OPERATING INSTRUCTIONS

DT1000 and DL1000

Distance sensor

SICK
Sensor Intelligence.

Described product

DT1000/DL1000

Manufacturer

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Original document

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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 operating 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 Further information

NOTE

Further documentation for the device can be found on the online product page at:

- www.sick.com/Dx1000

There, additional information has been provided depending on the product, such as:

- Model-specific online data sheets for device types, containing technical data, dimensional drawing, and specification diagrams
- EU declaration of conformity and certificates for the product family
- Dimensional drawings and 3D CAD dimension models of the device types in various electronic formats
- Other publications related to the devices described here
- Publications dealing with accessories

2 Safety information

2.1 Intended use

The Dx1000 distance sensor is an opto-electronic measuring device and is used for optical, non-contact distance measurement of objects.

The distance sensor is used for the detection of distances between the distance sensor and a measuring object. The measuring object can be a natural object (DT1000 product variant) or a suitable (retro-reflective) reflector (DL1000 product variant). The required optical properties of the measuring object are specified in the technical data section of this document.

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 these operating instructions must be strictly observed.
- Shut down the product immediately in case of damage.

2.3 Cybersecurity

To protect against cybersecurity threats, it is necessary to continuously monitor and maintain a comprehensive and holistic cybersecurity concept. A suitable concept comprises organizational, technical, procedural, electronic, and physical levels of defense and provides suitable measures for different types of risks. SICK's products and solutions must be viewed as a component of this concept.

Information on Cybersecurity can be found at: www.sick.com/psirt .

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.

This product documentation refers to the following qualification requirements for the various activities associated with the device:

- **Instructed personnel** have been briefed by the operator about the tasks assigned to them and about potential dangers arising from improper action.
- **Skilled personnel** have the specialist training, skills, and experience, as well as knowledge of the relevant regulations, to be able to perform tasks delegated to them and to detect and avoid any potential dangers independently.
- **Electricians** have the specialist training, skills, and experience, as well as knowledge of the relevant standards and provisions, to be able to carry out work on electrical systems and to detect and avoid any potential dangers independently. The electrician must comply with the provisions of the locally applicable work safety regulation.

The following qualifications are required for various activities:

Table 1: 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 particular hazards

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

The device is equipped with two laser sources:

- Measurement laser (not visible to the human eye)
- Alignment laser (visible to the human eye)
  Both lasers are classified as class 1 lasers based on the IEC 60825-1:2014 standard. The requirements for qualifying as a class 1 laser are met even if both lasers are operated simultaneously. Complies with 21 CFR 1040.10 and 1040.11 except for tolerances according to “Laser Notice No.50” dated June 24, 2007.

CAUTION
Optical radiation: Laser class 1

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

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

CAUTION
Hot surface!

The device is equipped with a heater. The viewing window can become hot when the heater is operating.

- When performing work directly on the device (e.g. cleaning, disassembly), switch off the device if necessary and allow it to cool down.

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 visible red laser and a non-visible infrared laser are installed in the device. This combination corresponds to laser class 1. The housing is labeled with a warning sign.

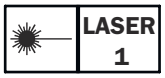


Figure 1: Warning sign on the device: LASER RADIATION: laser class 1

A heater is installed in the device. The housing is labeled with a warning sign.

Figure 2: Warning sign on the device: HOT SURFACE

2.9 UL conformity

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

For more information visit:

- www.sick.com/Dx1000

CAUTION
Hazardous radiation!

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

3 Product description

3.1 Scope of delivery

Included in scope of delivery:

- Distance sensor
- Protective caps for connections (on the device)
- Printed Safety Notes, multilingual (brief information and general safety notes)

With special variants, where optional extras have been ordered, or owing to the latest technical changes, the actual scope of delivery may vary from the features and illustrations shown here.

3.2 Product characteristics

The distance sensor consists of the optics, a sender/receiver unit and an evaluation unit.

The device emits invisible, infrared laser beam pulses. The receiver receives the light reflected from a measuring object (=echo). The evaluation electronics determines the distance between the sensor and the measuring object using time-of-flight measurement.

The device supports two measuring modes.

- Axial object tracking: Measuring object moves along the laser beam.
- Lateral entry of the object: Measuring object moves perpendicular to the laser beam.

Parameter presettings simplify device configuration for the respective measuring mode.

The achievement of configurable switching limits for the distance values, the speed of the measuring object and the signal level can be monitored using digital outputs. The device also offers a wide range of options for transmitting measurement and device data to a connected controller using the communication interfaces. The analog output converts the distance value into a 4 mA to 20 mA current output signal proportional to the distance.

A visible alignment laser facilitates alignment of the device with the measuring object.

The measurement technology is designed for indoor and outdoor applications. For such applications, the device must be protected from environmental factors, "Mounting instructions", page 32. The protective housing, available as an option, can be used for this purpose.

Measured distance values can be visualized and parameter settings can be made using the graphical touch display. Alternatively, the device can be parameterized via the thethe SOPAS ET user interface (PC, via Ethernet), the RS-422interface, or via the Ethernet interface.

3.3 Design

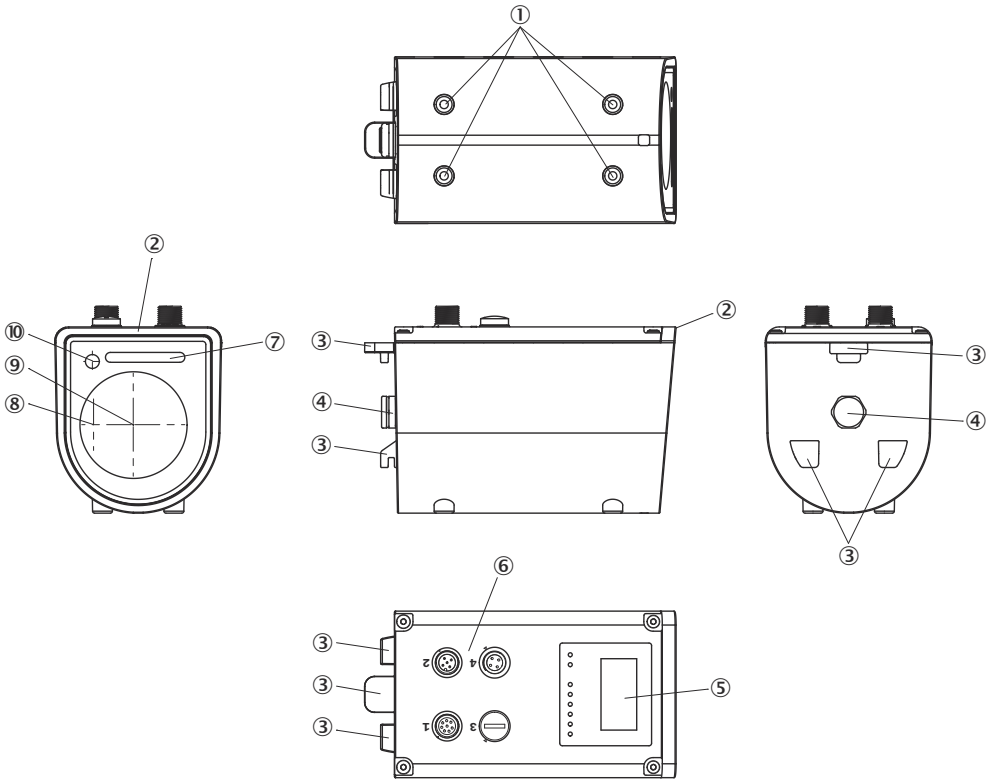


Figure 3: Dx1000 design

① Mounting thread M5 x 6
② Distance measurement zero point
③ Mounting points for the alignment bracket (accessory)
④ Pressure compensation element
⑤ Touch display
⑥ Electrical connection:

1 Power/RS-422/SSI

2 Auxilliary

3 not assigned, do not remove (glued) protection cap!

4 Ethernet

⑦ Status indicator
⑧ Measurement laser optical axis
⑨ Receiver optical axis
⑩ Alignment laser optical axis

3.4 Product ID

Type label

The following information can be read off the device from the type label:

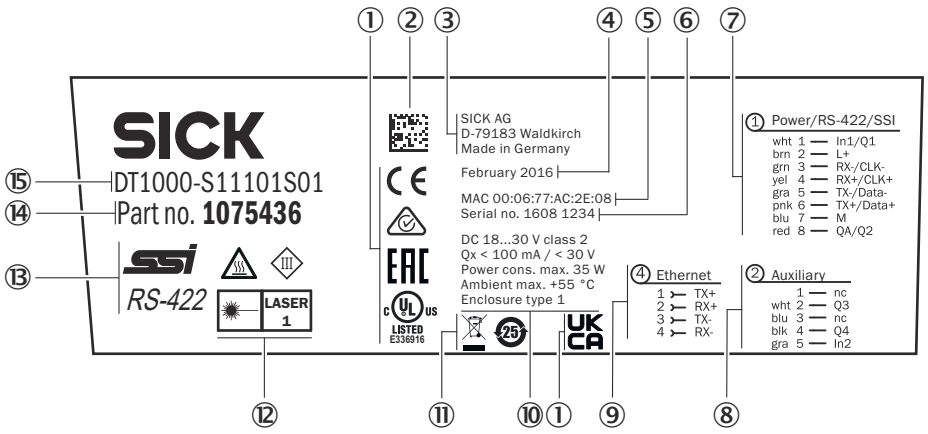


Figure 4: Dx1000 type label (example)

① Conformity mark
② 2D code with part number and serial number
③ Manufacturer
④ Month and year of manufacture
⑤ MAC address
⑥ Serial number
⑦ Pin assignment connection 1
⑧ Pin assignment connection 2
⑨ Pin assignment connection 4
⑩ Electrical data and environmental information
⑪ Mark according to electric device guidelines
⑫ Warning sings, protection class label
⑬ Interfaces
⑭ Part number
⑮ Type code

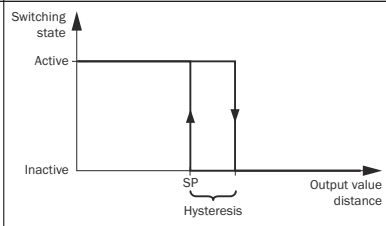
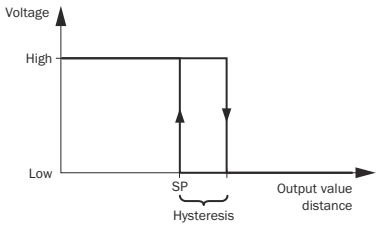
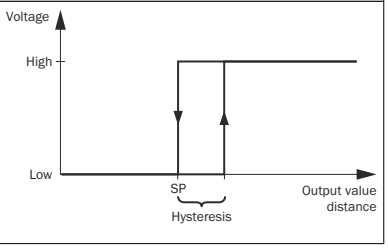
Device display

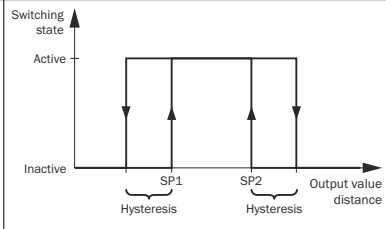
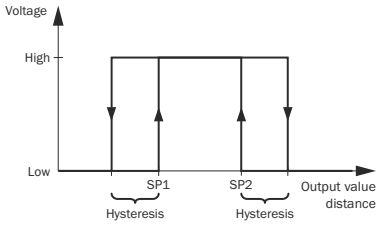
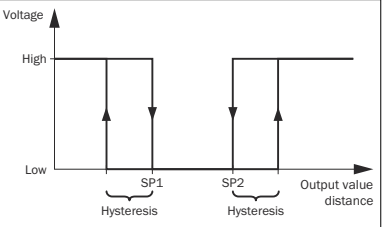
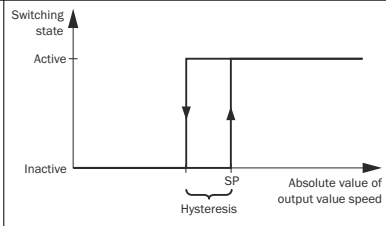
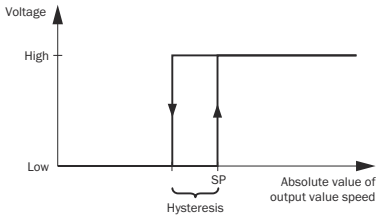
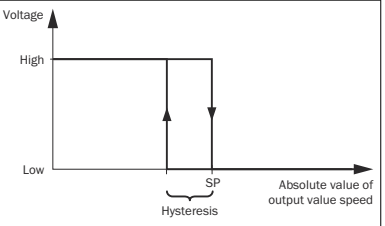
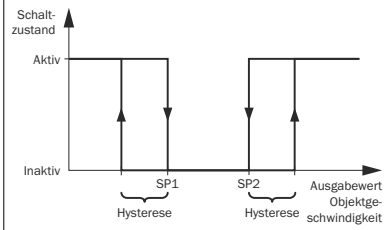
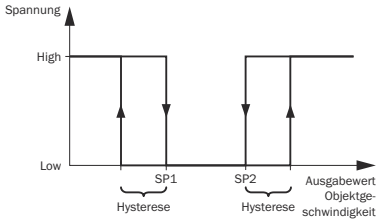
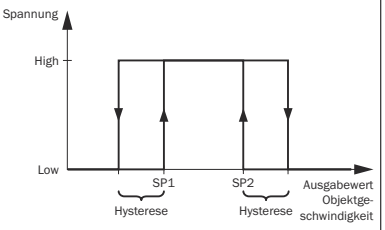
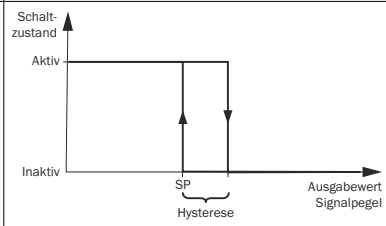
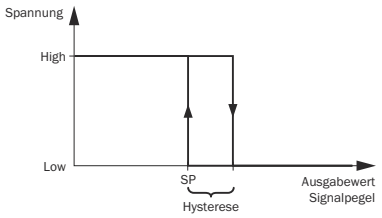
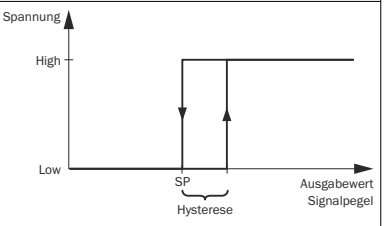
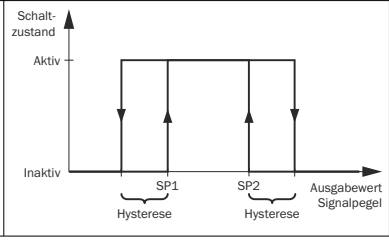
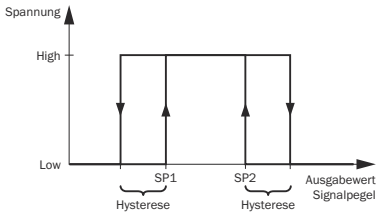
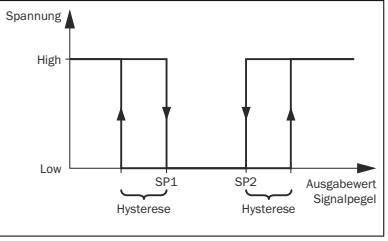
The following information can be called up using the info menu on the device display:

- Type code
- Part number, serial number
- Interface version, firmware verification, firmware creation date
- Hardware version

3.5 Switching functions

Table 2: Overview of switching functions

Switching function	Switching state	Voltage at Q_i at active state = High	Voltage at Q_i at active state = Low
Switching point for distance value (distance to object)			

Switching function	Switching state	Voltage at Q_i at active state = High	Voltage at Q_i at active state = Low
Switching window for distance value			
Switching point for the object speed value			
Switching window for object speed value			
Switching point for signal level			
Switching window for signal level			

3.6 Measured value technology

After application of the supply voltage and initialization, the device is ready for measurement.

The quality of the measured values in relation to noise and reliability can be optimized in line with the given application. The following parameters are available here.

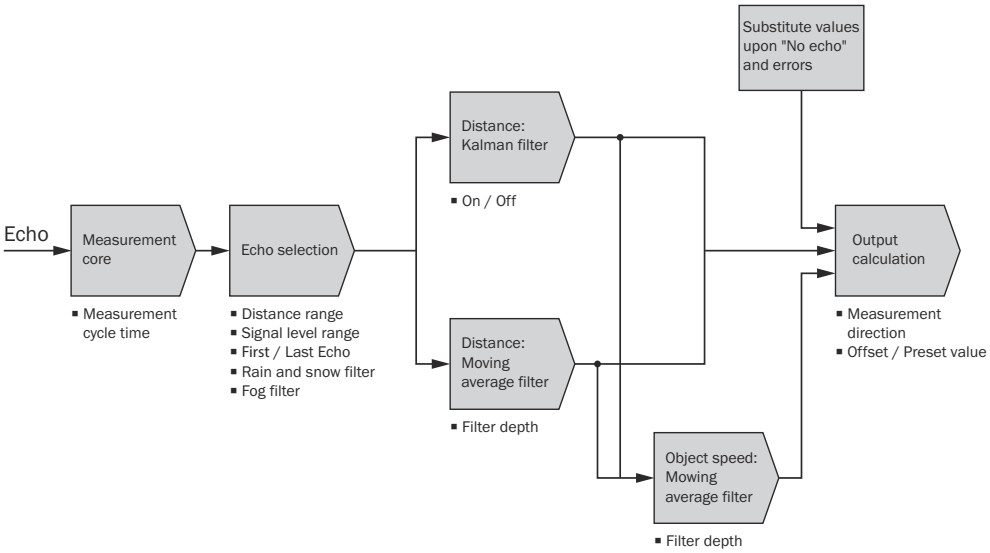


Figure 5: Measured value technology

Measurement cycle time

Increasing the measurement cycle time causes a rise in sensor detectability. A measured value can thus be created from very low signal strengths.

In product variant DT1000, the scalability of the range results from this: the longer the set measurement cycle time, the larger the range of the sensor, see figure 31, page 106.

For more information on the measurement cycle time, see "Defining the measurement cycle time", page 57.

Signal level range

Table 3: Minimal signal level for output of measured values, in distance range 0.2 m ... 20 m

Fog filter	Signal level
Off	500
On	1300

Table 4: Minimum signal level for output of measured values, in distance range > 20 m

Measurement cycle time [ms]	Signal level
1	300
4	125
16	70
64	30
128	20

Rain and snow filter

The measurement certainty with precipitation can be increased using the connectible rain and snow filter.

For more information on the rain and snow filter, see "Configuring the rain and snow filter", page 58.

Distance averaging filter

The distance averaging filter carries out a moving averaging method of the distance value.

For more information on the distance averaging filter, see "Configuring the distance averaging filter", page 59.

Fog filter

The measurement certainty with fog can be increased using the connectible fog filter, "Activating/deactivating the fog filter", page 59.

Kalman filter

The Kalman filter filters the distance and speed value based on a mathematical status model.

For more information about the Kalman filter: see "Activating/deactivating the Kalman filter", page 60.see "Activating/deactivating the Kalman filter", page 60.

Speed filter

The speed filter carries out a moving averaging method of the speed value.

For more information about the speed filter: see "Configuring the speed filter", page 60.see "Configuring the speed filter", page 60.

3.7 Interfaces

3.7.1 Signal inputs/outputs

Table 5: Overview of input/output signals

Signal	Type	Designation
1	Digital input/Digital output (switchable)	In1/Q1
2	Analog output/Digital output (switchable)	QA/Q2
3	Digital output	Q3
4	Digital output	Q4
5	Digital input	In2

3.7.2 SSI (synchronous serial interface)

The SSI interface makes possible serial data transmission of the distance value or of the distance value combined with the status information. Clock and data are transferred over the interface. The data is transferred upon request from the control system. For this purpose, the connected control unit applies a pulse sequence to the receiving input of the measuring device. At each positive pulse edge, a data bit is pushed onto the measuring device's transmission line. This starts with the highest-value bit. There is a pause of at least 30 µs between two pulse sequences. The cycle time and transmission rate can be adjusted in wide limits on the control side. The bit pulse is between 70 kHz and 500 kHz and is dependent on the length of cable, see "Wiring instructions", page 42.

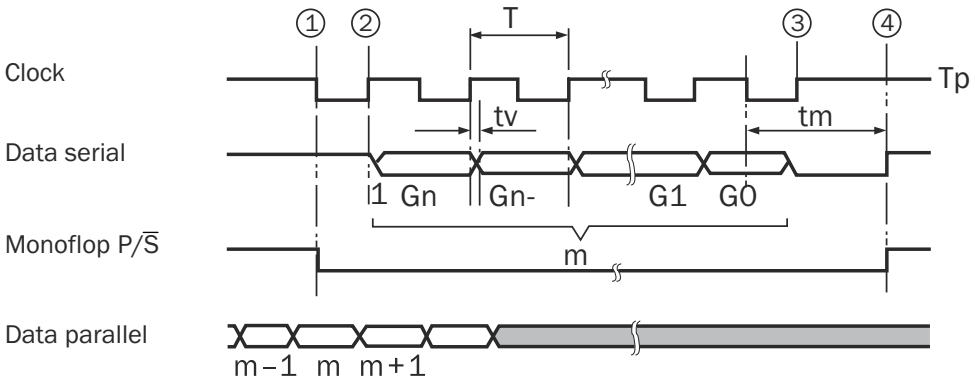


Figure 6: Pulse diagram

Gn Most significant bit in the Gray code

G0 Least significant bit in the Gray code

m Stored parallel information

tm Monoflop time 20 µs

tv Delay time: First clock max. 540 ns, all further clocks max. 360 ns

T Period duration of a clock signal

Tp Clock pause

Depending on the set SSI coding ("Defining SSI coding", page 85), the SSI telegram is structured according to the following tables. For more information on the SSI status bits, see table 35, page 101.

Table 6: Gray 24 or binary 24: 24 gray or binary measured value bit

MSB													LSB
Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	...	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
M24*	M23	M22	M21	M20	M19	...	M7	M6	M5	M4	M3	M2	M1

* M = Measured value bit

Table 7: Gray 24+1 or binary 24+1: 24 gray or binary measured value bit +1 error bit (binary)

MSB													LSB
Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	...	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
M24	M23	M22	M21	M20	M19	...	M6	M5	M4	M3	M2	M1	S1
													DE, AE

1) M = Measured value bit
2) S = Status bit
3) DE = Device error, AE = Application error

Table 8: Gray 24+8 or binary 24+8: 24 gray or binary measured value bit +8 status bit (binary)

MSB															LSB
Bit31	Bit30	Bit29	Bit28	...	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
M24	M23	M22	M21	...	M4	M3	M2	M1	S8	S7	S6	S5	S4	S3	S2	S1
									DE	AE	DW	AW	Q4	Q3	Q2	In1/ Q1

1) M = Measured value bit
2) S = Status bit
3) DE = Device error
4) AE = Application error
5) DW = Device warning
6) AW = Application warning
7) Digital output switching state
8) Digital output/Digital input state (depending on configuration)

Table 9: Gray 25 or binary 25: 25 gray or binary measured value bit

MSB													LSB
Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	...	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
M25*	M24	M23	M22	M21	M20	...	M7	M6	M5	M4	M3	M2	M1

* M = Measured value bit

3.7.3 RS-422 interface

The serial interface makes it possible to read out the measured values and other defined operating data and transmit parameter data to the device. All data is transmitted as ASCII characters. The syntax of the communication protocol corresponds to the specifications of the SICK SOPAS CoLa A protocol, see "Commands", page 22 .

As an option, the device can be configured so that distance values as well as selected combined data is output in a continuous data stream (see table 11, page 22) or output on request.

Two different protocol types are available for continuous output: “CRLF” and “STX/ETX”. This syntax of this continuous data is based on the DL100 and DME5000 SICK products.

The “STX/ETX” protocol type is available for output if needed, see "Data in requirement mode", page 24.

The factory presetting of the Dx1000 is:

- Protocol type: CRLF
- Output of measured values: on request
- Baud rate: 115200 Bit/s (115K2), 8n1 with a resolution of 1 mm

3.7.3.1 Protocol types and data for continuous output

Depending on the selected protocol type, the device transmits a continuous data stream, as shown below: The data fields have the length specified in table 11 and are filled out with leading zeros if necessary.

The ASCII characters of the number values such as the distance value are coded in decimals. An exception is the status double word, whose ASCII characters are coded as hexadecimals.

- CRLF protocol type:
  The data fields are completed by the non-displayable ASCII characters <CR> (0x0D) and <LF> (0x0A). These also act as separators in the data stream.
- STX/ETX protocol type:
  The data fields are integrated in the non-displayable ASCII characters <STX> (0x02) and <ETX> (0x03). The first four characters of the data field have a constant pre-assignment for compatibility reasons.

Table 10: Protocol structure and output mode

Protocol type	Protocol structure (example)	Output mode
CRLF	`<Data field><CR><LF>`	Continuous
STX/ETX	`<STX><data field><ETX>`	Continuous

NOTE
Non-volatile storage is possible for the selected protocol type and the mode for continuous output. The device then automatically begins continuous data output according to the saved settings after switching on, see "Special functions", page 25.

The following data can be output via the continual output:

Table 11: Data for continuous output

Designation	CRLF protocol structure	STX/ETX protocol structure
Distance (resolution according to setting)	<[sign]><7*[0...9]><CR><LF> Example **+1800 mm**: <0001800<CR><LF>	<STX>0322<[sign]><7*[0...9]><ETX> Example **+1800 mm**: <STX>0322+0001800<ETX>
Distance + speed (resolution of distance + speed according to setting)	<[sign]><7*[0...9]><[sign]><5*[0...9]><CR><LF> Example **+1800 mm or +2000 mm/s**: <0001800+02000<CR><LF>	<STX>0324<[sign]><7*[0...9]><[sign]><5*[0...9]><ETX> Example **+1800 mm or +2000 mm/s**: <STX>0324+0001800+02000<ETX>
Distance + status Status double word is coded in hexadecimals: 32 Bit (8 ASCII character), structure "Troubleshooting", page 100	<[sign]><7*[0...9]>_<8*[0...F]><CR><LF> Example **+1800 mm or status bit 20, 15, 14 and 8 active**: <0001800_0010C100<CR><LF>	<STX>0321<[sign]><7*[0...9]>_<8*[0...F]><ETX> Example **+1800 mm or status bit 20, 15, 14 and 8 active**: <STX>0321+0001800_0010C100<ETX>
Distance + signal level (RSSI)	<[sign]><7*[0...9]>_<5*[0...9]><CR><LF> Example **+1800 mm or 2300 digits**: <0001800_02300<CR><LF>	<STX>0323<[sign]><7*[0...9]_<5*[0...9]><ETX> Example **+1800 mm or 2300 digits**: <STX>0323+0001800_02300<ETX>

The following table shows the maximum possible output rate for continuous data output depending on the data transmission rate, protocol and scope of the output data. If needed, this output rate can be reduced via the “RS-422 output cycle time” parameter.

