

## ► P2HZ X1.10P

# PILZ

THE SPIRIT OF SAFETY

Operating Manual-20817-EN-09  
- Safety relays



This document is the original document.

Where unavoidable, for reasons of readability, the masculine form has been selected when formulating this document. We do assure you that all persons are regarded without discrimination and on an equal basis.

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SD means Secure Digital

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## Introduction

### Validity of documentation

This documentation is valid for the product P2HZ X1.10P. 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 two-hand control relay P2HZ X1.10P meets the requirements of EN ISO 13851 Type IIIC and EN 60204-1.


It forces an operator to keep his hands out of the hazardous area during the dangerous movement.

The device is suitable as a block for simultaneity, for example for mounting in press controllers, woodworking machinery or machine tools.

Note the respective valid regulations for these machines.

**Improper use**

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 operating manual,
- ▶ Use of the product outside the technical details (see chapter entitled [Technical Details](#) [ 19]).

**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 IEC 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. In order to inspect, assess and handle products, devices, systems, plant and machinery, this person must be familiar with 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).

**For your safety**

The unit meets all the necessary conditions for safe operation. However, please note the following:

- ▶ Note for overvoltage category III: If voltages higher than low voltage (>50 VAC or >120 VDC) are present on the unit, connected control elements and sensors must have a rated insulation voltage of at least 250 V.

**Unit features**

- ▶ Positive-guided relay outputs:
  - 3 safety contacts (N/O), instantaneous
  - 1 auxiliary contact (N/C), instantaneous
- ▶ 2 semiconductor outputs
- ▶ Connection options for:
  - 2 control elements (pushbuttons)
- ▶ LED display for:
  - Supply voltage
  - Switch status of the safety contacts
- ▶ Semiconductor outputs signal:
  - Supply voltage is present
  - Switch status of the safety contacts
- ▶ Plug-in connection terminals (either spring-loaded terminal or screw terminal)

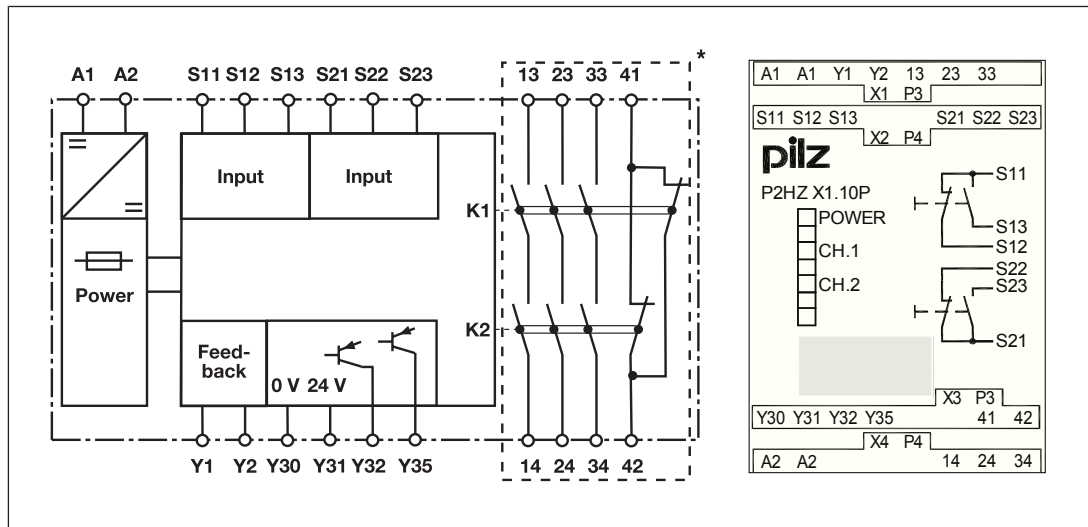
**Safety features**

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



## Block diagram/terminal configuration



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

## Function Description

The two-hand control relay P2HZ X1.10P is activated by simultaneously operating the two operator elements (simultaneity see [Technical details \[19\]](#)). If one or both of the operator elements are released, it interrupts the control command to close the press. The device is ready for operation when the supply voltage is applied and the feedback loop Y1-Y2 is closed. The "POWER" LED lights up.

