

Correct use

Safety switches series VAA-2E3A...-V1 are operated as slaves on the safety bus AS-Interface Safety at Work and function as interlocking devices with guard locking (separate actuator). The actuator has a low coding level. In combination with a movable safety guard and the machine control, this safety component prevents the safety guard from being opened while a dangerous machine function is being performed.

This means:

- ▶ Starting commands that cause a dangerous machine function must become active only when the safety guard is closed and locked.
- ▶ The guard locking device must not be unlocked until the dangerous machine function has ended.
- ▶ Closing and locking a safety guard must not cause automatic starting of a dangerous machine function. A separate start command must be issued. For exceptions, refer to EN ISO 12100 or relevant C-standards.

Devices from this series are also suitable for process protection.

Before the device is used, a risk assessment must be performed on the machine, e.g. in accordance with the following standards:

- ▶ EN ISO 13849-1, Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
- ▶ EN ISO 12100, Safety of machinery – General principles for design – Risk assessment and risk reduction
- ▶ IEC 62061, Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems.

Correct use includes observing the relevant requirements for installation and operation, particularly based on the following standards:

- ▶ EN ISO 13849-1, Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
- ▶ EN ISO 14119 (supersedes EN 1088), Safety of machinery – Interlocking devices associated with guards – Principles for design and selection
- ▶ EN 60204-1, Safety of machinery – Electrical equipment of machines.

Important!

- ▶ The user is responsible for the proper integration of the device into a safe overall system. For this purpose, the overall system must be validated, e.g. in accordance with EN ISO 13849-2.
- ▶ If the simplified method according to section 6.3 of EN ISO 13849-1:2008 is used for determining the Performance Level (PL), the PL might be reduced if several devices are connected in series.
- ▶ Logical series connection of safe contacts is possible up to PL d in certain circumstances. More information about this is available in ISO TR 24119.
- ▶ If a product data sheet is included with the product, the information on the data sheet applies in case of discrepancies with the operating instructions.

Safety precautions

⚠ WARNING

Danger to life due to improper installation or due to bypassing (tampering). Safety components perform a personal protection function.

- ▶ Safety components must not be bypassed, turned away, removed or otherwise rendered ineffective. On this topic pay attention in particular to the measures for reducing the possibility of bypassing according to EN ISO 14119:2013, section 7.

- ▶ The switching operation must be triggered only by actuators designated for this purpose.
- ▶ Prevent bypassing by means of replacement actuators. For this purpose, restrict access to actuators and to keys for releases, for example.
- ▶ A complete safety-oriented system generally consists of several signaling devices, sensors, evaluation units and concepts for safe shutdown. The manufacturer of a machine or installation is responsible for correct and safe overall function.
- ▶ All safety precautions and requirements stated in the operating instructions of the AS-Interface safety monitor used must be observed.
- ▶ Mounting, electrical connection and setup only by authorized personnel possessing special knowledge about handling safety components.

⚠ CAUTION

Danger due to high housing temperature at ambient temperatures above 40 °C.

- ▶ Protect switch against touching by personnel or contact with inflammable material.

Function

The safety switch permits the locking of movable safety guards.

In the switch head there is a rotating cam that is blocked/released by the guard locking pin.

The guard locking pin is moved on the insertion/removal of the actuator and on the activation/release of the guard locking. During this process the switching contacts are actuated.

If the cam is blocked (guard locking active), the actuator cannot be pulled out of the switch head. For design reasons, guard locking can be activated only when the safety guard is closed (failsafe locking mechanism).

Position monitoring of the safety guard and monitoring of interlocking are performed via two separate switching elements (door monitoring contact SK and solenoid monitoring contact UK).

When the safety guard is closed and guard locking effective, each VAA-2E3A...-V1 transmits a switch-specific, unique safety code sequence with 8 x 4 bits via the AS-Interface bus. This code sequence is evaluated by an AS-Interface safety monitor. The positively driven contact SK for door monitoring is represented by the AS-Interface input bits D0 and D1. The solenoid monitoring contact UK is represented by the AS-Interface input bits D2 and D3.

