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PNOZ ma1p

PNOZmulti Modular Safety System

Operating Manual – No. 21 687-EN-03

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SD means Secure Digital.

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1.1 Validity of documentation

This documentation is valid for the product **PNOZ ma1p**. 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 .

1.1.1 Retaining the documentation

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

1.2 Overview of documentation

1 Introduction

The introduction is designed to familiarise you with the contents, structure and specific order of this manual.

2 Overview

This chapter provides information on the product's most important features.

3 Safety

This chapter must be read as it contains important information on intended use.

4 Function Description

This chapter describes the product's mode of operation.

5 Installation

This chapter explains how to install the product.

6 Commissioning

This chapter describes the product's commissioning and wiring.

7 Operation

This chapter describes how to operate the product and gives tips in the case of a fault.

8 Technical Details

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1.3 Definition of symbols

Information that is of particular importance can be 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 situations in which the unit(s) could be damaged and also provides information on preventive measures that can be taken.



INFORMATION
This gives advice on applications and provides information on special features, as well as highlighting areas within the text that are of special importance.

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2.1 Unit structure

2.1.1 Scope of delivery

- Expansion module**PNOZ ma1p**
- Jumper 774 639

2.1.2 Unit features

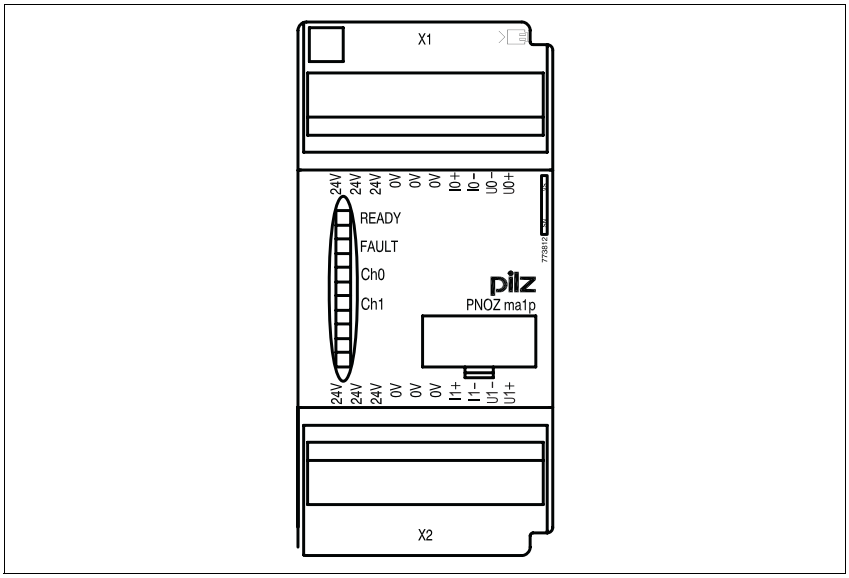
Using the product **PNOZ ma1p**:

Expansion module for connection to a base unit from the PNOZmulti modular safety system

The product has the following features:

- 2 safe analogue inputs for current or voltage measurement (configurable)
- Voltage range: -10,24 ... +10.2375 V
- Current range: 0 ... 25.59 mA
- Resolution
  - Voltage measurement: 13 Bit (signed 12 Bit)
  - Current measurement: 12 Bit
- Range monitoring (4 range limits can be configured)
- Threshold value monitoring (8 threshold values can be configured)
- Max. 4 PNOZ ma1p units can be connected to the base unit
- LED indicators for
  - Operating status
  - Status of the input signals (Ch0, Ch1)
  - Errors
- Coated version:
  Increased environmental requirements

2.2 Front view



Key:

- 0 V, 24 V:
  Supply connections
- I0+, I0-:
  Inputs for current measurement
- U0+, U0-
  Inputs for voltage measurement

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3.1 Intended use

The expansion module is an analogue input module. It provides 2 safe analogue inputs for current or voltage measurement. For current measurement, both inputs can be used independently. For voltage measurement, both inputs must always be wired. The analogue inputs are suitable for connecting transducers or input devices with standardised 10 V voltage signals or 20 mA current signals. The analogue inputs are designed as differential inputs. Each analogue input has a signal range of –10 VDC to +10 VDC or 0 mA to 25 mA.

