

**PNOZ m EF 4DI4DOR**

Configurable Control System PNOZmulti

The PILZ logo is displayed in a grey, lowercase, sans-serif font. The letters are bold and modern, with a small dot above the 'i'.

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SD means Secure Digital

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# 1 Introduction

## 1.1 Validity of documentation

This documentation is valid for the product PNOZ m EF 4DI4DOR. 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.

## 1.2 Retaining the documentation

This documentation is intended for instruction and should be retained for future reference.

## 1.3 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.

## 2 Overview

### 2.1 Scope of supply

- ▶ Expansion module PNOZ m EF 4DI4DOR
- ▶ Jumper 779 260

### 2.2 Unit features

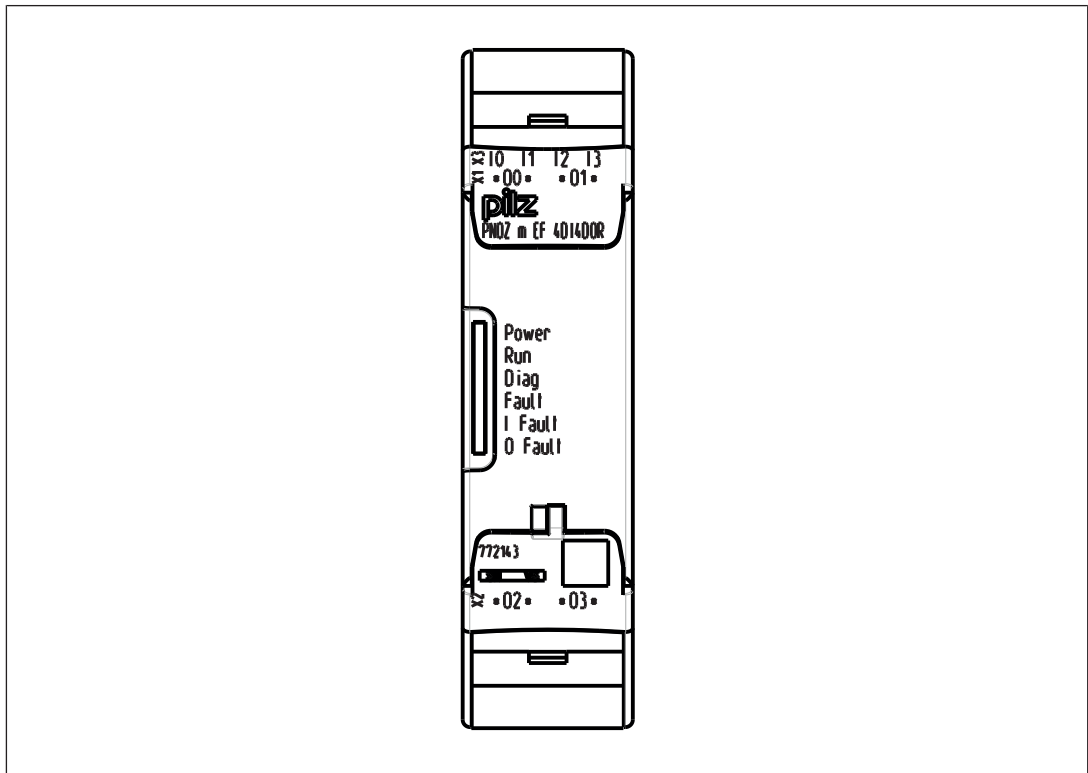
Using the product PNOZ m EF 4DI4DOR:

Expansion module for connection to a base unit from the configurable control system PNOZmulti 2 .

