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Programmable Safety Systems
PSS-Range

PSS DI2O T, PSS1 DI2O T
Operating Manual
Item No. 20 330-04



The spirit of safety.

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Introduction

This operating manual explains the function and operation of the centralised input/output module PSS(1) DI2O T.

Please also refer to the following documentation:
During installation:

- Installation Manual: PSS 3000/PSS 3100 Series

During configuration:

- PSS-Range Safety Manual
- Installation Manual: PSS 3000/PSS 3100 Series
- PSS-Range: FS System Description

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

Validity of documentation

This documentation is valid for the PSS(1) DI2O T from Version 1.2.

It is valid until new documentation is published. The latest documentation is always enclosed with the unit.

Introduction

Overview of documentation

1 Introduction
The introduction is designed to familiarise you with the contents, structure and specific order of this manual.

2 Overview
This chapter provides information on the module's most important features.

3 Safety
This chapter **must** be **read** as it contains important information on safety regulations and intended use.

4 Function Description
This chapter describes the module's functions.

5 Wiring
This chapter describes the module's safety-related wiring.

6 Operation and Maintenance
This chapter explains how to commission the module and advises on what to do if a fault occurs.

7 Technical Details

8 Appendix

Definition of symbols

Information in this manual that is of particular importance can be 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!

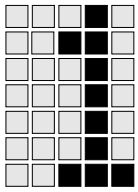
This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



NOTICE
This describes a situation in which the unit(s) could be damaged and also provides information on preventive measures that can be taken.



INFORMATION
This gives advice on applications and provides information on special features, as well as highlighting areas within the text that are of particular importance.



Notes

Overview

The module PSS(1) DI2O T has 16 digital inputs and 16 digital outputs. The inputs can be used to monitor emergency stop circuits, for example. They are generally suitable for connecting:

- Single-channel safety-related input devices
  - with test pulses
  - without test pulses
- Multi-channel safety-related input devices
  - with test pulses
  - without test pulses.

The outputs are suitable for connecting

- Resistive loads of max. 2 A
- Inductive loads of max. 2 A

In groups of 8, the outputs can be used to generate test pulses.
When combined with failsafe inputs, the external wiring can be monitored for shorts across contacts and external power sources.

Front view

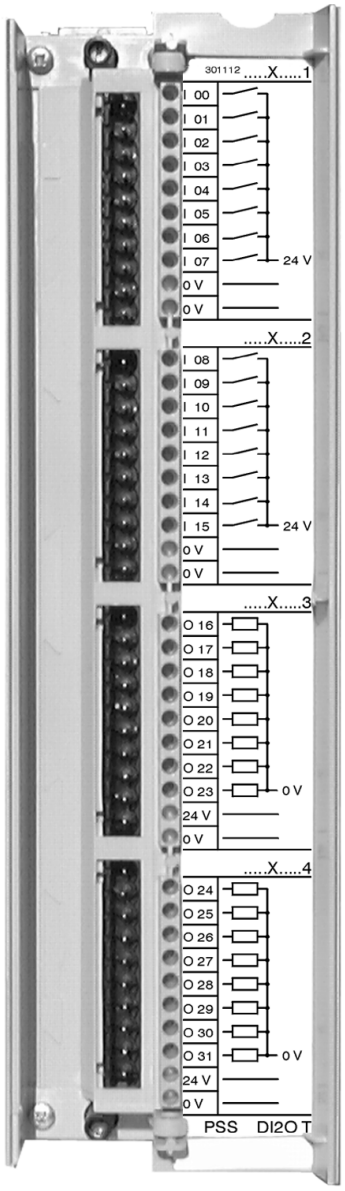


Fig. 2-1: Front view of the PSS(1) DI2O T

Safety

Intended use

The input/output module PSS(1) DI2O T is designed for use in safety-related applications. It is used in the failsafe section of the PSS.

The PSS DI2O T module is designed for use on a module rack from the PSS 3000 series.
The PSS1 DI2O T module is designed for use on a module rack from the PSS 3100 series.

The following is deemed improper use:

- Any component, technical or electrical modification to the module
- Use of the module outside the areas described in this manual
- Use of the module outside the documented technical details (see chapter entitled “Technical Details”).

Intended use includes making the installation EMC-compliant. Please refer to the guidelines given in the “PSS 3000/PSS 3100 Series Installation Manual” and the “PSS-Range Safety Manual”. The safety manual also includes check lists designed to help you with the safety-related planning, construction and operation of a plant.

System requirements

CPU versions

If you wish to use the PSS(1) DI2O T module, it is essential that the operating system can support it. On the CPUs listed below, the module is only supported from the stated version number onwards:

- PSS CPU from Version 1.7
- PSS1 CPU from Version 1.1

All other CPUs support the module without restrictions.

Safety

System software versions

The following system software is required in order to configure the module:

- PSS SW PG from Version 4.0
- PSS WIN-PRO from Version 1.0

Please contact Pilz if you have an older version of the system software.

Categories in accordance with EN 954-1



WARNING!

Please note: To achieve the corresponding category or requirement class, the whole system including all safety-related components (parts, devices, user program etc.) must be included in the assessment. For this reason, Pilz cannot accept liability for the correct classification into a category or requirement class.

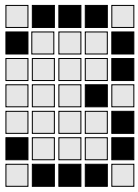
Digital inputs (DI2)

Depending on the application area and its respective regulations, the inputs may be used without test pulses for applications up to Category 3 in accordance with EN 954-1. The possibility of a short circuit occurring in the external wiring between different inputs or against L+ must be eliminated through appropriate wiring.

