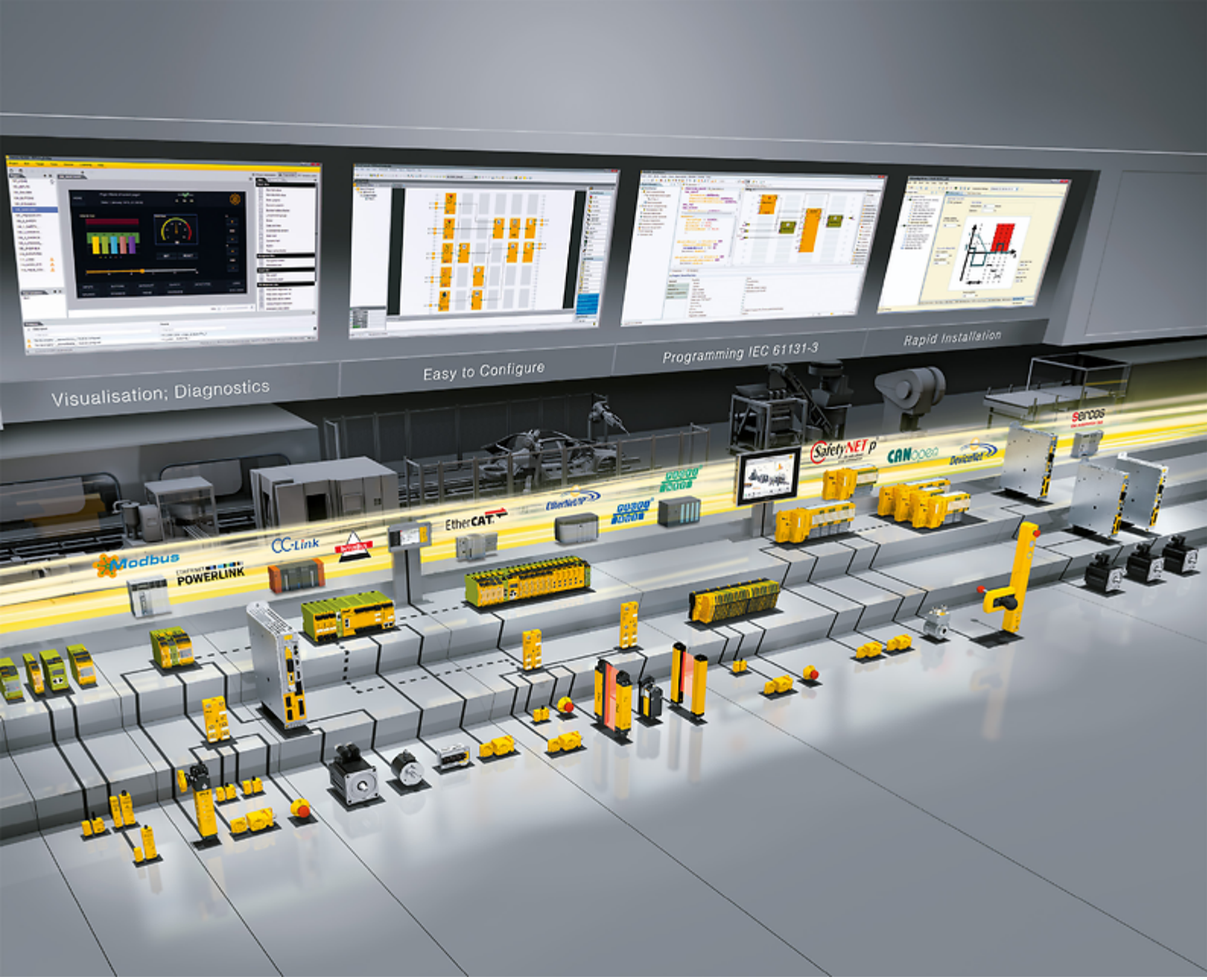


PSSu E S 2AI RTD(-T)

PILZ
THE SPIRIT OF SAFETY

- Decentralised system PSSuniversal I/O

Operating Manual-22017-EN-08

This document is the original document.

Where unavoidable, for reasons of readability, the masculine form has been selected when formulating this document. We do assure you that all persons are regarded without discrimination and on an equal basis.

1 Introduction

1.1 Validity of documentation

This documentation is valid for the products PSSu E S 2AI RTD and PSSu E S 2AI RTD-T. 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.

The module PSSu E S 2AI RTD-T is suitable for use where there are increased environmental requirements (see Technical Details).

1.1.1 Retaining the documentation

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

1.1.2 Terminology: System environment A and B

The PSSu system can be used in two different system environments. The module's application area is described in the chapter "Intended Use" of the manual.

The distinction is made between

- PSSu in system environment A
- PSSu in system environment B

The distinction is based on the application area of the PSSu system.

PSSu in system environment A may be used in the

- Decentralised system PSSu I/O
- **Not** in the automation system PSS 4000

PSSu in system environment B may be used in the

- Automation system PSS 4000, e.g. with
  - – Decentralised system PSSu I/O with SafetyNET p
  - – Control system PSSu PLC
  - – Control system PSSu multi

1.2 Definition of symbols

Information that is particularly important is identified as follows:

DANGER!

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

WARNING!

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

CAUTION!

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

NOTICE

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

INFORMATION

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

2 Overview

2.1 Module structure

A module consists of

- Electronic module and
- Base module with
  - Screw terminals or
  - Cage clamp terminals

The base modules are the carrier units for the electronic modules and are used to connect the field wiring. The electronic modules are inserted on to the base modules and determine the module's function.

Details of the base modules that can be used are available in the chapter entitled “Intended Use”.

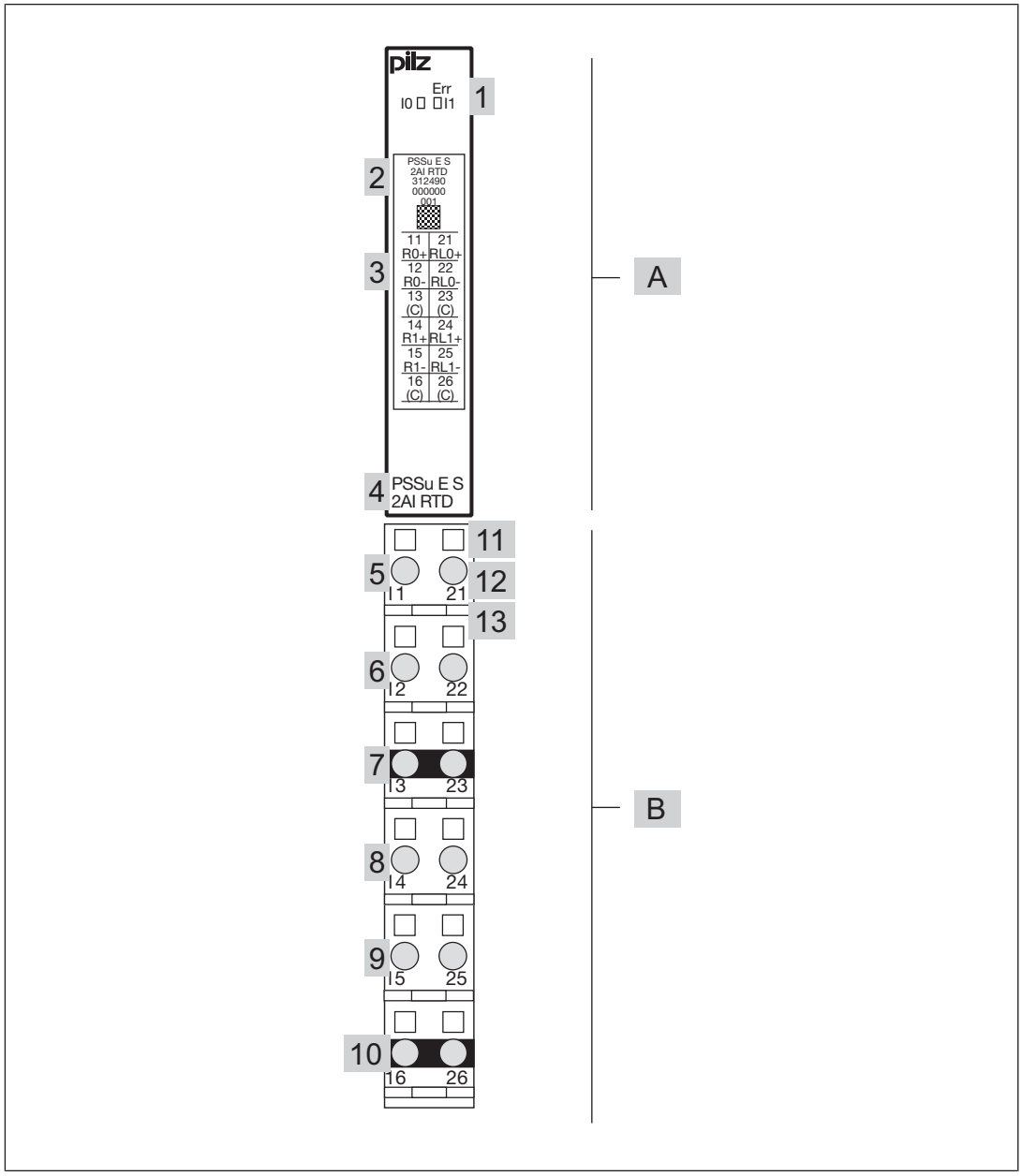
2.2 Module features

The product has the following features:

