

EUCHNER

Operating Instructions

Transponder-Coded Safety Switch, Guard Locking for Process Protection
CEM-AR Unicode/Multicode
CEM-AY Unicode

EN

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1. About this document





1.1. Scope

These operating instructions are valid for all CEM-AR... and CEM-AY... from version V1.0.0. These operating instructions, the document *Safety information* and any enclosed data sheet form the complete user information for your device.

1.2. Target group




Design engineers and installation planners for safety devices on machines as well as setup and servicing staff possessing special expertise in handling safety components.


1.3. Key to symbols

Symbol/depiction	Meaning
	Printed document
	Document is available for download at www.euchner.com
 DANGER WARNING CAUTION	Safety precautions Danger of death or severe injuries Warning about possible injuries Caution slight injuries possible
 NOTICE Important!	Notice about possible device damage Important information
Tip	Useful information

1.4. Supplementary documents

The overall documentation for this device consists of the following documents:

Document title (document number)	Contents	
Safety information (2525460)	Basic safety information	
Operating instructions (2124745)	(this document)	
Possibly enclosed data sheet	Item-specific information about deviations or additions	

	Important! Always read all documents to gain a complete overview of safe installation, setup and use of the device. The documents can be downloaded from www.euchner.com . For this purpose enter the doc. no. in the search box.
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2. Correct use

Safety switches series CEM-I2-... are interlocking devices with guard locking solenoid (type 4) for process protection without guard lock monitoring. Devices with unicode evaluation possess a high coding level, devices with multicode evaluation possess a low coding level.

In combination with a movable guard and the machine control, this safety component prevents dangerous machine functions from occurring while the guard is open. A stop command is triggered if the guard is opened during the dangerous machine function.

This means:

- Starting commands that cause a dangerous machine function must become active only when the guard is closed.
- Opening the guard triggers a stop command.
- Closing a 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.

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
- EN ISO 12100
- IEC 62061

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

- EN ISO 13849-1
- EN ISO 14119
- EN 60204-1

The safety switch must be used only in conjunction with the designated actuator from EUCHNER. On the use of different actuators, EUCHNER provides no warranty for safe function.

The following applies to CEM-AR: Connection of several devices in an AR switch chain is permitted only using devices intended for series connection in an AR switch chain. Check this in the instructions of the device in question.




A maximum of 20 safety switches are allowed to be operated in a switch chain.



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.
- It is only allowed to use components that are permissible in accordance with the table below.

Table 1: Possible combinations for CEM components

Safety switch	Actuator	
		A-C40-113869 113869
CEM-I2-...		
Key to symbols		Combination possible, guard locking for process protection

3. Description of the safety function

Devices from this series feature the following safety functions:

Monitoring of the guard position (interlocking device according to EN ISO 14119)

- Safety function (see chapter 6.7. *Switching states on page 8*):
 - The safety outputs are switched off when the guard is open (monitoring of the door position).
- Safety characteristics: category, Performance Level, PFH_D (see chapter 11. *Technical data on page 27*).

4. Exclusion of liability and warranty

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

5. General safety precautions

Safety switches fulfill personnel protection functions. Incorrect installation or tampering can lead to fatal injuries to personnel.

Check the safe function of the safeguard particularly

- after any setup work
- after the replacement of a system component
- after an extended period without use
- after every fault

Independent of these checks, the safe function of the safeguard should be checked at suitable intervals as part of the maintenance schedule.



WARNING

Danger to life due to improper installation or due to bypassing (tampering). Safety components fulfill a personnel 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 (only for multicode evaluation). For this purpose, restrict access to actuators and to keys for releases, for example.
- Mounting, electrical connection and setup only by authorized personnel possessing the following knowledge:
 - specialist knowledge in handling safety components
 - knowledge about the applicable EMC regulations
 - knowledge about the applicable regulations on operational safety and accident prevention



Important!

Prior to use, read the operating instructions and keep these in a safe place. Ensure the operating instructions are always available during mounting, setup and servicing. For this reason you should archive a printed copy of the operating instructions. You can download the operating instructions from www.euchner.com.

6. Function

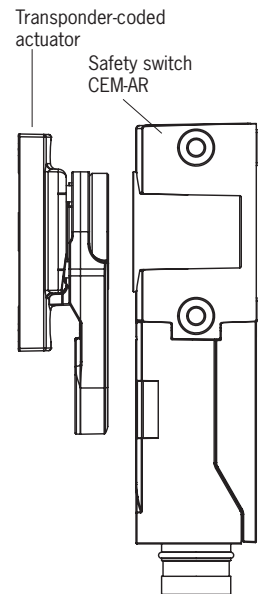
The device monitors the position of movable guards. The safety outputs are switched on/off when the actuator is moved to/removed from the actuating range.

The device additionally features a solenoid to produce the adhesive force and the locking force. The guard locking is not monitored (guard locking for process protection).

The system consists of the following components: coded actuator (transponder) and switch.

Whether the device learns the complete actuator code (unicode) or not (multicode) depends on the respective version.

- ▶ **Devices with unicode evaluation:** The actuator must be assigned to the safety switch by a teach-in operation so that it is detected by the system. This unambiguous assignment ensures a particularly high level of protection against tampering. The system thus possesses a high coding level.
- ▶ **Devices with multicode evaluation:** Unlike systems with unicode evaluation, on multicode devices a specific code is not requested but instead it is only checked whether the actuator is of a type that can be detected by the system (multicode evaluation). There is no exact comparison of the actuator code with the taught-in code in the safety switch (unicode evaluation). The system possesses a low coding level.



When the guard is closed, the actuator is moved towards the safety switch. When the operating distances are reached, power is supplied to the actuator by the switch and data are transferred.

If a permissible code and the anchor plate are detected, the safety outputs are switched on. The state of the guard locking or the detection of the anchor plate does not have any effect on the behavior for switching off the safety outputs. The safety outputs switch off only if the transponder signal from the actuator is no longer read.

When the guard is opened, the safety outputs and the monitoring outputs OT and OL are switched off.

In the event of a fault in the safety switch, the safety outputs are switched off and the DIA LED illuminates red. The occurrence of faults is detected at the latest on the next demand to switch on the safety outputs (e.g. on starting).

6.1. Door monitoring output and anchor plate detection (OT)

The device has a door monitoring output and anchor plate detection. The door monitoring output is switched on as soon as the actuator is in the actuating range and the anchor plate is detected by the solenoid (state: guard closed and not locked). The door monitoring output also remains switched on when guard locking is active.

The door monitoring output is switched off if the transponder is no longer in the actuating range or the anchor plate is no longer detected.

6.2. Diagnostic output (OI)

The diagnostic output is switched on in the event of a fault (switch-on condition as for DIA LED).

6.3. Guard lock monitoring output (OL)

The guard lock monitoring output is switched on when guard locking is active (locking force >400 N). On the activation of the guard locking, the device checks whether the locking force is at least 400 N. If this is not the case, the guard lock monitoring output OL is not switched on and the LOCK LED indicates that the minimum locking force has not been reached. The locking force is not checked during operation.

The guard lock monitoring output is switched off if the anchor plate is no longer detected (e.g.: door has been ripped open, air gap between guard locking solenoid and anchor plate too large. Possible cause: contamination or offset).

6.4. Guard locking on version CEM-I2

(Guard locking actuated by power-ON applied and released by power-OFF applied)

Activating guard locking: Apply control voltage to IMP.



Releasing guard locking: Disconnect control voltage from IMP.

Guard locking operates in accordance with the open-circuit current principle. If the control voltage (IMP) or the operating voltage U_B is interrupted, the guard locking is released and the guard can be opened directly!

The guard can be opened as long as no control voltage is applied.

6.5. Automatic reduction of the remanence

In particular during metal machining, the residual magnetism (remanence) in the guard locking solenoid can cause problems. In the open state, metal chips may be drawn to the contact area. The next time the guard is closed, there will be a gap between the actuator and read head that will limit the locking force. To prevent this effect, the guard locking solenoid is demagnetized when the guard locking is deactivated. For this purpose the operating voltage U_B must always be applied.

	<p>Important!</p> <p>Complete demagnetization takes place only if the adhesive force has been set to 0 N. Otherwise, the set adhesive force is active after the control voltage IMP is switched off.</p>
	<p>NOTICE</p> <p>With the 0 N setting, vibration may occur between the switch and actuator due the cyclic test pulses in the guard locking solenoid. It is therefore recommended to set an adhesive force.</p>

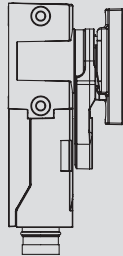
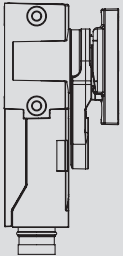
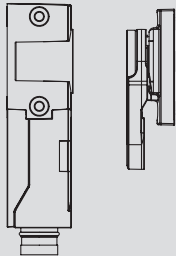
6.6. Adjustable adhesive force

The guard locking solenoid is pre-excited to achieve the adhesive force. This provides the switch with adhesive force even when guard locking is inactive. The operating voltage U_B must be present for this purpose. In this way it can be prevented, e.g., that the guard opens on its own.

The adhesive force can be set in steps of 0 N, approx. 30 N and approx. 50 N with the aid of a parameterization key (order no. 125481) (see chapter 9.2. *Setting adhesive force on page 21*).

6.7. Switching states

The detailed switching states for your switch can be found in chapter 10. *System status table on page 25*. All safety outputs, monitoring outputs and display LEDs are described there.

	Guard closed and locked	Guard closed and not locked	Guard open
			
Guard locking solenoid operated (IMP = on)	on	off	(irrelevant)
Safety outputs F01A and F01B	on	on ¹⁾	off
Guard lock monitoring output OL ²⁾	on	off	off
Door monitoring output and anchor plate detection OT ²⁾	on	on	off

1) Switch-on condition for safety outputs: transponder and anchor plate of the actuator detected.

2) On devices with NPN monitoring outputs, the On state corresponds to a voltage of 0 V and the Off state to a voltage of approx. 24 V.

7. Mounting



CAUTION

Safety switches must not be bypassed (bridging of contacts), turned away, removed or otherwise rendered ineffective.

- › Observe EN ISO 14119:2013, section 7, for information about reducing the possibilities for bypassing an interlocking device.



NOTICE

Risk of damage to equipment and malfunctions as a result of incorrect installation.

- › Safety switches and actuators are allowed to be used as an end stop. Please note here the max. impact energy in the technical data.
- › Observe EN ISO 14119:2013, sections 5.2 and 5.3, for information about mounting the safety switch and the actuator.
- › Protect the switch against damage, as well as foreign objects such as swarf, sand and blasting shot, etc.
- › Observe the min. door radii (see *Figure 2: Installation example on page 10*).
- › When the safety door is opened, the actuator must be moved away from the switch toward the front (see *Figure 3: Approach direction, maximum center offset and maximum actuator angle on page 10*).

