VAA-2E-KE1-S

Original Instructions

Manual

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Worldwide

Pepperl+Fuchs Group

Lilienthalstr. 200

68307 Mannheim

Germany

Phone: +49 621 776 - 0

E-mail: info@de.pepperl-fuchs.com

North American Headquarters

Pepperl+Fuchs Inc.

1600 Enterprise Parkway

Twinsburg, Ohio 44087

USA

Phone: +1 330 425-3555

E-mail: sales@us.pepperl-fuchs.com

Asia Headquarters

Pepperl+Fuchs Pte. Ltd.

P+F Building

18 Ayer Rajah Crescent

Singapore 139942

Phone: +65 6779-9091

E-mail: sales@sg.pepperl-fuchs.com

https://www.pepperl-fuchs.com

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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

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1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols

Note

This symbol brings important information to your attention.

Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

1.4 Declaration of Conformity

This product was developed and manufactured in line with the applicable European standards and directives.

Note

A declaration of conformity can be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs Group, 68307 Mannheim, Germany, has a certified quality assurance system that conforms to ISO 9001.

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2 Safety

2.1 Intended Use

When used as intended, the AS-Interface safety module allows the operation of sensor-controlled personal protective equipment up to category 4 and PL e as per ISO 13849 or up to SIL 3 as per EN/IEC 61508 and EN/IEC 62061 in combination with an appropriately programmed AS-Interface safety monitor. The safety level of the application is determined either via a risk analysis, e.g., in accordance with EN 1050, or is taken from a C standard.

2.2 Peripheral Requirements

Safety Monitor Requirements

The module must only be used as a safety-related slave in an AS-Interface segment with the corresponding AS-Interface safety monitor as intended. The AS-Interface safety monitor must meet the requirements of the "Specification of Safe AS-Interface Transmission" system specification (version 2.01) dated 05/12/2000.

To evaluate a safety-related function in accordance with a safety standard, all components found in the function must be evaluated in accordance with this standard.

The wiring and programming of the safety monitor determine whether or not the required safety function performs correctly. This also applies to the required safety response after a code fault or failure (see also safety monitor documentation). The safety function (including all safety-related sensors) must be checked prior to initial commissioning. The safety monitor PL category or SIL must, as a minimum, comply with the PL category or SIL required by the application.

Cabling Requirements

The requirements set out in EN/IEC 60204-1 or similar must always be observed. The requirements for the external cabling and selection of connected sensors are based both on the level of functionality to be achieved, and on the required category (ISO 13849-1, EN/IEC 61508, or EN/IEC 62061).

Switches or Mechanical Contacts

The switches must be positive opening. Combinations of switches that provide an equivalent level of safety (fault behavior analysis) can be used.

2.3 General safety instructions

Danger!

Any type of operation other than what is described in the instructions places the safety and functionality of the module and connected systems in question.

The module can only be operated by trained professionals in accordance with the available instruction manual.

Connecting modules and performing maintenance tasks while the devices are connected to a power source must only be performed by trained electrical specialists.

If malfunctions cannot be eliminated, the module must be taken out of operation and protected from being inadvertently placed back in operation.

Repairs must only be performed directly by the manufacturer.

Making changes to or tampering with the device is not permitted and will render the warranty void.

When operating the device, care must be taken to ensure that the requirements for installation of a housing in IP20 are also maintained.

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Note

The plant management is responsible for heeding local safety regulations.

2.4 Transfer time of the safety-relevant information

The transfer time depends essentially on the monitor. The corresponding documentation and the switch-off times of the actuators must be observed.

2.5 Probability of Failure on Demand Calculation

To calculate the probability of dangerous failure on demand (PFD) of a safety-related function, the PFD values for all components used within this function must be taken into consideration. In the case of dual-channel applications, the AS-Interface safe input module does not significantly contribute to the PFD or PFH (probability of dangerous failure per hour) of the overall system.

