OPERATING INSTRUCTIONS

DT35S

Safety related Distance sensors

SICK
Sensor Intelligence.

Described product

DT35S

Manufacturer

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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)	"Accessories", page 15 "Commissioning and configuration", page 27 "Technical data", page 58, "Accessories", page 15
	Installers	"Mounting", page 24
	Electricians	"Commissioning and configuration", page 27
	Safety experts	"Project planning", page 48, "Commissioning and configuration", page 27 "Regular thorough checks", page 55 "Technical data", page 58

Target group		Special sections of these operating instructions [1]
Operating entity	Operator of the device	"Parameterization of the device", page 27
	Maintenance staff	"Regular thorough checks", page 55 "Accessories", page 15

[1] Chapters 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

Further information can be found on the product page. which can be accessed via the **SICK Product IDpid.sick.com/{P/N}**

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

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 DT35S safety-related distance sensor (also referred to as “device’ in the further course) is an optoelectronic sensor intended for non-contact distance measurement of objects.

The device is intended for use in protective devices, in mobile applications on electrically operated autonomous platforms, and in stationary applications for access protection and presence monitoring for objects.

The safety-related distance sensor must only be used within the limits of the prescribed and specified technical data (see "Safety-related parameters", page 59) 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!

The objects to be protected may not be 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.

Device types with laser class 1:

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.

Device types with laser class 2:

CAUTION
Optical radiation: Class 2 Laser Product

The human eye is not at risk when briefly exposed to the radiation for up to 0.25 seconds. Exposure to the laser beam for longer periods of time may cause damage to the retina. The laser radiation is harmless to human skin.

- Do not look into the laser beam intentionally.
- Never point the laser beam at people's eyes.
- If it is not possible to avoid looking directly into the laser beam, e.g., during commissioning and maintenance work, suitable eye protection must be worn.
- Avoid laser beam reflections caused by reflective surfaces. Be particularly careful during mounting and alignment work.
- 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 Warning signs on the device

Depending on the version of the device, it has a laser of Class 2 or Class 1 installed. The device is labeled with a corresponding warning sign on the left side of the housing.

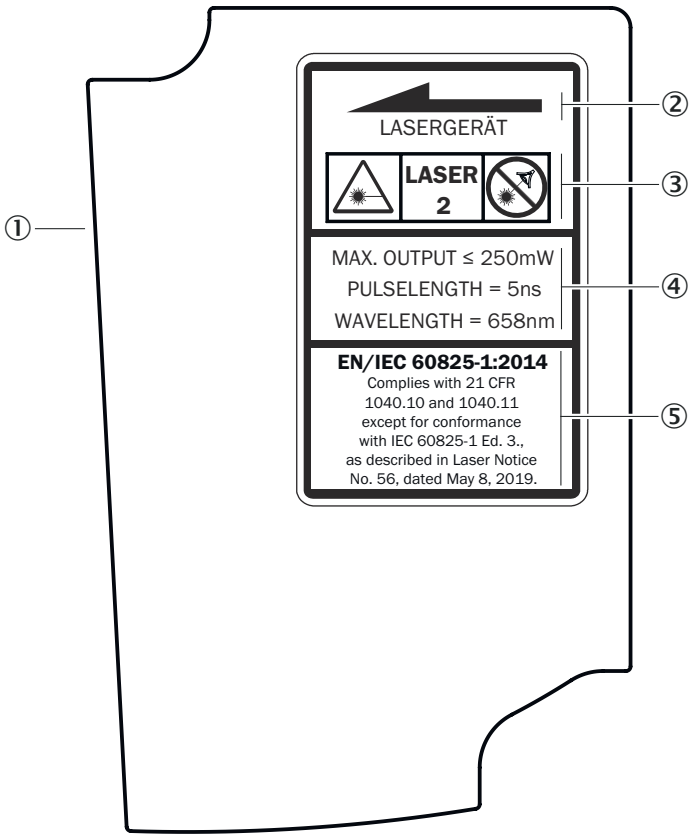


Figure 1: Warning label on the device: laser class 2

① Front of device

② Position of the laser output aperture

③ CAUTION LASER RADIATION, Laser class 2 product, Do not look into the beam

④ Maximum output power, pulse length, wavelength

⑤ 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 May 8, 2019.

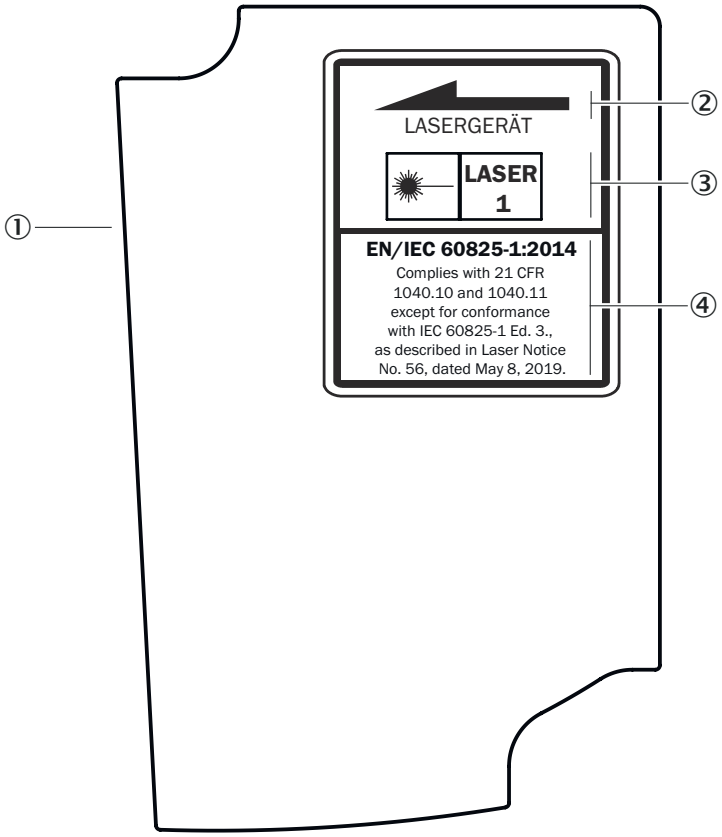


Figure 2: Warning label on the device: laser class 1

① Front of device

② Position of the laser output aperture

③ CAUTION LASER RADIATION, Laser class 1 product

④ Conforms to 21 CFR 1040.10 and 1040.11 except for conformance to IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

2.9 Norms and standards of functional safety management

The DT35S safety-related distance 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
- IEC TS 62998-1:2019 - Safety of machinery - Safety-related sensors of performance class B used for protection of persons
- 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	DT35S-B15551	DT35S-B15251
Device type	Safety-related distance sensor	
Type	Laser class 1	Laser class 2
Part number	1122103	1122104

3.2 Configuration software

Type	DT35S-B15551	DT35S-B15251
Designation	SOPAS ET	
Valid software version	2021.1 or higher	

3.3 Scope of delivery

- DT35S safety-related distance sensor of the relevant type
- 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

The type label is located on the top of the device.

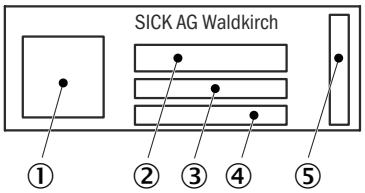


Figure 3: Type label

① 2D code (contents: part number and type designation)
② Type designation
③ Article number (order number)
④ Year and month of manufacture
⑤ Serial number

3.5 Device layout

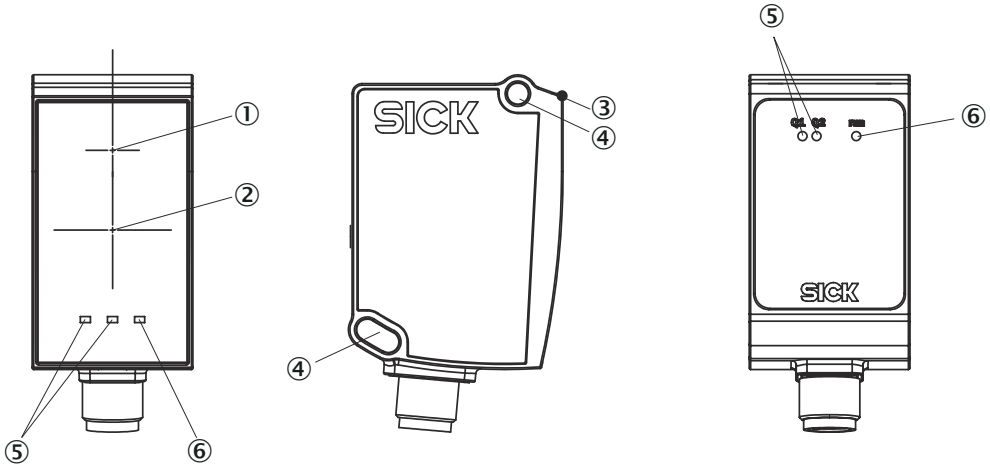


Figure 4: Device layout

① Optical axis transmitter, laser output aperture corresponds to the front viewing window at the height of the optical axis.

② Optical axis, receiver

③ Reference surface (corresponds to distance 0 mm)

④ M4 fixing hole

⑤ Q1/Q2 LEDs (status of digital outputs)

⑥ Run LED (operational status)

Status LEDs

Status LED	Status (color)	Description
Q1	● (Orange)	Digital output not active
	○ (Orange)	Digital output active
Q2	● (Orange)	Digital output not active
	○ (Orange)	Digital output active
Q1 and Q2 in run mode	☼ (Orange, Q1 and Q2 alternately for longer than 10 seconds)	Error is present. Check general conditions such as supply voltage, temperature range, EMC disturbances, etc.
Run	● (Front: Orange) ● (Rear: Green)	Supply voltage is on
	○ (Orange)	No supply voltage

● = Lights up; ☼ = Flashes; ○ = Does not light up.

3.6 Accessories

Accessories can be found on the product page, which can be accessed via the **SICK Product IDpid.sick.com/{P/N}**

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

The accessories listed with the relevant product and therefore approved are permitted to be used in conjunction with the DT35S for safety-related purposes.

A SiLink2 master is specifically required to configure the device.

3.7 Safety-related functions

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

To this end, it comes with a variety of safety-related functions.

The device has three interfaces for this purpose via which safety-related states and measured values can be displayed, depending on the selected safety-related function:

- Digital outputs
- Analog current output
- IO-Link

Compared to safety-related measured values, safety-related states are signals at interfaces that prompt the downstream processing units to respond in a safety-related manner by initiating or maintaining the safe state in the system.

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.

3.7.1 Distance to object – Safety-related Zone near

This function detects objects below a defined distance threshold (see ③) during distance determination. The signal level LOW indicates the requesting of the safety-related function, i.e., the active state has been reached. An additional configurable hysteresis of the switching point (see ④) provides the necessary tolerance in the switching range to prevent premature switching back to the inactive state.

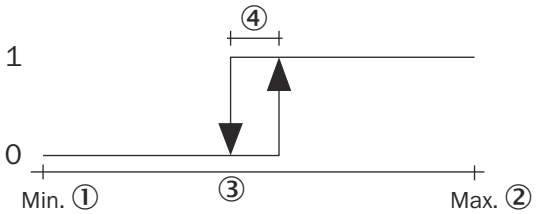


Figure 5: Distance to object, Safety-related Zone near

① Minimum distance
② Maximum distance
③ Switching point: Limit of safety-related zone
④ Hysteresis of the switching point

The safety-related information of this function (request of function yes/no) can be provided via the digital outputs (signal level Low/High) as well as in the process data via the IO-Link interface.

Status	Digital output	Status bit (bit 0 or bit 1) in the IO-Link process data
Active (safety-related)	Low	Logical 0
Deactivated	High	Logical 1

3.7.2 Distance to object – Safety-related Zone far

This function detects objects above a defined distance threshold (see ③) during distance determination. The signal level LOW indicates the requesting of the safety-related function, i.e., the active state has been reached. An additional configurable hysteresis of the switching point (see ④) provides the necessary tolerance in the switching range to prevent premature switching back to the inactive state.

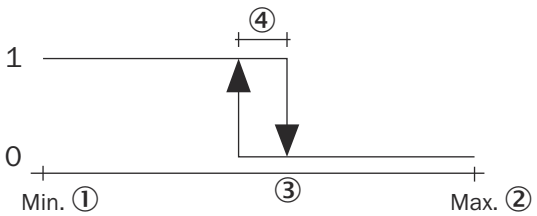


Figure 6: Distance to object, Safety-related Zone far

① Minimum distance
② Maximum distance
③ Switching point: Limit of safety-related zone
④ Hysteresis of the switching point

The safety-related information of this function (request of function yes/no) can be provided via the digital outputs (signal level Low/High) as well as in the process data via the IO-Link interface.

Status	Digital output	Status bit (bit 0 or bit 1) in the IO-Link process data
Active (safety-related)	Low	Static 0
Deactivated	High	Logical 1

3.7.3 Window function – Double safety-related zone

This function detects objects outside a defined distance window during distance determination. The limits of the distance window are signaled by a switching point close to and far from the sensor (see ③ and ④). This creates two separate safety-related areas. The signal level LOW indicates the requesting of the safety-related function, i.e., the active state has been reached due to entry of an object into one of the safety-related areas. An additional configurable hysteresis of the switching points (see ⑤) provides the necessary tolerance in both switching ranges to prevent premature switching back to the inactive state.

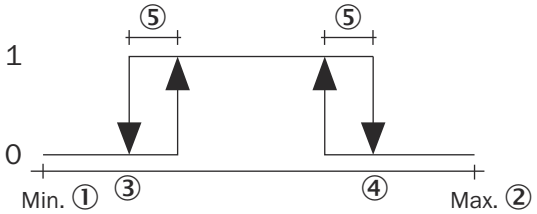


Figure 7: Window function, Double safety-related range

① Minimum distance
② Maximum distance
③ Switching point 1: Limit of safety-related zone 1
④ Switching point 2: Limit of safety-related zone 2
⑤ Hysteresis of the switching points

The safety-related information of this function (request of function yes/no) can be provided via the digital outputs (signal level Low/High) as well as in the process data via the IO-Link interface.