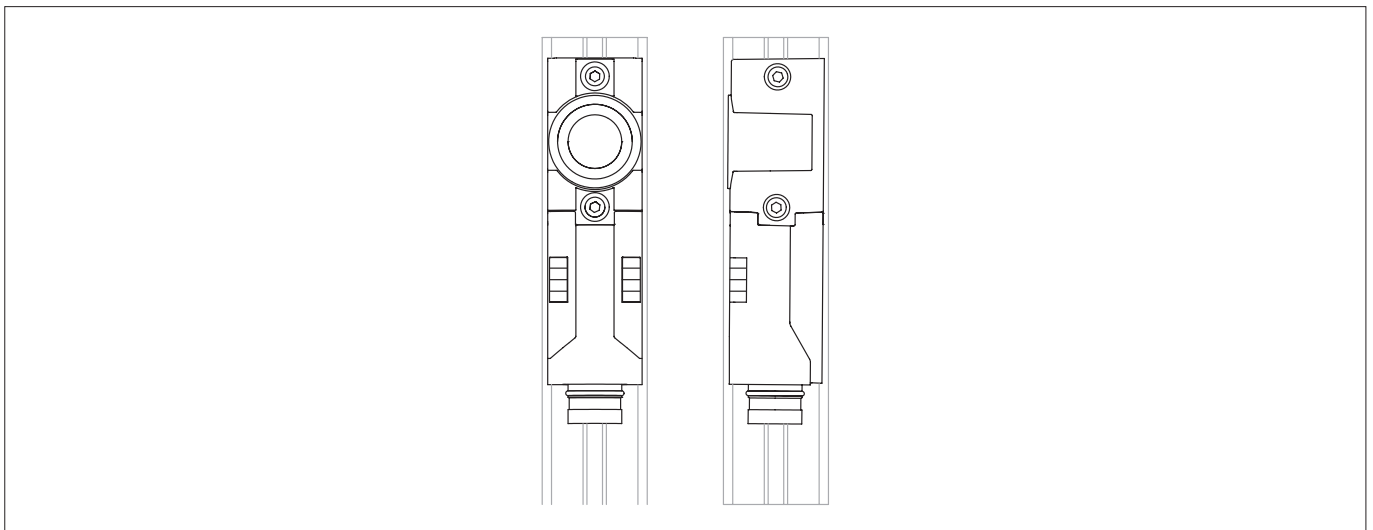


Figure 1: Installation directions, front and side mounting

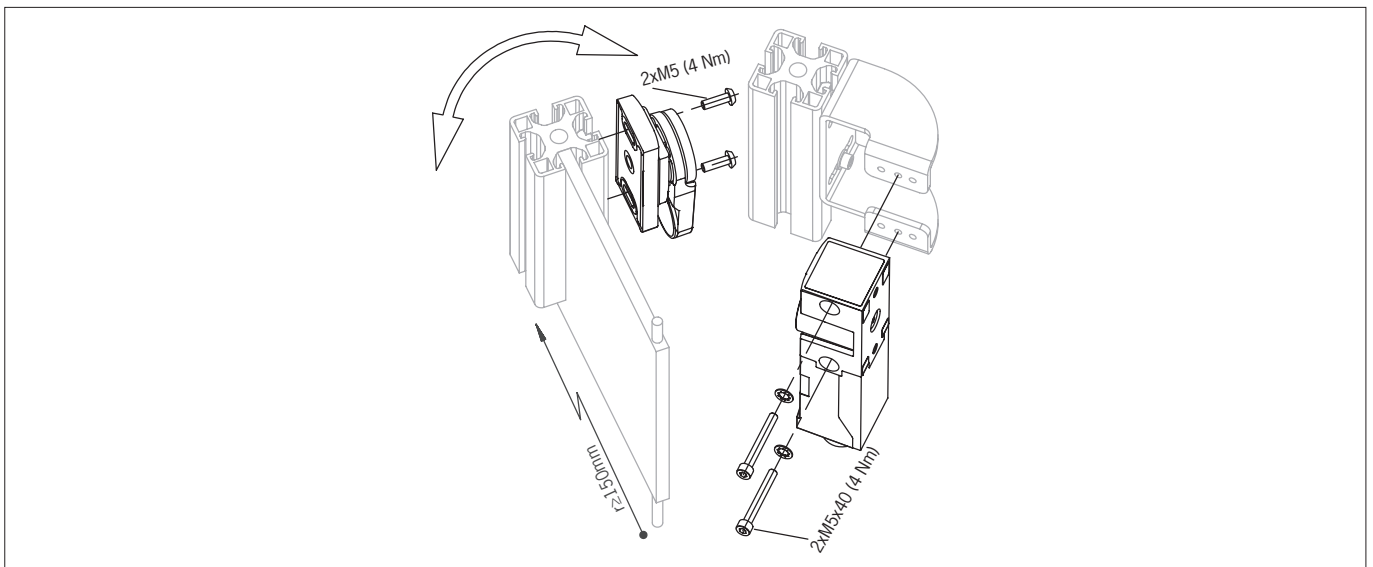


Figure 2: Installation example

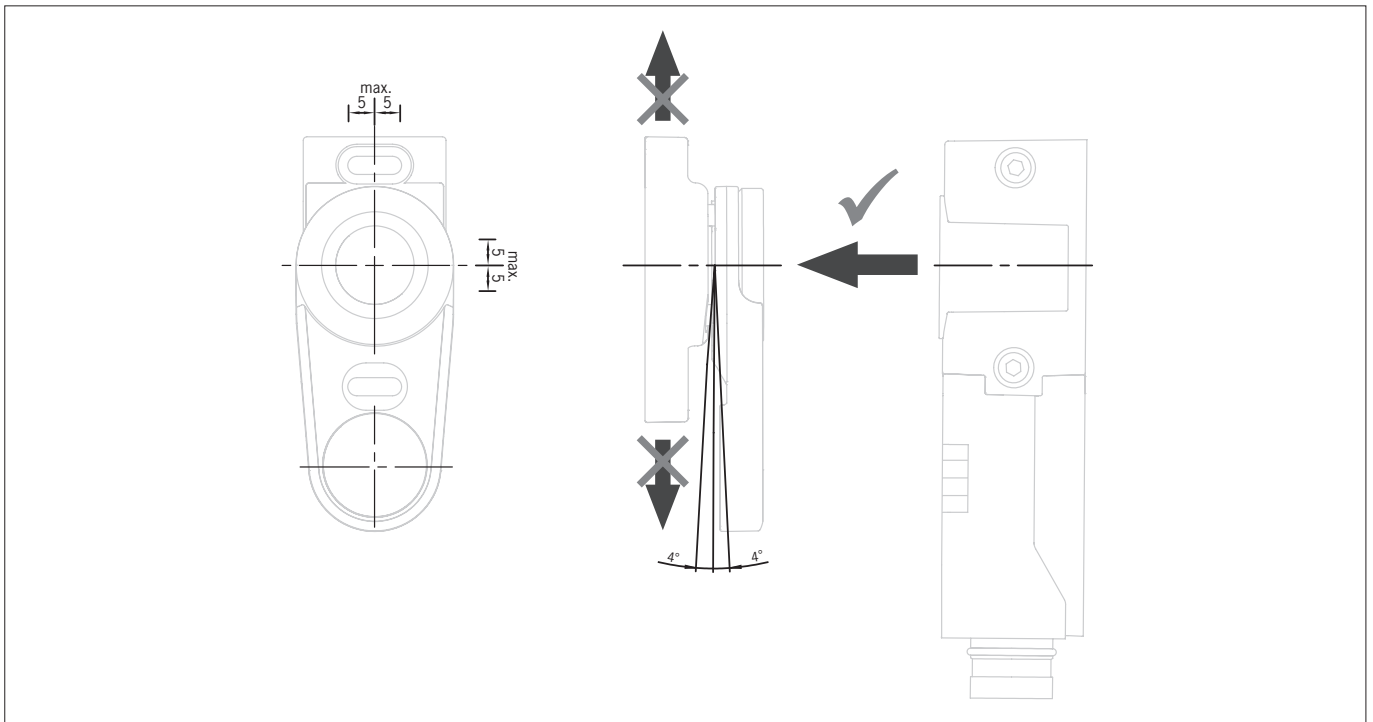


Figure 3: Approach direction, maximum center offset and maximum actuator angle

8. Electrical connection

The following connection options are available:

- › Separate operation (AR and AY devices)
- › Series connection with wiring in the control cabinet (AR devices only)



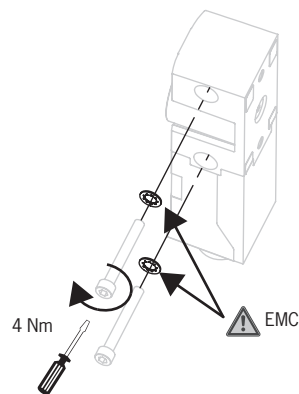
WARNING

- In the event of a fault, loss of the safety function due to incorrect connection.
- › To ensure safety, both safety outputs (FO1A and FO1B) must always be evaluated.
 - › Monitoring outputs must not be used as safety outputs.
 - › Lay the connecting cables with protection to prevent the risk of short circuits.



CAUTION

- Risk of damage to equipment or malfunctions as a result of incorrect connection.
- › The power supply for the evaluation electronics and the control voltage for the guard locking solenoid have the same ground potential.
 - › Do not use a control system with pulsing or switch off the pulsing function in your control system. The device generates its own test pulses on the output lines FO1A/FO1B. A downstream control system must tolerate these test pulses, which may have a length of up to 1 ms. The test pulses are also output when the safety outputs are switched off. Depending on the inertia of the downstream device (control system, relay, etc.), this can lead to short switching processes.
 - › The inputs on an evaluation unit connected must be positive-switching, as the two outputs on the safety switch deliver a level of +24 V in the switched-on state.
 - › All electrical connections must either be isolated from the mains supply by a safety transformer according to IEC 61558-2-6 with limited output voltage in the event of a fault, or by other equivalent isolation measures (PELV).
 - › All electrical outputs must have an adequate protective circuit for inductive loads. The outputs must be protected with a free-wheeling diode for this purpose. RC interference suppression units must not be used.
 - › Power devices which are a powerful source of interference must be installed in a separate location away from the input and output circuits for signal processing. The cable routing for safety circuits should be as far away as possible from the cables of the power circuits.
 - › It is imperative you use the enclosed toothed washers to mount the switch so that the housing is conductively connected to the underlying surface (see figure).



- › The function earth (FE) must be connected.
Important: FE is not connected to the device's housing but instead to the housing of the plug connector.
- › To avoid EMC interference, the physical environmental and operating conditions at the installation site of the device must comply with the requirements according to the standard EN 60204-1:2006, section 4.4.2 (EMC).



CAUTION

Pay attention to any interference fields from devices such as frequency converters or induction heating systems. Observe the EMC instructions in the manuals from the respective manufacturer.



Important!

If the device does not appear to function when operating voltage is applied (e.g. green STATE LED does not flash), the safety switch must be returned unopened to the manufacturer.

8.1. Notes about 



Important!