The PFD and PFH values for single-channel application can be found in the data sheet. The PFD or PFH values of the other components, in particular the safety monitor, can be found in the relevant documentation.

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3 Product Description

3.1 AS-Interface Safety at Work VAA-2E-KE1-S

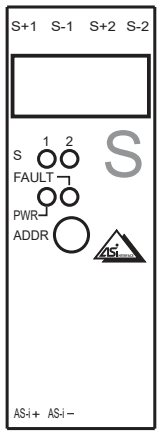
The VAA-2E-KE1 is an AS-Interface safety module with two safety-related inputs. A dual-channel mechanical switch or single-channel mechanical switch can be connected to the two inputs. The housing is only 22.5 mm wide and 48.5 mm tall and takes up little space in the switch cabinet. A snap-on function mounts the module onto the 35 mm mounting strip in line with EN 50022. An addressing socket is integrated in the module.

The connection is made via plug-in terminals. A four-way (black) terminal block is used for the inputs. The AS-Interface is connected via a two-way (yellow) terminal block. Each channel has an LED mounted on the top side of the module to display the current switching status. There is also an LED for monitoring AS-Interface communication and to display that the module has the address 0.

If single-channel positive-action mechanical switches are connected, the module can be graded up to category 2 / PL c in accordance with EN ISO 13849-1 if wired appropriately and the switch is selected accordingly. If a dual-channel positive-action mechanical switch is connected, the module can be graded up to category 4 / PL e in accordance with EN ISO 13849-1 if wired appropriately and the switch is selected accordingly. As per the approval in line with IEC 61508, a Safety Integrity Level of up to SIL 3 can be reached. Both module inputs are occupied. The two channels belonging to the mechanical switch are monitored for crossed circuits. An LED displays the AS-Interface voltage.

3.2 Connections and Indications

Connection layout



Safety-Related Inputs

Designation	Description
S1+	Mechanical switch 1+
S1-	Mechanical switch 1-
S2+	Mechanical switch 2+
S2-	Mechanical switch 2-

Indications

Designation	Description
FAULT	Fault indication: red LED Red: communication error or address is 0
PWR	AS-Interface voltage: green LED
S1	Switching status of input channel 1: yellow LED
S2	Switching status of input channel 2: yellow LED

3.3 Interface Properties

AS-Interface

The KE1 series module is connected to the AS-Interface via removable terminals. The cable must satisfy the minimum requirements for AS-Interface, e.g., AS-Interface ribbon cable VAZ-FK-S-YE.

Inputs

General

The switches are connected to removable terminals. One or more mechanical switches can be connected in series per channel.