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Positive-guided relay outputs:
  - 4 safety outputs
  - Depending on the application, up to PL e of EN ISO 13849-1 and up to SIL CL 3 of EN IEC 62061
- ▶ 4 inputs for connecting, for example:
  - E-STOP pushbutton
  - Two-hand button
  - Safety gate limit switch
  - Start button
  - Light beam devices
  - Scanner
  - Enabling switch
  - PSEN
  - Operating mode selector switch
- ▶ LED for:
  - Error messages
  - Diagnostics
  - Supply voltage
  - Output circuits
  - Input circuits
- ▶ Test pulse outputs used to monitor shorts across the inputs
- ▶ Monitoring of shorts between the safety outputs
- ▶ Plug-in connection terminals:
  - Either spring-loaded terminal or screw terminal available as an accessory (see order reference)
- ▶ Please refer to the document "PNOZmulti System Expansion" for the PNOZmulti base units that can be connected

## 2.3 Front view



### Legend:

- ▶ Inputs I0 – I3
- ▶ Outputs O0 – O3
- ▶ LEDs:
  - POWER
  - Run
  - Diag
  - Fault
  - I Fault
  - O Fault

## 3 Safety

### 3.1 Intended use

The expansion module may only be connected to a base unit from the configurable control system PNOZmulti 2 (please refer to the document "PNOZmulti System Expansion" for details of the base units that can be connected).

The configurable control system PNOZmulti 2 is used for the safety-related interruption of safety circuits and is designed for use in:

- ▶ E-STOP equipment
- ▶ Safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1

### 3.2 System requirements

Please refer to the "Product Modifications" document in the "Version overview" section for details of which versions of the base unit and PNOZmulti Configurator can be used for this product.

### 3.3 Safety regulations

#### 3.3.1 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by competent persons.

A competent person is someone who, because of their training, experience and current professional activity, has the specialist knowledge required to test, assess and operate the work equipment, devices, systems, plant and machinery in accordance with the general standards and guidelines for safety technology.

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 this description under "Safety"
- ▶ And have a good knowledge of the generic and specialist standards applicable to the specific application.

#### 3.3.2 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.).



### 3.3.3 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).

### 3.3.4 For your safety

The unit meets all necessary conditions for safe operation. However, you should always ensure that the following safety requirements are met:

- ▶ This operating manual only describes the basic functions of the unit. Information on the advanced functions can be found in the online help for the PNOZmulti Configurator and in the PNOZmulti technical catalogue. Only use these functions after you have read and understood the documentation. All necessary documentation can be found on the PNOZmulti Configurator CD.
- ▶ Do not open the housing or make any unauthorised modifications.
- ▶ Please make sure you shut down the supply voltage when performing maintenance work (e.g. exchanging contactors).

## 4 Function description

### 4.1 Integrated protection mechanisms

The relay conforms to the following safety criteria:

- ▶ The circuit is redundant with built-in self-monitoring.
- ▶ The safety function remains effective in the case of a component failure.

### 4.2 Functions

The expansion module provides additional inputs and additional relay outputs.

