

DT50-2 Pro

Distance sensor

SICK
Sensor Intelligence.



Described product

DT50-2 Pro

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. For more information, refer to the operating instructions of the specific machine or system.

1.2 Explanation of symbols

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



DANGER

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



WARNING

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



CAUTION

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



NOTICE

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



NOTE

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

1.3 Scope of delivery

Included in scope of delivery:

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

1.4 SICK service

If you require any technical information, our SICK Service will be happy to help. To find your agency, see the final page of this document.



NOTE

Before calling, make a note of all type label data such as type code, serial number, etc., to ensure faster processing.

1.5 Type label

There is a type label on the sensor that provides all relevant information.

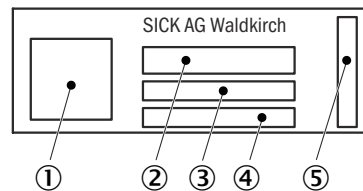


Figure 1: Type label

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

2 Safety information

2.1 Intended use

The Dx50-2 distance sensor is a opto-electronic sensor and is used for optical, non-contact distance measurement of objects.

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 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

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.

2.4 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.

2.5 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	<ul style="list-style-type: none"> ■ Basic practical technical training ■ Knowledge of the current safety regulations in the workplace
Electrical installation, device replacement	<ul style="list-style-type: none"> ■ Practical electrical training ■ Knowledge of current electrical safety regulations ■ Knowledge of the operation and control of the devices in their particular application
Commissioning, configuration	<ul style="list-style-type: none"> ■ 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	<ul style="list-style-type: none"> ■ Knowledge of the operation and control of the devices in their particular application ■ Knowledge of the software and hardware environment for the particular application

2.6 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.

Device types with laser class 1:

Device types with laser class 2:

**CAUTION****Optical radiation: Laser class 2**

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

- Do not look into the laser beam intentionally.
- Never point the laser beam at people's eyes.
- If it is not possible to avoid looking directly into the laser beam, e.g., during commissioning and maintenance work, suitable eye protection must be worn.
- Avoid laser beam reflections caused by reflective surfaces. Be particularly careful during mounting and alignment work.
- Do not open the housing. Opening the housing may increase the level of risk.
- Current national regulations regarding laser protection must be observed.

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

**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.

2.7 Warning signs on the device

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

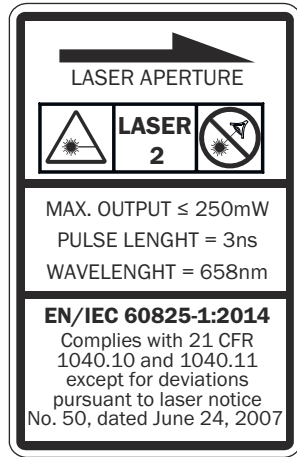


Figure 2: Warning sign on the device: LASER RADIATION: Do not look into the beam. Laser class 2

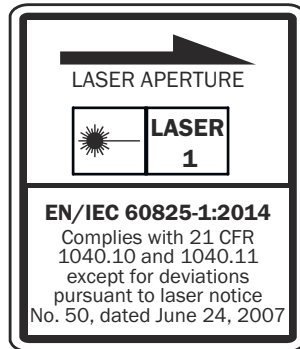


Figure 3: Warning sign on the device: LASER RADIATION: Do not look into the beam. Laser class 1

2.8 UL conformity



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

For more information visit:

▶ www.sick.com/Dx50-2



CAUTION
Hazardous radiation!

Using control elements or settings or executing procedures other than those specified in this document may result in dangerous exposure to radiation.

3 Transport and storage

3.1 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.

3.2 Transport inspection

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

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



NOTE

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

3.3 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 76](#).
- Relative humidity: [see "Technical data", page 76](#).
- For storage periods of longer than 3 months, check the general condition of all components and packaging on a regular basis.

4 Mounting

4.1 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.

4.2 Mounting the device

1. Mount the distance sensor using the provided fixing holes, see "[Dimensional drawing](#)", page 78.
2. Make the electrical connection. Attach and tighten a voltage-free cable, see "[Connecting the sensor electrically](#)", page 15.
3. Switch on the supply voltage.
- ✓ The green operating LED lights up.
4. Align the light spot so that the desired object is measured.

5 Electrical installation

5.1 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.

5.2 Wiring instructions



NOTE

Pre-assembled cables can be found online at:

- www.sick.com/Dx50-2



NOTICE

Faults during operation and device or system defects!

Incorrect wiring may result in operational faults and defects.

- Follow the wiring notes precisely.

Recommendation: use shielded cables.

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

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

Shielding requirements

- To ensure a fault-free data transmission, an effective and comprehensive shielding solution must be implemented.
- Apply a cable shield at each end, i.e. in the control cabinet and at the device. The cable shield of the pre-assembled cables is connected to the knurled nut and thus also to a large area of the device housing.
- The cable shield in the control cabinet must be connected to a large area of the signal ground.
- Take appropriate measures to prevent equipotential bonding currents flowing through the cable shield.
- During installation, pay attention to the different cable groups. The cables are grouped into the following four groups according to their sensitivity to interference or radiated emissions:
 - Group 1: cables very sensitive to interference, such as analog measuring cables
 - Group 2: cables sensitive to interference, such as device cables, communication signals, bus signals

- Group 3: cables that are a source of interference, such as control cables for inductive loads and motor brakes
- Group 4: cables that are a powerful source of interference, such as output cables from frequency inverters, welding system power supplies, power cables
- ▶ Cables in groups 1, 2 and 3, 4 must be crossed at right angles (see figure 4).
- ▶ Route the cables in groups 1, 2 and 3, 4 in different cable channels or use metallic separators (see figure 5 and see figure 6). This applies particularly if cables of devices with a high level of radiated emission, such as frequency converters, are laid parallel to device cables.

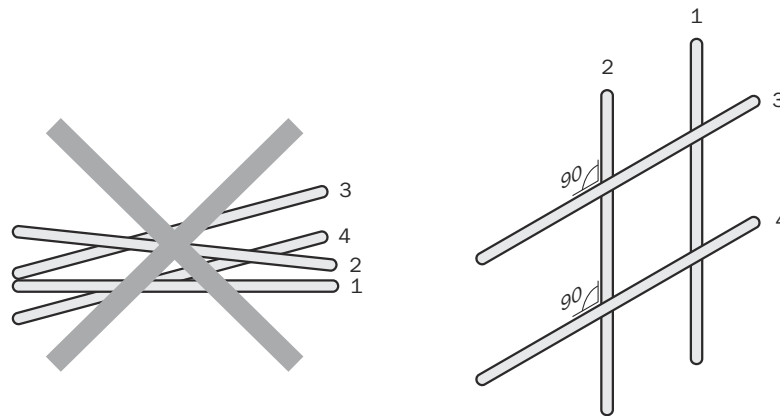


Figure 4: Cross cables at right angles

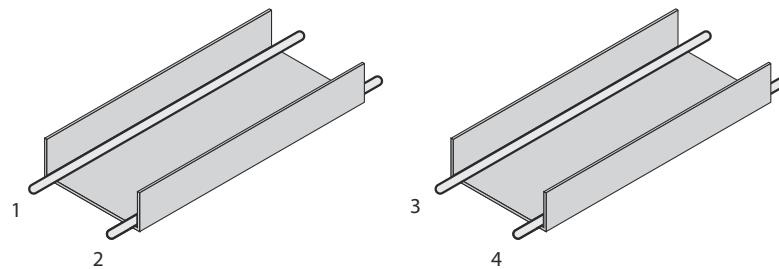


Figure 5: Ideal laying - Place cables in different cable channels

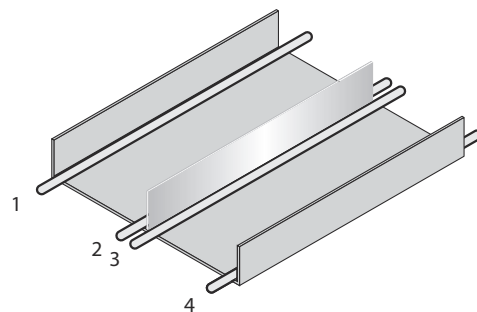


Figure 6: Alternative laying - Separate cables with metallic separators

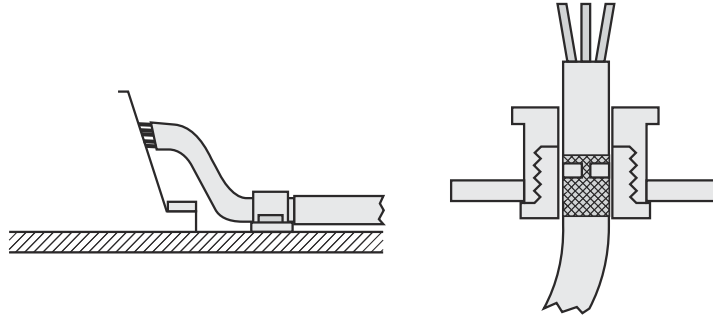


Figure 7: Shield connection in plastic housings



NOTE

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

5.3 Connecting the sensor electrically



NOTE

The connection diagram and information on inputs and outputs can be found on the side plate of the sensor.



NOTICE

All electrical circuits must be connected to the device with safety or protective extra-low voltage (SELV or PELV).

1. Ensure that the power supply is not connected.
2. Connect the sensor according to the connection diagram.
3. Observe the wiring instructions, see "[Wiring instructions](#)", page 13.

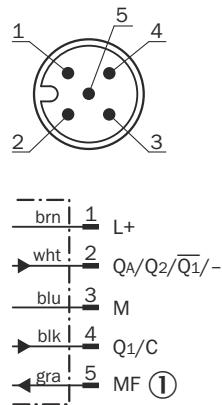


Figure 8: Connection diagram, 5-pin plug

① Multifunctional input

Table 2: Legend for connection diagram

Contact	Marking	Wire color	Description
1	L+	Brown	Supply voltage: +10 to 30 V DC
2	$Q_A/Q_2/Q_1/-$	White	Output 2: analog output / output signal switching device 2 / Q_1 not / inactive
3	M	Blue	Supply voltage: 0 V

Contact	Marking	Wire color	Description
4	Q ₁ /C	Black	Output 1: output signal switching device 1 / IO-Link
5	MF	Gray	Multifunctional input (MF)

6 Operation



NOTICE

Pushbutton damage due to improper handling.

Improper handling of the pushbuttons can damage them. This will make operation difficult or impossible.

- Only operate the pushbuttons with your fingers or a suitable pointing device.
- Do not operate the pushbuttons using sharp or hard objects.



NOTE

For basic instructions for the display and control elements see ["Control elements and status indicators"](#), page 17. Briefly pressing the **(Set)** pushbutton changes from the measured value display to the menu level.

For the overall menu structure see ["Menu structure"](#), page 84.

6.1 General notes

If the sensor is unable to measure, adjust the measuring speed or optimize the alignment.

For a successful teach operation, the sensor must be able to measure. The distance to the teach object must not change during the teach operation. The object must be in the measuring range, and the distance values taught in for the near-sensor distance and far-sensor distance must not be exactly the same during a switching window or the analog scaling.

To prevent EMC interference, observe the wiring instructions. If an environment is disrupted by EMC interference, data output via IO-Link is the preferred solution. If the application requires an output of the measured values in such an environment via the analog output, an analog current output should also be preferred to using the voltage output, because this is significantly less susceptible to EMC interference.



NOTE

The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see ["Multifunctional input \("MF Input"\)"](#), page 57) or IO-Link (see ["Operation via IO-Link"](#), page 21).

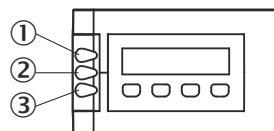


NOTE

The LEDs, the process data bits of the outputs in IO-Link and the output visualization in SOPAS display the logical status of the outputs. This does not necessarily correspond to the electrical level of the switching outputs. The electrical level of an output depends on the setting of the corresponding logic, the output circuit (NPN or PNP) and the logical status of the output. The examples in this document refer to a PNP circuit.

6.2 Control elements and status indicators

6.2.1 Indicator lights



- ① Operating LED (green)

- ② Status LED Q₁ (orange)
- ③ Status LED Q₂ / Q_A (orange)

Table 3: Meaning of the indicator lights

Display	Condition	Meaning
Status indicator (1)		Power supply available, sensor ready for use
		Power supply not available
		Power supply available, sensor ready for use, connection to an IO-Link master available
Output display Q ₁ (2)		Switching output active
		Switching output not active
Output display Q ₂ /Q _A (3)		Switching output active or measured value within the scaling range for the analog output
		Switching output not active or measured value outside the scaling range for the analog output
Output displays Q ₁ (2) and Q ₂ /Q _A (3)	simultaneously	Teach-in operation is carried out
	5 seconds in alternation	Teach-in operation has failed
	Permanently in alternation	There is a fault

- Does not light up
- Flashing
- Permanently on

6.2.2 Display

The display with keyboard can be used to call up measurement data and diagnostic data as well as to modify device parameters. The display is on the top side of the sensor. After the sensor is switched on it is in RUN mode. Pressing the pushbutton switches between the following display values:

Table 4: Displays in RUN mode

Display	Symbol in front of the display value	Meaning
Distance		Measured distance in millimeters or “NoDist”/“Max”/“Min”, if a valid measurement is not possible
Signal level	SL	Absolute value (level) of the received measurement signal, see "Signal level (“SL”)"
Signal quality	SQ	Signal quality in the form of a percentage (stability of the measurement, see "Signal quality (“SQ”)"
Temperature	+/-	Temperature within the sensor in °C.

Display	Symbol in front of the display value	Meaning
Shape match	SH	Shape comparison: Degree to which the last viewed object matches the taught-in reference object in % (only available in the "Shape match" mode, see "Shape comparison" ("Shape") switching mode , page 36

Briefly pressing the **Set** pushbutton in **Run** mode opens the menu.

Briefly pressing the **Set** and **Esc** pushbuttons switches between the various menu levels. Briefly pressing the **Esc** pushbutton repeatedly always takes you back to **RUN** mode.

If no pushbutton has been pressed over a period of 5 minutes, the sensor automatically returns to **RUN** mode and displays the measured distance.

6.3 Operating options

The DT50-2 Pro distance sensor provides various operating options. These are described in the following chapters. For more details about the various operating options, refer to the reference table, see ["Reference tables"](#), page 90.

6.3.1 Operation via pushbuttons and display

6.3.1.1 Measured value display

As soon as the measuring device is supplied with voltage, the display shows the current measured value.

6.3.1.2 Opening the menu

Briefly pressing the **Set** pushbutton in **RUN** mode opens the menu.

6.3.1.3 Selecting parameters

You can select a menu item, parameter, or option using the **▲** or **▼** pushbuttons and confirm these with **Set**. The menu path is specified in the respective chapters. For the overall menu structure see ["Menu structure"](#), page 84.

6.3.1.4 Selecting an option

1. Use the **▼** or **▲** pushbutton to select the desired parameter and confirm this with **Set**.
2. Select the desired option using the **▼** or **▲** pushbutton.
3. Perform one of the following steps:
 - Press the **Set** pushbutton to save the change.
 - Press the **Esc** pushbutton to cancel the process. The previously selected parameter name is displayed again.
4. Perform one of the following steps to return to the measured value display:
 - Press the **Esc** pushbutton repeatedly until the measured value is displayed again.
 - Wait for approx. 5 minutes. The display will automatically switch back to the measured value display if no pushbuttons are pressed. Any settings you have made will also be saved.

6.3.1.5 Changing the value

1. Select the desired parameter using the \uparrow and \downarrow pushbuttons.
2. Press the **Set** pushbutton.
- ✓ The current value of the parameter is displayed. The first digit on the left flashes.
3. Press the \uparrow pushbutton to increase the digit. Press the \downarrow pushbutton to decrease the digit.
4. Press the **Set** pushbutton to confirm the digit entered.
The next digit flashes. Press the **Esc** pushbutton to cancel the process.
5. Repeat steps 3 and 4 until the last digit has been confirmed and the setting has been saved.
- ✓ The parameter name is displayed.
6. Press the **Esc** pushbutton repeatedly until the measured value is displayed again.
Alternatively, you can wait 5 minutes.
- ✓ The display will switch back to the measured value display.

6.3.1.6 Display of the menu level

The current menu level is shown at the left edge of the display, see "[Menu structure](#)", page 84:

Table 5: Display of the menu level

Display	Menu level
RUN	Measured value display
RUN / SET	Menu level 1
SET	Menu level 2
SET / MEN	Menu level 3
MEN	Menu level 4

6.3.1.7 User level

The two user levels "Easy" and "Advanced" are available for operating the display. They differ in the scope of available parameters. In the "Easy" user level, you can view the parameters that are frequently needed. In the "Advanced" user level, you can view all parameters.

The "Easy" user level is set by default. You can change the user level in the menu under Device > User, see "[Operating example via display: Change user level to Advanced](#)", page 64.

6.3.2 Operation via SOPAS ET

The SOPAS Engineering Tool (SOPAS ET) software can be used for configuring parameters and for service and diagnostic purposes.

The following is required for configuring the sensor's parameters using a computer:

- A computer with SOPAS ET installed and a free USB2.0-compatible port
- SICK SiLink2 Master (Order No. 1061790)
- Connection cable with M12 male and female connectors, 5-pin (e.g. Order No. 6025930)

Connect the sensor to the SiLink2 Master via the connection cable. Connect the SiLink2 Master to the computer via the accompanying USB cable. If the computer's USB port cannot provide the required power for operating SiLink2 Master and sensor, also connect SiLink2 Master to the accompanying AC adapter.

**NOTE**

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

**NOTE**

To use SOPAS ET with the sensor you need a device description file (SDD) for this sensor. You can install this within SOPAS ET using the device catalog. An Internet connection is required to install the SDD file.

**NOTE**

The sensor immediately applies parameters that have been modified using SOPAS ET and permanently saves them. This does not require calling up a separate function.

6.3.3 Operation via SOPASair (Wi-Fi)

The “SOPASair” app is available for sensor versions with a Wi-Fi interface. The app is available for the Android and Apple iOS operating system platforms. It is installed via the corresponding store (Google Play Store for Android or Apple App Store for iOS). The app can be found in either store under the name “SOPASair”.

**NOTE**

The app will be displayed in the store only if the terminal device used meets the system requirements.

**NOTE**

It is not possible to establish a connection to the sensor via Wi-Fi using SOPAS ET.

6.3.4 Operation via IO-Link

The DT50-2 sensor can exchange process data and parameters via IO-Link. To do so, the sensor is connected to a suitable IO-Link master.

The IO-Link interface of the DT50-2 sensor has the following properties:

Table 6: Properties of the IO-Link interface

IO-Link specification	V 1.1
Minimum cycle time	0.4 ms
Transmission rate	COM3 (230.4 kBaud)
Process data width	16-bit outgoing (from the sensor to the master)
Process data type	UINT (unsigned integer)
Parameter configuration server function (data storage)	Yes

6.3.4.1 Process data

In the factory settings, the process data telegram displays the distance value measured by the sensor in millimeters (16-bit width unsigned).

By configuring the parameters of the sensor (see "Device data", page 22) you can change the process data format as well as resolution and offset for the distance value.

The following process data formats are available:

Table 7: Process data formats

No.	Description	Comments
1	Distance (14-bit) + Status Q ₁ + Status Q ₂	
2	Level (14-bit) + Status signal level warning (SLW) + Status alarm	
3	Distance (16-bit)	Factory setting
4	Distance (14-bit) + Signal quality (2-bit)	
5	Timer (16-bit)	
6	Timer (14-bit) + Status Q ₁ + Status Q ₂	
7	Shape match (7-bit) + Shape count (7-bit) + Status Q ₁ + Status Q ₂	

6.3.4.2 Device data

In addition to the process data, device data (parameters, identification data and diagnostic information) can be transmitted to and from the sensor. To use this function, a sensor-specific device description file (IODD) is needed in the IO-Link master.

A download package with the IODD and supplementary documentation is available at www.sick.com/Dx50-2.

The volume of device data that is accessible via IO-Link essentially corresponds to the data displayed in SOPAS ET.

6.3.5 Operation via multifunctional input (MF)

You can also use the multifunctional input (MF) to configure parameters and teach in for all DT50-2 Pro versions. More information about operation via multifunctional input (MF) see "Multifunctional input ("MF Input")", page 57.

