

MANUAL

VAA-2E1A-G10-SAJ/EA2J-*

VAA-2E-G10-SAJ*

AS-Interface Safety at Work

Version 2.0



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, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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1 Declaration of conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.



Note!

A Declaration of Conformity can be requested from the manufacturer.

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





2 Safety

2.1 Used Symbols

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 devices and any connected facilities or systems, 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.

2.2 Intended Use

The device, together with a programmed AS-Interface safety monitor, allows the 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, when this safety monitor is used as a safety module with safety-related inputs for connecting mechanical contacts such as emergency-stop switches and optional conventional electronic output, e.g., to activate signal lights.

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 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 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 notes on safety

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 only guaranteed if the device is operated in accordance with its intended use.

Installation and commissioning of all devices must be performed by a trained professional only.

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

User modification and or repair are dangerous and will void the warranty and exclude the manufacturer from any liability. If serious faults occur, stop using the device. Secure the device against inadvertent operation. In the event of repairs, return the device to your local Pepperl+Fuchs representative or sales office.

Only qualified electrical specialists are authorized to perform maintenance work.

Do not open the device.

Maintain ambient conditions for IP67.

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

2.4 Residual risk

The residual risk is the possible dangers of the security system, which can occur despite compliance with all regulations. Take note of the following instructions.



Warning!

Short circuit

If you are not using an existing output, make sure that the open wire ends are insulated. For example, open wire ends can be protected by placing them to a cable terminal block



Warning!

Electrical short from moisture

The specified degree of protection and safety function may not be guaranteed if the cable gland or the connector is not sealed correctly.

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.

In danger of manipulation, install connectors so that they are inaccessible to the 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 Exclusions

Within this device, short circuit faults on the PCB and within the cable have been excluded, as required by ISO 13849-2. The cable and the device must be protected against damage as part of maintenance work. Route the cable as described in 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-G10-SAJ/EA2J* is an AS-Interface safety module with two safety-related inputs and a conventional output. The VAA-2E-G10-SAJ* 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 safety-related inputs. The output is a conventional and not a safety-related electronic output. It can be loaded to 50 mA.

Systemübersicht

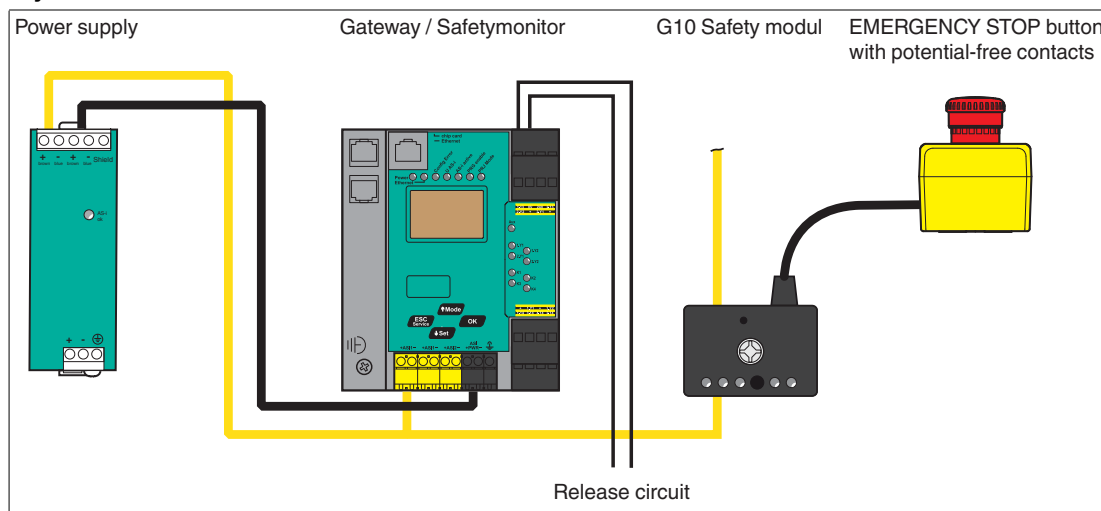


Figure 3.1 Example of an AS-Interface system with safety module and emergency stop button

The module is suitable for use for the decentralized connection of switches in very confined spaces. The one-piece housing offers degree of protection IP67. The connection to the AS-Interface line is achieved using insulation piercing technology in the flat cable inserted. Inputs and outputs are connected using open conductor ends.