- ▶ Both operator elements are operated within the simultaneity:
  - Safety contacts 13-14, 23-24 and 33-34 close, auxiliary contact 41-42 is opened, the device is active.
  - LEDs "CH1" and "CH2" will light.
  - A high signal is present at the semiconductor output switch state Y32.
- ▶ One operator element is released following simultaneous operation:
  - Safety contacts 13-14, 23-24 and 33-34 are opened redundantly, auxiliary contact 41-42 is closed.
  - The LED "CH1" or "CH2" goes out.
  - A low signal is present at the semiconductor output switch state Y32.
- ▶ To activate the device again, both operator elements have to be released and then operated again within the simultaneity.

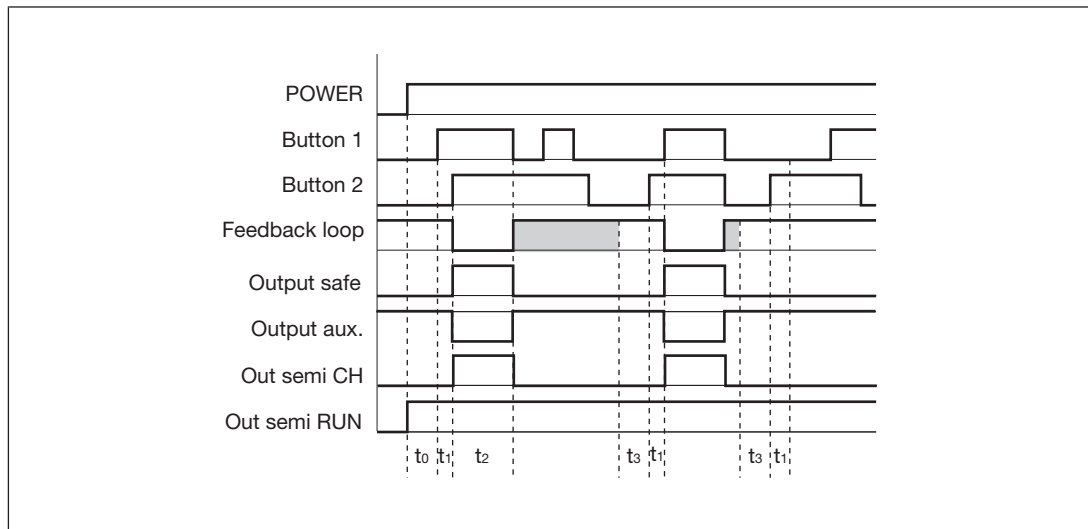
Semiconductor output supply voltage Y35:

- ▶ A high signal is present at semiconductor output Y35 if the supply voltage is present and the internal fuse has not blown.

### Operating modes

- ▶ Dual-channel operation with detection of shorts across contacts: Redundant input circuit, P2HZ X1.10P detects
  - earth faults in the start and input circuit,
  - short circuits in the input circuit,
  - shorts across contacts in the input circuit.

### Timing diagram



### Legend

- ▶ POWER: Supply voltage
- ▶ Button 1/Button 2: Pushbutton in the input circuit
- ▶ Feedback loop: Feedback loop
- ▶ Output safe: Safety outputs
- ▶ Output aux.: Auxiliary contact
- ▶ Out semi RUN: Semiconductor output supply voltage
- ▶ Out semi CH: Semiconductor output switch state
- ▶  $t_0$ : Recovery time after power on
- ▶  $t_1$ : Simultaneity, channel 1 and 2
- ▶  $t_2$ : Operating cycle ended through pushbutton 1 or 2
- ▶  $t_3$ : Y1-Y2 must be closed before the button is operated (recovery time)

Shaded area: State irrelevant

## Installation

- ▶ The unit should be installed in a control cabinet with a protection type of at least IP54.
- ▶ Use the notch on the rear of the unit to attach it to a DIN rail (35 mm).
- ▶ When installed vertically: Secure the unit by using a fixing element (e.g. retaining bracket or end angle).



### WARNING!

#### Loss of the safety function due to too short distance of the operator elements to the hazardous area!

The distance of the two-hand control relay to the nearest hazardous area must be large enough so that if one of the operator elements is released, the hazardous movement is interrupted before the operator reaches the hazardous area or can reach into the hazardous area. You must maintain the minimum distance in accordance with EN ISO 13855.

Depending on the application, serious injury or death may result.