- › This device is intended to be used with a Class 2 power source in accordance with UL1310. As an alternative an LV/C (Limited Voltage/Current) power source with the following properties can be used:
 - This device shall be used with a suitable isolating source in conjunction with a fuse in accordance with UL 248. The fuse shall be rated max. 3.3 A and be installed in the max. 30 V DC power supply to the device in order to limit the available current to comply with the UL requirements. Please note possibly lower connection ratings for your device (refer to the technical data).
- › For use and application as per the requirements of UL a connecting cable listed under the UL category code CYJV/7, min. 24 AWG, min 80 °C, must be used.

8.2. Safety in case of faults

- › The operating voltage UB and the control voltage IMP are reverse polarity protected.
- › The safety outputs FO1A/FO1B are short circuit-proof.
- › A short circuit between FO1A and FO1B is detected by the switch.
- › A short circuit in the cable can be excluded by laying the cable with protection.

8.3. Fuse protection for power supply

The power supply must be provided with fuse protection depending on the number of switches and the current required for the outputs. The following rules apply:

Max. current consumption of an individual switch I_{max}

- I_{max} = $I_{UB} + I_{FO1A} + I_{FO1B} + I_{OL} + I_{OT} + I_{IMP}$
- I_{UB} = Switch operating current 80 mA + active guard locking 270 mA = 350 mA
- I_{OL}/I_{OT} = Load current of monitoring outputs (max. 50 mA per monitoring output)
- $I_{FO1A+FO1B}$ = Load current of safety outputs FO1A + FO1B (150 mA per safety output)
- I_{IMP} = Current consumption at control input for solenoid

Max. current consumption of a switch chain ΣI_{max} (only for AR devices)

- $\Sigma I_{max} = I_{FO1A+FO1B} + n \times (I_{UB} + I_{OL} + I_{OT} + I_{IMP})$
- n = Number of connected switches

8.4. Requirements for connecting cables



CAUTION

Risk of damage to equipment or malfunctions as a result of incorrect connecting cables.

- › Use connection components and connecting cables from EUCHNER.
- › On the use of other connection components, the requirements in the following table apply. EUCHNER provides no warranty for safe function in case of failure to comply with these requirements.

Observe the following requirements with respect to the connecting cables:

Parameter	Value	Unit
Conductor cross-section, min.		
- with plug connector M23 (RC18)	0.5	mm ²
- with plug connector M12	0.34	
R max.	60	Ω/km
C max.	120	nF/km
L max.	0.65	mH/km
Recommended cable type		
- with plug connector M23 (RC18)	LIFY11Y min. 19-core	
- with plug connector M12	LIYY 8 x 0.25 mm ²	

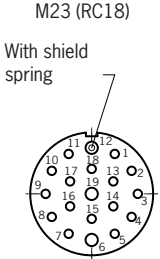
8.5. Maximum cable lengths

The maximum cable length per switch is 50 m. Pay attention to the requirements from chapter 8.4.

8.6. Connector assignment of safety switch CEM-I2-AR-...

8.6.1. Connector assignment of safety switch CEM-I2-AR-...-SH-... with plug connector M23 (RC18)

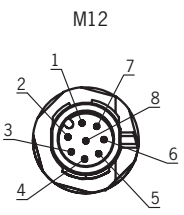
Wiring diagram B

Plug connector (view of connection side)	Pin	Designation	Function	Conductor coloring of connecting cable 1)
 <p>M23 (RC18) With shield spring</p>	1	IMP	Control voltage, guard locking solenoid, 24 V DC	VT
	2	F11A	Enable input for channel A	RD
	3	F11B	Enable input for channel B	GY
	4	F01A	Safety output channel A	RD/BU
	5	F01B	Safety output channel B	GN
	6	UB	Operating voltage, 24 V DC	BU
	7	RST	Reset input	GY/PK
	8	OT	Door monitoring output	GN/WH
	9	OI	Diagnostic output	YE/WH
	10	OL	Guard lock monitoring output	GY/WH
	11	-	n.c.	BK
	12	FE	Function earth (must be connected to meet the EMC requirements)	GN/YE
	13	-	n.c.	PK
	14	-	n.c.	BN/GY
	15	-	n.c.	BN/YE
	16	-	n.c.	BN/GN
	17	-	n.c.	WH
	18	-	n.c.	YE
	19	OVUB	Operating voltage, 0 V	BN

1) Only for standard EUCHNER connecting cable.

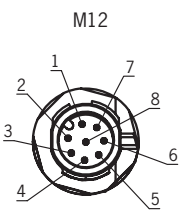
8.6.2. Connector assignment of safety switch CEM-I2-AY-...-SA-... with plug connector M12

Wiring diagram B

Plug connector (view of connection side)	Pin	Designation	Function
 <p>M12</p>	1	IMP	Control voltage, guard locking solenoid, 24 V DC
	2	UB	Operating voltage, 24 V DC
	3	F01A	Safety output, channel A PNP
	4	F01B	Safety output, channel B PNP
	5	OI	Diagnostic output PNP
	6	OT	Door monitoring output PNP
	7	OL	Guard lock monitoring output PNP
	8	OVUB	Operating voltage, 0 V

8.6.3. Connector assignment of safety switch CEM-I2-AY-...-LZ-SA-... with plug connector M12, NPN monitoring outputs

Wiring diagram B

Plug connector (view of connection side)	Pin	Designation	Function
 <p>M12</p>	1	IMP	Control voltage, guard locking solenoid, 24 V DC
	2	UB	Operating voltage, 24 V DC
	3	F01A	Safety output, channel A PNP
	4	F01B	Safety output, channel B PNP
	5	RST	Reset input 24 V DC
	6	OT	Door monitoring output NPN
	7	OL	Guard lock monitoring output NPN
	8	OVUB	Operating voltage, 0 V

8.7. Connection of a single CEM-AR or a CEM-AY

If a single CEM-AR or a CEM-AY is used, connect the device as shown in *Figure 4* or *Figure 5*. The monitoring outputs can be routed to a control system.

The following applies to CEM-AR: The switch can be reset via the RST input. To do this, a voltage of 24 V is applied to the RST input for at least 3 s. The RST input must be connected to 0 V if it is not used.



WARNING

In the event of a fault, loss of the safety function due to incorrect connection.

▸ To ensure safety, both safety outputs (FO1A and FO1B) must always be evaluated.



Important!

▸ The example shows only an excerpt that is relevant for connection of the device. The example illustrated here does not show complete system planning. The user is responsible for safe integration into the overall system. Detailed application examples can be found at www.euchner.com. Simply enter the order number of your switch in the search box. You will find all available connection examples for the device in *Downloads*.

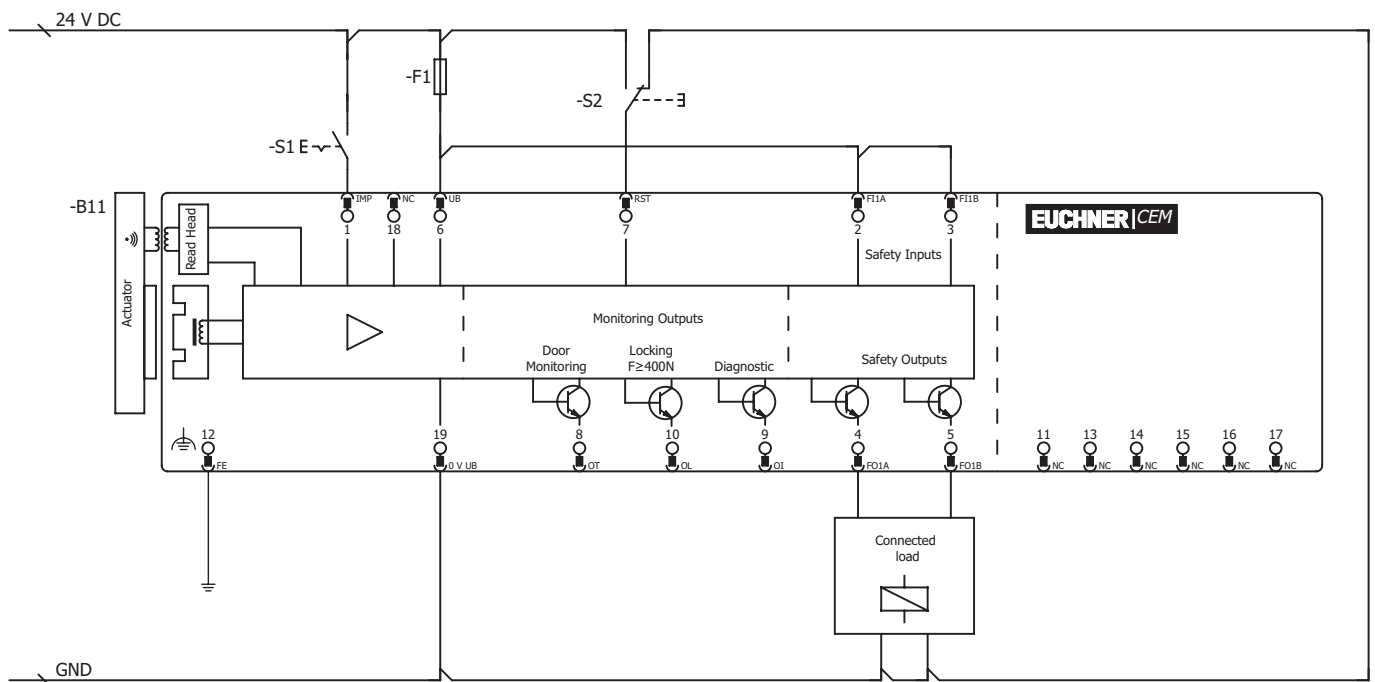


Figure 4: Connection example for separate operation of a CEM-AR; version with plug connector M23

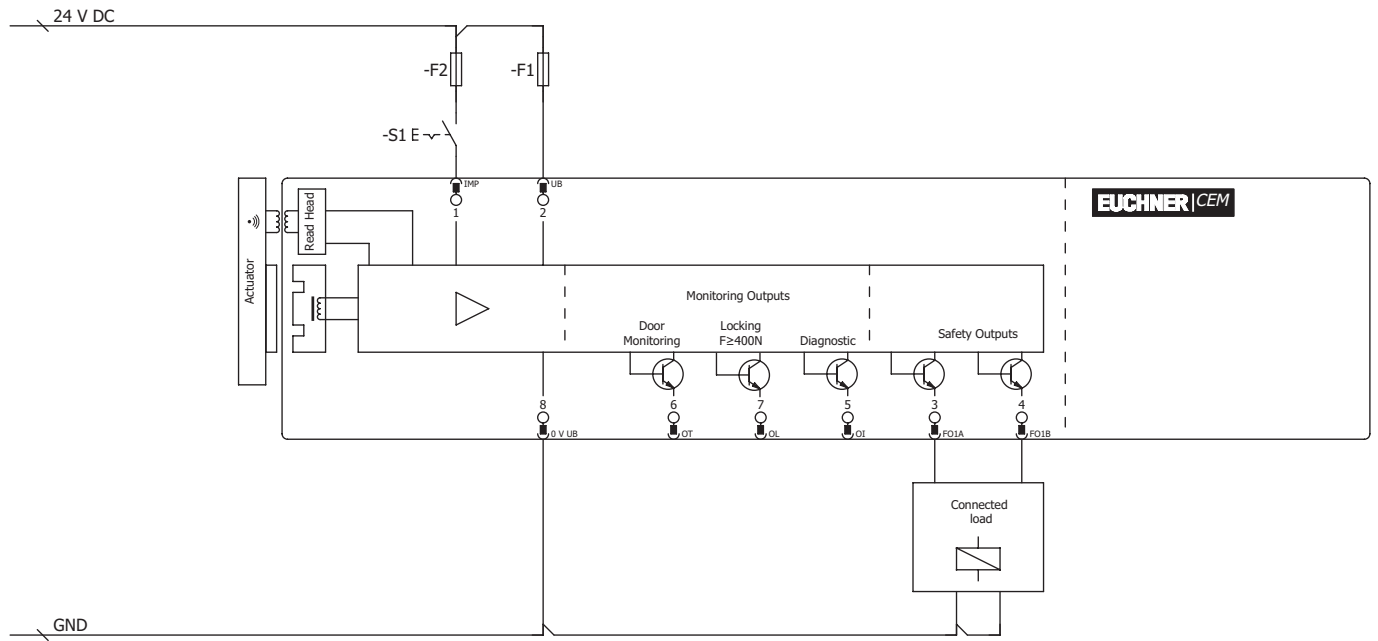


Figure 5: Connection example for CEM-AY; version with plug connector M12

8.8. Connection of several CEM-AR in a switch chain



Important!