- Analogue ST inputs: 2
- Type of inputs: Resistance thermometer
- Corresponding sensors (configurable):
  - Pt100
  - Pt200
  - Pt500
  - Pt1000
  - Ni100
  - Ni120
  - Ni1000
- Resistance measurement (configurable):
  - 0 ... 4000 Ohm
- Max. resolution:
  - 0.0625 °C
  - 0.0625 Ohm
- Open circuit detection
- LEDs for:
  - Operating status per input
  - Module error
- For standard applications in system environment A and B
- T-type:

  PSSu E S 2AI RTD-T: for increased environmental requirements

2.3 Front view



Legend:

- A: Electronic module
- B: Base module
- 1: LED for module diagnostics
- 2: Labelling strip with:
  - Name of electronic module
  - Order number
  - Serial number
  - Hardware version number
  - 2D code

- 3: Labelling strip for the terminal configuration on the base module
- 4: Name of electronic module
- 5: Connection level 1
- 6: Connection level 2
- 7: Connection level 3
- 8: Connection level 4
- 9: Connection level 5
- 10: Connection level 6
- 11: Square mounting holes (connection levels 1, 2, 3 and 4)
  - With screw to loosen/tighten the screw terminal on base modules with screw terminals
  - With mechanism to operate the cage clamp on base modules with cage clamp terminals
- 12: Round connection holes (connection levels 1, 2, 3 and 4) for connecting the signal lines
- 13: Mounting slot for colour marker to label the connection level (connection levels 1, 2, 3 and 4)

3 Safety

3.1 Intended use

The module may be used for standard applications in system environment A and B.

The module provides analogue inputs. It may be used as an input module for standard functions.

The modules PSSu E S 2AI RTD and PSSu E S 2AI RTD-T can be used as non-safety-related components in accordance with the Lifts Directive 2014/33/EU. The modules meet the environmental requirements for passenger and goods lifts in accordance with EN 81-1/2, EN 81-20, EN 81-22 and EN 81-50, as well as the requirements for escalators and moving walks in accordance with EN 115-1.

The programmable safety system should be installed in a protected environment that meets at least the requirements of pollution degree 2. Example: Protected inside space or control cabinet with protection class IP54 and corresponding air conditioning.

The module PSSu E S 2AI RTD-T is suitable for use where there are increased environmental requirements (see Technical Details).

With reference to the standard IEC 61131-2 the values stated in the technical details for ambient temperature are reduced at heights >2000 m operating height above sea level (see Supplementary data).

Intended use includes making the electrical installation EMC-compliant. Please refer to the guidelines stated in the "PSSuniversal Installation Manual". The module 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 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.

INFORMATION

The module is supported by:

- PSSuniversal Configurator and PSSuniversal Assistant from Version 1.6.0
- PAS4000 from version 1.8.0
  - We recommend that you always use the latest version (download from www.pilz.de).

The PSSu E S 2AI RTD module may be used in conjunction with the following base modules:

- PSSu BP 1/12 S
- PSSu BP 1/12 C
- PSSu BP-C 1/12 S
- PSSu BP-C 1/12 C

The module PSSu E S 2AI RTD-T may be used in conjunction with the following base modules:

- PSSu BP 1/12 S-T
- PSSu BP 1/12 C-T
- PSSu BP-C 1/12 S-T
- PSSu BP-C 1/12 C-T

3.2 Safety regulations

3.2.1 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.

3.2.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if

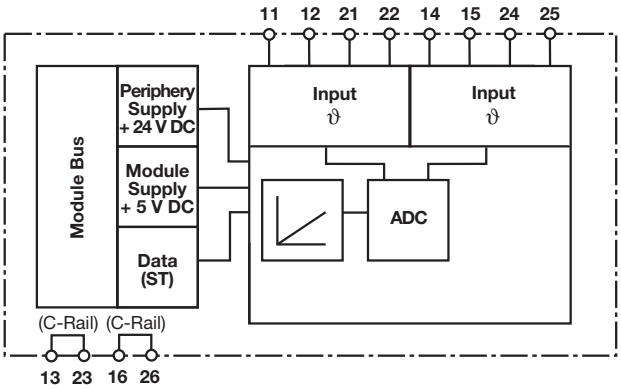
- The product was used contrary to the purpose for which it is intended,
- Damage can be attributed to not having followed the guidelines in the manual,
- Operating personnel are not suitably qualified,
- Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering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

3.2.3 Disposal

- In safety-related applications, please comply with the mission time T_M in the safety-related characteristic data.
- When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

4 Function description

4.1 Block diagram



4.2 Module features

4.2.1 Integrated protection mechanisms

When the PSSu E F PS1(-T) or PSSu E F PS2(-T)(-R) is used to supply the system, the module supply is buffered for 20 ms if the supply voltage is interrupted.

The module detects the following errors:

- Start-up error
- Configuration error
- ST communication error
- Bus termination error

4.2.2 Functions

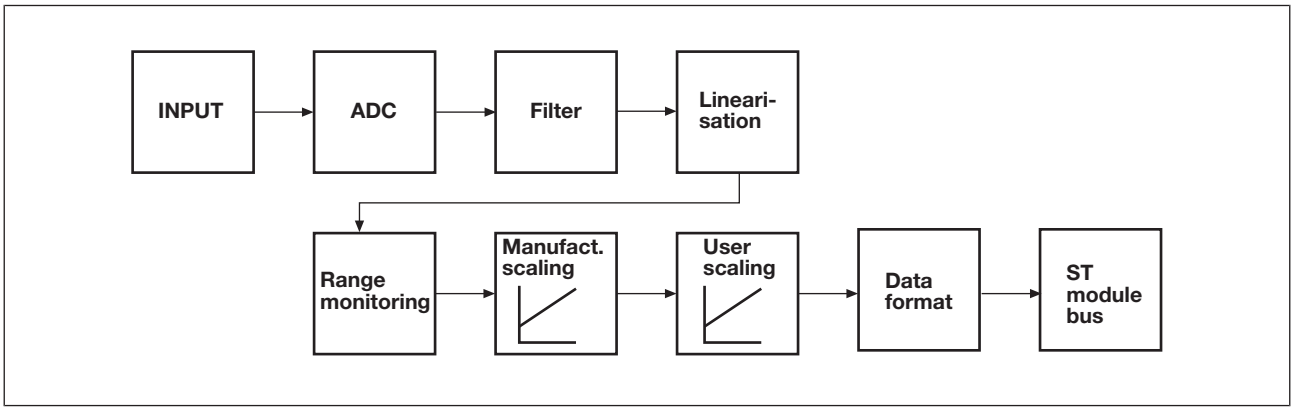
The module supply provides the module with voltage. The periphery supply provides the analogue section with voltage.

The input signals are read in and converted into digital signals. The resolution depends on the configured measuring range. Additional signal processing can be defined using the system software (see schematic representation of signal processing). The individual steps are described in the "Configuration" section.

The input signals are transmitted to the head module via the ST module bus. As an option the input module can send status information for each input.

All the configuration data is stored in the head module and is assigned to the input module on restart. This way the configuration data is retained even if you change the input module.

Schematic representation of signal processing:



4.3 Configuration

The following options exist for configuring the module in system environment A:

- Via a fieldbus without the modular device description file
  Without the modular device description file it is only possible to configure the input or output range. All other configuration details have default values.
- Via a fieldbus with the modular device description file
  With a modular device description file it is possible to configure all the values.
- Via the USB port of the head module, using the PSSuniversal Configurator
  All the values can be configured using the PSSuniversal Assistant. Any configuration via the USB port will overwrite the configuration made via the fieldbus.

If a module has been configured via the head module's USB port, it is locked and cannot be overwritten by the fieldbus. This lock can be deactivated again in the PSSuniversal Configurator.

The following options exist for configuring the module in system environment B:

- Via the head module's USB port with PAS4000.

4.3.1 Measuring ranges

The input measuring ranges may be configured per input:

- Pt100 (Default)
- Pt200
- Pt500
- Pt1000
- Ni100
- Ni120
- Ni1000
- 0 ... 4000 Ohm (resistance measurement)

The temperature ranges for these measuring ranges can be found in the technical details.

4.3.2 Connection type

The measuring circuits for the temperature measurements may be configured per input:

- 2-wire measurement
- 3-wire measurement (default)
- Connection for 4-wire sensor

The module will detect an open circuit on the measuring lines. Should an open circuit occur, the module will output 7FFF as the measured value. If resistance measurement is configured, the module will output FFFF in the case of an open circuit. With a 4-wire sensor connection, an open circuit on an individual measuring line will not be detected; consequently, the measurement result will be corrupted.