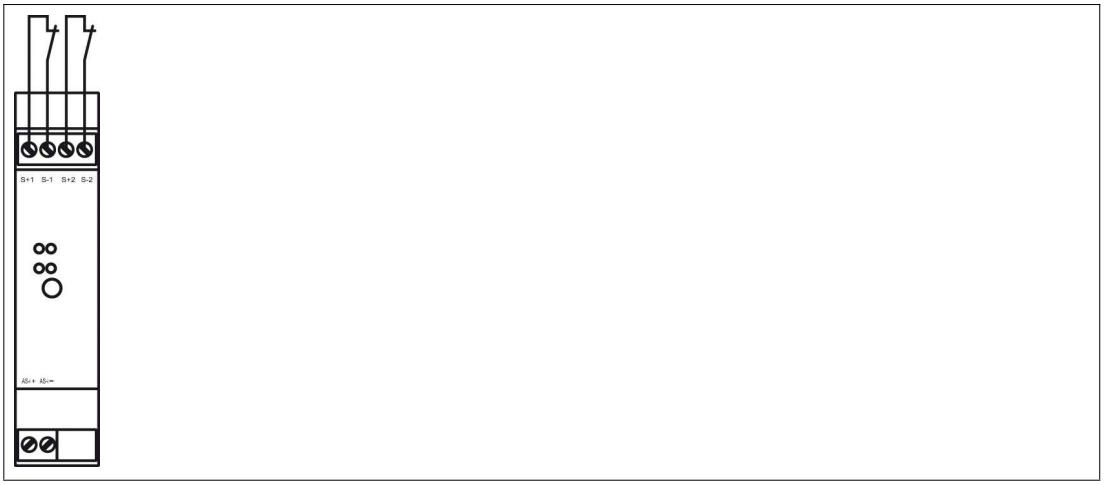


Figure 3.1 Two mechanical switches (or one dual-channel switch)

If only one single-channel switch is to be used, input 1 should be used in this case. If input 2 is not connected, it must be bridged.

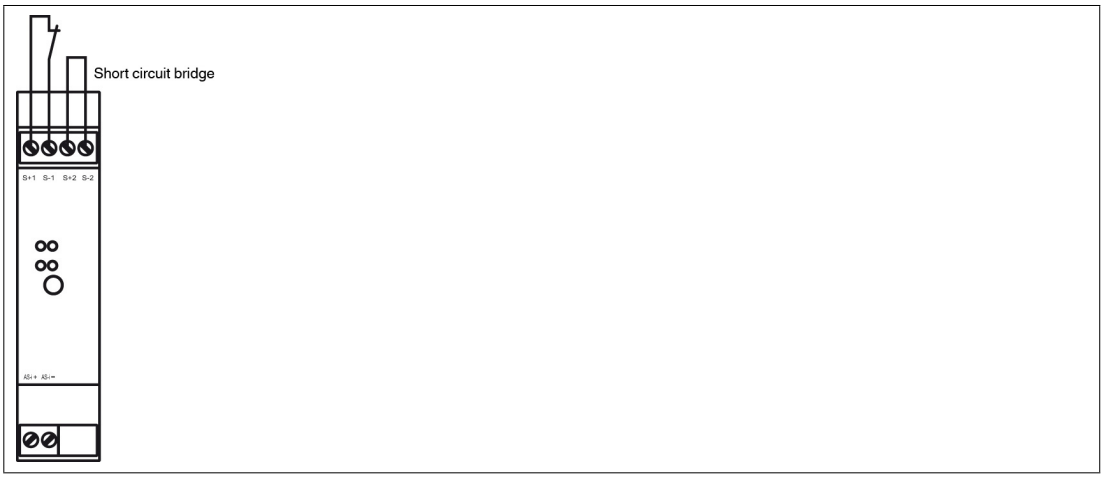


Figure 3.2 One mechanical switch

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Safety Category

The module contains two independent and redundant input channels that individually meet the requirements of category 4 / PL e in accordance with EN ISO 13849-1.

Crossed Circuit Monitoring

The inputs are monitored for inter-crossed circuits. The crossed circuit monitoring function is able to detect low-resistance crossed circuits between the two inputs caused by a metallic connection.

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4 Commissioning

4.1 Preparation

Unpacking the Device

1. Check the packaging and contents for damage.

   ↳ In the event of damage, inform the shipping company and notify the supplier.

2. Check the package contents against your order and the shipping documents to ensure that all items are present and correct.

   ↳ Should you have any questions, direct them to Pepperl+Fuchs.

3. Retain the original packaging in case the device is to be stored or shipped again at a later date.

4.2 Configuring the AS-Interface Safety Monitor

For details of necessary organizational measures affecting configuration of the safety monitor, please refer to the documentation for the safety monitor.

Safety Classification

The module contains two independent, redundant input channels. If both input channels are used, the module is suitable for use up to category 4/PL e in accordance with ISO 13849-1, or SIL 3 in accordance with EN/IEC 61508 and EN/IEC 62061. In this case, the monitor must be programmed so that dual-channel switching is monitored.

