



▶ PNOZmulti 2 Technical catalogue

Display 2023-02

- Configurable, safe small controllers PNOZmulti 2

PILZ
THE SPIRIT OF SAFETY



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Many functions, one solution – the configurable safe small controller PNOZmulti 2 bridges the gap between classic safety relays and programmable control systems. The system PNOZmulti 2 is convincing, with numerous benefits. The software tool PNOZmulti Configurator, for example, impresses with its simple handling: install, open, work intuitively. You also have the widest range of diagnostic options – for high plant availability and low downtimes. The variety of fieldbus and communication options is a huge benefit with the PNOZmulti 2 system. It means the system can be used independently from the higher level operational control system. Various expansion modules offer maximum flexibility of application.

This technical catalogue describes the structure of the configurable safe small control system PNOZmulti 2.

The units in the PNOZmulti 2 systems are described in a detailed data sheet, which will help you with module selection and enable project configuration.

Please refer to the units' operating manual for information on installation and operation.

Further information on the systems can be found in the following documents:

- ▶ PNOZmulti Installation Manual
- ▶ Safety manual PNOZmulti
- ▶ Communication interfaces – configurable safe small controllers PNOZmulti 2
- ▶ Special applications PNOZmulti

System description

System description

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System description

Overview

General

The configurable safe small controller PNOZmulti 2 is suitable for implementing multiple safety functions on a plant or machine. Thanks to its modular structure, the PNOZmulti 2 system can be adapted to the size of the plant and machinery. With a large number of the most diverse modules and a variety of base units, you can design your application with the utmost flexibility.

The system PNOZmulti 2 is suitable for use from four safety functions upwards. The base unit has an illuminated display for even faster diagnostics.

Modular structure, except PNOZ m C0

- ▶ The PNOZmulti 2 system consists of a base unit and various expansion modules. The type of expansion module that can be connected depends on the type of base unit (see chapter [System expansion](#) [20]).
- ▶ The base unit (exception: PNOZ m B1) has various inputs and outputs and is also fully functional without expansion modules.
- ▶ The expansion modules supplement the base unit with additional inputs or outputs.

PNOZ m C0

The base unit PNOZ m C0 is a standalone device, no expansion modules can be connected

Configuration in PNOZmulti Configurator

- ▶ The system's function is defined via the PNOZmulti Configurator.
- ▶ PNOZmulti Configurator is a graphic tool which is used to define the functions of the units. Various safety functions are available, such as emergency stop, two-hand monitoring, safety gate monitoring and drive monitoring. With the correct circuitry it is possible to achieve categories up to PL e of EN ISO 13849-1 and SIL 3 of EN IEC 62061.
- ▶ Using predefined symbols, a simple circuit diagram shows how the units' inputs and outputs should be connected. This circuit diagram is then downloaded to the base unit.
- ▶ The system can be expanded or the functions modified at any time.
- ▶ Frequently used parts of the circuit diagram can be combined into macro elements, stored in the macro library and reused.

Inputs

- ▶ The PNOZmulti 2 system has semiconductor inputs for safety-related and standard applications.
- ▶ Virtual inputs for standard applications are also available. They can be set via the integrated interface or via fieldbus modules (e.g. PROFIBUS-DP, CANopen, ...).
- ▶ Decentralised input modules provide safe inputs for use up to IP67 (e.g. PDP67 F DI ION).

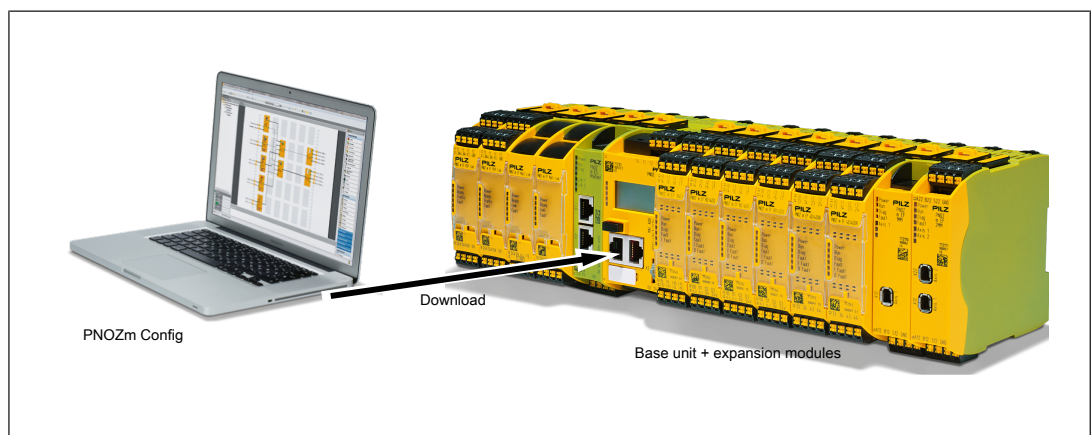
System description

Overview

- ▶ Analogue input modules can be connected to several base units of the PNOZmulti 2 system, thereby providing safe analogue inputs. For standard applications, the exact analogue values are made available to the base unit to forward to a fieldbus.

Outputs

- ▶ The PNOZmulti 2 system has various inputs:
 - Relay safety outputs
 - Semiconductor safety outputs
 - Semiconductor outputs for standard applications
- ▶ The safety outputs use semiconductor technology, require no maintenance and are non-wearing; they are therefore suitable for applications with frequent operations or cyclical functions. They can be used for 24 VDC applications.
- ▶ The relay safety outputs are suitable for less frequent operations, but they have a higher breaking capacity and can be used for AC applications.
- ▶ The outputs for standard applications are virtual outputs and they can be evaluated via the integrated interface or via fieldbus modules (e.g. PROFIBUS-DP, CANopen, ...).



System description

Hardware

Structure of the configurable control system

The configurable control system consists of the base unit and expansion modules. Depending on the unit type, a base unit will have:

- ▶ Inputs
- ▶ Relay outputs
- ▶ Safe semiconductor outputs
- ▶ Outputs for standard applications

The number of inputs and outputs can be increased at any time using the expansion modules. The modules are linked via a jumper. The system is configured using the PNOZmulti Configurator. Special expansion modules enable data to be exchanged via a fieldbus (non-safety-related) or safe speed monitoring, for example.

Operation of the units

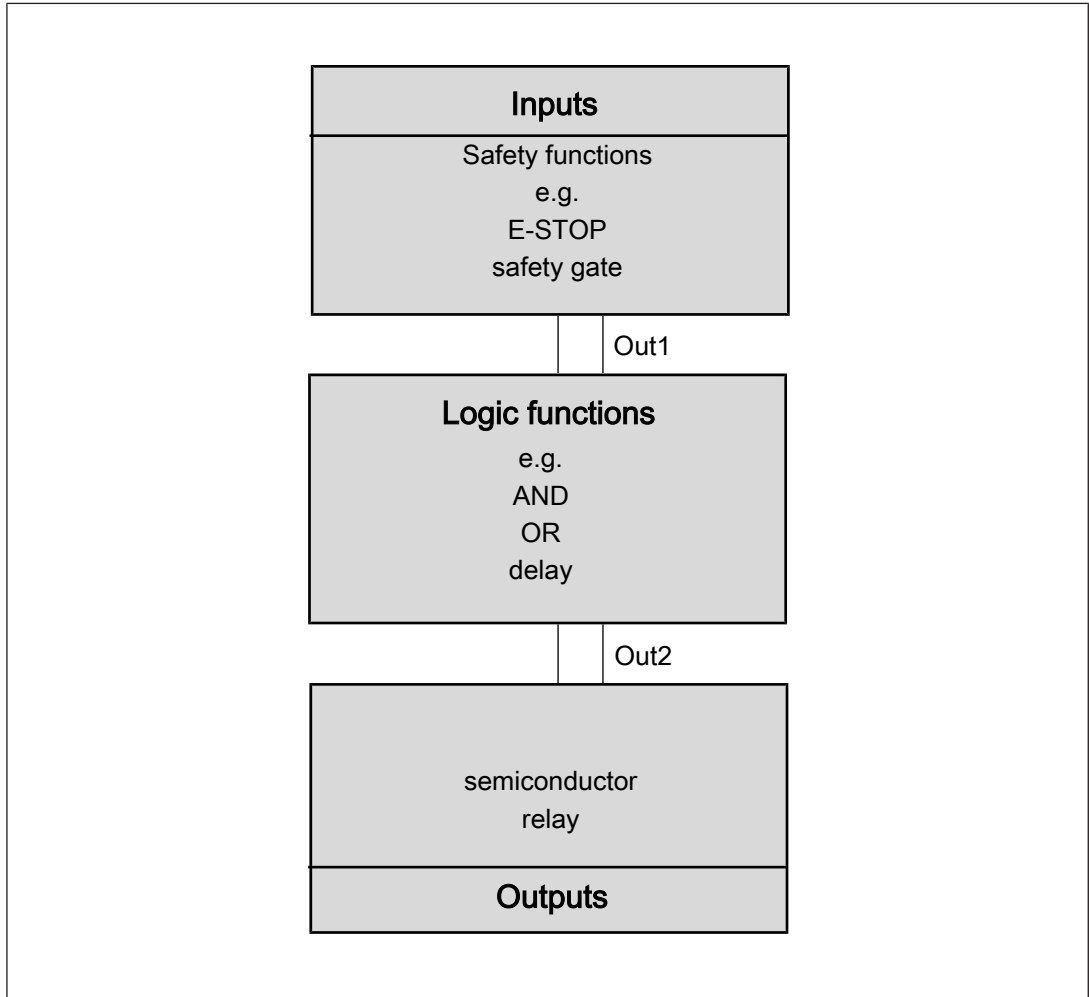
The PNOZmulti Configurator generates a project file which is downloaded to the base unit; there it defines:

- ▶ Which safety functions the inputs are to carry out, e.g. E-STOP monitoring, safety gate monitoring
- ▶ How the inputs are connected to the outputs via logic functions
- ▶ Which output is configured (semiconductor, relay)

The units react the same, irrespective of these functions:

If the start-up condition of the specific safety function is met, there will be a high signal at the output "Out1". The output signal can be linked via a logic function and is then present as the "Out2" signal at the output on the PNOZmulti 2 unit.

System description
Hardware



Fieldbus modules

The fieldbus modules are used to

- ▶ Read the diagnostic data
- ▶ Set virtual inputs for standard functions
- ▶ Read virtual outputs for standard functions

Interfaces


The base units have an interface to

- ▶ Download the project
- ▶ Read the diagnostic data
- ▶ Set virtual inputs for standard functions
- ▶ Read virtual outputs for standard functions
- ▶ Read the error stack.

System description

Hardware

Safety functions

The PNOZmulti 2 systems have inputs and outputs, which can be used for various safety functions. Special base units and modules may be needed to implement safety functions (see selection guide [Base units](#) [ 44]).

Monitoring of:

- ▶ E-STOP pushbuttons
- ▶ Operating mode selector switches
- ▶ Enabling switches
- ▶ Two-hand pushbuttons
- ▶ Safety gates
- ▶ Light curtains
- ▶ Light barriers
- ▶ Muting
- ▶ Pressure sensitive mats
- ▶ Analogue input signals (analogue input module PNOZ m EF 4AI)
- ▶ Drives (e.g. speed/speed range monitoring, direction of movement monitoring, operating stop monitoring)
- ▶ Furnaces (with base unit PNOZ m B1 Burner)
- ▶ Operating mode selection and authorisation with PITreader (see System Descriptions PITmode flex and PITmode flex visu)
- ▶ The key-in-pocket system is used to protect against an unintended and unauthorised machine restart with PITreader (see system descriptions key-in-pocket system).

Various switch types are available for the required safety-related applications. With some switch types it is possible to monitor for simultaneity (see online help for the PNOZmulti Configurator).

System description

Software

The functions of the PNOZmulti 2 system are defined in the software of the PNOZmulti Configurator.

Procedure

- ▶ First, the required hardware is selected in the PNOZmulti Configurator via drag and drop. Each unit is given an equipment identifier.
- ▶ When all the units are selected, the circuit diagram is created in the user program. The circuit diagram describes the application for which the safety system is to be used. It is here that you determine which inputs are assigned to which safety-related or standard functions.
- ▶ The inputs and/or the results of the safety-related or standard functions can be linked through logic functions. The results of the logic functions or the results of the safety-related or standard functions are channelled to the outputs on the PNOZmulti 2 units.
- ▶ The circuit diagram is generated on a graphical interface. Symbols are provided for the safety-related or standard functions, logic functions and the various output types. These are simply dragged on to a workspace, configured and interconnected.
- ▶ Frequently used parts of the circuit diagram can be combined into macro elements, stored in the macro library and reused.
- ▶ Complex modules are configured in a separate sub-program, the Module program (mIQ). The user program then consists of a main program and one or more module programs. Each module is configured in a separate module program.
- ▶ Once the circuit diagram is complete, the data must be saved and downloaded to the base unit. The circuit diagram, device configuration and all the data that has been entered are stored within a project.
- ▶ When the project is saved, various passwords can be used to protect it from unauthorised access.
- ▶ Once it is saved, the project has to be downloaded to the base unit. To do this, the project data is downloaded on to a chip card or a USB memory (with PNOZ m B1). It is either downloaded directly via the communications interface or via a chip card reader.
- ▶ After downloading, a test must be performed to check that the safety devices function correctly.
- ▶ When PNOZmulti Configurator is installed in various languages, the required language can be selected.

System description

Diagnostics

The PNOZmulti 2 system has many options for diagnostics and fault detection:

- ▶ LEDs on the base unit and expansion modules
- ▶ Diagnostic data via the communication interface and via a fieldbus
- ▶ Error stack
- ▶ Diagnostic word in PNOZmulti Configurator
- ▶ Expanded diagnostic options using a visualisation system, e.g. PASvisu with PMI
- ▶ Expanded diagnostics PVIS
- ▶ Display messages are configured in the PNOZmulti Configurator.

Detailed information on the diagnostic options are available in the document "PNOZmulti communication interfaces".

LEDs on the base unit and expansion modules

The LEDs signal

- ▶ Operating states (e.g. "RUN")
- ▶ External and internal errors

The meaning of the LEDs can be found in chapter "PNOZmulti 2 products" with the relevant base units and modules.

Communications interface

The integrated communications interface on the PNOZmulti 2 system is used to transfer diagnostic data to an application program.

Diagnostic data

The diagnostic data can be called up via the communications interface or via a connected fieldbus. All base units that have an Ethernet interface also support Modbus/TCP.

The diagnostic data may only be used for non-safety purposes, e.g. visualisation.

The diagnostic data on the PNOZmulti 2 system is:

- ▶ Version:
Product number, unit version, serial number
- ▶ Status of inputs/outputs:
Indicates whether inputs and outputs are active or inactive (open/closed)
- ▶ LED status:
Indicates the status of the LEDs on the base unit and expansion modules (on/off/ flashes), plus the operating mode (start up, RUN, STOP)
- ▶ Simplified status scan:
Shows group messages relating to the safety system: Signal changes, LED status, operating statuses
- ▶ Virtual inputs and outputs:
Virtual inputs can be set. The status of the virtual inputs and outputs can be scanned.

System description

Diagnostics

- ▶ Diagnostic word:
The diagnostic word contains the status of elements from the user program within the PNOZmulti 2 system.
- ▶ Test data:
To check communication.
- ▶ Data in table form:
This is structured data (arranged in tables and segments) from the PNOZmulti 2 system, as it could also be read via a fieldbus module:
 - Configuration
 - Status of the inputs and outputs
 - Status of LED
 - Diagnostic word
 - Element types
- ▶ Expanded diagnostic options using a visualisation system (e.g. PASvisu with PMI).
In PNOZmulti Configurator an expanded diagnostic configuration (PVIS) can be created. The diagnostic configuration enables appropriate event messages to be displayed in the case of:
 - Errors in or on the PNOZmulti 2 system:
Includes the event messages that are triggered when there are errors in or on the PNOZmulti 2 system (error stack)
 - Changes in the operating status of the PNOZmulti 2 system that are output when safeguards, inputs, outputs and connection points reach a defined state

PNOZmulti 2 system event messages can also be supplemented through additional information, which is helpful during diagnostics. With expanded diagnostics, a display unit is connected to a PNOZmulti 2 system. If an event occurs in or on the PNOZmulti 2 system, an event telegram is sent to the display unit. The event telegram is evaluated in the display unit. In most cases, the event message that corresponds to the event is displayed and is entered in the event list. The event message contains a description of the event. A remedy can be displayed for each event message. The remedy describes how to react to the event, in other words, what "actions" to take.

The diagnostic configuration is project-related, i.e. a separate diagnostic configuration is created for each PNOZmulti 2 project. Then the diagnostic configuration is downloaded to the PNOZmulti 2 system and to the display unit. The diagnostic configuration is described in detail in the PNOZmulti Configurator online help.

Error stack

The error stack on the PNOZmulti 2 system contains important information for diagnostics and troubleshooting. The error stack can be read out by the PNOZmulti Configurator. It includes messages and remedy texts such as:

- ▶ Hardware errors

System description

Diagnostics

- ▶ Wiring error
- ▶ Configuration error
- ▶ Errors in the operation of the interface or fieldbus
- ▶ Errors in the project's user program
- ▶ Messages relating to differences between the programs stored on the PNOZmulti 2 system and chip card

Diagnostic word

A diagnostic word can be called up for those elements of the PNOZmulti Configurator interface that have the ability to store a status:

- ▶ Online in PNOZmulti Configurator
- ▶ Via the Ethernet or serial interface on the base unit
- ▶ Via a connected fieldbus

The diagnostic word contains information about a certain element, e.g.:

- ▶ Operating states (e.g. switch operated)
- ▶ Error messages (e.g. monitoring time elapsed)


An individual bit from a diagnostic word can be evaluated in the user program of the PNOZmulti Configurator.

Installation

General guidelines

For detailed information about the installation of the PNOZmulti 2 systems, please read the installation manual for the PNOZmulti.

The position of the expansion modules is defined in the PNOZmulti Configurator. The expansion modules are connected to the left or right of the base unit, depending on the type.

Please refer to the section entitled [System expansion](#)  20] for details of the number of modules that can be connected to the base unit and the module types.

Install the expansion modules in the position in which it is configured in the PNOZmulti Configurator. For module selection please refer to the online help for the PNOZmulti Configurator.

Installation

Install PNOZmulti 2 systems

Control cabinet installation

- ▶ The unit should be installed in a control cabinet with a protection type of at least IP54.
- ▶ Install the system vertically on 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.

Installation

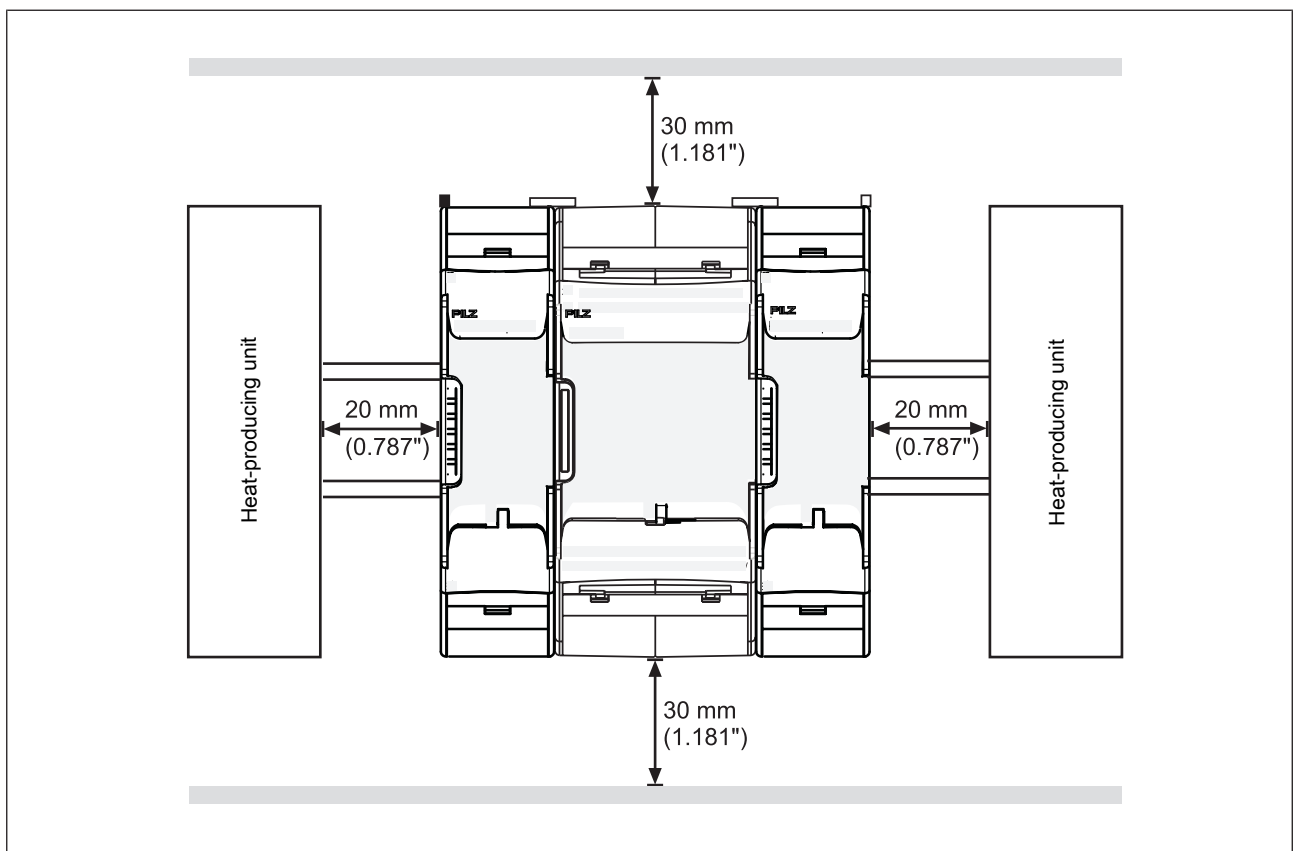
Install PNOZmulti 2 systems

Mounting distances

With control cabinet installation it is essential to maintain a certain distance from the top and bottom, as well as to other heat-producing devices (see diagram). The values stated for the mounting distances are minimum specifications.

The ambient temperature in the control cabinet must not exceed the figure stated in the technical details. Air conditioning may otherwise be required.

Mounting distances:

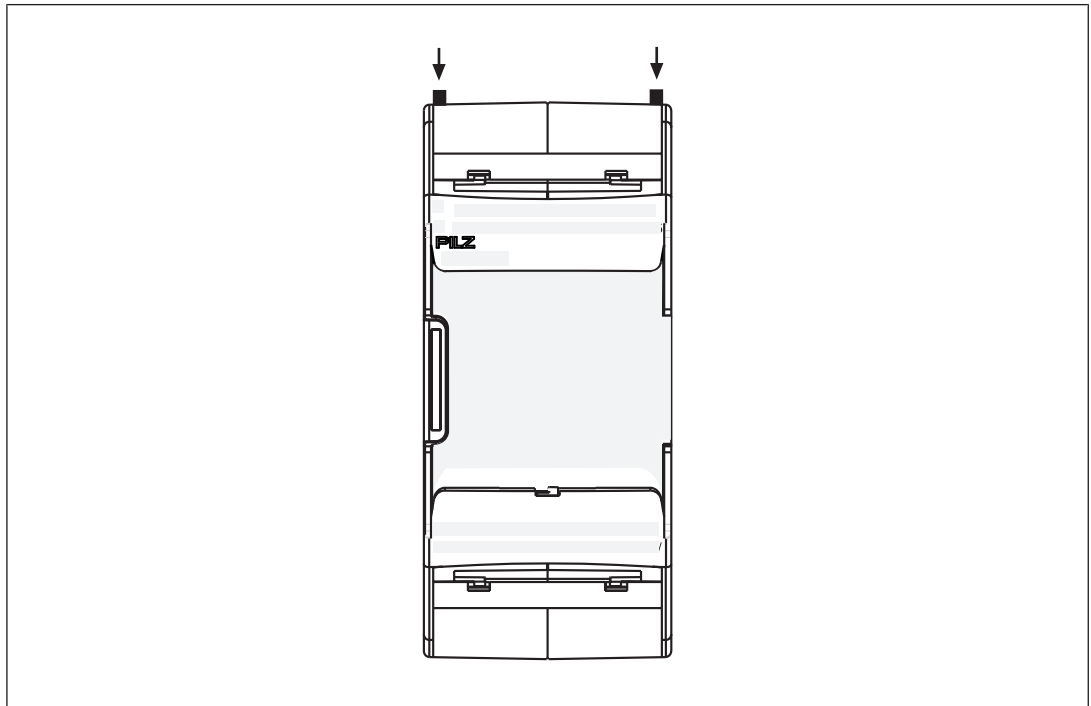


Installation

Install PNOZmulti 2 systems

Install base unit without expansion module

Make sure that the terminators are inserted on the top left and right of the unit.



Installation

Install PNOZmulti 2 systems

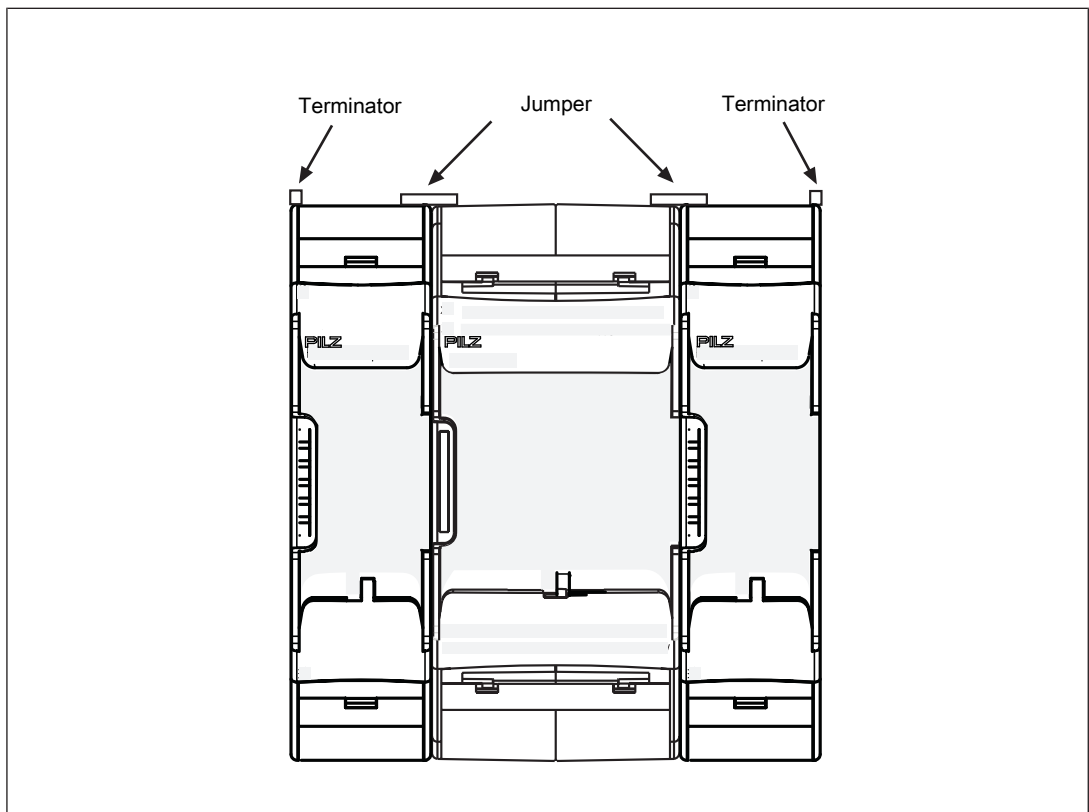
Connecting the base unit and expansion modules

The position of the expansion modules is defined in the PNOZmulti Configurator. The expansion modules are connected to the left or right of the base unit, depending on the type.

Please refer to the section entitled [System expansion](#) [📖 20] for details of the number of modules that can be connected to the base unit and the module types.

The modules are linked via jumpers.

- ▶ Remove the terminator on the side of the base unit and on the expansion module.
- ▶ Install the base unit and expansion modules on the mounting rail in the order configured in the PNOZmulti Configurator and connect the units using the jumper supplied.
- ▶ Fit the terminator to the unconnected interfaces on the base unit and expansion module.



System expansion

Configurable safe small controllers PNOZmulti 2

Maximum system expansion:

▶ To the right of the base unit:

PNOZ m B0

- 6 expansion modules

PNOZ m B1

- 12 expansion modules (restriction: The number of modules PNOZ m EF 4DI4DOR, PNOZ m EF 4DI4DORD and PNOZ m EF 2MM is in total limited to a maximum of 8)
- Until 10/2022 up to Firmware version 1.8: 1 standard module (position: last module to the right of the safety modules)
- Until 11/2022 up to Firmware version 1.8: 6 standard modules (position: to the right of the safety modules)

PNOZ m B0.1

- 1 expansion module

PNOZ m C0

- No expansion module

▶ To the left of the base unit

PNOZ m B0

- 4 expansion modules
- 1 communication module
- 1 fieldbus module

PNOZ m B1

- 4 expansion modules
- 1 fieldbus module

PNOZ m B0.1

- 4 expansion modules
- 1 communication module
- 1 fieldbus module

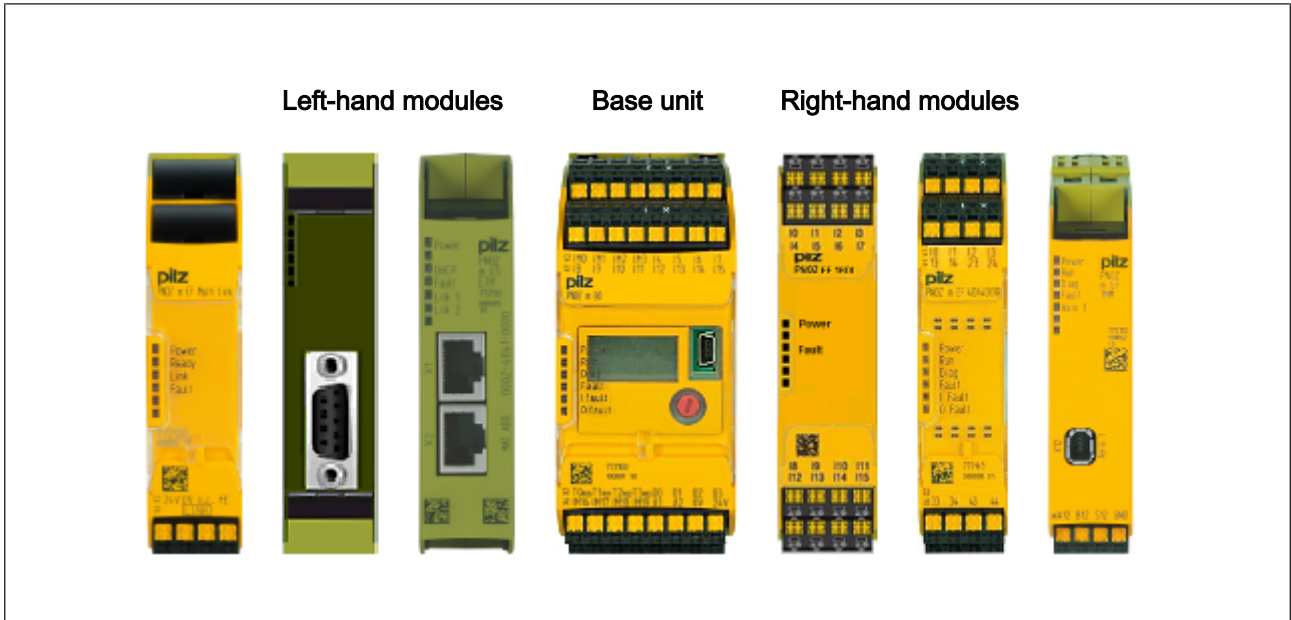
PNOZ m C0

- No expansion module

System expansion

Configurable safe small controllers PNOZmulti 2

Example of a control system PNOZmulti 2: Base unit PNOZ m B0 with expansion modules



System expansion depends on the base units:

Expansion modules		Slot	PNOZ m B0 (PNOZ m B0.1)	PNOZ m B1 PNOZ m B1 Burner
Number of connectable modules				
Link modules		left	4	4
PNOZ m EF Multi Link	To connect 2 base units		(-)	
PNOZ m EF PDP Link	To connect a base unit to up to 4 decentralised modules PDP67			
PNOZ m EF SafetyNET	To connect up to 16 SafetyNET p RTFL subscribers in a linear structure	left 1. safe module to the left of the base unit	1 (-)	1
Analogue input modules		right	6	12
PNOZ m EF 4AI	4 safe analogue inputs		(-)	

System expansion

Configurable safe small controllers PNOZmulti 2

Expansion modules		Slot	PNOZ m B0 (PNOZ m B0.1)	PNOZ m B1 PNOZ m B1 Burner
Input module		Right	6 (1)	12
PNOZ m EF 16DI	16 safe inputs			
Input and output modules				
PNOZ m EF 8DI4DO	8 safe inputs, 4 safe semiconductor outputs			
PNOZ m EF 8DI2DOT	8 safe inputs, 2 safe dual-pole semiconductor outputs			
PNOZ m EF 4DI4DOR	4 safe inputs, 4 safe relay outputs			
PNOZ m EF 4DI4DORD	4 safe inputs, 4 safe diverse relay outputs		8 (in total with PNOZ m EF 2MM)	
Output module		Right	6 (1)	8 (in total with PNOZ m EF 2MM)
PNOZ m EF 2DOR	2 safe relay outputs			
Output module for standard applications		Right To the right of the safe expansion modules	-	6 (-)
PNOZ m ES 14DO	14 semiconductor outputs for standard applications			
Motion Monitoring modules		Right	6 (-)	12
PNOZ m EF 1MM	Monitoring of 1 axis			
PNOZ m EF 1MM2DO	Monitoring of 1 axis, 2 safe semiconductor outputs, 1 semiconductor output for standard functions			
PNOZ m EF 2MM	Monitoring of 2 axes			
				8 (in total with PNOZ m EF 4DI4DOR and PNOZ m EF 4DI4DORD)

System expansion

Configurable safe small controllers PNOZmulti 2

Expansion modules		Slot	PNOZ m B0 (PNOZ m B0.1)	PNOZ m B1 PNOZ m B1 Burner
Fieldbus modules		left	1 (1)	1
PNOZ m ES Profibus	Profibus			
PNOZ m ES CANopen	CANopen			
PNOZ m ES CC-Link	CC-Link			
PNOZ m ES EtherCAT	EtherCAT			
PNOZ m ES Powerlink	Powerlink			
PNOZ m ES EtherNet/IP	EtherNet/IP			
PNOZ m ES Profinet	Profinet			
Communication modules		left	1 (1)	-
PNOZ m ES ETH	Ethernet interface			
PNOZ m ES RS232	Serial interface RS232			
Connected devices		Interface	PNOZ m B0 (PNOZ m B0.1)	PNOZ m B1
PITreader	System for authentication and authorisation on control systems	Ethernet (Modbus TCP)	- (-)	4
Visu Panel	Display unit for selecting safe operating modes (approved display units see MSO flex visu system description)	Ethernet (Modbus TCP)	- (-)	4

System expansion

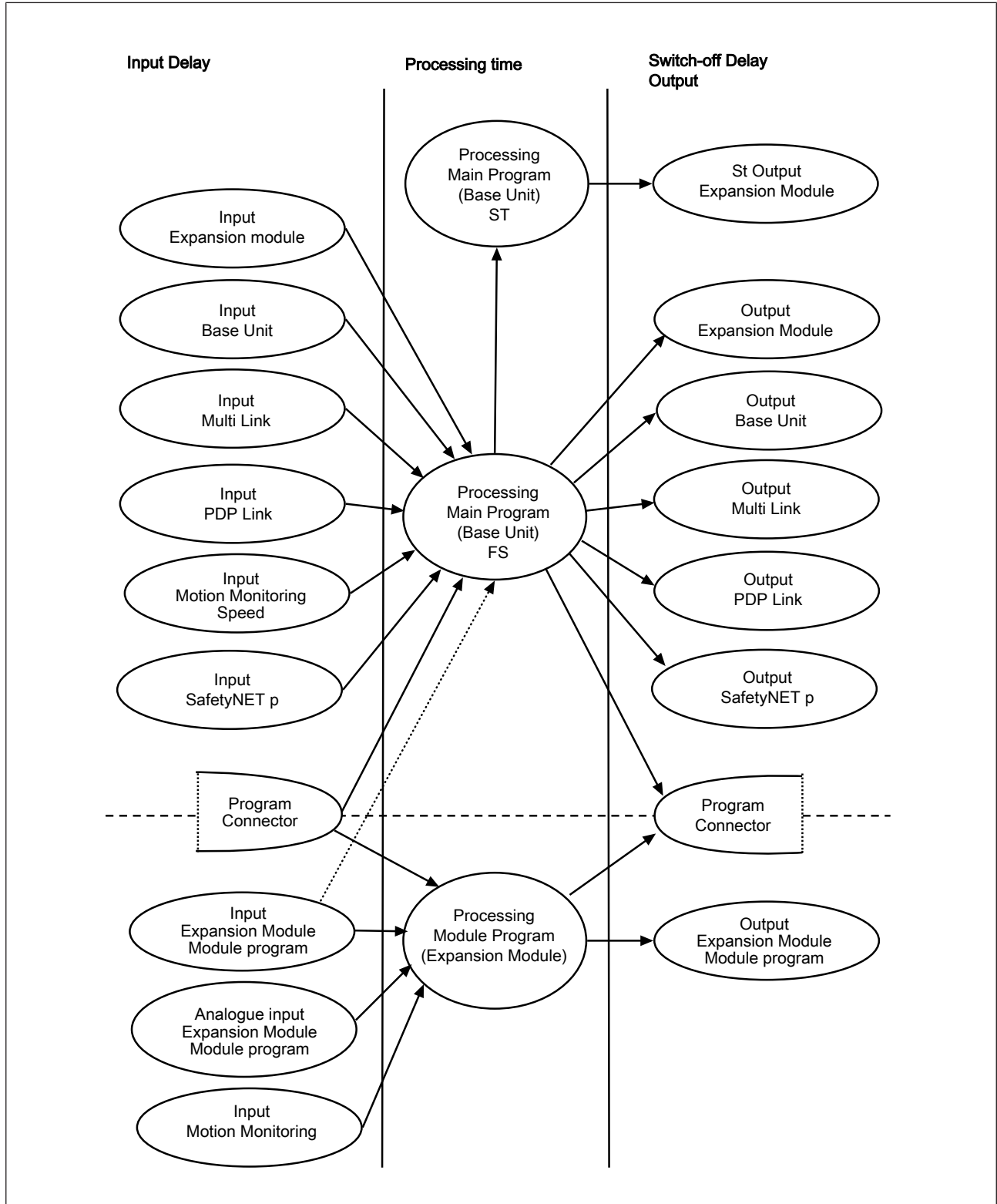
Configurable safe small controllers PNOZmulti 2

System reaction times

The reaction time between an input switching off and a linked output in the system switching off depends on the delay time at the input, the delay time at the output and the processing time. The times vary depending on which input/output is used by which device.

System expansion

Configurable safe small controllers PNOZmulti 2



System expansion

Configurable safe small controllers PNOZmulti 2

Calculation of the max. reaction time:

$t_{\text{ReactionMax}} = t_{\text{Max input delay}} + t_{\text{Max processing time}} + t_{\text{Max switch-off delay at the output}}$

Please note that the reaction time is also increased by

- ▶ Delay times configured in the user program
- ▶ Delay on the sensor that is used
- ▶ Delay on the actuator that is used

Maximum reaction times of the base units **and** expansion modules

Modules	Max. input delay	Max. processing time	Max. switch-off delay Output
PNOZ m B0	2 ms	30 ms	1 ms
PNOZ m B0.1	2 ms	30 ms	1 ms
PNOZ m B1 (FS)	-	30 ms	-
PNOZ m B1 (ST)	-	3 ms	-
PNOZ m EF 16DI	8 ms	-	-
PNOZ m EF 4AI	8 ms + signal smoothing ⁽¹⁾	5 ms	-
PNOZ m EF 8DI4DO	8 ms	-	3 ms
PNOZ m EF 4DI4DOR	8 ms	-	22 ms
PNOZ m EF 4DI4DORD	8 ms	-	22 ms
PNOZ m EF 2DOR	8 ms	-	22 ms
PNOZ m EF 8DI2DOT	8 ms + pulse suppression ⁽²⁾	-	6 ms
PNOZ m EF 8DI2DOT Input and output in the module program	8 ms + pulse suppression ⁽²⁾	-	-
PNOZ m EF Multi Link	0 ms ⁽³⁾	-	5 ms (connection's transmission delay)
PNOZ m EF PDP Link	15 ms + Max. processing time of the input PDP67 ⁽⁴⁾	-	5 ms
PNOZ m EF SafetyNET	0 ms	-	25 ms (connection's transmission delay)
PNOZ m EF 1MM, PNOZ m EF 2MM (configuration in the main program)	1/f _{actual} + 16 ms ⁽⁵⁾	-	-

System expansion

Configurable safe small controllers PNOZmulti 2

Modules	Max. input delay	Max. processing time	Max. switch-off delay Output
PNOZ m EF 1MM, PNOZ m EF 2MM (configuration in the module program)	$1/f_{\text{actual}} + 8 \text{ ms}$ ⁽⁵⁾	8 ms	-
PNOZ m EF 1MM2DO	Speed detection: $1/f_{\text{actual}} + 5 \text{ ms}$ ⁽⁵⁾ Cascading: 1.6 ms	4 ms	Semiconductor output: 1 ms Cascading: 0.1 ms Signal output: 0.1 ms
PNOZ m ES 14DO	-	-	1 ms
Program connector	0 ms ⁽⁶⁾	-	0 ms

(1) The signal smoothing can be set in the PNOZmulti Configurator (default setting: 2 ms).

(2) The pulse suppression time can be set in the PNOZmulti Configurator (default setting: 0.8 ms).

(3) An input delay does not need to be considered because it is already considered in the output delay of the communication partner.

(4) See technical details in the operating manual

(5) $1/f_{\text{actual}}$ corresponds to the period length T of the measured frequency. The maximum input delay $1/f_{\text{actual}} + X \text{ ms}$ is the reaction time at the input after a limit value is exceeded.

(6) No additional time needs to be added for data exchange between main program processing and module program processing via the program connectors. This delay is already included in the processing times.

To simplify the calculation, the stated times include various times that need to be considered within the system. As a result, transmission times, for example, do not need to be included separately in the calculation.

Example configuration: Input from PNOZ m EF 8DI4DO, output from PNOZ m EF 8DI4DO

Input PNOZ m EF 8DI4DO Max. input delay	Processing in the main program Processing time	Output PNOZ m EF 8DI4DO Switch-off delay
8 ms	30 ms	3 ms

$$t_{\text{ReactionMax}} = 8 \text{ ms} + 30 \text{ ms} + 3 \text{ ms}$$

$$t_{\text{ReactionMax}} = 41 \text{ ms}$$

System expansion

Configurable safe small controllers PNOZmulti 2

Example configuration: Input from base unit, output from PNOZ m EF 4DI4DOR

Input PNOZ m B0 Max. input delay	Processing in the main program Processing time	Output PNOZ m EF 4DI4DOR Switch-off delay
2 ms	30 ms	22 ms

$$t_{\text{ReactionMax}} = 2 \text{ ms} + 30 \text{ ms} + 22 \text{ ms}$$

$$t_{\text{ReactionMax}} = 54 \text{ ms}$$

Example configuration: Input from base unit, output from base unit

Base unit input Max. input delay	Processing in the main program Processing time	Base unit output Switch-off delay
2 ms	30 ms	1 ms

$$t_{\text{ReactionMax}} = 2 \text{ ms} + 30 \text{ ms} + 1 \text{ ms}$$

$$t_{\text{ReactionMax}} = 33 \text{ ms}$$

Example configuration: Input from PNOZ m EF 16DI, output for standard applications from PNOZ m ES 14DO

Input PNOZ m EF 16DI Max. input delay	Processing in the main program Processing time (FS + ST)	Output PNOZ m ES 14DO Switch-off delay
8 ms	30 ms + 3 ms	1 ms

$$t_{\text{ReactionMax}} = 8 \text{ ms} + 30 \text{ ms} + 3 \text{ ms} + 1 \text{ ms}$$

$$t_{\text{ReactionMax}} = 42 \text{ ms}$$

Example configuration: Input from PNOZ m EF 16DI, output for standard applications from PNOZ m ES 14DO

Input PNOZ m EF 16DI Max. input delay	Processing in the main program Processing time (FS + ST)	Output PNOZ m ES 14DO Switch-off delay
8 ms	30 ms + 3 ms	1 ms

$$t_{\text{ReactionMax}} = 8 \text{ ms} + 30 \text{ ms} + 3 \text{ ms} + 1 \text{ ms}$$

$$t_{\text{ReactionMax}} = 42 \text{ ms}$$

System expansion

Configurable safe small controllers PNOZmulti 2

Example configuration: Input from PNOZ m EF 4AI, output from base unit

$$t_{\text{SignalSmoothing}} = 2 \text{ ms}$$

Input PNOZ m EF 4AI Max. input delay	Processing in the module program Processing time	Processing in the main program Processing time	Base unit output Output delay
8 ms + signal smoothing	5 ms	30 ms	1 ms

$$t_{\text{ReactionMax}} = 8 \text{ ms} + 2 \text{ ms} + 5 \text{ ms} + 30 \text{ ms} + 1 \text{ ms}$$

$$t_{\text{ReactionMax}} = 46 \text{ ms}$$

Example configuration: Input from PNOZ m EF 4AI, output from PNOZ m EF 8DI4DO

$$t_{\text{SignalSmoothing}} = 2 \text{ ms}$$

Input PNOZ m EF 4AI Max. input delay	Processing in the module program Processing time	Processing in the main program Processing time	Output PNOZ m EF 8DI4DO Switch-off delay
8 ms + signal smoothing	5 ms	30 ms	3 ms

$$t_{\text{ReactionMax}} = 8 \text{ ms} + 2 \text{ ms} + 5 \text{ ms} + 30 \text{ ms} + 3 \text{ ms}$$

$$t_{\text{ReactionMax}} = 48 \text{ ms}$$

Example configuration: Input from PNOZ m EF 8DI2DOT, output from PNOZ m EF 8DI2DOT (in the main program)

Input PNOZ m EF 8DI2DOT Max. input delay	Processing in the main program Processing time	Output PNOZ m EF 8DI2DOT Switch-off delay
8 ms + pulse suppression 0.8 ms	30 ms	6 ms

$$t_{\text{ReactionMax}} = 8 \text{ ms} + 0.8 \text{ ms} + 30 \text{ ms} + 6 \text{ ms}$$

$$t_{\text{ReactionMax}} = 44.8 \text{ ms}$$

System expansion

Configurable safe small controllers PNOZmulti 2

Example configuration: Input from PNOZ m EF 8DI2DOT, output from PNOZ m EF 8DI4DO

Input PNOZ m EF 8DI2DOT Max. input delay	Processing in the main program Processing time	Output PNOZ m EF 8DI4DO Switch-off delay
8 ms + pulse suppression 0.8 ms	30 ms	3 ms

$$t_{\text{ReactionMax}} = 8 \text{ ms} + 0.8 \text{ ms} + 30 \text{ ms} + 3 \text{ ms}$$

$$t_{\text{ReactionMax}} = 41.8 \text{ ms}$$

Example configuration: Input from PNOZ m EF 1MM (configured in the main program), output from base unit

$$f_{\text{ist}} = 100 \text{ Hz}$$

Input PNOZ m EF 1MM Max. input delay	Processing in the main program Processing time	Base unit output Switch-off delay
26 ms	30 ms	1 ms

$$1/f_{\text{ist}} = 1/100 \text{ Hz} = 10 \text{ ms}$$

$$1/f_{\text{ist}} + 16 \text{ ms} = 26 \text{ ms}$$

$$t_{\text{ReactionMax}} = 26 \text{ ms} + 30 \text{ ms} + 1 \text{ ms}$$

$$t_{\text{ReactionMax}} = 57 \text{ ms}$$

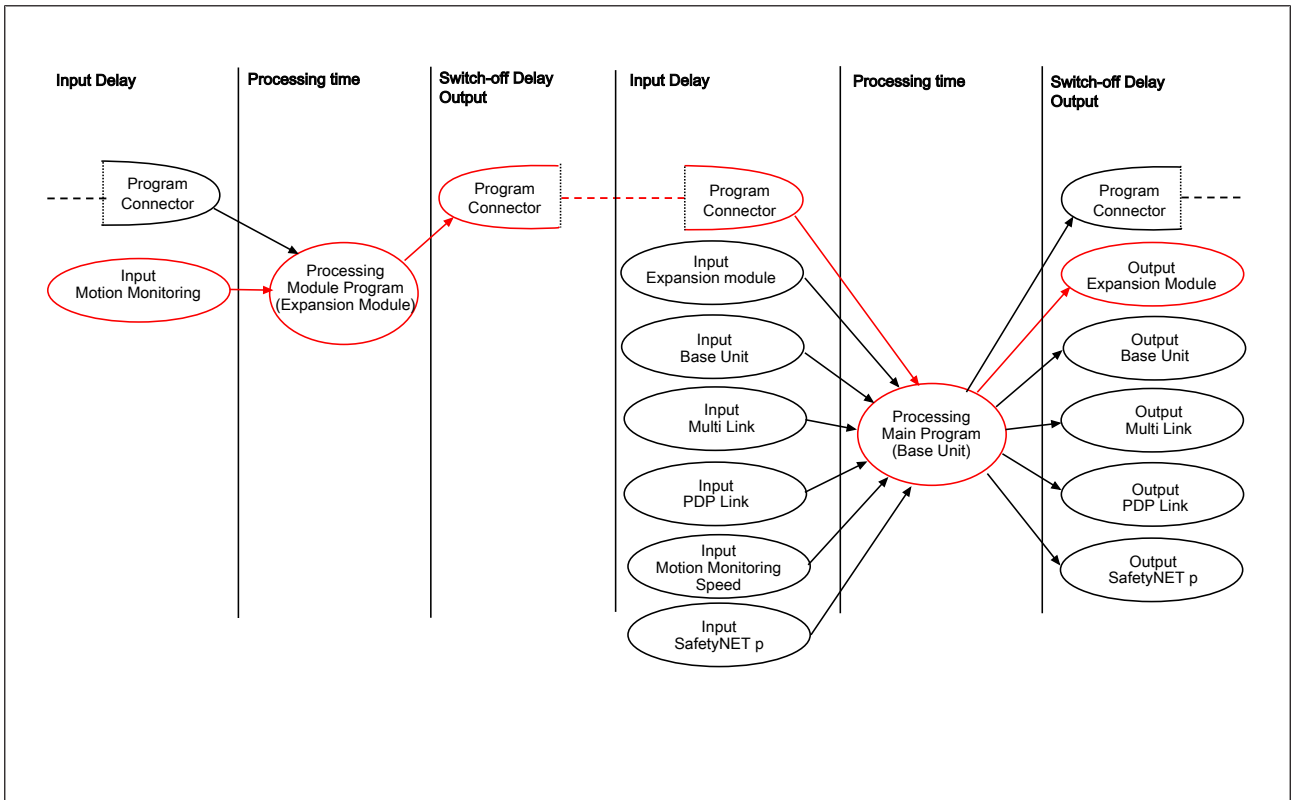
System expansion

Configurable safe small controllers PNOZmulti 2

Example configuration: Input from PNOZ m EF 1MM (configured in the module program), output from PNOZ m EF 8DI4DO

f_ist = 100 Hz

Input PNOZ m EF 1MM Input Delay.Max	Processing in module pro- gram Processing Max	Program connectors (output sig- nal from the module program to the main program)	Processing in the main pro- gram Processing Max	Output PNOZ m EF 8DI4DO Switch-off delay
18 ms	8 ms	0 ms	30 ms	3 ms



$$1/f_{ist} = 1/100 \text{ Hz} = 10 \text{ ms}$$

$$1/f_{ist} + 8 \text{ ms} = 18 \text{ ms}$$

$$t_{ReactionMax} = 18 \text{ ms} + 8 \text{ ms} + 30 \text{ ms} + 1 \text{ ms}$$

$$t_{ReactionMax} = 57 \text{ ms}$$

System expansion

Configurable safe small controllers PNOZmulti 2

Example configuration: Input from PNOZ m EF 1MM2DO, output from PNOZ m EF 1MM2DO

f_ist = 100 Hz

Input PNOZ m EF 1MM2DO Input Delay.Max	Processing in module program Max. processing time	Output PNOZ m EF 1MM2DO Switch-off delay
15 ms	4 ms	1 ms

$$1/f_{ist} = 1/100 \text{ Hz} = 10 \text{ ms}$$

$$1/f_{ist} + 5 \text{ ms} = 15 \text{ ms}$$

$$t_{ReactionMax} = 15 \text{ ms} + 4 \text{ ms} + 1 \text{ ms}$$

$$t_{ReactionMax} = 20 \text{ ms}$$

Test pulse suppression at the inputs

On function elements with switch type 3 (see online help for the PNOZmulti Configurator) a test pulse suppression on the inputs can be activated. This function can be used when self-monitored switches are used that create switch-off pulses > 300 µs.

When test pulse suppression is activated please note that the reaction time can increase by up to 15 ms!

System expansion

Connection of multiple PNOZmulti systems

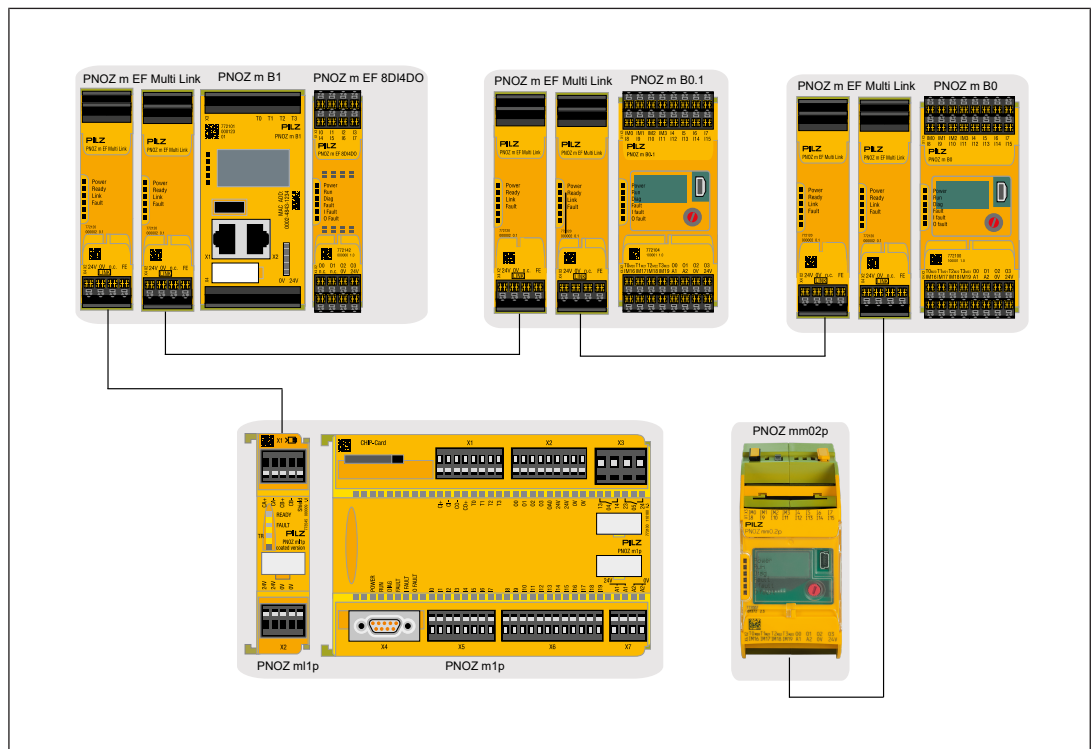
For safe data exchange two or more configurable control systems PNOZmulti can be connected to each other.

There are various options available:

- ▶ **PNOZmulti Link connection**
 The connection is created via two connection modules and/or connection interfaces that are assigned to one base unit each.
 Any number of base units can be connected via connection modules.
 However, only a max. of 4 link modules can be connected to a base unit.
- ▶ **SafetyNET p RTFL connection**
 The systems PNOZmulti 2 can also be connected via SafetyNET p RTFL. Up to 16 base units can be connected in a linear structure. Each base unit can create safe connections to the other connected base units. The position of the base units in the line does not matter.
 The reaction times are independent of the number of subscribers and their position in the line.

Connection via PNOZmulti Link

Example: Connecting 4 base units



System expansion

Connection of multiple PNOZmulti systems

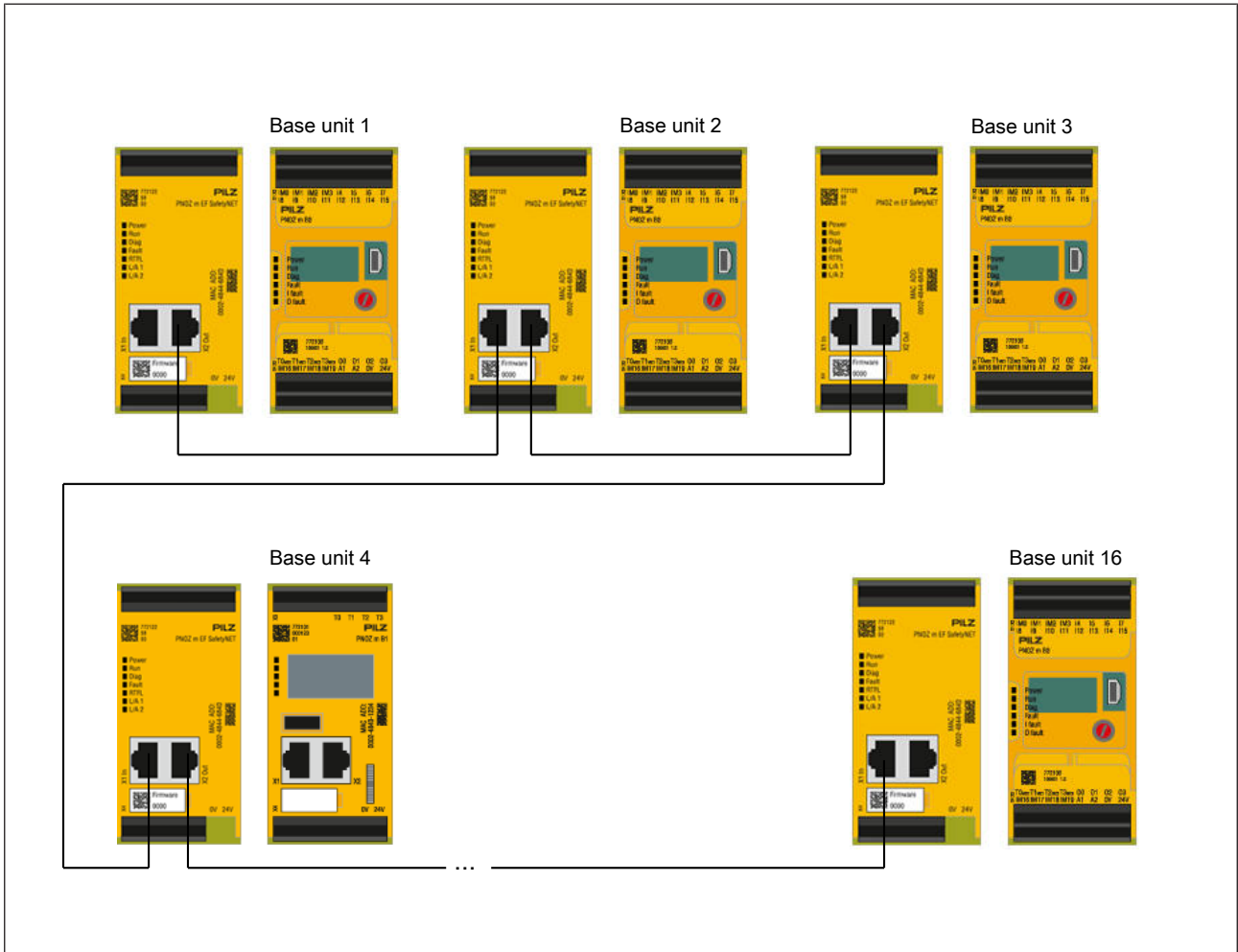
Connection options

	PNOZ m B0, PNOZ m B1 +PNOZ m EF Multi Link	PNOZ m0p/1p/ 2p/3p (ETH) +PNOZ ml1p	PNOZ mm0p PNOZ m C0	PNOZ mm0.1p +PNOZ mml1p	PNOZ mm0.2p
PNOZ m B0, PNOZ m B1 +PNOZ m EF Multi Link	x	x		x	x
PNOZ m0p/1p/2p/ 3p (ETH) +PNOZ ml1p	x	x		x	x
PNOZ mm0p PNOZ m C0					
PNOZ mm0.1p + PNOZ mml1p	x	x		x	x
PNOZ mm0.2p	x	x		x	x

System expansion

Connection of multiple PNOZmulti systems

Connection via SafetyNET p



Connection options

	PNOZ m B0, PNOZ m B1 + PNOZ m EF SafetyNET
PNOZ m B0, PNOZ m B1 +PNOZ m EF SafetyNET	x

Reaction times of the Multi Link connection

The reaction time when connecting two or more base units is calculated from the transmission delay of the connection at the link module of a communication partner and the input delay at the link module of the connected communication partner.

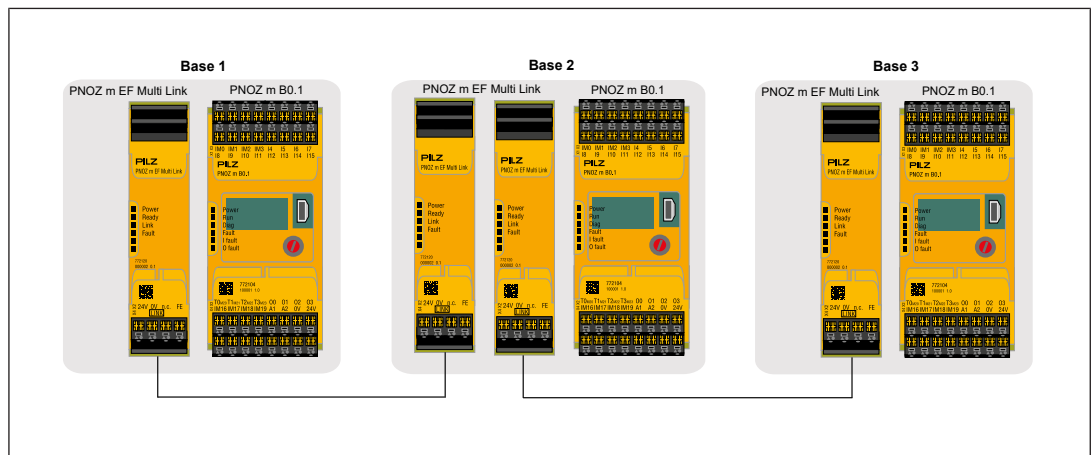
System expansion

Connection of multiple PNOZmulti systems

Example: Connecting 3 base units PNOZmulti 2

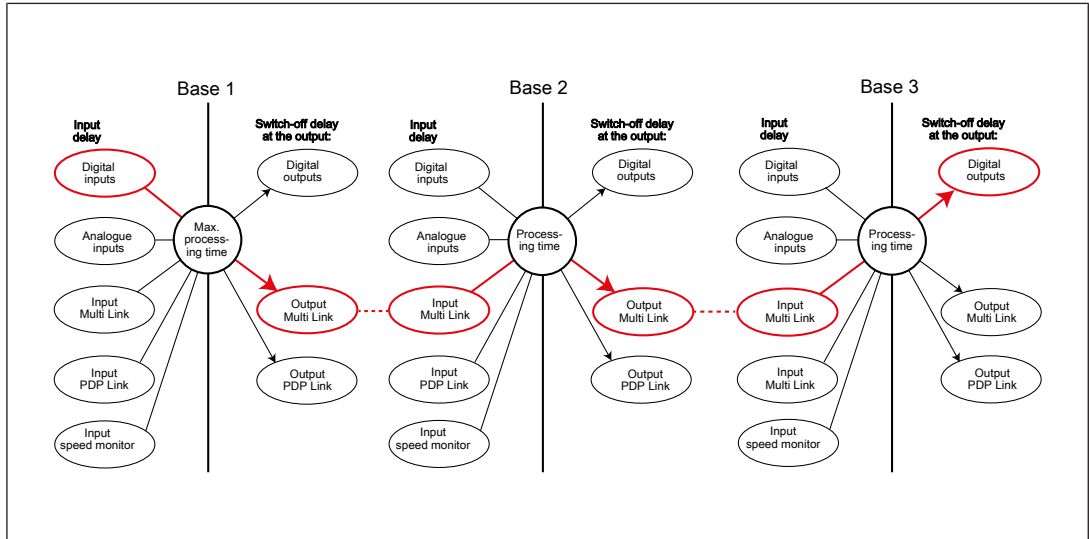
The maximum reaction time ($t_{\text{ReactionMax}}$) includes the following times:

- ▶ Base 1
 - Max. input delay input base unit PNOZ m B0.1 = 2 ms
 - Max. processing time main program base unit PNOZ m B0.1 = 30 ms
 - Max. output delay output PNOZ m EF MultiLink = 5 ms
- ▶ Base 2
 - Max. input delay input PNOZ m EF MultiLink = 0 ms
 - Max. processing time main program base unit PNOZ m B0.1 = 30 ms
 - Max. output delay output PNOZ m EF MultiLink = 5 ms
- ▶ Base 3
 - Max. input delay input PNOZ m EF MultiLink = 0 ms
 - Max. processing time main program base unit PNOZ m B0.1 = 30 ms
 - Max. output delay semiconductor output base unit PNOZ m B0.1 = 1 ms



System expansion

Connection of multiple PNOZmulti systems



$$\begin{aligned}
 t_{\text{ReactionMax}} &= \\
 &t_{\text{Base 1 input delayMax}} + t_{\text{Base 1 processing timeMax}} + t_{\text{Base 1 output delayMax}} \\
 &+ t_{\text{Base 2 input delayMax}} + t_{\text{Base 2 processing timeMax}} + t_{\text{Base 2 output delayMax}} \\
 &+ t_{\text{Base 3 input delayMax}} + t_{\text{Base 3 processing timeMax}} + t_{\text{Base 3 output delayMax}} \\
 \\
 t_{\text{ReactionMax}} &= \\
 &2 \text{ ms} + 30 \text{ ms} + 5 \text{ ms} \\
 &+ 0 \text{ ms} + 30 \text{ ms} + 5 \text{ ms} \\
 &+ 0 \text{ ms} + 30 \text{ ms} + 1 \text{ ms} \\
 &= 103 \text{ ms}
 \end{aligned}$$

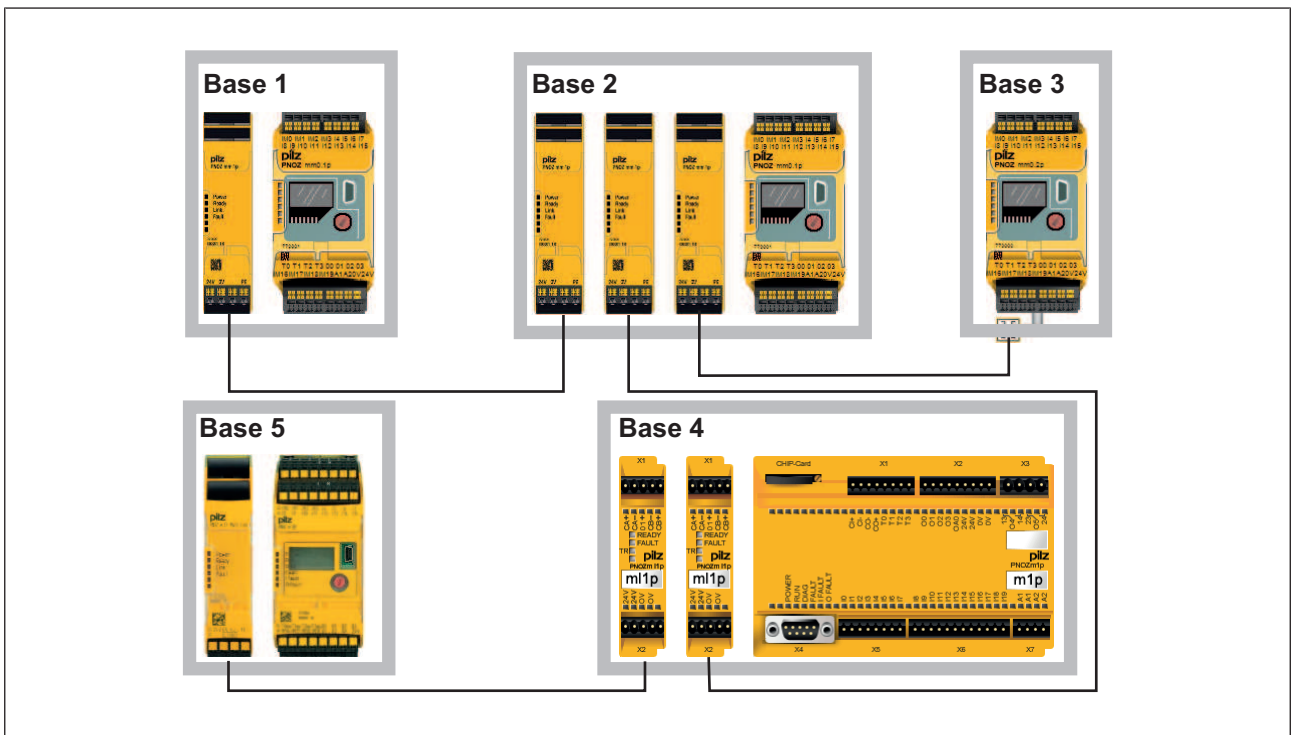
System expansion

Connection of multiple PNOZmulti systems

Example: Connecting 5 base units PNOZmulti

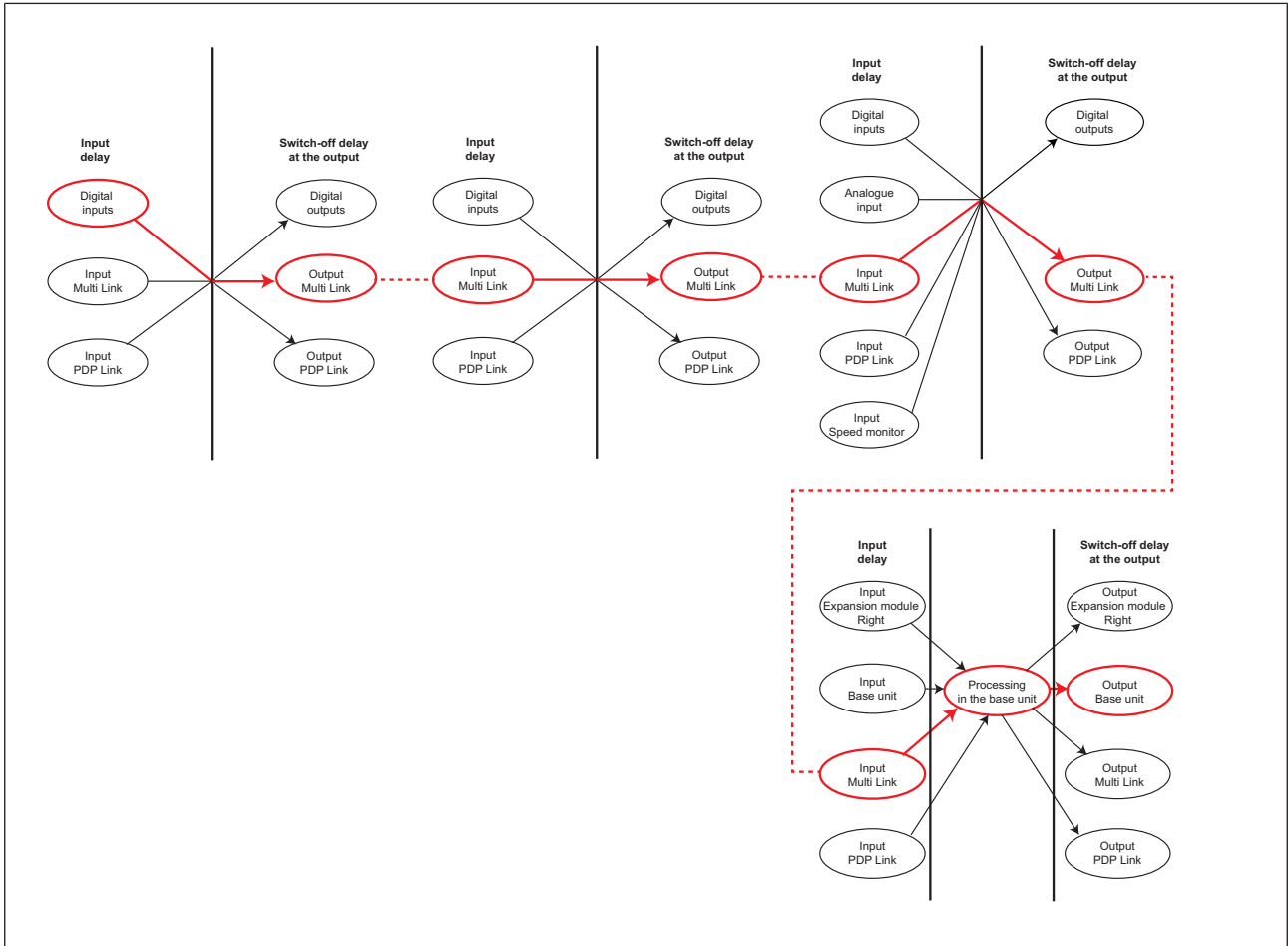
The maximum reaction time $t_{\text{ReactionMax}}$ includes the following times:

- ▶ Max. input delay PNOZ mm0.1p (Base 1): 4 ms
- ▶ Data transfer time of the connection at the PNOZ mml1p (Base 1): 35 ms
- ▶ Max. input delay PNOZ mml1p (Base 2): 0 ms
- ▶ Data transfer time of the connection at the PNOZ mml1p (Base 2): 35 ms
- ▶ Max. input delay PNOZ mml1p (Base 2): 0 ms
- ▶ Data transfer time of the connection at the PNOZ ml1p (Base 4): 35 ms
- ▶ Max. input delay PNOZ m EF Multi Link (Base 5): 0 ms
- ▶ Max. processing time PNOZ m B0 (Base 5): 30 ms
- ▶ Max. switch-off delay at the output PNOZ m B0 (Base 5): 1 ms



System expansion

Connection of multiple PNOZmulti systems



$$t_{\text{ReactionMax}} = 4 \text{ ms} + 35 \text{ ms} + 0 \text{ ms} + 35 \text{ ms} + 0 \text{ ms} + 35 \text{ ms} + 0 \text{ ms} + 30 \text{ ms} + 1 \text{ ms}$$

$$t_{\text{ReactionMax}} = 140 \text{ ms}$$

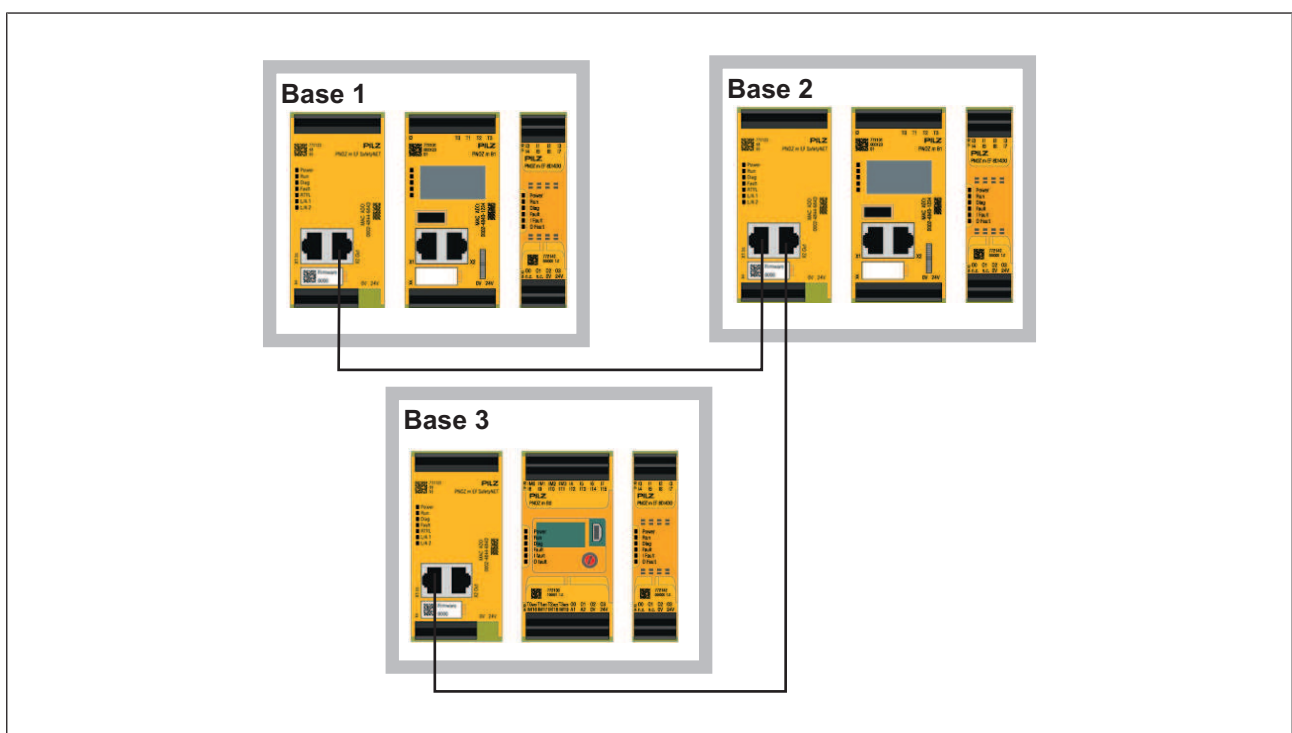
System expansion

Connection of multiple PNOZmulti systems

Reaction times of the connection via SafetyNET p

The reaction time with the SafetyNET p connection of two base units is calculated from the delay of the input and output modules, the processing time of the two base units and the input and output delay of the PNOZ m EF SafetyNET module.

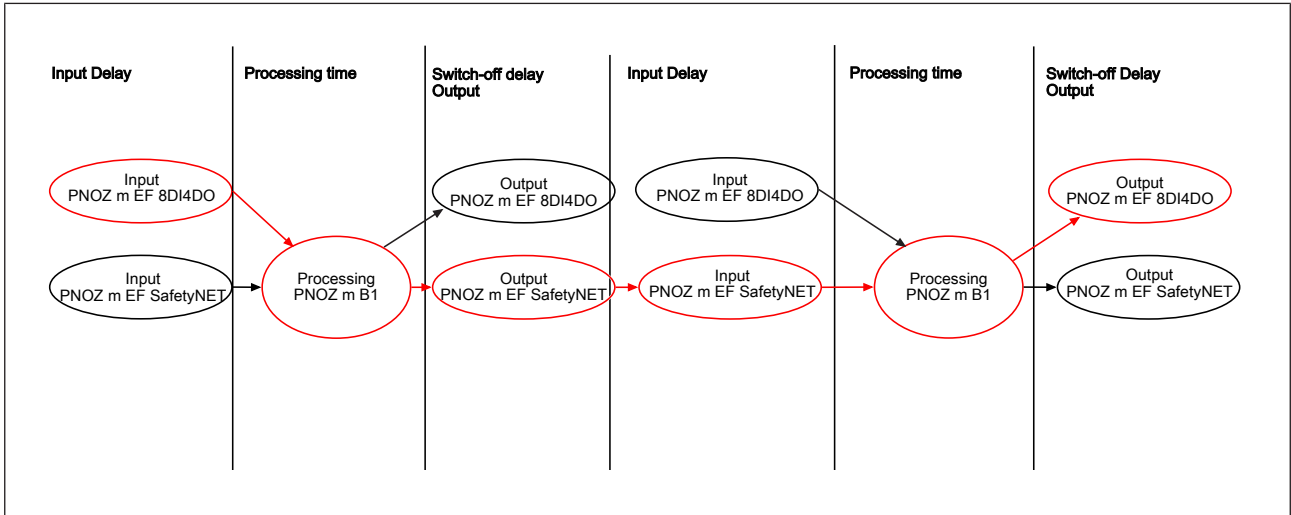
Example configuration: Reaction time of PNOZ m EF 8DI4DO of Base 1 to output PNOZ m EF 8DI4DO of Base 3



Input PNOZ m EF 8DI4DO (Base 1) Input delay Max	Processing in main program Processing Max	Output PNOZ m EF SafetyNET (Base 1) Connection's transmission delay	Input PNOZ m EF SafetyNET (Base 3) Input delay. Max	Processing in the main pro- gram Processing Max	Output PNOZ m EF 8DI4DO (Base 3) Switch-off delay
8 ms	30 ms	25 ms	0 ms	30 ms	3 ms

System expansion

Connection of multiple PNOZmulti systems



$$t_{\text{ReactionMax}} = 8 \text{ ms} + 30 \text{ ms} + 25 \text{ ms} + 0 \text{ ms} + 30 \text{ ms} + 3 \text{ ms}$$

$$t_{\text{ReactionMax}} = 96 \text{ ms}$$

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PNOZmulti 2 systems
Base units

PNOZmulti 2 systems
Base units

Type	Order number	Features	Common features
PNOZ m B0	772100	<p>Base unit</p> <ul style="list-style-type: none"> ▶ 20 safe inputs, up to 8 of which can be configured as outputs for standard applications ▶ 4 safe semiconductor outputs up to PL e, SIL 3 ▶ 4 semiconductor outputs, can be configured as outputs for standard applications or as test pulses ▶ Display for error messages, state of the supply voltage, state of the inputs and outputs, status and device information. Customised texts can be displayed ▶ Rotary knob for menu control ▶ Max. 6 expansion modules can be connected ▶ 1 link module or communication module can be connected ▶ Exchangeable program memory ▶ LED for fault, diagnostics, supply voltage, input and output circuits ▶ Dimensions (H x W x D): 101.4 x 45 x 120 mm 	<ul style="list-style-type: none"> ▶ Support for module programs (mIQ) ▶ To connect emergency stop devices, two-hand pushbuttons, safety gate limit switches, light barriers, scanners, enabling switches, safety gate switches, PSEN, operating mode selector switches, muting, pressure-sensitive mats, sensors, for example ▶ Configuration in PNOZmulti Configurator ▶ Diagnostic interface ▶ Plug-in connection terminals: Either either spring-loaded or screw terminals (available as accessory)
PNOZ m B1	772101	<p>Base unit</p> <ul style="list-style-type: none"> ▶ 4 test pulse outputs to detect shorts between the inputs ▶ Display for error messages, state of the supply voltage, state of the inputs and outputs, status and device information, Ethernet settings, system date and time, stop and start device ▶ Multifunction switch for menu control ▶ Maximum number of expansion modules: <ul style="list-style-type: none"> – Right-hand up to 12 safe expansion modules, additionally 1 output module for standard applications – Left-hand up to 4 safe expansion modules, 1 fieldbus module ▶ Exchangeable program memory USB memory (512 Byte, supplied with the device): Several projects can be saved, only one can be executed, managed via the Project Manager ▶ Larger programs in the PNOZmulti Configurator: Up to 1024 connection lines are possible ▶ System's date and time Can be set in PNOZmulti Configurator ▶ LED display for fault, diagnostics, supply voltage ▶ Dimensions (H x W x D): 101.4 x 45 x 120 mm 	

PNOZmulti 2 systems Base units

Type	Order number	Features	Common features
PNOZ m B1 Burner	772102	<p>Base unit specifically for burner management:</p> <p>Control and monitoring of furnaces, e.g. monitoring of safety sequences, combustion air pressure, ignition, flame, external compound controller and tightness control; plus control of safety valves, ignition valves, exhaust valves, ignition, external compound controller and combustion air blower</p> <p>Other features as PNOZ m B1</p>	<ul style="list-style-type: none"> ▶ Support for module programs (mIQ) ▶ To connect emergency stop devices, two-hand pushbuttons, safety gate limit switches, light barriers, scanners, enabling switches, safety gate switches, PSEN, operating mode selector switches, muting, pressure-sensitive mats, sensors, for example ▶ Configuration in PNOZmulti Configurator ▶ Diagnostic interface ▶ Plug-in connection terminals: Either either spring-loaded or screw terminals (available as an accessory)
PNOZ m B0.1	772104	<p>Base unit with a limited number of expansion modules</p> <ul style="list-style-type: none"> ▶ 12 safe inputs ▶ 8 configurable inputs/outputs, configurable as safe inputs (see above for connection options) or outputs for standard applications ▶ 4 safe semiconductor outputs up to PL e, SIL 3 ▶ 4 semiconductor outputs, can be configured as outputs for standard applications or as test pulses ▶ Display for error messages, state of the supply voltage, state of the inputs and outputs, status and device information. Customised texts can be displayed ▶ Rotary knob for menu control ▶ Max. 1 expansion module can be connected ▶ 1 link module or communication module can be connected ▶ Exchangeable program memory ▶ LED for fault, diagnostics, supply voltage, input and output circuits ▶ Dimensions (H x W x D): 101.4 x 45 x 120 mm 	
PNOZ m C0	772105	<p>Standalone base unit</p> <ul style="list-style-type: none"> ▶ 8 safe inputs ▶ 4 safe semiconductor outputs up to PL e, SIL 3 ▶ 2 semiconductor outputs, can be configured as outputs for standard applications or as test pulses ▶ Exchangeable program memory ▶ LED for fault, diagnostics, supply voltage, input and output circuits ▶ Device security: User management, security device key ▶ Dimensions (H x W x D): 101.4 x 22.5 x 120 mm 	

Please refer to the section entitled [System expansion](#) [20] for details of expansion modules that can be connected for the expandable base units.

PNOZmulti 2 systems Expansion modules

Type	Order number	Application area	Features
Link modules			
PNOZ m EF Multi Link	772120	For safe connection of two PNOZmulti base units	<ul style="list-style-type: none"> ▶ Point-to-point connection via 4-core shielded and twisted-pair cable ▶ 32 virtual inputs and 32 virtual outputs ▶ Status indicators
PNOZ m EF PDP Link	772121	For safe connection of one base unit with up to 4 decentralised modules PDP67 (see below)	<ul style="list-style-type: none"> ▶ Max. 4 decentralised modules PDP67 F 8DI ION can be connected to the link module PNOZ mml2p ▶ Status indicators
Decentralised modules (not included in this catalogue)			
PDP67 F 8DI ION	773600	Decentralised safe input module IP67	<ul style="list-style-type: none"> ▶ Protection type IP67 ▶ 8 inputs for connecting 8 single-channel or 4 dual-channel sensors ▶ 8 outputs, which can be configured as <ul style="list-style-type: none"> – Standard outputs – Test pulse outputs – 24 V outputs ▶ Status indicators
PDP67 F 8DI ION VA	773614		
PDP67 F 8DI ION HP	773601	Decentralised safe input module IP67	<ul style="list-style-type: none"> ▶ Protection type IP67 ▶ 8 inputs for connecting 8 single-channel or 4 dual-channel sensors ▶ 8 outputs, which can be configured as <ul style="list-style-type: none"> – Standard outputs – Test pulse outputs – 24 V outputs ▶ Separate output supply for applications with higher current consumption ▶ Module is galvanically isolated from CAN bus ▶ Status indicators
PDP67 F 8DI ION HP VA	773615		
Input module			
PNOZ EF 16DI	772140	Safe input module	<ul style="list-style-type: none"> ▶ 16 safe inputs ▶ Test pulse outputs used to monitor shorts across the inputs ▶ Status indicators
Input and output modules			
PNOZ EF 8DI4DO	772142	Safe input and output module	<ul style="list-style-type: none"> ▶ 8 safe inputs ▶ 4 safe, dual-pole semiconductor outputs up to PL e of EN ISO 13849-1 and SIL 3 of EN IEC 62061, depending on the application ▶ Status indicators

PNOZmulti 2 systems Expansion modules

Type	Order number	Application area	Features
PNOZ m EF 8DI2DOT	772144	Safe input and output module	<ul style="list-style-type: none"> ▶ 8 safe inputs ▶ 2 safe semiconductor outputs up to PL e of EN ISO 13849-1 and SIL 3 of EN IEC 62061, depending on the application. The outputs are suitable for controlling a press safety valve in accordance with EN 692. ▶ Status indicators
PNOZ EF 4DI4DOR	772143	Safe input and output module	<ul style="list-style-type: none"> ▶ 8 safe inputs ▶ 2 safe relay outputs, positive-guided up to PL e of EN ISO 13849-1 and SIL 3 of EN IEC 62061, depending on the application ▶ Status indicators
PNOZ m EF 4DI 4DORD	772145	Safe input and output module	<ul style="list-style-type: none"> ▶ 8 safe inputs ▶ 2 safe, diverse relay outputs, positive-guided up to PL e of EN ISO 13849-1 and SIL 3 of EN IEC 62061, depending on the application suitable for controlling the safety valves of a burner in accordance with DIN EN 50156 ▶ Status indicators
Output modules			
PNOZ m ES 14DO	772181	Output module for standard applications	<ul style="list-style-type: none"> ▶ 14 outputs for standard applications
Motion Monitoring modules			
PNOZ m EF 1MM	772170	Monitoring of 1 axis	<ul style="list-style-type: none"> ▶ Monitoring of 1 axis ▶ Measured value recorded by proximity switch and encoder ▶ Monitoring functions <ul style="list-style-type: none"> – Safe speed monitoring (SSM) – Safe speed range monitoring (SSR-M) – Safe direction of movement monitoring (SDI-M) – Safe operating stop monitoring (SOS-M) – Analogue voltage (track S) ▶ Status indicators

PNOZmulti 2 systems
Expansion modules

Type	Order number	Application area	Features
PNOZ m EF 1MM2DO	772172	Monitoring of 1 axis	<ul style="list-style-type: none"> ▶ Monitoring of 1 axis ▶ Measured value recorded by proximity switch and encoder ▶ 2 safe semiconductor outputs up to PL e of EN ISO 13849-1 and SIL 3 of EN IEC 62061, depending on the application ▶ 1 semiconductor output for standard applications ▶ Monitoring functions <ul style="list-style-type: none"> – Safe speed monitoring (SSM) – Safe speed range monitoring (SSR-M) – Safe direction of movement monitoring (SDI-M) – Safe operating stop monitoring (SOS-M) – Analogue voltage (track S) ▶ Status indicators
PNOZ m EF 2MM	772171	Monitoring of 2 axes	<ul style="list-style-type: none"> ▶ Monitoring of 2 independent axes ▶ Measured value recorded by proximity switch and encoder ▶ Monitoring functions <ul style="list-style-type: none"> – Safe speed monitoring (SSM) – Safe speed range monitoring (SSR-M) – Safe direction of movement monitoring (SDI-M) – Safe operating stop monitoring (SOS-M) – Analogue voltage (track S) ▶ Status indicators
Communication modules			
PNOZ m ES ETH	772130	Communication module with Ethernet interfaces (TCP/IP, Modbus/TCP)	<ul style="list-style-type: none"> ▶ 2 Ethernet interfaces ▶ Status indicators
PNOZ m ES RS232	772131	Communication module with serial interface RS232	<ul style="list-style-type: none"> ▶ 1 serial interface RS232 ▶ Status indicators
Fieldbus modules			
PNOZ m ES Profibus	772132	Fieldbus module PROFIBUS DP	<ul style="list-style-type: none"> ▶ Connection for PROFIBUS DP ▶ Station addresses from 0 ... 99, selected via rotary switch ▶ Status indicators
PNOZ m ES CANopen	772134	Fieldbus module CANopen	<ul style="list-style-type: none"> ▶ Connection for CANopen ▶ Station addresses from 0 ... 99, selected via rotary switch ▶ Transmission rate selected via rotary switch () ▶ Status indicators

PNOZmulti 2 systems Expansion modules

Type	Order number	Application area	Features
PNOZ m ES EtherCAT	772136	Fieldbus module EtherCAT	<ul style="list-style-type: none"> ▶ Connection for EtherCAT ▶ Network protocols: EtherCAT ▶ Supports CANopen over EtherCAT (DS301 V4.02 compliant) ▶ Status indicators
PNOZ m ES Powerlink	772119	Fieldbus module Ethernet POWERLINK	<ul style="list-style-type: none"> ▶ Connection for Ethernet POWERLINK (Ethernet POWERLINK V 2 protocol) ▶ Station addresses from 1 ... 239, selected via rotary switch ▶ The minimum cycle time for an application of 20 Byte Output and 20 Byte Input is 250µs. The minimum cycle time is 450 µs at the maximum PDO size of 254 Byte Input and 20 Byte Output (the inputs and outputs in this case are viewed from the Managing Node). ▶ Status indicators
PNOZ m ES EtherNet/IP	772137	Fieldbus module EtherNet/IP	<ul style="list-style-type: none"> ▶ Connection for EtherNet/IP ▶ Connection for EtherNet/IP as adapter ▶ Transmission rate 10 MBit/s (10BaseT) and 100 MBit/s (100BaseTX) ▶ Status indicators
PNOZ m ES Profinet	772138	Fieldbus module PROFINET	<ul style="list-style-type: none"> ▶ Connection for PROFINET ▶ Transmission rate 100 MBit/s (100BaseTX), full and half duplex ▶ Two RJ45 ports ▶ Profinet IO device (V2.2) functions in accordance with Conformance Class C ▶ Supported functions: <ul style="list-style-type: none"> – RT – IRT – MRP – LLDP ▶ Status indicators
PNOZ m ES CC-Link	772135	Fieldbus module CC-Link	<ul style="list-style-type: none"> ▶ CC-Link connection ▶ Station addresses from 1 ... 63, selected via rotary switch ▶ Station type: Remote Device ▶ Occupied stations: 3 ▶ Status indicators

Please refer to the section entitled [System expansion](#) [20]

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Base units PNOZ m B0



Overview

Unit features

Application of the product PNOZ m B0:

Base unit of the configurable control system PNOZmulti 2

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Semiconductor outputs:
 - 4 safety outputs
 - depending on the application, up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061
- ▶ 12 safe inputs for connecting, for example:
 - Emergency stop pushbuttons
 - Two-hand pushbuttons
 - Safety gate limit switches
 - Start buttons
 - Light barriers
 - Scanner
 - Enabling switches
 - PSEN
 - Operating mode selector switches
- ▶ 8 configurable inputs/outputs
 - Can be configured as:
 - Safe inputs (see above for connection options)
 - or
 - Auxiliary outputs

Base units PNOZ m B0

- ▶ 4 configurable outputs
Can be configured as:
 - Auxiliary outputsor
 - Test pulse outputs
- ▶ LED display for:
 - Error messages
 - Diagnostics
 - Supply voltage
 - Fault at the outputs
 - Fault at the inputs
- ▶ Backlit display for:
 - Error messages
 - State of supply voltage
 - State of the inputs and outputs
 - Status information
 - Device information
- ▶ 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 accessories (see Order references)
- ▶ Rotary knob for menu control
- ▶ Expansion modules can be connected
(please refer to the document "PNOZmulti System Expansion" for details of the type and number that can be connected)

Chip card

To be able to use the product you will need a chip card.

Chip cards are available with memories of 8 kByte and 32 kByte. For large-scale projects we recommend the 32 kByte chip card (see Technical Catalogue: Accessories chapter).

Base units PNOZ m B0

Front view

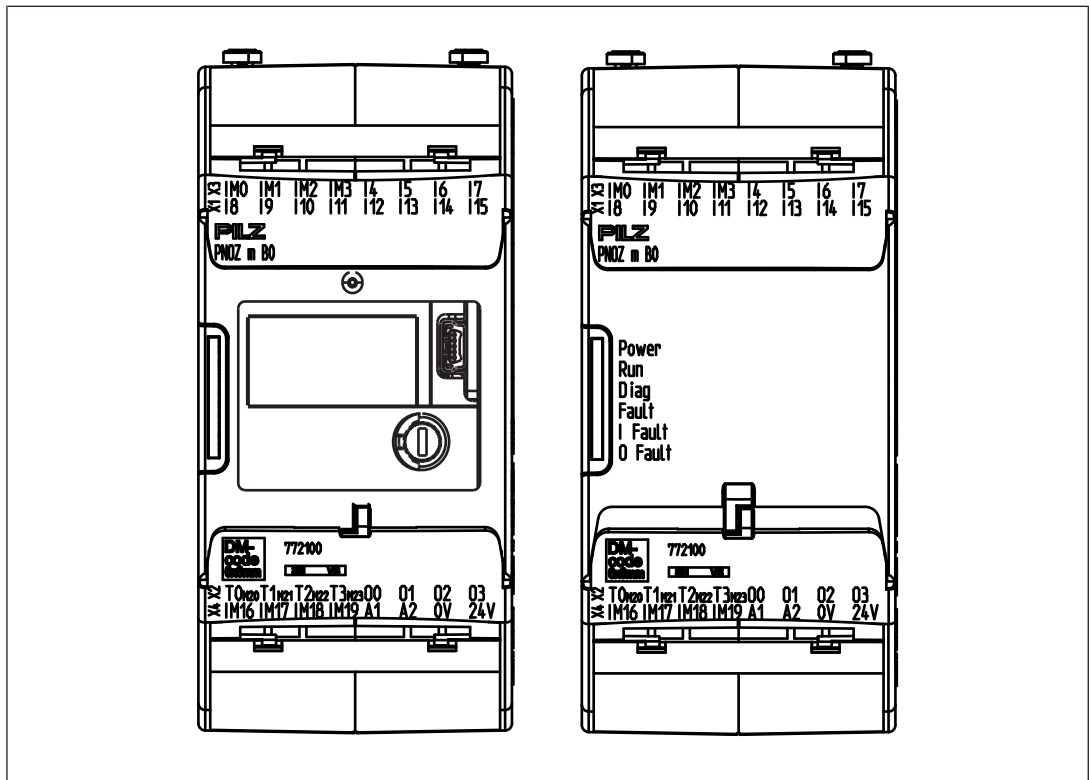


Fig.: Front view with and without cover

Legend

- X1: Inputs I8 ... I15
- X2: Configurable test pulse/auxiliary outputs TOM20 ... T3M23
Semiconductor outputs O0 ... O3
- X3: Configurable inputs/outputs IM0 – IM3
Inputs I4 ... I7
- X4: Configurable inputs/outputs IM16 – IM19
Supply connections
- LEDs: PWR
RUN
DIAG
FAULT
I FAULT
O FAULT

Base units PNOZ m B0

Function description

Functions

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.

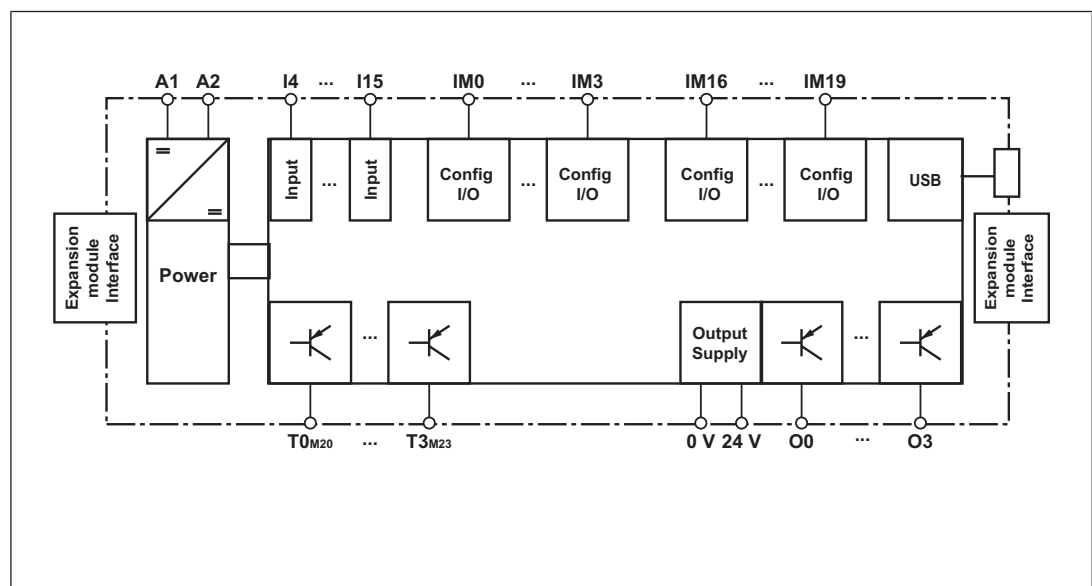
The LEDs on the base unit and expansion modules indicate the status of the configurable control system PNOZmulti.

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

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 "PNOZmulti System Expansion".

Block diagram

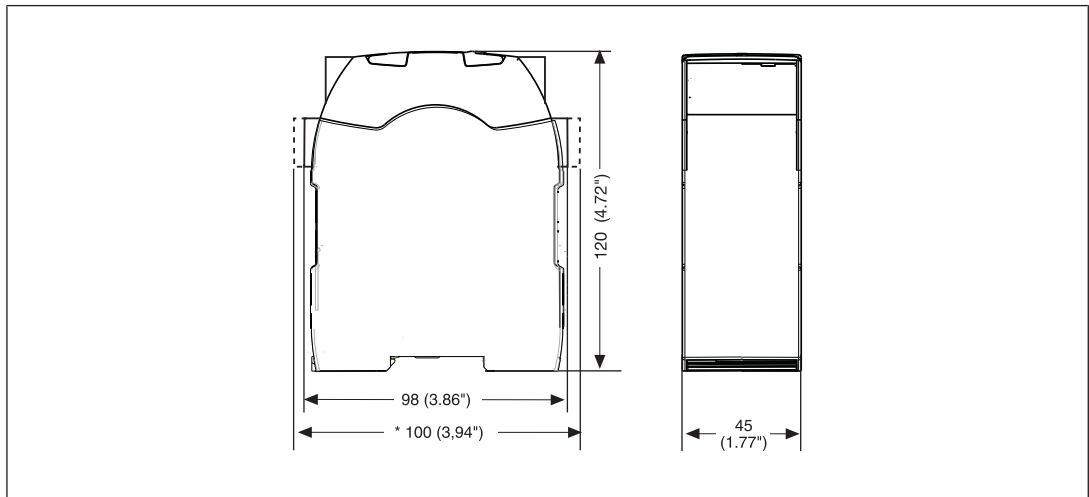


Base units PNOZ m B0

Installation

Dimensions in mm

*with spring-loaded terminals



Commissioning

General wiring guidelines

The wiring is defined in the circuit diagram in the Configurator. There you can select the inputs that are to perform a safety function and the outputs that are to switch this safety function.

Note:

- ▶ Information given in the [Technical details \[63\]](#) must be followed.
- ▶ Outputs O0 to O3 are semiconductor outputs
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ Sufficient protection circuit must be provided on all output contacts with inductive loads.
- ▶ The safety system and input circuits must always be supplied by a single power supply. The power supply must meet the regulations for extra low voltages with protective separation (SELV/PELV).
- ▶ Test pulse outputs must exclusively be used to test the inputs. They must not be used to drive loads.
Do not route the test pulse cables together with actuator cables within an unprotected sheathed cable.

Base units PNOZ m B0

Connection

Procedure:

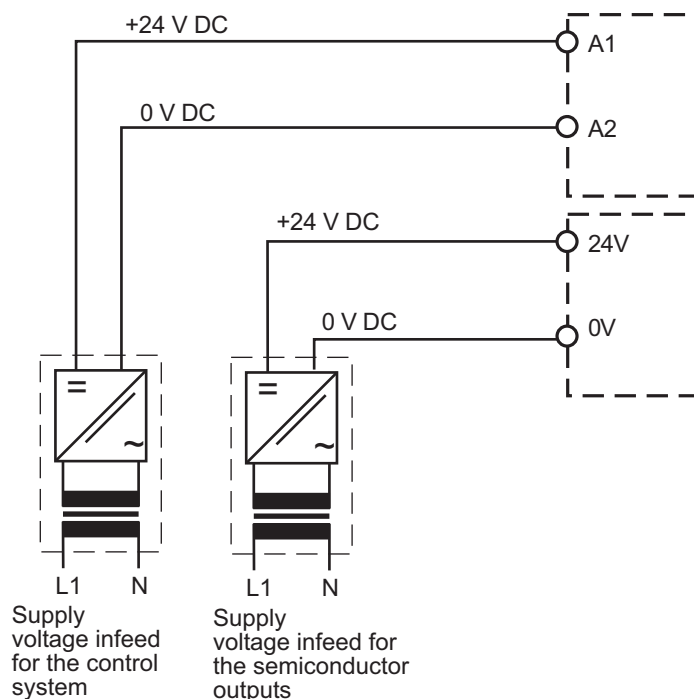
- ▶ Wire the inputs and outputs on the base unit in accordance with the circuit diagram.
- ▶ Connect the supply voltage:
 - Supply voltage for the control system:
 - Terminal A1: + 24 VDC
 - Terminal A2: 0 V
 - Supply voltage for the semiconductor outputs:
 - 24 V terminal: + 24 VDC
 - 0V terminal: 0 V

Please note: The supply voltage for the semiconductor outputs must always be present, even if you are not using the semiconductor outputs.

When the voltages are fed separately using two power supplies, the supply voltage for the control system and the supply voltage for the semiconductor outputs are galvanically isolated.

Supply voltage

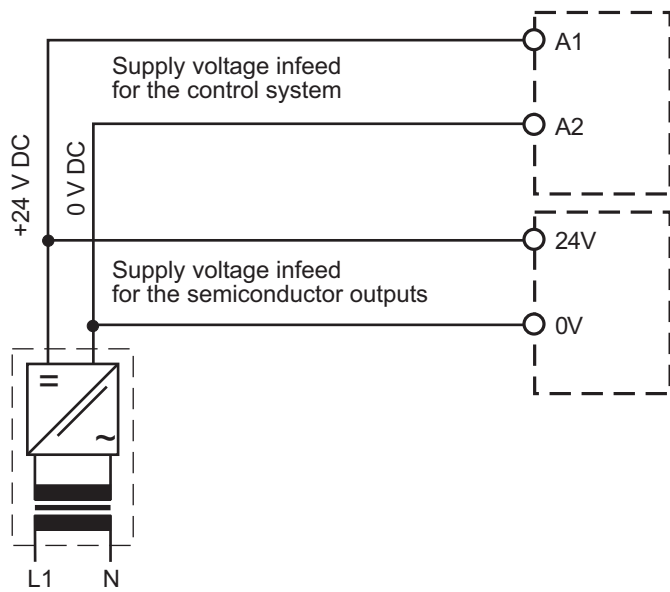
Separate power supplies for the supply voltage to the control system and the supply voltage to the semiconductor outputs



Base units PNOZ m B0

Supply voltage

Common power supply for the supply voltage to the control system and the supply voltage to the semiconductor outputs



Input circuit	Single-channel	Dual-channel
Emergency stop without detection of shorts across contacts		
Emergency stop with detection of shorts across contacts		
Start circuit	Input circuit without detection of shorts across contacts	Input circuit with detection of shorts across contacts

Base units PNOZ m B0

Semiconductor outputs		
Redundant output		
Single output		
Single output with advanced fault detection*		

*Two loads may be connected to each safety output with advanced fault detection, even on applications in accordance with EN IEC 62061, SIL 3. Prerequisite: Feedback loop is connected, shorts across contacts and external power sources are excluded (e.g. through separate multicore cables). Please note that, in the event of an error in the feedback loop, the safety system switches to a safe state and shuts down **all** the outputs.

Feedback loop	Redundant output	
Contacts from external contactors		

Base units PNOZ m B0

Load project from chip card

Procedure:

- ▶ Insert the chip card containing the current project into the card slot on the base unit.
- ▶ Switch on the supply voltage. The LC display shows the project name, CRC sum and the date the project was created. Please check this information.
- ▶ Load the project by pressing the rotary knob. For the project to be downloaded, the rotary knob must be held down for between 3 and 8 seconds. Once the project has been successfully downloaded, the status of the inputs and outputs will be shown on the display.

Load project via USB port

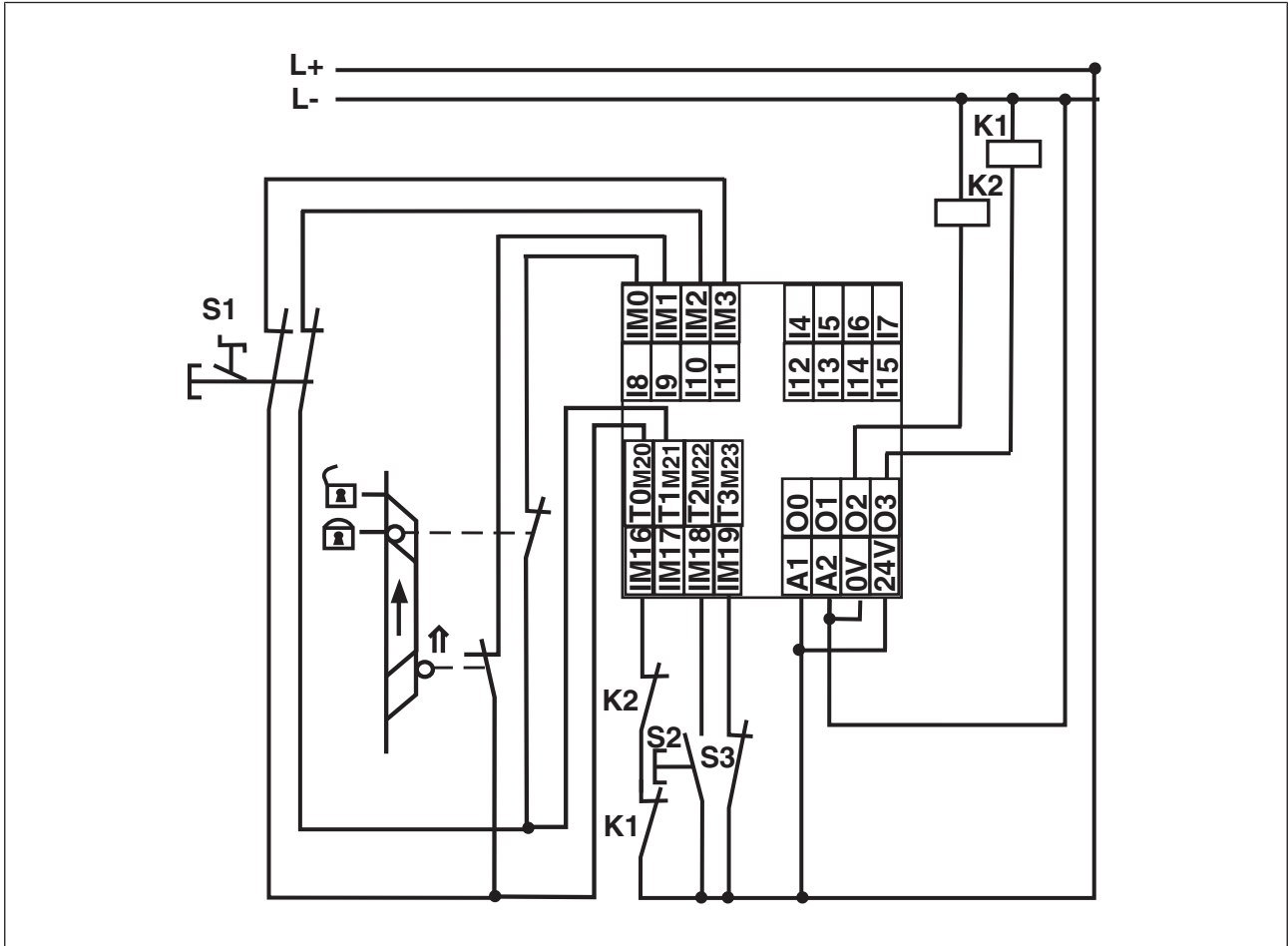
Procedure:

- ▶ Insert a chip card into the card slot on the base unit.
- ▶ Connect the computer containing the PNOZmulti Configurator to the base unit via the USB port.
- ▶ Switch on the supply voltage.
- ▶ Download the project (see PNOZmulti Configurator's online help).
- ▶ Once the project has been successfully downloaded, the status of the inputs and outputs and the supply voltage will be shown on the display. The "RUN" LED will be lit.

Base units PNOZ m B0

Connection example

Dual-channel E-STOP and safety gate wiring, monitored start (IM18), feedback loop (IM16)



Base units PNOZ m B0

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	0060h
Electrical data	
Supply voltage	
for	Supply to the system
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	1,6 A
Inrush current that the external power supply must provide	3 A
Supply voltage	
for	Supply to the SC outputs
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	8 A
Potential isolation	Yes
Supply voltage	
Current consumption	32 mA
Power consumption	0,8 W
Max. power dissipation of module	7,4 W
Status indicator	Display, LED
Permitted loads	inductive, capacitive, resistive
Configurable inputs/outputs (inputs or auxiliary outputs)	
Quantity	8
Potential isolation	No
Configurable inputs	
Input voltage in accordance with EN 61131-2 Type 1	24 V
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	2 ms

Base units PNOZ m B0

Configurable inputs/outputs (inputs or auxiliary outputs)

Configurable auxiliary outputs

Voltage	24 V
Output current	75 mA
Output current range	0 - 100 mA
Max. transient pulsed current	500 mA
Short circuit-proof	Yes
Residual current at "0"	0,5 mA
Voltage at "1"	UB - 2 V at 0.1 A

Inputs

Quantity	12
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	2 ms
Potential isolation	No

Semiconductor outputs

Number of positive-switching single-pole semiconductor outputs	4
Switching capability	
Voltage	24 V
Current	2 A
Permitted current range	0,000 - 2,500 A
Residual current at "0" signal	0,05 mA
Max. transient pulsed current	12 A
Max. capacitive load	1 µF
Max. internal voltage drop	500 mV
Max. duration of off time during self test	330 µs
Switch-off delay	1 ms
Potential isolation	Yes
Short circuit-proof	Yes

Test pulse outputs

Number of test pulse outputs	4
Voltage	24 V
Current	0,1 A
Max. duration of off time during self test	5 ms
Short circuit-proof	Yes
Potential isolation	No

Base units PNOZ m B0

Times	
Simultaneity in the two-hand circuit	0,5 s
Processing time	30 ms
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	SC output and system voltage
Type of potential isolation	Basic insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Mechanical data	
Mounting position	horizontally on mounting rail

Base units PNOZ m B0

Mechanical data	
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	1 km
Sum of individual cable lengths at the test pulse output	2 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm ² , 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm ² , 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm ² , 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	45 mm
Depth	120 mm
Weight	235 g

Where standards are undated, the 2018-07 latest editions shall apply.

Safety characteristic data

Unit	Operating mode	EN ISO 13849-1: 2015	EN ISO 13849-1: 2015	EN IEC 62061	EN IEC 62061	EN/IEC 61511	EN/IEC 61511	EN ISO 13849-1: 2015
		PL	Category	SIL CL/ maximum SIL	PFH _D [1/h]	SIL	PFD	T _M [year]

Base units PNOZ m B0

Logic								
CPU	2-channel	PL e	Cat. 4	SIL 3	4,74E-10	SIL 3	4,00E-05	20
Expansion left	–	PL e	Cat. 4	SIL 3	3,30E-11	SIL 3	2,49E-06	20
Expansion right	–	PL e	Cat. 4	SIL 3	2,79E-11	SIL 3	2,18E-06	20
Input								
Inputs	1-channel	PL d	Cat. 2	SIL 2	3,85E-09	SIL 2	3,38E-04	20
Inputs	2-channel	PL e	Cat. 4	SIL 3	7,95E-11	SIL 3	6,90E-06	20
Inputs	Short circuit-forming safety mats	PL d	Cat. 3	SIL 2	1,06E-09	SIL 2	9,14E-05	20
Inputs	1-ch., pulsed light barrier	PL e	Cat. 4	SIL 3	3,85E-10	SIL 3	3,40E-05	20
Output								
SC outputs	1-channel with advanced fault detection	PL e	Cat. 4	SIL 3	1,66E-11	SIL 3	1,46E-06	20
SC outputs	1-channel	PL d	Cat. 2	SIL 2	1,57E-10	SIL 2	1,35E-05	20
SC outputs	2-channel	PL e	Cat. 4	SIL 3	1,29E-10	SIL 3	1,12E-05	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_M 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.

Classification according to ZVEI, CB24I

The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Base units PNOZ m B0

Input

Interfaces

Drain	
Interface	Module
Class	C2

Source	
Interface	Sensor
Class	C2, C3

Drain parameters

Max. test pulse duration	500 µs
Min. input resistance	5,6 kOhm
Max. capacitive load	126 nF

Single-pole output

Interfaces

Source	
Interface	Module
Class	C2

Drain	
Interface	Actuator
Class	C1, C2

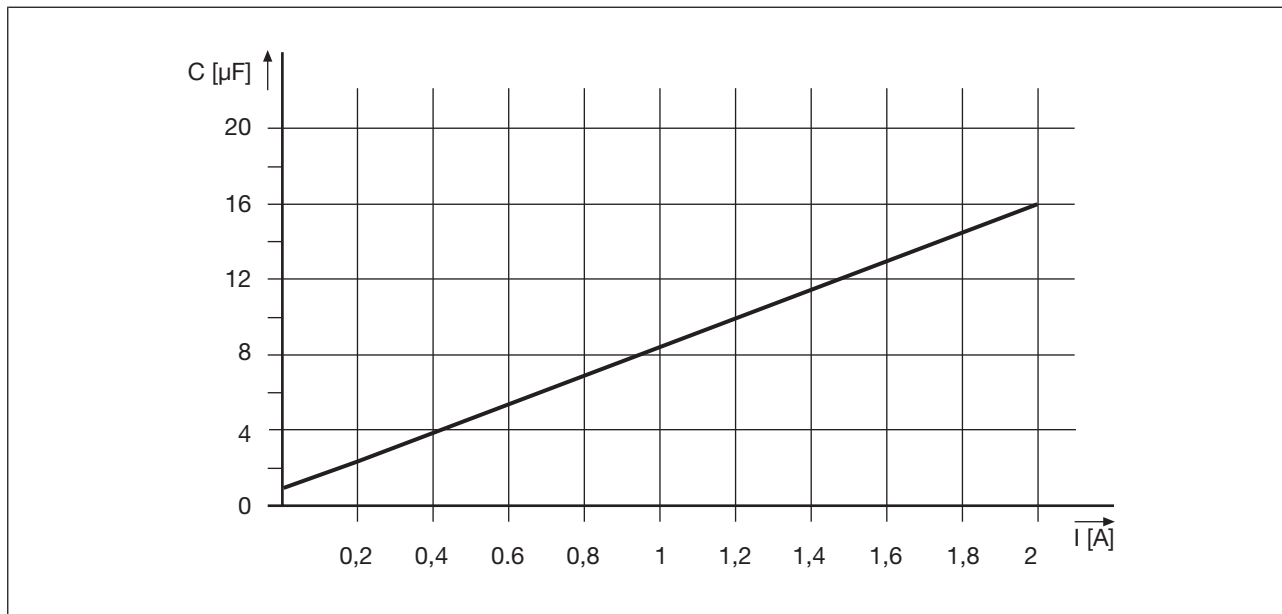
Parameter source

Max. test pulse duration	330 µs
Max. rated current	2 A
Max. capacitive load	1 µF

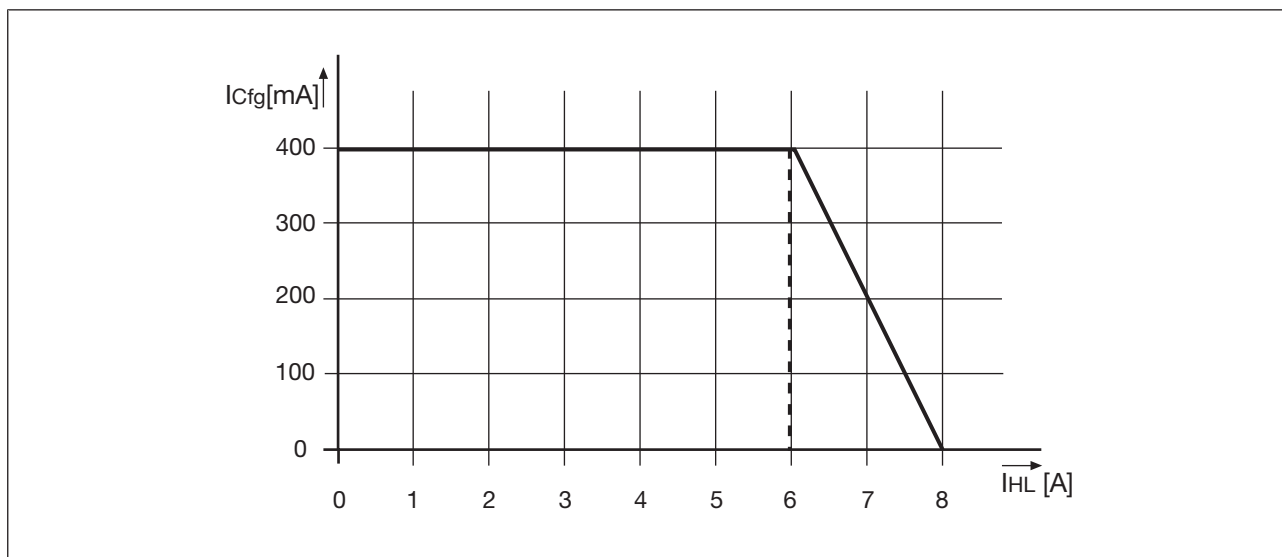
Base units PNOZ m B0

Supplementary data

Maximum capacitive load C (μF) with load current I (A) at the semiconductor outputs



Maximum permitted total current of the semiconductor outputs



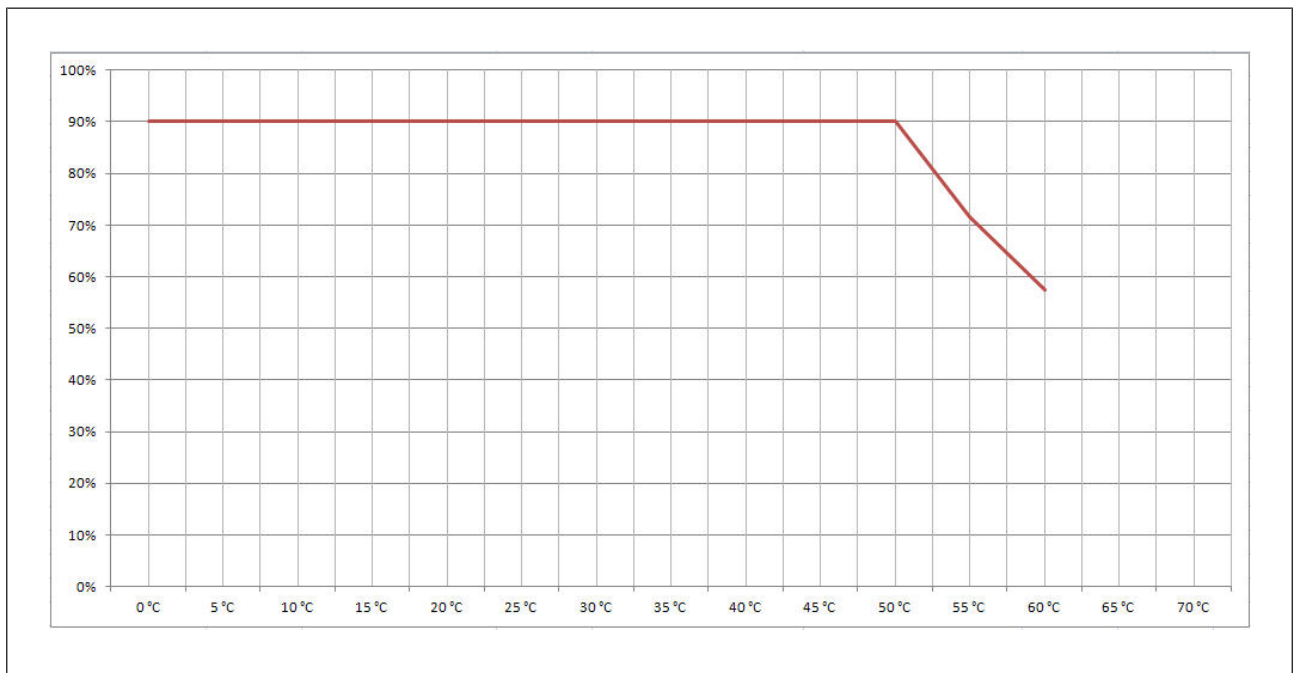
$I_{c_{fg}}$: Total current of the configurable semiconductor outputs (auxiliary outputs)

I_{HL} : Total current: Semiconductor outputs (safety outputs)

Base units PNOZ m B0

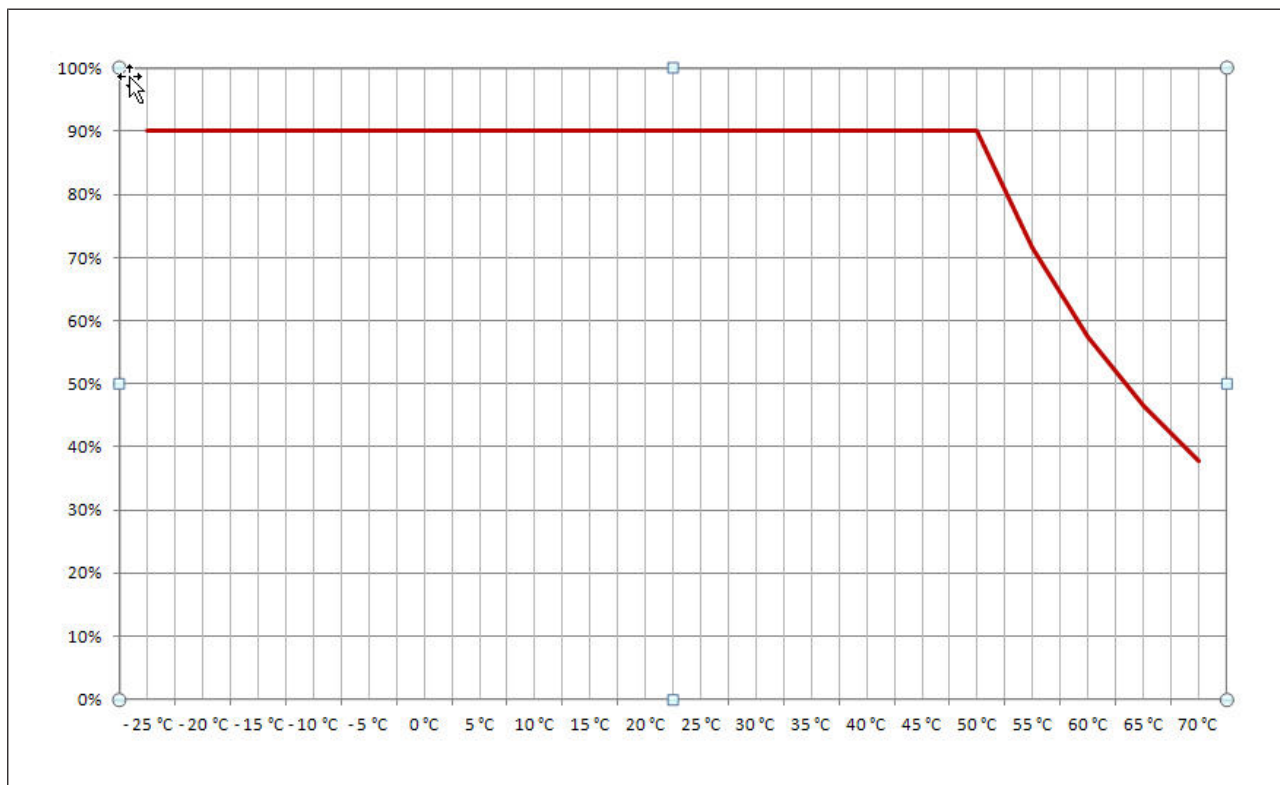
Maximum permitted humidity

Max. relative humidity, operation



Base units PNOZ m B0

Max. relative humidity, storage



Order reference

Product

Product type	Features	Order no.
PNOZ m B0	Configurable safe small controllers PNOZmulti 2, base unit, expandable, 20 safe digital inputs, 4 safe semiconductor outputs.	772100

Accessories

Chip card

Product type	Features	Order no.
PNOZmulti Chipcard 1 piece 32kB	PNOZmulti chip card, 1 piece, 32 kB.	779211
PNOZmulti Chipcard 1 piece 8kB	PNOZmulti chip card, 1 piece, 8 kB.	779201

Base units PNOZ m B0

Replacement terminals

Product type	Features	Order no.
PNOZ s Set1 screw terminals 45mm	Set of plug-in replacement terminals 8-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750008
PNOZ s Set1 spring-loaded terminals 45mm	Set of plug-in replacement terminals 8-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751008

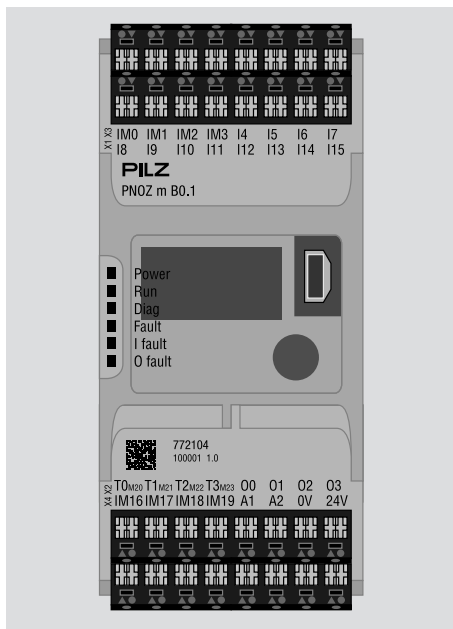
Cable

Product type	Features	Order no.
PSSu A USB-CAB03	PSSu, USB cable, length 3 m.	312992
PSSu A USB-CAB05	PSSu, USB cable, length 5 m.	312993

Terminating plug

Product type	Features	Order no.
PNOZ mm0.xp terminator left (10 pcs.)	Terminator on the left-hand side of the base unit PNOZmulti, yellow/black (10 pieces).	779261

Base units PNOZ m B0.1



Overview

Unit features

Application of the product PNOZ m B0.1:

Base unit of the configurable control system PNOZmulti 2

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Semiconductor outputs:
 - 4 safety outputs
depending on the application, up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061
- ▶ 12 safe inputs for connecting, for example:
 - Emergency stop pushbuttons
 - Two-hand pushbuttons
 - Safety gate limit switches
 - Start buttons
 - Light barriers
 - Scanner
 - Enabling switches
 - PSEN
 - Operating mode selector switches

Base units

PNOZ m B0.1

- ▶ 8 configurable inputs/outputs
Can be configured as:
 - Safe inputs (see above for connection options)or
 - Auxiliary outputs
- ▶ 4 configurable outputs
Can be configured as:
 - Auxiliary outputsor
 - Test pulse outputs
- ▶ LED display for:
 - Error messages
 - Diagnostics
 - Supply voltage
 - Fault at the outputs
 - Fault at the inputs
- ▶ Backlit display for:
 - Error messages
 - State of supply voltage
 - State of the inputs and outputs
 - Status information
 - Device information
- ▶ 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 accessories (see Order references)
- ▶ Rotary knob for menu control
- ▶ Expansion modules can be connected
(please refer to the document "PNOZmulti System Expansion" for details of the type and number that can be connected)

Chip card

To be able to use the product you will need a chip card.

