

VAA-2E1A-CB10-SJ/E2J-FL,  
VAA-2E2A-CB10-SJ/E2J-FL

AS-Interface Safety at Work  
Version 2.0

Manual



Your automation, our passion.

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## 1 Declaration of Conformity

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



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### Note

A declaration of conformity can be requested from the manufacturer.

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



## 2 Safety

### 2.1 Symbols Used

#### Safety-Relevant Symbols



##### **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.

### 2.2 Intended Use

The device can be used as a safety module with safety-related inputs for connecting mechanical contacts, such as emergency-stop switches, and an optional conventional electronic output, e.g., to activate signal lights. When used in this way in conjunction with a programmed AS-Interface safety monitor, the device allows operation of sensor-controlled personal protective equipment up to category 4/PL e as per ISO 13849-1, or up to SIL 3 as per EN/IEC 62061.

The maximum service life of the AS-Interface safety module is 20 years. Replace the device as a matter of course after 20 years at the latest.

#### 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.

**Danger!**

Incorrect device connection.

Do not use the outputs for safety-integrated functions.

**Approvals**

The device is approved in accordance with ISO 13849-1 and EN/IEC 62061.

**2.3 General Safety Information**

Always operate the device as described in these instructions to ensure that the device and connected systems function correctly. The protection of operating personnel and plant is guaranteed only if the device is operated in accordance with its intended use.

Installation and commissioning of all devices may be performed only by trained and qualified personnel.

Only instructed specialist staff may operate the device in accordance with the operating manual.

It is dangerous for the user to carry out modifications and/or repairs and doing so will void the warranty and exclude the manufacturer from any liability. In the event of any serious errors, stop using the device. Secure the device against unintended operation. To have the device repaired, return it to your local Pepperl+Fuchs representative or your sales center.

Only qualified electrical specialists are authorized to perform maintenance work.

Do not open the device.

The device must be installed in a switch cabinet or switch box with a degree of protection of at least IP54.

The operating company bears responsibility for observing locally applicable safety regulations.

**2.4 Residual Risk**

The residual risk is the potential dangers of the safety system even though the system complies with all regulations. Note the below instructions.

**Caution!**

Short circuit

If you are not using an available output, make sure that the bare cable end is insulated. Bare cable ends can be protected by fitting a terminal block, for example.

**Warning!**

Electrical short caused by moisture

If the surrounding enclosure or switch cabinet is not properly sealed, the safety function may be lost.

**2.5 Safety Monitor Requirements**

The device must be used only as intended as a safety-related slave in an AS-Interface segment with the corresponding AS-Interface Safety Monitor. 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 Performance Level or Safety Integrity Level (SIL) must, as a minimum, comply with the Performance Level or SIL required by the application.

If a restart interlock is required for the safety function, this restart interlock must be implemented in the safety monitor.

## 2.6 Cabling Requirements

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



### Caution!

Protected cable installation

Protect the cable of the safe inputs against mechanical damage in accordance with the requirements set out in EN/IEC 60204-1.

If there is a risk of tampering, attach terminal blocks or field-attachable connectors such that they are inaccessible to operating personnel.

## 2.7 Switch or mechanical contact requirements

The switches must be spring loaded. Switches combinations that guarantee an equivalent safety status (malfunction analysis) can be used.

## 2.8 Fault Eliminations

Within this device, short circuits on the PCB and within the cable have been eliminated, as required by ISO 13849-2. Maintenance work must include making sure that the individual wire strands and the device are protected against damage. Route the wire strands as per EN/IEC 60204-1.

## 2.9 Transmission Time for Safety-Related Information

Reliable details of the switch-on delay for the device can be found in the data sheet. This delay affects the switch-off time of the corresponding fail safe circuit.

## 2.10 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.



## 3 Product Description

### 3.1 Function

The VAA-2E1A-CB10-SJ/E2J-FL is an AS-Interface safety module with two safety-related inputs and one conventional output. The VAA-2E2A-CB10-SJ/E2J-FL is an AS-Interface safety module with two safety-related inputs and two conventional outputs. A dual-channel mechanical switch can be connected to the two safety-related inputs on both devices, or a single-channel mechanical switch can be connected to each device. The output(s) is/are conventional, non-safety-related electronic outputs that can have a total load of 100 mA.