If a single-channel switch is used, the module is suitable for use up to category 2/PL c in accordance with ISO 13849-1, or SIL 1 in accordance with EN/IEC 61508 and EN/IEC 62061. Only tested and certified power supplies with safe isolation may be used to supply power. These power supplies must have PELV voltage in accordance with EN 50295/IEC 62026-2, and a minimum MTBF of 50 years. The power supplies are designed to exclude a short circuit between the primary and secondary sides.

4.3 Installation

For installation of the module a suitable top hat DIN rail in accordance with DIN 50022 is recommended.

4.4 Addressing modules

Addressing of the module is performed by means of a manual addressing device or with an AS-Interface master. If a manual addressing device is used, it should be connected and addressed to the addressing socket of the module (identified with ADDR) using the addressing cable included with delivery. Addresses from 1 to 31 can be assigned. The state as supplied is address 0.

4.5 Operational Testing

Perform function tests as part of the installation by activating the safety function. The operational test uncovers all existing faults at the time of installation. Because the safe inputs are monitored for crossed circuits, it is not necessary to test for short circuits in the cabling.

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Note

In the case of single-channel safety functions, test the function for each channel.

For applications of category 4/PL e in accordance with ISO 13849-1 or SIL 3 in accordance with EN/IEC 61508 and EN/IEC 62061, the two inputs must be monitored using the safety monitor to ensure that they are synchronous.

Performing a Function Test

1. Activate the safety function by interrupting the input. This can be done by actuating a connected mechanical switch or on the cable.
2. Check whether the safety monitor detects the interruption without issuing a fault message.
3. Stop the interruption on the input on the connected mechanical switch or on the cable.
4. Enable the input on the safety monitor.

4.6 Operating mode

Activating operating modes for the inputs is not possible.

The parameters in the AS interface may influence the performance of the outputs. The chapter "Operating principle" contains a more accurate description.

4.7 Operation

Programming the safety monitor parameters defines the safety function of the device. Read the corresponding documentation.

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5 Maintenance and Repair

5.1 Maintenance and repair

Regular function tests may be necessary, depending on the safety category.

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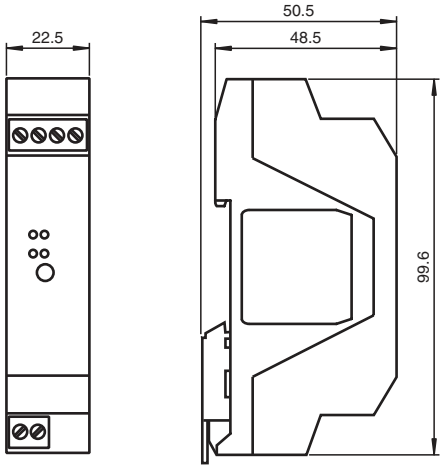
6 Technical Data



General specifications

Slave type	Safety-Slave
UL File Number	E87056

Indicators/operating means

LED FAULT	error display; LED red red: communication error or address is 0
LED PWR	AS-Interface voltage; LED green
LED IN	switching state (input); 2 LED yellow

Electrical specifications

Rated operating voltage	26.5 ... 31.6 V PELV from AS-Interface
Rated operating current	≤ 70 mA
Protection class	III

Input

Number/Type	2 safety-related inputs for mechanical contacts, cross-circuit monitored: 2 single-channel contacts: up to category 2 / PL c in accordance with EN ISO 13849-1 or 1, 2-channel contact: up to category 4 / PL e in accordance with EN ISO 13849-1 Cable length must not exceed 300 m per input.
Supply	from AS-Interface
Voltage	20 ... 30 V DC pulsed
Current loading capacity	input current limited ≤ 15 mA, overload and short-circuit resistant

Programming instructions

Profile	S-0.B
IO code	0
ID code	B
ID1 code	F
ID2 code	0

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Data bits (function via AS-Interface)	input output
D0	dyn. safety code 1 -
D1	dyn. safety code 1 -
D2	dyn. safety code 2 -
D3	dyn. safety code 2 -
Parameter bits (programmable via AS-i)	function
P0	not used
P1	not used
P2	not used
P3	not used

