OPERATING INSTRUCTIONS

TiM7xxS

Safety related 2D LiDAR sensor

SICK
Sensor Intelligence.

Product described

TiM7xxS

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Information on the operating instructions

These operating instructions provide important information on how to use devices from SICK AG.

Prerequisites for safe work are:

- Compliance with all safety notes and handling instructions supplied.
- Compliance with local work safety regulations and general safety regulations for device applications

The operating instructions are intended to be used by qualified personnel and electrical specialists.

NOTE
Read these operating instructions carefully to familiarize yourself with the device and its functions before commencing any work.

The operating instructions are an integral part of the product. Store the instructions in the immediate vicinity of the device so they remain accessible to staff at all times. Should the device be passed on to a third party, these operating instructions should be handed over with it.

These operating instructions do not provide information on the handling and safe operation of the machine or system in which the device is integrated. Information on this can be found in the operating instructions for the machine or system.

1.2 Target groups

These operating instructions are intended for the following target groups: project developers (planners, developers, designers), installers, electricians, safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application), operators, and maintenance personnel.

Target group specific contents

In many applications, the target groups consist of the manufacturer and the operating entity of the machine in which the device is integrated, as follows:

Target group		Special sections of these operating instructions [1]
Manufacturer	Project developers (planners, developers, designers)	"Project planning", page 50 "Commissioning and configuration", page 25 "Technical data", page 62, "Accessories", page 16
	Installers	"Mounting", page 23
	Electricians	"Commissioning and configuration", page 25
	Safety experts	"Project planning", page 50, "Commissioning and configuration", page 25 "Regular thorough checks", page 60 "Technical data", page 62

Target group		Special sections of these operating instructions [1]
Operating entity	Operator of the device	"Parameterization of the device", page 28
	Maintenance personnel	"Regular thorough checks", page 60 "Accessories", page 16

1) Sections not listed here are intended for all target groups. All target groups must comply with the safety notes in all of the operating instructions!

1.3 Explanation of symbols

Warnings and important information in this document are labeled with symbols. Signal words introduce the instructions and indicate the extent of the hazard. To avoid accidents, damage, and personal injury, always comply with the instructions and act carefully.

DANGER
... indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

WARNING
... indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

CAUTION
... indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

NOTICE
... indicates a potentially harmful situation, which may lead to material damage if not prevented.

NOTE
... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

1.4 Further information

More information can be found on the product page.

The product page can be accessed via the **SICK Product ID**: **pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

The following information is available depending on the product:

- Data sheets
- This document in all available language versions
- CAD files and dimensional drawings
- Certificates (e.g., declaration of conformity)
- Other publications
- Software
- Accessories

2 Safety information

2.1 Intended use

The TiM7xxS is a safety-related LiDAR sensor (laser scanner) that is suitable for the following applications:

- Hazardous area protection
- Hazardous point protection
- Access protection
- Mobile hazardous area protection (protection of mobile platforms)

The device is intended for use as a sensor in personal protection equipment, in mobile applications on electrically operated autonomous platforms, as well as in stationary applications for access protection and presence monitoring.

The safety-related 2D LiDAR sensor must only be used within the limits of the prescribed and specified technical data (see "Safety-related parameters", page 63) and operating conditions at all times.

Use inconsistent with the intended use, operation beyond the technical limits, improper modification of, or manipulation of the device, will invalidate any warranty from SICK; in addition, any responsibility and liability of SICK AG for damage and consequential damage caused by this is excluded.

2.1.1 Reasonably foreseeable misuse

WARNING

Risk of ineffectiveness of the protective device!

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

The device works as an indirect protective measure and cannot provide protection from pieces thrown from the application nor from emitted radiation. Objects within the blind zone and outside of the safety-related detection zone as well as transparent objects will not be detected.

- You must only use the device as an indirect protective measure.

The device is **not** suitable for the following applications (this list is not exhaustive):

- Outdoors
- Underwater
- In explosion-hazardous areas
- Use beyond the technical specifications

As a safety-related sensor, the device with performance level b (PL b), Category B (according to EN ISO 13849-1:2015) and performance class B (according to IEC TS 62998-1:2019) is only intended to perform part of the safety function (partial safety function). In its safety function, it provides sensor information to a downstream logic unit for further processing.

The safety function arises only in context with the target application, for example machine tools, a mobile platform, or a service robot.

Requirements and features of the application may differ from the features and characteristic values of the product and must be evaluated within the scope of project planning.

2.2 Improper use

Any use outside of the stated areas, in particular use outside of the technical specifications and the requirements for intended use, will be deemed to be incorrect use.

- The device must not be used in explosion-hazardous areas, in corrosive environments or under extreme environmental conditions.

WARNING
Danger due to improper use!

Any improper use can result in dangerous situations.

Therefore, observe the following information:

- Product should be used only in accordance with its intended use.
- All information in the documentation must be strictly observed.
- Shut down the product immediately in case of damage.

2.3 Cybersecurity

Overview

To protect against cybersecurity threats, it is necessary to continuously monitor and maintain a comprehensive cybersecurity concept. A suitable concept consists of organizational, technical, procedural, electronic, and physical levels of defense and considers suitable measures for different types of risks. The measures implemented in this product can only support protection against cybersecurity threats if the product is used as part of such a concept.

You will find further information at www.sick.com/psirt, e.g.:

- General information on cybersecurity
- Contact option for reporting vulnerabilities
- Information on known vulnerabilities (security advisories)

2.4 Limitation of liability

Relevant standards and regulations, the latest technological developments, and our many years of knowledge and experience have all been taken into account when compiling the data and information contained in these operating instructions. The manufacturer accepts no liability for damage caused by:

- Non-adherence to the product documentation (e.g., operating instructions)
- Incorrect use
- Use of untrained staff
- Unauthorized conversions or repair
- Technical modifications
- Use of unauthorized spare parts, consumables, and accessories

2.5 Modifications and conversions

NOTICE
Modifications and conversions to the device may result in unforeseeable dangers.

Interrupting or modifying the device or SICK software will invalidate any warranty claims against SICK AG. This applies in particular to opening the housing, even as part of mounting and electrical installation.

2.6 Requirements for skilled persons and operating personnel

WARNING
Risk of injury due to insufficient training.

Improper handling of the device may result in considerable personal injury and material damage.

- All work must only ever be carried out by the stipulated persons.

Project planning

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

Mechanical mounting

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

Electrical installation

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

Configuration

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

Commissioning

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

Operation and maintenance

For operation and maintenance, a person is considered qualified when he/she has the expertise and experience in the relevant field, is sufficiently familiar with the use of the protective device on machines in the respective area of application, and has been instructed by the operating entity of the machine in the details of operation.

An operator may clean the device and carry out specific thorough checks as instructed.

Regular thorough checks

For these regular thorough checks, a person is considered qualified when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the use of the protective device on machines in the respective area of application to be able to assess whether it is in an operationally safe state.

2.7 Operational safety and specific hazards

Please observe the safety notes and the warnings listed here and in other sections of this product documentation to reduce the possibility of risks to health and avoid dangerous situations.

CAUTION
Optical radiation: Class 1 Laser Product

The accessible radiation does not pose a danger when viewed directly for up to 100 seconds. It may pose a danger to the eyes and skin in the event of incorrect use.

- Do not open the housing. Opening the housing may increase the level of risk.
- Current national regulations regarding laser protection must be observed.

Caution – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

It is not possible to entirely rule out temporary disorienting optical effects, particularly in conditions of dim lighting. Disorienting optical effects may come in the form of dazzle, flash blindness, afterimages, photosensitive epilepsy, or impairment of color vision, for example.

WARNING
Electrical voltage!

Electrical voltage can cause severe injury or death.

- Work on electrical systems must only be performed by qualified electricians.
- The power supply must be disconnected when attaching and detaching electrical connections.
- The product must only be connected to a voltage supply as set out in the requirements in the operating instructions.
- National and regional regulations must be complied with.
- Safety requirements relating to work on electrical systems must be complied with.

WARNING
Risk of injury and damage caused by potential equalization currents!

Improper grounding can lead to dangerous equipotential bonding currents, which may in turn lead to dangerous voltages on metallic surfaces, such as the housing. Electrical voltage can cause severe injury or death.

- Work on electrical systems must only be performed by qualified electricians.
- Follow the notes in the operating instructions.
- Install the grounding for the product and the system in accordance with national and regional regulations.

2.8 Norms and standards of functional safety management

The safety-related TiM7xxS 2D-LiDAR sensors fulfill the requirements of EN ISO 13849-1:2015 regarding category B/PL b and the requirements of the following application standards:

- EN ISO 13482:2014 – Robots and robotic devices – Safety requirements for personal assistance robots
- EN ISO 13855:2010 – Safety of machinery – Positioning of protective devices with respect to the approach speeds of parts of the human body
- DIN CLC/TS 62046:2009 – Safety of machinery – Application of protective equipment to detect the presence of persons

- IEC TS 62998-1:2019 – Safety of machinery – Safety-related sensors
- EN ISO 13849-1:2015 Safety-related parts of control systems – Part 1: General principles for design
- ANSI/ITSDF B 56.5:2012 – Safety Standard for Driverless, Automatic Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles

3 Product description

3.1 Device

Type	TIM771S-2174104	TiM781S-2174104
Device type	Safety-related 2D LiDAR sensor	
Type	PNP	
Measurement principle	HDDM	HDDM+
Part number	1105052	1096363

3.2 Configuration software

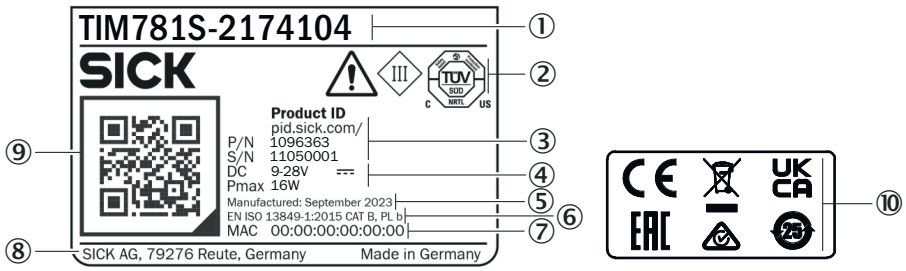
Type	TIM771S-2174104 TiM781S-2174104
Designation	SOPAS ET
Valid software version	3.3.3 or above

3.3 Scope of delivery

- Safety-related 2D-LiDAR sensor of the type ordered, including mounting kit 1 (2 fastening clips, 2 M3 x 5 mm screws)
- Printed safety notes with reference to the operating instructions in German and English; in other languages via the SICK AG website, if required
- Other optional accessories (if these have been ordered)

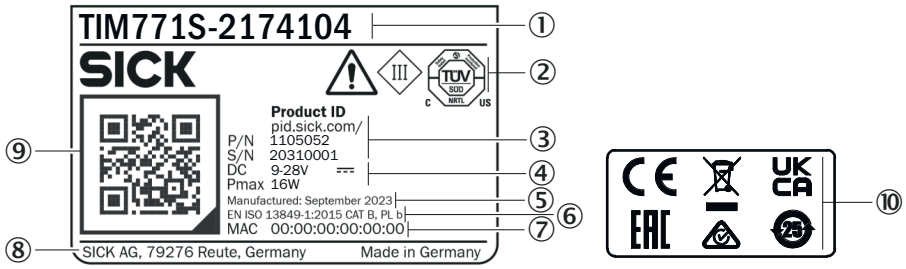
3.4 Type label

TiM781S



① Type code
② Conformity mark/certification mark, symbol: Observe the operating instructions!
③ Product ID with part number (P/N) and serial number (S/N)
④ Voltage supply, maximum power consumption
⑤ Production date
⑥ Complies with EN ISO 13849-1:2015 CAT B, Pl b
⑦ MAC address
⑧ Manufacturer/production location
⑨ QR code with product data (part number, serial number), example: pid.sick.com/1096363/11050001
⑩ Conformity mark/certification mark

TiM771S



① Type code
② Conformity mark/certification mark, symbol: Observe the operating instructions!
③ Product ID with part number (P/N) and serial number (S/N)
④ Voltage supply, maximum power consumption
⑤ Production date
⑥ Complies with EN ISO 13849-1:2015 CAT B, PI b
⑦ MAC address
⑧ Manufacturer/production location
⑨ QR code with product data (part number, serial number), example: pid.sick.com/1105052/20310001
⑩ Conformity mark/certification mark

3.5 Setup and dimensions

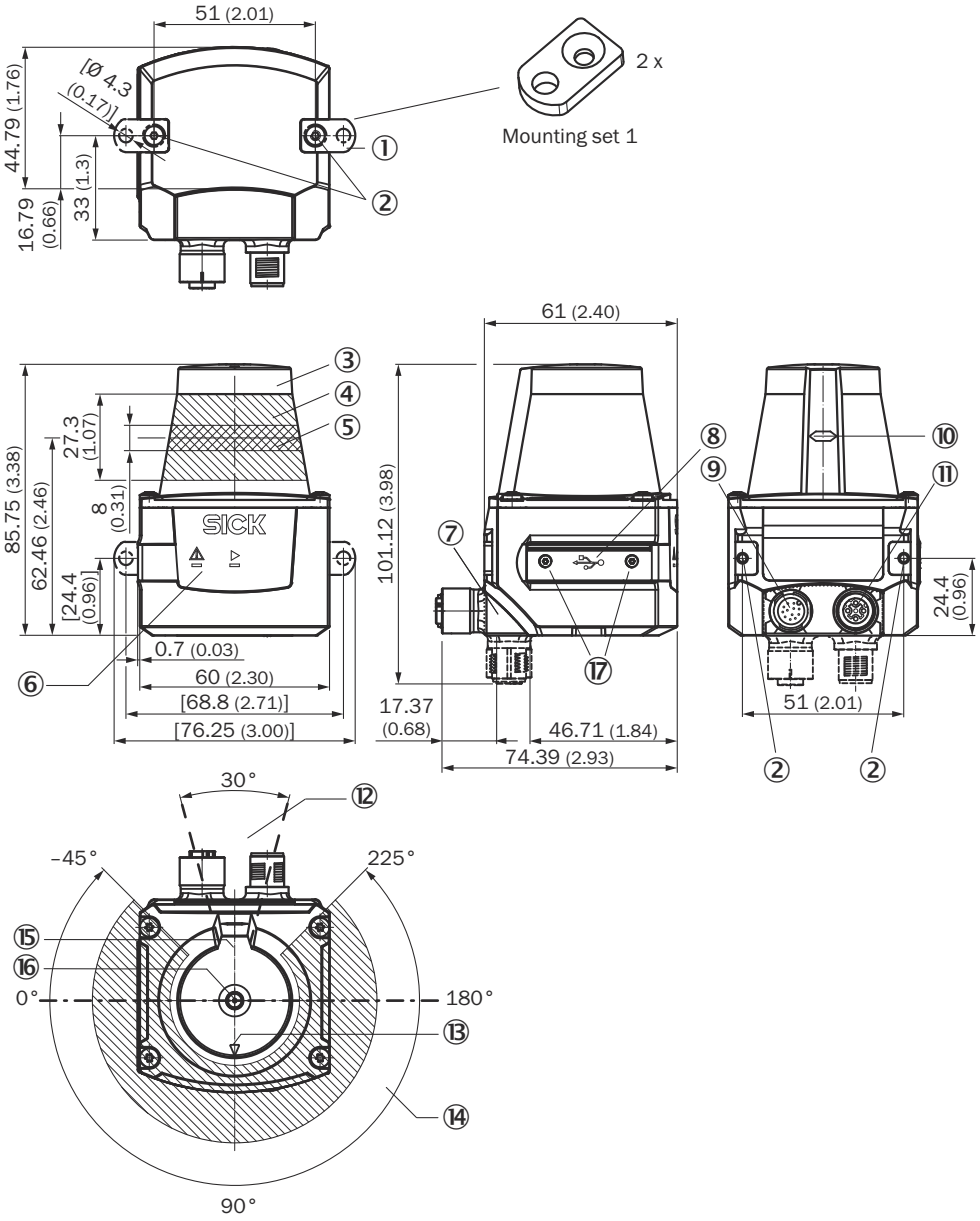


Figure 1: Structure and dimensions, unit: mm (inch), decimal separator: period

① Mounting kit 1: 2x fastening clip with M3 x 5 mm countersunk screw, self-locking (included in scope of delivery)

② M3 threaded mounting hole, 2.8 mm deep (blind hole thread), max. tightening torque 0.8 Nm

③ Optics cover

④ Receiving range (light inlet)

⑤ Transmission range (light emission)

⑥ Red and green LED (status indicators)

⑦ Swivel connector unit with electrical connections (recess the area for surface mounting)

⑧ Micro USB port, behind the black plastic cover (“Aux interface” connection for configuration with computer)

⑨ “Power/inputs and outputs” connection, 12-pin M12 male connector

⑩ Marking for the position of the light emission level

⑪ “Ethernet” connection, 4-pin M12 female connector: not used
⑫ Area in which no reflective surfaces are permitted when the device is mounted
⑬ Bearing marking to support alignment (90° axis)
⑭ 270° aperture angle (field of vision)
⑮ Internal reference target
⑯ Measurement origin
⑰ 2 x countersunk screw (Torx TX 6) M2 x 4 mm

3.6 Accessories

The following accessories are permissible for safety-related use in connection with the TiM7xxS.