#### System Overview

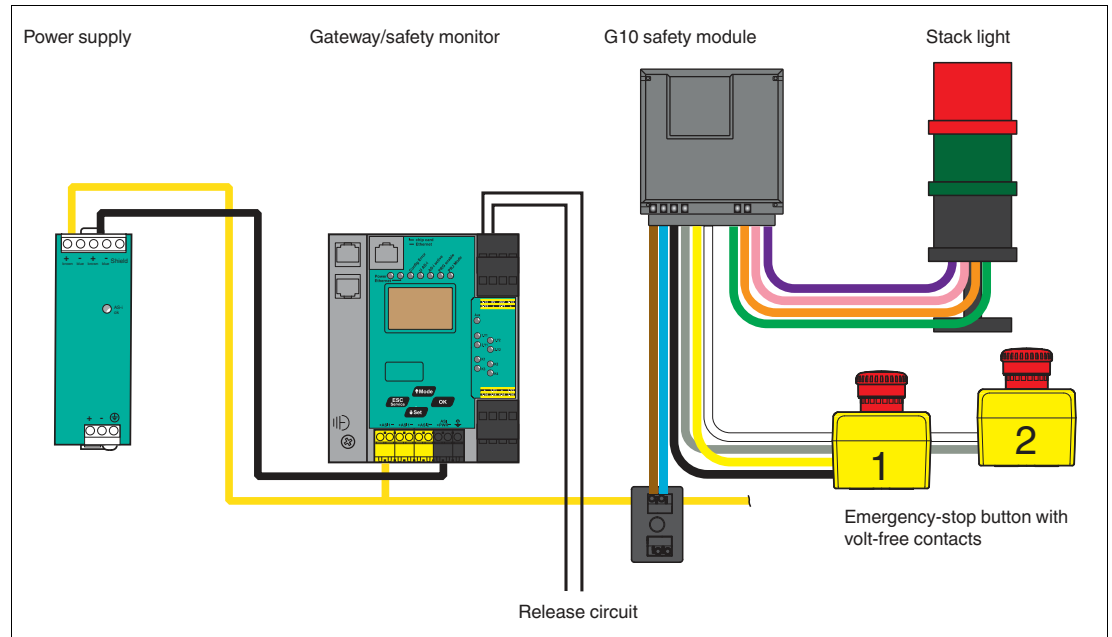


Figure 3.1 Example of an AS-Interface system with safety module and emergency-stop button  
The module is suitable for the decentralized connection of switches in very confined spaces. The connection to the AS-Interface cable and the connection of the inputs and the output(s) involves bare cable ends.

Each channel has an LED mounted on the top side of the module to indicate the current switch state. There is an LED for monitoring AS-Interface communication and for indicating that the module has the address 0. In the event of a communication failure, the outputs are disconnected from the power supply.

### 3.2 Slave Profile

The modules have the following profile:

	VAA-2E1A-CB10-SJ/E2J-FL	VAA-2E2A-CB10-SJ/E2J-FL
I/O	= 7	7
ID	= B	B
ID2	= 0	0
ID1	= F (programmable)	F (programmable)

The data value is transmitted as defined by AS-Interface profile 7.B.

### 3.3 Indicators and Operating Elements

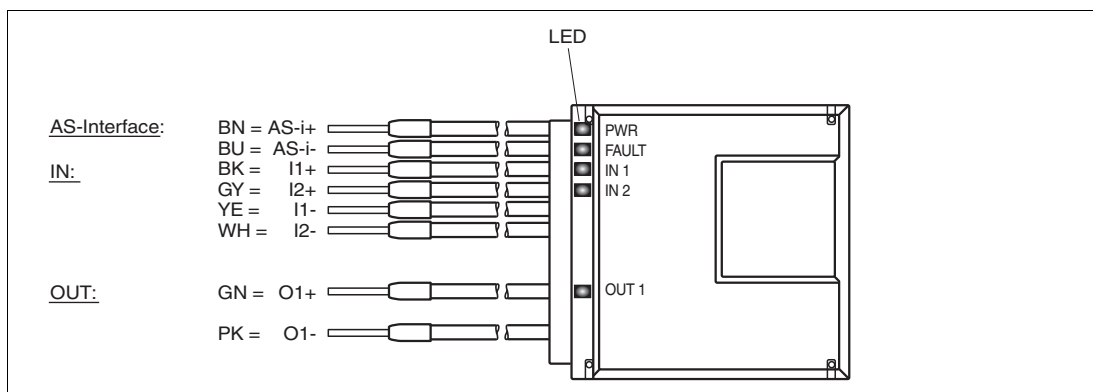


Figure 3.2 VAA-2E1A-CB10-SJ/E2J-FL

- PWR** AS-Interface status indicator
- FAULT** Fault indicator
- IN1, IN2** Input switch state
- OUT1** Output switch state