- ▶ An AR switch chain may contain a maximum of 20 safety switches.
- ▶ The example shows only an excerpt that is relevant for connection of the device. The example illustrated here does not show complete system planning. The user is responsible for safe integration into the overall system. Detailed application examples can be found at www.euchner.com. Simply enter the order number of your switch in the search box. You will find all available connection examples for the device in *Downloads*.

The series connection of the version with plug connector M23 is realized using additional terminals in a control cabinet. The safety outputs are permanently assigned to the respective safety inputs of the downstream switch. FO1A must be routed to FI1A and FO1B to FI1B. If the connections are interchanged (e.g. FO1A to FI1B), the device will switch to the fault state. Always use the RST input in series connections. All switches in a chain can be reset at the same time with this reset input. To do this, a voltage of 24 V must be applied to the RST input for at least 3 s. If the RST input is not used in your application, it should be connected to 0 V.

Note the following on this aspect:

- ▶ A common signal must be used for all switches in the chain. This can be a changeover switch or the output of a control system. A pushbutton is not suitable, because Reset must always be connected to GND during operation (see switch S11 in *Figure 6 on page 17*).
- ▶ Reset must always be performed simultaneously for all switches of the chain.

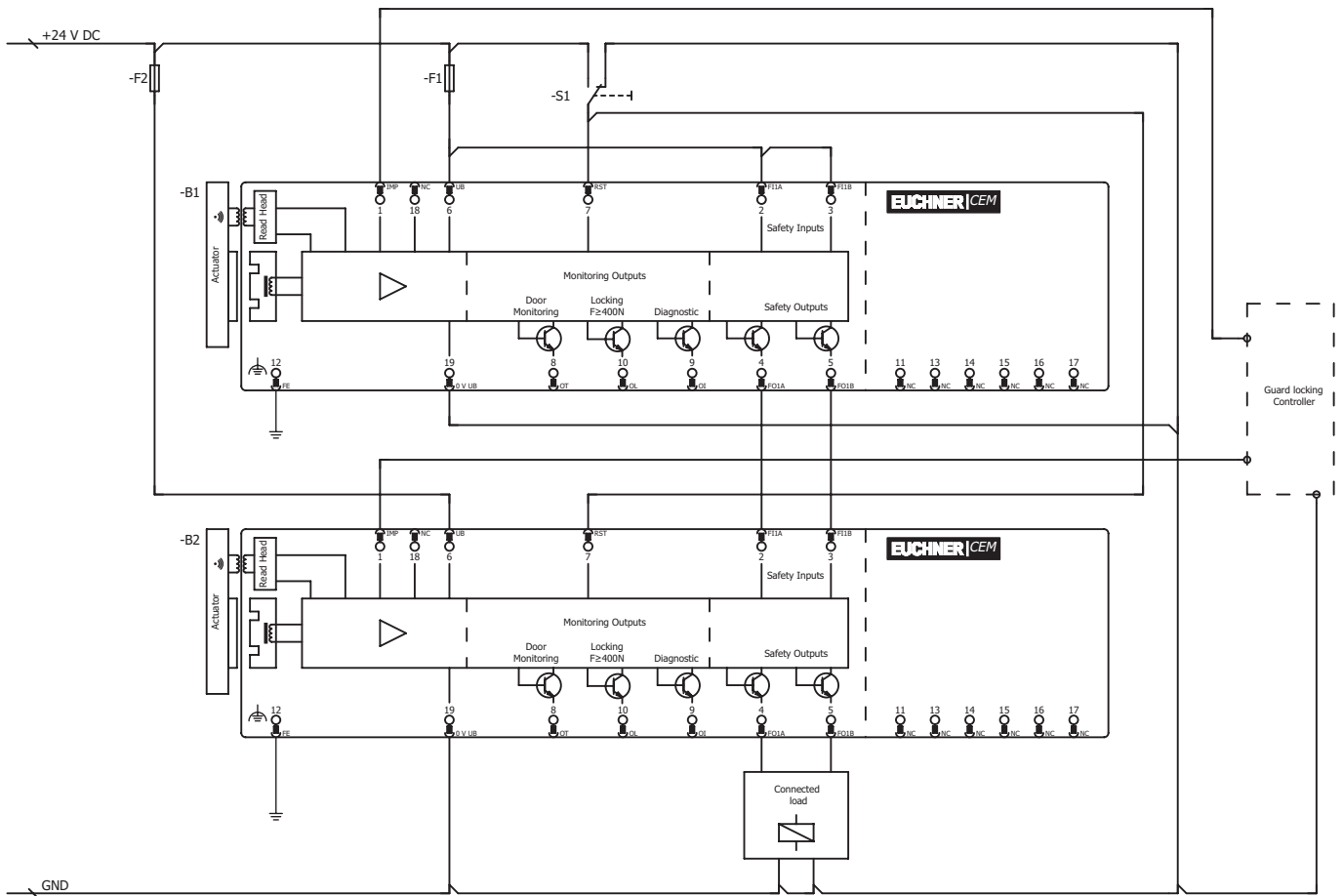
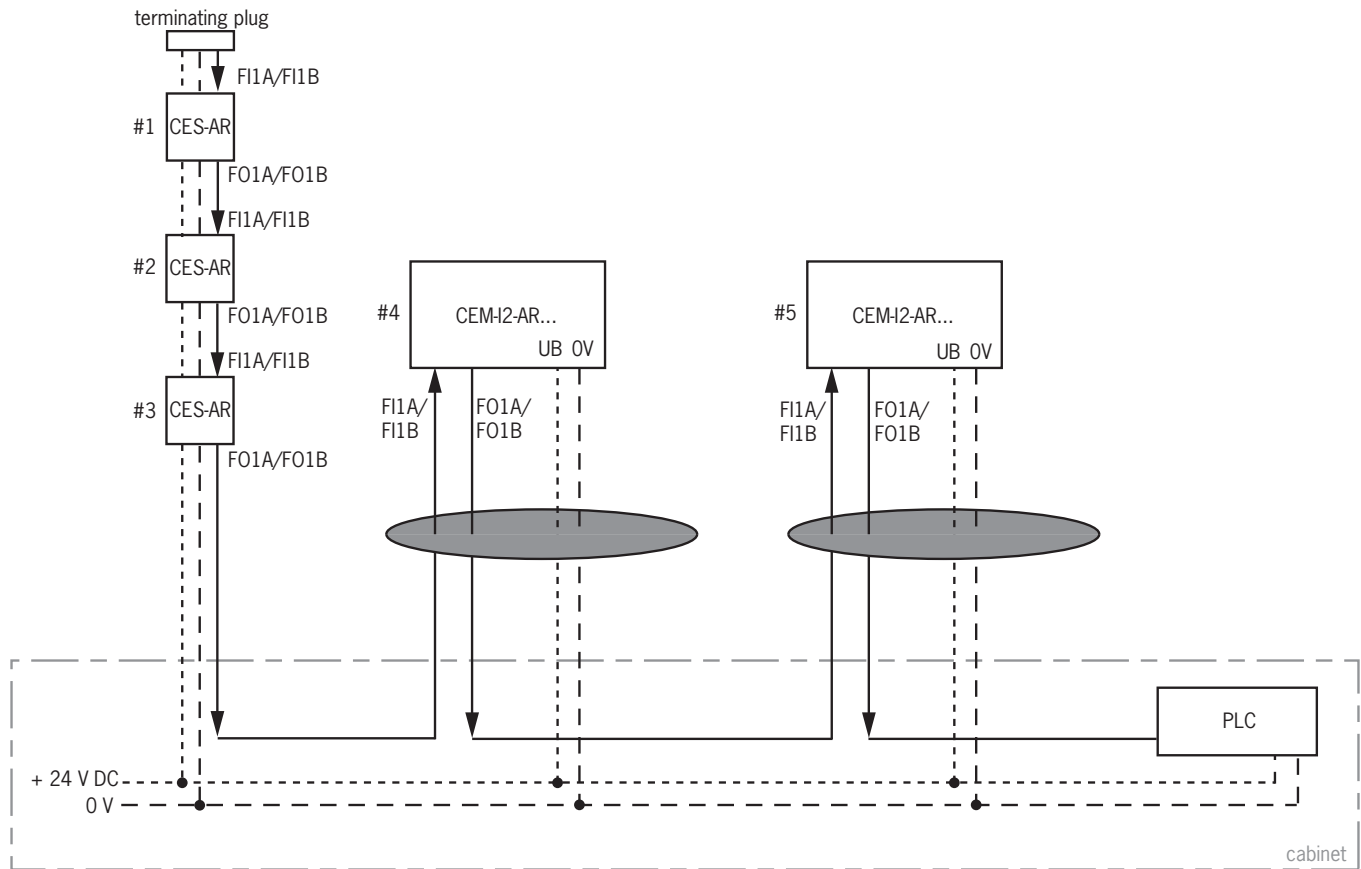


Figure 6: Connection example for operation in a CEM-AR switch chain

8.9. Information on operation in an AR switch chain

To prevent earth loops, the wiring must be in a star configuration (see Figure 7).



Important: lay cables in a common harness

Figure 7: Central wiring of an AR switch chain in the control cabinet

8.9.1. Number of devices in switch chains

In a pure CEM switch chain a maximum of 20 devices can be connected in series. In mixed switch chains (e.g. CEM-AR together with CES-AR) the maximum number of devices is also 20.