Status	Digital output	Status bit (bit 0 or bit 1) in the IO-Link process data
Active (safety-related)	Low	Static 0
Deactivated	High	Logical 1

3.7.4 Window function – observation window

This function detects objects within a defined distance window during distance determination. The limits of the distance window are signaled by a switching point close to and far from the sensor (see ④ and ③). This creates a safety-related observation range. The signal level LOW indicates the requesting of the safety-related function, i.e., the active state has been reached due to entry of an object into the safety-related observation range. An additional configurable hysteresis of the switching points (see ⑤) provides the necessary tolerance in both switching ranges to prevent premature switching back to the inactive state (i.e., outside the distance window).

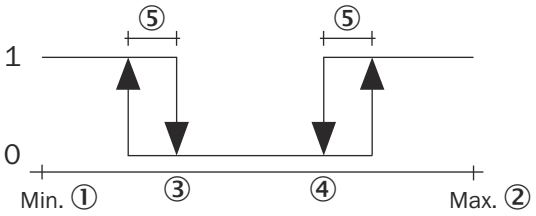


Figure 8: Window function, observation window

① Minimum distance
② Maximum distance
③ Switching point 1: Lower limit of observation range
④ Switching point 2: Upper limit of observation range
⑤ Hysteresis of the switching points

The safety-related information of this function (request of function yes/no) can be provided via the digital outputs (signal level Low/High) as well as in the process data via the IO-Link interface.

Status	Digital output	Status bit (bit 0 or bit 1) in the IO-Link process data
Active (safety-related)	Low	Static 0
Deactivated	High	Logical 1

3.7.5 Safe object detection between sensor and background

This function detects objects between the sensor itself and a background at a defined distance (see ③) during distance determination. The signal level LOW indicates the requesting of the safety-related function, i.e., an object has been detected between the sensor and the background (active state) or the installation position of the sensor has changed (with fixed background). An additional configurable tolerance around the background (see ④) ensures that minimal and, in this context, non-safety-relevant changes as well as possible measurement inaccuracies in the area of the background do not lead to unwanted triggering of the safety-related function.

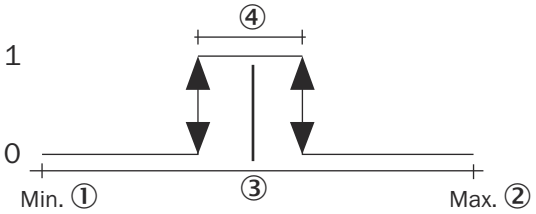


Figure 9: Safe object detection between sensor and background

① Minimum distance
② Maximum distance
③ Reference for switching points: Background

④ Distance between switching points: Tolerance around the background (twice the configured tolerance value)

The safety-related information of this function (request of function yes/no) can be provided via the digital outputs (signal level Low/High) as well as in the process data via the IO-Link interface.

Status	Digital output	Status bit (bit 0 or bit 1) in the IO-Link process data
Active (safety-related)	Low	Static 0
Deactivated	High	Logical 1

3.7.6 Safety-related normalized measurement function (increasing behavior)

The analog current output provides a continuous output of current values representing a measured value within a defined distance range. The scaling can be configured in the range from 4 mA to 20 mA. In contrast to the decreasing behavior, the increasing behavior can be used in a safety-related manner.

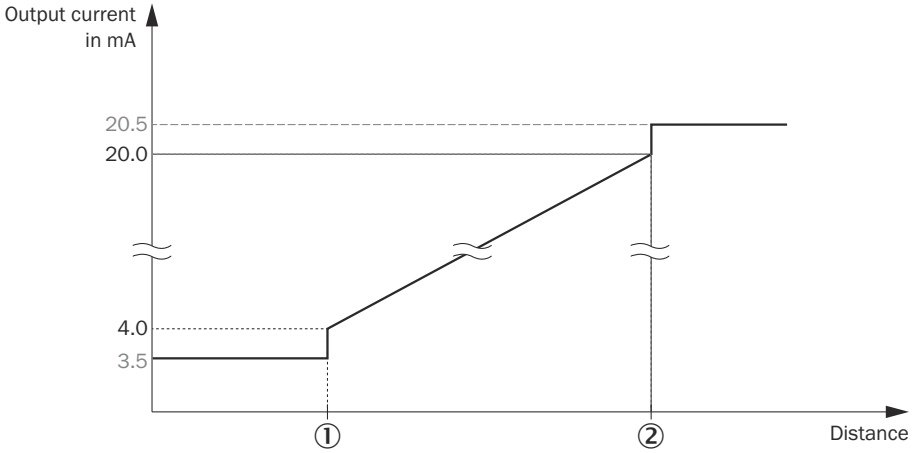


Figure 10: Safety-related normalized measurement function (increasing behavior)

① Reference point 4 mA

② Reference point 20 mA

The signal to initiate or maintain the safety-related state is a level of ≤ 3.5 mA. The prerequisite for this is the setting of the “Clamp” behavior when no measurement is possible. The “Hold” setting is not recommended for safety-related use as there is no immediate detection of an error condition.

Status	Analog current output
Operational status	Measured values in the range between 4 mA and 20 mA
Error condition	≤ 3.5 mA as well as ≥ 20.5 mA depending on the error case
Safety-related state	≤ 3.5 mA

3.7.7 Safety-related measurement function

The current distance value is continuously output in the process data via the IO-Link data interface (resolution 1 mm). The measured value is provided via IO-Link as a 14-bit number. The signal to initiate or maintain the safety-related state is represented by the value of 0 in the 14-bit process data field. The prerequisite for this is the setting

of the “Clamp” behavior when no measurement provides a result within the measuring range. The “Hold” setting is not recommended for safety-related use as there is no immediate detection of an error condition.

Status	IO-Link process data
Operational status	Measured values in the valid range
Safety-related state	No measured values (measured value 0) are transmitted

3.7.8 Alarm function - clamp

In the case of the alarm function with the “Clamp” setting, a defined state is assumed in the event of a measurement without a result, thus signaling that no target is currently available or that no measurement is possible for other reasons. This function can be used with the IO-Link interface as well as the analog current output, whereby the following states are assumed in the event of an error.

Interfaces	Safety-related state
IO-Link	Measured value 0
Analog current output	Measured value ≤ 3.5 mA

Figure 11: Clamp alarm function

① Measurement successful or measured value determined: Output measured values

② No measured value determined: Output substitute value

3.8 Non-safety-related functions

In addition to the safety-related functions, the device also has non-safety-related functions that can be used for diagnostic purposes and to generate additional application-specific information.

3.8.1 Normalized measurement function (decreasing behavior)

The analog current output provides a continuous output of current values representing a measured value within a defined distance range. The scaling can be configured in the range from 4 mA to 20 mA. The falling decreasing must only be used for non safety-related purposes.

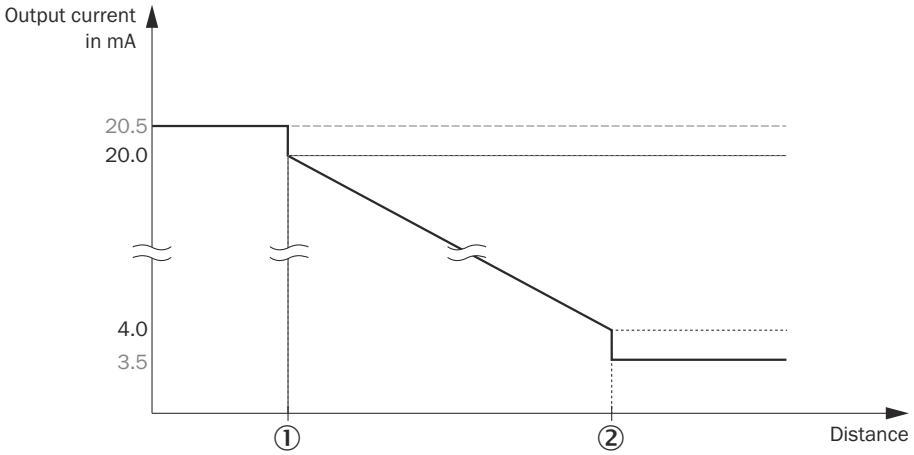


Figure 12: Normalized measurement function (decreasing behavior)

① Reference point 4 mA

② Reference point 20 mA

3.8.2 Alarm function - hold

With the “Hold” function, the last valid measured value is held in the event of an error. This process repeats until it is once again possible to run a measurement. This function can be used instead of the clamp function and also affects decision and measurement functions, however with this setting a fault condition in the device is not immediately detected. The function may therefore only conditionally be used for safety-related purposes.

Figure 13: Hold alarm function

① Measurement successful or measured value determined: Output measured values

② No measured value determined: Output substitute value

3.8.3 Signal level and signal quality

Signal level (“Level”)

The signal level corresponds to the amount of reflected light received by the receiver optics of the device. This is a dimensionless value. It essentially depends on the distance from the measuring object and on the surface of the measuring object (color, roughness/reflectivity, angle to the optical axis). To enable the device to measure the distance correctly, the signal level must not drop below a certain value. This value depends on the selected speed.

You can configure the Q1 or Q2 output for the signal level warning (OWS). The level can be adjusted within the range 0 ... 65535. If the signal exceeds or falls below the configured level, the output is connected. Hysteresis cannot be configured. The output behavior can be inverted.

Likewise, the status of the signal level warning can be provided via the status bits (bit 0 or bit 1) as part of the process data (process data format 0) via the IO-Link interface.

Depending on the application, the setting must always be defined by the system integrator. When using the signal level warning (OWS), we recommend first performing a measurement of a reference object with known and constant optical properties.

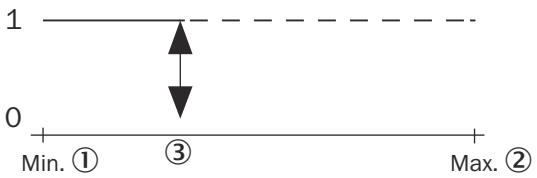


Figure 14: Output behavior for signal level warning (OWS) depends on the reception level

① Minimum reception level
② Maximum reception level
③ Switching point: Signal level threshold

Signal quality

The signal quality indicates the stability of the measurement. A meaningful value is output only if the distance between the device and the measuring object is constant. This value can be provided as part of the process data (process data format 4) via the IO-Link interface.

3.8.4 Alarm output

The digital outputs can be configured as a switching function for alarm signaling: Output of a switching signal if the device cannot generate a measured value (e.g., no object in the measuring range or remission of the measuring object too low)\.

This error output is particularly useful if the setting is activated whereby the device retains the last valid measured value as soon as no measurement is possible (see "Alarm function - hold", page 21). The output behavior can be inverted.

Likewise, the status of the alarm function can be provided via the status bits (bit 0 or bit 1) as part of the process data via the IO-Link interface.

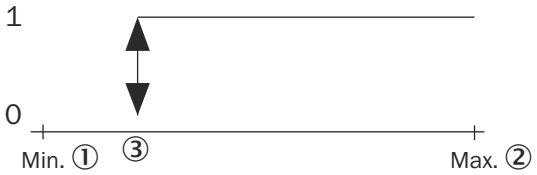


Figure 15: Digital output as alarm output

① Minimum reception level
② Maximum reception level
③ No measured value determined: Output substitute value

3.8.5 Multifunctional input MF

The laser can be switched off and on via the MF input. This can be used for diagnostic purposes to detect device faults with the help of an evaluating controller and thereby achieve a DC of up to 60% in the system network.

3.8.6 Find me!

The “Find me!” function makes it fast and easy to find a device that is installed in a machine or system.

When the “Find me!” function is activated, the two yellow LEDs on the device flash (Q1 and Q2) and the sender laser flashes with a frequency of 5 Hz. When the function is being used, it is not possible to perform a correct distance measurement. If the device is switched off and back on when the “Find me!” function is activated, the “Find me!” function will then no longer be active.

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

Store the device under the following conditions:

- Recommendation: Use the original packaging.
- Do not store outdoors.
- Store in a dry area that is protected from dust.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- Storage temperature: see "Technical data", page 58.
- Relative humidity: see "Technical data", page 58.
- 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 mounting site has to be designed for the weight of the device.
- Mount the device on a prepared bracket using suitable screws (M4). The screws are not included in the scope of delivery. Optionally available mounting accessories, see "Accessories", page 15.
- The device should be mounted and operated as free from shock and vibration as possible.
- The device can be mounted in any orientation to suit the particular application.
- 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.
- Observe the technical data.
- To prevent condensation, avoid exposing the device to rapid changes in temperature.

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.

The following requirements apply when using several devices in the application.

It is necessary to maintain a minimum axial distance of d = 100 mm to avoid any such effects.

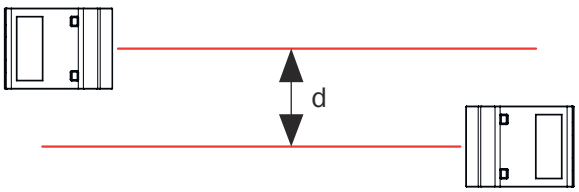


Figure 16: Minimum axial distance

When two devices are mounted opposite each other, avoid aligning them in such a way that the light source of one device hits the other in the optical receiving area. The typical specific minimum rotationally symmetrical angle is $\alpha > 1.4°$.

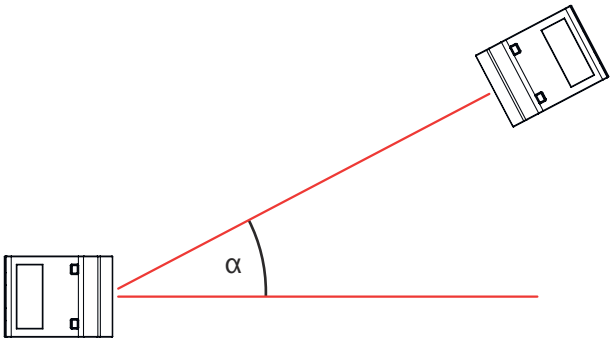


Figure 17: Minimum rotationally symmetrical angle

Installations with devices aligned in parallel will not be affected unless the entire laser light is redirected into the optical reception area of the other device (direct reflection).

