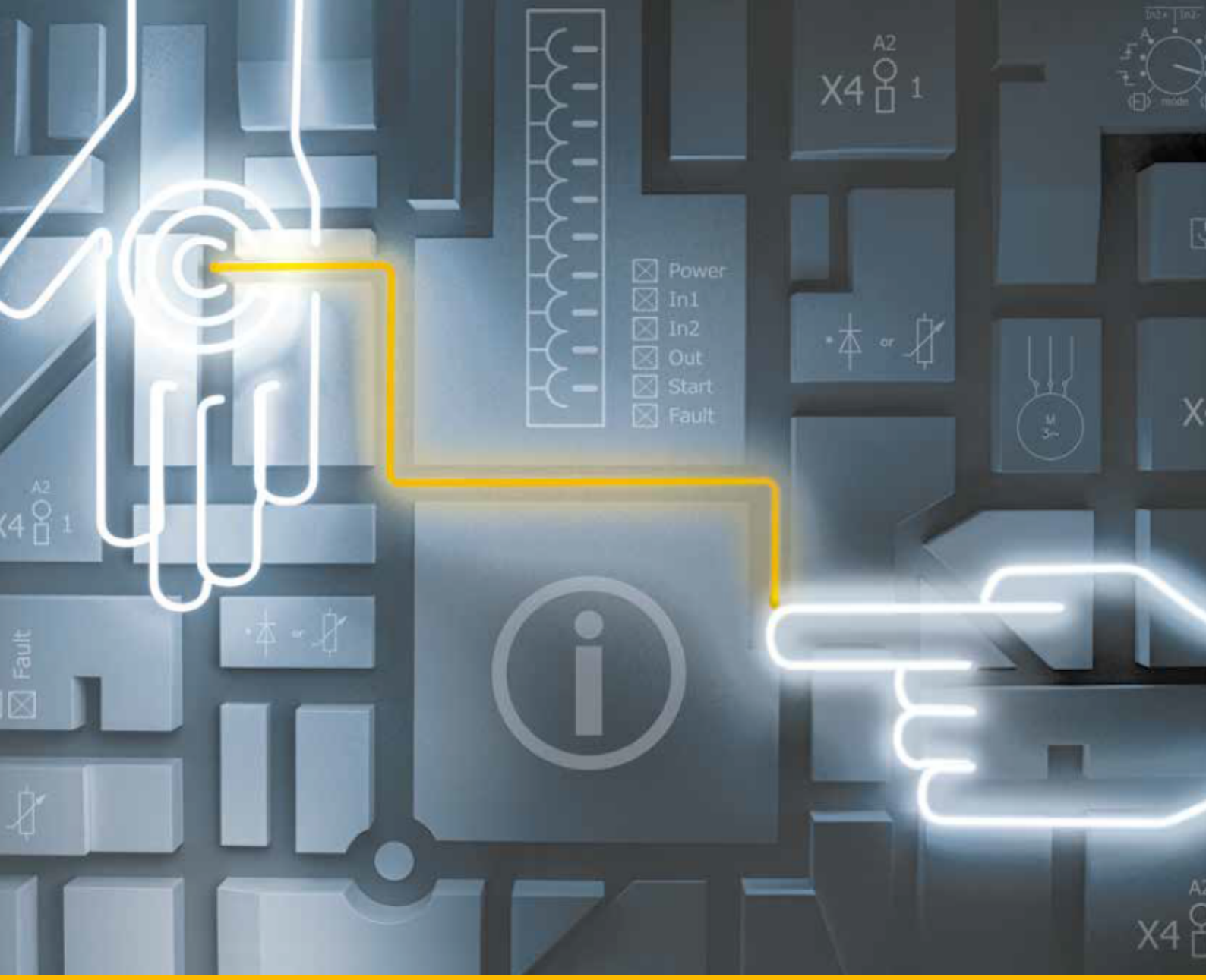


PSS u2 EF 8DI (-R)

PILZ
THE SPIRIT OF SAFETY

Operating Manual-1003619-EN-06

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

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 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.

1.2 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 EF 8DI from Version HW 01.00, FW 01.02.00. It is valid until new documentation is published.

This documentation is valid for the product PSS u2 EF 8DI -**R** ab Version HW 01.00, FW 01.02.00. It is valid until new documentation is published.

1.3 Terminology

PSS u2 system

System from a PSS u2 head module and PSS u2 electronic modules.

Remote I/O system PSS u2

PSS u2 system without control functionality that provides I/Os. The I/Os can be controlled via a fieldbus.

The configuration is performed in the tool PASconfig.

PSS u2 in the automation system PSS 4000

PSS u2 system with control functionality that can be used in the automation system PSS 4000. A PSS u2 system is a 2nd generation device in the automation system PSS 4000.

The configuration is performed in the tool PAS4000.

1.4 Definition of symbols

Information that is particularly important is identified as follows:

DANGER!

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

WARNING!

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

CAUTION!

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

NOTICE

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

INFORMATION

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

1.5 Third-party manufacturer licence information

This product includes Open Source software with various licenses.

Further information is available in the document "Third-party manufacturer licence information PSS u2 EF 8DI (-R)" (document number 1006609) at .www.pilz.com.

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 EF 8DI (-R):

Electronic module with digital inputs for failsafe applications

The product has the following features:

- 8 type 1/3 digital inputs in accordance with IEC 61131-2
  - Configurable input filter time: 0 … 10.0 ms
  - Configurable pulse stretching: 0 … 255 ms
  - Configurable discrepancy monitoring 10 … 30000 ms
- 4 Test pulse outputs
  - for module PSS u2 EF 8DI

    Configurable max. test pulse duration: 0.3 … 10.0 ms
  - for module PSS u2 EF 8DI **-R**

    Configurable max. test pulse duration: 0.5 … 10.0 ms
  - Short circuit proof
  - Can be configured either as:

    Test pulse outputs

    Voltage outputs (periphery supply)

    Switched-off outputs
- Energy-saving functions
- LEDs for:
  - Status of inputs
  - Status of test pulses
  - Module error
  - Operating status
- **R-type**:
  For railway applications (increased environmental requirements)

2.2 Side view right

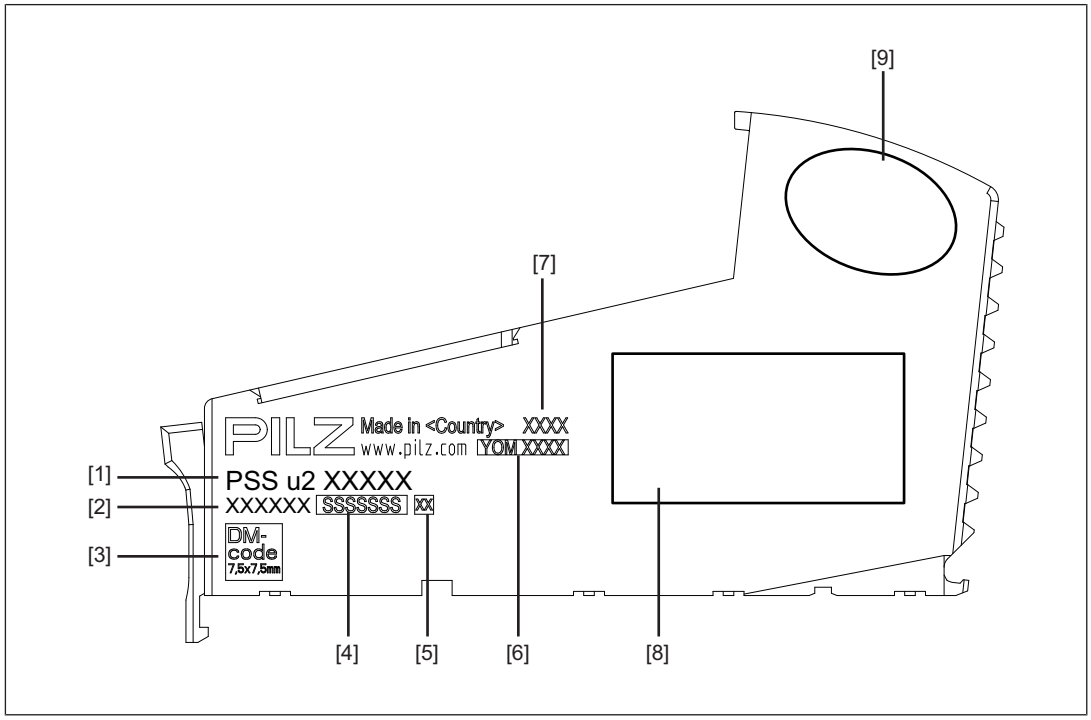


Fig.: Electronic module without terminal block, side view

Legend

[1]	Product Name
[2]	Order number
[3]	2D code product information
[4]	Serial number
[5]	Hardware version
[6]	"YOM" year of manufacture
[7]	Production site
[8]	Placeholder for block diagram
[9]	Placeholder for approval tags

3 Safety

3.1 Intended use

The module provides failsafe type 1/3 inputs in accordance with IEC 61131-2 and may be used for failsafe applications in the following PSS u2 systems (see Terminology [📖 5]):

- Remote I/O system PSS u2
- PSS u2 in the automation system PSS 4000 (generation 2)

Install the module/the safety controller in a protected environment. Example: Protected inside space or control cabinet with protection class see Technical details [📖 38]. Make sure that only authorised personnel have access to the safety controller.