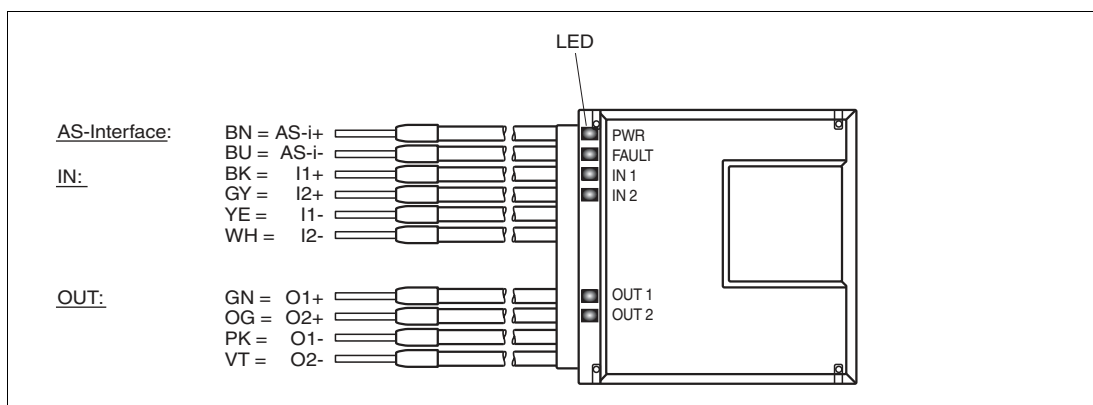


Figure 3.3 VAA-2E2A-CB10-SJ/E2J-FL

- PWR** AS-Interface status indicator
- FAULT** Fault indicator
- IN1, IN2** Input switch state
- OUT1, OUT2** Output switch state

#### Indicators

Designation	Description
PWR	AS-Interface voltage; green LED Green: voltage OK Green flashing: address 0
FAULT	Fault indication; red LED Red: communication error or address is 0 Red flashing: output overload
IN1 IN2	Switch state (input); 2 yellow LEDs
OUT1 OUT2	Switch state (output); 1 or 2 yellow LEDs

### 3.4 Connections

#### VAA-2E1A-CB10-SJ/E2J-FL Connections

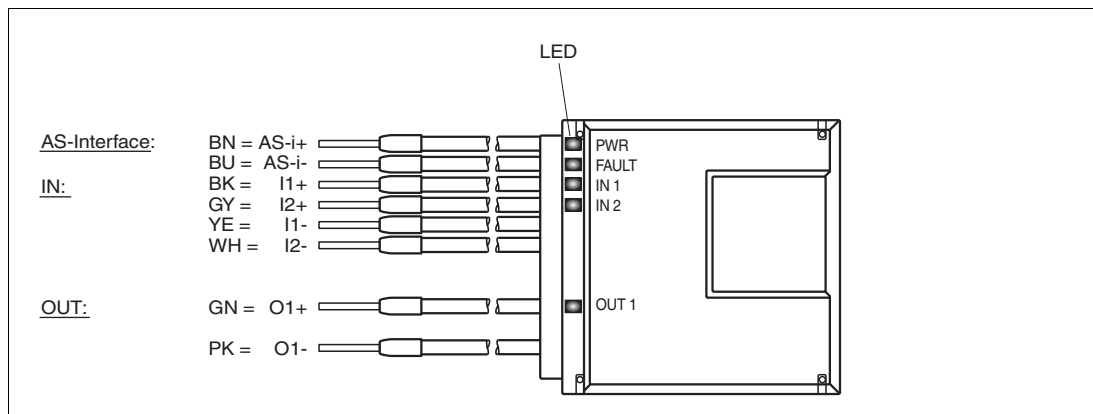


Figure 3.4 VAA-2E1A-CB10-SJ/E2J-FL

#### Safety-Related Inputs

Color	Designation	Description
Brown (BN)	AS-i +	AS-Interface +
Blue (BU)	AS-i -	AS-Interface -
Black (BK)	I1+	Mechanical switch 1 +
Gray (GY)	I2+	Mechanical switch 2 +
Yellow (YE)	I1-	Mechanical switch 1 -
White (WH)	I2-	Mechanical switch 2 -

