DL100 Pro EtherCAT®

Distance sensor

SICK
Sensor Intelligence.

Described product

DL100 Pro EtherCAT®

These operating instructions describe all DL100 Pro devices with a EtherCAT® interface with type designation DL100-2xxxx211 from firmware version V002.001.001 onwards

EtherCat® is a registered trademark and patented technology licensed by Beckhoff Automation GmbH, Germany.

Manufacturer

SICK AG
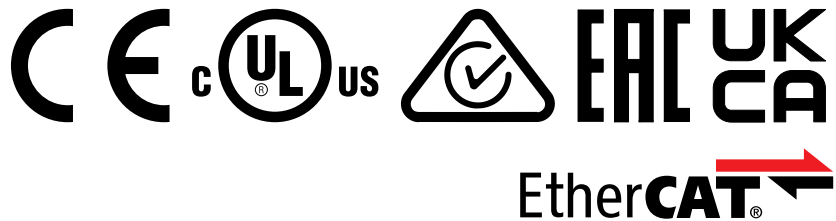Erwin-Sick-Str. 1
79183 Waldkirch
Germany

Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Information on the operating instructions

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

Prerequisites for safe work are:

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

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

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

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

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

1.2 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.

1.3   Scope of delivery

Table 1: Scope of delivery

No. of units	Component	Note
1	Device in the version ordered	Depending on version
	Protective caps	For connections (on the device)
1	Printed safety notes, multilingual	Brief information and general safety notes

The actual scope of delivery may differ for special designs, additional orders or due to the latest technical changes.

1.4   Further information

More information can be found on the product page.

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

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

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

The following information is available depending on the product:
- Data sheets
- This document in all available language versions
- CAD files and dimensional drawings
- Certificates (e.g., declaration of conformity)
- Other publications
- Software
- Accessories

2 Safety information

2.1 Intended use

The long range distance sensor is intended for non-contact measurement of distances to system components that are in linear motion. The distance measurement is performed on a reflector.

SICK AG assumes no liability for losses or damage arising from the use of the product, either directly or indirectly. This applies in particular to use of the product that does not conform to its intended purpose and is not described in this documentation.

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 does not constitute a safety component in accordance with the respective applicable safety standards for machines.
- The device must not be used in explosion-hazardous areas, in corrosive environments or under extreme environmental conditions.
- Any use of accessories not specifically approved by SICK AG is at your own risk.

⚠ **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.

The following qualifications are required for various activities:

Table 2: Activities and technical requirements

Activities	Qualification
Mounting, maintenance	- Basic practical technical training - Knowledge of the current safety regulations in the workplace
Electrical installation, device replacement	- Practical electrical training - Knowledge of current electrical safety regulations - Knowledge of the operation and control of the devices in their particular application
Commissioning, configuration	- Basic knowledge of the computer operating system used - Basic knowledge of the design and setup of the described connections and interfaces - Basic knowledge of data transmission
Operation of the device for the particular application	- Knowledge of the operation and control of the devices in their particular application - Knowledge of the software and hardware environment for the particular application

2.7 Operational safety and specific hazards

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

⚠ **CAUTION**
Optical radiation: Class 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

A class 2 laser is installed in the device. The housing is labeled with a warning sign.
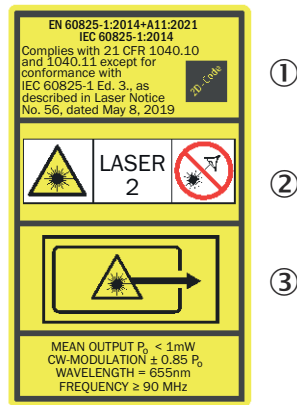
Figure 1: Warning symbol on the device: Laser class 2 (60825-1:2014+A11:2021/IEC 60825-1:2014), identical laser class for issue EN/IEC 60825-1:2007

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

② Laser radiation – Never look into the light beam – Laser class 2 (EN 60825-1:2014+A11:2021; IEC 60825-1:2014)

③ Laser output aperture

2.9 UL conformity

NFPA79 applications only. Adapters including field wiring cables are available.

More information can be found on the product page:

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

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

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

3 Function and use

3.1 Configuration
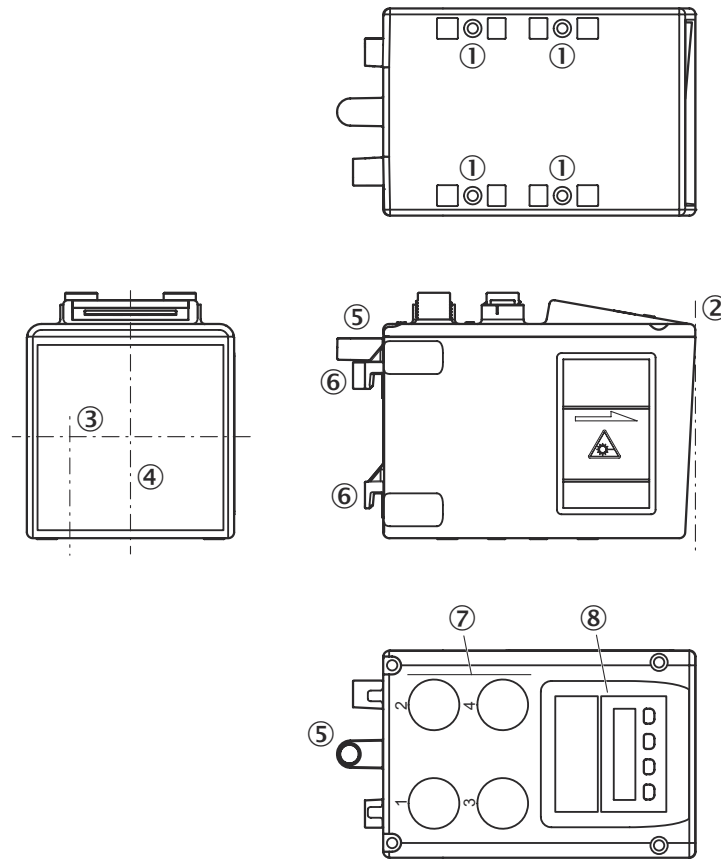
Figure 2: Distance sensor structure

①   M5 threaded mounting hole
②   Device zero point
③   Sender optical axis
④   Receiver optical axis
⑤   Hole for the star grip screw of the optional alignment bracket
⑥   Latch hook for alignment bracket
⑦   Electrical connection
⑧   Display and control elements

3.2 Function

The device consists of a laser, receiving optics and an integrated evaluation unit. The laser emits a light beam which is reflected back to the receiving optics by the reflector. The integrated evaluation unit determines the distance between the sensor and the reflector using phase-correlated time-of-flight measurement.

For the measurement, either the reflector or the device can move in a linear fashion along the laser beam.

The measured distance is transmitted via the data interface and can be used for control purposes or in a position control loop, for example.

3.3   Type label

The type label gives information for identification of the device.
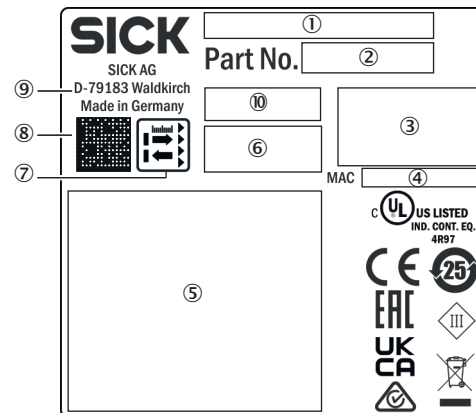
Figure 3: Type label

① Type code
② Part number
③ Electrical data and environmental data
④ MAC address
⑤ Pin assignment
⑥ Interface
⑦ Pictogram: Distance sensor reflector operation
⑧ 2D code with part number and serial number
⑨ Manufacturer, place of manufacture
⑩ Serial number, year and month of manufacture

3.4   Display and control elements
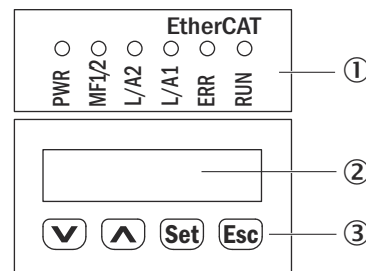
Figure 4: Display and control elements

① LEDs
② Display
③ Pushbuttons

3.4.1   LEDs

The status of the device and the status of all interfaces is displayed by LEDs in accordance with the following table.

Table 3: LEDs

LED	Description
PWR	Device status display For measures, see "Troubleshooting", page 65. ■ LED off: No operation ■ LED green: Interference-free operation ■ LED flashes orange: Warning ■ LED flashes red: Error
MF1/2	The status (output level) of the MF1 multifunctional input/output and MF2 multifunctional output

	MF1	**MF2**
LED off	LOW	LOW
Blue LED	HIGH	LOW
Yellow LED	LOW	HIGH
LED, white	HIGH	HIGH

LED	Description
L/A2, L/A1	Connection status (link) Ethernet port 2 (ECAT OUT) and port 1 (ECAT IN) ■ LED flashes orange: Data exchange active ■ LED green: Connection (link) to the next participant available. ■ LED off: No physical connection to the next participant available. For measures, see "Ethernet problems", page 67.
ERR (following the respective field-bus specification)	Error ● LED off: No error ● LED flashing red twice briefly: Watchdog time-out ● LED flashes red briefly: Local error/unsolicited change of EtherCAT® status ● LED flashing red, sustained: Configuration error ● LED solidly red: Application error
RUN (following the respective field-bus specification)	operational status ● LED off: Device has initialization status ● LED flashing green briefly: Device has safe-operational status ● LED flashing green, sustained: Device has pre-operational status ● LED green: Device has operational status
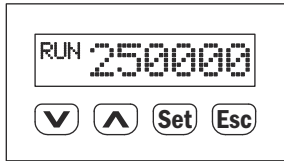
3.4.2 Display

The device has a display which provides a range of information. You can also call up and set parameters using the display.

Symbols for operating modes

The device has two different operating modes, "measured value display" and "menu display", which are indicated on the display by the symbols RUN and MEN.

Table 4: Symbols for operating modes

Icon	Description
RUN 250000 ∨ ∧ Set Esc	The device is in "measured value display" operating mode when it is switched on. The **RUN** symbol and the current distance value are displayed. This operating mode enables you to display other process values.

Icon	Description
MEN Menu ⌄ ⌃ Set Esc	The **MEN** symbol is displayed in "menu display" operating mode. In this operating mode, device parameters can be read out or set depending on the interface. When it comes to setting parameters in devices with fieldbus interface, make sure to observe the notes in see "Operation", page 33.

ⓘ NOTE

In the display, distance values always have the resolution "mm", speed values the resolution "mm/s". Positive numerical values do not have a sign, negative numerical values have the "-" sign. This limits the display range to 5 decimal places when numerical values are negative. In the "measured value display" operating mode, the sign and the highest decimal place are cut off and replaced by a "!" when the value -99,999 is undercut.

3.4.3   Operating pushbuttons

The device can be operated using the following 4 pushbuttons:

Table 5: Pushbuttons

Button	Description
⌄	▪ Scroll through process values or (main) menu ▪ Reduce value
⌃	▪ Scroll through process values or (main) menu ▪ Increase value.
Set	▪ Enter menu operation ▪ Switches to the next lower menu level ▪ Confirm selection
Esc	▪ Leave value/option input of a parameter without saving. ▪ Jump back to the next highest menu level or to the measured value display.

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   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.

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

4.3   Storage

- Do not store outdoors.
- Store in a place protected from moisture and dust.
- Recommendation: Use the original packaging.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- Storage temperature: see "Technical data", page 69.
- Relative humidity: see "Technical data", page 69.
- 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 procedure

1. Choose a mounting site bearing in mind the mounting instructions, see "Mounting instructions", page 17.
2. Selecting and mounting the reflector, see "Select and mount the reflector ", page 17.
3. Mounting alignment bracket and distance sensor, see "Mounting the alignment bracket and distance sensor", page 24.
4. Establishing electrical connection, see "Electrical installation", page 29.
5. Aligning distance sensor and reflector to one another see "Aligning the distance sensor and reflector with each other", page 26.

5.2 Mounting instructions

- Observe the technical data.
- Protect the sensor from direct sunlight.
- To prevent condensation, avoid exposing the device to rapid changes in temperature.
- The mounting site has to be designed for the weight of the device.
- Use a sensor with optional heater at low ambient temperatures such as in cold storage.
- Use a sensor with an optional cooler housing at higher temperatures.
- Maintain a sufficient distance to other distance sensors, see "Placement of multiple distance sensors", page 20.
- Maintain a sufficient distance to the data transmission photoelectric sensors, see "Arranging the distance sensor to the adjacent optical data transmission system", page 22.

5.3 Select and mount the reflector

> **ℹ NOTE**
> Suitable reflectors and suitable reflective tape can be found on the product page .
> The page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**
> {P/N} corresponds to the part number of the product, see type label.
> {S/N} corresponds to the serial number of the product, see type label (if indicated).

Reflector size

- Select a reflector size that always allows the entire light spot to hit the reflector.
- If the reflector is mounted to a vehicle and the distance sensor is secured in place at a fixed location, you can calculate the minimum size of the reflector using the distance-based light spot size, see "Optics", page 69.
- If the distance sensor is installed onto a vehicle, a larger reflector is typically necessary for taking into account the rolling movements of the vehicle and therefore of the laser.

> **ℹ NOTE**
> The reflector must always be at least 100 mm x 100 mm in size, even if the light spot is smaller due to a shorter measuring distance.

Reflector tilt

▶ To avoid direct surface reflections, mount the reflector with a tilt of approx.
+1° ... +3° in one of the 2 axes (horizontal or vertical).
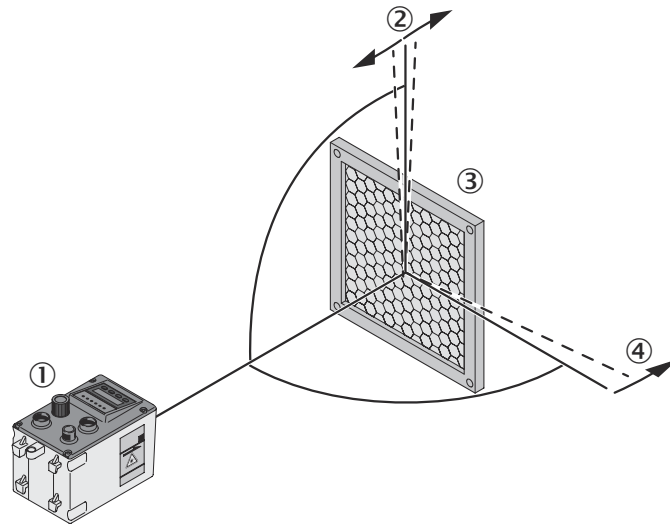
Figure 5: Reflector tilt

①   Distance sensor

②   Tilt of the vertical axis of the reflector approx. +1°...+3°

③   Reflector

④   Tilt of the horizontal axis of the reflector approx. +1°...+3°

- Shiny surfaces that are parallel to the laser beam axis may cause beam switching or light scatter and lead to incorrect measurements as a result. Therefore, align the reflector by giving it a 1 ... 3° tilt away from shiny surfaces into the free space. Shiny surfaces include, for example, storage profiles, pallets with stretch film, poles or rails.
- If the sensor is mounted in the driving axis of an automated storage and retrieval system, tilt the reflector toward the ceiling away from the rail .see figure 6, page 19.
- If the sensor is mounted in the stroke axis of an automated storage and retrieval system, tilt the reflector away from the mast system see figure 7, page 20.
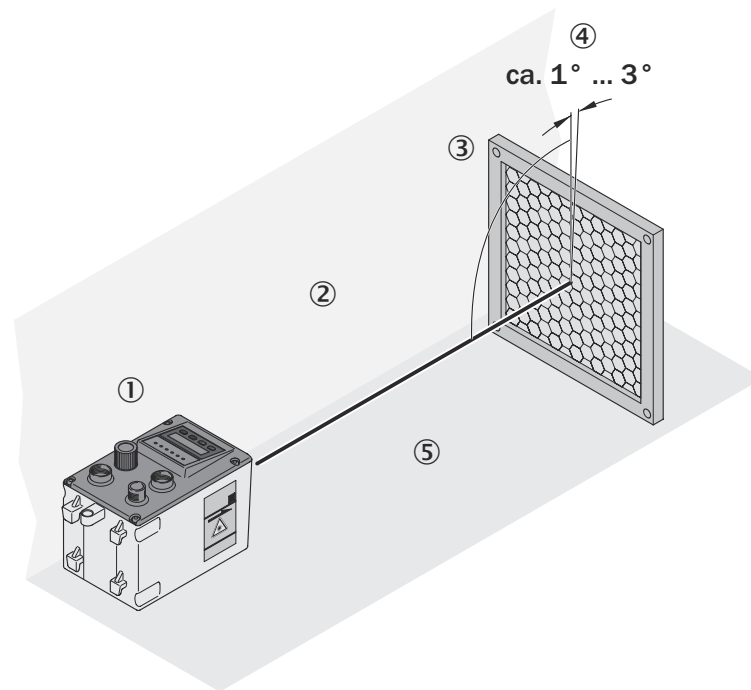
Figure 6: Reflector tilt for shiny surfaces and horizontal driving axis

①   Device
②   Shiny surface suchas a shelving section, stretch wrap
③   Reflector
④   Tilt of approx. 1° to 3°
⑤   Shiny surface suchas a rail
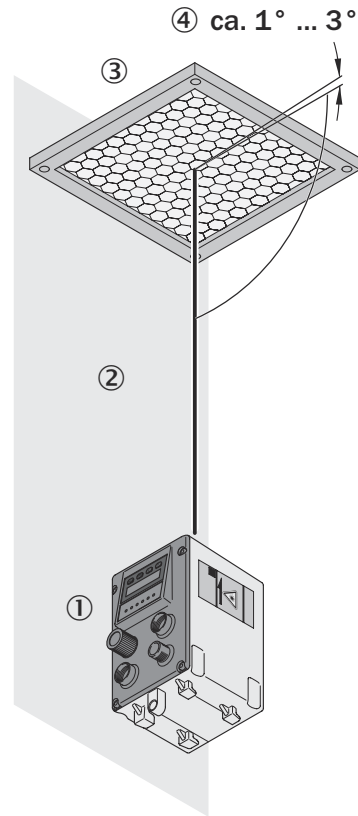
Figure 7: Reflector tilt for shiny surfaces and vertical stroke axis

①   Sensor
②   Shiny surface such as a masted automated storage and retrieval system
③   Reflector
④   Tilt of approx. 1° to 3°

5.4 Placement of multiple distance sensors

To mount several distance sensors side-by-side, you will need to maintain a minimum distance when mounting. The minimum distance **a** of the optical axis depends on the maximum travel distance s_{max}. This applies to mounting with light beams in both the same and opposite directions.

