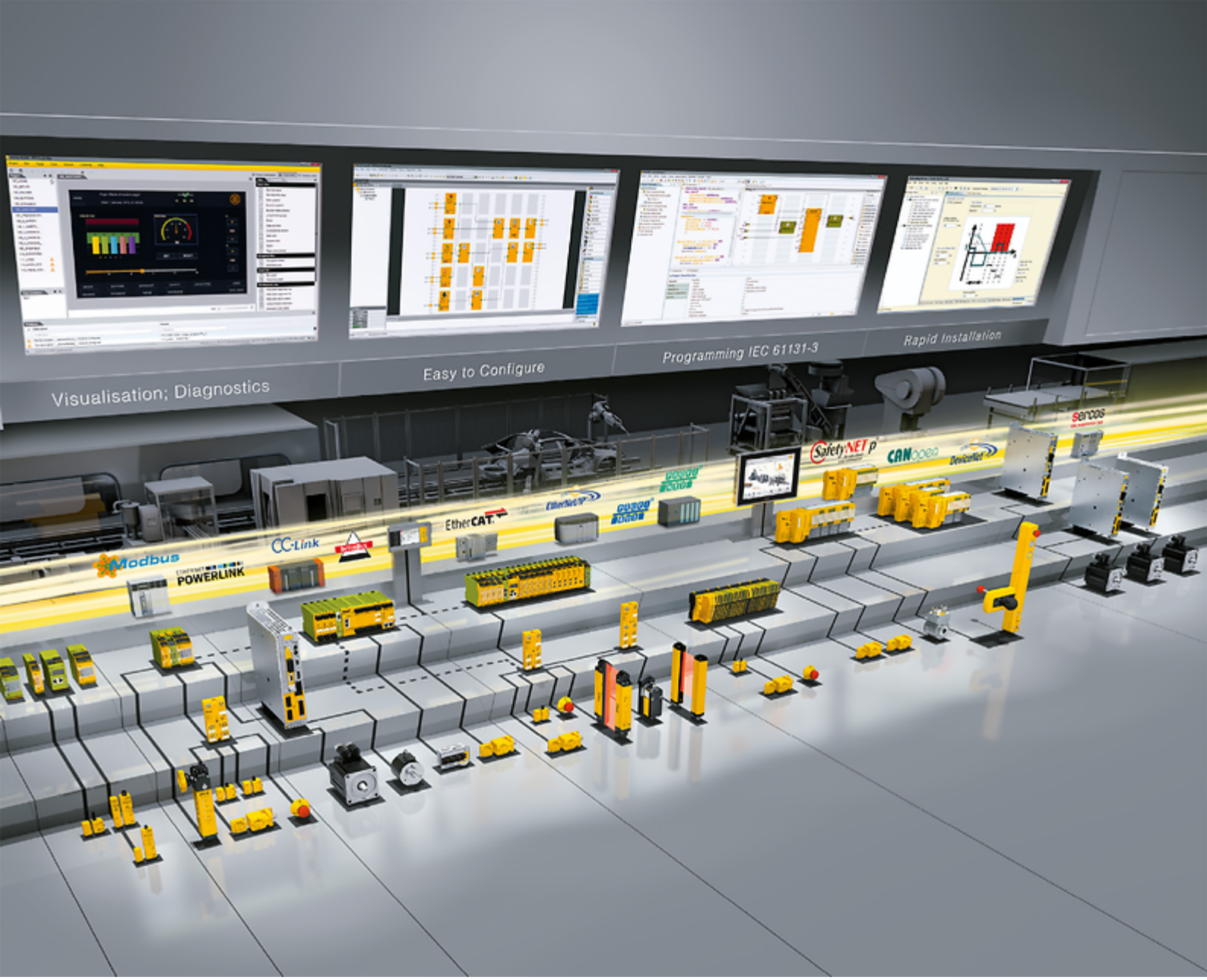


PSSu E S 2AI U(-T)

PILZ
THE SPIRIT OF SAFETY

- Decentralised system PSSuniversal I/O

Operating Manual-21405-EN-05

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**	**5**
1.1	Validity of documentation	5
1.1.1	Retaining the documentation	5
1.1.2	Terminology: System environment A and B	5
1.2	Definition of symbols	6
2	**Overview**	**7**
2.1	Module structure	7
2.2	Module features	7
2.3	Front view	8
3	**Safety**	**10**
3.1	Intended use	10
3.2	Safety regulations	11
3.2.1	Use of qualified personnel	11
3.2.2	Warranty and liability	11
3.2.3	Disposal	11
4	**Function description**	**12**
4.1	Block diagram	12
4.2	Module features	12
4.2.1	Functions	12
4.2.2	Integrated protection mechanisms	13
4.3	Configuration	13
4.3.1	Voltage range	13
4.3.2	Digital filter	14
4.3.3	Scaling	15
4.3.3.1	ADC raw value and initialisation value	16
4.3.3.2	Hardware calibration	16
4.3.3.3	Manufacturer scaling	16
4.3.3.4	User scaling	18
4.3.3.5	Example calculation	18
4.3.4	Limit values	19
4.3.5	Data formats	20
4.3.6	Addresses in the process image	21
4.3.7	Summary and overview	22
4.3.8	PSSu assignment in system environment A	23
4.3.8.1	Addresses in the process image	23
4.3.8.2	Status byte	24
4.3.9	PSSu assignment in system environment B	25
5	**Installation**	**26**
5.1	General installation guidelines	26
5.1.1	Dimensions	26
5.2	Installing the base module	27
5.3	Inserting and removing an electronic module	28
5.3.1	Inserting an electronic module	29
5.3.2	Removing an electronic module	30

5.3.3 Changing an electronic module during operation 30

6 Wiring 31
6.1 General wiring guidelines 31
6.1.1 Mechanical connection of the base modules 31
6.2 Terminal configuration 33
6.3 Connecting the module 35

7 Operation 36
7.1 Messages 36
7.2 Display elements 36
7.2.1 Display elements for module diagnostics 36
7.2.2 Display elements for input status 37

8 Technical details 38

9 Supplementary data 41
9.1 Permitted operating height 41

10 Order reference 42
10.1 Product 42
10.2 Accessories 42

1 Introduction

1.1 Validity of documentation

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

Electronic module with analogue inputs for standard applications

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”.