Chip cards are available with memories of 8 kByte and 32 kByte. For large-scale projects we recommend the 32 kByte chip card (see Technical Catalogue: Accessories chapter).

Base units PNOZ m B0.1

Front view

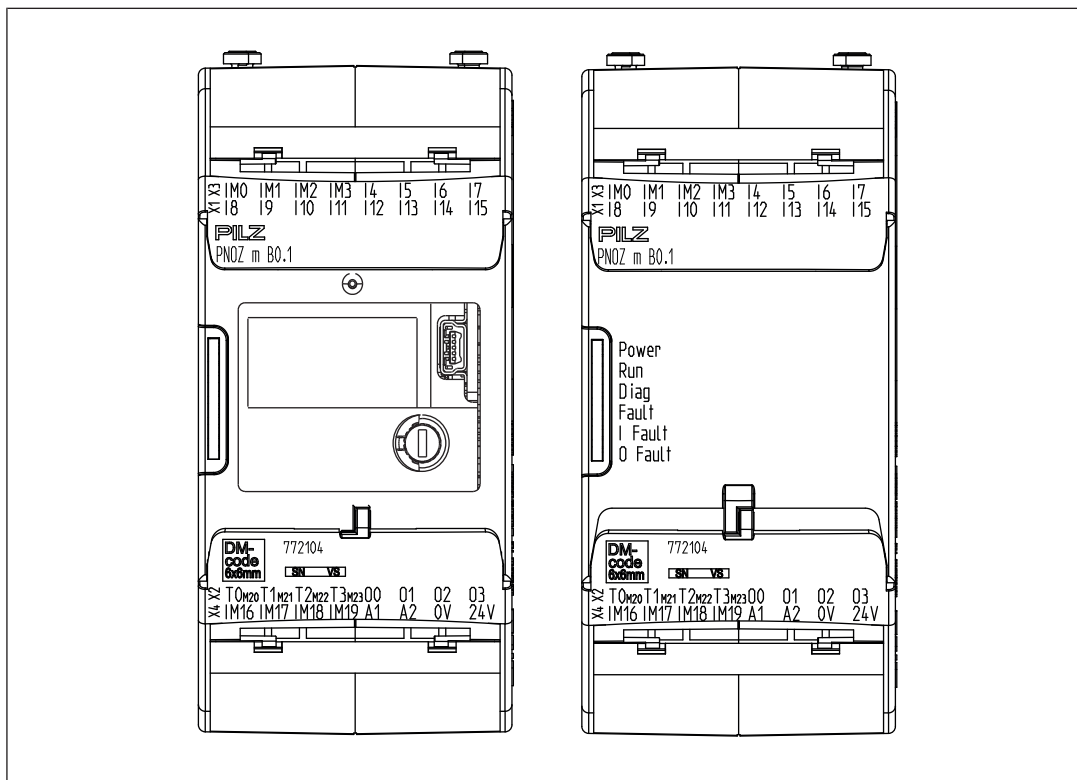


Fig.: Front view with and without cover

Legend

- X1: Inputs I8 ... I15
- X2: Configurable test pulse/auxiliary outputs TOM20 ... T3M23
Semiconductor outputs O0 ... O3
- X3: Configurable inputs/outputs IM0 – IM3
Inputs I4 ... I7
- X4: Configurable inputs/outputs IM16 – IM19
Supply connections
- LEDs: PWR
RUN
DIAG
FAULT
I FAULT
O FAULT

Base units PNOZ m B0.1

Security

To secure plants, systems, machines and networks against cyberthreats it is necessary to implement (and continuously maintain) an overall industrial security concept that is state of the art.

Perform a risk assessment in accordance with VDI/VDE 2182 or IEC 62443-3-2 and plan the security measures with care. If necessary, seek advice from Pilz Customer Support.

Required security measures

- ▶ The product is not protected from physical manipulation or from reading of memory contents during physical access. Use appropriate measures to ensure that there is no physical access by unauthorised persons. You should also use security seals so that you can detect any manipulation of the product or interfaces. Installation inside a lockable control cabinet is recommended as a minimum measure.
- ▶ The product can be incorporated into a machine network using the expansion module PNOZ m ES ETH. Ensure that the product is separated by a router (layer 3 switch or firewall) from the company network.
- ▶ Check the product's log for unauthorised program changes on a regular basis.
- ▶ Modbus/TCP has no security mechanisms. Use a firewall to protect the product from unauthorised access.

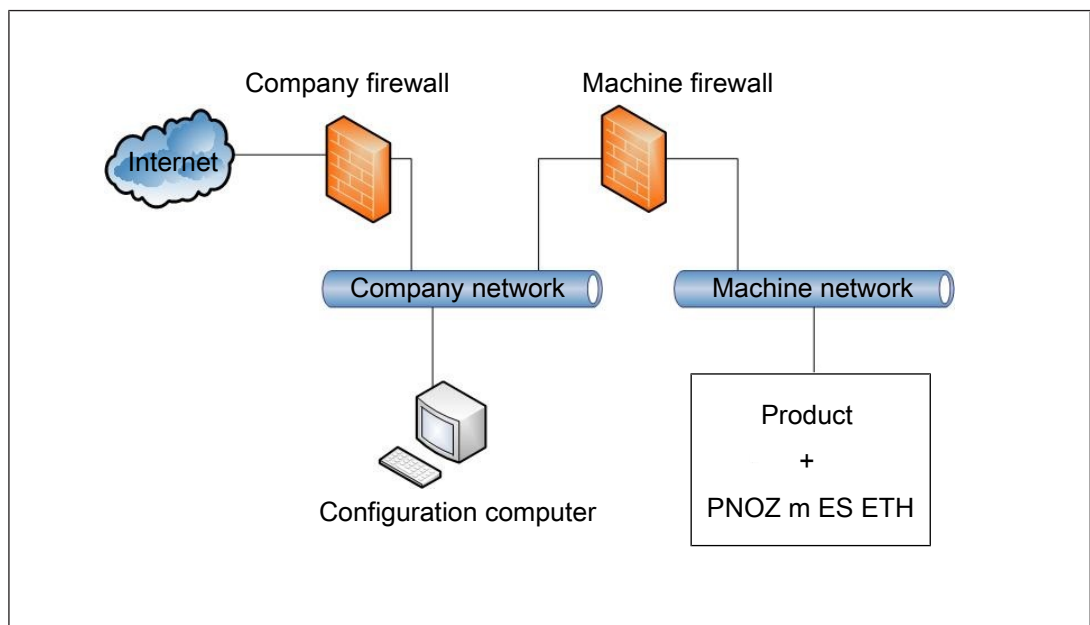


Fig.: Example network topology

- ▶ Note the network data for risk analysis and the security measures.
- ▶ Protect the configuration and log data from unauthorised changes.
- ▶ Delete or destroy the chip card before disposing of the product.

Base units PNOZ m B0.1

Function description

Functions

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.

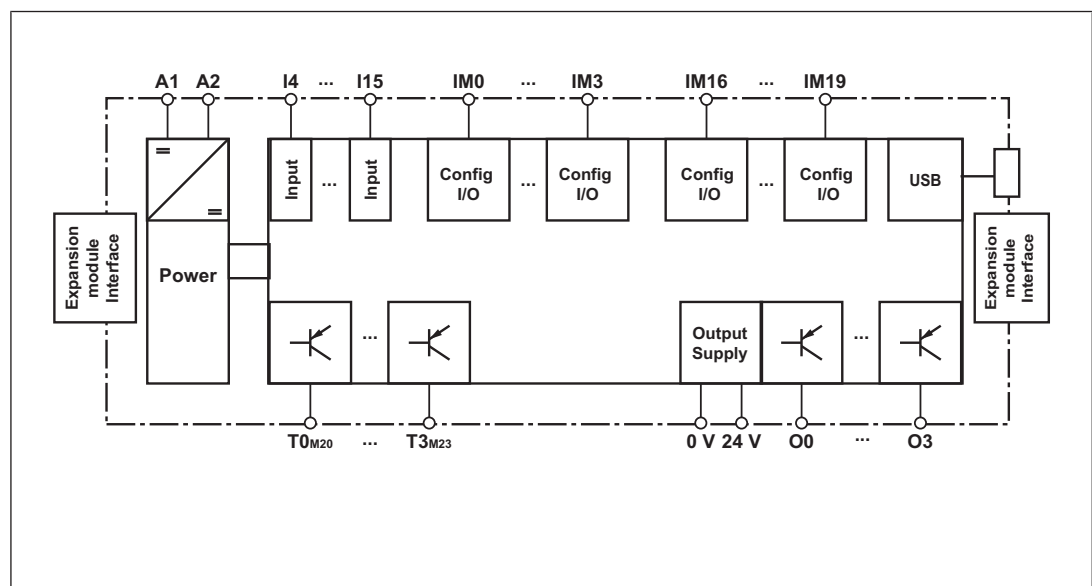
The LEDs on the base unit and expansion modules indicate the status of the configurable control system PNOZmulti.

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

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 "PNOZmulti System Expansion".

Block diagram



Detection of shorts across contacts

4 test pulse outputs (T0 ... T3) are available for detection of shorts between the inputs.

If the system is in a stop state, the test pulse outputs can be switched manually via the menu on the display.

This function can be used to

Base units PNOZ m B0.1

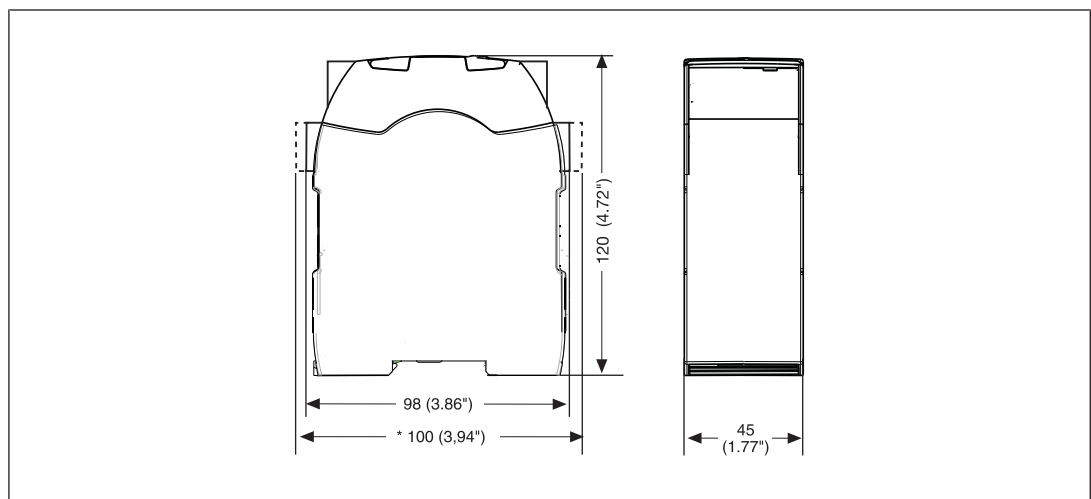
- ▶ Commission inputs with the test pulse signal from the base unit or
- ▶ Locate the error source in the event of test pulse errors.

For details of how to switch the test pulse outputs manually, see section entitled Switching the test pulse outputs.

Installation

Dimensions in mm

*with spring-loaded terminals



Commissioning

General wiring guidelines

The wiring is defined in the circuit diagram in the Configurator. There you can select the inputs that are to perform a safety function and the outputs that are to switch this safety function.

Note:

- ▶ Information given in the [Technical details \[84\]](#) must be followed.
- ▶ Outputs O0 to O3 are semiconductor outputs
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ Sufficient protection circuit must be provided on all output contacts with inductive loads.
- ▶ The safety system and input circuits must always be supplied by a single power supply. The power supply must meet the regulations for extra low voltages with protective separation (SELV/PELV).

Base units PNOZ m B0.1

- ▶ Do not route the test pulse cables together with actuator cables within an unprotected sheathed cable.

Connection

Procedure:

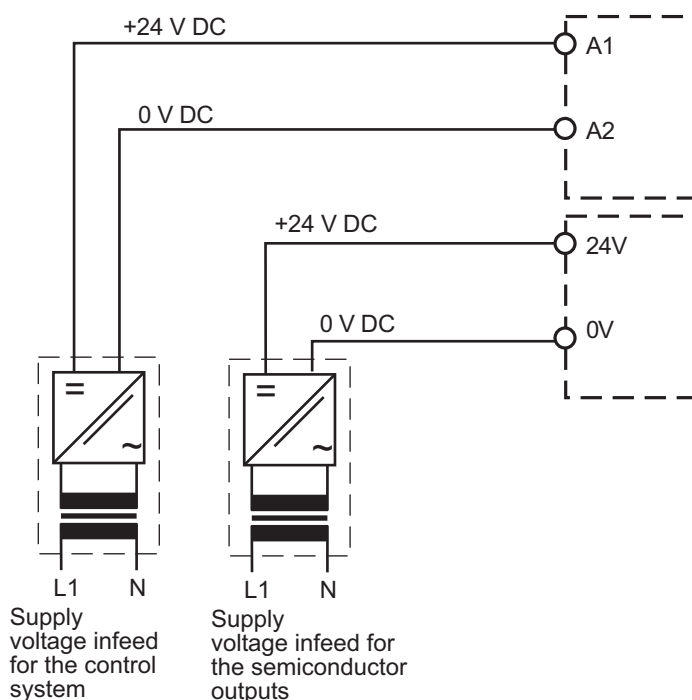
- ▶ Wire the inputs and outputs on the base unit in accordance with the circuit diagram.
- ▶ Connect the supply voltage:
 - Supply voltage for the control system:
 - Terminal A1: + 24 VDC
 - Terminal A2: 0 V
 - Supply voltage for the semiconductor outputs:
 - 24 V terminal: + 24 VDC
 - 0V terminal: 0 V

Please note: The supply voltage for the semiconductor outputs must always be present, even if you are not using the semiconductor outputs.

When the voltages are fed separately using two power supplies, the supply voltage for the control system and the supply voltage for the semiconductor outputs are galvanically isolated.

Supply voltage

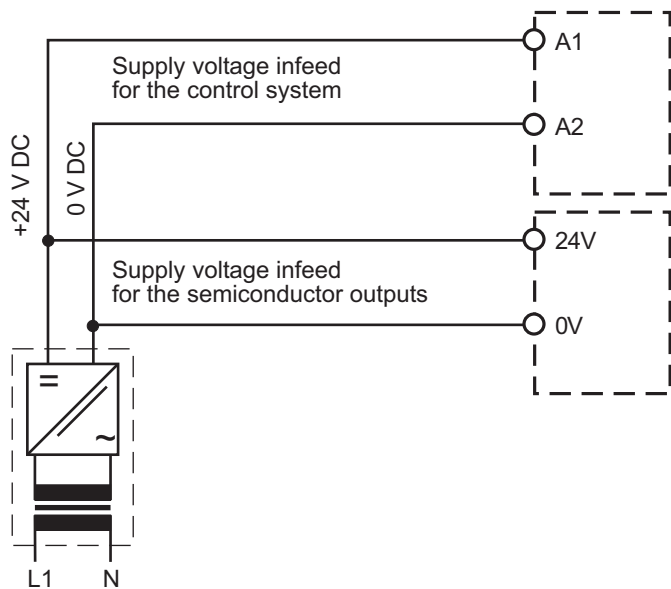
Separate power supplies for the supply voltage to the control system and the supply voltage to the semiconductor outputs



Base units PNOZ m B0.1

Supply voltage

Common power supply for the supply voltage to the control system and the supply voltage to the semiconductor outputs



Input circuit	Single-channel	Dual-channel
Emergency stop without detection of shorts across contacts		
Emergency stop with detection of shorts across contacts		
Start circuit	Input circuit without detection of shorts across contacts	Input circuit with detection of shorts across contacts

Base units PNOZ m B0.1

Semiconductor outputs		
Redundant output		
Single output		
Single output with advanced fault detection*		

*Two loads may be connected to each safety output with advanced fault detection, even on applications in accordance with EN IEC 62061, SIL 3. Prerequisite: Feedback loop is connected, shorts across contacts and external power sources are excluded (e.g. through separate multicore cables). Please note that, in the event of an error in the feedback loop, the safety system switches to a safe state and shuts down **all** the outputs.

Feedback loop	Redundant output	
Contacts from external contactors		

Base units

PNOZ m B0.1

Load project from chip card

Procedure:

- ▶ Insert the chip card containing the current project into the card slot on the base unit.
- ▶ Switch on the supply voltage. The LC display shows the project name, CRC sum and the date the project was created. Please check this information.
- ▶ Load the project by pressing the rotary knob. For the project to be downloaded, the rotary knob must be held down for between 3 and 8 seconds. Once the project has been successfully downloaded, the status of the inputs and outputs will be shown on the display.

Load project via USB port

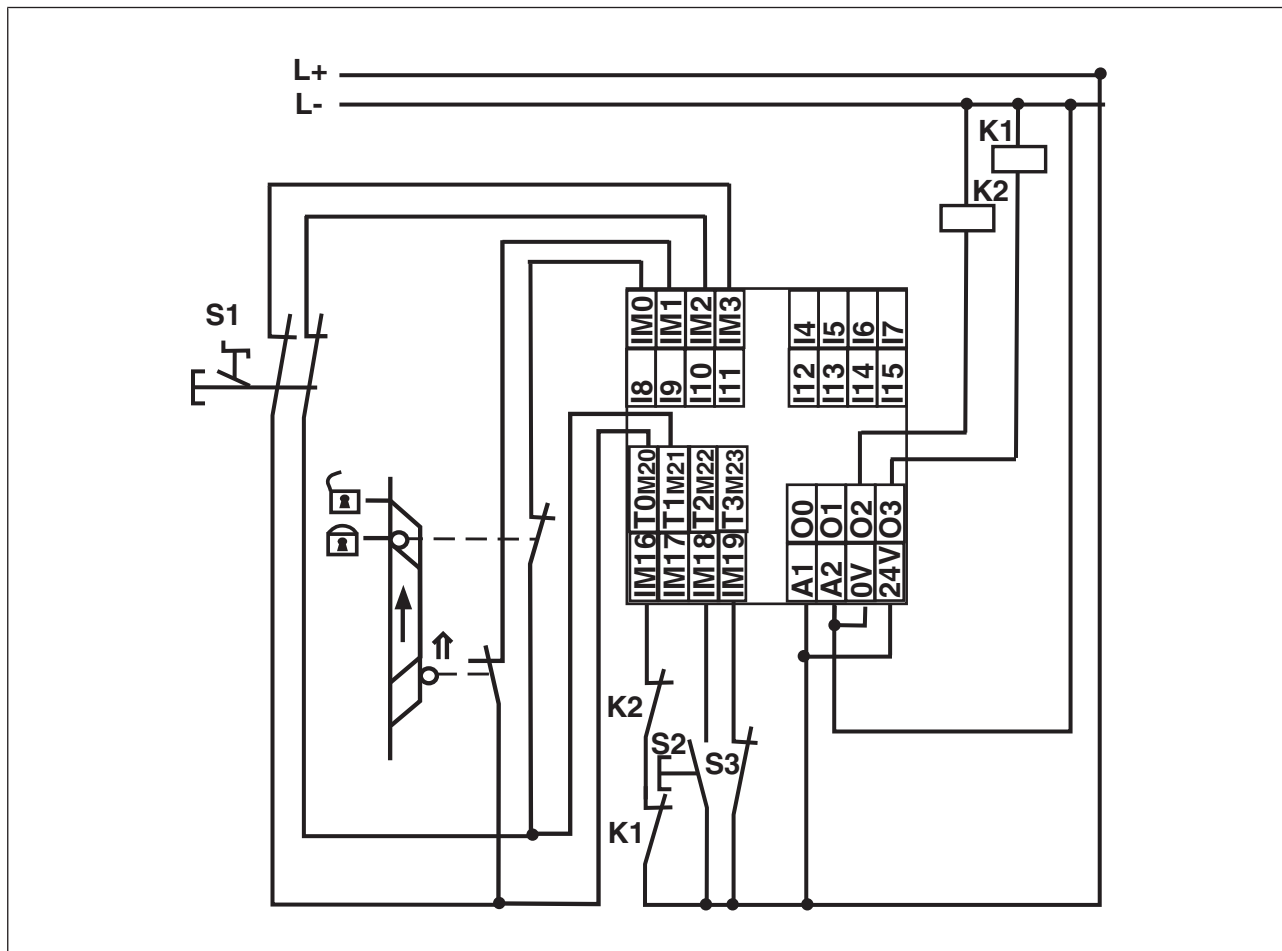
Procedure:

- ▶ Insert a chip card into the card slot on the base unit.
- ▶ Connect the computer containing the PNOZmulti Configurator to the base unit via the USB port.
- ▶ Switch on the supply voltage.
- ▶ Download the project (see PNOZmulti Configurator's online help).
- ▶ Once the project has been successfully downloaded, the status of the inputs and outputs and the supply voltage will be shown on the display. The "RUN" LED will be lit.

Base units PNOZ m B0.1

Connection example

Dual-channel E-STOP and safety gate wiring, monitored start (IM18), feedback loop (IM16)



Maintenance and testing

It is not necessary to perform maintenance work on the product in normal operation. Please return any faulty products to Pilz.

Base units PNOZ m B0.1

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA
Application range	Failsafe
Module's device code	0x5F
Electrical data	
Supply voltage	
for	Supply to the system
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	1,6 A
Inrush current that the external power supply must provide	3 A
External unit fuse protection F1	6 A, circuit breaker 24 V DC, characteristic B
Supply voltage	
for	Supply to the SC outputs
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	8 A
External unit fuse protection F2	10 A, circuit breaker 24 V DC, characteristic B/C
Potential isolation	Yes
Supply voltage	
Current consumption	32 mA
Power consumption	0,8 W
Max. power dissipation of module	7,4 W
Status indicator	Display, LED
Permitted loads	inductive, capacitive, resistive
Configurable inputs/outputs (inputs or auxiliary outputs)	
Quantity	8
Potential isolation	No

Base units PNOZ m B0.1

Configurable inputs/outputs (inputs or auxiliary outputs)

Configurable inputs

Input voltage in accordance with EN 61131-2 Type 1	24 V
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	2 ms

Configurable auxiliary outputs

Voltage	24 V
Output current	75 mA
Output current range	0 - 100 mA
Max. transient pulsed current	500 mA
Short circuit-proof	Yes
Residual current at "0"	0,5 mA
Voltage at "1"	UB - 2 V at 0.1 A

Inputs

Quantity	12
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	2 ms
Potential isolation	No

Semiconductor outputs

Number of positive-switching single-pole semiconductor outputs	4
Switching capability	
Voltage	24 V
Current	2 A
Permitted current range	0,000 - 2,500 A
Residual current at "0" signal	0,05 mA
Max. transient pulsed current	12 A
Max. capacitive load	1 µF
Max. internal voltage drop	500 mV
Max. duration of off time during self test	330 µs
Switch-off delay	1 ms
Potential isolation	Yes
Short circuit-proof	Yes

Test pulse outputs

Number of test pulse outputs	4
------------------------------	----------

Base units PNOZ m B0.1

Test pulse outputs	
Voltage	24 V
Current	0,1 A
Max. duration of off time during self test	5 ms
Short circuit-proof	Yes
Potential isolation	No
Times	
Simultaneity in the two-hand circuit	0,5 s
Processing time	30 ms
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	SC output and system voltage

Base units PNOZ m B0.1

Potential isolation	
Type of potential isolation	Basic insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	1 km
Sum of individual cable lengths at the test pulse output	2 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	45 mm
Depth	120 mm
Weight	220 g

Where standards are undated, the 2022-05 latest editions shall apply.

Base units PNOZ m B0.1

Safety characteristic data

Unit	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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
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Logic

CPU	2-channel	PL e	Cat. 4	SIL 3	4,74E-10	SIL 3	4,00E-05	20
Expansion left	–	PL e	Cat. 4	SIL 3	3,30E-11	SIL 3	2,49E-06	20
Expansion right	–	PL e	Cat. 4	SIL 3	2,79E-11	SIL 3	2,18E-06	20

Input

Inputs	1-channel	PL d	Cat. 2	SIL 2	3,85E-09	SIL 2	3,38E-04	20
Inputs	2-channel	PL e	Cat. 4	SIL 3	7,95E-11	SIL 3	6,90E-06	20
Inputs	Short circuit-forming safety mats	PL d	Cat. 3	SIL 2	1,06E-09	SIL 2	9,14E-05	20
Inputs	1-ch., pulsed light barrier	PL e	Cat. 4	SIL 3	3,85E-10	SIL 3	3,40E-05	20

Output

SC outputs	1-channel with reduced fault detection	PL d	Cat. 2	SIL 2	2,45E-09	SIL 2	1,04E-04	20
SC outputs	2-channel with reduced fault detection	PL e	Cat. 4	SIL 3	4,87E-09	SIL 3	2,06E-04	20
SC outputs	1-channel with advanced fault detection	PL e	Cat. 4	SIL 3	1,66E-11	SIL 3	1,46E-06	20
SC outputs	1-channel	PL d	Cat. 2	SIL 2	1,57E-10	SIL 2	1,35E-05	20

Explanatory notes for the safety-related characteristic data:

Base units

PNOZ m B0.1

- ▶ Safety characteristic data in accordance with EN IEC 62061 and EN/IEC 61511 was calculated based on EN/IEC 61508.
- ▶ T_M 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.

Classification according to ZVEI, CB24I

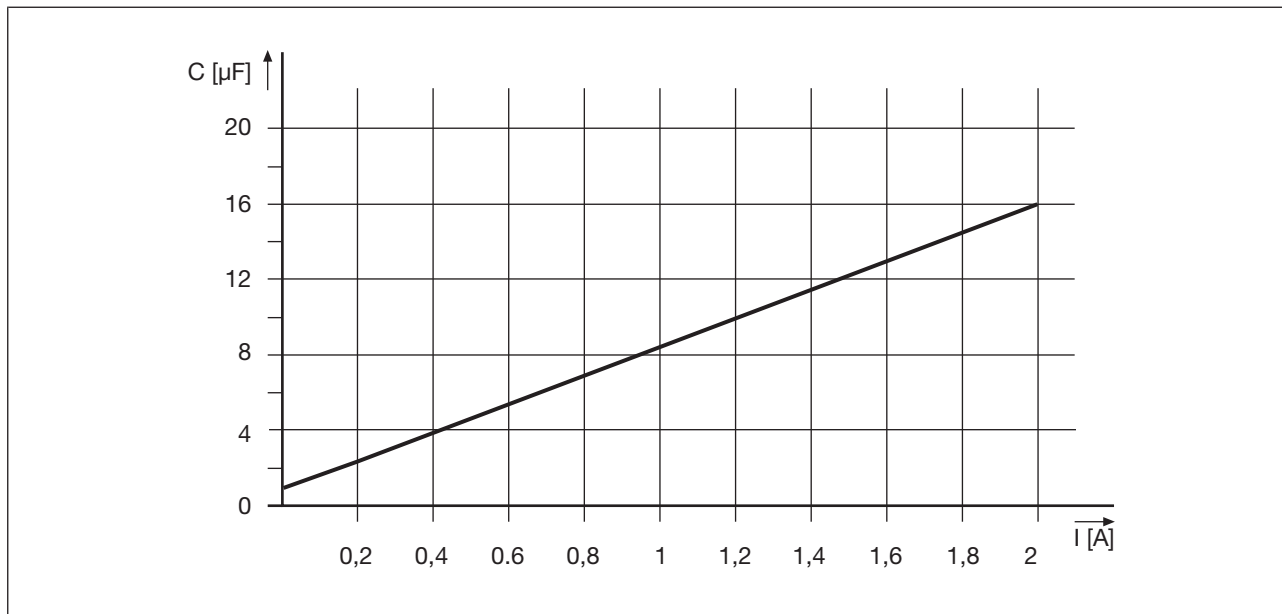
The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Input	
Interfaces	
Drain	
Interface	Module
Class	C2
Source	
Interface	Sensor
Class	C2, C3
Drain parameters	
Max. test pulse duration	500 μs
Min. input resistance	5,6 kOhm
Max. capacitive load	126 nF
Single-pole output	
Interfaces	
Source	
Interface	Module
Class	C2
Drain	
Interface	Actuator
Class	C1, C2
Parameter source	
Max. test pulse duration	330 μs
Max. rated current	2 A
Max. capacitive load	1 μF

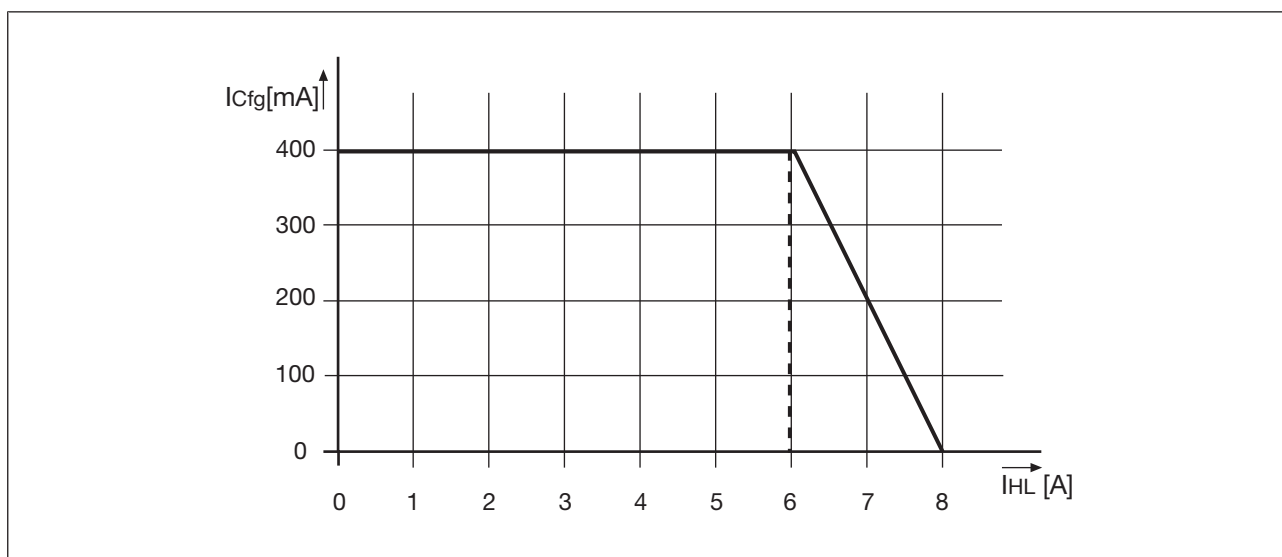
Base units PNOZ m B0.1

Supplementary data

Maximum capacitive load C (μF) with load current I (A) at the semiconductor outputs



Maximum permitted total current of the semiconductor outputs



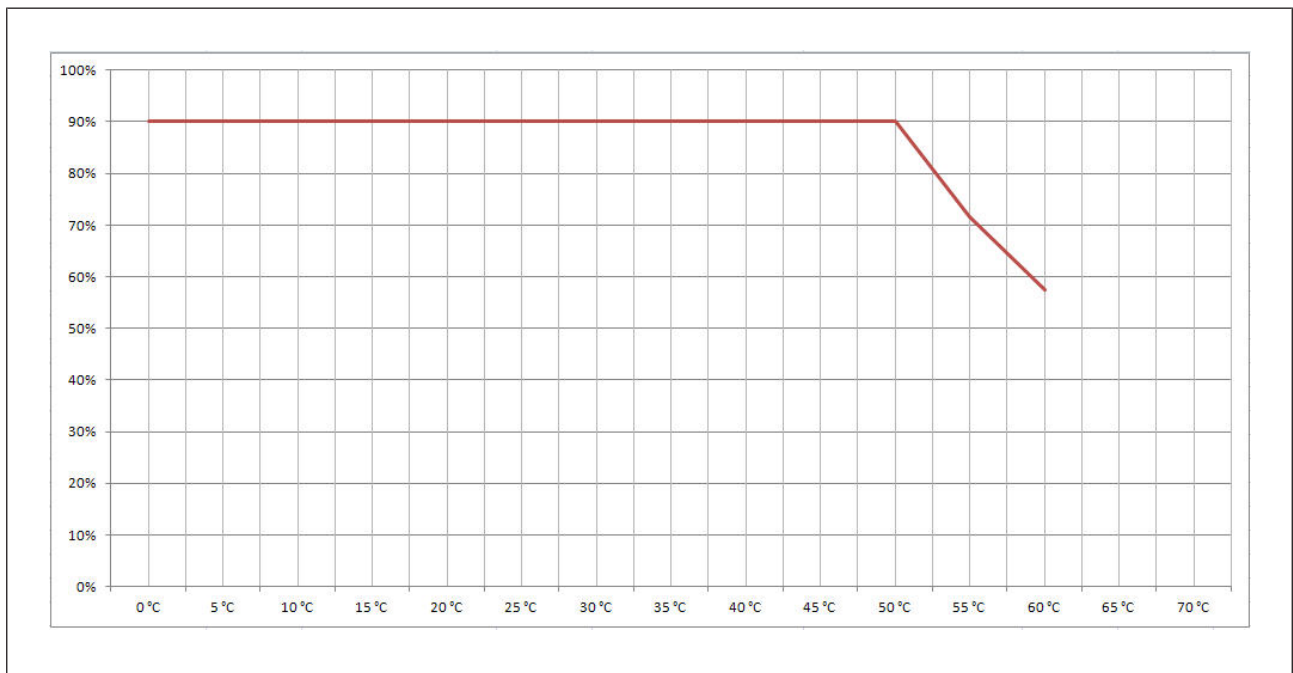
$I_{c_{fg}}$: Total current of the configurable semiconductor outputs (auxiliary outputs)

I_{HL} : Total current: Semiconductor outputs (safety outputs)

Base units PNOZ m B0.1

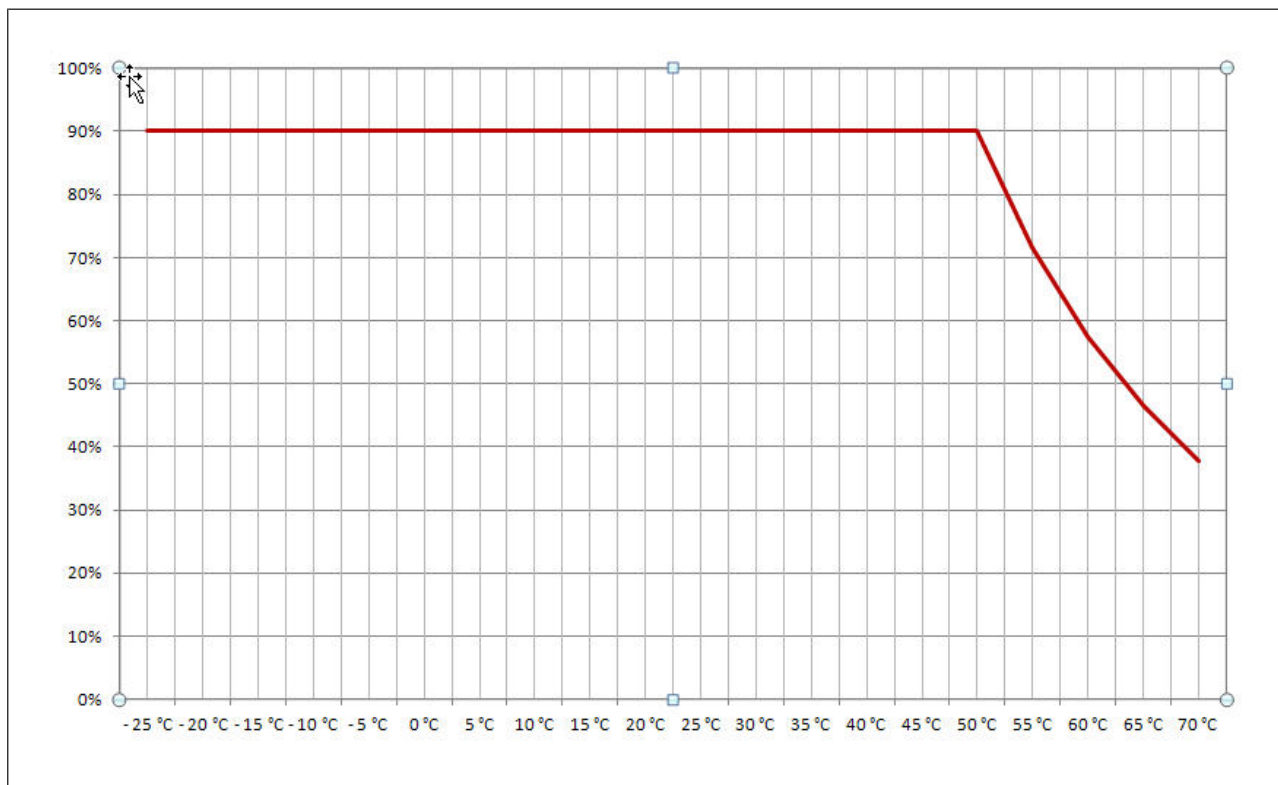
Maximum permitted humidity

Max. relative humidity, operation



Base units PNOZ m B0.1

Max. relative humidity, storage



Order reference

Product

Product type	Features	Order no.
PNOZ m B0.1	Configurable safe small controllers PNOZmulti 2, base unit, expandable via digital input/output modules, 20 safe inputs, 4 safe semiconductor outputs.	772104

Accessories

Terminating plug

Product type	Features	Order no.
PNOZ mm0.xp terminator left	Terminator, black/yellow, x1	779261

Base units

PNOZ m B0.1

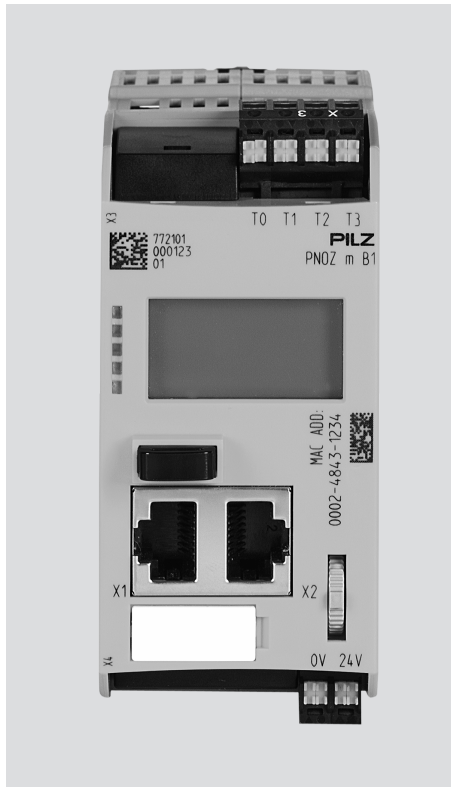
Cable

Product type	Features	Order no.
PSSu A USB-CAB03	Mini USB cable, 3 m	312992
PSSu A USB-CAB05	Mini USB cable, 5 m	312993

Terminals

Product type	Features	Order no.
PNOZ s Set1 spring loaded terminals	1 set of spring-loaded terminals	751008
PNOZ s Set1 screw terminals	1 set of screw terminals	750008

Base units PNOZ m B1



Overview

Unit features


Application of the product PNOZ m B1:

Base unit of the configurable control system PNOZmulti 2

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Support for module programs
- ▶ 4 test pulse outputs to detect shorts between the inputs
- ▶ Backlit display for:
 - Status information
 - Device information
 - Diagnostics
 - Activate project
 - Ethernet settings
 - System's date and time
 - Stop and start device

Base units PNOZ m B1

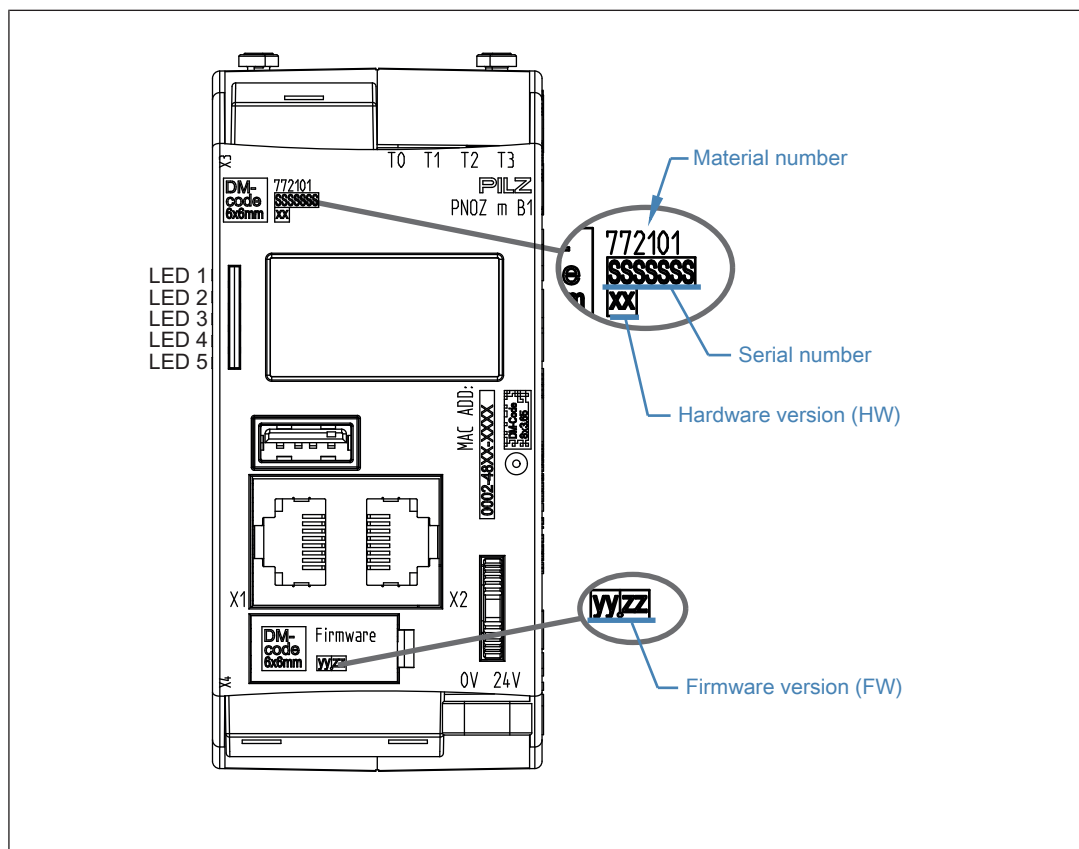
- ▶ Multifunction switch for menu control
- ▶ Ethernet interface with switch
- ▶ LED indicator for:
 - Operating status
 - Error messages
 - Diagnostics
 - Supply voltage
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#)  193]).
- ▶ Expansion modules can be connected
(please refer to the document "PNOZmulti System Expansion" for details of the type and number that can be connected)

USB memory

To save and transfer projects you need the Pilz USB memory that is supplied with the device.

Base units PNOZ m B1

Front view



Legend

- X1/X2: Ethernet interface
- X3: Test pulse outputs T0 - T3
- X4: Labelling clip for firmware version
- LED 1: Supply voltage
- LED 2 FS (Initialise/Run/Stop)
- LED 3 ST (Initialise/Run/Stop)
- LED 4 Diag (Project reset/Identify project)
- LED 5 FAULT (IFault/OFault)

To determine the version of the device, please note:

The firmware version number is on the labelling clip. This is also the version number that must be selected in the PNOZmulti Configurator under **Version** during the hardware configuration.

Base units PNOZ m B1

Function description

Functions

The function of the inputs and outputs on the control system depends on the safety circuit created using the PNOZmulti Configurator. A USB memory stick 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 expansion modules accordingly.

The LEDs on the base unit and expansion modules indicate the status of the configurable control system PNOZmulti.

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

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 "PNOZmulti System Expansion".

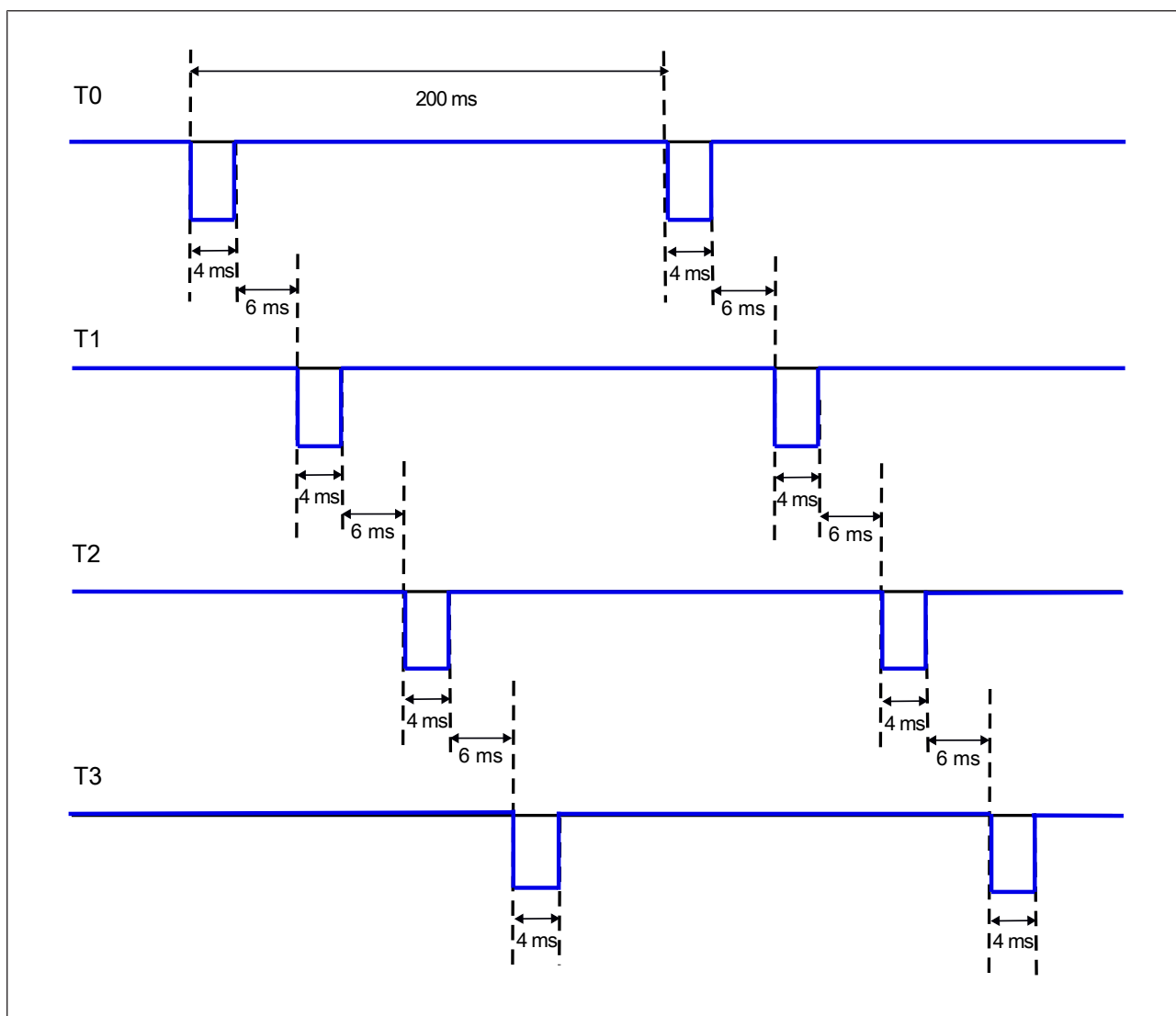
Base units PNOZ m B1

Detection of shorts across contacts

4 test pulse outputs that use different test pulses (test pulse 0 (T0) ... test pulse 3 (T3)) are available for detecting shorts between the inputs.

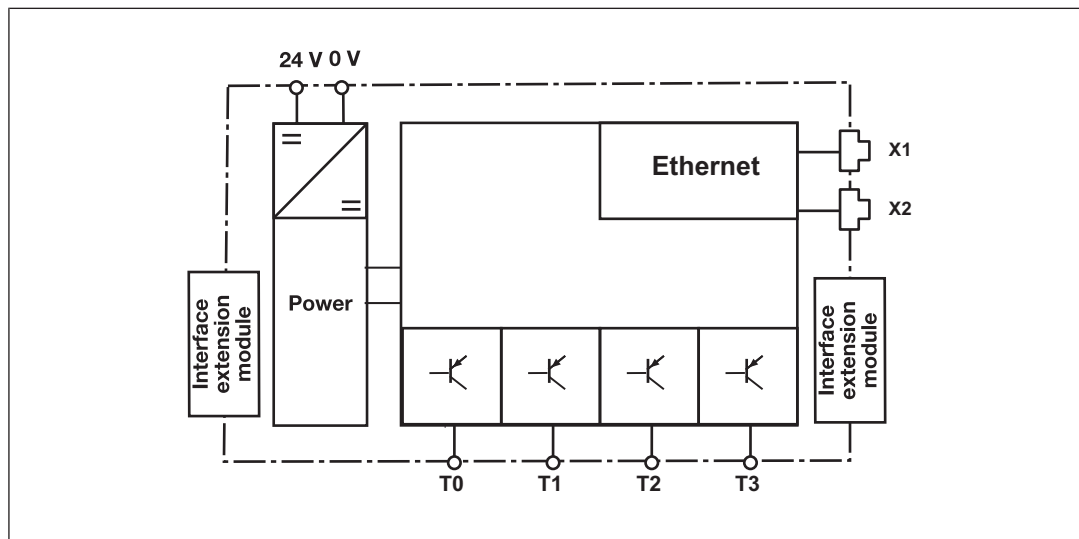
Shorts between inputs are detected if the inputs are connected to different test pulses (test pulse 0 ... test pulse 3).

Pulsing of test pulse outputs T0 ... T3 (typical times):



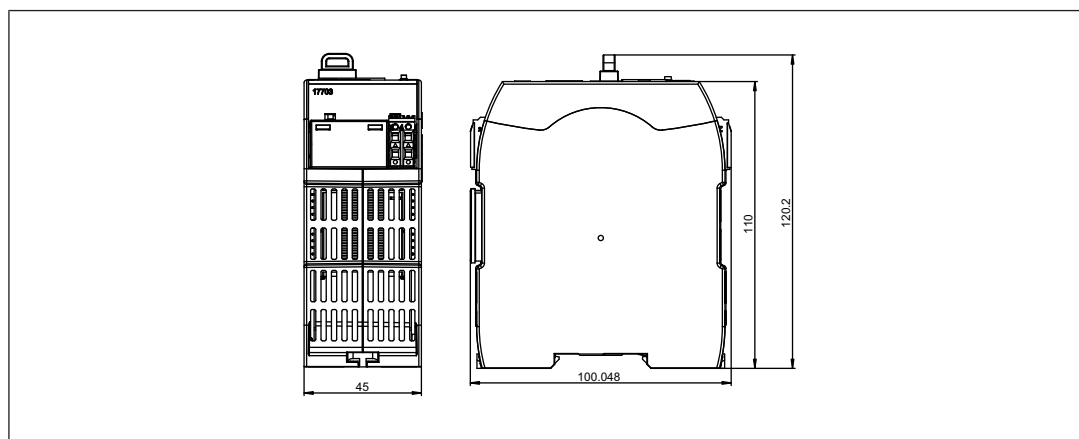
Base units PNOZ m B1

Block diagram



Installation

Dimensions in mm



Commissioning

General wiring guidelines

The wiring is defined in the circuit diagram in the Configurator. There you can select the inputs that are to perform a safety function and the outputs that are to switch this safety function.

Please note:

- ▶ Information given in the [Technical details \[112\]](#) must be followed.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Base units PNOZ m B1

- ▶ Adequate protection circuit must be provided on all output contacts with inductive loads.
- ▶ The safety system and input circuits must always be supplied by a single power supply. The power supply must meet the regulations for extra low voltages with protective separation (SELV, PELV).
- ▶ Test pulse outputs are used to detect shorts between the inputs. Shorts between inputs are detected if the inputs are connected to different test pulses (test pulse 0 ... test pulse 3). Shorts between inputs of the same module with the same test pulses will not be detected.
- ▶ Test pulse outputs must exclusively be used to activate the inputs. They must not be used to drive loads.
Do not route the test pulse lines together with actuator cables within an unprotected multicore cable.
- ▶ The maximum permitted total current of the test pulse outputs is 640 mA.

Connection

Procedure:

- ▶ Connect the supply voltage for the control system:
 - Terminal 24 V: + 24 VDC
 - Terminal 0 V: 0 V,
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

Base units PNOZ m B1

Use USB memory

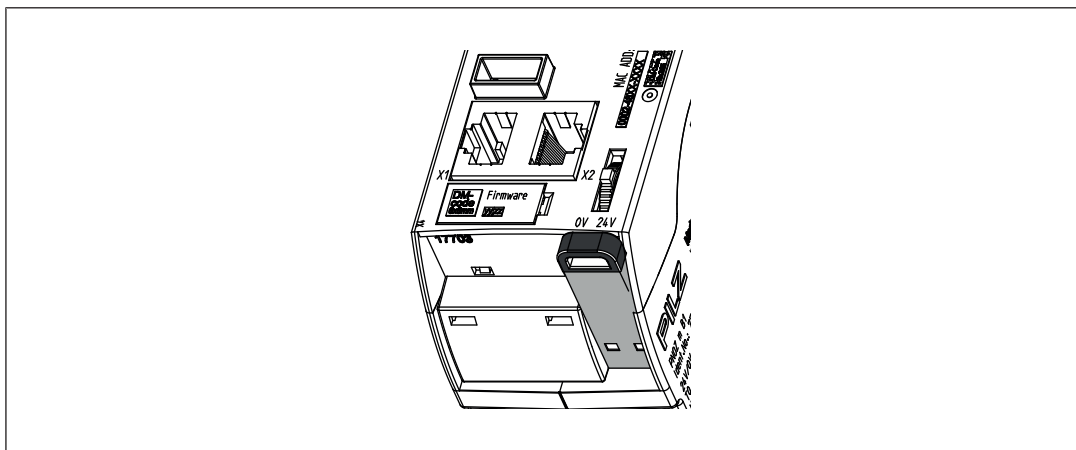
Multiple projects can be stored on the USB memory supplied. One of these can be activated and executed on the base unit.

Please note the following when using the USB memory:

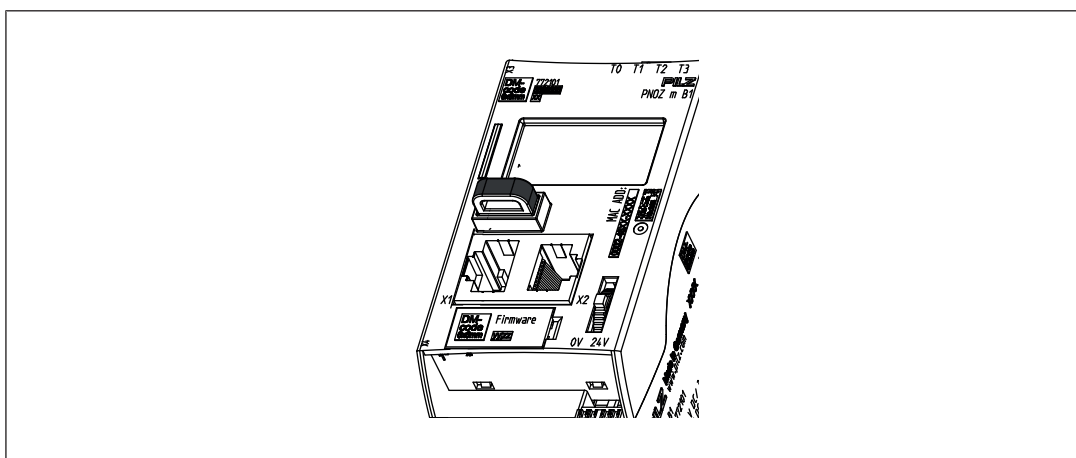
- ▶ The USB memory must always be plugged in during operation.
- ▶ In order to copy projects, for example, the USB memory can be removed and plugged into the PC or into another base unit PNOZ m B1.
- ▶ Only Pilz USB memories may be used!

Use USB memory

- ▶ Carefully remove the USB memory from the holder on the bottom of the device.



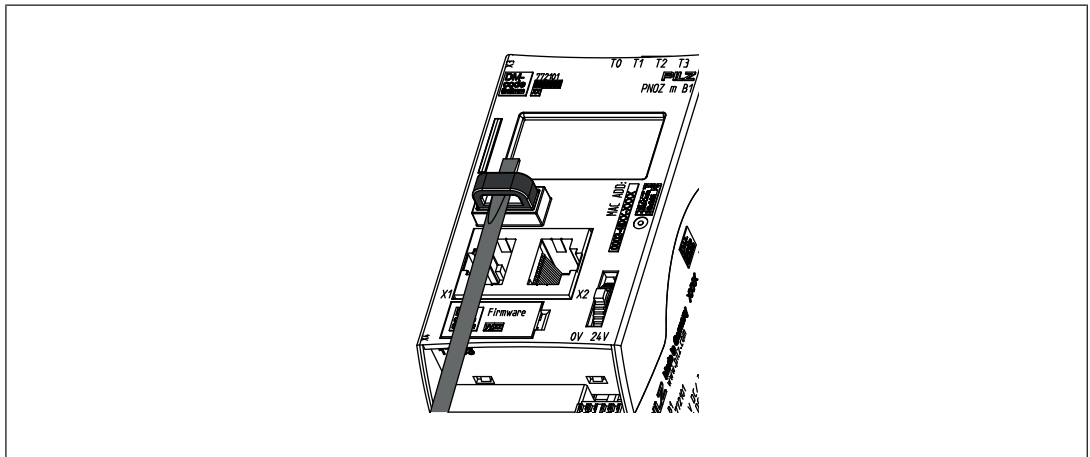
- ▶ Apply light pressure to insert the USB memory into the slot. Take care not to tilt the USB memory. It should be easy to insert.
- ▶ Insert the USB memory into the slot, only as far as the end of the metal housing. The plastic handle must not be inserted



Base units PNOZ m B1

Remove USB memory

- ▶ Due to mechanical requirements, the USB memory is inserted tightly within the device and so may be difficult to remove. In this case use an appropriate tool, such as a screwdriver for example, and carefully extract the USB memory (see diagram).



Load project from PNOZmulti Configurator

Projects can be transferred from the PNOZmulti Configurator to the USB memory. Several projects may be stored on the USB memory, A project can be activated directly. This can be performed in the Project Manager of the PNOZmulti Configurator (see online help for the PNOZmulti Configurator).

Procedure:

- ▶ Connect the computer containing the PNOZmulti Configurator to the base unit PNOZ m B1 via the Ethernet interface.
- ▶ Make sure that the USB memory is plugged into the base unit PNOZ m B1.
- ▶ Switch on the supply voltage.
- ▶ Transfer the required project to the USB memory and activate it on the base unit via the Project Manager on the PNOZmulti Configurator, as described in the online help for the PNOZmulti Configurator.
- ▶ As the project is loaded, the base unit must be stopped and then restarted.
- ▶ Once the project has been loaded successfully and the device has been restarted, the status of the supply voltage is shown on the display. The "RUN" LED is lit.

Activate project via the display on the base unit

A project that is stored on the USB memory can be activated in the base unit via settings on the display.

Procedure:

- ▶ Make sure that the USB memory containing the current project is plugged into the base unit PNOZ m B1.

Base units PNOZ m B1

- ▶ Switch on the supply voltage.
- ▶ Stop the device via the multifunction switch on the display via the menu setting **System mode** -> **Stop system** (for details of how to navigate the display see the section entitled [Display settings \[103\]](#))
- ▶ In the **Project** menu, navigate to the folder containing the required project and select the project file with the extension **.mpnoz2**.
- ▶ Load the project by pressing the multifunction switch and restart via the menu setting **System mode** -> **Restart system**.

Display settings

Various settings can be made and information displayed via the menu on the device's display.

Operate menu

The menu settings are made on the device's display via a multifunction switch. You can switch between the menu levels by pressing or turning the multifunction switch.

Press multifunction switch



- ▶ Confirm selection/setting
- ▶ Switch to sub-menu
- ▶ Exit menu: \..

Move multifunction switch up or down

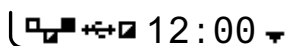


- ▶ Select menu

Displays and settings









The LC display has five lines. Information is shown on the display and settings can be made.

The field at the top right of the display shows information about the connection and instructions for the menu settings:

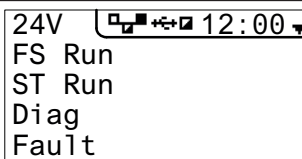

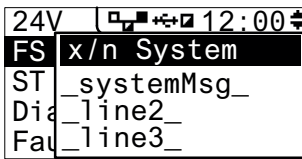
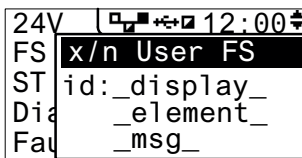




Base units PNOZ m B1

Legend:

-  Network connection/traffic
-  USB memory inserted
- 12:00** System time
-  Press the multifunction switch to go back to the higher level menu
-  Press the multifunction switch to access the sub-menu
-  Hold the multifunction switch down for 4 s to confirm the selection or perform the action
-  Press the multifunction switch to obtain information
-  Press the multifunction switch to call up the system message
-  Press the multifunction switch to call up the user message

Status indicators

Display	Display	Description
Permanent display	 	LED display ▶ A warning symbol shows that a message is present, which can be called up
System / User... System or display messages	 	 System message is present or  User message is present (user-specific messages that are created in the PNOZmulti Configurator)

Base units PNOZ m B1

Project menu

In the **Project** menu you can display information about the project that is activated on the device. You can also activate a different project from the USB memory on the device. See also [Activate project via the display on the base unit \[102\]](#) and reset the project on the device.

Display	Display	Description
Info:		Information is displayed about the project activated on the device
Name Project name		Name of project
Date / Time Creation data and time		Date and time that the project was created
Check sums FS Overall check sum and check sums of main program		Display of check sums: <ul style="list-style-type: none"> ▶ Overall project check sum ▶ Check sum safe of main program ▶ Check sum safe of main program without level 3
Check sums DP pos x Check sums of module program	 	Display of check sums of module program <ul style="list-style-type: none"> ▶ Check sum safe ▶ Check sum safe without level 3
History: Project history		Project information is displayed for one of the last 16 projects activated

Base units PNOZ m B1

Display	Display	Description
Name Date / Time Check sum FS Check sum DP pos x ...		Display of project information for a selected project
Select: Activate project		Select project contained in the USB memory and activate it on the base unit <ul style="list-style-type: none"> ▶ Prerequisite: Device must be stopped ▶ Hold down multifunction switch for 4 s in order to activate the project
Reset: Reset or update project.		After a reset, the active project is reloaded from the USB memory <ul style="list-style-type: none"> ▶ Prerequisite: Device must be stopped ▶ Hold down multifunction switch for 4 s in order to reset


Base units PNOZ m B1

Device Info menu

Display	Example	Description
Device Info		<p>Information on the base unit and expansion modules. Overview:</p> <ul style="list-style-type: none"> ▶ Position/slot ▶ Device type ▶ Firmware version
Device information for module		<p>Show device information for a selected module:</p> <ul style="list-style-type: none"> ▶ Order number ▶ Serial number ▶ Software versions ▶ Hardware version ▶ Operating hours

Base units PNOZ m B1

Error Stack menu

Display	Example	Description
Error stack	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <div style="text-align: right;">x / 256 ← →</div> <hr/> Date 2014-01-31 Time 23:59:59 Chn AB ST EC EN 01 AB </div> <div style="text-align: center;">  </div> <div style="border: 1px solid black; padding: 5px;"> <div style="text-align: right;">x / 256 ← →</div> <hr/> EC EN 01 AB EP 00 01 02 03 04 05 06 07 </div>	<p>Display of entries in the error stack (see also section entitled Show error stack on the display)</p> <p>To read the error stack entries please refer to the document <i>PNOZmulti Error Messages</i></p>

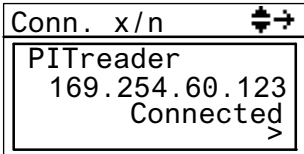
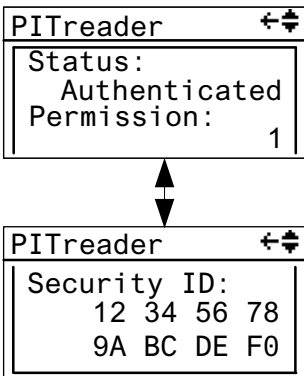
Operating Info menu

Display	Example	Description
Operating Info	<div style="border: 1px solid black; padding: 5px;"> <div style="text-align: right;">Pos Baseunit ← →</div> <hr/> FS cyc1 10000us FS cpu 80% </div>	<p>Display of specific operating parameters for the base unit and expansion modules.</p> <p>e.g.: cycle time, operating temperature, frequencies</p>

Connections menu

In the **Connections** menu the connections to the PNOZmulti can be displayed.

Base units PNOZ m B1

Display	Example	Description
Conn. x/n		<p>Information on the connected device:</p> <ul style="list-style-type: none"> ▶ Device ▶ IP address ▶ Connection status: <ul style="list-style-type: none"> – Connected: Connected – Connecting: Connecting – Failed: Connection has failed – Error: Error in the connection
PITreader		<p>Status information on PITreader:</p> <ul style="list-style-type: none"> ▶ Status: <ul style="list-style-type: none"> – Authenticated: PITreader detected the transponder key. Permission exists – No key: There is no transponder key inserted in PITreader – No permission: The transponder key has no permission (permission = 0) – Auth. failed: Authentication has failed. The data from PITreader are invalid – Not ready: The connection to PITreader is interrupted. ▶ Permission: Permission 1... 64 of the transponder key <p>Security ID: Safety identifier of the transponder key</p>

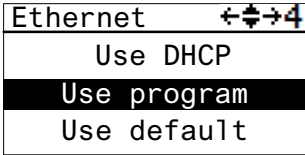
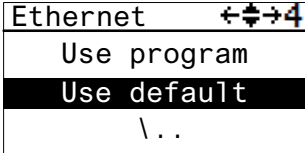
Base units PNOZ m B1

Ethernet menu

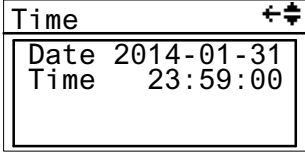
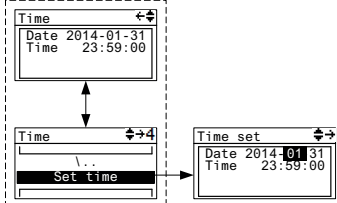
The Ethernet configuration can be displayed and changed in the **Ethernet** menu.

Display	Example	Description
Information	<p>The example shows three sequential screenshots of the Ethernet menu. The first shows 'IP address: DHCP', '169.254.60.1', and 'Subnet mask: 255.255.0.0'. The second shows 'Gateway: 0.0.0.0' and 'PG port: 9000'. The third shows 'Scan port: 10000'. Arrows indicate the sequence of screens.</p>	Display of the current Ethernet configuration
Change	<p>The screenshot shows the Ethernet menu with options: 'Info', 'Change' (highlighted), and '..'.</p>	Change Ethernet configuration...
Edit IP Change IP address	<p>The screenshot shows the 'Edit address' screen with fields for 'IP address' (169.254.60.001), 'Subnet mask' (255.255.000), and 'Gateway' (000.000.000.000).</p>	<ul style="list-style-type: none"> ▶ IP address ▶ Subnet mask ▶ Gateway Adjust -> Hold down multifunction switch for 2 s in order to access change mode
Edit ports Change IP address	<p>The screenshot shows the 'Edit ports' screen with 'PG port: 9100' and 'Scan port: 10000'.</p>	Adjust PG port and scan port -> Hold down multifunction switch for 2 s in order to access change mode
Use DHCP Change IP address	<p>The screenshot shows the Ethernet menu with options: 'Edit ports', 'Use DHCP' (highlighted), and 'Use program'.</p>	Obtain IP address automatically from the network (prerequisite: Network has a DHCP Server utility) -> Hold down multifunction switch for 2 s in order to perform the action

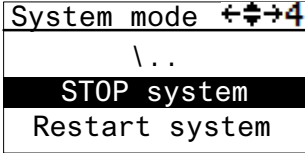
Base units PNOZ m B1

Display	Example	Description
Use program Change IP address	 <pre> Ethernet ←↕→4 Use DHCP Use program Use default </pre>	Load Ethernet settings from the active PNOZmulti project -> Hold down multifunction switch for 2 s in order to perform the action
Use default Change IP address	 <pre> Ethernet ←↕→4 Use program Use default \.. </pre>	Load default settings IP address: 169.254.60.1 Subnet mask: 255.255.0.0 Gateway: 0.0.0.0 -> Hold down multifunction switch for 2 s in order to perform the action

Time menu

Display	Example	Description
Time Show date and time	 <pre> Time ←↕→ Date 2014-01-31 Time 23:59:00 </pre>	Show system's date and time
Set time Set date and time	 <pre> Time ←↕→ Date 2014-01-31 Time 23:59:00 </pre> <pre> Time ←↕→4 \.. Set time </pre> <pre> Time set ←↕→ Date 2014.01.31 Time 23:59:00 </pre>	Change date and time -> Hold down multifunction switch for 2 s in order to access change mode

System mode menu

Display	Example	Description
Stop system Restart system	 <pre> System mode ←↕→4 \.. STOP system Restart system </pre>	Stop system Restart system -> Hold down multifunction switch for 4 s in order to perform the actions

Base units PNOZ m B1

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Electrical data	
Supply voltage	
for	Supply to the system
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Output of external power supply (DC)	18,5 W
Output of external power supply (DC) at no load	3 W
Max. power dissipation of module	4,5 W
Status indicator	Display, LED
Test pulse outputs	
Number of test pulse outputs	4
Voltage	24 V
Current	0,32 A
Max. duration of off time during self test	4 ms
Short circuit-proof	Yes
Potential isolation	No
Ethernet interface	
Quantity	2
IP address (automatically off)	169.254.60.1
Connection type	RJ45
Transmission rate	10 MBit/s, 100 MBit/s
Times	
Simultaneity in the two-hand circuit	0,5 s
Processing time	30 ms
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C

Base units PNOZ m B1

Environmental data	
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Humidity	93 % r. h. at 40 °C
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Sum of individual cable lengths at the test pulse output	2 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Cage clamp terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm

Base units PNOZ m B1

Mechanical data

Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector		0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection		2
Stripping length with spring-loaded terminals		9 mm
Dimensions		
Height	101,4 mm	
Width	45 mm	
Depth	120,2 mm	
Weight	209 g	

Where standards are undated, the 2018-07 latest editions shall apply.

Safety characteristic data

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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
2-channel	PL e	Cat. 4	SIL 3	4,19E-10	SIL 3	3,65E-05	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_M 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.

Base units PNOZ m B1

Order reference

Product

Product type	Features	Order no.
PNOZ m B1	Configurable safe small controllers PNOZmulti Mini base unit, expandable, Ethernet interface with switch, USB memory.	772101

Accessories

Terminals

Product type	Features	Order no.
Set4 Screw Terminals	Set of plug-in screw terminals for PNOZ m B1, base unit, small controllers PNOZmulti2.	750016
Set4 Spring Terminals	Set of spring-loaded terminals for PNOZ m B1, base unit, small controllers PNOZmulti 2.	751016

USB memory

Product type	Features	Order no.
USB Memory 512MB	USB memory, 512 MB, for PNOZ m B1, base unit PNOZmulti 2.	779213

Plug-in connector

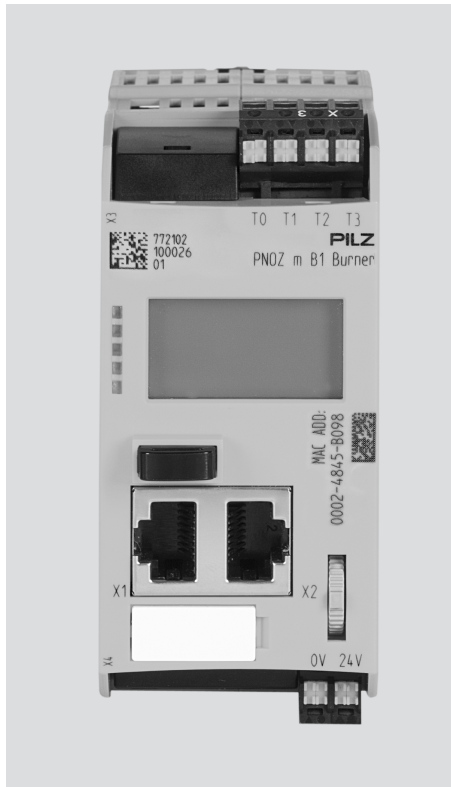
Product type	Features	Order no.
RJ45 Connector	RJ45 plug-in connector, straight, IP20, 8-pin, Cat6a, IDC connection, AWG22, cable diameter: 5.5 - 8.5 mm	380401

Terminating plug

Product type	Features	Order no.
PNOZ mm0.xp terminator left (10 pcs.)	Terminator on the left-hand side of the base unit PNOZmulti, yellow/black (10 pieces).	779261

Base units

PNOZ m B1 Burner



Overview

Unit features

Application of the product PNOZ m B1 Burner:


Base unit of the configurable control system PNOZmulti 2

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Designed to monitor and control furnaces
- ▶ Support for module programs
- ▶ 4 test pulse outputs to detect shorts between the inputs
- ▶ Backlit display for:
 - Status information
 - Unit information
 - Diagnostics
 - Activate project
 - Ethernet settings
 - System's date and time

Base units

PNOZ m B1 Burner

- Stop and start device
- ▶ Multifunction switch for menu control
- ▶ Ethernet interface with switch
- ▶ LED display for:
 - Operating status
 - Error messages
 - Diagnostics
 - Supply voltage
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [ 193]).
- ▶ Expansion modules can be connected
(please refer to the document "PNOZmulti System Expansion" for details of the type and number that can be connected)

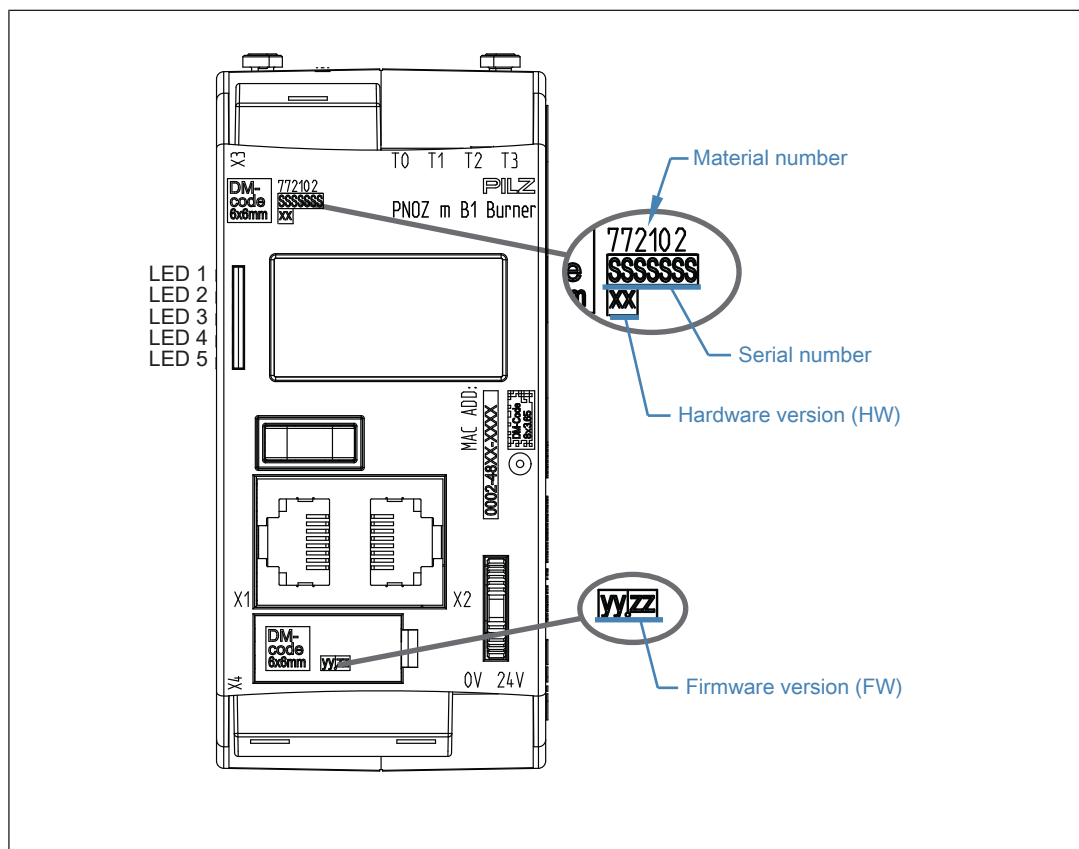
USB memory

To save and transfer projects you need the Pilz USB memory that is supplied with the device.

Base units

PNOZ m B1 Burner

Front view



Legend

- X1/X2: Ethernet interface
- X3: Test pulse outputs T0 - T3
- X4: Labelling clip for firmware version
- LED 1: Supply voltage
- LED 2: FS (Initialise/Run/Stop)
- LED 3: ST (Initialise/Run/Stop)
- LED 4: Diag (Project reset/Identify project)
- LED 5: FAULT (IFault/OFault)

To determine the version of the device, please note:

The firmware version number is on the labelling clip. This is also the version number that must be selected in the PNOZmulti Configurator under **Version** during the hardware configuration.

Base units

PNOZ m B1 Burner

Function description

Functions

The function of the inputs and outputs on the control system depends on the safety circuit created using the PNOZmulti Configurator. A USB memory stick 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 expansion modules accordingly.

The LEDs on the base unit and expansion modules indicate the status of the configurable control system PNOZmulti.

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

Application for furnaces

The base unit PNOZ m B1 Burner is designed for controlling and monitoring furnaces (see online help for the PNOZmulti Configurator).

These include:

Monitoring:

- ▶ Safety chains
- ▶ Combustion air pressure
- ▶ Ignition
- ▶ Flame monitoring
- ▶ External compound controller
- ▶ Tightness control

and controlling:

- ▶ Safety valves
- ▶ Ignition valves
- ▶ Vent valve
- ▶ Ignition
- ▶ External compound controller
- ▶ Combustion air blower

The following oil and gas burner types can be monitored:

- ▶ Master burner with direct ignition
- ▶ Master burner with indirect ignition and joint flame monitoring
- ▶ Master burner with indirect ignition and separate flame monitoring
- ▶ Slave burner with direct ignition
- ▶ Slave burner with indirect ignition and joint flame monitoring
- ▶ Slave burner with indirect ignition and separate flame monitoring

Base units

PNOZ m B1 Burner

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 "PNOZmulti System Expansion".

Base units

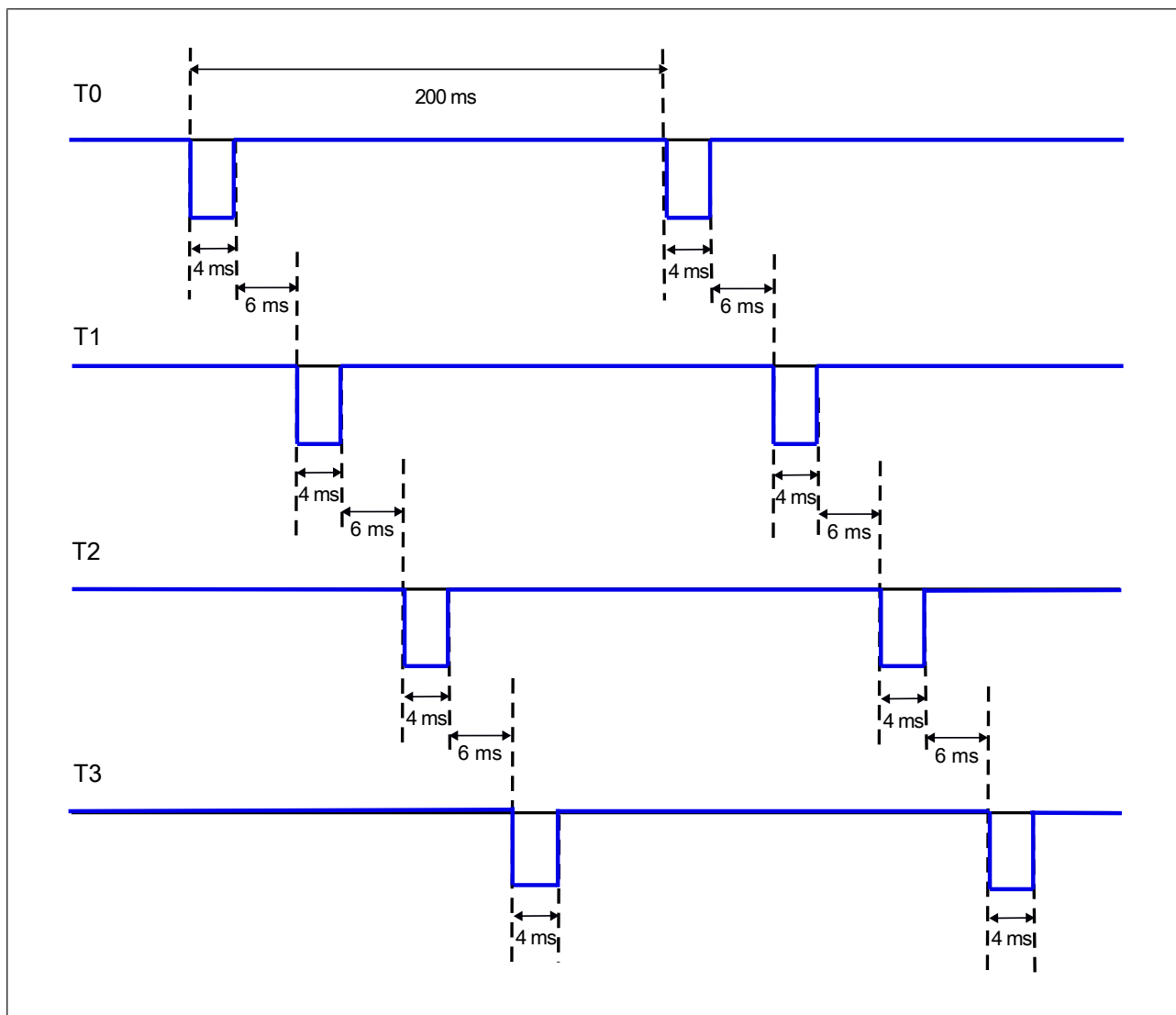
PNOZ m B1 Burner

Detection of shorts across contacts

4 test pulse outputs that use different test pulses (test pulse 0 (T0) ... test pulse 3 (T3)) are available for detecting shorts between the inputs.

Shorts between inputs are detected if the inputs are connected to different test pulses (test pulse 0 ... test pulse 3).

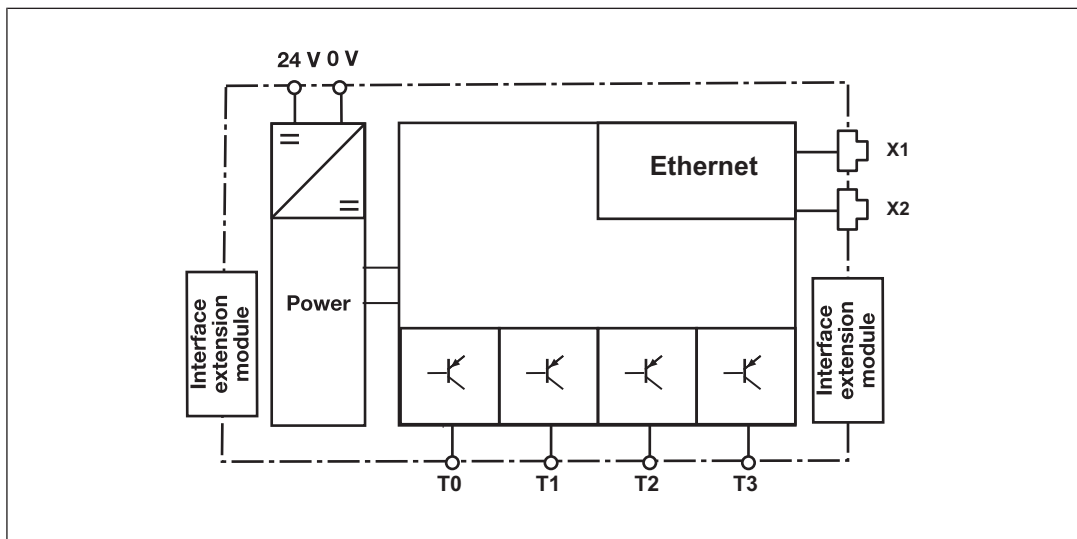
Pulsing of test pulse outputs T0 ... T3 (typical times):



Base units

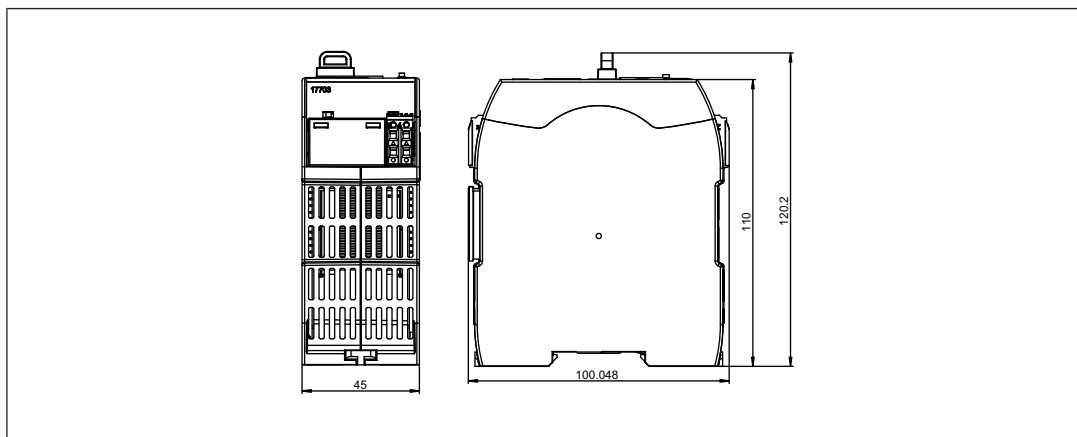
PNOZ m B1 Burner

Block diagram



Installation

Dimensions in mm



Commissioning

General wiring guidelines

The wiring is defined in the circuit diagram in the Configurator. There you can select the inputs that are to perform a safety function and the outputs that are to switch this safety function.

Please note:

- ▶ Information given in the [Technical details \[136\]](#) must be followed.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Base units

PNOZ m B1 Burner

- ▶ Adequate protection circuit must be provided on all output contacts with inductive loads.
- ▶ The safety system and input circuits must always be supplied by a single power supply. The power supply must meet the regulations for extra low voltages with protective separation (SELV, PELV).
- ▶ Test pulse outputs are used to detect shorts between the inputs. Shorts between inputs are detected if the inputs are connected to different test pulses (test pulse 0 ... test pulse 3). Shorts between inputs of the same module with the same test pulses will not be detected.
- ▶ Test pulse outputs must exclusively be used to activate the inputs. They must not be used to drive loads.
Do not route the test pulse lines together with actuator cables within an unprotected multicore cable.
- ▶ The maximum permitted total current of the test pulse outputs is 640 mA.

Connection

Procedure:

- ▶ Connect the supply voltage for the control system:
 - Terminal 24 V: + 24 VDC
 - Terminal 0 V: 0 V,
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

Base units

PNOZ m B1 Burner

Use USB memory

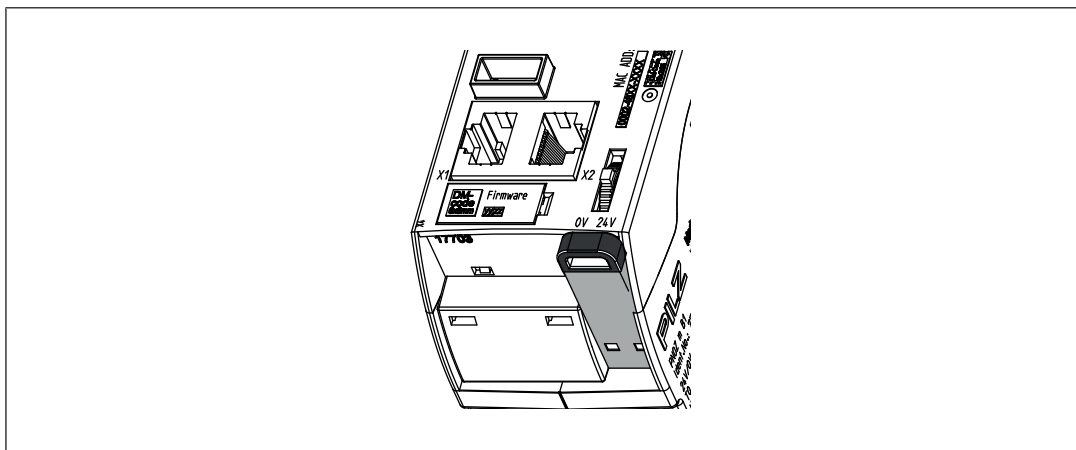
Multiple projects can be stored on the USB memory supplied. One of these can be activated and executed on the base unit.

Please note the following when using the USB memory:

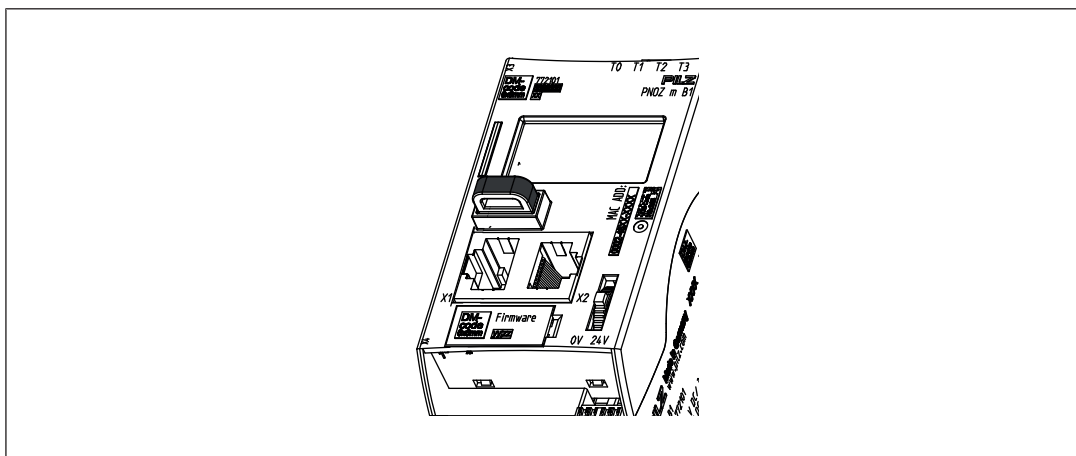
- ▶ The USB memory must always be plugged in during operation.
- ▶ In order to copy projects, for example, the USB memory can be removed and plugged into the PC or into another base unit PNOZ m B1 Burner.
- ▶ Only Pilz USB memories may be used!

Use USB memory

- ▶ Carefully remove the USB memory from the holder on the bottom of the device.



- ▶ Apply light pressure to insert the USB memory into the slot. Take care not to tilt the USB memory. It should be easy to insert.
- ▶ Insert the USB memory into the slot, only as far as the end of the metal housing. The plastic handle must not be inserted

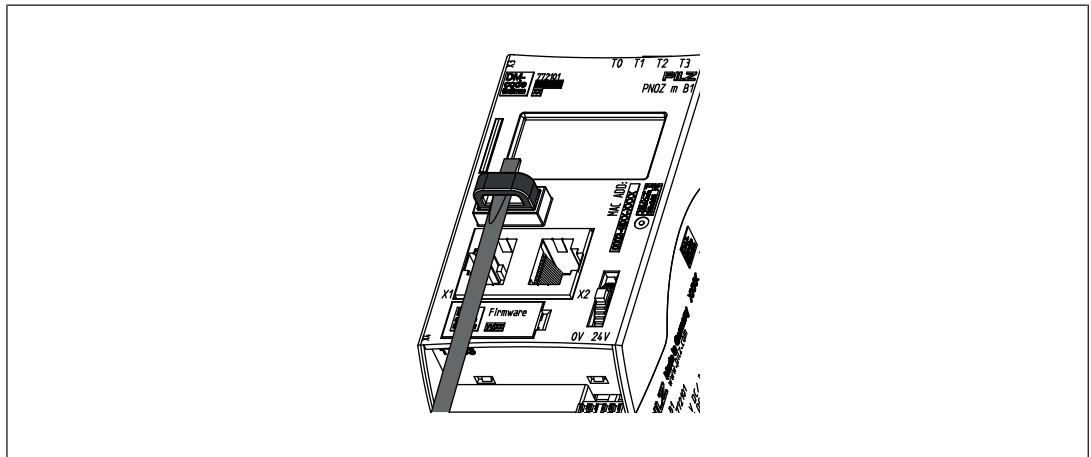


Base units

PNOZ m B1 Burner

Remove USB memory

- ▶ Due to mechanical requirements, the USB memory is inserted tightly within the device and so may be difficult to remove. In this case use an appropriate tool, such as a screwdriver for example, and carefully extract the USB memory (see diagram).



Load project from PNOZmulti Configurator

Projects can be transferred from the PNOZmulti Configurator to the USB memory. Several projects may be stored on the USB memory, A project can be activated directly. This can be performed in the Project Manager of the PNOZmulti Configurator (see online help for the PNOZmulti Configurator).

Procedure:

- ▶ Connect the computer containing the PNOZmulti Configurator to the base unit PNOZ m B1 Burner via the Ethernet interface.
- ▶ Make sure that the USB memory is plugged into the base unit PNOZ m B1 Burner.
- ▶ Switch on the supply voltage.
- ▶ Transfer the required project to the USB memory and activate it on the base unit via the Project Manager on the PNOZmulti Configurator, as described in the online help for the PNOZmulti Configurator.
- ▶ As the project is loaded, the base unit must be stopped and then restarted.
- ▶ Once the project has been loaded successfully and the device has been restarted, the status of the supply voltage is shown on the display. The "RUN" LED is lit.

Activate project via the display on the base unit

A project that is stored on the USB memory can be activated in the base unit via settings on the display.

Procedure:

- ▶ Make sure that the USB memory containing the current project is plugged into the base unit PNOZ m B1 Burner.

Base units

PNOZ m B1 Burner

- ▶ Switch on the supply voltage.
- ▶ Stop the device via the multifunction switch on the display via the menu setting **System mode** -> **Stop system** (for details of how to navigate the display see the section entitled [Display settings \[103\]](#))
- ▶ In the **Project** menu, navigate to the folder containing the required project and select the project file with the extension **.mpnoz2**.
- ▶ Load the project by pressing the multifunction switch and restart via the menu setting **System mode** -> **Restart system**.

Display settings

Various settings can be made and information displayed via the menu on the device's display.

Operate menu

The menu settings are made on the device's display via a multifunction switch. You can switch between the menu levels by pressing or turning the multifunction switch.

Press multifunction switch



- ▶ Confirm selection/setting
- ▶ Switch to sub-menu
- ▶ Exit menu: \..

Move multifunction switch up or down

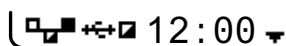


- ▶ Select menu

Displays and settings

The LC display has five lines. Information is shown on the display and settings can be made.









The field at the top right of the display shows information about the connection and instructions for the menu settings:



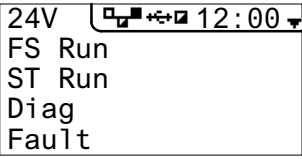

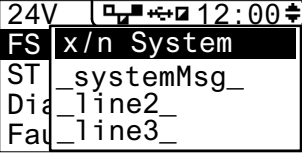
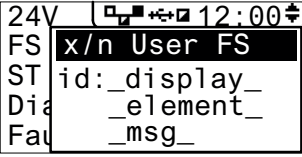


Base units

PNOZ m B1 Burner

Legend:

-  Network connection/traffic
-  USB memory inserted
- 12:00** System time
-  Press the multifunction switch to go back to the higher level menu
-  Press the multifunction switch to access the sub-menu
-  Hold the multifunction switch down for 4 s to confirm the selection or perform the action
-  Press the multifunction switch to obtain information
-  Press the multifunction switch to call up the system message
-  Press the multifunction switch to call up the user message

Status indicators

Display	Display	Description
Permanent display	 	LED display ▶ A warning symbol shows that a message is present, which can be called up
System / User... System or display messages	 	 System message is present or  User message is present (user-specific messages that are created in the PNOZmulti Configurator)

Base units

PNOZ m B1 Burner

Project menu

In the **Project** menu you can display information about the project that is activated on the device. You can also activate a different project from the USB memory on the device. See also [Activate project via the display on the base unit \[125\]](#) and reset the project on the device.

Display	Display	Description
Info:		Information is displayed about the project activated on the device
Name Project name		Name of project
Date / Time Creation data and time		Date and time that the project was created
Check sums FS Overall check sum and check sums of main program		Display of check sums: <ul style="list-style-type: none"> ▶ Overall project check sum ▶ Check sum safe of main program ▶ Check sum safe of main program without level 3
Check sums DP pos x Check sums of module program	 	Display of check sums of module program <ul style="list-style-type: none"> ▶ Check sum safe ▶ Check sum safe without level 3
History: Project history		Project information is displayed for one of the last 16 projects activated

Base units

PNOZ m B1 Burner

Display	Display	Description
Name Date / Time Check sum FS Check sum DP pos x ...		Display of project information for a selected project
Select: Activate project		Select project contained in the USB memory and activate it on the base unit <ul style="list-style-type: none"> ▶ Prerequisite: Device must be stopped ▶ Hold down multifunction switch for 4 s in order to activate the project
Reset: Reset or update project.		After a reset, the active project is reloaded from the USB memory <ul style="list-style-type: none"> ▶ Prerequisite: Device must be stopped ▶ Hold down multifunction switch for 4 s in order to reset

Base units

PNOZ m B1 Burner


Device Info menu

Display	Example	Description
Device Info		<p>Information on the base unit and expansion modules. Overview:</p> <ul style="list-style-type: none"> ▶ Position/slot ▶ Device type ▶ Firmware version
Device information for module		<p>Show device information for a selected module:</p> <ul style="list-style-type: none"> ▶ Order number ▶ Serial number ▶ Software versions ▶ Hardware version ▶ Operating hours

Base units

PNOZ m B1 Burner

Error Stack menu

Display	Example	Description
Error stack	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: right;">x / 256 ← →</p> <p>Date 2014-01-31</p> <p>Time 23:59:59</p> <p>Chn AB ST</p> <p>EC EN 01 AB</p> </div> <div style="text-align: center;">  </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: right;">x / 256 ← →</p> <p>EC EN 01 AB</p> <p>EP 00 01 02 03</p> <p>04 05 06 07</p> </div>	<p>Display of entries in the error stack (see also section entitled Show error stack on the display)</p> <p>To read the error stack entries please refer to the document <i>PNOZmulti Error Messages</i></p>

Operating Info menu

Display	Example	Description
Operating Info	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: right;">Pos Baseunit ← →</p> <p>FS cyc1 10000us</p> <p>FS cpu 80%</p> </div>	<p>Display of specific operating parameters for the base unit and expansion modules.</p> <p>e.g.: cycle time, operating temperature, frequencies</p>

Base units

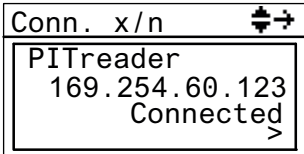
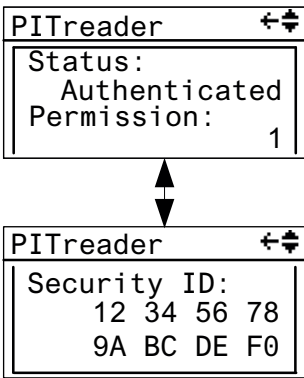
PNOZ m B1 Burner

Connections menu

In the **Connections** menu the connections to the PNOZmulti can be displayed.

Base units

PNOZ m B1 Burner

Display	Example	Description
Conn. x/n		<p>Information on the connected device:</p> <ul style="list-style-type: none"> ▶ Device ▶ IP address ▶ Connection status: <ul style="list-style-type: none"> – Connected: Connected – Connecting: Connecting – Failed: Connection has failed – Error: Error in the connection
PITreader		<p>Status information on PITreader:</p> <ul style="list-style-type: none"> ▶ Status: <ul style="list-style-type: none"> – Authenticated: PITreader detected the transponder key. Permission exists – No key: There is no transponder key inserted in PITreader – No permission: The transponder key has no permission (permission = 0) – Auth. failed: Authentication has failed. The data from PITreader are invalid – Not ready: The connection to PITreader is interrupted. ▶ Permission: Permission 1... 64 of the transponder key <p>Security ID: Safety identifier of the transponder key</p>

Base units

PNOZ m B1 Burner

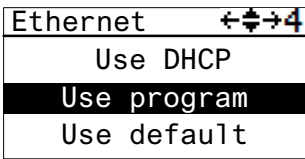
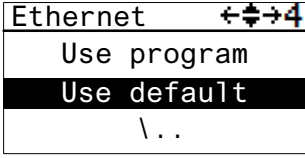
Ethernet menu

The Ethernet configuration can be displayed and changed in the **Ethernet** menu.

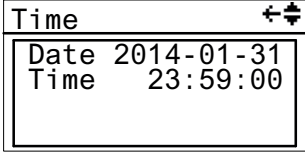
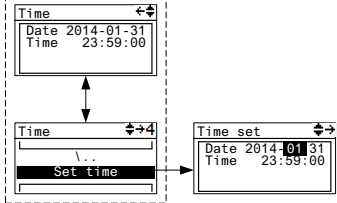
Display	Example	Description
Information	<p>The example shows three sequential screenshots of the Ethernet menu. The first shows 'IP address: DHCP' with '169.254.60.1' and 'Subnet mask: 255.255.0.0'. The second shows 'Gateway: 0.0.0.0' and 'PG port: 9000'. The third shows 'Scan port: 10000'. Arrows indicate the sequence of screens.</p>	Display of the current Ethernet configuration
Change	<p>The screenshot shows the Ethernet menu with options: 'Info', 'Change' (highlighted), and '..'.</p>	Change Ethernet configuration...
Edit IP Change IP address	<p>The screenshot shows the 'Edit IP address' screen with three input fields: 'IP address: 169.254.60.001', 'Subnet mask: 255.255.000.000', and 'Gateway: 000.000.000.000'.</p>	<ul style="list-style-type: none"> ▶ IP address ▶ Subnet mask ▶ Gateway Adjust -> Hold down multifunction switch for 2 s in order to access change mode
Edit ports Change IP address	<p>The screenshot shows the 'Edit ports' screen with 'PG port: 9100' and 'Scan port: 10000'.</p>	Adjust PG port and scan port -> Hold down multifunction switch for 2 s in order to access change mode
Use DHCP Change IP address	<p>The screenshot shows the Ethernet menu with options: 'Edit ports', 'Use DHCP' (highlighted), and 'Use program'.</p>	Obtain IP address automatically from the network (prerequisite: Network has a DHCP Server utility) -> Hold down multifunction switch for 2 s in order to perform the action

Base units

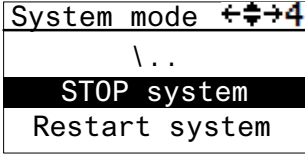
PNOZ m B1 Burner

Display	Example	Description
Use program Change IP address	 <pre> Ethernet ←↕→4 Use DHCP Use program Use default </pre>	Load Ethernet settings from the active PNOZmulti project -> Hold down multifunction switch for 2 s in order to perform the action
Use default Change IP address	 <pre> Ethernet ←↕→4 Use program Use default \.. </pre>	Load default settings IP address: 169.254.60.1 Subnet mask: 255.255.0.0 Gateway: 0.0.0.0 -> Hold down multifunction switch for 2 s in order to perform the action

Time menu

Display	Example	Description
Time Show date and time	 <pre> Time ←↕→ Date 2014-01-31 Time 23:59:00 </pre>	Show system's date and time
Set time Set date and time	 <pre> Time ←↕→ Date 2014-01-31 Time 23:59:00 </pre> <pre> Time ←↕→4 \.. Set time </pre> <pre> Time set ←↕→ Date 2014.01.31 Time 23:59:00 </pre>	Change date and time -> Hold down multifunction switch for 2 s in order to access change mode

System mode menu

Display	Example	Description
Stop system Restart system	 <pre> System mode ←↕→4 \.. STOP system Restart system </pre>	Stop system Restart system -> Hold down multifunction switch for 4 s in order to perform the actions

Base units

PNOZ m B1 Burner

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	0x62
Electrical data	
Supply voltage	
for	Supply to the system
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Output of external power supply (DC)	18,5 W
Output of external power supply (DC) at no load	3 W
Max. power dissipation of module	4,5 W
Status indicator	Display, LED
Test pulse outputs	
Number of test pulse outputs	4
Voltage	24 V
Current	0,32 A
Max. duration of off time during self test	4 ms
Short circuit-proof	Yes
Potential isolation	No
Ethernet interface	
Quantity	2
IP address (automatically off)	169.254.60.1
Connection type	RJ45
Transmission rate	10 MBit/s, 100 MBit/s
Times	
Simultaneity in the two-hand circuit	0,5 s
Processing time	30 ms
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C

Base units

PNOZ m B1 Burner

Environmental data	
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Humidity	93 % r. h. at 40 °C
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Sum of individual cable lengths at the test pulse output	2 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Cage clamp terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm

Base units

PNOZ m B1 Burner

Mechanical data

Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector		0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection		2
Stripping length with spring-loaded terminals		9 mm
Dimensions		
Height	101,4 mm	
Width	45 mm	
Depth	120,2 mm	
Weight	209 g	

Where standards are undated, the 2019-07 latest editions shall apply.

Safety characteristic data

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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
2-channel	PL e	Cat. 4	SIL 3	4,19E-10	SIL 3	3,65E-05	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_M 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.

Base units

PNOZ m B1 Burner

Order reference

Product

Product type	Features	Order no.
PNOZ m B1 Burner	Configurable safe small controllers PNOZmulti 2, base unit, expandable, communication connection, 2 Ethernet interfaces, USB memory, specifically for burner applications.	772102

Accessories

Terminals

Product type	Features	Order no.
Set4 Screw Terminals	Set of plug-in screw terminals for PNOZ m B1, base unit, small controllers PNOZmulti2.	750016
Set4 Spring Terminals	Set of spring-loaded terminals for PNOZ m B1, base unit, small controllers PNOZmulti 2.	751016

USB memory

Product type	Features	Order no.
USB Memory 512MB	USB memory, 512 MB, for PNOZ m B1, base unit PNOZmulti 2.	779213

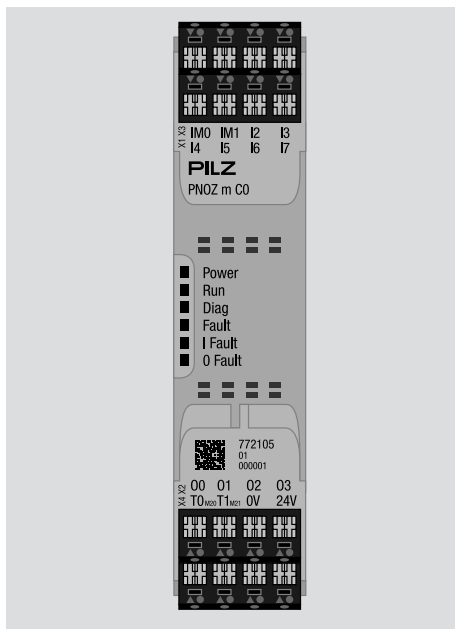
Plug-in connector

Product type	Features	Order no.
RJ45 Connector	RJ45 plug-in connector, straight, IP20, 8-pin, Cat6a, IDC connection, AWG22, cable diameter: 5.5 - 8.5 mm	380401

Terminating plug

Product type	Features	Order no.
PNOZ mm0.xp terminator left (10 pcs.)	Terminator on the left-hand side of the base unit PNOZmulti, yellow/black (10 pieces).	779261

Base units PNOZ m C0



Overview

Unit features

Application of the product PNOZ m C0:

Standalone base unit of the configurable control system PNOZmulti 2

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Semiconductor outputs:
 - 4 safety outputs
depending on the application, up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061
- ▶ 8 safe inputs for connecting, for example:
 - Emergency stop pushbuttons
 - Two-hand pushbuttons
 - Safety gate limit switches
 - Start buttons
 - Light barriers
 - Scanner
 - Enabling switches
 - PSEN

Base units PNOZ m C0

- Operating mode selector switches

Alternatively, inputs IM0 and IM1 can be configured as signal outputs.

The pulse suppression time for the inputs can be changed in the PNOZmulti Configurator. A change of the preset pulse suppression time (see [Technical details \[151\]](#)) can be used to suppress the self-monitored outputs and for interference suppression.

- ▶ 2 configurable outputs

Can be configured as:

- Test pulse outputs

or

- Signal outputs

- ▶ LED display for:

- Supply voltage
- Run operating state
- Diagnostics
- Internal and external fault
- Fault at the outputs
- Fault at the inputs

- ▶ 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 accessories (see Order references)

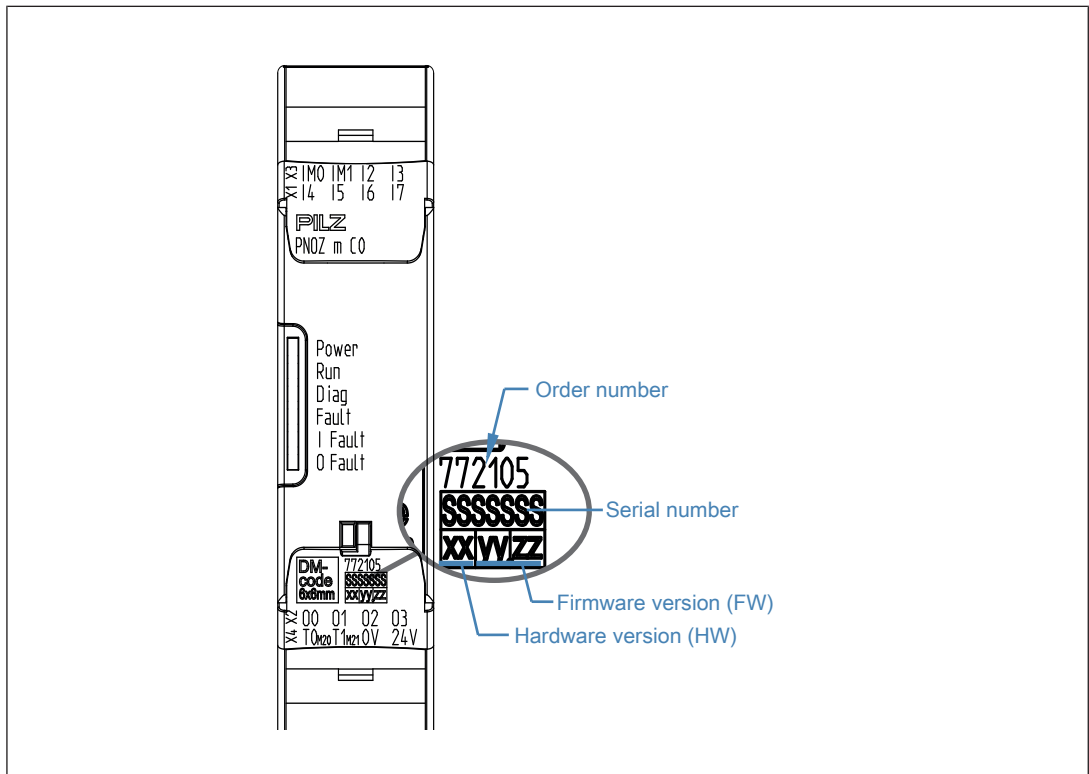
Chip card

As an option, a chip card can be used to transfer project data.

Chip cards with 8 kByte and 32 kByte memories are available. For large-scale projects we recommend the 32 kByte chip card (see Technical Catalogue: Accessories).

Base units PNOZ m C0

Front view



Legend

- X1: Inputs I4 ... I7
- X2: Semiconductor outputs O0 ... O3
- X3: Configurable inputs/outputs IM0 and IM1
Inputs I2 ... I3
- X4: Configurable test pulse/auxiliary outputs T0M20 and T1M21
Supply connections 24 V and 0 V
- LEDs: Power
- Run
- Diag
- Fault
- I Fault
- O Fault

Base units PNOZ m C0

Security

To secure plants, systems, machines and networks against cyberthreats it is necessary to implement (and continuously maintain) an overall industrial security concept that is state of the art.

Perform a risk assessment in accordance with VDI/VDE 2182 or IEC 62443-3-2 and plan the security measures with care. If necessary, seek advice from Pilz Customer Support.

Implemented security measures

- ▶ To carry out relevant operations in the PNOZmulti Configurator, a user must authenticate himself on the device with user name and password.
- ▶ Multiple users with different permissions can be created and configured in the PNOZmulti Configurator.
The user data is transmitted to the device and stored there.
- ▶ In the base unit PNOZ m C0 a security device key can be stored.
The security device key includes the following functions:
 - Verifiable trust anchor in the device for the plant manufacturer.
In the PNOZmulti Configurator you can verify whether a device key from device key management matches the device key on the connected device.
 - Ensure the authenticity of project data on the chip card
The base unit PNOZ m C0 accepts project data on the chip card only if it has been generated using the identical security device key.

Required security measures

- ▶ The product is not protected from physical manipulation or from reading of memory contents during physical access. Use appropriate measures to ensure that there is no physical access by unauthorised persons. You should also use security seals so that you can detect any manipulation of the product or interfaces. Installation inside a lockable control cabinet is recommended as a minimum measure.
- ▶ Protect the configuration and log data from unauthorised changes.
- ▶ Check the product's log for unauthorised program changes on a regular basis.
- ▶ A factory-set default password is active on the base unit along with permissions for users who are not logged in. Change the password immediately after logging in for the first time.
- ▶ Assign different permissions for the various user groups (e.g. diagnostics - configuration).
- ▶ The project data on the chip card is not protected when the security device key is not used, and it can be read by unauthorised persons.
 - Use the security device key to protect the project data during transfer
or
 - Remove the chip card.

Base units PNOZ m C0

- ▶ Only assign strong passwords and handle the passwords carefully. Be guided by generally accepted guidelines such as NIST 800-63b for example.

Function description

Functions

The function of the inputs and outputs on the control system depends on the user program created using the PNOZmulti Configurator. The user program is transferred to the base unit via chip card or via the USB port. The base unit has 2 microcontrollers that monitor each other. They evaluate the base unit's input circuits and switch the outputs accordingly.

The LEDs on the base unit indicate the status of the configurable control system PNOZmulti.

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

Reaction times

$t_{\text{ReactionMax}} = t_{\text{Max input delay}} + t_{\text{Max processing time}} + t_{\text{Max switch-off delay at the output}}$

Please note that the reaction time is also increased by

- ▶ Delay times configured in the user program
- ▶ Delay on the sensor that is used
- ▶ Delay on the actuator that is used

Example configuration: PNOZ m C0

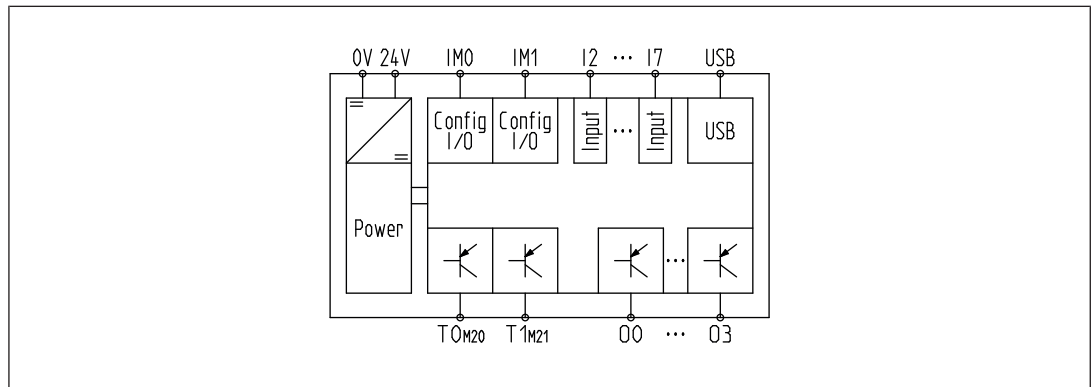
Input PNOZ m C0 Max. input delay	Processing in the user program Processing time	Output PNOZ m C0 Switch-off delay
14ms	5 ms	1 ms

$$t_{\text{ReactionMax}} = 14 \text{ ms} + 5 \text{ ms} + 1 \text{ ms}$$

$$t_{\text{ReactionMax}} = 20 \text{ ms}$$

Base units PNOZ m C0

Block diagram



Device security

User management

The base unit PNOZ m C0 can be protected from unauthorised access via user management.

In order to access the device or perform specific actions via the PNOZmulti Configurator, a user must use his credentials to authenticate himself.

A user account can be created for each user in the PNOZmulti Configurator's user management.

There are user groups that have access permissions with pre-defined permissions.

A user group is assigned to each user account.

Each user account obtains a unique user name and a password.

When you log into a new device for the first time or after a factory reset has been performed, use the factory-set default credentials to log in as administrator:

Login name	admin
Password	pilz

As administrator you have all the available permissions. Change the default password immediately after logging in for the first time.

User management is configured in the PNOZmulti Configurator and transferred to the device.

Detailed information on user management and how it is configured can be found in the online help for the PNOZmulti Configurator.

Security device key

In the base unit PNOZ m C0 a security device key can be stored.

The security device key includes the following functions:

Base units PNOZ m C0

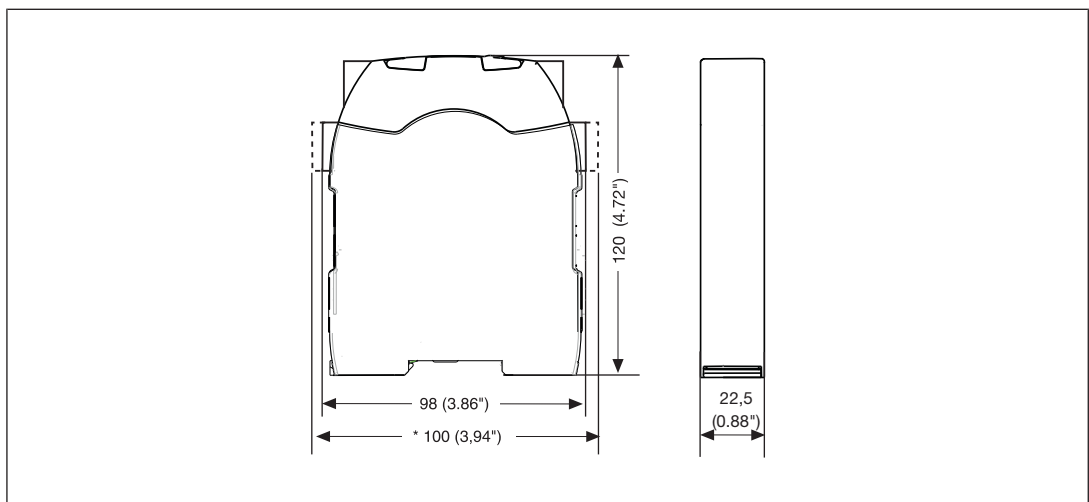
- ▶ Verifiable trust anchor in the device for the plant manufacturer. In the PNOZmulti Configurator you can verify whether a device key from device key management matches the device key on the connected device.
- ▶ Ensure authenticity of project data on the chip card
The PNOZ m C0 accepts project data on the chip card only if it has been generated using the identical security device key. This happens automatically when project data is transferred via the PNOZmulti Configurator or by selecting the correct security device key when the project data is saved directly to the chip card using the PNOZmulti Configurator. The project data is saved on the chip card in encrypted form.
The security device key is generated, edited, written and verified in the PNOZmulti Configurator in security device key management.

A factory reset resets the security device key.

Users who are signed in as administrators can overwrite the security device key. In this case, a prior factory reset is not required.

Installation

Dimensions in mm



Commissioning

General wiring guidelines

The wiring is defined in the circuit diagram in the Configurator. There you can select the inputs that are to perform a safety function and the outputs that are to switch this safety function.

Note:

Base units PNOZ m C0

- ▶ Information given in the [Technical details \[151\]](#) must be followed.
- ▶ Outputs O0 to O3 are semiconductor outputs
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ Sufficient protection circuit must be provided on all output contacts with inductive loads.
- ▶ The safety system and input circuits must always be supplied by a single power supply. The power supply must meet the regulations for extra low voltages with protective separation (SELV/PELV).
- ▶ Do not route the test pulse cables together with actuator cables within an unprotected sheathed cable.

Connection

Procedure:

- ▶ Wire the inputs and outputs on the base unit in accordance with the circuit diagram.
- ▶ Connect the supply voltage:
 - Terminal 24 V: + 24 V DC
 - 0V terminal: 0 V

Input circuit	Single-channel	Dual-channel
Emergency stop without detection of shorts across contacts		
Emergency stop with detection of shorts across contacts		
Start circuit	Input circuit without detection of shorts across contacts	Input circuit with detection of shorts across contacts

Base units PNOZ m C0

Semiconductor outputs		
Redundant output		
Single output		
Single output with advanced fault detection*		

*Two loads may be connected to each safety output with advanced fault detection, even on applications in accordance with EN IEC 62061, SIL 3. Prerequisite: Feedback loop is connected, shorts across contacts and external power sources are excluded (e.g. through separate multicore cables). Please note that, in the event of an error in the feedback loop, the safety system switches to a safe state and shuts down **all** the outputs.

Feedback loop	Redundant output	
Contacts from external contactors		

Base units PNOZ m C0

Load project from chip card

If you have a brand new device and a chip card containing a project is inserted, the project on the chip card is transferred to the base unit's internal memory when the device is switched on.

For devices that have already been used, proceed as follows:

- ▶ Insert the chip card containing the current project into the card slot on the base unit.
- ▶ Switch on the supply voltage.
- ▶ Remove the chip card as soon as the chip card has been detected by the base unit and the Run and Diag LEDs flash.
The chip card must be removed no later than 3s after the chip card is detected.
If the chip card has been removed within the required time, the Diag LED lights and the Run LED is off.
- ▶ Insert the chip card back into the card slot within 5 s.
When the chip card has once again been detected, the project is transferred into the base unit's internal memory. The Diag LED flashes
- ▶ Once the project has been transferred successfully, the chip card can be left inserted in the base unit or can be removed.

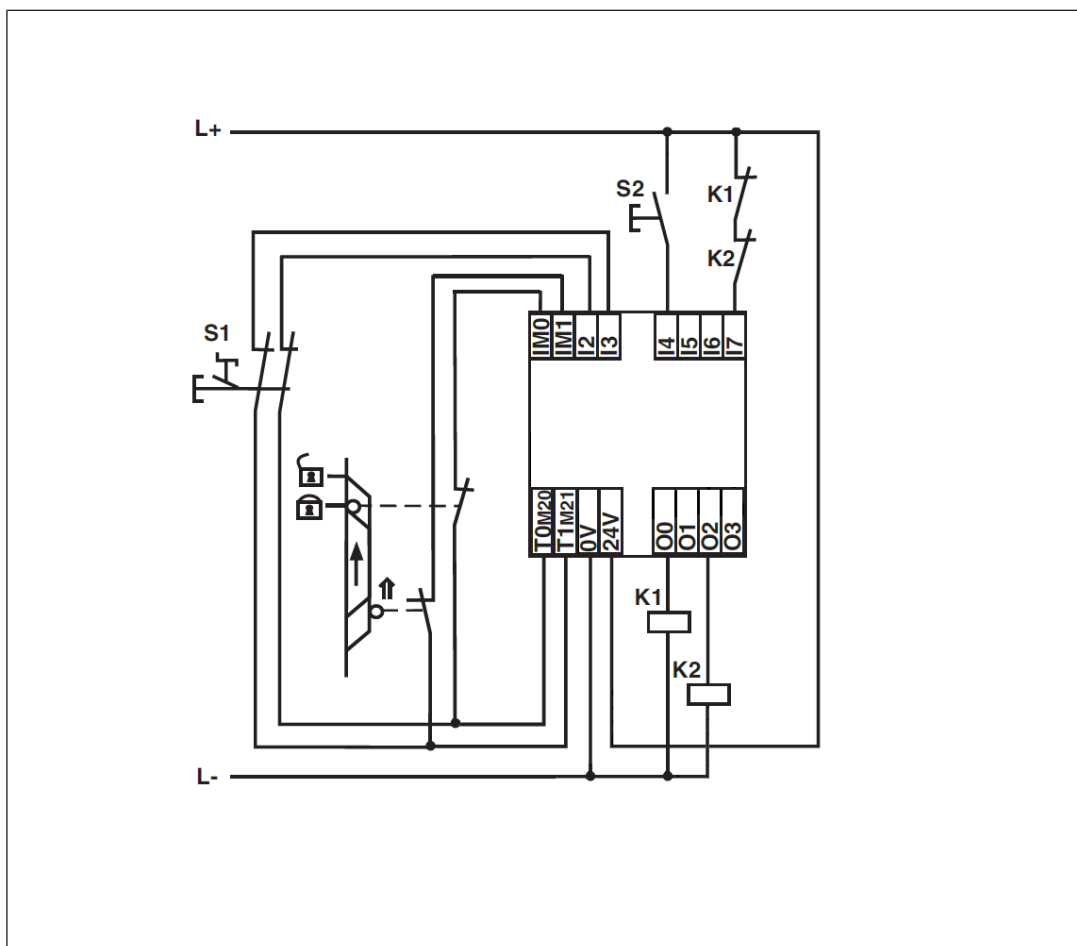
Load project via USB port

Procedure:

- ▶ Connect the computer containing the PNOZmulti Configurator to the base unit via the USB port.
- ▶ Switch on the supply voltage.
- ▶ Download the project (see PNOZmulti Configurator's online help).

Base units PNOZ m C0

Connection example



Factory reset

A factory reset of the device is always sensible or indeed necessary when the device is removed from the existing plant/machine, possibly to re-use it in another application.

During a factory reset, all the data stored in the device is reset:

- ▶ Project data is deleted from the internal memory.
- ▶ If a chip card is inserted, it is deleted and formatted.
- ▶ Error stack is deleted
- ▶ Program change log is deleted
- ▶ Configured user data (user name, passwords, permissions) is deleted and is reset to the default values.

You can initiate a factory reset both in the PNOZmulti Configurator (see online help for the PNOZmulti Configurator) and also directly on the device.

Base units PNOZ m C0

Initiate factory reset directly on the device

Procedure:

- ▶ Switch off the supply voltage to the base unit.
- ▶ Create a short across the contacts at o3 to the 24 V of the supply voltage.
- ▶ Switch on the supply voltage.
- ▶ Remove the short across the contacts from o3 as soon as the short has been detected by the base unit and the OFault and Diag LEDs flash.
The short across the contacts must be removed no later than 3s after the short is detected.
- ▶ When the o0 terminal LED lights, create a short across the contacts at o0 to 24 V and then remove it as soon as the o0 LED goes out.
- ▶ When the o3 terminal LED lights, create a short across the contacts at o3 to 24 V and then remove it as soon as the o3 LED goes out.

The base unit performs a factory reset, which is completed successfully when the Diag LED flashes rapidly.

Maintenance and testing

It is not necessary to perform maintenance work on the product in normal operation. Please return any faulty products to Pilz.

Technical details

General	
Certifications	CE, TÜV, UKCA
Application range	Failsafe
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	8,5 A
Output of external power supply (DC)	204 W
Output of external power supply (DC) at no load	1,1 W
External unit fuse protection F1	10 A, circuit breaker 24 V DC, characteristic B
Max. power dissipation of module	4 W
Status indicator	LED
Permitted loads	inductive, capacitive, resistive

Base units PNOZ m C0

Configurable inputs/outputs (inputs or auxiliary outputs)

Quantity	2
Potential isolation	No
Configurable inputs	
Input voltage in accordance with EN 61131-2 Type 1	24 V
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	14 ms
Configurable auxiliary outputs	
Voltage	24 V
Output current	100 mA
Output current range	0 - 120 mA
Max. transient pulsed current	200 mA
Short circuit-proof	Yes
Residual current at "0"	0,05 mA
Voltage at "1"	UB - 2 V at 0.1 A

Inputs

Quantity	6
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	14 ms
Potential isolation	No

Semiconductor outputs

Number of positive-switching single-pole semiconductor outputs	4
Switching capability	
Voltage	24 V
Current	2 A
Permitted current range	0,000 - 2,400 A
Residual current at "0" signal	0,05 mA
Max. transient pulsed current	4 A
Max. capacitive load	1 µF
Max. internal voltage drop	500 mV
Max. duration of off time during self test	400 µs
Switch-off delay	1 ms
Potential isolation	No
Short circuit-proof	Yes

Base units PNOZ m C0

Test pulse outputs	
Number of test pulse outputs	2
Voltage	24 V
Current	0,1 A
Max. duration of off time during self test	4 ms
Short circuit-proof	Yes
Potential isolation	No
USB interface	
Connection	Mini-B socket
Max. cable length	3 m
Times	
Simultaneity in the two-hand circuit	0,5 s
Processing time	5 ms
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 65 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2

Base units PNOZ m C0

Environmental data

Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Mechanical data

Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	1 km
Sum of individual cable lengths at the test pulse output	2 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	105 g

Where standards are undated, the 2022-02 latest editions shall apply.

