

# TOF/Spot

## Installation and Operation Manual



CEDES AG is certified according to ISO 9001: 2008

English

Pages 2 - 16

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## 1. About this manual

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This 'TOF/Spot Installation and Operation Manual', with metric and US measurements is the original version.

The version number is printed at the bottom of each page.

To make sure you have the latest version, visit [www.cedes.com](http://www.cedes.com) from where this manual and related documents can be downloaded.

### 1.1 Measurements

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Unless stated otherwise, measurements are given in mm (non-bracketed numbers) and inches (numbers in brackets).

### 1.2 Related documents

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#### TOF/Spot datasheet en

Part No. 001 206 en

#### TOF/Spot-S datasheet en

Part No. 001 213 en

#### Quickguide en de fr es zh, types P, N, C

Part No. 113 495

#### Quickguide en de fr es zh, type A

Part No. 113 496

#### Quickguide en de fr es zh, type T

Part No. 113 502

### 1.3 CEDES headquarters

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CEDES AG  
Science Park  
CH-7302 Landquart  
Switzerland

## 2. Safety information

### IMPORTANT! READ BEFORE INSTALLATION!

The TOF/Spot was developed and manufactured using state-of-the-art systems and technologies. However, injury and damage to the sensor can still occur.

#### To ensure safe operating conditions:

- ▶ Read all enclosed instructions and information.
- ▶ Follow the instructions given in this manual carefully.
- ▶ Observe all warnings included in the documentation and attached to the sensor.
- ▶ Do not use the sensor if it is damaged in any way.
- ▶ Keep the instruction manual on site.

The TOF/Spot should only be installed by authorized and fully trained personnel! The installer or system integrator is fully responsible for the safe integration of the sensor. It is the sole responsibility of the planner and/or installer and/or buyer to ensure that this product is used according to all applicable standards, laws and regulations in order to ensure safe operation of the whole application.

Any alterations to the device by the buyer, installer or user may result in unsafe operating conditions. CEDES is not responsible for any liability or warranty claim that results from such manipulation.

Failure to follow instructions given in this manual and/or other documents related to the TOF/Spot may cause customer complaints, serious call backs, damage, injury or death.

### 2.1 Non-intended use

The TOF/Spot **must not** be used for:

- Equipment in explosive atmospheres
- Equipment in radioactive environments



Use only specific and approved safety devices for such applications, otherwise serious injury or death or damage to property may occur!

## 3. Symbols, safety messages

Symbol	Meaning
▶	Single instruction or measures in no particular order
1. 2. 3.	Sequenced instructions
•	List, in no order of importance
→	Reference to a chapter, illustration or table within this document
<b>Important:</b>	Important information for the correct use of the sensor

### 3.1 Safety message categories

#### Warning of serious health risks



#### **WARNING** Serious health risks

Highlights critical information for the safe use of the sensor. **Disregarding these warnings can result in serious injury or death.**

- ▶ Follow the measures highlighted by the triangle-shaped arrows
- ▶ Consult the safety information in Chapter 2 of this manual

#### Caution of possible health risks



#### **CAUTION** Possible health risks

Highlights critical information for the safe use of the sensor. **Disregarding these warnings can result in injury.**

- ▶ Follow the measures highlighted by the triangle-shaped arrows
- ▶ Consult the safety information in Chapter 2 of this manual

#### Notice of damage risk

#### **NOTICE** Risk of damage

Disregarding these notices can lead to damage to the sensor, the door controller and/or other devices.

- ▶ Follow the measures highlighted by the triangle-shaped arrows

## 4. Introduction

The TOF/Spot is a compact yet powerful measuring system with the widest range of application possibilities. It uses Time-of-Flight technology (TOF) to ensure ultra reliable detection and exact detection range setting, regardless of the background. This enables a detection range of up to 6 m (20 ft).

The sensor can measure the exact distance at which a person or object enters the detection area or it can simply switch the output at a predefined level. This means the potential application areas are immense: from safeguarding the closing door edges of revolving doors, to measurement of levels, to providing touchless button functionality. Its small dimensions mean the TOF/Spot is ideal as a built-in solution.

### 4.1 Application examples

- Closing edge of revolving doors
- Bus doors
- Closing edge of glass doors



Figure 1: Typical TOF/Spot application environment

## 4.2 Features of the TOF/Spot

- Exact distance setting, independent of background
- Excellent detection capability
- Universal relay output
- Insensitive to ambient light
- Easy mounting
- Compact and sleek design
- Operating range of up to 6 m
- TÜV approved (TOF/Spot-S, safety version)
- Category 2, PL C (TOF/Spot-S, safety version)