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. In the event of a communication failure, the outputs are disconnected from the power supply (only for P0=1). See chapter 6.2.

3.2 Slave Profile

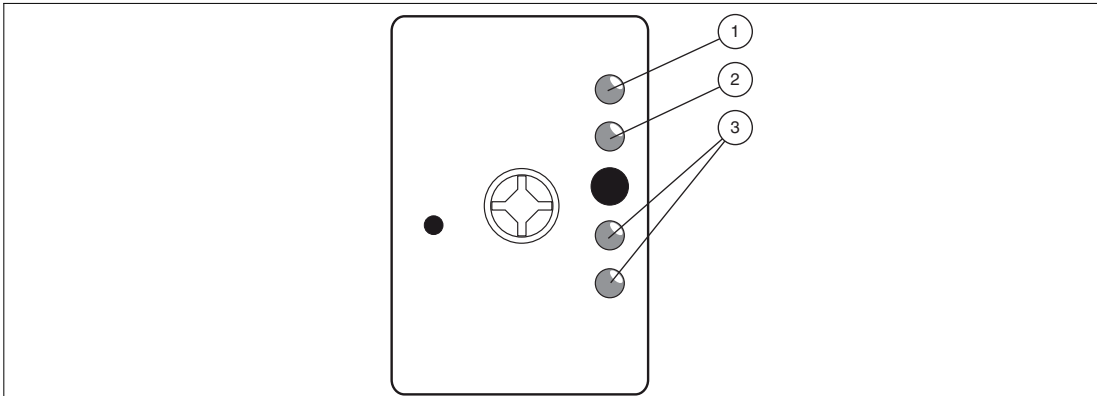
The analog output modules offer the following profile

		VAA-2E1A-G10-SAJ/EA2J*-*	VAA-2E-G10-SAJ-*M
I/O	=	7	0
ID	=	B	B
ID2	=	0	0
ID1	=	F (programmable)	F (programmable)

The data value is transmitted as defined by AS-Interface profile 7.B. or 0.B.

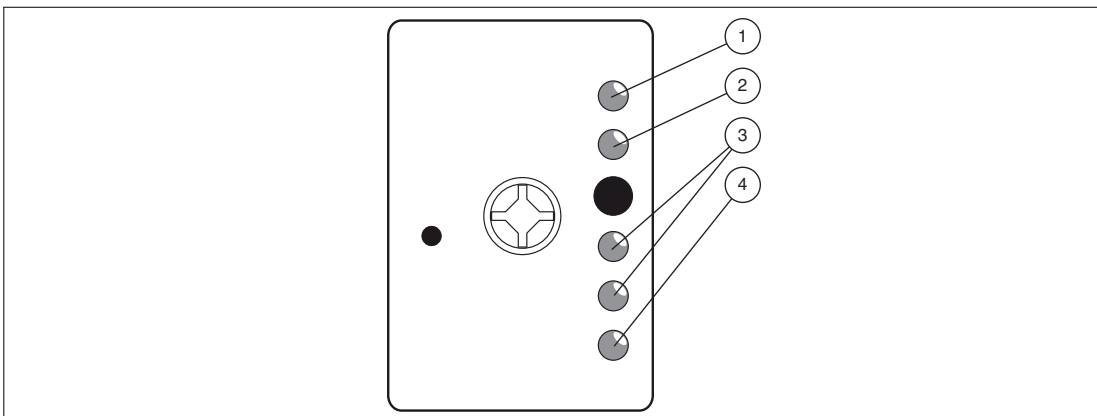
3.3 Displays and Controls

VAA-2E-G10-SAJ-*M



1. Status display AS-Interface
2. Error display
3. Switching state inputs

VAA-2E1A-G10-SAJ/EA2J-*



1. Status display AS-Interface
2. Error display
3. Switching state inputs
4. Switching state output

Displays

No.	Designation	Description
①	AS-i	AS-Interface voltage; green LED green: voltage OK flashing green: address 0
②	FLT	Fault indication; LED red red: communication fault or address is 0
③	I1 I2	switching state (input); 2 LED yellow
④	O1	Switching state (output); LED yellow