6.4 Description of operation

6.4.1 Switching mode for Q₁ ("ModeQ₁")

The output Q₁ of DT50-2 Pro provides the following switching modes:

- Distance to object or single switching point ("DtO (1point)")
- Switching window ("Window")
- Object between sensor and background ("ObSB (Background)")
- Shape comparison ("Shape", Advanced user level only)
- Fault output ("Alarm", Advanced user level only)
- Signal level warning ("SLWarning", Advanced user level only)

These are described in detail in the following.

6.4.1.1 "Distance to object" or single switching point ("DtO (1point)") switching mode

6.4.1.1.1 Description

Output of a signal if the measured distance value has undershot (High Active) or exceeded (Low Active) the switching point.

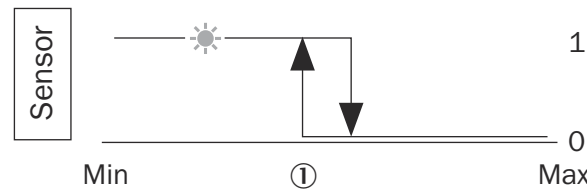


Figure 9: Distance to object or single switching point (High Active)

① Switching point

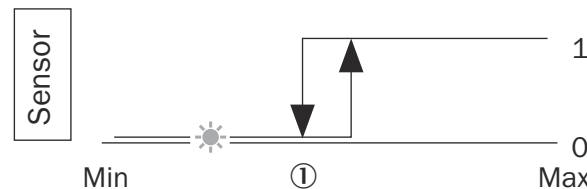


Figure 10: Distance to object or inverted single switching point (Low Active)

① Switching point

If the Distance to object (“DtO (1point)”) switching mode is selected, the required settings can be taught in or set manually. These are described in the following.

NOTE If the sensor is unable to measure (e.g. the object is in a blind spot of the sensor, there is too little remission or light reflection), a switching signal is output in the “Distance to object” (“DtO (1point)”) switching mode, which corresponds to the expected behavior with the maximum distance.

NOTE The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see “Multifunctional input (“MF Input)”, page 57) or IO-Link (see “Operation via IO-Link”, page 21).

NOTE When changing between the “Distance to object” (“DtO (1point)”) and “Switching window” (“Window”) switching modes, it is possible that the setting for the previously selected logic and/or the switching point setting will change.

6.4.1.1.2

Teachable settings (“Teach”)

Two teach functions are available for the “Distance to object” (“DtO (1point)”) switching mode.

Teach function	Description
Q ₁	You can use the teach function “Q ₁ ” to teach in a single switching point for the “Distance to object” (“DtO (1point)”) switching mode. In this case, a signal is output if the switching point that has been taught in is undershot. Thus the output acts as High Active (see figure 9, page 23).
Q ₁ not	You can use the teach function “Q ₁ not” to teach in an inverted logic for the “Distance to object” (“DtO (1point)”) switching mode. In this case, a signal is output if the switching point that has been taught in is exceeded. Thus the output acts as Low Active (see figure 10, page 23).

6.4.1.1.3 Manual settings

Setting	Description
Q ₁	You can use the “Q ₁ ” setting to manually set the switching threshold in millimeters for the “Distance to object” (“DtO (1point)”) switching mode.
Q ₁ hysteresis	<p>You can use the “Q₁ hysteresis” setting to manually set the switching hysteresis in millimeters. Hysteresis is the difference in distance between the switch-on and switch-off points. This is necessary for stable switching when the measured distance fluctuates around the switching point that has been set. More precise logic can be achieved by setting a lower value. Choose a higher value to ensure more stable switching or reduce the probability of a faulty switch.</p> <p>Figure 11: Q₁ Hysteresis</p>
Q ₁ Logic	You can use the “Q ₁ Logic” to manually select whether the output is to act as High Active (see figure 9, page 23) or Low Active (see figure 10, page 23).

6.4.1.1.4 Operating examples via display: “Distance to object” (“DtO”) switching mode

Teach in the current distance as a single or DtO switching point for Q ₁ using the Easy Teach function	
Operating example or steps: RUN mode (Set) Press for 5 sec. → Q ₁ Position object (Set) → Saved	Necessary default settings: Factory setting or mode Q ₁ = DtO (1 point) Factory setting: 30,000 mm
Teach in the current distance as an inverted single or DtO switching point for Q ₁ using the Easy Teach function	
Operating example or steps: RUN mode (Esc) Press for 5 sec. → Q ₁ not Position object (Set) → Saved	Necessary default settings: Factory setting or mode Q ₁ = DtO (1 point) Factory setting: -
Select and activate the DtO (1point) switching mode for Q ₁	
Operating example or steps: RUN mode (Set) → Q ₁ Output (Set) → ModeQ ₁ (Set) → ... (V)/(^) to → DtO (1point) (Set) → Saved (Esc) to → RUN mode	Necessary default settings: - Factory setting: DtO (1point)

Teach in the current distance as a single or DtO switching point for Q ₁ in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [↓]/[↑] to → Teach Q ₁ [Set] → Q ₁ Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Factory setting or mode Q ₁ = DtO (1 point)
	Factory setting: 30,000 mm

Teach in the current distance as an inverted single or DtO switching point for Q ₁ in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [↓]/[↑] to → Teach Q ₁ [Set] → Q ₁ [↓]/[↑] to → Q ₁ not Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Factory setting or mode Q ₁ = DtO (1 point)
	Factory setting: -

Manually teach in the desired distance as a single or DtO switching point for Q ₁	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [↓]/[↑] to → Manual Q ₁ [Set] → Q ₁ [Set] → 30000 (Note: 3 = flashing 3) [↓]/[↑] [Set], [↓]/[↑] [Set], [↓]/[↑] [Set], [↓]/[↑] [Set], [↓]/[↑] → desired distance in mm [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Factory setting or mode Q ₁ = DtO (1 point)
	Factory setting: 30,000 mm

Manually switch the logic for Q ₁ to “Low Active”	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ [V]/[^] to → Q ₁ Logic [Set] → High Active [V]/[^] to → Low Active [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Factory setting or mode Q ₁ = DtO (1 point)
	Factory setting: High Active

For the output function Q ₂ configure and activate /Q _a through switching	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [Set] → 4 - 20 mA [V]/[^] to → Switching [Set] → Saved [Esc] to → RUN mode	Necessary default settings: -
	Factory setting: 4 - 20 mA

Select and activate the DtO (1point) switching mode for Q ₂	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [V]/[^] to → ModeQ ₂ [Set] → ... [V]/[^] to → DtO (1point) [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Function Q ₂ /Q _a = Switching
	Factory setting: -

Teach in the current distance as a single or DtO switching point for Q ₂ in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [V]/[^] to → Teach Q ₂ [Set] → Q ₂ Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Function Q ₂ /Q _a = Switching ModeQ ₂ = DtO (1point)
	Factory setting: -

Manually teach in the desired distance as a single or DtO switching point for Q ₂	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [▼]/[▲] to → Q₂ Output [Set] → Function Q₂/Q_a [▼]/[▲] to → Manual Q₂ [Set] → Q₂ [Set] → 30000 (Note: 3 = flashing 3) [▼]/[▲][Set], [▼]/[▲][Set], [▼]/[▲][Set], [▼]/[▲][Set], [▼]/[▲] → desired distance in mm [Set] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: Function Q₂/Q_a = Switching ModeQ₂ = DtO (1point)</p> <p>Factory setting: -</p>

6.4.1.2 “Switching window” (“Window”) switching mode

6.4.1.2.1 Description

Output of a switching signal if the measured distance is inside (High Active) or outside (Low Active) of a switching window.

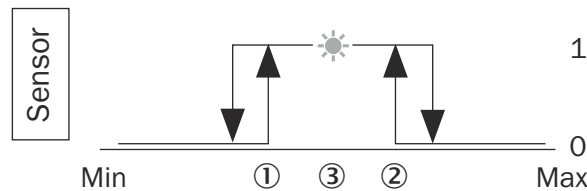


Figure 12: High Active switching window

- ① Switching point near
- ② Switching point far
- ③ Middle of switching window

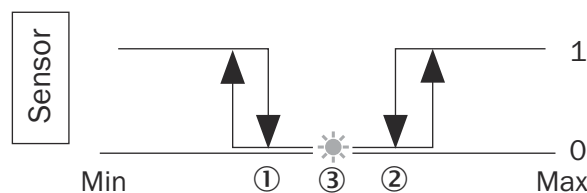


Figure 13: Low Active switching window

- ① Switching point near
- ② Switching point far
- ③ Middle of switching window



NOTE

If the sensor is unable to measure (e.g. the object is in a blind spot of the sensor, there is too little remission or light reflection), a switching signal is output in the “Switching window” (“Window”) switching mode, which corresponds to the expected behavior with the maximum distance.

**NOTE**

The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see "Multifunctional input ("MF Input")", page 57) or IO-Link (see "Operation via IO-Link", page 21).

**NOTE**

When changing between the "Switching window" ("Window") and "Distance to object" ("DtO (1point)") switching modes, it is possible that the setting for the previously selected logic and/or the switching point setting will change.

6.4.1.2.2**Teachable settings ("Teach")**

Two teach methods are available for the switching window ("Window") switching mode to set up the switching window in accordance with the application requirements.

Teach function	Description
Q ₁ near	You can use the "Q ₁ near" teach method to teach in the first of the two switching points for the switching window ("Window") switching mode. Depending on whether the smaller or larger distance value is taught in for "Q ₁ near" (compared to the distance value for "Q ₁ far"), the corresponding switching output acts either as High Active (distance for near < distance for far; see figure 12, page 27) or Low Active (distance for near > distance for far; see figure 13, page 27).
Q ₁ far	You can use the "Q ₁ far" teach method to teach in the second of the two switching points for the switching window ("Window") switching mode. Depending on whether the smaller or larger distance value is taught in for "Q ₁ far" (compared to the distance value for "Q ₁ near"), the corresponding switching output acts either as High Active (distance for near < distance for far; see figure 12, page 27) or Low Active (distance for near > distance for far; see figure 13, page 27).

6.4.1.2.3**Manual settings**

Setting	Description
Q ₁ near	You can use the "Q ₁ near" setting to manually set the first of the two switching points of the switching window in millimeters. Depending on whether the smaller or larger distance value is set for "Q ₁ near" compared to the distance value for "Q ₁ far", the corresponding switching output acts either as High Active (distance for near < distance for far; see figure 12, page 27) or Low Active (distance for near > distance for far; see figure 13, page 27).
Q ₁ far	You can use the "Q ₁ far" setting to set the second of the two switching points for the switching window ("Window") switching mode. Depending on whether the smaller or larger distance value is set for "Q ₁ far" (compared to the distance value for "Q ₁ near"), the corresponding switching output acts either as High Active (distance for near < distance for far; see figure 12, page 27) or Low Active (distance for near > distance for far; see figure 13, page 27).
Q _{1/2} hysteresis	You can use the "Q ₁ hysteresis" setting to manually set the switching hysteresis in millimeters. (More details on hysteresis: see "Manuelle Einstellungen DtO_Dx50-2")
Q ₁ Logic	You can use the "Q ₁ Logic" setting to manually select whether the output is to act as High Active (see figure 12, page 27) or Low Active (see figure 13, page 27). If the logic is modified, the sensor automatically exchanges the values set for near and far accordingly.

6.4.1.2.4 Operating examples via display: “Switching window” (“Window”) switching mode

Activate the “Switching window” (“Window”) switching mode for Q ₁	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [Set] → DtO (1point) [V]/[^] to → Window [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: DtO (1point)

Teach in the current distance for “Q ₁ near” in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Teach Q ₁ [Set] → Q ₁ near Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = Window Factory setting: -

Teach in the current distance for “Q ₁ far” in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Teach Q ₁ [Set] → Q ₁ near [V]/[^] to → Q ₁ far Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = Window Factory setting: -

Manually set the desired distance for “Q ₁ near”	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ near [Set] → 00200 (Note: 0 = flashing 0) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] → desired distance in mm [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = Window Factory setting: -

Manually set the desired distance for “Q ₁ far”	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ near [V]/[^] to → Q ₁ far [Set] → 30000 (Note: 3 = flashing 3) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] → desired distance in mm [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = Window
	Factory setting: -

Manually switch the logic for Q ₁ to “Low Active”	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ near [V]/[^] to → Q ₁ Logic [Set] → High Active [V]/[^] to → Low Active [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = Window
	Factory setting: High Active

For the output function Q ₂ configure and activate /Q _a through switching	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [Set] → 4 - 20 mA [V]/[^] to → Switching [Set] → Saved [Esc] to → RUN mode	Necessary default settings: -
	Factory setting: 4 - 20 mA

Activate the “Switching window” (“Window”) switching mode for Q ₂	
Operating example or steps: RUN mode [Set] → Q ₁ Output [▼]/[▲] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [▼]/[▲] to → ModeQ ₂ [Set] → DtO (1point) [▼]/[▲] to → Window [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Function Q ₂ /Q _a = Switching Factory setting: -

Teach in the current distance for “Q ₂ near” teach method in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [▼]/[▲] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [▼]/[▲] to → Teach Q ₂ [Set] → Q ₂ near Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Function Q ₂ /Q _a = Switching Mode Q ₂ = Window Factory setting: -

Manually set the desired distance for “Q ₂ near”	
Operating example or steps: RUN mode [Set] → Q ₁ Output [▼]/[▲] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [▼]/[▲] to → Manual Q ₂ [Set] → Q ₂ near [Set] → 00200 (Note: 0 = flashing 0) [▼]/[▲] [Set], [▼]/[▲] [Set], [▼]/[▲] [Set], [▼]/[▲] [Set], [▼]/[▲] → desired distance in mm [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Function Q ₂ /Q _a = Switching Mode Q ₂ = Window Factory setting: -

6.4.1.3 “Object between sensor and background” (ObSB) switching mode

6.4.1.3.1 Description

Output of a switching signal if the reference background is not detected (High Active) or is detected (Low Active). The “ObSB” or background mode provides for reliable detection of all objects deviating from the background, regardless of whether these are highly reflective or jet black.

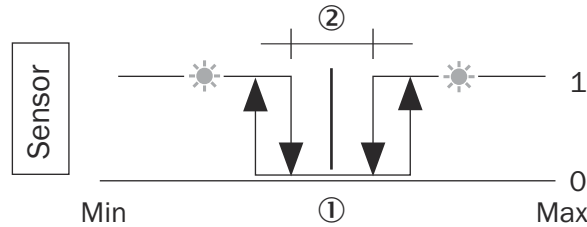


Figure 14: Object between sensor and background (High Active)

- ① Switching point (reference background)
- ② Tolerance around teach point: ± 25 mm

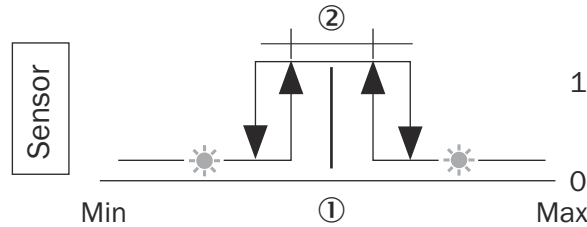


Figure 15: Object between sensor and background (Low Active)

- ① Switching point (reference background)
- ② Tolerance around switching point: ± 25 mm

If the “Object between sensor and background” (“ObSB (Background)”) switching mode is selected, the required settings can be taught in or set manually. These are described in the following.

NOTE
 If the sensor is unable to measure (e.g. the object is in a blind spot of the sensor, there is too little remission or light reflection), a switching signal is output in the “Object between sensor and background” (“ObSB (Background)”) switching mode, which corresponds to the expected behavior with the maximum distance.

NOTE
 The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see “Multifunctional input (“MF Input”)”, page 57) or IO-Link (see “Operation via IO-Link”, page 21).

NOTE
 When changing between the “Object between sensor and background” (“ObSB (Background)”) and “Switching window” (“Window”) switching modes, it is possible that the setting for the previously selected logic and/or the switching point setting will change.

NOTE
 The tolerance range of 25 mm around the switching point is a fixed setting for DT50-2 Pro, and thus cannot be adjusted, to ensure that background mode functions reliably even over time.

6.4.1.3.2

Teachable settings (“Teach”)

Two teach methods are available for the “Object between sensor and background” (“ObSB (Background)”) switching mode.

Teach function	Description
Q ₁	You can use the teach function “Q ₁ ” to teach in the target and reference background for the “Object between sensor and background” (“ObSB (Background)”) switching mode. In this case, a signal is output if the sensor no longer sees this taught-in background. Thus the output acts as High Active (see figure 14, page 32).
Q ₁ not	You can use the teach function “Q ₁ not” “ to teach in the target and reference background with inverted logic for the “Object between sensor and background” (“ObSB (Background)”) switching mode. In this case, a signal is output as long as the sensor detects the taught-in background. Thus the output acts as Low Active (see figure 15, page 32).

6.4.1.3.3

Manual settings

Setting	Description
Q ₁	You can use the “Q ₁ ” setting to manually set the distance to the reference background in millimeters for the “Object between sensor and background” (“ObSB (Background)”) switching mode.
Q ₁ hysteresis	You can use the “Q ₁ hysteresis” setting to manually set the switching hysteresis in millimeters. More details on hysteresis see "Manuelle Einstellungen DtO_Dx50-2".
Q ₁ Logic	You can use the “Q ₁ Logic” to manually select whether the output is to act as High Active (see figure 14, page 32) or Low Active (see figure 15, page 32).

6.4.1.3.4

Operating examples via display: “Object between sensor and background” (ObSB) switching mode

Select and activate the ObSB (Background) switching mode for Q ₁	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [Set] → DtO (1point) [V]/[^] to → ObSB (Background) [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: DtO (1point)

Teach in the current distance as a reference background for ObSB mode for Q ₁ in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Teach Q ₁ [Set] → Q ₁ Align the sensor with the reference background [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = ObSB (Background) Factory setting: -

Teach in the current distance as a reference background for the inverted ObSB mode for Q₁ in the menu

Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Teach Q ₁ [Set] → Q ₁ [V]/[^] to → Q ₁ not Align the sensor with the reference background [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = ObSB (Background)
	Factory setting: -

Manually set the desired distance of the reference background for ObSB mode for Q₁

Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ [Set] → 30000 (Note: 3 = flashing 3) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] to → distance to reference background in mm [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = ObSB (Background)
	Factory setting: 30,000 mm

Manually switch the logic for Q₁ to “Low Active”

Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ [V]/[^] to → Q ₁ Logic [Set] → High Active [V]/[^] to → Low Active [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Mode Q ₁ = ObSB (Background)
	Factory setting: High Active

For the output function Q ₂ configure and activate /Q _a through switching	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [Set] → 4 - 20 mA [V]/[^] to → Switching [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: 4 - 20 mA
Select and activate the ObSB (Background) switching mode for Q ₂	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [V]/[^] to → ModeQ ₂ [Set] → DtO (1point) [V]/[^] to → ObSB (Background) [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Function Q ₂ /Q _a = Switching Factory setting: -
Teach in the current distance as a reference background for ObSB mode for Q ₂ in the menu	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [V]/[^] to → Teach Q ₂ [Set] → Q ₂ Align the sensor with the reference background [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Function Q ₂ /Q _a = Switching Mode Q ₂ = ObSB (Background) Factory setting: -

Manually set the desired distance of the reference background for ObSB mode for Q ₂	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [V]/[^] to → Manual Q₂ [Set] → Q₂ [Set] → 30000 (Note: 3 = flashing 3) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] to → distance to reference background in mm [Set] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: Function Q₂/Q_a = Switching Mode Q₁ = ObSB (Background)</p> <p>Factory setting: -</p>

6.4.1.4 “Shape comparison” (“Shape”) switching mode

6.4.1.4.1 Description

The “Shape comparison” switching mode is only accessible if the “Advanced” user level is activated.

During the shape comparison, the shape of a measured object is compared to a reference shape that was previously taught in. The sensor automatically determines a match level for these two shapes (see figure 16, page 36). If the set switching point is undershot (High Active) or exceeded (Low Active), the sensor emits a switching signal corresponding to the match level.

The shape comparison is suitable for a rough check or sorting of objects with the same length, which are moved past the sensor at a constant speed.