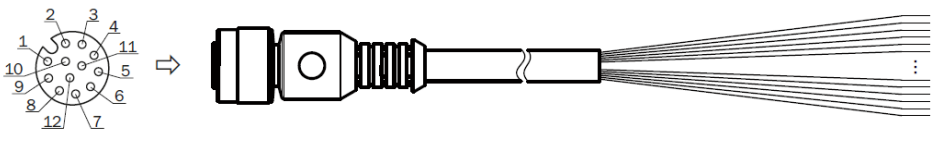
3.6.1 Mounting kit

The mounting kit with fine adjustment (part number 2086761) acts as a bracket, including the option of performing fine adjustment of the scan level, and also provides impact protection. The device can also be mounted directly on the bracket without the adapter plate (mechanical collision protection only).

3.6.2 Cables

Designation	Part number
USB – Guide for configuring the sensor	6036106
M12 female connector – open, 5 m, 12-wire, shielded, PUR, halogen-free	6054974
M12 female connector – open, 10 m, 12-wire, shielded, PUR, halogen-free	6054973
M12 female connector – open, 20 m, 12-wire, shielded, PUR, halogen-free	6054972
M12 male connector - M12 male connector, Ethernet cable, 5 m	6045277
M12 male connector - M12 male connector, Ethernet cable, 10 m	6045279
M12 male connector - M12 male connector, Ethernet cable, 20 m	6063693

3.6.3 Wire assignment, part numbers 6054973/6054972



Female connector, M12, 12-pin, A-coded (view from front)	Illustration may differ

PIN	Signal	Function	Cable wire colors 6054973 (10 m), 6054972 (20 m)
1	GND	Ground	Blue
2	DC 9 V ... 28 V	Supply voltage	Brown
3	IN 1	Digital input 1 (field set selection)	Red
4	IN 2	Digital input 2 (field set selection)	Green
5	OUT 1	Digital output 1 (object detection)	Pink
6	OUT 2	Digital output 2 (object detection)	Yellow

PIN	Signal	Function	Cable wire colors 6054973 (10 m), 6054972 (20 m)
7	OUT 3	Digital output 3 (object detection)	Black
8	OUT 4	Digital output 4 (index/error)	Gray
9	PNP: INGND	PNP: Common ground for all inputs	White
	NPN: IN DC 9 V ... 28 V	NPN: Common reference potential of all inputs	
10	IN 3	Digital input 3 (field set selection)	Violet
11	IN 4	Digital input 4 (field set selection)	Gray-pink
12	N. c.	-	Red-blue
-	-	Screen	

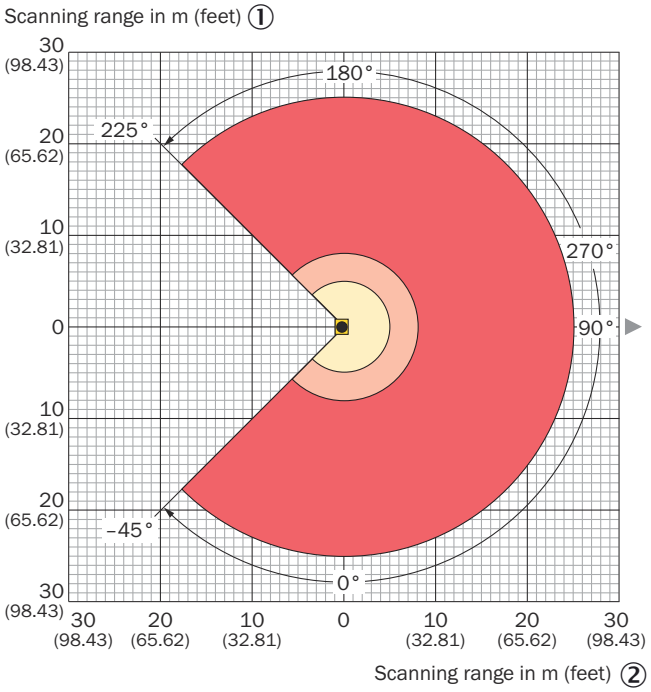
3.7 Measurement principle

The device is an opto-electronic 2D LiDAR sensor that uses laser beams to scan in a non-contact manner the outline of its surroundings on a plane. The device measures its surroundings in two-dimensional polar coordinates, relative to its measurement origin in the middle of the optics cover. The arrow visible on the optics cover marks the 90° angle as the middle of the scanning range. If a laser beam strikes an object, the position of that object is determined in terms of length (distance) and direction (angle).

The device uses a rotating mirror to deflect the emitted laser beams, thereby scanning its surroundings in a circular pattern across a 270° segment. The measurements are triggered internally by an encoder in regular angle increments.

The device works with a scanning frequency of 15 Hz (15 measurements per second).

Working range



Range for **not safety-related** detection at > 90% remission: 0.05 m (0.17 feet) to max. 25 m (82.02 feet) ③

Range for **not safety-related** detection 10% remission: 0.05 m (0.17 feet) to max. 8 m (26.25 feet) ④

Range for **safety-related** detection at 5% remission: 0.05 m (0.17 feet) to max. 5 m (16.40 feet) ⑤

Attention! From the measurement origin up to a distance of 0.05 m (0.17 feet) no objects are detected (blind zone!) over the entire radial field of view (scanning range of 270°). ⑥

Figure 2: TiM7xxS working range diagram, decimal separator: period

① Sensing range in meters (feet)

② Sensing range in meters (feet)

③ Scanning range for **non safety-related** detection at > 90 % remission: 0.05 m to max. 25 m

④ Scanning range for **non safety-related** detection at 10% remission: 0.05 m to max. 8 m

⑤ Scanning range for **safety-related detection** at 5% remission: 0.05 m to max. 5 m

⑥ **WARNING!** No objects will be detected within a range of 0.05 m from the measurement origin and across the entire radial field of view (scanning range of 270°) (blind zone!).

3.8 Object sizes

As the distance from the device increases, the laser beam expands. As a result, the diameter of the light spot on the surface of the object increases.

Figure 3: Beam expansion

① Expanded laser beam

② Optical axis

Required values for calculating the light spot size and minimum object size:

- Light spot size on the device cover: 7 mm (rounded up)
- Light spot divergence per single pulse: 0.49 deg (8.6 mrad)
- HDDM+ supplement (1 measured value consists of several overlapping single pulses): 5.8 mrad

Formula for calculating the light spot width:

(Light spot divergence [mrad] + supplement [mrad]) * distance [mm] + light spot size on the device cover [mm] = light spot width [mm]

Calculation example of light spot width at a distance of 4 m, with supplement 5.8 mrad:

(8.6 mrad +5.8 mrad) * 4,000 mm +7 mm = 64.6 mm

Formula for calculating the height of the light spot:

Light spot divergence [mrad] * Distance [mm] + Light spot size at the device cover [mm] = Light spot width [mm]

Example calculation of the light spot height at a distance of 4 m:

8.6 mrad * 4,000 mm +7 mm = 41.4 mm

Formula for calculating the minimum object size:

2 * supplement [mrad] * distance [mm] + light spot height [mm] = minimum object size [mm]

Calculation example of minimum object size at a distance of 4 m, with supplement 5.8 mrad:

2 * 5.8 mrad * 4,000 mm + 41.4 mm = 87.8 mm

NOTE

For reliable measurement, an object needs to be hit several times. Therefore, the object either needs to be larger than the minimum object size, or both the LiDAR sensor and the object must not be moving.

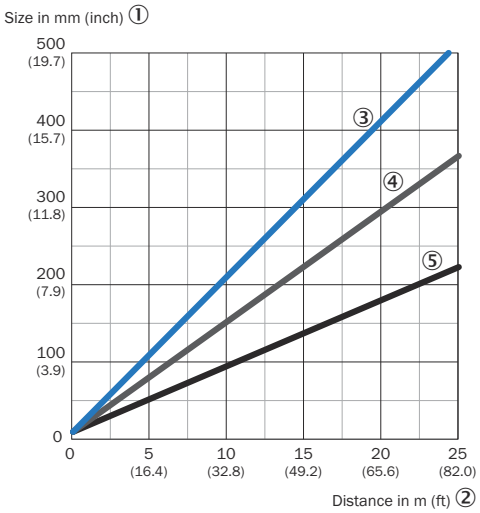


Figure 4: Minimum object size

① Size in millimeters (inc)
② Distance in meters (feet)
③ Minimum object size
④ Light spot width
⑤ Light spot height

3.9 Safety-related functions

The device is intended for use in personal protective equipment for detecting safety-related objects in mobile and stationary applications.

It also comes with two safety functions (see "Operating modes/operational statuses", page 44)

During normal operation, the **safety functions** are reporting the presence or penetration of objects into the active protective fields as well as the continuous output of distance values to objects in the safety-related detection zone.

The device meets the requirements of performance level b (PL b), Category B, according to EN ISO 13849-1:2015 and performance class B (according to IEC TS 62998-1:2019). It can be used within its area of application for risk reduction according to its features.

3.10 Safety characteristic values

The device has the following safety characteristic values in acc. with EN ISO 13849-1:2015:

- Performance level b (PL b)
- Category (Cat.): B
- Mean Time To Dangerous Failure ($MTTF_D$): 100 years (at 25 °C ambient temperature) [1)]
- Mission Time (MT) (period of use): 20 years

The device has the following safety characteristic values in acc. with EC TS 62998-1:2019 performance class B.

3.11 Safety-related detection capability (horizontal/vertical)

Values see "Safety-related parameters", page 63

3.11.1 Restrictions

The safety-related detection capability (determined by the measurement procedure) can be impaired for measurement of objects with edges and/or corners and/or those moving too quickly. This can result in incorrect distance values, causing impairment, reduction or complete loss of detection capability, and the device no longer being able to perform its function.

Values: see "Safety-related parameters", page 63.

3.11.2 Blind zone

No objects will be detected within a range of 0.05 m from the measurement origin.

3.11.3 Measurement on reflector

When using reflectors (max. remission of 330 Cd/lx*m^2) as the target, the statistical and systematic measurement accuracy diminishes at lower temperatures and therefore also the detection capability of the sensor.

Values: see "Safety-related parameters", page 63.

1) At higher ambient temperatures, the $MTTF_D$ value decreases according to the Arrhenius equation. These values can be requested from SICK.

3.11.4 Limits of the system

A measurement with minimal remission combined with maximum remission (reflector) represents the most challenging situation.

The most unfavorable case here - like in the visible spectrum - is spill from a weak emitter in front of a strong reflector.

If the dark object is relatively small and the reflector is moved to less than 1.5 meters behind the object, it may not be possible to distinguish the reflector from an object edge. The measured value could therefore be reduced by up to half the distance of the dark object from the reflector, like for an edge evaluation (see "Restrictions", page 20). This effect can be attributed to scattered light from the periphery of the laser beam falling onto the highly amplifying reflector.

Conversely, a reflector in the foreground, for example on a person's clothing, and in front of a dark background poses no difficulties and leads to a reliable detection. This object migration effect also does not occur for dark objects in front of normal white backgrounds with a remission of approx. 100%.

If strongly amplifying reflectors at a distance of less than 1.5 meters behind objects with a low remission cannot be excluded, then their impact on the safety function of the overall system needs to be specifically evaluated.

WARNING

Due to the necessary system reserve of the device, its detection range and/or system range is greater than the assured distances for safety-related detection.

This system reserve **must not** be used for safety-related analysis!

4 Transport and storage

4.1 Transport

NOTICE
Damage due to improper transport!

- The product must be packaged with protection against shock and damp.
- Recommendation: Use the original packaging.
- Note the symbols on the packaging.
- Do not remove packaging until immediately before you start mounting.

4.2 Unpacking

- To protect the device against condensation, allow it to equilibrate with the ambient temperature before unpacking if necessary.
- Handle the device with care and protect it from mechanical damage.
- To avoid ingress of dust and water, only remove the protective elements, e.g. protective caps of the electrical connections just before attaching the connecting cable.

4.3 Transport inspection

Immediately upon receipt in Goods-in, check the delivery for completeness and for any damage that may have occurred in transit. In the case of transit damage that is visible externally, proceed as follows:

- Do not accept the delivery or only do so conditionally.
- Note the scope of damage on the transport documents or on the transport company's delivery note.
- File a complaint.

NOTE
Complaints regarding defects should be filed as soon as these are detected. Damage claims are only valid before the applicable complaint deadlines.

4.4 Storage

- Electrical connections are provided with a protective cap.
- Do not store outdoors.
- Store in a place protected from moisture and dust.
- Recommendation: Use the original packaging.
- To allow any residual dampness to evaporate, do not package in airtight containers.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- Storage temperature: see "Technical data", page 62.
- Relative humidity: see "Technical data", page 62.
- For storage periods of longer than 3 months, check the general condition of all components and packaging on a regular basis.

5 Mounting

5.1 Mounting instructions

- The device must be mounted in such a way that it is ensured during operation that all specified values are adhered to and not exceeded.
- Mount the device using the optionally available assembly accessories, see "Accessories", page 16.
- Mount the device on a prepared bracket.
- The device should be mounted and operated as free from shock and vibration as possible.
- The device can be mounted in any position depending on the application purpose.
- Mount the device so that it is not exposed to direct sunlight (window, skylight) or other sources of heat. This prevents the temperature inside the device from increasing unacceptably, or a reduction or loss of detection capability.
- During mounting, make sure there is no reflective surface behind the internal reference target, see "Setup and dimensions", page 15. In general, to prevent a reduction or loss of detection capability, the mounting position of the device should be chosen so as to exclude any dazzle in the sensor's back area (behind the internal reference target) due to other light sources.
- When mounting the device, make sure the swivel connector area is recessed so it does not lie on the mounting surface see "Setup and dimensions", page 15.
- Avoid having shiny or reflective surfaces in the scanning range, e.g., stainless steel, aluminum, glass, reflectors, or surfaces with these types of coatings.