Base units PNOZ m C0

Safety characteristic data

Unit	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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
------	----------------	----------------------------	----------------------------------	---	--	---------------------	---------------------	---

Input								
Inputs	1-channel	PL d	Cat. 2	SIL 2	7,75E-09	SIL 2	6,80E-04	20
Inputs	2-channel	PL e	Cat. 4	SIL 3	1,65E-10	SIL 3	1,42E-05	20
Inputs	1-ch., pulsed light bar- rier	PL e	Cat. 4	SIL 3	7,75E-10	SIL 3	6,85E-05	20
Output								
SC outputs	1-channel with ad- vanced fault de- tection	PL e	Cat. 4	SIL 3	4,49E-10	SIL 3	3,84E-05	20
SC outputs	1-channel	PL d	Cat. 2	SIL 2	7,08E-10	SIL 2	6,03E-05	20
SC outputs	2-channel	PL e	Cat. 4	SIL 3	4,66E-10	SIL 3	4,00E-05	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_M 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.

Base units PNOZ m C0

Classification according to ZVEI, CB24I

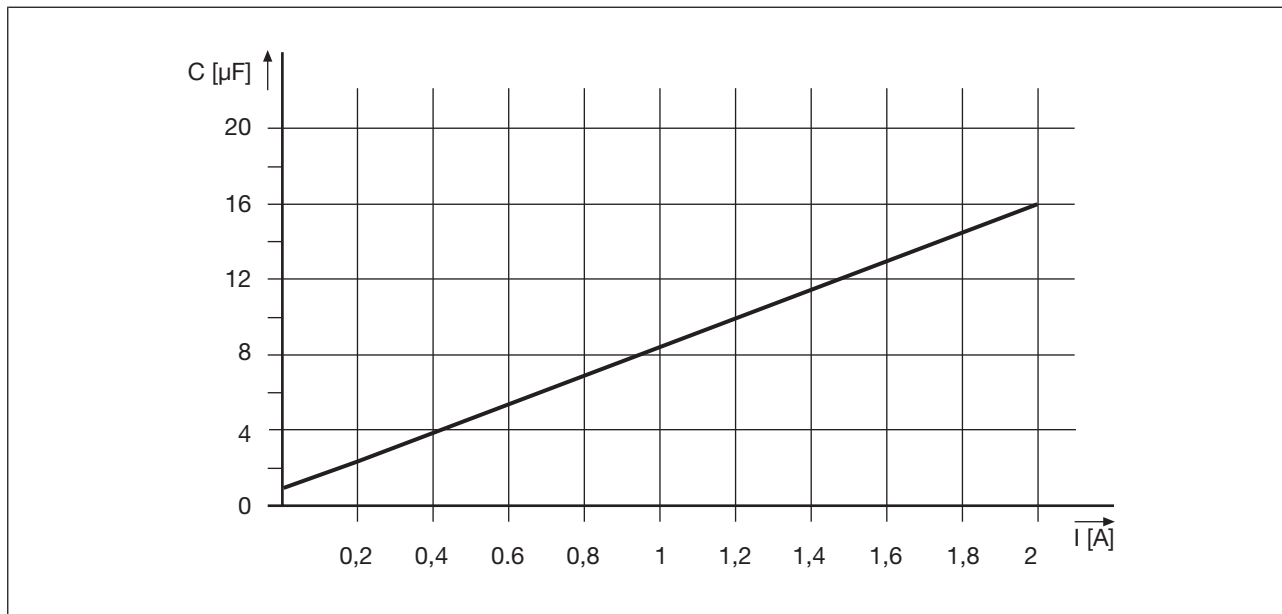
The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Input	
Interfaces	
Drain	
Interface	Module
Class	C2
Source	
Interface	Sensor
Class	C2, C3
Drain parameters	
Max. test pulse duration	500 μs
Min. input resistance	3,6 kOhm
Max. capacitive load	65 nF
Single-pole output	
Interfaces	
Source	
Interface	Module
Class	C2
Drain	
Interface	Actuator
Class	C1, C2
Parameter source	
Max. test pulse duration	400 μs
Max. rated current	2 A
Max. capacitive load	1 μF

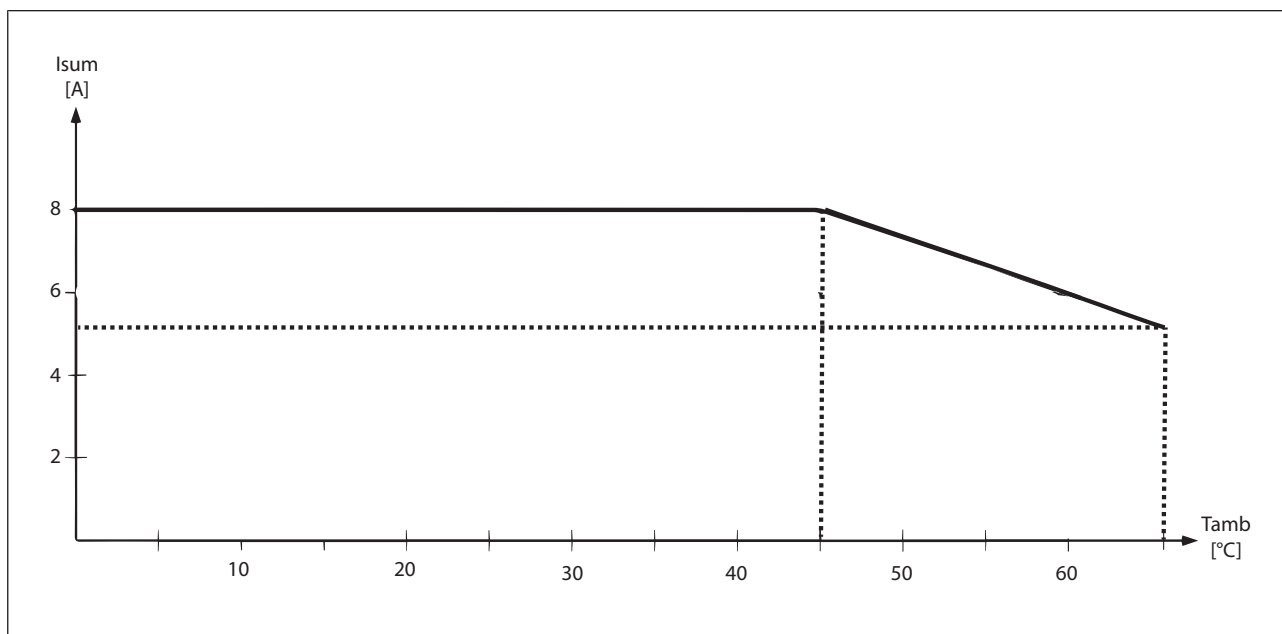
Base units PNOZ m C0

Supplementary data

Maximum capacitive load C (μF) with load current I (A) at the semiconductor outputs



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



A derating of 133 mA per 1°C must occur from an ambient temperature of 45°C and above.

Base units PNOZ m C0

Order reference

Product

Product type	Features	Order no.
PNOZ m C0	Configurable safe small controllers PNOZmulti 2, standalone base unit, non-expandable, 8 inputs, 4 safe semiconductor outputs.	772105

Accessories

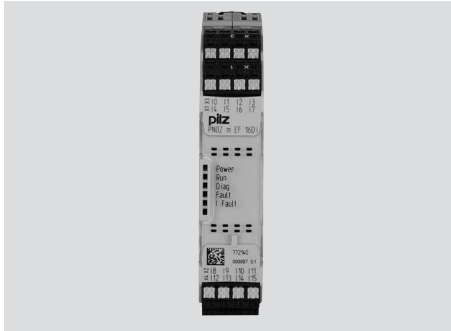
Replacement terminals

Product type	Features	Order no.
PNOZ s Setscrew terminals 22.5mm	Set of plug-in replacement terminals 4-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750004
PNOZ s Setspring-loaded terminals 22.5mm	Set of plug-in replacement terminals 4-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751004

Cable

Product type	Features	Order no.
PSSu A USB-CAB03	PSSu, USB cable, length 3 m.	312992
Cable/XX/USB-ASM/MIN-BAMX/U/003/Q009/SH	Connection cable, USB 2.0 Type A on USB 2.0 Type Mini-B, conductor cross section: 0.09 mm ² , shielded, cable length: 3 m	772300

Input module PNOZ m EF 16DI



Overview

Unit features

Application of the product PNOZ m EF 16DI:

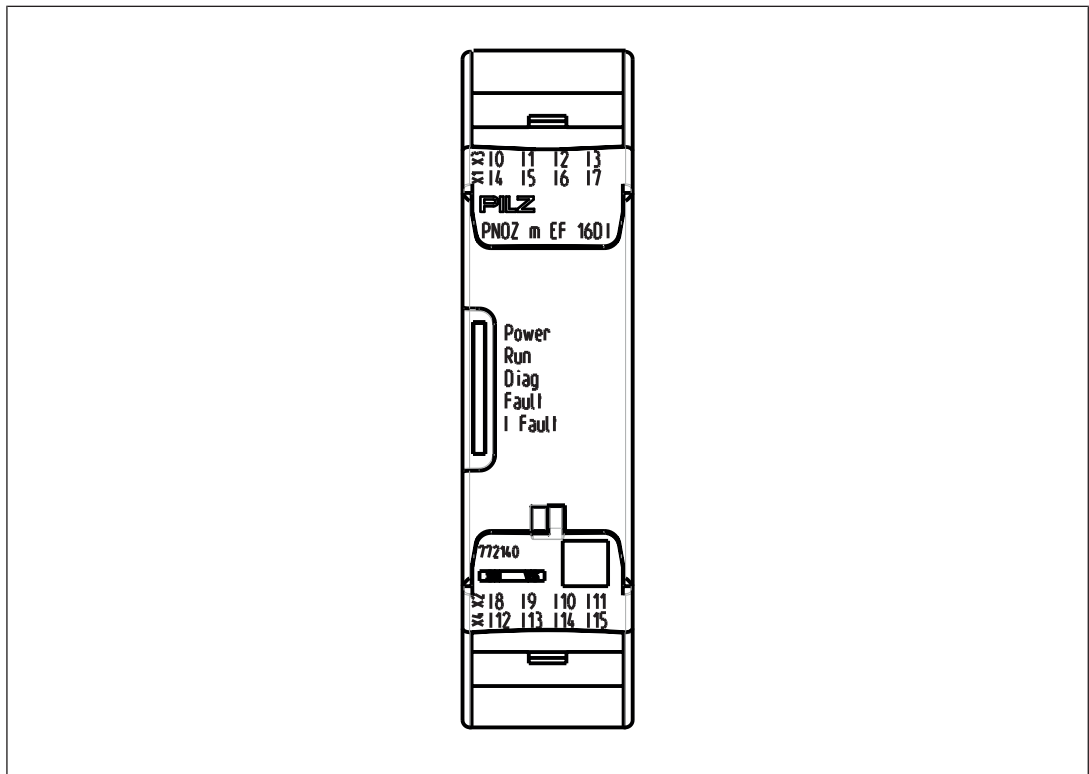
Expansion module for connection to a base unit from the system.

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ 16 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
- ▶ Test pulse outputs used to monitor shorts across the inputs
- ▶ 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.

Input module PNOZ m EF 16DI

Front view



Legend:

- ▶ Inputs I0 – I15
- ▶ LEDs:
 - POWER
 - Run
 - Diag
 - Fault
 - I Fault

To determine the version of the device, please note:

The firmware version number is on the labelling clip. This is also the version number that must be selected in the PNOZmulti Configurator under **Version** during the hardware configuration.

Input module PNOZ m EF 16DI

Function description

Functions

The expansion module provides additional inputs.

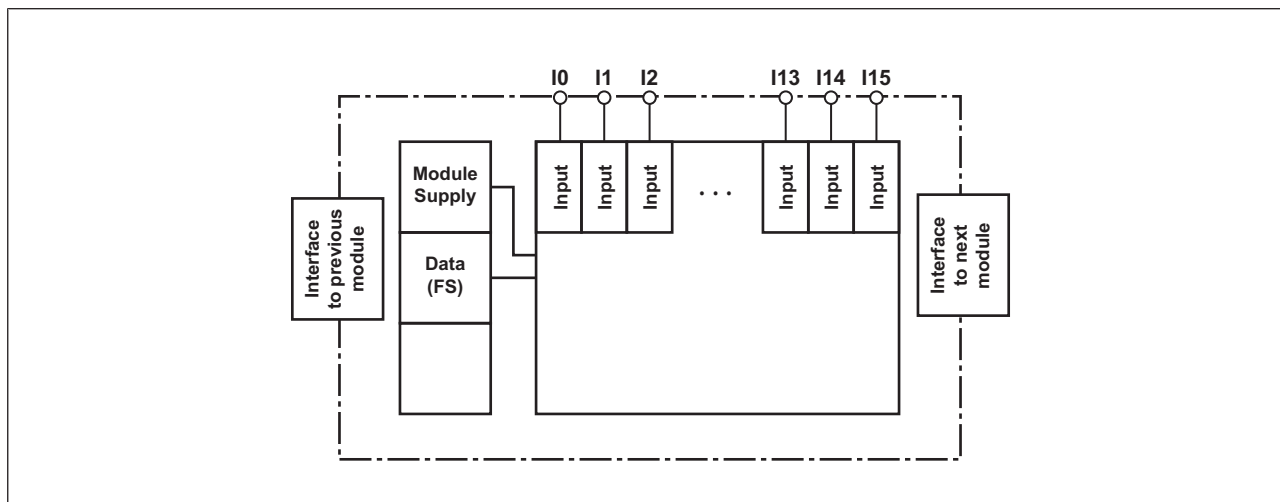
The function of the inputs on the safety system depends on the safety circuit created using the PNOZmulti Configurator. A removable data medium is used to download the safety circuit to the base unit. The base unit has 2 microcontrollers that monitor each other. They evaluate the input circuits on the 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 safety system, plus connection examples.

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 "PNOZmulti System Expansion".

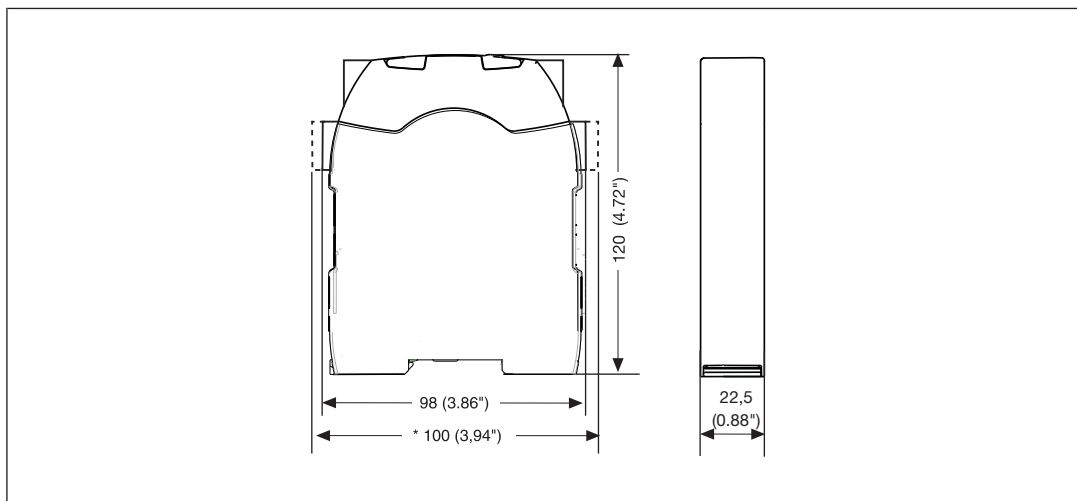
Block diagram



Input module PNOZ m EF 16DI

Installation

Dimensions in mm



Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[163\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Connection

Input circuit	Single-channel	Dual-channel
Example: E-Stop without detection of shorts across contacts		
Example: E-Stop with detection of shorts across contacts		

Input module PNOZ m EF 16DI

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E2h
Electrical data	
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	46 mA
Power consumption	1,1 W
Max. power dissipation of module	3 W
Status indicator	LED
Inputs	
Quantity	16
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	8 ms
Potential isolation	No
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g

Input module PNOZ m EF 16DI

Environmental data

Shock stress		
in accordance with the standard		EN 60068-2-27
Acceleration		15g
Duration		11 ms
Airgap creepage		
in accordance with the standard		EN 61131-2
Overtoltage category		II
Pollution degree		2
Rated insulation voltage		30 V
Protection type		
in accordance with the standard		EN 60529
Housing		IP20
Terminals		IP20
Mounting area (e.g. control cabinet)		IP54

Mechanical data

Mounting position		horizontally on mounting rail
DIN rail		
Top hat rail		35 x 7,5 EN 50022
Recess width		27 mm
Cable length		
Max. cable length per input		1 km
Material		
Bottom		PC
Front		PC
Top		PC
Connection type		Spring-loaded terminal, screw terminal
Mounting type		plug-in
Conductor cross section with screw terminals		
1 core flexible		0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors		0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals		0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector		
		0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection		2
Stripping length with spring-loaded terminals		9 mm
Dimensions		
Height		101,4 mm
Width		22,5 mm
Depth		120 mm

Input module PNOZ m EF 16DI

Mechanical data

Weight **95 g**

Where standards are undated, the 2012-08 latest editions shall apply.

Safety characteristic data

Unit	Operating mode	EN ISO 13849-1: 2015	EN ISO 13849-1: 2015	EN IEC 62061	EN IEC 62061	EN/IEC 61511	EN/IEC 61511	EN ISO 13849-1: 2015
		PL	Category	SIL CL/ maximum SIL	PFH _D [1/h]	SIL	PFD	T _M [year]

Logic

CPU	2-channel	PL e	Cat. 4	SIL 3	2,84E-10	SIL 3	2,44E-05	20
-----	-----------	------	--------	-------	----------	-------	----------	----

Input

Inputs	1-channel	PL d	Cat. 2	SIL 2	2,10E-09	SIL 2	1,84E-04	20
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Inputs	2-channel	PL e	Cat. 4	SIL 3	4,27E-11	SIL 3	3,73E-06	20
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Inputs	Short circuit-forming safety mats	PL d	Cat. 3	SIL 2	1,80E-10	SIL 2	1,54E-05	20
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Inputs	1-ch., pulsed light barrier	PL e	Cat. 4	SIL 3	2,10E-10	SIL 3	1,86E-05	20
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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_M 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.

Input module PNOZ m EF 16DI

Classification according to ZVEI, CB24I

The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Input	
Interfaces	
Drain	
Interface	Module
Class	C2
Source	
Interface	Sensor
Class	C2, C3
Drain parameters	
Max. test pulse duration	500 µs
Min. input resistance	5,6 kOhm
Max. capacitive load	126 nF

Input module

PNOZ m EF 16DI

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 16DI	Configurable safe small controllers PNOZmulti 2, expansion module, 16 safe digital inputs.	772140

Accessories

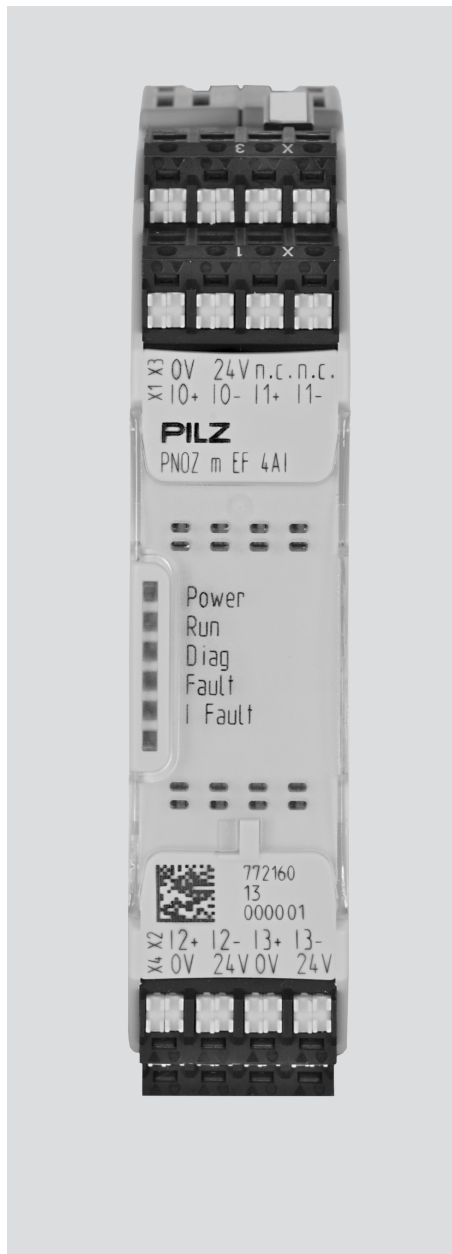
Replacement terminals

Product type	Features	Order no.
PNOZ s Setscrew terminals 22.5mm	Set of plug-in replacement terminals 4-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750004
PNOZ s Setspring-loaded terminals 22.5mm	Set of plug-in replacement terminals 4-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751004

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Analogue input module PNOZ m EF 4AI



Overview

Unit features









Application of the product PNOZ m EF 4AI:

Analogue input module for connection to a base unit from the PNOZmulti 2 system

The product has the following features:

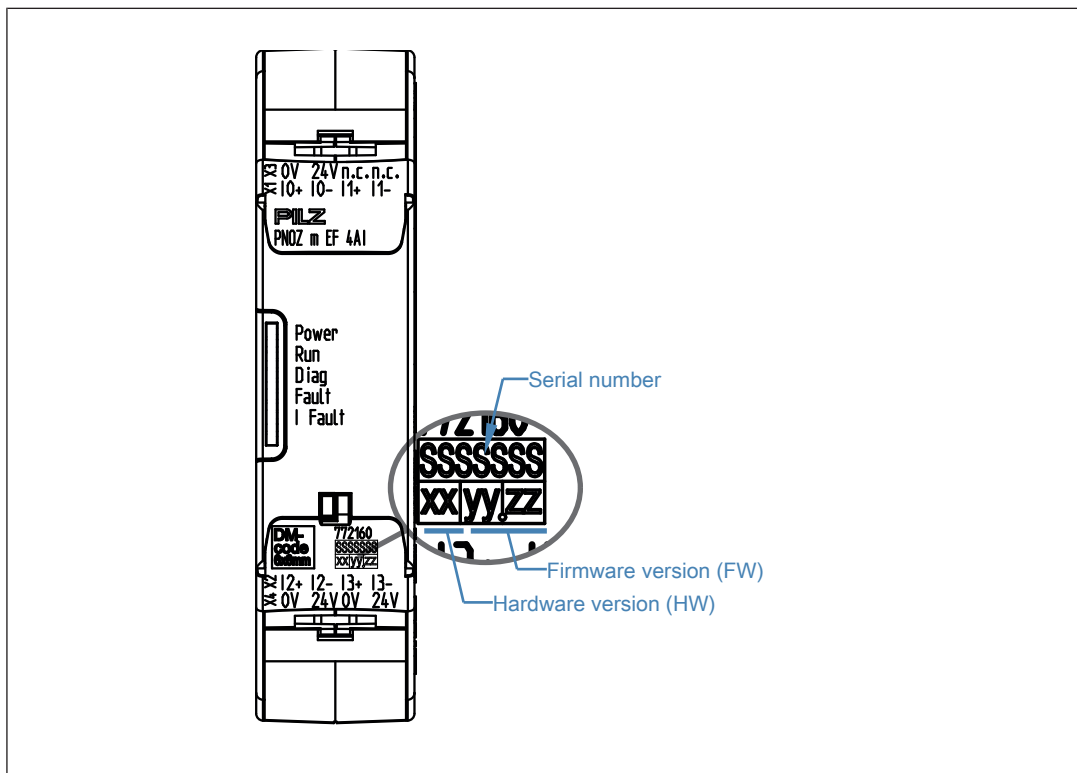
- ▶ 4 analogue inputs for current measurement

Analogue input module PNOZ m EF 4AI

- ▶ Each input can be configured separately
- ▶ Current range: 0 ... 25 mA
- ▶ Resolution current measurement: 15 Bit + sign Bit
- ▶ [Working range monitoring](#)  171] in accordance with NAMUR NE43 recommendation
- ▶ [Scaling function](#)  175]
- ▶ [Plausibility check](#)  173]
- ▶ [Mathematical operations](#)  176]
- ▶ [Constant](#)  176]
- ▶ [Threshold value monitoring](#)  176]
- ▶ [Range monitoring](#)  177]
- ▶ Exact analogue value can be passed to a fieldbus or OPC server for diagnostic purposes
- ▶ LEDs for
 - Operating status
 - Status of the input signals
 - Error/diagnostics
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#)  193]).
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Analogue input module PNOZ m EF 4AI

Front view



Legend

- X1: Analogue inputs I0+, I0-, I1+, I1 -
- X2: Analogue inputs I2+, I2-, I3+, I3-
- X3: Supply connections 0 V, 24 V to supply the sensors
- X4: Supply connections 0 V, 24 V, 0 V, 24 V to supply the analogue input module and to supply the sensors
- LEDs: Power, Run, Diag, Fault, I Fault,

Function Description

Analogue inputs

The module has 4 analogue inputs. This is to monitor analogue input current signals. The input signals are recorded and read in at each input through two channels and are converted into digital signals.

The measured value resolution is 15 Bit plus sign Bit.

The measuring range is 0 ... 25 mA

Analogue input module PNOZ m EF 4AI

Monitoring functions

In the PNOZmulti Configurator you can configure the following limit values and monitoring functions.

Working range monitoring

With the working range monitoring you define the valid working or measuring range. The working range monitoring is used to detect sensor errors or errors in the wiring.

You can define 4 limit values (R1 ... R4) that define the working range and the failure information area.

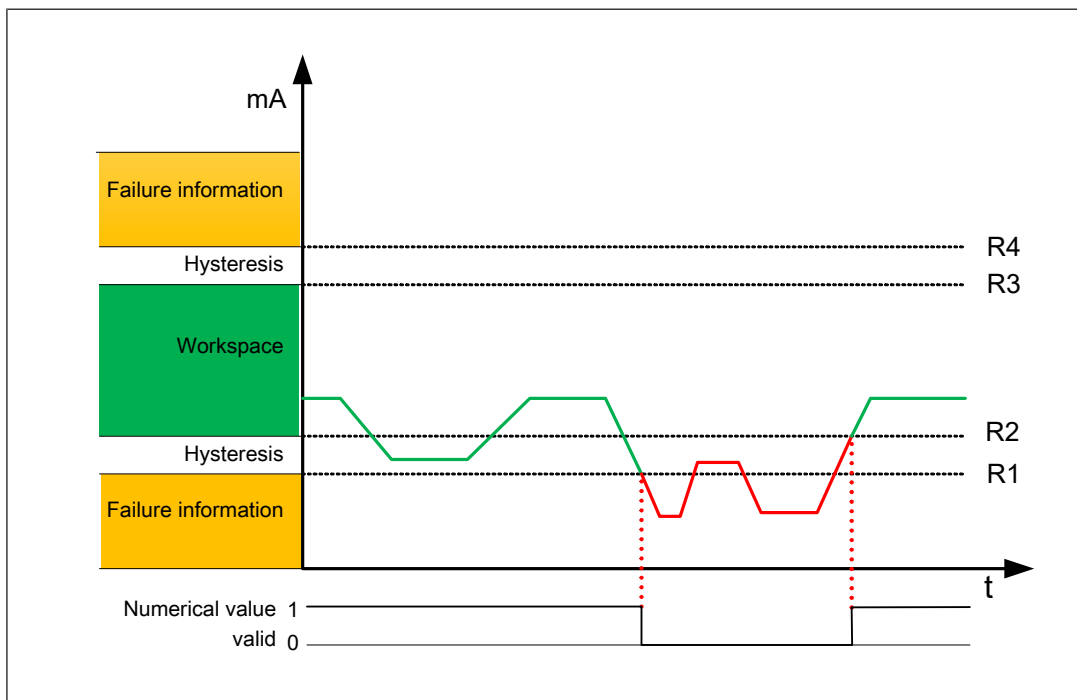
If you do not configure a working range, the working range will be 0 ... 25 mA.

The default settings are in accordance with NAMUR NE 43 recommendation to simplify the signal level for the failure information. We recommend compliance with NAMUR recommendation NE 43.

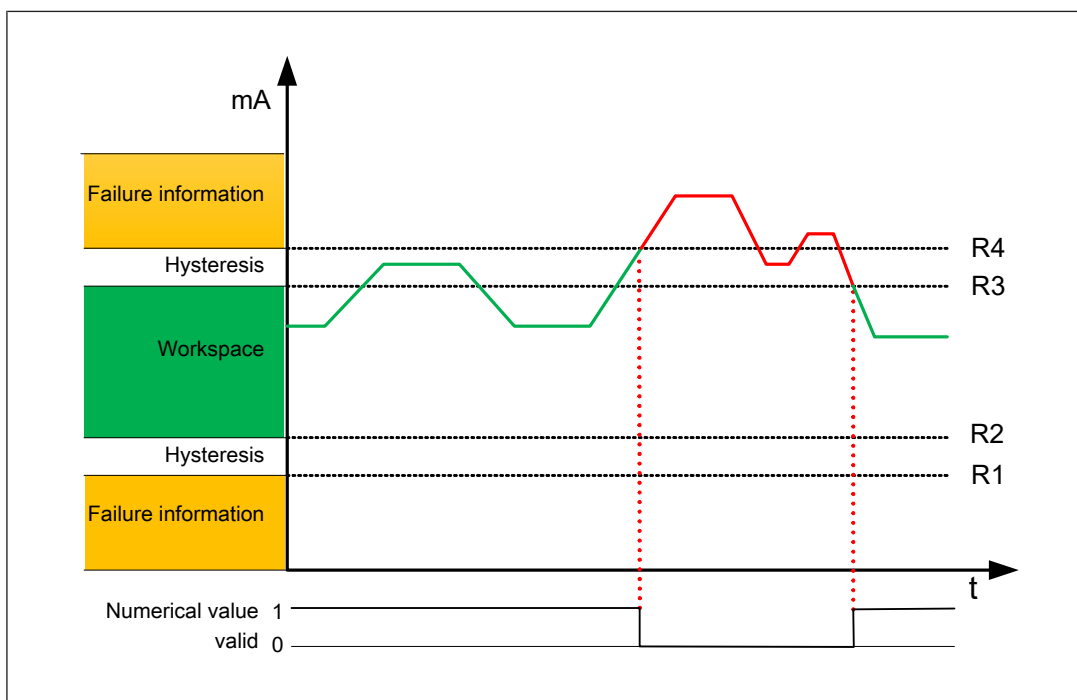
- ▶ **Lower failure information range (0 mA... R1)**
Default: 0 ... 3.6 mA
(e.g. circuit interrupted)
- ▶ **Working range (R2 ... R3)**
Default: 3.8 ... 20.5 mA
(valid measuring range, upper and lower range limit)
- ▶ **Upper failure information range (R4 ... 25 mA)**
Default: 21 ... 25 mA
(e.g. short circuit or transducer error)
- ▶ **Hysteresis (R1 ... R2, R3 ... R4)**
 - **Upper hysteresis R3 ... R4:**
The numerical value is invalid, when R4 is exceeded.
The numerical value is valid again when R3 is undershot.
 - **Lower hysteresis R1 ... R2:**
The numerical value is invalid, when R1 is undershot.
The numerical value is valid again when R2 is exceeded.

Analogue input module
PNOZ m EF 4AI

Example: Numerical value undershoots the working range



Example: Numerical value exceeds the working range



Analogue input module PNOZ m EF 4AI

Plausibility check

In the plausibility check, a leading signal (L) is checked with a reference signal (P).

When the deviation of both values is greater than the configured tolerance, the numerical value will be signalised as invalid.

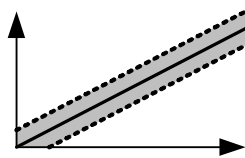
The reference signal is used to calculate the tolerance.

The following tolerances can be configured:

Difference tolerance

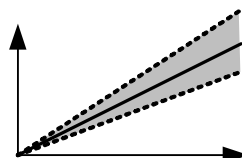
The tolerance value defines the maximum permitted deviation between the two numerical values. There are three different types of tolerance determination:

Absolute tolerance



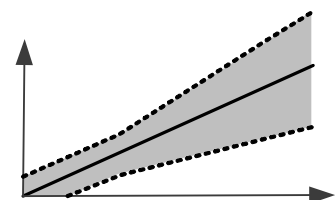
Absolute value by which the signals can deviate from each other as a maximum.

Percentage tolerance



Max. percentage by which the signals may differ.

Absolute/percentage tolerance



Combined tolerance. Both an absolute value and a percentage value are configured. The higher tolerance value is valid, respectively.

Peak tolerance

Peak values can be tolerated, that exceed the permitted deviation configured above for a short period.

- ▶ Tolerance time (t1)
Maximum time for which the tolerance value may be exceeded
- ▶ Tolerance period (t2)
Minimum time that may elapse from one limit value overshoot to the next

Analogue input module
PNOZ m EF 4AI

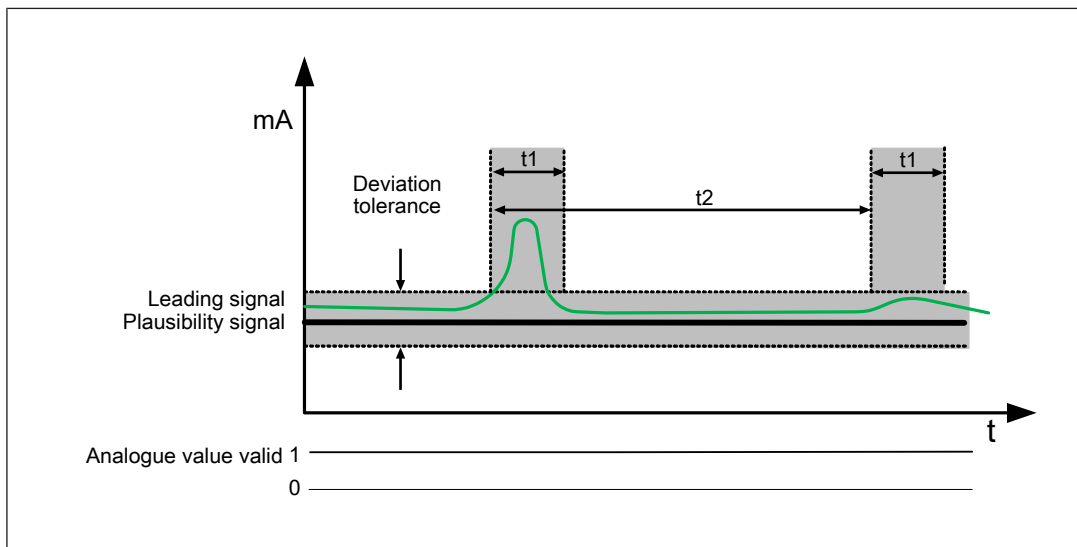


Fig.: Leading signal remains within the tolerance limits

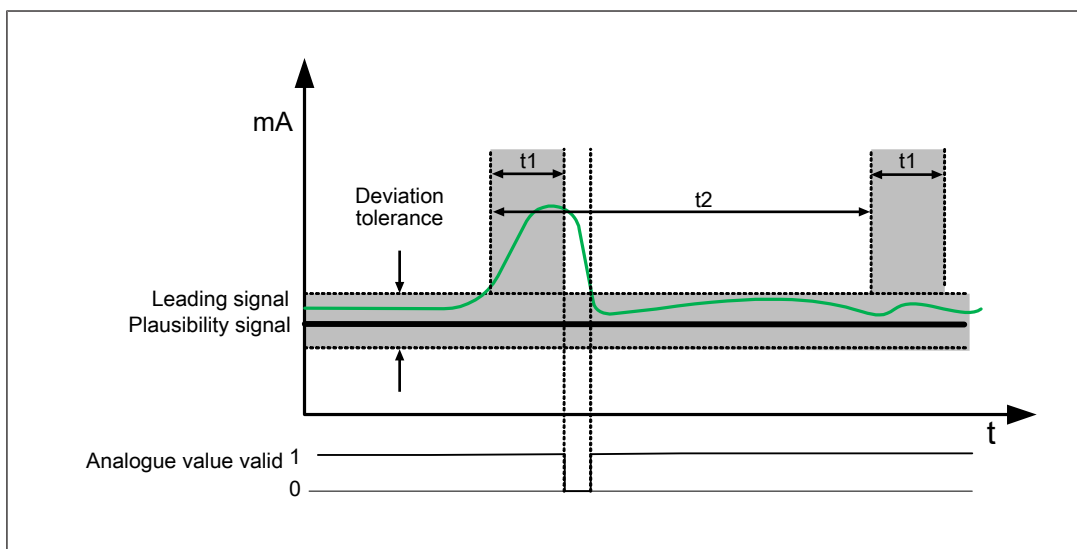


Fig.: Leading signal exceeds the tolerance time (t_1)

Analogue input module
PNOZ m EF 4AI

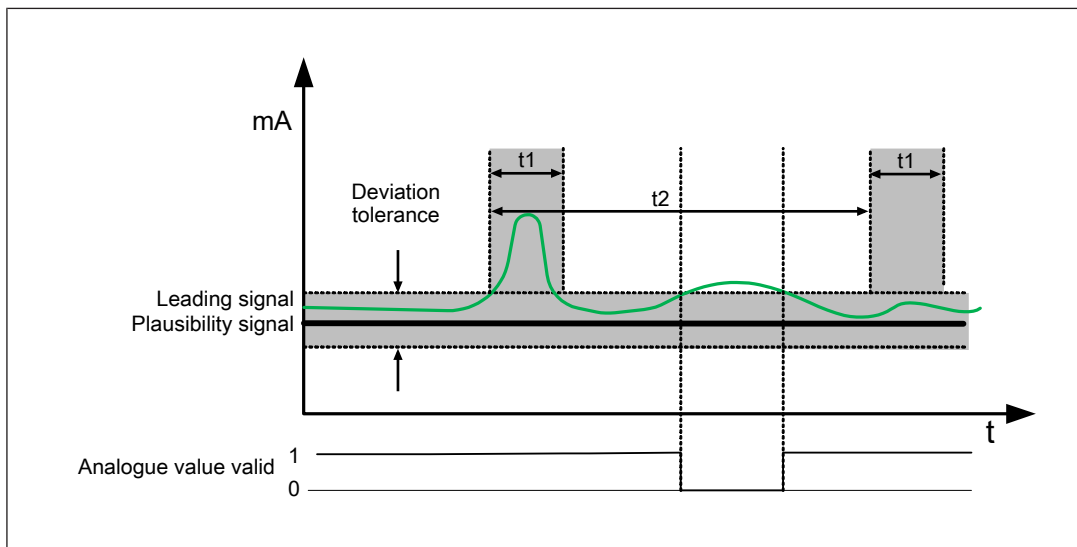
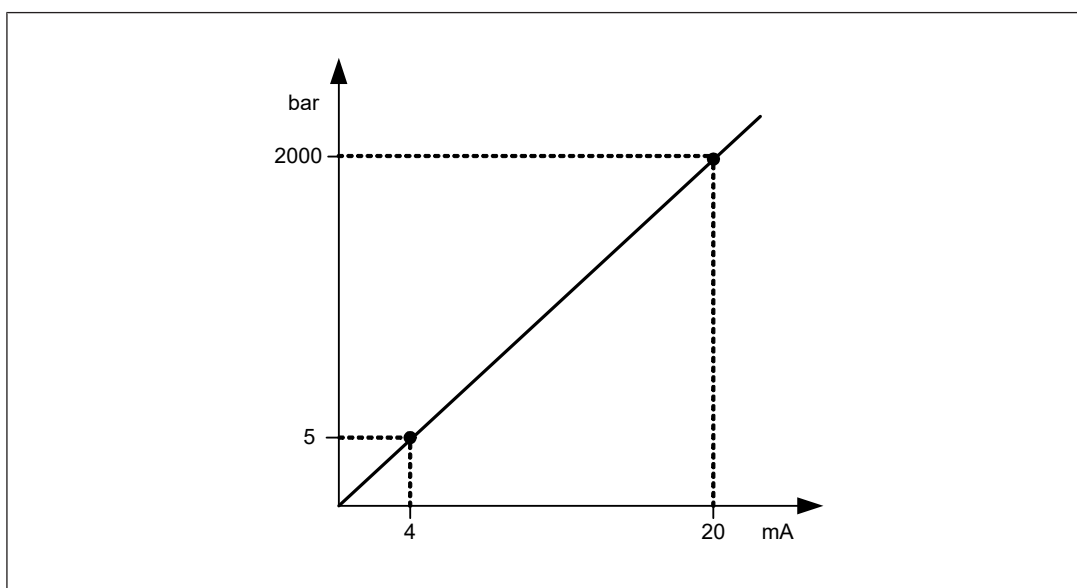


Fig.: Leading signal does not maintain the duration of the tolerance period (t2)

Scaling

The scaling function can be used to convert the analogue measured value (mA) to another numerical value (physical measured value of the transducer, e.g. in litres). The scaling can only be used with linear input variables

To do this, you define an upper and lower value each for the input value (current value) and for the scaled value, and you specify the unit of the scaled value.



Analogue input module

PNOZ m EF 4AI

Mathematical operations

You can perform a mathematical operation with two numerical values:

- ▶ Addition
The sum of two numerical values is calculated $(X + Y)$.
- ▶ Subtraction
The difference of two numerical values is calculated $(X - Y)$.
- ▶ Average
The average value of two numerical values is calculated $((X + Y) / 2)$.
- ▶ Multiplication
The product of two numerical values is calculated $(X * Y)$.
- ▶ Division
The quotient of two numerical values is (X / Y) .

The result of the mathematical operation can be issued as an amount (without sign).

Constant

A constant numerical value can be defined. The value is without dimensions and it can also be negative. It can be linked in the user program and used e.g. as an offset.

Threshold value monitoring

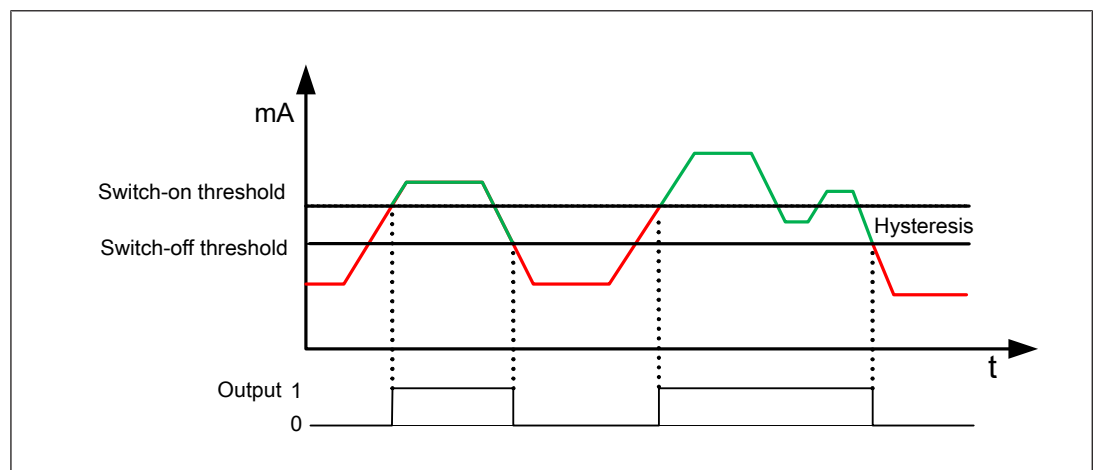
You can define switching thresholds, which can be used to monitor certain process variables (e.g. temperature values).

You can monitor whether a numerical value is greater or less than a configured switching threshold.

Hysteresis:

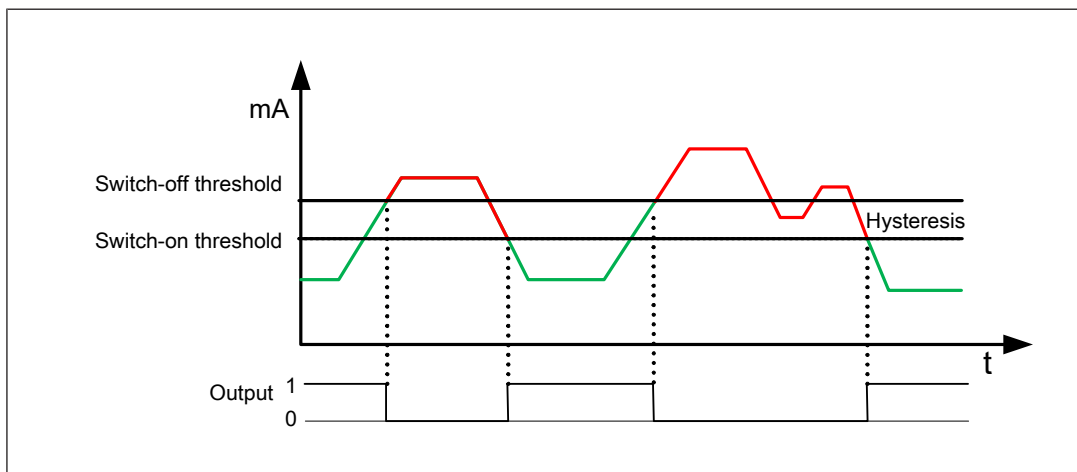
2 threshold values are configured per switching threshold. One threshold value (switch-on threshold) defines when the affected output is switched on. The second threshold value (switch-off threshold) defines when the output will be switched off again.

Monitoring to "greater than"



Analogue input module PNOZ m EF 4AI

Monitoring to "less than"



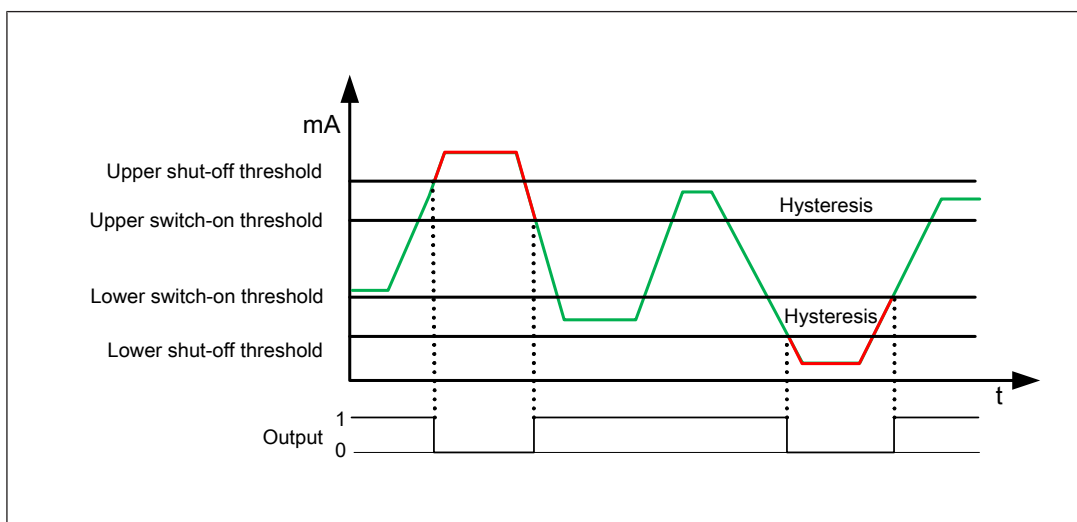
Range monitoring

In contrast to the threshold value monitoring, an upper and a lower switching threshold are defined in the range monitoring.

This is to monitor both exceeding or dropping below a limit value.

Hysteresis:

2 threshold values are configured per switching threshold. One threshold value (switch-on threshold) defines when the affected output is switched on. The second threshold value (switch-off threshold) defines when the output will be switched off again.



Diagnostics

Up to six numerical values can be passed to a fieldbus or OPC server for diagnostic purposes (see also document **Communication Interfaces PNOZmulti 2, chapter Process data/Advanced data**).

Analogue input module

PNOZ m EF 4AI

The numerical values are also output on the base unit display.

Each value to be passed on is assigned to a fieldbus address.

When no element **Diagnostics** is configured, the fieldbus address is assigned automatically to the 4 analogue inputs i0 ... i3:

i0 → Data ID 1

i1 → Data ID 2

i2 → Data ID 3

i3 → Data ID 4

The Diagnostics elements can be used to assign up to 6 numerical values user-defined to the fieldbus addresses (data ID 1 ... 6). The automatically assigned fieldbus addresses are overwritten.

The fieldbus address is configured in the element **Diagnostics**. Then the **Diagnostics** element is connected to the required numerical output of an element.

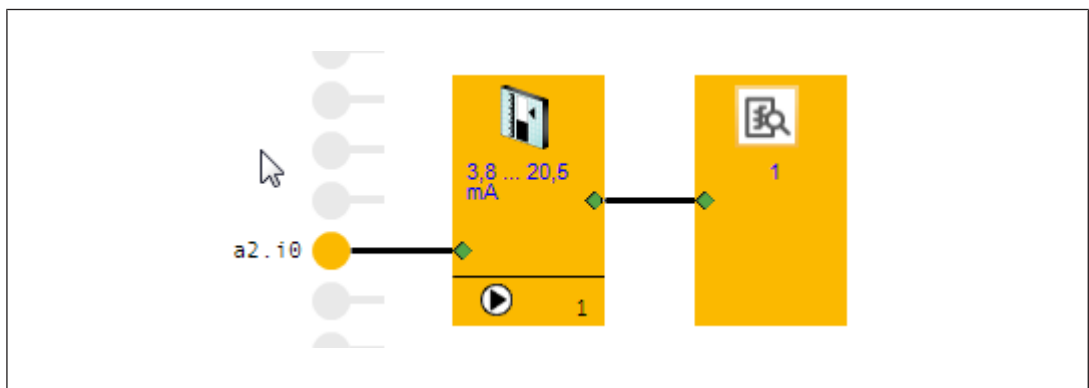


Fig.: Input i0 is assigned to the Data ID 1

Ramp monitoring

Process variables can be monitored for a maximum or minimum rate of change. When monitoring is started, a switching threshold is defined, which rises or falls with a configurable gradient during runtime.

There are two monitoring options

- ▶ Upper limit value
The input value is monitored to establish if it exceeds a configured limit value (ramp).
- ▶ Lower limit value
The input value is monitored to establish if it falls below a configured limit value (ramp).

The limit is configured from a gradient, plus a relative tolerance and an absolute tolerance.

- ▶ Gradient
The gradient indicates the number of units by which the limit value rises or falls per second or millisecond.

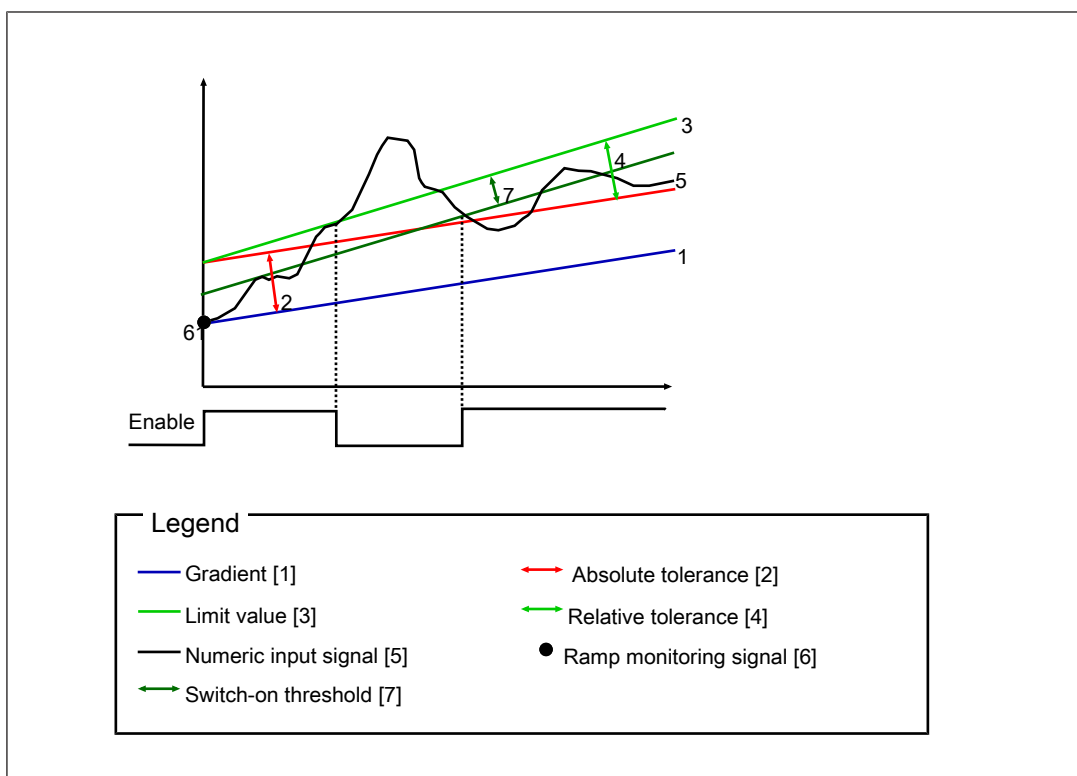
Analogue input module PNOZ m EF 4AI

- ▶ Absolute tolerance
Absolute value by which the value resulting from the configured gradient may be exceeded or undershot.
- ▶ Relative tolerance
Percentage value by which the value resulting from the configured gradient may be exceeded or undershot.

Either an automatic or manual reset can be configured.

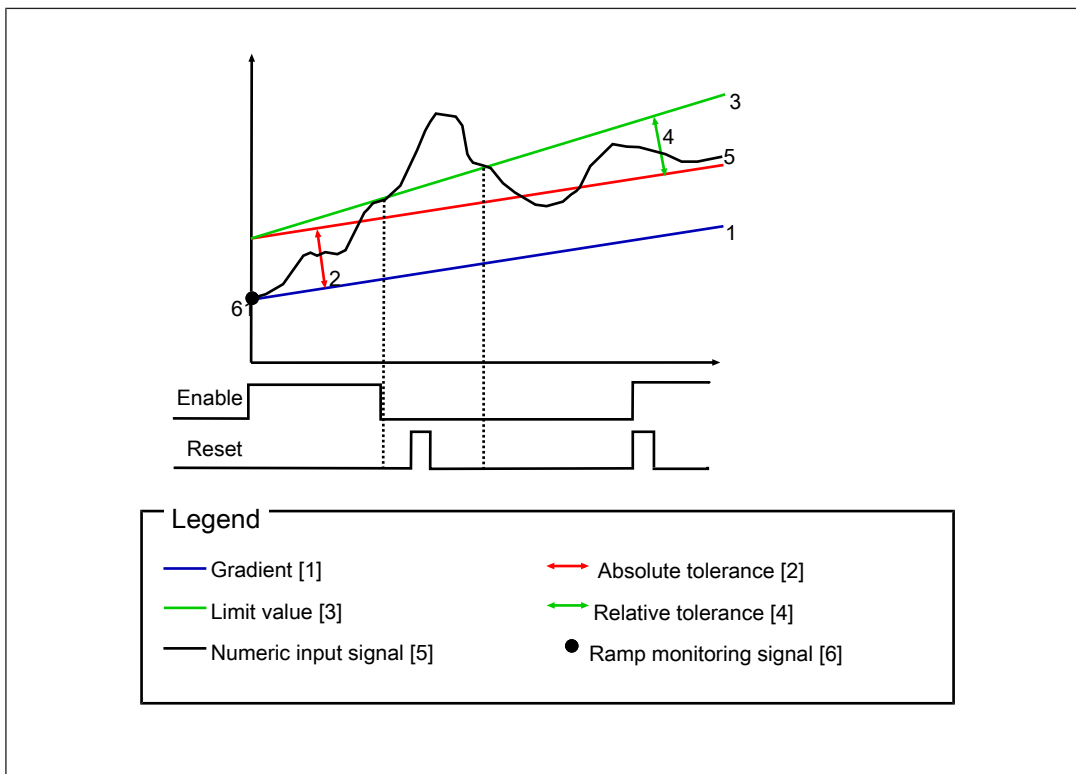
If an automatic reset is configured, a switch-on threshold (hysteresis) can be defined, which is used as the limit value for switching the enable signal back on.

Monitoring an upper limit with automatic reset

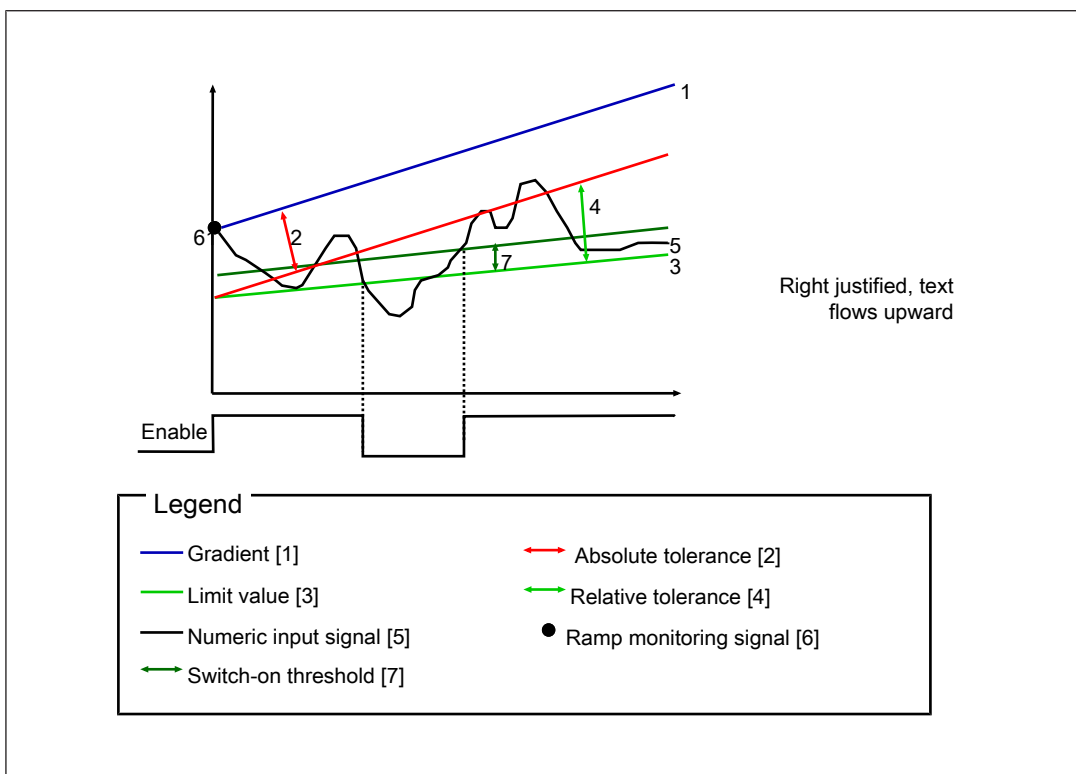


with manual reset

Analogue input module PNOZ m EF 4AI

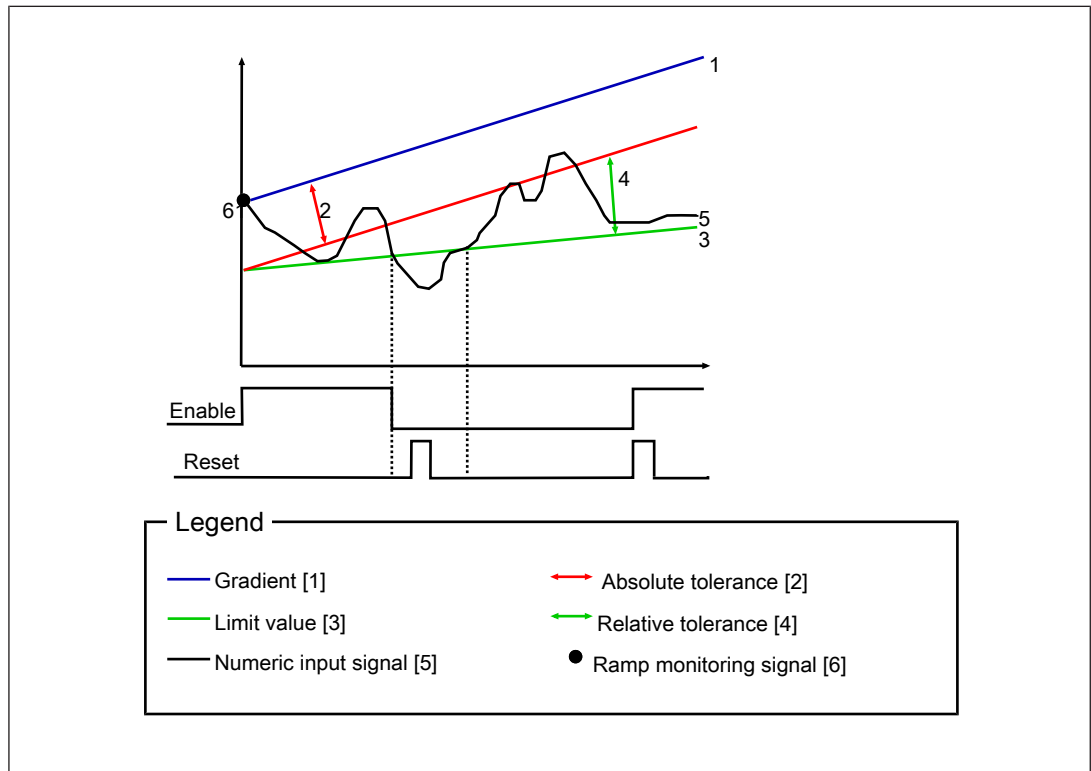


Monitoring a lower limit with automatic reset



Analogue input module PNOZ m EF 4AI

with manual reset



Differential

A value change measured at the input over a certain time interval can be delivered at the output.

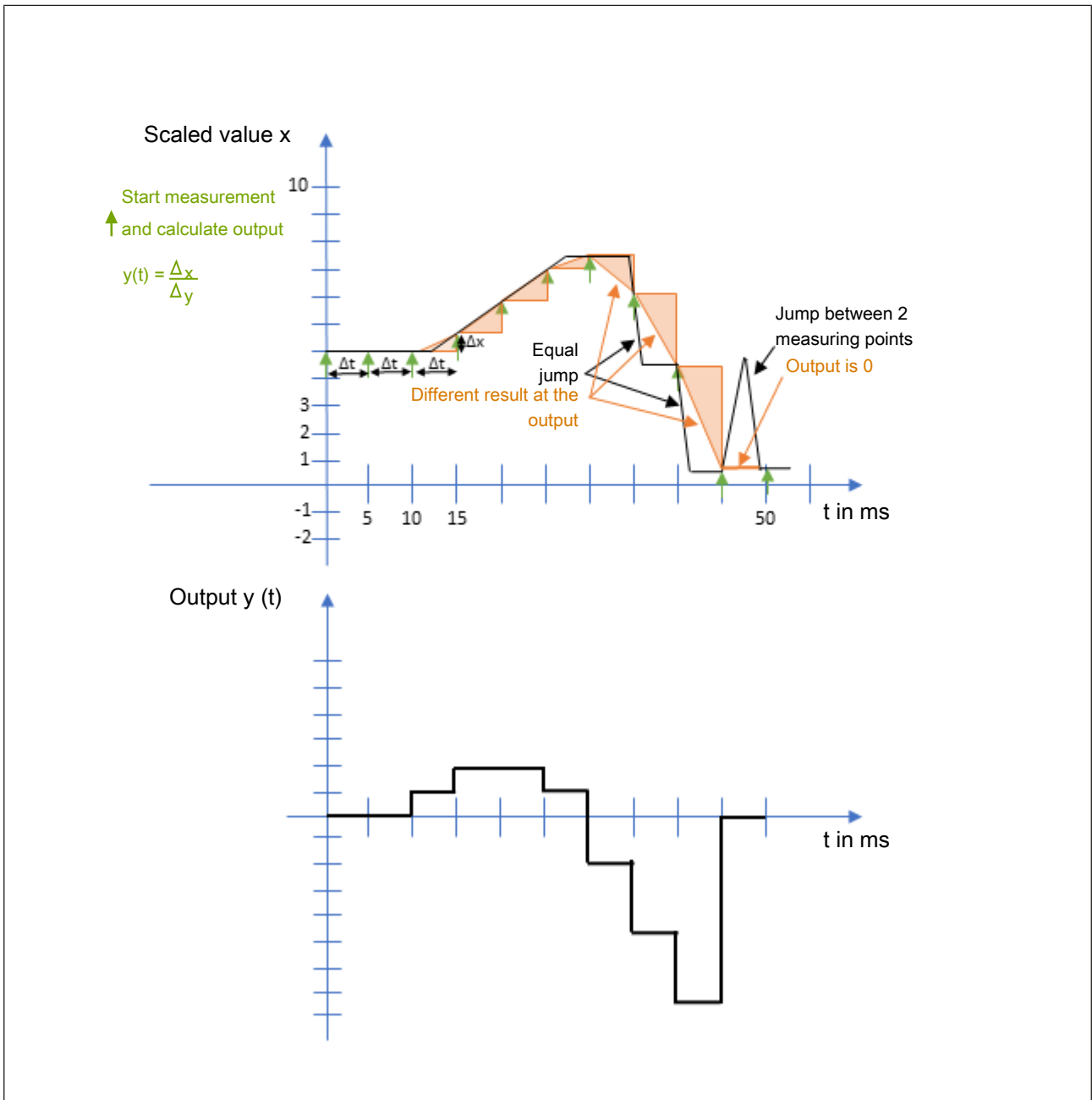
$$\text{Differential value} = (\text{Current value} - \text{Reference value}) / \text{Time interval}$$

So the output value corresponds to the gradient of the input value.

The result of the mathematical operations can be delivered as an amount (unsigned).

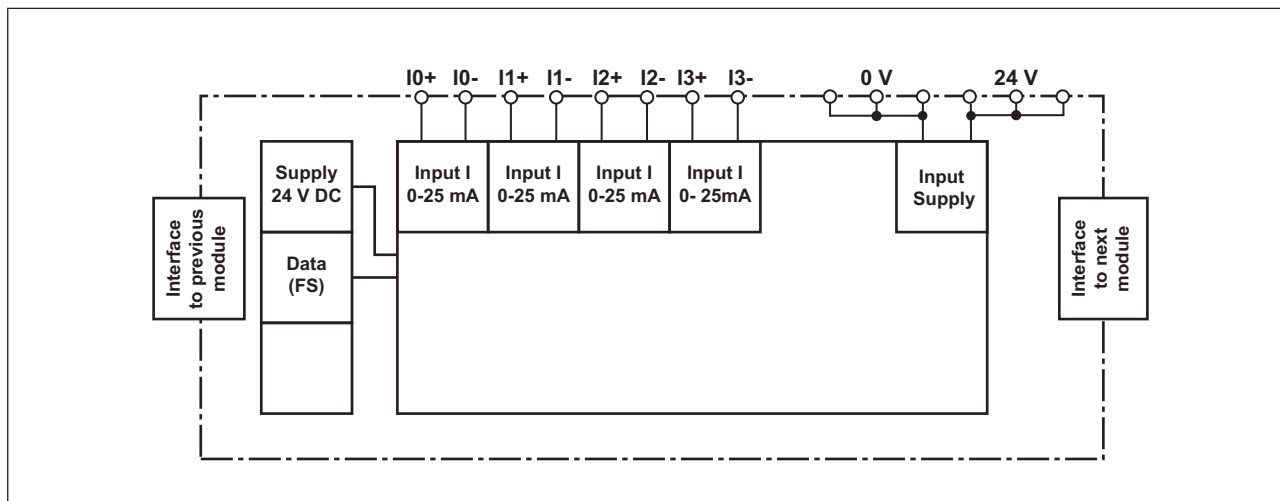
Example:

Analogue input module
PNOZ m EF 4AI



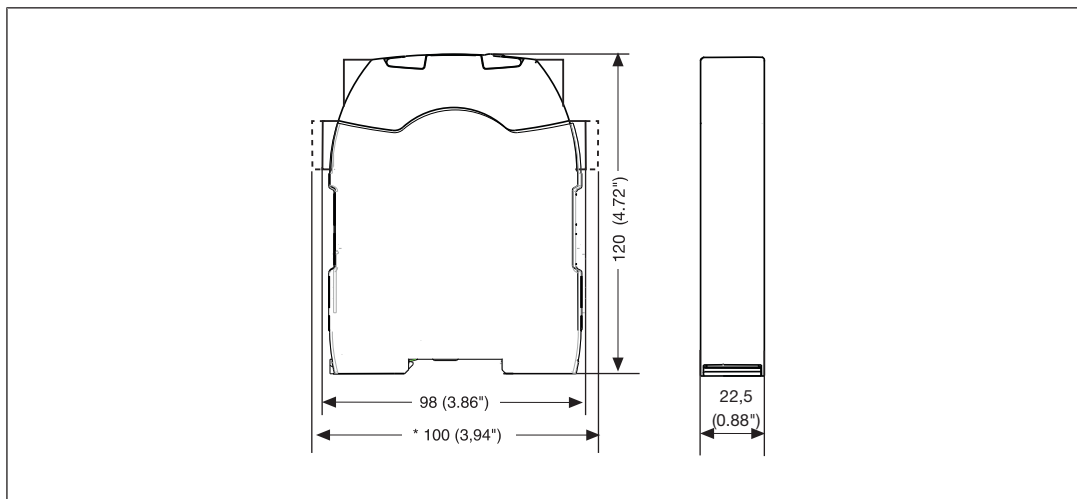
Analogue input module PNOZ m EF 4AI

Block diagram



Installation

Dimensions in mm



Commissioning

Wiring

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

Please note:

- ▶ Information given in the [Technical details \[189\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.

Analogue input module PNOZ m EF 4AI

- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The power supply that feeds the expansion module and the sensors must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).
- ▶ Supply connections

The 6 supply connections 24 V and 0 V to the terminal blocks X3 and X4 are interconnected internally.

 - The supply of the analogue input module PNOZ m EF 4AI has to be made via the supply connections 24 V and 0 V at the terminal block X4.
 - The other supply connections can be used for the supply of the sensors.
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C – 2 ... 6 A
 - or
 - Blow-out fuse, slow, 2 ... 6 A
- ▶ Use shielded, twisted pair cable for the connections on the input current circuits.
- ▶ Separate the supply voltage cable from the analogue input current lines.
- ▶ **For transducers located outside the control cabinet:** Where the cable enters the control cabinet, the cable shield **must** be connected to the earth potential over a wide surface area and with low impedance (connect in star).

Connection

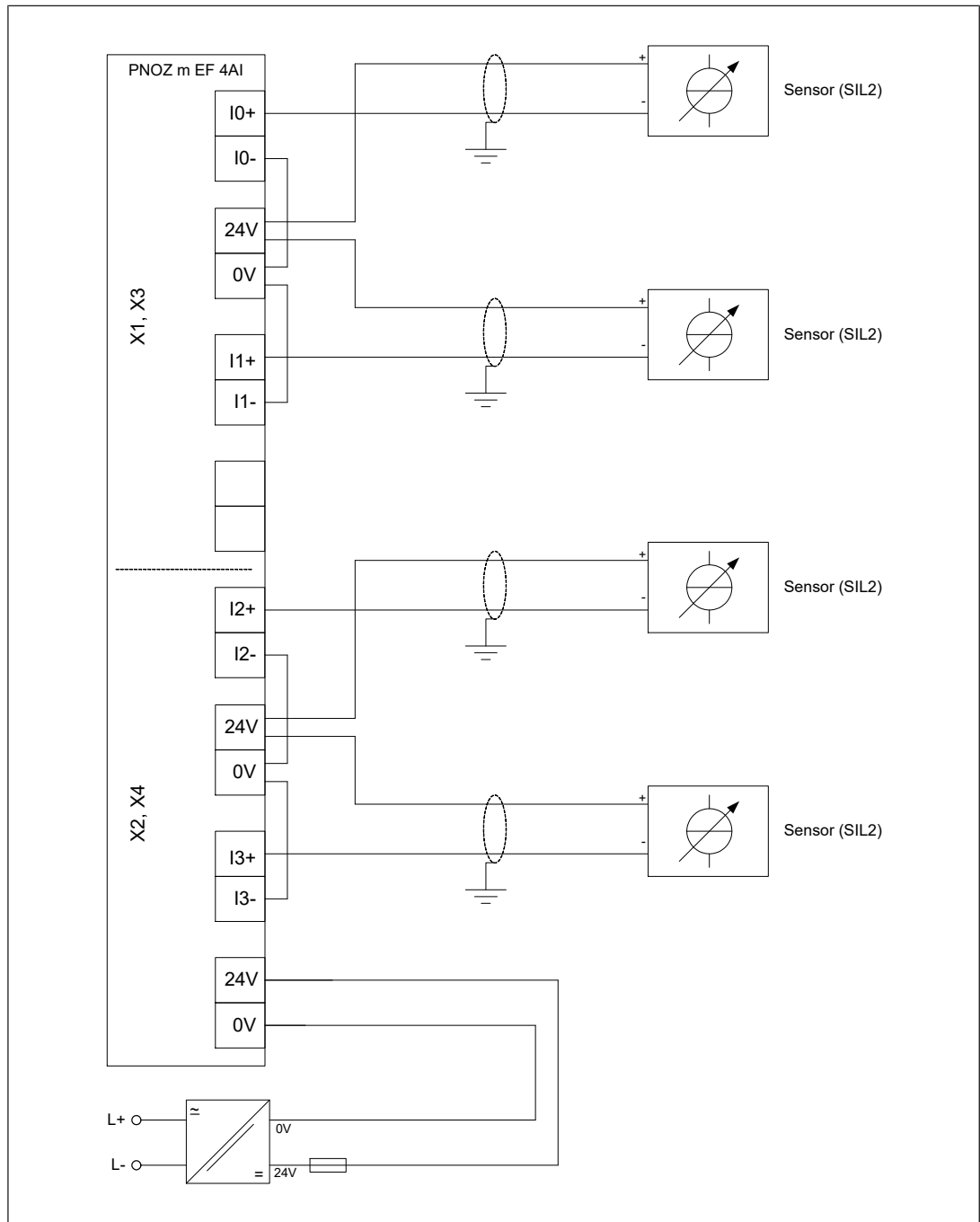
Supply voltage

Supply voltage	DC

2-wire connection, supply voltage of sensors via analogue input module

- ▶ Supply connections 24 V and 0 V are used to supply the analogue input module and to supply the sensors.
- ▶ The terminals I0- ... I3- and 0 V must be bridged.

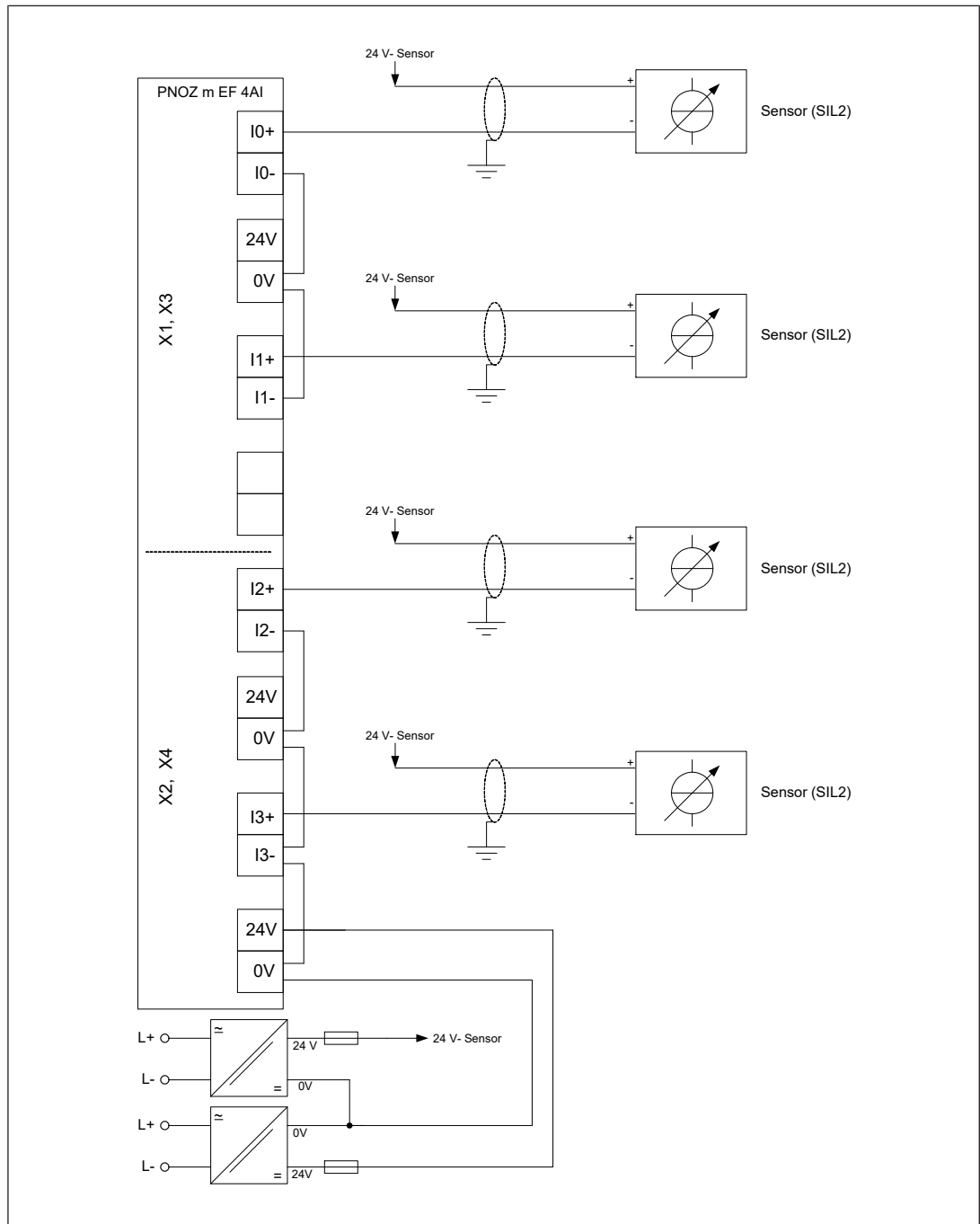
Analogue input module PNOZ m EF 4AI



2-wire connection, supply voltage of sensors externally

- ▶ The supply connections 24 V and 0 V are used only to supply the analogue input module.
- ▶ The terminals I0- ... I3- and 0 V must be bridged.
- ▶ The 0 V connections of the external power supplies have to be interconnected.

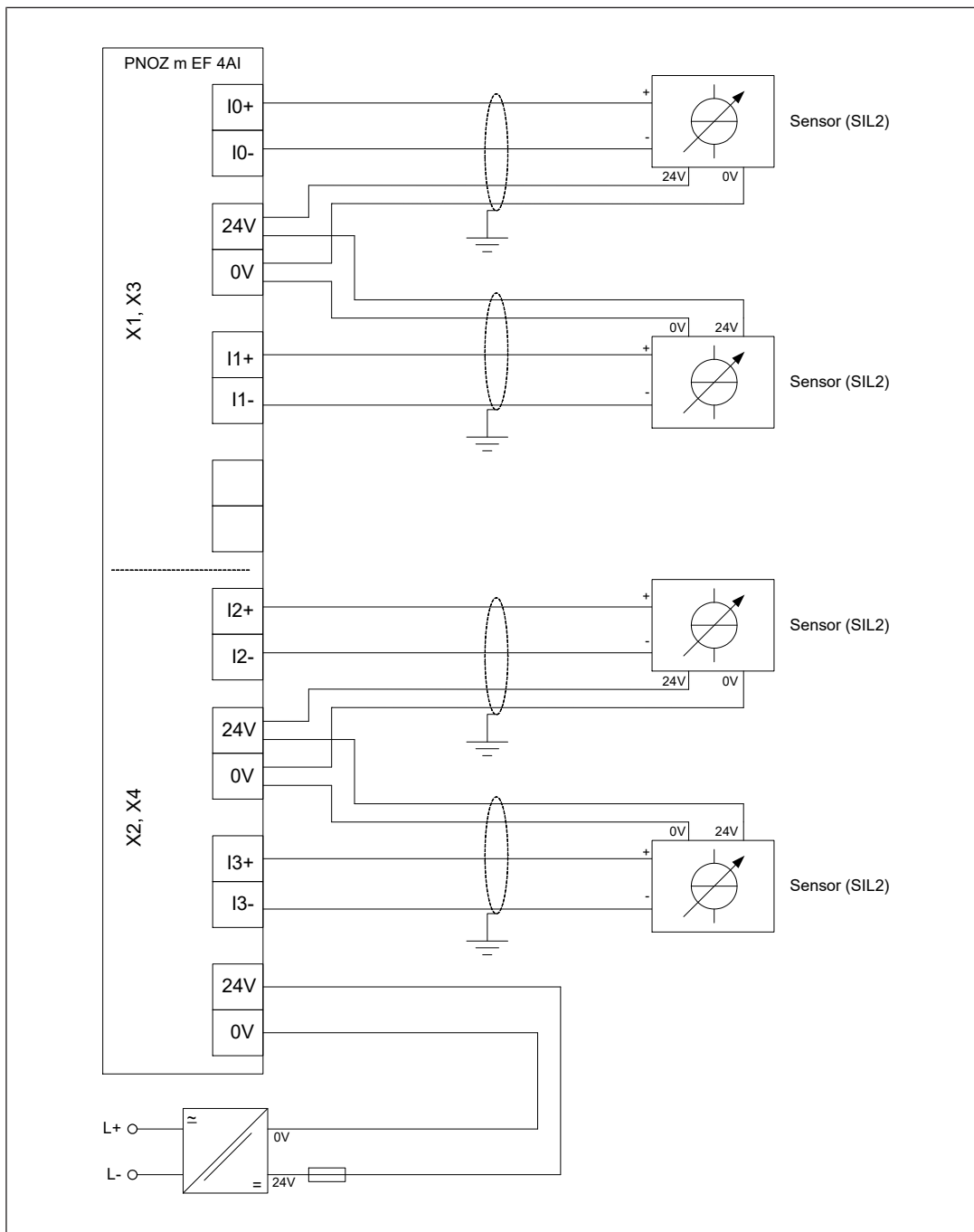
Analogue input module PNOZ m EF 4AI



4-wire connection, supply voltage of sensors via analogue input module

- ▶ Supply connections 24 V and 0 V are used to supply the analogue input module and to supply the sensors.

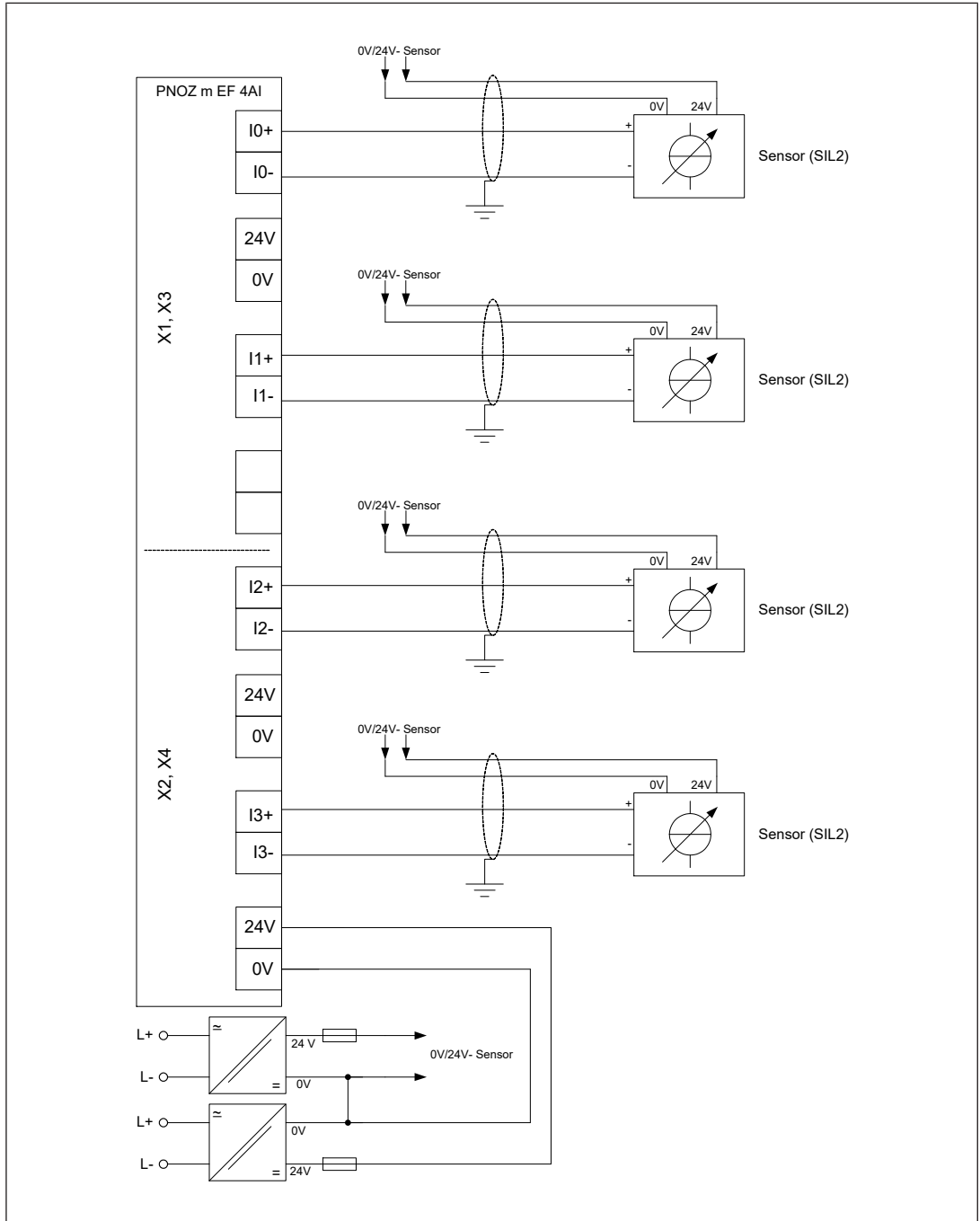
Analogue input module PNOZ m EF 4AI



4-wire connection, supply voltage of sensors externally

- ▶ The supply connections 24 V and 0 V are used only to supply the analogue input module.
- ▶ The 0 V- connections of the external power supplies can be interconnected.

Analogue input module PNOZ m EF 4AI



Analogue input module PNOZ m EF 4AI

Technical details

General

Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E6h

Electrical data

Supply voltage	
for	Supply to sensor evaluation
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. permitted current	0,25 A
Max. continuous current that the external power supply must provide	40 mA
Output of external power supply (DC) at no load	1 W
Potential isolation	Yes

Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	30 mA
Power consumption	0,7 W
Max. power dissipation of module	2 W
Status indicator	LED

Analogue inputs

Number of analogue inputs	4
Type of analogue inputs	Current
Measuring ranges	
Type	Differential input
Measuring range	4 .. 20 mA
Type	Differential input
Measuring range	0 .. 25 mA
Input filter	RC filter, 1st order
Cutoff frequency	700 Hz

Analogue input module PNOZ m EF 4AI

Analogue inputs

Current measurement	
Signal range	0,00 - 25,00 mA
Resolution	16 Bit (15 Bit + sign)
Value of least significant bit (LSB)	0,78 µA
input resistance	156 Ohm + approx. 1.6 V threshold voltage
Max. continuous current	30 mA
Scan rate	10 kHz
Safety-related accuracy (1 input)	1 %
Deviations from the measuring range limit value	
Linearity error	0,05 %
Output variable error at 25 °C	0,3 %
Temperature coefficient	0,003 %/K
Greatest transient deviation during el. interference test	0,6 %
Max. measurement error at full temperature range	0,5 %
Repetition accuracy at 25 °C	0,05 %
Monotony without error codes	Yes
Data format supplied to application program	Float
Conversion method	Successive approximation
Potential isolation	Yes

Environmental data

Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms

Analogue input module PNOZ m EF 4AI

Environmental data

Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2

Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Potential isolation

Potential isolation between	Sensor and system voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	500 V

Mechanical data

Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	108 g

Where standards are undated, the 2018-07 latest editions shall apply.

Analogue input module PNOZ m EF 4AI

Safety characteristic data

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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
1-channel	PL e	Cat. 4	SIL 3	2,32E-10	SIL 3	1,99E-05	20
2-channel	PL e	Cat. 4	SIL 3	2,32E-10	SIL 3	1,99E-05	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_M 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.

Analogue input module PNOZ m EF 4AI

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 4AI	Configurable safe small controllers PNOZmulti 2, expansion module, 4 safe analogue inputs 4..20 mA.	772160

Accessories

Spare terminals

Product type	Features	Order no.
PNOZ s Setscrew terminals 22.5mm	Set of plug-in replacement terminals 4-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750004
PNOZ s Setspring-loaded terminals 22.5mm	Set of plug-in replacement terminals 4-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751004

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Input and output modules PNOZ m EF 8DI4DO



Overview

Unit features

Application of the product PNOZ m EF 8DI4DO:

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

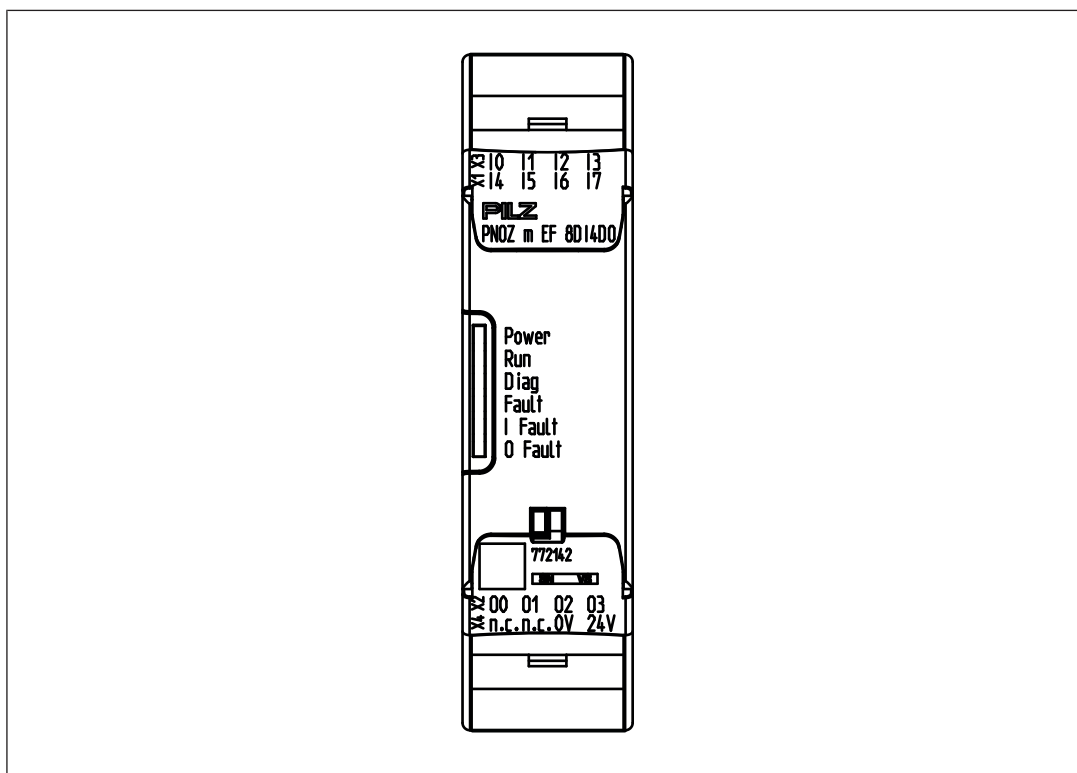
The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Semiconductor outputs:
 - 4 safety outputs
 - depending on the application, up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061
- ▶ 8 inputs for connecting, for example:
 - Emergency stop pushbuttons
 - Two-hand pushbuttons
 - Safety gate limit switches
 - Start buttons
 - Light barriers
 - Scanner
 - Enabling switches
 - PSEN
 - Operating mode selector switches
- ▶ LED display for:
 - Error messages
 - Diagnostics
 - Supply voltage
 - Output circuits
 - Input circuits

Input and output modules PNOZ m EF 8DI4DO

- ▶ 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 accessories (see Order references)
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Front view



Key:

- ▶ 0 V, 24 V: Supply connections
- ▶ Inputs I0 – I7
- ▶ Outputs O0 – O3
- ▶ LEDs:
 - POWER
 - Run
 - Diag
 - Fault
 - I Fault

Input and output modules PNOZ m EF 8DI4DO

- O Fault

Function description

Functions

The expansion module provides additional inputs and additional semiconductor outputs.

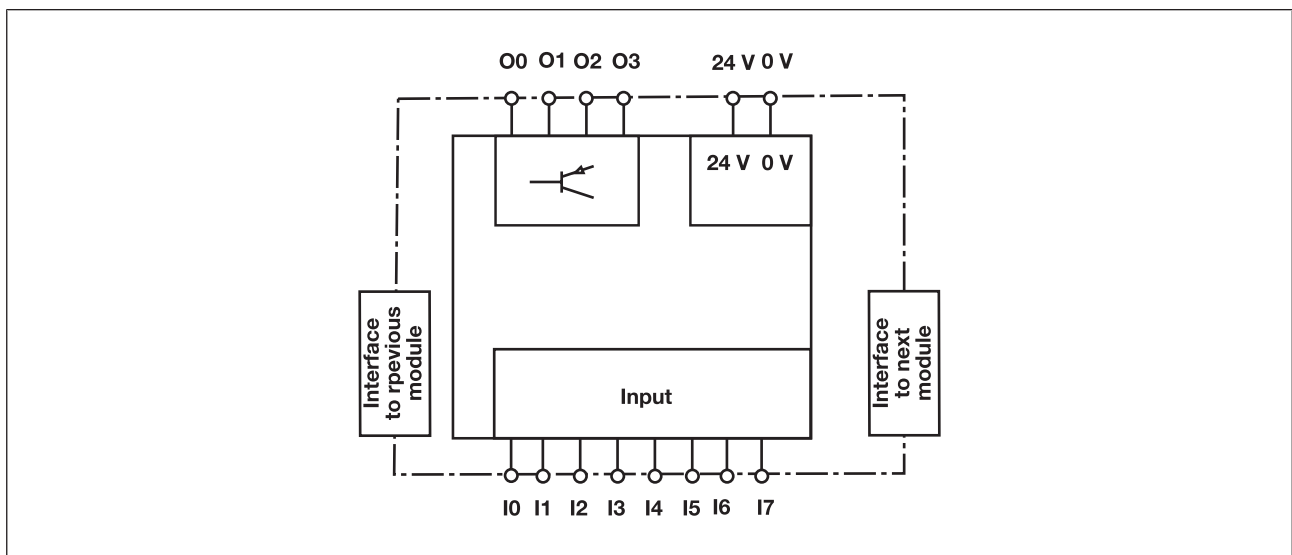
The function of the inputs and outputs on the control system depends on the safety circuit created using the PNOZmulti Configurator. A removable data medium is used to download the safety circuit to the base unit. The base unit has 2 microcontrollers that monitor each other. They evaluate the input circuits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

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 "PNOZmulti System Expansion".

Block diagram

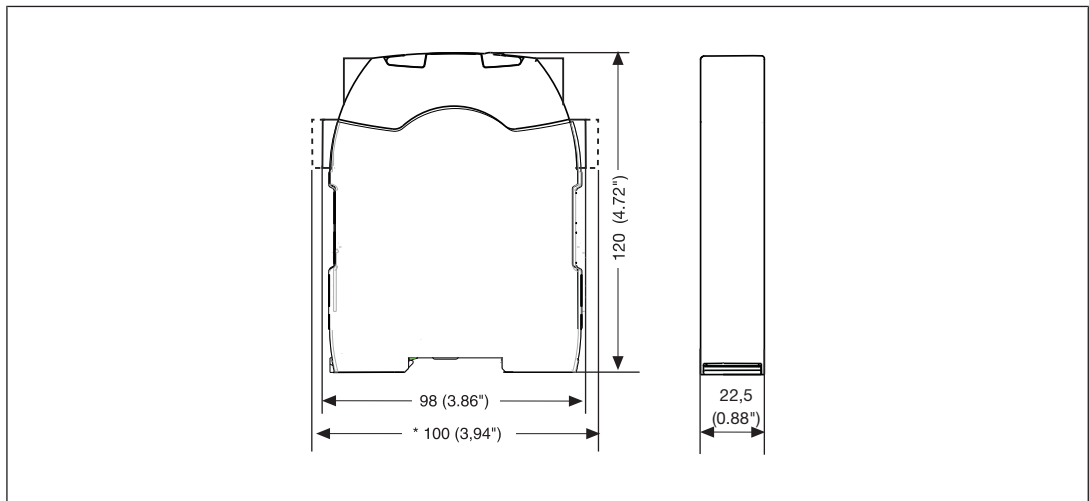


Input and output modules

PNOZ m EF 8DI4DO

Installation

Dimensions in mm



Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[200\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The power supply must meet the regulations for extra low voltages with protective separation (SELV/PELV).

Input and output modules PNOZ m EF 8DI4DO

Connection

Supply voltage	DC

Supply voltage

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

Input and output modules PNOZ m EF 8DI4DO

<p>Redundant output</p>		
<p>Single output</p>		
<p>Single output with advanced fault detection*</p>		

Connection examples for semiconductor outputs

*Two loads may be connected to each safety output with advanced fault detection, even on applications in accordance with EN IEC 62061, SIL 3. Prerequisite: Feedback loop is connected, shorts across contacts and external power sources are excluded (e.g. through separate multicore cables). Please note that, in the event of an error in the feedback loop, the safety system switches to a safe state and shuts down **all** the outputs.

<p>Feedback loop</p>	<p>Redundant output</p>
<p>Contacts from external contactors</p>	

Connection examples for feedback loop

Input and output modules PNOZ m EF 8DI4DO

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E0h
Electrical data	
Supply voltage	
for	Supply to the SC outputs
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	8 A
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	39 mA
Power consumption	1 W
Max. power dissipation of module	4,5 W
Status indicator	LED
Permitted loads	inductive, capacitive, resistive
Inputs	
Quantity	8
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	8 ms
Potential isolation	No
Semiconductor outputs	
Number of positive-switching single-pole semiconductor outputs	4
Switching capability	
Voltage	24 V
Typ. output current at "1" signal and rated voltage of semiconductor output	2 A
Permitted current range	0,000 - 2,500 A

Input and output modules PNOZ m EF 8DI4DO

Semiconductor outputs	
Residual current at "0" signal	0,05 mA
Max. transient pulsed current	12 A
Max. capacitive load	1 µF
Max. internal voltage drop	500 mV
Max. duration of off time during self test	330 µs
Switch-off delay	3 ms
Potential isolation	Yes
Short circuit-proof	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	SC output and system voltage

Input and output modules PNOZ m EF 8DI4DO

Potential isolation	
Type of potential isolation	Basic insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	1 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	105 g

Where standards are undated, the 2018-09 latest editions shall apply.

Input and output modules PNOZ m EF 8DI4DO

Safety characteristic data

Unit	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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
Logic								
CPU	2-channel	PL e	Cat. 4	SIL 3	2,84E-10	SIL 3	2,44E-05	20
Input								
Inputs	1-channel	PL d	Cat. 2	SIL 2	2,10E-09	SIL 2	1,84E-04	20
Inputs	2-channel	PL e	Cat. 4	SIL 3	4,27E-11	SIL 3	3,73E-06	20
Inputs	Short circuit-forming safety mats	PL d	Cat. 3	SIL 2	1,80E-10	SIL 2	1,54E-05	20
Inputs	1-ch., pulsed light barrier	PL e	Cat. 4	SIL 3	2,10E-10	SIL 3	1,86E-05	20
Output								
SC outputs	1-channel with advanced fault detection	PL e	Cat. 4	SIL 3	2,12E-11	SIL 3	1,86E-06	20
SC outputs	1-channel	PL d	Cat. 2	SIL 2	2,29E-10	SIL 2	1,95E-05	20
SC outputs	2-channel	PL e	Cat. 4	SIL 3	1,64E-10	SIL 3	1,41E-05	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_M 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.

Input and output modules PNOZ m EF 8DI4DO

Classification according to ZVEI, CB24I

The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Input

Interfaces

Drain

Interface	Module
Class	C2

Source

Interface	Sensor
Class	C2, C3

Drain parameters

Max. test pulse duration	500 μs
Min. input resistance	5,6 kOhm
Max. capacitive load	126 nF

Single-pole output

Interfaces

Source

Interface	Module
Class	C2

Drain

Interface	Actuator
Class	C1, C2

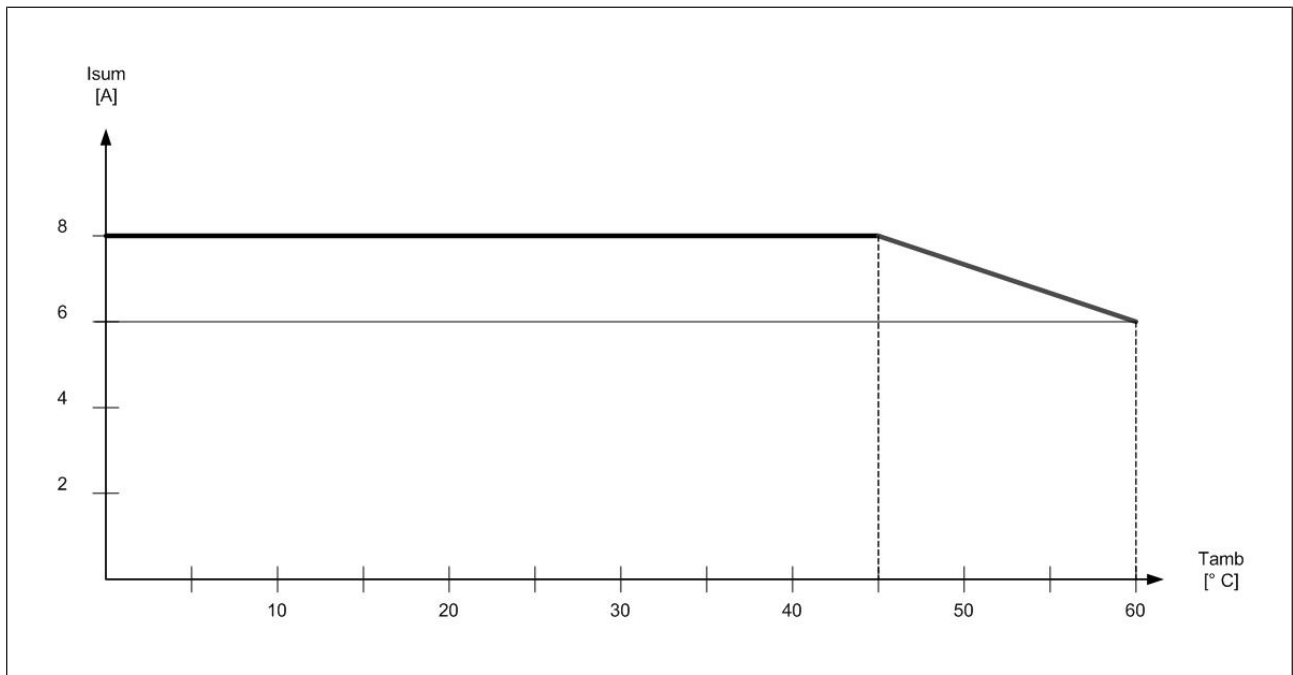
Parameter source

Max. test pulse duration	330 μs
Max. rated current	2 A
Max. capacitive load	1 μF

Input and output modules PNOZ m EF 8DI4DO

Supplementary data

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



Input and output modules PNOZ m EF 8DI4DO

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 8DI4DO	Configurable safe small controllers PNOZmulti 2, expansion module, 8 safe digital inputs, 4 safe semiconductor outputs.	772142

Accessories

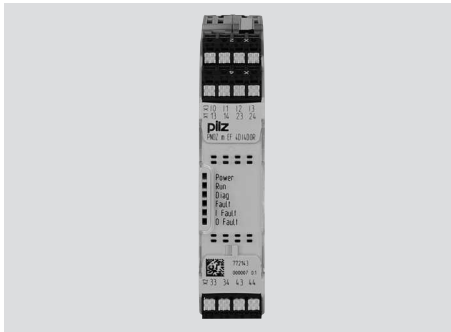
Replacement terminals

Product type	Features	Order no.
PNOZ s Setscrew terminals 22.5mm	Set of plug-in replacement terminals 4-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750004
PNOZ s Setspring-loaded terminals 22.5mm	Set of plug-in replacement terminals 4-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751004

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Input and output modules PNOZ m EF 4DI4DOR



Overview

Unit features

Application of the product PNOZ m EF 4DI4DOR:

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

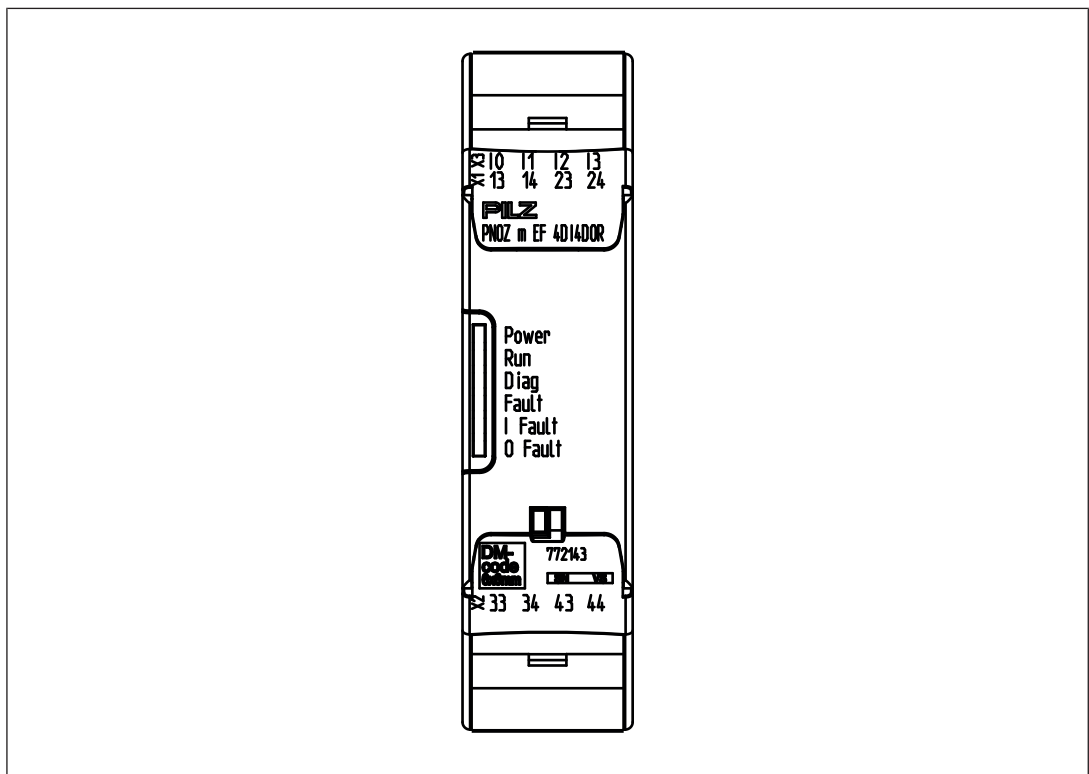
The product has the following features:

- ▶ 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 3 of EN IEC 62061
- ▶ 4 inputs for connecting, for example:
 - Emergency stop pushbuttons
 - Two-hand pushbuttons
 - Safety gate limit switches
 - Start buttons
 - Light barriers
 - Scanner
 - Enabling switches
 - PSEN
 - Operating mode selector switches
- ▶ LED display for:
 - Error messages
 - Diagnostics
 - Supply voltage
 - Output circuits
 - Input circuits

Input and output modules PNOZ m EF 4DI4DOR

- ▶ 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 accessories (see Order references)
- ▶ Please refer to the document "PNOZmulti System Expansion" for the PNOZmulti base units that can be connected.

Front view



Legend:

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

Input and output modules PNOZ m EF 4DI4DOR

Function description

Functions

The expansion module provides additional inputs and additional relay outputs.

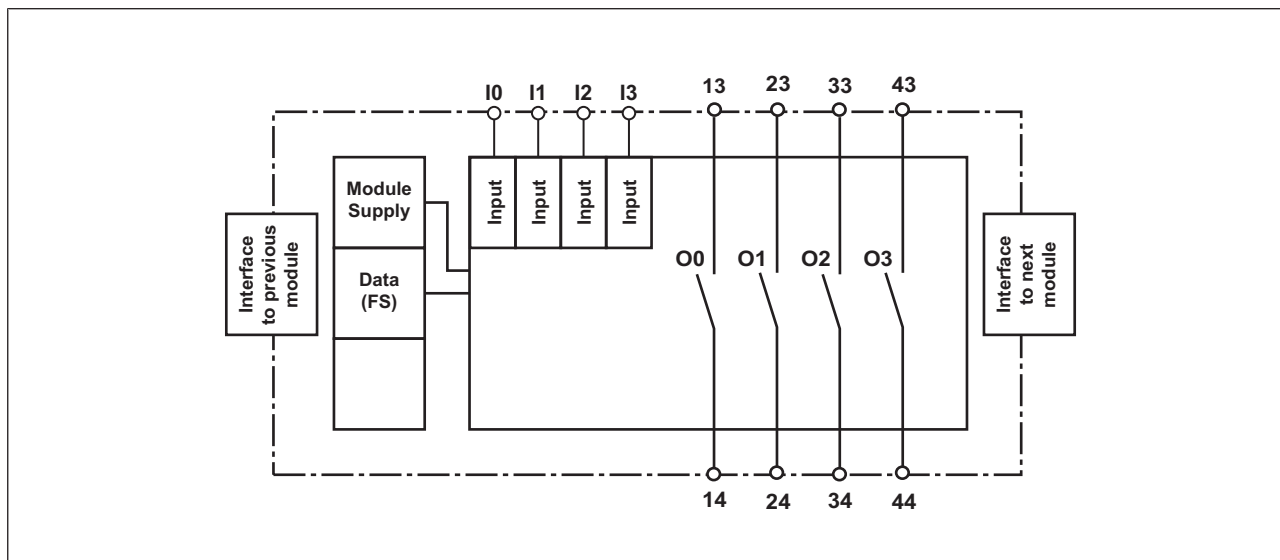
The function of the inputs and outputs on the control system depends on the safety circuit created using the PNOZmulti Configurator. A removable data medium is used to download the safety circuit to the base unit. The base unit has 2 microcontrollers that monitor each other. They evaluate the input circuits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

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 "PNOZmulti System Expansion".

Block diagram

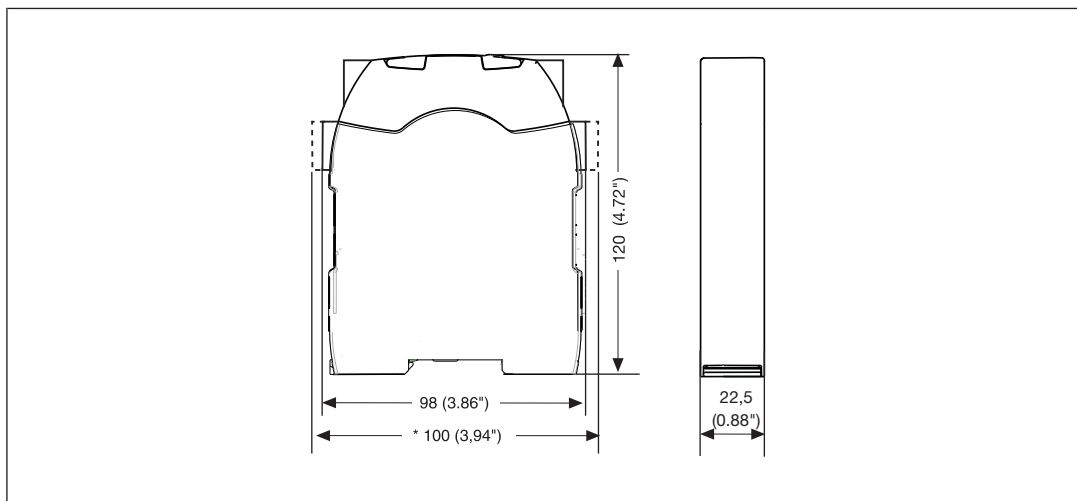


Input and output modules

PNOZ m EF 4DI4DOR

Installation

Dimensions in mm



Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[212\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ To prevent contact welding, a fuse should be connected before the output contacts (see [Technical details \[212\]](#)).
- ▶ Adequate protection must be provided on all output contacts with capacitive and inductive loads.

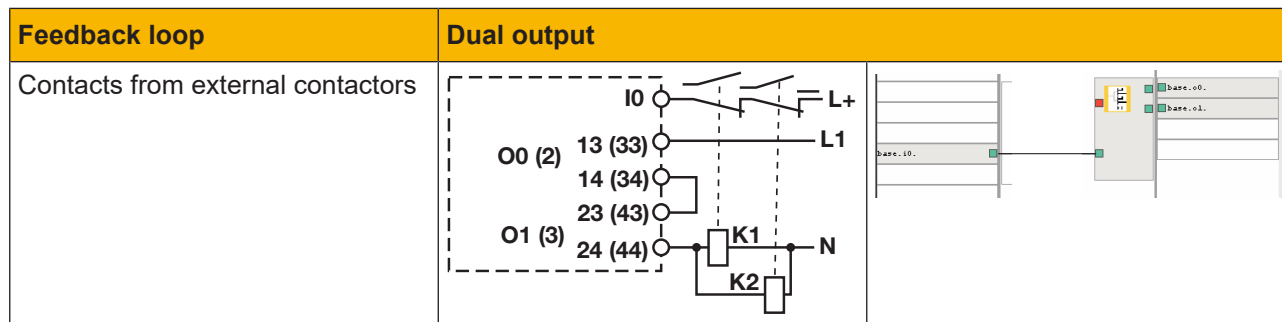
Input and output modules PNOZ m EF 4DI4DOR

Connection

Input circuit	Single-channel	Dual-channel
Example: E-Stop without detection of shorts across contacts		
Example: E-Stop with detection of shorts across contacts		

Relay outputs		
Dual output		
Single output		

Input and output modules PNOZ m EF 4DI4DOR



Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E1h
Electrical data	
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	122 mA
Power consumption	3 W
Max. power dissipation of module	6,5 W
Status indicator	LED
Permitted loads	inductive, resistive
Inputs	
Quantity	4
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	8 ms
Potential isolation	No
Relay outputs	
Number of relay outputs	4
Utilisation category	
in accordance with the standard	EN 60947-4-1

Input and output modules PNOZ m EF 4DI4DOR

Relay outputs

Utilisation category of safety contacts

AC1 at	250 V
Min. current	10 mA
Max. current	6 A
Max. power	1500 VA
DC1 at	24 V
Min. current	10 mA
Max. current	6 A
Max. power	144 W

Utilisation category

in accordance with the standard	EN 60947-5-1
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Utilisation category of safety contacts

AC15 at	230 V
Max. current	3 A
Max. power	690 W
DC13 (6 cycles/min) at	24 V
Max. current	3 A
Max. power	72 W

Utilisation category in accordance with UL

Voltage	240 V AC G.U. Resistive
with current	6 A
Voltage	24 V DC G. U. Resistive
with current	6 A
Pilot Duty; R300	24 V DC
with current	3 A
Pilot Duty; B300	230 V AC
with current	3 A

Airgap creepage between

Relay contacts	3 mm
Relay contacts and other circuits	5,5 mm

External contact fuse protection, safety contacts

in accordance with the standard	VDE 0660
Blow-out fuse, quick	10 A
Blow-out fuse, slow	6 A

Switch-off delay	22 ms
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Contact material	AgCuNi + 0,2 µm Au
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Potential isolation	Yes
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Input and output modules PNOZ m EF 4DI4DOR

Environmental data

Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Potential isolation

Potential isolation between	Relay output and system voltage
Type of potential isolation	Protective separation
Rated insulation voltage	250 V
Rated surge voltage	4000 V

Mechanical data

Mounting position	horizontally on mounting rail
Mechanical life	10,000,000 cycles
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm

Input and output modules PNOZ m EF 4DI4DOR

Mechanical data

Cable length	
Max. cable length per input	1 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	
	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	190 g

Where standards are undated, the 2012-04 latest editions shall apply.

Input and output modules PNOZ m EF 4DI4DOR

Safety characteristic data

Unit	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 _D [1/h]	EN ISO 13849-1: 2015 T _M [year]
Logic						
CPU	2-channel	PL e	Cat. 4	SIL 3	2,84E-10	20
Input						
Inputs	1-channel	PL d	Cat. 2	SIL 2	2,10E-09	20
Inputs	2-channel	PL e	Cat. 4	SIL 3	4,27E-11	20
Inputs	Short circuit-forming safety mats	PL d	Cat. 3	SIL 2	1,80E-10	20
Inputs	1-ch., pulsed light barrier	PL e	Cat. 4	SIL 3	2,10E-10	20
Output						
Relay outputs	1-channel	PL c	Cat. 1	-	3,75E-08	20
Relay outputs	2-channel	PL e	Cat. 4	SIL 3	7,52E-12	20

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

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.

Input and output modules PNOZ m EF 4DI4DOR

Classification according to ZVEI, CB24I

The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Input	
Interfaces	
Drain	
Interface	Module
Class	C2
Source	
Interface	Sensor
Class	C2, C3
Drain parameters	
Max. test pulse duration	500 µs
Min. input resistance	5,6 kOhm
Max. capacitive load	126 nF

Input and output modules
PNOZ m EF 4DI4DOR

Supplementary data

Service life graph for the relay contacts

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.

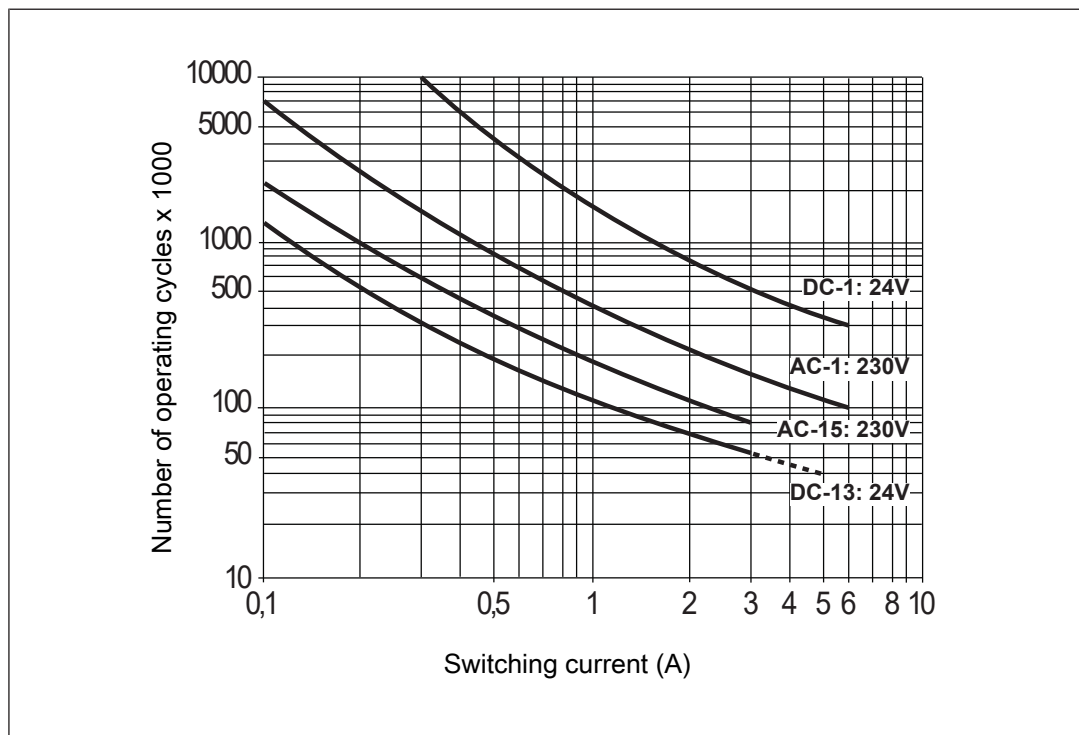


Fig.: Service life graphs at 24 VDC and 230 VAC

Input and output modules PNOZ m EF 4DI4DOR

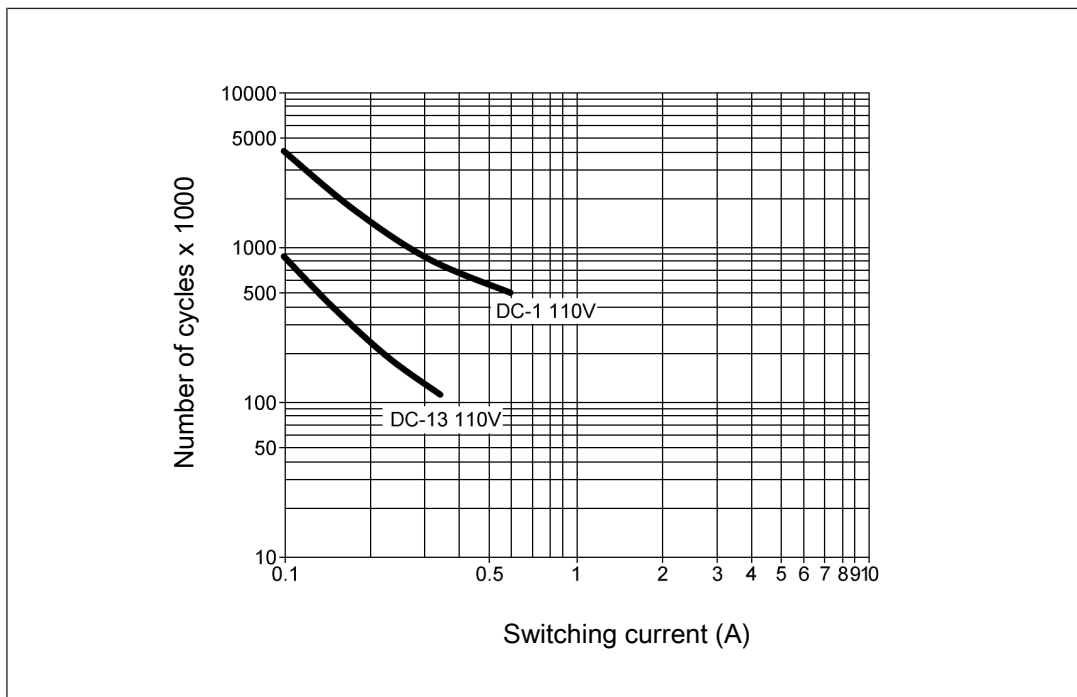


Fig.: Service life graphs at 110 VDC

Example

- ▶ Inductive load: 0.2 A
- ▶ Utilisation category: AC15
- ▶ Contact service life: 1 000 000 cycles

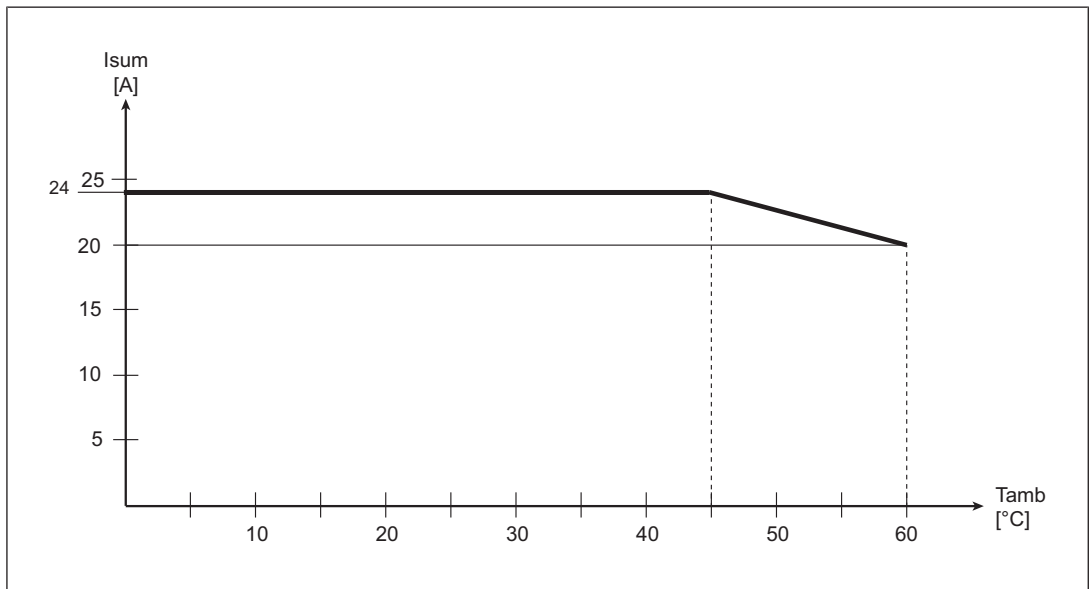
Provided the application to be implemented requires fewer than 1 000 000 cycles, the PFH value (see [Technical details \[212\]](#)) can be used in the calculation.

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

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

Input and output modules PNOZ m EF 4DI4DOR

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

Input and output modules PNOZ m EF 4DI4DOR

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 4DI4DOR	Configurable safe small controllers PNOZmulti 2, expansion module, 4 safe digital inputs, 4 safe relay outputs.	772143

Accessories

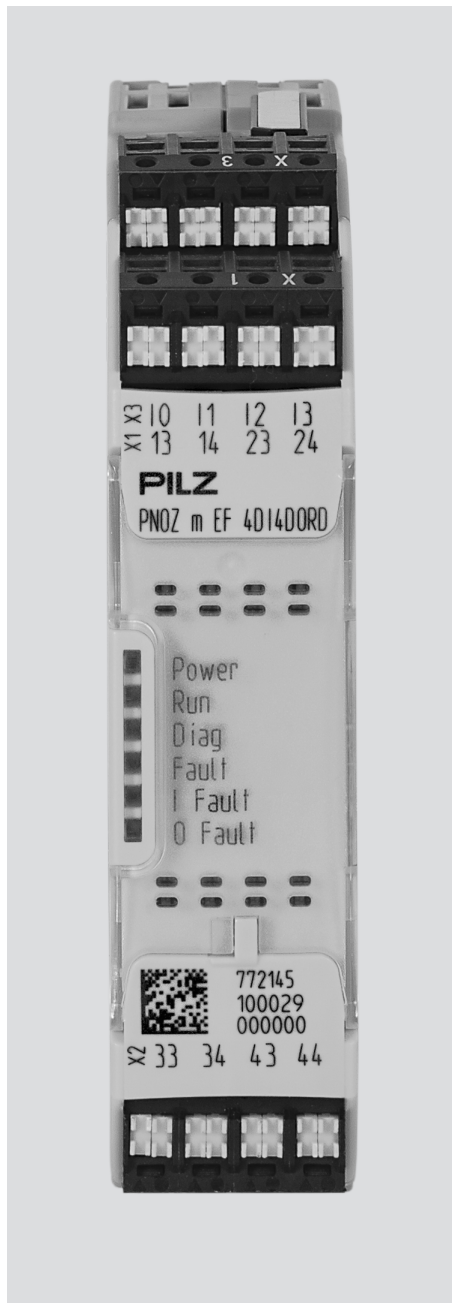
Terminals

Product type	Features	Order no.
Spring terminals PNOZ mml2p	Spring-loaded terminals, PNOZ mml2p, 1 set.	783540
Screw terminals PNOZ mml2p	Plug-in screw terminals, PNOZ mml2p, 1 set.	793540

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Input and output modules PNOZ m EF 4DI4DORD



Overview

Unit features

Application of the product PNOZ m EF 4DI4DORD:

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

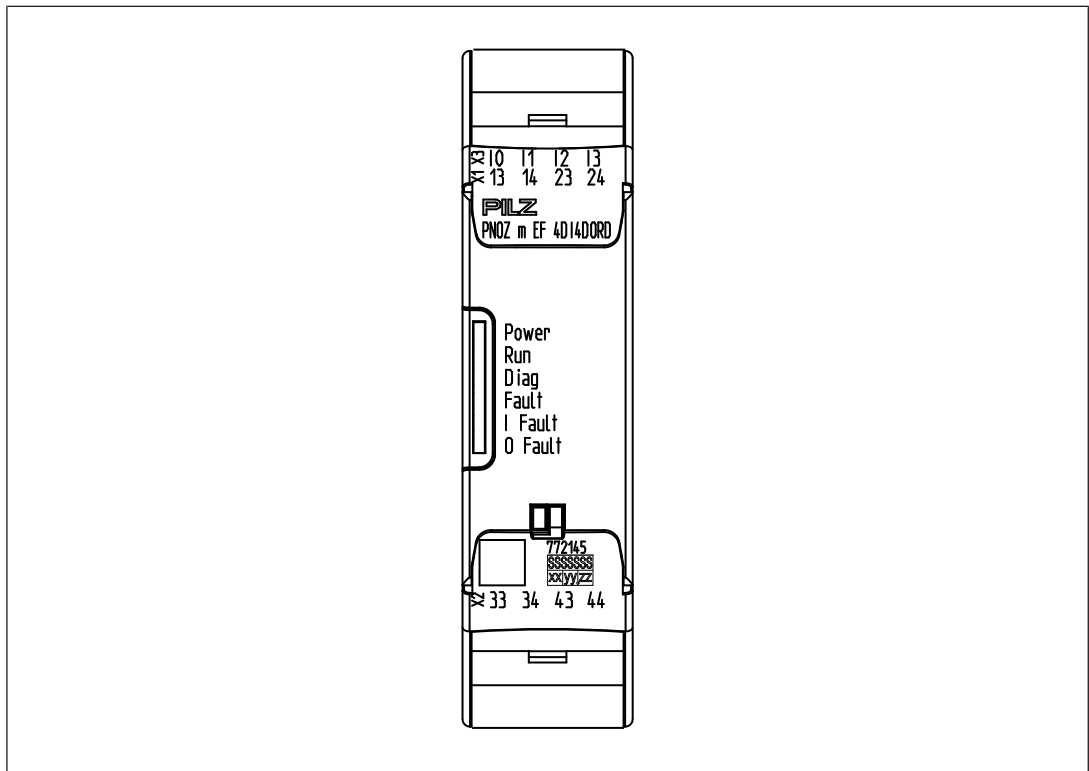
The product has the following features:

Input and output modules PNOZ m EF 4DI4DORD

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Positive-guided relay outputs, diverse:
 - 4 safety outputs
depending on the application, up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061
suitable for controlling the safety valves of a burner in accordance with DIN EN 50156.
- ▶ 4 inputs for connecting, for example:
 - Emergency stop pushbuttons
 - Two-hand pushbuttons
 - Safety gate limit switches
 - Start buttons
 - Light barriers
 - Scanner
 - Enabling switches
 - PSEN
 - Operating mode selector switches
- ▶ LED display 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 accessories (see Order references)
- ▶ Please refer to the document "PNOZmulti System Expansion" for the PNOZmulti base units that can be connected.

