



PSS u2 EF 8DO 0.5A

PILZ
THE SPIRIT OF SAFETY

- ▶ 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.

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SD means Secure Digital

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1 Introduction

1.1 Validity of documentation

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

This documentation is valid for the product PSS u2 EF 8DO 0.5A 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 EF 8DO 0.5A:

Electronic module with digital single-pole outputs for failsafe applications

The product has the following features:

- ▶ 8 digital outputs
 - Semiconductor technology
 - Single-pole
 - Positive-switching
 - Current load capacity per output: 0,5 A
 - Short circuit-proof
 - Overload-proof
 - Configurable switch-off delay
 - Configurable on/off tests
 - Configurable repetition time of the on tests
- ▶ Energy-saving functions
- ▶ LEDs for:
 - Switch status of each output
 - Module error

3 Safety

3.1 Intended use

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

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

The outputs may be used to switch:

- ▶ Resistive loads
- ▶ Inductive loads
- ▶ Capacitive loads

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.

Make sure that only authorised personnel have access to the programmable safety 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 EF 8DO 0.5A 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 1.0.0
 - We recommend that you always use the latest version (download from www.pilz.com).

3.3 Safety regulations

3.3.1 Safety assessment

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 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.

3.3.2 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.

3.3.3 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.).

3.3.4 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

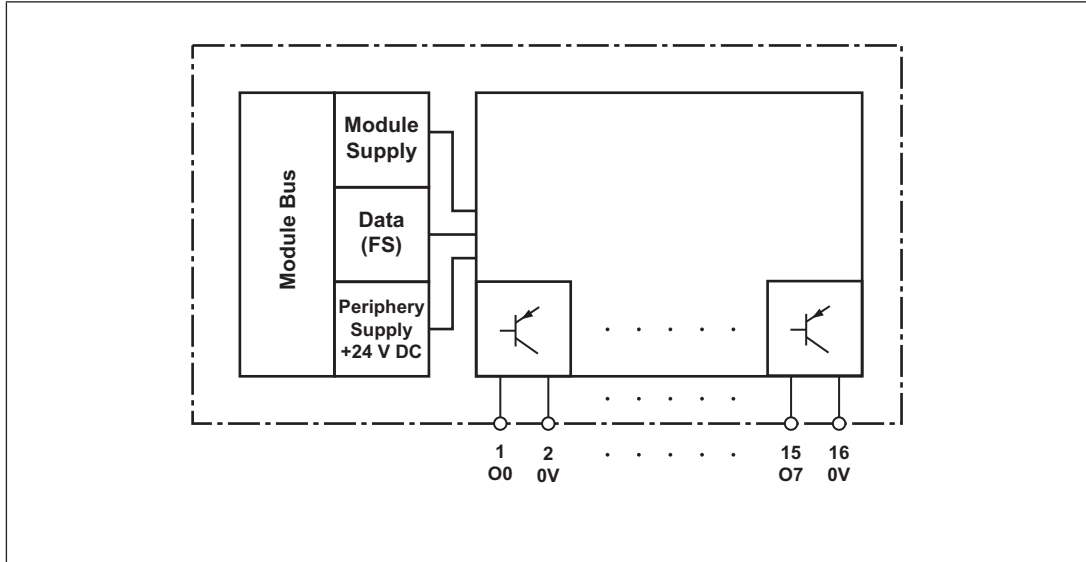


Fig.: Block diagram PSS u2 EF 8DO 0.5A

4.2 Supply

- ▶ The module is supplied with voltage via the head module.
- ▶ The periphery supply provides the outputs with voltage.
- ▶ The module routes the periphery supply from the module bus to the terminals on the terminal blocks.

4.3 Outputs

Signals at the output

- ▶ "0" signal (0 V) at the output:
 - Output is high impedance
 - No current to the load
- ▶ "1" signal (+24 V) at the output:
 - Output is low impedance
 - Current is supplied to the load

Output test

- ▶ Outputs that are switched on are checked via regular off tests.
 - Off tests are run in each test cycle
 - The maximum duration of the off test can be configured (default value: 3 ms)
 - Outputs that are switched on are switched off for the duration of the off test.
 - The load must not switch off because of the test.

- ▶ Outputs that are switched off are checked via regular on tests.
 - On tests are run based on the configured repetition time. If a repetition time has not been configured, then on tests are run in each test cycle.
 - The maximum duration of the on test can be configured (default value: 3 ms)
 - Outputs that are switched off are switched on for the duration of the on test.
 - The load must not switch on because of the test.