Table 12: Maximum output rate in milliseconds

Data transmission rate in Bit/s	STX/ETX protocol			CR/LF protocol		
	Distance	Distance + status	Distance + RRS or distance + speed	Distance	Distance + status	Distance + RRS or distance + speed
4800	29.5	48.5	42.0	21.5	40.0	34.0
9600	15.0	24.5	21.5	11.0	20.0	17.0
19200	7.5	12.5	11.0	5.5	10.5	9.0
38400	4.0	6.5	5.5	3.0	5.5	4.5
57600	3.0	4.5	4.0	2.0	3.5	3.0
115200	1.5	2.5	2.0	1.5	2.0	2.0
230400	1.0	1.5	1.5	1.0	1.5	1.0
250000	1.0	1.5	1.0	1.0	1.0	1.0

3.7.3.2 Commands

The following variables or methods can be read, written or executed via the RS-422 interface.

Table 13: Commands and responses

Description	Command	Response
Read	sRN	sRA
Write	sWN	sWA
Method	sMN	sAN

3.7.3.2.1 Setting authorization for parameter change

If device parameters need to be changed, the user must activate the access mode (“log in”). Changes become active when the access mode is set back to “Run” (“log out”).

Log in and log out must be done separately for each parameter. It is not possible to change several parameters with a single login.

Executing a special command is required for permanent saving of the changed parameters before logging out, see "Special functions", page 25.

Previously activated continuous data output is interrupted by the “Activate access mode” function. Continuous data output is restarted with the “Deactivate access mode” function.

Table 14: Syntax: Setting authorization for parameter change

Designation	Syntax
Activate access mode --> Response (0 = error, 1 = success) = “log in"	<STX>sMN SetAccessMode 4 81BE23AA<ETX> <STX>sAN SetAccessMode <[0,1]><ETX>
Deactivate access mode --> Response (1 = success) = “log out	<STX>sMN Run<ETX> <STX>sAN Run <[0,1]><ETX>

1) “81BE23AA” is the hash value of the password at the time of delivery (“service level”) for the “Service” user level. If the password has been changed, the respective hash value must be entered here, see "SOPAS ET configuration software", page 53.

3.7.3.2.2 Continuous output

Table 15: Syntax: Setting contents, protocol and output cycle

Designation	Syntax
Defining contents of continuous output --> Response OK Output Off 0 Distance 1 Distance + speed 2 Distance + status 3 Distance + RSSI 4	<STX>sWN rs422PeriodicOutputContent <[0...4]><ETX> <STX>sWA rs422PeriodicOutputContent<ETX>
Select STX/ETX protocol -> Response OK	<STX>sWN rs422PeriodicOutputFormat 0<ETX> <STX>sWA rs422PeriodicOutputFormat<ETX>
Select CRLF protocol -> Response OK	<STX>sWN rs422PeriodicOutputFormat 1<ETX> <STX>sWA rs422PeriodicOutputFormat<ETX>
Setting output rate in ms -->Response OK Coded in hexadecimals, 0 ... 1000 ms, corresponds to 0...3E8	<STX>sWN rs422PeriodicDuration <[0...3E8]><ETX> <STX>sWA rs422PeriodicDuration<ETX>

3.7.3.2.3 Data in requirement mode

The length of the transmitted process datum depends on the value and is not padded with leading zeros. The maximum length in each case is determined by the specified data type.

Table 16: Syntax: Requesting distance, speed, RSSI, device temperature and device status

Designation	Syntax

Request distance
--> Response
Output is coded in hexadecimals (Dint):
Resolution: 1 mm
Example:
Output `3E8` corresponds to 1000 mm
	`<STX>sRN Distance<ETX>`
	`<STX>sRA Distance <n*[0...F]><ETX>`
	
	`<STX>sRA Distance 3E8<ETX>`

Request speed
--> Response
Output is coded in hexadecimals (Dint):
Resolution: 1 mm/s
Example:
Output `7D0` corresponds to 2000 mm/s
Output `FFFFF830` corresponds to -2000 mm/s
	`<STX>sRN Velocity<ETX>`
	`<STX>sRA Velocity <n*[0...F]><ETX>`
	
	`<STX>sRA Velocity 7D0<ETX>`
	
	`<STX>sRA Velocity FFFFF830<ETX>`

Requesting signal level (RSSI)
--> Response
Output is coded in hexadecimals (Dint).
Example:
Output `1388` corresponds to 5000
	`<STX>sRN RSSI<ETX>`
	`<STX>sRA RSSI <n*[0...9]><ETX>`
	
	`<STX>sRA RSSI 1388<ETX>`

Device temperature (°C)
--> Response
Output is coded in hexadecimals (Sint).
Example:
Output `1F` corresponds to 31 °C
Output `F6` corresponds to -10 °C
	`<STX>sRN deviceTemperature<ETX>`
	`<STX>sRA deviceTemperature <n*[0...F]><ETX>`
	
	`<STX>sRA deviceTemperature 1F<ETX>`
	`<STX>sRA deviceTemperature F6<ETX>`

Designation	Syntax
Requesting device status double word --> Response Example: Hexadecimal: 439C Binary (Bit 31...0): 0000 0000 0000 0000 31 0100 0011 1001 1100 15 0 In this example, the leading "0000" from "0000439C" is not transmitted in the hexadecimal string. Status word structure: see "Troubleshooting", page 100	<STX>sRN deviceStatusWord<ETX> <STX>sRA deviceStatusWord <n* [0…F]><ETX> <STX>sRA deviceStatusWord 439C<ETX>

3.7.3.2.4 Special functions

Table 17: Syntax: Special functions

Designation	Syntax
Save parameter permanently --> Response (1 = success)	<STX>sMN mEEwriteall<ETX> <STX>sAN mEEwriteall <[0, 1]><ETX>
Measurement laser off --> Response (1 = success)	<STX>sMN disableMeasurementLaser<ETX> <STX>sAN disableMeasurementLaser <[0, 1]><ETX>
Measurement laser on --> Response (1 = success)	<STX>sMN enableMeasurementLaser<ETX> <STX>sAN enableMeasurementLaser <[0, 1]><ETX>
Alignment laser off --> Response (1 = success)	<STX>sMN disablePilotLaser<ETX> <STX>sAN disablePilotLaser <[0, 1]><ETX>
Alignment laser on --> Response (1 = success)	<STX>sMN enablePilotLaser<ETX> <STX>sAN enablePilotLaser <[0, 1]><ETX>
Set heater switch-on temperature --> Response OK (-20 °C ... 20 °C, corresponds to EC ... 14hex)	<STX>sWN heaterSwitchingThreshold <n*[0…F]><ETX> <STX>sWA heaterSwitchingThreshold<ETX>
Read heater switch-on temperature --> Response	<STX>sRN heaterSwitchingThreshold<ETX> <STX>sRA heaterSwitchingThreshold <n*[0…F]><ETX>
Permanently switch the heater on --> Response OK	<STX>sMN switchHeaterOn<ETX> <STX>sAN switchHeaterOn<ETX>
Permanently switch the heater off --> Response OK	<STX>sMN switchHeaterOff<ETX> <STX>sAN switchHeaterOff<ETX>
Heater automatic mode --> Response OK	<STX>sMN switchHeaterAuto<ETX> <STX>sAN switchHeaterAuto<ETX>

Designation	Syntax
Writing preset values --> Response OK Value coded in hexa-decimals, unit in mm, -1500 m ... 1500 m, corresponds to FFE91CA0 ... 16E360, note: 32 bit!)	<STX>sWN preset <n*[0…F]><ETX> <STX>sWA preset<ETX>
Read preset --> Response OK	<STX>sRN preset<ETX> <STX>sRA preset <n* [0...F]><ETX>
Activating preset --> Response Distance output value is set to the preset value for the current distance	<STX>sMN activatePreset<ETX> <STX>sAN activatePreset<ETX>
Setting output to 0 --> Response OK Distance value output is set to 0 for the current distance	<STX>sMN autoZero<ETX> <STX>sAN autoZero<ETX>
Deleting preset value --> Response OK Distance output value corresponds to the real measured value, offset = 0	<STX>sMN resetPreset<ETX> <STX>sAN resetPreset<ETX>
Restart --> Response OK Reboot	<STX>sMN mSCreboot<ETX> <STX>sAN mSCreboot<ETX>
Read out interface version --> Response	<STX>sRN interfaceVersion<ETX> <STX>sRA interfaceVersion B 001.004.019<ETX>
Read out firmware creation date --> Response	<STX>sRN firmwareBuildTime<ETX> <STX>sRA firmwareBuildTime 14 2016/04/19 16:12:23<ETX>
Read out firmware verification key --> Response	<STX>sRN firmwareVerification<ETX> <STX>sRA firmwareVerification 13 1106-0684-9500-0000<ETX>
Reset to factory settings --> Response OK	<STX>sMN resetParamAndReboot<ETX> <STX>sAN resetParamAndReboot <[0, 1]><ETX>

1) The heater can be switched on via SOPAS ET or the RS-422 interface.
When the heater is switched on and the upper or lower temperature warning limit is exceeded, the heater automatically switches to automated mode.

3.7.3.2.5 Examples of command sequences

Switching on continuous, permanent distance value output

Table 18: Example: Switching on continuous, permanent distance value output

To Dx1000 Example: 81BE23AA	<STX>sMN SetAccessMode 4 81BE23AA<ETX>
From Dx1000	<STX>sAN SetAccessMode 1<ETX>
To Dx1000	<STX>sWN rs422PeriodicOutputContent 1<ETX>
From Dx1000	<STX>sAN rs422PeriodicOutputContent<ETX>
To Dx1000	<STX>sMN mEEwriteall<ETX>
From Dx1000	<STX>sAN mEEwriteall 1<ETX>

To Dx1000	<STX>sMN Run<ETX>
From Dx1000	<STX>sAN Run 1<ETX>
Then continuously sent from Dx1000 Example: 5,378 mm, CRLF mode	+0005378<CR><LF> ...

1) "81BE23AA" is the hash value of the password at the time of delivery ("service level") for the "Service" user level. If the password has been changed, the respective hash value must be entered here, see "SOPAS ET configuration software", page 53.

Switching off continuous, permanent distance value output

Table 19: Example: Switching off continuous, permanent distance value output

To Dx1000 Example: 81BE23AA	<STX>sMN SetAccessMode 4 81BE23AA<ETX>
From Dx1000	<STX>sAN SetAccessMode 1<ETX>
Continuous output of Dx1000 stops	
To Dx1000	<STX>sWN rs422PeriodicOutputContent 0<ETX>
From Dx1000	<STX>sAN rs422PeriodicOutputContent<ETX>
To Dx1000	<STX>sMN mEEwriteall<ETX>
From Dx1000	<STX>sAN mEEwriteall 1<ETX>
To Dx1000	<STX>sMN Run<ETX>
From Dx1000	<STX>sAN Run 1<ETX>

1) "81BE23AA" is the hash value of the password at the time of delivery ("service level") for the "Service" user level. If the password has been changed, the respective hash value must be entered here, see "SOPAS ET configuration software", page 53.

Setting preset value to 10 m

Table 20: Example: Setting preset value to 10 m

Designation	Syntax
To Dx1000 Example: 81BE23AA	<STX>sMN SetAccessMode 4 81BE23AA<ETX>
From Dx1000	<STX>sAN SetAccessMode 1<ETX>
To Dx1000	<STX>sWN preset 2710<ETX>
From Dx1000	<STX>sWA preset<ETX>
To Dx1000	<STX>sMN Run<ETX>
From Dx1000	<STX>sAN Run 1<ETX>

1) "81BE23AA" is the hash value of the password at the time of delivery ("service level") for the "Service" user level. If the password has been changed, the respective hash value must be entered here, see "SOPAS ET configuration software", page 53.

Executing preset

Table 21: Example: Executing preset

Designation	Syntax
To Dx1000 Example: 81BE23AA	<STX>sMN SetAccessMode 4 81BE23AA<ETX>
From Dx1000	<STX>sAN SetAccessMode 1<ETX>
To Dx1000	<STX>sMN activatePreset<ETX>
From Dx1000	<STX>sAN activatePreset<ETX>

To Dx1000	<STX>sMN Run<ETX>
From Dx1000	<STX>sAN Run 1<ETX>

1) "81BE23AA" is the hash value of the password at the time of delivery ("service level") for the "Service" user level. If the password has been changed, the respective hash value must be entered here, see "SOPAS ET configuration software", page 53.

3.7.4 Ethernet interface

The Ethernet interface is used for communication by means of configuration software SOPAS ET (see "SOPAS ET configuration software", page 53).

It also enables setting of the device parameters as well as monitoring and control of the device via TCP/IP communication on the customer side.

Measurement data (e.g. distance, speed or signal level values) and operating data (e.g. inside temperature, operating hours or device status) can be transmitted on request or driven by events.

Additional information and a description of communication with the CoLa-A SICK protocol (ASCII values) used with the device can be found in the "Dx1000 Telegram Listing" (English, no. 8021820) technical information publication available at **www.sick.com/Dx1000**.

3.8 Display and operating elements

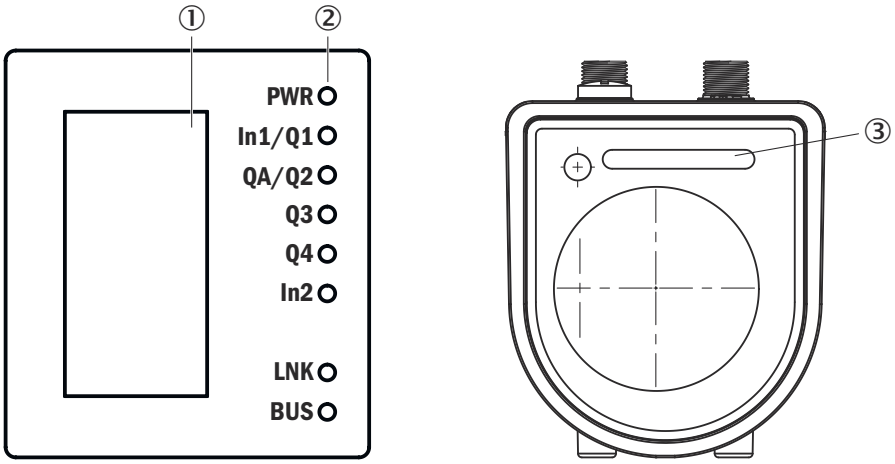


Figure 7: Display and operating elements

① Touch display

② LEDs

③ LED Status indicator

LEDs/LED Status indicator

Table 22: Description of LED displays

LED	Description
LED PWR and LED Status indicator	■ LED off: no operation, no supply voltage connected ■ Green LED: interference-free operation ■ LED flashes orange: Pending warning, see "Troubleshooting", page 100 ■ LED flashes red: Pending error, see "Troubleshooting", page 100
LED In1/Q1	■ LED off: digital output or digital input deactivated ■ Orange LED: digital output or digital input active

LED	Description
LED QA/Q2	■ LED off: digital output deactivated or analog output signal above or below the valid current levels (4 mA ... 20 mA) ■ Orange LED: digital output active or analog output signal within the valid current levels
LED Q3	■ LED off: digital output deactivated ■ Orange LED: digital output active
LED Q4	■ LED off: digital output deactivated ■ Orange LED: digital output active
LED In2	■ LED off: digital input deactivated ■ Orange LED: digital input active
LED LNK	■ LED off: No Ethernet connection available ■ Green LED: Ethernet connection available ■ LED flashes green: Ethernet data transmission active
LED BUS	■ LED off: no serial data traffic available ■ Red LED: serial data only from control, no response from device ■ Green LED: serial data only from device, no request from control (e.g. with continuous RS-422 output) ■ Orange LED: bidirectional serial data traffic

Background illumination of the touch display

Table 23: Description of backlight

Illumination	Description
Off	Normal operation without operation via the touch display (background illumination automatically switches off after 15 minutes).
White	Normal operation with illumination via the touch display.
Alternating orange and white	Pending warning, see "Troubleshooting", page 100
Alternating red and white	Pending error, see "Troubleshooting", page 100

4 Transport and storage

4.1 Transport

For your own safety, please read and observe the following notes:

NOTICE

Damage to the product due to improper transport.

- The device must be packaged for transport with protection against shock and damp.
- Recommendation: Use the original packaging as it provides the best protection.
- Transport should be performed by trained specialist staff only.
- The utmost care and attention is required at all times during unloading and transportation on company premises.
- Note the symbols on the packaging.
- Do not remove packaging until immediately before you start mounting.

4.2 Unpacking

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

NOTE

Connection 3 is not used, the protective cap is stuck shut. To preserve the tightness of the housing, do not loosen or remove the cap.

- Always place the device down on its bottom.

4.3 Transport inspection

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

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

NOTE

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

4.4 Storage

Store the device under the following conditions:

- Do not store outdoors.
- Store in a dry area that is protected from dust.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.

- Storage temperature: see "Technical data", page 103.
- Relative humidity: see "Technical data", page 103.
- 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 32.
2. Select and mount the reflector (only for DL1000) see "Select and mount the reflector (DL1000 only)", page 34.
3. If necessary, mount additional filter, "Mounting instructions", page 32, see "Mounting/Disassembling additional filter (DT1000 only)", page 35.
4. Mount alignment bracket and distance sensor, see "Mounting the alignment bracket and distance sensor", page 38.
5. Make the electrical connection, see "Electrical installation", page 42.
6. Align distance sensor, see "Aligning distance sensor", page 39.

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.
- A weatherproof housing that reliably protects the device from dust, direct sunlight, and precipitation is to be used for mounting outdoors. Information about available protective housing options, "Accessories", page 120.
- The device must be protected from impacts, vibrations, the effect of shocks, and other mechanical and chemical influences.
- A sufficient level of cooling using ambient air/convection and/or heat dissipation through mechanical mounting must be ensured. Observe the permitted operating temperature, see "Ambient data", page 115.
- DT1000: With high-temperature applications (typically > 1,200 °C) when the the “Ambient light” warning or error occurs: use optional additional filter for high-temperature applications (part number 2088511). Observe maximum object temperature, "Performance", page 103.
- Observe the data sheets of the connecting cables in particular in relation to ambient temperature and UV resistance. If necessary, protect the cable when laying.
- Provide a loop in the infeed so water can run off and is not led to the plug connectors.
- Observe the zero point of the distance measurement, "Design", page 15.
- Installation direction: any
- Operation: Operate only when screwed in place or standing with the underside on a stable base, otherwise a risk of tipping exists.
- Measuring object size (DT1000): The performance data specified in the technical data requires the measuring object (natural object) to be at least the size of the light spot and the measuring laser to hit the measuring object completely. Remission: see "Technical data", page 103.
- Measuring object size (DL1000): The performance data specified in the technical data requires the measuring laser completely hit the measuring object (reflector). For distances for which the light spot is larger than the reflector specified for this, the measuring laser must completely hit the reflector.
- The anisotropy of the light spot is to be taken into account particularly in the case of measurement or detection of objects approaching from the side: Mount the distance sensor so that the short light spot axis is parallel to the direction of movement (example: Container stack measurement). This enables the greatest possible repeatability of the measurement or detection of the edge to be achieved.

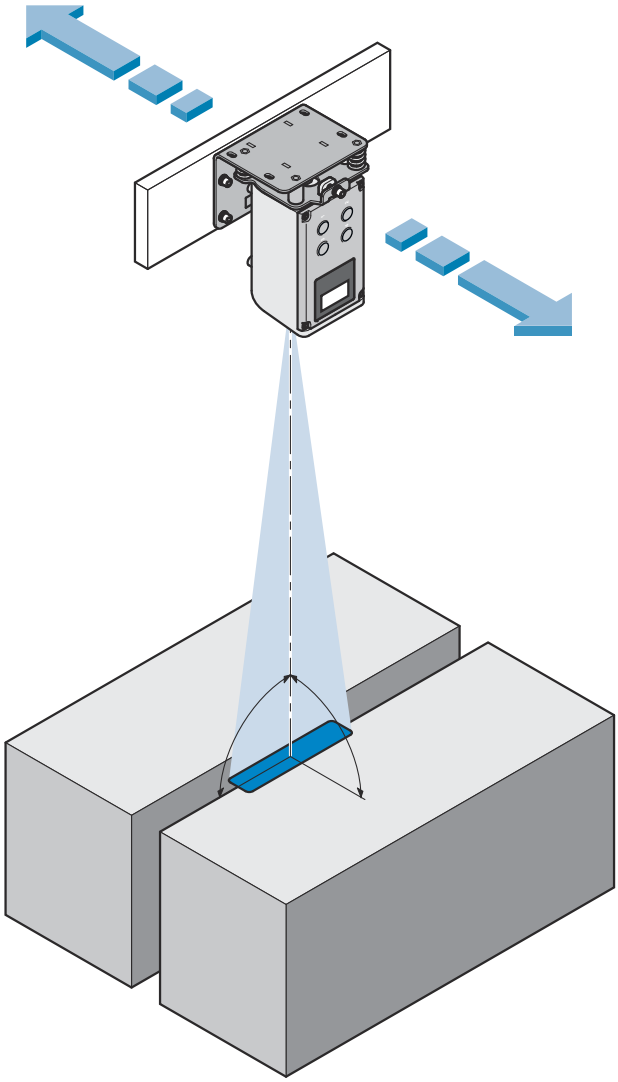


Figure 8: Container stack measurement

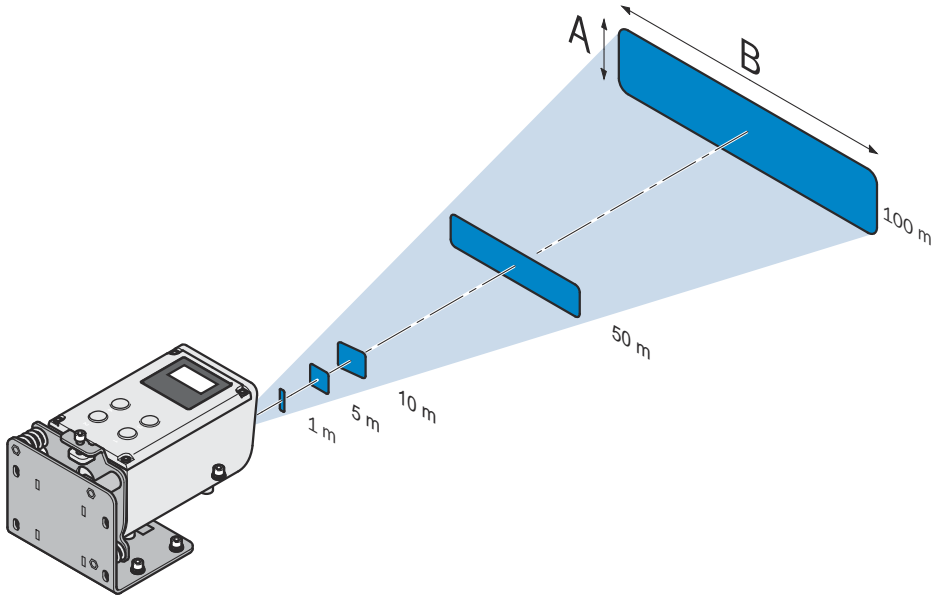


Figure 9: Anisotropy of the light spot

Table 24: Light spot size at different distances

Distance	A x B
1 m	20 mm x 5 mm
5 m	20 mm x 20 mm
10 m	25 mm x 35 mm
50 m	50 mm x 150 mm
100 m	80 mm x 290 mm
200 m	140 mm x 570 mm
1,500 m (DL1000 only)	920 mm x 4,200 mm

From a distance of 10 m, the light spot size can be determined from the angular extension of the emitted light of typically 0.6 mrad x 2.8 mrad.

- A = (0.0006 x distance [mm]) + 20 mm
  Example for 100 m:
  A = (0.0006 x 100,000 mm) + 20 mm = 80 mm
- B = (0.0028 x distance [mm]) + 10 mm
  Example for 100 m:
  B = (0.0028 x 100,000 mm) + 10 mm = 290 mm

- Maintain a sufficient distance to other distance sensors, see "Placement of multiple distance sensors", page 36.

5.3 Select and mount the reflector (DL1000 only)

NOTE
You can find suitable reflectors and suitable reflective tape at www.sick.com/Dx1000.

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).

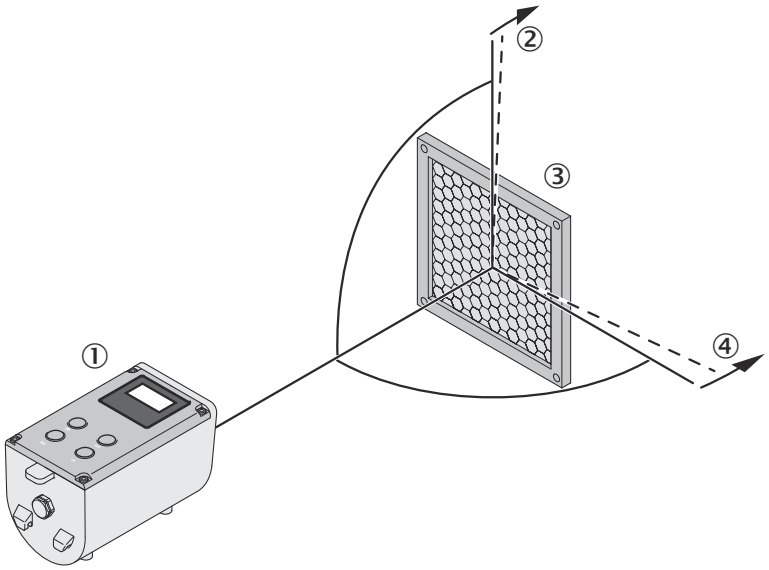


Figure 10: Reflector tilt

① Distance sensor
② Tilt of the vertical axis of the reflector approx. +1°...+3°
③ Reflektor
④ Tilt of the horizontal axis of the reflector approx. +1°...+3°

Avoid shiny surfaces in the measurement area since these cause beam deflections and therefore faulty measurements due to false echoes. False echoes may be able to be suppressed by selecting the suitable “Echo selection” parameter, see "Defining the echo selection", page 61.

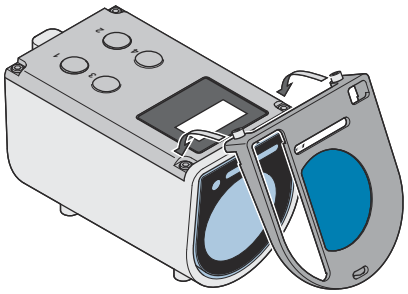
5.4 Mounting/Disassembling additional filter (DT1000 only)

Mounting additional filter

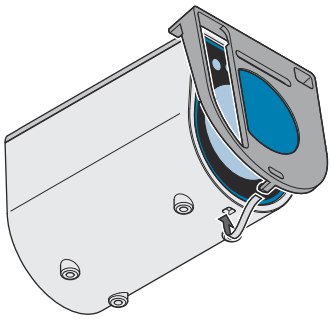
When using the additional filter, the sensing range of the DT1000 is reduced.