5.2 Mutual interference

NOTE

Optical sensors and other IR light sources can influence the measurement and detection capabilities of the device.

The device has been designed to minimize the probability of mutual interference with devices of the same type. To rule out even the slightest effects on the measurement accuracy, the devices should be arranged such the laser beams are not received by another device.

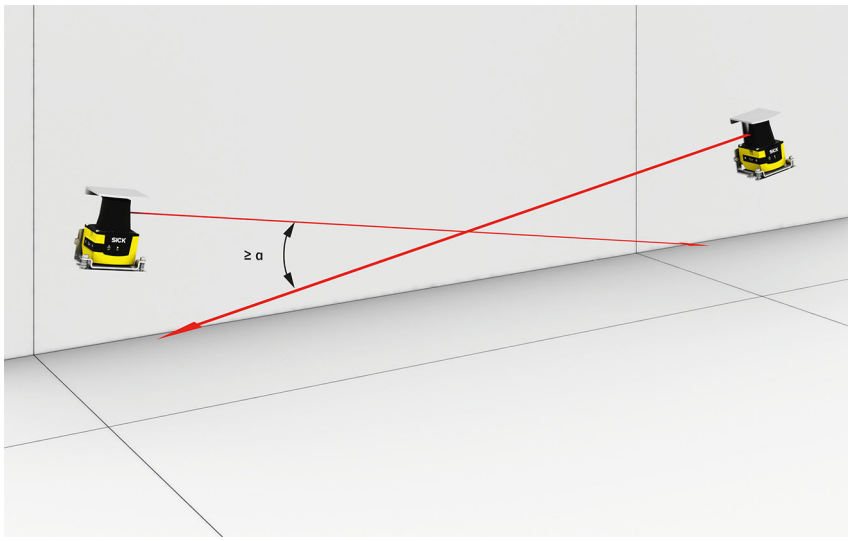


Figure 5: Angle ≥ 6 °

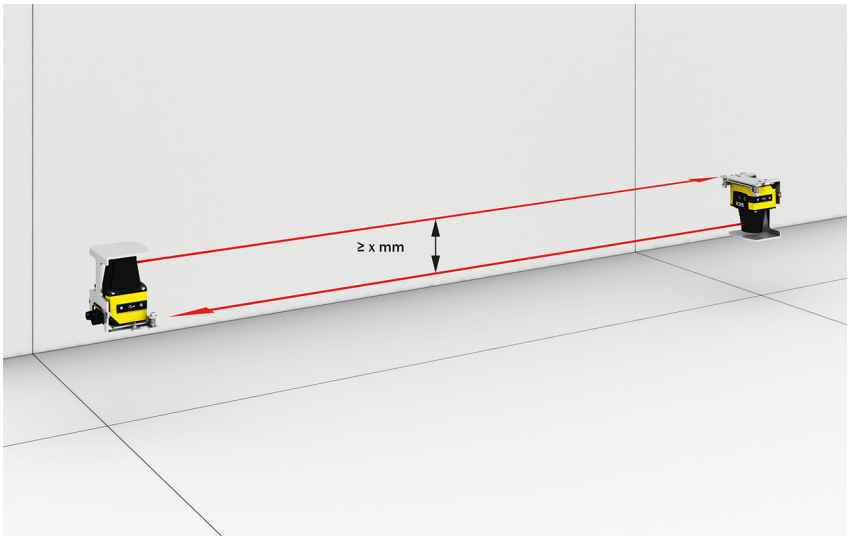


Figure 6: Distance ≥ 200 mm

6 Commissioning and configuration

6.1 Prerequisites for safe operation of the device

WARNING
Risk of injury and damage caused by electrical current!

As a result of equipotential bonding currents between the device and other grounded devices in the system, faulty grounding of the device can give rise to the following dangers and faults:

- Dangerous voltages are applied to the metal housings.
- Devices will behave incorrectly or be destroyed.
- Cable shielding will be damaged by overheating and cause cable fires.

Remedial measures

- Only skilled electricians should be permitted to carry out work on the electrical system.
- If the cable insulation is damaged, disconnect the voltage supply immediately and have the damage repaired.
- Ensure that the ground potential is the same at all grounding points.
- Where local conditions do not meet the requirements for a safe earthing method, take appropriate measures. For example, ensure low-impedance and current-carrying equipotential bonding.

The device is connected to the peripheral devices (any local trigger sensor(s), system controller) via shielded cables. The cable shield – for the data cable, for example – rests against the metal housing of the device.

The device can be grounded through the cable shield or through a blind tapped hole in the housing, for example.

If the peripheral devices have metal housings and the cable shields are also in contact with their housings, it is assumed that all devices involved in the installation have the **same ground potential**.

This is achieved by complying with the following conditions:

- Mounting the devices on conductive metal surfaces
- Correctly grounding the devices and metal surfaces in the system
- If necessary: low-impedance and current-carrying equipotential bonding between areas with different ground potentials

If these conditions are not fulfilled, equipotential bonding currents can flow along the cable shielding between the devices due to differing ground potentials and cause the hazards specified. This is, for example, possible in cases where there are devices within a widely distributed system covering several buildings.

Remedial measures

The most common solution to prevent equipotential bonding currents on cable shields is to ensure low-impedance and current-carrying equipotential bonding. If this equipotential bonding is not possible, the following solution approaches serve as a suggestion.

NOTICE
We expressly advise against opening up the cable shields. This would mean that the EMC limit values can no longer be complied with and that the safe operation of the device data interfaces can no longer be guaranteed.

Measures for widely distributed system installations

On widely distributed system installations with correspondingly large potential differences, the setting up of local islands and connecting them using commercially available **electro-optical signal isolators** is recommended. This measure achieves a high degree of resistance to electromagnetic interference.

The use of electro-optical signal isolators between the islands isolates the ground loop. Within the islands, a stable equipotential bonding prevents equalizing currents on the cable shields.

Measures for small system installations

For smaller installations with only slight potential differences, insulated mounting of the device and peripheral devices may be an adequate solution.

Even in the event of large differences in the ground potential, ground loops are effectively prevented. As a result, equalizing currents can no longer flow via the cable shields and metal housing.

NOTICE

The voltage supply for the device and the connected peripheral devices must also guarantee the required level of insulation.

Under certain circumstances, a tangible potential can develop between the insulated metal housings and the local ground potential.

6.2 Electrical block diagram

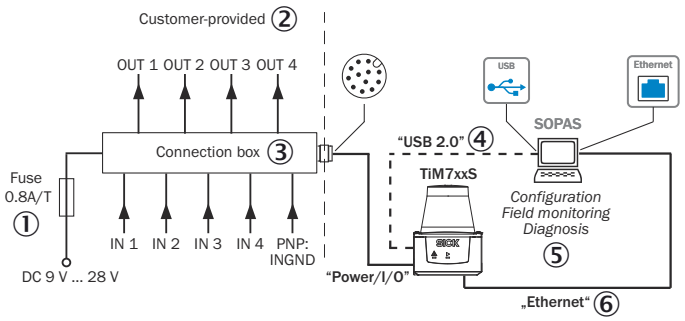


Figure 7: Block diagram for the TiM7xxS connection

① 0.8 A/T fuse
② Provided by customer
③ Switch-on device
④ USB interface
⑤ Configuration, field analysis, diagnostics
⑥ Ethernet interface

6.3 Wiring instructions

NOTE

Pre-assembled cables can be found on the product page.

The product page can be accessed via the **SICK Product ID**: **pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

NOTICE

Faults during operation and defects in the device or the system

Incorrect wiring may result in operational faults and defects.

- Follow the wiring notes precisely.

The enclosure rating stated in the technical data is achieved only with screwed plug connectors or protective caps.

Protect the device from dust and moisture when the plastic USB cover is open.

The USB interface is only for parameterization. Remove the USB cable for problem-free operation of the device.

All circuits connected to the device must be configured as SELV or PELV circuits. SELV = safety extra-low voltage, PELV = protective extra-low voltage.

Protect the device with an external 0.8 A slow-blow fuse at the beginning of the supply cable.

Connect the connecting cables in a de-energized state. Do not switch on the supply voltage until installation is complete and all connecting cables are connected to the device and control.

Wire cross-sections in the supply cable from the customer's power system must be implemented in accordance with the applicable standards.

6.4 Installation of SOPAS Engineering Tool

6.4.1 System requirements for SOPAS ET

System	Minimum requirement for version 3.3.3
CPU	Standard Intel Pentium computer or compatible, at minimum Pentium III 500 MHz
Frequency and working memory	Min. 1 GHz / 1 GB RAM
Interface	USB 2.0 or compatible
Operating system	Windows XP, Vista, Windows 7 or Windows 8 (32/64 bit)
Minimum resolution	1024 x 768 px
Memory	At least 450 MB

6.4.2 Installation process

NOTE

Use the standard version of the software, not the portable version. Using the standard version ensures that all SOPAS ET functions and drivers are available. For installation, it may also be necessary to have administrator authorizations.

- Select the installation language.

This selection only determines the language of the installation wizard. Regardless of the selected installation language, all SOPAS ET languages can be selected subsequently.

- Chose whether you want to have an icon on the desktop or on the Start Menu bar, and click **Next >**.
- Select the installation location for SOPAS ET.

It is recommended not to change the suggested location.

- Click **Next >**.

The installation process starts. Please wait until it is fully complete and the next page appears. The **Run SOPAS Engineering Tool** checkbox is preselected.

- Use the **Close** button to complete the installation and launch SOPAS ET.

6.4.3 Installing the device driver

The device driver is installed automatically the first time a connection is established between SOPAS ET and the device.

6.4.4 ROS driver

Suitable drivers for integrating the TiM7xxS into an ROS (robot operating system) are available for download on the product page: www.sick.com/TiM-S

NOTE

The ROS driver is not a component of the safety verification of the TiM7xxS.

The use of the ROS driver or comparable drivers in a safety-related context can only be made possible by an additional safety verification for the specific use case or the specific overall system; this safety verification must be kept separately by the user. In this case, safety-related evaluation is the responsibility of the customer or the user.

6.5 Parameterization of the device

The SOPAS ET computer software is provided for safety-related parameterization. Parameterization can be done using the following interfaces:

- USB
- Ethernet

WARNING

Risk of ineffectiveness of the protective device!

- Before establishing a connection between SOPAS ET and the device and before beginning parameterization, ensure that the machine, plant or application in which the device is involved as part of a safety function is in a safe state and thus not in operation.
- The prevention of manipulations during parameterization of the machine, plant or application must be ensured by the user, by additional measures if necessary.

NOTE

Safety-related programming using other released telegrams or tools (not SOPAS ET) can only be made possible by an additional safety verification for the specific use case; this safety verification must be kept separately by the user.

In this case, safety-related evaluation is the responsibility of the customer or the user.

6.5.1 Establishing the connection

Before launching SOPAS ET, a suitable cable (see "Accessories", page 16) must be used to establish a USB or Ethernet connection between the parameterization interface of the device and the computer.

► To run SOPAS ET, double-click the program icon – a new project is opened.

A quick search for connected devices is performed.

The progress bar shows how far the process has progressed. The **x** symbol to the right of the progress bar can be used to cancel the search process.

Found devices are listed in the search results window. If the device was previously connected to the computer, it will appear in the search results.

Found devices can be inserted into the project from the search results area via drag & drop, double-click, the Enter pushbutton, or the **Add** icon. They will remain in the search results but are displayed in gray.

Devices can only be parameterized and monitored if they have been added to the project.

No actions can be performed on the device in the search results window.

A device driver must be installed before establishing a connection with the device for the first time. Follow the instructions provided by SOPAS ET.

When selecting the source for the driver installation, choose the “Upload from device” option.

6.5.2 Configure the device

1. Double-click on the desired device.
✓ This opens the device window which displays all the device parameters.
2. Parameterize the device, load parameters into or from the device, or monitor parameter values.

NOTE

The parameter values then also remain in the project after you close the device window.

After closing the main window, you will be informed that parameters must be permanently saved in the device and parameter values will be lost if the project has not been saved.

6.5.3 Passwords

Software access to the device is protected by various passwords. After configuring the device successfully, the respective password must be changed so that it can fulfill its protective function.

NOTE

Software access to the device is protected by user levels and passwords. After successfully configuring the device, you should change the passwords so they can fulfill their protective function.

User level	Password
Machine operator	–
Maintenance	Does not have a factory-set password. To log in as the **Maintenance** user, a password must first be created by the **Authorized client** user. When creating the password, the **Current password** field must be left blank.
Authorized Client (Integrator)	The password `SICKSAFE` is set at the factory. Change this password to protect the device against unauthorized access.
Service	The password `servicelevel` is set at the factory. Change this password to protect the device against unauthorized access.

Table 1: User level and authorization

Machine operator	A **Machine operator** level user can view the basic device parameters. • No password required • Read only permissions • Not all parameters are visible
Maintenance	**Maintenance** can view the application-related device parameters. • Read only permissions • Not all parameters are visible • Can change the password for this user level
Authorized Client (Integrator)	Device parameters can be set as an **Authorized Client**. • Access to most parameters • Can change the password for this user level and the password for the **Maintenance** user level. • Can create a diagnostic report
Service	A **Service** level user can configure all device parameters. • Access to all parameters • Can change the password for this user level as well as the password for the user levels **Maintenance** and **Authorized Client** • Can create a diagnostic report • Can perform firmware updates

NOTE
Change the passwords during initial commissioning to protect your device.

A higher user level can change the password of a lower user level.

NOTE
If the password for the Service user level has been lost: see "Resetting the password for the Service user level", page 30.

6.5.3.1 Resetting the password for the Service user level

If you have forgotten the password of the **Service** user level, you can reset it with the assistance of SICK.

NOTE
The responsible SICK sales company or the responsible SICK service partner carefully checks each code request to reset the password. A risk of deception by third parties nevertheless exists. The operating entity should therefore take suitable security measures.

The operating entity should also take suitable measures to limit, as best as possible, access to the product. This includes, in particular, physical access as well as access to the software interfaces of the product.

Requesting an unlock code

1. Open SOPAS ET.
2. Open the device window.
3. Open the device name > **Password** > **Reset Service password**.

✓ The **Reset password** window appears.

4. Enter the relevant data.

   NOTE | Do not press **Generate** if an unlock code has already been requested from SICK. Only press this button if a new device code is required when inquiring again.

5. Click **Generate e-mail with data**.
✓ Your SICK subsidiary will create the unlock code based on the information provided and send it to you.
The code is only valid once for the reset process. You can close the window by clicking on the **x** without interrupting the reset process. If you select **Cancel** or enter an incorrect code several times, the current reset process is terminated. The requested code is no longer valid. The process must be restarted.
6. Wait for the unlock code: The dialog box can be closed and the device switched off.

Entering the unlock code

Prerequisite
- SICK has sent an unlock code.

1. Open SOPAS ET.
2. Open the device window.
3. Open the device name > **Password** > **Reset Service password**.
✓ The **Reset password** window appears.
4. Click **Next**.
5. Enter the code sent by SICK.
6. Click **Ok**.
✓ Password has been reset to the default password `servicelevel`. Parameters are not changed.

Assigning a new password for the Service user level

1. Open SOPAS ET.
2. Log on to the device with the **Service** user level and the default password `servicelevel`.
3. Open the device name > **Password** > **Change password**.
4. Assign the new password for the **Service** user level.