Figure 18: Devices aligned in parallel

5.3 Mounting the device

1. Mount the distance sensor using the fixing holes provided, see "Mechanics/Electronics", page 58.
   Note the permissible tightening torques of the screws:
   - When using the mounting accessories or equivalent construction: max. 1.2 Nm.
   - When using screws with a polyamide spot coating (according to ISO 8992): max. 2.0 Nm.
   - For any other type of connection between the device and screws: max. 1.0 Nm.
   - The connection between a screw and the housing of the device must be made using a washer (ISO 7092, for size M4) or an equivalent washer.
2. Make the electrical connection. Attach and tighten the tension-free cable, see "Connecting the device electrically", page 26.
3. Switch on the supply voltage.

✓ The green operating LED lights up.

4. Align the device to suit the application.

6 Electrical installation

6.1 Wiring instructions

NOTE

Pre-assembled cables can be found on the product page. which can be accessed via the **SICK Product IDpid.sick.com/{P/N}**

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

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 electrical connection of the device is configured as an M12 round connector.

The enclosure rating stated in the technical data is achieved only with a screwed plug connector or protective cap.

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 2 A slow-blow fuse at the beginning of the supply cable.

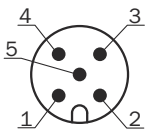
6.2 Connecting the device electrically

1. Ensure the voltage supply is not connected.
2. Connect the device according to the connection diagram, see "Connection diagram", page 26.
3. Switch on the supply voltage.

6.3 Connection diagram

Power

Table 1: Pin assignment Power connection

Male/female connector	Contact	Short form	Signal description
M12 male connector, 5-pin A-coded 	1	L+	Supply voltage
	2	Qa/Q2	Analog output / digital output 2
	3	M	Supply voltage: 0 V
	4	Q1	Digital output 1 / IO-Link
	5	MF	Multifunctional input MF

7 Commissioning and configuration

7.1 Installation of SOPAS Engineering Tool

7.1.1 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.

7.1.2 Installing the device driver

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

7.2 Parameterization of the device

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

- IO-Link in conjunction with the SiLink2 master

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 parameterization by means of other tools (not SOPAS ET) is not permitted.

7.2.1 Establishing the connection

Before launching SOPAS ET, a suitable cable (see "Accessories", page 15) must be used to establish a 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.

7.2.2 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.

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

After editing the parameters, you need to transfer them to the device by pressing the

“Write all parameters” button ( ).

7.3 Configuring the functions

The product is delivered with the following parameterization, which prevents unintentional or inadvertent activation of the device. The device has a default parameterization or factory setting in the delivery state.

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.

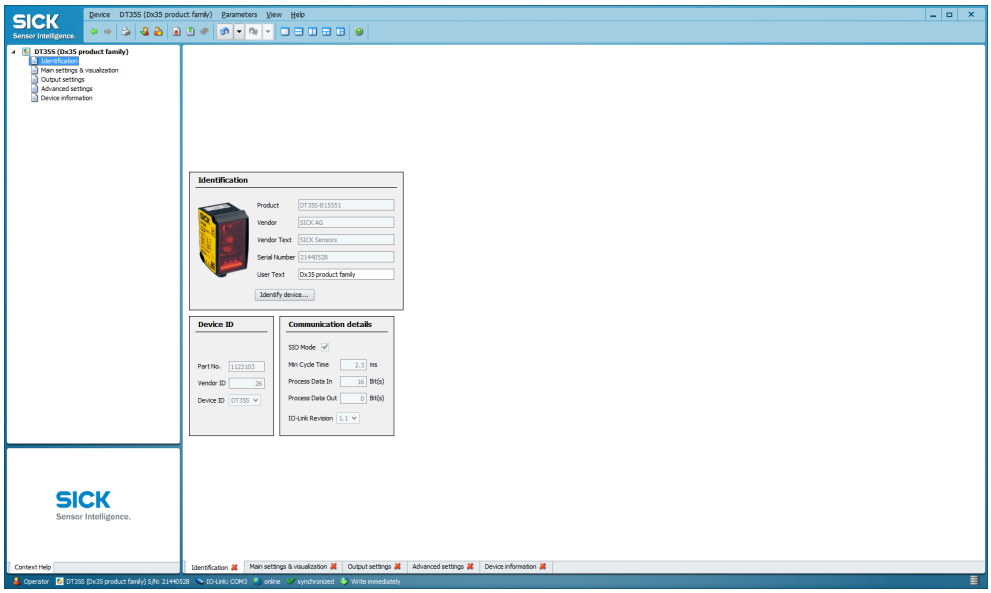
NOTE
The parameterization and commissioning in the case of a safety-related use of the device must only be performed by appropriately qualified personnel. This applies in particular to settings that differ from the default parameterization, and the resultant requirement for an assessment of the safety-related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

7.3.1 Identification

This page contains general information about the device. A user description can also be assigned for easier identification of the device. After pressing the “Find me...” button, the device changes to a flashing mode to make it easier to locate in the system, see "Find me!", page 22.

Factory setting:

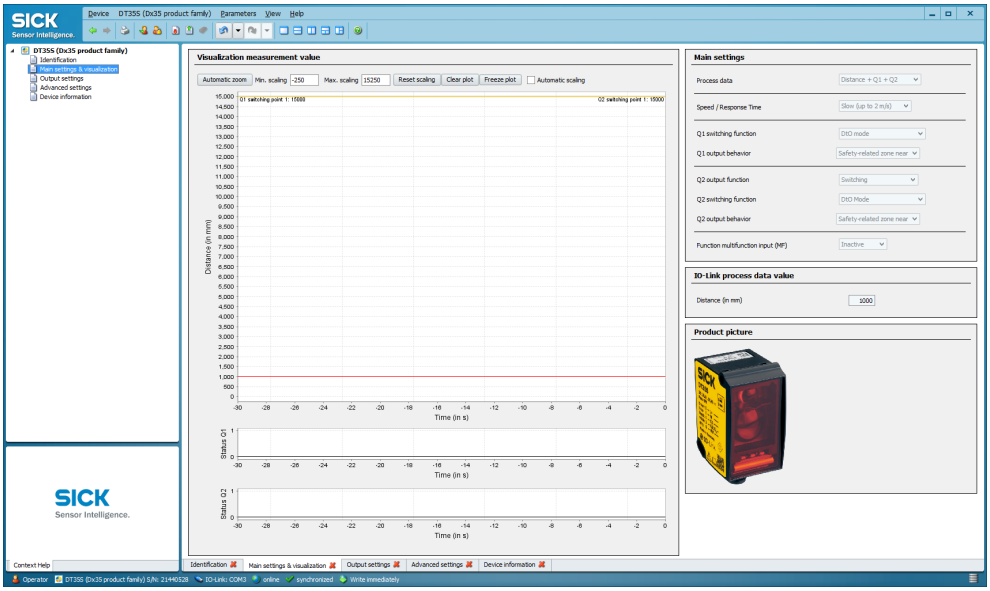
- User description: Dx35 product family



7.3.2 Main Settings & Visualization

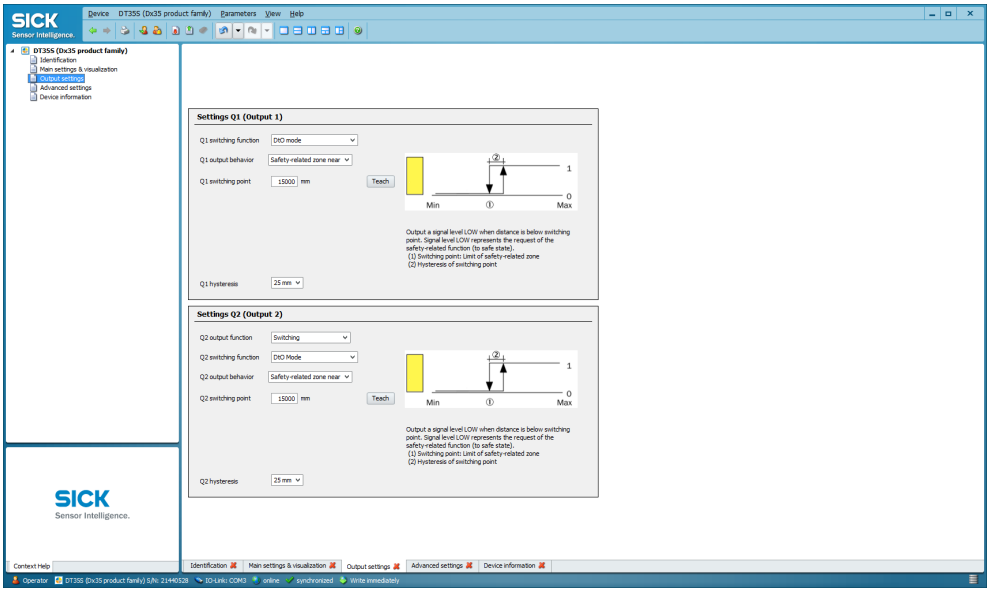
This page provides an overview of the currently configured functions and the measured value. This page is display only; no changes can be made to the functions.

In the **Visualization measurement value** area, the measured distance of the device is plotted as a function of time. In addition, the switching points stored in the device for Q1 and Q2 are displayed graphically and their status is shown in the lower area (for **Distance + Q1 + Q2** process data selection). If **Distance + Signal quality** is selected as the process data, the signal quality is visualized accordingly in the lower area.



7.3.3 Outputs Settings

This page is used to configure the safety-related functions (highlighted in yellow in the graphs) and the non-safety-related functions. These can be assigned to the respective outputs (digital output or analog current output). It is also possible in connection with this for the device to perform several functions simultaneously.



In the following, the functions described in "Safety-related functions", page 16 and the associated parameters are explained in relation to a possible configuration.

Factory setting (for Q1 and Q2):

- Switching function: **DtO mode**
- Digital output behavior: **Safety-related Zone near**

- Switching point: **15000 mm**
- Hysteresis: **25 mm**

7.3.3.1 DtO Mode

The DtO mode can be configured via the switching function for Q1 and Q2. The digital output can be parameterized for the **Safety-related Zone near** or **Safety-related Zone far** behavior. The necessary settings can either be taught-in or set manually. These are described in the following.

For a detailed functional description, see "Safety-related functions", page 16.

NOTE

The switching point can only be set in the valid measuring range from 50 mm to 15,000 mm.

When switching between the “Distance to object” (**DtO mode**) switching function and the “Switching window” (**Window mode**) switching function, it is possible for the setting of the previously selected switching behavior and/or the switching point setting to change.

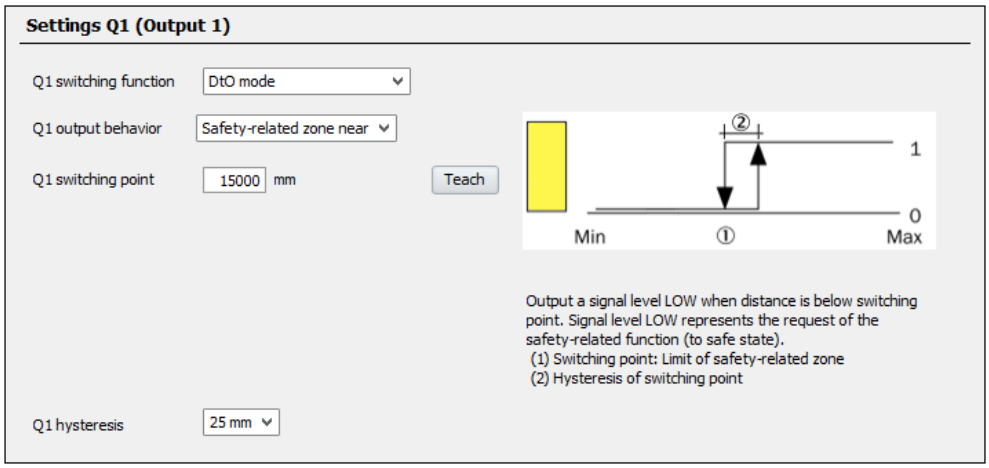


Figure 19: Safety-related Zone near

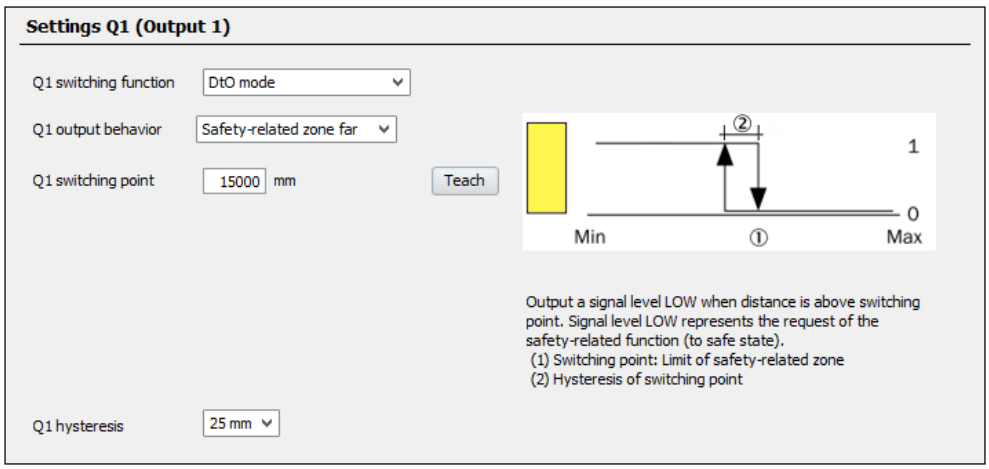


Figure 20: Safety-related Zone far

Setting	Description
Behavior of digital output	With the “Switching behavior” setting, you can manually select whether the output should relate to the Safety-related Zone far (see figure 20, page 31) or Safety-related Zone near (see figure 19, page 31).
switching point	• The switching threshold of the “Distance to object” (**DtO mode**) switching mode can be set manually in millimeters via the switching point. • The teach function can be used to teach a simple switching point for the “Distance to object” (**DtO mode**) switching mode.
Hysteresis	With the “Hysteresis” setting, the switching hysteresis can be manually set to **10 mm**, **25 mm** or **50 mm**.

