PNOZ mml1p

▸ Configurable, safe compact controllers PNOZmulti Mini

PILZ

THE SPIRIT OF SAFETY

Contents

Contents

1 Introduction

1.1 Validity of documentation

This documentation is valid for the product PNOZ mml1p. It is valid until new documentation is published.

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

1.2 Using the documentation

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

1.3 Definition of symbols

Information that is particularly important is identified as follows:

DANGER!

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

WARNING!

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

CAUTION!

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

NOTICE

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

INFORMATION

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

2 Overview

2.1 Scope of supply

▸ Expansion module PNOZ mml1p

▸ Jumper

2.2 Unit features

Application of the product PNOZ mml1p:

Link module to safely connect two configurable small control systems PNOZmulti.

The product has the following features:

▸ Connection options:

– Two PNOZmulti Mini base units

or

– One PNOZmulti Mini base unit with one PNOZmulti base unit

▸ Can be configured in the PNOZmulti Configurator

▸ Point-to-point connection via 4-core shielded and twisted-pair cable

▸ 32 virtual inputs and 32 virtual outputs

▸ Status indicators

▸ 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).

2.3 Front view
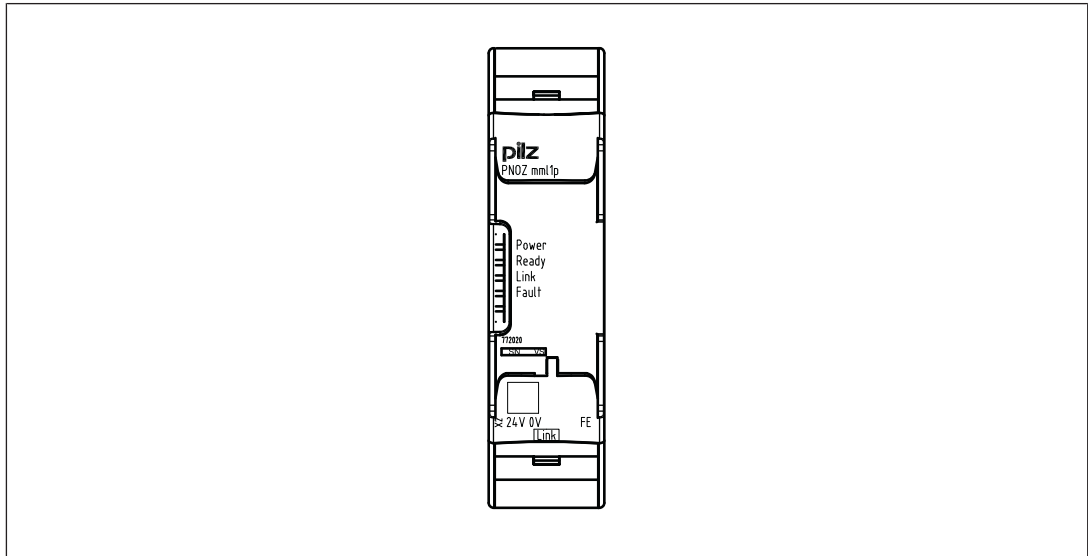
Key:

▸ X2:

 – 0 V, 24 V:Supply connections

 – FE: Functional earth

▸ Link:
 Connection

▸ LEDs:

 – Power

 – Ready

 – Link

 – Fault

3 Safety

3.1 Intended use

The expansion module is used for the point-to-point connection of safe virtual inputs and outputs between two base units.

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

The configurable small control systems PNOZmulti are used for the safety-related interruption of safety circuits and are designed for use in:

▸ E-STOP equipment

▸ Safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1

The following is deemed improper use in particular

▸ Any component, technical or electrical modification to the product,

▸ Use of the product outside the areas described in this operating manual,

▸ Use of the product outside the technical details (see Technical details [21]).

NOTICE

EMC-compliant electrical installation

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

3.2 System requirements

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

3.3 Safety regulations

3.3.1 Safety assessment

Before using a device it is necessary to perform a safety assessment in accordance with the Machinery Directive.

Functional safety is guaranteed for the product as a single component. However, this does not guarantee the functional safety of the overall plant/machine. In order to achieve the required safety level for the overall plant/machine, define the safety requirements for the plant/machine and then define how these must be implemented from a technical and organisational standpoint.