3.4

Connections

Connections VAA-2E-G10-SAJ-*M

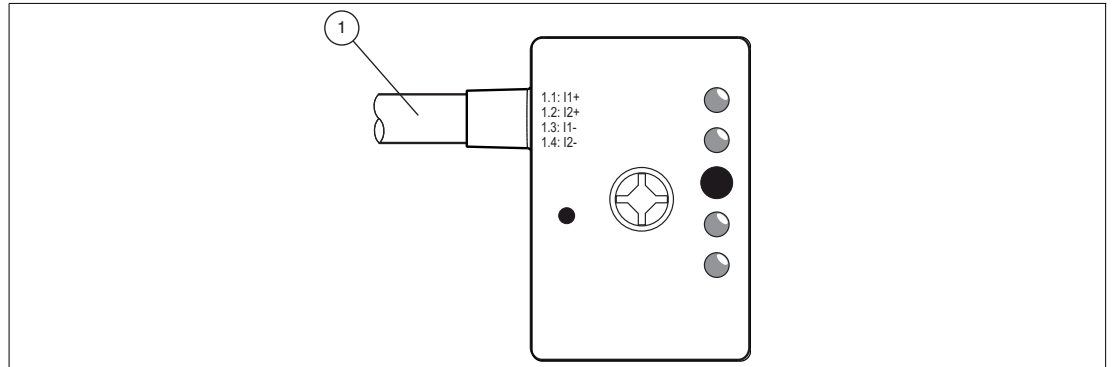


Figure 3.2 VAA-2E-G10-SAJ-*M

Safety-Related Inputs

No.	Pin	Color	Designation	Description
①	1.1	Brown	I1+	Mechanical switch 1 +
	1.2	White	I2+	Mechanical switch 2 +
	1.3	Blue	I1-	Mechanical switch 1 -
	1.4	Black	I2-	Mechanical switch 2 -

Connections VAA-2E1A-G10-SAJ/EA2J-*M

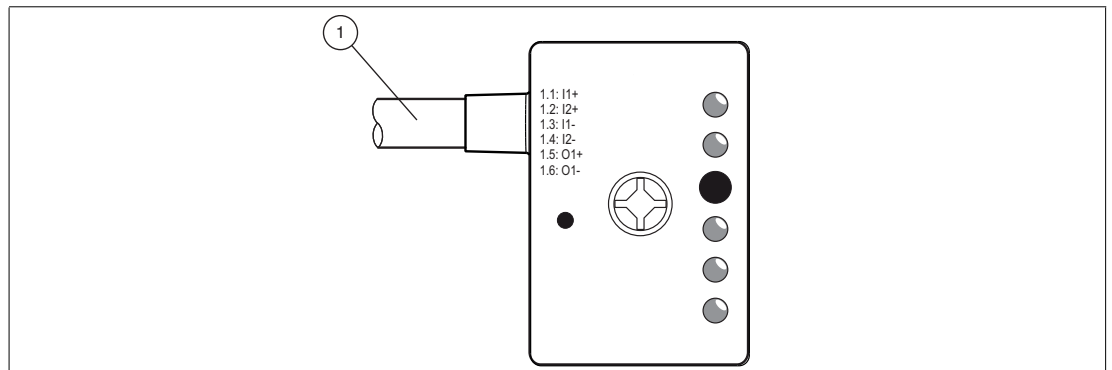


Figure 3.3 VAA-2E1A-G10-SAJ/EA2J-*M

Safety-Related Inputs

No.	Pin	Color	Designation	Description
①	1.1	Brown	I1+	Mechanical switch 1 +
	1.2	White	I2+	Mechanical switch 2 +
	1.3	Blue	I1-	Mechanical switch 1 -
	1.4	Black	I2-	Mechanical switch 2 -