Excluding individual outputs from the output test:

- ▶ If a plant is particularly sensitive to the output test, the output test may be switched off for individual outputs.
- ▶ The test must be replaced by other measures, depending on the safety requirement.
- ▶ When output tests are switched off:
 - The correct switch state is always checked.
 - The output's ability to switch will not be detected until the next time the output is switched on/off. That is why the outputs must be switched regularly during normal operation, so that safety and characteristic safety values are not reduced.

Monitoring the maximum permitted test cycle time

- ▶ The duration of a test cycle depends on the number and type of modules. A maximum test cycle time can be configured. If the output test is not run within the configured cycle monitoring time, then an error is registered.

Testing for shorts

- ▶ The outputs are switched on individually in order to detect shorts across contacts.
- ▶ For applications in accordance with Category 4, PL e and SIL 3, detection of shorts between contacts must be guaranteed either via the on/off test or through other measures (e.g. asynchronous switching). A short between contacts must be simulated during commissioning.

Outputs

- ▶ The head module sets the output status via the module bus.
- ▶ The max. capacity at an output depends on the load (see characteristic). Connecting a higher capacity may lead to an error.
- ▶ Operation with electronic contactors has not been tested and may lead to errors. Please contact our Customer Support team if you are using electronic contactors.



WARNING!

When wiring an output with capacitance it is essential to note the pulse duration, repetition period and scan time of the power-up test, otherwise the load may switch on unintentionally.

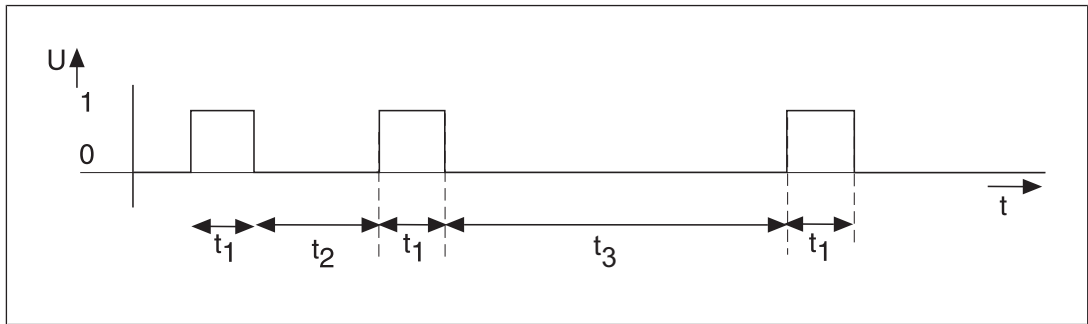


Fig.: On test for single-pole outputs

Legend

t_1 Configurable max. test duration (default value: 3 ms)

t_2 Configurable repetition time of on test in error-free operation
(default value: test is run in each test cycle)

The test cycle time is not configurable and is determined by the head module. The configuration enables a longer repetition time to be set between the on tests.

t_3 Configurable repetition time of on test in the event of an error (default value: 30 s)

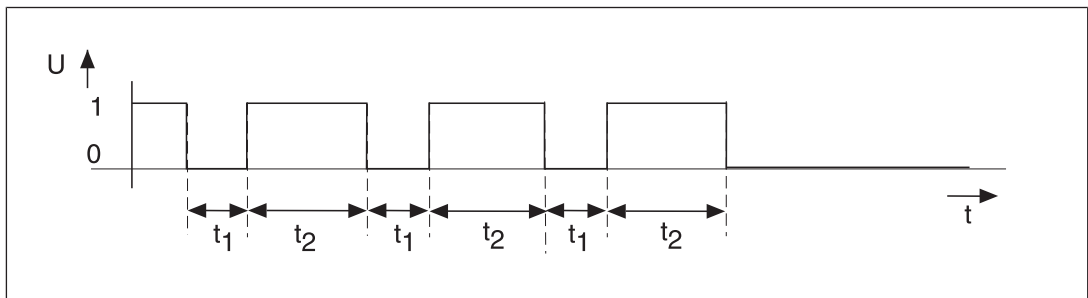


Fig.: Off test for single-pole outputs

Legend

t_1 Configurable max. test duration (default value: 3 ms)

t_2 Repetition of off test in each test cycle

Switch-off delay

FS outputs can be switched off with a delay. Even if the process image of outputs switches from "1" to "0", a "1" signal may remain at the output for the duration of the delay. If there is another "1" signal during the switch-off delay, the switch-off delay time is reset again and restarts at the next "0" signal.

In the event of external errors, e.g. if the connection to the controller is lost, the output is switched off after the set switch-off delay.