## Wiring

Please note:

- ▶ Information given in the "[Technical details \[19\]](#)" must be followed.
- ▶ Outputs 13-14, 23-24, 33-34 are safety contacts; output 41-42 is an auxiliary contact (e.g. for display).
- ▶ Do **not** use auxiliary contacts 41-42 and semiconductor outputs Y32 and Y35 for safety circuits!
- ▶ To prevent contact welding, a fuse should be connected before the output contacts (see [Technical details \[19\]](#)).
- ▶ 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 \[19\]](#))

$R_l / \text{km}$  = 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.
- ▶ The supply voltage must be switched off with the operating energy of the machine.
- ▶ The connection cables between the P2HZ X1.10P and the pushbuttons should not be laid directly next to power cables, otherwise inductive and capacitive interference coupling can result.
- ▶ On account of the low currents you should use gold-plated pushbutton contacts.
- ▶ Only contactors with positive-guided contacts should be used for safety functions.

- ▶ Adequate protection circuit must be provided on all output contacts with capacitive and inductive loads.
- ▶ Do not switch low currents using contacts that have been used previously with high currents.
- ▶ The power supply must comply with the regulations for extra low voltages with protective electrical separation (SELV, PELV) in accordance with VDE 0100, Part 410.

### Preparing for operation

Supply voltage	AC	DC
Input circuit	Single-channel	Dual-channel
Two-hand pushbuttons <b>with</b> detection of shorts across contacts	/	
Feedback loop	without feedback loop monitoring	with feedback loop monitoring
Link or contacts from external contactors		
Semiconductor output		

#### Legend

- ▶ S1/S2: Two-hand pushbuttons

## Operation

When the relay outputs are switched on, the mechanical contact on the relay cannot be tested automatically. Depending on the operational environment, measures to detect the non-opening of switching elements may be required under some circumstances.

When the product is used in accordance with the European Machinery Directive, a check must be carried out to ensure that the safety contacts on the relay outputs open correctly. Open the safety contacts (switch off output) and start the device again, so that the internal diagnostics can check that the safety contacts open correctly

- ▶ for SIL 3/PL e at least 1x per month
- ▶ for SIL 2/PL d at least 1x per year



### NOTICE

The safety functions 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



### POWER

Supply voltage is present and E-STOP pushbutton not operated.



### CH.1

Safety contacts of channel 1 are closed.



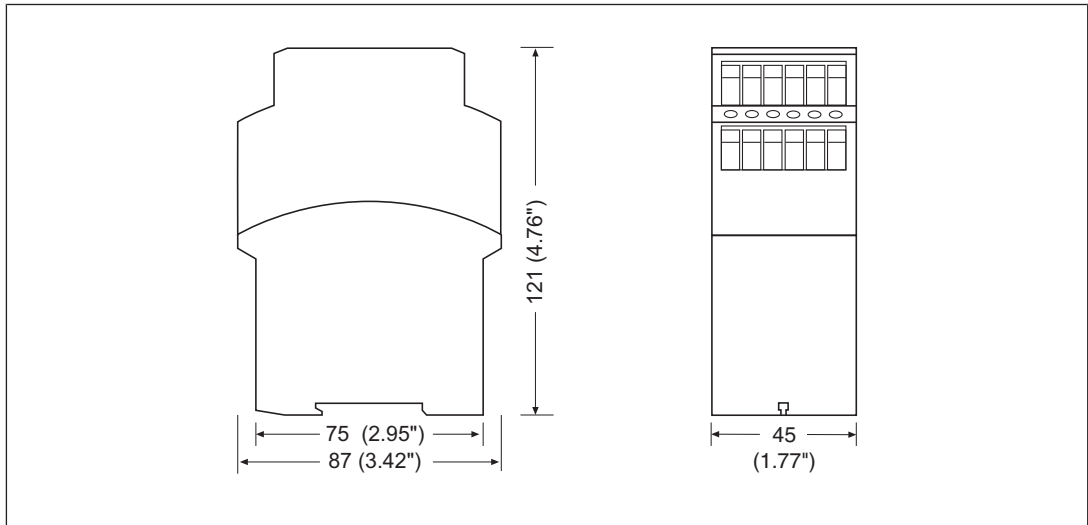
### CH.2

Safety contacts of channel 2 are closed.

## Faults – Interference

- ▶ Contact malfunctions: If the contacts have welded, reactivation will not be possible after the input circuit has opened.

