OPERATING INSTRUCTIONS

TR110 Lock

Safety locking device

TR110-SRUSA00S01, TR110-SRUSA01S02

SICK
Sensor Intelligence.

Described product

TR110 Lock

Manufacturer

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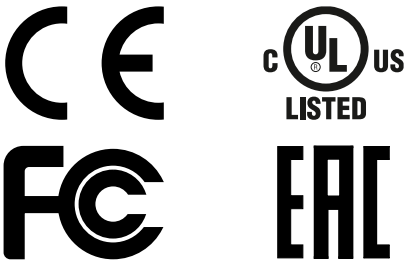
Legal information

Original document

This document is an original document of SICK AG.



Contents

1 Ordering information

1.1 Scope of delivery

- Safety switches
- Extension of the escape release (only for variants with escape release)
- Safety note
- Mounting instructions
- Operating instructions for download: www.sick.com

1.2 Ordering information

Table 1: Ordering information TR110 Lock

Locking principle	Connection type	Type	Part number
Power to release principle	M12 female connector (8-pin), straight	TR110-SRUSA00S01	1115309
Power to release principle with escape release	M12 female connector (8-pin), straight	TR110-SRUSA01S02	1115310

2 About this document

2.1 Scope

These operating instructions are valid for the TR110 Lock safety locking device.

This document is included with the following SICK part numbers (this document in all available language versions):

8026132

2.2 Target groups of these operating instructions

Some chapters of these operating instructions are intended for certain target groups. However, the entire operating instructions are relevant for intended use of the product.

Table 2: Target groups and selected chapters of these operating instructions

Target group	Chapters of these operating instructions
Project developers (planners, developers, designers)	"Project planning", page 13 "Technical data", page 34
Installers	"Mounting", page 20
Electricians	"Electrical installation", page 24
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 13 "Commissioning", page 26 "Technical data", page 34
Operators	"Troubleshooting", page 31
Maintenance personnel	"Troubleshooting", page 31

2.3 Additional information

www.sick.com

The following information is available on the Internet:

- This document in other languages
- Data sheets and application examples
- CAD data and dimensional drawings
- Certificates (e.g. EU declaration of conformity)
- Guide for Safe Machinery Six steps to a safe machine

2.4 Symbols and document conventions

The following symbols and conventions are used in this document:

Safety notes and other notes

DANGER
Indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.

WARNING
Indicates a situation presenting possible danger, which may lead to death or serious injuries if not prevented.

CAUTION
Indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.

NOTICE
Indicates a situation presenting possible danger, which may lead to property damage if not prevented.

NOTE
Indicates useful tips and recommendations.

Instructions to action

▶ The arrow denotes instructions to action.

1. The sequence of instructions for action is numbered.
2. Follow the order in which the numbered instructions are given.

✓ The check mark denotes the result of an instruction.

LED symbols

These symbols indicate the status of an LED:

○ The LED is off.
☼ The LED is flashing.
● The LED is illuminated continuously.

3 Safety information

3.1 General safety notes

The safety locking device must be configured and operated correctly by qualified safety personnel according to the machine requirements.

3.2 Intended use

When used in conjunction with a movable physical guard and the machine controller, the safety locking device prevents the protective device from being opened while a dangerous machine function is being executed.

The safety locking device may only be used on the machine on which it was configured, mounted, installed, and commissioned by qualified safety personnel in accordance with these operating instructions.

Incorrect use, improper modification of or tampering with the safety locking device will invalidate any warranty from SICK AG; in addition, any responsibility and liability of SICK AG for damage and secondary damage caused by this is excluded.

NOTE
The safety locking device is also suitable for process protection.

3.3 Requirements for the qualification of personnel

The safety locking device must be configured, installed, connected, commissioned, and serviced only by qualified safety personnel.

Project planning

For project planning, a person is considered competent when he/she has expertise and experience in the selection and use of protective devices on machines and is familiar with the relevant technical rules and national work safety regulations.

Mechanical mounting, electrical installation, and commissioning

For the task, a person is considered qualified when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine to be able to assess whether it is in an operationally safe state.

Operation and maintenance

For operation and maintenance, a person is considered competent when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine and has been instructed by the machine operator in its operation.

4 Product description

4.1 Structure and function

Structure

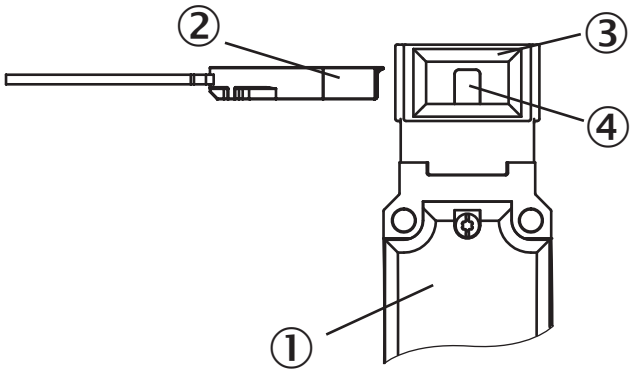


Figure 1: Structure of the TR110 Lock safety locking device

① Safety switches
② Coded actuator
③ Actuating head
④ Locking pin

The safety locking device is an interlocking device with a locking function. The safety locking device consists of a safety switch and a coded actuator. The actuator has a high coding level (uniquely coded).

Function

When the protective device is closed, the actuator is inserted into the actuating head of the safety switch. In doing so, the locking pin is pressed downward by the actuator. If the actuator reaches the end position, the locking pin moves into the provided hole of the actuator.

In the power to release principle, the inserted actuator is immediately blocked and the locking device is locked (to unlock the locking device, the locking solenoid must be energized).

Complementary information

- The code of the actuator is read out and evaluated using transponder technology. If the code is valid, the door application diagnostic output (Out AUX DOOR) switches to the ON state.
- If the locking device is locked, the safe output signal switching devices (OSSD) are switched to the ON state. In addition, the locking function application diagnostic output (Out AUX LOCK) switches to the ON state.
- If the locking device is locked, the actuator cannot be removed from the actuating head.
- The locking device can only be locked when the protective device is closed (prevention of incorrect closing).

4.2 Product characteristics

4.2.1 Product variants

The TR110 Lock safety locking device differs between the following variants:

- Power to release principle
- Power to release principle with escape release

4.2.2 OSSD

Output signal switching device: signal output for the protective device, which is used for stopping the dangerous movement.

An OSSD is a safety switching output. The functionality of each OSSD is tested periodically. OSSDs are always connected in pairs and must undergo dual-channel analysis for safety reasons. An OSSD pair is formed from 2 OSSDs that are connected and analyzed together.

4.2.3 Status indicators

The safety locking device indicates status information using multiple LEDs.

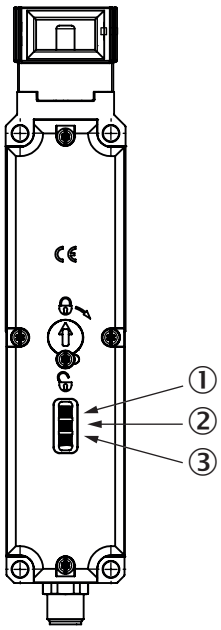


Figure 2: Status LEDs

① STATE
② LOCK
③ DIA

Table 3: Status LEDs

Item	Name	Color
①	STATE	Green
②	LOCK	Yellow
③	DIA	Red

4.3 Manual unlocking

In some situations, it necessary to unlock the locking device manually (e.g. if faults are present). When unlocking, the safe output signal switching devices (OSSD) switch to the OFF status. A stop command must be generated as a result.

After manual unlocking, a function test must be performed (see "Testing", page 28).

4.3.1 Escape release

The escape release makes it possible to open a closed protective device without tools from within the hazardous area.

NOTICE

- The escape release must be able to be actuated manually from inside the protected area without tools.
- Mount the escape release so that actuation can only take place from inside of protected area (hazardous area).

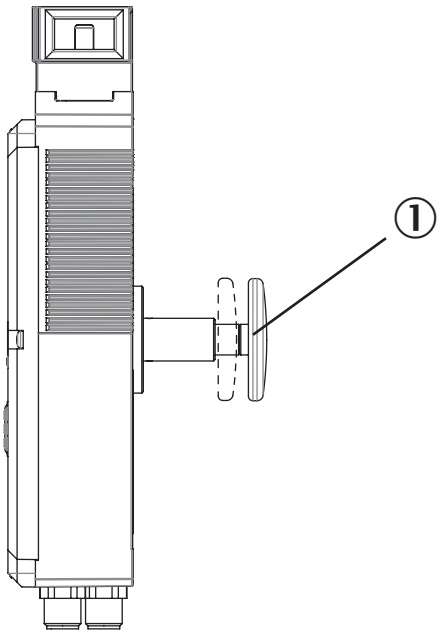


Figure 3: Escape release

① Red button of the escape release

4.3.2 Emergency release

The emergency release can be retrofitted as an accessory. The emergency release can be used to actuate the mechanical unlocking mechanism without tools.

NOTICE

- The emergency release must be able to be actuated manually outside of the protected area without tools.
- The emergency release must have a label stating that it may only be actuated in an emergency.

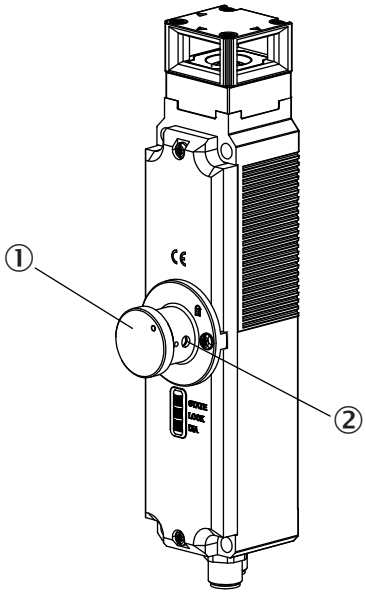


Figure 4: Emergency release

① Emergency release

② Stop bolt

5 Project planning

5.1 Manufacturer of the machine

DANGER
Failure to comply with manufacturer's obligations
Hazard due to lack of effectiveness of the protective device

- Carry out a risk assessment before using the safety locking device.
- Do not tamper with or modify the components of the safety locking device.
- Make sure that the safety locking device is only repaired by the manufacturer or by someone authorized by the manufacturer. Improper repair can lead to a loss of the protective function.
- Make sure that switch-on commands which bring about a dangerous state of the machine are not enabled until the protective device is closed and the lock is activated.
- Make sure that the lock is not deactivated until the dangerous state of the machine has stopped.
- Make sure that closing a protective device and activating the lock does not cause a dangerous machine function to start by itself. This must be controlled by a separate start command.
- The safety locking device must not be bypassed (contacts jumpered), turned away, removed, or rendered ineffective in any other way. Take measures to reduce bypassing options as necessary.

Observe EN ISO 14119 for using interlocking devices associated with physical guards.

5.2 Operator of the machine

DANGER
Failure to observe operator obligations
Hazard due to lack of effectiveness of the protective device

- Changes to the machine and changes to the mechanical mounting of the safety locking device necessitate a new risk assessment. The results of this risk assessment may require the operator of the machine to meet a manufacturer's obligations.
- Apart from the procedures described in this document, the components of the safety locking device must not be opened or modified.
- Do not carry out any repair work on components. Improper repair of the safety locking device can lead to a loss of the protective function.
- Make sure that replacement actuators are not used for bypassing. Restrict access to actuators.