As long as there is no fog or steam in the light beam area, deactivating the fog filter set at the factory is recommended.

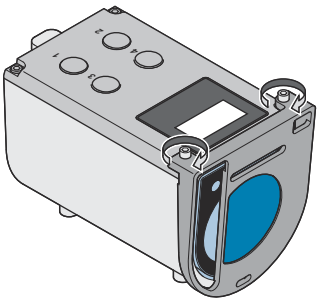
1. Set the additional filter on the upper front edge of the distance sensor so the locking screws of the additional filter lie on the screw heads of the housing screws:



2. Press the additional filter onto the front side of the distance sensor so the snap hook of the additional filter enrages in the recess in the underside of the housing:

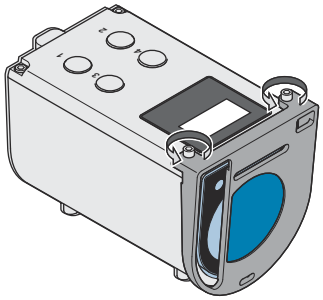


3. Tighten locking screws to fasten the additional filter:

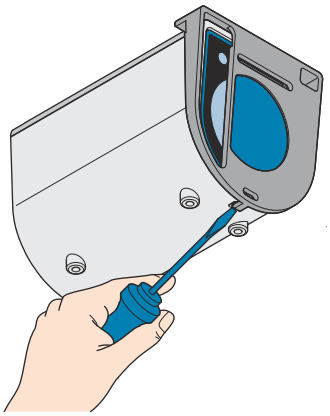


Disassembling additional filter

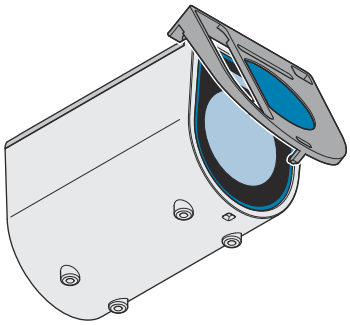
1. Unscrew locking screws:



2. Insert a screwdriver with a thin bald under the snap hook into the recess in the underside of the housing to loosen the snap hook:



3. Remove additional filter upwards:



5.5 Placement of multiple distance sensors

For the DL1000, no particular requirements have to be upheld concerning a minimum distance.

For the DT1000, observe the following information on minimum distances.

Light beams in the same direction

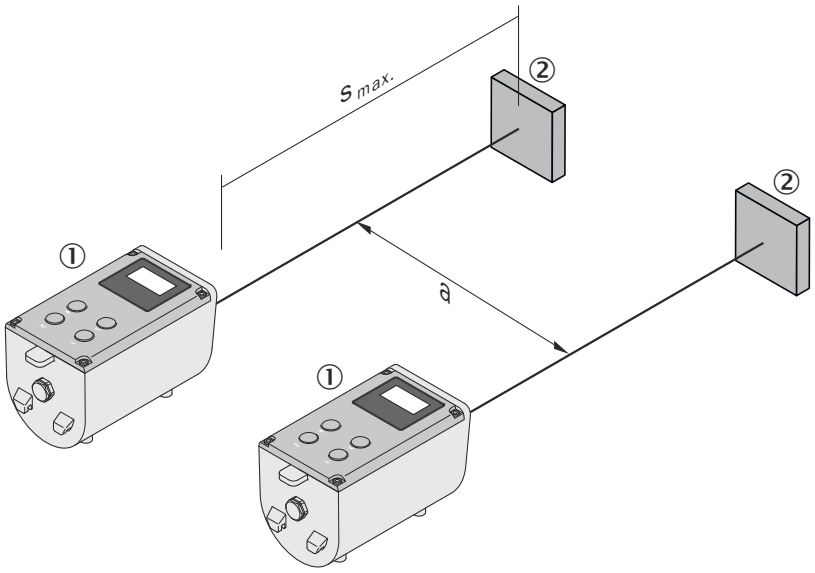


Figure 11: Placement of two DT1000 units with light beams in the same direction

① DT1000
② Measuring object (natural object)
a Minimum distance
s_{max} Maximum measurement distance

Light beams in opposite directions

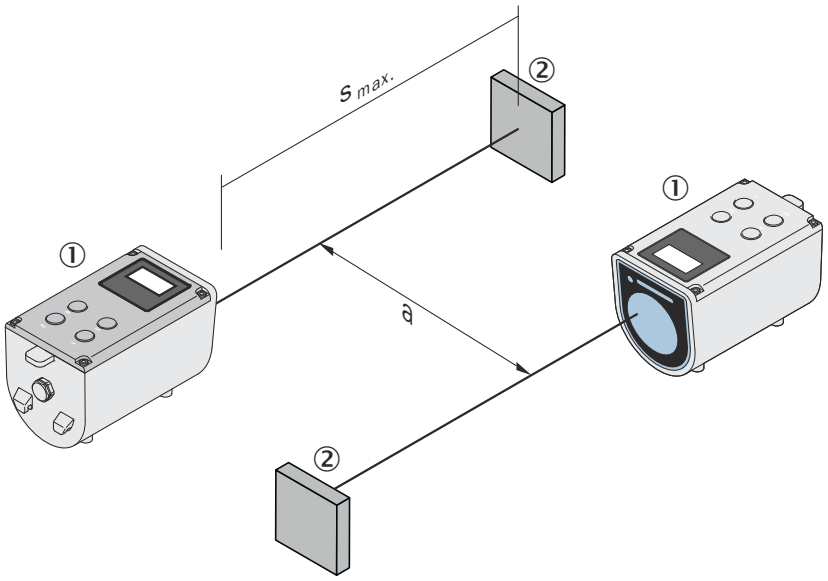


Figure 12: Placement of two DT1000 units with light beams in the opposite direction

① DT1000
② Measuring object (natural object)
a Minimum distance
s_{max} Maximum measurement distance

Formula

$a \geq 0.2\ m + 0.004 \times s_{max}\ [m]$

Example

- s_{max}: 200 m
- Calculation: a ≥ 0.2 m + 0.004 x 200 m = 1 m

5.6 Mounting the alignment bracket and distance sensor

The distance sensor is mounted using the optional alignment bracket BEF-AH-DX1000 (part number 2080392).

1. Mount the alignment bracket above the four slotted holes. The alignment bracket is suitable for mounting on horizontal and vertical surfaces.

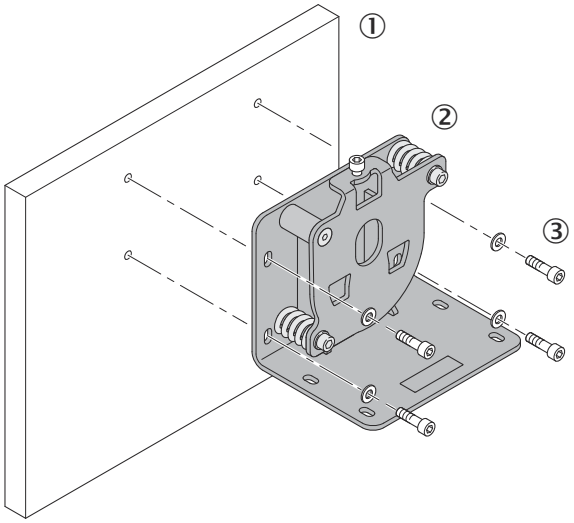


Figure 13: Alignment bracket mounting on vertical surfaces

① Mounting surface
② Alignment bracket
③ Mounting screw, M5 hexagon socket screw

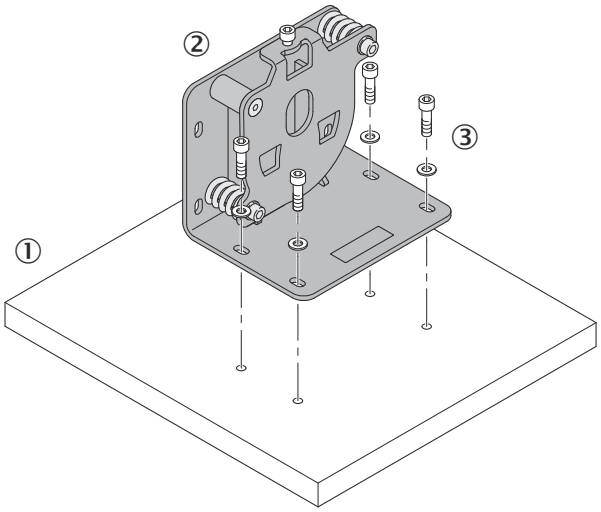


Figure 14: Alignment bracket mounting on horizontal surfaces

① Mounting surface
② Alignment bracket
③ Mounting screw, M5 hexagon socket screw

2. Loosen hexagonal socket screw.
3. Insert the distance sensor into the alignment bracket.

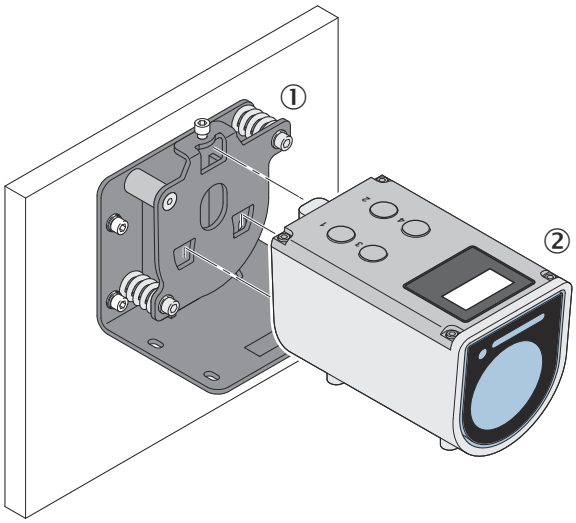


Figure 15: Inserting the distance sensor into the alignment bracket

① Alignment bracket
② Distance sensor

4. Securing the distance sensor with hexagonal socket screw

NOTICE
The hexagon socket screw must be sufficiently tightened (with a torque of at least 3 Nm). Do not apply a lock nut to the hexagon socket screw.

5.7 Aligning distance sensor

When aligning the distance sensor, you can select between two processes, which you can also combine:

NOTE
When using the alignment laser, make sure this laser is located about 30 mm above the measuring laser, "Design", page 15. The max. angular deviation between the measuring laser optics axis and alignment laser optics axis is 4 mrad (4 mm per meter distance from the front device edge).

Switch alignment laser on/off, "Switching the laser on and off", page 79.

If the alignment laser is not visible when aligning on natural surfaces due to a large distance or a bright environment, temporary use of (retro-reflective) reflective tape on the measuring object surface is recommended.

- Alignment using the alignment laser:
  Align the distance sensor so that the light spot of the measuring laser hits the center of the measuring object.
- Alignment using the signal level display in the device display, via SOPAS ET or the RS-422 interface

  Align the distance sensor so that a level maximum is displayed at the expected distance. Recommended at large distances at which the light spot of the alignment laser might no longer be detected with precision.

Table 25: DL1000: Typical signal level on PLxxxDG reflectors

Distance [m]	Signal level		
	PL240DG	PL560DG	PL880DG
1	10500	10500	10500
5	9400	9400	9400
50	7500	7500	7500
100	6200	6200	6200
200	5000	5000	5000
500	1600	3300	3400
1000	850	1500	1850
1500	-	450	800

A step-by-step process is recommended for alignment:

1. Bring the distance sensor and measuring object close together.
2. Align the distance sensor so that the light spot of the measuring laser hits the center of the reflector or the natural object or the level maximum for this distance is displayed.
3. Increase the distance between the distance sensor and measuring object. The light spot must continue to hit the center of the reflector or the natural object or the level maximum for the respective distance must be displayed.

Proceed as follows to align the distance sensor:

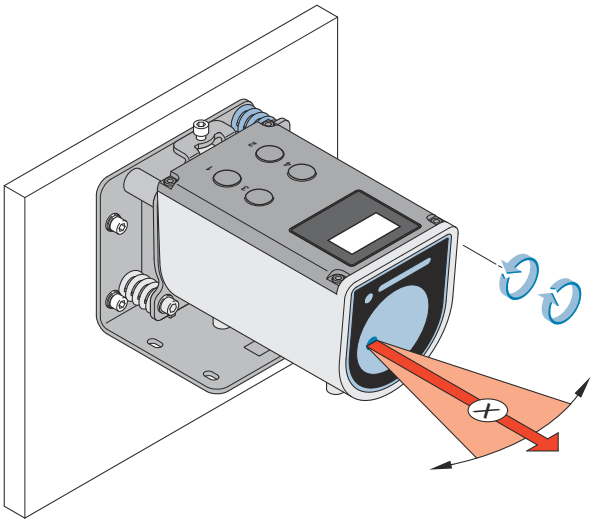


Figure 16: Align the distance sensor with alignment bracket in the X-direction

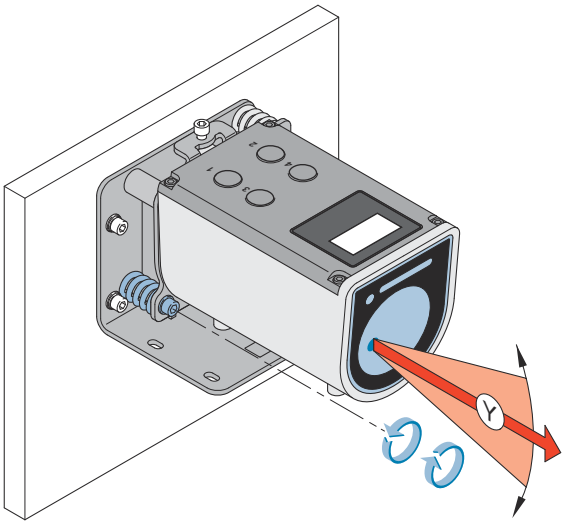


Figure 17: Align the distance sensor with alignment bracket in the Y-direction

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 and disconnect electrical connections when the power is off.

6.2 Wiring instructions

NOTE
Pre-assembled cables can be found online at:

- www.sick.com/Dx1000

NOTICE
Faults during operation and device or system defects!

Incorrect wiring may result in operational faults and defects.

- Follow the wiring notes precisely.

To ensure trouble-free operation, observe the following wiring instructions:

- Connect the connecting cables in a de-energized state. Do not switch on the voltage supply until installation is complete and all connection work on the device and controller has been finished.
- No earthing is required for the housing.
- A twisted-pair cable is necessary for connecting the RS-422 serial interface or SSI.
- Isolate the wires of unused digital outputs at the control cabinet.
- Recommendation: Use a supply cable with a cross-section of at least 0.25 mm^2. When operated with a 24 V DC supply and with a maximum switching current of 100 mA per digital output, the maximum length of cable up to the feed-in point is 30 m.
- Use proper connecting cables and male connectors for the application/environment, see "Accessories", page 120.
- The specified enclosure rating of the distance sensor is valid only with suitable mating connectors or with the protective cap installed.
- Electrical protection class III/SELV or PELV supply voltage.
- Use shielded cables. Position the cable shield on both sides and connect to earth on the control side with a large surface area. Take appropriate measures to prevent equipotential bonding currents flowing through the cable shield.

- When installing, observe the special requirements which arise as a result of the surroundings. Apply good professional practice with regard to cable interference: Best possible separation of cables susceptible to interference (e.g. devices, bus cables) from faulty cables (e.g. motor control, brakes).
- The transmission rate of the SSI interface depends on the length of the cable:

Table 26: SSI interface: Maximum transmission rate depending on the length of cable

Length of cable	Transfer rate
< 25 m	500 kHz
< 50 m	400 kHz
< 100 m	300 kHz
< 200 m	200 kHz
< 400 m	100 kHz

6.2.1 Digital outputs

The digital outputs are designed as push-pull outputs. That means that the signal on Q_i is connected either to L^+ (for PNP controls) or M (for NPN controls) depending on the active state.

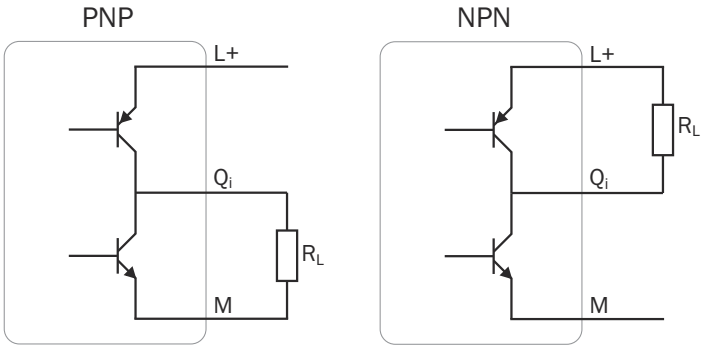


Figure 18: Digital output simplified diagram

The “Active status” function (can be configured using the device menu) specifies what electric voltage level is applied to the digital output based on the switching state of the respective digital output.

Switching state	Active status (adjustable)	Voltage at Q_i
Active	High	High
Active	Low	Low
Inactive	High	Low
Inactive	Low	High

6.2.2 Analog output

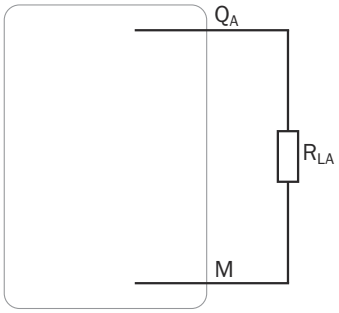


Figure 19: Analog output simplified diagram

The current output signal is scaled using the settings of the distance values for 4 mA and 20 mA (see "Operation", page 47).

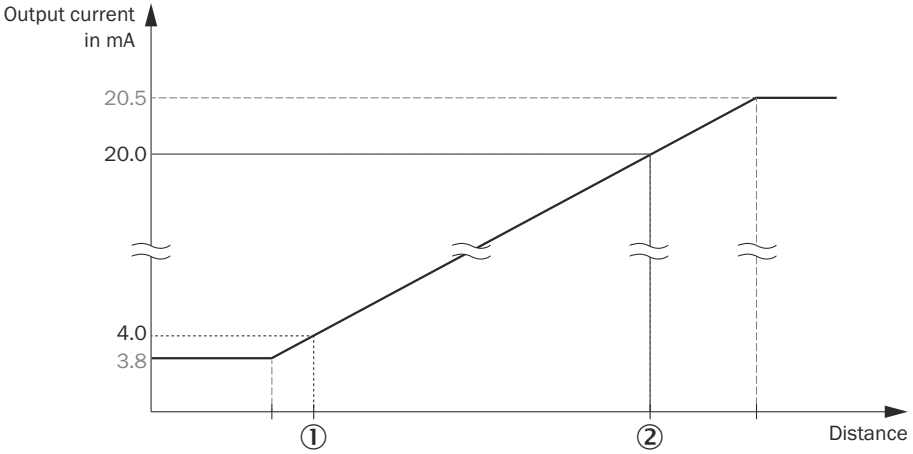


Figure 20: Current output signal, 20 mA distance value is greater than the 4 mA distance value

① Distance value for 4 mA

② Distance value for 20 mA

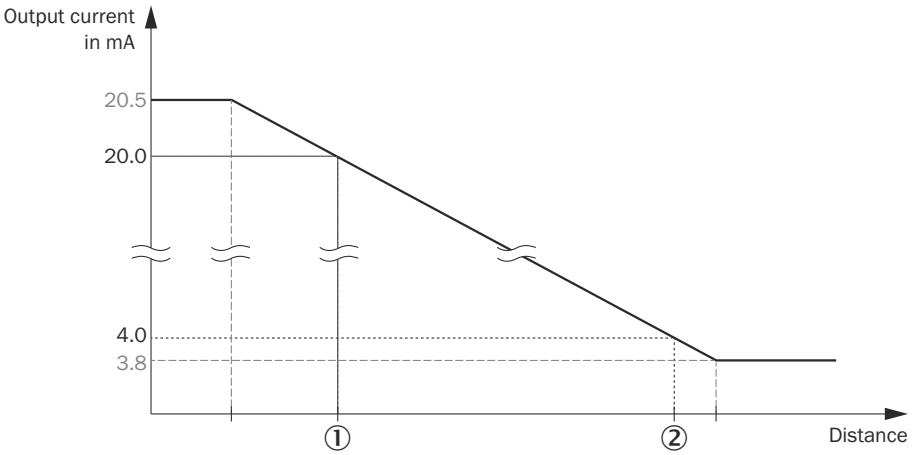


Figure 21: Current output signal, 20 mA distance value is less than the 4 mA distance value (inverted current output signal)

① Distance value for 20 mA

② Distance value for 4 mA

6.3 Connect 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.

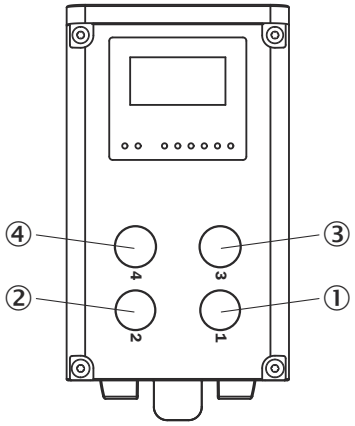


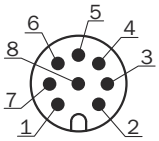
Figure 22: Position of the electrical connections

① Power, RS-422 / SSI, In1 / Q1, QA/Q2
② Auxilliary
③ not assigned, do not remove (glued) protection cap!
④ Ethernet

6.3.1 Pin assignment

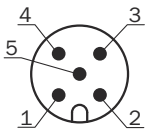
1 Power, RS-422/SSI, In1/Q1, QA/Q2

Table 27: Pin assignment connection 1: Power/RS-422/SSI/analog

Male/female connector	Contact	Short form	Signal description
M12 male connector, 8-pin A-coded 	1	In1/Q1	Push-pull digital output, can be switched to digital input (internal pull-down)
	2	L+	Supply voltage: +18 V ... +30 V DC
	3	RX-/CLK-	RS-422 data input neg/SSI CLK neg.
	4	RX+/CLK+	RS-422 data input pos/SSI CLK pos.
	5	TX-/Data-	RS-422 data output neg/SSI data neg.
	6	TX+/Data+	RS-422 data output pos/SSI data pos.
	7	M	Supply voltage: 0 V
	8	QA/Q2	Push-pull digital output, can be switched to current output
	Thread	-	Cable shield (housing)

2 auxiliary (Q3, Q4, In2)

Table 28: Pin assignment connection 2: Auxiliary

Male/female connector	Contact	Short form	Signal description
M12 male connector, 5-pin A-coded 	1	nc	-
	2	Q3	Push-pull digital output
	3	nc	-
	4	Q4	Push-pull digital output
	5	In2	Digital input (internal pull-down)

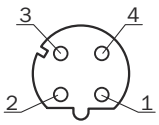
3 NC

Table 29: Pin assignment connection 3: NC

Male/female connector	Contact	Short form	Signal description
Not used			

4 Ethernet

Table 30: Pin assignment connection 4: Ethernet

Male/female connector	Contact	Short form	Signal description
M12 female connector, 4-pin D-coded 	1	TX+	Transmit data pos.
	2	RX+	Receive data pos.
	3	TX-	Transmit data neg.
	4	RX-	Receive data neg.

7 Operation

7.1 Operating concept

The device is operated via a resistive touch display and is described in the following.

NOTICE

Damage to the display due to improper operation!

The display reacts to pressure.

- Only use the tip of your finger or a suitable pointing device to operate the touch display.
- Do not use a tool.

NOTE

Alternatively, the following configuration options are available:

- Using the SOPAS ET user interface (PC) (via Ethernet), see "SOPAS ET configuration software", page 53.
- Via Ethernet TCP/IP, see "Ethernet interface", page 28.

If no inputs are made for a duration of 15 min, the display is automatically dimmed. Pressing on the display area once increases the brightness.

7.1.1 Main display level

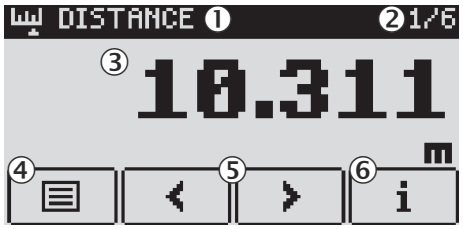


Figure 23: Main display level

① Selected display or menu element
② Number of available display or menu elements on this level (1 of 6)
③ Display of values or parameters
④ Menu button
⑤ Buttons for switching between the displays
⑥ Button for displaying device status

In the main display level, various measured values and information on the device status are available.

The arrow buttons are used for switching between the individual displays. Pressing and holding the menu button down switches to the main menu.

7.1.2 Menu groups

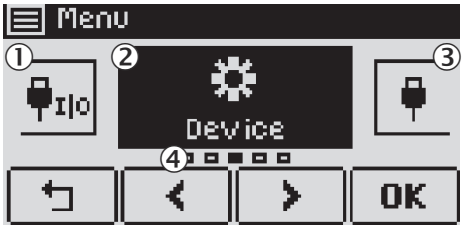


Figure 24: Menu group selection

① Previous menu group
② Selected menu group
③ Next menu group
④ Current position within the menu group selection

The first level of the menu contains various menu groups to choose between, which are arranged by topic. To open the selected menu group, press the OK button.

7.1.3 Menu items

Figure 25: Various menu items

In the next menu level, the individual menu items are represented by buttons. The currently active selection is displayed with inverted colors.

NOTE
The inverted button display is also used to show the currently active status of a setting. In the figure, the DHCP client is active in the screenshot on the left while a static IP address has been assigned in the screenshot on the right.

7.1.4 Parameter input

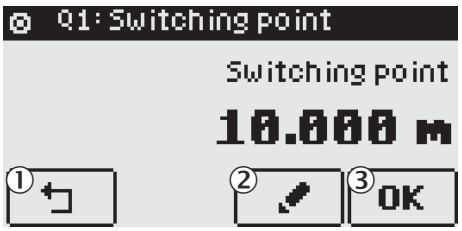


Figure 26: Displaying and editing parameters

① Cancel/Back
② Edit numerical values
③ OK/Apply values

If numerical parameters can be entered or changed, edit buttons appear on the display.

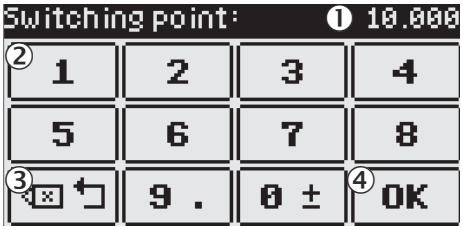


Figure 27: Numerical input

① Value currently entered
② Input field (digits, decimal separators, signs)
③ Delete last digit/Cancel entry
④ Confirm input

Decimal values can be entered by pressing and holding the “9.” button for numerical parameter input. Pressing and holding the “0 ±” button reverses the plus/minus sign.