Conventional (Non-Safe) Electronic Output

No.	Pin	Color	Designation	Description
①	1.5	Gray	O1+	Output 1 +
	1.6	Pink	O1-	Output 1 -

Connections VAA-2E1A-G10-SAJ/EA2J-*M-V1-G

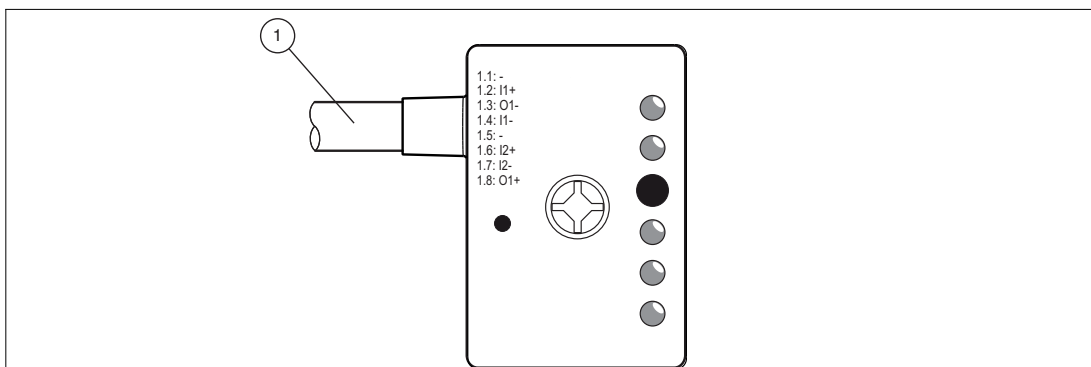


Figure 3.4 VAA-2E1A-G10-SAJ/EA2J-*M-V1-G

Safety-Related Inputs

No.	Pin	Designation	Description
①	1.2	I1+	Mechanical switch 1 +
	1.4	I1-	Mechanical switch 1 -
	1.6	I2+	Mechanical switch 2 +
	1.7	I2-	Mechanical switch 2 -

Conventional (Non-Safe) Electronic Output

No.	Pin	Designation	Description
①	1.3	O1-	Output 1 -
	1.8	O1+	Output 1 +

Connections VAA-2E1A-G10-SAJ/EA2J-2X*M & VAA-2E1A-G10-SAJ/EA2J-*M

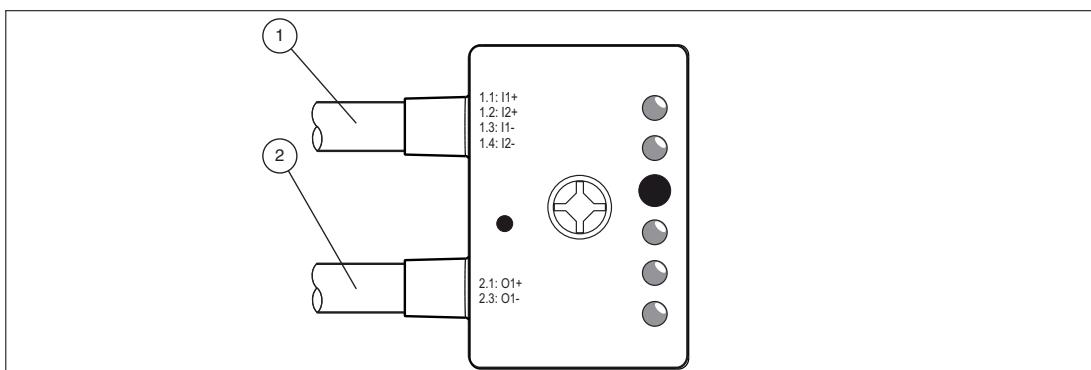


Figure 3.5 VAA-2E1A-G10-SAJ/EA2J-2X*M & VAA-2E1A-G10-SAJ/EA2J-*M

Safety-Related Inputs

No.	Pin	Color	Designation	Description
①	1.1	Brown	I1+	Mechanical switch 1 +
	1.2	White	I2+	Mechanical switch 2 +
	1.3	Blue	I1-	Mechanical switch 1 -
	1.4	Black	I2-	Mechanical switch 2 -