5.3 Design

5.3.1 Selection of the actuator

NOTICE
Selecting unsuitable actuators or improper mounting can damage the device.

- Select the right actuator (see table 18).
- Pay attention to the door radius and mounting options (see "Actuator dimensional drawings", page 39).
- Pay attention to the door hinge.

5.3.2 Actuating direction

Actuating direction

The safety locking device can be actuated from three horizontal directions (from the left, from the front and from the right). If the safety locking device is to be actuated from behind, an actuating head has to be used.

The safety locking device is not suited for an approach from a vertical angle.

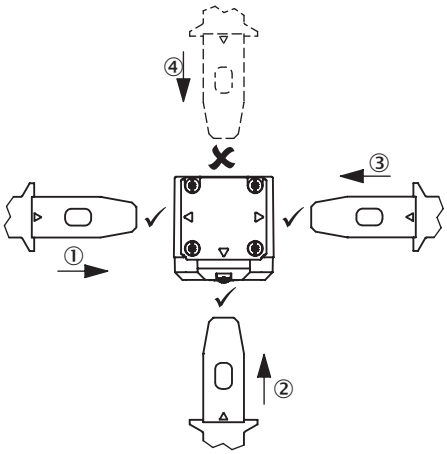


Figure 5: Directions of approach

① Left
② Front
③ Right
④ Rear (only possible with switched actuating head)

Further topics

- "Changing the actuation direction", page 20

5.3.3 Escape release

In order to mount the variant with the escape release, corresponding holes must be made in the mounting surface.

The shaft of the escape release can be extended by 30 mm or 50 mm using with spacers

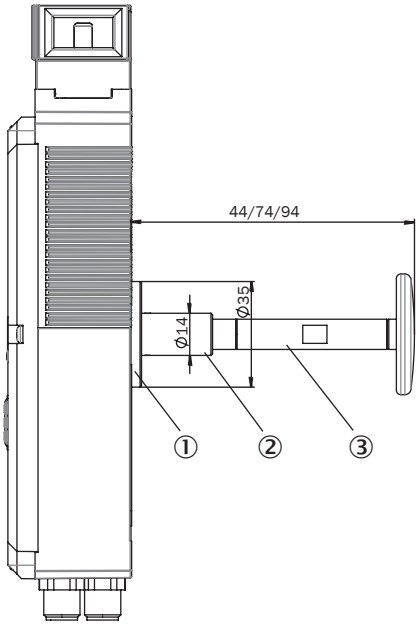


Figure 6: Escape release shaft

① Escape release flange
② Escape release shaft
③ Extension spacer

5.4 Integration in the electrical control system

Switch-on commands that put the machine in a dangerous state may only be activated when the protective device is closed and the locking device is locked. The locking device may only be unlocked when the dangerous state has ended. Depending on the safety concept, the signal is analyzed by safety relays or a safety controller, for example.

The connected controller and all devices responsible for safety must comply with the required performance level and the required category (for example according to ISO 13849-1).

The overall concept of the control system in which the safety locking device is integrated must be validated in accordance with ISO 13849-2.

5.4.1 Locking function

Prerequisites

- A shared power supply is used for the control system and for the locking solenoids of the safety locking device.
- A clocked power supply is **not** used.
- When connecting the locking solenoids to the output of a controller, this output must supply sufficient current.

Power to release principle

- Locking the locking device: Close the protective device, no voltage on the magnet
- Unlocking the locking device: Apply voltage to magnet

If voltage is interrupted at the magnet, the locking device remains locked and the protective device cannot be opened immediately.

WARNING
The locking device locks even when voltage is not present
People could get trapped!

- If people are in the hazardous area, do not close the protective device even if voltage is not present.
  Or:
- Use the variant with an escape release.

Activating the locking function

For single-channel activation of the locking function, the controller and the safety locking device must have the same ground.

For dual-channel activation of the locking function, clock pulses are tolerated up to a max. length of 5 ms. If possible, switch off the clocking of outputs in the control system.

NOTICE

- The locking solenoid of the TR110 Lock safety locking device is controlled externally (no control function within the device). Therefore, the TR110 Lock safety locking device does not have any characteristic safety values for controlling the locking function.
- The safety level for controlling the locking function is determined exclusively by external control (e.g. by the PFHd of an external standstill monitor).

Die Typen zur Reihenschaltung der OSSDs haben einen separaten Pin MAG 0V DC, um 0 V am Zuhaltemagneten anzulegen (see "Device connection", page 24). Bei den anderen Typen ist der 0V-Anschluss des Zuhaltemagneten mit dem 0V-Anschluss der Sicherheitszuhaltung verbunden.

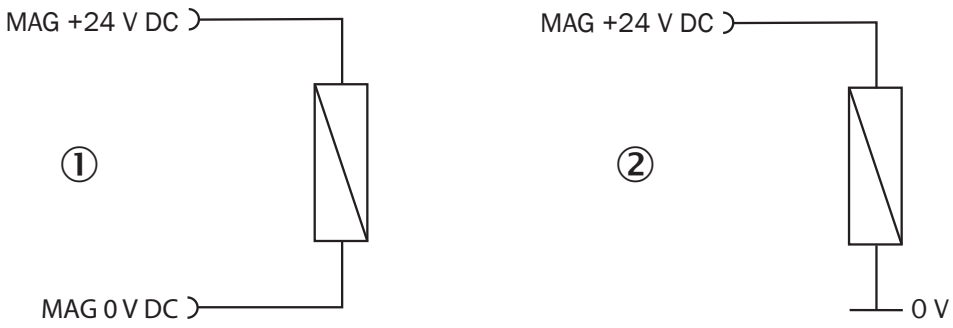


Figure 7: Connection of the locking solenoid

① In types for series connection of OSSDs
② In all other types

5.4.2 OSSDs

Safety locking devices with local inputs and outputs can be directly integrated into the machine controller.

DANGER

Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

▶ Make sure that the following control and electrical requirements are met so the protective function can be fulfilled.

- The output signals from an OSSD pair must not be connected to each other.
- In the machine controller, both signals from an OSSD pair must be processed separately.

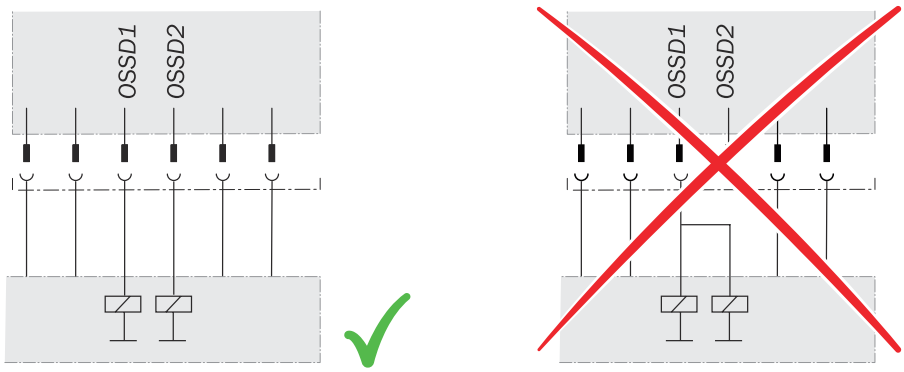


Figure 8: Dual-channel and isolated connection of OSSD 1 and OSSD 2

- The machine must switch to the safe state at any time if at least one OSSD in an OSSD pair switches to the OFF state.
- Prevent the formation of a potential difference between the load and the protective device. If you connect loads to the OSSDs (safety outputs) that then also switch if controlled with negative voltage (e.g. electro-mechanical contactor without reverse polarity protection diode), you must connect the 0 V connections of these loads and those of the corresponding protective device individually and directly to the same 0 V terminal strip. In the event of a fault, this is the only way to ensure that there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.

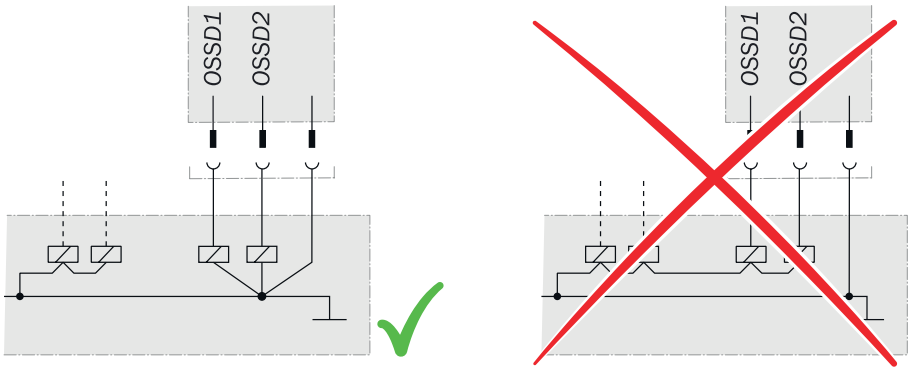


Figure 9: No potential difference between load and protective device

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

Downstream contactors must be positively guided and monitored depending on applicable national regulations or required reliability of the safety function.

- Make sure that downstream contactors are monitored (external device monitoring, EDM).

The OSSDs are short-circuit protected to 24 V DC and 0 V. If the safety locking device is locked, the OSSDs signal the ON state with the HIGH signal level (non-isolated). If the safety locking device is unlocked or there is a device fault, the OSSDs signal the OFF state with the LOW signal level.

Do not use a control system with clocking or switch off the clocking function of the control system. The device generates its own test pulses at the OSSDs. A downstream controller must tolerate these test pulses, which can have a length of up to 1 ms. The test pulses are also output when the OSSDs are switched off. Depending on the sluggishness of the downstream device (controller, relay, etc.), this can lead to short switching processes.

For inductive loads, the OSSDs must be protected with a freewheeling diode. RC suppressors must not be used:

5.4.3 Application diagnostic outputs

Door application diagnostic output (Out AUX DOOR)

The signal of the door application diagnostic output changes as soon as the actuator is moved into or leaves the response range of the safety switch. In other words, the output signal changes when the protective device is opened and closed. This is not a safety output.

Table 4: Switching behavior of the door application diagnostic output

Actuator	Door application diagnostic output
Actuator not in response range	OFF
Actuator in response range	ON

Locking function application diagnostic output (Out AUX LOCK)

The signal of the locking function application diagnostic output changes as soon as the locking function has been activated. This is not a safety output.

Table 5: Switching behavior of the locking function application diagnostic output

Locking function	Locking function application diagnostic output
Locking function active	ON
Locking function not active	OFF

Fault application diagnostic output (Out AUX DIA)

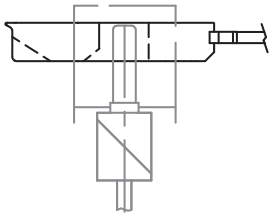
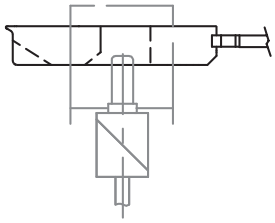
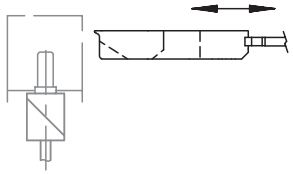
The signal of the fault application diagnostic output changes as soon as a fault occurs. This is not a safety output.