The expansion module may only be connected to a base unit from the PNOZmulti modular safety system.

The PNOZmulti modular safety system is used for the safety-related interruption of safety circuits and is designed for use on:
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1

Intended use includes making the electrical installation EMC-compliant. The product is designed for use in an industrial environment. It is not suitable for use in a domestic environment, as this can lead to interference.

The following is deemed improper use in particular:
- Any component, technical or electrical modification to the product
- Use of the product outside the areas described in this manual
- Use of the product outside the technical details (see chapter entitled “Technical Details”)

The coated version of the product **PNOZ ma1p** is suitable for use where there are increased environmental requirements (see Technical Details).

3.1.1 System requirements

- PNOZmulti Configurator: From Version 5.3.0
- Base unit PNOZ m1p: From Version 5.6
- Base unit PNOZ m2p: From Version 2.6

Please contact Pilz if you have an older version.

3.2 Safety regulations

3.2.1 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decomissioned by persons with proven skills. Persons with proven skills are people who, because they are:

- Qualified electrical engineers or
- Have received training from qualified electrical engineers

are suitably experienced to operate 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 safety guidelines given in this description
- Have a good knowledge of the generic and specialist standards applicable to the specific application.

3.2.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if:

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

3.2.3 Disposal

The product must be disposed of properly when it reaches the end of its service life.

3.2.4 For your safety

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

- This operating manual only describes the basic functions of the unit. Information on the advanced functions can be found in the online help

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3.2 Safety regulations

for the PNOZmulti Configurator and in the PNOZmulti technical catalogue. Only use these functions after you have read and understood the documentation. All necessary documentation can be found on the PNOZmulti Configurator CD.

- Do not open the housing or make any unauthorised modifications.
- Please make sure you shut down the supply voltage when performing maintenance work (e.g. exchanging contactors).
- Ensure that your application with the analogue input module fulfills the safety-related requirements of the plant by means of a theoretical and practical test. You must take note of the warnings given in other sections of these operating instructions. These are highlighted visually through the use of symbols.

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4.1 Device properties

4.1.1 Integrated protection mechanisms

The relay conforms to the following safety criteria:

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

The analogue input module can be used for applications up to SIL3.

For applications in accordance with SIL2 or SIL3, input devices must be attached that are certified for SIL2 in accordance with IEC 61508. The output signal of the input device must be monitored, i.e. actual and set value must be compared with one another. In the event of a deviation, a reaction must occur that the PNOZmulti recognises and to which it reacts.

- **SIL2 applications:**
  SIL2 applications are **only possible for current measurement**. If the analogue input module is to be used for current measurement on SIL2 applications, both inputs can be used independently for current measurement.
- **SIL3 applications:**
  If the analogue input module is to be used for SIL3 applications, both inputs must be configured. They will then be combined to form a SIL3 input. To do this, connect a suitable encoder to each input. The analogue input module will then check the feasibility of the input signals, i.e. the values measured from both input signals are compared.

NOTICE
For SIL3 applications, set a maximum permitted deviation between the measured values of both input signals (tolerance) in the PNOZmulti Configurator. A tolerance is only entered to balance out the imprecision of the signal recording, the encoder and the analogue input module. To maintain safety, the tolerance should be set as low as possible. Please note that the **maximum safety-related measurement error for the overall system** is composed of the following measurement errors:
Error during signal recording
+ Sensor measurement error
+ Max. measurement error in the event of a potential module error
To ensure that your application switches off safely in the event of a critical process variable, the configuration of the range limits/ threshold values must be increased/decreased to take into account the maximum measurement error.

4.1 Device properties

NOTICE
When using the analogue input module for voltage measurement, please note the following:
If the input signal is open circuit or there is a short circuit, this will not be detected with an input voltage of 0 V. Please use your risk assessment/hazard analysis to check whether your application fulfills the safety-related requirements or whether additional measures must be taken. We recommend that you configure a permitted value range between 2 - 10 V PNOZmulti Configurator.