4.3.3 Range monitoring

You can deactivate range monitoring for each input. Range monitoring refers to the measuring range of the sensor which is configured for the input. This option is activated in the default configuration. The module writes the result of range monitoring as follows:

- System environment A:

  In the status byte (see PSSu assignment in system environment A [20])
- System environment B:

  in the I/O data element "Overrange" or "Underrange" (see PSSu assignment in system environment B [21])

The module behaves as follows, irrespective of the range monitoring configuration:

- If the value falls **below** the range, the temperature value stops. The temperature value corresponding to the lower limit of the measuring range is output.
- If the range is **exceeded**, the temperature value continues. The module extrapolates the temperature value linearly.

4.3.4 Offset for the 2-wire measurement

In the case of 2-wire measurement, the line resistance influences the measurement as a matter or principle, corrupting the result. The module allows you to take the value for the line resistance into account and to compensate for it when determining the temperature.

You can calculate the line resistance (feed and return line), measure it directly using a meter or define it via the module.

To use the module to define the measuring line resistance, follow the instructions below:

- Short out the temperature sensor. The short circuit should be as close as possible to the temperature sensor.
- Connect the PSSuniversal system to the system software.
- Call up the module configuration.
  - Deactivate "Manufacturer scaling" and "User scaling".
  - Select the resistance measurement ("0.0 ... 4000.0") under "Measuring range".
  - Select 2-wire measurement under "Connection type".
  - Enter zero under "2-wire measurement offset".

- Start the PSSuniversal system. Measurement of the line resistance will start.
  - The measurement will be more accurate if the line temperature is the same during measurement as it is during operation.
- In the system's PII (system environment A) or in the I/O data element "Data" (system environment B), the measurement value appears as a hexadecimal value. Convert this value into a decimal figure and note down the decimal value. This decimal value is the measuring line resistance in 1/16 Ohm.

To account for the line resistance within the configuration, follow the instructions below:

- Call up the module configuration in the system software.
- Enter the measuring line resistance (feed and return line) in 1/16 Ohm under "2-wire measurement offset".
  - When you have established the measuring line resistance using the module, re-select the required sensor under "Measuring range".

4.3.5 Digital filter

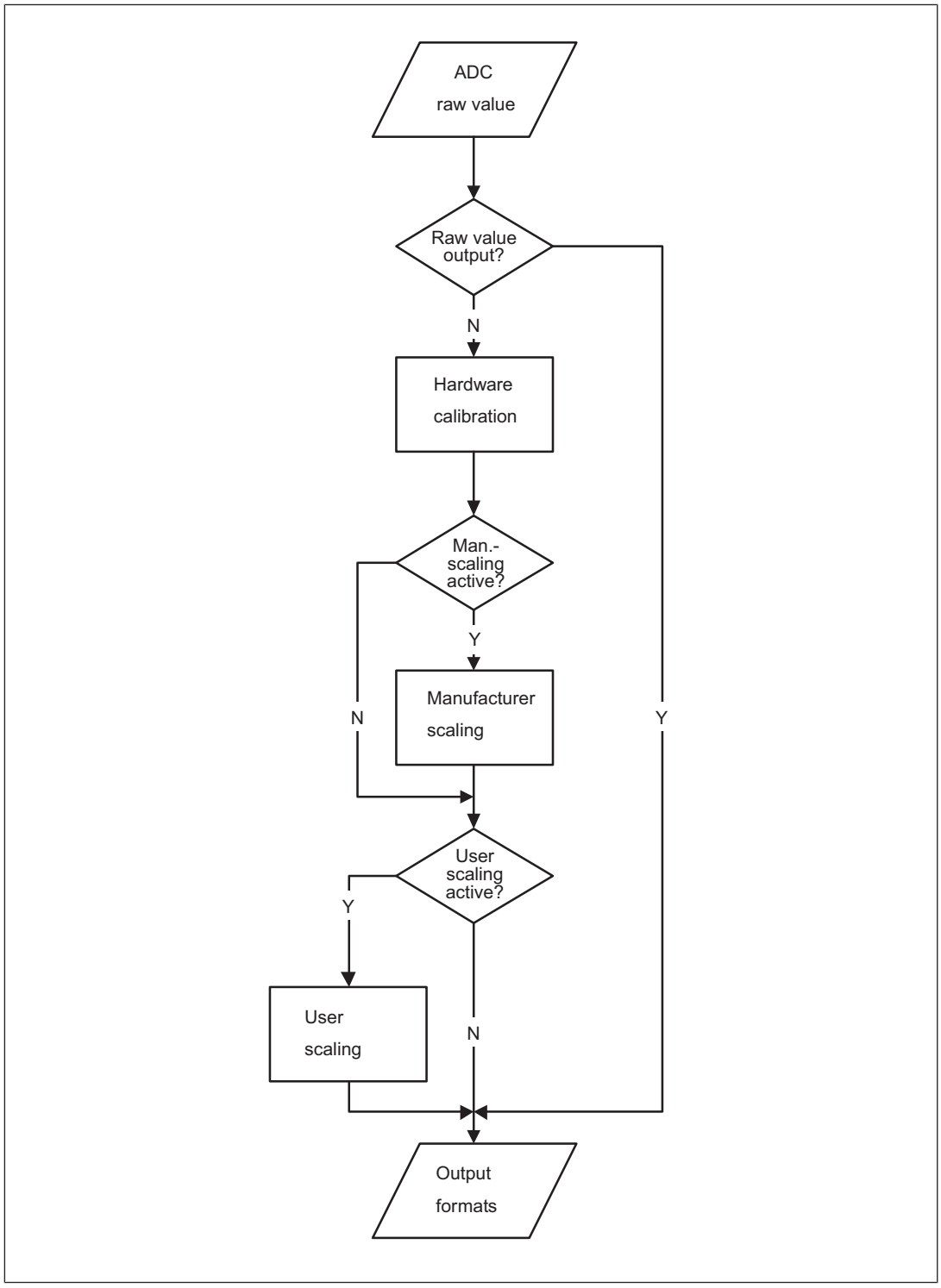
A digital filter suppresses interference frequencies in the input signals. The module's processing time will vary depending on the filter. With 3-wire measurement, or when a sensor with four wires is connected, the filter time is double that found with a 2-wire measurement. The module's processing time corresponds approximately to the sum of the filter times of both inputs.

You can select one of the following filters per input:

Filtered frequencies	Attenuation	Filter time per input 2-wire measurement	Filter time per input 3-wire measurement 4-wire sensor connection
60 Hz	90 dB	103 ms	206 ms
50 Hz	80 dB	122 ms	244 ms
50 Hz and 60 Hz	65 dB	122 ms	244 ms
50 Hz and 60 Hz	69 dB	202 ms	404 ms
50 Hz and 60 Hz	74 dB	482 ms	964 ms

4.3.6 Scaling

Scaling is a multi-stage process to adapt the values from the AD converter. The straight path in the diagram indicates the default configuration.



4.3.6.1 ADC raw value

You can configure each input so that the raw value from the AD converter is output directly, without calibration or scaling. The following configurations are possible:

- No raw value (default)

  The ADC value is calibrated, linearised (in the case of temperature output) and scaled if necessary.

- Raw value for sensor

  The raw value of the sensor is output.

- Raw value for wire

  The raw value from a feed wire is output in the case of 3-wire measurement or when a sensor with four wires is connected. In the case of 2-wire measurement, "0" is output.

If the AD converter fails to supply a valid value, the module will adopt the last valid value for this input instead.

4.3.6.2 Manufacturer scaling

Scaling is used to define the offset (zero point compensation) and gain (amplification) of the digital signal. Offset and gain are entered in the system software as decimal vaues. The relationship between the signal before manufacturer scaling (x), the signal after manufacturer scaling (y), offset (b_1) and gain (a_1) is a linear equation as follows:

$y = (a_1 / 256_D * x) + b_1$ or

$y = (a_1 / 100_H * x) + b_1$

The term $a_1 / 256_D$ corresponds to the amplification factor. With the stated amplification factor, a_1 is calculated as follows:
a_1 = Amplification factor * 256_D

Amplification by 5 % is therefore:
$1.05 * 256_D = 269_D$

Manufacturer scaling is activated in the default setting. The default value for offset is 0. The default value for gain is 160_D ($0A0_H$). That corresponds to an amplification factor of 10/16. The resolution is 1/10 K or 1/10 Ohm.

If the manufacturer scaling **and** the user scaling are deactivated, the resolution will be 1/16 K or 1/16 Ohm.

4.3.6.3 User scaling

User scaling is an additional scaling level applied after manufacturer scaling. You can use this scaling to correct local influences. The function is the same as that of manufacturer scaling:

- $y = (a_2 / 256_D * x) + b_2$ or
- $y = (a_2 / 100_H * x) + b_2$
- a_2 = Amplification factor * 256_D

User scaling is deactivated in the default setting. The default value for offset is 0. The default value for gain is 256_D (100_H). That corresponds to amplification factor 1.