### Dimensions in mm



### Technical details

General	777341	787341
Certifications	CCC, CE, EAC, TÜV, UKCA, cULus Listed	CCC, CE, EAC, TÜV, UKCA, cULus Listed
Electrical data	777341	787341
Supply voltage		
Voltage	24 V	24 V
Kind	DC	DC
Voltage tolerance	-15 %/+10 %	-15 %/+10 %
Output of external power supply (DC)	2,5 W	2,5 W
Residual ripple DC	10 %	10 %
Duty cycle	100 %	100 %
Current at		
N/O contact	30 mA	30 mA
N/C contact	20 mA	20 mA
Max. overall cable resistance RI-max per input circuit	14 Ohm	14 Ohm
External unit fuse protection F1 min.	1 A	1 A
External unit fuse protection F1 max.	Max. conductor cross section	Max. conductor cross section
Two-hand control relay type		
in accordance with the standard	EN ISO 13851	EN ISO 13851
Type	III C	III C
Inputs	777341	787341
Quantity	2	2

<b>Inputs</b>	<b>777341</b>	<b>787341</b>
Voltage at		
Input circuit DC	24 V	24 V
Feedback loop DC	24 V	24 V
Current at		
Feedback loop DC	45 mA	45 mA
<b>Semiconductor outputs</b>	<b>777341</b>	<b>787341</b>
Quantity	2	2
Voltage	24 V	24 V
Current	20 mA	20 mA
External supply voltage	24 V	24 V
Voltage tolerance	-15 %/+10 %	-15 %/+10 %
Residual current at "0" signal	0,1 mA	0,1 mA
Max. internal voltage drop	4 V	4 V
Conditional rated short circuit current	100 A	100 A
Lowest operating current	0 mA	0 mA
Utilisation category in accordance with EN 60947-1	DC-12	DC-12
<b>Relay outputs</b>	<b>777341</b>	<b>787341</b>
Number of output contacts		
Safety contacts (N/O), instantaneous	3	3
Auxiliary contacts (N/C)	1	1
Max. short circuit current I <sub>K</sub>	1 kA	1 kA
Utilisation category		
in accordance with the standard	EN 60947-4-1	EN 60947-4-1
Utilisation category of safety contacts		
AC1 at	240 V	240 V
Min. current	0,01 A	0,01 A
Max. current	5 A	5 A
Max. power	1250 VA	1250 VA
DC1 at	24 V	24 V
Min. current	0,01 A	0,01 A
Max. current	5 A	5 A
Max. power	125 W	125 W
Utilisation category of auxiliary contacts		
AC1 at	240 V	240 V
Min. current	0,01 A	0,01 A
Max. current	2 A	2 A
Max. power	500 VA	500 VA
DC1 at	24 V	24 V
Min. current	0,01 A	0,01 A
Max. current	2 A	2 A
Max. power	50 W	50 W

<b>Relay outputs</b>	<b>777341</b>	<b>787341</b>
Utilisation category		
in accordance with the standard	<b>EN 60947-5-1</b>	<b>EN 60947-5-1</b>
Utilisation category of safety contacts		
AC15 at	<b>230 V</b>	<b>230 V</b>
Max. current	<b>2,5 A</b>	<b>2,5 A</b>
DC13 (6 cycles/min) at	<b>24 V</b>	<b>24 V</b>
Max. current	<b>1,5 A</b>	<b>1,5 A</b>
Utilisation category of auxiliary contacts		
AC15 at	<b>230 V</b>	<b>230 V</b>
Max. current	<b>2 A</b>	<b>2 A</b>
DC13 (6 cycles/min) at	<b>24 V</b>	<b>24 V</b>
Max. current	<b>1,5 A</b>	<b>1,5 A</b>
Utilisation category in accordance with UL		
Voltage with current	<b>240 V AC G. P. 5 A</b>	<b>240 V AC G. P. 5 A</b>
Voltage with current	<b>24 V DC Resistive 5 A</b>	<b>24 V DC Resistive 5 A</b>
Pilot Duty	<b>C300, R300</b>	<b>C300, R300</b>
External contact fuse protection, safety contacts		
in accordance with the standard	<b>EN 60947-5-1</b>	<b>EN 60947-5-1</b>
Max. melting integral	<b>240 A<sup>2</sup>s</b>	<b>240 A<sup>2</sup>s</b>
Blow-out fuse, quick	<b>6 A</b>	<b>6 A</b>
Blow-out fuse, slow	<b>4 A</b>	<b>4 A</b>
Blow-out fuse, gG	<b>6 A</b>	<b>6 A</b>
Circuit breaker 24V AC/DC, characteristic B/C	<b>4 A</b>	<b>4 A</b>
External contact fuse protection, auxiliary contacts		
Max. melting integral	<b>240 A<sup>2</sup>s</b>	<b>240 A<sup>2</sup>s</b>
Blow-out fuse, quick	<b>4 A</b>	<b>4 A</b>
Blow-out fuse, slow	<b>2 A</b>	<b>2 A</b>
Blow-out fuse, gG	<b>4 A</b>	<b>4 A</b>
Circuit breaker, 24 V AC/DC, characteristic B/C	<b>2 A</b>	<b>2 A</b>
Conventional thermal current	<b>5 A</b>	<b>5 A</b>
Contact material	<b>AgSnO<sub>2</sub> + 0,2 µm Au</b>	<b>AgSnO<sub>2</sub> + 0,2 µm Au</b>
<b>Times</b>	<b>777341</b>	<b>787341</b>
Delay-on de-energisation (response time t <sub>A</sub> in accordance with EN ISO 13851)		
N/O contact	<b>15 ms</b>	<b>15 ms</b>
N/C contact	<b>30 ms</b>	<b>30 ms</b>
Recovery time	<b>250 ms</b>	<b>250 ms</b>



