



## PSS u2 ES 4AI RTD/TC

**PILZ**  
THE SPIRIT OF SAFETY

- ▶ PSS u2 in the automation system PSS 4000
- ▶ Remote I/O system PSS u2

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SD means Secure Digital

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# 1 Introduction

## 1.1 Validity of documentation

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

This documentation is valid for the product PSS u2 ES 4AI RTD/TC hardware version 01 or higher. It is valid until new documentation is published.

## 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.

Please refer to the PSS u2 Installation Manual.

## 1.3 Third-party manufacturer licence information

This product includes Open Source software with various licenses.

You can receive further information in the document "Third-party manufacturer licence information PSS u2 ES 4AI RTD/TC" under [www.pilz.com](http://www.pilz.com).

## 1.4 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

Module structure:

A module consists of

- ▶ an electronic module,
- ▶ a terminal block with cage clamp terminals and
- ▶ a module carrier

The electronic modules are plugged into the backplane and determine the function. The backplane is used for communication between the head module and the electronic modules and forms the carrier unit for the electronic modules. The terminal block is plugged into the electronic modules and is used to connect the field wiring.

Details of the terminal blocks that can be used are available under "Intended Use".

### 2.1 Module features

Application of the product PSS u2 ES 4AI RTD/TC:

Electronic module with analogue inputs to connect temperature sensors for standard applications.

- ▶ 4 analogue inputs for temperature measurement
- ▶ Resolution of the measured value: 0.125 °K
- ▶ Sensor type configurable separately per input:
  - Thermocouples (TC) nach EN 60584-1, resistance thermometers or thermoresistors
- ▶ Supported thermocouples (configurable) with the code letters:
  - J, K, E, N, R, S, T, B
- ▶ Thermocouples:
  - Configurable open circuit detection
  - Configurable measuring point for the reference temperature
- ▶ Supported resistance thermometer (configurable):
  - RTD Pt10
  - RTD Pt50
  - RTD Pt100
  - RTD Pt200
  - RTD Pt500
  - RTD Pt1000
  - RTD Ni120
- ▶ RTD connection type configurable:
  - 2-wire
  - 3-wire
  - 4-wire

- ▶ RTD linearisation standard configurable:
  - European (EN 60751)
  - American (US Industrial Standard)
  - Japanese (JIS)
  - International (ITS-90)
  - $\alpha = 0.00375$  (only for RTD Pt1000)
- ▶ Supported thermoresistors (configurable):
  - Thermistor 44004/44033 2.252k $\Omega$  bei 25°C
  - Thermistor 44005/44030 3k $\Omega$  bei 25°C
  - Thermistor 44007/44034 5k $\Omega$  bei 25°C
  - Thermistor 44006/44031 10k $\Omega$  bei 25°C
  - Thermistor 44008/44032 30k $\Omega$  bei 25°C
  - Thermistor YSI 400 2.252k $\Omega$  bei 25°C
  - Thermistor Spectrum 1003k 1k $\Omega$  bei 25°C
- ▶ LED displays for:
  - Operating status per input
  - Module error



## 3 Safety

### 3.1 Intended use

The module provides analogue inputs and may be used for standard applications in the PSS u2 system.

Intended use includes making the electrical installation EMC-compliant. The module is designed for use in an industrial environment. Interference may occur if used in other areas.

The following is deemed improper use in particular

- ▶ Any component, technical or electrical modification to the module,
- ▶ Use of the module outside the areas described in this manual,
- ▶ Any use of the module that is not in accordance with the technical details.

The module PSS u2 ES 4AI RTD/TC may be used in conjunction with the following terminal block:

- ▶ 16-pin terminal block

### 3.2 System requirements



#### INFORMATION

The module is supported by

- ▶ PASconfig from version 4.0.0
  - We recommend that you always use the latest version (download from [www.pilz.com](http://www.pilz.com)).

### 3.3 Safety regulations

#### 3.3.1 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by persons who are competent to do so.

A competent person is a qualified and knowledgeable person who, because of their training, experience and current professional activity, has the specialist knowledge required. To be able to inspect, assess and operate devices, systems and machines, the person has to be informed of the state of the art and the applicable national, European and international laws, directives and standards.

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

- ▶ Are familiar with the basic regulations concerning health and safety / accident prevention,
- ▶ Have read and understood the information provided in the section entitled Safety
- ▶ Have a good knowledge of the generic and specialist standards applicable to the specific application.

### **3.3.2      Warranty and liability**

All claims to warranty and liability will be rendered invalid if

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

### **3.3.3      Disposal**

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

## 4 Function description

### 4.1 Block diagram

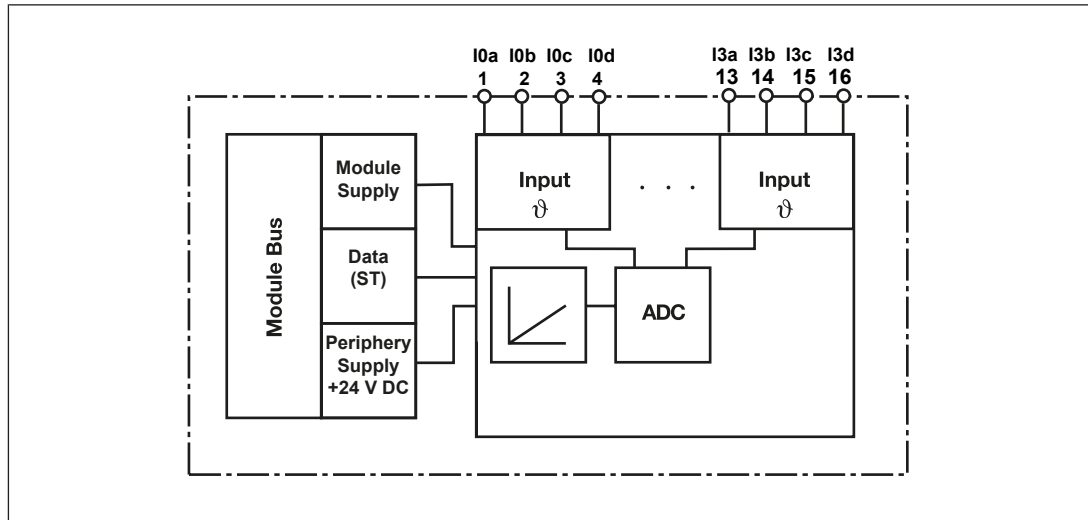


Fig.: Block diagram PSS u2 ES 4AI RTD/TC

### 4.2 Supply

- The module is supplied with voltage via the head module.

### 4.3 Thermocouples (CP)

Thermocouples generate a thermoelectric voltage based on the temperature difference between the measurement point and the reference point. To determine the temperature of the measurement point it is necessary to measure the temperature at the reference point (see [Reference temperature with thermocouples](#) [13]). The module uses the measured thermoelectric voltage and the temperature measured at the reference point to determine the temperature of the measurement point in °C or °F.

The thermocouple wires consist of two different metals. These wires are connected at the measurement point. The end of the wires is called the reference point. The thermocouple wires can be extended using a thermowire or compensating wire. The compensating wires consist of materials with the same thermoelectric properties to the thermocouples within a limited temperature range.

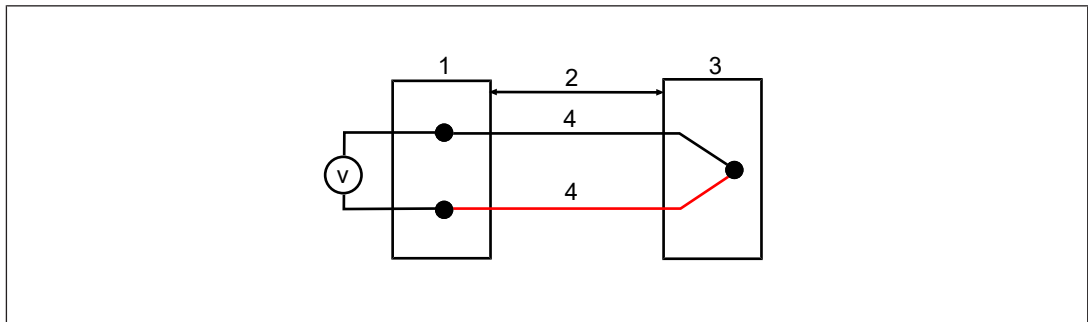


Fig.: Schematic connection of thermocouples

#### Legend

- 1 Reference point
- 2 Temperature difference
- 3 Measurement point
- 4 Thermocouple wires made of different metals

Supported sensors are thermocouples with the letter codes:

- ▶ Y
- ▶ K
- ▶ E
- ▶ N
- ▶ R
- ▶ S
- ▶ T
- ▶ B

The measuring ranges can be found in the [Technical details](#) [36].

An open circuit detection and an internal or external reference point can be configured for the thermocouples.

### 4.3.1 Reference temperature with thermocouples

#### Internal reference point

The reference temperature is measured in the module. The reference point is close to the contacts on the terminal block. There is a temperature difference between the connection point and the measurement point in the module, arising in a measurement error (see measurement error information in the technical details).

#### External reference point

Where the precision requirements for the temperature measurement are high, it may be necessary to determine the measurement of the reference temperature with an additional sensor at an external reference point. The additional sensor is connected to a second temperature measurement input on the module. The lines of the thermocouple or any compensating wires are connected to the external reference point. The module is connected to the reference point using copper cable.

When there is an external reference point please note that the contacts for the thermocouple and the measuring point of the additional sensor have the same temperature.

A difference between the measured and the actual temperature of the contacts for the thermocouple results in a greater measurement error of the temperature determined by the module.

Permitted sensor types for measurement of the reference temperature:

- ▶ RTDs
- ▶ Thermistors



#### INFORMATION

For a type B thermocouple the reference temperature may not be lower than 0°C.