Table 6: Switching behavior of the fault application diagnostic output

Fault	Fault application diagnostic output
Fault has occurred	ON
No fault	OFF

5.4.4 Switching behavior

Table 7: Switching behavior

	 *Figure 10: Protective device closed and locked*	 *Figure 11: Protective device closed but not locked*	 *Figure 12: Protective device open*
Activating the locking function	ON	OFF	Not relevant
OSSDs	ON	OFF	OFF
Out AUX LOCK	ON	OFF	OFF
Out AUX DOOR	ON	ON	OFF

5.4.5 Protection of the voltage supply

The voltage supply must be provided with fuse protection depending on the number of safety locking devices and the required current for the outputs.

Max. current consumption of a single safety locking device I_{max}:

$I_{max} = I_{TR110} + I_{OSSD1} + I_{OSSD2} + I_{OAUXL} + I_{OAUXD}$

I_{TR110} = Operating current of the TR110 Lock safety locking device

I_{OSSD1} = Load current of OSSD 1 (max. 150 mA)

I_{OSSD2} = Load current of OSSD 2 (max. 150 mA)

I_{OAUXL} = Load current of locking function application diagnostic output (max. 50 mA)

I_{OAUXD} = Load current of door application diagnostic output (max. 50 mA)

Max. current consumption of a safe series connection of safety locking devices $I_{Cascade}$:

$I_{Cascade} = I_{OSSD1} + I_{OSSD2} + n \times (I_{TR110} + I_{OAUXL} + I_{OAUXD})$

n = Number of connected safety locking devices

5.5 Testing plan

The safety locking device must be tested by appropriately qualified safety personnel when commissioning, after modifications, and at regular intervals.

The regular thorough checks serve to investigate the effectiveness of the safety locking device and discover defects because of modifications or external influences (such as damage or tampering).

The manufacturer and user must define the type and frequency of the thorough checks on the machine on the basis of the application conditions and the risk assessment. Determination of the thorough checks must be documented in a traceable manner.

6 Mounting

6.1 Safety

DANGER
Hazard due to unexpected starting of the machine
Death or severe injury

- Make sure that the dangerous state of the machine is and remains switched off.

NOTICE
If incorrectly installed or if the ambient conditions are not suitable, the safety locking device can be damaged.

- Arrange the safety switch and actuator so that damage due to unintentional outside influences is prevented.
- Do not use a safety switch and actuator as a stop.
- Secure the safety switch and actuator using screws of strength class 8.8 or higher.
- Secure the fastening materials against loosening, e.g., using a medium-strength, material-bonding screw adhesive.
- Note the min. door radii, see "Actuator dimensional drawings", page 39.
- Protect the switch head against damage and ingress of foreign bodies, e.g., chips, sand, abrasives, etc.
- The set-up and mounting of the safety switch and actuator must be stable enough to maintain proper operation.
- Use only reliable mounting elements that can only be removed with tools.
- If an opening is created in the physical guard due to alignment errors, it must not impair the protective function.
- Checking for environmental influences before using the safety locking device, e.g., UV radiation or corrosion.

6.2 Changing the actuation direction

Overview

The safety locking device can be actuated from three directions (A, B and C). The actuation direction only needs to be changed if the safety locking device is to be actuated from behind (D).

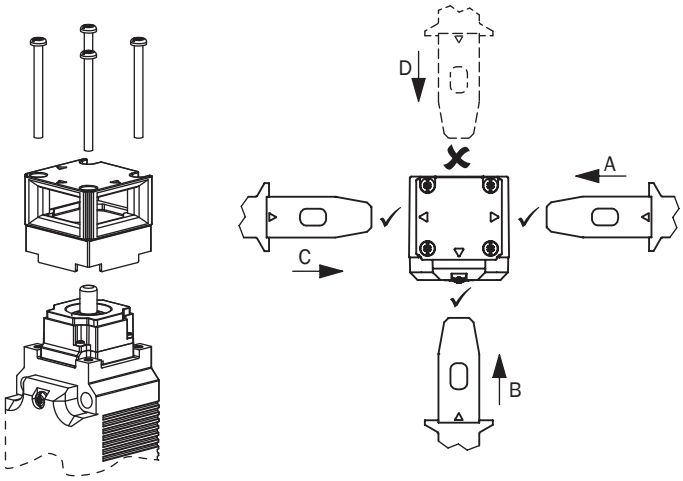


Figure 13: Changing the direction of approach

Approach

1. Loosen the screws on the actuating head.
2. Turn the actuating head in the desired direction.
3. Tighten the screws to 1.2 Nm.

6.3 Mounting the safety switch

Important information

NOTICE
The actuator must not be used for guiding or used as a stop.

Prerequisites

- To mount on the machine, the safety switch and actuator must be put together.
- A clearance of 12 mm must be maintained around the actuating head.

Approach

The safety locking device may be in any installation position.

▶ Mount the safety switch using 4 × M5 screws.
▶ Observe the maximum tightening torque of 1.4 Nm.

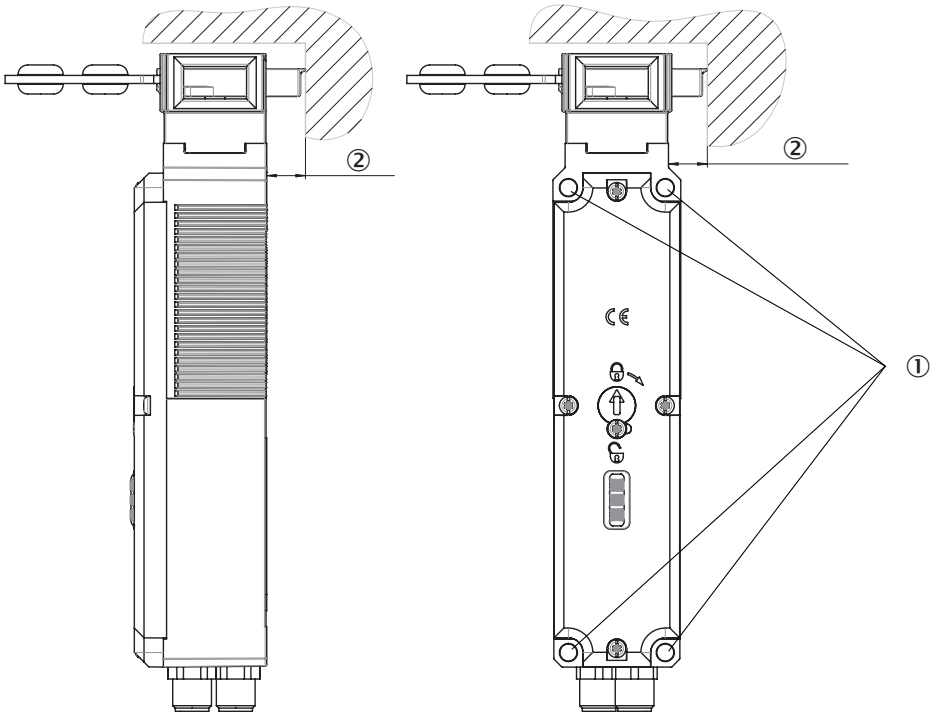


Figure 14: Mounting the safety switch

① Mounting holes
② 12 mm clearance for actuator

Complementary information

Mounting brackets are available for the actuator and safety locking device as accessories (see "Dimensional drawings of the mounting bracket", page 44).

6.4 Mounting straight and angled actuators

Important information

NOTICE
The actuator must not be used for guiding or used as a stop.

Prerequisites

To mount on the machine, the safety switch and actuator must be put together.

Approach

▶ Mount the actuator using 2 × M4 screws.

Complementary information

Mounting brackets are available for the actuator and safety locking device as accessories (see "Dimensional drawings of the mounting bracket", page 44).

6.5 Mounting the radius actuator

Important information

NOTICE
The actuator must not be used for guiding or used as a stop.

Prerequisites

- To mount on the machine, the safety switch and actuator must be put together.
- The actuator must be positioned perpendicularly to the guide slot before insertion.

Approach

1. Mount the actuator using 2 × M5 screws.
2. For larger radii, the actuator can be aligned using the adjustment screw.

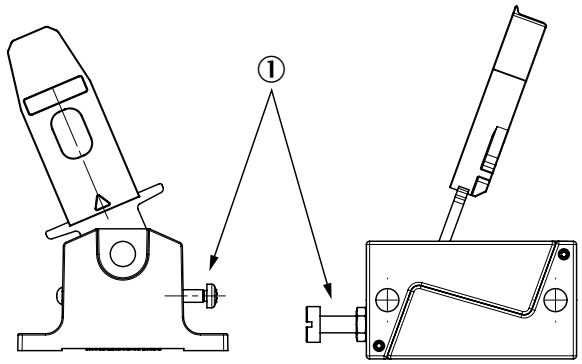


Figure 15: Adjustment screw for alignment

① Adjustment screw

Complementary information

Mounting brackets are available for the actuator and safety locking device as accessories (see "Dimensional drawings of the mounting bracket", page 44).

6.6 Mounting the escape release

Prerequisites

- Hole in the mounting surface for the escape release (see "Escape release", page 14).
- Spacers with lengths of 30 mm or 50 mm for the escape release shaft (optional).

Approach

1. Unscrew the red button of the escape release.
2. Extend the escape release shaft if necessary.
3. Insert the escape release shaft through the hole.
4. Mount the safety switch using 4 × M5 screws.
5. Screw on the red button of the escape release.

7 Electrical installation

7.1 Safety

DANGER
Hazard due to electrical voltage

Hazard due to unexpected starting of the machine

- Make sure that the machine is and remains disconnected from the power supply during electrical installation.
- Make sure that the dangerous state of the machine is and remains switched off during electrical installation.
- Make sure that the outputs of the safety locking device have no effect on the machine during electrical installation.

DANGER
Incorrect connection of the safety locking device

Loss of safety function

- In the case of insulating material/connection strands, observe the necessary temperature resistance and mechanical load capability.
- Only use safe contacts for safety functions.

7.2 Notes on cULus

For use according to the requirements of UL 508, the following conditions must also be met:

- A power supply marked as “for use in class 2 circuits” must be used.
- Alternative solutions must correspond to the following requirements: Electrically isolated power supply unit with fuse protection in accordance with UL248. This fuse should be rated for max. 3.3 A and be integrated in the 30 V DC voltage section.
- A connecting cable must be used that is listed under UL Category Code CYJV / 7, min. 24 AWG, min. 80 °C.

7.3 Device connection

Prerequisites

- All electrical connections must be isolated from the supply network either through safety transformers in accordance with IEC 61558-2-6 with output voltage limitation or through equivalent isolation measures (PELV).
- Power devices that represent a strong source of interference must be locally isolated from the input and output circuits for signal processing. The cable routing of the safety circuits should be separated from the cables of the power circuits by the greatest possible distance.
- In order to avoid EMC disturbances, the physical ambient and operating conditions at the installation location of the device must comply with the requirements of IEC 60204-1.

