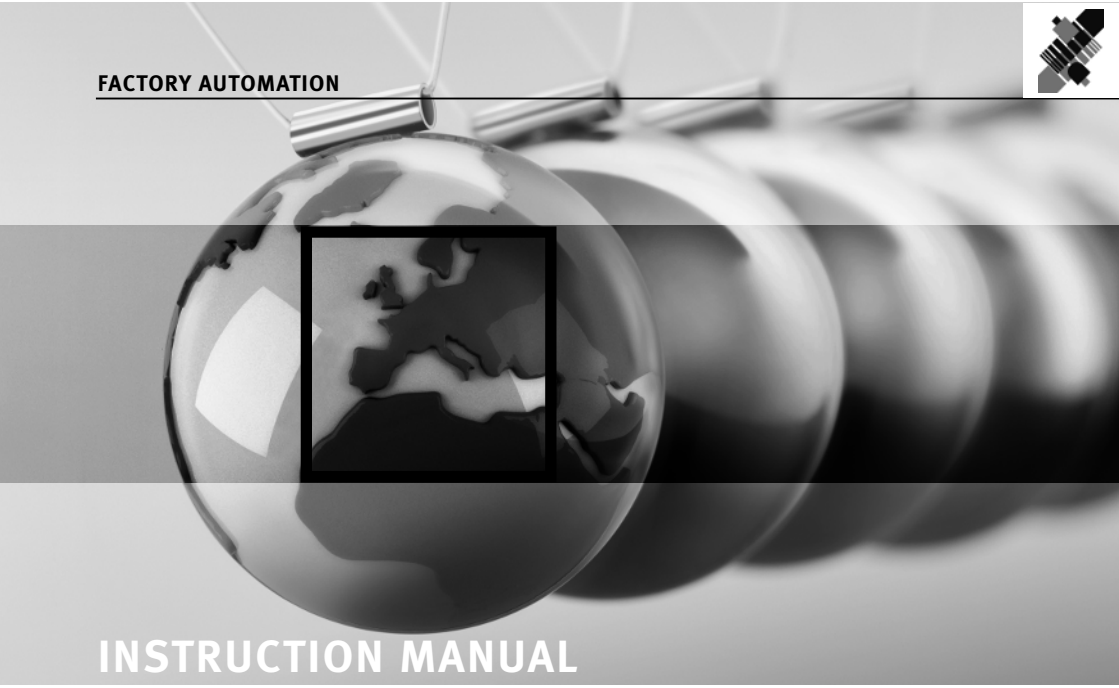


INSTRUCTION MANUAL

AS-Interface Safety at Work
VAA-2E-G4-SE

Version 1.0

CE

PEPPERL+FUCHS

Date of Issue 2005-09-07

1 Declaration of conformity

The AS-Interface-Safety-Module VAA-2E-G4-SE offering 2 safety inputs designed for two-channel ESPE (electro sensitive protective equipment, for instance safety light curtains and light grids) was developed and manufactured in observance of applicable European standards and regulations.

Note

A declaration of conformity can be obtained from the manufacturer.

The manufacturer of this product, Pepperl+Fuchs GmbH in D-68307 Mannheim, retains a certified quality system in accordance with ISO 9001.

Date of Issue 2005-09-07

2 Symbols used in this document

Warning

This symbol warns of danger.

In the event the warning is ignored, the consequences may range from personal injury to death of persons or from damage to destruction of equipment.

Attention

This symbol warns of a possible fault.

Failure to observe may result in damage to the device or systems and installations connected to it up to and including compete lack of proper functionality.

Note

This symbol brings important information to your attention.

Date of Issue 2005-09-07

3 Safety

3.1 Intended use

The AS-Interface safety module permits the connection of one two-channel ESPE to safeguard danger zones or areas in a system utilizing AS-Interface 'Safety at Work'. It must be used as intended with a properly configured AS-Interface safety monitor and a suitable ESPE (safety light curtain or light grid with electronic OSSDs.) This allows the implementation of safety applications up to Category 4 according to EN 954-1 and/or SIL 3 according to EN/IEC 61508 as well as Type 4 based on EN/IEC 61496-1.