Conventional (Non-Safe) Electronic Output

No.	Pin	Color	Designation	Description
②	2.1	Brown	O1+	Output 1 +
	2.2	White	N.C.	Not used
	2.3	Blue	O1-	Output 1 -
	2.4	Black	N.C.	Not used

AS-Interface Flat Cable Connection

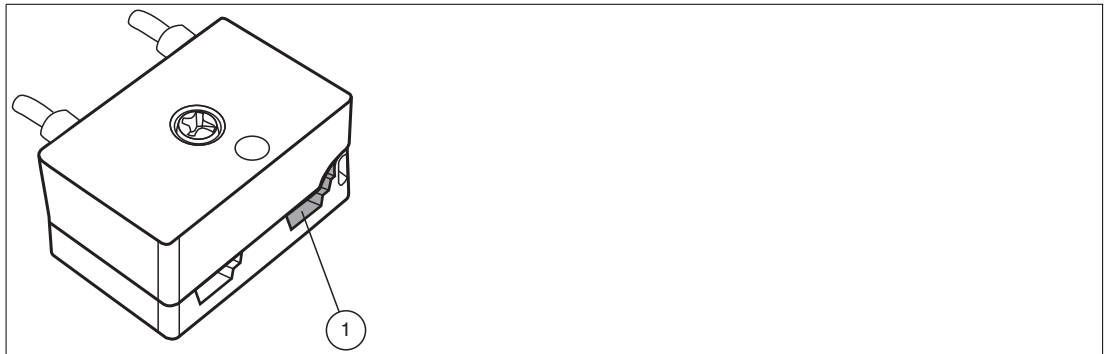


Figure 3.6 VAA-2E*-G10-SAJ*

AS-Interface

No.	Pin	Designation	Description
①	3.1	AS-i+	AS-Interface +
	3.2	AS-i-	AS-Interface -

3.5 Operating principle

3.5.1 Safety-Related Inputs

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

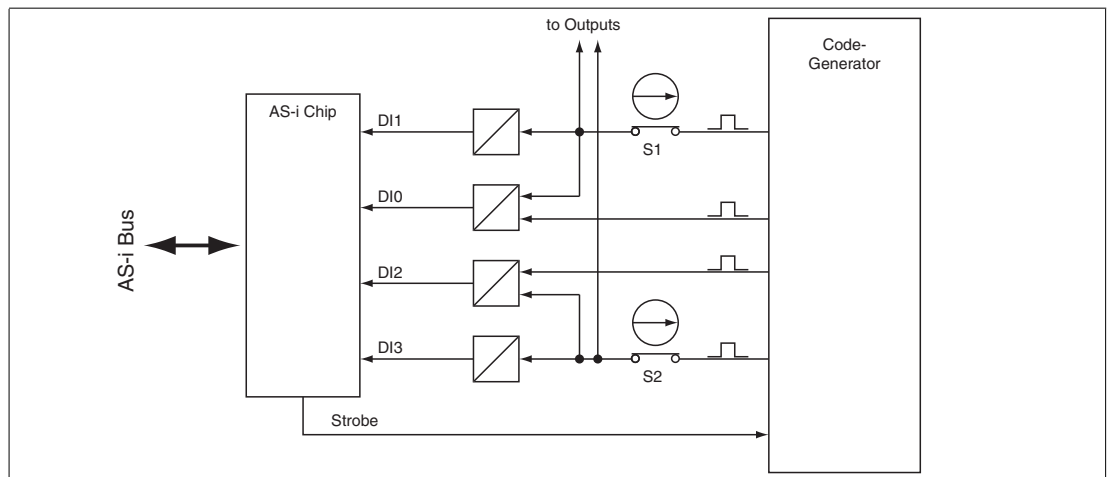


Figure 3.7 Code generator

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	Codebit 3 2 1 0
1	X X 0 0
2	0 0 X X
1 and 2	0 0 0 0
None	X X X X¹⁾

Table 3.1 ¹⁾ = working state

The code words 0000, XX00 and 00XX prompt the safety monitor to put the installation in safe mode (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 installation to safe mode and will indicate a slave fault.