Light beams in the same direction
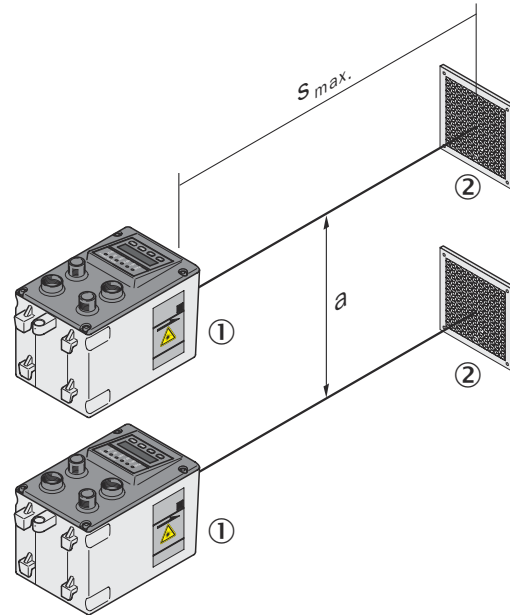
Figure 8: Placement of two distance sensors light beams in the same direction

① Distance sensor
② Reflector
a Minimum distance
s_{max} Maximum travel distance

Light beams in opposite directions
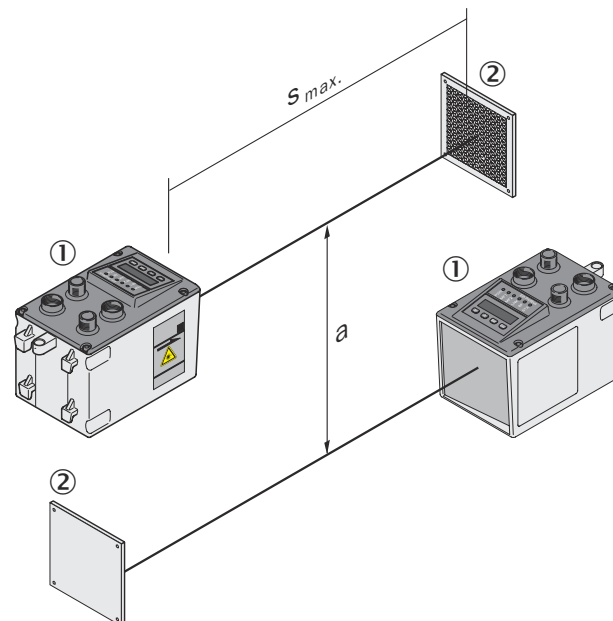
Figure 9: Placement of two distance sensors light beams in opposite directions

① Distance sensor
② Reflector
a Minimum distance
s_{max} Maximum travel distance

Formula

$a \geq 0.1\ m + 0.01 \times s_{max}\ [m]$

Example

- Maximum travel distance s_{max}: 60 m
- Calculation of minimum distance: $a \geq 0.1\ m + 0.01 \times 60\ m = 0.1\ m + 0.6\ m = 0.7\ m$

Configurable modulation frequency

If the required minimum distance cannot be observed, then devices from the Dx100 series are available which are equipped with configurable modulation frequencies for avoiding mutual interference. These devices can be mounted without any minimum distance of separation from each other and are identified in the type code using the letter **B** (e.g. DL100-21A**B**2101). There are 3 modulation frequencies available see "SpecFu menu", page 41.

5.5 Arranging the distance sensor to the adjacent optical data transmission system

5.5.1 Arrangement of ISD400-7xxx

Dx100-2xxAxxxx

For arrangement and the travel distance from the DL100-2xxAxxxx distance sensor (or the DL100-2xxBxxxx up to serial number 1925xxxx) without integrated spectral to the ISD400-7xxx data transmission system, the following applies:
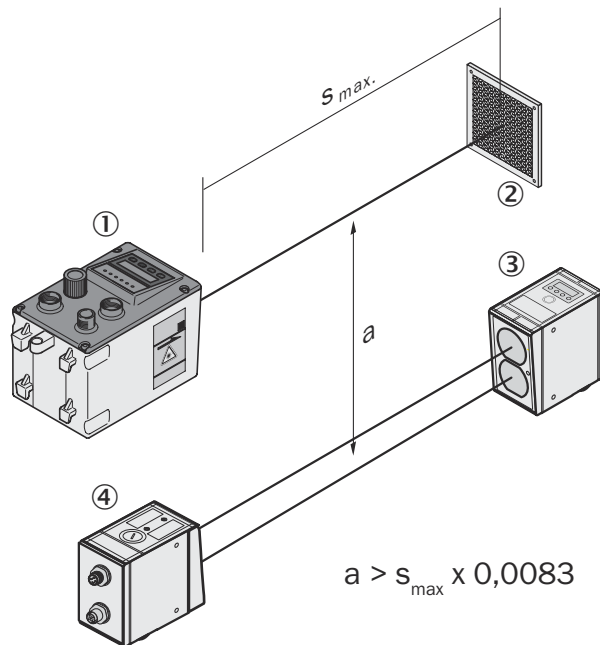
Figure 10: Arrangement of distance sensor DL100-2xxAxxxx to data transmission system ISD400-7xxx

①	DL100-2xxAxxxx distance sensor
②	Reflector
③	ISD400-7xx1, red
④	ISD400-7xx2, infrared
a	Minimum distance
s $_{max}$	Maximum travel distance

Formula: $a \geq 0.0083 \times s_{max}$

Example

- Maximum travel distance s_{max}: 60 m
- Minimum distance calculation: a ≥ 0.0083 x 60 m = 0.5 m

Dx100-2xxBxxxx

No minimum distance is required for the arrangement of a distance sensor with integrated spectral filter (Dx100-2xxBxxxx from serial number 1926xxxx) to an ISD400-7xxx optical data transmission system. The following arrangement is required when doing so:
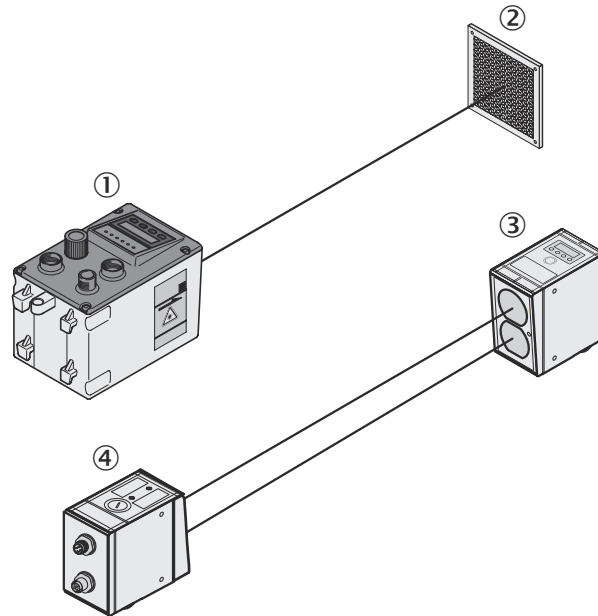
Figure 11: Arrangement of distance sensor Dx100-2xxBxxxx to data transmission system ISD400-7xxx

①	Dx100-2xxBxxxx distance sensor
②	Reflector
③	ISD400-7xx2, infrared
④	ISD400-7xx1, red

5.5.2   Assignment to ISD300, ISD400-1xxx or ISD400-6xxx

A minimum distance of at least 100 mm must always be maintained when mounting a data transmission system of the ISD300, ISD400-1xxx and ISD400-6xxx product family. The maximum measurement distance and variant of the distance sensor does not have an impact on the minimum distance.
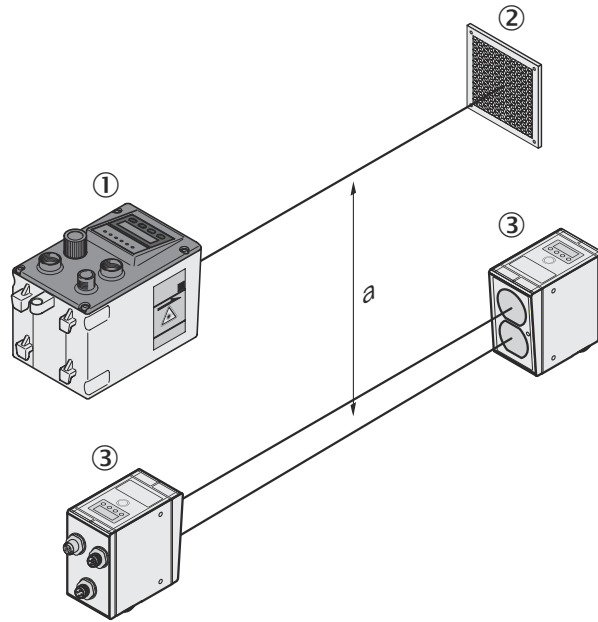
Figure 12: Arranging a distance sensor with the data transmission system

①   Distance sensor
②   Reflector
③   ISD300, ISD400-1xxx or ISD400-6xxx
a   Minimum distance, a ≥ 100 mm

5.6 Mounting the alignment bracket and distance sensor

The distance sensor is installed using the optional alignment bracket see "Mounting systems", page 73.

The alignment bracket is suitable for mounting on horizontal and vertical surfaces.

If the device is used for vertical measurements (e.g.in the stroke axis of an automated storage and retrieval system), you can mount the alignment bracket horizontally or use the optional deflector mirror.

> ⓘ **NOTE**
> The operation must be accessible.

1. Mount the alignment bracket using the four slotted holes with the supplied screws.
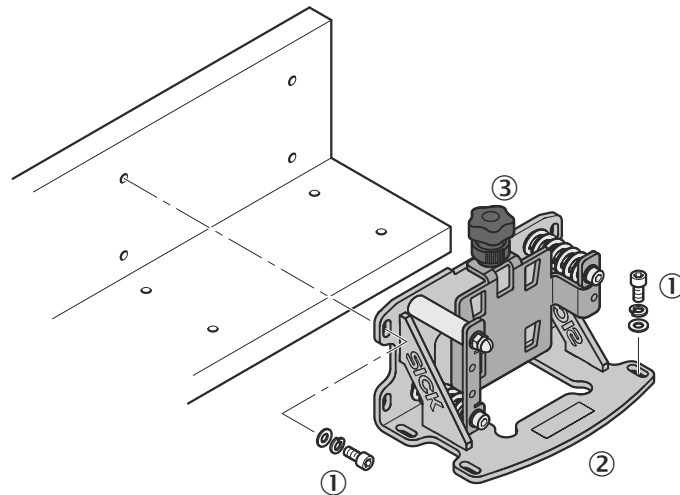
①   Mounting screw, M5 hexagon socket screw
②   Alignment bracket
③   Star grip screw

2.   Unscrew the star grip screw.
3.   Insert the distance sensor into the alignment bracket.
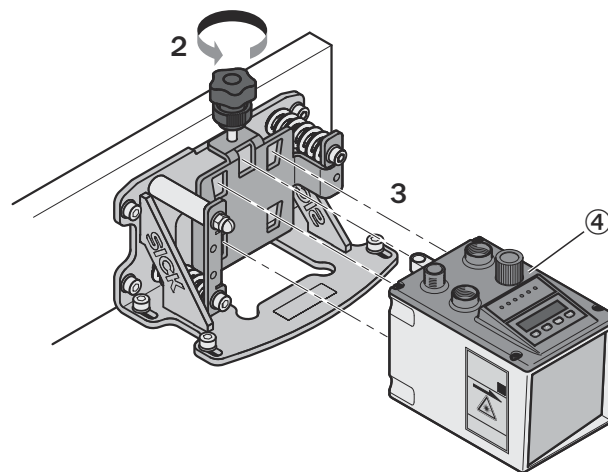
④   Distance sensor

4.   Secure the distance sensor using the star grip screw.
5.   Secure the star grip screw in place using a knurled nut.
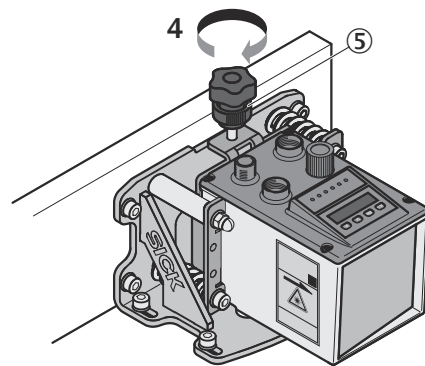
⑤   Knurled nut

5.7 Aligning the distance sensor and reflector with each other

Align the distance sensor using the alignment bracket according to the following figures and proceed as follows.

1. Bring the distance sensor and reflector close together.
2. Align the distance sensor so that the light spot hits the center of the reflector.
3. Increase the distance between the distance sensor and reflector. The light spot must continuously hit the center of the reflector. If necessary, adjust the alignment using the adjustment screws of the alignment bracket
4. Check the attenuation. The value for the attenuation must not exceed certain values, see "Received signal level", page 27.

i NOTE
Do not change the factory setting of the adjustment screws by more than ± 3 mm. This results in a spring travel of 41.5 ± 3 mm. This results in a maximum adjustment angle of ± 2° in the X- and ± 3.5° in the Y-direction.

Alignment in the X-direction
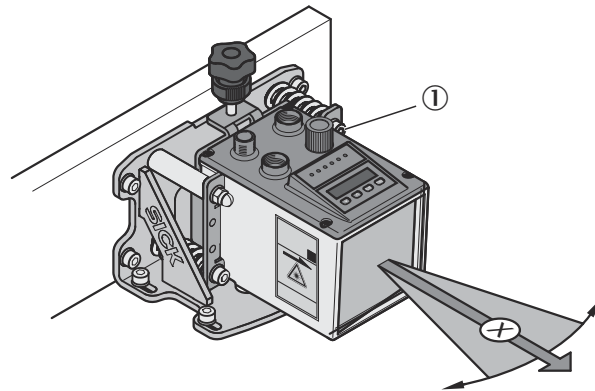
Figure 13: Align the distance sensor in the X-direction

① M5 hex socket adjustment screw for aligning the distance sensor in the X-direction

Alignment in the Y-direction
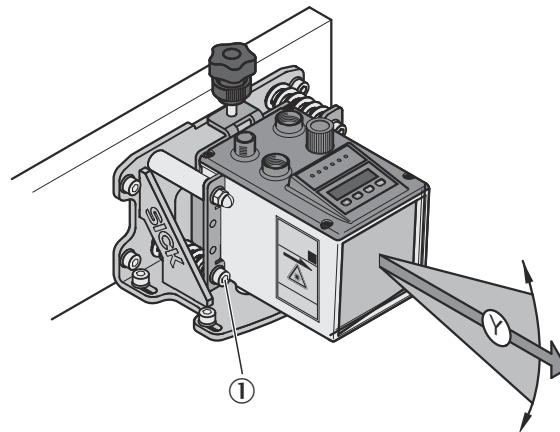
Figure 14: Align the distance sensor in the Y-direction

① M5 hex socket adjustment screw for aligning the distance sensor in the Y-direction

5.8 Received signal level

The highest possible received signal level is required for precise measurement. With increasing distance and/or contamination of the adjoining optical faces (sensor viewing window/reflector), the received signal level decreases. This means an increase in signal attenuation which you can read off as the dB value in the main menu.

The table below specifies the signal attenuation values in relation to the distance between the distance sensor and the reflector. The values in the "Typical signal attenuation" column represent the expected values when the measuring path and the distance sensor are in perfect working order. If the signal attenuation value exceeds the value in the "Maximum signal attenuation" column, check the condition of the measuring distance and the adjoining optical faces. The distance sensor issues a level warning if the signal attenuation value reaches the critical value of approximately –96 dB. If the signal attenuation value then continues to rise, a level and plausibility error is output, along with the measured value "0".