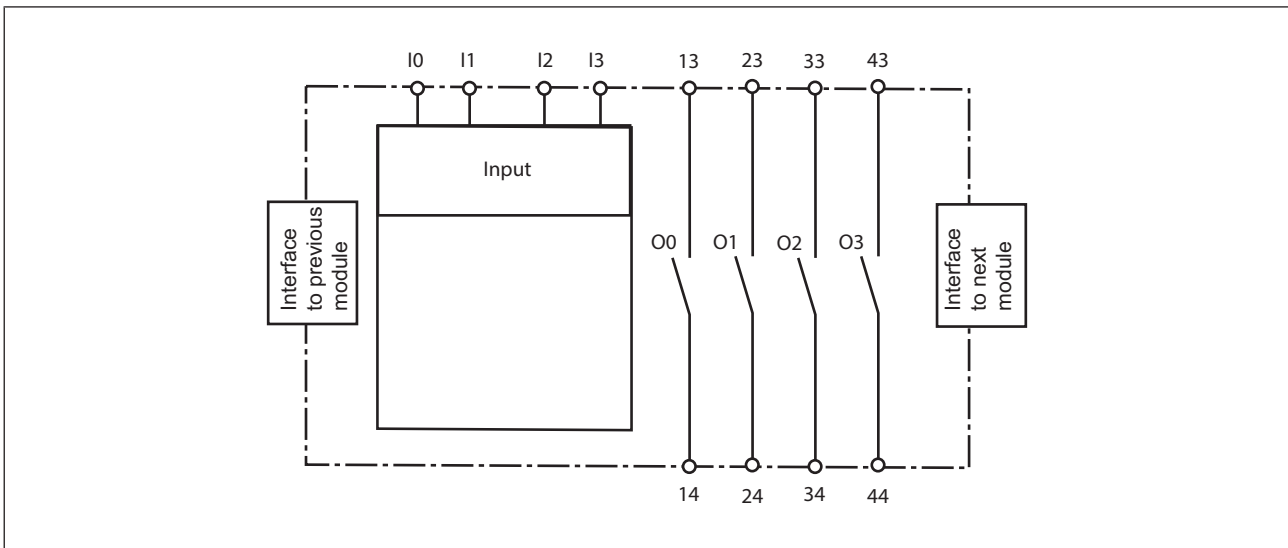
The function of the inputs and outputs on the control system depends on the safety circuit created using the PNOZmulti Configurator. A chip card is used to download the safety circuit to the base unit. The base unit has 2 microcontrollers that monitor each other. They evaluate the input circuits on the base unit and expansion modules and switch the outputs on the base unit and expansion modules accordingly.

The online help on the PNOZmulti Configurator contains descriptions of the operating modes and all the functions of the PNOZmulti control system, plus connection examples.

### 4.3 System reaction time

Calculation of the maximum reaction time between an input switching off and a linked output in the system switching off is described in the document "System Expansion".

### 4.4 Block diagram



## 5 Installation

### 5.1 General installation guidelines

- ▶ The unit should be installed in a control cabinet with a protection type of at least IP54.
- ▶ Fit the safety system to a horizontal mounting rail. The venting slots must face upward and downward. Other mounting positions could damage the safety system.
- ▶ Use the locking elements on the rear of the unit to attach it to a mounting rail.
- ▶ In environments exposed to heavy vibration, the unit should be secured using a fixing element (e.g. retaining bracket or end angle).
- ▶ Open the locking slide before lifting the unit from the mounting rail.
- ▶ To comply with EMC requirements, the mounting rail must have a low impedance connection to the control cabinet housing.
- ▶ The ambient temperature of the PNOZmulti units in the control cabinet must not exceed the figure stated in the technical details, otherwise air conditioning will be required.

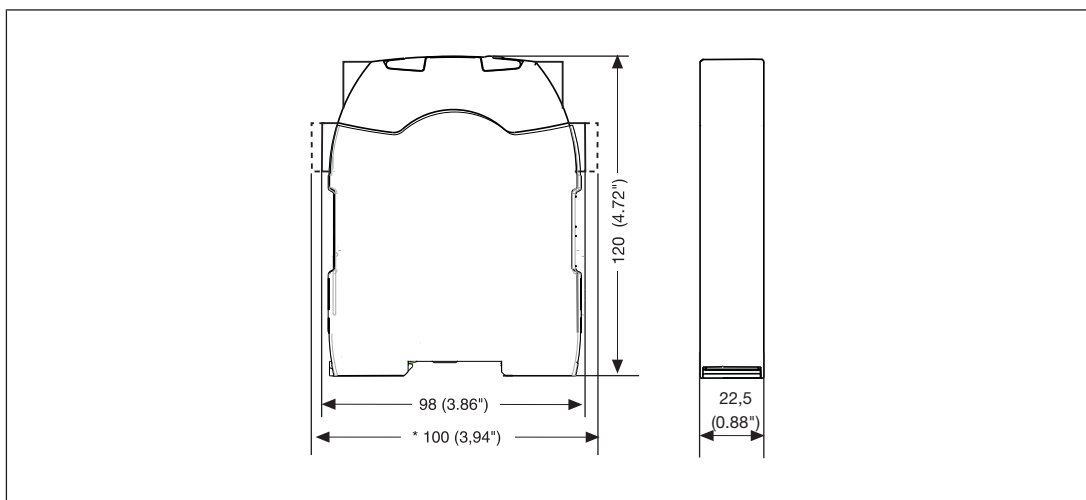


#### CAUTION!

Damage due to electrostatic discharge!