The two input channels on the safety monitor are independent. The safety monitor can be programmed to monitor the input synchronicity 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

The device can be screwed onto a flat mounting surface using two M4 mounting screws. The mounting screws are not included.



Caution!

Mechanical damage

Protect the device against mechanical damage.

Do not mount the device in an exposed location.

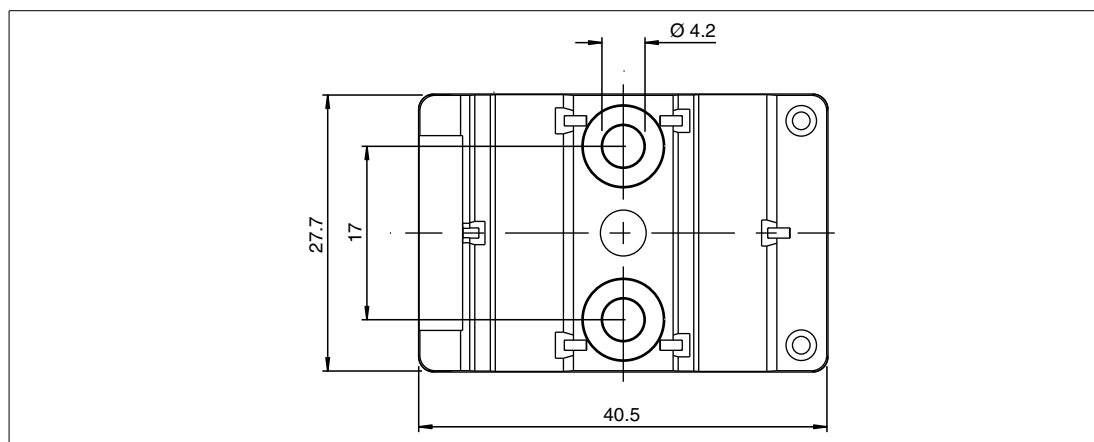


Figure 4.1

4.2 Connecting Inputs and Outputs



Warning!

Electrical short from moisture

The specified degree of protection and safety function may not be guaranteed if the cable gland or the connector is not sealed correctly.



Note!

If you connect only a single-channel switch, use input 1. In this case, you must bridge input 2.



Modules with open cable end

Connect the switches and actuators to the open cable end. You can connect only one mechanical switch per channel. If you connect a two-channel switch, you must use both channel.