If the manufacturer scaling **and** the user scaling are deactivated, the resolution will be 1/16 K or 1/16 Ohm.

4.3.6.4 Values that fall outside the range limits

If a value lies outside the range that can be displayed in the PII, the respective upper or lower range limit is output (see section entitled "Data formats")

4.3.7 Data formats

The way in which the analogue value is displayed depends on the measuring range, on scaling and on the data format. The following examples show the relationship between the values with default scaling.

You can configure the following data formats:

- Two's complement (default)
  The digital values are transferred with 16 bits.
- Sign and magnitude representation
  The digital values are transferred with 15 bits plus a sign bit (MSB). The MSB is "1" with negative values and "0" with positive values.

With negative values there is a distinction between sign and magnitude representation and two's complement representation. The values in the following tables apply with default scaling.

Analogue value and typical digital value with a measuring range of -100 °C ... +100 °C, two's complement:

Temperature	Decimal digital value	Binary digital value	Hexadecimal digital value
-100 °C	-1000	1111 1100 0001 1000	$FC18_H$
0 °C	0	0000 0000 0000 0000	0000_H
100 °C	1000	0000 0011 1110 1000	$03E8_H$

Analogue value and typical digital value with a measuring range of -100 °C ... +100 °C, sign and magnitude representation:

Temperature	Decimal digital value	Binary digital value	Hexadecimal digital value
-100 °C	-1000	1000 0011 1110 1000	$83E8_H$
0 °C	0	0000 0000 0000 0000	0000_H
100 °C	1000	0000 0011 1110 1000	$03E8_H$

With resistance measurement, data is always transmitted with 16 bits as positive values.

Analogue value and typical digital value with a measuring range of 0 Ohm ... 1000 Ohm:

Resistance	Decimal digital value	Binary digital value	Hexadecimal digital value
0 Ohm	0	0000 0000 0000 0000	0000_H
1000 Ohm	10000	0010 0111 0001 0000	2710_H

Range limits:

Measurement type	Lower range limit		Upper range limit
	Two's complement	Sign and magnitude representation	Two's complement/sign and magnitude representation
Temperature	8001_H	$FFFF_H$	$7FFF_H$
Resistance	0000_H	0000_H	$FFFF_H$

4.3.8 Summary and overview

The module has the following configuration options:

Configurable parameters	Configurable values		Default	Key
Measuring range	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000, 0 … 4000 Ohm		Pt100	
Connection type	2-wire measurement, 3-wire measurement, Connection for 4-wire sensor		3-wire measurement	
2-wire measurement offset	0 … 32767_D		0	Resolution in 1/16 Ohm
Manufacturer scaling	-		Activated/TRUE	
Manufacturer scaling offset	-32768 … 32767_D		0	
Manufacturer scaling gain	-32768 … 32767_D		160_D	Amplification factor 10/16
User scaling	-		Deactivated/ FALSE	
User scaling offset	-32768 … 32767_D		0	
User scaling gain	-32768 … 32767_D		256_D	Amplification factor 1
Filter characteristic	2-wire measurement: 103 ms/90 dB (60 Hz), 122 ms/80 dB (50 Hz), 122 ms/65 dB (50 Hz and 60 Hz), 202 ms/69 dB (50 Hz and 60 Hz), 482 ms/74 dB (50 Hz and 60 Hz)	3-wire measurement or 4-wire sensor connection: 206 ms/90 dB (60 Hz), 244 ms/80 dB (50 Hz), 244 ms/65 dB (50 Hz and 60 Hz), 404 ms/69 dB (50 Hz and 60 Hz), 964 ms/74 dB (50 Hz and 60 Hz)	404 ms/69 dB (50 Hz and 60 Hz)	With 2-wire measurement, 202 ms/69 dB (50 Hz and 60 Hz) is the default setting

Configurable parameters	Configurable values	Default	Key
Range monitoring	-	Activated/TRUE	
Sign and magnitude representation	-	Deactivated/ FALSE	Two's complement is activated
ADC raw value	No raw value, Raw value of sensor, Raw value of wire	No raw value	

4.3.9 PSSu assignment in system environment A

Each input occupies 16 consecutive bit addresses for the input data. Each input occupies an additional 8 consecutive bit addresses for the status byte, where this has been configured for the input. All the status bytes are displayed first in the PII, followed by the input data.

Configuration	Standard bus system	
	ST-PII	ST-PIO
Input data	32 Bit	- - -
Input data and status byte ("X")	48 Bit	- - -

Bit sequence in the PII, input data only, no status byte:

Input	PII	Assignment
Input I0	1	LSB input data
	...	...
	16	MSB input data
Input I1	17	LSB input data
	...	...
	32	MSB input data

Bit sequence in the PII, input data and status byte:

Input	PII	Assignment
Input I0	1	LSB status byte
	...	...
	8	MSB status byte
Input I1	9	LSB status byte
	...	...
	16	MSB status byte
Input I0	17	LSB input data
	...	...
	32	MSB input data

Input	PII	Assignment
Input I1	33	LSB input data
	...	...
	48	MSB input data

4.3.9.1 Status byte

ST modules for measuring temperature can transfer a variety of status information to the ST-PII (see table below for the conveyed status). The information is transmitted using the input's status byte. Read access (R) is configured for the input for that purpose.

Structure and contents of the status byte:

Bit number	Content	Meaning
0	0	Input value above or equal to the lower limit value
	1	Value below the lower limit value
1	0	Input value below or equal to the upper limit value
	1	Value above the upper limit value
2-5, 7	0	Reserved
	1	Reserved
6	0	No module error
	1	Module error

4.3.10 PSSu assignment in system environment B

Data access is via pre-defined I/O data types:

I/O data name	I/O data type	I/O data element	Meaning
I0(11, 21) I1(14, 24)	ST_I_THERMO	Data: WORD	Input data I0 ... I1
		Underrange: BOOL	0: Input value above or equal to the lower limit value 1: Value below the lower limit value
		Overrange: BOOL	0: Input value below or equal to the upper limit value 1: Value exceeds the upper limit value

5 Installation

5.1 General installation guidelines

Please refer also to the PSSuniversal Installation Manual.

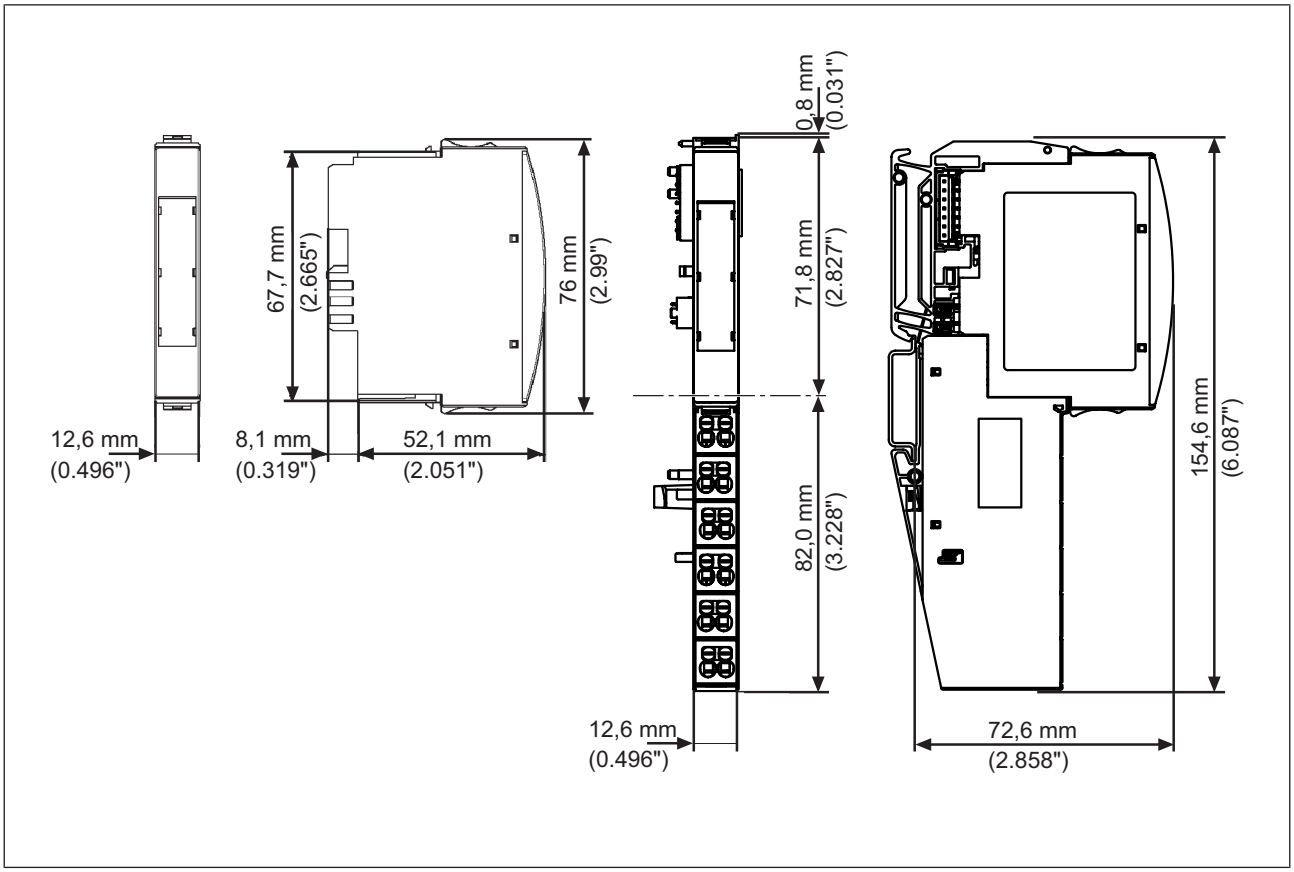
NOTICE

Damage due to electrostatic discharge!

