



## INSTRUCTION MANUAL

AS-INTERFACE SAFETY AT WORK  
VAA-2E-G4-SN

VERSION 1.2



With regard to the supply of products, the current issue of the following document is applicable:  
The General Terms of Delivery for Products and Services of the Electrical Industry, as published by  
the Central Association of the "Elektrotechnik und Elektroindustrie (ZVEI) e.V.",  
including the supplementary clause "Extended reservation of title".

We at Pepperl+Fuchs recognize a duty to make a contribution to the future.  
For this reason, this printed matter is produced on paper bleached without the use of chlorine.

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### Declaration of conformity

The AS-Interface safety slave for mechanical switches and SN/S1N proximity switches VAA-2E-G4-SN was developed and manufactured taking into consideration applicable European standards and regulations.



#### Note

*A corresponding declaration of conformity may be requested from the manufacturer.*

The manufacturer of the product, Pepperl+Fuchs GmbH in D-68301 Mannheim, has a certified quality assurance program in accordance with ISO 9001.



## 1 Symbols used in this document



**Warning**

*This symbol indicates a warning about a possible danger. Failure to observe this warning may result in consequences ranging from personal injury to death or from damage of equipment to destruction.*



**Attention**

*This symbol warns of a possible fault. Failure to observe the instructions given in this warning may result in developing a fault or even complete failure of the device and any facilities or systems connected to it.*



**Note**

*This symbol brings important information to your attention.*

### 2 Safety

#### 2.1 Intended use



#### Warning

*Protection of operating personnel and the system is only ensured if the AS-Interface safety slave is used in accordance with the usage for which it is properly intended.*

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

*It must only be used as a safety-oriented slave on an AS-Interface line with a corresponding AS-Interface safety monitor in accordance with the intended purpose.*

*The requirements for external cabling and selection of connected sensors are based on both the functionality to be fulfilled and the required category (EN 954-1/ISO 13849-1). This category is determined either with the aid of risk analysis (for example in accordance with EN 1050) or from a C standard. The category of the safety monitor must correspond at least to the category required by the application.*

*The correct design of the desired safety function also depends on the circuitry and programming of the safety monitor. This also applies to the desired safety response after a code malfunction or failure. See also the documentation for the safety monitor and the section of connection assignment. The safety function (including all safety-related sensors) must be verified before the unit is placed in service for the first time.*

## 2.2 General Safety Instructions



### Warning

*Any other type of operation than what is described in this manual places the safety and functionality of the device and systems connected to it in question. Only professionals trained in electronics are permitted to connect the device and to perform maintenance tasks while operation.*

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

*Repairs may only be performed at the manufacturer's facility.*

*No changes and operations made to the device are permitted and will render any warranty claim void.*



### Note

*The operator is responsible for adhering to local safety regulations and directives.*

### 3 General information

The Actuator Sensor Interface (AS-Interface) is established as a system for networking primarily binary sensors and actuators on the lowest level of the automation hierarchy. The high number of installed systems, simple handling and the reliable operating behaviour make AS-Interface promising for the area of machine safety as well.

#### System features

When used according to the intended purpose in combination with an appropriately programmed AS-Interface Safety at Work safety monitor, the AS-Interface safety slave described here makes it possible to operate sensorcontrolled personal protection equipment up through Category 4 in accordance with EN 954-1.

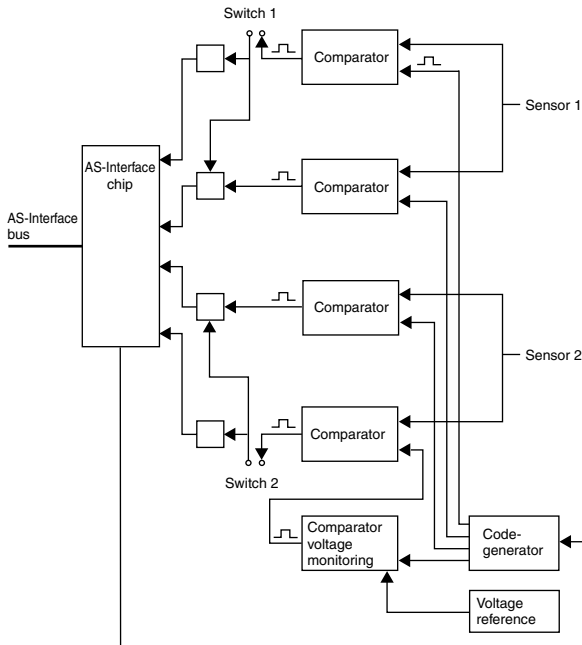
The safety monitor must be sufficient for the requirements of the system specification "Specification of secure AS-Interface transfer" Version 2.01 dated May 12, 2000.