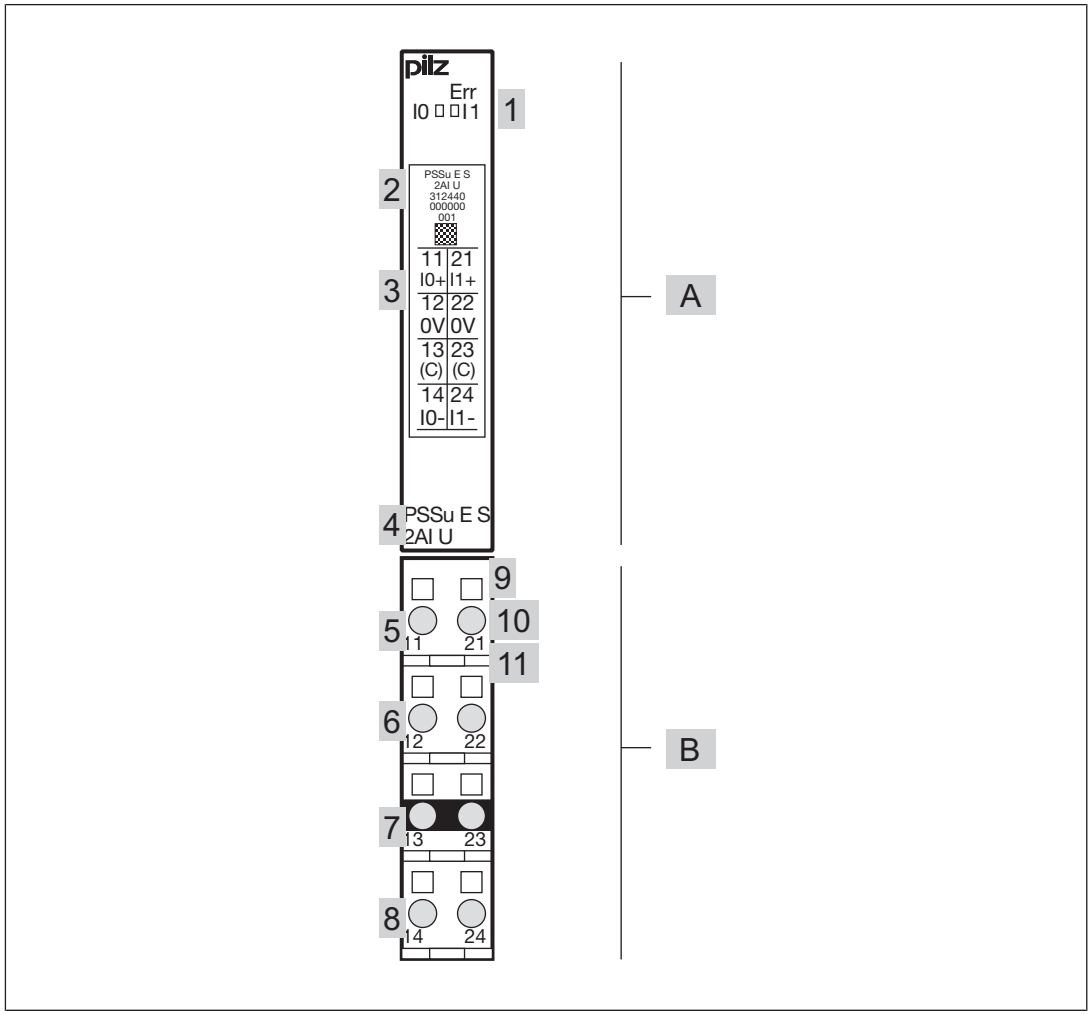
2.2 Module features

The product has the following features:

- 2 Analogue voltage inputs
- Configurable voltage ranges:
  - 0 ... +10 V single-pole, referenced to earth (single-ended)
  - 0 ... +10 V dual-pole, differential input
  - -10 V ... +10 V dual-pole, differential input
- Resolution: 12 bit plus sign bit
- LEDs for:
  - Operating status per input
  - Module error
- For standard applications in system environment A and B
- T-type:

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

2.3 Front view



Legend:

- A: Electronic module
- B: Base module
- 1: LEDs for
  - Module diagnostics
  - Status indicator
- 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: 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
- 10: Round connection holes (connection levels 1, 2, 3 and 4) for connecting the signal lines
- 11: 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 U and PSSu E S 2AI U-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 U-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 1.4.0
- PAS4000 from Version 1.0.0
  - We recommend that you always use the latest version (download from www.pilz.com).

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

- PSSu BP 1/8 S
- PSSu BP 1/8 C
- PSSu BP 1/12 S
- PSSu BP 1/12 C
- PSSu BP-C 1/8 S
- PSSu BP-C 1/8 C

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

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

- PSSu BP 1/8 S-T
- PSSu BP 1/8 C-T
- PSSu BP 1/12 S-T
- PSSu BP 1/12 C-T
- PSSu BP-C 1/8 S-T
- PSSu BP-C 1/8 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

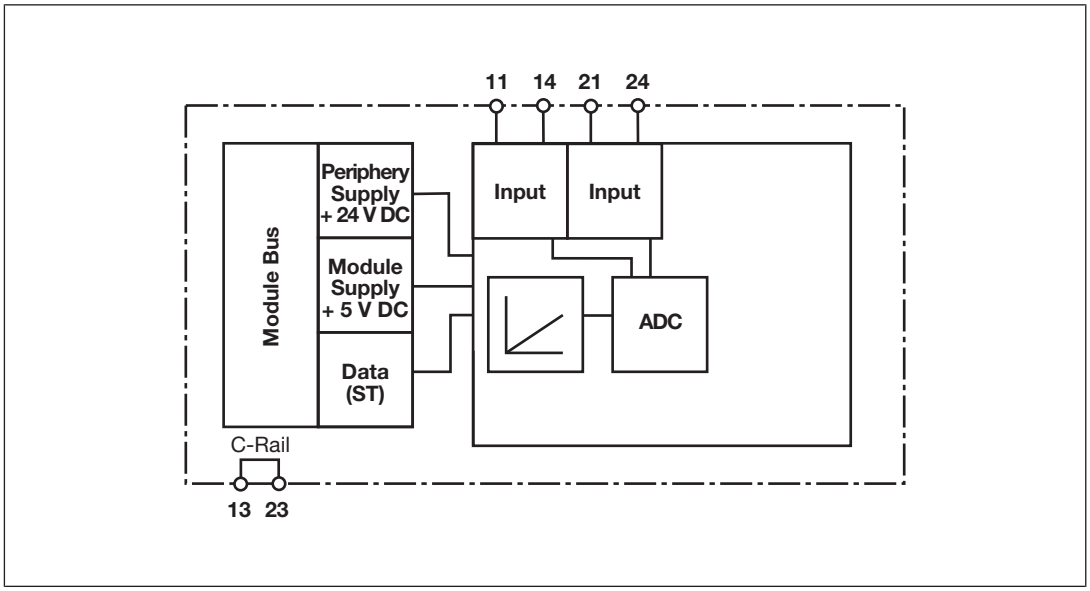
- The product was used contrary to the purpose for which it is intended,
- Damage can be attributed to not having followed the guidelines in the manual,
- Operating personnel are not suitably qualified,
- Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering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

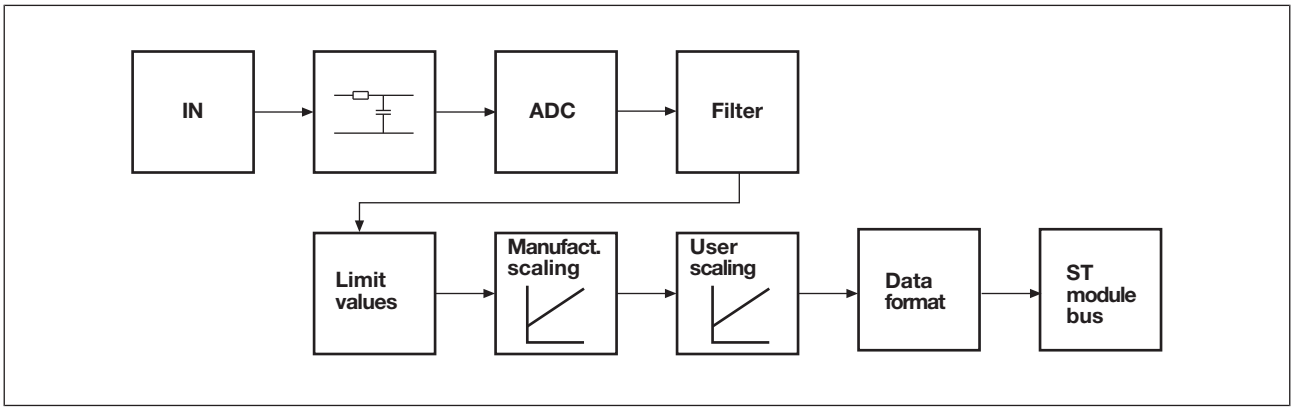
The module supply provides the module with voltage.

The input signals are read in, analogue prefiltered and converted into digital signals. The resolution is 12 bits (4095 steps) and is converted into a 16 Bit value. 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:



4.2.2 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

4.3 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 Voltage range

You can configure the following voltage ranges per module:

- 0 ... +10 V single-pole, referenced to earth (single-ended)
- 0 ... +10 V dual-pole, differential input
- -10 V ... +10 V dual-pole, differential input

INFORMATION

The inputs on the module are connected differently for single-pole and dual-pole operation.

Please refer to the section entitled "Wiring" for details.

4.3.2 Digital filter

A digital filter can suppress spurious frequencies in the input signals.

- FIR filters specifically suppress certain spurious frequencies (notch mode). In this way, for example, the residual ripple from the power supply can be filtered out of the input signal.
- IIR filters suppress all frequencies above a cutoff frequency (low pass mode). This means that short-term fluctuations can be filtered out of the input signal.