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

5.1.1 Dimensions

Base modules with six connection levels:



5.2 Installing the base module

Prerequisite:

- The head module must be installed.
- If the head module does not have an integrated power supply, a supply voltage module must be installed to the right of the head module.

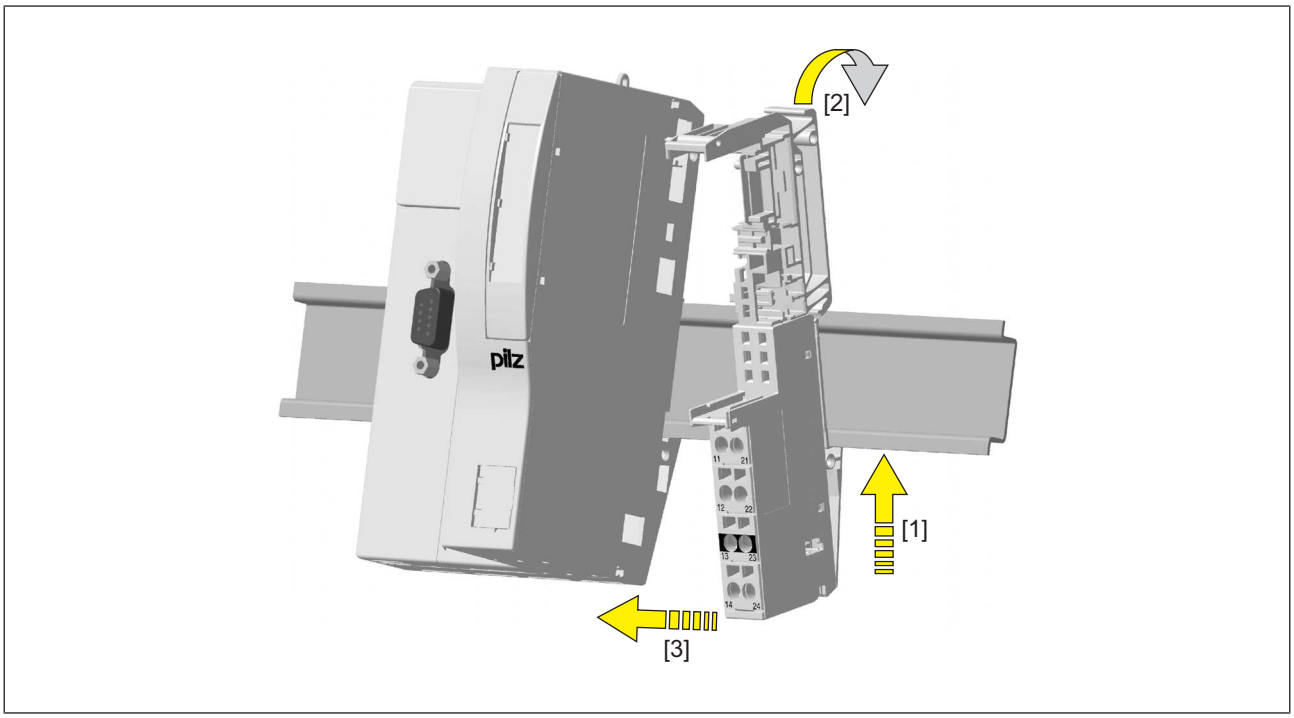
Please note:

- For mechanical reasons it is not possible to mix base modules with screw terminals and base modules with cage clamp terminals.
- All contacts should be protected from contamination.
- The mechanics of the base modules are designed for 50 plug in/out cycles.

Procedure:

- We recommend that you wire up the base modules before inserting the electronic modules.
- Slot the groove on the base module on to the mounting rail from below [1].
- Push the base module back [2] until you hear it lock into position.
- On the mounting rail, slide the base module to the left until you hear the two lateral mounting hooks on the adjacent module lock into position [3].

Schematic representation:



5.3 Inserting and removing an electronic module

Please note:

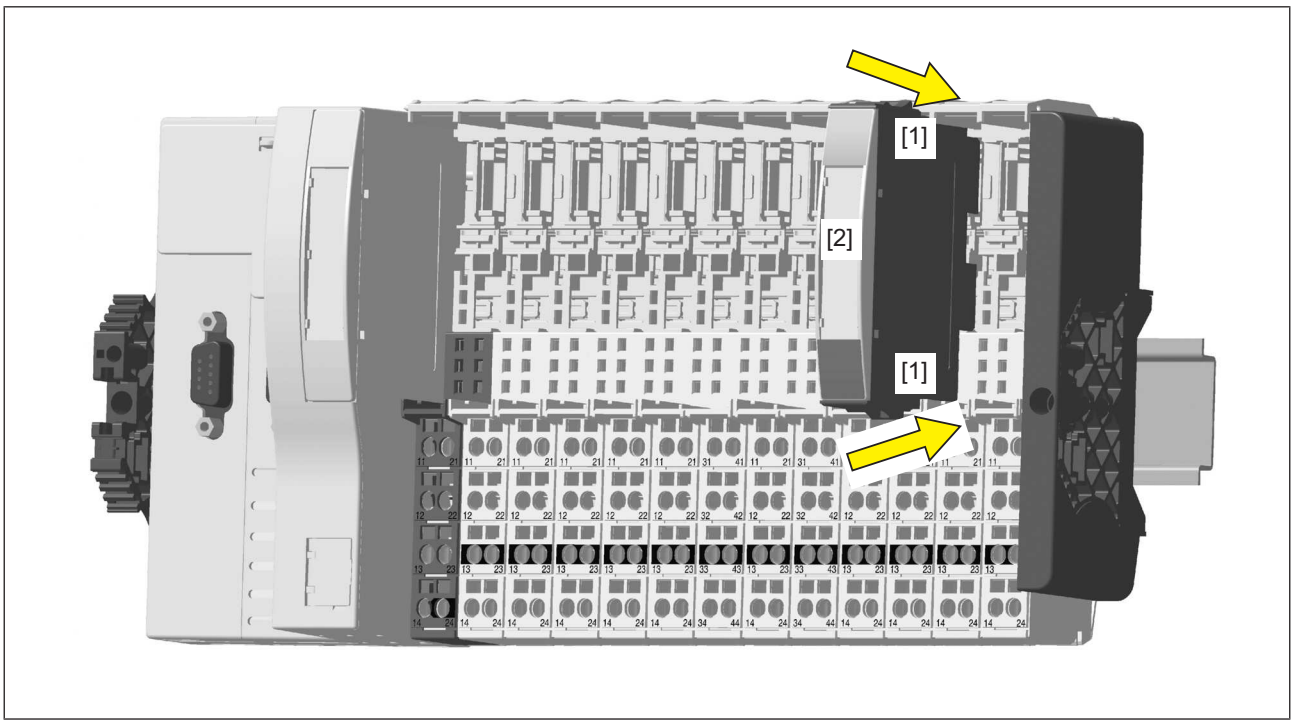
- Only insert on to base modules that are already installed.
- Preferably these base modules should be ready wired.
- Electronic modules with outputs may only be inserted and removed when the load is switched off. Unforeseeable error reactions may be triggered if modules are inserted and removed under load.
- When an electronic module is plugged into a base module for the first time, one part of the coding element remains on the electronic module, while its counterpart is fixed on to the base module. This is how the base module is coded.
- The mechanics of the electronic modules are designed for 50 plug in/out cycles.

5.3.1 Inserting an electronic module

Procedure:

- The electronic module must audibly lock into position [1].
- Mark the electronic module using the labelling strips [2].