Compliance with standards and directives

Directive conformity	
EMC Directive 2004/108/EC	EN 61326:2006, EN 50295:1999, EN 61496-1:2004
Standard conformity	
Electromagnetic compatibility	EN 61000-6-2, EN 61000-4-5 1 kV asymmetric, criterion B, EN 61000-6-4
Emitted interference	EN 61000-6-4:2001
Insulation coordination	EN 50178:1998
Functional safety	Cat. 4 / PL e acc. to EN ISO 13849-1:2015 SIL 3 acc. to IEC 62061:2015 and IEC 61508 part 1-7:2010
Degree of protection	EN 60529:2000
Fieldbus standard	EN 50295:1999, IEC 62026-2:2006
Electrical safety	EN 50178:1998 , IEC 60204-1:2007

Ambient conditions

Ambient temperature	-25 ... 50 °C (-13 ... 122 °F)
Storage temperature	-25 ... 85 °C (-13 ... 185 °F)
Shock and impact resistance	10 g, 16 ms in 6 spatial directions 1000 shocks
Vibration resistance	0.75 mm 10 ... 57 Hz , 5 g 57 ... 150 Hz, 20 cycles

Mechanical specifications

Degree of protection	IP20
Connection	removable terminals, terminal connection ≤ 2.5 mm^2
Material	
Housing	PA 66-FR
Mass	80 g
Mounting	DIN mounting rail

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7 Annex A

7.1 Application Examples

Note

The examples listed here correspond to our understanding of the categories in accordance with ISO 13849-1 and should not be regarded as binding.

7.2 Category 2

The safety function(s) must be tested at appropriate intervals of time by the machine control system. Loss of the safety function will be detected by the test. The test intervals must be adjusted to match the application.

Connecting two independent mechanical position switches of Category 2:

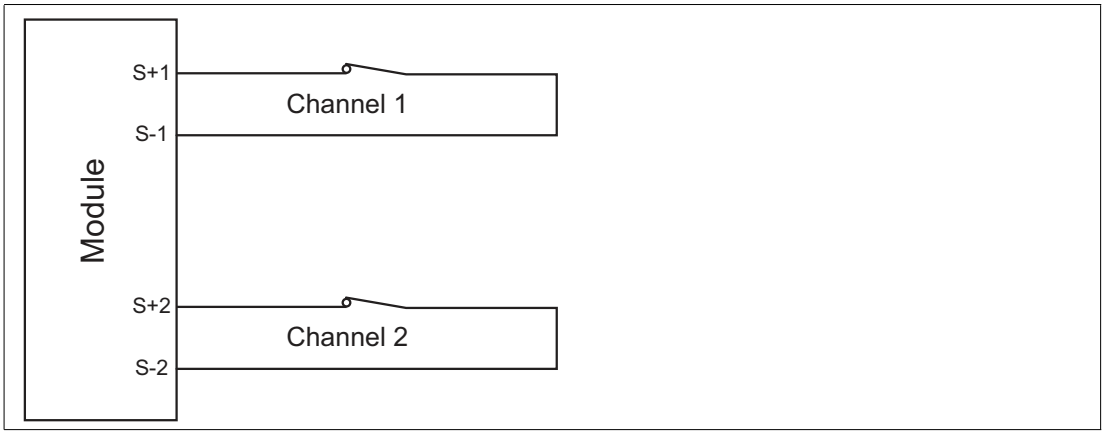

Figure 7.1

7.3 Category 3

The occurrence of a fault must not lead to the loss of the safety function.

Connection of two dependent mechanical position switches per channel (two safety functions).