You can select one of the following filters per module:

- 2nd order FIR filter
- IIR filter, cutoff frequency 1 kHz
- IIR filter, cutoff frequency 100 Hz
- IIR filter, cutoff frequency 50 Hz
- IIR filter, cutoff frequency 20 Hz
- IIR filter, cutoff frequency 10 Hz
- IIR filter, cutoff frequency 5 Hz
- IIR filter, cutoff frequency 1 Hz
- FIR filter, notch frequency 50 Hz
- FIR filter, notch frequency 60 Hz

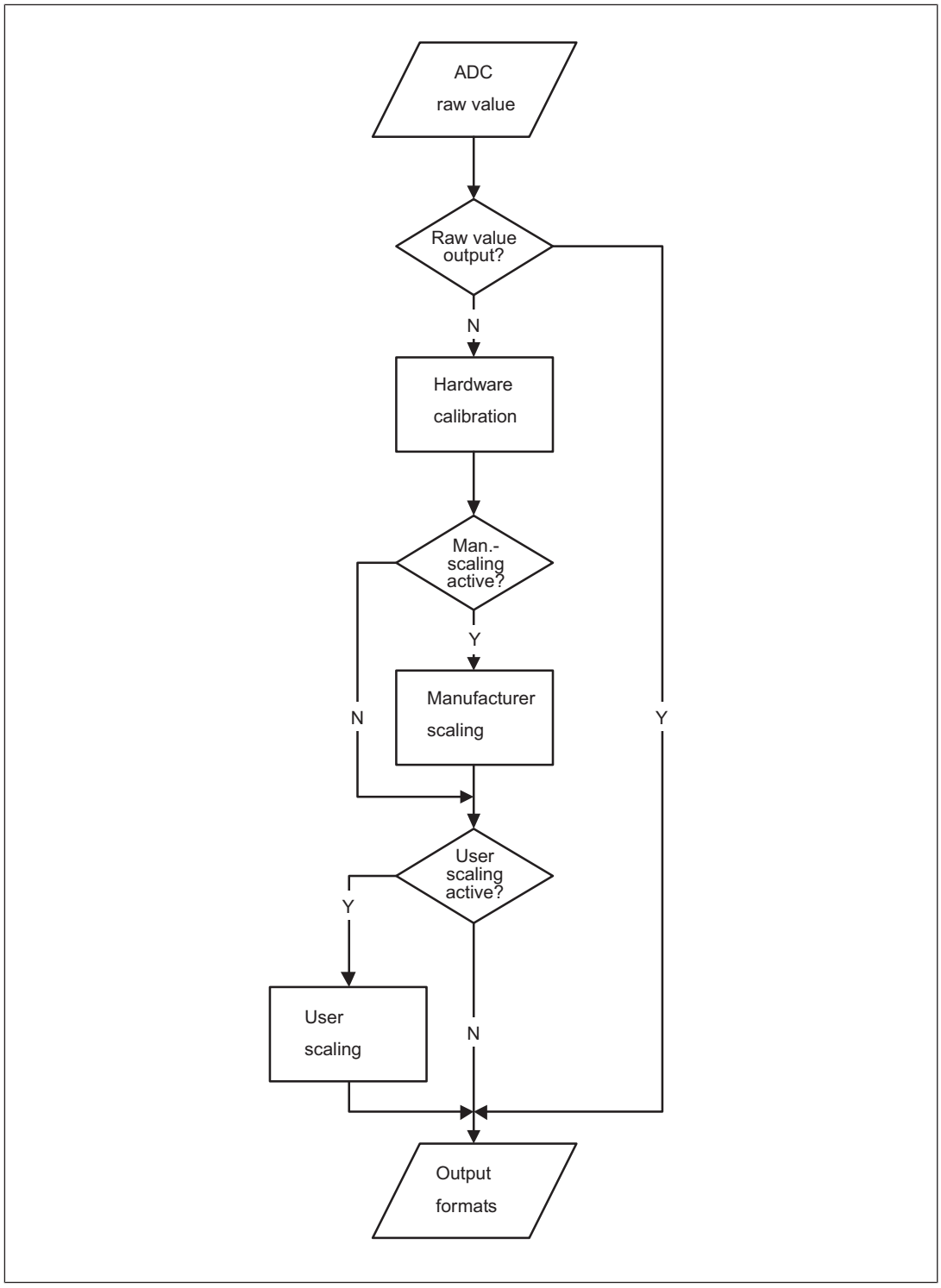
The filter is deactivated as the default value.

INFORMATION

A filter needs time to make the calculation and this increases the module's processing time.

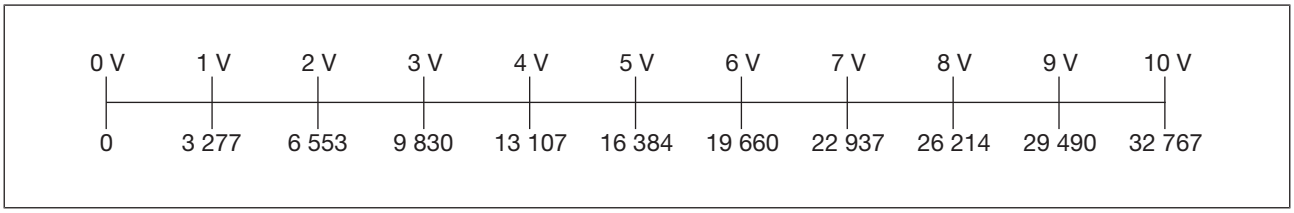
4.3.3 Scaling

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



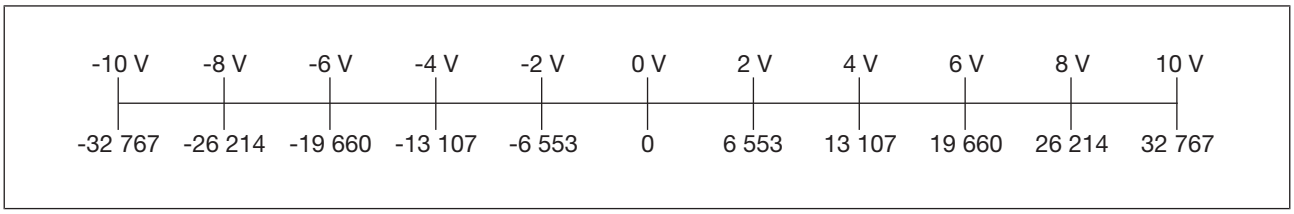
Analogue value and typical digital value with a voltage range of 0 ... +10 V and default values:

Analogue value of voltage	Decimal digital value
0 V	0
5 V	16 384
10 V	32 767



Analogue value and typical digital value with a voltage range of -10 V ... +10 V and default values:

Analogue value of voltage	Decimal digital value
-10 V	-32 767
-5 V	-16 384
0 V	0
5 V	16 384
10 V	32 767



4.3.3.1 ADC raw value and initialisation value

You can configure each channel so that the raw value from the AD converter is issued directly, without calibration or scaling.

If the AD converter fails to supply a valid value, the module will adopt the ADC initialisation value for this channel instead. The default value is 4096_D (1000_H).

4.3.3.2 Hardware calibration

Each channel is calibrated ex-works in order to correct component dispersion and other influences.

The range is divided so that zero is assigned the value 0 and the end point is assigned the value 4095_D ($0FFF_H$).

4.3.3.3 Manufacturer scaling

The manufacturer scaling is used to define the offset (zero point compensation) and gain (amplification) of the digital signal.

Manufacturer scaling active (default setting)

- Default values for manufacturer scaling:
  - Offset (b_1): 0
  - Gain (a_1): 8194_D (2002_H)

INFORMATION

The default setting for gain (**a_1**) means an amplification factor of 8.