Schematic representation:

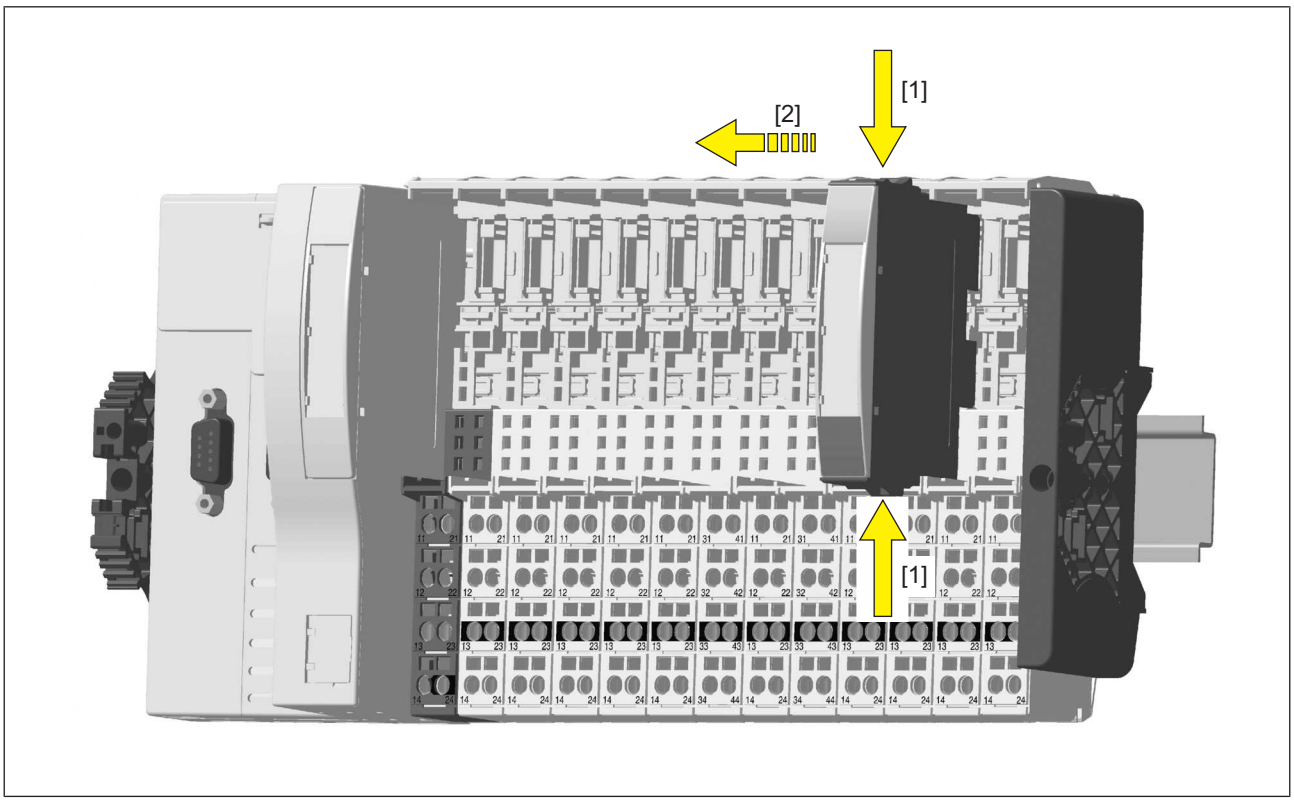


5.3.2 Removing an electronic module

Procedure:

- Press the locking mechanisms [1] together simultaneously.
- Pull out the electronic module [2].

Schematic representation:



5.3.3 Changing an electronic module during operation

It is possible to change an electronic module during operation. The configuration data is retained when a module is changed.

Effects:

- System environment A:
  - In the event of a potential FS communication error, the FS section of the PSSu system and all relevant I/O-Groups (SafetyBUS p) switch to a STOP condition.
- System environment B:
  - All FS hardware outputs on the PSSu system switch to a safe condition.
  - The substitute values are used for the modules' FS outputs, with Valid Bits = FALSE.

CAUTION!

Sparking can cause interference and errors!

Only change the module when the load is switched off!

6 Wiring

6.1 General wiring guidelines

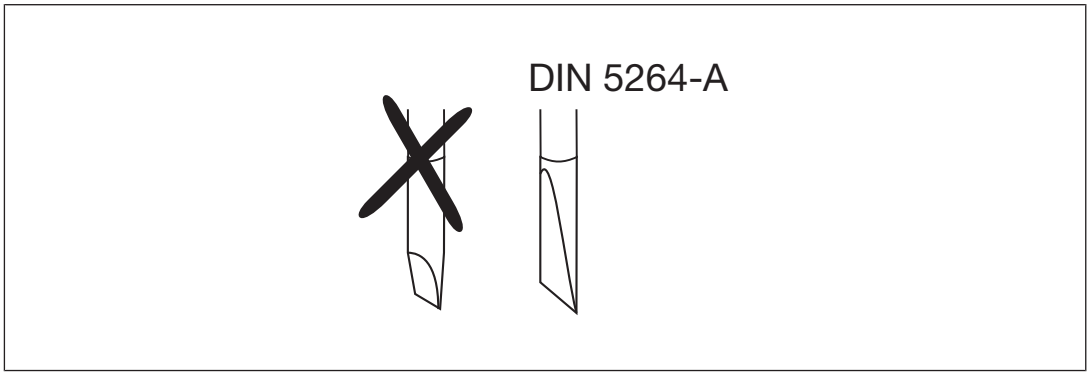
Please note:

- The supply voltages for actuators and sensors must be extra low voltages with protective electrical separation (PELV or SELV) in accordance with VDE 0100, Part 410. Failure to do so could result in electric shock.
- We recommend that you use shielded signal lines.
- On base modules with C-rail:
  - Connect the shield to the terminals on the C-rail.
  - Connect the C-rail with low impedance to the functional earth.
- On base modules without C-rail:
  - Connect the shield as shown in the terminal configuration section.
    The module connects the shield to the mounting rail.
  - Connect the mounting rail to the functional earth via an earthing terminal.
- In environments with strong EMC interference, base modules without a C-rail provide better protection if the shield is connected.
- Use copper wiring.
- The terminal configuration as stated on the front plate applies for base modules with C-rail. The terminal configuration as stated in the technical documentation applies for all other base modules.

6.1.1 Mechanical connection of the base modules

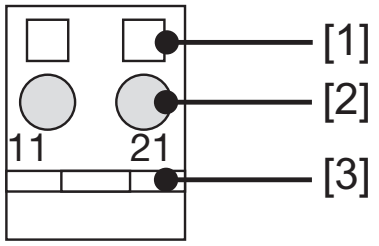
Procedure:

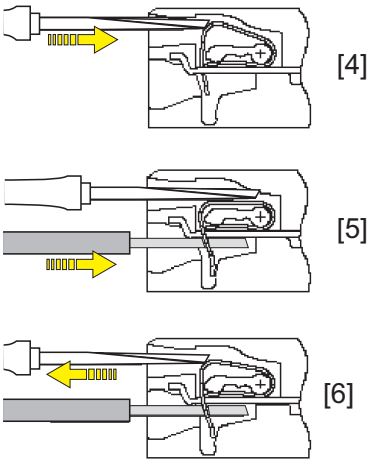
- Use a flat blade screwdriver (DIN 5264-A)!



- Strip the wire back 8 mm.
- If necessary, label the connection level with a colour marker [3].
- Base module with screw terminals:
  - Use a screwdriver to loosen the screw on the screw terminal [1]
  - Insert the stripped cable into the round fixing hole [2], as far as it will go.
  - Tighten up the screw on the screw terminal.
  - Check that the cable is firmly seated.

- Base module with cage clamp terminals:
  - Insert the screwdriver [4] into the square hole [1].
  - Insert the stripped cable into the round fixing hole [2], as far as it will go [5].
  - Pull out the screwdriver [6].
  - Check that the cable is firmly seated.



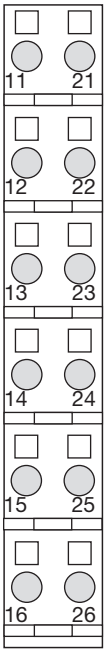


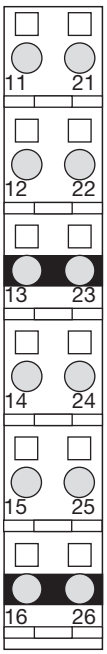
Please note:

- The minimum cable cross section for field connection terminals on the base modules is 0.14 mm² (AWG26).
- The maximum cable cross section for field connection terminals is:
  - Digital inputs: 1.5 mm² (AWG16)
  - Digital outputs: 2.0 mm² (AWG14)
  - Inputs/outputs on the counter modules: 1.5 mm² (AWG16)
  - Analogue inputs/outputs: 1.5 mm² (AWG16)
  - Communication cables: 1.5 mm² (AWG16)
  - Test pulse outputs: 1.5 mm² (AWG16)
  - Power supply: 2.5 mm² (AWG12)
  - Functional earth: 2.5 mm² (AWG12)