The safety switch must be correspondingly configured in the AS-Interface safety monitor (refer to the operating instructions of the AS-Interface safety monitor used and the status table).

The safety switch is designed so that fault exclusions for internal faults in accordance with EN ISO 13849 2:2013, Table A4, can be assumed.

Version VAA-2E3A-LIM1-PU-L-S-V1

(guard locking actuated by spring force applied and power-ON released)

Important!

For the purpose of protecting people against dangerous over-traveling movements, the black AS-Interface cable (auxiliary power) leading to the AS-Interface distribution box to which the switch is connected can additionally be switched via a standstill monitor or via the safe switch-on delay feature of a dual-channel AS-Interface safety monitor (e.g. door locking for duration of the time delay).

- ▶ Activating guard locking: Close safety guard; no voltage at the solenoid and/or clear AS-Interface output bit D0
- ▶ Releasing guard locking: Apply voltage to the solenoid and set AS-Interface output bit D0

The guard locking actuated by spring force applied functions in accordance with the closed-circuit current principle. If voltage is interrupted at the solenoid, guard locking remains active and the safety guard cannot be opened directly.

If the safety guard is open when the power supply is interrupted and the guard is then closed, guard locking is activated. This can lead to persons being locked in unintentionally.

Version VAA-2E3A-LIM1-PL-L-S-V1

(guard locking actuated by power-ON applied and spring released)

Important!

Use as guard locking for personnel protection is possible only in special cases, after strict assessment of the accident risk (see EN ISO 14119:2013, section 5.7.1)!

- ▶ Activating guard locking: Apply voltage to the solenoid and set AS-Interface output bit D0
- ▶ Releasing guard locking: Disconnect voltage from the solenoid or clear AS-Interface output bit D0

The magnetically actuated guard locking operates in accordance with the open-circuit current principle. If the voltage at the solenoid is interrupted, the guard locking is released and the safety guard can be opened directly!

Switching states

The detailed switching states and code sequences for your switch can be found in the status table.

Selection of the actuator

NOTICE

Damage to the device due to unsuitable actuator. Make sure to select the correct actuator (see table in Figure 3).

Additionally pay attention to the door radius and the fastening options (see Figure 4).

Manual release

Some situations require guard locking to be released manually (e.g. malfunctions or an emergency). A function test should be performed after release.


More information on this topic can be found in the standard EN ISO 14119:2013, section 5.7.5.1. The device can feature the following release functions:

Auxiliary release

In the event of malfunctions, the guard locking can be released with the auxiliary release irrespective of the state of the solenoid.

The half-sequence is sent with the auxiliary release actuated.

Actuating auxiliary release

1. Unscrew locking screw.
 2. Using a screwdriver, turn the auxiliary release to  in the direction of the arrow.
- ➔ Guard locking is released.

Important!

- ▶ The actuator must not be under tensile stress during manual release.
- ▶ After use, reset the auxiliary release and screw in and seal the locking screw (for example, with sealing lacquer).

Mounting

NOTICE

- Device damage due to improper mounting and unsuitable ambient conditions
- ▶ Safety switches and actuators must not be used as an end stop.
 - ▶ Observe EN ISO 14119:2013, sections 5.2 and 5.3, for information about fastening the safety switch and the actuator.
 - ▶ Observe EN ISO 14119:2013, section 7, for information about reducing the possibilities for bypassing an interlocking device.
 - ▶ Protect the switch head against damage, as well as penetrating foreign objects such as swarf, sand and blasting shot, etc.

Changing the actuating direction

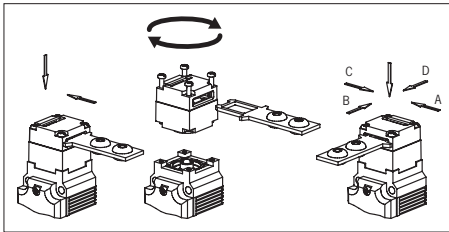


Figure 1: Changing the actuating direction

1. Remove the screws from the actuating head.
2. Set the required direction.
3. Tighten the screws with a torque of 0.8 Nm.
4. Cover the unused actuating slot with the enclosed slot cover.