The digital value after manufacturer scaling is calculated using the following formula:

- $y = (a_1 / 1024_D * x) + b_1$ or
- $y = (a_1 / 400_H * x) + b_1$

Legend:

- **y**: Digital value after manufacturer scaling
- **x**: Digital value before manufacturer scaling
- **a_1**: Gain
- **b_1**: Offset
- **$a_1 / 1024_D$**: Amplification factor

INFORMATION

With the given amplification factor, gain (**a_1**) is calculated as follows:

Gain (**a_1**) = Amplification factor * 1024_D

Amplification by 5 % is therefore:
$1.05 * 1024_D = 1075_D$

Arithmetic examples using decimal values:

Digital value before manufacturer scaling (x)	Gain (a_1)	Offset (b_1)	Amplification factor ($a_1 / 1024_D$)	Value after manufacturer scaling (y)
1 000	1 024	0	1	1 000
1 000	2 048	0	2	2 000
1 000	8 192	0	8	8 000
1 000	1 075	500	1.05	1 550
1 000	512	-50	0.5	450

The module always uses two's complement representation for internal processing, irrespective of the configured data format. The values from 0000_H to $FFFF_H$ form a number circle in the two's complement representation. 8000_H follows $7FFF_H$ (= $32\ 767_D$) and is interpreted as the lowest negative number (= $-32\ 768_D$). $32\ 767_D$ is never exceeded; the value never falls below $-32\ 768_D$.

4.3.3.4 User scaling

User scaling is a second level of scaling. You can use this scaling to correct local influences. The function is the same as that of manufacturer scaling, but a different value is used for amplification factor 1:

- $y = (a_2 / 256_D * x) + b_2$ 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.

Key:

- **y**: Digital value after user scaling
- **x**: Digital value before user scaling
- **a_2**: Gain
- **b_2**: Offset
- **a_2 / 1024_D**: Amplification factor

4.3.3.5 Example calculation

Task:

When there is 10 V at the input, the PII should show a decimal value of 10 000. User scaling (Gain a_2) should be used in this case. Manufacturer scaling should not be changed. All numbers are decimals.

Solution:

Manufacturer scaling
$y = (a_1 / 1024 * x) + b_1$
and user scaling
$y = (a_2 / 256 * x) + b_2$
act consecutively, giving:
$y = (a_2 / 256 * ((a_1 / 1024 * x) + b_1)) + b_2$ or:
$y = (a_1 * a_2 * x / 262144) + (a_2 * b_1 / 256) + b_2$

With default values for $a_1 = 8194$, $b_1 = 0$ and the default value $b_2 = 0$:

$y = a_2 / 32 * x$

$a_2 = y * 32 / x$

Due to the hardware calibration the converter's input range is divided so that the 10 V end point is assigned the value x = 4095. With the default values x = 4095 and y= 10 000 the result is:
Gain $a_2 = 78$

4.3.4 Limit values

The module has range monitoring and limit value monitoring on each channel:

- Range monitoring
  - Upper limit value: 4095_D
  - Lower limit value: -4095_D
  - The module compares the upper and lower limit value with the digital value after the hardware calibration (values with 12 bits plus sign) and writes the result of the comparison as follows:
    - System environment A:
    - In the status byte (see "PSSu assignment in system environment A")
    - System environment B:
    - In the I/O data element "Overrange" or "Underrange" (see "PSSu assignment in system environment B").
  - The limit of the measuring range corresponds to 4095_D.
- Limit value monitoring
  - Limit value 1
  - Limit value 2
  - The module compares limit value 1 and limit value 2 with the digital value after scaling (values with 15 bits plus sign) and writes the result of the comparison as follows:
    - System environment A:
    - In the status byte (see "PSSu assignment in system environment A")
    - System environment B:
    - In the I/O data element "LimitValue1" or "LimitValue2" (see "PSSu assignment in system environment B").
  - The limit of the measuring range corresponds to $32\ 767_D$ with default scaling values.

You can change the default values in the system software.

The decimal value for the PSSuniversal Configurator (n) is calculated from the analogue value at the input (U_{Limit}) as follows:

$n = 32\ 768 * U_{Limit} / 10\ V$

Example:

- Voltages at the input, which are to be monitored through the limit values:
  - Limit value 1 is to be -8 V.
  - Limit value 2 is to be 5 V.
- Entry in the PSSuniversal Configurator:
  - Limit value 1 corresponds to -26 214
  - Limit value 2 corresponds to 16 384

4.3.5 Data formats

The way in which the analogue value is displayed depends on the voltage 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 15 bits plus a sign bit (MSB). The MSB is "1" with negative values and "0" with positive values.
- 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.

Analogue value and typical digital value with a voltage range of 0 ... two's complement or sign and magnitude representation:

Analogue value of voltage	Decimal digital value	Binary digital value	Hexadecimal digital value
0 V	0	0000 0000 0000 0000	0000_H
5 V	16 384	0100 0000 0000 0000	4000_H
10 V	32 767	0111 1111 1111 1111	$7FFF_H$

Analogue value and typical digital value with a voltage range of -10 V ... +10 V, two's complement:

Analogue value of voltage	Decimal digital value	Binary digital value	Hexadecimal digital value
-10 V	-32 767	1000 0000 0000 0001	8001_H
-5 V	-16 384	1100 0000 0000 0000	$C000_H$
-2.4 mV (= 1 LSB)	-8	1111 1111 1111 1000	$FFF8_H$
0 V	0	0000 0000 0000 0000	0000_H
10 V	32 767	0111 1111 1111 1111	$7FFF_H$

Analogue value and typical digital value with a voltage range of -10 V ... +10 V, sign and magnitude representation:

Analogue value of voltage	Decimal digital value	Binary digital value	Hexadecimal digital value
-10 V	-32 768	1111 1111 1111 1111	$FFFF_H$
-5 V	-16 384	1011 1111 1111 1111	$BFFF_H$
-2.4 mV (= 1 LSB)	-8	1000 0000 0000 0100	8008_H
0 V	0	0000 0000 0000 0000	0000_H
10 V	32 767	0111 1111 1111 1111	$7FFF_H$

4.3.6 Addresses in the process image

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. If the status byte is configured to be transferred without input data, each input occupies 8 consecutive bit addresses. All the status bytes are displayed first in the PII, followed by the input data.

Configuration	Standard bus system	
	ST-PII	ST-PIO
Send input data	32 Bit	- - -
Send status byte ("R")	16 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 I1	33	LSB input data
	...	...
	48	MSB input data

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

Input	PII	Assignment
Input I0	1	LSB status byte
	...	...
	8	MSB status byte
Input I1	9	LSB status byte
	...	...
	16	MSB status byte

4.3.7 Summary and overview

The module has the following configuration options:

Configurable properties	Default value	Meaning
Input area	0	0 V … 10 V, single-pole, referenced to earth (single-ended) (1 = 0 ... +10 V dual-pole, differential input) (2 = -10 V ... +10 V dual-pole, differential input)
Manufacturer scaling active	1/TRUE	Activated
Manufacturer scaling offset	0	Offset: Magnitude 0
Manufacturer scaling gain	8194_D	8x amplification, displaced three bit places
User scaling active	0/FALSE	Deactivated
User scaling offset	0	Offset: Magnitude 0
User scaling gain	256_D	1x amplification, signal unchanged
Filter active	0/FALSE	Deactivated
Filter characteristic	0	2nd order FIR filter
Range monitoring active	1/TRUE	Activated
Upper limit value	4095_D	Upper limit of number range
Lower limit value	-4095_D	Lower limit of number range
Limit value 1 active	0/FALSE	Deactivated
Limit value 1	$-32\ 767_D$	Lower limit of number range
Limit value 2 active	0/FALSE	Deactivated
Limit value 2	$32\ 767_D$	Upper limit of number range
Sign and magnitude representation active	0/FALSE	Deactivated; two's complement is activated
Output ADC raw value only	0/FALSE	Deactivated
ADC initialisation value	4096_D	4096_D (1000_H) is issued when no data is detected.

4.3.8 PSSu assignment in system environment A

4.3.8.1 Addresses in the process image

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. If the status byte is configured to be transferred without input data, each input occupies 8 consecutive bit addresses. All the status bytes are displayed first in the PII, followed by the input data.