However, in the event of internal module errors, the switch-off delay cannot be guaranteed.

Default value: 0 ms (immediate shutdown).

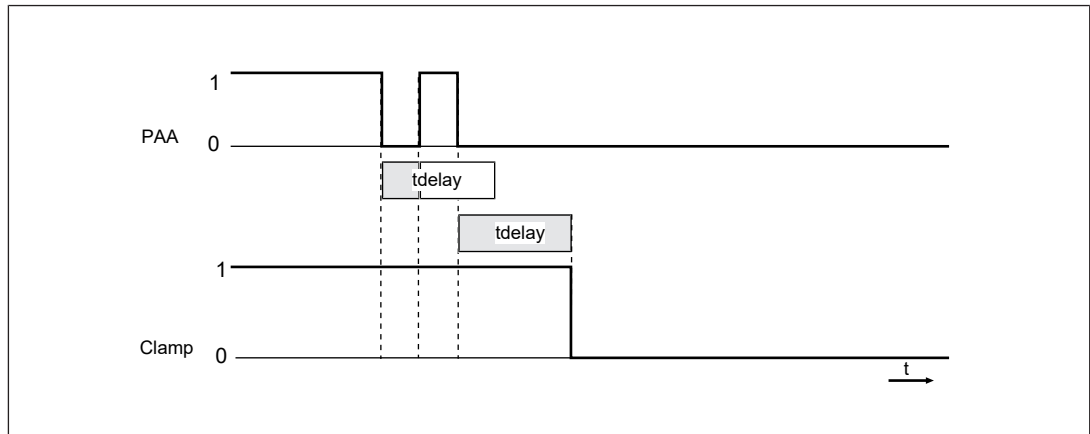


Fig.: Switch-off delay

Legend

PIO	Process image of outputs
tdelay	Configured switch-off delay time
	If there is another "1" signal, the time is reset and restarts at the next "0" signal
Clamp	Signal at the terminal

4.4 Output capacitance C

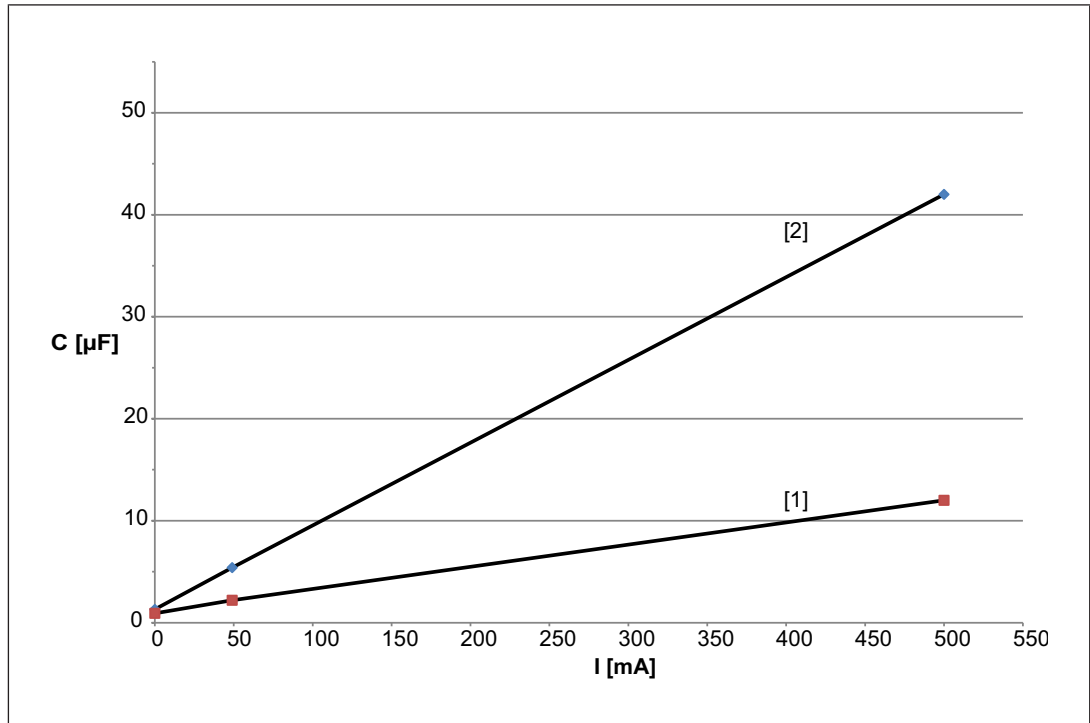


Fig.: Output capacitance C dependent on load current I

Legend

- [1] Max. test duration 1 ms
- [2] Max. test duration 3 ms

FS outputs can be switched off with a delay. Even if the process image of outputs switches from "1" to "0", a "1" signal may remain at the output for the duration of the delay. If there is another "1" signal during the switch-off delay, the switch-off delay time is reset again and restarts at the next "0" signal.