NOTE ACTIVATION (TEMPORARY STORAGE) AND (NON-VOLATILE) STORAGE OF PARAMETER SETTINGS

In principle the parameter settings are activated by pressing the OK button (temporarily stored).

Exception: Pressing the OK button in numerical input editor.
Changed parameter values are not activated (temporarily stored) in the input editor until confirmation (pressing again) of the OK button in the overlying level.
All parameter settings are (only) saved in a non-volatile manner when going back to the main display level in the device storage.
When no entries are made in the menu for a duration of 15 minutes, the display automatically switches back to the main display level and parameter changes previously activated with OK are stored in a non-volatile manner.

7.1.5 Selection lists

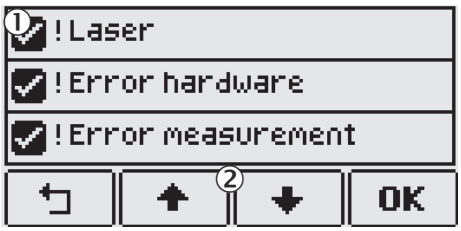


Figure 28: Selection list

① Selection list with check boxes
② Scrolling up and down

Selection lists are used wherever parameters can be linked to a logical disjunction.

Active parameters are identified by a check mark in the check box. Press on the respective row to activate/deactivate.

The arrow buttons are used to scroll within the selection list.

7.2 Standard buttons

Standard buttons refer to buttons that fulfill the same function in every menu.

Button	Function	Description
	Menu	Hold the button to go to the menu.
OK	OK	Confirms entries or switches to the next menu level of a selected element.
	Back	Cancels entries (when held) or switches to the previous menu level.
	Edit	Opens the input field for numerical value entry.
	Info	Opens an information window.
	Forward	Switches between multiple screens on one menu level or moves parameter values to the right on scale entries.
	Back	Switches between multiple screens on one menu level or moves parameter values to the left on scale entries.
	Down	Scrolls down in selection lists.
	Up	Scrolls up in selection lists.

7.3 Measured value displays

In normal operation, various measured values are shown on the device display. The Forward and Back buttons can be used to switch between the specific measured value displays.

7.3.1 Distance display

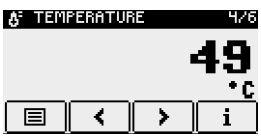
The distance display indicates the current measured distance value. This value is calculated using the actual measured distance plus an optional distance offset value.

7.3.2 Signal level display

The signal level display represents the height of the received signal (RSSI). It can be displayed as a bar graph or a numerical value.

The numerical signal level is output as a dimensionless value with number values between 0 and 16383.

7.3.3 Temperature display



The temperature display shows the current inside temperature of the device.

7.3.4 Operating time display

The operating time display depicts the number of operating hours since the first commissioning.

7.3.5 Speed display

The speed display depicts the current measured speed value of the measuring object relative to the device.

The display can show positive or negative values. Depending on the defined direction of measurement, this can indicate a movement to or from the device.

7.4 Overview of parameters

7.4.1 Measuring behavior

Basic measuring parameters

- **Measurement mode**: "Measuring mode", page 56
- **Measurement cycle time**: "Defining the measurement cycle time", page 57
- **Distance offset**: "Defining the distance offset", page 57
- **Measurement direction**: "Defining the measuring direction", page 58
- **Distance range**: "Configuring the distance range", page 61

Improving measurements

- **Measurement cycle time**: "Defining the measurement cycle time", page 57
- **Rain and snow filter**: "Configuring the rain and snow filter", page 58
- **Fog filter**: "Activating/deactivating the fog filter", page 59
- **Kalman filter**: "Activating/deactivating the Kalman filter", page 60
- **Averaging filter**: "Configuring the distance averaging filter", page 59
- **Echo selection**: "Defining the echo selection", page 61
- **Signal level limits**: "Configuring signal level range limits", page 62
-

Defining behavior if “no echo” occurs

- **Delay time**: "Configuring delay time for "No echo"", page 62
- **Mode**: "Defining substitute values for "No echo"", page 63
- **Substitute values**: "Configuring user-defined substitute values", page 63

Defining behavior if an error occurs

- **Substitute values**: "Configuring user-defined substitute values", page 63

7.4.2 IO interfaces

Digital inputs

- **Digital input:** see "Configuring the switching input", page 78
- **Switching function:** see "Defining the active state for digital input", page 78

Digital outputs

- **Switching point distance:** see "Defining the switching point for distance value (distance to object)", page 64
- **Distance switching window:** see "Defining the switching window for the distance value", page 66
- **Switching point object speed:** see "Defining the switching point for the object speed value", page 68
- **Object speed switching window:** see "Defining the switching window for the object speed value", page 70
- **Signal level switching window:** see "Defining the switching window for the signal level value", page 74
- **Signal level switching point:** see "Defining the switching point for the signal level value", page 72
- **Service function switching event:** see "Assigning a switching event to the service functions", page 76
- **Monitoring direction speed:** see "Defining the monitoring direction for the object speed value", page 69
- **Distance switching point hysteresis:** see "Defining the switching point hysteresis for the distance value", page 65
- **Distance switching window hysteresis:** see "Defining the switching window hysteresis for the distance value", page 67
- **Object speed switching point hysteresis:** see "Defining the switching point hysteresis for the object speed value", page 68
- **Object speed switching window hysteresis:** see "Defining the switching window hysteresis for the object speed value", page 71
- **Signal level switching point hysteresis:** see "Defining the switching point hysteresis for the signal level value", page 72
- **Signal level switching window hysteresis:** see "Defining the switching window hysteresis for the signal level value", page 74
- **Signal logic:** see "Defining the switching point active state for the distance value", page 65 / see "Defining the switching window active status for the distance value", page 67 / see "Defining the switching point active state for the object speed value", page 69

Analog output

- **Analog output QA:** see "Configuring the QA analog output", page 77

RS 422 connection

- **Data transmission rate:** see "Defining the RS-422 data transmission rate", page 81
- **Data format:** see "Defining the RS-422 data format", page 82
- **Protocol:** see "Defining the RS-422 data protocol", page 84
- **Distance value resolution:** see "Defining the distance value resolution for the RS-422 data transfer", page 84
- **Resolution speed value:** see "Defining the speed value resolution for the RS-422 data transfer", page 84
- **Transmission mode:** see "Setting the continuous RS-422 output", page 82

SSI connection

- **SSI coding**: see "Defining SSI coding", page 85
- **Distance value resolution**: see "Defining the distance value resolution for the SSI data transfer", page 85

7.4.3 Device information

- **Firmware information**: see "Retrieving firmware information", page 87
- **Hardware information**: see "Retrieving hardware information", page 88
- **Device name**: see "Calling up device name", page 88
- **Operating hour counter**: see "Operating time display", page 51
- **Operating temperature**: see "Temperature display", page 50
- **Switching events**: see "Retrieving the counter readings of switching events", page 88
- **IP network configuration**: see "Entering an Ethernet IP address", page 86

7.5 SOPAS ET configuration software

Purpose

The SOPAS ET configuration software is used for parameterization and service purposes, among other (e.g. diagnostics, data logger, firmware update).

The software from version 2018.1 can be used for this device.

NOTE
The most up-to-date version of the SOPAS ET software can be downloaded from www.sick.com/SOPAS_ET. The respective system requirements for installing SOPAS ET are also specified there.

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 via SOPAS ET is not described in this document.

NOTE
Changes to parameters that are made in SOPAS ET are not saved automatically in the device. After you have completed the configuration, you must save it in the device permanently by pressing the **Save permanent** button.

Connection of device to PC and establishment of connection

1. Connect the Ethernet interface of the PC to the Ethernet interface of the device (connection 4 “Ethernet”).
2. Open SOPAS ET and start searching for connected devices.
3. Insert the found device into the project (e.g. via drag & drop).
   The IP settings of the PC and the device must match to be able to communicate with the device via SOPAS ET.
4. Make adjustments in the device via the IP network configuration during the establishment of connection to SOPAS ET or via network configuration in the PC system controller (LAN connection). Administrator rights are needed to change the system control.:

5. If a request to install a device driver (SDD file) appears in the device window: Perform installation by uploading from the device or install device drivers from the SICK web page (Internet connection required); the wizard in SOPAS ET guides this process.
6. After installing the SDD file, switch to online mode by selecting the corresponding button of the device window and upload the parameters from the device to SOPAS ET.

NOTE
If SOPAS ET does not find a connected device, the IP network configuration can be reset to the factory setting, see "Entering an Ethernet IP address", page 86 (device restart required).

Log on to device

Certain functions (e.g., Edit parameters) require you to be logged in to the device:

1. > **Device** > **Login** > Select user level and enter password:

User levels	User rights	Password (factory settings)
Machine operator	Show parameters and measured values	(No registration required)
Maintenance	Show parameters and measured values	Main
Authorized client	Show parameters and measured values Change parameters	Client
Service	Show parameters and measured values Change parameters Run firmware update	Service level

NOTE
Change the passwords at initial commissioning to ensure your device is protected.

It is possible to change the password when you are logged in:

▶ > **Device** > **Change password** > Enter data.

The hash value of the password defined in SOPAS ET is needed for a parameter change using the RS-422 interface and the Ethernet interface, see "Setting authorization for parameter change", page 23 for RS-422 and telegram listing Dx1000 (English, part number 8021820) for Ethernet.

Example: Hash value “81BE23AA” corresponds to the password “service level”.

Hash values can be calculated:

▶ > **Functions** > **Calculate hash value** > Enter data.

NOTE
Password forgotten?

Please contact SICK service to reset to the factory settings.

Information about the device is displayed in the device window (> **Device** > **Open**) and the device can also be configured here.

Firmware update

The SOPAS ET configuration software makes it possible to update the device firmware. You can get the necessary firmware file (firmware package, *.ssp) and key file (*.key) on request from your responsible SICK sales organization.

NOTICE

System damage during firmware update

The device function is not available during the firmware update.

- Make sure that this does not cause unwanted reactions in your system.

NOTICE

Device damage during firmware update

- Do not interrupt the Ethernet connection and the voltage supply to the device during the download process.
- Do not terminate the process until the download is complete.

1. Start online mode and open device window.
2. > **Transmit firmware** .
3. Select the storage path of the firmware package and open the corresponding file.
4. Select the storage path of the associated key file and open the corresponding file.
5. **Start update**.
6. Enter the password.

✓ The download is executed, this will take several minutes.

✓ A successful download is confirmed with **Download succeeded**.

7. Close the download window and, if required, perform the optional steps for updating the SOPAS ET project and transmitting the device parameters from SOPAS ET to the device.

8 Reference

8.1 Measurement menu group: Basic settings

8.1.1 Measuring mode

The “Measuring mode” allows the parameter presettings to be activated for two different measuring tasks:

- **Axial object tracking**: used when the measuring object to be detected moves along the laser beam axis, i.e. if the distance constantly changes, for example, for object tracking.
- **Lateral object introduction**: used if the measuring object to be detected primarily moves vertically to the laser beam axis or moves into the laser bean from the side, i.e. if erratic distance changes are to be detected when the light beam is entered.

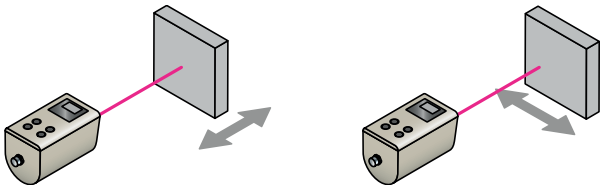


Figure 29: "Axial object tracking" and "Lateral entry of the object" measuring tasks

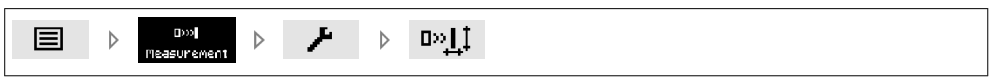
The selected setting results in application-specific pre-selection of the parameters shown in the following table.

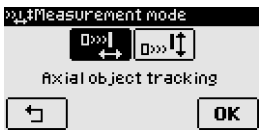
These parameters can be adjusted further for specific measuring tasks in the “Basic” or “Expert settings.” In such cases, parameter pre-setting is deactivated.

If one of the two parameter pre-settings is activated later, the parameter settings made are reset to the default values shown in the following table.

Table 31: Parameter values for parameter presettings

Parameter	Axial object tracking	Lateral entry of the object
Measurement cycle time	4 ms	1 ms
Rain and snow filter	3	1
Distance filter	Kalman filter	Averaging filter
Fog filter	On	On
Distance filter depth	-	1
Speed filter depth	10	10
Echo selection	First echo	First echo
Delay time if “no echo”	50 cycles	50 cycles
Mode if “no echo”	Replacement value	Replacement value
Substitute value for “no echo” distance	6096.000 m	6096.000 m
Substitute value for “no echo” speed	0 m/s	0 m/s



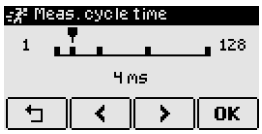


Parameter	Factory setting
Axial object tracking: Measuring object moves along the laser beam axis	Axial object tracking
Lateral entry of the object Measuring object moves diagonally to the laser beam axis	

8.1.2 Defining the measurement cycle time

The measurement cycle time defines the intervals at which measurements are made. The measurement cycle time designates the processing time of the distance sensor's measuring core.

A larger measurement cycle time results in an increase in the measuring range of the sensor and a reduction in signal noise. The sensor´s response time, however, increases. Shortening the measurement cycle time results in a faster response time. However, this increases the signal noise and decreases the measuring range, see "Technical data", page 103.

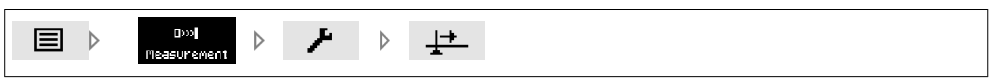


Parameter	Factory setting
1: 1 ms	4 ms
4: 4 ms	
16: 16 ms	
64 (only DT1000): 64 ms	
128 (only DT1000): 128 ms	

8.1.3 Defining the distance offset

The distance value the distance sensor outputs on its interface and the distance value that is evaluated in the switching functions is the same as the actual distance between the distance sensor and measuring object plus the distance offset:

Output distance value = measured distance value x measuring direction + distance offset



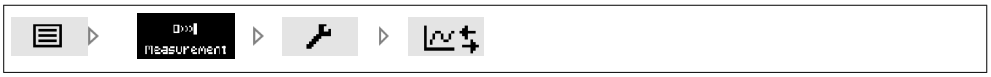
Parameter	Factory setting
Distance offset: -4500 m to 4500 m	0 m

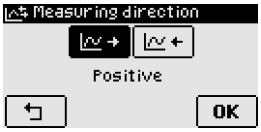
8.1.4 Defining the measuring direction

If the measuring direction is positive, the output distance value is equal to the distance value measured by the measuring module.

If the measuring direction is negative, the measured 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.





Parameter	Factory setting
Positive: Output distance value = measured distance value + distance offset	Positive
Negative: Output distance value = measured distance value x (-1) + distance offset	

8.1.5 Configuring the rain and snow filter

The measurement certainty with precipitation can be increased using the connectible rain and snow filter.

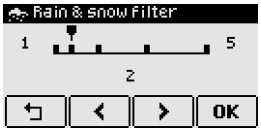
Precipitation like rain or snow along the measuring path can lead to false echos. The sensor detects both false echos and the relevant echo of the measuring object. In contrast to the relevant echo, false echos occur with temporal irregularity and exhibit high statistical scatter of distance values. The multi-echo technology of the Dx1000 makes it possible to differentiate false echos from relevant echos.

The rain and snow filter can be set to 5 different levels to fit the application. A higher filter level allows false echos to be ignored over a longer period of time, whereby the sensor is more resistant to precipitation.

When the distance changes erratically (e.g. when scanning edges), activation of the rain and snow filter extends the response time (response time of the sensor to changes in distance). The response time varies both with the set filter depth and with the measurement cycle time. The maximum expected response time is given in the following table. The response time when activating the rain and snow filter remains unchanged with continual changes in the distance with time.

Table 32: Maximum response time due to the rain and snow filter

Measurement cycle time	1 ms	4 ms	16 ms	64 ms	128 ms
Filter depth 1	1 ms	4 ms	16 ms	64 ms	128 ms
Filter depth 2	8 ms	32 ms	128 ms	512 ms	1,024 ms
Filter depth 3	16 ms	64 ms	256 ms	1,024 ms	2,048 ms
Filter depth 4	24 ms	96 ms	384 ms	1,536 ms	3,072 ms
Filter depth 5	32 ms	128 ms	512 ms	2,048 ms	4,096 ms



Parameter	Factory setting
1 (off): Rain and snow filter deactivated	3
2: Filter depth 2	
3: Filter depth 3	
4: Filter depth 4	
5: Filter depth 5	

8.1.6 Activating/deactivating the fog filter

The fog filter results in the blanking of false echoes caused by fog on the measurement section. Activating the filter results in a reduced level of detection sensitivity at close range (up to approx. 20 m).

The fog filter does not affect the response time of the sensor. Should the application not need a fog filter, deactivating it is recommended to ensure the maximum possible detection sensitivity. This is recommended in particular when using the optional additional filter for high-temperature applications. When using the additional filter and the fog filter is activated at the same time, it might be necessary to increase the measurement cycle time.

Parameter	Factory setting
On: Fog filter active	On
Off: Fog filter deactivated	

8.2 Measurement menu group: Expert settings

8.2.1 Configuring the distance averaging filter

The distance average filter carries out a moving averaging method for reducing the measured value noise. The moving average results in an increased response time of the distance sensor. The average filter is recommended in particular for applications for which erratic distance changes can occur, for example for objects or reflectors entering the light beam from the side.

Using the average filter deactivates the Kalman filter.

Parameter	Factory setting
Distance filter depth: 1 to 1023 cycles (duration of averaging = cycles x measurement cycle time)	10 cycles

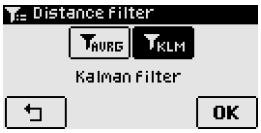
8.2.2 Activating/deactivating the Kalman filter

In the Kalman filter, the distance and speed value is filtered based on a mathematical status model.

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.

This property is favorable especially for use in control circuits. Distance output value overshoots are possible in the event of erratic changes in distance.

Using the Kalman filter deactivates the average filter.



Parameter	Factory setting
On: Kalman filter active	On
Off: Kalman filter deactivated	

8.2.3 Configuring the speed filter

The speed filter is a moving averaging method.

The filter depth of the averaging filter corresponds to the duration of the averaging in multiples of the measurement cycle time.

The response time of the sensor to changes in speed of the measuring object relative to the sensor is extended in multiples of the measurement cycle time according to the set filter depth.

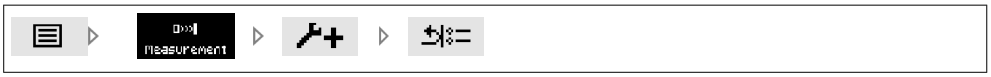
Parameter	Factory setting
Filter depth speed: 1 to 128 cycles (duration of averaging = cycles x measurement cycle time)	10 cycles

8.2.4 Defining the echo selection

Depending on the measuring situation, the distance sensor receives echoes that cannot be assigned to the direct distance between the distance sensor and the measuring object.

One possible cause for an echo like this is a viewing window in the measuring path between the device and the measuring object.

The first echo (corresponds to the shorter distance between measuring object and device) or the last echo (corresponds to the longer distance between measuring object and device) from multiple detected echoes in the set distance and signal level area can be selected for the signal evaluation.



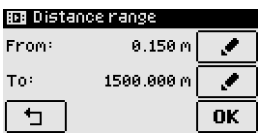
Parameter	Factory setting
First echo: For signal evaluation, the first echo is selected in the set distance and signal level range.	First echo
Last echo: For signal evaluation, the last echo is selected in the set distance and signal level range.	

8.2.5 Configuring the distance range

The distance range is the selectable, physical distance measurement range inside of which measuring objects are evaluated and further processed.

Echoes from distances below or beyond this range are not included in the evaluation.

If no echo with a level within the signal level range is detected, the operating state “No echo” is output. If a suitable lower measuring range limit is selected, disruptive optical reflections of the viewing window of a protective housing can be blanked, for example.



Parameter	Factory setting
From: The measuring range limit facing the device (echoes from short distances are ignored): 0.1 … 1,500 m	0.5 m

Parameter	Factory setting
To: The measuring range limit facing away from the device (echoes from larger distances are ignored): 0.1 ... 1,500 m	1500 m

8.2.6 Configuring signal level range limits

The signal level limits define the selectable range inside of which measuring objects are evaluated and processed further.

Echoes with level sizes below or above this range are not included in the evaluation and therefore blanked.

The “No echo” operational status is output if no echo within the signal level range is detected.

Parameter	Factory setting
From: Lower signal level limit (weaker echoes are ignored): 0 to 16383 digit	0 digit
To: Upper signal level limit (stronger echoes are ignored): 0 to 16383 digit	16383 digit

8.2.7 Configuring delay time for "No echo"

During the delay time, the "No echo" state is ignored and the last valid measured values are output.

On the control side, this can be detected, after corresponding parameterization, by evaluating a digital output (“Service/No echo: Delay time active” switching variable) or the RS-422 status double word (bit 12). When using the SSI interface with the 24+8 data format, the status of the digital output named above can be read in via the respective status bit.

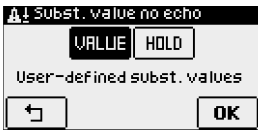
Parameter	Factory setting
Delay time: 0 to 1023 cycles	50 cycles

8.2.8 Defining substitute values for "No echo"

If "No echo" is present uninterrupted after expiration of the delay time, substitute values can be defined for output. These can either be the last valid measured values or user-defined substitute values.

The digital outputs are set corresponding to the substitute values, when using switching functions "Distance to object", "Window" or "Object speed".

The output of substitute values can be detected, after corresponding parameterization, by evaluating a digital output (“Service/No echo” switching variable) or the RS-422 status double word (bit 11). When using the SSI interface with the 24+8 data format, the status of the digital output named above can be read in via the respective status bit.



Parameter	Factory setting
HOLD: Last valid distance/speed measured values	Deactivated
VALUE: Free choice of values, see "Configuring user-defined substitute values", page 63.	Activated

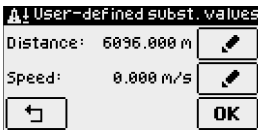
8.2.9 Configuring user-defined substitute values

User-defined substitute values are used to provide signal evaluation with a value for calculation and output in the event of “No echo”.

NOTE

The -6096,000 m and 6096,000 m (-20000,000 ft and 20000,000 ft) distance substitute values have a special meaning. These values generate NAMUR failure information on the analog output (3.0 mA/21.5 mA).

The distance substitute values can be selected directly in the numeric input editor by pressing the “1” or “4” buttons for a long time.



Parameter	Factory setting
Distance: -6096.000 m ... 6096.000 m	6,096 m
Speed: -20 m/s to 20 m/s	0 m/s

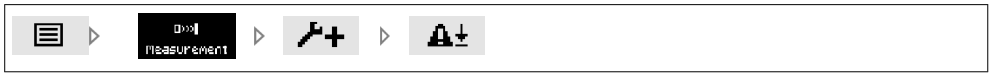
8.2.10 Behaviour on error

If an error occurs (see "Troubleshooting", page 100), a user defined substitute value is output without a delay time.

NOTE

The -6096,000 m and 6096,000 m (-20000,000 ft and 20000,000 ft) distance substitute values have a special meaning. These values generate NAMUR failure information on the analog output (3.0 mA/21.5 mA).

The distance substitute values can be selected directly in the numeric input editor by pressing the “1” or “4” buttons for a long time.



Parameter	Factory setting
Distance: -6096.000 m ... 6096.000 m	0 m
Speed: -20 m/s to 20 m/s	0 m/s

8.3 Interface menu group

NOTE

The following procedure is recommended for configuration:

1 Define input/output to be parameterized.
2 Make selection: In/Q1 as digital input or digital output.
3 Make selection: QA/Q2 as analog output or digital output
4 Configure inputs/outputs.

8.3.1 Defining the switching point for distance value (distance to object)

NOTE

The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching state is active if the distance output value is smaller than the switching point.

The switching point SP designates the distance value at which the switching event is triggered (see "Switching functions", page 16).

The switching point value refers to the output distance value = measurement direction x measured distance value + distance offset.

Parameter	Factory setting
Switching point: -4500 m to 4500 m	10 m

8.3.2 Defining the switching point hysteresis for the distance value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

Unwanted switching can be prevented by entering a hysteresis if the determined distance value fluctuates around the set switching points (see "Switching functions", page 16).

Parameter	Factory setting
Hysteresis: 0 m to 1500 m	0.1 m

8.3.3 Defining the switching point active state for the distance value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

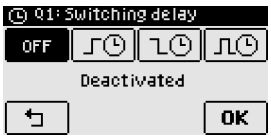
The active state describes the relationship between the switching state (active or inactive) and the voltage present on the digital output (high or low) (see "Switching functions", page 16).

Parameter	Factory setting
LOW: Output potential for active switching state: low voltage Output potential for inactive switching state: high voltage	LOW
HIGH: Output potential for active switching state: high voltage Output potential for inactive switching state: low voltage	

8.3.4 Defining the switching point switching delay for the distance value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching delay is used to output state changes with a time delay.



Parameter	Factory setting
Deactivated	Deactivated Switching delay time: 200 ms
Switch-on delay (delay time only for power-up): 1 ms ... 10,000 ms	
Switch-off delay (delay time only for power-down): 1 ms ... 10,000 ms	
Switch-on/off delay (delay time for power-up and -down): 1 ms ... 10,000 ms each	

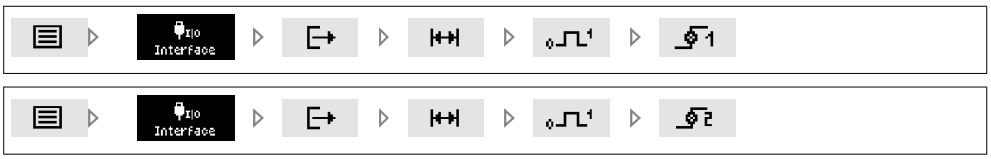
8.3.5 Defining the switching window for the distance value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching state is active if the distance output value is between switching point SP1 and switching point SP2.

Switching points SP1 and SP2 respectively designate the distance value at which the switching event is triggered (see "Switching functions", page 16).

The values of the switching points refer to the output distance value = measurement direction x measured distance value + distance offset.



Parameter	Factory setting
Switching point 1: -4500 m to 4500 m	10 m
Switching point 2: -4500 m to 4500 m	20 m

8.3.6 Defining the switching window hysteresis for the distance value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

Unwanted switching can be prevented by entering a hysteresis if the determined distance value fluctuates around the set switching points (see "Switching functions", page 16).