#### Notes on the measurement errors of the thermocouples with external reference point:

The measuring errors specified in the technical data at 25°C with an external reference point apply with a temperature error at the external reference point of max. 0.5 K. To ensure that the temperature error of 0.5 K is not exceeded, the external reference point may be set up as follows, for example:

- ▶ Sensor types:
  - Pt sensors, class A according to EN 60751
- ▶ Connection type:
  - 3-wire or 4-wire
- ▶ Reference point temperatures:
  - for types J, K, E, N, T: -100°C ... 100°C
  - for types R and S: -50°C ... 100°C
  - for type B: 0°C ... 100°C

### 4.3.2 Status and error information on thermocouples

Meaning of the status information for thermocouples

- Byte 1 => Input I0
- Byte 3 => Input I1
- Byte 5 => Input I2
- Byte 7 => Input I3

| PII<br>Byte 1, 3, 5, 7 | Description                                                                                                                                                                                                                                                                                                              | Temperature output in the event of an error<br>(Bit 0 = "0", Bit 1 ... 7 = "1")                                                                                                                     |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bit 0                  | 0: Analogue value is invalid                                                                                                                                                                                                                                                                                             | 0: The output temperature value is invalid.                                                                                                                                                         |
|                        | 1: Analogue value is valid                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                     |
| Bit 1                  | 0: No error                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                     |
|                        | 1: Input voltage of the AD converter is outside the valid range                                                                                                                                                                                                                                                          | 1: The output temperature value is far outside the valid measuring range and may therefore vary greatly from the actual temperature at the measurement point.                                       |
| Bit 2                  | 0: The measured temperature is above the lower temperature limit                                                                                                                                                                                                                                                         |                                                                                                                                                                                                     |
|                        | 1: Temperature has dropped below the lower temperature limit for the configured thermocouple type<br>(temperature limits for types K, E, N and T: -265°C, for types R and S: -50°C, for type J: -210°C, for type B: 40°C)                                                                                                | 1: The measuring error of the output temperature value may be greater than specified in the technical data in case it falls below the lower measuring range limits specified in the technical data. |
| Bit 3                  | 0: The measured temperature is below the upper temperature limit                                                                                                                                                                                                                                                         |                                                                                                                                                                                                     |
|                        | 1: Upper temperature limit for the configured thermocouple type has been exceeded<br>(temperature limits for types R, S: 1768°C, for type J: 1200°C, for type K: 1372°C, for type E: 1000°C, for type N: 1300°C, for type T: 400, for type B 1820°C)                                                                     | 1: The measuring error of the output temperature value can be greater than specified in the technical data in case it exceeds the upper measuring range limits specified in the technical data.     |
| Bit 4                  | 0: No error; the temperature measured at the reference sensor is within the valid measuring range                                                                                                                                                                                                                        |                                                                                                                                                                                                     |
|                        | 1: The temperature measured at the configured reference sensor (for measuring ranges see chapters <a href="#">Status and error information on RTDs</a> [17] and <a href="#">Status and error information on thermoresistors</a> [19]) is below -50°C for types R and S, below 0°C for type B and above 400°C for type T. | 1: The measurement error of the output temperature value may be greater than specified in the technical details.                                                                                    |
| Bit 5                  | 0: No error at the reference sensor                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     |
|                        | 1: Reference sensor faulty                                                                                                                                                                                                                                                                                               | 1: The temperature value -999°C or °F is output.                                                                                                                                                    |

| PII<br>Byte 1, 3, 5, 7 | Description                                                               | Temperature output in the event of an error<br>(Bit 0 = "0", Bit 1 ... 7 = "1") |
|------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Bit 6                  | 0: No error                                                               |                                                                                 |
|                        | 1: Analogue evaluation error e.g. due to EMC interference or open circuit | 1: The temperature value -999°C or °F is output.                                |
| Bit 7                  | 0: No error                                                               |                                                                                 |
|                        | 1: Open circuit or internal error or faulty reference sensor              | 1: The temperature value -999°C or °F is output.                                |

## 4.4 Resistance thermometer (RTD)

RTDs change their resistance as the temperature changes. The resistance increases as the sensor temperature rises.

The following resistance thermometers are suitable sensors:

- ▶ RTD Pt10
- ▶ RTD Pt50
- ▶ RTD Pt100
- ▶ RTD Pt200
- ▶ RTD Pt500
- ▶ RTD Pt1000
- ▶ RTD Ni-120

The measuring ranges can be found in the [technical details](#)  36].

### Connection type

The connection type for the temperature measurements (RTD) is configurable per input:

- ▶ 2-wire connection (default)

With a 2-wire RTD connection, the cable resistance causes an error that cannot be compensated for. Significant errors (several degrees) may occur, depending on the sensor type, cable resistance and temperature. 2-wire RTDs should only be used when the cable length between the sensor and module is very short and/or the sensor resistance is high impedance within the required temperature range (e.g. Pt1000).

- ▶ 3-wire connection

With a 3-wire connection, all three wires must have the same electrical properties, otherwise there will not be optimum cable resistance compensation.

- ▶ 4-wire connection

With a 4-wire connection the cables are compensated.

If necessary, select the sensor, connection type and conductor cross section based on the recommendation of the sensor manufacturer. An unsuitable combination of sensor resistance, cable length, conductor cross section and connection type can considerably reduce the accuracy of the temperature measurement.

**Linearisation**

For platinum sensors, linearisation of the resistance temperature curve is calculated in the module using the Callendar-Van Dusen linearisation equation:

► for  $t < 0\text{ °C}$ :

$$R_t = R_0 (1 + At + Bt^2 + C (t-100\text{ °C}) t^3)$$

► for  $t > 0\text{ °C}$ :

$$R_t = R_0 (1 + At + Bt^2)$$

**Legend:**

$R_t$ : Resistance at temperature  $t$

$R_0$  states the resistance in ohms of the platinum sensor at  $t=0\text{ °C}$ .

$t$ : Temperature in  $\text{°C}$

The values for the coefficients A, B, C can be found in the table below. The values depend on the configured standard curve.

EN 60751 defines the mean temperature coefficient  $\alpha$  between  $0\text{ °C}$  and  $100\text{ °C}$  as an additional parameter.

$$\alpha = (R_{100} - R_0) / 100\text{ °C} * R_0$$

Use the coefficient table to check which sensors are suitable for use with the module.

| Standard                                       | ALPHA ( $\alpha$ )    | A            | B             | C             |
|------------------------------------------------|-----------------------|--------------|---------------|---------------|
| EN 60751 (European standard) (default setting) | 0.00385/ $\text{°C}$  | 3,908300E-03 | -5,775000E-07 | -4,183000E-12 |
| US (US industrial standard)                    | 0.003911/ $\text{°C}$ | 3,969200E-03 | -5,849500E-07 | -4,232500E-12 |
| JIS (Japanese industrial standard)             | 0.003916/ $\text{°C}$ | 3,973900E-03 | -5,870000E-07 | -4,400000E-12 |
| ITS-90 (international temperature scale)       | 0.003926/ $\text{°C}$ | 3,984800E-03 | -5,870000E-07 | -4,000000E-12 |
| RTD Pt1000-375                                 | 0.00375/ $\text{°C}$  | 3,810200E-03 | -6,018880E-07 | -6,000000E-12 |
| *Ni120                                         | 0.00672/ $\text{°C}$  | N/A          | N/A           | N/A           |

► \* A resistance table is provided in the Appendix for the nickel sensors (Ni120) (see [Appendix !\[\]\(4146d17f71dced09c6ad789cacceaa6d\_img.jpg\) 44](#))



#### 4.4.1 Status and error information on RTDs

Meaning of the status information for RTDs

- ▶ Byte 1 => Input I0
- ▶ Byte 3 => Input I1
- ▶ Byte 5 => Input I2
- ▶ Byte 7 => Input I3

| PII<br>Byte 1, 3, 5, 7 | Description                                                                                                                                                   | Temperature output in the event of an error<br>(Bit 0 = "0", Bit 1 ... 7 = "1")                                                                                                                     |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bit 0                  | 0: Analogue value is invalid                                                                                                                                  | 0: The output temperature value is invalid.                                                                                                                                                         |
|                        | 1: Analogue value is valid                                                                                                                                    |                                                                                                                                                                                                     |
| Bit 1                  | 0: No error                                                                                                                                                   |                                                                                                                                                                                                     |
|                        | 1: Input voltage of the AD converter is outside the valid range                                                                                               | 1: The output temperature value is far outside the valid measuring range and may therefore vary greatly from the actual temperature at the measurement point.                                       |
| Bit 2                  | 0: The measured temperature is above the lower temperature limit                                                                                              |                                                                                                                                                                                                     |
|                        | 1: Temperature has dropped below the lower temperature limit for the configured RTD type<br>(temperature limits for platinum RTDs: -200°C, for Ni-120: -80°C) | 1: The measuring error of the output temperature value may be greater than specified in the technical data in case it falls below the lower measuring range limits specified in the technical data. |
| Bit 3                  | 0: The measured temperature is below the upper temperature limit                                                                                              |                                                                                                                                                                                                     |
|                        | 1: Upper temperature limit for the configured RTD type has been exceeded<br>(temperature limits for platinum RTDs: 850°C, for Ni-120: 260°C)                  | 1: The measuring error of the output temperature value can be greater than specified in the technical data in case it exceeds the upper measuring range limits specified in the technical data.     |
| Bit 4                  | Not used                                                                                                                                                      |                                                                                                                                                                                                     |
| Bit 5                  | Not used                                                                                                                                                      |                                                                                                                                                                                                     |
| Bit 6                  | 0: No error                                                                                                                                                   |                                                                                                                                                                                                     |
|                        | 1: Analogue evaluation error (e.g. due to EMC interference or open circuit)                                                                                   | 1: The temperature value -999 °C or °F is output.                                                                                                                                                   |
| Bit 7                  | 0: No error                                                                                                                                                   |                                                                                                                                                                                                     |
|                        | 1: Short circuit or sensor interruption or internal error                                                                                                     | 1: The temperature value -999 °C or °F is output.                                                                                                                                                   |

## 4.5 Thermoresistors (thermistors)

The following thermoresistors are suitable sensors:

- ▶ Thermistor 44004/44033 2.252kΩ at 25°C
- ▶ Thermistor 44005/44030 3kΩ at 25°C
- ▶ Thermistor 44007/44034 5kΩ at 25°C
- ▶ Thermistor 44006/44031 10kΩ at 25°C
- ▶ Thermistor 44008/44032 30kΩ at 25°C
- ▶ Thermistor YSI 400 2,252kΩ at 25°C
- ▶ Thermistor Spectrum 1003k 1kΩ at 25°C

The measuring ranges can be found in the [technical details](#)  36].

Thermistors change their resistance as the temperature changes. NTC thermistors may be connected to the module. NTC thermistors show better conductivity with increasing temperatures.

Linearisation of the resistance temperature curve is calculated in the module using the Steinhart-Hart equation:

$$t = 1 / (A + B \ln(R) + C \ln(R)^3)$$

**Legend:**

t: Temperature in °C

R: Resistance value in Ohms

The following table states the values for the coefficients used by the module, depending on the thermistor that is used:

| Thermistor                                | A           | B           | C           |
|-------------------------------------------|-------------|-------------|-------------|
| Thermistor 44004/44033<br>2.252kΩ at 25°C | 1,46800E-03 | 2,38300E-04 | 1,00700E-07 |
| Thermistor 44005/44030 3kΩ<br>at 25°C     | 1,40300E-03 | 2,37300E-04 | 9,82700E-08 |
| Thermistor 44007/44034 5kΩ<br>at 25°C     | 1,28500E-03 | 2,36200E-04 | 9,28500E-08 |
| Thermistor 44006/44031 10kΩ<br>at 25°C    | 1,03200E-03 | 2,38700E-04 | 1,58000E-07 |
| Thermistor 44008/44032 30kΩ<br>at 25°C    | 9,37600E-04 | 2,20800E-04 | 1,27600E-07 |
| Thermistor YSI-400 2.252kΩ at<br>25°C     | 1,47134E-03 | 2,37624E-04 | 1,05034E-07 |
| Thermistor Spectrum 1003k<br>1kΩ at 25°C  | 1,445904E-3 | 2,68399E-04 | 1,64066E-07 |

Use the coefficient table to check which sensors are suitable for use with the module.