For Category 4 applications, shorts between the input contacts must be detected. This can be achieved through the use of test pulses on the PSS or, depending on the type of input device, through a feasibility test or through detection of shorts across the contacts on the input device (e.g. light barrier) (for connection examples please see Chapter 5, “Wiring”).

Single-pole outputs (DOT)

The DOT outputs can be used in single-channel operation for applications up to Category 2 in accordance with EN 954-1 (11/94). With Category 2 there must be a second shutdown route, which is activated via the STOP condition of the PSS.
To achieve Category 3, two actuators must be connected to two different outputs. Please note that a failure of the actuator must be detected, e.g. through feedback loop monitoring.



Notes

Function Description

Digital inputs DI2

The module PSS(1) DI2O T has 16 DI2 type inputs (I0 ... I15).

Input signals must show a “High” of 24 VDC (+15 ... +30 VDC) or a “Low” of 0 VDC (-3 ... +5 VDC). The inputs have a filter and are galvanically isolated from the control electronics through optocouplers and converters.

Input status is transmitted to the CPU as a “0” signal (“Low”) or “1” signal (“High”). LEDs indicate the status of the inputs. An LED lights up as soon as a “1” signal is present at the input.

Diagnostic circuitry checks the function of the inputs, including the input filter and optocoupler. If an error occurs, the PSS will switch to a STOP condition, switch off the outputs and trigger a message on the CPU-display.

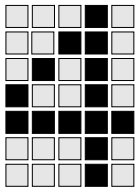
Digital outputs DOT

The module PSS(1) DI2O T has 16 DOT type outputs (O16 ... O31).

DOT type outputs are push-pull outputs, which can be used in groups of 8 as test pulse outputs or as single-pole 2 A outputs. The following terminal configuration is possible, depending on the number of test pulses required:

- **Number ≤ 8:**
  O16 ... O23 are test pulse outputs
  O24 ... O31 are single-pole 2 A outputs
- **Number > 8:**
  O16 ... O31 are test pulse outputs
- **Number = 0:**
  O16 ... O31 are single-pole 2 A outputs

The terminal configuration is generated automatically from the test pulse configuration set in the system software’s PSS Configurator (PG).
Please note that unused test pulses must remain unconnected.



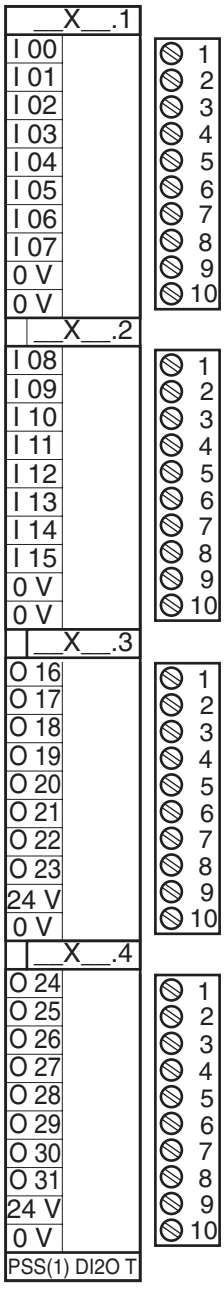
Single-pole 2 A outputs
The outputs are protected against short-circuit, overload and excess temperature. They can switch both resistive and inductive loads. The blocks of 8 outputs are galvanically isolated from the control electronics through optocouplers.

If the CPU sends a “1” signal to an output, the module will apply 24 VDC to the corresponding output. LEDs indicate the status of the outputs. An LED lights up as soon as a “1” signal is present at the output.

Diagnostic circuitry checks the function of the single-pole 2 A outputs. During each cycle, the CPU compares the actual status of the outputs with the process image of the outputs. Outputs that are switched on will be switched off in the configurable self-check, in order to check that the output transistors can be switched. If an error occurs, the PSS will switch to a STOP condition, switch off the outputs and trigger a message on the CPU-display.

Test pulse outputs
Outputs configured as test pulse outputs supply the test pulses to check the wiring for shorts across contacts and external power sources and, if necessary, to check the input filters and optocouplers on the input modules.

Configuration



Connector description:

X1 Digital inputs DI2 I0 ... I7

X2 Digital inputs DI2 I8 ... I15

X3 Single-pole outputs/test pulse outputs DOT O16 ... O23

X4 Single-pole outputs/test pulse outputs DOT O24 ... O31

Fig. 5-1: Configuration of the PSS(1) DI2O T

Wiring

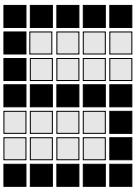
Notes on wiring

In addition to the "Notes on wiring" in the "PSS 3000/PSS 3100 Series Installation Manual", please note the following:

- Safety-related input signals must operate in accordance with the failsafe principle (on switching off).
- In the user program, make sure that a "0" signal from the module always causes the relevant outputs to shut down.
- Do not assign the same test pulse to adjacent inputs.
- Do not connect DIF and DI2 inputs to the same test pulse.
- With cable runs greater than 200 m and a cable cross section of 1.5 mm^2, or with cable runs greater than 300 m and a cable cross section of 2.5 mm^2, the operating system would not detect a short circuit to earth.
- With cable runs over 800 m, the test pulse outputs may be damaged by switching operations in 24 VDC signals.
- With cable runs greater than 500 m, the functionality of the test pulses must be checked by simulating short circuits between the pulsed inputs.
- Do **not** use the push-pull level to drive a load to L+, otherwise the switch-off test will detect a connection to L+ and will register an error.
- Appropriate wiring must be used to exclude the possibility of short circuits between the test pulse output and the corresponding input.
- Only one 0 V terminal needs to be connected to terminals X1 und X2.
- Both 24 V terminals and 0 V terminals must be connected to terminals X3 and X4.
- Use copper as the conductive material.
- The torque setting on the connection terminals should be 0.5 ..0.6 Nm.