3.3.2   Use of qualified personnel

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

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

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

▸ Are familiar with the basic regulations concerning health and safety / accident prevention,

▸ Have read and understood the information provided in this description under "Safety",

▸ And have a good knowledge of the generic and specialist standards applicable to the specific application.

3.3.3   Warranty and liability

All claims to warranty and liability will be rendered invalid if

▸ The product was used contrary to the purpose for which it is intended,

▸ Damage can be attributed to not having followed the guidelines in the manual,

▸ Operating personnel are not suitably qualified,

▸ Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

3.3.4   Disposal

▸ In safety-related applications, please comply with the mission time T_M in the safety-related characteristic data.

▸ When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

3.3.5   For your safety

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

▸ This operating manual only describes the basic functions of the unit. The expanded functions are described in the PNOZmulti Configurator's online help. Only use these functions once you have read and understood the documentations.

▸ Do not open the housing or make any unauthorised modifications.

▸ Please make sure you shut down the supply voltage when performing maintenance work (e.g. exchanging contactors).

4 Function Description

4.1 Integrated protection mechanisms

The relay 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.

4.2 Functions

The link module PNOZ mml1p 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.

Data transmission time:

The t_{BUS} data transmission time is the time between the virtual output at base unit 1 being set and the virtual input at base unit 2 becoming available (see "Technical details").

The maximum reaction time for series connection of n base units

This is the time between the activation of a safety function at the input on one base unit and the switching of an output on the connected base unit.

▸ The maximum reaction time t_{SUM} includes the following times:

t_{ON}: Input delay = 4 ms

t_{COND}: Switch-off delay of semiconductor output = 30 ms

t_{REL}: Switch-off delay of relay output = 50 ms

t_{BUS}: Data transmission time between two base units = 35 ms

n: Number of connections between base units

The maximum reaction time t_{SUM} for series connection of n base units

▸ On semiconductor outputs:

$t_{SUM} = t_{ON} + (n * t_{BUS}) + t_{COND}$

▸ On relay outputs:

$t_{SUM} = t_{ON} + (n * t_{BUS}) + t_{REL}$

> ⚠ **CAUTION!**
>
> For signals that are forwarded or received via the link module, a calculation must always be made in accordance with the above formulas.

▸ Input delay and switch-off delay are only included once in the reaction time. The data transmission time between the link modules is multiplied by the number of connections.

▸ Please refer to the connection examples under "Preparing for operation".

> ⚠ **CAUTION!**
>
> For signals that are forwarded or received via the link module, the overall reaction time, e.g. the maximum reaction time of the series connection of n base units, must always be considered in the risk assessment.
> The risk assessment must consider all hazards as regards the reaction time and the safety distance. The overall reaction time must not delay the arrival of a safe condition by more than the permitted time.