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 EF 8DI (-R) may be used in conjunction with the following terminal block:

- 16-pin terminal block

Module for applications in an industrial environment

Module PSS u2 EF 8DI

The module meets the requirements of EN IEC 61508 up to SIL 3 and EN ISO 13849-1 up to PL e.

Module for railway applications R-type

Module PSS u2 EF 8DI **-R**

- The module is suitable for use in railway applications (where there are increased environmental requirements) (see Technical details [📖 38]).
- Condensation during operation is permitted for the module.
- The module must only be installed on the carrier module PSS u2 B 4 **-R**.
- Depending on the selected railway architecture (see system description Safety architectures for railway applications (1006614)) the requirements of EN 50129 up to SIL 3 or SIL 4.

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 [📖 43]).

3.2 System requirements (remote I/O system PSS u2)

INFORMATION

The module is supported by

- PASconfig from Version 3.0.0
  - We recommend that you always use the latest version (download from www.pilz.com).

3.3 System requirements (PSS u2 in automation system PSS 4000)

INFORMATION

The module is supported by

- PAS4000, from Version 1.25.0
  - We recommend that you always use the latest version (download from www.pilz.com).

3.4 Safety regulations

3.4.1 Additional documents that apply

Please read and take note of the following documents:

- Installation Manual remote I/O system PSS u2 (1004152)
- Installation Manual PSS u2 in the automation system PSS 4000 (1006253)
- System Description PSS 4000 (1001467)
- Safety Manual PSS 4000 (1001468)

With railway applications it also important to note:

- System description safety architectures for railway applications (1006614)

You will need to be conversant with the information in these documents in order to fully understand this operating manual.

3.4.2 Safety assessment in an industrial environment (remote I/O system PSS u2)

Before using a device, a safety assessment in accordance with the Machinery Directive is required.

The product as an individual component fulfils the functional safety requirements in accordance with EN ISO 13849 and EN IEC 62061. However, this does not guarantee the functional safety of the overall plant/machine. To achieve the relevant safety level of the overall plant/machine's required safety functions, each safety function needs to be considered separately.

3.4.3 Safety assessment in railway applications (PSS u2 in the automation system PSS 4000)

Before using a device, a safety assessment with risk assessment and risk analysis is required.

Using the architectures defined in the system description "Safety architectures for railway applications", the product fulfils the functional safety requirements in accordance with EN 50126/EN 50129. However, this does not guarantee the functional safety of the overall railway application/plant. To achieve the relevant safety level of the overall railway application's/plant's required safety function, each safety function needs to be considered separately.

3.4.4 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.

3.4.5 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.).

3.4.6 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).

3.5 Sensors

The module PSS u2 EF 8DI (-R) **does not detect** the failure of the sensor (e.g. loss of switchability).

Therefore, the user must

- select a sensor whose safety characteristic data reach the required safety characteristic data of the application. Depending on the application, the operator must be required to perform a regular function test of the sensor OR
- have an expectation of the sensor, preform plausibility test in the user program and react accordingly OR
- use a dual-channel sensor.

The module PSS u2 EF 8DI (-R) **does not detect** a short circuit between supply line and the signal line of the sensor (short out the sensor).

Therefore, the user must

- have an expectation of the sensor signal, perform plausibility test in the user program and react accordingly OR
- use a dual-channel sensor OR
- exclude short circuits.

4 Security

To secure plants, systems, machines and networks against cyberthreats it is necessary to implement (and continuously maintain) an overall industrial security concept that is state of the art.
Perform a risk assessment in accordance with VDI/VDE 2182 or IEC 62443-3-2 and plan the security measures with care. If necessary, seek advice from Pilz Customer Support.

4.1 Security (remote I/O system PSS u2)

Further information on Security can be found in the operating manuals of the relevant head modules.

4.2 Security (PSS u2 in the automation system PSS 4000)

Further information on Security can be found in the system description PSS 4000 (1001467).

5 Function description

5.1 Block diagram

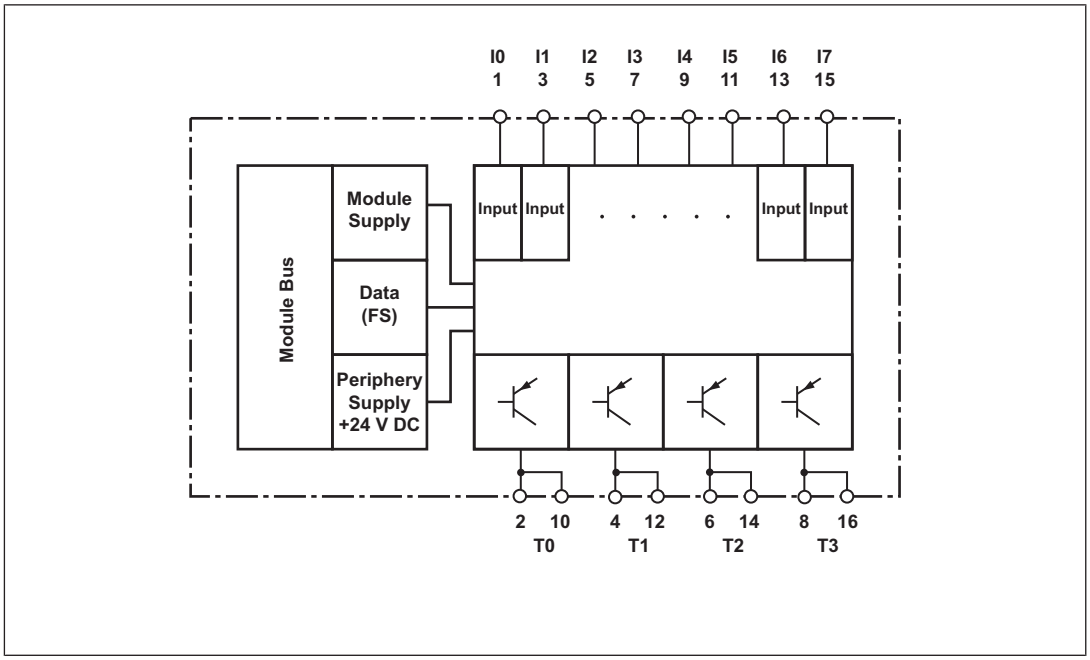


Fig.: Block diagram PSS u2 EF 8DI (-R)

5.2 Supply

- The module is supplied with voltage via the head module/main voltage supply PSS u2 PS1 -R connected to the head module.
- The periphery supply is used to supply the sensors and test pulses.
- The module routes the periphery supply from the backplane to the terminal block.

When the supply voltage for the periphery supply is interrupted, the periphery supply is buffered for 20 ms. The buffering is designed for the input currents.

5.3 Inputs

- The status of the inputs is signalled to the head module via the module bus.
- The inputs are fitted with a configurable software filter.
- Pulse stretching can be configured for the inputs.
- The maximum test pulse duration can be configured for the inputs.
- Discrepancy monitoring can be configured for the inputs.

Pulse stretching:

The module stretches a 1-signal or 0-signal at the input terminals to the configured pulse stretch time $t_{stretch.}$ If the signal is longer than the pulse stretch time, then it is not stretched any further.

Signal requirements at the terminals:

The 0-signal and the subsequent 1-signal together must be present at the input for longer than twice the configured pulse stretch time $t_{stretch}$.