The safety requirements for the application are determined by either a risk analysis (i. e. based on EN 1050) or derived from a C-standard.

In addition to the instructions included in this user manual, all applicable safety requirements, standards and regulations as well as operating instructions for the connected peripheral devices must be considered.

Warning

Protection of operating personnel and equipment is not ensured if the module is not used in accordance with its intended use.

3.1.1 Safety Monitor requirements

The module shall only be used as a safty slave in an AS-Interface network and must be connected to a suitable AS-Interface safety monitor. All instructions in the user documentation must be followed. The AS-Interface monitor must fulfill the requirements of the system specifications version 2.01 dated 12.05.2000 ("Spezifikation der sicheren AS-Interface-Uebertragung") or higher.

In order to evaluate a safety related function based on a safety standard all components of the function have to be evaluated according to the same safety standard.

The correct execution of a desired safety function also depends on the proper connection and configuration of the AS-Interface safety monitor. This also applies to the desired reaction when safety codes are corrupted or the unit exhibits a hardware fault (refer to the documentation of the AS-Interface safety monitor). The safety function (including all attached safety devices) must be tested before the first startup. The minimal requirement for the safety classification of the safety monitor needs to match the safety classification required by the application.

3.1.2 Wiring requirements

The demands of the EN/IEC 60204-1 (or similar standard) must always be considered. The requirements for the external wiring and the selection of connected safety devices depend on the desired functionality as well as on the required safety classifications (EN 954-1 or EN/IEC 61508).

Wires have to be safeguarded against simultaneous short circuit connections of the inputs SE1 and SE2 to the positive supply.

Date of Issue 2005-09-07

3.1.3 Light grids and light curtains

Safety systems must use ESPEs that satisfy EN/IEC 61496-1 and offer short-circuit protection between channels. Type SLC and SLPCM light curtains (devices with an integrated controller) are recommended. For application details refer to the user manuals of the connected safety devices.

The time limits for positive test pulses given in the data sheets must be observed.

3.2 General safety instructions

Warning

Any operation differing from what is described in this user manual may compromise the safety and functionality of the connected system.

The module should only be used by trained operators according to these instructions.

Installation and maintenance of the module under power shall only be performed by trained electricians.

If malfunction of the module cannot be corrected it must be taken out of operation and safeguarded against being inadvertently put back into operation.

Repair work shall only be performed by the manufacturer.

Alterations of or on the device are prohibited and void any warranty claims.

The requirements for the installations of a housing in IP67 applications need to be checked before operating the device.

Note

Plant management has the responsibility to comply with the requirements of local regulations.

3.3 Transfer time of safety relevant information

The module shuts down in less than 10 ms. The overall shut down time can be determined by summing up the shut down times of all peripheral devices connected to the safety system (i. e. ESPE, safety monitor, expansion relays and any additional secondary switches). Refer to the appropriate user documentations.

Date of Issue 2005-09-07

3.4 PFD-Calculation

In order to calculate the PFD (probability of dangerous failure on demand) of a safety related function it is crucial to consider the PFD values of all components used in this function.

At low demand rates the average PFD depends on the average environmental temperature:

	T_A = 40 °C	T_A = 55 °C
PFD	$2{,}5 \cdot 10^{-5}$	$4{,}7 \cdot 10^{-5}$

At a high demand rate for the safety function the average probability of dangerous failure per hour (PFH) of the safety function is:

	T_A = 40 °C	T_A = 55 °C
PFH	$1{,}54 \cdot 10^{-9}$ 1/h	$3 \cdot 10^{-9}$ 1/h

These values apply to equipment use for up to 10 years.

PFD and/or PFH values of other components, especially the safety monitor, are found in their respective documentations.

Date of Issue 2005-09-07

4 Operating Principles of the input channels

The safety module generates a code sequence of 4-bit code words. A safety monitor evaluates the correctness of the code sequence. As soon as the connected peripheral device reports an undisturbed operation of the application to the module, the code sequence is transmitted through the AS-Interface network.

If the safety monitor determines a code sequence as being incorrect, it starts the transition to a safe system state based on its configuration. If the peripheral device signals the activation of the safety function, the transmission of the code sequence is terminated.

The module has two inputs for two separate and independently operating input channels. Each channel operates on two of the 4-bit code words.

