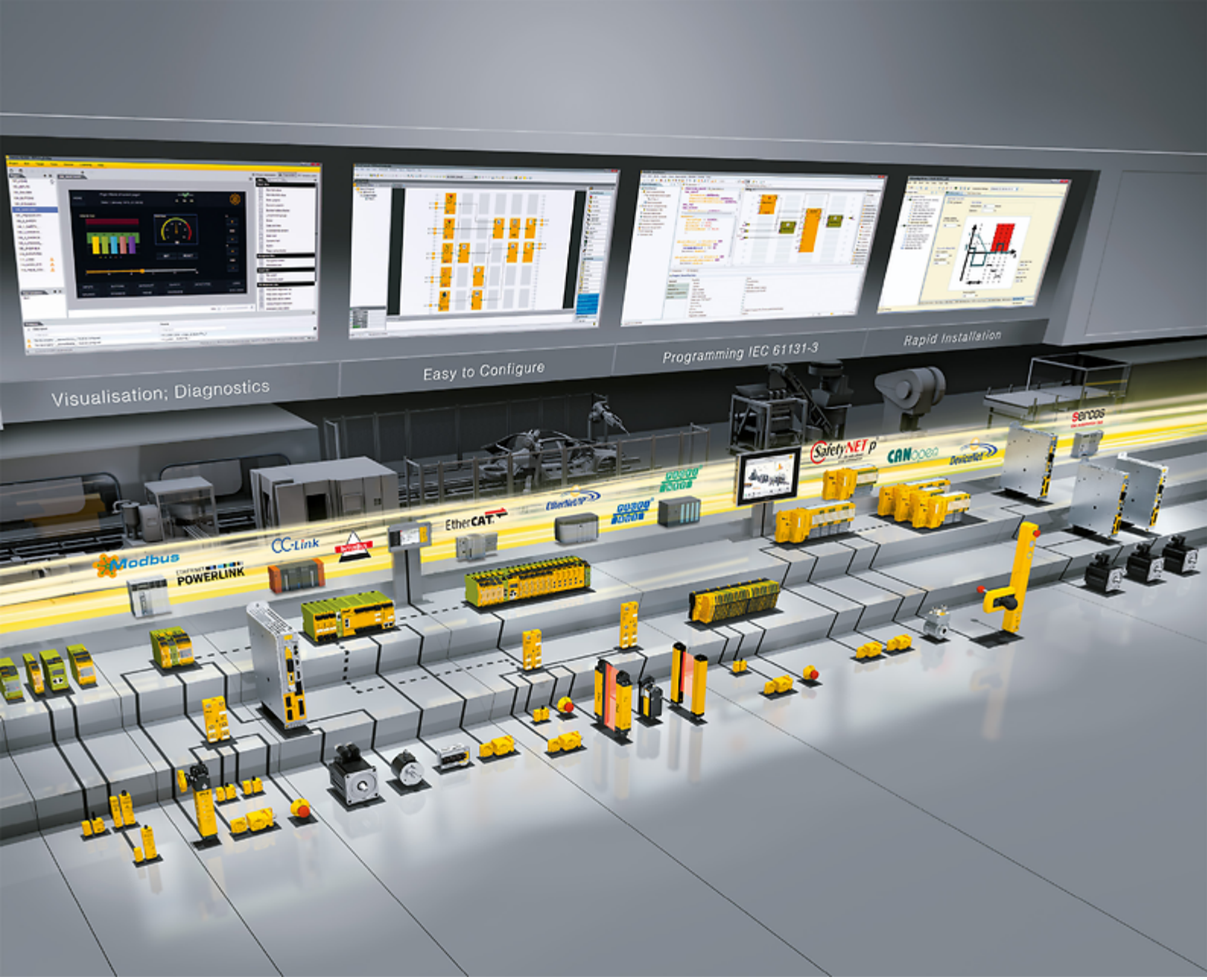


PSS u2 ES 4AO U/I

PILZ
THE SPIRIT OF SAFETY

- Control system PSS u2
- Remote I/O system PSS u2

Operating Manual-1005178-EN-03

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

This documentation is valid for the product PSS u2 ES 4AO U/I hardware version 01 or higher. It is valid until new documentation is published.

1.2 Using the documentation

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

Please refer to the PSS u2 Installation Manual.

1.3 Definition of symbols

Information that is particularly important is identified as follows:

DANGER!

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

WARNING!

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

CAUTION!