Stand-alone connection

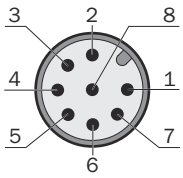


Figure 16: Device connection (male connector, M12, 8-pin, A-coded)

Table 8: Device connection pin assignment (male connector, M12, 8-pin, A-coded)

Pin	Wire color [1]	Designation	Description
1	White	Out AUX DOOR	Door application diagnostic output (not safe)
2	Brown	24 V DC	Voltage supply 24 V DC
3	Green	MAG +24 V DC	Magnet activation 24 V DC
4	Yellow	Out AUX DIA	Fault application diagnostic output (not safe)
5	Gray	OSSD 1	Output OSSD 1
6	Pink	OSSD 2	Output OSSD 2
7	Blue	0 V	Voltage supply 0 V DC
8	Red	Out AUX LOCK	Locking device application diagnostic output (not safe)

1) Applies to the extension cables recommended as accessories.

8 Commissioning

8.1 Switching on

The device initializes after it is switched on. The OSSDs are in the OFF state during this and the STATE LED flashes green at 5 Hz.

8.2 Teach-in

8.2.1 Safety

DANGER
Bypassing the protective device
The dangerous state may not be stopped in the event of non-compliance.

- Document teaching-in of an actuator.
- During regular thorough checks, make sure that the taught-in actuator is still being used.

An actuator must be taught-in during commissioning. Only the most recently taught-in actuator is valid.

During a teach-in operation, the OSSDs are in the OFF state, i.e. the system is in a safe state.

8.2.2 Teaching-in the first actuator in delivery condition

Important information

NOTE
Safety locking devices switched on in delivery condition have a teach-in readiness with no time limitation.

NOTE
The teach-in process is invalid if canceled, e.g. by interruption of the voltage supply or removal of the actuator.

Then the TR110 Lock safety locking device enters the safe error state, the DIA LED lights up red, the STATE LED flashes (see "System status", page 31).

Approach

1. Apply the supply voltage to the safety switch.
✓ The STATE LED flashes 3 times repeatedly.
2. Insert the actuator into the actuating head (close the protective device).
✓ The teach-in process starts, the STATE LED flashes at approx. 1 Hz.
The teach-in process is completed after about 30 seconds. The STATE and DIA LEDs flash in alternation.
3. Switch off the supply voltage at the safety switch for at least 3 seconds and then switch it back on.
✓ The code for the actuator that was just taught-in is enabled in the safety switch.
4. Check the effectiveness of the protective device.

8.2.3 Teaching-in the new actuator

Overview

The TR110 Lock safety locking device can be operated only with the actuator that was last taught-in.

Important information

NOTE
Safety locking devices with an actuator that has already been taught-in have a teach-in readiness of approx. 3 minutes after being switched on.

NOTE

- If the safety switch detects an actuator that has already been taught-in, then the teach-in process is canceled and the safety switch returns to normal mode.
- If the safety switch detects a blocked code of a direct predecessor actuator, then the teach-in process is canceled and the code of the previous actuator remains active. The safety switch goes into an error state (see "System status", page 31).

Approach

1. Apply the supply voltage to the safety switch.
✓ The STATE LED flashes 3 times repeatedly.
2. Insert the actuator into the actuating head within 3 minutes.
3. The teach-in process starts, the STATE LED flashes at approx. 1 Hz.
✓ The teach-in process is completed after about 30 seconds. The STATE and DIA LEDs flash in alternation.
4. Switch off the supply voltage at the safety switch for at least 3 seconds and then switch it back on.
✓ This activates the new code and deactivates the old code.
5. Check the effectiveness of the protective device.

Complementary information

When a new actuator is taught-in, the safety switch blocks the code of the last actuator. The latter cannot be taught-in again immediately when a new teach-in operation is performed. The blocked code is released again in the safety switch only after a third code has been taught-in.

8.2.4 Teaching-in the actuator in safe series connection

Important information

NOTE
It is recommended to teach in the actuators not in the safe series connection, but individually.

Prerequisites

If the actuators need to be taught-in in a safe series connection, then it has to be possible to switch from 0 V DC to 24 V DC at the RST inputs of the safety switches.

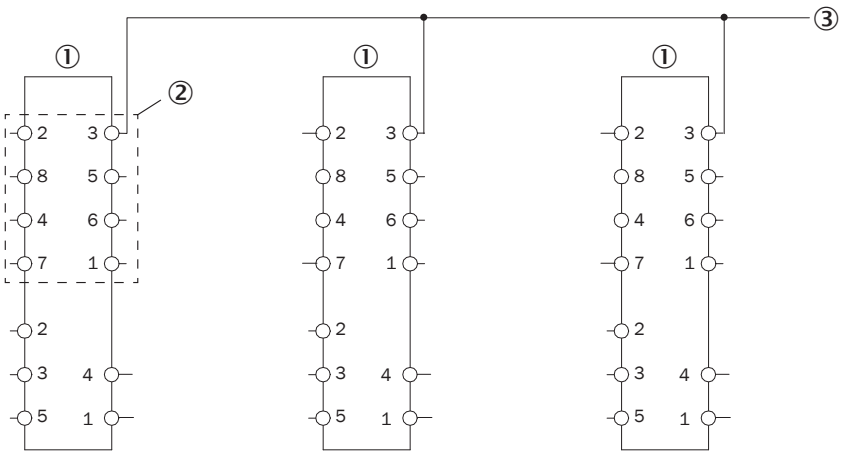


Figure 17: Connection to RST input

① TR110 Lock
② Male connector, M12, 8-pin
③ Signal for changing from 0 V DC to 24 V DC at RST

Approach

- ▶ Apply supply voltage to the safety switches.
- ✓ The STATE LEDs flash 3 times repeatedly.
- ▶ Insert the actuators into the actuating heads.
- ▶ Connect the RST to +24 V DC for at least 3 s.
- ▶ The teach-in process on the safety switches of the safe series connection begins; the STATE LEDs flash at approx. 1 Hz.
- ✓ The teach-in process is completed after about 30 seconds. The STATE and DIA LEDs flash in alternation.
- ▶ Reconnect the RST to +24 V DC for at least 3 s.
- ✓ The code for the actuators that were just taught-in is enabled in the safety switches.
- ▶ Check the effectiveness of all protective devices in the safe series connection.

8.3 Testing

DANGER
Hazard due to unexpected starting of the machine
Death or severe injury

- ▶ Before carrying out the functional test, make sure that there are no people in the hazardous area.

Approach

Check that the device is functioning properly after installation and after every fault. To do this, proceed as follows:

Mechanical functional test

- ▶ Open the protective device and close it again. The components of the safety locking device must not collide with other parts. When the protective device is closed, the actuator must be in a position which enables the lock to be actuated.

Electrical functional test

1. Switch on the supply voltage.
2. Close all protective devices and activate the locks. The machine must not start up on its own.
3. Check the lock. It must not be possible to open the protective device.
4. Start the machine function.
5. Make sure that the lock cannot be deactivated as long as the dangerous machine function is active.
6. Stop the machine function and deactivate the lock.
7. Check whether the protective device is kept locked until there is no more risk of injury (e.g., due to run-on movements).
8. Check the restart interlock. The machine function must not start while the lock is deactivated.
9. Repeat steps 3 to 8 individually for each protective device.

8.4 Regular thorough check

Important information

DANGER

Insufficient checks or incorrect repair

Hazard due to lack of effectiveness of the protective device

- ▶ In the event of wear or damage, replace the entire safety locking device with actuator. Never replace individual parts or assemblies.
- ▶ Check the safety locking device following the inspection intervals specified in the national rules and regulations.

Monitoring

The following checks must be done to ensure permanent and proper function:

- Proper switching function
- Safe mounting of all components
- No damage, contamination, deposits or wear
- No loose plug connectors
- No manipulation by employees

9 Operation

9.1 Actuating the escape release

Approach

1. Press the red button of the escape release as far as it goes.

✓ The locking device is unlocked.

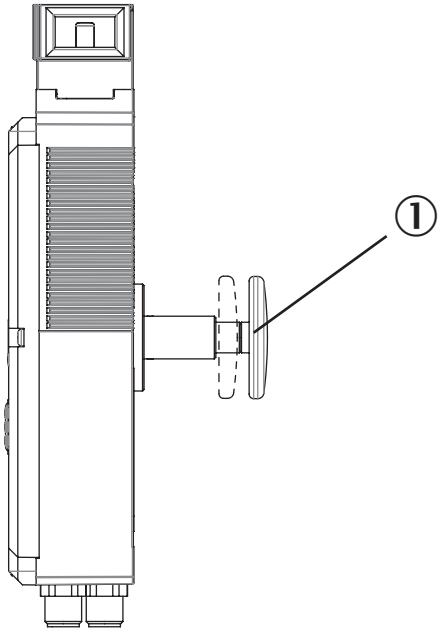


Figure 18: Fluchtentriegelung betätigen

① Red button of the escape release

9.1.1 Moving the escape release back after use

Approach

- ▶ Pull the red button of the escape release back out.
- ▶ Open the protective device and close it again.

✓ The safety locking device operates in normal mode again.

- ▶ Carry out a functional test.

10 Troubleshooting

10.1 Safety

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- Immediately shut the machine down if the behavior of the machine cannot be clearly identified.
- Immediately put the machine out of operation if you cannot clearly identify or allocate the fault and if you cannot safely remedy the fault.
- Secure the machine so that it cannot switch on unintentionally.

DANGER
Hazard due to unexpected starting of the machine

- When any work is taking place, use the protective device to secure the machine or to ensure that the machine is not switched on unintentionally.

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- Do not do repair work on device components.
- Do not make changes to or manipulate device components.
- Apart from the procedures described in this document, the device components must not be opened.

NOTE
Additional information on troubleshooting can be found at the responsible SICK subsidiary.

10.2 System status

Important information

NOTE
Displays other than those described here indicate an internal device fault. In this case, please contact your responsible SICK subsidiary.

Status indicators

Table 9: Status indicators

		Outputs				LED indicators			Status
	Door	OSSDs	AUX LOCK	AUX DOOR	AUX DIA	STATE	DIA	LOCK	
Self-test	X	OFF	OFF	OFF	OFF	☀ 5 Hz 10 s	○	○	Self-test after switch-on

		Outputs				LED indicators			Status
	Door	OSSDs	AUX LOCK	AUX DOOR	AUX DIA	STATE	DIA	LOCK	
Normal operation	Closed	ON	ON	ON	OFF	●	○	●	Door closed and locked
	Closed	OFF	OFF	ON	OFF	☼ 1 x inverse	○	○	Door closed and not locked
	Open	OFF	OFF	OFF	OFF	☼ 1 ×	○	○	Door open
Teach-in	Open	OFF	OFF	OFF	OFF	☼ 3 ×	○	○	Teach-in readiness
	Closed	OFF	X	ON	OFF	☼ 1 Hz	○	○	Teach-in process
	X	OFF	X	X	OFF	☼	☼	○	Teach-in process successful
Error display	X	OFF	X	X	ON	☼ 1 ×	●	○	Error during teach-in (actuator removed from the response range before the teaching operation ended or defective actuator detected)
	X	OFF	OFF	OFF	ON	☼ 2 ×	●	○	Input error (e.g. missing test pulses, non-logical switching state of the predecessor in the switch chain)
	X	OFF	OFF	OFF	ON	☼ 3 ×	●	○	Read error (e.g. actuator defective)
	X	OFF	OFF	OFF	ON	☼ 4 ×	●	○	Error at output (e.g. cross-circuit, loss of switching capability)
	X	OFF	X	X	ON	☼ 5 ×	●	○	Locked actuator detected
	X	OFF	OFF	OFF	ON	○	●	X	Internal error

11 Decommissioning

11.1 Disposal

Approach

- Always dispose of unusable devices in accordance with national waste disposal regulations.