Both channels are required when connecting a safety device. If the safe state is initiated 4-bit code words with the value 0000 will be transmitted.

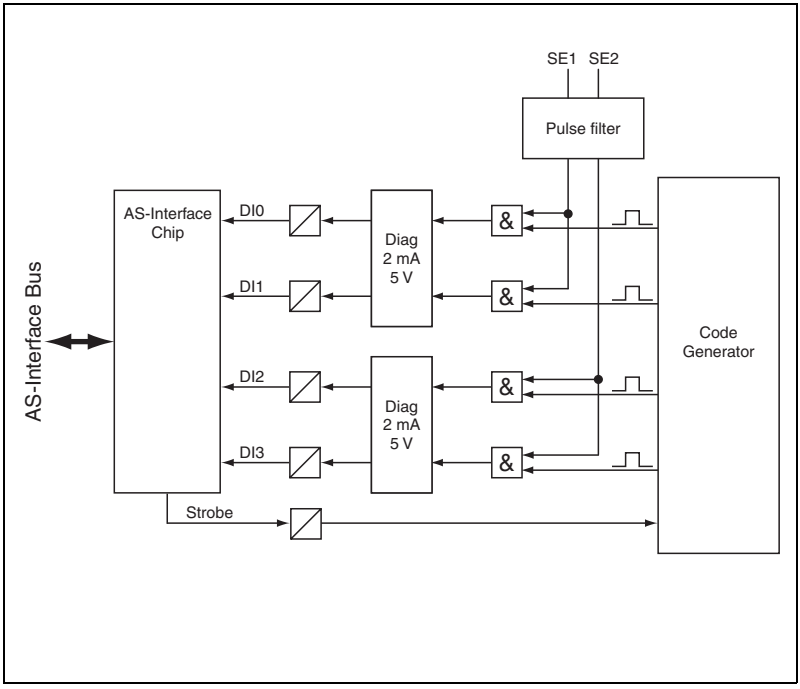


Fig. 4.1: Code generation

Date of Issue 2005-09-07

The safety monitor goes into the safe state without reporting a malfunction, as soon as the code word 0000 is received. If one bit of a 4-bit code word differs from the expected code word, the safety monitor actuates the safe state for the equipment and indicates a fault.

The two input channels are independent. The safety monitor evaluates the synchronicity of two input signals depending on its configuration.

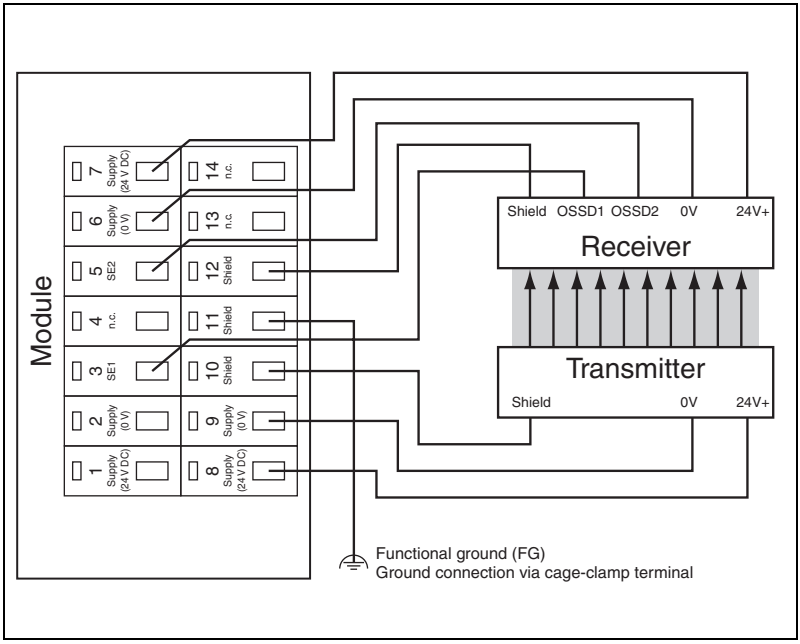
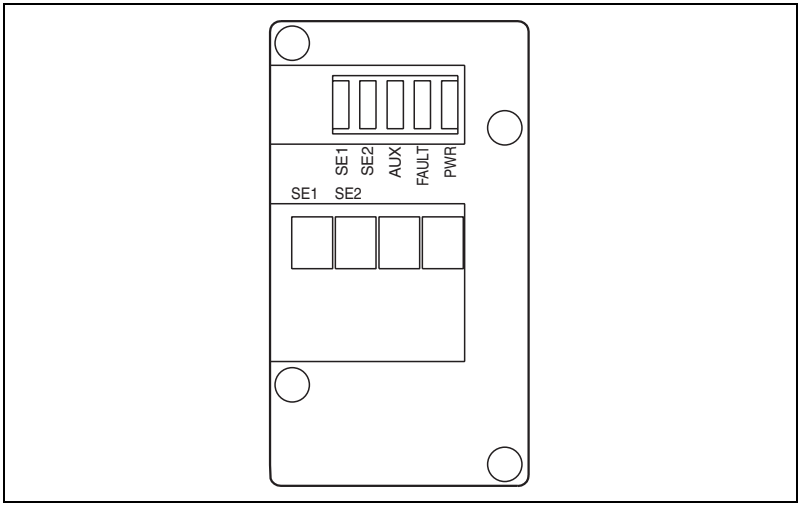