## 4.3 Type description

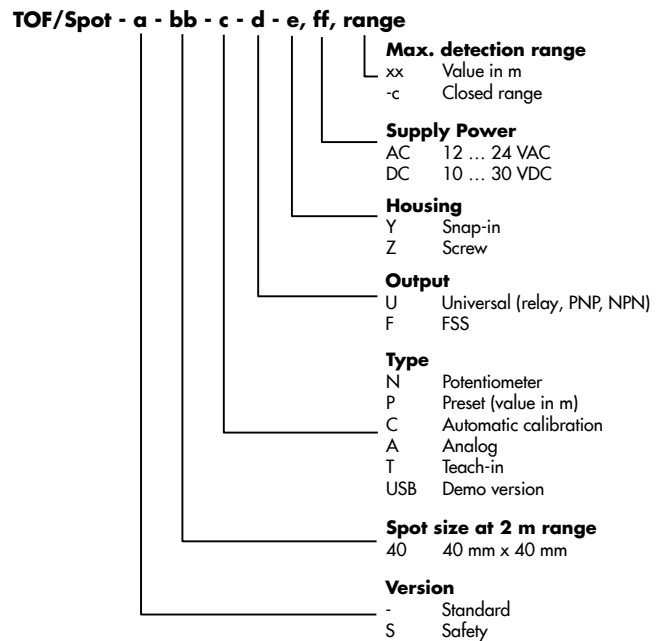


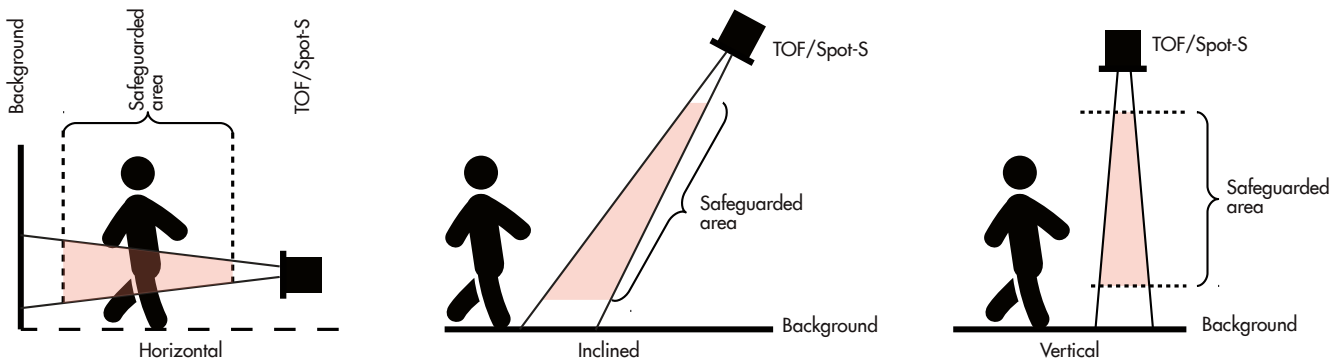
Figure 2: TOF/Spot type description

## 4.4 Category 2 operation (TOF/Spot-S)

The TOF/Spot-S is certified by TÜV according to EN 13849-1, Cat. 2, PLC as well as EN 16005 and DIN 18650.

However, there are certain requirements connected to this certification:

- The system integrator has to define the correct electrical connection to the controller to fulfill Cat. 2 operation.
- The sensor must be tested regularly by the controller through the test input. Using the FSS output alone does not fulfill the Category 2 requirements.
- For a safety application, the following mounting options are valid for a category 2 application:



- In the examples above the sensor recognizes the background. A background is needed to successfully test the sensor with the test input. If the TOF/Spot-S doesn't recognize a background within the maximal range, the output will be switched to OBJECT DETECTED.
- The sensor looks towards a flat, plain background (non-mirroring). There is no need to be perpendicular to the optical axis.

## 4.5 Delivery package

A delivery package contains:

- 1 × TOF/Spot sensor
- 1 × quick guide manual (depends on the type ordered)



Figure 3: TOF/Spot delivery package

### 4.6 TOF/Spot product overview

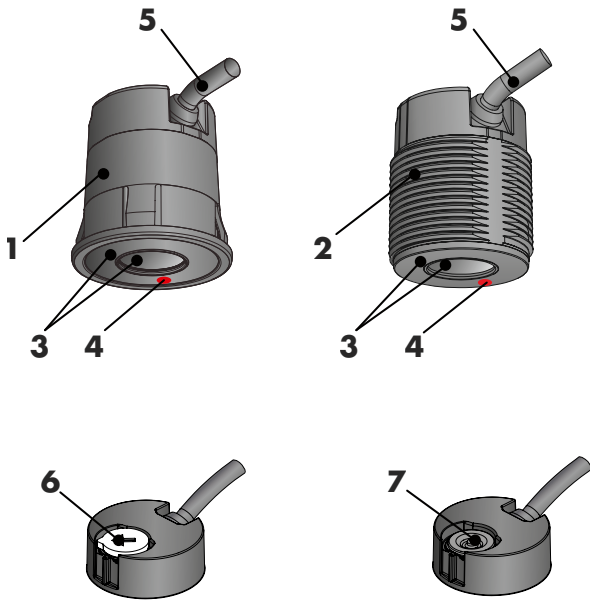


Figure 4: TOF/Spot overview

- 1 Snap-in housing
- 2 Screw housing
- 3 Optical window
- 4 Status LED
- 5 Connection cable
- 6 Potentiometer
- 7 Teach-in button and cap

### 5. Overview

Based on Time-of-Flight technology (TOF), the TOF/Spot consists of an active infrared emitter and receiver combined in the same housing. There are two sizes of spot-like detection areas available which reflect an exact picture of the safeguarded area. One output signals the detection of an object within the detection area. With the A type, there is also a variant available, which sends the exact distance information to the controller.