#### Conventional (Non-Safe) Electronic Output

Color	Designation	Description
Green (GN)	O1+	Output 1 +
Pink (PK)	O1-	Output 1 -

#### VAA-2E2A-CB10-SJ/E2J-FL Connections

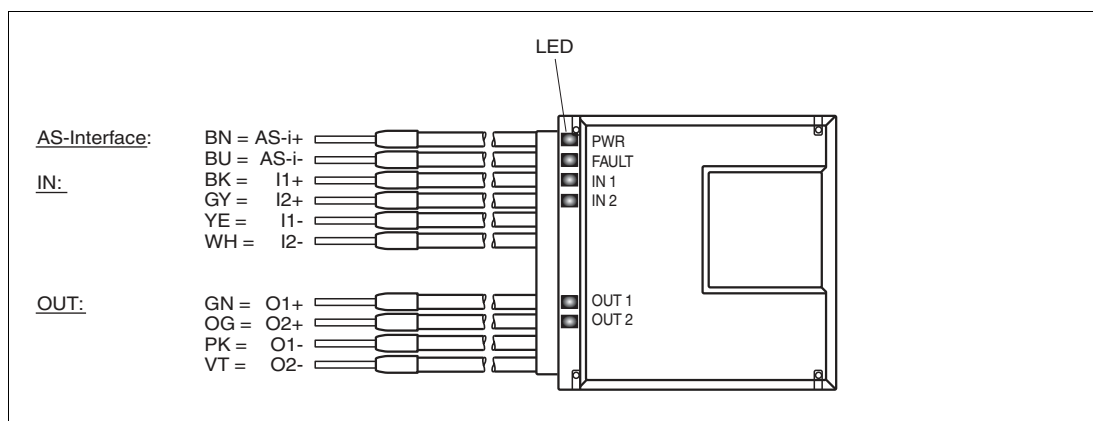


Figure 3.5 VAA-2E2A-CB10-SJ/E2J-FL

#### Safety-Related Inputs

Color	Designation	Description
Brown (BN)	AS-i +	AS-Interface +
Blue (BU)	AS-i -	AS-Interface -

Color	Designation	Description
Black (BK)	I1+	Mechanical switch 1 +
Gray (GY)	I2+	Mechanical switch 2 +
Yellow (YE)	I1-	Mechanical switch 1 -
White (WH)	I2-	Mechanical switch 2 -

**Conventional (Non-Safe) Electronic Output**

Color	Designation	Description
Green (GN)	O1+	Output 1 +
Orange (OG)	O2+	Output 2 +
Pink (PK)	O1-	Output 1 -
Violet (VT)	O2-	Output 2 -

### 3.5 Operating Principle

#### 3.5.1 Safety-Related Inputs

The module generates an internal code sequence. This code sequence is monitored by a safety monitor (additional node) to ensure the correct order.