Fig. 4.2: example: a light curtain with 2 outputs uses both channels of the module

Date of Issue 2005-09-07

5 Connections and LED indications



5.1 Connections

Terminal	Function	Description
1	Supply 24V	power supply 1 (receiver)
2	Supply 0V	power supply 1 (receiver)
3	SE1	input signal 1
4	n.c.	-
5	SE2	input signal 2
6	Supply 0V	power supply 2 (receiver)
7	Supply 24V	power supply 2 (receiver)
8	Supply 24V	power supply 3 (transmitter)
9	Supply 0V	power supply 3 (transmitter)
10	Shield	functional ground for transmitter
11	Shield	functional ground for the module
12	Shield	functional ground for receiver
13	n.c.	-
14	n.c.	-

AS-Interface (yellow flat cable) and auxiliary power U_{AUX} (black flat cable) are connected using an appropriate mounting base (sold separately).

Date of Issue 2005-09-07

5.2 LED indication

Function	Description
FAULT	fault indication: LED red: AS-Interface communication error and/or module address is 0
PWR	AS-Interface power on; LED green
AUX	auxiliary power U_{AUX} present; LED green
SE1	input channel 1 indicating run mode; LED yellow
SE2	input channel 2 indicating run mode; LED yellow

Date of Issue 2005-09-07

6 Interface properties

6.1 AS-Interface, auxiliary power

AS-Interface and auxiliary power U_{AUX} are connected by using an appropriate mounting base.

The AS-Interface connection is reverse polarity protected and the maximum available current is internally limited.

The auxiliary power connection is also protected against reverse polarity.

The module is protected against overloads on its ouputs by a self healing fuse.

6.2 Transmitter and receiver

Transmitter and receiver are connected by spring terminals. Every lead of the cable from the safety device must be connected to a terminal on the connection block. This is necessary to prevent the occurrence of internal short circuits.

The power supply terminals may be used arbitrarily.

The two supply power connections on the terminal block inside the module are at the same potential and overload protected with respect to auxiliary power. When auxiliary power is reversed the auxiliary power on the terminal block of the module is also reversed.

The inputs are designed to be power limiting and operate according to EN/IEC 61496-1 and EN 61131-2.

ESPE are permitted to generate test pulses on the module inputs. The width and frequency of these test pulses are typically listed in the user manual or data sheet of the safety device.

Warning

Positive test pulses must stay within the limits listed in the data sheet.

6.3 Shielding

Terminals marked as 'Shield' can be used as a feed-through for ground connections and shields. In order to be used as a shield one terminal must be connected to a machine ground or other suitable ground.

Date of Issue 2005-09-07

6.4 Inputs

6.4.1 General

For a Type 4 application according to EN 61496, the ESPE must provide two safe output signals. The device must be able to check for a short circuit between output signals as well as a short circuit to the supply voltage.

In this case safety systems can achieve SIL 3 according to EN 61508 or category 4 according to EN 954-1.