Electrical connection

The safety switch is connected to the bus system with a 4-pin connecting cable with M12 plug connector via a passive AS-Interface distribution box with a yellow and black AS-Interface cable.

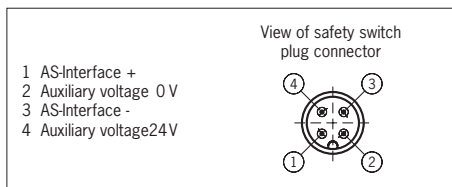


Figure 2: Terminal assignment of M12 plug connector

The following information applies to devices with plug connector:

- ▶ Check that the plug connector is sealed.

Setup

Setting the AS-Interface address

The address can be set prior to or after assembly. The AS-Interface address of the safety switch is set using an AS-Interface programming device. Addresses 1 to 31 are valid.

The unit is programmed by connecting the programming device to the M12 plug connector of the safety switch with a programming cable.

Address 0 is the default setting on delivery (the AS-Interface Fault LED is lit during operation).

Configuration in the AS-Interface safety monitor

(see operating instructions for the AS-Interface safety monitor and status table)

The safety switch is configured in the AS-Interface safety monitor with the AS-Interface address set as follows, for example:

- ▶ Dual-channel dependent
- ▶ Synchronization time = infinite ∞

In this operation mode, after unlocking the guard locking the safety guard must be opened each time prior to restarting.

▶ Dual-channel independent

The guard locking is opened and closed using the output D0. When the guard locking is open, the safety circuit shuts down. It is not necessary to open the door. Safety is provided again when the guard locking is closed.

The dual-channel feature and the door contact are not tested in this configuration. Additional measures outside the monitor must be provided for testing.

▶ Dual-channel conditionally dependent

▶ Independent: In-1

The guard locking is opened and closed using the output D0. When the guard locking is open, the safety circuit shuts down. It is not necessary to open the door. Safety is provided again when the guard locking is closed.

The switch is monitored for a malfunction.

Observe the following if the guard locking solenoid on a **VAA-2E3A-LIM1-PU-L-S-V1** spring interlock safety switch in the operation mode *door locking for duration of the time delay* is switched on (unlocked) via the second release contact of a dual-channel safety monitor and a PLC:

- ▶ It is not possible to switch off the guard locking solenoid by means of the monitor alone.

The control system (PLC) must therefore switch off the guard locking solenoid in the locked position via AS-Interface output D0 = 0 in order to re-establish the switch-on conditions for the first OSSD.

- ▶ The AS-Interface output must be switched on with D0 = 1 so that the guard locking solenoid can be unlocked by the second safety output of the monitor.

Status signals (not relevant to safety)

The state of the AS-Interface input bits D0 and D1 for door monitoring and the AS-Interface input bits D2 and D3 for solenoid monitoring can also be polled by the control system (PLC) (refer to the operating instructions for the AS-Interface safety monitor).

LED displays

The AS-Interface bus status is indicated by two LEDs (Power, Fault).

Two additional LEDs can be connected via the AS-Interface bus, e.g. to indicate the status signals (see Status signals and Technical data).

Function test

⚠ WARNING

Fatal injury due to faults during the function test.

- ▶ Before carrying out the function test, make sure that there are no persons in the danger area.
- ▶ Observe the valid accident prevention regulations.

Check the device for correct function after installation and after every fault.

Proceed as follows:

Mechanical function test

The actuator must slide easily into the actuating head. Close the safety guard several times to check the function. The function of any manual releases (except for the auxiliary release) must also be tested.

Electrical function test

1. Switch on operating voltage.
2. Close all safety guards and activate guard locking.
 - The machine must not start automatically.
 - It must not be possible to open the safety guard.
3. Start the machine function.
 - It must not be possible to release guard locking as long as the dangerous machine function is active.
4. Stop the machine function and release guard locking.
 - The safety guard must remain locked until there is no longer any risk of injury (e.g. due to movements with overtravel).
 - It must not be possible to start the machine function as long as guard locking is released.