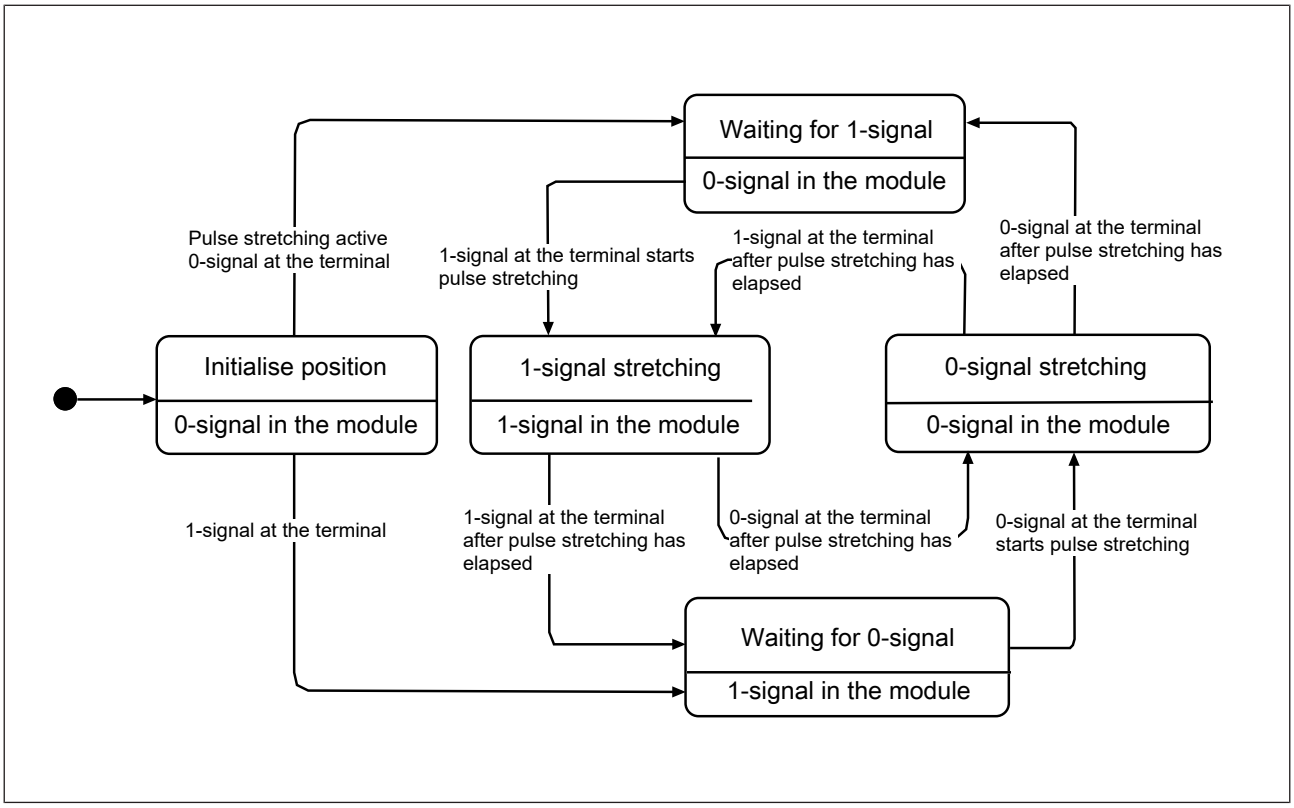


Fig.: States for pulse stretching

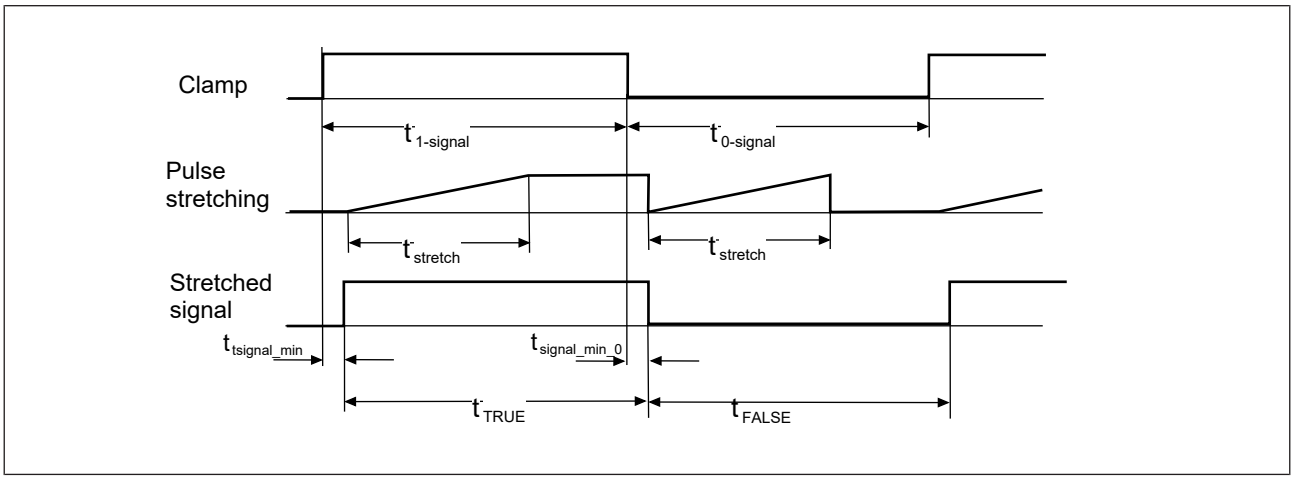


Fig.: Timing diagram: pulse stretching ≤ signal duration of 1-signal

Legend

Clamp	Signal at the terminal
Pulse stretching	Pulse stretching
Stretched signal	Stretched signal
$t_{1\text{-signal}}$	Duration of 1-signal
$t_{stretch}$	Duration of pulse stretching

$t_{signal\_min\_0}$ Time for which a 0-signal must be present in order to be detected safely

t_{signal_min} Time for which a 1-signal must be present in order to be detected.

t_{TRUE} Stretched 1-signal in the module

t_{FALSE} Stretched 0-signal in the module

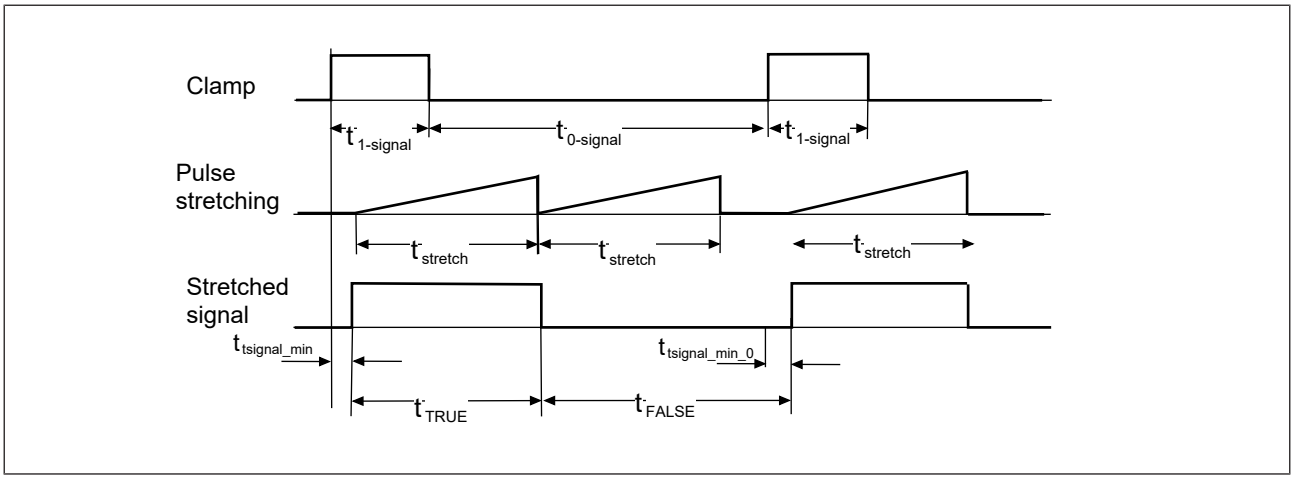


Fig.: Timing diagram: pulse stretching > signal duration of 1-signal

Legend

Clamp Signal at the terminal

Pulse stretching Pulse stretching

Stretched signal Stretched signal

$t_{1\text{-signal}}$ Duration of 1-signal

$t_{stretch}$ Duration of pulse stretching

$t_{signal\_min\_0}$ Time for which a 0-signal must be present in order to be detected safely

t_{signal_min} Time for which a 1-signal must be present in order to be detected.