An unsuitable combination of sensor type, cable length and conductor cross section can considerably reduce the accuracy of the temperature measurement.

#### 4.5.1 Status and error information on thermoresistors

Meaning of the status information for thermistors

- Byte 1 => Input I0
- Byte 3 => Input I1
- Byte 5 => Input I2
- Byte 7 => Input I3

| PII<br>Byte 1, 3, 5, 7 | Description                                                                                                                                                                                             | Temperature output in the event of an error<br>(Bit 0 = "0", Bit 1 ... 7 = "1")                                                                                                                    |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bit 0                  | 0: Analogue value is invalid                                                                                                                                                                            | 0: The output temperature value is invalid.                                                                                                                                                        |
|                        | 1: Analogue value is valid                                                                                                                                                                              |                                                                                                                                                                                                    |
| Bit 1                  | 0: No error                                                                                                                                                                                             |                                                                                                                                                                                                    |
|                        | 1: Input voltage of the AD converter is outside the valid range                                                                                                                                         | 1: The output temperature value is far outside the valid measuring range and may therefore vary greatly from the actual temperature at the measurement point.                                      |
| Bit 2                  | 0: The measured temperature is above the lower temperature limit                                                                                                                                        |                                                                                                                                                                                                    |
|                        | 1: Temperature has dropped below the lower temperature limit for the configured thermistor type<br>(temperature limits for YSI 400: -80°C, for Spectrum 1003k: -50°C, for all other thermistors: -40°C) | 1: The measuring error of the output temperature value may be greater than specified in the technical data in case it falls below the lower measuring range limits specified in the technical data |
| Bit 3                  | 0: The measured temperature is below the upper temperature limit                                                                                                                                        |                                                                                                                                                                                                    |
|                        | 1: Upper temperature limit for the configured thermistor type has been exceeded<br>(temperature limits for YSI 400: 250°C, for Spectrum 1003k: 125°C, for all other thermistors: 150°C)                 | 1: The measuring error of the output temperature value can be greater than specified in the technical data in case it exceeds the upper measuring range limits specified in the technical data.    |
| Bit 4                  | Not used                                                                                                                                                                                                |                                                                                                                                                                                                    |
| Bit 5                  | Not used                                                                                                                                                                                                |                                                                                                                                                                                                    |
| Bit 6                  | 0: No error                                                                                                                                                                                             |                                                                                                                                                                                                    |
|                        | 1: Analogue evaluation error (e.g. due to EMC interference or open circuit)                                                                                                                             | 1: The temperature value -999°C or °F is output.                                                                                                                                                   |
| Bit 7                  | 0: No error                                                                                                                                                                                             |                                                                                                                                                                                                    |
|                        | 1: Short circuit or sensor interruption or internal error                                                                                                                                               | 1: The temperature value -999°C or °F is output.                                                                                                                                                   |

## 4.6 Summary of configuration options

The module has the following configuration options:

| Configurable properties             | Configurable values                                                                                                                                                                                                                                         | Default value       | Meaning                                                                                                                                                                                              |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Unit of temperature                 | Celsius, Fahrenheit                                                                                                                                                                                                                                         | Celsius             | Unit for the temperature value output                                                                                                                                                                |
| Sensor type                         | Resistance thermometer:<br>▶ Thermocouples: J, K, E, N, R, S, T, B<br>▶ RTD: Pt10, Pt50, Pt100, Pt200, Pt500, Pt1000 ( $\alpha=0.00375$ ), Ni120<br>▶ Thermistors: 44004/44033, 44005/44030, 44007/44034, 44006/44031, 44008/44032, YSI 400, Spectrum 1003k | no sensor           | Type of sensor connected to the input                                                                                                                                                                |
| Thermocouple reference temperature  | Internal, input I00, input I01, input I02, input I03                                                                                                                                                                                                        | internal            | Selection of internal or external reference point. With external reference point selection of the input to which the additional sensor is to be connected (for measuring the reference temperature). |
| Thermocouple open circuit detection | yes, no                                                                                                                                                                                                                                                     | no                  | Detects open circuits in the sensor cable                                                                                                                                                            |
| RTD connection type                 | 2-wire, 3-wire, 4-wire                                                                                                                                                                                                                                      | 2-wire              | Connection type                                                                                                                                                                                      |
| RTD linearisation standard          | European (EN 60751), American (US Industrial Standard), Japanese (JIS), International (ITS-90)                                                                                                                                                              | European (EN 60751) | Standard for the resistance temperature curves                                                                                                                                                       |

## 4.7 Energy-saving functions

The energy-saving levels are controlled by the head module and are not configurable. The module supports the following energy-saving levels:

► Switching off the LEDs

The LEDs have two energy-saving levels:

- Switching off the LEDs to display the terminal status
- Switching off the LEDs to display the module and terminal status

► Standby mode

- All module functions are inactive.
- The LEDs for displaying the module and terminal status are switched off.

## 4.8 Reaction times

Detailed information on the reaction times is available in the operating manual of the head modules.

## 5 Structure of the process image

The module occupies 4 Byte in the process image of inputs for valid bits:

| PII    |       | Meaning               | State                                                                                                                            |
|--------|-------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Byte 0 | Bit 0 | Valid bit of input I0 | 0: Temperature value in the PII is invalid<br>1: Temperature value in the PII is valid<br><br>Note: Bit 1 ... 7 are constant "0" |
| Byte 2 | Bit 0 | Valid bit of input I1 |                                                                                                                                  |
| Byte 4 | Bit 0 | Valid bit of input I2 |                                                                                                                                  |
| Byte 6 | Bit 0 | Valid bit of input I3 |                                                                                                                                  |

The module occupies 4 Byte in the process image of inputs for status and error information.

The description of status and error information is to be found in the following chapters:

- ▶ [Status and error information on thermocouples](#)  14]
- ▶ [Status and error information on RTDs](#)  17]
- ▶ [Status and error information on thermoresistors](#)  19]

The module occupies 8 Byte in the process image of the inputs for the measured temperature (2 Byte per input):

| PII            | Meaning                                                              |
|----------------|----------------------------------------------------------------------|
| Byte 8 ... 9   | Temperature value of the sensor at the input I0 in Big Endian format |
| Byte 10 ... 11 | Temperature value of the sensor at the input I1 in Big Endian format |
| Byte 12 ... 13 | Temperature value of the sensor at the input I2 in Big Endian format |
| Byte 14 ... 15 | Temperature value of the sensor at the input I3 in Big Endian format |

The analogue value in the process image is represented in two's complement with 16 Bit including sign. That is, there are 15 Bits available for the representation of the measured temperature's magnitude. 12 Bit of this are used for the representation of the digits before the decimal points and 3 Bits for the representation of the digits after the decimal points. The measured value is limited to three digits after the decimal point and the maximum resolution of the measured value is therefore 0.125 K.

Example for representation of the temperature in the process image:

| Temperature | Binary |           |   |   |   |           |   |   |   |           |   |   |   |               |   |
|-------------|--------|-----------|---|---|---|-----------|---|---|---|-----------|---|---|---|---------------|---|
|             | VZ     | Half-Byte |   |   |   | Half-Byte |   |   |   | Half-Byte |   |   |   | Decimal place |   |
| 4095.875 °C | 0      | 1         | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 1             | 1 |
| 2048.000 °C | 0      | 1         | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0             | 0 |
| 1.000 °C    | 0      | 0         | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0         | 0 | 0 | 1 | 0             | 0 |
| 1/8 °C      | 0      | 0         | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0             | 1 |
| 0 °C        | 0      | 0         | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0         | 0 | 0 | 0 | 0             | 0 |
| - 1/8 °C    | 1      | 1         | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 1             | 1 |
| - 1,000 °C  | 1      | 1         | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 1         | 1 | 1 | 1 | 0             | 0 |
| -273.875 °C | 1      | 1         | 1 | 1 | 0 | 1         | 1 | 1 | 0 | 1         | 1 | 1 | 0 | 0             | 1 |

## 6 Installation

### 6.1 General installation guidelines



#### 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.

#### 6.1.1 Dimensions

The dimensions include the backplane, electronic module and terminal block.

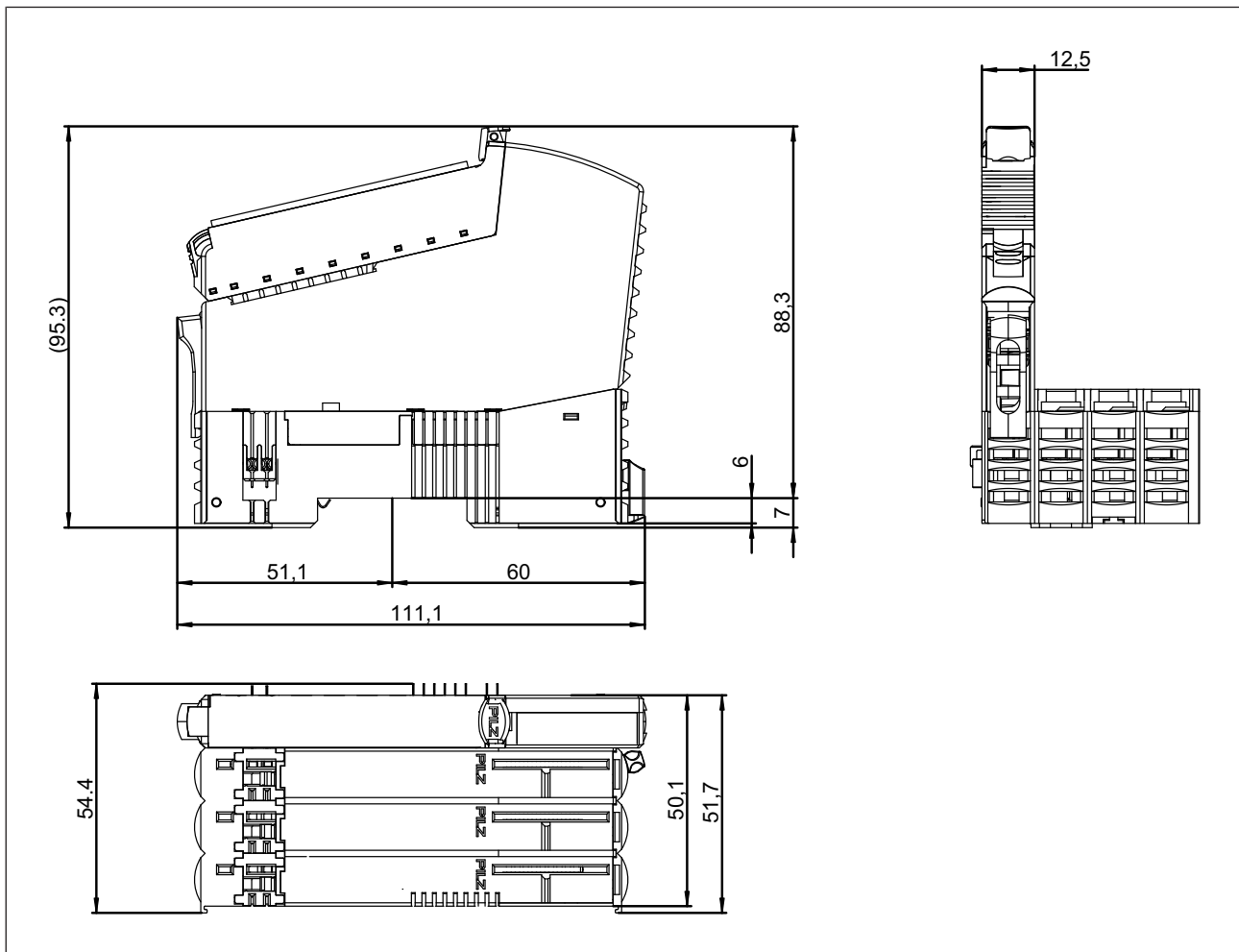


Fig.: Dimensions in mm, including backplane, electronic module and terminal block