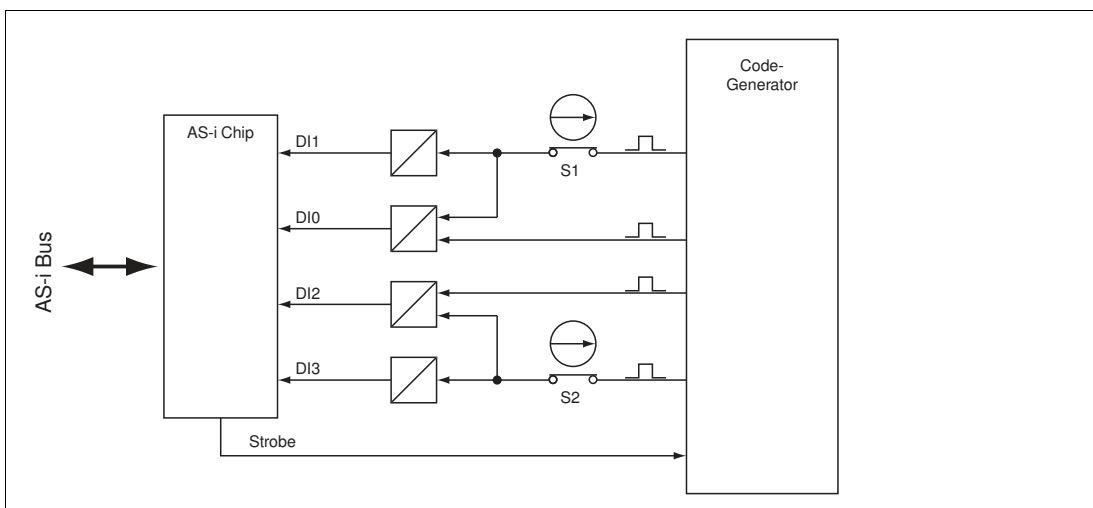


Figure 3.6 Code generation

The status of the externally connected mechanical switches influences the code sequence transmission.

Information regarding the activation of the connected mechanical switches (e.g., if the emergency-stop button is pressed, code transmission is interrupted) is transmitted as follows:

Activated input channel	Code bit 3 2 1 0
1	X X 0 0
2	0 0 X X
1 and 2	0 0 0 0
<b>None</b>	<b>X X X X<sup>1</sup></b>

Table 3.1

1. Operating condition

The code words 0000, XX00, and 00XX prompt the safety monitor to put the plant in a safe state (for instance using the emergency-stop button), without reporting a fault. If a code word bit differs from the target code word, the safety monitor will switch the plant to a safe state and will indicate a slave fault.

The two input channels on the safety module are independent. The safety monitor can be parameterized to monitor the synchronicity of both inputs for dual-channel applications.

### 3.5.2 Cross Circuit Monitoring of Inputs

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

## 3.6 Scope of Delivery

The scope of delivery includes:

- Safety module
- Documentation

## 4 Installation

### 4.1 Mounting

You can attach the device to a flat mounting surface using the supplied double-sided adhesive tape.



#### Caution!

Mechanical damage

Protect the device against mechanical damage.

Do not mount the device in an exposed location.

Install the device in a switch cabinet or switch box with a degree of protection of at least IP54.