Table 6: Attenuation values

Distance [m]	Typical signal attenuation [dB]	Maximum signal attenuation [dB]
10	–32	–37
20	–44	–49
35	–54	–59
60	–63	–68
100	–72	–77
130	–76	–81
200	–84	–89
220	–85	–90
300	–91	–96

Attenuation in dB ③
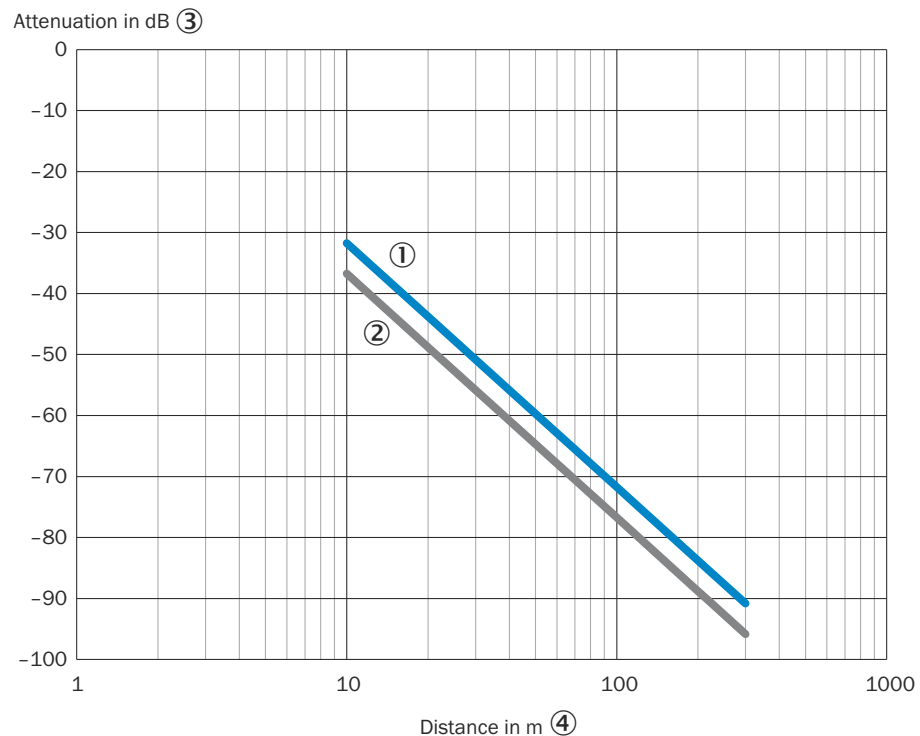
Distance in m ④

Figure 15: Signal attenuation depends on the distance between device and reflector

①   Typical signal attenuation

②   Maximum signal attenuation

③   Signal damping in dB

④   Distance in m

6 Electrical installation

6.1 Safety

> ⚠️ **WARNING**
> **Personal injury due to improper supply voltage!**
>
> - Only operate the device using safety extra-low voltage and safe electrical insulation as per protection class III.

> ⚠ **NOTICE**
> **Equipment damage or unpredictable operation due to working with live parts.**
>
> Working with live parts may result in unpredictable operation.
>
> - Only carry out wiring work when the power is off.
> - Only connect or disconnect electrical connections when the power is off.

6.2 Wiring instructions

> ℹ️ **NOTE**
> Pre-assembled cables can be found on the product page.
>
> The page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**
>
> {P/N} corresponds to the part number of the product, see type label.
>
> {S/N} corresponds to the serial number of the product, see type label (if indicated).

> ⚠ **NOTICE**
> **Faults during operation and defects in the device or the system**
>
> Incorrect wiring may result in operational faults and defects.
>
> - Follow the wiring notes precisely.

For data transmission, use only shielded cables with twisted-pair wires.

All electrical connections of the device are configured as M12 round connectors. The connection male connectors of the device are compatible with SpeedCon™ quick connectors and standard M12 screw connectors.

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

In the case of open end cables, make sure that bare wire ends do not touch. Wires must be appropriately insulated from each other.

Shielding requirements

- To ensure a fault-free data transmission, an effective and comprehensive shielding solution must be implemented.
- Apply a cable shield at each end, i.e. in the control cabinet and at the device. The cable shield of the pre-assembled cables is connected to the knurled nut and thus also to a large area of the device housing.
- The cable shield in the control cabinet must be connected over a large surface to the ground potential on the potential equalization conductor.
- Take appropriate measures to prevent equipotential bonding currents flowing through the cable shield.

- To ensure the highest possible EMC resistance, the alignment bracket must be fastened so that it has a low-resistance electrical connection to the system.
- During installation, pay attention to the different cable groups. The cables are grouped into the following four groups according to their sensitivity to interference or radiated emissions:

  - Group 1: cables very sensitive to interference, such as analog measuring cables
  - Group 2: cables sensitive to interference, such as device cables, communication signals, bus signals
  - Group 3: cables that are a source of interference, such as control cables for inductive loads and motor brakes
  - Group 4: cables that are a powerful source of interference, such as output cables from frequency inverters, welding system power supplies, power cables

  ▶ Cables in groups 1, 2 and 3, 4 must be crossed at right angles (see figure 16).
  ▶ Route the cables in groups 1, 2 and 3, 4 in different cable channels or use metallic separators (see figure 17 and see figure 18). This applies particularly if cables of devices with a high level of radiated emission, such as frequency converters, are laid parallel to device cables.
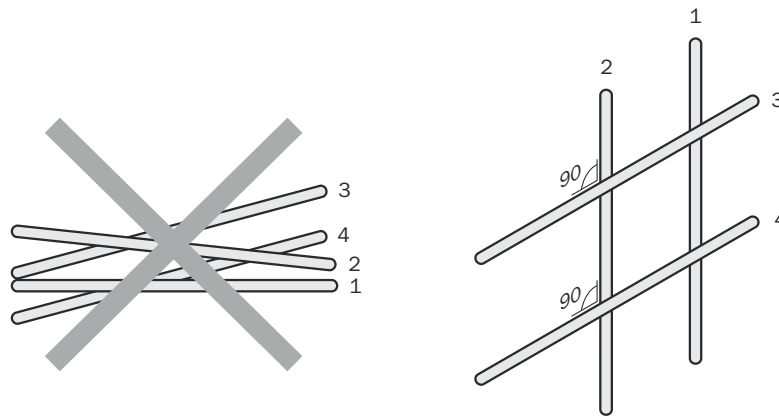
Figure 16: Cross cables at right angles
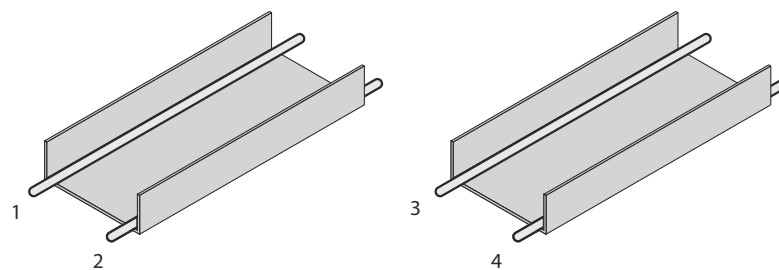
Figure 17: Ideal laying – Place cables in different cable channels
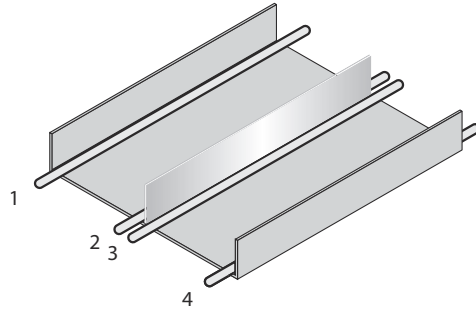
Figure 18: Alternative laying – Separate cables with metallic separators
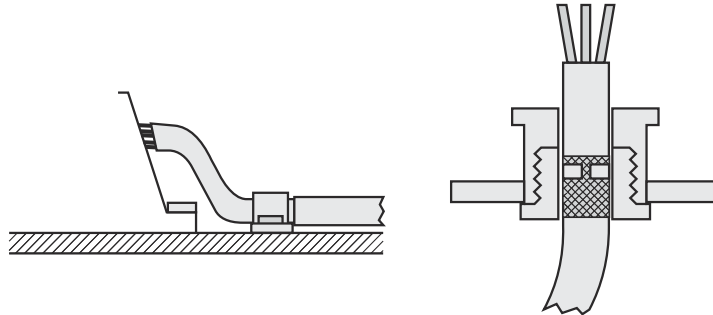
Figure 19: Shield connection in plastic housings

> **NOTE**
> Use an appropriate earthing method to prevent equipotential bonding currents flowing through the cable shield.

6.3 Connecting the device electrically

> **NOTE**
> The connection diagram, and information on inputs and outputs can be found on the type label on the device.

1. Ensure the voltage supply is not connected.
2. Connect the device according to the connection diagram.
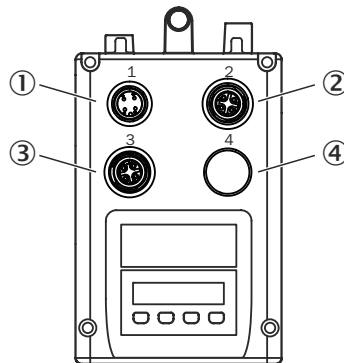
Figure 20: Position of electrical connections

① Supply voltage (male connector M12, 4-pin, A-coded)
② EtherCAT® IN (female connector M12, 4-pin, D-coded)
③ EtherCAT® OUT (female connector M12, 4-pin, D-coded)
④ Not assigned (spare)

6.4 Connection diagrams

6.4.1 MF1, MF2 supply voltage connection diagram
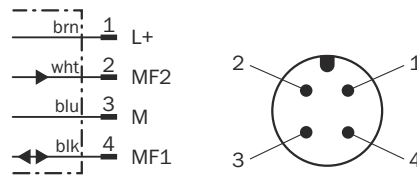
Figure 21: MF1, MF2 supply voltage connection diagram

Contact	Identifier	Wire color	Description
1	L+	Brown	Supply voltage: +18 … +30 V DC
2	MF2	White	Multifunctional output MF2, B-type
3	M	Blue	Supply voltage: 0 V
4	MF1	Black	Multifunctional input and output MF1, B-type

6.4.2 Ethernet connection diagram
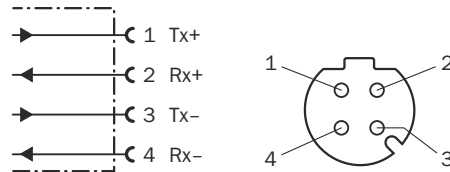
Table 7: Ethernet port connection diagram

Contact	Marking	Description
1	Tx+	Send data signal +
2	Rx+	Receive data signal +
3	Tx–	Send data signal –
4	Rx–	Receive data signal –

7 Operation

> **NOTICE**
>
> Device parameterization should not be carried out via the display, but exclusively via the fieldbus interface with the help of the controller-specific project planning tool, see "Purpose", page 45.

> **NOTICE**
>
> **Pushbutton damage due to improper handling!**
>
> Improper handling of the pushbuttons can damage them. This will make operation difficult or impossible.
>
> - Only operate the pushbuttons with your fingers or a suitable pointing device.
> - Do not operate the pushbuttons using sharp or hard objects.

> **NOTE**
>
> For basic instructions for the display and control elements, see "Display and control elements", page 13. Pressing the (Set) pushbutton for more than 2 seconds switches from **measured value display** to **menu display** operating mode.
>
> For the overall menu structure, see "Menu structure", page 75.

> **NOTE**
>
> Parameters set using the operating buttons are not permanently saved until the system jumps back to the measured value display. Depending on the menu level, it jumps back if the (Esc) is pushed several times or automatically if no button is pressed for longer than 90 seconds. Depending on the changed parameter, the device restarts when switching to the measured value display, which causes a brief interruption in fieldbus communication.

7.1 Parameter description

7.1.1 Main menu

The distance value is shown in the display by default. With the (V) pushbutton, you can switch from the distance value display to the **bar graph level** display and other process values.

You can scroll through the process values in the main menu using the (V) and (∧) pushbuttons.

Table 8: Process values

Process values	Description
Distance value	Display of distance value in mm
Bar graph level	Display of the received signal level as a bar graph
Numerical level	Display of the received signal attenuation as a numerical value see "Received signal level", page 27.
Temperature	Display of the internal device temperature
Laser operating hours	Display of the operating hours of the laser diode
Warnings	Displays the pending warnings. If there is a warning pending, the **PWR** LED flashes orange. If there are no warnings pending, **NoWarn** is displayed, see "Warning messages", page 65.

Process values	Description
Error	Display of the pending errors. If there is an error pending, the **PWR** LED flashes red. If there are no errors pending, **NoErr** is displayed, see "Error messages", page 66.

You get from measured value display to menu operation by pressing the ⒮ⒺⓉ pushbutton. You can use the Ⓥ pushbutton to select between displaying the **Menu** device parameter, the **SwVers** software version and the **HwVers** hardware version in the main menu. Select the respective menu and confirm by pressing the ⒮ⒺⓉ pushbutto.

7.1.2 SwVers menu

The **SwVers** menu displays all information relating to the software.

Table 9: SwVers menu

Parameter	Description
App-uC	Displays the version of the application processor
FPGA	Displays the version of the FPGA (field programmable gate array)
Com-uC	Displays the version of the communication processor

> **NOTE**
> Since the display can only show a total of 6 characters, this information is automatically displayed as running text.

7.1.3 HwVers menu

The **HwVers** menu displays all information relating to the hardware.

Table 10: HwVers menu

Parameter	Description
HwVers	Display of the version number (=hardware update number). During initial delivery, this corresponds to the serial number and can change due to a hardware update during repair.

7.1.4 Menu menu

The **Menu** menu contains all device parameters.

Table 11: Menu menu

Options	Description
more?	Activation of advanced menu view see "More? menu", page 34.

7.1.5 More? menu

In the **more?** menu, you can activate or deactivate the advanced menu view.

Table 12: More? menu

Options	Description
Yes / No	Activate or deactivate advanced menu view The entire menu is displayed when activated. When deactivated, the **MF1**, **MF2**, **Offset** and **SpecFu** parameters are hidden. Options • Yes • No Factory setting • No

7.1.6 MFx On menu

In this menu, you can activate or deactivate multifunctional input/output MF1 and multifunctional output MF2.

Requirement for display

More? menu: **Yes** option.

Table 13: MFx On menu

Options	Description
Enable / Disable	Activate or deactivate MF1 and MF2. **Options** • **Enable**: MF1 and MF2 are activated in the hardware. • **Disable**: MF1 and MF2 are deactivated in the hardware and are therefore hidden in the menu. **Factory setting** • **Enable**

7.1.7 MF1 menu

You can parameterize multifunctional input/output MF1 using this menu.

Requirement for display:
• **more?** menu: **Yes** option
• Menu **MFx On**: **Enable** option

Table 14: MF1 menu

Parameter	Description
ActSta	Select the active level or signal edge of the MF1. **Options** • **ActLow**: LOW level output with active output (safety criterion fulfilled) or activation of input at falling signal edge • **ActHi**: HIGH level output with active output (safety criterion fulfilled) or activation of input at rising signal edge **Factory setting** • **ActLow**
Functn	Select MF1 function. **Options** • **Dist**: MF1 is used as a distance switch output. • **Speed**: MF1 is used as a speed switch output. • **Srvice**: MF1 is used as a service output. • **LsrOff**: MF1 is used as an input for switching off the laser. • **Preset**: MF1 is used as an input for activating the static preset. **Factory setting** • **Dist** The corresponding menu is displayed depending on the function selected for the **Functn** parameter. See the relevant table for the parameter description.
Count	Counts the switching events of the MF1. You can reset the counter by switching the device off and on again.

7.1.8 MF1 – Dist submenu

In this submenu, you can configure the MF1 as a distance switch output.

Requirement for display:

- **more?** menu: **Yes** option
- Menu **MFx On: Enable** option
- **Functn** parameter: **Dist** option

*Table 15: **MF1 – Dist** submenu*

Parameter	Description
Limit	Set switching threshold for the distance value. The digital output is activated when the current distance value exceeds the set switching threshold.
	Options
	• −300,000 ... + 300,000 [mm]
	Factory setting
	• 1,990 [mm]
	NOTE
	Because the display can only handle six digits, only negative values down to −99999 can be input via the operating buttons.
	Via SOPAS ET or an existing fieldbus interface, the entire value range is available as input. For values smaller than −99999, the highest decimal place is truncated in the display.
	*Figure 22: Representation of the **Dist** function*
	Limit Distance-based switching threshold
	Hyst Hysteresis of switching threshold
	Dist Measured distance
Hyst	Sets hysteresis for the switching threshold.
	Options
	• 1... +300,000 [mm]
	Factory setting
	• 10 [mm]
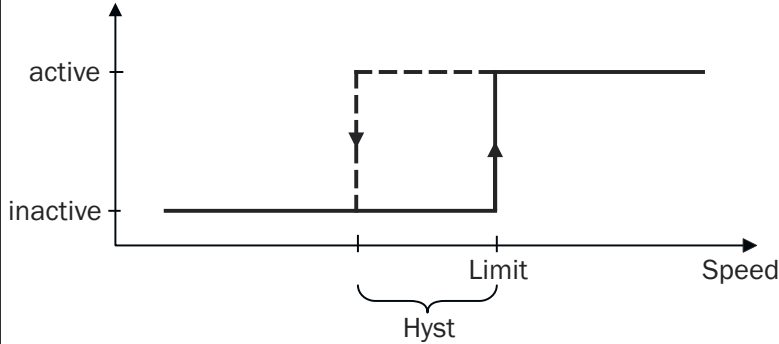
7.1.9 MF1 – Speed submenu

In this submenu, you can parameterize the MF1 as a speed switching output.

Requirement for display:

- **more?** menu: **Yes** option
- Menu **MFx On: Enable** option
- **Functn** parameter: **Speed** option

*Table 16: **MF1 – Speed** submenu*

Parameter	Description
Limit	Sets speed switching threshold. The digital output is activated when the current speed exceeds the set threshold. The switching hysteresis is fixed at 100 mm/s. **Options** • 50 ... 15,000 [mm/s] **Factory setting** • 5,000 [mm/s] *Figure 23: Representation of the **Speed** function* **Limit** Speed-based switching threshold **Hyst** Hysteresis of switching threshold **Speed** Measured speed
Sign	Select the direction of travel to be monitored. **Options** • + / –: Monitoring in both directions of movement • +: Monitoring in + direction of movement (increasing distance) • –: Monitoring in – direction of movement (decreasing distance) **Factory setting** • + / –

7.1.10   MF1 – Srvice submenu

In this submenu, you can parameterize the MF1 as a digital output for pending faults.

The digital output is activated as soon as at least one of the selected parameters has reached the warning limit. The digital output remains active if the error limit is reached due to continued overshoot. For more information on faults, .

For devices with integrated heating, the MF1 can also be parameterized as a digital output for the current status of the device heating, thereby monitoring the heating activity.

You can select several parameters. These are **OR** linked and assigned the MF1 as a shared output.