The switching point hysteresis for the “Window” switching function is the same for both SP1 and SP2 window limits.

Parameter	Factory setting
Hysteresis: 0 m to 1500 m	0.1 m

8.3.7 Defining the switching window active status for the distance value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

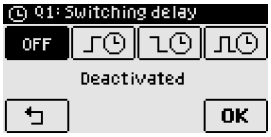
The active state describes the relationship between the output state (active or inactive) and the voltage present on the digital output (high or low) (see "Switching functions", page 16 / see "Signal inputs/outputs", page 19).

Parameter	Factory setting
LOW: Output potential for active switching state: low voltage Output potential for inactive switching state: high voltage	LOW
HIGH: Output potential for active switching state: high voltage Output potential for inactive switching state: low voltage	

8.3.8 Defining the switching window switching delay for the distance value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching delay is used to output state changes with a time delay.

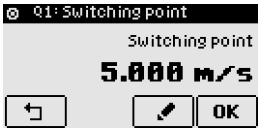


Parameter	Factory setting
Deactivated	Deactivated Switching delay time: 200 ms
Switch-on delay (delay time only for power-up): 1 ms ... 10,000 ms	
Switch-off delay (delay time only for power-down): 1 ms ... 10,000 ms	
Switch-on/off delay (delay time for power-up and -down): 1 ms ... 10,000 ms each	

8.3.9 Defining the switching point for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching point SP designates the speed value at which the switching event is triggered (see "Switching functions", page 16).

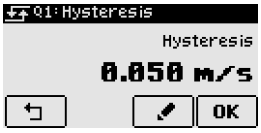


Parameter	Factory setting
Switching point: 0 m/s to 20 m/s	5 m/s

8.3.10 Defining the switching point hysteresis for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

Unwanted switching can be prevented by entering a hysteresis if the determined object speed value fluctuates around the set switching points (see "Switching functions", page 16).



Parameter	Factory setting
Hysteresis: 0 m/s to 1 m/s	0.05 m/s

8.3.11 Defining the monitoring direction for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The “monitoring direction” defines the measuring object direction of movement in relation to the device at which a switching event occurs when the object speed is exceeded.

A switching event can be triggered when the switching point for the speed is exceeded both for an increasing as well as a decreasing distance or if movement goes in both directions from the measuring object to the device.

Parameter	Factory setting
Positive and negative (+/-): Both directions of movement	Positive and negative (+/-)
Positive (+): Increasing distance of the measuring object from the device	
Negative (-): Decreasing distance of the measuring object to the device	

8.3.12 Defining the switching point active state for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

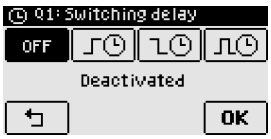
The active state describes the relationship between the switching state (active or inactive) and the voltage present on the digital output (high or low) (see "Switching functions", page 16 / see "Signal inputs/outputs", page 19).

Parameter	Factory setting
LOW: Output potential for active switching state: low voltage Output potential for inactive switching state: high voltage	LOW
HIGH: Output potential for active switching state: high voltage Output potential for inactive switching state: low voltage	

8.3.13 Defining the switching point switching delay for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching delay is used to output state changes with a time delay.



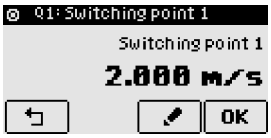
Parameter	Factory setting
Deactivated	Deactivated Switching delay time: 200 ms
Switch-on delay (delay time only for power-up): 1 ms ... 10,000 ms	
Switch-off delay (delay time only for power-down): 1 ms ... 10,000 ms	
Switch-on/off delay (delay time for power-up and -down): 1 ms ... 10,000 ms each	

8.3.14 Defining the switching window for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The output state is deactivated if the object speed value is between switching point SP1 and switching point SP2.

Switching points SP1 and SP2 respectively designate the object speed value at which the switching event is triggered (see "Switching functions", page 16).



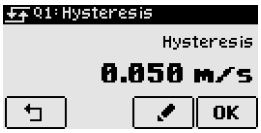
Parameter	Factory setting
Switching point 1: -20 m/s ... 20 m/s	2 m/s
Switching point 2: -20 m/s ... 20 m/s	5 m/s

8.3.15 Defining the switching window hysteresis for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

Unwanted switching can be prevented by entering a hysteresis if the determined object speed value fluctuates around the set switching points (see "Switching functions", page 16).

The switching point hysteresis for the “Window” switching function is the same for both SP1 and SP2 window limits.



Parameter	Factory setting
Hysteresis: 0 m ... 1 m/s	0.05 m/s

8.3.16 Defining the switching window active state for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

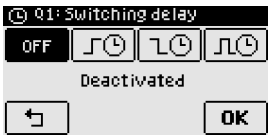
The active state describes the relationship between the output state (active or deactivated) and the voltage present on the digital output (high or low) (see "Switching functions", page 16 / see "Signal inputs/outputs", page 19).

Parameter	Factory setting
LOW: Output potential for active output state: low voltage Output potential for deactivated output state: high voltage	LOW
HIGH: Output potential for active output state: high voltage Output potential for deactivated output state: low voltage	

8.3.17 Defining the switching window switching logic for the object speed value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching delay is used to output state changes with a time delay.



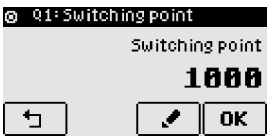
Parameter	Factory setting
Deactivated	Deactivated Switching delay time: 200 ms
Switch-on delay (delay time only for power-up): 1 ms ... 10,000 ms	
Switch-off delay (delay time only for power-down): 1 ms ... 10,000 ms	
Switch-on/off delay (delay time for power-up and -down): 1 ms ... 10,000 ms each	

8.3.18 Defining the switching point for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The output state is active if the signal level value is smaller than the switching point.

Switching point SP designates the signal level value at which the switching event is triggered (see "Switching functions", page 16).

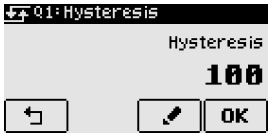


Parameter	Factory setting
Switching point: 0 ... 32,768	1000

8.3.19 Defining the switching point hysteresis for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

Unwanted switching can be prevented by entering a hysteresis if the signal level value fluctuates around the set switching points (see "Switching functions", page 16).



Parameter	Factory setting
Hysteresis: 0 ... 32,768	100

8.3.20 Defining the switching point active state for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

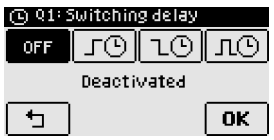
The active state describes the relationship between the output state (active or deactivated) and the voltage present on the digital output (high or low) (see "Switching functions", page 16).

Parameter	Factory setting
LOW: Output potential for active output state: low voltage Output potential for deactivated output state: high voltage	LOW
HIGH: Output potential for active output state: high voltage Output potential for deactivated output state: low voltage	

8.3.21 Defining the switching point switching delay for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching delay is used to output state changes with a time delay.



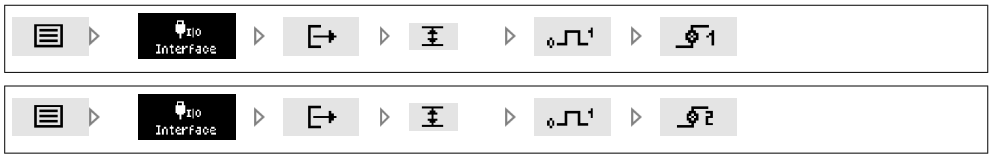
Parameter	Factory setting
Deactivated	Deactivated Switching delay time: 200 ms
Switch-on delay (delay time only for power-up): 1 ms ... 10,000 ms	
Switch-off delay (delay time only for power-down): 1 ms ... 10,000 ms	
Switch-on/off delay (delay time for power-up and -down): 1 ms ... 10,000 ms each	

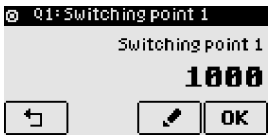
8.3.22 Defining the switching window for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The output state is active if the signal level value is between switching point SP1 and switching point SP2.

Switching points SP1 and SP2 respectively designate the signal level value at which the switching event is triggered (see "Switching functions", page 16).





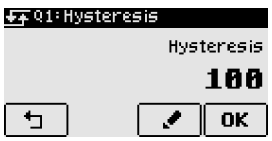
Parameter	Factory setting
Switching point 1: 0 ... 32,768	1000
Switching point 2: 0 ... 32,768	1500

8.3.23 Defining the switching window hysteresis for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

Unwanted switching can be prevented by entering a hysteresis if the signal level value fluctuates around the set switching points (see "Switching functions", page 16).

The switching point hysteresis for the “Window” switching function is the same for both SP1 and SP2 window limits.



Parameter	Factory setting
Hysteresis: 0 ... 32,768	100

8.3.24 Defining the switching window active state for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

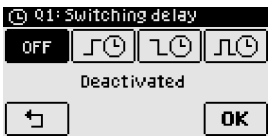
The active state describes the relationship between the output state (active or deactivated) and the voltage present on the digital output (high or low) (see "Switching functions", page 16 / see "Signal inputs/outputs", page 19).

Parameter	Factory setting
LOW: Output potential for active output state: low voltage Output potential for deactivated output state: high voltage	LOW
HIGH: Output potential for active output state: high voltage Output potential for deactivated output state: low voltage	

8.3.25 Defining the switching window switching delay for the signal level value

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching delay is used to output state changes with a time delay.



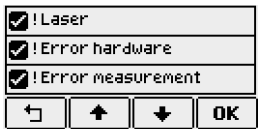
Parameter	Factory setting
Deactivated	Deactivated Switching delay time: 200 ms
Switch-on delay (delay time only for power-up): 1 ms ... 10,000 ms	
Switch-off delay (delay time only for power-down): 1 ms ... 10,000 ms	
Switch-on/off delay (delay time for power-up and -down): 1 ms ... 10,000 ms each	

8.3.26 Assigning a switching event to the service functions

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

Various service functions can be assigned to the switching output.

This uses a logical disjunction setup, i.e. multiple selectable events and statuses can be assigned to an switching state.



Parameter	Factory setting
!Laser: Switching signal for “Laser” error or “Laser” warning	Activated
!Error hardware	Activated
!Error Measurement	Activated
!Temperature: Switching signal for “Temperature” error or warning	Activated
!Ambient light: Switching signal for “Ambient light” error or warning	Activated
!Firmware	Activated
!Digital output short-circuit: Switching signal for “short-circuit” warning	Deactivated
Alignment laser active: Switching signal for switched on alignment laser	Deactivated
Measuring laser active: Switching signal for switched on measuring laser	Deactivated
Heater active: Switching signal for switched on heating	deactivated
No echo: delay time active Switching signal during delay time up to “No echo” output	Deactivated
No echo: Switching signal after expiration of the delay time for “No echo”	Deactivated

For a description of the possible causes of the event, see "Troubleshooting", page 100.

8.3.27 Defining the active state for service functions

NOTE
The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The active state describes the relationship between the switching state (active or inactive) and the voltage present on the digital output (high or low) (see "Switching functions", page 16).

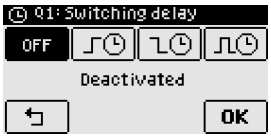
Parameter	Factory setting
LOW: Output potential for active switching state: low voltage Output potential for inactive switching state: high voltage	LOW
HIGH: Output potential for active switching state: high voltage Output potential for inactive switching state: low voltage	

8.3.28 Defining the switching delay for service functions

NOTE

The procedure for configuring switching outputs Q1 through Q4 is identical. The configuration is illustrated on switching output Q1.

The switching delay is used to output state changes with a time delay.



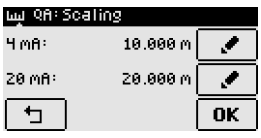
Parameter	Factory setting
Deactivated	Deactivated Switching delay time: 200 ms
Switch-on delay (delay time only for power-up): 1 ms ... 10,000 ms	
Switch-off delay (delay time only for power-down): 1 ms ... 10,000 ms	
Switch-on/off delay (delay time for power-up and -down): 1 ms ... 10,000 ms each	

8.3.29 Configuring the QA analog output

Scaling the analog output signal to the distance values (see "Analog output", page 44).

NOTE

The analog output signal is inverted if the distance value for the lower analog output limit (4 mA) is defined to be larger than the distance value for the upper analog output limit (20 mA), that means if the output current is reduced as the distance increases.



Parameter	Factory setting
4 mA: Distance value for lower analog output signal: -4500 m to 4500 m	10 m
20 mA: Distance value for upper analog output signal: -4500 m to 4500 m	20 m

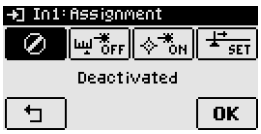
8.3.30 Configuring the switching input

NOTE

The procedure for configuring the In1 and In2 switching inputs is identical. The configuration is illustrated on switching input In1.

The switching inputs are deactivated ex works. When a switching input is not in use, it is to be deactivated to ensure the highest possible level of interference immunity.

Various device functions can be activated using the switching input.



Parameter	Factory setting
Deactivated: Deactivate the switching input	active
Measurement laser off: Switching signal deactivates the measurement laser	deactivated
Alignment laser to: Switching signal activates the alignment laser	deactivated
Preset: Switching the input signal from deactivated to activated sets the output distance value to the preset value entered under “In1: Preset” (initialization position). The automatically calculated distance offset value is permanently saved in the device. Triggering the preset overwrites a previously parameterized distance offset. The preset should be triggered during a standstill or at very low speed. The following applies at the initialization position: Preset = output distance value = measured distance value x measuring direction + distance offset Preset value: -1,500 m ... 1,500 m (factory setting: 0 m)	disabled

8.3.31 Defining the active state for digital input

NOTE

The procedure for configuring the In1 and In2 switching inputs is identical. The configuration is illustrated on switching input In1.

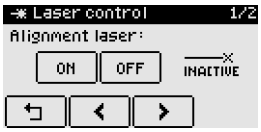
The active state describes the relationship between the physical input signal (high or low) and the logical status of the input signal (active or inactive).

Parameter	Factory setting
LOW: Input potential for the active state: low voltage	LOW
HIGH: Input potential for the active state: high voltage	

8.4 Device menu group

8.4.1 Switching the laser on and off

Switching the measurement and alignment laser on and off manually.



Parameter	Factory setting
Alignment laser on: Switching the alignment laser on/off	Off
Measurement laser on: Switching the measurement laser on/off	On

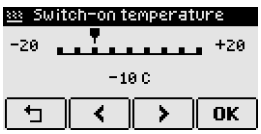
8.4.2 Configuring the heater

Define the switch-on temperature of the heater. The heater is parametrized to the “Automatic” operating mode at the factory. It is activated when the ambient temperature is below the defined switch-on temperature. The hysteresis for switching off is fixed at 2 Kelvin.

Via SOPAS ET, the RS-422 interface or the Ethernet interface, the heater can be switched from “Automatic” to the manual “On” or “Off” operating mode.

In the manual operating modes, the heater automatically switches to “Automatic” mode when the upper or lower temperature warning limit is exceeded.

Fogging and/or frosting of the viewing window depends on the temperature, pressure and air humidity. The dew point and/or the frost point can be calculated from these values. To prevent fogging and/or frosting of the viewing window, the heater must be activated when the dew point or frost point is reached.



Parameter	Factory setting
-20 °C ... +20 °C	-10 °C

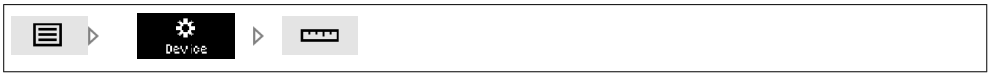
8.4.3 Defining the language

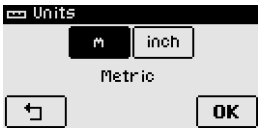
Selection of languages indicated on the display.

Parameter	Factory setting
DE: Deutsch | German	EN
EN: English | Englisch	

8.4.4 Defining units of measure

Selection of units indicated on the display.

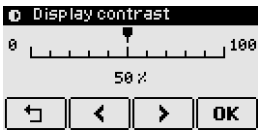




Parameter	Factory setting
m: Metric units m and C°	m
inch: Anglo-American units inch and F°	

8.4.5 Adjusting the display contrast

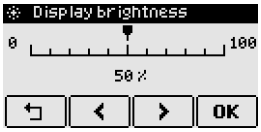
Adjust the display contrast to the lighting conditions at the location of use.



Parameter	Factory setting
0% to 100%	50%

8.4.6 Adjusting the display brightness

Adjust the display brightness to the lighting conditions at the location of use.



Parameter	Factory setting
0% to 100%	50%

8.4.7 Defining the display orientation

Define the display orientation. The display content can be rotated by 180°.

Parameter	Factory setting
0°: Display in original orientation	0°
180°: Display rotated by 180°	

8.5 Communication menu group

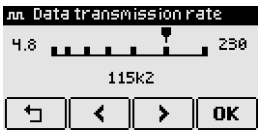
8.5.1 Configuring the serial interface

Configuration of the serial interface.

Parameter	Factory setting
RS-422: RS-422 interface	RS-422
SSI: SSI interface	

8.5.2 Defining the RS-422 data transmission rate

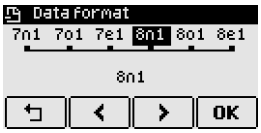
Define the data transmission rate (baud rate).



Parameter	Factory setting
4k8: 4800 baud	115k2
9k6: 9600 baud	
19k2: 19200 baud	
38k4: 38400 baud	
57k6: 57600 baud	
115k2: 115200 baud	
230k4: 230,400 Baud	

8.5.3 Defining the RS-422 data format

Define the data output format of the RS-422 interface.



Parameter	Factory setting
8n1: 8 data bits, no parity, 1 stop bit	8n1
8o1: 8 data bits, odd parity, 1 stop bit	
8e1: 8 data bits, even parity, 1 stop bit	
7n1: 7 data bits, no parity, 1 stop bit	
7o1: 7 data bits, odd parity, 1 stop bit	
7e1: 7 data bits, even parity, 1 stop bit	

8.5.4 Setting the continuous RS-422 output

Select the type of data output using the RS-422 interface.

The device can be configured so that the desired output value are output in a continuous data stream or on request:

- During “continuous data output”, the distance sensor provides distance values or selected combined data to the interface at defined intervals. The data output is started automatically after switching on the supply voltage. If the device has been configured for “data output on request”, continuous data output is started as soon as the desired output value (distance or combined values) is selected.
- During “data output on request”, the measured values are only transmitted to the controller on request. Continuous data transmission in this case must be deactivated by selecting “REQ”.

Parameter	Factory setting
Off: No continuous data output; data output active on request	Off
Distance: Continuous output of distance values	
Distance + speed: Continuous output of distance and speed values	
Distance + service: Continuous output of distance values and service data	
Distance + signal level (RSSI): Continuous output of distance and signal level values	

8.5.5 Defining the RS-422 output cycle time

Define the output cycle time of the data to be transmitted for continuous data output over the serial interface.

The output cycle time should not be shorter than the set measurement cycle time, since otherwise several identical values are output between two subsequent measurements cycles.

The minimum achievable output cycle time depends on the data transmission rate, the RS-422 data protocol (STX/ETX or CRLF) and the selected output value (distance, distance+speed etc.), see "RS-422 interface", page 21. If a shorter output cycle time is set, output is done in accordance with the values specified in table 12.

Parameter	Factory setting
Output cycle time: 0 ms ... 1,000 ms	1 ms

8.5.6 Defining the RS-422 data protocol

Define the data protocol (only for continuous output, see "Protocol types and data for continuous output", page 21).

Parameter	Factory setting
CR/LF: CarriageReturn/LineFeed as a separation symbol	CR/LF
STX/ETX: STX/ETX protocol	

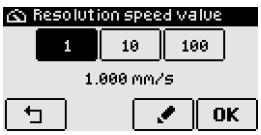
8.5.7 Defining the distance value resolution for the RS-422 data transfer

Define the resolution of the distance measured value for continuous output. The distance values are output in multiples of the set resolution. The resolution in request mode is always 1 mm.

Parameter	Factory setting
0.1: 0.1 mm	1 mm
1: 1 mm	
10: 10 mm	
100: 100 mm	
Free input: 0.001 mm ... 1000 mm	

8.5.8 Defining the speed value resolution for the RS-422 data transfer

Define the resolution of the speed measured value being output. The speed values are output in multiples of the set resolution.



Parameter	Factory setting
1: 1 mm/s	1 mm/s
10: 10 mm/s	
100: 100 mm/s	
Free input: 0.001 mm/s ... 1000 mm/s	

8.5.9 Defining SSI coding

Define the coding, "SSI (synchronous serial interface)", page 19.

Parameter	Factory setting
Gray 24+1: 24 measured value bits (gray) +1 error bit (binary)	Gray 24+1
Gray 24: 24 measured value bit (gray)	
Gray 25: 25 measured value bit (gray)	
Binary 24+1: 24 measured value bits (binary) +1 error bit (binary)	
Binary 24: 24 measured value bit (gray)	
Binary 25: 25 measured value bit (gray)	
Gray 24+8: 24 measured value bits (gray) +8 status bits (binary)	
Binary 24+8: 24 measured value bits (binary) +8 status bits (binary)	

8.5.10 Defining the distance value resolution for the SSI data transfer

Define the resolution of the output distance measured value. The distance values are output in multiples of the set resolution.

Parameter	Factory setting
0.1: 0.1 mm	0.1 mm
1: 1 mm	
10: 10 mm	
100: 100 mm	
Free input: 0.001 mm to 100 mm	

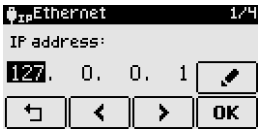
8.5.11 Defining Ethernet addressing mode

Ethernet address assignment selection. The network address can be obtained either dynamically using a DHCP server or set manually.

Parameter	Factory setting
DHCP: Automatic network address assignment	STATIC
STATIC: Manual network address assignment	

8.5.12 Entering an Ethernet IP address

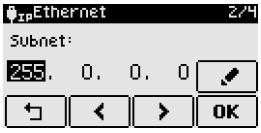
Display of the IP address and manual input in the event of non-dynamically assigned IP address.



Parameter	Factory setting
IP address	192.168.100.236

8.5.13 Entering an Ethernet subnet mask

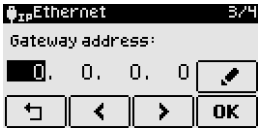
Subnet mask display and input.



Parameter	Factory setting
Subnet mask	255.255.255.0

8.5.14 Entering an Ethernet gateway address

Gateway address display and input.



Parameter	Factory setting
Gateway address	0.0.0.0

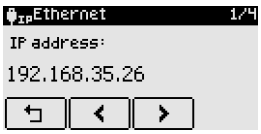
8.5.15 Displaying an Ethernet MAC address

MAC address display.

Parameter	Factory setting
MAC address	(device-specific)

8.5.16 Activating Ethernet DHCP

Activates the DHCP client and displays the network parameters that were obtained via DHCP. Use the arrow buttons to scroll through the individual parameters.



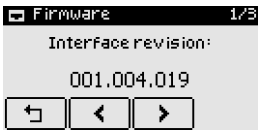
Parameter	Factory setting
-	-

8.6 Info menu group

8.6.1 Retrieving firmware information

Firmware version information.

Different firmware version parameters can be viewed using the arrow buttons.



Parameter	Factory setting
-	-

8.6.2 Retrieving hardware information

Information on the device hardware.

Different information on the device (e.g. serial number) can be viewed using the arrow buttons.

Parameter	Factory setting
-	-

8.6.3 Calling up device name

Show device name.

The device name can be assigned via SOPAS ET.

Parameter	Factory setting
-	-

8.6.4 Retrieving the counter readings of switching events

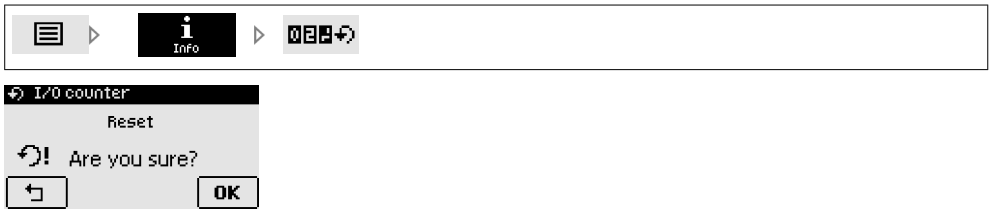
Shows the switching events counter for all digital interfaces since the last time the supply voltage was switched on.

The different counter readings can be viewed using the arrow buttons.

Parameter	Factory setting
-	-

8.6.5 Deleting the counter readings of switching events

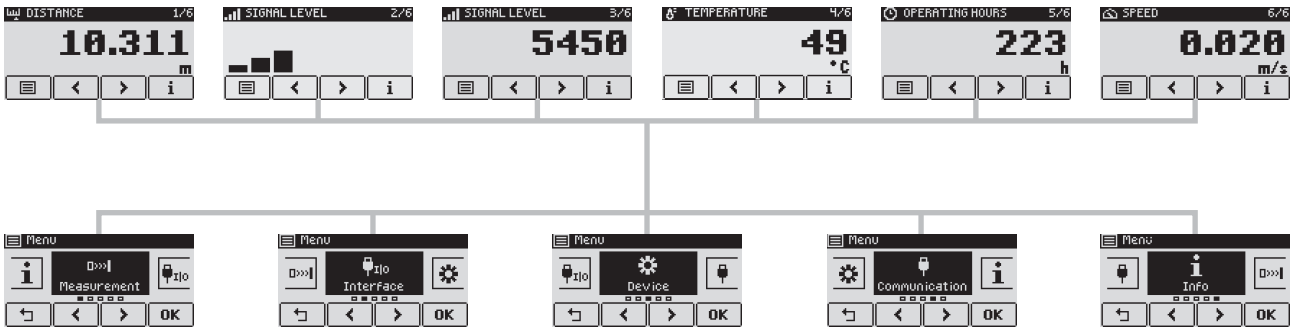
Upon confirmation, resets the switching event counters for all digital interfaces.