#### VAA-2E1A-CB10-SJ/E2J-FL

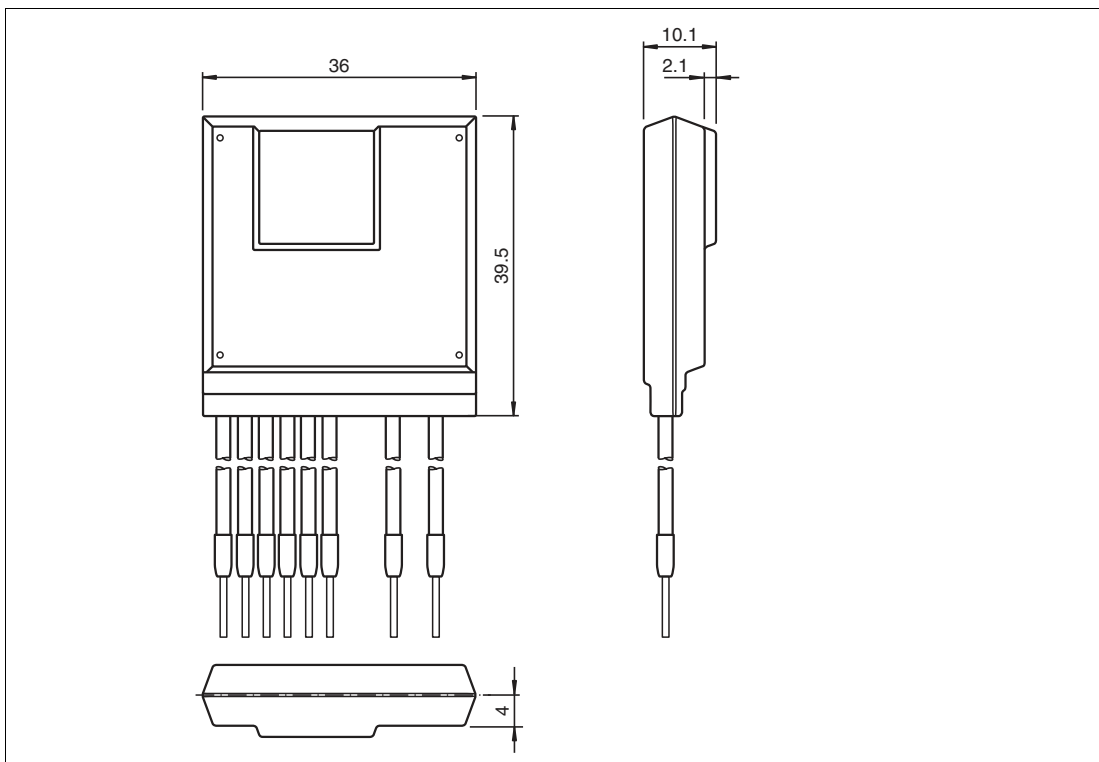


Figure 4.1

## VAA-2E2A-CB10-SJ/E2J-FL

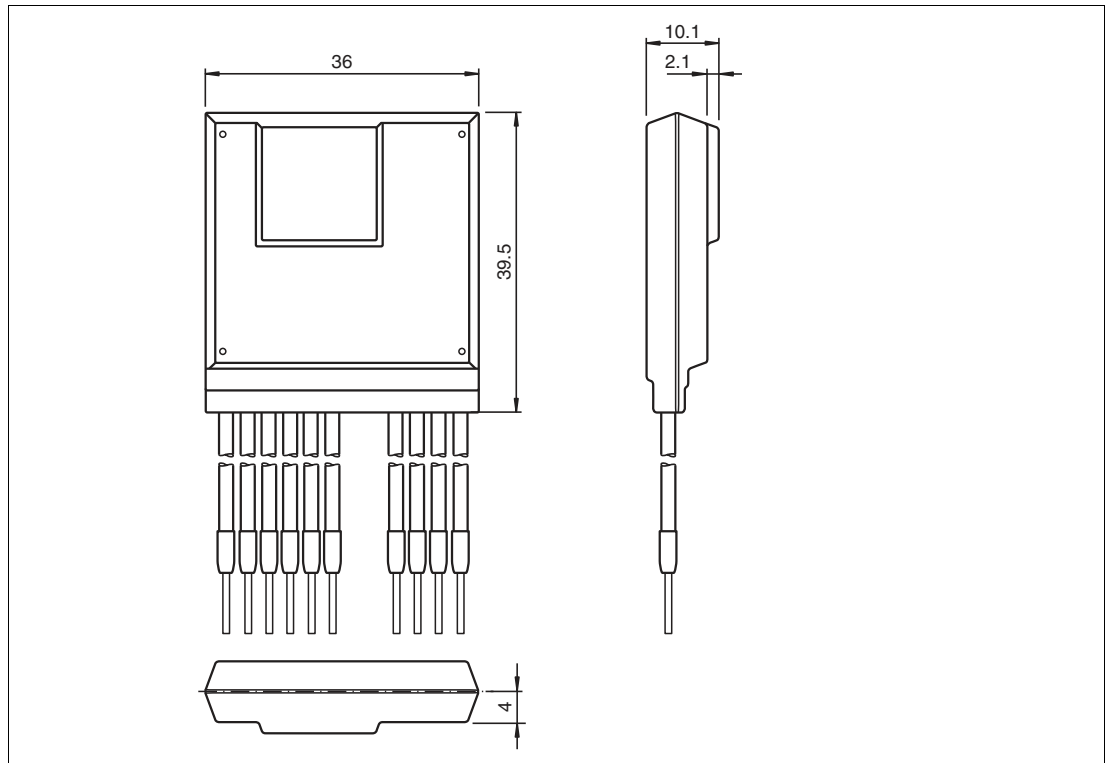


Figure 4.2

## 4.2

## Connecting Inputs and Outputs

**Warning!**

Electrical short caused by moisture

If the surrounding enclosure or switch cabinet is not properly sealed, the safety function may be lost.

**Note**

If you are connecting just one single-channel switch, use input 1. In this case, you must bridge input 2.