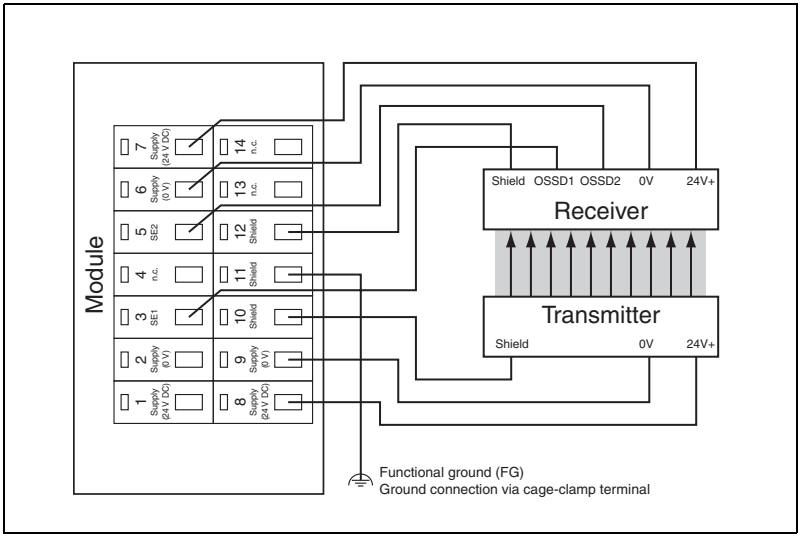


Fig. 6.1: A connected device with two short circuit monitored inputs

It is necessary for the safety monitor to verify synchronous deactivation of input channels SE1 and SE2. This can be achieved by defining the devices as two channel forced or two channel dependent inputs in the configuration of the safety monitor.

6.4.2 Safety classification

The module offers two independent and redundant input channels. When both inputs channels are used a safety application up to category 4 according to EN 954-1 and/or SIL 3 according to EN/IEC 61508 and/or Type 4 according to EN/IEC 61496-1 can be implemented.

6.4.3 Channel short circuit monitoring

ESPE usually monitor their outputs by applying appropriate test signals. These test signals are designed to determine short circuits between channels and between a channel and the supply power.

Date of Issue 2005-09-07

7 Implementation

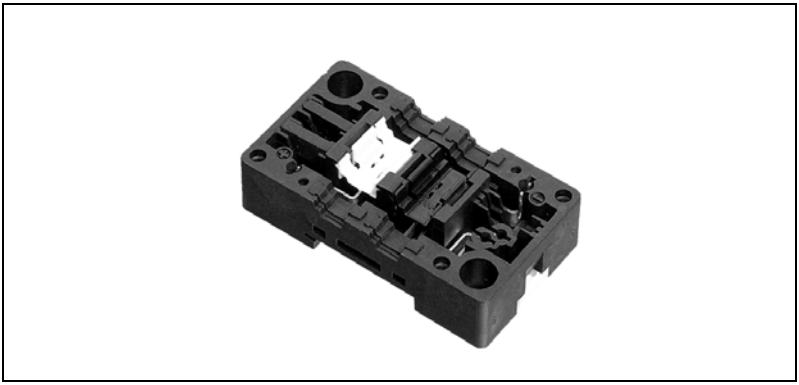
7.1 Configuration requirements for the safety monitor

Organizational measures necessary for the configuration of the safety monitor are given in the safety monitor documentation.

7.2 Installation

Connecting the G4-series module to AS-Interface is accomplished by using the appropriate mounting base (sold separately).

When using yellow AS-Interface flat cables (VAZ-FK-S-YE) and black U_{AUX} flat cable (VAZ-FK-S-BK) the module is connected using either a U-G1FF or U-G1FFA mounting base.



Alternatively, the mounting base U-G1PP can be used with either round or flat cable.

To obtain IP67 protection the mounting screws on the module must be tightened such that the support points on the module bottom side make even contact with the mounting base.

During the installation the unit must to be kept free of dirt and humidity.

Date of Issue 2005-09-07

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

Transmitter, receiver, and ground connections are connected via cage-clamp terminals. Refer to chapter 5.1 for more information.