8.9.2. Resetting in switch chains



Important!

Use the reset input (RST) for resetting in AR switch chains. All devices in the chain must be reset simultaneously. Resetting individual switches will result in faults.

8.10. Information on operation on an AR evaluation unit

The device cannot be operated on an AR evaluation unit.

8.11. Notes on operation with safe control systems

Please observe the following requirements for connection to safe control systems:

- › Use a common power supply for the control system and the connected safety switches.
- › A pulsed power supply must not be used for UB. Tap the supply voltage directly from the power supply unit. If the power supply is connected to a terminal of a safe control system, this output must provide sufficient electrical current.
- › **The following applies to CEM-AR:** Always connect inputs FI1A and FI1B directly to a power supply unit or to the outputs FO1A and FO1B of another EUCHNER AR device (series connection). Pulsed signals must not be present at inputs FI1A and FI1B.
- › The safety outputs FO1A and FO1B can be connected to the safe inputs of a control system. Prerequisite: The input must be suitable for pulsed safety signals (OSSD signals, e.g. from light grids). The control system must tolerate test pulses on the input signals. This normally can be set up by parameter assignment in the control system. Observe the notes of the control system manufacturer. For the pulse duration of your safety switch, refer to chapter 11. *Technical data on page 27.*

A detailed example of connecting and setting the parameters of the control system is available for many devices at www.euchner.com, in the area *Downloads/Applications/CEM*. The features of the respective device are dealt with there in greater detail.

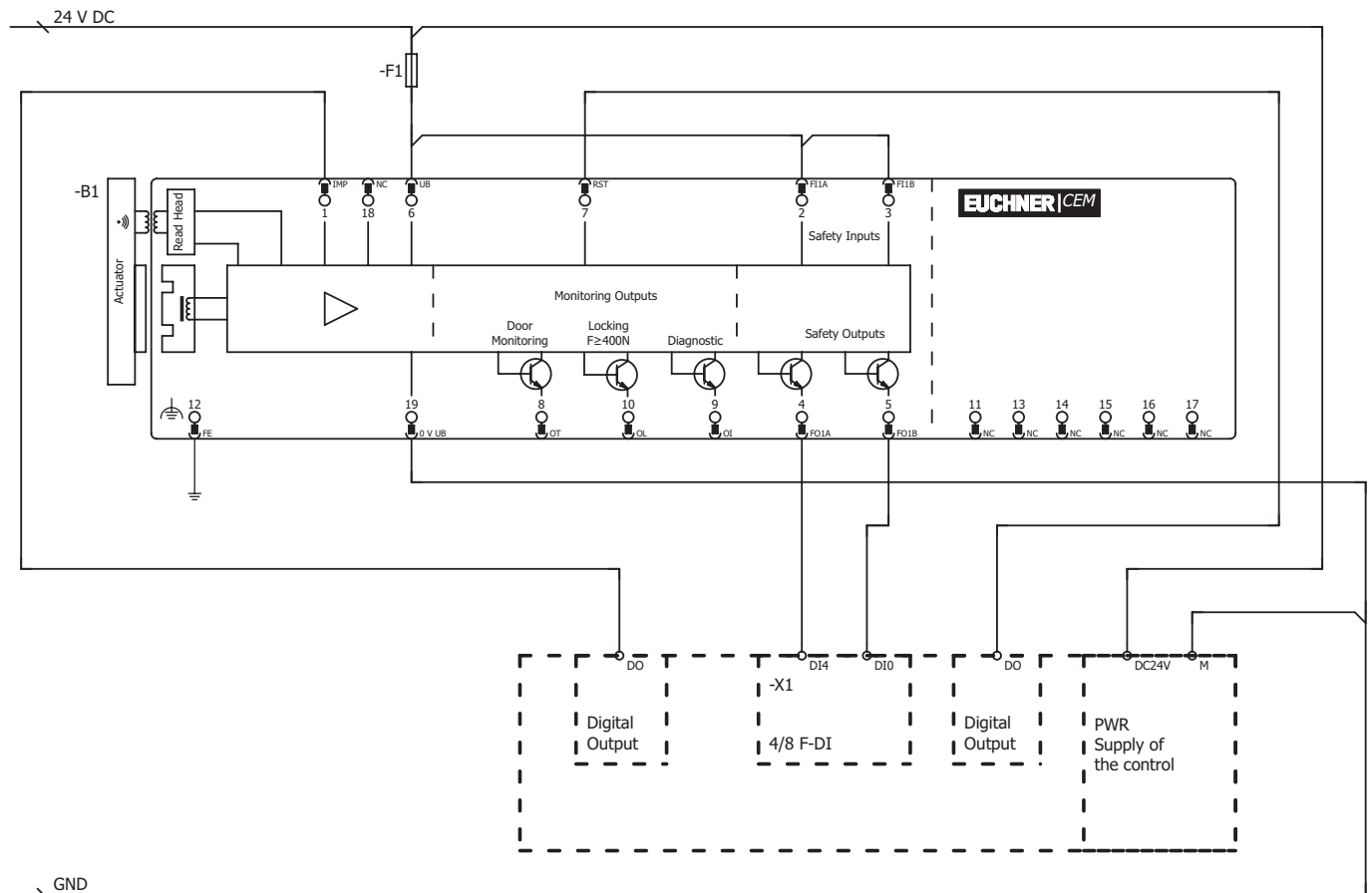


Figure 8: Connection example for the connection to ET200

8.12. Connection of guard locking control

1-channel control
1 x p-switching

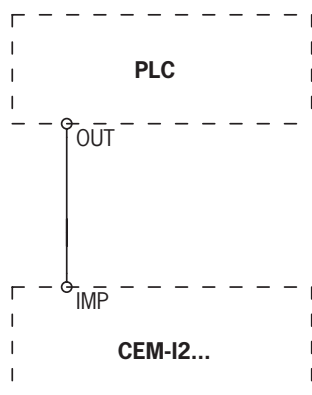


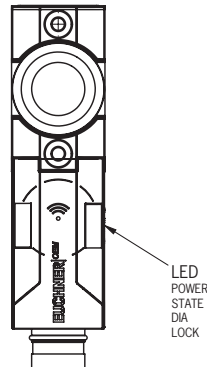
Figure 9: Connection options for guard locking control

9. Setup

9.1. LED displays

You will find a detailed description of the signal functions in chapter 10. *System status table on page 25.*

LED	Color
POWER	green
STATE	green
DIA	red
LOCK	yellow



9.2. Setting adhesive force

The adhesive force can be set in steps of 0 N, approx. 30 N and approx. 50 N (default setting on delivery) with the aid of a parameterization key (order no. 125481). The adhesive force is active if guard locking is inactive. The operating voltage U_B must be present for this purpose.



Important!

Prior to setting the adhesive force, an actuator must be taught-in. Otherwise the device will enter the fault state.

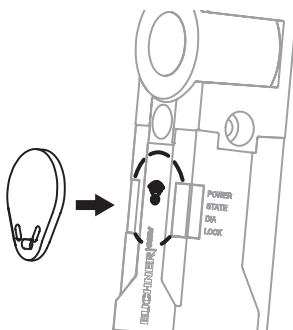


Tip!

Always set an adhesive force to prevent unintentional opening of the guard with the guard locking inactive.

Proceed as follows:

1. Voltage on U_B , no voltage on IMP.
2. Open the guard.
3. Hold parameterization key against active face.



➔ LOCK LED flashes to indicate the current setting. The flashing code for each step is displayed once and changes to the next step after approx. 8 s.

Adhesive force steps	LOCK LED flashing code
0 N	1x
approx. 30 N	2x
approx. 50 N	3x

4. Remove the parameterization key once the required adhesive force step is reached.



➔ The device has applied the adhesive force set and is in normal operation.

9.3. Teach-in function for actuator (only for unicode evaluation)

The actuator must be allocated to the safety switch using a teach-in function before the system forms a functional unit.

During a teach-in operation, the safety outputs are switched off, i.e. the system is in the safe state. Door monitoring output OT indicates a HIGH signal during teach-in operation as long as an actuator that is ready for teach-in is located in the actuating range.

The teach-in operation is fully automatic. The number of possible teach-in operations is unlimited.

	<p>Tip!</p> <p>Prior to switching on, close the guard on which the actuator to be taught-in is installed. The teach-in operation starts immediately after switching on. This feature simplifies above all teach-in with series circuits and on large installations.</p>
	<p>Important!</p> <ul style="list-style-type: none"> › The teach-in operation may be performed only if the device does not have any internal fault. › Devices in the condition as supplied remain in teach-in standby state until they have successfully taught-in the first actuator. Once taught-in, switches remain in the teach-in standby state for approx. 3 min. after each switch-on. › The safety switch disables the code of the preceding device if teach-in is carried out for a new actuator. Teach-in is not possible again immediately for this device if a new teach-in operation is carried out. The disabled code is released again in the safety switch only after a third code has been taught-in. › The safety switch can be operated only with the last actuator taught-in. › If the switch detects the actuator that was most recently taught-in when in the teach-in standby state, this state is ended immediately and the switch changes to normal operation. › If the actuator to be taught-in is within the actuating range for less than 30 s, it will not be activated and the most recently taught-in actuator will remain saved.

9.3.1. Actuator teach-in

1. Establish teach-in standby:
 - Devices in the condition as supplied: unlimited teach-in standby after switching on.
 - Switch already taught-in: teach-in standby is available for approx. 3 min after switching on.

➔ Teach-in standby indication, STATE LED flashes 3x repeatedly.
2. Close the guard during teach-in standby.
 - ➔ The automatic teach-in operation starts (duration approx. 30 s). During the teach-in operation the STATE LED flashes (approx. 1 Hz). Alternate flashing of the STATE and DIA LEDs acknowledges the successful teach-in operation. Teach-in errors are indicated by the illumination of the red DIA LED and a flashing code on the green STATE LED (see chapter 10. System status table on page 25).
3. Switch off operating voltage U_B (min. 3 s).
 - ➔ The code of the actuator that was just taught-in is activated in the safety switch.
4. Switch on operating voltage U_B .
 - ➔ The device operates normally.

9.3.2. Teach-in function with series connection, replacing and teaching-in device (only for AR devices)

It is recommended not to teach-in the actuators in the series connection but to teach them in one by one instead. Teach-in in a series connection works analogously to separate operation in principle. It is a prerequisite that the steps below are followed. Further steps might have to be observed for mixed switch chains (e.g. for chains with CES and CET). Observe the operating instructions for the other devices in the chain for this purpose.

Work on the wiring (e.g. during device replacement) should generally be performed in a de-energized state. On certain systems, it is nevertheless necessary to perform this work and subsequent teach-in during ongoing operation.

The RST input must be connected as shown in *Figure 6 on page 17* to permit this.