Repeat steps 2 - 4 for each safety guard.

Inspection and service

⚠ WARNING

Danger of severe injuries due to the loss of the safety function.

- ▶ If damage or wear is found, the complete switch and actuator assembly must be replaced. Replacement of individual parts or assemblies is not permitted.
- ▶ Check the device for proper function at regular intervals and after every fault. For information about possible time intervals, refer to EN ISO 14119:2013, section 8.2.

Inspection of the following is necessary to ensure trouble-free long-term operation:

- ▶ correct switching function
- ▶ secure mounting of all components
- ▶ damage, heavy contamination, dirt and wear
- ▶ sealing of cable entry
- ▶ loose cable connections or plug connectors.

Information: The year of manufacture can be seen in the bottom, right corner of the type label.

Exclusion of liability and warranty

In case of failure to comply with the conditions for correct use stated above, or if the safety instructions are not followed, or if any servicing is not performed as required, liability will be excluded and the warranty void.

Notes about us

For use and operation as per the requirements of (UL), an isolating transformer or a power supply with secondary overcurrent protection (3 A) must be used.

EC declaration of conformity

The manufacturer named below herewith declares that the product fulfills the provisions of the directive(s) listed below and that the related standards have been applied.

Pepperl+Fuchs GmbH
Lilienthalstr. 200
68307 Mannheim, Germany

Directives applied:

- ▶ Machinery Directive 2006/42/EC

Standards applied:

- ▶ EN 60947-5-1:2004 + Cor.:2005 + A1:2009
- ▶ EN 1088:1995+A2:2008
- ▶ EN 14119:2013

The original EC declaration of conformity can also be found at: www.pepperl-fuchs.de

Technical data

Parameter	Value
Housing material	Reinforced thermoplastic
Degree of protection acc. to IEC 60529	IP 67, mating connector inserted
Mechanical life	1 x 10 ⁶ operating cycles
Ambient temperature	-20 ... +55 °C
Degree of contamination (external, acc. to EN 60947-1)	3 (industrial)
Installation position	Any
Approach speed, max.	20 m/min
Extraction force (not locked)	30 N
Retention force	20 N
Actuating force, max.	35 N
Actuation frequency	1,200/h
Switching principle SK, ÜK	Positively driven, slow-action switching contact
Contact material	Silver alloy, gold flashed
Connection	Plug connector M12, 4-pin
Weight	Approx. 0.5 kg
Locking force F _{max}	
Straight actuator with bush	F _S = 2,500 N
Bent actuator with bush	F _S = 1,500 N
Locking force F _{zh}	
acc. to EN ISO 14119	(F _{zh} = $\frac{F_{max}}{1.3}$) = 2,000 N
Guard locking solenoid	
Solenoid operating voltage	DC 24 V +10%/-15% 8 W
(auxiliary voltage on black AS-Interface cable)	Power supply unit with electrical isolation (IEC 60742, PELV)
Solenoid operating current	300 mA
Duty cycle	100%
Connection	M12 plug connector
AS-Interface data acc. to AS-Interface specification 2.1	
EA code:	7
ID code:	B
Operating voltage AS-Interface	DC 22.5 ...31.6 V
Total current consumption, max.	45 mA
Valid AS-Interface addresses	1 - 31
AS-Interface inputs	
Door monitoring contact SK	Acc. to AS-Interface Safety at Work D0, D1
Solenoid monitoring contact ÜK	D2, D3
AS-Interface outputs	
D0	Guard locking solenoid, 1 = solenoid energized
D1	Red LED, 1 = LED on
D2	Green LED, 1 = LED on
AS-Interface Power LED	Green, AS-Interface Power on
AS-Interface Fault LED	Red, offline phase or address 0"
Reliability values acc. to EN ISO 13849-1	
B _{10L}	5 x 10 ⁶