t_{TRUE} Stretched 1-signal in the module

t_{FALSE} Stretched 0-signal in the module

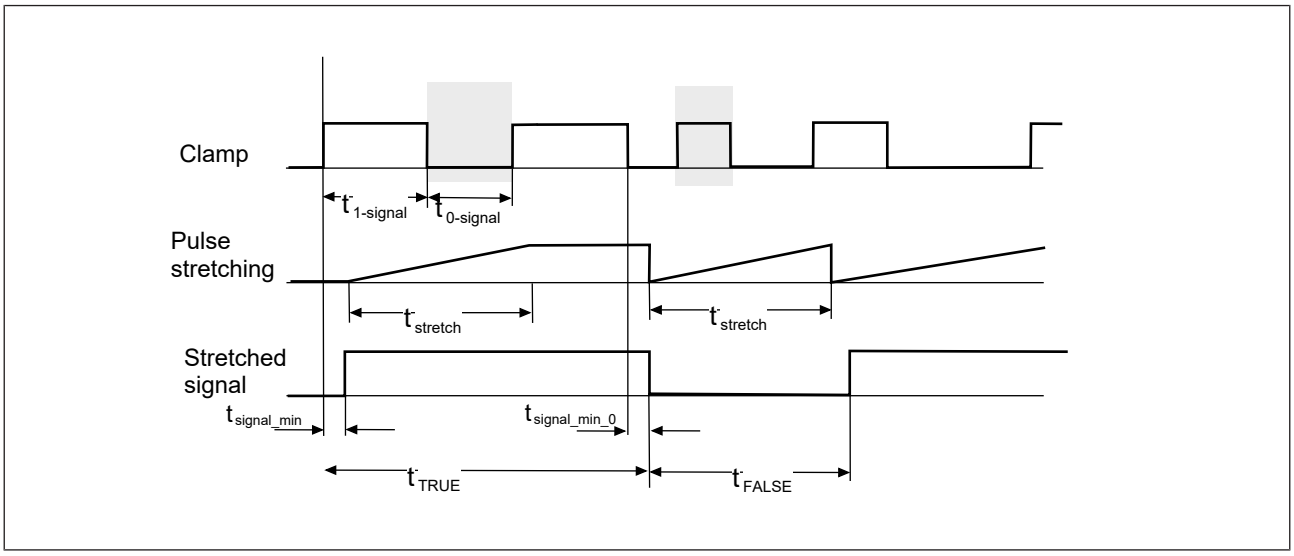


Fig.: Timing diagram: pulse stretching with variable signal duration

Legend

Clamp	Signal at the terminal
Pulse stretching	Pulse stretching
Stretched signal	Stretched signal
$t_{1\text{-signal}}$	Duration of 1-signal
$t_{stretch}$	Duration of pulse stretching
$t_{signal\_min\_0}$	Time for which a 0-signal must be present in order to be detected safely
t_{signal_min}	Time for which a 1-signal must be present in order to be detected.
t_{TRUE}	Stretched 1-signal in the module
t_{FALSE}	Stretched 0-signal in the module

Pulse duration

The specified times apply to the signal processing in the electronic module.

For the signal processing in a controller[1] the times documented for the relevant systems apply.

Calculation of the minimum signal duration t_{signal_min} and $t_{signal\_min\_0}$

$t_{signal\_min} = t_{signal\_min\_0} = 1\ ms + t_{TestPulse} + t_{SW\ filter}$

$t_{TestPulse}$: Configured test pulse duration

$t_{SW\ filter}$: Configured software filter time

Any signals that are shorter than the maximum signal suppression time $t_{signal\_sup\_max}$ are filtered out.

$t_{signal\_sup\_max} = t_{SW\ filter} - 200\ \mu s$

[1] **Pulse duration, PSS u2 in the automation system PSS 4000**

In the automation system PSS 4000 the entire system must be considered, see System Description PSS 4000 (1001467).

Discrepancy monitoring

- Discrepancy monitoring monitors signals at the inputs of a terminal pair. A terminal pair consists of two consecutive inputs, e.g. I0 and I1.
- 2-channel equivalent or non-equivalent sensors can be connected to a terminal pair.
- The process image during the discrepancy time can be configured. The configured value will be in the PII, provided:
  - The discrepancy exists
  - The maximum duration of discrepancy monitoring has not elapsed.

  Configuration options:
  - Set the value for the terminal pair in the PII to "0"
  - Retain the last valid value in the PII. The last valid value for the lower order input of a terminal pair (in this example input I0) before the discrepancy arose is evaluated.

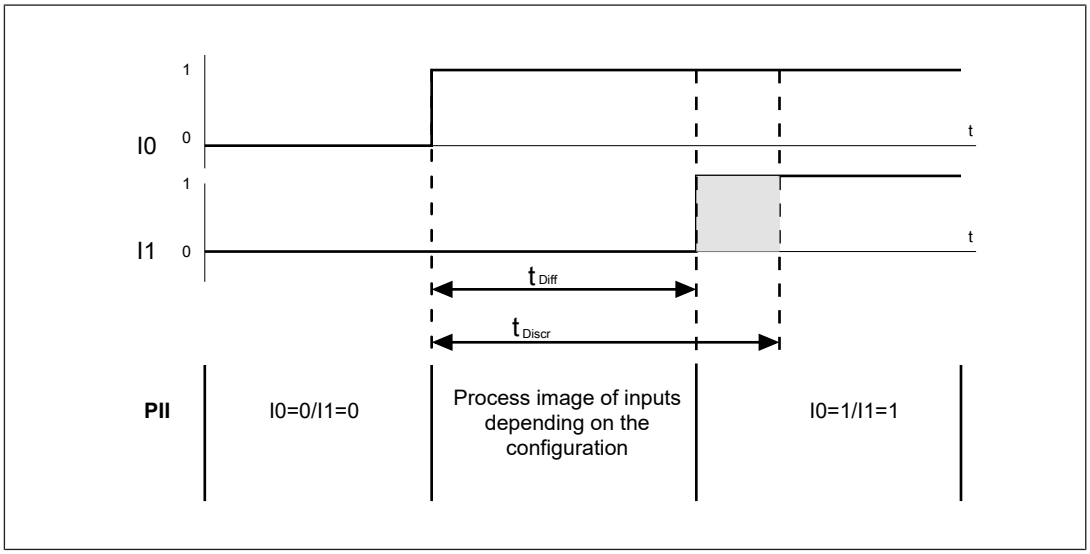


Fig.: Example for discrepancy monitoring of equivalent signals

Legend

I0	Input I0
I1	Input I1
PII	Process image of inputs
t_{Diff}	Time difference between the two input signals Discrepancy monitoring is retriggered as soon as both signals are as expected. During this time, the PII depends on the configuration: ▸ Keep last valid value: I0=0 (I1 is not evaluated) ▸ Set value to "0": I0=0/I1=0
t_{Discr}	Configurable maximum duration of discrepancy monitoring If the configured duration has elapsed and the expected signals are not present, then a discrepancy error is reported and the PII is set to "0/0".

Behaviour in the event of a discrepancy error

An error message is issued for each input of a terminal pair. Both errors take into account the last valid state of both inputs before the discrepancy time elapsed.

Reintegration after a discrepancy error

After an error, discrepancy monitoring will either start automatically as soon as there is no longer a discrepancy or it will start with a restart interlock, depending on the configuration.

- ***Without restart interlock*** (no acknowledgement required)

  As soon as there is no longer a discrepancy, monitoring begins again

- ***With restart interlock*** (acknowledgement required)

  Equivalent sensor:

  A "0" signal must be present at both inputs in a discrepancy group in order to start a new monitoring task.

  Antivalent sensor:

  Within a discrepancy group, a "0" signal must be present at the input with the lower terminal number and a "1" signal must be present at the input with the higher terminal number.

  Example:

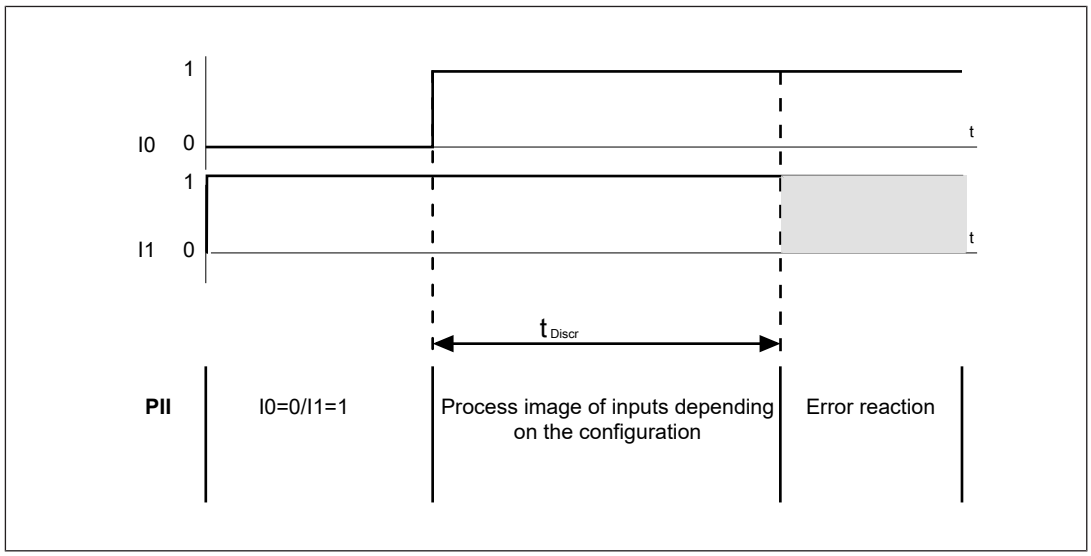
  Terminal pair 01:

  "0" signal at terminal 0 and "1" signal at terminal 1

  Terminal pair 23

  "0" signal at terminal 2 and "1" signal at terminal 3

Example 1: Sensor type is configured as "non-equivalent".