Electrostatic discharge can damage components. Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

### 5.2 Dimensions



### 5.3 Connecting the base unit and expansion modules

Connect the base unit and the expansion modules as described in the operating manuals for the base modules.

- ▶ The terminator must be fitted to the last expansion module
- ▶ Install the expansion module in the position configured in the PNOZmulti Configurator.

## 6 Commissioning

### 6.1 Wiring

The wiring is defined in the circuit diagram of the PNOZmulti Configurator.

Please note:

- ▶ Information given in the "Technical details" must be followed.
- ▶ Use copper wire that can withstand 75°C.

### 6.2 Download modified project to the PNOZmulti safety system

As soon as an additional expansion module has been connected to the system, the project must be amended using the PNOZmulti Configurator. Proceed as described in the operating instructions for the base unit.

**NOTICE**

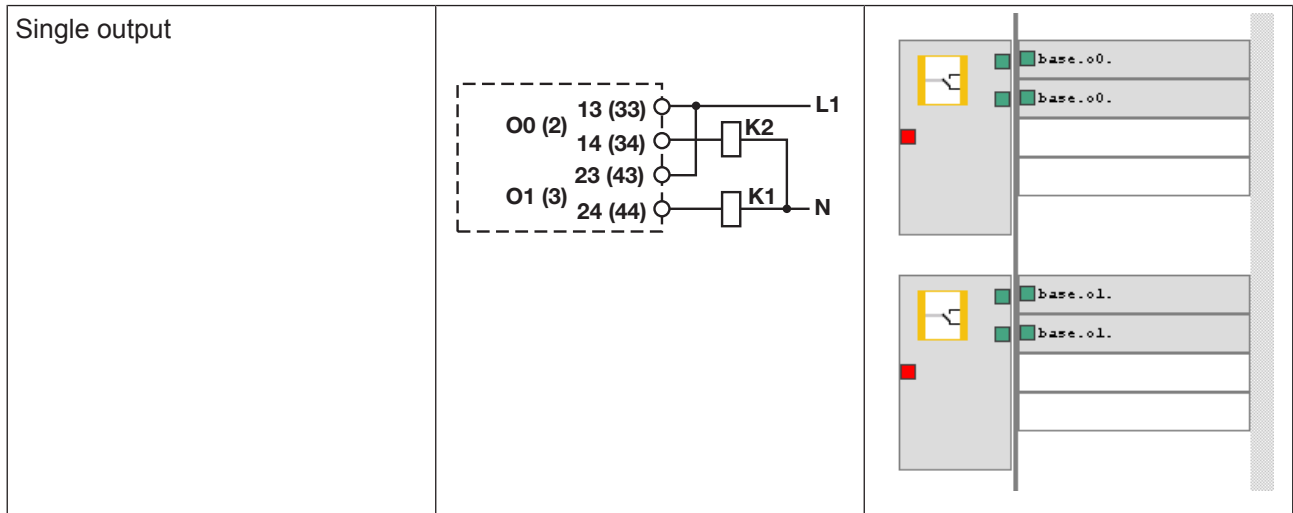
For the commissioning and after every program change, you must check whether the safety devices are functioning correctly.