6.5.4 Display of the current operational status

The **Field Evaluation Monitor** page (in the navigation area of the device window, below the **Monitor** node) displays the current operational status consisting of measurement data, status of the individual fields as well as status of the digital inputs and digital outputs.

The **field monitor**, which is located in the middle of the page, displays measurement data as blue points and/or a blue line. Occupied fields are shown in yellow; free fields appear in green.

6.5.5 Changing parameters

WARNING
Risk of injury/risk of damage due to incorrect parameters!

- Parameter changes are transferred to the device and take effect immediately after being edited. Permanent saving (in the non-volatile memory of the device) does not occur, however, until the **Save permanent** button is clicked.
- Correct transmission of the parameters must be checked for each device, e.g. by testing in the application. A new test is required each time the parameters are changed.
- After parameter changes, the effectiveness of the protective device in the application must be reviewed and documented.
- Before beginning the parameterization, ensure that the machine, plant or application in which the device is involved as part of a safety function is in a safe state.

Please note:

The individual parameters of the device can be changed on the pages below the **Parameters** node in the navigation area.

The device for safety-related applications must be configured/parameterized using the SOPAS ET configuration software.

6.5.6 Default configuration

The product is delivered with the following parameterization, which prevents unintentional or inadvertent activation of the sensor. The device has this default parameterization in the delivery condition.

WARNING
Risk of ineffectiveness of the protective device!

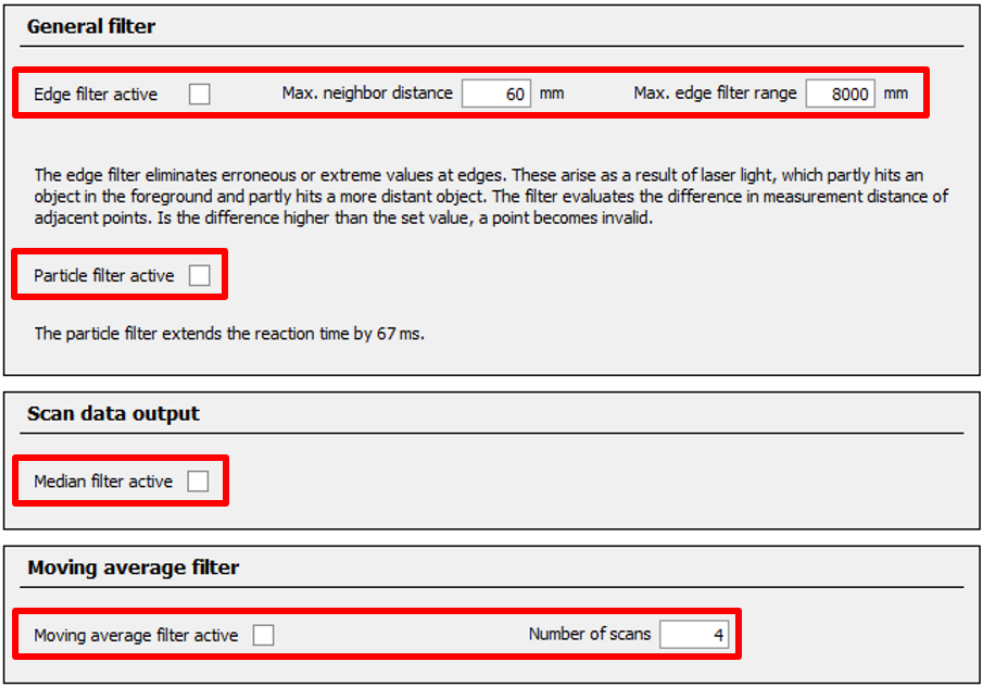
- After parameterizing the device or subsequently modifying the parameters, the effectiveness of the protective device in the application must be reviewed and documented. For a safety-related use of the device, this may in certain circumstances include a comprehensive safety assessment.

NOTE
The parameterization and commissioning in the case of a safety-related use of the device must only be performed by appropriately qualified personnel. This applies in particular to settings that differ from the default parameterization, and the resultant requirement for an assessment of the safety-related sensor function within the application.

6.5.6.1 Edge filter, particle filter, median filter,, moving average filter

Default: All filters “inactive”

NOTICE
Adherence to the safety-related technical data listed in section see "Safety-related parameters", page 63 can only be ensured when the filters are deactivated. The activation or use of filters in a safety-related context can therefore only be made possible by an additional safety verification for the specific use case or the specific overall system; this safety verification must be kept separately by the user.

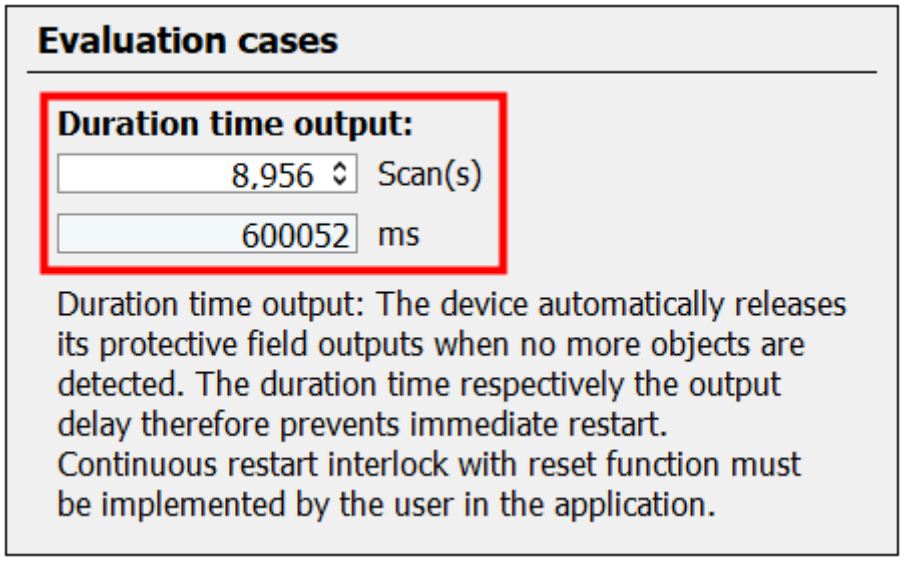


The filters should be deactivated, otherwise objects that appear sporadically and for a short time will not be detected and/or filtered out.

Filters can also slow down the response of the digital outputs, and the outputting of measured values via the Ethernet interface.

6.5.6.2 Hold time of outputs

Default: Maximum duration time of the outputs (8,956 scans / 600,052 ms)

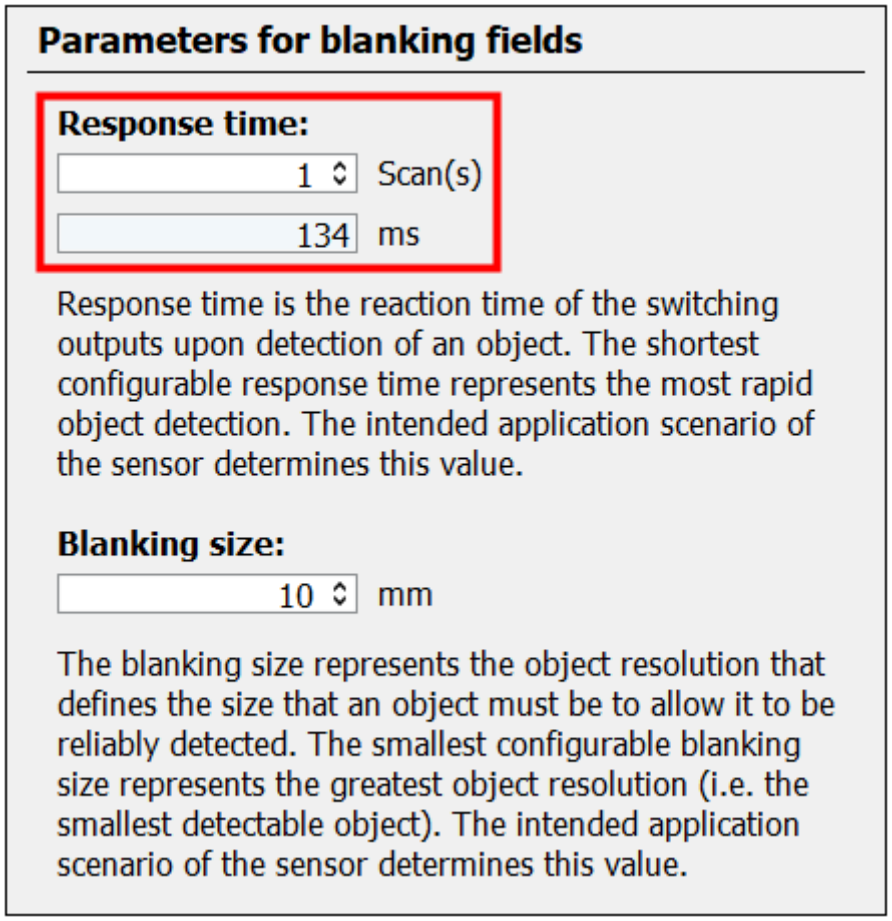


The device automatically releases its protective field outputs when no more objects are detected. The maximum output delay therefore prevents immediate restart.

Continuous restart interlock with reset function must be implemented by the user in the application.

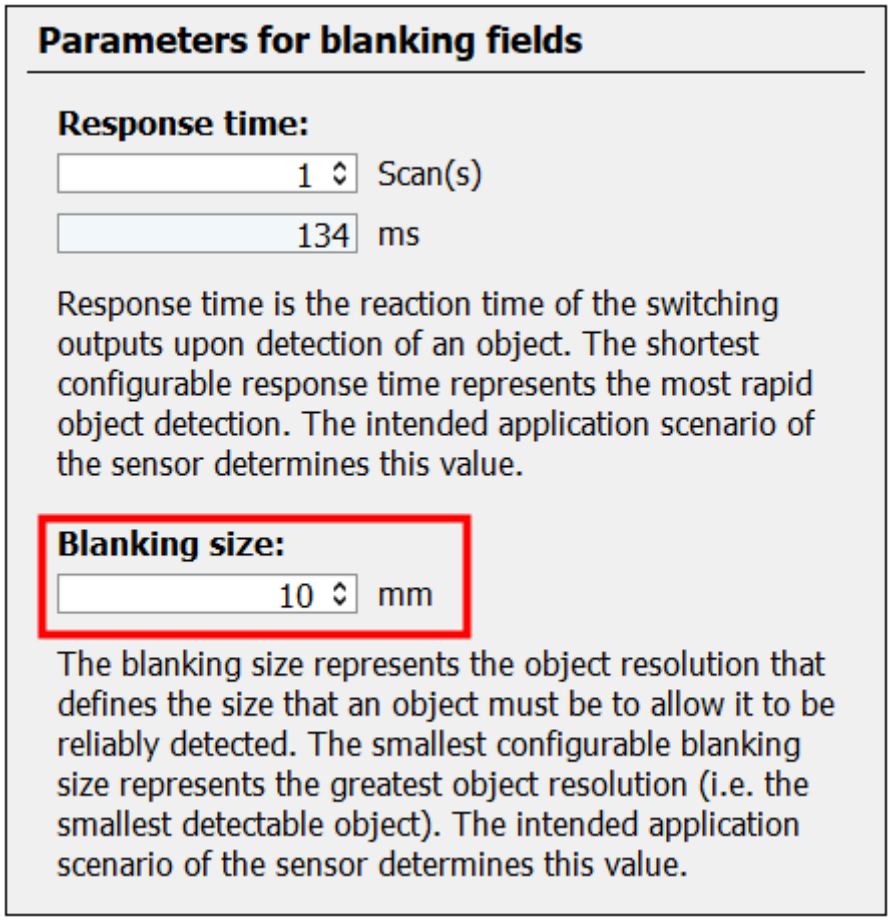
6.5.6.3 Response time for object detection

Default: Minimum response time for object detection



6.5.6.4 Object sensitivity

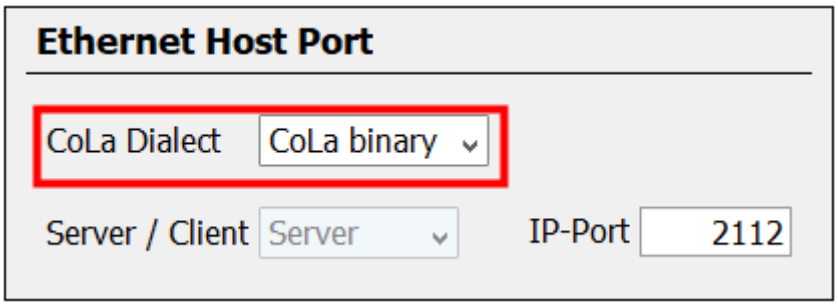
Default: Smallest blanking size (10 mm)



The smallest configurable blanking size of 10 mm represents the greatest degree of object detection (i.e., the minimum detectable object).

6.5.6.5 Ethernet interface

Default: Measurement data output using an LMDscandata (CoLa-B) data telegram via the Ethernet interface



The telegram-related checksum when using binary CoLa enables a downstream controller to detect errors during telegram transmission.

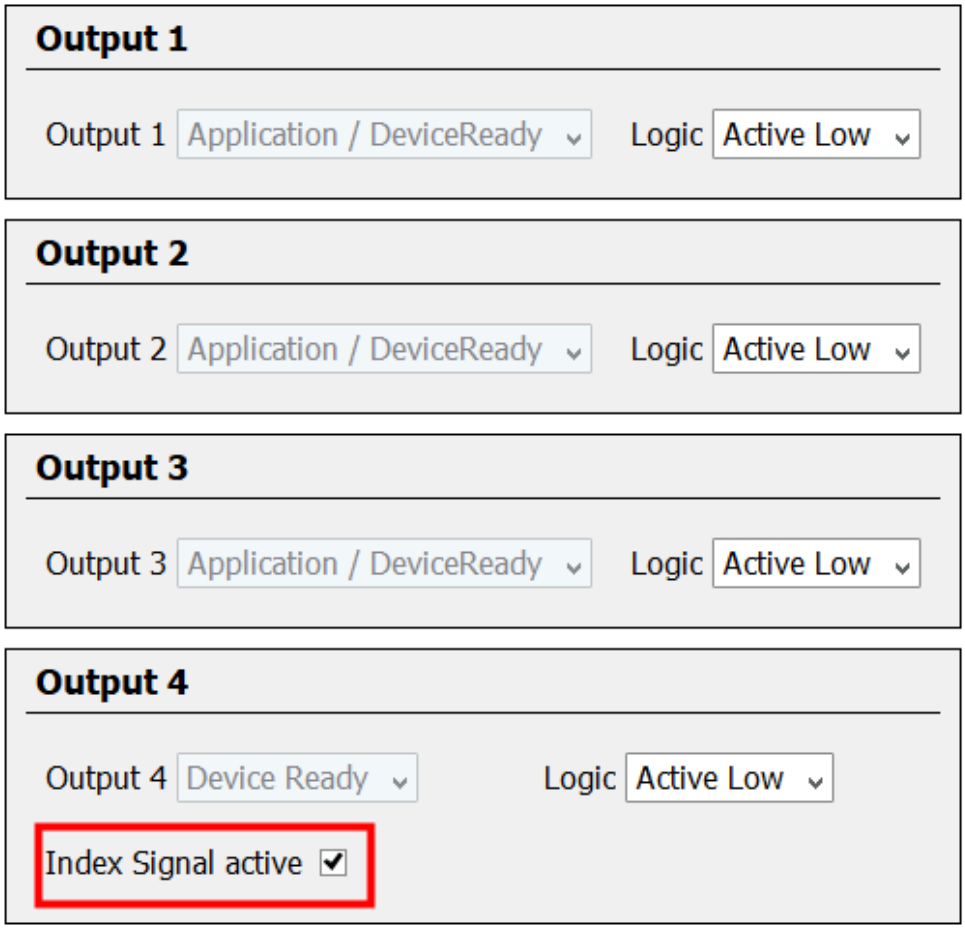
6.5.6.6 Digital outputs

Default: All outputs are set to **Active low** in the PNP version.