<b>Times</b>	<b>777341</b>	<b>787341</b>
Supply interruption before de-energisation	150 ms	150 ms
Simultaneity, channel 1 and 2 max.	500 ms	500 ms
<b>Environmental data</b>	<b>777341</b>	<b>787341</b>
Climatic suitability	EN 60068-2-78	EN 60068-2-78
Ambient temperature		
Temperature range	-25 - 55 °C	-25 - 55 °C
Storage temperature		
Temperature range	-40 - 85 °C	-40 - 85 °C
Climatic suitability		
Humidity	93 % r. h. at 40 °C	93 % r. h. at 40 °C
Condensation during operation	Not permitted	Not permitted
EMC	EN 60947-5-1, EN 61000-6-2	EN 60947-5-1, EN 61000-6-2
Vibration		
in accordance with the standard	EN 60068-2-6	EN 60068-2-6
Frequency	10 - 55 Hz	10 - 55 Hz
Amplitude	0,35 mm	0,35 mm
Airgap creepage		
in accordance with the standard	EN 60947-1	EN 60947-1
Overvoltage category	III / II	III / II
Pollution degree	2	2
Rated insulation voltage	250 V	250 V
Rated impulse withstand voltage	4 kV	4 kV
Protection type		
Housing	IP40	IP40
Terminals	IP20	IP20
Mounting area (e.g. control cabinet)	IP54	IP54
<b>Mechanical data</b>	<b>777341</b>	<b>787341</b>
Mounting position	Any	Any
Mechanical life	10,000,000 cycles	10,000,000 cycles
Material		
Bottom	PPO UL 94 V1	PPO UL 94 V1
Front	ABS UL 94 V0	ABS UL 94 V0
Top	PPO UL 94 V1	PPO UL 94 V1
Connection type	Screw terminal	Spring-loaded terminal
Mounting type	plug-in	plug-in

<b>Mechanical data</b>	<b>777341</b>	<b>787341</b>
Conductor cross section with screw terminals		
1 core flexible	<b>0,25 - 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>	–
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	<b>0,2 - 1,5 mm<sup>2</sup>, 24 - 16 AWG</b>	–
Torque setting with screw terminals	<b>0,5 Nm</b>	–
Stripping length with screw terminals	<b>8 mm</b>	–
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	–	<b>0,2 - 1,5 mm<sup>2</sup>, 24 - 16 AWG</b>
Spring-loaded terminals: Terminal points per connection	–	<b>2</b>
Stripping length with spring-loaded terminals	–	<b>8 mm</b>
Dimensions		
Height	<b>94 mm</b>	<b>101 mm</b>
Width	<b>45 mm</b>	<b>45 mm</b>
Depth	<b>121 mm</b>	<b>121 mm</b>
Weight	<b>290 g</b>	<b>285 g</b>

Where standards are undated, the 2022-09 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 IEC 62061 SIL CL/ maximum SIL	EN IEC 62061 PFH <sub>D</sub> [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T <sub>M</sub> [year]
–	PL e	Cat. 4	SIL 3	3,01E-09	SIL 3	3,24E-06	20

Explanatory notes for the safety-related characteristic data:

- ▶ Safety characteristic data in accordance with EN IEC 62061 and EN/IEC 61511 was calculated based on EN/IEC 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/IEC 61508-6 and EN/IEC 61511 and as the proof test interval and mission time in accordance with EN IEC 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.