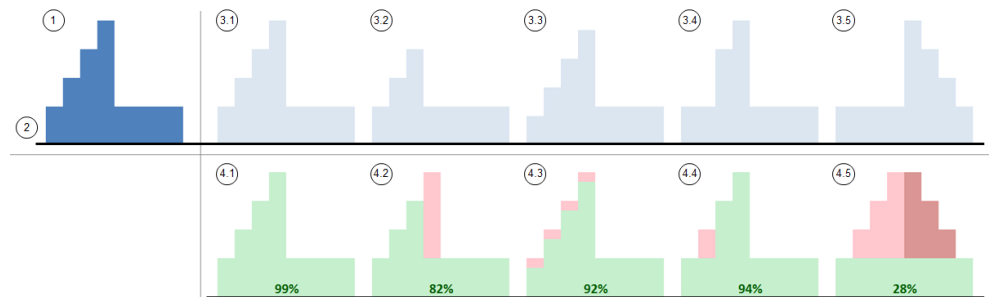


Figure 16: Example function of the shape comparison

- ① Reference shape
- ② Background (e.g. conveyor belt)
- ③ Shape of measured objects 1 to 5
- ④ Graphic and percentage illustration of the match level

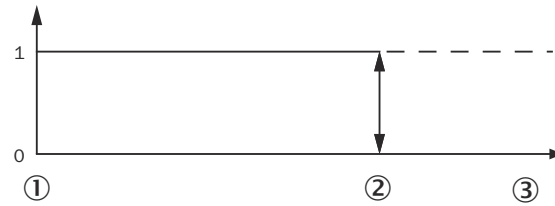


Figure 17: Shape comparison (“High Active”)

- ① 0 percent match of the shape comparison
- ② Selected switching threshold of the shape comparison
- ③ 100 percent match of the shape comparison

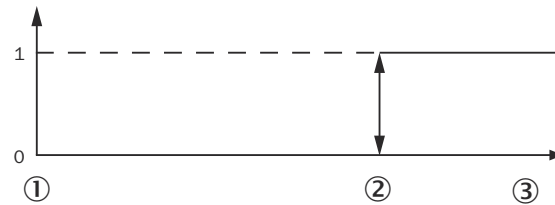


Figure 18: Shape comparison (“Low Active”)

- ① 0 percent match of the shape comparison
- ② Selected switching threshold of the shape comparison
- ③ 100 percent match of the shape comparison

The settings of the shape comparison are configured in the following steps:

- 1 Optional: Setting the shape trigger threshold
- 2 Setting or teaching in the object length in ms
- 3 Teaching in the reference shape
- 4 Setting or teaching in the switching threshold for the shape comparison

The points mentioned are described in the following subchapters.

Trigger threshold

Use of the shape comparison requires a stable background (distance changes significantly smaller than the shape trigger threshold), on which the sensor can measure reliably.

To detect objects for the shape comparison, the measuring object must exceed the shape trigger threshold. Accordingly, it is appropriate when the area relevant for the shape comparison first begins above the shape trigger threshold.

Length of the objects to be measured

For the shape comparison it is necessary that the sensor is able to measure toward this at least for the better part of the object. If this is not the case when attempting to teach in a reference shape, a teach error occurs. If the sensor is partially unable to measure toward a shape to be compared, the match level drops accordingly. Accordingly, it is advisable to choose the speed setting (see ["Speed setting \("Speed"\)"](#), page 62) of the sensor sensibly, or qualify it in the application.

**NOTE**

The teaching in and measurements for the shape comparison must be carried out at a constant process speed, and thus a constant movement speed of the measuring object.

For the shape comparison to function flawlessly, it is absolutely necessary to either set (see "Manual settings", page 39) or teach in (see "Teachable settings ("Teach")", page 38) the object length to make optimum use of the sensor's internal memory and thus achieve a meaningful result.

The object length of the object to be compared may correspond to the length of the reference object at maximum. If a shape to be compared is longer than the reference shape, but matches this shape for the length of the reference shape, then very high match levels can be achieved due to the time-limited viewing range (or "reference object length").

Only one reference object can be taught in for the shape comparison (length, shape and shape trigger threshold). For example, if a shape has been taught in for output Q_1 and another shape is taught in for Q_2 , then the preceding shape is overwritten. It is possible to set the outputs for the match level of this one shape so that they are independent of each other.

Depending on the speed setting selected for the sensor and the transport speed of the measuring object, the following minimum detectable object lengths or reference object times are recommended for the shape comparison.

Table 8: Minimum detectable object lengths and reference object times

Speed setting	Min. time the object is in front of the sensor	Min. object length at 0.2 m/s	Min. object length at 0.5 m/s	Min. object length at 1.0 m/s	Min. object length at 2.0 m/s
Super-fast	40 ms	0.01 m	0.02 m	0.04 m	0.08 m
Fast	160 ms	0.03 m	0.08 m	0.16 m	0.32 m
Medium	400 ms	0.08 m	0.20 m	0.40 m	0.80 m
Slow	1200 ms	0.24 m	0.60 m	1.20 m	2.40 m
Super-slow	3600 ms	0.72 m	1.80 m	3.60 m	7.20 m

**NOTE**

The values displayed in the table refer to the laser class 2 variants of DT50-2 Pro. In the case of devices with laser class 1, the values are to be multiplied by a factor of 2.

**NOTE**

The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see "Multifunctional input ("MF Input")", page 57) or IO-Link (see "Operation via IO-Link", page 21).

6.4.1.4.2**Teachable settings ("Teach")**

For the "Shape comparison" ("Shape") switching mode it is necessary to teach in the length and shape of the reference object. In addition, you have the option of teaching in the switching threshold of the shape comparison.

Teach function	Description
Reference object length	You can use the "Reference object length" ("Length Ref. Object") teach function to teach in the length of the reference object.

Teach function	Description
Reference object shape	You can use the “Reference object shape” (“Shape Ref. Object”) teach function to teach in the shape of the reference object. Then the shape that is taught in corresponds to a kind of “target shape” and serves as a basis for the shape comparison.
Q ₁ Good Teach	After both the length and the shape of the reference object have been taught in, the desired switching threshold can be taught in using either good or bad objects. The teach function “Q ₁ Good Teach” is used for teaching in the switching threshold based on good objects. With this teach you can have one to as many good objects as desired move past the sensor. Based on the good objects that move past it, the sensor automatically saves the value of the lowest match as a threshold, to be able to identify all good objects as such.
Q ₁ Bad Teach	You can use the teach function “Q ₁ Bad Teach” to teach in the switching threshold based on bad objects. With this teach you can have one to as many bad objects as desired move past the sensor. Based on the good objects that move past it, the sensor automatically saves the value of the lowest match as a threshold, to be able to identify all good objects as such. In the case of the shape comparison, the display cannot be used for an inverted teach. If necessary, however, the inversion can be done by manually changing the switching output behavior.

6.4.1.4.3

Manual settings

Setting	Description
Q ₁ Logic	You can use the “Q ₁ Logic” setting to manually select whether the output of the shape comparison is to act as High Active (see figure 17, page 37) or Low Active (see figure 18, page 37).
Reference object length	You can use the “Reference object length” (“Length Ref. Object”) setting to set the length of the reference object in milliseconds.
Reference object shape	The shape of the reference object cannot be entered manually. Accordingly, the teach function for teaching in the shape of the reference object (see “Teachable settings (“Teach”)”, page 38) is available also for the manual settings.
Shape trigger threshold	The beginning and end of the object is detected directly by the sensor for teaching in the length and shape of the reference object as well as for the shape comparison function. This detection is based on the difference in height between the background (e.g. a conveyor belt) and the object, which is called the shape trigger threshold (“Self Trigger”). This trigger threshold is set by default to a height of 25 mm. You can manually adjust this height threshold in millimeters to detect even smaller objects or hide larger height fluctuations of the background.
Shape tolerance Q ₁	You can use the shape tolerance Q ₁ (“Q ₁ Tolerance”) to manually set the switching threshold for the shape comparison in the form of a percentage. To enable estimation of the match level of various objects and setting of a useful switching threshold based on this, it is advisable to measure some objects in Run mode as a test and observe the results of the shape comparison.

6.4.1.4.4 Operating examples via display: “Shape comparison” (“Shape”) switching mode

Select and activate the “Advanced” user level	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Device [Set] → User level [Set] → Easy [V]/[^] to → Advanced [Set] → Saved [Esc] to → RUN mode	Necessary default settings: -
	Factory setting: Easy

Select the “Shape” switching mode for Q ₁	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [Set] → DtO (1point) [V]/[^] to → Shape [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced
	Factory setting: DtO (1point)

Teach in the length of the reference object	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Teach Q ₁ [Set] → Length of ref. object [Set] → ESC? Move the object past the sensor After reference object [Esc] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Mode Q ₁ = Shape
	Factory setting: -

Teaching in the reference object shape	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Teach Q ₁ [Set] → Length of ref. object [V]/[^] to → Shape of ref. object [Set] → ... Move the object past the sensor After the object is automatically saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Mode Q ₁ = Shape Length of ref. object taught in or configured
	Factory setting: -

Carry out a good teach-in for Q ₁	
<p>Operating example or steps: RUN mode (Set) → Q₁ Output (Set) → ModeQ₁ (V)/(^) to → Teach Q₁ (Set) → Length of ref. object (V)/(^) to → Q₁ Good teach-in (Set) → ESC? Move one or more good objects past the sensor After the last good object (Esc) → Saved (Esc) to → RUN mode</p>	<p>Necessary default settings: User level = Advanced Mode Q₁ = Shape Length of ref. object taught in or configured Shape of ref. object taught in</p> <p>Factory setting: -</p>

Set the switching threshold for the shape comparison for Q ₁ manually	
<p>Operating example or steps: RUN mode (Set) → Q₁ Output (Set) → ModeQ₁ (V)/(^) to → Manual Q₁ (Set) → Q₁ Logic (V)/(^) to → Q₁ Tolerance (Set) → 100 (Note: 1 = flashing 1) (V)/(^)(Set), (V)/(^)(Set), (V)/(^)(Set) to the → desired switching threshold (Set) → Saved (Esc) to → RUN mode</p>	<p>Necessary default settings: User level = Advanced Mode Q₁ = Shape Length of ref. object taught in or configured Shape of ref. object taught in</p> <p>Factory setting: -</p>

Set the shape of the trigger threshold for Q ₁ manually	
<p>Operating example or steps: RUN mode (Set) → Q₁ Output (Set) → ModeQ₁ (V)/(^) to → Manual Q₁ (Set) → Q₁ Logic (V)/(^) to → Q₁ Self trigger (Set) → 00025 (Note: 0 = flashing 0) (V)/(^)(Set), (V)/(^)(Set), (V)/(^)(Set), (V)/(^)(Set), (V)/(^)(Set), (V)/(^)(Set) to → desired shape trigger threshold (Set) → Saved (Esc) to → RUN mode</p>	<p>Necessary default settings: User level = Advanced Mode Q₁ = Shape</p> <p>Factory setting: -</p>

For the output function Q ₂ configure and activate /Q _a through switching	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [Set] → 4 - 20 mA [V]/[^] to → Switching [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: 4 - 20 mA

Select the "Shape" switching mode for Q ₂	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [V]/[^] to → ModeQ ₂ [Set] → DtO (1point) [V]/[^] to → Shape [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Function Q ₂ /Q _a = Switching Factory setting: -

Carry out a good teach-in for Q ₂	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [V]/[^] to → Teach Q ₂ [Set] → Length of ref. object [V]/[^] to → Q ₂ Good teach-in [Set] → ESC? Move one or more good objects past the sensor After the last good object [Esc] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Output function Q ₂ /Q _a = switching Mode Q ₂ = Shape Length of ref. object taught in or configured Shape of ref. object taught in Factory setting: -

Set the switching threshold for the shape comparison for Q ₂ manually	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [V]/[^] to → Manual Q₂ [Set] → Q₂ Logic [V]/[^] to → Q₂ Tolerance [Set] → 100 (Note: 1 = flashing 1) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] to the → desired switching threshold [Set] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: User level = Advanced Output function Q₂/Q_a = switching Mode Q₂ = Shape Length of ref. object taught in or configured Shape of ref. object taught in</p> <p>Factory setting: -</p>

6.4.1.5 “Alarm” switching mode

6.4.1.5.1 Description

The “Alarm” switching mode is only accessible if the “Advanced” user level is activated.

Output of one (“High Active”) or no (“Low Active”) switching signal if the sensor is not capable of generating a measured value (e. g. no object in the measuring range or remission of the measuring object too low). Utilization of the error output is particularly useful if the setting stipulating that the sensor retain the last valid measured value is activated (assuming that a measurement is not possible), see ["Behavior if no measurement is possible \(NoMeasurement\)", page 65](#).

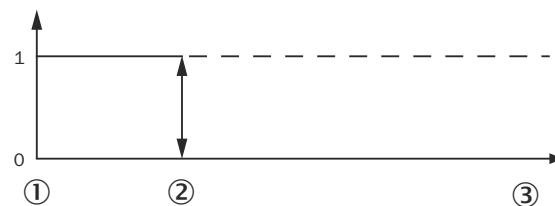


Figure 19: Error output (“High Active”)

- ① Minimum signal level
- ② Signal level starting when a measurement is no longer possible
- ③ Maximum signal level

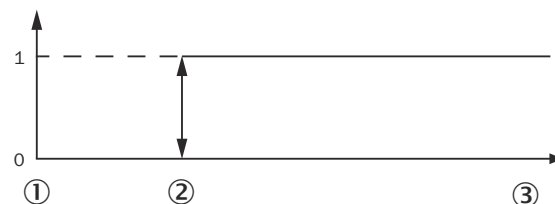


Figure 20: Error output (“Low Active”)

- ① Minimum signal level
- ② Signal level starting when a measurement is no longer possible
- ③ Maximum signal level

In “Alarm” switching mode, the switching threshold is automatically defined based on the measurability of the sensor. In this case, the switching output behavior can be manually selected.



NOTE

The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see "Multifunctional input (“MF Input”)", page 57) or IO-Link (see "Operation via IO-Link", page 21).



NOTE

In addition to the reflection and remission properties of the measuring object, changes to the angle and distance can have a significant impact on the sensor's ability to measure.

The sensor's ability to measure is affected not only by the distance and remission properties of the measuring object, but also by the selected speed setting of the sensor, see "Speed setting (“Speed”)", page 62.

6.4.1.5.2

Manual settings

Setting	Description
Q ₁ Logic	You can use the “Q ₁ “ “Q ₁ Logic” can be manually selected if the error output is to act as High Active (see figure 19, page 43) or Low Active (see figure 20, page 43).

6.4.1.5.3

Operating examples via display: “Alarm” switching mode

Select and activate the “Advanced” user level	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Device [Set] → User level [Set] → Easy [V]/[^] to → Advanced [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: Easy

Activate the “Alarm” switching mode for Q ₁	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [Set] → DtO (1point) [V]/[^] to → Alarm [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Factory setting: DtO (1point)

Manually switch the logic for Q ₁ to “Low Active”	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ Logic [Set] → High Active [V]/[^] to → Low Active [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Mode Q ₁ = Alarm Factory setting: High Active

6.4.1.6 “SLWarning” switching mode

6.4.1.6.1 Description

The “SLWarning” switching mode is only accessible if the “Advanced” user level is activated.

Output of a switching signal occurs if a set level threshold or signal level switching point is undershot (High Active) or exceeded (Low Active).

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

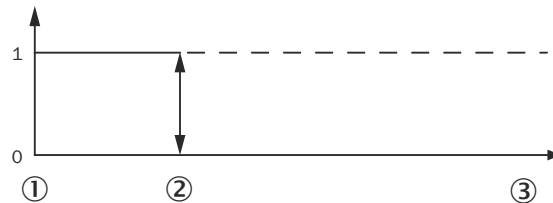


Figure 21: Signal level warning (“High Active”)

- ① Minimum signal level
- ② Signal level switching point
- ③ Maximum signal level

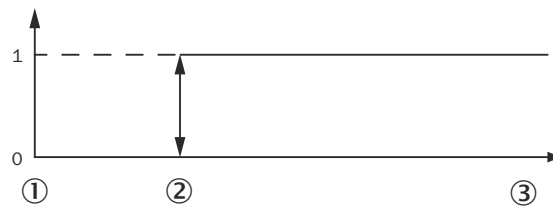


Figure 22: Signal level warning (“Low Active”)

- ① Minimum signal level
- ② Signal level switching point
- ③ Maximum signal level

If the “SLWarning” switching mode is activated, the level threshold to be defined can either be taught in using a reference object or manually configured. These options are described below.

**NOTE**

The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see "Multifunctional input ("MF Input")", page 57) or IO-Link (see "Operation via IO-Link", page 21).

**NOTE**

External teach via the cable and via IO-Link can be used to make the inverted teach of the level warning threshold available, too, for the "Signal level warning" switching mode.

Surface of the object to be measured

In addition to the reflection and remission properties of the measuring object, changes to the angle and distance can have a significant impact on the distance level measured by the sensor. Particularly for objects with a reflective surface, a change in angle can result in very significant changes to the signal level measurement.

Depending on the angle of the measuring object in combination with its reflective properties, a change in distance can also have a significant impact on the measured signal level. For example, some areas in the sensor receiver may experience direct reflection of the emitted light reflected by the object. The signal level varies when the distance changes also for diffusely reflecting measuring objects. In this case, a drop in the signal level is particularly to be observed in the direction of the measuring range limits.

6.4.1.6.2**Teachable settings ("Teach")**

A teach-in function is accessible for the "SLWarning" switching mode.

Teach function	Description
Q ₁ Signal level warning	You can use the teach function "Q ₁ SLWarning" to teach in the level warning threshold or signal level switching point for the "SLWarning" switching mode using the reflective properties of a reference object. In the case of a signal level warning, a switching signal is output as soon as the taught-in signal level is undershot. Thus the output acts as High Active (see figure 21, page 45).

6.4.1.6.3**Manual settings**

Setting	Description
Q ₁ Signal level warning	You can use the setting "Q ₁ SLWarning" to manually teach in the level warning threshold or signal level switching point for the "SLWarning" switching mode using a signal level within the value range of 0 to 6000. Since the signal level is not expressed as a standardized unit, but instead corresponds to a sensor-specific value, it is advisable to determine and define the level warning threshold for each application based on test measurements using the signal level display shown in RUN mode. There is no switching hysteresis function in the "SLWarning" switching mode. This is because both the level warning threshold and time-dependent behavior of the signal level curve vary from one application to the next. In light of these facts, it is also advisable to use external and specific or time-dependent filtering of the signal level warning in the control system in addition to the output of the signal level warning.
Q ₁ Logic	You can use the "Q ₁ Logic" setting to manually select whether the output of the signal level warning is to act as High Active (see figure 21, page 45) or Low Active (see figure 22, page 45).

6.4.1.6.4

Operating examples via display: "Q₁ SLWarning" switching mode

Select and activate the "Advanced" user level	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Device [Set] → User level [Set] → Easy [V]/[^] to → Advanced [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: Easy

Select and activate the "SLWarning" switching mode for Q ₁	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [Set] → DtO (1point) [V]/[^] to → SLWarning [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Factory setting: DtO (1point)

Teach in the current signal level as the switching point or level warning threshold for the signal level warning via Q ₁ as a switching point or level warning threshold	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Teach Q ₁ [Set] → SLWarning Position the reference object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Mode Q ₁ = SLWarning Factory setting: -

Manually configure the desired signal level in the menu via Q ₁ as a switching point or level warning threshold	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ SLWarning [Set] → 0000 (Note: 0 = flashing 0) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] to the → desired level warning threshold [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Mode Q ₁ = SLWarning Factory setting: -

Manually switch the logic for Q ₁ to “Low Active”	
Operating example or steps: RUN mode [Set] → Q ₁ Output [Set] → ModeQ ₁ [V]/[^] to → Manual Q ₁ [Set] → Q ₁ SLWarning [V]/[^] to → Q ₁ Logic [Set] → High Active [V]/[^] to → Low Active [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Mode Q ₁ = SLWarning Factory setting: High Active

6.4.2 “Function Q₂/Q_a” output function

Output 1 of DT50-2 Pro is used exclusively for switching (see "Switching mode for Q₁ ("ModeQ₁")", page 22). Accordingly, the output function cannot be freely selected. You can choose from the following functions for output 2.

- 4 - 20 mA
- 0 - 10 V
- Switching
- “Q₂=Q₁not”
- “OFF” (only in the “Advanced” user level)

These are described in detail in the following.

6.4.2.1 4-20 mA output function

If the 4-20 mA setting is selected, output 2 functions as an analog current output. The measured value of the sensor is output as a proportional-linear current value that corresponds to the other sensor settings.

6.4.2.2 0-10 V output function

If the 0-10 V setting is selected, output 2 functions as an analog voltage output. The measured value of the sensor is output as a proportional-linear voltage value that corresponds to the other sensor settings.