In the event of external errors, e.g. if the connection to the controller is lost, the output is switched off after the set switch-off delay.

However, in the event of internal module errors, the switch-off delay cannot be guaranteed.

Default value: 0 ms (immediate shutdown).

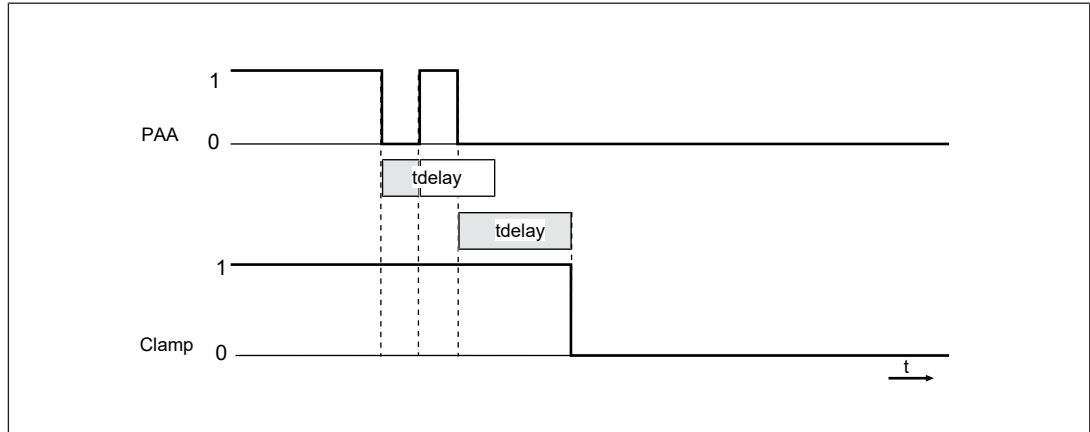


Fig.: Switch-off delay

Legend

PAA	Process image of outputs
tdelay	Configured switch-off delay time
	If there is another "1" signal, the time is reset and restarts at the next "0" signal
Clamp	Signal at the terminal

4.5 Integrated protection mechanisms

The module has the following protection mechanisms:

- ▶ Common second shutdown route, tested regularly
- ▶ Cyclical output tests
- ▶ Tests for shorts between the outputs

The module provides the following diagnostic data:

- ▶ Start-up error
- ▶ Configuration error
- ▶ FS communication error
- ▶ Temperature error: too warm
- ▶ Temperature error: too hot
- ▶ Output error

4.6 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

4.7 Reaction times

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

5 Address assignment

The module occupies 1 Byte in the process image of outputs.

PIO	Meaning	State
Bit 0	Output data O0	0: "0" signal (0 V) at the output 1: "1" signal (+ 24 V) at the output
Bit 1	Output data O1	
Bit 2	Output data O2	
Bit 3	Output data O3	
Bit 4	Output data O4	
Bit 5	Output data O5	
Bit 6	Output data O6	
Bit 7	Output data O7	

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	Valid bit of output O4	
Bit 5	Valid bit of output O5	
Bit 6	Valid bit of output O6	
Bit 7	Valid bit of output O7	