The slave is equipped with two safety-related inputs. A mechanical switch in accordance with EN/IEC 60947-5-1 or a proximity switch of Pepperl+Fuchs with defined behavior in case of a failure in accordance with the SN/S1N Specification and EN/IEC 60947-5-3, Type S (corresponding to Category 3 in accordance with EN 954-1/ISO 13849-1) can be connected to each of these.



### Principle of operation

The slave generates a code sequence internally. This code sequence is monitored by a safety monitor (additional bus participant) for the correct sequence.



Transferring the code sequence is affected by the status of externally connected sensors.

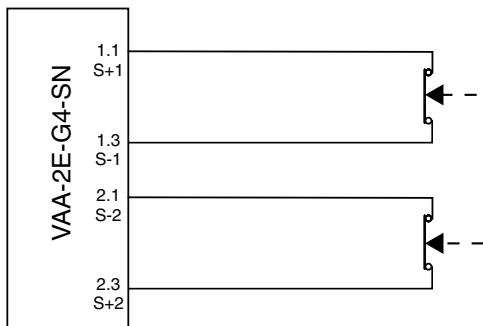
Information regarding the activation of the connected sensors (for example with Emergency Stop activated, SN proximity switch muted, code transfer is interrupted) is transferred as follows:

Activated input channel	Code Data bit D4, D3, D2, D1
1	XX00
2	00XX
1 and 2	0000
None	XXXX

Code words 0000, XX00 and 00XX cause the safety monitor to bring the system to a safe state (for example in Emergency Stop) without reporting a malfunction. If a bit of a code word deviates from the target code word, the safety monitor switches the system into the safe state and indicates a malfunction in the slave.

An input circuit consists of two dynamically controlled comparators that affect 2 of the 4 data inputs of the AS-Interface interface component. One input for SN/S1N proximity switches and one input for mechanical position switches each are switched logically in series.

Example: An Emergency Stop with two separate circuits (Fault detection behaviour according to Category 4) assigns both module channels.



## 4 Connections, displays and control elements

### Connections

The sensor connections consist of cage clamp terminals.

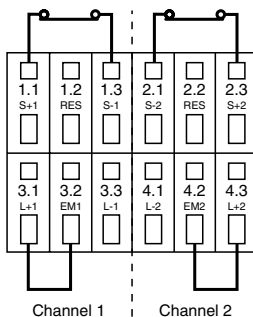
Either one mechanical position switch or a SN/S1N proximity switch may be connected to each channel.

Connections		
1.1	Mechanical position switch 1 +	S+1
1.2	Reserved	RES
1.3	Mechanical position switch 1 +	S-1
2.1	Mechanical position switch 2 +	S-2
2.2	Reserved	RES
2.3	Mechanical position switch 2 +	S+2
3.1	SN/S1N proximity switch 1 +	S+1
3.2	Proximity switch 1 emulation	EM1
3.3	SN/S1N proximity switch 1 -	L-1
4.1	SN/S1N proximity switch 2 -	L-2
4.2	Proximity switch 2 emulation	EM2
4.3	SN/S1N proximity switch 2 +	L+2

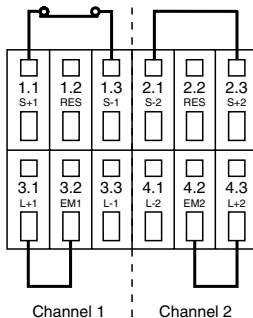


*Terminals 1.2 and 2.2 are reserved and must not be assigned (used).*

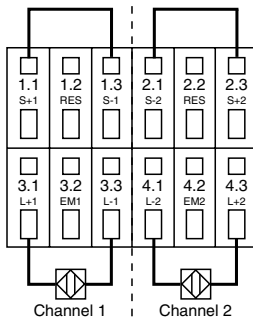
*Each of the unassigned terminals should be wired as follows:*



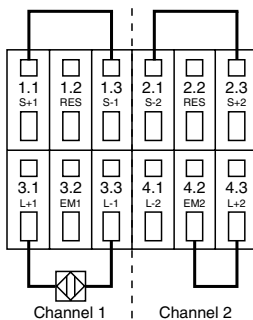
2 mechanical position switches (or one two-channel position switch)



1 mechanical position switch



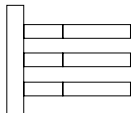
2 SN/S1N proximity switches



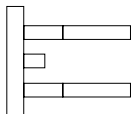
1 SN/S1N proximity switch

### Short-circuit terminals

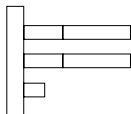
The corresponding short-circuit terminals (#119797) are included with delivery and must be adapted to match the application.