Requirement for display:
• **more?** menu: **Yes** option
• Menu **MFx On: Enable** option
• **Functn** parameter: **Srvice** option

Table 17: MF1 – Srvice submenu

Parameter	Description
WrnLsr	Activates MF1 when the aging of the laser diode means that the device is nearly due to be replaced. Options • On • Off Factory setting • On
WrnLvl	Activates MF1 when the signal attenuation value reaches the critical value, for example due to contamination. Options • On • Off Factory setting • On
WrnTemp	Activates MF1 if the interior device temperature reaches the critical value. Options • On • Off Factory setting • On
WrnPlb	Activates MF1 if extrapolated measured values are output for implausible measured values see table 21, page 41, **ErrRej**. This may be caused by an internal error, hardware errors, obstruction of the light beam, optical interference or electrical interference. Options • On • Off Factory setting • On
NotRdy	Activates MF1 if the device is not ready for operation. Possible causes could be hardware errors, optical or electrical interference or a deactivated laser diode. This warning message is also issued during initialization. Options • On • Off Factory setting • On
Heat	Activates MF1 if the interior device heating is in operation. This parameter is only displayed on measuring devices with the "Heating" option. Options • On • Off Factory setting • Off

7.1.11 MF1 – LsrOff submenu

You can parameterize the MF1 as a switching input to switch off the laser diode by selecting **LsrOff**. If MF1 is active, the laser diode is switched off.

Switching off the laser diodes during downtime can increase their service lives. The time span from deactivating the MF1 to renewed measured value output is max. 45 ms.

7.1.12 MF1 – Preset submenu

In this submenu, you can parameterize the MF1 as a switching input to activate the static preset. This makes it possible to automatically adjust the measured distance value to a reference value (preset) known to the system during commissioning, maintenance or device replacement.

For the static preset described here, the time for adopting the reference value in the device is determined by activating MF1. The distance value measured at this time is automatically provided with an offset and therefore adjusted to the reference value. The following applies: Offset = Preset – measured distance value.

As an alternative to MF1, presetting can be performed via the fieldbus interface see "Object 6003h Distance Preset, dynamic", page 62.

> **NOTE**
> When activating the preset, the output of measured values of the distance sensor will be temporarily unavailable. We recommend carrying out the preset while the machine is at a standstill or running at very low speeds. The maximum activation number is typically around 10,000 cycles. The offset value calculated when activating the preset is permanently saved in the device.

Requirement for display:
- **more?** menu: **Yes** option
- Menu **MFx On: Enable** option
- **Functn** parameter: **Preset** option

Table 18: MF1 – Preset submenu

Parameter	Description
sPrset	Assign reference value. When activating the MF1, the reference value is adopted and the associated offset calculated. Negative preset values are not permitted, as per specification CiA 406. **Options** - 0 ... + 300,000 [mm]. **Factory setting** - 0 [mm] > **NOTE** > Because the display can only handle six digits, only negative values down to -99999 can be input. > > Via SOPAS ET or an existing fieldbus interface, the entire value range is available as input. For values smaller than -99999, the highest decimal place is truncated in the display.

Setting the preset

1. Select the **Preset** function for multifunctional input MF1.
2. Enter the desired initialization value for the **Preset** parameter.
3. Drive the vehicle to the initialization position.
4. To do so, activate multifunctional input In1 / MF1, for exampling using a proximity switch, a photoelectric sensor or a switch.
✓ The output value of the device corresponds to the set value for **Preset** at the initialization position.

7.1.13 MF2 menu

You can parameterize MF2 in this menu and its submenus.

Requirement for display:
- **more?** menu: **Yes** option
- Menu **MFx On**: **Enable** option

Table 19: MF2 menu

Parameter	Description
ActSta	Select active MF2 level. **Options** • **ActLow**: LOW level output with active output (safety criterion fulfilled) • **ActHi**: HIGH level output with active output (safety criterion fulfilled) **Factory setting** • **ActLow**
Functn	Select MF2 function. **Options** • **Dist**: MF2 is used as a distance switch output. • **Speed**: MF2 is used as a speed switch output. • **Srvice**: MF2 is used as a service output. **Factory setting** • **Srvice**
Count	Counts the switching events of the MF2. You can reset the counter by switching the device off and on again.

MF2 – Dist submenu

This submenu corresponds to the **Dist** submenu in the **MF1** menu .

MF2 – Speed submenu

This submenu corresponds to the **Speed** submenu in the **MF1** menu .

MF2 – Srvice submenu

This submenu corresponds to the **Srvice** submenu in the **MF1** menu .

7.1.14 Offset menu

You can set an offset in this menu.

Requirement for display:
- **more?** menu: **Yes** option

*Table 20: **Offset** menu*

Parameter	Description
Offset	Specify the offset. The offset is added to the internally determined distance value. The offset is applied to all outputs and to what is shown on the distance display. Triggering a preset overwrites the offset. The following applies: Offset = Preset - measured distance value. **Options** • –600,000 … +300,000 [mm] **Factory setting** • 0 [mm]

7.1.15 SpecFu menu

In this menu you can set special functions.

Requirement for display:
• **more?** menu: **Yes** option

*Table 21: **SpecFu** menu*

Parameter	Description
AvgDst	Select filter characteristic for the distance measured values. The distance and speed values are filtered based on a mathematical state model (Kalman filter). This model is optimized for use in continuously changing distance conditions and results in faster distance sensor response time while reducing the measured value noise at the same time. The set option affects both the measured value noise as well as the dynamic behavior of the distance measured value and the speed measured value derived from this. A slower filter setting reduces measured value noise but can lead to distance value overshoots if the distance changes rapidly. **Options** • Medium • Slow • Fast **Factory setting** • Medium
AvgSpd	Select filter depth for the speed measured values (moving average filter). The filter is downstream of the Kalman filter (see **AvgDst** parameter). **Options** • Medium (8 values) • Slow (32 values) • Fast (1 value) **Factory setting** • Medium
MsrDir	Defining measurement direction: If the measuring direction is positive +, the distance output value is equal to the internal distance value measured by the measuring module. If the measuring direction is negative –, the internal distance value is multiplied by the factor -1. The change in direction affects both the output value for the distance and the output value for the speed. **Options** • + (positive direction) • - (negative direction) **Factory setting** • +

Parameter	Description
ErrRej	Select time for maximum error suppression. If no measurement is possible due to an error (e.g. brief light beam interruption), measured value are extrapolated until no later than when the set error suppression time expires. During this time, a **WrnPlb** plausibility warning is output. If no measurement is possible after expiration of the error suppression time, measured value 0, plausibility error **ErrPlb** and possibly other errors (e.g. level error **ErrLvl**) are output.
	Options
	• 200 ms: Plausibility error is reported when the error is indicated for longer than 200 ms.
	• 50 ms: Plausibility error is reported when the error is indicated for longer than 50 ms.
	• Off: The plausibility error is reported when the error is indicated for longer than 5 ms.
	Factory setting
	• 200 [ms]
Heat	**NOTE**
	Only for DL100-xxHxxxxx variants with heating
	In this menu, you can set the ambient temperature at which the heating turns on if undercut. The hysteresis is fixed at 3 K. Increasing the temperature set at the factory can reduce the formation of condensation in some cases.
	Options
	• −10 ... +40 °C
	Factory setting
	• −10 °C
FrqSet	**NOTE**
	Only for DL100-xxxBxxxx variants with frequency changeover
	You can set laser transmission frequencies in this menu. If the minimum distance between the optical axes cannot be maintained when mounting several distance sensors, mutual interference is prevented by setting different frequencies (mode 0 ... mode 2). No minimum distance is required for this purpose see "Placement of multiple distance sensors", page 20. Mode 0 corresponds to the laser transmission frequency of the variant without switchable frequency (DL100-xxxAxxxx). Mode 3 is reserved for later use.
	Options
	• Mode 0
	• Mode 1
	• Mode 2
	• Mode 3 (reserved)
	Factory setting
	• Mode 0
Reset	Reset to factory settings see "Performing a reset", page 42.

7.1.16 Performing a reset

1. Select the **Reset** parameter in the **SpecFu** menu see "SpecFu menu", page 41.
2. Press the (Set) pushbutton.
✓ The **Sure?** confirmation prompt appears.
3. Press the (Esc) pushbutton to terminate the process.

    Press the ⌨Set pushbutton to reset the measuring device to factory settings.

✓   The **OK** reset confirmation appears.

4.   Press the ⌨Esc pushbutton several times to get back to the **measured value display** operating mode.

8   Ethernet interface

There are two equal Ethernet interfaces available on the device. They lead to an internal switch and are used for communication via EtherCAT®.

They can also be used for communication via SICK configuration software SOPAS ET see "SOPAS ET configuration software", page 45.

Each device has its own MAC address. The MAC address can be found on the type label see "Type label", page 13.

> **NOTE**
> You can download the SOPAS ET configuration program online at www.sick.com/ SOPAS_ET.

> **NOTE**
> SOPAS ET should only be used for service purposes (e.g. diagnosis, firmware update) and not for parameterization.

8.1   Features

The Ethernet interfaces have the following features:

- Transmission rate 10 or 100 MBit, half or full duplex
- Auto-negotiation (automatic adjustment of transfer rate and duplex procedures)
- Auto-crossover (automatic adjustment in the case of Ethernet cables)
- DHCP (dynamic IP address assignment via DHCP server) or static IP address assignment

8.2   IP network configuration

During delivery or after a reset to factory settings, the following IP network configuration is set on the device:

- Dynamic IP address assignment via DHCP switched off
- Static IP address assignment switched on
- IP address: 192.168.100.236
- IP network mask: 255.255.255.0
- Default gateway: 0.0.0.0

You can change the IP network configuration via the SOPAS ET configuration software.

> **NOTE**
> If address assignment using the DHCP server is parameterized and it fails, the last selected static IP address is used for the device. The delivery configuration is used if this static IP address is invalid (IP address 0.0.0.0). This process may take up to approx. 1 minute. If the IP address is 0.0.0.0, the device cannot be found via SOPAS ET. It may be necessary to reset to factory settings and restart the device.

9 SOPAS ET configuration software

9.1 Purpose

The SOPAS ET configuration software offers uniform operation of all SICK devices and is used, among other things, for parameterization and service purposes (e.g. diagnosis, data logger, firmware update).

SOPAS ET can be downloaded from the Internet at **www.sick.com/SOPAS_ET**. Help with general operation of the SOPAS ET program user interface as well as for the different options can be found in the SOPAS ET online help. Parameterization of SOPAS ET is self-explanatory and is therefore not described in detail in this document.
Changes to parameters made in SOPAS ET are only saved in a non-volatile manner when the **Save** button is selected to perform a save function either via the menu bar or the respective device.

SOPAS ET should only be used for service purposes. We recommend parameterizing the device using the EtherCAT® interface with the help of the control-specific EtherCAT® planning tool (e.g. TwinCAT). All device parameters are saved in the control when doing so. When the device is replaced, this makes it possible to transmit all device parameters from the control to the new device. Parameters set via SOPAS ET are generally overwritten with the parameters defined in the EtherCAT® planning tool. The are also lost as soon as the device is integrated in an EtherCAT® network and cyclical data exchange is started.

9.2 Connection of device to computer and establishment of connection

> **ⓘ NOTE**
> The associated Ethernet communication must be tunneled to the device to allow for communication with the device via SOPAS ET. With this EoE tunneling (Ethernet over EtherCAT®), the SOPAS ET Ethernet frames are inserted into the EtherCAT® protocol and transmitted.

If supported by the EtherCAT® controller, the EoE tunneling is done directly from the engineering computer on which SOPAS ET is installed, via the EtherCAT® controller to the device and vice-versa. If the EtherCAT® controller does not support EoE, tunneling can be done via an additionally installed network component (e.g. Ethernet switchport terminal). It is connected via a separate network connection to the computer on which SOPAS ET is installed and to the EtherCAT® network.

The use of EoE is activated via the controller-specific EtherCAT® configuration tool. The corresponding settings for the controller and device must also be made there. More information on EoE is available in the documentation of the controller manufacturer.

1. Establish network connections depending on the EoE tunneling selected.
2. Make EoE settings for the controller and device. Checking the tunneling function by pinging the device is an option. For factory IP settings of the device .
✓ SOPAS ET automatically begins looking for connected devices after start-up.
3. Enter the found device to the project using drag & drop, double click, enter button or add icon.

9.3 Logging into the device

Logging into the device is required for some functions (e.g. changing to the **Device name** or **User information** windows or a firmware update) .

Select the suggested **Maintenance technician** user level here. Depending on the set language, the name of the suggested user level changes. Regardless of which language is selected, the password is "esick".

9.4 Firmware update

The SOPAS configuration software makes it possible to update the device firmware. You can get the necessary firmware file (SICK Service Pack, *.ssp) on request from your responsible SICK sales organization (see overleaf).

> **(i) NOTE**
> Depending on the SOPAS ET version used, the following figures can deviate slightly.

1. Copy the file onto the hard drive of the computer used for the update or onto a portable storage medium.
2. Log into the device.
3. Use the button (three dots) in the device window to start the update process.
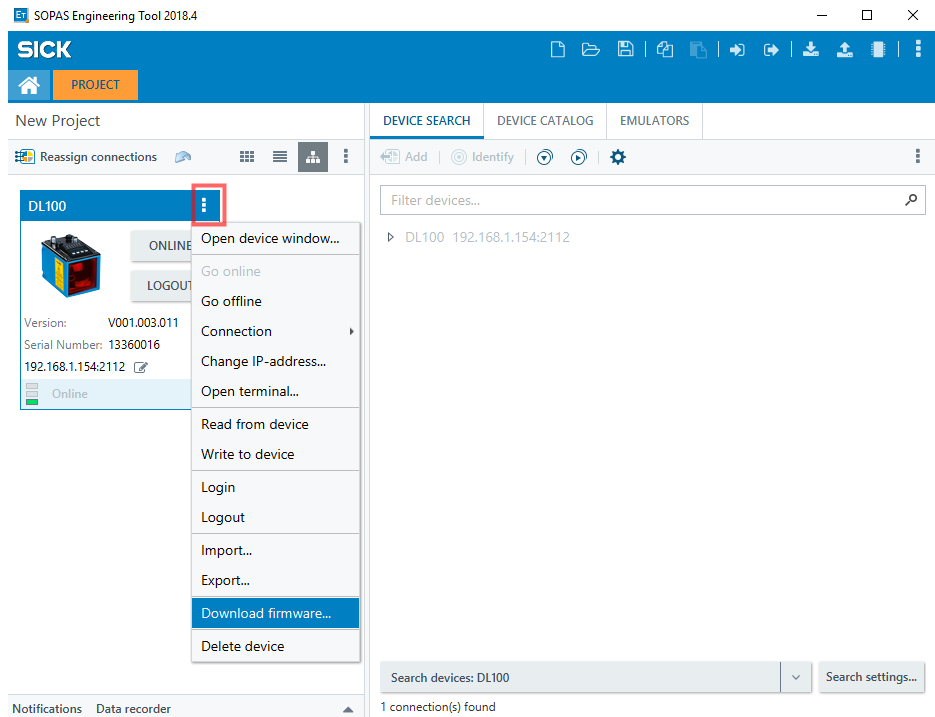
✓ SOPAS ET shows the firmware version of the individual components.
4. Select storage location of the service pack. Check whether the type code in the file name of the service pack (e.g. DL100-2xxxxx10) matches the type code on the type label of the device.
5. Open service pack file.
✓ SOPAS ET checks compatibility of the device and the service pack.
6. Confirm note when compatibility is given.
✓ Download process starts.
✓ Successful transmission of the new firmware is displayed.
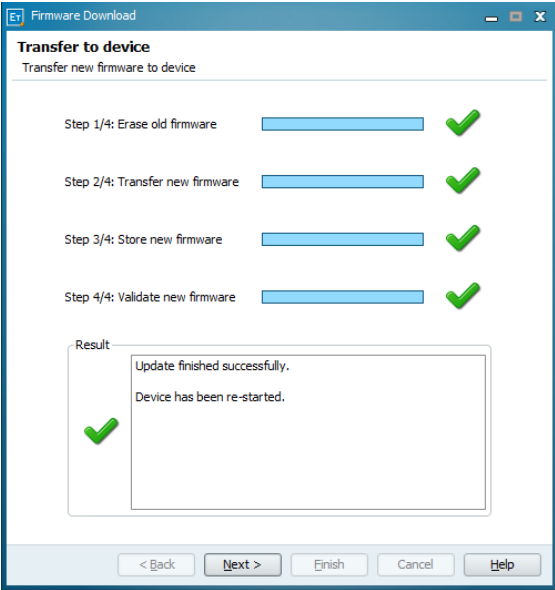
7. If desired: Transmit previous device parameters into the device and update the device in the current SOPAS project.
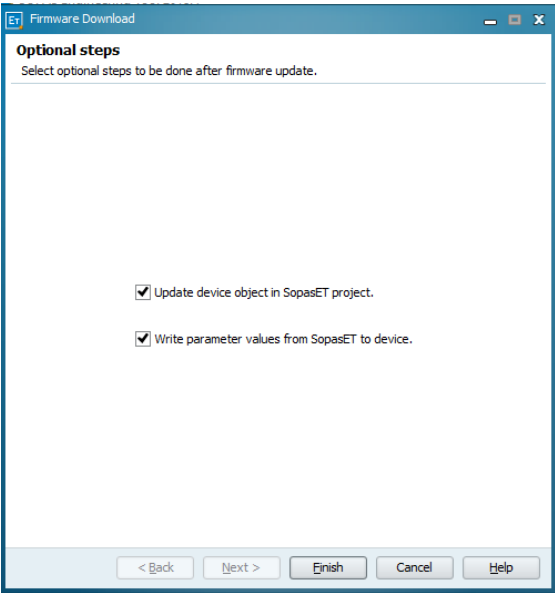
8. Update device driver via upload from the device.
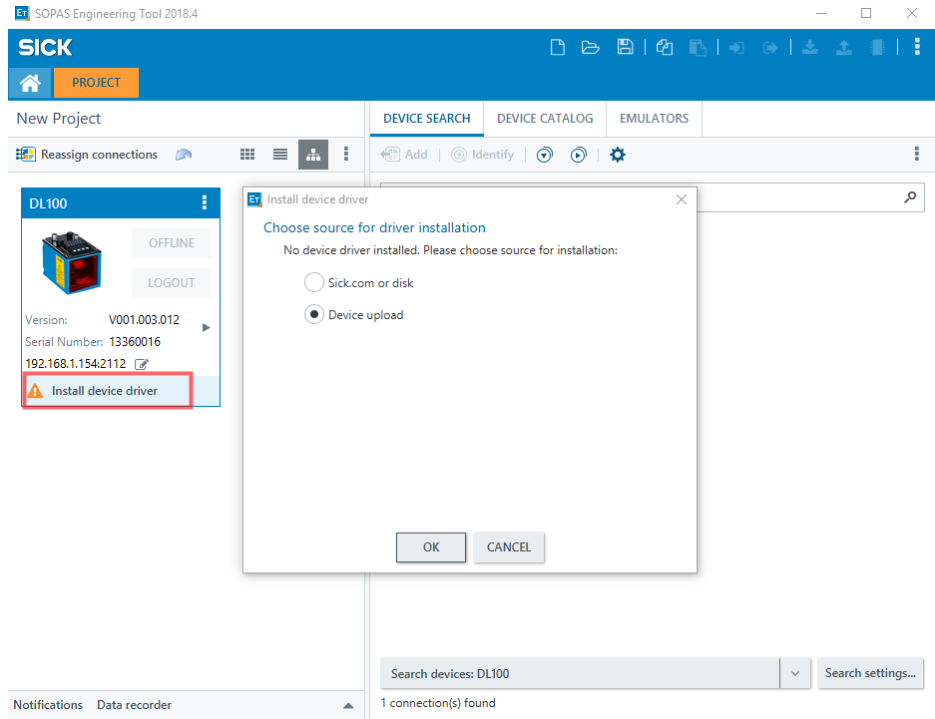
✓ Firmware update and update of the device in the SOPAS project are complete.
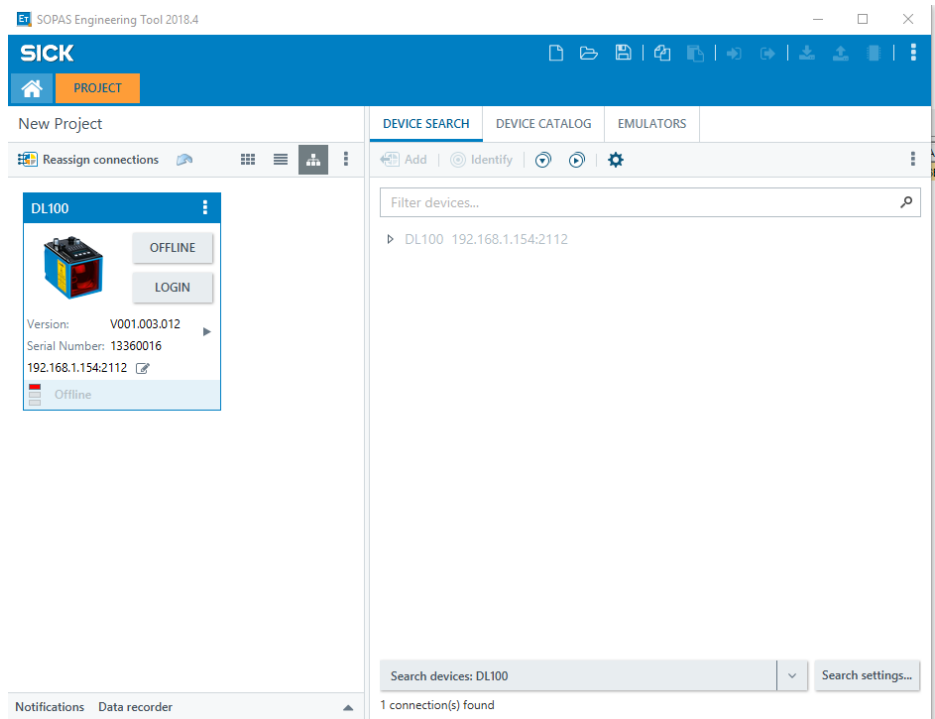
10   EtherCAT® interface