Legend

I0 Input I0

I1 Input I1

PII Process image of inputs

t_{Discr} Maximum duration of discrepancy monitoring

The PII during this time depends on the configuration:

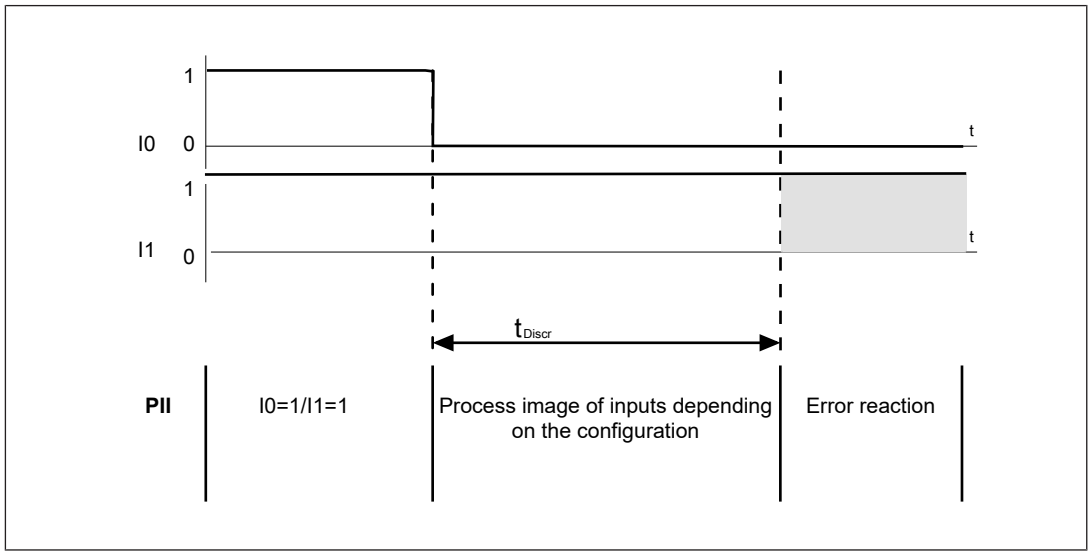
- Keep last valid value: I0=0 (I1 is not evaluated)
- Set value to "0": I0=0/I1=0

Error messages:

Input I0: Discrepancy error. Signal at input I0 is "1"

Input I1: Discrepancy error. Signal at input I1 is "1"

Example 2: Sensor type is configured as "equivalent".



Legend

I0 Input I0

I1 Input I1

PII Process image of inputs

t_{Discr} Maximum duration of discrepancy monitoring

During this time the process image of inputs depends on the configuration:

- Keep last valid value: I0=1 (I1 is not evaluated)
- Set value to "0": I0=0/I1=0

Error messages:

Input I0: Discrepancy error. Signal at input I0 is "0"

Input I1: Discrepancy error. Signal at input I1 is "1"

5.4 Test pulse outputs

- Test pulses are used to detect shorts between inputs and to detect short circuits to 24 V. Shorts between inputs and short circuits to 24 V are detected when
  - the test pulses are different (test pulse 0, test pulse 1) or when
  - the test pulses originate from other modules on the PSS u2 system.
- Shorts between inputs of the same module with the same test pulses will not be detected.
- The test pulses are assigned to the following inputs in the default setting:
  - T0: I0 and I4
  - T1: I1 and I5
  - T2: I2 and I6
  - T3: I3 and I7
- Inputs may only be wired to test pulses of the same module.
- Inputs for which the "No test pulse" option is configured should not be connected to a test pulse that has already been assigned to another input on the module as test pulse. Otherwise, the test pulses can be detected in the process image, depending on the configured input filter time and test pulse duration.
- Example of an unfavourable test pulse assignment

Configuration in the tool	Wiring
The option "**No test pulse assigned**" is selected for I1	I1 with test pulse 1 **(T1)**
The option "Test pulse 1 **(T1)**" is selected for I3	I3 with test pulse 1 **(T1)**

If a test pulse is assigned to an input, a test pulse is generated at the test pulse output.

As I3 is assigned to T1, a test pulse is generated at test pulse T1.

If I1 is wired to T1, although the option "No test pulse assigned" is selected in the configuration, then the test pulse T1 can be detected unintentionally in the process image, depending on the configured input filter time and test pulse duration.

- The periphery supply will constantly be available at the test pulse outputs if they have not been assigned to an input (option ***24 V*** in the configuration tool).
- The test pulses can be switched off if they are not assigned to an input. The test pulse outputs are then high impedance to the periphery supply (option ***High impedance HiZ*** in the configuration tool).
- The maximum test pulse duration can be configured:
  - for module PSS u2 EF 8DI

    Configurable max. test pulse duration: 0.3 … 10.0 ms
  - for module PSS u2 EF 8DI **-R**

    Configurable max. test pulse duration: 0.5 … 10.0 ms
  - Default setting: 3 ms.

5.5 Integrated protection mechanisms

Test pulse signals are buffered for a minimum of 20 ms. The buffering is designed for the input currents for the supply via the test pulse outputs.

The module provides the following diagnostic data:

- Start-up error
- Configuration error
- FS communication error
- Temperature error: too warm, too hot
- Test pulse error
- Errors that are detected through test pulses

5.6 Reaction times

Calculation of the processing times for dual-channel signals (pulse stretching is not considered).

Worst Case Delay Input

Calculation of the time between a signal changing at the input and the signal being available at the module bus interface:

$t_{ProcIM\_wcd} = 1\ ms + t_{TestPulse} + t_{SW\ filter} + t_{Discr}$

$t_{TestPulse}$: Configured test pulse duration

$t_{SW\ filter}$: Configured software filter time

t_{Discr}: Configured discrepancy time

When test pulses are deactivated

$t_{TestPulse} = 0$

When discrepancy monitoring is deactivated

$t_{Discr} = 0$

When discrepancy monitoring is activated and behaviour at discrepancy is "Set value to zero"

- Signal changes from "1" to "0":

  $t_{Discr} = t_{TestPulse} = 0$
- Signal changes from "0" to "1":

  t_{Discr}: Configured discrepancy time

When discrepancy monitoring is activated and behaviour at discrepancy is "Keep last valid value"

- Signal changes from "1" to "0"

  t_{Discr}: Configured discrepancy time
- Signal changes from "0" to "1":

  t_{Discr}: Configured discrepancy time

One Fault Delay Input

Calculation of the time between a signal changing at the input and the signal being available at the module bus interface when a fault occurs:

$t_{ProcIM\_ofd} = t_{ProcOM\_wcd} + t_{TestPulse}$

When test pulses are deactivated

$t_{TestPulse} = 0$

5.7 Energy-saving functions

The energy levels are supported by the head module and are not configurable. The module supports the following energy levels:

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

– Switching off the LEDs that display the terminal status

6 Structure of the process image (Remote I/O system PSS u2)

When the electronic module is used in the remote I/O system, the data described below are available.

FS-PII

The module occupies 2 Byte in the process image of inputs.

Byte	Bit	Meaning
0	0	Input data I0
0	1	Input data I1
0	2	Input data I2
0	3	Input data I3
0	4	Input data I4
0	5	Input data I5
0	6	Input data I6
0	7	Input data I7
1	0	Valid bit of input I0
1	1	Valid bit of input I1
1	2	Valid bit of input I2
1	3	Valid bit of input I3
1	4	Valid bit of input I4
1	5	Valid bit of input I5
1	6	Valid bit of input I6
1	7	Valid bit of input I7

7 I/O data of the module (PSS u2 in the automation system PSS 4000)

When the electronic module for PSS u2 is used in the automation system PSS 4000, the data described below are available.

7.1 Available I/O data in the I/O mapping

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

I/O data name	I/O data type	Data element: Data type	Meaning
I0(1)	FS_I_DI	Data: SAFEBOOL	Input data I0
I1(3)	FS_I_DI	Data: SAFEBOOL	Input data I1
I2(5)	FS_I_DI	Data: SAFEBOOL	Input data I2
I3(7)	FS_I_DI	Data: SAFEBOOL	Input data I3
I4(9)	FS_I_DI	Data: SAFEBOOL	Input data I4
I5(11)	FS_I_DI	Data: SAFEBOOL	Input data I5
I6(13)	FS_I_DI	Data: SAFEBOOL	Input data I6
I7(15)	FS_I_DI	Data: SAFEBOOL	Input data I7

7.2 Other I/O data

In addition to the I/O data available via I/O mapping, it is possible to access further I/O data in the user program:

- Valid bit of input I0
- Valid bit of input I1
- Valid bit of input I2
- Valid bit of input I3
- Valid bit of input I4
- Valid bit of input I5
- Valid bit of input I6
- Valid bit of input I7

In the Multi programming, access is via the PSS 4000 system control block "Valid".

In IEC 61131 programming, access is via the variable extension "WITH VALID".

8 Installation

8.1 General installation guidelines

NOTICE

R-type electronic modules may only be installed on R-type backplanes.

CAUTION!

Risk of material damage

The incorrect ambient temperature during assembly/dismantling can lead to material damage.

– Comply with the permitted ambient temperature for assembly/dismantling: -20°C … +45°C

CAUTION!