State as supplied



SN jumper



Mechanical position switch jumper

## Displays

I1	Yellow LED, switching state of input channel 1 (independent of the sensor technology)
I2	Yellow LED, switching state of input channel 2 (independent of the sensor technology)
FAULT	Red LED, AS-Interface communication error
PWR	Green LED, AS-Interface power

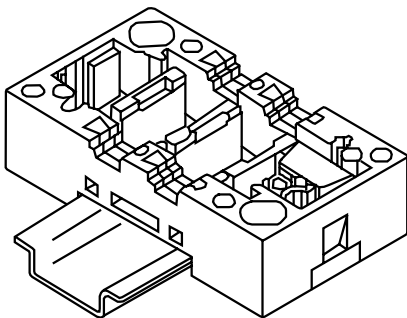
**Note**

*The yellow LEDs I1 and I2 indicate the status of the dynamic safety code, which is forwarded on to the safety motor. Since the frequency of the safety code decreases with the number of AS-Interface slaves that are connected, the LEDs may flicker noticeably. This is a normal operating state.*



### 5 Power supply of the modules

The SN module is connected to the AS-Interface via the electromechanical EMS interface.





## 6 Assignment of the connections

### 6.1 General information

The attachable Emergency Stop or position switches must be implemented as normally closed contacts. Interfaces in accordance with the SN specification (Pepperl+Fuchs) are provided for the safety sensors. The slave contains two redundantly structured input channels that are independent of each other.

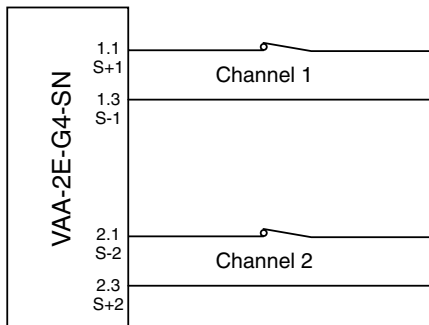
### 6.2 Connection examples

The following system requirements must be fulfilled to achieve a safety category:

#### Category 2

Testing

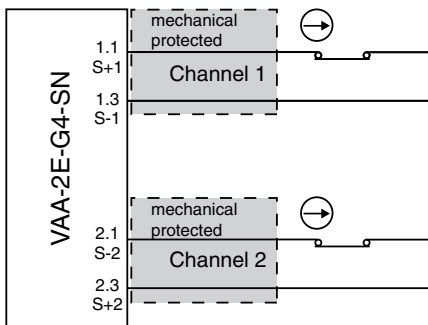
- Connection of two independent mechanical switches of Category 2: Since a short-circuit over the switch is not detected, the switches and safety slaves must be tested regularly. The test intervals must be adapted to the application. There are no special requirements for cables or switches.



### Category 3

The occurrence of an error must not result in loss of the safety function (Category 3).

- Connection of two independent mechanical switches of Category 3: Since a short-circuit over the switch is not detected, the lines between the safety slave and the switch must be laid with protection against mechanical damage. The switch must be positively driven so that it is not possible for the contacts to become fused together.



The following functional devices can be used in this application while operating the AS-Interface safety slave together with a safety monitor type VAS-1A-K12-U or VAS-2A-K12-U to meet the requirements of Category 3:



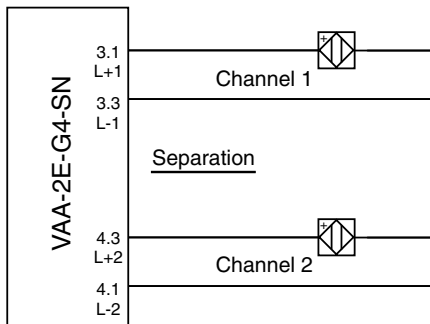
Two channels dependent



Two channels independent

## Assignment of the connections

- Connection of two separate SN proximity switches of Category 3/S: Since a short-circuit between the proximity switch circuits cannot always be detected, they should not be connected by a common multi wire cable, unless a cross-circuit between the two proximity switch inputs can be excluded by protected wire laying or similar means.