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

NOTICE

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

INFORMATION

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

2 Overview

Module structure:

A module consists of

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

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

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

2.1 Module features

Application of the product PSS u2 ES 4AO U/I:

Electronic module with analogue outputs for standard applications

- 4 analogue voltage and current outputs
- Resolution [10]: 16 bit
- Each terminal configurable separately as a voltage or current output
- 2 current and voltage ranges configurable [9]
- Current output: Open circuit detection
- Voltage output: Short circuit detection
- LED displays [21] for:
  - Operating status per input
  - Module error

3 Safety

3.1 Intended use

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

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

The following is deemed improper use in particular

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

The module PSS u2 ES 4AO U/I may be used in conjunction with the following terminal block:

- 16-pin terminal block

3.2 System requirements

INFORMATION

The module is supported by

- PASconfig from version 3.1.0
  - We recommend that you always use the latest version (download from www.pilz.com).

3.3 Safety regulations

3.3.1 Use of qualified personnel

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

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

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

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

3.3.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if

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

3.3.3 Disposal

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

4 Function description

4.1 Block diagram

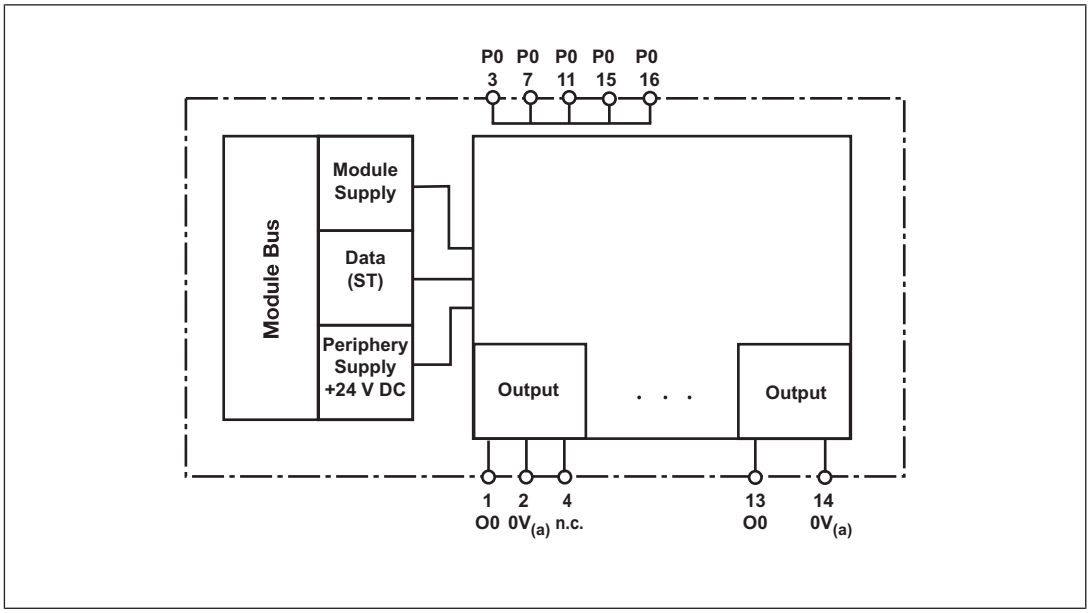


Fig.: Block diagram PSS u2 ES 4AO U/I

4.2 Supply

- The module is supplied with voltage via the head module.
- The periphery supply is used to supply the outputs.

4.3 Current and voltage range

The output signals for each output are transmitted to the output module via the ST module bus. For each terminal, a current or voltage range can be configured. The resolution is always 16 Bit, independent of the range.

You can configure the following current ranges per module:

- -24 mA ... +24 mA
- 0 mA ... +20 mA (default value)

You can configure the following voltage ranges per terminal:

- -12 V ... +12 V
- 0 V ... +10 V (default value)

4.4 Representation of the analogue value

The representation of the analogue value depends on the current or voltage range. The following examples show the relationship between the values.

Analogue value and digital value with a current range of 0 mA ... +20 mA:

Analogue value of current	Decimal	Binary	Hexadecimal
20 mA	65535	1111 1111 1111 1111	$FFFF_H$
17.5 mA	57344	1110 0000 0000 0000	$E000_H$
15 mA	49152	1100 0000 0000 0000	$C000_H$
12.5 mA	40959	1001 1111 1111 1111	$9FFF_H$
10 mA	32768	1000 0000 0000 0000	8000_H
7.5 mA	24576	0110 0000 0000 0000	6000_H
5 mA	16384	0100 0000 0000 0000	4000_H
2.5 mA	8192	0010 0000 0000 0000	2000_H
1 mA	3277	0000 1100 1100 1101	$0CCD_H$
0.1 mA	328	0000 0001 0100 1000	0148_H
0.05 mA	164	0000 0000 1010 0100	$00A4_H$
0.025 mA	82	0000 0000 0101 0010	0052_H
0.0125 mA	41	0000 0000 0010 1001	0029_H
4.88 µA	16	0000 0000 0001 0000	0010_H
2.44 µA	8	0000 0000 0000 1000	0008_H
1.221 µA	4	0000 0000 0000 0100	0004_H
0.61036 µA	2	0000 0000 0000 0010	0002_H
0.30517 µA	1	0000 0000 0000 0001	0001_H
0 mA	0	0000 0000 0000 0000	0000_H