Input and output modules PNOZ m EF 4DI4DORD

Front view



Legend:

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

Function description

Integrated protection mechanisms

The relay meets the following safety requirements:

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

Input and output modules PNOZ m EF 4DI4DORD

- ▶ The relay contacts meet the requirements for protective separation through increased insulation compared with all other circuits in the safety system.
- ▶ A defective relay contact will be detected during switching.

Functions

The expansion module provides additional inputs and diverse relay outputs.

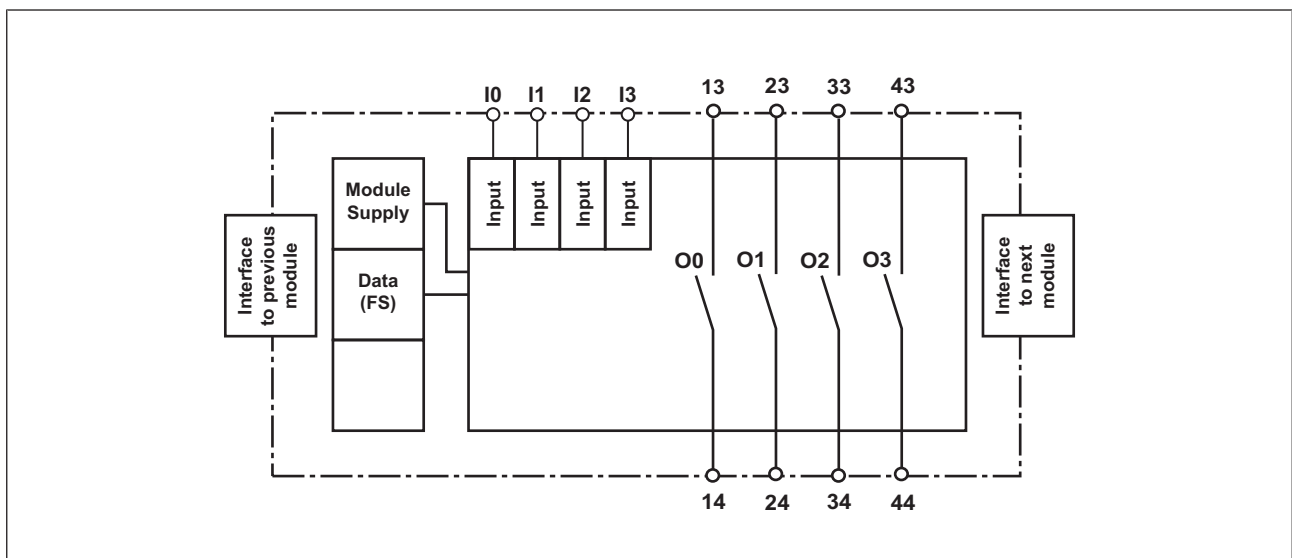
The function of the inputs and outputs on the control system depends on the safety circuit created using the PNOZmulti Configurator. A removable data medium is used to download the safety circuit to the base unit. The base unit has 2 microcontrollers that monitor each other. They evaluate the input circuits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

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 "PNOZmulti System Expansion".

Block diagram

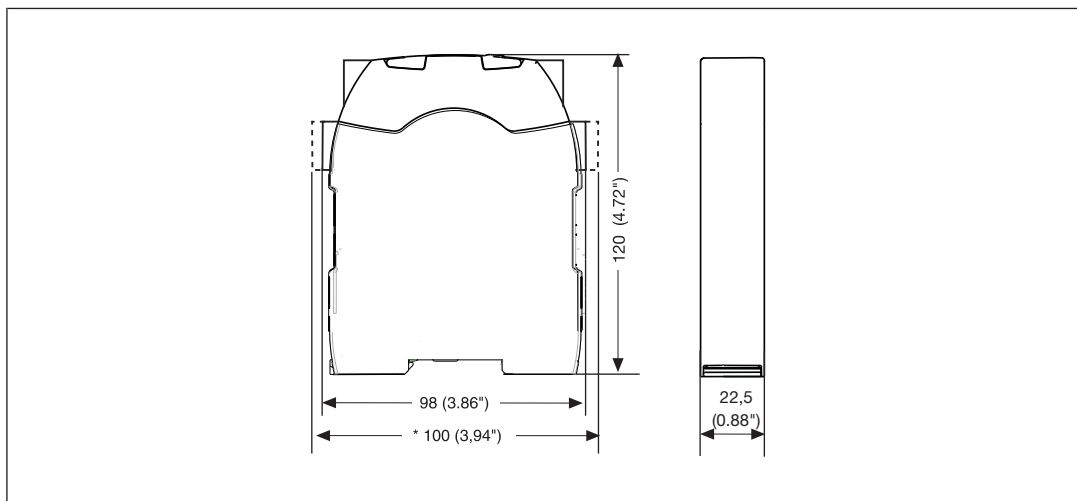


Input and output modules

PNOZ m EF 4DI4DORD

Installation

Dimensions in mm



Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[229\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ To prevent contact welding, a fuse should be connected before the output contacts (see [Technical details \[229\]](#)).
- ▶ Adequate protection must be provided on all output contacts with capacitive and inductive loads.

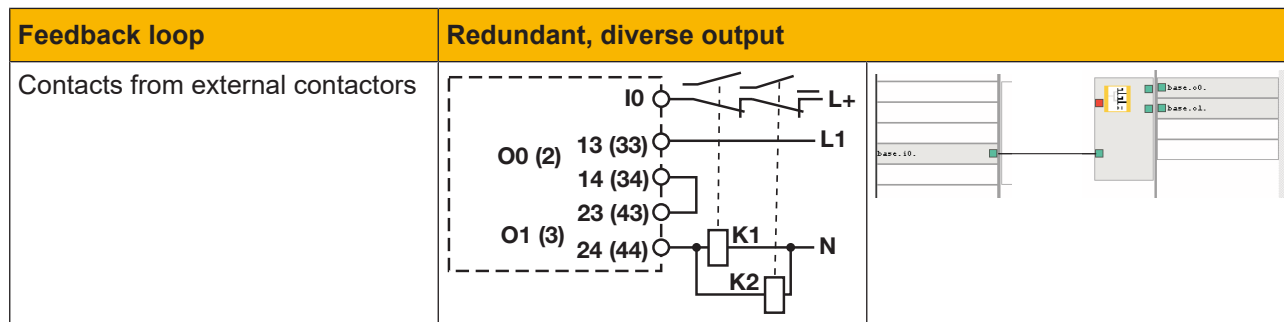
Input and output modules PNOZ m EF 4DI4DORD

Connection

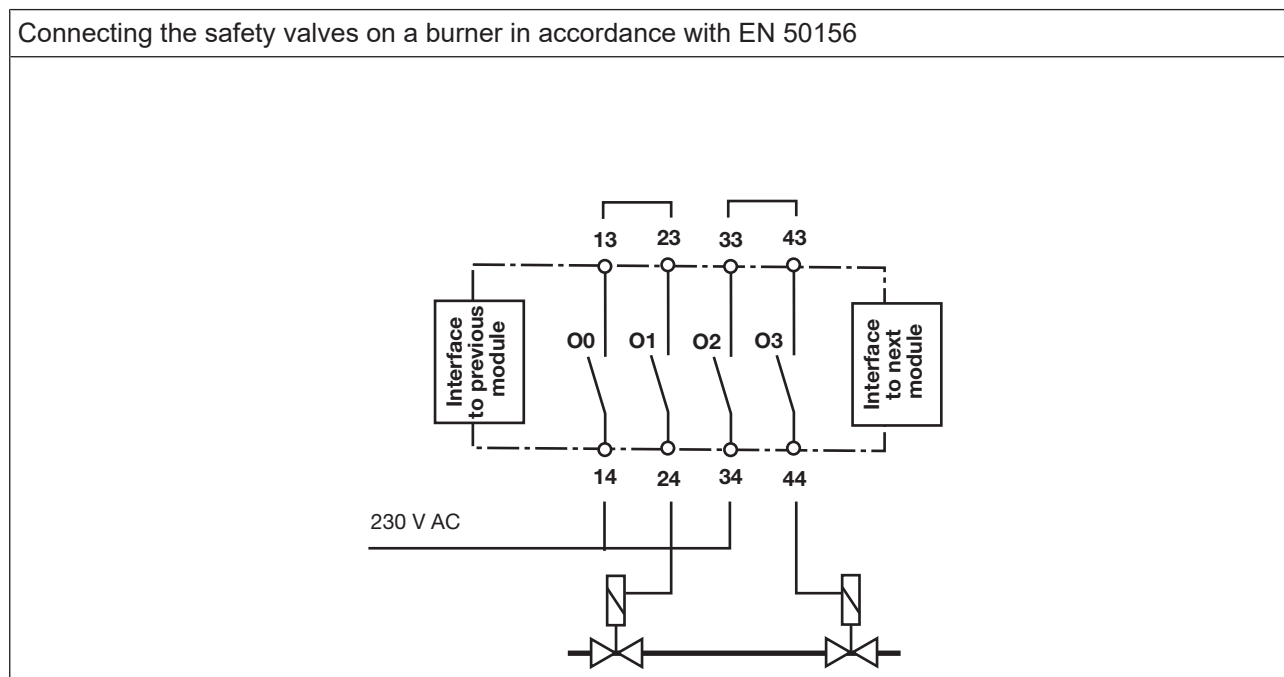
Input circuit	Single-channel	Dual-channel
Example: Emergency stop without detection of shorts across contacts		
Example: Emergency stop with detection of shorts across contacts		

Relay outputs		
Redundant, diverse output		
Single output		

Input and output modules PNOZ m EF 4DI4DORD



Connecting the safety valves on a burner in accordance with EN 50156



Maintenance and testing

It is not necessary to perform maintenance work on the product in normal operation. Please return any faulty products to Pilz.

Input and output modules PNOZ m EF 4DI4DORD

Technical details

General	
Certifications	CE, TÜV, UKCA
Application range	Failsafe
Module's device code	00E9h
Electrical data	
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	122 mA
Power consumption	3 W
Max. power dissipation of module	6,5 W
Status indicator	LED
Permitted loads	inductive, resistive
Inputs	
Quantity	4
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,5 ms
Maximum input delay	8 ms
Potential isolation	No
Relay outputs	
Number of relay outputs	4
Utilisation category	
in accordance with the standard	EN 60947-4-1
Utilisation category of safety contacts	
AC1 at	250 V
Min. current	10 mA
Max. current	6 A
Max. power	1500 VA
DC1 at	24 V
Min. current	10 mA
Max. current	6 A
Max. power	144 W
Utilisation category	
in accordance with the standard	EN 60947-5-1

Input and output modules PNOZ m EF 4DI4DORD

Relay outputs

Utilisation category of safety contacts

AC15 at	230 V
Max. current	3 A
Max. power	690 W
DC13 (6 cycles/min) at	24 V
Max. current	3 A
Max. power	72 W

Utilisation category in accordance with UL

Pilot Duty; R300	24 V DC
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Airgap creepage between

Relay contacts	3 mm
Relay contacts and other circuits	5,5 mm

External contact fuse protection, safety contacts

in accordance with the standard	VDE 0660
Blow-out fuse, quick	10 A
Blow-out fuse, slow	6 A

Switch-off delay

22 ms

Contact material

AgCuNi + 0,2 µm Au

Potential isolation

Yes

Environmental data

Ambient temperature

in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C

Storage temperature

in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C

Climatic suitability

in accordance with the standard	EN 60068-2-30, EN 60068-2-78
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Condensation during operation

Not permitted

Max. operating height above SL

2000 m

EMC

EN 61131-2

Vibration

in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g

Shock stress

in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms

Input and output modules PNOZ m EF 4DI4DORD

Environmental data

Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2

Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Potential isolation

Potential isolation between	Relay output and system voltage
Type of potential isolation	Protective separation
Rated insulation voltage	250 V
Rated surge voltage	4000 V

Mechanical data

Mounting position	horizontally on mounting rail
Mechanical life	10,000,000 cycles
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	1 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm

Input and output modules PNOZ m EF 4DI4DORD

Mechanical data

Dimensions

Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	185 g

Where standards are undated, the 2020-09 latest editions shall apply.

Safety characteristic data

Unit	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 _D [1/h]	EN ISO 13849-1: 2015 T _M [year]
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Logic

CPU	2-channel	PL e	Cat. 4	SIL 3	2,84E-10	20
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Input

Inputs	1-channel	PL d	Cat. 2	SIL 2	2,10E-09	20
Inputs	2-channel	PL e	Cat. 4	SIL 3	4,27E-11	20
Inputs	Short circuit-forming safety mats	PL d	Cat. 3	SIL 2	1,80E-10	20
Inputs	1-ch., pulsed light barrier	PL e	Cat. 4	SIL 3	2,10E-10	20

Output

Relay outputs	1-channel	PL c	Cat. 1	-	4,41E-07	20
Relay outputs	2-channel	PL e	Cat. 4	SIL 3	9,58E-11	20

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

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.

Input and output modules PNOZ m EF 4DI4DORD

Classification according to ZVEI, CB24I

The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Input	
Interfaces	
Drain	
Interface	Module
Class	C2
Source	
Interface	Sensor
Class	C2, C3
Drain parameters	
Max. test pulse duration	500 µs
Min. input resistance	5,6 kOhm
Max. capacitive load	126 nF

Input and output modules
PNOZ m EF 4DI4DORD

Supplementary data

Service life graph for the relay contacts

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.

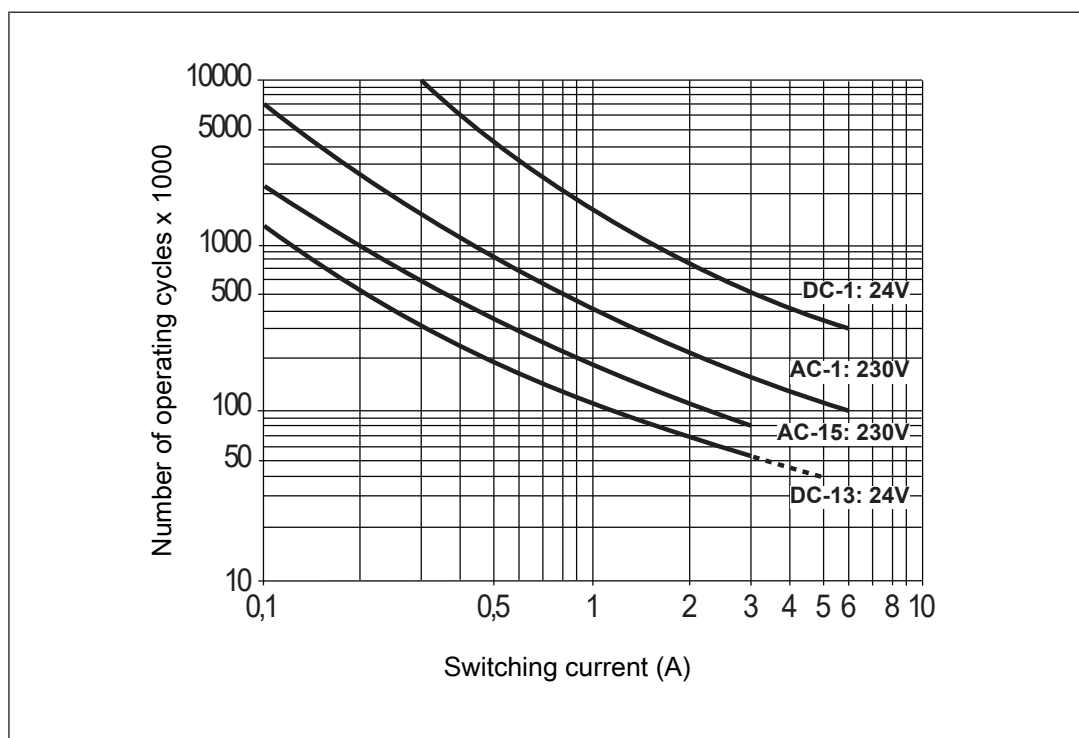


Fig.: Service life graphs at 24 VDC and 230 VAC

Input and output modules PNOZ m EF 4DI4DORD

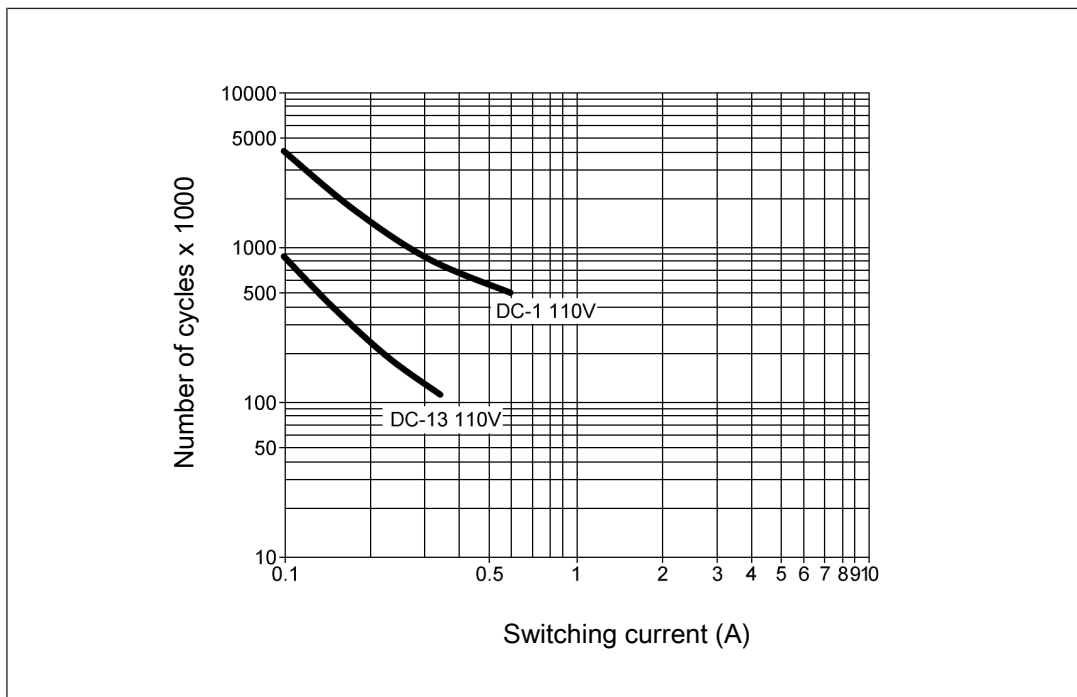


Fig.: Service life graphs at 110 VDC

Example

- ▶ Inductive load: 0.2 A
- ▶ Utilisation category: AC15
- ▶ Contact service life: 1 000 000 cycles

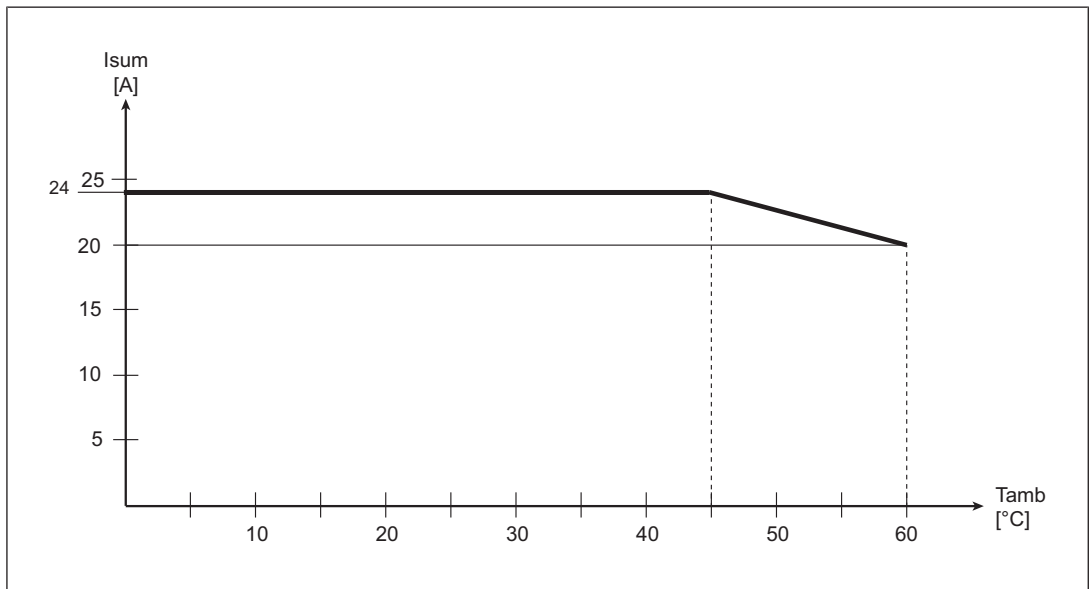
Provided the application to be implemented requires fewer than 1 000 000 cycles, the PFH value (see [Technical details \[229\]](#)) can be used in the calculation.

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

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

Input and output modules PNOZ m EF 4DI4DORD

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

Input and output modules PNOZ m EF 4DI4DORD

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 4DI4-DORD	Configurable safe small controllers PNOZmulti 2, expansion modules, 4 safe digital inputs, 4 safe relay outputs, diverse, to control the safety valves of a furnace in accordance with EN 50156.	772145

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ mml2p	Spring-loaded terminals, PNOZ mml2p, 1 set.	783540
Screw terminals PNOZ mml2p	Plug-in screw terminals, PNOZ mml2p, 1 set.	793540

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Input and output modules

PNOZ m EF 8DI2DOT



Overview


Unit features

Application of the product PNOZ m EF 8DI2DOT:

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

The product has the following features:

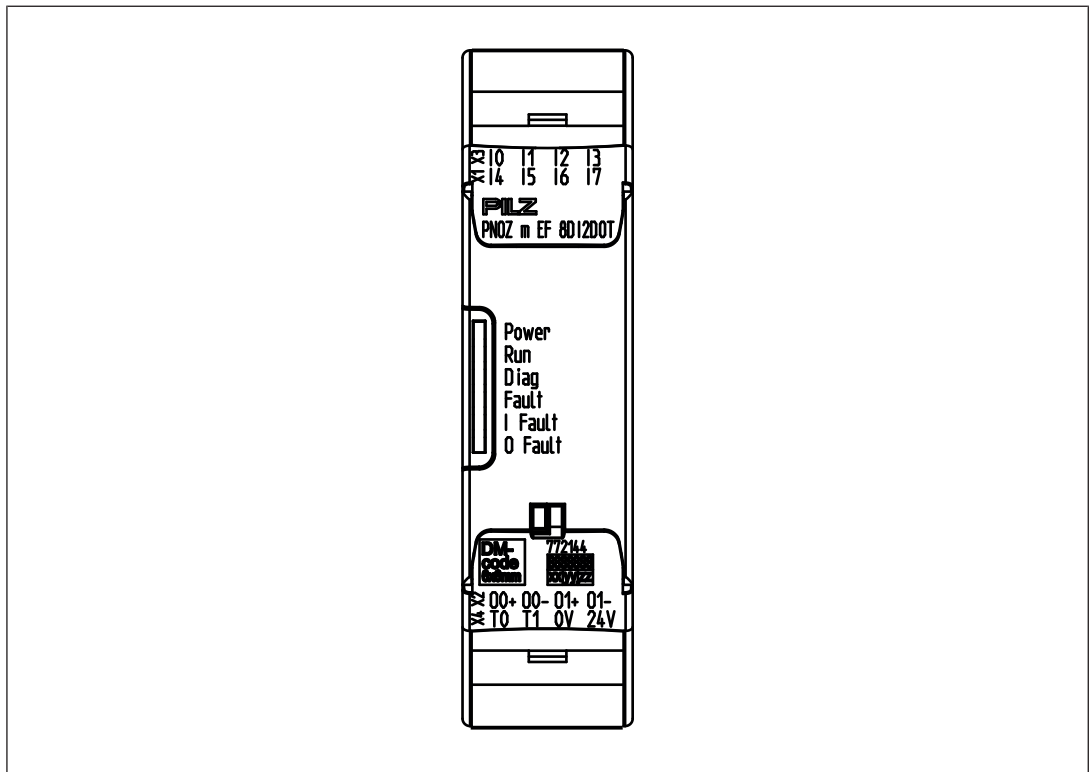
- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Semiconductor outputs:
 - 2 dual-pole safety outputs depending on the application, up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061. The outputs are suitable for controlling a press safety valve in accordance with EN 692.
 - Open circuit detection configurable
- ▶ 8 inputs
 - The inputs can be used to evaluate run monitoring for press applications.
 - Configurable pulse suppression at the inputs
- ▶ LED display for:
 - Error messages
 - Diagnostics
 - Switch state of the outputs
 - Switch state of the inputs
- ▶ Monitoring of shorts across contacts at the inputs by test pulses
 - from the base unit
 - from the expansion module
- ▶ Monitoring of shorts between the safety outputs
- ▶ Plug-in connection terminals:

Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#)  193).

Input and output modules PNOZ m EF 8DI2DOT

- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Front view



Legend

- X1, X3: Inputs I0 – I7
- X2: Dual-pole outputs O0+, O0- and O1+, O1-
- X4: Supply connections 0 V, 24 V
- Test pulse outputs T0, T1
- LEDs POWER, Run, Diag, Fault, I Fault, O Fault
- Terminal LEDs: Each terminal is assigned an LED.

Input and output modules

PNOZ m EF 8DI2DOT

Function description

Functions

The expansion module provides additional inputs and dual-pole semiconductor outputs.

The function of the inputs and outputs on the control system depends on the user program created using the PNOZmulti Configurator. The user program is downloaded from the PNOZmulti Configurator 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.

Inputs

The expansion module provides 8 inputs.

Features

- ▶ Each input can be used to evaluate run monitoring for press applications.
- ▶ Each input can be configured for pulse detection for run monitoring.
 - The pulse width has to be at least 1 ms for reliable pulse detection.
 - When pulse detection is active, the functions pulse suppression and detection of shorts across contacts are deactivated via the test pulses.
- ▶ In PNOZmulti Configurator the pulse suppression time can be changed for the inputs. A change of the preset pulse suppression time (see [Technical details \[📖 246\]](#)) can be used to suppress the self-monitored outputs and for interference suppression.
- ▶ For detection of shorts across contacts of the inputs:
 - In the main program the inputs can be connected with the test pulses of the base unit.
 - In the module program the inputs can be connected to the test pulses of the expansion module.

2-pole outputs

The expansion module provides two dual-pole outputs.

Input and output modules PNOZ m EF 8DI2DOT

Features:

- ▶ Signals at the output
 - "0" signal (0 V) at the output (O+/O-):
Output is high impedance
No current to the load
 - "1" signal (+24 V) at the output (O+/O-):
Output is low impedance
Current is supplied to the load
- ▶ The max. capacity at an output depends on the load (see drawing on the max. capacitive load). Connecting a higher capacity may lead to an error.
- ▶ Operation with electronic contactors has not been tested and may lead to errors. Please contact our Customer Support team if you are using electronic contactors.
- ▶ Open circuit detection
- ▶ Cannot be used as a single-pole output

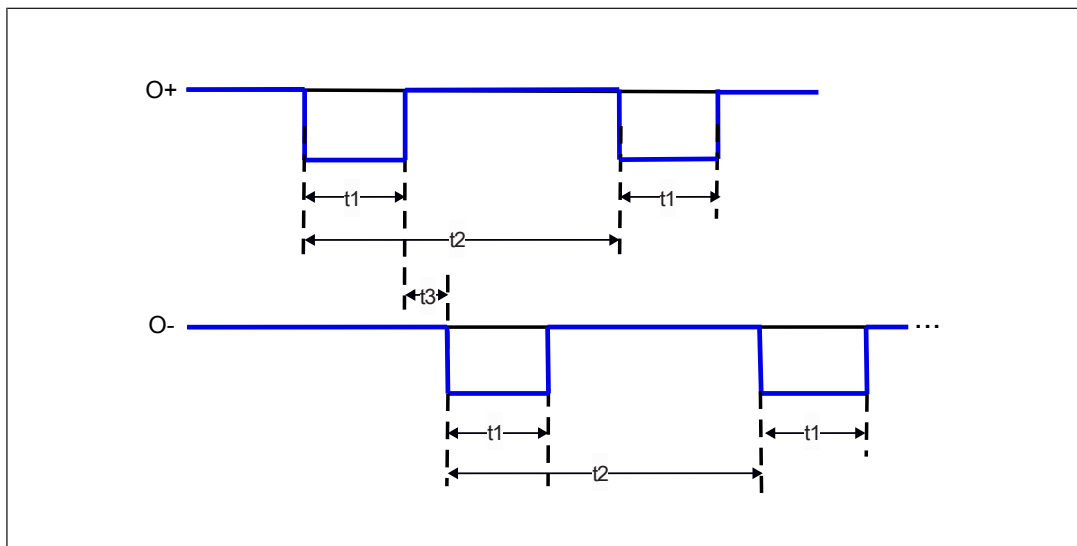
Output tests

The following output tests are carried out:

- ▶ Asymmetric test in error-free operation
 - In this test, one output transistor is switched on and the other switched off for the test duration t_1 as a maximum. The load is not switched on because of the test. If errors are detected during this test, then an advanced on test is run.
 - The test duration t_1 is max. 5 ms.
 - The repetition time between the asymmetrical tests t_2 is at least 30 s.
 - The time t_3 between two asymmetrical tests O+ and O- is at least 1 s.
- ▶ Advanced on test in the event of an error
 - The advanced on test is always run directly after an asymmetric test, in which an error has occurred. It is used to determine the cause of the error.
 - The test is run for the test duration t_1 as a maximum
 - The test duration t_1 is max. 5 ms.
 - The test enables precise error diagnostics
 - The load must not switch on because of the test.
 - The following errors are detected:
 - Shorts across contacts (external error),
 - Short circuits and interruptions on the transistors,
 - Short circuits and open circuit on the connected load

Input and output modules PNOZ m EF 8DI2DOT

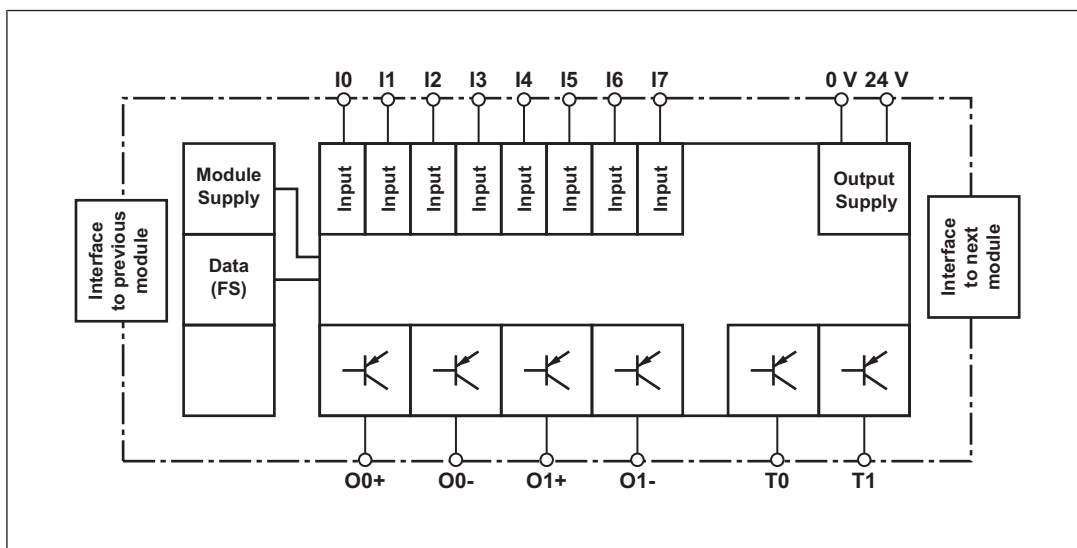
Function diagram of the asymmetric test



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 "PNOZmulti System Expansion".

Block diagram

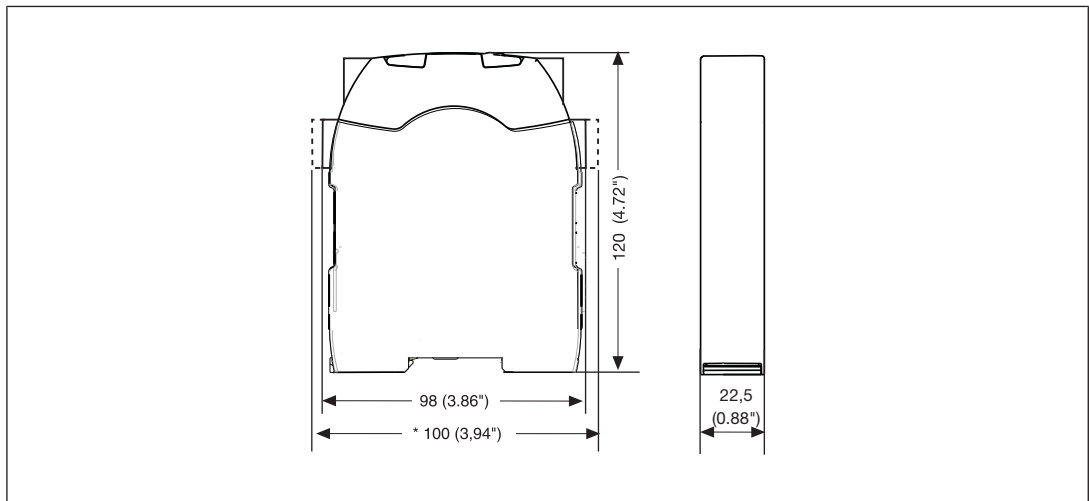


Input and output modules

PNOZ m EF 8DI2DOT

Installation

Dimensions in mm



Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[246\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The power supply must meet the regulations for extra low voltages with protective separation (SELV/PELV).
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6 A
- ▶ The unit has two dual-pole semiconductor outputs. These may be configured as single-pole or redundant outputs. The output assignment is defined in the PNOZmulti Configurator. Wire the outputs as described in the table.

Input and output modules PNOZ m EF 8DI2DOT

Connection

Supply voltage

Supply voltage	DC

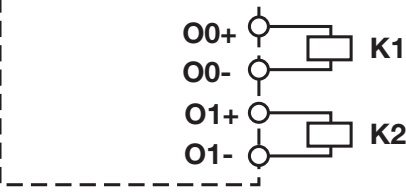
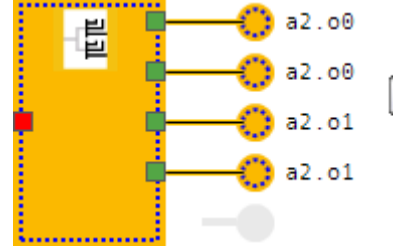
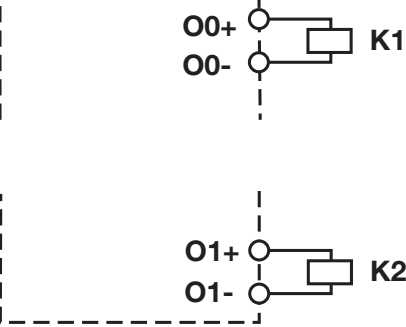
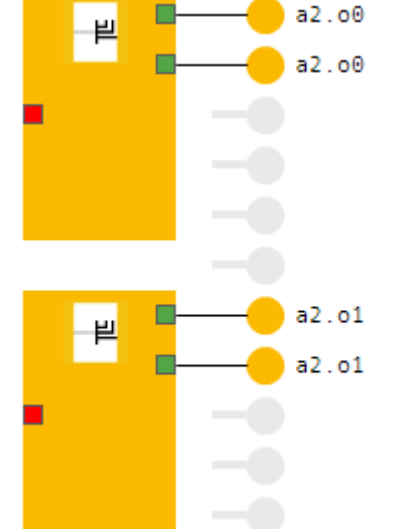
Connection examples for the input circuit

Input circuit	Single-channel	Dual-channel
Example: E-STOP without detection of shorts across contacts		
Example: E-STOP with detection of shorts across contacts		

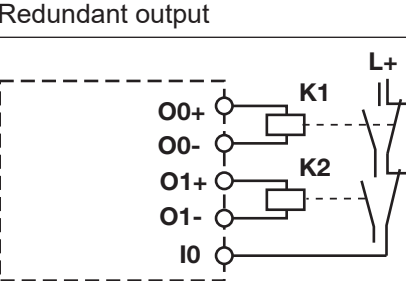
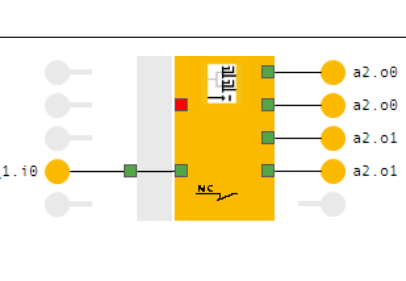
Input and output modules

PNOZ m EF 8DI2DOT

Connection examples for the output circuit

<p>Redundant output</p>		
<p>Single output</p>		

Feedback loop

<p>Feedback loop</p> <p>Contacts from external contactors</p>	<p>Redundant output</p> 	
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Input and output modules PNOZ m EF 8DI2DOT

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E5h
Electrical data	
Supply voltage	
for	Supply to the SC outputs
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	4 A
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	35 mA
Power consumption	0,8 W
Max. power dissipation of module	8 W
Status indicator	LED
Inputs	
Quantity	8
Input voltage in accordance with EN 61131-2 Type 1	24 V DC
Input current at rated voltage	5 mA
Input current range	2,5 - 5,3 mA
Pulse suppression	0,4 - 5 ms
Input delay	8 ms + pulse suppression
Potential isolation	No
Semiconductor outputs, 2-pole	
Number of dual-pole semiconductor outputs	2
Permitted loads	0,00 - 2,40 A
Switching capability	
Voltage	24 V DC
Typ. output current at "1" signal and rated voltage of semiconductor output	2 A
Residual current at "0" signal	0,5 mA
Max. pulsed current for t < 100 ms	12 A

Input and output modules PNOZ m EF 8DI2DOT

Semiconductor outputs, 2-pole	
Switch-off delay	6 ms
Short circuit-proof	Yes
Max. duration of off time during self test	5 ms
Test pulse outputs	
Number of test pulse outputs	2
Voltage	24 V
Current	0,05 A
Max. duration of off time during self test	1,4 ms
Short circuit-proof	Yes
Potential isolation	No
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 55 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Input and output modules PNOZ m EF 8DI2DOT

Potential isolation	
Potential isolation between	2-pole semiconductor outputs and system voltage
Type of potential isolation	Basic insulation
Rated surge voltage	2500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	1 km
Sum of individual cable lengths at the test pulse output	1 km
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 2,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	105 g

Where standards are undated, the 2017-09 latest editions shall apply.

Input and output modules PNOZ m EF 8DI2DOT

Safety characteristic data

Unit	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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
Logic								
CPU	2-channel	PL e	Cat. 4	SIL 3	2,84E-10	SIL 3	2,44E-05	20
Input								
Inputs	1-channel	PL d	Cat. 2	SIL 2	2,10E-09	SIL 2	1,84E-04	20
Inputs	2-channel	PL e	Cat. 4	SIL 3	4,27E-11	SIL 3	3,73E-06	20
Inputs	Short circuit-forming safety mats	PL d	Cat. 3	SIL 2	1,80E-10	SIL 2	1,54E-05	20
Inputs	1-ch., pulsed light barrier	PL e	Cat. 4	SIL 3	2,10E-10	SIL 3	1,86E-05	20
Output								
SC outputs (2-pole)	2-channel	PL e	Cat. 4	SIL 3	2,82E-10	SIL 3	2,42E-05	20

Explanatory notes for the safety-related characteristic data:

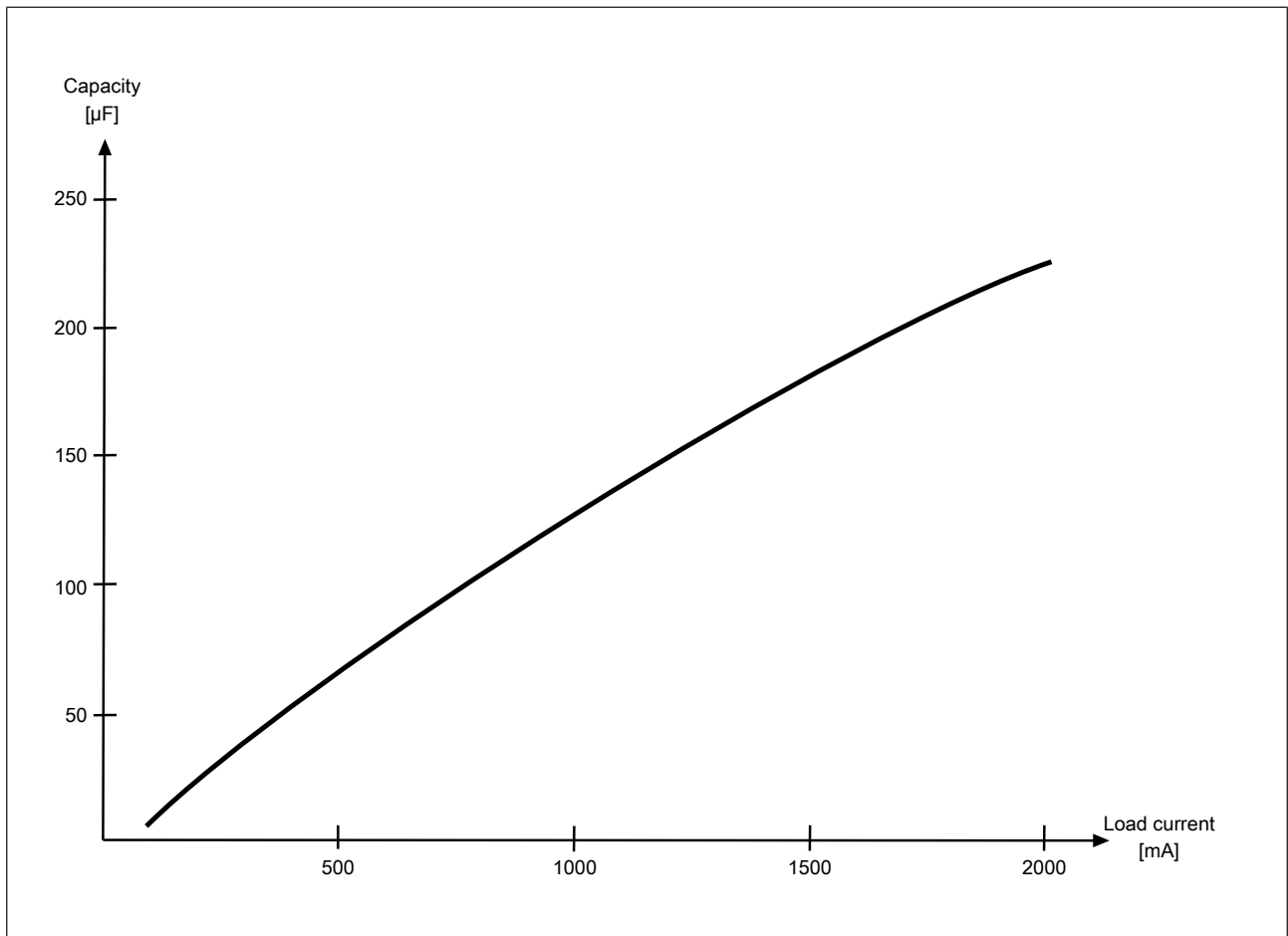
- ▶ Safety characteristic data in accordance with EN IEC 62061 and EN/IEC 61511 was calculated based on EN/IEC 61508.
- ▶ T_M is the maximum mission time in accordance with EN ISO 13849-1. The value also applies as the retest interval in accordance with EN/IEC 61508-6 and EN/IEC 61511 and as the proof 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.

Input and output modules PNOZ m EF 8DI2DOT

Supplementary data

Maximum capacitive load C (μF) with load current I (A) at the semiconductor outputs



Input and output modules PNOZ m EF 8DI2DOT

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 8DI4-DOT	Configurable safe small controllers PNOZmulti 2, expansion module, 8 safe inputs, 2 safe dual-pole semiconductor outputs.	772144

Accessories

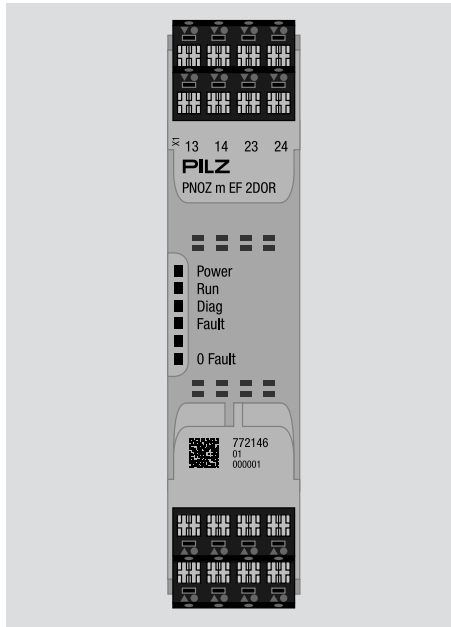
Replacement terminals

Product type	Features	Order no.
PNOZ s Setscrew terminals 22.5mm	Set of plug-in replacement terminals 4-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750004
PNOZ s Setspring-loaded terminals 22.5mm	Set of plug-in replacement terminals 4-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751004

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Input and output modules PNOZ m EF 2DOR



Overview

Unit features

Application of the product PNOZ m EF 2DOR:

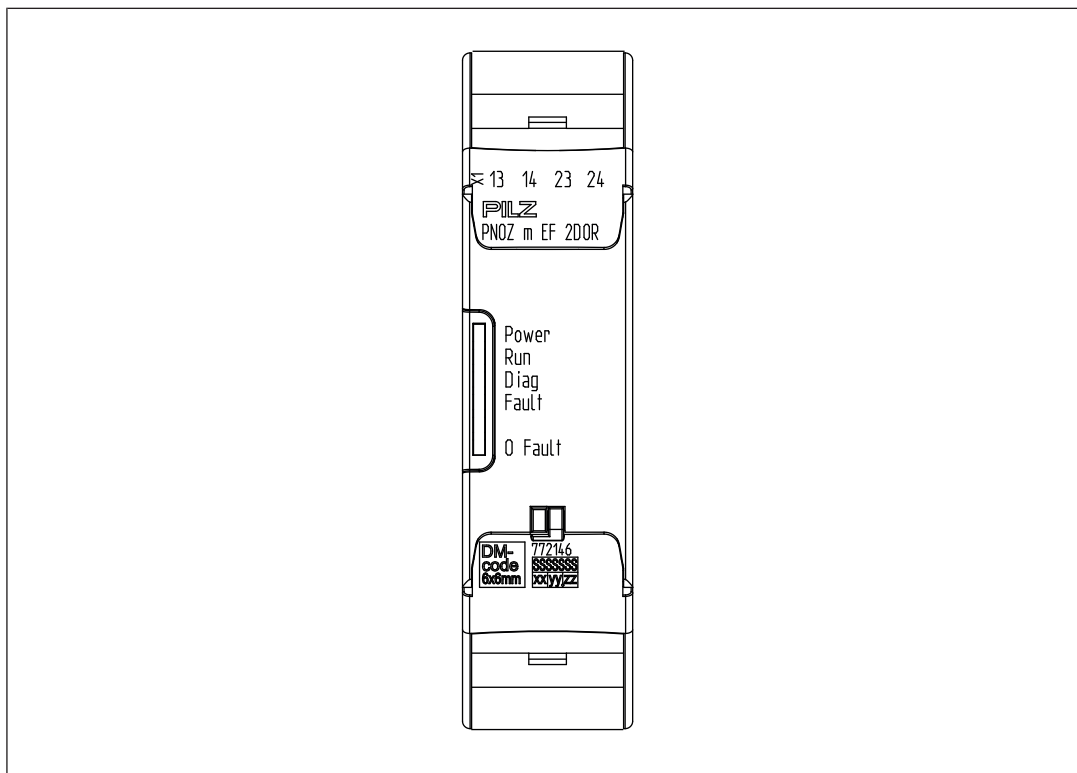
Expansion module for connection to a base unit from the PNOZmulti 2 system.

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Positive-guided relay outputs:
 - 2 safety outputs up to PL c of EN ISO 13849-1
 - 1 safety output up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061
- ▶ LED display for:
 - Error messages
 - Diagnostics
 - Supply voltage
 - Output circuits
- ▶ Plug-in connection terminals:
 - Either spring-loaded terminal or screw terminal available as accessories (see Order references)
- ▶ Please refer to the document "PNOZmulti System Expansion" for the PNOZmulti base units that can be connected.

Input and output modules PNOZ m EF 2DOR

Front view



Legend:

- ▶ Outputs O0 – O1
- ▶ LEDs:
 - POWER
 - Run
 - Diag
 - Fault
 - O Fault

Function description

Integrated protection mechanisms

The relay meets the following safety requirements:

- ▶ The circuit is redundant with built-in self-monitoring.
- ▶ The safety device remains effective in the case of a component failure.
- ▶ The relay contacts meet the requirements for protective separation through increased insulation compared with all other circuits in the safety system.
- ▶ A defective relay contact will be detected during switching.

Input and output modules PNOZ m EF 2DOR

Functions

The expansion module provides additional relay outputs.

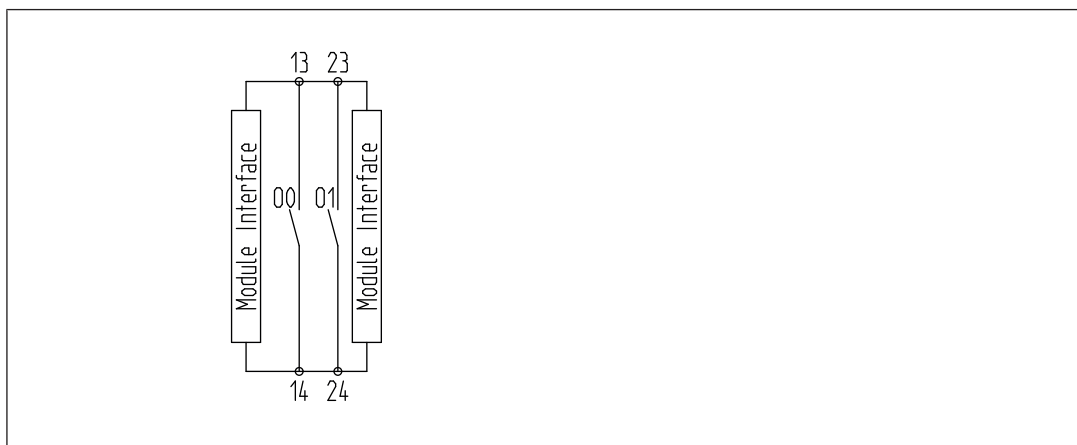
The function of the outputs on the safety system depends on the safety circuit created using the PNOZmulti Configurator. A chip card is used to download the safety circuit to the base unit. The base unit has 2 microcontrollers that monitor each other. They evaluate the input circuits on the base unit 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 safety system, plus connection examples.

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 "PNOZmulti System Expansion".

Block diagram

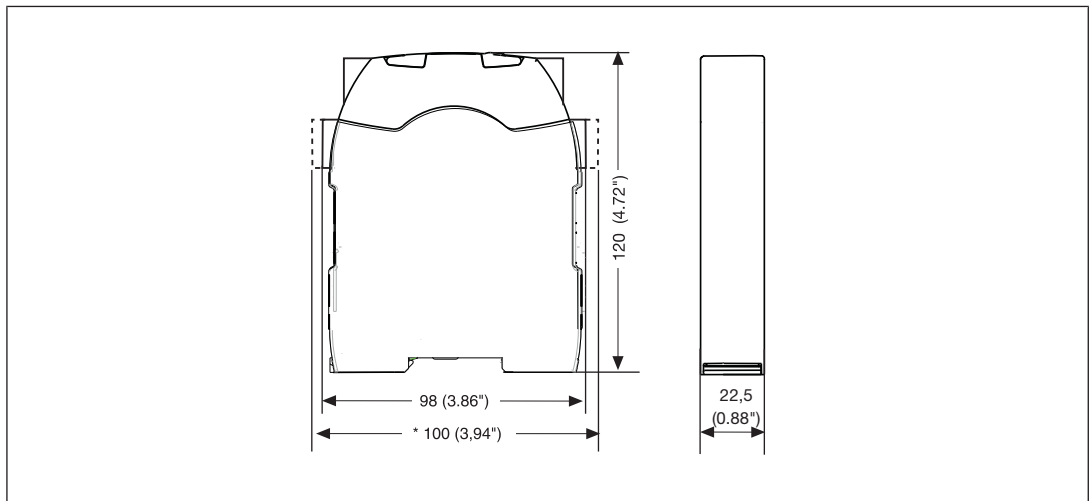


Input and output modules

PNOZ m EF 2DOR

Installation

Dimensions in mm



Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[257\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ To prevent contact welding, a fuse should be connected before the output contacts (see [Technical details \[257\]](#)).
- ▶ Adequate protection must be provided on all output contacts with capacitive and inductive loads.

Input and output modules PNOZ m EF 2DOR

Connection

Relay outputs		
Dual output		
Single output		
Feedback loop	Dual output	
Contacts from external contactors		

Maintenance and testing

It is not necessary to perform maintenance work on the product in normal operation. Please return any faulty products to Pilz.

Input and output modules

PNOZ m EF 2DOR

Technical details

General	
Certifications	CE, TÜV, UKCA
Application range	Failsafe
Module's device code	00EAh
Electrical data	
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	75 mA
Power consumption	2 W
Max. power dissipation of module	2,5 W
Status indicator	LED
Permitted loads	inductive, resistive
Relay outputs	
Number of relay outputs	2
Utilisation category	
in accordance with the standard	EN 60947-4-1
Utilisation category of safety contacts	
AC1 at	250 V
Min. current	10 mA
Max. current	6 A
Max. power	1500 VA
DC1 at	24 V
Min. current	10 mA
Max. current	6 A
Max. power	144 W
Utilisation category	
in accordance with the standard	EN 60947-5-1
Utilisation category of safety contacts	
AC15 at	230 V
Max. current	3 A
Max. power	690 W
DC13 (6 cycles/min) at	24 V
Max. current	3 A
Max. power	72 W

Input and output modules PNOZ m EF 2DOR

Relay outputs

Airgap creepage between	
Relay contacts	3 mm
Relay contacts and other circuits	5,5 mm
External contact fuse protection, safety contacts	
in accordance with the standard	VDE 0660
Blow-out fuse, quick	10 A
Blow-out fuse, slow	6 A
Switch-off delay	22 ms
Contact material	AgCuNi + 0,2 µm Au
Potential isolation	Yes

Environmental data

Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Input and output modules PNOZ m EF 2DOR

Potential isolation	
Potential isolation between	Relay output and system voltage
Type of potential isolation	Protective separation
Rated insulation voltage	250 V
Rated surge voltage	4000 V
Mechanical data	
Mounting position	horizontally on mounting rail
Mechanical life	10,000,000 cycles
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	144 g

Where standards are undated, the 2021-09 latest editions shall apply.

Input and output modules PNOZ m EF 2DOR

Safety characteristic data

Unit	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 _D [1/h]	EN ISO 13849-1: 2015 T _M [year]
Logic						
CPU	2-channel	PL e	Cat. 4	SIL 3	2,84E-10	20
Output						
Relay outputs	1-channel	PL c	Cat. 1	-	4,41E-07	20
Relay outputs	2-channel	PL e	Cat. 4	SIL 3	9,58E-11	20

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

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.

Input and output modules
PNOZ m EF 2DOR

Supplementary data

Service life graph for the relay contacts

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.

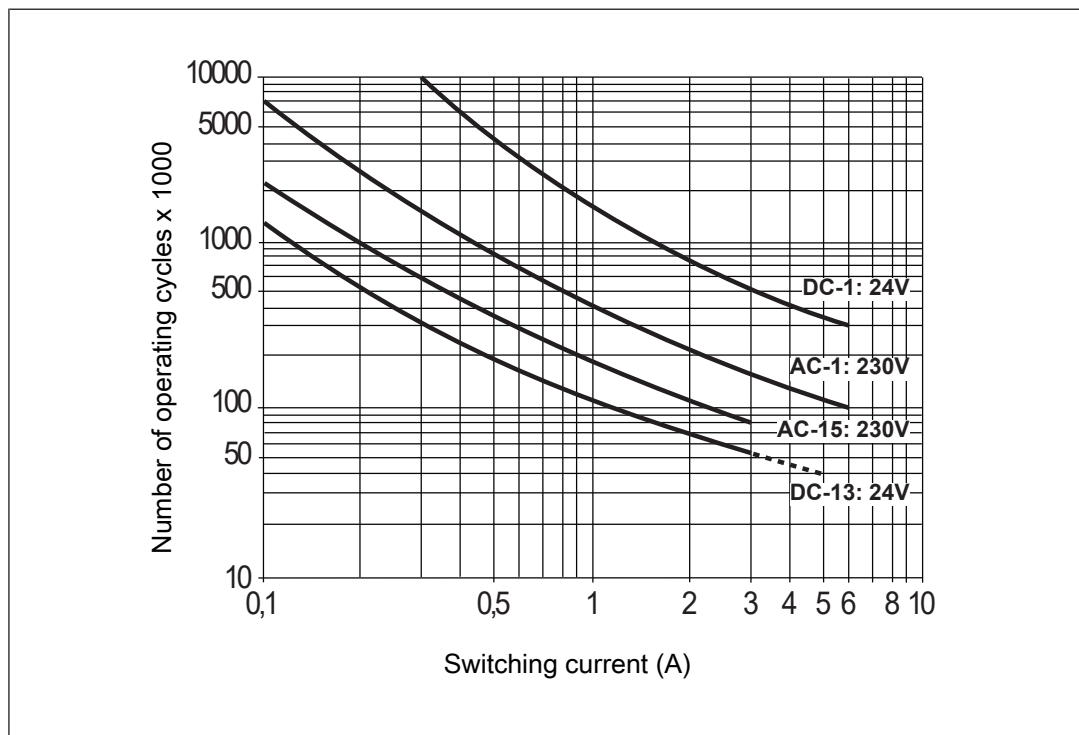


Fig.: Service life graphs at 24 VDC and 230 VAC

Input and output modules PNOZ m EF 2DOR

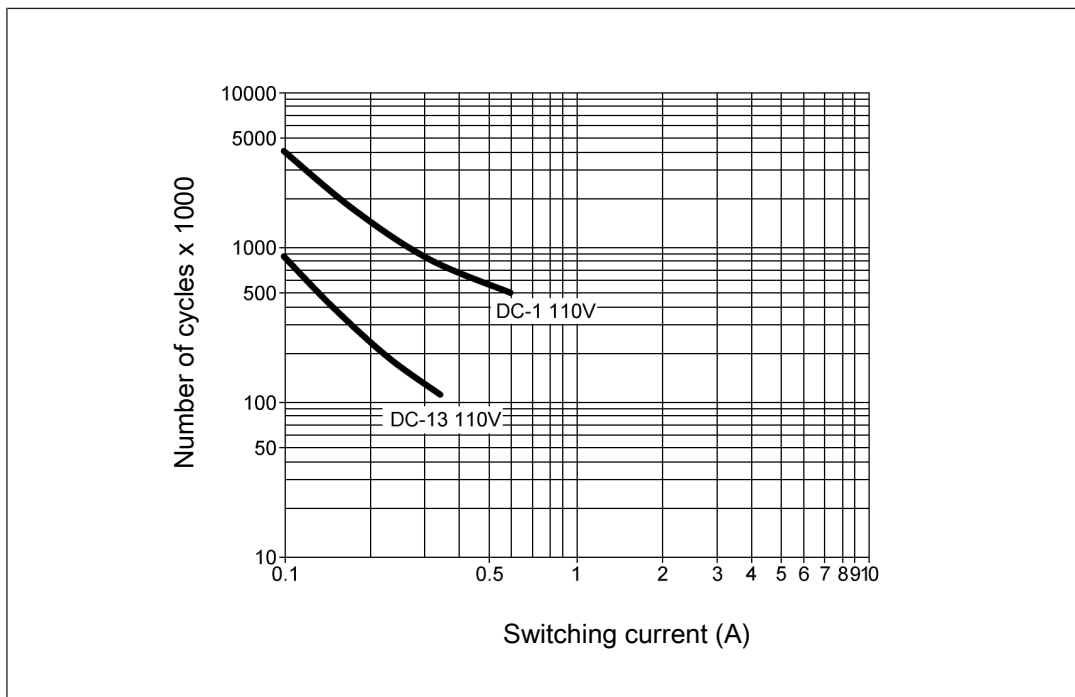


Fig.: Service life graphs at 110 VDC

Example

- ▶ Inductive load: 0.2 A
- ▶ Utilisation category: AC15
- ▶ Contact service life: 1 000 000 cycles

Provided the application to be implemented requires fewer than 1 000 000 cycles, the PFH value (see [Technical details \[257\]](#)) can be used in the calculation.

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

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

Input and output modules PNOZ m EF 2DOR

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 2DOR	Configurable safe small controllers PNOZmulti 2, expansion module, 2 safe relay outputs.	772146

Accessories

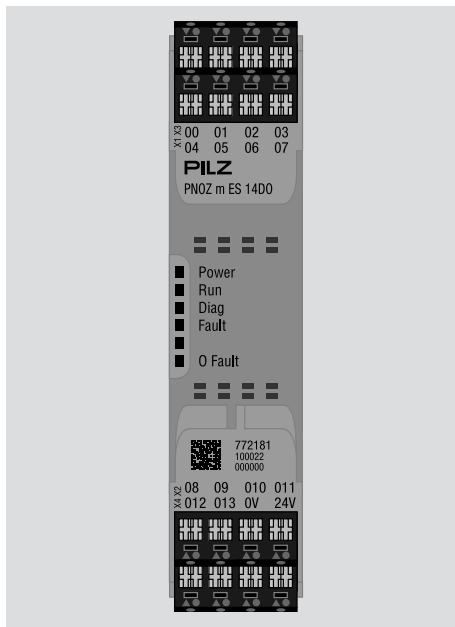
Connection terminals

Product type	Features	Order no.
PNOZm spring terminals X1	1 set of spring-loaded terminals	751018
PNOZm screw terminals X1	1 set of screw terminals	750018

Terminator, jumper

Product type	Features	Order no.
PNOZ mm0.xp connector left	Jumper yellow/black to connect the modules, 10 piece	779260

Output modules PNOZ m ES 14DO



Overview

Unit features

Application of the product PNOZ m ES 14DO:

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

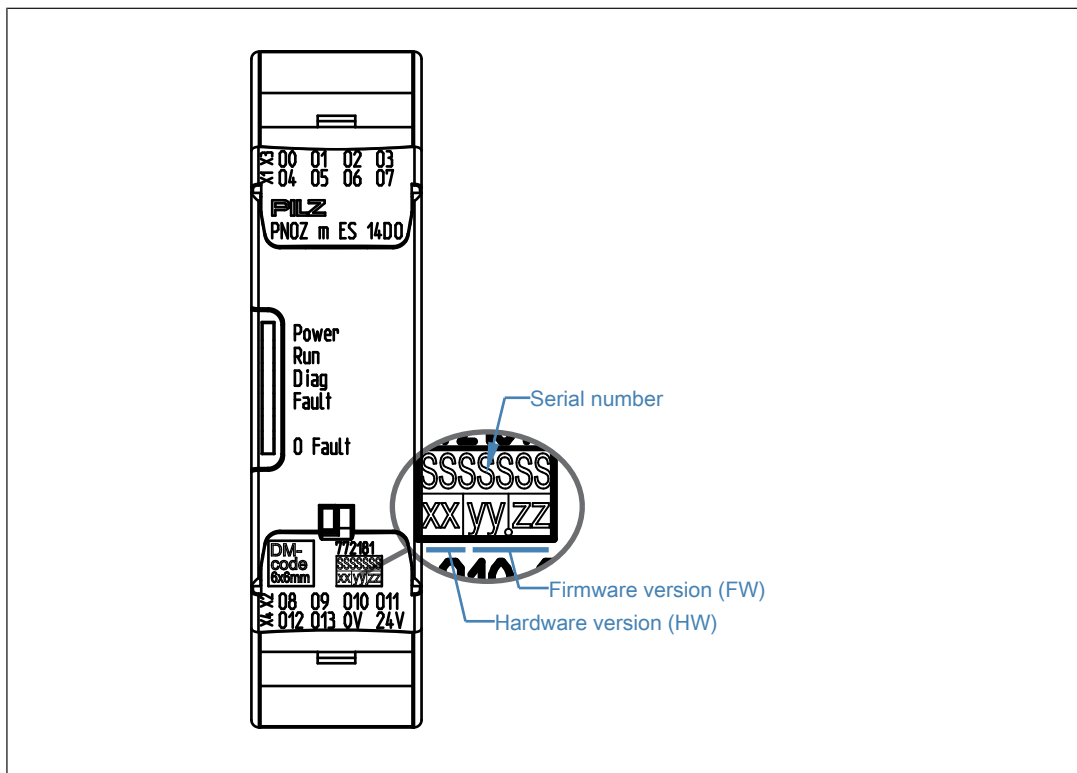
The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ 14 semiconductor outputs for standard applications
- ▶ LED display for:
 - Error messages
 - Diagnostics
 - Supply voltage
 - Output circuits
- ▶ Plug-in connection terminals:

Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories \[272\]](#)).
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Output modules PNOZ m ES 14DO

Front view



Legend:

- ▶ 0 V, 24 V: Supply connections
- ▶ Outputs O0 – O13
- ▶ LEDs:
 - POWER
 - Run
 - Diag
 - Fault
 - O Fault

Function description

Functions

The expansion module provides additional semiconductor outputs for standard applications.

The function of the outputs depends on the user program created using the PNOZmulti Configurator. The online help on the PNOZmulti Configurator contains descriptions of the operating modes and all the functions of the PNOZmulti system, plus connection examples.

Output modules PNOZ m ES 14DO

To be able to switch higher loads, you can switch several outputs in parallel.

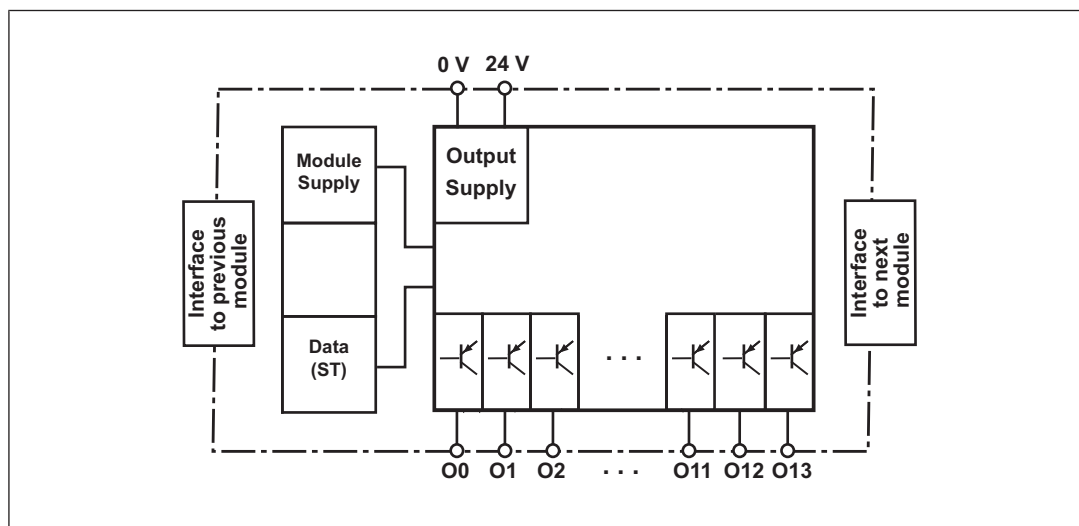
There are two groups:

Any of the outputs O0 to O7 can be connected in parallel, and any of the outputs O8 to O13 can be connected in parallel.

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 "PNOZmulti System Expansion".

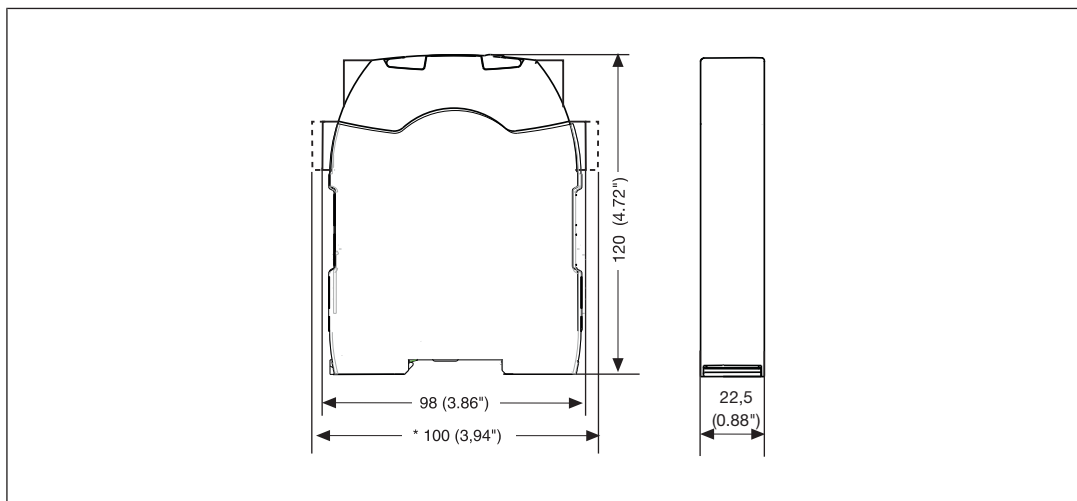
Block diagram



Output modules PNOZ m ES 14DO

Installation

Dimensions in mm



Commissioning

General wiring guidelines

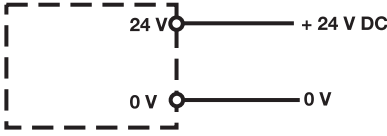
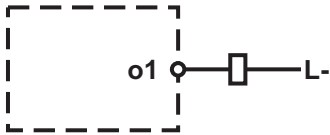
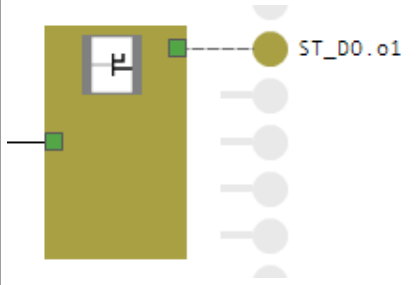
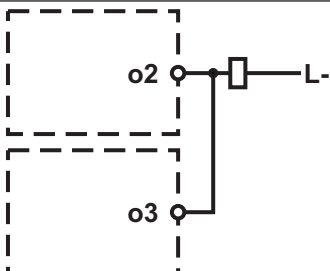
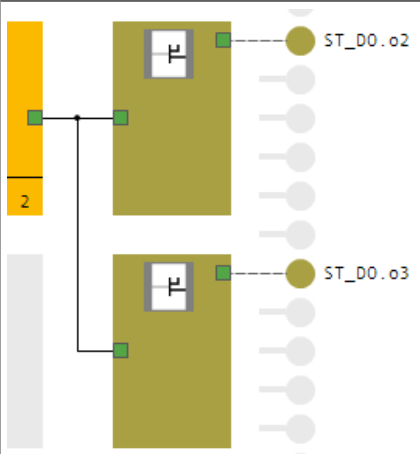
The wiring is defined in the circuit diagram of the PNOZmulti Configurator.

Please note:

- ▶ Information given in the [Technical details \[269\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The supply voltage of the semiconductor outputs and the supply voltage of the system are galvanically isolated from each other.
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 10 A
 - or
 - Blow-out fuse, slow, 10 A

Output modules PNOZ m ES 14DO

Connection

Supply voltage	DC	
		
Connection example		
Single output		
Two outputs parallel		

Output modules PNOZ m ES 14DO

Technical details

General	
Certifications	CE, UKCA, UL Listed
Application range	Standard
Module's device code	00F8h
Electrical data	
Supply voltage	
for	Supply to the SC outputs
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	8,5 A
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	20 mA
Power consumption	0,5 W
Max. power dissipation of module	2,5 W
Status indicator	LED
Permitted loads	inductive, capacitive, resistive
Semiconductor outputs	
Number of positive-switching single-pole semiconductor outputs	14
Switching capability	
Voltage	24 V
Typ. output current at "1" signal and rated voltage of semiconductor output	0,5 A
Permitted current range	0,000 - 0,600 A
Residual current at "0" signal	0,5 mA
Max. transient pulsed current	1,4 A
Max. internal voltage drop	500 mV
Switch-off delay	1 ms
Potential isolation	Yes
Short circuit-proof	Yes
Utilisation category in accordance with UL	
Voltage	24 V DC P. D.
Current	0,5 A

Output modules PNOZ m ES 14DO

Environmental data

Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Amplitude	0,35 mm
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Rated insulation voltage	30 V
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Potential isolation

Potential isolation between	SC output and system voltage
Type of potential isolation	Basic insulation
Rated surge voltage	2500 V

Mechanical data

Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm

Output modules PNOZ m ES 14DO

Mechanical data

Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	
	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	100 g

Where standards are undated, the 2016-05 latest editions shall apply.

Output modules PNOZ m ES 14DO

Order reference

Product

Product type	Features	Order no.
PNOZ m ES 14DO	Configurable safe small controllers PNOZmulti 2, expansion module, 14 semiconductor outputs for standard applications.	772181

Accessories

Replacement terminals

Product type	Features	Order no.
PNOZ s Setscrew terminals 22.5mm	Set of plug-in replacement terminals 4-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750004
PNOZ s Setspring-loaded terminals 22.5mm	Set of plug-in replacement terminals 4-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751004

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Motion monitoring modules PNOZ m EF 1MM



Overview

Unit features

Application of the product PNOZ m EF 1MM:


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

The product has the following features:

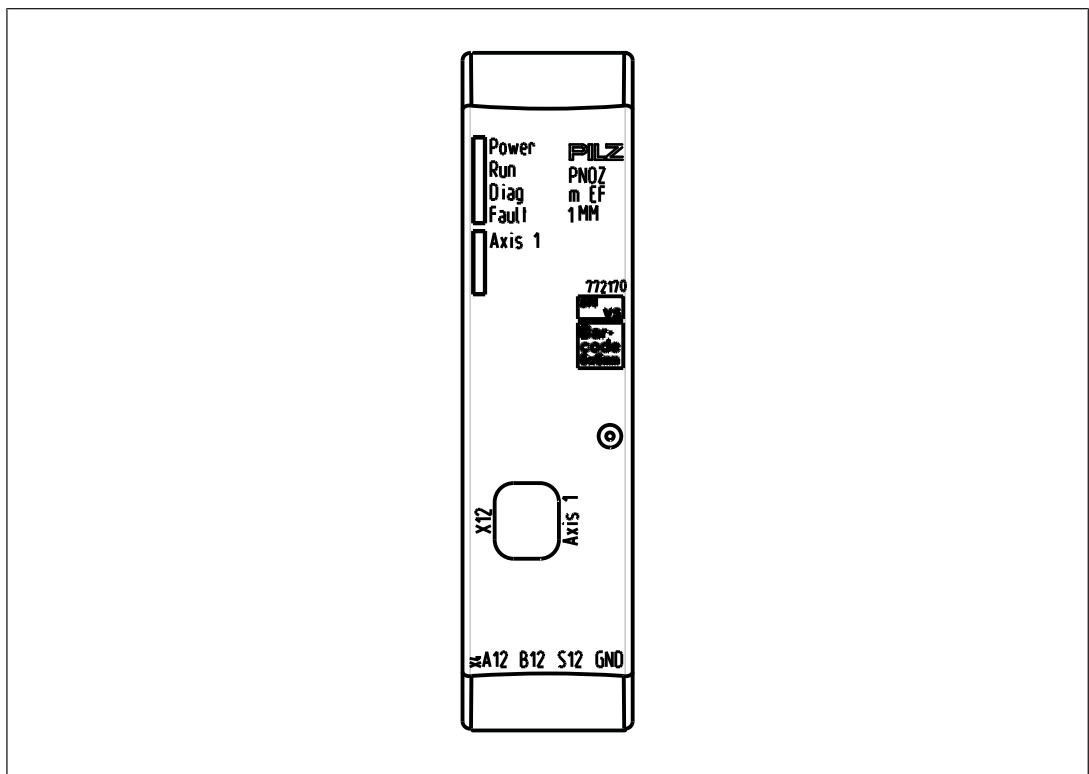
- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Monitoring of 1 axis
- ▶ Measured value recorded by proximity switch and encoder
- ▶ Monitoring functions
 - Safe speed monitoring (SSM)
 - Safe speed range monitoring (SSR-M)
 - Safe direction of movement monitoring (SDI-M)
 - Safe operating stop monitoring (SOS-M)
 - Safe stop 1 monitoring (SS1-M)
 - Safe stop 2 monitoring (SS2-M)
 - Safely limited acceleration monitoring (SLA-M)
 - Safely limited acceleration range monitoring (SAR-M)
 - Analogue voltage (track S)
- ▶ LED display for:
 - Supply voltage
 - Diagnostics
 - Axis status
 - Fault
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Motion monitoring modules

PNOZ m EF 1MM

- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [ 272]).

Front view



Legend:

- ▶ X4: Connection for proximity switch at axis 1
- ▶ X12: Mini IO socket for connecting encoder or proximity switch at axis 1.
- ▶ LEDs:
 - Power
 - Run
 - Diag
 - Fault
 - Axis 1

Motion monitoring modules

PNOZ m EF 1MM

Function description

Operation

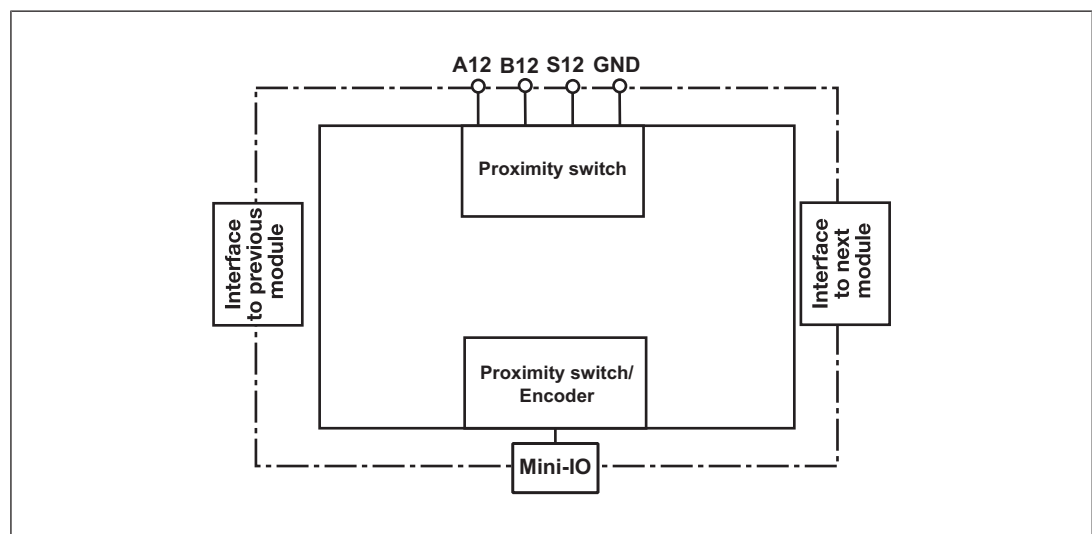
The motion monitoring module PNOZ m EF 1MM can monitor one axis. The motion monitoring module signals the status of the monitored values to the base unit. Depending on the implemented safety circuit, the values may be transferred from the base unit to an output on the control system. Proximity switches or encoders are used to record the values.

The configuration of the motion monitoring module is described in detail in the PNOZmulti Configurator's online help.

The relay meets the following safety requirements:

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

Block diagram



Monitoring functions

The motion monitoring module PNOZ m EF 1MM supports the following monitoring functions.

Please note that the position monitoring functions SOS-M, SDI-M and SS2-M cannot be used in conjunction with 2 proximity switches, as no position can be detected.

Safe speed monitoring

The **Safe speed monitoring** function (SSM) monitors the current speed to see if a limit value is exceeded.

Motion monitoring modules PNOZ m EF 1MM

If the configured limit value is exceeded, the output switches off. As soon as the value falls below the limit value (plus hysteresis), the output switches off again.

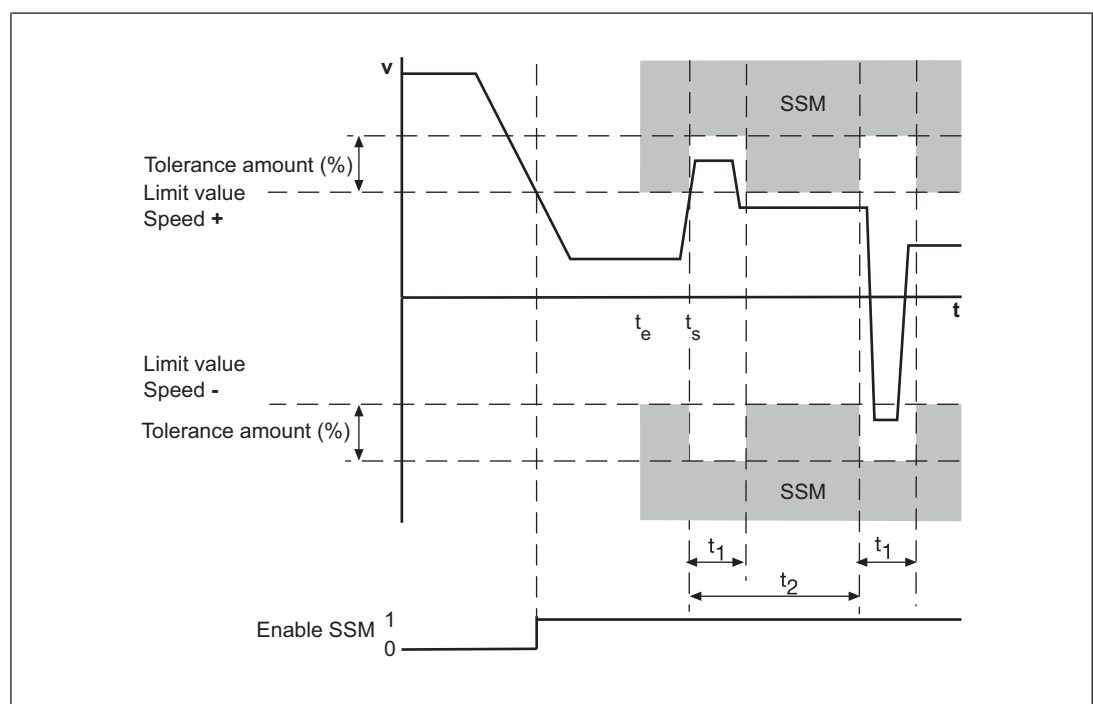
If a manual reset is configured, the output will not switch back on until the value is inside the limit value (plus hysteresis) and the reset input is activated.

In PNOZmulti Configurator 12 areas can be configured per axis (with units < Version 2.0 only 8 limit values can be configured).

A tolerance range may also be set for the limit values used to monitor the speed. This tolerance range modifies the set limit values. As a result, one-off or periodic overshoots that exceed the limit values can be tolerated.

The following values can be configured for the tolerance range:

- ▶ Tolerance time (t_1), which takes into account the length of the overshoots (maximum time for which the limit value may be exceeded). It must not be possible that the sum of all the overshoots exceeds the tolerance time (t_1) within a tolerance period (t_2).
- ▶ Tolerance period (t_2), which takes into account the oscillation period (minimum time that must elapse between one limit value overshoot and the next)
- ▶ Tolerance amount (%), which takes into account the amplitude of the overshoots (maximum permitted percentage by which the configured limit values may be exceeded)



Legend:

- ▶ Enable SSM:
 - "1": Monitored limit value not exceeded
 - "0": Monitored limit value exceeded

Motion monitoring modules PNOZ m EF 1MM

- ▶ t_s : Speed v exceeds the limit value and activates the tolerance range (tolerance time, tolerance period, tolerance amount)
- ▶ t_1 : Tolerance time
- ▶ t_2 : Tolerance period
- ▶ Tolerance amount (%): Tolerance amount of limit value in both directions

Safe speed range monitoring

The **Safe speed range monitoring** function (SSR-M) monitors the current speed to ensure it stays within a maximum and minimum permitted limit value.

If the speed is outside the configured range, the output switches off. As soon as the speed returns within the configured range (plus hysteresis), the output switches back on.

If manual reset is configured, the output will not switch back on until the value is below the limit value (plus hysteresis) and the reset input is activated.

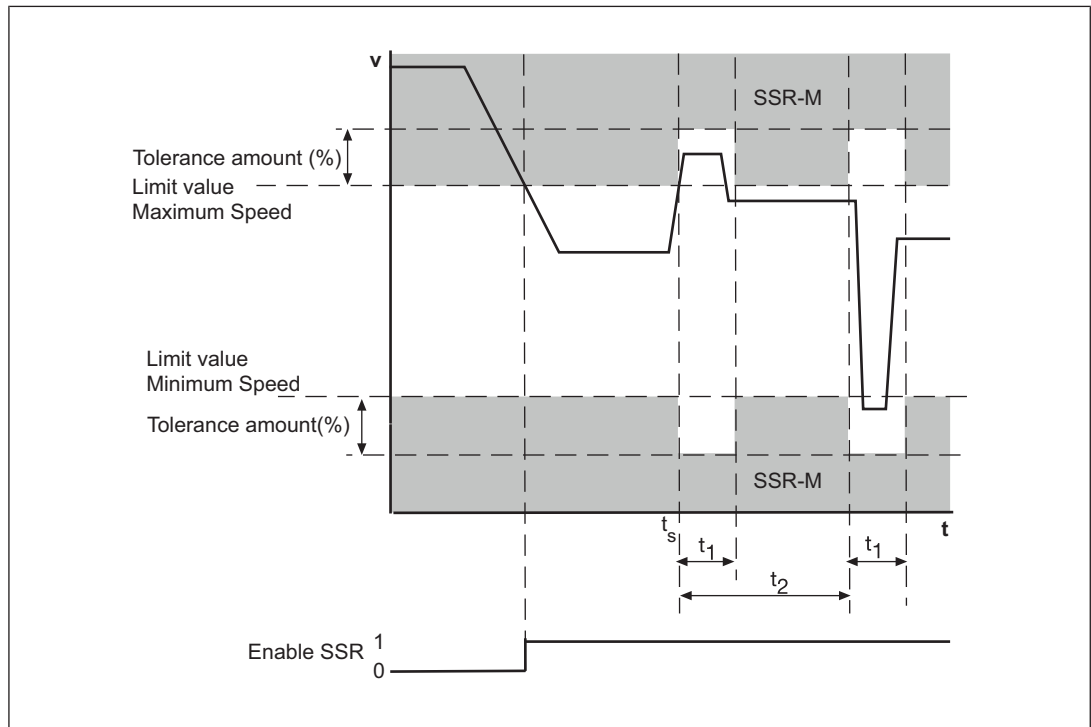
In PNOZmulti Configurator 2 areas can be configured per axis (with units < Version 2.0 only 1 area can be configured).

A tolerance range may also be set for the limit values used to monitor the speed range. This tolerance range modifies the set limit values. As a result, one-off or periodic overshoots that exceed the range limits can be tolerated.

The following values can be configured for the tolerance range:

- ▶ Tolerance time (t_1), which takes into account the length of the overshoots (maximum time for which the limit value may be exceeded). It must not be possible that the sum of all the overshoots exceeds the tolerance time (t_1) within a tolerance period (t_2).
- ▶ Tolerance period (t_2), which takes into account the oscillation period (minimum time that must elapse between one limit value overshoot and the next)
- ▶ Tolerance amount as a %, which takes into account the amplitude of the overshoots (maximum permitted percentage by which the limit value may be exceeded)

Motion monitoring modules PNOZ m EF 1MM



Legend:

- ▶ Enable SSR:
 - "1": Speed is within the configured range
 - "0": Speed is outside the configured range
- ▶ t_s : Speed v exceeds the limit value and activates the tolerance range (tolerance time, tolerance period, tolerance amount)
- ▶ t_1 : Tolerance time
- ▶ t_2 : Tolerance period
- ▶ Tolerance amount (%): Tolerance amount of the two limit values, maximum and minimum speed

Safe direction monitoring

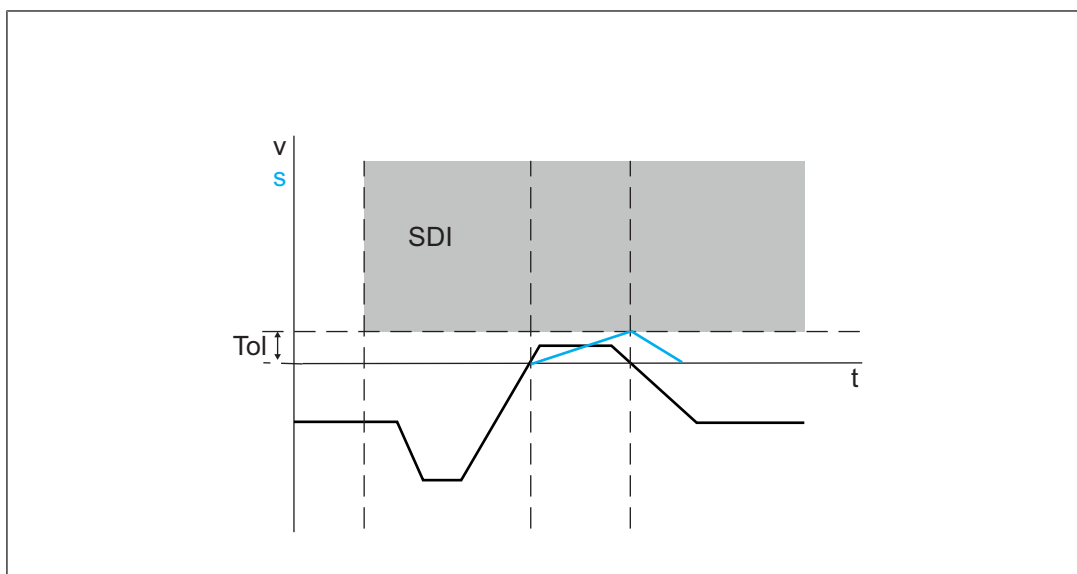
The **Safe direction monitoring** function (SDI-M) monitors the direction of movement defined for the drive axis (positive or negative). Safe direction of movement monitoring is activated via the start input. It remains active until the configured tolerance is exceeded in the opposite direction. The function can be retriggered at any time by a rising edge at the start input. As a result, the current position can be used at any time as the start point for the monitoring function.

One SDI-M element can be configured per axis for each direction in the PNOZmulti Configurator.

Motion monitoring modules PNOZ m EF 1MM

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.



Safe operating stop monitoring

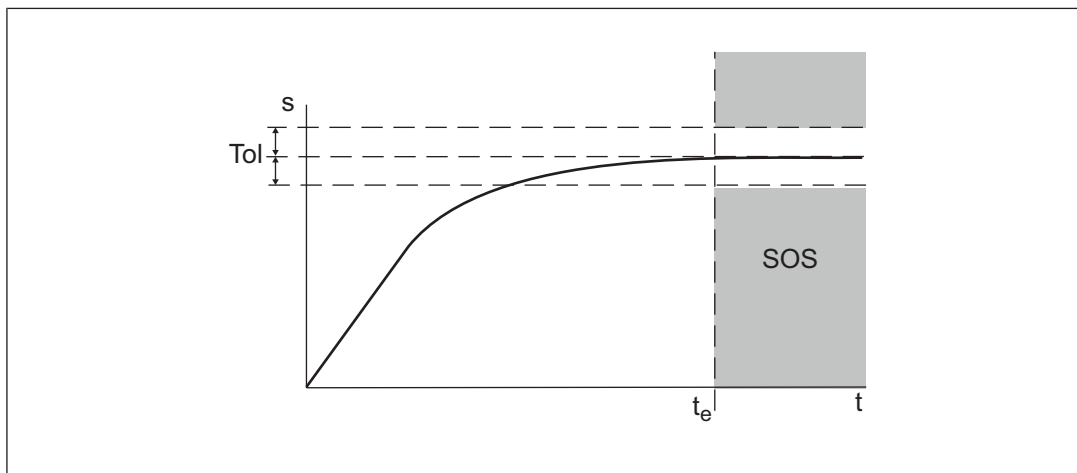
The **Safe operating stop monitoring** function (SOS-M) monitors whether the stop position remains within a configured tolerance window. Safe operating stop monitoring is activated within a rising edge at the start input. It remains active until the value is outside the tolerance band. The function can be retriggered at any time by a rising edge at the start input. As a result, the current position can be used at any time as the start point for the monitoring function.

In PNOZmulti Configurator 3 elements SOS-M can be configured per axis (with units < Version 2.0 only 1 element can be configured).

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.

Motion monitoring modules PNOZ m EF 1MM



Legend:

- ▶ t_e : Activation of the monitoring function SOS

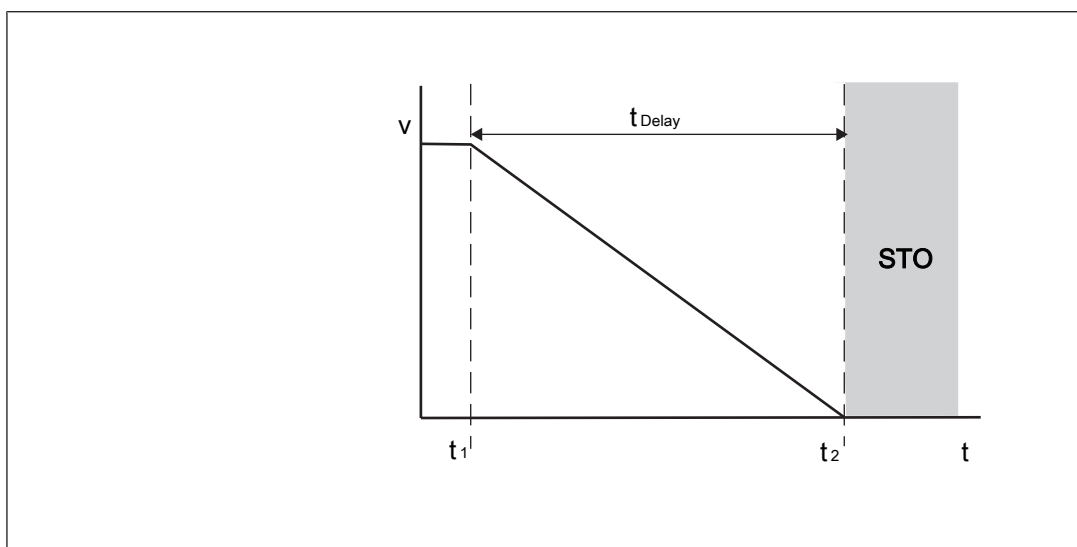
Safe stop 1 monitoring

The **Safe stop 1 monitoring** function (SS1-M) monitors whether the set delay time has elapsed (until controlled braking of the motor) or the standstill limit value for automatic STO is below the limit value.

- ▶ If the monitoring function SS1-M is triggered, the **Braking ramp** output is switched off. The drive controller's braking ramp is activated.
- ▶ After the set delay time has elapsed or the value for the automatic STO is below the limit value, the output **ST** switches off. The safety function **Safe torque off** (STO) is activated.

A maximum of 1 SS1-M element can be configured per axis in the PNOZmulti Configurator.

Sequence without standstill limit value for automatic STO:

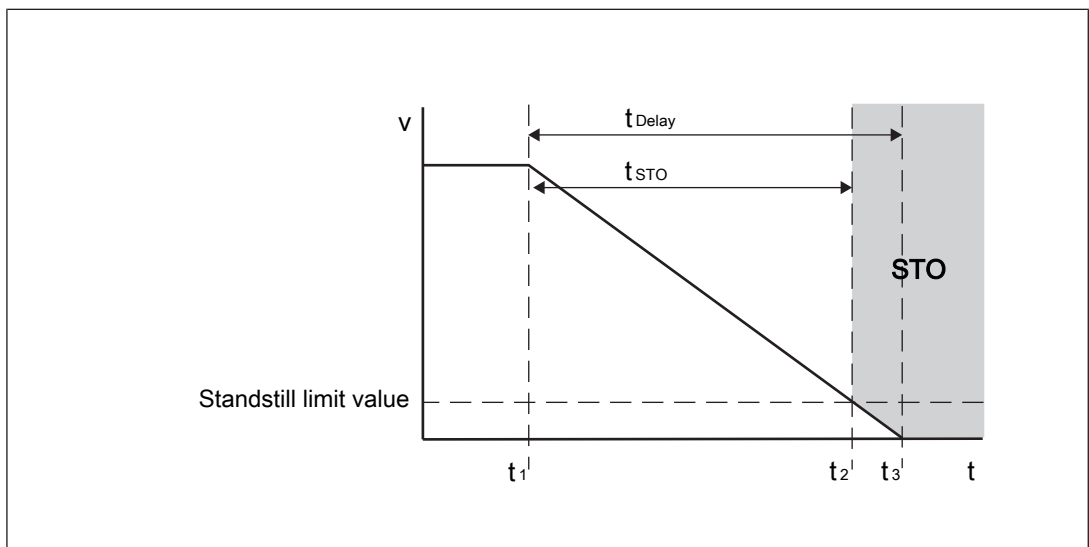


Motion monitoring modules PNOZ m EF 1MM

Legend

- t_1 : Monitoring function SS1-M is activated
- t_2 : Delay time elapses, safety function "Safe torque off" (STO) is activated
- t_{Delay} : Set delay time for controlled braking of motor

Sequence with standstill limit value for automatic STO:



Legend

- t_1 : Monitoring function SS1-M is activated
- t_2 : Standstill limit value for automatic STO reached, safety function "Safe torque off" (STO) is activated
- t_3 : Delay time elapses
- t_{Delay} : Set delay time for controlled braking of motor
- t_{STO} : Actual time from activation of monitoring function until STO is activated

Safe stop 2 monitoring

The **Safe stop 2 monitoring** function (SS2-M) monitors

- ▶ Whether the set delay time has expired (until controlled braking of the motor) or the standstill limit value for automatic SOS is below the limit value.
and
- ▶ Whether the stop position ultimately remains within a configured tolerance window.

Reaction:

- ▶ If the monitoring function SS2-M is triggered, the "Braking ramp" output switches off. The drive controller's braking ramp is activated.
- ▶ If the set delay time has elapsed or the value for the automatic SOS is below the limit value, the stop position is monitored, the **Position monitoring** output switches on. If the stop position is outside the tolerance window, the **Position monitoring** and **STO** outputs switch off, the safety function **Safe torque off** (STO) is activated.

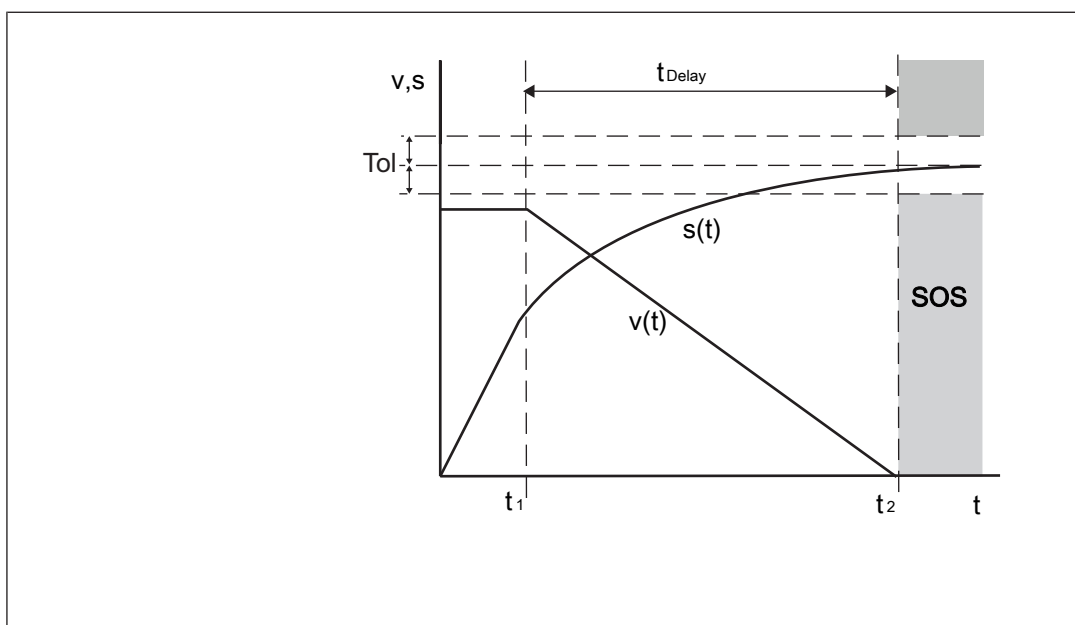
Motion monitoring modules PNOZ m EF 1MM

A maximum of 1 SS2-M element can be configured per axis in the PNOZmulti Configurator.

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.

Sequence without standstill limit value for automatic SOS:

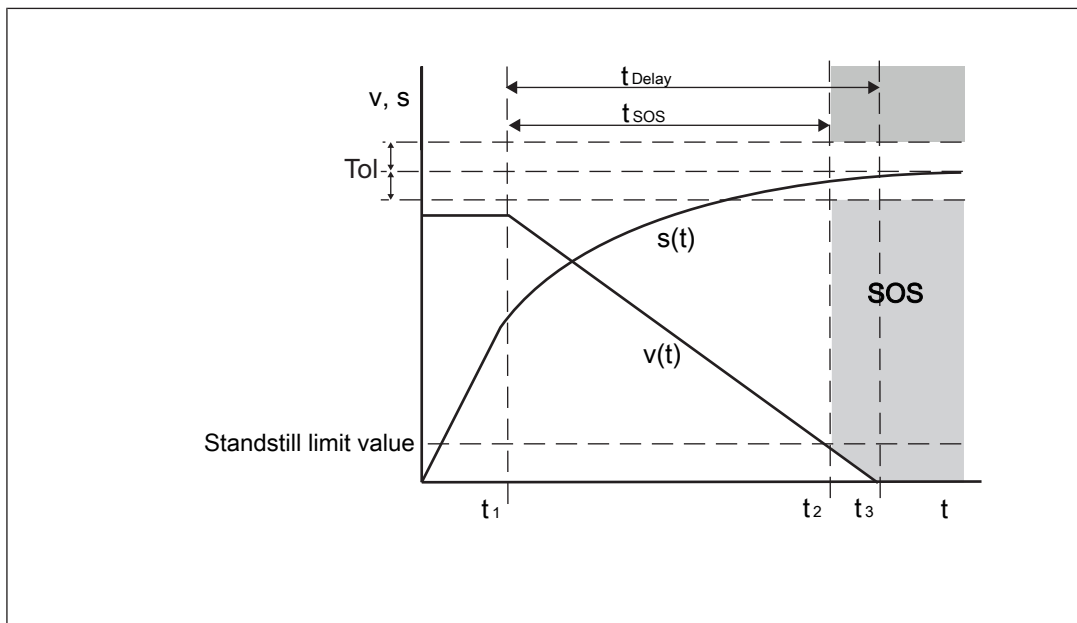


Legend

- t_1 : Activation of the monitoring function SS2-M
- t_2 : Delay time elapses, monitoring of stop position (SOS) is activated
- t_{Delay} : Set delay time for controlled braking of motor

Sequence with standstill limit value for automatic SOS:

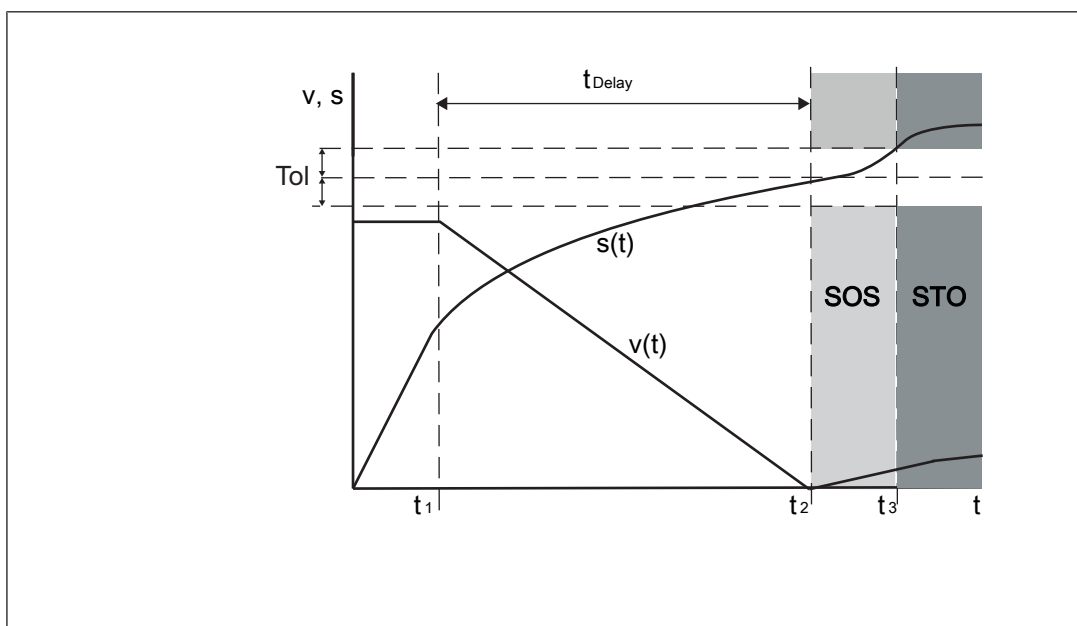
Motion monitoring modules PNOZ m EF 1MM



Legend

- t_1 : Activation of the monitoring function SS2-M
- t_2 : Standstill limit value for automatic SOS reached, monitoring of stop position (SOS) is activated
- t_3 : Delay time elapses
- t_{Delay} : Set delay time for controlled braking of motor
- t_{STO} : Actual time from activation of monitoring function until STO is activated

Sequence when stop position is violated:



Motion monitoring modules

PNOZ m EF 1MM

Legend

t_1 :	Activation of the monitoring function SS2-M
t_2 :	Standstill limit value for automatic SOS reached, monitoring of stop position (SOS) is activated
t_3 :	Stop position outside of tolerance window, safety function "Safe torque off" (STO) is activated
t_{Delay} :	Set delay time for controlled braking of motor

Safely limited acceleration monitoring (SLA-M)

The monitoring function **Safely limited acceleration monitoring** monitors the speed change per time unit.

Both the acceleration and the deceleration can be monitored.

Monitoring checks whether the acceleration or deceleration exceeds or falls below a certain limit value.

4 SLA-M elements can be configured per axis in the PNOZmulti Configurator.

The monitoring function **Safely limited acceleration monitoring** is activated with a rising edge at the start input. The trigger detection phase starts with a falling edge at the start input. In this process the current speed is taken as the start speed.

Monitoring of safely limited acceleration starts,

- ▶ when the trigger threshold is passed, that is, when the start speed changes by the configured percentage ($V1$).
- ▶ When monitoring starts within the maximum trigger time ($t1$).

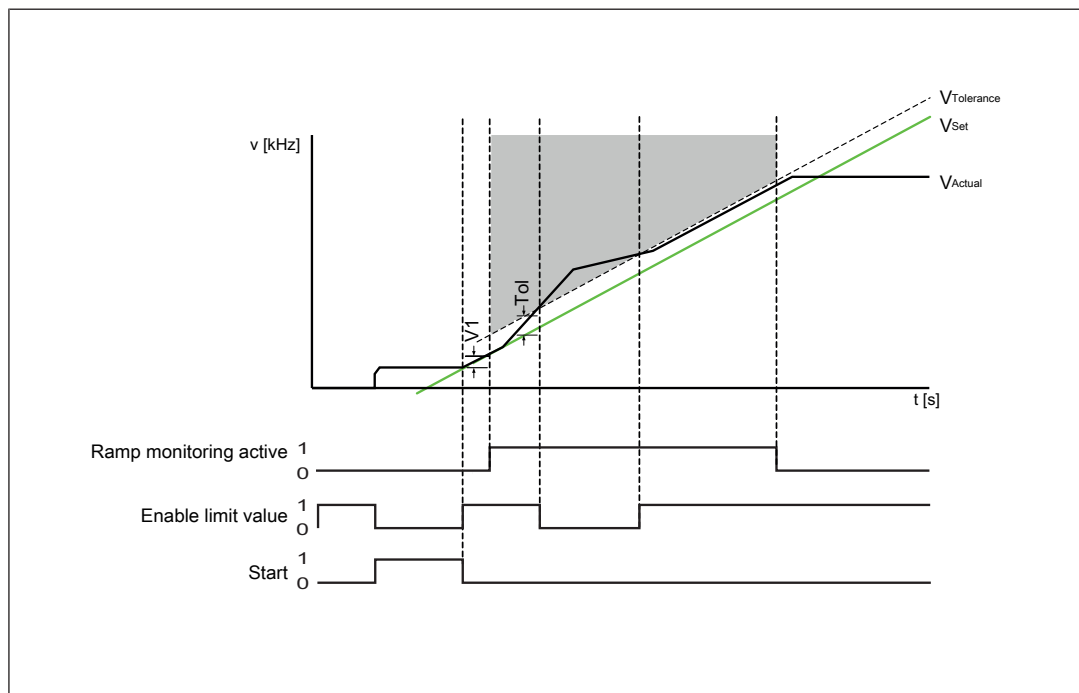
When monitoring is started, the set acceleration is calculated as a straight line V_{Set} . A tolerance band $V_{\text{Tolerance}}$ is calculated from the Tolerance and V_{Edge} parameters. If the actual speed V_{Actual} leaves the tolerance band, the output **Enable SLA** switches off.

Monitoring is ended,

- ▶ When monitoring is reset by a rising edge at the start input,
- ▶ When a range has been violated and it is no longer possible to return within the valid range,
- ▶ When the target speed is passed.

Motion monitoring modules PNOZ m EF 1MM

Example: Monitoring for too fast acceleration



Safely limited acceleration range monitoring (SAR-M)

The monitoring function **Safely limited acceleration monitoring** monitors the speed change per time unit.

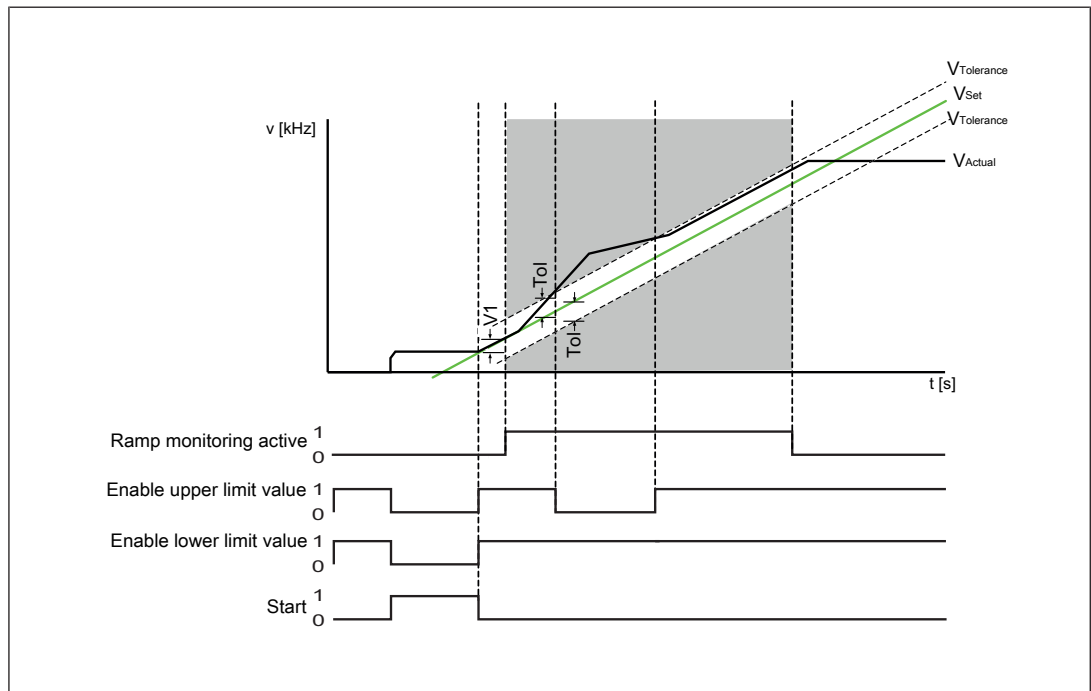
In contrast to the monitoring function SLA-M, safely limited acceleration range monitoring monitors not only a limit value but also the upper and lower limit value simultaneously. Both the acceleration and the deceleration can be monitored.

Otherwise the functionality is the same as the monitoring function SLA-M.

4 SAR-M elements can be configured per axis in the PNOZmulti Configurator.

Motion monitoring modules PNOZ m EF 1MM

Example: Monitoring for too fast and too slow acceleration



Central motion monitoring functions

These functions apply centrally for all the monitoring functions.

Hysteresis

A central hysteresis can be configured for the monitoring functions. This prevents the outputs from bouncing if there are fluctuations around the response value. The hysteresis takes effect when the output is switched on.

Validation cut-off frequency

As implausible sensor signals may arise due to jitter on the sensors around the stop position, a central validation cut-off frequency must be configured for sensor types with proximity switches in the PNOZmulti Configurator (edge jitter is caused by the position control of the drive frequency converter or by external interference signals).

If the value of the validation cut-off frequency falls below the configured value, the feasibility check of the sensors will no longer be run.

Advanced Settings tab

A tolerance time can be configured for tracks AB, Z and S respectively.

The tolerance time influences the sensitivity towards invalid signal levels (e.g. in the event of EMC interference).

The greater the configured tolerance time, the less sensitive the system will be towards invalid signal levels.

Motion monitoring modules PNOZ m EF 1MM

The tolerance time can be deactivated for individual tracks by setting 0 ms.

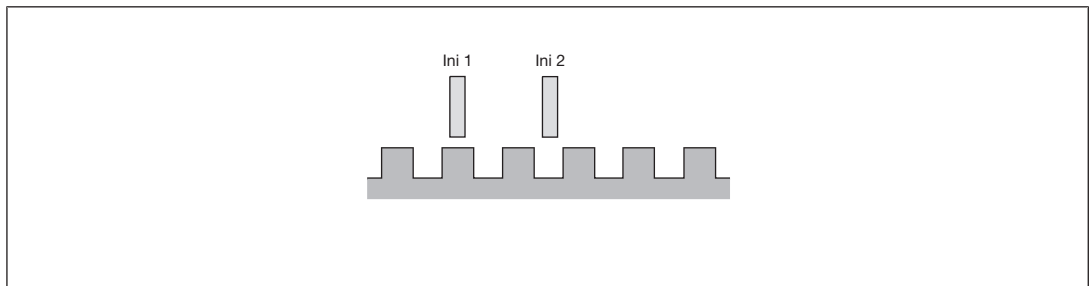
System reaction time

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 "PNOZmulti System Expansion".

Proximity switch

- ▶ Proximity switches can be used with a pnp or npn output.
- ▶ The proximity switches must be fitted so that at least one is always activated. In other words, the proximity switches must be fitted so that the recorded signals always overlap.
- ▶ The cable used to connect the proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ A DC voltage in the range of 0 - 30 V can be monitored via track S. It should be used to monitor the supply voltage of the proximity switches.

Proximity switch assembly:



Signal characteristics:

Proximity switch combinations	Signal image in an energised state
PNP / PNP	
NPN / NPN	

Motion monitoring modules PNOZ m EF 1MM

Proximity switch combinations	Signal image in an energised state
NPN / PNP	<p>De-energised energised energised De-energised > 1% of the period length</p>
PNP / NPN	<p>energised De-energised De-energised energised > 1% of the period length</p>

- ▶ For a full configuration, the maximum frequency of the sensors you are using must be entered in the PNOZmulti Configurator (see sensor's data sheet).

Special features for proximity switches with reduced diagnostics

- ▶ A: pnp, B: pnp
- ▶ It is permitted that both proximity switches are energised simultaneously.
- ▶ The safety level is reduced.
- ▶ The cables for connecting the proximity switches must be laid separately.
- ▶ The supply voltage of the proximity switches must be monitored (e.g. via track S).

Encoder

- ▶ The following encoders can be used:
 - TTL, HTL (single-ended or differential signals)
 - Sin/Cos 1 Vss
 - Hiperface®
- ▶ The encoders can be connected with or without Z index (0 index).
- ▶ The cables used to connect the encoders must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").

Motion monitoring modules

PNOZ m EF 1MM

- ▶ A proximity switch can also be connected to track Z to monitor for broken shearpins.

Please note:
Broken shearpin monitoring only becomes active when


 - The minimum speed is exceeded
 - and
 - The tolerance for detecting feasibility errors has elapsed.

The minimum speed and tolerance depend on the ratio of the frequency on tracks AB " f_{AB} " to the frequency on track Z " f_Z " in your configuration (see PNOZmulti Configurator **Motion Monitor Element, Calculated Ratio AB/Z**).

Minimum speed:

 - Calculated ratio $AB/Z \geq 1.0$
 $f_Z = 10 \text{ mHz}$ or $f_{AB} = (f_{AB}/f_Z) \times 10 \text{ mHz}$
 - when f_{AB}/f_Z **Ratio** < 1.0
 $f_{AB} = 10 \text{ mHz}$ or $f_Z = 10 \text{ mHz}/(f_{AB}/f_Z)$

Tolerance for detecting feasibility errors:

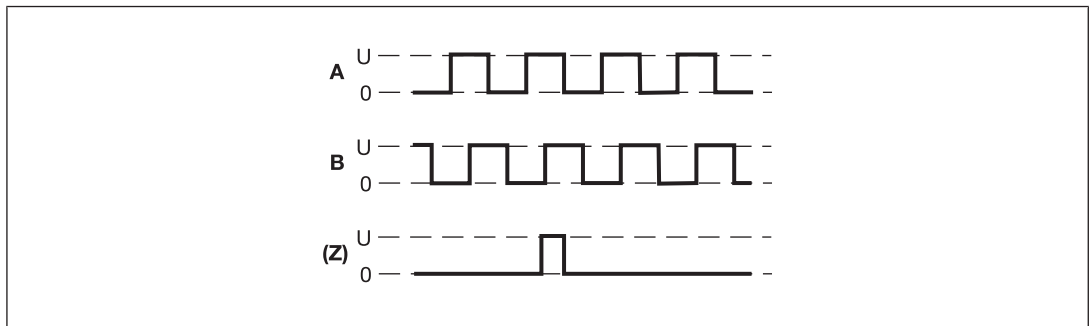
 - when f_{AB}/f_Z **Ratio** ≥ 1.0
 7.5 Z pulses or $7.5 \times (f_{AB}/f_Z) \text{ AB pulses}$
 - when f_{AB}/f_Z **Ratio** < 1.0
 4.5 AB pulses or $4.5 \times (f_{AB}/f_Z) \text{ Z pulses}$
- ▶ With Hiperface encoders, the Sin- Cos track is recorded and monitored via an adapter (see [Adapters for encoders](#) [ 291]).
- ▶ Track S can be used:
 - To connect an encoder's error output.
 - To monitor voltages between 0 V and 30 V for a permitted upper and lower limit. For example, the encoder's supply voltage can be monitored.
- ▶ The maximum frequency of the used encoders must be entered for a complete configuration.
- ▶ Pay attention to the values in the technical details.

Motion monitoring modules PNOZ m EF 1MM

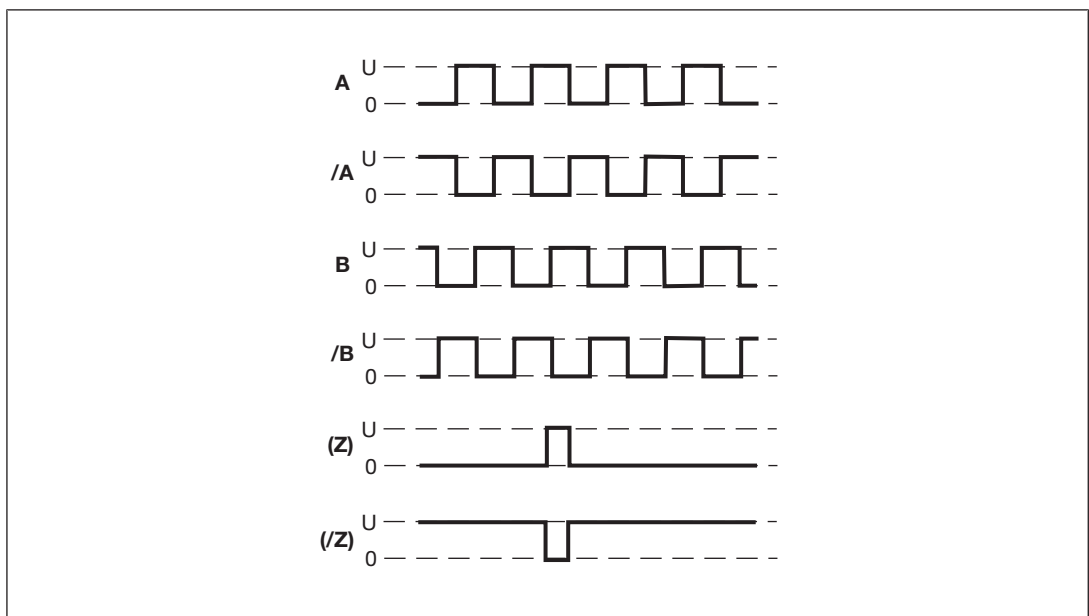
Output signals

Output signals TTL, HTL

Single ended



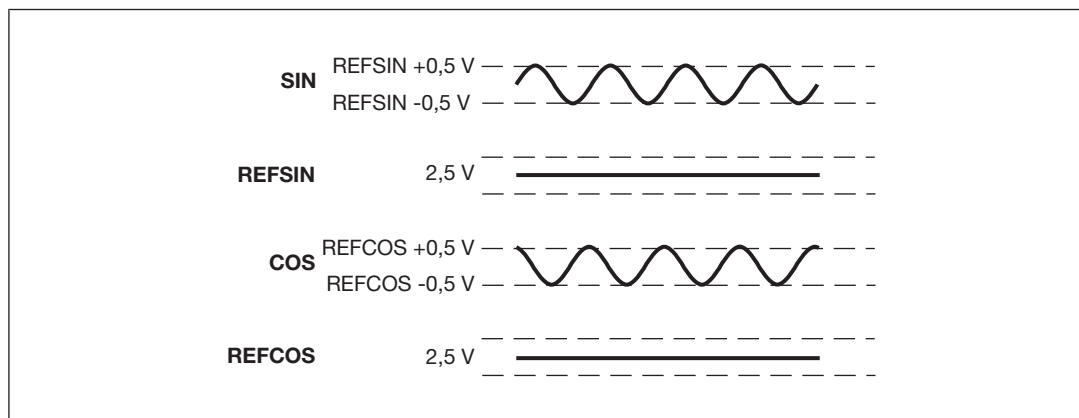
Differential



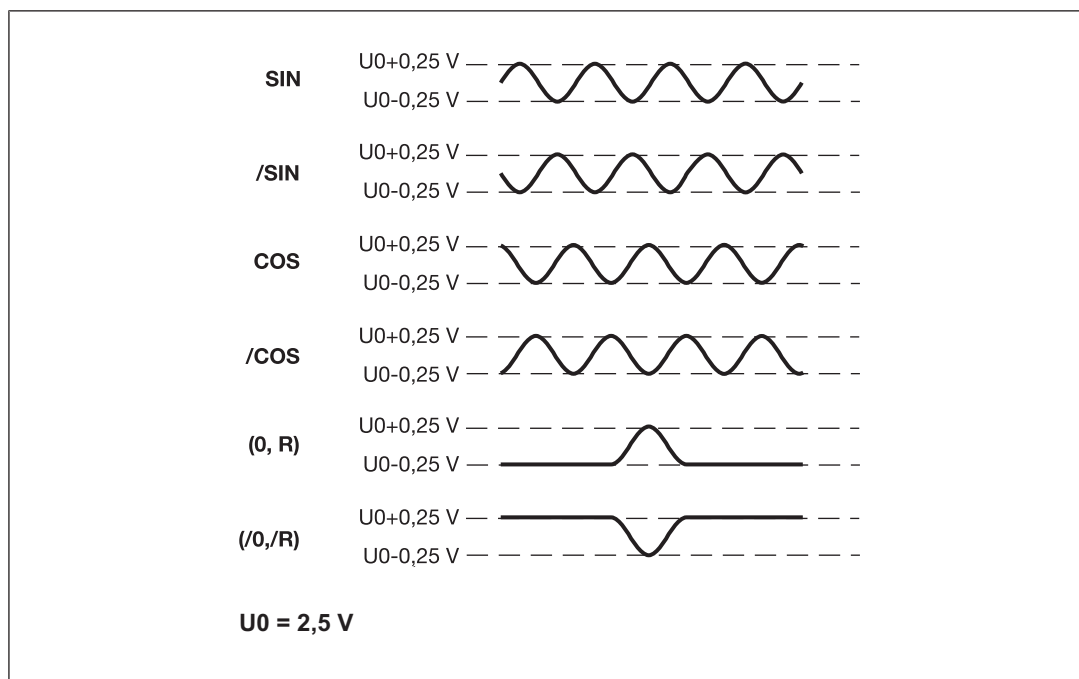
Motion monitoring modules PNOZ m EF 1MM

Output signals Sin/Cos (1 Vss)

Single ended with reference track (e.g. Hiperface®)



Differential with/without Z index (e.g. Heidenhain 1 Vss)



Adapters for encoders

The adapter records the data between the encoder and the drive and makes it available to the PNOZ m EF 1MM via the Mini-IO socket.

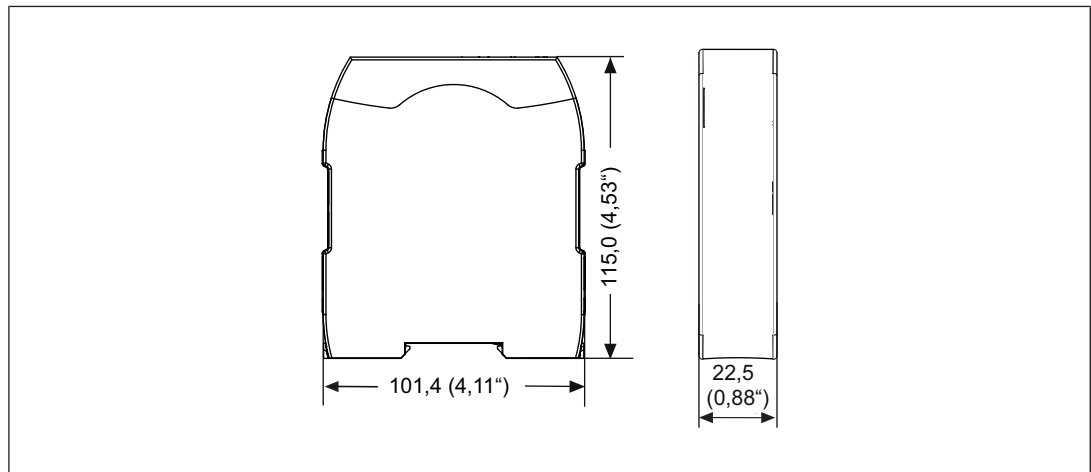
Pilz supplies complete adapters as well as ready-made cable with Mini-IO connector, which can be used when making your own adapter. The range of products in this area is constantly being expanded. Please contact us about the range of adapters that is currently available.

Motion monitoring modules

PNOZ m EF 1MM

Installation

Dimensions in mm



Commissioning

Wiring

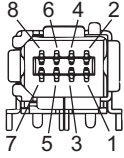
The wiring is defined in the circuit diagram of the PNOZmulti Configurator.

Please note:

- ▶ Information given in the [Technical details \[304\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The power supplies for the safety system and sensors must comply with the regulations for low voltages with safe isolation (SELV/PELV).
- ▶ The cable used to connect the encoders and proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ The shield may only be connected to earth at a single point.
- ▶ Earth loops should be avoided.
- ▶ If possible, the connections for the various earth potentials (GND, A2) should not be connected on the PNOZ m EF 1MM but should be connected directly to the GNDs on the connected units. otherwise noise susceptibility may be increased significantly (conductor loops are not permitted).