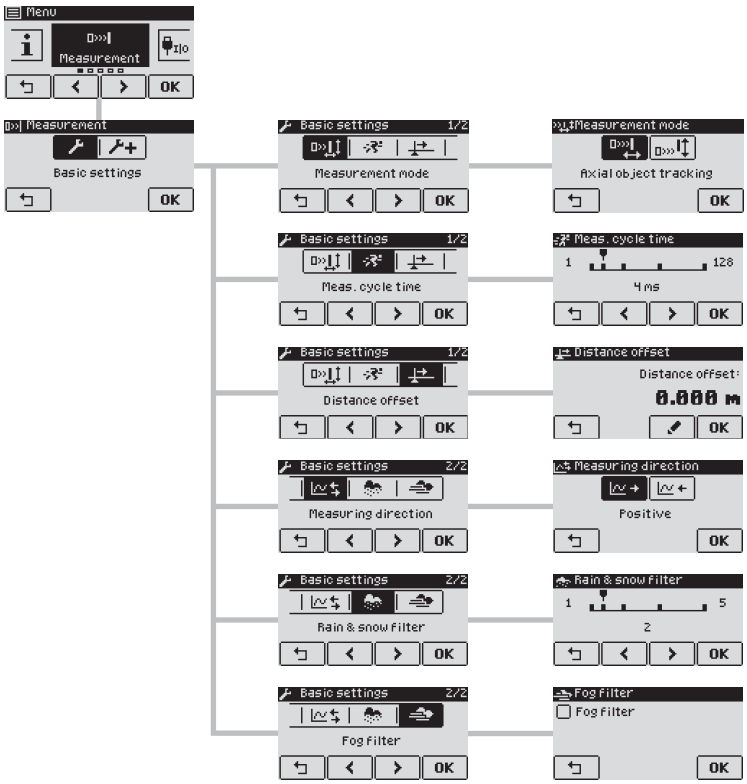
Parameter	Factory setting
-	-

8.7 Menu tree overview

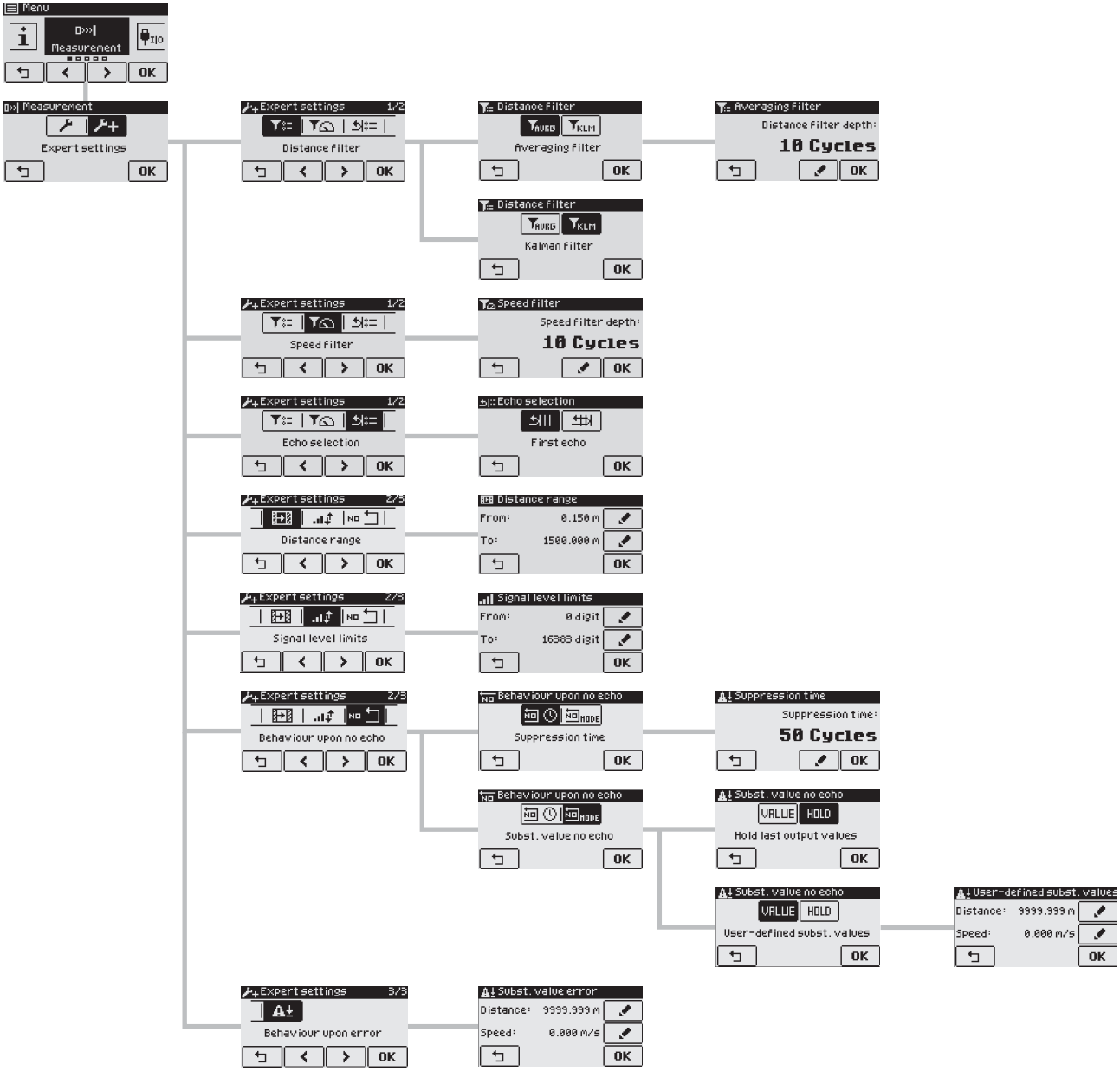
8.7.1 Main menu



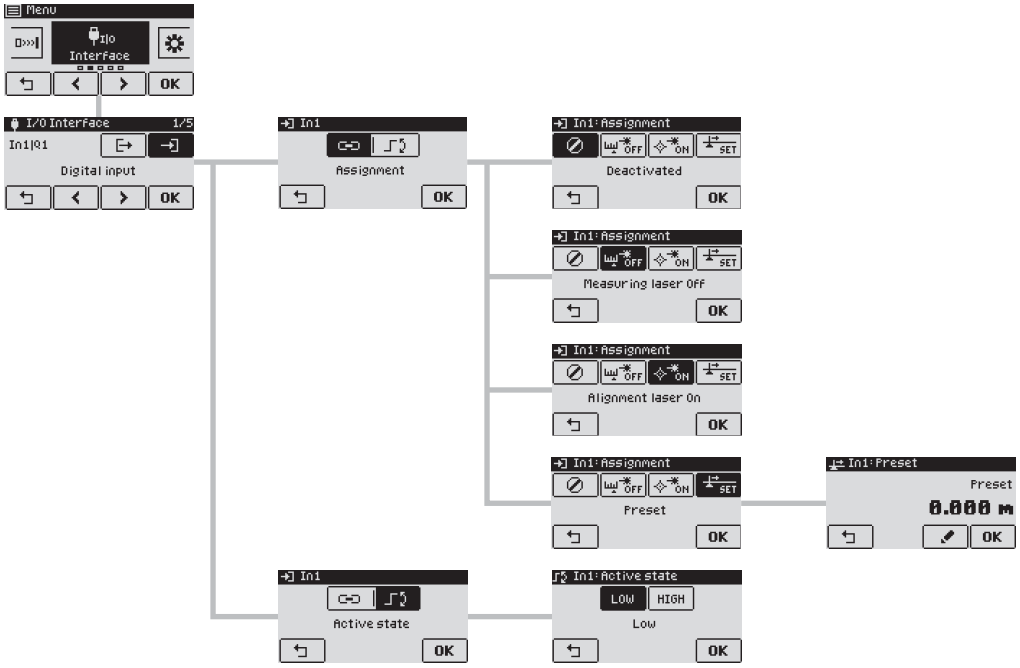
8.7.2 Measurement menu group: Basic settings



8.7.3 Measurement menu group: Expert settings



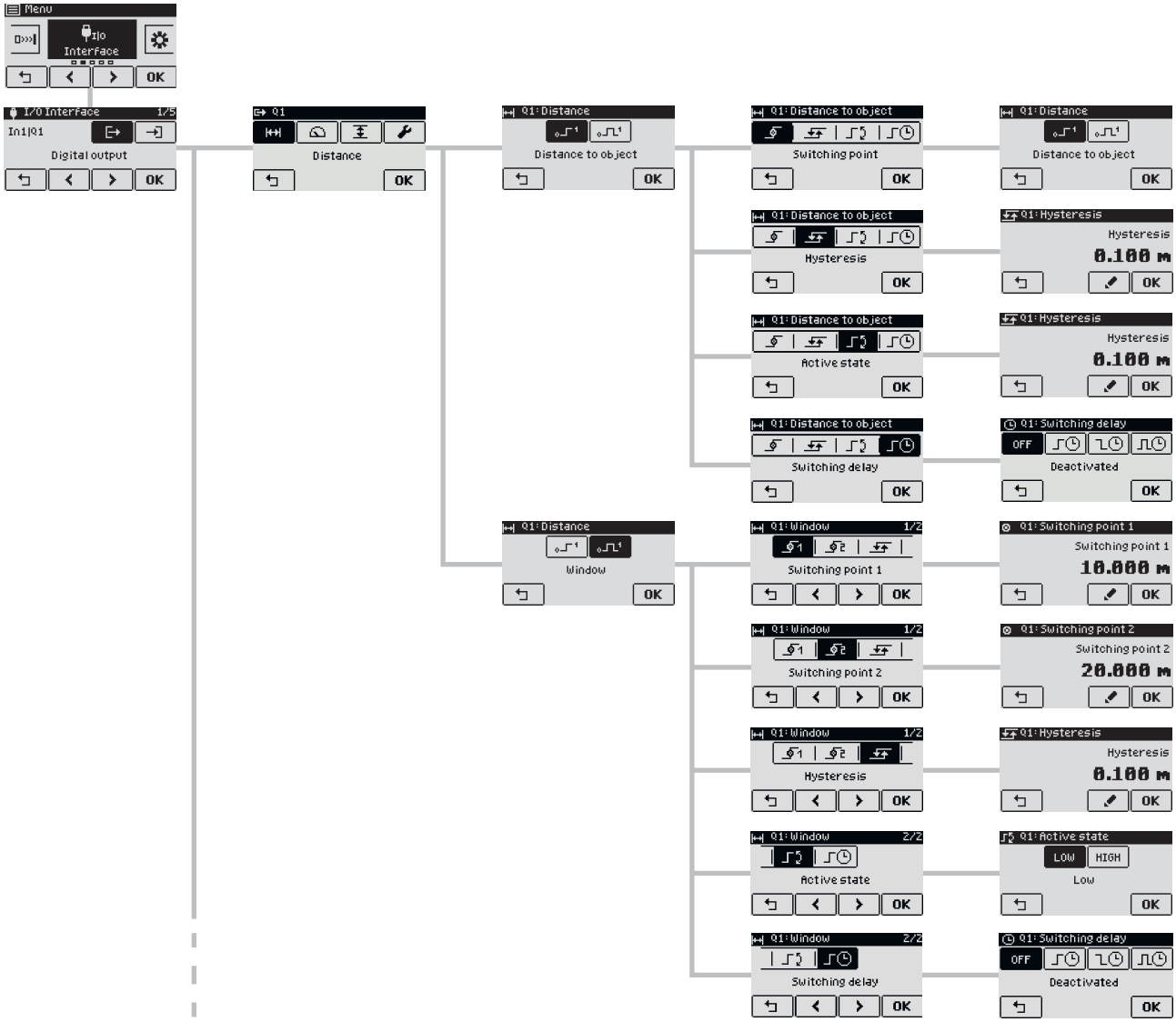
8.7.4 IO interface menu group: Digital input In1

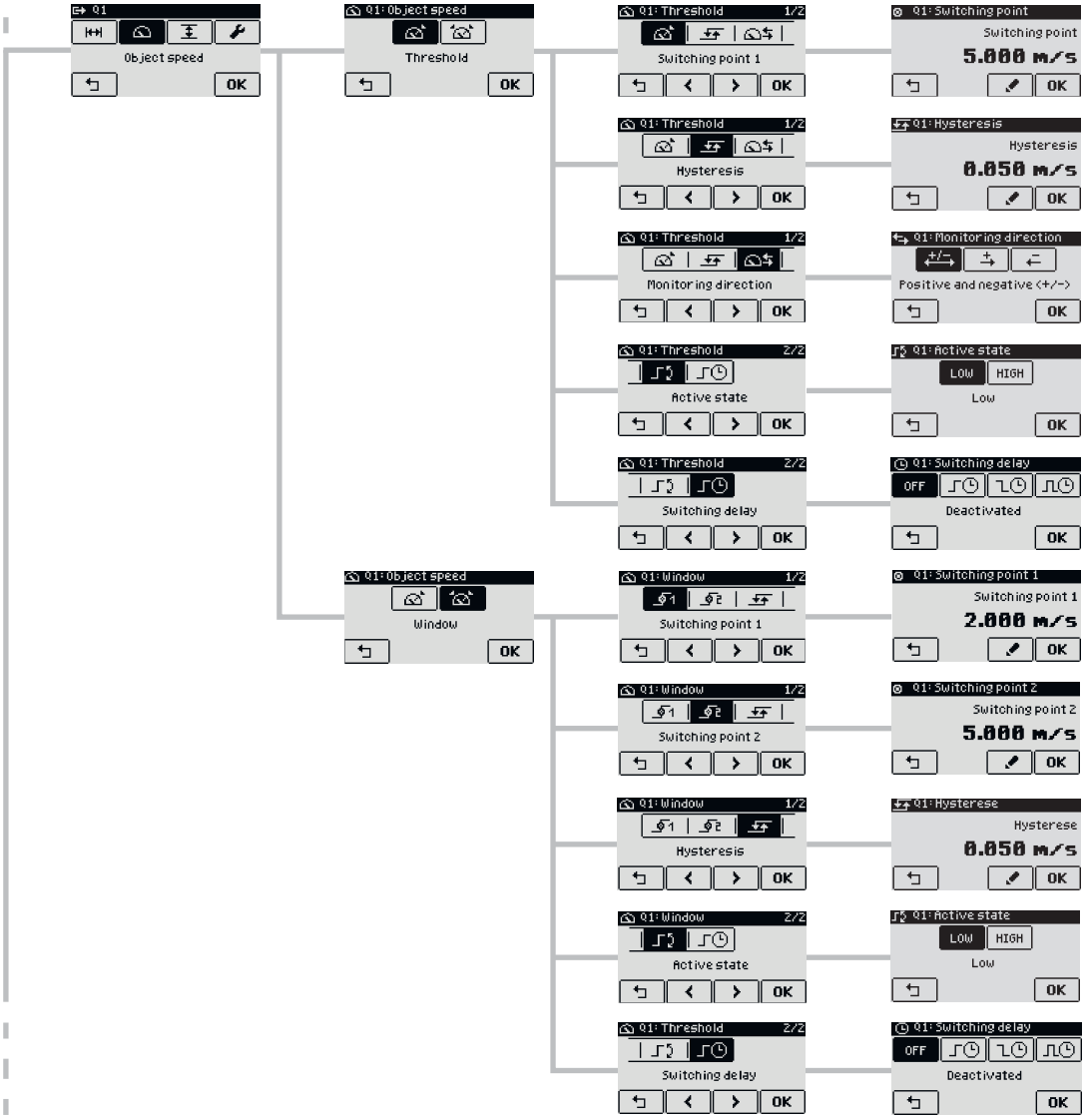


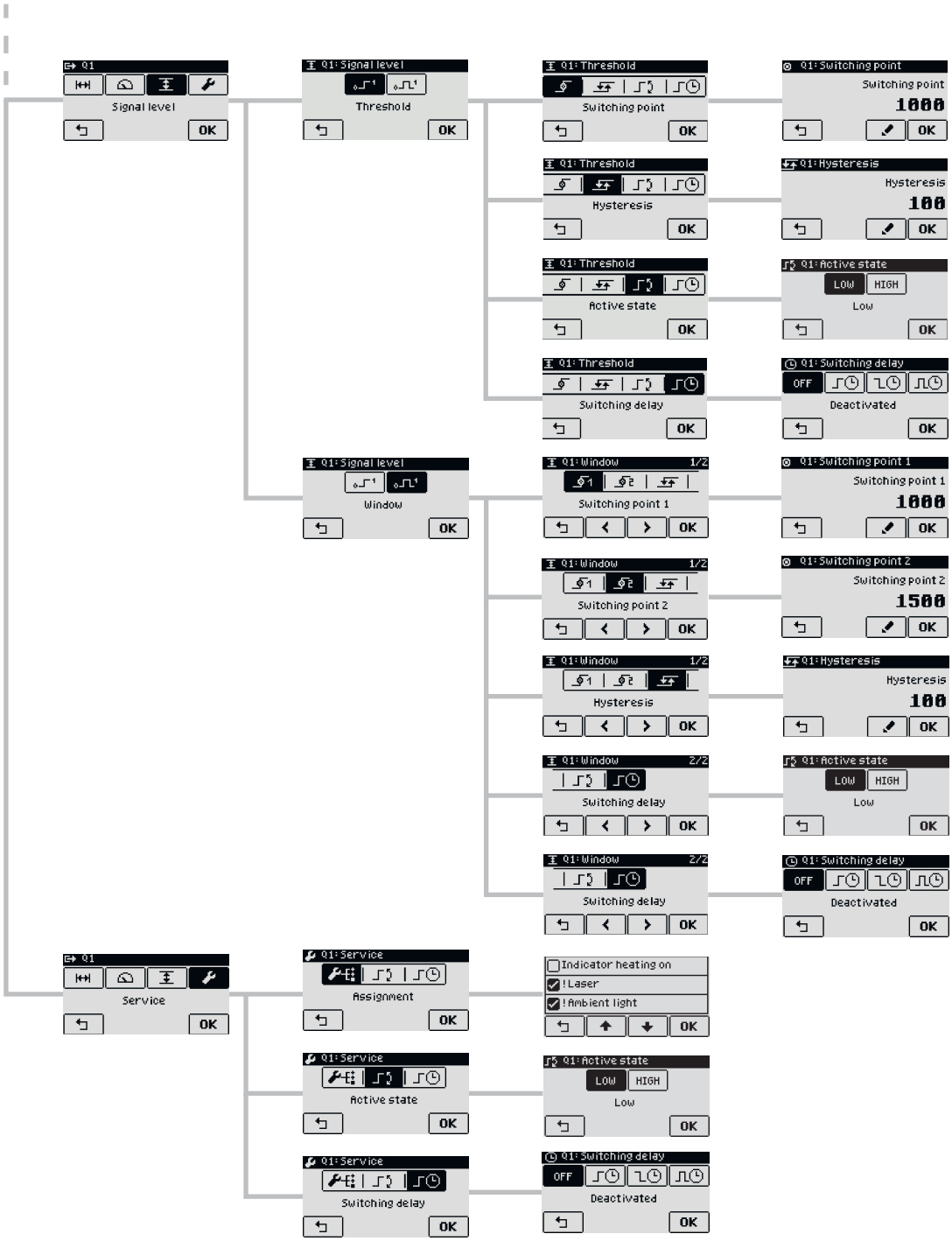
8.7.5 IO interface menu group: Digital output Q1 / Q2 / Q3 / Q4

NOTE

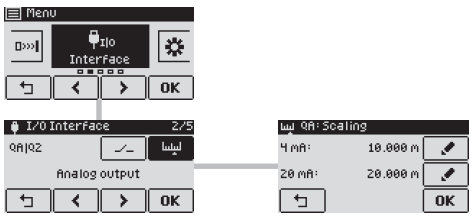
The menu structure of digital outputs Q1, Q2, Q3 and Q4 is identical. The menu tree is depicted with display images of digital output Q1.


Menu
Interface
OK
I/O Interface
1/5
In1|Q1
Digital output
Q1
Distance
Q1: Distance
Distance to object
Q1: Distance to object
Switching point
Hysteresis
Active state
Switching delay
Q1: Hysteresis
0.100 m
Q1: Switching delay
OFF
Deactivated
Window
Q1: Window
1/2
Switching point 1
10.000 m
Switching point 2
20.000 m
2/2
Q1: Active state
LOW
HIGH
Low

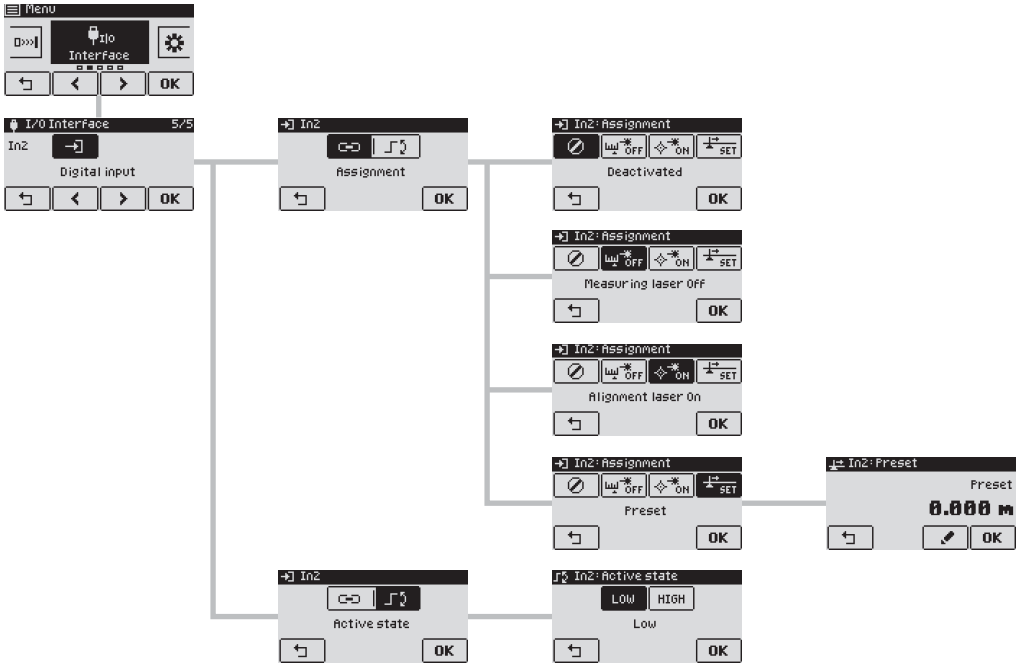

Q1
Object speed
OK
Q1: Object speed
Threshold
OK
Q1: Threshold 1/2
Switching point 1
OK
Q1: Switching point
Switching point
5.000 m/s
OK
Q1: Threshold 1/2
Hysteresis
OK
Q1: Hysteresis
Hysteresis
0.050 m/s
OK
Q1: Threshold 1/2
Monitoring direction
OK
Q1: Monitoring direction
Positive and negative (+/-)
OK
Q1: Threshold 2/2
Active state
OK
Q1: Active state
LOW
HIGH
Low
OK
Q1: Threshold 2/2
Switching delay
OK
Q1: Switching delay
OFF
Deactivated
OK
Q1: Object speed
Window
OK
Q1: Window 1/2
Switching point 1
OK
Q1: Switching point 1
Switching point 1
2.000 m/s
OK
Q1: Window 1/2
Switching point 2
OK
Q1: Switching point 2
Switching point 2
5.000 m/s
OK
Q1: Window 1/2
Hysteresis
OK
Q1: Hysterese
Hysterese
0.050 m/s
OK
Q1: Window 2/2
Active state
OK
Q1: Active state
LOW
HIGH
Low
OK
Q1: Threshold 2/2
Switching delay
OK
Q1: Switching delay
OFF
Deactivated
OK



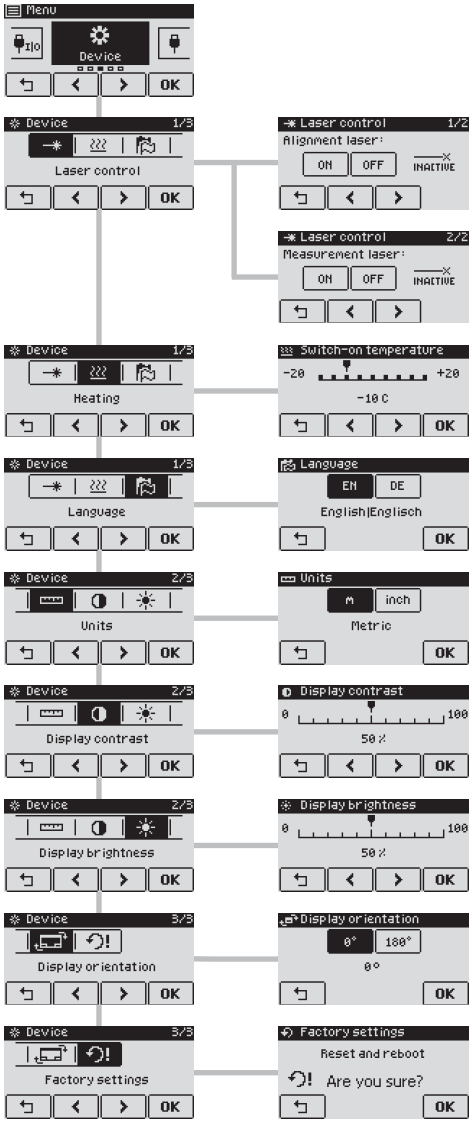
8.7.6 IO interface menu group: Analog output QA



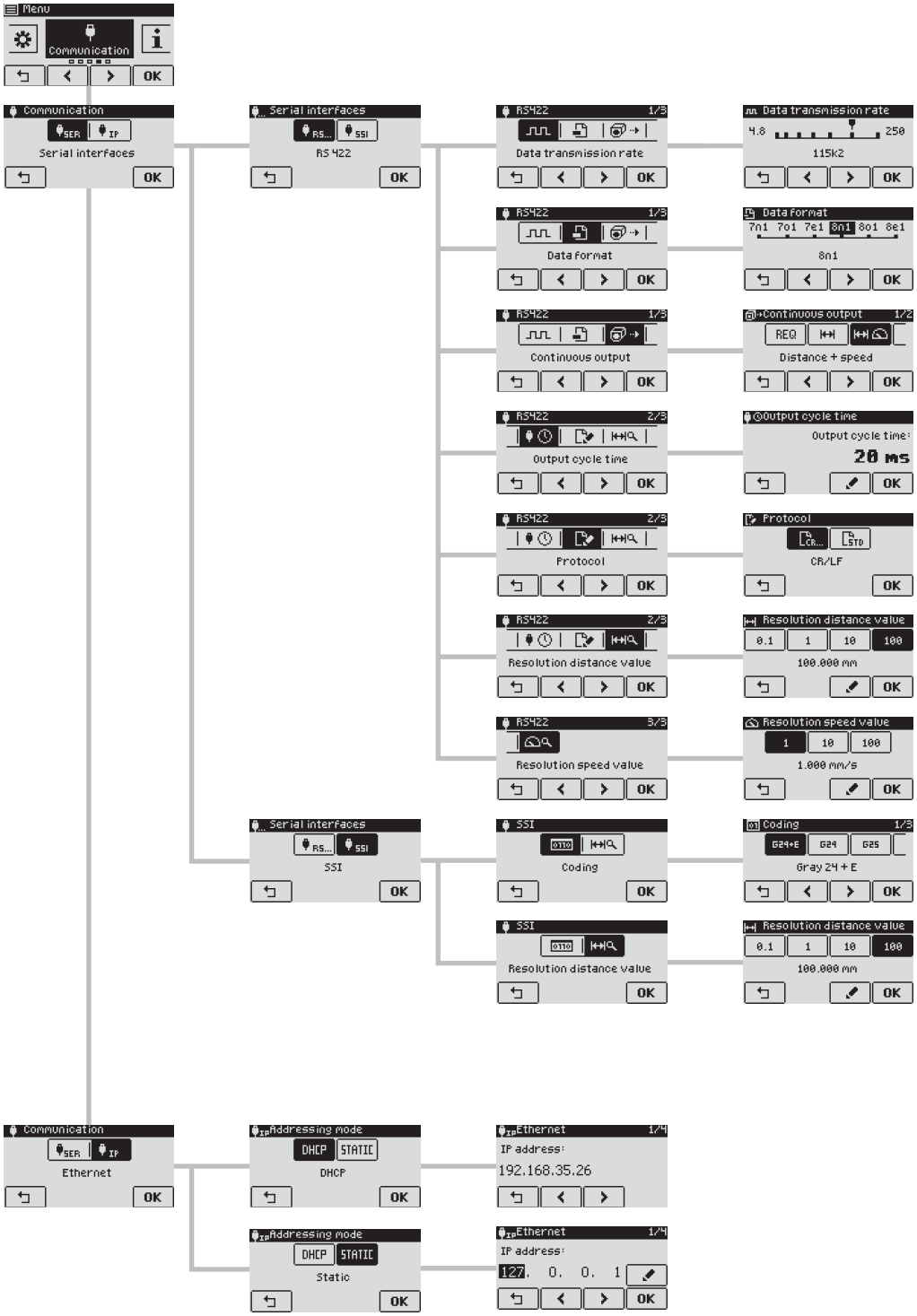
8.7.7 IO interface menu group: Digital input In2



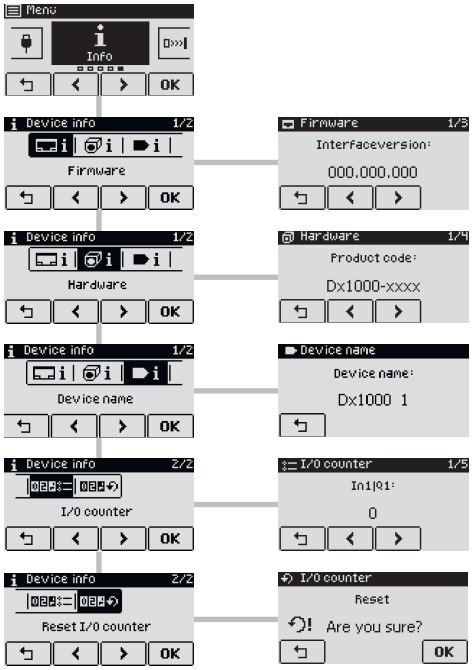
8.7.8 Device menu group



8.7.9 Communication menu group



8.7.10 Info menu group



9 Maintenance

9.1 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 a commercially available glass cleaning spray.