Analogue value and digital value with a current range of -24 mA ... +24 mA:

Analogue value of current	Decimal	Binary	Hexadecimal
24 mA	65535	1111 1111 1111 1111	$FFFF_H$
18 mA	57344	1110 0000 0000 0000	$E000_H$
12 mA	49152	1100 0000 0000 0000	$C000_H$
6 mA	40960	1001 1111 1111 1111	$9FFF_H$
0 mA	32768	1000 0000 0000 0000	8000_H
-6 mA	24576	0110 0000 0000 0000	6000_H
-12 mA	16384	0100 0000 0000 0000	4000_H
-18 mA	8192	0010 0000 0000 0000	2000_H
-21.5998 mA	3277	0000 1100 1100 1101	$0CCD_H$
-23.7597 mA	328	0000 0001 0100 1000	0148_H

Analogue value of current	Decimal	Binary	Hexadecimal
-23.8798 mA	164	0000 0000 1010 0100	$00A4_H$
-23.9399 mA	82	0000 0000 0101 0010	0052_H
-23.9699 mA	41	0000 0000 0010 1001	0029_H
-23.9882 mA	16	0000 0000 0001 0000	0010_H
-23.9941 mA	8	0000 0000 0000 1000	0008_H
-23.9970 mA	4	0000 0000 0000 0100	0004_H
-23.9985 mA	2	0000 0000 0000 0010	0002_H
-23.9992 mA	1	0000 0000 0000 0001	0001_H
-24 mA	0	0000 0000 0000 0000	0000_H

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

Analogue value of voltage	Decimal	Binary	Hexadecimal
10 V	65535	1111 1111 1111 1111	$FFFF_H$
8.75 V	57344	1110 0000 0000 0000	$E000_H$
7.5 V	49152	1100 0000 0000 0000	$C000_H$
6.25 V	40959	1001 1111 1111 1111	$9FFF_H$
5 V	32768	1000 0000 0000 0000	8000_H
3.75 V	24576	0110 0000 0000 0000	6000_H
2.5 V	16384	0100 0000 0000 0000	4000_H
1.25 V	8192	0010 0000 0000 0000	2000_H
0.5 V	3277	0000 1100 1100 1101	$0CCD_H$
50 mV	328	0000 0001 0100 1000	0148_H
25 mV	164	0000 0000 1010 0100	$00A4_H$
12.5 mV	82	0000 0000 0101 0010	0052_H
6.25 mV	41	0000 0000 0010 1001	0029_H
2.44 mV	16	0000 0000 0001 0000	0010_H
1.22 mV	8	0000 0000 0000 1000	0008_H
610.36 µV	4	0000 0000 0000 0100	0004_H
305.18 µV	2	0000 0000 0000 0010	0002_H
152.59 µV	1	0000 0000 0000 0001	0001_H
0 V	0	0000 0000 0000 0000	0000_H

Analogue value and digital value with a voltage range of -12 V ... +12 V:

Analogue value of voltage	Decimal	Binary	Hexadecimal
12 V	65535	1111 1111 1111 1111	$FFFF_H$
9 V	57344	1110 0000 0000 0000	$E000_H$
6 V	49152	1100 0000 0000 0000	$C000_H$
3 V	40960	1001 1111 1111 1111	$9FFF_H$
0 V	32768	1000 0000 0000 0000	8000H
-3 V	24576	0110 0000 0000 0000	6000_H
-6 V	16384	0100 0000 0000 0000	4000_H
-9 V	8192	0010 0000 0000 0000	2000_H
-10.8 V	3277	0000 1100 1100 1101	$0CCD_H$
-11.88 V	328	0000 0001 0100 1000	0148_H
-11.94 V	164	0000 0000 1010 0100	$00A4_H$
-11.97 V	82	0000 0000 0101 0010	0052_H
-11.9850 V	41	0000 0000 0010 1001	0029_H
-11.9941 V	16	0000 0000 0001 0000	0010_H
-11.9970 V	8	0000 0000 0000 1000	0008_H
-11.9985 V	4	0000 0000 0000 0100	0004_H
-11.9993 V	2	0000 0000 0000 0010	0002_H
-11.9996 V	1	0000 0000 0000 0001	0001_H
-12 V	0	0000 0000 0000 0000	0000_H