Proceed as follows:

1. Open the guard on which the switch or actuator is to be replaced.
2. Mount the new switch or actuator and prepare it for the teach-in operation (see chapter 9.3.1. *Actuator teach-in on page 22*).
3. Close all guards in the chain and activate guard locking.
4. To reset the switch, apply a voltage of 24 V to the RST input for at least 3 s (Reset).
 - ➔ On the safety switch that is positioned at a new actuator, the green LED flashes at approx. 1 Hz and the actuator is taught-in. This takes approx. 30 s. Do not switch off during this time and do not actuate reset! The teach-in operation is complete when the STATE and DIA LEDs flash alternately.
5. To reset the switch, apply a voltage of 24 V to the RST input for at least 3 s (Reset).
 - ➔ The system restarts and then continues to function in normal operation.

9.4. Functional check



WARNING

Danger of fatal injury as a result of faults in installation and functional check.

- › Before carrying out the functional check, make sure that there are no persons in the danger zone.
- › Observe the valid accident prevention regulations.

9.4.1. Mechanical function test

Close the guard several times to check the function. Ensure that the actuator and anchor plate make contact with the switch in the designated area.

9.4.2. Electrical function test

After installation and any fault, the safety function and the guard locking for process protection must be fully checked. Proceed as follows:



NOTICE

This function test applies if the process is allowed to run only with process protection guard locking active. The procedure may vary depending on the application.

1. Switch on operating voltage.
 - ➔ The machine must not start automatically.
 - ➔ The safety switch carries out a self-test. The green STATE LED flashes for 10 s at 5 Hz. The green STATE LED then flashes at regular intervals.
2. Close all guards. In case of guard locking by solenoid force: activate guard locking.
 - ➔ The machine must not start automatically. It must not be possible to open the guard.
 - ➔ The green STATE LED illuminates continuously.
3. Enable operation in the control system.
 - ➔ It must not be possible to deactivate guard locking as long as operation is enabled.
4. Disable operation in the control system and deactivate guard locking.
 - ➔ The guard must remain locked until the process is at an end.
 - ➔ It must not be possible to start the machine as long as guard locking is deactivated.

Repeat steps 2 - 4 for each guard.

10. System status table

Operating mode	Actuator/door position	Safety outputs F01A and F01B	Guard lock monitoring output OL	Door monitoring output OT	LED indicator Output		LOCK (yellow)	State
					STATE (green)	DIA (red) and diagnostic output OI		
Self-test	X	off	off	off	5 Hz (10 s)	○	○	Self-test after power-up
Normal operation	closed	on	on	on		○		Normal operation, door closed and locked, IMP = on
	closed	on	off	on		○	6 x in-verse	Normal operation, door closed and locked, IMP = on. Min. adhesive force < 400 N. Possible causes: contamination or offset
	closed	off	on	on	1 x in-verse	○		Normal operation, door closed and locked, IMP = on. Safety outputs not switched because: - Preceding device in the switch chain signals <i>door open</i> (only with series connection) - Anchor plate of the actuator not detected
	closed	on	X	on	6 x in-verse	○	X	Normal operation, door closed and not locked, IMP = off. - Actuator in the limit range → re-adjust door
	closed	on	off	on		○	○	Normal operation, door closed and not locked, IMP = off
	open	off	off	off	1 x	○	○	Normal operation, door open, IMP = off
	open	off	off	off	1 x	○	1 x	Normal operation, door open, IMP = on
Teach-in operation (only unicode)	open	off	off	off	3 x	○	○	Device in teach-in standby
	closed	off	off	on	1 Hz	○	○	Teach-in operation
	X	off	X	X	↔	○	○	Positive acknowledgment after completion of teach-in operation
Fault display	X	off	X	X	1 x		○	Error in the teach-in operation (only unicode). Actuator removed from the actuating range prior to the end of the teach-in operation, faulty actuator detected or attempt to set adhesive force on switch without teach-in.
	X	off	off	off	2 x		○	Input error, only for AR devices (e.g. missing test pulses, illogical switching state from previous switch in the switch chain)
	X	off	off	off	3 x		○	Read error (e.g. actuator faulty)
	X	off	off	off	4 x		○	Output error when voltage is applied (e.g. short circuits, loss of switching capability)
						1 x in-verse	○	Output error during operation (e.g. short circuits, loss of switching capability)
	X	off	X	X	5 x		○	Disabled actuator detected
	X	off	off	off	○		X	Internal error
X	X	off	off	○		2 x	External error - Temperature too high - UB too low	
Key to symbols					○			LED not illuminated
								LED illuminated
					1 x in-verse			LED illuminated, briefly goes out 1 x
					5 Hz (10 s)			LED flashes for 10 s at 5 Hz
					3 x			LED flashes three times, and this is then repeated
					↔			LEDs flash alternately
					X			Any state

After the output error is corrected during operation, the fault display can generally be reset by opening and closing the guard. If the fault is still displayed afterward, use the reset function or briefly interrupt the power supply. This applies to all other fault displays as well.

Please contact the manufacturer if the fault display is not reset after restarting.



Important!

If you do not find the displayed device status in the system status table, this indicates an internal device fault. In this case, you should contact the manufacturer.

11. Technical data



NOTICE

If a data sheet is included with the product, the information on the data sheet applies.

11.1. Technical data for safety switch CEM-I2-...

Parameter	Value			Unit
	min.	typ.	max.	
Mechanical values and environment				
Material	Aluminum, powder-coated Plastic (PBT) Nickel-plated steel			
- Switch housing/magnet holder				
- Active read head face				
- Active solenoid face				
Ambient temperature at UB = 24 V	-20	-	+55	°C
Degree of protection	IP65/IP67 (screwed tight with the corresponding mating connector)			
Safety class acc. to EN IEC 61558	III			
Degree of contamination	3			
Installation orientation	Any			
Weight	Approx. 0.64			kg
Impact energy				
- Front mounting	-	-	1	J
- Side mounting	-	-	1	J
Electrical connection ratings				
Operating voltage UB (reverse polarity protected, regulated, residual ripple < 5%)	24 ± 15% (PELV)			V DC
External fuse (operating voltage UB), per switch	1			A
Current consumption I _{UB} (monitoring outputs not loaded)				
- Guard locking inactive	80			mA
- Guard locking active	350			
Connection (depending on version)	Plug connector M23, 19-pin/plug connector M12, 8-pin			
Rated insulation voltage U _i	-	-	30	V
Rated impulse withstand voltage U _{imp}	-	-	0.5	kV
Resilience to vibration	Acc. to EN 60947-5-3			
EMC protection requirements	Acc. to EN 60947-5-3			
Conditional short-circuit current	100			A
Ready delay	-	12	-	s
Risk time for single device	-	-	260	ms
Risk time delay per device	5			ms
Turn-on time				
- For safety outputs	-	0.7	2.5	s
- For monitoring output OT	-	0.7	2.5	
- For monitoring output OL (guard locking active)	-	2	-	
Discrepancy time	-	-	10	ms
Test-pulse duration	1			ms
Frequency band	120 ... 130			kHz
Assured release distance S _{ar}	18			mm
Safety outputs F01A/F01B				
Type of outputs	Semiconductor outputs, p-switching, short circuit-proof			
- Output voltage U _{F01A} /U _{F01B} ¹⁾				
HIGH U _{F01A} /U _{F01B}	UB - 1.5	-	UB	V DC
LOW U _{F01A} /U _{F01B}	0	-	1	V DC
Switching current per safety output	1	-	150	mA
Utilization category acc. to EN 60947-5-2	DC-13 24V 150 mA Caution: outputs must be protected with a free-wheeling diode in case of inductive loads			
Switching frequency	0.5			Hz
Duty cycle	100			%
CEM-I2-AR-.../CEM-I2-AY-... Monitoring output OT, OI and OL, p-switching				
Type of outputs	Semiconductor outputs, p-switching, short circuit-proof			
Output voltage	0.8 x UB	-	UB	V DC
Max. load per output	-	-	50	mA
Only CEM-I2-AY-...-LZ-... Monitoring output OT and OL, n-switching				
Type of outputs	Semiconductor outputs, n-switching, short circuit-proof			
Output voltage	0	-	0.7	V DC
Switching voltage	21	24	27	
Max. load per output	-	-	20	mA
Solenoid				
Locking force in axial direction	-	600 ²⁾	-	N
Adjustable adhesive force	0, approx. 30, approx. 50			N
Solenoid center offset	± 5 (in all directions)			mm
Current consumption at control input I _{MP}	Min. 20			mA

Parameter	Value			Unit
	min.	typ.	max.	
Reliability values acc. to EN ISO 13849-1		Monitoring of the guard position		
Category		4		
Performance Level (PL)		e		
PFD ₀		4.5 x 10 ⁻⁹ /h		
Mission time		20		years

1) Values at a switching current of 50 mA without taking into account the cable lengths.

2) On the activation of the guard locking, the device checks whether the locking force is at least 400 N. If this is not the case, this is signaled by the LOCK LED.

11.1.1. Typical system times

Refer to the technical data for the exact values.

Ready delay: After switch-on, the device carries out a self-test. The system is ready for operation only after this time.

Turn-on time of safety outputs: The max. reaction time t_{on} is the time from the moment when the guard is closed to the moment when the safety outputs switch on.

Simultaneity monitoring, safety inputs F11A/F11B (only for AR devices): If the safety inputs have different switching states for longer than a specific time, the safety outputs (FO1A and FO1B) will be switched off. The device switches to the fault state.

Risk time according to EN 60947-5-3: If an actuator moves outside the actuating range, the safety outputs (FO1A and FO1B) are switched off after the risk time at the latest.

If several devices are operated in a series connection, the risk time of the overall device chain will increase with each device added. Use the following calculation formula:

$$t_r = t_{r,e} + (n \times t_i)$$

t_r = Total risk time

$t_{r,e}$ = Risk time, single device (see technical data)

t_i = Risk time delay per device

n = Number of additional devices (total number -1)