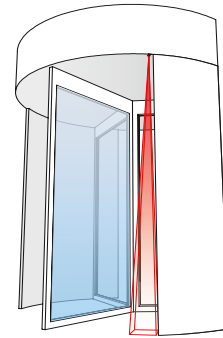


Figure 5: Closing edge of revolving doors

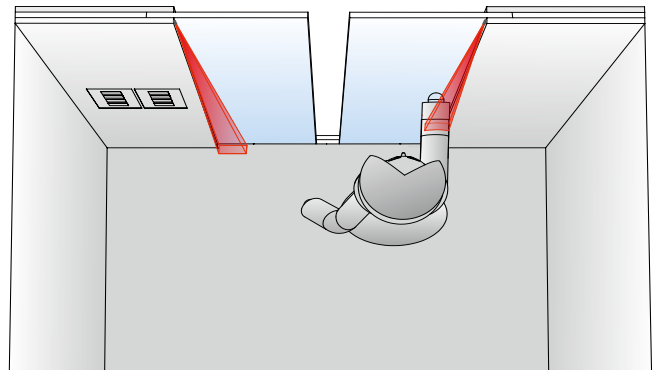


Figure 6: Closing edge of glass doors

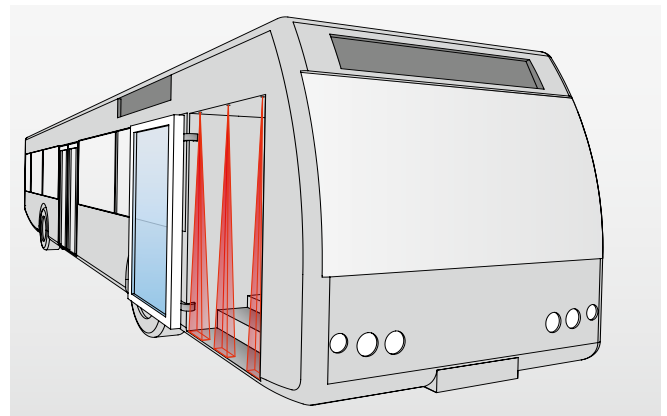
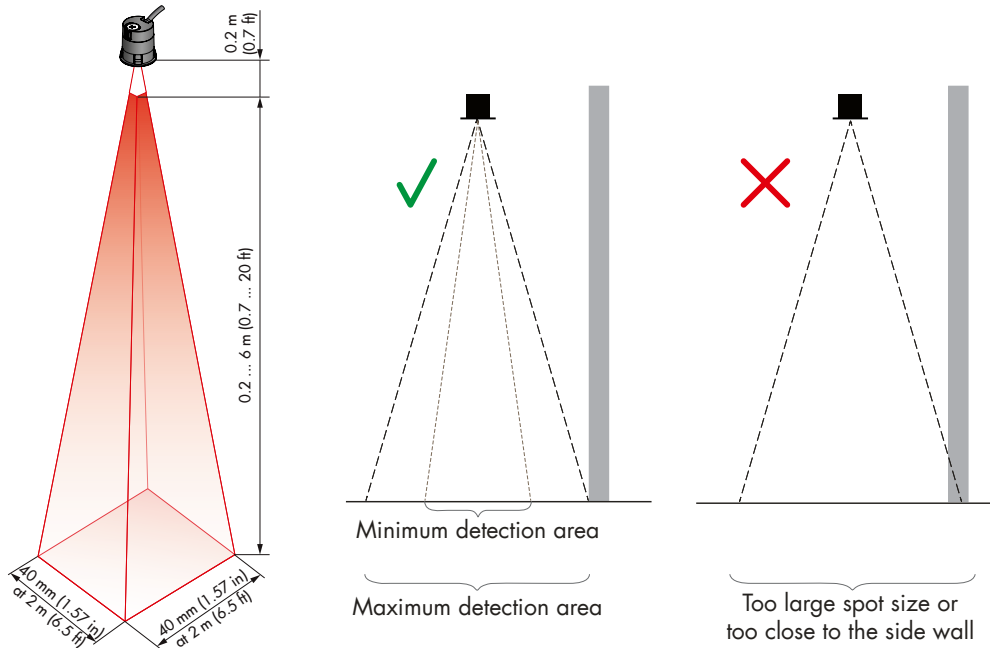


Figure 7: Closing edge of bus doors

## 5.1 Detection area dimensions

The maximum detection range is 6 m (20 ft). Object detection at a range less than 0.2 m (0.7 ft) cannot be guaranteed.

The TOF/Spot features a detection area of 40 x 40 mm at 2 m (1.57 x 1.57 in at 6.5 ft) range. It reads the correct distance and switches the output reliably for objects covering the full beam size (detection area). For objects being only partially in the detection area, a correct distance evaluation cannot be guaranteed.

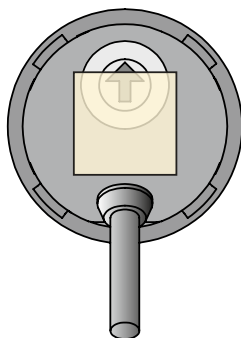


**Figure 8:** Dimensions of detection area

As the illumination size is bigger than the detection size, at 2 m (6.5 ft) range, the TOF/Spot needs at least 20 cm (7.87 in) space to the next sensor to avoid interference.

## 5.2 Alignment

As the detection area of the TOF/Spot looks like a square, it is important to know where the flat borders and where the edges are:



### Important:

- ▶ For proper functionality, the remission range of the background or the object has to be between 2 ... 90%.
- ▶ Do not use high reflective, retro-reflective or mirroring backgrounds or objects. They can lead to malfunction of the sensor due to the emitted beam not being directly remitted back to the sensor, which leads to measurements out of the operating range.

## 6. Configuration and operation

There are different TOF/Spot types available. Some of them need to be set manually, others are factory set.

### 6.1 P type (Preset)

The P type needs no configuration; a specific detection range is factory set according customer request. Due to the preset value, the P type is a pure plug-and-play sensor.

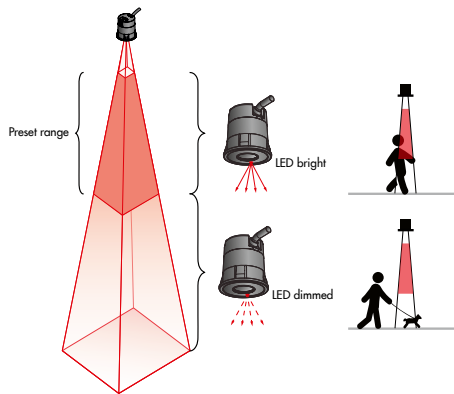


Figure 9: Configuration - P type

**Important:** The sensor uses a  $\pm 40$  mm ( $\pm 1.57$  in) hysteresis. The hysteresis is the difference between the switching points changing the status from “free field” to “object detected” and back from “object detected” to “free field” compared to the nominal limit.