The following function devices can be used in this application while operating the AS-Interface safety slave together with a safety monitor of types VAS-1A-K12-U or VAS-2A-K12-U to meet the requirements of Category 3:



Two channels dependent

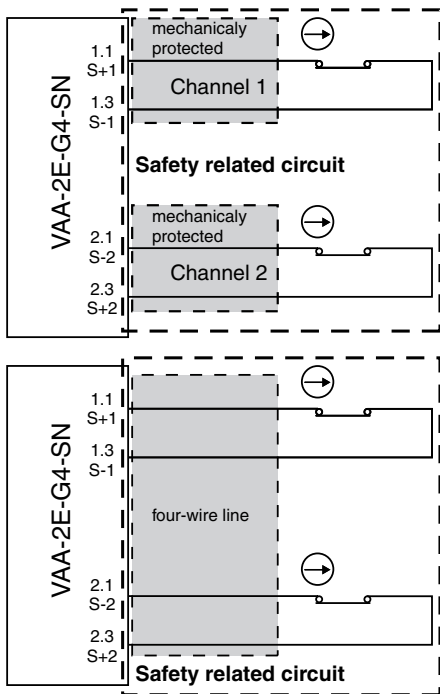


Two channels independent

### Category 4

The occurrence of an error must not result in loss of the safety function.  
An accumulation of errors must not result in loss of the safety function

- Connection of two dependent mechanical switches:  
Since the short-circuit over the switch is not detected, the lines between the safety slave and the switch must either be laid with protection or must be designed as a four-wire line. The switch must be positively driven so that it is not possible for the contacts to become fused together.



## Assignment of the connections

The following function devices can be used in this application while operating the AS-Interface safety slave on a safety monitor of types VAS-1A-K12-U or VAS-2A-K12-U to meet the requirements of Category 4:



Two-channel positively driven



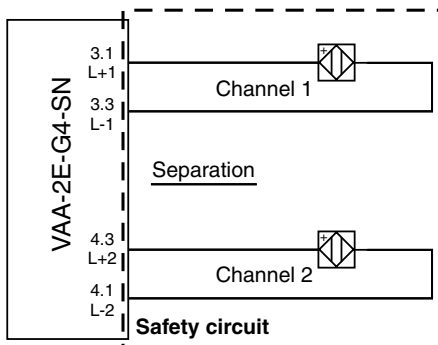
Two-channel dependent



The function device "two-channel independent" must **not** be used.

### Warning

- Connection of two functionally dependent SN proximity switches of Category 3/S:  
Since a short-circuit between the proximity switch circuits cannot always be detected, they must not be connected by a common multiwire cable, unless a cross-circuit between the two proximity switch inputs can be excluded by protected wire laying or similar means.



### Assignment of the connections

The following function devices can be used in this application while operating the AS-Interface safety slave together with a safety monitor of types VAS-1A-K12-U or VAS-2A-K12-U to meet the requirements of Category 4:




Two-channel positively driven



Two-channel dependent



The function device " two-channel independent" must **not** be used.

Warning



Attention

The cable length between the VAA-2E-G4-SN and the sensor is limited to 30 m for both the position switch and the proximity switch.

## 7 Operating the modules

### 7.1 Installation



**Attention**

*In order to achieve IP67 the housing must be screwed with the lower section in a way that it lies evenly on the supporting points on the lower section.*

Put the screw fittings on the sensor/actuator cable.



Connect the den insulated sensor/actuator cable in sequence 3, 4, 2, 1.

### 7.2 Addressing of the modules

The addressing of the AS-Interface slave is performed with the aid of a manual addressing device or with an AS-Interface master. When using the manual addressing device, the AS-Interface slave is simply plugged into this device and then the address can be set. Addresses from 1 to 31 can be assigned. The state as supplied is address 0.

### 7.3 Operation of the AS-Interface safety input modules

The safety function of the slave is also determined by the monitor. The corresponding documentation must be observed.

### 8 Transfer time of safety-related information

The response time depends fundamentally on the monitor. Attention must be paid to the corresponding documentation and switch-off times of the actuators.