Complementary information

SICK will be glad to help you dispose of these devices on request.

12 Technical data

12.1 Data sheet

Table 10: Features

Features	
Sensor principle	Transponder
Coding	Uniquely coded
Locking force F_{max}	
With straight TR110-XAS actuator	3,900 N (EN ISO 14119)
With angled TR110-XABT actuator	1,500 N (EN ISO 14119)
With TR110-XAFx hinged actuator	2,600 N (EN ISO 14119)
Locking force F_{Zh} ($F_{Zh} = F_{max}$ /1.3)	
With straight TR110-XAS actuator	300 N (EN ISO 14119)
With angled TR110-XABT actuator	1,100 N (EN ISO 14119)
With TR110-XAFx hinged actuator	2,000 N (EN ISO 14119)
Actuating force	10 N
Retaining force	20 N
Force against which unlocking is possible	≤ 20 N
Actuating frequency	≤ 0.5 Hz
Approaching speed of the actuator	≤ 20 m/min
Overrun	5 mm

Table 11: Safety-related parameters

Safety-related parameters	
Performance level [1]	PL e (EN ISO 13849-1)
Category [1]	4 (EN ISO 13849-1)
PFHd [2] (mean probability of a dangerous failure per hour)	4.1×10^{-9}
T_M (mission time)	20 years (EN ISO 13849–1)
Type	Type 4 (EN ISO 14119)
Coding level	High coding level (EN ISO 14119)
Safe status when a fault occurs	At least one safety-related semiconductor output (OSSD) is in the OFF state.

1) Applies to monitoring the door position (interlocking monitoring) and locking monitoring.
2) The locking solenoid is externally controlled and so does not contribute to the probability of failure. The safety level of the locking device controller is determined exclusively by the external controller.

Table 12: Electrical data

Electrical data	
Classification based on cULus	Class 2
Protection class	III (IEC 61140)
Utilization category	DC-13: 24 V, 150 mA (IEC 60947-5-2)
Supply voltage U_V	
Safety switches Locking solenoid[1]	20.4 V DC ... 27.6 V DC 20.4 V DC ... 26.4 V DC
Current consumption	

Electrical data	
Safety switches Locking solenoid	40 mA 400 mA
Power consumption of locking solenoid	6 W
External device protection[2)]	
Safety switches Locking solenoid	0.25 A ... 2 A 0.5 A ... 8 A
Switch-on time of locking solenoid	100%
Contamination rating	3 (EN 60947-1)
Power-up delay	1 s
Response time	≤ 260 ms (+5 ms for each additional safety locking device in a safe series connection)
Release time	400 ms
Discrepancy time	≤ 10 ms (EN IEC 60947-5-3)
Risk time [3)]	260 ms
Rated insulation voltage Ui	50 V DC (IEC 60947-1)
Rated impulse withstand voltage U_{imp}	500 V (IEC 60947-5-1)
Rated short-circuit current	100 A
Locking principle	
TR110-SRxxxx TR110-SLxxxx	Closed-circuit current principle Open-circuit current principle

1) The locking solenoid of the TR110 Lock safety locking device is externally controlled and supplied with power.
2) Medium time-lag triggering characteristics.
3) The risk time is the time needed to detect internal and external faults. External errors affect the OSSDs (short-circuit to an OSSD and cross-circuit between the two OSSDs). At least one of the two OSSDs is safely switched off during the risk time.

Table 13: Interfaces

Interfaces	
System connection	Male connector, M12, 8-pin, A-coded

Table 14: Outputs

Output data	
Type of output	
Safety outputs	2 semiconductor outputs (OSSDs), p-switching, short-circuit protected
Application diagnostic outputs	p-switching, short-circuit protected
Output current (OSSDs)	
ON state OFF state	1 mA ... 150 mA ≤ 250 µA
Output voltage (OSSDs)	
ON state OFF state	U_v -1.5 V DC ... U_v 0 V DC ... 1 V DC
Test pulse duration (OSSDs)	300 µs
Test pulse interval (OSSDs)	≤ 100 ms
Application diagnostic outputs	
Output current Output voltage	1 mA ... 50 mA 0.8 × U_v ... U_v

Table 15: Mechanical data

Mechanical data	
Dimensions (W x H x D)	Siehe "Safety switch dimensional drawings", page 37
Material	
Safety switch housing Actuating head Plug connector	Fiberglass-reinforced thermoplastic Zinc die cast Nickel-plated brass
Weight	0.42 kg
Mechanical service life	1 × 10^6 switching operations

Table 16: Ambient data

Ambient data	
Enclosure rating	IP 67 (IEC 60529) IP 69 (IEC 60529) IP 69K (IEC 20653)
Ambient operating temperature	–20 °C ... +55 °C
Vibration resistance	EN IEC 60947-5-3
EMC	EN IEC 60947-5-3

12.2 Connecting cables

Requirements for the connecting cables

Table 17: Requirements for the connecting cables

Parameter	Value
Min. wire cross-section	0.25 mm^2
R max.	60 Ohm/km
C max.	120 nF/km
L max.	0.65 mH/km

Recommended cable type = LIYY 8 x 0.25 mm^2 or 5 x 0.34 mm^2

12.3 Safety switch dimensional drawings

TR110-SRUSA01S01 safety switches

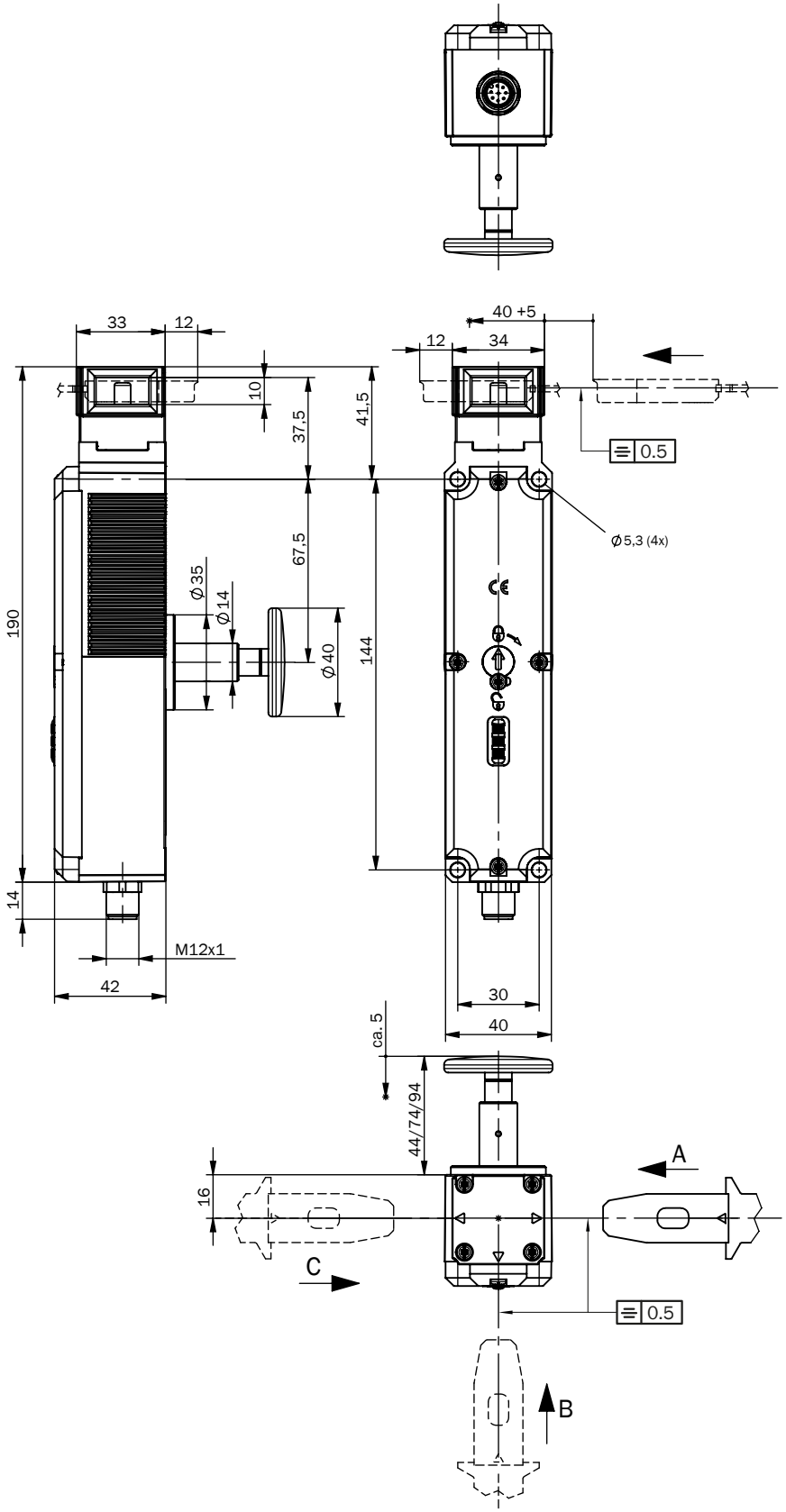


Figure 19: Dimensional drawing of TR110-SRUSA01 and TR110-SRUFL0100 safety switches (mm)