### 6.2 C type (Automatic calibration)

The C type cannot be manually calibrated. The sensor calibrates the background every time it starts up.

The C type has to be fully installed and implemented into the application before connecting it to the controller.

#### Functionality:

Every time the sensor starts up (power-up), the TOF/Spot learns the background information anew during the first 30 s after start-up (the start-up time increases by 30 s). If the sensor has no background (e.g. it doesn't “see” anything) at start-up, the switching distance is set to 6 m (20 ft).

#### Important:

- ▶ When there is a background, be aware that the set switching distance is always set about 150 mm (5.9 in) less than the distance to the background or the object used for calibration.
- ▶ A background is used to calibrate the sensor. If there is none, an object has to be used for simulating the background during the distance setting or the sensor calibrates to the maximal range.
- ▶ The C type is not available as a safety version.

**Important:** The sensor uses a  $\pm 40$  mm ( $\pm 1.57$  in) hysteresis. The hysteresis is the difference between the switching points changing the status from “free field” to “object detected” and back from “object detected” to “free field” compared to the nominal limit.

### 6.3 N type (Potentiometer)

The detection range can be individually set to between 0.2 m and 3 m (0.7 ft and 10 ft) using the potentiometer located at the rear of the sensor.

#### Important:

- ▶ When setting with the potentiometer, use figure 10 below as the settings are not printed on the sensor.
- ▶ Take a small screw driver and turn the potentiometer to the required position.

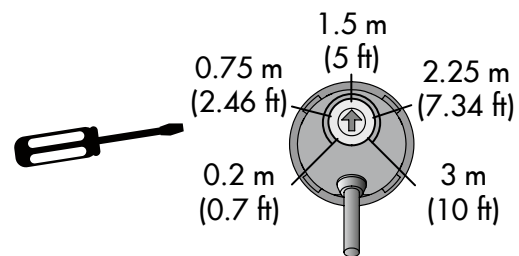


Figure 10: Example of an adjustment between 0.2 m and 3 m

#### Preset:

- ▶ Set the potentiometer to the limit value before the sensor is mounted.

#### Teach:

- ▶ Mount the sensor at its final position.
- ▶ Place an object (or person) at the limit distance.
- ▶ Turn the potentiometer clockwise, starting at the left, until the LED shines bright.
- ▶ Turn it back slowly until the LED dims.
- ▶ Now the limit is set to the correct distance.



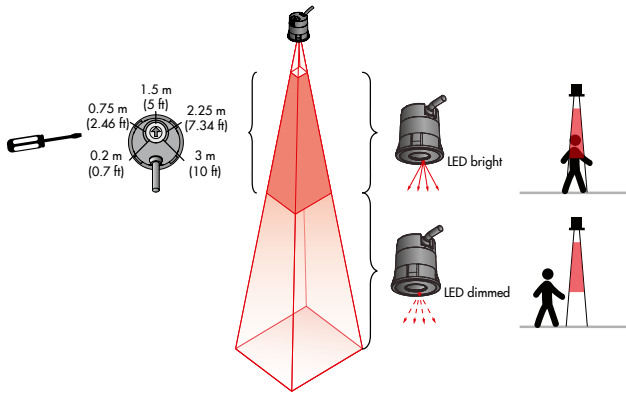


Figure 11: Configuration - N type

**Important:** The sensor uses a  $\pm 40$  mm ( $\pm 1.57$  in) hysteresis. The hysteresis is the difference between the switching points changing the status from “free field” to “object detected” and back from “object detected” to “free field” compared to the nominal limit.

### 6.4 T type (Teach-in)

The T type features a teach-in function that can be initiated in two ways:

#### 1. Exchange of the polarity of the supply voltage (brown wire to GND and blue wire to USP)

With the exchanged connection of GND and USP, the sensor is put into a setting mode and learns the distance to the background. The status LED starts to blink. To indicate that the calibration is finished, the sensor stops blinking and stays red for about 30 s. Now the wiring of the TOF/Spot has to be adjusted according to the electrical connections (brown wire to USP and blue wire to GND). The mode is an endless loop of 30 s setting time (blinking LED) followed by a 30 s break (red LED). In this mode, the sensor cannot work.

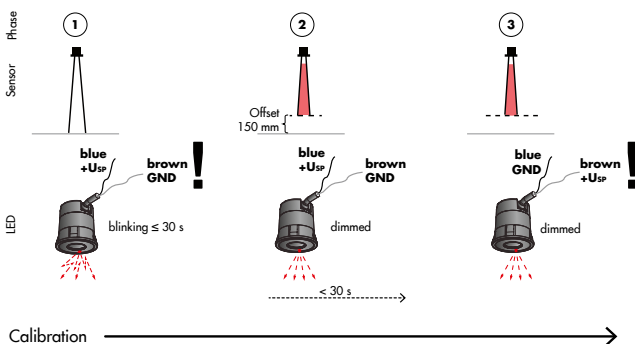


Figure 12: Configuration T type - exchange of the polarity

#### 2. Setting with the teach-in button

There is a button located at the back of the sensor. When the teach-in button is pressed for at least 2 s, the LED blinks for 30 s; the detection area (distance to the background minus 150 mm (5.9 in) is saved and the LED dims. As soon as a person or object enters the detection area, the sensor switches the output. The set switching distance can only be changed by pressing the teach-in button again.