Example 1:

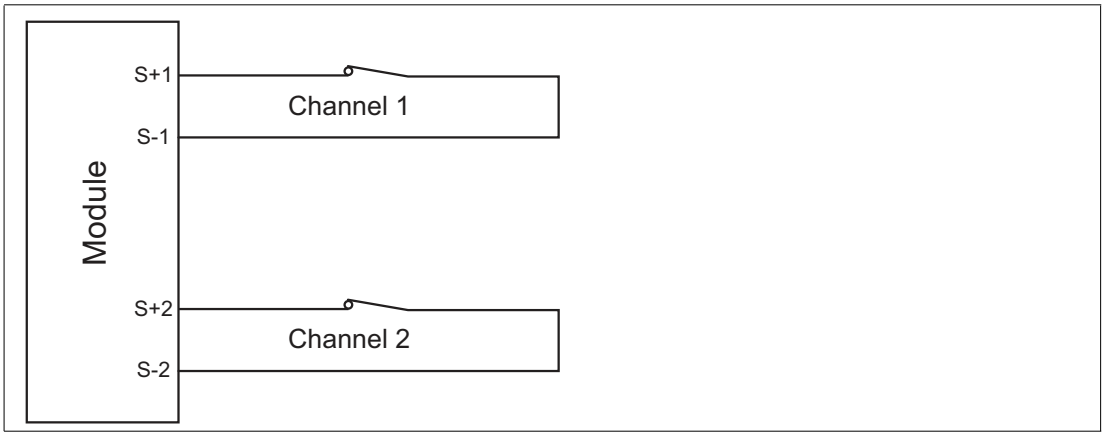

Figure 7.2

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Example 2:

If a dangerous failure (short circuit) of the switches cannot be excluded, these switches must be duplicated and connected in series.

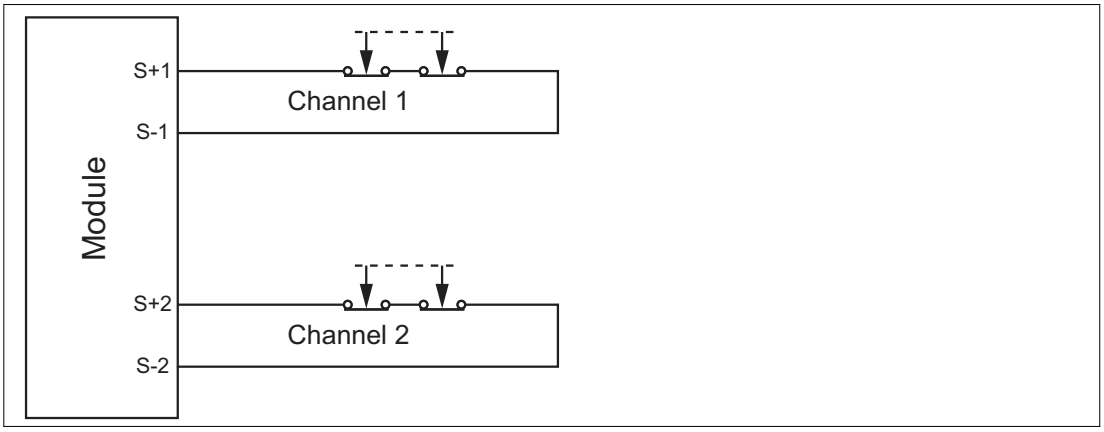

Figure 7.3

Example 3:

If a short circuit in the cabling across the switches cannot be excluded, both channels are needed to achieve a category 3 safety function.