6.4.2.3 “Switching” output function

Output 2 functions as a switching output for the “switching” output function. Since output 1 is used exclusively for switching, this setting corresponds to the behavior of output 1. A switching signal that corresponds to the other sensor settings (see "Switching mode for Q₂ ("ModeQ₂")", page 49) is output based on the current measured value.

6.4.2.4 “Q₂=Q₁not” output function

In the “Q₂ = Q₁ not”=Q₁the opposite switching signal to that of output 1 is output via output 2. For example, if a “high” signal is output at output 1, then the signal output via output 2 will be “low”. This is also known as a complementary output. This is used if an error notification is needed in the event of cable breakage.

6.4.2.5 “Off” output function

The “Off” output function is only accessible if the “Advanced” user level is activated. In the “Off” output function, output 2 does not have any function and is therefore deactivated.

6.4.3 Switching mode for Q_2 (“Mode Q_2 ”)

If the output function for Q_2 (“Function Q_2/Q_a ”) is set to “Switching”, the following switching modes are available:

- Distance to object or single switching point (“DtO (1point)”)
- Switching window (“Window”)
- Object between sensor and background (“ObSB (Background)”)
- Shape comparison (“Shape”, Advanced user level only)
- Fault output (“Alarm”, Advanced user level only)
- Signal level warning (“SLWarning”, Advanced user level only)

Since this and its function, apart from the designation (Q_2 instead of Q_1) are absolutely identical to the switching modes for Q_1 , the following chapters do not provide a new description. For more details about the switching modes and operating examples for output Q_2 , refer to the [Switching mode for \$Q_1\$ \(“Mode \$Q_1\$ ”\)](#) chapter.

6.4.4 Analog mode for Q_a („Mode Q_a “)

In the factory settings of DT50-2 Pro, output 2 is operated in the “Distance” analog mode. If the “4-20 mA” or “0-10 V” output function has been selected and the Advanced user level has been activated, you can choose between “Distance” (see [“Distance” analog mode](#), page 49) and Shape (see [“Shape comparison” \(“Shape”\) analog mode](#), page 54) for the analog mode or the measured value to be output.

6.4.4.1 “Distance” analog mode

6.4.4.1.1 Description

In the “Distance” analog mode, the measured distance value is output as a linearly proportional current or voltage signal, according to the selected setting for the output function. Depending on the setting, the analog output behavior for this can be “rising” or “falling”.

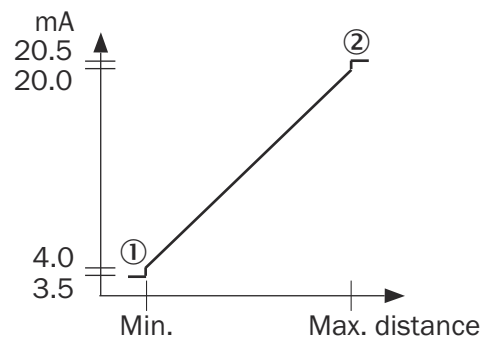


Figure 23: 4-20 mA output function in distance mode with rising output behavior

- ① Taught-in or manually set distance for 4 mA
- ② Taught-in or manually set distance for 20 mA

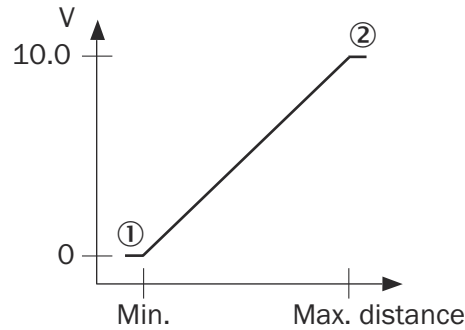


Figure 24: 0-10 V output function in distance mode with rising output behavior

- ① Taught-in or manually set distance for 0 V
- ② Taught-in or manually set distance for 10 V

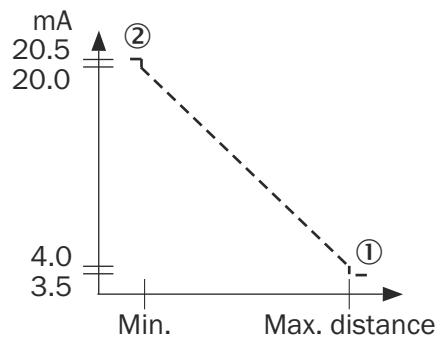


Figure 25: 4-20 mA output function in distance mode with falling output behavior

- ① Taught-in or manually set distance for 4 mA
- ② Taught-in or manually set distance for 20 mA

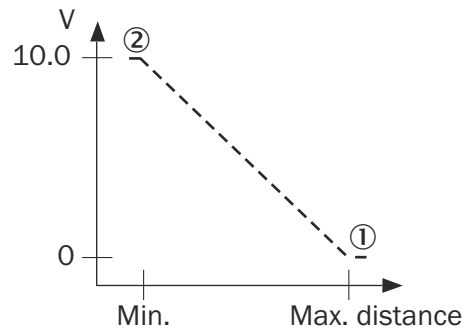


Figure 26: 0-10 V output function in distance mode with falling output behavior

- ① Taught-in or manually set distance for 0 V
- ② Taught-in or manually set distance for 10 V

If an analog output function is selected in combination with distance mode, then the required settings can be either taught in or manually set. These are described in the following.



NOTE

If the sensor is unable to measure (e.g. the object is in a blind spot of the sensor, or there is too little remission or light reflection), a signal is output in the “Distance” analog mode, which corresponds to the expected behavior with the maximum distance, see ["Behavior if no measurement is possible \(NoMeasurement\)", page 65.](#)

**NOTE**

The switching mode and the settings can be changed by executing a teach function by means of a multifunctional input (see "Multifunctional input ("MF Input")", page 57) or IO-Link (see "Operation via IO-Link", page 21).

6.4.4.1.2**Teachable settings ("Teach")**

Both the "4-20 mA" and "0-10 V" analog output functions have two teach functions available that can be executed to scale the analog output in accordance with the application requirements.

Teach function	Description
4 mA	The "4 mA" teach function can be used for the "4-20 mA" output function to teach in the current distance value for the analog output of measured values with 4 mA.
20 mA	The "20 mA" teach function can be used for the "4-20 mA" output function to teach in the current distance value for the analog output of measured values with 20 mA.
0 V	The "0 V" teach function can be used for the "0-10 V" output function to teach in the current distance value for the analog output of measured values with 0 V.
10 V	The "10 V" teach function can be used for the "0-10 V" output function to teach in the current distance value for the analog output of measured values with 10 V.

**NOTE**

Depending on whether the larger distance value is taught in for 4 mA or 0 V, or for 20 mA or 10 V, the analog output behavior is either "rising" (distance for 4 mA or 0 V < distance for 20 mA or 10 V) or "falling" (distance for 4 mA or 0 V > distance for 20 mA or 10 V).

6.4.4.1.3**Manual settings**

Setting	Description
4 mA	The "4 mA" setting can be used to manually set the distance value in millimeters to be output with 4 mA at the analog output.
20 mA	The "20 mA" setting can be used to manually set the distance value in millimeters to be output with 20 mA at the analog output.
0 V	The "0 V" setting can be used to manually set the distance value in millimeters to be output with 0 V at the analog output.
10 V	The "10 V" setting can be used to manually set the distance value in millimeters to be output with 10 V at the analog output.
Q _a Logic	With the "Q _a Logic" setting of the output behavior you can manually select whether the analog output curve will be "rising" (see figure 23, page 49) or "falling" (see figure 25, page 50). If the output behavior is modified, the sensor automatically exchanges the values set for 4 mA and 20 mA, or 0 V and 10 V, accordingly.

**NOTE**

Depending on whether the larger distance value is taught in for 4 mA or 0 V, or for 20 mA or 10 V, the analog output behavior is either "rising" (distance for 4 mA or 0 V < distance for 20 mA or 10 V) or "falling" (distance for 4 mA or 0 V > distance for 20 mA or 10 V).

6.4.4.1.4 Operating examples via display: Scaling the analog output with respect to the distance value output

Use Easy Teach to teach in the current distance for "4 mA" in the menu	
Operating example or steps: RUN mode [V] Press for 5 sec. → 4 mA Position object [Set] → Saved	Necessary default settings: Factory setting or function $Q_2/Q_a = 4-20$ mA Mode $Q_a =$ Distance (only for user level = Advanced) <hr/> Factory setting: 200 mm

Use Easy Teach to teach in the current distance for "20 mA" in the menu	
Operating example or steps: RUN mode [^] Press for 5 sec. → 20 mA Position object [Set] → Saved	Necessary default settings: Factory setting or function $Q_2/Q_a = 4-20$ mA Mode $Q_a =$ Distance (only for user level = Advanced) <hr/> Factory setting: 30,000 mm

Teach in the current distance for "4 mA" in the menu	
Operating example or steps: RUN mode [Set] → Q_1 Output [V]/[^] to → Q_2 Output [Set] → Function Q_2/Q_a [V]/[^] to → Teach Q_a [Set] → 4 mA Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Factory setting or function $Q_2/Q_a = 4-20$ mA Mode $Q_a =$ Distance (only for user level = Advanced) <hr/> Factory setting: 200 mm

Teach in the current distance for "20 mA" in the menu	
Operating example or steps: RUN mode [Set] → Q_1 Output [V]/[^] to → Q_2 Output [Set] → Function Q_2/Q_a [V]/[^] to → Teach Q_a [Set] → 4 mA [V]/[^] to → 20 mA Position object [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Factory setting or function $Q_2/Q_a = 4-20$ mA Mode $Q_a =$ Distance (only for user level = Advanced) <hr/> Factory setting: 30,000 mm

Manually set the desired distance for “4 mA”	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [V]/[^] to → Manual Q_a [Set] → 00200 (Note: 0 = flashing 0) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] → desired distance in mm [Set] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: Factory setting or function Q₂/Q_a = 4-20 mA Mode Q_a = Distance (only for user level = Advanced)</p> <hr/> <p>Factory setting: 200 mm</p>

Manually set the desired distance for “20 mA”	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [V]/[^] to → Manual Q_a [Set] → 4 mA [V]/[^] to → 20 mA [Set] → 30000 (Note: 3 = flashing 3) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] → desired distance in mm [Set] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: Factory setting or function Q₂/Q_a = 4-20 mA Mode Q_a = Distance (only for user level = Advanced)</p> <hr/> <p>Factory setting: 30,000 mm</p>

Activate the “0-10 V” output function or analog voltage output	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [Set] → 4-20 mA [V]/[^] to → 0-10 V [Set] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: -</p> <hr/> <p>Factory setting: 4-20 mA</p>

Change the analog output behavior to "falling"	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Q ₂ Output [Set] → Function Q ₂ /Q _a [V]/[^] to → Manual Q _a [Set] → 4 mA [V]/[^] to → Q _a Logic [Set] → Rising [V]/[^] to → Falling [Set] → Saved [Esc] to → RUN mode	Necessary default settings: Factory setting or function Q ₂ /Q _a = 4-20 mA or 0-10 V Mode Q _a = Distance (only for user level = Advanced)
	Factory setting: Rising

6.4.4.2 "Shape comparison" ("Shape") analog mode

6.4.4.2.1 Description

The "Shape comparison" analog mode is only accessible if the Advanced user level and an analog function for Q₂/Q_a are activated. During the shape comparison, the shape of a measured object is compared to a reference shape that was previously taught in. The sensor outputs an analog signal in accordance with the match level.

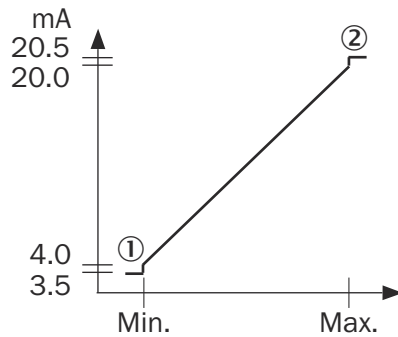


Figure 27: 4-20 mA output function in shape mode with rising output behavior

- ① Taught-in or manually set match for bad objects
- ② Taught-in or manually set match for good objects

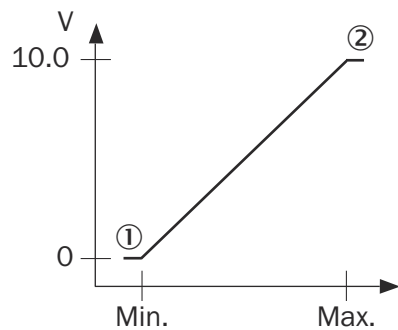


Figure 28: 0-10 V output function in shape mode with rising output behavior

- ① Taught-in or manually set match for bad objects
- ② Taught-in or manually set match for good objects

For general information and notes about shape comparison, refer to the [“Shape comparison” \(“Shape”\) switching mode](#) chapter.

6.4.4.2.2 Teachable settings (“Teach”)

For the “Shape comparison” (“Shape”) analog mode it is necessary to teach in the length and shape of the reference object. In addition, you have the option of teaching in the scaling of the analog output.

Teach function	Description
Reference object length (“Length Ref. Object”)	You can use the “Reference object length” (“Length Ref. Object”) teach function to teach in the length of the reference object.
Reference object shape (“Shape Ref. Object”)	You can use the “Reference object shape” (“Shape Ref. Object”) teach function to teach in the shape of the reference object. Then the shape that is taught in corresponds to the “target shape” and serves as a basis for the shape comparison.
Q _a Good Teach	In the factory setting, a match level of 100% with 20 mA or 10 V is output with the “Shape comparison” (“Shape”) analog mode. Alternatively, after the length and shape of the reference object have been taught in, it is also possible to teach in the desired match level to be output with 20 mA or 10 V instead. With this teach you can have one to as many good objects as desired move past the sensor. Based on the good objects that move past it, the sensor automatically saves the value of the lowest match as upper scaling of the analog output.
Q _a Bad Teach	In the factory setting, a match level of 0% with 4 mA or 0 V is output with the “Shape comparison” (“Shape”) analog mode. Alternatively, after the length and shape of the reference object have been taught in, it is also possible to teach in the desired match level to be output with 4 mA or 0 V instead. With this teach you can have one to as many bad objects as desired move past the sensor. Based on the good objects that move past it, the sensor automatically saves the value of the highest match as lower scaling of the analog output.

6.4.4.2.3 Manual settings

Setting	Description
Reference object length (“Length Ref. Object”)	You can use the “Reference object length” (“Length Ref. Object”) setting to set the length of the reference object in milliseconds.
Reference object shape (“Shape Ref. Object”)	The shape of the reference object cannot be entered manually. Accordingly, the teach function for teaching in the shape of the reference object (see “Teachable settings (“Teach”)”, page 55) is available also for the manual settings.
Shape trigger threshold (“Self Trigger”)	The beginning and end of the object is detected directly by the sensor for teaching in the length and shape of the reference object as well as for the shape comparison function. This detection is based on the difference in height between the background (e.g. a conveyor belt) and the object; it is called the shape trigger threshold – “Self Trigger”. This trigger threshold is set by default to a height of 25 mm. You can manually adjust this height threshold in millimeters to detect even smaller objects or hide larger height fluctuations of the background.
Good object shape tolerance Q _a (“Q _a Good Tolerance”)	The good object shape tolerance Q _a (“Q _a Good Tolerance”) setting can be used to manually define the match level to be assigned to the upper scaling of the analog output in the form of a percentage. To enable estimation of the match level of various objects and setting of useful scaling based on this, it is advisable to measure some objects in Run mode and observe the results of the shape comparison.

Setting	Description
Bad object shape tolerance Q_a (“ Q_a Bad Tolerance”)	The bad object shape tolerance Q_a (“ Q_a Bad Tolerance”) setting can be used to manually define the match level to be assigned to the lower scaling of the analog output in the form of a percentage. To enable estimation of the match level of various objects and setting of useful scaling based on this, it is advisable to measure some objects in Run mode and observe the results of the shape comparison.



NOTE

The analog output behavior cannot be changed in the “Shape comparison” (“Shape”) analog mode.

6.4.4.2.4

Operating examples via display: “Shape comparison” (“Shape”) switching mode

Select and activate the “Advanced” user level	
Operating example or steps: RUN mode [Set] → Q_1 Output [V]/[^] to → Device [Set] → User level [Set] → Easy [V]/[^] to → Advanced [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: Easy

Activate the “0-10 V” output function or analog voltage output	
Operating example or steps: RUN mode [Set] → Q_1 Output [V]/[^] to → Q_2 Output [Set] → Function Q_2/Q_a [Set] → 4-20 mA [V]/[^] to → 0-10 V [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: 4-20 mA

Activate “Shape comparison” (“Shape”) analog mode	
Operating example or steps: RUN mode [Set] → Q_1 Output [V]/[^] to → Q_2 Output [Set] → Function Q_2/Q_a [V]/[^] to → Mode Q_a [Set] → Distance [V]/[^] to → Shape [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced Function Q_2/Q_a = 4-20 mA or 0-10 V Factory setting: Distance

Teach in the length of the reference object	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [V]/[^] to → Teach Q_a [Set] → Length Ref. Object [Set] → ESC? Move the object past the sensor After reference object [Esc] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: User level = Advanced Function Q₂/Q_a = 4-20 mA or 0-10 V ModeQ_a = Shape</p> <p>Factory setting: -</p>

Teaching in the reference object shape	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [V]/[^] to → Teach Q_a [Set] → Length Ref. Object [V]/[^] to → Shape of ref. object [Set] → ... Move the object past the sensor After the object is automatically saved [Esc] to → RUN mode</p>	<p>Necessary default settings: User level = Advanced Function Q₂/Q_a = 4-20 mA or 0-10 V ModeQ_a = Shape Length Ref. Object = defined</p> <p>Factory setting: -</p>

Manually set the shape trigger threshold for Q _a	
<p>Operating example or steps: RUN mode [Set] → Q₁ Output [V]/[^] to → Q₂ Output [Set] → Function Q₂/Q_a [V]/[^] to → Manual Q_a [Set] → Length Ref. Object [V]/[^] to → Self Trigger [Set] → 000025 (Note: 0 = flashing 0) [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set], [V]/[^] [Set] to → desired shape trigger threshold [Set] → Saved [Esc] to → RUN mode</p>	<p>Necessary default settings: User level = Advanced Function Q₂/Q_a = 4-20 mA or 0-10 V ModeQ_a = Shape</p> <p>Factory setting: -</p>

6.4.5 Multifunctional input (“MF Input”)

Description

The multifunctional input (MF, at pin 5) is for

- configuring various sensor parameters (see ["External teach \("Teach"\)"](#), page 59) and
- for switching the laser on or off based on time definitions.

Necessary default setting

The multifunctional input (MF) must be active (each setting except for "MF off").



NOTE

Deactivating the multifunctional input "MF off") is possible only via the display, SOPAS ET or IO-Link, but not via the multifunctional input itself.

6.4.5.1 Options for setting the MF

The DT50-2 Pro display can be used to configure the following settings for the multifunctional input:

MF Function

- Teach, see "External teach" table
- Switch the laser on or off for the duration of the current signal ("Laser off")
- Deactivate MF ("MF off")

If "MF Function" is set to "Teach" (factory setting), the specific parameters can be configured by creating signal levels of different lengths at pin 5, see ["External teach \("Teach"\)"](#), page 59. If "MF Function" is set to "Laser off", when a signal is created the laser is switched off for the duration of the created signal.

MF Logic

- High active
- Low active

The input behavior of the MF can be selected as High Active (factory setting) or Low Active via "MF Logic". When "Laser off" is used, the logic also determines whether the creation of a signal at MF causes the laser to switch off (factory setting) or on.

Confirm teach

- Switch on confirmation ("Yes")
- Switch off confirmation ("No")

In the factory setting, the confirmation of a teach that has happened via MF is switched off. If confirmation of a teach via multifunctional input is activated, this happens via the switching output Q1 of the sensor, see ["Confirmation of the teach via MF via output Q₁ \("Confirm teach"\)"](#), page 60.

6.4.5.1.1 Operating example via display: MF Function

Function of the multifunctional input MF ("MF Function")	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → MF Input [Set] → MF Function [Set] → Teach [V]/[^] until the desired function of the multifunctional input MF is displayed [Set] → Saved [Esc] to → RUN mode	Necessary default settings: -
	Factory setting: Teach

6.4.5.2 External teach ("Teach")

Description

In the "Teach" operating mode you can use various teach functions by creating signal levels of various lengths at the multifunctional input. The timing tolerance for all teach functions is +/- 20 ms.