TR110-SRUSA00S01 safety switches

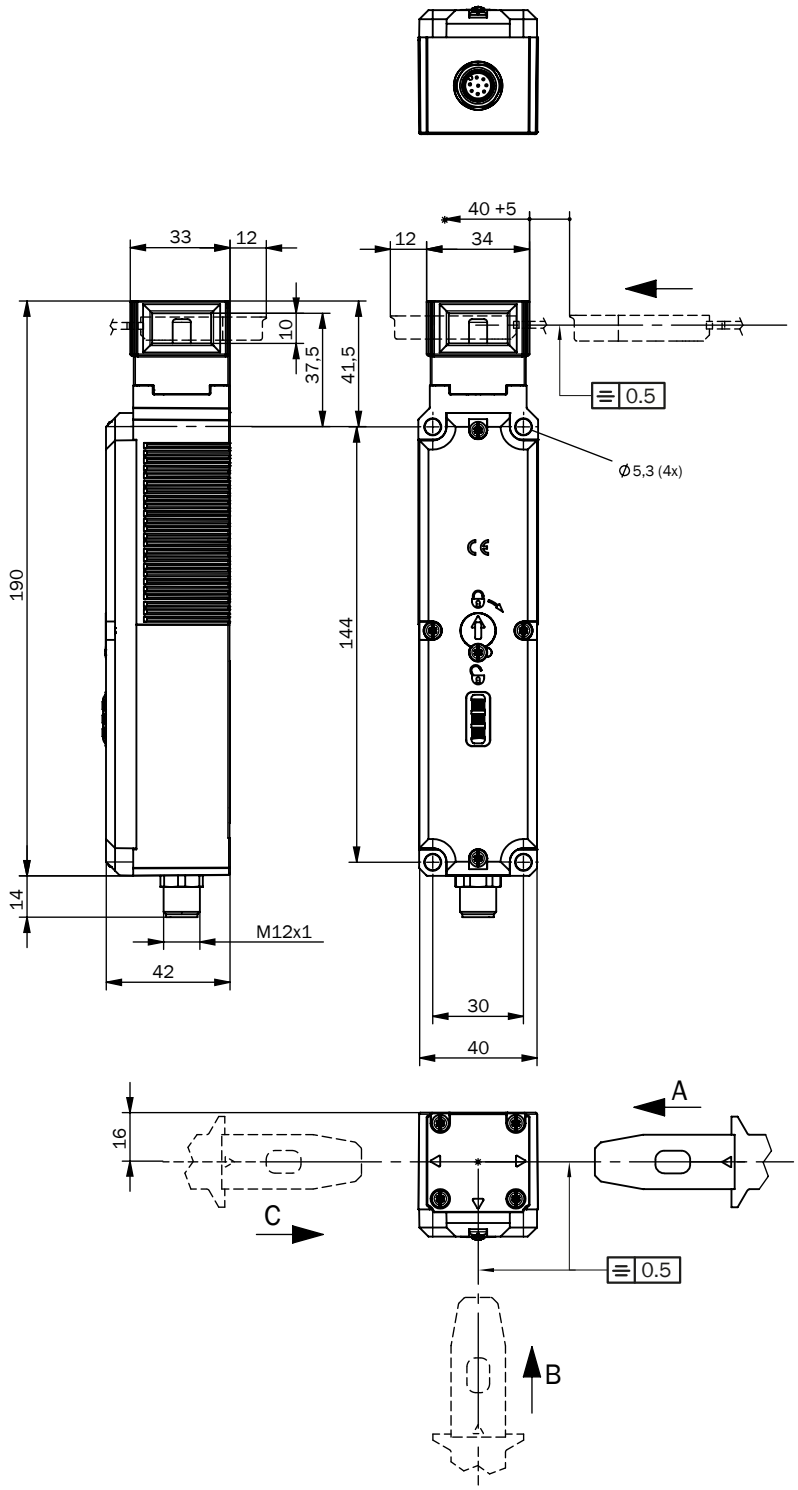


Figure 20: Dimensional drawing of TR110-SRUFL00, TR110-SLUFL00, TR110-SRUSA00 and TR110-SLUSA0000 safety switches (mm)

12.4 Actuator dimensional drawings

Straight actuator – TR110-XAS

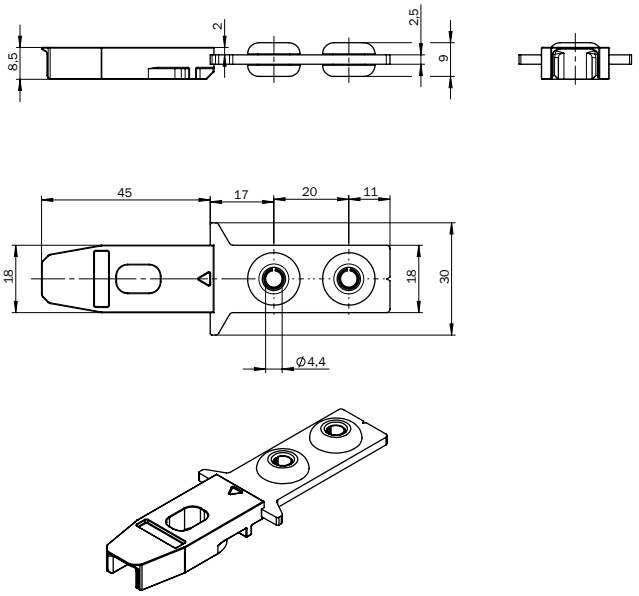


Figure 21: Dimensional drawing of TR110-XAS straight actuator (mm)

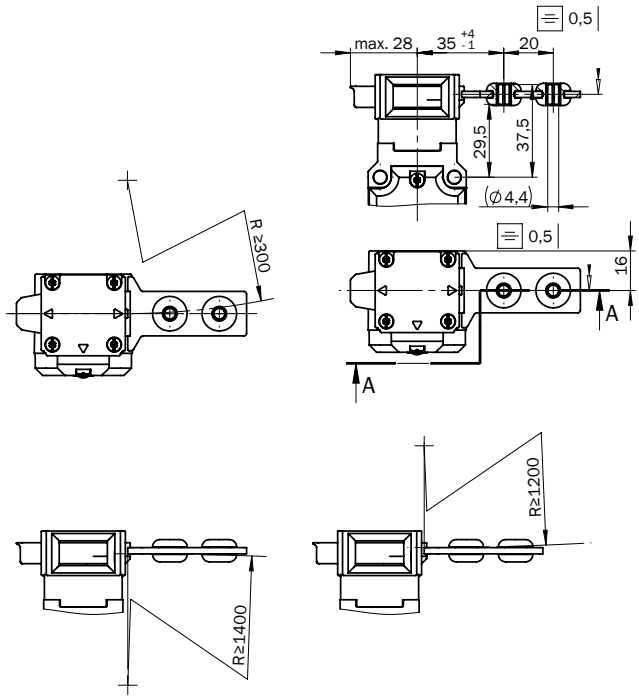


Figure 22: Min. door radii for TR110-XAS straight actuator (mm)

Angled actuator – TR110-XABT

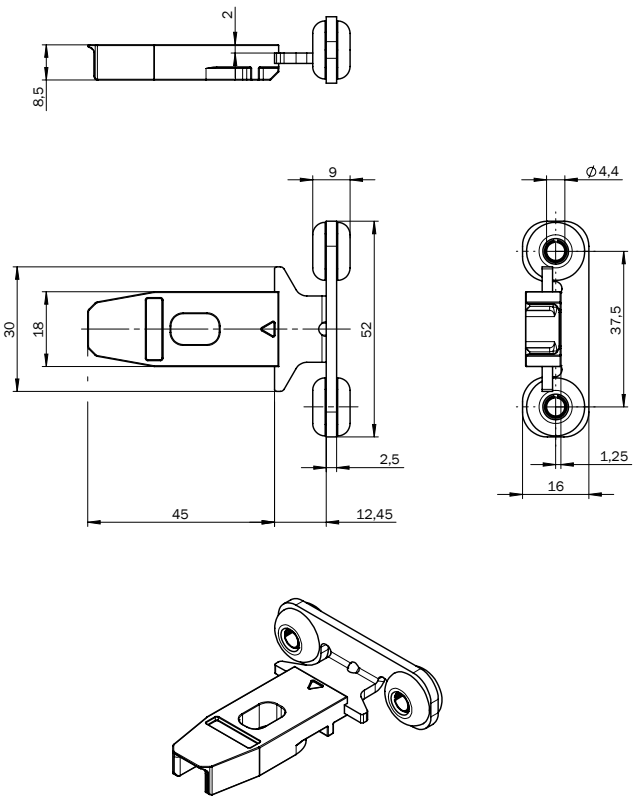


Figure 23: Dimensional drawing of TR110-XABT angled actuator (mm)

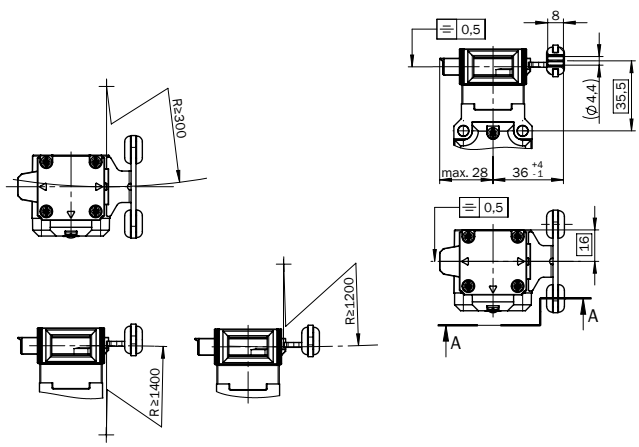


Figure 24: Min. door radii for TR110-XABT angled actuator (mm)

Hinged actuators for top-hinged doors – TR110-XAFT

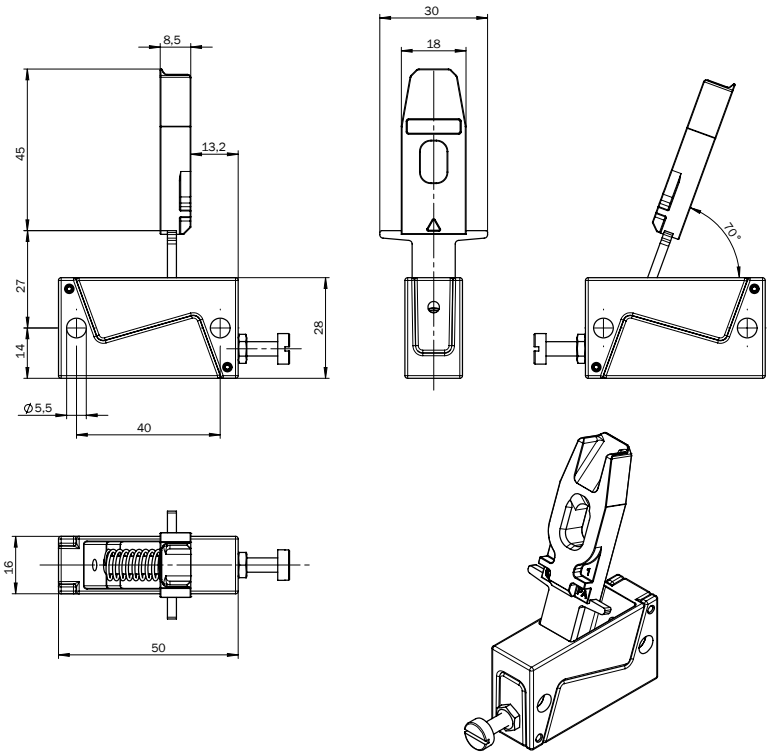


Figure 25: Dimensional drawing of TR110-XAFT hinged actuator (mm)

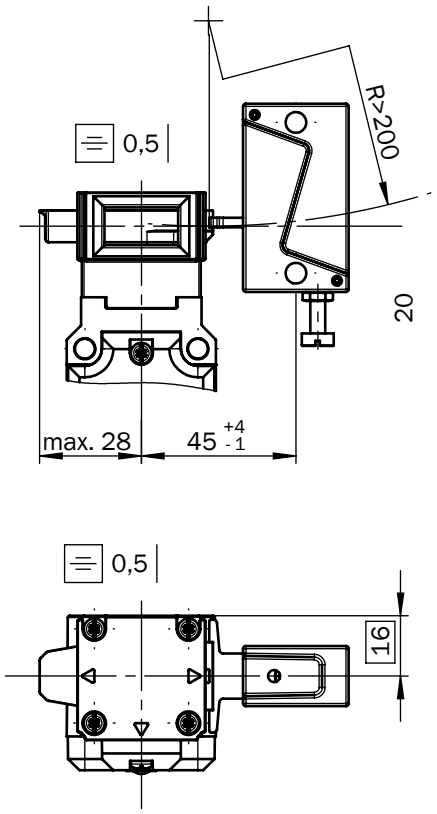


Figure 26: Min. door radii for TR110-XAFT hinged actuator (mm)