4.1.2 Function description

4.1.2.1 Operation

The analogue input module monitors analogue input signals. It can measure both current and voltage.

The input signals are collected and read in at each input through two channels and are converted into digital signals. The resolution is 13 Bit for voltage measurement, 12 Bit for current measurement.

In the PNOZmulti Configurator you can define limit values, which are to be monitored:

- **Range monitoring**
  With range monitoring you can define the permitted value range. You can define up to 4 range limits (e.g. < 3 mA monitored for open circuit; I > 21 mA monitored for input device error). Depending on the selected condition ("greater than" or "less than"), the ENBL output bit and output bits 1 - 8 for threshold value monitoring are set to "0" if the recorded value exceeds or drops below a range limit. An entry is added to the error stack.
  Exception: If "automatic reset" type has been selected, no entry will be added to the error stack.
- **Threshold value monitoring**
  You can define up to 8 switching thresholds, which can be used to monitor certain process variables (e.g. different temperature values). The thresholds can be configured with or without scaling. 2 threshold values are configured per threshold. One threshold value defines when the relevant output bit (1 ... 8) is set to "1". The second threshold value defines when the output bit is reset to "0". No entry is added to the error stack.

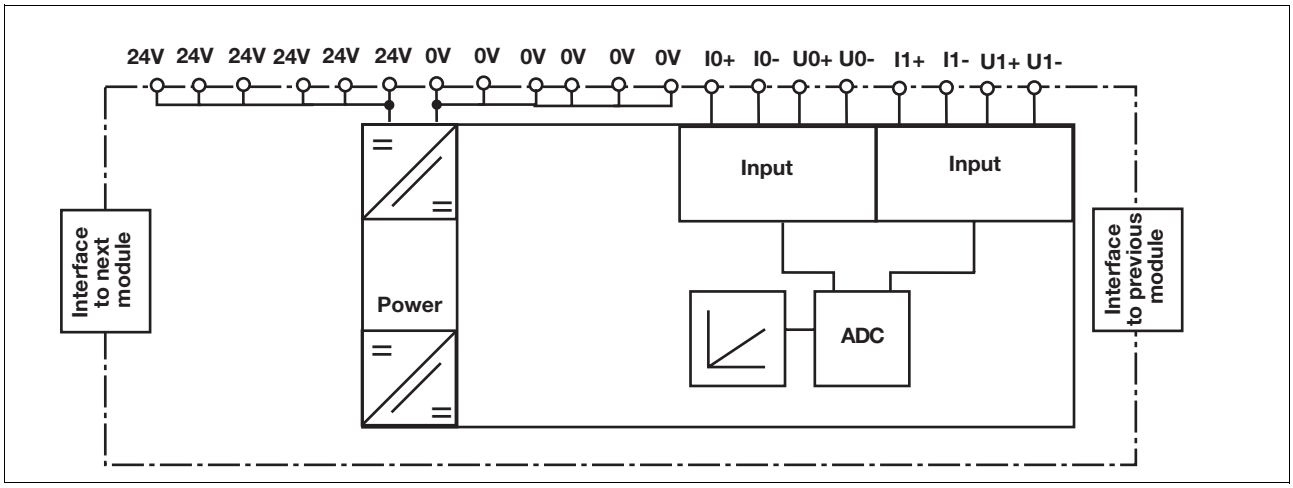
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4.1 Device properties

The **exact analogue values** are made available to the base unit to forward to a fieldbus. This value is transmitted through a single channel and is not safety-related. It can be used for diagnostic purposes.

INFORMATION
The online help on the PNOZmulti Configurator contains descriptions of the operating modes and all the functions of the PNOZmulti safety system.