The active-low logic uses the principle of energy release as active status.

6.5.6.7 Index Signal

Default: **Index signal active** is enabled

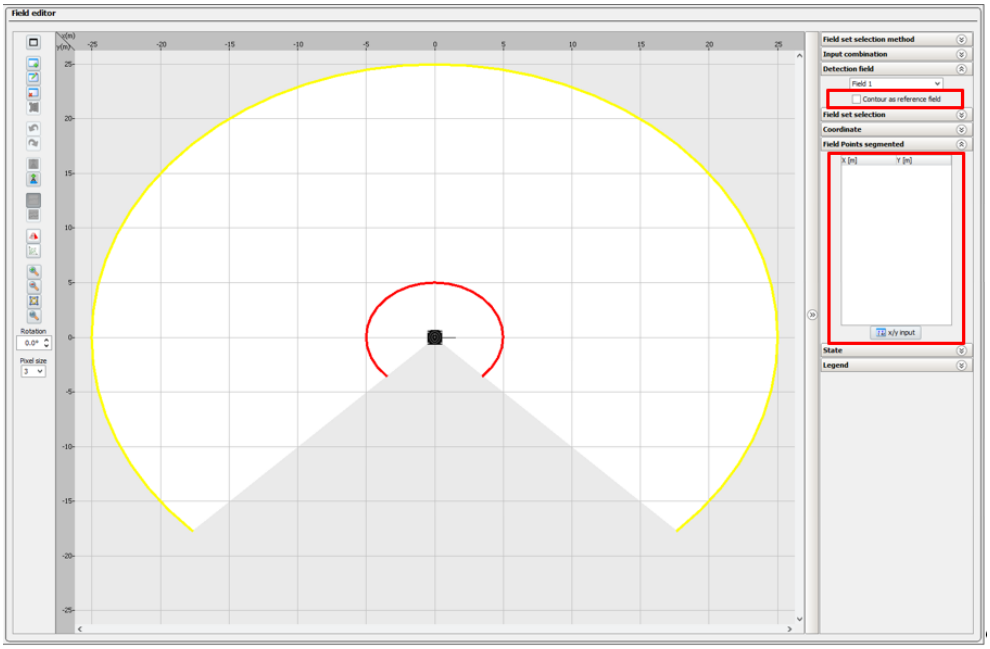


The index signal (1x per scan) of the device can be used by a downstream controller.

6.5.6.8 Protective fields

Default: No protective fields are parameterized, i.e., all field points of a protective field are deleted (no entries).

The **Contour as Reference** function is deactivated for all fields in all field sets.



After deleting the field points, the corresponding outputs for signaling object detections in the protective fields will be active (active low) until they are actively changed.

When the field points are deleted, the field editor will not display any protective fields!

6.6 Editing protective fields

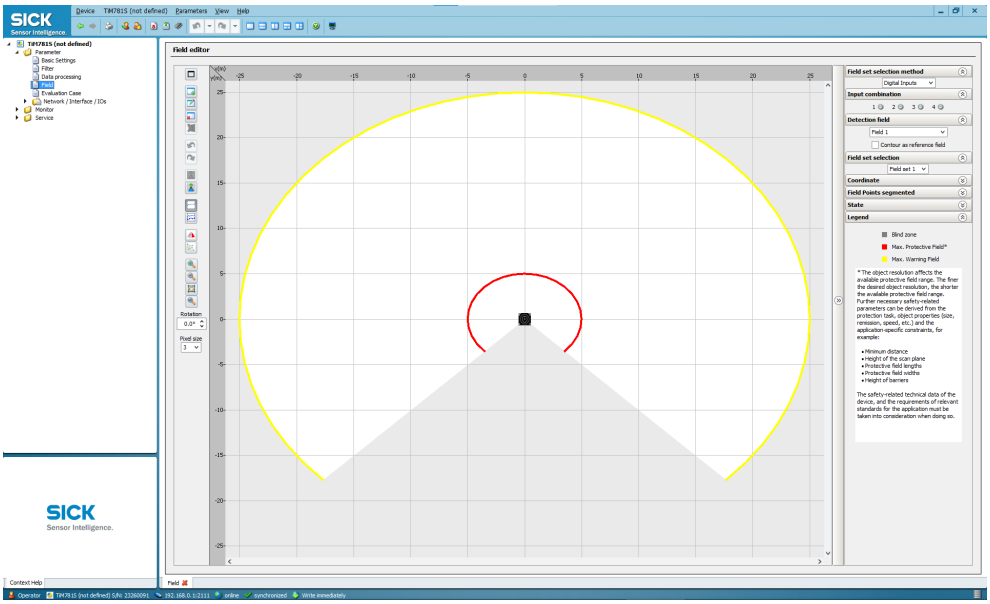


Figure 8: Device window: Parameters - detection fields (evaluation fields)

The user can change parameters in the right part of the window. SOPAS immediately transfers these changes to the device (default setting).

However, detection fields that have been changed in size and shape must always be manually transferred to the device using the button. All changed parameters are only temporarily stored in the device for the time being and are not stored on the computer.

To optimize the dimensions of the detection fields:

1. Under Field selection, for example, select field set 1.
2. Select the field to be configured.
3. Make the required optimizations, see description in the following sections.

Shifting field positions

1. Button .
2. Click on the green marking rectangle of the desired field position in the outer field.

✓ The color of the marker square changes to blue.

3. Re-click the rectangle and drag it to the desired position, then release the push-button.

✓ SOPAS controls the available positioning area during shifting.

Inserting additional field positions

1. Button .
2. Click on the desired position on the limits of the outer field.

✓ SOPAS inserts a new green marker square. This can also be shifted.

Deleting field points

1. Button .
2. Click on the green marking rectangle of the field position to be deleted in the outer field.

✓ The color of the marking rectangle changes to red.

3. Re-click the marking rectangle.

✓ SOPAS removes the marker square and instead connects the two nearest marker squares with a new line.

Rotating the field pair and device around the central axis

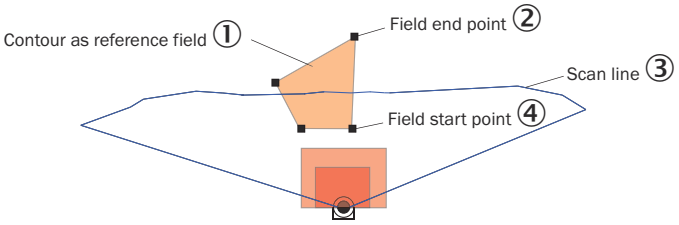
► In order to align the position of the field pair in SOPAS to the conditions on site from the user´s perspective, enter and confirm the desired angle of rotation in the 0.0° input. A negative "-" sign sets the turning direction to the right.

Setting up the contour as reference field

In each field set, any field can be selected as a contour as reference field.

The contour as reference field is used to monitor contours. This can be used to check whether the background is still recognized correctly. If this is no longer the case, possible reasons are that the device is covered or rotated.

The same evaluation strategy is used for all contour as reference fields (evaluation time and blanking size).



① Contour as Reference field
② End point of contour
③ Scanning line
④ Start point of contour

1. Select the required field in the field set.
2. Select the **contour as reference field** check mark under **Field selection**.

3. Delete the two field positions closest to the device.
4. Mark the two remaining field positions and shift them outside of the required reference contour area.
5. The button can switch to the configuration for the contour as reference field start points.
   The field starting points must lie between the scan line and the device so that the scan line passes between the start and end points of the contour as reference field.
6. Depending on the required shape of the reference contour field, create additional field points between the device and the reference contour field. The distance between the start and end points of the contour as reference field should be approximately 20 cm.

The button can be used to switch between the start and end points of the contour as reference field for editing purposes. The active points are highlighted in light green while the deactivated points are dark green.

6.7 Digital inputs/outputs

The device has the following safety-related interfaces, the statuses of which only become valid after operational readiness is reached (see also Operating modes/operational statuses):

6.7.1 Digital inputs

The device has 4 PNP digital inputs (IN 1-4), which by means of selecting the corresponding binary combination (see the following table), activate one of the 16 available field data sets, and therefore the active protective fields.

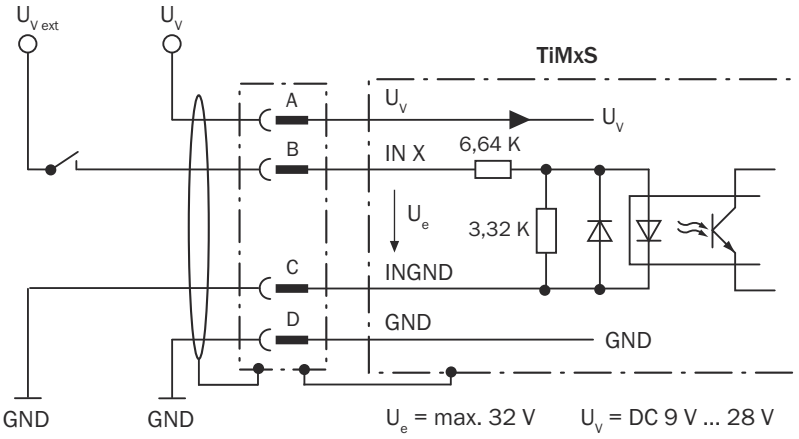


Figure 9: Configuration and switching principle of the IN 1, IN 2, IN 3, IN 4 inputs

Field set factory settings – digital inputs:

Field set	Digital inputs			
	IN 1	IN 2	IN 3	IN 4
1	0	0	0	0
2	1	0	0	0
3	0	1	0	0
4	1	1	0	0
5	0	0	1	0
6	1	0	1	0
7	0	1	1	0

Field set	Digital inputs			
	IN 1	IN 2	IN 3	IN 4
8	1	1	1	0
9	0	0	0	1
10	1	0	0	1
11	0	1	0	1
12	1	1	0	1
13	0	0	1	1
14	1	0	1	1
15	0	1	1	1
16	1	1	1	1

Characteristic data of the digital inputs:

The characteristic data is identical for of all digital inputs.

Switching behavior	Current to the input starts the assigned function in the device. Default: “active high” level, 10 ms debounce
Properties	Opto-decoupled Switchable with an electronic switch (PNP output) or mechanical switch
PNP electrical values	see "Mechanics/electronics", page 63

6.7.2 Digital outputs

Infringement of the respective protective field is displayed in the active field data set by means of 3 available PNP digital outputs (OUT1 ... OUT3).

The factory setting for the digital outputs is the status “Field 1, 2, and 3 infringed”.

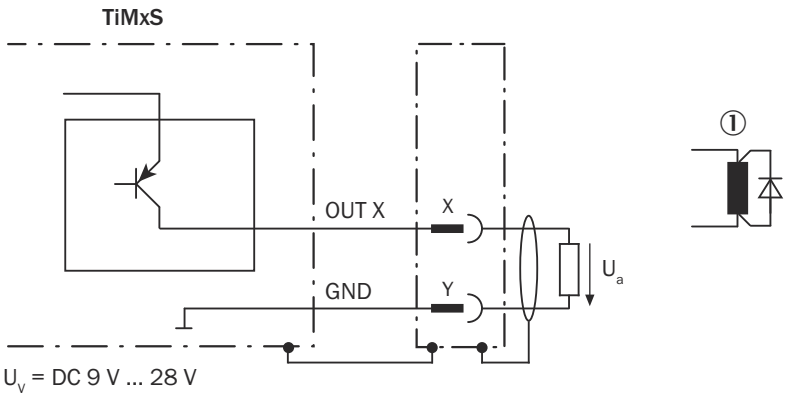


Figure 10: Configuration and switching principle of the OUT 1, OUT 2, OUT 3 outputs

① With an inductive load: Sweep-out circuit – attach a freewheeling diode directly to the load!

Table 2: Assignment of infringed fields – digital outputs:

Fields of a field set	Digital outputs		
	OUT 1	OUT 2	OUT 3
Fields 1, 2, and 3 infringed	Active	Active	Active

Fields of a field set	Digital outputs		
	OUT 1	OUT 2	OUT 3
Fields 2 and 3 infringed	Deactivated	Active	Active
Field 3 infringed	Deactivated	Deactivated	Active
All fields free	Deactivated	Deactivated	Deactivated
Active: in working position; deactivated: in resting position			

Initial level:

The level of the PNP switching outputs OUT1 ... OUT3 is “active low” (deactivated status, resting position: high, working position: low i.e. field infringed).

All fields of a field set are considered infringed upon switching on, booting, in the event of an error and when the device is switched off.

PNP switching output 4 works with the following levels:

Function	Level
Device Ready	High
Index signal (15 Hz), corresponds to measurement at 90°	Low peaks
Fault	Low

6.7.3 Characteristic data of the digital outputs

PNP switching behavior	PNP switching to supply voltage U_V. • OUT1 ... OUT3: Resting level high (no object detection), Working level low (object detection) Response time 134 ms ... 30 s (configurable via SOPAS ET), Duration time: 0 ms ... 600 s (configurable via SOPAS ET) • OUT4: Resting level: high (Device Ready), Working level: low (error), low-impulse (15 Hz, index, corresponds to measurement at 90°)
Properties	Short-circuit protected and temperature protected Not electrically isolated from supply voltage U_V
PNP electrical values	see "Mechanics/electronics", page 63

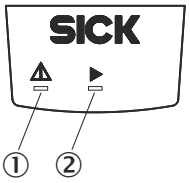
NOTE

Longer connecting cables at the digital outputs of the device should be avoided due to the resulting fall in voltage. This is calculated as follows:

ΔU = 2 x length x current/conductance value x cross-section

Conductance value for copper: 56 m/Ω mm^2

6.8 Function and status displays



① Red LED
② Green LED

Red LED	Green LED	Status
-	Lights up	Device ready/monitoring mode
Lights up	Lights up	Object detection within field/fields
Flashing	-	Fault
-	-	Device without supply voltage

6.9 Measurement data interface and network parameters

Safety-related distance values (between the measurement origin and the detected objects) are transmitted as measured values via the Ethernet interface, see "Safety-related functions", page 45. The transmitted measured values contain the following information:

- 0 m: no object present or no object detected!
- > 0 to 0.016 m: error codes (not measured values)
- > 0.016 to < 0.05 m: not defined! (not measured values)
- 0.05 to 25 m: distance values (valid measured values)

The safety-related range of measured values is between 0.05 m and max. 5 m with a resolution of 1 mm.

The LMDscandata telegram supports the following options for querying the measurement data:

- The request of exactly one measured value telegram using the `sRN LMDscandata` (the last measured scan is transmitted).
- Continuous request of measured data using the `sEN LMDscandata` telegram (measured data is transmitted until the output of measured values is stopped with the `sEN LMDscandata` telegram)

The detailed structure of the output telegram as well as the flow of requests and outputs is described in the “Measurement output telegram” section in the Telegram Listing publication (English, No. 8014631). The document also describes all telegrams available in the TiM7xxS.

WARNING
Risk of ineffectiveness of the protective device!

Only the LMDscandata output telegram can be used for safety-related purposes without additional measures.

Furthermore, safety-related use of the telegrams for field set switching is permitted under certain conditions see "Field set selection via telegram", page 47.