You can connect only one mechanical switch per channel. If you connect a two-channel switch, you must use both channels.

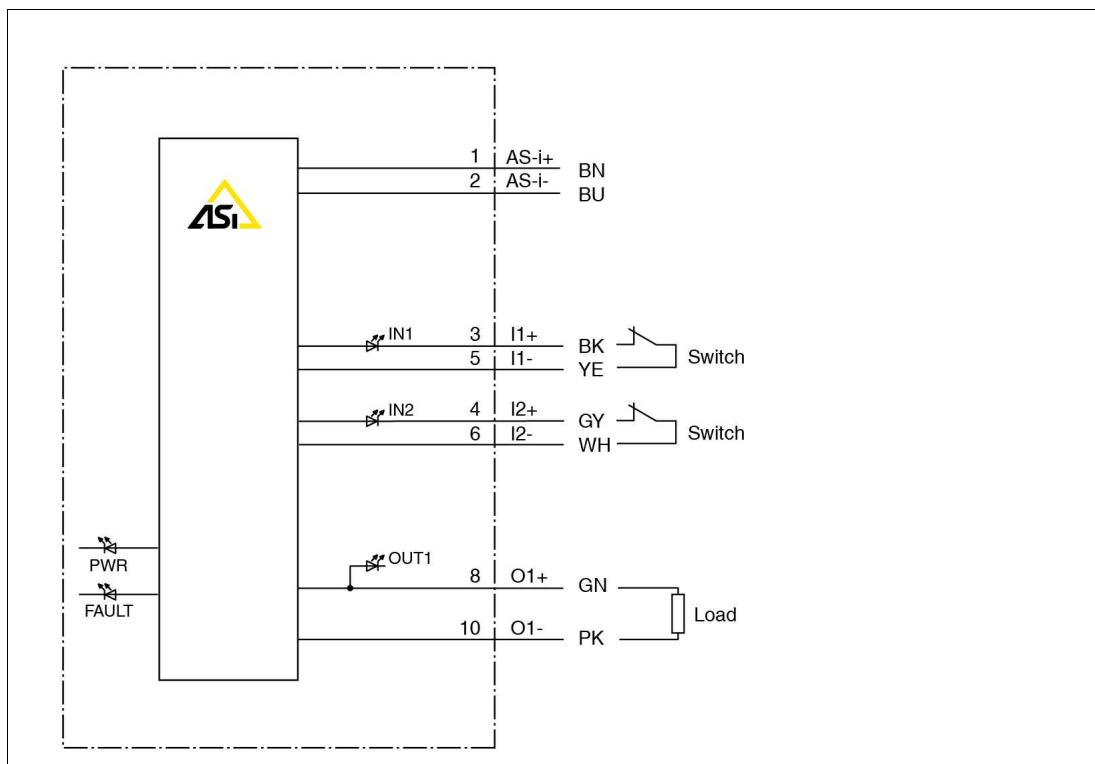


Figure 4.3 VAA-2E1A-CB10-SJ/E2J-FL connection

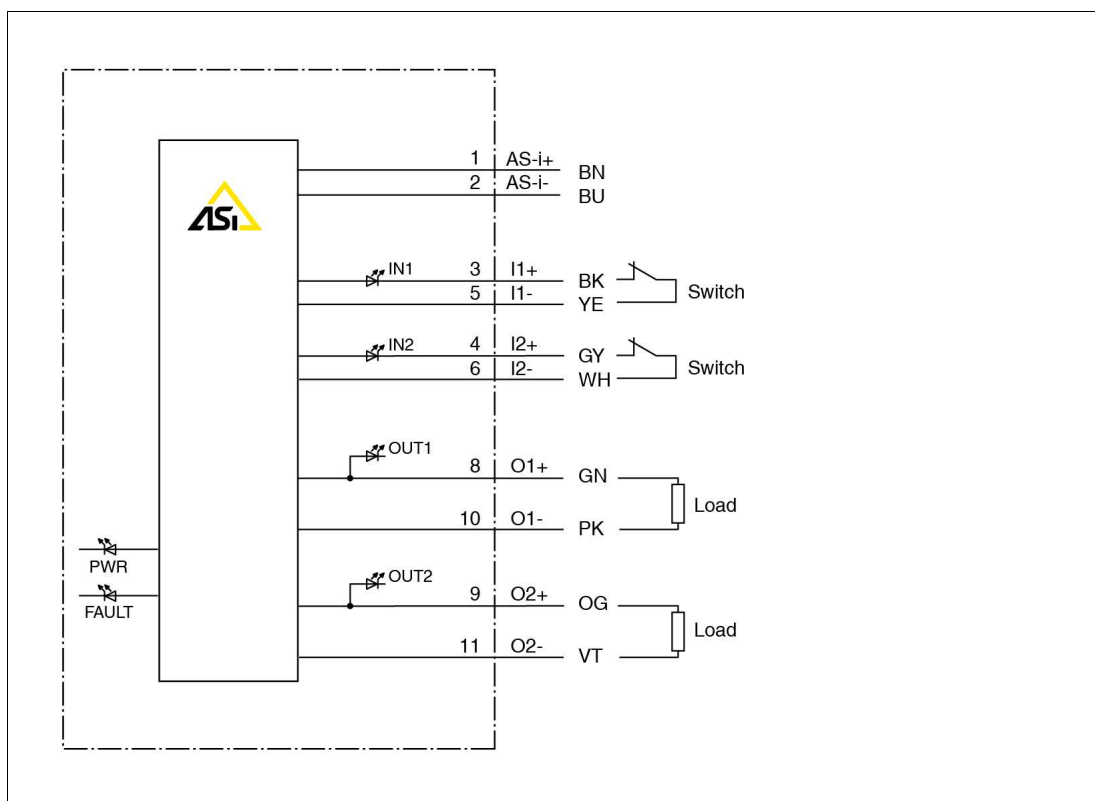


Figure 4.4 VAA-2E2A-CB10-SJ/E2J-FL connection



**Caution!**

Short circuit

If you are not using an available output, make sure that the bare cable end is insulated. Bare cable ends can be protected by fitting a terminal block, for example.

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## 5 Commissioning

### 5.1 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.

### 5.2 Assigning an Address to the Module

Assign an address to the module using a handheld or an AS-Interface master. You can assign addresses from 1 to 31. The default safety module address is 0.

### 5.3 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.



#### 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.

### 5.4 Operating Mode

No operating modes can be activated for the inputs.

## 6 Operation

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

### 6.1 Safety-Related Inputs

The module generates an internal code sequence. This sequence is monitored by a safety monitor (additional bus device) to ensure the correct order.

The status of the externally connected mechanical switches controls the code sequence transmission. To ensure the safe state of the device, use switches with a safety function with positive opening operation. The code sequence is interrupted by actuating the switch.

The two input channels on the safety module are independent. The safety monitor must be parameterized to monitor that the two inputs are synchronous for dual-channel applications of category 4/PL e as per ISO 13849-1 or SIL 3 as per EN/IEC 62061.