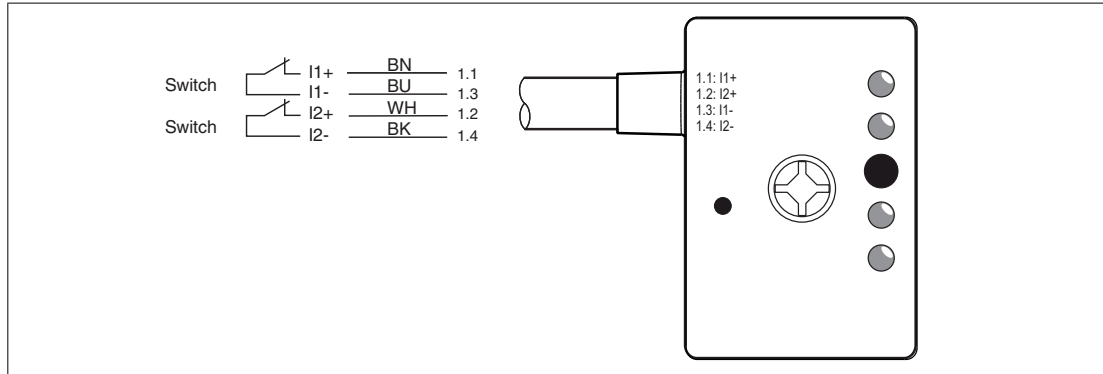


Figure 4.2 Connection VAA-2E-G10-SAJ-*M

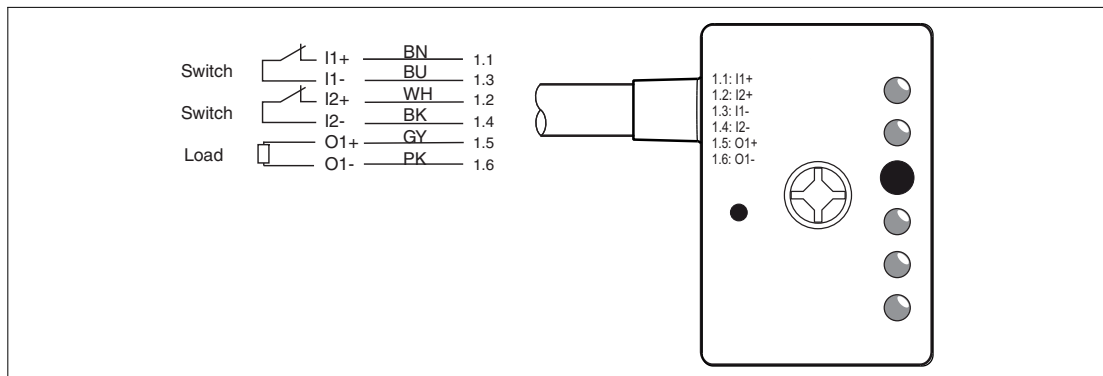


Figure 4.3 Connection VAA-2E1A-G10-SAJ/EA2J-*M

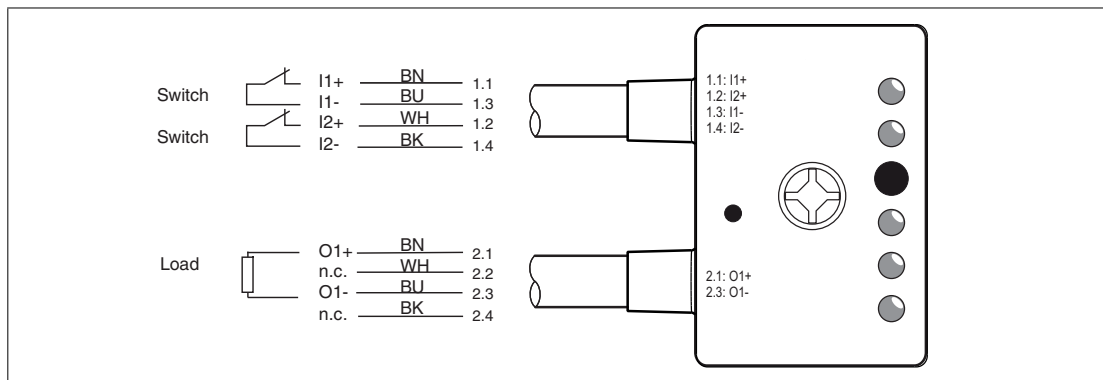


Figure 4.4 Connections VAA-2E1A-G10-SAJ/EA2J-2X*M & VAA-2E1A-G10-SAJ/EA2J-*/*M



Caution!
Short circuit

If you are not using an available output, make sure that the open cable end is insulated. Open cable ends can be protected by placing them on a cable terminal block.

Modules with connector

Connect the switches and actuators to the connector. You can connect only one mechanical switch per channel. If you connect a two-channel switch, you must use both channel.

The tightening torque of the cable gland is 0.4 Nm.