Conversion of the digital value in decimal representation in the analogue output value in mA or in V depending on the range:

The analogue value at the output (I_{out}) is calculated from the decimal value (O-PI) in the process image of the outputs as follows:

- Range 0 … +20 mA:

  I_{out} = 20 mA * **O-PI** / 65535
- Range -24 mA … +24 mA

  I_{out} = 48 mA * **O-PI** / 65535 - 24 mA
- Range 0 V … +10 V

  U_{out} = 10 V * **O-PI** / 65535
- Range -12 V … +12 V

  U_{out} = 24V * **O-PI** / 65535 - 12V

  O-PI: Digital value in the process image of outputs in decimal representation

  Note: The digital value in decimal representation can assume values between 0 … 65 535.

4.5 Reaction times

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

4.6 Energy-saving functions

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

- Switching off the LEDs

  The LEDs have two energy-saving levels:

  – Switching off the LEDs that display the terminal status

  – Switching off the LEDs that display the module and terminal status

5 Structure of the process image

The module occupies 8 Byte in the process image of outputs.

PIO		Byte sequence (Big endian)	Assignment
16 Bit (1 word)	Byte 0	MSB (most significant byte)	Output data O0
	Byte 1	LSB (least significant byte)	
16 Bit (1 word)	Byte 2	MSB (most significant byte)	Output data O1
	Byte 3	LSB (least significant byte)	
16 Bit (1 word)	Byte 4	MSB (most significant byte)	Output data O2
	Byte 5	LSB (least significant byte)	
16 Bit (1 word)	Byte 6	MSB (most significant byte)	Output data O3
	Byte 7	LSB (least significant byte)	

The module occupies 1 Byte in the process image of inputs:

PII	Meaning	State
Bit 0	Valid bit of output O0	0: Output error 1: The signal in the PIO corresponds to the output signal
Bit 1	Valid bit of output O1	
Bit 2	Valid bit of output O2	
Bit 3	Valid bit of output O3	
Bit 4 … 7	None	Constant "0"

6 Installation

6.1 General installation guidelines

NOTICE

Damage due to electrostatic discharge!