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.
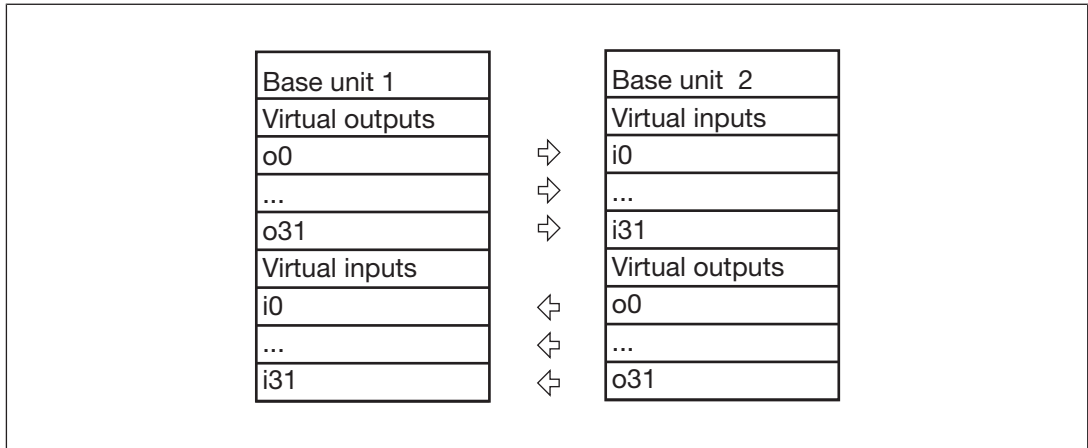
4.3 Block diagram
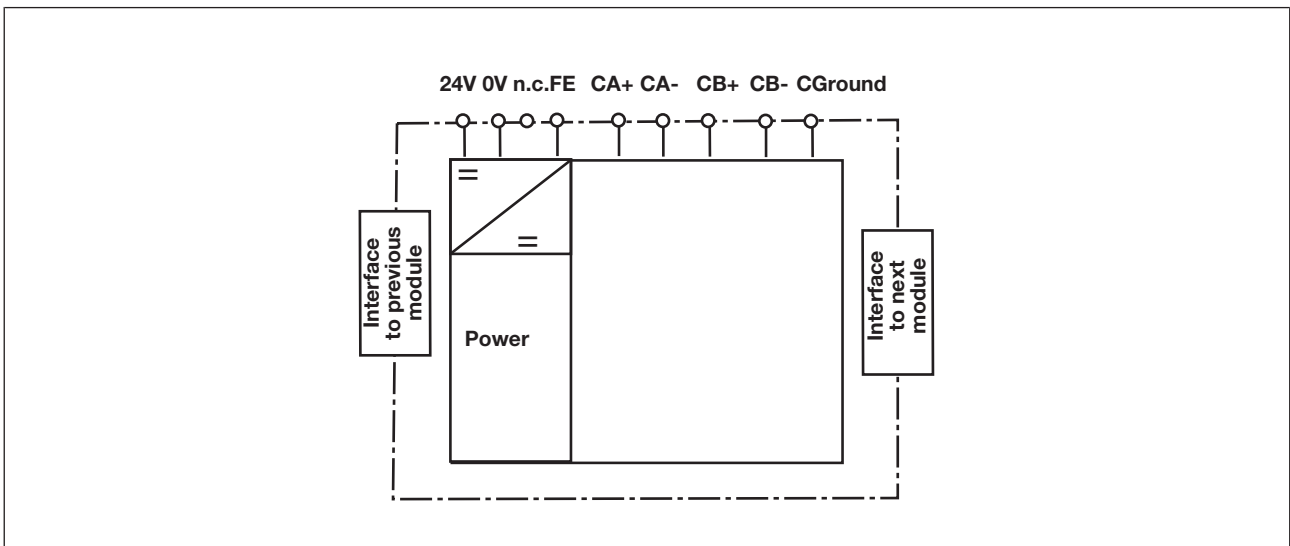
5 Installation

5.1 General installation guidelines

‣ The unit should be installed in a control cabinet with a protection type of at least IP54.

‣ Fit the safety system to a horizontal mounting rail. The venting slots must face upwards and downwards. Other mounting positions could destroy the safety system.

‣ Use the notch 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).

‣ Push the unit upwards or downwards before lifting it from the mounting rail.

‣ To comply with EMC requirements, the mounting rail must have a low impedance connection to the control cabinet housing.

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

> **NOTICE**
>
> **Damage due to electrostatic discharge!**
>
> Electrostatic discharge can damage components. Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

5.2 Dimensions
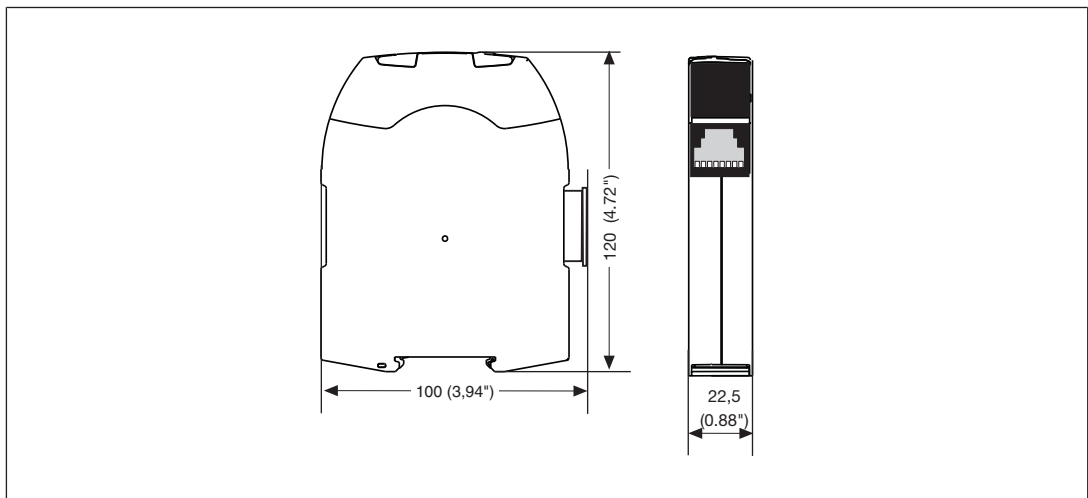
5.3 Connect the base unit and expansion modules

Connect the base unit and the expansion module as described in the operating instructions for the base units.