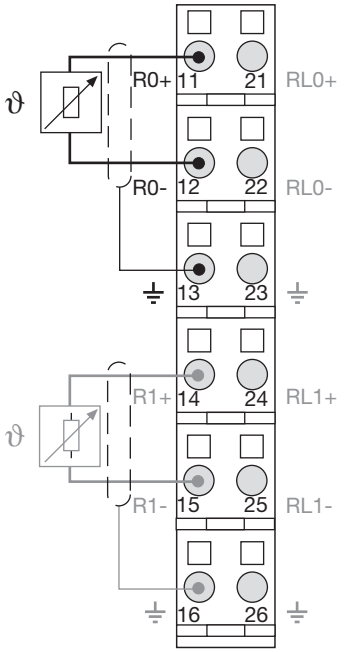
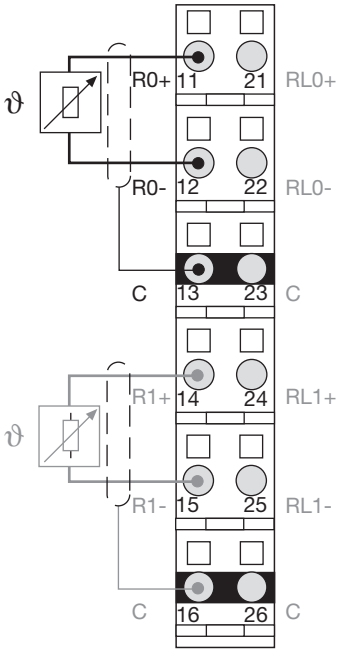
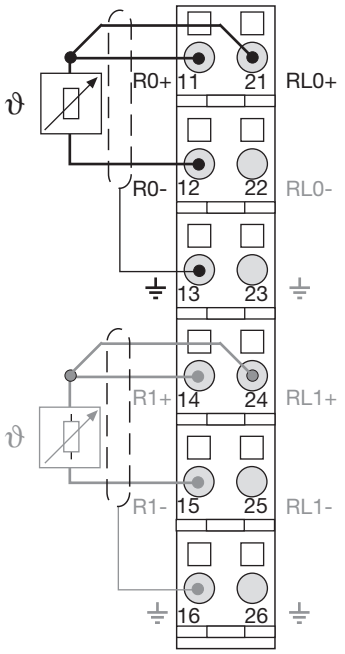
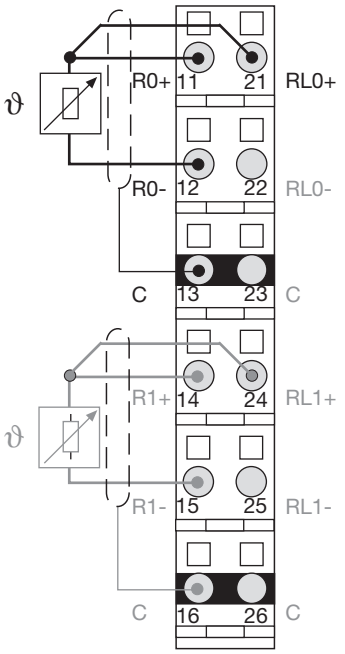
- On base modules with screw terminals:
  - If you use a multi-strand cable to connect the I/Os, it is recommended that you use ferrules conforming to Parts 1 and 2 of DIN 46228, 0.14 ... 1.5 mm², Form A or C, although this is not essential. To crimp the ferrules you can use crimp pliers (crimp form A or C) conforming to EN 60947-1, such as the PZ 1.5 or PZ 6.5 from Weidmüller, for example.
  - Maximum torque setting: 0.8 Nm
- Use copper wiring.

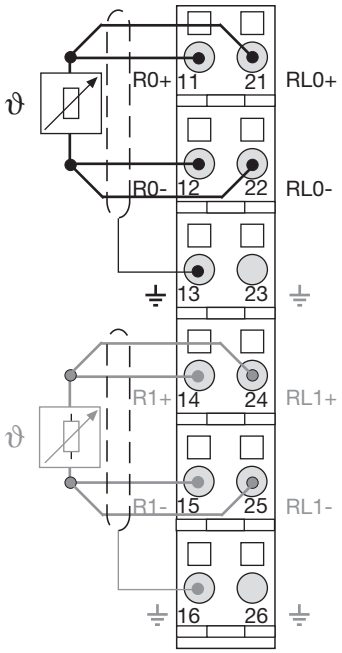
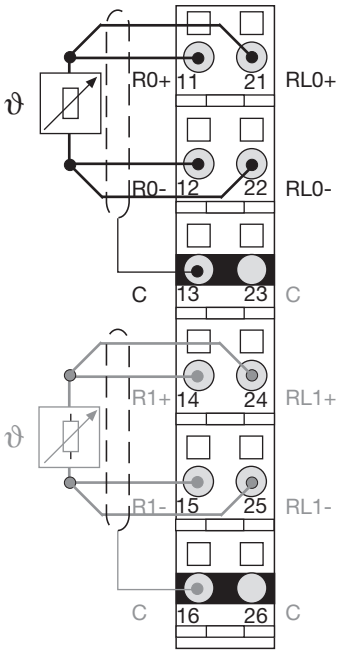
6.2 Terminal configuration

Base module	Terminal configuration	
Screw terminals: PSSu BP 1/12 S PSSu BP 1/12 S-T Cage clamp terminals: PSSu BP 1/12 C PSSu BP 1/12 C-T	Without C-rail: 11: Input R0+ 21: Input RL0+ 12: Input R0- 22: Input RL0- 13-23: Shield connection (13-23-16-26 linked within the base module) 14: Input R1+ 24: Input RL1+ 15: Input R1- 25: Input RL1- 16-26: Shield connection (13-23-16-26 linked within the base module)	

Base module	Terminal configuration	
Screw terminals: PSSu BP-C 1/12 S PSSu BP-C 1/12 S-T Cage clamp terminals: PSSu BP-C 1/12 C PSSu BP-C 1/12 C-T	With C-rail: 11: Input R0+ 21: Input RL0+ 12: Input R0- 22: Input RL0- 13-23: C-rail supply, shield connection (13-23-16-26 linked within the base module) 14: Input R1+ 24: Input RL1+ 15: Input R1- 25: Input RL1- 16-26: C-rail supply, shield connection (13-23-16-26 linked within the base module)	

6.3 Connecting the module

Input circuit	Without C-rail	With C-rail
2-wire measurement		
3-wire measurement		

Input circuit	Without C-rail	With C-rail
Connection for 4-wire sensor		

7 Operation

7.1 Messages

An error will be signalled to the head module and will be entered in the head module's error stack. A module error will also be displayed via the "Err" LED (see section entitled "Display elements").

The module can detect the following errors:

Errors	Explanation	Remedy
Start-up error	Error as the PSSu system starts up	Change faulty module.
Configuration error	Incorrect module type configured.	The configured hardware registry does not match the actual hardware registry.
ST communication error	Error during ST communication	Change faulty module.
Bus termination error	There is no terminating plate or there is a bad contact with the module bus.	Install a terminating plate with integrated end bracket or insert the base modules together correctly.

7.2 Display elements

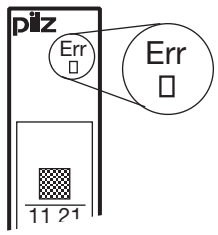
Legend

☼ LED on

● LED off

7.2.1 Display elements for module diagnostics

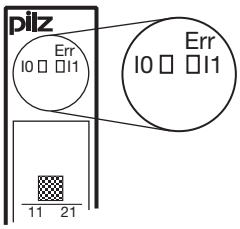
The module has an LED for displaying module errors ("Err" LED).



LED			Meaning
Designation	Colour	Status	
Err	- - -	●	No error
	Red	☼	Module is faulty

7.2.2 Displaying the input status

Each input is assigned an LED for displaying the input status (LEDs "I0" and "I1").



LED			Meaning		
Designation	Colour	Status	Signal	Input	Terminal
I0	- - -	●	No signal detected	I0 (Input 1)	11, 12 21, 22
	green	☼	Signal detected		
I1	- - -	●	No signal detected	I1 (Input 2)	14, 15, 24, 25
	green	☼	Signal detected		

8 Technical Details

General	312490	314490
Certifications	**CE, TÜV, UKCA, cULus Listed**	**CE, TÜV, UKCA, cULus Listed**
Application range	**Standard**	**Standard**
Module's device code	**0303h**	**0303h**
Number of ST input bits	**32**	**32**
Number of ST status bits	**16**	**16**
Application in system environment A		
From ST firmware version, other head modules	**14**	**14**
From ST firmware version PSSu H S PN	**2**	**2**
From ST firmware version PSSu WR S IDN	**6**	**6**
Application in system environment B		
From ST firmware version, head modules	**1.8.0**	**1.8.0**
Electrical data	**312490**	**314490**
Internal supply voltage (module supply)		
Module's power consumption	**0,63 W**	**0,63 W**
Periphery's supply voltage (periphery supply)		
Voltage range	**16,8 - 30 V**	**16,8 - 30 V**
Module's current consumption with no load	**15 mA**	**15 mA**
Module's power consumption with no load	**0,36 W**	**0,36 W**
Max. power dissipation of module	**1 W**	**1 W**
Analogue inputs	**312490**	**314490**
Number of analogue inputs	**2**	**2**
Type of analogue inputs	**Resistance thermometer**	**Resistance thermometer**
Input area	**Ni100, Ni1000, Ni120, Pt100, Pt1000, Pt200, Pt500, resistance**	**Ni100, Ni1000, Ni120, Pt100, Pt1000, Pt200, Pt500, resistance**
Input area		
Platinum sensors in accordance with the standard	**DIN EN 60751**	**DIN EN 60751**
Nickel sensors in accordance with the standard	**DIN 43760**	**DIN 43760**