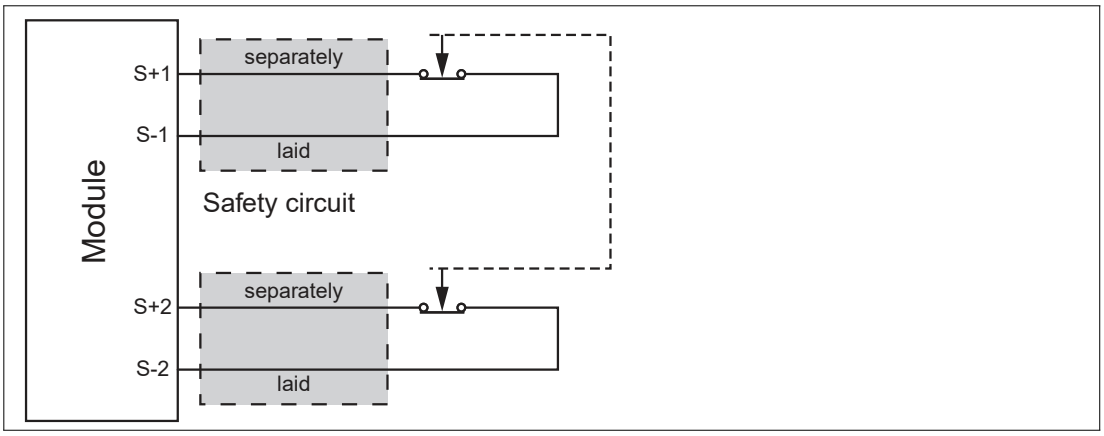

Figure 7.4

The following function blocks can be parameterized to achieve safety category 3 in this application during operation of the AS-Interface safety module on a safety monitor (e.g., VAS-1A-K12 or VAS-2A-K12):

Examples 1 and 2:


Dual-channel, independent

Example 3:


Dual-channel, dependent


Dual-channel, force-guided

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Danger!

The function block  "Dual-channel, independent" must **not** be used in example 3.

7.4 Category 4

The occurrence of a fault and an accumulation of faults must not lead to the loss of the safety function.

Example 1:

Connection of a dual-channel mechanical position switch.

To detect a dangerous accumulation of faults, the safety function must be tested. The test intervals must be adapted to the application.

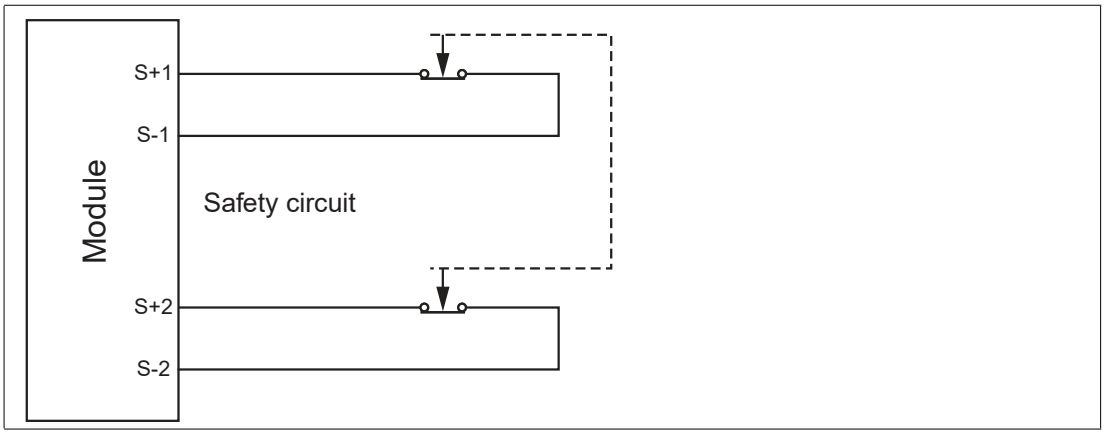

Figure 7.5

Example 2:

If a dangerous failure (short circuit) of the switch cannot be excluded, two dependent mechanical switches must be used for each channel. To detect a dangerous accumulation of faults, the safety function must be tested. The test intervals must be adapted to the application.