▶ Connect the black/yellow terminator to the expansion module.

▶ Install the expansion module in the position in which it is configured in the PNOZmulti Configurator.

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 document "PNOZmulti System Expansion" for details of the number of modules that can be connected to the base unit and the module types.

6 Commissioning

6.1 General wiring guidelines

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

Please note:

‣ Information given in the Technical details [📖 21] 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 ml1p <V2.0: 100 m

– PNOZ ml1p from V2.0, PNOZ mml1p: 1000 m

‣ Connect the inputs and outputs from two link modules with 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.

> ⚠ **CAUTION!**
>
> Only connect and disconnect the expansion module when the supply voltage is switched off.

6.2 Download modified project to the PNOZmulti system
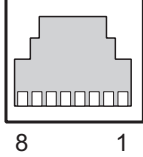
As soon as an additional expansion module has been connected to the system, the project must be amended in the PNOZmulti Configurator and downloaded back into the base unit. Proceed as described in the operating manual for the base unit.
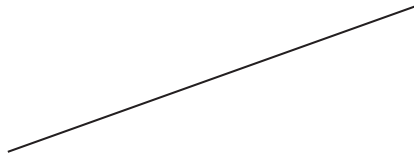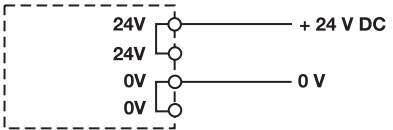
> ⓘ **NOTICE**
>
> For the commissioning and after every user program change, you must check whether the safety devices are functioning correctly.

6.3 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

Supply voltage	AC	DC

Supply voltage
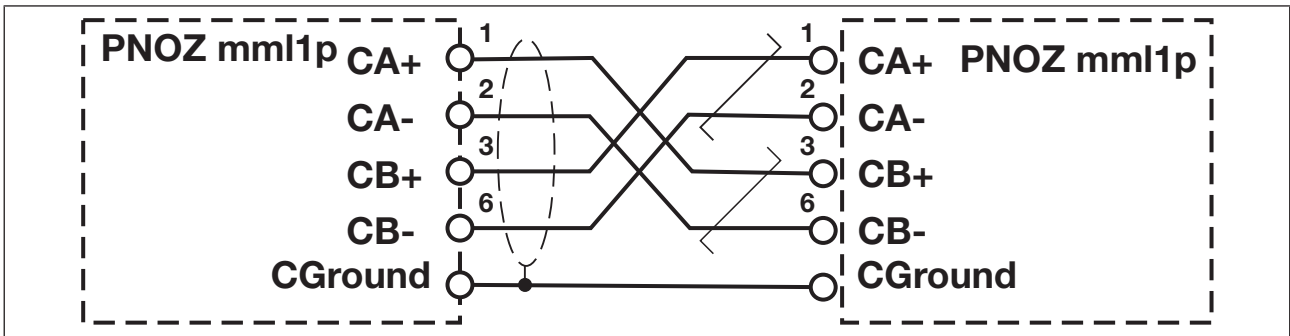
Connection of two base units PNOZmulti Mini via PNOZ mml1p

6.4 Connection examples

6.4.1 Example: Series connection of 3 base units

Reaction time t_{SUM} between base unit Base 1 and Base 2:

Input delay t_{ON} at I4 and I6 + data transmission time1 * t_{BUS} through link module/interface + switch-off delay t_{COND} of the semiconductor output at O0

$t_{SUM} = t_{ON} + (n * t_{BUS}) + t_{COND}$

$t_{SUM} = 4\ ms + (1 * 35\ ms) + 30\ ms = 69\ ms$

Reaction time t_{SUM} between base unit Base 1 and Base 3:

Input delay t_{ON} at I4 und I6 + data transmission time 2 * t_{BUS} through link modules/interfaces + switch-off delay t_{COND} of the semiconductor output at O1