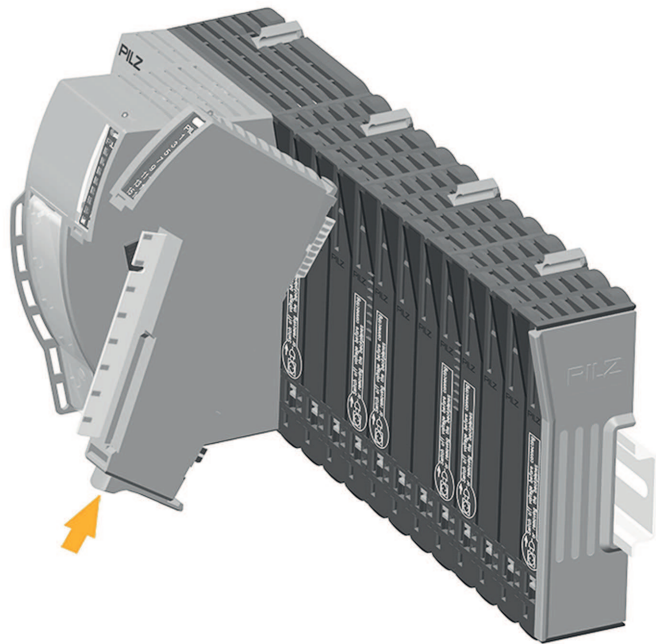
## 6.2 Inserting and removing an electronic module

Please note:

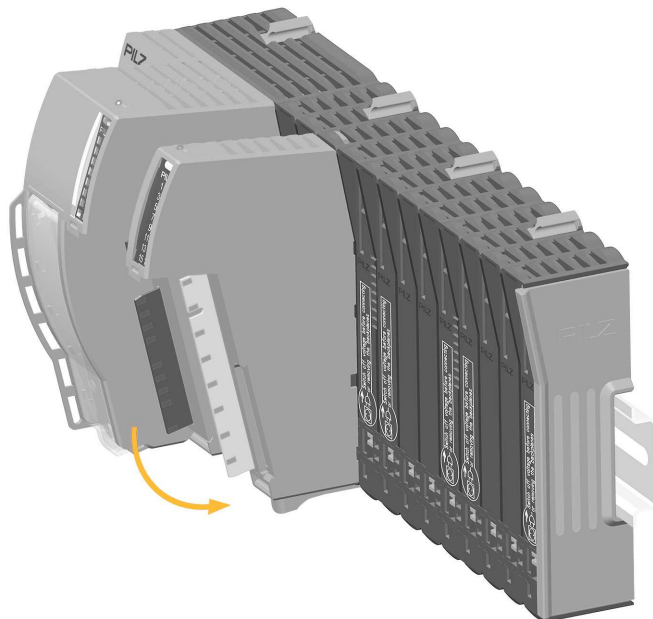
- ▶ Backplane must be installed first.
- ▶ Electronic modules may only be plugged or unplugged if the terminal block has been removed first.
- ▶ The mechanics of the electronic modules are designed for 20 plug in/out cycles.

### 6.2.1 Inserting an electronic module

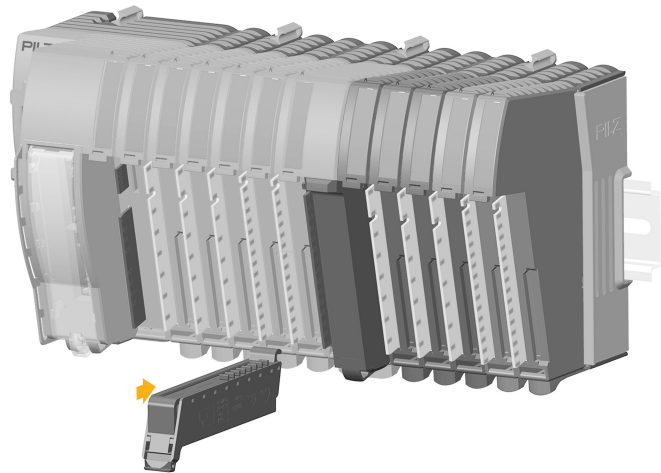
1. Insert the electronic module into the suspension lug on the backplane.



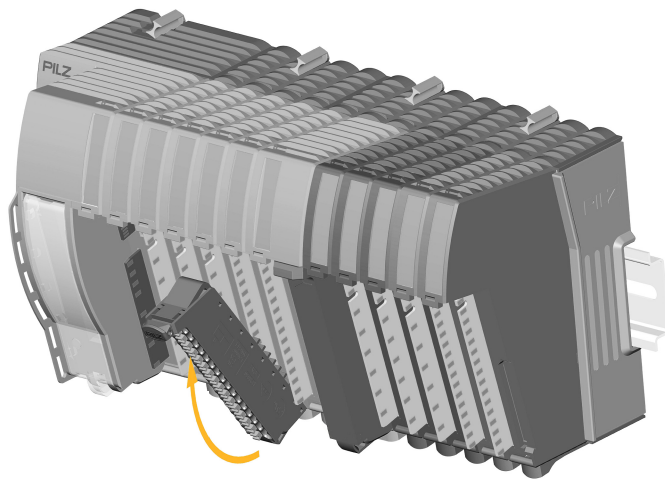
2. Swivel the electronic module downwards until you hear it click into place.



3. Insert the terminal block into the suspension lug on the module.

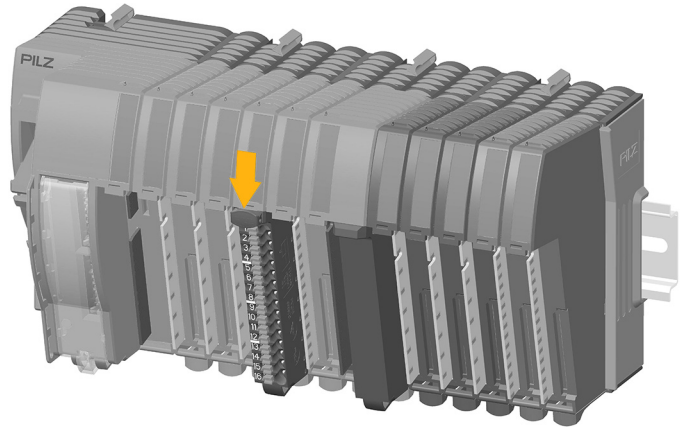


4. Swivel the terminal block upwards until you hear it click into place.

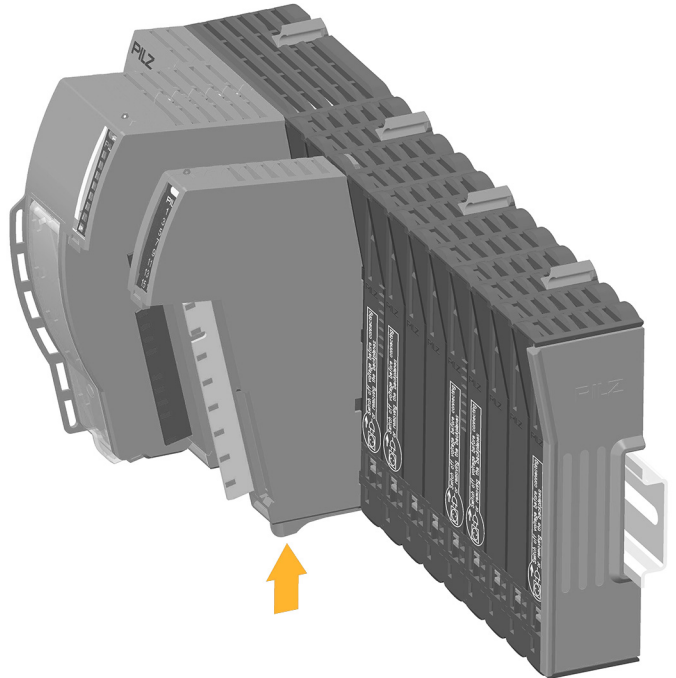


## 6.2.2 Removing an electronic module

1. Press the unlocking mechanism on the terminal block that is shown by the arrow and pull off the terminal block forward.



2. Press the unlocking mechanism that is shown by the arrow and pull off the electronic module upwards.



### 6.2.3 Changing an electronic module during operation

An electronic module can be hot swapped.

Effects:

- ▶ Module bus communication between the other modules is not interrupted.
- ▶ The configuration data is retained.
- ▶ The module is detected automatically as soon as the module is re-inserted.

Procedure:

1. [Removing an electronic module](#)  27]
2. [Inserting an electronic module](#)  25]

A new electronic module can be inserted during operation.

Procedure:

- ▶ [Inserting an electronic module](#)  25]

Effects:

- ▶ Module bus communication between the other modules is not interrupted.
- ▶ To detect the new module the following steps can be necessary:
  - Creating a new configuration or changing an existing configuration
  - Download of the configuration to the head module
  - Restart of the head module. After a restart, the system behaves as after a warm reset using a reset pushbutton (see operating manual of the head module, chapter "Reset pushbutton", section "Carrying out a warm reset (restart)").