10.1   ESI file

In order to easily connect EtherCAT® slave devices to an EtherCAT® master, an ESI file must exist for each EtherCAT® slave device. This file is in an XML format and contains information on the following features of the DL100 Pro EtherCAT®.

- Information about the device manufacturer
- Name, type, and version number of the device
- Type and version number of the protocol to be used for this device
- Default parameters of the device and default configuration of the process data

10.2   CANopen over EtherCAT® (CoE)

EtherCAT® defines only one new protocol for the transfer layer. It does not define a separate user or device protocol. EtherCAT® is able to transfer different existing and tested user and device protocols through the EtherCAT® protocol (tunneling).

For the drive systems, CANopen over EtherCAT® (CoE), for example, is relevant. This protocol is supported by the DL100 Pro EtherCAT®. The CoE protocol enables the use of all CANopen profiles and therefore also the use of the DS-406 Class 1 encoder profile. The objects of the encoder profile that are implemented in the DL100 Pro EtherCAT® are specified in see "Object directory overview", page 49.

The EtherCAT® protocol provides two different transfer types for transmission. These two transfer types are the mailbox telegram protocol for acyclical data and the process data telegram protocol for the transfer of cyclical data.

Mailbox telegram protocol

This transfer type is used to transfer the service data objects (SDOs) defined under CANopen. These are transmitted to SDO frames in EtherCAT®.

Service data objects form the communication channel through which device parameters are transmitted (e.g., programming the encoder resolution). The transmission of these parameters is acyclic (i.e., takes place just once when starting up the network).

Process data telegram protocol

This transfer type is used to transfer the process data objects (PDOs) defined under CANopen, which are used to exchange cyclical data. These are transmitted to PDO frames in EtherCAT®.

The process data objects are used for rapid and efficient exchange of real-time data (e.g., I/O data, setpoint values or actual values).

10.3   Object directory overview

The following objects are supported by the device:

Index [hex]	Subindex [hex]	Name	Data type	Access	Value range		
					Min.	Max.	Default
1000h see "Object 1000h – Device Type", page 53		Device type	Unsigned32	const	-	-	524694d, 80196h
1001h see "Object 1001h – Error Register", page 53		Error Register	Unsigned8	ro	0	153d, 99h (All errors set)	0

Index [hex]	Subindex [hex]	Name	Data type	Access	Value range		
					Min.	Max.	Default
1008h see "Object 1008h – Manufacturer Device Name", page 54		Manufacturer Device Name	String	const	-	-	DL100
1009h see "Object 1009h – Manufacturer Hardware Version", page 54		Manufacturer Hardware Version	String	const	-	-	-
100Ah see "Object 100Ah – Manufacturer Software Version", page 54		Manufacturer Software Version	String	const	-	-	-
1018h see "Object 1018h – Identity Object", page 54		Identity Object					
	0h	Number of Entries	Unsigned8	ro	-	-	4
	1h	Vendor Id	Unsigned32	ro	-	-	16777302d ,1000056h
	2h	Product Code	Unsigned32	ro	-	-	22528d, 00005800h
	3h	Revision Number	Unsigned32	ro	-	-	-
	4h	Serial Number	Unsigned32	ro	-	-	-
1600h see "Object 1600h Receive PDO 1: Command", page 54		Receive PDO 1 Mapping					
	0h	Number of Entries	Unsigned8	ro	-	-	1
	1h	4006h "Command"	Unsigned32	ro	-	-	1074135056d, 40060010h
1A00h see "Object 1A00h – Transmit PDO 1: Distance", page 54		Transmit PDO 1 Mapping					
	0h	Number of Entries	Unsigned8	ro	-	-	1
	1h	6004h "Distance"	Unsigned32	ro	-		1610874912d, 60040020h
1A03h see "Object 1A03h – Transmit PDO 4: Velocity", page 54		Transmit PDO 4 Mapping					
	0h	Number of Entries	Unsigned8	ro	-	-	1
	1h	6030h "Velocity"	Unsigned32	ro	-	-	1613758480d, 60300010h
1A04h see "Object 1A04h Transmit PDO 5: Error and Status", page 54		Transmit PDO 5 Mapping					
	0h	Number of Entries	Unsigned8	ro	-	-	1
	1h	4007h "Error&Status"	Unsigned32	ro	-	-	1074200592d, 40070010h
1C00h see "Object 1C00h Sync Manager Communication Type", page 54		Sync Manager Communication Type					

Index [hex]	Subindex [hex]	Name	Data type	Access	Value range		
					Min.	Max.	Default
	0h	Number of Entries	Unsigned8	ro	-	-	4
	1h	Communication Type Sync Manager 0	Unsigned8	ro	-	-	1
	2h	Communication Type Sync Manager 1	Unsigned8	ro	-	-	2
	3h	Communication Type Sync Manager 2	Unsigned8	ro	-	-	3
	4h	Communication Type Sync Manager 3	Unsigned8	ro	-	-	4
1C12h see "Object 1C12h Sync Manager 2 PDO Assignment", page 55		Sync Manager 2 PDO Assignment					
	0h	Number of Entries	Unsigned8	ro	-	-	1
	1h	1st assigned RxPDO	Unsigned16	rw	-	-	5632d, 1600h
1C13h see "Object 1C13h Sync Manager 3 PDO Assignment", page 55		Sync Manager 3 PDO assignment					
	0h	Number of Entries	Unsigned8	ro	-	-	3
	1h	1st assigned TxPDO	Unsigned16	rw	-	-	6656d, 1A00h
	2h	2nd assigned TxPDO	Unsigned16	rw	-	-	6659d, 1A03h
	3h	3rd assigned TxPDO	Unsigned16	rw	-	-	6660d, 1A04h
2000h see "Object 2000h – Distance", page 55		Distance	Signed32	ro	Depending on version: -300 m (minimum value with negative measuring direction)	Version-dependent: +600 m (maximum value including offset)	-
2001h see "Object 2001h – Velocity", page 55		Velocity	Signed32	ro	-15 m/s	15 m/s	-
2002h see "Object 2002h – Time Stamp", page 55		Time stamp	Unsigned32	ro	0	$2^{32}-1$	0
2003h see "Object 2003h – Level", page 55		Level	Signed16	ro	-127d, FF81h	-30d, FFE2h (typ.)	0
4000h see "Object 4000h – Distance Resolution", page 55		Distance Resolution	Unsigned8	rw	0	5	0
4001h see "Object 4001h – Velocity Resolution", page 56		Velocity resolution	Unsigned8	rw	0	4	1

Index [hex]	Subindex [hex]	Name	Data type	Access	Value range		
					Min.	Max.	Default
4002h see "Object 4002h – Device Product Code", page 56		Device Product Code	String	const	–	–	–
4003h see "Object 4003h – Software Versions", page 56		Software Versions					
	0h	Number of Entries	Unsigned8	const	–	–	3
	1h	Application Controller	String	const	–	–	–
	2h	FPGA	String	const	–	–	–
	3h	Communication Controller	String	const	–	–	–
4004h see "Object 4004h – Device Temperature", page 56		Device Temperature	Signed8	ro	–	–	–
4005h see "Object 4005h – Laser Operating Hours", page 56		Laser Operating Hours	Unsigned32	ro	0	2^{32}-1	–
4006h see "Object 4006h Command", page 56		Command	Unsigned8	rw	0	1	0
4007h see "Object 4007h – Error and Status", page 56		Errors & Status	Unsigned16	ro	–	–	–
4008h see "Object 4008h – Setup MF1/2", page 58		Setup MF1/2	struct	rw	–	–	–
4009h see "Object 4009h Distance Preset, static", page 60		Distance Preset, static	Signed32	rw	-300000d, FFFB6C20h	300000d, 493E0h	0
400Ah see "Object 400Ah – Special Functions", page 60		Special Functions	struct	rw	–	–	–
6000h see "Object 6000h Operating Parameters", page 62		Operating Parameters	Unsigned16	rw	0	8	0
6003h see "Object 6003h Distance Preset, dynamic", page 62		Distance Preset, dynamic	Unsigned32	rw	0	300000d, 493E0h	0
6004h see "Object 6004h – Distance", page 63		Distance	Unsigned32	ro	0	Version-dependent: +600 m (maximum value including off-set)	–
6005h see "Object 6005h Linear Encoder Measuring Step Settings", page 63		Linear Encoder Measuring Step Settings					
	0h	Number of Elements	Unsigned32	ro	–	–	2

Index [hex]	Subindex [hex]	Name	Data type	Access	Value range		
					Min.	Max.	Default
	1h	Position Measuring Step	Unsigned32	rw	1	100000000d, 5F5E100h	100d, 64h
	2h	Speed Measuring Step	Unsigned32	rw	1	10000d, 2710h	1000d, 3E8h
6030h see "Object 6030h – Velocity", page 63		Velocity	Signed16	ro	-15 m/s	15 m/s	–
6500h see "Object 6500h Operating Status", page 63		Operating status	Unsigned16	ro	0	8	0
6501h see "Object 6501h Single-turn Resolution and Measuring Step", page 63		Single-turn Resolution and Measuring Step	Unsigned32	ro	1	100000000d, 5F5E100h	100000d, 186A0h
6502h see "Object 6502h Number of Distinguishable Revolutions", page 63		Number of Distinguish-able Revolutions	Unsigned32	ro	–	–	1
6507h see "Object 6507h Profile and Software Version", page 63		Profile and Software Version	Unsigned32	ro	–	–	0196XXXXh
6508h see "Object 6508h Operating Time", page 63		Operating time	Unsigned32	ro	0	2^{32}-1	0
6509h see "Object 6509h Distance Offset", page 63		Distance Offset	Signed32	rw	-600000d, FFF6D840h	300000d, 49E0h	0

10.4 Communication segment (1000h to 1FFFh)

Object 1000h – Device Type

The object describes the device type.

- Byte 0 to 1 (0196h = 406d) represents device profile CiA 406.
- Bytes 2 to 3 (0008h = 8d) represent the overall profile of an absolute linear encoder

Object 1001h – Error Register

The error register indicates the error status of the device. An assigned bit indicates that a corresponding error has occurred.

Bit	Mandatory/optional	Description	Supported
0	Mandatory	General error	Yes
1	Optional	Current error	No
2	Optional	Voltage error	No
3	Optional	Temperature error	Yes
4	Optional	Communication error (buffer overflow)	Yes
5	Optional	Device profile-related error	No
6	Optional	Reserved (always 0)	No
7	Optional	Manufacturer-specific error	Yes

Object 1008h – Manufacturer Device Name

Name of the product family: DL100

Object 1009h – Manufacturer Hardware Version

In delivered state, corresponds to the serial number. In case of repairs, the hardware version may change.

Object 100Ah – Manufacturer Software Version

Specification of software version of the application controller. Format: Vxxx.xxx.xxx ([primary].[secondary].[rev]).

Object 1018h – Identity Object

The object contains general data on the EtherCAT®Slave.

Subindex	Name	Description
0h	Number of Entries	Specification of the number of subindices within the object 1018h.
1h	Vendor ID	The vendor ID (1000056h) uniquely identifies the manufacturer and is issued by the EtherCAT® Technology Group.
2h	Product Code	Consecutive, unique number within the vendor ID (00005800h), which is issued by the manufacturer.
3h	Revision Number	The revision number is composed of the main (bit 31 to 16) and secondary number (bit 15 to 0) of the software version displayed in object 100Ah. The software version refers to the application controller.
4h	Serial Number	8-digit serial number

Object 1600h Receive PDO 1: Command

Receive process data object with fixed mapping

- Transfer type: Synchronous
- Mapping: Fixed, object[4006h] "Command"

Object 1A00h – Transmit PDO 1: Distance

Transmit process data object with fixed mapping

- Transfer type: Synchronous
- Mapping: Fixed, object [6004h] "Distance"

Object 1A03h – Transmit PDO 4: Velocity

Transmit process data object with fixed mapping

- Transfer type: Synchronous
- Mapping: Fixed, object [6030h] "Velocity"

Object 1A04h Transmit PDO 5: Error and Status

Transmit process data object with fixed mapping

- Transfer type: Synchronous
- Mapping: Fixed, object [4007h] "Error and Status"

Object 1C00h Sync Manager Communication Type

This object indicates the assignment of the four EtherCAT® Sync Managers.

Subindex	Name	Description
0h	Number of Entries	Specification of the number of subindices within the object 1C00h.
1h	Communication Type Sync Manager 0	1: Receive mailbox (EtherCAT® master to EtherCAT® slave)
2h	Communication Type Sync Manager 1	1: Send mailbox (EtherCAT® slave to EtherCAT® master)
3h	Communication Type Sync Manager 2	3: Receive (Rx) PDO (EtherCAT® master to EtherCAT® slave)
4h	Communication Type Sync Manager 3	4: Transmit (Tx) PDO (EtherCAT® slave to EtherCAT® master)

Object 1C12h Sync Manager 2 PDO Assignment

This object is used to assign sync channel 2 to a RxPDO (see "Object 1600h Receive PDO 1: Command", page 54) and is written by the EtherCAT® master.

Object 1C13h Sync Manager 3 PDO Assignment

This object is used to assign sync channel 3 to a TxPDO (see "Object 1A00h – Transmit PDO 1: Distance", page 54, see "Object 1A03h – Transmit PDO 4: Velocity", page 54, see "Object 1A04h Transmit PDO 5: Error and Status", page 54) and is written by the EtherCAT® master.

10.5 Manufacturer-specific segment (2000h to 5FFFFh)

Object 2000h – Distance

The object 2000h issues the current distance value in the selected resolution. The resolution can be selected in the objects 4000h or 6005h subindex 01h.

Object 2001h – Velocity

The object 2001h issues the current speed value in the selected resolution. The resolution can be selected in the objects 4001h or 6005h subindex 02h.

The filter settings "slow", "medium" or "fast" have an effect on the speed. You can parameterize the filter settings via object 400Ah, subindex 02h.