### 6.2 Conventional (Non-Safe) Electronic Outputs

The outputs are designed in line with the AS-Interface standard. Positive potential (PNP technology) is switched for these outputs.

- The output is controlled directly by data bits D0 and D1 of the AS-Interface master.

Communication monitoring:

- In the event of a communication failure, the outputs are disconnected from the power supply.
- Do not use the conventional output for safety functions.
- Make sure that the individual cable ends of the connection lines do not touch each other.

## 7 Servicing

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



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**Note**

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

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**Performing a Function Test**

1. Activate the safety function by actuating a connected mechanical switch and thus interrupting the input.
2. Check whether the safety monitor detects the interruption without issuing a fault message.
3. End the interruption at the input created by the connected mechanical switch.
4. Enable the input on the safety monitor.

## 8 Troubleshooting

Source of Fault	Possible Cause	Remedy
The safety monitor puts the plant into a safe state and reports a malfunction.	<ul style="list-style-type: none"> <li>There is a crossed circuit at one of the inputs.</li> <li>There is electromagnetic interference in the lines.</li> </ul>	Check the line and repair if necessary. If none of the lines are damaged, send the device to Pepperl+Fuchs for repair.
The safety monitor acts like an emergency-stop mechanism without an emergency-stop mechanism switch having been activated.	The line on one of the inputs is defective or not connected correctly.	Check the line and repair if necessary. Check that the connections are seated correctly.

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