Motion monitoring modules PNOZ m EF 1MM

Pin assignment of Mini-IO socket

Mini-IO socket 8-pole	PIN	Track
	1	S
	2	GND
	3	Z
	4	A
	5	/A
	6	/Z
	7	B
	8	/B

Motion monitoring modules

PNOZ m EF 1MM

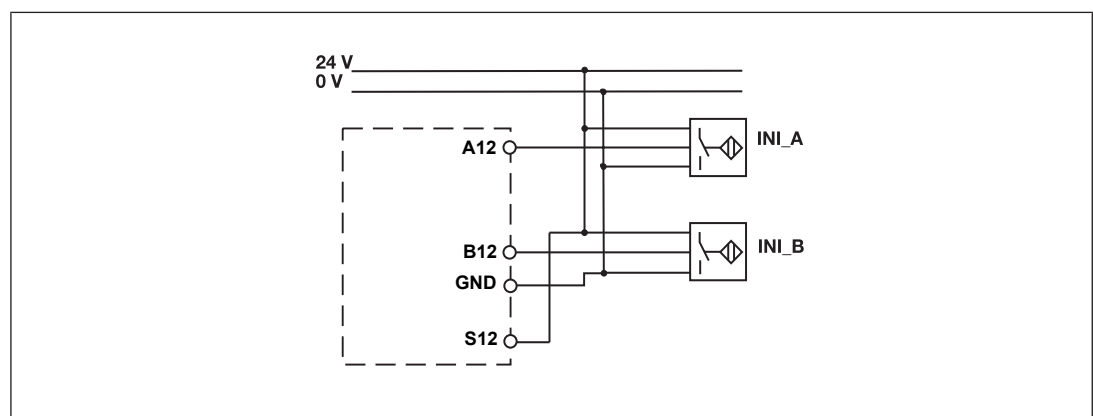
Connection of proximity switches

The following proximity switch combinations can be connected:

- ▶ A: pnp, B: pnp
- ▶ A: npn, B: npn
- ▶ A: pnp, B: npn
- ▶ A: npn, B: pnp

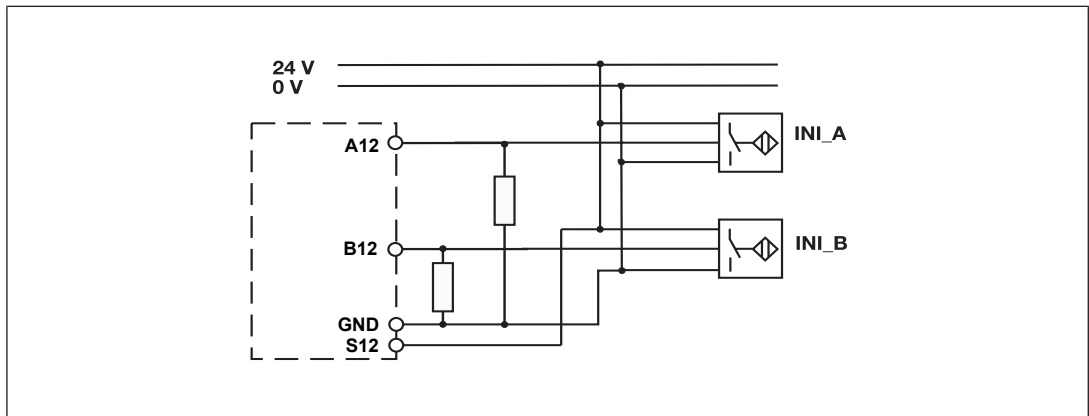
When connecting proximity switches please note:

- ▶ Proximity switches can be connected to
 - terminals A12, B12, GND for axis 1
 - or
 - tracks A, B and GND of the Mini-IO socket (X12 for axis 1).
- ▶ Track S (S12) should be used to monitor the supply voltage (see drawing). A permitted voltage range can be entered in the menu.
- ▶ Connect the proximity switch to 24 VDC of the power supply.
- ▶ When connecting the proximity switches, please refer to the chapter entitled "EMC-compliant wiring".
- ▶ Invalid signals may occur with long cable lengths. In this case we recommend that you connect a resistor between the signal lines, as shown in the diagrams.
- ▶ Connection of the proximity switches may only be performed in three-wire technology and not in two-wire technology.
- ▶ Special features for proximity switches with reduced diagnostics:
 - A: pnp, B: pnp
 - It is permitted that both proximity switches are energised simultaneously.
 - The safety level is reduced.
 - The cables for connecting the proximity switches must be laid separately.
 - The supply voltage of the proximity switches must be monitored (e.g. via track S).

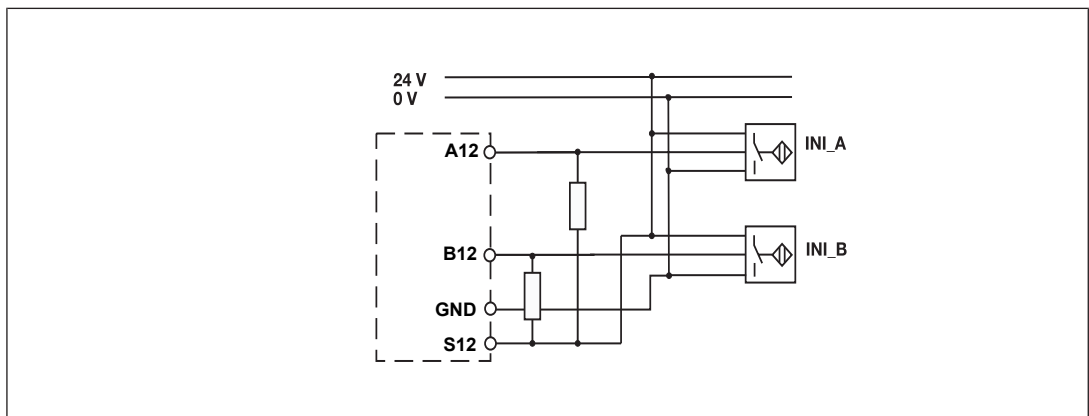


Motion monitoring modules PNOZ m EF 1MM

pnp proximity switch with resistor $R = 10\text{ k}\Omega$



npn proximity switch with resistor $R = 47\text{ k}\Omega$



Connection of an encoder

Proceed as follows when connecting the encoder:

- ▶ The encoder can be connected via an adapter (e.g. MM A Mini-IO-CAB99) or directly to the PNOZ m EF 1MM.
- ▶ Use only shielded cables for all connections. Please refer to the chapter entitled "EMC-compliant wiring".
- ▶ Always connect GND on the encoder to GND on the Mini-IO connector.
- ▶ If the encoder signals are not terminated with 120 Ohm in the frequency converter, the encoder signals must be terminated with $Z_0 = 120\text{ Ohm}$ between A and /A, B and /B, Z and /Z.
- ▶ Please refer to the information provided by the encoder manufacturer with regard to the recommended max. cable length when taking into consideration
 - Output frequency
 - Supply voltage
 - Operating temperature

Motion monitoring modules PNOZ m EF 1MM

- Existing interference

When calculating the maximum cable length, remember that the length of the adapter cable must also be taken into account.

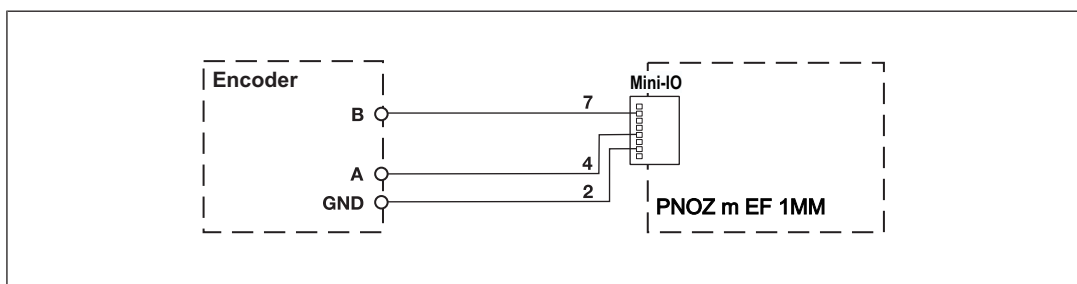
Connect encoder

Encoder types:

- ▶ TTL single ended
- ▶ HTL single ended

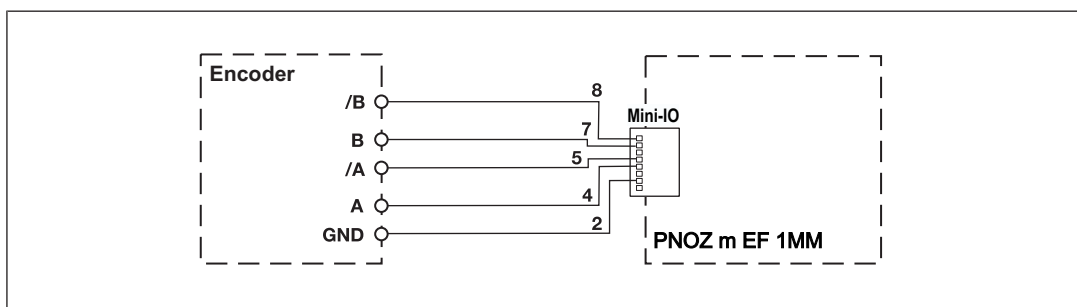
Please note:

- ▶ Tracks/A, /B, Z and /Z must remain free



Encoder types:

- ▶ TTL Differential
- ▶ HTL differential
- ▶ sin/cos 1 Vss
- ▶ Hiperface



Connect encoder with Z index

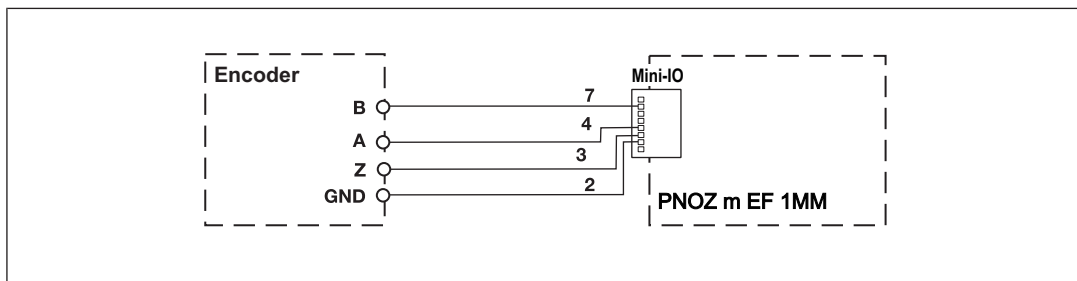
Encoder types:

- ▶ TTL single ended Z Index
- ▶ HTL single ended Z Index

Please note:

- ▶ Tracks /A, /B and /Z must remain free

Motion monitoring modules PNOZ m EF 1MM

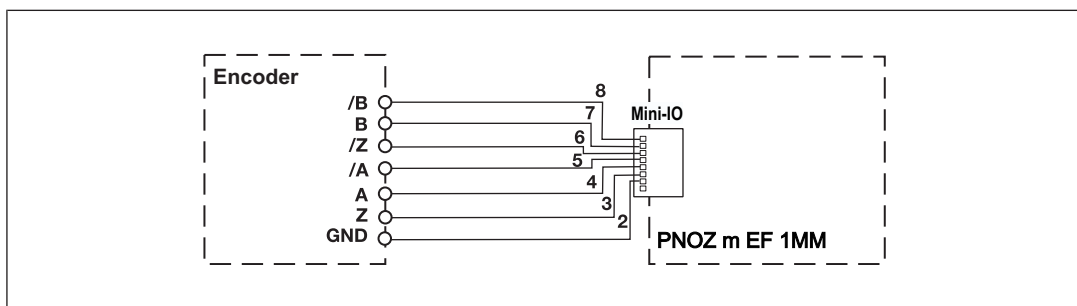


Encoder types:

- ▶ TTL differential + Z Index
- ▶ HTL differential + Z Index
- ▶ sin/cos 1 Vss Z Index

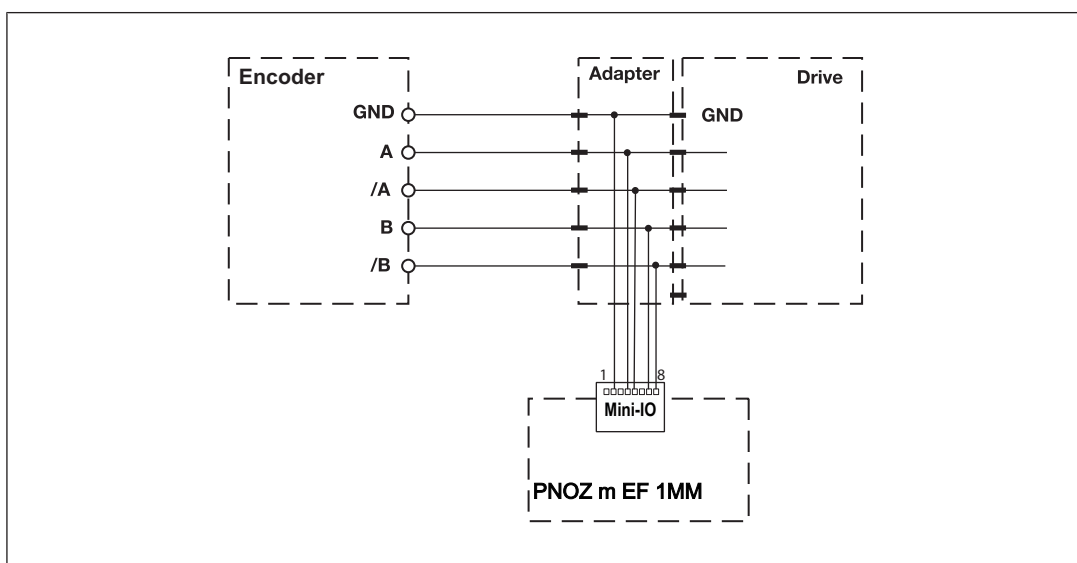
Please note:

- ▶ When using the encoder type sin/cos 1 Vss Z Index, the length of the encoder cable may be max. 30 m.



Connect encoder via an adapter

The adapter (see Accessories) is connected between the encoder and the drive. The output on the adapter is connected to the Mini-IO socket on the PNOZ m EF 1MM.



Motion monitoring modules PNOZ m EF 1MM

Connection of proximity switch and encoder

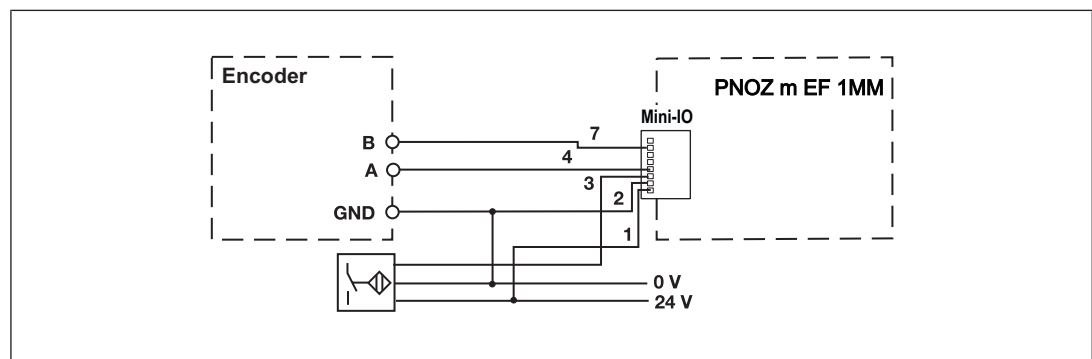
When connecting the encoders and proximity switches, please refer to the chapter entitled "EMC-compliant wiring".

Sensor types:

- ▶ Configuration: HTL single Z Freq. Ini pnp
 - HTL single ended (A,B) + Ini pnp (Z)
 - HTL single ended (A,B) + HTL differential (A as Z)
 - HTL single ended (A,B) + HTL single ended (A as Z)
- ▶ Configuration: TTL single Z Freq. Ini pnp
 - TTL single ended (A,B) + Ini pnp (Z)
 - TTL single ended (A,B) + HTL differential (A as Z)
 - TTL single ended (A,B) + HTL single ended (A as Z)

Please note:

Tracks /A, /B and /Z must remain free.



Sensor types:

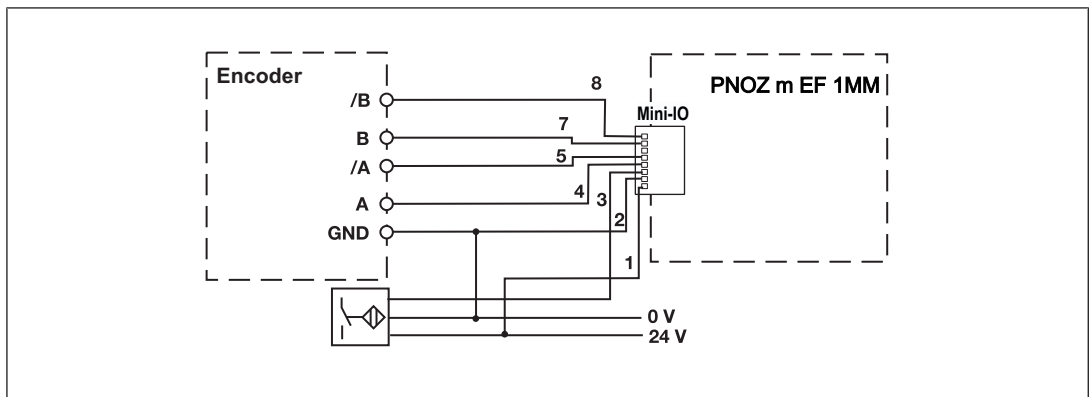
- ▶ Configuration: TTL differential Z Freq. Ini pnp
 - TTL differential (A,/A,B,/B) + Ini pnp (Z)
 - TTL differential (A,/A,B,/B) + HTL differential (A as Z)
 - TTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: HTL differential Z Freq. Ini pnp
 - HTL differential (A,/A,B,/B) + Ini pnp (Z)
 - HTL differential (A,/A,B,/B) + HTL differential (A as Z)
 - HTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: sin/cos 1 Vss Z Freq. Ini pnp
 - sin/cos 1 Vss (A,/A,B,/B) + Ini pnp (Z)
 - sin/cos 1 Vss (A,/A,B,/B) + HTL differential (A as Z)
 - sin/cos 1 Vss (A,/A,B,/B) + HTL single ended (A as Z)

Motion monitoring modules PNOZ m EF 1MM

- ▶ Configuration: Hiperface Z Freq. Ini pnp
 - Hiperface (A,/A,B,/B) + Ini pnp (Z)
 - Hiperface (A,/A,B,/B) + HTL differential (A as Z)
 - Hiperface (A,/A,B,/B) + HTL single ended (A as Z)

Please note:

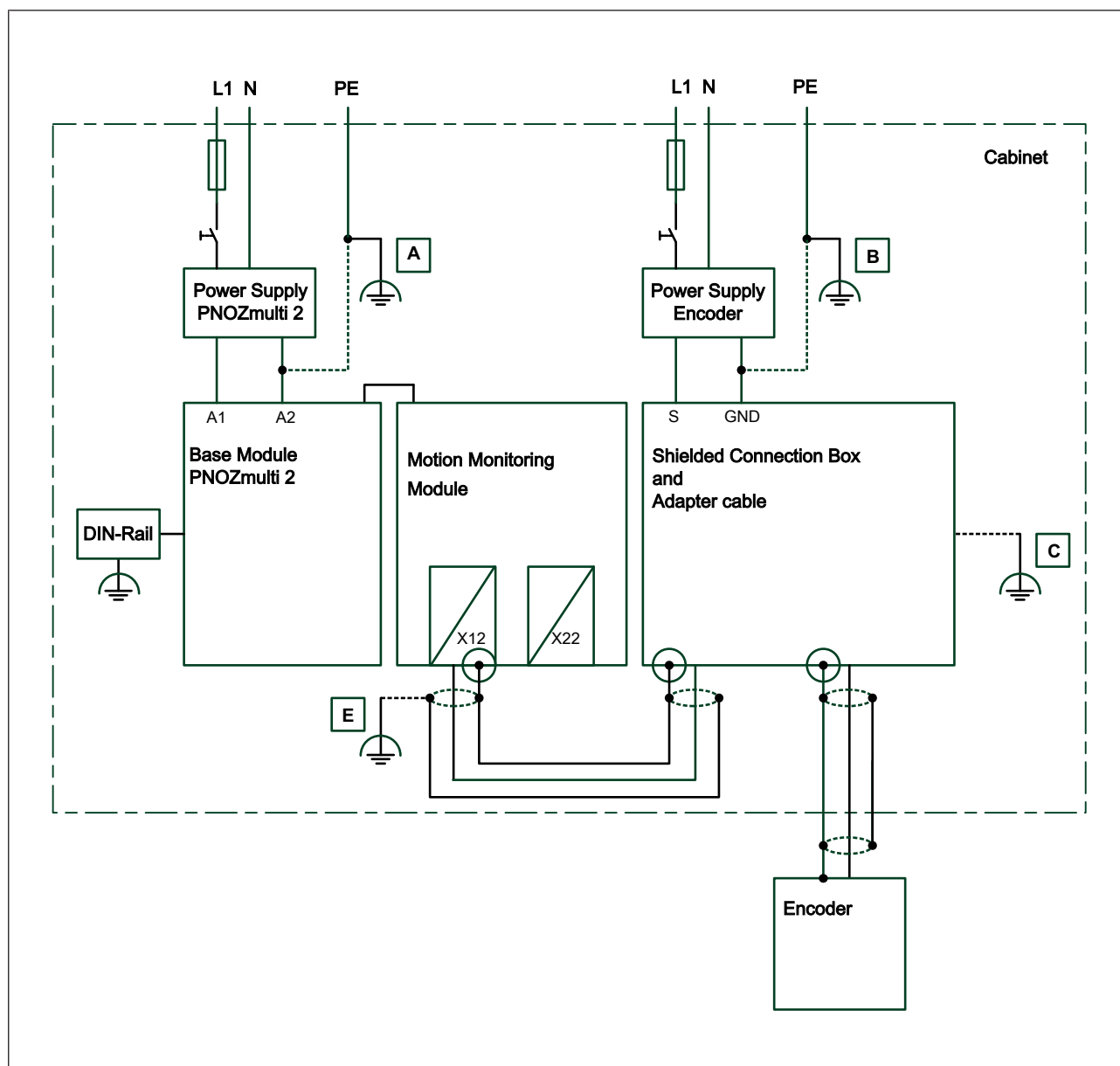
Track /Z must remain free!!



Motion monitoring modules PNOZ m EF 1MM

EMC-compliant wiring

EMC-compliant wiring for connecting an encoder



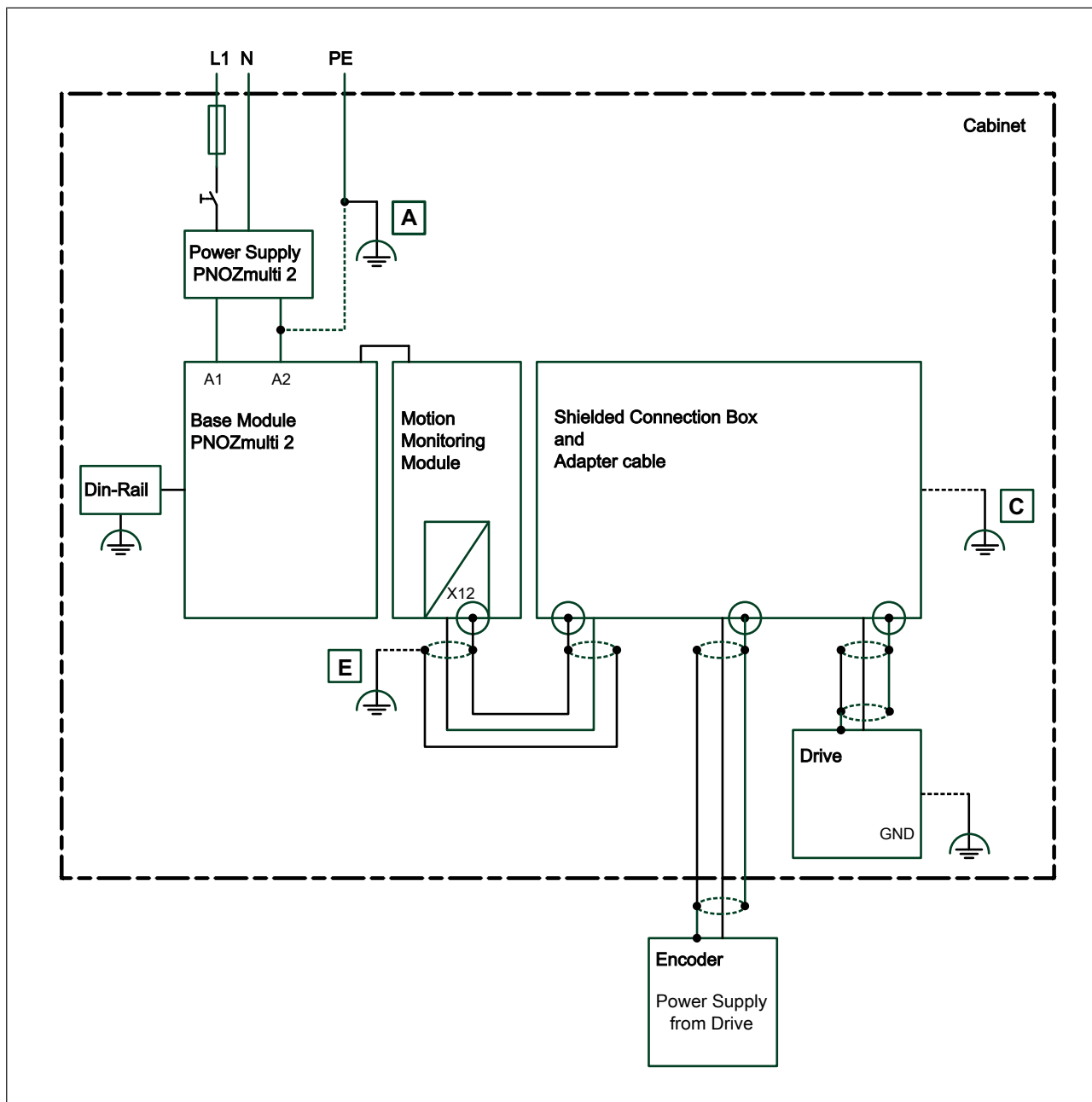
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM

EMC-compliant wiring for connecting an encoder with drive



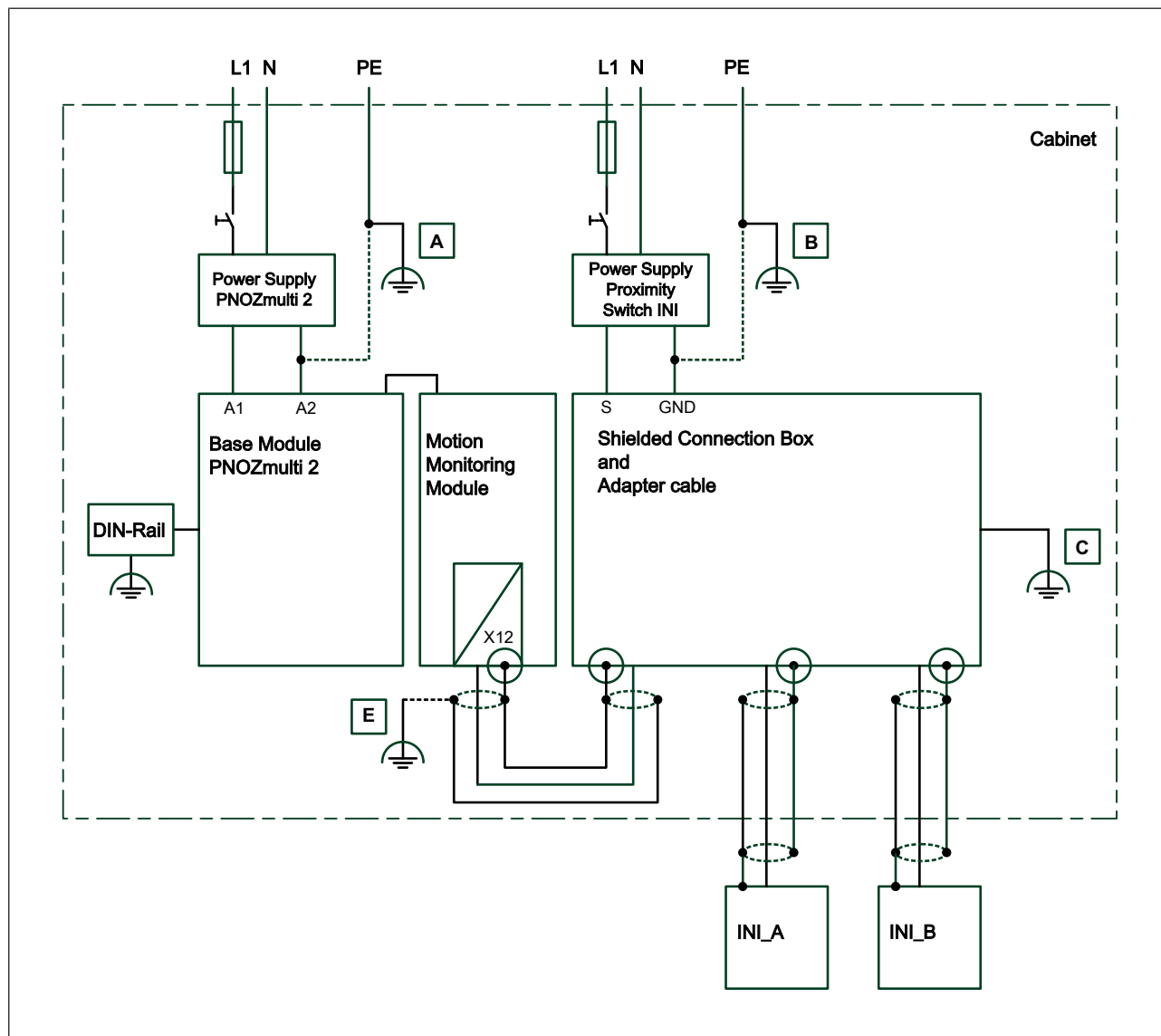
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM

EMC-compliant wiring for connecting 2 proximity switches



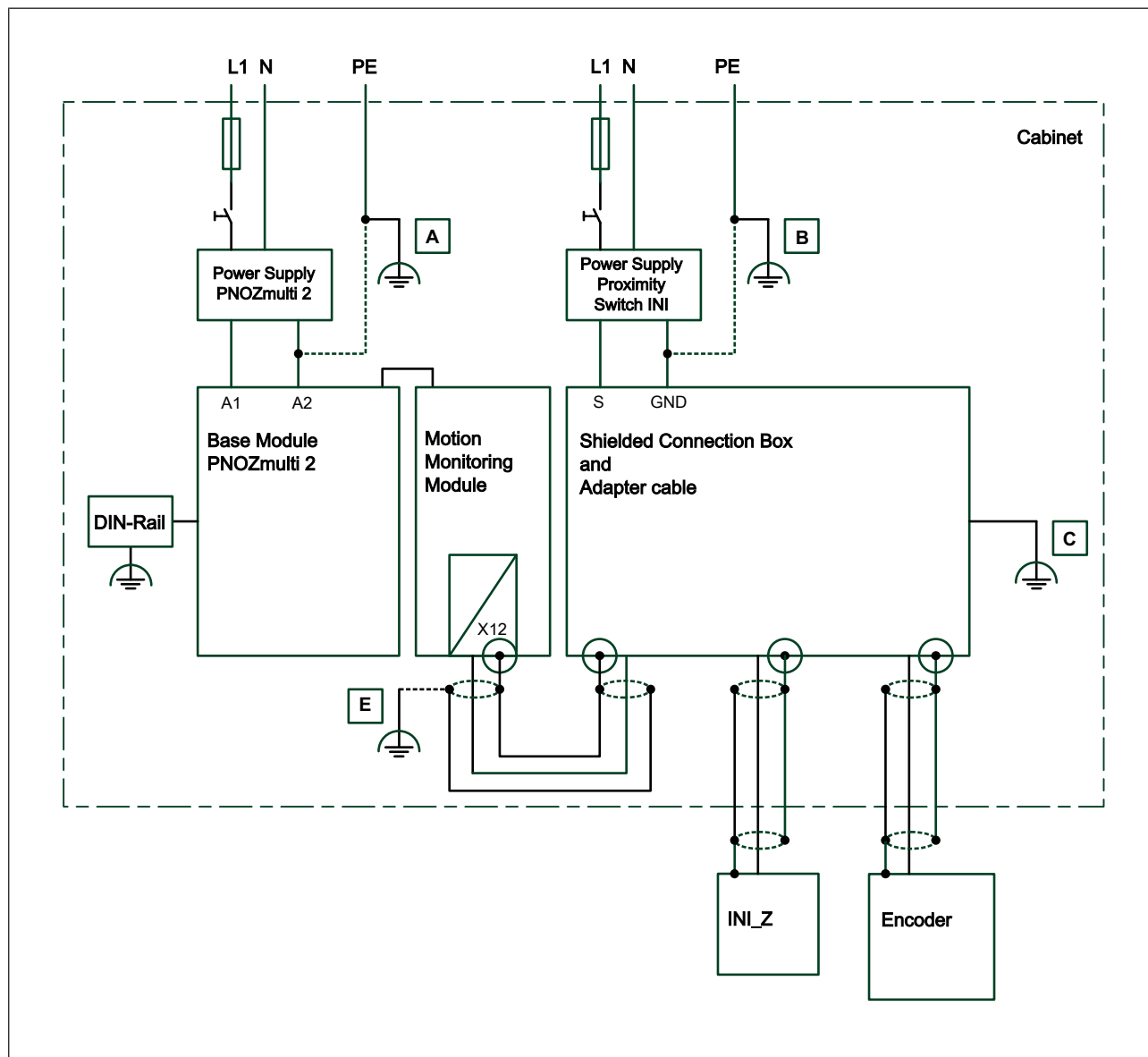
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM

EMC-compliant wiring for connecting an encoder and a proximity switch



To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E3h
Electrical data	
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	90 mA
Power consumption	2 W
Max. power dissipation of module	2,2 W
Status indicator	LED
Proximity switch input	
Number of inputs	2
Input signal level	
Signal level at "1"	11 - 30 V
Signal level at g0 h	0,0 - 3,0 V
Input resistance	22 kOhm
Input's frequency range	0 - 5 kHz
Configurable monitoring frequency	
without hysteresis	0,1 Hz - 5 kHz
Incremental encoder input	
Number of inputs	1
Connection type	Mini-IO female connector, 8-pin
Input signal level	0,5 - 30 Vss
Phase position for the differential signals A, /A and B, /B	90° ±30°
Overload protection	-50 - 65 V
Input resistance	20 kOhm
Input's frequency range	0 - 500 kHz
Configurable monitoring frequency	
Without hysteresis	0,1 Hz - 500 kHz
Inputs	
Potential isolation	Yes
Times	
Reaction time after limit value is exceeded	1/f_ist + 16 ms

Motion monitoring modules PNOZ m EF 1MM

Environmental data

Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Potential isolation

Potential isolation between	Sensor and system voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V

Mechanical data

Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm

Motion monitoring modules PNOZ m EF 1MM

Mechanical data	
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	111 mm
Weight	90 g

Where standards are undated, the 2018-09 latest editions shall apply.

Motion monitoring modules PNOZ m EF 1MM

Safety characteristic data

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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
Monitoring 1 encoder	PL d	Cat. 2	SIL 2	1,80E-08	SIL 2	1,58E-03	20
Monitoring 2 encoders	PL e	Cat. 3	SIL 3	1,01E-09	SIL 3	8,41E-05	20
Monitoring safe encoder	PL e	Cat. 4	SIL 3	2,35E-09	SIL 3	2,04E-04	20
2-channel	PL e	Cat. 4	SIL 3	3,37E-10	SIL 3	2,88E-05	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_M 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.

Supplementary data

Categories

Safety level

The maximum achievable safety level depends, among other things, on the sensor, the wiring and the operating mode of the PNOZ m EF 1MM.

Information on the safety-related characteristic data for the subsystems *Sensor* and PNOZ m EF 1MM

Example:

Sensor subsystem			Subsystem PNOZ m EF 1MM	
Category	MTTFd	DC	Operating mode	PFH [1/h]
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

Motion monitoring modules PNOZ m EF 1MM

The values for **Category** and **DC** can be set for the sensor subsystem, bearing in mind the restrictions stated in the respective chapter. The MTTFd value must be stated by the sensor manufacturer.

The values for **DC** refer to the standard EN/IEC 61508.

Assuming that all faults are dangerous, MTTF = MTTFd can be set.

The characteristic value MTTF is a property of the sensor, which may only be stated by the manufacturer.

Forced dynamisation:

When monitoring sensors with square output signals (TTL, HTL) or safe sensors, the axis must be moved within 8 hours so that the signal changes on all the connected tracks.

Key:

SRP/CS = Safety-related part of a control system (EN 13849-1, Tab. 2)

Safety functions

The following safe monitoring functions are available:

- ▶ Safe speed monitoring (SSM)
- ▶ Safe speed range monitoring (SSR-M)
- ▶ Safe direction monitoring (SDI-M)
- ▶ Safe operating stop monitoring (SOS-M)
- ▶ Safe stop 1 monitoring (SS1-M)
- ▶ Safe stop 2 monitoring (SS2-M)
- ▶ Safely limited acceleration monitoring (SLA-M)
- ▶ Safely limited acceleration range monitoring (SAR-M)

The safety functions of the PNOZ m EF 1MM are monitoring functions, whereby a safe output signal is used to show if defined limit values are exceeded.

The reaction function that takes place (e.g. shutting down the drive, activating a mechanical brake) when exceeded limit values are detected during the normal operation of the safety function must be defined and implemented by the machine/plant developer and does not form part of the PNOZ m EF 1MM.

The monitoring function of the PNOZ m EF 1MM can be used to implement safety functions defined in the standard EN 61800-5-2 for Adjustable speed electrical power drive systems.

Safety functions in accordance with EN 61800-5-2	Implemented with monitoring function of the PNOZ m EF 1MM
Safe Operating Stop (SOS)	Safe operating stop monitoring (SOS-M)
Safe Speed Range (SSR)	Safe speed range monitoring (SSR-M)
Safe Direction (SDI)	Safe direction monitoring (SDI-M)

Motion monitoring modules PNOZ m EF 1MM

Safety functions in accordance with EN 61800-5-2	Implemented with monitoring function of the PNOZ m EF 1MM
Safe Speed Monitoring (SSM)	Safe speed monitoring (SSM)
Safe Stop 1 (SS1)	Safe stop 1 monitoring (SS1-M)
Safe Stop 2 (Safe stop 2, SS2)	Safe stop 2 monitoring (SS2-M)
Safely Limited Acceleration (Safely Limited Acceleration, SLA)	Safely limited acceleration monitoring (SLA-M)
Safely Acceleration Range Monitoring (Safely Acceleration Range Monitoring, SAR)	Safely limited acceleration range monitoring (SAR-M)

Safety-related characteristic data for operation with non-safety-related encoder without additional requirements

Permitted sensor types and output signals

Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Motion monitoring modules PNOZ m EF 1MM

Safety-related architecture

To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem PNOZ m EF 1MM:

Sensor			Subsystem PNOZ m EF 1MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
1*	Manufacturer-specific	0 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

*In accordance with EN ISO 13849-1, Category 1 is only met if the sensor is a "well-trying component".

Achievable safety level

Monitoring function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL c (Cat.1)	-
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		

Safety-related characteristic data for operation with non-safety-related encoder with mechanical fault exclusion

In accordance with EN 61800-5-2: 2007, Table D.16 (Motion and position feedback sensors), fault exclusions are permitted for faults in the mechanical connection between the sensor and motor.

Permitted sensor types and output signals

Permitted encoder types:

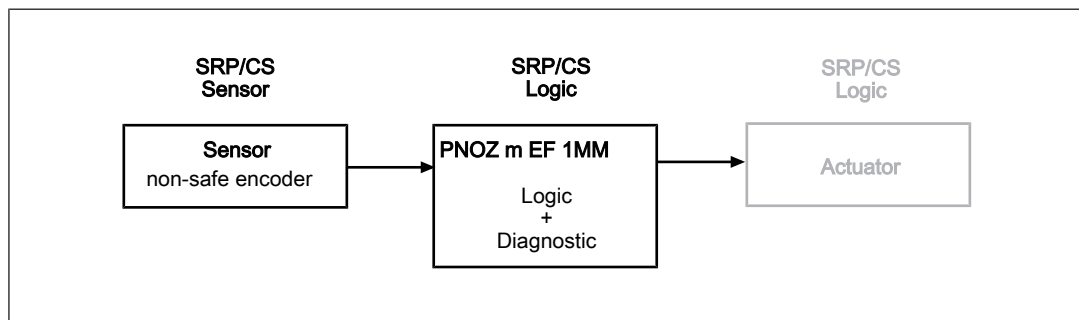
- ▶ Rotary non-safety-related encoders

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Motion monitoring modules PNOZ m EF 1MM

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM":

Sensor			Subsystem PNOZ m EF 1MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL d (Cat.2)	2
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with non-safety-related encoder with diagnostics via the drive controller

The detection of sensor errors (diagnostics for the sensor subsystem via the evaluation device) can be supplemented with a drive controller.

Motion monitoring modules PNOZ m EF 1MM

Permitted sensor types and output signals

Permitted sensor types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

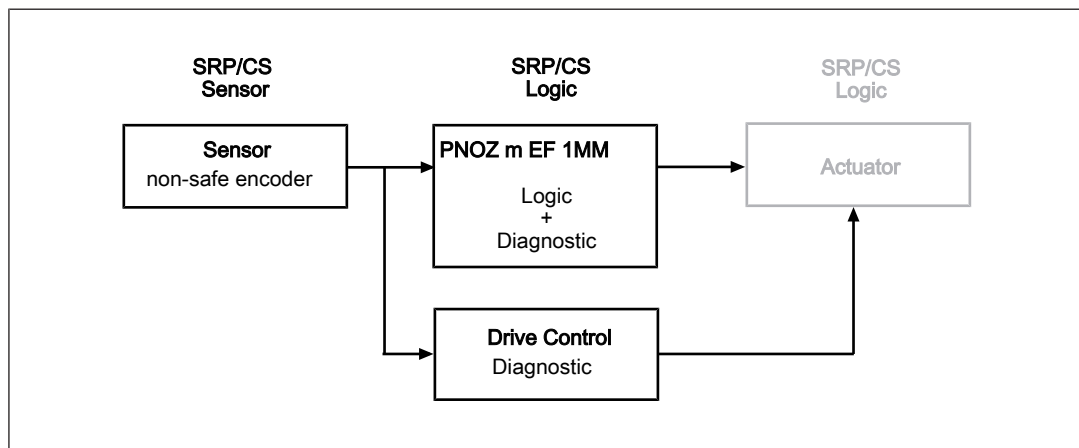
- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Requirements of the drive controller

- ▶ Parameters for the control loops and motor control must be set in such a way as to guarantee stable operation.
Drag error detection (see below) must be capable of operating in accordance with the requirements of the safety function.
- ▶ The motor must be operated with a current impressing control procedure, based on the rotor position (field-oriented control). If the analogue track signals are idle, field-oriented control will brake and/or stop the rotor.
- ▶ The drive controller must be in position control operating mode.
- ▶ If a maximum error variable is exceeded (set/true comparison) the drive controller must switch to a fault condition and stop the drive (drag error detection). The error reaction to drag error detection should be a controlled motor stop.
- ▶ Fault detection via the error variable with subsequent shutdown must meet the requirements of the safety function, with regard to reaction times for example.
- ▶ The drive controller must evaluate the same incremental/SinCos signals from the encoder for control as are processed by the safe evaluation device (important on encoders with combined analogue/digital interface).

Motion monitoring modules PNOZ m EF 1MM

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM":

Sensor			Subsystem PNOZ m EF 1MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL d (Cat.2)	2
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with a safe encoder

Safe encoders are certified in accordance with EN/IEC 61508, EN 13849 and EN/IEC 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ m EF 1MM) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

Motion monitoring modules PNOZ m EF 1MM

Permitted sensor types and output signals

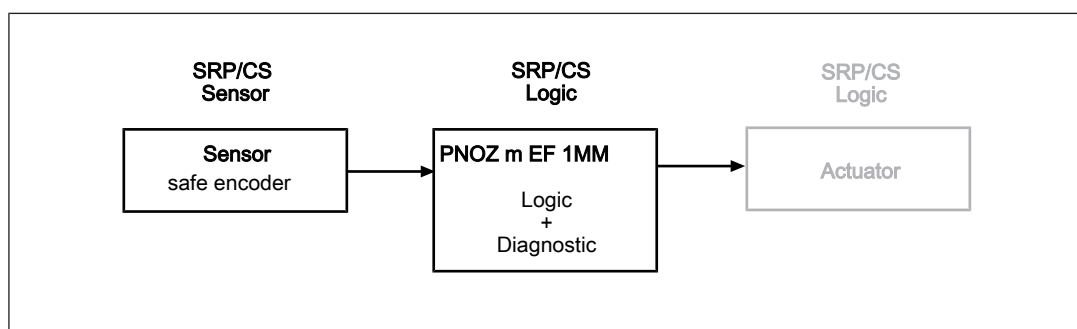
Permitted encoder types:

- ▶ Rotary safety-related encoders
- ▶ Linear safety-related encoders

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM":

Sensor			Subsystem PNOZ m EF 1MM	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring Safe sensor	2,69E-09

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL e (Cat.4)	3
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Motion monitoring modules PNOZ m EF 1MM

Safety-related characteristic data for operation with a safe encoder with Z index

Safe encoders are certified in accordance with EN/IEC 61508, EN 13849 and EN/IEC 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ m EF 1MM) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

Permitted sensor types and output signals

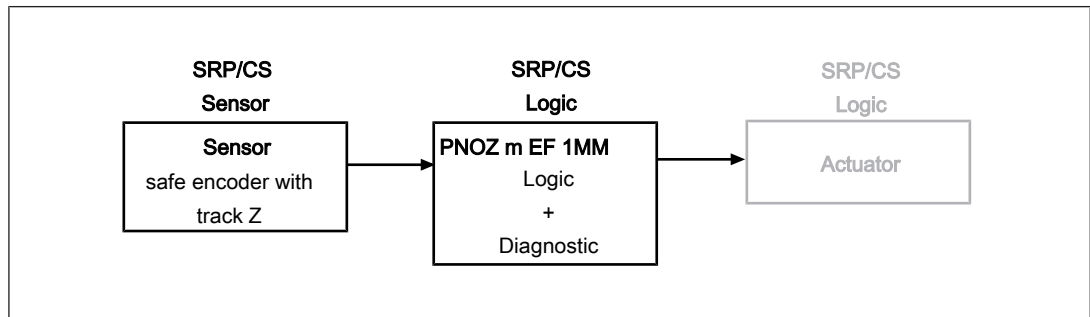
Permitted encoder types:

- ▶ Rotary safety-related encoders
- ▶ Linear safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, differential with Z index
- ▶ Square output signals HTL, differential with Z index
- ▶ Sin/Cos output signals 1Vss, reference voltage with Z index
- ▶ Sin/Cos output signals 1Vss, differential with Z index

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM":

Sensor			Subsystem PNOZ m EF 1MM	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring 2 sensors	1,35E-09

Motion monitoring modules PNOZ m EF 1MM

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL e (Cat.4)	3
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with non-safety-related encoder and proximity switch

The speed monitoring of the non-safety-related encoder can be verified via an additional reference sensor.

Permitted sensor types and output signals

Non-safety-related encoder

Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1V_{ss}, reference voltage
- ▶ Sin/Cos output signals 1V_{ss}, differential

Reference sensor

Permitted encoder types:

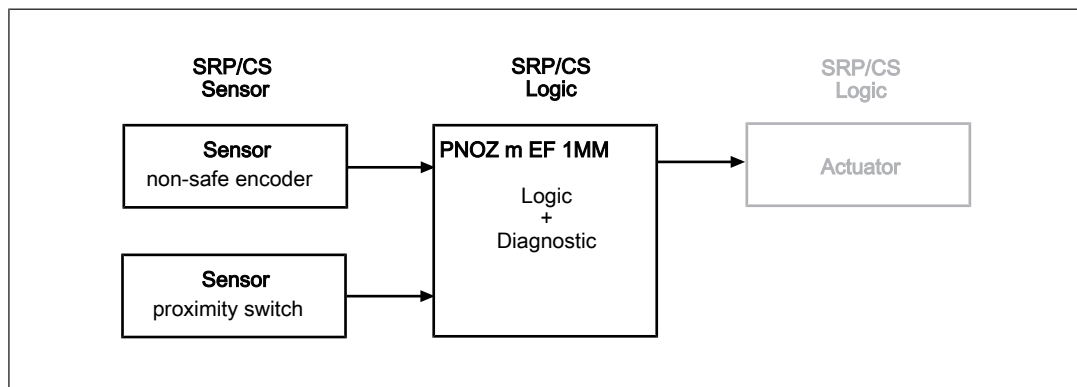
- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders
- ▶ Inductive proximity switches

Permitted output signals:

- ▶ Square output signals HTL, single ended
- ▶ Square output signal 24 V, pnp

Motion monitoring modules PNOZ m EF 1MM

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem PNOZ m EF 1MM:

Sensor			Subsystem PNOZ m EF 1MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 sensors	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The values for **DC** refer to the standard EN/IEC 61508.

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M SDI-M SS2-M	PL c (Cat.1)	-
SSR-M SSM SS1-M SLA-M SAR-M	PL e (Cat.4)	3

Please note:

For the "sensor" subsystem, a minimum speed must be exceeded within forced dynamisation.

Motion monitoring modules PNOZ m EF 1MM

The minimum speed depends on the ratio of the frequency at tracks AB " f_{AB} " to the frequency at track Z " f_Z " in your configuration (see PNOZmulti Configurator **Element Motion Monitor**, value **Calculated Ratio AB/Z**) and is determined as follows:

- ▶ when **f_{AB}/f_Z Ratio** ≥ 1.0
 $f_Z = 10 \text{ mHz}$ or $f_{AB} = (f_{AB}/f_Z) \times 10 \text{ mHz}$
- ▶ when **f_{AB}/f_Z Ratio** < 1.0
 $f_{AB} = 10 \text{ mHz}$ or $f_Z = 10 \text{ mHz}/(f_{AB}/f_Z)$

At the very latest, a feasibility error will be detected when a tolerance expires. The tolerance level depends on the ratio of the frequency at tracks AB " f_{AB} " to the frequency at track Z " f_Z " in your configuration (**f_{AB}/f_Z Ratio** setting in the menu) and is calculated as follows:

- ▶ when **f_{AB}/f_Z Ratio** ≥ 1.0
 7.5 Z-pulses or $7.5 \times (f_{AB}/f_Z) \text{ AB-pulses}$
- ▶ when **f_{AB}/f_Z Ratio** < 1.0
 4.5 AB-pulses or $4.5/(f_{AB}/f_Z) \text{ Z-pulses}$

Safety-related characteristic data for operation with 2 proximity switches

Permitted sensor types and output signals

Non-safety-related sensor

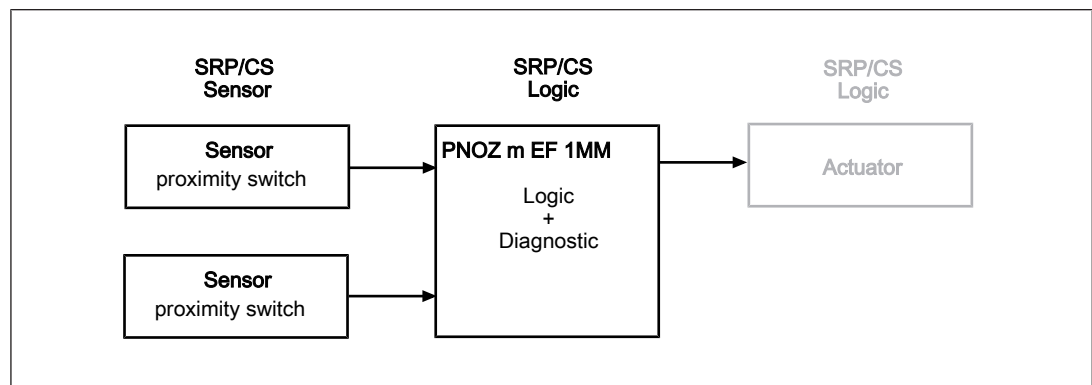
Permitted sensor types:

- ▶ Inductive proximity switches

Permitted output circuits:

- ▶ pnp
- ▶ npn

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM":

Motion monitoring modules PNOZ m EF 1MM

Sensor			Subsystem PNOZ m EF 1MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 sensors	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The values for **DC** refer to the standard EN/IEC 61508.

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M SDI-M SS2-M	-	-
SSR-M SSM SS1-M SLA-M SAR-M	PL e (Cat.4)	3

Please note:

Common cause failures (CCF) are possible for the sensor subsystem. An appropriate analysis must be carried out.

To use proximity switches 1 and 2 we recommend that you:

- ▶ Use different technologies/design or physical principles (e.g. different manufacturers) and
- ▶ Evaluate the sensor supply via track S

Safety characteristic data for operation with 2 proximity switches with reduced diagnostics

Permitted sensor types and output signals

Non-safety-related sensor

Permitted sensor types:

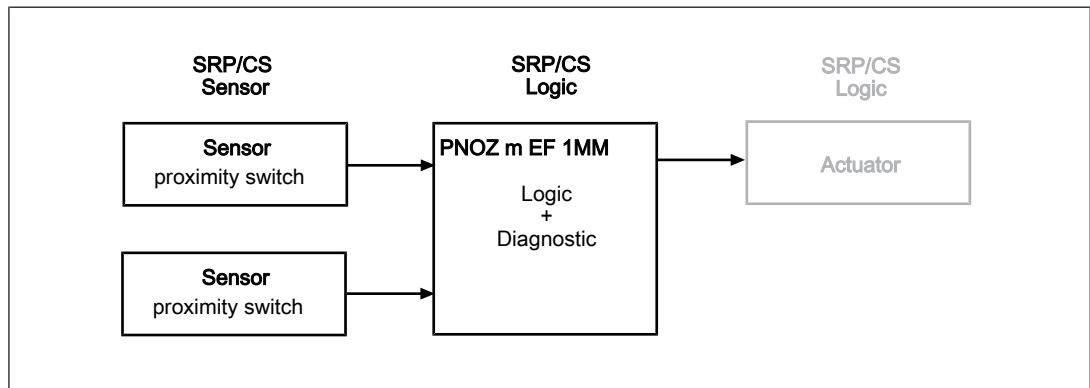
- ▶ Inductive proximity switches

Permitted output circuits:

- ▶ pnp

Motion monitoring modules PNOZ m EF 1MM

Safety-related architecture



The supply voltage of the proximity switches must be monitored as a measure against systemic failure.

To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM":

Sensor			Subsystem PNOZ m EF 1MM	
Category	MTTFd	DC ₁₃₈₄₉	Operating mode	PFH (1/h)
3	Manufacturer-specific	90 %*	Monitoring 2 sensors with reduced diagnostics	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The value for DC refers to the standard EN13849

*see EN 13849-1 table E.1

"Cross monitoring of input signals with dynamic test if short circuits are not detectable (for multiple I/O)" → 90%

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	-	-
SDI-M		
SS2-M		
SSR-M	PL d (Cat.3)	2
SSM		
SS1-M		
SLA-M		
SAR-M		

Motion monitoring modules PNOZ m EF 1MM

Please note:

Common cause failures (CCF) are possible for the sensor subsystem. An appropriate analysis must be carried out.

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 1MM	Configurable safe small controllers PNOZmulti 2, expansion module, safe monitoring of 1 axis.	772170

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Screw terminals PNOZ mmcpx, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Connection box

Product type	Features	Order no.
PNOZ msi b4 Box	Shielded connection box PSEN msi b4, for connecting an incremental encoder to a proximity switch, with/without pull resistor, with additional supply for the proximity switch.	773845

Motion monitoring modules PNOZ m EF 1MM

Adapter

Product type	Features	Order no.
MM A MINI-IO CAB99 1.5m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 1.5 m.	772200
MM A MINI-IO CAB99 2.5m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 2.5 m.	772201
MM A MINI-IO CAB99 5.0m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 5 m.	772202

Motion monitoring modules PNOZ m EF 2MM



Overview

Unit features


Application of the product PNOZ m EF 2MM:

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

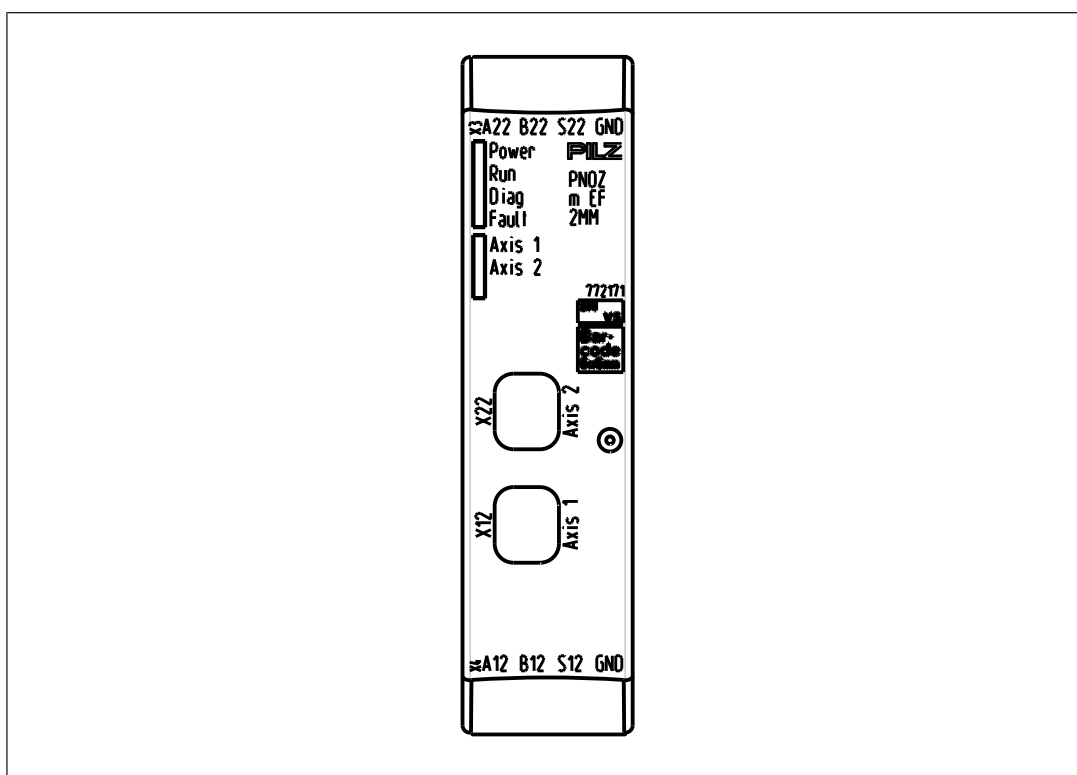
The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Monitoring of 2 independent axes
- ▶ Measured value recorded by proximity switch and encoder
- ▶ Monitoring functions
 - Safe speed monitoring (SSM)
 - Safe speed range monitoring (SSR-M)
 - Safe direction of movement monitoring (SDI-M)
 - Safe operating stop monitoring (SOS-M)
 - Safe stop 1 monitoring (SS1-M)
 - Safe stop 2 monitoring (SS2-M)
 - Safely limited acceleration monitoring (SLA-M)
 - Safely limited acceleration range monitoring (SAR-M)
 - Analogue voltage (track S)
- ▶ LED display for:
 - Supply voltage
 - Diagnostics
 - Axis status
 - Fault
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Motion monitoring modules PNOZ m EF 2MM

- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [ 272]).

Front view



Legend:

- ▶ X4: Connection for proximity switch at axis 1
- ▶ X3: Connection for proximity switch at axis 2
- ▶ X12: Mini IO socket for connecting encoder or proximity switch at axis 1
- ▶ X22: Mini IO socket for connecting encoder or proximity switch at axis 2
- ▶ LEDs:
 - Power
 - Run
 - Diag
 - Fault
 - Axis 1
 - Axis 2

Motion monitoring modules PNOZ m EF 2MM

Function description

Operation

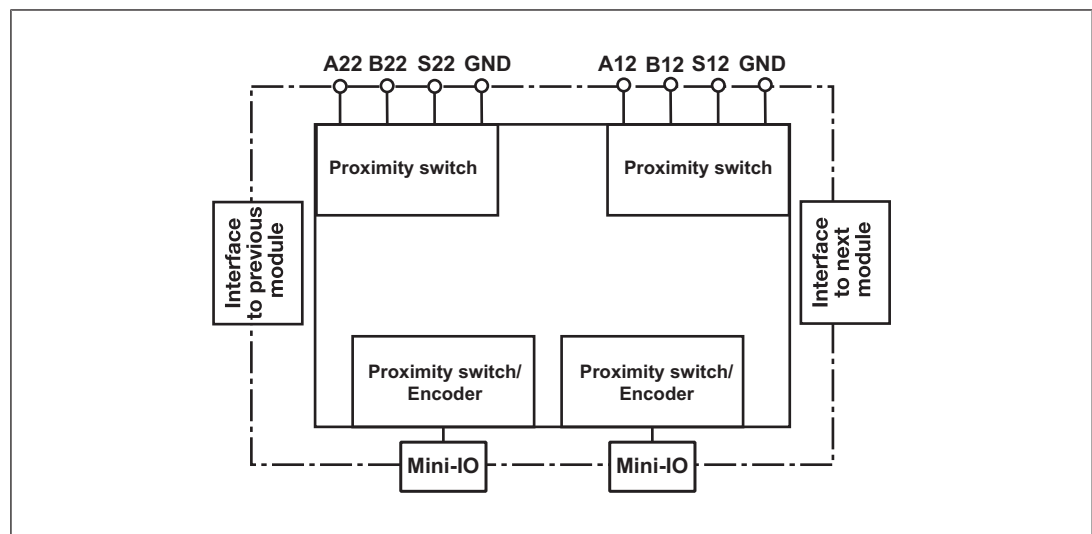
The motion monitoring module PNOZ m EF 2MM can monitor two axes independently. The motion monitoring module signals the status of the monitored values to the base unit. Depending on the implemented safety circuit, the values may be transferred from the base unit to an output on the control system. Proximity switches or encoders are used to record the values.

The configuration of the motion monitoring module is described in detail in the PNOZmulti Configurator's online help.

The relay meets the following safety requirements:

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

Block diagram



Monitoring functions

The motion monitoring module PNOZ m EF 2MM supports the following monitoring functions.

Please note that the position monitoring functions SOS-M, SDI-M and SS2-M cannot be used in conjunction with 2 proximity switches, as no position can be detected.

Safe speed monitoring

The **Safe speed monitoring** function (SSM) monitors the current speed to see if a limit value is exceeded.

Motion monitoring modules PNOZ m EF 2MM

If the configured limit value is exceeded, the output switches off. As soon as the value falls below the limit value (plus hysteresis), the output switches off again.

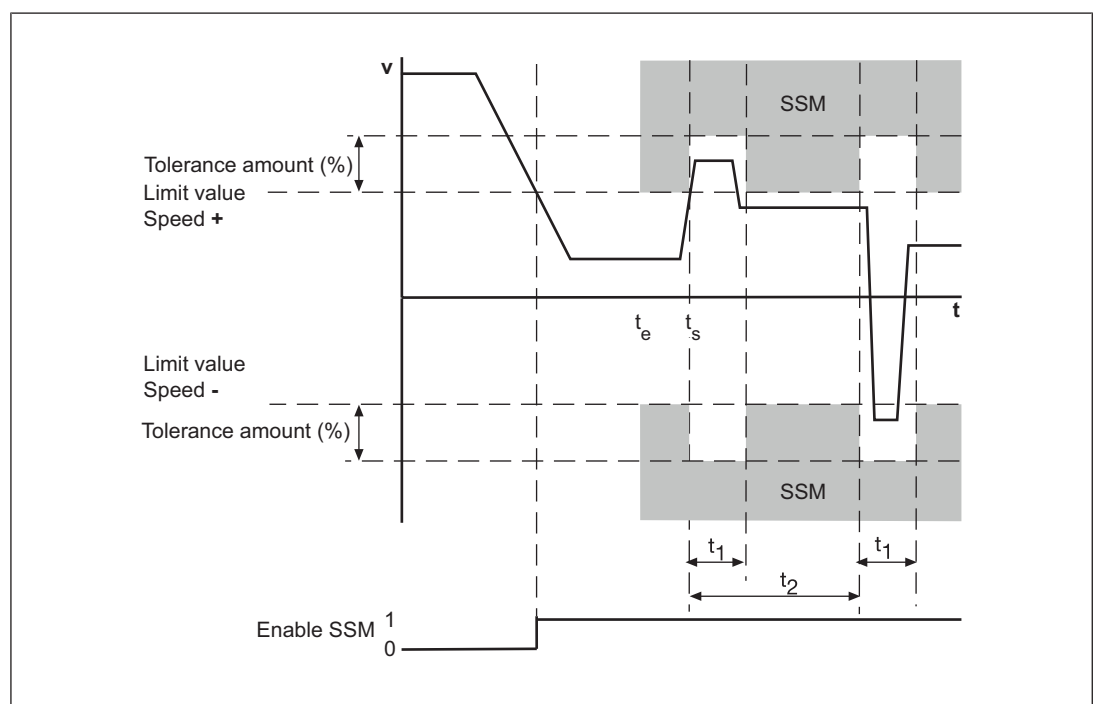
If a manual reset is configured, the output will not switch back on until the value is inside the limit value (plus hysteresis) and the reset input is activated.

In PNOZmulti Configurator 12 areas can be configured per axis (with units < Version 2.0 only 8 limit values can be configured).

A tolerance range may also be set for the limit values used to monitor the speed. This tolerance range modifies the set limit values. As a result, one-off or periodic overshoots that exceed the limit values can be tolerated.

The following values can be configured for the tolerance range:

- ▶ Tolerance time (t_1), which takes into account the length of the overshoots (maximum time for which the limit value may be exceeded). It must not be possible that the sum of all the overshoots exceeds the tolerance time (t_1) within a tolerance period (t_2).
- ▶ Tolerance period (t_2), which takes into account the oscillation period (minimum time that must elapse between one limit value overshoot and the next)
- ▶ Tolerance amount (%), which takes into account the amplitude of the overshoots (maximum permitted percentage by which the configured limit values may be exceeded)



Legend:

- ▶ Enable SSM:
 - "1": Monitored limit value not exceeded
 - "0": Monitored limit value exceeded

Motion monitoring modules PNOZ m EF 2MM

- ▶ t_s : Speed v exceeds the limit value and activates the tolerance range (tolerance time, tolerance period, tolerance amount)
- ▶ t_1 : Tolerance time
- ▶ t_2 : Tolerance period
- ▶ Tolerance amount (%): Tolerance amount of limit value in both directions

Safe speed range monitoring

The **Safe speed range monitoring** function (SSR-M) monitors the current speed to ensure it stays within a maximum and minimum permitted limit value.

If the speed is outside the configured range, the output switches off. As soon as the speed returns within the configured range (plus hysteresis), the output switches back on.

If manual reset is configured, the output will not switch back on until the value is below the limit value (plus hysteresis) and the reset input is activated.

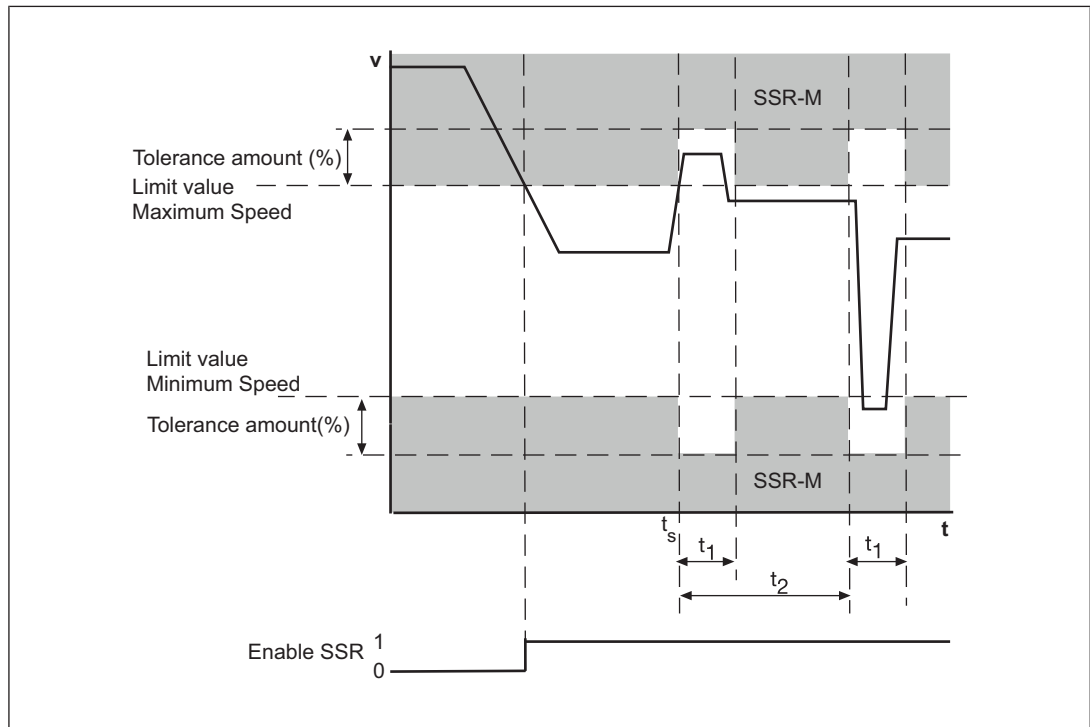
In PNOZmulti Configurator 2 areas can be configured per axis (with units < Version 2.0 only 1 area can be configured).

A tolerance range may also be set for the limit values used to monitor the speed range. This tolerance range modifies the set limit values. As a result, one-off or periodic overshoots that exceed the range limits can be tolerated.

The following values can be configured for the tolerance range:

- ▶ Tolerance time (t_1), which takes into account the length of the overshoots (maximum time for which the limit value may be exceeded). It must not be possible that the sum of all the overshoots exceeds the tolerance time (t_1) within a tolerance period (t_2).
- ▶ Tolerance period (t_2), which takes into account the oscillation period (minimum time that must elapse between one limit value overshoot and the next)
- ▶ Tolerance amount as a %, which takes into account the amplitude of the overshoots (maximum permitted percentage by which the limit value may be exceeded)

Motion monitoring modules PNOZ m EF 2MM



Legend:

- ▶ Enable SSR:
 - "1": Speed is within the configured range
 - "0": Speed is outside the configured range
- ▶ t_s : Speed v exceeds the limit value and activates the tolerance range (tolerance time, tolerance period, tolerance amount)
- ▶ t_1 : Tolerance time
- ▶ t_2 : Tolerance period
- ▶ Tolerance amount (%): Tolerance amount of the two limit values, maximum and minimum speed

Safe direction monitoring

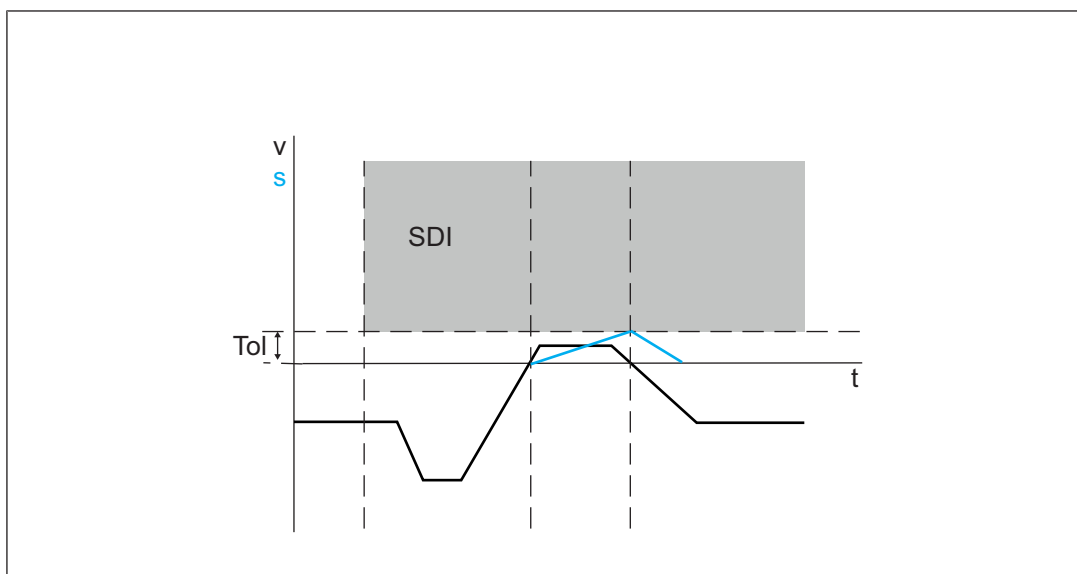
The **Safe direction monitoring** function (SDI-M) monitors the direction of movement defined for the drive axis (positive or negative). Safe direction of movement monitoring is activated via the start input. It remains active until the configured tolerance is exceeded in the opposite direction. The function can be retriggered at any time by a rising edge at the start input. As a result, the current position can be used at any time as the start point for the monitoring function.

One SDI-M element can be configured per axis for each direction in the PNOZmulti Configurator.

Motion monitoring modules PNOZ m EF 2MM

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.



Safe operating stop monitoring

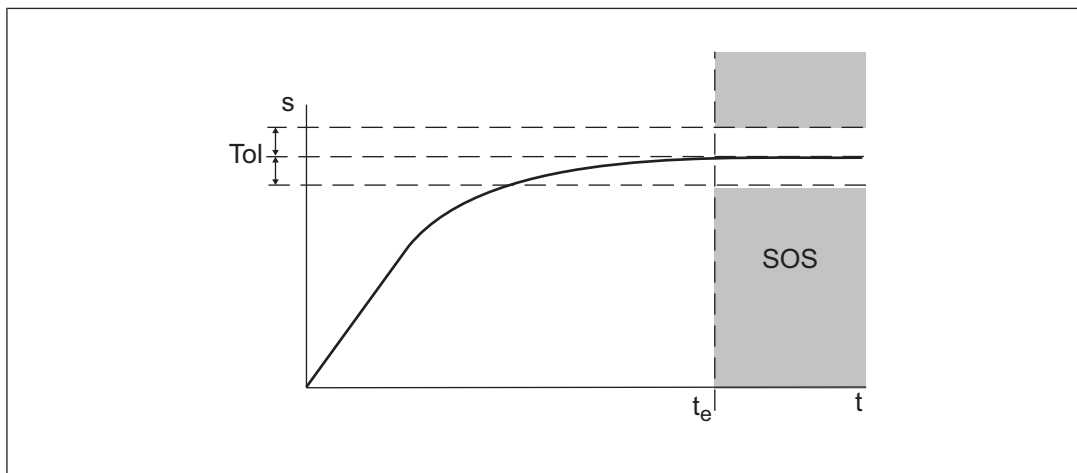
The **Safe operating stop monitoring** function (SOS-M) monitors whether the stop position remains within a configured tolerance window. Safe operating stop monitoring is activated within a rising edge at the start input. It remains active until the value is outside the tolerance band. The function can be retriggered at any time by a rising edge at the start input. As a result, the current position can be used at any time as the start point for the monitoring function.

In PNOZmulti Configurator 3 elements SOS-M can be configured per axis (with units < Version 2.0 only 1 element can be configured).

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.

Motion monitoring modules PNOZ m EF 2MM



Legend:

- ▶ t_e : Activation of the monitoring function SOS

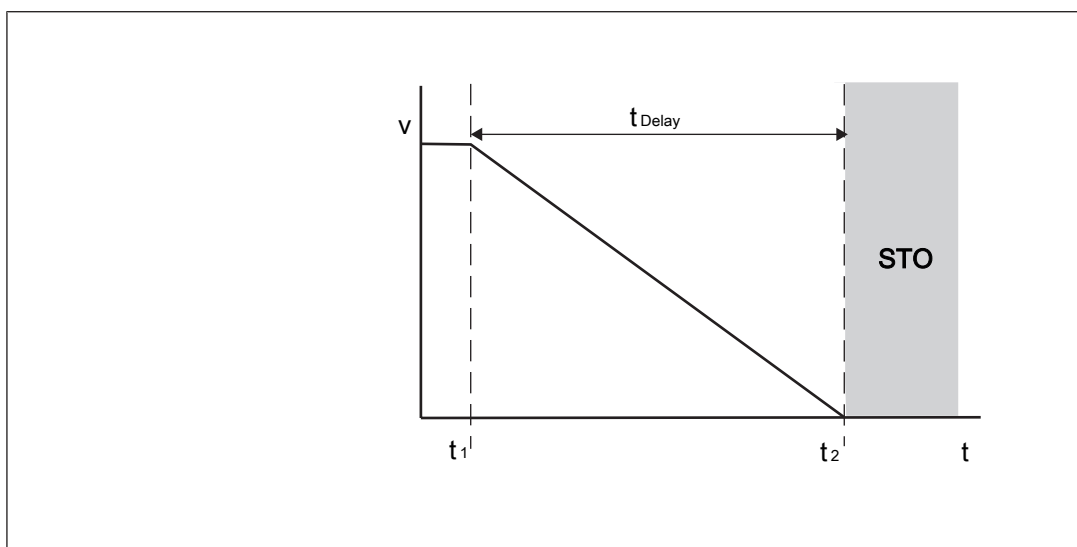
Safe stop 1 monitoring

The **Safe stop 1 monitoring** function (SS1-M) monitors whether the set delay time has elapsed (until controlled braking of the motor) or the standstill limit value for automatic STO is below the limit value.

- ▶ If the monitoring function SS1-M is triggered, the **Braking ramp** output is switched off. The drive controller's braking ramp is activated.
- ▶ After the set delay time has elapsed or the value for the automatic STO is below the limit value, the output **ST** switches off. The safety function **Safe torque off** (STO) is activated.

A maximum of 1 SS1-M element can be configured per axis in the PNOZmulti Configurator.

Sequence without standstill limit value for automatic STO:

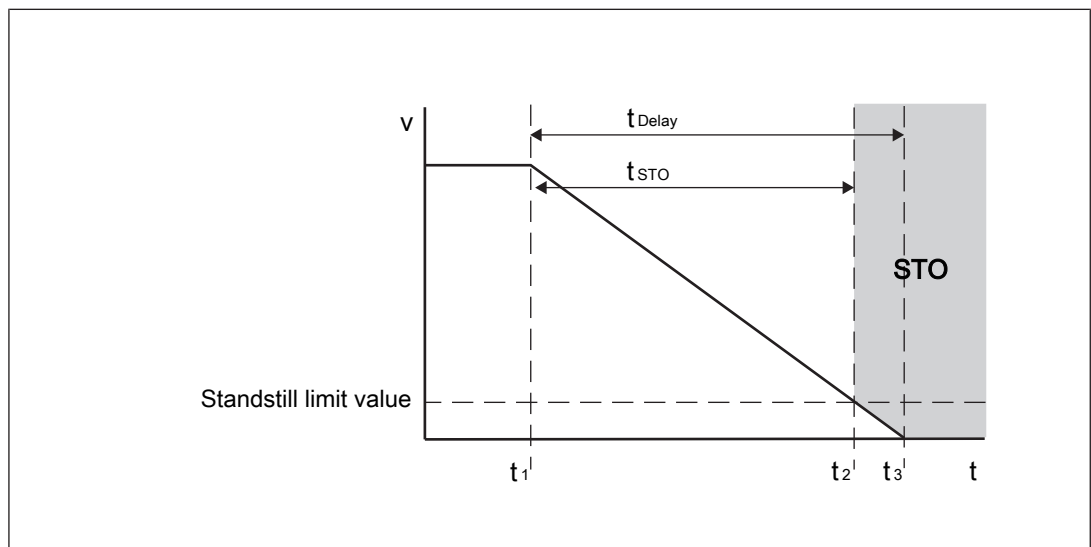


Motion monitoring modules PNOZ m EF 2MM

Legend

- t_1 : Monitoring function SS1-M is activated
- t_2 : Delay time elapses, safety function "Safe torque off" (STO) is activated
- t_{Delay} : Set delay time for controlled braking of motor

Sequence with standstill limit value for automatic STO:



Legend

- t_1 : Monitoring function SS1-M is activated
- t_2 : Standstill limit value for automatic STO reached, safety function "Safe torque off" (STO) is activated
- t_3 : Delay time elapses
- t_{Delay} : Set delay time for controlled braking of motor
- t_{STO} : Actual time from activation of monitoring function until STO is activated

Safe stop 2 monitoring

The **Safe stop 2 monitoring** function (SS2-M) monitors

- ▶ Whether the set delay time has expired (until controlled braking of the motor) or the standstill limit value for automatic SOS is below the limit value.
and
- ▶ Whether the stop position ultimately remains within a configured tolerance window.

Reaction:

- ▶ If the monitoring function SS2-M is triggered, the "Braking ramp" output switches off. The drive controller's braking ramp is activated.
- ▶ If the set delay time has elapsed or the value for the automatic SOS is below the limit value, the stop position is monitored, the **Position monitoring** output switches on. If the stop position is outside the tolerance window, the **Position monitoring** and **STO** outputs switch off, the safety function **Safe torque off** (STO) is activated.

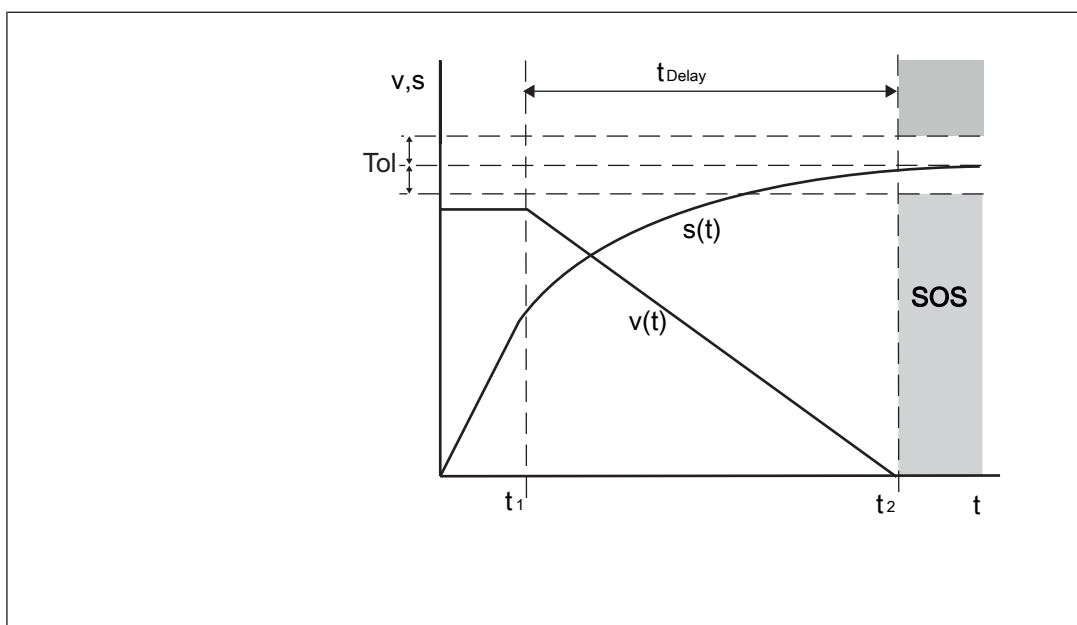
Motion monitoring modules PNOZ m EF 2MM

A maximum of 1 SS2-M element can be configured per axis in the PNOZmulti Configurator.

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.

Sequence without standstill limit value for automatic SOS:

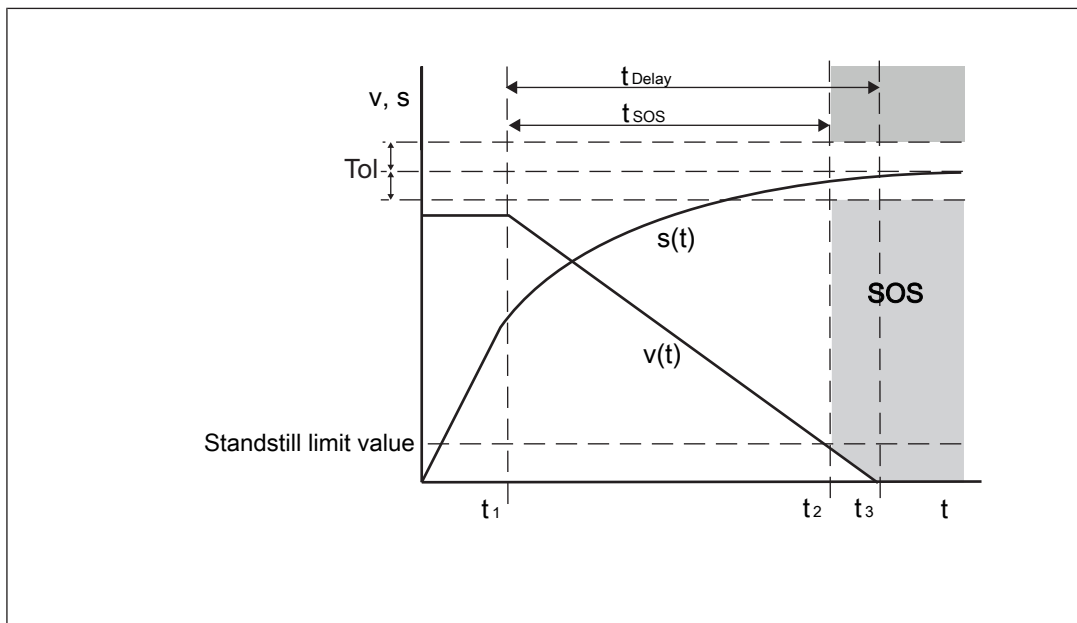


Legend

- t_1 : Activation of the monitoring function SS2-M
- t_2 : Delay time elapses, monitoring of stop position (SOS) is activated
- t_{Delay} : Set delay time for controlled braking of motor

Sequence with standstill limit value for automatic SOS:

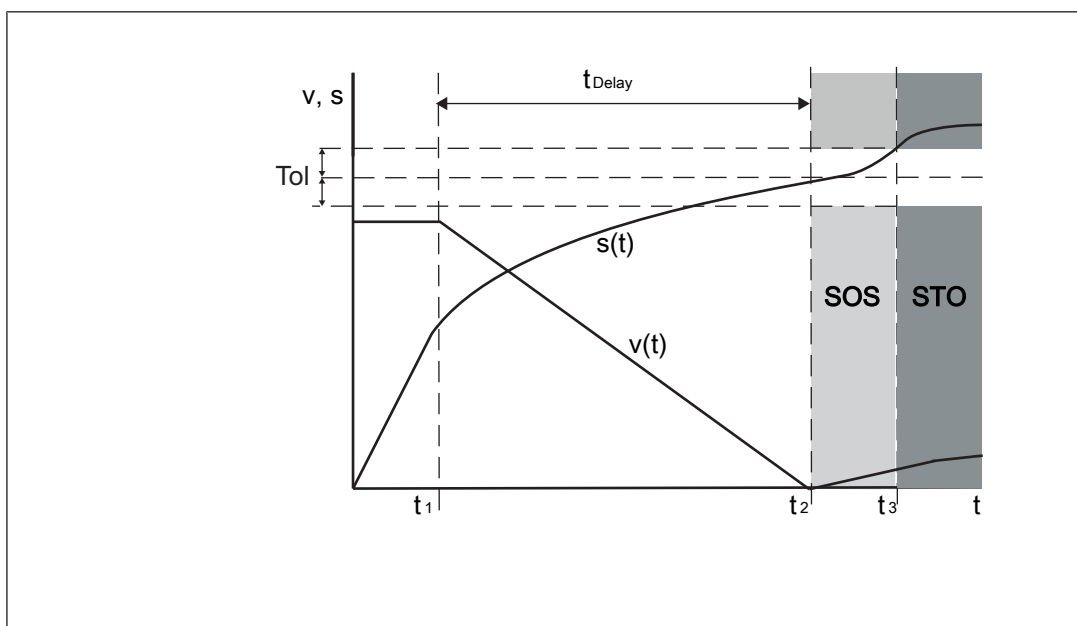
Motion monitoring modules PNOZ m EF 2MM



Legend

- t_1 : Activation of the monitoring function SS2-M
- t_2 : Standstill limit value for automatic SOS reached, monitoring of stop position (SOS) is activated
- t_3 : Delay time elapses
- t_{Delay} : Set delay time for controlled braking of motor
- t_{STO} : Actual time from activation of monitoring function until STO is activated

Sequence when stop position is violated:



Motion monitoring modules

PNOZ m EF 2MM

Legend

t_1 :	Activation of the monitoring function SS2-M
t_2 :	Standstill limit value for automatic SOS reached, monitoring of stop position (SOS) is activated
t_3 :	Stop position outside of tolerance window, safety function "Safe torque off" (STO) is activated
t_{Delay} :	Set delay time for controlled braking of motor

Safely limited acceleration monitoring (SLA-M)

The monitoring function **Safely limited acceleration monitoring** monitors the speed change per time unit.

Both the acceleration and the deceleration can be monitored.

Monitoring checks whether the acceleration or deceleration exceeds or falls below a certain limit value.

4 SLA-M elements can be configured per axis in the PNOZmulti Configurator.

The monitoring function **Safely limited acceleration monitoring** is activated with a rising edge at the start input. The trigger detection phase starts with a falling edge at the start input. In this process the current speed is taken as the start speed.

Monitoring of safely limited acceleration starts,

- ▶ when the trigger threshold is passed, that is, when the start speed changes by the configured percentage (V1).
- ▶ When monitoring starts within the maximum trigger time (t_1).

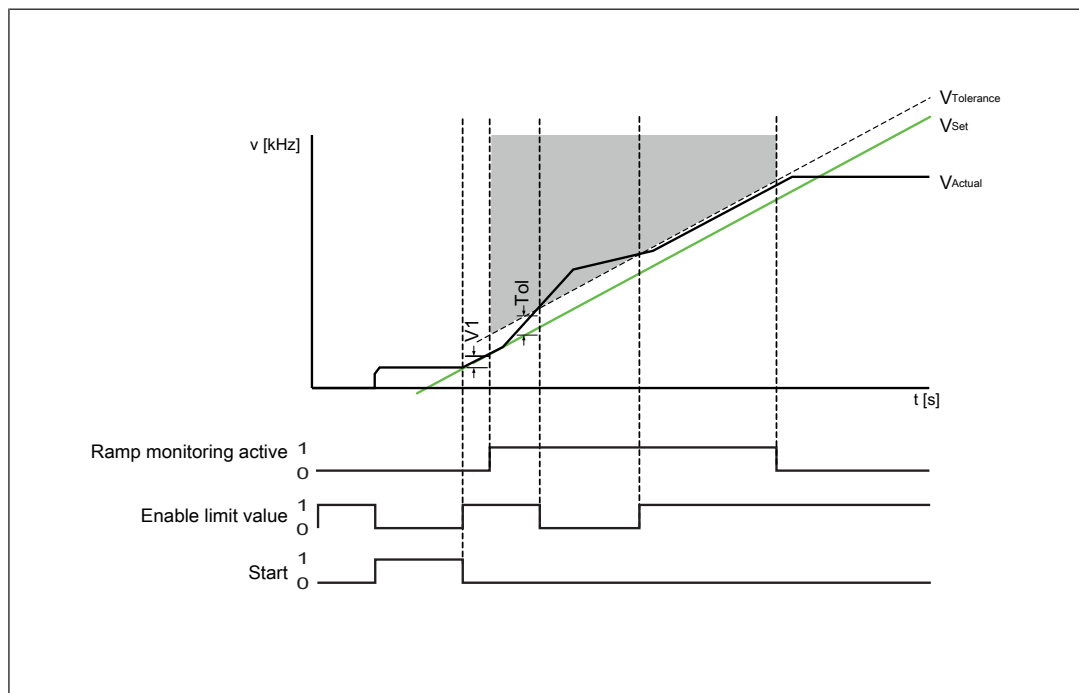
When monitoring is started, the set acceleration is calculated as a straight line V_{Set} . A tolerance band $V_{\text{Tolerance}}$ is calculated from the Tolerance and V_{Edge} parameters. If the actual speed V_{Actual} leaves the tolerance band, the output **Enable SLA** switches off.

Monitoring is ended,

- ▶ When monitoring is reset by a rising edge at the start input,
- ▶ When a range has been violated and it is no longer possible to return within the valid range,
- ▶ When the target speed is passed.

Motion monitoring modules PNOZ m EF 2MM

Example: Monitoring for too fast acceleration



Safely limited acceleration range monitoring (SAR-M)

The monitoring function **Safely limited acceleration range monitoring** monitors the speed change per time unit.

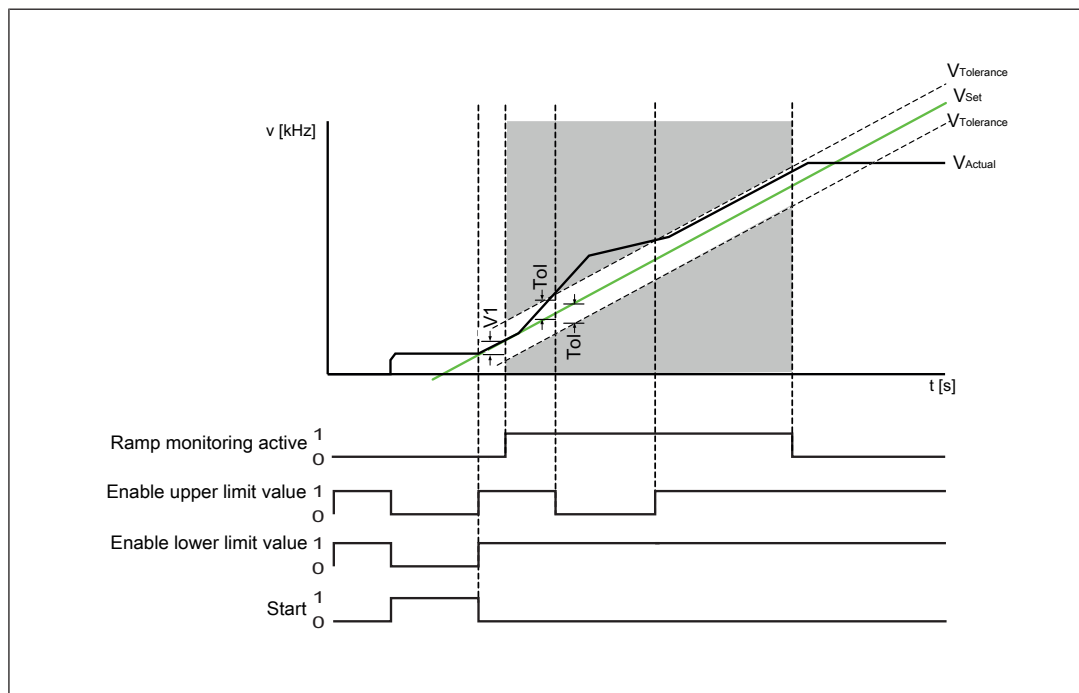
In contrast to the monitoring function SLA-M, safely limited acceleration range monitoring monitors not only a limit value but also the upper and lower limit value simultaneously. Both the acceleration and the deceleration can be monitored.

Otherwise the functionality is the same as the monitoring function SLA-M.

4 SAR-M elements can be configured per axis in the PNOZmulti Configurator.

Motion monitoring modules PNOZ m EF 2MM

Example: Monitoring for too fast and too slow acceleration



Central motion monitoring functions

These functions apply centrally for all the monitoring functions.

Hysteresis

A central hysteresis can be configured for the monitoring functions. This prevents the outputs from bouncing if there are fluctuations around the response value. The hysteresis takes effect when the output is switched on.

Validation cut-off frequency

As implausible sensor signals may arise due to jitter on the sensors around the stop position, a central validation cut-off frequency must be configured for sensor types with proximity switches in the PNOZmulti Configurator (edge jitter is caused by the position control of the drive frequency converter or by external interference signals).

If the value of the validation cut-off frequency falls below the configured value, the feasibility check of the sensors will no longer be run.

Advanced Settings tab

A tolerance time can be configured for tracks AB, Z and S respectively.

The tolerance time influences the sensitivity towards invalid signal levels (e.g. in the event of EMC interference).

The greater the configured tolerance time, the less sensitive the system will be towards invalid signal levels.

Motion monitoring modules PNOZ m EF 2MM

The tolerance time can be deactivated for individual tracks by setting 0 ms.

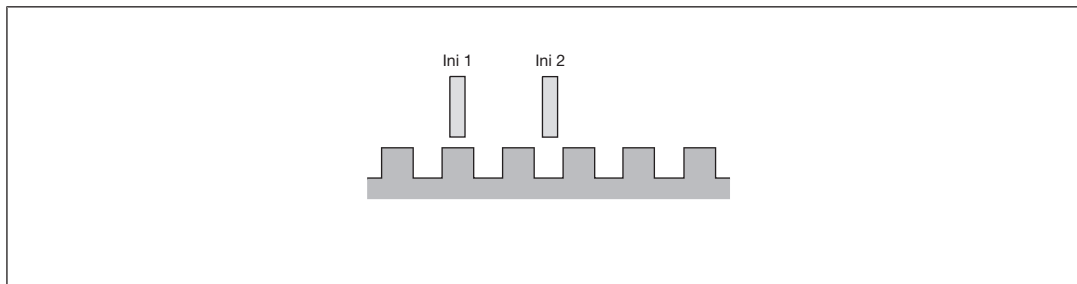
System reaction time

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 "PNOZmulti System Expansion".

Proximity switch

- ▶ Proximity switches can be used with a pnp or npn output.
- ▶ The proximity switches must be fitted so that at least one is always activated. In other words, the proximity switches must be fitted so that the recorded signals always overlap.
- ▶ The cable used to connect the proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ A DC voltage in the range of 0 - 30 V can be monitored via track S. It should be used to monitor the supply voltage of the proximity switches.

Proximity switch assembly:



Signal characteristics:

Proximity switch combinations	Signal image in an energised state
PNP / PNP	
NPN / NPN	

Motion monitoring modules PNOZ m EF 2MM

Proximity switch combinations	Signal image in an energised state
NPN / PNP	
PNP / NPN	

- ▶ For a full configuration, the maximum frequency of the sensors you are using must be entered in the PNOZmulti Configurator (see sensor's data sheet).

Special features for proximity switches with reduced diagnostics

- ▶ A: pnp, B: pnp
- ▶ It is permitted that both proximity switches are energised simultaneously.
- ▶ The safety level is reduced.
- ▶ The cables for connecting the proximity switches must be laid separately.
- ▶ The supply voltage of the proximity switches must be monitored (e.g. via track S).

Encoder

- ▶ The following encoders can be used:
 - TTL, HTL (single-ended or differential signals)
 - Sin/Cos 1 Vss
 - Hiperface®
- ▶ The encoders can be connected with or without Z index (0 index).
- ▶ The cables used to connect the encoders must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ A proximity switch can also be connected to track Z to monitor for broken shearpins.

Please note:

Broken shearpin monitoring only becomes active when

- The minimum speed is exceeded
- and

Motion monitoring modules PNOZ m EF 2MM

- The tolerance for detecting feasibility errors has elapsed.

The minimum speed and tolerance depend on the ratio of the frequency on tracks AB " f_{AB} " to the frequency on track Z " f_Z " in your configuration (see PNOZmulti Configurator **Motion Monitor Element, Calculated Ratio AB/Z**).

Minimum speed:

- Calculated ratio $AB/Z \geq 1.0$
 $f_Z = 10 \text{ mHz}$ or $f_{AB} = (f_{AB}/f_Z) \times 10 \text{ mHz}$
- when $f_{AB}/f_Z \text{ Ratio} < 1.0$
 $f_{AB} = 10 \text{ mHz}$ or $f_Z = 10 \text{ mHz}/(f_{AB}/f_Z)$

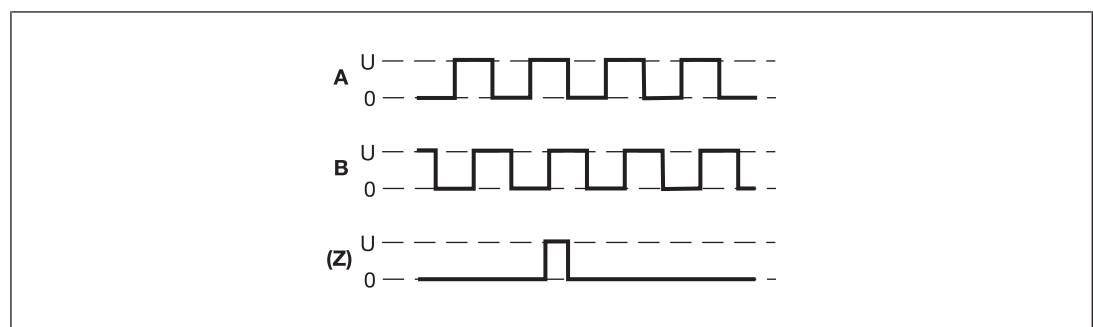
Tolerance for detecting feasibility errors:

- when $f_{AB}/f_Z \text{ Ratio} \geq 1.0$
7.5 Z pulses or $7.5 \times (f_{AB}/f_Z)$ AB pulses
- when $f_{AB}/f_Z \text{ Ratio} < 1.0$
4.5 AB pulses or $4.5 \times (f_{AB}/f_Z)$ Z pulses
- ▶ With Hiperface encoders, the Sin- Cos track is recorded and monitored via an adapter (see [Adapters for encoders](#) [341]).
- ▶ Track S can be used:
 - To connect an encoder's error output.
 - To monitor voltages between 0 V and 30 V for a permitted upper and lower limit. For example, the encoder's supply voltage can be monitored.
- ▶ The maximum frequency of the used encoders must be entered for a complete configuration.
- ▶ Pay attention to the values in the technical details.

Output signals

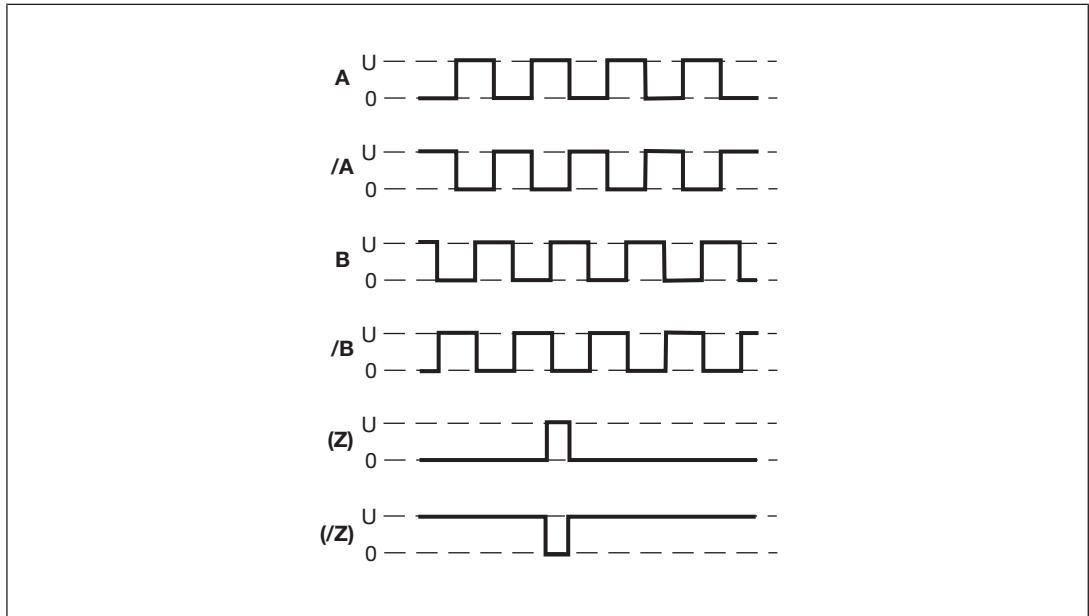
Output signals TTL, HTL

Single ended



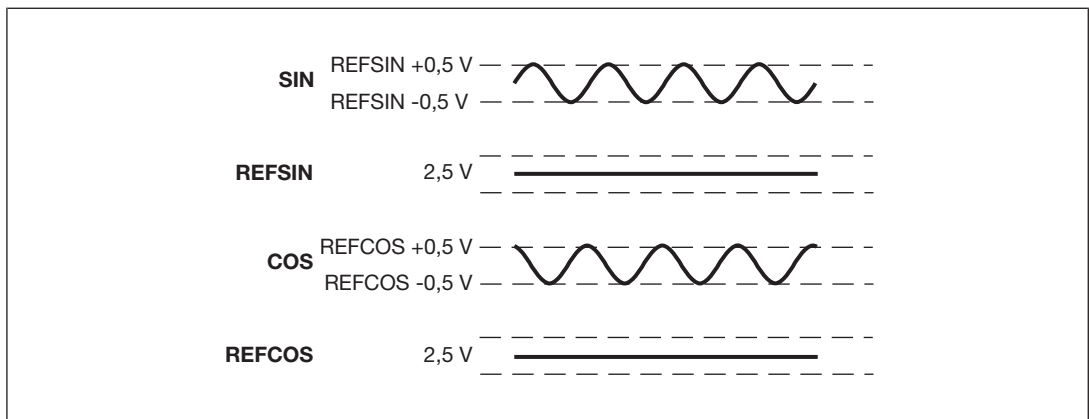
Motion monitoring modules PNOZ m EF 2MM

Differential



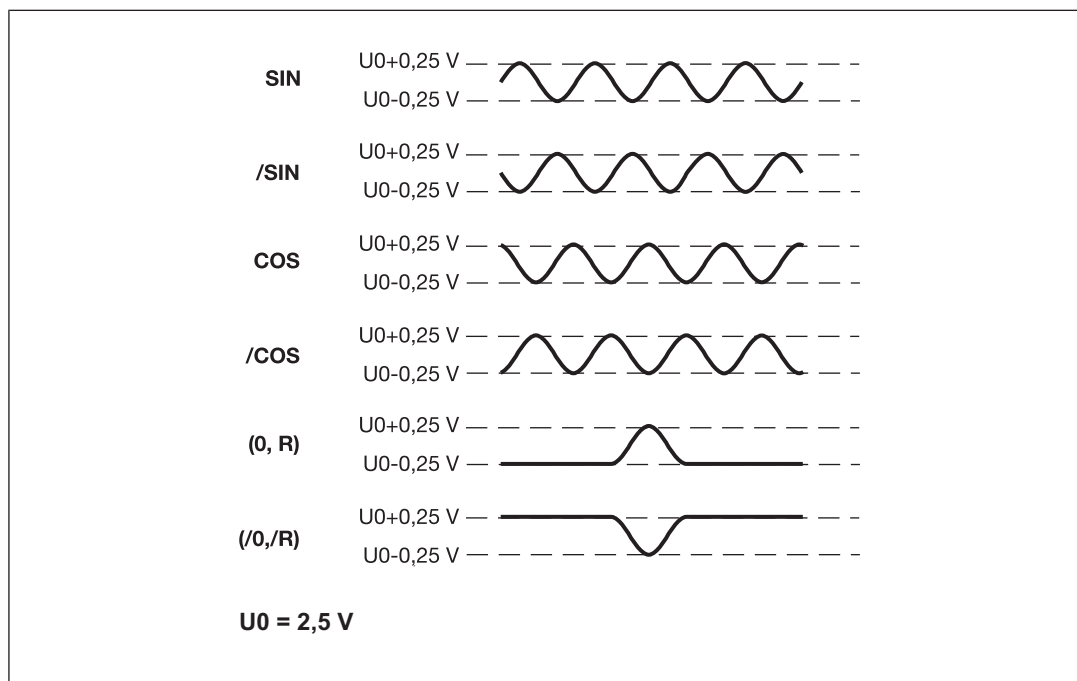
Output signals Sin/Cos (1 Vss)

Single ended with reference track (e.g. Hiperface®)



Motion monitoring modules PNOZ m EF 2MM

Differential with/without Z index (e.g. Heidenhain 1 Vss)



Adapters for encoders

The adapter records the data between the encoder and the drive and makes it available to the PNOZ m EF 2MM via the Mini-IO socket.

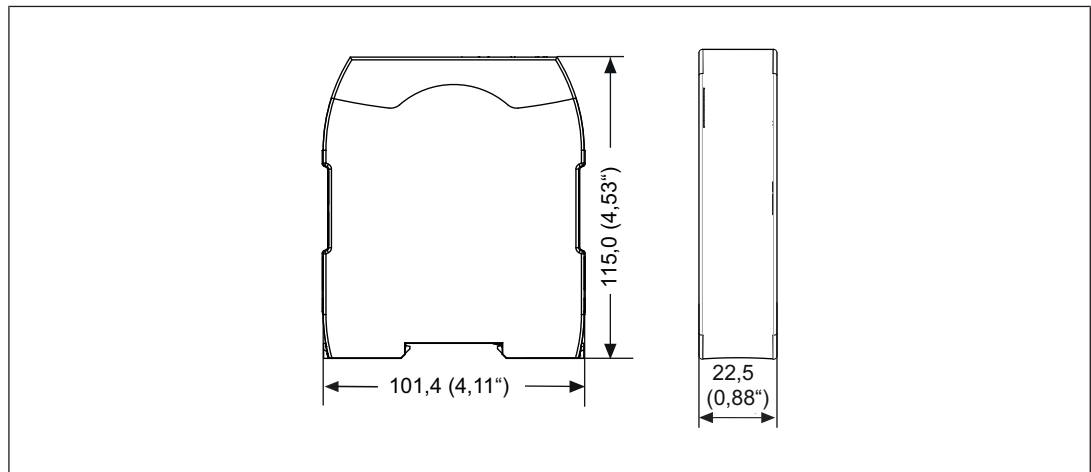
Pilz supplies complete adapters as well as ready-made cable with Mini-IO connector, which can be used when making your own adapter. The range of products in this area is constantly being expanded. Please contact us about the range of adapters that is currently available.

Motion monitoring modules

PNOZ m EF 2MM

Installation

Dimensions in mm



Commissioning

Wiring

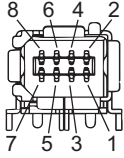
The wiring is defined in the circuit diagram of the PNOZmulti Configurator.

Please note:

- ▶ Information given in the [Technical details \[354\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The power supplies for the safety system and sensors must comply with the regulations for low voltages with safe isolation (SELV/PELV).
- ▶ The cable used to connect the encoders and proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ The shield may only be connected to earth at a single point.
- ▶ Earth loops should be avoided.
- ▶ If possible, the connections for the various earth potentials (GND, A2) should not be connected on the PNOZ m EF 2MM but should be connected directly to the GNDs on the connected units. otherwise noise susceptibility may be increased significantly (conductor loops are not permitted).

Motion monitoring modules PNOZ m EF 2MM

Pin assignment of Mini-IO socket

Mini-IO socket 8-pole	PIN	Track
	1	S
	2	GND
	3	Z
	4	A
	5	/A
	6	/Z
	7	B
	8	/B

Motion monitoring modules

PNOZ m EF 2MM

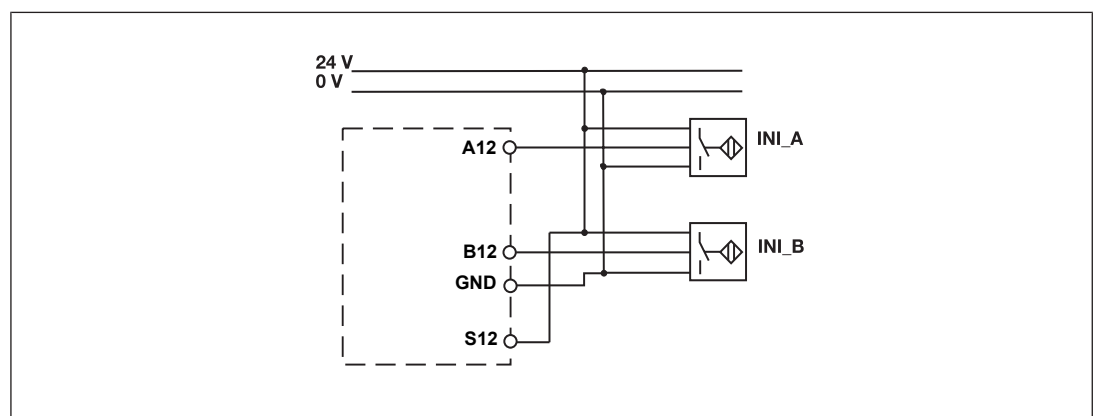
Connection of proximity switches

The following proximity switch combinations can be connected:

- ▶ A: pnp, B: pnp
- ▶ A: npn, B: npn
- ▶ A: pnp, B: npn
- ▶ A: npn, B: pnp

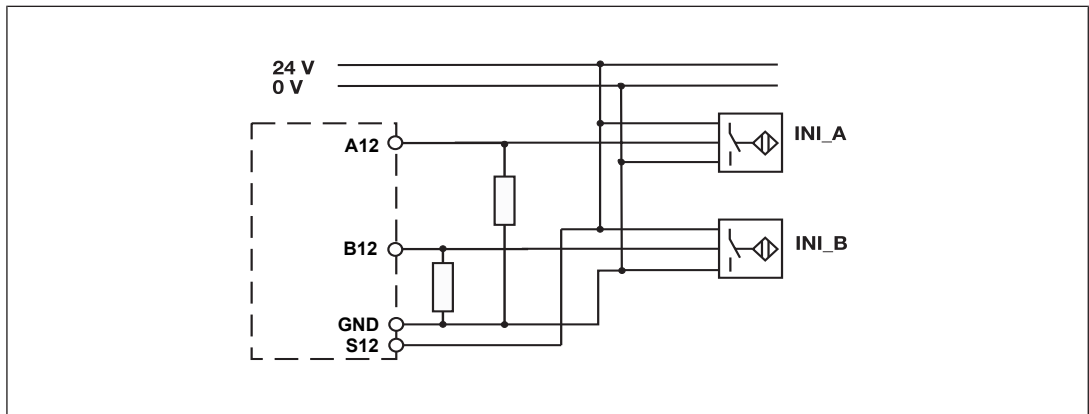
When connecting proximity switches please note:

- ▶ Proximity switches can be connected to
 - terminals A12, B12, GND for axis 1 and A22, B22, GND for axis 2
 - or
 - tracks A, B and GND of the Mini-IO socket (X12 for axis 1, X22 for axis 2).
- ▶ Track S (S12, S22) should be used to monitor the supply voltage (see drawing). A permitted voltage range can be entered in the menu.
- ▶ Connect the proximity switch to 24 VDC of the power supply.
- ▶ When connecting the proximity switches, please refer to the chapter entitled "EMC-compliant wiring".
- ▶ Invalid signals may occur with long cable lengths. In this case we recommend that you connect a resistor between the signal lines, as shown in the diagrams.
- ▶ Connection of the proximity switches may only be performed in three-wire technology and not in two-wire technology.
- ▶ Special features for proximity switches with reduced diagnostics:
 - A: pnp, B: pnp
 - It is permitted that both proximity switches are energised simultaneously.
 - The safety level is reduced.
 - The cables for connecting the proximity switches must be laid separately.
 - The supply voltage of the proximity switches must be monitored (e.g. via track S).

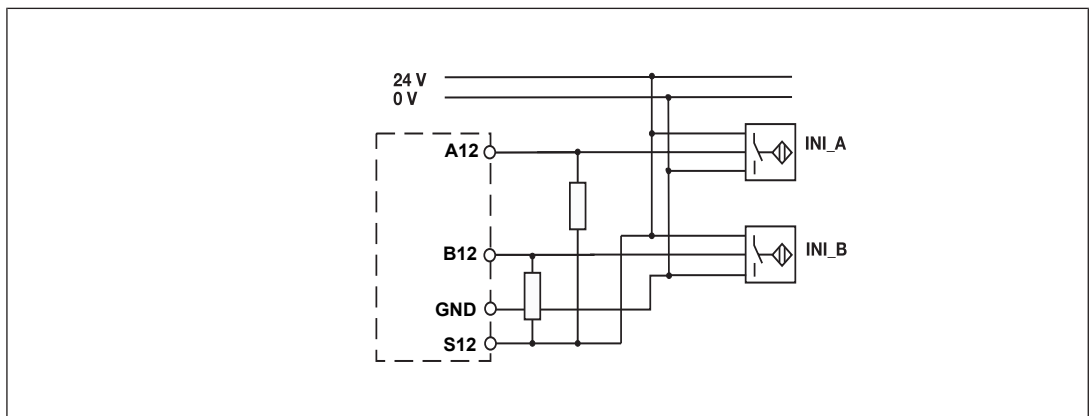


Motion monitoring modules PNOZ m EF 2MM

pnp proximity switch with resistor $R = 10\text{ k}\Omega$



npn proximity switch with resistor $R = 47\text{ k}\Omega$



Connection of an encoder

Proceed as follows when connecting the encoder:

- ▶ The encoder can be connected via an adapter (e.g. MM A Mini-IO-CAB99) or directly to the PNOZ m EF 2MM.
- ▶ Use only shielded cables for all connections. Please refer to the chapter entitled "EMC-compliant wiring".
- ▶ Always connect GND on the encoder to GND on the Mini-IO connector.
- ▶ If the encoder signals are not terminated with 120 Ohm in the frequency converter, the encoder signals must be terminated with $Z_0 = 120\text{ Ohm}$ between A and /A, B and /B, Z and /Z.
- ▶ Please refer to the information provided by the encoder manufacturer with regard to the recommended max. cable length when taking into consideration
 - Output frequency
 - Supply voltage
 - Operating temperature

Motion monitoring modules PNOZ m EF 2MM

- Existing interference

When calculating the maximum cable length, remember that the length of the adapter cable must also be taken into account.

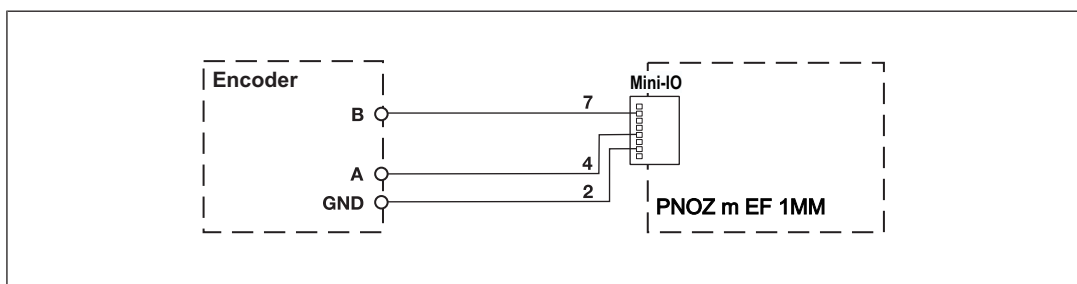
Connect encoder

Encoder types:

- ▶ TTL single ended
- ▶ HTL single ended

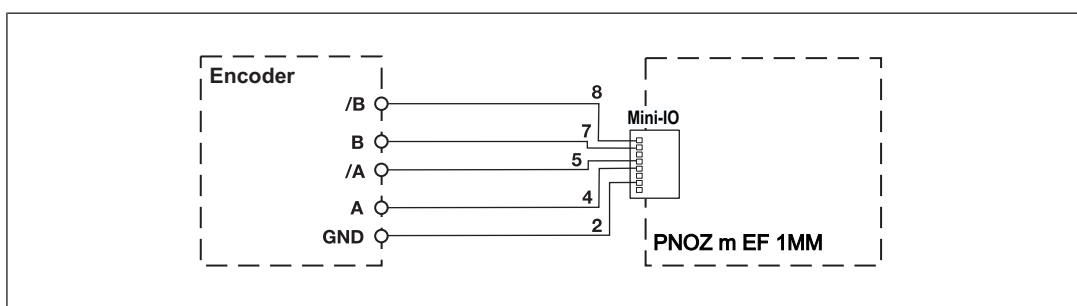
Please note:

- ▶ Tracks/A, /B, Z and /Z must remain free



Encoder types:

- ▶ TTL Differential
- ▶ HTL differential
- ▶ sin/cos 1 Vss
- ▶ Hiperface



Connect encoder with Z index

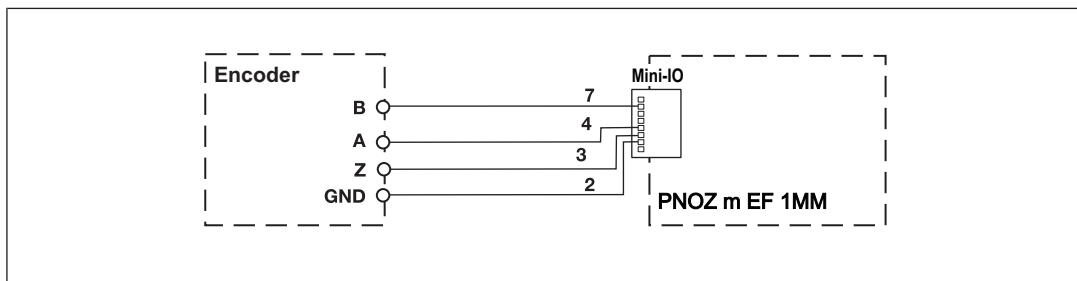
Encoder types:

- ▶ TTL single ended Z Index
- ▶ HTL single ended Z Index

Please note:

- ▶ Tracks /A, /B and /Z must remain free

Motion monitoring modules PNOZ m EF 2MM

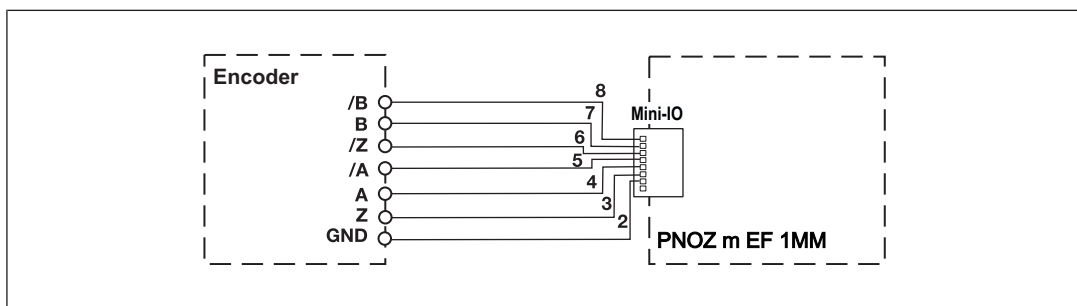


Encoder types:

- ▶ TTL differential + Z Index
- ▶ HTL differential + Z Index
- ▶ sin/cos 1 Vss Z Index

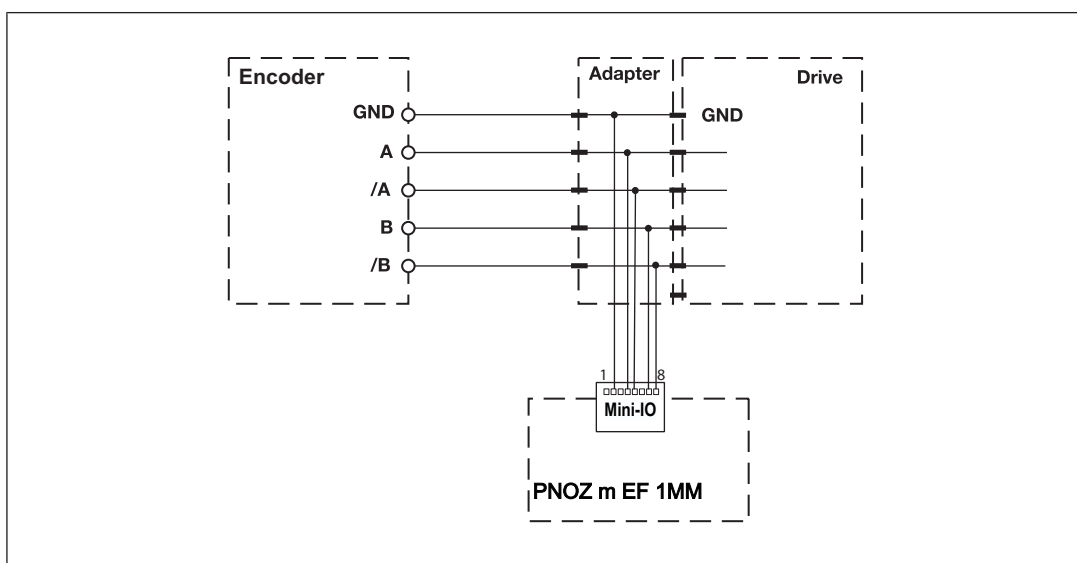
Please note:

- ▶ When using the encoder type sin/cos 1 Vss Z Index, the length of the encoder cable may be max. 30 m.



Connect encoder via an adapter

The adapter (see Accessories) is connected between the encoder and the drive. The output on the adapter is connected to the Mini-IO socket on the PNOZ m EF 2MM.



Motion monitoring modules PNOZ m EF 2MM

Connection of proximity switch and encoder

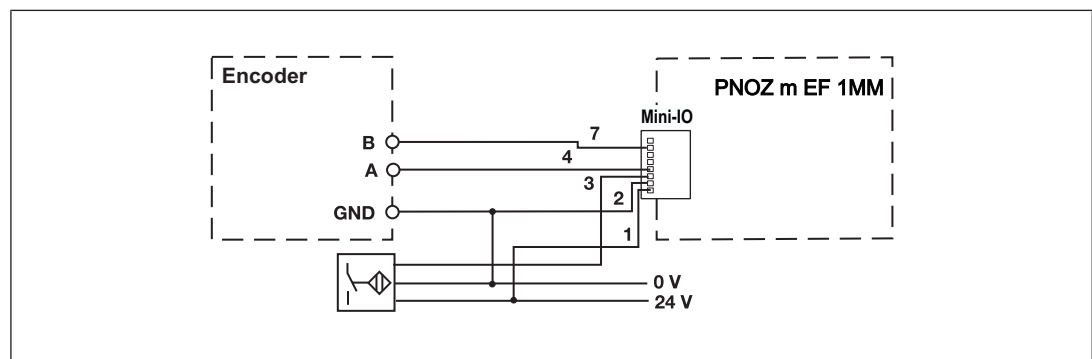
When connecting the encoders and proximity switches, please refer to the chapter entitled "EMC-compliant wiring".

Sensor types:

- ▶ Configuration: HTL single Z Freq. Ini pnp
 - HTL single ended (A,B) + Ini pnp (Z)
 - HTL single ended (A,B) + HTL differential (A as Z)
 - HTL single ended (A,B) + HTL single ended (A as Z)
- ▶ Configuration: TTL single Z Freq. Ini pnp
 - TTL single ended (A,B) + Ini pnp (Z)
 - TTL single ended (A,B) + HTL differential (A as Z)
 - TTL single ended (A,B) + HTL single ended (A as Z)

Please note:

Tracks /A, /B and /Z must remain free.



Sensor types:

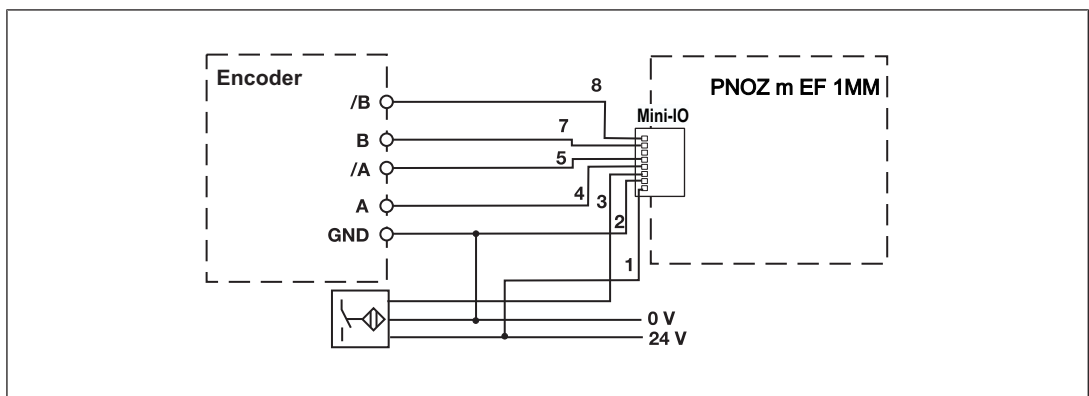
- ▶ Configuration: TTL differential Z Freq. Ini pnp
 - TTL differential (A,/A,B,/B) + Ini pnp (Z)
 - TTL differential (A,/A,B,/B) + HTL differential (A as Z)
 - TTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: HTL differential Z Freq. Ini pnp
 - HTL differential (A,/A,B,/B) + Ini pnp (Z)
 - HTL differential (A,/A,B,/B) + HTL differential (A as Z)
 - HTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: sin/cos 1 Vss Z Freq. Ini pnp
 - sin/cos 1 Vss (A,/A,B,/B) + Ini pnp (Z)
 - sin/cos 1 Vss (A,/A,B,/B) + HTL differential (A as Z)
 - sin/cos 1 Vss (A,/A,B,/B) + HTL single ended (A as Z)

Motion monitoring modules PNOZ m EF 2MM

- ▶ Configuration: Hiperface Z Freq. Ini pnp
 - Hiperface (A,/A,B,/B) + Ini pnp (Z)
 - Hiperface (A,/A,B,/B) + HTL differential (A as Z)
 - Hiperface (A,/A,B,/B) + HTL single ended (A as Z)

Please note:

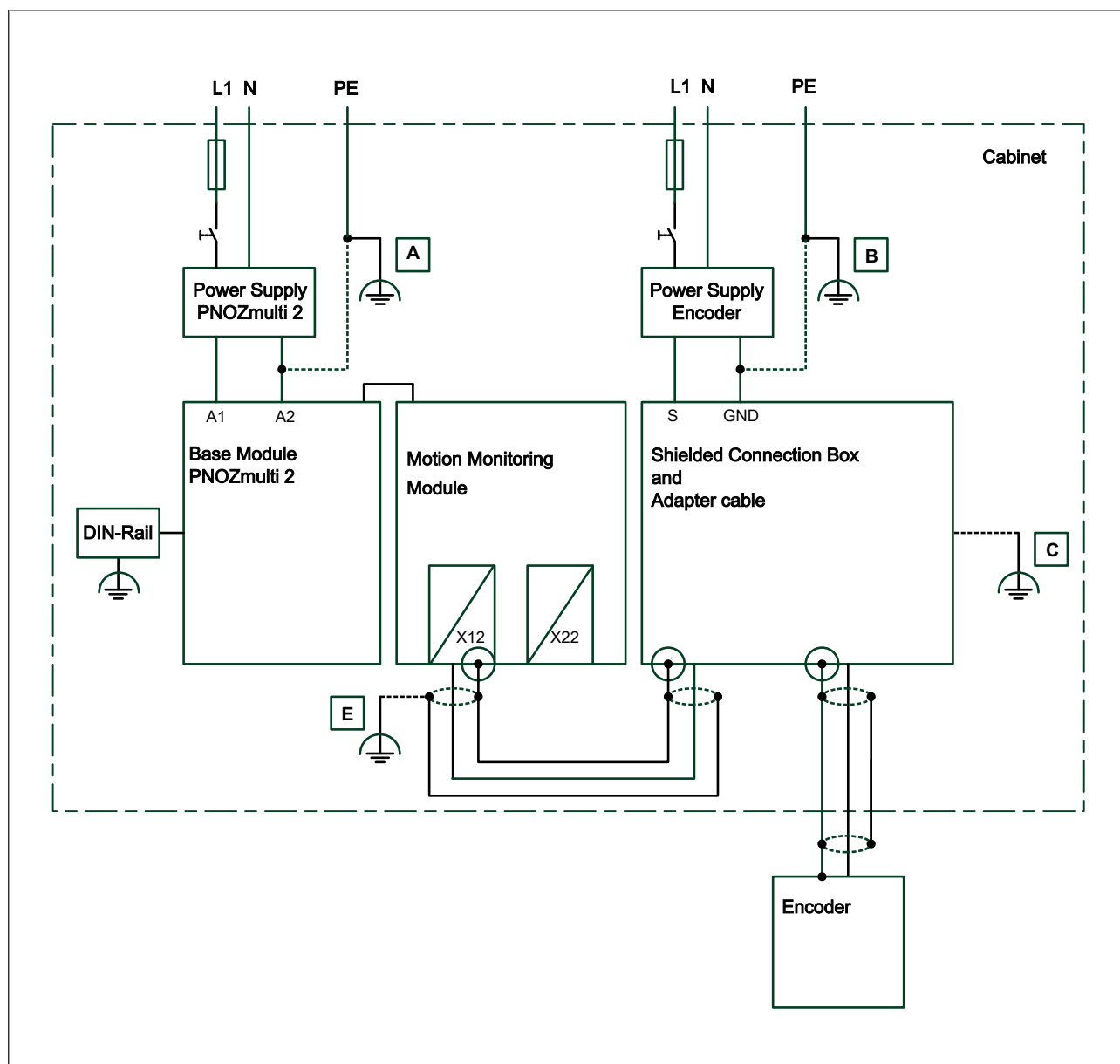
Track /Z must remain free!!