Analogue inputs	312490	314490
Measuring ranges		
Type	**Pt100**	**Pt100**
Measuring range	**-200 - 850 °C**	**-200 - 850 °C**
Type	**Pt200**	**Pt200**
Measuring range	**-200 - 850 °C**	**-200 - 850 °C**
Type	**Pt500**	**Pt500**
Measuring range	**-200 - 850 °C**	**-200 - 850 °C**
Type	**Pt1000**	**Pt1000**
Measuring range	**-200 - 850 °C**	**-200 - 850 °C**
Type	**Ni100**	**Ni100**
Measuring range	**-60 - 250 °C**	**-60 - 250 °C**
Type	**Ni120**	**Ni120**
Measuring range	**-60 - 250 °C**	**-60 - 250 °C**
Type	**Ni1000**	**Ni1000**
Measuring range	**-60 - 250 °C**	**-60 - 250 °C**
Type	**Resistance**	**Resistance**
Measuring range	**0 - 4000 Ohm**	**0 - 4000 Ohm**
Input filter	**Digital filter**	**Digital filter**
Filter time per input (2-wire measurement) with attenuation		
Attenuation	**90 dB (60 Hz)**	**90 dB (60 Hz)**
Filter time	**103 ms**	**103 ms**
Attenuation	**80 dB (50 Hz)**	**80 dB (50 Hz)**
Filter time	**122 ms**	**122 ms**
Attenuation	**65 dB (50 Hz, 60 Hz)**	**65 dB (50 Hz, 60 Hz)**
Filter time	**122 ms**	**122 ms**
Attenuation	**69 dB (50 Hz, 60 Hz)**	**69 dB (50 Hz, 60 Hz)**
Filter time	**202 ms**	**202 ms**
Attenuation	**74 dB (50 Hz, 60 Hz)**	**74 dB (50 Hz, 60 Hz)**
Filter time	**482 ms**	**482 ms**
Voltage measurement		
Input resistance	**100 MOhm**	**100 MOhm**
Max. continuous voltage	**5 V**	**5 V**
Temperature measurement		
Value of least significant bit (LSB)	**0,0625 K**	**0,0625 K**
Resistance measurement		
Value of least significant bit (LSB)	**0,0625 Ohm**	**0,0625 Ohm**
Typ. conversion time per input	**404 ms**	**404 ms**
Max. measuring current	**500 µA**	**500 µA**
Deviations from the measuring range limit value		
Output variable error at 25 °C	**0,3 %**	**0,3 %**
Temperature coefficient	**0,004 %/K**	**0,004 %/K**
Conversion method	**Delta sigma**	**Delta sigma**

Analogue inputs	312490	314490
Potential isolation between input and periphery supply	yes	yes
Typ. processing time of the analogue input	808 ms	808 ms
Inputs	**312490**	**314490**
Potential isolation between input and internal module bus voltage	yes	yes
Environmental data	**312490**	**314490**
Climatic suitability	EN 60068-2-1, EN 60068-2-14, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78	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	EN 60068-2-14
Temperature range	0 - 60 °C	-40 - 70 °C
Storage temperature		
In accordance with the standard	EN 60068-2-1/-2	EN 60068-2-1/-2
Temperature range	-25 - 70 °C	-40 - 70 °C
Climatic suitability		
In accordance with the standard	EN 60068-2-30, EN 60068-2-78	EN 60068-2-30, EN 60068-2-78
Humidity	93 % r. h. at 40 °C	93 % r. h. at 40 °C
Condensation during operation	Not permitted	Short-term
Max. operating height above sea level	2000 m	5000 m
Max. operating height above sea level in accordance with EN 81-1, EN 81-2 and EN 115-1	2000 m	2000 m
EMC	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61131-2	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61131-2
Vibration		
In accordance with the standard	EN 60068-2-6	EN 60068-2-6
Frequency	10 - 150 Hz	10 - 1000 Hz
Acceleration	1g	5g
Shock stress		
In accordance with the standard	EN 60068-2-27	EN 60068-2-27
Number of shocks	6	6
Acceleration	15g	15g
Duration	11 ms	11 ms
In accordance with the standard	EN 60068-2-27	EN 60068-2-27
Number of shocks	1000	1000
Acceleration	10g	25g
Duration	16 ms	6 ms
Airgap creepage		
In accordance with the standard	EN 60664-1, EN 61131-2	EN 60664-1, EN 61131-2
Overvoltage category	II	II
Pollution degree	2	2

Environmental data	312490	314490
Protection type		
In accordance with the standard	**EN 60529**	**EN 60529**
Housing	**IP20**	**IP20**
Mounting area (e.g. control cabinet)	**IP54**	**IP54**
Mechanical data	**312490**	**314490**
Material		
Bottom	**PC**	**PC**
Front	**PC**	**PC**
Coding	**PA**	**PA**
Dimensions		
Height	**76 mm**	**76 mm**
Width	**12,6 mm**	**12,6 mm**
Depth	**60,2 mm**	**60,2 mm**
Weight	**35 g**	**34 g**
Mechanical coding		
Type	**G**	**G**
Colour	**Dark grey**	**Dark grey**

Where standards are undated, the 2008-06 latest editions shall apply.

9 Supplementary data

9.1 Permitted operating height

The values stated in the technical details apply to the use of the device in operating heights up to max. 2000 m above SL. When used at higher levels, restrictions of the ambient temperature (standard IEC 61131-2) must be taken into account.

Operating height above SL [m]	Multiplication factors for the devices' ambient temperature
0 … 2000	1.0
3000	0.9
4000	0.8
5000	0.7

10 Order reference

10.1 Product

Product type	Features	Order no.
PSSu E S 2AI RTD	Electronic module, base type	312490
PSSu E S 2AI RTD-T	Electronic module, T-type	314490

10.2 Accessories

Base modules

Product type	Features	Order no.
PSSu BP 1/12 S	Base module without C-rail with screw terminals	312618
PSSu BP 1/12 S-T	Base module without C-rail with screw terminals, T-type	314618
PSSu BP 1/12 C	Base module without C-rail with cage clamp terminals	312619
PSSu BP 1/12 C-T	Base module without C-rail with cage clamp terminals, T-type	314619
PSSu BP-C 1/12 S	Base module with C-rail and screw terminals	312620
PSSu BP-C 1/12 S-T	Base module with C-rail and screw terminals, T-type	314620
PSSu BP-C 2/12 C	Base module with C-rail and cage clamp terminals	312621
PSSu BP-C 2/12 C-T	Base module with C-rail and cage clamp terminals, T-type	314621

Support

Technical support is available from Pilz round the clock.

Americas
Brazil
+55 11 97569-2804
Canada
+1 888 315 7459
Mexico
+52 55 5572 1300
USA (toll-free)
+1 877-PILZUSA (745-9872)

Asia
China
+86 21 60880878-216
Japan
+81 45 471-2281
South Korea
+82 31 778 3300

Australia and Oceania
Australia
+61 3 95600621
New Zealand
+64 9 6345350

Europe
Austria
+43 1 7986263-0
Belgium, Luxembourg
+32 9 3217570
France
+33 3 88104003
Germany
+49 711 3409-444
Ireland
+353 21 4804983
Italy, Malta
+39 0362 1826711
Scandinavia
+45 74436332
Spain
+34 938497433
Switzerland
+41 62 88979-32
The Netherlands
+31 347 320477
Turkey
+90 216 5775552
United Kingdom
+44 1536 462203

You can reach our international hotline on:
+49 711 3409-222
support@pilz.com

Pilz develops environmentally-friendly products using ecological materials and energy-saving technologies. Offices and production facilities are ecologically designed, environmentally-aware and energy-saving. So Pilz offers sustainability, plus the security of using energy-efficient products and environmentally-friendly solutions.

BLUEcoMPETENCE Alliance Member
Partner of the Engineering Industry Sustainability Initiative

BRANDS OF THE CENTURY PILZ 2019 GERMAN STANDARDS

Quality Management ISO 9001:2015 REG. NO. 2462
Environmental Management ISO 14001 REG. NO. 2462
Energy Management ISO 50001 REG. NO. 2462

22017-EN-08 , 2022-12 Printed in Germany

We are represented internationally. Please refer to our homepage www.pilz.com for further details or contact our headquarters.

Headquarters: Pilz GmbH & Co. KG, Felix-Wankel-Straße 2, 73760 Ostfildern, Germany
Telephone: +49 711 3409-0, Telefax: +49 711 3409-133, E-Mail: info@pilz.com, Internet: www.pilz.com

PILZ
THE SPIRIT OF SAFETY