### 6.3 Connection

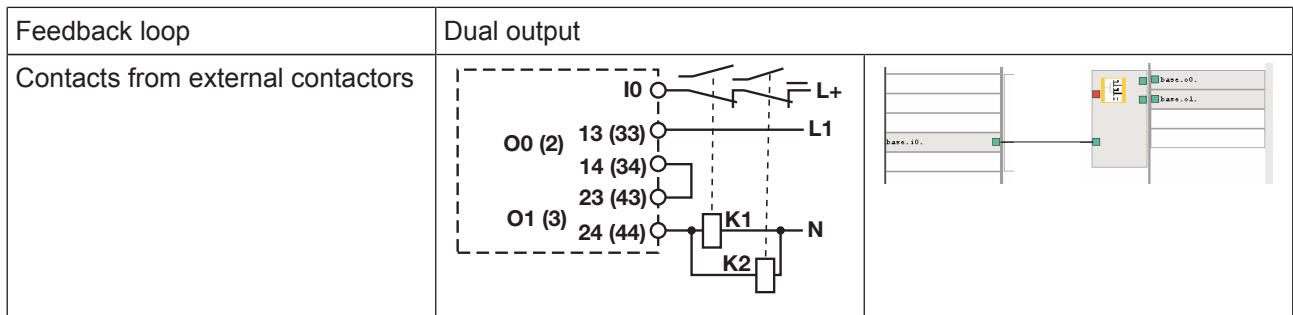
input circuit	Single-channel	Dual-channel
Example: Emergency stop without detection of shorts across contacts		
Example: Emergency stop with detection of shorts across contacts		

Connection examples for the input circuit

Dual output		
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Relay outputs



Feedback loop

## 7 Operation

When the supply voltage is switched on, the PNOZmulti safety system copies the configuration from the chip card.

The LEDs "POWER", "DIAG", "FAULT", "IFAULT" and "OFAULT" light up on the base unit.

The PNOZmulti control system is ready for operation when the "POWER" and "RUN" LEDs on the base unit are lit continuously.

### 7.1 Messages

Legend:

	LED on
	LED flashes
	LED off

LED						Error
PO WE R	Ru n	Dia g	Fa ult	IFa ult	OF ault	
						No supply voltage
✖	✖					Expansion module PNOZ m EF 4DI4DOR running without error
✖						Expansion module PNOZ m EF 4DI4DOR is in a STOP condition
✖			⚡			Internal error on the expansion module PNOZ m EF 4DI4DOR or on the overall system. Expansion module is in a safe condition.
✖			✖			External error on the expansion module PNOZ m EF 4DI4DOR or on the overall system. Expansion module is in a safe condition.
✖				⚡		Internal error on the inputs of the expansion module PNOZ m EF 4DI4DOR. Expansion module is in a safe condition, e.g. pulse error.
✖					⚡	Internal error on the outputs of the expansion module PNOZ m EF 4DI4DOR. Expansion module is in a safe condition.
✖				✖		External error on the inputs of the expansion module PNOZ m EF 4DI4DOR. Expansion module is in a safe condition.
✖	✖				⚡	External error on the outputs of the expansion module PNOZ m EF 4DI4DOR. Expansion module is in a safe condition, e.g. defective feedback loop

## 8 Technical details

<b>General</b>	<b>772143</b>
Approvals	<b>BG, CCC, CE, GOST, TÜV, cULus Listed</b>
Application area	<b>Failsafe</b>
Module's device code	<b>00E1h</b>
<b>Electrical data</b>	<b>772143</b>
Supply voltage	
For	<b>Module supply</b>
Internal	<b>Via base unit</b>
Voltage	<b>24,0 V</b>
Type	<b>DC</b>
Current consumption	<b>122 mA</b>
Power consumption	<b>3,0 W</b>
Max. power dissipation of module	<b>6,50 W</b>
Status indicator	<b>LED</b>
Permitted loads	<b>inductive, resistive</b>
<b>Inputs</b>	<b>772143</b>
Number	<b>4</b>
Input voltage in accordance with EN 61131-2 Type 1	<b>24 V DC</b>
Input current at rated voltage	<b>5 mA</b>
Input current range	<b>2,5 - 5,3 mA</b>
Pulse suppression	<b>0,5 ms</b>
Maximum input delay	<b>8 ms</b>
Potential isolation	<b>No</b>
<b>Relay outputs</b>	<b>772143</b>
Utilisation category	
In accordance with the standard	<b>EN 60947-4-1</b>
Safety contacts, AC1 at	<b>250 V</b>
Max. current	<b>6,0 A</b>
Min. current	<b>10,00 mA</b>
Max. power	<b>1500 VA</b>
Safety contacts, DC1 at	<b>24 V</b>
Max. current	<b>6,0 A</b>
Min. current	<b>10,00 mA</b>
Max. power	<b>144 W</b>
Utilisation category	
In accordance with the standard	<b>EN 60947-5-1</b>
Safety contacts, AC15 at	<b>230 V</b>
Max. current	<b>3,0 A</b>
Max. power	<b>690 W</b>
Safety contacts, DC13 (6 cycles/min) at	<b>24 V</b>
Max. current	<b>3,0 A</b>
Max. power	<b>72 W</b>