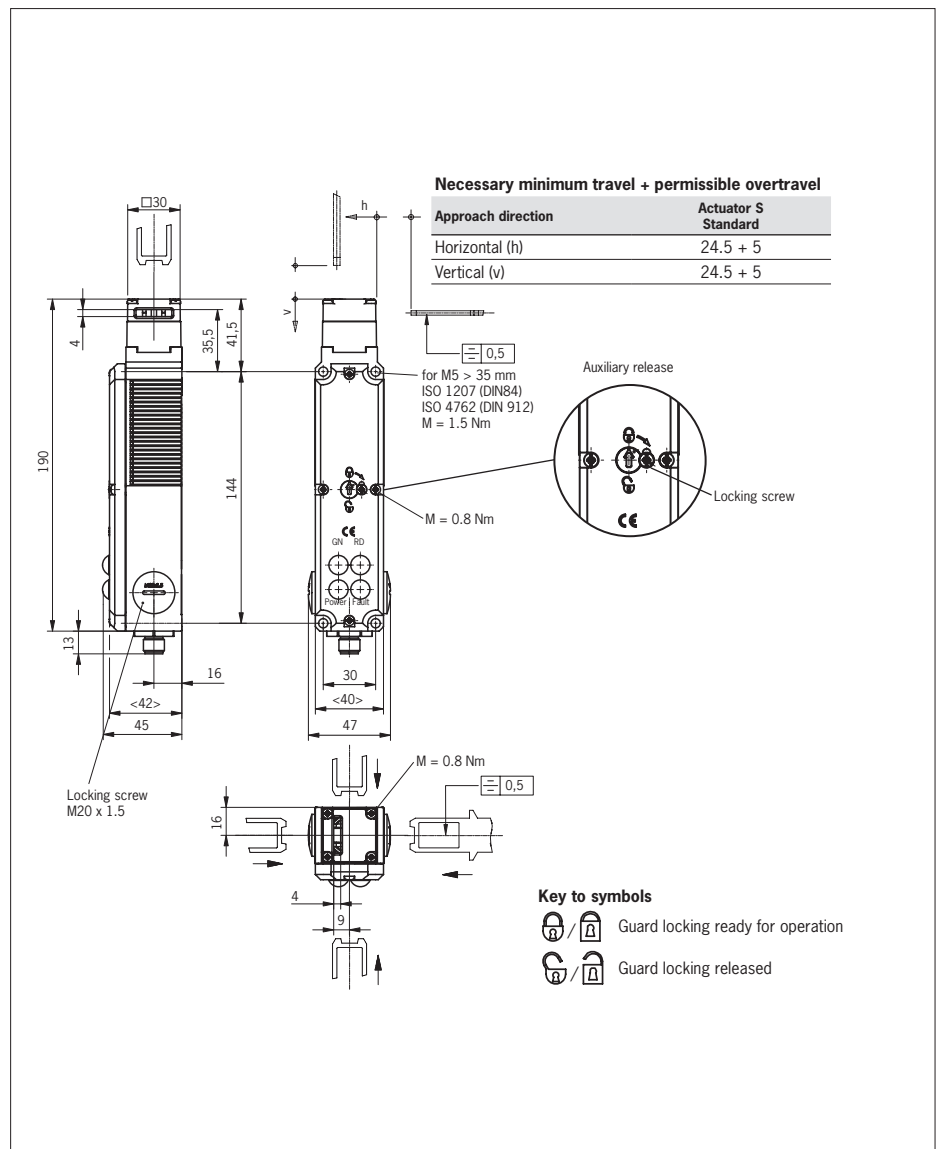


Figure 3: Dimension drawing

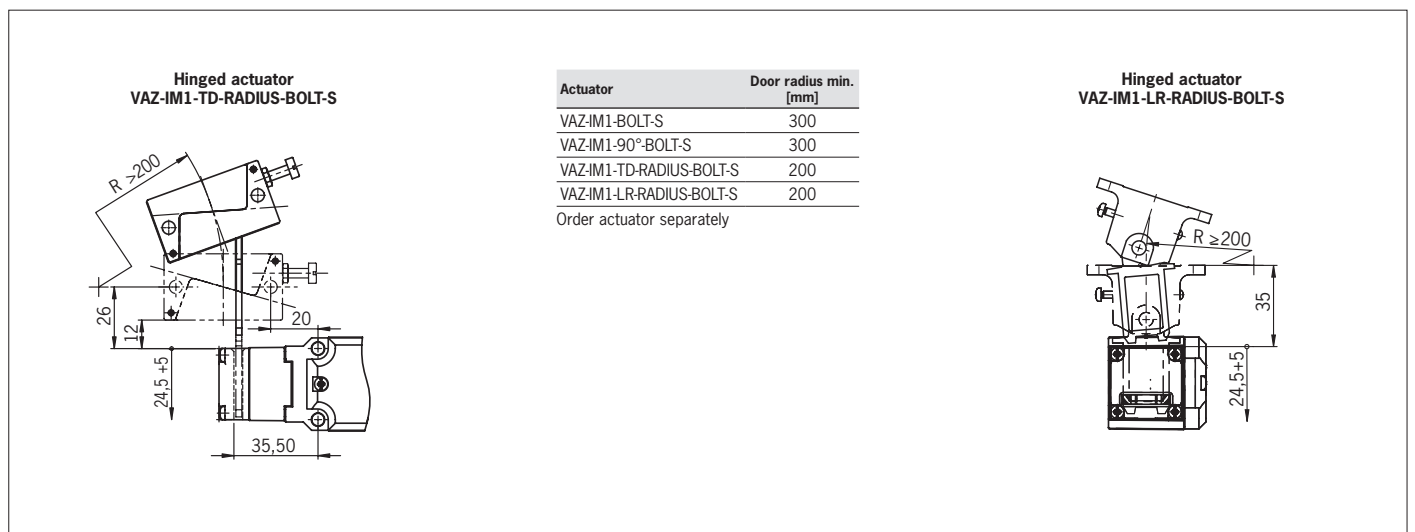
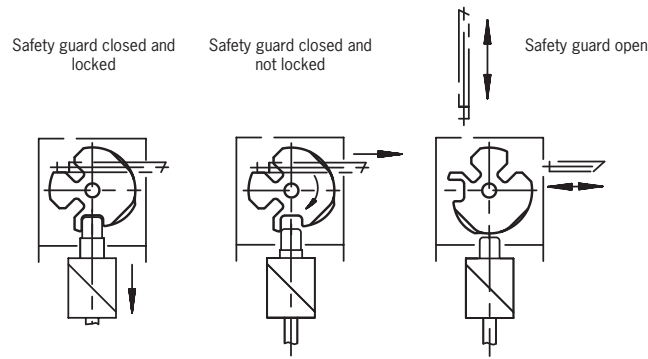





FIGURE 4: MINIMUM DOOR RADII

Status table



Programming	State	D0, D1	D2, D3	Monitor diagnosis
Dual channel conditionally dependent	Safety guard closed and locked 	Code sequence		Green
	Safety guard closed and not locked	Half-sequence	00	Yellow flashing
	Invalid state (safety guard open, guard locking active)	00	Half-sequence	Red flashing (monitoring of the invalid state)
	Safety guard open	00	00	Red
	Address 0 or communication disrupted	-		Gray
Dual channel independent	Safety guard closed and locked 	Code sequence		Green
	Safety guard closed and not locked	Half-sequence	00	Red
	Invalid state (safety guard open, guard locking active)	00	Half-sequence	Red
	Safety guard open	00	00	Red
	Address 0 or communication disrupted	-		Gray
Dual channel dependent Synchronization time infinite ∞	Safety guard closed and locked 	Code sequence		Green if safety guard was previously open or yellow flashing after startup if only the guard locking was open.
	Safety guard closed and not locked	Half-sequence	00	Yellow flashing if safety guard was previously closed. Red if safety guard was previously open.
	Invalid state (safety guard open, guard locking active)	00	Half-sequence	Yellow flashing if safety guard was previously closed. Red if safety guard was previously open.
	Safety guard open	00	00	Red
	Address 0 or communication disrupted	-		Gray

1.04447-02-1/L/16 (translation of the original operating instructions)