### 9 Certificates

Approvals in accordance with EN 954-1/ISO 13849 -1, EN 60947-5-3

### 10 Summary of the requirements for categories

Summary of the requirements for categories in accordance with EN 954-1/ISO 13849 -1

Category	Summary of requirements	System behaviour <sup>1)</sup>	Fundamental principle for achieving safety
B	The safety-related parts of the machine control system and/or its components must be designed, constructed, selected, composed and combined in accordance with the applicable standards so that it will be able to withstand effects that are expected.	If an error occurs, it may result in a loss of the safety function.	by selecting components
1	The requirements of B must be fulfilled. Use of tried and tested safety-related components and principles	As was described for Category B, but with a higher safety-related reliability of the safety function	
2	The requirements of B and the use of tried and tested safety-related principles must be fulfilled. The safety-function(s) must be tested at suitable intervals of time by the machine control unit. <b>REMARK:</b> What is suitable depends on the application and the type of machine.	The occurrence of an error may result in loss of the safety function between testing intervals. Loss of the safety function is detected by the test.	by the structure



## Summary of the requirements for categories

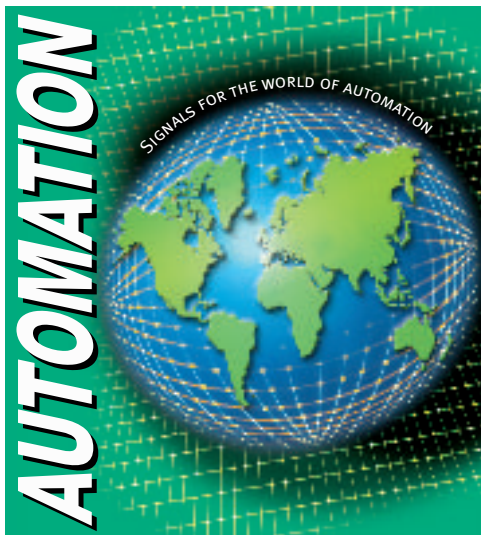
Category	Summary of requirements	System behaviour <sup>1)</sup>	Fundamental principle for achieving safety
3	<p>The requirements of B and the use of tried and tested safety-related principles must be fulfilled.</p> <p>The control units must be designed so that:</p> <ul style="list-style-type: none"> <li>- a single error does not result in the loss of safety functions and</li> <li>- whenever it is feasible in an appropriate manner, the individual error is detected.</li> </ul>	<p>If an individual error occurs, the safety function remains intact.</p> <ul style="list-style-type: none"> <li>- Some, but not all errors are detected.</li> </ul> <p>An accumulation of undetected errors can result in loss of the safety function</p>	by the structure
4	<p>The requirements of B and the use of tried and tested safety-related principles must be fulfilled.</p> <p>The control units must be designed so that:</p> <ul style="list-style-type: none"> <li>- a single error does not result in the loss of safety functions and</li> <li>- The individual error during or before the next requirement for the safety function is detected. In case this is not possible, an accumulation of errors must not result in loss of the safety function.If errors occur, the safety function still remains intact.</li> </ul>	<p>If errors occur, the safety function still remains intact.</p> <p>Errors are detected early enough to prevent loss of the safety functions.</p>	

<sup>1)</sup> The risk evaluation indicates whether complete or partial loss of safety function(s) due to errors occurring is acceptable.



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**Worldwide Headquarters**

Pepperl+Fuchs GmbH · Königsberger Allee 87  
68307 Mannheim · Germany  
Tel. +49 621 776-0 · Fax +49 621 776-1000  
e-mail: [info@de.pepperl-fuchs.com](mailto:info@de.pepperl-fuchs.com)

**USA Headquarters**

Pepperl+Fuchs Inc. · 1600 Enterprise Parkway  
Twinsburg, Ohio 44087 · Cleveland-USA  
Tel. +1 330 4253555 · Fax +1 330 4 25 93 85  
e-mail: [sales@us.pepperl-fuchs.com](mailto:sales@us.pepperl-fuchs.com)

**Asia Pacific Headquarters**

Pepperl+Fuchs Pte Ltd. · P+F Building  
18 Ayer Rajah Crescent · Singapore 139942  
Tel. +65 67799091 · Fax +65 68731637  
e-mail: [sales@sg.pepperl-fuchs.com](mailto:sales@sg.pepperl-fuchs.com)

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