Example DtO mode parameterization for Q1:

1. Connect to the device and switch to the **Outputs settings** page in SOPAS ET.
2. Set the Q1 switching function to **DtO mode**.
3. Set the Q1 output behavior according to the desired function: **Safety-related Zone near**
4. Enter the distance to the switching point in the input window (optional: position the object at switching point 1 and perform a **Teach**).
5. Select a suitable Q1 hysteresis according to the application properties (see "Project planning", page 48): **25 mm**
6. Transfer parameters the device using the “Write all parameters” button.
7. Check whether the function works appropriately for the configured parameters!

7.3.3.2 Window mode

The window mode can be configured via the switching function for Q1 and Q2. The digital output can be parameterized for the **Double safety-related zone** or **Observation window** behavior. The necessary settings can either be taught-in or set manually. These are described in the following.

For a detailed functional description, see "Safety-related functions", page 16.

NOTE

The switching point can only be set in the valid measuring range from 50 mm to 15,000 mm.

For proper functioning, the distance between switching point 1 and switching point 2 must be greater than twice the hysteresis.

When switching between the “Switching window” (**Window mode**) switching function and the “Distance to object” (**DtO mode**) switching function, it is possible for the setting of the previously selected switching behavior and/or the switching point setting to change.

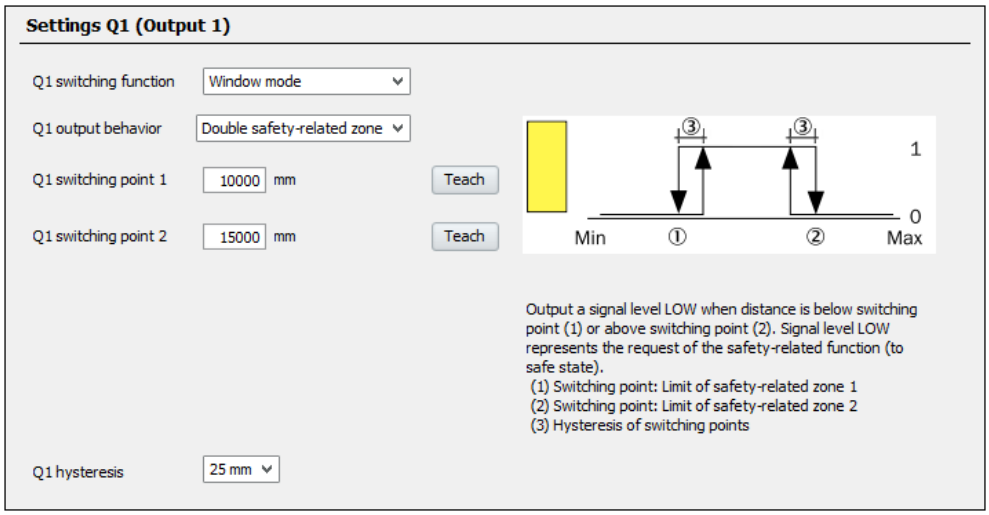


Figure 21: Double safety-related zone

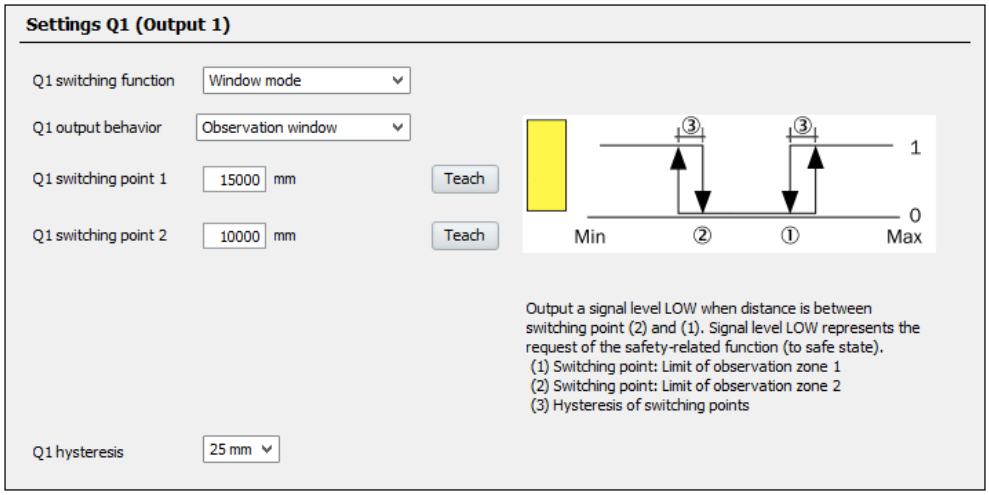


Figure 22: Observation window

Setting	Description
Behavior of digital output	The “Switching behavior” setting can be used to manually select whether the output should relate to the Double safety-related Zone (see figure 21, page 33) or Observation window (see figure 22, page 33). When the switching behavior is changed, the values set for switching point 1 and switching point 2 are automatically swapped by the device.
Switching point 1	• With the “Switching point 1” setting, the first of the two switching points of the switching window can be set manually in millimeters. • The first of the two switching points can be taught in for the Switching window (**Window mode**) switching mode using the “Switching point 1” teach method. For **Double safety-related zone** (see figure 21, page 33), “Switching point 1” must be taught in first, for **Observation window** (see figure 22, page 33), “Switching point 2” must be taught in first to avoid switching the behavior twice during teach-in.

Setting	Description
Switching point 2	• With the “Switching point 2” setting, the second of the two switching points of the switching window can be set manually in millimeters. • The second of the two switching points can be taught in for the Switching window(**window mode**) switching mode using the “Switching point 2” teach method. For **Double safety-related zone** (see figure 21, page 33), “Switching point 1” must be taught in first, for **Observation window** (see figure 22, page 33), “Switching point 2” must be taught in first to avoid switching the behavior twice during teach-in.
Hysteresis	With the “Hysteresis” setting, the switching hysteresis can be manually set to 10 mm, 25 mm or 50 mm.

Example window mode parameterization for Q1:

1. Connect to the device and switch to the **Outputs settings** page in SOPAS ET.
2. Set the Q1 output behavior according to the desired function: **Double safety-related zone**
3. Enter the distance to switching point 1 in the input window (optional: position the object at switching point 1 and perform a **Teach**). [1)]
4. Enter the distance to switching point 2 in the input window (optional: position the object at switching point 2 and perform a **Teach**). [1)]
5. Select a suitable Q1 hysteresis according to the application properties (see "Project planning", page 48): **25 mm**
6. Transfer parameters the device using the “Write all parameters” button.
7. Check whether the function works appropriately for the configured parameters!

7.3.3.3 Object between Sensor and Background (ObSB)

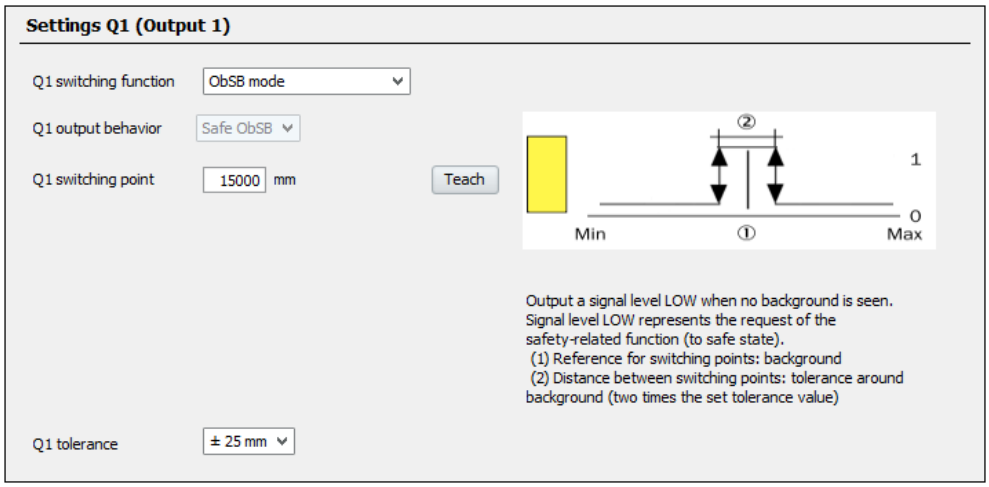
The ObSB mode can be configured via the switching function for Q1 and Q2. The necessary settings can either be taught-in or set manually. These are described in the following.

For a detailed functional description, see "Safety-related functions", page 16.

NOTE
The switching point can only be set in the valid measuring range from 50 mm to 15,000 mm.

When switching between the “Object between sensor and background” (**ObSB mode**) switching function and the “Switching window” (**Window mode**) switching function, it is possible for the setting of the previously selected switching behavior and/or the switching point setting to change.

1) Please note that switching point 1 and switching point 2 are rotated for the “Observation window” behavior.



Setting	Description
switching point	• The distance to the reference background for the “Object between sensor and background” (**ObSB mode**) switching mode can be set manually in millimeters via the switching point. • The teach function can be used to teach in the target and reference background for the “Object between sensor and background” (**ObSB mode**) switching mode.
Tolerance	With the “Tolerance” setting, the tolerance around the background can be manually set to **±10 mm**, **±25 mm** or **±50 mm**.

Example ObSB mode parameterization for Q1:

1. Connect to the device and switch to the **Outputs settings** page in SOPAS ET.
2. Set the Q1 switching function to **ObSB mode**.
3. Enter the distance to switching point 1 in the input window (optional: position the object at switching point 1 and perform a **Teach**).
4. Select a suitable Q1 tolerance according to the application properties (see "Project planning", page 48): **± 25 mm**
5. Transfer parameters the device using the “Write all parameters” button.
6. Check whether the function works appropriately for the configured parameters!

7.3.3.4 Signal level warning (VMA)

The signal level warning (VMA) can be configured via the switching function for Q1 and Q2.

The necessary settings can either be taught-in or set manually. These are described in the following.

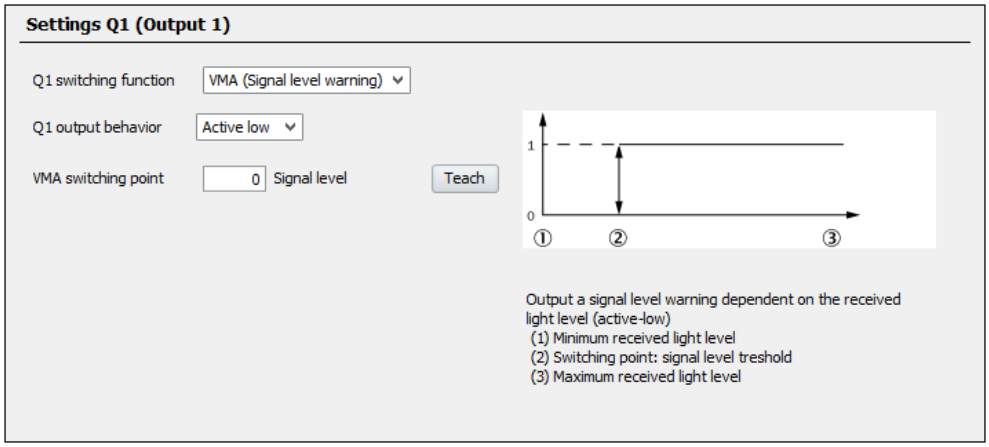
For a detailed functional description, see "Non-safety-related functions", page 20.

A switching signal is output when the level falls below a configurable threshold or the signal level switching point. The switching signal is then High (“Active high”) or LOW (“Active low”).

Utilization of the signal level warning can be useful for outputting a warning message if measurement conditions are marginal (for example, outputting a warning message for objects that must be measured). When measuring a reference object using known, uniform optical properties, the signal level warning can also be used to notify a user of required cleaning of the optical interfaces of the device.

NOTE

After successful teach-in (Teach), the value should be adjusted to suit the application conditions. Since all variations should be considered in this value, both a teach-in under good conditions and a teach-in under challenging conditions should be performed. The value can then be better estimated. After that, it is useful to multiply the determined value by 80% for a maximum allowed aging.



Function	Description
VMA switching threshold (signal level warning)	• The **VMA (Signal level warning)** switching threshold can be used to manually set the level warning threshold or signal level switching point for the **VMA (Signal level warning)** switching mode in the form of a signal level within the value range of 0 to 65535. • The Teach function can be used to teach in the level warning threshold or the signal level switching point for the **VMA (Signal level warning)** switching mode based on the reflective properties of a reference object. Since the signal level is not expressed as a standardized unit, but instead corresponds to a device-specific value, it is advisable to determine and define the level warning threshold for each application based on test measurements. There is no switching hysteresis function in the **VMA (Signal level warning)** switching mode. This is because both the level warning threshold and time-dependent behavior of the signal level curve vary from one application to the next. In light of these facts, it is also advisable to use external and specific or time-dependent filtering of the signal level warning in the control system in addition to the output of the signal level warning.
Switching behavior	With the “Q1 output behavior” setting, you can manually select whether the signal level warning output is **Active high** or **Active low**.