4.1.2.2 Internal wiring diagram

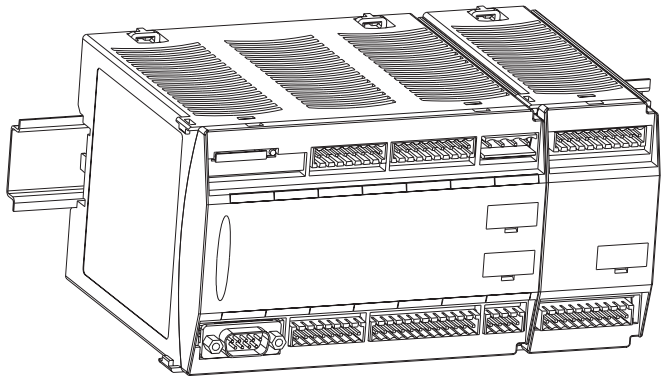


4.1 Device properties

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5.1 General installation guidelines

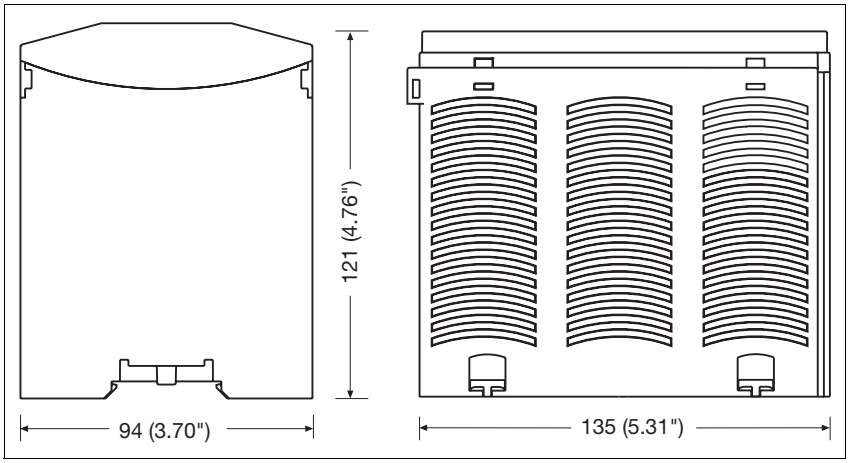
- The safety system should be installed in a control cabinet with a protection type of at least IP54. Fit the safety system to a horizontal DIN rail. The venting slots must face upward and downward. Other mounting positions could destroy the safety system.
- Use the notches on the back of the unit to attach it to a DIN rail. Connect the safety system to the DIN rail in an upright position so that the earthing springs on the safety system are pressed on to the DIN rail.
- The ambient temperature of the PNOZmulti units in the control cabinet must not exceed the figure stated in the technical details, otherwise air conditioning will be required.
- To comply with EMC requirements, the DIN rail must have a low impedance connection to the control cabinet housing.