$t_{SUM} = t_{ON} + (n * t_{BUS}) + t_{COND}$

$t_{SUM} = 4\ ms + (2 * 35\ ms) + 30\ ms = 104\ ms$
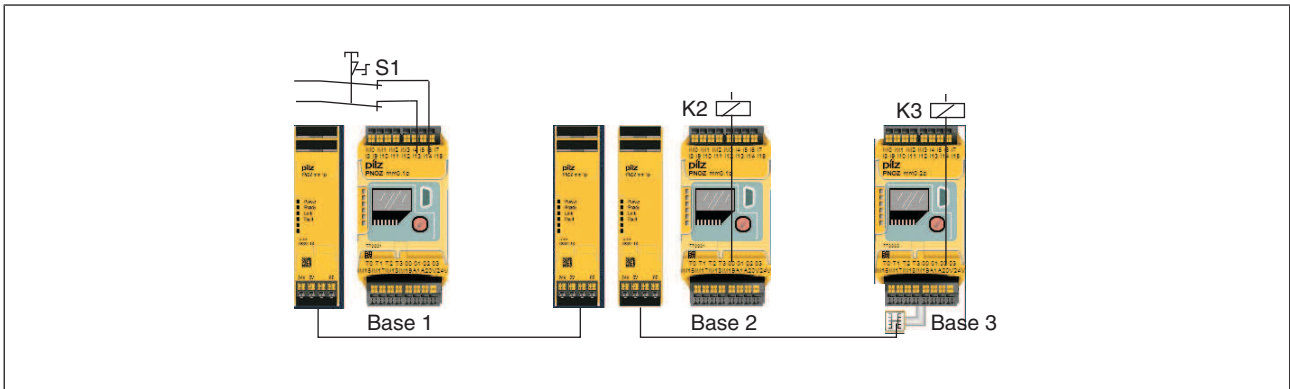
6.4.2 Example: Connection of 5 base units

The reaction times are calculated in the same way as application example 1. After pressing S1 on Base 1, the semiconductor outputs switch after the following reaction times t_{SUM}:

O0 on Base 2: 69 ms

O1 on Base 3: 104 ms

O0 on Base 4: 139 ms

O0 on Base 5: 104 ms

7 Operation

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

The PNOZmulti safety system is ready for operation when the "POWER" and "RUN" LEDs on the base unit and the "READY" LED on the PNOZ mml1p are lit continuously.

7.1 LED indicators

Legend

☼ LED on

◐ LED flashes

● LED off

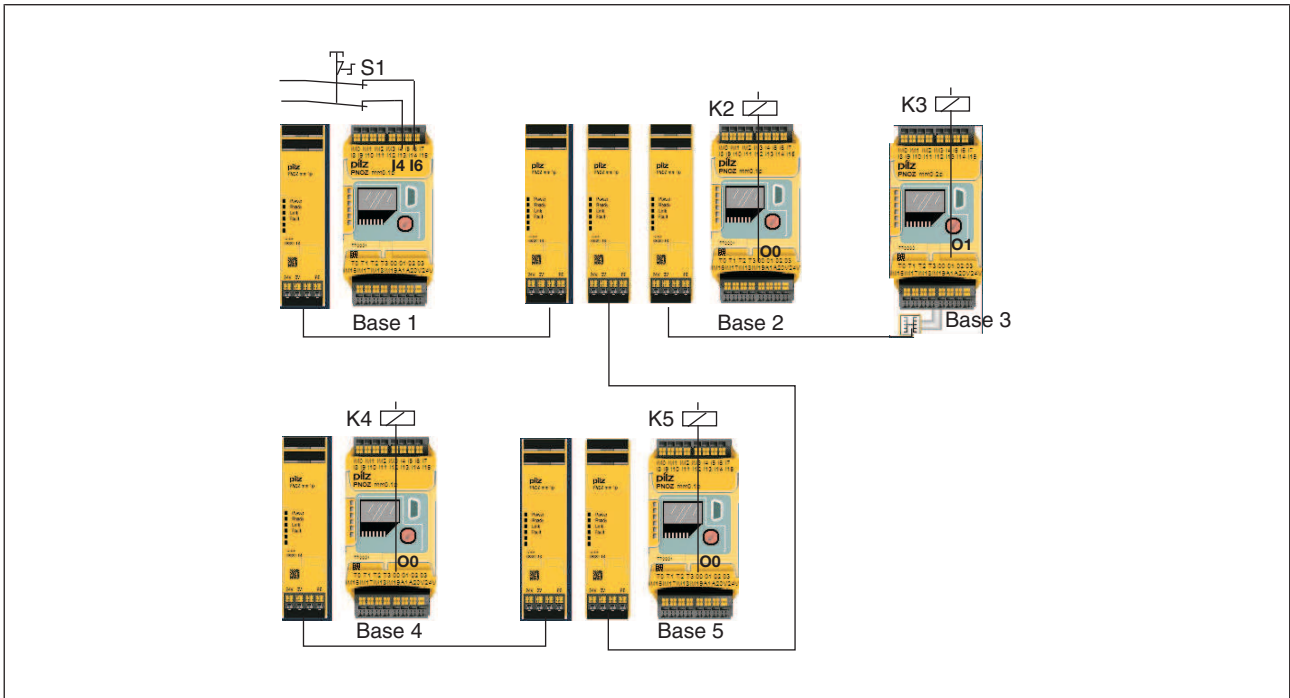| LED	LED status		Meaning
Power	●		No supply voltage
	☼	Green	Supply voltage is present
Ready	☼	Green	The unit is ready for operation
	●		The unit is not ready for operation
Fault	☼	Red	External fault
	◐	Red	Internal fault
	●		No fault
Link	☼	Yellow	Connection available to another link module
	●		No connection available to another link module