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 in mm

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

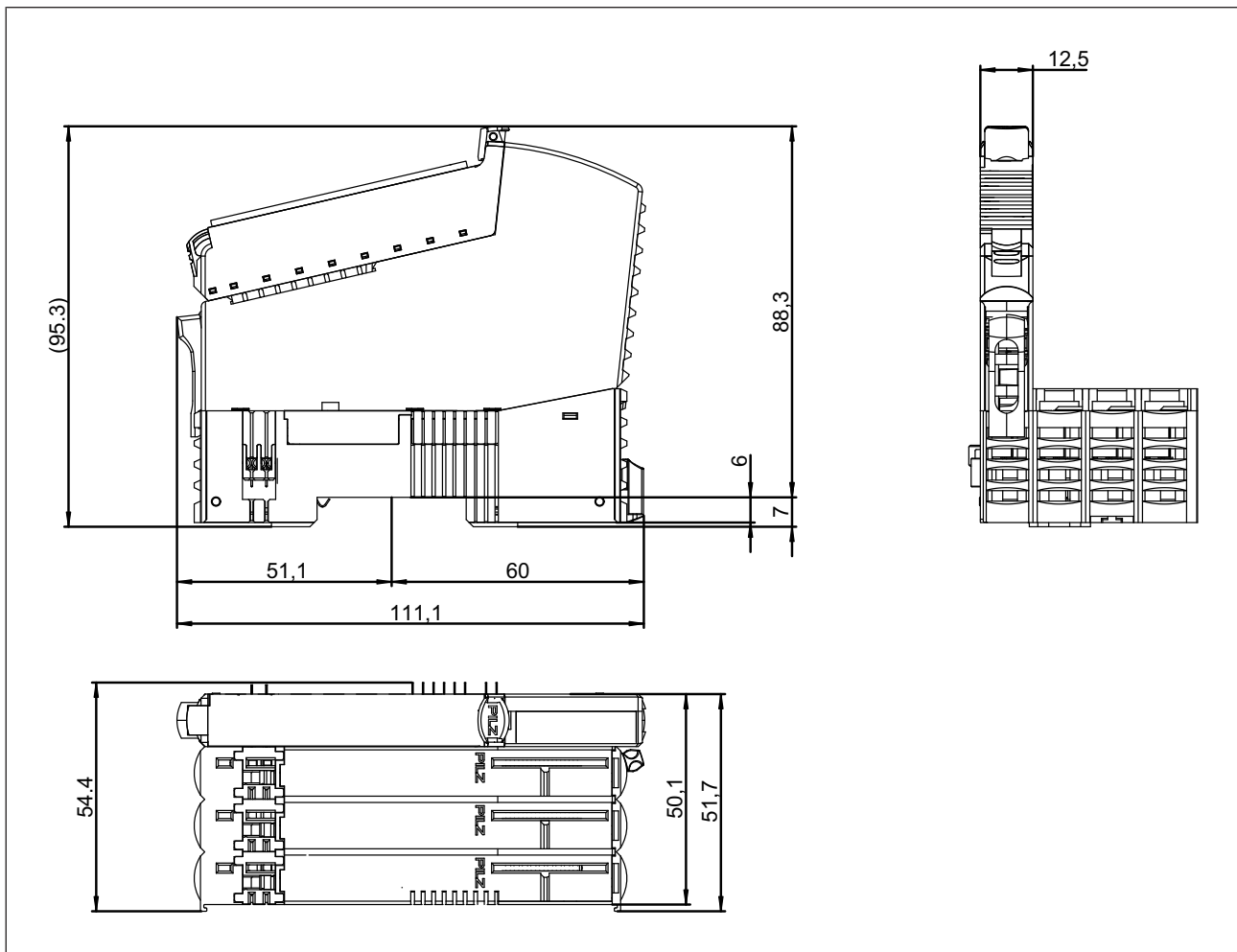


Fig.: Dimensions in mm, including backplane, electronic module and terminal block

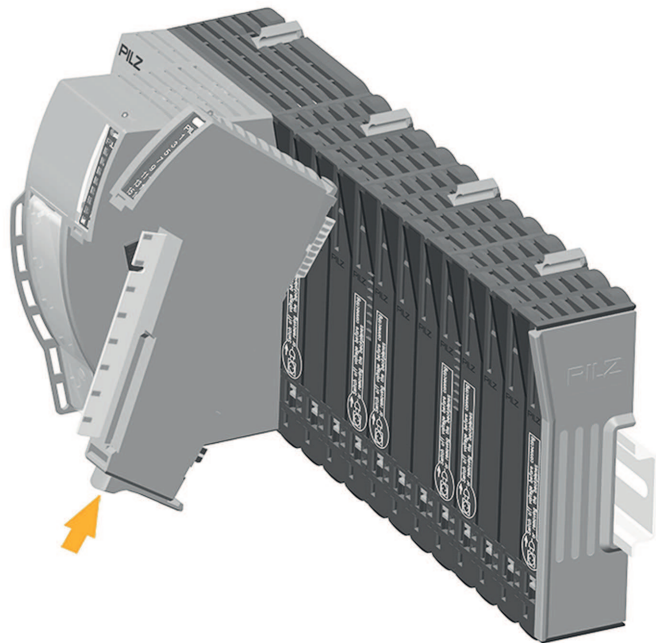
6.2 Inserting and removing an electronic module

Please note:

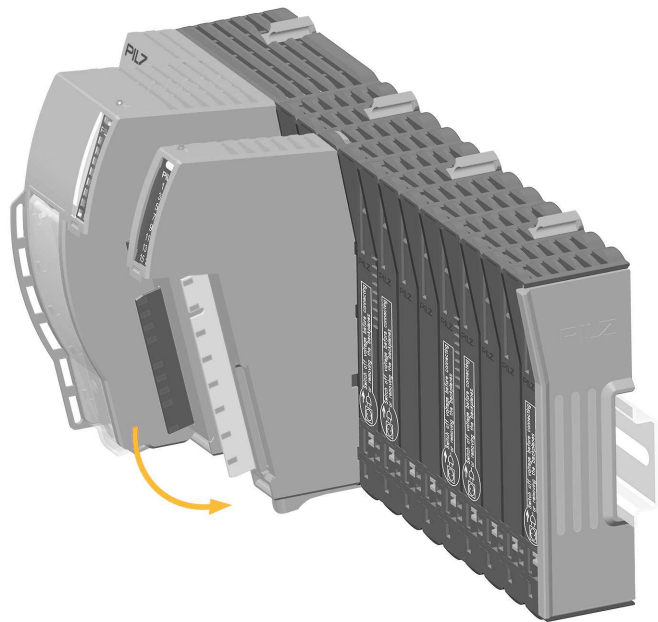
- ▶ Backplane must be installed first.
- ▶ Electronic modules may only be plugged or unplugged if the terminal block has been removed first.
- ▶ The mechanics of the electronic modules are designed for 20 plug in/out cycles.
- ▶ On electronic modules with outputs, the terminal block may only be inserted and removed when the load is switched off. Unforeseeable error reactions may be triggered if modules are inserted and removed under load.

6.2.1 Inserting an electronic module

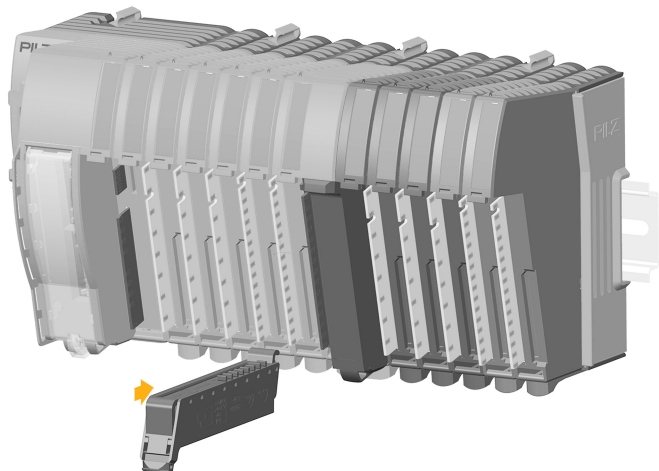
1. Insert the electronic module into the suspension lug on the backplane.



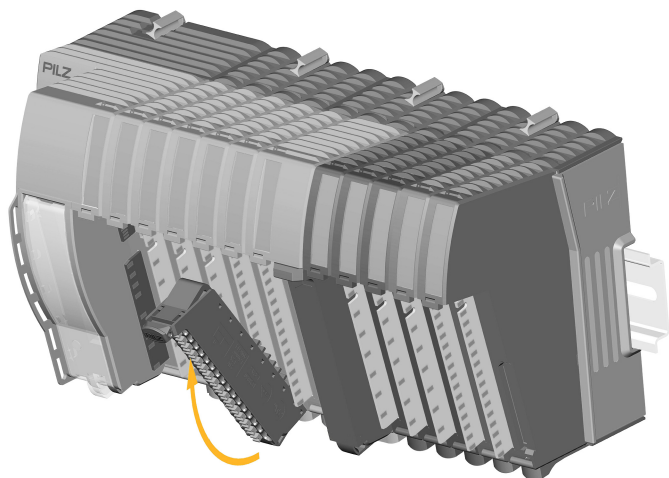
2. Swivel the electronic module downwards until you hear it click into place.