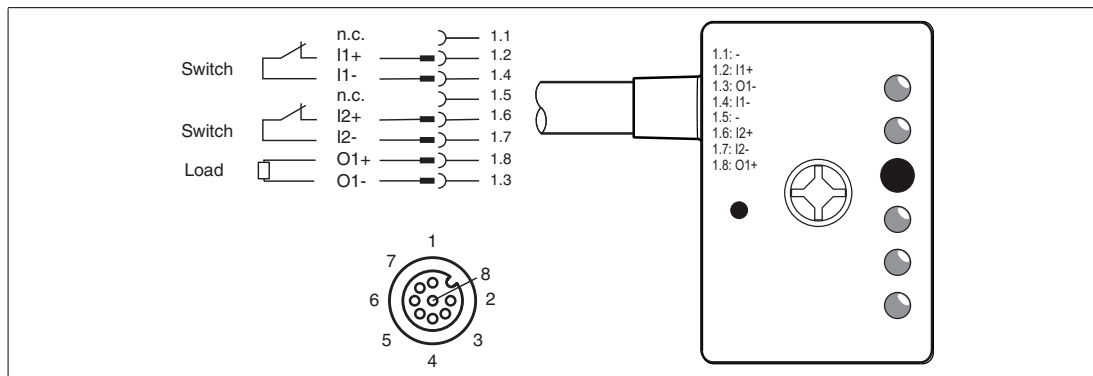


Figure 4.5 Connection VAA-2E1A-G10-SAJ/EA2J-*M-V1-G

4.3 AS-Interface

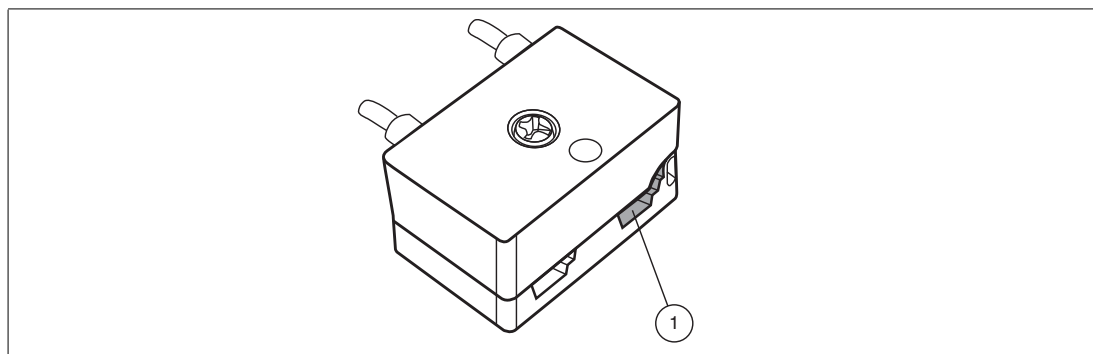


Figure 4.6 VAA-2E*-G10-SAJ*

Connecting the AS-Interface

1. Loosen the screw to open the safety module mounting base.
2. Place the yellow flat cable into the rear cable duct ①. Ensure correct alignment.
3. Connect the safety module mounting base. Tighten the screw to a torque of 1.65 Nm.
↳ The connection to the AS-Interface flat cable is achieved using insulation piercing technology.



Warning!

Electrical short caused by moisture

If the device is mounted in a manner that deviates from this description, this may result in the loss of the specified degree of protection, as well as the loss of the safety function.

Note the information concerning the degree of protection provided in the data sheet for your safety module.

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 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 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 device or an AS-Interface master. You will need an extension cable, which is available separately, if you use a handheld device. You can assign addresses from 1 to 31. The default safety module address is 0.

5.3 Function Tests

Perform function tests as part of the installation by activating the safety function. The function test uncovers all existing faults at the time of installation. Because of the cross-bridging detection of safe inputs, 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 as per ISO 13849-1 or SIL 3 as per EN/IEC 62061, the synchronicity of both inputs must be monitored in the safety monitor.



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.

The output properties can be controlled using the parameters in the AS-Interface. For a detailed description, see chapter 6.2.

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. Negative potential (NPN technology) is switched for these outputs.

- The output is controlled directly by the AS-Interface master's related data bits D0.

Communication monitoring:

- P0 = 1 (basic setting), monitoring = ON, i.e. if communication fails, the outputs are de-energised.
- P0 = 0, monitoring = OFF, if communication fails, the outputs maintain their condition.
- Do not use the conventional output for safety functions.
- Make sure that the individual conductors of the cable ends do not touch each other.



7

Maintenance

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



Note!

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



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.

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"> ■ There is a crossed circuit at one of the inputs. ■ There is electromagnetic interference in the lines. 	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.

FACTORY AUTOMATION – SENSING YOUR NEEDS



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