## 7 Wiring

### 7.1 General wiring guidelines

- ▶ The analogue inputs are not potentially isolated to one another.
- ▶ The supply voltages of the actuators and encoders must meet the regulations for extra low voltages with safe separation (SELV, PELV). Failure to do so could result in electric shock.
- ▶ When selecting the sensors, make sure that the sensors' dielectric strength guarantees the required insulation against live parts. The voltage permitted on the module is SELV/PELV.
- ▶ Use shielded signal cables. The optional shield connection element can be used to connect the shield (see [Accessories](#)  42).
- ▶ When using an external reference point, ensure that the shielding effect on the reference point's connections is disturbed as little as possible. Connect the shields of the thermocouple/compensation wires and the copper cables over as large a surface area as possible and with low impedance. Ideally, the complete reference point is in the shielded housing.
- ▶ Do not connect the lines of a sensor to those of another sensor. This may cause inaccurate measurements and malfunctions.
- ▶ Use copper wire material for RTDs and thermistors.
- ▶ Please note that cable resistance may cause significant measurement errors when using the 2-wire connection of RTDs and thermistors.
- ▶ With a 3-wire measurement, all three wires must have the same electrical properties, otherwise there will not be optimum cable resistance compensation. If two of the three lines are twisted around each other, the twisted lines should be connected to the terminals Ixb and Ixc.
- ▶ When twisted pair cables are used in a 4-wire measurement, we recommend that Ixa and Ixd, and Ixb and Ixc each form a pair.
- ▶ The accuracy specifications in the technical details do not consider the tolerances and ageing of the sensor, they refer to the stable ambient temperature of 25 °C of the electronic module.
- ▶ Analogue input modules detect even very small signal changes. They are therefore much more sensitive than digital inputs. In a particularly disturbed environment it can happen that signal changes caused by interferences are also detected.

In these cases, we recommend the following measures:

- Earth the mounting rail on both sides of the modules.
- Earth the shield connection of the cables on both sides (on the sensor and either on the module or directly on the point where the cable enters the control cabinet).
- Ensure that no transient currents flow across the cable screening, which may damage the cables or the connectors.

## 7.2 Terminal configuration

The table shows what terminals must be used for connecting the various sensor types.

### Thermocouples:

| Terminal     | Terminal designation | Terminal assignment |
|--------------|----------------------|---------------------|
| 1, 5, 9, 13  | Input Ixa            | n.c.                |
| 2, 6, 10, 14 | Input Ixb            | Measuring line -    |
| 3, 7, 11, 15 | Input Ixc            | Measuring line +    |
| 4, 8, 12, 16 | Input Ixd            | n.c.                |

### Thermistors and 2-wire RTDs:

| Terminals    | Terminal designation | Terminal assignment |
|--------------|----------------------|---------------------|
| 1, 5, 9, 13  | Input Ixa            | Measuring line +    |
| 2, 6, 10, 14 | Input Ixb            | Measuring line -    |
| 3, 7, 11, 15 | Input Ixc            | n.c.                |
| 4, 8, 12, 16 | Input Ixd            | n.c.                |

### 3-wire RTDs:

| Terminals    | Terminal designation | Terminal assignment     |
|--------------|----------------------|-------------------------|
| 1, 5, 9, 13  | Input Ixa            | Constant current line - |
| 2, 6, 10, 14 | Input Ixb            | Measuring line -        |
| 3, 7, 11, 15 | Input Ixc            | Measuring line +        |
| 4, 8, 12, 16 | Input Ixd            | n.c.                    |

### 4-wire RTDs:

| Terminal     | Terminal designation | Terminal assignment     |
|--------------|----------------------|-------------------------|
| 1, 5, 9, 13  | Input Ixa            | Constant current line 1 |
| 2, 6, 10, 14 | Input Ixb            | Measuring line 1        |
| 3, 7, 11, 15 | Input Ixc            | Measuring line 2        |
| 4, 8, 12, 16 | Input Ixd            | Constant current line 2 |

n.c.: not connected

x: Input number

## 7.2.1 Connection examples

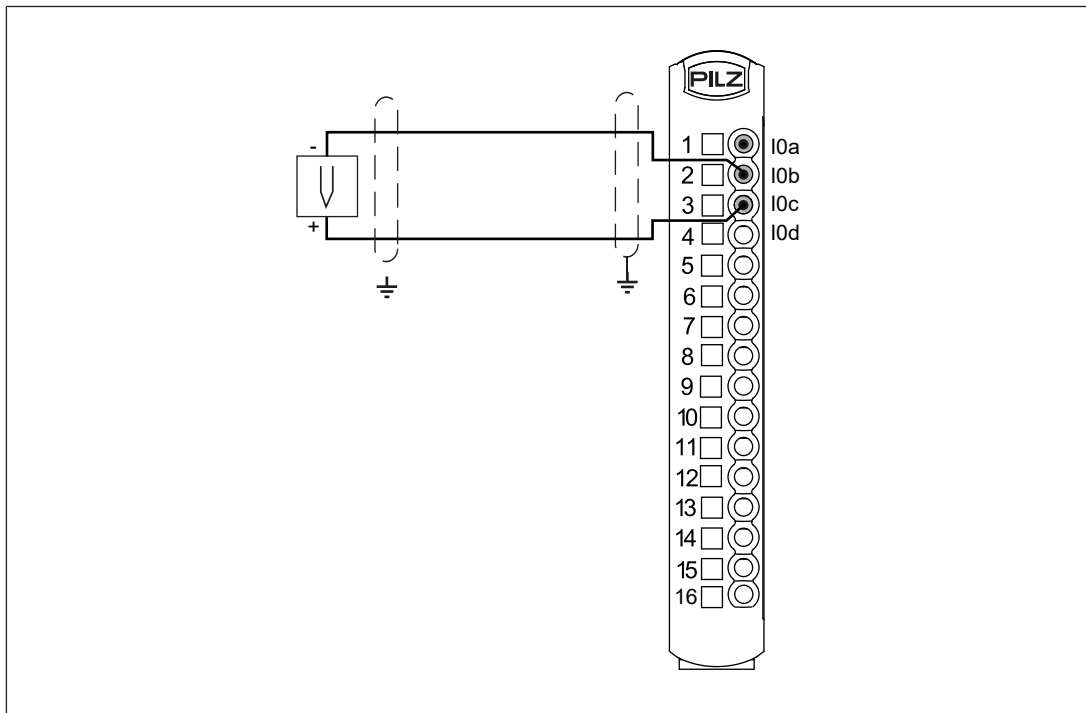


Fig.: Thermocouple with internal reference measurement

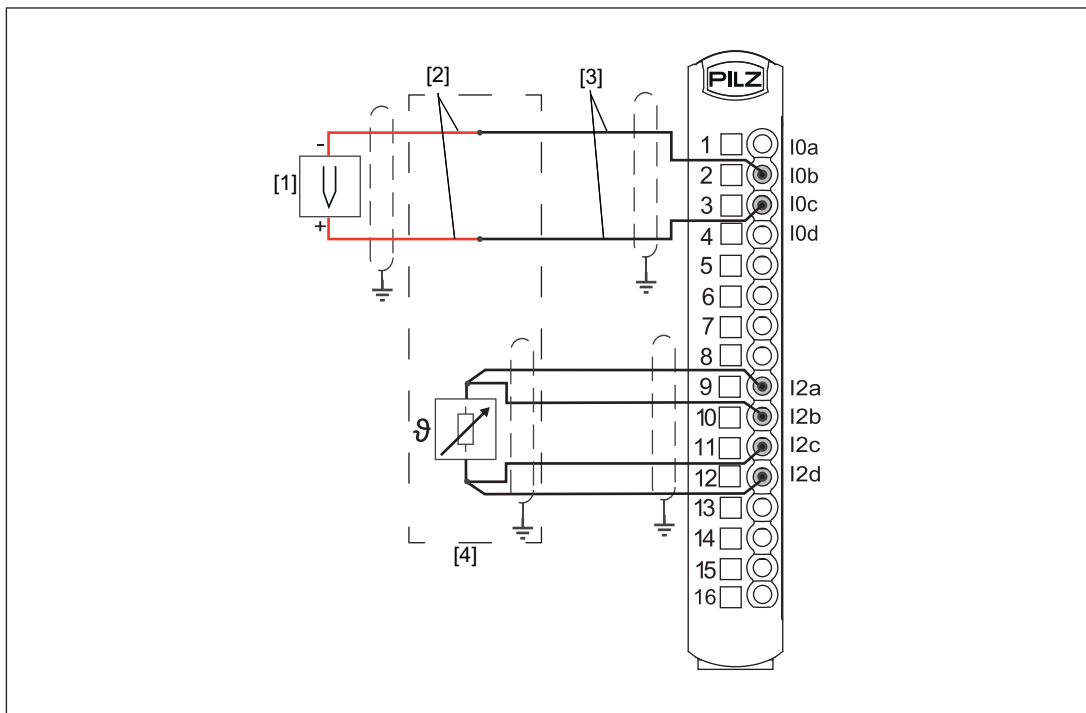


Fig.: Thermocouple with external reference measurement

### Legend

- 1 Thermocouple
- 2 Thermowire or compensating wire
- 3 Copper cable
- 4 Reference point