Motion monitoring modules PNOZ m EF 2MM

EMC-compliant wiring

EMC-compliant wiring for connecting an encoder



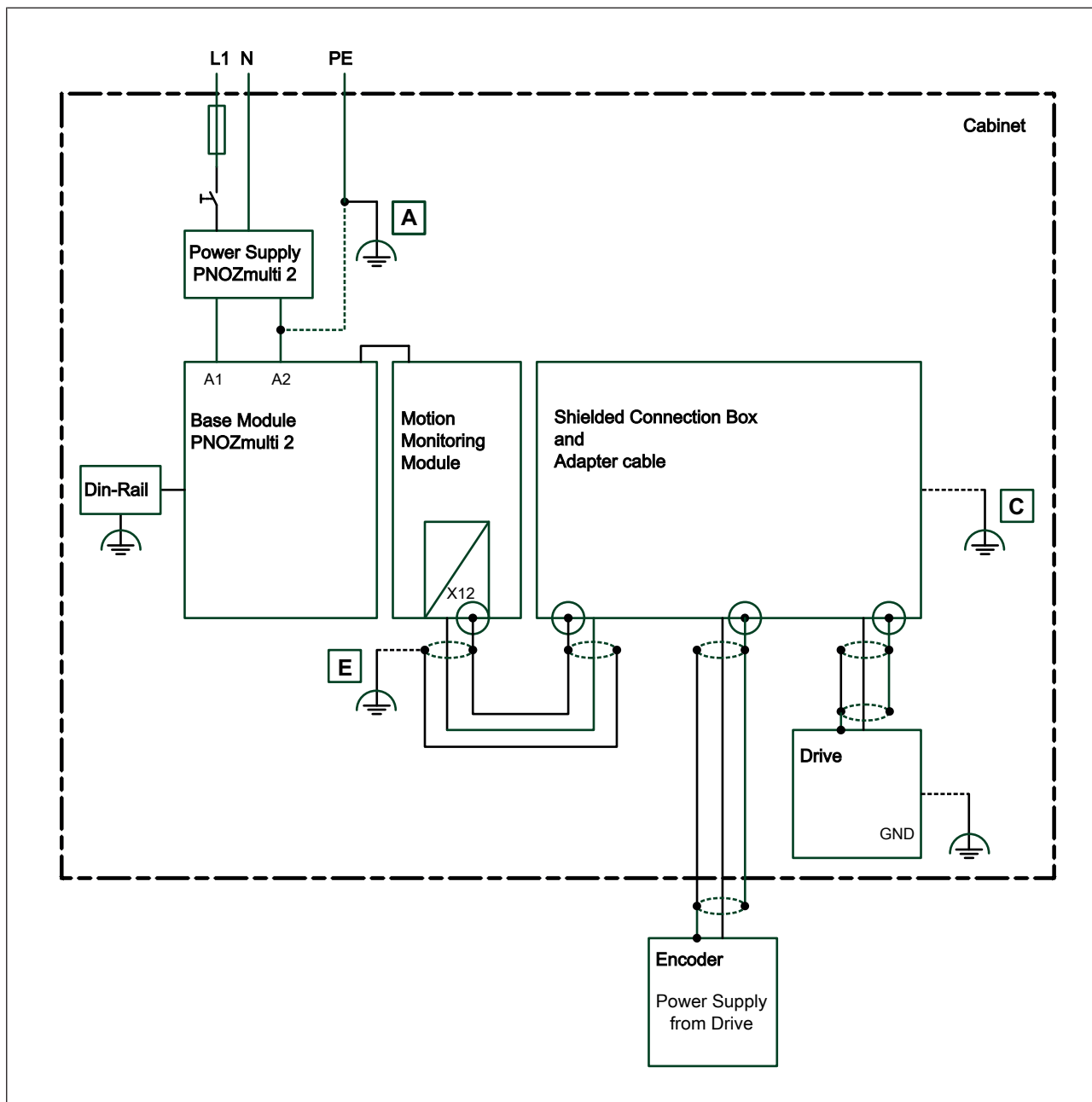
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 2MM

EMC-compliant wiring for connecting an encoder with drive



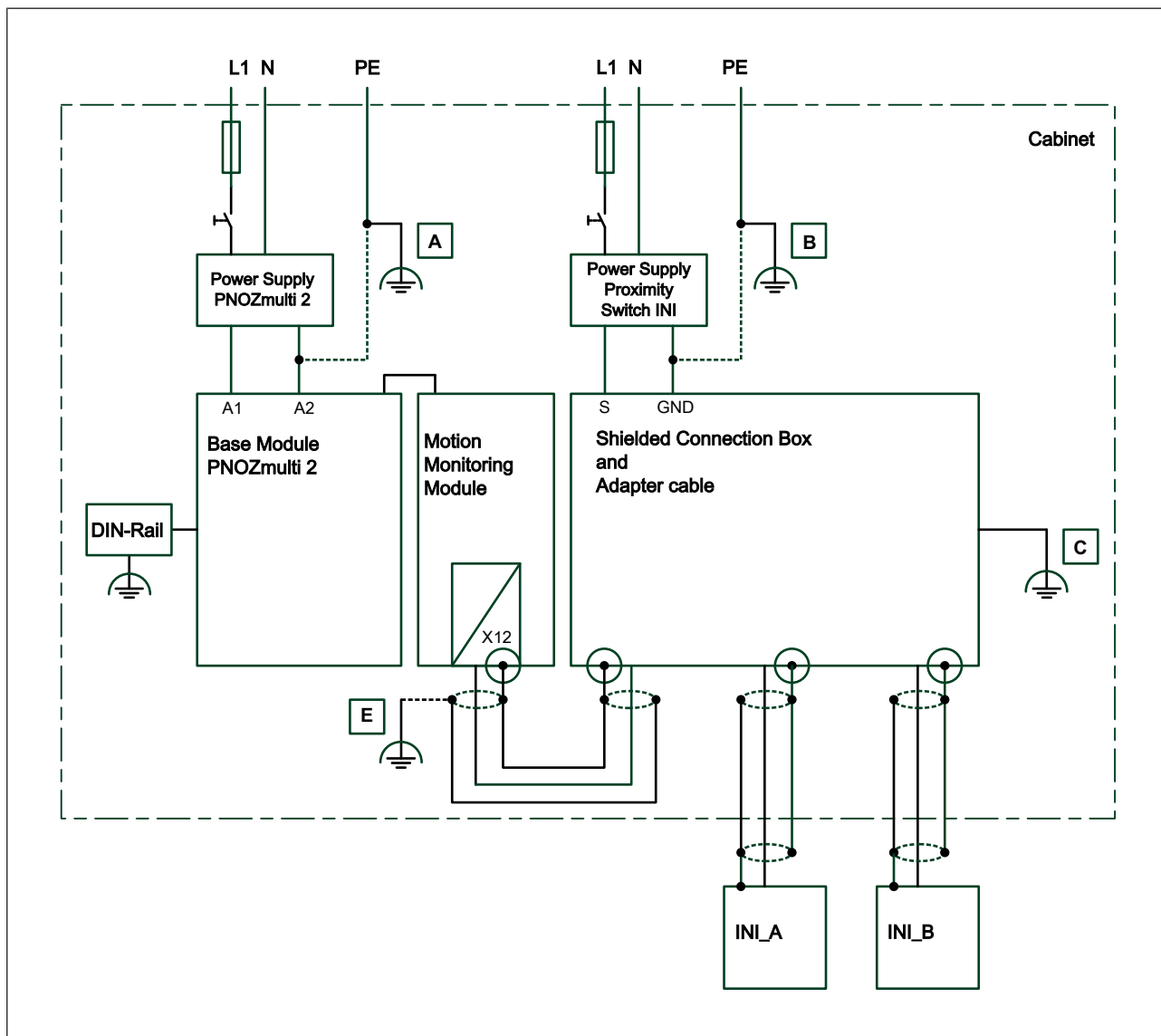
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 2MM

EMC-compliant wiring for connecting 2 proximity switches



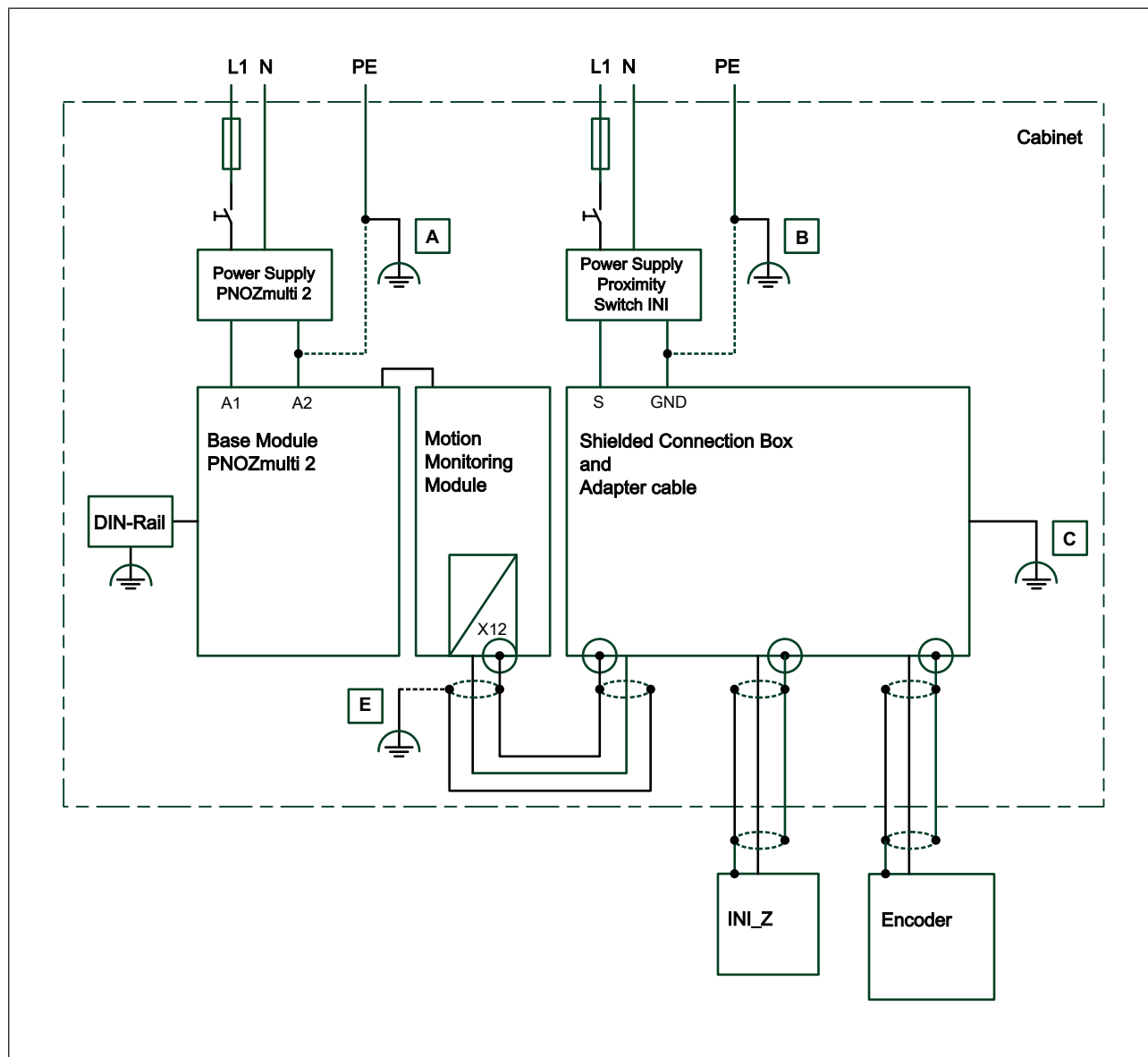
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 2MM

EMC-compliant wiring for connecting an encoder and a proximity switch



To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 2MM

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E4h
Electrical data	
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	150 mA
Power consumption	3,5 W
Max. power dissipation of module	3,9 W
Status indicator	LED
Proximity switch input	
Number of inputs	4
Input signal level	
Signal level at "1"	11 - 30 V
Signal level at g0 h	0,0 - 3,0 V
Input resistance	22 kOhm
Input's frequency range	0 - 5 kHz
Configurable monitoring frequency	
without hysteresis	0,1 Hz - 5 kHz
Incremental encoder input	
Number of inputs	2
Connection type	Mini-IO female connector, 8-pin
Input signal level	0,5 - 30 Vss
Phase position for the differential signals A, /A and B, /B	90° ±30°
Overload protection	-50 - 65 V
Input resistance	20 kOhm
Input's frequency range	0 - 500 kHz
Configurable monitoring frequency	
Without hysteresis	0,1 Hz - 500 kHz
Inputs	
Potential isolation	Yes
Times	
Reaction time after limit value is exceeded	1/f_ist + 16 ms

Motion monitoring modules PNOZ m EF 2MM

Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Sensor and system voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Potential isolation between	Sensor 1 and sensor 2
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Mechanical data	
Mounting position	horizontally on mounting rail

Motion monitoring modules PNOZ m EF 2MM

Mechanical data	
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	
	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	111 mm
Weight	120 g

Where standards are undated, the 2018-09 latest editions shall apply.

Motion monitoring modules PNOZ m EF 2MM

Safety characteristic data

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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
Monitoring 1 encoder	PL d	Cat. 2	SIL CL 2	1,80E-08	SIL 2	1,58E-03	20
Monitoring 2 encoders	PL e	Cat. 3	SIL CL 3	1,01E-09	SIL 3	8,41E-05	20
Monitoring safe encoder	PL e	Cat. 4	SIL CL 3	2,35E-09	SIL 3	2,04E-04	20
2-channel	PL e	Cat. 4	SIL 3	3,37E-10	SIL 3	2,88E-05	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_M 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.

Supplementary data

Categories

Safety level

The maximum achievable safety level depends, among other things, on the sensor, the wiring and the operating mode of the PNOZ m EF 2MM.

Information on the safety-related characteristic data for the subsystems *Sensor* and PNOZ m EF 2MM

Example:

Sensor subsystem			Subsystem PNOZ m EF 2MM	
Category	MTTFd	DC	Operating mode	PFH [1/h]
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

Motion monitoring modules PNOZ m EF 2MM

The values for **Category** and **DC** can be set for the sensor subsystem, bearing in mind the restrictions stated in the respective chapter. The MTTFd value must be stated by the sensor manufacturer.

The values for **DC** refer to the standard EN/IEC 61508.

Assuming that all faults are dangerous, MTTF = MTTFd can be set.

The characteristic value MTTF is a property of the sensor, which may only be stated by the manufacturer.

Forced dynamisation:

When monitoring sensors with square output signals (TTL, HTL) or safe sensors, the axis must be moved within 8 hours so that the signal changes on all the connected tracks.

Key:

SRP/CS = Safety-related part of a control system (EN 13849-1, Tab. 2)

Safety functions

The following safe monitoring functions are available:

- ▶ Safe speed monitoring (SSM)
- ▶ Safe speed range monitoring (SSR-M)
- ▶ Safe direction monitoring (SDI-M)
- ▶ Safe operating stop monitoring (SOS-M)
- ▶ Safe stop 1 monitoring (SS1-M)
- ▶ Safe stop 2 monitoring (SS2-M)
- ▶ Safely limited acceleration monitoring (SLA-M)
- ▶ Safely limited acceleration range monitoring (SAR-M)

The safety functions of the PNOZ m EF 2MM are monitoring functions, whereby a safe output signal is used to show if defined limit values are exceeded.

The reaction function that takes place (e.g. shutting down the drive, activating a mechanical brake) when exceeded limit values are detected during the normal operation of the safety function must be defined and implemented by the machine/plant developer and does not form part of the PNOZ m EF 2MM.

The monitoring function of the PNOZ m EF 2MM can be used to implement safety functions defined in the standard EN 61800-5-2 for Adjustable speed electrical power drive systems.

Safety functions in accordance with EN 61800-5-2	Implemented with monitoring function of the PNOZ m EF 2MM
Safe Operating Stop (SOS)	Safe operating stop monitoring (SOS-M)
Safe Speed Range (SSR)	Safe speed range monitoring (SSR-M)
Safe Direction (SDI)	Safe direction monitoring (SDI-M)

Motion monitoring modules PNOZ m EF 2MM

Safety functions in accordance with EN 61800-5-2	Implemented with monitoring function of the PNOZ m EF 2MM
Safe Speed Monitoring (SSM)	Safe speed monitoring (SSM)
Safe Stop 1 (SS1)	Safe stop 1 monitoring (SS1-M)
Safe Stop 2 (Safe stop 2, SS2)	Safe stop 2 monitoring (SS2-M)
Safely Limited Acceleration (Safely Limited Acceleration, SLA)	Safely limited acceleration monitoring (SLA-M)
Safely Acceleration Range Monitoring (Safely Acceleration Range Monitoring, SAR)	Safely limited acceleration range monitoring (SAR-M)

Safety-related characteristic data for operation with non-safety-related encoder without additional requirements

Permitted sensor types and output signals

Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1V_{ss}, reference voltage
- ▶ Sin/Cos output signals 1V_{ss}, differential

Safety-related architecture

To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem PNOZ m EF 2MM:

Sensor			Subsystem PNOZ m EF 2MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
1*	Manufacturer-specific	0 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 2MM

*In accordance with EN ISO 13849-1, Category 1 is only met if the sensor is a "well-tried component".

Achievable safety level

Monitoring function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL c (Cat.1)	-
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		

Safety-related characteristic data for operation with non-safety-related encoder with mechanical fault exclusion

In accordance with EN 61800-5-2: 2007, Table D.16 (Motion and position feedback sensors), fault exclusions are permitted for faults in the mechanical connection between the sensor and motor.

Permitted sensor types and output signals

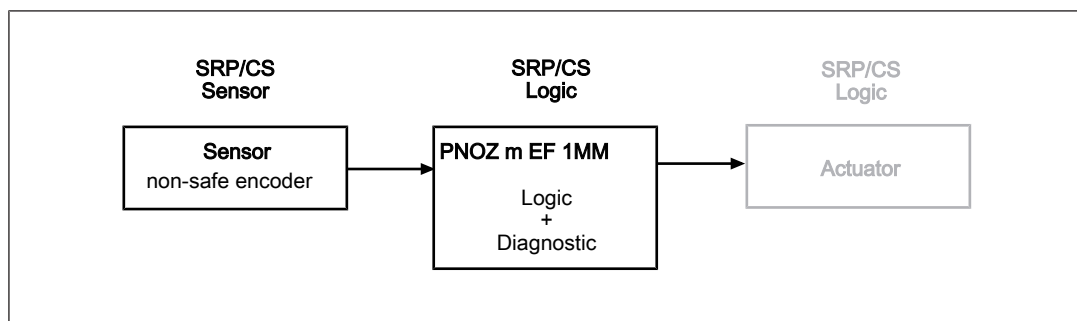
Permitted encoder types:

- ▶ Rotary non-safety-related encoders

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 2MM":

Motion monitoring modules PNOZ m EF 2MM

Sensor			Subsystem PNOZ m EF 2MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL d (Cat.2)	2
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with non-safety-related encoder with diagnostics via the drive controller

The detection of sensor errors (diagnostics for the sensor subsystem via the evaluation device) can be supplemented with a drive controller.

Permitted sensor types and output signals

Permitted sensor types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

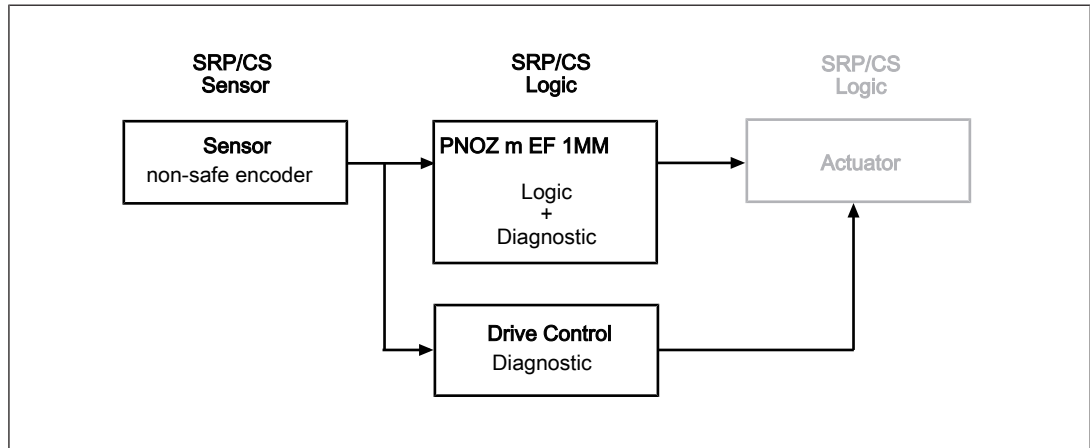
- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Motion monitoring modules PNOZ m EF 2MM

Requirements of the drive controller

- ▶ Parameters for the control loops and motor control must be set in such a way as to guarantee stable operation.
Drag error detection (see below) must be capable of operating in accordance with the requirements of the safety function.
- ▶ The motor must be operated with a current impressing control procedure, based on the rotor position (field-oriented control). If the analogue track signals are idle, field-oriented control will brake and/or stop the rotor.
- ▶ The drive controller must be in position control operating mode.
- ▶ If a maximum error variable is exceeded (set/true comparison) the drive controller must switch to a fault condition and stop the drive (drag error detection). The error reaction to drag error detection should be a controlled motor stop.
- ▶ Fault detection via the error variable with subsequent shutdown must meet the requirements of the safety function, with regard to reaction times for example.
- ▶ The drive controller must evaluate the same incremental/SinCos signals from the encoder for control as are processed by the safe evaluation device (important on encoders with combined analogue/digital interface).

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 2MM":

Sensor			Subsystem PNOZ m EF 2MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 2MM

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL d (Cat.2)	2
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with a safe encoder

Safe encoders are certified in accordance with EN/IEC 61508, EN 13849 and EN/IEC 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ m EF 2MM) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

Permitted sensor types and output signals

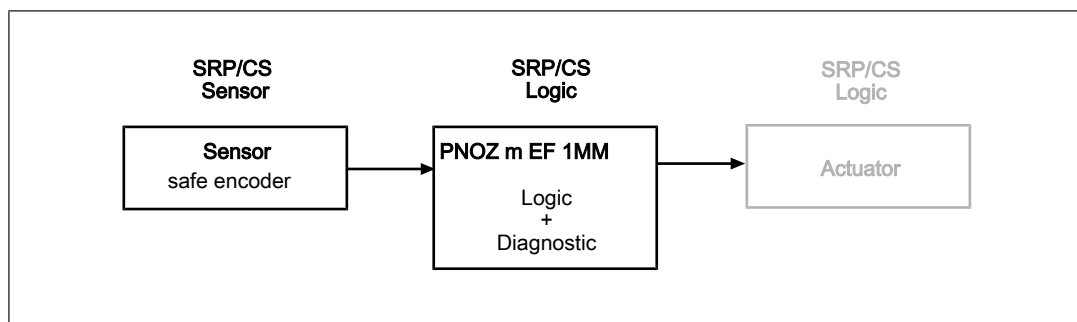
Permitted encoder types:

- ▶ Rotary safety-related encoders
- ▶ Linear safety-related encoders

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 2MM":

Motion monitoring modules PNOZ m EF 2MM

Sensor			Subsystem PNOZ m EF 2MM	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring Safe sensor	2,69E-09

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL e (Cat.4)	3
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with a safe encoder with Z index

Safe encoders are certified in accordance with EN/IEC 61508, EN 13849 and EN/IEC 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ m EF 2MM) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

Permitted sensor types and output signals

Permitted encoder types:

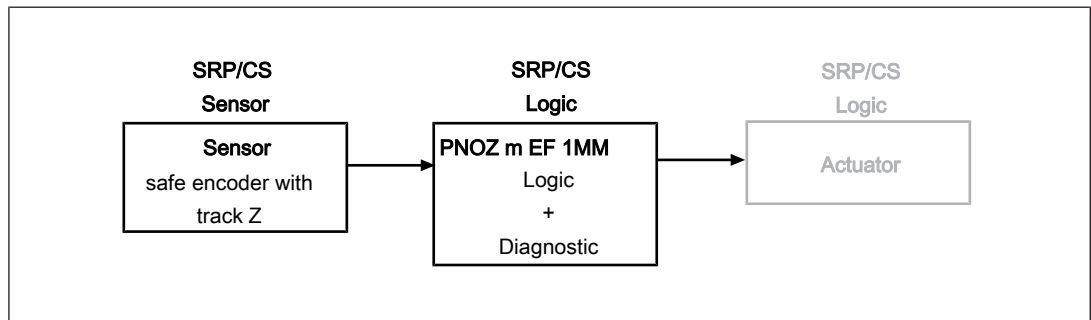
- ▶ Rotary safety-related encoders
- ▶ Linear safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, differential with Z index
- ▶ Square output signals HTL, differential with Z index
- ▶ Sin/Cos output signals 1Vss, reference voltage with Z index
- ▶ Sin/Cos output signals 1Vss, differential with Z index

Motion monitoring modules PNOZ m EF 2MM

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 2MM":

Sensor			Subsystem PNOZ m EF 2MM	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring 2 sensors	1,35E-09

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL e (Cat.4)	3
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with non-safety-related encoder and proximity switch

The speed monitoring of the non-safety-related encoder can be verified via an additional reference sensor.

Permitted sensor types and output signals

Non-safety-related encoder

Permitted encoder types:

- ▶ Rotary non-safety-related encoders

Motion monitoring modules PNOZ m EF 2MM

- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Reference sensor

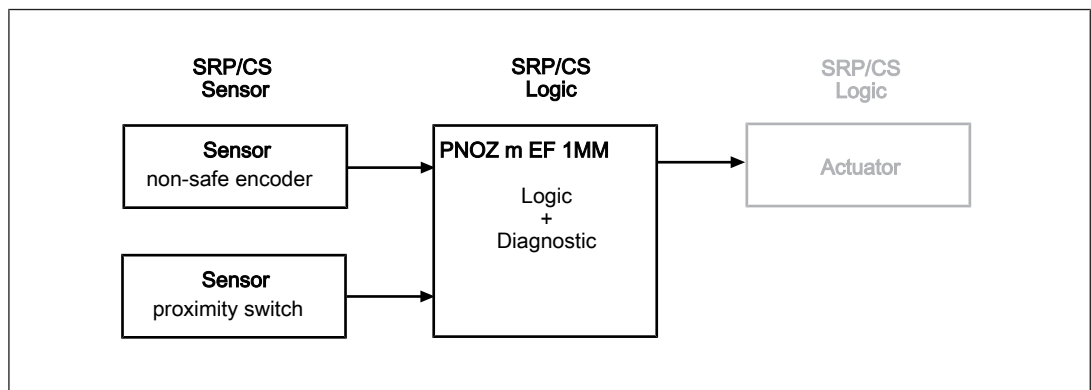
Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders
- ▶ Inductive proximity switches

Permitted output signals:

- ▶ Square output signals HTL, single ended
- ▶ Square output signal 24 V, pnp

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem PNOZ m EF 2MM:

Sensor			Subsystem PNOZ m EF 2MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 sensors	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 2MM

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M SDI-M SS2-M	PL c (Cat.1)	-
SSR-M SSM SS1-M SLA-M SAR-M	PL e (Cat.4)	3

Please note:

For the "sensor" subsystem, a minimum speed must be exceeded within forced dynamisation.

The minimum speed depends on the ratio of the frequency at tracks AB " f_{AB} " to the frequency at track Z " f_Z " in your configuration (see PNOZmulti Configurator **Element Motion Monitor**, value **Calculated Ratio AB/Z**) and is determined as follows:

- ▶ when **f_{AB}/f_Z Ratio** ≥ 1.0
 $f_Z = 10$ mHz or $f_{AB} = (f_{AB}/f_Z) \times 10$ mHz
- ▶ when **f_{AB}/f_Z Ratio** < 1.0
 $f_{AB} = 10$ mHz or $f_Z = 10$ mHz / (f_{AB}/f_Z)

At the very latest, a feasibility error will be detected when a tolerance expires. The tolerance level depends on the ratio of the frequency at tracks AB " f_{AB} " to the frequency at track Z " f_Z " in your configuration (**f_{AB}/f_Z Ratio** setting in the menu) and is calculated as follows:

- ▶ when **f_{AB}/f_Z Ratio** ≥ 1.0
7.5 Z-pulses or $7.5 \times (f_{AB}/f_Z)$ AB-pulses
- ▶ when **f_{AB}/f_Z Ratio** < 1.0
4.5 AB-pulses or $4.5 / (f_{AB}/f_Z)$ Z-pulses

Motion monitoring modules PNOZ m EF 2MM

Safety-related characteristic data for operation with 2 proximity switches

Permitted sensor types and output signals

Non-safety-related sensor

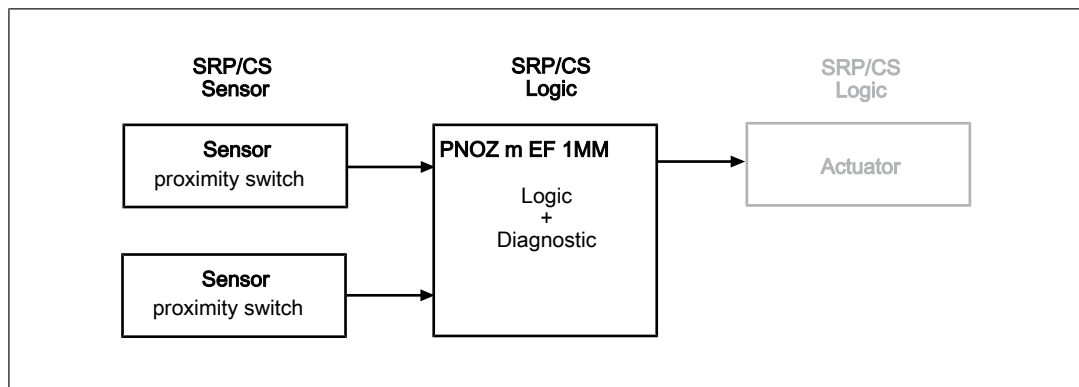
Permitted sensor types:

- ▶ Inductive proximity switches

Permitted output circuits:

- ▶ pnp
- ▶ npn

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 2MM":

Sensor			Subsystem PNOZ m EF 2MM	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 sensors	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 2MM

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M SDI-M SS2-M	-	-
SSR-M SSM SS1-M SLA-M SAR-M	PL e (Cat.4)	3

Please note:

Common cause failures (CCF) are possible for the sensor subsystem. An appropriate analysis must be carried out.

To use proximity switches 1 and 2 we recommend that you:

- ▶ Use different technologies/design or physical principles (e.g. different manufacturers) and
- ▶ Evaluate the sensor supply via track S

Safety characteristic data for operation with 2 proximity switches with reduced diagnostics

Permitted sensor types and output signals

Non-safety-related sensor

Permitted sensor types:

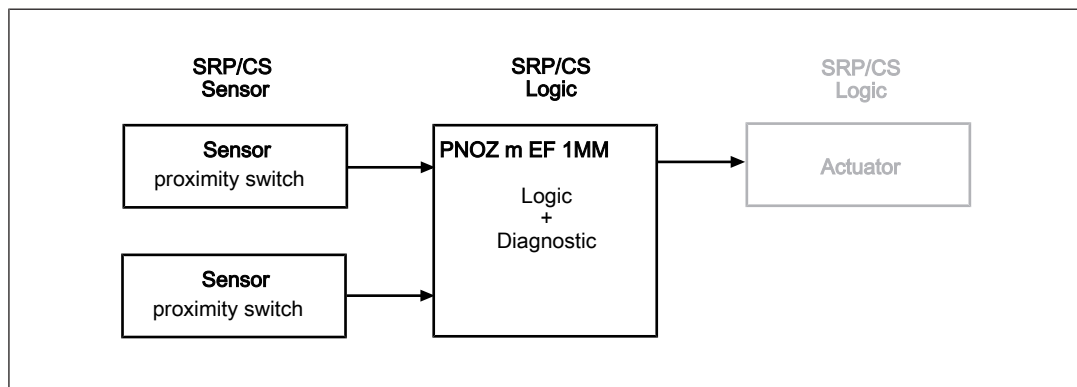
- ▶ Inductive proximity switches

Permitted output circuits:

- ▶ pnp

Motion monitoring modules PNOZ m EF 2MM

Safety-related architecture



The supply voltage of the proximity switches must be monitored as a measure against systemic failure.

To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 2MM":

Sensor			Subsystem PNOZ m EF 2MM	
Category	MTTFd	DC ₁₃₈₄₉	Operating mode	PFH (1/h)
3	Manufacturer-specific	90 %*	Monitoring 2 sensors with reduced diagnostics	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The value for DC refers to the standard EN13849

*see EN 13849-1 table E.1

"Cross monitoring of input signals with dynamic test if short circuits are not detectable (for multiple I/O)" → 90%

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	-	-
SDI-M		
SS2-M		
SSR-M	PL d (Cat.3)	2
SSM		
SS1-M		
SLA-M		
SAR-M		

Motion monitoring modules PNOZ m EF 2MM

Please note:

Common cause failures (CCF) are possible for the sensor subsystem. An appropriate analysis must be carried out.

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 2MM	Configurable safe small controllers PNOZmulti 2, expansion module, safe monitoring of 2 axes.	772171

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ 2MM 1 set	Spring-loaded terminals, PNOZmulti 2 Motion Monitoring module 2MM, 1 set.	783544
Screw terminals PNOZ 2MM 1 set	Plug-in screw terminal, PNOZmulti 2 Motion Monitoring 2MM, 1 set.	793544

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Connection box

Product type	Features	Order no.
PNOZ msi b4 Box	Shielded connection box PSEN msi b4, for connecting an incremental encoder to a proximity switch, with/without pull resistor, with additional supply for the proximity switch.	773845

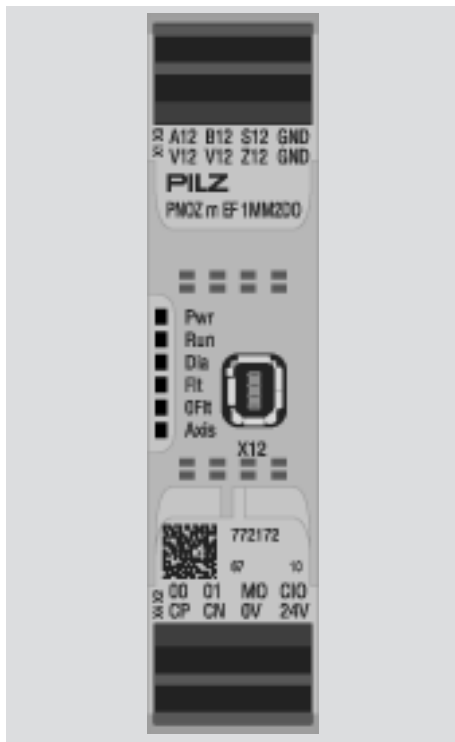
Motion monitoring modules PNOZ m EF 2MM

Adapter

Product type	Features	Order no.
MM A MINI-IO CAB99 1.5m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 1.5 m.	772200
MM A MINI-IO CAB99 2.5m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 2.5 m.	772201
MM A MINI-IO CAB99 5.0m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 5 m.	772202

Motion monitoring modules

PNOZ m EF 1MM2DO



Overview

Unit features

Application of the product PNOZ m EF 1MM2DO:


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

The product has the following features:

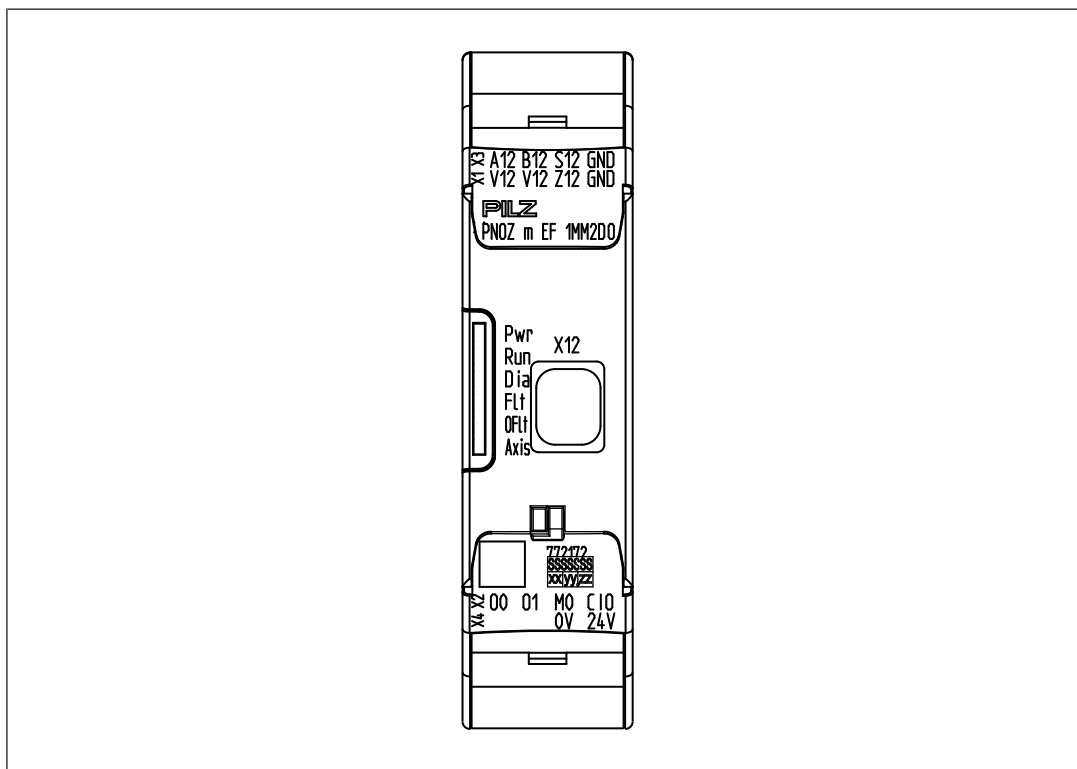
- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Monitoring of 1 axis
- ▶ Measured value recorded by proximity switch and encoder
- ▶ Monitoring functions
 - Safe speed monitoring (SSM)
 - Safe speed range monitoring (SSR-M)
 - Safe direction of movement monitoring (SDI-M)
 - Safe operating stop monitoring (SOS-M)
 - Safe stop 1 monitoring (SS1-M)
 - Safe stop 2 monitoring (SS2-M)
 - Safely limited acceleration monitoring (SLA-M)
 - Safely limited acceleration range monitoring (SAR-M)

Motion monitoring modules

PNOZ m EF 1MM2DO

- Analogue voltage (track S)
- ▶ 2 safe semiconductor outputs
 - depending on the application, up to PL e of EN ISO 13849-1 and up to SIL 3 of EN IEC 62061
 - Switch-off delay in stop (event of an error) configurable
- ▶ 1 cascading input/output
- ▶ 1 semiconductor output for standard functions
- ▶ LED display for:
 - Supply voltage
 - Diagnostics
 - Axis status
 - Error
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.
- ▶ Plug-in connection terminals:
 - Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [ 272]).

Front view



Motion monitoring modules PNOZ m EF 1MM2DO

Legend

X1:	Connection for proximity switch on axis 1 (V12, V12, Z12, GND)
X2:	Safe semiconductor outputs O0, O1 semiconductor output for standard functions M0 cascading input/output CIO
X3:	Connection for proximity switch on axis 1 (A12, B12, S12, GND)
X4:	Supply connections 0 V, 24 V
X12:	Mini IO socket for connecting encoder or proximity switch
LEDs:	Pwr (Power) Run Dia (Diagnosis) Flt (Fault) OFlt (Output-Fault) Axis

Function description

Operation

The motion monitoring module PNOZ m EF 1MM2DO can safely monitor one axis. The recorded speed and position values can be evaluated in the user program using various monitoring functions.

The module has 2 safe semiconductor outputs for fast shutdown or for delayed shutdown (in case of an error) of transmissions.

With the standard cascading input/output a cross-system not safety-related fast shutdown cannot be implemented.

The configuration of the motion monitoring module is described in detail in the PNOZmulti Configurator's online help.

The relay meets the following safety requirements:

- ▶ The circuit is redundant with built-in self-monitoring.
- ▶ The safety device remains effective in the case of a component failure.
- ▶ The safety outputs are tested periodically using an off-test.

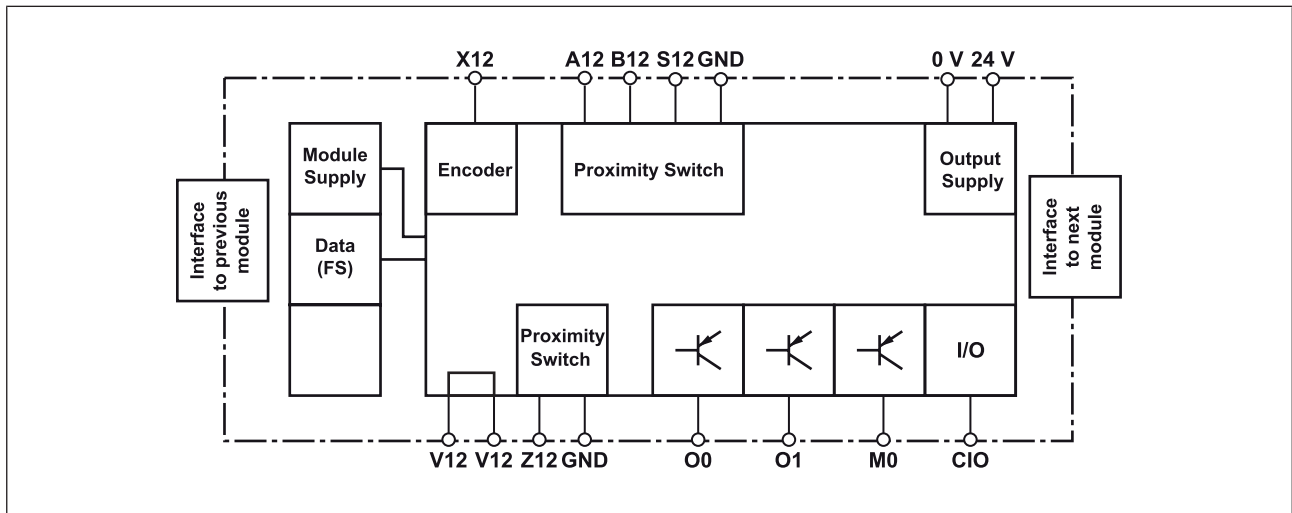
The module supplies diagnostic data, such as:

- ▶ Start-up error
- ▶ Configuration error
- ▶ FS communication error
- ▶ Temperature error: too hot
- ▶ Output error
- ▶ Supply voltage error

Motion monitoring modules

PNOZ m EF 1MM2DO

Block diagram



Monitoring functions

The motion monitoring module PNOZ m EF 1MM2DO supports the following monitoring functions.

Please note that the position monitoring functions SOS-M, SDI-M and SS2-M cannot be used in conjunction with 2 proximity switches, as no position can be detected.

Safe speed monitoring

The **Safe speed monitoring** function (SSM) monitors the current speed to see if a limit value is exceeded.

If the configured limit value is exceeded, the output switches off. As soon as the value falls below the limit value (plus hysteresis), the output switches off again.

If a manual reset is configured, the output will not switch back on until the value is inside the limit value (plus hysteresis) and the reset input is activated.

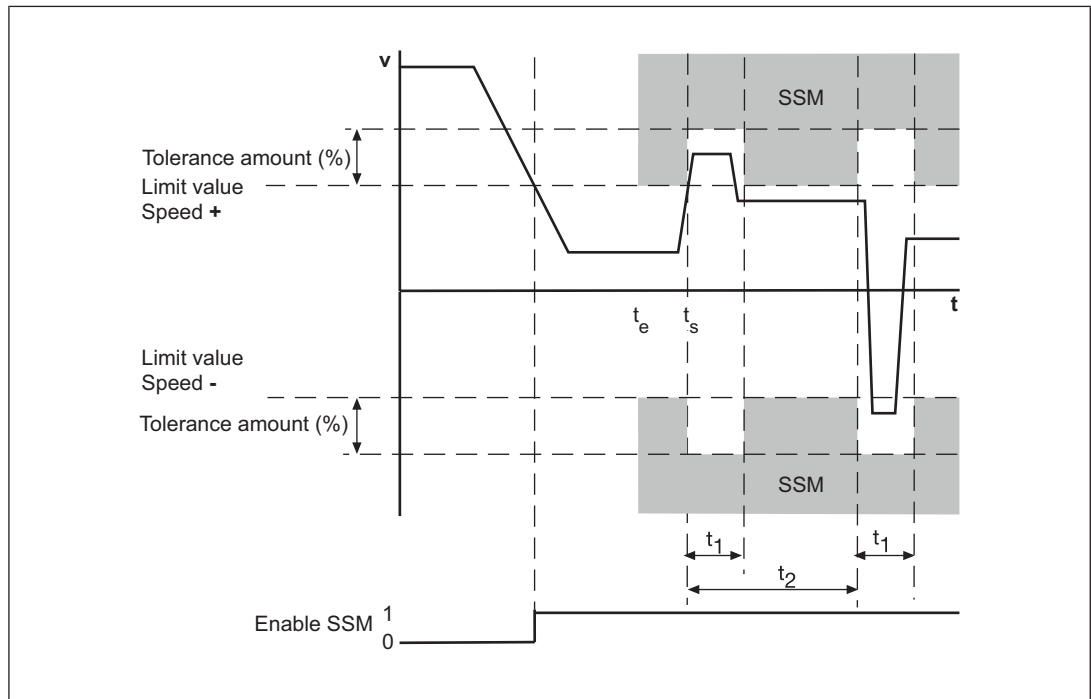
12 limit values can be configured per axis in the PNOZmulti Configurator.

A tolerance range may also be set for the limit values used to monitor the speed. This tolerance range modifies the set limit values. As a result, one-off or periodic overshoots that exceed the limit values can be tolerated.

The following values can be configured for the tolerance range:

- ▶ Tolerance time (t1), which takes into account the length of the overshoots (maximum time for which the limit value may be exceeded). It must not be possible that the sum of all the overshoots exceeds the tolerance time (t1) within a tolerance period (t2).
- ▶ Tolerance period (t2), which takes into account the oscillation period (minimum time that must elapse between one limit value overshoot and the next)
- ▶ Tolerance amount (%), which takes into account the amplitude of the overshoots (maximum permitted percentage by which the configured limit values may be exceeded)

Motion monitoring modules PNOZ m EF 1MM2DO



Legend:

- ▶ Enable SSM:
 - "1": Monitored limit value not exceeded
 - "0": Monitored limit value exceeded
- ▶ t_s : Speed v exceeds the limit value and activates the tolerance range (tolerance time, tolerance period, tolerance amount)
- ▶ t_1 : Tolerance time
- ▶ t_2 : Tolerance period
- ▶ Tolerance amount (%): Tolerance amount of limit value in both directions

Safe speed range monitoring

The **Safe speed range monitoring** function (SSR-M) monitors the current speed to ensure it stays within a maximum and minimum permitted limit value.

If the speed is outside the configured range, the output switches off. As soon as the speed returns to within the configured range (plus hysteresis), the output switches back on.

If a manual reset is configured, the output will not switch back on until the value is inside the limit value (plus hysteresis) and the reset input is activated.

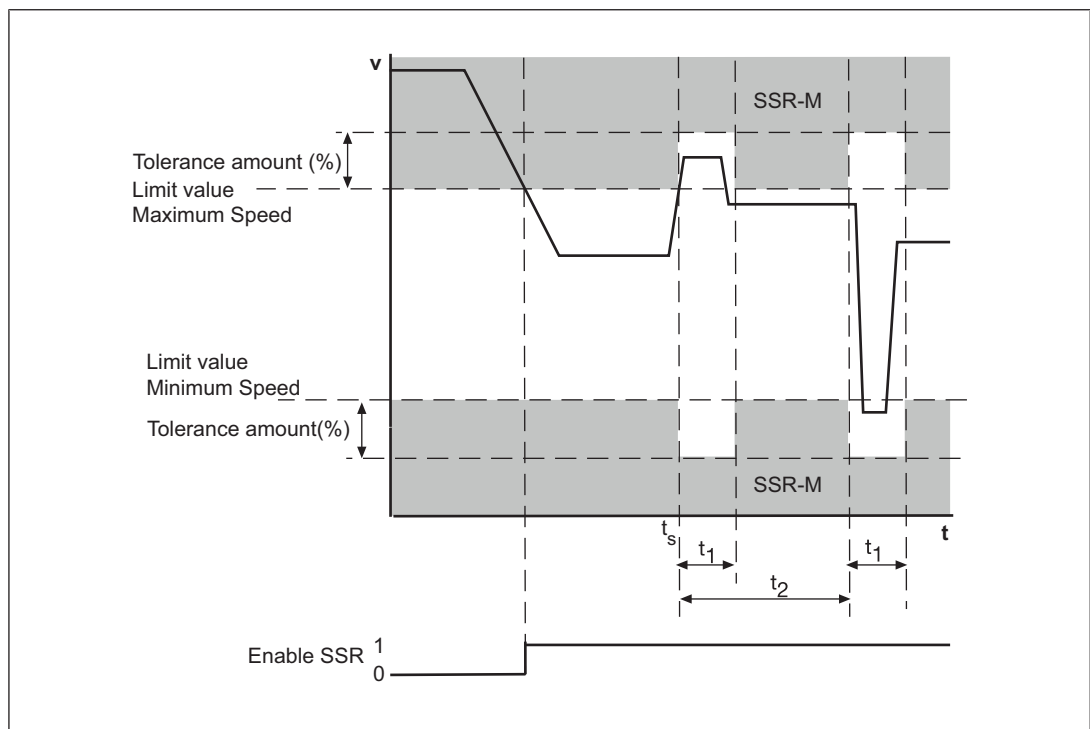
2 ranges can be configured per axis in the PNOZmulti Configurator.

A tolerance range may also be set for the limit values used to monitor the speed range. This tolerance range modifies the set limit values. As a result, one-off or periodic overshoots that exceed the range limits can be tolerated.

The following values can be configured for the tolerance range:

Motion monitoring modules PNOZ m EF 1MM2DO

- ▶ Tolerance time (t_1), which takes into account the length of the overshoots (maximum time for which the limit value may be exceeded). It must not be possible that the sum of all the overshoots exceeds the tolerance time (t_1) within a tolerance period (t_2).
- ▶ Tolerance period (t_2), which takes into account the oscillation period (minimum time that must elapse between one limit value overshoot and the next)
- ▶ Tolerance amount as a %, which takes into account the amplitude of the overshoots (maximum permitted percentage by which the limit value may be exceeded)



Legend:

- ▶ Enable SSR:
 - "1": Speed is within the configured range
 - "0": Speed is outside the configured range
- ▶ t_s : Speed v exceeds the limit value and activates the tolerance range (tolerance time, tolerance period, tolerance amount)
- ▶ t_1 : Tolerance time
- ▶ t_2 : Tolerance period
- ▶ Tolerance amount (%): Tolerance amount of the two limit values, maximum and minimum speed

Motion monitoring modules

PNOZ m EF 1MM2DO

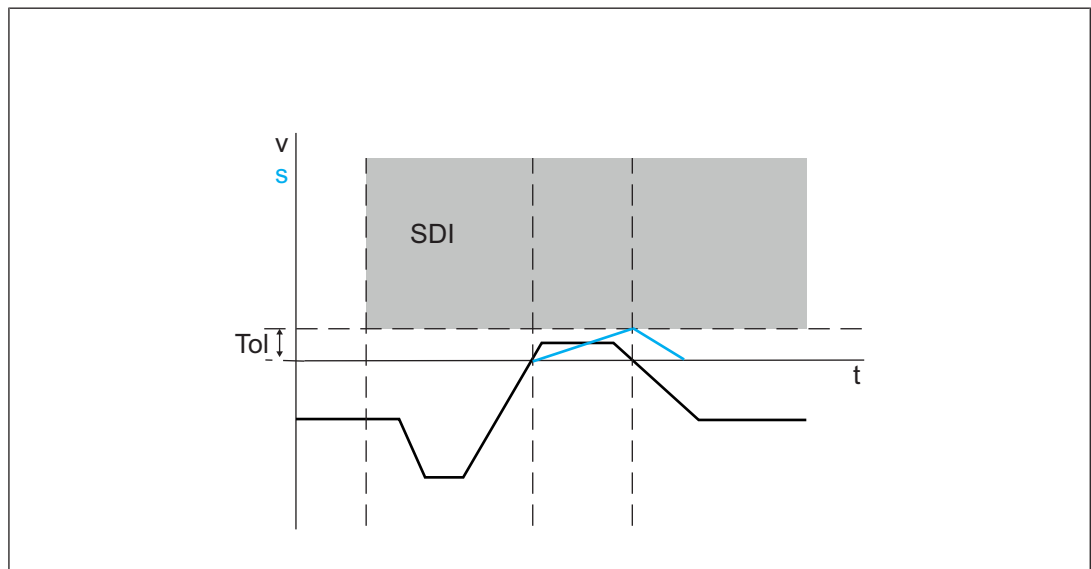
Safe direction monitoring

The **Safe direction monitoring** function (SDI-M) monitors the direction of movement defined for the drive axis (positive or negative). Safe direction of movement monitoring is activated via the start input. It remains active until the configured tolerance is exceeded in the opposite direction. The function can be retriggered at any time by a rising edge at the start input. As a result, the current position can be used at any time as the start point for the monitoring function.

One SDI-M element can be configured per axis for each direction in the PNOZmulti Configurator.

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.



Safe operating stop monitoring

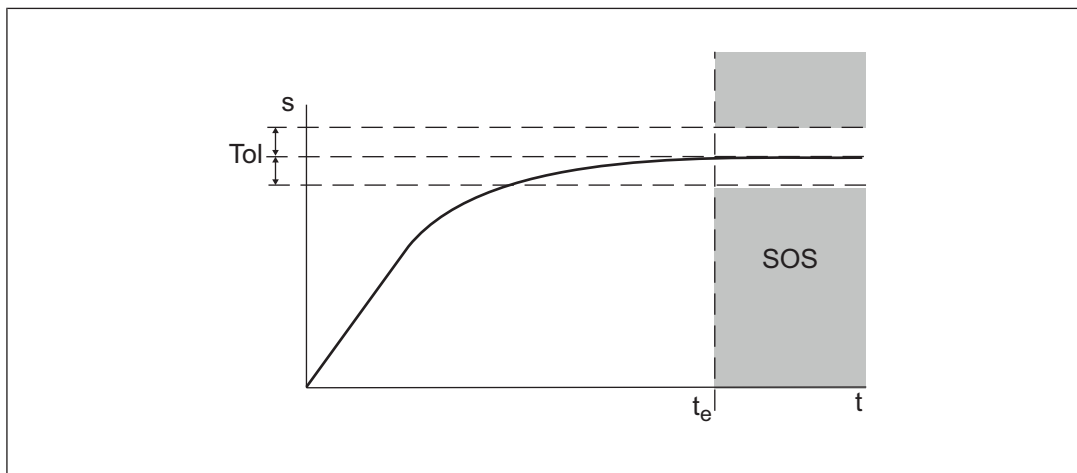
The **Safe operating stop monitoring** function (SOS-M) monitors whether the stop position remains within a configured tolerance window. Safe operating stop monitoring is activated within a rising edge at the start input. It remains active until the value is outside the tolerance band. The function can be retriggered at any time by a rising edge at the start input. As a result, the current position can be used at any time as the start point for the monitoring function.

3 SOS-M elements can be configured per axis in the PNOZmulti Configurator.

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.

Motion monitoring modules PNOZ m EF 1MM2DO



Legend:

- ▶ t_e : Activation of the monitoring function SOS

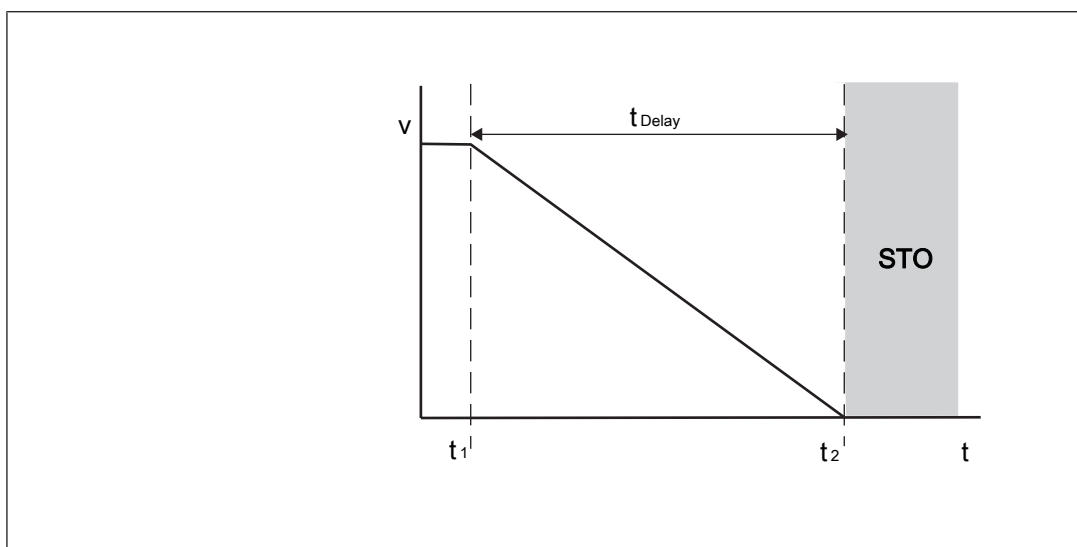
Safe stop 1 monitoring

The **Safe stop 1 monitoring** function (SS1-M) monitors whether the set delay time has elapsed (until controlled braking of the motor) or the standstill limit value for automatic STO is below the limit value.

- ▶ If the monitoring function SS1-M is triggered, the **Braking ramp** output is switched off. The drive controller's braking ramp is activated.
- ▶ After the set delay time has elapsed or the value for the automatic STO is below the limit value, the output **ST** switches off. The safety function **Safe torque off** (STO) is activated.

A maximum of 1 SS1-M element can be configured per axis in the PNOZmulti Configurator.

Sequence without standstill limit value for automatic STO:

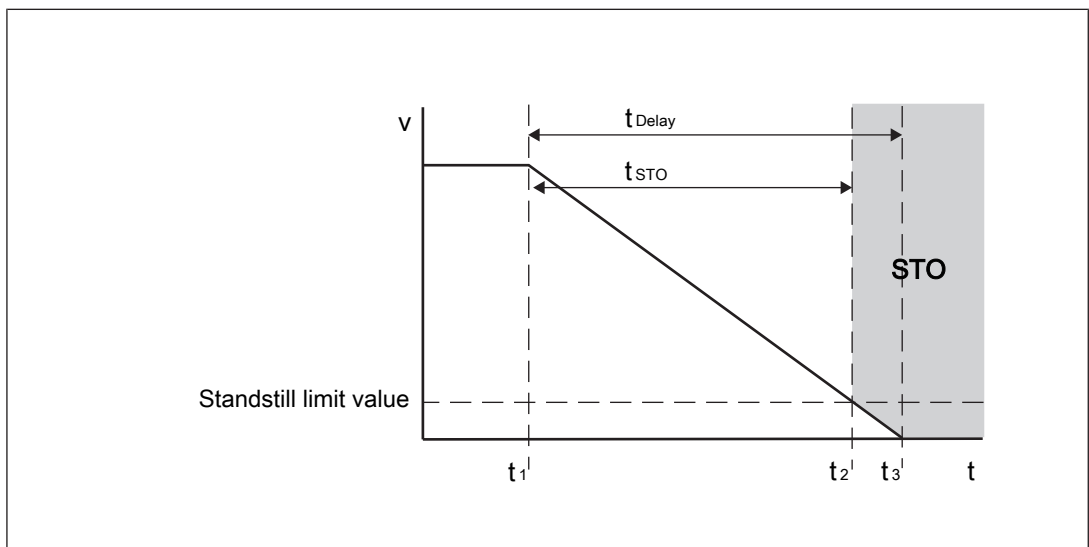


Motion monitoring modules PNOZ m EF 1MM2DO

Legend

- t_1 : Monitoring function SS1-M is activated
- t_2 : Delay time elapses, safety function "Safe torque off" (STO) is activated
- t_{Delay} : Set delay time for controlled braking of motor

Sequence with standstill limit value for automatic STO:



Legend

- t_1 : Monitoring function SS1-M is activated
- t_2 : Standstill limit value for automatic STO reached, safety function "Safe torque off" (STO) is activated
- t_3 : Delay time elapses
- t_{Delay} : Set delay time for controlled braking of motor
- t_{STO} : Actual time from activation of monitoring function until STO is activated

Safe stop 2 monitoring

The **Safe stop 2 monitoring** function (SS2-M) monitors

- ▶ Whether the set delay time has expired (until controlled braking of the motor) or the standstill limit value for automatic SOS is below the limit value.
and
- ▶ Whether the stop position ultimately remains within a configured tolerance window.

Reaction:

- ▶ If the monitoring function SS2-M is triggered, the "Braking ramp" output switches off. The drive controller's braking ramp is activated.
- ▶ If the set delay time has elapsed or the value for the automatic SOS is below the limit value, the stop position is monitored, the **Position monitoring** output switches on. If the stop position is outside the tolerance window, the **Position monitoring** and **STO** outputs switch off, the safety function **Safe torque off** (STO) is activated.

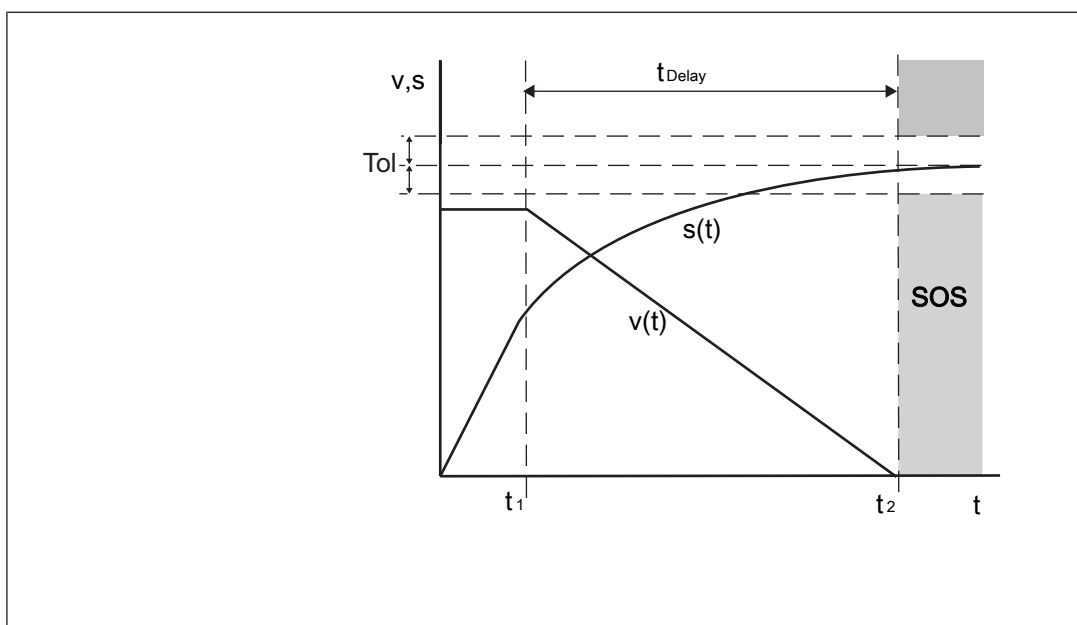
Motion monitoring modules PNOZ m EF 1MM2DO

A maximum of 1 SS2-M element can be configured per axis in the PNOZmulti Configurator.

Please note:

This monitoring function cannot be used in conjunction with 2 proximity switches because position detection is not possible.

Sequence without standstill limit value for automatic SOS:

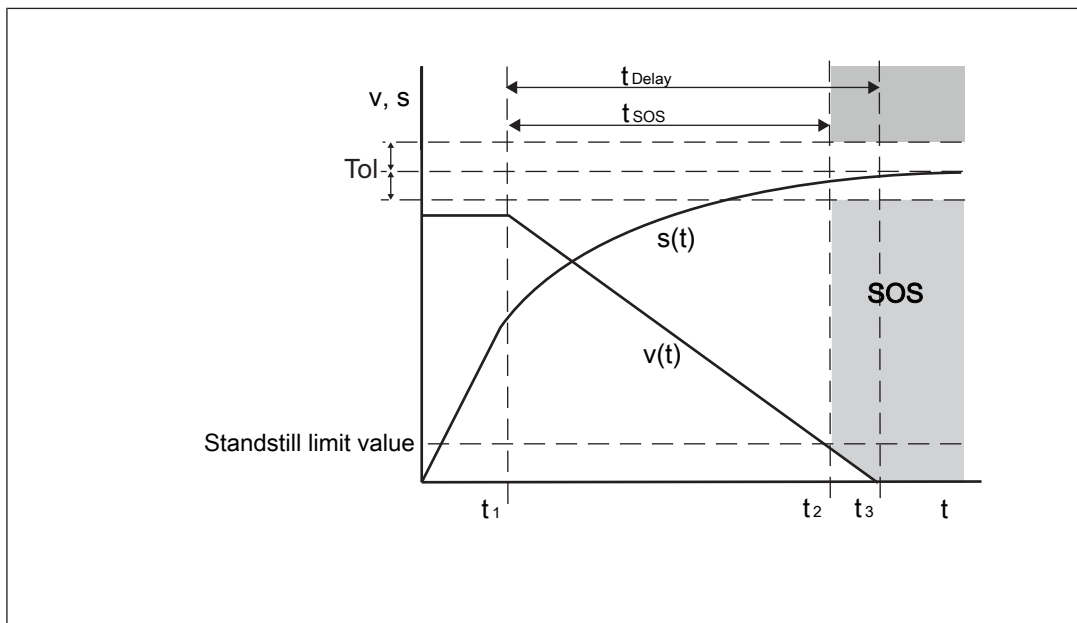


Legend

- t_1 : Activation of the monitoring function SS2-M
- t_2 : Delay time elapses, monitoring of stop position (SOS) is activated
- t_{Delay} : Set delay time for controlled braking of motor

Sequence with standstill limit value for automatic SOS:

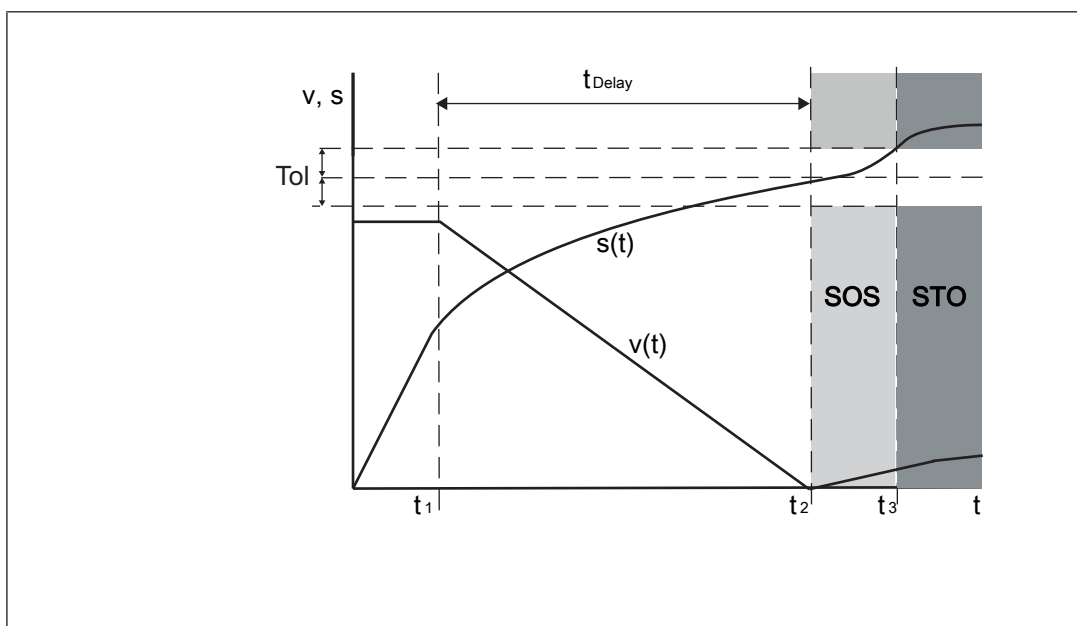
Motion monitoring modules PNOZ m EF 1MM2DO



Legend

- t_1 : Activation of the monitoring function SS2-M
- t_2 : Standstill limit value for automatic SOS reached, monitoring of stop position (SOS) is activated
- t_3 : Delay time elapses
- t_{Delay} : Set delay time for controlled braking of motor
- t_{STO} : Actual time from activation of monitoring function until STO is activated

Sequence when stop position is violated:



Motion monitoring modules

PNOZ m EF 1MM2DO

Legend

t_1 :	Activation of the monitoring function SS2-M
t_2 :	Standstill limit value for automatic SOS reached, monitoring of stop position (SOS) is activated
t_3 :	Stop position outside of tolerance window, safety function "Safe torque off" (STO) is activated
t_{Delay} :	Set delay time for controlled braking of motor

Safely limited acceleration monitoring (SLA-M)

The monitoring function **Safely limited acceleration monitoring** monitors the speed change per time unit.

Both the acceleration and the deceleration can be monitored.

Monitoring checks whether the acceleration or deceleration exceeds or falls below a certain limit value.

4 SLA-M elements can be configured per axis in the PNOZmulti Configurator.

The monitoring function **Safely limited acceleration monitoring** is activated with a rising edge at the start input. The trigger detection phase starts with a falling edge at the start input. In this process the current speed is taken as the start speed.

Monitoring of safely limited acceleration starts,

- ▶ when the trigger threshold is passed, that is, when the start speed changes by the configured percentage ($V1$).
- ▶ When monitoring starts within the maximum trigger time ($t1$).

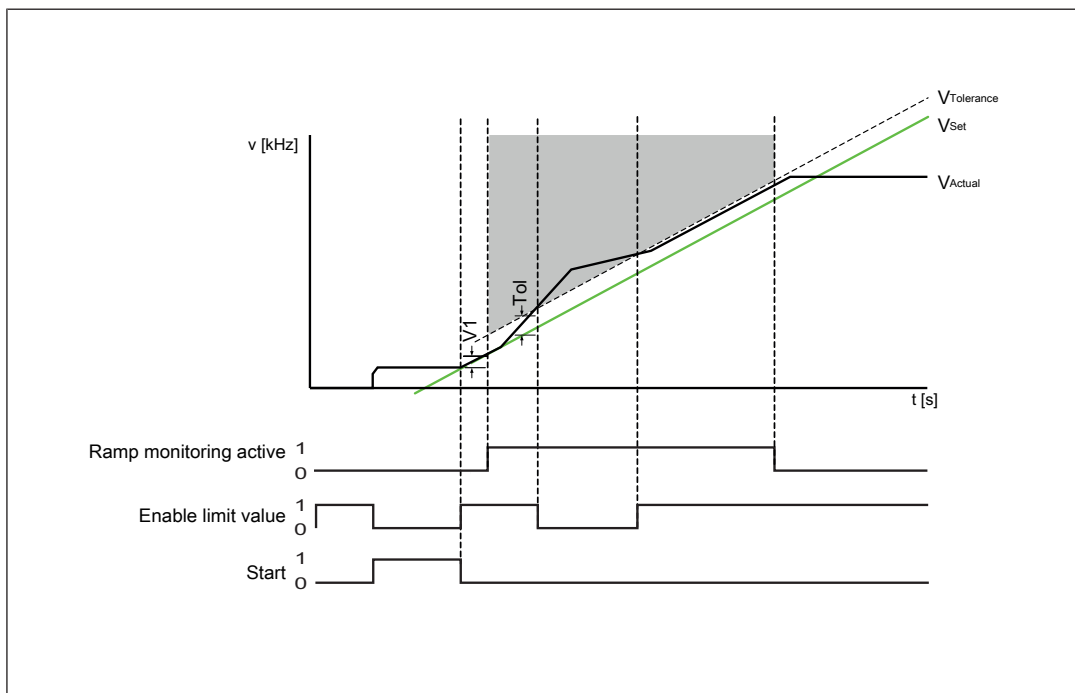
When monitoring is started, the set acceleration is calculated as a straight line V_{Set} . A tolerance band $V_{\text{Tolerance}}$ is calculated from the Tolerance and V_{Edge} parameters. If the actual speed V_{Actual} leaves the tolerance band, the output **Enable SLA** switches off.

Monitoring is ended,

- ▶ When monitoring is reset by a rising edge at the start input,
- ▶ When a range has been violated and it is no longer possible to return within the valid range,
- ▶ When the target speed is passed.

Motion monitoring modules PNOZ m EF 1MM2DO

Example: Monitoring for too fast acceleration



Safely limited acceleration range monitoring (SAR-M)

The monitoring function **Safely limited acceleration monitoring** monitors the speed change per time unit.

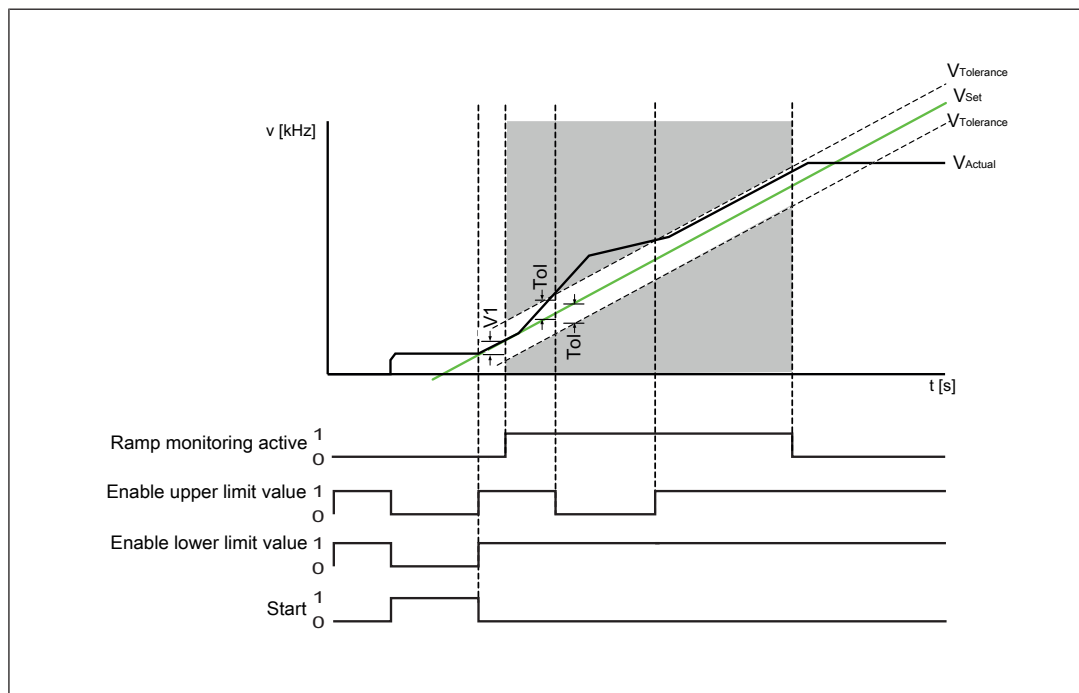
In contrast to the monitoring function SLA-M, safely limited acceleration range monitoring monitors not only a limit value but also the upper and lower limit value simultaneously. Both the acceleration and the deceleration can be monitored.

Otherwise the functionality is the same as the monitoring function SLA-M.

4 SAR-M elements can be configured per axis in the PNOZmulti Configurator.

Motion monitoring modules PNOZ m EF 1MM2DO

Example: Monitoring for too fast and too slow acceleration



Central motion monitoring functions

These functions apply centrally for all the monitoring functions.

Hysteresis

A central hysteresis can be configured for the monitoring functions. This prevents the outputs from bouncing if there are fluctuations around the response value. The hysteresis takes effect when the output is switched on.

Validation cut-off frequency

As implausible sensor signals may arise due to jitter on the sensors around the stop position, a central validation cut-off frequency must be configured for sensor types with proximity switches in the PNOZmulti Configurator (edge jitter is caused by the position control of the drive frequency converter or by external interference signals).

If the value of the validation cut-off frequency falls below the configured value, the feasibility check of the sensors will no longer be run.

Motion monitoring modules

PNOZ m EF 1MM2DO

Advanced Settings tab

A tolerance time can be configured for tracks AB, Z and S respectively.

The tolerance time influences the sensitivity towards invalid signal levels (e.g. in the event of EMC interference).

The greater the configured tolerance time, the less sensitive the system will be towards invalid signal levels.

The tolerance time can be deactivated for individual tracks by setting 0 ms.

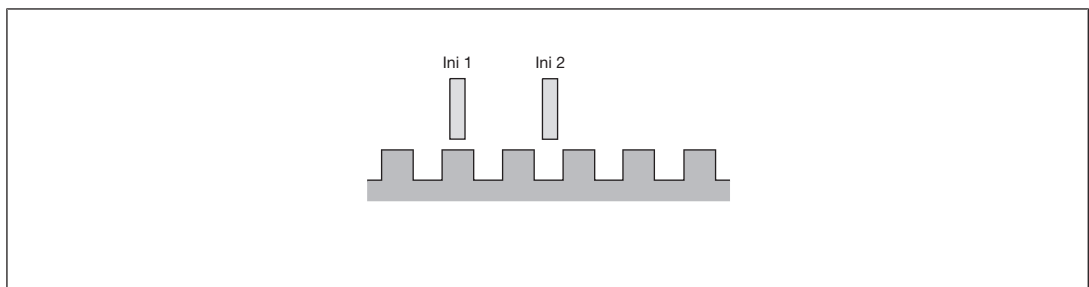
System reaction time

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 "PNOZmulti System Expansion".

Proximity switch

- ▶ Proximity switches can be used with a pnp or npn output.
- ▶ The proximity switches must be fitted so that at least one is always activated. In other words, the proximity switches must be fitted so that the recorded signals always overlap.
- ▶ The cable used to connect the proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ A DC voltage in the range of 0 - 30 V can be monitored via track S. It should be used to monitor the supply voltage of the proximity switches.

Proximity switch assembly:



Motion monitoring modules PNOZ m EF 1MM2DO

Signal characteristics:

Proximity switch combinations	Signal image in an energised state
PNP / PNP	<p>Timing diagram for PNP / PNP combination. Ini 1 is high (energised) and Ini 2 is low (de-energised) during the pulse. A dashed vertical line marks the start of the pulse, and a horizontal double-headed arrow below it indicates a duration greater than 1% of the period length.</p>
NPN / NPN	<p>Timing diagram for NPN / NPN combination. Ini 1 is low (de-energised) and Ini 2 is high (energised) during the pulse. A dashed vertical line marks the start of the pulse, and a horizontal double-headed arrow below it indicates a duration greater than 1% of the period length.</p>
NPN / PNP	<p>Timing diagram for NPN / PNP combination. Ini 1 is low (de-energised) and Ini 2 is high (energised) during the pulse. A dashed vertical line marks the start of the pulse, and a horizontal double-headed arrow below it indicates a duration greater than 1% of the period length.</p>
PNP / NPN	<p>Timing diagram for PNP / NPN combination. Ini 1 is high (energised) and Ini 2 is low (de-energised) during the pulse. A dashed vertical line marks the start of the pulse, and a horizontal double-headed arrow below it indicates a duration greater than 1% of the period length.</p>

- ▶ For a full configuration, the maximum frequency of the sensors you are using must be entered in the PNOZmulti Configurator (see sensor's data sheet).

Special features for proximity switches with reduced diagnostics

- ▶ A: pnp, B: pnp
- ▶ It is permitted that both proximity switches are energised simultaneously.
- ▶ The safety level is reduced.
- ▶ The cables for connecting the proximity switches must be laid separately.
- ▶ The supply voltage of the proximity switches must be monitored (e.g. via track S).

Motion monitoring modules

PNOZ m EF 1MM2DO

Encoder

- ▶ The following encoders can be used:
 - TTL, HTL (single-ended or differential signals)
 - Sin/Cos 1 Vss
 - Hiperface®
- ▶ The encoders can be connected with or without Z index (0 index).
- ▶ The cables used to connect the encoders must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ A proximity switch can also be connected to track Z to monitor for broken shearpins.

Please note:
Broken shearpin monitoring only becomes active when

 - The minimum speed is exceeded
and
 - The tolerance for detecting feasibility errors has elapsed.

The minimum speed and tolerance depend on the ratio of the frequency on tracks AB " f_{AB} " to the frequency on track Z " f_Z " in your configuration (see PNOZmulti Configurator **Motion Monitor Element, Calculated Ratio AB/Z**).

Minimum speed:

 - Calculated ratio $AB/Z \geq 1.0$
 $f_Z = 10 \text{ mHz}$ or $f_{AB} = (f_{AB}/f_Z) \times 10 \text{ mHz}$
 - when $f_{AB}/f_Z \text{ Ratio} < 1.0$
 $f_{AB} = 10 \text{ mHz}$ or $f_Z = 10 \text{ mHz}/(f_{AB}/f_Z)$

Tolerance for detecting feasibility errors:

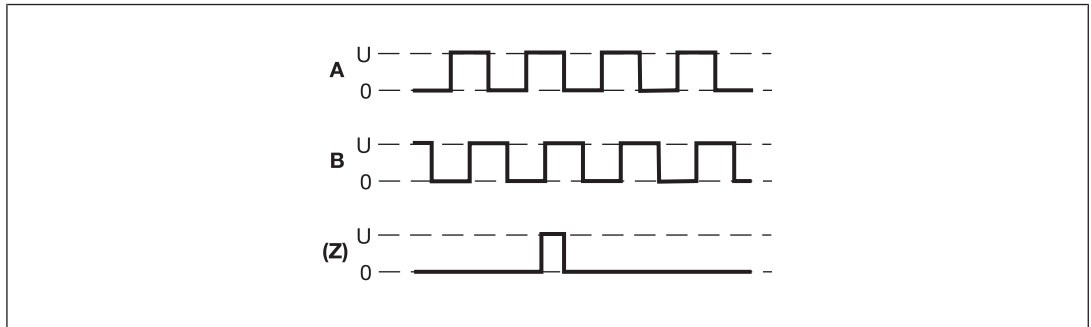
 - when $f_{AB}/f_Z \text{ Ratio} \geq 1.0$
7.5 Z pulses or $7.5 \times (f_{AB}/f_Z)$ AB pulses
 - when $f_{AB}/f_Z \text{ Ratio} < 1.0$
4.5 AB pulses or $4.5 \times (f_{AB}/f_Z)$ Z pulses
- ▶ With Hiperface encoders, the Sin- Cos track is recorded and monitored via an adapter (see [Adapters for encoders](#) [📖 391]).
- ▶ Track S can be used:
 - To connect an encoder's error output.
 - To monitor voltages between 0 V and 30 V for a permitted upper and lower limit. For example, the encoder's supply voltage can be monitored.
- ▶ The maximum frequency of the used encoders must be entered for a complete configuration.
- ▶ Pay attention to the values in the technical details.

Motion monitoring modules PNOZ m EF 1MM2DO

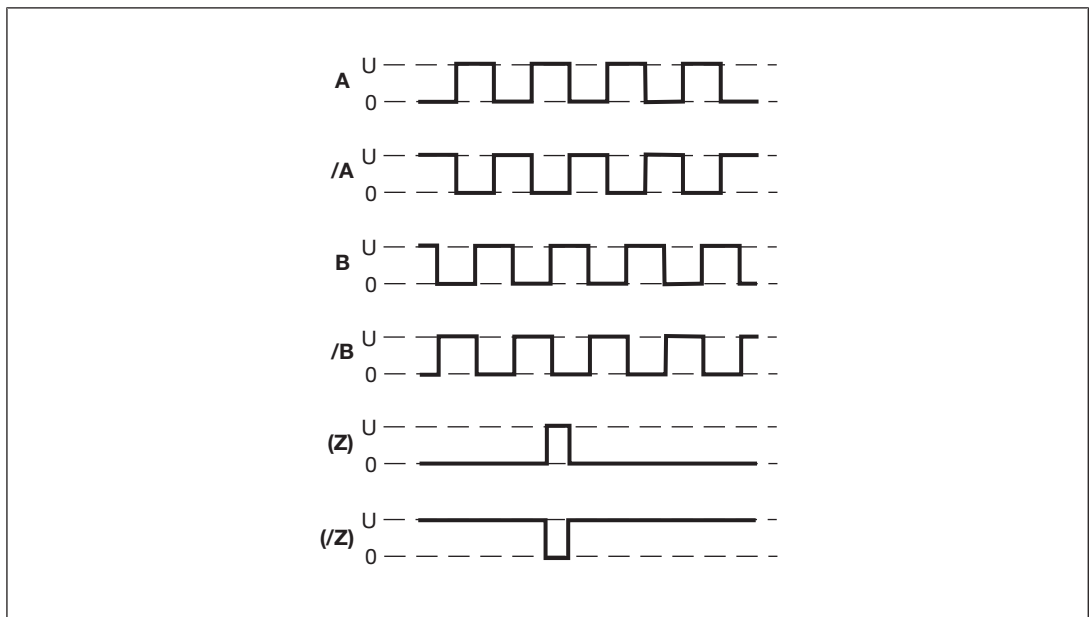
Output signals

Output signals TTL, HTL

Single ended



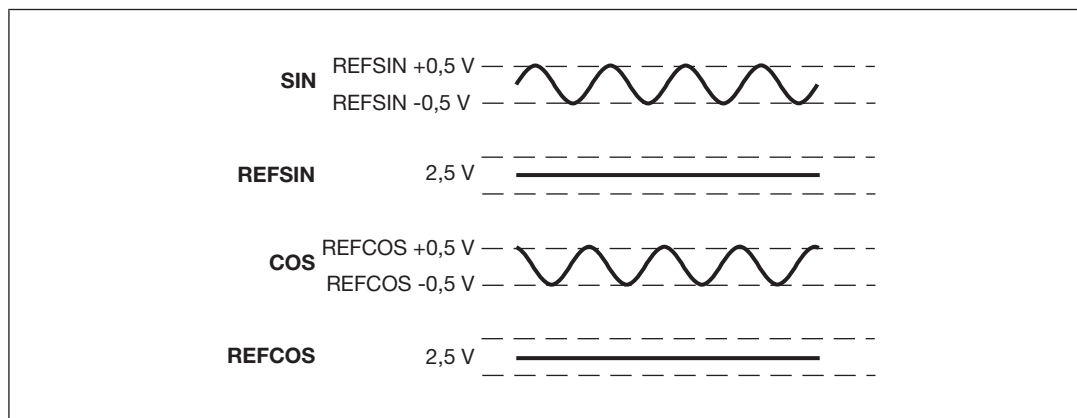
Differential



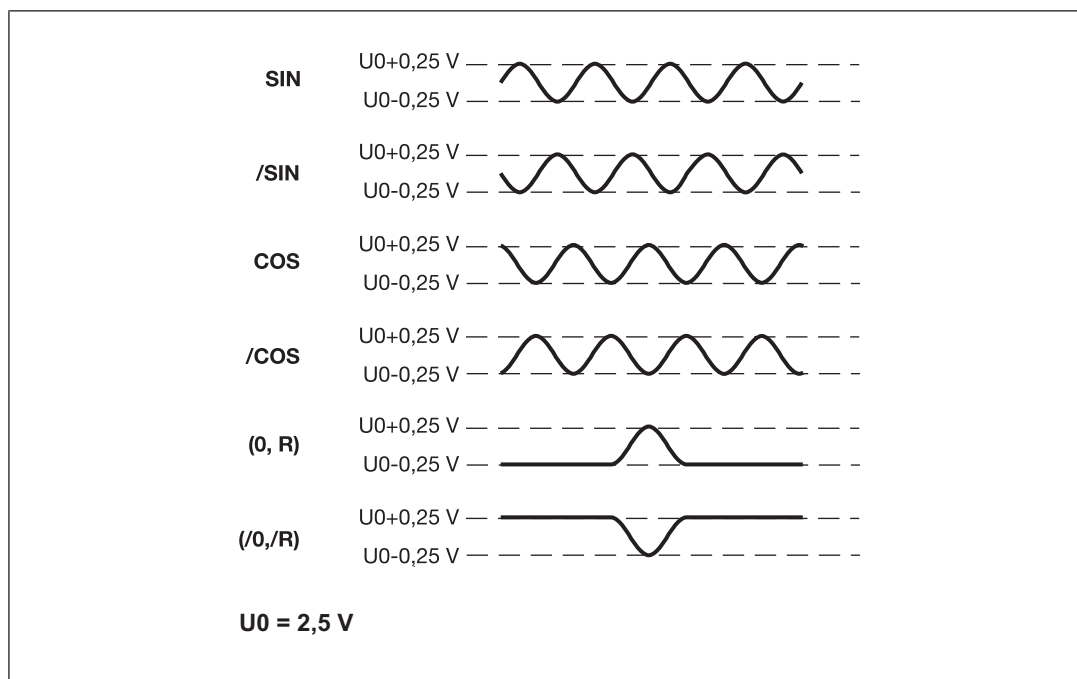
Motion monitoring modules PNOZ m EF 1MM2DO

Output signals Sin/Cos (1 Vss)

Single ended with reference track (e.g. Hiperface®)



Differential with/without Z index (e.g. Heidenhain 1 Vss)



Adapters for encoders

The adapter records the data between the encoder and the drive and makes it available to the PNOZ m EF 1MM2DO via the Mini-IO socket.

Pilz supplies complete adapters as well as ready-made cable with Mini-IO connector, which can be used when making your own adapter. The range of products in this area is constantly being expanded. Please contact us about the range of adapters that is currently available.

Motion monitoring modules PNOZ m EF 1MM2DO

Supply

The module is internally supplied by the base unit.

Outputs

The expansion module provides safe semiconductor outputs and it may be used for safe applications in the system PNOZmulti 2. The outputs may be used to switch:

- ▶ Resistive loads
- ▶ Inductive loads
- ▶ Capacitive loads

Signals at the output

- ▶ "0" signal (0 V) at the output:
 - Output is high impedance
 - No current to the load
- ▶ "1" signal (+24 V) at the output:
 - Output is low impedance
 - Current is supplied to the load

Output test

Outputs that are switched on are checked via regular off tests.

- ▶ Switch-off tests are performed once per test cycle
- ▶ Outputs that are switched on are switched off for the duration of the off test.

Testing for shorts

- ▶ For applications in accordance with Category 4, PL e and SIL 3, detection of shorts between contacts must be guaranteed through additional measures (e.g. asynchronous switching on - once per shift).
- ▶ A short between contacts must be simulated during commissioning.
- ▶ In the on state, shorts across contacts to the supply voltage are not detected. Only with the next operational switching off of the output it is detected whether there is a short circuit to the supply voltage on the line to the load.

Motion monitoring modules

PNOZ m EF 1MM2DO

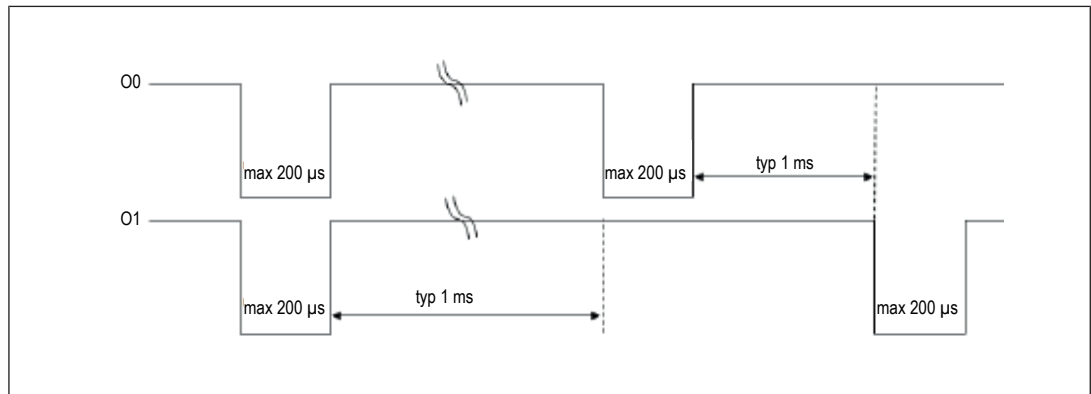


Fig.: Signal characteristic at the semiconductor outputs O0 and O1 while switched on

Outputs

- ▶ The max. capacity at an output depends on the load. Connecting a higher capacity may lead to an error.
- ▶ Operation with electronic contactors has not been tested and may lead to errors.

Switch-off delay in stop

A switch-off delay can be configured for each of the safe semiconductor outputs on the PNOZ m EF 1MM2DO module. When switching to a system stop, the safe semiconductor outputs switch off in accordance with the configured time delay. All the self-tests of the module PNOZ m EF 1MM2DO continue to be performed during the switch-off delay.

Cascading

Cascading enables up to 8 modules to be networked. A combined standard input/output CIO connects the modules. In the Configurator, cascading can be linked to any monitoring function. If the monitoring function is triggered, a non-safety-related fast shutdown of all the cascaded functions is initiated.

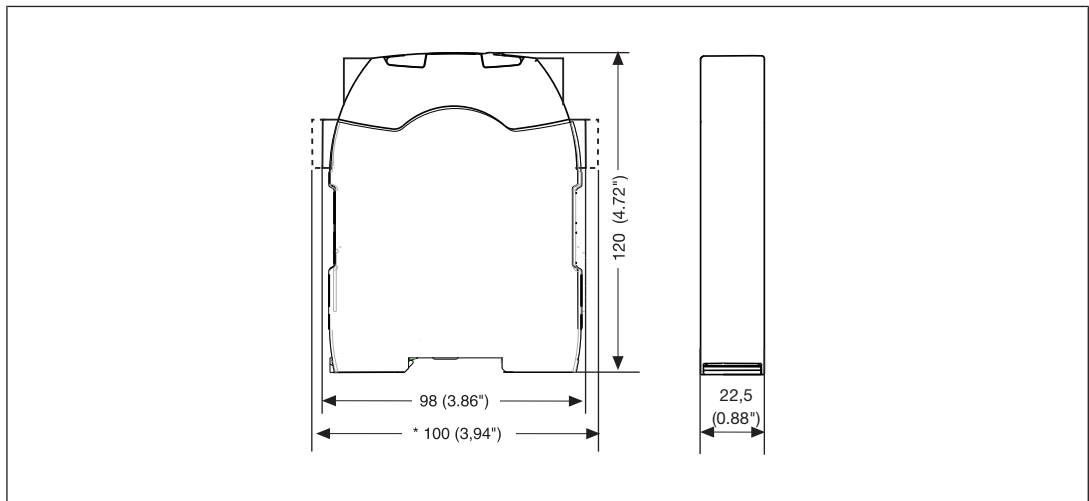
- ▶ Connect the CIO terminals of all modules whose monitoring functions are to be linked.
- ▶ Make sure that the modules are connected to a common 0 V supply.
- ▶ Cascading is used for fast messaging between the networked modules.

Motion monitoring modules

PNOZ m EF 1MM2DO

Installation

Dimensions in mm



Commissioning

Wiring

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

Please note:

- ▶ Information given in the [Technical details \[408\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The power supplies for the safety system and sensors must comply with the regulations for low voltages with safe isolation (SELV/PELV).
- ▶ The cable used to connect the encoders and proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ The shield may only be connected to earth at a single point.
- ▶ Earth loops should be avoided.
- ▶ If possible, the connections for the various earth potentials (GND, A2) should not be connected on the PNOZ m EF 1MM2DO but should be connected directly to the GNDs on the connected units. otherwise noise susceptibility may be increased significantly (conductor loops are not permitted).

Motion monitoring modules PNOZ m EF 1MM2DO

- ▶ If short circuits occur between the cable from the output to the load and a supply line, it will no longer be possible to switch off the load. Possible remedies:
 - Exclude the error by using separate multicore cable for supply voltages
 - Use an additional shutdown device such as a main contactor
- ▶ Use appropriate wiring to exclude short circuits between the outputs!
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 3 A
 - or
 - Blow-out fuse, slow, 3 A
- ▶ With lift applications, the screen of the encoder should be connected to earth on both sides.

Motion monitoring modules PNOZ m EF 1MM2DO

Connection supply voltage and outputs

Supply voltage

Supply voltage	DC

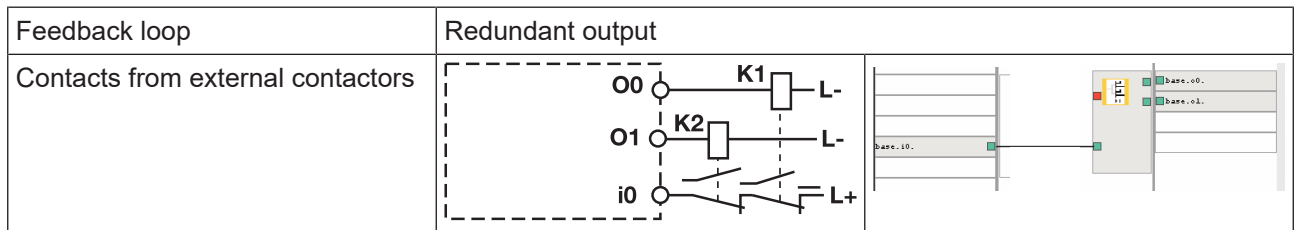
Connection examples for semiconductor outputs

Redundant output		
Single output		
Single output with advanced fault detection*		

*Two loads may be connected to each safety output with advanced fault detection, even on applications in accordance with EN IEC 62061, SIL 3. Prerequisite: Feedback loop is connected, shorts across contacts and external power sources are excluded (e.g. through separate multicore cables). Please note that, in the event of an error in the feedback loop, the safety system switches to a safe state and shuts down **all** the outputs.

Motion monitoring modules PNOZ m EF 1MM2DO

Connection example feedback loop



Pin assignment of Mini-IO socket

Mini-IO socket 8-pole	PIN	Track
	1	S
	2	GND
	3	Z
	4	A
	5	/A
	6	/Z
	7	B
	8	/B

Connection of proximity switches

The following proximity switch combinations can be connected:

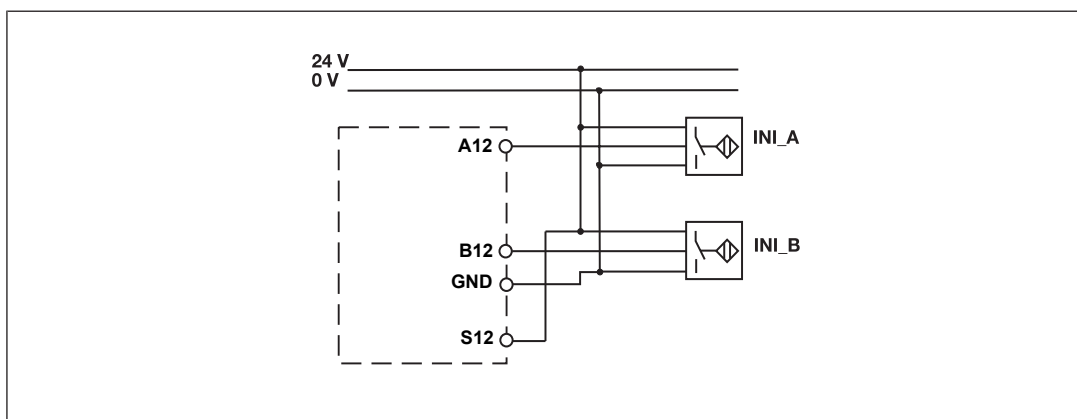
- ▶ A: pnp, B: pnp
- ▶ A: npn, B: npn
- ▶ A: pnp, B: npn
- ▶ A: npn, B: pnp

When connecting proximity switches please note:

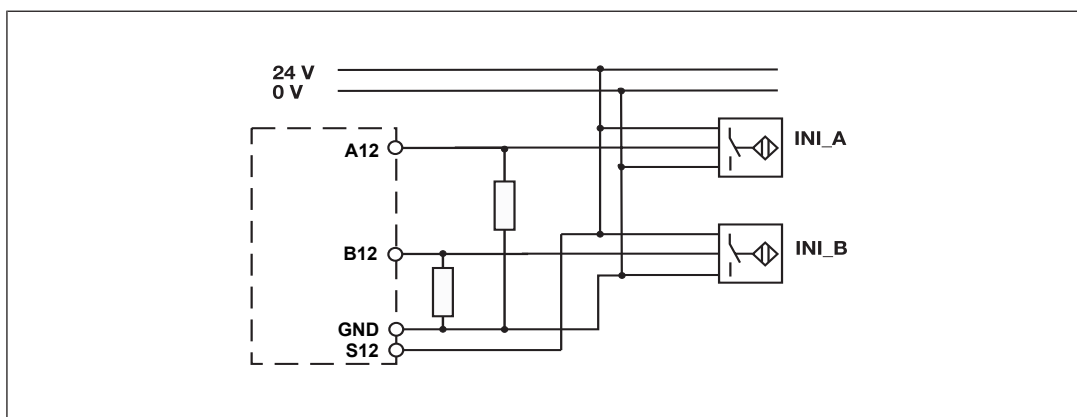
- ▶ Proximity switches can be connected to
 - terminals A12, B12, GND for axis 1
 - or
 - tracks A, B and GND of the Mini-IO socket (X12 for axis 1).
- ▶ The terminal points V12 can be used as a shunt terminal, for example for the supply voltage of the proximity switches. The current load capacity is max. 3 A per terminal.
- ▶ Track S (S12) should be used to monitor the supply voltage (see drawing). A permitted voltage range can be entered in the menu.
- ▶ Connect the proximity switch to 24 V DC of the power supply.

Motion monitoring modules PNOZ m EF 1MM2DO

- ▶ When connecting the proximity switches, please refer to the chapter entitled "EMC-compliant wiring".
- ▶ Invalid signals may occur with long cable lengths. In this case we recommend that you connect a resistor between the signal lines, as shown in the diagrams.
- ▶ Connection of the proximity switches may only be performed in three-wire technology and not in two-wire technology.
- ▶ Special features for proximity switches with reduced diagnostics:
 - A: pnp, B: pnp
 - It is permitted that both proximity switches are energised simultaneously.
 - The safety level is reduced.
 - The cables for connecting the proximity switches must be laid separately.
 - The supply voltage of the proximity switches must be monitored (e.g. via track S).



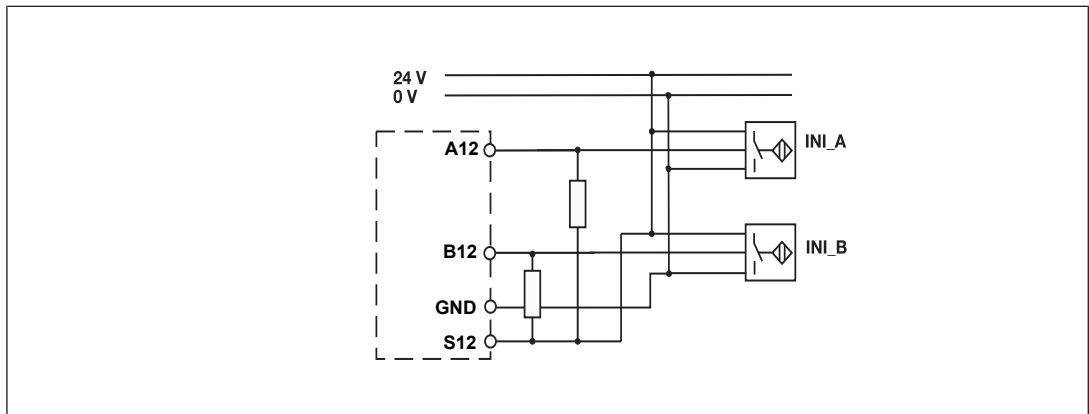
pnp proximity switch with resistor R = 10 kOhm



Motion monitoring modules

PNOZ m EF 1MM2DO

npn proximity switch with resistor $R = 47 \text{ k}\Omega$



Connection of an encoder

Proceed as follows when connecting the encoder:

- ▶ The encoder can be connected via an adapter (e.g. MM A Mini-IO-CAB99) or directly to the PNOZ m EF 1MM2DO.
- ▶ Use only shielded cables for all connections. Please refer to the chapter entitled "EMC-compliant wiring".
- ▶ Always connect GND on the encoder to GND on the Mini-IO connector.
- ▶ If the encoder signals are not terminated with 120 Ohm in the frequency converter, the encoder signals must be terminated with $Z_0 = 120 \text{ Ohm}$ between A and /A, B and /B, Z and /Z.
- ▶ Please refer to the information provided by the encoder manufacturer with regard to the recommended max. cable length when taking into consideration
 - Output frequency
 - Supply voltage
 - Operating temperature
 - Existing interference
- ▶ The cable length from the encoder to the evaluation device including the length of the adapter cable may be a maximum of 30 m.

When calculating the maximum cable length, remember that the length of the adapter cable must also be taken into account.

Connect encoder

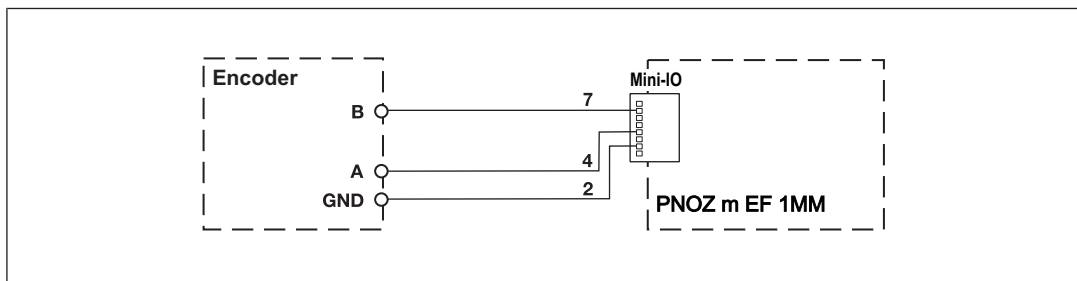
Encoder types:

- ▶ TTL single ended
- ▶ HTL single ended

Please note:

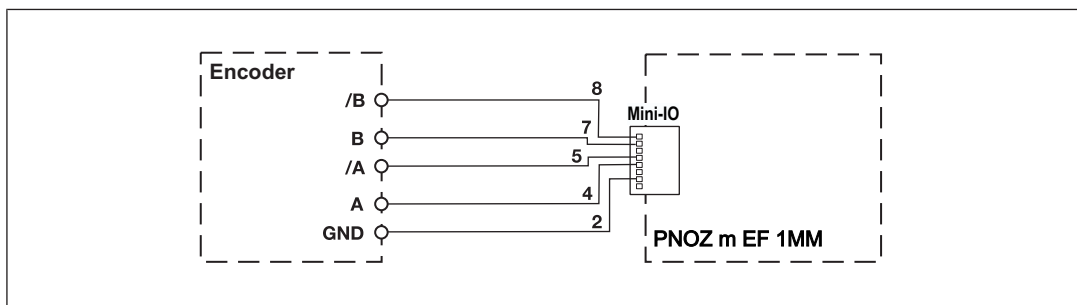
Motion monitoring modules PNOZ m EF 1MM2DO

- ▶ Tracks /A, /B, Z and /Z must remain free



Encoder types:

- ▶ TTL Differential
- ▶ HTL differential
- ▶ sin/cos 1 Vss
- ▶ Hiperface



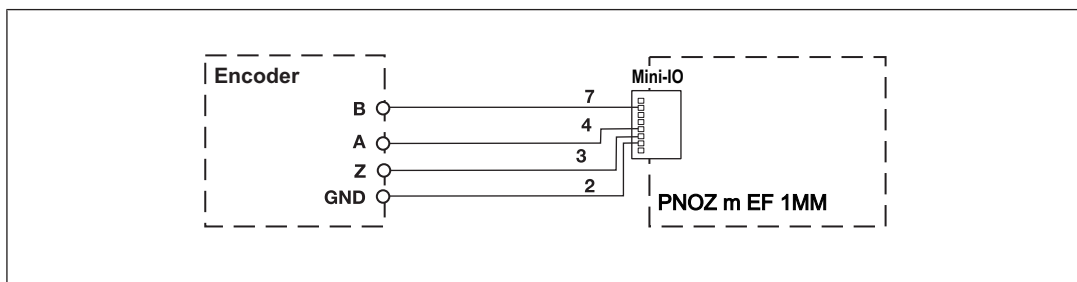
Connect encoder with Z index

Encoder types:

- ▶ TTL single ended Z Index
- ▶ HTL single ended Z Index

Please note:

- ▶ Tracks /A, /B and /Z must remain free



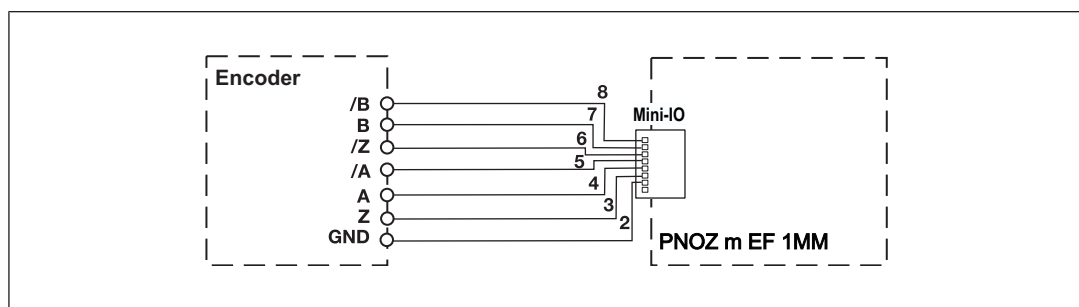
Encoder types:

- ▶ TTL differential + Z Index
- ▶ HTL differential + Z Index
- ▶ sin/cos 1 Vss Z Index

Motion monitoring modules PNOZ m EF 1MM2DO

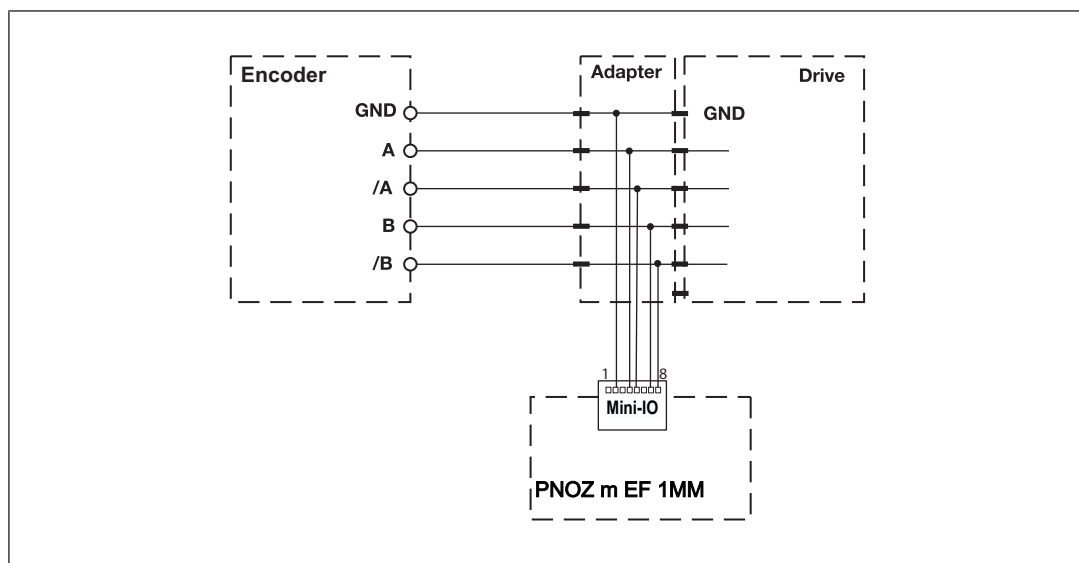
Please note:

- ▶ When using the encoder type sin/cos 1 Vss Z Index, the length of the encoder cable may be max. 30 m.



Connect encoder via an adapter

The adapter (see Accessories) is connected between the encoder and the drive. The output on the adapter is connected to the Mini-IO socket on the PNOZ m EF 1MM2DO.



Connection of proximity switch and encoder

When connecting the encoders and proximity switches, please refer to the chapter entitled "EMC-compliant wiring".

Sensor types:

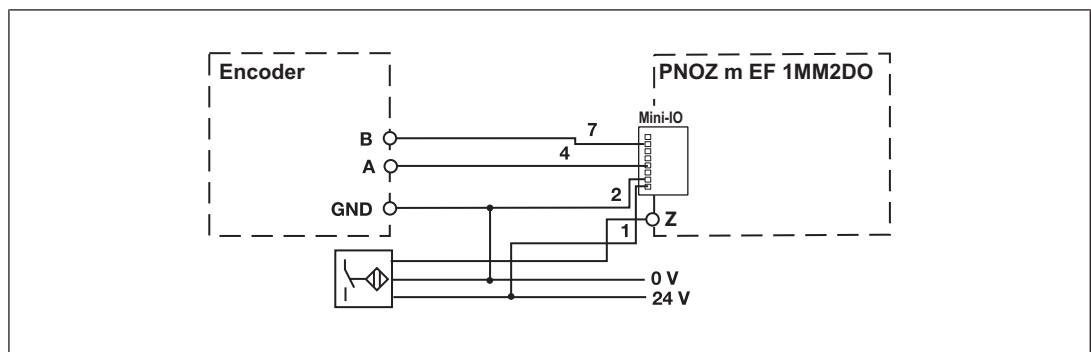
- ▶ Configuration: HTL single Z Freq. Ini pnp
 - HTL single ended (A,B) + Ini pnp (Z)
 - HTL single ended (A,B) + HTL differential (A as Z)
 - HTL single ended (A,B) + HTL single ended (A as Z)

Motion monitoring modules PNOZ m EF 1MM2DO

- ▶ Configuration: TTL single Z Freq. Ini pnp
 - TTL single ended (A,B) + Ini pnp (Z)
 - TTL single ended (A,B) + HTL differential (A as Z)
 - TTL single ended (A,B) + HTL single ended (A as Z)

Please note:

Tracks /A, /B and /Z must remain free.

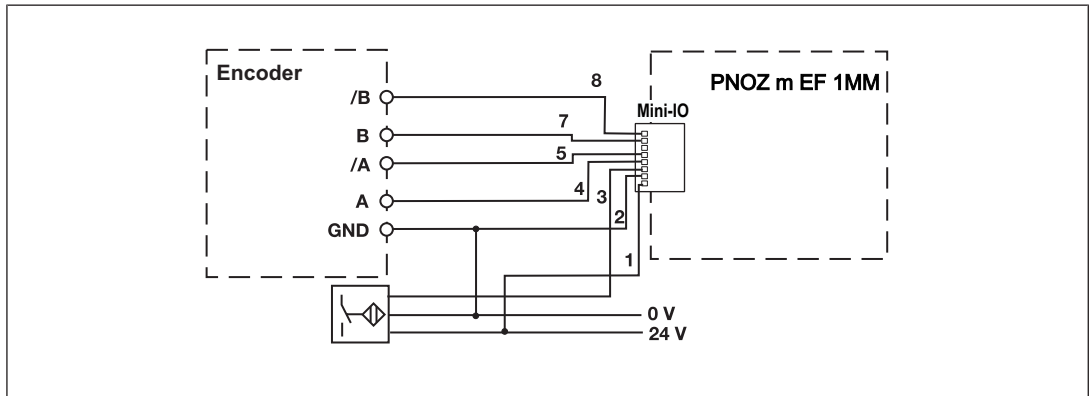


Sensor types:

- ▶ Configuration: TTL differential Z Freq. Ini pnp
 - TTL differential (A,/A,B,/B) + Ini pnp (Z)
 - TTL differential (A,/A,B,/B) + HTL differential (A as Z)
 - TTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: HTL differential Z Freq. Ini pnp
 - HTL differential (A,/A,B,/B) + Ini pnp (Z)
 - HTL differential (A,/A,B,/B) + HTL differential (A as Z)
 - HTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: sin/cos 1 Vss Z Freq. Ini pnp
 - sin/cos 1 Vss (A,/A,B,/B) + Ini pnp (Z)
 - sin/cos 1 Vss (A,/A,B,/B) + HTL differential (A as Z)
 - sin/cos 1 Vss (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: Hiperface Z Freq. Ini pnp
 - Hiperface (A,/A,B,/B) + Ini pnp (Z)
 - Hiperface (A,/A,B,/B) + HTL differential (A as Z)
 - Hiperface (A,/A,B,/B) + HTL single ended (A as Z)

Motion monitoring modules PNOZ m EF 1MM2DO

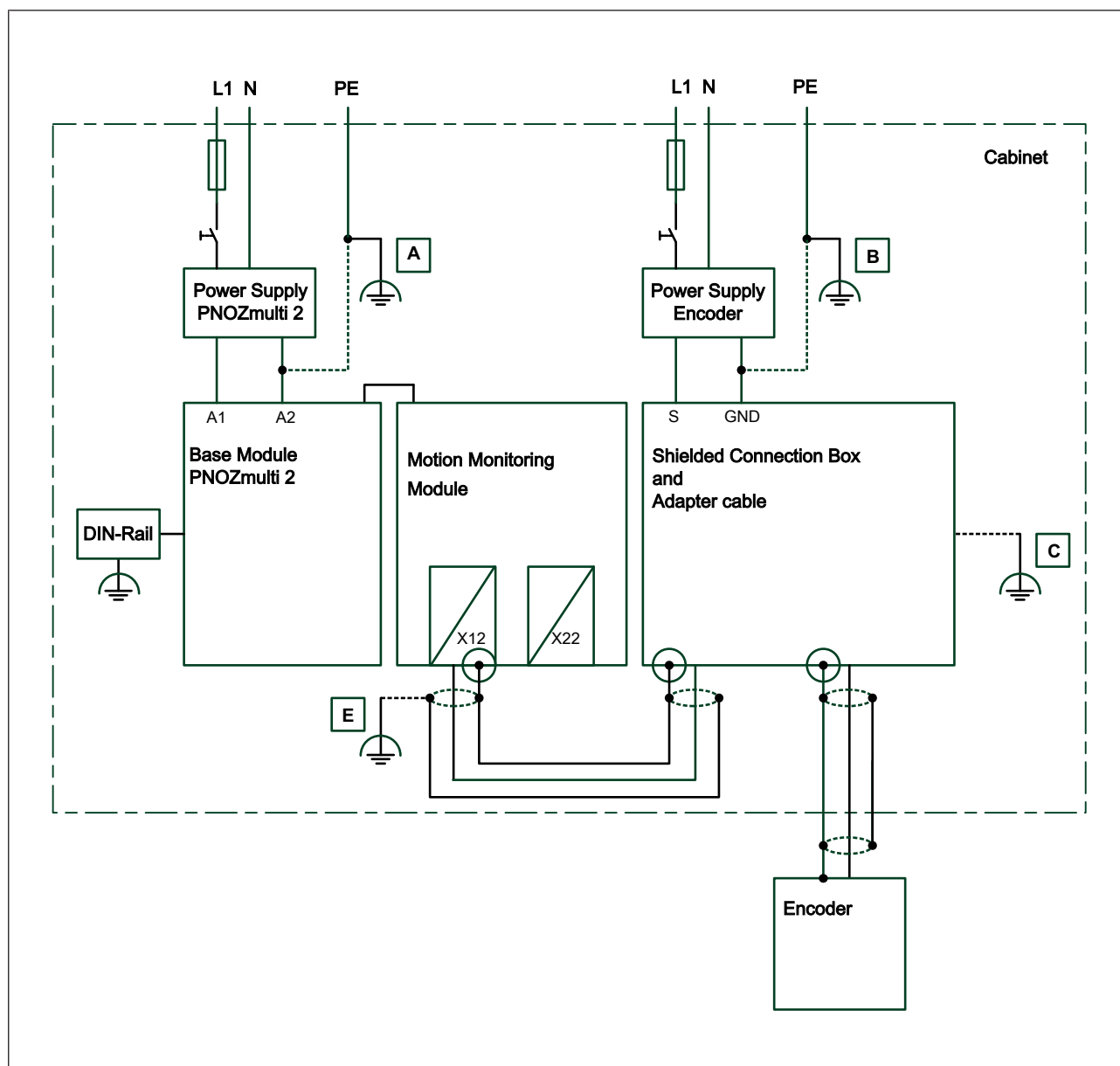
Please note:
Track /Z must remain free!!



Motion monitoring modules PNOZ m EF 1MM2DO

EMC-compliant wiring

EMC-compliant wiring for connecting an encoder



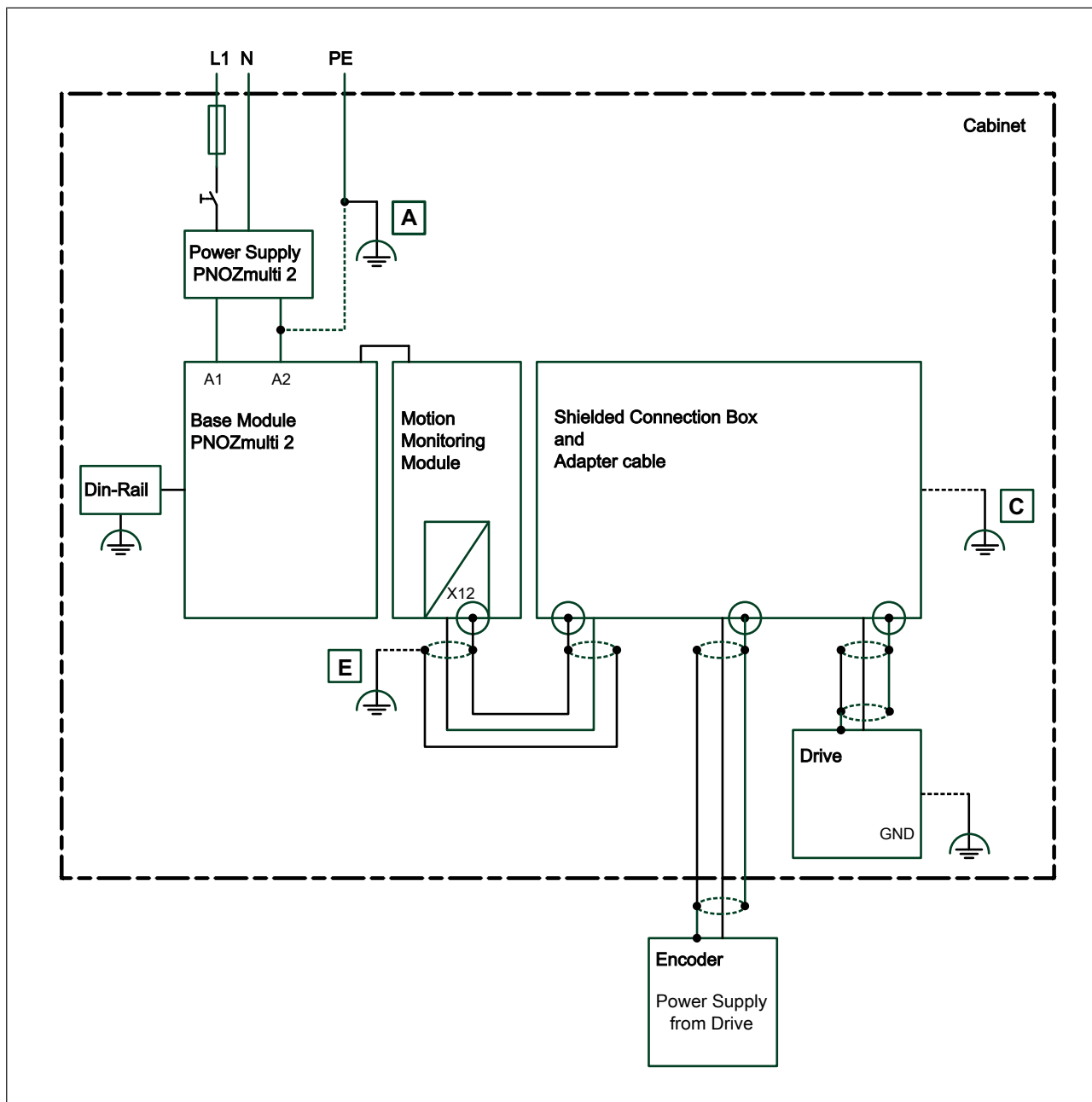
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM2DO

EMC-compliant wiring for connecting an encoder with drive



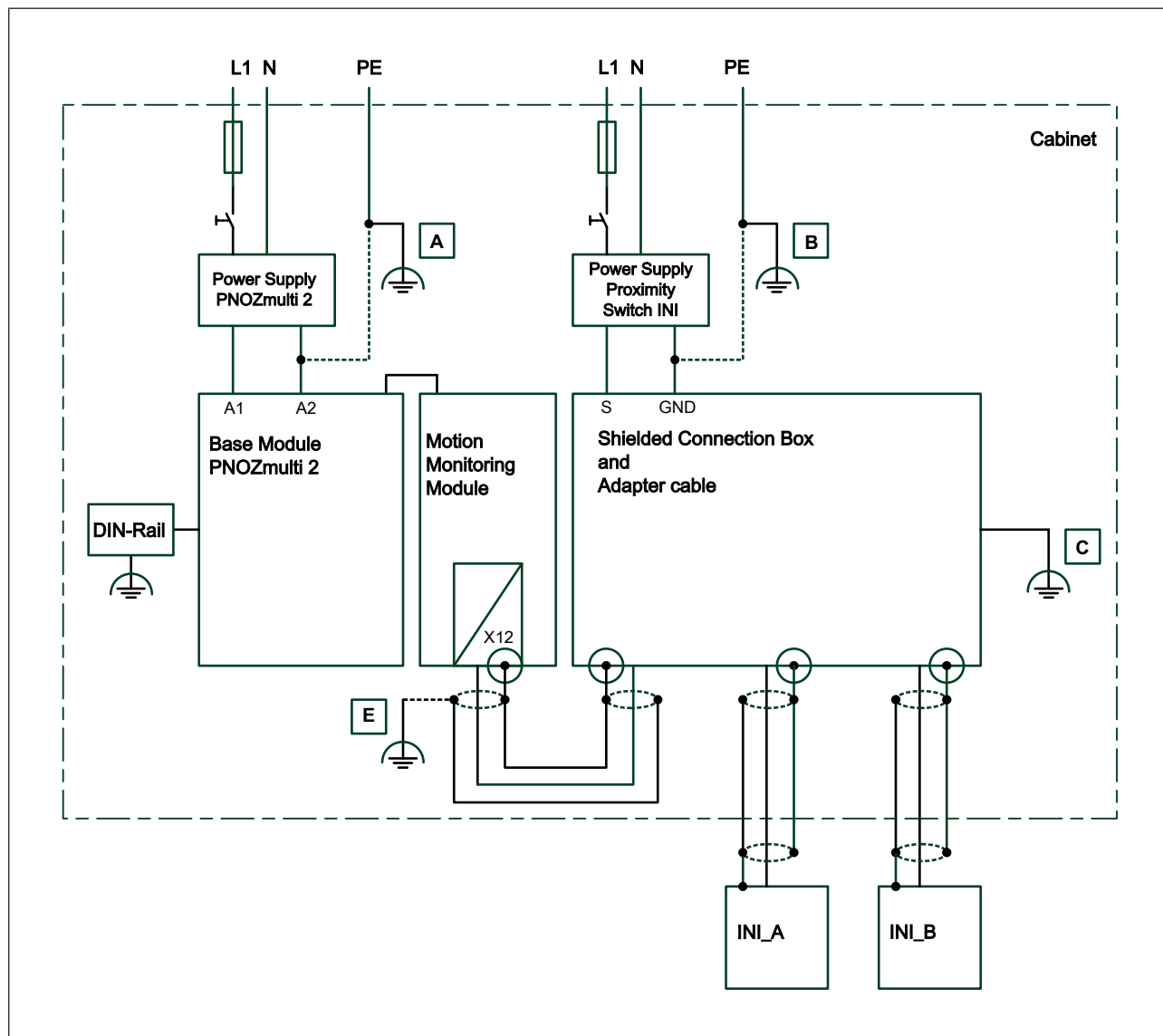
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM2DO

EMC-compliant wiring for connecting 2 proximity switches



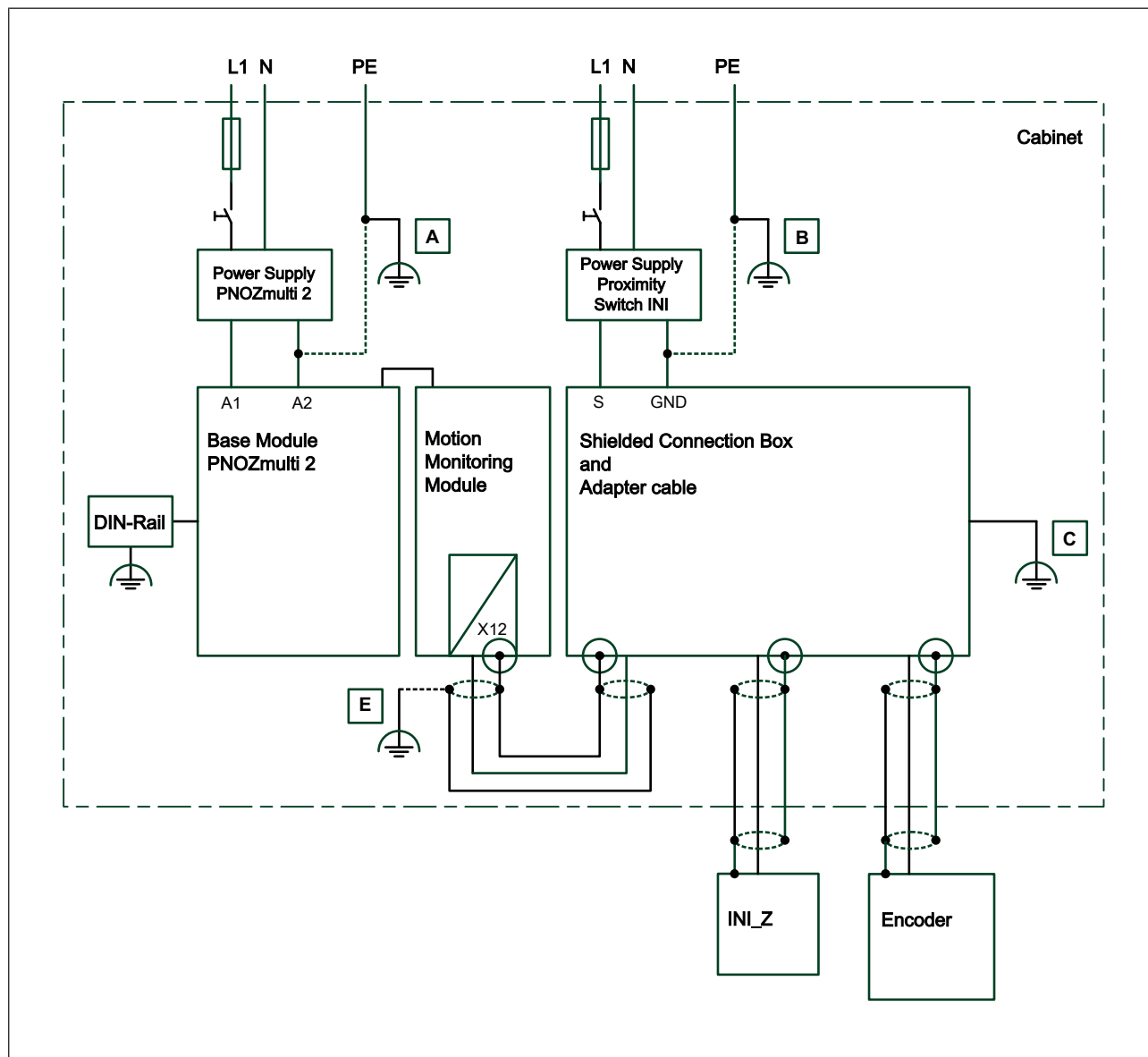
To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM2DO

EMC-compliant wiring for connecting an encoder and a proximity switch



To avoid EMC interference we recommend that the shield on the sensor cable is connected to earth at **C** or **E**. However, depending on the application, it may be helpful to establish the connection to functional earth at another point (in this case **A** or **B**).