## Supplementary data



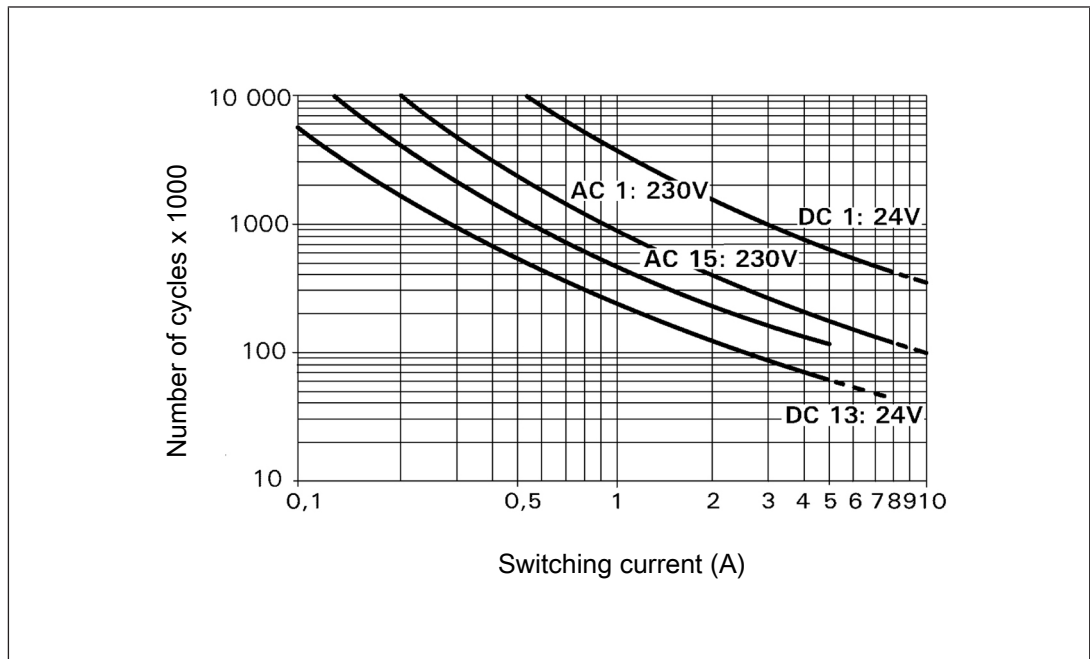
### CAUTION!

It is essential to consider the relay's service life graphs. The relay outputs' safety-related characteristic data is only valid if the values in the service life graphs are met.

The PFH value depends on the switch frequency and the load of the relay output. If the service life graphs are not accessible, the stated PFH value can be used irrespective of the switch frequency and the load, as the PFH value already considers the relay's B10d value as well as the failure rates of the other components.

### Service life graph

The service life graphs indicate the number of cycles from which failures due to wear must be expected. The wear is mainly caused by the electrical load; the mechanical load is negligible.



### Example

- ▶ Inductive load: 0.2 A
- ▶ Utilisation category: AC15
- ▶ Contact service life: 4 000 000 cycles

Provided the application to be implemented requires fewer than 4 000 000 cycles, the PFH value (see Technical details) can be used in the calculation.

To increase the service life, sufficient spark suppression must be provided on all output contacts. With capacitive loads, any power surges that occur must be noted. With DC contacts, use flywheel diodes for spark suppression.

**Order reference**

Product type	Features	Terminals	Order no.
P2HZ X1.10P C	24 V DC	Spring-loaded terminals	787341
P2HZ X1.10P	24 V DC	Screw terminals	777341

**EC declaration of conformity**

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

Representative: Hansjürgen Horter, Pilz GmbH & Co. KG, Felix-Wankel-Straße 2, 73760 Ostfildern, Germany

**UKCA-Declaration of Conformity**

This product(s) complies with following UK legislation: Supply of Machinery (Safety) Regulation 2008.

The complete UKCA Declaration of Conformity is available on the Internet at [www.pilz.com/downloads](http://www.pilz.com/downloads).

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# ► Support

Technical support is available from Pilz round the clock.

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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.



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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