Configuration	Standard bus system	
	ST-PII	ST-PIO
Send input data	32 Bit	- - -
Send status byte ("R")	16 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 I1	33	LSB input data
	...	...
	48	MSB input data

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

Input	PII	Assignment
Input I0	1	LSB status byte
	...	...
	8	MSB status byte
Input I1	9	LSB status byte
	...	...
	16	MSB status byte

4.3.8.2 Status byte

ST modules for analogue input 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 the lower limit value
	1	Value below the lower limit value
1	0	Input value below the upper limit value
	1	Value exceeds the upper limit value
2 / 3	0 0	Limit value 1 inactive
	0 1	Input value greater than or equal to limit value 1
	1 0	Input value less than limit value 1
	1 1	Reserved
4 / 5	0 0	Limit value 2 inactive
	0 1	Input value greater than limit value 2
	1 0	Input value less than or equal to limit value 2
	1 1	Reserved
6	0	Valid data from A/D converter
	1	No valid data from A/D converter
7	0	Reserved
	1	Reserved

4.3.9 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) I1(21)	ST_I_AI	Data: WORD	Input data I0 ... I1
		Underrange: BOOL	0: Input value above the lower limit value 1: Value below the lower limit value
		Overrange: BOOL	0: Input value below the upper limit value 1: Value exceeds the upper limit value
		LimitValue1: BOOL	0: Limit value 1 inactive 1: Input value greater than or equal to limit value 1
		LimitValue2: BOOL	0: Limit value 2 inactive 1: Input value greater than or equal to limit value 2

5 Installation

5.1 General installation guidelines

Please also refer to the PSSuniversal Installation Manual.

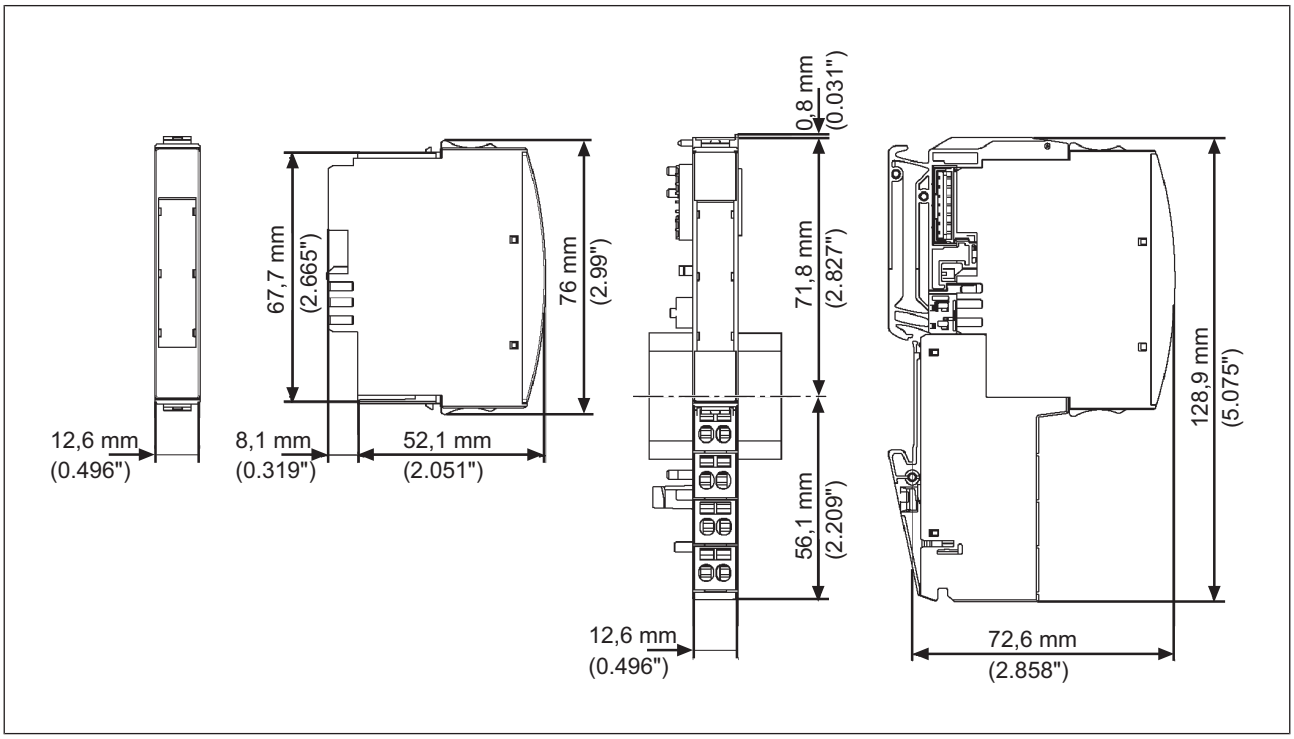
NOTICE

Damage due to electrostatic discharge!

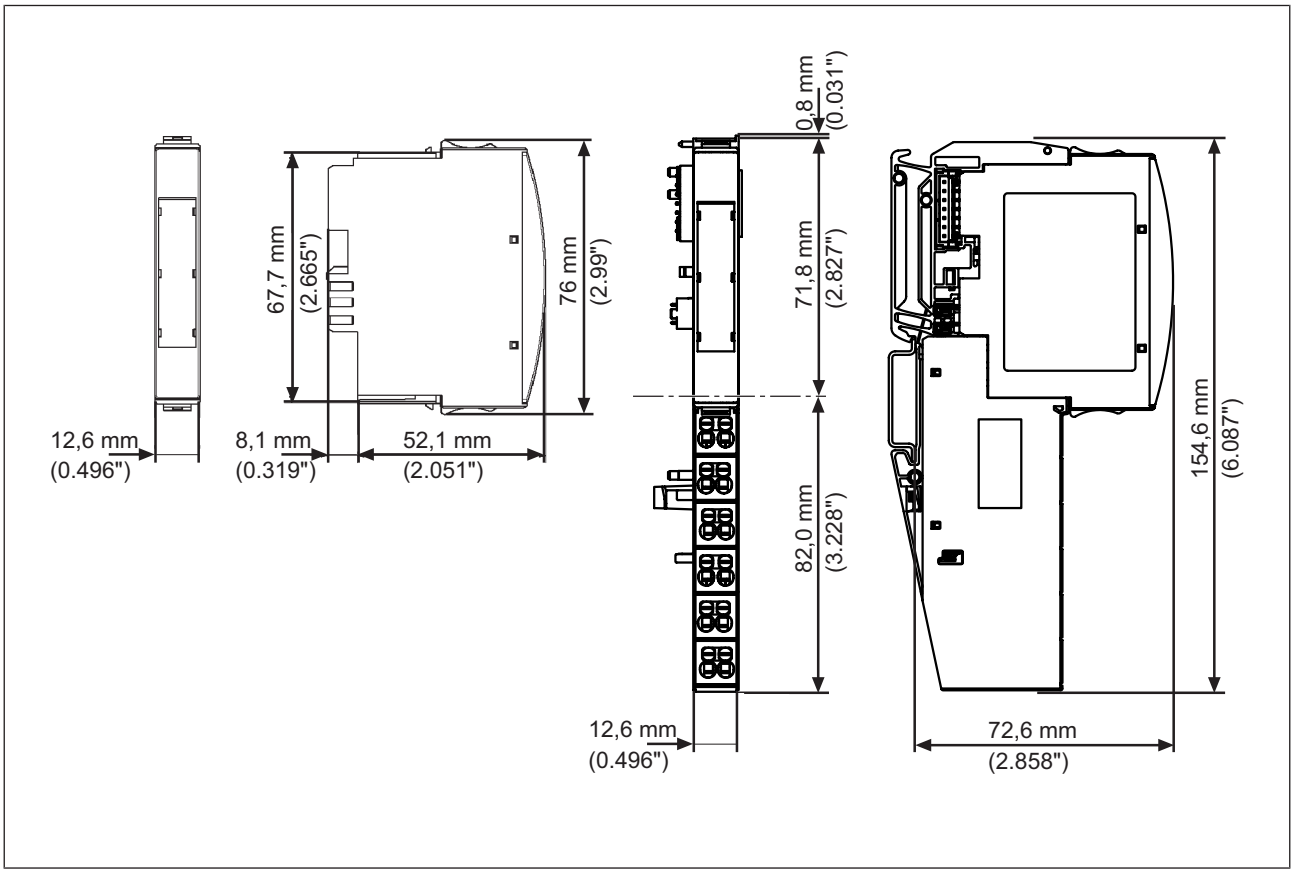
Electrostatic discharge can damage components. Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

5.1.1 Dimensions

Base modules with four connection levels:



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.