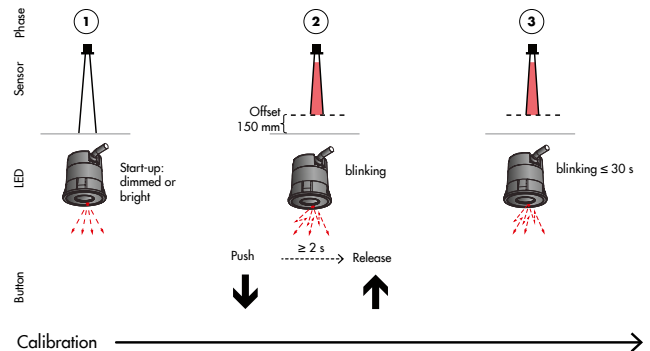


Figure 13: Configuration T type with the teach-in button

#### Important:

- ▶ Be aware that the set switching level is always about 150 mm (5.9 in) above the background.
- ▶ A background within the maximal detection range is used to calibrate the sensor. If there is none, an object has to be used for simulating a background. A calibration into nothingness does not work.
- ▶ When the power is switched off the sensor remembers the last setting as the switching distance. This distance can only be changed by doing the setting process again.

**Important:** The sensor uses a  $\pm 40$  mm ( $\pm 1.57$  in) hysteresis. The hysteresis is the difference between the switching points changing the status from “free field” to “object detected” and back from “object detected” to “free field” compared to the nominal limit.

## 7. In- / Output description

There are different possibilities of in- and outputs. Please be aware that not all variants can be used with every type e.g. the A type is only available with an analog output.

### 7.1 Universal output (relays output)

**Available for:**

DC supply: Types P, N, C, T; with logic selector.  
 AC supply: Types P, N, T; no logic selector; output “normally closed (NC)”

The TOF/Spot features a universal (relays) output. With the help of the logic selector, the output signal can be configured according to the controller requirements for “normally open” or “normally closed” operation.

### 7.2 Logic selector

**Available for:**

DC supply: Types P, N, C, T

**Important:** The logic selector has to have a DC signal. An AC signal will not work.

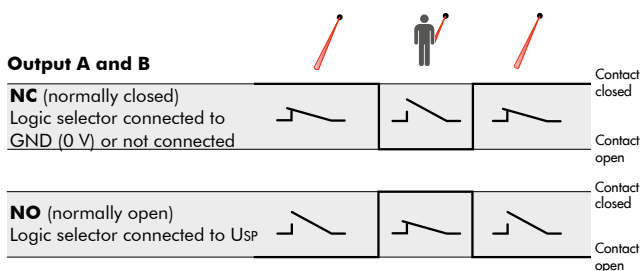


Figure 14: Logic selector

### 7.3 FSS output

**Available for:**

DC supply: Types P, N, T; no logic selector

A FSS output is a dynamic output signal with a frequency of 1 kHz.

As long as the safeguarded area is free, the FSS output sends the 1 kHz signal. When an object enters the safeguarded area (OBJECT DETECTED) the FSS output switches to GND (0 V). When the object leaves the safeguarded area (NO OBJECT) the toggling (frequency) restarts again.

**Important:**

The FSS signal must be used in conjunction with a test input to fulfill the requirements of a Cat.2 system according EN ISO 13849-1:2008.

### 7.4 Analog output

**Available for:**

DC supply: Type A; no logic selector

The A type has an analog current output that is directly related to the measured distance to the object in the detection field.

The value of the analog output has a range of 4 ... 20 mA and corresponds directly to the measured distance.

The value of the current output in regards of the distance is as follows:

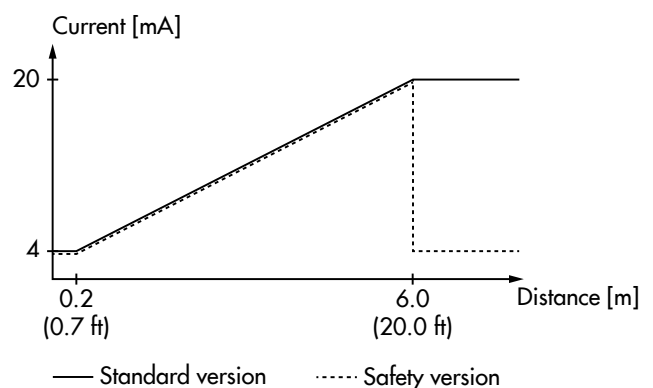


Figure 15: Analog output

The load needs to be a maximum of 250 Ω and leads to a respective voltage output of 1 ... 5 VDC.

### 7.5 Test input

**Available for:**

All TOF/Spot-S with DC supply

The logic of the test signal is being recognized automatically. This works as follows:

1. Connect the TOF/Spot-S with the controller.
2. Power up the controller.
3. The sensor recognizes the voltage level at the test input during the power up time and sets the test to inactive. From this point on, this level is used as “test inactive”.
4. When the voltage level of the test input changes, the sensor will recognize it as test signal (test active). The sensor switches the output and the status LED to “OBJECT DETECTED” (see figure 22, Timing diagram).
5. As soon as the voltage level of the test input switches back to the initial level, the sensor returns to normal operating mode. The output voltage level switches back only if the background or an object is within the operating range, but outside the switching level (Detection field FREE).

**Important:**

- ▶ A test sequence must be implemented by the system integrator to achieve safe operation according Cat. 2.
- ▶ The test signal has to be a DC signal, an AC signal will not work.
- ▶ The test can only be used if the sensor has a permanent background. If not, the test cannot be carried out.

## 8. Installation

### 8.1 Standard installation

It is recommended to carry out the system installation according to the following steps:

1. Check if the scope of delivery is complete.
2. Mark clearly that the modifying system is out of service and switch off main power and door control unit.
3. The installation place needs to fulfill the criteria detailed in Chapter 5.1.
4. Drill a hole at the required position (see drilling template for flush and surface mounting).
5. If needed, mount the mounting bracket.
6. Screw or snap in the sensor at the defined position.
7. Connect the TOF/Spot with the controller.

#### 8.1.2 Mounting of snap-in housing

The mounting hole recommended for flush mounting is 30 to 31 mm. The sheet thickness cannot be greater than 3 mm.