The following functions are available:

Teach function	Time [ms]	Explanation in chap.
Move last teach point + 10 mm	60	
Move last teach point - 10 mm	120	
Switching off laser	200	see "Switch the laser on/off", page 69
Switching on laser	300	see "Switch the laser on/off", page 69
Distance to object for Q ₁ : Teach Q	400	see "Operating examples via display: "Distance to object" ("DtO") switching mode", page 24
Distance to object for Q ₁ : Teach Q not	500	see "Operating examples via display: "Distance to object" ("DtO") switching mode", page 24
Switching window for Q ₁ : Teach Q near	600	see "Operating examples via display: "Switching window" ("Window") switching mode ", page 29
Switching window for Q ₁ : Teach Q far	700	see "Operating examples via display: "Switching window" ("Window") switching mode ", page 29
ObSB (Background) for Q ₁ : Teach Q	800	see "Operating examples via display: "Object between sensor and background" (ObSB) switching mode", page 33
ObSB (Background) for Q ₁ : Teach Q not	900	see "Operating examples via display: "Object between sensor and background" (ObSB) switching mode", page 33
Switching window for Q ₁ : Centering teach ¹	1000	see "Centering function or center displacement", page 67
Distance to object for Q ₂ : Teach Q	1100	see "Switching mode for Q₂ ("ModeQ₂")", page 49
Distance to object for Q ₂ : Teach Q not	1200	see "Switching mode for Q₂ ("ModeQ₂")", page 49

Teach function	Time [ms]	Explanation in chap.
Switching window for Q ₂ : Teach Q near	1300	see "Switching mode for Q ₂ ("ModeQ ₂ ")", page 49
Window for Q ₂ : Teach Q far	1400	see "Switching mode for Q ₂ ("ModeQ ₂ ")", page 49
ObSB (Background) for Q ₂ : Teach Q	1500	see "Switching mode for Q ₂ ("ModeQ ₂ ")", page 49
ObSB (Background) for Q ₂ : Teach Q not	1600	see "Switching mode for Q ₂ ("ModeQ ₂ ")", page 49
Switching window for Q ₂ : Centering teach ¹	1700	see "Centering function or center displacement", page 67
Q _A with 4-20 mA for Q ₂ : Teach 4 mA	1800	see "Operating examples via display: Scaling the analog output with respect to the distance value output", page 52
Q _A with 4-20 mA for Q ₂ : Teach 20 mA	1900	see "Operating examples via display: Scaling the analog output with respect to the distance value output", page 52
Q _A with 0-10 V for Q ₂ : Teach 0 V	2000	see "Operating examples via display: Scaling the analog output with respect to the distance value output", page 52
Q _A with 0-10 V for Q ₂ : Teach 10 V	2100	see "Operating examples via display: Scaling the analog output with respect to the distance value output", page 52
Q _A (4-20 mA or 0-10 V): Centering teach ¹	2200	see "Centering function or center displacement", page 67
Switch off the MF confirmation	2300	see "Confirmation of the teach via MF via output Q ₁ ("Confirm teach")", page 60
Switch on the MF confirmation	2400	see "Confirmation of the teach via MF via output Q ₁ ("Confirm teach")", page 60
Signal level warning (SLW) Q ₁ : Teach Q	2500	see "Operating examples via display: "Q ₁ SLWarning" switching mode", page 47
Signal level warning (SLW) Q ₁ : Teach Q not	2600	see "Operating examples via display: "Q ₁ SLWarning" switching mode", page 47
Signal level warning (SLW) Q ₂ : Teach Q	2700	see "Operating examples via display: "Q ₁ SLWarning" switching mode", page 47
Signal level warning (SLW) Q ₂ : Teach Q not	2800	see "Switching mode for Q ₂ ("ModeQ ₂ ")", page 49
Reset Wi-Fi settings to factory condition ²	3800	
Laser off	> 5000	see "Switch the laser on/off", page 69

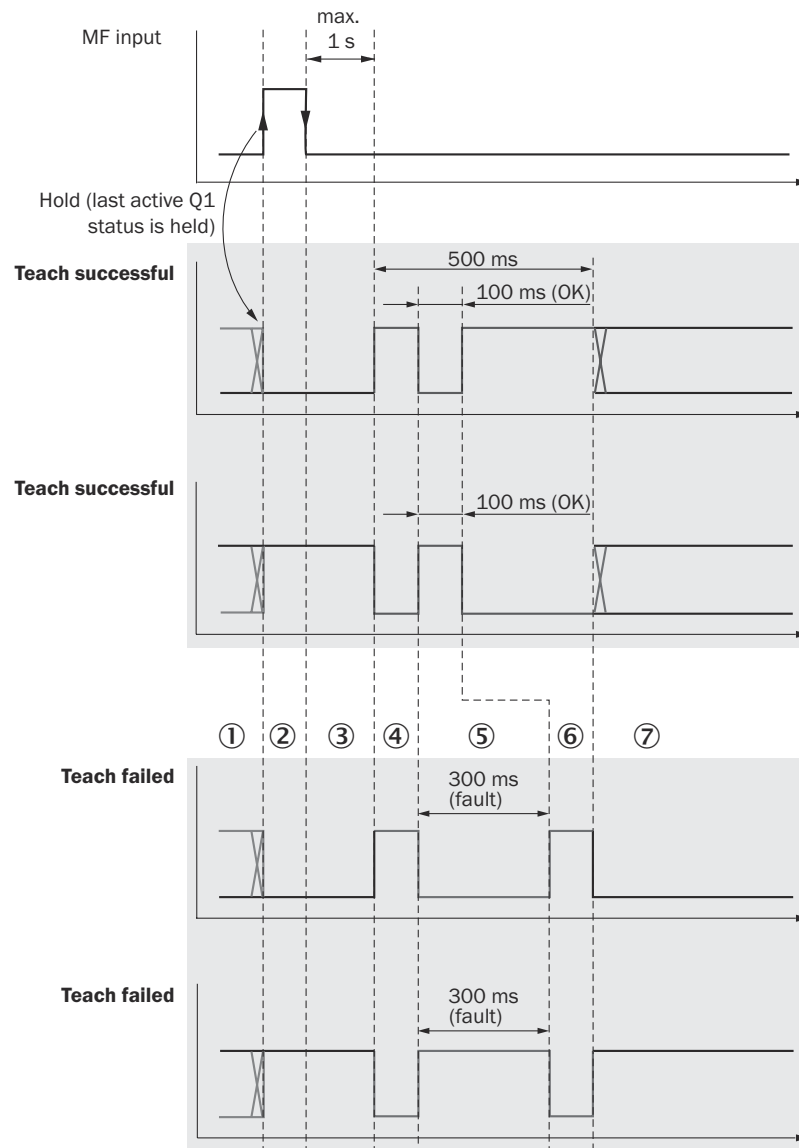
¹ Centering limits. The near and far points that have been moved via centering must always lie within the value range limits. Moved points must always be evaluated by the user.

² Can be used only in variants with a Wi-Fi interface. Function available only in the first 60 seconds after switching on the device.

6.4.5.3 Confirmation of the teach via MF via output Q₁ ("Confirm teach")

Description

With this function, a confirmation can be output via the switching output Q₁ for each teach via multifunctional input.



- ① Switching output before teach
- ② Teach request retains the last active Q₁ status in order, for example, to avoid toggling if hysteresis is too low
- ③ Teach execution time, max. 1 s
- ④ First signal edge at Q₁ after starting the teach: Initiate confirmation by inverting for 100 ms.
- ⑤ Result: OK (100 ms), error (300 ms)
- ⑥ Quit confirmation after 500 ms.
- ⑦ Return to current switching output. The switching output can be modified via a new teach point.

6.4.5.3.1 Operating example via display: Confirm teach

Confirmation of the teach via MF ("Confirm teach")	
Operating example or steps: RUN mode (Set) → Q ₁ Output (▼)/(▲) to → MF Input (Set) → MF Function (▼)/(▲) to → Confirm Teach (Set) → No (▼)/(▲) to → Yes (Set) → Saved (Esc) to → RUN mode	Necessary default settings: User level = Advanced MF Function = Teach
	Factory setting: No

6.4.6 Speed setting ("Speed")

Description

The DT50-2 Pro distance sensor provides the option of setting various speeds.

The Easy user level has five predefined speed settings: Super fast, Fast, Medium (factory setting), Slow and Super Slow; the Advanced user level additionally has the configurable Expert mode.

Table 9: Speed settings for the sensor

Easy user level	Super-fast	-	Fast	Medium	-	Slow	Super-slow	-	-
Advanced user level	0	1	2	3	4	5	6	7	8
Integration time ¹ / output time (laser class 2) [ms]	0.33	0.67	1.33	3.33	6.67	10.0	30.0	74.0	160.0
Integration time ¹ / output time (laser class 1) [ms]	0.67	1.33	2.67	6.67	13.33	20.0	60.0	148.0	320.0
Integration depth [measuring cycles]	1	2	4	10	20	30	90	222	480
Response time ² / analog output (laser class 2) [ms]	0.83	1.67	3.33	8.33	16.67	25.0	75.0	185.0	400.0
Response time ² / analog output (laser class 1) [ms]	1.67	3.33	6.67	16.67	33.33	50	150	370	800
Switching frequency ² switching output (laser class 2) [Hz]	1000.0	500.0	250.0	100.0	50.0	33.33	11.11	4.50	2.08
Switching frequency ² switching output (laser class 1) [Hz]	500	250	125	50	25	16.67	5.5	2.25	1

¹ Continuous change of the distance from the object in the measuring range

² Lateral entry of the object into the measuring range

The selected speed setting affects the performance of the device. The appendix shows the "repeatability" and "distance" performance data as a function of the remission values 6%, 18% and 90% for the five predefined speed settings, see "Diagram repeatability", page 81.

Integration time, averaging and bit filter

The following parameters can be configured individually in the Advanced user level and when selecting the Expert speed setting:

- **Integration time of the measurement (“Sampling Period”)**
 The integration time, also called output time, defines the time provided for the statistical analysis via the HDDM process.
 An updated measured value is output after each of these measurement cycles is completed. The integration times available for selection are listed in the preceding table.
- **“Averaging (analog)” analog output**
 If required, a moving average can be configured for the analog output. This requires defining a specific number of measurement cycles in order to determine the average. This average measured value is output via an analog interface. This can be used to smooth jumps in a distance value, which results in a more stable process.
 You can choose from the following number of measurement value cycles to be averaged: off (1; factory setting); 2; 4; 8; 16; 32.
 This will not affect the integration or output times. However, the respective output values are averaged. As a result, equalization of the output value may be delayed in the event of a change in distance.
- **“BitFilter (switch)” switching outputs**
 The bit filter for switching outputs determines how often an identical output state has to recur consecutively before the signal at the switching output changes accordingly. If the defined number is not reached, the switching output remains unchanged. This may increase the reliability in the application if the distance value around the selected switching point fluctuates.
 You can choose the following condition of identical, successive output states: off (1; factory setting); 2; 4; 8; 16; 32.
 This will not affect the integration or output times.

6.4.6.1 Operating example via display: Speed setting

Select the predefined speed setting	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Speed [Set] → Medium [V]/[^] until the → desired speed setting is visible [Set] → Saved [Esc] to → RUN mode	Necessary default settings: - Factory setting: Medium

6.4.7 Device settings

6.4.7.1 User level

There are two different user levels for display operation:

- Easy: frequently required functions (factory setting)
- Advanced: almost all functions available in the sensor

A changeover only affects operation of the display. Any time SOPAS ET is in operation or configurations are being carried out via IO-Link, all functions available in the sensor can be used.

6.4.7.1.1 Operating example via display: Change user level to Advanced

Select and activate the "Advanced" user level	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Device [Set] → User level [Set] → Easy [V]/[^] to → Advanced [Set] → Saved [Esc] to → RUN mode	Necessary default settings: -
	Factory setting: Easy

6.4.7.2 Lock

The pushbuttons on the sensor display can be locked to prevent unintentional actuation.

If a pushbutton is pressed when the lock function is active, the text "Locked" appears on the display.

6.4.7.2.1 Operating example via display: Lock

Activate lock function	
Operating example or steps: RUN mode [Set] → Q ₁ Output [V]/[^] to → Device [Set] → User level [V]/[^] to → Lock [Set] → No [V]/[^] to → Yes [Set] → Saved → Locked appears when a pushbutton is pressed	Necessary default settings: -
	Factory setting: No
Deactivate lock function	
Operating example or steps: RUN mode [Set] Press and hold for 5 seconds → Unlock	Necessary default settings: Lock function activated = Yes
	Factory setting: No

6.4.7.3 Display Off

The display can be switched off. This also simultaneously deactivates the keyboard on the display.

If a pushbutton is pressed when the display is off, the display temporarily switches on again. The messages "Display" and "Off" appear in alternation.

6.4.7.3.1 Operating example via display: Display Off

Display Off	
Operating example or steps: RUN mode (Set) → Q ₁ Output (V)/(^) to → Device (Set) → User level (V)/(^) to → Disply (Set) → On (V)/(^) to → Off (Set) The display is switched off → Display Off appears when a pushbutton is pressed	Necessary default settings: -
	Factory setting: On
Display On	
Operating example or steps: RUN mode (Set) Press and hold for 5 seconds → Distance value reappears	Necessary default settings: Display = Off
	Factory setting: On

6.4.7.4 Reset factory settings

The DT50-2 Pro can be reset to its factory settings.



NOTE

Upon confirmation that the device has been reset to its factory settings, it carries out a warm start. During the device restarting process, the distance sensor function is temporarily deactivated.

6.4.7.4.1 Operating example via display: Reset factory settings

Reset factory settings	
Operating example or steps: RUN mode (Set) → Q ₁ Output (V)/(^) to → Device (Set) → User level (V)/(^) to → Reset (Set) → No (V)/(^) to → Yes (Set) → SICK DT50-2 RUN mode	Necessary default settings: -
	Factory setting: -

6.4.7.5 Behavior if no measurement is possible (NoMeasurement)

If a distance measurement cannot be run, an error is output. Possible causes of the error:

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

The sensor behaves as follows when the factory settings are active:

Table 10: Behavior if no measurement is possible

	Minimum distance undershot	Maximum distance exceeded	Signal too weak
Display	“Min” text	“Max” text	“noDist” text
Analog output (current)	3.5 mA	20.5 mA	20.5 mA
Analog output (voltage)	0 V	10 V	10 V
Distance value in IO-Link	Distance value	Distance value	0 mm
Distance value in SOPAS	Distance value	Distance value	0 mm

You can configure the sensor behavior for the event that no measurement is possible.

The following options are available:

Output minimum/maximum value (clamp)

A replacement value is output in place of the distance value (see value for “Signal too weak” in the previous table).

This behavior corresponds to the factory settings.

Hold last measured value

The last valid distance value is frozen and output again (held). This process repeats until it is once again possible to run a measurement.

Temporarily hold the last measured value (HoldX)

The last valid distance value is frozen and output again (held). This process repeats until it is once again possible to run a measurement. However, it does not continue beyond a preset time span. If a measurement is still not possible after this time has elapsed, the minimum/maximum value is output.

The maximum time span is adjustable. It is the product of the configured measurement integration time and a selectable factor. This factor is one of the following values: 2, 4, 8, 16 or 32.

Example

Integration time: 3.33 ms (medium speed), factor: 8 (HoldX8)

Maximum holding time = 8 x 3.33 ms = 26.64 ms

6.4.7.5.1 Operating example via display: Behavior if no measurement is possible (NoMeasurement)

Select behavior if no measurement is possible (NoMeasurement)	
Operating example or steps: RUN mode [Set] → Q ₁ Output [↓]/[↑] to → Device [Set] → User level [↓]/[↑] to → NoMeasurement [Set] → Clamp [↓]/[↑] until → the desired behavior is carried out if no measurement is possible [Set] → Saved [Esc] to → RUN mode	Necessary default settings: User level = Advanced
	Factory setting: Clamp

6.4.8 Read out sensor information

It is possible read out various status information from the sensor.

Table 11: Sensor status information

	Display	Wi-Fi (app)	SOPAS	IO-Link
Hardware version	Info > HW Ver	--	"Identification" page	Index 22 (0x16) "Hardware Version"
Software version	Info > FW Ver	--	"Diagnostics" page	Index 23 (0x17) "Software Version"
Error memory ²	Info > Status ¹	--	"Diagnostics" page	Index 89 (0x59) Error Status
Temperature ³	-	--	"Diagnostics" page	Index 153 (0x99) "Temperature"
Operating hour counter	Info > Operat ¹	--	"Diagnostics" page	Index 90 (0x5A) "Device Operating Time"

¹ Only available in the "Advanced" user level

² For more information, visit see "Detecting and displaying errors", page 74.

³ Related information see table 4, page 18

6.4.9 Other functions

Additional functions are described in this chapter. Most of these functions cannot be accessed via the display. The operating options used to access these functions are included in their respective descriptions.

6.4.9.1 Centering function or center displacement

The centering function can be used to shift the center of the switching range or analog range (12 mA/5 V) to a new position.

This new position can be taught in or input as a numerical value.

The centering function is available for the outputs Q₁ and Q₂ in "Window" mode and for the Q_a (analog) output.

The previous distance between both points (close and distant) is maintained. The close and distant values must not be moved beyond the sensor limits during the centering process. Otherwise, the value shift is rejected.

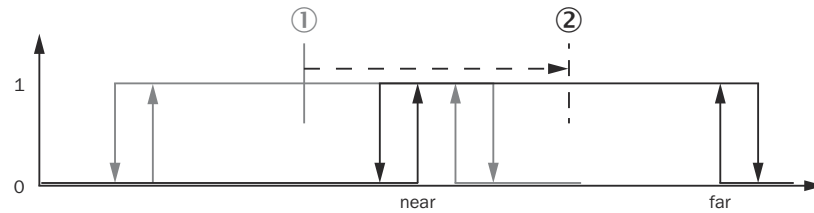


Figure 29: Centering function for the example “window not inverted.”

- ① Old center point before centering teach
- ② New center point after centering teach

Available under

SOPAS ET: “Output settings” page

IO-Link:

- Index 94 (0x5E) “Q1 center of window”
- Index 95 (0x5F) “Q2 center of window”
- Index 96 (0x60) “Qa center of analog output”
- Index 130 (0x82) “Teach”
- Index 131 (0x83) “Teach status”

6.4.9.2 Switching delay

For the output functions Q_1 and Q_2 , a time function can be activated. The configured time function applies to both switching outputs. The following functions are available:

Deactivated

Right after the measured distance has exceeded the specified switching point, the state of the switching output changes (factory setting).

Switch-on delay

The changeover of the switching output from an inactive to an active state is time-delayed. The delay time is adjustable. The changeover from an active to an inactive state is not delayed.

Switch-off delay

The changeover of the switching output from an active to an inactive state is time-delayed. The delay time is adjustable. The changeover from an inactive to an active state is not delayed.

ON and OFF delay

The changeover from an inactive to an active state and vice versa is time-delayed. The delay time is adjustable.

One-time timer

Once the switching condition has been met, the switching output changes from an inactive to an active state. The switching output remains in an active state for a specified period regardless of how long the switching condition is met. It does not switch back to an inactive state until this time has elapsed. Any additional changes made to the switching condition during this period are still not taken into account.

**NOTE**

An additional delay between the time at which the switching point is exceeded and the changeover of the switching output may result from the speed settings (integration time, depth of the bit filter).

Available under

SOPAS ET: “Output settings” page > “Switching delay”

IO-Link:

- Index 212 (0xd4) “Q time function”
- Index 214 (0xd6) “Time of the time function”

6.4.9.3 Switch the laser on/off

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

Temporarily switch the laser off

The laser can be switched off temporarily via the multifunctional input MF using the “Laser off” or “External teach” function. The laser switches off as soon as the switching condition has been met and remains switched off until it is no longer met, see ["Multifunctional input \(“MF Input”\)", page 57](#).

Permanently switch the laser off

The laser can be permanently switched off via IO-Link, SOPAS ET and the multifunctional input MF (in the “External teach” function). It remains switched off until it is switched back on by another event. If the sensor's power supply is interrupted in the meantime, the laser remains switched off afterwards; see also [see "Multifunctional input \(“MF Input”\)", page 57](#).

6.4.9.4 Find me!

The “Find me!” function makes it fast and easy to find a sensor that is installed in a machine or system. When the “Find me!” function is activated, the two yellow LEDs on the sensor flash (Q_1 and Q_2) and the sender laser flashes with a frequency of 5 Hz. When the function is being used, it is not possible to perform a correct distance measurement. If the sensor is switched off and back on when the “Find me!” function is activated, the “Find me!” function will no longer be active then.