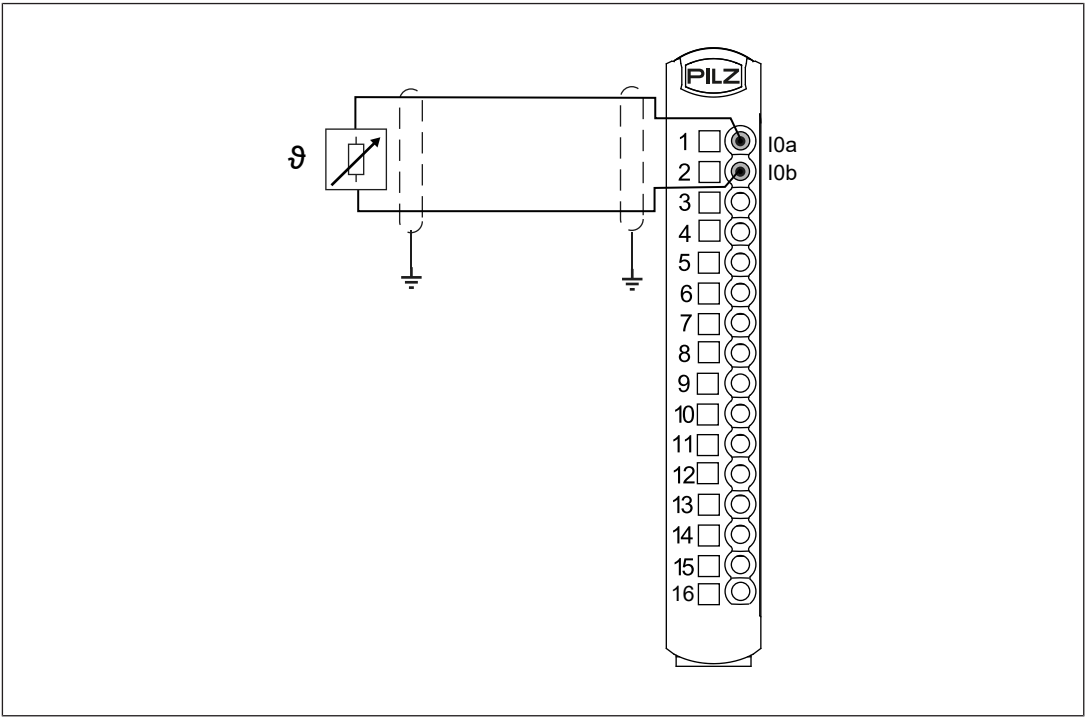


Fig.: RTD 2-wire connection

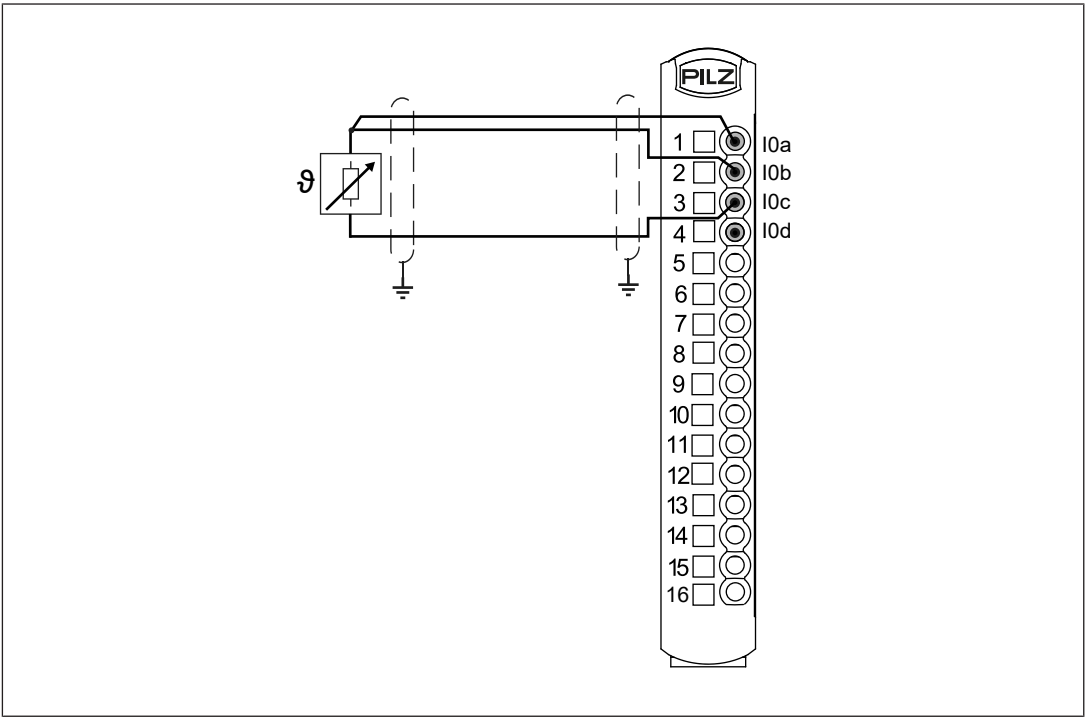


Fig.: RTD 3-wire connection



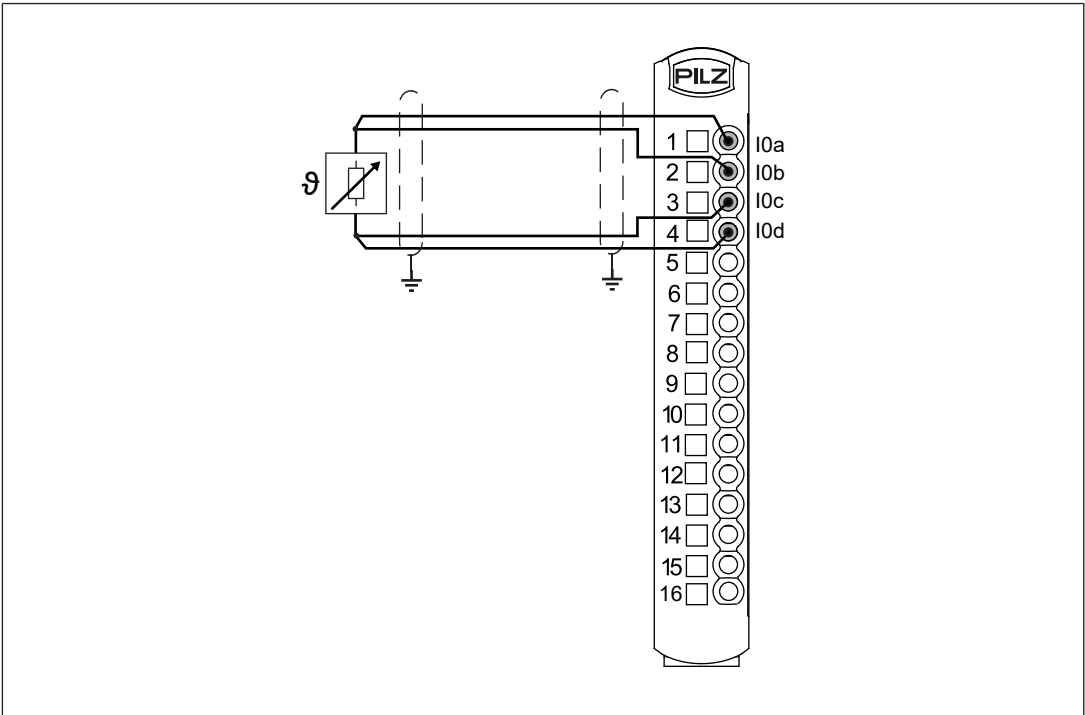


Fig.: RTD 4-wire connection

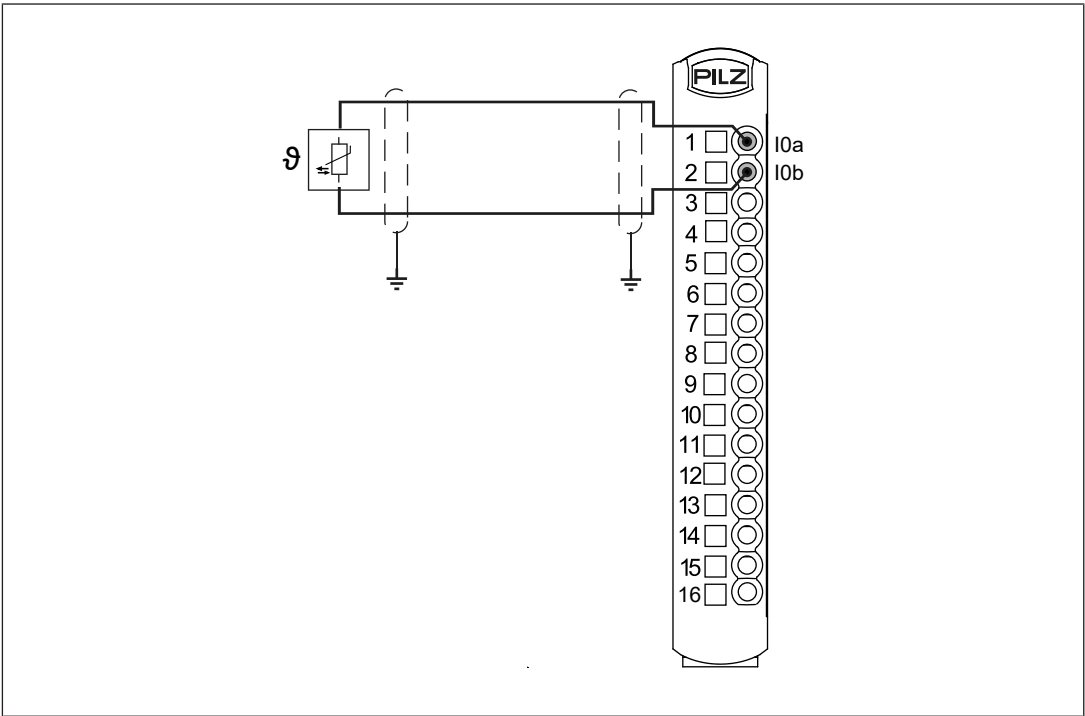


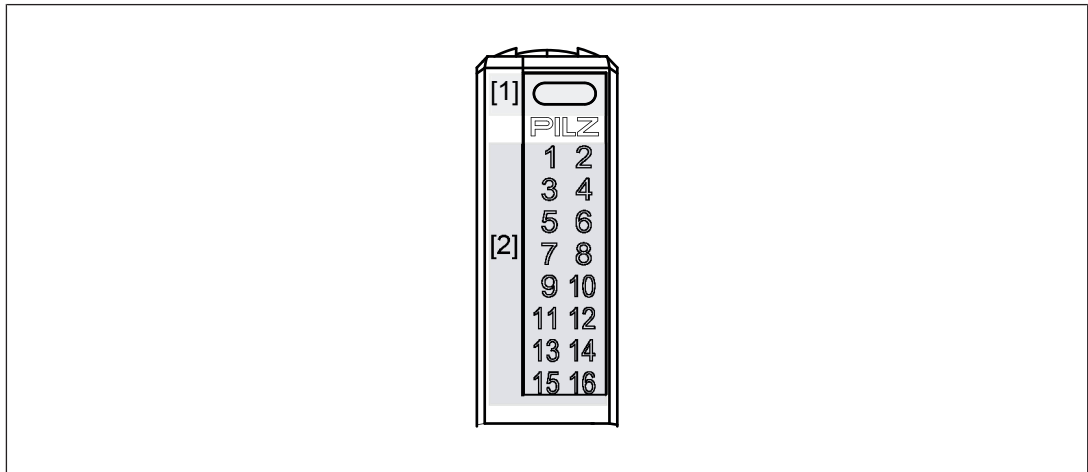
Fig.: NTC thermistor

## 8 Operation

The status of the module is displayed via a red and a green LED. The status of the terminals is displayed via a green LED. If there is a module error, the module status display will light up red. The error will be signalled to the head module and will be entered in the head module's diagnostic log.

### 8.1 Display elements and messages

All the terminal status displays are active depending on the wiring.



#### Legend

- [1] Module status display
- [2] Terminal status display

#### Legend

-  LED on
-  LED flashes
-  LED flashes briefly
-  LED off

The module can detect the following module states:

| [1]                                                                                 | Colour [1] | [2]                                                                                 | Colour [2] | Meaning                                                                    | Further information         |
|-------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------|-----------------------------|
| ●                                                                                   | --         | ●                                                                                   |            | Module not ready for operation                                             |                             |
|  | Green      | ●                                                                                   |            | Module ready for operation                                                 |                             |
|  | Green      |  | Green      | Module in operation and there is a valid input value at the relevant input |                             |
|  | Red        | ●                                                                                   | --         | Configuration error<br>Module was inserted in the wrong slot.              |                             |
|  | Red        | ●                                                                                   | --         | Internal errors                                                            | See module's diagnostic log |

| [1]                                                                               | Colour [1] | [2]                                                                               | Colour [2] | Meaning                                                                                                                                      | Further information         |
|-----------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
|  | Red        |  | Green      | The module status display and the terminal status displays on the relevant input flash synchronously<br>Measuring range error                | See module's diagnostic log |
|  | Red        |  | Green      | Temperature warning: Too warm (1)                                                                                                            | See module's diagnostic log |
|  | Red        |  | Green      | The module status display and all terminal status displays flash synchronously<br>Periphery supply is missing/temperature error: Too hot (1) | See module's diagnostic log |

(<sup>1</sup>) There are two levels of overtemperature.