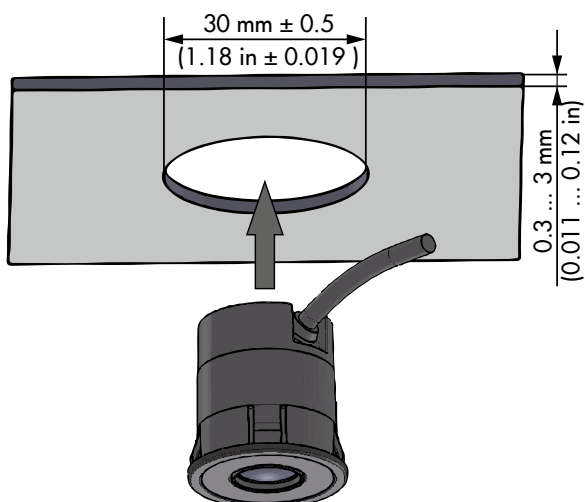


Figure 16: Mounting of snap-in housing

#### 8.1.2 Mounting of screw housing

The screw housing has a M30 thread.

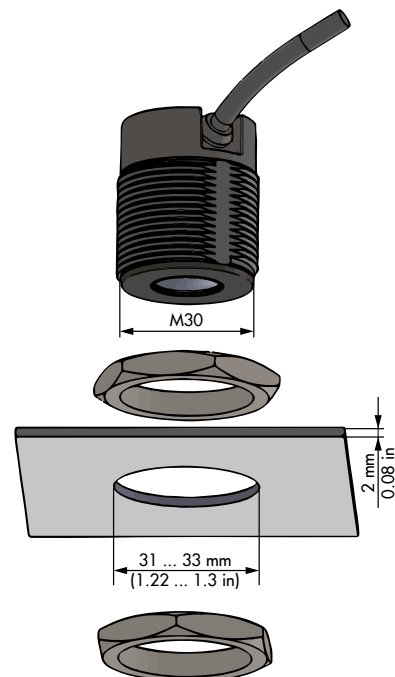


Figure 17: Mounting of screw housing

## 9. Electrical connection

There are different possibilities according to supply power and output chosen.

### 9.1 Power

There are two variants, one with a DC power supply (10 ... 30 VDC) and one with an AC power supply (12 ... 24 VAC). The two variants have to be ordered accordingly.

#### Outputs available for DC and AC supply power:

Relay output (Universal output; types P, C, N, T)

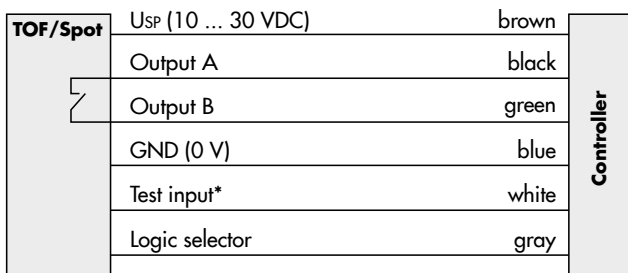


Figure 18: Solid-state relay output (DC supply)

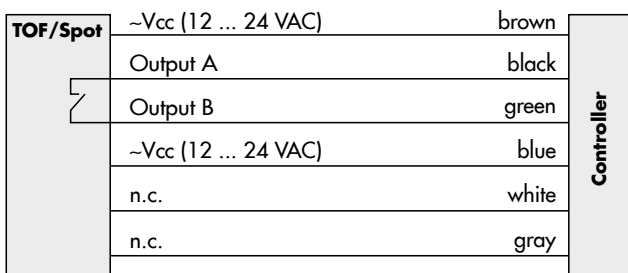


Figure 19: Solid-state relay output (AC supply)

#### Important:

- ▶ Output A and Output B are interchangeable
- ▶ Any unconnected (n.c.) wires have to be separated and isolated