NOTICE
Please refer to the following application examples!



Notes

Wiring

Example: Single-channel, failsafe input device, without test pulse

Features:

- Depending on the application area and its respective regulations, this connection diagram is suitable for **input devices with frequent and infrequent operation** in accordance with EN 954-1, **up to Category 2**. The possibility of a short circuit occurring in the external wiring between different inputs or against L+ must be eliminated through appropriate wiring.
- **The input device must be approved for failsafe applications.**
- Please read the instructions provided with the input device.



CAUTION!

A short circuit in the cable between the input device and input with the L+ line or between adjacent inputs will not be detected. Neither will a short circuit between several input devices be detected. Depending on the type of input device connected, this could create a risk to both personnel and machinery (e.g. E-STOP). Always ensure that the unit is suitably wired to eliminate the risk of short circuits.

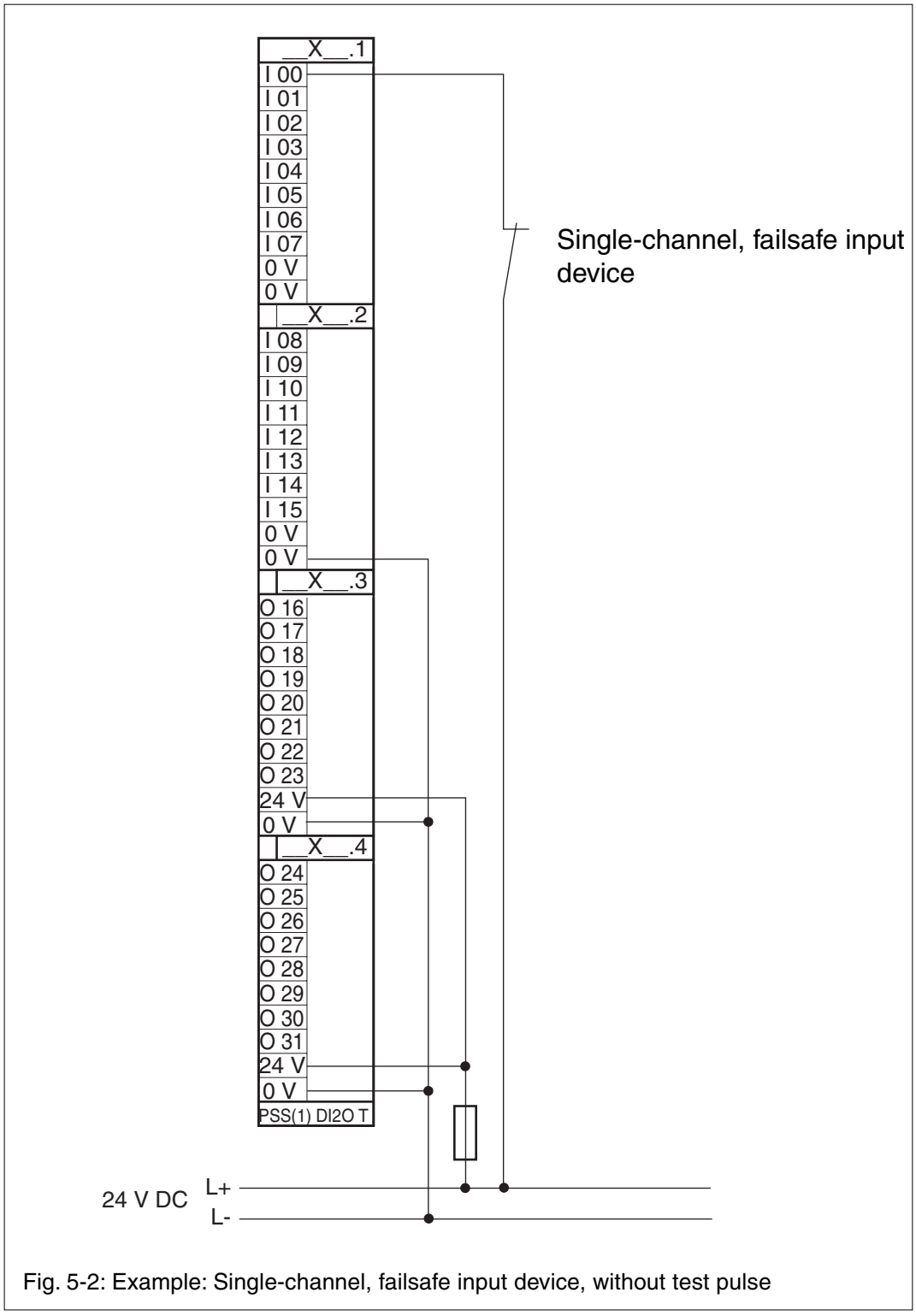


Fig. 5-2: Example: Single-channel, failsafe input device, without test pulse

Please ensure safety regulations and EMC guidelines are met!

Example: Dual-channel, failsafe input devices, without test pulses

Features:

- Depending on the application area and its respective regulations, this connection diagram is suitable for input devices with **frequent operation** and diverse channels, **up to Category 4** in accordance with EN 954-1, provided the functionality of both input device channels is monitored in the user program via a **feasibility check** (see example in the Programming Manual).
- Depending on the application area and its respective regulations, this connection diagram is suitable for input devices with **infrequent operation up to Category 3** in accordance with EN 954-1, provided the functionality of both input device channels is monitored in the user program via a **feasibility check**.
- The possibility of a short circuit occurring between adjacent connector terminals cannot be eliminated. For this reason, the two identical (homogenous) channels on an input device must **not** be connected to adjacent inputs.
- If you are using input devices with different (diverse) channels, adjacent inputs may be used. The user program will detect short circuits via the feasibility check.