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

6.1.1 Dimensions

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

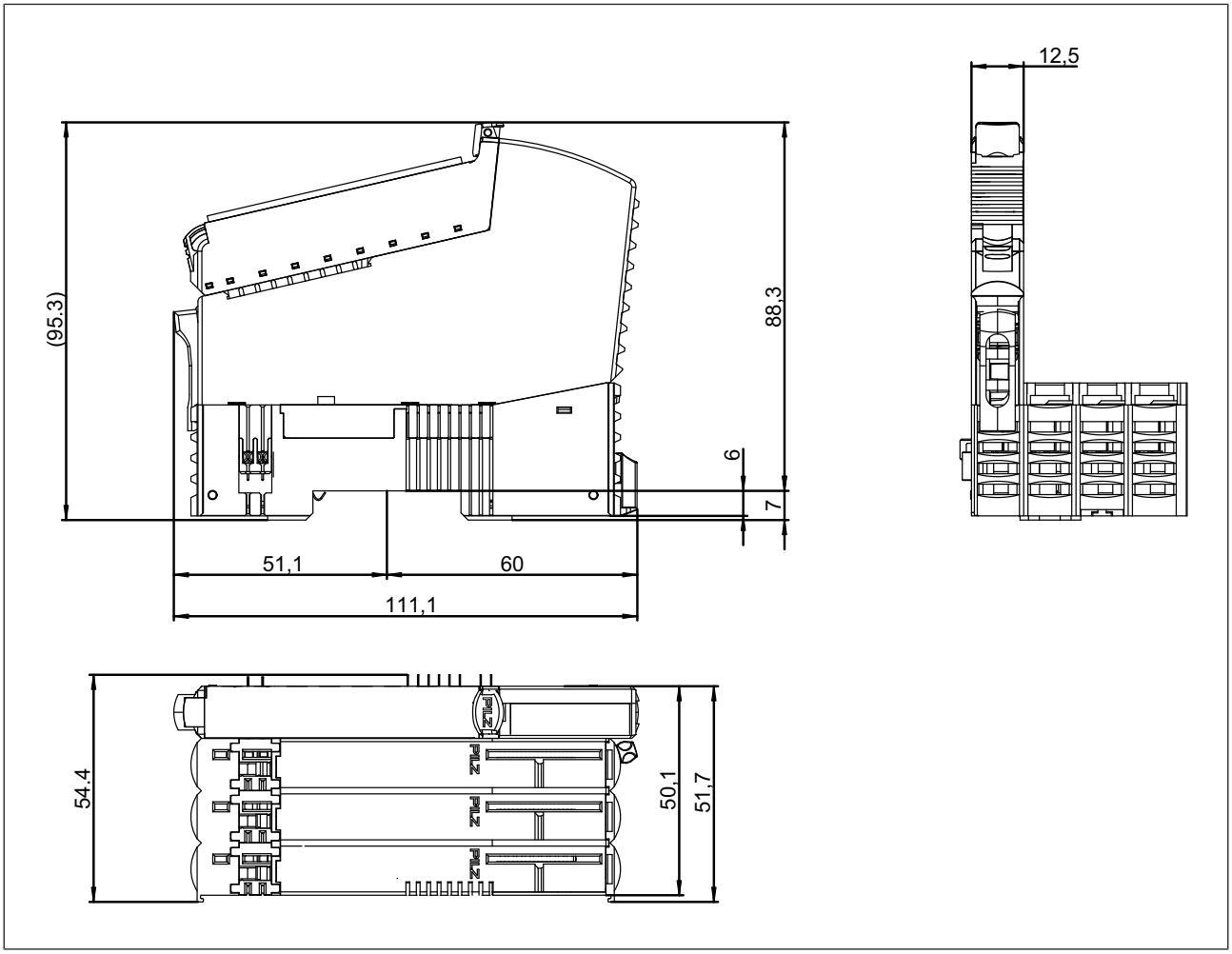


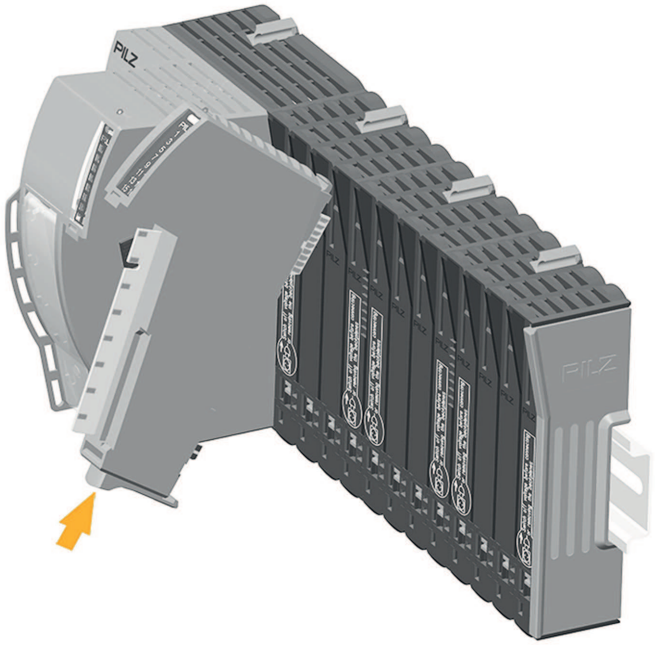
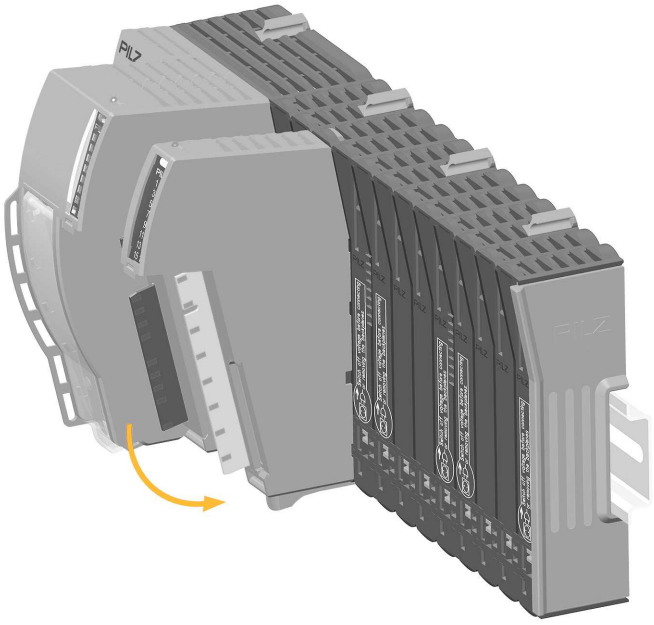
Fig.: Dimensions in mm, including backplane, electronic module and terminal block