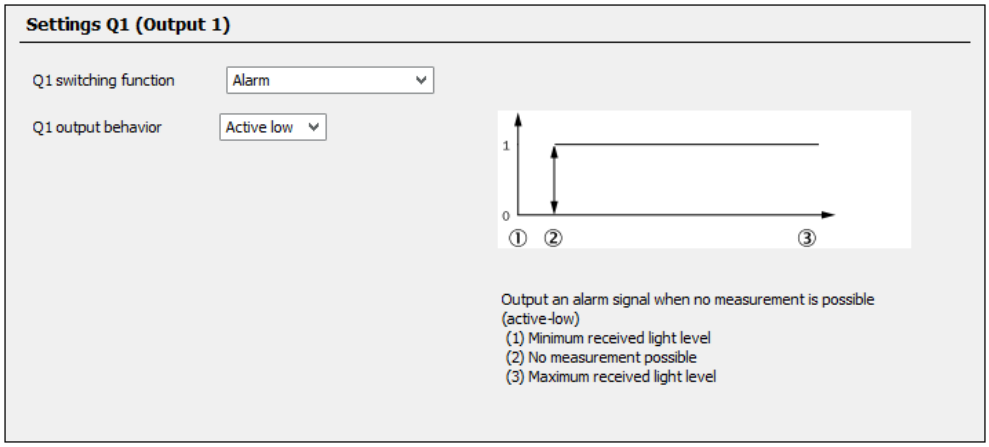
Example VMA (signal level warning) parameterization for Q1:

1. Connect to the device and switch to the **Outputs settings** page in SOPAS ET.
2. Set the Q1 switching function to **VMA (Signal level warning)**.
3. Set the Q1 output behavior according to the desired function: **Active low**
4. Position the reference object in front of the device and perform a **Teach**.
5. Position a “bad” reference object in front of the device and perform a **Teach**.
6. Determine and enter the **VMA (Signal level warning)** switching threshold based on the Teach results.
7. Transfer parameters the device using the “Write all parameters” button.
8. Check whether the function works appropriately for the configured parameters!

7.3.3.5 Alarm

The alarm output can be configured via the switching function for Q1 and Q2.

For a detailed functional description, see "Non-safety-related functions", page 20.



Function	Description
Alarm	In **Alarm** switching mode, the switching threshold is automatically defined based on the measuring capability of the device. In this case, the switching output behavior can be manually selected.
Switching behavior	With the **Q1 output behavior** setting, you can manually select whether the signal level warning output is **Active high** or **Active low**.

Example alarm parameterization for Q1:

1. Connect to the device and switch to the **Outputs settings** page in SOPAS ET.
2. Set the Q1 switching function to **Alarm**.
3. Set the Q1 output behavior according to the desired function: **Active low**
4. Transfer parameters the device using the “Write all parameters” button.
5. Check whether the function works appropriately for the configured parameters!

7.3.3.6 Analog output

If the 4 mA ... 20 mA setting is selected, output 2 functions as an analog current output. The measured value of the device is output as a proportional-linear current value that corresponds to the other device settings. Increasing (safety-related) and decreasing (non-safety-related) scaling is possible.

The necessary settings can either be taught-in or set manually. These are described in the following.

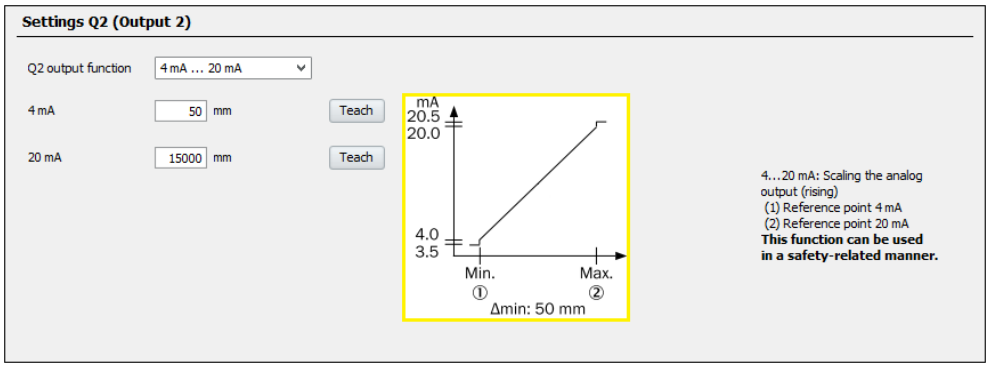
For a detailed functional description, see "Safety-related functions", page 16 and "Non-safety-related functions", page 20.

NOTE

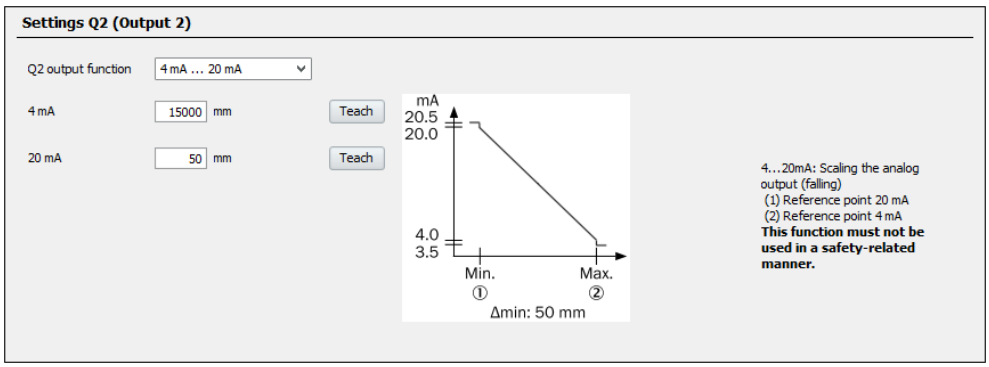
The analog output has a resolution of 12 bits.

Depending on whether the larger distance value is taught in for 4 mA or for 20 mA, the analog output behavior is either “increasing” (distance for 4 mA < distance for 20 mA) or “decreasing” (distance for 4 mA > distance for 20 mA).

Increasing scaling of the analog output (safety-related function)



Decreasing scaling of the analog output (non-safety-related function)



Setting	Description
4 mA	• With the **4 mA** setting, the distance value to be output with 4 mA at the analog output can be set manually in millimeters. • The Teach function can be used to teach in for the **4 mA ... 20 mA** output function the current distance value for an analog output of 4 mA for the measured value.
20 mA	• With the **20 mA** setting, the distance value to be output with 20 mA at the analog output can be set manually in millimeters. • The Teach function can be used to teach in for the **4 mA ... 20 mA** output function the current distance value for an analog output of 20 mA for the measured value.

Example analog output parameterization for Q2:

1. Connect to the device and switch to the **Outputs settings** page in SOPAS ET.
2. Set the Q2 switching function to **4 mA ... 20 mA**.
3. Enter the distance to switching point 1 in the input window (optional: position the object at switching point 1 and perform a **Teach**). [2)]
4. Enter the distance to switching point 2 in the input window (optional: position the object at switching point 2 and perform a **Teach**). [2)]
5. Transfer parameters the device using the “Write all parameters” button.
6. Check whether the function works appropriately for the configured parameters!

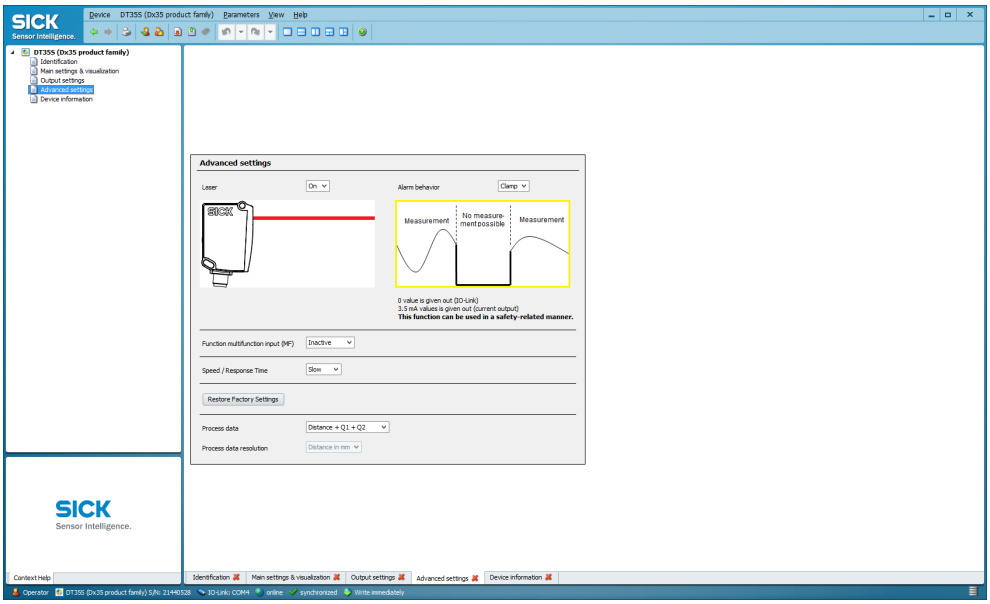
2) For a decreasing behavior, the distance for 20 mA must be smaller than the distance for 4 mA.

7.3.4 Advanced settings

This page is used to configure further device-related settings. These affect, among other things, the functions and process data of the device and are briefly explained below.

Factory setting:

- Laser: **On**
- Behavior if no measurement possible: **Clamp**
- Multifunctional input (MF) function: **Inactive**
- Speed / response time: **Slow**
- IO-Link process data: **Distance + Q1 + Q2**

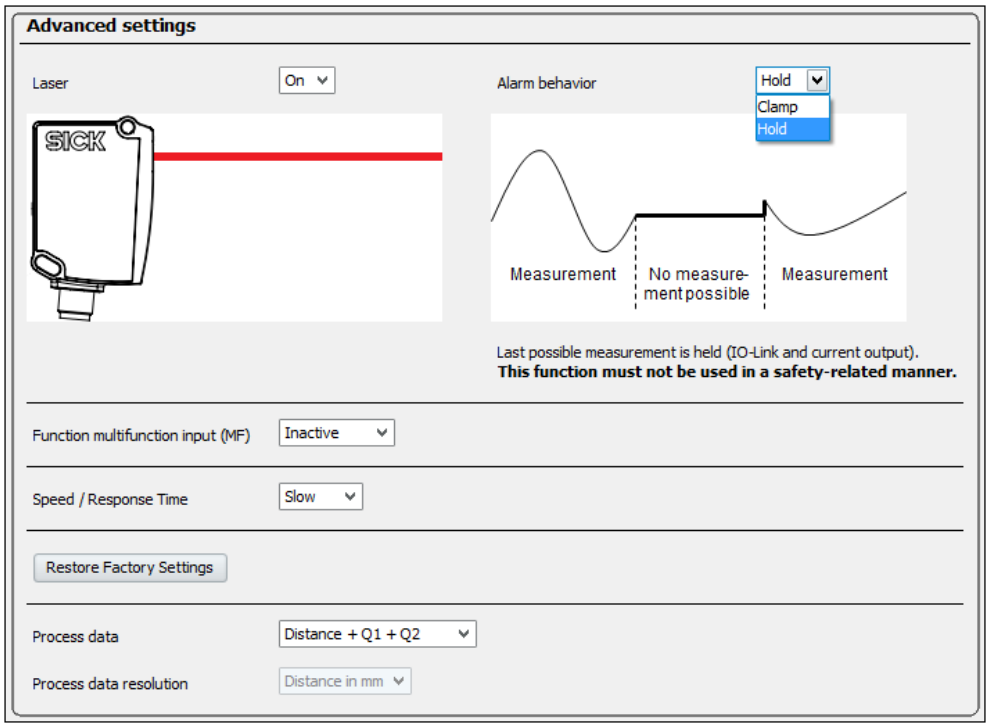


7.3.4.1 Behavior if no measurement is possible

The **Clamp** alarm function or **Hold** alarm function can be configured here. If a measurement of the distance does not provide a valid result, the alarm state is set and an alternative measured value is used (the last measured value for **Hold**, the measured value 0 for **Clamp**). Possible causes of the error:

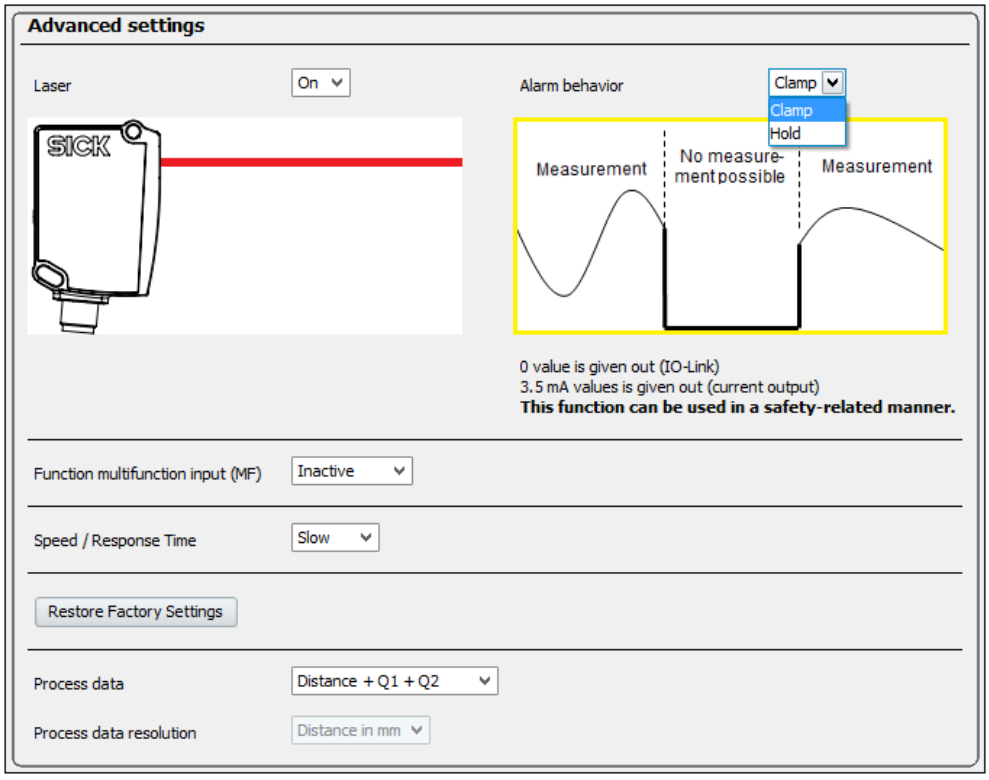
- The measuring object is outside of the measuring range.
- The light signal received by the device is not strong enough.
- The laser is switched off.
- Device defective.