7.3 Module addressing

The module can be addressed by using a handheld addressing device or the AS-Interface master. When using the handheld addressing device the AS-Interface slave is simply inserted into its 'head' and then addressed. The module is preset to address 0 and can be set to addresses 1 through 31.

7.4 Functionality Test

Functionality tests must be performed as a part of the installation. Because the connected ESPE employ short circuit monitoring between channels, additional short circuit testing of the cabling is not necessary.

Date of Issue 2005-09-07

8 AS-Interface safety module

The safety function of the module depends on the proper configuration of the safety monitor (refer to the documentation of the AS-Interface safety monitor).

9 Certificates

Certified according to EN 954-1, EN/IEC 61496-1, and EN/IEC 61508.

Date of Issue 2005-09-07

A Summary of the requirements for categories to EN 954-1/ISO 13849-1

Category	Summary of requirements	System behaviour [1)]	Important principle for achieving safety
B	The safety-related parts of the machine control system and/or their components must be designed, constructed, selected, put together and combined to meet the requirements of the corresponding standards in such a manner as to be able to withstand anticipated effects.	If a fault occurs, it may result in a loss of the safety function.	By selection of components
1	The requirements of B must be met. Use of components and principles with proven safety-related effectiveness	As described for Category B, but with higher safety-related reliability of the safety function	
2	The requirements of B and the use of components and principles with proven safety-related effectiveness must be satisfied.The safety function(s) must be tested at appropriate intervals of time by the machine control system. **NOTE:** What is suitable depends on the application and the type of machine.	• The occurrence of a fault may result in a loss of the safety function between testing intervals. • Loss of the safety function will be detected by the test.	by the structure
3	The requirements of B and the use of components and principles with proven safety-related effectiveness must be satisfied. The control systems must be designed in such a manner that: • an individual fault in the control system does not result in a loss of the safety function and • the individual fault is detected whenever it is practical to do so in a reasonable manner.	• If the individual fault occurs, the safety function still remains intact. • Some but not all faults are detected. • An accumulation of unknown faults may result in a loss of the safety function.	
4	The requirements of B and the use of components and principles with proven safety-related effectiveness must be satisfied. The control systems must be designed in such a manner that: • an individual fault in the control system does not result in a loss of the safety function and • the individual fault is detected during or before the next requirement for the safety function. If this is not possible, then it must not be possible for an accumulation of faults to result in loss of the safety function.	If errors occur, the safety function still remains intact. The fault is detected with sufficient time to prevent a loss of the safety function.	

[1)] The risk evaluation indicates whether the complete or partial loss of safety function(s) resulting from the occurrence of faults is acceptable.

Date of Issue 2005-09-07

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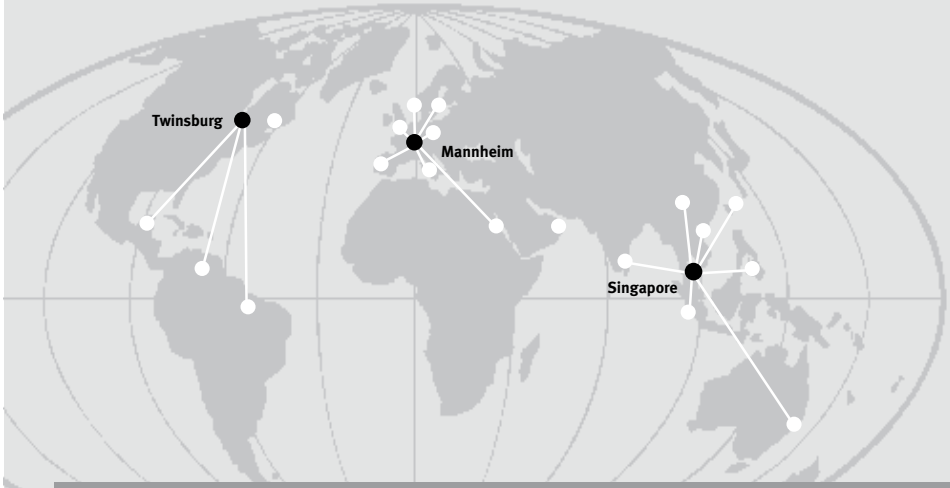

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