CAUTION!

A short circuit in the cable between the input device and input with the L+ line or between several inputs will not be detected. Depending on the type of input device connected, this could create a risk to both personnel and machinery (e.g. E-STOP). Always ensure that the unit is suitably wired to eliminate the risk of short circuits.

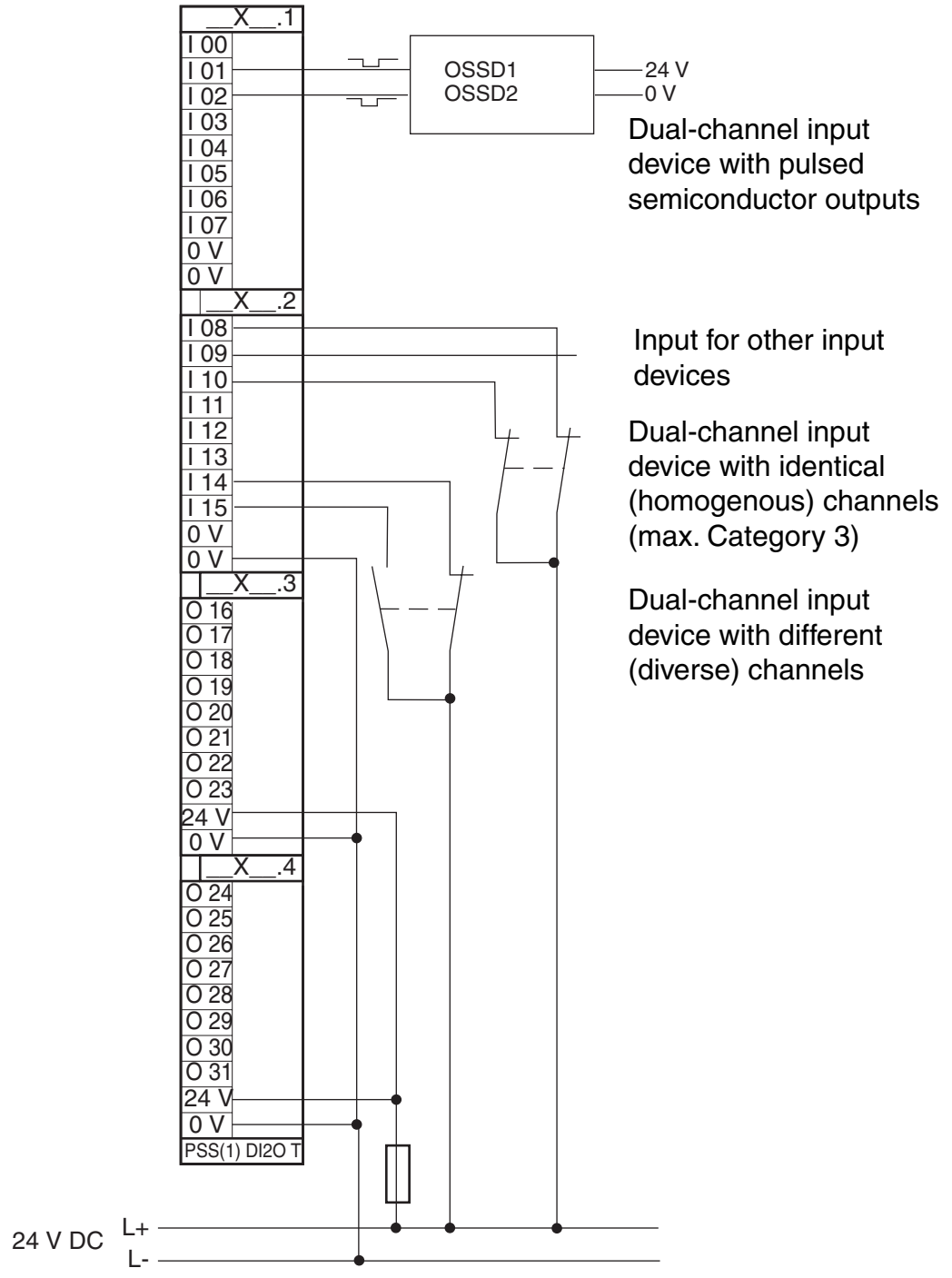


Fig. 5-3: Example: Dual-channel input devices, without test pulses

Please ensure safety regulations and EMC guidelines are met!

Example: Single-channel, failsafe input device, with test pulse

Features:

- Depending on the application area and its respective regulations, this connection diagram is suitable for applications **up to Category 2** in accordance with EN 954-1.
- The input device must be approved for failsafe applications.
- Please read the instructions provided with the input device.
- The test pulse must be allocated to the input in the system software's PSS Configurator (e.g. PSS WIN-PRO).
- Testing will detect short circuits on the input device cable to L+ and to other test pulses.
- Only input devices with N/C contacts can be tested.
- Cable runs (distance from input device)

  200 m; with 1 kOhm resistance parallel to input max. 800 m



CAUTION!

Short circuits between the cable from the test pulse to the input device and the cable from the input device to the input will not be detected.