For a description of the associated functions, see "Safety-related functions", page 16 and "Non-safety-related functions", page 20.



Output minimum value (“Clamp”) (safety-related)

Instead of the distance value, a substitute value is output (see "Alarm function - clamp", page 20). This behavior corresponds to the factory settings and can be used in a safety-related manner.

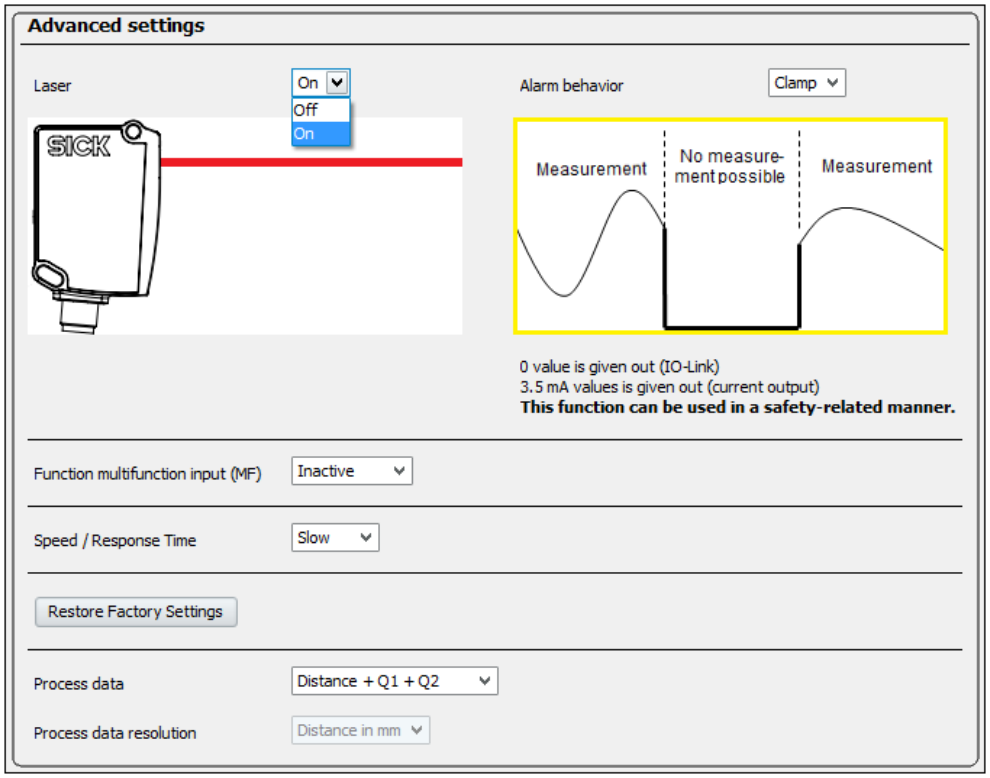


Hold last measured value (“Hold”) (conditionally safety-related)

The last valid distance value is frozen and output again (held). This process repeats until it is once again possible to run a measurement. This behavior should only conditionally be used for safety-related purposes.

7.3.4.2 Laser

It is possible to switch off the sender laser temporarily or permanently. No measurement is possible when the laser is switched off.



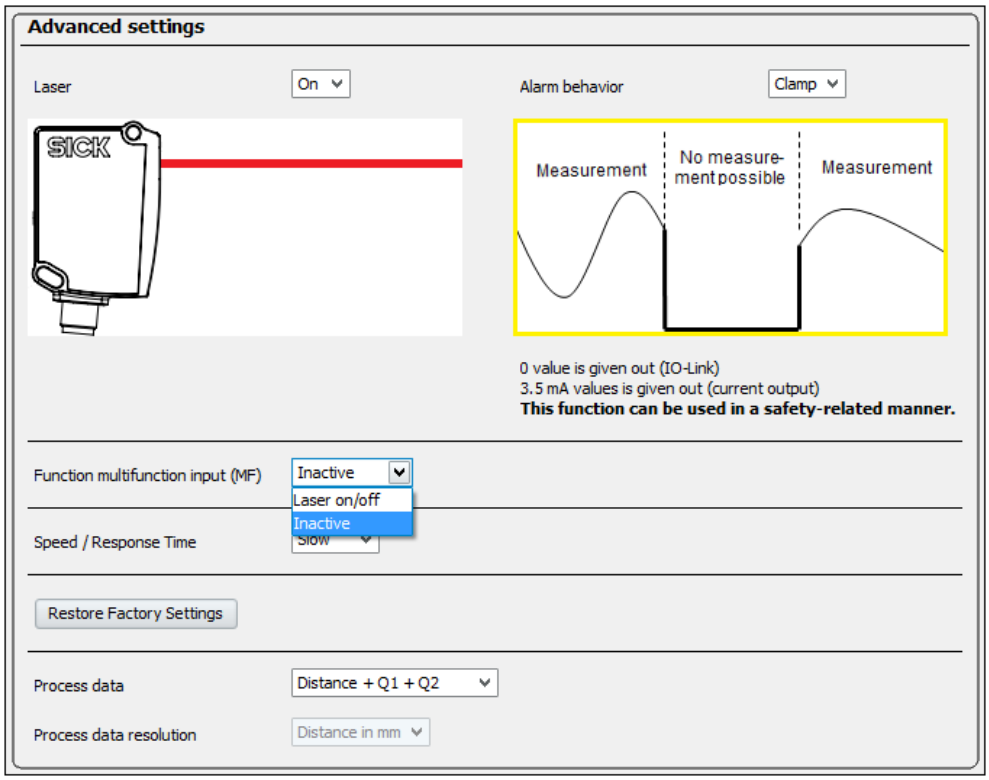
Permanently switch the laser off

The laser can be switched off permanently via SOPAS ET. It remains switched off until it is switched back on by another event. If the power supply of the device is interrupted in the meantime, the laser remains switched off afterwards.

7.3.4.3 Multifunctional input

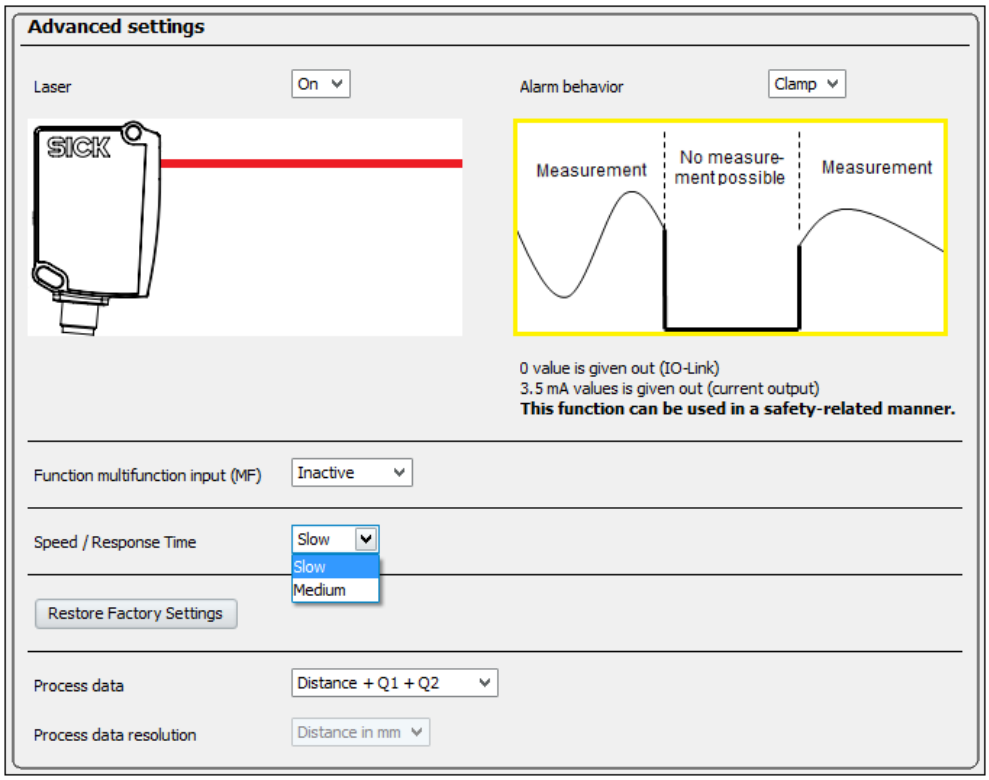
The laser can be switched off temporarily via the multifunctional input (MF) using the **Laser on/off** function. The laser switches off as soon as the switching condition has been met and remains switched off until it is no longer met.

If the MF input is not used, the **Inactive** setting should be selected, or the input connected to GND or 24 V accordingly.



7.3.4.4 Speed / response time

The device supports different speed settings (**Slow** and **Medium**). The selected speed setting affects the performance of the device. The “Safety-related detection range” and “Safety-related response time” performance data as a function of the remission factors 6%, 10%, 20% and 90% are shown in the technical data, see "Safety-related parameters", page 59.



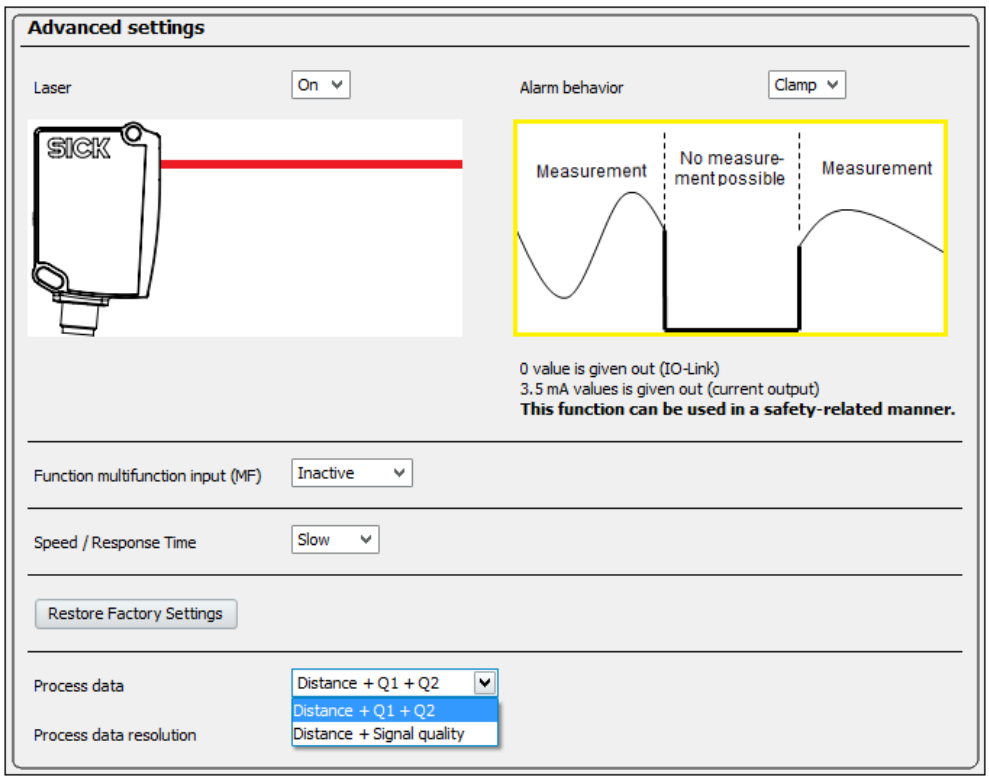
7.3.4.5 IO-Link process data

Process data is cyclically transferred via IO-Link from the device to the IO-Link master. It is possible to configure the content of this process data:

- **Distance + Q1 + Q2** (process data format 0)
- **Distance + Signal quality** (process data format 4)

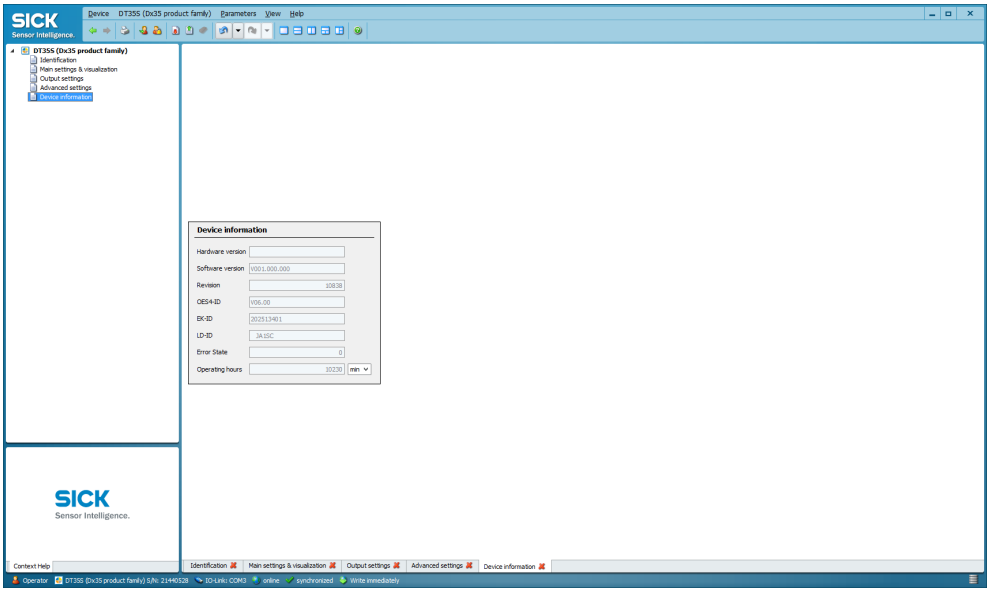
For details, see "Process data", page 44.

The process data setting affects, among other things, the visual display on the **Main settings & visualization** page.