Risk of material damage

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.

8.1.1 Dimensions

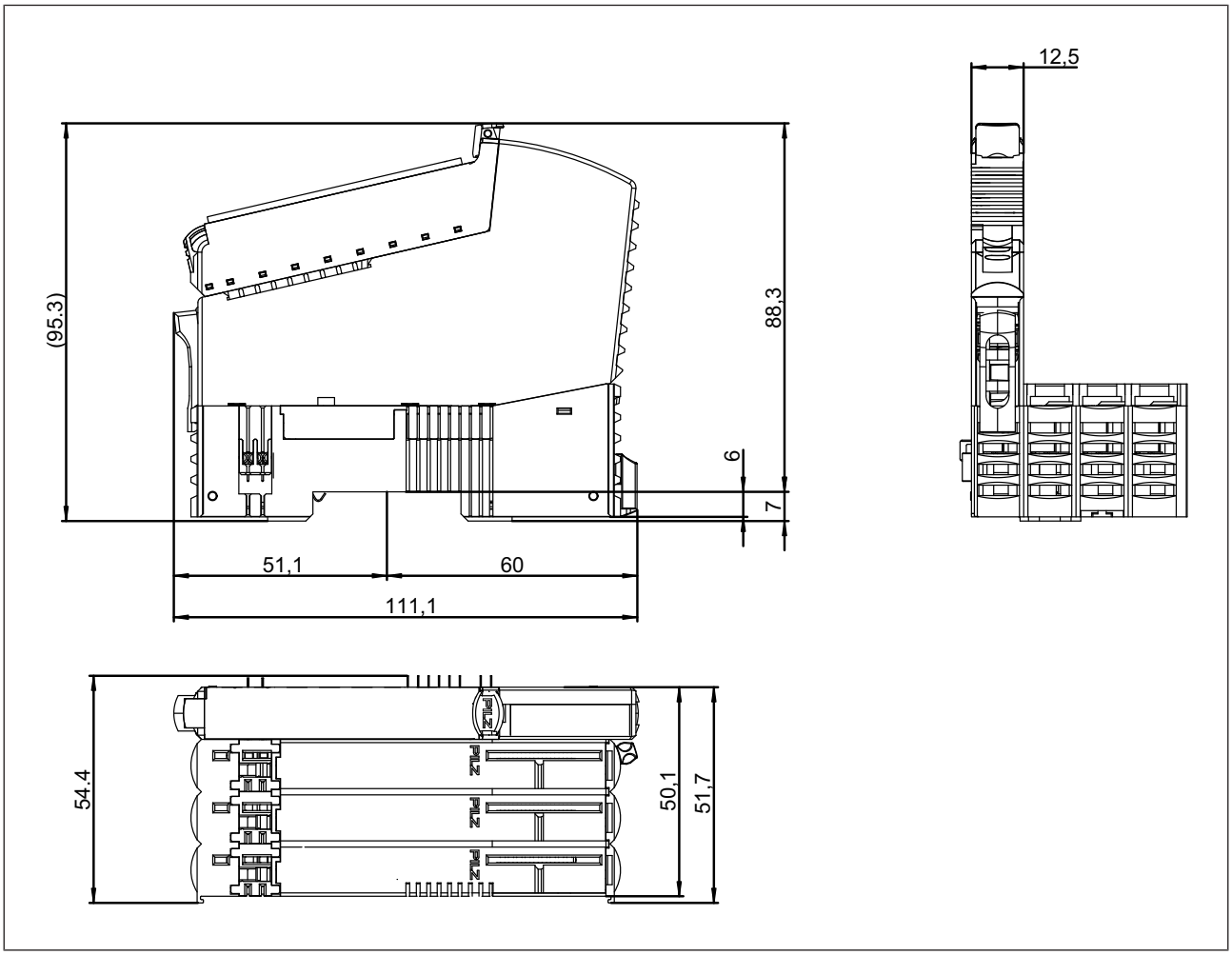


Fig.: Dimensions in mm, including backplane, electronic module and terminal block

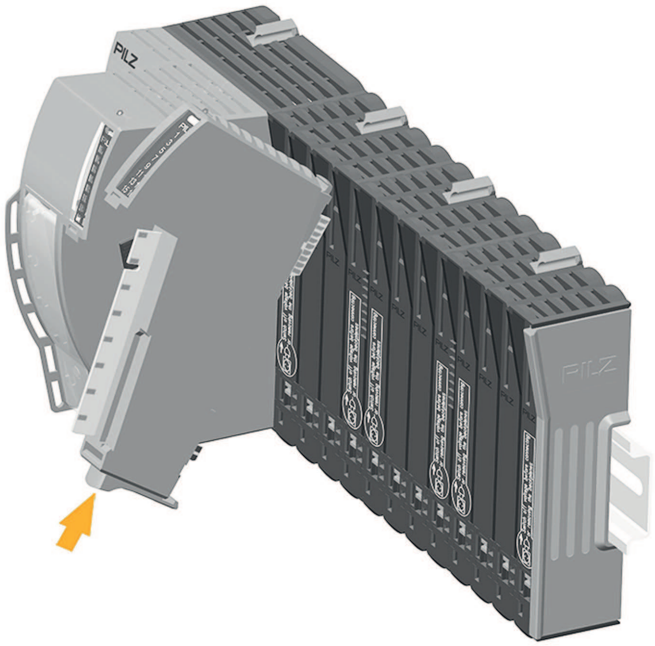
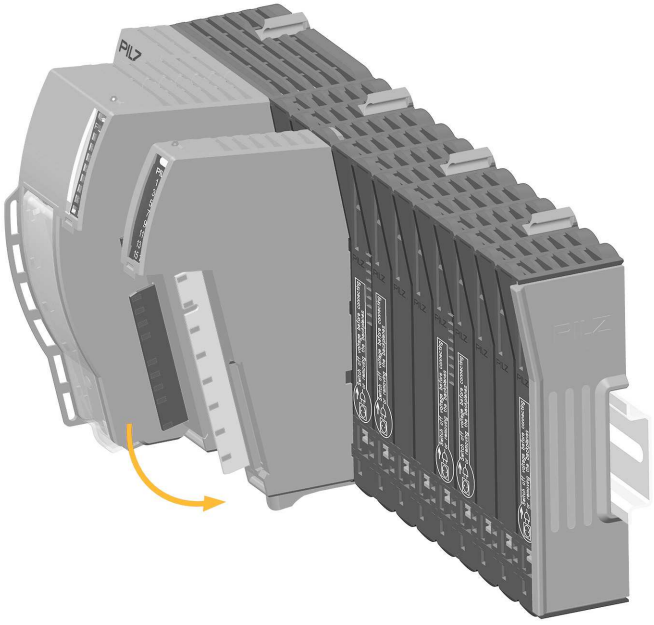
8.2 Inserting and removing an electronic module

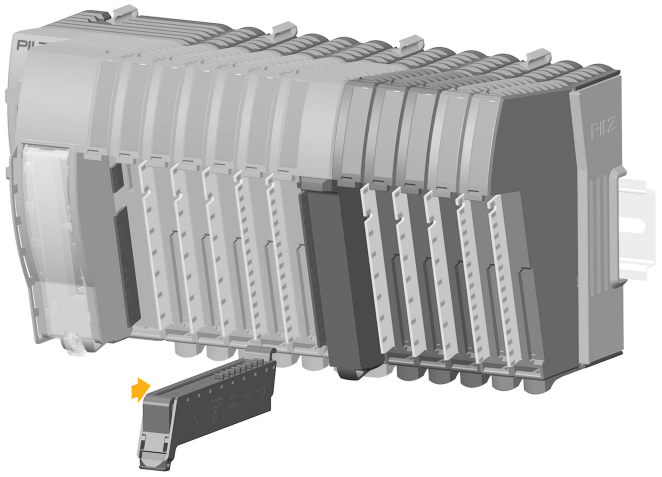
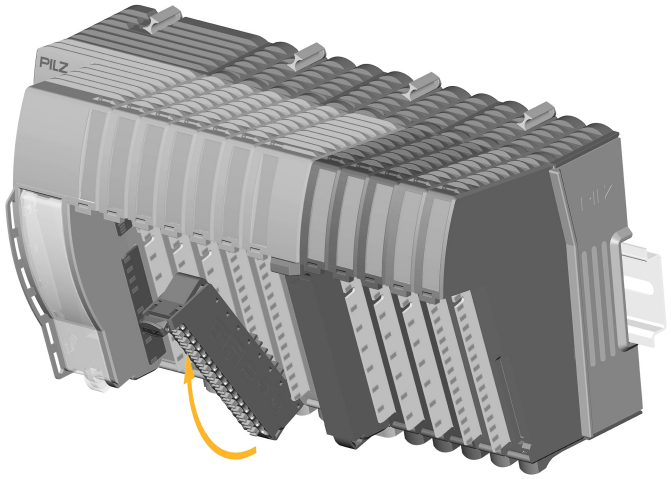
Please note:

- 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.