Hinged actuators for bottom-hinged doors – TR110-XAFB

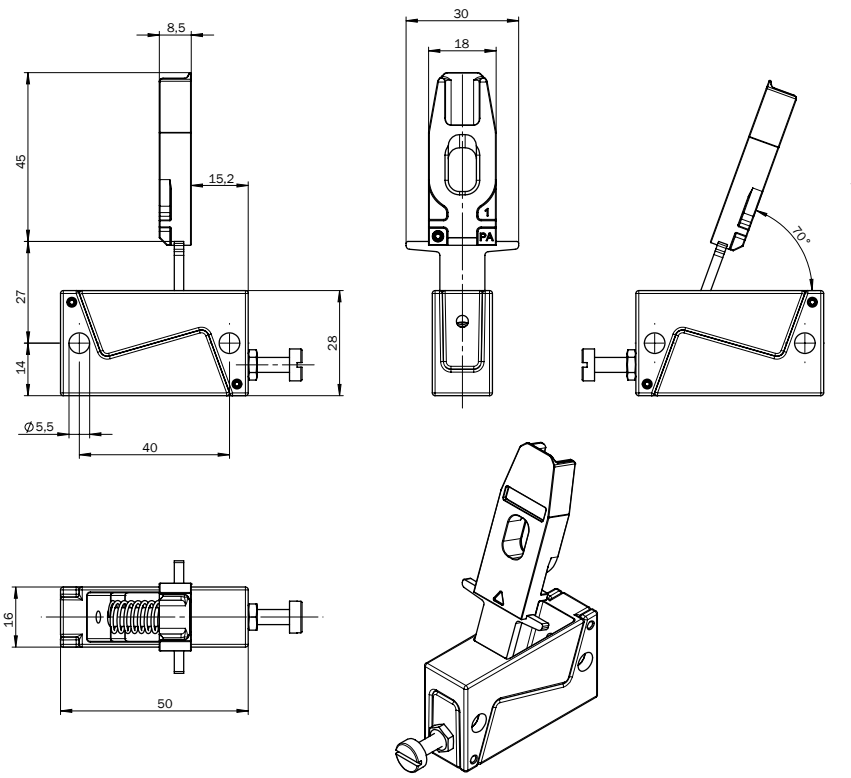


Figure 27: Dimensional drawing of TR110-XAFB hinged actuator (mm)

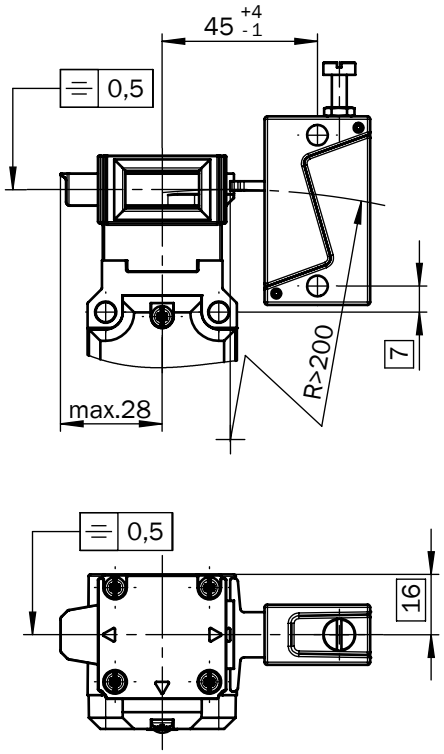


Figure 28: Min. door radii for TR110-XAFB hinged actuator (mm)

Hinged actuators for left-hinged doors – TR110-XAFL

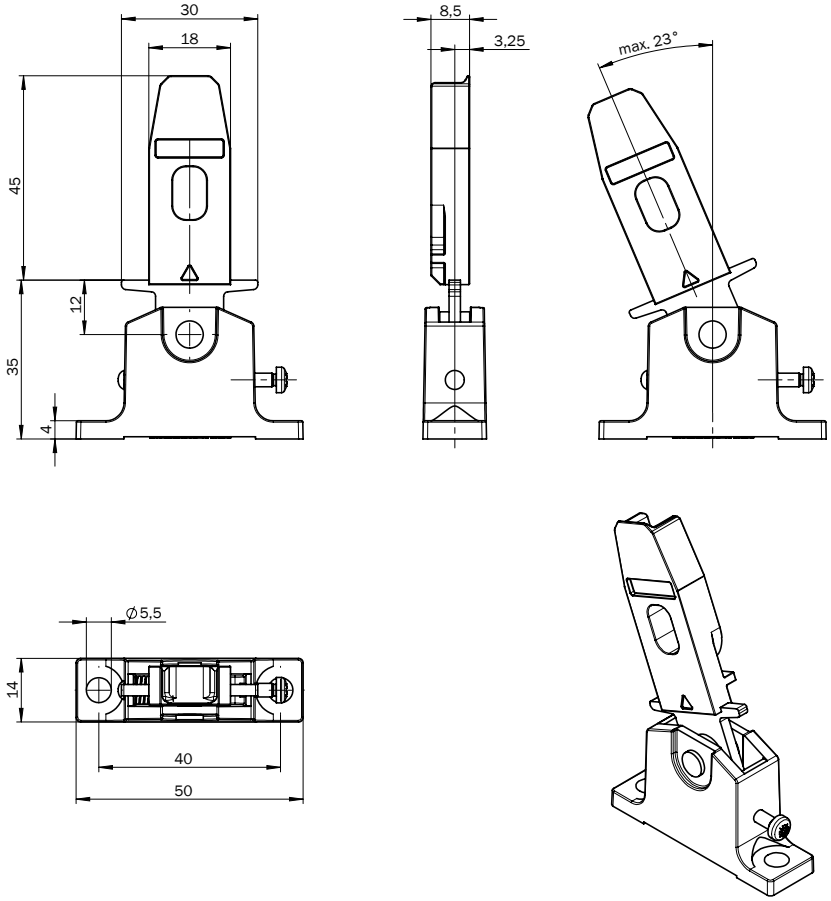


Figure 29: Dimensional drawing of TR110-XAFL hinged actuator (mm)

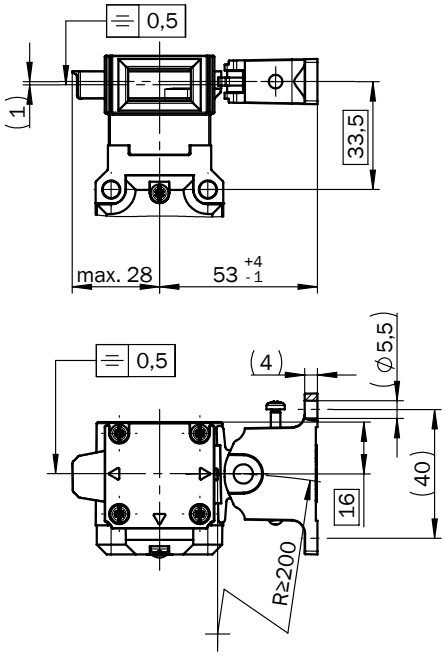


Figure 30: Min. door radius for TR110-XAFL hinged actuator (mm)

Hinged actuators for right-hinged doors – TR110-XAFR

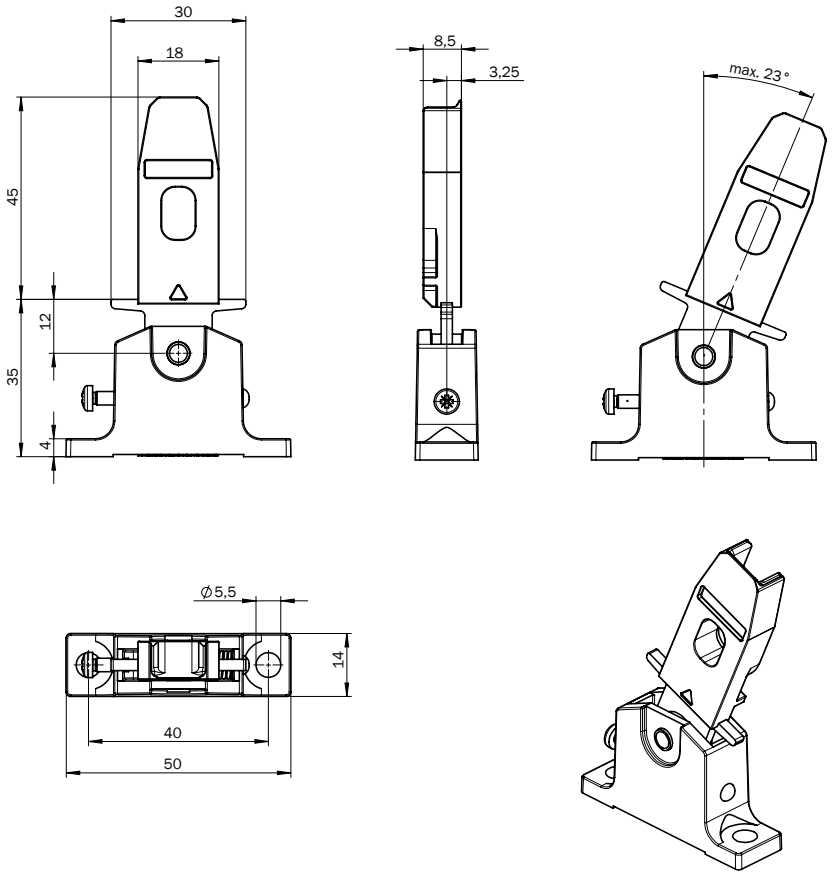


Figure 31: Dimensional drawing of TR110-XAFR hinged actuator (mm)

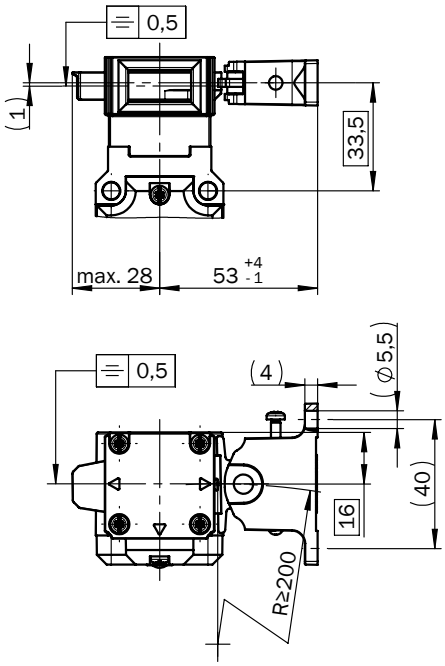


Figure 32: Min. door radius for TR110-XAFR hinged actuator (mm)