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

5.1 General installation guidelines

5.1.1 Dimensions

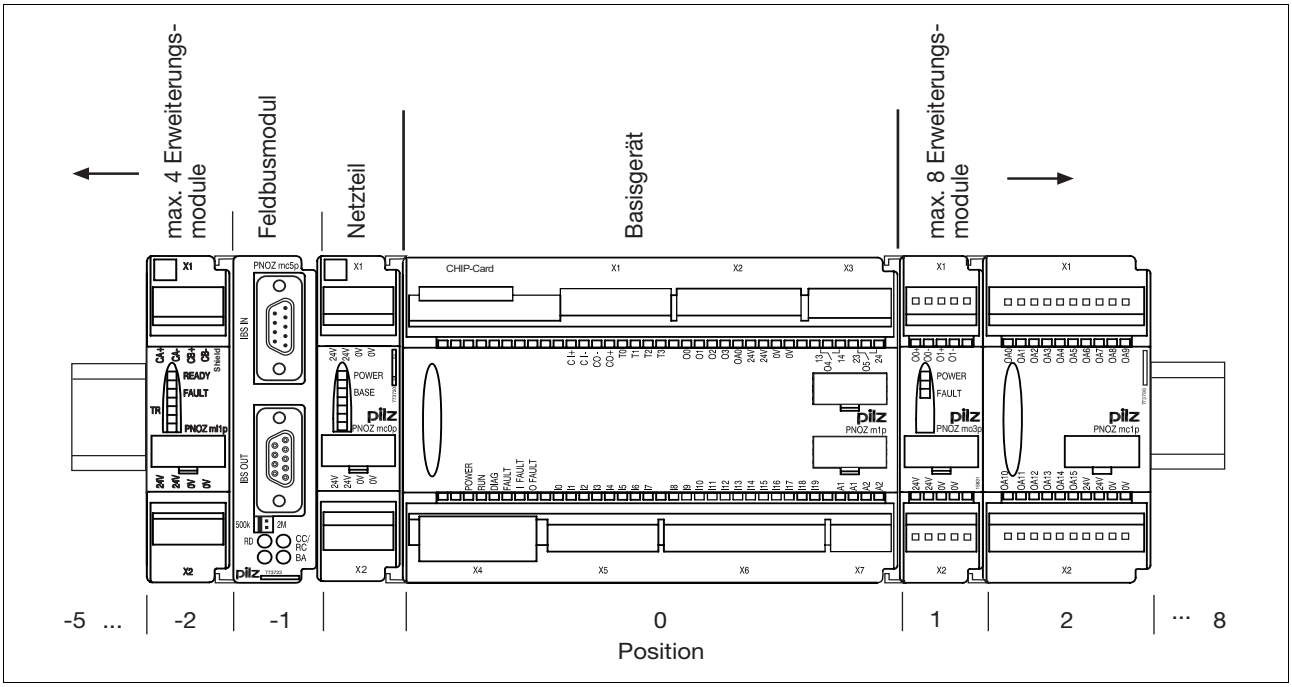


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5.2 Connecting the base unit and expansion modules

- Do **not** connect terminators to the last expansion module.
- Install the expansion module in the position in which it is configured in the PNOZmulti Configurator.

You can install a maximum of 4 **PNOZ ma1p** to the left of the base unit.



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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" must be followed.
- Use copper wire that can withstand 75 °C.
- The power supply that feeds the expansion module and the input devices must meet the regulations for extra low voltages with safe separation (SELV, PELV).
- 6 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 and the encoder can be supplied.
- Use shielded, twisted pair cable for the connections on the input current circuits.
- Separate the supply voltage cable from the analogue input current lines.
- If the analogue input module is used to measure current, the voltage inputs must be short-circuited.
- **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).

NOTICE
If the analogue input module is used to measure voltage, both inputs must be wired.

6.2 Preparing for operation

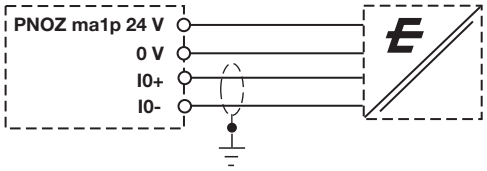
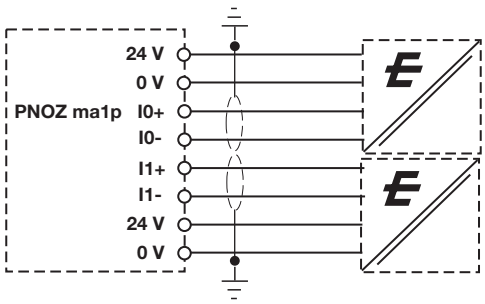
6.2.1 Download modified project to the PNOZmulti safety system

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

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

6.2.2 Connection

- Connection to transducer (SIL2 or SIL3)

Example for current measurement	
SIL2 application	
SIL3 application	

Please note:
- The transducers are SIL2 certified
- The voltage supply to the input device is optional
- With current measurement, the voltage inputs U+ - U- must be short-circuited.

CAUTION!
A constant load of ± 15 V or ± 50 mA per input must not be exceeded under any circumstances

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7.1 Messages

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

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

The PNOZmulti safety system is ready for operation when the "POWER" and "RUN" LEDs on the base unit and the "READY" LED on the **PNOZ ma1p** are lit continuously.