All other released telegrams are not components of the safety verification of the TiM7xxS. The use of other telegrams in a safety-related context can therefore only be made possible by an additional safety verification for the specific use case or the specific overall system; this safety verification must be kept separately by the user. In this case, safety-related evaluation is the responsibility of the customer or the user.

On the other hand, all released telegrams may be used for non-safety-related purposes; in this case, no additional safety verification is required.

WARNING
Risk of ineffectiveness of the protective device!

The Ethernet interface is provided for safety-related measurement data transmission (use of LMDscandata output telegram). Without additional measures, the number of devices connected to the Ethernet interface is limited to max. 4 users, whereby max. 2 TiM7xxS devices may be used. This would include, for example, a typical network for a mobile platform with two TiM7xxS devices, a switch and an evaluating control.

Consideration of a larger number of network users in a safety-related context can only be made possible by an additional safety verification for the specific use case or the specific overall system; this safety verification must be kept separately by the user. In this case, safety-related evaluation is the responsibility of the customer or the user.

Devices connected to the Ethernet interface that have incorrect IP settings are not recognized and can lead to corruption of the measurement data and to **loss of the safety function**.

In the delivery state, the device can transmit measurement data using the following connection settings:

IP-Address	192.168.0.1
Subnet mask	255.255.255.0
TCP port	2112

The IP address and subnet mask settings of the device can be changed using the SOPAS Engineering Tool (SOPAS ET).

Only one TCP port must be used to out the safety-related measurement data.

6.10 Operating modes/operational statuses

The device has the following operating modes and operational statuses:

6.10.1 Power On and boot phase

Begins after connecting and/or interruption of the supply voltage, and ends with operational readiness or fault/error

6.10.2 Operational readiness

Begins after Power On and boot phase, and ends 1 min or more after connection of the supply voltage. The operational status is indicated visually by the “green” LED on the device.

6.10.3 Operational status (monitoring mode)

The device automatically enters this status after reaching operational readiness and after the “Device Ready” output (OUT4) has changed to the “high” status. To do so, the device must not be in parameterization mode, "Configuration mode", page 45.

The sensor can only be employed for safety-related purposes once it is operating in monitoring mode. Other safety-oriented measures may, in some circumstances, therefore need to be implemented until the sensor becomes operational.

6.10.4 Configuration mode

Once the device is connected to the SOPAS ET parameterization software via the USB interface or Ethernet interface, the device can be configured.

The “Device Ready” output remains unchanged until write access to the device is initiated by SOPAS (e.g., changing a parameter, downloading field data, or accessing the **Save permanent** function), then the “Device Ready” (OUT4) output enters the status “low” for a certain period of time.

6.10.5 Fault/error

The device automatically enters this status when it detects an internal error. If there is an internal error, the output “Device Ready” (OUT4) is deactivated and enters the “low” status. This status is shown optically on the device **red LED** flashes.

6.10.6 Safety-related functions

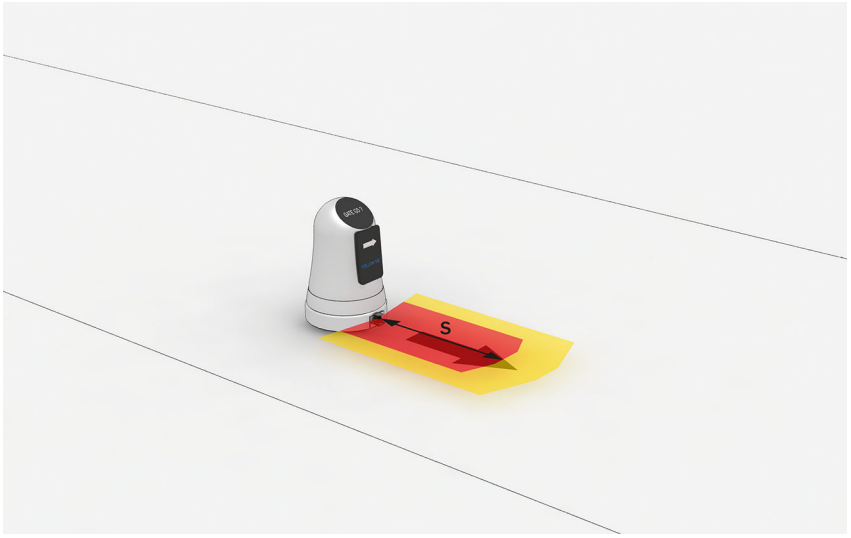
The device is equipped with two safety functions:

Safety function 1 is detecting the presence or entry of an object in a defined detection field (protective field).

Valid for default configuration only: When **safety function 1** is requested, the **defined status 1** is entered within max. 2 scans (134 ms) and the safety-related output signals (OUT1-3) assigned according to the detection field are switched off (deactivated state).

Example:

When an automated guided vehicle (AGV) system approaches a person, a warning field can trigger an optical or acoustic signal. If the person does not respond and the AGV system continues to approach, the detection of the person in the protective field can be used to stop the AGV system via the associated safety outputs before it reaches the person.



Safety function 2 is the continuous measurement of distance values to objects in the safety-related detection zone and their output via the Ethernet interface.

When **safety function 2** is requested, **defined status 2** is entered within less than or equal to 2 scans (134 ms) and the continuous distances values between the device (measurement origin) and the objects that are present in or have entered the safety-related detection zone are output via the Ethernet interface. The measurement data is updated within less than or equal to 2 scans.

The use of measurement data of individual angle-related beams (e.g. 90° beam) does not represent a valid safety function.

Values: see "Safety-related parameters", page 63.

6.10.7 Defined states/safe state

The device has four defined statuses.

When **safety function 1** is requested, **defined status 1** (object detection as part of the field evaluation) is used to switch off (deactivated status) the safety-related output signal (OUT1, OUT2, OUT3) assigned according to the detection field.

When **safety function 2** is requested, **defined status 2** (output of the distance values to a detected object) is used to continuously output safety-related distance values, via the measured value interface (Ethernet interface), between the device and objects that are present in or have entered the safety-related detection zone.

Defined status 3 (factory settings, no fields have been configured) is the status in which one or more of the safety-related output signals (OUT1, OUT2, OUT3) has entered the switched off (deactivated) status while the **safety function 1** was not requested.

Defined status 4 (internal error, during the boot process or configuration) is the status in which the safety-related “Device Ready” (OUT4) output signal has entered the switched off (deactivated) status for more than 67 ms.

The **safe state** is reached when at least one of the defined states (1 - 4) occurs.

6.10.8 Response times for defined statuses

Upon request of **safety function 1**, the device enters **defined status 1** within a response time of less than or equal to 2 scans, and upon request of **safety function 2**, it enters **defined status 2** within an average response time of less than or equal to 2 scans.

It enters **defined status 3** within a response time of less than or equal to 45 scans, and **defined status 4** within a response time of less than or equal to 45 scans.

6.10.9 Protective field evaluation and measured value generation

In normal operation (monitoring mode), the device reports the entry or presence of an object it has detected in its active protective fields and delivers, with an angular resolution of 0.33°, a distance value between the device and the object detected in the detection field (detection range). Please note the previously specified response times.

6.10.10 Protective fields

The device can simultaneously analyze 3 independent protective fields (detection fields). Each protective field is assigned to a digital output OUT1, OUT2, OUT3 which is activated when an object is detected in the protective field (active low). The 3 independent protective fields are configured in a field set in the device and saved.

If a field set change occurs, the device activates analysis of the new protective fields with a response time of less than or equal to 2 scans.

6.10.11 Field set selection via input wiring

The device has 16 independent field sets. Selection of the active field set, and therefore also of the active protective fields, is performed via inputs IN1, IN2, IN3, IN4 see "Digital inputs", page 40.

6.10.12 Field set selection via telegram

One of the predefined field sets can be activated by means of a telegram sent via the Ethernet interface on the device. To select field sets via telegram, the “SOPAS telegram” field set selection method must be set in the device. This can only be done in the “Service” user level using a telegram or via settings in SOPAS ET. The device can then be instructed via a telegram of the predefined field set that is to be activated. Field set 1 is preselected by default.

Overview of the telegram functionality for field set selection:

- Select the field set selection method (`sWN FieldSetSelectionMethod` [0; 1])
- Read the field set selection method (`SRN FieldSetSelectionMethod`)
- Select the active field set (`sWN ActiveFieldSet`)
- Read the active field set (`SRN ActiveFieldSet`)

WARNING
Risk of ineffectiveness of the protective device!

The effectiveness of the protective device and the corresponding safety-related characteristics are only assured under the following conditions.

Please note the following:

- During the switching of the field set via telegram, the safe state of the system must be ensured by other measures (e.g. machine standstill).
- A delay time of two scans plus the time required to transmit the telegram to the device (which depends, for example, on the network environment) must be taken into account.
- If the requirements from see "Function and status displays", page 42 cannot be met, additional safety assessment measures must be carried out by the user.
- Changes to the field set selection via telegram may only be made at a maximum frequency of greater than or equal to 1 second. The controller must check whether the device has received the command for field set switching. This is done by querying the response of the device via the TCP channel.
- To ensure that the correct field set is active at all times, the active field set must be periodically compared with the target value. (Telegram: Read active fieldset [`sRN ActiveFieldSet`]) The interval between queries must be selected to suit the customer application, but must not be less than 134 ms.
- To prevent unauthorized field set switching, the user’s network must be adequately secured.
- The field set selection method cannot and must not be changed during operation to avoid unintentional switching of the field set selection method. This is achieved by the mechanism that only a logged-in user can switch the method. No safe functions are executed while a person is logged in (outputs remain in the safe state, no measurement data output).

7 Error behavior

7.1 General

A non-hazardous failure of the device occurs:

- When the device switches to defined status 1 and/or 2 **without the safety functions having being requested**.
- When the device switches to defined status 3 and/or 4 in the event of a **detected internal error**.

A hazardous undetected failure occurs:

- When the device fails to switch to defined status 1 and/or 2, or to defined status 3 and/or 4 upon request of the **safety functions**.

7.2 Detected errors

The device detects some internal errors merely to improve its availability and support troubleshooting in the event of an error.

The device has a diagnostic coverage (DC) of zero in accordance with EN ISO 13849-1:2015 PL b. The internal errors detected by the sensor **cannot** be used to increase the DCs within the meaning of this standard!

7.3 Undetected errors and faults

The device will **not** detect the following errors and faults, among others:

- **Digital inputs**: short to ground, wire break, short-circuit, cross-circuit to the digital inputs for field set selection (IN1, IN2, IN3, IN4), making it possible to select an incorrect field set.
- **Digital outputs**: short to ground, wire break, short-circuit, cross-circuit to the digital outputs for object detection (OUT1, OUT2, OUT3) and Device Ready (OUT4), with the effect that the defined statuses can no longer be detected by the downstream controller. This also applies in the case of incorrect wiring of the connection pins.
- **Measurement data interface**: wire break, short-circuit, cross-circuit, EMC influences, and devices with the same IP address on the Ethernet measurement data interface, with the effect that corrupted or no measurement data are transmitted to the downstream controller.
- **Status indicators**: Failure of the status indicators for field set status, with the result that the object detection is not correctly displayed optically on the device.
- **Contamination**: Contamination of the optics and/or the front screen, causing impairment, reduction or complete loss of detection capability, and the device no longer being able to perform the safety function.
- **Ambient light**: Malfunctions due to faults of other scanners and light sources within the level of the scan field, causing impairment, reduction or complete loss of detection capability, and the device no longer being able to perform its function.
- **Incorrect measurements**: Measurement of objects with edges and/or corners and/or which are moving too quickly (determined by the measurement procedure) can result in incorrect distance values, causing impairment, reduction or complete loss of detection capability, and the device no longer being able to perform the safety function.
- **Blind zone**: Objects, especially covering objects, located within the blind zone extending f 0.05 m from the measurement origin of the device, causing impairment, reduction or complete loss of detection capability, and the device no longer being able to perform the safety function.

WARNING

Risk of ineffectiveness of the protective device!

Undetected errors and faults can cause impairment, reduction or complete loss of detection capability, such that the device is no longer able to perform the safety function.

NOTE

The device has a diagnostic coverage (DC) of zero in accordance with EN ISO 13849-1:2015 PL b, i.e., it is not required to detect errors, and if they do occur, they can result in loss of the **safety functions**.

The downstream controller, for example, can be used to detect errors by means of testing and diagnostic measures.

7.4 Fault exclusions

No fault exclusions have been specified for the device. The occurrence of errors can result in the loss of the **safety functions**.

7.5 Manipulation

The device does not have any protective measures against manipulation, especially none that relate to the optical system. Objects, especially covering objects on the optics cover and/or in the blind zone, are not detected by the device, causing impairment, reduction or complete loss of detection capability, and the device no longer being able to perform the safety function.

Manipulations with effects similar to undetected errors (see "Undetected errors and faults", page 48) are also not detected.

8 Project planning

8.1 Manufacturer of the machine

WARNING
Risk of ineffectiveness of the protective device!

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

- ► Use of the device requires a risk assessment. Check whether additional protective measures are required.
- ► Comply with the applicable national regulations derived from the application (e.g., work safety regulations, safety rules, or other relevant safety guidelines).
- ► Apart from the procedures described in this document, the components of the device must not be opened.
- ► The device must not be tampered with or changed.
- ► Improper repair of the device can lead to loss of the safety function. The protective device must only be repaired by the manufacturer or by someone authorized by the manufacturer.

8.2 Operating entity of the machine

WARNING
Risk of ineffectiveness of the protective device!

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

- ► Changes to the electrical integration of the device in the machine controller and changes to the mechanical mounting of the device necessitate a new risk assessment. The results of this risk assessment may require the entity operating the machine to meet the obligations of a manufacturer.
- ► Changes to the device's configuration may impair the safety function of the device. Therefore the device's safety function and the effectiveness of the protective device must be checked after any change in configuration. The person carrying out the change is responsible for maintaining the safety function of the device and the protective device.
- ► The device must not be tampered with or changed.
- ► Improper repair of the device can lead to loss of the safety function. The protective device must only be repaired by the manufacturer or by someone authorized by the manufacturer.

WARNING
Danger due to optical and electromagnetic ambient conditions!

Optical and electromagnetic ambient conditions can impair the functioning of the device. This can result in loss of the **safety functions**.

- Please note the following:

- ► Avoid having strong electric fields in the vicinity of the device. These may be caused by nearby welding or induction cables, for example.
- ► Prevent condensation on and/or contamination of the optics cover. To ensure the continuing, reliable safety function of the device, the optics cover must be cleaned regularly.

8.3 Protection tasks

People approach the monitoring plane parallel or orthogonally, depending on the orientation of the protective field in your application.

- Hazardous area protection (horizontal): Typically, for a horizontal approach, the requirement is to detect the leg. The typical object resolution is the leg (70 mm).
- Access protection (vertical): Typically, for access protection, the requirement is to detect a person. The typical object resolution is the body (200 mm).
- Hazardous point protection (vertical): Typically, for hazardous point protection, the requirement is to detect a hand. The typical object resolution is the hand (40 mm).

Contour as Reference monitoring

If the monitoring plane has a vertical alignment, a contour (such as the floor, a part of the machine bed, or an access threshold) must typically be defined and monitored as a reference contour.

Object resolution

The object resolution defines the size that an object must be to allow it to be reliably detected.

Typical object resolutions are:

- 40 mm = hand detection/arm detection
- 50 mm = leg detection/arm detection
- 70 mm = leg detection
- 200 mm = body detection

The object resolution affects the available protective field range. The finer the desired object resolution, the shorter the available protective field range.

