using ecological materials and energy-saving technologies. Offices and production facilities are ecologically designed, environmentally-aware and energy-saving. So Pilz offers sustainability, plus the security of using energy-efficient products and environmentally-friendly solutions.

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We are represented internationally. Please refer to our homepage [www.pilz.com](http://www.pilz.com) for further details or contact our headquarters.

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**PILZ**  
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