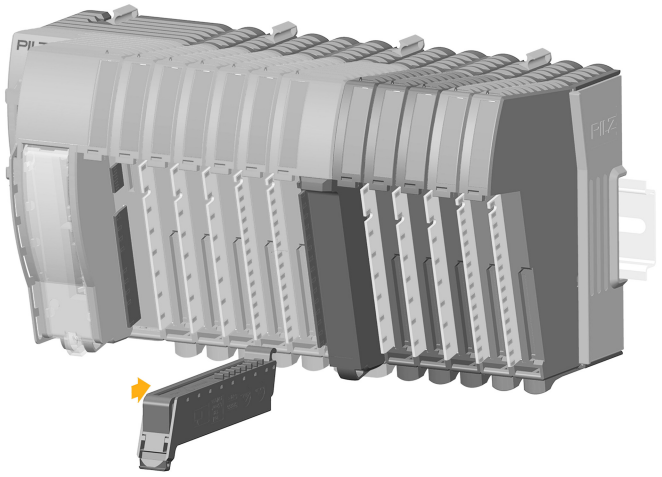
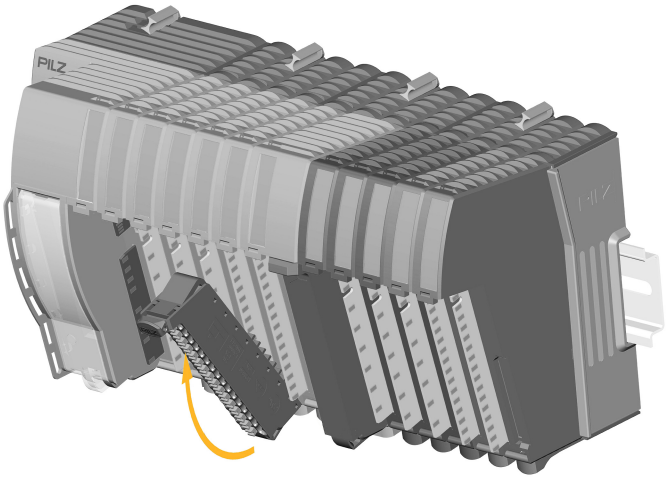
6.2 Inserting and removing an electronic module

Please note:

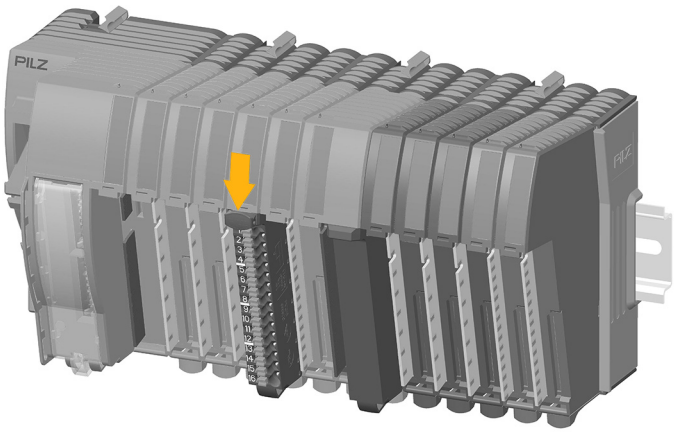
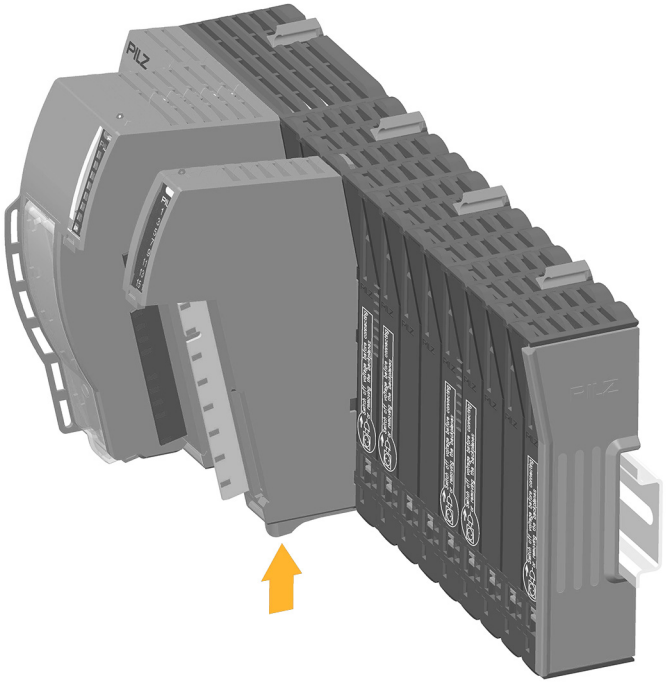
- Backplane must be installed first.
- Electronic modules may only be plugged or unplugged if the terminal block has been removed first.
- The mechanics of the electronic modules are designed for 20 plug in/out cycles.