9.2 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 33: 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
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

10 Troubleshooting

General faults are subdivided into warnings and errors. Current measured values continue being output when there are warnings; measurement is no longer possible when there are errors.

Possible faults and rectification measures are described in the table below. In the case of faults that cannot be rectified using the information below, please contact the manufacturer. See the back page for your agency.

Warnings and errors are described in a status word which is shown on the device display and is output via the RS-422 interface in the upper half (byte 3 and byte 2) of a double word coded in hexadecimals.

The status bits can also be output via the Ethernet interface, see Dx1000 Telegram Listing (English, part number 8021820).

The lower half of the double word (byte 1 and byte 0) contains, among other things, the status of the digital outputs, the activity indication of the measuring laser and the alignment laser as well as other functions. The entire status double word is shown in table 35.

Press the **i** button to display the device status.

Pending errors and warnings present can be called up in the display via the **[WARNG]** and **[ERROR]** buttons or read out via SOPAS ET.

Table 34: Assignment of status double word to error/warning

Byte 3 and 2 status double word	Error/Warning	Cause and measures
0x**8000**...	Error laser	Device is no longer functional. Contact SICK Service.
0x**4000**...	Error hardware	Device is no longer functional. Contact SICK Service.
0x**0080**...	Warning laser	Laser age. Keep a replacement device ready for use.
0x**2000**...	Error measurement	Optical interference. Check measuring distance.
0x**1000**...	Error temperature	Internal device temperature is outside the permitted range. Lower ambient temperature of the sensor.
0x**0010**...	Warning temperature	Internal device temperature is outside the warning limits. Lower ambient temperature of the sensor.
0x**0800**...	Error ambient light	Signal level outside the permitted range due to ambient light (e.g. strong sunlight or thermal radiation of measuring objects > 1200 °C). Protect sensor from ambient light (e.g. protective housing with tube or optional additional filter for high-temperature applications).
0x**0008**...	Warning ambient light	Signal level outside the warning limits due to ambient light (e.g. strong sunlight or thermal radiation of measuring objects > 1200 °C). Protect sensor from ambient light (e.g. protective housing with tube or optional additional filter for high-temperature applications).

Byte 3 and 2 status double word	Error/Warning	Cause and measures
0x**0040**...	Warning firmware	Firmware update has failed. Prevent interruption of voltage supply, repeat firmware update.
0x**0020**...	Warnign short-circuit	Short-circuit at one of the digital outputs. Remove the short-circuit.
0x**0000**	(No warning or error, device OK)	-

Table 35: Definition of device status double word

Byte	Bits	Device state	Grouping (for SSI status bits)	Status bit assignment/ SSI24+1	Status bit assignment/ SSI24+8
3	31	Error laser	Device error (DE)	Bit 0	Bit 7
	30	Error hardware			
	29	Error measurement			
	28	Error temperature	Application error (AE)		Bit 6
	27	Error ambient light			
	26	Reserved			
	25	Reserved			
	24	Reserved			
2	23	Warning: Laser	Device warning (DW)		Bit 5
	22	Firmware warning			
	21	Warning: Short-circuit at switching output	Application warning (AW)		Bit 4
	20	Warning: Temperature			
	19	Warning: Ambient light			
	18	Reserved			
	17	Reserved			
	16	Reserved			
1	15	Alignment laser active			
	14	Measurement laser active			
	13	Heating active			
	12	No echo: delay time active			
	11	No echo			
	10	Status In2			
	9	Status Q4			Bit 3
	8	Status Q3			Bit 2
0	7	Status Q2			Bit 1
	6	Status Q1/In1			Bit 0
	5	Reserved			
	4	Signal level Q4			
	3	Signal level Q3			
	2	Signal level Q2			
	1	Signal level Q1/In1			
	0	Reserved			

10.1 Information for the service case

You should collect and write down the following device information ahead of time if you need to contact the manufacturer's service department:

- Information about the firmware version, see "Retrieving firmware information", page 87
- Information about the hardware, see "Retrieving hardware information", page 88
- Operating hours information, see "Operating time display", page 51

10.2 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

10.3 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.

10.4 Disposal

CAUTION

Risk of injury due to hot device surface.

The surface of the device can become hot during operation.

- 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.

11 Technical data

NOTE

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

- www.sick.com/Dx1000

Please note: This documentation may contain further technical data.

11.1 Performance

Product type	DL1000	DT1000
Measuring range	0.2 m ... 1,500 m ·, see "Measuring range diagrams", page 105	0.2 m ... 460 m ·, see "Measuring range diagrams", page 105
Resolution	0.001 mm ... 100 mm, adjustable	
Reproducibility	1 mm ... 15 mm ···, see "Repeatability diagrams", page 107	1 mm ... 15 mm ···, see "Repeatability diagrams", page 107
Accuracy (distance)	Typically ± 15 mm , see "Measurement accuracy diagrams", page 113	
Measurement accuracy (speed)	Typically ± 10 mm/s	
Response time	3 ms ... 384 ms	
Measurement cycle time	1 ms, 4 ms, 16 ms	1 ms, 4 ms, 16 ms, 64 ms, 128 ms
Max. axial traversing speed	128 m/s (at 1 ms measurement cycle time) 32 m/s (at 4 ms measurement cycle time) 8 m/s (at 16 ms measurement cycle time)	128 m/s (at 1 ms measurement cycle time) 128 m/s (at 4 ms measurement cycle time) 128 m/s (at 16 ms measurement cycle time) 2 m/s (at 64 ms measurement cycle time) 1 m/s (at 128 ms measurement cycle time)
Max. acceleration	150 m/s²	150 m/s² (at 1, 4 or 16 ms measurement cycle time) 31.3 m/s² (at 64 ms measurement cycle time) 7.8 m/s² (at 128 ms measurement cycle time)
Light sender	Measurement laser, infrared (invisible, wavelength 905 nm, max. output power ≤ 21 W, pulse length 2.5 ns) Alignment laser, red (visible, wavelength 650 nm, max. output power ≤ 390 µW, pulse length 50 ms)	
Laser class	1 (EN 60825-1, even with simultaneous operation of measurement and alignment laser) Complies with 21 CFR 1040.10 and 1040.11 except for tolerances according to “Laser Notice No. 50”, dated June 24, 2007.	

Product type	DL1000	DT1000
Typical light spot size W x H (distance)	5 mm x 20 mm (at 1 m) 20 mm x 20 mm (at 5 m) 35 mm x 25 mm (at 10 m) 150 mm x 50 mm (at 50 m) 290 mm x 80 mm (at 100 m) 570 mm x 140 mm (at 200 m) 4,200 mm x 920 mm(at 1,500 m)	5 mm x 20 mm (at 1 m) 20 mm x 20 mm (at 5 m) 20 mm x 20 mm (at 10 m) 20 mm x 20 mm (at 50 m) 20 mm x 20 mm (at 100 m) 20 mm x 20 mm (at 200 m)
Filter	Rain and snow filter Fog filter Moving average distance value Kalman filter Moving average speed value	
Maximum object temperature	n/a	+1,400 °C
Additional function	Selection of the relevant distance and signal level range, selection of first or last echo in the selected distance and signal level range	
Average service life of measurement laser (at 25 °C)	100,000 hours	

1) With max. ambient light 100 kLux sunlight
2) On “diamond grade” reflective tape (DG983)
3) Dependent on reflector size and measurement cycle time
4) Dependent on remission factor and measurement cycle time
5) 6% ... 90% remission factor
6) Data interface resolution
7) 1 σ statistical error, ambient conditions constant, min. power-up delay of 15 minutes
8) At T = +23 °C and after warm-up time > 15 minutes
9) Values apply for “Axial object tracking” measurement mode with factory settings (measurement cycle time 4 ms, Kalman filter on, speed filter 10 cycles)
10) Values apply for the following settings: Rain and snow filter deactivated, distance average filter deactivated (filter depth 1 cycle)
11) For high-temperature applications (typically > 1,200 °C) when the the “Ambient light” warning or error occurs: only with optional additional filter for high-temperature applications (part number 2088511).

11.1.1 Measuring range diagrams

DL1000 measuring range diagram

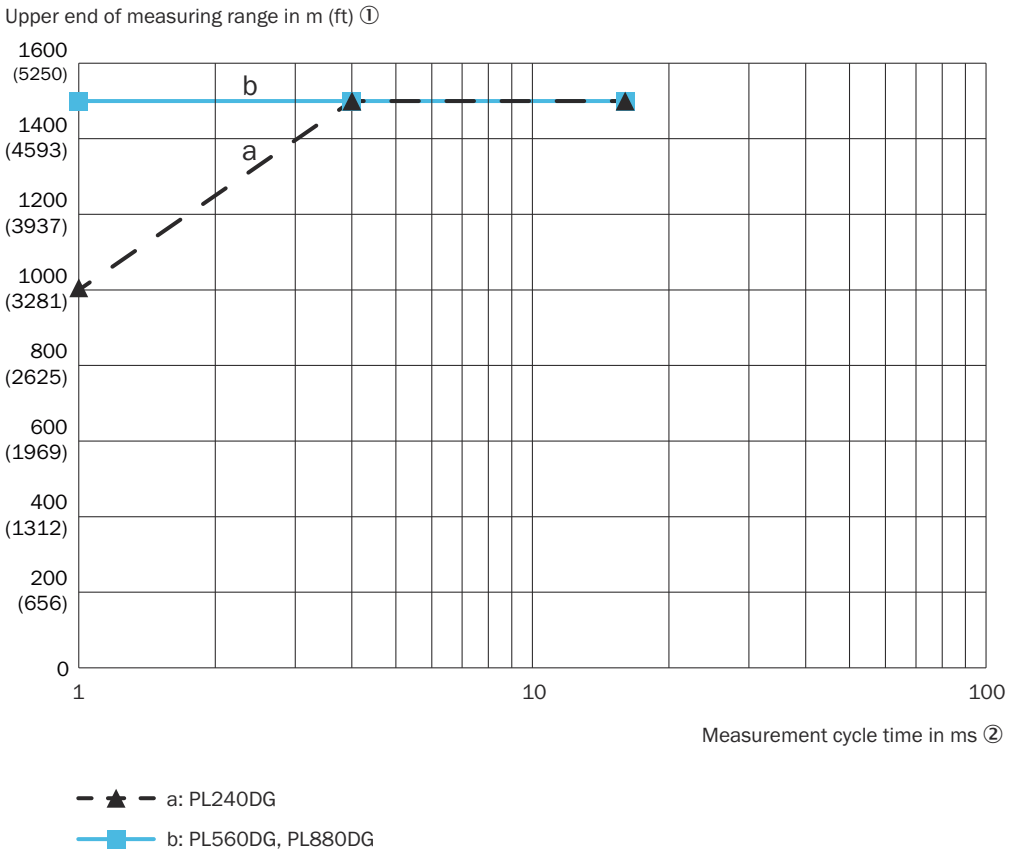


Figure 30: Upper end of DL1000 measuring range with PLxxxDG reflectors

① Upper end of measuring range in m (ft)

② Measurement cycle time in ms

DT1000 measuring range diagram

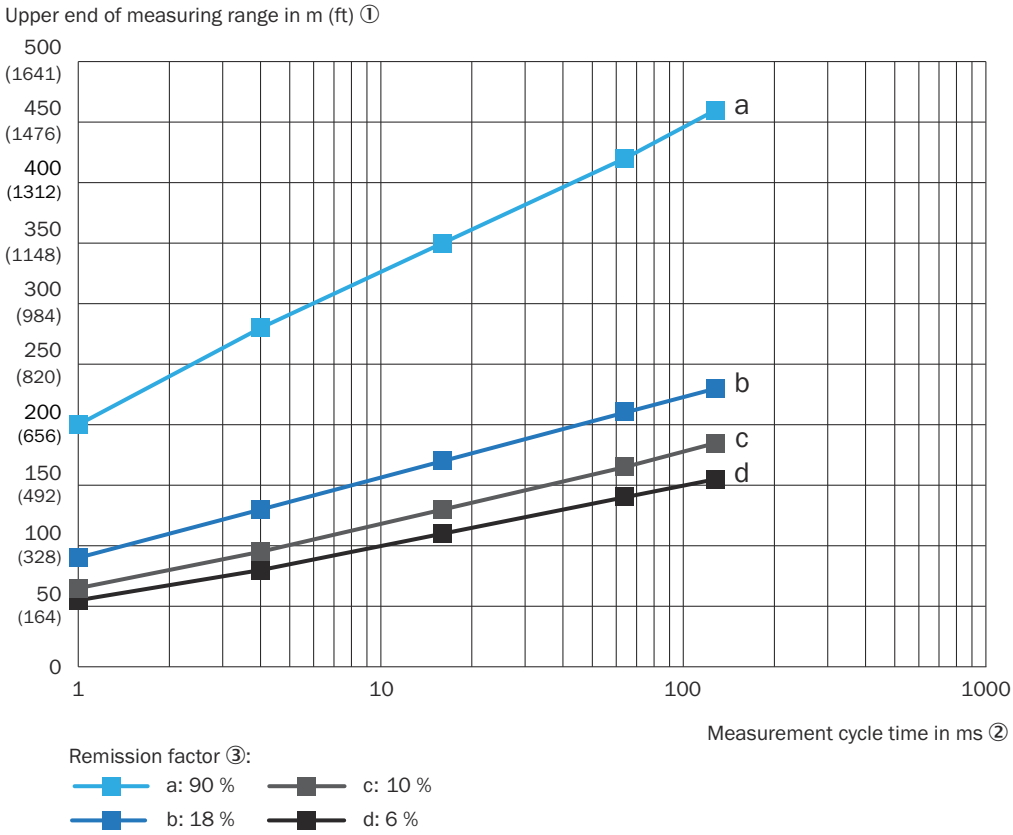


Figure 31: Upper end of DT1000 measuring range

① Upper end of measuring range in m (ft)

② Measurement cycle time in ms

③ Remission factor

11.1.2 Repeatability diagrams

DL1000 repeatability diagram

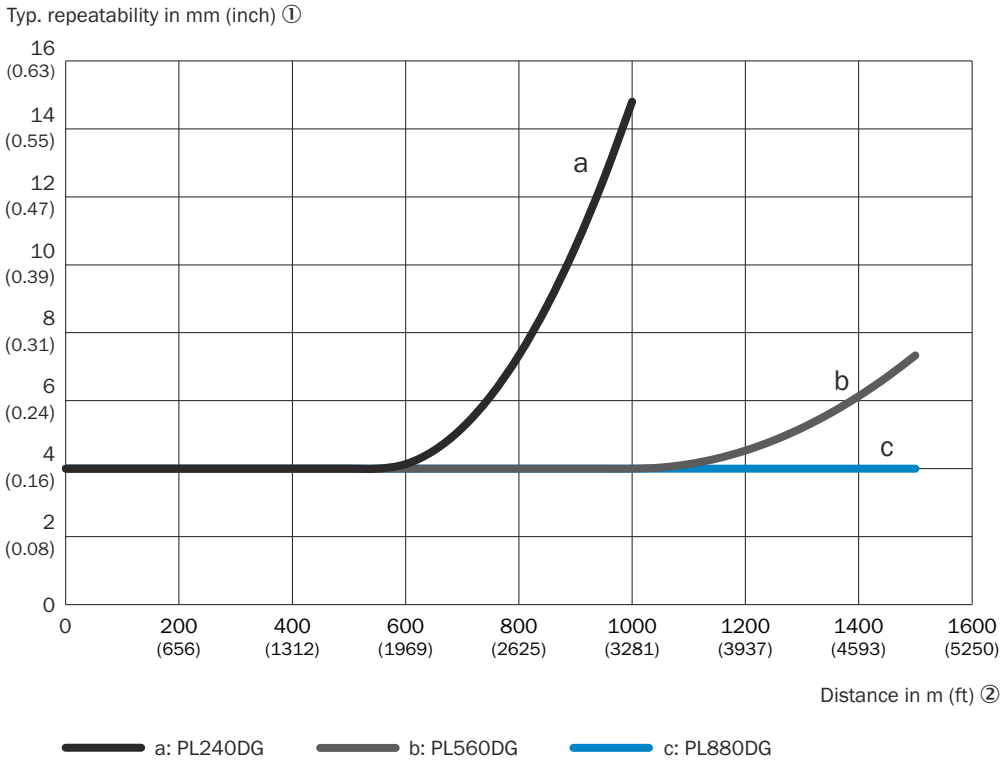


Figure 32: DL1000 repeatability with 1 ms measurement cycle time

① Typical repeatability in mm (inch)

② Distance in m (ft)

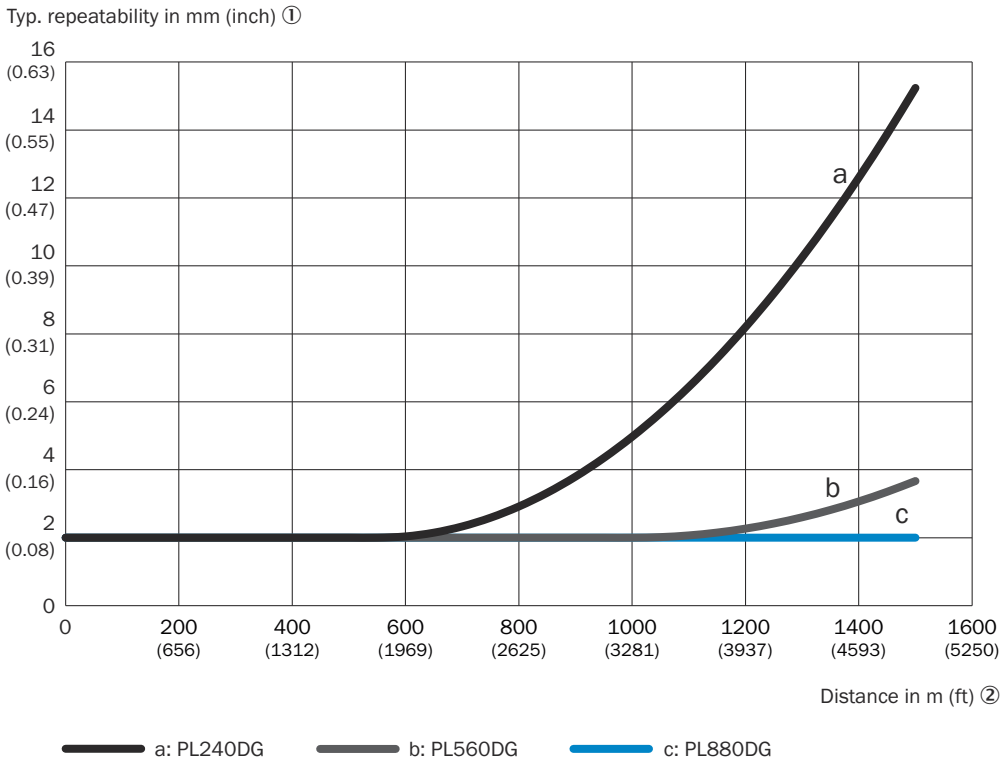


Figure 33: DL1000 repeatability with 4 ms measurement cycle time

① Typical repeatability in mm (inch)

② Distance in m (ft)

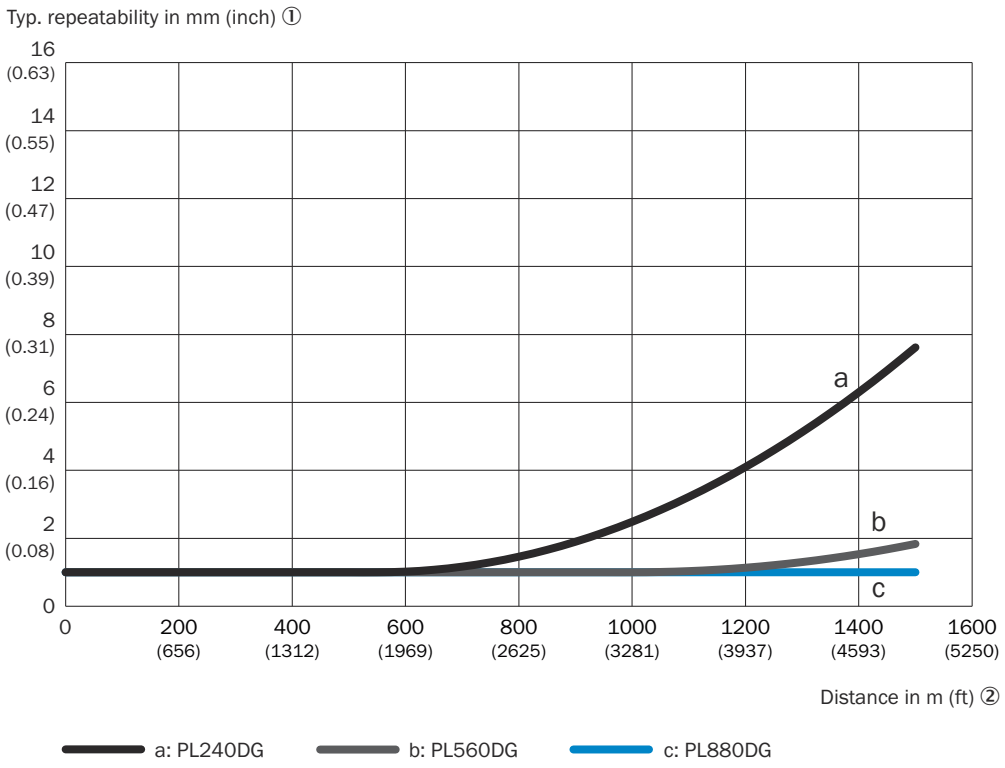


Figure 34: DL1000 repeatability with 16 ms measurement cycle time

① Typical repeatability in mm (inch)

② Distance in m (ft)

DT1000 repeatability diagram

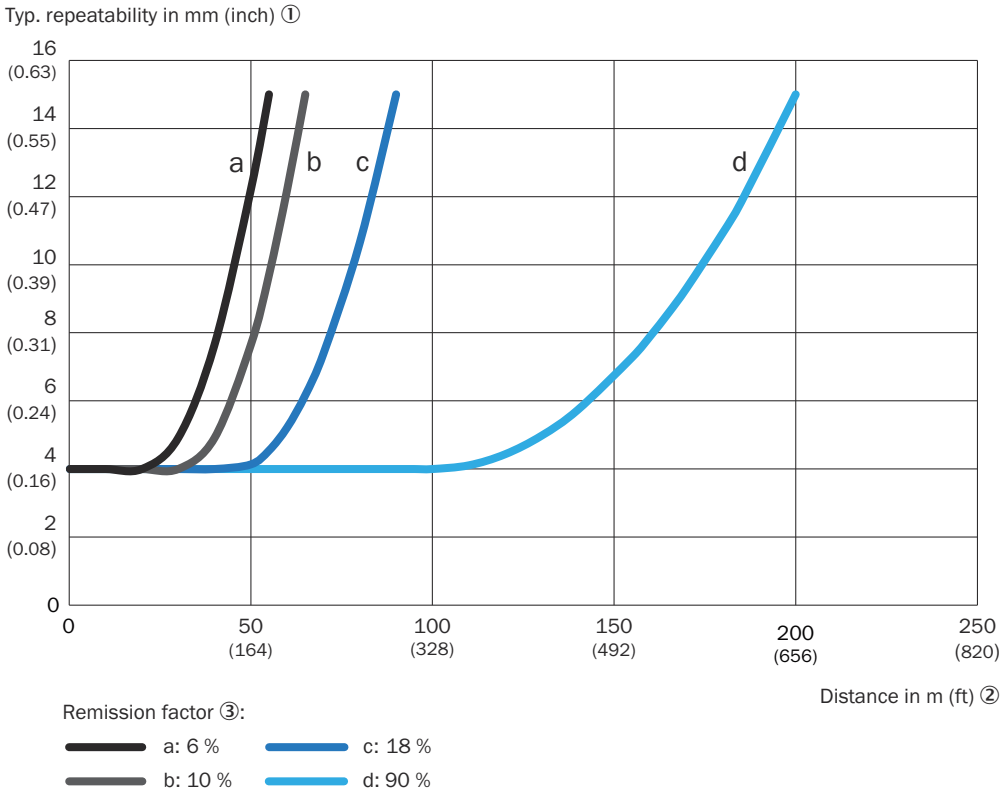


Figure 35: DT1000 repeatability with 1 ms measurement cycle time

① Typical repeatability in mm (inch)