Further necessary safety-related parameters can be derived from the protection task, object resolution, and the application-specific constraints, for example:

- Minimum distance
- Height of the scan plane
- Protective field lengths
- Protective field widths
- Height of barriers

These parameters must be determined for each specific application. The safety-related technical data of the device, and the requirements of relevant national and international standards (e.g., ISO 13855, ISO 13857,...) must be taken into consideration when doing so.

8.4 Preventing unprotected areas

WARNING
Risk of ineffectiveness of the protective device!

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

- Make sure that the following design requirements are met so that the device can fulfill its protective function.

- The device must be affixed so that people or parts of the body are reliably detected upon entry into the hazardous area.
- The device must be affixed so that no mirrors or other highly specular objects (e.g. due to gloss effects) are in the protective field, thereby limiting the detection capability.
- The device must be affixed so that people cannot enter unsecured areas.

- The device must be affixed so that no small objects (e.g. cables) are in the protective field, even if the safety outputs do not switch to the OFF state as a result.
- The device must be affixed so that no obstacles disrupt the safety sensor's field of view. Take additional protective measures if a risk arises due to unavoidable obstacles.
- If people can stay between the protective device and the hazardous point without being detected, check if additional protective measures (e.g. restart interlock) are required.
- Reaching under, over and around, crawling beneath and stepping over the device, as well as moving it, must be prevented.

WARNING
Risk of ineffectiveness of the protective device!

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

The optical beam path must not be disrupted, e.g. if the system is incorporated into paneling.

- Do not attach an additional front screen.

8.5 Response time of the device

The device's response time must be taken into account, among other things, so that the device can be positioned in a suitable location and the protective fields can be sized correctly.

The response times are specified in the technical data.

8.6 Contour as Reference field

The contour as reference field monitors a contour of the environment. The device switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting of the device has been changed.

The contour as reference field detects unintentional and intentional changes to the position or alignment of the device. Unintentional changes may be caused, for example, by vibrations. An example of an intentional change is deliberate tampering to disable the device's functionality.

National and international standards require or recommend that a contour as reference is monitored, if the safety sensor is used in vertical operation for hazardous point protection or for access protection.

WARNING
Risk of ineffectiveness of the protective device!

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

- Use a contour from the environment as a reference to protect the protective device from inadvertent adjustment or tampering.

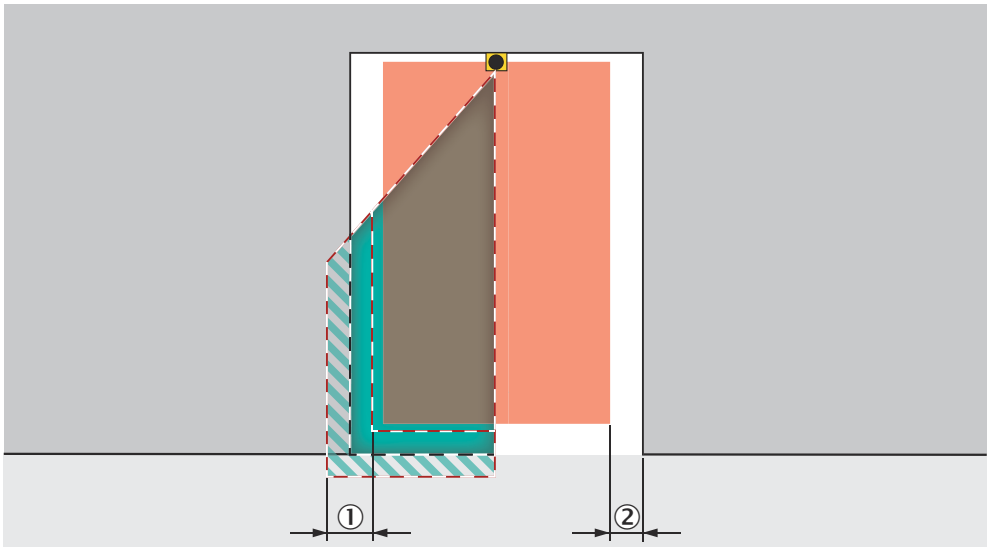


Figure 11: Tolerance band of the contour as reference field (protective field within the protected opening, edge of the protected opening = reference contour)

① Tolerance band of the contour as reference field

② Distance of the protective field from the contour, to ensure availability

8.7 Timing of analysis case switching

When switching between analysis cases (field sets), it is possible that a person may already be in the newly activated protective field when switching takes place. Only timely switching (namely before the danger arises at this location) can ensure protection.

WARNING

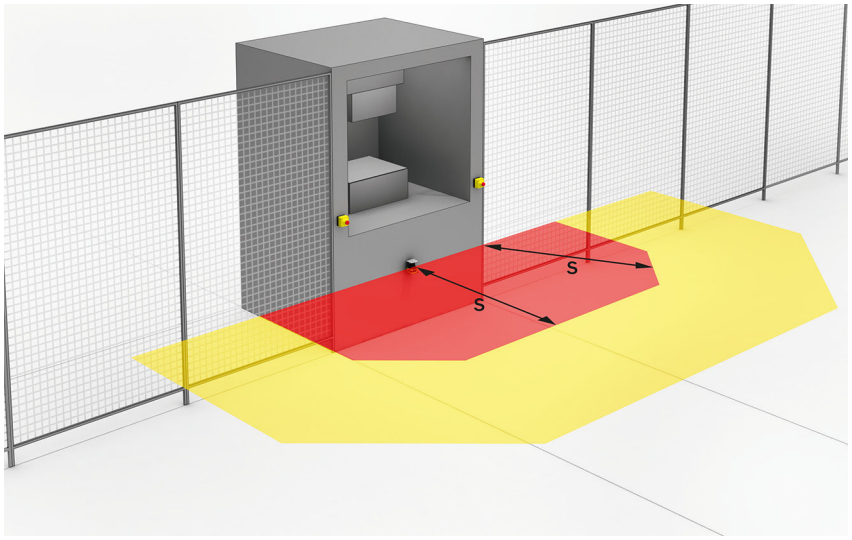
Risk of ineffectiveness of the protective device!

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

- Switching of the analysis case should be timed so that the device detects a person in the protective field with a sufficient minimum distance before the dangerous state occurs.

8.8 Hazardous area protection

The device is mounted with a horizontal scan plane in a stationary application, for example on a machine where the hazardous area is not completely surrounded by a physical guard. During hazardous area protection, the device detects a person's legs. The protective field is parallel to the person's direction of approach.



Protective field

The protective field (S) must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In hazardous area protection, the minimum distance typically defines the protective field size required.

If you define a number of analysis cases with different protective fields, you must calculate the protective field size separately for each protective field used.

In many cases, a resolution of 50 mm or 70 mm is suitable for hazardous area protection.

Height of the scan plane

WARNING
Risk of ineffectiveness of the protective device!

It is possible to get around the protective device by crawling beneath.

- Prevent people from being able to crawl beneath the protective field by mounting the device appropriately.
- If you mount the protective device higher than 300 mm, you must use additional measures to prevent people crawling underneath.

WARNING
Risk of ineffectiveness of the protective device!

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

Body parts to be protected may not be detected under coarse resolution.

- Use a resolution of 70 mm or finer for hazardous area protection.
- For hazardous area protection with a resolution of 70 mm: make sure that it is possible to detect a human leg.
- For hazardous area protection with a resolution of 70 mm: mount the device at a height of at least 300 mm (height of the scan plane).
- If it is not possible to mount the device at a height of at least 300 mm, use a finer resolution

Calculating minimum distance

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

The minimum distance depends, among other things, on the following:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state, including signal propagation times in the network and processing time in the control)
- Response time of the protective device
- Reach or approach speed of the person
- Resolution (detection capability) of the device
- Type of approach: parallel
- Parameters specified based on the application
- Supplements for general and, possibly, reflection-based measurement errors
- Supplement to protect against reaching over
- Height of the scan plane
- Switching time between monitoring cases

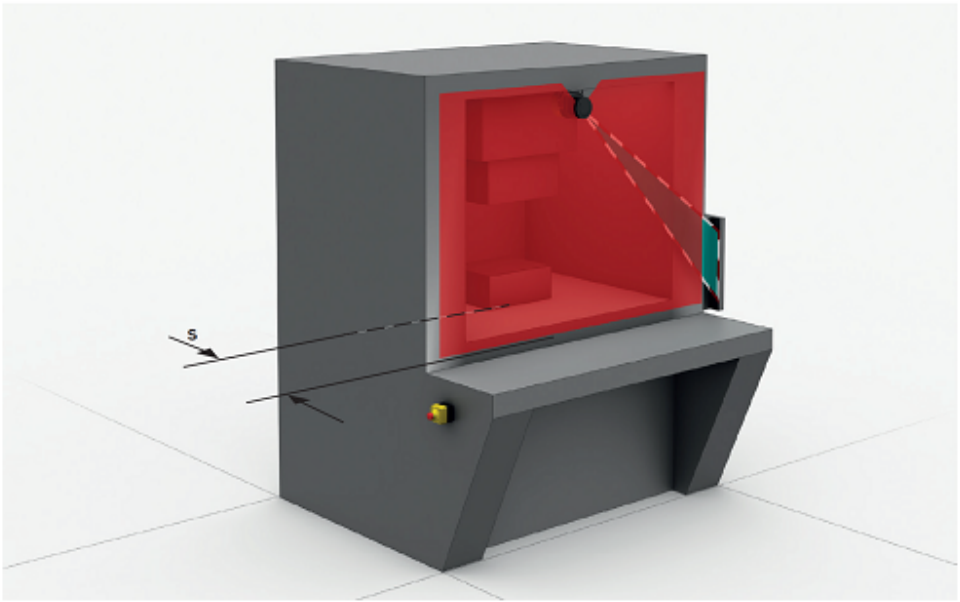
8.9 Hazardous point protection

The device is mounted with a vertical scan plane in a stationary application, for example on a machine where the operator must stay close to the hazardous point.

There is a fixed barrier in front of the hazardous point. The required height is specific to the particular application, and the applicable standards (for example ISO 13857) should be taken into consideration when calculating the height.

The operator can reach over the barrier and through the scan plane into the hazardous point. But the operator cannot climb over the barrier. If there is no such barrier available, access protection may be required.

During hazardous point protection, the device detects the arm or another part of a person's body. The protective field is orthogonal to the direction of approach of the body part. A resolution of 40 mm is required to ensure detection of the arm during hazardous point protection.



WARNING
Risk of ineffectiveness of the protective device!

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

- Never use the device for applications requiring the detection of fingers. The device is not suitable for finger detection because the finest resolution is 40 mm.
- Use the contour of the surroundings as a reference to protect the protective device from inadvertent adjustment or tampering.

Protective field

The protective field must be designed so that it detects access by a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In hazardous area protection, the minimum distance typically defines the position at which the device is mounted.

In many cases, a resolution of 40 mm is suitable for hazardous point protection.

WARNING
Risk of ineffectiveness of the protective device!

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

- Always mount the device so that it is impossible to reach around or behind it.
- Provide suitable additional measures if necessary.

Calculating minimum distance

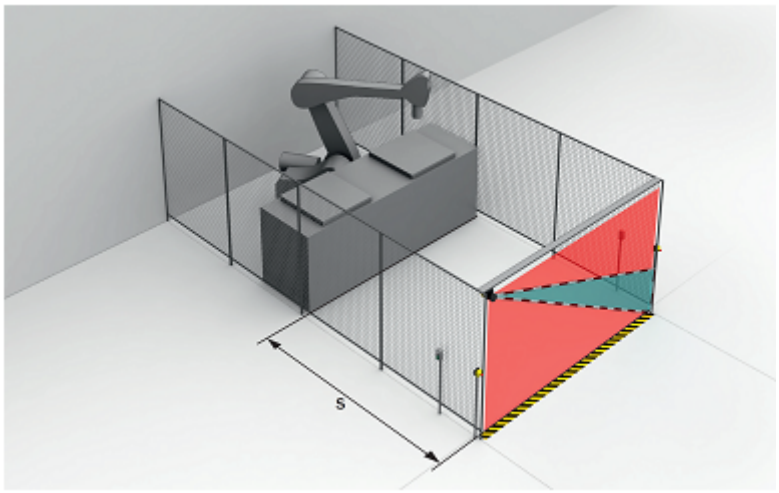
The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

The minimum distance depends, among other things, on the following:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device
- Reach or approach speed of the person
- Resolution (detection capability) of the safety sensor
- Type of approach: orthogonal
- Parameters specified based on the application

8.10 Access protection

The device is mounted with a vertical scan plane in a stationary application, for example on a machine, for which access to the hazardous area may be defined structurally. In access protection applications, the device detects the entry of an entire body. The protective field is orthogonal to the person's direction of approach.



WARNING
Ineffectiveness of the protective device

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

- Use a resolution of 200 mm or finer. Otherwise, protection will not be ensured during access protection.
- Use the contour of the surroundings as a reference to protect the protective device from inadvertent adjustment or tampering.

Protective field

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In access protection, the minimum distance typically defines the position at which the device is mounted.

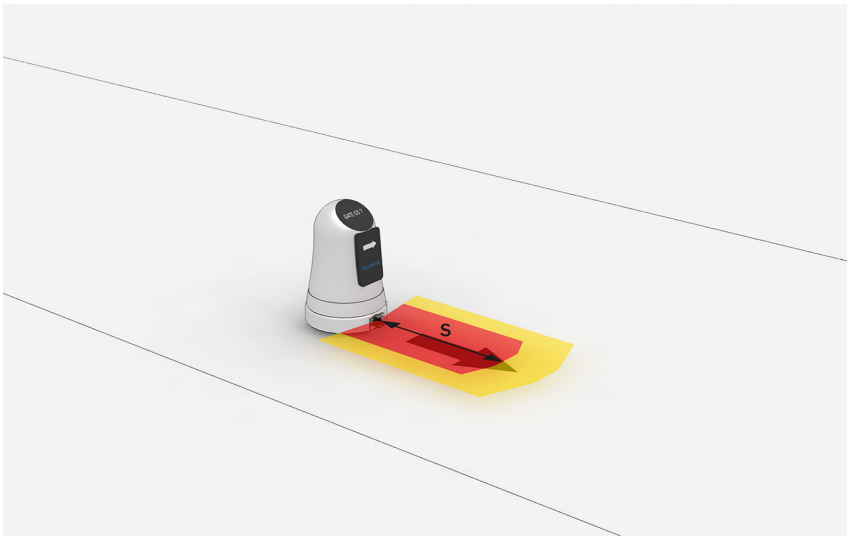
Calculating minimum distance

The minimum distance depends, among other things, on the following:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device
- Reach or approach speed of the person
- Resolution (detection capability) of the safety sensor
- Type of approach: orthogonal
- Parameters specified based on the application
- Supplement to prevent reaching through

8.11 Mobile hazardous area protection

The device is mounted with a horizontal scan plane in a mobile application, for example on an automated guided vehicle or service robot. In mobile hazardous area protection, the device protects the hazardous area created by the vehicle's movement. The device detects a person's legs. The protective field is parallel to the direction of approach.



NOTE

- In a mobile application, a resolution of 70 mm (leg detection) is sufficient for detecting people. In contrast to stationary hazardous point protection, this is also true for a low mounting height, as the device moves together with the vehicle.
- In typical protective field calculations, only the vehicle speed is taken into account, not the speed of a walking person. This is based on the assumption that the person recognizes the danger and stands still

Protective field length

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to ensure that the vehicle comes to a stop before it reaches a person or an object.