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

Motion monitoring modules PNOZ m EF 1MM2DO

Maintenance and testing

It is not necessary to perform maintenance work on the product in normal operation. Please return any faulty products to Pilz.

Technical details

General	
Certifications	CE, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	00E8h
Electrical data	
Supply voltage	Supply to sensor evaluation, supply to the SC outputs
for	
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	1,6 A
Output of external power supply (DC)	2,1 W
Potential isolation	Yes
Supply voltage	Module supply
for	
internal	Via base unit
Voltage	24 V
Kind	DC
Current consumption	40 mA
Power consumption	0,9 W
Max. power dissipation of module	5 W
Status indicator	LED
Permitted loads	inductive, capacitive, resistive
Proximity switch input	
Number of inputs	2
Input signal level	11 - 30 V
Signal level at "1"	
Signal level at g0 h	0,0 - 3,0 V
Input resistance	22 kOhm
Input's frequency range	0 - 5 kHz
Configurable monitoring frequency	0,1 Hz - 5 kHz
without hysteresis	

Motion monitoring modules PNOZ m EF 1MM2DO

Incremental encoder input	
Number of inputs	1
Connection type	Mini-IO female connector, 8-pin
Input signal level	0,5 - 30 Vss
Phase position for the differential signals A, /A and B, /B	90° ±30°
Overload protection	-50 - 65 V
Input resistance	20 kOhm
Input's frequency range	0 - 500 kHz
Configurable monitoring frequency	
Without hysteresis	0,1 Hz - 500 kHz
Semiconductor outputs	
Number of positive-switching single-pole semiconductor outputs	2
Switching capability	
Voltage	24 V
Typ. output current at "1" signal and rated voltage of semiconductor output	0,5 A
Permitted current range	0,000 - 0,600 A
Residual current at "0" signal	0,02 mA
Max. transient pulsed current	3 A
Max. capacitive load	1 µF
Max. internal voltage drop	500 mV
Max. duration of off time during self test	200 µs
Switch-off delay	1 ms
Potential isolation	Yes
Short circuit-proof	Yes
Semiconductor outputs (standard)	
Quantity	1
Switching capability	
Voltage	24 V
Current	0,5 A
Galvanic isolation	Yes
Switch-off delay	1 ms
Short circuit-proof	Yes
Cascading output as standard output	
Quantity	1
Switching capability	
Voltage	24 V
Galvanic isolation	Yes
Short circuit-proof	Yes

Motion monitoring modules PNOZ m EF 1MM2DO

Times	
Reaction time after limit value is exceeded	1/f_ist + 10ms
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Sensor and system voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Potential isolation between	SC output and system voltage
Type of potential isolation	Basic insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V

Motion monitoring modules PNOZ m EF 1MM2DO

Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	131 g

Where standards are undated, the 2019-12 latest editions shall apply.

Motion monitoring modules PNOZ m EF 1MM2DO

Safety characteristic data

Unit	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 _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
------	----------------	----------------------------	----------------------------------	---	--	---------------------	---------------------	---

Logic

Input module	Monitoring 1 encoder	PL d	Cat. 2	SIL 2	1,80E-08	SIL 2	1,58E-03	20
Input module	Monitoring 2 encoders	PL e	Cat. 3	SIL 3	1,01E-09	SIL 3	8,41E-05	20
Input module	Monitoring safe encoder	PL e	Cat. 4	SIL 3	2,35E-09	SIL 3	2,04E-04	20
CPU	2-channel	PL e	Cat. 4	SIL 3	3,54E-10	SIL 3	3,04E-05	20

Output

SC outputs	1-channel	PL d	Cat. 2	SIL 2	5,43E-11	SIL 2	4,74E-06	20
SC outputs	1-channel with advanced fault detection	PL e	Cat. 4	SIL 3	1,49E-11	SIL 3	1,31E-06	20
SC outputs	2-channel	PL e	Cat. 4	SIL 3	4,30E-11	SIL 3	3,76E-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_M 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.

Motion monitoring modules PNOZ m EF 1MM2DO

Classification according to ZVEI, CB24I

The following tables describe the classes and specific values of the product interface and the classes of interfaces compatible with it. The classification is described in the ZVEI position paper "Classification of Binary 24 V Interfaces - Functional Safety aspects covered by dynamic testing".

Single-pole output

Interfaces

Source

Interface	Module
Class	C2

Drain

Interface	Actuator
Class	C1, C2

Source parameters

Max. test pulse duration	200 µs
Max. rated current	0,5 A
Max. capacitive load	1 µF

Supplementary data

Categories

Safety level

The maximum achievable safety level depends, among other things, on the sensor, the wiring and the operating mode of the PNOZ m EF 1MM2DO.

Information on the safety-related characteristic data for the subsystems *Sensor* and PNOZ m EF 1MM2DO

Example:

Sensor subsystem			Subsystem PNOZ m EF 1MM2DO	
Category	MTTFd	DC	Operating mode	PFH [1/h]
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

The values for **Category** and **DC** can be set for the sensor subsystem, bearing in mind the restrictions stated in the respective chapter. The MTTFd value must be stated by the sensor manufacturer.

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 1MM2DO

Assuming that all faults are dangerous, MTTF = MTTFd can be set.

The characteristic value MTTF is a property of the sensor, which may only be stated by the manufacturer.

Forced dynamisation:

When monitoring sensors with square output signals (TTL, HTL) or safe sensors, the axis must be moved within 8 hours so that the signal changes on all the connected tracks.

Key:

SRP/CS = Safety-related part of a control system (EN 13849-1, Tab. 2)

Safety functions

The following safe monitoring functions are available:

- ▶ Safe speed monitoring (SSM)
- ▶ Safe speed range monitoring (SSR-M)
- ▶ Safe direction monitoring (SDI-M)
- ▶ Safe operating stop monitoring (SOS-M)
- ▶ Safe stop 1 monitoring (SS1-M)
- ▶ Safe stop 2 monitoring (SS2-M)
- ▶ Safely limited acceleration monitoring (SLA-M)
- ▶ Safely limited acceleration range monitoring (SAR-M)

The safety functions of the PNOZ m EF 1MM2DO are monitoring functions, whereby a safe output signal is used to show if defined limit values are exceeded.

The reaction function that takes place (e.g. shutting down the drive, activating a mechanical brake) when exceeded limit values are detected during the normal operation of the safety function must be defined and implemented by the machine/plant developer and does not form part of the PNOZ m EF 1MM2DO.

The monitoring function of the PNOZ m EF 1MM2DO can be used to implement safety functions defined in the standard EN 61800-5-2 for Adjustable speed electrical power drive systems.

Safety functions in accordance with EN 61800-5-2	Implemented with monitoring function of the PNOZ m EF 1MM2DO
Safe Operating Stop (SOS)	Safe operating stop monitoring (SOS-M)
Safe Speed Range (SSR)	Safe speed range monitoring (SSR-M)
Safe Direction (SDI)	Safe direction monitoring (SDI-M)
Safe Speed Monitoring (SSM)	Safe speed monitoring (SSM)

Motion monitoring modules PNOZ m EF 1MM2DO

Safety functions in accordance with EN 61800-5-2	Implemented with monitoring function of the PNOZ m EF 1MM2DO
Safe Stop 1 (SS1)	Safe stop 1 monitoring (SS1-M)
Safe Stop 2 (Safe stop 2, SS2)	Safe stop 2 monitoring (SS2-M)
Safely Limited Acceleration (Safely Limited Acceleration, SLA)	Safely limited acceleration monitoring (SLA-M)
Safely Acceleration Range Monitoring (Safely Acceleration Range Monitoring, SAR)	Safely limited acceleration range monitoring (SAR-M)

Safety-related characteristic data for operation with non-safety-related encoder without additional requirements

Permitted sensor types and output signals

Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1V_{ss}, reference voltage
- ▶ Sin/Cos output signals 1V_{ss}, differential

Safety-related architecture

To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem PNOZ m EF 1MM2DO:

Sensor			Subsystem PNOZ m EF 1MM2DO	
Category	MTTF _d	DC	Operating mode	PFH (1/h)
1*	Manufacturer-specific	0 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

*In accordance with EN ISO 13849-1, Category 1 is only met if the sensor is a "well-tried component".

Motion monitoring modules PNOZ m EF 1MM2DO

Achievable safety level

Monitoring function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL c (Cat.1)	-
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		

Safety-related characteristic data for operation with non-safety-related encoder with mechanical fault exclusion

In accordance with EN 61800-5-2: 2007, Table D.16 (Motion and position feedback sensors), fault exclusions are permitted for faults in the mechanical connection between the sensor and motor.

Permitted sensor types and output signals

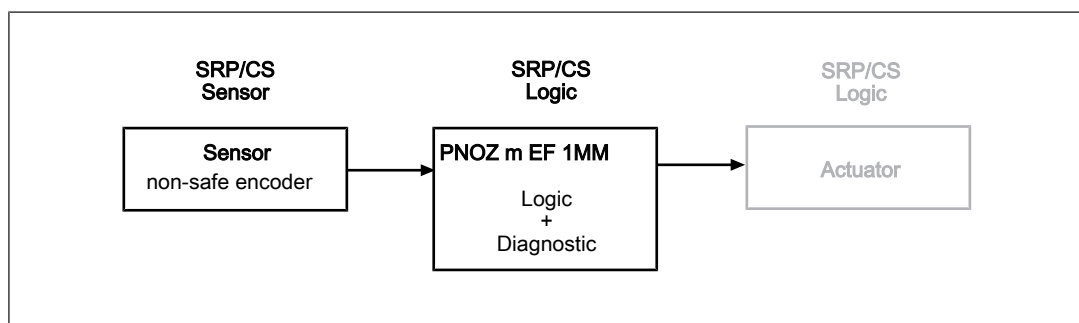
Permitted encoder types:

- ▶ Rotary non-safety-related encoders

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Safety-related architecture



Motion monitoring modules PNOZ m EF 1MM2DO

To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM2DO":

Sensor			Subsystem PNOZ m EF 1MM2DO	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL d (Cat.2)	2
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with non-safety-related encoder with diagnostics via the drive controller

The detection of sensor errors (diagnostics for the sensor subsystem via the evaluation device) can be supplemented with a drive controller.

Permitted sensor types and output signals

Permitted sensor types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

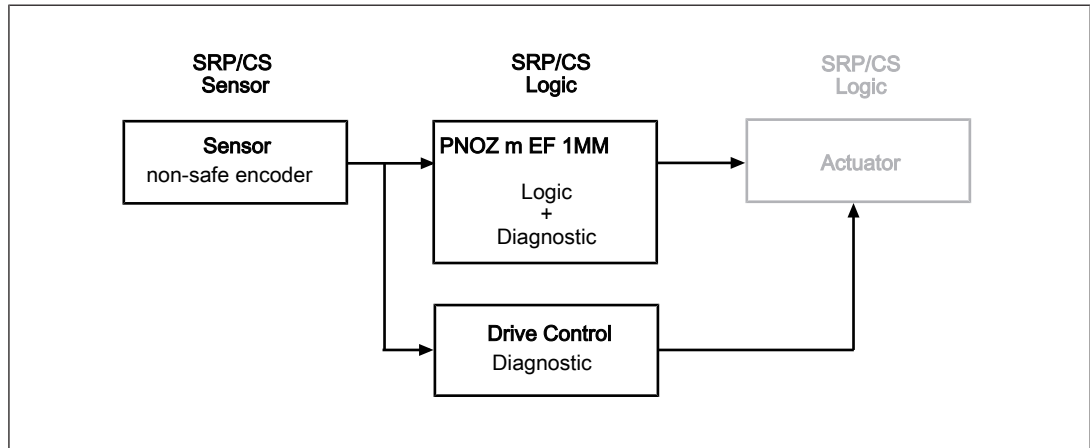
- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Motion monitoring modules PNOZ m EF 1MM2DO

Requirements of the drive controller

- ▶ Parameters for the control loops and motor control must be set in such a way as to guarantee stable operation.
Drag error detection (see below) must be capable of operating in accordance with the requirements of the safety function.
- ▶ The motor must be operated with a current impressing control procedure, based on the rotor position (field-oriented control). If the analogue track signals are idle, field-oriented control will brake and/or stop the rotor.
- ▶ The drive controller must be in position control operating mode.
- ▶ If a maximum error variable is exceeded (set/true comparison) the drive controller must switch to a fault condition and stop the drive (drag error detection). The error reaction to drag error detection should be a controlled motor stop.
- ▶ Fault detection via the error variable with subsequent shutdown must meet the requirements of the safety function, with regard to reaction times for example.
- ▶ The drive controller must evaluate the same incremental/SinCos signals from the encoder for control as are processed by the safe evaluation device (important on encoders with combined analogue/digital interface).

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM2DO":

Sensor			Subsystem PNOZ m EF 1MM2DO	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 sensor	1,83E-08

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 1MM2DO

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL d (Cat.2)	2
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with a safe encoder

Safe encoders are certified in accordance with EN/IEC 61508, EN 13849 and EN/IEC 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ m EF 1MM2DO) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

Permitted sensor types and output signals

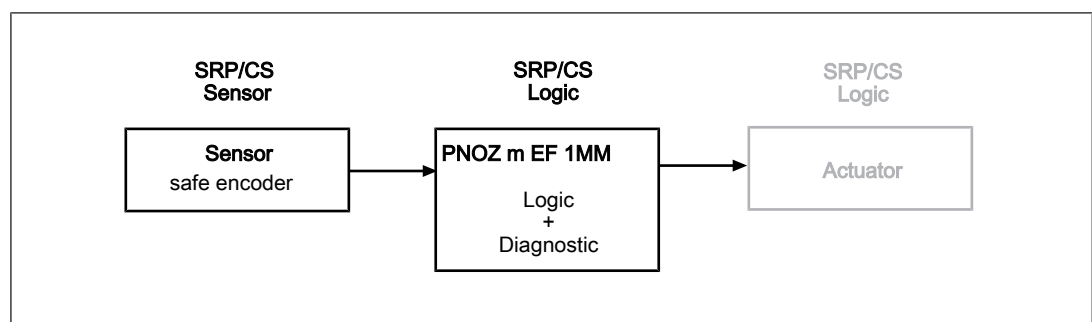
Permitted encoder types:

- ▶ Rotary safety-related encoders
- ▶ Linear safety-related encoders

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM2DO":

Motion monitoring modules PNOZ m EF 1MM2DO

Sensor			Subsystem PNOZ m EF 1MM2DO	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring Safe sensor	2,69E-09

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL e (Cat.4)	3
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with a safe encoder with Z index

Safe encoders are certified in accordance with EN/IEC 61508, EN 13849 and EN/IEC 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ m EF 1MM2DO) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

Permitted sensor types and output signals

Permitted encoder types:

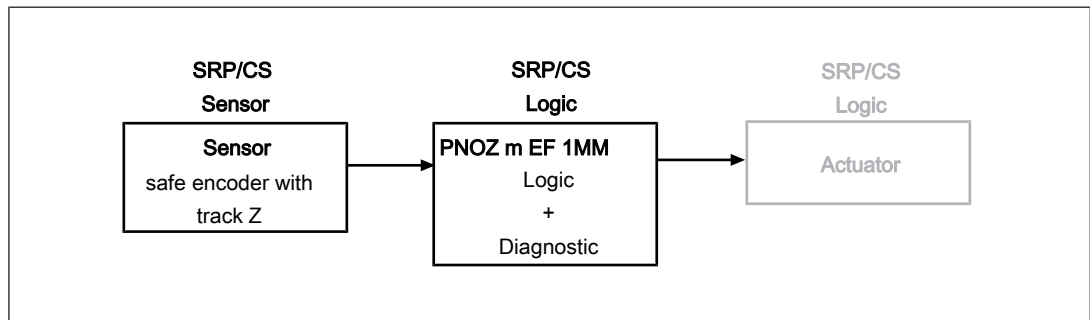
- ▶ Rotary safety-related encoders
- ▶ Linear safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, differential with Z index
- ▶ Square output signals HTL, differential with Z index
- ▶ Sin/Cos output signals 1Vss, reference voltage with Z index
- ▶ Sin/Cos output signals 1Vss, differential with Z index

Motion monitoring modules PNOZ m EF 1MM2DO

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM2DO":

Sensor			Subsystem PNOZ m EF 1MM2DO	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring 2 sensors	1,35E-09

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	PL e (Cat.4)	3
SSR-M		
SDI-M		
SSM		
SS1-M		
SS2-M		
SLA-M		
SAR-M		

Safety-related characteristic data for operation with non-safety-related encoder and proximity switch

The speed monitoring of the non-safety-related encoder can be verified via an additional reference sensor.

Permitted sensor types and output signals

Non-safety-related encoder

Permitted encoder types:

- ▶ Rotary non-safety-related encoders

Motion monitoring modules PNOZ m EF 1MM2DO

- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

Reference sensor

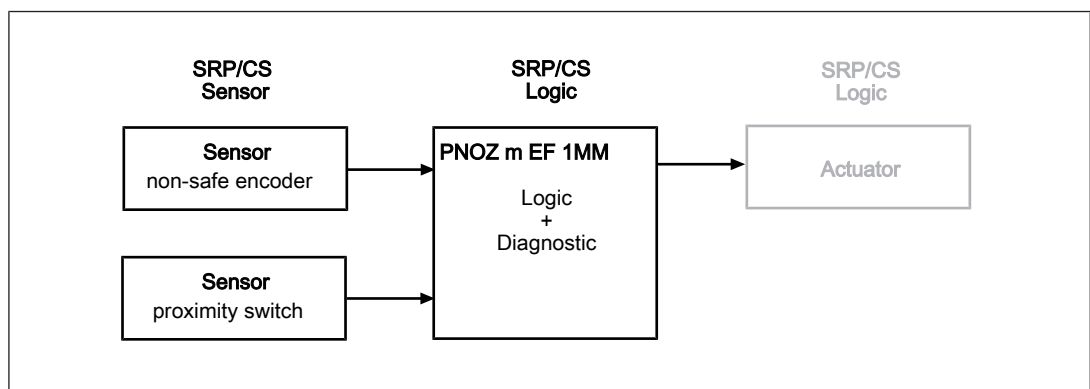
Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders
- ▶ Inductive proximity switches

Permitted output signals:

- ▶ Square output signals HTL, single ended
- ▶ Square output signal 24 V, pnp

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem PNOZ m EF 1MM2DO:

Sensor			Subsystem PNOZ m EF 1MM2DO	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 sensors	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 1MM2DO

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M SDI-M SS2-M	PL c (Cat.1)	-
SSR-M SSM SS1-M SLA-M SAR-M	PL e (Cat.4)	3

Please note:

For the "sensor" subsystem, a minimum speed must be exceeded within forced dynamisation.

The minimum speed depends on the ratio of the frequency at tracks AB " f_{AB} " to the frequency at track Z " f_Z " in your configuration (see PNOZmulti Configurator **Element Motion Monitor**, value **Calculated Ratio AB/Z**) and is determined as follows:

- ▶ when **f_{AB}/f_Z Ratio** ≥ 1.0
 $f_Z = 10$ mHz or $f_{AB} = (f_{AB}/f_Z) \times 10$ mHz
- ▶ when **f_{AB}/f_Z Ratio** < 1.0
 $f_{AB} = 10$ mHz or $f_Z = 10$ mHz / (f_{AB}/f_Z)

At the very latest, a feasibility error will be detected when a tolerance expires. The tolerance level depends on the ratio of the frequency at tracks AB " f_{AB} " to the frequency at track Z " f_Z " in your configuration (**f_{AB}/f_Z Ratio** setting in the menu) and is calculated as follows:

- ▶ when **f_{AB}/f_Z Ratio** ≥ 1.0
7.5 Z-pulses or $7.5 \times (f_{AB}/f_Z)$ AB-pulses
- ▶ when **f_{AB}/f_Z Ratio** < 1.0
4.5 AB-pulses or $4.5 / (f_{AB}/f_Z)$ Z-pulses

Motion monitoring modules PNOZ m EF 1MM2DO

Safety-related characteristic data for operation with 2 proximity switches

Permitted sensor types and output signals

Non-safety-related sensor

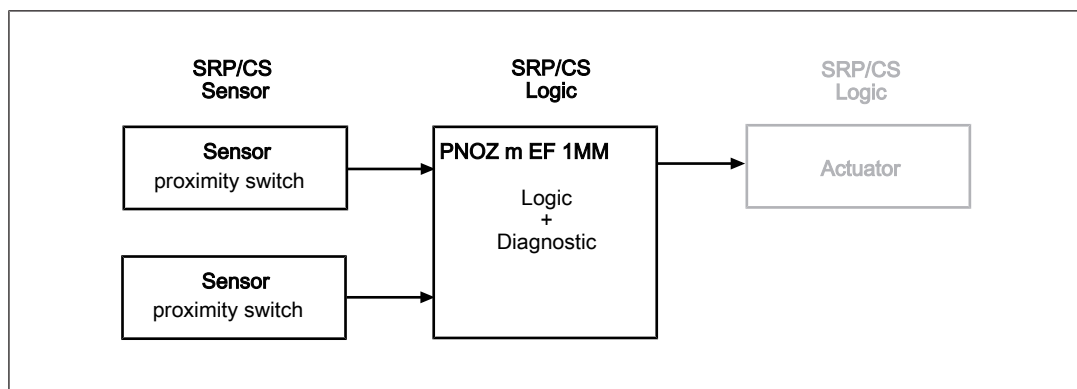
Permitted sensor types:

- ▶ Inductive proximity switches

Permitted output circuits:

- ▶ pnp
- ▶ npn

Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM2DO":

Sensor			Subsystem PNOZ m EF 1MM2DO	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 sensors	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The values for **DC** refer to the standard EN/IEC 61508.

Motion monitoring modules PNOZ m EF 1MM2DO

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M SDI-M SS2-M	-	-
SSR-M SSM SS1-M SLA-M SAR-M	PL e (Cat.4)	3

Please note:

Common cause failures (CCF) are possible for the sensor subsystem. An appropriate analysis must be carried out.

To use proximity switches 1 and 2 we recommend that you:

- ▶ Use different technologies/design or physical principles (e.g. different manufacturers) and
- ▶ Evaluate the sensor supply via track S

Safety characteristic data for operation with 2 proximity switches with reduced diagnostics

Permitted sensor types and output signals

Non-safety-related sensor

Permitted sensor types:

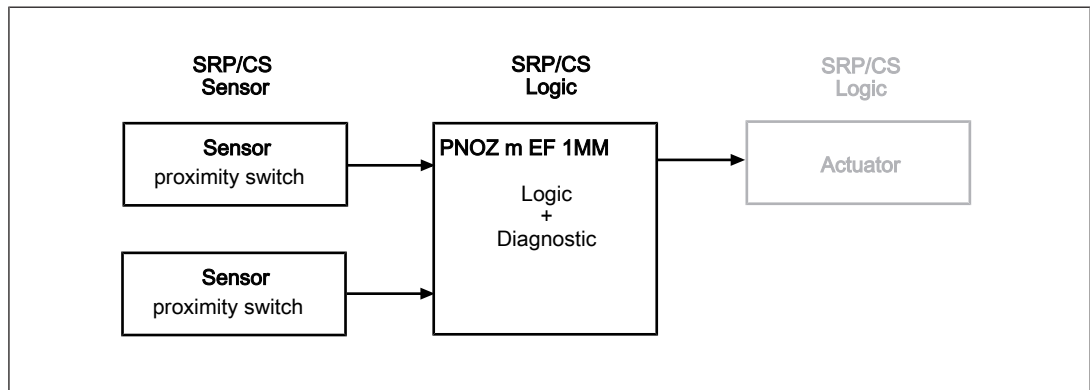
- ▶ Inductive proximity switches

Permitted output circuits:

- ▶ pnp

Motion monitoring modules PNOZ m EF 1MM2DO

Safety-related architecture



The supply voltage of the proximity switches must be monitored as a measure against systemic failure.

To calculate the safety function you will need the following data for the "sensor" subsystem and the subsystem "PNOZ m EF 1MM2DO":

Sensor			Subsystem PNOZ m EF 1MM2DO	
Category	MTTFd	DC ₁₃₈₄₉	Operating mode	PFH (1/h)
3	Manufacturer-specific	90 %*	Monitoring 2 sensors with reduced diagnostics	1,35E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

The value for DC refers to the standard EN13849

*see EN 13849-1 table E.1

"Cross monitoring of input signals with dynamic test if short circuits are not detectable (for multiple I/O)" → 90%

Achievable safety level

Monitoring function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
SOS-M	-	-
SDI-M		
SS2-M		
SSR-M	PL d (Cat.3)	2
SSM		
SS1-M		
SLA-M		
SAR-M		

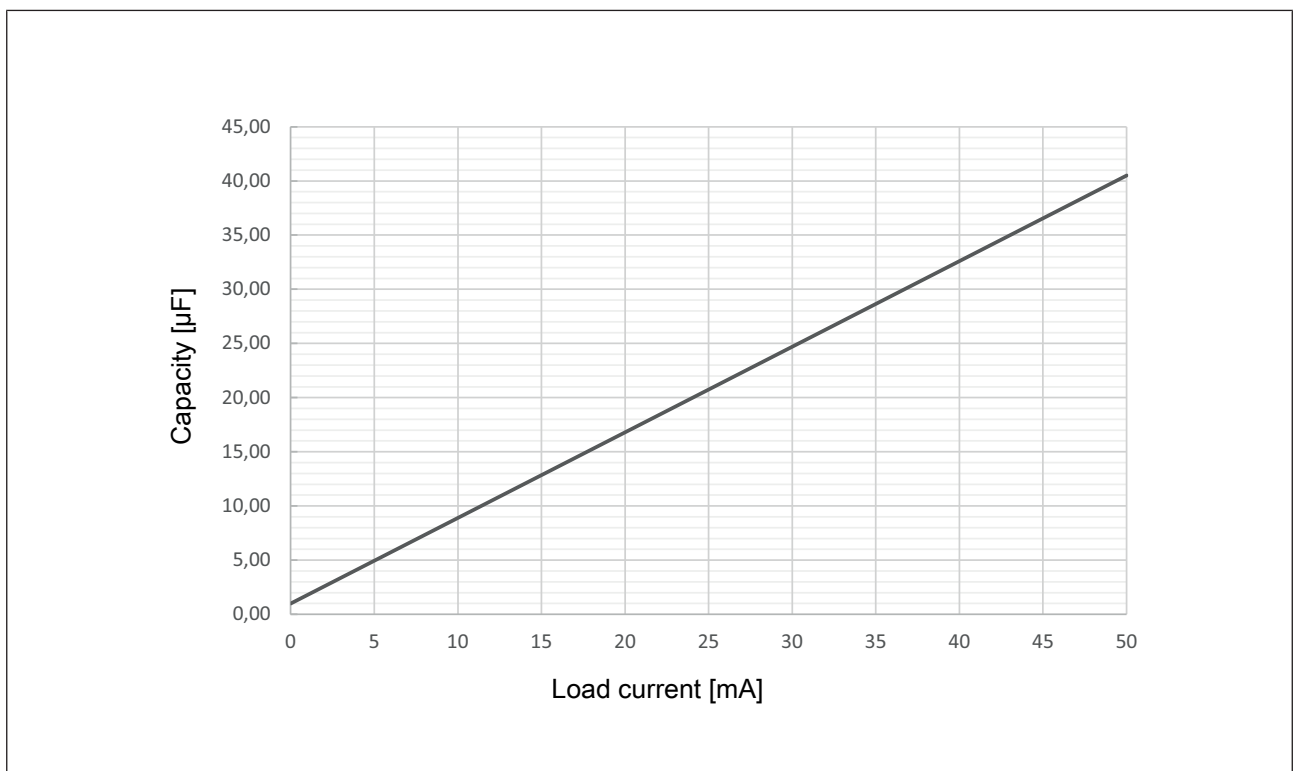
Motion monitoring modules PNOZ m EF 1MM2DO

Please note:

Common cause failures (CCF) are possible for the sensor subsystem. An appropriate analysis must be carried out.

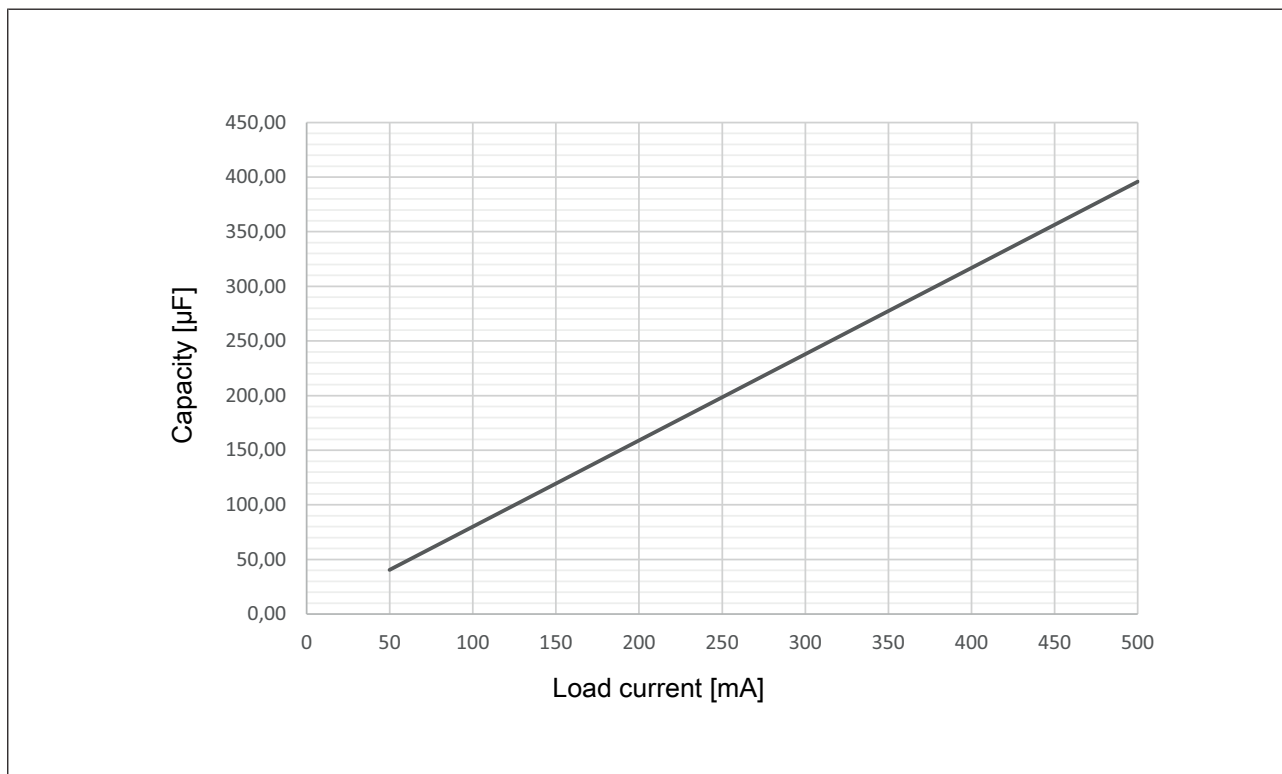
Output capacitance C

Typical load capacity at 0 to 50 mA

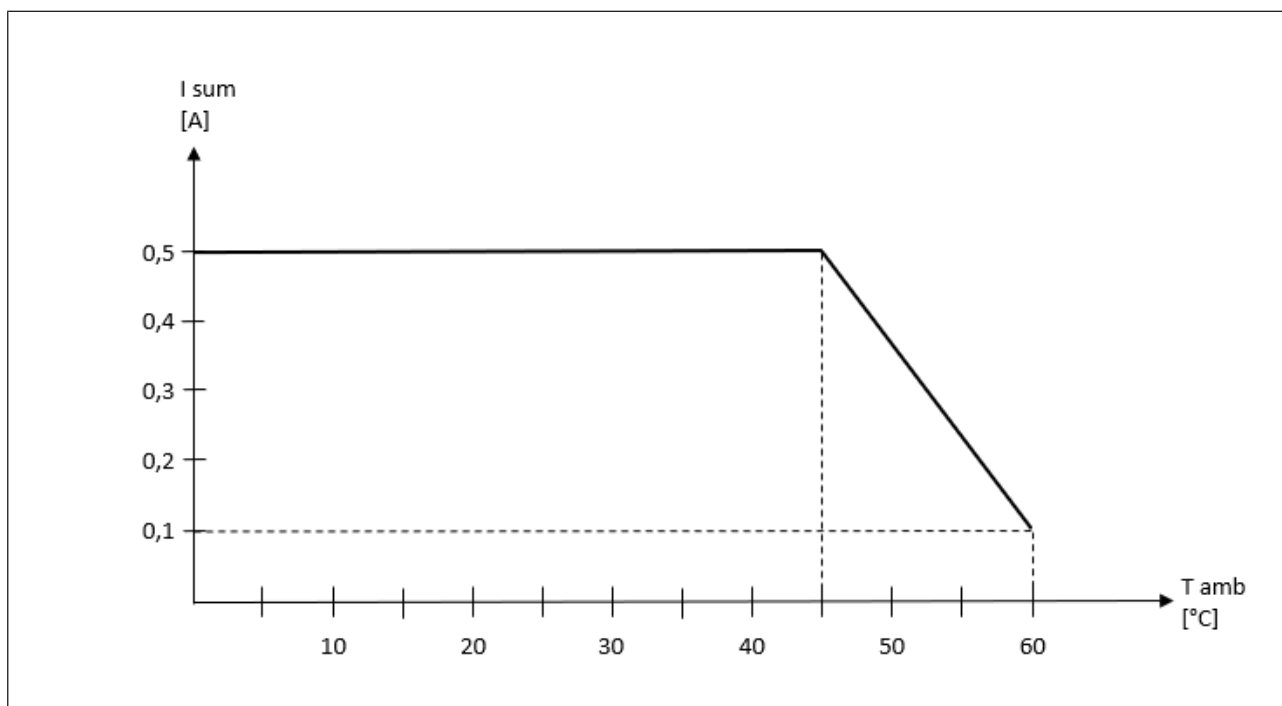


Motion monitoring modules PNOZ m EF 1MM2DO

Typical load capacity at 50 to 500 mA



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



Motion monitoring modules PNOZ m EF 1MM2DO

Order reference

Product

Product type	Features	Order no.
PNOZ m EF 1MM2DO	Configurable safe small controllers PNOZmulti 2, expansion module, safe monitoring of 1 axis, 2 safe outputs, cascading input.	772172

Accessories

Terminals

Product type	Features	Order no.
PNOZ s Setscrew terminals 22.5mm	Set of plug-in replacement terminals 4-pin of screw type, PU = 1 piece each X1, X2, X3, X4.	750004
PNOZ s Setspring-loaded terminals 22.5mm	Set of plug-in replacement terminals 4-pin of spring-loaded type, PU = 1 piece each X1, X2, X3, X4.	751004

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Connection box

Product type	Features	Order no.
PNOZ msi b4 Box	Shielded connection box PSEN msi b4, for connecting an incremental encoder to a proximity switch, with/without pull resistor, with additional supply for the proximity switch.	773845

Adapter

Product type	Features	Order no.
MM A MINI-IO CAB99 1.5m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 1.5 m.	772200
MM A MINI-IO CAB99 2.5m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 2.5 m.	772201
MM A MINI-IO CAB99 5.0m	Adapter cable for PNOZmulti 2 and PSS 4000 Motion Monitoring, 5 m.	772202

Link modules

PNOZ m EF Multi Link




Overview

Unit features

Application of the product PNOZ m EF Multi Link:

Link module to safely connect two configurable small control systems PNOZmulti.

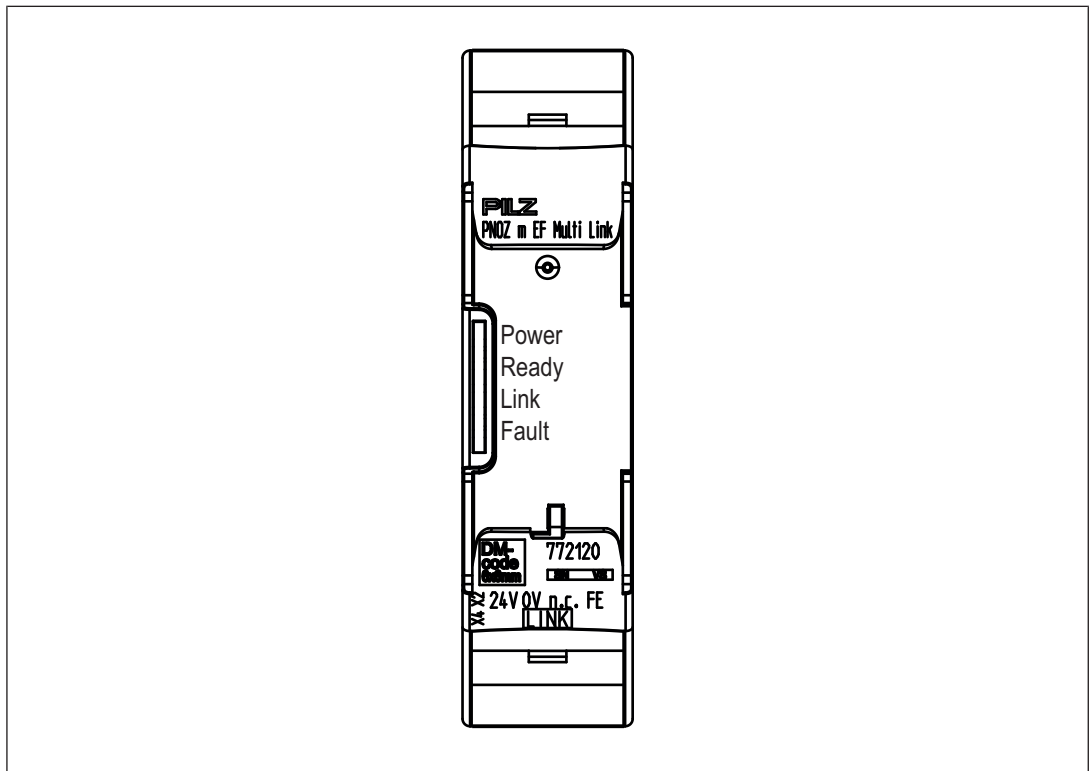
The product has the following features:

- ▶ Connection options: Two base units of the configurable small control systems PNOZmulti
- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Point-to-point connection via 4-core shielded, twisted-pair cable
- ▶ 32 virtual inputs and 32 virtual outputs
- ▶ Status indicators
- ▶ Max. 4 PNOZ m EF Multi Link can be connected to the base unit
- ▶ LED indicators for
 - Operating status
 - Error
 - Connection status
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [ 272]).

Link modules

PNOZ m EF Multi Link

Front view



Legend:

- ▶ X2:
 - 0 V, 24 V: Supply connections
 - FE: Functional earth
- ▶ Link: Connection
- ▶ LEDs:
 - Power
 - Ready
 - Link
 - Fault

Link modules

PNOZ m EF Multi Link

Function Description

Functions

The link module PNOZ m EF Multi Link is used to safely transfer the input information from 32 virtual inputs and 32 virtual outputs between two PNOZmulti systems. One link module is assigned to each base unit. Data is exchanged cyclically.

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 LEDs on the base unit and expansion modules indicate the status of the configurable control system PNOZmulti.

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

Data exchange:

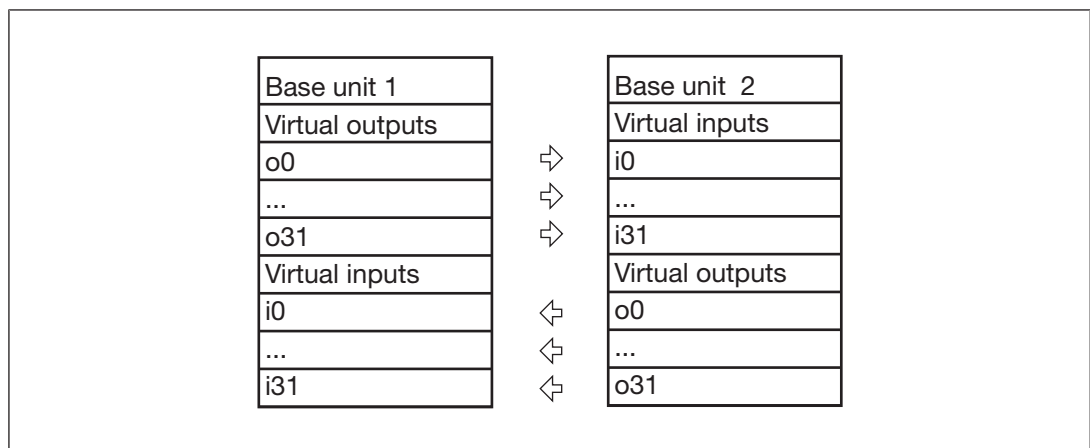
- ▶ Data is exchanged cyclically.
- ▶ After the end of a PNOZmulti cycle, each base unit sends its output data to its link module. This output data is immediately sent to the link module on the other base unit.
- ▶ At the same time, the base unit reads the input data from the link module.

Connection of multiple base units:

Any number of base units can be connected via link modules. Two link modules are required for a connection between two base units. However, only a maximum of 4 link modules may be connected to any one base unit.

Virtual inputs and outputs:

Inputs and outputs for both PNOZmulti systems are assigned in the PNOZmulti Configurator. Inputs and outputs with the same number are assigned to each other, e.g. output o5 on one PNOZmulti system to input i5 on the other PNOZmulti system.



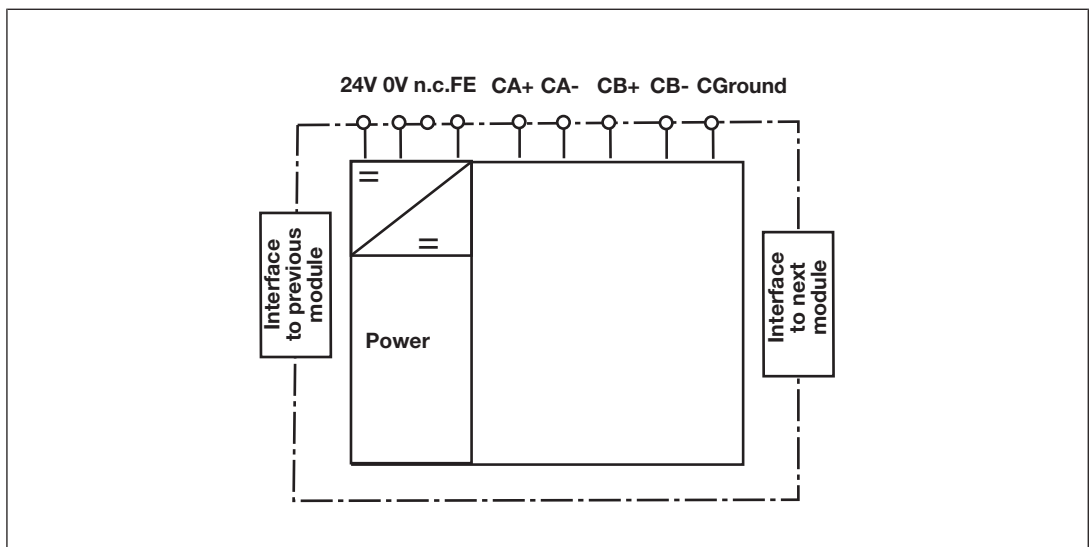
Link modules

PNOZ m EF Multi Link

System reaction time

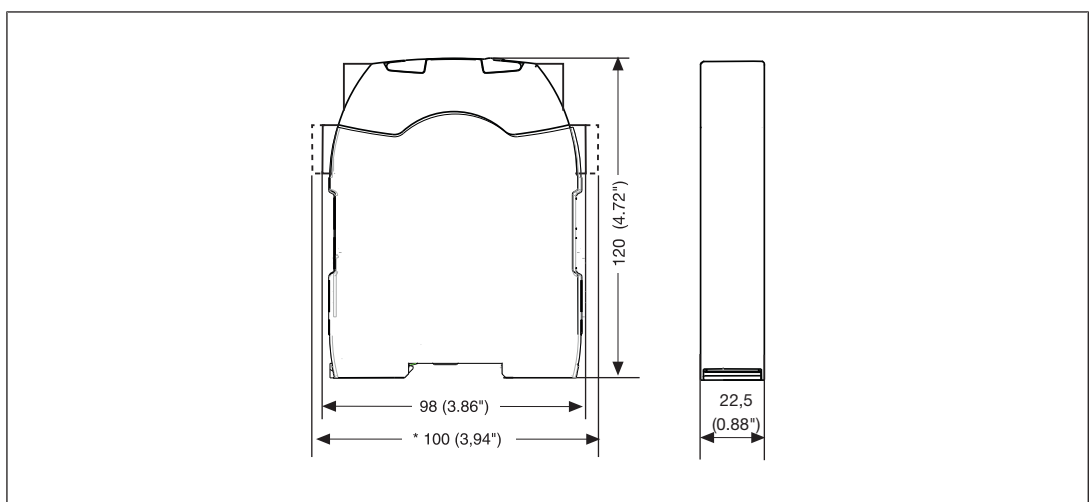
Calculation of the maximum reaction time between an input switching off and a linked output in the system switching off is described in the document "System Expansion".

Block diagram



Installation

Dimensions in mm



Link modules

PNOZ m EF Multi Link

Commissioning

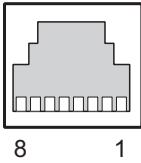
Wiring

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

Please note:

- ▶ Information given in the [Technical details \[435\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).
- ▶ 2 connection terminals are available for each of the supply connections 24 V and 0 V. This means that the supply voltage can be looped through several connections. The current at each terminal may not exceed 3 A.
- ▶ The max. cable length between two link modules on a connection with one link module
 - PNOZ m1p <V2.0: 100 m
 - PNOZ m1p from V2.0, PNOZ mml1p, PNOZ m EF Multi Link: 1000 m
- ▶ Connect the inputs and outputs from two link modules with a 4-core shielded cable. The cables must be twisted in pairs.
- ▶ Note the crossover cabling, e.g. CA+ with CB+.
- ▶ The cables must be classified into a minimum of Category 5 in accordance with ISO/IEC 11801.

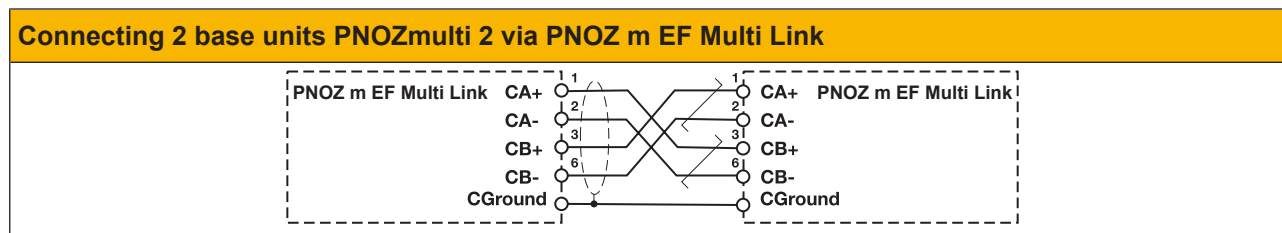
Connection

RJ45 socket 8-pin	PIN	Layout
	1	CA+
	2	CA-
	3	CB+
	4	n.c.
	5	n.c.
	6	CB-
	7	n.c.
	8	n.c.
	Shield	CGround

Link modules

PNOZ m EF Multi Link

Supply voltage	AC	DC
	/	



Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-15 %/+20 %
Output of external power supply (DC)	2,5 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	3 W
Status indicator	LED
Fieldbus interface	
Galvanic isolation	Yes
Times	
Max. data transmission time	5 ms

Link modules

PNOZ m EF Multi Link

Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 55 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Module and supply voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Potential isolation between	Module and system voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Mechanical data	
Mounting position	horizontally on mounting rail

Link modules

PNOZ m EF Multi Link

Mechanical data	
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	
	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	91 g

Where standards are undated, the 2013-01 latest editions shall apply.

Link modules

PNOZ m EF Multi Link

Safety characteristic data

Operating mode	EN ISO 13849-1: 2015	EN ISO 13849-1: 2015	EN IEC 62061 SIL CL/ maximum SIL	EN IEC 62061 PFH _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
2-channel	PL e	Cat. 4	SIL 3	8,82E-09	SIL 3	3,86E-05	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_M 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.

Order reference

Product

Product type	Features	Order no.
PNOZ m EF Multi Link	Configurable safe small controllers PNOZmulti 2, expansion module, safe connection of 2 configurable safe small controllers PNOZmulti 2.	772120

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ mmc2p, mml1p 1 pc.	Spring-loaded terminals, PNOZ mmc2p, PNOZ mml1p, 1 set.	783538
Screw terminals PNOZ mmc2p, mml1p 1 pc.	Plug-in screw terminals, PNOZ mmc2p, PNOZ mml1p, 1 set.	793538
Spring terminals PNOZ mmc2p, mml1p 10 pcs	Spring-loaded terminals, PNOZ mmc2p, PNOZ mml1p, 10 sets.	783539

Link modules

PNOZ m EF Multi Link

Product type	Features	Order no.
Screw terminals PNOZ mmc2p,mml1p 10 pcs.	Plug-in screw terminals, PNOZ mmc2p, PNOZ mml1p, 10 sets.	793539

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp con- nector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Link modules

PNOZ m EF PDP Link




Overview

Unit features

Application of the product PNOZ m EF PDP Link:

Link module to safely connect decentralised input/output modules to a configurable control system PNOZmulti 2

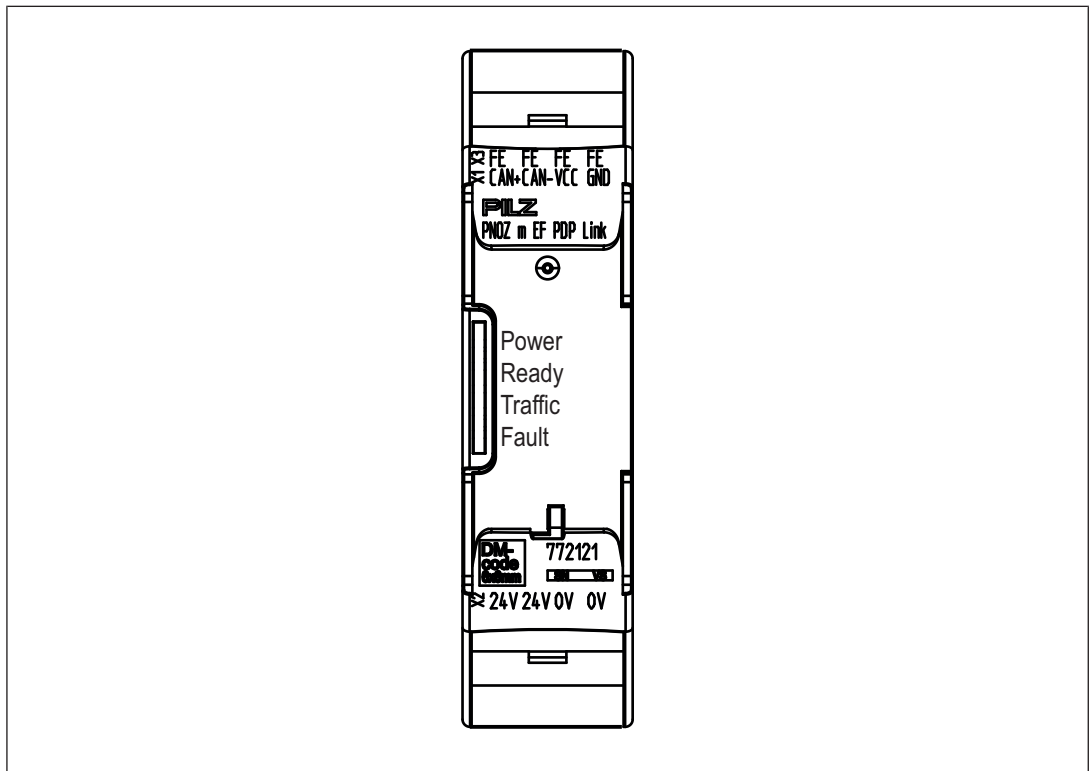
The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Max. 4 PNOZ m EF PDP Link can be connected to the base unit
- ▶ Max. 4 decentralised modules can be connected to the link module PNOZ m EF PDP Link
- ▶ LEDs for
 - Operating state
 - Error
 - Connection status
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [ 272]).

Link modules

PNOZ m EF PDP Link

Front view



Legend:

- ▶ 0 V, 24 V:
Supply connections
- ▶ CAN+, CAN-, VCC, GND:
Connection for decentralised modules
- ▶ FE:
Functional earth

Function description

Functions

The link module PNOZ m EF PDP Link is used to safely transfer the input information from decentralised modules to the control system PNOZmulti 2.

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 LEDs on the base unit and expansion modules indicate the status of the configurable control system PNOZmulti.

Link modules

PNOZ m EF PDP Link

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

Data exchange:

- ▶ Communication with the decentralised modules is via a safe data link.
- ▶ The link module PNOZ m EF PDP Link reads the input information from the decentralised modules as part of each cycle and then forwards it to the base unit.
- ▶ At the end of a PNOZmulti cycle, the base unit sends its output data to its link module. This output data is immediately sent to the decentralised modules.

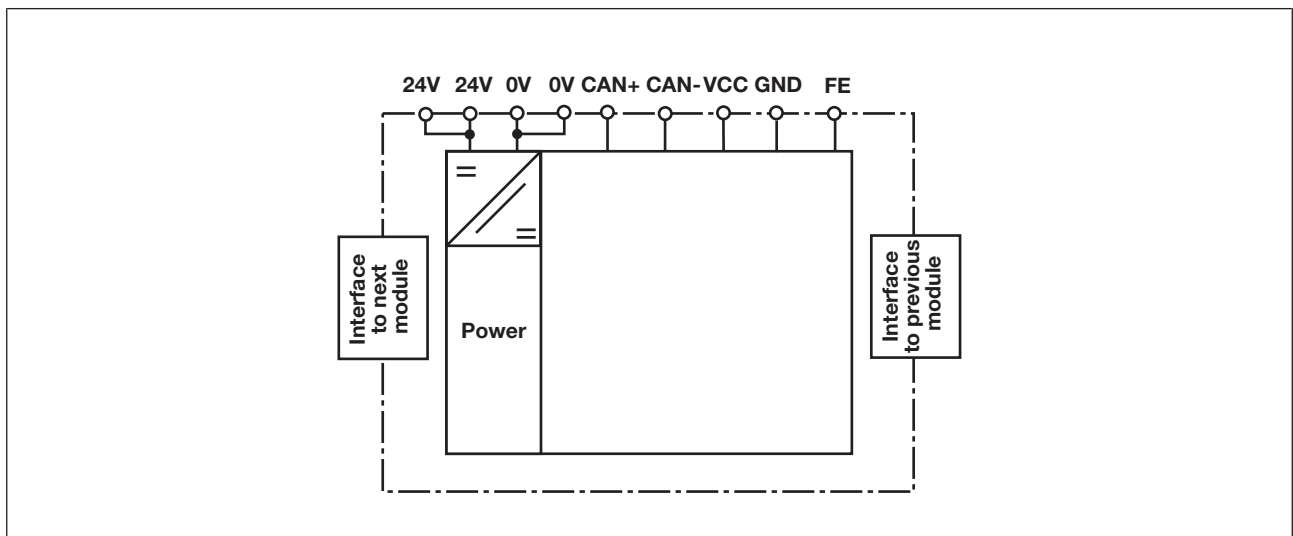
Linking several decentralised modules:

- ▶ A maximum of 4 link modules can be connected to a base unit PNOZmulti 2.
- ▶ A maximum of 4 decentralised modules can be connected to a link module PNOZ m EF PDP Link.
- ▶ If a decentralised module receives data intended for a different decentralised module that is connected, the data is forwarded without being processed.

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 "PNOZmulti System Expansion".

Block diagram

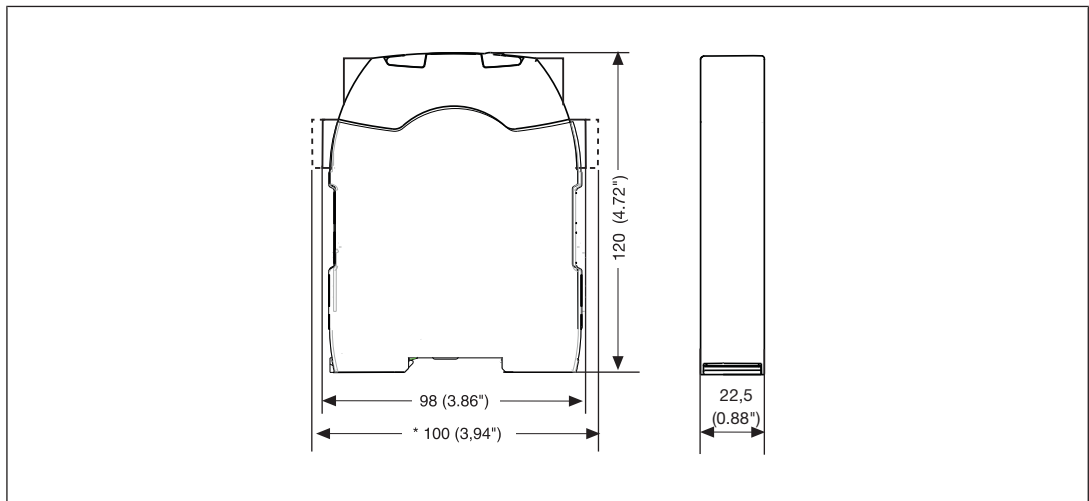


Link modules

PNOZ m EF PDP Link

Installation

Dimensions in mm



Commissioning

Wiring

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

Please note:


- ▶ Information given in the [Technical details \[447\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ External measures must be used to connect the FE terminal to the functional earth (e.g. mounting rail).
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).
- ▶ 2 connection terminals are available for each of the supply connections 24 V and 0 V. This means that the supply voltage can be looped through several connections. The current at each terminal may not exceed 3 A.
- ▶ Please refer to the technical details for information on the maximum cable length. Please also read the section entitled "Voltage drop".
- ▶ With a cable length of 30 m or above, or in environments with strong interfaces, shielded cables must be used.

Link modules

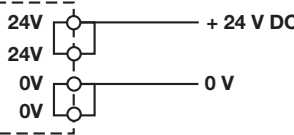
PNOZ m EF PDP Link

- ▶ If there are signal interferences/EMC problems that are to be expected or present, we recommend that you use a shielded cable from the beginning. In addition, you can place the braided shield of the cables directly next to the device via a shielded terminal to the functional earth (mounting rail).
- ▶ Pilz pre-assembled cable can be used to connect the decentralised modules (see order reference).
- ▶ The plug-in connection terminals are either designed as cage clamp terminals or screw terminals (see order reference).

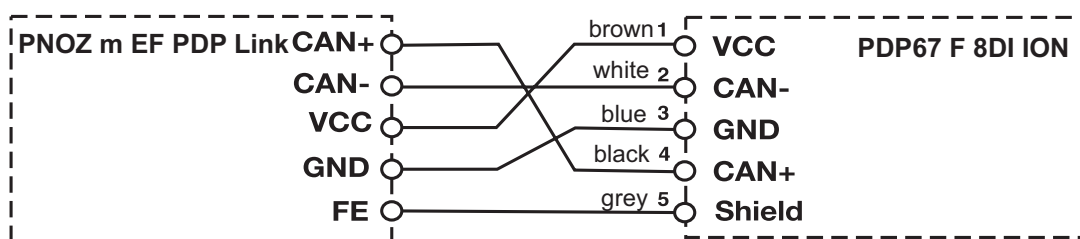
Insulation voltage test

The product PNOZ m EF PDP Link is connected to functional earth  via protection elements on the supply voltage. Insulation voltage tests are only possible with voltages up to ca. 42 V.

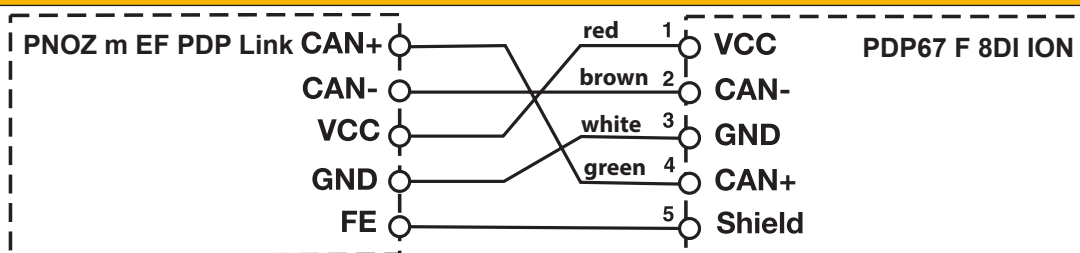
Connection

Supply voltage	AC	DC
	/	

Connection to a decentralised input module PDP67 when using the PSEN op cable axial M12 5-pole from Pilz (see order reference)



Connection when using the PSS SB BUSCABLE LC in conjunction with a Pilz self-assembly "PSS67 M12 connector" (see order reference in the Technical Catalogue)



Link modules

PNOZ m EF PDP Link

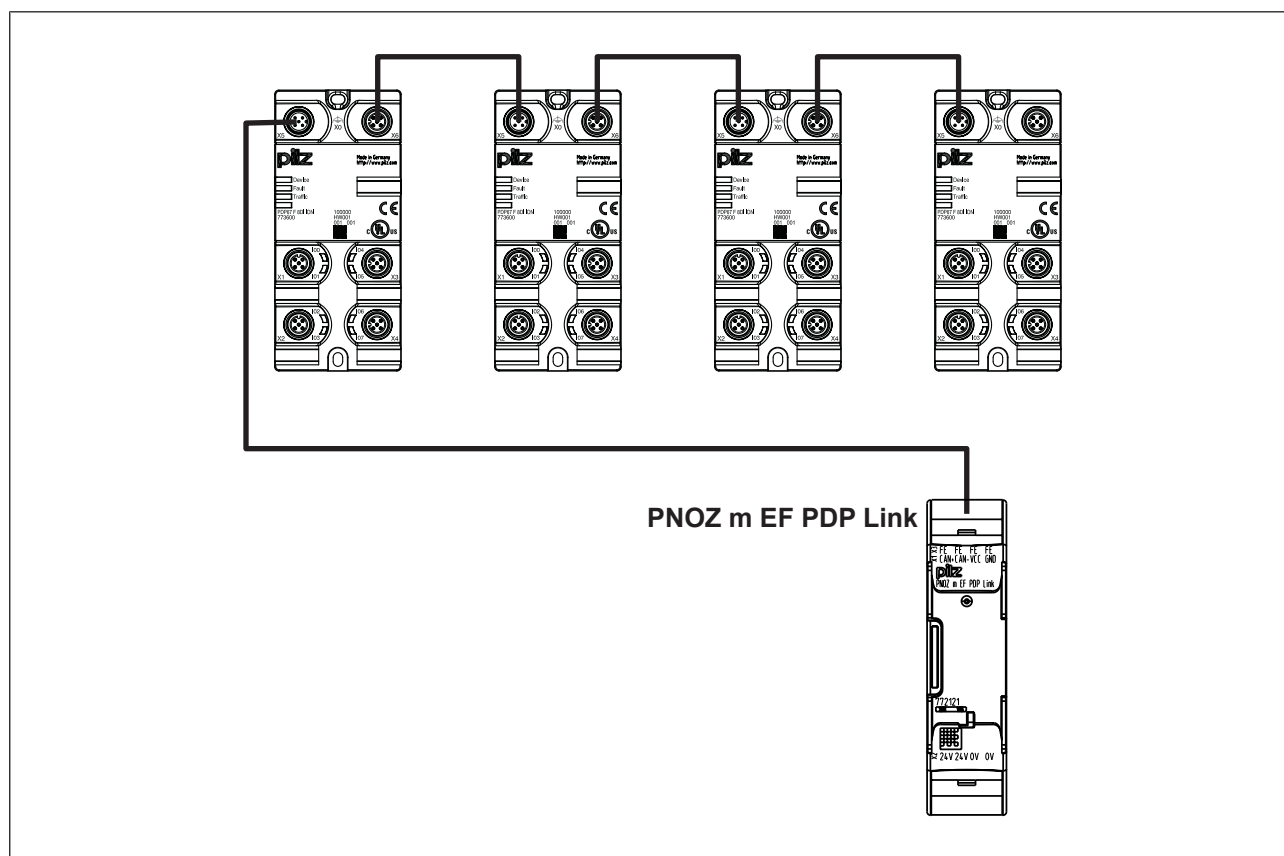
Download modified project to the PNOZmulti safety system

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

Series connection of 4 decentralised modules

You can connect up to 4 decentralised modules in series to a PNOZmulti link module.

The cable length between every connection must be max. 100 m (see [Technical details](#) [447]).



Voltage drop

The max. cable length depends on the voltage drop in the supply voltage cables. The level of voltage drop is determined by the:

- ▶ Cable resistance on the supply voltage cables
- ▶ Operating current of the modules
- ▶ Load on the modules

To increase the max. cable length, the input voltage can be permanently increased by the voltage tolerance (see Technical Details).

Link modules

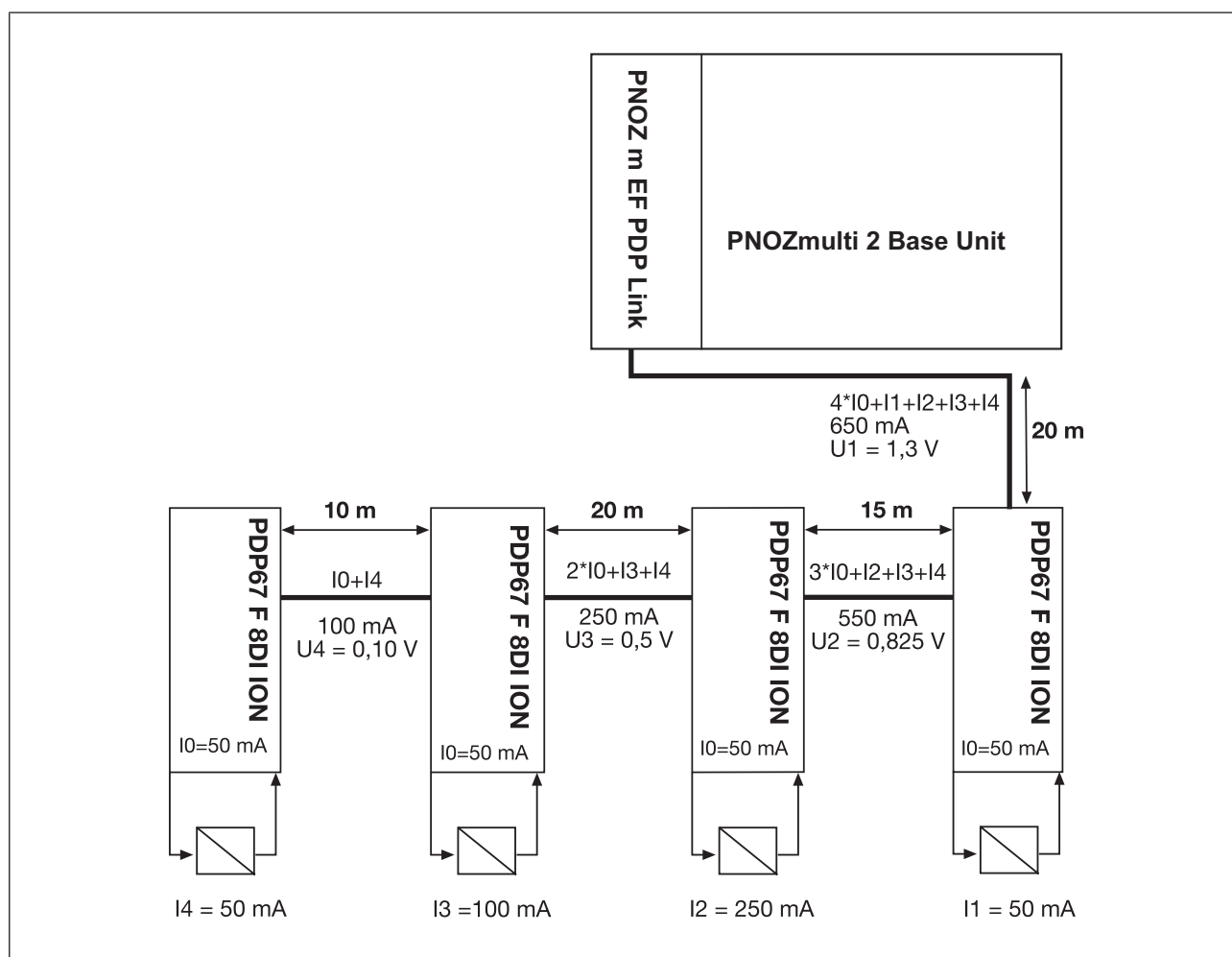
PNOZ m EF PDP Link

Guidelines for various cable types

Cable type	Voltage drop per 10 m and per 100 mA
PSS SB BUSCABLE LC	0.1 V
Sensor cable 0.25 mm ²	0.15 V
Sensor cable 0.34 mm ²	0.11 V
Sensor cable 0.5 mm ²	0.07 V

Calculation example

- ▶ The PSS SB BUSCABLE LC is used in accordance with the pin assignment in section 6.2.2.
Voltage drop per 10 m and per 100 mA: 0.1 V



Legend:

- ▶ I_0 : Module's consumption.
- ▶ $I_1 \dots I_5$: Load current taken from the module

Link modules

PNOZ m EF PDP Link

- ▶ U1 ... U4: Voltage drop on the respective connection path

Total voltage drop from the link module PNOZ m EF PDP Link to the final PDP67 F 8DI ION:

$$U_{\text{total}} = U_1 + U_2 + U_3 + U_4$$

$$U_{\text{total}} = 1.3 \text{ V} + 0.825 \text{ V} + 0.5 \text{ V} + 0.10 \text{ V} = 2.725 \text{ V}$$

Technical details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-15 %/+20 %
Output of external power supply (DC)	100 W
Output of external power supply (DC) at no load	2,5 W
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	4 W
Status indicator	LED
Inputs	
Maximum input delay	15 ms
Semiconductor outputs	
Switch-off delay	5 ms
Test pulse outputs	
Maximum output current, decentralised module supply	4 A
Short circuit protection of decentralised module supply	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C

Link modules

PNOZ m EF PDP Link

Environmental data	
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 55 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Module and system voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	2500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Max. cable length unshielded	30 m
Max. cable length shielded	100 m
Material	
Bottom	PC
Front	PC
Top	PC

Link modules

PNOZ m EF PDP Link

Mechanical data	
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm ² , 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm ² , 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm ² , 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	96 g

Where standards are undated, the 2013-01 latest editions shall apply.

Safety characteristic data

Operating mode	EN ISO 13849-1: 2015	EN ISO 13849-1: 2015	EN IEC 62061 SIL CL/ maximum SIL	EN IEC 62061 PFH _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
–	PL e	Cat. 4	SIL 3	5,35E-09	SIL 3	3,30E-05	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_M 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.

Link modules

PNOZ m EF PDP Link

Order reference

Product

Product type	Features	Order no.
PNOZ m EF PDP Link	Configurable safe small controllers PNOZmulti 2, expansion module, safe connection decentralised I/O modules.	772121

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ mml2p	Spring-loaded terminals, PNOZ mml2p, 1 set.	783540
Screw terminals PNOZ mml2p	Plug-in screw terminals, PNOZ mml2p, 1 set.	793540
Spring terminals PNOZ mml2p 10 pcs.	Spring-loaded terminals, PNOZ mml2p, 10 sets.	783541
Screw terminals PNOZ mml2p 10 pcs.	Plug-in screw terminals, PNOZ mml2p, 10 sets.	793541

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

By the metre

Product type	Features	Order no.
PSS SB BUSCABLE LC	By the metre, bus/power hybrid line, PUR, yellow RAL1003, 2x0.38+2x0.24+1x0.38, colour of the single wires: Red, white, green, brown	311074
PSS67 I/O Cable	By the metre, PUR, yellow RAL1003, 5x0.25, colour of the single wires: Brown, white, blue, black, grey	380320

Link modules

PNOZ m EF PDP Link

Cable

Product type	Features	Order no.
PSS67 Cable M8sf M12sm, 3m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket straight M8, on connector straight M12, A-coded, cable length: 3 m.	380200
PSS67 Cable M8sf M12sm, 5m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket straight M8, on connector straight M12, A-coded, cable length: 5 m	380201
PSS67 Cable M8sf M12sm, 10m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket straight M8, on connector straight M12, A-coded, cable length: 10 m	380202
PSS67 Cable M8sf M12sm, 30m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket straight M8, on connector straight M12, A-coded, cable length: 30 m	380203
PSS67 Cable M8af M12sm, 3m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket angled M8, on connector straight M12, A-coded, cable length: 3 m	380204
PSS67 Cable M8af M12sm, 5m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket angled M8, on connector straight M12, A-coded, cable length: 5 m	380205
PSS67 Cable M8af M12sm, 10m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket angled M8, on connector straight M12, A-coded, cable length: 10 m	380206
PSS67 Cable M8af M12sm, 30m	Connection cable, PUR, yellow RAL1003, suitable for drag chains, 4-pin, socket angled M8, on connector straight M12, A-coded, cable length: 30 m	380207
PSS67 Cable M12sf M12sm, 3m	Connection cable, PUR, yellow RAL1003, 5-pin, socket straight, on connector straight M12, A-coded, cable length: 3 m	380208
PSS67 Cable M12sf M12sm, 5m	Connection cable, PUR, yellow RAL1003, 5-pin, socket straight, on connector straight M12, A-coded, cable length: 5 m	380209
PSS67 Cable M12sf M12sm, 10m	Connection cable, PUR, yellow RAL1003, 5-pin, socket straight, on connector straight M12, A-coded, cable length: 10 m	380210
PSS67 cable M12-5sf, M12-5sm, 20m	Connection cable, PUR, yellow RAL1003, 5-pin, socket straight, on connector straight M12, A-coded, cable length: 20 m	380220
PSS67 Cable M12sf M12sm, 30m	Connection cable, PUR, yellow RAL1003, 5-pin, socket straight, on connector straight M12, A-coded, cable length: 30 m	380211
PSS67 Cable M12af M12am, 3m	Connection cable, PUR, yellow RAL1003, 5-pin, socket angled, on connector angled M12, A-coded, cable length: 3 m	380212
PSS67 Cable M12af M12am, 5m	Connection cable, PUR, yellow RAL1003, 5-pin, socket angled, on connector angled M12, A-coded, cable length: 5 m	380213
PSS67 Cable M12af M12am, 10m	Connection cable, PUR, yellow RAL1003, 5-pin, socket angled, on connector angled M12, A-coded, cable length: 10 m	380214

Link modules PNOZ m EF PDP Link

Product type	Features	Order no.
PSS67 Cable M12af M12am, 30m	Connection cable, PUR, yellow RAL1003, 5-pin, socket angled, on connector angled M12, A-coded, cable length: 30 m	380215
PSEN op cable axial M12 5-pole 3m	Connection cable, PUR, yellow, RAL1003, 5-pin, socket straight M12, on open line end, A-coded, cable length: 3 m	630310
PSEN op cable axial M12 5-pole 5m	Connection cable, PUR, yellow, RAL1003, 5-pin, socket straight M12, on open line end, A-coded, cable length: 5 m	630311
PSEN op cable axial M12 5-pole 10m	Connection cable, PUR, yellow, RAL1003, 5-pin, socket straight M12, on open line end, A-coded, cable length: 10 m	630312
PSEN cable M12-5sf 20m	Connection cable, PUR, yellow, RAL1003, 5-pin, socket straight M12, on open line end, A-coded, cable length: 20 m	630298
PSEN op cable axial M12 5-pole 30m	Connection cable, PUR, yellow, RAL1003, 5-pin, socket straight M12, on open line end, A-coded, cable length: 30 m	630297

Adapter

Product type	Features	Order no.
PSEN ma adapter	Cable, adapter, IP68, M12 female connector, black, straight, 4-pin, A-coded on M12 male connector, black, angled, 5-pin, A-coded, PUR, 0.1 m, 4x 0.34 mm ² , black, for connecting the sensors PSEN-mag (safety switch)/PIT en1.0 (enabling switch) to PSS67 and PDP67.	380300
PSEN cs adapter	Cable, adapter, IP68, M12 female connector, black, straight, 8-pin, A-coded on M12 male connector, black, angled, 5-pin, A-coded, PUR, 0.1 m, 5x 0.25 mm ² , black, with shielding (wire mesh), for connecting a PSENcode sensor (coded safety switch) to PSS67 and PDP67.	380301
PSEN sl adapter	Cable, adapter, IP68, M12 female connector, black, straight, 8-pin, A-coded on M12 male connector, black, angled, 5-pin, A-coded, PUR, 0.1 m, 5x 0.25 mm ² , black, with shielding (wire mesh), for connecting a PSENslock sensor (safety gate monitoring) to PSS67 and PDP67.	380325

Plug-in connector

Product type	Features	Order no.
PSS67 M12 connector, straight, male, 5 pole	Plug-in connector, 5-pin, straight M12 connector, A-coded, screw connection, material ring nut: CuZn nickel-plated, outer cable diameter: 4 - 6 mm	380308
PSS67 M12 connector straight, female, 5pin	Plug-in connector, 5-pin, straight M12 socket, A-coded, screw connection, material ring nut: CuZn nickel-plated, outer cable diameter: 4 - 6 mm	380309
PSS67 M12 connector, angled, male, 5pole	Plug-in connector, 5-pin, angled M12 connector, A-coded, screw connection, material ring nut: CuZn nickel-plated, outer cable diameter: 4 - 6 mm	380310

Link modules

PNOZ m EF PDP Link

Product type	Features	Order no.
PSS67 M12 connector, angled, female, 5 pole	Plug-in connector, 5-pin, angled M12 socket, A-coded, screw connection, material ring nut: CuZn nickel-plated, outer cable diameter: 4 - 6 mm	380311
M12 con., straight, male, 4-pin, D	Plug-in connector, 4-pin, straight M12 connector, D-coded, IDC connection, material ring nut: Die-cast zinc nickel-plated, cable screw connection Pg9, outer cable diameter 6 - 8 mm	380316
M12 con., straight, female, 5 pin, L, S	Plug-in connector, 5-pin (4+FE), shielded, straight M12 socket, L-coded (power), crimp connection, material ring nut: Die-cast zinc nickel-plated, cable screw connection Pg11, outer cable diameter 5 - 9 mm	380317
M12 con., straight, male, 5 pin, L, S	Plug-in connector, 5-pin (4+FE), shielded, straight M12 socket, L-coded (power), crimp connection, material ring nut: Die-cast zinc nickel-plated, cable screw connection Pg11, outer cable diameter 5 - 9 mm	380318

Communication modules PNOZ m ES ETH



Overview

Unit features

Application of the product PNOZ m ES ETH:

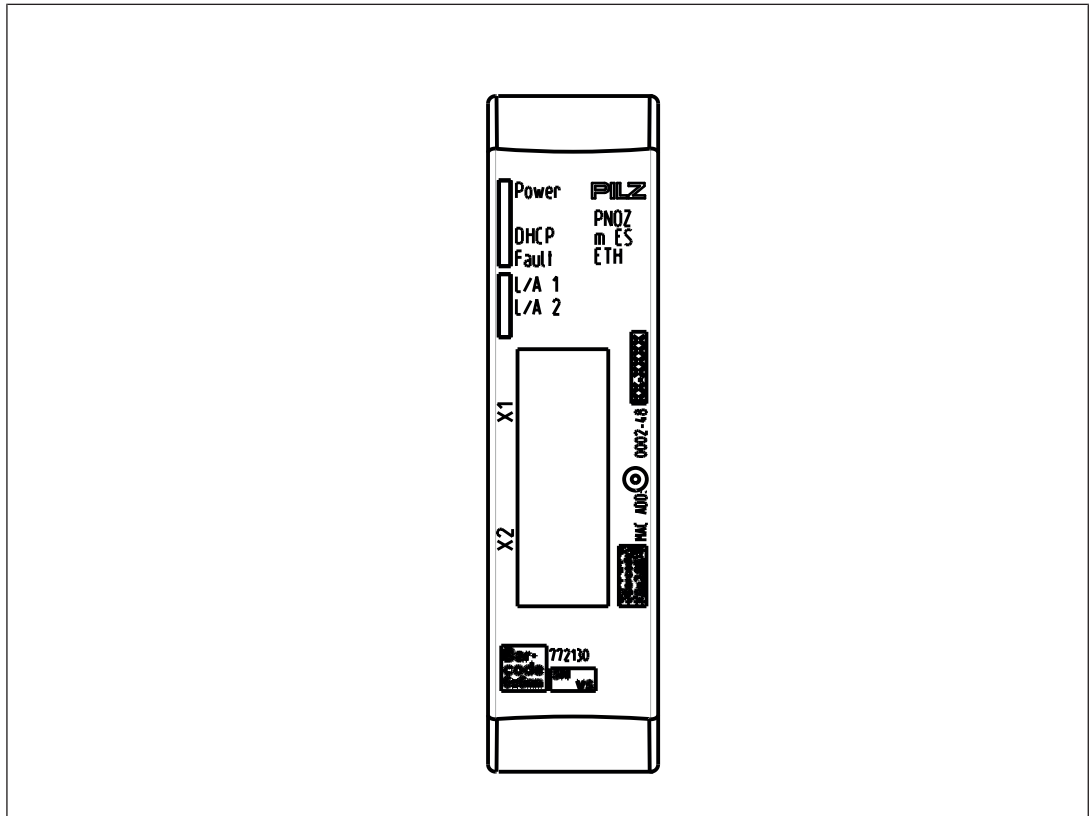
Communication module for connection to a base unit from the configurable control system PNOZmulti 2.

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ 2 Ethernet interfaces
- ▶ Status indicators for supply voltage, communication and errors
- ▶ Max. 1 communication module can be connected to the left of the base unit PNOZmulti 2
- ▶ Please refer to the document "PNOZmulti System Expansion" for the PNOZmulti base units that can be connected.

Communication modules PNOZ m ES ETH

Front view



Legend:

- ▶ X1, X2:
Ethernet interfaces
- ▶ LEDs:
 - Power
 - DHCP
 - L/A 1 (Link/Act 1)
 - L/A 2 (Link/Act 2)

Communication modules PNOZ m ES ETH

Function description

Unit properties

The product PNOZ m ES ETH has two Ethernet interfaces to

- ▶ Download the project
- ▶ Read the diagnostic data
- ▶ Set virtual inputs for standard functions
- ▶ Read virtual outputs for standard functions

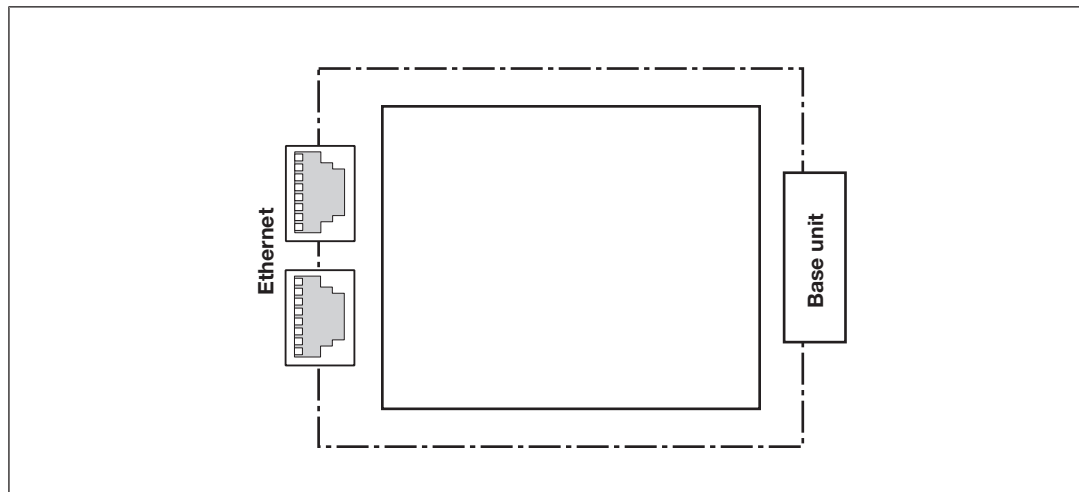
via Ethernet (TCP/IP, Modbus/TCP).

Information on diagnostics via the Ethernet interfaces can be found in the document entitled "PNOZmulti 2 communication interfaces".

The connection to Ethernet is made via the two 8-pin RJ45 sockets.

The Ethernet interface is configured in the PNOZmulti Configurator and is described in the online help for the PNOZmulti Configurator.

Block diagram

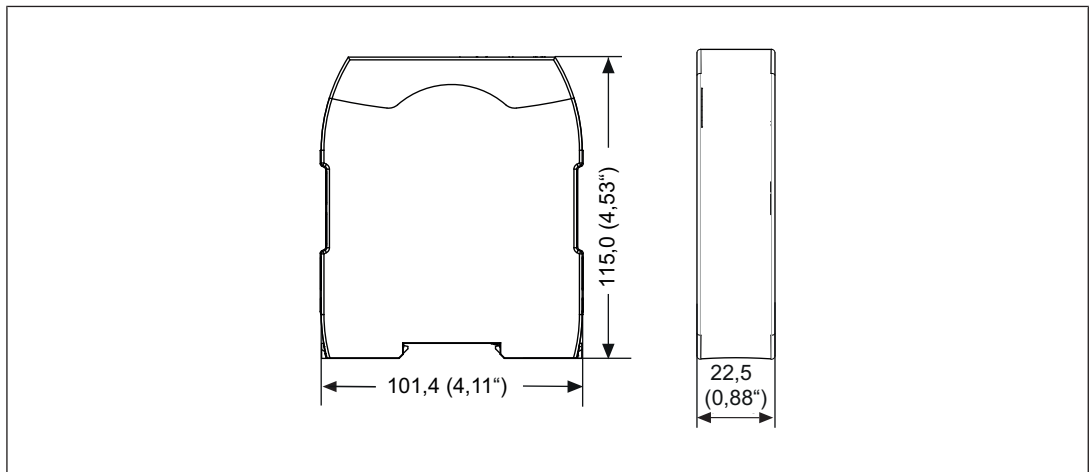


Communication modules

PNOZ m ES ETH

Installation

Dimensions in mm



Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[458\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Preparing for operation

Detection and activation of the Ethernet interface, depending on the USB interface on the base unit:

- ▶ **USB interface on the base unit not connected**
If the USB interface on the base unit is not connected, the Ethernet interface will be detected and activated by the base unit as soon as the communication module has been connected to the base unit.
- ▶ **USB interface on the base unit connected**
If the USB interface on the base unit is already connected, the "Ethernet" interface will first need to be selected on the base unit display to enable the Ethernet interface on the base unit to be detected and activated (see operating manual for the base unit for details of the setting).

Communication modules PNOZ m ES ETH

Tecnical details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Application range	Standard
Module's device code	1202h
Electrical data	
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Voltage tolerance	-2 %/+2 %
Current consumption	295 mA
Power consumption	1 W
Status indicator	LED
Ethernet interface	
Quantity	2
IP address (automatically off)	169.254.60.1
Connection type	RJ45
Transmission rate	10 MBit/s, 100 MBit/s
Fieldbus interface	
Fieldbus interface	Modbus/TCP
Device type	Slave
Connection	RJ45
Galvanic isolation	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2

Communication modules PNOZ m ES ETH

Environmental data	
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overtoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	0,1 km
Material	
Bottom	PC
Front	PC
Top	PC
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	111 mm
Weight	80 g

Where standards are undated, the 2012-04 latest editions shall apply.

Communication modules PNOZ m ES ETH

Order reference

Product

Product type	Features	Order no.
PNOZ m ES ETH	Configurable safe small controllers PNOZmulti 2, communication module, 2 Ethernet / Modbus TCP interfaces.	772130

Accessories

Plug-in connector

Product type	Features	Order no.
RJ45 Connector	RJ45 plug-in connector, straight, IP20, 8-pin, Cat6a, IDC connection, AWG22, cable diameter: 5.5 - 8.5 mm	380401

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Communication modules PNOZ m ES RS232



Overview

Unit features

Application of the product PNOZ m ES RS232:

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

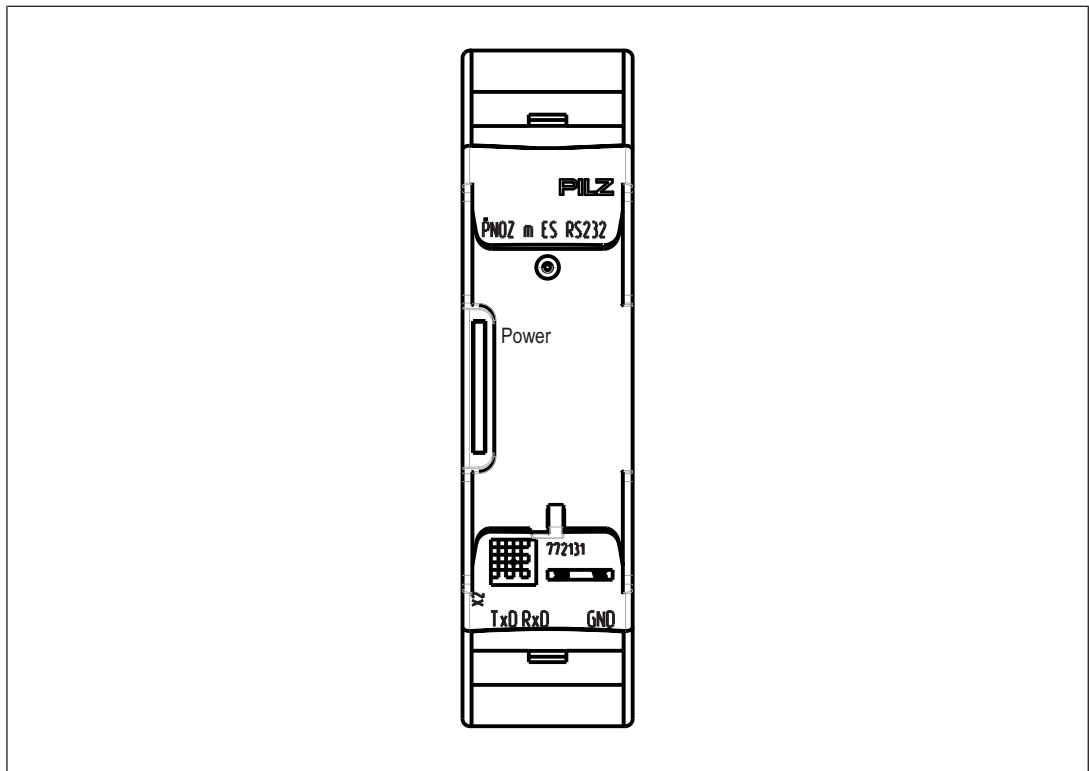
The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ 1 serial interface RS232
- ▶ Status indicator for supply voltage
- ▶ Max. 1 communication module can be connected to the left of the base unit PNOZmulti 2
- ▶ Plug-in connection terminals (either cage clamp terminals or screw terminals)

Communication modules

PNOZ m ES RS232

Front view



Key:

- ▶ X2: Serial interface RS 232
- ▶ LED:
 - Power

Function description

Functions

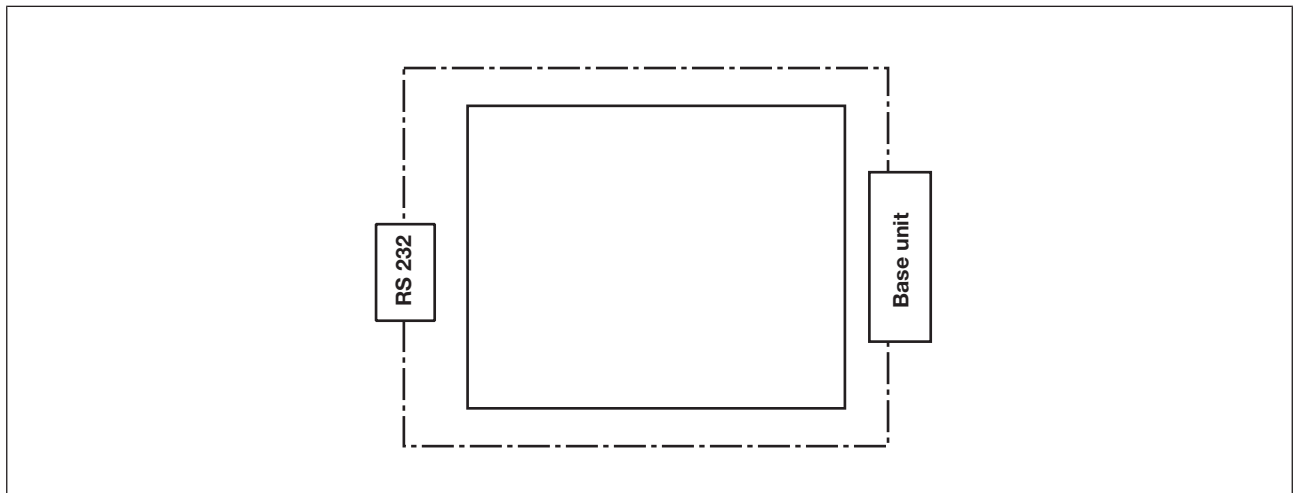
The product PNOZ m ES RS232 has a serial interface RS232 interface to

- ▶ Download the project
- ▶ Read the diagnostic data
- ▶ Set virtual inputs for standard functions
- ▶ Read virtual outputs for standard functions.

Information on diagnostics can be found in the document "Communication Interfaces".

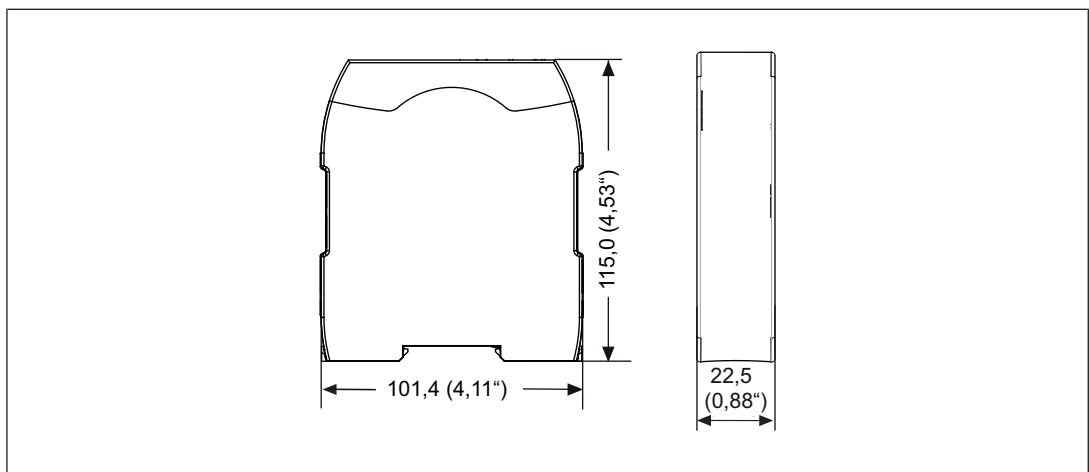
Communication modules PNOZ m ES RS232

Block diagram



Installation

Dimensions in mm




Commissioning

General wiring guidelines

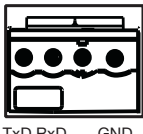
The wiring is defined in the circuit diagram of the PNOZmulti Configurator.

Please note:

- ▶ Information given in the [Technical details](#)  [465](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Communication modules PNOZ m ES RS232

Interface configuration

Serial interface RS232	Standard			
 <p>TxD RxD GND</p>	<table border="1"> <tr> <td>TxD (Transmit)</td> </tr> <tr> <td>RxD (Receive)</td> </tr> <tr> <td>GND (Ground)</td> </tr> </table>	TxD (Transmit)	RxD (Receive)	GND (Ground)
TxD (Transmit)				
RxD (Receive)				
GND (Ground)				

Preparing for operation

The serial interface RS 232 is activated and detected depending on the USB interface on the base unit:

▶ **USB interface on the base unit not connected**

In this case, the serial interface RS 232 will be detected and activated by the base unit as soon as the communication module has been connected to the base unit.

▶ **USB interface on the base unit connected**

If the USB interface on the base unit is already connected, the "External" interface will first need to be selected on the base unit display to enable the serial interface RS 232 on the base unit to be detected and activated (see operating manual for the base unit for details of the setting).

Communication modules PNOZ m ES RS232

Technical details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Application range	Standard
Electrical data	
Supply voltage	
internal	Via base unit
Voltage	3,3 V
Current consumption	9 mA
Power consumption	30 mW
Max. power dissipation of module	30 mW
Status indicator	LED
Fieldbus interface	
Galvanic isolation	No
Serial interface	
Number of RS232 interfaces	1
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II

Communication modules PNOZ m ES RS232

Environmental data	
Rated insulation voltage	30 V
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Cable length	
Max. cable length per input	22 m
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	120 mm
Weight	85 g

Where standards are undated, the 2012-04 latest editions shall apply.

Communication modules

PNOZ m ES RS232

Order reference

Product

Product type	Features	Order no.
PNOZ m ES RS232	Configurable safe small controllers PNOZmulti 2, communication module, 1 serial interface RS232.	772131

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ mmc2p, mml1p 1 pc.	Spring-loaded terminals, PNOZ mmc2p, PNOZ mml1p, 1 set.	783538
Screw terminals PNOZ mmc2p, mml1p 1 pc.	Plug-in screw terminals, PNOZ mmc2p, PNOZ mml1p, 1 set.	793538
Spring terminals PNOZ mmc2p,mml1p 10 pcs	Spring-loaded terminals, PNOZ mmc2p, PNOZ mml1p, 10 sets.	783539
Screw terminals PNOZ mmc2p,mml1p 10 pcs.	Plug-in screw terminals, PNOZ mmc2p, PNOZ mml1p, 10 sets.	793539

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp con- nector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m ES Profibus



Overview

Unit features

Application of the product PNOZ m ES Profibus:

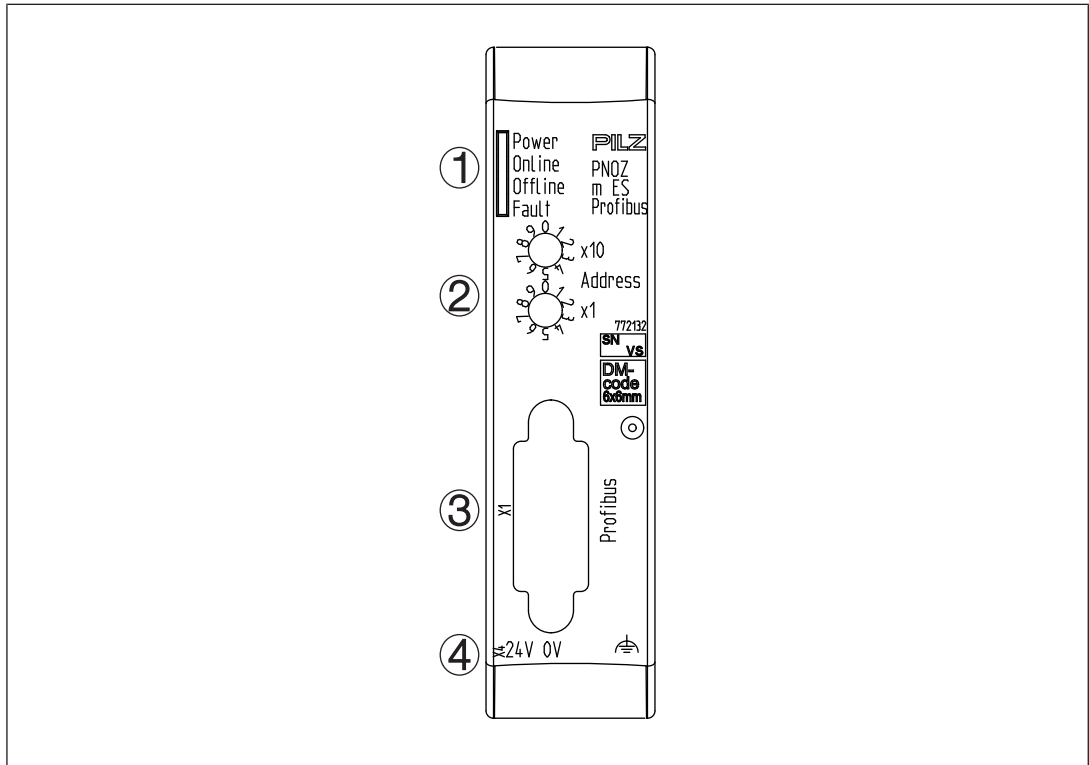
Expansion module for connection to a base unit from the PNOZmulti 2 system.

The product has the following features:


- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Connection for PROFIBUS-DP
- ▶ Station addresses from 0 ... 99, selected via rotary switch
- ▶ Status indicators for communication with PROFIBUS-DP and for errors
- ▶ In the PNOZmulti Configurator, 128 virtual outputs of the PNOZmulti 2 control system can be defined for communication with the fieldbus PROFIBUS-DP .
- ▶ Max. 1 PNOZ m ES Profibus can be connected to the base unit
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories \[522\]](#)).
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Fieldbus modules PNOZ m ES Profibus

Front view



Legend

- ① LED:
 - Power
 - Online
 - Offline
 - Fault
- ② Rotary switch
 - x10 = Tens digit for the station address
 - x1 = Units digit for the station address
- ③ X1: PROFIBUS-DP interface (female 9-pin D-Sub connector)
- ④ X4: 0 V, 24 V:
Supply connections
-  Functional earth

Fieldbus modules

PNOZ m ES Profibus

Function description

Operation

The virtual inputs and outputs that are to be transferred via PROFIBUS are selected and configured in the PNOZmulti Configurator. The base unit and the expansion module PNOZ m ES Profibus are connected via a jumper.

The station address is set via rotary switches. After the supply voltage is switched on or the control system PNOZmulti 2 is reset, the expansion module PNOZ m ES Profibus is configured and started automatically.

LEDs indicate the status of the expansion module on PROFIBUS.

The configuration is described in detail in the PNOZmulti Configurator's online help.

Data access

The data is structured as follows:

- ▶ Virtual data
 - Input area PNOZ m ES Profibus
The values for the inputs are set in the Master as an output and transferred to the PNOZmulti 2.
 - Output area PNOZ m ES Profibus
The outputs are configured in the PNOZmulti Configurator and transferred to the Master.
- ▶ Status of LEDs:
LED status 1 Output Byte
The LED status of the base unit can be requested directly as follows
 - Bit 0 = 1: LED OFAULT is lit or flashes
 - Bit 1 = 1: LED IFAULT is lit or flashes
 - Bit 2 = 1: LED FAULT is lit or flashes
 - Bit 3 = 1: LED DIAG is lit or flashes
 - Bit 4 = 1: LED RUN FS is lit
 - Bit 5: Reserved
 - Bit 6 = 1: LED RUN ST is lit (not for PNOZ m B0)
 - Bit 7: Reserved
- ▶ Data exchange is displayed in Bit 5.
- ▶ Polling the payload data: 2 Bytes with the table number and segment number are sent by the Master for access to the payload data table (15 Bytes are returned to the Master).

Fieldbus modules

PNOZ m ES Profibus

Detailed information on data exchange (tables, segments) is available in the document "Communication Interfaces" in the section entitled "Fieldbus modules".

Assigning the inputs/outputs in the PNOZmulti Configurator to the PROFIBUS-DP inputs/outputs

Virtual inputs and outputs can be requested or set directly via the following objects. Each element can be selected individually in the master control system, e.g. virtual inputs i0-31. The data width is also established this way.

Input data

The Master writes to the virtual inputs of the PNOZmulti 2.

Description	Input data from PNOZmulti 2
Virtual inputs i0 – i31	4 Input Bytes
Virtual inputs i32 – i63	4 Input Bytes
Virtual inputs i64 – i95	4 Input Bytes
Virtual inputs i96 – i127	4 Input Bytes

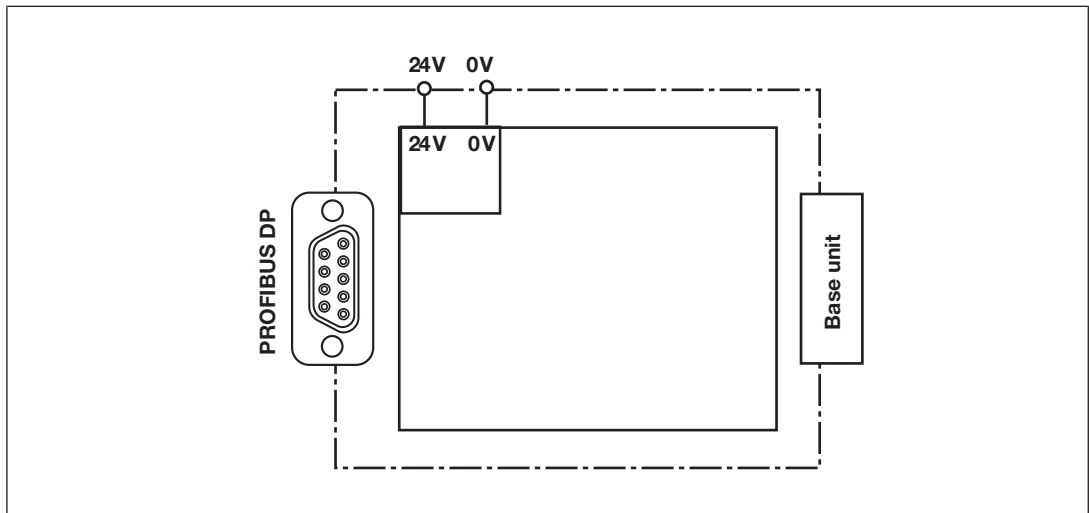
Output data

The Master reads the virtual outputs of the PNOZmulti 2.

Description	Output data from PNOZmulti 2
Virtual outputs o0 – o31	4 Output Bytes
Virtual outputs o32 – o63	4 Output Bytes
Virtual outputs o64 – o95	4 Output Bytes
Virtual outputs o96 – o127	4 Output Bytes

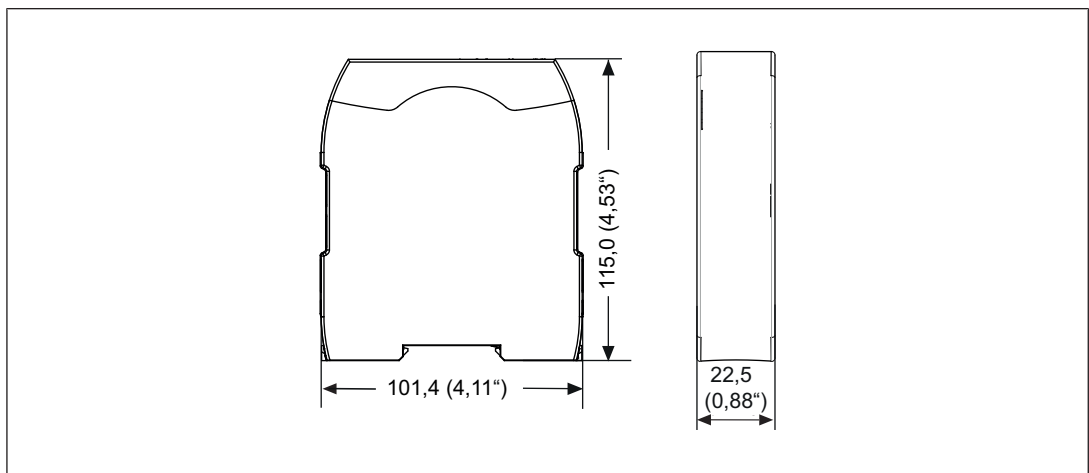
Fieldbus modules PNOZ m ES Profibus

Block diagram



Installation

Dimensions in mm



Fieldbus modules PNOZ m ES Profibus


Commissioning

Wiring

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[477\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ External measures must be used to connect the terminal  to the functional earth, when the mounting rail is **not** connected to the functional earth.
- ▶ Always connect the mounting rail to the protective earth via an earthing terminal. This will be used to dissipate hazardous voltages in the case of a fault.
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).

Connecting the supply voltage

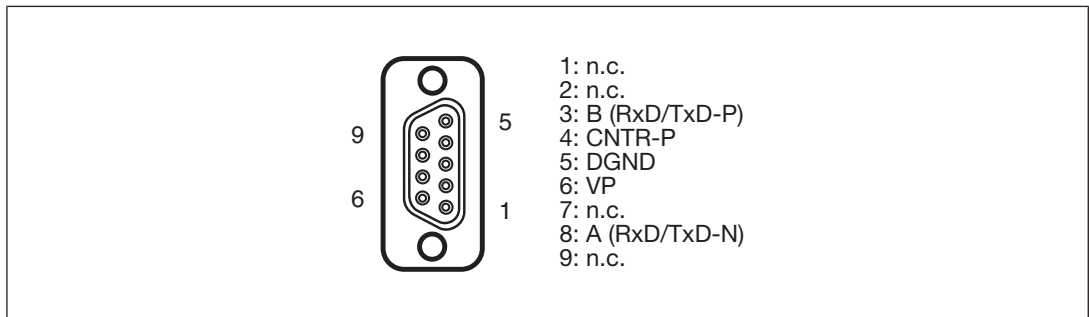
Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

PROFIBUS DP interface

It is possible to define which outputs on the control system will communicate with PROFIBUS-DP. The connection to PROFIBUS-DP is made via a female 9-pin D-Sub connector in accordance with the guidelines of the PROFIBUS User Group (PNO).

Fieldbus modules PNOZ m ES Profibus



n.c. = not connected

Please note the following when connecting to PROFIBUS-DP:

- ▶ Only use metal plugs or metallised plastic plugs
- ▶ Twisted pair, screened cable must be used to connect the interfaces

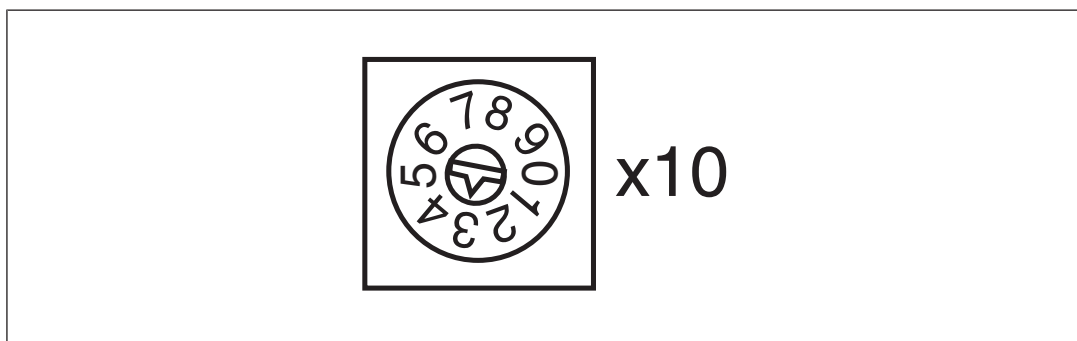
Fieldbus modules

PNOZ m ES Profibus

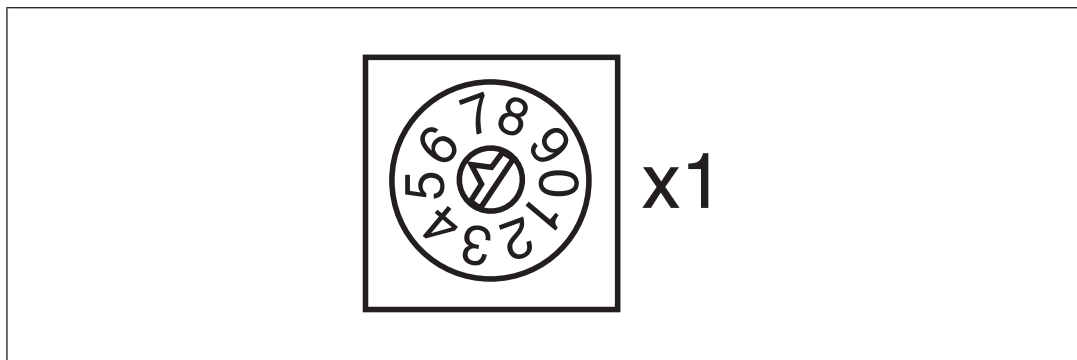
Preparing for operation

Setting the station address

The station address of the expansion module PNOZ m ES Profibus is set between 0 ... 99 (decimal) via two rotary switches x1 and x10.



- ▶ On the upper rotary switch x10, use a small screwdriver to set the tens digit for the address ("3" in the example).



- ▶ On the lower rotary switch x1, set the ones digit for the address ("6" in the example).

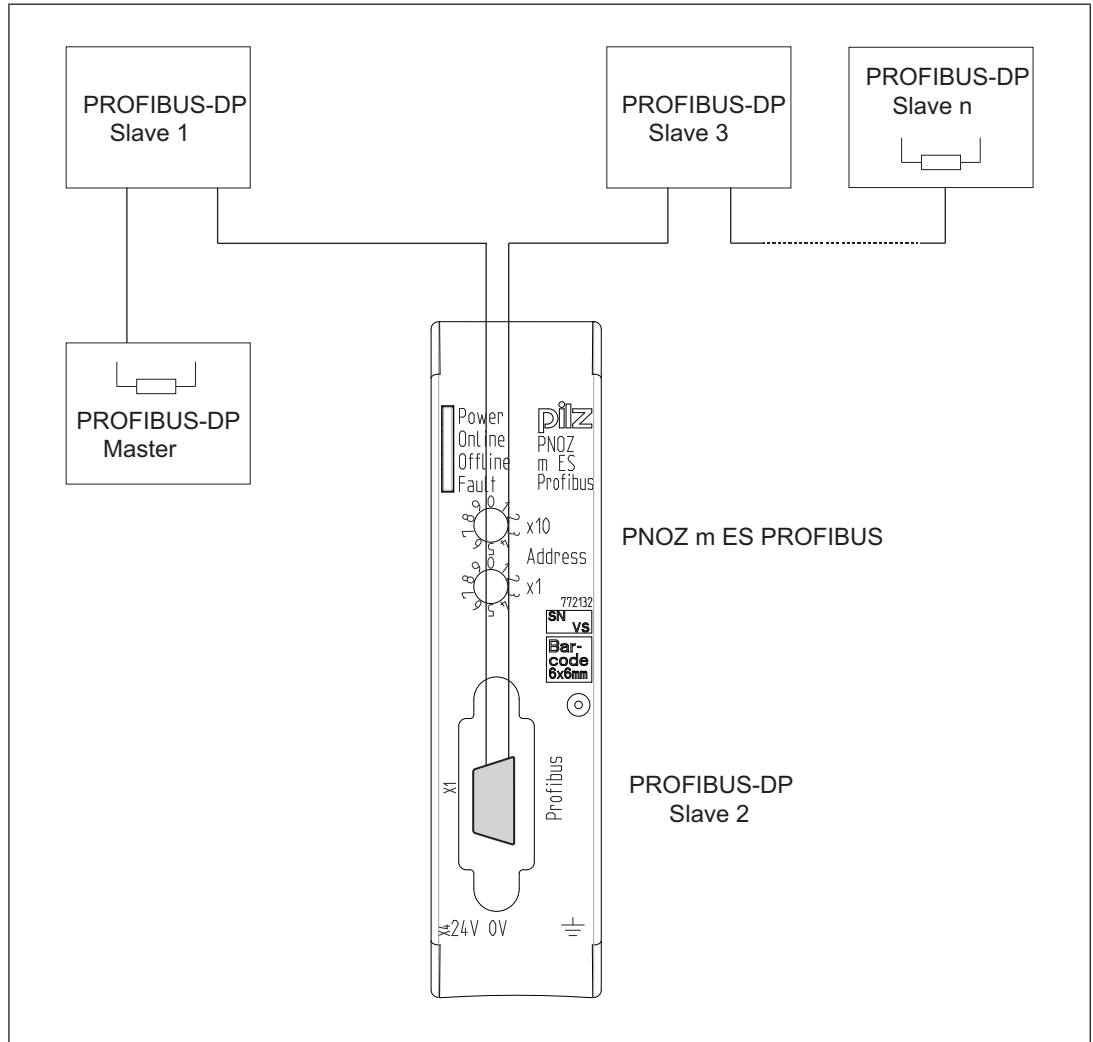
Station address 36 is set in the diagrams as an example.

Download modified project to the control system PNOZmulti

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

Fieldbus modules PNOZ m ES Profibus

Connection example



Fieldbus modules PNOZ m ES Profibus

Technical details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	35 mA
Output of external power supply (DC)	0,9 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	1,5 W
Status indicator	LED
PROFIBUS-DP interface	
Quantity	1
Fieldbus interface	
Fieldbus interface	PROFIBUS-DP
Device type	Slave DPV0
Station address	0 - 99d
Transmission rate	9,6 kBit/s - 12 MBit/s
Connection	9-pin D-Sub female connector
Galvanic isolation	Yes
Test voltage	500 V AC
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C

Fieldbus modules PNOZ m ES Profibus

Environmental data

Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Potential isolation

Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	500 V

Mechanical data

Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG

Fieldbus modules PNOZ m ES Profibus

Mechanical data

Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	115 mm
Weight	95 g

Where standards are undated, the 2012-10 latest editions shall apply.

Fieldbus modules

PNOZ m ES Profibus

Order reference

Product

Product type	Features	Order no.
PNOZ m ES Profibus	Configurable safe small controllers PNOZmulti 2, fieldbus module, Profibus.	772132

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Spring terminals PNOZ mmcpx, 10 pcs.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 10 sets.	783543
Screw terminals PNOZ mmcpx, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542
Screw terminals PNOZ mmcpx, 10 pcs.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 10 sets.	793543

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m ES CANopen



Overview

Unit features

Application of the product PNOZ m ES CANopen:

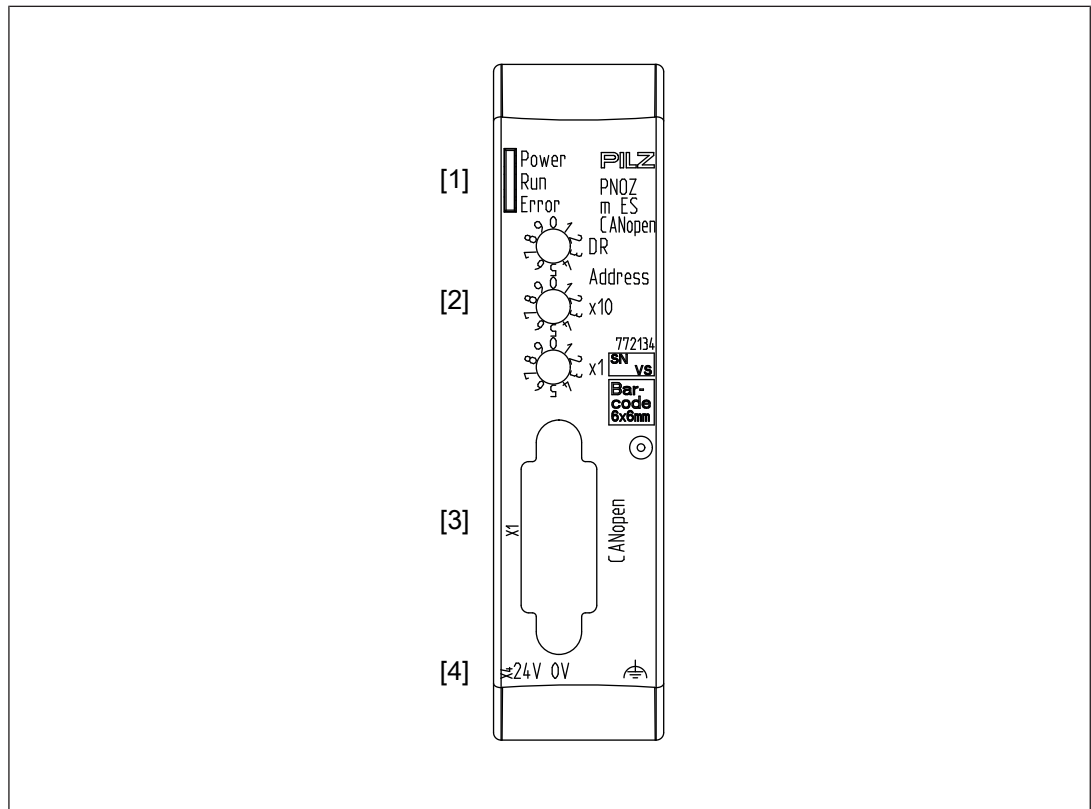
Expansion module for connection to a base unit from the PNOZmulti 2 system.

The product has the following features:


- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Connection for CANopen
- ▶ Station addresses from 0 ... 99, selected via rotary switch
- ▶ Transmission rate selected via rotary switch (1 MBit/s, 10 kbit/s, 125 kBit/s, 20 kbit/s, 250 kBit/s, 50 kbit/s, 500 kBit/s, 800 kbit/s)
- ▶ Status indicators for communication with CANopen and for errors
- ▶ 128 virtual inputs and outputs on the control system PNOZmulti 2 can be defined in the PNOZmulti Configurator for communication with the fieldbus CANopen.
- ▶ Max. 1 PNOZ m ES CANopen can be connected to the base unit
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories \[522\]](#)).
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Fieldbus modules PNOZ m ES CANopen

Front view



Legend

- [1] LED
 - Power
 - Run
 - Error
 - [2] Rotary switch
 - DR = Transmission rate
 - X10 = Tens digit for the station address
 - X1 = Units digit for the station address
 - [3] X1: CANopen interface (male 9-pin D-Sub connector)
 - [4] X4: 0 V, 24 V:
 - Supply connections
-  Functional earth

Fieldbus modules PNOZ m ES CANopen

Function description

Operation

The virtual inputs and outputs that are to be transferred via CANopen are selected and configured in the PNOZmulti Configurator. The base unit and the expansion module PNOZ m ES CANopen are connected via a jumper. The station address and the transmission rate are set using rotary switches. After the supply voltage is switched on or the control system PNOZmulti 2 is reset, the expansion module PNOZ m ES CANopen is configured and started automatically.

LEDs indicate the status of the expansion module on CANopen.

The configuration is described in detail in the PNOZmulti Configurator's online help.

Data access

The data is structured as follows:

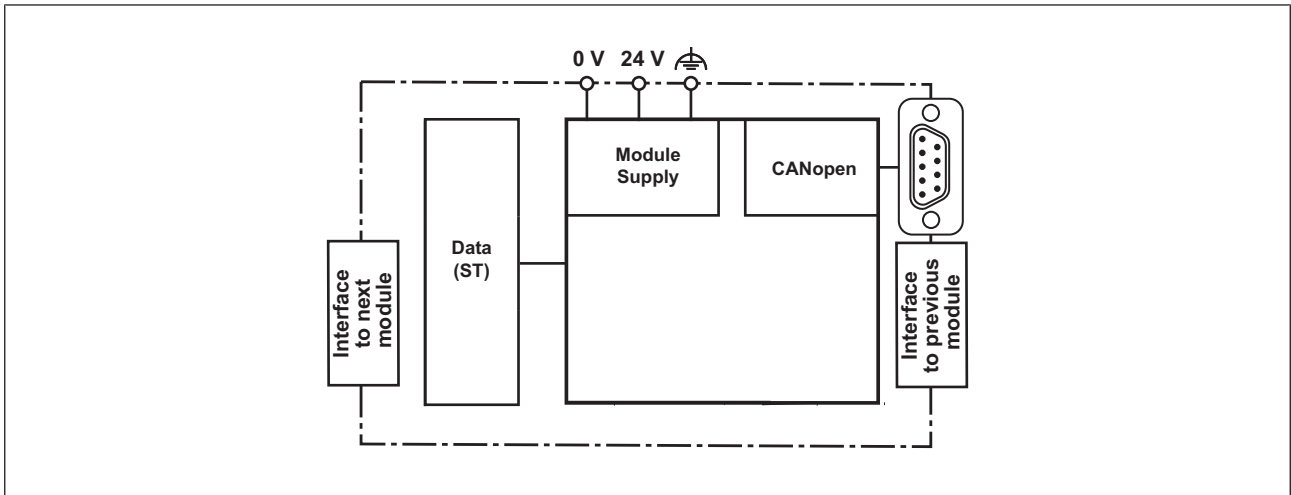
- ▶ Virtual data
 - Input area PNOZ m ES CANopen
The values for the inputs are set as an output in the Master and transferred to the PNOZmulti 2.
 - Output range PNOZ m ES CANopen
The outputs are configured in the PNOZmulti Configurator and transferred to the Master.
- ▶ Status of LEDs:
LED status 1 Output Byte
The LED status of the base unit can be requested directly as follows
 - Bit 0 = 1: LED OFAULT is lit or flashes
 - Bit 1 = 1: LED IFAULT is lit or flashes
 - Bit 2 = 1: LED FAULT is lit or flashes
 - Bit 3 = 1: LED DIAG is lit or flashes
 - Bit 4 = 1: LED RUN FS is lit
 - Bit 5: Reserved
 - Bit 6 = 1: LED RUN ST is lit (not for PNOZ m B0)
 - Bit 7: Reserved
- ▶ Data exchange is displayed in Bit 5.
- ▶ Polling the payload data: 2 Bytes with the table number and segment number are sent by the Master for access to the payload data table (15 Bytes are returned to the Master).

The document "Communication Interfaces" contains detailed information

Fieldbus modules PNOZ m ES CANopen

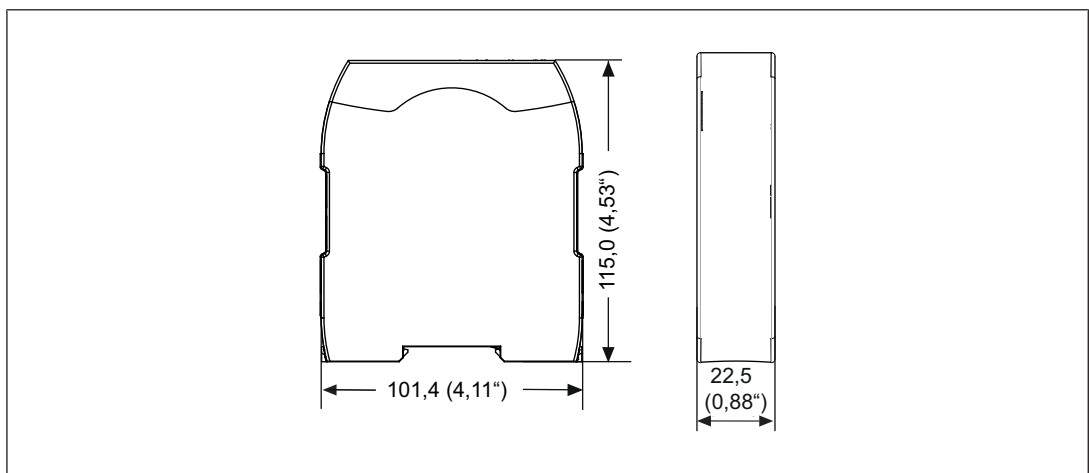
- ▶ on data exchange (tables, segments) in the section entitled "Fieldbus modules",
- ▶ on the virtual data in chapter "Service Data Objects (SDOs)" for PNOZ m ES CANopen.

Block diagram



Installation

Dimensions in mm



Fieldbus modules

PNOZ m ES CANopen


Commissioning

Wiring

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[488\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ External measures must be used to connect the terminal  to the functional earth, when the mounting rail is **not** connected to the functional earth.
- ▶ Always connect the mounting rail to the protective earth via an earthing terminal. This will be used to dissipate hazardous voltages in the case of a fault.
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).