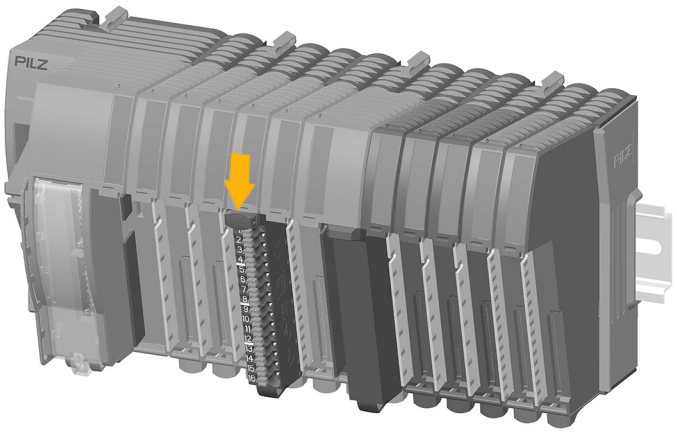
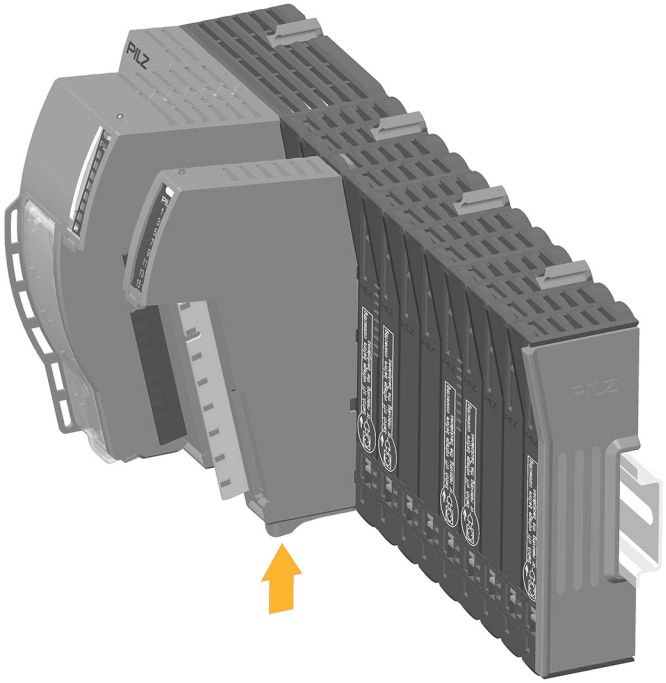
The following illustrations in chapters "Inserting an electronic module", "Removing an electronic module" and "Changing an electronic module during operation" are displayed as an example in the remote I/O system PSS u2 (see Terminology [📖 5]).

8.2.1 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.	

8.2.2 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.	

8.2.3 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 remain (exchange of an electronic module with identical order number).
- The module is detected automatically as soon as the module is re-inserted.

Procedure

1. Removing an electronic module
2. Inserting an electronic module

A new electronic module can be inserted during operation.

Procedure (inserting an electronic module with not identical order number)

- Inserting an electronic module

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 (supply voltage on/off) or Warm Reset using the Reset pushbutton.

9 Wiring

9.1 General wiring guidelines

Please note:

- Appropriate wiring must be used to exclude short circuits between the test pulse outputs and corresponding inputs!
- If test pulses are not used, appropriate wiring must be used to exclude short circuits between the inputs or to a supply line!
- The cable runs for the test pulses may be max. 1000 m.
- Signal lines do not have to be shielded.
- Use copper wiring.

9.1.1 Connection mechanism for terminal blocks

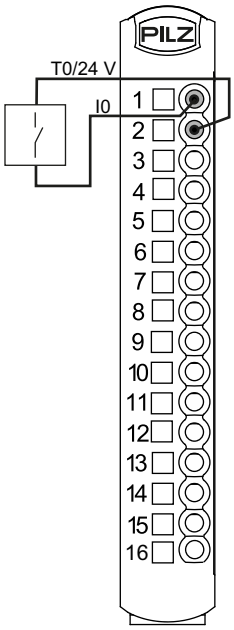
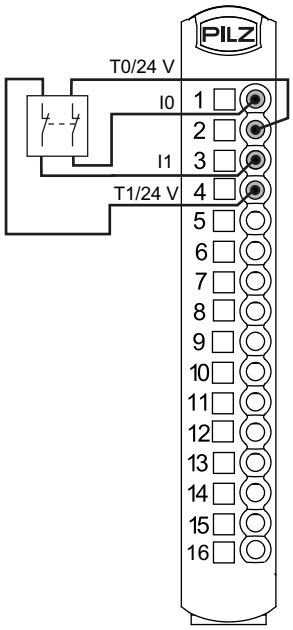
Procedure:

- Use a flat head screwdriver.
- Strip the wire back 9 mm.
- Feed the stripped cable as far as it will go into the opening for the spring-loaded terminal.
- Check that the cable is firmly seated.

Please note:

- The minimum cable cross section for field connection terminals on the terminal blocks is 0.15 mm^2 (AWG26).
- The maximum cable cross section for field connection terminals on the terminal blocks is 1.5 mm^2 with ferrules (AWG14)
- Use copper wiring.

9.2 Terminal configuration

Terminal configuration	Connection examples	
1: Input I0 **2:** Test pulse output T0 / +24 V voltage output (periphery supply) / HiZ (voltage output switched off) **3:** Input I1 **4:** Test pulse output T1 / +24 V voltage output (periphery supply) / HiZ (output switched off) **5:** Input I2 **6:** Test pulse output T2 / +24 V voltage output (periphery supply) / HiZ (output switched off) **7:** Input I3/ **8:** Test pulse output T3 / +24 V voltage output (periphery supply) / HiZ (output switched off) **9:** Input I4 **10:** Test pulse output T0 / +24 V voltage output (periphery supply) / HiZ (output switched off) **11:** Input I5 **12:** Test pulse output T1 / +24 V voltage output (periphery supply) / HiZ (output switched off) **13:** Input I6 **14:** Test pulse output T2 / +24 V voltage output (periphery supply) / HiZ (output switched off) **15:** Input I7 **16:** Test pulse output T3 / +24 V voltage output (periphery supply) / HiZ (output switched off)	1-channel sensor Depending on the configuration with test pulses or 24 V voltage output (periphery supply)	2-channel sensor Depending on the configuration with test pulses or 24 V voltage output (periphery supply)
		

For module PSS u2 EF 8DI

To reach SIL 3 of the safety characteristic data, input signals have to be executed dual-channel. The discrepancy analysis must be configured in accordance with the connected sensor and the safety function requirements.

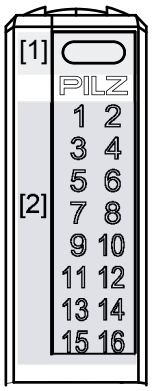
For module PSS u2 EF 8DI -R

To reach SIL 3 or SIL 4 of the safety characteristic data, please note the architecture specifications in the system description Safety architectures for railway applications.

10 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.

10.1 Display elements and messages



Legend

[1] Module status display

[2] Terminal status display

The module can detect the following module states:

[1]	Colour [1]	[2]	Colour [2]	Meaning	Further information
●	--	●		Module not ready for operation	
◐	Green	●		Module ready for operation	
✳	Green	✳	Green	Module in operation and there is a "1"-signal at terminal [2]	
✳	Green	●	--	Module in operation and there is a “0"-signal at terminal [2]	
◐	Red	●	--	Configuration error Module was inserted in the wrong slot.	
✳	Red	●	--	Internal error/firmware update	See module's diagnostic log

[1]	Colour [1]	[2]	Colour [2]	Meaning	Further information
	Red		Green	The module status display and terminal status display of the relevant test pulse and affected inputs flash synchronously: ▸ Short circuit of test pulses to 24 V/ short circuit between the test pulses/ short circuit to earth/overload of test pulses/error in the test pulse wiring The module status display and terminal status of the relevant terminal pair displays flash synchronously: ▸ Discrepancy error	See module's diagnostic log
	Red		Green	Temperature error: too warm[1]/ warning e.g. undervoltage	See module's diagnostic log
	Red		Green	The module status display and all terminal status displays flash synchronously Temperature error: too hot[1]/Periphery supply missing/FS error	See module's diagnostic log

Legend

 LED on

 LED flashes

 LED flashes

 LED off

[1] There are two levels of overtemperature.

▸ Too warm:

If the module temperature exceeds a threshold value, then:

– a warning is sent to the head module.

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

▸ Too hot:

If the module temperature exceeds another threshold value, then:

– an error message is sent to the head module

– the FS inputs in the PII are set to "0".