In mobile hazardous area protection, the minimum distance typically defines the protective field length required. When calculating the protective field length, the impact of turning must be considered separately.

If you define a number of analysis cases with different protective fields, you must calculate the protective field size separately for each protective field used.

Protective field width

The protective field must be wide enough to cover the width of the loaded vehicle with supplements for measurement error and the lack of ground clearance. When calculating the protective field width, the impact of turning must be considered separately.

The minimum protective field width is determined based on a max. speed of moving objects as well as the sensor platform (for mobile applications). The minimum protective field width is 0.3 m taking into consideration the specified response times and scanning frequency (see "Technical data", page 62). For the maximum safety detection distance of 5 m, this minimum protective field width corresponds to an angular resolution of 4.5°, which is well above the minimum angular resolution of 0.33°.

Calculating minimum distance

The minimum distance depends, among other things, on the following:

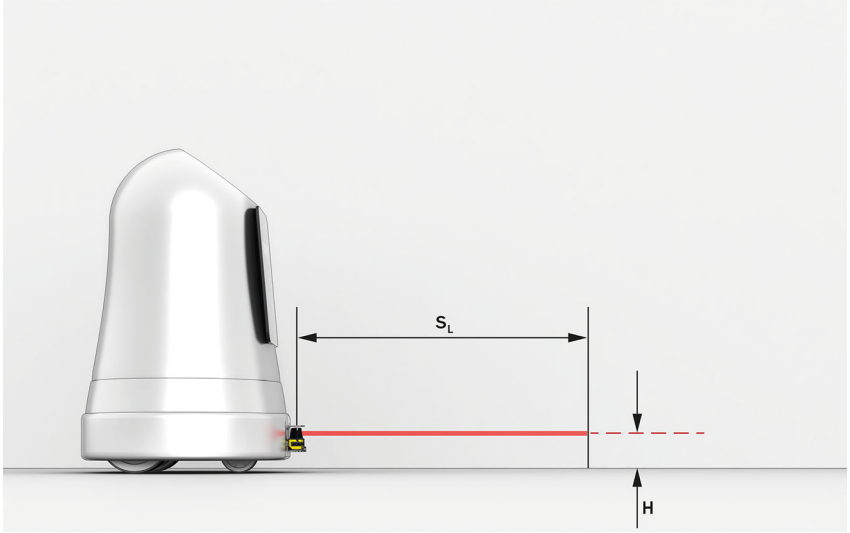
- Response time of the protective device
- Position of the device on the vehicle
- Approach speed of personnel
- Resolution of the device
- Speed of the vehicle

- Reflection-related measurement error
- Ground clearance of the device on the vehicle
- Braking force of the vehicle
- Parameters specified based on the application

Height of the scan plane

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

- Always mount the device so that the maximum scan plane height is 200 mm.



9 Regular thorough checks

At regular intervals the user must demonstrate that the measures taken still fulfill the protective purpose, and that the protective device still functions correctly in the application during the service life.

Thorough checks and tests are required in this regard:

- Upon commissioning (e.g., initial commissioning, recommissioning)
- After changes and extraordinary events (e.g., conversion, change of parameters, modification, retrofitting and equipment, damage, repair, ...)
- At regular intervals (e.g., recurring thorough checks intended to ensure that a safety-related function and/or safety function still functions correctly in the application)

These thorough checks and tests must be documented clearly and comprehensibly.

Determination of the time intervals for thorough checks at regular intervals must be decided and established by the manufacturer of the machine and/or by the operating entity depending on the specific application, place of application and influencing factors prevailing there. (e.g., dirt, demand rate, EMC, ...).

Example: thorough check of the effectiveness of protective fields

The effectiveness of protective fields can be demonstrated, for example, by positioning a suitable test object with the diameter and remission of the desired detection capability at multiple points along the effective protective range, and having the device detect them.

10 Working with the product

10.1 Safety

Risk of ineffectiveness of the protective device

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

- Do not do repair work on device components.
- Do not make changes to or manipulate device components (including the software).
- The device components must not be opened.
- If the device is damaged or defective, it must be replaced.

10.2 Maintenance and care

The device does not contain any components that require maintenance. The device must not be opened. Maintenance is not necessary to ensure compliance with laser class 1, either.

► The black, infrared-transparent optics cover should be cleaned, at regular intervals and in the event of contamination, with a lint-free lens cloth (part no. 4003353) and plastic cleaning agent (part no. 5600006). In this regard, the cleaning interval essentially depends on the ambient conditions.

10.3 Transport and storage

The device must be transported and stored in its original packaging with the USB protective cap screwed on. Do not store outdoors. To ensure that any residual moisture present can escape, do not store the device in airtight containers. Do not expose to aggressive media (e.g. solvents).

Storage conditions: Dry, dust-free, no direct sunlight, as little vibration as possible, storage temperature –40 ... +75 °C, relative humidity max. 90% (non-condensing).

10.4 Repair

Repair work on the device may only be performed by qualified and authorized service personnel from the company SICK AG.

10.5 Disassembly and disposal

Any device which can no longer be used must be disposed of in an environmentally friendly manner in accordance with the applicable country-specific waste disposal regulations.

As it is classified as electronic waste, the device must never be disposed of with household waste.

11 Technical data

NOTE

The relevant online product page for your product, including technical data, dimensional drawing, and connection diagrams, can be downloaded, saved, and printed from the Internet.

The product page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

Please note: This documentation may contain further technical data.

11.1 Features

Variant	TiM7xxS
Measurement principle	**TiM771S**: HDDM (lower statistical error) **TiM781S**: HDDM+ (improved behavior with edge hits)
Application	Indoor
Light source	Infrared (wavelength 850 nm, max. pulse power 880 mW, max. pulse width 5 ns, pulse frequency 1,500 kHz)
Laser class	1 (IEC 60825-1:2014, EN 60825-1:2014+A11:2021) Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed.3., as described in Laser Notice No. 56 dated 8 May 2019.
Aperture angle	270° (horizontal)
Scan field flatness [1]	± 1.5°
Scanning frequency	15 Hz
Angular resolution	0.33°
Workspace	0.05 m ... 25 m
Safety-related working range	0.05 m ... 5 m (at 5% radiance factor)
Blind zone	0.00 m ... 0.05 m
Sensing range for 10% remission	8 m (typical) [2]
Minimum physical object sizes (cross-section)	169 mm at a distance of 8 m 88 mm at a distance of 4 m 47 mm at a distance of 2 m At respective radiance factor
Distance resolution	1 mm
Spot size	Spot size on the optics cover: 7 mm Divergence: 8.6 mrad (0.49°)
Number of echoes evaluated	1
Scan/frame rate	12195 measurement point(s)

1) Reference area for base of housing
2) at ambient temperature < -15 °C: typ. 7.5 m

11.2 Mechanics/electronics

Variant	TiM7xxS
Electrical connection	1 x Ethernet connection, 4-pin M12 female connector 1 x voltage supply connection, 12-pin M12 male connector 1 x micro USB female connector, type B
Supply voltage	9 V DC ... 28 V DC, SELV and PELV according to IEC 60364-4-41
Power consumption	4 W (typical), with unloaded digital outputs, incl. start-up current Max. 16 W with 4 loaded digital outputs
Input voltage	Low: $V_{in} \leq 2$ V; $I_{in} \leq 0.3$ mA High: 8 V $\leq V_{in} \leq$ 32 V; 0.7 mA $\leq I_{in} \leq$ 5 mA
Output voltage	Low: 0 V $\leq V_{out} \leq 2$ V High: (V_S – 2 V) $\leq V_{out} \leq V_S$; $I_{out} \leq$ 100 mA
Electrical safety	According to IEC 61010-1 (ed.3)
Housing	Base part: Aluminum die cast Optics cover: Polycarbonate with scratch-resistant coating
Housing color	Yellow
Enclosure rating	IP67 (IEC 60529:1989+AMD1:1999+AMD2:2013), only valid with closed “Aux interface” plastic cover
Protection class	III (IEC 61140:2016-1)
Weight	250 g without connecting cables
Dimensions (L x W x H)	60 mm x 60 mm x 86 mm
Contamination	Contamination level 1, EN 61010-1 outside housing Contamination level 3, EN 61010-1 outside housing, with sealed USB connection (All specifications regarding contamination do **not** apply to the optics)

11.3 Safety-related parameters

Variant	TiM7xxS
Category	B (EN ISO 13849-1:2015)
Performance level	PL b (EN ISO 13849-1:2015)
Performance class SRS/ SRSS	B (IEC TS 62998-1:2019)
$MTTF_D$ (mean time to dangerous failure)	100 years at 25 °C ambient temperature (EN ISO 13849-1:2015) [1)]
T_M (mission time)	20 years (EN ISO 13849-1:2015)
Conformities	EN ISO 13849-1:2015, IEC TS 62998-1:2019, EN ISO 13482:2014, EN ISO 13855:2010, ANSI/ITSDF B 56.5:2012
Safety-related detection range	0.05 m ... 5 m; at 5% remission

Variant	TiM7xxS
Safety-related detection capability	Up to a relative speed of 3.2 m/s (max. speed of object = 1.6 m/s and max. speed of sensor = 1.6 m/s) and at min. 5% remission: Objects 40 mm in diameter at a distance of 0.05 m up to max. 1.5 m Objects 50 mm in diameter at a distance of 0.05 m up to max. 2 m Objects 70 mm in diameter at a distance of 0.05 m up to max. 2.5 m Objects 200 mm in diameter at a distance of 0.05 m up to max. 5 m
Safety-related measurement error/accuracy [2]	Safety-related statistical error (4.4 σ) in accordance with IEC TS 62998-1: < 60 mm (TiM771S) < 100 mm (TiM781S) The safety-related statistical error may fluctuate over the temperature range but will remain within the specified limits. This value may not be upheld when measuring on very strong reflectors, especially at close range. Here, multiple floating reflections can occur, which have a particularly strong effect at low temperatures.
Safety-related systematic error [2]	< 60 mm (TiM771S) < 60 mm (TiM781S) This value may not be upheld when measuring on very strong reflectors, especially at close range. Here, multiple static reflections can occur, which have a particularly strong effect at low temperatures. Example: When measuring on a reflector with specific remission of 330 Cd/lx*m², a linear increase of the systematic error to 120 mm at -25 °C must be expected at < 10 °C.
Blind zone	No objects are detected across the entire radial visual range (scanning range of 270°) from the measurement origin up to a distance of 0.05 m
Response time [3]	Max. 2 scans: 134 ms [4]
Protective field/Field evaluation	1 analysis case with 1 field set and up to 3 independent protective fields, signaling of object detections in the protective fields via a combination of 3 PNP switching outputs (OUT1 ... OUT3)
Protective field width	Minimum protective field width ≥ 0.3 m
Protective field tolerance	+100 mm; 0.66° acc. to IEC 62046 at 5% remission Temperature drift: 1.5 mm/Kelvin
Number of field sets	16 field sets with 3 independently configurable protective fields each
Digital inputs	PNP inputs: 4 x IN, IN1...IN4, (U_e = max. 28 V, I_e = max. 5 mA), opto-decoupled, debounce approx. 10 ms
Digital outputs	PNP outputs: 4x OUT, OUT1...OUT4, (each I_a max. 100 mA), not electrically isolated from supply voltage, short-circuit protected/temperature protected Adjustable for OUT 1 .... OUT 3: Response time (134 ms ... 30 s) Holding time (0 ms ... 600 s) [5]
Safety-related measurement range	Output of safety-related distance values between the measurement origin and detected objects: > 0.05 m ... to 5 m; with a resolution of 1 mm
Measured value interface	Ethernet interface max. data transmission rate: 10 Mbit and 100 Mbit, cable length limited to max. 100 m

1) At higher ambient temperatures, the $MTTF_D$ value decreases according to the Arrhenius equation. These values can be requested from SICK.

2) In safety-related detection zone
3) Response of the digital outputs when an object is detected with the smallest response time that can be set and the filter deactivated, see "Default configuration", page 32.
4) At +45° to +225° of the working range; max. 150 ms at -45° to +45° of the working range (see figure 2, page 18)
5) The device has an internal, system-related time delay of 67 ms

Note

The product is intended for use indoors. It is not suitable for use in special surroundings (e.g., radiation and sparks from welding systems, strong sources of infrared, thermal convection, fluorescent and stroboscopic light sources, snow, rain, contamination) or must yet be made suitable, if applicable.

11.4 Performance

Variant	TiM7xxS
Response time	Typ. 1 scan: 67 ms Max. 2 scans: 134 ms [1]
Operational readiness	≥ 1 min
Integrated application	Protective field evaluation with flexible fields, measurement data output
Protective field tolerance	100 mm, 0.66° (IEC 62046, at 5% remission)
Measurement errors	Statistical (1 σ): < 20 mm [2] / < 10 mm [3] Systematic: ± 60 mm [2] Temperature drift: 0.5 mm/K
Number of field sets	16 triple fields (48 protective fields)
Simultaneous evaluation cases	3 simultaneous protective fields (per field set)
Filter	Edge filter Particle filter Median filter Average filter

1) Corresponds to max. 134 ms between +45° and +225° of the working range, max. 150 ms between -45° and +45° of the working range (see figure 2, page 18)
2) Typical value at 90% remission up to maximum sensing range; real value depends on ambient conditions.
3) Devices with HDDM measurement principle only (TiM771S): Typical value at 10% remission up to 6 m sensing range; real value depends on ambient conditions.

11.5 Interfaces

Variant	TiM7xxS
Ethernet	TCP/IP Max. data transmission rate: 10 Mbit and 100 Mbit Length of cable: max. 100 m Function: measured value interface and parameterization
USB	Type: Micro-USB Function: Parameterization
Digital inputs	4 (PNP, for field switching)
Digital outputs	3 (PNP, for displaying an object detection in the protective fields), additional 1 x “Device Ready”
Optical indicators	2 LEDs (on, “device ready”)

11.6 Ambient data

Variant	TiM7xxS
Electromagnetic compatibility (EMC)	**Radiation emitted:** Residential area (EN 61000-6-3:2007+AMD:A1:2011) **Electromagnetic immunity:** Industrial environment (EN 61000-6-2: 2005)
Vibration resistance	**Sine resonance scan:** 10 Hz ... 1,000 Hz (IEC 60068-2-6:2007) **Sine test:** 10 Hz ... 500 Hz; 5 g; 10 frequency cycles (IEC 60068-2-6:2007) **Noise test:** 10 ... 250 Hz; 4.24 grms, 5 h (IEC 60068-2-64:2008)
Shock resistance	50 g; 11 ms; 6 shocks/axis 25 g; 6 ms; 2,000 shocks/axis 50 g; 3 ms; 10,000 shocks/axis (IEC 60068-2-27:2008)
Ambient temperature	Commissioning/switching on: –10 °C ... +50 °C Operation: –25 °C ... +50 °C Storage: –40 °C ... +75 °C (IEC 60068-2-14:2009)
Ambient humidity	Operation: ≤ 80%, non-condensing Storage: ≤ 95%, non-condensing (EN 60068-2-30:2005)
Ambient light immunity	3,000 lx (direct exposure) 80,000 lx (indirect exposure)
Altitude	< 2,900 m above sea level
damp heat	+25 °C ... +55 °C, 95% r.h., 6 cycles (EN 60068-2-30:2005)
temperature change	-25 °C ... +50 °C, 10 cycles (EN 60068-2-14:2009)

12 Annex

12.1 Declarations of conformity and certificates

You can download declarations of conformity and certificates via the product page.

The product page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

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