► Too warm:

If the module temperature exceeds a threshold value, then:

- a warning is sent to the head module.

If the temperature drops back below the threshold value, the module sends an all-clear.

► Too hot:

If the module temperature exceeds another threshold value, then:

- an error message is sent to the head module
- the inputs continue to be read and appear in the ST-PII

After the "too hot" message has been received, if the temperature drops back below the "too warm" threshold value, the module will switch to an error-free state.

## 9 Technical details

| General                                                   |                                                      |
|-----------------------------------------------------------|------------------------------------------------------|
| Certifications                                            | CE, UKCA                                             |
| Application range                                         | Standard                                             |
| Module's device code                                      | 0027h                                                |
| Number of ST input bits                                   | 64                                                   |
| Number of ST status bits                                  | 28 - 36                                              |
| Electrical data                                           |                                                      |
| Internal supply voltage (module supply)                   |                                                      |
| Module's power consumption                                | 0,36 W                                               |
| Periphery's supply voltage (periphery supply)             |                                                      |
| Module's power consumption with no load                   | 0,29 W                                               |
| Max. power dissipation of module                          | 0,65 W                                               |
| Analogue inputs                                           |                                                      |
| Number of analogue inputs                                 | 4                                                    |
| Type of analogue inputs                                   | Thermoresistor, thermocouple, resistance thermometer |
| Input area                                                |                                                      |
| Thermocouples in accordance with the standard             | EN 60584-1                                           |
| Type                                                      | J                                                    |
| Measuring range                                           | -210 ... 1200 °C                                     |
| Measurement error at 25 °C with positive measured values  | 0,3 %                                                |
| Measurement error at 25 °C over the whole measuring range | 0,5 %                                                |
| Temperature coefficient                                   | 0,002 %/K                                            |
| Type                                                      | K                                                    |
| Measuring range                                           | -200 ... 1372 °C                                     |
| Measurement error at 25 °C with positive measured values  | 0,4 %                                                |
| Measurement error at 25 °C over the whole measuring range | 0,5 %                                                |
| Temperature coefficient                                   | 0,002 %/K                                            |
| Type                                                      | E                                                    |
| Measuring range                                           | -200 ... 1000 °C                                     |
| Measurement error at 25 °C with positive measured values  | 0,3 %                                                |
| Measurement error at 25 °C over the whole measuring range | 0,6 %                                                |
| Temperature coefficient                                   | 0,002 %/K                                            |
| Type                                                      | N                                                    |
| Measuring range                                           | -200 ... 1300 °C                                     |
| Measurement error at 25 °C with positive measured values  | 0,3 %                                                |
| Measurement error at 25 °C over the whole measuring range | 0,5 %                                                |

## Analogue inputs

|                                                           |                         |
|-----------------------------------------------------------|-------------------------|
| Temperature coefficient                                   | <b>0,002 %/K</b>        |
| Type                                                      | <b>R</b>                |
| Measuring range                                           | <b>0 ... 1768 °C</b>    |
| Measurement error at 25 °C                                | <b>0,3 %</b>            |
| Temperature coefficient                                   | <b>0,002 %/K</b>        |
| Type                                                      | <b>S</b>                |
| Measuring range                                           | <b>0 ... 1768 °C</b>    |
| Measurement error at 25 °C                                | <b>0,3 %</b>            |
| Temperature coefficient                                   | <b>0,002 %/K</b>        |
| Type                                                      | <b>T</b>                |
| Measuring range                                           | <b>-200 ... 400 °C</b>  |
| Measurement error at 25 °C with positive measured values  | <b>0,6 %</b>            |
| Measurement error at 25 °C over the whole measuring range | <b>1,6 %</b>            |
| Temperature coefficient with positive measured values     | <b>0,002 %/K</b>        |
| Temperature coefficient over the whole measuring range    | <b>0,004 %/K</b>        |
| Type                                                      | <b>B</b>                |
| Measuring range                                           | <b>400 ... 1820 °C</b>  |
| Measurement error at 25 °C                                | <b>0,2 %</b>            |
| Temperature coefficient                                   | <b>0,002 %/K</b>        |
| Type                                                      | <b>J</b>                |
| Measuring range                                           | <b>-210 ... 1200 °C</b> |
| Measurement error at 25 °C with positive measured values  | <b>1 %</b>              |
| Measurement error at 25 °C over the whole measuring range | <b>2,5 %</b>            |
| Temperature coefficient                                   | <b>0,003 %/K</b>        |
| Type                                                      | <b>K</b>                |
| Measuring range                                           | <b>-200 ... 1372 °C</b> |
| Measurement error at 25 °C with positive measured values  | <b>1,1 %</b>            |
| Measurement error at 25 °C over the whole measuring range | <b>2,1 %</b>            |
| Temperature coefficient                                   | <b>0,003 %/K</b>        |
| Type                                                      | <b>E</b>                |
| Measuring range                                           | <b>-200 ... 1000 °C</b> |
| Measurement error at 25 °C with positive measured values  | <b>1,2 %</b>            |
| Measurement error at 25 °C over the whole measuring range | <b>2,7 %</b>            |
| Temperature coefficient with positive measured values     | <b>0,003 %/K</b>        |

## Analogue inputs

|                                                           |                  |
|-----------------------------------------------------------|------------------|
| Temperature coefficient over the whole measuring range    | 0,005 %/K        |
| Type                                                      | N                |
| Measuring range                                           | -200 ... 1300 °C |
| Measurement error at 25 °C with positive measured values  | 0,9 %            |
| Measurement error at 25 °C over the whole measuring range | 2,3 %            |
| Temperature coefficient with positive measured values     | 0,003 %/K        |
| Temperature coefficient over the whole measuring range    | 0,004 %/K        |
| Type                                                      | R                |
| Measuring range                                           | 0 ... 1768 °C    |
| Measurement error at 25 °C                                | 0,8 %            |
| Temperature coefficient                                   | 0,003 %/K        |
| Type                                                      | S                |
| Measuring range                                           | 0 ... 1768 °C    |
| Measurement error at 25 °C                                | 0,8 %            |
| Temperature coefficient                                   | 0,003 %/K        |
| Type                                                      | T                |
| Measuring range                                           | -200 ... 400 °C  |
| Measurement error at 25 °C with positive measured values  | 3 %              |
| Measurement error at 25 °C over the whole measuring range | 7,3 %            |
| Temperature coefficient with positive measured values     | 0,006 %/K        |
| Temperature coefficient over the whole measuring range    | 0,02 %/K         |
| Type                                                      | B                |
| Measuring range                                           | 400 ... 1820 °C  |
| Measurement error at 25 °C                                | 0,2 %            |
| Temperature coefficient                                   | 0,002 %/K        |
| Type                                                      | Pt10             |
| Measuring range                                           | -200 ... 800 °C  |
| Measurement error at 25 °C with 2-wire measurement        | 1,2 %            |
| Measurement error at 25 °C with 3/4-wire measurement      | 0,5 %            |
| Temperature coefficient                                   | 0,005 %/K        |
| Type                                                      | Pt50             |
| Measuring range                                           | -200 ... 800 °C  |
| Measurement error at 25 °C                                | 0,6 %            |
| Temperature coefficient                                   | 0,003 %/K        |
| Type                                                      | Pt100            |
| Measuring range                                           | -200 ... 800 °C  |
| Measurement error at 25 °C                                | 0,5 %            |

## Analogue inputs

|                            |                               |
|----------------------------|-------------------------------|
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | Pt200                         |
| Measuring range            | -200 ... 800 °C               |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | Pt500                         |
| Measuring range            | -200 ... 800 °C               |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | Pt1000                        |
| Measuring range            | -200 ... 800 °C               |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | Ni120                         |
| Measuring range            | -80 ... 260 °C                |
| Measurement error at 25 °C | 0,4 %                         |
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | 44004/44033 2.252 kΩ at 25 °C |
| Measuring range            | -10 ... 150 °C                |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | 44005/44030 3 kΩ at 25 °C     |
| Measuring range            | -5 ... 150 °C                 |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | 44007/44034 5 kΩ at 25 °C     |
| Measuring range            | 5 ... 150 °C                  |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,001 %/K                     |
| Type                       | 44006/44031 10 kΩ at 25 °C    |
| Measuring range            | 20 ... 150 °C                 |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,001 %/K                     |
| Type                       | 44008/44032 30 kΩ at 25 °C    |
| Measuring range            | 45 ... 150 °C                 |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,001 %/K                     |
| Type                       | YSI 400 2.252 kΩ at 25 °C     |
| Measuring range            | -10 ... 150 °C                |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,002 %/K                     |
| Type                       | Spectrum 1003 k 1 kΩ at 25 °C |
| Measuring range            | -30 ... 125 °C                |
| Measurement error at 25 °C | 0,5 %                         |
| Temperature coefficient    | 0,002 %/K                     |

| Analogue inputs                                |                                                                         |
|------------------------------------------------|-------------------------------------------------------------------------|
| Input filter                                   | Digital filter                                                          |
| Filter properties per input (digital filter)   |                                                                         |
| Attenuation                                    | 70 dB (50 Hz, 60 Hz)                                                    |
| Filter time                                    | 220 ms                                                                  |
| Temperature measurement                        |                                                                         |
| Value of least significant bit (LSB)           | 0,125 K                                                                 |
| Input resistance                               | 100 MOhm                                                                |
| Typ. conversion time per input                 | 325 ms                                                                  |
| Resolution                                     | 16 Bit                                                                  |
| Max. measuring current                         | 700 µA                                                                  |
| Conversion method                              | Delta sigma                                                             |
| Max. processing time tProclM of analogue input | 1.5 s                                                                   |
| Potential isolation                            | yes                                                                     |
| Environmental data                             |                                                                         |
| Climatic suitability                           | EN 60068-2-1, EN 60068-2-14, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78 |
| 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                              | -40 - 70 °C                                                             |
| Climatic suitability                           |                                                                         |
| In accordance with the standard                | 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 (Zone B)                                                     |
| Vibration                                      |                                                                         |
| In accordance with the standard                | EN 60068-2-6                                                            |
| Frequency                                      | 8,4 - 150 Hz                                                            |
| Acceleration                                   | 10 m/s <sup>2</sup>                                                     |
| Shock stress                                   |                                                                         |
| In accordance with the standard                | EN 60068-2-27                                                           |
| Acceleration                                   | 150 m/s <sup>2</sup>                                                    |
| 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                                                                    |
| Mounting area (e.g. control cabinet)           | IP54                                                                    |



### Potential isolation

|                             |                                            |
|-----------------------------|--------------------------------------------|
| Potential isolation between | <b>Analogue input and Module Supply</b>    |
| Type of potential isolation | <b>Functional insulation</b>               |
| Rated surge voltage         | <b>2500 V</b>                              |
| Potential isolation between | <b>Analogue input and Periphery Supply</b> |
| Type of potential isolation | <b>Functional insulation</b>               |
| Rated surge voltage         | <b>2500 V</b>                              |
| Potential isolation between | <b>Periphery supply and module supply</b>  |
| Type of potential isolation | <b>Functional insulation</b>               |
| Rated surge voltage         | <b>2500 V</b>                              |

### Mechanical data

|               |                 |
|---------------|-----------------|
| Material      |                 |
| Housing       | <b>PC</b>       |
| Mounting type | <b>plug-in</b>  |
| Dimensions    |                 |
| Height        | <b>110,8 mm</b> |
| Width         | <b>12,5 mm</b>  |
| Depth         | <b>72,5 mm</b>  |
| Weight        | <b>40 g</b>     |

Where standards are undated, the 2016-08 latest editions shall apply.