<b>Relay outputs</b>	<b>772143</b>
Utilisation category in accordance with UL	
Voltage	<b>240 V AC G.U. Resistive</b>
With current	<b>6,0 A</b>
Voltage	<b>24 V DC G. U. Resistive</b>
With current	<b>6,0 A</b>
Pilot Duty; R300	<b>24 V DC</b>
With current	<b>3,0 A</b>
Pilot Duty; B300	<b>230 V AC</b>
With current	<b>3,0 A</b>
Airgap creepage between	
Relay contacts	<b>3 mm</b>
Relay contacts and other safe circuits	<b>5,5 mm</b>
Contact fuse protection, external safety contacts	
In accordance with the standard	<b>VDE 0660</b>
Blow-out fuse, quick	<b>10 A</b>
Blow-out fuse, slow	<b>6 A</b>
Switch-off delay	<b>22 ms</b>
Contact material	<b>AgCuNi + 0,2 µm Au</b>
Potential isolation	<b>Yes</b>
<b>Environmental data</b>	<b>772143</b>
Ambient temperature	
In accordance with the standard	<b>EN 60068-2-14</b>
Temperature range	<b>0 - 60 °C</b>
Forced convection in control cabinet off	<b>55 °C</b>
Storage temperature	
In accordance with the standard	<b>EN 60068-2-1/-2</b>
Temperature range	<b>-25 - 70 °C</b>
Climatic suitability	
In accordance with the standard	<b>EN 60068-2-30, EN 60068-2-78</b>
Condensation during operation	<b>Not permitted</b>
EMC	<b>EN 61131-2</b>
Vibration	
In accordance with the standard	<b>EN 60068-2-6</b>
Frequency	<b>5,0 - 150,0 Hz</b>
Acceleration	<b>1g</b>
Shock stress	
In accordance with the standard	<b>EN 60068-2-27</b>
Acceleration	<b>15g</b>
Duration	<b>11 ms</b>
Max. operating height above sea level	<b>2000 m</b>
Airgap creepage	
In accordance with the standard	<b>EN 61131-2</b>
Overvoltage category	<b>II</b>
Rated insulation voltage	<b>30 V</b>



<b>Environmental data</b>	<b>772143</b>
Protection type	
In accordance with the standard	<b>EN 60529</b>
Mounting (e.g. cabinet)	<b>IP54</b>
Housing	<b>IP20</b>
Terminals	<b>IP20</b>
<b>Mechanical data</b>	<b>772143</b>
Mounting position	<b>Horizontal on top hat rail</b>
Mechanical life	<b>10,000,000 cycles</b>
DIN rail	
Top hat rail	<b>35 x 7,5 EN 50022</b>
Recess width	<b>27 mm</b>
Max. cable length	
Max. cable length per input	<b>1,0 km</b>
Material	
Bottom	<b>PC</b>
Front	<b>PC</b>
Top	<b>PC</b>
Conductor cross section with screw terminals	
1 core flexible	<b>0,25 - 2,50 mm<sup>2</sup>, 24 - 12 AWG</b>
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	<b>0,20 - 1,50 mm<sup>2</sup>, 24 - 16 AWG</b>
Torque setting with screw terminals	<b>0,50 Nm</b>
Connection type	<b>Spring-loaded terminal, screw terminal</b>
Mounting type	<b>plug in</b>
Conductor cross section with spring-loaded terminals: flexible with/without crimp connector	<b>0,20 - 2,50 mm<sup>2</sup>, 24 - 12 AWG</b>
Spring-loaded terminals: Terminal points per connection	<b>2</b>
Stripping length	<b>9 mm</b>
Dimensions	
Height	<b>101,4 mm</b>
Width	<b>22,5 mm</b>
Depth	<b>120,0 mm</b>
Weight	<b>190 g</b>