② Distance in m (ft)

③ Remission factor

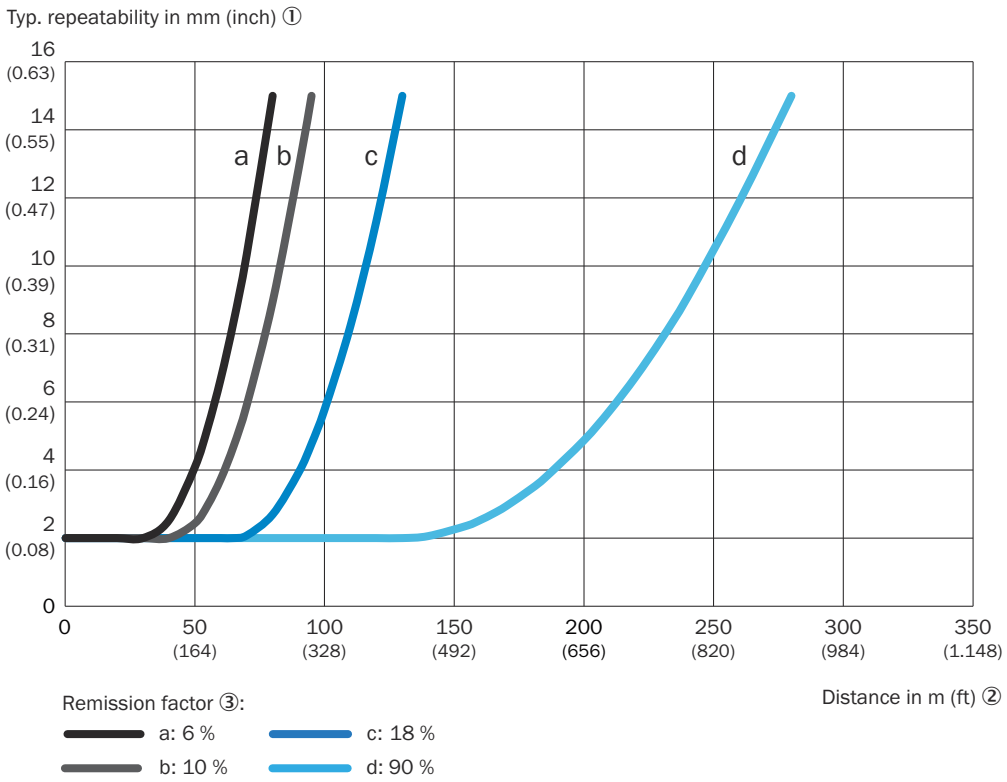


Figure 36: DT1000 repeatability with 4 ms measurement cycle time

① Typical repeatability in mm (inch)

② Distance in m (ft)

③ Remission factor

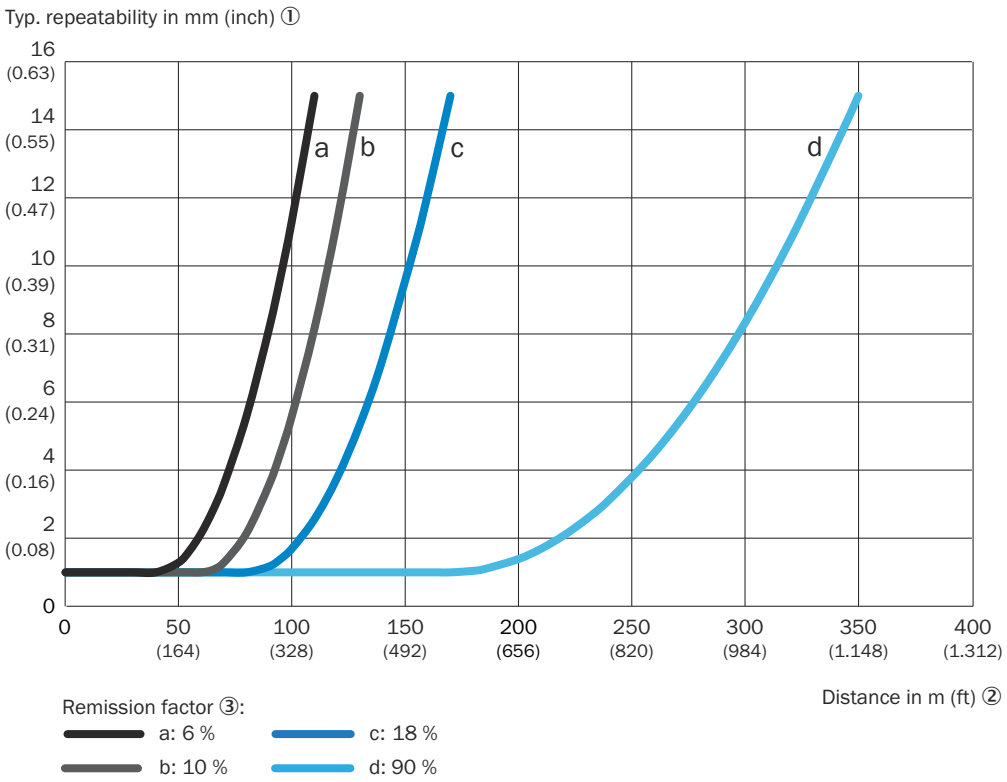


Figure 37: DT1000 repeatability with 16 ms measurement cycle time

① Typical repeatability in mm (inch)

② Distance in m (ft)

③ Remission factor

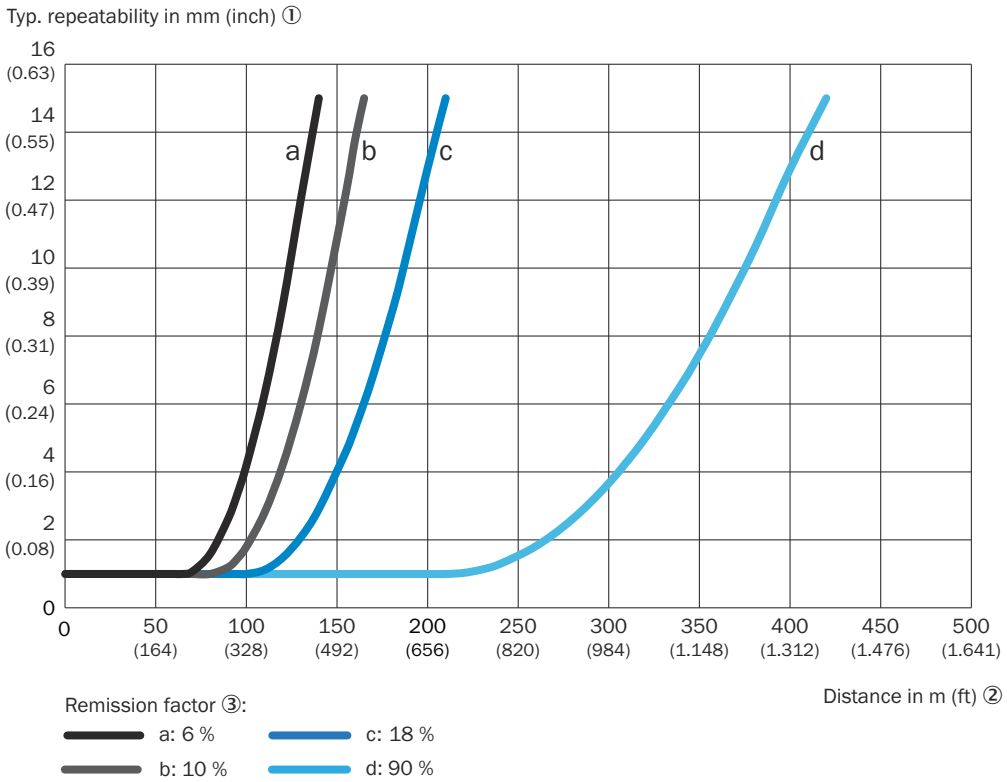


Figure 38: DT1000 repeatability with 64 ms measurement cycle time

① Typical repeatability in mm (inch)

② Distance in m (ft)

③ Remission factor

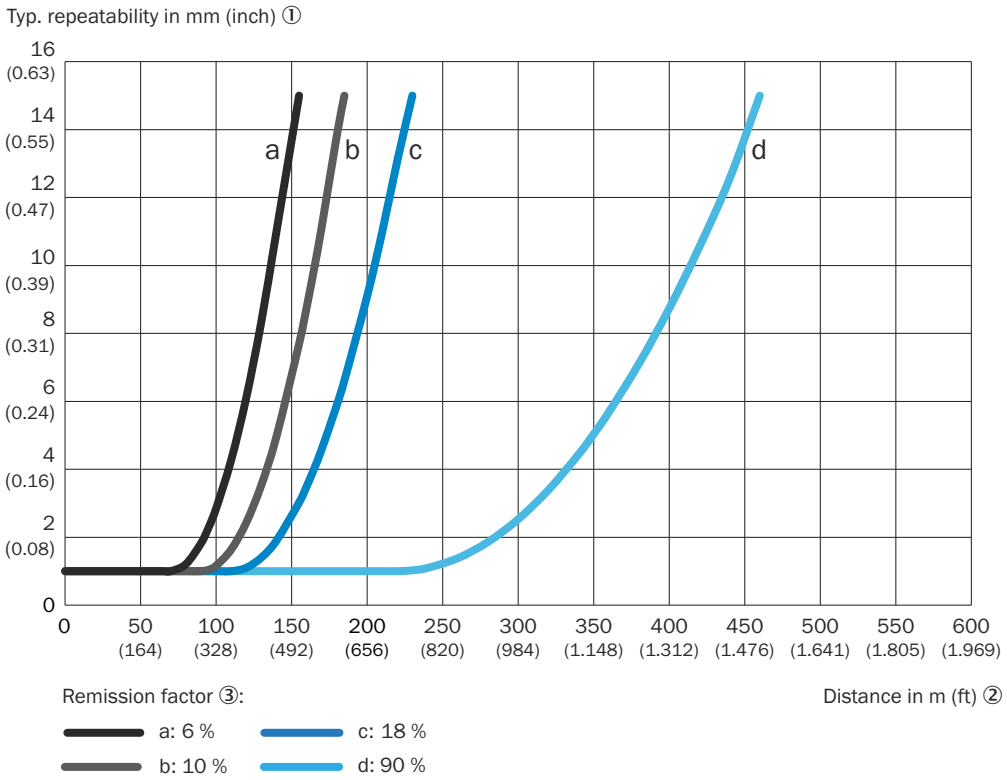


Figure 39: DT1000 repeatability with 128 ms measurement cycle time

① Typical repeatability in mm (inch)
② Distance in m (ft)
③ Remission factor

11.1.3 Measurement accuracy diagrams

DL1000 measurement accuracy diagrams

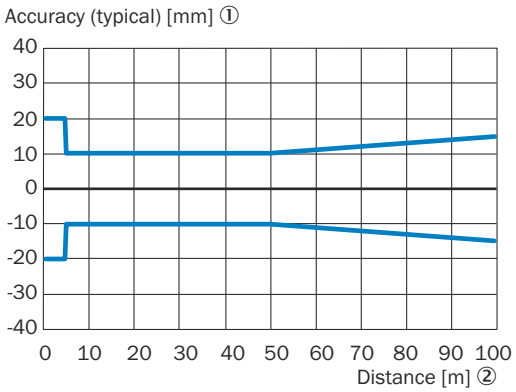


Figure 40: Typical DL1000 measurement accuracy in range 0.2 m ... 100 m

① Accuracy (typical) [mm]
② Distance [m]

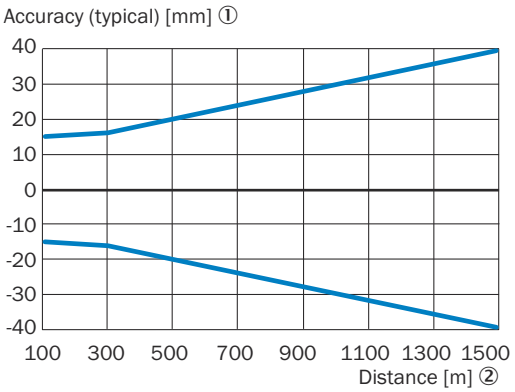


Figure 41: Typical DL1000 measurement accuracy in range 100 m ... 1,500 m

① Accuracy (typical) [mm]
② Distance [m]

DT1000 measurement accuracy diagram

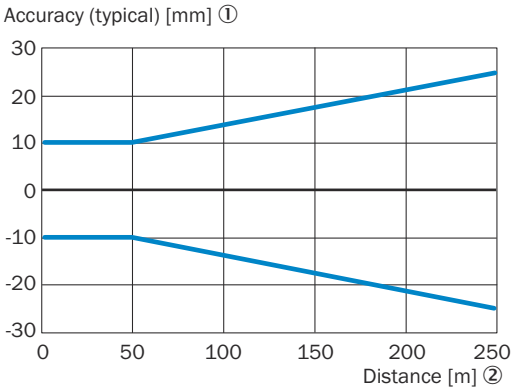


Figure 42: Typical DT1000 measurement accuracy in range 0.2 m ... 250 m

① Accuracy (typical) [mm]

② Distance [m]

11.2 Interfaces

Product type	DL1000 and DT1000
Inputs/outputs	In1/Q1: digital input, digital output (switchable) QA/Q2: analog output, digital output (switchable) Q3: digital output Q4: digital output In2: digital input
Digital Input	Switching type: Sink for PNP output (open input corresponds to the LOW input signal) Input current: 7 mA (typical), at switching voltage < (Uv - 1 V) Circuit protection: reverse polarity protected HIGH switching voltage: min. 13 V (In1), min. 8 V (In2) LOW switching voltage: max. 8 V (In1), max. 5 V (In2) Switching functions: deactivate measuring laser, activate alignment laser, preset
Digital outputs	Switching type: push-pull Continuous current: max. 100 mA Circuit protection: short-circuit protected HIGH residual voltage: min. U_v -4 V LOW residual voltage: max. 3 V Capacitive load: max. 100 nF Inductive load: max. 20 mH Switching functions: distance to the object, distance switching window, switching point for object speed, service functions
Analog output	Current: 4 mA ... 20 mA (working range 3.8 mA ... 20.5 mA), can be freely scaled in distance value range Current limit values: 3.0 mA and 21.5 mA (NAMUR downtime information) Maximum load resistance: (Uv - 7 V) / 21.5 mA (corresponds to 510 Ω ... 1,070 Ω at Uv = 18 V ... 30 V) Resolution: 16 bit

Product type	DL1000 and DT1000
SSI, RS-422	Switchable Function: measurement data output (distance output value, speed output value, device status, signal level) RS-422-Baudraten: 4.8 kbit/s; 9.6 kbit/s; 19.2 kbit/s; 38.4 kbit/s; 57.6 kbit/s; 115.2 kbit/s; 230.4 kbit/s RS-422 data format: 8n1 (8 data bits, no parity, 1 stop bit), 8o1 (8 data bits, odd parity, 1 stop bit), 8e1 (8 data bits, even parity, 1 stop bit), 7n1 (7 data bits, no parity, 1 stop bit), 7o1 (7 data bits, odd parity, 1 stop bit), 7e1 (7 data bits, even parity, 1 stop bit) Output protocol: 8 bit ASCII-coded characters SSI baud rates: 70 kHz ... 500 kHz bit pulse
Ethernet	Function: Parameterization, measurement data output (TCP/IP). Not real-time capable. Transmission characteristics depend on external network.

11.3 Mechanics/electronics

Product type	DL1000 and DT1000
Supply voltage V_s	DC 18 V ... 30 V, reverse polarity protected, SELV or PELV
Residual ripple	≤ 5 V_{ss}
Power consumption P_v	With heater switched off (≤ 22 W) With heater switched on (≤ 35 W)
Initialization time	< 15 s
Housing material	Aluminum alloy Glass Polycarbonate PA
Connection type	M12 round connector x 1
Display	Graphical, resistive touch display, status LEDs
Weight	980 g
Enclosure rating	IP 65, IP 67 (IEC 60529)
Protection class	III (EN 61140)
Electrical safety	EN 61010

1) May not fall short of or exceed U_V tolerances
2) With external load
3) Plugged in with suitable mating connector

11.4 Ambient data

Product type	DL1000 and DT1000
Ambient temperature	Operation: –40 °C ... +55 °C Storage: –40 °C ... +75 °C
Max. rel. air humidity (non-condensing)	≤ 95%
Effect of air pressure	0.3 ppm/hPa
Effect of temperature	-1 ppm/K
Temperature drift	Typ. 0.25 mm/K

Product type	DL1000 and DT1000
Mechanical stability	Shock: 30 g / 6 ms according to DIN EN 60068-2-27 (Ea), 6 axes Continuous shock: 25 g / 6 ms according to DIN EN 60068-2-27 (fatigue), 500 shocks, 6 axes Sine-wave vibration: 10 Hz ... 500 Hz, 1 g according to DIN EN 60068-2-6
Altitude	< 5,000 m above sea level
Ambient conditions	Degree of contamination 3 (according to EN 61010-1)

1) At a temperature of -40 °C, a warm-up time of typ. 20 minutes is required (when supply voltage Uv = 24 V)
2) Valid for device environment

11.5 Classifications

Product type	DL1000 and DT1000
ECl@ss 5.0	27270801
ECl@ss 5.1.4	27270801
ECl@ss 6.0	27270801
ECl@ss 6.2	27270801
ECl@ss 7.0	27270801
ECl@ss 8.0	27270801
ECl@ss 8.1	27270801
ECl@ss 9.0	27270801
ETIM 5.0	EC001825
ETIM 6.0	EC001825
UNSPSC 16.0901	41111613

11.6 Dimensional drawings

Device

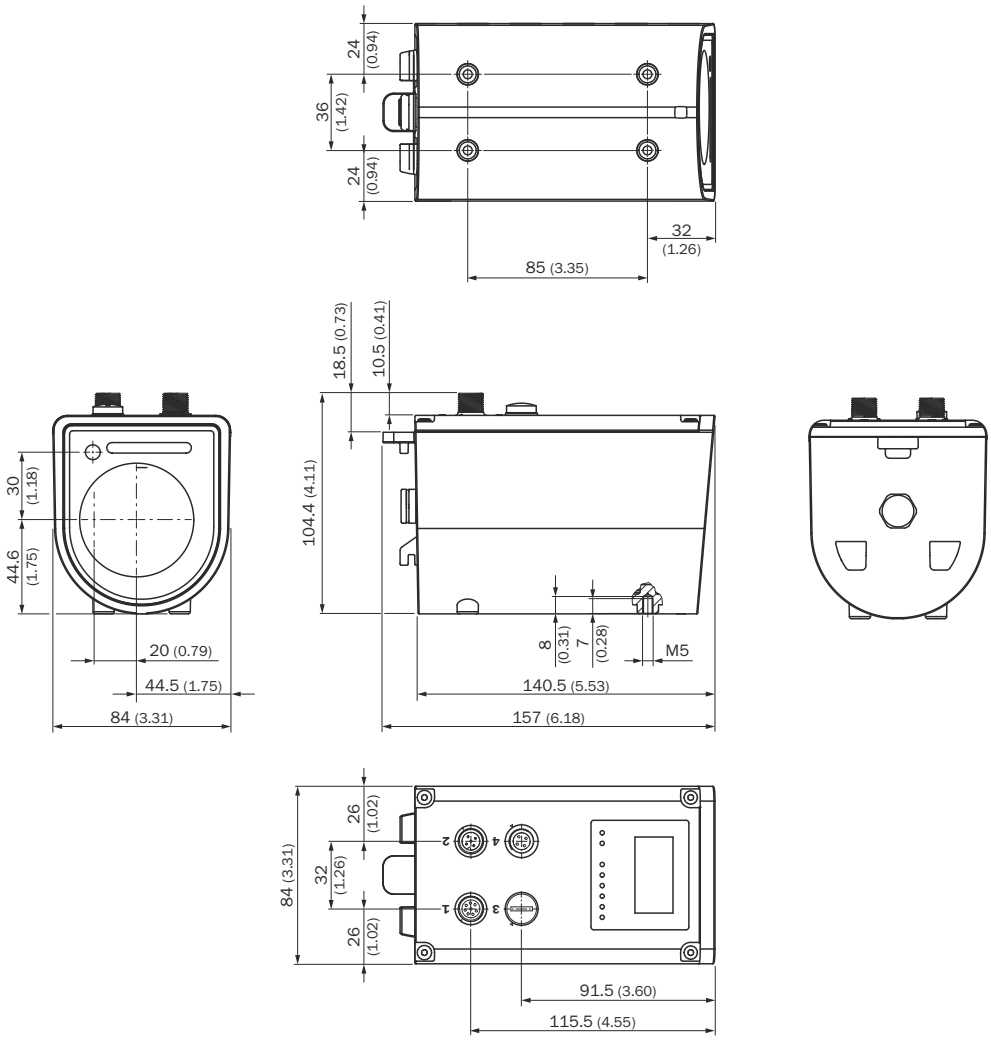


Figure 43: Device measurements, unit: mm (inch), decimal separator: period

Alignment bracket (optional)

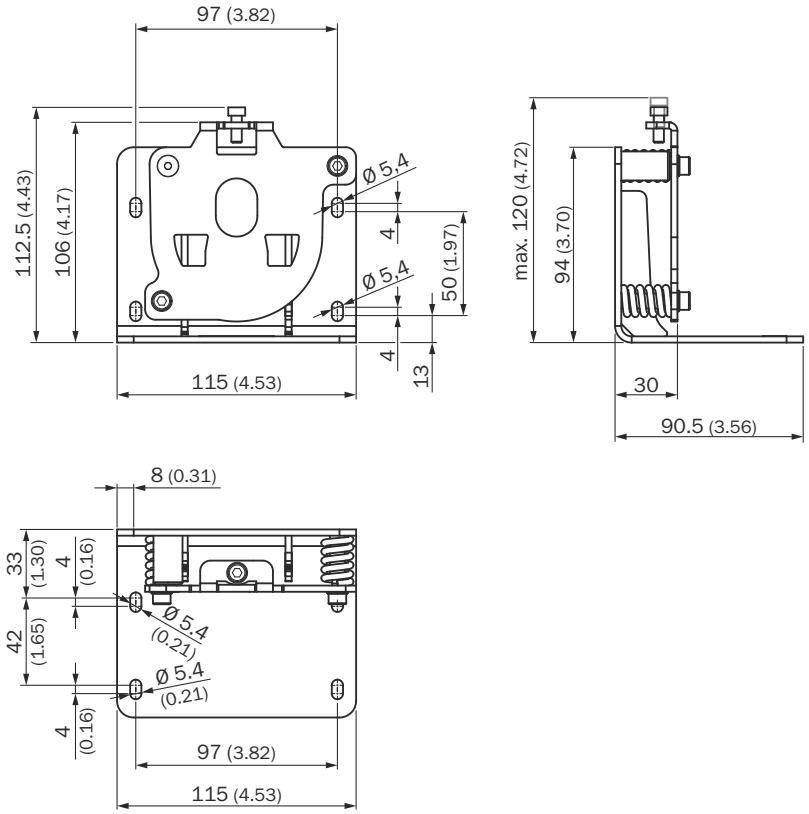


Figure 44: Alignment bracket, unit: mm (inch), decimal separator: period

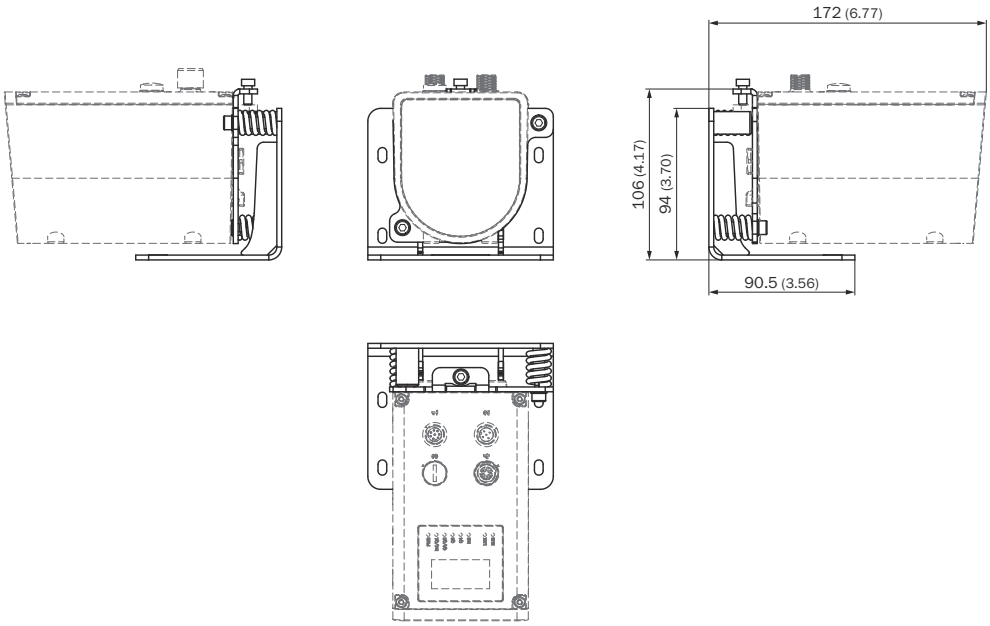


Figure 45: Alignment bracket with device, unit: mm (inch), decimal separator: period

Additional filter for high temperature applications (optional)

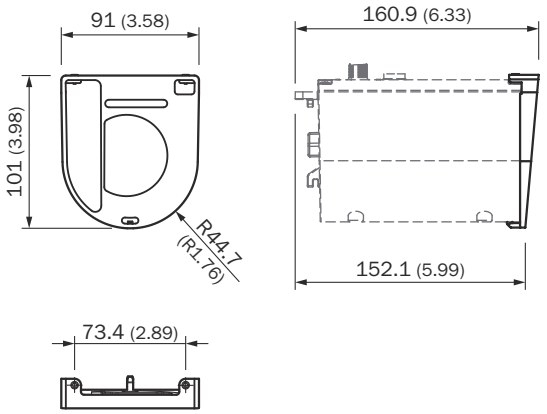


Figure 46: Additional filter for high temperature applications, unit: mm (inch), decimal separator: period

12 Accessories

NOTE

Accessories and where applicable mounting information can be found online at:

- www.sick.com/Dx1000

13 Appendix

13.1 Declarations of conformity and certificates

The declarations of conformity and certificates can be downloaded from the Internet at:

- www.sick.com/Dx1000

13.2 Licenses

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Printed copies of the license texts are also available on request.

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