\* If test input not used - connect with U<sub>SP</sub> or GND

#### Outputs available with a DC supply power only:

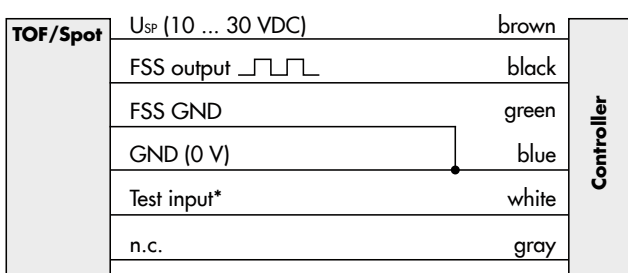


Figure 20: FSS output

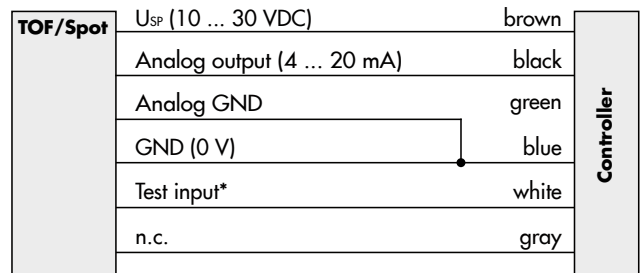


Figure 21: Analog output

#### Important:

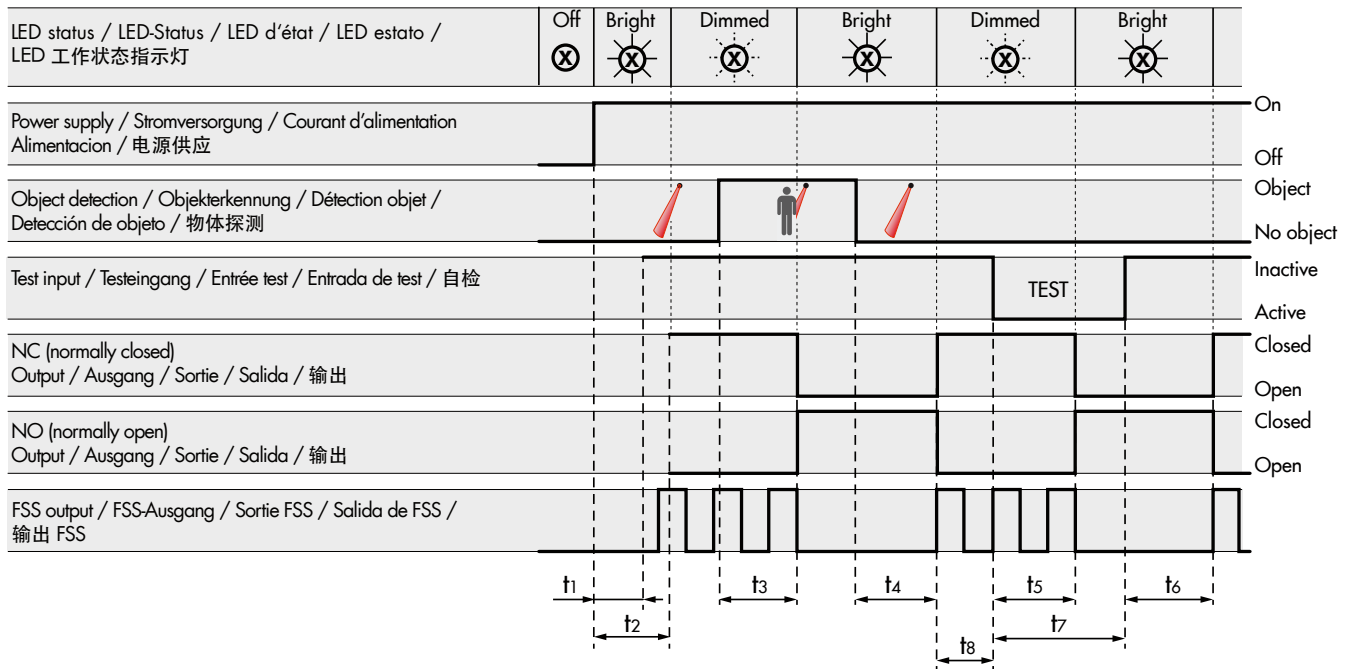
- ▶ Any unconnected (n.c.) wires have to be separated and isolated. No termination needed.
- ▶ Only the relay output is available in combination with an AC supply power.

\* If test input not used - connect with U<sub>SP</sub> or GND

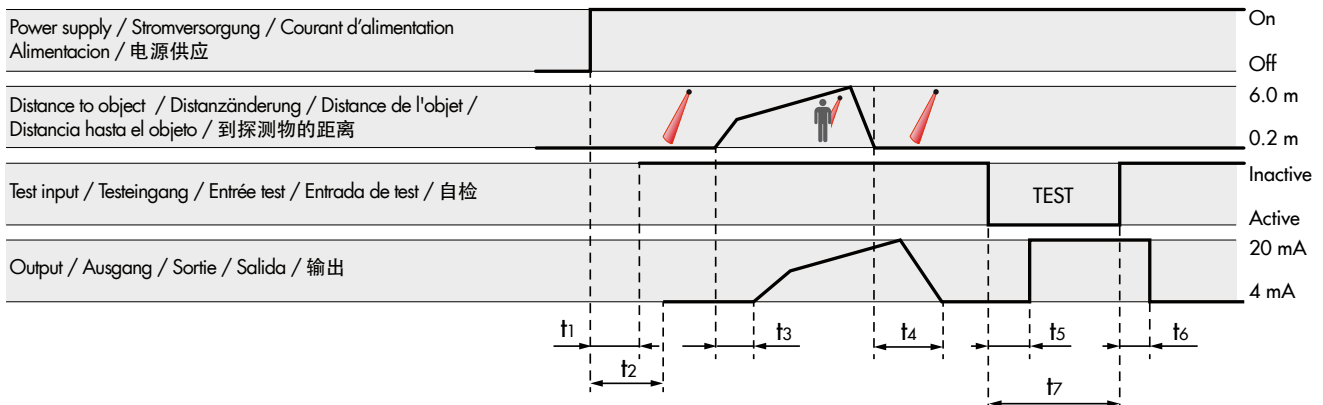
## 10. Start-up

1. Switch on mains and power up the door control unit.
2. Check if LED lights up.
3. Check the distance setting and the reaction of the sensor, including the status LED, by placing a hand into the detection area at different heights.
4. Perform a test run with the controller using the test input.

# 11. Timing diagrams



**Figure 22:** Timing diagram for relay and FSS outputs



**Figure 23:** Timing diagram for the analog output

	Time	Value		Value
Test input			HIGH	10 VDC ... USP
			LOW	0 ... 3 VDC
Logic selector input			NC: normally closed	0 ... 3 VDC
			NO: normally open	10 VDC ... USP
Output A and B (relay)			Voltage pin to GND	-30 ... +30 V
			Voltage between pins	-60 ... +60 V
			Current	< ±150 mA
FSS output			No object	0 ... 3.8 VDC / 1 kHz
			Object detected	0 ... 0.2 V
Analog output			Current	4 ... 20 mA
			Voltage	< 6 VDC
			Input resistance	< 250 Ω
Start-up time test input	$t_1$	< 200 ms		
Power-on time	$t_2$	1,000 ms		
Response time	$t_3$	≤ 60 ms		
Release time	$t_4$	≤ 60 ms		
Test response time	$t_5$	5 ms		
Test release time	$t_6$	≤ 60 ms		
Test time	$t_7$	> 60 ms		
FSS sequence time	$t_8$	1 ms		