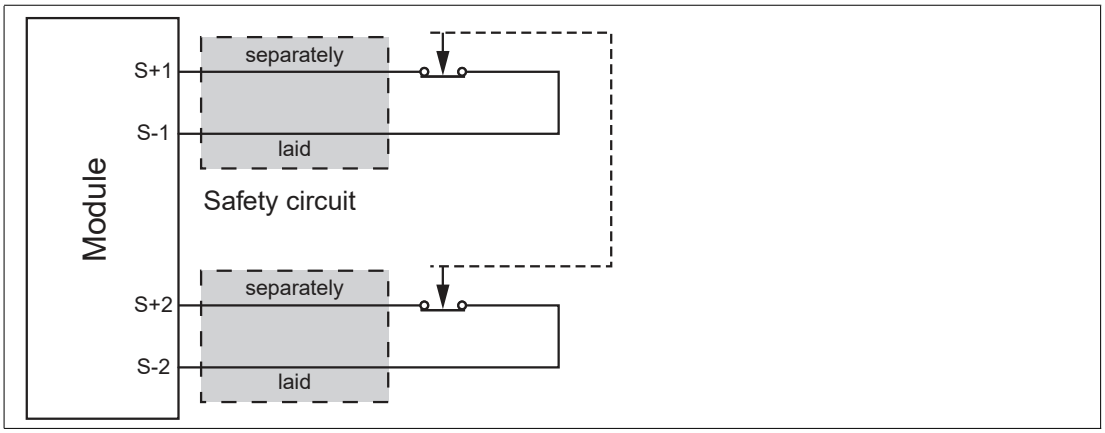

Figure 7.6

The following function blocks can be parameterized to achieve safety category 4 in this application during operation of the AS-Interface safety module on a safety monitor (e.g., VAS-1A-K12 or VAS-2A-K12):

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 Dual-channel, dependent

 Dual-channel, force-guided

Danger!

The function block  "Dual-channel, independent" must **not** be used.

Warning!

The cable length between the module and the sensor is limited to 300 m.

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8 Annex B

8.1 Summary of the Requirements for Categories in Accordance with ISO 13849-1

Category	Summary of the requirement	System behavior [1)]	Essential principle to achieve safety
B	The safety-related parts of machine control and/or their components must be designed, constructed, selected, assembled, and combined in accordance with the applicable standards such that they can withstand the expected influences.	If a fault occurs, it can lead to the loss of the safety function.	Via the selection of components
1	The requirements of B must be fulfilled. Use of components and principles that are proven for safety engineering purposes.	As described for category B, but with the safety function providing a higher level of safety-related reliability.	
2	The requirements of B must be fulfilled and principles that are proven for safety engineering purposes must be used. The safety function(s) must be checked by the machine control at suitable intervals. **NOTE**: What is suitable depends on the application and the type of machine.	• The occurrence of a fault can lead to the loss of the safety function between the test intervals. • The loss of the safety function is detected by the test.	Via the structure
3	The requirements of B must be fulfilled and principles that are proven for safety engineering purposes must be used. The control systems must be designed such that: • An individual fault in the control system does not lead to the loss of the safety function, and • Whenever reasonably practicable, individual faults are detected.	• When an individual fault occurs, the safety function is always maintained. • Some, but not all, faults are detected. • An accumulation of undetected faults can lead to the loss of the safety function.	
4	The requirements of B must be fulfilled and principles that are proven for safety engineering purposes must be used. The control systems must be designed such that: • An individual fault in the control system does not lead to the loss of the safety function, and • The individual fault is detected during or before the next time the safety function is invoked. If this is not possible, then an accumulation of faults must not lead to the loss of the safety function.	When faults occur, the safety function is always maintained. The faults are detected in good time to prevent a loss of the safety functions.	

1) The risk assessment indicates whether the complete or partial loss of the safety function(s) due to the occurrence of faults is acceptable.

8.2 Certificates

Approvals in accordance with EN ISO 13849-1, EN/IEC 62061 and EN/IEC 61508.

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- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
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