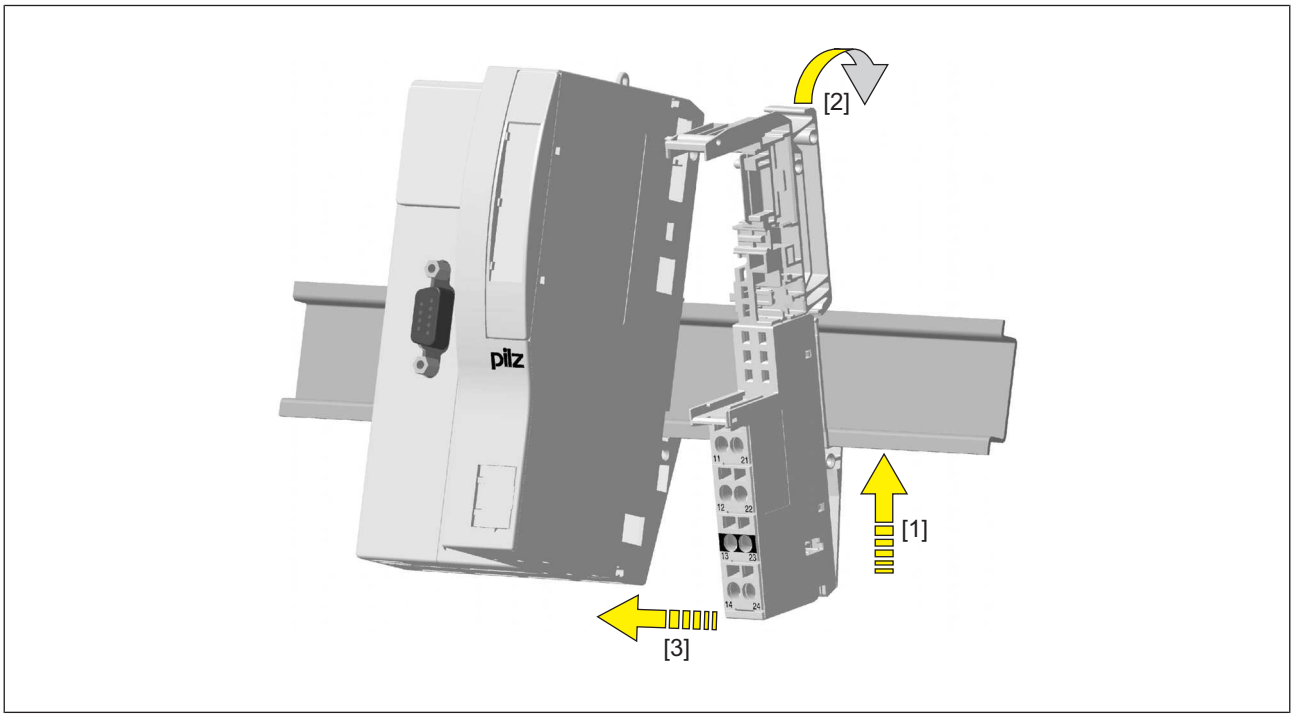
Please note:

- 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:

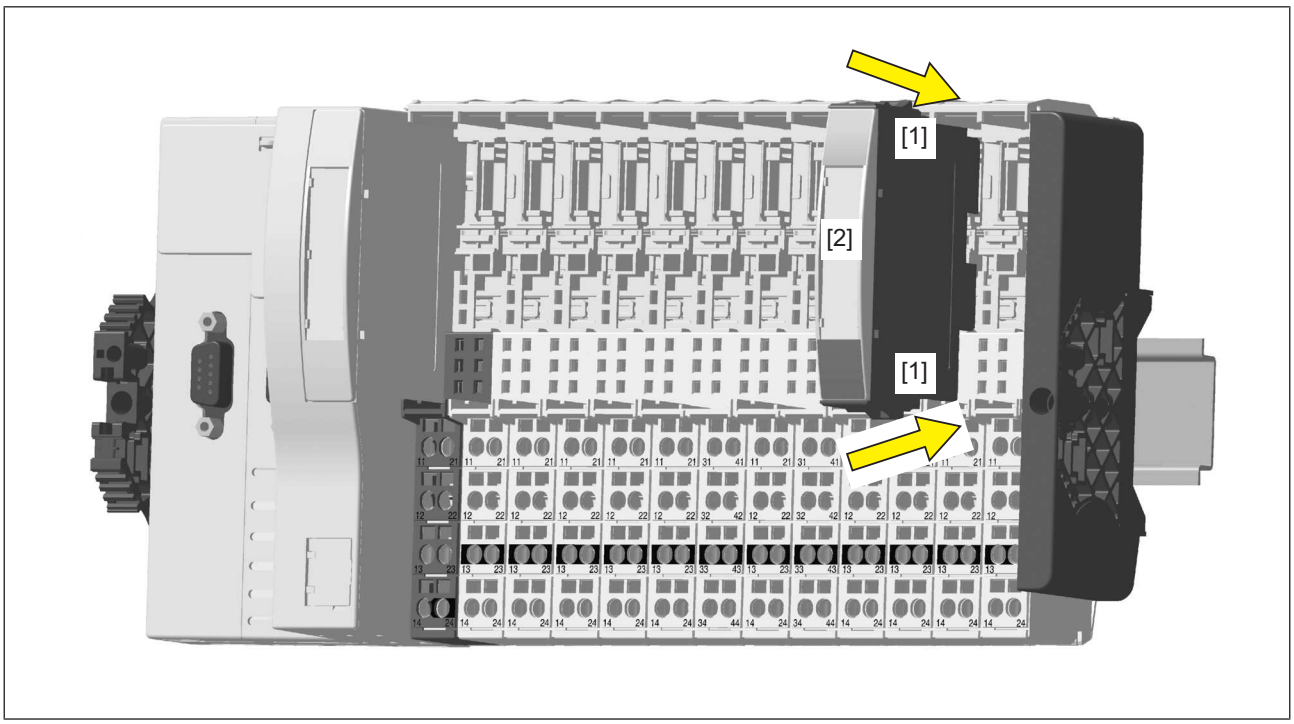
- Only insert on to base modules that are already installed.
- Preferably these base modules should be ready wired.
- Electronic modules with outputs may only be inserted and removed when the load is switched off. Unforeseeable error reactions may be triggered if modules are inserted and removed under 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:

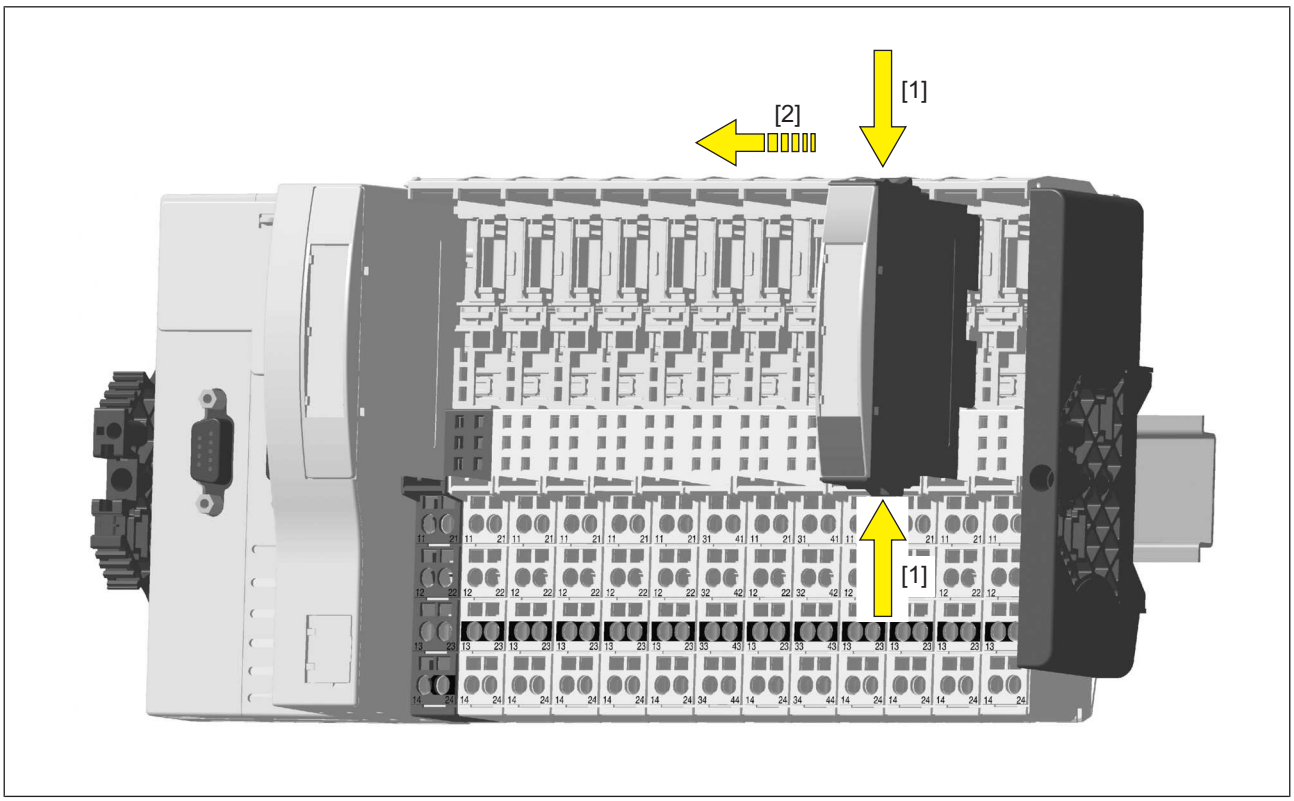


5.3.2 Removing an electronic module

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

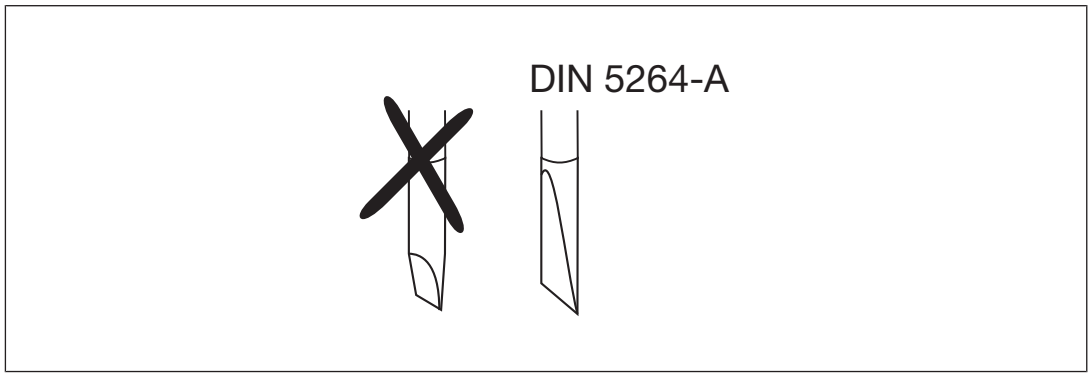
Please note:

- 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

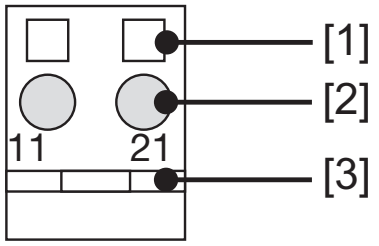
Procedure:

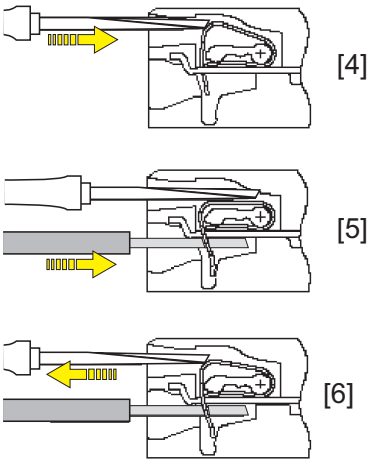
- Use a flat blade screwdriver (DIN 5264-A)!



- 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.



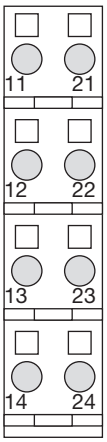


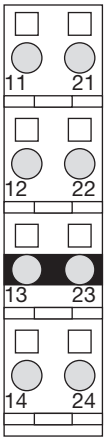
Please note:

- 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)

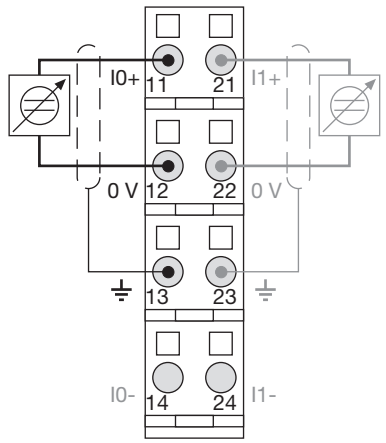
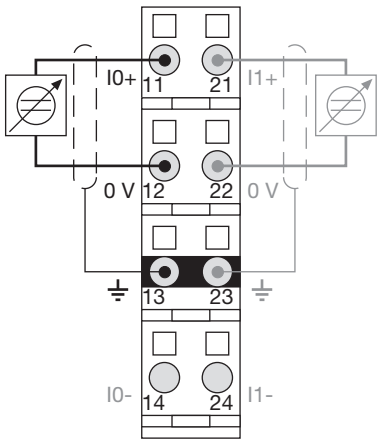
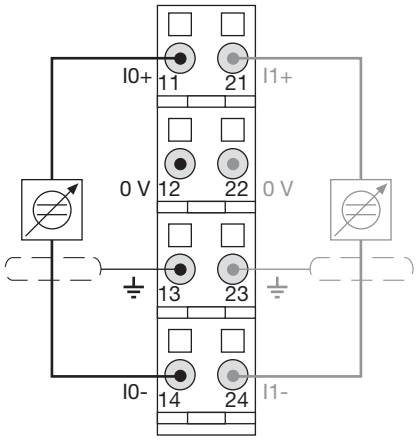
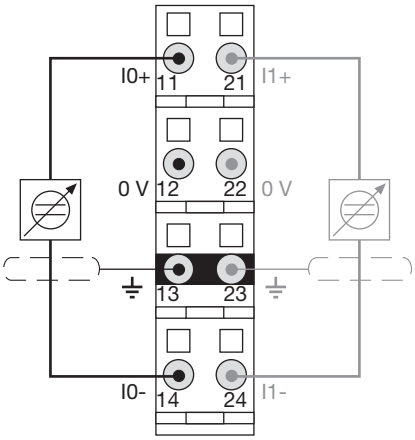
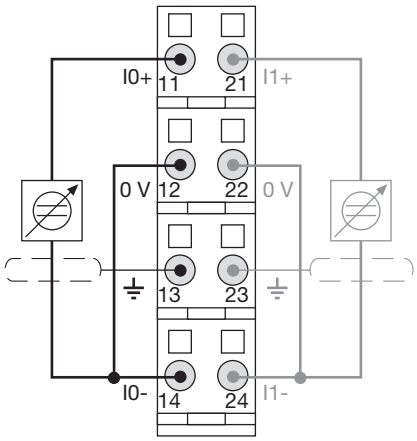
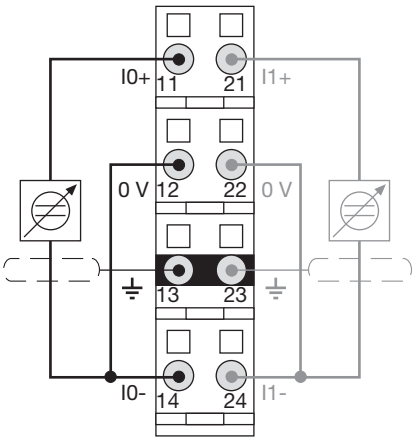
- On base modules with screw terminals:
  - If you use a multi-strand cable to connect the I/Os, it is recommended that you use ferrules conforming to Parts 1 and 2 of DIN 46228, 0.14 ... 1.5 mm², Form A or C, although this is not essential. To crimp the ferrules you can use crimp pliers (crimp form 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 1/8 S PSSu BP 1/8 S-T Cage clamp terminals: PSSu BP 1/8 C PSSu BP 1/8 C-T	Without C-rail: 11: Input I0+ 21: Input I1+ 12-22: 0 V analogue (12-22 linked within the base module) 13-23: Shield connection (13-23 linked within the base module) 14: Input I0- 24: Input I1-	