6.2.1 Inserting an electronic module

1. Insert the electronic module into the suspension lug on the backplane.	
2. Swivel the electronic module downwards until you hear it click into place.	

3. Insert the terminal block into the suspension lug on the module.	
4. Swivel the terminal block upwards until you hear it click into place.	

6.2.2 Removing an electronic module

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

6.2.3 Changing an electronic module during operation

An electronic module can be hot swapped.

Effects:

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

Procedure:

1. Removing an electronic module [18]
2. Inserting an electronic module [16]

A new electronic module can be inserted during operation.

Procedure:

- Inserting an electronic module [16]

Effects:

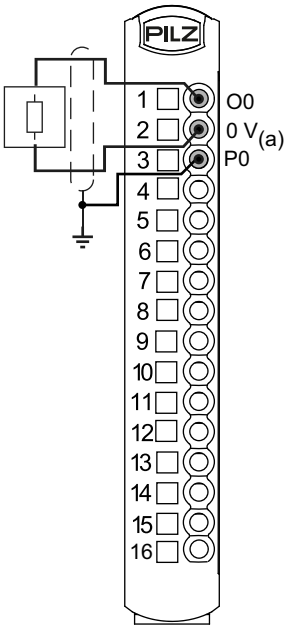
- Module bus communication between the other modules is not interrupted.
- To detect the new module the following steps can be necessary:
  - Creating a new configuration or changing an existing configuration
  - Download of the configuration to the head module
  - Restart of the head module. After a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

7 Wiring

7.1 General wiring guidelines

- The analogue outputs are not potentially isolated to one another.
- The supply voltages of the actuators and encoders must meet the regulations for extra low voltages with safe separation (SELV, PELV). Failure to do so could result in electric shock.
- Use shielded signal cables. The optional shield connection element can be used to connect the shield (see Accessories [📖 25]).
- Use copper wiring.

7.2 Terminal configuration

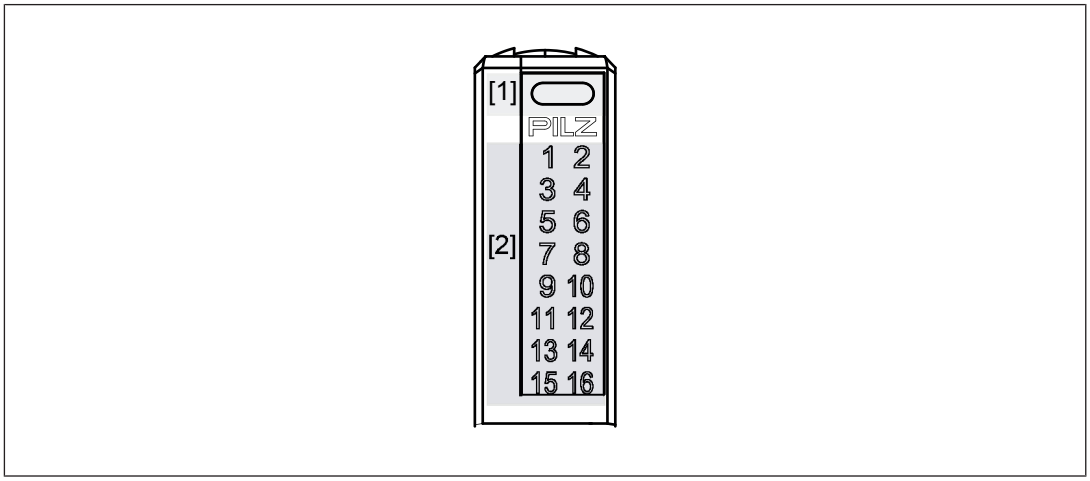
Terminal configuration	Connection example
1: O0 current/voltage output 2: $0V_{(a)}$ ground analogue output 3: P0 shield connection 4: Not assigned 5: O1 current/voltage output 6: $0V_{(a)}$ ground analogue output 7: P0 shield connection 8: Not assigned 9: O2 current/voltage output 10: $0V_{(a)}$ ground analogue output 11: P0 shield connection 12: Not assigned 13: O3 current/voltage output 14: $0V_{(a)}$ ground analogue output 15: P0 shield connection 16: Not assigned	

8 Operation

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

8.1 Display elements and messages

Only the terminals 1, 5, 9 and 13 are active.