The standards current on 2012-04 apply.

## 8.1 Safety characteristic data

Unit	Operating mode	EN ISO 13849-1: 2008 PL	EN ISO 13849-1: 2008 Category	EN IEC 62061 SIL CL	EN IEC 62061 PFH <sub>D</sub> [1/h]	EN ISO 13849-1: 2008 T <sub>M</sub> [year]
<b>Logic</b>						
CPU	–	PL e	Cat. 4	SIL CL 3	2,84E-10	20
<b>Input</b>						
SC inputs	1-channel	PL d	Cat. 2	SIL CL 2	2,10E-09	20
SC inputs	2-channel	PL e	Cat. 4	SIL CL 3	4,27E-11	20
SC inputs	1-ch., pulsed light beam device	PL e	Cat. 4	SIL CL 3	2,10E-10	20
<b>Output</b>						
Relay outputs	1-channel	PL c	Cat. 1	-	3,75E-08	20
Relay outputs	2-channel	PL e	Cat. 4	SIL CL 3	7,52E-12	20

Requirement on 1-channel relay outputs for Category 1 in accordance with EN 13849-1: An additional output switches to a safe condition in the event of an error or, if that is impossible, signals a hazardous condition.

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.



### CAUTION!

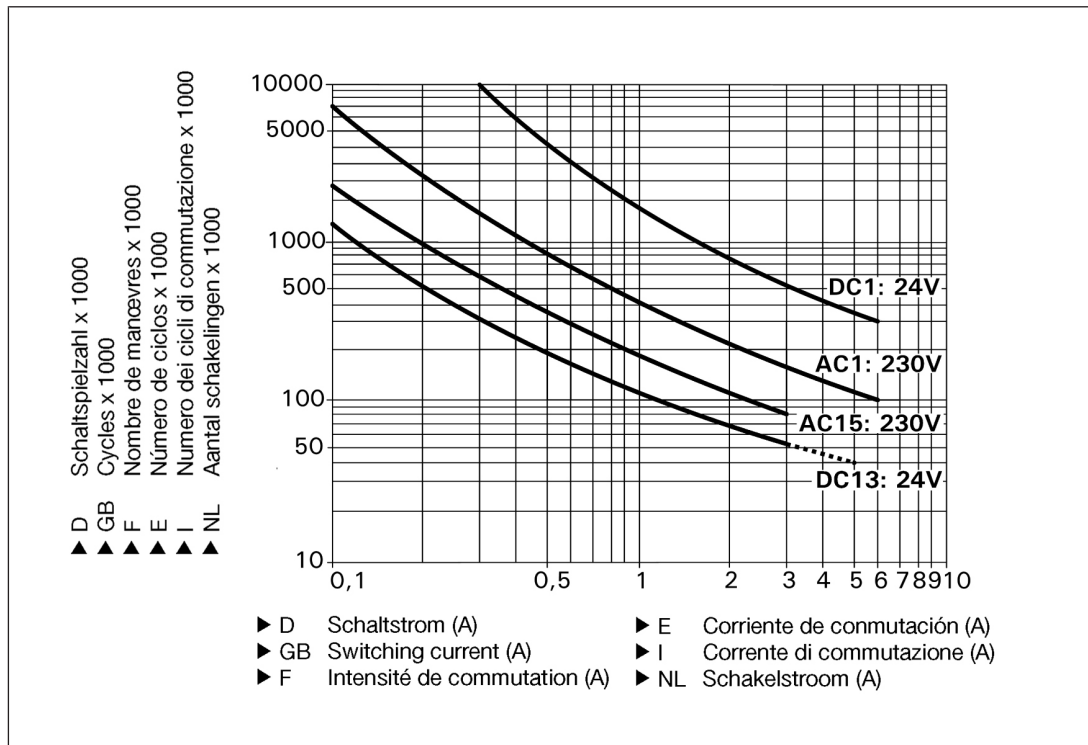
It is essential to consider the relay's service life graphs. The relay outputs' safety-related characteristic data is only valid if the values in the service life graphs are met.