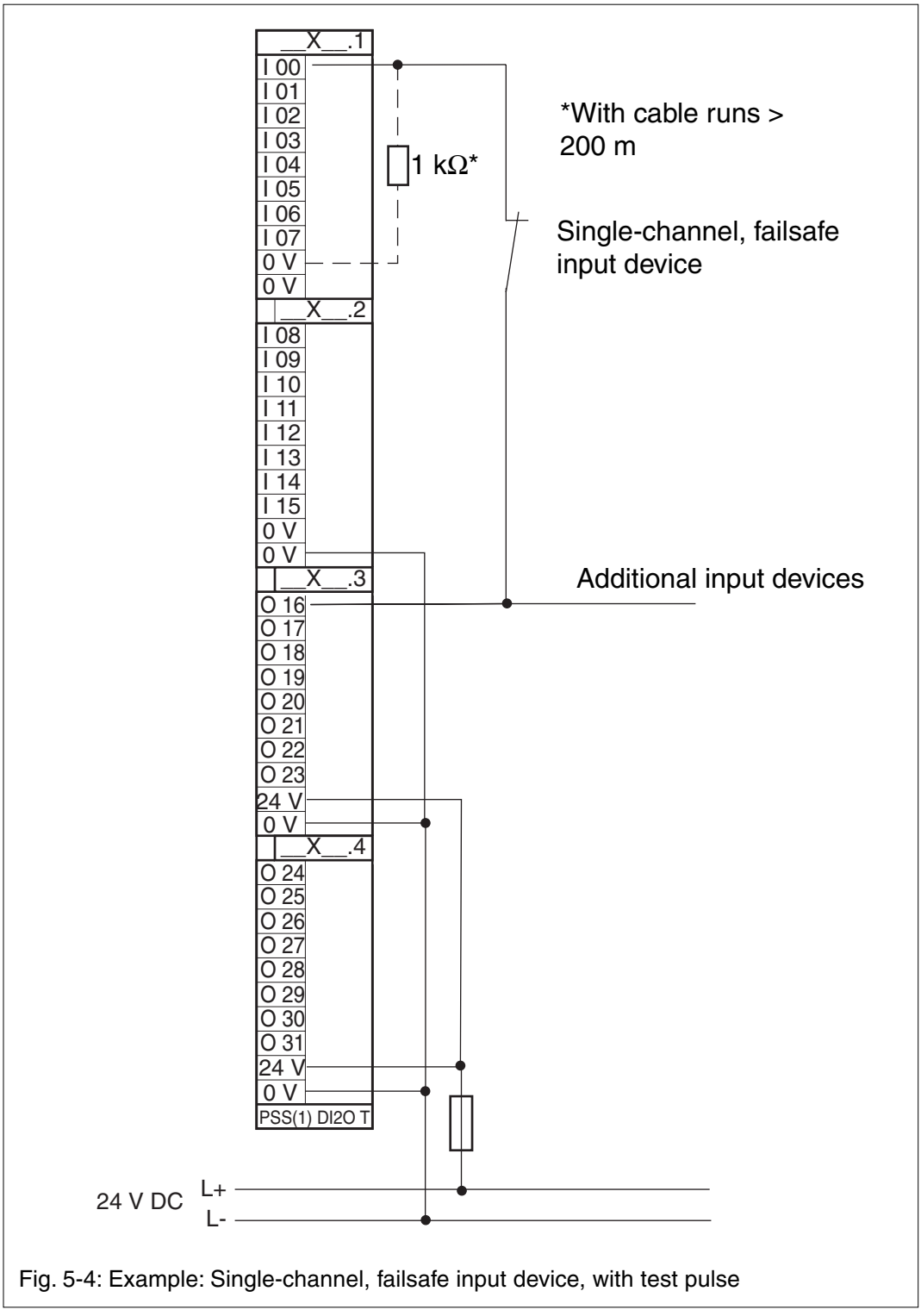


Fig. 5-4: Example: Single-channel, failsafe input device, with test pulse

Please ensure safety regulations and EMC guidelines are met!

Example: Dual-channel, failsafe input device, with test pulse

Features:

- Depending on the application area and its respective regulations, this connection diagram is suitable for applications **up to Category 4** in accordance with EN 954-1.
- This type of connection is mainly used for signal inputs with infrequent operation.
- The operating system will detect all shorts between contacts and short circuits to L+ and L-.
- Short circuits across the contact can be detected via the feasibility check in the user program.
- The test pulse must be allocated to the input in the system software's PSS Configurator (e.g. PSS WIN-PRO).
- On input devices with identical channels, each channel should be given a separate test pulse. This will ensure that all short circuits are detected, with the exception of short circuits that short out the input device (cable from the test pulse to the input device and cable from the input device to the input).
- Cable runs (distance from input device)
  200 m; with 1 kOhm resistance parallel to input max. 800 m