Object 2002h – Time Stamp

The object 2002h issues the time stamp corresponding to the measurement and speed value. The time stamp begins to count from 0 immediately after the voltage supply is switched on. The unit used by the time stamp is microseconds.

The time stamp has an average rounding error of 5%.

Object 2003h – Level

Display of the current received signal level (attenuation value).

Object 4000h – Distance Resolution

In object 4000h, the resolution for the distance value can be adjusted. The following distance resolutions are possible:

- 0 = 0.1 mm (default, see also detailed description of object 6005h, subindex 2)
- 1 = 0.125 mm
- 2 = 1 mm
- 3 = 10 mm
- 4 = 100 mm
- 5 = freRes (free resolution distance, controlled via object 6005h subindex 01h)

If the value is equal to 5, the resolution is only possible via object 6005h, subindex 1, "Linear Encoder Measuring Step Settings." If the value is not equal to 5, object 6005h is ignored.

Object 4001h – Velocity Resolution

In object 4001h, the resolution for the speed value can be adjusted. The following speed resolutions are possible:

- 0 = 0.1 mm/s
- 1 = 1 mm/s (default)
- 2 = 10 mm/s
- 3 = 100 mm/s
- 4 = freRes (free resolution speed, controlled via object 6005h subindex 02h)

If the value is equal to 4, the resolution is only possible via object 6005h, subindex 2, "Linear Encoder Measuring Step Settings." If the value is not equal to 4, object 6005h is ignored.

Object 4002h – Device Product Code

Specification of the product code, e.g., DL100-21AA2211

Object 4003h – Software Versions

Specification of the software versions in the device in format Vxxx.xxx.xxx (Main.Secondary.Rev)

Subindex	Name	Description
0h	Number of Entries	Specification of the number of subindices within the object 4003h.
1h	Application controller	Specification of software version of the application controller.
2h	FPGA	Indication of the software version of the FPGA.
3h	Communication controller	Indication of the software version of the communication controller.

Object 4004h – Device Temperature

Indication of the temperature in the device in °C.

Object 4005h – Laser Operating Hours

Laser operating hours specified as a multiple of 10 h, e.g., 1000 h of operation equates to 100 * 10 h.

Object 4006h Command

This object is used to switch the measuring laser on and off.

- Bit [15:1]: <reserved>
- Bit [0]: 1 = Laser OFF, 0 = Laser ON

Object 4007h – Error and Status

Bit [0] = LSB; bit [15] = MSB

Table 22: Display of current errors, warnings and status information

Bit	Description
[15]	Bit = 1: Laser error Laser error – the laser diode may have reached the end of its service life. Type • 1 bit
[14]	Bit = 1: Signal level error The signal attenuation is too high. Type • 1 bit
[13]	Bit = 1: Temperature error The device is operating outside the specified temperature range. Type • 1 bit
[12]	Bit = 1: Plausibility error No valid measured value can be calculated. Type • 1 bit
[11]	Bit = 1: Laser warning The device must be replaced soon due to aging of the laser diode. The likelihood of an error occurring is high. Type • 1 bit
[10]	Bit = 1: Signal level warning The signal attenuation has reached the critical value, e.g., due to contamination. The likelihood of an error occurring is high. Type • 1 bit
[9]	Bit = 1: Temperature warning Internal temperature of the device has reached the critical value. The likelihood of an error occurring is high. Type • 1 bit
[8]	Bit = 1: Plausibility warning Measured values are faulty. Extrapolated measured values are output instead see table 21, page 41, **ErrRej**. This may be caused by an internal error, hardware errors, obstruction of the light beam, optical interference or electrical interference. The likelihood of an error occurring is high. Type • 1 bit
[7]	• Bit = 0: Device ready for operation • Bit = 1: Device not ready for operation. Possible causes could be hardware errors, temperature errors, optical or electrical interference or a deactivated laser diode. Type • 1 bit
[6:4]	Reserved
[3]	Bit = 1: MF2 output is active. Type • 1 bit

Bit	Description
[2]	Bit = 1: Either a input level is active at MF1 of the output is active. **Type** • 1 bit
[1]	Bit = 1: Device-internal heating in operation **Type** • 1 bit
[0]	Bit = 1: Laser switched off **Type** • 1 bit

Object 4008h – Setup MF1/2

Object 4008h defines the behavior of the switchable MF1 input/output and the MF2 output.

Subindex	Data type	Name	Description	Default
01	Enum8	MFx	Activate or deactivate MF1 and MF2. 1 = activate 0 = deactivate	1
02	Enum8	Function MF1	Select function for MF1 input/output. 0 = Distance Threshold: Output is switched when the distance from object 4008h, subindex 04 "[MF1 Distance] threshold" has been overwritten. 1 = Velocity Threshold: Output is switched when the speed limit from object 4008h, subindex 06 "[MF1 Velocity] threshold" has been overwritten. The direction is defined in object 4008h, subindex 07 "[MF1 Velocity] mode." 2 = Service: The output switches when at least one of the switched-on service bits selected in object 4008h subindex 08...0D has been set. 3 = Laser Off: Measuring laser is deactivated via the input. 4 = Preset Static: Preset static function activated via the input.	0
03		[MF1] Active State	Select the active level or signal edge of the MF1. 0: High active State 1: Low active State	1
04	DInt	[MF1 Distance] Threshold [mm]	Enter the distance threshold value Value range: -300,000 ... + 300,000 [mm]	1990
05	DInt	[MF1 Distance] Hysteresis [mm]	Enter the distance threshold hysteresis Value range: 1 ... 300,000 [mm]	10
06	Int	[MF1 Velocity] Threshold [mm/s]	Enter speed threshold. The switching hysteresis is fixed at 100 mm/s. Value range: 0 ... 15,000 [mm/s]	5000
07	Enum8	[MF1 Velocity] Mode	Select direction for detecting the speed overrun 0: Positive direction [+] 1: Negative direction [-] 2: Both directions [+/-]	2
08	Bool	[MF1 Service] Laser Warning	The output switches when the aging of the laser diode means that the device is nearly due to be replaced.	True

Subin-dex	Data type	Name	Description	Default
09	Bool	[MF1 Service] Level Warning	The output switches when the signal attenuation value reaches the critical value, for example due to contamination.	True
0A	Bool	[MF1 Service] Temp. Warning	The output switches when the interior device temperature reaches the critical value.	True
0B	Bool	[MF1 Service] Plausib. Warning	The output switches if extrapolated measured values are to be output for implausible measured values see table 21, page 41, ErrRej. This may be caused by an internal error, hardware errors, obstruction of the light beam, optical interference or electrical interference.	True
0C	Bool	[MF1 Service] Not Ready	The output switches when the device is not ready for operation. Possible causes could be hardware errors, optical or electrical interference or a deactivated laser diode. This warning message is also issued during initialization.	True
0D	Bool	[MF1 Service] Heating Status	The output switches if the internal device heater is in operation.	False
0E	Enum8	Function MF2	Select function for MF2 output. 0 = Distance Threshold: Output is switched when the distance from object 4008h, subindex 10 "[MF2 Distance] threshold" has been overwritten. 1 = Velocity Threshold: Output is switched when the speed limit from object 4008h subindex 12 "[MF2 Velocity"] threshold" has been overwritten. The direction is defined in object 4008h, subindex 13 "[MF2 Velocity] mode." 2 = Service: The output switches when at least one of the switched-on service bits from object 4008h, subindex 14 …19 has been set.	2
0F	Enum8	[MF2] Active State	Select the active level or signal edge of the MF2. 0: High active State 1: Low active State	1
10	DInt	[MF2 Distance] Threshold [mm]	Enter the distance threshold value Value range: -300,000 … + 300,000 [mm]	1990
11	DInt	[MF2 Distance] Hysteresis [mm]	Enter the distance threshold hysteresis Value range: 1 … 300,000 [mm]	10
12	Int	[MF2 Velocity] Threshold [mm/s]	Enter speed threshold. The switching hysteresis is fixed at 100 mm/s. Value range: 0 … 15,000 [mm/s]	5000
13	Enum8	[MF2 Velocity] Mode	Select direction for detecting the speed overrun 0: Positive direction [+] 1: Negative direction [-] 2: Both directions [+/-]	2
14	Bool	[MF2 Service] Laser Warning	The output switches when the aging of the laser diode means that the device is nearly due to be replaced.	True
15	Bool	[MF2 Service] Level Warning	The output switches when the signal attenuation value reaches the critical value, for example due to contamination.	True
16	Bool	[MF2 Service] Temp. Warning	The output switches when the interior device temperature reaches the critical value.	True

Subin-dex	Data type	Name	Description	Default
17	Bool	[MF2 Service] Plausib. Warning	The output switches if extrapolated measured values are to be output for implausible measured values see table 21, page 41, ErrRej. This may be caused by an internal error, hardware errors, obstruction of the light beam, optical interference or electrical interference.	True
18	Bool	[MF2 Service] Not Ready	The output switches when the device is not ready for operation. Possible causes could be hardware errors, optical or electrical interference or a deactivated laser diode. This warning message is also issued during initialization.	True
19	Bool	[MF2 Service] Heating Status	The output switches if the internal device heater is in operation.	False

Object 4009h Distance Preset, static

In object 4009h, the reference value for the static preset is set via switching input MF1 in millimeters, see "MF1 – Preset submenu", page 39.

- Value range: -300,000 ... 300,000
- Default: 0

Object 400Ah – Special Functions

In object 400Ah, the filter characteristic can be used for the measured distance values, the filter depth for the measured speed values, the measurement direction, the time for maximum error suppression, the temperature threshold for switching on the heater, and the laser transmission frequency.

Subin-dex	Data type	Name	Description	Default
01	Enum8	Average Filter Distance	Select filter characteristic for the distance measured values. The distance and speed values are filtered based on a mathematical state model (Kalman filter). This model is optimized for use in continuously changing distance conditions and results in faster distance sensor response time while reducing the measured value noise at the same time. The set option affects both the measured value noise as well as the dynamic behavior of the distance measured value and the speed measured value derived from this. A slower filter setting reduces measured value noise but can lead to distance value overshoots if the distance changes rapidly. 0 (fast), 1 (medium), 2 (slow)	1
02	Enum8	Average Filter Velocity	Select filter depth for the speed measured values (moving average filter). The filter is downstream of the Kalman filter (see object 400Ah, subindex 01). 0 (fast) = 1 value 1 (medium) = 8 values 2 (slow) = 32 values	1

Subindex	Data type	Name	Description	Default
03	Enum8	Counting Direction	Defining measurement direction: If the measuring direction is positive "+", the distance output value is equal to the internal distance value measured by the measuring module. If the measuring direction is negative "-", the internal distance value is multiplied by a factor of "-1". The change in direction affects both the output value for the distance and the output value for the speed. 0 = Positive direction 1 = Negative direction	0
04	Enum8	Error Rejection	Select time for maximum error suppression. If no measurement is possible due to an error (e.g. brief light beam interruption), measured value are extrapolated until no later than when the set error suppression time expires. During this time, a **WrnPlb** plausibility warning is output. If no measurement is possible after expiration of the error suppression time, measured value 0, plausibility error **ErrPlb** and possibly other errors (e.g. level error **ErrLvl**) are output. 0 = off 1 = 50 ms 2 = 200 ms	2
05	DInt	Threshold for heating	ⓘ **NOTE** | Only for DL100-xxHxxxxx variants with heating Select the ambient temperature below which the heater should switch on. The hysteresis is fixed at 3 K. Increasing the temperature set at the factory can reduce the formation of condensation in some cases. Value range: -10 °C … 40 °C	-10
06	Enum8	Frequency sets	ⓘ **NOTE** | Only for DL100-xxxBxxxx variants with frequency changeover Set the laser transmission frequencies. If the minimum distance between the optical axes cannot be maintained when mounting several distance sensors, mutual interference is prevented by setting different frequencies (mode 0 … mode 2). No minimum distance is required for this purpose see "Placement of multiple distance sensors", page 20. Mode 0 corresponds to the laser transmission frequency of the variant without switchable frequency (DL100-xxxAxxxx). Mode 3 is reserved for later use. 0 = Mode 0 1 = Mode 1 2 = Mode 2 3 = Mode 3 (reserved)	0

10.6 Device profile CiA 406 absolute linear encoder (6000h to 9FFFh)

The device profile is an encoder profile, thus enabling complete replacement by devices which also use the CiA 406 device profile. The device profile is divided into different classes. The DL100 Pro is based on device profile CiA 406 (absolute linear encoder), version 3.2, class 1 (C1).

Object 6000h Operating Parameters

Operating parameters can be adjusted in object 6000h. The implemented operating parameters can be found in the following table.

Table 23: Operating parameters, bit-coded

| Bit	15…12	11…5	4	3	2	1	0
Name	msp1…msp4	r	hsfc	md	sfc	cdc	cs
Default value	0	0	0	0	0	0	0
Done	No	-	No	Yes	No	No	No

Cs: Code sequence: Only relevant for rotary encoders.

Md: Measuring direction: The md bit defines the counting direction and inverts the current measured value. Since object 6004h can only accept positive values, a suitable positive offset must be set when the counting direction is inverted.

ℹ️ **NOTE**
If you want to change the counting direction, you must first delete an existing preset. An existing preset is applied when the object 6509h is not equal to 0.
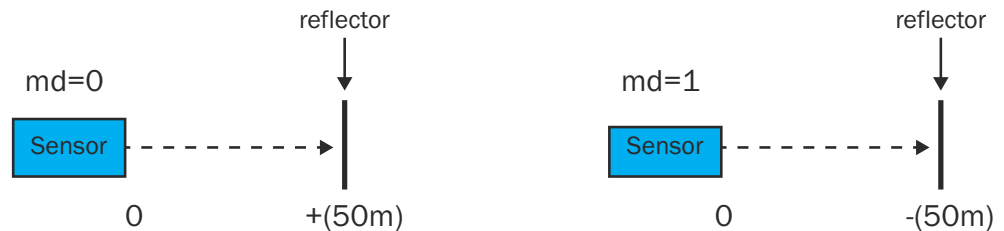
Object 6003h Distance Preset, dynamic

Use this object to set a preset value. This makes it possible to automatically adjust the measured distance value to a reference value (preset) known to the system during commissioning, maintenance or device replacement.

For the dynamic preset described here, the time for adopting the reference value in the device is determined by writing object 6003h. The distance value measured at this time is automatically provided with an offset and therefore adjusted to the reference value.

The following applies: Offset = Preset – measured distance value. The preset is entered in 0.1 mm.

Setting a preset value automatically updates object 6509h (distance offset).

The value range of the preset is +300,000 mm. Negative values are not permitted, as per specification CiA 406.

As an alternative to object 6003h, a preset can be made via switching input MF1, see "MF1 – Preset submenu", page 39.

ℹ️ **NOTE**
When activating the preset, the output of measured values of the distance sensor will be temporarily unavailable. We recommend carrying out the preset while the machine is at a standstill or running at very low speeds. The maximum activation number is typically around 10,000 cycles. The offset value calculated when activating the preset is permanently saved in the device.

Object 6004h – Distance

According to the CiA 406 specification, object 6004h Distance is of data type uInt32 and can only display positive values. If there is a negative value, the object 6004h is assigned the value of 0.

The manufacturer-specific object 2000h Distance must be used in order to represent negative values. This is mapped to object 6004h.

Object 6005h Linear Encoder Measuring Step Settings

This object has the same functionality as object 4000h. The difference is that any resolution can be specified between the lowest and the highest resolution.

Subindex	Name	Description
0h	Linear Encoder Measuring Step Settings	Specification of the number of subindices within the object 6005h.
1h	Position Measuring Step	Resolution as a multiple of 1 nm (nanometer) within range 1 nm...100,000,000 nm.
2h	Velocity Measuring Steps	Resolution as a multiple of 0.01 mm/s within range 0.01 mm/s...100 mm/s.

Object 6030h – Velocity

The manufacturer-specific object 2001h Velocity is mapped onto object 6030h.

Object 6500h Operating Status

This object provides the operating status of the encoder functions configured in object 6000h.

Object 6501h Single-turn Resolution and Measuring Step

Specification of the resolution for the distance value as a multiple of 1 nm (nanometer). The resolution output here corresponds to the resolution set via objects 4000h or 6005h subindex 1. A a resolution of 1 mm corresponds to 1,000,000.

Object 6502h Number of Distinguishable Revolutions

For linear encoders, i.e. also for the DL100 Pro, this value is always "1".

Object 6507h Profile and Software Version

Byte 3-2: CiA device profile: Device profile for encoders (0196h), Byte 1-0: Application controller version (main and secondary number, e.g. 0201h for V002.001.xxx).

Object 6508h Operating Time

Operating hours specified as a multiple of 10 h, e.g., 1000 h of operation equates to 100 * 10 h. Object 6508h corresponds to object 4005h. 4005h is mapped to 6508h.

Object 6509h Distance Offset

By default, the offset value is 0. If a preset is specified via object 6003h Preset Value, the object 6509h is updated automatically as follows:

Offset = Preset – measured distance value

11   Maintenance

11.1   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 viewing window at regular intervals and in the event of contamination. First, remove any solid deposits with oil-free compressed air or, if necessary, with a mixture of water and a few drops of a commercially available rinsing agent and a soft brush, and then rinse. If required, remove the drying residue with cleaning cloths that are suitable for optics and plastic cleaning agent.

11.2   Maintenance plan

During operation, the device works maintenance-free.

Depending on the assignment location, the following preventive maintenance tasks may be required for the device at regular intervals:

Table 24: Maintenance plan

Maintenance work	Interval	To be carried out by
Check device and connecting cables for damage at regular intervals.	Depends on ambient conditions and climate.	Specialist
Clean housing and viewing window.	Depends on ambient conditions and climate.	Specialist
Clean the reflector and check it for damage.	Depends on the ambient conditions and company requirements.	Specialist
Check that the laser beam is directed at the center of the reflector.	Depends on the ambient conditions and company requirements. Recommended: At least every 6 months.	Specialist
Check the screw connections and plug connectors.	Depends on the place of use, ambient conditions or operating requirements. Recommended: At least every 6 months.	Specialist

12   Troubleshooting

12.1   General faults, warnings, and errors

General faults are subdivided into warnings and errors. Current measured values as well as respective warning messages continue to be output when there are warnings. Measurement is no longer possible when there are faults and measured value **0** and the respective error value are therefore output. If there is an error, the device continues to extrapolate measured values no later than when the error suppression time set in **ErrRej** expires. During this time, the **WrnPlb** plausibility warning is output. If measurement is still not possible after the error suppression time expires, measured value **0** and the associated error message are output.