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

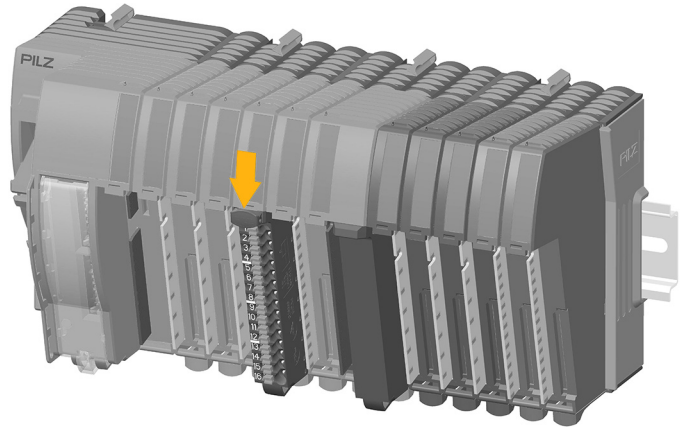


4. Swivel the terminal block upwards until you hear it click into place.

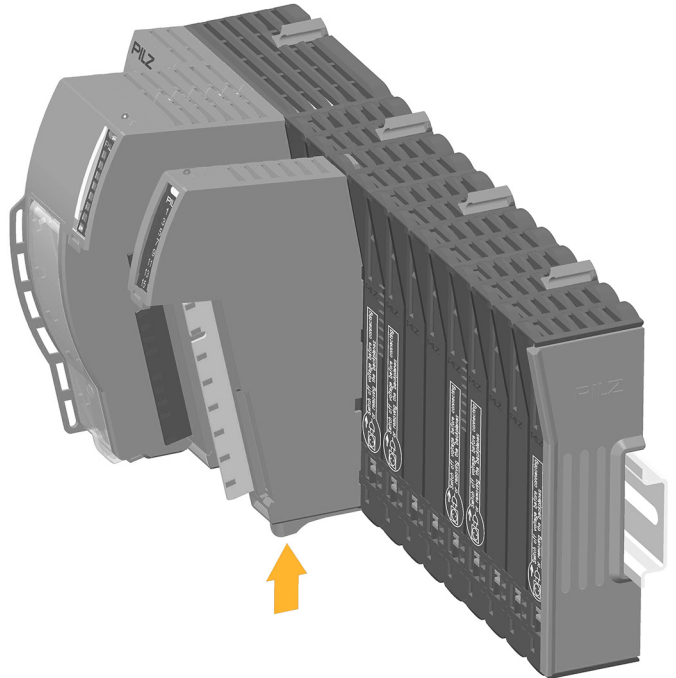


6.2.2 Removing an electronic module

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
2. Inserting an electronic module

A new electronic module can be inserted during operation.

Procedure:

- ▶ 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. After a restart, the system behaves as after a warm reset using a reset pushbutton (see operating manual of the head module, chapter "Reset pushbutton", section "Carrying out a warm reset (restart)").

7 Wiring

7.1 General wiring guidelines

Please note:

- ▶ If short circuits occur between the cable from the output to the load and a supply line, it will no longer be possible to switch off the load. Possible remedies:
 - Exclude the error by using separate multicore cable for supply voltages
 - Use dual actuators, e.g. two contactors in series
 - Use an additional shutdown device such as a main contactor
- ▶ Use appropriate wiring to exclude short circuits between the outputs!
- ▶ The actuators may be connected using unshielded cables.
- ▶ The outputs do not need suppression for inductive loads.
- ▶ Use copper wiring.

7.1.1 Connection mechanism for terminal blocks

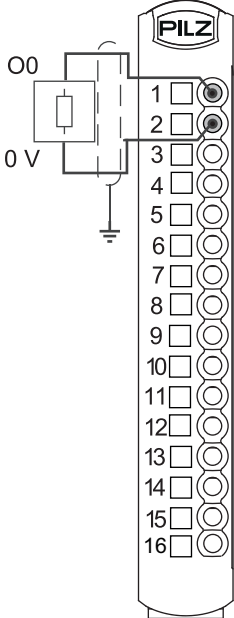
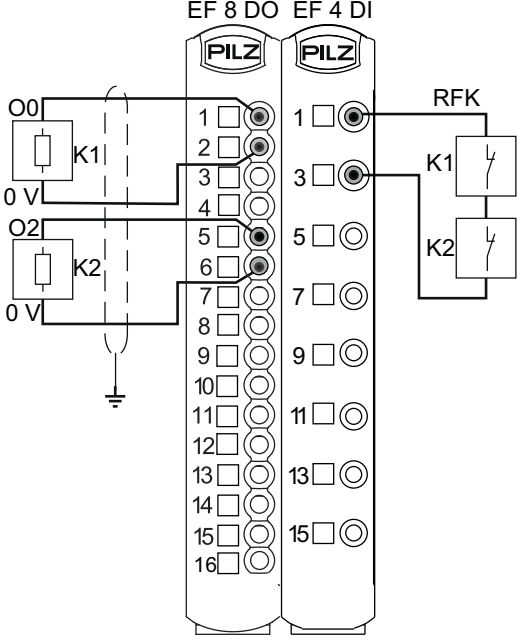
Procedure:

- ▶ 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 mm² (AWG26).
- ▶ The maximum cable cross section for field connection terminals on the terminal blocks is 1.5 mm² with ferrules (AWG14)
- ▶ Use copper wiring.