Available under

SOPAS ET: “Identification” page

IO-Link: Index 204 (0xcc) “Find me!”

6.4.9.5 Configuring the IO process data

Process data is cyclically transferred via IO-Link from the sensor to the IO-Link Master. With the DT50-2 sensor, the contents of this process data can be configured as described in the following.

Process data structure

The structure of the process data can be selected from multiple predefined formats. The following formats are available:

Table 12: Process data formats

No.	Designation	Note
1	Distance value (14-bit) + Status Q ₁ + Status Q ₂	
2	Distance value (14-bit) + Status SLW + Status Alarm	
3	Distance value (16-bit)	Factory setting
4	Distance (14-bit) + Signal quality (2-bit)	
5	Timer (16-bit)	
6	Timer (14-bit) + Status Q ₁ + Status Q ₂	
7	Shape comparison match (7-bit) + Shape comparison counter (7-bit) + Status Q ₁ + Status Q ₂	

**NOTE**

A detailed description of the process data structures is contained in the operating instructions of the IODD file (see download at www.sick.com/Dx50-2).

Alternatively, all values transferred into the process data can be read out also via the acyclical channel ("All process data" parameter).

Further settings for the distance value

You can set the resolution for the distance value of the process data. Possible values include 0.1 mm, 1 mm (factory setting) and 10 mm.

Furthermore, it is possible to set off the measured distance value for the output via IO-Link with an offset. This is done by subtracting the offset from the measured distance value. You can set offset values from 0 to 50,000 mm (50 m) (factory setting is 0 mm).

**NOTE**

If an offset value is set, only measured values greater than the set value are output. Smaller measured values are output as 0 mm.

Value range of the distance value

The value range of the distance value in the process data (largest value that can be displayed in theory) depends on the process data format selected and on the resolution set. If the actually measured distance value exceeds the maximum value that can be displayed, then that maximum value is displayed instead of the actual value.

The following limits apply:

Table 13: Maximum values of the distance value

	Resolution 0.1 mm	Resolution 1 mm (factory setting)	Resolution 10 mm
Process data format No. 3 (distance value 16-bit, factory setting)	6553.5 mm (6.55 m)	65,535 mm (65.53 m)	655,350 mm (655.35 m)
Process data formats No. 0, 1, 4 (distance value 14-bit)	1638.3 mm (1.64 m)	16,383 mm (16.38 m)	163,830 mm (163.83 m)

Available under

SOPAS ET:

- "Advanced settings" page (configuring the process data)
- "Main settings & visualization" page (display of the process data)

IO-Link:

- Index 105 (0x69) "Process data resolution"
- Index 107 (0x6b) "Process data standardization offset"
- Index 109 (0x6d) "All process data" (acyclical reading of the process data)
- Index 120 (0x78) "IO-Link process data" (process data structure)

6.4.9.6 Timer function

The timer function can be used to determine how long output Q_1 is active. This can be used, for example, to measure the time for which an object is in the sensor's detection range. The timer function can be used with all switching functions of output Q_1 .

The timekeeping is started each time when output Q_1 changes over from an inactive to an active state. The timekeeping is stopped when output Q_1 changes over from an active to an inactive state. After the timekeeping has been ended, the measured time can be read out via the process data using IO-Link.

The measured time is output in milliseconds. The accuracy of the timer is affected by the sensor's speed settings (response time, depth of the bit filter). The longest measurable time span is 65,535 milliseconds (65.5 seconds).

Available under

SOPAS ET:

- "Advanced settings" page (configuring the process data)
- "Main settings & visualization" page (display of the measured time)

IO-Link:

- Index 120 (0x78) "IO-Link process data" (process data structure)
- Index 109 (0x6d) "All process data" (acyclical reading of the process data)

For the settings for switching output Q_1 see ["Switching mode for \$Q_1\$ \("Mode \$Q_1\$ "\)"](#), page 22.

6.4.9.7 Signal level and signal quality

Signal level ("SL")

The signal level corresponds to the amount of light received by the sensor's receiver optics. This is a dimensionless value. It essentially depends on the distance from the measuring object and on the surface of the measuring object (color, roughness/reflectivity, angle to the optical axis).

To enable the sensor to measure the distance correctly, the signal level must not drop below a certain value. This value depends on the selected speed.

Signal level warning ("Warning (SLW)")

A warning can be output via switching outputs Q_1 and Q_2 if the signal level drops below a certain value. This value can either be specified as a number value or determined by the "Teach" function. When the "Teach" function is used, the threshold value for outputting the warning is calculated by reducing the measured signal level value by about 12%. Then the warning will not be output until the signal level is about 12% lower than it was at the time it was taught in.

Signal quality ("SQ")

The signal quality indicates the stability of the measurement. A meaningful value is output only if the distance between the sensor and the measuring object is constant.

6.4.9.7.1 Operating examples via display: Signal level (“SL”) and signal quality (“SQ”)

Display signal level (“SL”)	
Operating example or steps: RUN mode <input checked="" type="checkbox"/> to → SL	Necessary default settings: -
	Factory setting: Distance value
Display signal quality (“SQ”)	
Operating example or steps: RUN mode <input checked="" type="checkbox"/> to → SQ	Necessary default settings: -
	Factory setting: Distance value

6.4.9.8 Application description

The application description is a free text that can be saved in the sensor. This can be, for example, the name of the application, the installation location of the sensor within the application or any other text. The text can be a maximum of 32 characters long. The contents of the application description have no impact on how the sensor functions.

Available under

SOPAS ET: “Identification” page

IO-Link: Index 24 (0x18) “Application-specific mark”

6.4.9.9 Device Access Locks

The “Device Access Locks” function can be used to limit access to the device. The sensor offers four different locks:

Table 14: Device Access Locks

Name	Meaning
Parameter (Write-) Access Lock	This locks writing of parameters via IO-Link and Sopas ET. Write operations are acknowledged by the device with an error message.
Data Storage Lock	The data storage mechanism of IO-Link is deactivated
Local Parameterization Lock	The device is locked and cannot be operated. This includes use of the display buttons as well as inputs via the multifunctional input MF.
Local User Interface Lock	

The “Device Access Locks” function is based on the IO-Link specification (Version 1.1.2, Chapter “B.2.4 Device Access Locks”).

Available under

SOPAS ET: “Identification” page

IO-Link: Index 12 (0x0c) “Device Access Locks”

7 Maintenance

7.1 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 front screen at regular intervals and in the event of contamination using a lint-free lens cloth (part no. 4003353) and plastic cleaning agent (part no. 5600006). The cleaning interval essentially depends on the ambient conditions.

7.2 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 15: 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

8 Troubleshooting

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

General faults, warnings and errors

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 faults. Warnings and errors are signaled by the **Status LED**. The **Power LED** signals that the sensor is connected to the power supply.

8.1 Detecting and displaying errors

In addition to measurement errors (see "[Behavior if no measurement is possible \(NoMeasurement\)](#)", page 65), the sensor can also detect and display other errors. These are output by the display, Sopas ET or IO-Link.

Error memory

The sensor has an error memory where internal error states of the sensor are recorded. The last error to have occurred is always saved. The contents of the error memory are retained when the sensor is switched off and when the "Restore Factory Settings" function is used.

Possible errors

Table 16: Explanation of the error code

Error code	Meaning	Countermeasure(s)
OK	No error	--
ERR010	Operating temperature under-shot	Check the ambient temperature and raise it, if necessary
WRN011, ERR011	Operating temperature exceeded	Check the ambient temperature and lower it, if necessary
WRN045, WRN046, ERR045, ERR046	Electrical fault	Check the electrical environment and improve it, if necessary (stability, power supply, EMC influences)

If a different message is output, please contact the manufacturer's technical support.

8.1.1 Operating example via display: Display device status ("Status")

Display device status ("Status")	
Operating example or steps: RUN mode Set → Q ₁ Output ▼ / ▲ to → Info Set → FW Version ▼ / ▲ to → Status Set → Status is displayed Esc to → RUN mode	Necessary default settings: User level = Advanced Factory setting: OK

8.2 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

8.3 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.

8.4 Disposal



CAUTION

Risk of injury due to hot device surface.

The surface of the device can become hot during operation.

- Before commencing disassembly, switch off the device. Let the device cool down if needed.

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.

9 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/Dx50-2

Please note: This documentation may contain further technical data.

9.1 Performance

Table 17: Technical data for performance

Measuring range ^{1 2}	200 mm ... 10,000 mm, 6% remission 200 mm ... 17,000 mm, 18% remission 200 mm ... 30,000 mm, 90% remission
Resolution	0.1 mm
Repeatability ^{2 3 4}	0.5 mm ... 5 mm
Accuracy ^{4 5}	± 7 mm
Light sender	Laser, red
Laser class	2 (EN 60825-1) / 1 (EN 60825-1)
Maximum output	250 mW
Pulse duration	3 ns
Wavelength	658 nm
Pulse rate	1/250 (laser class 2) / 1/666 (laser class 1)
Typical light spot size	10 mm x 10 mm (at 10 m)
Laser operating life (MTTF at +25 °C)	100,000 h

¹ With the Slow speed setting

² See repeatability curves

³ Equivalent to 1 σ

⁴ 6% ... 90% remission

⁵ Temperature drift typically 0.25 mm/K

Table 18: Output time, response time, and switching frequency as a function of the speed setting (laser class 2)

	Super-fast	Fast	Medium	Slow	Super-slow
Output time ¹	0.33 ms	1.33 ms	3.33 ms	10 ms	30 ms
Response time ²	0.83 ms	3.33 ms	8.33 ms	25 ms	75 ms
Switching frequency ¹	1000 Hz	250 Hz	100 Hz	33 Hz	11 Hz

¹ Continuous change of the distance from the object in the measuring range.

² Lateral entry of the object into the measuring range.

Table 19: Output time, response time, and switching frequency as a function of the speed setting (laser class 1)

	Super-fast	Fast	Medium	Slow	Super-slow
Output time ¹	0.67 ms	2.67 ms	6.67 ms	20 ms	60 ms
Response time ²	1.67 ms	6.67 ms	16.67 ms	50 ms	150 ms
Switching frequency ¹	500 Hz	125 Hz	50 Hz	16.6 Hz	5.5 Hz

¹ Continuous change of the distance from the object in the measuring range.

² Lateral entry of the object into the measuring range.

9.2 Interfaces

Table 20: Interfaces

Analog output ¹		1 x 4 mA ... 20 mA ($\leq 450 \Omega$) / 1 x 0 V ... 10 V ($\geq 50 \text{ k}\Omega$) / -
Resolution, analog output		16 bit
Switching output ^{1 2 3}		1 x / 2 x complementary / 2 x push-pull: PNP/NPN ($Q_x < 100 \text{ mA}$), IO-Link
Hysteresis		0 mm ... 29,950 mm
Data interface		IO-Link
WIFI (only WIFI variants)		✓, app for configuring SOPASair
	Function	Configuration, diagnostics, Access Point / Client
	Data transmission rate	$\leq 54 \text{ Mbit/s}$
	Protocol	IEEE 802.11 b/g, encryption: WPA2 / WPA
IO-Link		✓
	Function	Process data, configuration, diagnostics, data storage
	Data transmission rate	230.4 kbaud
	Protocol	V1.1
Multifunctional input (MF) ⁴		1 x

¹ Output Q2, adaptable: 4 mA ... 20 mA / 0 V ... 10 V / switching output / Q1 not / deactivated

² Output Q short-circuit protected, Voltage drop < 3 V

³ Max. total output current < 200 mA

⁴ Response time $\leq 60 \text{ ms}$

9.3 Mechanics/electronics

Table 21: Information about mechanics and electronics

Supply voltage V_S ^{1 2}	DC 10 V ... 30 V
Residual ripple ³	$\leq 5 \text{ Vss}$
Power consumption ^{4 5}	< 1.7 W
Initialization time	$\leq 300 \text{ ms}$
Warm-up time	$\leq 15 \text{ min}$
Weight	235 g
Housing material	<ul style="list-style-type: none"> ■ Housing: zinc die cast ■ Front screen: acrylic glass (PMMA)
Connection type	Male connector, M12, 5-pin
Display	3 x LED, LCD (only display variants)

¹ Limit values, reverse-polarity protected; operation in short-circuit protected network: max. 8 A

² When using IO-Link: $V_S > 18 \text{ V}$; when using the analog output: $V_S > 13 \text{ V}$


³ May not fall below or exceed V_S tolerances

⁴ At $\geq 0 \text{ }^\circ\text{C}$

⁵ Without load

9.4 Ambient data

Table 22: Ambient data

Protection class	
------------------	---

Ambient temperature range ¹	-40 °C ... +65 °C
Storage temperature range	-40 °C ... +75 °C
Typical ambient light immunity	40 klx
Enclosure rating	IP 65, IP 67
Vibration resistance	EN 60068-2-6, EN 60068-2-64
Shock resistance	EN 60086-2-27

¹ $U_v \leq 24 \text{ V}$

9.5 Dimensional drawing

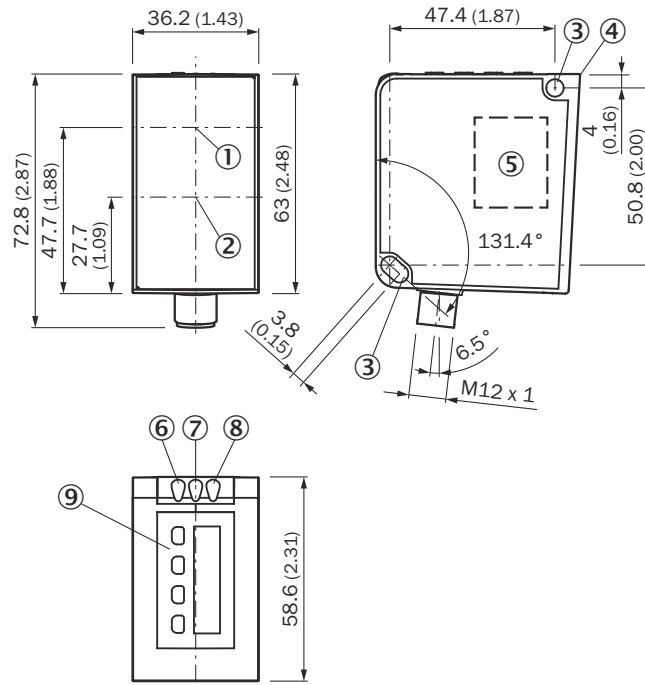


Figure 30: Dimensions of DT50-2 Pro with display

- ① Optical axis, sender
- ② Optical axis, receiver
- ③ Fixing hole, $\varnothing 4.5 \text{ mm}$
- ④ Reference surface = 0 mm
- ⑤ Laser warning label
- ⑥ Status LED Q_2 / Q_A (orange)
- ⑦ Status LED Q_1 (orange)
- ⑧ Operating LED (green)
- ⑨ Operating buttons and display

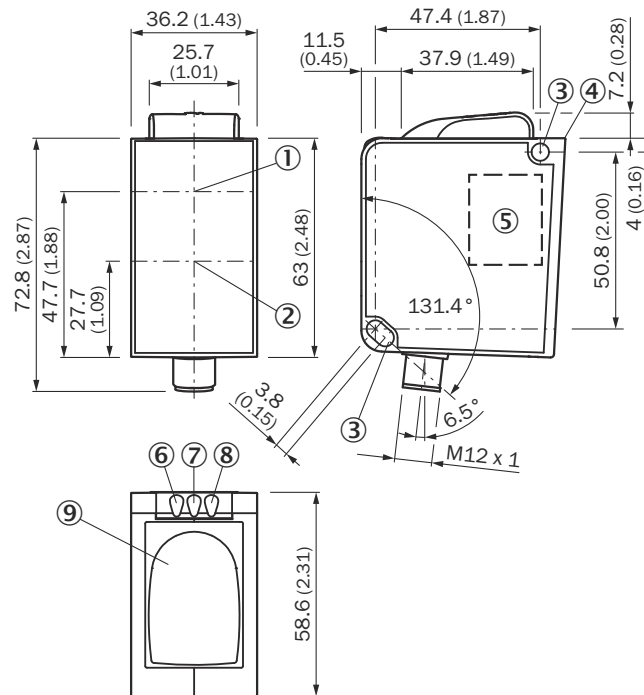


Figure 31: Dimensions of DT50-2 Pro with Wi-Fi

- ① Optical axis, sender
- ② Optical axis, receiver
- ③ Fixing hole, Ø 4.5 mm
- ④ Reference surface = 0 mm
- ⑤ Laser warning label
- ⑥ Status LED Q₂ / Q_A (orange)
- ⑦ Status LED Q₁ (orange)
- ⑧ Operating LED (green)
- ⑨ Wi-Fi antenna

10 Accessories



NOTE

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

- www.sick.com/Dx50-2
-

11 Appendix

11.1 EU declaration of conformity/Certificates

The EU declaration of conformity and other certificates can be downloaded from the Internet at:

- www.sick.com/Dx50-2

11.2 Diagram repeatability

Super Slow

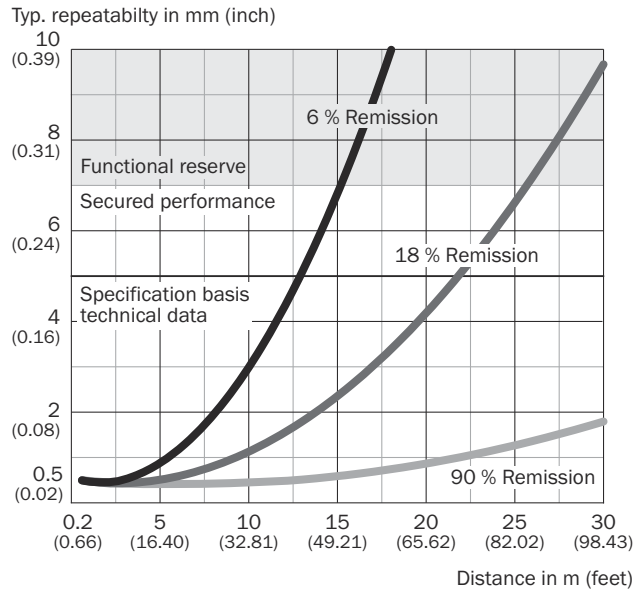


Figure 32: Characteristic curve for "super-slow" speed

Slow

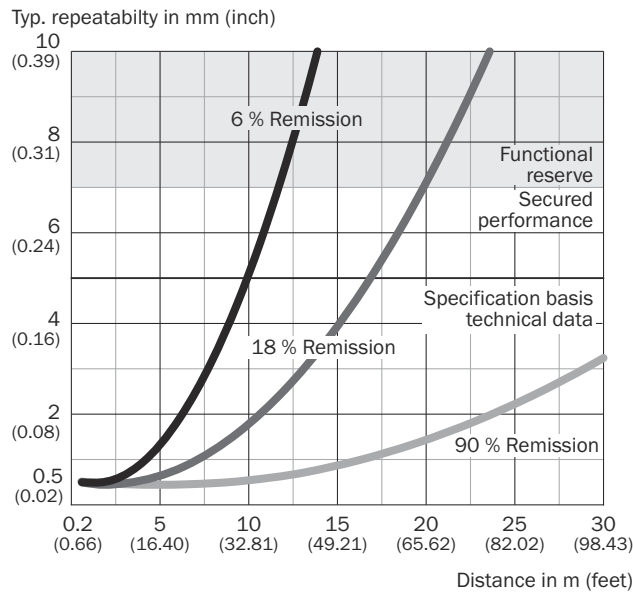


Figure 33: Characteristic curve for "slow" speed

Medium

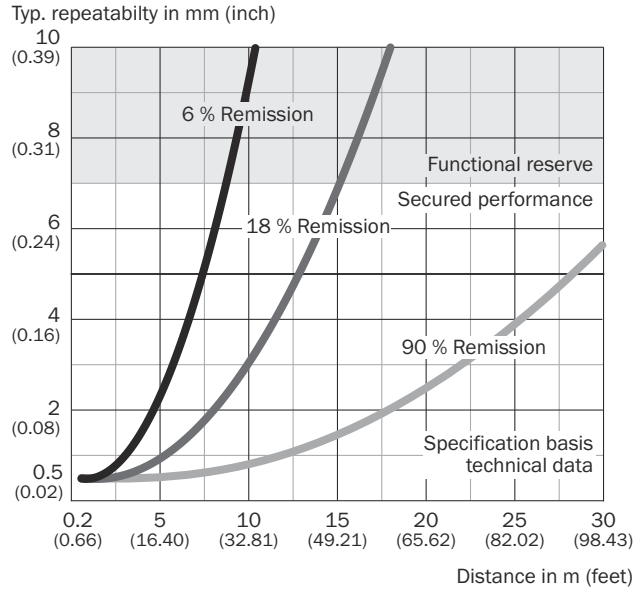


Figure 34: Characteristic curve for "medium" speed

Fast

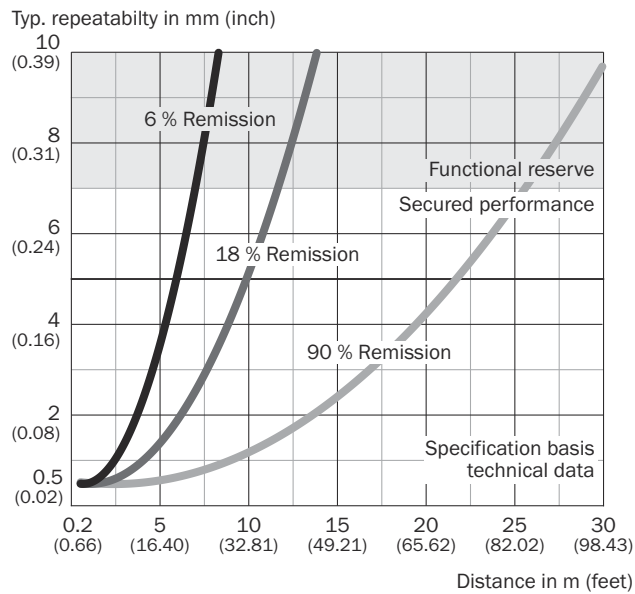


Figure 35: Characteristic curve for "fast" speed

Super Fast

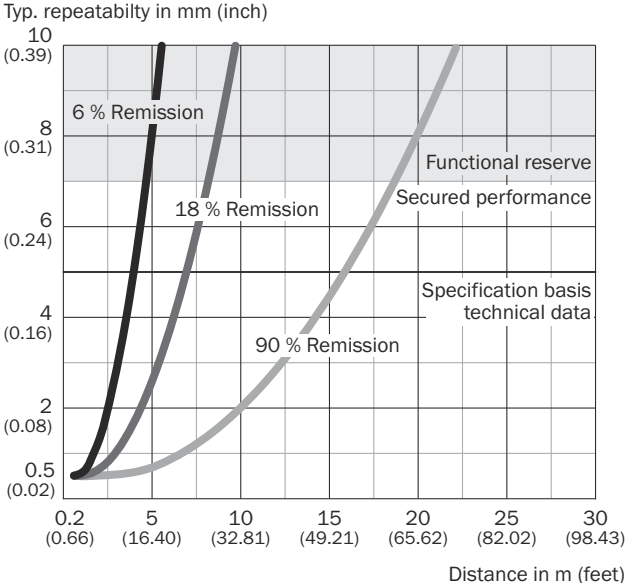


Figure 36: Characteristic curve for "super-fast" speed

11.3 Menu structure

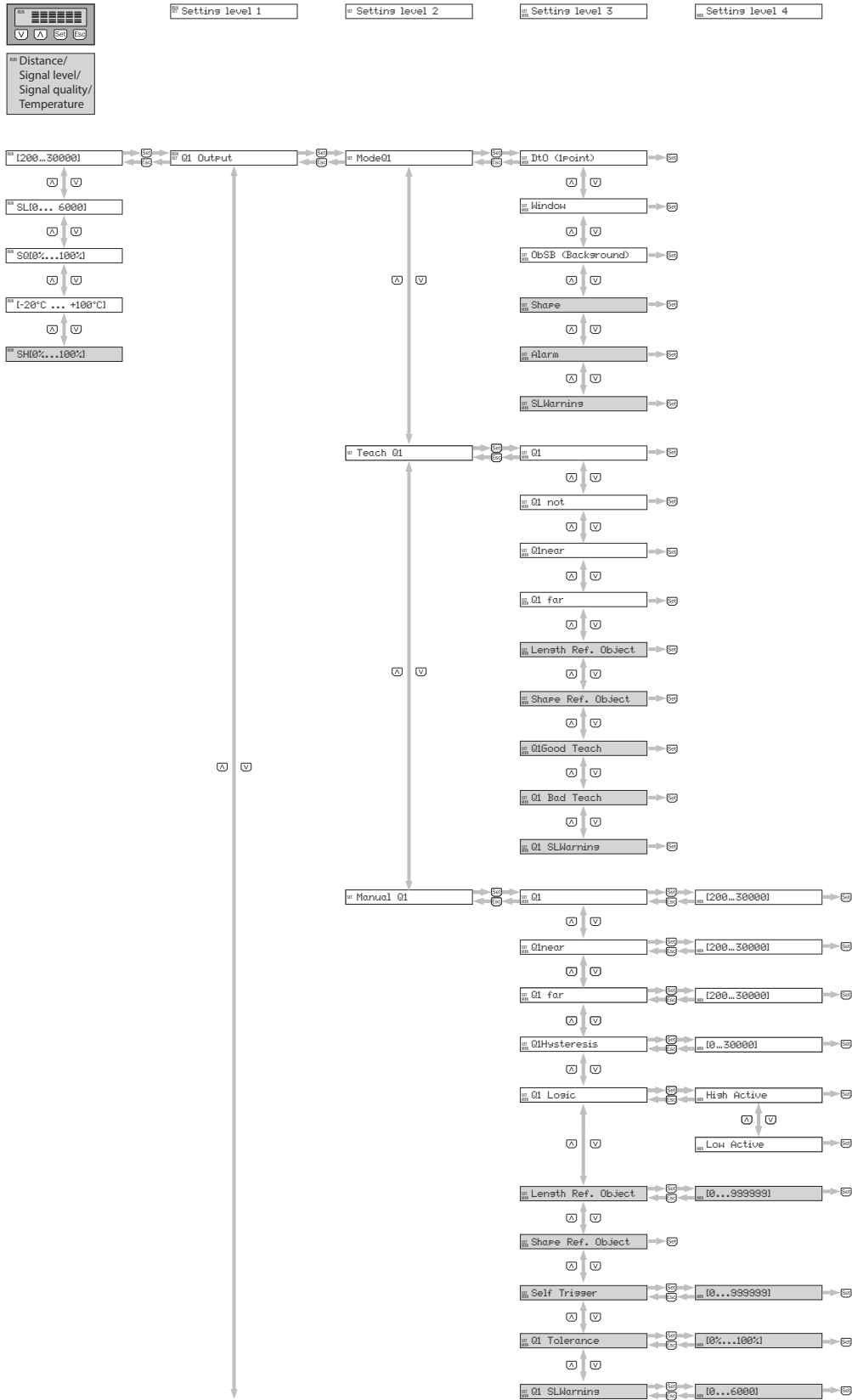


Figure 37: DT50-2 menu structure (Part 1 of 6)

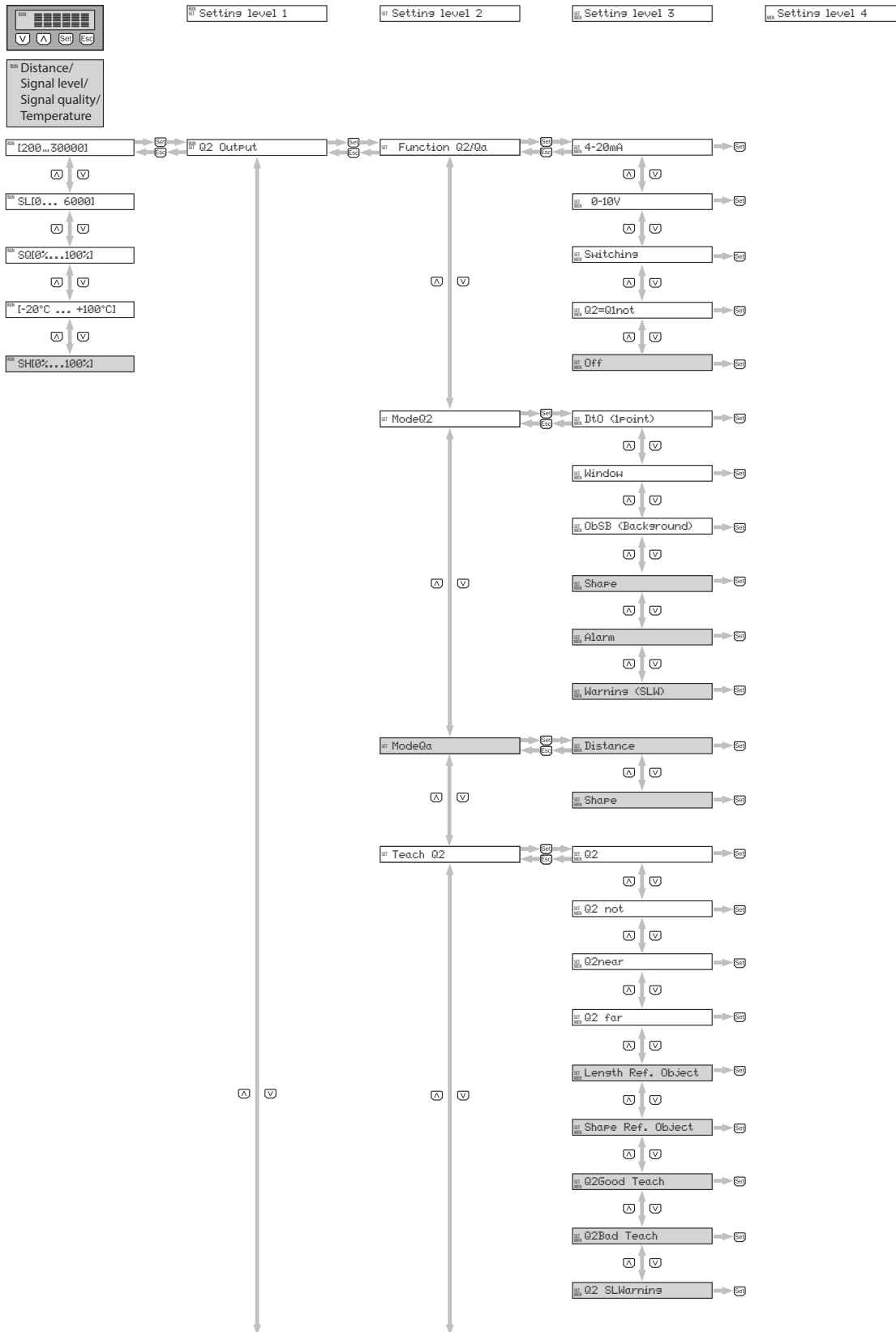


Figure 38: DT50-2 menu structure (Part 2 of 6)

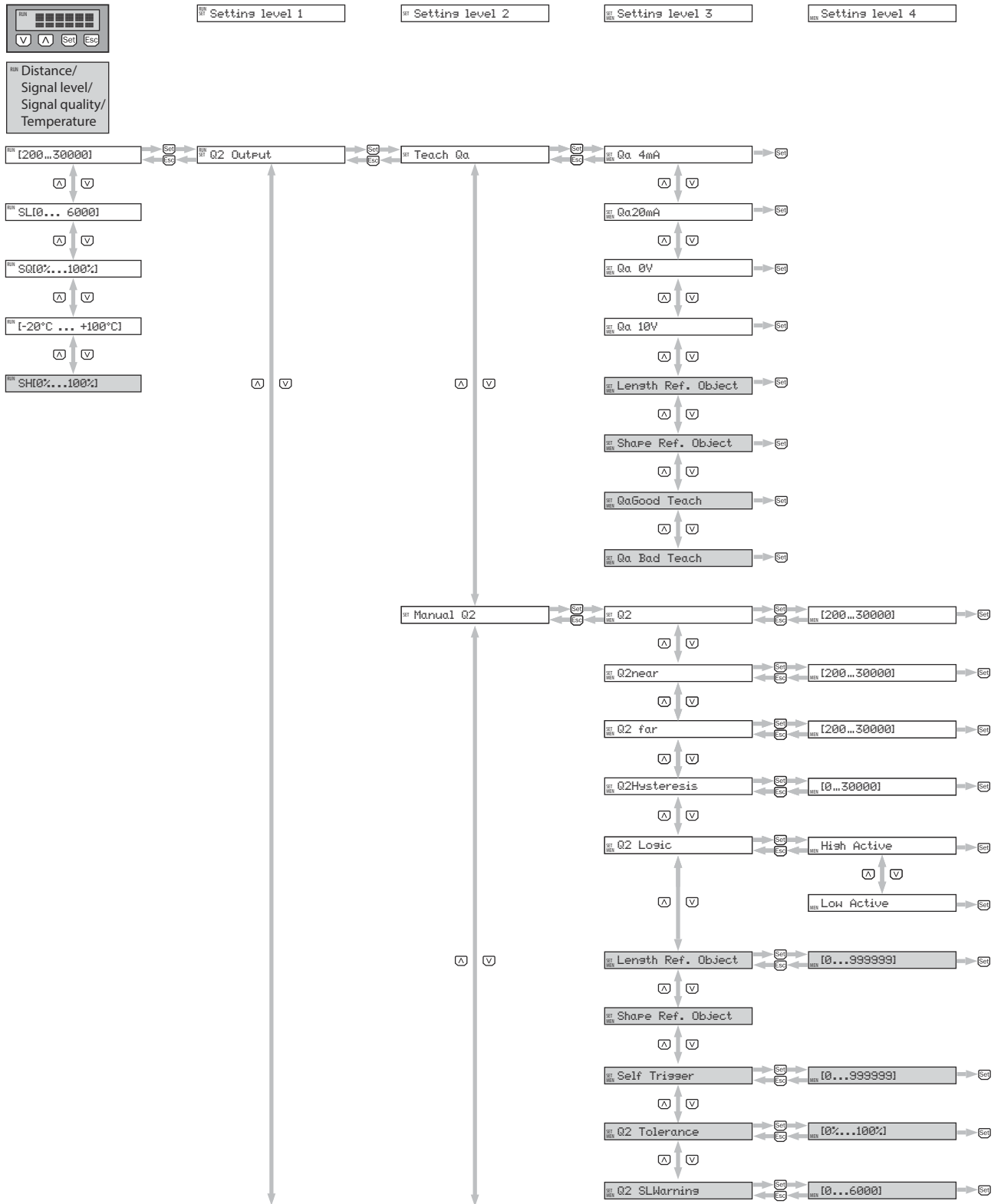


Figure 39: DT50-2 menu structure (Part 3 of 6)

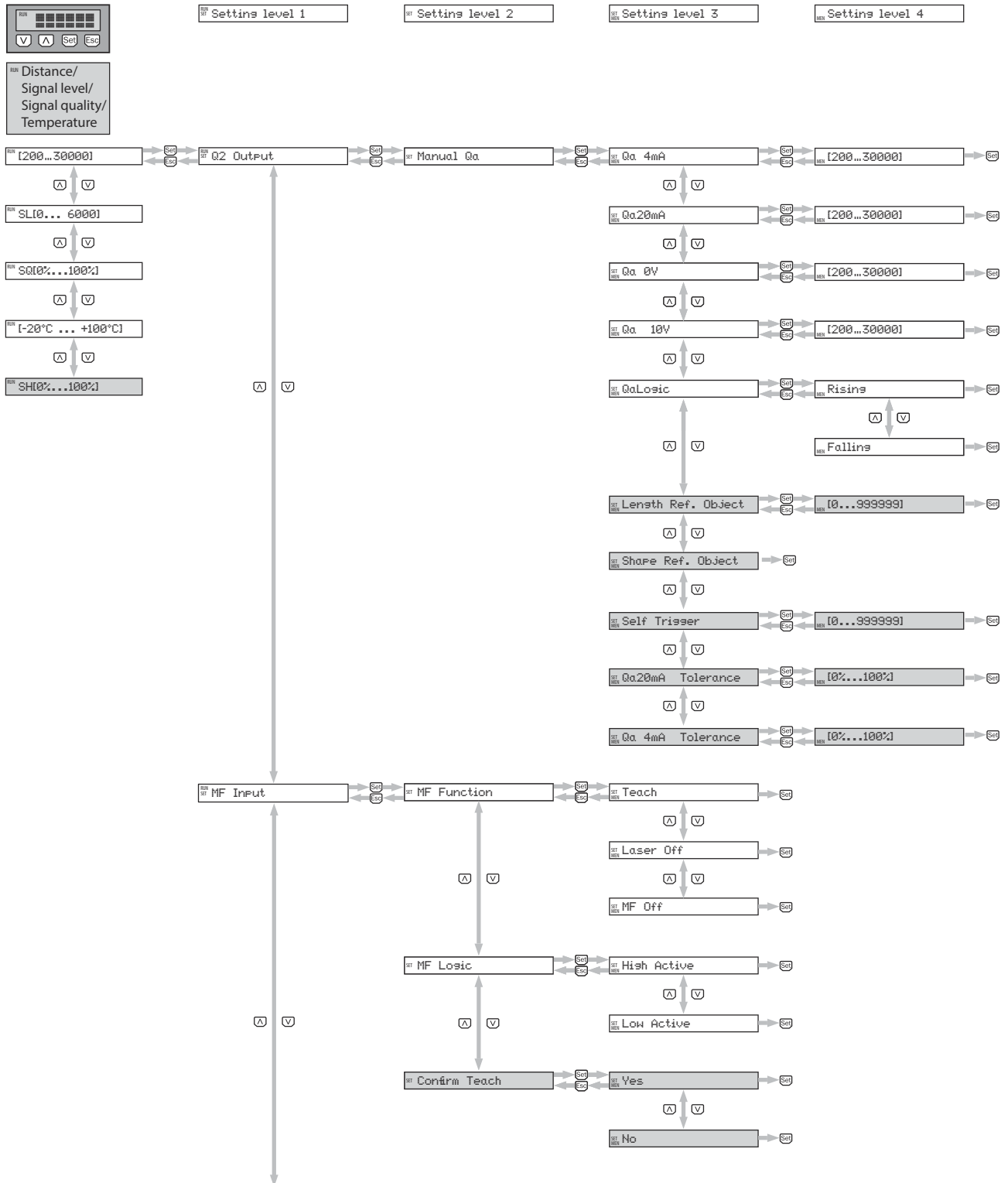


Figure 40: DT50-2 menu structure (Part 4 of 6)

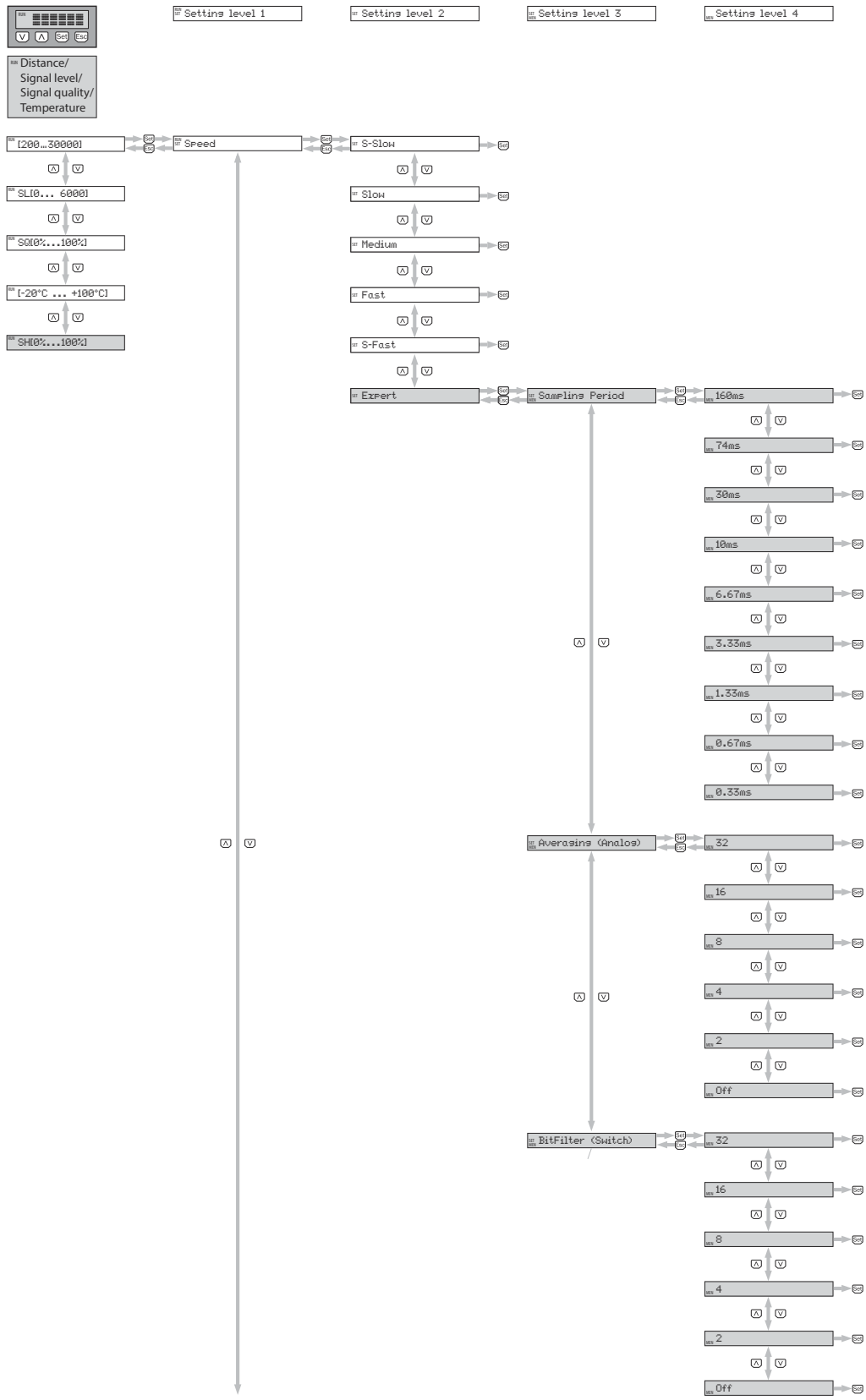


Figure 41: DT50-2 menu structure (Part 5 of 6)