Warnings and errors are signaled via the **PWR** LED and can be read in the main menu as long they are active. Warnings and errors can also be output via the multi-functional outputs or the fieldbus interface via the SOPAS ET configuration software. They are not stored on the device. **NoWrn** or **NoErr** is displayed in the main menu during fault-free operation.

The **PWR** LED signals the device status.

> **ⓘ**   **NOTE**
> Possible faults and corrective actions are described in the tables below for trouble-shooting. In the case of faults that cannot be rectified using the description below, please contact the manufacturer. See the back page for relevant contact details.

12.2   Device status (LED PWR)

Table 25: LED status indicator

Display	Fault	Measures
The **PWR** LED does not light up.	No operation. Device is defective.	Check the supply voltage. Return the device for repairs.
The **PWR** LED flashes orange.	A warning is present.	For possible causes and correcting them see "Warning messages", page 65.
The **PWR** LED flashes red.	An error is present.	For possible causes and correcting them see "Error messages", page 66.

12.3   Warning messages

An active warning is indicated by an orange flashing **PWR** LED. The warning can be read in the main menu see "Main menu", page 33.

Table 26: Warning messages

Display in the main menu (meaning)	Possible causes	Troubleshooting
NoWrn	No warning	-

Display in the main menu (meaning)	Possible causes	Troubleshooting
WrnPlb (plausibility warning)	Measured value briefly not plausible. Light path between the measuring device and the reflector briefly interrupted.	Observe the light spot on the reflector. The light spot must not drift from the reflector. If necessary, realign the measuring device and reflector or use a larger reflector. For alignment and mounting see "Mounting", page 17.
	Measured value briefly not plausible. Optical interference is present, e.g. as a result of parallel mounted optical sensors.	▪ Remove any optical interference see "Mounting", page 17.
WrnLsr (laser warning)	The measurement laser is still ready for operation but is at the end of its service life.	Keep a replacement device ready for use. It is advisable to replace the device during the next maintenance session.
WrnLvl (level warning)	Current attenuation value is beyond the error limit. For recommended attenuation values, see "Received signal level", page 27.	▪ Align the device and reflector with each other, see "Aligning the distance sensor and reflector with each other", page 26. ▪ Clean the optical interfaces like the reflector and viewing window. ▪ Check the reflective tape for damage.
WrnTmp (temperature warning)	The internal device temperature is outside the range of –10 °C ... +75 °C. For the permissible ambient temperature see "Ambient data", page 70.	▪ Check the ambient temperature. Provide better ventilation, if necessary. ▪ Shield the device from radiated heat, e.g. shade the measuring device from direct sunlight. ▪ At low ambient temperatures, use a heating system for the device. ▪ At high ambient temperatures, use a cooling housing.

12.4 Error messages

An active error is indicated by a red flashing **PWR** LED. The error can be selected in the main menu see "Main menu", page 33.

Table 27: Error messages

Display in the main menu (meaning)	Possible causes	Troubleshooting
NoErr	No errors	–

Display in the main menu (meaning)	Possible causes	Troubleshooting
ErrPlb (Plausibility error)	Measured value not plausible. Light path between the measuring device and the reflector interrupted.	Observe the light spot on the reflector. The light spot must not drift from the reflector. If necessary, realign the measuring device and reflector or use a larger reflector. For alignment and mounting see "Mounting", page 17.
	Measured value not plausible. Measured value outside the permissible measuring range.	Check measurement range. If necessary, use device variant with high measuring range.
	Measured value not plausible. Optical interference is present, e.g. as a result of parallel mounted optical sensors.	Remove any optical interference see "Mounting", page 17.
ErrLsr (Laser error)	The service life of the measurement laser has been exceeded.	Replace the device. It is advisable to replace the device during the next maintenance session.
ErrLvl (Level error)	Current signal attenuation is beyond the error limit see "Received signal level", page 27.	■ Align the distance sensor and reflector with each other see "Aligning the distance sensor and reflector with each other", page 26. ■ Clean the optical interfaces like the reflector and viewing window. ■ Check the reflective tape for damage.
ErrTmp (Temperature error)	The internal device temperature is outside the range of −15 °C ... +80 °C. For the permissible ambient temperature see "Ambient data", page 70.	■ Check the ambient temperature. Provide better ventilation if necessary. ■ Shield the device from radiated heat, e.g. shade the measuring device from direct sunlight. ■ At low ambient temperatures, use a heating system for the device. ■ At high ambient temperatures, use a cooling housing.

12.5 Communication problems

12.5.1 Ethernet problems

The **L/A1** and **L/A2** LEDs signal the connection status (link) of Ethernet ports 1 and 2.

*Table 28: LED **L/A1** / **L/A2***

Display	Status	Measures
Off	No physical connection (link) to the next participant available.	Check Ethernet wiring.

12.6 Returns

▶ Only send in devices after consulting with SICK Service.
▶ The device must be sent in the original packaging or an equivalent padded packaging.

NOTE

To enable efficient processing and allow us to determine the cause quickly, please include the following when making a return:

- Details of the contact person
- Description of the application
- Description of the fault that occurred

12.7 Repairs

Repair work on the device may only be performed by qualified and authorized personnel from SICK AG. Interruptions or modifications to the device by the customer will invalidate any warranty claims against SICK AG.

12.8 Disposal

CAUTION

Risk of injury due to hot device surface.

The surface of the device can become hot.

- Before performing work on the device (e.g. mounting, cleaning, disassembly), switch off the device and allow it to cool down.
- Ensure good dissipation of excess heat from the device to the surroundings.

If a device can no longer be used, dispose of it in an environmentally friendly manner in accordance with the applicable country-specific waste disposal regulations. Do not dispose of the product along with household waste.

NOTICE

Danger to the environment due to improper disposal of the device.

Disposing of devices improperly may cause damage to the environment.

Therefore, observe the following information:

- Always observe the national regulations on environmental protection.
- Separate the recyclable materials by type and place them in recycling containers.

---

13 Technical data

> **NOTE**
> The relevant online product page for your product, including technical data, dimensional drawing, and connection diagrams, can be downloaded, saved, and printed from the Internet.
>
> The page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**
>
> {P/N} corresponds to the part number of the product, see type label.
>
> {S/N} corresponds to the serial number of the product, see type label (if indicated).
>
> Please note: This documentation may contain further technical data.

13.1 Optics

Table 29: Laser/optics

Light sender	Laser diode, red light
Laser class	2 (EN 60825-1:2014+A11:2021, IEC 60825-1:2014)
CW modulation	± 0.85 Po sinusoidally modulated
Maximum peak output	≤ 1.9 mW
Pulse duration	6.8 ns
Average performance P_0	< 1 mW
Shaft Length	655 nm
Frequency	≥ 90 MHz
Light spot size	Typically 5 mm + (2 mm x distance [m])
Average service life	Typically 100,000 h at +25 °C ambient temperature

13.2 Performance data

Table 30: Performance data

Measuring ranges	• DL100–21XXXXXX: 0.15 m … 100 m • DL100–22XXXXXX: 0.15 m … 200 m • DL100–23XXXXXX: 0.15 m … 300 m
Measuring object	On Diamond Grade reflective tape DG983
Measurement accuracy	• DL100–21XXXXXX: ± 2.0 mm • DL100–22XXXXXX: ± 2.5 mm • DL100–23XXXXXX: ± 3.0 mm
Repeatability [2]	• DL100–21XXXXXX: ± 0.50 mm • DL100–22XXXXXX: ± 1.00 mm • DL100–23XXXXXX: ± 2.00 mm
Measurement cycle time	1 ms
Response time/Measured value age	2 ms
Initialization time	▪ Typically 1.5 s ▪ After reflector loss: < 40 ms

[1] The measurement accuracy can be up to ± 4 mm in the 150 mm…180 mm measuring range.
[2] Statistical error 1 σ, environmental conditions constant, minimum warm-up time 10 min.

13.3 Supply

Table 31: Supply

Supply voltage V_S	18 V DC … 30 V DC, reverse polarity protected
Current consumption (without load)	▪ Without heating: < 250 mA at 24 V DC ▪ With heating: < 1,000 mA at 24 V DC
Residual ripple	< 5 V_{SS} within the permissible supply voltage U_V

13.4 Inputs

Table 32: Inputs

Inputs	Multifunctional input MF1, switching function adjustable Switching type: Sink for PNP output (open input corresponds to the LOW input signal) ▪ HIGH > 12 V ▪ LOW < 3 V
Circuit protection	None, no reverse-polarity protection.

13.5 Outputs

Table 33: Outputs

Outputs	Multifunctional outputs MF1 and MF2, type B (push/pull), adjustable switching function ▪ HIGH > U_V – 3 V ▪ LOW < 2 V
Circuit protection	▪ Short-circuit protected ▪ Overload-proof
Maximum output current	Max. 100 mA
Output load	▪ Capacitive: 100 nF ▪ Inductive: 20 mH

13.6 Interfaces

Table 34: Interfaces

2x Ethernet	• Process data interface EtherCAT® • Configuration/Service interface (SOPAS ET) via EoE (Ethernet over EtherCAT®)

13.7 Ambient data

Table 35: Ambient data

Protection class	⬦III⬦ Suitable for operation in PELV (Protective Extra Low Voltage) systems with safe separation.
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4, Class A
Ambient operating temperature range	–20 … +55 °C [2] –40 … +55 °C (with integrated heating) [3] -20 … +75 °C (with cooler housing TPCC)

Warehouse ambient temperature range	-40 ... +75 °C
Relative humidity	Max 95% (non-condensing)
Enclosure rating	IP 65
Effect of air pressure	0.3 ppm/hPa
Effect of temperature	1 ppm/K
Temperature drift	Typically 0.1 mm/K
Maximum traversing speed	15 m/s
Maximum acceleration	15 m/s^2
Mechanical strength	EN 60068-2-27 (Ea): Continuous shock: 25 g / 6 ms, half sine, 6 axes, 500 shocks per axis EN 60068-2-27 (Ea): Shock: 30 g / 6 ms, half sine, 6 axes, 3 shocks per axis EN 60068-2-64 (Fh): Broadband noise vibrations: 10 g rms, 10... 500 Hz, 6 axes, 2 h per axis

[1] The device may cause interference if used in a residential environment.

[2] A warm-up phase until activation of the laser diode is required for temperatures under –10 °C; typical duration at –20 °C: 20 min at 24 V.

[3] For operation below –20 °C, a supply voltage of at least 24 V is required. A warm-up phase up until activation of the laser diode is required for temperatures under –10 °C: typical duration at –40 °C: 35 min at 24 V.

[4] Maximum 95% humidity, non condensing

13.8   Structural design

Table 36: Structural design

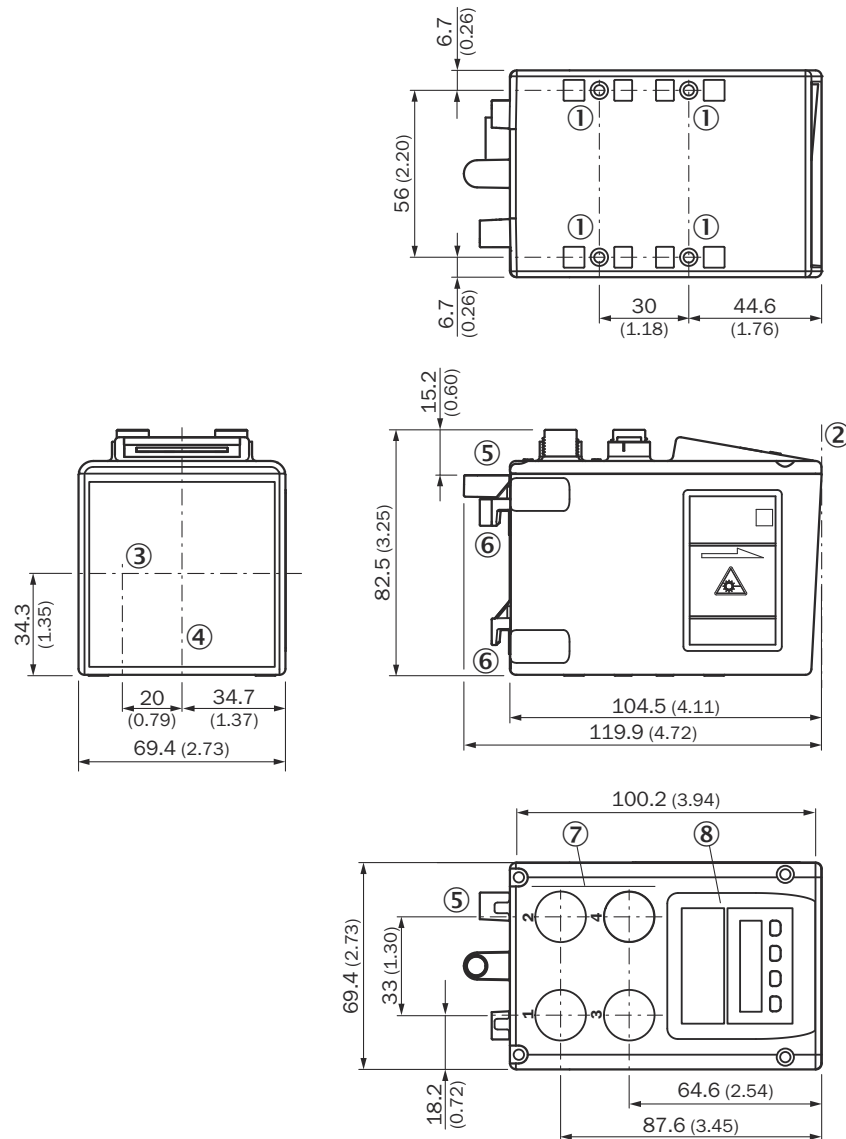|	
Dimensions	
Weight	▪ Device: approx. 800 g ▪ Alignment bracket (optional): approx. 800 g
Materials	▪ Housing: Cast aluminum GD-AlSi12Cu1 (3.2982.05) ▪ Viewing window: PMMA
Connections	• M12, SpeedCon™-compatible
Display	▪ 6-digit with a 5 x 7 dot matrix

13.9   Dimensional drawing

Figure 24: Device dimensions; unit: mm (inch), decimal separator: period

①   Mounting thread M5, 10 mm depth

②   Device zero point

③   Sender optical axis

④   Receiver optical axis

⑤   Hole for the star grip screw of the optional alignment bracket

⑥   Latch hook for alignment bracket

⑦   Electrical connection

⑧   Display and control elements

14 Accessories

> ℹ️ **NOTE**
> On the product page you will find accessories and, if applicable, related installation information for your product.
>
> The page can be accessed via the **SICK Product ID**: pid.sick.com/{P/N}/{S/N}
>
> {P/N} corresponds to the part number of the product, see type label.
>
> {S/N} corresponds to the serial number of the product, see type label (if indicated).
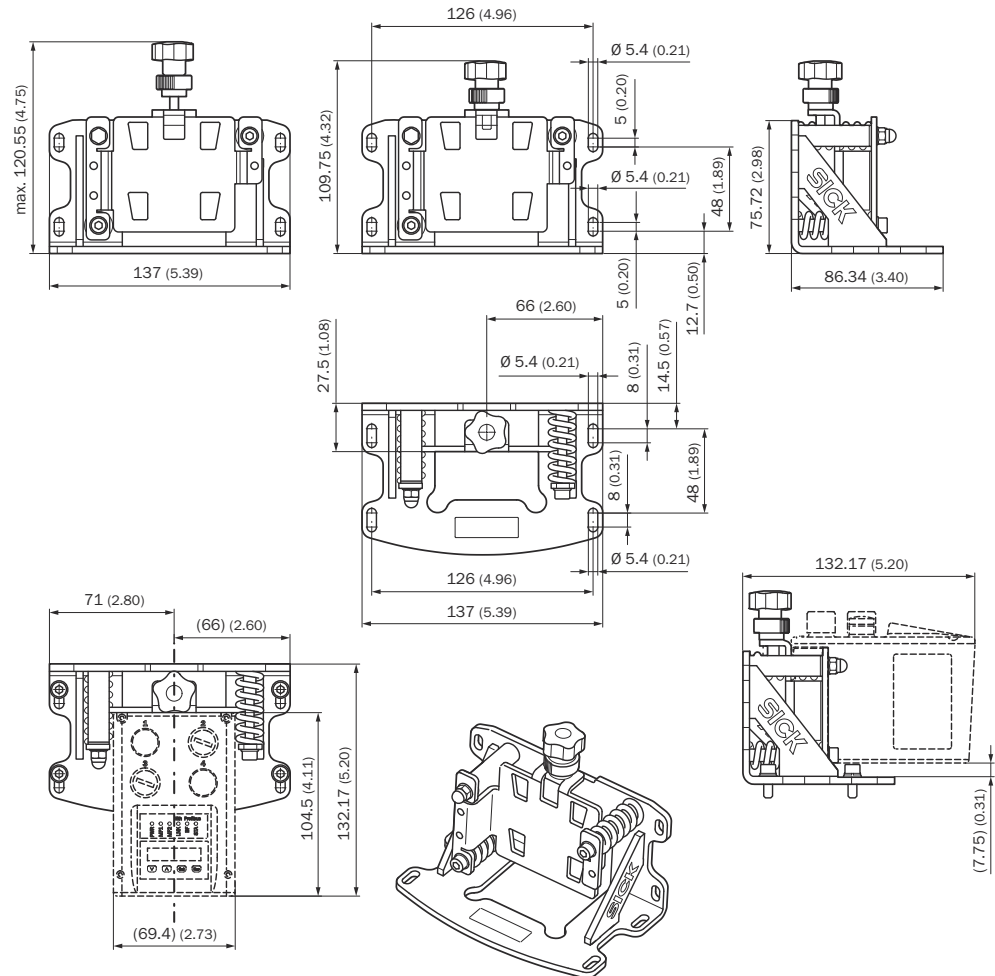
14.1 Mounting systems