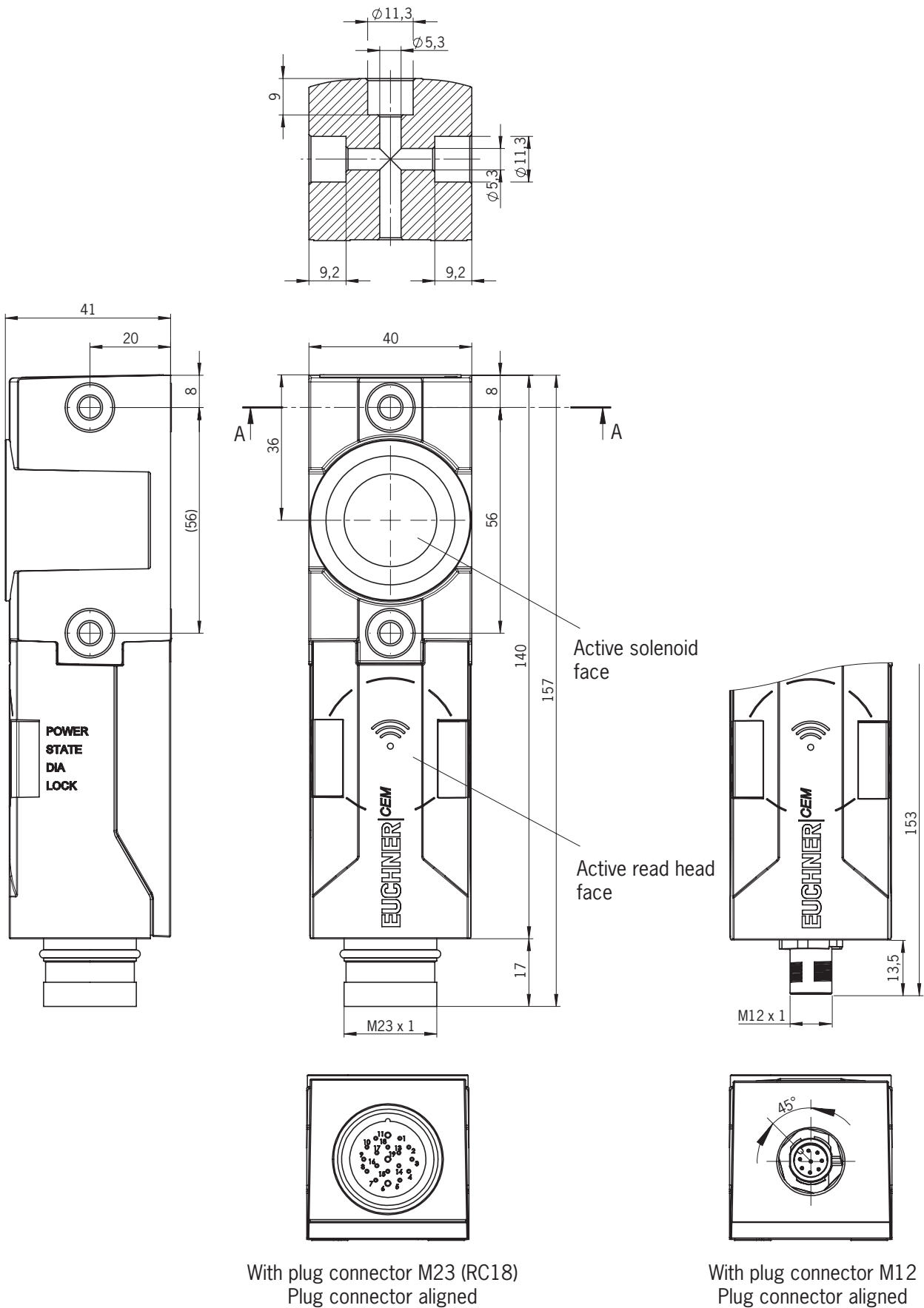
Discrepancy time: The safety outputs (FO1A and FO1B) switch with a slight time offset. They have the same signal state no later than after the discrepancy time.

Test pulses at the safety outputs: The device generates its own test pulses on the safety outputs (FO1A and FO1B). A downstream control system must tolerate these test pulses.

This can usually be set up in the control systems by parameter assignment. If parameter assignment is not possible for your control system or if shorter test pulses are required, contact our support organization.

The test pulses are also output when the safety outputs are switched off.

11.2. Dimension drawing for safety switch CEM-I2-...



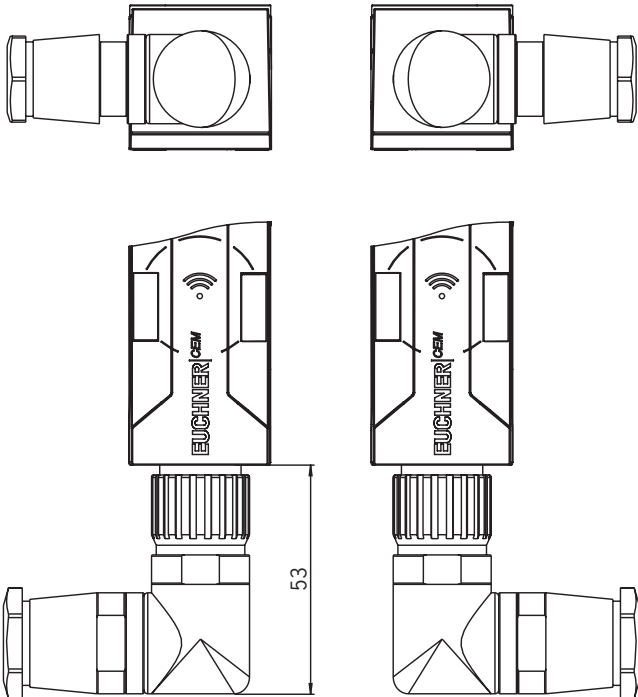
With plug connector M23 (RC18)
Plug connector aligned

With plug connector M12
Plug connector aligned

Plug connector M23

Cable outlet C

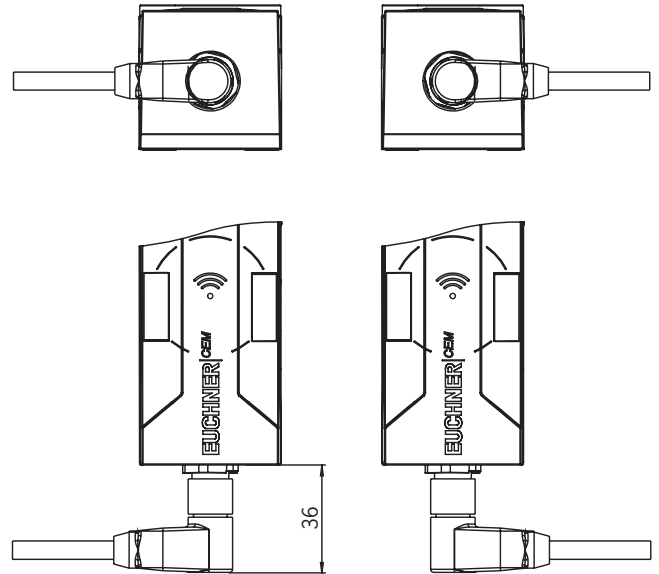
Cable outlet A



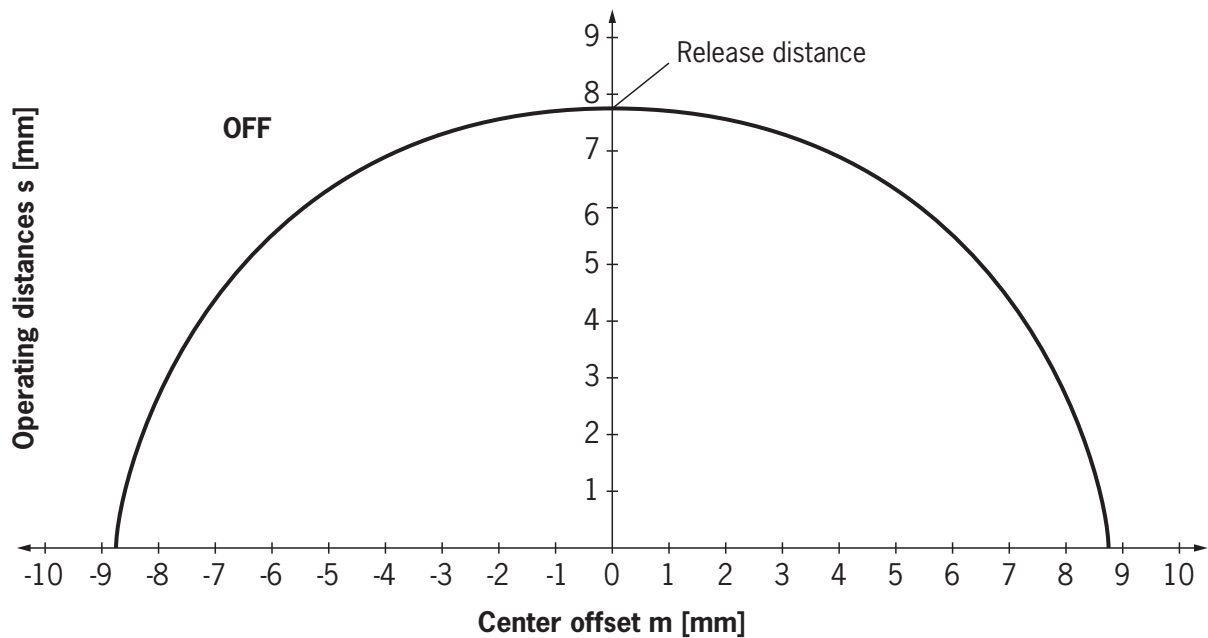
Plug connector M12

Cable outlet C

Cable outlet A



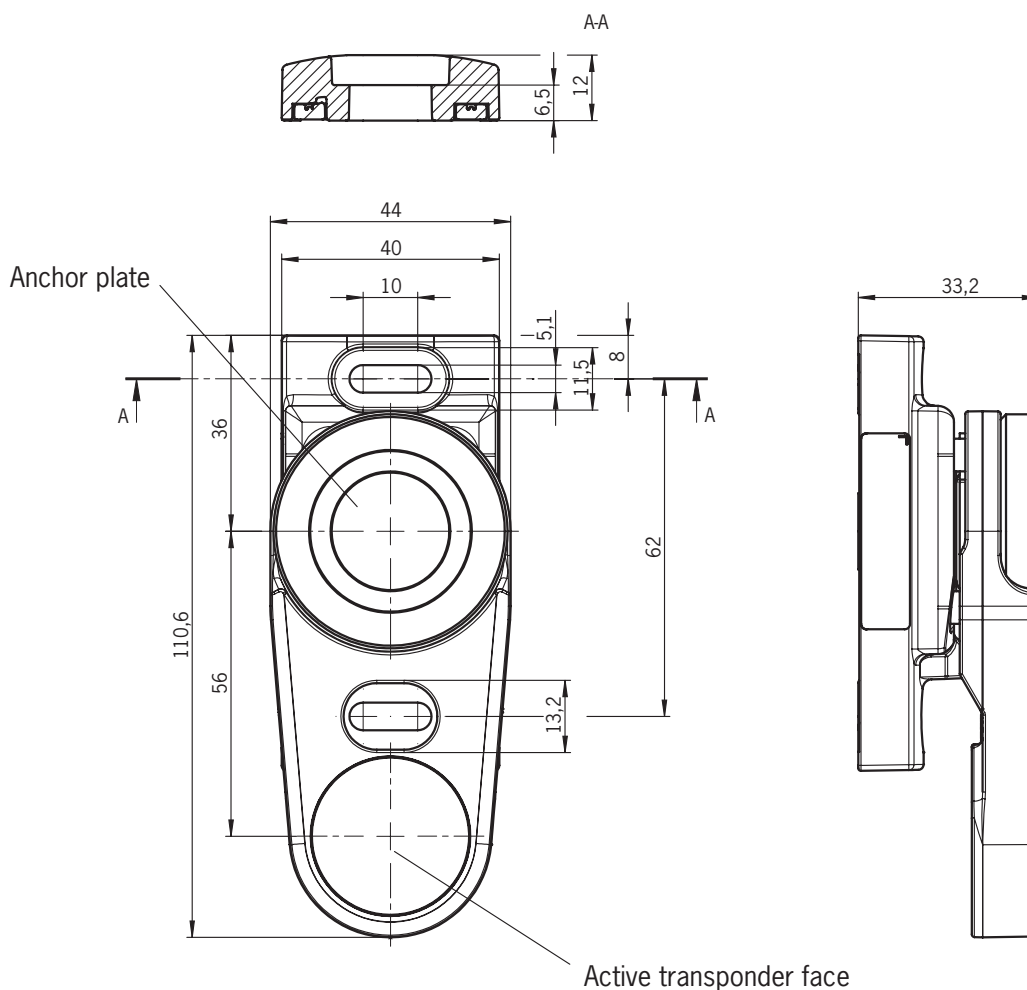
11.3. Actuating range of safety switch CEM-I2-...