7.2 Display elements

Key:

☼	LED on
◐	LED flashes
●	LED off

7.2.1 Display elements for device diagnostics

LED	LED status		Meaning
READY	☼	Green	The unit is ready for operation
	●		The unit is not ready for operation
FAULT	☼	Red	External error
	◐	Red	Internal error
	●		No fault
CH0	☼	Red	Value at I0 has fallen below the lower range limit
	◐	Red	Upper threshold value at I0 exceeded; with SIL3 (Ch0 and Ch1 flashing alternately): set tolerance exceeded
	☼	Green	Measuring range at I0 within the defined range
CH1	☼	Red	Value at I1 has fallen below the lower range limit
	◐	Red	Upper threshold value at I1 exceeded; with SIL3 (Ch0 and Ch1 flashing alternately): set tolerance exceeded
	☼	Green	Measuring range at I1 within the defined range

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8.1 Technical details

Technical details	
Electrical data	
Supply voltage	
Supply voltage U_B DC	**24 V**
Voltage tolerance	**-15 %/+20 %**
Power consumption at U_B DC	**2.0 W**
Residual ripple DC	**5 %**
Times	
Switch-on delay	**5.00 s**
Max. reaction time when the input signal changes	**100 ms**
Supply interruption before de-energisation	**20 ms**
Inputs	
Number of analogue inputs	**2**
Type of analogue inputs	**Voltage**, **Current**
Max. measurement error at 25 °C	**0.5 %**
Temperature coefficient*	**0.0025 %/K**
Max. measurement error at full temperature range	**0.5 %**
Greatest transient deviation during el. interference test	**1.0 %**
Max. measurement error in the case of a potential module error	**1.5 %**
Max. voltage between the I0 and I1 inputs during current or voltage measurement	**30 V**
Analogue input filter	**first order**, **RC filter**
Cutoff frequency	**80 Hz**
Filter time constant	**2.0 ms**
Galvanic isolation	**no**
Current measurement	
Signal range	**0.00 - 25.59 mA**
Value range	**0 - 4095 d**
Resolution	**12 Bit**
Value of least significant bit (LSB)	**6.25 µA**
Input resistance (current input)	**100.000 Ohm**
Max. continuous current	**50 mA**
Voltage measurement	
Signal range	**-10.2400 - 10.2375 V**
Value range	**-4096 - 4095 d**
Resolution	**13 Bit**
Value of least significant bit (LSB)	**5 mV**
Input resistance (voltage input)	**290 kOhm**
Max. continuous voltage	**+/- 30 V**
Environmental data	
EMC	**EN 60947-5-1**
Vibration to **EN 60068-2-6**	
Frequency	**10 - 55 Hz**
Amplitude	**0.35 mm**
Climatic suitability	**EN 60068-2-1**, **EN 60068-2-30**, **EN 60068-2-78** coated version
Airgap creepage in accordance with	**EN 60664-1**
Ambient temperature	**0 - 60 °C** **-25 - 60 °C** coated version
Climatic suitability	**95 % r. F.** coated version

8.1 Technical details

Environmental data	
Condensation	**yes** **no** coated version
Storage temperature	**-25 - 70 °C**
Protection type	
Mounting (e.g. cabinet)	**IP54**
Housing	**IP20**
Terminals	**IP20**
Mechanical data	
DIN rail	
Top hat rail	**35 x 7.5 EN 50022**
Recess width	**27 mm**
Housing material	
Housing	**PPO UL 94 V0**
Front	**ABS UL 94 V0**
Cross section of external conductors with screw terminals	
Rigid single-core, flexible multicore or multi-core with crimp connector	**0.5 - 1.5 mm²**
Torque setting with screw terminals	**0.25 Nm**
Spring-loaded terminals: Terminal points per connection	**1**
Stripping length	**9 mm**
Dimensions	
Height	**94.0 mm**
Width	**45.0 mm**
Depth	**121.0 mm**
Weight	**200 g**

Safety characteristic data

Unit	Operating mode	EN ISO 13849-1 PL	EN 954-1 Category	EN IEC 62061 SIL CL	PFH [1/h]	t_M [year]
analogue inputs	single-channel	**PL e** (**Cat. 4**)	**Cat. 4**	**SIL CL 3**	**8.71E-09**	**20**
analogue inputs	dual-channel	**PL e** (**Cat. 4**)	**Cat. 4**	**SIL CL 3**	**8.71E-09**	**20**

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

The standards current on **2009-10** apply.

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TOP 100 2009 top innovator

ÖKOPROFIT

Deutscher Akkreditierungs Rat DAR
DAT - I - 010/05

CERTIFIED DIN EN ISO 9001 QUALITY SYSTEM REG. NO. 3462

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