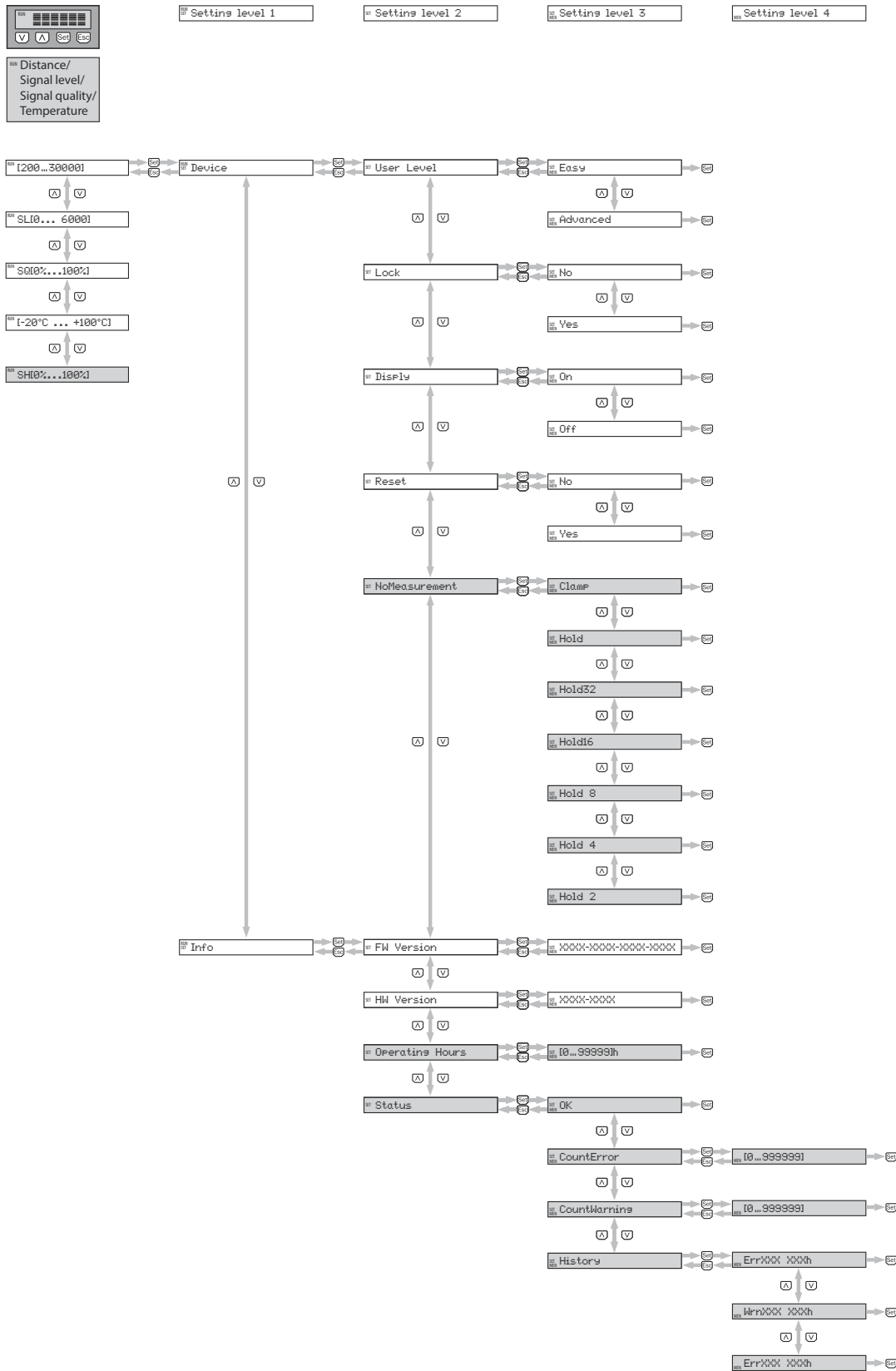


Figure 42: DT50-2 menu structure (Part 6 of 6)

11.4 Reference tables

The following reference tables indicate how the functions are designated for the different operating options, based on the designation in the display. The menu levels in the display are visualized in the reference table as follows:

- Menu level 1: bold font
- Menu level 2: regular font
- Menu level 3: arrow in front

11.4.1 RUN mode

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Min / xxx / Max / NoDist	Distance	109 (0x6D)	1 (0x01)	-	Distance
SLxxx	Signal level	109 (0x6D)	2 (0x02)	-	Signal Level
SQxxx%	-	-	-	-	-
+ xxx °C	Temperature	153(0x99)	-	-	Temperature
SHxxx% ¹	Shape level	109 (0x6D)	9 (0x09)	-	Shape match

¹ Advanced user level and use of the shape comparison

11.4.2 Q₁ Output

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Q₁ Output	Settings Q₁ (Output Q₁)	61 (0x3D)	-	-	Switchpoint 1 settings
ModeQ ₁	Q ₁ switching function	61 (0x3D)	2 (0x02)	-	Q ₁ Switching function
→ DtO (1point)	DtO mode	61 (0x3D)	2 (0x02)	1	Distance to object (DtO) – 1point
→ Window	Window mode	61 (0x3D)	2 (0x02)	2	Window
→ ObSB (Background)	ObSB mode	61 (0x3D)	2 (0x02)	128	Background (ObSB)
→ Shape ¹	Shape	61 (0x3D)	2 (0x02)	129	Shape comparison
→ Alarm ¹	Alarm	61 (0x3D)	2 (0x02)	130	Alarm
→ SLWarning ¹	SLW	61 (0x3D)	2 (0x02)	131	SLW (signal level warning)

¹ Advanced user level

Teach Q₁

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Teach Q ₁	Teach	130 (0x82)	-	-	Teach
→ Q ₁	Q ₁ switching point	130 (0x82)	-	1	Q ₁ Distance to object (DtO) = active high
→ Q ₁ not		130 (0x82)	-	2	Q ₁ Distance to object (DtO) = active low
→ Q ₁ near	Q ₁ switching point near	130 (0x82)	-	9	Q ₁ near
-	Q ₁ center	130 (0x82)	-	11	Q ₁ center
→ Q ₁ far	Q ₁ switching point far	130 (0x82)	-	10	Q ₁ far
→ Length Ref. Object ¹	Teach length	130 (0x82)	-	24	Shape length
→ Shape Ref. Object ¹	Teach shape	130 (0x82)	-	25	Shape reference
→ Q ₁ Good Teach ¹	Teach Q ₁ good	130 (0x82)	-	27	Q ₁ good shape tolerance
Q ₁ Bad Teach ¹	Teach Q ₁ bad	130 (0x82)	-	26	Q ₁ bad shape tolerance
→ Q ₁ SLWarning ¹	SLW switching point (Signal level warning)	130 (0x82)	-	3	Q ₁ SLW (Signal level warning) = active high

¹ Advanced user level

Manual Q₁

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Manual Q ₁	-	60 (0x3C)	-	-	Q ₁ switching points
→ Q ₁	Q ₁ switching point	60 (0x3C)	1 (0x01)	-	Far
→ Q ₁ near	Q ₁ switching point near	60 (0x3C)	2 (0x02)	-	Near
-	Q ₁ center	94 (0x5E)	-	-	Q ₁ center
→ Q ₁ far	Q ₁ switching point far	60 (0x3C)	1 (0x01)	-	Far
→ Q ₁ Hysteresis	Q ₁ hysteresis near	61 (0x3D)	3 (0x03)	-	Q1 Hysteresis
→ Q ₁ Logic	Q1 output behavior	61 (0x3D)	1 (0x01)	-	Q1 output behavior
→ Length Ref. Object ¹	Teach length	112 (0x70)	-	-	Length of reference object

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
→ Shape Ref. Object ¹	Teach shape	-	-	-	-
→ Self trigger ¹	Shape trigger threshold	111 (0x6F)	-	-	Shape trigger threshold
→ Q ₁ Tolerance ¹	Shape Tolerance Q ₁	113 (0x71)	-	-	Shape tolerance Q ₁
→ Q ₁ SLWarning ¹	SLW switching point (signal level warning)	93 (0x5D)	1 (0x01)	-	SLW1 (signal level warning 1) = Q ₁ threshold

¹ Advanced user level

11.4.3 Q₂ Output

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Q₂ Output	Settings Q₂ (Output Q₂)	63 (0x3F)	-	-	Switchpoint 2 settings
Function Q ₂ /Q _a	Q ₂ /Q _a output function	121 (0x79)	-	-	Q ₂ Output function
→ 4-20 mA	4 mA ... 20 mA	121 (0x79)	-	1	4 mA ... 20 mA
→ 0-10 V	0 V ... 10 V	121 (0x79)	-	2	0 V ... 10 V
→ Switching	Switching	121 (0x79)	-	3	Switching
→ Q ₂ =Q ₁ not	not Q ₁	121 (0x79)	-	4	not Q ₁
→ Off ¹	Off	121 (0x79)	-	0	Off

¹ Advanced user level

Mode Q₂

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
ModeQ ₂	Q ₂ switching function	63 (0x3F)	2 (0x02)	-	Q ₂ switching function
→ DtO (1point)	DtO mode	63 (0x3F)	2 (0x02)	1	Distance to object (DtO) - 1point
→ Window	Window mode	63 (0x3F)	2 (0x02)	2	Window
→ ObSB (Background)	ObSB mode	63 (0x3F)	2 (0x02)	128	Background (ObSB)
→ Shape ¹	Shape	63 (0x3F)	2 (0x02)	129	Shape comparison

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
→ Alarm ¹	Alarm	63 (0x3F)	2 (0x02)	130	Alarm
→ SLWarning ¹	SLW	63 (0x3F)	2 (0x02)	131	SLW (signal level warning)

¹ Advanced user level

Mode Q_a

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
ModeQ _a ¹	Q _a operation mode	75 (0x4B)	-	-	Q _a Operation mode
→ Distance ¹	Distance	75 (0x4B)	-	0	Distance
→ Shape ¹	Shape	75 (0x4B)	-	1	Shape

¹ Advanced user level

Teach Q₂

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Teach Q ₂	Teach	130 (0x82)	-	-	Teach
→ Q ₂	Q ₂ switching point	130 (0x82)	-	5	Q ₂ Distance to object (DtO) = active high
→ Q ₂ not		130 (0x82)	-	6	Q ₂ Distance to object (DtO) = active low
→ Q ₂ near	Q ₂ switching point near	130 (0x82)	-	12	Q ₂ near
-	Q ₂ center	130 (0x82)	-	14	Q ₂ center
→ Q ₂ far	Q ₂ switching point far	130 (0x82)	-	13	Q ₂ far
→ Length Ref. Object ¹	Teach length	130 (0x82)	-	24	Shape length
→ Shape Ref. Object ¹	Teach shape	130 (0x82)	-	25	Shape reference
→ Q ₂ Good teach-in ¹	Teach Q ₂ good	130 (0x82)	-	29	Q ₂ good shape tolerance
→ Q ₂ Bad Teach ¹	Teach Q ₂ bad	130 (0x82)	-	28	Q ₂ bad shape tolerance

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
→ Q ₂ SLWarning ¹	SLW switching point (signal level warning)	130 (0x82)	-	7	Q ₂ SLW (Signal level warning) = active high

¹ Advanced user level

Teach Q_a

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Teach Q _a	Teach	130 (0x82)	-	-	Teach
→ Q _a 4 mA	4 mA	130 (0x82)	-	19	Q _a 4 mA
-	Center (12 mA)	130 (0x82)	-	23	Q _a center (12 mA or 5 V)
→ Q _a 20 mA	20 mA	130 (0x82)	-	20	Q _a 20 mA
→ Q _a 0 V	0 V	130 (0x82)	-	21	Q _a 0 V
-	Center (5 V)	130 (0x82)	-	23	Q _a center (12 mA or 5 V)
→ Q _a 10 V	10 V	130 (0x82)	-	22	Q _a 10 V
→ Length Ref. Object ¹	Teach length	130 (0x82)	-	24	Shape length
→ Shape Ref. Object ¹	Teach shape	130 (0x82)	-	25	Shape reference
→ Q _a Good Teach ¹	Teach 4 mA Teach 0 V	130 (0x82)	-	30	Q _a 4 mA shape tolerance Q _a 0 V shape tolerance
→ Q _a Bad Teach ¹	Teach 20 mA Teach 10 V	130 (0x82)	-	31	Q _a 20 mA shape tolerance Q _a 10 V shape tolerance

¹ Advanced user level

Manual Q₂

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Manual Q ₂	-	62 (0x3E)	-	-	Q ₂ switching points
→ Q ₂	Q ₂ switching point	62 (0x3E)	1 (0x01)	-	Far

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
→ Q ₂ near	Q ₂ switching point near	62 (0x3E)	2 (0x02)	-	Near
-	Q ₂ center	95 (0x5F)	-	-	Q ₂ center
→ Q ₂ far	Q ₂ switching point far	62 (0x3E)	1 (0x01)	-	Far
→ Q ₂ Hysteresis	Q ₂ Hysteresis	63 (0x3F)	3 (0x03)	-	Q ₂ Hysteresis
→ Q ₂ Logic	Q ₂ output behavior	63 (0x3F)	1 (0x01)	-	Q ₂ output behavior
→ Length Ref. Object ¹	Teach length	112 (0x70)	-	-	Length of reference object
→ Shape Ref. Object ¹	Teach shape	-	-	-	-
→ Self trigger ¹	Shape trigger threshold	111 (0x6F)	-	-	Shape trigger threshold
→ Q ₂ Tolerance ¹	Shape Tolerance Q ₂	114 (0x72)	-	-	Shape tolerance Q ₂
→ Q ₂ SLWarning ¹	SLW switching point (signal level warning)	93 (0x5D)	2 (0x02)	-	SLW2 (signal level warning 2) = Q ₂ threshold

¹ Advanced user level

Manual Q_a

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Manual Q _a	-	-	-	-	-
→ Q _a 4 mA	4 mA	79 (0x4F)	-	-	Q _a near
-	Center (12 mA)	96 (0x60)	-	-	Q _a center
→ Q _a 20 mA	20 mA	80 (0x50)	-	-	Q _a far
→ Q _a 0 V	0 V	79 (0x4F)	-	-	Q _a near
-	Center (5 V)	96 (0x60)	-	-	Q _a center
→ Q _a 10 V	10 V	80 (0x50)	-	-	Q _a far
→ Q _a Logic	Analog output behavior	100 (0x64)	-	-	Analog output behavior
→ Length Ref. Object ¹	Teach length	112 (0x70)	-	-	Length of reference object
→ Shape Ref. Object ¹	Teach shape	-	-	-	-

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
→ Self trigger ¹	Shape trigger threshold	111 (0x6F)	-	-	Shape trigger threshold
→ Q _a 20 mA tolerance ¹	Shape Tolerance Q _a Bad	116 (0x74)	-	-	Shape tolerance Q _a bad
→ Q _a 4 mA tolerance ¹	Shape Tolerance Q _a Good	115 (0x73)	-	-	Shape tolerance Q _a good

¹ Advanced user level

11.4.4 MF Input

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub Index	Value	Text
MF Input					
MF Function	Function multifunction input (MF)	122 (0x7A)	-	-	MF function
→ Teach	External teach	122 (0x7A)	-	1	External teach
→ Laser Off	Laser on/off	122 (0x7A)	-	2	Laser on/off
→ MF Off	Inactive	122 (0x7A)	-	0	Inactive
MF Logic	Multifunction input (MF) behavior	99 (0x63)	1 (0x01)	-	Input behavior
→ High Active	Active high	99 (0x63)	1 (0x01)	0	High active
→ Low Active	Active low	99 (0x63)	1 (0x01)	1	Low active
Confirm ¹	MF Teach Confirmation on Q ₁	99 (0x63)	2 (0x02)	-	Teach confirmation on Q ₁
→ Yes ¹	Activated	99 (0x63)	2 (0x02)	0	Yes
→ No ¹	Deactivated	99 (0x63)	2 (0x02)	1	No

¹ Advanced user level

11.4.5 Speed

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Speed	Speed / Response Time	103 (0x67)	-	-	Speed / Response time
S-Slow	Super slow	103 (0x67)	-	5	Super slow

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Slow	Slow	103 (0x67)	-	4	Slow
Medium	Medium	103 (0x67)	-	3	Medium
Fast	Fast	103 (0x67)	-	2	Fast
S-Fast	Super fast	103 (0x67)	-	1	Super fast
Expert ¹	Expert	103 (0x67)	-	0	Expert
→ Sampling Period ¹	Integration time of measurement	64 (0x40)	-	-	Integration time of measurement
→ Averaging (analog) ¹	Averaging for analog output	67 (0x43)	-	-	Averaging for analog output
→ BitFilter (Switch) ¹	Bit filter for switching output(s)	66 (0x42)	-	-	Bit filter for switching output(s)

¹ Advanced user level

11.4.6 Device

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Device					
User level	User level (Display)	73 (0x49)	-	-	-
→ Easy	Easy	73 (0x49)	-	0	Easy
→ Advanced	Advanced	73 (0x49)	-	1	Advanced
Lock	Keylock	81 (0x51)	-	-	Keylock
→ No	Unlocked	81 (0x51)	-	0	Unlocked
→ Yes	Locked	81 (0x51)	-	1	locked
Disply	Display Backlight	72 (0x48)	-	-	-
→ On	On	72 (0x48)	-	-	On
→ Off	Off	72 (0x48)	-	1	Off
Reset	Restore Factory Settings	2 (0x02)	-	130	Restore Factory Settings
NoMeasurement ¹	Alarm behavior	104 (0x68)	-	-	Alarm behavior

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
→ Clamp ¹	Clamp	104 (0x68)	-	0	Clamp
→ Hold ¹	Hold	104 (0x68)	-	1	Hold
→ Hold32 ¹	Hold x32	104 (0x68)	-	2	Hold x32
→ Hold16 ¹	Hold x16	104 (0x68)	-	3	Hold x16
→ Hold8 ¹	Hold x8	104 (0x68)	-	4	Hold x8
→ Hold4 ¹	Hold x4	104 (0x68)	-	5	Hold x4
→ Hold2 ¹	Hold x2	104 (0x68)	-	6	Hold x2

¹ Advanced user level

11.4.7 Info

Display	SOPAS ET / SOPASair	IO-Link / IODD			
		Index dec (hex)	Sub index	Value	Text
Info					
FW Version	Software version	23 (0x17)	-	-	Firmware Version
HW Version	Serial number	22 (0x16)	-	-	Hardware Version
Operating Hours ¹	Device operating hours	90 (0x5A)	-	-	Device Operating Time
Status ¹	Error State	80 (0x59)	-	-	Error Status
→ OK / ERRxxx / WRNxxx ¹	0 / xxx	-	-	-	0 / xxx
→ - / CountError ¹	-	-	-	-	-
→ - / CountWarning ¹	-	-	-	-	-
→ - / History ¹	-	-	-	-	-

¹ Advanced user level

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