Legend

[1] Module status display

[2] Terminal status display

Legend

LED on

LED flashes

LED flashes briefly

LED off

The module can detect the following errors:

[1]	Colour [1]	[2]	Colour [2]	Meaning	Further information
	--		--	Module not ready for operation	
	Green		--	Module ready for operation	
	Green		Green	Module in operation and there is a signal at the output	
	Green		--	Module in operation and there is no signal at the output	
	Red		--	Configuration error Module was inserted in the wrong slot.	
	Red		--	Internal errors	See module's diagnostic log
	Red		Green	The module status display and the terminal status display on the relevant output flash synchronously Short circuit (voltage output), load breakage (current output)	See module's diagnostic log
	Red		--	Temperature warning: Too warm (1)	See module's diagnostic log
	Red		Red	The module status display and all terminal status displays flash synchronously Periphery supply is missing/temperature error: Too hot (1)/EMC error	See module's diagnostic log

9 Technical details

General	
Certifications	**CE, UKCA**
Application range	**Standard**
Module's device code	**0028h**
Number of ST output bits	**64**
Number of ST status bits	**4**
Electrical data	
Internal supply voltage (module supply)	
Module's power consumption	**0,18 W**
Periphery's supply voltage (periphery supply)	
Module's power consumption with no load	**1,5 W**
Max. power dissipation of module	**1,8 W**
Analogue outputs	
Number of analogue outputs	**4**
Type of analogue outputs	**Voltage, current**
Resolution (without sign bit)	**16 Bit**
Voltage output	
Output range	**0 .. 10 V**
Max. short circuit current	**22 mA**
Min. permitted resistive load	**1 kOhm**
Current output	
Output range	**0 .. 20 mA**
Max. open circuit voltage	**22 V**
Max. permitted resistive load	**500 Ohm**
Deviations from the measuring range limit value	
Linearity error	**0,05 %**
Output variable error at 25 °C	**0,2 %**
Max. output variable error for EMC measurements at 25 °C	**1 %**
Temperature coefficient	**0,03 %/K**
Max. processing time tProcOM of analogue output	**0,2 ms**
Typ. processing time of the analogue output	**0,1 ms**
Environmental data	
Climatic suitability	**EN 60068-2-1, EN 60068-2-14, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78**
Ambient temperature	
In accordance with the standard	**EN 60068-2-14**
Temperature range	**0 - 60 °C**
Storage temperature	
In accordance with the standard	**EN 60068-2-1/-2**
Temperature range	**-40 - 70 °C**

Environmental data	
Climatic suitability	
In accordance with the standard	**EN 60068-2-78**
Humidity	**93 % r. h. at 40 °C**
Condensation during operation	**Not permitted**
Max. operating height above sea level	**2000 m**
EMC	**EN 61131-2 (Zone B)**
Vibration	
In accordance with the standard	**EN 60068-2-6**
Frequency	**8,4 - 150 Hz**
Acceleration	**10 m/s²**
Shock stress	
In accordance with the standard	**EN 60068-2-27**
Acceleration	**150 m/s²**
Duration	**11 ms**
Airgap creepage	
In accordance with the standard	**EN 61131-2**
Overvoltage category	**II**
Pollution degree	**2**
Protection type	
In accordance with the standard	**EN 60529**
Housing	**IP20**
Mounting area (e.g. control cabinet)	**IP54**
Potential isolation	
Potential isolation between	**Analogue output and Module Supply**
Type of potential isolation	**Functional insulation**
Rated surge voltage	**2500 V**
Potential isolation between	**Analogue output and Periphery Supply**
Type of potential isolation	**Functional insulation**
Rated surge voltage	**2500 V**
Potential isolation between	**Periphery supply and module supply**
Type of potential isolation	**Functional insulation**
Rated surge voltage	**2500 V**
Mechanical data	
Material	
Housing	**PC**
Mounting type	**plug-in**
Dimensions	
Height	**110,8 mm**
Width	**12,5 mm**
Depth	**72,5 mm**
Weight	**40 g**

Where standards are undated, the 2015-08 latest editions shall apply.

10 Order reference

10.1 Product

Product type	Features	Order no.
PSS u2 ES 4AO U/I	Standard electronic module to output analogue signals	328551

10.2 Accessories

Terminal block

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

Labelling bracket

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

Label holder for terminal block

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

Coding elements

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

Backplanes

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

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

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
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