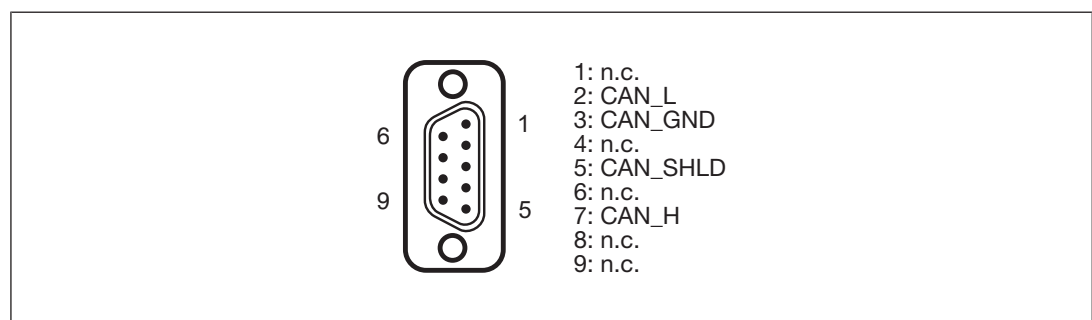
Connecting the supply voltage

Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

CANopen interface

The connection to CANopen is made via a male 9-pin D-Sub connector.



n.c. = not connected

Fieldbus modules PNOZ m ES CANopen

Please note the following when connecting to CANopen:

- ▶ Only use metal plugs or metallised plastic plugs
- ▶ Twisted pair, screened cable must be used to connect the interfaces

Termination CANopen

To minimise cable reflection and to guarantee a defined rest signal on the transmission line, CANopen must be terminated at both ends.

Setting the transmission rate

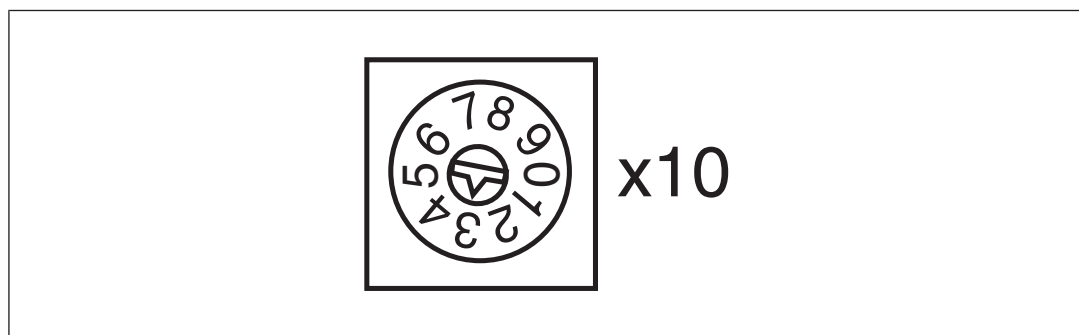


- ▶ On the upper rotary switch DR, use a small screwdriver to set the transmission rate (in the example, "3" corresponds to 50 kBit/s).

Switch setting	0	1	2	3	4	5	6	7	8	9
Transmission rate	-	10 kBit/s	20 kBit/s	50 kBit/s	125 kBit/s	250 kBit/s	500 kBit/s	800 kBit/s	1 MBit/s	-

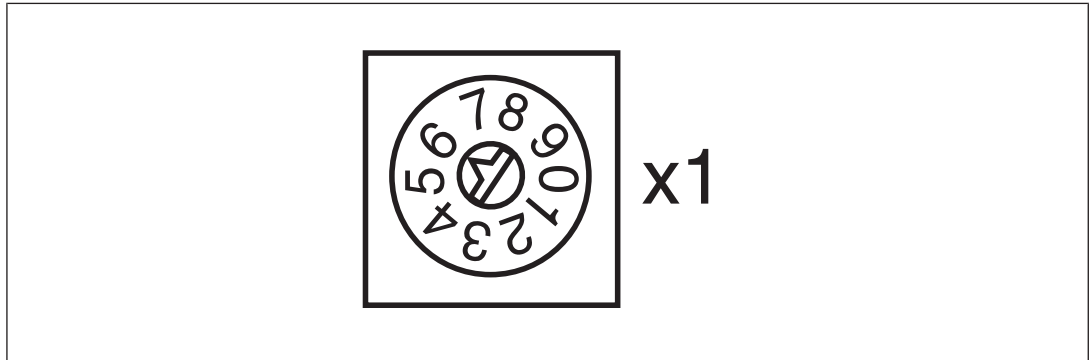
Setting the station address

The station address of the expansion module PNOZ m ES CANopen is set between 0 ... 99 (decimal) via two rotary switches x1 and x10.



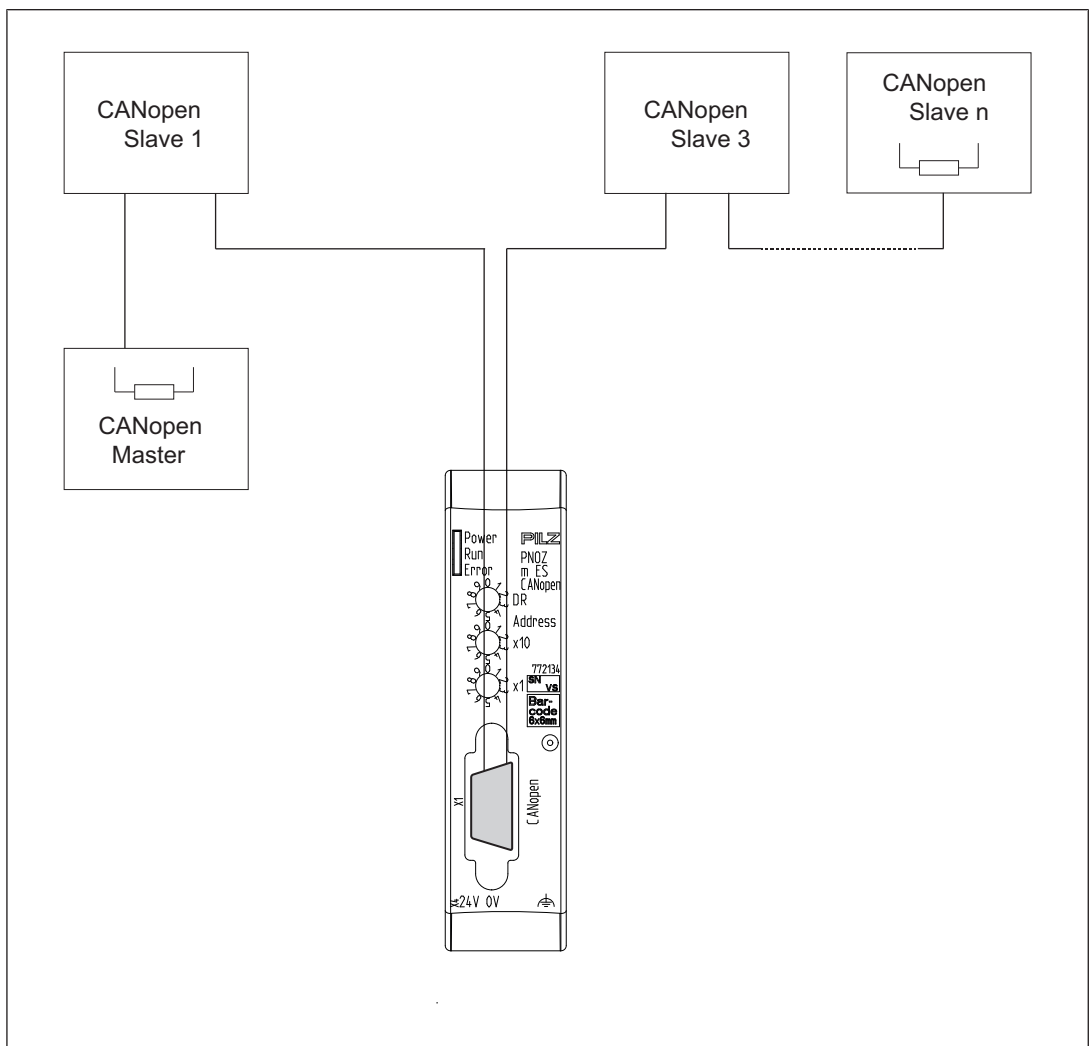
- ▶ On the middle rotary switch x10, use a small screwdriver to set the tens digit for the address ("3" in the example).

Fieldbus modules PNOZ m ES CANopen



- ▶ On the lower rotary switch x1, set the ones digit for the address ("6" in the example). Station address 36 is set in the diagrams as an example.

Connection example



Fieldbus modules PNOZ m ES CANopen

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 in the PNOZmulti Configurator and downloaded back into the base unit. Proceed as described in the operating manual for the base unit.

Technical details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	35 mA
Output of external power supply (DC)	0,9 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	1,5 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	CANopen
Device type	Slave
Protocol	CiA 301 V4.2.0
Station address	0 - 99d
Transmission rates	1 MBit/s, 10 kbit/s, 125 kBit/s, 20 kbit/s, 250 kBit/s, 50 kbit/s, 500 kBit/s, 800 kbit/s
Connection	9-pin D-Sub male connector
Galvanic isolation	Yes
Test voltage	500 V AC

Fieldbus modules PNOZ m ES CANopen

Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Rated insulation voltage	30 V
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal

Fieldbus modules PNOZ m ES CANopen

Mechanical data

Conductor cross section with screw terminals

1 core flexible **0,25 - 2,5 mm², 24 - 12 AWG**

2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors **0,2 - 1,5 mm², 24 - 16 AWG**

Torque setting with screw terminals **0,5 Nm**

Conductor cross section with spring-loaded terminals:

Flexible with/without crimp connector **0,2 - 2,5 mm², 24 - 12 AWG**

Spring-loaded terminals: Terminal points per connection

2

Stripping length with spring-loaded terminals **9 mm**

Dimensions

Height **101,4 mm**

Width **22,5 mm**

Depth **115 mm**

Weight **95 g**

Where standards are undated, the 2012-10 latest editions shall apply.

Fieldbus modules PNOZ m ES CANopen

Order reference

Product

Product type	Features	Order no.
PNOZ m ES CAN-open	Configurable safe small controllers PNOZmulti 2, fieldbus module, CANopen	772134

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Spring terminals PNOZ mmcxp, 10 pcs.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 10 sets.	783543
Screw terminals PNOZ mmcxp, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542
Screw terminals PNOZ mmcxp, 10 pcs.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 10 sets.	793543

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m ES EtherCAT



Overview

Unit features

Application of the product PNOZ m ES EtherCAT:

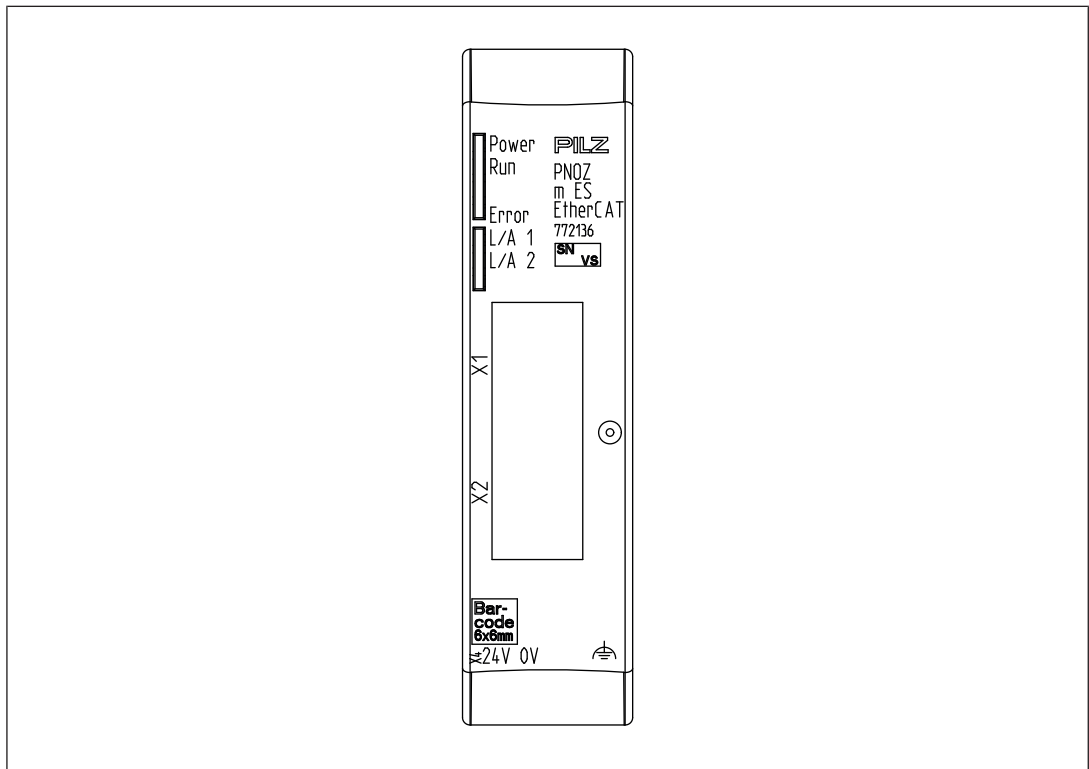
Expansion module for connection to a base unit from the PNOZmulti 2 system.

The product has the following features:

- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Network protocols: EtherCAT
- ▶ Supports CANopen over EtherCAT (DS301 V4.02 compliant)
- ▶ Status indicators for communication with EtherCAT and for errors
- ▶ 128 virtual inputs and outputs on the control system PNOZmulti can be defined in the PNOZmulti Configurator for communication with the fieldbus EtherCAT.
- ▶ Max. 1 PNOZ m ES EtherCAT can be connected to the base unit
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories \[522\]](#)).
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Fieldbus modules PNOZ m ES EtherCAT

Front view




Legend:

- ▶ X1: EtherCAT IN
- ▶ X2: EtherCAT OUT
- ▶ X4: 0 V, 24 V:
Supply connections

⏏ Functional earth

- ▶ LEDs:
 - Power
 - Run
 - Error
 - L/A 1
 - L/A 2

EtherCAT  is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany

Fieldbus modules PNOZ m ES EtherCAT

Function description

Operation

The virtual inputs and outputs that are to be transferred via EtherCAT are selected and configured in the PNOZmulti Configurator. The base unit and the expansion module PNOZ m ES EtherCAT are connected via a jumper. After the supply voltage is switched on or the PNOZmulti control system is reset, the expansion module PNOZ m ES EtherCAT is configured and started automatically.

The connection to EtherCAT is made via the two RJ45 sockets.

LEDs indicate the status of the expansion module on EtherCAT.

The configuration is described in detail in the PNOZmulti Configurator's online help.

Data access

The data is structured as follows:

▶ Virtual data

- Input area PNOZ m ES EtherCAT

The values for the inputs are set in the Master as an output and transferred to the PNOZmulti 2.

- Output range PNOZ m ES EtherCAT

The outputs are configured in the PNOZmulti Configurator and transferred to the Master.

▶ Status of LEDs:

LED status 1 Output Byte

The LED status of the base unit can be requested directly as follows

- Bit 0 = 1: LED OFAULT is lit or flashes
- Bit 1 = 1: LED IFAULT is lit or flashes
- Bit 2 = 1: LED FAULT is lit or flashes
- Bit 3 = 1: LED DIAG is lit or flashes
- Bit 4 = 1: LED RUN FS is lit
- Bit 5: Reserved
- Bit 6 = 1: LED RUN ST is lit (not for PNOZ m B0)
- Bit 7: Reserved

▶ Data exchange is displayed in Bit 5.

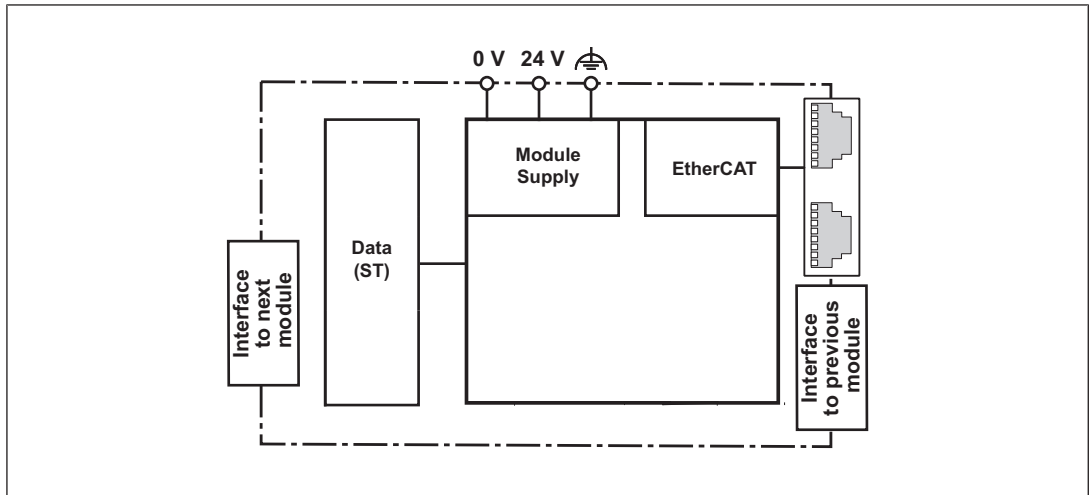
▶ Polling the payload data: 2 Bytes with the table number and segment number are sent by the Master for access to the payload data table (15 Bytes are returned to the Master).

The document "Communication Interfaces" contains detailed information

Fieldbus modules PNOZ m ES EtherCAT

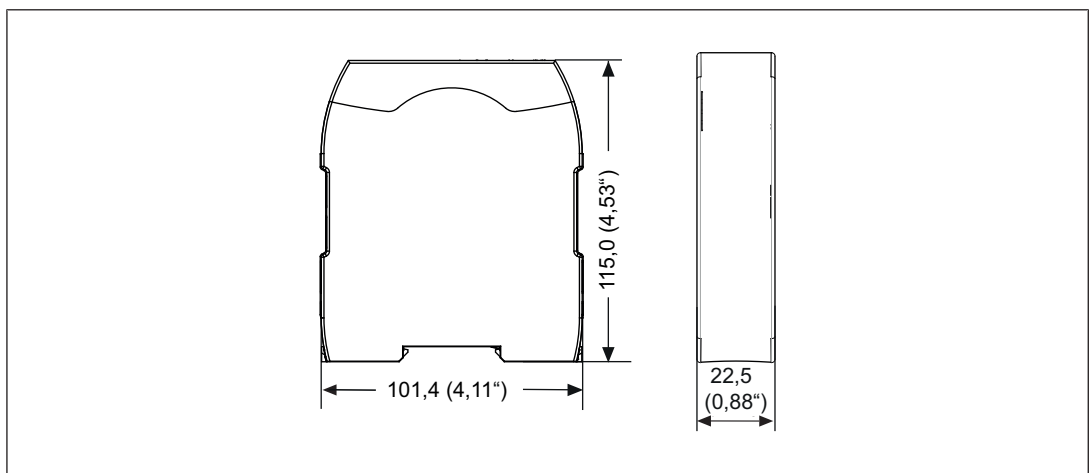
- ▶ on data exchange (tables, segments) in the section entitled "Fieldbus modules",
- ▶ on the virtual data in chapter "Service Data Objects (SDOs)" for PNOZ m ES EtherCAT.

Block diagram



Installation

Dimensions in mm



Fieldbus modules PNOZ m ES EtherCAT


Commissioning

General wiring guidelines

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

It is possible to define which inputs and outputs on the safety system will communicate with EtherCAT.

Note:

- ▶ Information given in the "Technical details" must be followed.
- ▶ Use copper wire that can withstand 75 °C.
- ▶ External measures must be used to connect the terminal  to the functional earth, when the mounting rail is **not** connected to the functional earth.

Please note the following when connecting to EtherCAT:

- ▶ The following minimum requirements of the connection cable and connector must be met:
 - Only use standard industrial Ethernet cable and connectors.
 - Only use double-shielded twisted pair cable and shielded RJ45 connectors (industrial connectors).
 - 100BaseTX cable in accordance with the Ethernet standard (min. Category 5)
- ▶ Measures to protect against interference:
Ensure the requirements for the industrial use of EtherCAT are met, as stated in the Installation Manual published by the User Group.

Connecting the supply voltage

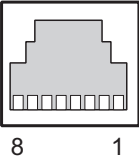
Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

Fieldbus modules

PNOZ m ES EtherCAT

Interface assignment

RJ45 socket 8-pin	PIN	Standard
	1	TD+ (Transmit+)
	2	TD- (Transmit-)
	3	RD+ (Receive+)
	4	n.c.
	5	n.c.
	6	RD- (Receive-)
	7	n.c.
	8	n.c.

n.c.: Not connected

Download modified project to the PNOZmulti safety system

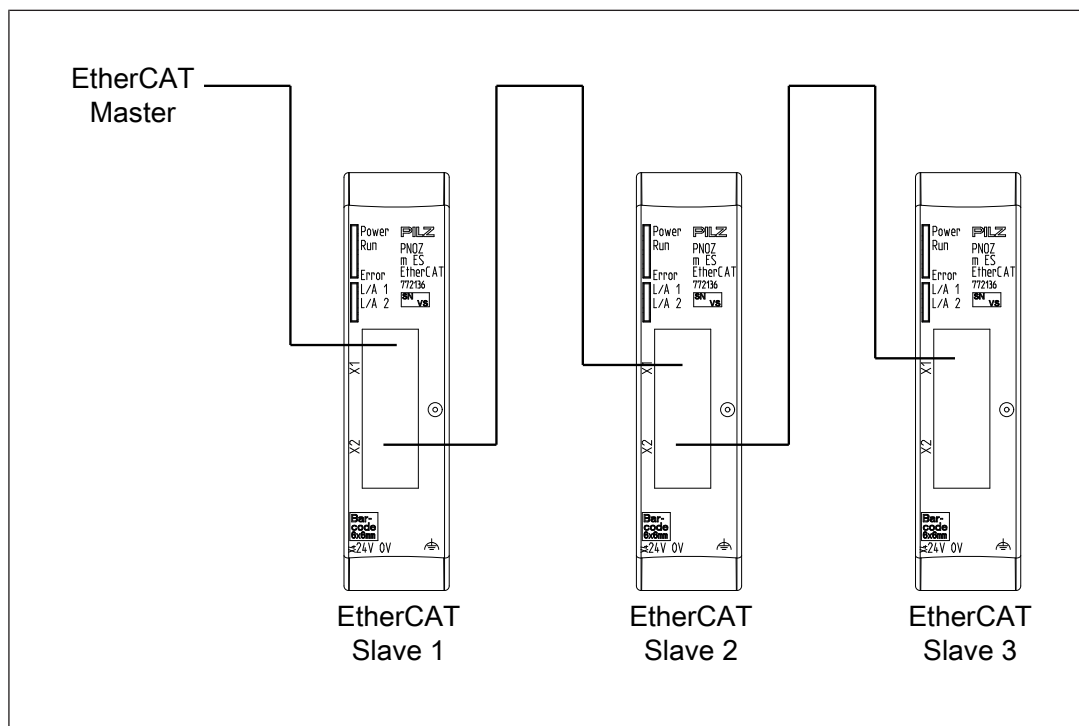
As soon as an additional expansion module has been connected to the system, the project must be amended in the PNOZmulti Configurator and downloaded back into the base unit. Proceed as described in the operating manual for the base unit.

Preparing for operation

- ▶ Install Device Description File
Install the *Device Description File* in your configuration software. You can only then use the PNOZ m ES EtherCAT.
- ▶ Connect the supply voltage to the base unit:
Terminals **24 V** and **A1 (+)**: + 24 VDC
Terminals **0 V** and **A2 (-)**: 0 V

Fieldbus modules PNOZ m ES EtherCAT

Connection example



Technical details

General

Certifications **CE, EAC, UKCA, cULus Listed**

Electrical data

Supply voltage

for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	35 mA
Output of external power supply (DC)	0,9 W
Potential isolation	Yes

Supply voltage

for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W

Fieldbus modules PNOZ m ES EtherCAT

Electrical data	
Max. power dissipation of module	1,5 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	EtherCAT
Device type	Slave
Protocol	CANopen over EtherCAT
Transmission rates	100 MBit/s
Connection	RJ45
Galvanic isolation	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Rated insulation voltage	30 V
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54

Fieldbus modules PNOZ m ES EtherCAT

Potential isolation	
Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated surge voltage	500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	115 mm
Weight	85 g

Where standards are undated, the 2013-06 latest editions shall apply.

Fieldbus modules PNOZ m ES EtherCAT

Order reference

Product

Product type	Features	Order no.
PNOZ m ES Ether-CAT	Configurable safe small controllers PNOZmulti 2, fieldbus module, EtherCAT.	772136

Accessories

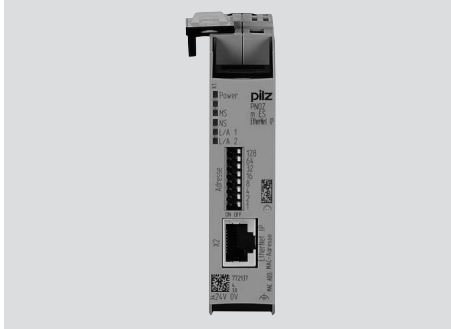
Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Spring terminals PNOZ mmcxp, 10 pcs.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 10 sets.	783543
Screw terminals PNOZ mmcxp, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542
Screw terminals PNOZ mmcxp, 10 pcs.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 10 sets.	793543

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m ES EtherNet/IP



Overview

Unit features

Application of the product PNOZ m ES EtherNet/IP:

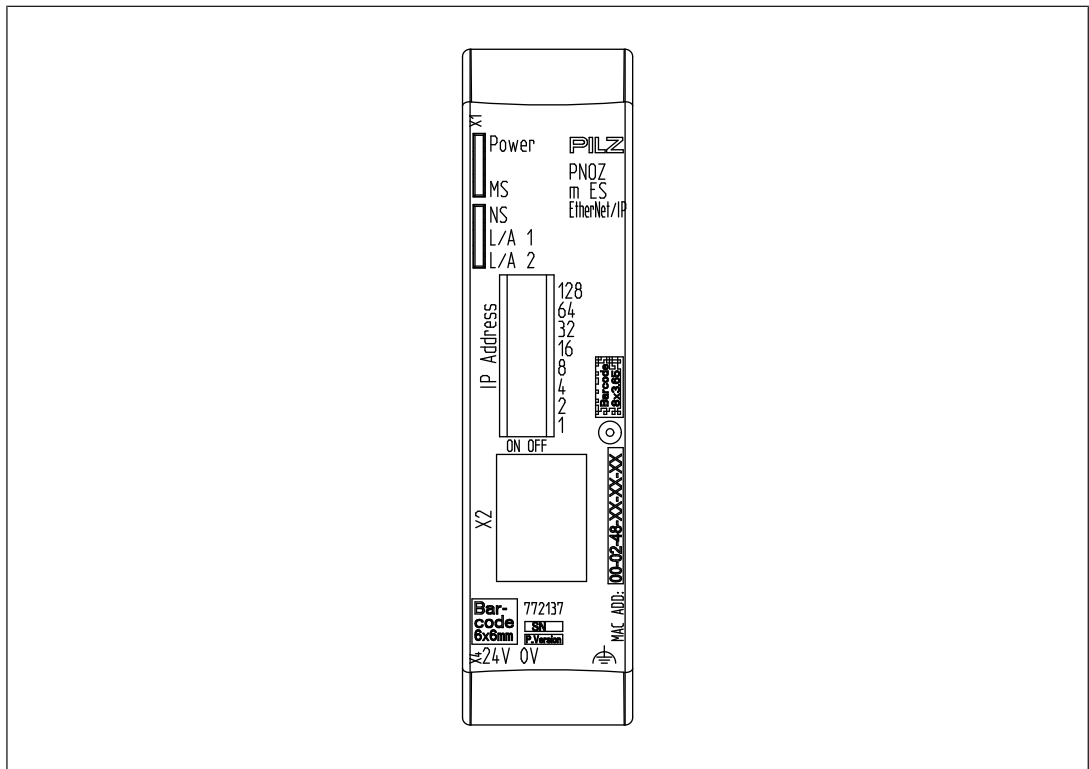
Expansion module for connection to a base unit from the PNOZmulti 2 system.

The product has the following features:


- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Connection for EtherNet/IP as adapter
- ▶ Transmission rate 10 MBit/s (10BaseT) and 100 MBit/s (100BaseTX)
- ▶ Status indicators for communication and for errors
- ▶ 128 virtual inputs and outputs on the control system PNOZmulti can be defined in the PNOZmulti Configurator for communication with the fieldbus EtherNet/IP.
- ▶ Max. 1 PNOZ m ES EtherNet/IP can be connected to the base unit
- ▶ 2-port switch
- ▶ Device Level Ring (DLR)
- ▶ Integrated web server
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Fieldbus modules PNOZ m ES EtherNet/IP

Front view



Legend:

- ▶ X1, X2: EtherNet/IP - Interfaces
- ▶ 0 V, 24 V: Supply connections
- ▶ IP address: for setting the IP address
- ▶ : Functional earth
- ▶ LED:
 - Power
 - MS
 - NS
 - L/A 1
 - L/A 2

EtherNet/IP™ is registered trademark and patented technology, licensed by ODVA.

Fieldbus modules PNOZ m ES EtherNet/IP

Function description

Operation

The virtual inputs and outputs that are to be transferred via the fieldbus EtherNet/IP are selected and configured in the PNOZmulti Configurator. The base unit and the fieldbus module PNOZ m ES EtherNet/IP are connected via a jumper. After the supply voltage is switched on or the PNOZmulti control system is reset, the fieldbus module PNOZ m ES EtherNet/IP is configured and started automatically.

LEDs indicate the status of the fieldbus module EtherNet/IP.

The configuration is described in detail in the PNOZmulti Configurator's online help.

Data exchange

17 or 32 bytes must always be sent and received for communication with the PNOZmulti.

Fixed parameters for the input/output assembly instances are set in the fieldbus module PNOZ m ES EtherNet/IP. The following data lengths can be selected:

Assembly Instance Input	Data length	Description
100	32 Bytes	Inputs, tables
101	17 Bytes	Inputs
Assembly Instance Output	Data length	Description
150	32 Bytes	Outputs, LEDs, tables
151	17 Bytes	Outputs, LEDs
Assembly Instance Configuration	Data length	Description
4	0 Bytes	-

Input and output data

The data is structured as follows:

Input area

The inputs are defined in the master and transferred to the PNOZmulti. Each input has a number, e.g. input bit 4 of byte 1 has the number I12.

Virtual inputs PNOZmulti Configurator	I0 ... I7	I8 ... I15	I16 ... I23	...	I120...I127
EtherNet/IP	Byte 0: Bit 0 ... 7	Byte 1: Bit 0 ... 7	Byte 2: Bit 0 ... 7	...	Byte 15: Bit 0 ... 7

Fieldbus modules PNOZ m ES EtherNet/IP

Output range

The outputs are defined in the PNOZmulti Configurator. Each output that is used is given a number there, e.g. O0, O5... .

The status of output O0 is stored in bit 0 of byte 0; the status of output O5 is stored in bit 5 of byte 0 etc.

Virtual inputs PNOZmulti Configurator	O0 ... O7	O8 ... O15	O16 ... O23	...	O120... O127
EtherNet/IP	Byte 0: Bit 0 ... 7	Byte 1: Bit 0 ... 7	Byte 2: Bit 0 ... 7	...	Byte 15: Bit 0 ... 7

▶ Status of LEDs:

LED status 1 Output Byte

The LED status of the base unit can be requested directly as follows

- Bit 0 = 1: LED OFAULT is lit or flashes
- Bit 1 = 1: LED IFAULT is lit or flashes
- Bit 2 = 1: LED FAULT is lit or flashes
- Bit 3 = 1: LED DIAG is lit or flashes
- Bit 4 = 1: LED RUN FS is lit
- Bit 5: Reserved
- Bit 6 = 1: LED RUN ST is lit (not for PNOZ m B0)
- Bit 7: Reserved

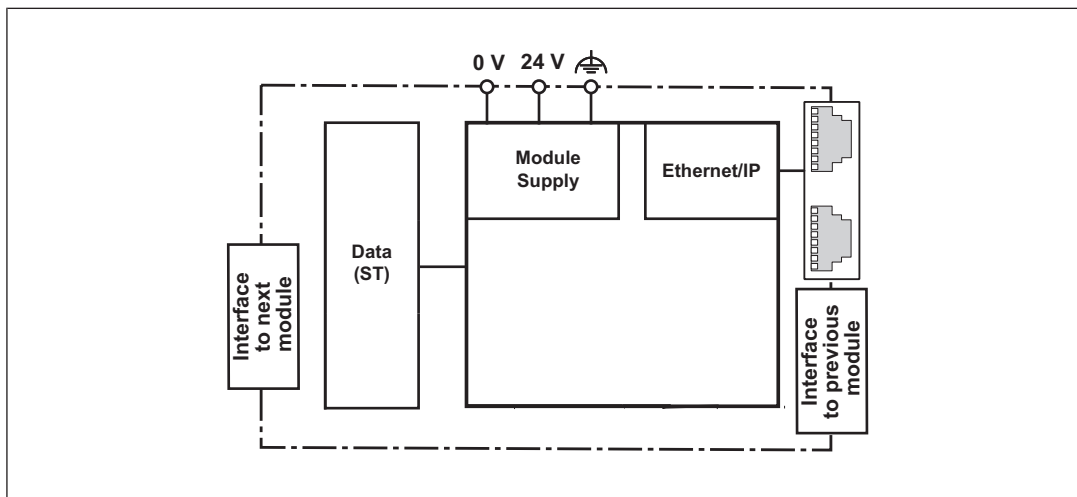
▶ Data exchange is displayed in Bit 5.

▶ Polling the payload data: 2 Bytes with the table number and segment number are sent by the Master for access to the payload data table (15 Bytes are returned to the Master).

Detailed information on data exchange is available in the document "Communication Interfaces PNOZmulti 2" in the section entitled "Fieldbus modules".

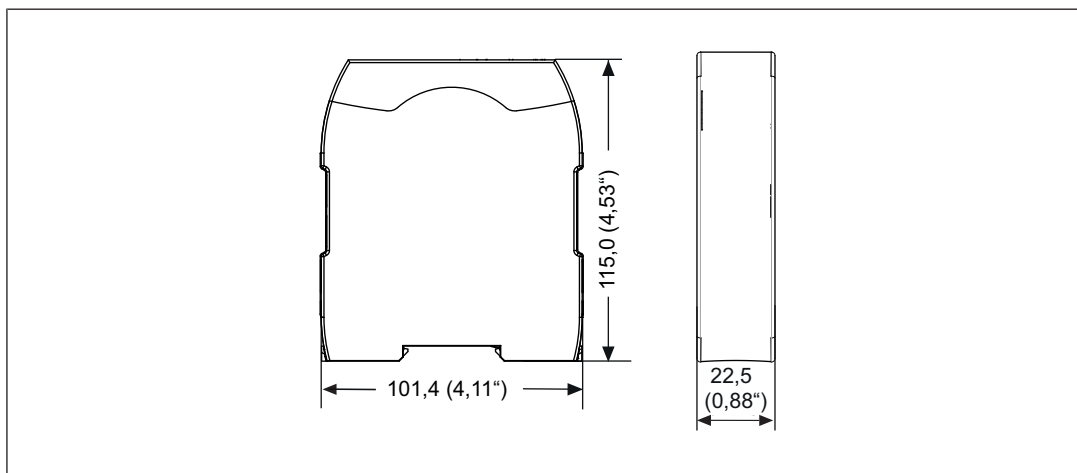
Fieldbus modules PNOZ m ES EtherNet/IP

Block diagram



Installation

Dimensions in mm



Commissioning

General wiring guidelines

The wiring is defined in the circuit diagram of the PNOZmulti Configurator. It is possible to define which inputs and outputs on the safety system will communicate with EtherNet/IP.


Please note:

- ▶ Information given in the "[Technical details \[510\]](#)" must be followed.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Please note the following when connecting to EtherNet/IP:

Fieldbus modules PNOZ m ES EtherNet/IP

- ▶ The following minimum requirements of the connection cable and connector must be met:
 - Only use standard industrial Ethernet cable and connectors.
 - Only use double-shielded twisted pair cable and shielded RJ45 connectors (industrial connectors).
 - 100BaseTX cable in accordance with the Ethernet standard (min. Category 5)
- ▶ Measures to protect against interference:

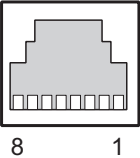
Ensure the requirements for the industrial use of EtherNet/IP are met, as stated in the Installation Manual published by the User Group.
- ▶ External measures must be used to connect the terminal  to the functional earth, when the mounting rail is **not** connected to the functional earth.
- ▶ Always connect the mounting rail to the protective earth via an earthing terminal. This will be used to dissipate hazardous voltages in the case of a fault.
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).

Connecting the supply voltage

Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

Interface assignment

RJ45 socket 8-pin	PIN	Standard
	1	TD+ (Transmit+)
	2	TD- (Transmit-)
	3	RD+ (Receive+)
	4	n.c.
	5	n.c.
	6	RD- (Receive-)
	7	n.c.
	8	n.c.

Fieldbus modules PNOZ m ES EtherNet/IP

n.c.: Not connected

Set IP address

When setting the IP address, please note:

- ▶ Switch off the supply voltage to the fieldbus module PNOZ m ES EtherNet/IP before setting the DIP switches.
- ▶ The IP address for the fieldbus module PNOZ m ES EtherNet/IP should not be the same as the PC's IP address.

The following different options are available for setting the IP address.

Set IP address via DIP switches

IP address is set using the DIP switch on the front of the PNOZ m ES EtherNet/IP:

- ▶ The first three bytes of the IP address are: 192.168.1.
- ▶ Subnet mask: 255.255.255.0.
- ▶ The last byte of the IP address is configured using the DIP switch (value range: 1 ...254).
- ▶ The IP address that is set at the DIP switch is used. DHCP is therefore disabled.

DIP switch "IP address"	Meaning		Example: IP address 020 _D
	OFF	ON	
1	0	128 _D	
2	0	64 _D	
3	0	32 _D	
4	0	16 _D	
5	0	8 _D	
6	0	4 _D	
7	0	2 _D	
8	0	1 _D	

Obtain IP address automatically via DHCP Server

The IP address can be assigned automatically via a DHCP server.

To do this, DHCP must be activated on the fieldbus module PNOZ m ES EtherNet/IP.

- ▶ DHCP is already activated when the module is delivered. The IP address is obtained automatically from the DHCP Server when the DIP switch is set to 0. The module waits to receive an address from a DHCP Server.
- ▶ If a fixed IP address has previously been set and you wish to activate DHCP via DIP switch, set the DIP switch to 255.
DHCP will always be used, irrespective of the configuration in the web server.

Fieldbus modules PNOZ m ES EtherNet/IP

Set IP address via web server or EtherNet/IP scanner

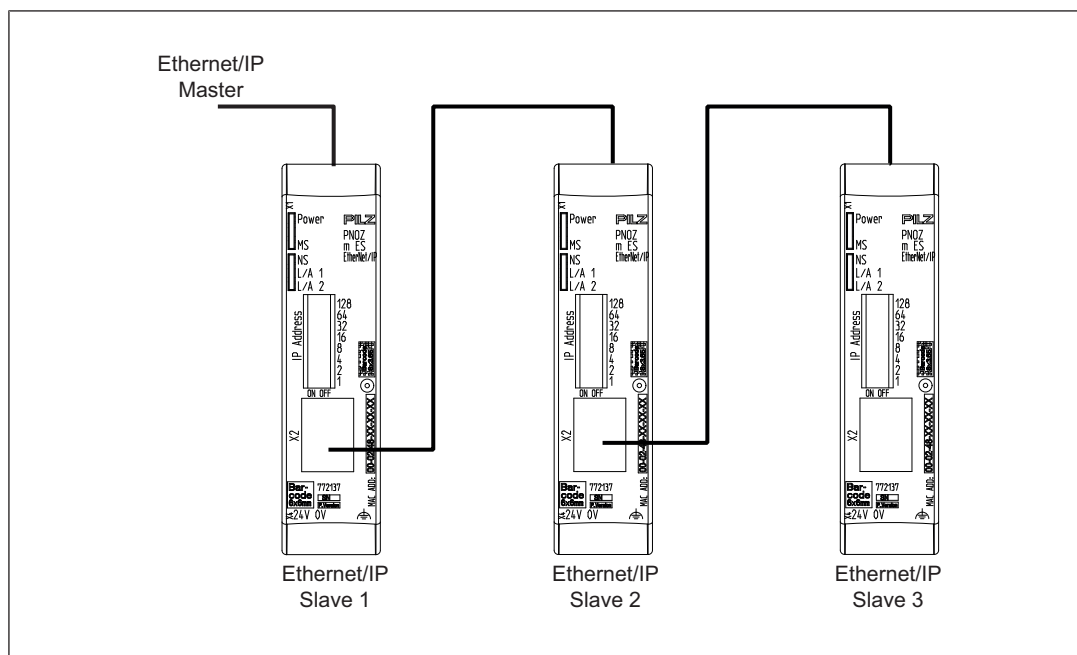
For details of how to set the IP address via the implemented web server, refer to the section entitled Web server.

If a fixed IP address has been assigned via EtherNet/IP Scanner or via the web server, then this will be used.

Please note:

- ▶ If you are setting the IP address via the web server, the DIP switch must not be set to 255.
- ▶ If you are setting the IP address via the EtherNet/IP Scanner, the DIP switch must be set to 0 and DHCP must be active.

Connection example



Fieldbus modules PNOZ m ES EtherNet/IP

Technical Details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	50 mA
Output of external power supply (DC)	1,2 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	1,5 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	EtherNet/IP (TM)
Device type	Adapter
Transmission rates	10 MBit/s, 100 MBit/s
Connection	2 x RJ45
Galvanic isolation	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m

Fieldbus modules PNOZ m ES EtherNet/IP

Environmental data	
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Rated insulation voltage	30 V
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated surge voltage	500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm ² , 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm ² , 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm ² , 24 - 12 AWG

Fieldbus modules PNOZ m ES EtherNet/IP

Mechanical data

Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	110,4 mm
Weight	90 g

Where standards are undated, the 2014-04 latest editions shall apply.

Fieldbus modules PNOZ m ES EtherNet/IP

Order reference

Product

Product type	Features	Order no.
PNOZ m ES EtherNet/IP	Configurable safe small controllers PNOZmulti 2, fieldbus module, EtherNet/IP.	772137

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Spring terminals PNOZ mmcpx, 10 pcs.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 10 sets.	783543
Screw terminals PNOZ mmcpx, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542
Screw terminals PNOZ mmcpx, 10 pcs.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 10 sets.	793543

Plug-in connector

Product type	Features	Order no.
RJ45 Connector	RJ45 plug-in connector, straight, IP20, 8-pin, Cat6a, IDC connection, AWG22, cable diameter: 5.5 - 8.5 mm	380401

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m ES Powerlink




Overview

Unit features

Application of the product PNOZ m ES Powerlink:

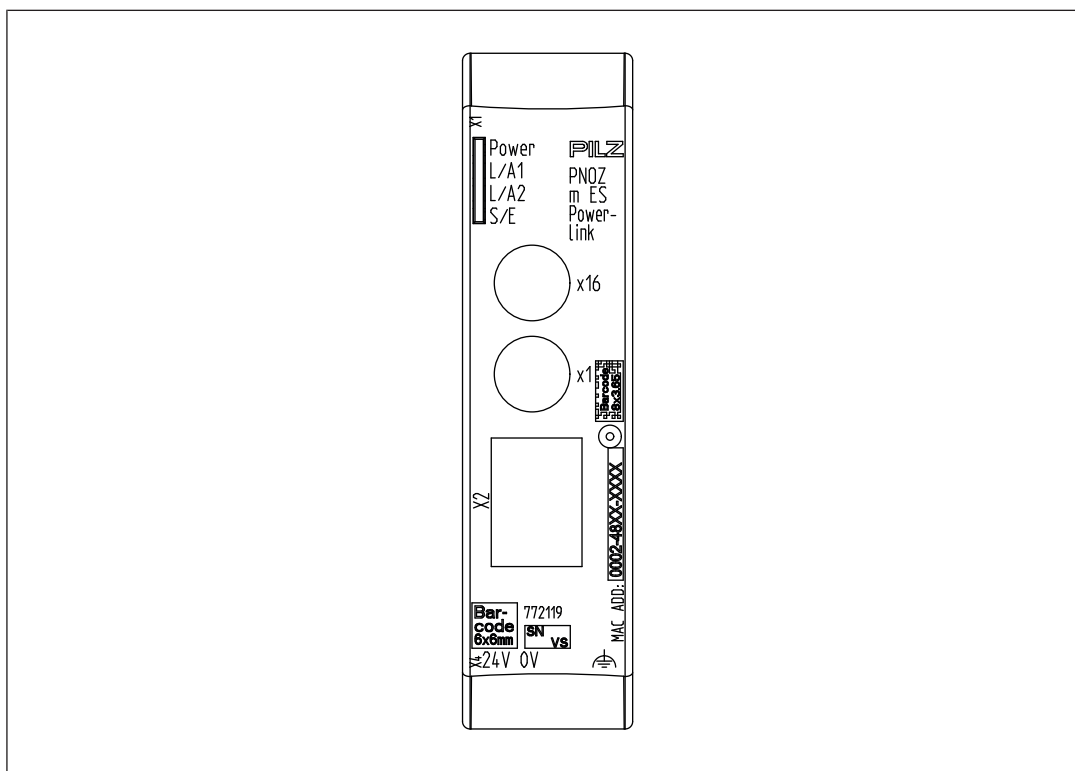
Expansion module for connection to a base unit from the PNOZmulti 2 system.

The product has the following features:


- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Connection for Ethernet POWERLINK (Ethernet POWERLINK V 2 protocol)
- ▶ Station addresses from 1 ... 239, selected via rotary switch
- ▶ The minimum cycle time for an application of 32 Byte Output and 32 Byte Input is 275µs. The minimum cycle time is 500 µs at the maximum PDO size of 254 Byte Input and 32 Byte Output. (The inputs and outputs in this case are viewed from the Managing Node.)
- ▶ 128 virtual inputs and outputs on the control system PNOZmulti can be defined in the PNOZmulti Configurator for communication with the fieldbus Ethernet POWERLINK.
- ▶ Max. 1 PNOZ m ES Powerlink can be connected to the base unit
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [ 522]).

Fieldbus modules PNOZ m ES Powerlink

Front view



Legend:

- ▶ X1, X2: Ethernet POWERLINK interfaces
- ▶ 0 V, 24 V: Supply connections
- ▶ : Functional earth
- ▶ LED:
 - Power
 - L/A1
 - L/A2
 - S/E (Status/Error)

Function description

Functions

The virtual inputs and outputs that are to be transferred via the fieldbus Ethernet POWERLINK are selected and configured in the PNOZmulti Configurator. The base unit and the fieldbus module PNOZ m ES Powerlink are connected via a jumper. After the supply voltage is switched on or the PNOZmulti control system is reset, the fieldbus module PNOZ m ES Powerlink is configured and started automatically.

Fieldbus modules PNOZ m ES Powerlink

LEDs indicate the status of the fieldbus module Ethernet POWERLINK.

The configuration is described in detail in the PNOZmulti Configurator's online help.

Input and output data

The data is structured as follows:

▶ **Input area PNOZ m ES Powerlink**

The values for the virtual inputs are set as an output in the Managing Node and transferred to the PNOZmulti 2. Each input has a number, e.g. input bit 4 of SDO 2100:02 has the number i12.

Virtual inputs PNOZmulti Configurator	I0 ... I7	I8 ... I15	I16 ... I23
Ethernet POWER-LINK	SDO 2100:01: Bit 0 ... 7	SDO 2100:02: Bit 0 ... 7	SDO 2100:03: Bit 0 ... 7

▶ **Output range PNOZ m ES Powerlink**

The virtual outputs are configured in the PNOZmulti Configurator. Each output that is used is given a number there, e.g. o0, o5... The state of output o0 is stored in Bit 0 of SDO 2000:01.

Virtual outputs PNOZmulti Configurator	O0 ... O7	O8 ... O15	O16 ... O23
Ethernet POWER-LINK	SDO 2000:01: Bit 0 ... 7	SDO 2000:02: Bit 0 ... 7	SDO 2000:03: Bit 0 ... 7

▶ **Status of LEDs:**

LED status 1 Output Byte

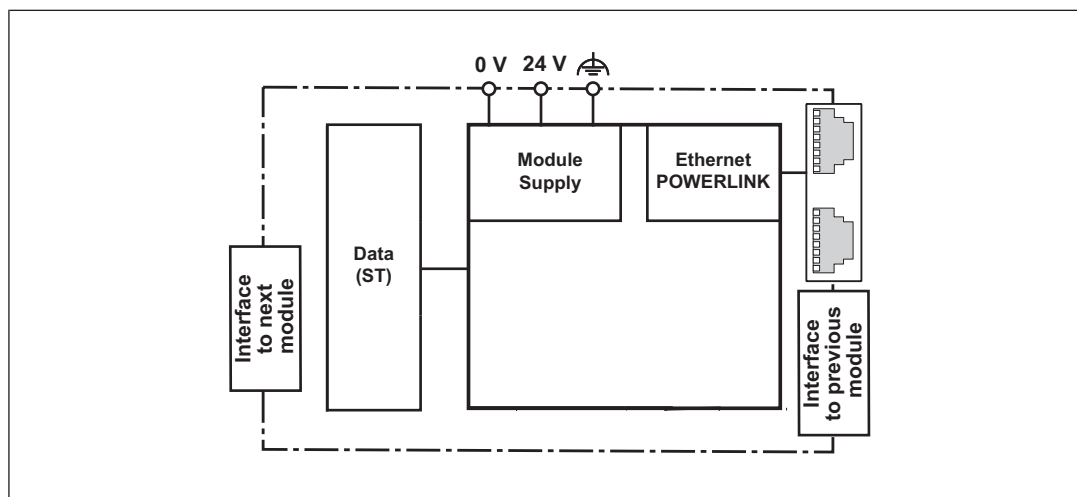
The LED status of the base unit can be requested directly as follows

- Bit 0 = 1: LED OFAULT is lit or flashes
- Bit 1 = 1: LED IFAULT is lit or flashes
- Bit 2 = 1: LED FAULT is lit or flashes
- Bit 3 = 1: LED DIAG is lit or flashes
- Bit 4 = 1: LED RUN FS is lit
- Bit 5: Reserved
- Bit 6 = 1: LED RUN ST is lit (not for PNOZ m B0)
- Bit 7: Reserved

Detailed information on data exchange is available in the document "Communication Interfaces PNOZmulti 2" in the section entitled "Fieldbus modules".

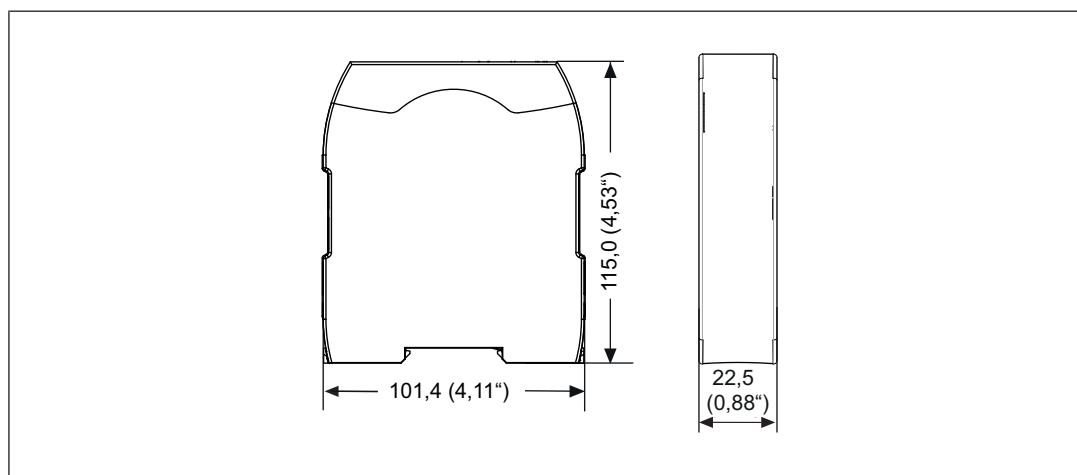
Fieldbus modules PNOZ m ES Powerlink

Block diagram



Installation

Dimensions in mm



Commissioning

General wiring guidelines

The wiring is defined in the circuit diagram of the PNOZmulti Configurator. It is possible to define which inputs and outputs on the safety system will communicate with Ethernet POWERLINK.


Please note:

- ▶ Information given in the "Technical details [[520](#)]" must be followed.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Fieldbus modules PNOZ m ES Powerlink

Please note the following when connecting to Ethernet POWERLINK:

- ▶ The following minimum requirements of the connection cable and connector must be met:
 - Only use standard industrial Ethernet cable and connectors.
 - Only use double-shielded twisted pair cable and shielded RJ45 connectors (industrial connectors).
 - 100BaseTX cable in accordance with the Ethernet standard (min. Category 5)
- ▶ Measures to protect against interference:

Ensure the requirements for the industrial use of Ethernet POWERLINK are met, as stated in the Installation Manual published by the User Group.
- ▶ External measures must be used to connect the terminal  to the functional earth, when the mounting rail is **not** connected to the functional earth.
- ▶ Always connect the mounting rail to the protective earth via an earthing terminal. This will be used to dissipate hazardous voltages in the case of a fault.
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).

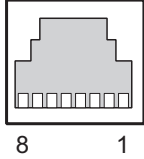
Connecting the supply voltage

Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

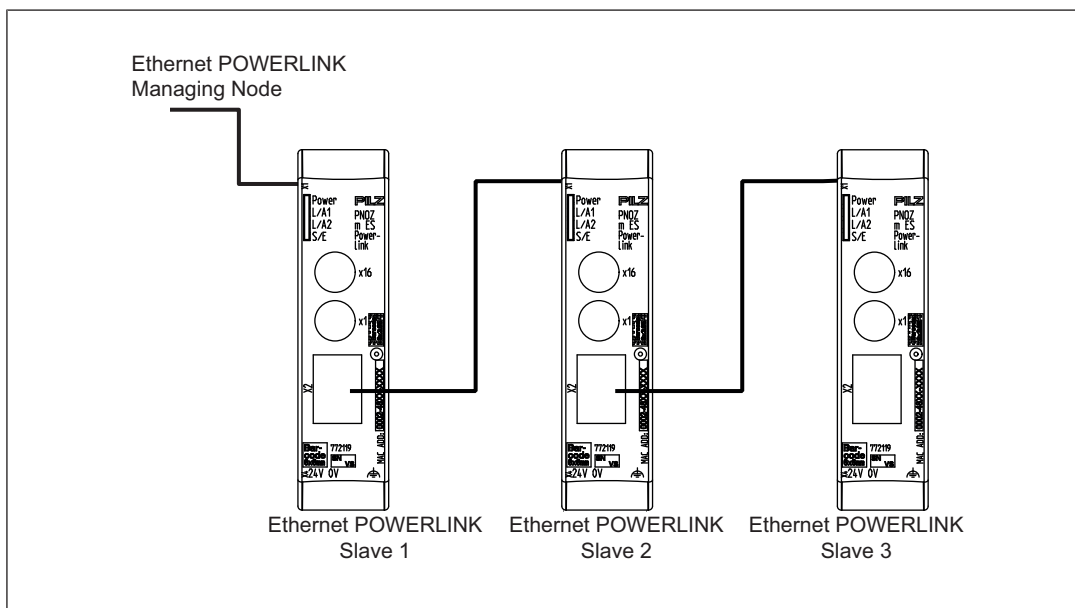
Fieldbus modules PNOZ m ES Powerlink

Interface assignment

RJ45 socket 8-pin	PIN	Standard
	1	TD+ (Transmit+)
	2	TD- (Transmit-)
	3	RD+ (Receive+)
	4	n.c.
	5	n.c.
	6	RD- (Receive-)
	7	n.c.
	8	n.c.

n.c.: Not connected

Connection example



Fieldbus modules PNOZ m ES Powerlink

Technical Details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	50 mA
Output of external power supply (DC)	1,2 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	1,5 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	Ethernet POWERLINK V2
Device type	Controlled Node
Transmission rates	100 MBit/s
Connection	RJ45
Galvanic isolation	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m

Fieldbus modules PNOZ m ES Powerlink

Environmental data	
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Rated insulation voltage	30 V
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated surge voltage	500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm ² , 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm ² , 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm ² , 24 - 12 AWG

Fieldbus modules PNOZ m ES Powerlink

Mechanical data

Spring-loaded terminals: Terminal points per connection

2

Stripping length with spring-loaded terminals

9 mm

Dimensions

Height

101,4 mm

Width

22,5 mm

Depth

110,4 mm

Weight

90 g

Where standards are undated, the 2013-10 latest editions shall apply.

Order reference

Product

Product type	Features	Order no.
PNOZ m ES Powerlink	Configurable safe small controllers PNOZmulti 2, fieldbus module, POWERLINK.	772119

Accessories

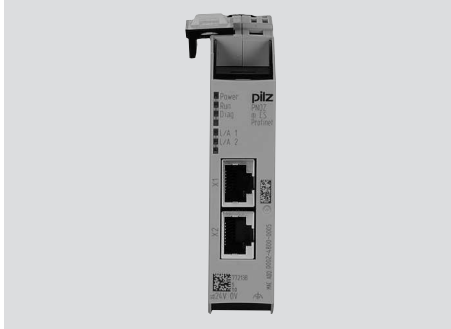
Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Spring terminals PNOZ mmcxp, 10 pcs.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 10 sets.	783543
Screw terminals PNOZ mmcxp, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542
Screw terminals PNOZ mmcxp, 10 pcs.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 10 sets.	793543

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m ES Profinet



Overview

Unit features

Application of the product PNOZ m ES Profinet:

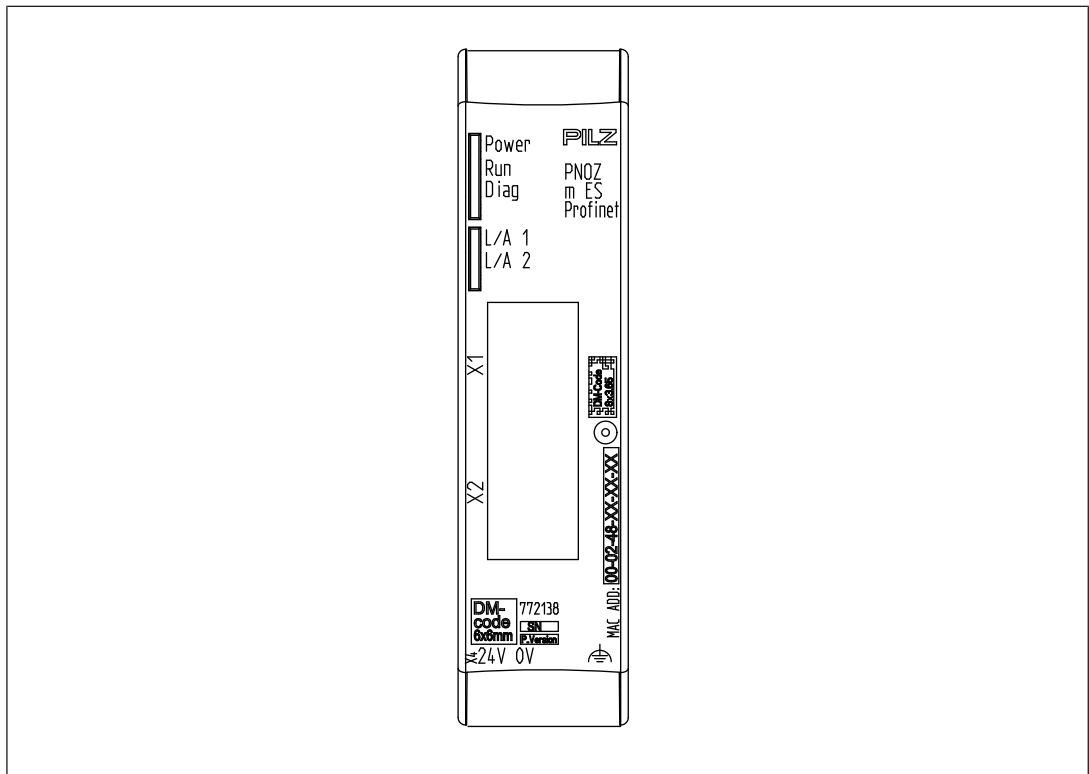
Expansion module for connection to a base unit from the PNOZmulti 2 system.

The product has the following features:


- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Connection for PROFINET
- ▶ Status, diagnostic and error displays for communication with PROFINET
- ▶ 128 virtual inputs and outputs on the control system PNOZmulti 2 can be defined in the PNOZmulti Configurator for communication with the fieldbus PROFINET.
- ▶ Transmission rate 100 MBit/s (100BaseTX), full and half duplex
- ▶ Max. 1 PNOZ m ES Profinet can be connected to the base unit
- ▶ Two RJ45 ports
- ▶ PNOZ m ES Profinet <V2.0: Profinet IO device V2.2 functions in accordance with Conformance Class C
PNOZ m ES Profinet from V2.0: Profinet IO device V2.3 functions in accordance with Conformance Class C
- ▶ Supported functions:
 - RT
 - IRT
 - MRP
 - LLDP
 - I&M 0-4
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [522]).
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Fieldbus modules PNOZ m ES Profinet

Front view



Legend:

- ▶ X1, X2: Profinet interfaces
- ▶ 0 V, 24 V: Supply connections
- ▶ : Functional earth
- ▶ LED:
 - Power
 - Run
 - Diag
 - L/A 1
 - L/A 2

Fieldbus modules PNOZ m ES Profinet

Function description

Operation

The virtual inputs and outputs that are to be transferred via PROFINET are selected and configured in the PNOZmulti Configurator. The base unit and the expansion module PNOZ m ES Profinet are connected via a jumper.

After the supply voltage is switched on or the PNOZmulti 2 is reset, the expansion module PNOZ m ES Profinet is configured and started automatically.

LEDs indicate the status of the fieldbus module PROFINET.

The configuration is described in detail in the PNOZmulti Configurator's online help.

Data access

The data is structured as follows:

▶ Virtual data

- Input area PNOZ m ES Profinet

The values for the inputs are set in the Master as an output and transferred to the PNOZmulti 2.

- Output area PNOZ m ES Profinet

The outputs are configured in the PNOZmulti Configurator and transferred to the Master.

▶ Status of LEDs:

LED status 1 Output Byte

The LED status of the base unit can be requested directly as follows

- Bit 0 = 1: LED OFAULT is lit or flashes
- Bit 1 = 1: LED IFAULT is lit or flashes
- Bit 2 = 1: LED FAULT is lit or flashes
- Bit 3 = 1: LED DIAG is lit or flashes
- Bit 4 = 1: LED RUN FS is lit
- Bit 5: Reserved
- Bit 6 = 1: LED RUN ST is lit (not for PNOZ m B0)
- Bit 7: Reserved

▶ Data exchange is displayed in Bit 5.

- ▶ Polling the payload data: 2 Bytes with the table number and segment number are sent by the Master for access to the payload data table (15 Bytes are returned to the Master).

Detailed information on data exchange (tables, segments) is available in the document "Communication Interfaces" in the section entitled "Fieldbus modules".

Fieldbus modules PNOZ m ES Profinet

Assigning the inputs/outputs in the PNOZmulti Configurator to the PROFINET inputs/outputs

Virtual inputs and outputs can be requested or set directly via the following modules. Each element can be selected individually in the master control system, e.g. virtual inputs i0-31. The data width is also established this way.

Input data

The Master writes to the virtual inputs of the PNOZmulti 2.

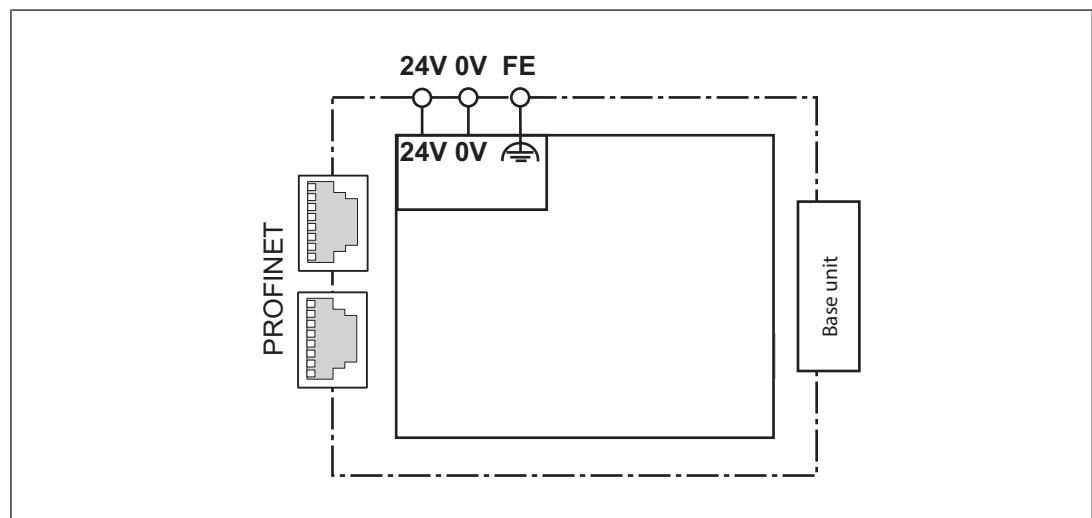
Description	Input data from PNOZmulti 2
Virtual inputs i0 – i31	4 Input Bytes
Virtual inputs i32 – i63	4 Input Bytes
Virtual inputs i64 – i95	4 Input Bytes
Virtual inputs i96 – i127	4 Input Bytes

Output data

The Master reads the virtual outputs of the PNOZmulti 2.

Description	Output data from PNOZmulti 2
Virtual outputs o0 – o31	4 Output Bytes
Virtual outputs o32 – o63	4 Output Bytes
Virtual outputs o64 – o95	4 Output Bytes
Virtual outputs o96 – o127	4 Output Bytes

Block diagram

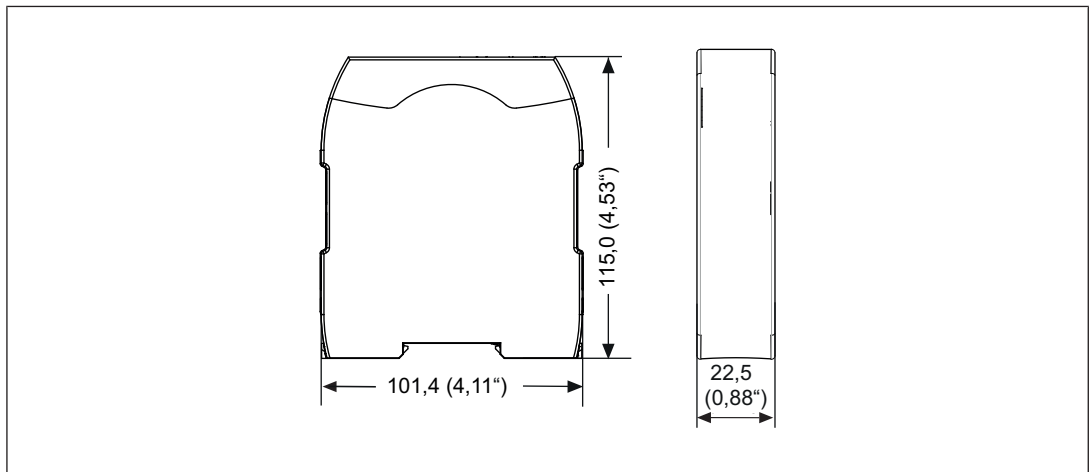


Fieldbus modules

PNOZ m ES Profinet

Installation

Dimensions in mm



Commissioning

General wiring guidelines


The wiring is defined in the circuit diagram of the PNOZmulti Configurator. It is possible to define which inputs and outputs on the safety system will communicate with PROFINET.

Please note:

- ▶ Information given in the "[Technical details \[530\]](#)" must be followed.
- ▶ Use copper wiring with a temperature stability of 75 °C.

Please note the following when connecting to PROFINET:

- ▶ The following minimum requirements of the connection cable and connector must be met:
 - Only use standard industrial Ethernet cable and connectors.
 - Only use double-shielded twisted pair cable and shielded RJ45 connectors (industrial connectors).
 - 100BaseTX cable in accordance with the Ethernet standard (min. Category 5)
- ▶ Measures to protect against interference:

Ensure the requirements for the industrial use of PROFINET are met, as stated in the Installation Manual published by the User Group.
- ▶ External measures must be used to connect the terminal  to the functional earth, when the mounting rail is **not** connected to the functional earth.
- ▶ Always connect the mounting rail to the protective earth via an earthing terminal. This will be used to dissipate hazardous voltages in the case of a fault.

Fieldbus modules PNOZ m ES Profinet

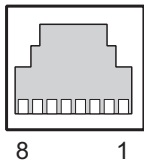
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).

Connecting the supply voltage

Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

Interface assignment

RJ45 socket 8-pin	PIN	Standard
	1	TD+ (Transmit+)
	2	TD- (Transmit-)
	3	RD+ (Receive+)
	4	n.c.
	5	n.c.
	6	RD- (Receive-)
	7	n.c.
	8	n.c.

n.c.: Not connected

Preparing for operation

Set IP address

There are two options:

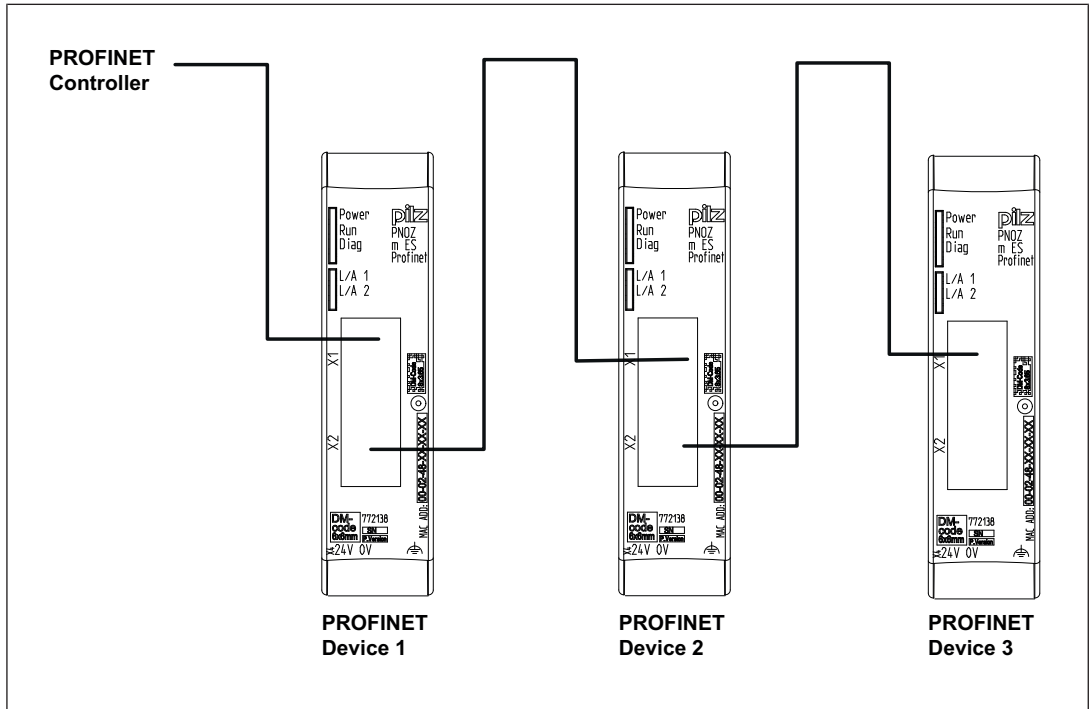
- ▶ Automatic assignment of the IP address with the Dynamic Host Configuration Protocol (DHCP)
- ▶ Assignment of the IP address by the IO controller before system startup based on the unique unit name.

Install GSDLM file

Install the GSDML file. You can find the GSDML file in the Internet at www.pilz.de.

Fieldbus modules PNOZ m ES Profinet

Connection example



Fieldbus modules PNOZ m ES Profinet

Technical details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	60 mA
Output of external power supply (DC)	1,4 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	1,5 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	PROFINET
Device type	IO-Device
Transmission rates	100 MBit/s
Connection	2 x RJ45
Galvanic isolation	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m

Fieldbus modules PNOZ m ES Profinet

Environmental data	
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated insulation voltage	30 V
Rated surge voltage	500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG

Fieldbus modules PNOZ m ES Profinet

Mechanical data

Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	110,4 mm
Weight	86 g

Where standards are undated, the 2014-04 latest editions shall apply.

Fieldbus modules PNOZ m ES Profinet

Order reference

Product

Product type	Features	Order no.
PNOZ m ES Profinet	Configurable safe small controllers PNOZmulti 2, fieldbus module, Profinet.	772138

Accessories

Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Spring terminals PNOZ mmcpx, 10 pcs.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 10 sets.	783543
Screw terminals PNOZ mmcpx, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542
Screw terminals PNOZ mmcpx, 10 pcs.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 10 sets.	793543

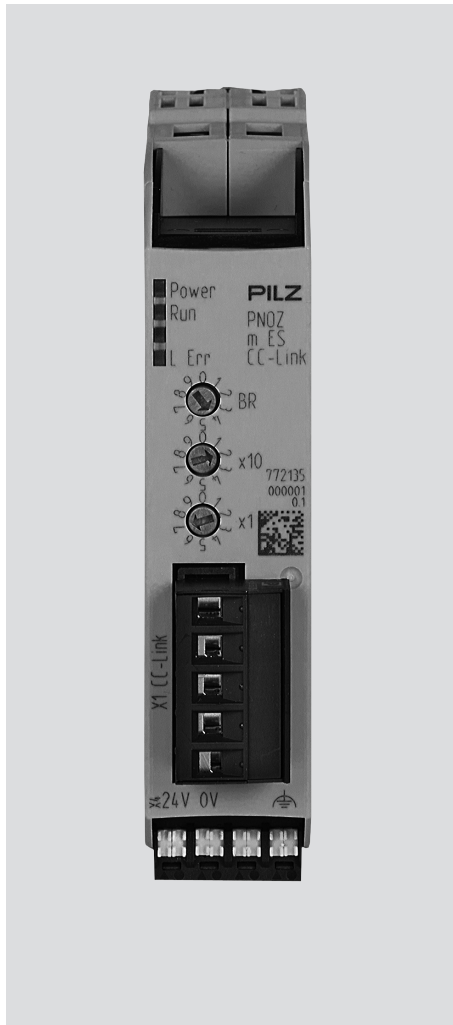
Plug-in connector

Product type	Features	Order no.
RJ45 Connector	RJ45 plug-in connector, straight, IP20, 8-pin, Cat6a, IDC connection, AWG22, cable diameter: 5.5 - 8.5 mm	380401

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m ES CC-Link



Overview

Unit features

Application of the product PNOZ m ES CC-Link:

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

The product has the following features:

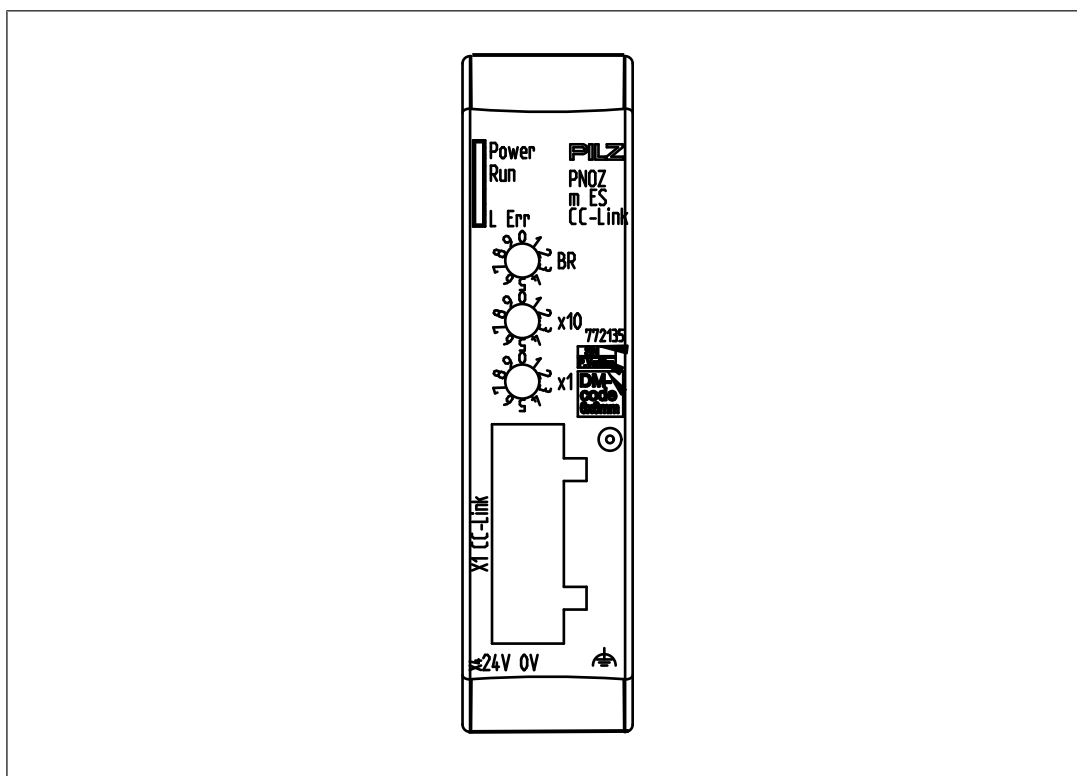
- ▶ Can be configured in the PNOZmulti Configurator
- ▶ Connection for CC-Link
- ▶ Station addresses from 1 ... 63, selected via rotary switch
- ▶ Station type: Remote Device
- ▶ Occupied stations: 3

Fieldbus modules


PNOZ m ES CC-Link

- ▶ 128 virtual inputs and outputs on the control system PNOZmulti can be defined in the PNOZmulti Configurator for communication with the fieldbus CC-Link.
- ▶ Max. 1 PNOZ m ES CC-Link can be connected to the base unit
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [522]).
- ▶ Please refer to the document "PNOZmulti System Expansion" for the PNOZmulti base units that can be connected.

Front view



Legend:

- | | |
|---|-----------------------------------|
| X1: | CC-Link interface |
| X4: 0 V, 24 V: | Supply connections |
|  | Functional earth |
| Rotary switch | For setting the station addresses |
| LEDs: | Power, Run, L Err |

Fieldbus modules PNOZ m ES CC-Link

Function description

Functions

The virtual inputs and outputs that are to be transferred via the fieldbus CC-Link are selected and configured in the PNOZmulti Configurator. The base unit and the fieldbus module PNOZ m ES CC-Link are connected via a jumper. After the supply voltage is switched on or the PNOZmulti control system is reset, the fieldbus module PNOZ m ES CC-Link is configured and started automatically.

LEDs indicate the status of the fieldbus module CC-Link.

The configuration is described in detail in the PNOZmulti Configurator's online help.

To send and receive data three stations have to be created in CC-Link master.

Input and output data

Virtual inputs and outputs can be requested or set directly via the following addresses. The implementation to the names of the inputs and outputs in PNOZmulti 2 is performed as in the table listed below.

The data is structured as follows:

► Input area

- Inputs on PNOZmulti Configurator: i00 .. i127
- Input data CC-Link: RYmn.. RY(m+50)n, RWw l .. RWw l+2
with l = address can be set as required on the master side (word address)
with m = address can be set as required on the master side (Bit address)
with n = 0 .. F (Bit number)

Example: (with m=100) i23 -> n = 7 -> RY117

Bit addressed input data i00 - i87

n	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
RY m n	i15	i14	i13	i12	i11	i10	i09	i08	i07	i06	i05	i04	i03	i02	i01	i00
RY(m+10)n	i31	i30	i29	i28	i27	i26	i25	i24	i23	i22	i21	i20	i19	i18	i17	i16
RY(m+20)n	i47	i46	i45	i44	i43	i42	i41	i40	i39	i38	i37	i36	i35	i34	i33	i32
RY(m+30)n	i63	i62	i61	i60	i59	i58	i57	i56	i55	i54	i53	i52	i51	i50	i49	i48
RY(m+40)n	i79	i78	i77	i76	i75	i74	i73	i72	i71	i70	i69	i68	i67	i66	i65	i64
RY(m+50)n									i87	i86	i85	i84	i83	i82	i81	i80

Word addressed input data i88 - i127

	High byte								Low byte							
Bit no	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
RWw l	i103	i102	i101	i100	i99	i98	i97	i96	i95	i94	i93	i92	i91	i90	i89	i88

Fieldbus modules PNOZ m ES CC-Link

RWw I+1	i119	i118	i117	i116	i115	i114	i113	i112	i111	i110	i109	i108	i107	i106	i105	i104
RWw I+2	-	-	-	-	-	-	-	-	i127	i126	i125	i124	i123	i122	i121	i120

► **Output range**

- Outputs on PNOZmulti Configurator: o00 .. o127
- Output data CC-Link: RXmn .. RX(m+50)n, RWr I .. RWr I+2
with I = address can be set as required on the master side (word address)
with m = address can be set as required on the master side (Bit address)
with n = 0 .. F (Bit number)
Example: (with m=100) o22 -> n = 6 -> RX116

Bit addressed output data o00 - o87

n	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
RX m n	o15	o14	o13	o12	o11	o10	o09	o08	o07	o06	o05	o04	o03	o02	o01	o00
RX(m+10)n	o31	o30	o29	o28	o27	o26	o25	o24	o23	o22	o21	o20	o19	o18	o17	o16
RX(m+20)n	o47	o46	o45	o44	o43	o42	o41	o40	o39	o38	o37	o36	o35	o34	o33	o32
RX(m+30)n	o63	o62	o61	o60	o59	o58	o57	o56	o55	o54	o53	o52	o51	o50	o49	o48
RX(m+40)n	o79	o78	o77	o76	o75	o74	o73	o72	o71	o70	o69	o68	o67	o66	o65	o64
RX(m+50)n									o87	o86	o85	o84	o83	o82	o81	o80

Word addressed output data o88 - o127

Bit No.	High byte								Low byte							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
RWr I	o10 3	o10 2	o10 1	o10 0	o99	o98	o97	o96	o95	o94	o93	o92	o91	o90	o89	o88
RWr I+1	o11 9	o11 8	o11 7	o11 6	o11 5	o11 4	o11 3	o11 2	o11 1	o11 0	o10 9	o10 8	o10 7	o10 6	o10 5	o10 4
RWr I+2	-	-	-	LED R U N F S	LED D I A G	LED F A U L T	LED I F A U L T	LED O F A U L T	o12 7	o12 6	o12 5	o12 4	o12 3	o12 2	o12 1	o12 0

Fieldbus modules PNOZ m ES CC-Link

LED status

The LED status of PNOZmulti 2 can be read out via the following High Byte.

	High Byte								Low Byte							
Bit no	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
RWr (I+2)	LED Byte								Output data o120 - o127							

Bit 5-7: Reserved

The LED status of the base unit PNOZ m B0 can be requested directly as follows

- ▶ Bit 0 = 1: LED OFAULT is lit or flashes
- ▶ Bit 1 = 1: LED IFAULT is lit or flashes
- ▶ Bit 2 = 1: LED FAULT is lit or flashes
- ▶ Bit 3 = 1: LED DIAG is lit or flashes
- ▶ Bit 4 = 1: LED RUN is lit
- ▶ Bit 5-7: Reserved

The LED status of the base unit PNOZ m B1 can be requested directly as follows

- ▶ Bit 0 = 1: LED OFAULT is lit or flashes
- ▶ Bit 1 = 1: LED IFAULT is lit or flashes
- ▶ Bit 2 = 1: LED FAULT is lit or flashes
- ▶ Bit 3 = 1: LED DIAG is lit or flashes
- ▶ Bit 4 = 1: LED RUN FS is lit
- ▶ Bit 5: Reserved
- ▶ Bit 6 = 1: LED RUN ST is lit
- ▶ Bit 7: Reserved

Access to table segments

The data in the tables can be requested via the following addresses.

Input data

The Master requests a table segment:

	High Byte	Low Byte
RWw (I+3)	Segment number	Table number

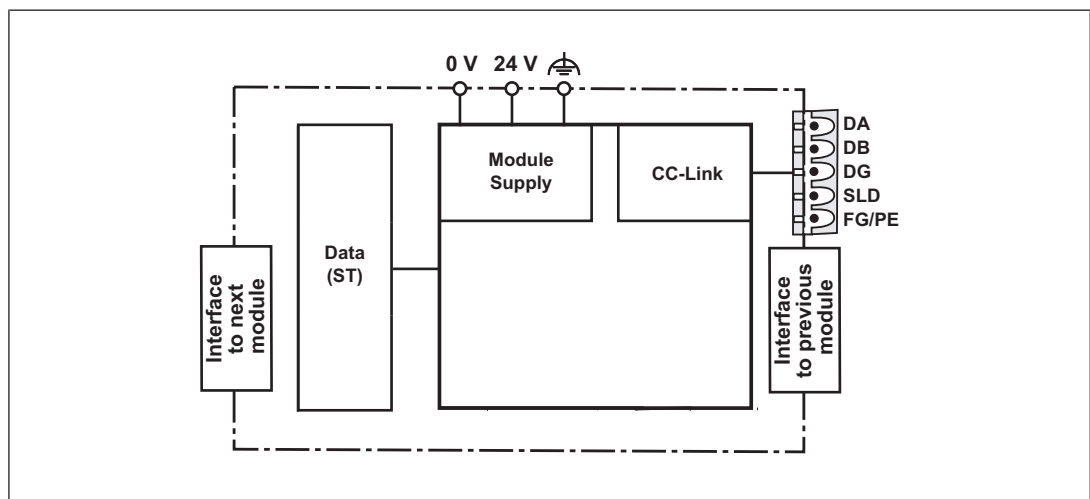
Fieldbus modules PNOZ m ES CC-Link

Output data

PNOZmulti 2 answers as follows:

	High Byte	Low Byte
RWr(I+3)	Segment number	Table number
RWr(I+4)	Segment Byte 1	Segment Byte 0
RWr(I+5)	Segment Byte 3	Segment Byte 2
RWr(I+6)	Segment Byte 5	Segment Byte 4
RWr(I+7)	Segment Byte 7	Segment Byte 6
RWr(I+8)	Segment Byte 9	Segment Byte 8
RWr(I+9)	Segment Byte 11	Segment Byte 10
RWr(I+A)	Reserved	Segment Byte 12
RWr(I+B)	Reserved	Reserved

Block diagram

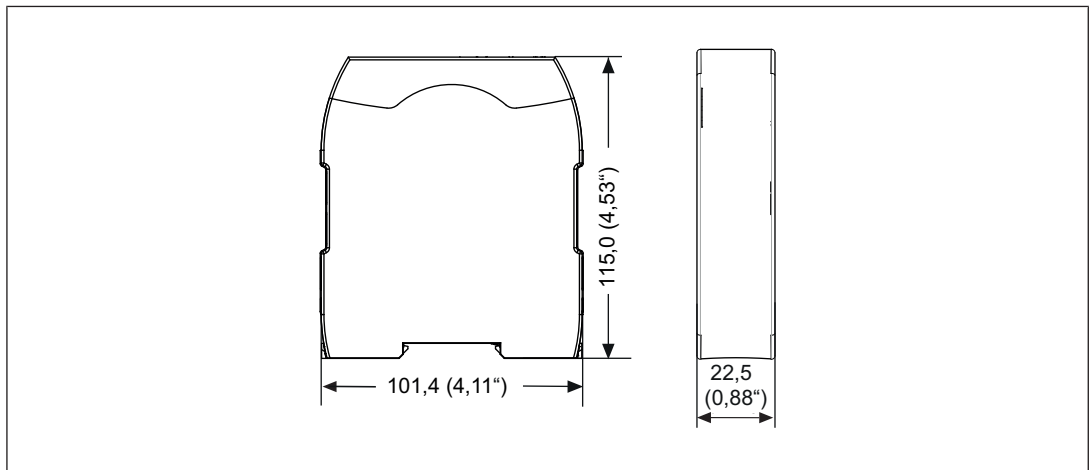


Fieldbus modules

PNOZ m ES CC-Link

Installation

Dimensions in mm




Commissioning

General wiring guidelines

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

Please note:

- ▶ Information given in the [Technical details \[544\]](#) must be followed.
- ▶ The position of the expansion module is specified in the Hardware configuration of the PNOZmulti Configurator.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ External measures must be used to connect the terminal  to the functional earth, when the mounting rail is **not** connected to the functional earth.
- ▶ Always connect the mounting rail to the protective earth via an earthing terminal. This will be used to dissipate hazardous voltages in the case of a fault.
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).

Fieldbus modules

PNOZ m ES CC-Link

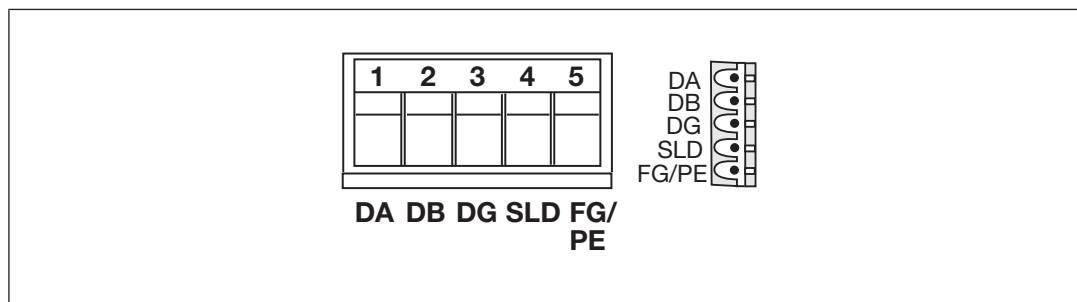
Connecting the supply voltage

Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

Interface assignment

It is possible to define which outputs on the safety system will communicate with CC-Link. The connection to CC-Link is made via a 5-pin screw connector.



- 1: DA (Channel A)
- 2: DB (Channel B)
- 3: DG (Earth)
- 4: SLD (Cable shield)
- 5: FG/PE (Functional earth)

Setting the transmission rate



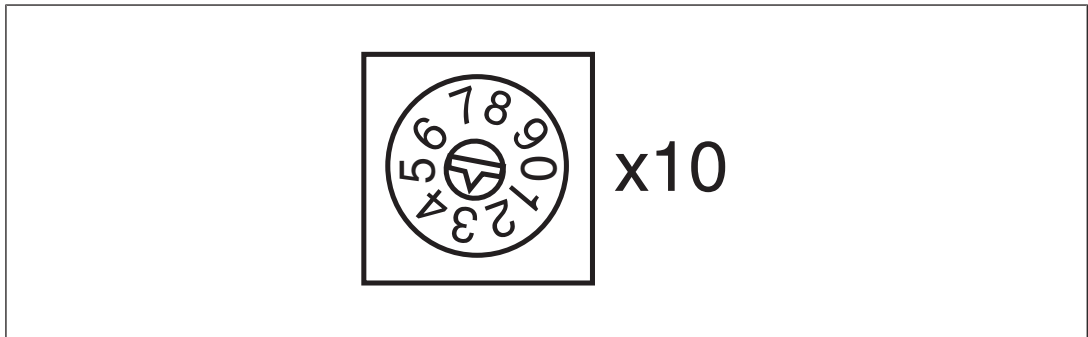
- ▶ On the upper rotary switch DR, use a small screwdriver to set the transmission rate (in the example, "3" corresponds to 50 kBit/s).

Fieldbus modules PNOZ m ES CC-Link

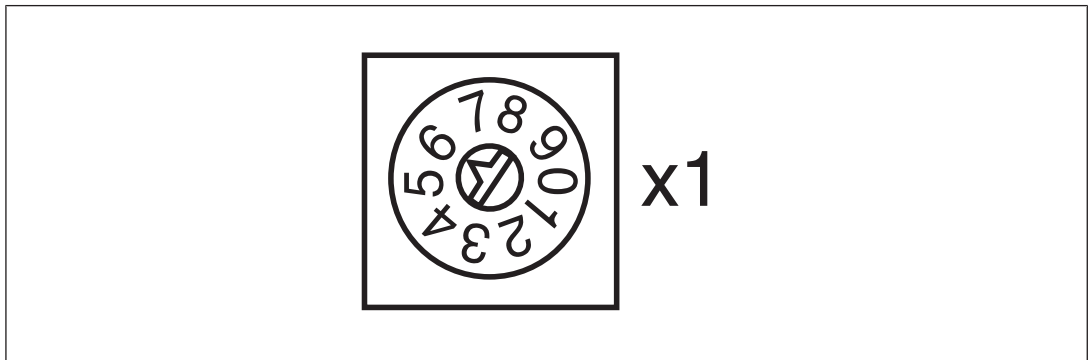
Switch setting	0	1	2	3	4	5	6	7	8	9
Transmission rate	-	10 kBit/s	20 kBit/s	50 kBit/s	125 kBit/s	250 kBit/s	500 kBit/s	800 kBit/s	1 MBit/s	-

Setting the station address

The station address of the expansion module PNOZ m ES CC-Link is set between 0 ... 99 (decimal) via two rotary switches x1 and x10.



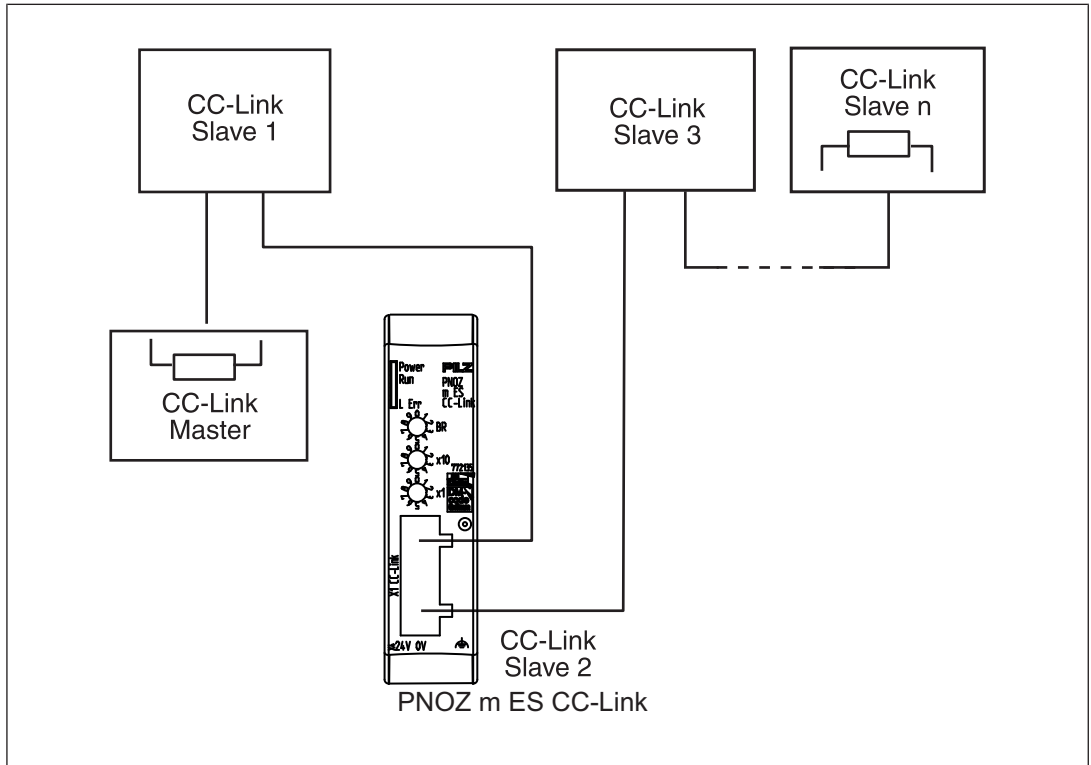
- ▶ On the middle rotary switch x10, use a small screwdriver to set the tens digit for the address ("3" in the example).



- ▶ On the lower rotary switch x1, set the ones digit for the address ("6" in the example).
- Station address 36 is set in the diagrams as an example.

Fieldbus modules PNOZ m ES CC-Link

Connection example



Fieldbus modules PNOZ m ES CC-Link

Technical Details

General	
Certifications	CE, EAC, UKCA, cULus Listed
Application range	Standard
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	45 mA
Output of external power supply (DC)	1,1 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	1,5 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	CC-Link V1.10
Device type	Slave
Station address	1 ... 63d
Transmission rates	10 MBit/s, 156 kbit/s, 2,5 MBit/s, 5 MBit/s, 625 kbit/s
Connection	5-pin Combicon plug-in connector
Assigned stations	3
Galvanic isolation	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C

Fieldbus modules PNOZ m ES CC-Link

Environmental data	
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Condensation during operation	Not permitted
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	10 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Rated insulation voltage	30 V
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated surge voltage	500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG

Fieldbus modules PNOZ m ES CC-Link

Mechanical data	
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	22,5 mm
Depth	110,4 mm
Weight	90 g

Where standards are undated, the 2015-08 latest editions shall apply.

Fieldbus modules PNOZ m ES CC-Link

Order reference

Product

Product type	Features	Order no.
PNOZ m ES CC-Link	Configurable safe small controllers PNOZmulti 2, fieldbus module, CC-Link.	772135

Accessories

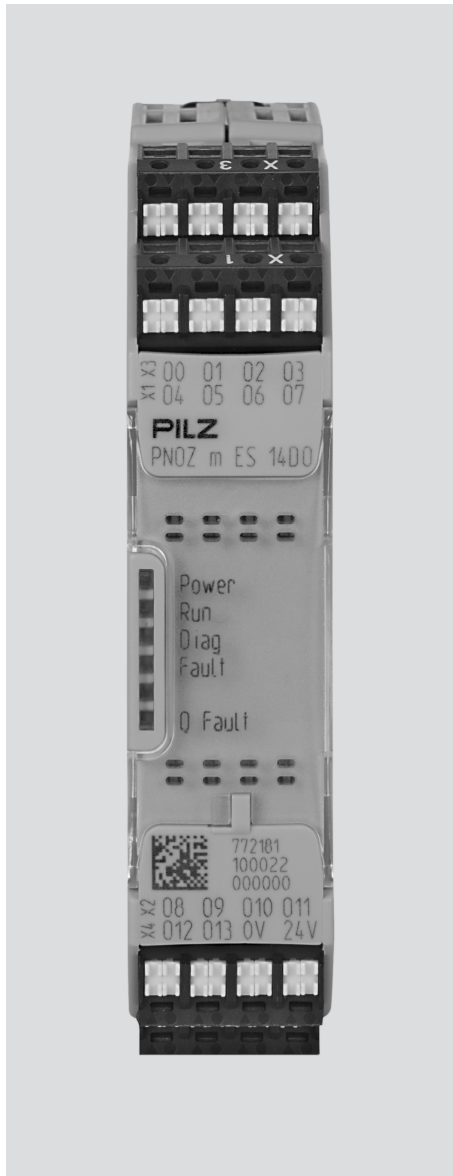
Terminals

Product type	Features	Order no.
Spring terminals PNOZ, 1 pc.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 1 set.	783542
Screw terminals PNOZ mmcxp, 1 pc.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 1 set.	793542
Spring terminals PNOZ mmcxp, 10 pcs.	Spring-loaded terminals, for fieldbus modules on PNOZ mm0.xp, 10 sets.	783543
Screw terminals PNOZ mmcxp, 10 pcs.	Plug-in screw terminal, fieldbus modules on PNOZ mm0.xp, 10 sets.	793543

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

Fieldbus modules PNOZ m EF SafetyNET



Overview

Unit features

Application of the product PNOZ m EF SafetyNET:

Expansion module for safe data exchange between SafetNET p subscribers via SafetyNET p RTFL.

The product has the following features:

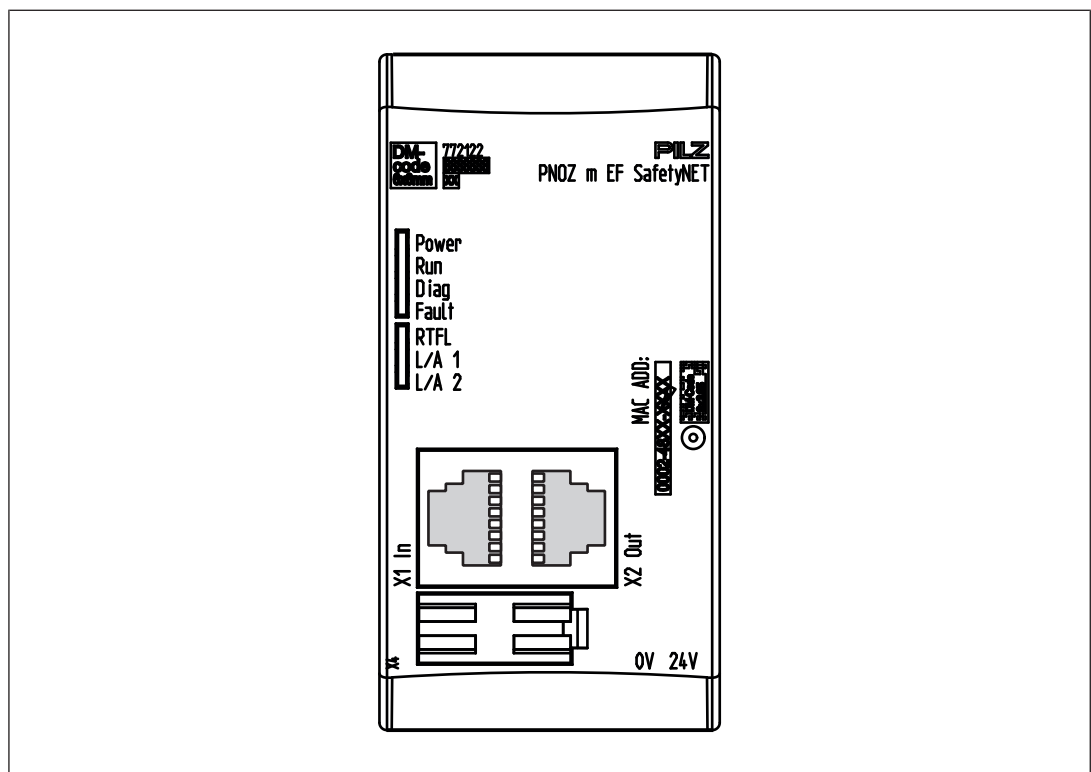
- ▶ Can be configured in the PNOZmulti Configurator

Fieldbus modules

PNOZ m EF SafetyNET

- ▶ RTFL (Real Time Frame Line) communication for applications with high real-time requirements
- ▶ In PNOZmulti Configurator up to 128 virtual inputs and 32 virtual outputs can be defined for safe communication via SafetyNET p.
- ▶ Every PNOZmulti 2 SafetyNET p subscriber (base unit PNOZmulti 2) is assigned a module PNOZ m EF SafetyNET.
- ▶ Up to 16 SafetyNET p subscribers can be connected in a line structure.
- ▶ The module PNOZ m EF SafetyNET is connected as the first safe module to the left of the base unit.
- ▶ LED display for communication via SafetyNET p and for displaying errors.
- ▶ Plug-in connection terminals:
Either spring-loaded terminal or screw terminal available as an accessory (see [Order references for accessories](#) [522]).
- ▶ Please refer to the document "PNOZmulti System Expansion" for details of the base units PNOZmulti 2 that can be connected.

Front view



Legend

- X1 In: SafetyNET p input
- X2 Out: SafetyNET p output

Fieldbus modules PNOZ m EF SafetyNET

0 V, 24 V: Supply connections
LEDs: Power, Run, Diag, Fault, RTFL, L/A 1, L/A 2

To determine the version of the device, please note:

The firmware version number is on the labelling clip. This is also the version number that must be selected in the PNOZmulti Configurator under **Version** during the hardware configuration.

Function Description

Functions

The expansion module PNOZ m EF SafetyNET is used for safe data exchange between several SafetyNET p subscribers via SafetyNET p RTFL.

The safe virtual inputs and outputs that are defined via SafetyNET p are selected and configured for each PNOZmulti 2 system in PNOZmulti Configurator. Inputs and outputs are assigned to the SafetyNET p subscribers in the software tool PNOZmulti Network Editor.

The LEDs on the base unit and expansion modules indicate the status of the configurable control system PNOZmulti 2.

You can find a description of the configuration in the PNOZmulti Configurator online help and in the PNOZmulti Network Editor online help.

Data exchange:

Communication can start when all the configured SafetyNET p subscribers are available.

Communication is ended when a SafetyNET p subscriber ends its participation (is in stop state).

- ▶ Data is exchanged cyclically
- ▶ After the end of a PNOZmulti 2 cycle, each PNOZmulti 2 base unit sends its output data to the module PNOZ m EF SafetyNET.
- ▶ Within the next cycle, the output data are transferred to all the participating modules PNOZ m EF SafetyNET.
- ▶ At the beginning of a cycle of PNOZmulti 2 each base unit requests its input data from the module PNOZ m EF SafetyNET an.

SafetyNET p network:

Every PNOZmulti 2 base unit is assigned an expansion module PNOZ m EF SafetyNET. Up to 16 SafetyNET p subscribers can be connected via SafetyNET p in a line structure.

The SafetyNET p subscribers are interconnected in a linear topology. That is, all the SafetyNET p subscribers are combined without branches. However, the wiring sequence has no influence on communication.

Fieldbus modules PNOZ m EF SafetyNET

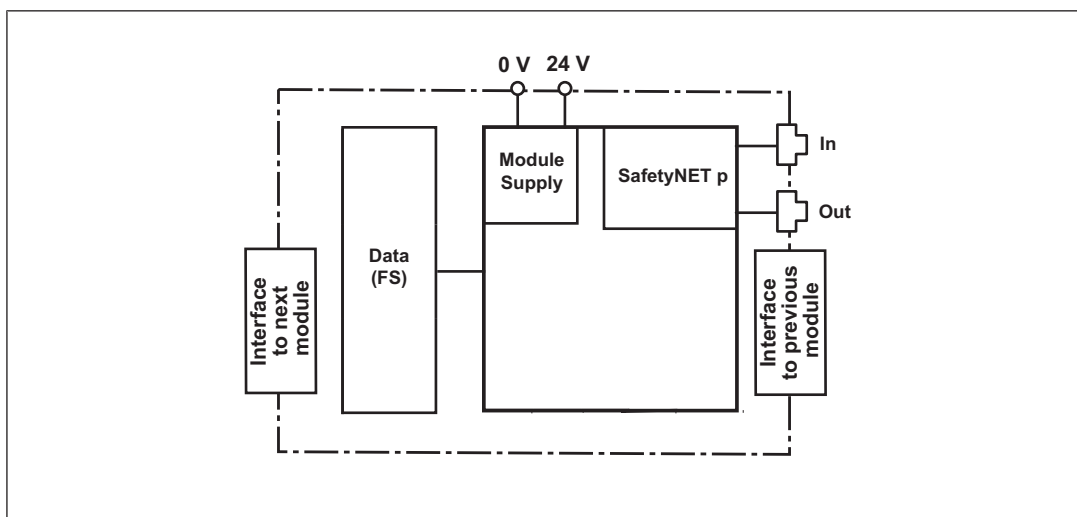
Virtual inputs and outputs:

For each module, 32 safe outputs and 128 safe inputs can be defined. Inputs and outputs to the communicating SafetyNET p subscribers are assigned in the PNOZmulti Network Editor.

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 "PNOZmulti System Expansion".

Block diagram



Installation

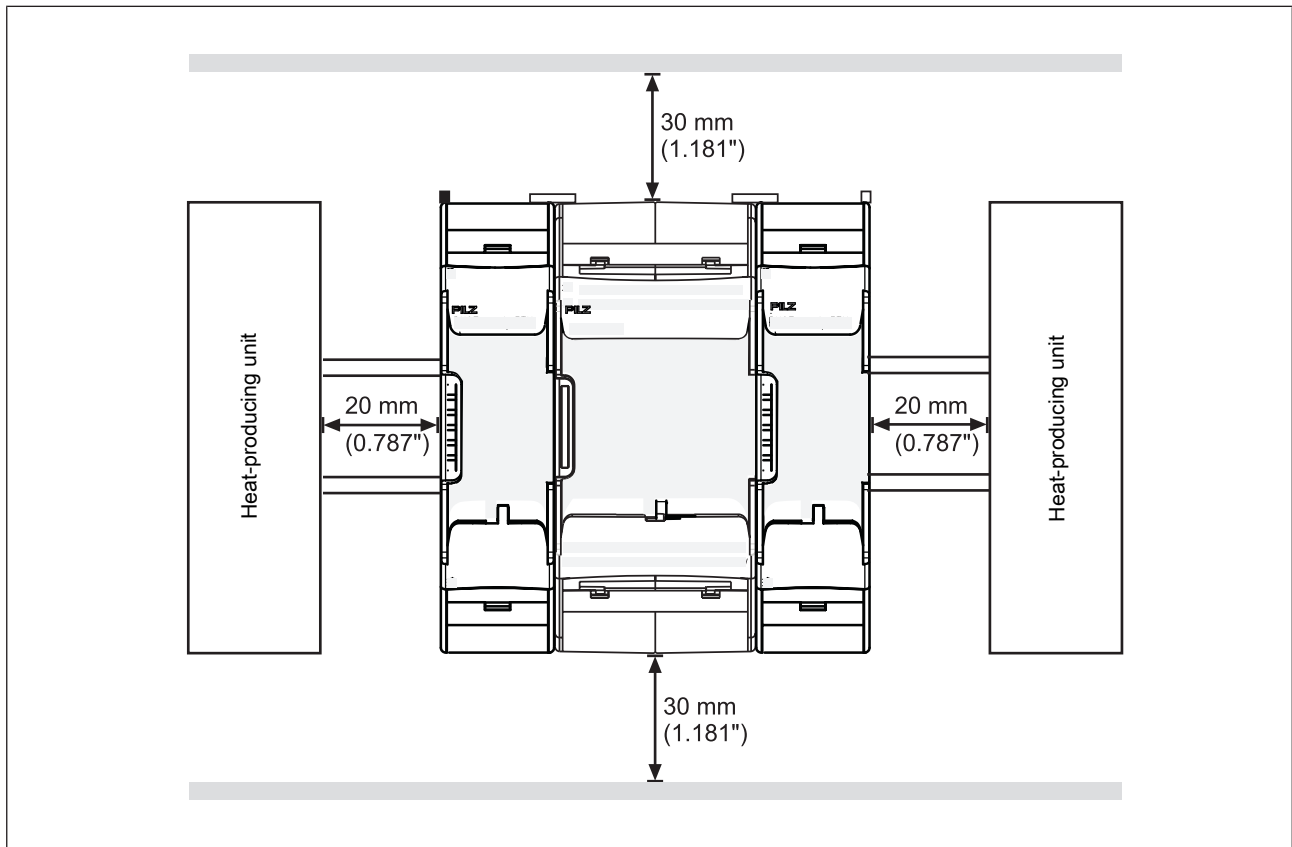
Mounting distances

With control cabinet installation it is essential to maintain a certain distance from the top and bottom, as well as to other heat-producing devices (see diagram). The values stated for the mounting distances are minimum specifications.

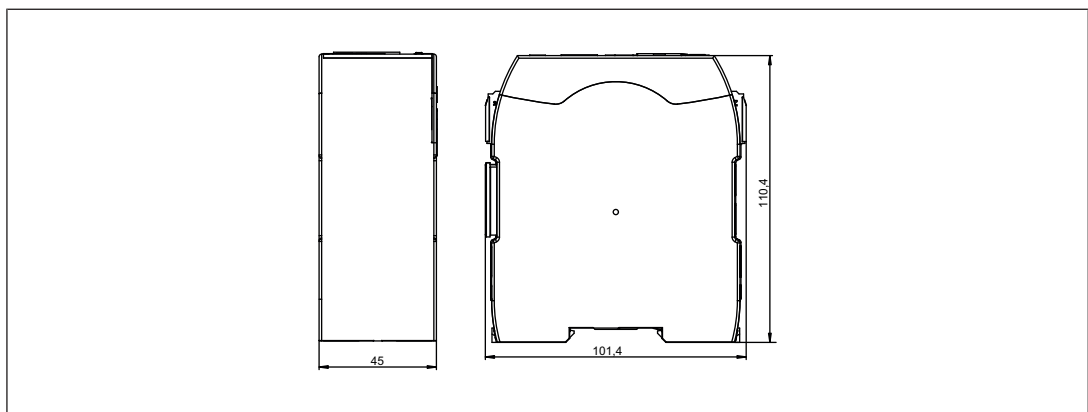
The ambient temperature in the control cabinet must not exceed the figure stated in the technical details. Air conditioning may otherwise be required.

Fieldbus modules PNOZ m EF SafetyNET

Mounting distances:



Dimensions in mm



Fieldbus modules PNOZ m EF SafetyNET

Commissioning

General wiring guidelines

The wiring is defined in the PNOZmulti Configurator user program.

Please note:

- ▶ Information given in the "[Technical details \[557\]](#)" must be followed.
- ▶ Use copper wiring with a temperature stability of 75 °C.
- ▶ The following minimum requirements of the connection cable and connector must be met:
 - Only use standard industrial Ethernet cable and connectors.
 - Only use double-shielded twisted pair cable and shielded RJ45 connectors (industrial connectors).
 - 100BaseTX cable in accordance with the Ethernet standard (min. category 5)
 - Use only straight through cables. Do not use crossover cables.
- ▶ The max. cable length between two modules may be max. 100 m.
- ▶ The power supply must meet the regulations for extra low voltages with protective electrical separation (SELV, PELV).

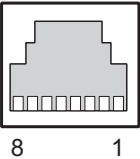
Connecting the supply voltage

Connect the supply voltage to the fieldbus module:

- ▶ **24 V** terminal: + 24 VDC
- ▶ **0 V** terminal: 0 V
- ▶ Protect the supply voltage as follows:
 - Circuit breaker, characteristic C - 6 A
 - or
 - Blow-out fuse, slow, 6A

Fieldbus modules PNOZ m EF SafetyNET

Interface assignment

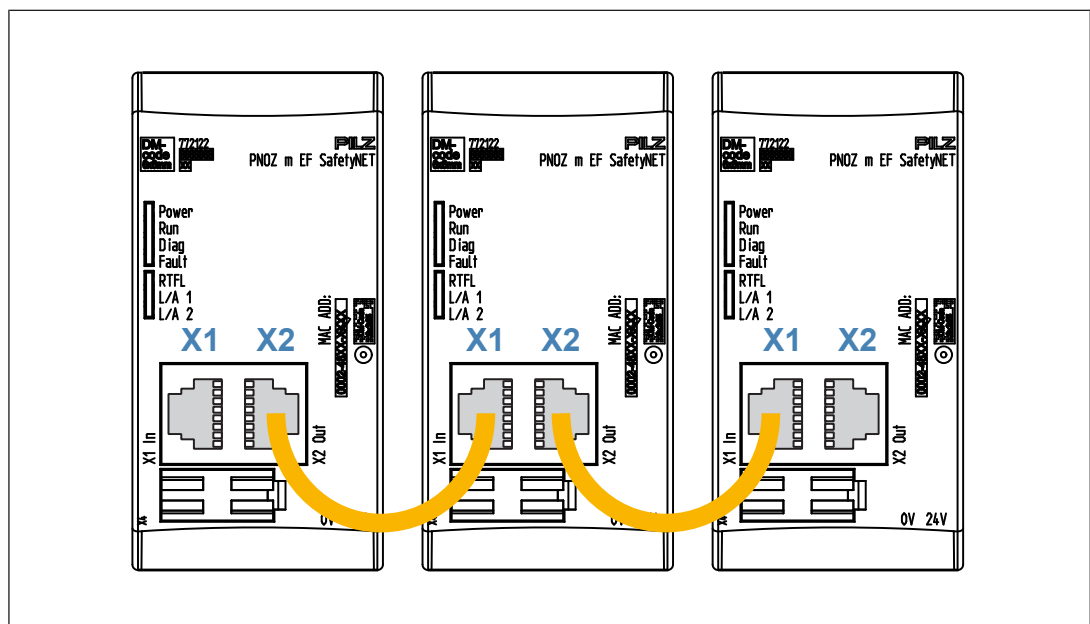
RJ45 socket 8-pin	PIN	Standard
	1	TD+ (Transmit+)
	2	TD- (Transmit-)
	3	RD+ (Receive+)
	4	n.c.
	5	n.c.
	6	RD- (Receive-)
	7	n.c.
	8	n.c.

n.c.: Not connected

Connect SafetyNET p subscribers

The SafetyNET p subscribers are networked in a linear topology. That is, all the SafetyNET p subscribers are combined without branches. To connect the SafetyNET p subscribers, proceed as follows:

- ▶ The X2 Out- interface of a SafetyNET p subscriber always has to be connected to the X1 In interface of the subscriber following in the line.
Please note: The interfaces X2 Out and X1-In have no switch function.
- ▶ The X1 In interface of the first SafetyNET p subscriber and the X2 Out interface of the last SafetyNET p subscriber remain free.



Fieldbus modules PNOZ m EF SafetyNET

- ▶ The SafetyNET p subscribers can be connected in the SafetyNET p line in any sequence when all the PNOZmulti SafetyNET p subscribers have the same version. This has no influence on communication.

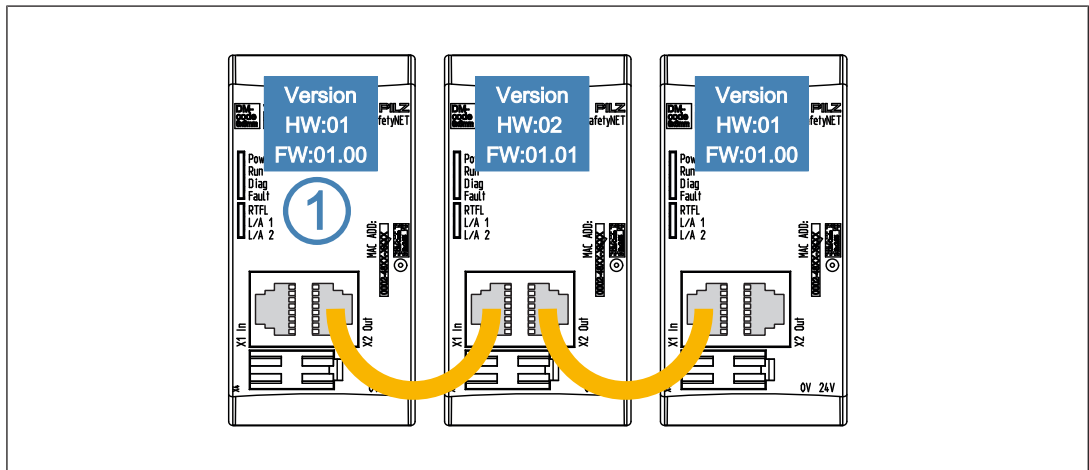


Fig.: SafetyNET p line with different versions of PNOZ m EF SafetyNET.

- ▶ Up to 16 SafetyNET p subscribers can be connected in a line structure.
- ▶ The SafetyNET p subscribers must be connected directly. No Ethernet switch must be interposed.

Fieldbus modules PNOZ m EF SafetyNET

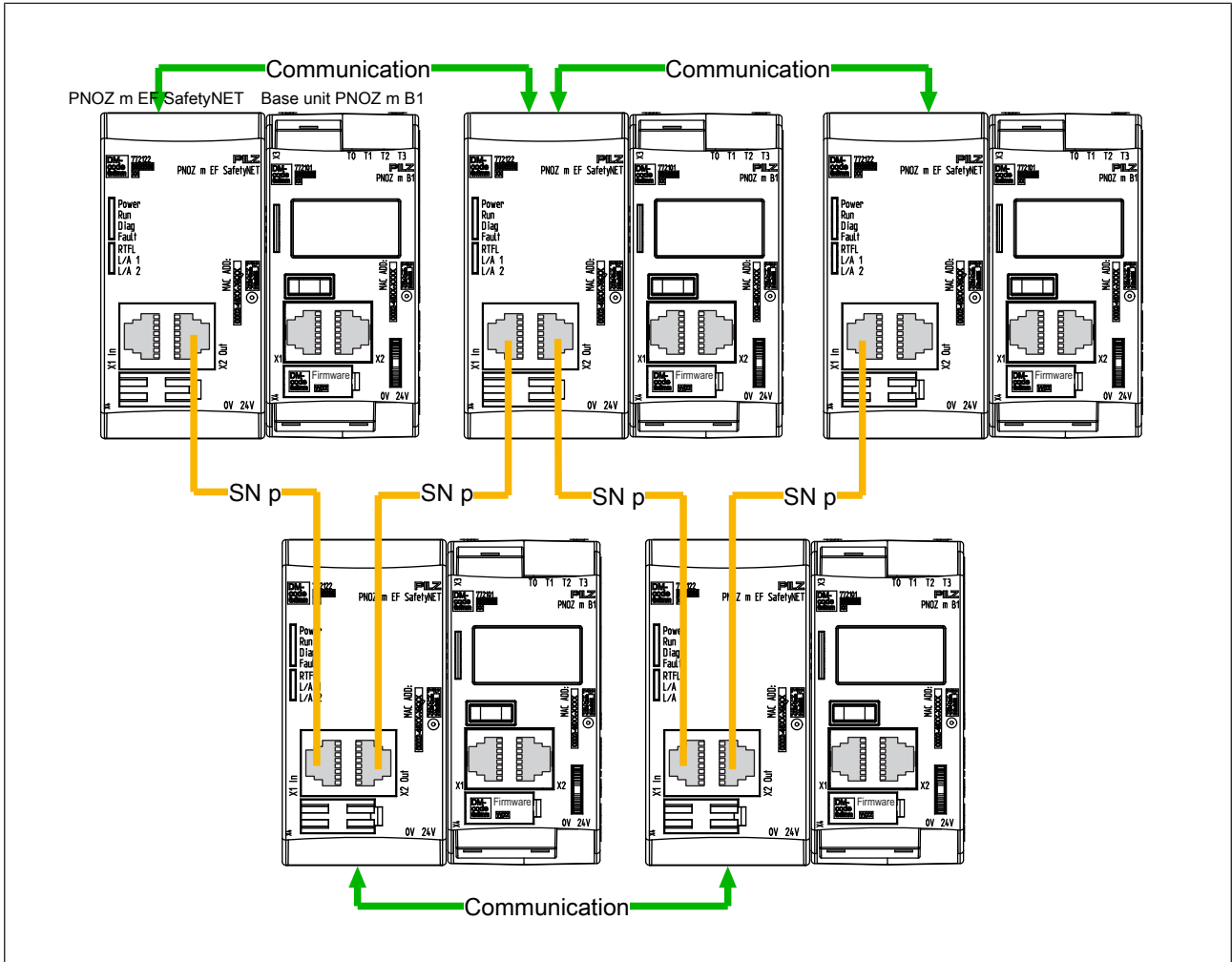


Fig.: SafetyNET p line with 5 SafetyNET p subscribers

Fieldbus modules PNOZ m EF SafetyNET

Technical details

General	
Certifications	CE, EAC, TÜV, UKCA, cULus Listed
Application range	Failsafe
Electrical data	
Supply voltage	
for	Module supply
Voltage	24 V
Kind	DC
Voltage tolerance	-20 %/+25 %
Max. continuous current that the external power supply must provide	165 mA
Output of external power supply (DC)	4 W
Potential isolation	Yes
Supply voltage	
for	Module supply
internal	Via base unit
Voltage	3,3 V
Kind	DC
Current consumption	60 mA
Power consumption	0,2 W
Max. power dissipation of module	4,5 W
Status indicator	LED
Fieldbus interface	
Fieldbus interface	SafetyNET p
Device type	Device
Connection	2 x RJ45
Galvanic isolation	Yes
Environmental data	
Ambient temperature	
in accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Forced convection in control cabinet off	55 °C
Storage temperature	
in accordance with the standard	EN 60068-2-1/-2
Temperature range	-25 - 70 °C
Climatic suitability	
in accordance with the standard	EN 60068-2-30, EN 60068-2-78
Humidity	93 % r. h. at 40 °C
Condensation during operation	Not permitted

Fieldbus modules PNOZ m EF SafetyNET

Environmental data	
Max. operating height above SL	2000 m
EMC	EN 61131-2
Vibration	
in accordance with the standard	EN 60068-2-6
Frequency	5 - 150 Hz
Acceleration	1g
Shock stress	
in accordance with the standard	EN 60068-2-27
Acceleration	15g
Duration	11 ms
Airgap creepage	
in accordance with the standard	EN 61131-2
Overvoltage category	II
Pollution degree	2
Protection type	
in accordance with the standard	EN 60529
Housing	IP20
Terminals	IP20
Mounting area (e.g. control cabinet)	IP54
Potential isolation	
Potential isolation between	Fieldbus and module voltage
Type of potential isolation	Functional insulation
Rated surge voltage	500 V
Mechanical data	
Mounting position	horizontally on mounting rail
DIN rail	
Top hat rail	35 x 7,5 EN 50022
Recess width	27 mm
Material	
Bottom	PC
Front	PC
Top	PC
Connection type	Spring-loaded terminal, screw terminal
Mounting type	plug-in
Conductor cross section with screw terminals	
1 core flexible	0,25 - 2,5 mm², 24 - 12 AWG
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	0,2 - 1,5 mm², 24 - 16 AWG
Torque setting with screw terminals	0,5 Nm
Conductor cross section with spring-loaded terminals:	
Flexible with/without crimp connector	0,2 - 2,5 mm², 24 - 12 AWG

Fieldbus modules PNOZ m EF SafetyNET

Mechanical data

Spring-loaded terminals: Terminal points per connection	2
Stripping length with spring-loaded terminals	9 mm
Dimensions	
Height	101,4 mm
Width	45 mm
Depth	110,4 mm
Weight	180 g

Where standards are undated, the 2017-06 latest editions shall apply.

Safety characteristic data

Operating mode	EN ISO 13849-1: 2015	EN ISO 13849-1: 2015	EN IEC 62061 SIL CL/ maximum SIL	EN IEC 62061 PFH _D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
–	PL e	Cat. 4	SIL 3	1,54E-09	SIL 3	5,66E-05	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_M 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.

Fieldbus modules PNOZ m EF SafetyNET

Order reference

Product

Product type	Features	Order no.
PNOZ m EF SafetyNET	Configurable safe small controllers PNOZmulti 2, safe communication module SafetyNET p RTFL for PNOZ m Bx.	772122

Accessories

Terminals

Product type	Features	Order no.
Set 5 Screw Terminals	Set of plug-in screw terminals for PNOZ m EF SafetyNet, communication module, small controllers PNOZmulti 2.	750017
Set 5 Spring Terminals	Set of plug-in screw terminals for PNOZ m EF SafetyNet, communication module, small controllers PNOZmulti 2.	751017

Plug-in connector

Product type	Features	Order no.
RJ45 Connector	RJ45 plug-in connector, straight, IP20, 8-pin, Cat6a, IDC connection, AWG22, cable diameter: 5.5 - 8.5 mm	380401

By the metre

Product type	Features	Order no.
SafetyNET p cable	By the metre, Cat5e (100mBit/s), PUR, yellow RAL1003, 2x2x0.35, colour single wires: White, yellow, blue, orange	380000

Connector plug

Product type	Features	Order no.
PNOZ mm0.xp connector left (10 pcs)	Connector plug to connect the modules to the left-hand side of the PNOZmulti base unit, yellow/black (10 pieces).	779260

PNOZmulti Configurator Illustration



PNOZmulti Configurator Features

- ▶ Graphic configuration of safety circuit
- ▶ Project configuration, configuration generation, documentation, commissioning
- ▶ Data transfer via integrated interface or chip card
- ▶ User interface in German, English, French, Italian, Spanish, Japanese, Chinese (selectable)

PNOZmulti Configurator System requirements

Please refer to the readme file for the PNOZmulti Configurator for details of the current system requirements.

PNOZmulti Configurator Description

The PNOZmulti Configurator is a graphic tool for the configuration and programming of the configurable control system PNOZmulti.

The elements of the safety circuit are depicted as icons on the Configurator user interface.

The safety circuit can be created quickly and easily using drag & drop.

The PNOZmulti Configurator downloads the complete safety circuit to the PNOZmulti via a chip card or via the integrated interface.

The safety circuit can also be uploaded from the PNOZmulti to the PNOZmulti Configurator for revision.

Safety functions that can be created using the PNOZmulti Configurator include, for example:

- ▶ E-Stop
- ▶ Two-hand button
- ▶ Enabling switch
- ▶ Operating mode selector switches
- ▶ Press functions
- ▶ Light beam device
- ▶ Light grid
- ▶ Pressure sensitive mat
- ▶ Speed monitoring
- ▶ Muting

Users can configure fieldbus inputs and outputs in conjunction with the fieldbus modules. These inputs and outputs can only be used for standard functions.

Virtual inputs and outputs can be configured via the integrated interface. They are handled in exactly the same way as fieldbus inputs and outputs.

Inputs and outputs for standard functions are supported.

The PNOZmulti Configurator contains a wide range of test and diagnostic options, such as:

- ▶ Dynamic program display
- ▶ Diagnostic word for evaluating the element status
- ▶ Display PNOZmulti error stack

The project can be protected through passwords.

PNOZmulti Configurator

Licences and versions

The PNOZmulti Configurator is free of license fees from Version 11.0. You can select between the licenses "Basic Licence" and "Advanced Licence".

Basic licence

The Basic Licence is included and free of license fees.

The Basic licence contains the hardware PNOZmulti 2. All the safety functions of the base units and expansion modules are active.

Advanced Licence

Complex functions that do not require special hardware or expanded software functions are activated using licences.

These functions will be free of licence fees in future versions.

Contents	Page
Chip card, USB memory	568
Cable, adapter, connectors, terminals	569

Chip card, USB memory

Tool Kit, chip card	Order no.
Chip card 8 kByte, 1 piece	779201
Chip card, 8 kByte, 10 pieces	779200
Chip card 32 kByte, 1 piece	779211
Chip card 32 kByte, 10 pieces	779212
Chip card holder	779240
Chip card reader	779230
Labels for chip card, seal, 10 pieces	779250
USB memory, 512 MB	779213
Adapter for converting USB interface to RS232	305160

Cable, adapter, connectors, terminals

Further accessories such as adapter, cable connectors and terminals can be found in chapter "PNOZmulti 2 products" in the relevant operating manuals under "Order reference".

► Support

Technical support is available from Pilz round the clock.

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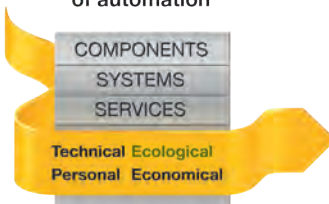
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Pilz develops environmentally-friendly products using ecological materials and energy-saving technologies. Offices and production facilities are ecologically designed, environmentally-aware and energy-saving. So Pilz offers sustainability, plus the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

The 4-fold safety of automation



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