12.5 Dimensional drawings of the mounting bracket

Mounting bracket for safety locking device

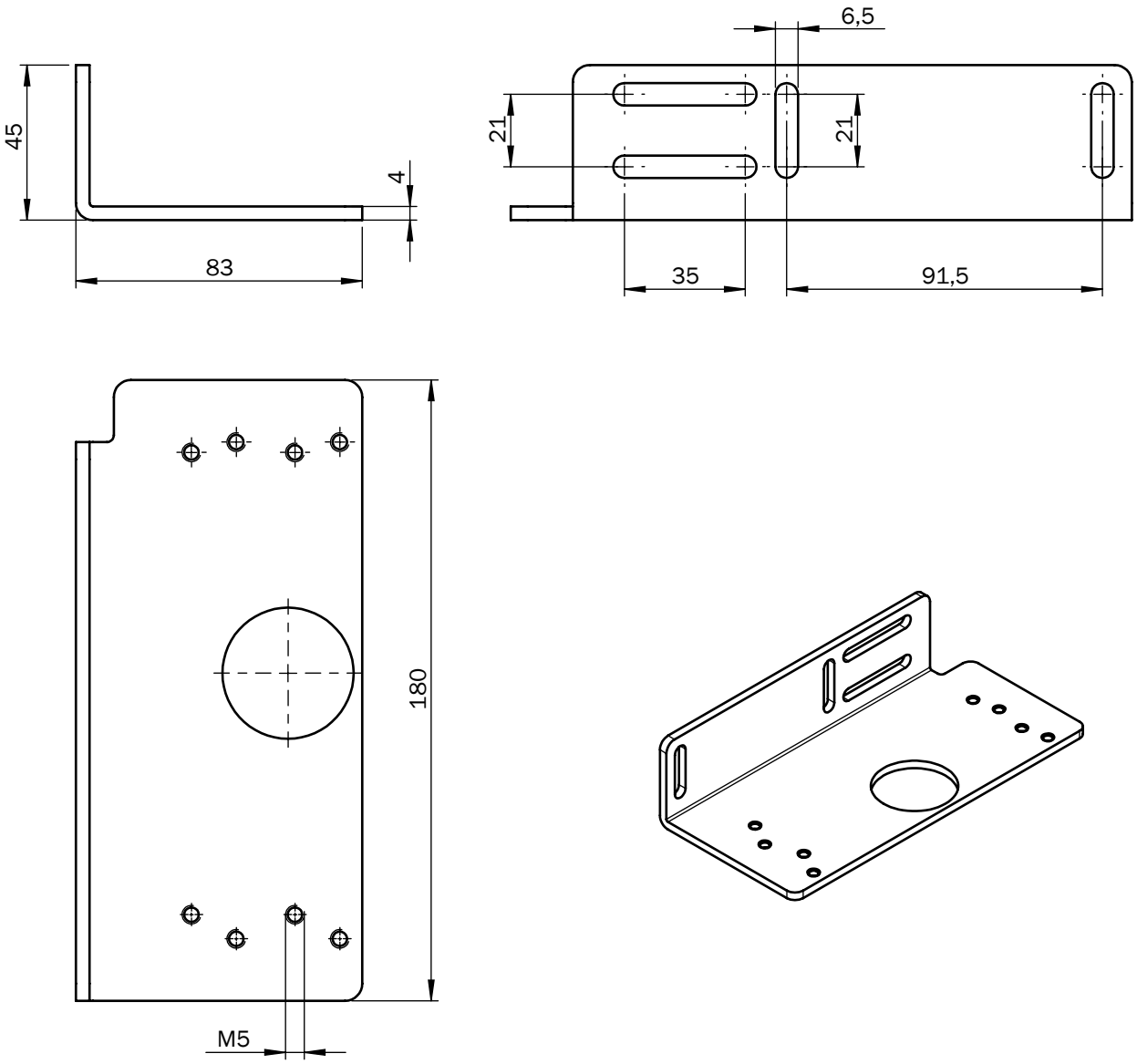


Figure 33: Mounting bracket for safety locking device

Mounting bracket for actuator

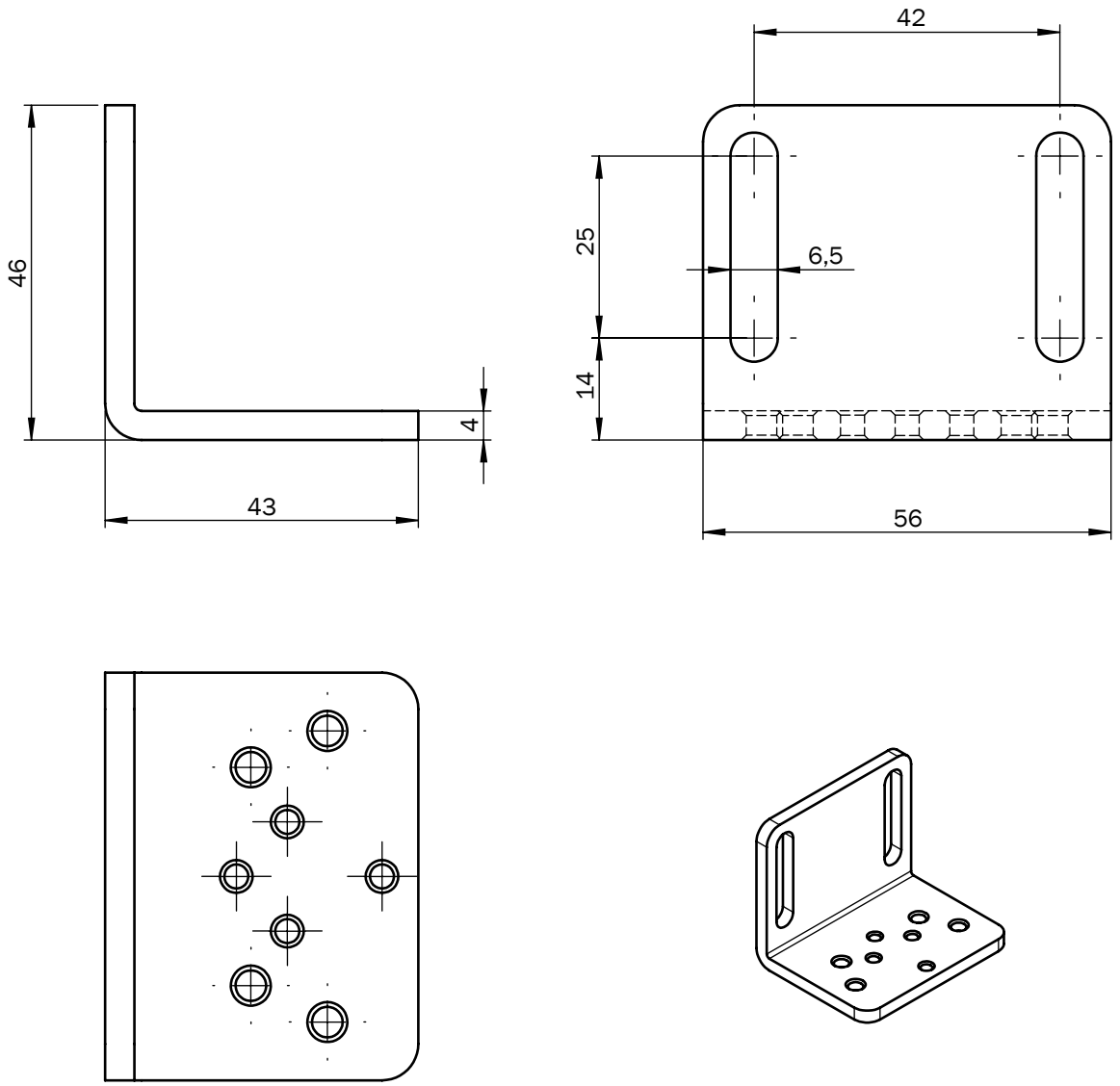


Figure 34: Mounting bracket for actuator

13 Accessories

13.1 Actuator

TR110 Lock actuator

Table 18: Actuator

Description	Type code	Part number
Actuator, straight	TR110-XAS	5321176
Actuator, angled	TR110-XABT	5334663
Hinged actuators for top-hinged doors	TR110-XAFT	5338336
Hinged actuators for bottom-hinged doors	TR110-XAFB	5338338
Hinged actuators for left-hinged doors	TR110-XAFL	5338331
Hinged actuators for right-hinged doors	TR110-XAFR	5338332

Complementary information

- The straight actuators and angled actuators are provided with 2 × M4 retaining screws.
- The hinged actuators are provided with 2 × M5 retaining screws.

13.2 Connectivity

M12 connecting cable, 8-pin (0.25 mm²)

Table 19: Ordering information for M12 connecting cable, 8-pin (0.25 mm²) [1)]

Part	Type code	Part number
Female connector, straight, 2.5 m cable, flying leads	YF2A18-025UA5XLEAX	2099229
Female connector, straight, 5 m cable, flying leads	YF2A18-050UA5XLEAX	2095653
Female connector, straight, 7.5 m cable, flying leads	YF2A18-075UA5XLEAX	2099230
Female connector, straight, 10 m cable, flying leads	YF2A18-100UA5XLEAX	2095654
Female connector, straight, 15 m cable, flying leads	YF2A18-150UA5XLEAX	2095679
Female connector, straight, 20 m cable, flying leads	YF2A18-200UA5XLEAX	2095680
Female connector, straight, 30 m cable, flying leads	YF2A18-300UA5XLEAX	2095681
Female connector, angled, 2 m cable, flying leads	YG2A18-020UA5XLEAX	2095779
Female connector, angled, 5 m cable, flying leads	YG2A18-050UA5XLEAX	2095780
Female connector, angled, 10 m cable, flying leads	YG2A18-100UA5XLEAX	2095781

1) *Ambient operating temperature: Down to -30 °C with fixed installation.*

M12 connection cable, 8-pin (0.25 mm²)

Table 20: Ordering information for M12 connection cable, 8-pin (0.25 mm²) [2)]

Part	Type code	Part number
Female connector, straight, 0.6 m cable, straight male connector	YF2A18-C60UA5M2A18	2096031
Female connector, straight, 1 m cable, straight male connector	YF2A18-010UA5M2A18	2096032
Female connector, straight, 20 m cable, straight male connector	YF2A18-020UA5M2A18	2096033
Female connector, straight, 1 m cable, straight male connector	YF2A18-050UA5M2A18	2096034
Female connector, straight, 10 m cable, straight male connector	YF2A18-100UA5M2A18	2096035

Distributor

Table 21: Ordering information for distributor

Part	Type code	Part number
T-connector	STR1-XXA	5339609

Terminator plug

Table 22: Ordering information for terminator plug

Part	Type code	Part number
End connector for series connection	MLP1-XXT	1078201

13.3 Additional accessories

Table 23: Additional accessories

Description	Type code	Part number
Emergency release	TR110-XER	5338333
Safety switch mounting plate, angled	TR110-XMSB	5338334
Actuator mounting plate, angled	TR110-XMAB	5338335

2) *Ambient operating temperature: Down to −30 ° C with fixed installation.*

14 Annex

14.1 Compliance with EU directives

TR110 Lock, Safety locking device

SICK AG, Erwin-Sick-Strasse 1, D-79183 Waldkirch, Germany

You can find the EU declaration of conformity and the current operating instructions by entering the part number in the search field at www.sick.com (for the part number, see the type label entry in the “Ident. no.” field).

Direct link to EU declaration of conformity: www.sick.com/9298268

The undersigned, representing the manufacturer, herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the standards and/or technical specifications stated in the EU declaration of conformity have been used as a basis for this.

- MACHINERY DIRECTIVE 2006/42/EC
- RE DIRECTIVE 2014/53/EU
- ROHS DIRECTIVE 2011/65/EU

Waldkirch: 2019-01-03

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