#### Note on specifying deviations for analogue inputs:

All specifications of deviations in % or in %/K refer to the measuring range end values.

#### Notes on the measurement errors of the thermocouples with external reference point:

The measuring errors specified in the technical data at 25°C with an external reference point apply with a temperature error at the external reference point of max. 0.5 K. To ensure that the temperature error of 0.5 K is not exceeded, the external reference point may be set up as follows, for example:

- ▶ Sensor types:
  - Pt sensors, class A according to EN 60751
- ▶ Connection type:
  - 3-wire or 4-wire
- ▶ Reference point temperatures:
  - for types J, K, E, N, T: -100°C ... 100°C
  - for types R and S: -50°C ... 100°C
  - for type B: 0°C ... 100°C

## 10 Order reference

### 10.1 Product

| Product type         | Features                                              | Order no. |
|----------------------|-------------------------------------------------------|-----------|
| PSS u2 ES 4AI RTD/TC | Standard electronic module for recording temperatures | 328540    |

### 10.2 Accessories

#### Terminal block

| Product type              | Features                                          | Order no. |
|---------------------------|---------------------------------------------------|-----------|
| PSS u2 T 16 (1 pc.)       | Terminal block 16-pin, scope of supply: 1 pieces  | 328850    |
| PSS u2 T 16 (10 pcs.)     | Terminal block 16-pin, scope of supply: 10 pieces | 328851    |
| PSS u2 T 16 (5 x 10 pcs.) | Terminal block 16-pin, scope of supply: 50 pieces | 328852    |

#### Labelling bracket

| Product type             | Features                                                                             | Order No. |
|--------------------------|--------------------------------------------------------------------------------------|-----------|
| PSS u2 A LC E1 (10 pcs.) | Labelling bracket for electronic module 23.5 x 10.5 mm, scope of delivery: 10 pieces | 328910    |
| PSS u2 A LC E2 (10 pcs.) | Labelling bracket for electronic module 103 x 10.5 mm, scope of delivery: 10 pieces  | 328911    |
| PSS u2 A LA E1 (10 pcs.) | Labelling strips for electronic module 23.5 x 10.5 mm (10 x DIN A4 sheet)            | 328913    |
| PSS u2 A LA E2 (10 pcs.) | Labelling strips for electronic module 103 x 10.5 mm (10 x DIN A4 sheet)             | 328914    |

#### Label holder for terminal block

| Product type             | Features                                                                 | Order no. |
|--------------------------|--------------------------------------------------------------------------|-----------|
| PSS u2 A LC T3 (10 pcs.) | Label holder for terminal block 61 x 11.5 mm, scope of supply: 10 pieces | 328912    |

**Coding elements**

| Product type               | Features                                                              | Order no. |
|----------------------------|-----------------------------------------------------------------------|-----------|
| PSS u2 A CE E<br>(10 pcs.) | Coding elements for electronic modules,<br>scope of supply: 10 pieces | 328860    |

**Backplanes**

| Product type | Features           | Order no. |
|--------------|--------------------|-----------|
| PSS u2 B 1   | Backplane, 1 slot  | 328811    |
| PSS u2 B 4   | Backplane, 4 slots | 328810    |

| Product type               | Features                                                                              | Order No. |
|----------------------------|---------------------------------------------------------------------------------------|-----------|
| PSS u2 A SH 4<br>(10 pcs.) | Shield connection element for backplane<br>with 4 slots, scope of delivery: 10 pieces | 328820    |

## 11

## Appendix

Resistance in Ohm as a function of temperature in °C for Ni120

| Temp°C | 0        | 1        | 2        | 3        | 4        | 5        | 6        | 7        | 8        | 9        |
|--------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| -80    | 66.6000  |          |          |          |          |          |          |          |          |          |
| -70    | 73.1032  | 72.4525  | 71.8019  | 71.1514  | 70.5011  | 69.8508  | 69.2005  | 68.5503  | 67.9002  | 67.2501  |
| -60    | 79.6200  | 78.9673  | 78.3149  | 77.6627  | 77.0108  | 76.3591  | 75.7075  | 75.0562  | 74.4051  | 73.7541  |
| -50    | 86.1647  | 85.5085  | 84.8527  | 84.1974  | 83.5424  | 82.8878  | 82.2336  | 81.5797  | 80.9262  | 80.2729  |
| -40    | 92.7552  | 92.0936  | 91.4326  | 90.7722  | 90.1123  | 89.4531  | 88.7944  | 88.1362  | 87.4786  | 86.8214  |
| -30    | 99.4100  | 98.7411  | 98.0730  | 97.4057  | 96.7392  | 96.0734  | 95.4084  | 94.7440  | 94.0804  | 93.4175  |
| -20    | 106.1497 | 105.4712 | 104.7937 | 104.1173 | 103.4419 | 102.7676 | 102.0942 | 101.4218 | 100.7503 | 100.0797 |
| -10    | 113.0029 | 112.3116 | 111.6217 | 110.9332 | 110.2461 | 109.5602 | 108.8757 | 108.1924 | 107.5103 | 106.8294 |
| -0     | 120.000  | 119.2929 | 118.5876 | 117.8839 | 117.1819 | 116.4816 | 115.7828 | 115.0855 | 114.3898 | 113.6956 |
| 0      | 120.000  | 120.7088 | 121.4193 | 122.1317 | 122.8457 | 123.5616 | 124.2792 | 124.9987 | 125.7199 | 126.4430 |
| 10     | 127.1678 | 127.8945 | 128.6231 | 129.3534 | 130.0857 | 130.8197 | 131.5557 | 132.2935 | 133.0333 | 133.7749 |
| 20     | 134.5184 | 135.2638 | 136.0112 | 136.7604 | 137.5116 | 138.2648 | 139.0199 | 139.7770 | 140.5360 | 141.2970 |
| 30     | 142.0600 | 142.8250 | 143.5920 | 144.3610 | 145.1320 | 145.9050 | 146.6800 | 147.4571 | 148.2362 | 149.0173 |
| 40     | 149.8004 | 150.5857 | 151.3729 | 152.1622 | 152.9536 | 153.7470 | 154.5425 | 155.3401 | 156.1398 | 156.9416 |
| 50     | 157.7454 | 158.5513 | 159.3594 | 160.1695 | 160.9818 | 161.7962 | 162.6127 | 163.4313 | 164.2521 | 165.0750 |
| 60     | 165.9000 | 166.7272 | 167.5565 | 168.3880 | 169.2216 | 170.0574 | 170.8953 | 171.7353 | 172.5775 | 173.4218 |
| 70     | 174.2682 | 175.1167 | 175.9674 | 176.8202 | 177.6751 | 178.5321 | 179.3912 | 180.2525 | 181.1159 | 181.9813 |
| 80     | 182.8489 | 183.7186 | 184.5904 | 185.4643 | 186.3402 | 187.2183 | 188.0985 | 188.9807 | 189.8651 | 190.7515 |
| 90     | 191.6391 | 192.5297 | 193.4224 | 194.3172 | 195.2140 | 196.1130 | 197.0141 | 197.9173 | 198.8226 | 199.7300 |
| 100    | 200.6396 | 201.5513 | 202.4652 | 203.3812 | 204.2994 | 205.2198 | 206.1423 | 207.0670 | 207.9939 | 208.9229 |
| 110    | 209.8542 | 210.7877 | 211.7233 | 212.6612 | 213.6013 | 214.5436 | 215.4882 | 216.4350 | 217.3840 | 218.3353 |
| 120    | 219.2900 | 220.2458 | 221.2039 | 222.1642 | 223.1268 | 224.0917 | 225.0588 | 226.0281 | 226.9998 | 227.9737 |
| 130    | 228.9499 | 229.9283 | 230.9090 | 231.8920 | 232.8773 | 233.8648 | 234.8545 | 235.8466 | 236.8409 | 237.8375 |
| 140    | 238.8364 | 239.8375 | 240.8409 | 241.8466 | 242.8545 | 243.8648 | 244.8773 | 245.8920 | 246.9091 | 247.9284 |
| 150    | 248.9500 | 249.9739 | 251.0001 | 252.0286 | 253.0594 | 254.0927 | 255.1283 | 256.1664 | 257.2069 | 258.2499 |
| 160    | 259.2954 | 260.3435 | 261.3941 | 262.4472 | 263.5030 | 264.5614 | 265.6225 | 266.6862 | 267.7526 | 268.8218 |
| 170    | 269.8937 | 270.9684 | 272.0459 | 273.1263 | 274.2095 | 275.2956 | 276.3845 | 277.4764 | 278.5713 | 279.6691 |
| 180    | 280.7700 | 281.8739 | 282.9808 | 284.0908 | 285.2039 | 286.3202 | 287.4396 | 288.5621 | 289.6879 | 290.8169 |
| 190    | 291.9491 | 293.0845 | 294.2233 | 295.3654 | 296.5108 | 297.6596 | 298.8117 | 299.9673 | 301.1263 | 302.2887 |
| 200    | 303.4546 | 304.6240 | 305.7969 | 306.9734 | 308.1535 | 309.3371 | 310.5244 | 311.7153 | 312.9098 | 314.1081 |
| 210    | 315.3092 | 316.5149 | 317.7243 | 318.9375 | 320.1544 | 321.3751 | 322.5996 | 323.8278 | 325.0598 | 326.2957 |
| 220    | 327.5353 | 328.7787 | 330.0260 | 331.2771 | 332.5320 | 333.7908 | 335.0534 | 336.3199 | 337.5903 | 338.8645 |
| 230    | 340.1426 | 341.4246 | 342.7105 | 344.0004 | 345.2941 | 346.5918 | 347.8934 | 349.1989 | 350.5084 | 351.8218 |
| 240    | 353.1400 | 354.4614 | 355.7867 | 357.1160 | 358.4493 | 359.7864 | 361.1275 | 362.4726 | 363.8215 | 365.1743 |
| 250    | 366.5310 | 367.8916 | 369.2561 | 370.6244 | 371.9966 | 373.3726 | 374.7525 | 376.1361 | 377.5236 | 378.9149 |
| 260    | 380.3100 |          |          |          |          |          |          |          |          |          |

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