7.3.5 Device information

This page shows detailed device information. This information is not required for normal operation. If a fault arises in the device, please inform technical support.



7.3.6 Preventing unintended or unauthorized modification

To prevent unintentional modification, configuration of the device is only allowed via SOPAS ET and the SiLink2 master required for this. The output of the sensor must be connected directly to the SiLink2 master. This means that if modification of the device parameters is desired, the device must first be disconnected from the application. The device can then be connected to a computer on which SOPAS ET is installed via the SiLink2 master. The system integrator is responsible for ensuring that this is only done by authorized and also instructed personnel. The system integrator is also responsible for checking whether further measures are required to prevent unauthorized modification.

7.4 IO-Link interface

Table 2: Properties of the IO-Link interface

IO-Link specification	V1.1
SIO mode (standard I/O mode)	Yes
Minimum cycle time	2.3 ms
Transmission rate	COM2 (38.4 kBaud)
Process data width	16-bit outgoing (from the device to the master)
Process data type	UINT (unsigned integer)
Parameter configuration server function (data storage)	Yes

The device-specific IO-Link device description and the IODD can be found on the product page, which can be accessed via the **SICK Product IDpid.sick.com/{P/N}**

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

7.4.1 Process data

The process data have a data width of 16 bits. The content can be adjusted using the “process data structure” index 83. Factory setting for index 83: Option “0”: Distance (14 bit) + status Q1 + status Q2

Table 3: Process data

Description	Value
Access	Read

Description	Value
Data	2 bytes
Data type	UINT (unsigned integer)

Table 4: Process data formats

No.	Description	Comment
0	Distance (14 bits), status of the switching output Q1 and Q2 [1]	Factory setting
4	Distance (14 bits) + signal quality (2 bits), [1]	-

[1] With a fixed resolution of 1 mm and an available process data width of 14 bits, a maximum distance measurement value of 16,383 mm can be displayed. Higher values are output as 16,383 mm.

7.4.2 Safety-related use of the IO-Link interface

Safety-related distance values can be transmitted as 14-bit measured values via the IO-Link interface (process data formats 0 and 4). The status of safety-related switching functions can also be transmitted via the process data (process data format 0). The possibility of transmitting safety-related data with PL b via IO-Link is determined as part of the safety verification of the DT35S.

7.4.2.1 System integration

The system integrator is responsible for ensuring that the sensor is correctly connected to the logic unit or controller. It is especially important in this regard to ensure that the logic unit evaluates the sensor (with the associated configuration) at the correct port or channel interface. It must also be taken into consideration that the sensor and the evaluating logic unit or controller must constitute a point-to-point connection (no intermediate gateways allowed). The system integrator must always provide specific proof of safety for the respective application or for the overall system (including the communication network used). This must also specifically include a safety-related evaluation of the logic unit or controller used.

7.4.2.2 Parameterization of the device

Parameterization of the device via an IO-Link data interface integrated into a network is not permitted, i.e., use of a network engineering tool is not permitted. Parameterization may only be performed locally via SOPAS ET and a SiLink2 master required for configuration. When doing so, the IO-Link interface of the device must be disconnected from the network and connected to the SiLink2 master.

7.4.2.3 Data storage

When using data storage, it must be ensured that the correct parameters of the device have been transmitted and thereby set for the intended application when a device is replaced (use of spare part) and after each local parameterization. It is therefore always necessary in both cases to valid the safety-related functions in the application and to check them for correct operation.

We therefore strongly recommend not to implement data storage to avoid unintentional highly incorrect operation when devices are exchanged or local parameterization is performed.

8 Error behavior

8.1 General

A non-hazardous failure of the device occurs:

- If the safety-related function is not fulfilled and the device changes to one of the safety-related states.
- If the device changes to one of the safety-related states when an internal error is detected.

A hazardous undetected failure occurs:

- If a safety-related function is fulfilled and the device does not change to one of the safety-related states.
- If the safety-related measured value deviates by more than the defined uncertainty.

8.2 Internally detected errors

The device itself, i.e., based on the internal diagnostics performed in the device, has a diagnostic coverage (DC) of zero according to EN ISO 13849-1:2015. By taking into account further external diagnostics and thus supplementing the internal diagnostics, it is possible however to achieve a DC of 60% in a higher-level system. The required combination of diagnostic measures to achieve a DC of 60% are described in "Use in the safety-related system", page 51. This makes it necessary, however, to include an external downstream controller when determining the diagnostic coverage. This controller plays a significant role in detecting the errors and enabling a DC of 60% to be achieved. The effectiveness of the required diagnostics must always be evaluated and validated by the system integrator for the specific application.

8.3 Internally undetected errors and faults

The device itself will **not reliably detect** the following errors and faults as a minimum:

- **Input**: Short to ground, wire break, short-circuit, cross circuit at the digital input.
- **Outputs**: Short to ground, wire break, short-circuit, cross circuit at the digital outputs. This also applies in the case of incorrect wiring of the connection pins.
- **Measurement data interfaces**: Wire break, short-circuit, cross-circuit and EMC influences, with the effect that corrupted or no measurement data are transmitted to the downstream controller.
- **Display elements / LED**: Failure of the status indicators for operational status and the digital outputs.
- **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 devices and light sources at the level of the optical receiver unit, 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 at the measurement spot 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.

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.

8.4 Environmental influences

The measurement by means of the time-of-flight method is well established and is used in the single-echo method employed here only in the protected area (indoors) in order to avoid inadvertent shadowing. This enables disturbances due to moisture, precipitation and contamination to be minimized.

The device reacts to temperatures and different remissions at various distances with a systematic mismeasurement. To minimize this, the systematic error can be minimized by means of the teach-in function.

If the sensor is likely to be contaminated, a reserve against reduced detection capability should be factored in and additional monitoring of the signal quality or signal strength is recommended.

The ObSB function is provided to prevent misalignment caused by, for example, vibration or impact.

Excessive light on the target or in the sensor may reduce the detection capability.

Avoiding reflectors and thereby reducing the presence of diffusely reflecting objects increases the detection capability due to a lower dynamic range of the remission. Measurement or distance determination on reflectors (as the target object) in a safety-related context is not permitted.

Faults or errors that lead to loss of detection capability (e.g., due to environmental influences) are covered within the maximum downtime per year required by IEC TS 62998-1. This corresponds to a maximum of 5 minutes per year for Performance Class B. This also specifically takes into account any undetected corrupted messages that may occur during data communication due to electromagnetic ambient conditions.

8.5 Fault exclusions

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

8.6 Manipulation

The device does not have any protective measures against manipulation, especially none that relate to the optical system. Objects, especially objects covering the viewing window 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 "Internally undetected errors and faults", page 46) are also not detected.

9 Project planning

9.1 Placing the machine on the market (system integrator)

WARNING
Risk of ineffectiveness of the protective device!

The objects to be protected may not be recognized in case of non-observance.

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

- ▶ 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.

9.2 Operating entity of the machine

WARNING
Risk of ineffectiveness of the protective device!

The objects to be protected may not be recognized in case of non-observance.

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

- ▶ 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 viewing window. To ensure the continuing, reliable safety function of the device, the viewing window must be cleaned regularly.

9.3 Preventing unprotected areas

WARNING
Risk of ineffectiveness of the protective device!

The objects to be protected may not be recognized in case of non-observance.

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

- The device must be mounted in such a way that objects are reliably detected when they enter 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 detection zone, thereby limiting the detection capability.
- The device must be affixed so that no small objects (e.g., cables) are in the detection zone, 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 objects can be present between the protective device and the hazardous point without being detected, check if additional protective measures (e.g., restart interlock) are required.
- The optical beam path must not be disrupted, e.g. if the system is incorporated into paneling. No additional protective screen may be fitted.

9.4 Response time of the device

The response times of the device must be taken into account, among other things, so that the device can be positioned in a suitable location and the switching points can be configured correctly.

The response times are specified in the technical data, see "Technical data", page 58.

9.5 Basic measurement deviations

When determining the safe position or distance in the application, the statistical and systematic error must always be taken into account.

Manual specification of the distance value for the switching point setting

When entering distance values as switching points (without using the teach-in function), both types of error must be taken into account. This gives a total measurement deviation of 50 mm. When using the safety-related switching functions, this value must be taken into account during project planning and must result in an increase in the safety ranges.

To prevent constant switching of the safety function, the hysteresis can be set to 25 mm and, in case of constantly changing ambient conditions, also to 50 mm. Unchanging conditions and a high signal quality also allow a hysteresis of 10 mm.

Using the teach function for switching point adjustment

If the exact position value is important for selecting the switching points, the switching point can be determined using another measuring device and adjusted by means of a teach in. The systematic error can be minimized while doing so. Any measurement deviation can then be attributed solely to the statistical error and the total error will amount to 25 mm. In this case, the ambient conditions that lead to the change in systematic errors must be kept constant.

9.6 Dynamic measurement deviations

The dynamic measurement deviation represents the deviation between the real distance and the distance output when the device and/or the object to be detected moves with velocity v at a point in time. The dynamic measurement error can be estimated assuming a constant velocity.

X = v x T

X: Dynamic measurement deviation

v: speed

T: Response time

To evaluate the dynamic deviation from the real position within the scope of a safety function, the following must be considered separately for safety-related systems:

- Time required for data transmission from the device to the safe evaluation unit
- Time required for the data evaluation itself

Allowed approach speeds in the application

Depending on the device variant and the speed setting of the device, the approach speeds present in the application must be limited to the values shown in the table. This ensures that the dynamic measurement errors, which depend on the respective response times, remain commensurate with the other errors.

Table 5: Allowed approach speed

Device variant	Speed setting	Max. allowed approach speed
DT35S-B15251	Medium	5 m/s
	Slow	2 m/s
DT35S-B15551	Medium	2 m/s
	Slow	1 m/s

When considering high approach speeds in the application, care must be taken however to ensure that the required minimum distances, e.g., to stop a mobile platform, can be maintained. This applies in particular if objects with a low remission factor (for example 6%) are to be detected in an associated short safety-related detection range.

9.7 Calculation of minimum distances in the application

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 of the safety function and assumption of the safe machine state, including signal propagation times in the network and processing time in the controller)
- Response time of the entire protective device
- Position of the device, e.g., on the vehicle
- Speed of the sensor platform

- Approach speed of the objects
- Resolution (detection capability) of the device
- Type of approach
- Parameters specified based on the application
- Supplements for general and, possibly, reflection-based measurement errors

The calculation of the minimum distances and the associated verification must be performed by the system integrator on an application-specific basis.

9.8 Use in the safety-related system

The device contains functions that can be used in a higher-level system to detect errors or to assess the quality of the measurement data. The associated information can thus be used to improve decision-making at the system level (e.g., as part of the controller evaluation). It is also possible in this way to implement a higher safety integrity at the system level.

9.8.1 Measures to improve the diagnostic coverage

Diagnostic options can be used to increase the device availability or to integrate the device into systems with more stringent requirements on functional safety.

A distinction is made between internal and external diagnostics.

Internal diagnostics are performed online by the device and put the safety-related outputs in an error state that requests the safety function performed by the device (the system changes to the safe state).

External diagnostics require an evaluation of the system, e.g., of the expected values from the project planning, with the device providing information for this purpose. Based on this information, decisions can then be made to increase the device availability or safety, and actions or decisions can be triggered in the system.

9.8.1.1 Clamp alarm function

The device measures the amount of reflected light and can use it to make a prediction about the reliability of the measurement. If the device is intended to be used in an application where one or more targets are constantly present in the measurement area, this internal diagnostic can be used to diagnose the measurement capability of the system.

To use the internal diagnostics, the alarm function parameter must be set to “Clamp”. The alarm value (see "Alarm function - clamp", page 20)will then be assumed at all safety-related interfaces if the measuring capability is too low.

The diagnostics relate to the optical measuring path and can detect associated internal and external errors.

9.8.1.2 Digital output alarm function

For diagnostic purposes, the alarm parameter can be set for the switching function. This places the result of the internal diagnostics test at the assigned digital output. The output is switched active when the alarm condition is met. The status of the alarm output can also be displayed via the status bits in the IO-Link process data.

The diagnostics relate to the optical measuring path and can detect associated internal and external errors.

9.8.1.3 Digital output signal level warning

The device measures the amount of reflected light and can compare it to a reference value to issue a warning to initiate a countermeasure. An external controller with knowledge of the state of the overall safety function can use this value to derive the measurement capability of the system.

To use the external signal level warning diagnostics, the switching function parameter must be set to signal level warning. The result of the check whether the current amount of reflected light is smaller than the taught-in or projected value (stored in the signal threshold parameter) is then output at the assigned digital output. The output is switched active when the condition is met.

To methods are generally used to teach in or configure the signal threshold.

Applications with varying measurement scenarios or objects to be detected:

Starting from the most demanding measurement scenario in the application (usually lowest remission factor at highest distance), the measured signal level is reduced by 20% for aging and possibly further percentages for a high operating reserve.

Applications with a defined measurement scenario or a fixed object to be detected:

Starting from the scenario to be diagnosed in the application, this is reproduced, for example by contaminating the windshield or target, and the signal threshold value for this is recorded. Particular attention must be paid to the statistical fluctuation of the measured value to determine whether it meets the requirements. Since the measurement capability has been verified at this signal threshold, no additional margins for aging of the laser need to be factored in.

If there is an expected value for a certain object at a recurring distance, a contamination detection can be performed by checking the signal level against a defined signal threshold. An early warning of impending failures due to contamination can then be issued and cleaning initiated before loss of device function occurs.

The diagnostics relate to the optical measuring path and can detect associated internal and external errors.

9.8.1.4 IO-Link timeout

When communicating via IO-Link, the controller checks whether the communication was successful within a defined time period. After a timeout, i.e., no successful communication within the defined time period, the controller must assume the safe state

According to ISO 13849 4.5.4, a test or diagnostic rate equal to at least 100 times the demand rate of the safety function is prescribed for category 2. The timer must therefore always be adjusted for the demand rate and evaluated in the application.