7.2 Terminal configuration

Terminal configuration	Connection examples	
1: Output O0 2: 0 V (periphery supply) 3: Output O1 4: 0 V (periphery supply) 5: Output O2 6: 0 V (periphery supply) 7: Output O3 8: 0 V (periphery supply) 9: Output O4 10: 0 V (periphery supply) 11: Output O5 12: 0 V (periphery supply) 13: Output O6 14: 0 V (periphery supply) 15: Output O7 16: 0 V (periphery supply)	1-channel actuator 	2-channel actuator with feedback loop on the module PSS u2 EF 4 DI 

7.3 Function test during commissioning

An error must be simulated for each safety-related output during commissioning: The anticipated error reaction must occur when an output has an error against a supply voltage.



INFORMATION

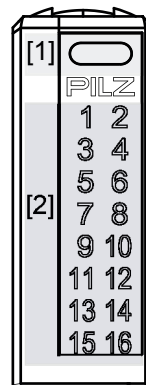
The safety-related test must be performed on the load and not on the output terminal.

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 terminal status displays 1, 3, 5, 7, 9, 11, 13, 15 are active.



Legend

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

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 "1"-signal at the output	
☀	green	●	--	Module in operation and there is a "0"-signal at the output	
⚡	red	●	--	Configuration error Module was inserted in the wrong slot.	
☀	red	●	--	Internal error/firmware update	See module's diagnostic log
●	red	☀	green	The module status display and the terminal status display on the relevant output flash synchronously Short circuit/overload/undervoltage	See module's diagnostic log.

[1]	Colour [1]	[2]	Colour [2]	Meaning	Further information
	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 Periphery supply is missing/temperature error: Too hot (1)	See module's diagnostic log

(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 outputs are switched off
- The valid bits for the outputs 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.

Legend

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

9 Technical Details

General	
Certifications	CE, EAC, KOSHA, TÜV, UKCA, cULus Listed
Application range	Failsafe
Module's device code	4044h
Number of FS output bits	8
Number of FS status bits	8
Electrical data	
Internal supply voltage (module supply)	
Module's power consumption	0,65 W
Periphery's supply voltage (periphery supply)	
Voltage range	16,8 - 30 V
Module's current consumption with no load	55 mA
Module's power consumption with no load	1,65 W
Max. power consumption of a positive-switching single-pole semiconductor output	0,05 W
Max. power dissipation of module	2,7 W
Permitted loads	inductive, capacitive, resistive
Semiconductor outputs	
Number of positive-switching single-pole semiconductor outputs	8
Typ. output current at "1" signal and rated voltage of semiconductor output	0,5 A
Permitted current range	0,000 - 0,625 A
Residual current at "0" signal	0,02 mA
Max. transient pulsed current	12 A
Max. internal voltage drop	80 mV
Max. duration of on time during self test	100 - 12700 µs
Max. duration of off time during self test	100 - 12700 µs
Max. processing time of semiconductor output when signal changes from "1" to "0"	8 ms
Max. processing time of semiconductor output when signal changes from "0" to "1"	8 ms
Potential isolation from system voltage	yes
Short circuit-proof	yes
Environmental data	
Climatic suitability	EN 60068-2-1, EN 60068-2-14, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78
Ambient temperature	
In accordance with the standard	EN 60068-2-14
Temperature range	0 - 60 °C
Storage temperature	
In accordance with the standard	EN 60068-2-1/-2
Temperature range	-40 - 70 °C

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, UL/IEC 61010-2-201
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	Semiconductor output and module 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	35 g
--------	-------------

Where standards are undated, the 2015-04 latest editions shall apply.

9.1 Safety characteristic data



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 62061 SIL CL	EN 62061 PFH _D [1/h]	IEC 61511 SIL	IEC 61511 PFD	EN ISO 13849-1: 2015 T _M [year]
1-channel	PL d	Cat. 2	SIL CL 2	1,32E-09	SIL 2	1,16E-04	20
2-channel	PL e	Cat. 4	SIL CL 3	1,99E-10	SIL 3	1,72E-05	20

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 and apply for the ambient temperature range stated in the technical details.

10 Order reference

10.1 Product

Product type	Features	Order no.
PSS u2 EF 8DO 0.5 A	Electronic module	328131

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

Codierelemente

Produkttyp	Merkmale	Bestell-Nr.
PSS u2 A CE E (10 pc.)	Codierelemente für Elektronikmodule, 10 Stück	328860

Backplanes

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

11 **EC declaration of conformity**

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

12 UKCA-Declaration of Conformity

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/support/downloads.

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THE SPIRIT OF SAFETY