7.2 Fault detection

Each base unit contains information about

▸ its own link module (in order, defective, no supply voltage)

▸ the status of the connection (yes, no)

▸ the operating status of the connected base unit (RUN, STOP)

When the connection is interrupted, the base units switch the virtual inputs to zero. The base units remains in a RUN condition.

Defective link module:

▸ The corresponding base unit switches to a STOP condition. The virtual outputs on the link module are set to zero.

▸ The connected base unit remains in a RUN condition.

8 Technical details

General	
Certifications	**CE, EAC, KOSHA, TÜV, UKCA, cULus Listed**
Electrical data	
Supply voltage	
for	**Module supply**
Voltage	**24 V**
Kind	**DC**
Voltage tolerance	**-15 %/+20 %**
Output of external power supply (DC)	**5 W**
Residual ripple DC	**5 %**
Status indicator	**LED**
Virtual inputs	
Number of virtual inputs	**32**
Virtual outputs	
Number of virtual outputs	**32**
Times	
Switch-on delay	**5 s**
Supply interruption before de-energisation	**20 ms**
Max. data transmission time	**35 ms**
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**
Humidity	**93 % r. h. at 40 °C**
Condensation during operation	**Not permitted**
Max. operating height above sea level	**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**

Environmental data	
Airgap creepage	
Overvoltage category	**II**
Pollution degree	**2**
Rated insulation voltage	**30 V**
Rated impulse withstand voltage	**2,5 kV**
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**
Max. cable length between two link modules	**1 km**
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	**100 mm**
Width	**22,5 mm**
Depth	**120 mm**
Weight	**95 g**

Where standards are undated, the 2011-01 latest editions shall apply.

9 Order reference

9.1 Product

Product type	Features	Order No.
PNOZ mml1p	Expansion module	772 020

9.2 Accessories

Connection terminals

Product type	Features	Order no.
Spring terminals PNOZ mmc2p, mml1p 1 pc.	Spring-loaded terminals, 1 piece	783 538
Spring terminals PNOZ mmc2p,mml1p 10 pcs	Spring-loaded terminals, 10 pieces	783 539
Screw terminals PNOZ mmc2p, mml1p 1 pc.	Screw terminals, 1 piece	793 538
Screw terminals PNOZ mmc2p,mml1p 10 pcs.	Screw terminals, 10 piece	793 539

Terminator, jumper

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

10 EC declaration of conformity

This product/these products meet the requirements of the directive 2006/42/EC for machinery of the European Parliament and of the Council. The complete EC Declaration of Conformity is available on the Internet at www.pilz.com/downloads.
Authorised representative: Norbert Fröhlich, Pilz GmbH & Co. KG, Felix-Wankel-Str. 2, 73760 Ostfildern, Germany

11 UKCA-Declaration of Conformity

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

The complete UKCA Declaration of Conformity is available on the Internet at www.pilz.com/support/downloads.

Representative: Pilz Automation Technology, Pilz House, Little Colliers Field, Corby, Northamptonshire, NN18 8TJ United Kingdom, eMail: mail@pilz.co.uk

▶ Support

Technical support is available from Pilz round the clock.

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