This diagnostic measure enables faults in the logic and output path of the device to be detected.

NOTE
This diagnostic measure is only able to be used via the IO-Link data interface

9.8.1.5 System response when the laser is switched off and on

The laser is periodically switched off and on via the safety-related input (MF input, change from inactive to active and back to inactive). The “Clamp” alarm function or the alarm function need to be configured via the digital output at the same time.

When switched off, no sufficient signal strength is achieved due to the absence of laser light. As a result, the algorithm triggers the alarm state and the state changes is output via the selected alarm function (“clamp” or switching output). For clamp this means: Digital outputs change to the safety-related state or remain in this state while the input

is active, the outputs for measured values output an invalid value or an error value. The outputs then go back to the previous state. The switching output as an alarm output changes to the active state and back during the test or remains there if the alarm state already existed before.

According to ISO 13849 4.5.4, a test or diagnostic rate equal to at least 100 times the demand rate of the safety function is prescribed for category 2. The periodic switching off and on of the laser must therefore always be adjusted for the demand rate and evaluated in the application.

These diagnostic measures enable faults in the logic and output path of the device to be detected.

9.8.2 DC = 60% target value

In order to achieve a DC of 60% for the complete device despite inadequate internal self-diagnostics, both internal and external diagnostic measures must be performed in order to obtain sufficient diagnostic coverage for the complete device (optical path, logic, output path). A DC of 60% can thus only be achieved with external diagnostics in the system network, taking into account an evaluation unit (controller) designed for this purpose. The device does not have a DC of 60% based on its internal diagnostics!

The table shows the possible combinations of diagnostic measures to achieve a DC of 60% depending on the interface used. To achieve a DC of 60%, a diagnostic measure 1 must always be linked to a diagnostic measure 2.

Table 6: Diagnostic measures for DC = 60%

Interface used for diagnostics	Diagnostic measure 1	Diagnostic measure 2	Achieved DC
Digital outputs	Switching function alarm function	Laser off/on system response	60 %
	Switching function signal level warning	Laser off/on system response	
Analog current output	Clamp alarm function	Laser off/on system response	
IO-Link	Clamp alarm function	IO-Link timeout	
		Laser off/on system response	
	Switching function alarm function (status bit)	IO-Link timeout	
		Laser off/on system response	
	Switching function signal level warning (status bit)	IO-Link timeout	
		Laser off/on system response	

9.8.3 Measures to improve sensor fusion at the system level

If the safety-related measured values are to be used via the IO-Link process data for a safety function at system level, e.g., also in combination or in fusion with further device data, the confidence of the transmitted measured values at the current time can be decisive. The confidence of the measured values depends to a large extent on the systematic and statistical measurement error of the device.

The systematic measurement error is < 25 mm over the entire temperature range as well as over the entire safety-related detection range.

The safety-related statistical error of the device is also < 25 mm over the entire detection range, which corresponds to a coverage probability of 4.4 σ according to IEC TS 62998-1 and is the required value for Performance Class B. This measurement uncertainty must be taken into account in addition to the systematic error when making a decision at system level based on the device measurement data.

The signal quality level (bit 0, bit 1), which provides information about the current quality of the transmitted measurement data, can also be transmitted via the IO-Link process data. Depending on the value, the following conclusions can be drawn about the measured values with regard to the statistical measurement accuracy.

Bit 1	Bit 0	Value	Statistical measurement error
1	1	3	< 10 mm
1	0	2	< 25 mm
0	1	1	< 25 mm
0	0	0	Measured value is not trustworthy

NOTE

When using the signal quality level to evaluate the measured value quality, it is necessary to evaluate each transmitted measured value including signal quality level at system level. This is the only way to ensure that changes in signal quality can be taken into account immediately in the decision-making process of the system.

Depending on the application, consistently good signal qualities can be achieved for small scanning ranges or even materials with a large remission factor. If the signal quality is output as the value 3, it is possible to take smaller measurement errors of the device into account in the evaluation or decision-making at system level (<10 mm). This only applies, however, as long as the value 3 is displayed as the signal quality level. Otherwise, larger measurement uncertainties must be taken into account. The validation of the safety function that processes the measured values in conjunction with the signal quality must be performed by the system integrator of the application.

On the other hand, by outputting the value 0, for example in the event of short-term faults in the application (covered by the max. cumulative downtime per year), it is possible to immediately recognize that the currently transmitted measured values are not trustworthy and must not be used for further processing. It is then possible for the higher-level system to rely on other data at this point in time or to perform a degradation of the safety function.

10 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 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, ...).

11 Working with the product

11.1 Safety

WARNING
Risk of ineffectiveness of the protective device!

The objects to be protected may not be recognized in case of non-observance.

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

- ▶ 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.

11.2 Cleaning

NOTICE
Equipment damage due to improper cleaning.

Improper cleaning may result in equipment damage.

- Only use recommended cleaning agents and tools.
- Never use sharp objects for cleaning.

Clean the front screens at regular intervals with a lint-free cloth and plastic cleaning agent.

The cleaning interval essentially depends on the ambient conditions.

11.3 Maintenance

The device does not contain any components that require maintenance. The device must not be opened.

The following maintenance work is required at regular intervals:

Table 7: Maintenance schedule

Maintenance work	Interval	To be performed by
Cleaning the housing	Cleaning interval depends on ambient conditions and climate	Specialist
Check screw connections and plug connectors	Every 6 months, depending on the application conditions with regard to shock and vibration	Specialist

11.4 Transport and storage

Transport and store the device in its original packaging. 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).

11.5 Repair

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

11.6 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.

12 Technical data

NOTE

Via the product page, you can download, save and print the associated online data sheet with technical data, dimensional drawing and connection diagrams for your product.

which can be accessed via the **SICK Product IDpid.sick.com/{P/N}**

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

Please note: This documentation may contain further technical data.

12.1 Dimensions

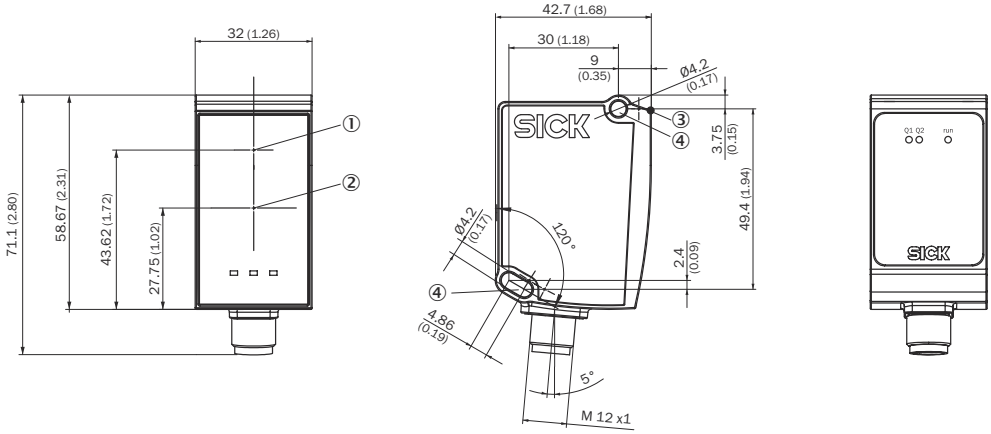


Figure 23: Dx35S dimensions, dimensions in mm (inch), decimal separator: point

① Optical axis, sender

② Optical axis, receiver

③ Reference surface (corresponds to distance 0 mm)

④ M4 fixing hole

12.2 Mechanics/Electronics

Supply voltage (V_s)	19.2 V DC ... 26.4 V DC [1]
Residual ripple	≤ 5 V_{pp} [2]
Power consumption	≤ 1.7 W [3]
Initialization time	≤ 500 ms
Warm-up time	≤ 20 min
Housing material	Plastic (ABS and PC)
Viewing window material	Plastic (PMMA)
Connection type	Male connector, M12, 5-pin
Display	LEDs
Enclosure rating	IP65 / IP67 (IEC 60529:1989+AMD1:1999+AMD2:2013)
Protection class	III (IEC 61140:2016-11)
Electrical safety	According to IEC 61010-1 (ed.3)
Weight	65 g

Dimensions (L x W x H)	32 mm x 58.67 mm x 42.7 mm

1) Limit values, reverse-polarity protected. Operation in short-circuit protected network: max. 8 A.
2) May not fall short of or exceed U_v tolerances
3) At 20 °C and without load

12.3 Safety-related parameters

Category	B (EN ISO 13849-1:2015)
Performance level	b (EN ISO 13849-1:2015)
Performance class	B (IEC TS 62998-1:2019)
$MTTF_D$ (mean time to dangerous failure)	82 years, at 50 °C ambient temperature(EN ISO 13849-1:2015)
DC (diagnostic coverage)	Without external test or diagnostic equipment: 0% With external test or diagnostic equipment: 60% [1]
T_M (mission time)	20 years (EN ISO 13849-1:2015) 10 years, at 50 °C ambient temperature (EN ISO 13849-1:2015)
Max. cumulative downtime per year	< 5 min (IEC TS 62998-1)
Conformities	EN ISO 13849-1:2015, IEC TS 62998-1:2019, EN ISO 13842:2014, ANSI/ITSDF B 56.5:2012
Safety-related measurement accuracy (static error)	4.4 σ according to IEC TS 62998-1: < 25 mm (in the safety-related detection range) [2]
Safety-related systematic error	< 25 mm (in the safety-related detection range) [2]
Blind zone	No objects are detected from the measurement origin up to a distance of 0.05 m

1) Selection of an appropriate combination of diagnostic measures is required, see "DC = 60% target value", page 53.
2) The error may vary over the temperature range, but will remain within the specified limits.

Safety-related detection range - Slow

Device variant	Sensing range for a target with a remission factor of ...			
	6 %	**10 %**	**20 %**	**90 %**
DT35S-B15551	50 mm ... 2,000 mm	50 mm ... 3,000 mm	50 mm ... 4,500 mm	50 mm ... 8,500 mm
DT35S-B15251	50 mm ... 2,000 mm	50 mm ... 3,000 mm	50 mm ... 4,500 mm	50 mm ... 8,500 mm

Safety-related detection range - Medium

Device variant	Sensing range for a target with a remission factor of ...			
	6 %	**10 %**	**20 %**	**90 %**
DT35S-B15551	50 mm ... 1500 mm	50 mm ... 2,500 mm	50 mm ... 3,500 mm	50 mm ... 7,000 mm
DT35S-B15251	50 mm ... 1,500 mm	50 mm ... 2,500 mm	50 mm ... 3,500 mm	50 mm ... 7,000 mm

Safety-related response times - Slow

Device variant	Response time for functions via ...			
	Digital output	IO-Link measured value	IO-Link status bits (Q1/ Q2)	Analog current output
DT35S-B15551	≤ 50 ms	≤ 32 ms	≤ 50 ms	≤ 50 ms
DT35S-B15251	≤ 25 ms	≤ 16 ms	≤ 25 ms	≤ 25 ms

Safety-related response times - Medium

Device variant	Response time for functions via ...			
	Digital output	IO-Link measured value	IO-Link status bits (Q1/ Q2)	Analog current output
DT35S-B15551	≤ 25 ms	≤ 16 ms	≤ 25 ms	≤ 50 ms
DT35S-B15251	≤ 15 ms	≤ 8 ms	≤ 15 ms	≤ 25 ms

12.4 Performance

Device variant	DT35S-B15251	DT35S-B15551
Measuring object	Natural objects	
Resolution	1 mm	
Repeatability	5 mm (1 σ)	
Accuracy	Typ. ±10 mm Temperature response of 0.5 mm/K	
Light sender	Laser, red Visible red light Max. power ≤ 250 mW, pulse duration 4 ns, wavelength: 658 nm, pulse rate: 1/250	Laser, red Visible red light Max. power ≤ 250 mW, pulse duration 4 ns, wavelength: 658 nm, pulse rate: 1/500
Laser class	2 (IEC 60825-1:2014, EN 60825-1:2014)	1 (IEC 60825-1:2014, EN 60825-1:2014)
Typ. light spot size (distance)	15 mm x 15 mm at 2 m	

12.5 Interfaces

IO-Link	IO-Link V1.1, COM2 (38.4 kBaud) Function: Process data
Digital output	Quantity: 1 ... 2 [1) 2)] Type: Push-pull: PNP/NPN Function: Q2 output switchable: current output / digital output Maximum output current I_A: ≤ 100 mA
Analog output	Quantity: 1 Type: Current output Current: 4 mA ... 20 mA, ≤ 450 Ω Resolution: 12 bit
Multifunctional input (MF)	Quantity: 1 [3)]
Optical displays	2 LEDs (operational status, status of digital outputs)

1) Output Q, short-circuit protected
2) Voltage drop < 3 V
3) Response time ≤ 60 ms

12.6 Ambient data

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.

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	**Sinusoidal vibrations (resonance):** 10 Hz ...1000 Hz (IEC 60068-2-6:2007) **Broadband noise:** 10 Hz ... 500 Hz; 10 grms, 100 min/axis (IEC 60068-2-64:2008)
Shock resistance	**Single shock:** 30 g; 6 ms; 3 shocks/axis Continuous shock 25 g; 6 ms; 500 shocks/axis (IEC 60068-2-27:2008)
Ambient light immunity	3,000 lx (direct exposure) 40,000 lx (indirect exposure)
Altitude	< 2,900 m above sea level
Ambient temperature, operation	-25 °C ... +50 °C
Ambient temperature, storage	-40 °C ... +75 °C
Permissible relative humidity	≤ 95 %, non-condensing (EN60068-2-30:2005)
damp heat	25 ... 55 % r.h. 6 cycles (EN 60068-2-30:2005)
temperature change	-25 ... +50 °C 10 cycles (EN 60068-2-14:2009)

13 Annex

13.1 Declarations of conformity and certificates

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

which can be accessed via the **SICK Product IDpid.sick.com/{P/N}**

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

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