11.4. Technical data for actuator A-C40-113869, adjustable transversely

Parameter	Value			Unit
	min.	typ.	max.	
Material				
- Housing		Aluminum		
- Active actuator face		Plastic (PBT)		
- Anchor plate		Nickel-plated steel		
Weight		0.24		kg
Adjustment angle		$\pm 4^\circ$		
Ambient temperature	-25	-	+55	$^\circ\text{C}$
Degree of protection		IP67		
Mechanical life		1×10^6		
Installation orientation		Active face opposite read head		
Power supply		Inductive via read head		

11.4.1. Dimension drawing for actuator A-C40-113869, adjustable transversely



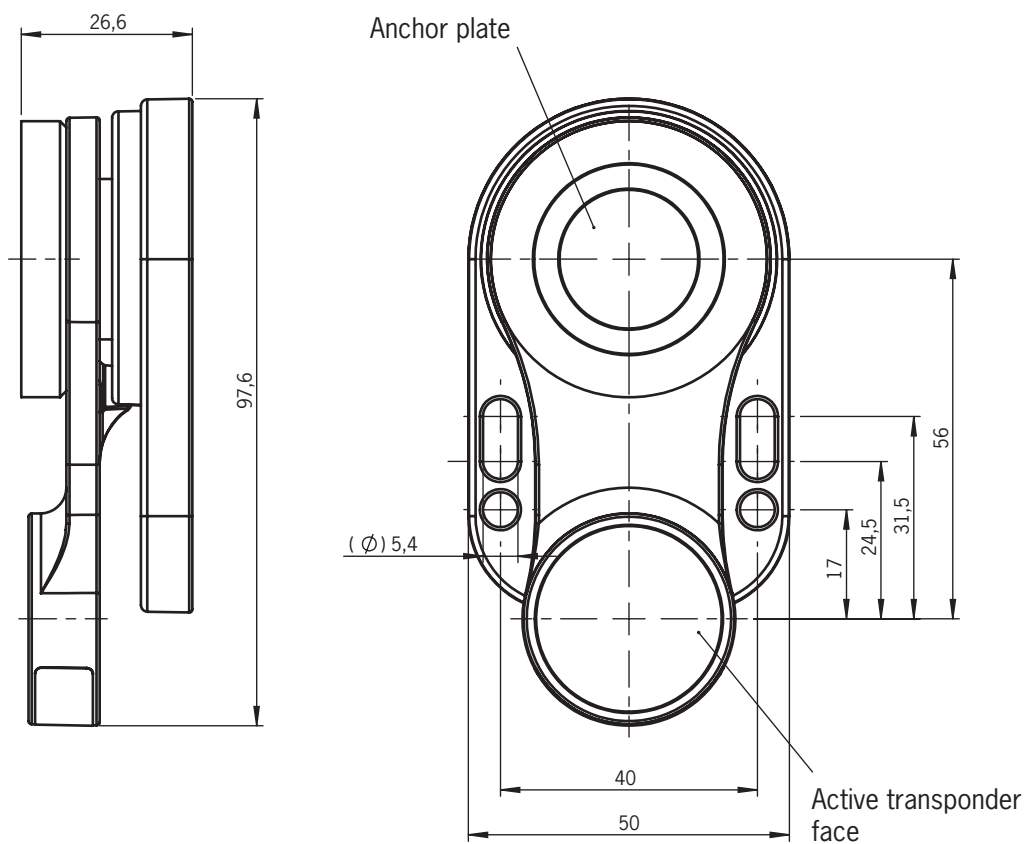
Tip!

The actuator includes two M5 x 16 screws, one of which is a safety screw.

11.5. Technical data for actuator A-C40-158436, adjustable lengthwise

Parameter	Value			Unit
	min.	typ.	max.	
Material				
- Housing		Aluminum		
- Active actuator face		Plastic (PBT)		
- Anchor plate		Nickel-plated steel		
Weight		0.2		kg
Adjustment angle		$\pm 4^\circ$		
Ambient temperature	-25	-	+55	°C
Degree of protection		IP65/IP67		
Mechanical life		1×10^6		
Installation orientation		Active face opposite read head		
Power supply		Inductive via read head		

11.5.1. Dimension drawing for actuator A-C40-158436, adjustable lengthwise



Tip!

The actuator includes two M5 x 16 screws, one of which is a safety screw.

12. Ordering information and accessories



Tip!

Suitable accessories, e.g. cables or assembly material, can be found at www.euchner.com. To order, enter the order number of your item in the search box and open the item view. Accessories that can be combined with the item are listed in *Accessories*.

13. 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.

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

- › Check the switching function (see chapter 9.4. *Functional check on page 24*)
- › Check all additional functions (e.g. escape release, lockout bar, etc.)
- › Check the secure mounting of the devices and the connections
- › Check for soiling

No servicing is required. Repairs to the device are only allowed to be made by the manufacturer.



NOTICE

The year of manufacture can be seen in the lower right corner of the type label. The current version number in the format (V X.X.X) can also be found on the device.

14. Service

If servicing is required, please contact:

EUCHNER GmbH + Co. KG
Kohlhammerstraße 16
70771 Leinfelden-Echterdingen
Germany

Service telephone:

+49 711 7597-500

E-mail:

support@euchner.de

Internet:

www.euchner.com

15. Declaration of conformity



EUCHNER

More than safety.

EU-Konformitätserklärung
EU declaration of conformity
Déclaration UE de conformité
Dichiarazione di conformità UE
Declaración UE de conformidad

Original DE
Translation EN
Traduction FR
Traduzione IT
Traducción ES

2539422-01-07/20

Die nachfolgend aufgeführten Produkte sind konform mit den Anforderungen der folgenden Richtlinien (falls zutreffend):
The beneath listed products are in conformity with the requirements of the following directives (if applicable):
Les produits mentionnés ci-dessous sont conformes aux exigences imposées par les directives suivantes (si valable)
I prodotti sotto elencati sono conformi alle direttive sotto riportate (dove applicabili):
Los productos listados a continuación son conforme a los requisitos de las siguientes directivas (si fueran aplicables):

I:	Maschinenrichtlinie <i>Machinery directive</i> <i>Directive Machines</i> <i>Direttiva Macchine</i> <i>Diretiva de máquinas</i>	2006/42/EG 2006/42/EC 2006/42/CE 2006/42/CE 2006/42/CE
II:	Funkanlagen-Richtlinie (RED) <i>Radio equipment directive</i> <i>Directive équipement radioélectrique</i> <i>Direttiva apparecchiatura radio</i> <i>Diretiva equipo radioeléctrico</i>	2014/53/EU 2014/53/UE 2014/53/UE 2014/53/UE 2014/53/UE
III:	RoHS Richtlinie <i>RoHS directive</i> <i>Directive de RoHS</i> <i>Direttiva RoHS</i> <i>Diretiva RoHS</i>	2011/65/EU 2011/65/UE 2011/65/UE 2011/65/UE 2011/65/UE

Die Schutzziele der Niederspannungsrichtlinie 2014/35/EU und EMV Richtlinie 2014/30/EU werden gemäß Artikel 3.1 der Funkanlagen-Richtlinie eingehalten.
The safety objectives of the Low-voltage directive 2014/35/EU and EMC Directive 2014/30/EU comply with article 3.1 of the Radio equipment directive.
Les objectifs de sécurité de la Directive basse tension 2014/35/UE et Directive de CEM 2014/30/UE sont conformes à l'article 3.1 de la Directive équipement radioélectrique.
Gli obiettivi di sicurezza della Direttiva bassa tensione 2014/35/UE e Direttiva CEM 2014/30/UE sono conformi a quanto riportato nell'articolo 3.1 della Direttiva apparecchiatura radio.
Los objetivos de seguridad de la Directiva de bajo voltaje 2014/35/UE y Directiva CEM 2014/30/UE cumplen con el artículo 3.1 de la Directiva equipo radioeléctrico.

Folgende Normen sind angewandt:
Following standards are used:
Les normes suivantes sont appliquées:
Vengono applicate le seguenti norme:
Se utilizan los siguientes estándares:

a:	EN 60947-5-3:2013	d:	EN IEC 63000:2018 (RoHS)
b:	EN ISO 14119:2013	e:	EN 50364:2018
c:	EN ISO 13849-1:2015	f:	EN 300 330 V2.1.1

Bezeichnung der Bauteile <i>Description of components</i> <i>Description des composants</i> <i>Descrizione dei componenti</i> <i>Descripción de componentes</i>	Type <i>Type</i> <i>Type</i> <i>Tipo</i> <i>Tipo</i>	Richtlinie <i>Directives</i> <i>Directive</i> <i>Direttiva</i> <i>Directivas</i>	Normen <i>Standards</i> <i>Normes</i> <i>Norme</i> <i>Estándares</i>	Zertifikats-Nr. <i>No. of certificate</i> <i>Numéro du certificat</i> <i>Numero del certificato</i> <i>Número del certificado</i>
Sicherheitsschalter <i>Safety Switches</i> <i>Interrupteurs de sécurité</i> <i>Fincorsa di sicurezza</i> <i>Interruptores de seguridad</i>	CEM-I2-...-C40...	I, II, III	a, b, c, d, e, f	UQS 124482
Betätiger <i>Actuator</i> <i>Actionneur</i> <i>Azionatore</i> <i>Actuador</i>	A-C40-... A-TI-...	I, II, III	a, b, c, d, e, f	UQS 124482

Genehmigung der umfassenden Qualitätssicherung (UQS) durch die benannte Stelle 0035
Approval of the full quality assurance system by the notified body 0035
Approbation du système d'assurance qualité complet par l'organisme notifié 0035
Approvazione del sistema di garanzia di qualità totale da parte dell'organismo notificato 0035
Aprobación del sistema de aseguramiento de calidad total por parte del organismo 0035 notificado

TÜV Rheinland Industrie Service GmbH
Alboinstr. 56
12103 Berlin
Germany

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller:
This declaration of conformity is issued under the sole responsibility of the manufacturer:
La présente déclaration de conformité est établie sous la seule responsabilité du fabricant:
La presente dichiarazione di conformità è rilasciata sotto la responsabilità esclusiva del fabbricante:
La presente declaración de conformidad se expide bajo la exclusiva responsabilidad del fabricante:

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EUCHNER

More than safety.

Leinfelden, Juli 2020

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