– the valid bits for the inputs are set to "0"

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

11 Technical details

General	328101	327101
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed	CE, TÜV
Application range	Failsafe	Failsafe
Module's device code	4040h	4C40h
Electrical data	**328101**	**327101**
Supply voltage		
Max. power consumption of an input	0,11 W	0,11 W
Internal supply voltage (module supply)		
Module's power consumption	0,57 W	0,57 W
Periphery's supply voltage (periphery supply)		
Module's power consumption with no load	0,29 W	0,29 W
Max. power consumption of a test pulse output	0,13 W	0,13 W
Max. power dissipation of module	2,3 W	2,3 W
Process data remote IO system PSS u2	**328101**	**327101**
Number of FS input bytes (assigned bits)	2 (16)	–
Process data PSS u2 in the automation system PSS 4000	**328101**	**327101**
Number of FS input bits	–	8
Number of FS status bits	–	8
Inputs	**328101**	**327101**
Quantity	8	8
Signal level at g0 h	-3 - +5 V DC	-3 - +5 V DC
Signal level at "1"	11 - 30 V DC	11 - 30 V DC
Voltage at inputs	24 V DC	24 V DC
Input type in accordance with EN 61131-2	3	3
Input current range	3 - 3,5 mA	3 - 3,5 mA
Potential isolation	Yes	Yes
Test pulse outputs	**328101**	**327101**
Number of test pulse outputs	4	4
Voltage, test pulse outputs	24 V DC	24 V DC
Short circuit-proof	Yes	Yes
Number of outputs that can be configured as test pulses	4	4
Max. output current at "1" signal	0,25 A	0,25 A
Potential isolation	Yes	Yes

Environmental data	328101	327101
Application site		
in accordance with the standard	–	**EN 50125-3**
Application site	–	**Track area (1 m - 3 m)**
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	**-40 - 70 °C**	**-40 - 70 °C**
Climatic suitability		
in accordance with the standard	**EN 60068-2-78**	**EN 60068-2-78**
Humidity	**93 % r. h. at 40 °C**	**95 % r. h. at 40 °C**
Condensation during operation	**Not permitted**	**EN 60068-2-30**
Max. operating height above SL	**2000 m**	**5000 m**
EMC	**EN 61131-2 (Zone B)**	**EN 50121-4, EN 61000-6-2, EN 61000-6-4, EN 61131-2 (Zone B)**
Vibration		
in accordance with the standard	**EN 60068-2-6**	–
Frequency	**8,4 - 150 Hz**	–
Acceleration	**10 m/s²**	–
Broadband noise		
in accordance with the standard	–	**EN 60068-2-64**
Frequency	–	**5 - 2.000 Hz**
Acceleration	–	**2,3 m/s² eff.**
Shock stress		
in accordance with the standard	**EN 60068-2-27**	**EN 60068-2-27**
Number of shocks	**6**	**6**
Acceleration	**150 m/s²**	**20 m/s²**
Duration	**11 ms**	**11 ms**
Airgap creepage		
in accordance with the standard	–	**EN 50124-1**
Overvoltage category	–	**OV2**
Pollution degree	–	**PD2**
in accordance with the standard	**EN 61131-2, UL/IEC 61010-2-201**	**EN 61131-2**
Overvoltage category	**II**	**II**
Pollution degree	**2**	**2**
Protection type		
in accordance with the standard	**EN 60529**	**EN 60529**
Housing	**IP20**	**IP20**
Mounting area (e.g. control cabinet)	**IP54**	**IP51**
Potential isolation	**328101**	**327101**
Potential isolation between	**Input and module supply**	**Input and module supply**

Potential isolation	328101	327101
Type of potential isolation	**Functional insulation**	**Functional insulation**
Rated surge voltage in operating heights up to max. 2000 m	**2000 V**	**2000 V**
Rated surge voltage in operating heights up to max. 5000 m	–	**1500 V**
Potential isolation between	**Test pulse output and module supply**	**Test pulse output and module supply**
Type of potential isolation	**Functional insulation**	**Functional insulation**
Rated surge voltage in operating heights up to max. 2000 m	**2000 V**	**2000 V**
Rated surge voltage in operating heights up to max. 5000 m	–	**1500 V**
Mechanical data	**328101**	**327101**
Material		
Housing	**PC**	**PC**
Mounting type	**plug-in**	**plug-in**
Dimensions		
Height	**110,8 mm**	**110,8 mm**
Width	**12,5 mm**	**12,5 mm**
Depth	**72,5 mm**	**72,5 mm**
Weight	**37 g**	**37 g**

Where standards are undated, the 2020-01 latest editions shall apply.

11.1 Safety-related characteristic data (remote I/O system PSS u2)

NOTICE

You must comply with the safety characteristic data in order to achieve the required safety level for your plant/machine.

Operating mode	EN ISO 13849-1: 2015 PL	EN ISO 13849-1: 2015 Category	EN IEC 62061 SIL CL/ maximum SIL	EN IEC 62061 PFH_D [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T_M [year]
1-channel	**PL d**	**Cat. 2**	**SIL CL 2**	**2,33E-09**	**SIL 2**	**2,04E-04**	**20**
2-channel	**PL e**	**Cat. 4**	**SIL CL 3**	**1,25E-10**	**SIL 3**	**1,09E-05**	**20**
2-ch., pulsed	**PL e**	**Cat. 4**	**SIL CL 3**	**8,40E-11**	**SIL 3**	**7,30E-06**	**20**
1-ch., pulsed light barrier	**PL e**	**Cat. 4**	**SIL CL 3**	**3,05E-10**	**SIL 3**	**2,68E-05**	**20**

Explanatory notes for the safety-related characteristic data:

- Safety characteristic data in accordance with EN IEC 62061 and EN/IEC 61511 was calculated based on EN/IEC 61508.
- T_M is the maximum mission time in accordance with EN ISO 13849-1. The value also applies as the retest interval in accordance with EN/IEC 61508-6 and EN/IEC 61511 and as the proof test interval and mission time in accordance with EN IEC 62061.

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

INFORMATION

A safety function's SIL/PL values are **not** identical to the SIL/PL values of the units that are used and may be different. We recommend that you use the PAScal software tool to calculate the safety function's SIL/PL values.

The safety-related characteristic data (PFH, PFD) are mean values. They have been calculated at an average ambient component temperature of 40 °C.

11.2 Safety-related characteristic data (PSS u2 in the automation system PSS 4000)

Safety-related characteristics of the safety outputs

Safety-related characteristic data for railway applications must be considered for the overall system, see System description for railway applications (1006614).

The mission time of the module is T_M = 20 years.

12 Supplementary data

12.1 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

13 Order reference

13.1 Product

Product type	Features	Order no.
PSS u2 EF 8DI	PSS u2, electronic module, failsafe, 8 outputs, pulse stretching, discrepancy monitoring, test pulse outputs with 24 V DC 0.25 A, configurable, short circuit proof, 1-row, terminal block PSS u2 T 16 required (not supplied with the device).	328101
PSS u2 EF 8DI -R	PSS u2, electronic module, failsafe, 8 outputs, pulse stretching, discrepancy monitoring, test pulse outputs with 24 V DC 0.25 A, configurable, short circuit proof, 1-row, for increased environmental requirements and railway applications, terminal block PSS u2 T 16 required (not supplied with the device).	327101

13.2 Accessories

Terminal block

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

Labelling bracket

Product type	Features	Order no.
PSS u2 A LC E1 (10 pcs.)	Label holder for electronic module 23.5 x 10.5 mm, scope of delivery: 10 pieces	328910
PSS u2 A LC E2 (10 pcs.)	Label holder 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 delivery: 10 pieces	328912

Coding elements

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

Backplanes

Product type	Features	Order no.
PSS u2 B 1	PSS u2, accessories, backplane, for electronic modules, 1 slot, width 12.6 mm, height 107 mm, note the mounting distances.	328811
PSS u2 B 4	PSS u2, accessories, backplane, for electronic modules, 4 slots, width 50.1 mm, height 107 mm, note the mounting distances.	328810
PSS u2 B 4 -R	PSS u2, accessories, backplane, for electronic modules, 4 slots, for increased environmental requirements and railway applications, width 50.1 mm, height 107 mm, note the mounting distances.	327810

14 EC declaration of conformity for PSS u2 EF 8DI

This product/these products meet the requirements of the directive 2006/42/EC for machinery of the European Parliament and of the Council. The complete EC Declaration of Conformity is available on the Internet at www.pilz.com/downloads.
Authorised representative: Norbert Fröhlich, Pilz GmbH & Co. KG, Felix-Wankel-Str. 2, 73760 Ostfildern, Germany

15 UKCA-Declaration of Conformity for PSS u2 EF 8DI

This product(s) complies with following UK legislation: Supply of Machinery (Safety) Regulation 2008.
The complete UKCA Declaration of Conformity is available on the Internet at www.pilz.com/downloads.

Representative: Pilz Automation Technology, Pilz House, Little Colliers Field, Corby, Northamptonshire, NN18 8TJ United Kingdom, eMail: mail@pilz.co.uk

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