Base module	Terminal configuration	
Screw terminals: PSSu BP-C 1/8 S PSSu BP-C 1/8 S-T Cage clamp terminals: PSSu BP-C 1/8 C PSSu BP-C 1/8 C-T	With C-rail: 11: Input I0+ 21: Input I1+ 12-22: 0 V analogue (12-22 linked within the base module) 13-23: C-rail supply, shield connection (13-23 linked within the base module) 14: Input I0- 24: Input I1-	

6.3 Connecting the module

Input circuit	Without C-rail	With C-rail
Voltage range (0 ... +10 V single-pole, referenced to earth		
Voltage range (0 ... +10 V Voltage range –10 V ... +10 V dual-pole, differential input		
Voltage range –10 V ... +10 V Differential measurement refer- enced to earth In a noise susceptible environment		

7 Operation

7.1 Messages

A module error is displayed via the "Err" LED (see section entitled "Display elements"). It is signalled to the head module and then entered in the

- Error stack, with PSSu in system environment A
- Diagnostic log, with PSSu in system environment B.

of the head module.

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

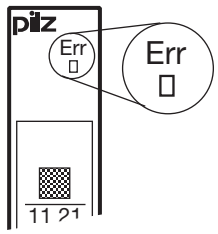
Legend

☼ LED on

● LED off

7.2.1 Display elements for module diagnostics

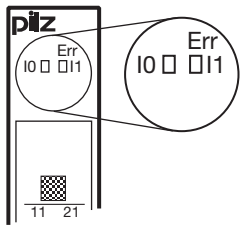
The module has an LED for displaying module errors ("Err" LED).



LED			Meaning
Name	Colour	Status	
Err	- - -	●	No error
	Red	☼	Module error

7.2.2 Display elements for 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
	Green	☼	Signal detected		
I1	- - -	●	No signal detected	I1 (Input 2)	21
	Green	☼	Signal detected		

8 Technical details

General	312440	314440
Certifications	**CE, TÜV, UKCA, cULus Listed**	**CE, TÜV, UKCA, cULus Listed**
Application range	**Standard**	**Standard**
Module's device code	**0300h**	**0300h**
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	**7**	**7**
From ST firmware version PSSu H S PN	**1**	**1**
From ST firmware version PSSu WR S IDN	**4**	**4**
Application in system environment B		
From ST firmware version, head modules	**1.0.0**	**1.0.0**
Electrical data	**312440**	**314440**
Internal supply voltage (module supply)		
Module's power consumption	**0,22 W**	**0,22 W**
Periphery's supply voltage (periphery supply)		
Voltage range	**16,8 - 30 V**	**16,8 - 30 V**
Module's current consumption with no load	**10 mA**	**10 mA**
Module's power consumption with no load	**0,24 W**	**0,24 W**
Max. power dissipation of module	**0,5 W**	**0,5 W**
Analogue inputs	**312440**	**314440**
Number of analogue inputs	**2**	**2**
Type of analogue inputs	**Voltage**	**Voltage**
Input area	**-10 ... 10 V (differential input), 0 ... 10 V (differential input), 0 ... 10 V (single-ended)**	**-10 ... 10 V (differential input), 0 ... 10 V (differential input), 0 ... 10 V (single-ended)**
Measuring ranges		
Type	**Single-ended**	**Single-ended**
Measuring range	**0 - 10 V**	**0 - 10 V**
Type	**Differential input**	**Differential input**
Measuring range	**0 - 10 V**	**0 - 10 V**
Type	**Differential input**	**Differential input**
Measuring range	**-10 - 10 V**	**-10 - 10 V**
Input filter	**RC filter**	**RC filter**
Cutoff frequency	**130 Hz**	**130 Hz**

Analogue inputs	312440	314440
Voltage measurement		
Input resistance	100 kOhm	100 kOhm
Max. continuous voltage	12 V	12 V
Resolution	12 Bit	12 Bit
Max. common mode voltage	5 V	5 V
Deviations from the measuring range limit value		
Linearity error	0,05 %	0,05 %
Output variable error at 25 °C	0,2 %	0,2 %
Temperature coefficient	0,02 %/K	0,02 %/K
Max. measurement error during EMC test	1 %	1 %
Conversion method	Successive approximation	Successive approximation
Potential isolation between input and periphery supply	yes	yes
Typ. processing time of the analogue input	1 ms	1 ms
Inputs	**312440**	**314440**
Potential isolation between input and internal module bus voltage	yes	yes
Environmental data	**312440**	**314440**
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
EMC	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-6-2, EN 61000-6-4	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-6-2, EN 61000-6-4
Vibration		
In accordance with the standard	EN 60068-2-6	EN 60068-2-6
Frequency	10 - 150 Hz	10 - 150 Hz
Amplitude	0,35 mm	0,35 mm
Acceleration	1g	1g

Environmental data	312440	314440
Broadband noise		
In accordance with the standard	–	**EN 60068-2-64**
Frequency	–	**5 - 500 Hz**
Acceleration	–	**1,9grms**
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**	**10g**
Duration	**16 ms**	**16 ms**
Airgap creepage		
In accordance with the standard	**EN 60664-1**	**EN 60664-1**
Overvoltage category	**II**	**II**
Pollution degree	**2**	**2**
Protection type		
In accordance with the standard	**EN 60529**	**EN 60529**
Housing	**IP20**	**IP20**
Terminals	**IP20**	**IP20**
Mounting area (e.g. control cabinet)	**IP54**	**IP54**
Mechanical data	**312440**	**314440**
Material		
Bottom	**PC**	**PC**
Front	**PC**	**PC**
Coding	**PA**	**PA**
Mounting type	**plug-in**	**plug-in**
Dimensions		
Height	**76 mm**	**76 mm**
Width	**12,6 mm**	**12,6 mm**
Depth	**60,2 mm**	**60,2 mm**
Weight	**35 g**	**37 g**
Mechanical coding		
Type	**D**	**D**
Colour	**Dark grey**	**Dark grey**

Where standards are undated, the 2005-04 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 U	Electronic module, base type	312440
PSSu E S 2AI U-T	Electronic module, T-type	314440

10.2 Accessories

Base modules

Product type	Features	Order no.
PSSu BP 1/8 S	Base module without C-rail with screw terminals	312600
PSSu BP 1/8 S-T	Base module without C-rail with screw terminals, T-type	314600
PSSu BP 1/8 C	Base module without C-rail with cage clamp terminals	312601
PSSu BP 1/8 C-T	Base module without C-rail with cage clamp terminals, T-type	314601
PSSu BP-C 1/8 S	Base module with C-rail and screw terminals	312610
PSSu BP-C 1/8 S-T	Base module with C-rail and screw terminals, T-type	314610
PSSu BP-C 1/8 C	Base module with C-rail and cage clamp terminals	312611
PSSu BP-C 1/8 C-T	Base module with C-rail and cage clamp terminals, T-type	314611
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 1/12 C	Base module with C-rail and cage clamp terminals	312621
PSSu BP-C 1/12 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

21405-EN-05, 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