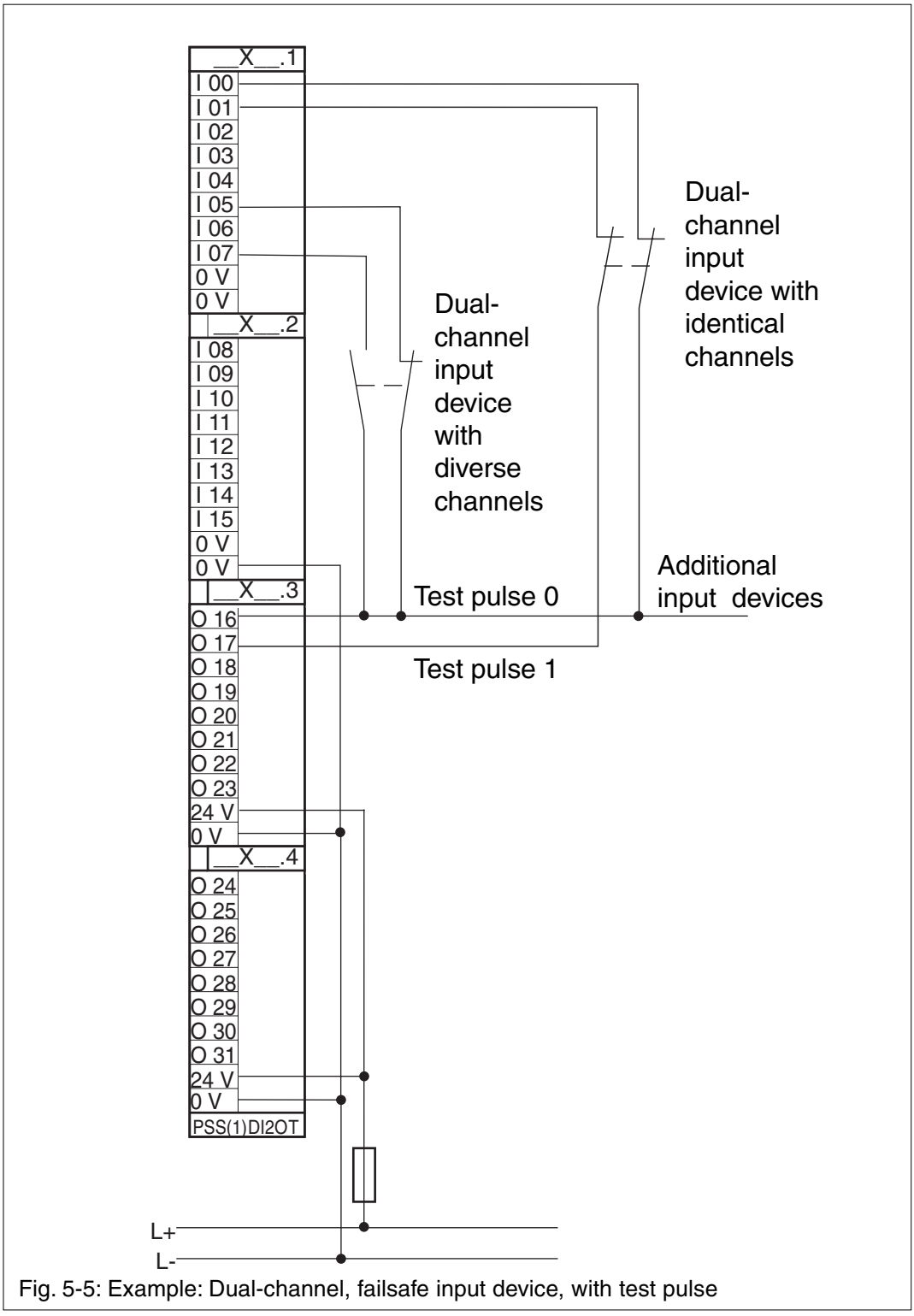


Fig. 5-5: Example: Dual-channel, failsafe input device, with test pulse

Please ensure safety regulations and EMC guidelines are met!

Example: Single-channel actuator

Features:

- With single-channel operation, the module's outputs may be used for applications **up to Category 2** in accordance with EN 954-1 (11/94) (depending on the application area and its respective regulations). To achieve this, an additional shutdown device (e.g. main contactor) must be available.
- Connect a separate fuse before each block of 8 outputs (max. 10 A blow-out fuse or circuit breaker).
- The following example is only applicable when the relay is monitored (e.g. through a feedback loop).



NOTICE
If you are using single-pole outputs, make sure that you use appropriate wiring to exclude the possibility of short circuits.