**Table 1:** General timing table

**Table 2:** General value table

## 12. LED signals

LED status	Description
LED off	No power
LED dimmed red	No object detected
LED bright red	Object detected or test active
LED blinking (C and T type only)	Distance setting active

## 13. Trouble shooting

Status	Action
LED off	<ul style="list-style-type: none"> <li>▶ Check supply power</li> <li>▶ Check electrical connections</li> </ul>
Object in the safeguarded area and LED dimmed red	<ul style="list-style-type: none"> <li>▶ Check distance setting</li> <li>▶ Check alignment</li> </ul>
No object in the safeguarded area and LED bright red	<ul style="list-style-type: none"> <li>▶ Check electrical connections</li> <li>▶ Check distance setting</li> <li>▶ Check alignment</li> </ul>
The output doesn't switch after starting test	<ul style="list-style-type: none"> <li>▶ Is an object in the detection area?</li> <li>▶ Check electrical connections</li> </ul>
The output doesn't switch back after ending of test	<ul style="list-style-type: none"> <li>▶ Sensor doesn't see a background</li> <li>▶ Is an object in the detection area?</li> <li>▶ Check distance setting</li> </ul>
FSS output toggles even with an object in the detection area	<ul style="list-style-type: none"> <li>▶ Check distance setting</li> <li>▶ Check alignment</li> </ul>
No object in the detection area and FSS output stays low	<ul style="list-style-type: none"> <li>▶ Check electrical connections</li> <li>▶ Check alignment</li> </ul>

If the problem persists, please contact your local CEDES representative ([www.cedes.com](http://www.cedes.com)).

## 14. Maintenance

Although the TOF/Spot does not need regular maintenance, a periodical functional check is strongly recommended as follows:

- ▶ Check the mounting position and detection area of the sensor
- ▶ Clean the optical window with a soft towel and a little soapy water

### NOTICE

#### Damage to the optical window

- ▶ Never use any solvents, cleaners or mechanically abrasive towels or high-pressure water to clean the sensor.

## 15. Disposal

The TOF/Spot should only be replaced if a similar protection device is installed. Disposal should be done using the most up-to-date recycling technology according to local regulations and laws. There are no harmful materials used in the design and manufacture of the sensor. Traces of such dangerous materials may be found in the electronic components but not in the quantities that are harmful.

## 16. Product Label

Each TOF/Spot and TOF/Spot-S is labelled as below. It contains following information:



Figure 24: Product label - TOF/Spot (standard version)



Figure 25: Product label - TOF/Spot-S (safety version)

### Lot No.:

yymmdd: year (2 digits), month, day  
 mmmmmmmm: manufacturing job number  
 eeeee: employee number responsible for final test  
 ccccc: incremental number

## 17. Technical data

### Optical

Operating range	
- Types P, C, T and A	0.2 ... 6 m (0.7 ... 20 ft)
- Type N	0.2 ... 3 m (0.7 ... 10 ft)
Active light spot at 2 m distance	40 mm × 40 mm (1.57 in × 1.57 in at 6.5 ft)
Switching level	
- Types C and T	0.15 m (5.9 in)
Measurement precision	±5% at 2 m (at 6.5 ft) ±10 cm (3.93 in) over the whole range
Max. ambient light	100,000 Lux

### Mechanical

Dimensions	Ø 29.5 mm × 35.8 mm (1.16 in × 1.41 in)
Housing material	Polycarbonate
Housing color	Black
Enclosure rating	IP65
Operating temperature range	-40 °C... +60 °C
Relative humidity (non-condensing)	0 ... 95%

### Electrical

Supply voltage U <sub>SP</sub>	10 ... 30 VDC / 12 ... 24 VAC
Current consumption at 24 VDC	50 mA
Peak current consumption during power-up at 24 VDC	500 mA
Output	Solid-state relay, FSS, analog
Max. switching voltage	60 V
Max. switching current	150 mA
Max power-up time	1 s
Max. response time	60 ms
Test response time	5 ms

### Connection cable and electrical connection

Length	2 m
Diameter	Ø 3.4 mm (0.134 in)
Material	PVC, black
Wires	AWG26
• brown	+U <sub>SP</sub>
• black	Output A, FSS and analog output
• green	Output B, FSS GND and analog GND
• blue	GND (0 V) / -U <sub>SP</sub>
• white	Test input
• gray	Logic selector

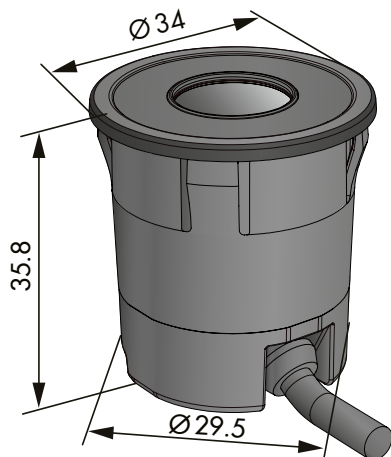
## General

EMC emission	EN 61000-6-3:2007, EN 12015:2014
EMC immunity	EN 61000-6-2:2005, EN 12016:2013 +A1:2008
Vibration	EN 60068-2-6:2008
Shock	EN 60068-2-27:2009
Change of temperature	EN 60068-2-14:2009
Safety rules for the construction and installation of lifts	DIN EN 81-1/-2:2010
Part 20: Passenger and goods passenger lifts	DIN EN 81-20:2011
RoHS	2011/65/EU
Certificate	CE, TÜV
Applicable standards - TOF/Spot-S	EN ISO 13849-1:2008, Cat. 2 PL C* EN 12978:2009 DIN 18650:2010, clause 5.7.4 EN 16005:2013, clause 4.6.8 EN 61508:2010, SIL1*

\* only when the sensor is pointed towards a background within the max. operating range

## 18. Dimensions

**Metric measurements** (all dimensions in mm)



**US measurements** (all dimensions in inches)