Figure 25: Alignment bracket; unit: mm (inch), decimal separator: period

Table 37: Alignment bracket

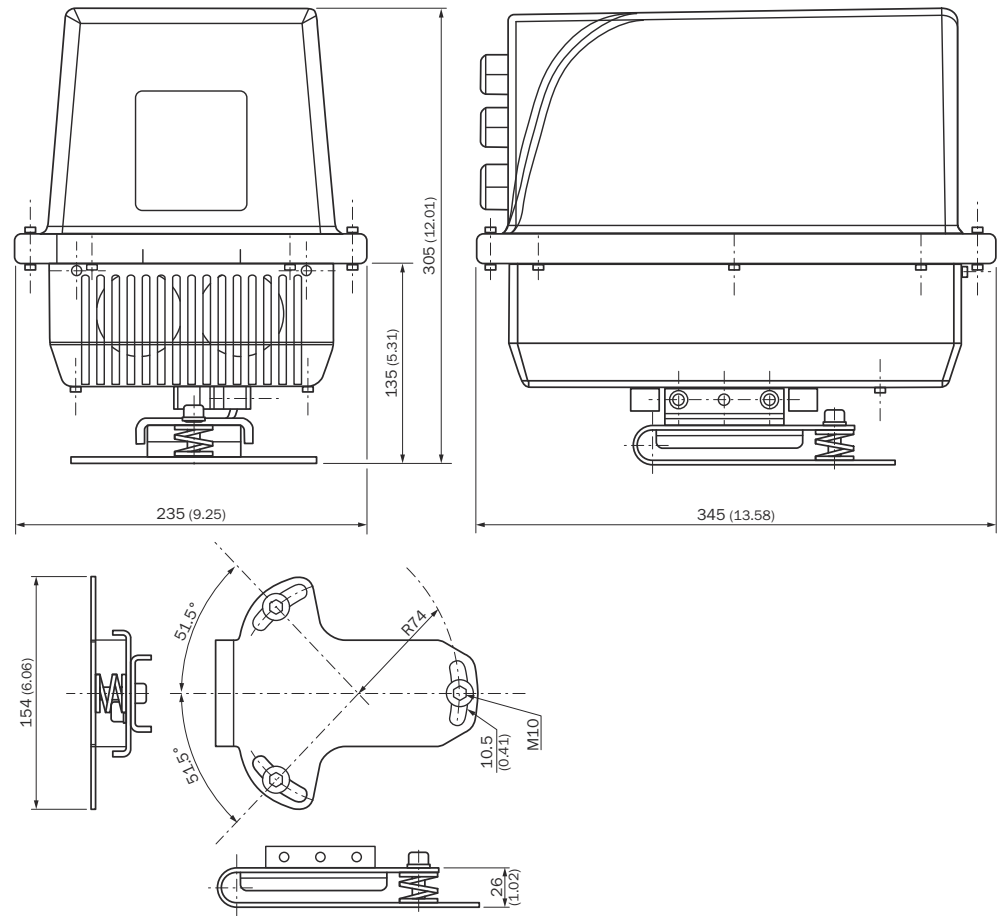| Description	Alignment bracket including fastening accessories
Type	BEF-AH-DX100
Part number	2058653
Material	Galvanized sheet steel

14.2 Cooler housing

Figure 26: Cooler housing; unit: mm (inch), decimal separator: period

Table 38: Cooler housing

Description	Cooler housing including sensor-specific adapter plate and BEF-AH-DME alignment bracket (part number: 2027721)
Type	TPCC-Dx100
Part number	6048328
Material	Plastic (polyamide 6)
Weight	7.5 kg
Ambient temperature, operation	–40 ... +75 °C (+80 °C for max. 1 h)
Ambient temperature storage	–40 ... +50 °C
Supply voltage	24 ... 30 V DC
Current consumption	11 A at 24 V DC; start-up current max. 15 A at 24 V DC
Enclosure rating	IP55 (horizontal mounting) IP54 (vertical mounting)

15 Annex

15.1 Menu structure
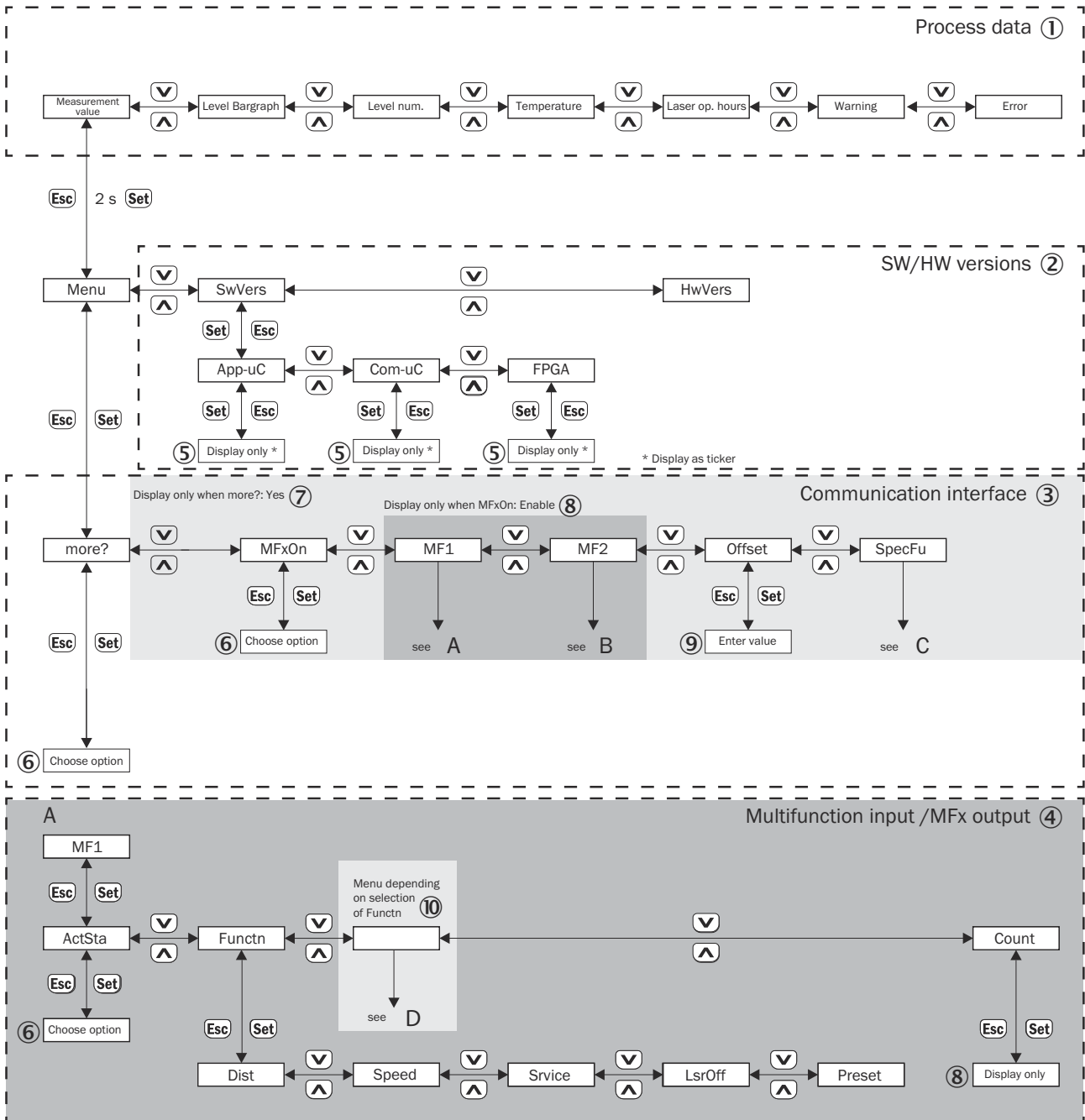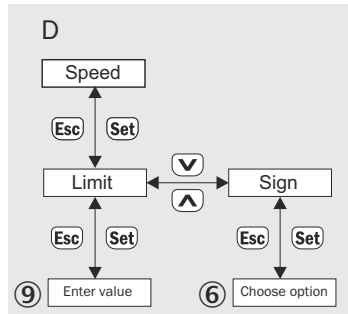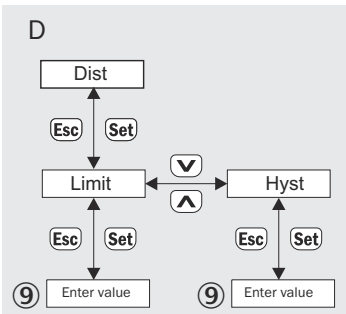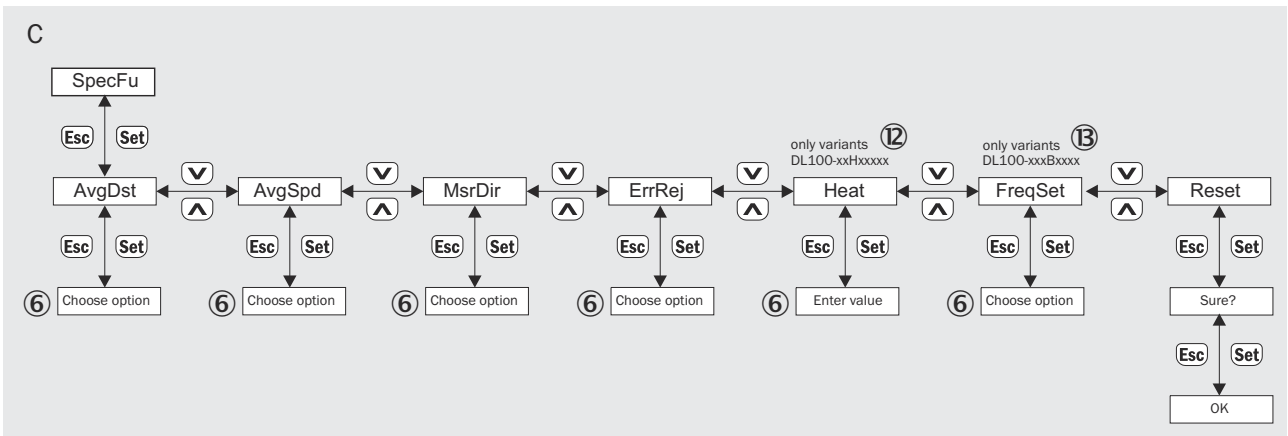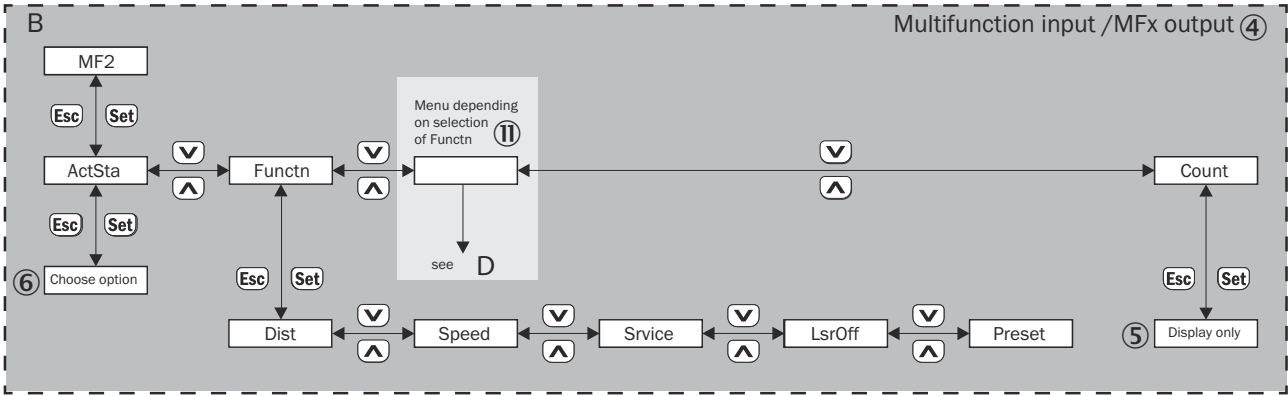

① Process data
② Software and hardware versions
③ Interface
④ Multifunctional input/multifunctional outputs
⑤ Indication only
⑥ Select option
⑦ Only displayed if **more?** = **Yes**
⑧ Only displayed if **MFxOn** = **Enable**
⑨ Adjust the value

⑩ The menu displayed depends on the selected function (**Functn**) see D

B — Multifunction input /MFx output ④

MF2

Esc Set

ActSta ←→ Functn ←→ Menu depending on selection of Functn ⑪ ←→ Count

⑥ Choose option

Esc Set

see D

Dist ←→ Speed ←→ Srvice ←→ LsrOff ←→ Preset ←→ ⑤ Display only

C

SpecFu

Esc Set

AvgDst ←→ AvgSpd ←→ MsrDir ←→ ErrRej ←→ Heat ⑫ only variants DL100-xxHxxxxx ←→ FreqSet ⑬ only variants DL100-xxxBxxxx ←→ Reset

⑥ Choose option | ⑥ Choose option | ⑥ Choose option | ⑥ Choose option | ⑥ Enter value | ⑥ Choose option | Sure?

Esc Set

OK

D

Dist

Esc Set

Limit ←→ Hyst

⑨ Enter value ⑨ Enter value

D

Speed

Esc Set

Limit ←→ Sign

⑨ Enter value ⑥ Choose option

D

Preset

Esc Set

sPrset

Esc Set

⑨ Enter value

D

Srvice

Esc Set

WrnLsr ←→ WrnLvl ←→ WrnTmp ←→ WrnPlb ←→ NotRdy ←→ Heat

⑥ Choose option | ⑥ Choose option | ⑥ Choose option | ⑥ Choose option | ⑥ Choose option | ⑥ Choose option

④ Multifunctional input/multifunctional output

⑤ Display the value

⑥ Selecting an option

⑨ Adjust the value

⑪   The menu displayed depends on the selected function (**Functn**) see D

⑫   For the variants DL100-xxHxxxxx only

⑬   For the variants DL100-xxxBxxxx only

15.2   Declarations of conformity and certificates

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

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

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

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

Australia
Phone +61 (3) 9457 0600
1800 33 48 02 – tollfree
E-Mail sales@sick.com.au

Austria
Phone +43 (0) 2236 62288-0
E-Mail office@sick.at

Belgium/Luxembourg
Phone +32 (0) 2 466 55 66
E-Mail info@sick.be

Brazil
Phone +55 11 3215-4900
E-Mail comercial@sick.com.br

Canada
Phone +1 905.771.1444
E-Mail cs.canada@sick.com

Czech Republic
Phone +420 234 719 500
E-Mail sick@sick.cz

Chile
Phone +56 (2) 2274 7430
E-Mail chile@sick.com

China
Phone +86 20 2882 3600
E-Mail info.china@sick.net.cn

Denmark
Phone +45 45 82 64 00
E-Mail sick@sick.dk

Finland
Phone +358-9-25 15 800
E-Mail sick@sick.fi

France
Phone +33 1 64 62 35 00
E-Mail info@sick.fr

Germany
Phone +49 (0) 2 11 53 010
E-Mail info@sick.de

Greece
Phone +30 210 6825100
E-Mail office@sick.com.gr

Hong Kong
Phone +852 2153 6300
E-Mail ghk@sick.com.hk

Hungary
Phone +36 1 371 2680
E-Mail ertekesites@sick.hu

India
Phone +91-22-6119 8900
E-Mail info@sick-india.com

Israel
Phone +972 97110 11
E-Mail info@sick-sensors.com

Italy
Phone +39 02 27 43 41
E-Mail info@sick.it

Japan
Phone +81 3 5309 2112
E-Mail support@sick.jp

Malaysia
Phone +603-8080 7425
E-Mail enquiry.my@sick.com

Mexico
Phone +52 (472) 748 9451
E-Mail mexico@sick.com

Netherlands
Phone +31 (0) 30 204 40 00
E-Mail info@sick.nl

New Zealand
Phone +64 9 415 0459
0800 222 278 – tollfree
E-Mail sales@sick.co.nz

Norway
Phone +47 67 81 50 00
E-Mail sick@sick.no

Poland
Phone +48 22 539 41 00
E-Mail info@sick.pl

Romania
Phone +40 356-17 11 20
E-Mail office@sick.ro

Singapore
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Slovakia
Phone +421 482 901 201
E-Mail mail@sick-sk.sk

Slovenia
Phone +386 591 78849
E-Mail office@sick.si

South Africa
Phone +27 10 060 0550
E-Mail info@sickautomation.co.za

South Korea
Phone +82 2 786 6321/4
E-Mail infokorea@sick.com

Spain
Phone +34 93 480 31 00
E-Mail info@sick.es

Sweden
Phone +46 10 110 10 00
E-Mail info@sick.se

Switzerland
Phone +41 41 619 29 39
E-Mail contact@sick.ch

Taiwan
Phone +886-2-2375-6288
E-Mail sales@sick.com.tw

Thailand
Phone +66 2 645 0009
E-Mail marcom.th@sick.com

Turkey
Phone +90 (216) 528 50 00
E-Mail info@sick.com.tr

United Arab Emirates
Phone +971 (0) 4 88 65 878
E-Mail contact@sick.ae

United Kingdom
Phone +44 (0)17278 31121
E-Mail info@sick.co.uk

USA
Phone +1 800.325.7425
E-Mail info@sick.com

Vietnam
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Detailed addresses and further locations at **www.sick.com**

SICK Sensor Intelligence.

SICK AG | Waldkirch | Germany | www.sick.com