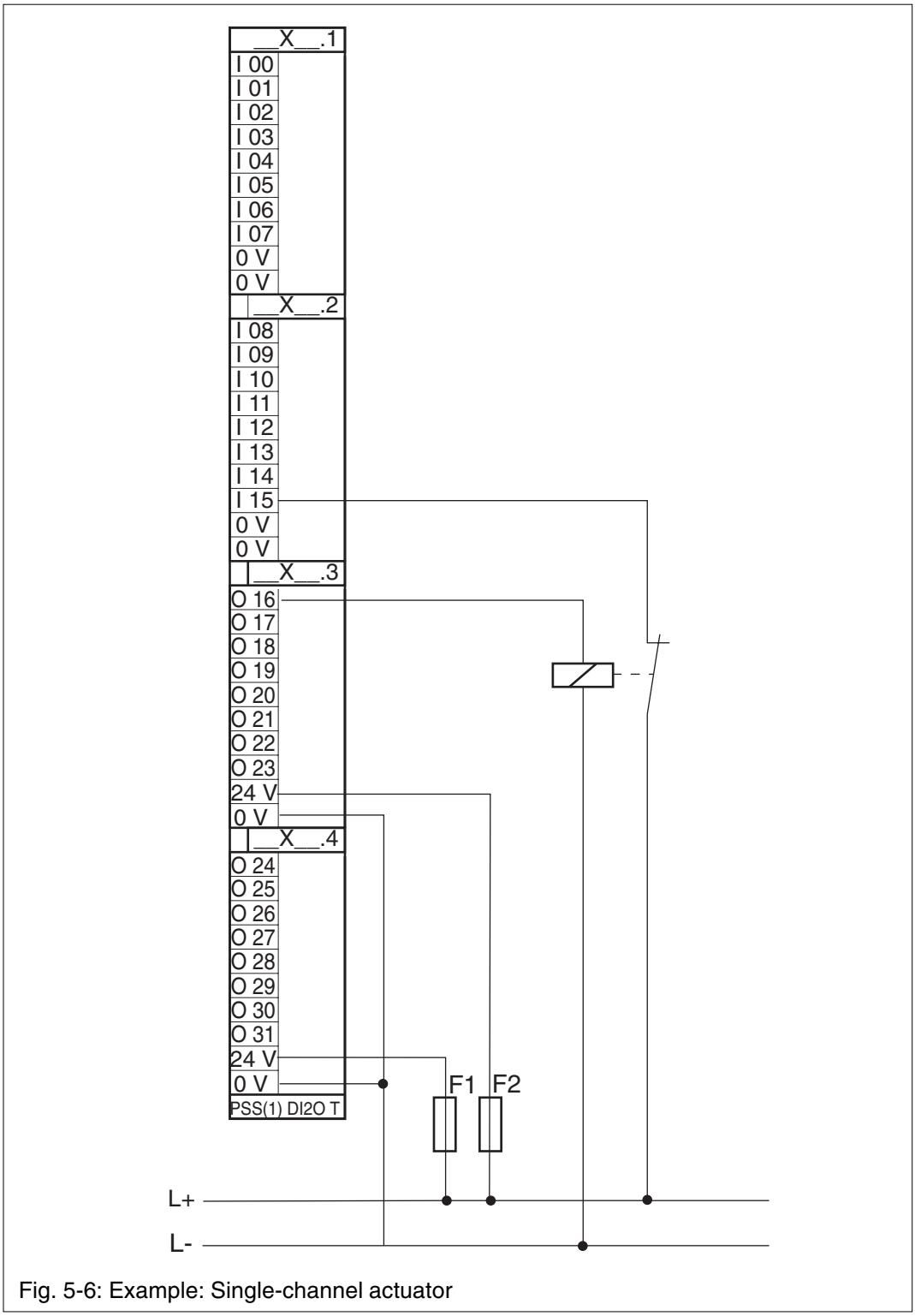


Fig. 5-6: Example: Single-channel actuator

Please ensure safety regulations and EMC guidelines are met!

Example: Dual-channel actuator

Features:

- With dual-channel operation, the outputs may be used for applications **up to Category 3** in accordance with EN 954-1 (11/94) (depending on the application area and its respective regulations). To achieve this, two actuators must be connected to two different outputs.
- Connect a separate fuse before each block of 8 outputs.
- The following example is only applicable for self-monitoring actuators, otherwise position monitoring is required (e.g. through a feedback loop).

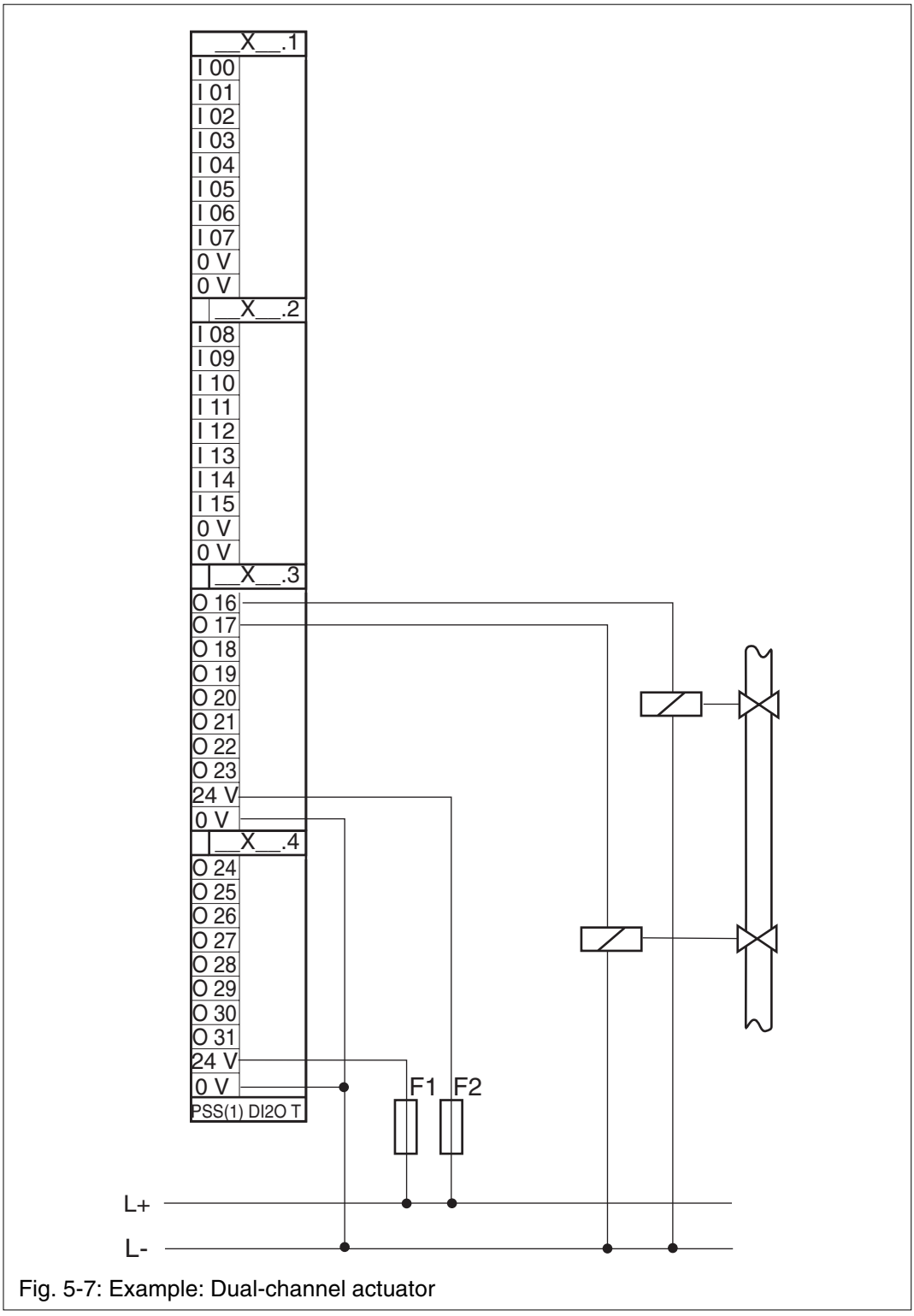
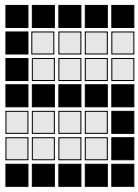