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

## 9 Supplementary data

### 9.1 Service life graph of output relays

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

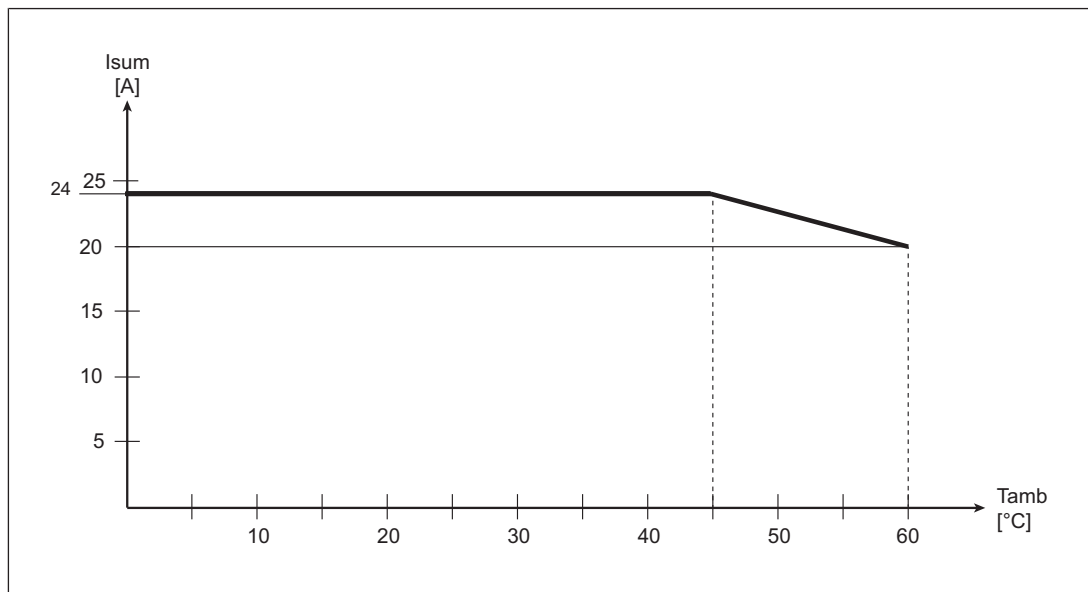
- ▶ Inductive load: 0,2 A
- ▶ Utilisation category: AC15
- ▶ Contact service life: 1,000,000 cycles

Provided the application requires fewer than 1,000,000 cycles, the PFH value (see technical details) can be used in the calculation.

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

We recommend you use semiconductor outputs to switch 24 VDC loads.

## 9.2 Permitted ambient temperature $T_{amb}$ dependent on the total current $I_{sum}$



Max. permitted total current of relay outputs at an ambient temperature of < 45 °C: 24 A

Max. permitted total current of relay outputs at an ambient temperature of = 60 °C: 20 A

## 10 Order reference

Order reference		
Product type	Features	Order no.
PNOZ m EF 4DI4DOR	Expansion module	772 143
Order reference: Accessories		
Product type	Features	Order no.
Set spring terminals	1 set of spring-loaded terminals	751 004
Set screw terminals	1 set of screw terminals	750 004
Order reference: Terminator, jumper		
Product type	Features	Order no.
PNOZ mm0.xp connector left	Jumper yellow/black to connect the modules, 1 piece	779 260



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# pilz