Fig. 5-7: Example: Dual-channel actuator

Please ensure safety regulations and EMC guidelines are met!



Notes

Operation and Maintenance

Commissioning

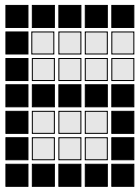
- Install the module on the module rack as described in the “PSS 3000/ PSS 3100 Series Installation Manual”.
- Connect the module as described in the chapter entitled “Wiring”.

CAUTION!

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

Faults

If a fault occurs on the module or there is a wiring error, the PSS will switch to a STOP condition, switch off all the outputs and trigger a message on the display.
The error stack display in the system software (e.g. PSS WIN-PRO) can be used to locate the error.



Notes

Technical Details

Electrical data	
Supply voltage	24 VDC
Tolerance range	20 ... 30 VDC including residual ripple
Current consumption	380 mA via backboard bus
Galvanic isolation	Yes (optocoupler, converter)
Polarity protection	Yes
Connection type	Screw connectors, max. 2.5 mm^2 (AWG 12)
Outputs	
Number of outputs	16
Potential isolation	Yes (in groups of 8 outputs)
Status display	One LED per output
Output current at “1” signal	2 A
Total load capacity	10 A per block of 8
Permitted range	0 ... 2.5 A
Short circuit protection	Electronic
Limitation of inductive switch-off at the load	ca. UB - 42 V
Simultaneity	100 % up to max. 10 A per block of 8
Residual current at “0” signal	0 mA
Output signal level “1” signal (high) and 2.5 A load: “0” signal (low):	 UB - 1 VDC 0 VDC
Output switch delay	50 µs
Off time during self test	< 200 µs
Inputs	
Number of inputs	16
Potential isolation	Yes
Input signal level “1” signal (high): “0” signal (low):	 +15 ... +30 VDC -3 ... +5 VDC
Input current	Typ. 6 mA

Technical Details

Input delay	1 ms
Pulse suppression	≤ 300 µs (requirement: in the PSS Configurator, ≥ 3 ms must be configured under “Max. delay of digital inputs” and “DI test time”)
Status display	One LED per input
Environmental data	
Protection type (EN 60 529, 10/91)	IP20 (installed in module rack)
Mounting position	Vertical in module rack
Ambient temperature (DIN IEC 68-2-14, 06/87)	0 ... 60 °C
Storage temperature (EN 60 068-2-1/-2, 03/93)	-25 ... +70 °C
Climatic suitability (DIN IEC 68-2-30, 09/86)	Max. 95 % r.h.
Condensation	Not permitted
Vibration (EN 60 068-2-6, 04/95)	Frequency range: 10 ... 100 Hz Amplitude: 0.1 mm, max. 5g
Shock (DIN IEC 68-2-29)	30g, 11 ms/10g, 16 ms
EMC	EN 50 082-2, 03/95 EN 55 011-A, 08/96
Mechanical data	
Torque setting for the screws	0.5 ... 0.6 Nm
Weight	PSS DI2O T: 1380 g PSS1 DI2O T: 590 g

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Power dissipation

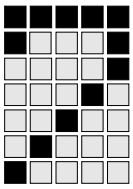
The power dissipation on the module is as follows:

$P = P_G + n_{O2} * P_{O2} + n_{O1} * P_{O1} + n_{I1} * P_{I1}$

- P_G: Basic power dissipation
- P_{O1}: Power dissipation on **one** output at a “1” signal, under load
- P_{O2}: Power dissipation on **one** output at a “1” signal, without load
- P_{I1}: Power dissipation on **one** input at a “1” signal
- n_{O1}: Number of outputs at which a “1” signal may be present simultaneously, under load
- n_{O2}: Number of outputs at which a “1” signal may be present simultaneously, without load
- n_{I1}: Number of inputs at which a “1” signal may be present simultaneously

Relationship between power dissipation and supply voltage:

	Supply voltage in V		
	20 V	**24 V**	**30 V**
P_G	3.5 W	3.8 W	4.6 W
P_{O1}	75 mOhm * I_{Load}	75 mOhm * I_{Load}	75 mOhm * I_{Load}
P_{O2}	0.25 W	0.32 W	0.47 W
P_{I1}	0.1 W	0.14 W	0.28 W



Notes

Appendix

Changes in the documentation

Changes from Version I to Version II

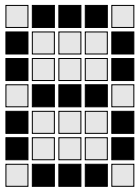
Old page	New page	Change
8	8	Environmental data: Condensation not permitted

Changes from Version II to Version III

Old page	New page	Change
7	7	Output signal level “1” signal (high) and 2.5 A load: U_B - 1 VDC
5	5	Protection class
5	5	Condensation not permitted

Changes in Version 20 330-04

The operating manual was completely revised.



Notes

Hotline
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